



# **FSP1000 User Manual** VB.0.04

MEMS differential pressure sensors



# **MEMS Differential Pressure Sensors**

**with MEMS thermal sensing technology**

FSP1000 Series

## **User Manual**

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## Attention!

- Please carefully read this manual before operating this product.
- Do not open or modify any hardware that may lead to irrecoverable damage.
- Do not use this product if you suspect any malfunctions or defects.
- Do not use this product for corrosive media or in a strong vibrational environment.
- Use this product according to the specified parameters.
- Only the trained or qualified personnel shall be allowed to perform product services.



## Use with caution!

- Be cautious of electrical safety, even if it operates at a low voltage; any electrical shock might lead to some unexpected damage.
- The gas to be measured should be clean and free of particles, as even light particles may be accumulated inside the tiny pressure port that may result in inaccuracy in metrology, clogging, or other irrecoverable damage.
- Do not apply for any unknown or non-specified gases that may damage the product.

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## 1. Overview

All contact information can be found at the end of this manual.

This manual provides essential information for the FSP1000 series of differential pressure sensors for various applications. The product performance, maintenance, and troubleshooting, as well as the information for product order, technical support, and repair, are also included.

The FSP1000 dual pressure sensors are manufactured with the company's proprietary MEMS (micro-electro-mechanical systems) sensing and package technology that offers unique, very low differential pressure sensing.

The designed sensor can be applied for HVAC control, medical CPAP (continuous positive airway pressure), medical ventilators, instrumentation, and many other applications where a low differential pressure or flow measurement is required.

## 2. Receipt / unpack of the products

Upon receipt of the products, please check the packing box before dismantling the packing materials. Ensure no damage during shipping. If any abnormality is observed, please contact and notify the carrier who shipped the product, and inform the distributors or sales representatives if the order is not placed directly with the manufacturer; otherwise, the manufacturer should be informed. For any further actions, please refer to the return and repair section in this manual.

If the packing box is intact, open it to find the product (either the sensor formality as per the actual order) and any other accessories included.



FSP1000



Optional power and data cable

Figure 2.1: FSP1000 flow sensor and accessories

Please check immediately for the integrity of the product and the power and data cable; if any abnormality is identified, please notify the distributor/sales representative or manufacturer as soon as you can. If any defects are confirmed, an exchange shall be arranged immediately via the original sales channel. This user manual shall also be included in the packing box or via an online link for an electronic version, which your sales agent should send. In most cases, this manual shall be made available to the customer before the actual order.

Please note that the sensor has a pinout that is designed to be directly placed onto a printed circuit board. Therefore, the power and data cable is an option that will not come with the order automatically.

### 3. Knowing the products

#### 3.1 Product description

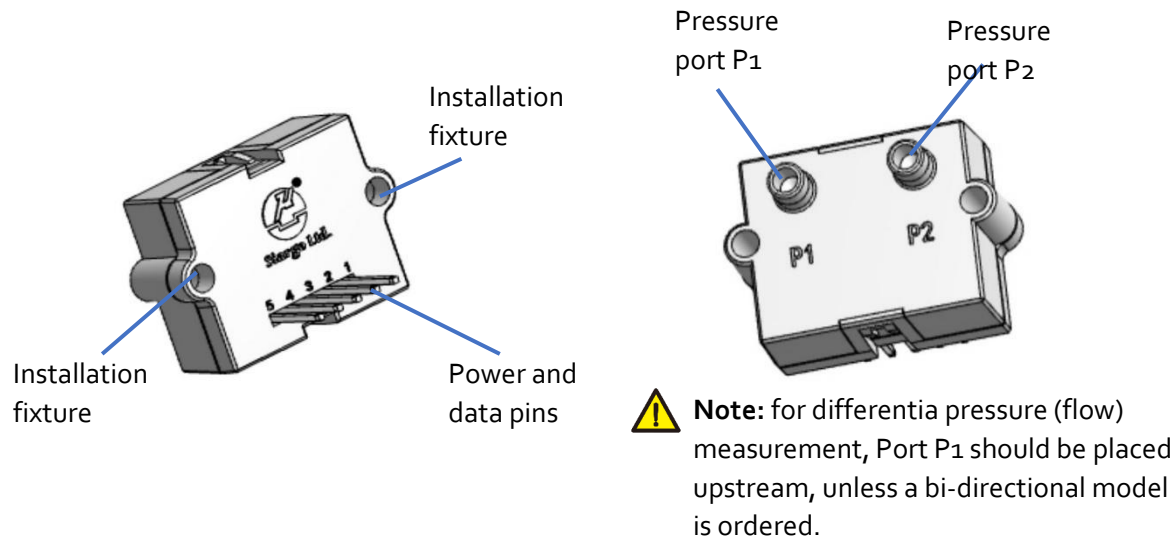


Figure 3.1: FSP1000 parts description

#### 3.2 Power and data pinout description



Figure

3.2: Connections Pins: 2.54 mm centers, 0.635 mm square

Table 3.1: FSP1000 pin assignment.

| PIN | COLOR  | DEFINITION                  |
|-----|--------|-----------------------------|
| 1   | Blue   | SDA, I <sup>2</sup> C data  |
| 2   | Green  | Analog output (+)           |
| 3   | Red    | VCC, power supply (+)       |
| 4   | Black  | GND, ground                 |
| 5   | Yellow | SCL, I <sup>2</sup> C clock |

The FSP1000 electrical interface has five pins. The power supply is required to be 3.0 ~ 3.6 Vdc. The voltage is internally filtered and regulated to power the circuitry. The sensor consumes less than 10 mA normally, but the minimum supply current must be larger than 10 mA for a stable performance.

For the I<sup>2</sup>C communication, please refer to the following descriptions.

If the optional data/power cable is ordered, please refer to the color code for connection.

### 3.3 Mechanical dimensions

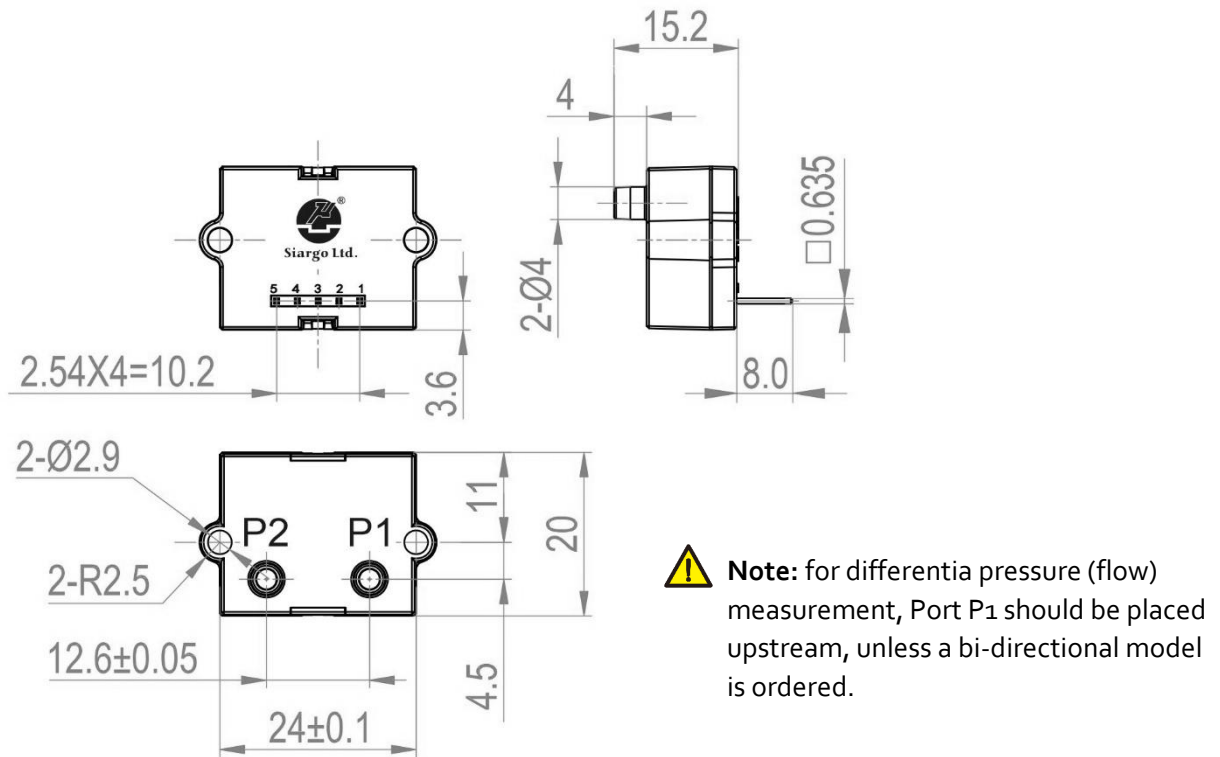


Figure 3.3: FSP1000 mechanical dimensions.

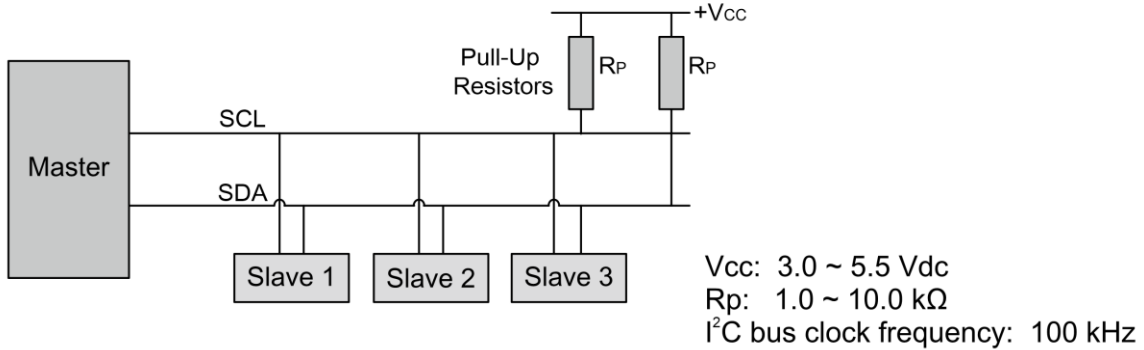
## 4. Installation

Do not open or alter any part of the product, which would lead to malfunction and irrecoverable damage.

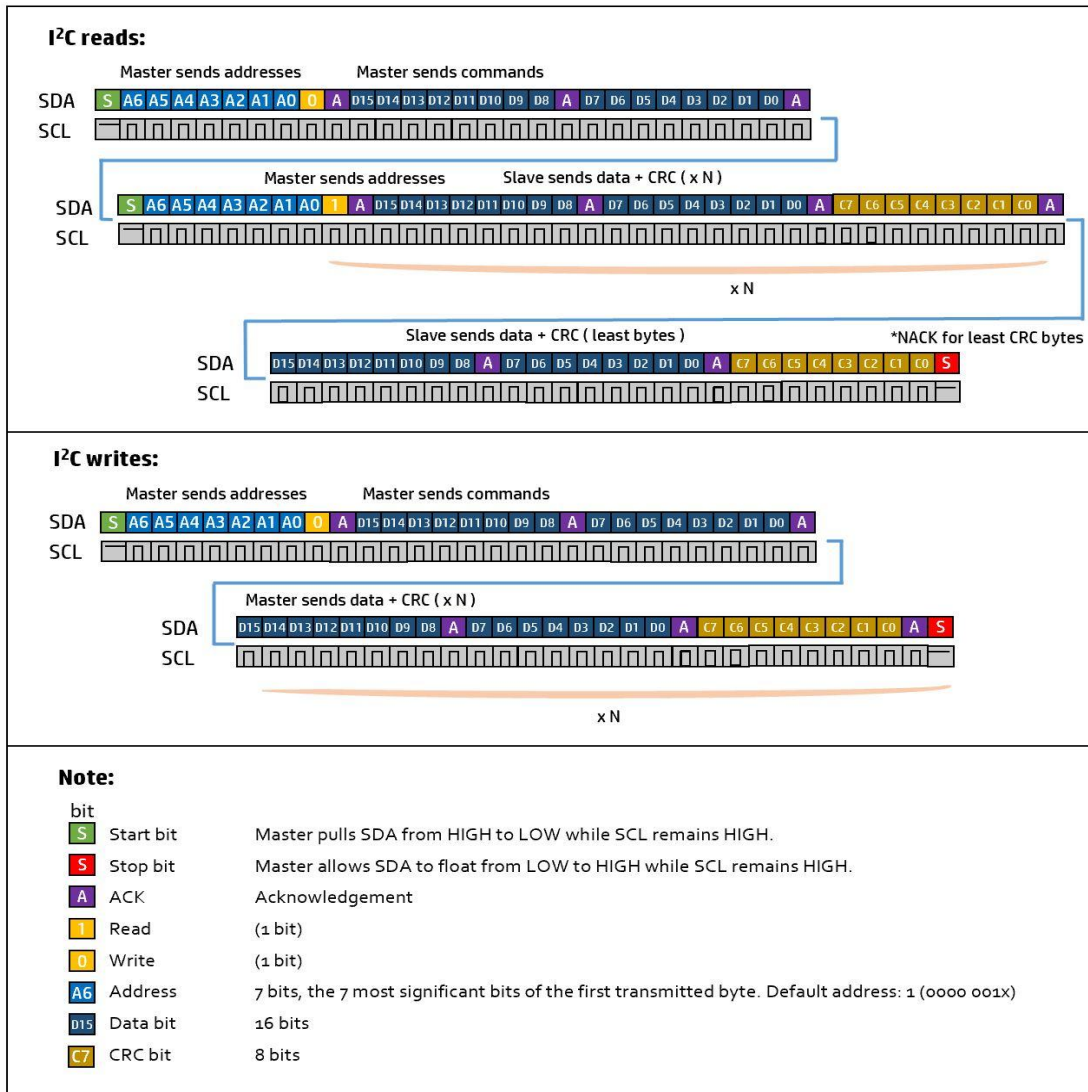
There are no other special requirements for the installation. However, it is recommended that the user ensure no leakage of the connections and that all electrical pins are properly engaged.

## 5. Basic operation

### 5.1 I<sup>2</sup>C interface connection diagram



### 5.2 I<sup>2</sup>C interface read/write sequences



### 5.3 I<sup>2</sup>C interface command description

Please note the addition of the CRC in the protocol. If you are using an older version, you may need to update your firmware for the current products.

| Command Byte | Length (int 16) | Command Name                                  | Read/Write | Notes                                                                                                                                                                                    |
|--------------|-----------------|-----------------------------------------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0x00A4       | 1               | I <sup>2</sup> C address                      | Read/Write | Int 16.<br>Bit 0 is the R/W flag bit.<br>bits 1 ~ 7 are available;<br>bit 8 ~ bit 15 = 0.                                                                                                |
| 0x0030       | 6               | Sensor serial number                          | Read       | ASCII                                                                                                                                                                                    |
| 0x0043       | 2               | Differential pressure                         | Read       | Int 32/1000 Pa                                                                                                                                                                           |
| 0x008C       | 1               | Filter depth                                  | Read/Write | Int 16, 0 ~ 9, corresponding to 2 <sup>0</sup> ~ 2 <sup>9</sup> data in the software filter.<br>The default value is 3, corresponding to 2 <sup>3</sup> = 8 data in the software filter. |
| 0x00Fo       | 1               | Reset the offset of the differential pressure | Write      | Fixed value, 0xAA55                                                                                                                                                                      |

**Note:** The I<sup>2</sup>C address is set to bit 7 ~ bit 1. E.g., if the I<sup>2</sup>C address is 1 (0000 001x), the write address will be 0x02 (0000 0010) and the read address will be 0x03 (0000 0011).

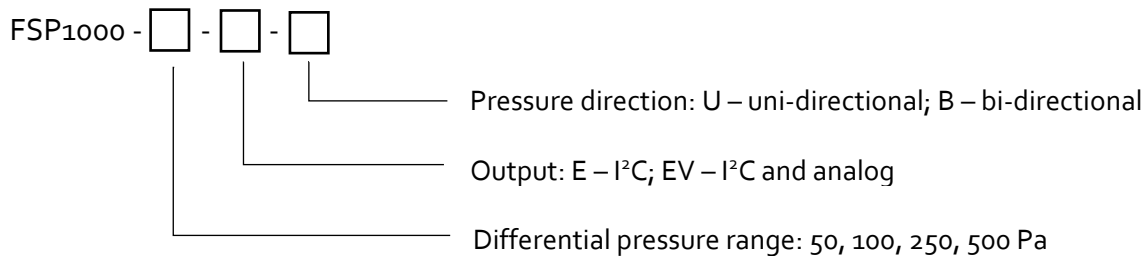
### 5.4 CRC checksum calculation

The 8-bit CRC checksum transmitted after each two data bytes (int 16) is generated by a CRC algorithm. Its properties are listed in the table below. To calculate the checksum, only these two previously transmitted data bytes are used.

| Property       | Value                                          |
|----------------|------------------------------------------------|
| Name           | CRC-8                                          |
| Protected data | I <sup>2</sup> C read and write                |
| Width          | 8 bits                                         |
| Polynomial     | 0x07 (x <sup>8</sup> + x <sup>2</sup> + x + 1) |
| Initialization | 0x00                                           |
| Reflect input  | False                                          |
| Reflect output | False                                          |
| Final XOR      | 0x00                                           |
| Example        | CRC(0x4E20) = 0x6D                             |

## 6. Product selection

The product part number is composed of the product model number and suffixes, indicating each of the selectable parameters. Refer to the following for details.



### Note:

1. Example: FSP1000-500-EV-B: the differential pressure range will be  $\pm 500\text{Pa}$ , and outputs are analog and I<sup>2</sup>C.

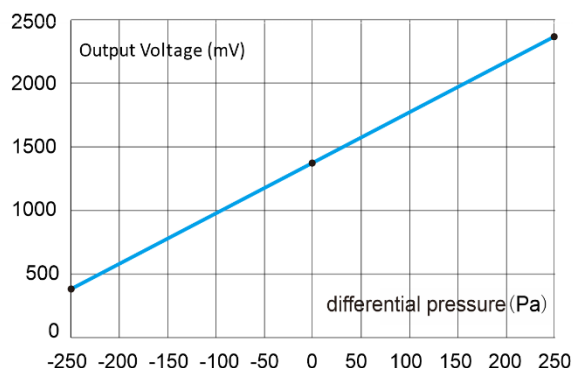
## 7. Technical specifications

All specifications listed in the following table, unless otherwise noted, apply for calibration conditions at 20°C and 101.325 kPa absolute pressure with air.

|                           | Value                                                            | Unit |
|---------------------------|------------------------------------------------------------------|------|
| Differential pressure     | 2 ~ 50 / 2 ~ 100 / 5 ~ 250 / 5 ~ 500<br>±50 / ±100 / ±250 / ±500 | Pa   |
| Power supply              | 3.0 ~ 3.6 (10 mA)                                                | Vdc  |
| Output                    | Linear, analog (0.4 ~ 2.4 Vdc) / I <sup>2</sup> C                |      |
| Output resolution         | Analog: 12-bit / I <sup>2</sup> C: 14 bit                        |      |
| Response time             | 20                                                               | msec |
| Pneumatic flow resistance | <95 @500 Pa                                                      | sccm |
| Span accuracy             | ±(2.0+0.5FS)                                                     | %    |
| Span repeatability        | (0.5+0.15FS)                                                     | %    |
| Span temperature shift    | <0.16                                                            | %/°C |
| Temperature range         | -5 ~ +65                                                         | °C   |
| Offset tolerance          | 0.5                                                              | Pa   |
| Offset repeatability      | ±0.1                                                             | Pa   |
| Altitude correction       | Full compensated                                                 |      |
| Maximum pressure          | 2.0                                                              | bar  |
| Humidity                  | <95, no condensation                                             | %RH  |
| Warm-up time              | <500                                                             | msec |
| Storage temperature       | -20 ~ +70                                                        | °C   |
| Vibration                 | 20g; MIL-STD-883E, Method 2002.4.                                |      |
| Compliance                | RoHS; REACH                                                      |      |

**Note:** \*FS = full scale in one direction. A customized differential pressure range is available upon request.

$$1 \text{ cmH}_2\text{O} (4 \text{ } ^\circ\text{C}) = 98.06 \text{ Pa} = 0.014 \text{ PSI}$$



Typical analog output: ±250Pa.

## **8. Technical notes for the product performance**

### **8.1 Measurement principle**

The products utilize the Company's proprietary micro-machined (MEMS) sensing technology. The differential pressure is measured via a pass-through flow sensing at two ports, where the flow channel defines the differential pressure from the channel design.

### **8.2 Precautions for the best performance of the product**

#### **8.2.1 Particle contamination**

It is critical to have the measured gas free of particle contamination. Since the data ports for both the gauge pressure and differential pressure are small, any particle's presence may create a deformed channel, leading to significant measurement errors. The particle deposition may also clog the channel, creating unstable data output and other instabilities, resulting in unpredictable measurement circumstances.

#### **8.2.2 Altitude changes**

Unlike some other products on the market, the design of the sensor has a built-in pressure balancer that prevents membrane deformation due to altitude changes. Therefore, the sensor is intrinsically insensitive to altitude change-induced errors.

#### **8.2.3 Excessive humidity or condensation**

The humidity change will not alter the performance of the sensor. However, if excessive humidity is present, resulting in condensation, the measurement port or channel could be blocked or changed. This would result in a very unreliable data output. Please use other tools to prevent this situation from occurring when using this product.

## 9. Warranty and Liability

(Effective January 2018)

Siargo warrants that the products sold hereunder will be used appropriately and installed correctly under normal circumstances and service conditions. As described in this user manual, it 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 of a serviced product shall bear the same terms in this warranty.

Siargo makes no warranty, representation, or guarantee and shall not assume any liability regarding the suitability of the products described in this manual for any purposes that are not specified in this manual. The users shall be held fully responsible for validating the performance and suitability of the products for their particular design and applications. For any misuse of the products out of the scope described herein, the user shall indemnify and hold Siargo and its officers, employees, subsidiaries, affiliates, and sales channels harmless against all claims, costs, damages, and expenses or reasonable attorney fees from direct or indirect sources.

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, etc., or 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, strict 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. Regardless of form, no action 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 the 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. It shall not be amended, modified, or its terms waived except by Siargo's sole action.

This manual's product information is believed to be accurate and reliable at the time of release or when made available to the users. However, Siargo shall assume no responsibility for any inaccuracies and/or errors and reserves the right to make changes without further notice for the relevant information herein.

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, as 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) Products that have been subject to chemical attacks, including exposure to corrosive substances or contaminants. In the case of battery usage, long-term discharge, or leakage-induced damage;
- (3) Products that have been opened or dismantled for whatever reason;
- (4) Products that have been subject to working conditions beyond the technical specification as described by this manual or related datasheet published by the manufacturer;
- (5) Any damages incurred by the incorrect usage of the products;
- (6) Siargo does not provide any warranty on finished goods manufactured by others. Only the original manufacturer's warranty applies.
- (7) Products that unauthorized dealers or any third parties resell.

## 10. Service/order contact and other information

Siargo Ltd. is making every effort to ensure the quality of its products. For questions or product support, please get in touch with your direct sales representative. If you need additional assistance, please get in touch with customer service at the address listed below. We will respond to your request in a timely fashion and work with you toward your complete satisfaction.

For sales or product orders, please get in touch with the local sales representatives or distributors listed on the company's webpage: [www.Siargo.com](http://www.Siargo.com).

For any returns, please get in touch with your direct sales representative to obtain an RMA. If you require further assistance, please get in touch with [info@siargo.com](mailto:info@siargo.com) for additional information or a Return Materials Authorization (RMA) before returning the product to the factory for servicing, including calibration. Please specify in your email message that you intend to return the product to the factory and include your shipping address. Be sure to write the RMA on the returned package or include a letter with the RMA information.

Direct customer service request(s) should be addressed to

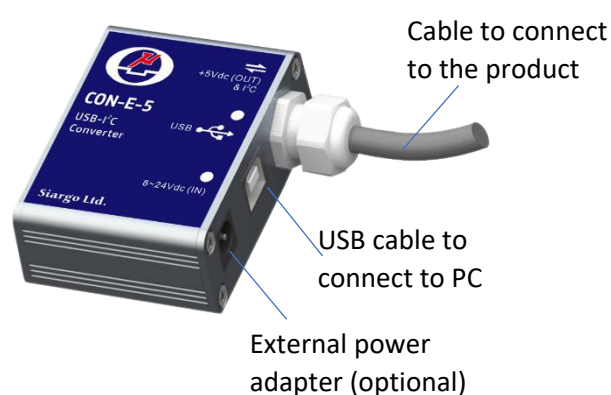
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For further information and updates, please visit [www.Siargo.com](http://www.Siargo.com).

## Appendix I: Sensor evaluation kit

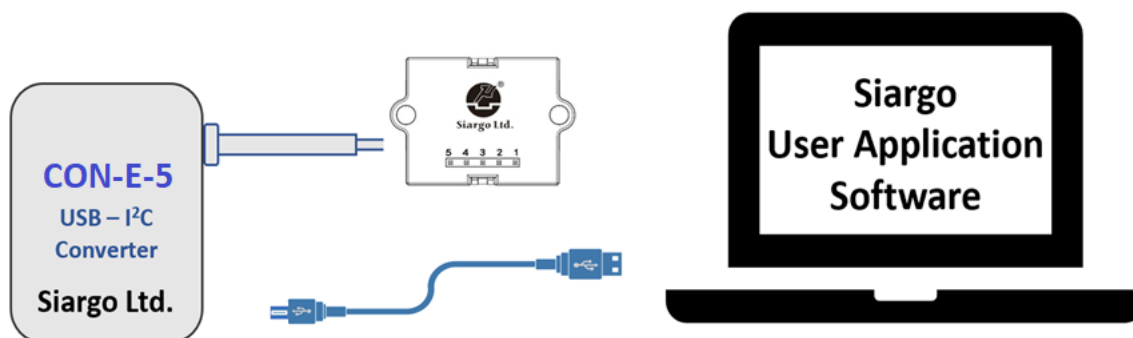
Siargo offers a sensor evaluation kit, including a digital data converter, USB data cable, and User Application software, that allows the user to evaluate the product performance on a Microsoft Windows-based computer. The user can read and visualize the flow rate of the product, obtain the totalized values, and save the data for further analysis. It can read from up to 128 sensors with the I<sup>2</sup>C interface in serial.

For further information and purchase of the evaluation kit, please get in touch with the manufacturer or the sales representative.



Each converter has a fixed cable that can be directly connected to the product. The USB cable connected to the PC is also included.

For most of the products, the power from the PC via the USB cable will be sufficient to power the sensor product; no external power will be required. However, for multiple sensors in serial, the power via the USB cable may not be enough; an external power adapter with 8~24Vdc will be necessary.



## Appendix II: Document history

### Revision VB.0.04 (August 2025)

- Corrections.

### Revision VB.0.03 (July 2024)

- Minor corrections.

### Revision VB.0.02 (July 2023)

- Update contact address and corrections.

### Revision VB.0.01 (July 2022)

- Update service information.

### Revision VB.0 (June 2021)

- Reformatted and I<sup>2</sup>C communication update.

### Revision VA.7 (October 2020)

- ISO 45001 update.

### Revision VA.6 (July 2019)

- Update mountings.

### Revision VA.5 (July 2018)

- Update response time, temperature shift, and warm-up time; update I<sup>2</sup>C protocol.

### Revision VA.4 (September 2017)

- Added range (50 and 100 Pa); added working electrical current requirement.

### Revision VA.3 (July 2017)

- Added uni-directional option;
- Added document history tracking.