



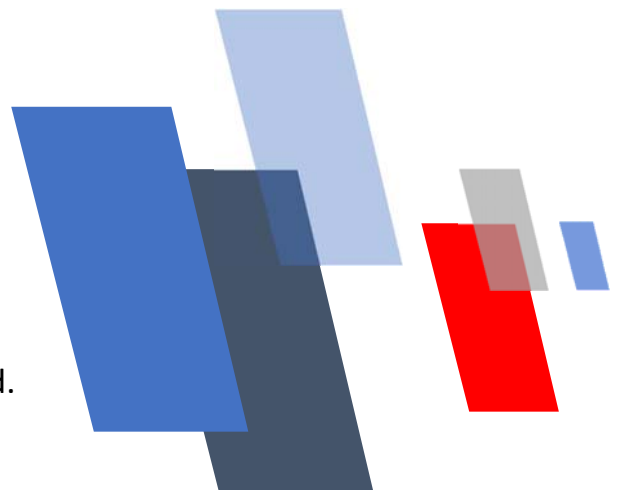
# FS6122 User Manual VB.1

Integrated flow, pressure & temperature sensors



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# **MEMS Flow, Pressure and Temperature Sensors**

with thermal and piezo sensing technology

FS6122 Series

## **User Manual**

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## Attention !

- Please carefully read this manual prior to operating this product.
- Do not open or modify any hardware which may lead to irrecoverable damage.
- Do not use this product if you suspect any malfunctions or deflection.
- Do not use this product for corrosive media or in a strong vibration 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 for electrical safety, and even it operates at a low voltage, any electrical shock might lead to some unexpected damages.
- 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 FS6122 series of combo sensors for a medical ventilator or CPAP (Continuous Positive Airway Pressure) equipment applications. The product performance, maintenance, and troubleshooting, as well as the information for product order, technical support, and repair, are also included.

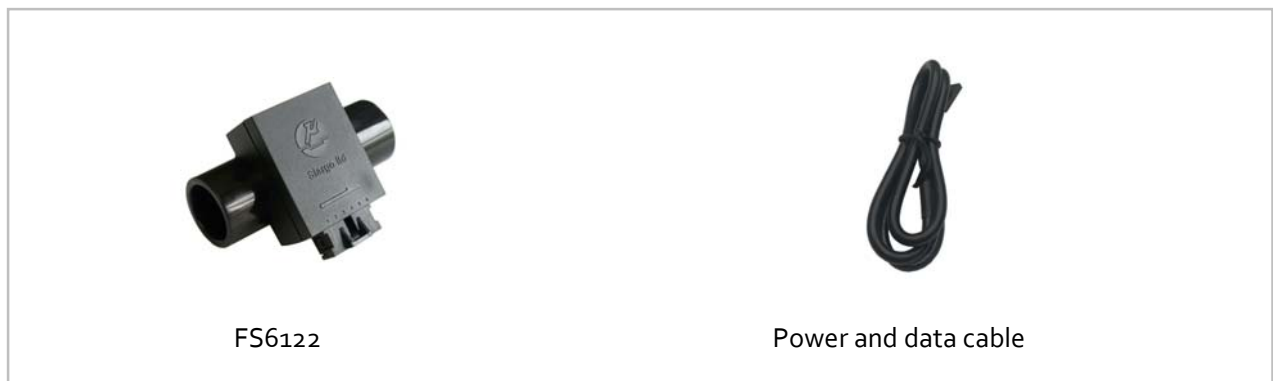
The FS6122 sensors are manufactured with the company's proprietary MEMS (micro-electro-mechanical systems) sensing and package technology that offers primarily the mass flow and gauge pressure with optional temperature and humidity sensing in a compact design without the needs for additional calibrations, which significantly reduces cost for the equipment manufacturers.

While the current packages are best for medical applications, the manufacturer also offers alternative customized packages with customized adapters. Please contact the manufacturer for additional information.

## 2. Receipt / unpack of the products

Upon receipt of the products, please check the packing box before the dismantlement of the packing materials. Ensure no damages 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, proceed to open the packing box, and you shall find the product (either the sensor formality per the actual order), together with the power and data cable if the order is included as shown below.

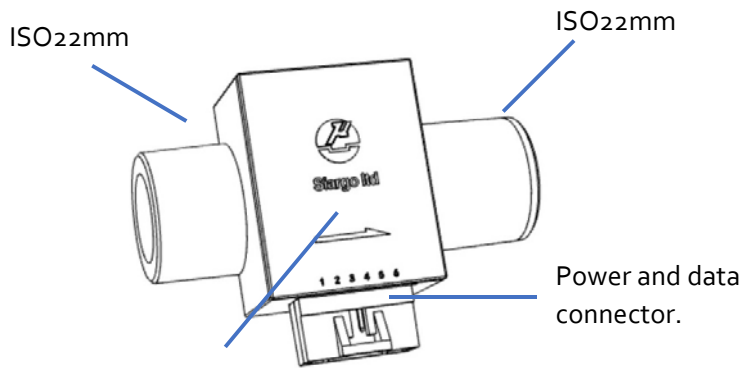


Please check immediately for the integrity of the product and the power and data cable; if any abnormality is identified, please notify the distributor/sales representative or manufacturer as soon as you can. If any defects are confirmed, an exchange shall be arranged immediately via the original sales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

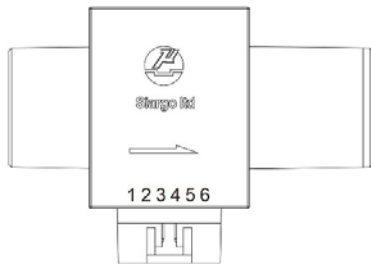


Direction for flow measurement. For dual directional model, the arrow does not apply.

**⚠ Note:** Analog outputs only apply for flow and gauge pressure.

#### 3.2 Power and data pinout description

Table 3.2: FS6122 pin assignment.



PIN	COLOR	DEFINITION
1	White	Analog, pressure data
2	Green	Analog, Flow data
3	Black	GND, ground
4	Red	VCC, power supply
5	Yellow	SCL, I <sup>2</sup> C clock
6	Blue	SDA, I <sup>2</sup> C data

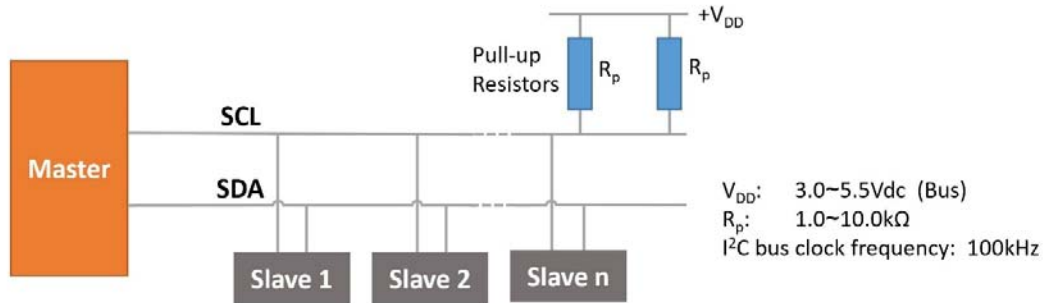
- Note:**
1. Power supply: The FS6122 requires a power supply of  $5 \pm 5\%$  Vdc. The sensor consumes less than 20 mA normally and the minimum supply current must be larger than 15 mA.
  2. The pressure analog output can be optional. The pin provides 0.5 ~ 4.5 Vdc corresponding with the specified pressure full-scale range. If the pressure option is not selected, this pin output is NULL.
  3. The flow rate analog outputs 0.5 ~ 4.5 Vdc corresponding with the specified flow full-scale range.
  4. SDA and SCL are the I<sup>2</sup>C serial data line and serial clock line.





## 5. Basic operation

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



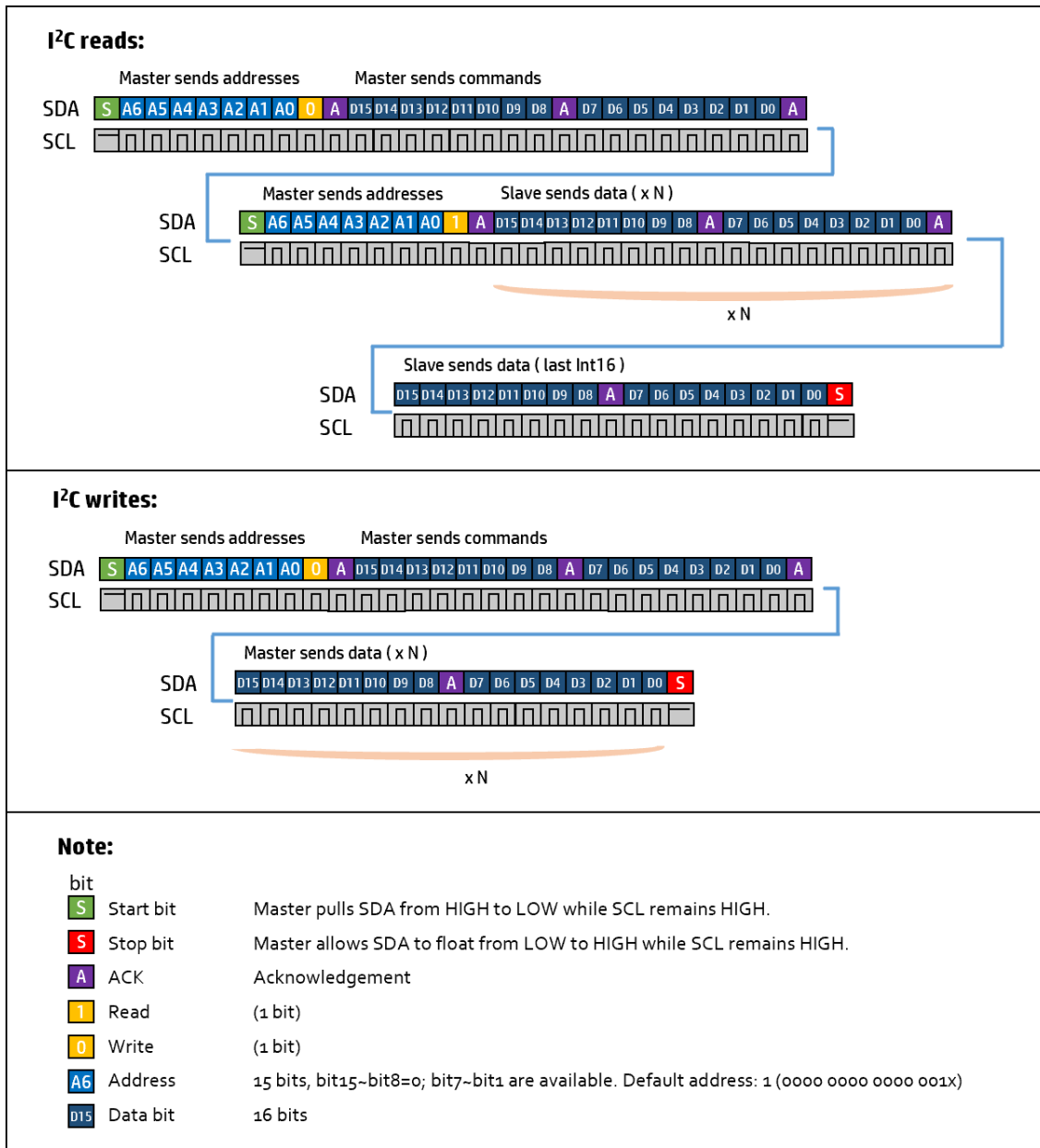
### 5.2 I<sup>2</sup>C interface command description

Command Byte (Hex)	Length (int 16)	Command Name	Read/Write	Notes
05H	1	I <sup>2</sup> C address	Write	Bit 0 is R/W flag bit; Bit 1~ Bit 7 are available.
0BH	1	Filter depth	Write	Int 8, 0~254
1CH	1	Flowrate offset reset	Write	1 byte, ensure no-flow conditions
24H	1	Pressure offset reset	Write	1 byte, ensure no-flow conditions
9DH	4	Write protection	Write	4 bytes, 0x53, 0x49, 0x41, 0x52. One-time effective.
82H	12	Serial number	Read	ASCII
83H	5	Flow rate	Read	Int <sub>32</sub> (/1000 SLPM)+CRC CRC=(Byte1)XOR(Byte2)XOR(Byte3)XOR(Byte4)
84H	9	Flow rate & Pressure	Read	Int <sub>32</sub> (/1000 SLPM), INT <sub>32</sub> (/1000 cmH <sub>2</sub> O)+CRC CRC=(Byte1)XOR(Byte2)XOR(Byte3)XOR(Byte8)
85H	1	I <sup>2</sup> C address	Read	Bit 7 ~ Bit 1
8BH	1	Filter depth	Read	Int 8, 0~254
A3H	5	Pressure	Read	Int <sub>32</sub> (/1000 cmH <sub>2</sub> O)+CRC CRC=(Byte1)XOR(Byte2)XOR(Byte3)XOR(Byte4)
B2H	3	Temperature	Read	Int <sub>16</sub> (/100 °C) + CRC CRC=(Byte1)XOR(Byte2)
B3H	3	Humidity	Read	Int <sub>16</sub> (/100 %RH) + CRC CRC=(Byte1)XOR(Byte2)

**Note:** 1. Before writing to the register, please ensure the write protection is disabled.

- 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).
- The write protection is a one-time effective function.

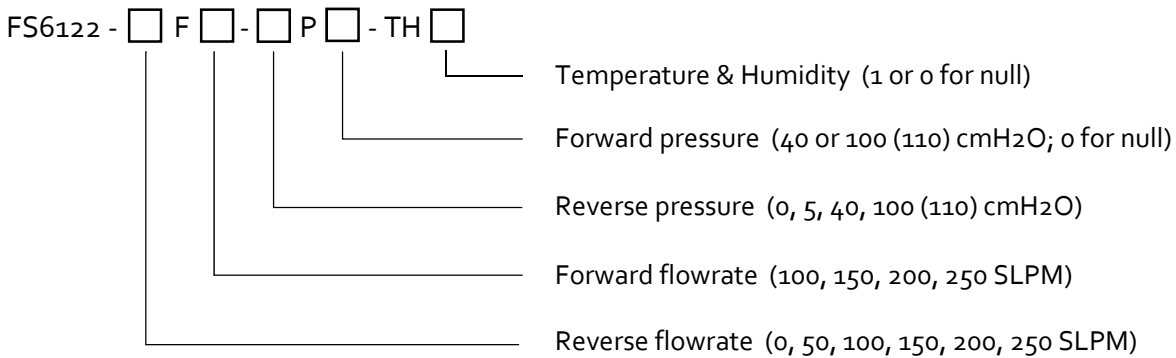
### 5.3 I<sup>2</sup>C interface read/write sequences



## 6. Product selection and order information

### 6.1 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. Except for the temperature/humidity option, the numbers are designated for full-scale value.
2. Except for flowrate, 0 stands for null or without the corresponding sensing option.
3. Example: FS6122-50-F200-5P40-TH1 is a sensor that measures mass flow rate from reverse 50 to forward 200SLPM; gauge pressure from -5 to 40 cmH<sub>2</sub>O, temperature, and relative humidity.
4. The current configuration would not guarantee the response time for humidity, the humidity value could take additional and unspecific time to reach the real value.

### 6.2 Order contact and customer support

The sales offices and the sales distributors/representatives are listed at the end of this document. For small quantities, the order can be placed either through the Siargo website: [www.siargo.com](http://www.siargo.com) or the sales office. For large quantities, please contact the sales office, 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 the customer service listed at the end of the document.

## 7. Product performance

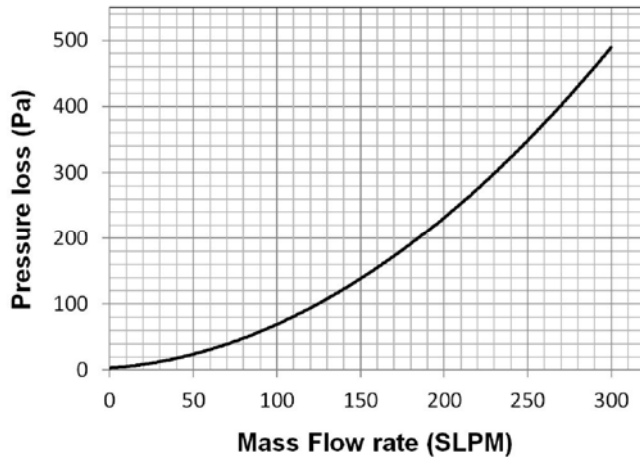
### 7.1 Technical specifications

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
Flow range	-250 ... +250	SLPM
Accuracy (total error band)	±(2.5+0.5FS)	%
Output	Linear, analog 0.5~4.5Vdc / I <sup>2</sup> C (14bit)	
Response time	1.8	msec
Gauge pressure	-5, -40, -100, 0 ... 40, 100 (110)	cmH <sub>2</sub> O
Accuracy (total error band)	±1.0	%FS
Output	Linear, analog 0.5~4.5Vdc / I <sup>2</sup> C (14bit)	
Response time	1.8	msec
Temperature	-10~60	°C
Accuracy	±0.5	°C
Humidity	0~100(no condensation)	%RH
Accuracy	±2.0 (20~80%RH); ±5.0 (other ranges)	%
Resolution	0.7	%RH
Response time (63%)	5.0 (25~75%)	sec
Gas compatibility	Air, O <sub>2</sub> , N <sub>2</sub>	
Supply voltage	5.0±5%	Vdc
Power consumption	<60	mA
Warm-up time	<50	msec
Temperature compensation	-5~+65	°C
Altitude compensation	-400~+3000 (700~1060)	m (hPa)
Storage temperature	-20 ~ +70	°C
Compliance	RoHS; REACH	
CE	IEC 61000-4-2;4;8	

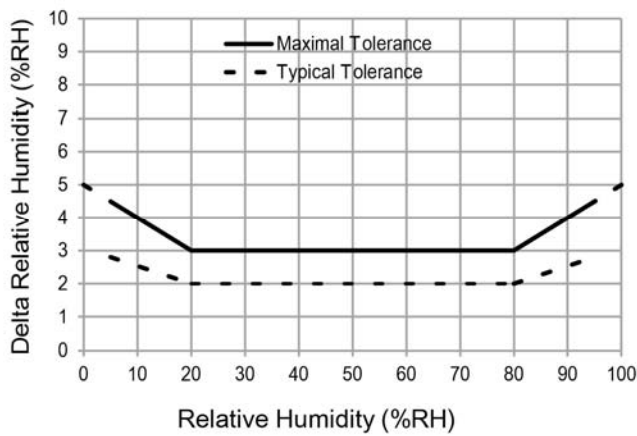
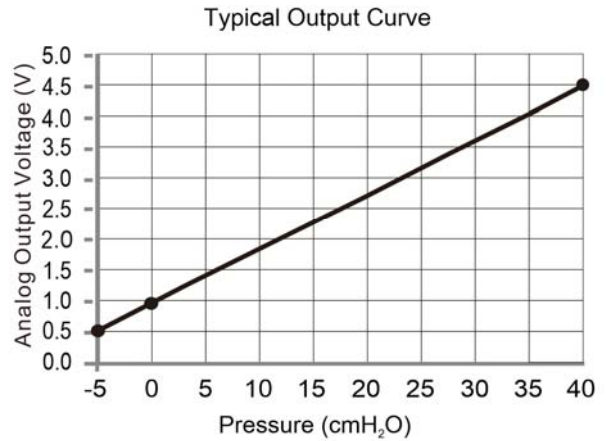
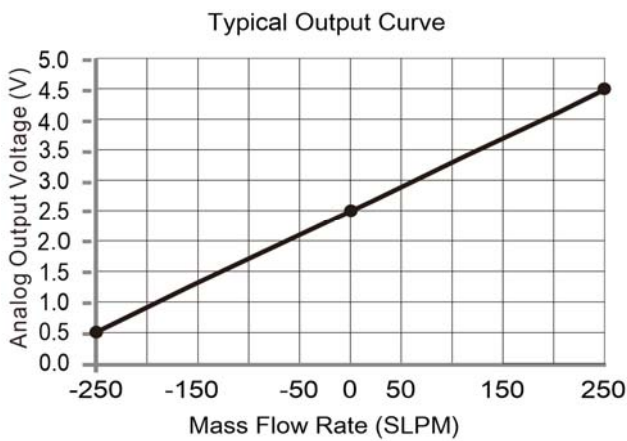
- Note:**
1. The analog output is correlating to the full-scale whatever it is specified.
  2. Burst pressure for pressure range: ±40kPa (-5~40 cmH<sub>2</sub>O) and ±100kPa (-5~100 cmH<sub>2</sub>O).
  3. The data and power cable connector is supplied with the product. It is compatible with AMPMODU MAT 6 positions. (e.g. TE 5-103956-5 <https://www.te.com/usa-en/product-5-103956-5.html>)

## 7.2 Pressure loss



The pressure loss shown in the graph is one-directional. The reverse direction will have an identical loss value.

## 7.3 Typical (analog) output



The temperature and humidity data can only be accessed via the I<sup>2</sup>C interface due to the limited analog ports.

## 8. Technical notes for the product performance

### 8.1 Measurement principles

The products utilize the Company's proprietary micro-machined (MEMS) sensing technology. The mass flow sensing is via calorimetry with temperature compensation. The gauge pressure is realized via the piezoresistive sensing, while the temperature sensor is a micromachined platinum thermistor, and the humidity sensor is again micromachined with the capacitive sensing principle. The MEMS sensors allow the integration in a small footprint while offering multiparameter sensing.

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

#### 8.2.1 Contamination and sterilization

It is critical to have the measurements performed in a contamination-free environment for data accuracy. Excessive contaminants such as vapors will lead to data deviation or even product malfunctions in severe cases.

For the medical applications, it may be desired to have the product to be sterilized from time to time. Standard EtO sterilization process is recommended. For the detailed procedure please consult your local experts or contact the manufacturer.

#### 8.2.2 Altitude changes

Unlike some other products on market, the design of the sensor has a built-in pressure balancer that preventing membrane deformation due to altitude changes. Therefore, the sensor is intrinsically insensitive to the altitude change-induced errors. The specified altitude in Sec 7.1 has been fully tested.

#### 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 altered.

This would result in a very unreliable data output. Please filter or other tools to prevent this situation to occur when using this product.

#### **8.2.4 Metrology verification**

Testing the products with local metrology tools will be performed in almost all cases. It should be noted that for this particular sensor, special care should be applied while performing such a task.

The gauge pressure tests are relatively simple, as long as the pressure is tested under a stable media condition, the metrology data should be well reproduced.

For the mass flowrate comparison, however, in addition to the flow system setup conditions recommended by OIML R137, a stable flow system must be ensured. This is because the current product is designed for a small pressure loss, therefore the sensor does not have a strong flow restrictor or conditioners to handle the flow instability that may exist in the system. Therefore to compare the metrology data, the user should ensure the system is stable, otherwise, the output could be noisy and metrology deviations would be inevitable. If such cases present, please contact the manufacturer for further solutions.

For temperature and humidity measurement, because of the small package space, the response of the humidity could be slower than the specified. For additional information, please contact the manufacturer.

## 9. Warranty and Liability

(Effective January 2018)

Siargo warrants the products sold hereunder, properly used, and properly installed under normal circumstances and service. 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 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 for full responsibility for validating the performance and suitability of the products for their particular design and applications. For any of the 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 expense or reasonable attorney fee 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. 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, 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 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 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 damages;
- (3) Products that have been opened or dismantled for whatever reasons;
- (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 are re-sold by unauthorized dealers or any third parties.

## 10. Service contact and information

Siargo Ltd. is making every effort to ensure the quality of the products. In case of questions and or product supports, please contact 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.

Customer service and all orders should be addressed to

Siargo Ltd.  
3100 De La Cruz Boulevard, Suite 210,  
Santa Clara, California 95054, USA  
Phone: +01(408)969-0368  
Email: [info@Siargo.com](mailto:info@Siargo.com)

For orders, please provide an accurate and full postal address. Siargo will not ship to P.O. Boxes or via a third party.

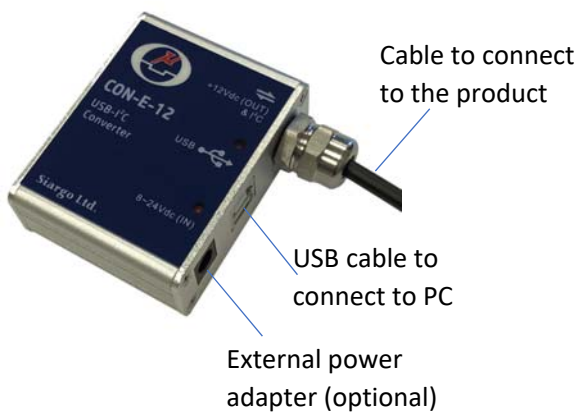
Please contact [info@siargo.com](mailto:info@siargo.com) to obtain a Return Materials Authorization (RMA) before shipping the product back to the factory for returns or factory services such as calibration. Please specify as clear and detailed as possible in your email message the product's status that you intend to ship back to the factory. Be sure to write the RMA on the returned package or include a letter with the RMA information.

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

## Appendix I: Sensor evaluation kit

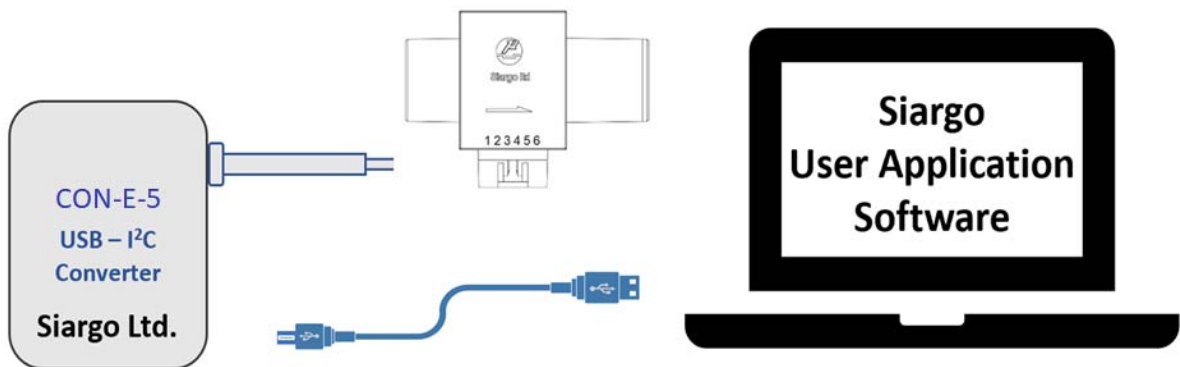
Siargo offers a sensor evaluation kit, including a digital data converter, USB data cable, and User Application software, that allows the user to evaluate the product performance on a Microsoft Windows-based computer. The user can read and visualize the flow rate of the product, obtain the totalized 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 contact 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 required.



## Appendix II: Document history

06.2021	VB.1 – Reformated and updated.
10.2020	VA.14 – Revised ISO45001
07.2020	VA.13 – I <sup>2</sup> C communication protocol update
06.2020	VA.12 – I <sup>2</sup> C communication protocol update
10.2019	VA.11 – Output pin assignment update
10.2018	VA.10 – Add additional gauge pressure range
04.2018	VA.9 – I <sup>2</sup> C communication protocol update
07.2017	VA.8 – Response time update; build materials update; Application notes update; Added document history tracking.