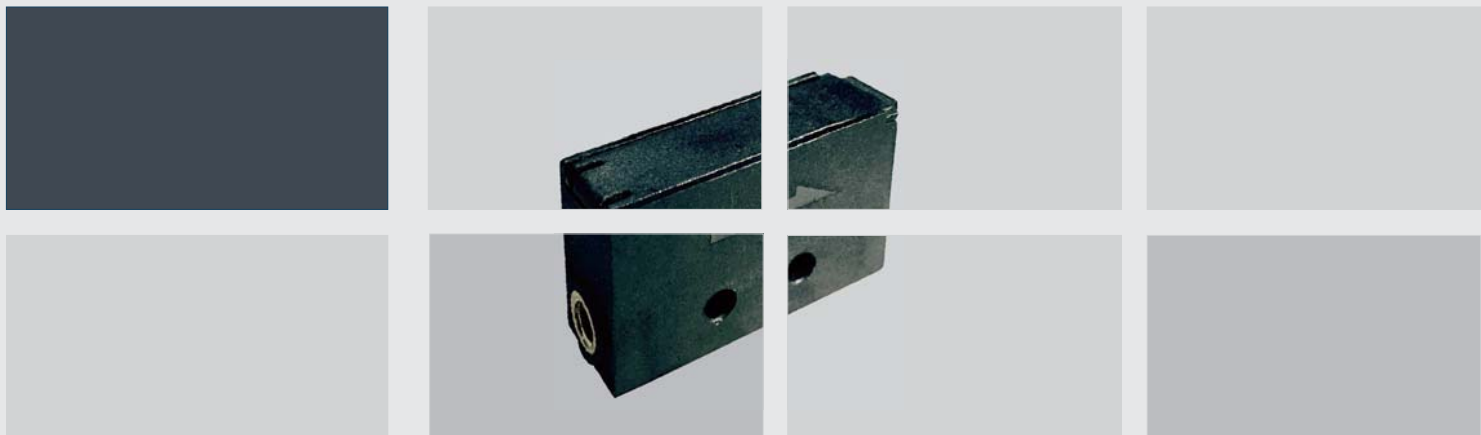




Siargo Ltd.



# Model FS8001

SIARGO MEMS FLOW SENSING PRODUCTS  
**MEMS Mass Flow Sensors**

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VB.0.a



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# MEMS Mass Flow Sensors

FS8001 Series

## User Manual

Document No. 10-2018-S13.a EN  
Issue date: 2018.10  
Revision: VB.0.a

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# MEMS Mass Flow Sensors



Siargo Ltd.

## Model FS8001

### Features

- Fast response time
- High sensitivity
- Low pressure drop
- Miniature design for easy installation



### Description

The FS8001 mass flow sensors are designed and manufactured using Siargo's proprietary MEMS flow sensor and package technology.

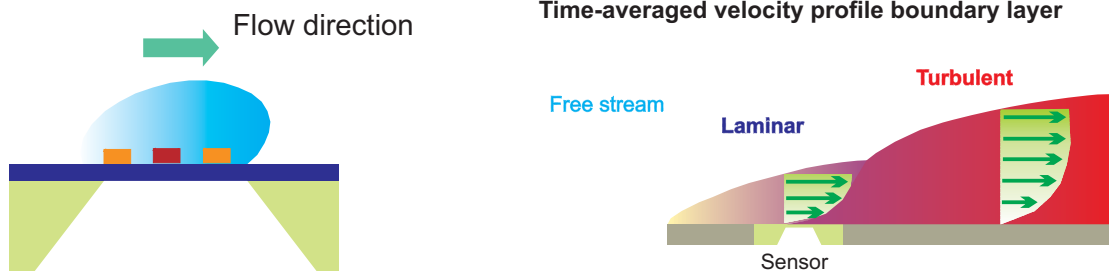
The FS8001 mass flow sensors are developed preliminarily for die-attachment equipment air flow path control during pick and placement, and possibly for other instrumentation applications.

The packaging enclosure is made of the chemically inert and thermally stable polyphenylene sulfite (PPS) material.

The FS8001 requires a power supply of 8 ~ 24 Vdc, and provides an analog output of 0.5 ~ 4.5 Vdc corresponding to the flow rate from 0 to full scale.

### Working Principle

The MEMS sensor chip utilizes the calorimetric principle. It is packaged on a plate installed inside the flow channel, which provides additional flow conditioning from the boundary layer configuration resulting in a laminar flow. The mass flow measurement is established as the gas carries heat away from the heater leading to the redistribution of the temperature field. Accurate flow rate is obtained by calibration with standard gas at preset conditions.



## 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.

| Model                              | FS8001                                  |               |               |               |          |
|------------------------------------|---|---------------|---------------|---------------|----------|
| Flow range                         | 0 ~ 15                                  | 0 ~ 50        | 0 ~ 150       | 0 ~ 500       | sccm     |
| Turn-down ratio                    | 15:1                                    | 50:1          | 100:1         | 100:1         | sccm     |
| Accuracy <sup>1</sup>              | ± (2.0+1.0FS)                           | ± (2.0+0.5FS) | ± (2.0+0.5FS) | ± (2.0+0.5FS) | %        |
| Repeatability                      | ±1.0                                    |               |               |               | %FS      |
| Output                             | Linear, analog voltage/l <sup>2</sup> C |               |               |               |          |
| Analog Output Range                | 0.5 ~ 4.5                               |               |               |               | Vdc      |
| Null Shift                         | <30                                     |               |               |               | mVdc     |
| Output Shift                       | <±0.12                                  |               |               |               | %/°C     |
| Response Time                      | 5                                       |               |               |               | ms       |
| Power Supply                       | 8 ~ 24 Vdc, 50 mA                       |               |               |               |          |
| Operating Current                  | 17                                      |               |               |               | mA       |
| Max. Working Pressure              | 0.5                                     |               |               |               | MPa      |
| Working Temperature                | 0 ~ +55                                 |               |               |               | °C       |
| Storage Temperature                | -20 ~ +65                               |               |               |               | °C       |
| Humidity                           | < 95 %RH ( No icing or condensation)    |               |               |               |          |
| Life Time                          | 10                                      |               |               |               | years    |
| Mechanical Connection <sup>2</sup> | M5                                      |               |               |               |          |
| Electrical Connector <sup>3</sup>  | SM05B-SRSS-TB (JST)                     |               |               |               |          |
| Calibration                        | Air ( @ 20°C , 101.325kPa )             |               |               |               |          |
| Maximum Overflow                   | 500                                     | 500           | 500           | 3000          | sccm     |
| Maximum Flow Change                | 100                                     | 100           | 100           | 500           | sccm/sec |

1, To obtain accurate flow measurement, let the sensor warm up 1 minute at power up.

While using the mounting holes the M3 screws shall be tighten carefully with a max. torque of ≤0.28 N·m to obtain accuracy.

2, Tightening torque should be 2.1 ~ 2.8 N·m.

3, The electrical connector of the FS8001 sensor is SM05B-SRSS-TB (JST). Connector SHR-05-S (JST) is suitable.

### 1.2 Flow Characteristics

The FS8001 provides a linear analog output corresponding with 0 ~ full scale. The typical output characteristics of 150 sccm illustrated in Figure 1.1 and of 500 sccm illustrated in Figure 1.2. The data are obtained at 12 Vdc supply.

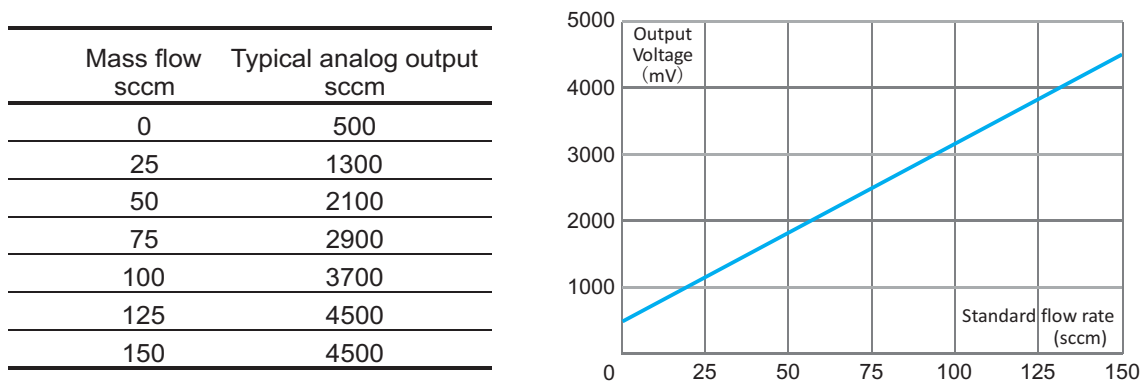


Figure 1.1: The typical analog output curve of full scale 150 sccm.

**Compliance Statement:** All components of this product are RoHS compliant. The product fully complies with CE norm EN61000-6-1 through 61000-6-4 and EMC directive 2014/30/EU.

| Mass flow sccm | Typical analog output mV |
|----------------|--------------------------|
| 0              | 500                      |
| 100            | 1300                     |
| 200            | 2100                     |
| 300            | 2900                     |
| 400            | 3700                     |
| 500            | 4500                     |

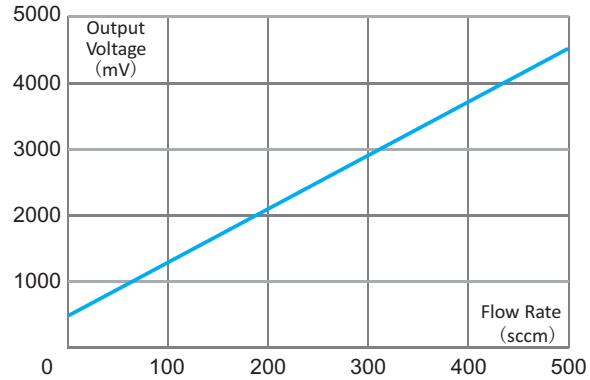


Figure 1.1: The typical analog output curve of full scale 500 sccm.

## 2. Electrical Interface

### 2.1 Pin Definition

The FS8001 provides a 5-pin electrical interface. The sensor pin configuration is shown in Figure 2.1.

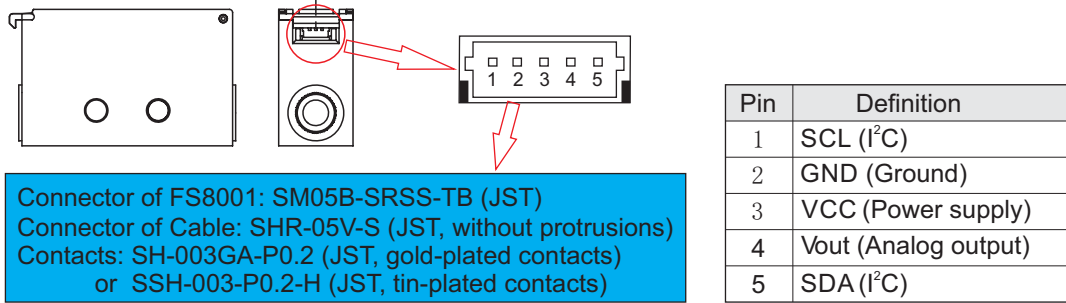


Figure 2.1: FS8001 pin configuration.

### 2.2 Pin Description

**VCC and GND:** The FS8001 requires a power supply of 8~24 Vdc. The voltage is internally filtered and regulated to power the circuit. The sensor output is dependent on the accuracy of the power supply and the  $\pm 5\%$  power accuracy will ensure the performance. 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<sup>2</sup>C, please contact Siargo for protocol.

## 3. Mechanical Dimensions and Mountings

The FS8001 provides two mounting holes for easy installation. Be sure to align the arrow mark (on the sensor body) with the measurement flow direction. The sensor dimensions are shown in Figure 3.1.

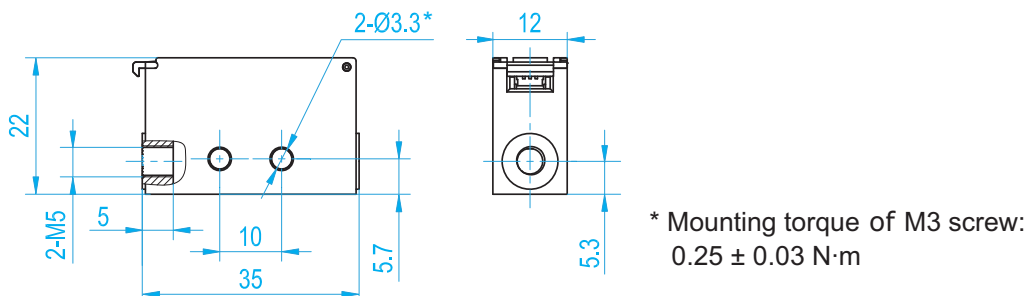


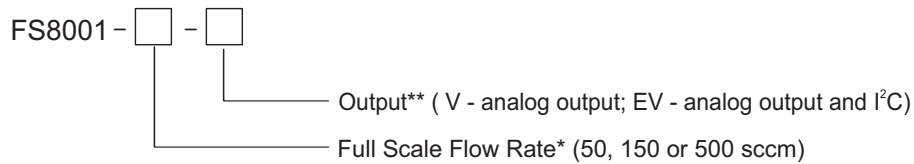
Figure 3.1: The FS8001 mechanical dimensions.



## 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.



\* Flow rate number only, without unit. The default unit is sccm.

\*\* The sensor standard output is analog, while digital output is optional.

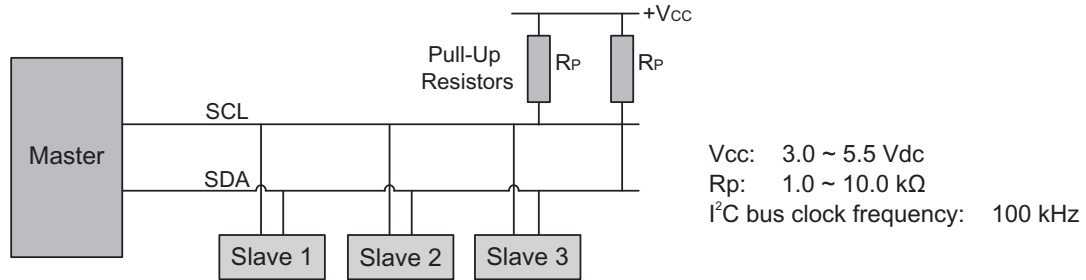
### 4.2 Order Contact and Customer Support

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](http://www.siargo.com) or the sales office. For large quantities, please contact the sales office or distributors or sales representatives.

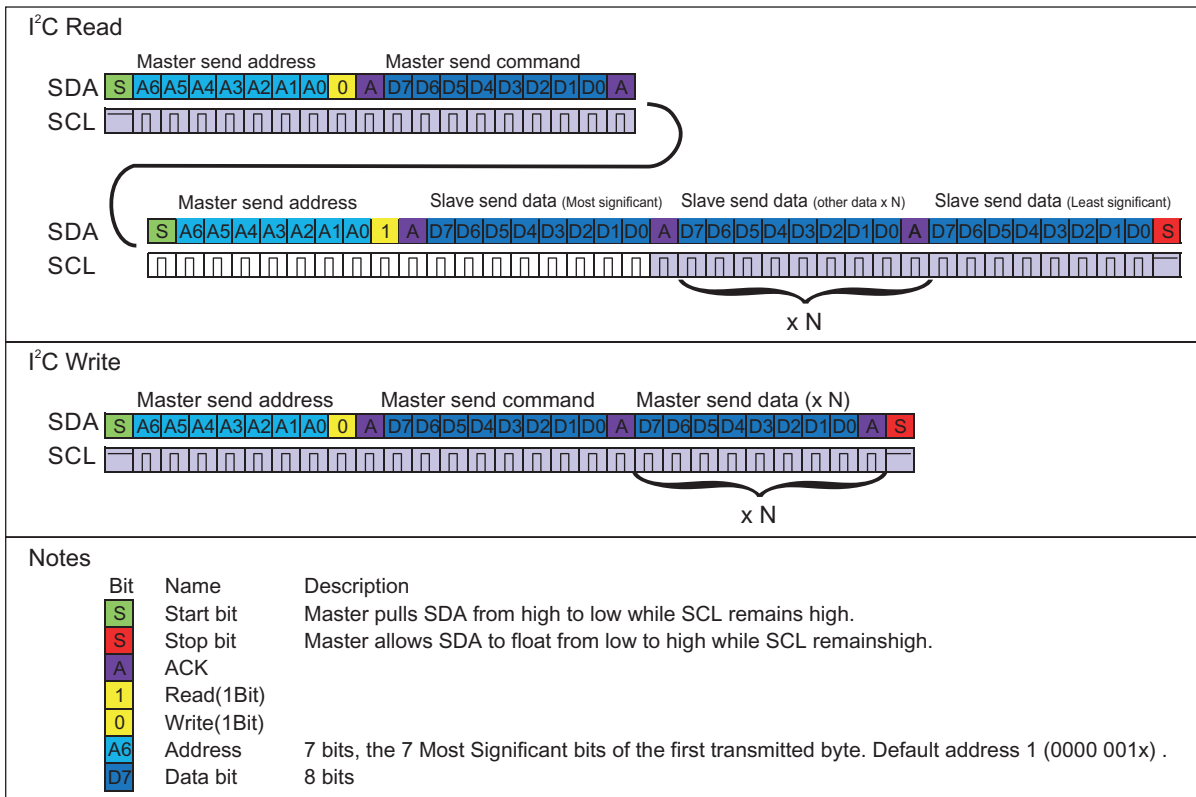
Siargo is making every effort to ensure the quality of the products. In case of questions and/or product supports, please contact customer service listed at the end of the document. We will respond your request in a timely fashion and will work with you toward your complete satisfaction.

## 5. I<sup>2</sup>C Communication

### 5.1 I<sup>2</sup>C Connection



### 5.2 I<sup>2</sup>C Read and Write Sequences



### 5.3 I<sup>2</sup>C Commands description

| Command Byte (Hex) | Length | Command Name                       | Read / Write | Notes                                     |
|--------------------|--------|------------------------------------|--------------|---|
| 05H                | 1      | Write the I <sup>2</sup> C address | W            | Bit7 ~ Bit1 can be set*                   |
| 0BH                | 1      | Write the filter depth             | W            | Int8, 0~254                               |
| 1CH                | 1      | Calibration the offset             | W            | 1 byte, ensure <b>NO</b> flow in the pipe |
| 82H                | 12     | Read the sensor SN                 | R            | ASCII                                     |
| 83H                | 4      | Read flow rate                     | R            | Int32/1000 sccm                           |
| 85H                | 1      | Read the I <sup>2</sup> C address  | R            | Bit7 ~ Bit1                               |
| 8BH                | 1      | Read the filter depth              | R            | Int8, 0~254                               |

\* The address is set with Bit7~Bit1, For instance, sensor I<sup>2</sup>C 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 polyphenylene sulfite (PPS), brass and stainless steel. 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  $\text{HOCH}_3$ ,  $(\text{SiO})_n$ ,  $\text{CH}_3\text{H}$  and epoxy resin.

### 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.

It is suggested to design your application so that nominal flow rate is approximately 70% of the full scale flow rating of the sensor. Don't use a sensor with a flow range at the extreme cases, for instance, don't use a 6 SLPM sensor for a 0.6 SLPM application.

### 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.





## Contact Information

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Email: info@servoflo.com

### Representative in Japan

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## Appendix: Revision History

### Revision B.0.a (October 2018):

- ✎ Removed Fs8003;
- ✎ Added maximum flow rate of 15sccm, 50sccm and 150sccm;
- ✎ Added turn-down ratio (*1.1 Performance Specifications*).

### Revision A.11 (August 2018):

- ✎ Added life time (*1.1 Performance Specifications*);
- ✎ Revised the I<sup>2</sup>C sequences and I<sup>2</sup>C commands description (*5.2 I<sup>2</sup>C Read and Write Sequences, 5.3 I<sup>2</sup>C Commands description*).

### Revision A.10 (March 2018):

- ✎ Added maximum overflow and maximum flow change (*1.1 Performance Specifications*);

### Revision A.9 (April 2017):

- ✎ Added notes of accuracy (*1.1 Performance Specifications*);
- ✎ Added cable connectors information (*2.1 Pin Definition*);
- ✎ Added the mounting screw torque (*3. Mechanical Dimensions and Mountings*);
- ✎ Added the revision history (*Appendix*).

### Revision A.8 (January 2017):

- ✎ Added the connectors information (*1.1 Performance Specifications*).