

The SEC-G100 Series 39 mm Square Mass Flow Controller for Gas Supply System Integration

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Abstract

In the semiconductor industry, dealing with the large size wafer(φ300mm) and shortening the process time have become strong requirements. In the cause of these requirements, we have developed the mount type small size MFC. This new MFC is 1/3 to 1/2 of the former model in size and weight. It has achieved standard dimensions and square bottom shape.

Recent gas supplying panel weighs more than 50kg and it is hard to handle these gas panel alone. Mounting new MFC on a gas panel reduces the weight of a gas panel more than 10%. And because of its size and weight, applying this type MFC to other instruments, such as “helium chucking”, is increasing. On this paper, hoping an extent of the market, we introduce the feature of this MFC.

1 Introduction

In the semiconductor and liquid crystal industries, flow controllers for use in the thin film process are required to provide not just higher performance, but improved cost-effectiveness and compactness.

As integrated gas panels for the gas supply system have been increasingly adopted, our mass flow controllers (MFCs) have been incorporated in those gas panels. The latest models of our MFCs are introduced below.

2 Development History of SEC-G100

The gas supply system has been required to comply with downsizing and higher purity as larger wafer diameters and miniaturization have been realized for various kinds of products. Thus, a surface mounting type integrated gas panel has been proposed by each manufacturer.

The surface mounting type is now becoming the mainstream, but has many points to be improved, such as footprint, weight, cost, and internal volume.

This paper introduces our new MFC that has been developed to meet the above requirements.

This MFC is the SEC-G100, which is the world-smallest in the semiconductor and liquid crystal industries.

3 Overview of SEC-G100

3.1 Appearance

Fig.1 shows the dimensions of the SEC-G100. Among the conventional integrated gas components, only the MFC was larger than the other components. However, our MFC product has an integrated base block conforming to the size of 39mm (1.5inch). The base bottom of this block is shaped as square. This size is the same as the block size for integrated parts such as valves and filters and offers a great benefit to the users.

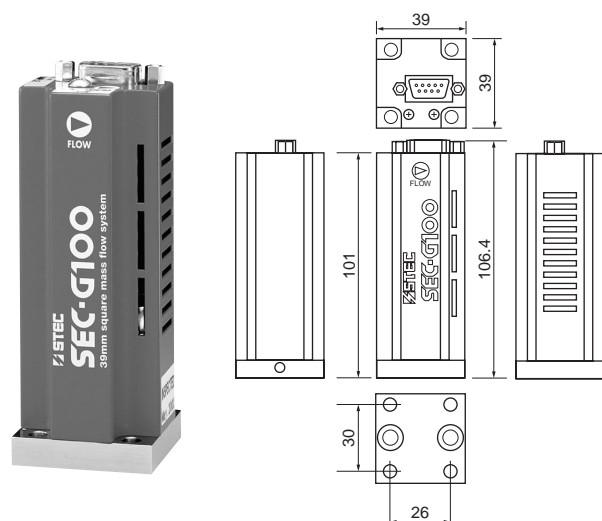


Fig.1 Dimensions of SEC-G100

3.2 Structure

Fig.2 shows the structure of the SEC-G100.

It consists of the flow rate sensor, bypass, control valve, and electric circuit. The measurement and control principles are the same as those used in the current mainstream models.

In order to achieve downsizing and improved stability, the sensor has been newly developed, and the design and layout have been devised for downsizing without compromising the performance of each component part.

The welded and sealed locations have been minimized to greatly improve the safety and substitution easiness.

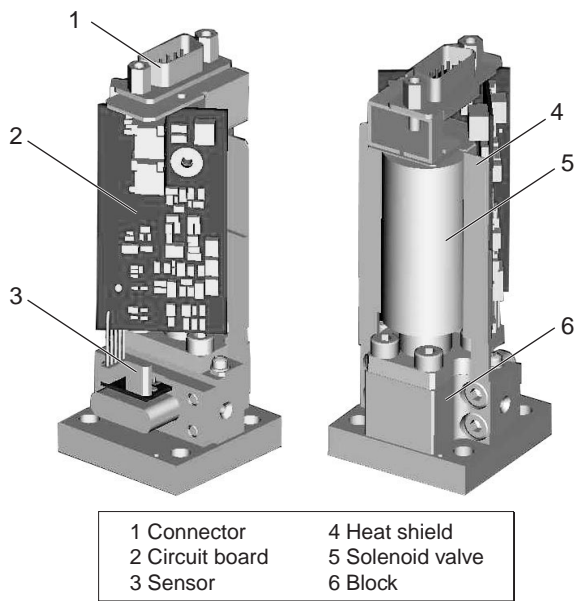


Fig.2 Internal Structure of SEC-G100

4 Features of SEC-G100

To comply with the latest semiconductor processes, the SEC-G100 features downsizing, ultra-cleanliness, high reliability, and high-speed response as its design concept (Table 1).

| | SEC-G111 | SEC-4400 | Other company(A) |
|------------------------------|----------|----------|------------------|
| Internal volume of flow path | 1/5 | 1/2 | 1 |
| Volume of main unit | 1/3 | 1 | 1 |
| Weight | 2/5 | 4/5 | 1 |

Table 1 Comparison of Sizes

(1) Downsizing (World-Smallest)

The SEC-G100 is of 39mm square size.

(2) Light Weight

The weight of the SEC-G100 is 390g, 2/5 the weight of the former model.

(3) Ultra-Cleanliness

The standard welded and sealed locations have been minimized on the internally polished gas-contact surface. The SEC-G100 is free of particles and dead volume.

(4) High Reliability and High Speed Response

The “quick function” has been incorporated to enable high speed response in the range of control flow rates. Fig.3 shows an example of responding to each setting value.

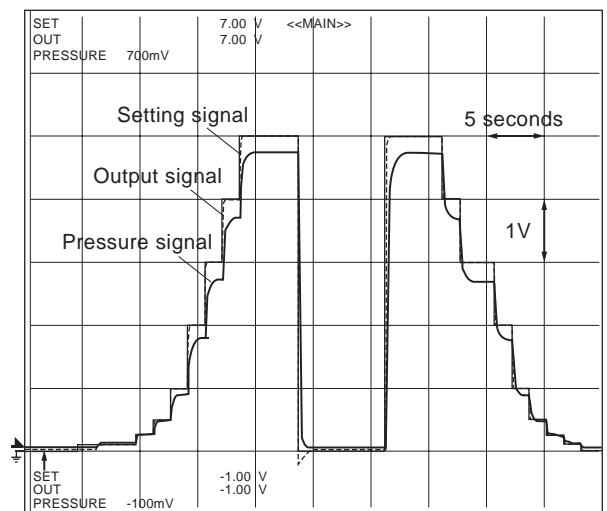


Fig.3 Example of Response to Each Setting Value

(5) High Speed Substitution

The volume of the gas flow path is 2/5 that of the former one and the dead volume is minimized.

Fig.4 shows the substitution data in comparison with that in the piping using a straight pipe.

The substitution easiness is better than in a straight pipe of the same length because the flow velocity in the bypass of the SEC-G100 is faster.

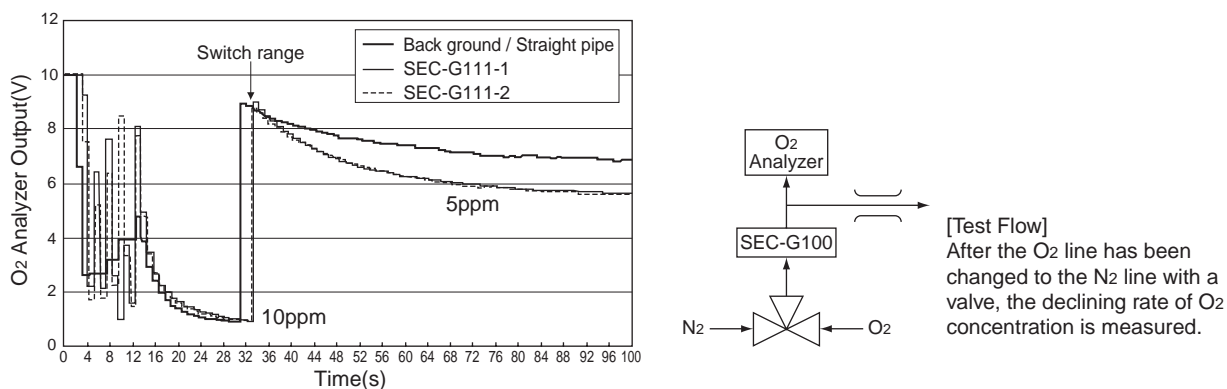


Fig.4 Substitution Data as Compared with That on Piping Using a Straight Pipe

Table 2 shows the specifications of the SEC-G111A and the SEF-G111A. The SEC-G111A is a model of SEC-G100 series MFC. The SEF-G111A is a model of the SEF-G100 series MFM.

| | | | |
|---|--|---------------|---------------|
| Model (mass flow controller) | SEC-G111A | | |
| Mass flow meter | SEF-G111A | | |
| Gas contact material | SUS-316L, PTFE, magnetic stainless steel | | |
| Valve type | Solenoid valve: closed when power is OFF | | |
| Standard flow rate range (FS flow rate as converted into N ₂) | 10SCCM~1SLM | 2SLM | 3SLM~5SLM |
| Flow rate control range (compatible with SEC) | 2~100% (fully closed when setting is 2% or less) | | |
| Flow rate measurement range (compatible with SEC) | 0~100% | | |
| Response speed (compatible with SEC) | Within 1 sec. (T98) | | |
| Accuracy of flow rate | Within ±1% of full-scale value | | |
| Linearity | Within ±0.5% of full-scale value | | |
| Repeatability | Within ±0.2% of full-scale value | | |
| Operating pressure (compatible with SEC) | 50~300kPa(d) | 100~300kPa(d) | 200~300kPa(d) |
| Operating pressure (compatible with SEF) | 300kPa (G) max. | | |
| Withstand pressure | 100kPa(G) | | |
| External leak rate | 5×10 ⁻¹² Pa·m ³ /s(He) | | |
| Seal type | Metallic seal | | |
| Operating temperature | 5~50°C (Accuracy assured: 15°C to 45°C) | | |
| Flow rate setting signal | 0.1~5VDC/2~100% (Input impedance: 1M min.) | | |
| Flow rate output signal | 0~5VDC (Minimum load resistance: 2M min.) | | |
| Drive power source | +15VDC ±5% 60mA, -15VDC ±5% 200mA | | |
| Standard joint | CS-seal, W-seal | | |
| Standard additional features | Quick Start, Auto Close, Auto Zero, and internal polishing | | |
| External dimensions | D:39mm W:39mm H:101mm (excluding connectors) | | |
| Weight of main unit | SEC-G111:390g (SEF-G111:290g) | | |

Table 2 Specifications

5 Conclusion

As the requirements of the MFC have become more diverse, we have increased its variations. We will also increase vaporization and control variations for various kinds of liquid and solid materials as well as gas materials to comply with more diversified processes. We wish to contribute to further development of the semiconductor and liquid crystal industries while considering total warranty for the material supply system as a critical requirement.



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