

## Digital Mass Flow Controllers

Gas supply systems require devices that are ultra-clean, compact, and support greater circuit integration, and lately there is increasing demand for devices that offer highly intelligent functioning in more intelligent gas supply systems as well. Mass flow controllers are commonly considered the core of gas supply systems, and the advance of digital mass flow controllers with CPUs is the focus of a great deal of attention.

HORIBA STEC succeeded in developing the world's first mass-produced digital mass flow controller in 1990. Since then, digital mass flow controllers have come to be regarded as high-end products. HORIBA STEC has consistently pursued the advance of digital mass flow controllers through the development of new functions and the improvement of existing functions, including the creation of higher performance CPUs, the addition of DeviceNet™ communications compatibility, and the expansion of software capabilities to push mass flow controller performance to its limit.



## SEC-Z500 series

Multi Range Multi Gas  
digital mass flow controllers

### Cutting edge models with DeviceNet™ or Digital communications

- ▶ Advanced High reliability 32bit CPU installed.
- ▶ 10SCCM-10SLM FS (standard gas) is covered by 6MFCs.
- ▶ Gas and FS flow specification are available to change easily by user. (MRMG function)
- ▶ High precision. (Set point accuracy)
- ▶ Fast Response across the whole flow range. (Variable PID function)
- ▶ Analog/Digital (RS485) control mode or DeviceNet Interface available.  
(Passed the ODVA (DeviceNet Association) SEMI SIG conformance test.)
- ▶ Compact  
SEC-Z512: Compatible with 1.125 inch pitch gas panel.  
SEC-Z512/522: 106mm between VCR surface (Compatible with 1.5 inch gas panel.)



## SEC-Z10D/Z10DW series

DeviceNet™ compatible  
digital mass flow controllers

### Cutting edge models with DeviceNet™ communications

- ▶ Compatible with the DeviceNet™ interface: Passed the ODVA (DeviceNet™ Association) SEMI SIG conformance test.
- ▶ Full scale 5 SCCM to 100 SLM flow rate lineup.
- ▶ Fast response in the control flow rate range.
- ▶ Ultra clean models featuring piezo valves.
- ▶ Compact  
SEC-Z11D/Z12D: Compatible with 1.125 inch pitch gas panels  
SEC-Z10DW/Z12DW: 106 mm between VCR type surfaces  
(Compatible with 1.5 inch pitch gas panels)



DeviceNet®

## SEC-F700 series

Digital mass flow controllers

### The pioneer series of digital mass flow controllers

- ▶ High precision: By using a digital linearizer (polynomial calibration curve). Up to five calibration can be stored curve internally.
- ▶ Fast response: Have digital PID for fast response in a low flow rate range.
- ▶ A variety of alarms alert the operator to changes in the gas quickly, averting trouble.
- ▶ Sensor alarm functions: The mass flow controller determines if there are changes in the control conditions and outputs an alarm.
- ▶ Ultra clean models featuring piezo valves.
- ▶ Compact: 106 mm between surfaces, suitable for integrated gas panels.



## SEC-V100D series

Digital mass flow controllers

### High precision models offering set point precision

- ▶ High precision: Set point  $\pm 1.0\%$  (30 to 100% F.S.)
- ▶ Fast response: Quick start function and response times of under a second.
- ▶ A lineup of models that are not affected by orientation: A MF (mount-free) sensor that prevents thermal siphoning through its construction (MF models option).
- ▶ Completely interchangeable with analog mass flow controllers.
- ▶ Compact: 106 mm between surfaces, suitable for integrated gas panels.



# SEC-Z500 series

Model	SEC-	Z512MG (DeviceNet™ model: Z514MG)	Z522MG (DeviceNet™ model: Z524MG)
Materials used in gas contact area		M: type, SUS316L, internal surface polishing standard	
Valve Type		Open at power-off: O	Close at power-off: C
Standard Flow Range (N <sub>2</sub> Equivalent F.S.)		#01: 30/#1.5: 55/#02: 100/#2.5: 175/#03: 300/#3.5: 550 SCCM #04: 1/#4.5: 1.75/#05: 3/#5.5: 5.5/#06: 10 SLM	#07: 30/#08: 50 SLM *Available for N <sub>2</sub> , H <sub>2</sub> , Ar, O <sub>2</sub> Please contact us if you need another gases others
Flow Rate Control Range		2 to 100% F.S.	
Response speed		Less than 1 sec across the entire flow rate control range (T98)	
Accuracy		± 1.0% S.P. (30 to 100% F.S.) ± 0.25% F.S. (2 to 25% F.S.) (Description in accordance with SEMI STANDARD E56-1296)	
Linearity		± 0.5% F.S.	
Repeatability		± 0.2% F.S.	
Operating differential pressure		50 to 300kPa (d) [0.5 to 3.0kg/cm <sup>2</sup> (d)] (#5.5 and #06 100 to 300kPa(d))	#07: 200 to 300kPa(d) #08: 200(valve C)/250(valve O) to 300kPa(d)
Maximum operating pressure		450 kPa (G)	
Pressure Resistance		1MPa(G)	
Leak Integrity		less than 5 x 10 <sup>-12</sup> Pa·m <sup>3</sup> /s (He)	
Operating Temperature		5 to 50°C	
Flow rate setting signal		Digital: RS-485 (F-Net protocol) DeviceNet™: (SEC-Z514MG/Z524MG) Analog: 0.1 to 5VDC (Input impedance : more than 1MΩ)	
Flow rate output signal		Digital: RS-485 (F-Net protocol) DeviceNet™: (SEC-Z514MG/Z524MG) Analog: 0 to 5VDC (Minimum load resistance 2kΩ)	
Drive Power Source		+15V ± 5% 150mA -15V ± 5% 150mA DeviceNet : Conforms to ODVA standard (rated value 24VDC (11 to 25VDC)) 3.5VA	
Standard Fitting		1/4"VCR Type or IGS	

\*SCCM and SLM are symbols indicating gas flow rate (mL/min, L/min at 0°C, 101.3 kPa).

# SEC-Z10D/Z10DW series

Model	SEC-	Z10D	Z12D	Z13D	Z11DW	Z12DW	Z13DW			
Materials used in gas contact area		M: type, SUS316L, internal surface polishing standard								
Valve type		Open at power-off: O Close at power-off: C	Closed at power-off: C			Open at power-off: O Close at power-off: C				
Standard flow rate range (N <sub>2</sub> equivalent F.S.)		5/10/20/30/50/100 200/300/500 SCCM 1/2/3/5 SLM	10 SLM	20/30 SLM	100 SLM (Hz, Hz)	5/10/20/30/50/100 200/300/500 SCCM 1/2/3/5 SLM	10 SLM	20/30 SLM	50 SLM	100 SLM (Hz 200 SLM: Option)
Flow rate control range		2 to 100% F.S.		5 to 100% F.S.		2 to 100% F.S.				
Response speed		Less than 1 sec (T98)								
Accuracy		± 1% F.S.								
Linearity		± 0.5% F.S.								
Repeatability		± 0.2% F.S.								
Operating differential pressure		50 to 300 kPa (d)	100 to 300 kPa (d)	20 SLM: 150 to 300 kPa (d) 30 SLM: 200 to 300 kPa (d)	N <sub>2</sub> : 350 to 400 kPa (d) H <sub>2</sub> : 250 to 300 kPa (d)	150 to 300 kPa (d)	200 to 300 kPa (d)	150 to 300 kPa (d)	200 to 300 kPa (d)	100 SLM: 150 to 300 kPa (d) Hz 200 SLM: 200 to 300 kPa (d)
Maximum operating pressure		300 kPa (G)			N <sub>2</sub> : 400 kPa (G) H <sub>2</sub> : 300 kPa (G)	300 kPa (G)				
Pressure Resistance		1 MPa (G)								
Leak Integrity		less than 5 x 10 <sup>-12</sup> Pa·m <sup>3</sup> /s (He)								
Operating temperature		5 to 50°C (accuracy guaranteed between 15 and 45°C)								
Drive power source		Conforms to ODVA standard (rated value 24 VDC (11 to 25 VDC)) 3.5 VA								
Connector position		Top or sides			Top	Top or sides		Top		
Standard Fitting		1/4 VCR type or IGS			3/8 VCR type or IGS		1/4 VCR type or IGS		3/8 VCR type	

\*SCCM and SLM are symbols indicating gas flow rate (mL/min, L/min at 0°C, 101.3 kPa).

# SEC-F700 series

Model	SEC-	F730	F740	F750
Materials used in gas contact area		M: type, SUS316L		
Valve type		Open at power-off: O Close at power-off: C		
Standard flow rate range (N <sub>2</sub> equivalent F.S.)		5/10/20/30/50/100 200/300/500 SCCM 1/2 SLM	3/5/10 SLM	20/30 SLM
Flow rate control range		2 to 100% F.S.		
Response speed		Less than 1 sec (T98)		
Accuracy		20 to 100% ± 0.8% F.S./2 to 20% ± 0.3% F.S.		
Linearity		± 0.5% F.S.		
Repeatability		± 0.2% F.S.		
Operating differential pressure		5 SCCM to 5 SLM: 50 to 300 kPa (d) 10 SLM: 100 to 300 kPa (d)	20 SLM: 100 to 300 kPa (d) 30 SLM: 100 to 300 kPa (d)	
Maximum operating pressure		300 kPa (G)		
Pressure Resistance		1 MPa (G)		
Leak Integrity		5 x 10 <sup>-12</sup> Pa·m <sup>3</sup> /s (He)		
Operating temperature		5 to 50°C (accuracy guaranteed between 15 and 35°C)		
Flow rate setting signal		Digital: RS-422A (F-Net protocol) Analog: 0.1 to 5VDC (Input impedance : more than 1MΩ)		
Flow rate output signal		Digital: RS-422A (F-Net protocol) Analog: 0 to 5VDC (Minimum load resistance 2kΩ)		
Drive power source		+15 VDC ± 5%, 140 mA -15 VDC ± 5%, 120 mA, 3.9 VA		
Standard Fitting		1/4 VCR type or IGS		

\*SCCM and SLM are symbols indicating gas flow rate (mL/min, L/min at 0°C, 101.3 kPa).

# SEC-V100D series

Model	SEC- (mass flow controller) SEF- (mass flow meter)	V110D V110D	V120D V120D
Materials used in gas contact area		M: type, SUS316L, PTFE, magnetic stainless steel	
Valve type	Open at power-off: O Close at power-off: C		Close at power-off: C
Standard flow rate range (N <sub>2</sub> equivalent F.S.)	10/20/30/50/100/200/300/500 SCCM 1/2/3/5/10 SLM		20/30/50 SLM
Flow rate control range (for SEC series)	2 to 100% F.S.		
Flow rate control range (for SEF series)	0 to 100% F.S.		
Response speed	Less than 1 sec (T98)		
Accuracy	± 1.0% within S.P [30 to 100% F.S.] / ± 0.3% within F.S. [2 to 30% F.S.] (Description in accordance with SEMI STANDARD E56-1296)		
Linearity	Within ± 0.5% F.S.		
Repeatability	Within ± 0.2% F.S.		
Operating differential pressure <sup>1</sup> (for SEC series)	50 to 300 kPa (d) 10 SLM: 100 to 300 kPa (d)		150 to 300 kPa (d) 50 SLM: 250 to 300 kPa (d)
Operating differential pressure <sup>1</sup>	300 kPa (G) or under		
Pressure Resistance	1 MPa (G)		
Leak Integrity	5 x 10 <sup>-12</sup> Pa·m <sup>2</sup> /s (He)		
Seal method	Metal seal		
Operating temperature	5 to 50°C		
Temperature influence span	0.08% F.S./°C		
Flow rate setting signal	Digital: RS-422A (F-Net protocol) Analog: 0.1 to 5VDC (Input impedance : more than 1MΩ)		
Flow rate output signal	Digital: RS-422A (F-Net protocol) Analog: 0 to 5VDC (Minimum load resistance 2kΩ)		
Drive power source	+15 VDC ± 5% 150 mA/-15 VDC ± 5% 200 mA		+15 VDC ± 5% 150 mA/-15 VDC ± 5% 250 mA
Standard Fitting	1/4 VCR type or IGS		
Standard expanded functions	Quick start function <sup>2</sup> , auto-close function <sup>2</sup> , valve voltage function <sup>2</sup> , auto-zero function (SEC-V110DM) <sup>2</sup> , zero adjustment switch		

<sup>1</sup>1 Maximum inlet pressure is 300 kPa (G).  
<sup>2</sup>2 Compatible with SEC series.

\*Mount-free sensor (MF sensor) can also be used.  
\* SCCM and SLM are symbols indicating gas flow rate (mL/min, L/min at 0 °C, 101.3 kPa).

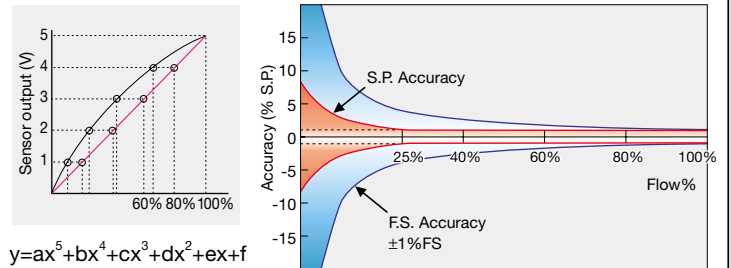
## SEC-Z500 series

### ► High Accuracy

MFC's linearity is compensated by polynomial approximated curve. This achieves high accuracy for all flow control ranges. For the purpose of advancement of actual gas accuracy, the calibration data of various process gases are measured by HORIBA STEC standard gas measurement system.

Accuracy	±1.0% S.P. : 25-100% F.S.
	±0.25% F.S. : <25% F.S.

### Linearity is compensated by polynomial approximated curve



### ► High Speed Response

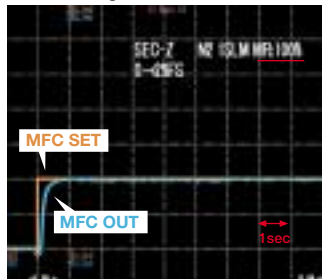
SEC-Z500 is installed with a newly developed "Variable PID system", which can achieve 1 second response to all setting points. Variable PID is continuously changing depending on setting flow points. This allows the PID factor to be optimized when you changed full scale flow and gases.

### ► Multi Gas/Multi Range Solution

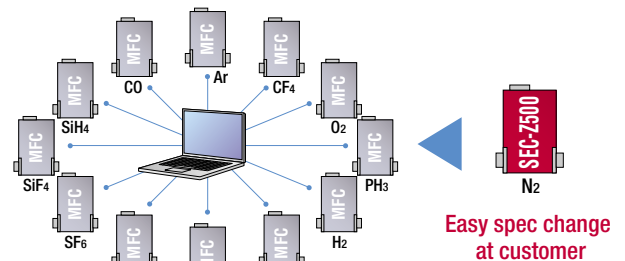
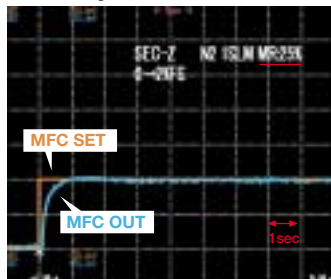
SEC-Z500 series Gases and Full Scale Range can be changed by the customer using our exclusive software. It is possible to configure the MFC without dismounting it from the gas panel or piping, giving an advantage for cost and time reduction on your maintenance operation.

### SEC-Z500 0-2% response

Before changed full scale



After changed full scale to 25%

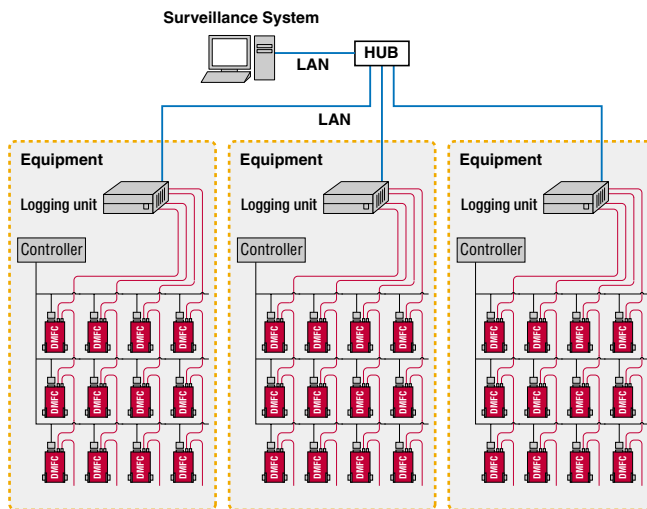


## Digital Mass Flow Controller Logging System

The importance of preventative maintenance for production equipment in semiconductor device manufacturing plants is widely acknowledged. In fact, preventative maintenance is considered a critical factor for increasing productivity. HORIBA STEC offers a preventative maintenance system for its mass flow controllers, which are considered key devices in the semiconductor manufacturing process. The mass flow controller's preventative maintenance system monitors the flow rate control conditions and the position of the valve, and determines the status of overall flow rate control in the mass flow controller. The system informs the user of what sort of maintenance is required before the mass flow controller becomes unable to control the flow rate. It is considered difficult to predict the maintenance required for a mass flow controller's functioning by monitoring its flow control status alone. HORIBA STEC's mass flow controller monitoring system collects information on the control status of the digital mass flow controllers (analog control) in semiconductor manufacturing equipment using digital communications, and monitors whether or not there is a need for any preventative maintenance. This system is compatible with LAN (TCP/IP) networks, and a single superior Surveillance Server can be used to monitor the mass flow controllers in each semiconductor manufacturing system. It's also relatively easy to create a wide area network (WAN) for this monitoring system.

The logging unit can be used to log the flow rate control status of digital mass flow controller in each semiconductor manufacturing system. The Surveillance Server is connected to the logging unit through a LAN. The logging unit monitors the flow rate control conditions and the position of the flow control valve, and determines

### ▶ Sample system setup



whether any preventative maintenance is necessary. This data can be used to investigate the reasons for problems or to review changes in the gas pressure, in addition to determining whether or not preventative maintenance is required.

### ▶ Main screen



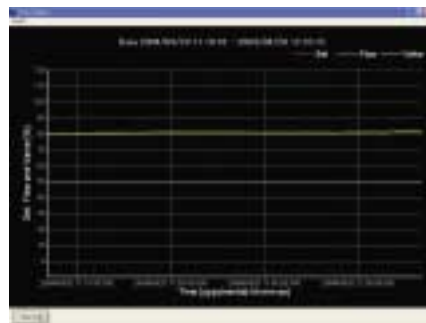
Each type of alarm is displayed in a different color.

Setup	PC communications
Valve center	Data initialization
Valve	MFC communications

### ▶ Alarm information screen



### ▶ Logging data screen



## D-Net Data Logger DeviceNet™ mass flow controller monitoring tool

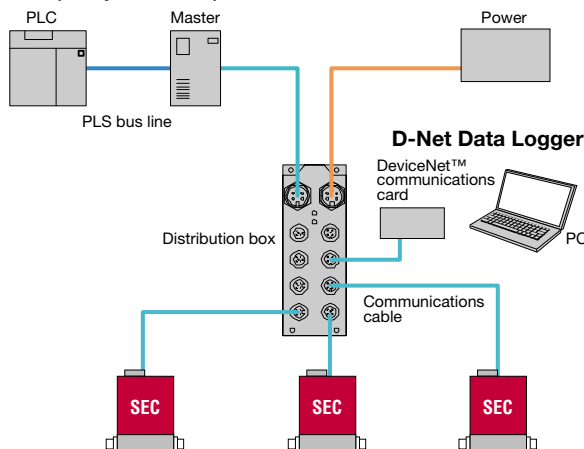
Since DeviceNet™ mass flow controllers do not use an analog signal for flow rate output, they cannot be checked using analog recorders or analog checkers. As a result, there is no simple tool for checking and recording their operating conditions. Checking generally requires additional equipment and extra work by the equipment operator.

HORIBA STEC has used the technology it developed through the mass production of DeviceNet™ mass flow controllers to create a new software product called D-Net Data Logger, which makes it easy to check the operating status of mass flow controllers. D-Net Data Logger consists of a PC, DeviceNet™ communications card, and communications cable. A DeviceNet™ communications connector, which does not include any proprietary HORIBA STEC equipment, makes it easy to check and record the flow rate control status of mass flow controllers.



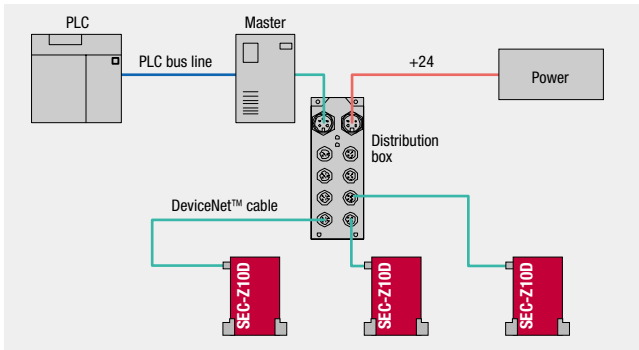
### ▶ Settings screen

### ▶ Sample system setup

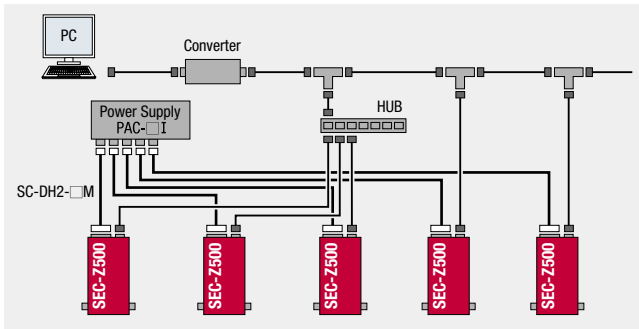


## Connecting digital mass flow controllers (examples)

### ▶ DeviceNet™ communications: SEC-Z10D series



### ▶ Digital communications: SEC-Z500 series



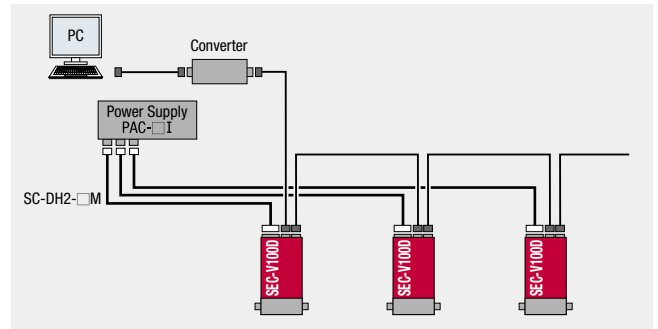
### DeviceNet™ communications

DeviceNet™ is an open and global field network that was developed by the ODVA (Open DeviceNet™ Vendor Association, Inc.) as a unique means for supporting standardization worldwide. The ODVA offers EDS (Electronic Data Sheet) specifications, which are designed to allow shared operability and programming in a multi-vendor environment. The ODVA also carries out conformance testing. Devices that have passed the ODVA's conformance testing can display the *DeviceNet*® logo.

#### Advantages

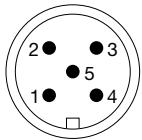
- Reduces costs, since AD/DA converters and I/O boards are not required.
- The user simply connects the devices through network cables and makes address settings. This reduces both the number of processes required and the time involved.
- No special accessories are necessary for the devices. Users can simply choose DeviceNet™ conforming products, which reduces costs.

### ▶ Digital communications: SEC-V100D series



## Signal connectors

### ▶ SEC-Z10D series: DeviceNet™ communications



Pin no.	Signal name
1	Drain
2	V+
3	V-
4	CAN_H
5	CAN_L

### ▶ SEC-F700 series

Pin no.	Signal name
1	Signal ground [D. COM] *1
2	Serial input (-) [R x D (B)]
3	Serial output (-) [T x D (B)]
4	CPU hang-up signal and A alarm pin [ALM. A]
5	Analog flow rate output signal [OUT] (0 to 5 VDC)
6	Analog flow rate setting signal [SET] (0.1 to 5 VDC)
7	Analog COMMON and power source COMMON [A. COM] *1
8	Power source input [-15 V]
9	Power source output [+5 V] *2
10	Analog/digital switching pin [ANALOG/DIGITAL] *3
11	Valve forced open/close signal [OPEN/CLOSE] *4
12	Serial input (+) [R x D (A)]
13	Serial output (+) [T x D (A)]
14	B alarm pin [ALM. B]
15	Power source input [+15 V]

Connector used: D-subminiature 15 contact pin connector (with M3 fitting screws)

- \*1 [A. COM] and [D. COM] are connected internally.  
 \*2 Not for use by the user, since it is already required for the system.  
 \*3 Can be altered using digital commands.  
 \*4 Highest priority, both in digital and analog modes.  
 \*5 +15V is the capacity when the 5V power source output is at no load.  
 Please do not connect anything to the [RESERVED] pin. Connecting to this pin can cause malfunctions and errors.

### ▶ SEC-Z500 series: Digital connector connections

Pin no.	Signal name
1	Signal ground [D. COM]
2	Signal ground [D. COM]
3	N.C. *1
4	Serial output/input (-)
5	Serial output/input (+)
6	N.C. *1
7	N.C. *1
8	N.C. *1

\*1: N.C. means No Connection.

\*2: Be sure to use shield cable to minimize the effect of electrical noise.

### ▶ SEC-V100D series: Digital connector connections

Pin no.	Signal name
1	Serial output (+) [T x D [A]]
2	Serial output (-) [T x D [B]]
3	Serial input (+) [R x D [A]]
4	Serial input (-) [R x D [B]]
5	Analog/digital switching pin [ANALOG/DIGITAL] When open, analog mode (electric current at point of contact: 0 mA) Digital mode when connected to [D.COM] (electric current at point of contact: 0.45 mA)
6	Signal ground [D. COM]
7	NC
8	NC

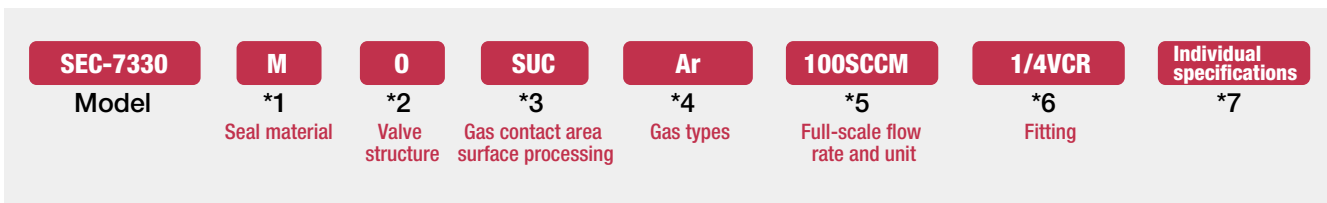
### ▶ Analog connector connections

Pin no.	Signal name
1	Valve override open/close signal *1
2	Analog flow rate output signal (0-5VDC) Minimum resistance: 2kΩ
3	Power supply input (+15VDC, capacity: 150mA)
4	Power COMMON *2
5	Power supply input (-15VDC, capacity: 150mA)
6	Analog flow rate setting signal (0-5VDC) *1 Input impedance: 1MΩ and over
7	S. COMMON *2
8	S. COMMON *2
9	N.C. *3

- \*1: No connection for SEF series.  
 \*2: Power COMMON (Pin No.4) and S. COMMON (Pin No.7) are not connected inside the DMFC. Pin No.7 (S. COMMON) and Pin No.8 (S. COMMON) are connected inside the DMFC.  
 \*3: N.C. means No Connection.

## Choosing the appropriate mass flow controller model and specifications

### ► SEC series



\*1 Select the seal material.

M: Metal seal R: Rubber seal

If you are using poisonous or corrosive gases, we recommend using M (metal) as the seal material.

(Examples: AsH<sub>3</sub>, B<sub>2</sub>H<sub>6</sub>, PH<sub>3</sub>, GeH<sub>4</sub>, H<sub>2</sub>Se, BCl<sub>3</sub>, BF<sub>3</sub>, Cl<sub>2</sub>, F<sub>2</sub>, HBr, HF, SiCl<sub>4</sub>, TiCl<sub>4</sub>, ClF<sub>3</sub>, HCl, WF<sub>6</sub>, etc.)

\*2 Select the desired valve state for when there is no electricity. (Select the desired normal valve state.)

O: Open C: Closed (This option is not available for flow meters.)

\*3 Gas contact area surface processing

The gas contact area can be processed to ultra clean levels (option).

SUC: Surfaces are polished until the roughness is at the sub-micron level.

CRP: A CRP film (passivation film) is formed on the gas contact surfaces (stainless steel).

\*4 Select the types of gas you wish to use.

\*5 Select the full scale flow rate and flow rate unit. The flow rate unit is usually noted at 0°C or 25°C (101.3 kPa). See Chart 1 for more information.

Chart 1

Flow rate unit	0°C display	25°C display
L/min	SLM	LM
mL/min	SCCM	CCM

\*6 Fitting

A variety of contact joints other than 1/4 VCR type fitting can be used. Units can also be made compatible with integrated gas panels. Please contact HORIBA STEC for more information.

\*7 Units can be adjusted to meet non-standard specifications. Please contact HORIBA STEC for more information.

### ► Digital interface

RS-485.F-Net protocol : SEC-Z512MG/Z522MG

RS-422A.F-Net protocol : SEC-F700series SEC-V100Dseries

DeviceNet™ : SEC-Z514MG/Z524MG

SEC-Z10D/Z10DWseries

Series	Standard Flow Range (N <sub>2</sub> Equivalent F.S.)	Operating temperature		Seal material		Internal surface polishing	Interface			Fitting				
		Normal temp model	High temp model	Metal	Rubber		Analog	Digital (F-Net)		Digital DeviceNet™	VCR Type	Swagelok type	IGS	
								RS-422A	RS-485				1.125inch	1.5inch
SEC-Z500	5SCCM to 50SLM	○		○		Standard	○		○	○		○	○	
SEC-Z10D/DW	5SCCM to 100SLM	○		○		Standard			○			○	○	
SEC-F700	5SCCM to 30SLM	○		○		Option	○	○				○	○	
SEC-V100D	10SCCM to 50SLM	○		○		Option	○	○				○	○	
SEC-7300	1SCCM to 100SLM	○		○	○	Option	○				○	○	○	
SEC-4400	5SCCM to 100SLM	○		○	○	Option	○				○	○		
SEC-4001	5SCCM to 20SLM	○		○	○	Option	○				○	○		
SEC-G100A	10SCCM to 5SLM	○		○		Standard	○				○		○	
SEC-E400J	10SCCM to 30SLM	○		○		Option	○				○	○		
SEC-E40	10SCCM to 500SLM	○		○	○	—	○				○	○		
SEC-8000	5SCCM to 100SLM	○	○	○		Option	○				○	○		
SEC-2000	10SCCM to 100SLM		○	○	○	—	○				○	○		
SEC-400	5SCCM to 200SLM	○			○	—	○				○	○		

Mass flow meters: For the SEF series, please start by deciding without valve structure and then consider the other options.