



## Solenoid Actuator Type Mass Flow Controllers

Smaller, less expensive equipment offering more functions is now considered a primary factor in increasing productivity. The demand for smaller, more cost-efficient and functional equipment applies with equal force to gas supply systems—and therefore to the key production devices known as mass flow controllers.

HORIBA STEC, which has always offered products that provide the performance required for the latest processes, has created the world's smallest class of mass flow controllers, the SEC-G100 series, and solenoid actuator type mass flow controllers that offer terrific cost performance.

## SEC-G100A series

Ultra-compact mass flow controllers

**World's smallest class: Models that can fit into a 39 mm x 39 mm design**

- ▶ World's smallest class: The same 39 mm x 39 mm size as other devices in integrated gas panels.
- ▶ High speed replacement: Polishing of the gas contact area is standard, and since the gas flow passage volume has been reduced by 80% (compared with previous models), the series offers greatly improved gas replacement.
- ▶ Fast response: Quick start function included.
- ▶ Auto-close function is standard.
- ▶ Contributes to the creation of more compact, lighter weight, and more highly functional integrated gas panels.



## SEC-E400J series

Mass flow controllers

**Metal seals at a low cost**

- ▶ Feature a metal O-ring: Can be used with corrosive gases.
- ▶ Error alarm function: A red light that illuminates in the main unit's LED when an error occurs and an alarm output function (at point of contact) are standard.
- ▶ Low cost: The components have been redesigned for improved cost efficiency.



## SEC-E40 series

Mass flow controllers

**Low cost models that can be used to control from extremely small to large flow rates**

- ▶ Compatible with a wide variety of flow rate control needs: Flow rate control between 0.2 SCCM and 500 SLM (N<sub>2</sub>) available in a single series.
- ▶ Suitable for a wide range of uses: Already in use in general production at many factories.
- ▶ Low cost: A line up of models that offer terrific cost performance: SEC-E40MK3/E50MK3



# SEC-G100 series

Model	SEC- SEF-	G111AMC G111AM		
Materials at gas contact area	M: type, SUS316L, PTFE, magnetic stainless steel			
Valve type	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 SLM	2 SLM		3/5 SLM
Flow rate control range (for SEC series)	2 to 100% F.S. (fully closed at settings of 2% or lower)			
Flow rate control range (for SEF series)	0 to 100%			
Response speed	Less than 1 sec (T98)			
Accuracy	± 1% F.S.			
Linearity	± 0.5% F.S.			
Repeatability	± 0.2% F.S.			
Operating differential pressure (for SEC series)	50 to 300kPa (d)	100 to 300kPa (d)		200 to 300kPa (d)
Operating differential pressure (for SEF series)	300kPa (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)			
Seal method	Metal seal			
Operating temperature	5 to 50°C (accuracy guaranteed between 15 and 45°C)			
Flow rate setting signal	0.1 to 5VDC (Input impedance : more than 1MΩ)			
Flow rate output signal	0 to 5VDC (Minimum load resistance 2kΩ)			
Drive power source	+15 VDC ± 5%, 60 mA; -15 VDC ± 5%, 200 mA, 3.9 VA			
Standard Fitting	CS seal/W seal/B seal/C seal			
Standard functions	Quick start function <sup>*1</sup> , auto-close function <sup>*1</sup> , auto-zero function <sup>*1</sup> , interior surfaces polished			
Unit weight	SEC-G111: 390 g; SEF-G111: 290g <sup>*4</sup>			

\*1 For SEC series.

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

# SEC-E400J series

Model	SEC-	E-440J	E-450J
Materials at gas contact area	M: type, SUS316L, PTFE		
Valve type	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 SLM	
Flow rate control range	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 300kPa (d)	100 to 300kPa (d)	
Maximum operating pressure	300kPa (G)		
Pressure Resistance	1MPa (G)		
Leak Integrity	1 x 10 <sup>-11</sup> Pa·m <sup>3</sup> /s (He)		
Seal method	Metal seal		
Operating temperature	5 to 50°C (accuracy guaranteed between 15 and 35°C)		
Flow rate setting signal	0.1 to 5VDC (Input impedance : more than 1MΩ)		
Flow rate output signal	0 to 5VDC (Minimum load resistance 2kΩ)		
Drive power source	+15 VDC ± 5%, 60 mA -15 VDC ± 5%, 150 mA 3.2 VA	+15 VDC ± 5%, 60 mA -15 VDC ± 5%, 200 mA 3.9 VA	
Standard Fitting	1/4VCR type		

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

# SEC-E40 series

Model	SEC- SEF-	E40/E40MK3 E40	E50/E50MK3 E50	E60 E60	E70 E70	E80 E80
Types of gas <sup>*1</sup>	Non-corrosive gases (the MK3 model can handle N <sub>2</sub> , O <sub>2</sub> , air, H <sub>2</sub> , Ar, and He)			N <sub>2</sub> , O <sub>2</sub> , Air, H <sub>2</sub> , Ar, C <sub>3</sub> H <sub>8</sub> , CH <sub>4</sub> , C <sub>4</sub> H <sub>10</sub>		N <sub>2</sub> , O <sub>2</sub> , Air, H <sub>2</sub>
Materials at gas contact area	SUS316L, Viton®, PTFE, magnetic stainless steel			SUS316L, Viton®, magnetic stainless steel		
Valve type	Close at power-off: C					
Standard flow rate range (N <sub>2</sub> equivalent F.S.) <sup>*1</sup>	10/20/30/50/100/ 200/300/500 SCCM 1/2/3/5/10 SLM	20/30 SLM	50/100 SLM	200 SLM	300/500 SLM	
Flow rate control range (for SEC series)	2 to 100% F.S.			5 to 100% F.S.		
Flow rate control range (for SEF series)	0 to 100% F.S.					
Response speed	Less than 1 sec (T98)				Less than 2 seconds (T98)	
Accuracy	± 1% F.S.				± 2% F.S.	
Linearity	± 0.5% F.S.				± 1% F.S.	
Repeatability	± 0.2% F.S.				± 1% F.S.	
Operating differential pressure (for SEC series)	10 SCCM to 5 SLM: 50 to 300 kPa (d); 10 to 30 SLM: 100 to 300 kPa (d)			100 to 300kPa (d)		200 to 350kPa (d)
Usage pressure (for SEF series)	300 kPa (G)			350 kPa (G)		
Pressure Resistance	1 MPa (G)					
Leak Integrity	1 x 10 <sup>-9</sup> Pa·m <sup>3</sup> /s (He)			1 x 10 <sup>-7</sup> Pa·m <sup>3</sup> /s (He)		450 kPa (G) added pressure with loss of pressure less than 1% over 10 minutes
Operating temperature	5 to 50°C (accuracy guaranteed between 15 and 35°C)			5 to 45°C (accuracy guaranteed between 15 and 35°C)		
Flow rate setting signal	SEC-E40(MK3), E50(MK3) : 0.1 to 5VDC (Input impedance : more than 1MΩ) SEC-E60, E70, E80 : 0.25 to 5VDC (Input impedance : more than 1MΩ)					
Flow rate output signal	Analog: 0 to 5VDC (Minimum load resistance 2kΩ)					
Drive power source	+15 VDC ± 5%, 50 mA -15 VDC ± 5%, 150 mA, 3 VA		+15 VDC ± 5%, 50 mA -15 VDC ± 5%, 200 mA, 3.9 VA			
Standard Fitting <sup>*2</sup>	1/4 Swagelok type			3/8 Swagelok type		1/2 Swagelok type

\*1 Please contact HORIBA STEC for information on types of gas other than those listed. \*2 Non-standard joints can also be used. Please contact HORIBA STEC for more information.

\* The SEC-E40, SEC-E50, SEC-E40MK3 and SEC-E50MK3 feature an auto-zero function as well.

\* Inlet pressure for the SEC-E40/50/60/E40MK3/E50MK3: maximum 300 kPa (G) or under. For the SEC-70/80: maximum 350 kPa (G) or under.

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

\* Viton® is registered trademark of E. I. DuPont de Nemours.

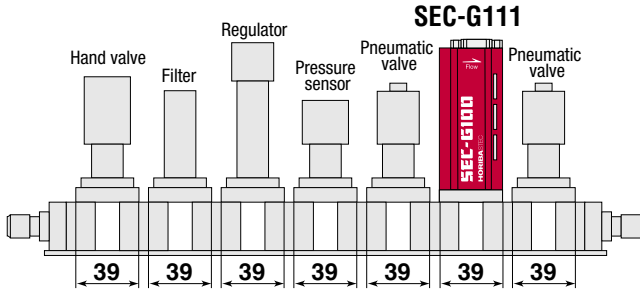
## Reduced footprints

## SEC-G100 series

Currently, 39 mm x 39 mm (1.5 inch pitch) is the standard for components in the accumulation systems of integrated gas panels. In the new SEC-G100 series of mass flow controllers, each part of the mass flow controller has been made more compact, so that a unit can fit into the same 39 mm x 39 mm as the other components making up the gas

panel. In addition to reducing the footprint of the accumulated gas panel, this new series of mass flow controllers makes it possible to use the same base block size for all the components, which reduces design and production costs, as well as overall accumulated gas panel costs.

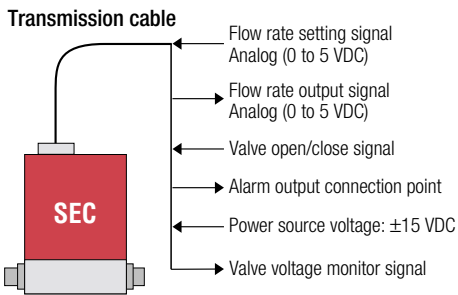
► The SEC-G111 in a sample integrated gas panel



	SEC-G111	SEC-4400	Other company (A)
Internal flow passage volume	1/5	1/2	1
Unit volume	1/3	1	1
Weight	2/5	4/5	1

## Electrical signal/drive power source connections

## SEC-G100, SEC-E400J, SEC-E40 series



► Signal connector

Pin no.	Signal name
1	Valve open/close signal
2	Flow rate output signal (0 to 5 VDC)
3	Power source (+15 VDC)
4	Power source (COMMON)
5	Power source (-15 VDC)
6	Flow rate setting signal (0 to 5 VDC)
7	Signal (COMMON)
8	Valve voltage output signal (please check this)
9	NC

Connector used: D-subminiature 9 contact pin connector (with M3 fitting screws)

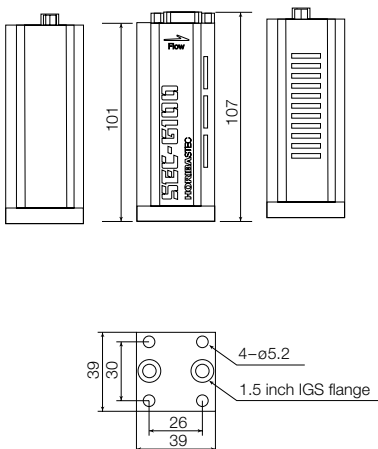
► Peripherals

In order to avoid changes in the COMMON power source, caused by the valve drive current, it is necessary to connect both the power source COMMON pin and the single COMMON pin to the same shared power source. Since they are not connected in the interior of the mass flow controller, please be sure to wire them separately, but so that they share the same power source.

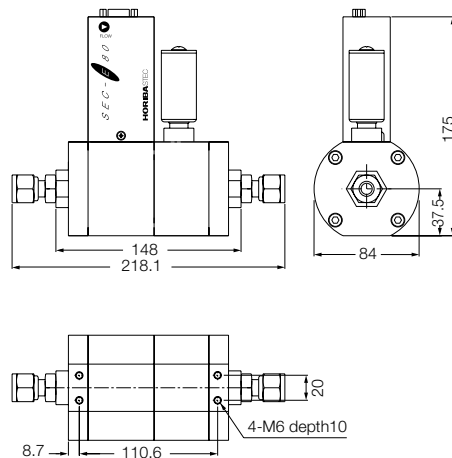
## Dimensions

## SEC-G100, SEC-E40 series

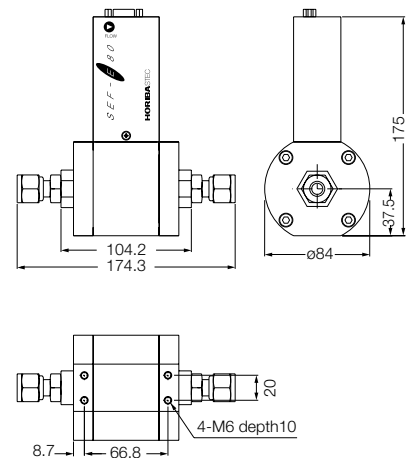
► SEC-G111 AMC



► SEC-E80



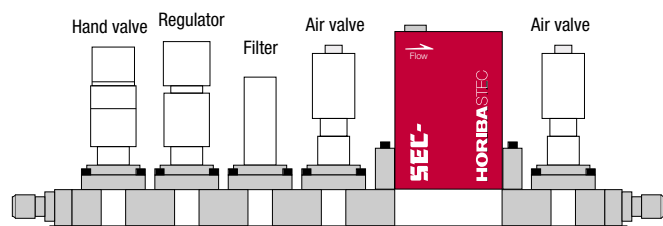
► SEF-E80



## Mass flow controllers for integrated gas panels

Integrated gas panels are made up of separate modules, including mass flow controllers, valves, regulators, filters, and so on, that perform the functions that were traditionally performed by parts in gas supply systems. Integrated gas panels can be manufactured without welding joints and piping since individual modules are used, and they are smaller and easier to maintain than traditional gas supply systems.

### ▶ Sample integrated gas panel design



### ▶ Advantages

- **Compatible with a wide variety of fittings**  
Compatible with every type of fitting, including C seals, CS seals, and W seals.
- **Easier to maintain**  
Unidirectional desorption makes it easier to desorb the mass flow controller.
- **Less dead volume**  
The amount of useless volume at the joint area is greatly reduced.

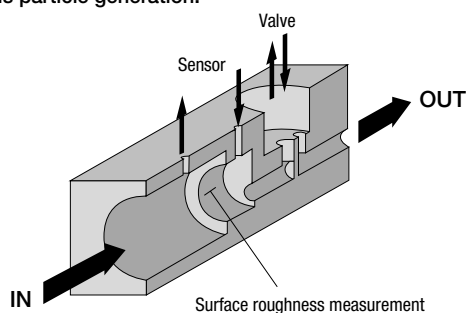
Pitch size	Compatible model series
1.125 inch	SEC-Z512 series
	SEC-Z10D series (DeviceNet™ compatible mass flow controllers)
	SEC-7300 series
1.5 inch	SEC-Z512/522 series
	SEC-Z10DW series (DeviceNet™ compatible mass flow controllers)
	SEC-F700 series
	SEC-F400 series
	SEC-V100D series
	SEC-7300 series

## SUC processing

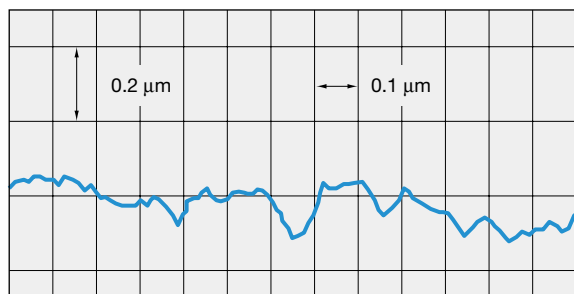
After machining, the surface of the stainless steel (SUS316L) that makes up the unit is polished until its roughness is at the sub-micron level.

### ▶ Advantages

- Improves gas emission characteristics.
- Controls particle generation.



### ▶ Results of surface roughness measurement



Ra	0.035 μm
RMS	0.035 μm
Rt	0.120 μm
Ro	0.06 μm
Rv	0.06 μm
Rz	0.090 μm
Sm	0.113 μm
SC	13 TL
Slope	0.003
<u>Rmax</u>	<u>0.31 μm</u>

Measurement conditions	Results
Measurement scaling factor	5000
Drive speed	0.3 mm/s
Cutoff	0.8 mm
Measurement length	2.5 mm

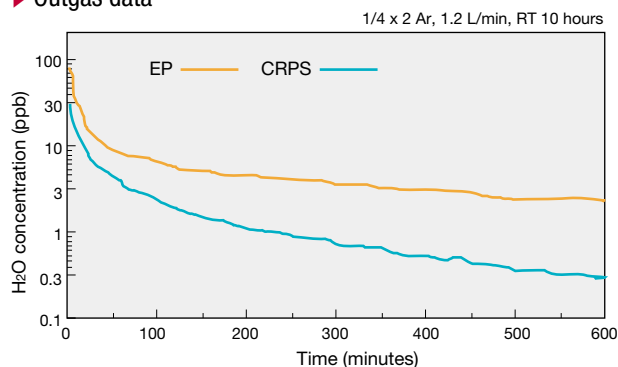
## CRP processing

After machining, the surface of the stainless steel (SUS316L) that makes up the unit is subjected to composite electrolytic polishing, and then a 100% Cr<sub>2</sub>O<sub>3</sub> oxidation film is formed on the surface.

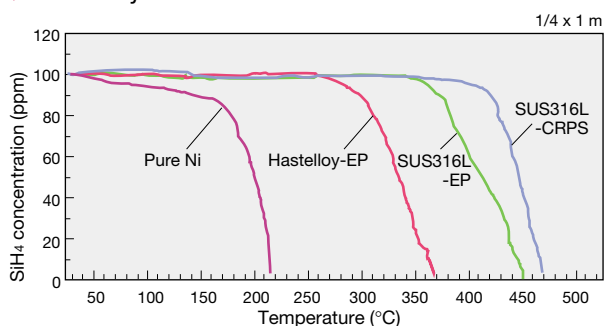
### ▶ Advantages

- Reduces outgassing of moisture and hydrocarbon gases.
- Increases resistance to corrosion by chlorine gases (highly corrosive gases).
- Has a non-catalytic effect on the spontaneous decomposition of SiH<sub>4</sub>/B<sub>2</sub>He and other similar chemicals.
- Suppresses contamination by particles from certain corrosive gases.

### ▶ Outgas data



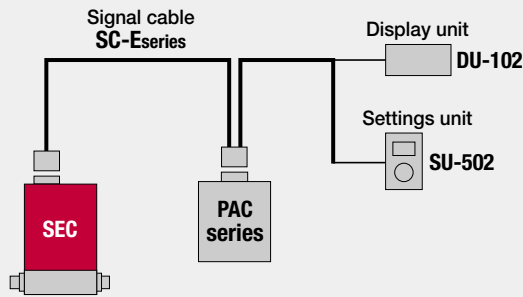
### ▶ Non-catalytic data



## Connecting analog mass flow controllers (examples)

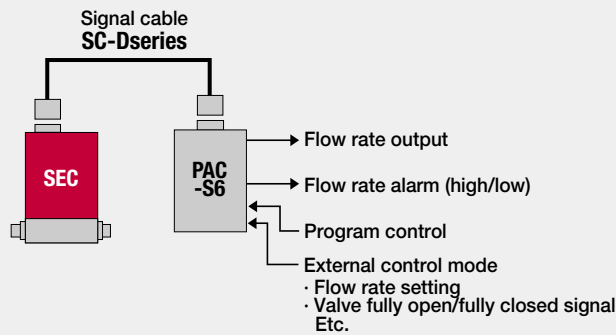
### ▶ Connecting to a digital power source, display unit, and settings unit

#### Basic connections

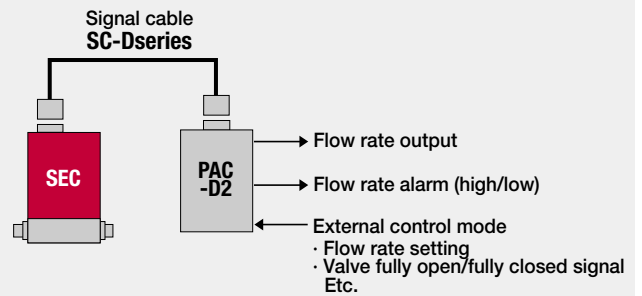


### ▶ Connecting to a dedicated controller

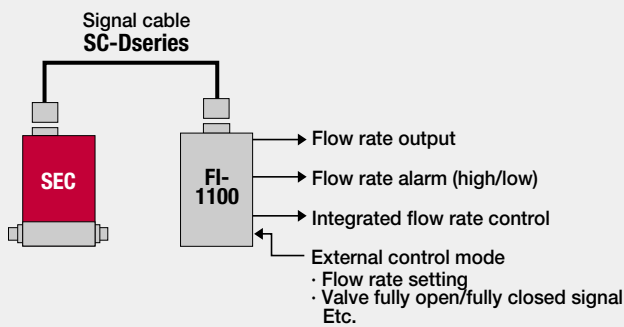
#### Control using PAC-S6



#### Control using PAC-D2

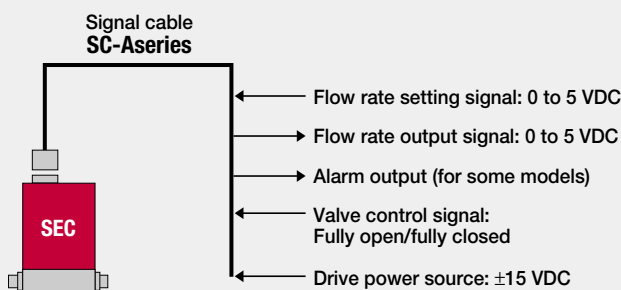


#### Control using an FI-1100 integrator/control unit



### ▶ Connecting to an external controller

#### Basic connections



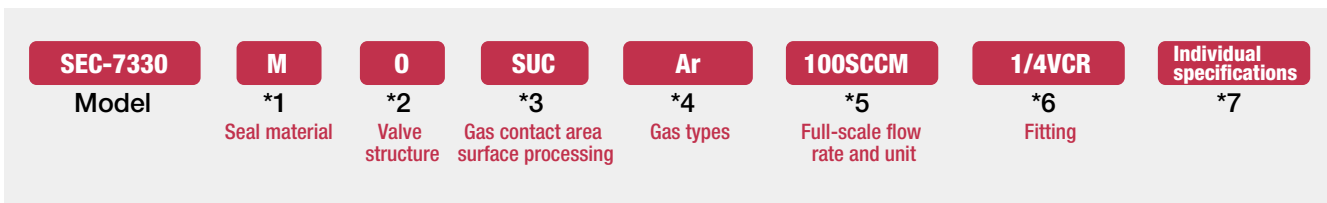
#### Connector connections

Pin no.	Signal name
1	Valve forced open/close signal
2	Analog flow rate output signal (0 to 5 VDC)
3	Power source input (+15 VDC)
4	COMMON power source
5	Power source input (-15 VDC)
6	Analog flow rate setting signal (0 to 5 VDC)
7	COMMON signal
8	Alarm (option)
9	Valve voltage monitor (option)

Connector used: D-subminiature 9 contact pin connector (with M3 fitting screws)

## 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.
- \*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.

Chart 1

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

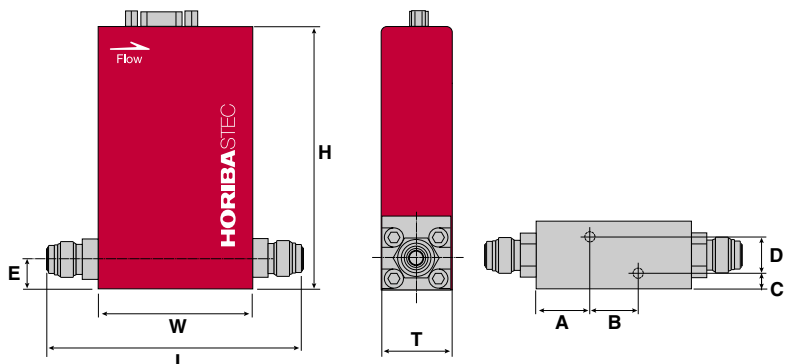
### ► Digital interface

- 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	○			○	—	○					○	○	

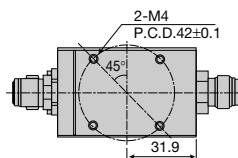
Mass flow meters: For the SEF series, please start by deciding without valve structure and then consider the other options.

# Dimensions

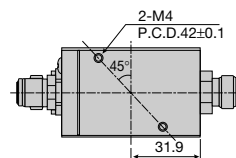


\*Please contact HORIBA STEC for information on details not shown here.

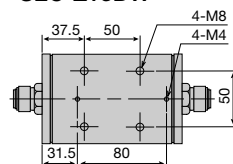
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SEC-Z522



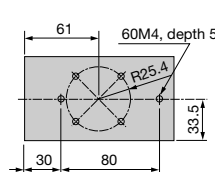
<2>  
SEC-V100 series  
SEC-Z10D series



<3>  
SEC-4600  
SEC-Z13DW



<4>  
SEC-600



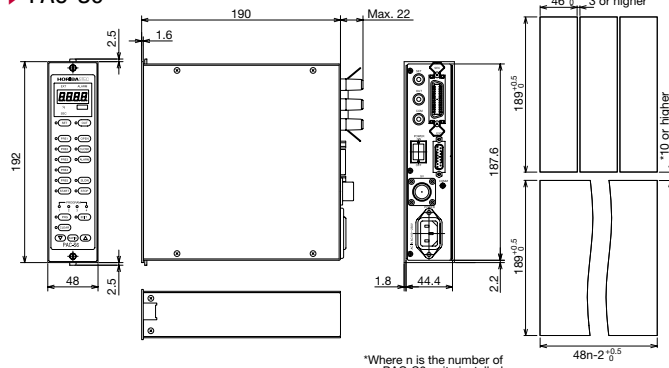
Model	H	T	W	(1/4 VCR)	(1/4 Swagelok)	(3/8 VCR)	(3/8 Swagelok)	A	B	C	D	E
SEC-Z512	126	28	63.8	106				21.9	20	6.5	15	12.7
SEC-Z522	143	38.5	63.8	106				See <1>				12.7
SEC-Z11D	127	28.5	81.8	124				See <2>				12.7
SEC-Z12D	127	28.5	81.8	124				See <2>				12.7
SEC-Z13D	151.3	38.6	63.8			150.4		21.9	20	4.8	29	15.6
SEC-Z11DW	140	38.6	63.8	106				See <2>				12.7
SEC-Z12DW	140	38.6	63.8	106				See <2>				12.7
SEC-Z13DW	172	80	125			177		See <3>				20
SEC-F730	106	35	64.2	106 2				22.1	20	10	15	12.7
SEC-F740	126	35	64.2	106 2				22.1	20	10	15	12.7
SEC-F750	140	40	64.2	106 2		118		19.4	25	7.5	25	12.7
SEC-F440	112	38	76.2	124	127			19.1	38.1	9.75	18.5	12.7
SEC-F450	112	38	76.2	124	127			19.1	38.1	9.75	18.5	12.7
SEC/SEF-V110DM	116.5	37.6	63.8	106 2				See <2>				12.7
SEC/SEF-V120DM	116.5	37.6	63.8	106 2				See <2>				12.7
SEC-7320	106	28	63.8	106 2	110			21.9	20	6.5	15	12.7
SEC/SEF-7330	106	28	63.8	106 2	127			21.9	20	6.5	15	12.7
SEC-7340(LD)	126	28	63.8	106 2	127			21.9	20	6.5	15	12.7
SEC/SEF-7350	140	34	63.5	106 2	127			19.2	25	4.5	25	12.7
SEC/SEF-7355	145	49	80.8	124		132	135	20.4	40	12	25	20
SEF-7140	106	32	47	87				27.6	0	9	14	12.7
SEC/SEF-4400(MF)	126	32	76	124	127			19	38.1	6.75	18.5	12.7
SEC/SEF-4500(MF)	132	32	108	156	159			20.2	67.7	3.7	24.6	14.6 inner; 12 outer
SEC/SEF-4550	150	50	108	156	159	160	163	20.1	67.7	12.7	24.6	14.6 inner; 12 outer
SEC/SEF-4600	150	80	125			177	179	See <3>				20
SEC-4400SP/SR	126	32	76	124				19	38.1	6.75	18.5	12.7
SEC-4401(MF)	126	32	76	124				19	38.1	6.75	18.5	12.7
SEC-4501(MF)	132	32	108	156		164		20.2	67.7	3.7	24.6	14.6 inner; 12 outer
SEC-E440J	112	38	76.2	124	127			19.1	38.1	9.75	18.5	12.7
SEC-E450J	112	38	76.2	124	127			19.1	38.1	9.75	18.5	12.7
SEC-E40(MK3)	126	32	76		127			3.5	69	6.75	18.5	12.75
SEC-E50(MK3)	126	32	76		127			3.5	69	6.75	18.5	12.75
SEC-E60	159	44	95			150.8		3.5	50	8	28	22
SEC-E70	159	44	95			150.8		3.5	50	8	28	22
SEC/SEF-6470 1	147	40	150					—	45	—	20	35
SEC/SEF-6480 1	152.5	108	204					—	—	—	—	50
SEC-8340	130.5	48	76	124	127			19	38.1	6.75	18.5	22.7
SEC/SEF-8440	120.5	32	76	124	127			19	38.1	6.75	18.5	12.7
SEC/SEF-8450	127	32	108	156	159			20.2	67.7	3.7	24.6	14.6 inner; 12 outer
SEC/SEF-8455	150	50	108	156	159	160	163	20.1	67.7	12.7	24.6	14.6 inner; 12 outer
SEC/SEF-8460	150	80	125	172	172	177	179	31.5	80	15	50	20
SEC/SEF-2410	122	25.5	76	124		131		3.5	69	3.5	18.5	12.7
SEC/SEF-2510	131.5	32	108	156		163		17.2	101.6	9.3	25.4	14.6 inner; 12 outer
SEC/SEF-2551	137	44	136	184		191		30	80	33.5	—	14.6 inner; 12 outer
SEC/SEF-310	80	20	60	106	110			20	20	10	—	10
SEC/SEF-320	80	20	60	106	110			20	20	10	—	10
SEC/SEF-400	122	25.5	76	124	127	131	131	3.5	69	3.5	18.5	12.7
SEC/SEF-500	131.5	32	108	156	160	163	163	9	80	3.7	24.6	14.6 inner; 12 outer
SEC/SEF-550	137	44	136	184	188	191	190	17.2	101.6	9.3	25.4	14.9
SEC/SEF-600 1	140	67	122	170	173	177	175	See <4>				20
SEC-400MK2-3	115.5	25.5	76	124	127		131	3.5	69	3.5	18.5	12.7
SEC-500MK2-3	125	32	108	156	160	163	163	9	90	3.7	24.6	14.6 inner; 12 outer

\*1 Please contact HORIBA STEC for details on the dimensions of the SEC/SEF-6470/6480.  
\*2 Surface dimensions: 124 mm models can also be produced.

\* Please contact HORIBA STEC to request a copy of the dimension drawing.  
\* Equivalent products are sometimes used in place of the joints listed here.

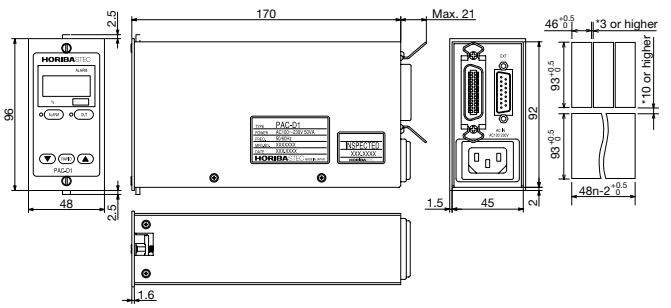
## Accessory dimensions

### ▶ PAC-S6



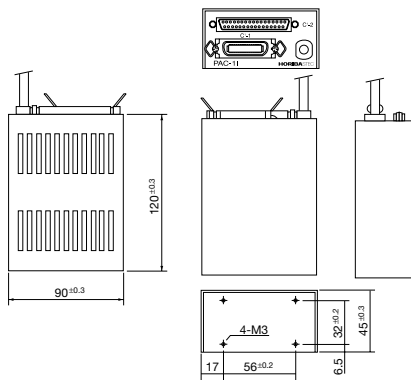
\*Where n is the number of PAC-S6 units installed.

### ▶ PAC-D1/D2

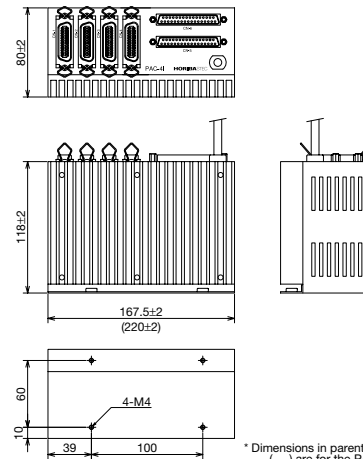


\*Where n is the number of PAC-D1/D2 units installed.

### ▶ PAC-11

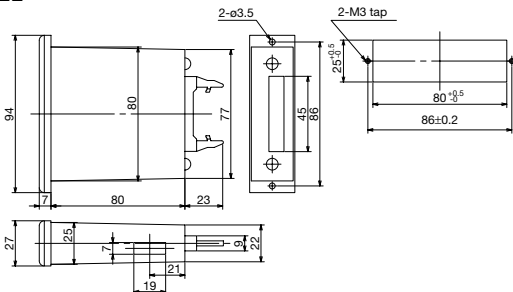


### ▶ PAC-41/61

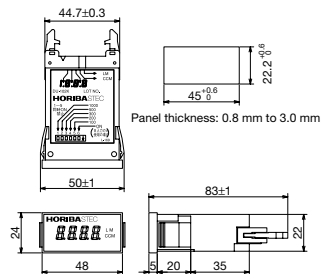


\* Dimensions in parentheses ( ) are for the PAC-61.

### ▶ DU-102E

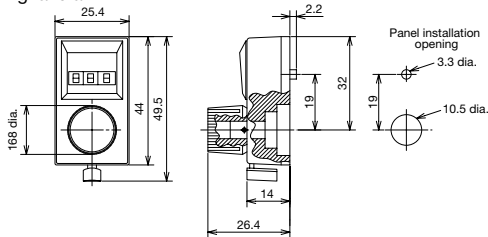


### ▶ DU-102K



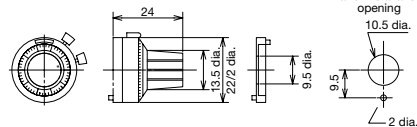
### ▶ SU-502ED

Digital dial

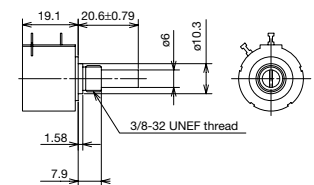


### ▶ SU-502EA

Analog dial



### ▶ Settings unit



### ▶ FI-1100

