Materials Mag!c

HITACHI

Pamphlet

SAM™

Speedy Accuracy Maintainability

1480G
2480G series

Hitachi Metals, Ltd.

Proposal for a new generation

SAM™
Speedy Accuracy Maintainability

1480G
2480G series

G series = Next Ge

mass flow controller

neration

From the release of the first of our SFC480 series, SAM brand high-performance mass flow controllers continue in the tradition of perfection. High corrosion resistance and stable control performance are possible thanks to a waveform diaphragm made of a Ni-Co alloy (YET® 101), developed by Hitachi Metals. This technology demonstrates that Hitachi is a manufacturer of high grade metallic materials. Hitachi includes features like "dual-range" mass flow controller and a "hybrid" mass flow controller, thanks to the latest digital control technology developed for the SFC1480F series. Hitachi products that are equipped with these technologies enjoy a well deserved reputation from globally recognized customers. Real SAM-brand products are highly valued as premium performance designs.
In an ever changing and demanding market for even more advanced mass flow controllers, Hitachi Metals is proud to introduce the G series. This design is positioned to play a major role in the next generation of controllers. This G series is an all-in-one mass flow controller that meets or exceeds the next generation of requirements, a step ahead of the competition. These advances are in response to our customers' needs for functions such as guaranteed control accuracy with actual gas, MG/MR, PI, valve shut off, and flow rate veritication.

With SAM's advanced technologies, such as its reliable diaphragm valve structure, digital control, etc., the G series offers innovative features that can be used for a variety of new functions. Hitachi Metals is developing a product lineup that best meets user's needs, such as an all-in-one mass flow controller that includes all the functions along with models that include only desired functions.

The search for excellent technologies with unlimited investment is a bygone era. Today we seek appropriate technologies with appropriate levels of investment. We believe our new mass flow controller must apply the technologies which are desired to receive good marks from customers. Customers can get the most desirable functions in performance from one of our many G series models, at a cost to match the expectation of performance. If users have a mass flow controller problems, Hitachi Metals strongly recommends that close review of the G series will satisfy the demands for next generation semiconductor production.

G series

The G series controllers are all-in-one mass flow controllers ready for the next generation of requirements for guaranteed accuracy with the actual gas, MG/MR, PI, valve shut off, and flow rate verification.

New functions in the G series

Multi-gas / multi-range (MG/MR) function

The G4 has new functions which allow one mass flow controller to hande two or more gas types and ranges. When mass flow controllers are equipped with this function the need for dedicated devices is reduced to only a few models which reduces the capital investment and inventory liability.

Also, the G series MFCs provide a flow rate accuracy guarantee for the actual gas type, so that the performance (precision and response) of the MFC before changing the flow rate can be maintained the after a change.

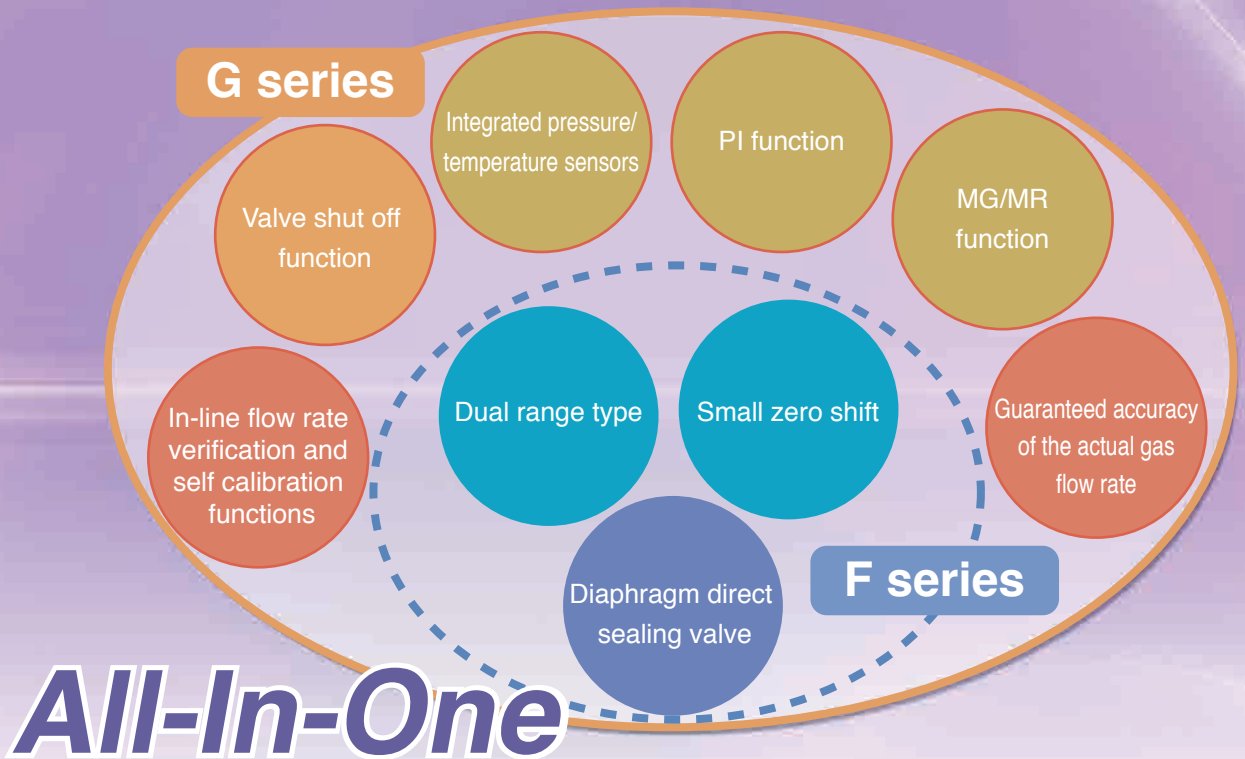
Pressure Insensitive (PI) function

While a mass flow controller is controlling the flow rate and another gas line is connected to the same gas source, the upstream gas supply pressure changes instantly which can cause the flow rate control to fluctuate by this change in pressure.
This symptom comes from the fact that the mass flow controller tries to maintain control of the flow rate as it detects the change in pressure at the flow rate sensor.

To reduce or eliminate this problem, a line regulators for each gas line is installed to augment pressure fluctuation.
The PI function reduces this influence by sensing pressure changes with a pressure sensor incorporated in the device. This interrupts the feedback from the flow rate sensor to the control valve, and keeps the control valve opening at the optimum level.

Valve shut off function

The flow rate control valve on a mass flow controller stabilizes the flow rate, but it cannot shut off the flow like an ordinary pneumatic valve. That is why a minute leak may still occur if a mass flow controller tries to shut off the gas flow completely. Therefore, normally a mass flow controller is installed with pneumatic control valves upstream and downstream the MFC. Sometimes, leaking gas may be left in the space between the mass flow controller valve and the downstream pneumatic valve. This can cause an unexpected gas surge when gas is re-introduced which may negatively impact the process.
Hitachi Metals has incorporated a positive valve shut off function which makes it possible to isolate the gas completely by integrating an ultra-small pneumatic valve linked to the control valve.



In-line flow rate verification and self calibration functions

The requirements for flow rate accuracy and repeat performance from a mass flow controller are constantly growing. In manufacturing semi-conductor devices, where process margins are tight, and stopping operation of the devices is not allowed, it must be possible to evaluate the performance of the mass flow controller without removing it from the gas circuit.

The in-line flow rate verification function measures the current flow rate using an integrated flow rate verification system, while the mass flow controller remains installed in the gas circuit. The report identifies deviation in flow rate after comparing the measured data with previously recorded data in memory. And, this function allows you to re-calibrate the stored data in memory whenever you like.
Using this function, you can identify risks that might otherwise cause significant damage to your products, and it prolongs the life of the mass flow controller by using the calibration function until it is time to be replaced. It also contributes to maintaining planned maintenance cycles.

Table of models and functions

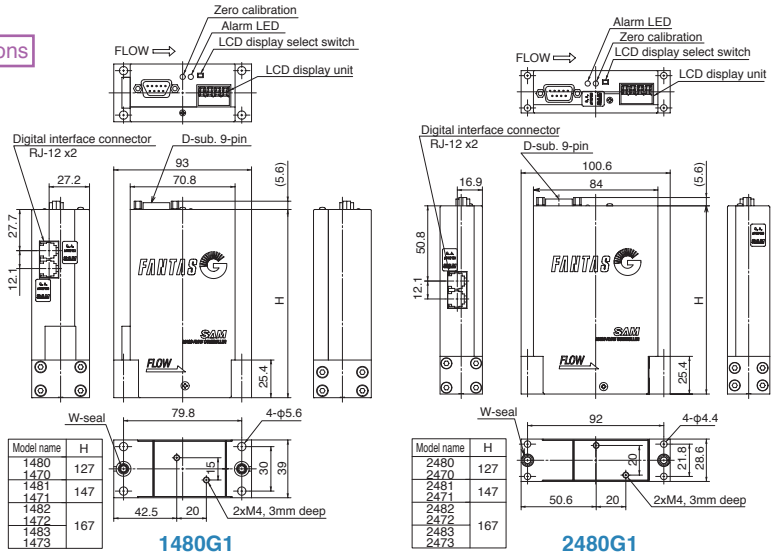
Model name	Function					
	Standard	Optional				
	MG/MR function (Guaranteed accuracy with the actual gas)	PI function	Valve shut off function	Flow rate verification function	LCD display unit	
1480FX 2480FX	*					MG / MR
1480G1 2480G1	*	*			*	MG / MR + PI
1480G2 2480G2	*		*			MG/MR + valve shut off
1480G3 2480G3	*	*	*		*	MG/MR + PI + valve shut off
1480G4 2480G4	*	*	*	*	*	All-In-One

Connection specifications	Communication specifications
W seal C seal H1G seal HMJ (UJR)	RS232C RS485 DeviceNet™

1480G1 / 2480G1 series

For both the 1.5" and 1.125"IGS PI Mass Flow Controllers

Dimensions



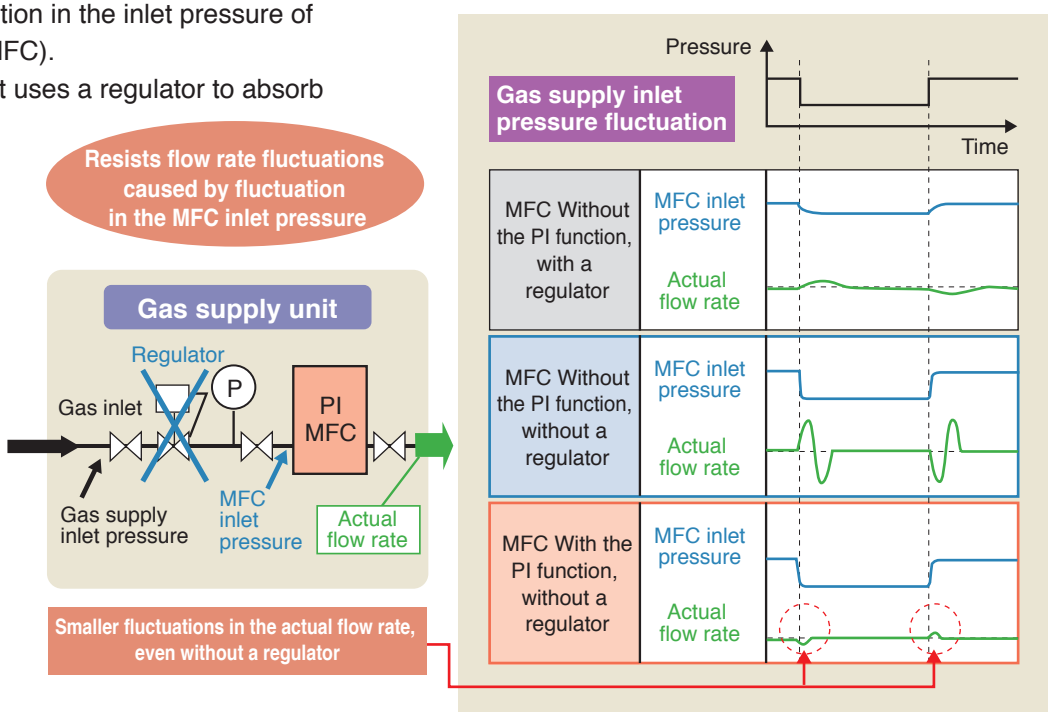
Item				Specifications *1			
Model name				1480G1 2480G1	1481G1 2481G1	1482G1 2482G1	1483G1 2483G1
Basic specifications	Standard full scale flow rate (N_2 equivalent)			5SCCM ～5,500SCCM	～11SLM	～30SLM	～50SLM
	Function			1) Multi-gas/multi-range, 2) PI function, 3) LCD display (flow rate output, flow rate setting, pressure, and temperature)			
	Valve operation			Normally closed / normally open			
	Flow rate control range			2～100% F.S.			
	Operation pressure *2	Inlet pressure		0.05～0.3 MPa (G) 7.3～43.5 PSI (G)		0.1～0.3 MPa (G) 14.5～43.5 PSI (G)	0.2～0.3 MPa (G) 29.0～43.5 PSI (G)
		Outlet pressure		Vacuum to ambient pressure			
	Proof pressure			1.0 MPa(G) 145 PSI(G)			
	Temperature	Operation		5～50 °C			
		Accuracy guaranteed		15～35 °C			
		Heating temperature when not powered		65 °C max			
	Humidity			35～80%RH (non condensing)			
	Installation position			Horizontal, Vertical	Horizontal, Vertical (option)		
	Flow rate setting signal			0.1 - 5 VDC (absolute rating: Max. ±15 VDC)			
	Flow rate output signal			0 - 5 VDC (maximum output: ±15 VDC)			
	Required power			+15 VDC ±4%, 140 mA max -15 VDC ±4%, 140 mA max			
Hardware	Material of gas wetted surface	Housing, flange, valve seat		SUS316L			
		Diaphragm		YET101 (Ni-Co alloy)			
		Flow sensor		SUS316L	Ni		
		Seal *3		SUS316L			
		Pressure sensor		SUS316L			
	Surface finish of components that contact the gas			Specially electro-polished (standard)			
	Fitting *4			W seal, C seal, H1G seal, 1/4" HMJ (UJR) male			
	LCD display unit			4 digit display (6 x 4 mm), LED backlight			
	External leakage standard			Max. $1x10^{-11}$ Pa·m^3/s (He)			
Flow rate control	Accuracy	N_2 gas	10～100%	± (0.5% S.P. + 0.15% F.S.)			
			2～10%	±0.2% F.S.			
		Actual gas	10～100%	± (1.5% S.P. + 0.35% F.S.)			
			2～10%	±0.5% F.S.			
	Linearity	N_2 gas		±0.3% F.S.			
		Actual gas		±1.0% F.S.			
	Repeatability	10～100%		± (0.1% S.P. + 0.05% F.S.)			
		2～10%		±0.06% F.S.			
	Flow rate sensor guaranteed zero point deviation range			±0.5% F.S. / year, max.			
	Temperature dependence	Zero point		±0.01% F.S. / °C (15～35 °C)			
		Span		±0.01% S.P. / °C (15～35 °C)			
	Response Time	0% → (20～100%)		Max. 1.0 sec. to reach ±2% S.P of the set value.			
		0% → (2～20%)		Max. 1.5 sec. to reach ±0.4% S.P of the set value.			
PI function *5	Flow rate fluctuation width during pressure variations	Pressure gradient: ＜0.5kPa 0.1PSI/0.12sec		±1.0% S.P.			
		Pressure gradient: ＞0.5kPa 0.1PSI/0.12sec	Pressure fluctuation width ＜0.02MPa 2.9PSI	± (1.5% S.P. + 1.0%F.S.)			
			Pressure fluctuation width 0.02～0.05MPa 2.9～7.3PSI	± (3.0% S.P. + 1.0% F.S.)			
	Flow rate change time when the pressure changes			Within 1 second of the pressure fluctuation			
Pressure, temperature display	Pressure sensor	Pressure range		-99.9～999.9 kPa (G) -14.5～145 PSI (G)			
		Accuracy		±0.5% F.S.			
		Repeatability		±0.01% F.S.			
		Temperature dependence		0.05% / °C			
		Pressure output		LCD display and digital communication (no analog output)			
	Temperature measuring range			273.2～323.2 K (0～50°C)			

*1: The specifications above are guaranteed values when the MFC was measured by itself in standard conditions. The MFC may not meet the specifications above, depending on the measurement conditions.
*2: The 147*G1 / 247*G1 series are also available for use with minute pressure differences. Please inquire separately for the specifications of our minute pressure difference models.
*3: A model using a rubber seal is also available. Please inquire separately about the rubber seal specifications.
*4: An H1G seal is only available on the SFC14**G1 series
*5: The PI function may not perform as specified in certain plumbing conditions. Please consult us in advance.

What is a G1?

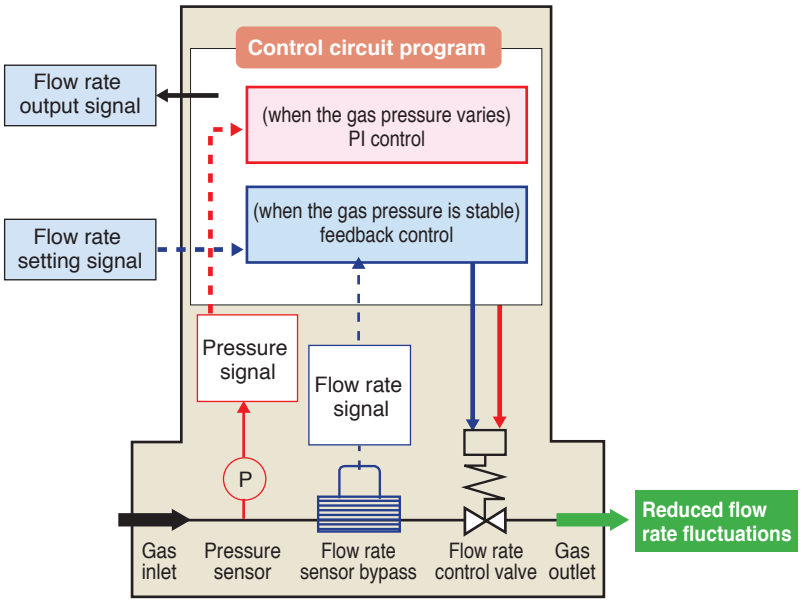
The G1 series is a line of mass flow controllers that are equipped with MG/MR an PI (Pressure Insensitive) functions.
The PI function is resistant to fluctuation in the actual flow rate caused by fluctuation in the inlet pressure of the mass flow controller (MFC).
An ordinary gas supply unit uses a regulator to absorb pressure fluctuation in the gas supply inlet, and to stabilize the actual flow rate.
Therefore, any current mass flow controller, without this regulator, is directly influenced by fluctuation in the gas supply inlet pressure, and the actual flow rate will change instantly by a large amount.

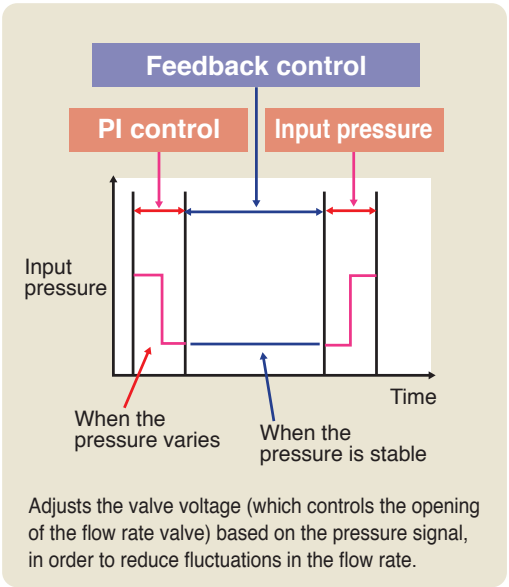
The PI function, without needing this regulator, restricts the influence of fluctuation in the gas supply inlet pressure, and greatly reduces fluctuation in the actual flow rate.



Principle of the PI control

At a normal stable pressure, a mass flow controller controls the flow rate using feedback control, in order to match the signal from the flow rate sensor with the setting.
The PI control stops this feedback when the integrated pressure sensor detects an inlet pressure fluctuation. The pressure sensing circuit controls valve voltage directly using this pressure signal, thereby reducing fluctuation in the flow rate. It controls the opening of the flow rate control valve directly.
In other words, a PI equipped mass flow controller uses two control methods: PI control when a pressure fluctuation occurs, and feedback control while the pressure is stable.

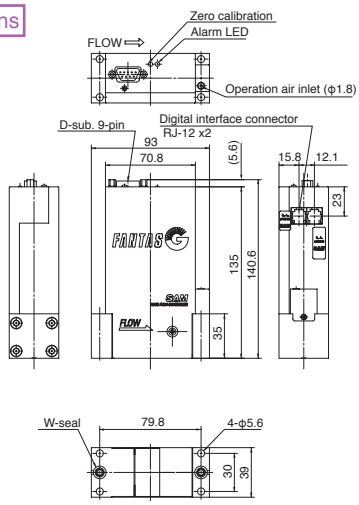




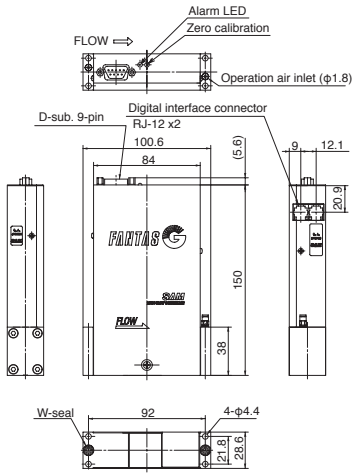
1480G2 / 2480G2 series

Applied to 1.5" and 1.125" IGS Valve shut off Mass Flow Controllers

Dimensions



1480G2



2480G2

Item			Specifications *1
Model name			1480G2 2480G2
Basic specifications	Standard full scale flow rate (N_2 equivalent)		5SCCM～5,500SCCM
	Function		1) Multi-gas/multi-range, 2) Valve shut off function
	Valve operation		Normally closed / normally open
	Flow rate control range		2～100% F.S.
	Operation pressure *2	Inlet pressure	0.05～0.3 MPa (G) 7.3～43.5 PSI (G)
		Outlet pressure	Vacuum to ambient pressure
	Proof pressure		1.0 MPa(G) 145 PSI (G)
	Temperature	Operation	5～50 °C
		Accuracy guaranteed	15～35 °C
		Heating temperature when not powered	65 °C max
	Humidity		35～80%RH (non condensing)
	Installation position		Horizontal, vertical
	Flow rate setting signal		0.1 - 5 VDC (absolute rating: Max. ±15 VDC)
	Flow rate output signal		0 - 5 VDC (maximum output: ±15 VDC)
	Required power		+15 VDC ±4%, 200 mA max -15 VDC ±4%, 150 mA max
Hardware	Material of gas wetted surface	Housing, flange, valve seat	SUS316L
		Diaphragm	YET101 (Ni-Co alloy)
		Flow sensor	SUS316L
		Seal *3	SUS316L
		Shut off valve	SUS316L, YET101, PCTFE
		Pressure sensor	SUS316L
	Surface finish of components that contact the gas		Specially electro-polished (standard)
	Fitting *4		W seal, C seal, H1G seal
	External leakage standard		Max. $1x10^{-11}$ Pa·m³/s (He)
Flow rate control	Accuracy	N_2 gas 10～100%	± (0.5% S.P. + 0.15% F.S.)
		N_2 gas 2～10%	±0.2% F.S.
		Actual gas 10～100%	± (1.5% S.P. + 0.35% F.S.)
		Actual gas 2～10%	±0.5% F.S.
	Linearity	N_2 gas	±0.3% F.S.
		Actual gas	±1.0% F.S.
	Repeatability	10～100%	± (0.1% S.P. + 0.05% F.S.)
		2～10%	±0.06% F.S.
	Flow rate sensor guaranteed zero point deviation range		±0.5% F.S. / year, max.
	Temperature dependence	Zero point	±0.01% F.S. / °C (15～35 °C)
		Span	±0.01% S.P. / °C (15～35 °C)
	Response Time	0% → (20～100%)	Max. 1.0 sec. to reach ±2% S.P of the set value.
		0% → (2～20%)	Max. 1.5 sec. to reach ±0.4% S.P of the set value.
Control valve shut off function	Valve operation pneumatic pressure		0.4～0.7 MPa (G) 58.0～101.5 PSI (G)
	Valve seat leakage amount		Max. $1x10^{-8}$ Pa・m³/s (He)
	Number of durability		2 million times
	Operation of integrated metal diaphragm valve		Normally open

*1: The specifications above are guaranteed values when the MFC was measured by itself in standard conditions. The MFC may not meet the specifications above, depending on the measurement conditions.
*2: The 147*G2 / 247*G2 series are also available for use with minute pressure differences. Please inquire separately for the specifications of our minute pressure difference models.
*3: A model using a rubber seal is also available. Please inquire separately about the rubber seal specifications.
*4: An H1G seal is only available on the SFC14**G2 series

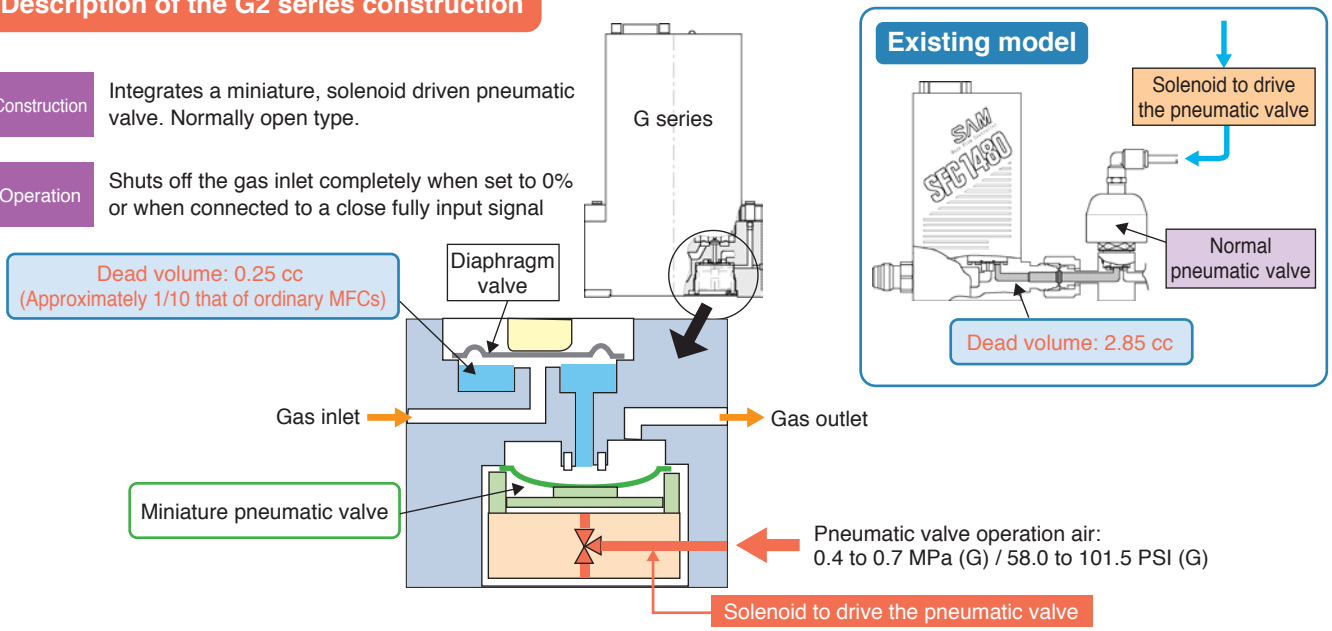
What is a G2?

The G2 series is a line of mass flow controllers that are equipped with MG/MR and valve shut off functions.
The major purpose of the valve shut off function is to reduce the gas purge time that is required to vent residual gas in the space between the downstream pneumatic valve and the mass flow controller valve.
The ordinary flow rate control valve installed in a mass flow controller cannot shut off the gas completely. In order to overcome this problem, a minute, solenoid driven pneumatic valve is integrated near the downstream flow rate control valve, to enable the valve shut off function. The integrated minute pneumatic valve is a normally open type and is normally fully open. It absolutely shuts off all gas with a setting of 0 % or when a close fully signal is received. Also, this miniature pneumatic valve is always installed together with a flow rate control valve, so that the volume of gas leaking (that could cause a gas surge) will be approximately 1/10 that in a combination of an ordinary mass flow controller and pneumatic valve, as shown in the figure.

Description of the G2 series construction

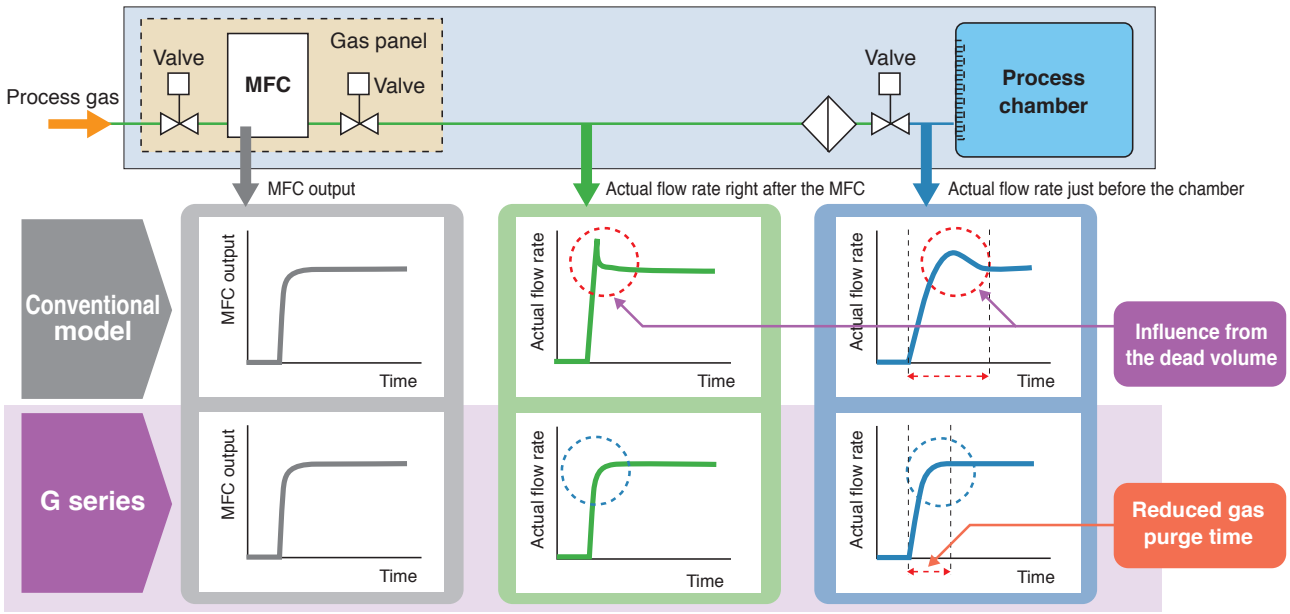
Construction Integrates a miniature, solenoid driven pneumatic valve. Normally open type.

Operation Shuts off the gas inlet completely when set to 0% or when connected to a close fully input signal



Using the configuration above, the G2 series MFCs reduce the gas that can surge into a chamber due to residual gas in the pipe, as shown in the figure, and it shorten the gas purge time needed to achieve a stable flow rate. Finally, it provides productivity improvements and reduces the amount of wasted expensive gas.

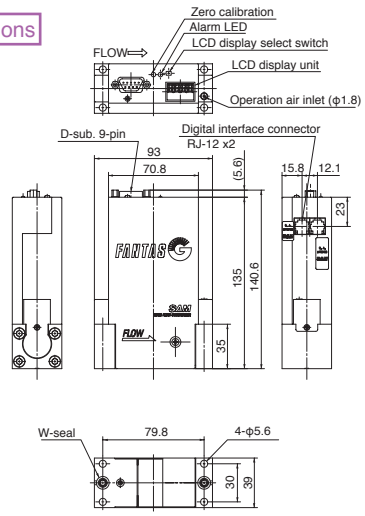
Reduction of gas purge time



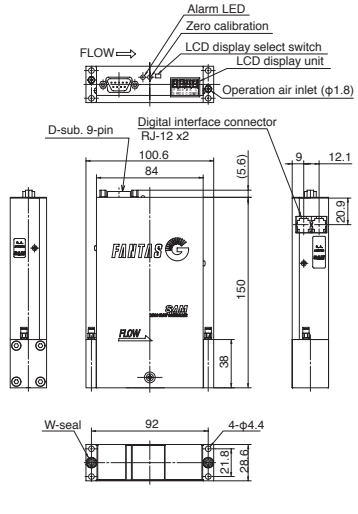
1480G4 / 2480G4 series

Applied to 1.5" and 1.125" IGS　All-in-one Mass Flow Controllers

Dimensions



1480G4



2480G4

Item			Specifications *1
Model name			1480G4 2480G4
Basic specifications	Standard full scale flow rate (N_2 equivalent)		5SCCM～5,500SCCM
	Function		1) Multi-gas/multi-range, 2) PI function, 3) Valve shut off function, 4) Flow rate confirmation function, 5) LCD display (flow rate output, flow rate setting, pressure, and temperature)
	Valve operation		Normally closed / normally open
	Flow rate control range		2～100% F.S.
	Operation pressure *2	Inlet pressure	0.05～0.3 MPa (G) 7.3～43.5PSI(G)
		Outlet pressure	Vacuum to ambient pressure
	Proof pressure		1.0 MPa (G) 145 PSI (G)
	Temperature	Operation	5～50 °C
		Accuracy guaranteed	15～35 °C
		Heating temperature when not powered	65°C max
	Humidity		35～80%RH (non condensing)
	Installation position		Horizontal, vertical
	Flow rate setting signal		0.1 to 5 VDC (absolute rating: Max. ±15 VDC)
	Flow rate output signal		0 to 5 VDC (maximum output: ±15 VDC)
	Required power		+15 VDC ±4%, 200 mA max -15 VDC ±4%, 150 mA max
Hardware	Material of gas wetted surface	Housing, flange, valve seat	SUS316L
		Diaphragm	YET101 (Ni-Co alloy)
		Flow sensor	SUS316L
		Seal *3	SUS316L
		Shut off valve	SUS316L, YET101, PCTFE
		Pressure sensor	SUS316L
		Flow rate confirmation tank	SUS316L
	Surface finish of components that contact the gas		Specially electro-polished (standard)
	Fitting *4		W seal, C seal, H1G seal
	LCD display		4 digit display (6 x 4 mm), LED backlight
	External leakage standard		Max. $1x10^{-11}$ Pa・m^3/s (He)
Flow rate control	Accuracy	N_2 gas 10～100%	± (0.5% S.P. + 0.15% F.S.)
		N_2 gas 2～10%	±0.2% F.S.
		Actual gas 10～100%	± (1.5% S.P. + 0.35% F.S.)
		Actual gas 2～10%	±0.5% F.S.
	Linearity	N_2 gas	±0.3% F.S.
		Actual gas	±1.0% F.S.
	Repeatability	10～100%	± (0.1% S.P. + 0.05% F.S.)
		2～10%	±0.06% F.S.
	Flow rate sensor guaranteed zero point deviation range		±0.5% F.S. / year, max.
	Temperature dependence	Zero point	±0.01% F.S. / °C (15～35 °C)
		Span	±0.01% S.P. / °C (15～35 °C)
	Response Time	0% → (20～100%)	Max. 1.0 sec. to reach ±2% S.P of the set value.
		0% → (2～20%)	Max. 1.5 sec. to reach ±0.4% S.P of the set value.

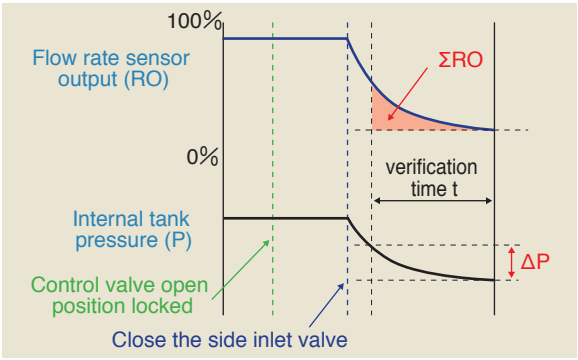
Item			Specifications *1
Model name			1480G4 2480G4
PI function *5	Flow rate fluctuation width during pressure variation	Pressure gradient:＜0.5kPa 0.1PSI/0.12sec	±1.0% S.P.
		Pressure gradient: ＜0.02MPa 2.9PSI	± (1.5% S.P. + 1.0%F.S.)
		>0.5kPa 0.1PSI /0.12sec, Pressure fluctuation width 0.02～0.05MPa 2.9～7.3PSI	± (3.0% S.P. + 1.0% F.S.)
	Flow rate change time when pressure changed		Within +1 of pressure changed time
Control valve shut off function	Valve operation pneumatic pressure		0.4～0.7 MPa (G) 58.0～101.5 PSI (G)
	Valve seat leakage amount		Max. $1x10^{-8}$ Pa・m^3/s (He)
	Number of durability		2 million times (including the number of times when in-line flow rate verification)
	Operation of integrated metal diaphragm valve		Normally open
Flow rate confirmation function	Flow rate confirmation range	Flow range	10SCCM～5,500SCCM
		Confirmation range	2～100% F.S.
	Confirmation repeatability (3σ)	10～400SCCM	±1.5% S.P.
		401～5,500SCCM	±2.5% S.P.
	Confirmation of available pressure *6	Input pressure	0.05～0.3 MPa (G) (7.3～43.5 PSI (G))
		Output pressure	Max. - 0.08 MPa (G) - 11.6 PSI (G) (when controlling at 100 % of the flow rate)
	Confirmation repeatability at a guaranteed pressure		Pressure at measuring reference data: ±0.03 MPa (G) ±4.4 PSI (G)
	Confirmation time		2 to 4 minutes
	Re-calibration	Span deviation calibration (allowable range)	±20 % (cumulative)
		Zero position deviation calibration (allowable range)	±20 % (cumulative)
		Re-calibration time	2 seconds
Pressure, temperature display	Pressure sensor	Pressure range	-99.9～999.9 kPa (G) 14.5～145 PSI (G)
		Accuracy	±0.5% F.S.
		Repeatability	±0.01% F.S.
		Temperature dependence	0.05% / °C
		Pressure output	LCD display and digital communication (not analog output)
	Temperature measuring range		273.2～323.2 K (0～50°C)

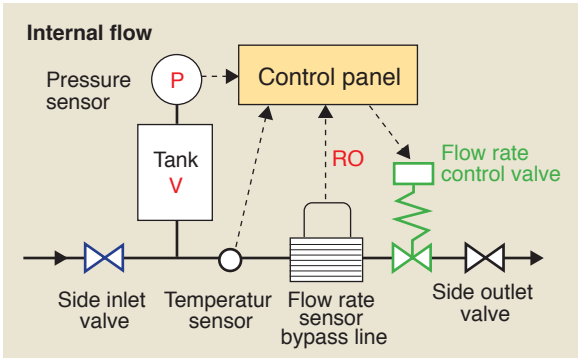
*1: The specifications above are guaranteed values when the MFC was measured by itself in standard conditions. The MFC may not meet the specifications above, depending on the measurement conditions.
*2: The 147*G4 / 247*G4 series are also available for use with low inlet pressure. Please inquire separately for the specifications for low inlet pressure models.
*3: A model using a rubber seal is also available. Please inquire separately about the rubber seal specifications.
*4: An H1G seal is available only on the SFC14**G4 series
*5: The PI function may not perform its specifications depending on each plumbing condition. Please consult us in advance.
*6: For details about the confirmation pressure for the minute pressure difference model, please contact Hitachi Metals.

What is a G4?

The G4 series MFCs are full specification G series models. They are equipped with the MG/MR, PI (Pressure Insensitive), valve shut off, inline flow rate verification, and self calibration functions.
Flow rate verification is a method for verifying changes in the flow rate over time. It compares reference data for normal operation when starting to the current flow rate verification results at certain intervals.
A tank with an integrated pressure sensor and a side inlet valve are the main items used for verification.
At the beginning of the verification the MFC temporarily stops the normal flow rate control and locks the opening position of the flow rate control valve. Next, the side inlet valve closes. The chart below shows the relationship between the internal tank pressure P and the flow rate sensor output RO, with time on the horizontal axis and pressure and output on the vertical axis. After closing the side inlet valve, P and RO change as shown below. The amount of flow rate deviation (the verification value), can be obtained from the ratio between flow rate when starting to use the MFC, and the results of the verification calculation after a certain period has elapsed.
The results of the verification can be checked on a personal computer display or on the LCD on the main housing. If needed, the mass flow controller can be re-calibrated to normalize the data using the self calibration function.

Principle Compare the flow rate when the initial data was obtained and the data when you are confirming the flow rate. Then calculate the change in the flow rate output over time

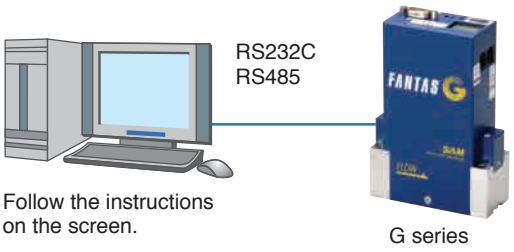




There are three types of verification operations

Three types of verification operations are available as follows.
One is operation uses a special program on a personal computer.
Another is a stand alone operation using the mass flow controller by itself.
With this method, the zero reset switch on top of the main housing is used for the verification and the verification results are shown on the LCD. This method does not need a personal computer.
The last method controls the operation with commands from a system.
In any of these methods, the basic operation procedures are the same, as shown below. You can easily calibrate a periodically verified flow rate.

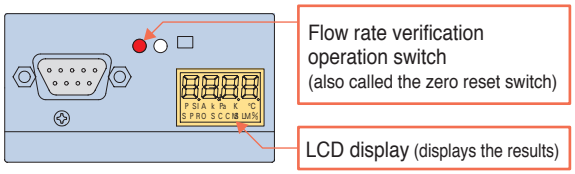
1) Operation using a special program on a personal computer



Follow the instructions on the screen.

G series

2) Stand alone operation



Perform the verification using the zero reset switch on the top of the MFC housing.

3) Verification using commands from a system

Basic operating procedures

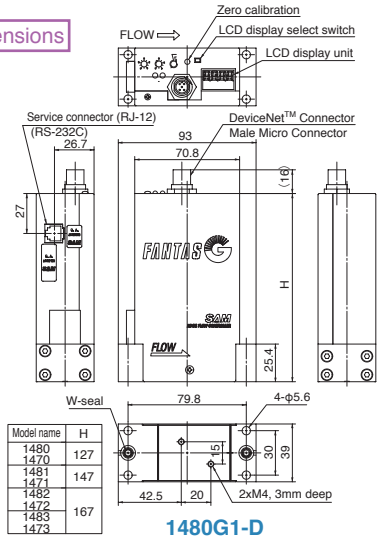
1. Obtain the initial data or select the flow rate verification (Up to 5 sets of initial data can be stored.)
2. Start obtaining the initial data.
3. Set the verification flow rate, and start the verification.
4. The measured results are displayed.
   ...
5. **Verity the flow rate periodically**
   => The user can calibrate the MFC using the verification results.

* For details about the operation method, see the instruction manual.

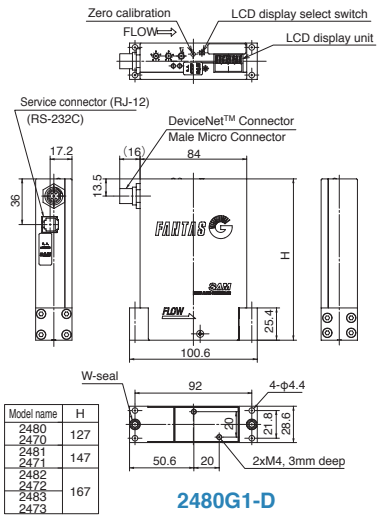
1480G1-D / 2480G1-D series

DeviceNet™ communication type For both the 1.5" and 1.125"IGS PI Mass Flow Controllers

Dimensions



1480G1-D



2480G1-D

	Item			Specifications *1			
	Model name			1480G1-D0 2480G1-D0	1481G1-D0 2481G1-D0	1482G1-D0 2482G1-D0	1483G1-D0 2483G1-D0
Basic specifications	Standard full scale flow rate (N2 equivalent)			5SCCM ～5,500SCCM	11SLM	30SLM	50SLM
	Function			1) Multi-gas/multi-range, 2) PI function, 3) LCD display (flow rate output, flow rate setting, pressure, and temperature)			
	Valve operation			Normally closed / normally open			
	Flow rate control range			2～100% F.S.			
	Operation pressure *2	Inlet pressure		0.05～0.3 MPa (G) 7.3～43.5 PSI (G)		0.1～0.3 MPa (G) 14.5～43.5 PSI (G)	0.2～0.3 MPa (G) 29.0～43.5 PSI (G)
		Outlet pressure		Vacuum to ambient pressure			
	Proof pressure			1.0 MPa(G) 145 PSI(G)			
	Temperature	Operation		5～50 °C			
		Accuracy guaranteed		15～35 °C			
		Heating temperature when not powered		65 °C max			
	Humidity			35～80%RH (non condensing)			
	Installation position			Horizontal, Vertical	Horizontal, Vertical (option)		
	Flow rate setting signal			DeviceNet™ communication *3			
	Flow rate output signal						
	Required power			+24 VDC, 0.3 A max			
Hardware	Material of gas wetted surface	Housing, flange, valve seat		SUS316L			
		Diaphragm		YET101 (Ni-Co alloy)			
		Flow sensor		SUS316L		Ni	
		Seal *4		SUS316L			
		Pressure sensor		SUS316L			
	Surface finish of components that contact the gas			Specially electro-polished (standard)			
	Fitting *5			W seal, C seal, H1G seal, 1/4" HMJ (UJR) male			
	LCD display unit			4 digit display (6 x 4 mm), LED backlight			
	External leakage standard			Max. $1x10^{-11}$ Pa·m³/s (He)			
Flow rate control	Accuracy	N2 gas	10～100%	± (0.5% S.P. + 0.15% F.S.)			
			2～10%	±0.2% F.S.			
		Actual gas	10～100%	± (1.5% S.P. + 0.35% F.S.)			
			2～10%	±0.5% F.S.			
	Linearity	N2 gas		±0.3% F.S.			
		Actual gas		±1.0% F.S.			
	Repeatability	10～100%		± (0.1% S.P. + 0.05% F.S.)			
		2～10%		±0.06% F.S.			
	Flow rate sensor guaranteed zero point deviation range			±0.5% F.S. / year, max.			
	Temperature dependence	Zero point		±0.01% F.S. / °C (15～35 °C)			
		Span		±0.01% S.P. / °C (15～35 °C)			
	Response Time	0% → (20～100%)		Max. 1.0 sec. to reach ±2% S.P of the set value.			
		0% → (2～20%)		Max. 1.5 sec. to reach ±0.4% S.P of the set value.			
PI function *6	Flow rate fluctuation width during pressure variations	Pressure gradient: ＜0.5kPa 0.1PSI/0.12sec		±1.0% S.P.			
		Pressure gradient: ＞0.5kPa 0.1PSI /0.12sec	Pressure fluctuation width ＜0.02MPa 2.9PSI	± (1.5% S.P. + 1.0%F.S.)			
			Pressure fluctuation width 0.02～0.05MPa 2.9～7.3PSI	± (3.0% S.P. + 1.0% F.S.)			
	Flow rate change time when the pressure changes			Within 1 second of the pressure fluctuation			
Pressure, temperature display	Pressure sensor	Pressure range		-99.9～999.9 kPa (G) 14.5～145 PSI (G)			
		Accuracy		±0.5% F.S.			
		Repeatability		±0.01% F.S.			
		Temperature dependence		0.05% / °C			
		Pressure output		LCD display and DeviceNet™ communication (not analog output)			
	Temperature measuring range			273.2～323.2 K (0～50°C)			

*1: The specifications above are guaranteed values when the MFC was measured by itself in standard conditions. The MFC may not meet the specifications above, depending on the measurement conditions.
*2: The 147*G1-D / 247*G1-D series are also available for use with minute pressure differences. Please inquire separately for the specifications of our minute pressure difference models.
*3: For details about DeviceNet™ communication, see page 14.
*4: A model using a rubber seal is also available. Please inquire separately about the rubber seal specifications.
*5: An H1G seal is available only on the SFC14**G1 series
*6: The PI function may not perform its specifications depending on each plumbing condition. Please consult us in advance.

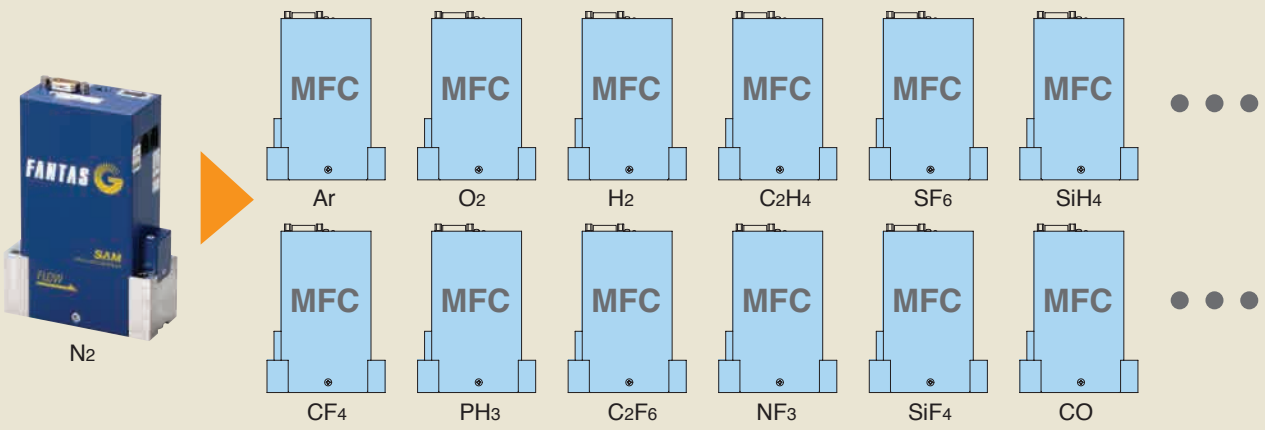
MG/MR (multi-gas/multi-range) function

This is the core technology that is included in all the G series models is the MG/MR (multi-gas / multi-range) function. In conventional mass flow controllers, one controller would only handle one type of gas and one full scale flow rate range. This means that customers needed to have a dedicated mass flow controller for each system, and for each process recipe. With the FX series flow rate controller equipped with the MG/MR function, you can have up to 14 user recipes (full scale ranges of 2 SCCM to 50 SLM) to match the intended flow range, and you can change the gas type and flow rate to match the actual gas you want to handle. When connected to a personal computer, the metering conditions can be changed instantly (See page 14).

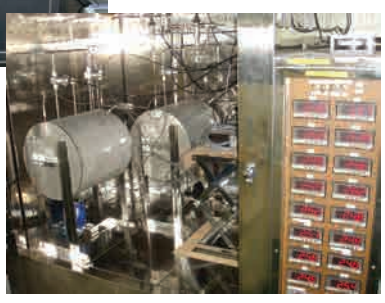
Hitachi Metals actual gas flow rate accuracy warranty system backs up this MG/MR function. A conventional mass flow controller only guarantees the flow rate accuracy with N_2 gas.

To get the flow rate conditions for your actual gas using a conventional MFC, a conversion factor must be used as a coefficient to convert the flow rate.
The reference values for these coefficients have been based of a variety of values, including calculated values, actually measured values, and empirical values. And, these were merely guidelines or reference values with some gas types. Although the MG/MR function is included, if the gas data deviates from the characteristics of the actual gas, the mass flow controller cannot perform as its designed level.
With the G series mass flow controller, in addition to the flow rate reference for N_2 gas (that ensures conformance with the national standard using the conventional gravimetric method), we installed full scale actual gas metering and exhaust gas processing facilities at our factory. Using these facilities, measurement is made for each type of gas at each full-scale range, and record the data. This is then used as actual gas data.

Conceptual diagram of the MG/MR (multi-gas/multi-range) mass flow controller



N_2 gas reference flow rate



Actual gas flow rate measurement facility

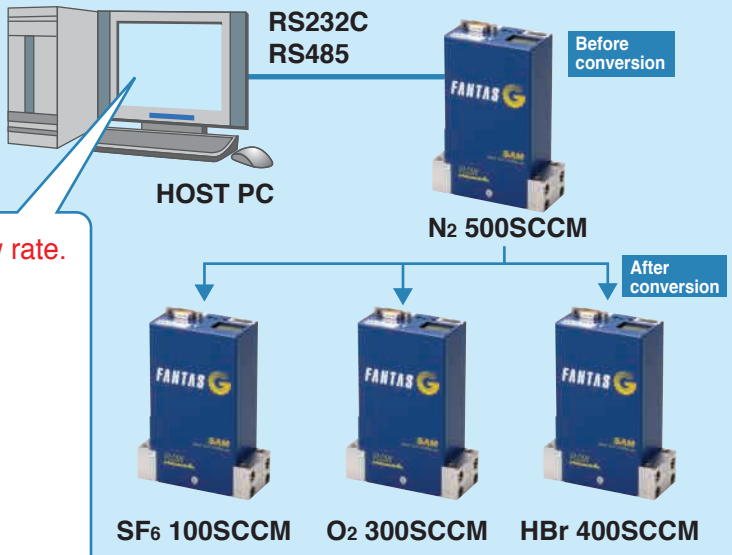
Abbreviation	Standard full-scale flow rate range (N_2 equivalent)
MG/MR	Flow range
FR-01	2～5 SCCM
FR-02	6～14 SCCM
FR-03	15～27 SCCM
FR-04	28～38 SCCM
FR-05	39～71 SCCM
FR-06	72～103 SCCM
FR-07	104～192 SCCM
FR-08	193～279 SCCM
FR-09	280～754 SCCM
FR-10	755～2037 SCCM
FR-11	2038～5500 SCCM
FR-12	5501～11000 SCCM
FR-13	11001～30000 SCCM
FR-14	30001～50000 SCCM

How to use the MG/MR conversion program

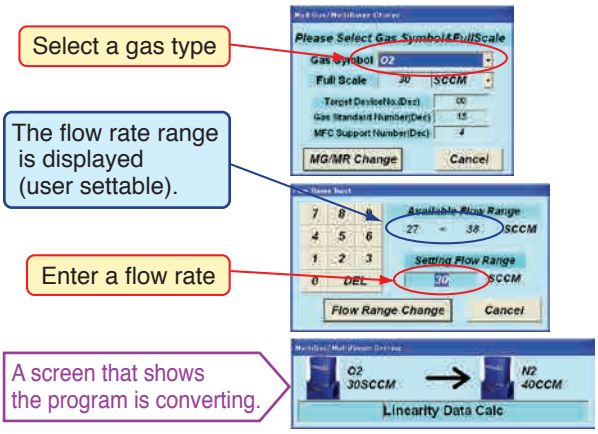
Gas type and flow rate can be converting using an MG/MR conversion program. Connect the mass flow controller to a personal computer using a digital communication cable, and use our proprietary program. One can convert the data easily with a simple GUI interface program. Following the program instructions, first select the gas type, and then flow rate units. A flow rate range will appear, and it can be changed. Enter a flow rate value and the setting is complete.

Users can change the gas type and flow rate.

<MG/MR conversion program> Select the correction amount data according to the gas type and flow rate you want to control



Simple operation to set the gas type and flow rate.

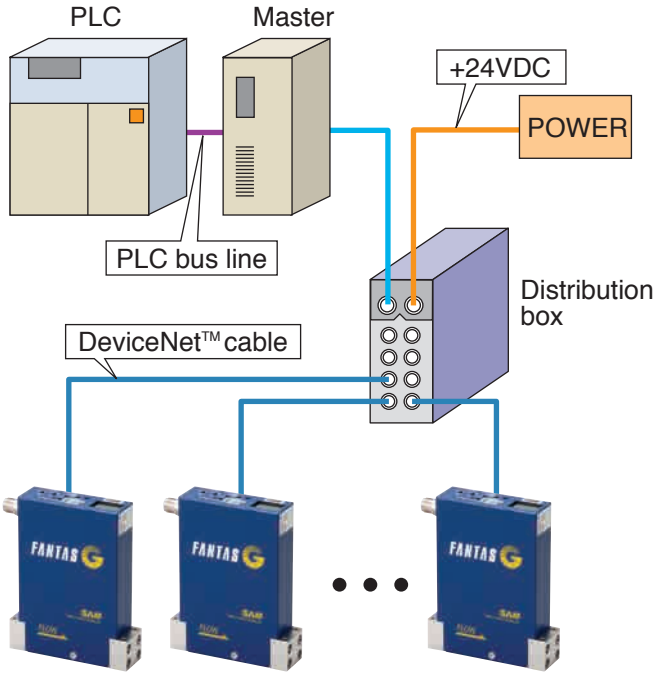


* For details about the operation, see the instruction manual

Models compatible with the DeviceNet™ communication system

About DeviceNet™

This is a field network recognized world wide, and it is approved as a standard sensor bus by the SEMI.
Field devices can be connected using serial communication in place of an I/O connection, allowing transfer of a large volume of data effectively.
The DeviceNet™ specifications are administrated by the ODVA (Open DeviceNet Vendor Association, Inc.) a non-profit body established to promote the spread of this system world-wide.



What are the advantages of employing DeviceNet™

1) By using serial communication from an I/O connection, one does not need an AD / DA / O board which can decrease configuration and set up costs.
2) Only network cables are needed and this reduces cabling costs, which decreses required man-hours, shortening engineering periods, and avoids problems from incorrect wiring.
3) DeviceNet™ employs a CAN (Controller Area Network) as a communication controller, and you can use a variety of CAN error detection functions.
4) The DeviceNet™ specifications are administrated by the ODVA, and have been normalized as international standards by IEC and SEMI. With this normalization, they are completely open, and lots of control devices are available from multiple venders. You can choose the optimum device for your application.
5) The power for DeviceNet™ is only +24 VDC. You do not need to supply ±15 VDC for the mass flow controller.

Communication connector pin assignment

Analog interface connector (D-Sub 9-pin)

Connector used : D-Subminiature, 9-pin connector (M3 screw)

Compatible plug : 17JE-13090-02 (D8B) (made by DDK) or equivalent

1) Connector model : L type

Pin number	Function
1	Valve open/close input (+15 VDC = Fully open; -15 VDC = Fully closed)
2	Output (0 to 5 VDC)
3	+15 VDC
4	COM (±15 VDC)
5	-15 VDC
6	Input (0.1 to 5 VDC)
7	COM (output)
8	COM (Input)
9	Valve valtage (0 to 5VDC)

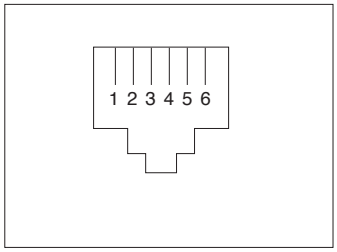
2) Connector model: Q type

Pin number	Function
1	Valve Full open (operate by connecting to COM)
2	Out put (0 to 5 VDC)
3	+15 VDC
4	COM (±15 VDC)
5	-15 VDC
6	Input (0.1 to 5 VDC)
7	COM (output)
8	COM (Input)
9	Valve Full-close (operate by connecting to COM)

Digital interface connector

Connector used : 43814-6621 (made by Molex) (RJ-12 x 2 connectors)

Pin number	Signal name	
	RS232C	RS485
1	COM (Siginal)	
2	No Connection	
3	Rxd	RS-
4	Txd	RS+
5	N.C.	
6	N.C.	



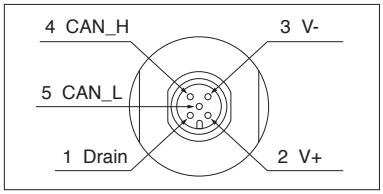
Note 1 : Rxd, Txd: RS232C Input and output

Note 2 : RS-, RS+: RS480 Input and output

DeviceNet™ connector

Connector used : DeviceNet™ Male Micro Connector (CM02-8DR5P(D5) made by DDK, or equivalent)

Pin number	Signal name
1	Drain
2	V+
3	V-
4	CAN_H
5	CAN_L



Additional functions

Function name	Description	Setting and reading methods
Alarm function	See the item for the alarm function	By command
Flow sensor zero reset function	Reset the flow sensor zero	By command or when the switch on the top is pressed
Pressure sensor zero reset function	Reset the pressure sensor zero	By command
Pressure sensor span correction function	Correct the pressure sensor span	By command
Lamp response function	Control the flow rate using a specified time for the step flow rate setting.	By command
Flow control valve voltage monitor output function	Set the flow control valve opening (0 to 5 VDC)	By command or analog voltage output (only L type)
Flow control valve fully open / close function	Open and close the flow control valve completely	By command, ±15 VDC, or contact point connection

Alarm function

Alarm cause	Alarm LED display	Alarm output condition
Normal operation	Green LED blinks at 1 Hz	No alarm
Flow rate setting does not the match flow rate output	Red LED lights	The mis-match between the flow rate setting and the flow rate output is 10% or more of the full scale and has continued for 10 seconds or longer
Abnormal ±15 VDC power supply	Turns off	The ±15 VDC power supply is outside the range of ±12 VDC to ±17 VDC, and has been for 0.5 seconds or longer.
EEPROM access error	Red LED lights	Abnormal value in the EEPROM data.
Digital communication error	Red LED goes on	Did not receive a normal digital command
Change in flow rate control status (Change from the preset status) ・Flow rate setting changed ・Flow rate output changed ・Flow control valve open level changed ・Abnormal zero point correction value for the flow sensor	Red LED blinks at 2 Hz	The change in the preset value was 10% or more of the full scale and continued for 10 seconds or longer. Or, the cumulative value of the zero point correction amount for the flow sensor is more than ±20% of full scale

⚠ Precautions to ensure safe use

In order to use our products safely, make sure to read the relevant instruction manuals before use.

1480G, 2480G series ordering information

Model name						
Size	Temperature	Pressure	Flow range	Series	Seal	Operation
1	4	8	0	G1	M	C

1	1.5" size
2	1.125" size

4	Normal temperature type

8	Normal pressure type
7	Low inlet pressure type

0	5～5,500 SCCM (FR-01～11)
1	11 SLM (FR-12)
2	30 SLM (FR-13)
3	50 SLM (FR-14)

G1	Multi gas, multi range, Pressure insensitive
G2 *	Multi gas, multi range, valve shut off
G3 *	Multi gas, multi range, Pressure insensitive, valve shut off
G4 *	Multi gas, multi range, Pressure insensitive, valve shut off, flow rate calibration verification

M	Metal seal
R	Rubber seal

C	Normally closed
O	Normally open

Optional code			
Fitting	Connector	Flow sensor material	Option
UG	L	N	

4V **	1/4” HMJ (UJR) male
UG	1.5” W seal, 1.125” W seal
AG	1.5" C seal, 1.125” C seal
HG ***	1.5” H1G seal (Hitachi GS seal)

L0	D-sub 9-pin (top mount), valve open/close signal ±15 VDC type
Q0	D-sub 9-pin (top mount), valve open/close signal COM connection type
T0 ****	D-sub 9-pin (upstream mount), digital output type
D0	DeviceNet™

Blank	Ni free
N	Ni sensor

Blank	None
-	For details, please contact us.

Note: * G2, G3, and G4 series can only control flow rates up to 5,500 SCCM.

** Only the G1 series can be used with a 4V fitting.
Can be used with a 1/4” HMJ (UJR) male, 124 mm.

*** Only the 14** series can be used with an H1G fitting

**** Only the 24** series can be used with a T0 connector.

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