

MPC Series Panel-Mount Mass Flow Controller User's Manual

Thank you for purchasing an MPC mass flow controller. Before operating this product described in this user's manual, please take note of the points below regarding safety. Be sure to keep this manual nearby for handy reference.

RESTRICTIONS ON USE

This product has been designed, developed and manufactured for general-purpose application in machinery and equipment. Accordingly, when used in applications outlined below, special care should be taken to implement a fail-safe and/or redundant design concept as well as a periodic maintenance program.

- Safety devices for plant worker protection
- Start/stop control devices for transportation and material handling machines
- Aeronautical/aerospace machines
- Control devices for nuclear reactors

Never use this product in applications where human safety may be put at risk.

©2003 Yamatake Corporation ALL RIGHTS RESERVED

This manual explains the handling precautions, mounting, wiring, basic operation and main specifications. See the user's manuals listed below for detailed handling procedures, setting methods, etc. These manuals also contain information on using various functions. Please read if necessary.

- MPC Series Panel-Mount Mass Flow Controller Installation, CP-SP-1153E
- MPC Series Panel-Mount Mass Flow Controller Communications, CP-SP-1154E

Unpacking

Check the following items when removing the MPC from its package:

Name	Model No.	Q'ty
Mounting bracket	81446917-001	1
Connector		1
User's Manual	CP-UM-5317E	1

SAFETY PRECAUTIONS

WARNING

Warnings are indicated when mishandling this product might result in death or serious injury to the user.

CAUTION

Cautions are indicated when mishandling this product might result in minor injury to the user, or only physical damage to this product.

WARNING

- Never allow combustible gases (especially gases that are within explosive limits) to pass through this controller. Doing so might result in an explosion.
- Do not use this controller for gases other than standard compatible gas types (nitrogen/air, argon and carbon dioxide).
- Do not use this controller for medical instruments.

CAUTION

- Prevent foreign matter from entering the device. If rust, water droplets, oil mist, or dust in the pipes enters the device, measurement or control error or damage to the device might occur. If there is a possibility of foreign matter entering the device, provide an upstream filter, strainer or mist trap capable of eliminating foreign matter 0.1 μm or greater in diameter. Be sure to inspect and replace the filter at regular intervals.
- Make sure that wire scraps, shavings, water, etc. do not enter inside the case. Failure to heed this caution may lead to malfunction or equipment failure.

CAUTION

- Use this controller within the operating differential pressure range. Also, do not apply pressure outside the pressure resistance range. Doing so might damage this controller.
- Be sure to use this product within the flowrate range stated in the specifications. To prevent excessive flow, use a suitable means to control the supply pressure or use a throttle valve or the like to control the flowrate. If the flowrate exceeds the upper limit, both the flowrate display and the output value may indicate considerably lower values than the actual flowrate.
- If damage could result from the abnormal functioning of this device, include appropriate redundancy in the system design.
- This controller is not provided with the capability of completely closing the valve. If the valve is needed to be completely closed, provide a shutoff valve separately. When the external valve is closed, it is necessary also to fully close the MPC valve using either of the following methods:
 - Make the flowrate to zero.
 - Set the operation mode to the fully closed mode.
 If this valve is maintained in control mode despite of closing the external shutoff valve (zero flowrate), large excess flowrate will instantly flow when the external shutoff valve is opened. If the external shutoff valve is closed for more than 5 minutes under control mode or valve forced fully open in the case of the MPC0020, the valve over-heat limit (RL7) operates and the valve driving current is forcibly limited. If this status exists for more than 30 minutes, the valve is forced to full close condition.
- When this controller is mounted on a panel, use piping which does not give stress to the controller case during and after the piping work. If a metal piping is directly connected to the pipe connection port of this controller, the case might be deformed or damaged.
- The part between the power supply circuit of this controller and the I/O circuit is not isolated. Therefore, ensure that the power supply of this controller is isolated from the power supply for external devices (insulate the power supply). If a common power supply is used for the controller and the external devices, it might cause malfunction or faulty operation.
- For the model with analog I/O function, do not apply a negative-voltage or extremely large voltage more than 5V to the analog setting input terminal. Doing so might cause malfunction or faulty operation.
- Use Yamatake Corporation's SurgeNon if there is the risk of power surges caused by lightning. Failure to do so might cause fire or faulty operation.

Introduction

This device is a compact and lightweight mass flow controller for the general industrial market. The integration of an array of advanced technologies—the ultra high-speed μF (Micro Flow) thermal flow velocity sensor, made with proprietary Yamatake technology, an ultra-compact proportional solenoid valve, a new flow channel system, and advanced actuator control technology—has made this panel-mount mass flow controller possible.

Mounting

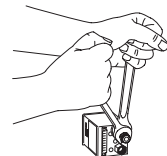
Location

- Avoid mounting this controller in the following locations:
- Locations subject to high and low temperature and humidity
 - Locations subject to sudden changes in temperature and condensation
 - Locations subject to be filled with corrosive gases and flammable gases
 - Locations whose atmospheres contain large amounts of dirt and dust, salt, conductive substances such as iron powder, water droplets, oil mist and organic solvents
 - Locations directly subject to mechanical vibration or shock
 - Locations subject to direct sunlight and rain
 - Locations subject to splashing of oil or chemicals
 - Locations close to sources of electrical noise
 - Locations where strong magnetic or electrical fields are generated

Mounting Procedure

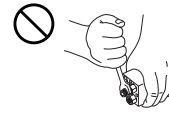
Joint connection

- Connect the joint by holding the hexagonal section of the pipe connection port of the body with a spanner (or wrench).



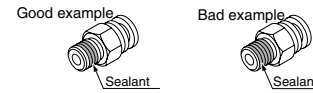
Handling Precautions

- Do not hold the case of the controller with your hand when screwing the joint into the connection port. Doing so might deform the body.



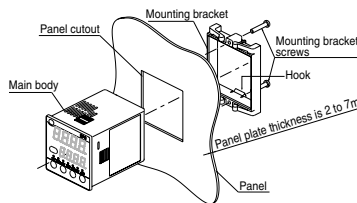
- Screw the joint with an appropriate torque as recommended by the joint manufacturer. Exceeding the torque limits will cause damage the connection port.

- Apply appropriate amount of sealant. Do not coat the top most thread of the screw. Remove any dirt or burrs from inside the joint.



Mounting on a panel

The mounting panel should be used with a thickness of 2 to 7mm of steel.

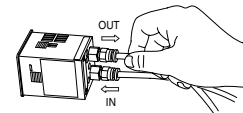


Handling Precautions

To fasten this controller onto the panel, tighten the mounting bracket screws, and turn one more half turn when there is no play between the bracket and panel. Excessively tightening the screws might deform the controller case.

Piping connection

- When this controller is mounted on a panel, use piping which does not give a stress to the controller case during and after the piping work.
- Connect the piping so that the gas flows in the direction from IN to OUT as indicated on the body.
- After connecting piping, check for any gas leaks.



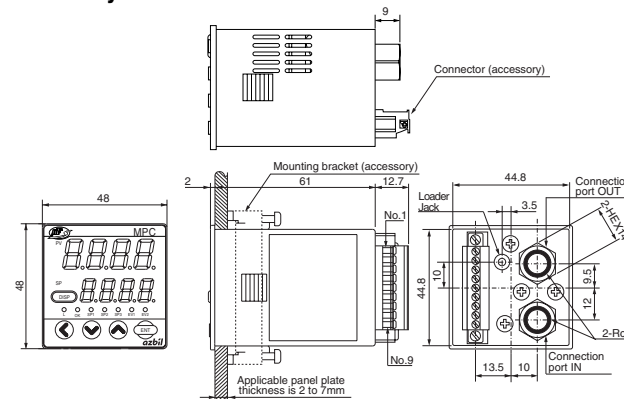
Handling Precautions

- When metal piping is directly connected to the piping connection port, this controller cannot be mounted on a panel. Doing so will deform or damage the case.
- When leak check is performed using leak check liquid, ensure to avoid spillage or contact of liquid on to the case, electrical wires and connectors. Doing so might cause malfunction or faulty operation.

External Dimensions

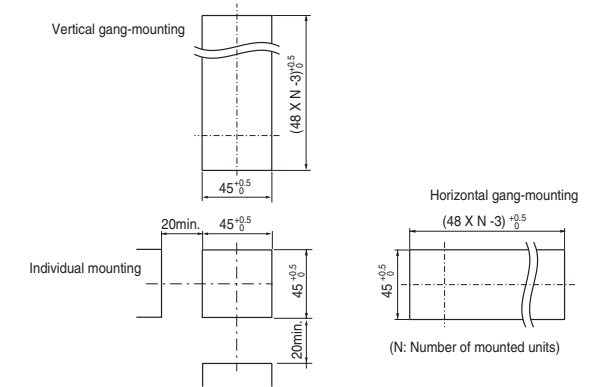
Body

unit: mm



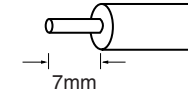
Panel cutout

unit: mm



Connector specifications

- Part No.: MCVW1.5 / 9-STF-3.5 (Phoenix Contact Mfg.)
- Wire type: Either of solid wire or stranded wire applicable.
- Compatible cable: 0.08 to 1.5mm² (AWG#28 to #16)
- Appropriate length of stripped wire: 7mm

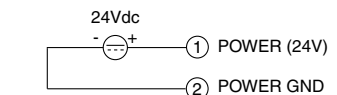


- Compatible screw driver: Tip size 2.5 x 0.4mm (a flat-head driver)

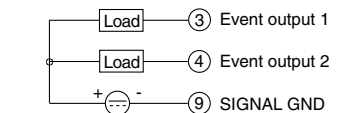
Wiring

Wiring

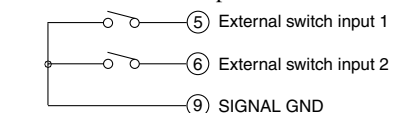
- Power supply



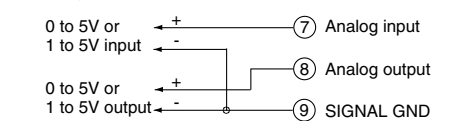
- Event output



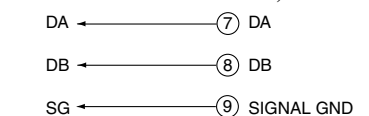
- External switch input



- Analog input/output (only for the model with analog I/O function)



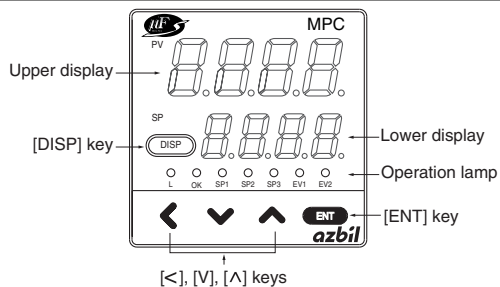
- RS-485 communication (only for the model with RS-485 communication function)



Handling Precautions

- Be sure to turn off the power before doing the wiring work. Not doing so could cause equipment failure.
- Be sure to check that the wiring is correct before you turn the power ON. Incorrect wiring might cause damage or malfunction.
- Be sure that the event output does not exceed the specified output rating of this controller. When driving a relay, use the relay with a built-in diode for coil surge absorption. Doing so might cause faulty operation.

Part names and functions



Definition of terms

SP (Set Point): Set flowrate value
 PV (Process Variable): Instantaneous flowrate value (control flowrate)
 Operation mode: 3 mode of "valve fully-closed / valve control / valve fully-open"

Upper display:

Displays the instantaneous flowrate value (7-segment display).
 When the display is switched, it also displays the integrated flowrate value (upper 4 digits), parameter setup item, function setup item or alarm details.

Lower display:

Displays the set flowrate (7-segment display).
 When the display is switched, it also displays the operation mode, integrated flowrate values (lower 4 digits), value drive output, parameter setup values, function setup values.

Operation lamp:

- L:** Indicates that the integrated flowrate is displayed. Flashes when an integration event occurs.
- OK:** Lights when the control flowrate is within the "setting value \pm allowable range". Flashes when the operating mode is valve full-open.
- SP1 to SP3:** The lamp corresponding to the SP No. which is used at multi-setup is lit.
- EV1, EV2:** Lights when the event output is ON.
- [DISP] key:** Used when switching the details of display.
- <, [V], [^] keys:** Used when incrementing/decrementing the digit or moving to a desired digit.
- [ENT] key:** Used when setting the SP value and storing the value. It also can be used for the integrated flowrate resetting and alarm resetting.

Gas type setting

Gas type is initially set to the nitrogen/air at factory before shipment. When this controller is used for argon, carbon dioxide, or their mixed gases, the required gas type setting can be set as per the following procedure:

- (1) After the power is turned ON, press the [DISP] key 2 times to display the integrated flowrate.
 >>"L" lamp lights.
- (2) Press the [<] key for 3 seconds.
 >> The upper display indicates "0.0000". (Parameter setup mode)
- (3) Additionally, press the [<] key for 3 seconds.
 >> The upper display indicates the setup item No. "0-00". (Function setup mode)
- (4) Press the [^] key or [V] key.
 >> The setup item No. "0-00" (gas type setting) is indicated.
- (5) Press the [ENT] key.
 >> The present setting value (initial value 1: Nitrogen / air) indicated on the lower display flashes.
- (6) Press the [^] key or [V] key to select the desired gas type out of those listed below, and then press the [ENT] key.
 >> Set the gas type setting.
 0: Mixed gas (The compensation factor (C.F.) of each gas type must be set by user.)
 1: Nitrogen / air
 3: Argon
 4: Carbon dioxide (CO₂)
- (7) Press [DISP] key.
 >> Display is returned to the one shown at power supply ON.

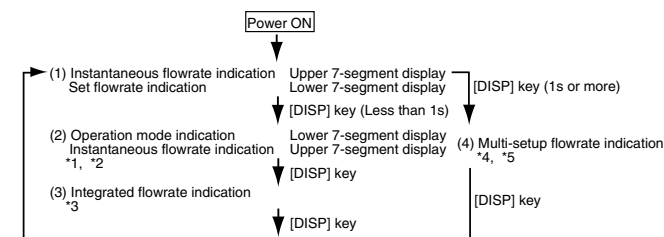
Note

In case of mixed gases, the compensation factor (C.F.) setting is required in parameter setup. For details on parameter setup, refer to;
 MPC Series Panel-Mount Mass Flow Controller Installation, CP-SP-1153E Chapter 5 APPLICATION OPERATION

Basic Operation

Switching Displays

Each press of the [DISP] key switches the display as shown below.



- *1: The operation mode indication is not displayed when the "0: no operation mode selection by key setting" is selected at the operation mode selection "0-00" in function setup.
- *2: If no operation is made while the operation mode is displayed, the display is automatically returned to the (1) instantaneous flowrate indication after approx. 10 seconds.
- *3: When the [ENT] key is pressed for approx. 3 seconds while the integrated flowrate is displayed, the integrated flowrate is reset.
- *4: The multi-setup flowrate is displayed only when the multi-setup (1 to 3) is selected at flowrate setup number selection "0-00" in function setup.
- *5: If no setup-change is made while the multi-setup flowrate is displayed, the display will automatically return to the (1) instantaneous flowrate indication after approx. 10 seconds.

Note

For details on function setup method, refer to;
 MPC Series Panel-Mount Mass Flow Controller Installation, CP-SP-1153E Chapter 5 APPLICATION OPERATION

Setting the flowrate

Follow the procedure below to change the SP value (set flowrate):

- (1) Press the [DISP] key.
 >> The instantaneous flowrate and SP value (set flowrate) are displayed. (Display at power supply ON.)
- (2) Press the [^] key or [V] key to change the SP value.
 >> The digit being changed flashes.
 In addition, when the [<] key is pressed, the digit being changed is moved.
- (3) When you have reached the target value, press the [ENT] key.
 >> At this point, the SP value is stored.

Handling Precautions

If the [DISP] key is pressed without pressing the [ENT] key in the step (3), the SP value is not stored and returns to the previous value.

Note

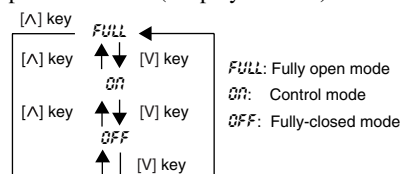
By changing the function setup, the multi-setup (max. 4 units) or analog voltage setting (only for the model with analog I/O function) can be made. For the details, refer to;
 MPC Series Panel-Mount Mass Flow Controller Installation, CP-SP-1153E Item 4-2 Setting the flowrate

Selecting the operation mode (fully-closed / control / fully-open)

When the [DISP] key is pressed (for less than 1 second) while the instantaneous flowrate is displayed (the display at power supply ON), the upper display maintains the instantaneous flowrate indication and the lower display shows the operation mode, enabling the selection of operation mode.

Follow the procedure below to select the operation mode:

- (1) Press the [DISP] key.
 >> The operation mode is displayed.
- (2) Press the [^] key or [V] key.
 >> The display is changed as shown below. Select the desired operation mode. (Display flashes.)



- (3) Press the [ENT] key to set the operation mode.
 >> The operation mode is set.

Handling Precautions

If no operation is made while the operation mode is displayed, the display will automatically return to the instantaneous flowrate indication after approx. 10 seconds.

Note

By changing the function setup, the operation mode selection can be made by an external switch input. For the details, refer to;
 MPC Series Panel-Mount Mass Flow Controller Installation, CP-SP-1153E Item 4-3 Selecting the Operation Mode

Troubleshooting

Alarm code display

Alarm code	Error	Cause	Countermeasure
R101	Flowrate deviation lower limit alarm	Insufficient alarm judgment delay time, Insufficient power voltage, Insufficient inlet pressure, etc. or excessive operating temperature.	Request for repair service if there is no problem on the items listed on the left.
R102	Flowrate deviation upper limit alarm	Insufficient alarm judgment delay time, valve trouble, sensor trouble, etc.	Request for repair service if there is no problem with the delay time.
R171	Valve overheat prevention limit is operated	During the control or fully-open mode, the gas is forcibly stopped by external device for more than 5 minutes.	When the gas is continuously shut off by external device, set the set flowrate to zero or valve fully-closed mode.
R181	Sensor error	Sensor trouble, foreign object attached to sensor, or entering of hydrogen or helium gas.	If sensor is not restored after turning the power OFF, then request for repair service.
R191	I/O correction data error	Data corrupted due to electrical noise.	Request for repair service.
R192	Sensor calibration data error	Data corrupted due to electrical noise.	Request for repair service.
R193	User setup data error	Power shutoff during writing of data.	Set data again.

Handling Precautions

- R171 (Valve overheat prevention limit) is operated only for the MPC0020.
- If R181 (sensor error) occurs, the control flowrate will become indefinite.
- When canceling the alarm, make the alarm reset operation.

Alarm reset operation

When the [ENT] key is continuously pressed while the instantaneous flowrate is displayed, the alarm is reset after 3 seconds.

Other troubles

Error	Cause	Countermeasure
Flowrate display does not become zero even in spite of an actual zero flowrate (Display does not become OFF even if the valve is fully closed.)	*Zero point deviation due to the influence of pressure. *Gas type setup is incorrect. *Condensation on sensor. *Foreign object attached to sensor.	*Match the primary pressure setting (function setup 0-20) with the actual primary pressure used, or use the PV forced zero function (function setup 0-29). *Match the gas type setting (function setup 0-18) with the actual gas used. *Insert a mist trap upstream. *Request for repair service.
Flowrate does not stabilize.	*Operation differential pressure range is exceeded. *Large primary pressure fluctuations. *Regulator interference *Large pressure loss (Large fluctuation in primary pressure according to flowrate.)	*Reduce the primary pressure. *Insert a regulator upstream. *Change the regulator pressure setting or apply the PV filter(function setup 0-23) *Increase the pipe diameter
Poor accuracy	*Temperature reference does not match the reference flowmeter. *Regulator is vibrating slightly. *Foreign object attached to sensor	*Match the temperature reference. (Can be changed in the function setup 0-19) *Change the regulator pressure setting. *Request for repair service.

Model selection table

Basic model No.	Control flow range	Model	Material	Connec-tion	Gas type	No use	Option 1	Option 2	Option 3	Option 4	Code	Specifications
MPC	9500											Panel mount mass flow controller
	0002											0.00 to 0.500 L/min(standard) *1
	0005											0.08 to 2.00 L/min(standard) *1
	0020											0.10 to 5.00 L/min(standard) *1
												0.4 to 20.0 L/min(standard) *1
												Model with integrated display
												Brass
												Rc1/8
												Nitrogen / air *2
												None
												With analog input/output function (without RS-485 communication function)
												With RS-485 communication function (without analog input/output function)
												None
												None
												With test data
												Complying with traceability certification
												Product version

*1: L/min(standard) indicates the volume flowrate (L/min) per minute converted to 20°C, and 101.325 kPa (1 atmospheric pressure). The reference temperature can also be changed to 0°C, 25°C and 35°C.

*2: The air/nitrogen is set as a factory setting. The MPC can be used for argon and carbon dioxide gases by setup change.

Main specifications

Model No.	MPC9500	MPC0002	MPC0005	MPC0020
Valve type	Proportional solenoid valve			
Valve operation	Normally closed when de-energized (N.C.)			
Standard full-scale flowrate (Nitrogen conversion value)*1	0.500 L/min(standard)	2.00 L/min(standard)	5.00 L/min(standard)	20.0 L/min(standard)
Standard compatible gas types (C ₂ flow rate)	Nitrogen/air, argon, carbon dioxide (CO ₂)		2 to 100%FS	
Control	Control range*1		2 to 100%FS	
Response	Within 1.0s (typ) to set point \pm 2%FS			
Accuracy	\pm 2%FS max. (at standard temperature and differential pressure)			
Repeatability	\pm 1%FS max.			
Influence of temperature	Within 0.1%FS/°C			
Influence of pressure	Q ₀ \geq 40%FS	0.7%FS max.	0.4%FS max.	0.2%FS max.
Q ₀ < 40%FS	1.2%FS max.	0.7%FS max.	0.3%FS max.	
per 0.1MPa	Q ₀ < 10%FS	2%FS max.	1.2%FS max.	0.5%FS max.
Standard differential pressure	0.2MPa (inlet pressure: 0.2MPa(gauge), Outlet pressure: 0.0MPa(gauge))			
Required differential pressure *3	0.05MPa	0.05MPa	0.1MPa	0.15MPa
Operating differential pressure range *4	0.3MPa max.			
Pressure resistance	0.5MPa(gauge)			
Standard operating temperature *2	+25°C			
Allowable operating temperature range	-10 to +50°C			
Allowable storage temperature range	-10 to +60°C			
Humidity	10 to 90%RH(no condensation allowed)			
Integration function	Indication range	0.00 to 999,999.99L	0.0 to 9,999,999.9L	0.0 to 99,999,999L
Indication resolution	0.01L	0.1L	0.1L	1L
Backup timing	1: At each 5L count	1: At each 20L count	1: At each 50L count	1: At each 200L count
Flowrate output *5	Output scale	2: At each 1-hour from the previous backup		
Standard output range	0 to 5Vdc / 1 to 5Vdc (selectable by function setup)			
Event output	Number of outputs	2 points		
Output rating	30Vdc 15mA max. (open collector non-insulated output)			
Integrated pulse output width	100ms \pm 10% (when the integrated pulse output is selected.)			
Integrated pulse rate	0.01L/pulse	0.1L/pulse	0.1L/pulse	1L/pulse
External switch input	Number of inputs	2 points		
Other party circuit type	Non-voltage contact or open collector			
Power supply	Rating	24Vdc, current consumption 300mA max.		
Allowable voltage range	22.8 to 25.4Vdc (ripple 5% max.)			
Material of gas-contacting parts	Brass(Ni plated), stainless steel, Teflon, Viton			
Connection method	Rc1/8			
Mounting orientation	Display surface must face to front (inlet port: down, outlet port: up)			
Mass	Approx. 300g			
Accessory parts	Mounting bracket (81446917-001), wiring connector			
Applicable standard	EN61326: 1997 / Amendment A1: 1998 / A2: 2001			

- *1: L/min(standard) indicates the volume flowrate (L/min) per minute converted to 20°C and 101.325 kPa (1 atmospheric pressure). The reference temperature can also be changed to 0°C, 25°C and 35°C. The controllable flowrate range varies according to the gas type. Refer to the following table:

	MPC9500		MPC0002	
	Control flowrate range L / min(standard)	Setting/indication resolution L / min(standard)	Control flowrate range L / min(standard)	Setting/indication resolution L / min(standard)
Nitrogen / air	0.020 to 0.500	0.002	0.08 to 2.00	0.01
Argon	0.020 to 0.500	0.002	0.08 to 2.00	0.01
Carbon dioxide	0.012 to 0.300	0.001	0.040 to 1.200	0.005

	MPC0005		MPC0020	
	Control flowrate range L / min(standard)	Setting/indication resolution L / min(standard)	Control flowrate range L / min(standard)	Setting/indication resolution L / min(standard)
Nitrogen / air	0.10 to 5.00	0.02	0.4 to 20.0	0.1
Argon	0.10 to 0.50	0.02	0.4 to 2.00	0.1
Carbon dioxide	0.06 to 3.00	0.01	0.3 to 16.0	0.1

- *2: The temperature and pressure at calibration.

- *3: Differential pressure required for obtaining full-scale flowrate. (When outlet pressure = 0.0MPa (gauge))

- *4: Operation is possible even under the required differential pressure. However, the controllable flowrate range will become narrow. For details, refer to;
 MPC Series Panel-Mount Mass Flow Controller Installation, CP-SP-1153E.

- *5: Applicable only to the model with analog input/output function.

azbil

Specifications are subject to change without notice.

Yamatake Corporation Advanced Automation Company

1-12-2 Kawana, Fujisawa
Kanagawa 251-8522 Japan

URL: <http://www.azbil.com>

Printed in Japan.
1st Edition: Issued in Nov. 2003 (W)
5th Edition: Issued in Aug. 2007 (A)