MPC SERIES PANEL MOUNT MASS FLOW CONTROLLER "INSTALLATION & PROGRAMMING" USER'S MANUAL

FM-1038 Rev. 0 4/08

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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 gases within explosive limits to pass through the MPC Series Panel Mount Mass Flow Controller (MFC). Doing so may result in an explosion.
- Do not use the MPC Series Panel Mount MFC for gases other than compatible gas types.

CAUTION

- Prevent foreign materials from entering the MPC Series Panel Mount MFC. If foreign materials are introduced to the MFC, measurement error may occur and result in damaging the MFC. To eliminate contamination from foreign materials, start-up cleaning is highly recommended prior to MFC installation. Start-up cleaning must remove weld debris, tube scale and any loose particulate generated during system fabrication. Install an upstream filter and periodically inspect the filter.
- Do not allow foreign materials to enter the MFC housing. Failure to do so may result in malfunction or faulty operation.
- Use the MPC Series Panel Mount MFC within the operating differential pressure range. Do not exceed the maximum allowable operating pressure.
- The control valve in the MPC Series Panel Mount MFC does not offer positive shut-off. If positive shut-off is a system requirement, install a separate shut-off valve. When a separate shut-off valve is closed, the user must command the MFC control valve fully closed by one of the following methods:
    - Establish a zero setpoint signal.
    - Set the operation mode to the fully closed mode.

  If the MFC's control valve is maintained in the control mode despite closing the separate shut-off valve (resulting in no flow through the MFC), a flow surge will occur upon opening of the shut-off valve. With Model MPC20, if the separate shut-off valve is closed for more than five (5) minutes while in the control mode or the valve is forced full open, the valve overheat limit ('***AL71***') is activated and the valve driving current is limited. If this status exists for greater than 30 minutes, the valve is forced to a fully closed condition.
- When the MPC Series Panel Mount MFC is panel-mounted, use tubing that does not stress the MFC housing. If metal piping is directly connected to the 1/8" FNPT connector of the MFC, the housing could be damaged.
- The MPC Series Panel Mount MFC's power supply circuitry and the input/output circuitry are not isolated. Ensure the MFC's power supply is isolated from the power supply for external devices. If a common power supply is used for both the MFC and the external devices, MFC malfunction or faulty operation may occur.
- Do not supply a negative setpoint voltage or a setpoint voltage greater than 5 Vdc to the MFC. Doing so may cause MFC malfunction or faulty operation.
- A surge suppressor is recommended should power spikes occur.

SECTION 1 – INTRODUCTION

PREFACE

Thank you for purchasing Porter's MPC Series Panel Mount Mass Flow Controller (MFC). Please keep this user's manual available for future reference. Before operating the MPC Series Panel Mount MFC, please note the safety precautions (warnings and cautions). It is recommended these instructions be read and understood before performing any operation. Failure to do so could result in serious injury and/or damage to the equipment.

This "Installation & Programming" user's manual explains the handling precautions, specifications, installation, start-up, programming, maintenance, and troubleshooting of your MPC Series Panel Mount MFC. The "Installation & Programming" user's manual also contains information on the various functions of the MPC Series Panel Mount MFC. For basic instructions on how to use this product, refer to the MPC Series Panel Mount MFC "Quick-Start" user's manual # FM-1032. A copy of user's manual # FM-1032 is included with every MPC Series Panel Mount MFC.

When unpacking the MPC Series Panel Mount MFC, confirm the following components were received. The original shipping container in which your MPC Series Panel Mount MFC was received should not be discarded in case reshipment is necessary.

COMPONENT	QUANTITY
MPC Series Panel Mount MFC	One (1)
Mounting Bracket	One (1)
Mating Electrical Connector	One (1)
User's Manual # FM-1032	One (1)

FEATURES

- The MPC Series Panel Mount MFC is a mass flow controller featuring high performance in a compact package design. Integrating the advanced technologies of an ultra-high speed response thermal flow velocity sensor, a sensor assembly made utilizing proprietary technology, a miniature proportional solenoid valve, a new flow channel system and advanced actuator control technology achieves the realization of the MFC which has panel-mount capabilities.

- The MPC Series Panel Mount MFC is a compact (1.89 x 1.89 inches [48 x 48 mm] front panel size) and lightweight (approximately 10.6 ounces [300 grams]) MFC.

- A wide variety of functions are provided as a standard features to satisfy the various user needs.

- Simple mounting and operation make the MPC Series Panel Mount MFC a viable option when replacing from a variable-area (i.e. float and glass tube-type) flowmeter. In addition, the automatic control of flow rate and remote setting value change can be performed.

- The effects of temperature and pressure fluctuations are negligible when compared to a variable-area flowmeter.

- With a variable-area flowmeter, pressure and temperature compensation is inevitable. Additionally, if the original sizing conditions (i.e. specific gravity, operating temperature or operating pressure) are different from the actual operating conditions, the indicated flow rate must be corrected to compensate for the change in operating parameters. Since the MPC Series Panel Mount MFC controls mass flow, these corrections are not necessary.

FUNCTIONS

MULTI-SETTING FUNCTION

Up to four (4) preset flow rate settings can be instantaneously switched to by key operation or external switching input.

GAS TYPE SWITCHING FUNCTION

The gas type to be used can be selected from the standard compatible gases by key operation.

GAS TYPE SETTING FUNCTION

The user can set conversion factors for any gas type, including mixed gases, to accommodate gases other than standard compatible gases.

VALVE FULL OPEN/FULL CLOSE FUNCTION (SELECTING THE OPERATION MODE)

The valve can be driven fully opened or fully closed by key operation or external switching input.

SLOW START FUNCTION

Sudden changes in the controlled flow rate, when control is initiated or when the flow rate setting value is changed, can be suppressed. The control speed can be changed in eight (8) stages within the range from approximately 1 to 6 seconds.

FLOW RATE TOTALIZATION FUNCTION

The flow rate can be totalized up to eight (8) digits (99,999,999 counts) (the display is switched in four [4] digits at a time). The display resolution is:

Model MPC95:..... 0.01L
Models MPC02 and MPC05: 0.1L
Model MPC20:..... 1L

The count can be reset by key operation or external switching input. Totalization start/stop/reset can be remote-controlled by external switching input.

After a reset-by-key operation, the totalization calculation is started automatically. However, if a reset (contact ON) is carried out by external switching input, totalization is resumed by the contact turning OFF.

VALVE DRIVE OUTPUT DISPLAY

The valve drive output can be displayed as a range of 0.0 to 100.0%. This allows detection of supply pressure fluctuations and excessive pressure drop due to piping restrictions.

ALARM DISPLAY/OUTPUT/SHUT-OFF

The flow rate deviation alarm can be output by detecting the deviation between setting flow rate and controlled flow rate. The alarm judgment delay time can also be programmed. When a flow rate alarm occurs or an alarm occurs during MFC self-diagnostics, the event signal is output and, at the user's option, the valve can be driven fully closed or fully opened.

EVENT LAMP LIGHTING/OUTPUT

Two (2) of the following event types can be output:

- Alarm output (when the flow rate deviation alarm or self-diagnostics occurs).
- Flow rate upper/lower limit output (output by comparison to the optional upper/lower flow rate limit setting value).
- Totalization count up output (when the totalization setting flow rate is exceeded).
- Totalization pulse output (pulse can be output for each totalization display unit).
- '**OK**' output (when the control flow rate is within the range of "setpoint ± allowable range").

- The operating mode can be identified and output externally as an event.

The output ON delay time can also be programmed. However, the delay cannot be set to totalization pulse output. In addition, the output logic can be reversed (during normal operation: ON; at event occurrence: OFF). However, the output is always OFF when power is off.

'OK' LAMP LIGHTING/OUTPUT

The '**OK**' lamp can be made to light when the controlled flow rate is within the "setting value ± allowable range". This function is beneficial for visual verification whether or not the new setting value is being followed properly when a setting value is changed. The '**OK**' lamp output can also be used as an interlock signal for subsequent processes by assigning it to an event output and loading it to a sequence program.

AUTOMATIC SHUT-OFF FUNCTION

The valve can be automatically closed under the following conditions:

- When the totalization count value reaches the setting value.
- When one of the alarms, including flow rate alarms, occurs.

Please note the control valve in the MPC Series Panel Mount MFC does not offer positive shut-off. If positive shut-off is a system requirement, install a separate shut-off valve.

AUTOMATIC RESET OF TOTALIZATION COUNT AT START OF CONTROL FUNCTION

Start of control and totalization count reset can be carried out simultaneously by a single action (key operation or external switching input). Combining this function with the automatic shut-off function described above is handy for shutting the valve off when a fixed number of totalization values have been counted repeatedly.

DIRECT SETUP FUNCTION

Allows users to easily change the flow rate setup. This function is useful when you frequently change setting values, for example, when you adjust the preset flow rate during trial operation.

LOADER COMMUNICATION FUNCTION

The connection of a dedicated loader cable (available separately) to the loader jack on the rear of the MFC enables direct communication with a personal computer in the form of one-to-one using the user-supplied communication program. By using this loader communication, various settings in the function setup and the flow rate setup can be configured from a personal computer. The controlled flow rate or alarm status can be observed with the personal computer.

MODEL SELECTION GUIDE

MODEL NUMBER	FLOW RANGE
MPC95-BBNSP1	0.02-0.5 SLPM Nitrogen
MPC02-BBNSP1	0.08-2.0 SLPM Nitrogen
MPC02-BBNHP1	0.08-2.0 SLPM Helium
MPC05-BBNSP1	0.1-5.0 SLPM Nitrogen
MPC20-BBNSP1	0.4-20 SLPM Nitrogen

SECTION 2 – PRODUCT SPECIFICATIONS

Model Number			**MPC95**	**MPC02**	**MPC05**	**MPC20**
Control Valve Type			Normally closed proportional solenoid valve			
Maximum Flow Capacity (N_2 unless otherwise noted) (Note 1)			0.5 SLPM	2.0 SLPM (N_2 or Helium)	5.0 SLPM	20 SLPM
Compatible Gases			Nitrogen/air, oxygen, argon, carbon dioxide (all models except Model MPC02-BBNHP1); Helium (Model MPC02-BBNHP1 only) - Gas must be dry, clean and oil-free.			
Control	Rangeability (Control Range) (Refer to Table 1)		25:1 (4-100% full scale [FS])		50:1 (2-100% FS)	
	Response Time		1.0 second to within ±2% FS of setpoint (typical)			
	Accuracy		±2% FS (at 20°C and 30 PSIG)			
	Repeatability		±1% FS			
	Temperature Coefficient		±0.1% FS/°C (±0.056% FS/°F)			
	Pressure Coefficient (Per 14.5 PSI)	Flow ≥40% FS	0.7% FS	0.4% FS	0.2% FS	0.2% FS
		Flow ≥10% FS Flow <40% FS	1.2% FS	0.7% FS	0.3% FS	
		Flow <10% FS	2% FS	1.2% FS	0.5% FS	
Pressure	Minimum Differential Pressure (Note 3)		7 PSIG	7 PSIG	14.5 PSIG	22 PSIG
	Maximum Differential Pressure (Note 4)		40 PSIG			
	Calibration Pressure (Note 2)		30 PSIG (Inlet pressure: 30 PSIG and outlet pressure: 0 PSIG)			
	Maximum Operating Pressure		75 PSIG			
Temperature	Calibration Temperature (Note 2)		20°C			
	Operating Temperature Range		-10 to 50°C (14 to 122°F)			
	Storage Temperature Range		-10 to 60°C (14 to 140°F)			
Humidity	Operating Humidity Range		10 to 90% Relative Humidity (non-condensing)			
Setpoint	Setpoint Input		Keypad Operation or External Setpoint Voltage Input			
	Resolution		Refer to Table 1			
	Setpoint Input Voltage		0 to 5 Vdc or 1 to 5 Vdc (selectable)			
Flow Rate Indication	Display Type		7-segment LED; 8 digits (Instantaneous flow rate display: 4 digits; Setpoint flow rate display: 4 digits)			
	Display Resolution		Refer to Table 1			
	Indication Accuracy		±2% FS ±1 digit			
Totalizer Function	Display Range		0.00 to 999,999.99L	0.0 to 9,999,999.9L	0.0 to 9,999,999.9L	0 to 99,999,999L
	Display Resolution		0.01L	0.1L	0.1L	1L
	Totalizer Backup Timing		Every 5L count	Every 20L count	Every 50L count	Every 200L count
			Every hour (time) from the previous backup			
Flow Rate Output	Output Scale		0 to full scale flow rate (scaling selectable)			
	Output Signal Voltage		0 to 5 Vdc or 1 to 5 Vdc (selectable)			
	Maximum Output Signal Voltage		7 Vdc maximum (maximum output signal when flow rate exceeds maximum flow capacity)			
	Accuracy		±0.5% FS (Input impedance of the connected device must be 100k ohms or greater). Overall output accuracy: Indication accuracy ±0.5% FS			
Event Output	Number of Outputs		2			
	Output Rating		30 Vdc, 15 mAdc maximum (Open collector non-isolated output)			
	Totalizer Pulse Output Width		100 ms (±10%) (when totalizer pulse output is selected)			
	Totalizer Pulse Output Rate		0.01L/pulse	0.1L/pulse	0.1L/pulse	1L/pulse

PRODUCT SPECIFICATIONS (continued)

External Contact Input	Number of Inputs	2
	Input Type	Potential-free contact or open collector
	Contact OFF Terminal Voltage	2.0 Vdc (±0.5Vdc)
	Contact ON Terminal Current	Approx. 0.5 mAdc (contact current)
	Allowable ON Contact Resistance	250 ohms maximum
	Allowable OFF Contact Resistance	100k ohms minimum
	Allowable ON Residual Voltage	1.0 Vdc maximum (with open collector)
	Allowable OFF Leakage Current	50 μAdc maximum (with open collector)
Communication	System (Note 5)	Loader communication (dedicated cable required)
	Transmission Speed	19200 bps
Power Supply Requirements		24 Vdc (±5%); current consumption 300 mAdc maximum
Materials of Construction		Brass (nickel-plated), stainless steel, Teflon®, Viton®
Process Connections		1/8" FNPT
Mounting Orientation		Housing horizontal with inlet & outlet ports vertically oriented ('IN' - bottom & 'OUT' - top)
Weight (Approximate)		10.6 oz. (300 grams)
Applicable Standard		CENELEC # EN61326: 1997; Amendment A1: 1998; Amendment A2: 2000
Accessory Components (Included With Every MFC)		Mounting bracket and mating electrical connector

Note 1: SLPM indicates the volumetric flow corrected to 20°C and 1 atmosphere (14.7 PSIA). The reference temperature can also be changed to 0°C, 25°C and 35°C. The controllable flow range varies according to the gas type. Refer to Table 1.

Note 2: Temperature and pressure during calibration.

Note 3: Differential pressure required for obtaining maximum flow capacity.

Note 4: Operation is possible with less than required minimum differential pressure, however, rangeability (control range) decreases.

Note 5: Loader communications package (available separately) is required.

TABLE 1 – FLOW RANGES

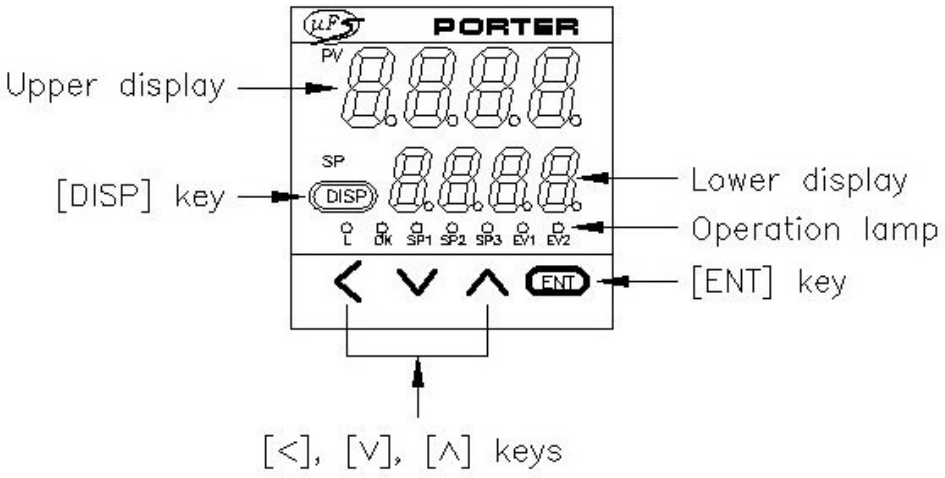
	MPC95		MPC02		MPC05		MPC20	
	Flow Range (SLPM)	Setpoint/ Display Resolution (SLPM)	Flow Range (SLPM)	Setpoint/ Display Resolution (SLPM)	Flow Range (SLPM)	Setpoint/ Display Resolution (SLPM)	Flow Range (SLPM)	Setpoint/ Display Resolution (SLPM)
Nitrogen /Air	0.020 to 0.500	0.002	0.08 to 2.00	0.01	0.10 to 5.00	0.02	0.4 to 20.0	0.1
Oxygen								
Argon								
Carbon Dioxide	0.012 to 0.300	0.001	0.040 to 1.200	0.005	0.06 to 3.00	0.01	0.3 to 16.0	0.1
Helium	Not Applicable	Not Applicable	0.08 to 2.00	0.01	Not Applicable	Not Applicable	Not Applicable	Not Applicable

Teflon® - E.I. DuPont de Nemours & Co.
Viton® - DuPont Dow Elastomers L.L.C.

Specifications and dimensions subject to change

SECTION 3 – DISPLAY TERMS AND FUNCTIONS

DISPLAY (FRONT VIEW)



DEFINITION OF TERMS

- **SP** (Setpoint): Set flow rate value.
- **PV** (Process Variable): Instantaneous flow rate value (i.e. controlled flow rate).
- Operation mode: Three (3) modes of 'Valve Fully Closed'/'Valve Control'/'Valve Fully Open'.

FUNCTIONS

UPPER DISPLAY

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

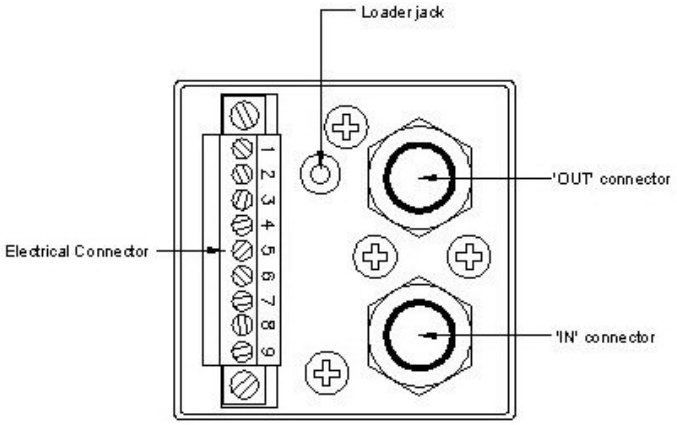
LOWER DISPLAY

- Displays the set flow rate value (7-segment display).
- When the display is switched, also displays the operation mode, totalized flow rate value (lower 4 digits), valve drive output, parameter setup values or function setup values.

OPERATION LAMP

- '**L**': Indicates the totalized flow rate is displayed. Blinks when a totalization event occurs.
- '**OK**': Lights when the controlled flow rate is within the "setting value ± allowable range". Blinks when the operating mode is 'Valve Fully Open'.
- '**SP1**' to '**SP3**': The lamp corresponding to the **SP** number that is used at multi-setting is lit.
- '**EV1**' & '**EV2**': Lights when the event output is ON.
- [**DISP**] key: Used when switching the details of the display.
- [<], [∨] & [∧] 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. This key may also be used for the totalized flow rate resetting and alarm resetting.

REAR VIEW



LOADER JACK: The connection of a dedicated loader cable (available separately) to the loader jack on the rear of the MFC enables direct communication with a personal computer.

'IN' CONNECTOR: 1/8" FNPT inlet connector.

'OUT' CONNECTOR: 1/8" FNPT outlet connector.

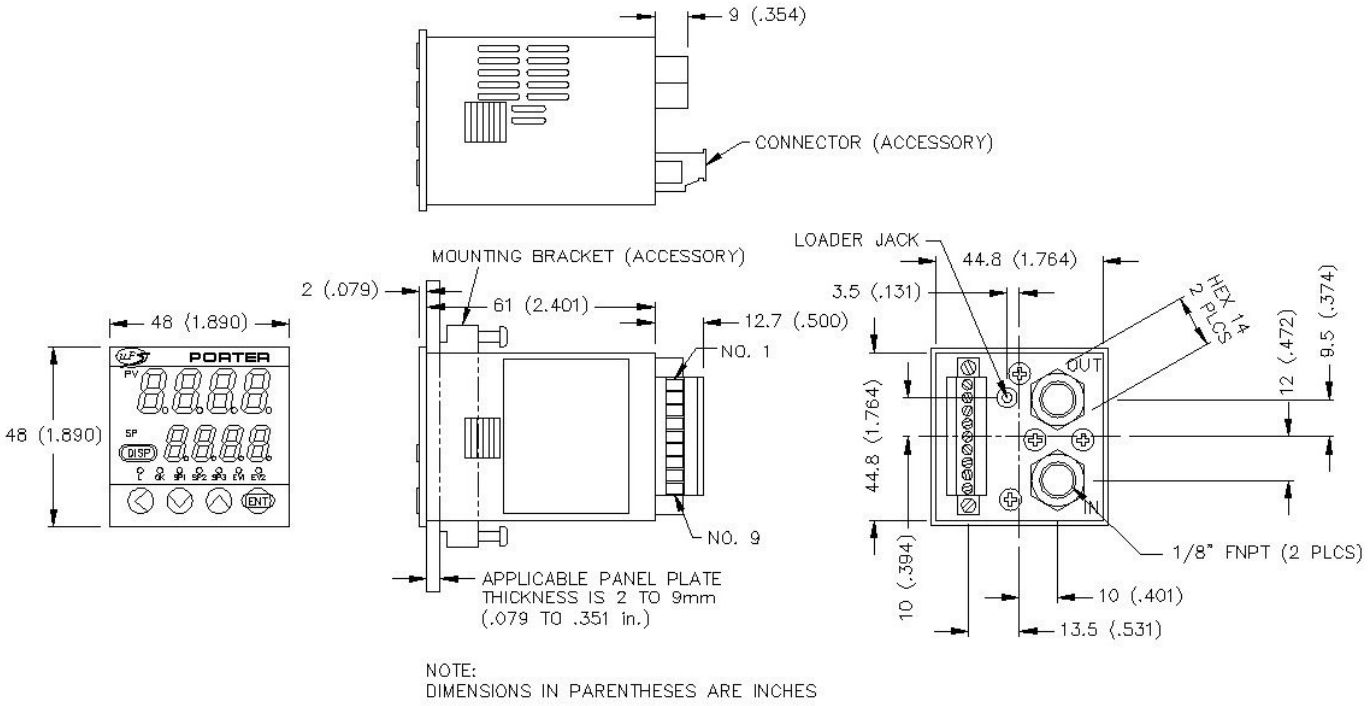
SECTION 4 – MOUNTING AND WIRING

LOCATION

Avoid mounting the MPC Series Panel Mount MFC in locations subject to:

- High and low temperature and humidity.
- Sudden changes in temperature and condensation.
- Corrosive and/or flammable gas-containing environments.
- Environments containing high amounts of dirt, dust, salt, conductive substances (e.g. metal particles, water, oil mist, etc.) and organic solvents.
- Mechanical shock or vibration.
- Direct sunlight or precipitation.
- Splashing of oil or chemicals.
- Sources of electrical interference and magnetic fields.

DIMENSIONAL DATA

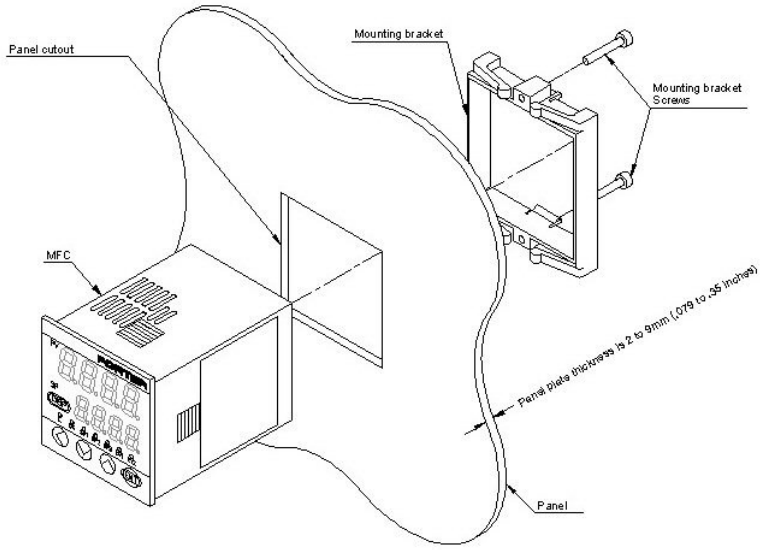


MOUNTING PROCEDURE

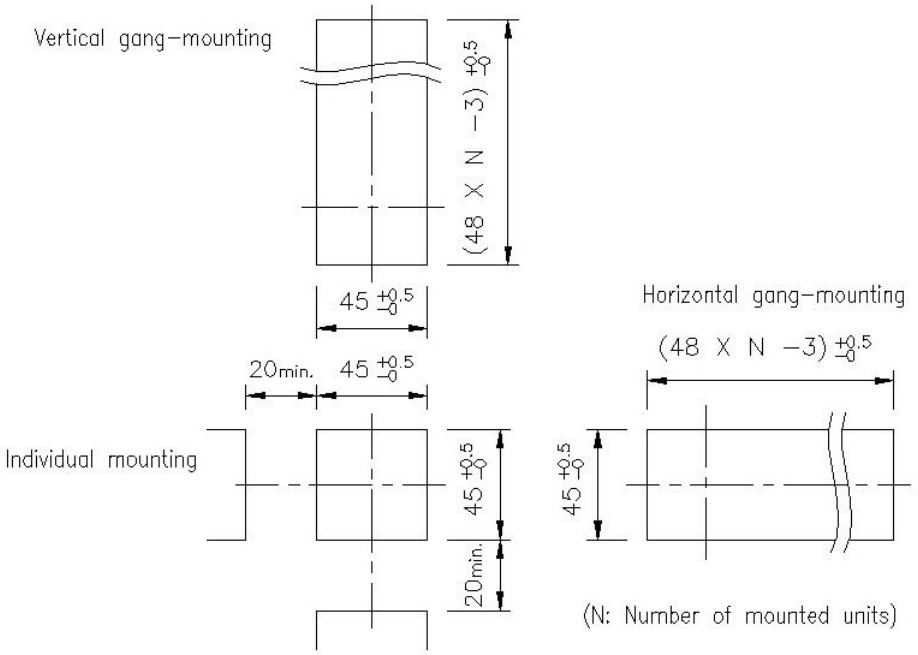
PROCESS CONNECTION INSTALLATION

- While installing the inlet and outlet process connections to the inlet and outlet 1/8" FNPT connectors, do not hold the housing of the MPC Series Panel Mount MFC. Doing so may damage the MFC.
- Inspect the process connections for any dirt or particulate matter. Apply an appropriate amount of thread sealant to the 1/8" MNPT threads of both process connections.
- Using a 14 mm wrench to secure the inlet and outlet 1/8" FNPT connectors and an appropriate size wrench for the process connections, install each process connection according to the applicable process connection manufacturer's specific recommendations regarding installation and tightening. Overtightening the process connections will damage the 1/8" FNPT connectors.

PANEL MOUNTING



- To panel-mount the MPC Series Panel Mount MFC, the panel thickness must be 2 to 9 mm (.079 to .35") and a panel cut-out be made to accommodate the MFC's 44.8 x 44.8 mm (1.764 x 1.764") housing. To panel-mount multiple MFC's, refer to the panel cutout dimensions below.
- Remove the mounting bracket from the MFC's housing.
- From the front of the panel, insert the MFC through the panel cutout until the MFC's bezel rests against the front of the panel.
- With the mounting bracket screws oriented vertically (i.e. 6 o'clock and 12 o'clock), slide the mounting bracket onto the MFC's housing and up against the back of the panel.
- Fasten the MFC onto the panel by tightening the mounting bracket screws. Tighten the screws an additional half turn when there is no space between the mounting bracket and panel. Overtightening the screws may damage the MFC's housing.



TUBING CONNECTION

- When the MPC Series Panel Mount MFC is panel-mounted, use tubing that does not stress the MFC housing. If metal piping is directly connected to the 1/8" FNPT connector of the MFC, the MFC should not be panel-mounted.
- Connect the tubing to ensure the gas flows in the direction from 'IN' to 'OUT' as indicated on the housing.
- After connecting the tubing, check for any gas leaks. While performing the leak check, exercise caution to avoid spillage or contact of the leak detection fluid to the housing, electrical wiring or mating electrical connector. If fluid contact occurs, MFC malfunction or faulty operation may occur.

EXTERNAL ELECTRICAL CONNECTIONS

Prior to wiring, confirm:

- Power supply source is off prior to wiring connection.
- Wiring is correct prior to introducing power.
- The event output does not exceed the specified output rating of the MFC. When driving a relay, use a relay with a built-in diode for coil surge suppression.

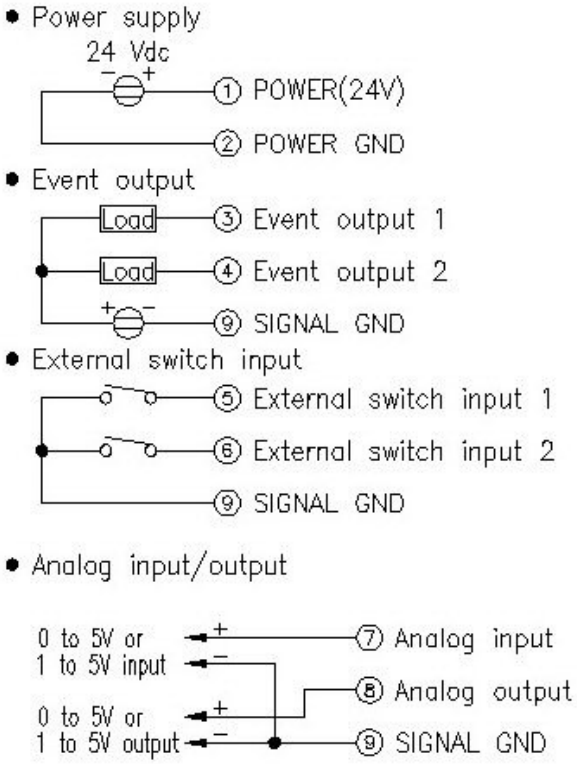
ELECTRICAL CONNECTOR SPECIFICATIONS

- Part No.: MCVW1.5/9-STF-3.5 (Phoenix Contact Mfg.)
- Wire type: Either of single core wire or stranded wire applicable.
- Compatible cable: 0.08 to 1.5mm^2 (SWF=28 to =16)
- Appropriate length of stripped wire: 7mm
- Compatible screw driver: Tip size 2.5 x 0.4mm (a flat-head driver)

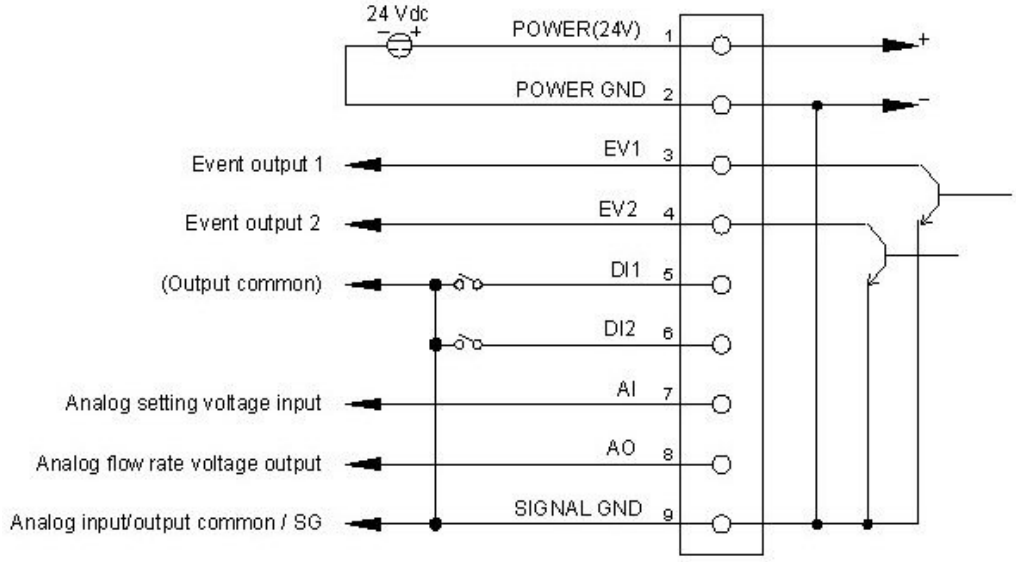
INPUT/OUTPUT DESIGNATIONS

PIN NUMBER	NAME/FUNCTION	DESCRIPTION	COMMENTS
1	POWER (24V)	Power (+24 Vdc)	
2	POWER GND	Power supply ground	
3	EV1	Event output 1	Open collector non-isolated output
4	EV2	Event output 2	
5	DI1	External switch input 1	Switching input (OPEN/GND)
6	DI2	External switch input 2	
7	AI	Analog setpoint voltage input	0 to 5 Vdc or 1 to 5 Vdc (selectable)
8	A0	Analog flow rate voltage output	
9	SIGNAL GND	Signal ground	Input/output signal common. Signal ground is connected with power supply ground within MFC.

WIRING



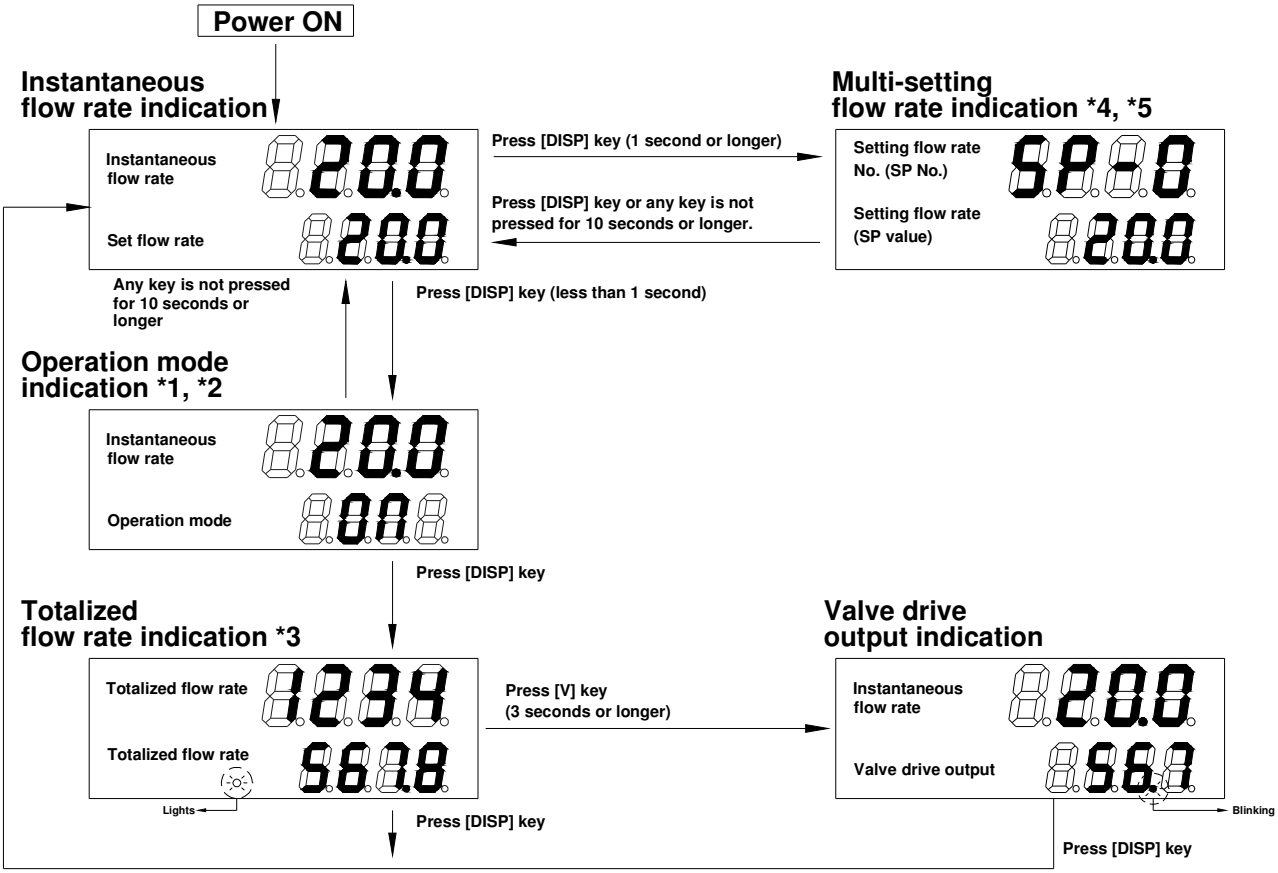
TYPICAL WIRING



SECTION 5 – BASIC OPERATION

SWITCHING DISPLAYS

Each press of the [**DISP**] key switches the display as shown in the example 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 *'C-02'* in the function setup.

*2: If no operation is made while the operation mode is displayed, the display is automatically returned to the instantaneous flow rate indication after approximately ten (10) seconds.

*3: When the [**ENT**] key is pressed for three (3) seconds or longer while the totalized flow rate is displayed, the totalized flow rate is reset.

*4: The multi-setting flow rate is displayed only when the multi-setting (1 to 3) is selected at flow rate setup number selection *'C-04'* in the function setup. For details on function setup method, refer to 'SECTION 6 – APPLICATION OPERATION'.

*5: If no setting change is made while the multi-setting flow rate is displayed, the display will automatically return to the instantaneous flow rate indication after approximately ten (10) seconds.

INSTANTANEOUS FLOW RATE DISPLAY (SETTING FLOW RATE DISPLAY)

When power is turned ON, the instantaneous flow rate value is indicated on the upper display and the setting flow rate value is indicated on the lower display. Please note the number of effective digits displayed differs according to the MFC's maximum flow.

The operating mode is also indicated on the upper display when the operating mode is changed. For details, refer to 'SECTION 5 – SELECTING THE OPERATING MODE'.

OPERATING MODE DISPLAY (INSTANTANEOUS FLOW RATE DISPLAY)

When the [**DISP**] key is pressed (for less than 1 second) while the instantaneous flow rate is displayed (the display at power ON), the upper display maintains the instantaneous flow rate and the lower display shows the operation mode, enabling the selection of the operation mode. The table below shows the lower display contents for each operation mode.

For details regarding operating mode selection, refer to 'SECTION 5 – SELECTING THE OPERATING MODE'.

If no operation is made while the operation mode is displayed, the display will automatically return to the instantaneous flow rate indication after approximately ten (10) seconds

OPERATION MODE	LOWER DISPLAY
Fully closed mode	*'**OFF**'*
Control mode	*'**ON**'*
Fully open mode	*'**FULL**'*

INTEGRATED FLOW RATE DISPLAY

When the [**DISP**] key is pressed while the operation mode is displayed, the '**L**' lamp lights and the totalized flow rate value is indicated on the upper display and lower display. For example, if the totalized flow rate is 1,234,567.8L, the "1234" is indicated on the upper display and the "567.8" is indicated on the lower display.

To reset the totalized flow rate, depress the [**ENT**] key for three (3) seconds or longer while the totalized flow rate is displayed.

VALVE DRIVE OUTPUT DISPLAY (INSTANTANEOUS FLOW RATE DISPLAY)

When the [v] key is depressed for three (3) seconds or longer while the totalized flow rate is displayed, the valve drive output value (indication range: 0.0 to 100.0%) is indicated on the lower display while the instantaneous flow rate is indicated on the upper display.
To differentiate the valve drive output display from other indication, the decimal point indication blinks while the valve drive output is displayed.

MULTI-SETTING FLOW RATE DISPLAY (ONLY WHEN THE MULTI-SETTING IS ENABLED)

When the [**DISP**] key is depressed for one (1) second or longer while the instantaneous flow rate is displayed, the setpoint flow rate number (**SP** number) currently being selected is indicated on the upper display and the setpoint flow rate value (**SP** value) is indicated on the lower display. If no key is pressed within ten (10) seconds while the multi-setting flow rate is displayed, indication is automatically returned to the instantaneous flow rate display.

SETTING THE FLOW RATE

PROCEDURE FOR CHANGING FLOW RATE IN DIGITAL SETTING

Single SP (Setpoint) Setting Mode (Single Setpoint Per Function Setup *'C-04'*)

Follow the procedure below to change the **SP** (setpoint) value (set flow rate):

1. Press the [**DISP**] key (the instantaneous flow rate and **SP** values are displayed [display at power supply ON]).
2. Press the [∧] key or [∨] key to change the **SP** value (the digit being changed blinks. Also, when the [<] key is pressed, the digit being changed is moved.).
3. When you have reached the desired value, press the [**ENT**] key (the **SP** value is stored). If the [**DISP**] key is pressed without pressing the [**ENT**] key, the **SP** value is not stored and returns to the previous value.

Note: By changing the function setup, the multi-setting (4 maximum) or analog voltage setting may be selected.

Direct Setup Function

Flow control can be achieved using the **SP** value currently being changed (indicated by blinking display) when the direct setup function is enabled at function setup ***'C-21'*** (the direct setup function is enabled as the default setting). For instructions to change the function setup modes, refer to 'SECTION 6 – APPLICATION OPERATION'.

The [**ENT**] key does not to be pressed to establish the **SP** value. However, to switch the display by pressing the [**DISP**] key, press the [**ENT**] key to establish the **SP** value prior to switching the display. This function is useful when performing incremental changes to the **SP** value.

Multi-SP (Setpoint) Setting Mode (Multiple Setpoints Per Function Setup *'C-04'*)

Up to four (4) **SP** (setpoint) values (setting flow rate values) can be programmed by key operation or by external switch inputs.

To program by key operation, follow the procedure below to change to **SP** number and **SP** value:

1. Press the [**DISP**] key (the instantaneous flow rate value and **SP** value are displayed [display at power supply ON]).
2. Press the [**DISP**] key for one (1) second or longer (the **SP** number currently being selected [***SP-0***, ***SP-1***, ***SP-2*** or ***SP-3***] is indicated on the upper display and the **SP** value is indicated on the lower display).
3. Press the [∧] key or [∨] key to change the **SP** number.
4. When the desired **SP** number is displayed, press the [**ENT**] key.
5. Press the [∧] key or [∨] key to change the **SP** value (the digit being changed blinks; move to the digit to be changed by pressing the [<] key).
6. When the desired **SP** value is displayed, press the [**ENT**] key (the **SP** value is programmed). Both the **SP** value and **SP** number are now updated.

Direct Setup Function

Flow control can be achieved using the **SP** value currently being changed (indicated by blinking display) when the direct setup function is enabled at function setup ***'C-21'*** (the direct setup function is enabled as the default setting). For instructions to change the function setup modes, refer to 'SECTION 6 – APPLICATION OPERATION'.

The [**ENT**] key does not need to be pressed to establish the **SP** value. However, to switch the display by pressing the [**DISP**] key, press the [**ENT**] key to establish the **SP** value prior to

switching the display. This function is useful when performing incremental changes to the **SP** value.

As shown in the following table, up to four (4) **SP** values can be switched according to the ON/OFF status of the external switch inputs when the '3: Switching of SP No.' is selected at the external switch input function assignments '***C-10***' and '***C-11***' in the function setup. If the number of **SP** values is two (2), set either one of '***C-10***' or '***C-11***' to '3: Switching of SP No'. However, in this situation, the **SP** number cannot be updated using the [∧] key or [∨] key. Only the **SP** value can be updated.

EXTERNAL SWITCH INPUT STATUS		**SP NUMBER BEING SELECTED**
INPUT 1 (DI1)	**INPUT 2 (DI2)**	
OFF	OFF	SP-0
ON	OFF	SP-1
OFF	ON	SP-2
ON	ON	SP-3

Notes:

1. *If the [**DISP**] key is pressed during the setup operation while the setpoint is blinking, the **SP** number and **SP** value cannot be stored and are returned to the previous value.*
2. *When '1: Analog Setup' is selected at the function setup '**C-03**' and the **SP** value is established via the analog setting voltage, the **SP** number and **SP** value cannot be changed using the [∧] key or [∨] key.*
3. *If no key is pressed within ten (10) seconds while the multi-setting flow rate is displayed, indication is automatically returned to the instantaneous flow rate display.*

PROCEDURE FOR CHANGING FLOW RATE IN ANALOG SETTING

To change the **SP** value using an external setpoint voltage, confirm '1: Analog Setup' is selected at the function setup '***C-03***' (the analog setup function is disabled as the default setting). For instructions to change the function setup modes, refer to 'SECTION 6 – APPLICATION OPERATION'.

The setpoint voltage range is selected at the function setup '***C-05***'. The analog setpoint voltage value to the **SP** value can be calculated from the calculation formulas in the following table:

'C-05'	**VOLTAGE RANGE**	**HOW TO CALCULATE SETPOINT VOLTAGE**
0	0 to 5 Vdc	Setting Voltage [V]= Setting Flow Rate÷Full-Scale Flow Rate X 5.00
1	1 to 5 Vdc	Setting Voltage [V]= Setting Flow Rate÷Full-Scale Flow Rate X 4.00+ 1.00

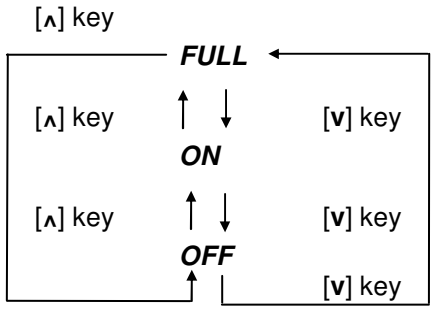
Notes:

1. *When '1: Function enabled' is selected at the function setup '**C-28**', the full-scale flow rate can be set. Both the full-scale flow rate output voltage (**PV** output voltage) and the setpoint input voltage are changed. The scaling flow rate is set in the parameter setup mode. For instructions to change the function setup and parameter setup modes, refer to 'SECTION 6 – APPLICATION OPERATION'.*
2. *Do not supply a negative setpoint voltage or a setpoint voltage greater than 5 Vdc to the MFC. Doing so may cause MFC malfunction or faulty operation.*

SELECTING THE OPERATION MODE

When the [**DISP**] key is pressed (for less than 1 second) while the instantaneous flow rate is displayed (the display at power ON), the upper display maintains the instantaneous flow rate indication and the lower display shows the operation mode, enabling the selection of the 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 [∨] key (the display is changed as shown below). Select the desired operation mode (display blinks).
3. Press the [**ENT**] key to select the desired operating mode.



FULL: Fully open mode

ON: Control mode

OFF: Fully closed mode

If no operation is made while the operation mode is displayed, the display will automatically return to the instantaneous flow rate indication after approximately ten (10) seconds.

Notes:

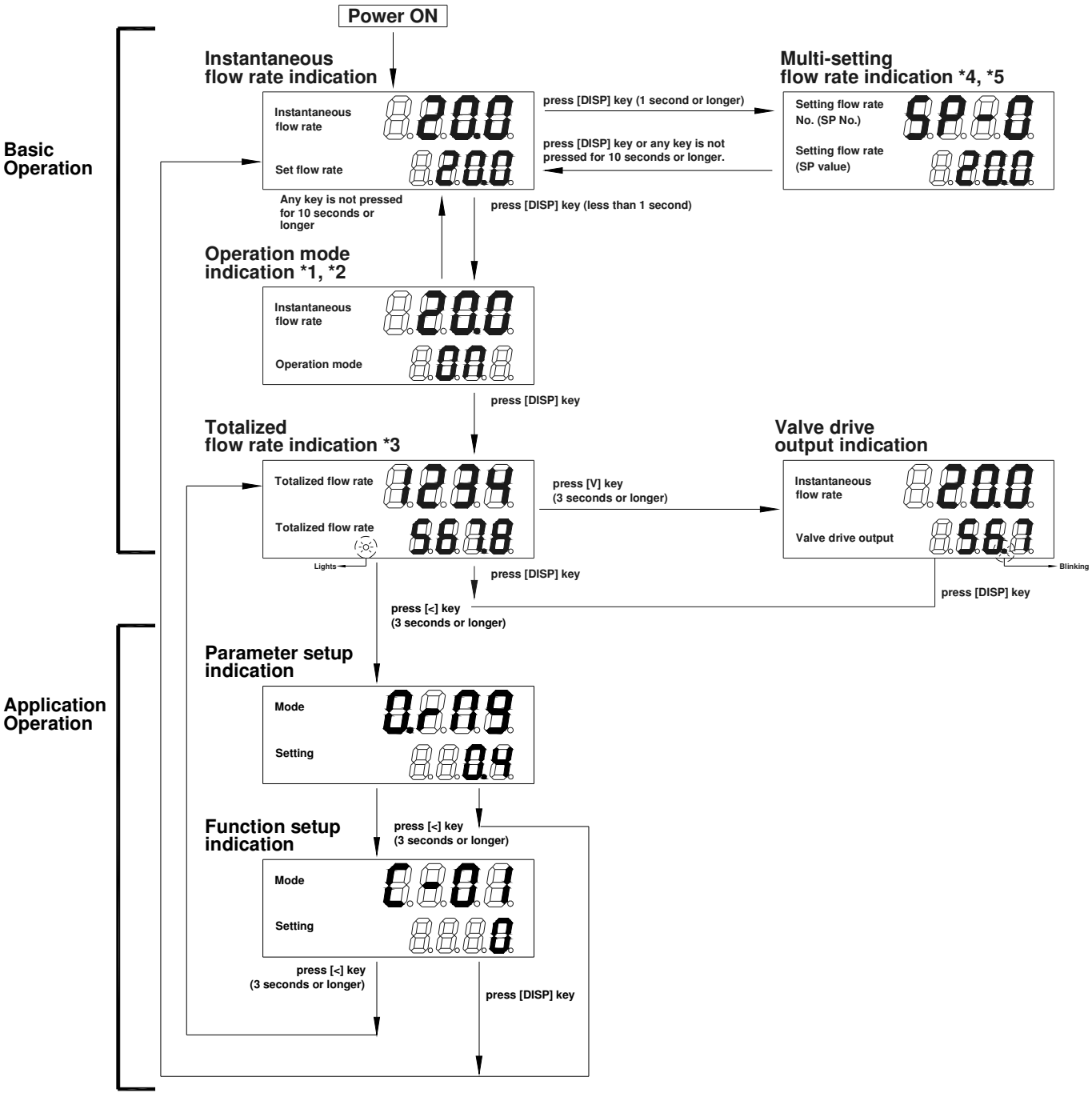
1. *By changing the function setup, the operation mode selection can be made by an external switch input*
2. *When '0: Operating mode selection by key operation is disabled' is selected at the function setup '**C-02**', the operating mode is not displayed even if the [**DISP**] key is pressed.*
3. *When the [**DISP**] key is pressed while the display is flashing (step 2 of "Selecting the Operating Mode" procedure above) the operating mode selection is cancelled.*
4. *When '5: Valve fully closed', '6: Valve fully open', or '8: Switching of operating mode – Contact ON: control mode; Contact OFF: fully closed mode' is selected at function setup '**C-10**' and '**C-11**', the operating mode selection (valve fully closed/valve fully open) by the ON/OFF operation of external switch inputs can be performed.*
5. *For instructions to change the function setup mode, refer to 'SECTION 6 – APPLICATION OPERATION'*
6. *When each operation mode is entered, even while the instantaneous flow rate is displayed, the operation mode is indicated on the upper display as shown below. The '**OK**' lamp blinks in fully open mode.*

Following is a table of operation mode displays while the instantaneous flow rate is displayed:

OPERATING MODE	**UPPER DISPLAY**	**'OK' LAMP**	**REMARKS**
Fully closed mode	***OFF***	Off	'***OFF***' is displayed at all times after zero flow rate is confirmed.
Control mode	***ON***	On or Off	'***ON***' is displayed for one (1) second when the control mode is entered
Fully open mode	***FULL***	Blinking	'***FULL***' is displayed for one (1) second when the fully open mode is entered

SECTION 6 – APPLICATION OPERATION

When the following operation is performed while the totalized flow rate is displayed, the parameter setup mode and function setup mode are entered and each setting value can be changed.



FUNCTION SETUP

Follow the procedure below to set the functions such as event output type and external switch input assignments:

1. After introducing power to the MFC, press the [**DISP**] key twice (2x) to display the totalized flow rate ('**L**' lamp lights).
2. Press the [<] key for three (3) seconds or longer (the upper display indicates *'**0.r**∩**9**'* [parameter setup mode]).
3. Again, press the [<] key for three (3) seconds or longer (the upper display indicates the function setup item number *'**C-01**'* [function setup mode]).
4. Press either the [∧] or [∨] key until the desired setup item number is indicated.
5. Press the [**ENT**] key (the present setting value indicated on the lower display blinks).
6. Press either the [∧] or [∨] key to select the desired setting value. Press the [**ENT**] key to store the selected value. If the [**DISP**] key is pressed prior to pressing the [**ENT**] key, the setting value remains at the previous value without being updated.
7. Repeat steps 4, 5 and 6 for any setup item requiring programming. Once setup items are completed, proceed to step 8.
8. Press the [**DISP**] key to return to the instantaneous flow rate display, the display shown after introducing power.

Note: If no operation is performed for one (1) minute after entering the function setup mode, the display automatically returns to the instantaneous flow rate display.

FUNCTION SETUP ITEM LIST

Display	Function Description	Setup Options and Descriptions	Factory Setting	Remarks
C-01	Key lock	0: Unlocked 1: Settings other than flow rate setting are locked 2: All settings locked	0	The key lock can be canceled even while it is enabled. '***LoC***' is indicated on the display during the key-locked setting.
C-02	Operating mode selection (selection by key operation)	0: Operating mode selection by key operation is disabled. 1: Operating mode selection by key operation is enabled.	1	The selection of whether operating mode selection by key operation (fully closed/control/fully open) is "enabled" or "disabled" is available. Refer to instructions for "Selecting the Operating Mode".
C-03	Instantaneous flow rate setup method (instantaneous **SP** setup method selection)	0: Digital setup (set by key operation) 1: Analog setup (set by external analog voltage input)	0	When '4: Switching of flow rate setup method' is selected at the external switch input function assignment '***C-10***' or '***C-11***', the switching by external switch input takes precedence.
C-04	Selection of total number of instantaneous flow rate setups (selection of total number of **SP** values)	0: Number of **SP** values = 1 (***SP-0*** only) 1: Number of **SP** values = 2 (***SP-0*** and ***SP-1***) 2: Number of **SP** values = 3 (***SP-0***, ***SP-1*** and ***SP-2***) 3: Number of **SP** values = 4 (***SP-0***, ***SP-1***, ***SP-2*** and ***SP-3***)	0	
C-05	Setpoint input voltage range selection, at analog setting (analog **SP** input range selection)	0: 0 to 5 Vdc input 1: 1 to 5 Vdc input	0	

FUNCTION SETUP ITEM LIST (continued)

Display	Function Description	Setup Options and Descriptions	Factory Setting	Remarks
C-06	Flow rate output voltage range selection (analog **PV** output range selection)	0: 0 to 5 Vdc output 1: 1 to 5 Vdc output	0	
C-07	Event output 1 type assignment	0: Not used (OFF at all times) 1: ON when alarm activated 2: Totalization pulse output 3: On when **PV** is in flow rate OK judgment range 4: ON in control mode 5: ON in fully open mode 6: ON in control mode or fully open mode 7: ON in fully closed mode 8: Instantaneous **PV** upper limit event 9: Instantaneous **PV** lower limit event 1 10: Instantaneous **PV** lower limit event 2 11: Integrated flow rate event -1 through -11: Reverse output of 1 to 11 (At no events: ON; at event occurred: OFF)	0	Flow rate OK judgment range, upper/lower limit event flow rate, totalized event flow rate and event output delay time are set in the parameter setup mode. See "Parameter Setup" for details. Note the delay time cannot be set to totalization pulse output. 9: Events are output even in fully closed operation mode. 10: Events are not output in fully closed operation mode. -1 through -11: Always OFF during power supply OFF.
C-08	Event output 2 type assignment		0	
C-10	External switch input 1 function assignment	0: Not used 1: Reset totalization 2: Stop totalization count operation 3: Switching of **SP** number 4: Switching of flow rate setup method 5: Valve fully closed 6: Valve fully open 7: Switching of slow start operation 8: Switching of operating mode: Contact ON: control mode Contact OFF: fully closed mode	0	3: To select three (3) or more **SP** settings, assign "3" to both '***C–10***' and '***C–11***'. 4: The '***C-03***' (analog/digital) setting is reversed when the contact is ON. 7: "Slow start enabled" must be selected in '***C-17***'. 5, 6, 8: When the valve fully closed input and the valve fully open input are put in at the same time by two contacts, the both inputs are disabled.
C-11	External switch input 2 function assignment		0	
C-13	Valve automatic shut-off when the totalization event occurred	0: Function disabled 1: Function enabled	0	When the totalized count value reaches the totalized event setting value, the valve is fully closed.
C-14	Resetting the totalized value at start of control	0: Function disabled 1: Function enabled	0	When control is resumed from the fully closed mode, the totalized value is automatically reset.
C-15	Flow rate alarm setup type	0: Not used 1: Only upper limit alarm used 2: Only lower limit alarm used 3: Upper/lower limit alarm used	3	Set the alarm flow rate in the parameter setup mode. See "Parameter Setup" for details.

FUNCTION SETUP ITEM LIST (continued)

Display	Function Description	Setup Options and Descriptions	Factory Setting	Remarks
C-16	Operation selection at alarm occurrence	0: Control continued (alarm ignored) 1: Move to fully closed 2: Move to fully open	0	Alarm output turns ON even if "0" is selected
C-17	Slow start setup	0: Slow start disabled 1 to 8: Slow start enabled (equivalent to approximately 1 to 6 seconds settling time)	0	Slow start is enabled when the external contact input turns ON. For slow start operation, switching is selected at '***C-10***' and '***C-11***'.
C-18	Gas type selection	0. Conversion factor for each gas type set by the user (all models) 1. Air, nitrogen* 2. Oxygen* 3. Argon* 4. Carbon dioxide (CO_2)* 10. Helium (Model MPC02-BBNHP1 only)	2*	If the flow rate range changes due to a change in the gas type, the flow rate OK range and flow rate alarm range in the parameter setup must be changed. When "0" is selected, set the conversion factor in the parameter setup mode. *All models except Model MPC02-BBNHP1. Factory setting for Model MPC02-BBNHP1 is "10".
C-19	Flow rate display	0: Referenced to 20°C (68°F) and 1 atmosphere 1: Referenced to 0° C (32°F) and 1 atmosphere 2: Referenced to 25°C (77°F) and 1 atmosphere 3: Referenced to 35°C (95°F) and 1 atmosphere	0	
C-20	Inlet pressure adjustment	0: 0-0.1 MPa (0-14.5 PSIG) 1: 0.05-0.15 MPa (7.25-21.8 PSIG) 2: 0.15-0.25 MPa (21.8-36.3 PSIG) 3: 0.25-0.35 MPa (36.3-50.8 PSIG) 4: 0.35-0.45 MPa (50.8-65.3 PSIG) 5: 0.45-0.5 MPa (65.3-72.5 PSIG)	2	The accuracy drift caused by the influence of pressure can be compensated by adjusting the inlet pressure setting to the actual inlet pressure.
C-21	Instantaneous flow rate direct setup function switching	0: Function disabled 1: Function enabled	1	Can be controlled by instantaneous **SP** being changed (blinking)
C-23	**PV** filter	0: Without filter 1: Sampling two (2) times moving-average 2: Sampling four (4) times moving-average 3: Sampling eight (8) times moving-average	0	If the **PV** filter is used in a "2" or "3" setting, the operational differential pressure must be lower than the standard differential pressure. Do not change the setting under the control.
C-28	Analog optional scaling function	0: Function disabled 1: Function enabled	0	The maximum flow rate can be optionally set. The flow rate is set in the parameter setup mode. Refer to parameter setup item # 13 for details.
C-29	**PV** forced zero function	0: Function disabled 1: Function enabled	0	When the setting flow rate is zero or when the valve fully closed mode is entered, the **PV** is forcibly made to zero after delay time. The shifting of **PV** by influence of pressure can be compensated. The delay time is set in the parameter setup mode.

PARAMETER SETUP

Follow the procedure below to set the parameters such as flow rate deviation alarm, upper and lower limit flow rate and event output delay time:

1. After introducing power to the MFC, press the [**DISP**] key twice (2X) to display the totalized flow rate ('**L**' lamp lights).
2. Press the [<] key for three (3) seconds (the upper display indicates ***'0.r∩9'*** [parameter setup mode]).
3. Press either the [∧] or [∨] key until the desired setup item number is indicated.
4. Press the [**ENT**] key (the present setting value indicated on the lower display blinks).
5. Press either the [∧] or [∨] key to select the desired setting value (move to the digit to be changed by pressing the [<] key). Press the [**ENT**] key to store the selected value. If the [**DISP**] key is pressed prior to pressing the [**ENT**] key, the setting value remains at the previous value without being updated.
6. Repeat steps 3, 4 and 5 for any setup item requiring programming. Once setup items are completed, proceed to step 7.
7. Press the [**DISP**] key to return to the instantaneous flow rate display, the display shown after introducing power.

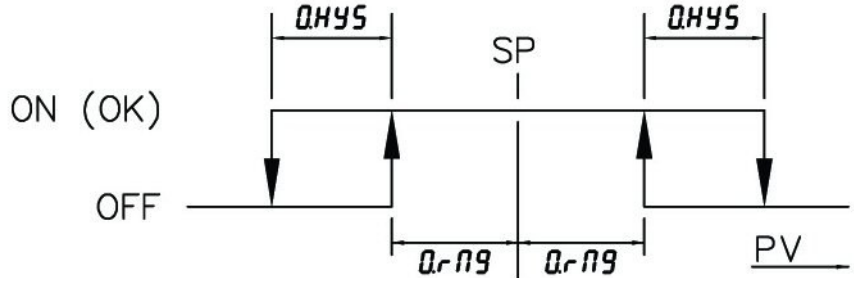
Note: If no operation is performed for one (1) minute after entering the parameter setup mode, the display automatically returns to the instantaneous flow rate display.

PARAMETER SETUP ITEM LIST

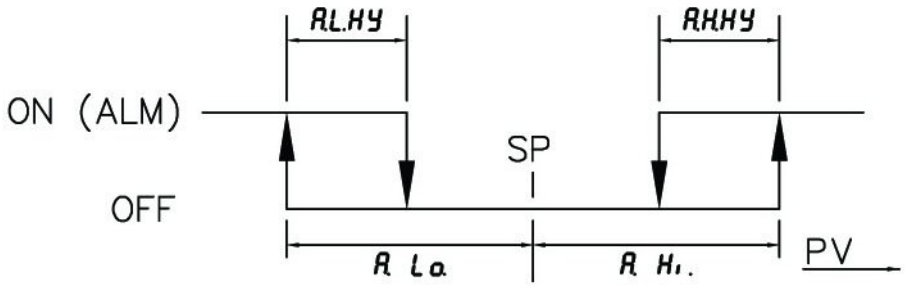
Reference No.	Display	Parameter Description	Factory Setting	Setting Range	Refer to Function Setup Item	Remarks
1	***0.r∩9*** *1	Flow rate OK judgment range	(2% FS) *10	(0.5 to 100% FS) *10	***C-07***, ***C-08***	Unit: SLPM
2	***0.HYS*** *1	Flow rate OK judgment hysteresis	(1% FS) *10	(0.5 to 100% FS) *10		
3	***A. HI*** *2, *3	Flow rate deviation upper limit alarm	(10% FS) *10	(0.5 to 100% FS) *10	***C-07***, ***C-08***, ***C-15***, ***C-16***	
4	***A.H.HY*** *2, *3	Flow rate deviation upper limit alarm hysteresis	(2% FS) *10	(0.5 to 100% FS) *10		
5	***A. Lo*** *2, *3	Flow rate deviation lower limit alarm	(10% FS) *10	(0.5 to 100% FS) *10		
6	***A.L.HY*** *2, *3	Flow rate deviation lower limit alarm hysteresis	(2% FS) *10	(0.5 to 100% FS) *10		
7	***A.dLY*** *3	Flow rate deviation alarm judgment delay time	10.0 seconds	1.0 to 999.9 seconds		
8	***E.I,dL*** *4	Event output 1 delay time	0.0 seconds	0.0 to 999.9 seconds	***C-07***, ***C-08***	Even if the delay time is set, it is disabled during selection of totalization pulse output.
9	***E.2.dL*** *4	Event output 2 delay time				
10	***C,F,*** *5	User setup conversion factor	1.000	0.100 to 9.999	***C-18***	
11	***E.1.SP*** *6	Event output 1 upper/lower limit flow rate setup	(0% FS) *10	(0 to 100% FS) *10	***C-07***, ***C-08***	Unit: SLPM
12	***E.2.SP***	Event output 2 upper/lower limit flow rate setup				
13	***A.SCL*** *7	Analog optional scaling	(100% FS) *10	(10 to 100% FS) *10	***C-28***	The maximum flow rate is set. Unit: SLPM
14	***E.A.Lo*** *8	Totalized event flow rate (lower 4 digits)	0	0 to 9999	***C-07***, ***C-08***, ***C-13***	
15	***E.A.HI*** *8	Totalized event flow rate (upper 4 digits)				
16	***P.0.dL*** *9	**PV** forced zero function	3.0 seconds	0.0 to 999.9 seconds	***C-29***	

PARAMETER SETUP ITEM LIST (continued)

*1: Operation during judgment of flow rate OK:



*2. Operation during judgment of flow rate deviation upper and lower limit alarms.



*3: This can be set only when other than '0: Not used' is selected at the flow rate alarm setup type '***C-15***' in the function setup.

*4: This can be set only when other than '0: Not used' is selected at the event output type assignment '***C-07***' and '***C-08***' in the function setup.

*5: This can be set only when '0: User setting" is selected at gas type selection '***C-18***' in the function setup.

*6: This can be set only when '8: Instantaneous **PV** upper limit event', '9: Instantaneous **PV** lower limit event 1' and '10: Instantaneous **PV** lower limit event 2' is selected for the '***C-07***' and '***C-08***' event output type assignment in the function setup.

*7: This can be set only when '1: Function enabled' is selected for the '***C-28***' analog optional scaling function in the function setup.

*8: This can be set only when '11: Integrated flow rate event' is selected at the event output type assignment '***C-07***' and '***C-08***' in the function setup or when '1: Function enabled' is selected at the valve automatic shut-off function '***C-13***'.

*9: This can be set only when '1: Function enabled' is selected at the **PV** forced zero function '***C-29***' in the function setup.

*10: The result of the factory setting and setting range becomes the flow rate obtained by multiplying the full scale flow rate by the percentage in parentheses. The factory setting and setting range vary according to the gas type.

SECTION 7 – TROUBLESHOOTING

ALARM CODE DISPLAY

When a flow rate deviation alarm occurs or when an alarm occurs during MFC self-diagnostics, the operating mode defaults to the operating mode currently selected at '***C-16***' in the function setup, 'Operation selection at alarm occurrence'. This holds true for all alarm codes except '***AL71***'.

The upper display alternately indicates the alarm codes shown in the table below and the regular display, the instantaneous flow rate display. Alarm codes are displayed only when the instantaneous flow rate, operation mode or totalized flow rate is displayed.

ALARM CODE	ERROR	POSSIBLE CAUSE	CORRECTIVE ACTION
AL01	Flow rate deviation lower limit alarm	Insufficient alarm judgment delay time. Insufficient power supply voltage. Insufficient inlet pressure, etc. or excessive operating temperature.	If none of the possible causes resolves the problem, contact factory.
AL02	Flow rate deviation upper limit alarm	Insufficient alarm judgment delay time, valve problem, sensor problem, etc.	If no problem found with delay time, contact factory.
AL71	Valve overheat prevention limit is actuated	During the control or fully-open mode, the gas is shut off for more than five (5) minutes.	If the gas is shut off for more than five (5) minutes, set the set flow rate (**SP**) to zero or valve fully-closed.
AL81	Sensor error	Sensor problem, particulate in sensor or use of helium or hydrogen gas.	Turn power off and restore power. If sensor not restored, contact factory.
AL91	I/O correction data error	Data corrupted due to electrical noise.	Contact factory.
AL92	Sensor calibration data error	Data corrupted due to electrical noise.	Contact factory.
AL93	User setup data error	Power loss during data transmission.	Reset data.

*'**AL71**'* (valve overheat prevention limit) is available only for Model MPC20. Despite the current selection at '***C-16***' in the function setup, 'Operation selection at alarm occurrence', the valve drive current is forcibly limited. If this situation occurs for thirty (30) minutes or more, the valve is fully closed.

If *'**AL81**'* (sensor error) occurs, the flow rate will be uncontrolled. This occurs even if the '***C-16***' function setup '0: Control continued (alarm ignored)' is selected.

When '1: Move to fully closed' or '2: Move to fully open' is selected at '***C-16***' in the function setup, the alarm display and the operating mode at alarm occurrence can be maintained even after the cause of alarm is removed. When canceling the alarm, perform the alarm reset operation.

Alarm Reset Operation

When the [**ENT**] key is continuously pressed while the instantaneous flow rate is displayed, the alarm will reset after three (3) seconds.

MISCELLANEOUS ERRORS

ERROR	POSSIBLE CAUSE	CORRECTIVE ACTION
Flow rate display does not reach zero (0) when actual flow stops. Display does not read *'**OFF**'* even if valve is fully closed.	▪ Zero point deviation due to pressure effect. ▪ Gas type setup is incorrect. ▪ Condensation on sensor. ▪ Particulate in sensor.	▪ Match the inlet pressure setting (function setup ***C-20***') with the actual inlet pressure used or the **PV** forced zero function (function setup *'**C-29**'*). ▪ Match the gas type setting (function setup *'**C-18**'*) with the actual gas used. ▪ Install an upstream filter. ▪ Contact factory.
Flow rate does not stabilize.	▪ Operational differential pressure range is exceeded. ▪ Excessive supply pressure fluctuations. ▪ Pressure regulator compatibility. ▪ Excessive pressure drop (excessive supply pressure fluctuations versus flow changes).	▪ Reduce the supply pressure. ▪ Install a pressure regulator to regulate supply pressure. ▪ Adjust the pressure regulator setting or apply the **PV** filter (function setup *'**C-23**'*). ▪ Increase the tubing diameter.
Poor accuracy.	▪ Temperature reference not identical to reference flowmeter. ▪ Pressure regulator is vibrating slightly. ▪ Particulate in sensor.	▪ Match the temperature reference (function setup *'**C-19**'*). ▪ Adjust the pressure regulator setting. ▪ Contact factory.

SECTION 8 – POLICIES AND CERTIFICATE OF WARRANTY

POLICIES

PRICES

All prices are F.O.B. Hatfield, PA, and subject to change without notice. All merchandise will be invoiced at prices in effect at time of shipment. Prices do not include insurance, freight, taxes or special handling. These charges, if applicable, will be shown separately on invoice. Minimum order $30.00.

PAYMENT TERMS

Net 30 days after invoice date. All invoices past due are subject to a finance charge of 1½% per month (18% annual rate).

SHIPMENTS

Shipment of merchandise shall at times be subject to credit approval and will be contingent upon fires, accidents, emergencies, acts of God or any other causes which are beyond Porter Instrument Division's control.

Specifications and dimensions subject to change.

CANCELLATIONS

No cancellations will be accepted on non-standard or special merchandise, except by payment of full purchase price. If buyer requests cancellation of any order or part thereof, and is agreed to by Porter Instrument Division's in writing, buyer will be subject to cancellation charges to cover the cost of material and/or fabrication incurred by Porter Instrument Division to date of cancellation.

CHANGES OF ORDER

A minimum of 90 days notice is required on all changes to orders and will be subject to rescheduling as a new order at Porter Instrument Division's discretion.

RETURNS

No returns will be accepted unless authorized in writing by Porter Instrument Division and accompanied by a properly completed Returned Goods Authorization. All returns are subject to restocking and possible rework charges to be determined by Porter Instrument Division.

CERTIFICATE OF WARRANTY

THIS WARRANTY IS GIVEN IN PLACE OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR OTHERWISE. NO PROMISE OR STATEMENT MADE BY ANY REPRESENTATIVE OR AUTHORIZED DEALER OF PARKER HANNIFIN CORP. SHALL CONSTITUTE A WARRANTY BY PARKER HANNIFIN CORP.

Parker Hannifin Corporation, Porter Instrument Division, warrants this equipment to be free from defects in workmanship and materials, when used in accordance with applicable specifications and with appropriate maintenance, for one (1) year from date of delivery to the customer, unless otherwise specified in writing.

Equipment which malfunctions may be returned, shipment prepaid, to Parker Hannifin Corporation, Porter Instrument Division, for test and evaluation. Equipment determined to be defective and in warranty will be repaired or replaced at no charge to the customer. Equipment out of warranty will be evaluated, and if the equipment does not meet original specifications and calibration, the customer will be notified of the costs before proceeding with repair or replacement. Repaired equipment will be warranted ninety (90) days from date of delivery to the customer or for the balance of the original warranty, whichever is longer.

Failures due to shipping damage, accident, misuse, improper mechanical or electrical installation or operation, or internal clogging or corrosion due to use of contaminated fluids or inadequate system purging are excluded from warranty coverage.

Parker Hannifin Corporation's obligation for breach of this warranty, or for negligence or otherwise, shall be strictly and exclusively limited to the repair or replacement of the equipment. This warranty shall be void as to any equipment on which the serial number, if applicable, has been altered, defaced, or removed. Parker Hannifin Corporation shall under no circumstances be liable for incidental or consequential damages.

No other promise or statement about the equipment by any representative or authorized dealer of Parker Hannifin Corporation shall constitute a warranty by Parker Hannifin Corporation or give rise to any liability or obligation of Parker Hannifin Corporation.

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