



Hydraulik - Pneumatik

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# Mass Flow Measurement and Control System

FM - 441  
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## KATALOG

**Vertrieb:**

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|----------------|------------------------------|--|

# PORTER

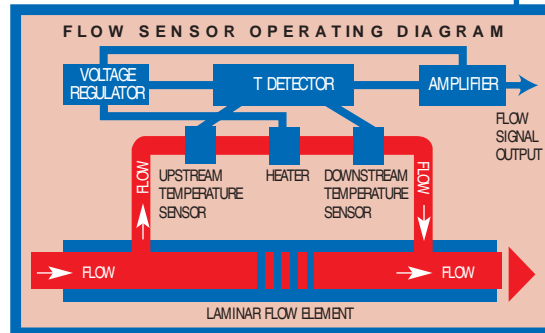
MASS FLOW MEASUREMENT AND CONTROL SYSTEMS



# PORTER:

THE STANDARD OF  
EXCELLENCE IN MASS FLOW

Porter Mass Flow products reflect nearly three decades of experience in the design and manufacture of precision instruments for the measurement and control of gas flow. They incorporate design principles that are simple and straightforward, yet flexible enough to operate under a wide variety of process parameters. The result is flowmeters, flow controllers and control valves that are accurate, reliable and cost-effective solutions for any mass flow application.



## PRINCIPLE OF OPERATION

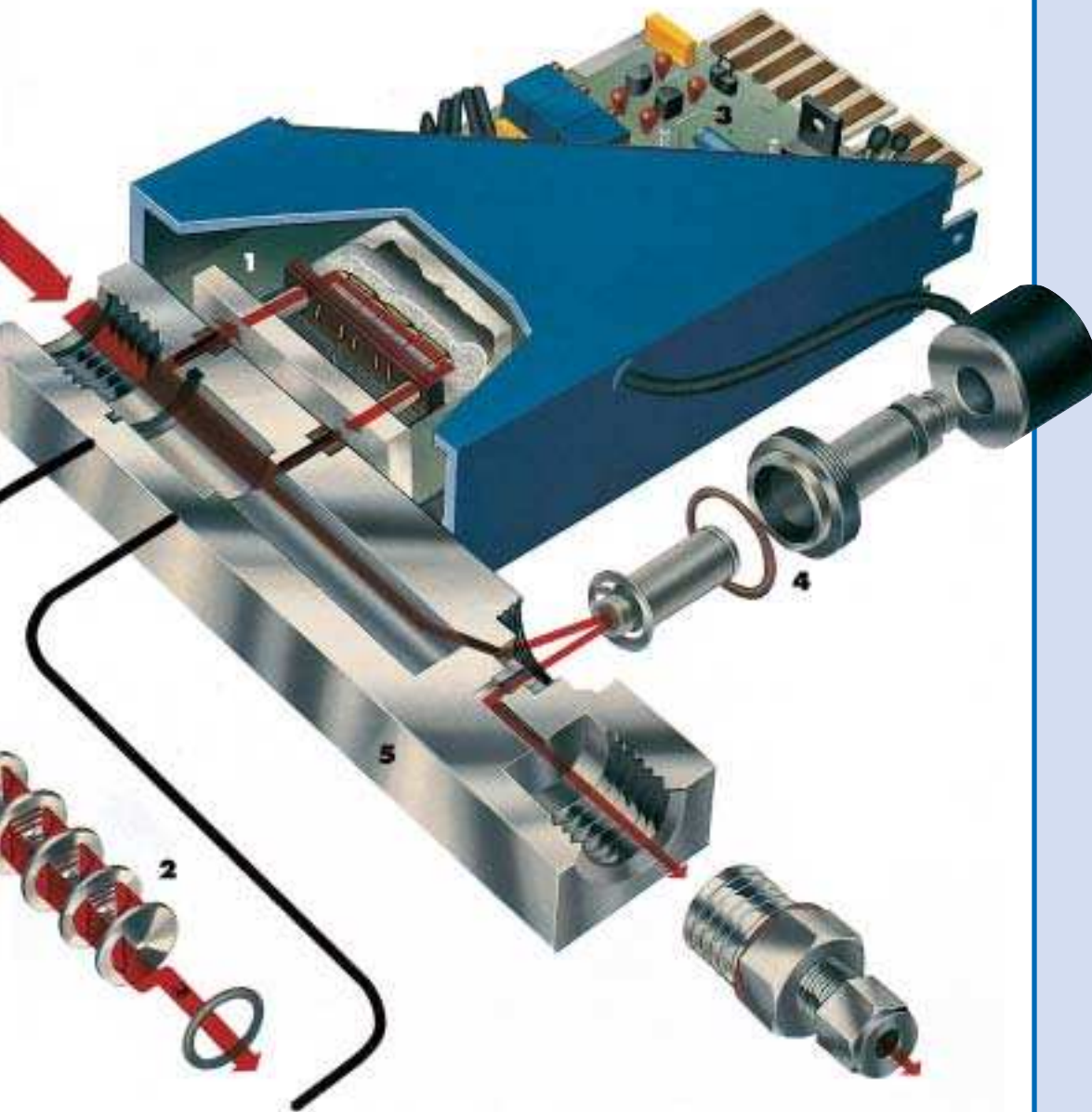
The sensing system utilizes a bypass sensing tube with a heater wound around the center of the tube and precision temperature sensors equidistant upstream and downstream of the heater. A patented laminar flow element package in the main flowstream creates a pressure drop which forces a fixed percentage of total flow through the sensor tube for temperature differential detection.

At zero flow, temperature at both sensors is equal. As gas flows through the sensor tube, heat is displaced to the downstream sensor, creating a temperature differential between the two sensors. The resulting signal is amplified to 0-5 Vdc or 4-20 mA dc output, which is directly proportional to Mass Flow rate. The flow controller circuit compares the output signal with a setpoint input and generates a control voltage to a solenoid-operated control valve, forming a closed loop control system.



1. REMOVABLE SENSING TUBE ASSEMBLY simplifies maintenance.
2. PATENTED LAMINAR FLOW ELEMENT PACKAGE – Computer-determined for each specific application based on flow rate and physical properties of the process gas.
3. CHOICE OF CONTROL CIRCUITRY – Fast response circuitry available in a card edge or D-type electrical connector. Card edge electrical connector pin-out configuration facilitates retrofitting of existing mass flow meters/flow controllers.
4. SIMPLIFIED NORMALLY CLOSED VALVE DESIGN – Easily disassembled for service.
5. STAINLESS STEEL CONSTRUCTION – VITON®, Buna N, NEOPRENE®, EPDM or KALREZ® elastomers available.

VITON, NEOPRENE and KALREZ are registered trademarks of E.I. DuPont de Nemours & Co.



## PORTER: PERFORMANCE

**FAST RESPONSE** – The Porter MFC responds to a step change in setpoint in less than one second. Actual flow is stabilized within 2 seconds, virtually without overshoot. (See response chart below.)

**WIDE FLOW RANGE** – Models are available with flow ranges of 0-5 sccm to 0-1000 slpm N<sub>2</sub>. High pressure models have operating pressures to 3000 psig.

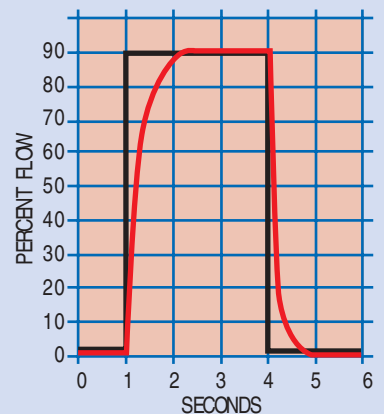
**SOFT RECOVERY VALVE OVERRIDE** – Available with the card edge electrical connector, the control valve may be held open or closed by an external logic signal. Return to normal setpoint is smooth and without overshoot or undershoot, preventing potential damage to the valve or process system.

**STABLE ZERO CONTROL** – Ensures valve shutoff at zero setpoint and reduces zero drift.

**INTERNAL VOLTAGE REGULATION AND TEMPERATURE COMPENSATION CIRCUITS** – Stabilizes output signal and control regardless of power supply and temperature fluctuations.

**ATTITUDE INSENSITIVITY** – Mounting position does not affect performance.

**INTERCHANGEABILITY** – The Model 201's physical dimensions and the card edge electrical connector pin-out configuration are designed to easily retrofit competitive equipment.



### MODEL 201

**Flow Range:**

Any range from 0-5 sccm to 0-10 slpm N<sub>2</sub>.

**Length (less fittings):**

3.005 inches

**Width:** 1.00 inch

**Height:** 4.897 inches

(card edge electrical connector) or 4.520 inches (D-type electrical connector).

**Maximum Operating**

**Pressure:** 1000 psig

*(For applications requiring maximum operating pressure up to 3000 psig, consult factory.)*



MODEL 201

### MODEL 251

**Flow Range:**

Any range from 0-10 slpm to 0-50 slpm N<sub>2</sub>.

**Length (less fittings):**

3.005 inches

**Width:** 1.00 inch

**Height:**

5.272 inches (card edge electrical connector) or 4.895 inches (D-type electrical connector).

**Maximum Operating**

**Pressure:** 1000 psig



MODEL 251

### MODEL 202

**Flow Range:**

Any range from 0-10 slpm to 0-100 slpm N<sub>2</sub> (Consult factory for correct sizing)

**Length (less fittings):**

4.335 inches

**Width:** 1.750 inches

**Height:** 5.522 inches (card

edge electrical connector) or 5.145 inches (D-type electrical connector).

**Maximum Operating**

**Pressure:** 1000 psig

*(For applications requiring maximum operating pressure up to 3000 psig, consult factory.)*



MODEL 202



## MODEL 204A

The Porter Instrument Models 202A, 203A and 204A Mass Flow Controllers accurately control flow rates up to 1000 slpm N<sub>2</sub> with low differential pressure. This is accomplished by incorporating a unique spring-loaded diaphragm/orifice design with a solenoid-operated pilot valve. The normally closed valve configuration adds an important margin of safety.

### MODEL 202A

**Flow Range:** Any range from 0-10 slpm to 0-100 slpm N<sub>2</sub>. (Consult factory for correct sizing)  
**Length (less fittings):** 5.241 inches  
**Width:** 1.875 inches  
**Height:** 5.647 inches (card edge electrical connector) or 5.270 inches (D-type electrical connector)  
**Maximum Operating Pressure:** 200 psig

### MODEL 203A

**Flow Range:** Any range from 0-100 slpm to 0-500 slpm N<sub>2</sub>.  
**Length (less fittings):** 6.299 inches  
**Width:** 2.500 inches  
**Height:** 6.272 inches (card edge electrical connector) or 5.895 inches (D-type electrical connector)  
**Maximum Operating Pressure:** 200 psig

### MODEL 204A

**Flow Range:** Any range from 0-500 slpm to 0-1000 slpm N<sub>2</sub>.  
**Length (less fittings):** 6.299 inches  
**Width:** 2.500 inches  
**Height:** 6.272 inches (card edge electrical connector) or 5.895 inches (D-type electrical connector)  
**Maximum Operating Pressure:** 200 psig

## SPECIFICATIONS ALL MODELS

**Response Time:** 2 seconds

**Accuracy and Linearity:**

± 1% full scale (all models except Models 114 and 204A)  
 ± 1.5% full scale (Models 114 and 204A)

**Repeatability:** ± 0.2% full scale

**Control Range:**

50:1 (2%-100% full scale)

**Temperature (Ambient and Operating):**

-10 to 70°C (14 to 158°F)

**Temperature Coefficient:**  
0.1% / °C

**Pressure Coefficient:**

1.0%/Atmosphere

**Input Setpoint Voltage:**

0-5 Vdc  
 (for 0-5 Vdc output signal)  
 or 1-5 Vdc  
 (for 4-20 mAdc output signal)

**Electrical Connector:**

card edge (20-Pin) or  
 D-type (9-Pin)

**Power Requirements:**

**Card Edge Electrical Connector:**  
 +15 Vdc < 25 mAdc  
 (flowmeter and flow controller)  
 -15 Vdc < 25 mAdc  
 (flowmeter)  
 or < 300 mAdc  
 (flow controller)

**D-type Electrical Connector:**

+15 Vdc < 75 mAdc  
 (flowmeter)  
 or < 250 mAdc  
 (flow controller)  
 -15 Vdc < 25 mAdc  
 (flowmeter and flow controller)

**Output Signal:**

0-5 Vdc (2K ohm minimum load impedance)  
 or 4-20 mAdc  
 (non-floating/ground-reference d)

**Mounting Orientation:**

attitude insensitive

**Warm-up Time:** 10 minutes

Specifications subject to change.

## MASS FLOW METERS

Models 111, 112, 113 and 114 Mass Flowmeters, working on the same operating principles as the Mass Flow Controllers, are available in any flow range between 0-5 sccm and 0-1000 slpm N<sub>2</sub>. Performance and electrical specifications are shown on page five.



MODEL 112

## MASS FLOW CONTROL VALVES

Models 001, 002 and 003A Mass Flow Control Valves are normally-closed, proportional control valves, handling 0-5 sccm to 0-500 slpm N<sub>2</sub> flow rates. When coupled with a Mass Flowmeter, a closed-loop control system is achieved which permits separate component (flowmeter and control valve) configuration.



MODEL 002

## MODELS CM 2 , CM 4 AND PCIM 4

Porter Instrument's Models CM2, CM4 and PCIM4 Interface Modules are designed for use with Porter's Mass Flowmeters and Flow Controllers. Models CM2 (two-channel), CM4 (four-channel) and PCIM4 (four-channel) provide operating voltages, setpoint control (for flow controllers), and an LED display. Both process flow rates and channel setpoints are indicated on the display as a percentage of full scale. Setpoints are adjustable to any value in the range using the 10-turn adjustment controls.

All three models feature the Automatic Proportional Tracking (APT) mode. APT operation permits controlling the flow rate in one or more channels as a fixed ratio of the flow rate in a reference channel, and allows the slave (secondary) channel(s) to track any change in the reference channel flow rate. Additionally, the Model PCIM4 includes Porter's exclusive COM-LINK feature, a two-way computer interface communicating link.



MODEL PCIM 4

## SPECIFICATIONS

CM2 (2-channel)  
CM4 (4-channel)  
PCIM4 (4-channel)

### Inputs:

0-5 Vdc flow signal from flowmeter/flow controller (one per channel)

0-5 Vdc remotely-generated setpoint (one per channel) from computer or other control source (Model PCIM4 only)

Optically-isolated COM-LINK activation (Model PCIM4 only)

### Outputs:

0-5 Vdc setpoint (one per channel), adjustable with front panel-mounted 10-turn potentiometer

0-5 Vdc flow signal (one per channel) for operation of external data acquisition equipment.

± 15 Vdc operating voltages (one set per channel) for powering flowmeter/flow controller

### Power Requirements:

117 Vac ± 10%, 50 to 60 Hz, 50 watts

### Dimensions:

8.5"W x 4.875"H x 9.75"D

Specifications subject to change.

## MODEL NUMBER DESCRIPTION

(Flow Controller, Flowmeter and Control Valve)

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EXAMPLE:  | 2 | 5 | 1 | D | K | A | S | V | C | A | A |
| <b>MODEL</b>  |   |   |   |   |   |   |   |   |   |   |   |
| <b>MODEL REVISION LEVEL</b>                               |   |   |   |   |   |   |   |   |   |   |   |
| D: Current Revision                                       |   |   |   |   |   |   |   |   |   |   |   |
| <b>PC BOARD ELECTRICAL CONNECTOR</b>                      |   |   |   |   |   |   |   |   |   |   |   |
| F: Card Edge      K: 9-Pin "D"                            |   |   |   |   |   |   |   |   |   |   |   |
| X: No PC Board (used when ordering a control valve)       |   |   |   |   |   |   |   |   |   |   |   |
| <b>SETPOINT SIGNAL/OUTPUT SIGNAL</b>                      |   |   |   |   |   |   |   |   |   |   |   |
| A: 0-5 Vdc/0-5 Vdc    H: 4-20 mAdc/4-20 mAdc(sourcing)    |   |   |   |   |   |   |   |   |   |   |   |
| X: Not applicable (used when ordering a control valve)    |   |   |   |   |   |   |   |   |   |   |   |
| <b>BODY MATERIAL</b>                                      |   |   |   |   |   |   |   |   |   |   |   |
| S: 316 Stainless Steel                                    |   |   |   |   |   |   |   |   |   |   |   |
| <b>ELASTOMERS (VALVE SEAT/O-RINGS)</b>                    |   |   |   |   |   |   |   |   |   |   |   |
| B: Buna N/Buna N    N: Neoprene/Neoprene <sup>2</sup>     |   |   |   |   |   |   |   |   |   |   |   |
| E: EPDM/EPDM <sup>2</sup> T: Teflon®/Kalrez <sup>2</sup>  |   |   |   |   |   |   |   |   |   |   |   |
| K: Kalrez/Kalrez <sup>2</sup> V: Viton/Viton              |   |   |   |   |   |   |   |   |   |   |   |
| <b>FITTING SIZE AND TYPE<sup>3</sup></b>                  |   |   |   |   |   |   |   |   |   |   |   |
| A: 3/8" CPI®      K: 3/8" VCO      T: 1/2" UltraSeal      |   |   |   |   |   |   |   |   |   |   |   |
| B: 1/8" Swagelok®    L: 1/2" VCO      U: 3/8" A-Lok®      |   |   |   |   |   |   |   |   |   |   |   |
| C: 1/4" Swagelok    M: 1/4" UltraSeal®    V: 1/2" A-Lok   |   |   |   |   |   |   |   |   |   |   |   |
| D: 3/8" Swagelok    N: 3/4" VCR®      W: 6mm Swagelok     |   |   |   |   |   |   |   |   |   |   |   |
| E: 1/2" Swagelok    P: 1/4" VCR      X: No fitting        |   |   |   |   |   |   |   |   |   |   |   |
| F: 1/2" CPI      Q: 3/8" VCR      Y: 1/4" A-Lok           |   |   |   |   |   |   |   |   |   |   |   |
| G: 3/4" Swagelok    R: 3/8" UltraSeal    3: 12mm Swagelok |   |   |   |   |   |   |   |   |   |   |   |
| H: 10mm Swagelok    S: 1/2" VCR      4: 1/4" CPI          |   |   |   |   |   |   |   |   |   |   |   |
| J: 1/4" VCO®  |   |   |   |   |   |   |   |   |   |   |   |
| <b>ASSEMBLY/CALIBRATION FEATURES</b>                      |   |   |   |   |   |   |   |   |   |   |   |
| AA: Factory Standard                                      |   |   |   |   |   |   |   |   |   |   |   |

<sup>1</sup>Available only on PC board type "K" (9-Pin, D-Connector)

<sup>2</sup>Not available on Models 003A, 202A, 203A and 204A

<sup>3</sup>When questionable, consult factory to determine fitting availability for a given model

A-Lok®, Parker Hannifin Corp.

CPI®, Parker Hannifin Corp.

Swagelok®, Swagelok Co.

Teflon®, E.I.DuPont de Nemours & Co.

UltraSeal®, Parker Hannifin Corp.

VCO®, Cajon Co.

VCR®, Cajon Co.

## ORDERING INFORMATION

(Flow Controller, Flowmeter and Control Valve)

### To Order Please Specify:

1. Model Number
2. Flow Capacity
3. Gas Type
4. Operating Temperature
5. Upstream Pressure
6. Downstream Pressure (not required for flowmeters)
7. Calibration Standard (i.e. 0 or 21.1°C)
8. Additional Accessories Required (i.e. interface module, interconnecting cable assembly, etc.)





The mass flow products in this catalog are part of a quality line of flow measurement and control devices manufactured by Porter Instrument Company. For additional information on other products, request catalog number FM-169 (variable area flowmeters, manual control valves, manual flow controllers and pressure regulators), FM-606 (electronic proportional control valves) and/or FM-645 (liquid mass flowmeters and flow controllers).

Porter Instrument Company has been an innovative leader in flow measurement and control technology for nearly thirty years. Our company's reputation is well known by the leading companies in many divergent industries, not only for the quality of our products, but also for our flexibility in being able to modify existing products to suit specific customer needs.

The products presented in this catalog represent our product line for electronic mass flow measurement and control. If you have special applications, or need a modified flow controller that is not shown in our catalog, please contact us.

We look forward to being of service to you.

Very Truly Yours,

PORTER INSTRUMENT COMPANY, INC.

Gary K. Porter  
President

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