Thermal Mass Flow Meters and Controllers (Analog)

Series 100 / 200

Precision Fluidics

ENGINEERING YOUR SUCCESS.

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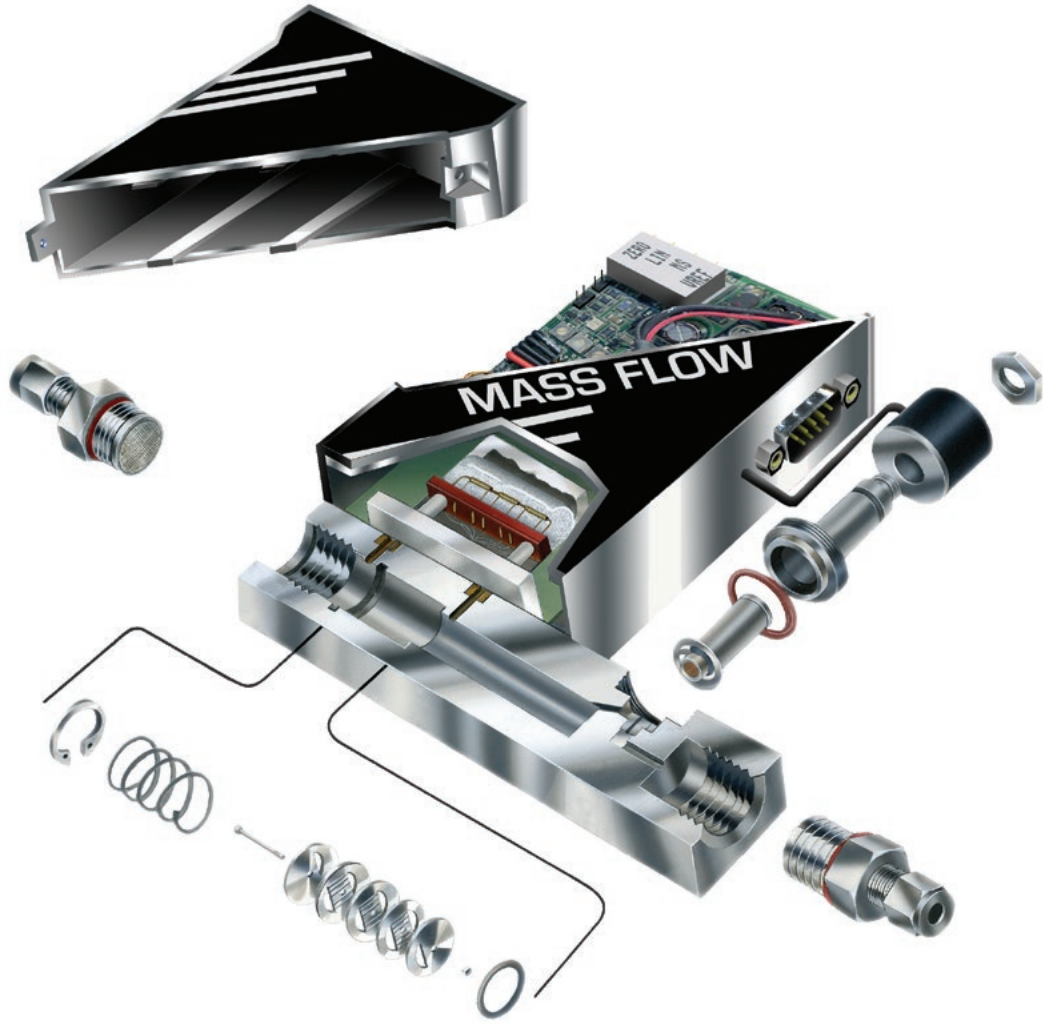


Consistent. Repeatable. Reliable.

For over 50 years, Parker thermal mass flow meters and controllers provide accurate flow rates you can use with confidence from lab to production. Founded on the George K. Porter family legacy for engineered solutions with a personal touch, Parker Precision Fluidics continues this legacy through one-on-one engineering collaboration to ensure premium performance you can trust.

Parker

Table of Contents

Series 100 Thermal Mass Flow Meters

Traditional Analog Flow Meter

Parker Series 100 Thermal Mass Flow Meters provide reliable analog flow measurements configured for your process conditions. Each meter offers a linear flow signal output proportional to a calibrated flow rate and is available with a D-connector.

The Series 100 Thermal Mass Flow Meters include the following models:

111 112 113 114

Typical Applications

- Burner Ratio Control for Ceramics and Metals

Features

- Cleaned for Analytical Service Use
- RoHS and REACH compliant

Product Specifications

Physical Properties

Sensor Technology:
Thermal Sensor, Bypass Method

Media:
Air, Nitrogen, Helium, Argon, Hydrogen, Oxygen, Krypton, Neon, Xenon and other non-corrosive primary and blended gases

Width:
See Dimensional Drawing

Length:
See Dimensional Drawing

Height:
See Dimensional Drawing

Weight:
See weights provided on each Dimensions page

Mounting Orientation:
Attitude sensitive

Porting:
1/8", 1/4", 3/8", 1/2", 3/4", 6mm and 10mm compression;
1/4", 3/8", 1/2" CPI;
1/4", 3/8", 1/2", 3/4" A-Lok;
1/4" MMGFS*

*Male Metal Gasket Face Seal

Electrical

Power Supply:
+12 (±5%) or +15 (±10%) VDC

Input Control Signal:
0-5 VDC, 0-10 VDC, 4-20 mA

Monitor Output Voltage:
0-5 VDC, 0-10 VDC, 4-20 mA

Max Current Requirement:
< 400 mA

Power Supply Requirement:
(Current consumption <45 mA)

Voltage output models:
+12 (±5%) (0-5 VDC flow signal outputs only) or +15 (±10%) VDC

Current loop models:
+15 (±5%) or +24 (±15%) VDC

Setpoint / Flow Signal I/O:
0-5, 0-10 VDC; 4-20 mA

External Electrical Connector:
Nine (9)-pin D-connector

Wetted Materials

Body: 316 Stainless Steel

Sensor Assembly:
316L Stainless Steel

O-Rings and Valve Seat:
Buna-N, EPDM, FFKM, Neoprene, FKM

Process Connections:
316 Stainless Steel

Performance Ratings

Ratings:
Max operating pressure:
1,500 psig (103 barg)
Max working temperature:
158°F (70°C)

Pressure Coefficient:
± 0.1% / atmosphere typical using nitrogen (N2)

Minimum Pressure Drop:
2 psid (0.14 bard)

Performance Characteristics

Accuracy and Linearity:
±1% Full Scale
Model 114 ±1.5% Full Scale;

Repeatability:
Within ±0.2% Full Scale at any constant temperature within operating temperature range

Response Time: 2-4 sec

Rangeability:
50:1 (2-100% Full Scale)

Temperature Coefficient:
±0.05% Full Scale / °C of zero;
±0.05% of reading / °C of span

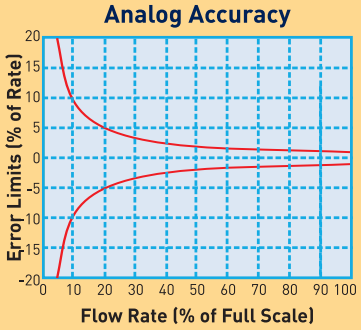
Warm-Up Time: 10 minutes

Flow Control Range:
See flow control ranges provided on each model catalog page

Series 100 Thermal Mass Flow Meters

Accuracy

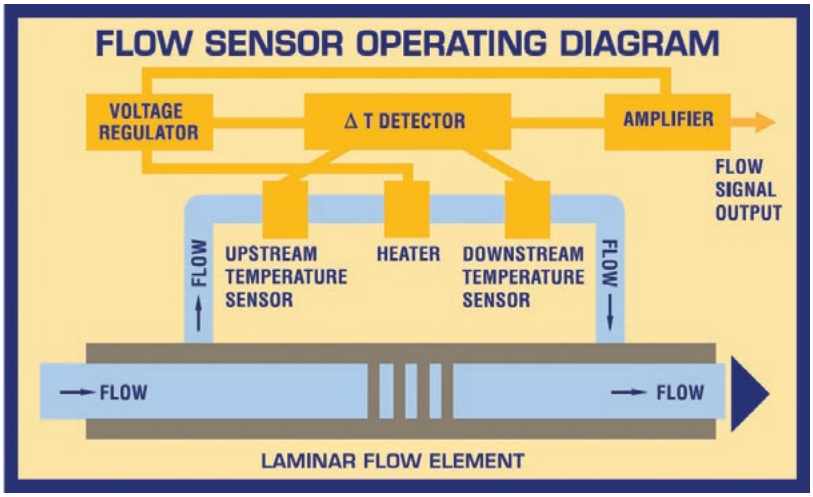
Parker mass flow meters and controllers offer standard ±1.0% and ±2.0% full scale accuracy of calibrated span referenced to nitrogen at 21.1°C and 14.7 PSIA. Gas correction factors may be used to determine the equivalent flow rate of your process gas or, for an additional cost, live gas calibrations at a different reference temperature and pressure are also available.



Principle of Operation

Parker Series 100 Mass Flow Meters (MFM) incorporate an operating principle based on the thermodynamic properties of the process gas being measured.

Mass flow measurement relates to the amount of heat absorbed by the process gas. The amount of heat the gas absorbs is determined by the gas molecular structure. Specific heat, the amount of heat required to raise the temperature of one gram of a given gas one degree centigrade quantitatively describes this “thermal absorbency”.



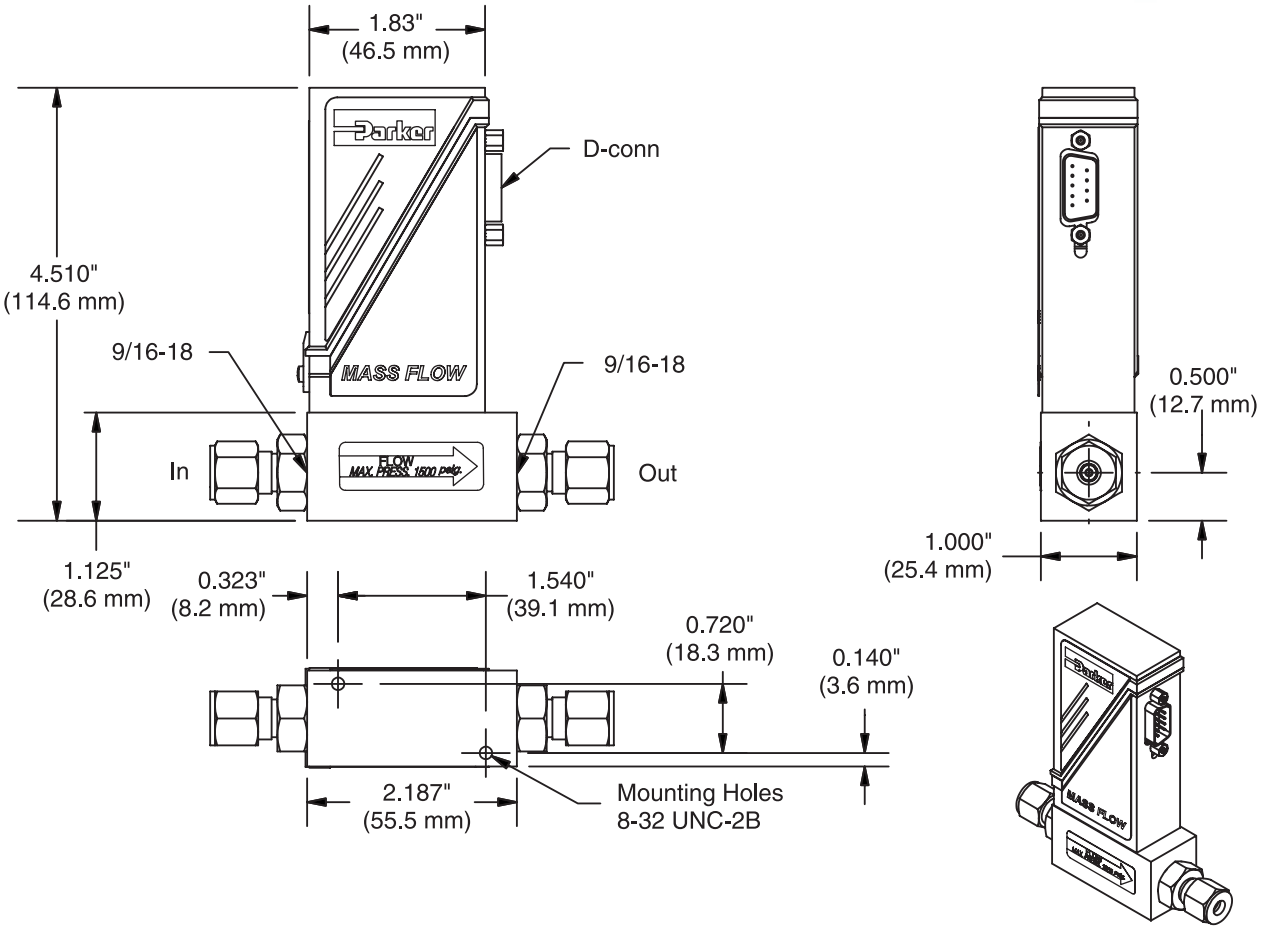
Mass flow measurement consists of a bypass sensing tube with a heater wound around the center of the sensing tube and precision resistance type temperature sensors located equidistant upstream and downstream of the heater. A laminar flow element package, located in the main flow stream, acts as an appropriate restriction creating a pressure drop forcing a fixed percentage of the total flow, approximately 10 sccm, through the bypass sensing tube for temperature differential detection. As gas flows through the sensing tube, heat is displaced to the downstream temperature sensor creating a temperature differential between the upstream and downstream temperature sensors. The upstream and downstream temperature sensors form two legs of a bridge network at the sensor assembly inputs to the PCB. The resulting temperature differential is amplified on the PCB assembly to a 0-5 VDC output signal directly proportional to the gas mass flow rate. To ensure an accurate flow measurement, flow disturbances must be eliminated or greatly reduced. Accordingly, both the sensor tube and the laminar flow element package are designed for laminar flow. Actual gas or gas factors are used in calibration to account for the specific heat of the measured gas.

Series 100 Thermal Mass Flow Meters

Mechanical Integration

Dimensions

Basic Dimensions Model 111



Model 111	
Weight	0.9 lbs (0.4 kg)

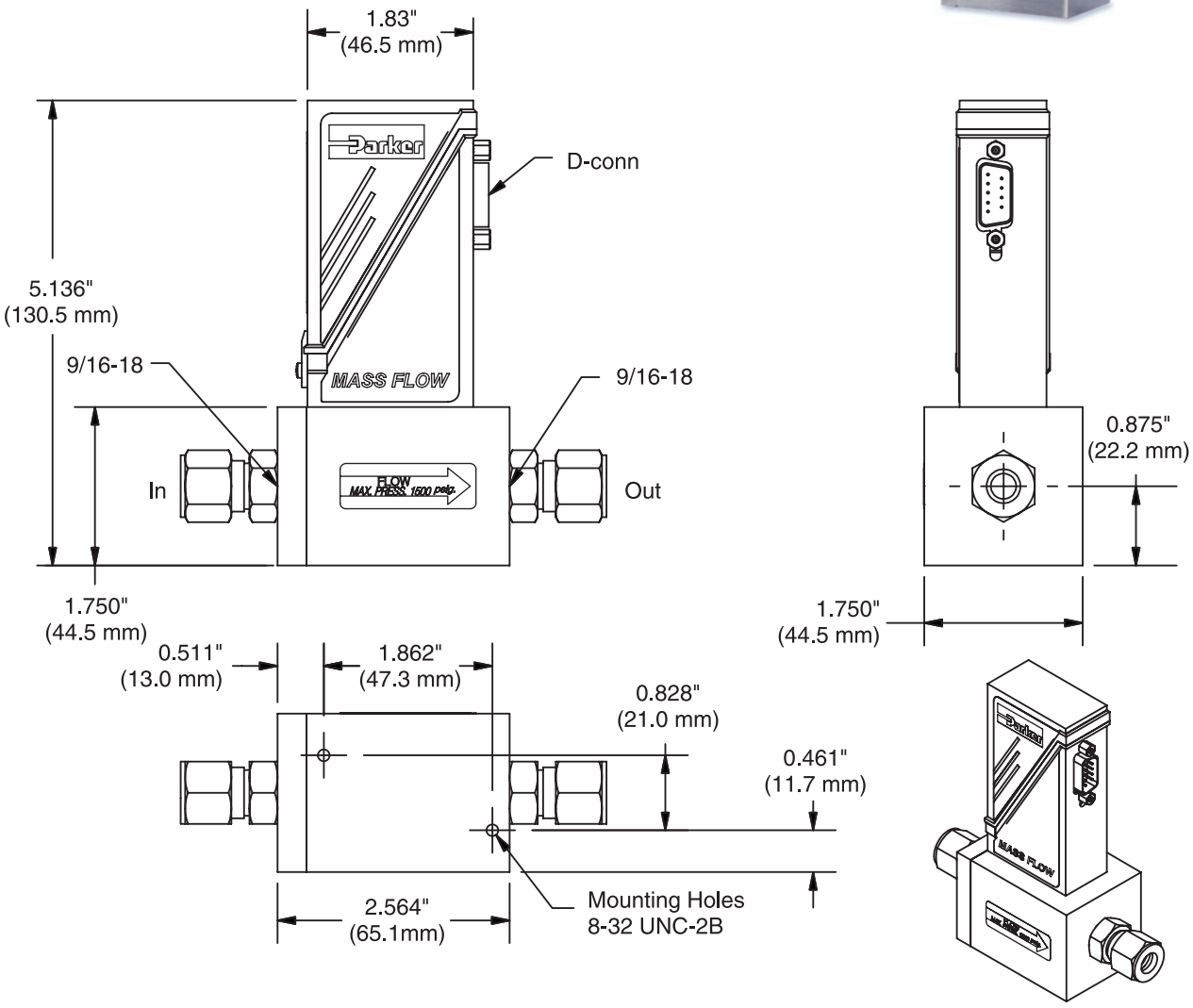
Units
In (mm)

Series 100 Thermal Mass Flow Meters

Mechanical Integration

Dimensions

Basic Dimensions Models 112



Model 112	
Weight	2.1 lbs (1.0 kg)

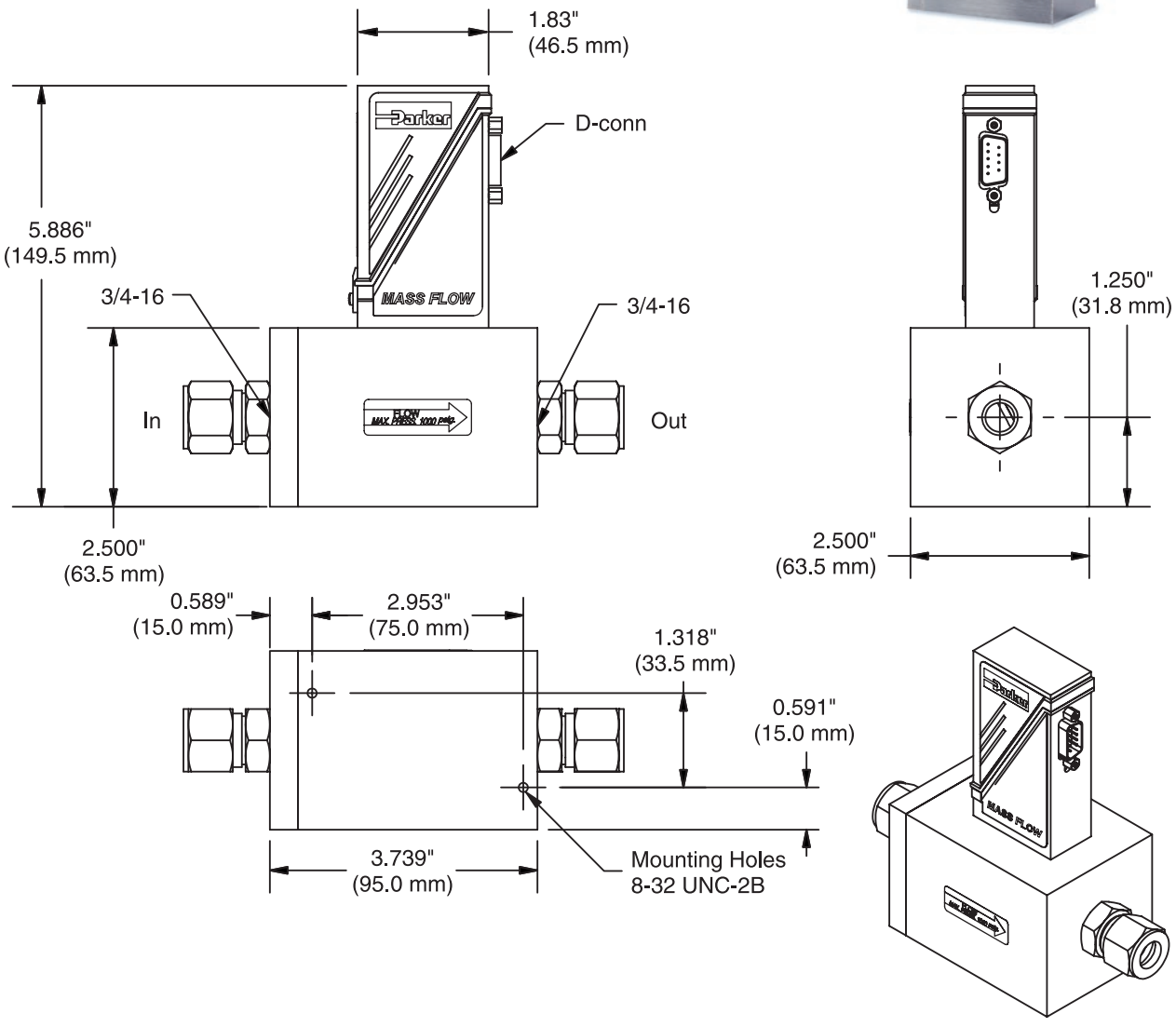
Units
In (mm)

Series 100 Thermal Mass Flow Meters

Mechanical Integration

Dimensions

Basic Dimensions Models 113



Model 113	
Weight	5.2 lbs (2.4 kg)

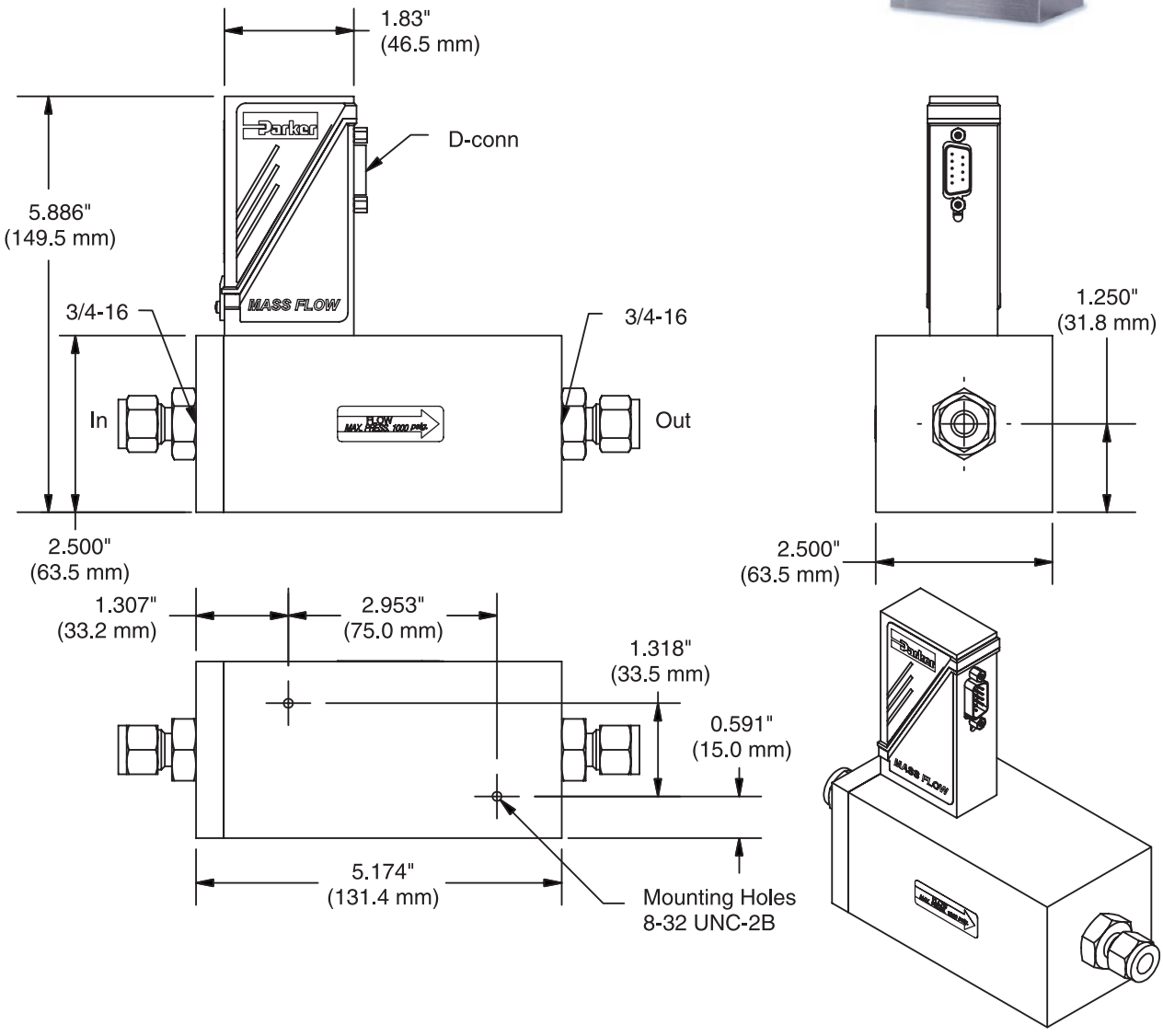
Units
In (mm)

Series 100 Thermal Mass Flow Meters

Mechanical Integration

Dimensions

Basic Dimensions Models 114

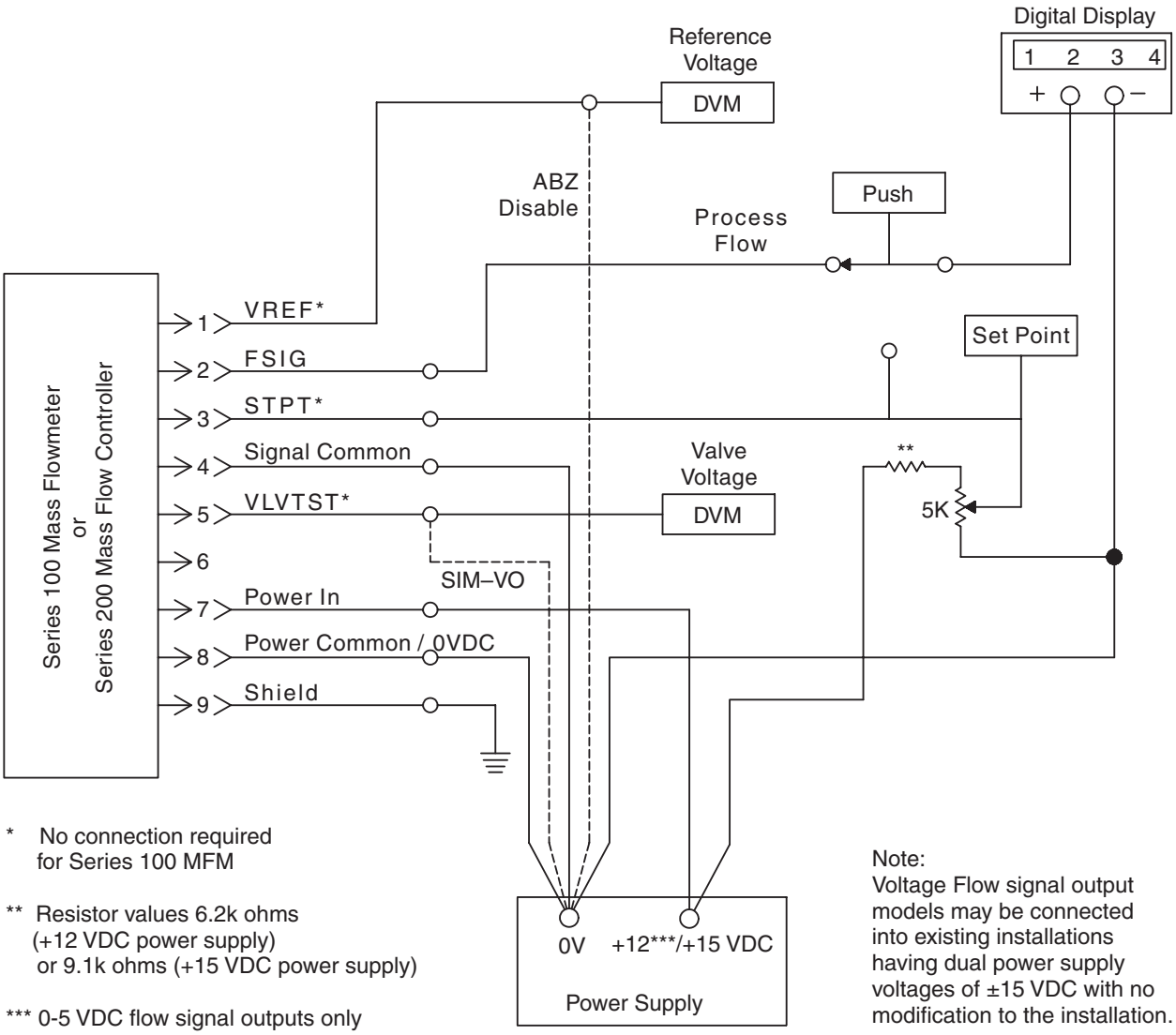


Model 114	
Weight	6.6 lbs (3.0 kg)

Units
In (mm)

Series 100 Thermal Mass Flow Meters

Electrical Integration and Recommendation



* No connection required for Series 100 MFM

** Resistor values 6.2k ohms (+12 VDC power supply) or 9.1k ohms (+15 VDC power supply)

*** 0-5 VDC flow signal outputs only

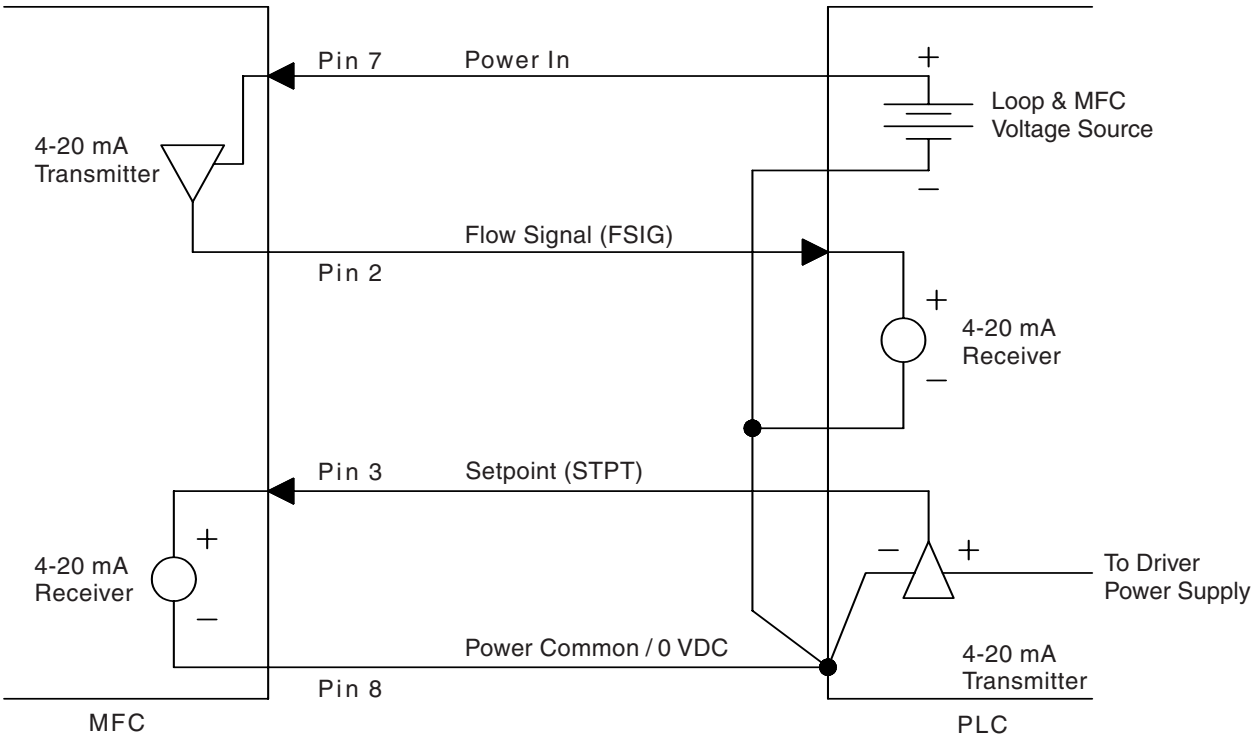
Note:
Voltage Flow signal output models may be connected into existing installations having dual power supply voltages of ±15 VDC with no modification to the installation.

Parker-Supplied Cable Assembly Color Codes		
Signal	**Connector Pin**	
	No.	**Insulation Color**
Voltage Reference	1	Brown
Flow Signal	2	Red
Setpoint	3	Yellow
Signal Common	4	Green
Valve Test	5	Blue
Open	6	Violet or White
Power In	7	Orange
Power Common /0 VDC	8	Black
Shield (Drain Wire)	9	Shield (Drain Wire)

Note: Cable color codes are for reference only and are subject to change without notice

Series 100 Thermal Mass Flow Meters

Electrical Integration and Recommendation



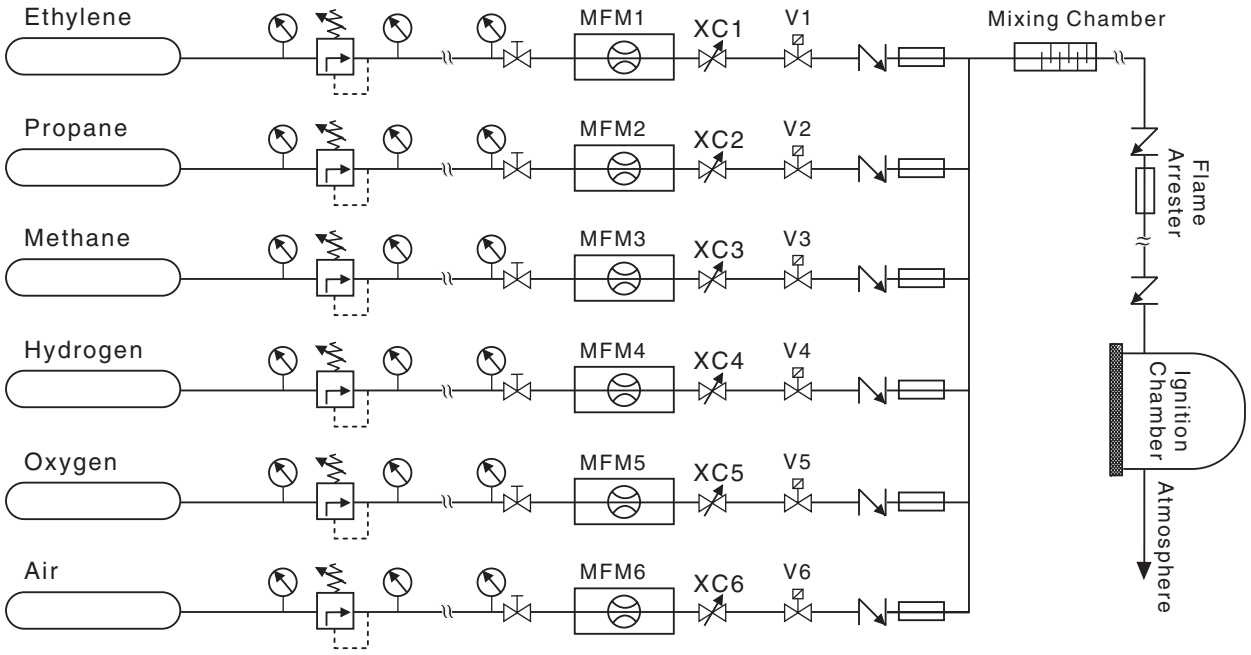
Notes:
1. Setpoint: 4-20 mA
2. For input/output designations (i.e., iondividual pin functions)fo pin numbers not shown, refer to electrical integration drawing on previous page.

Parker-Supplied Cable Assembly Color Codes		
Signal	**Connector Pin**	
	No.	**Insulation Color**
Voltage Reference	1	Brown
Flow Signal	2	Red
Setpoint	3	Yellow
Signal Common	4	Green
Valve Test	5	Blue
Open	6	Violet or White
Power In	7	Orange
Power Common /0 VDC	8	Black
Shield (Drain Wire)	9	Shield (Drain Wire)

Note: Cable color codes are for reference only and are subject to change without notice

Series 100 Thermal Mass Flow Meters

Typical Flow Diagram



Series 100 Thermal Mass Flow Meters

Installation Guide

- Clean dry area with adequate space
- Indoor use only
- Follow process connection manufacturer guidelines and leak check all connections
- Purge all gas lines with nitrogen before installation
- Remove all loose particulate or debris from system

Key Things to Remember:

- Standard Flow Sizing Specifications
  1. Gas Type
  2. Flow Rate
  3. Inlet Pressure
  4. Outlet Pressure
  5. Operating Temperature
  6. Standard Calibration Condition*
  7. Connection Fitting Size and Type
  8. Set point/Output signal
- CM-400 4-channel Power Supply/Control
- Power Cables
- PN: C-700-002, Interface cable with flying leads on one end
- PN: C-1666-010, CABLE ASSY, MFC, CM-400

* Default standard calibration conditions = 21.1C and 14.7 PSIA. Consult Applications for support to specify other common calibration standards such as: 0C, 20C, 25C.

Series 100 Thermal Mass Flow Meters

Ordering Information

Model Number Example:

111-	F	K	A	S	V	X	AA

Nominal Range - Nitrogen Equivalent*

Model	Rev	Description
111-	F	±1% FS, 5 sccm to 10 slpm
112-	F	±1% FS, 10 slpm to 100 slpm
113-	F	±1% FS, 100 slpm to 500 slpm
114-	F	±1% FS, 500 slpm to 1000 slpm

* **Note:** The flow ranges listed are minimum and maximum nitrogen (N2) flow ranges available for each given model. Intermediate flow ranges are available. For correct sizing when operating parameters are questionable, please consult the factory.

Assembly/Calibration Features

Code	Description
AA	Standard, Calibrated Horizontally
CP	Environmental Chamber Calibration
EY	Calibrated Vertically (Inlet Down)
NX [1)]	CE Appproved Design

PC -Board Electrical Connector

Code	Description
K	Nine (9)-Pin "D"
W [1)]	Nine (9)-Pin "D" CE Approved Design

Fitting Size and Type

Code	Description
X	Without Fitting
B	Compression - 1/8"
C	Compression - 1/4"
D	Compression - 3/8"
E	Compression - 1/2"
G	Compression - 3/4"
P	Male Metal Gasket Face Seal - 1/4"
Q	Male Metal Gasket Face Seal - 3/8"
S	Male Metal Gasket Face Seal - 1/2"

Note: Fitting Size Restricted by Model Size.
Note: Additional Fitting Types Available.
Consult Factory for Availability & Restrictions.

Setpoint Signal/Output Signal

Code	Description
A	0-5 VDC/0-5 VDC
E	0-10 VDC/0-10 VDC
H	4-20 mAdc (sourcing)

Body Material

Code	Description
S	Stainless Steel
J	Stainless Steel / Silconert [2)]

Elastomers (Valve Seat/O-Rings)

Code	Description
V	FKM
B	Buna N
E	EPDM
N	Neoprene
K	FFKM

Note: Models 202A/203A/204A Available With Buna N Or FKM Only

[1)] NX CE Approved Design Assembly/Calibration feature must be selected in tandem with W 9-Pin CE approved design PC-board.

[2)] Consult factory for information pertaining to the Silconert process and estimated additional lead times.

NOTE: In order to provide the best possible solution for your application, please provide the following requirements when contacting Applications Engineering:

- Media, Inlet & Outlet Pressures
- Minimum Required Flow Rate.

For more detailed information, visit us on the web or call Applications Engineering.

ORDER ON-LINE

Parker Hannifin Precision Fluidics Division reserves the right to make changes. Drawings are for reference only.

Series 2200 Thermal Mass Flow Meters

Traditional Analog Flow Meter

Parker Model 2211 Thermal Mass Flow Meters provide reliable analog flow measurements configured for your process conditions. Each controller offers a linear flow signal output proportional to a calibrated flow rate and is available with a D-connector. Choose Model 2211 when you need performance at an economical price.

Typical Applications

- Burner Ratio Control for Ceramics and Metals

Features

- Cleaned for Analytical Service Use
- RoHS and REACH compliant

Product Specifications

Physical Properties

Sensor Technology:
Thermal Sensor, Bypass Method

Media:
Air, Nitrogen, Helium, Argon, Hydrogen, Oxygen, Krypton, Neon, Xenon and other non-corrosive primary and blended gases

Width:
See Dimensional Drawing

Length:
See Dimensional Drawing

Height:
See Dimensional Drawing

Weight:
1.2 lbs (0.54 kg) (typical)
See weights provided on each Dimensions page

Porting:
1/8", 1/4", 3/8" compression; 1/4", 3/8" CPI; 1/4", 3/8" A-Lok; 1/4" MMGFS*

*Male Metal Gasket Face Seal

Electrical

Main Voltage: 24 VDC + 10%

Input Control Signal:
0-5 VDC standard

Monitor Output Voltage:
0-5 VDC standard

Max Current Requirement:
< 400 mA

Setpoint / Flow Signal I/O:
0-5, 0-10 VDC; 4-20 mA

Wetted Materials

Body:
Aluminum

Sensor Assembly:
C36000 Brass (standard)
316 Stainless Steel (optional)

Orifice:
C36000 Brass (standard)
316 Stainless Steel (optional)

Valve Components:
302, 316, 430F Stainless Steel or Sandvik 1802

O-Rings and Valve Seat:
Buna-N, FKM, FFKM, Neoprene

Performance Ratings

Ratings:
Max operating pressure:
1,000 psig (69 barg)
Max working temperature:
158°F (70°C)

Minimum Pressure Drop:
2 psid (0.14 bard)

Performance Characteristics

Accuracy and Linearity:
±2% Full Scale

Repeatability:
Within ±0.2% Full Scale at any constant temperature within operating temperature range

Response Time: 1-2 sec

Rangeability:
50:1 (2-100% Full Scale)

Temperature Coefficient:
±0.05% Full Scale / °C of zero;
±0.05% of reading / °C of span

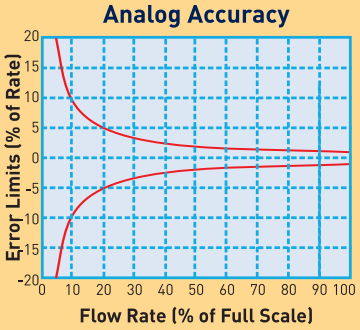
Warm-Up Time: 10 minutes

Flow Control Range:
0.5 sccm to 0-1000 slpm (nitrogen equivalent)

Series 2200 Thermal Mass Flow Meters

Accuracy

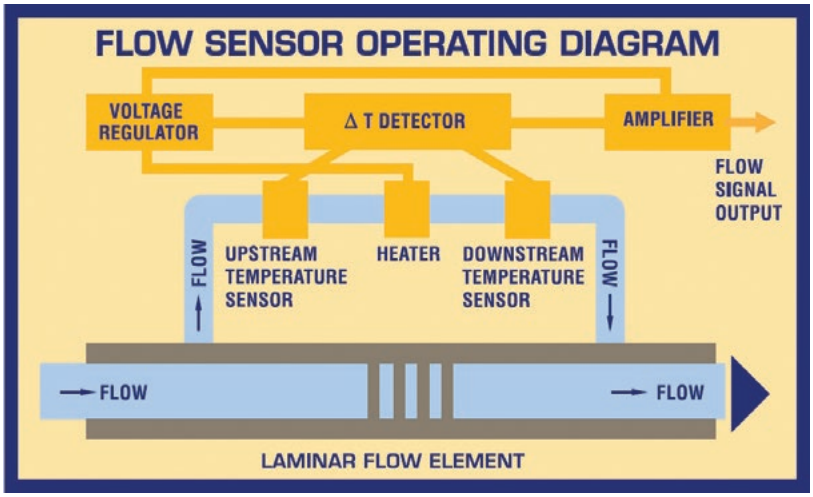
Parker mass flow meters and controllers offer standard ±1.0% and ±2.0% full scale accuracy of calibrated span referenced to nitrogen at 21.1°C and 14.7 PSIA. Gas correction factors may be used to determine the equivalent flow rate of your process gas or, for an additional cost, live gas calibrations at a different reference temperature and pressure are also available.



Principle of Operation

Parker Series 2200 Mass Flow Meters (MFM) incorporate an operating principle based on the thermodynamic properties of the process gas being measured.

Mass flow measurement relates to the amount of heat absorbed by the process gas. The amount of heat the gas absorbs is determined by the gas molecular structure. Specific heat, the amount of heat required to raise the temperature of one gram of a given gas one degree centigrade quantitatively describes this “thermal absorbency”.



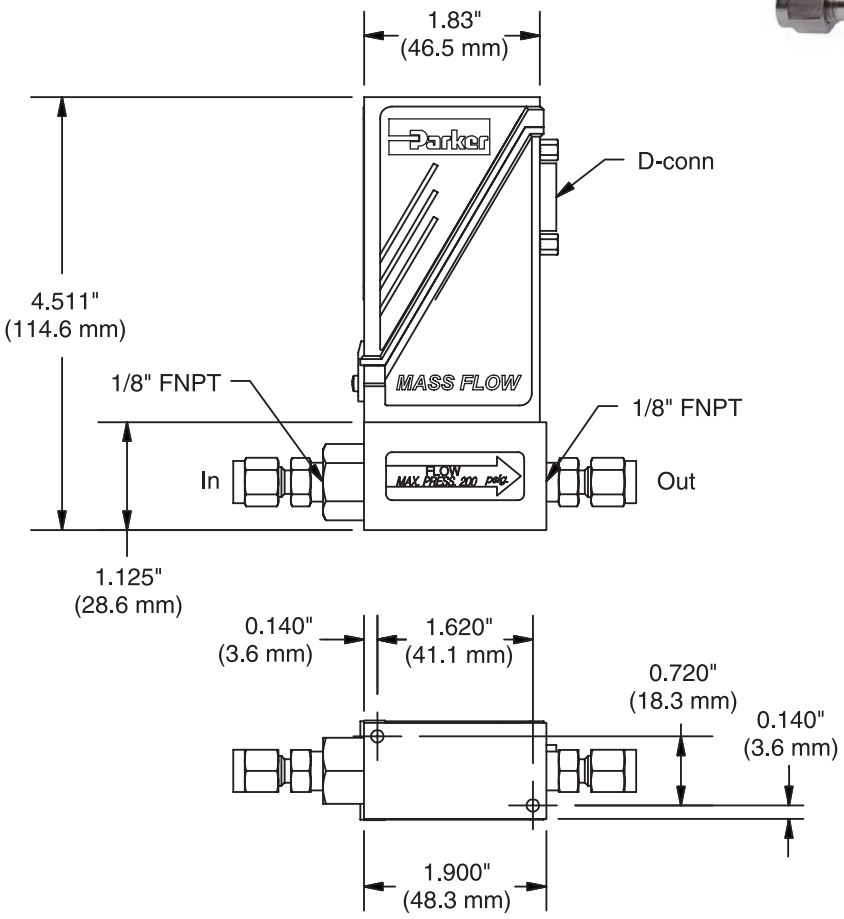
Mass flow measurement consists of a bypass sensing tube with a heater wound around the center of the sensing tube and precision resistance type temperature sensors located equidistant upstream and downstream of the heater. A laminar flow element package, located in the main flow stream, acts as an appropriate restriction creating a pressure drop forcing a fixed percentage of the total flow, approximately 10 sccm, through the bypass sensing tube for temperature differential detection. As gas flows through the sensing tube, heat is displaced to the downstream temperature sensor creating a temperature differential between the upstream and downstream temperature sensors. The upstream and downstream temperature sensors form two legs of a bridge network at the sensor assembly inputs to the PCB. The resulting temperature differential is amplified on the PCB assembly to a 0-5 VDC output signal directly proportional to the gas mass flow rate. To ensure an accurate flow measurement, flow disturbances must be eliminated or greatly reduced. Accordingly, both the sensor tube and the laminar flow element package are designed for laminar flow. Actual gas or gas factors are used in calibration to account for the specific heat of the measured gas.

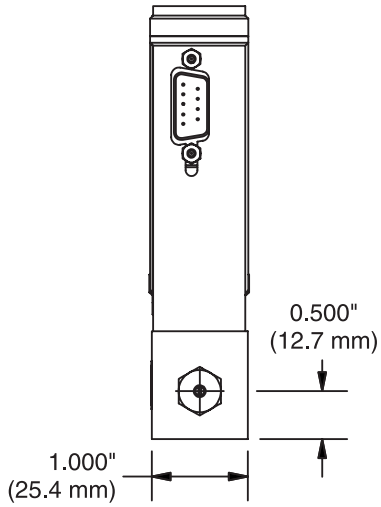
Series 2200 Thermal Mass Flow Meters

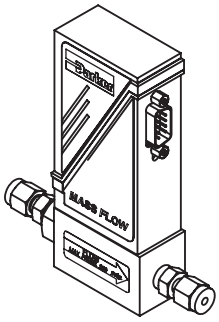
Mechanical Integration

Dimensions

Basic Dimensions Model 2211





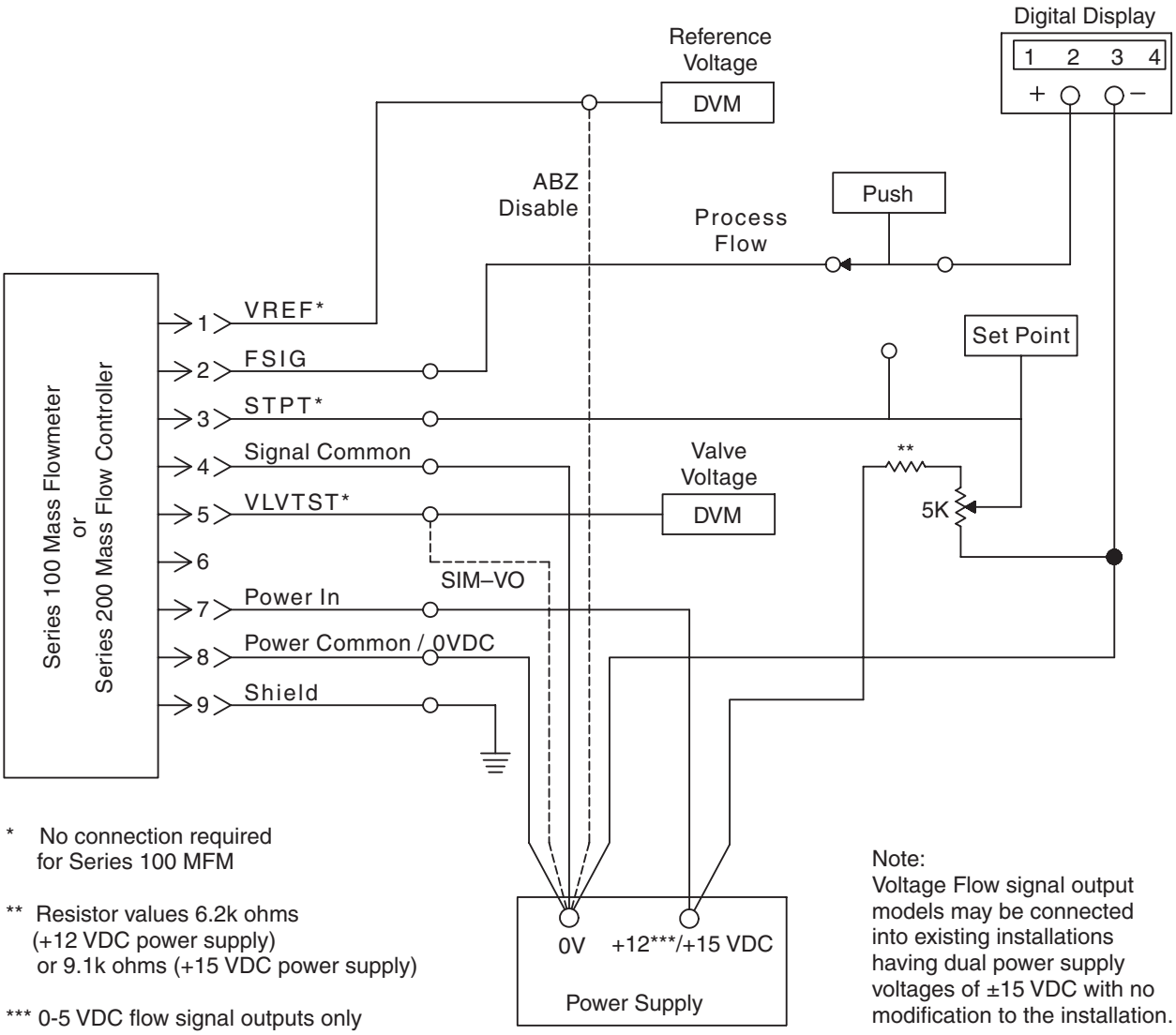


Model	2211
Weight	3.7 lbs (1.7 kg)

Units
In (mm)

Series 2200 Thermal Mass Flow Meters

Electrical Integration and Recommendation



* No connection required for Series 100 MFM

** Resistor values 6.2k ohms (+12 VDC power supply) or 9.1k ohms (+15 VDC power supply)

*** 0-5 VDC flow signal outputs only

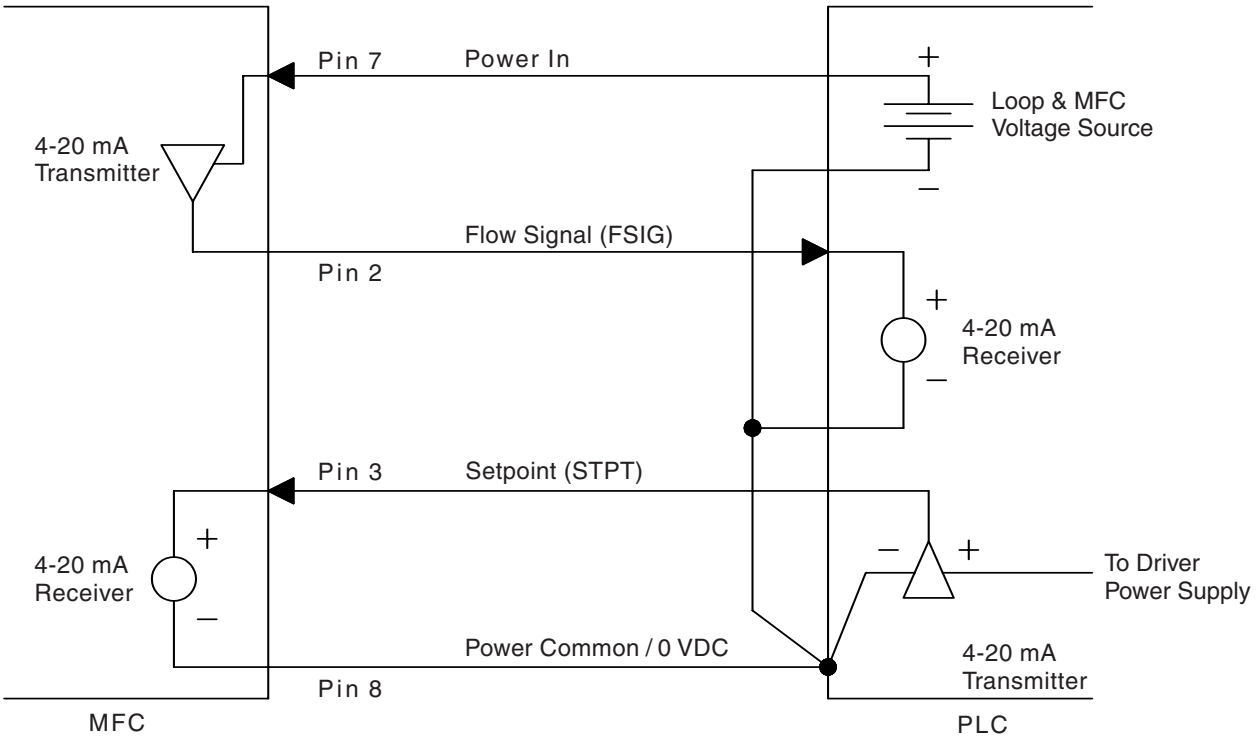
Note:
Voltage Flow signal output models may be connected into existing installations having dual power supply voltages of ±15 VDC with no modification to the installation.

Parker-Supplied Cable Assembly Color Codes		
Signal	**Connector Pin**	
	No.	**Insulation Color**
Voltage Reference	1	Brown
Flow Signal	2	Red
Setpoint	3	Yellow
Signal Common	4	Green
Valve Test	5	Blue
Open	6	Violet or White
Power In	7	Orange
Power Common /0 VDC	8	Black
Shield (Drain Wire)	9	Shield (Drain Wire)

Note: Cable color codes are for reference only and are subject to change without notice

Series 2200 Thermal Mass Flow Meters

Electrical Integration and Recommendation



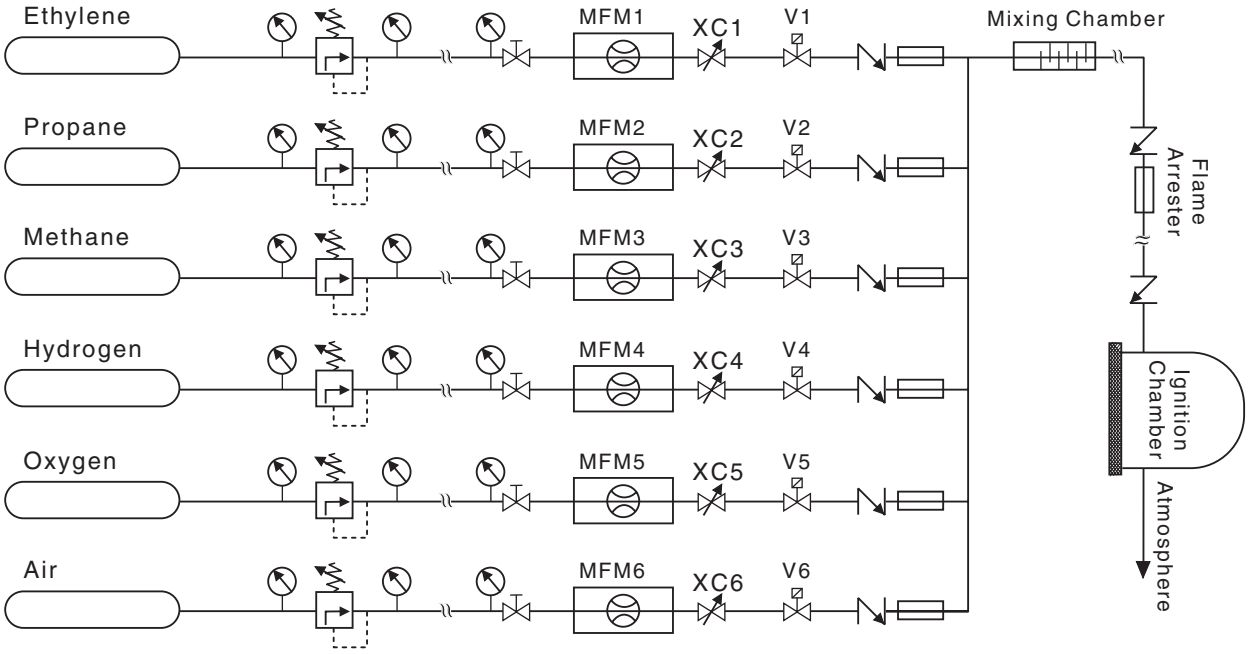
Notes:
1. Setpoint: 4-20 mA
2. For input/output designations (i.e., iondividual pin functions)fo pin numbers not shown, refer to electrical integration drawing on previous page.

Parker-Supplied Cable Assembly Color Codes		
Signal	Connector Pin	
	No.	Insulation Color
Voltage Reference	1	Brown
Flow Signal	2	Red
Setpoint	3	Yellow
Signal Common	4	Green
Valve Test	5	Blue
Open	6	Violet or White
Power In	7	Orange
Power Common /0 VDC	8	Black
Shield (Drain Wire)	9	Shield (Drain Wire)

Note: Cable color codes are for reference only and are subject to change without notice

Series 2200 Thermal Mass Flow Meters

Typical Flow Diagram



Series 2200 Thermal Mass Flow Meters

Installation Guide

- Clean dry area with adequate space
- Indoor use only
- Follow process connection manufacturer guidelines and leak check all connections
- Purge all gas lines with nitrogen before installation
- Remove all loose particulate or debris from system

Key Things to Remember:

- Standard Flow Sizing Specifications
  1. Gas Type
  2. Flow Rate
  3. Inlet Pressure
  4. Outlet Pressure
  5. Operating Temperature
  6. Standard Calibration Condition*
  7. Connection Fitting Size and Type
  8. Set point/Output signal
- CM-400 4-channel Power Supply/Control
- Power Cables
- PN: C-700-002, Interface cable with flying leads on one end
- PN: C-1666-010, CABLE ASSY, MFC, CM-400

* Default standard calibration conditions = 21.1C and 14.7 PSIA. Consult Applications for support to specify other common calibration standards such as: 0C, 20C, 25C.

Series 2200 Thermal Mass Flow Meters

Ordering Information

Model Number Example:

2211-	A	A	A	V	C	1	AA

Nominal Range - Nitrogen Equivalent*

Model	Rev	Description
2211-	A	±1% FS, 40 sccm to 10 slpm

* **Note:** The flow ranges listed are minimum and maximum nitrogen (N2) flow ranges available for each given model. Intermediate flow ranges are available. For correct sizing when operating parameters are questionable, please consult the factory.

Assembly/Calibration Features

Code	Description
AA	Standard, Calibrated Horizontally
AW	Calibrated Vertically (Inlet Down)
AS	CE Appproved Design

Setpoint Signal/Output Signal

Code	Description
A	0-5 VDC/0-5 VDC
E	0-10 VDC/0-10 VDC
H	4-20 mAdc (sourcing)
K*	0-5 VDC/0-5 VDC - CE Approved Design

* NX CE Approved Design Assembly/Calibration feature must be selected in tandem with W 9-Pin CE approved design PC-board.

Fitting Size and Type

Code	Description
1	1/8" FNPT
2	1/8" Compression
4	1/4" Compression

Material of Construction Body/Orifice Inlet Adapter

Code	Description
A	Aluminum/Brass/Brass
C	Aluminum/St. Stl./St. Stl.

Elastomers (Valve Seat/O-Rings)

Code	Description
B	Buna N
E	EPDM
N	Neoprene
V	FKM

Orifice Size

Code	Description
A	.003 Orifice
B	.004 Orifice
C	.008 Orifice
D	.012 Orifice
E	.021 Orifice
F	.028 Orifice
G	.030 Orifice
H	.039 Orifice
J	.047 Orifice
K	.055 Orifice
L	.006 Orifice
M	.010 Orifice
X	None

Note: Consult Factory for Proper Orifice Selection.

NOTE: In order to provide the best possible solution for your application, please provide the following requirements when contacting Applications Engineering:

- Media, Inlet & Outlet Pressures
- Minimum Required Flow Rate.

For more detailed information, visit us on the web or call Applications Engineering.

Parker Hannifin Precision Fluidics Division reserves the right to make changes. Drawings are for reference only.

Series 100 Thermal Mass Flow Meters

Portfolio Review

Customization

Contact Division Applications at (603) 595 1500 or ppfinfo@parker.com.

Model 111

Model 112

Model 113

Model 114

Model 2211

Type	Model	Min. Flow (sccm)	Min. Flow (slpm)	Max. Flow[1] (slpm)	Max. Pressure[2] (psig)	Min. Delta[3] (psig)
Analog Flow Meters	111	5	—	10	1500	2
	112	—	10	100	1500	2
	113	—	100	500	1000	2
	114	—	500	1000	1000	2
	2211	40	—	10	200	2

[1] The maximum full scale flow rate available.
[2] The maximum operating inlet pressure available.
[3] The minimum required pressure differential for maximum full scale

Series 200 Thermal Mass Flow Controllers

Traditional Analog Flow Control

Parker Series 200 Thermal Mass Flow Controllers provide reliable analog flow measurements configured for your process conditions. Each controller offers a linear flow signal output proportional to a calibrated flow rate and is available with a D-connector.

The Series 200 Thermal Mass Flow Controllers include the following models:

201 202 202A 203A 204A 251 261

Typical Applications

- Bioreactor Gas Management
- Burner Ratio Control for Ceramics and Metals
- Environmental Analyzers – Carrier Gas Control
- Laboratory and Process Gas Chromatography
- Environmental and Emissions Monitoring

Features

- Fast response to setpoint changes
- Stable Zero Control Preventing Gas Flow Overshoot
- Soft recovery valve override preventing process system damage
- Normally closed control valve for safe operation
- Cleaned for Analytical Service Use
- RoHS and REACH compliant

Product Specifications

Physical Properties

Sensor Technology:
Thermal Sensor, Bypass Method

Media:
Air, Nitrogen, Helium, Argon, Hydrogen, Oxygen, Krypton, Neon, Xenon and other non-corrosive primary and blended gases

Width:
See Dimensional Drawing

Length:
See Dimensional Drawing

Height:
See Dimensional Drawing

Weight:
1.2 lbs (0.54 kg) (typical)
See weights provided on each Dimensions page

Porting:
1/8", 1/4", 3/8" compression; 1/4", 3/8" CPI; 1/4", 3/8" A-Lok; 1/4" MMGFS*

*Male Metal Gasket Face Seal

Electrical

Main Voltage: 24 VDC + 10%

Input Control Signal:
0-5 VDC standard

Monitor Output Voltage:
0-5 VDC standard

Max Current Requirement:
< 400 mA

Setpoint / Flow Signal I/O:
0-5, 0-10 VDC; 4-20 mA

Wetted Materials

Body:
316 Stainless Steel, Siliconert

Sensor Assembly:
316L Stainless Steel

Orifice:
316 Stainless Steel

Valve Components:
302, 316, 430F Stainless Steel or Sandvik 1802

O-Rings and Valve Seat:
Buna-N, FKM, FFKM, Neoprene

Performance Ratings

Ratings:
Max operating pressure:
1,000 psig (69 barg)
Max working temperature:
158°F (70°C)

Minimum Pressure Drop:
7 psid (0.48 bard)

Performance Characteristics

Accuracy and Linearity:
±1% Full Scale

Repeatability:
Within ±0.2% Full Scale at any constant temperature within operating temperature range

Response Time: 1-2 sec

Rangeability:
50:1 (2-100% Full Scale)

Temperature Coefficient:
±0.05% Full Scale / °C of zero;
±0.05% of reading / °C of span

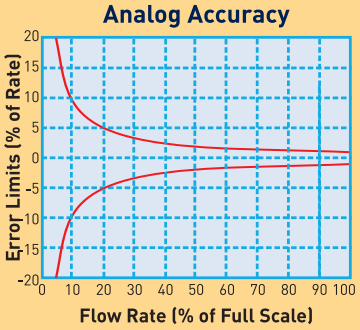
Warm-Up Time: 10 minutes

Flow Control Range:
0.5 sccm to 0-1000 slpm (nitrogen equivalent)

Series 200 Thermal Mass Flow Controllers

Accuracy

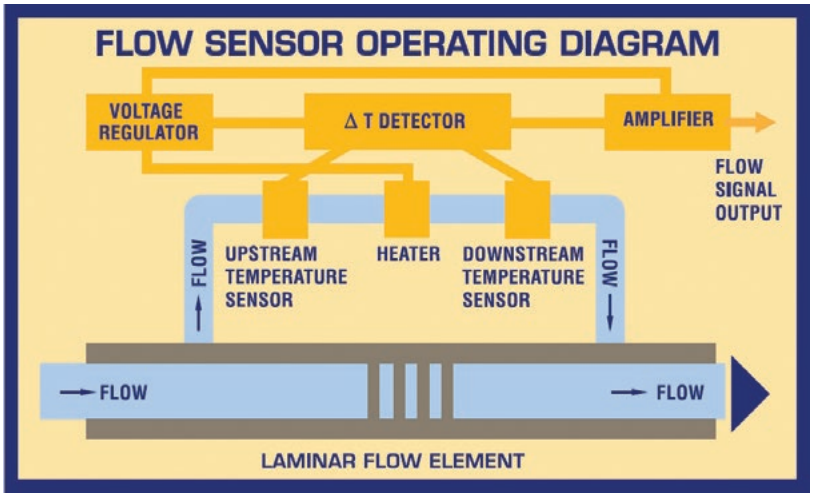
Parker mass flow meters and controllers offer standard ±1.0% and ±2.0% full scale accuracy of calibrated span referenced to nitrogen at 21.1°C and 14.7 PSIA. Gas correction factors may be used to determine the equivalent flow rate of your process gas or, for an additional cost, live gas calibrations at a different reference temperature and pressure are also available.



Principle of Operation

Parker Series 200 Mass Flow Controllers (MFC) incorporate an operating principle based on the thermodynamic properties of the process gas being measured.

Mass flow measurement relates to the amount of heat absorbed by the process gas. The amount of heat the gas absorbs is determined by the gas molecular structure. Specific heat, the amount of heat required to raise the temperature of one gram of a given gas one degree centigrade quantitatively describes this “thermal absorbency”.



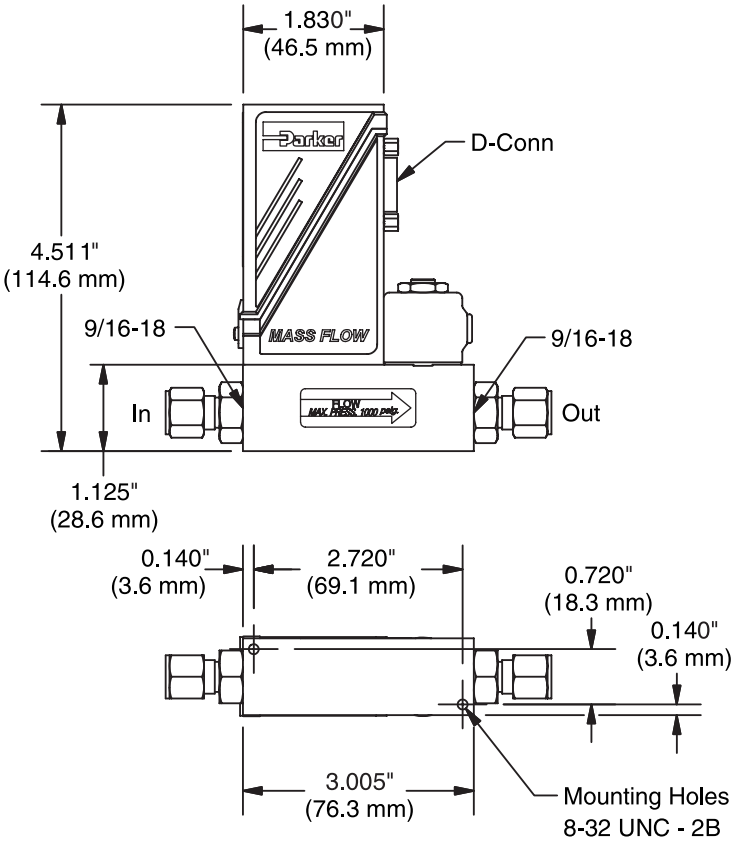
Mass flow measurement consists of a bypass sensing tube with a heater wound around the center of the sensing tube and precision resistance type temperature sensors located equidistant upstream and downstream of the heater. A laminar flow element package, located in the main flow stream, acts as an appropriate restriction creating a pressure drop forcing a fixed percentage of the total flow, approximately 10 sccm, through the bypass sensing tube for temperature differential detection. As gas flows through the sensing tube, heat is displaced to the downstream temperature sensor creating a temperature differential between the upstream and downstream temperature sensors. The upstream and downstream temperature sensors form two legs of a bridge network at the sensor assembly inputs to the PCB. The resulting temperature differential is amplified on the PCB assembly to a 0-5 VDC output signal directly proportional to the gas mass flow rate. To ensure an accurate flow measurement, flow disturbances must be eliminated or greatly reduced. Accordingly, both the sensor tube and the laminar flow element package are designed for laminar flow. Actual gas or gas factors are used in calibration to account for the specific heat of the measured gas.

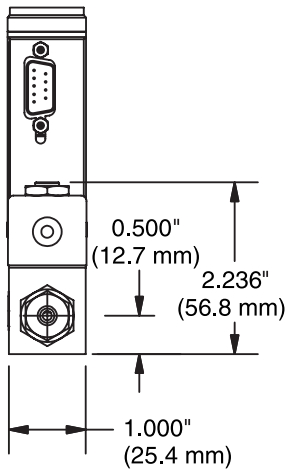
Series 200 Thermal Mass Flow Controllers

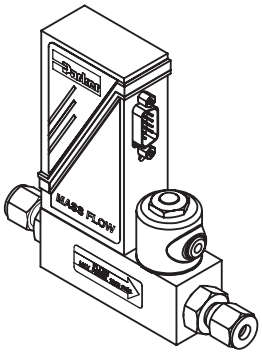
Mechanical Integration

Dimensions

Basic Dimensions Model 201







Model	201
Weight	3.1 lbs (1.4 kg)

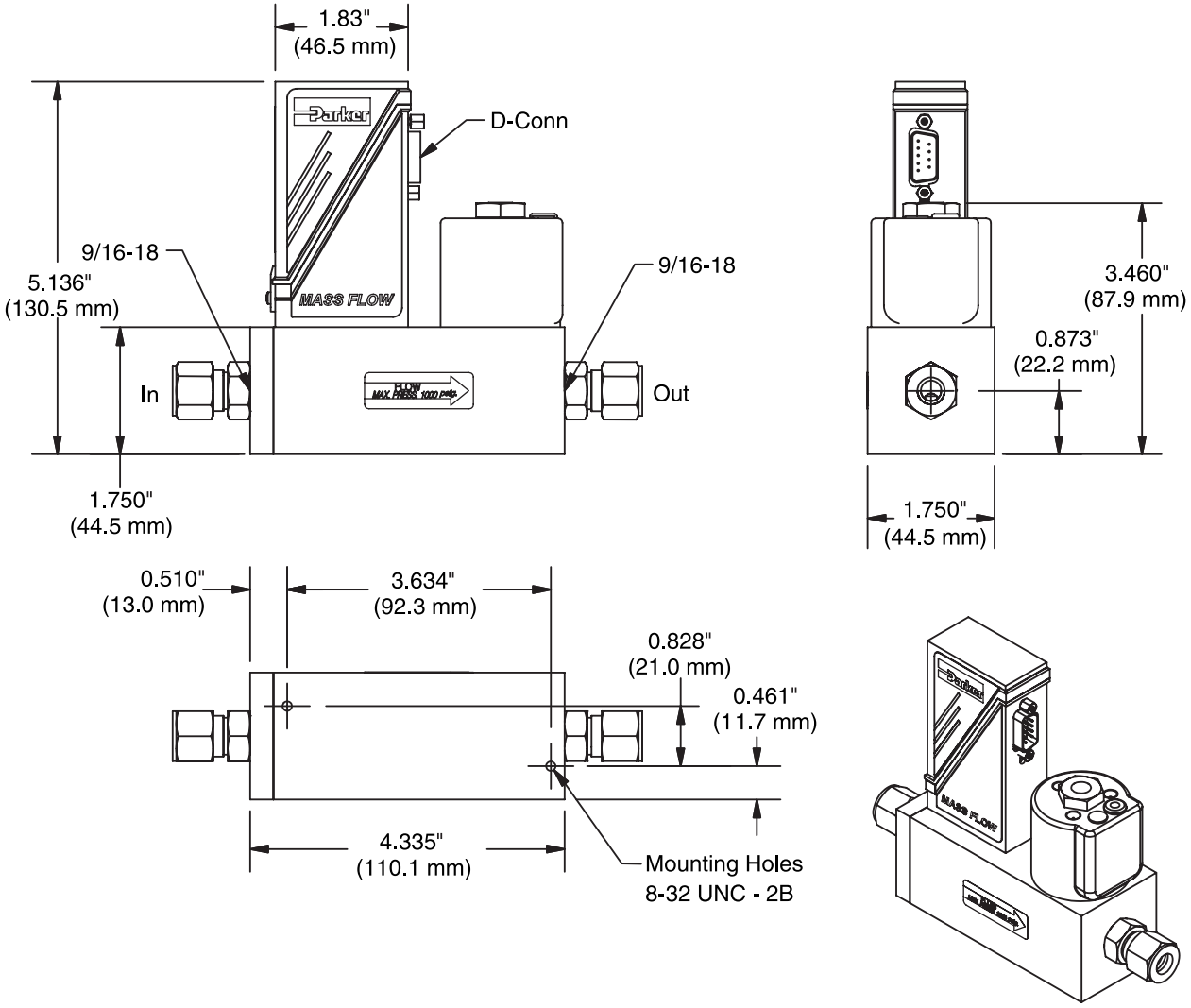
Units
In (mm)

Series 200 Thermal Mass Flow Controllers

Mechanical Integration

Dimensions

Basic Dimensions Models 202



Model	202
Weight	4.6 lbs (2.1 kg)

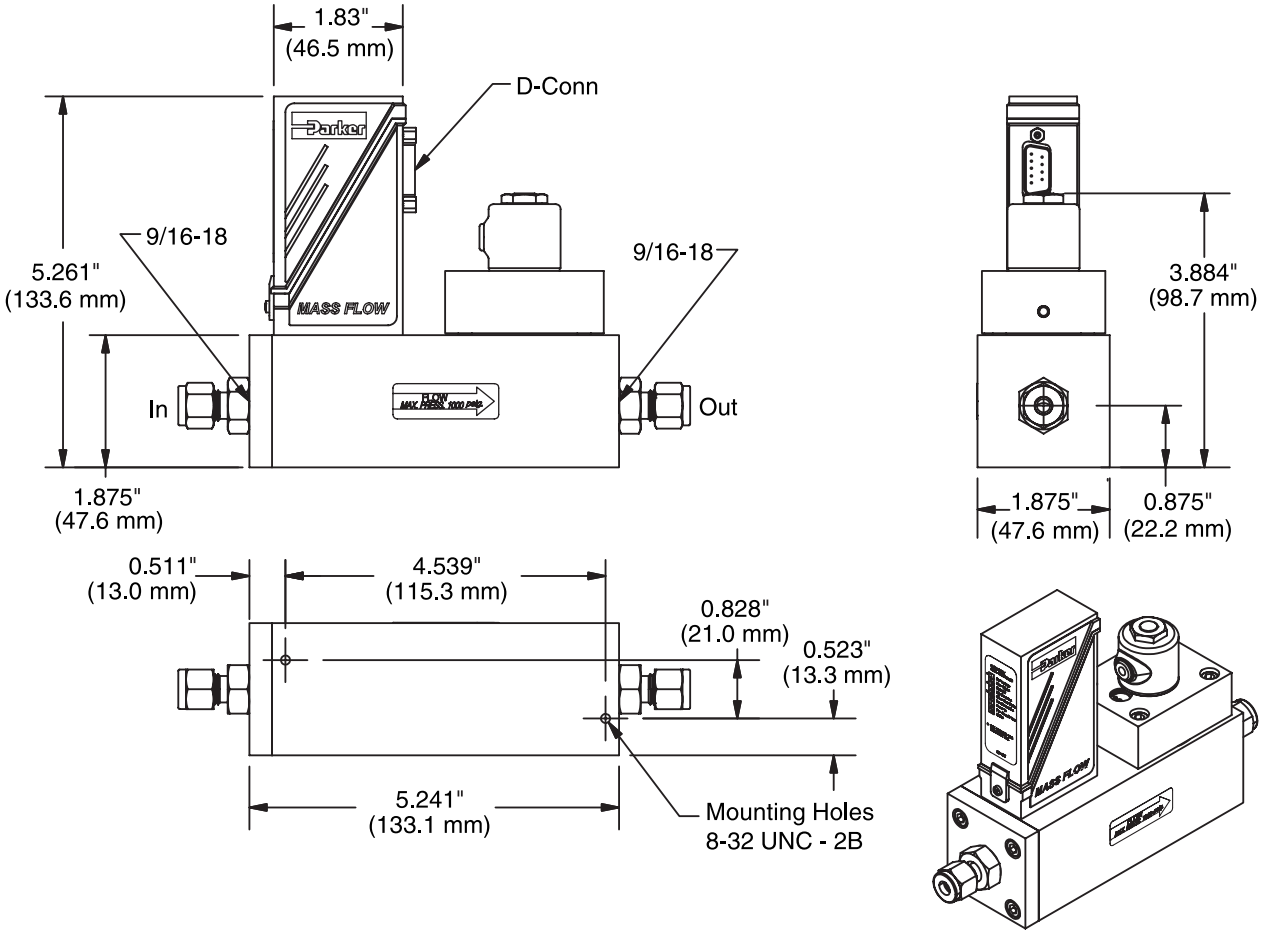
Units
In (mm)

Series 200 Thermal Mass Flow Controllers

Mechanical Integration

Dimensions

Basic Dimensions Models 202A



Model	202A
Weight	5.8 lbs (2.6 kg)

Units
In (mm)

Series 200 Thermal Mass Flow Controllers

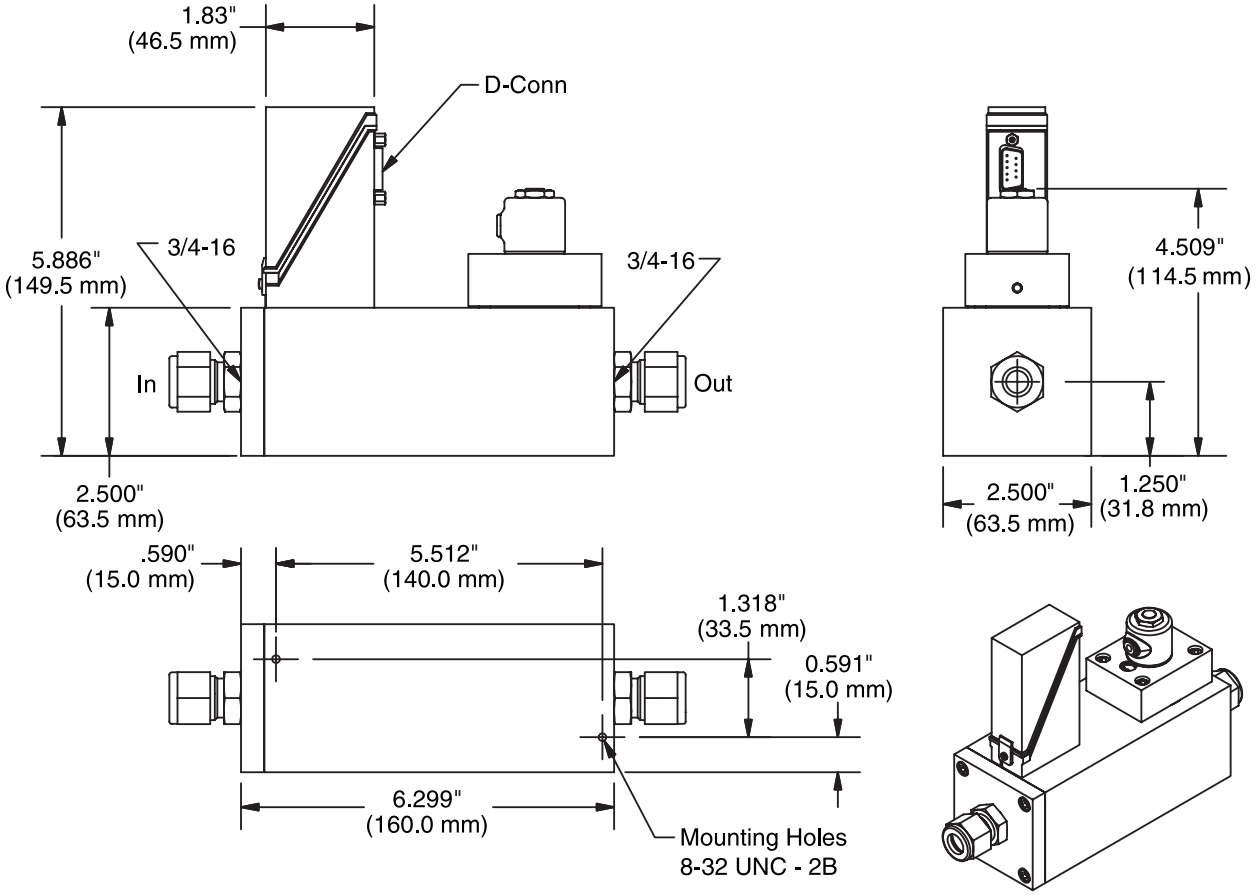
Mechanical Integration

Dimensions

Basic Dimensions Models 203A and 204A

Model 203A

Model 204A



Model	203A	204A
Weight	10.9 lbs (4.9 kg)	10.9 lbs (4.9 kg)

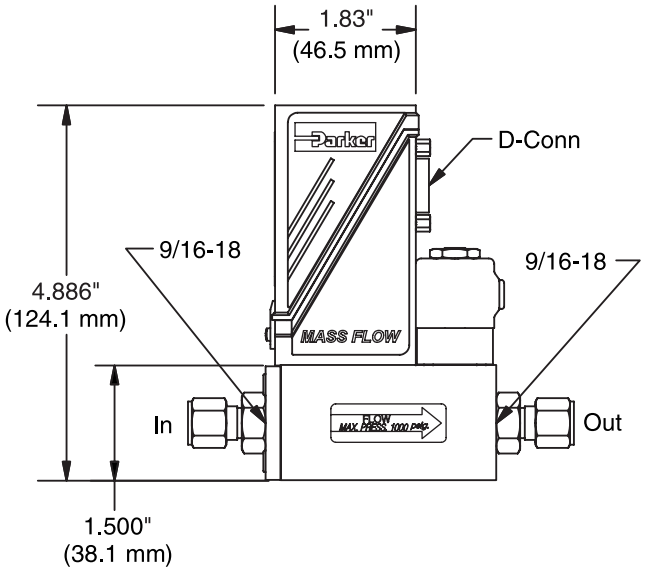
Units
In (mm)

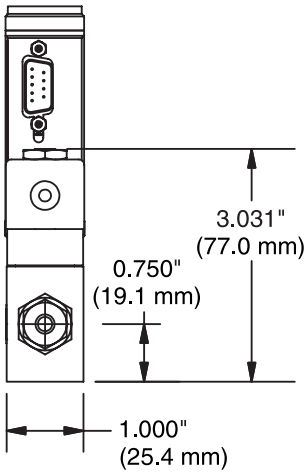
Series 200 Thermal Mass Flow Controllers

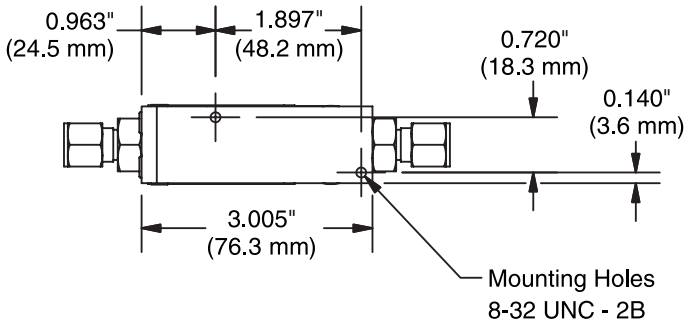
Mechanical Integration

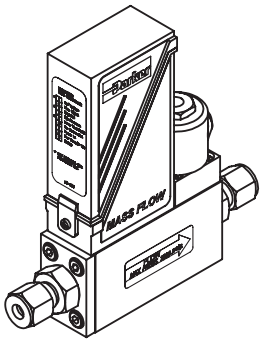
Dimensions

Basic Dimensions Model 251









Model	251
Weight	1.4 lbs (0.6 kg)

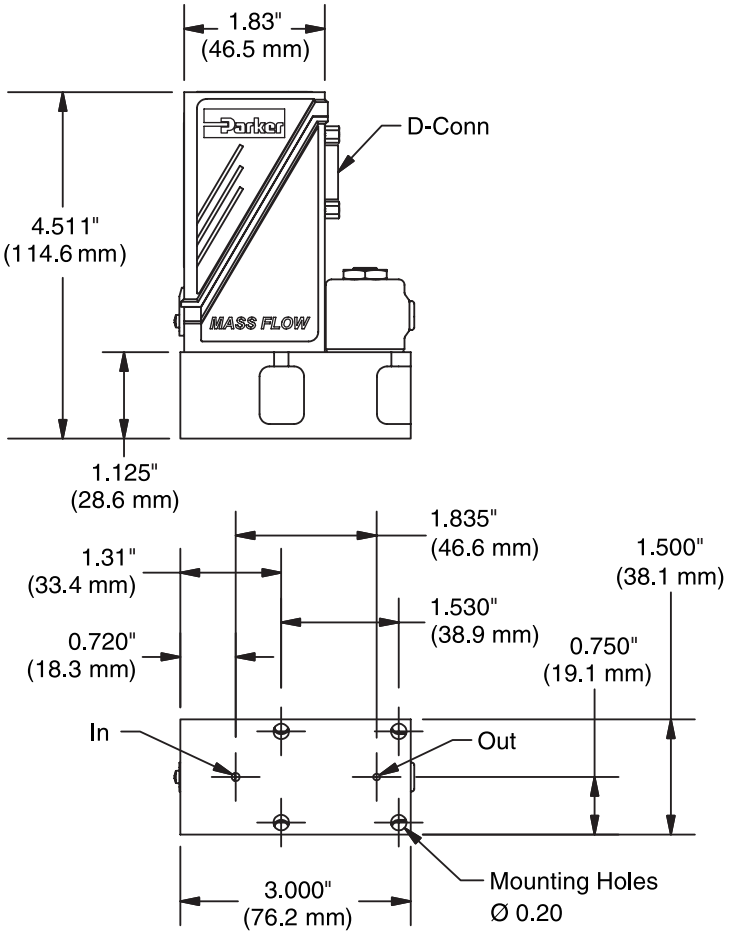
Units
In (mm)

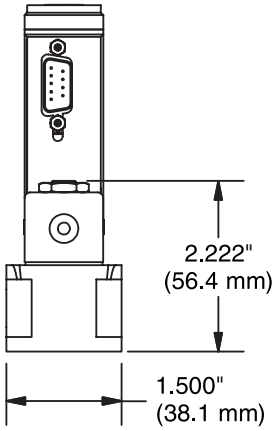
Series 200 Thermal Mass Flow Controllers

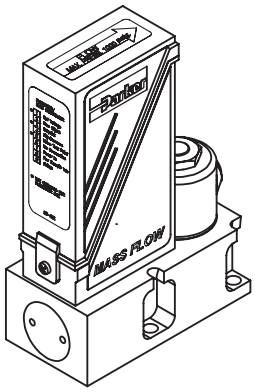
Mechanical Integration

Dimensions

Basic Dimensions Model 261





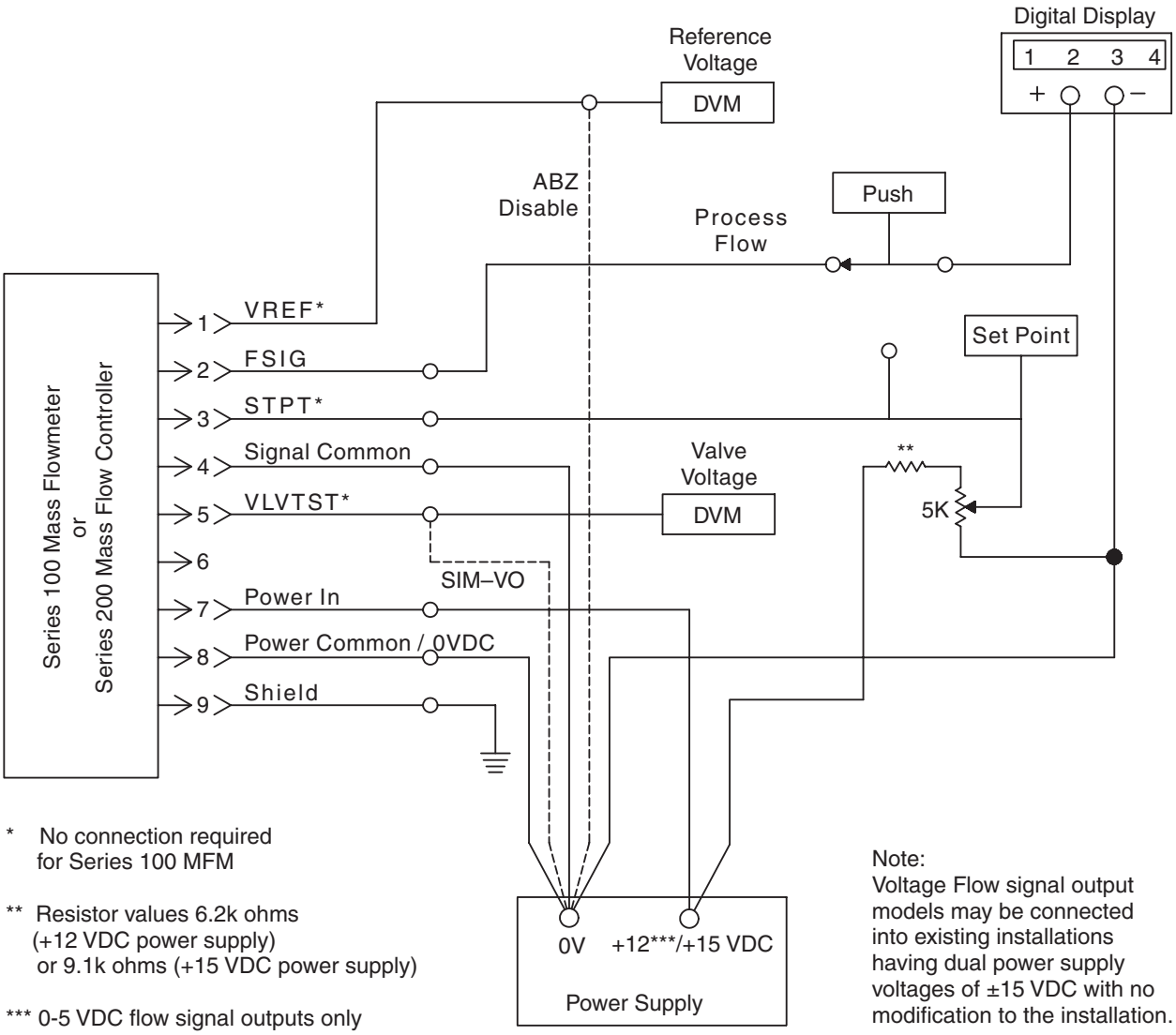


Model	261
Weight	3.4 lbs (1.5 kg)

Units
In (mm)

Series 200 Thermal Mass Flow Controllers

Electrical Integration and Recommendation



* No connection required for Series 100 MFM

** Resistor values 6.2k ohms (+12 VDC power supply) or 9.1k ohms (+15 VDC power supply)

*** 0-5 VDC flow signal outputs only

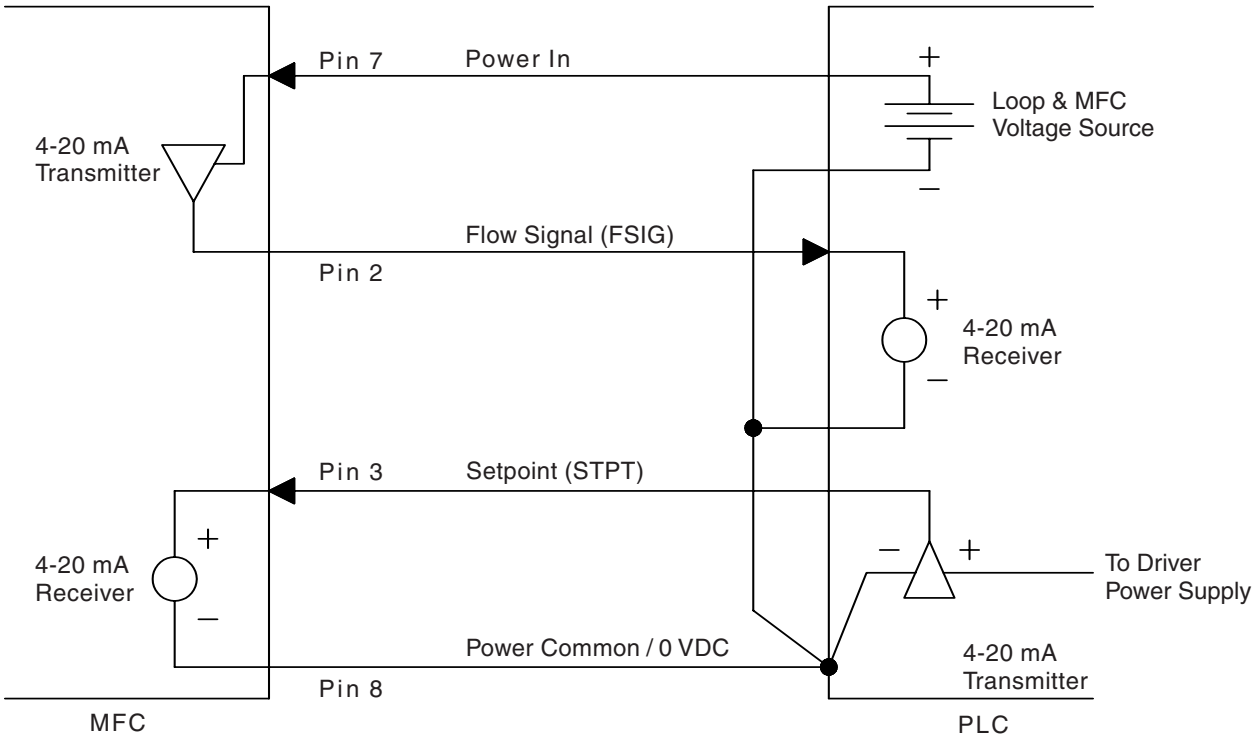
Note:
Voltage Flow signal output models may be connected into existing installations having dual power supply voltages of ±15 VDC with no modification to the installation.

Parker-Supplied Cable Assembly Color Codes		
Signal	**Connector Pin**	
	No.	**Insulation Color**
Voltage Reference	1	Brown
Flow Signal	2	Red
Setpoint	3	Yellow
Signal Common	4	Green
Valve Test	5	Blue
Open	6	Violet or White
Power In	7	Orange
Power Common /0 VDC	8	Black
Shield (Drain Wire)	9	Shield (Drain Wire)

Note: Cable color codes are for reference only and are subject to change without notice

Series 200 Thermal Mass Flow Controllers

Electrical Integration and Recommendation



Notes:
1. Setpoint: 4-20 mA
2. For input/output designations (i.e., iondividual pin functions)fo pin numbers not shown, refer to electrical integration drawing on previous page.

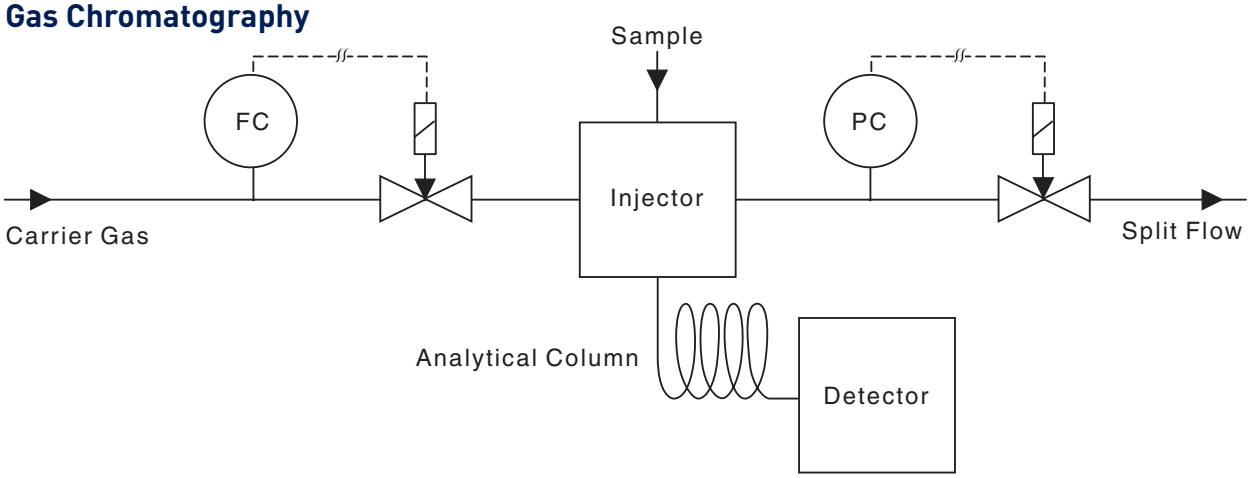
Parker-Supplied Cable Assembly Color Codes		
Signal	Connector Pin	
	No.	Insulation Color
Voltage Reference	1	Brown
Flow Signal	2	Red
Setpoint	3	Yellow
Signal Common	4	Green
Valve Test	5	Blue
Open	6	Violet or White
Power In	7	Orange
Power Common /0 VDC	8	Black
Shield (Drain Wire)	9	Shield (Drain Wire)

Note: Cable color codes are for reference only and are subject to change without notice

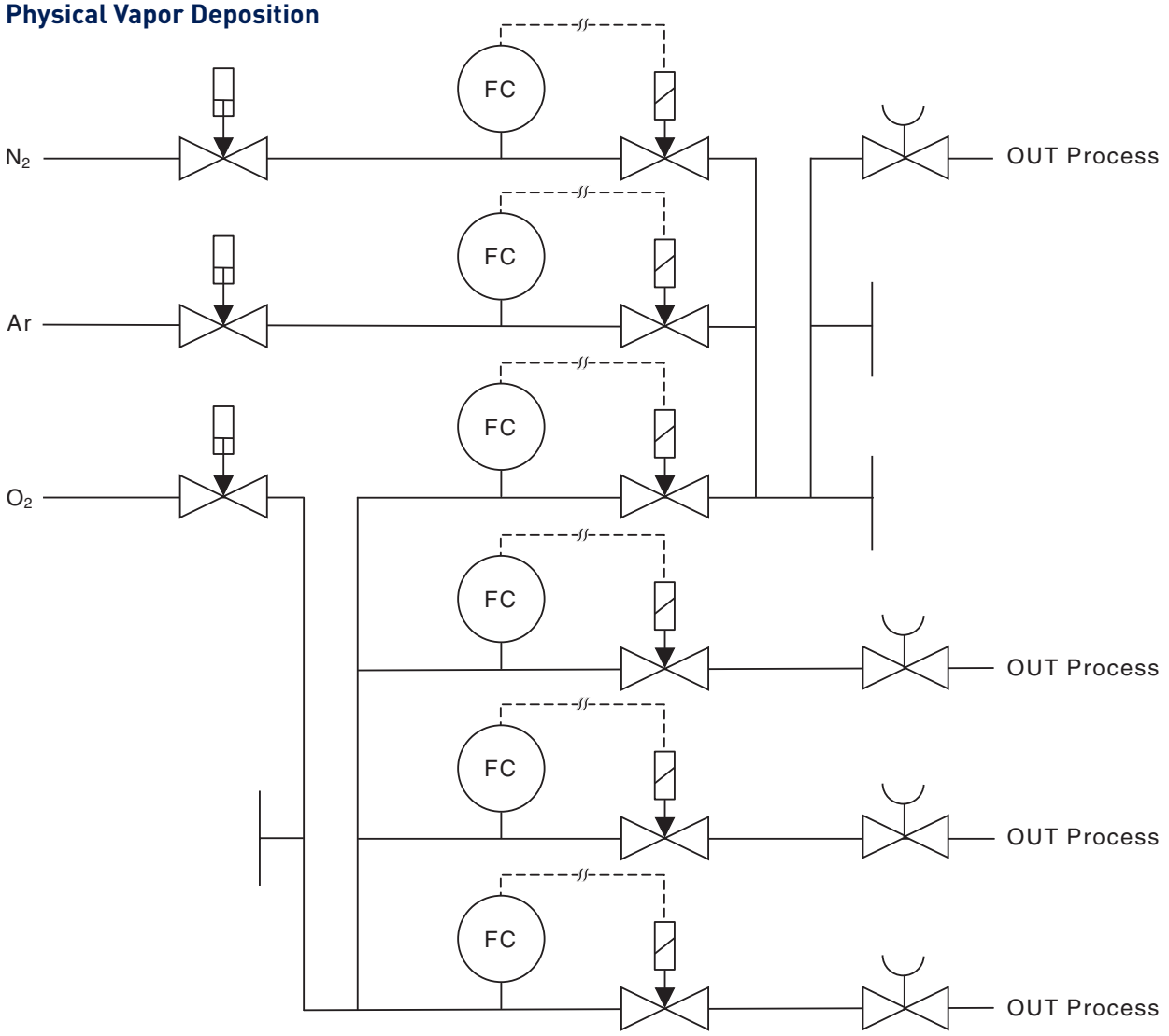
Series 200 Thermal Mass Flow Controllers

Typical Flow Diagram

Gas Chromatography



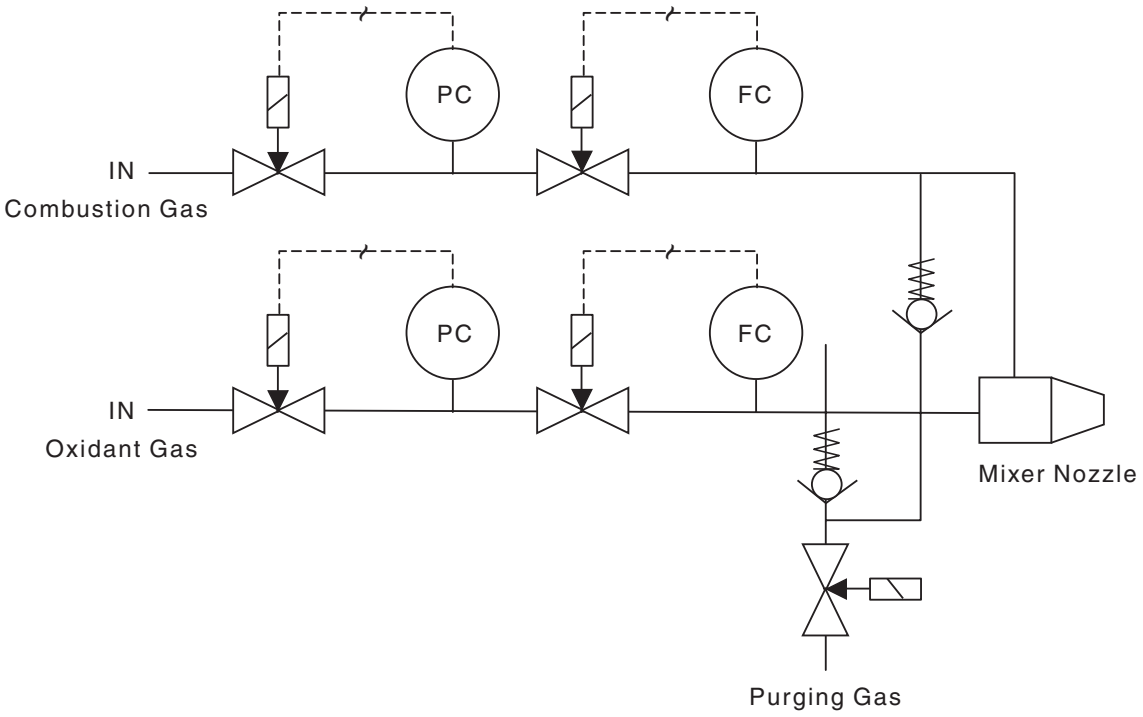
Physical Vapor Deposition



Series 200 Thermal Mass Flow Controllers

Typical Flow Diagram

Burn Ratio Control



Series 200 Thermal Mass Flow Controllers

Installation Guide

- Clean dry area with adequate space
- Indoor use only
- Follow process connection manufacturer guidelines and leak check all connections
- Purge all gas lines with nitrogen before installation
- Remove all loose particulate or debris from system

Key Things to Remember:

- Standard Flow Sizing Specifications
  1. Gas Type
  2. Flow Rate
  3. Inlet Pressure
  4. Outlet Pressure
  5. Operating Temperature
  6. Standard Calibration Condition*
  7. Connection Fitting Size and Type
  8. Set point/Output signal
- CM-400 4-channel Power Supply/Control
- Power Cables
- PN: C-700-002, Interface cable with flying leads on one end
- PN: C-1666-010, CABLE ASSY, MFC, CM-400

* Default standard calibration conditions = 21.1C and 14.7 PSIA. Consult Applications for support to specify other common calibration standards such as: 0C, 20C, 25C.

Series 200 Thermal Mass Flow Controllers

Ordering Information

Model Number Example:

202A	F	K	A	S	V	X	AA

Nominal Range - Nitrogen Equivalent*

Model	Rev	Description
201-	F	±1% FS, 5 sccm to 10 slpm
202-	F	±1% FS, 10 slpm to 100 slpm
202A	F	±1% FS, 5 sccm to 10 slpm
203A	F	±1% FS, 100 slpm to 500 slpm
204A	F	±1% FS, 100 slpm to 1000 slpm
251-	F	±1% FS, 10 slpm to 50 slpm
261-	F	±1% FS, 5 sccm to 10 slpm

* **Note:** The flow ranges listed are minimum and maximum nitrogen (N2) flow ranges available for each given model. Intermediate flow ranges are available. For correct sizing when operating parameters are questionable, please consult the factory.

PC -Board Electrical Connector

Code	Description
K	Nine (9)-Pin "D"
W [1]	Nine (9)-Pin "D" CE Approved Design

Setpoint Signal / Output Signal

Code	Description
A	0-5 VDC / 0-5 VDC
E	0-10 VDC / 0-10 VDC
H	4-20 mAdc (sourcing)

Body Material

Code	Description
S	Stainless Steel
J	Stainless Steel / Silconert [2]

Assembly / Calibration Features

Code	Description
AA	Standard, Calibrated Horizontally
CP	Environmental Chamber Calibration
EY	Calibrated Vertically (Inlet Down)
NX [1]	CE Appproved Design

Fitting Size and Type

Code	Description
B	Compression - 1/8"
C	Compression - 1/4"
D	Compression - 3/8"
E	Compression - 1/2"
G	Compression - 3/4"
P	Male Metal Gasket Face Seal - 1/4"
Q	Male Metal Gasket Face Seal - 3/8"
S	Male Metal Gasket Face Seal - 1/2"
X	Without Fitting

Note: Fitting Size Restricted by Model Size.
Note: Additional Fitting Types Available.
Consult Factory for Availability & Restrictions.

Elastomers (Valve Seat / O-Rings)

Code	Description
B	Buna N
E	EPDM
K	FFKM
N	Neoprene
V	FKM

Note: Models 202A / 203A / 204A Available With Buna N Or FKM Only

[1] NX CE Approved Design Assembly / Calibration feature must be selected in tandem with W 9-Pin CE approved design PC-board.

[2] Consult factory for information pertaining to the Silconert process and estimated additional lead times.

NOTE: In order to provide the best possible solution for your application, please provide the following requirements when contacting Applications Engineering:

- Media, Inlet & Outlet Pressures
- Minimum Required Flow Rate.

For more detailed information, visit us on the web or call Applications Engineering.

ORDER ON-LINE

Parker Hannifin Precision Fluidics Division reserves the right to make changes. Drawings are for reference only.

Series 2200 Thermal Mass Flow Controllers

Traditional Analog Flow Control

Parker Model 2201 Thermal Mass Flow Controllers provide reliable analog flow measurements configured for your process conditions. Choose Model 2201 when you need performance at an economical price.

Typical Applications

- Bioractor Gas Management
- Burner Ratio Control for Ceramics and Metals
- Environmental Analyzers – Carrier Gas Control
- Laboratory and Process Gas Chromatography
- Environmental and Emissions Monitoring

Features

- Stable Zero Control Preventing Gas Flow Overshoot
- Soft recovery valve override preventing process system damage
- Normally closed control valve for safe operation
- Cleaned for Analytical Service Use
- RoHS and REACH compliant

Product Specifications

Physical Properties

Sensor Technology:
Thermal Sensor, Bypass Method

Media:
Air, Nitrogen, Helium, Argon, Hydrogen, Oxygen, Krypton, Neon, Xenon and other non-corrosive primary and blended gases

Width:
See Dimensional Drawing

Length:
See Dimensional Drawing

Height:
See Dimensional Drawing

Weight:
1.2 lbs (0.54 kg) (typical)
See weights provided on each Dimensions page

Porting:
1/8", 1/4", 3/8" compression; 1/4", 3/8" CPI; 1/4", 3/8" A-Lok; 1/4" MMGFS*

*Male Metal Gasket Face Seal

Electrical

Main Voltage: 24 VDC + 10%

Input Control Signal:
0-5 VDC standard

Monitor Output Voltage:
0-5 VDC standard

Max Current Requirement:
< 400 mA

Setpoint/Flow Signal I/O:
0-5, 0-10 VDC; 4-20 mA

Wetted Materials

Body:
Aluminum

Sensor Assembly:
C36000 Brass (standard)
316 Stainless Steel (optional)

Orifice:
C36000 Brass (standard)
316 Stainless Steel (optional)

Valve Components:
302, 316, 430F Stainless Steel or Sandvik 1802

O-Rings and Valve Seat:
Buna-N, FKM, FKKM, Neoprene

Performance Ratings

Ratings:
Max operating pressure:
1,000 psig (69 barg)
Max working temperature:
158°F (70°C)

Minimum Pressure Drop:
7 psid (0.48 bard)

Performance Characteristics

Accuracy and Linearity:
±2% Full Scale

Repeatability:
Within ±0.2% Full Scale at any constant temperature within operating temperature range

Response Time: 1-2 sec

Rangeability:
50:1 (2-100% Full Scale)

Temperature Coefficient:
±0.05% Full Scale / °C of zero;
±0.05% of reading / °C of span

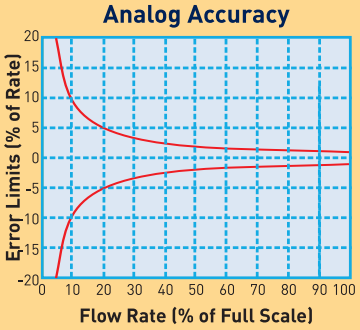
Warm-Up Time: 10 minutes

Flow Control Range:
0.5 sccm to 0-1000 slpm (nitrogen equivalent)

Series 2200 Thermal Mass Flow Controllers

Accuracy

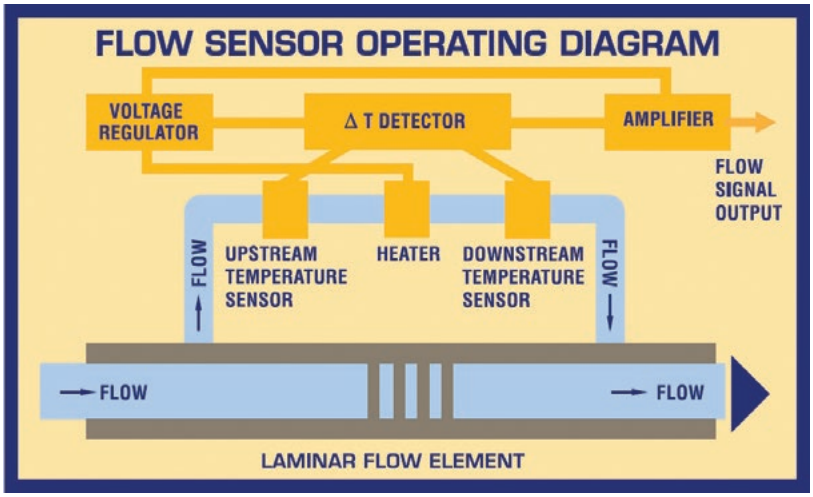
Parker mass flow meters and controllers offer standard ±1.0% and ±2.0% full scale accuracy of calibrated span referenced to nitrogen at 21.1°C and 14.7 PSIA. Gas correction factors may be used to determine the equivalent flow rate of your process gas or, for an additional cost, live gas calibrations at a different reference temperature and pressure are also available.



Principle of Operation

Parker Series 2200 Mass Flow Controllers (MFC) incorporate an operating principle based on the thermodynamic properties of the process gas being measured.

Mass flow measurement relates to the amount of heat absorbed by the process gas. The amount of heat the gas absorbs is determined by the gas molecular structure. Specific heat, the amount of heat required to raise the temperature of one gram of a given gas one degree centigrade quantitatively describes this “thermal absorbency”.



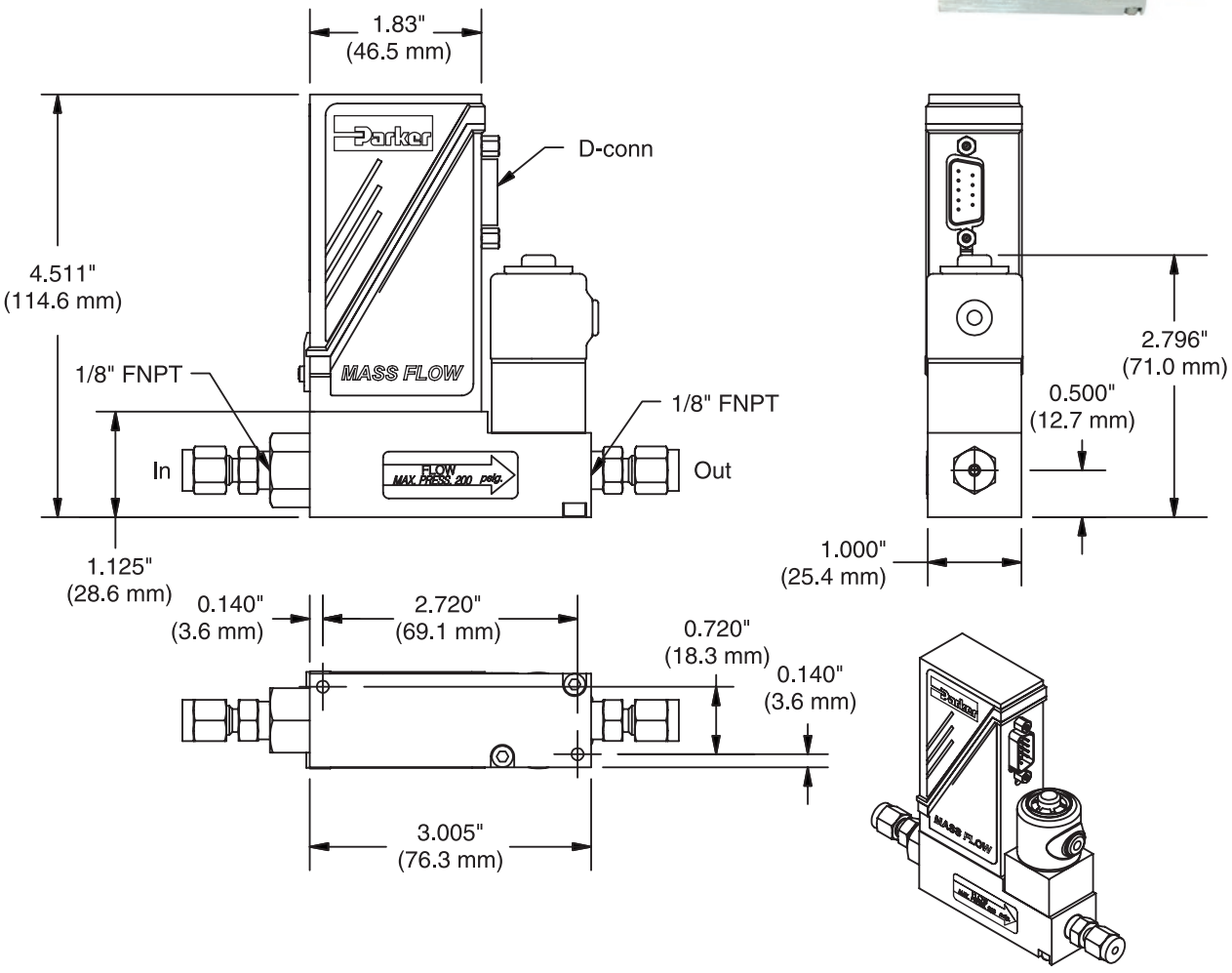
Mass flow measurement consists of a bypass sensing tube with a heater wound around the center of the sensing tube and precision resistance type temperature sensors located equidistant upstream and downstream of the heater. A laminar flow element package, located in the main flow stream, acts as an appropriate restriction creating a pressure drop forcing a fixed percentage of the total flow, approximately 10 sccm, through the bypass sensing tube for temperature differential detection. As gas flows through the sensing tube, heat is displaced to the downstream temperature sensor creating a temperature differential between the upstream and downstream temperature sensors. The upstream and downstream temperature sensors form two legs of a bridge network at the sensor assembly inputs to the PCB. The resulting temperature differential is amplified on the PCB assembly to a 0-5 VDC output signal directly proportional to the gas mass flow rate. To ensure an accurate flow measurement, flow disturbances must be eliminated or greatly reduced. Accordingly, both the sensor tube and the laminar flow element package are designed for laminar flow. Actual gas or gas factors are used in calibration to account for the specific heat of the measured gas.

Series 2200 Thermal Mass Flow Controllers

Mechanical Integration

Dimensions

Basic Dimensions Model 2201

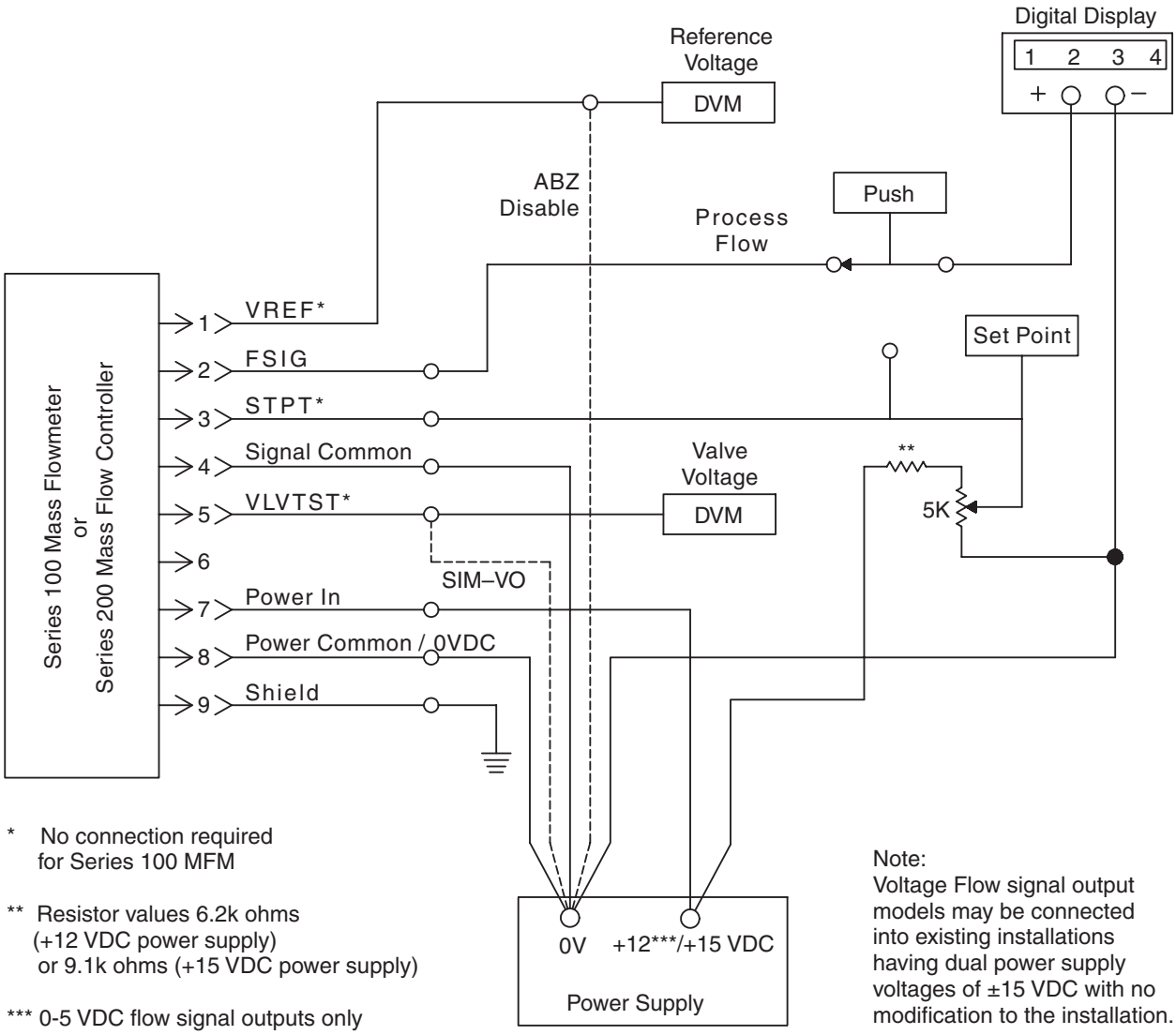


Model	2201
Weight	4.0 lbs (1.8 kg)

Units
In (mm)

Series 2200 Thermal Mass Flow Controllers

Electrical Integration and Recommendation



* No connection required for Series 100 MFM

** Resistor values 6.2k ohms (+12 VDC power supply) or 9.1k ohms (+15 VDC power supply)

*** 0-5 VDC flow signal outputs only

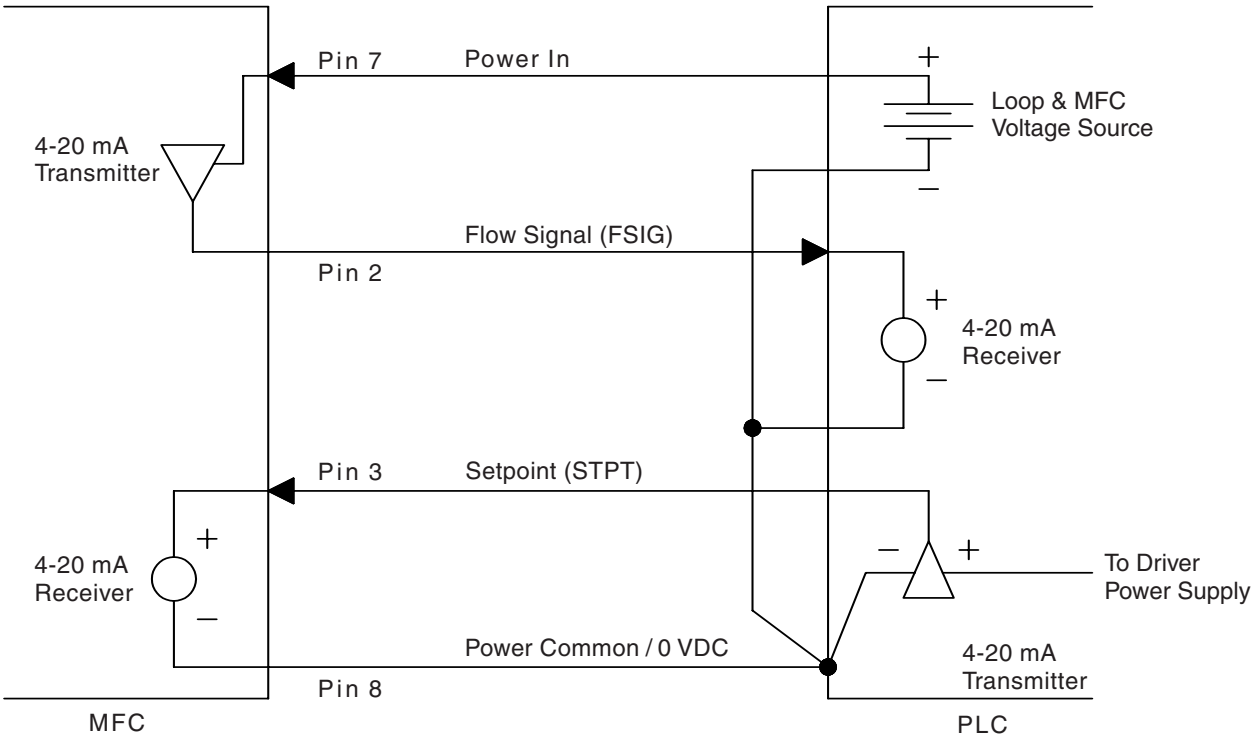
Note:
Voltage Flow signal output models may be connected into existing installations having dual power supply voltages of ±15 VDC with no modification to the installation.

Parker-Supplied Cable Assembly Color Codes		
Signal	**Connector Pin**	
	No.	**Insulation Color**
Voltage Reference	1	Brown
Flow Signal	2	Red
Setpoint	3	Yellow
Signal Common	4	Green
Valve Test	5	Blue
Open	6	Violet or White
Power In	7	Orange
Power Common /0 VDC	8	Black
Shield (Drain Wire)	9	Shield (Drain Wire)

Note: Cable color codes are for reference only and are subject to change without notice

Series 2200 Thermal Mass Flow Controllers

Electrical Integration and Recommendation



Notes:
1. Setpoint: 4-20 mA
2. For input/output designations (i.e., iondividual pin functions)fo pin numbers not shown, refer to electrical integration drawing on previous page.

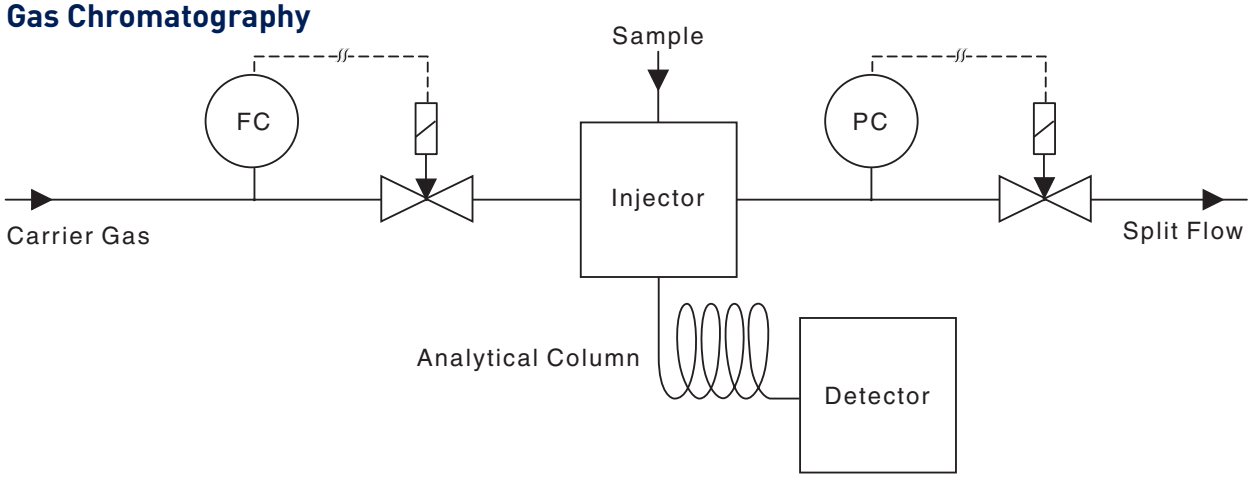
Parker-Supplied Cable Assembly Color Codes		
Signal	**Connector Pin**	
	No.	**Insulation Color**
Voltage Reference	1	Brown
Flow Signal	2	Red
Setpoint	3	Yellow
Signal Common	4	Green
Valve Test	5	Blue
Open	6	Violet or White
Power In	7	Orange
Power Common /0 VDC	8	Black
Shield (Drain Wire)	9	Shield (Drain Wire)

Note: Cable color codes are for reference only and are subject to change without notice

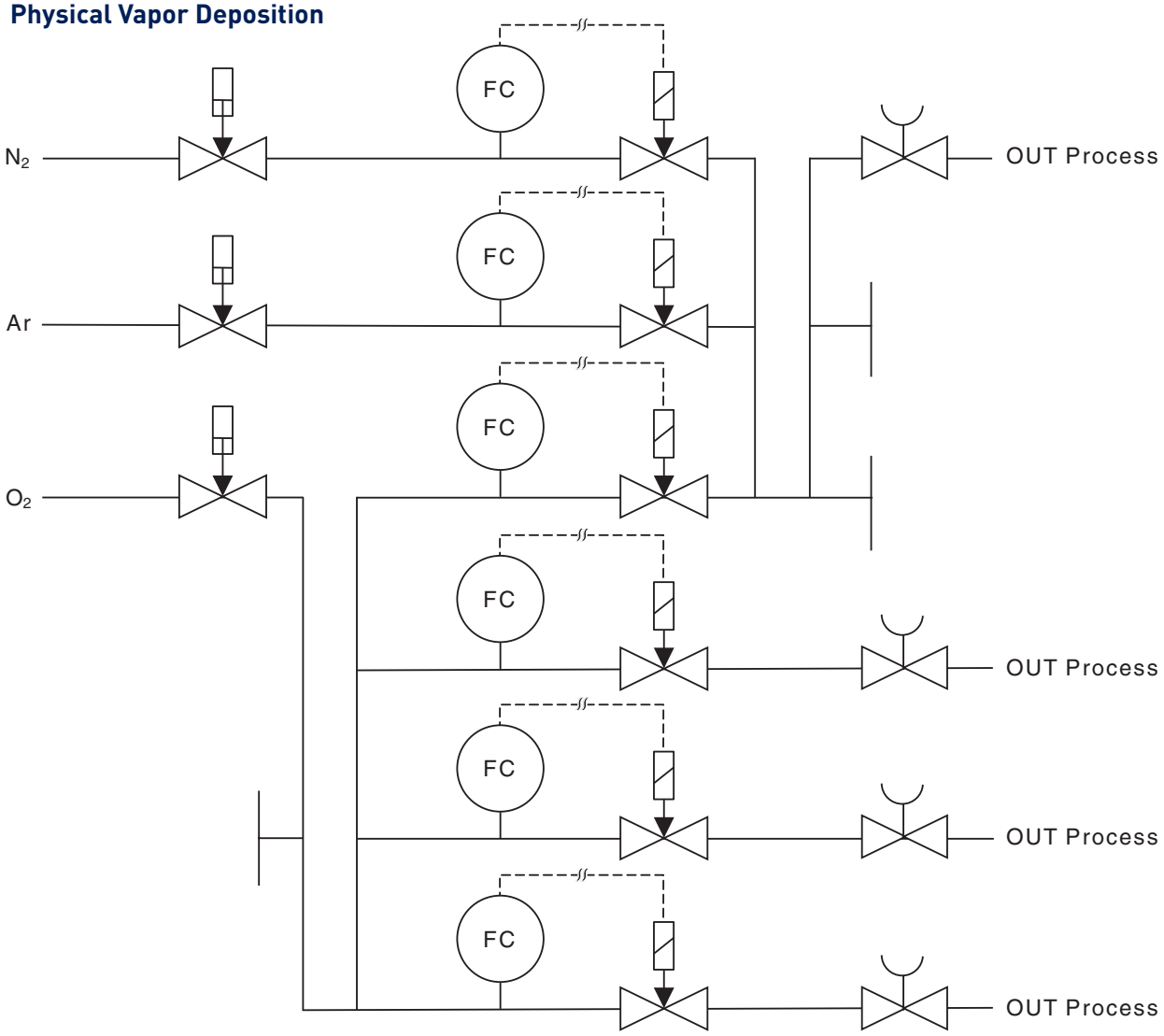
Series 2200 Thermal Mass Flow Controllers

Typical Flow Diagram

Gas Chromatography



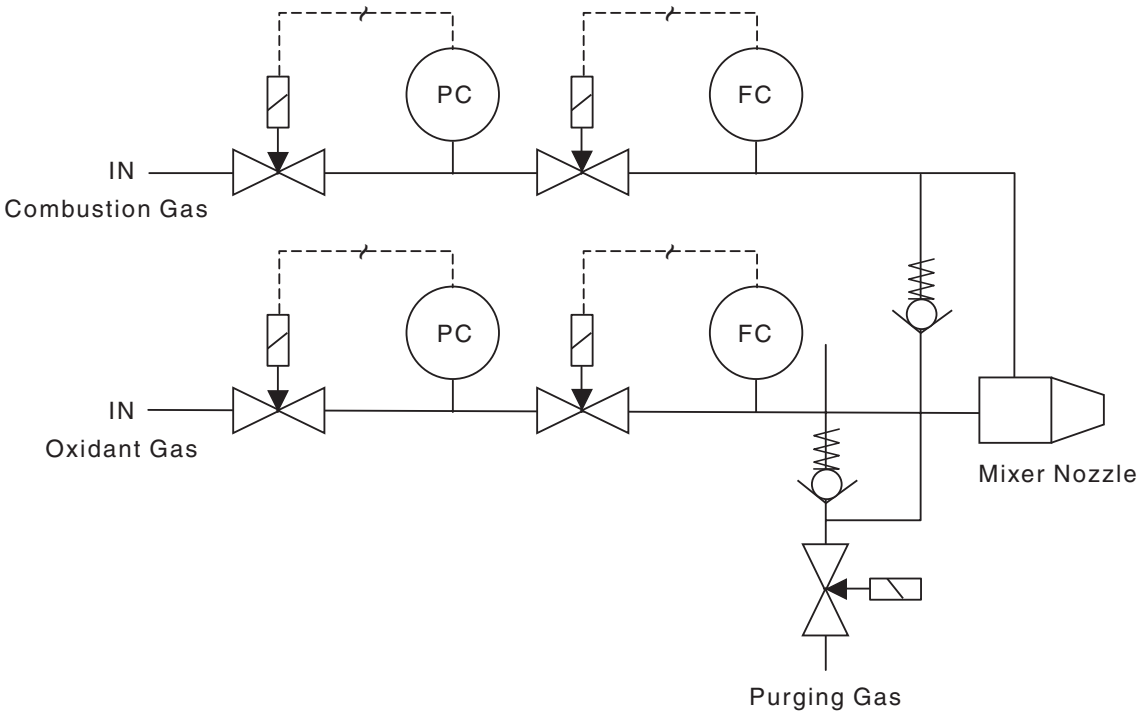
Physical Vapor Deposition



Series 2200 Thermal Mass Flow Controllers

Typical Flow Diagram

Burn Ratio Control



Series 2200 Thermal Mass Flow Controllers

Installation Guide

- Clean dry area with adequate space
- Indoor use only
- Follow process connection manufacturer guidelines and leak check all connections
- Purge all gas lines with nitrogen before installation
- Remove all loose particulate or debris from system

Key Things to Remember:

- Standard Flow Sizing Specifications
  1. Gas Type
  2. Flow Rate
  3. Inlet Pressure
  4. Outlet Pressure
  5. Operating Temperature
  6. Standard Calibration Condition*
  7. Connection Fitting Size and Type
  8. Set point/Output signal
- CM-400 4-channel Power Supply/Control
- Power Cables
- PN: C-700-002, Interface cable with flying leads on one end
- PN: C-1666-010, CABLE ASSY, MFC, CM-400

* Default standard calibration conditions = 21.1C and 14.7 PSIA. Consult Applications for support to specify other common calibration standards such as: 0C, 20C, 25C.

Series 2200 Thermal Mass Flow Controllers

Ordering Information

Model Number Example:

2201	A	A	A	V	C	1	AA

Nominal Range - Nitrogen Equivalent*

Model	Rev	Description
2201-	A	±1% FS, 10 slpm to 10 slpm

* **Note:** The flow ranges listed are minimum and maximum nitrogen (N2) flow ranges available for each given model. Intermediate flow ranges are available. For correct sizing when operating parameters are questionable, please consult the factory.

Assembly/Calibration Features

Code	Description
AA	Standard, Calibrated Horizontally
AW	Calibrated Vertically (Inlet Down)
AS	CE Appproved Design

Setpoint Signal/Output Signal

Code	Description
A	0-5 VDC/0-5 VDC
E	0-10 VDC/0-10 VDC
H	4-20 mAdc (sourcing)
K*	0-5 VDC/0-5 VDC - CE Approved Design

* NX CE Approved Design Assembly/Calibration feature must be selected in tandem with W 9-Pin CE approved design PC-board.

Fitting Size and Type

Code	Description
1	1/8" FNPT
2	1/8" Compression
4	1/4" Compression

Material of Construction Body/Orifice Inlet Adapter

Code	Description
A	Aluminum/Brass/Brass
C	Aluminum/St. Stl./St. Stl.

Orifice Size

Code	Description
A	.003 Orifice
B	.004 Orifice
C	.008 Orifice
D	.012 Orifice
E	.021 Orifice
F	.028 Orifice
G	.030 Orifice
H	.039 Orifice
J	.047 Orifice
K	.055 Orifice
L	.006 Orifice
M	.010 Orifice
X	None

Note: Consult Factory for Proper Orifice Selection.

Elastomers (Valve Seat/O-Rings)

Code	Description
B	Buna N
E	EPDM
N	Neoprene
V	FKM

NOTE: In order to provide the best possible solution for your application, please provide the following requirements when contacting Applications Engineering:

- Media, Inlet & Outlet Pressures
- Minimum Required Flow Rate.

For more detailed information, visit us on the web or call Applications Engineering.

Parker Hannifin Precision Fluidics Division reserves the right to make changes. Drawings are for reference only.

Series 200 Thermal Mass Flow Controllers

Portfolio Review

Customization

Contact Division Applications at (603) 595 1500 or ppfinfo@parker.com.

Model 201

Model 202

Model 202A

Model 203A

Model 204A

Type	Model	Min. Flow (sccm)	Min. Flow (slpm)	Max. Flow[1] (slpm)	Max. Pressure[2] (psig)	Min. Delta[3] (psig)
Analog Flow Meters	201	5	—	10	1000	7
	202	—	10	100	1000	60
	202A	5	—	10	200	10
	203A	—	100	500	200	40
	204A	—	500	1000	200	80

Portfolio is continued on the following page.

[1] The maximum full scale flow rate available.
[2] The maximum operating inlet pressure available.
[3] The minimum required pressure differential for maximum full scale.

Series 200 Thermal Mass Flow Controllers

Portfolio Review

Customization

Contact Division Applications at (603) 595 1500 or ppfinfo@parker.com.

Model 251

Model 261

Model 2201

Type	Model	Min. Flow (sccm)	Min. Flow (slpm)	Max. Flow[1] (slpm)	Max. Pressure[2] (psig)	Min. Delta[3] (psig)
Analog Flow Meters	251	—	10	50	1000	35
	261	5	—	10	1000	7
	2201	10	—	10	200	7

[1] The maximum full scale flow rate available.
[2] The maximum operating inlet pressure available.
[3] The minimum required pressure differential for maximum full scale.

⚠ WARNING – USER RESPONSIBILITY

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY, AND PROPERTY DAMAGE.

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The products described herein, including without limitation product features, specifications, designs, availability, and pricing, are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

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Thermal Mass Flow Meters and Controllers (Analog)

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