

Model **AF** mass flow meters and controllers are designed to indicate flow rates and control set flow rates of gases.

Each of these units incorporates an advanced straight tube sensor in conjunction with flow passage elements constructed of stainless steel.

LED readouts of command modules are supplied with 0 to 100 percent calibrations. Zero and span adjustments are conveniently accessible from outside of the transmitters.

Design Features

- Rigid metallic construction.
- Maximum pressure of 1000 psig (70 bars).
- 0-5 Vdc or 4-20mA signals.
- Leak integrity 1 x 10⁻⁹ smL/sec of helium.
- Accuracy of ±1% F.S.
- Totalizer option.
- Circuit protection.

Principles of Operation

Metered gases are divided into two laminar flow paths one through the primary flow conduit and the other through a capillary sensor tube.

Both flow conduits are designed to ensure laminar flows and therefore the ratio of their flow rates is constant.

Two precision temperature sensing windings on the sensor tube are heated, and when flow takes place, gas carries heat from the upstream to the downstream windings. The resultant temperature differential is proportional to the change in resistance of the sensor windings.

A Wheatstone bridge design is used to monitor the temperature dependent resistance gradient on the sensor windings which is linearly proportional to the instantaneous rate of flow.

Output signals of 0 to 5Vdc or 4 to 20mA are generated indicating mass molecular based flow rates of the metered gas.



ANALOG MASS FLOW METERS AND CONTROLLERS



In AFC mass flow controllers the combined gas streams flow through a proportionating electromagnetic valve with an appropriately selected orifice. The closed loop control circuit continuously monitors the mass flow output and maintains it at the set flow rate.

Flow rates are unaffected by temperature and pressure variations within stated limitations.

Transducer power supply ports are fuse and polarity protected.

AFC mass flow controllers include an electromagnetic control valve that allows the flow to be set to any desired

flow rate within the range of the particular model. The valve is normally closed as a safety feature to ensure that gas flow is shut off in case of a power outage.

AF mass flow meters and controllers are designed to meter and control flow rates of gases.

AF mass flow meters and controllers are available with flow ranges from 10 mL/min to 100LPM [N2]. Gases are connected by means of 1/4", 3/8", or optional 1/8" compression fittings.

These controllers may be used as bench top units or mounted by means of screws in the base.

CALIBRATIONS: Performed at standard conditions [14.7 psia (101.4 kPa) and 70 °F (21.1°C)] unless otherwise stated. REPEATABILITY: ±0.2% of full scale. REPEATABILITY: ±0.2% of full scale. AFC26: (Cmax = 10 L/min): 300 ms. AFC36: (Cmax = 50 L/min): 600 ms. AFC46: (Cmax = 10 L/min): 600 ms. AFC36: (Cmax = 10 L/min): Approximately 1 second to within ±2% of set flow rate for 25% to 100% of full scale flow. AFC36: (Cmax = 10 L/min): Approximately 1 second to within ±2% of set flow rate for 25% to 100% of full scale flow. AFC36: (Cmax = 50 L/min) and AFC46: (Cmax=100 L/min): Approximately 2 second to within ±2% of set flow rate for 25% to 100% of set flow rate for 25% to 100% of full scale flow. DESENTE COEFFICIENT: 0.1% of full scale/ °C. DOPTIMUM GAS PRESSURE: 25 psig (1.73 bars). REAR NOBLENT Standard calibration is at 20 psig (1.4 bars) inlet pressure. REFERSURE COEFFICIENT: 0.01% of full scale/ °C. DOPTIMUM GAS PRESSURE: 32° °F to 122°F (0 °C to 50 °C). 14 °F to 122°F (-10 °C to 50 °C) - Dry gases only. Stand AmbleNT 32° °F to 122°F (0 °C to 50 °C). 14 °F to 122°F (-10 °C to 50 °C) - Dry gases only. CALL FLEGRITY: 1 x 10° smL/sec of helium maximum, to the outside environment. "MATERIALS IN 316 stainless steel, 416 stainless steel, Viton* 0-rings. Optional 0-rings: Buan*, EPR and Kalrez*. DUTPUT SIGNALS: Linear 0-5 Vidc (2000 W min. load impedance); 4 - 20 mA optiona	TABLE 27 - SPECIFICATIONS						
REFEATABILITY: ±0.2% of full scale. TIME CONSTANT: AFM SERIES - 300 ms. AFC36: (Omax = 10 L/min): 300 ms. AFC36: (Omax = 50 L/min): 600 ms. AFC36: (Omax = 50 L/min): 600 ms. AFC36: (Omax = 10 L/min): 600 ms. AFC36: (Omax = 10 L/min): 600 ms. AFC36: (Omax = 10 L/min): 600 ms. AFC36: (Omax = 50 L/min) and AFC46: (Omax=100 L/min): Approximately 1 second to within ±2% of set flow rate for 25% to 100% of full scale flow. AFC36: (Omax = 50 L/min) and AFC46: (Omax=100 L/min): Approximately 2 second to within ±2% of set flow rate for 25% to 100% of scale flow. AFC36: (Omax = 50 L/min) and AFC46: (Omax=100 L/min): Approximately 2 second to within ±2% of set flow rate for 25% to 100% of full scale flow. TEEMPERATURE DOFFICIENT: 0.1% of full scale/psi (0.07 bar). DPTIMUM GAS PRESSURE: 25 psig (1.73 bars). MAXIMUM GAS PRESSURE: 1000 psig (70 bars) maximum. Standard calibration is at 20 psig (1.4 bars) inlet pressure. RAX. PRESSURE DROPO: AI full scale flow) 32 °F to 122 °F (0 °C to 50 °C). 14 °F to 122 °F (-10 °C to 50 °C) - Dry gases only. SAS AND AMBIENT TEMPERATURE: 32 °F to 122 °F (0 °C to 50 °C). 14 °F to 122 °F (-10 °C to 50 °C) - Dry gases only. LEAK INTEGRITY: 1 x 10° smL/sec of helium maximum, to the outside environment. *** MATEGIALS: No greater than ±15 degree rotation from horizontal to vertical; standard calibration is in horizontal position. Linear 0-5 Vdc (2000 W min. load impedance); 4 - 20 mA optional (0 - 500 Ω loop resistance); maximum noise 20 mV peak to peak. CONNECTIONS: AFM /AFC26, AFM /AFC36: Optional: CPUTO STAC: AFM /A	ACCURACY:	±1% of FS at calibration temperature and pressure.					
TIME CONSTANT: AFM SERIES - 300 ms. AFC63: (0max = 10 L/min): 300 ms. AFC63: (0max = 10 L/min): 600 ms. AFC63: (0max = 10 L/min): Approximately 1 second to within ±2% of set flow rate for 25% to 100% of full scale flow. AFC63: (0max = 50 L/min) and AFC64: (0max=100 L/min): Approximately 2 second to within ±2% of set flow rate for 25% to 100% of full scale flow. AFC63: (0max = 50 L/min) and AFC64: (0max=100 L/min): Approximately 2 second to within ±2% of set flow rate for 25% to 100% of full scale flow. TEMPERATURE COEFFICIENT: 0.1% of full scale/9C. OPTIMUM GAS PRESSURE 25 psig (1.73 bars). MAXIMUM GAS PRESSURE 25 psig (70 bars) maximum. Standard calibration is at 20 psig (1.4 bars) inlet pressure. MAX. PRESSURE DROP: (at full scale flow) 32 °F to 122 °F (0 °C to 50 °C). 14 °F to 122 °F (-10 °C to 50 °C) - Dry gases only. TEMPERATURE: LEAK INTEGRITY: 1 x 10" smL/sec of helium maximum, to the outside environment. ***MATERIALS IN FLUID CONTACT: 316 stainless steel, 416 stainless steel, Viton" 0-rings. Optional 0-rings: Buna", EPR and Kalrez". DUTPUT SIGNALS: MV peak to peak. AFM /AFC63: MV peak to peak. 1/4" compression fittings. Fm compression or 3/3" compression or 1/4" VCR" or 1/8" compression fittings. GM mompression or 3/3" compression or 1/4" VCR" or 1/8" compression fittings. GM M /AFC46: AFC 46: MAX - 4F5 45% Vdc, 80 M max, 12W; -15 ± 5% Vdc, 80 M max, 3W; AFC 56 /AFC46: AFK /AFC26: MAX / AFC26: MAX / AFC26: MAX / AFC26: MAX / AFC26: MAX / AFC26: MAX / AFC26: MAX / AFC26:	CALIBRATIONS:	Performed at standard conditions [14.7 psia (101.4 kPa) and 70 $^{\circ}$ F (21.1 $^{\circ}$ C)] unless otherwise stated.					
AFC26: (Dmax = 10 L/min): 300 ms. AFC36: (Dmax = 50 L/min): 600 ms. AFC46: (Dmax = 100 L/min): 600 ms.RESPONSE TIME:AFM SERIES: Approximately 1 second to within ±2% of set flow rate for 25% to 100% of full scale flow. AFC36: (Dmax = 10 L/min): Approximately 1 second to within ±2% of set flow rate for 25% to 100% of full scale flow. AFC36: (Dmax = 10 L/min): Approximately 1 second to within ±2% of set flow rate for 25% to 100% of full scale flow. AFC36: (Dmax = 10 L/min): Approximately 1 second to within ±2% of set flow rate for 25% to 100% of full scale flow.TEMPERATURE DOLFFICIENT:0.1% of full scale/°C.ODTFINUM GAS PRESSURE:25 psig (1.73 bars).WAXIMUM GAS PRESSURE:25 psig (1.73 bars).WAXIMUM GAS PRESSURE:1000 psig (70 bars) maximum. Standard calibration is at 20 psig (1.4 bars) inlet pressure.GAS AND AMBIENT TEMPERATURE:22 °F to 122 °F (0 °C to 50 °C). 14 °F to 122 °F (-10 °C to 50 °C) - Dry gases only.CAS AND AMBIENT TEMPERATURE:32 °F to 122 °F (0 °C to 50 °C). 14 °F to 122 °F (-10 °C to 50 °C) - Dry gases only.CONTACT:1 x 10° smL/sec of helium maximum, to the outside environment.***MATERIALS IN FLUID CONTACT:316 stainless steel, 416 stainless steel, Viton° 0-rings. Optional 0-rings: Buna°, EPR and Kalrez°.DUTPUT SIGNALS:Linear 0-5 Vdc (2000 W min. Ioat impedance): 4 - 20 mA optional (0 - 500 Ω 100 presistance); maximum noise 20 mV peak to peak.CONNECTIONS:AFM /AFC26; AFM /AFC26;1/4 ° compression of 3/8° compression or 1/4° VCR® or 1/8° compression fittings. GATM /AFC26;AFM AFC26:AFM /AFC26; AFC26;1/4 ° compression fittings. (AFM/AFC26);AFM /AFC26:415 55% Vdc, 200 mA max, 3.3	REPEATABILITY:	±0.2% of full scale.					
AFC26: (Qmax = 10 L/min): Approximately 1 second to within ±2% of set flow rate for 25% to 100% of full scale flow. AFC36: (Qmax = 50 L/min) and AFC46: (Qmax=100 L/min): Approximately 2 second to within ±2% of set flow rate for 25% to 100% of full scale flow. COEFFICIENT: 0.1% of full scale/°C. PRESSURE COEFFICIENT: 0.01% of full scale/psi (0.07 bar). DPTIMUM GAS PRESSURE: 25 psig (1.73 bars). WAX. PRESSURE DROP: 25 psig (70 bars) maximum. Standard calibration is at 20 psig (1.4 bars) inlet pressure. WAX. PRESSURE flow? 32 °F to 122 °F (0 °C to 50 °C). 14 °F to 122 °F (-10 °C to 50 °C) - Dry gases only. IEAK INTEGRITY: 1 x 10° smL/sec of helium maximum, to the outside environment. ****MATERIALS IN FLUID CONTACT: 316 stainless steel, 416 stainless steel, Viton® O-rings. Optional O-rings: Buna®, EPR and Kalrez®. CONNECTIONS: AFW /AFC26, AFM /AFC36: Optional: 1/4" compression or 3/8" compression or 1/4" VCR® or 1/8" compression fittings. Gmm compression or 3/8" compression or 1/4" VCR® or 1/8" compression fittings. Gmm compression or 3/8" compression or 3/8" compression or 1/4" VCR® or 1/8" compression fittings. AFM /AFC26: AFC46: +15 ±5% Vdc, 80 mA max, 1.2W; -15 ±5% Vdc, 200 mA max, 3W; +15 ±5% Vdc, 200 mA max, 3.3W; -15 ±5% Vdc, 600 mA max, 9W.	TIME CONSTANT:	AFC26: (Qmax = 10 L/min): 300 ms. AFC36: (Qmax = 50 L/min): 600 ms.					
COEFFICIENT: 0.01% of full scale/psi (0.07 bar). PRESSURE COEFFICIENT: 0.01% of full scale/psi (0.07 bar). DPTIMUM GAS PRESSURE: 25 psig (1.73 bars). MAX.INUM GAS PRESSURE: 1000 psig (70 bars) maximum. Standard calibration is at 20 psig (1.4 bars) inlet pressure. MAX.PRESSURE DROP: Refer to Table 29. (at full scale flow) Refer to Table 29. GAS AND AMBIENT 32 °F to 122 °F (0 °C to 50 °C). 14 °F to 122 °F (-10 °C to 50 °C) - Dry gases only. ILEAK INTEGRITY: 1 x 10° smL/sec of helium maximum, to the outside environment. ***MATERIALS IN FLUID CONTACT: 316 stainless steel, 416 stainless steel, Viton® O-rings. Optional O-rings: Buna®, EPR and Kalrez®. OUTPUT SIGNALS: Linear 0-5 Vdc (2000 W min. load impedance); 4 - 20 mA optional (0 - 500 Ω loop resistance); maximum noise 20 mV peak to peak. CONNECTIONS: AFM /AFC26, AFM /AFC36: Mr compression or 3/8" compression or 1/4" VCR® or 1/8" compression fittings. (AFW/AFC26). AFM /AFC46: 3/8" compression fittings. MAX / POWER: AFM /AFC26: +15 ±5% Vdc, 80 mA max, 1.2W; -15 ± 5% Vdc, 200 mA max, 3W; +15 ±5% Vdc, 600 mA max, 9W.	RESPONSE TIME:	AFC26: (Qmax = 10 L/min): Approximately 1 second to within $\pm 2\%$ of set flow rate for 25% to 100% of full scale flow. AFC36: (Qmax = 50 L/min) and AFC46: (Qmax=100 L/min): Approximately 2 second to within $\pm 2\%$ of set flow rate					
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WAX. PRESSURE DROP: (at full scale flow) Refer to Table 29. GAS AND AMBIENT TEMPERATURE: 32 °F to 122 °F (0 °C to 50 °C). 14 °F to 122 °F (-10 °C to 50 °C) - Dry gases only. LEAK INTEGRITY: 1 x 10° smL/sec of helium maximum, to the outside environment. ***MATERIALS IN FLUID CONTACT: 316 stainless steel, 416 stainless steel, Viton® O-rings. Optional O-rings: Buna®, EPR and Kalrez®. ATTITUDE SENSITIVITY: No greater than ±15 degree rotation from horizontal to vertical; standard calibration is in horizontal position. DUTPUT SIGNALS: Linear 0-5 Vdc (2000 W min. load impedance); 4 - 20 mA optional (0 - 500 Ω loop resistance); maximum noise 20 mV peak to peak. CONNECTIONS: AFM /AFC26, AFM /AFC36: 1/4° compression or 3/8° compression or 1/4° VCR® or 1/8° compression fittings. Optional: AFM /AFC46: 3/8° compression fittings. AFM /AFC46: 3/8° compression fittings. OPTIONER: AFM /AFC26: +15 ±5% Vdc, 80 mA max, 1.2W; -15 ± 5% Vdc, 200 mA max, 3W; AFC36 /AFC46:	OPTIMUM GAS PRESSURE:	25 psig (1.73 bars).					
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TEMPERATURE: 1 x 10° smL/sec of helium maximum, to the outside environment. **MATERIALS IN FLUID CONTACT: 316 stainless steel, 416 stainless steel, Viton® O-rings. Optional O-rings: Buna®, EPR and Kalrez®. ATTITUDE SENSITIVITY: No greater than ±15 degree rotation from horizontal to vertical; standard calibration is in horizontal position. DUTPUT SIGNALS: Linear 0-5 Vdc (2000 W min. load impedance); 4 - 20 mA optional (0 - 500 Ω loop resistance); maximum noise 20 mV peak to peak. CONNECTIONS: AFM /AFC26, AFM /AFC36: 1/4" compression fittings. Optional: 6mm compression or 3/8" compression or 1/4" VCR® or 1/8" compression fittings (AFM/AFC26). AFM /AFC46: 3/8" compression fittings. AFM /AFC26: +15 ±5% Vdc, 80 mA max, 1.2W; -15 ± 5% Vdc, 200 mA max, 3W; +15 ±5% Vdc, 600 mA max, 9W.	MAX. PRESSURE DROP: (at full scale flow)	Refer to Table 29.					
**MATERIALS IN FLUID CONTACT:316 stainless steel, 416 stainless steel, Viton® 0-rings. Optional 0-rings: Buna®, EPR and Kalrez®.ATTITUDE SENSITIVITY:No greater than ±15 degree rotation from horizontal to vertical; standard calibration is in horizontal position.DUTPUT SIGNALS:Linear 0-5 Vdc (2000 W min. load impedance); 4 - 20 mA optional (0 - 500 Ω loop resistance); maximum noise 20 mV peak to peak.CONNECTIONS:AFM /AFC26, AFM /AFC36: Optional:1/4" compression fittings. 6mm compression or 3/8" compression or 1/4" VCR® or 1/8" compression fittings (AFM/AFC26).TRANSDUCER INPUT POWER:AFM /AFC26: AFC26:+15 ±5% Vdc, 80 mA max, 1.2W; -15 ± 5% Vdc, 200 mA max, 3W; +15 ±5% Vdc, 220 mA max, 3.3W; -15 ±5% Vdc, 600 mA max, 9W.	GAS AND AMBIENT TEMPERATURE:	32 °F to 122 °F (0 °C to 50 °C). 14 °F to 122 °F (-10 °C to 50 °C) - Dry gases only.					
FLUID CONTACT:ATTITUDE SENSITIVITY:No greater than ±15 degree rotation from horizontal to vertical; standard calibration is in horizontal position.DUTPUT SIGNALS:Linear 0-5 Vdc (2000 W min. load impedance); 4 - 20 mA optional (0 - 500 Ω loop resistance); maximum noise 20 mV peak to peak.CONNECTIONS:AFM /AFC26, AFM /AFC36: Optional:1/4" compression fittings. 6mm compression or 3/8" compression or 1/4" VCR® or 1/8" compression fittings (AFM/AFC26).TRANSDUCER INPUT POWER:AFM /AFC26: AFC46:+15 ±5% Vdc, 80 mA max, 1.2W; -15 ± 5% Vdc, 200 mA max, 3W; +15 ±5% Vdc, 220 mA max, 3.3W; -15 ±5% Vdc, 600 mA max, 9W.	LEAK INTEGRITY:	1 x 10 ^{.9} smL/sec of helium maximum, to the outside environment.					
DUTPUT SIGNALS:Linear 0-5 Vdc (2000 W min. load impedance); 4 - 20 mA optional (0 - 500 Ω loop resistance); maximum noise 20 mV peak to peak.CONNECTIONS:AFM /AFC26, AFM /AFC36: Optional:1/4" compression fittings. 6mm compression or 3/8" compression or 1/4" VCR® or 1/8" compression fittings (AFM/AFC26).AFM /AFC46:3/8" compression fittings. 3/8" compression fittings.TRANSDUCER INPUT POWER:AFM /AFC26: AFC36 /AFC46:+15 ±5% Vdc, 80 mA max, 1.2W; -15 ± 5% Vdc, 200 mA max, 3W; +15 ±5% Vdc, 220 mA max, 3.3W; -15 ±5% Vdc, 600 mA max, 9W.	**MATERIALS IN Fluid contact:	316 stainless steel, 416 stainless steel, Viton [®] O-rings. Optional O-rings: Buna [®] , EPR and Kalrez [®] .					
mV peak to peak. CONNECTIONS: AFM /AFC26, AFM /AFC36: Optional: MV peak to peak. AFM /AFC26, AFM /AFC36: MV peak to peak. AFM /AFC26, AFM /AFC36: MV peak to peak. AFM /AFC26, AFM /AFC36: MV peak to peak. AFM /AFC46: 3/8" compression or 3/8" compression or 1/4" VCR® or 1/8" compression fittings. AFM /AFC46: 3/8" compression fittings. AFM /AFC26: +15 ±5% Vdc, 80 mA max, 1.2W; -15 ± 5% Vdc, 200 mA max, 3W; +15 ±5% Vdc, 220 mA max, 3.3W; -15 ±5% Vdc, 600 mA max, 9W.	ATTITUDE SENSITIVITY:	No greater than ± 15 degree rotation from horizontal to vertical; standard calibration is in horizontal position.					
Optional: 6mm compression or 3/8" compression or 1/4" VCR® or 1/8" compression fittings (AFM/AFC26). AFM /AFC46: 3/8" compression fittings. TRANSDUCER INPUT POWER: AFM /AFC26: +15 ±5% Vdc, 80 mA max, 1.2W; -15 ± 5% Vdc, 200 mA max, 3W; +15 ±5% Vdc, 220 mA max, 3.3W; -15 ±5% Vdc, 600 mA max, 9W.	OUTPUT SIGNALS:						
TRANSDUCER INPUT AFM /AFC26: +15 ±5% Vdc, 80 mA max, 1.2W; -15 ± 5% Vdc, 200 mA max, 3W; POWER: AFC36 /AFC46: +15 ±5% Vdc, 220 mA max, 3.3W; -15 ±5% Vdc, 600 mA max, 9W.	CONNECTIONS:		6mm compression or 3/8" compression or 1/4" VCR® or 1/8" compression fittings				
POWER: AFC36 /AFC46: +15 ±5% Vdc, 220 mA max, 3.3W; -15 ±5% Vdc, 600 mA max, 9W.		AFM /AFC46:	3/8" compression fittings.				
Circuit boards have built-in polarity reversal protection. Replaceable fuses provide power input protection.	TRANSDUCER INPUT Power:						
	CIRCUIT PROTECTION:	Circuit boards have built-in polarity reversal protection. Replaceable fuses provide power input protection.					

**The selection of materials of construction, is the responsibility of the customer. The company accepts no liability.

www.aalborg.com - e-mail 🖂 info@aalborg.com - 🖀 845.770.3000 - fax 845.770.3010 - Toll Free in U.S.A. and Canada 1.800.866.3837

Leak Integrity

1 x $10^{.9}$ smL/sec of helium max to outside environment.

Mass Flow Systems

Complete Mass Flow Systems include Command Modules, transducers and cables. Command modules contain appropriate power supplies, 24x2 alpha-numeric dot matrix display readout, and four panel buttons which provide complete control over all the various functions necessary to measure and/or control flow.

Optional built in Ethernet interface allows accessing any Internet-connected SDPROC from a browser on your work station, PC, or laptop computer.

TABLE 28 - FLOW RANGES FOR AFC / AFM

AFC 26 / AFM 26					
UNITS [NITROGEN]					
0 to 10 mL/min					
0 to 20 mL/min					
0 to 50 mL/min					
0 to 100 mL/min					
0 to 200 mL/min					
0 to 500 mL/min					
0 to 1 L/min					
0 to 2 L/min					
0 to 5 L/min					
0 to 10 L/min					
AFC 36 / AFM36					
0 to 15 L/min					
0 to 20 L/min					
0 to 30 L/min					
0 to 40 L/min					
0 to 50 L/min					
AFC 46 / AFM46					
0 to 60 L/min					
0 to 80 L/min					
0 to 100 L/min					

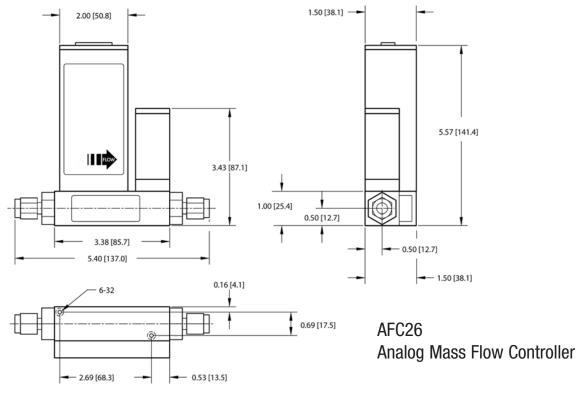
TABLE 29 - MAXIMUM PRESSURE DROP FOR AFC / AFM

FLOW RATE	AFC SERIES		AFM SERIES	
[liters/min]	[psid]	[bars]	[psid]	[bars]
up to 10	1.06	0.072	0.04	0.003
up to 15	3.87	0.26	0.09	0.006
up to 20	2.0	0.136	0.44	0.030
up to 30	3.5	0.238	1.18	0.080
up to 40	5.5	0.374	2.18	0.148
up to 50	8	0.544	3.23	0.220
up to 100	18.9	1.302	8.08	0.557

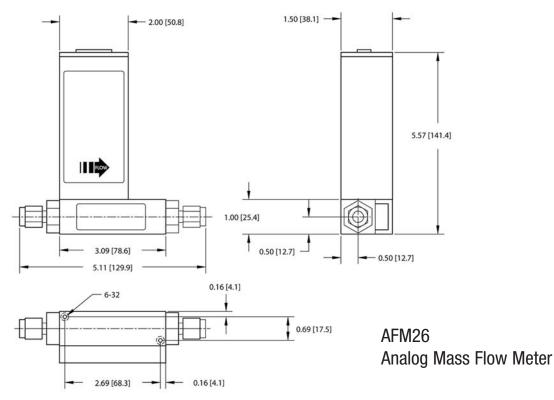
AFC







DIMENSIONS: INCH [mm]

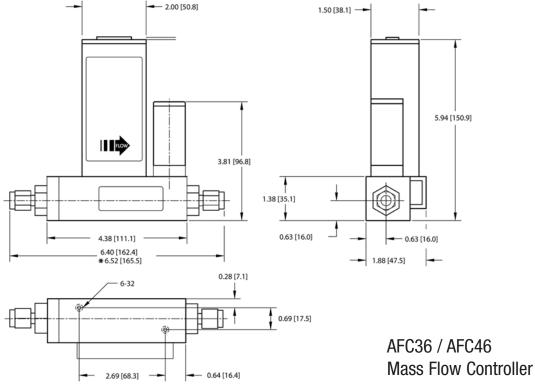


DIMENSIONS: INCH [mm]

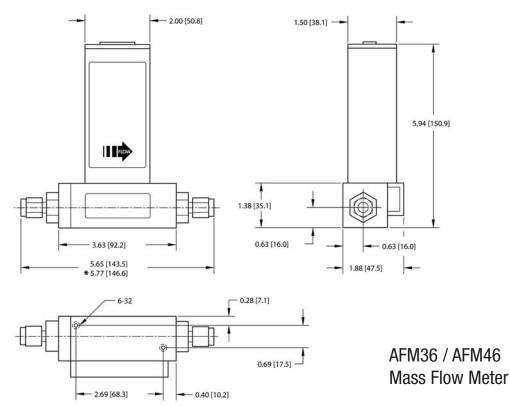
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ANALOG MASS FLOW METERS AND CONTROLLERS



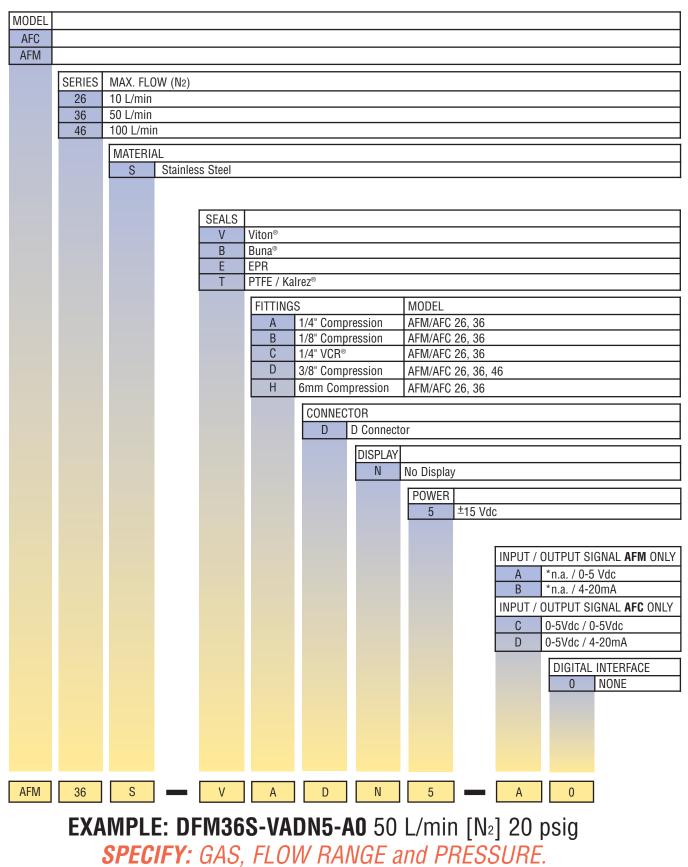






DIMENSIONS: INCH [mm] * FOR HIGH FLOW MASS FLOWMETER ONLY

BULLETIN EM201101 AFC / AFM



AFM36 stainless steel, Viton® seals with 1/4" compression fittings, D connector, Without a display, ±15 Vdc, *n.a./0-5Vdc input/output signal, and no digital interface.