

Product Data Sheet

PS-00714, Rev. C

March 2007

Micro Motion[®] LF-Series Low Flow Meters/Controllers for Measurement and Control



Micro Motion® LF-Series meters and controllers

Micro Motion's family of products offers unmatched accuracy and zero stability in demanding low flow gas and liquid applications. Micro Motion LF-Series meters and controllers provide mass flow measurement and integrated control with on-line density and temperature measurement in one compact package.

The heart of the LF-Series meter or controller is a patented and revolutionary Coriolis sensor design, which measures flow independent of fluid type or process conditions. This provides precision and performance in the most challenging operating environments. The Micro Motion LF-Series meter and controller features no moving parts or obstructions in the flow path.

Process control

Most critical processes require control as well as measurement. To support these applications, the LF-Series controller includes an integrally

mounted in-line control valve. No remote electronics are required, as all transmitting and control electronics are contained within the product housing.

Applications

Micro Motion LF-Series meters and controllers provide accurate measurement and control for virtually any process fluid, independent of its characteristics. They have been designed for low flow applications in the demanding specialty chemical, petrochemical, pharmaceutical, semiconductor, analytical, laboratory, and OEM markets. Micro Motion's LF-Series meters and controllers provide precise measurement and control of critical process fluids like food additives, CVD precursors, catalysts, hydrocarbons, inhibitors, nutrients, and many other difficult-to-handle fluids for low flow applications. A Micro Motion LF-Series meter or controller is an excellent solution for your low flow application.

LF-Series meter/controller feature

Lowest flow Coriolis meter or controller available

Multivariable output including mass flow, volumetric flow, density, and temperature

Industry-leading mass flow measurement precision

Direct (not inferred) mass flow measurement

No internal moving parts

Small physical size

Multiple functions, including Coriolis sensor and transmitter, in a single package. When controller is purchased, device includes in-line valve with full PID function.

Gas and liquid measurement and control capability in one package

LF-Series meter/controller advantage

Meets the demands of ultra low flow direct mass measurement and control where Coriolis flow measurement has never been available before

One-stop shopping and simplified installation

Provides accurate mass measurement of your fluids in demanding low flow processes, research, and pilot plant applications

Process chemistry and/or process conditions can be altered without the need to change or recalibrate the measurement system, providing the user with maximum flexibility

Minimizes maintenance requirements, reducing overall cost of ownership

Easily integrated into the most intricate process systems

Four different outputs from a single device – improves and simplifies process monitoring and diagnostics, further reducing cost of ownership

The ultimate in process flexibility



Specifications

⚠ WARNING

Do not operate this instrument in excess of the specifications in this section. Failure to heed this warning can result in serious personal injury and/or damage to the equipment.

- (1) LF-Series LFC (controller) includes integral valve; LF-Series LFM (meter) does not include valve.
- (2) The nominal flow range is the flow rate at which water at reference conditions causes approximately 1 bar (14.5 psid) of pressure drop.
- (3) Standard volumetric conditions are 14.696 psia and 70 °F.
- (4) Stated flow accuracy includes the combined effects of repeatability, linearity, and hysteresis. All specifications for liquids are based on reference conditions of water at 70 °F (21 °C). At temperatures other than 70 °F (21 °C), you can expect an additional density error of approximately 0.0005 g/cm³ per °C.
- (5) The closeness of agreement among a number of consecutive measurements of the output for the same value of the input under the same operating conditions, approaching from the same direction, for full range traverses.
- (6) In process instrumentation, the closeness of agreement among repeated measurements of the output for the same value of input made under the same operating conditions over a period of time.
- (7) Differential pressures are based on reference conditions of water and air at 68 to 77 °F (20 to 25 °C).

Liquid flow specifications, metric units

Product type	Model ⁽¹⁾	Tube size	Maximum flow rate (kg/h or l/h) ⁽²⁾		Nominal flow range 0 to _____ (kg/h or l/h) ⁽²⁾		Minimum full scale	Minimum measurable flow
Controller	LFC	2	0.30		0.15		0.01 kg/h	0.001 kg/h
		3	1.00		0.78		0.10 kg/h	0.01 kg/h
		4	18.64		9.32		1.00 kg/h	0.10 kg/h
Meter	LFM	2	0.38		0.19		0.01 kg/h	0.001 kg/h
		3	1.00		1.00		0.10 kg/h	0.01 kg/h
		4	27.00		13.50		1.00 kg/h	0.10 kg/h

Liquid flow specifications, English units

Product type	Model ⁽¹⁾	Tube size	Maximum flow rate ⁽²⁾		Nominal flow range 0 to _____ ⁽²⁾		Minimum full scale	Minimum measurable flow
			lb/hr	gal/hr	lb/hr	gal/hr		
Controller	LFC	2	0.66	0.08	0.33	0.04	0.022 lb/hr	0.002 lb/hr
		3	2.21	0.26	1.72	0.21	0.22 lb/hr	0.022 lb/hr
		4	41.10	4.92	20.55	2.46	2.204 lb/hr	0.220 lb/hr
Meter	LFM	2	0.84	0.10	0.42	0.05	0.022 lb/hr	0.002 lb/hr
		3	2.21	0.26	2.21	0.26	0.22 lb/hr	0.022 lb/hr
		4	59.54	7.13	29.77	3.57	2.204 lb/hr	0.220 lb/hr

Specifications *continued*

Gas flow specifications

Flow rates that produce approximately 14.5 psid (1.0 bar) pressure drop on air at 70 °F (21.1 °C) with inlet pressure of 500 psi (35 bar)

Product type	Model ⁽¹⁾	Tube size	Mass		Volume	
			lb/hr	kg/h	scfh ⁽³⁾	sccm
Controller	LFC	2	0.168	0.076	2.226	1050.9
		3	0.472	0.214	6.262	2955.4
		4	4.653	2.110	61.685	29,111.9
Meter	LFM	2	0.227	0.103	2.99	1432
		3	0.893	0.405	11.7	5595
		4	8.026	3.640	106.7	50,350

Zero stabilities

Tube size	lb/hr	kg/h
2	0.0003	0.00013
3	0.0022	0.00100
4	0.0088	0.00400

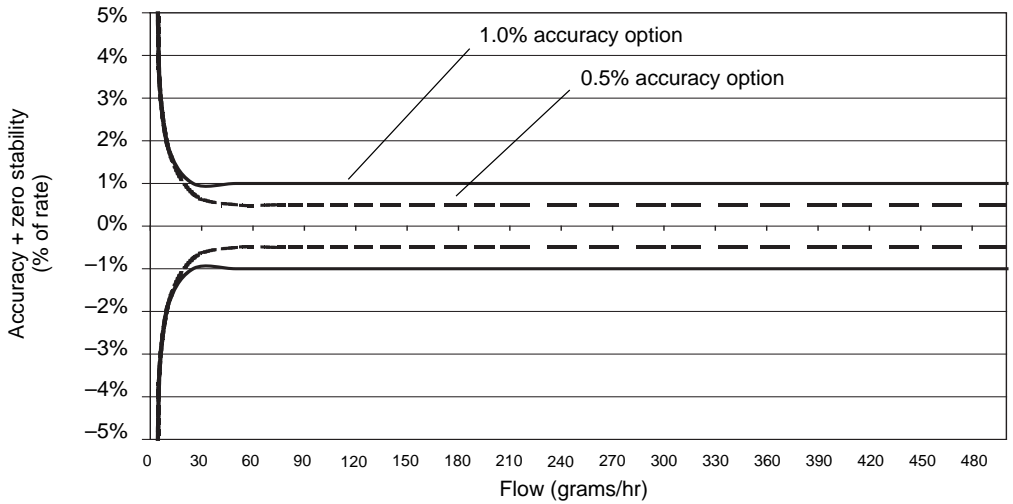
Accuracy⁽⁴⁾

Standard		$\pm 1.0\%$ of rate or $\pm \left[\left(\frac{\text{zero stability}}{\text{flow rate}} \right) \times 100 \right] \%$ of rate, whichever is greater
Optional		$\pm 0.5\%$ of rate or $\pm \left[\left(\frac{\text{zero stability}}{\text{flow rate}} \right) \times 100 \right] \%$ of rate, whichever is greater
Repeatability ⁽⁵⁾		$\pm 0.05\%$ of rate or $\pm \frac{1}{2} \left[\left(\frac{\text{zero stability}}{\text{flow rate}} \right) \times 100 \right] \%$ of rate, whichever is greater
Reproducibility ⁽⁶⁾		$\pm 0.05\%$ of rate or $\pm \frac{1}{2} \left[\left(\frac{\text{zero stability}}{\text{flow rate}} \right) \times 100 \right] \%$ of rate, whichever is greater
Density	Range	0 to 0.3 g/cm ³ (gas) and 0.5 to 2.0 g/cm ³ (liquid) (Contact factory for applications with fluid density between 0.3 and 0.5 g/cm ³)
	Accuracy—liquid only	± 0.005 g/cm ³
	Repeatability—liquid only	± 0.002 g/cm ³
Temperature	Ambient range	0 to 65 °C (32 to 149 °F)
	Accuracy	± 0.5 °C (± 1.0 °F)
Device leak integrity		Outboard 1×10^{-9} atm, cm ³ /sec., helium (maximum)

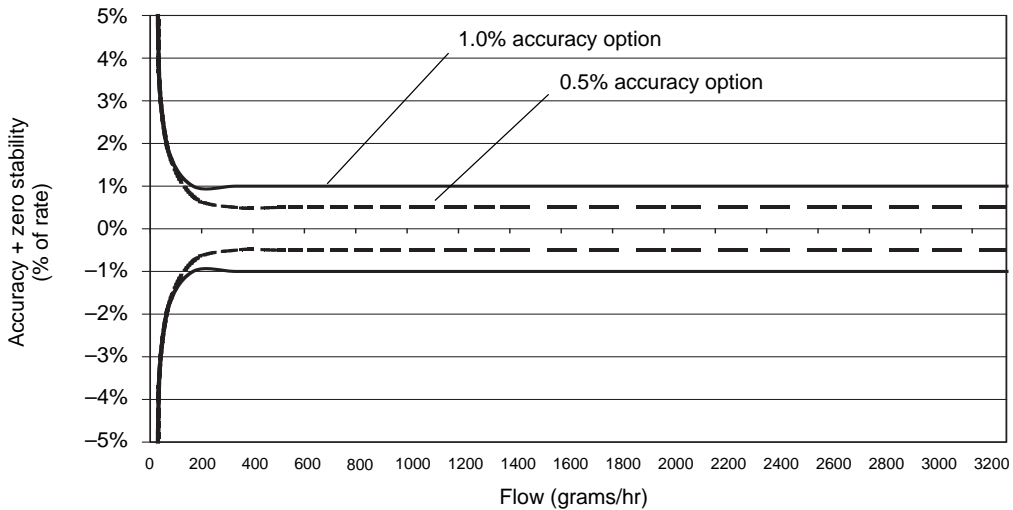
Specifications *continued*

Accuracy vs. flow rate

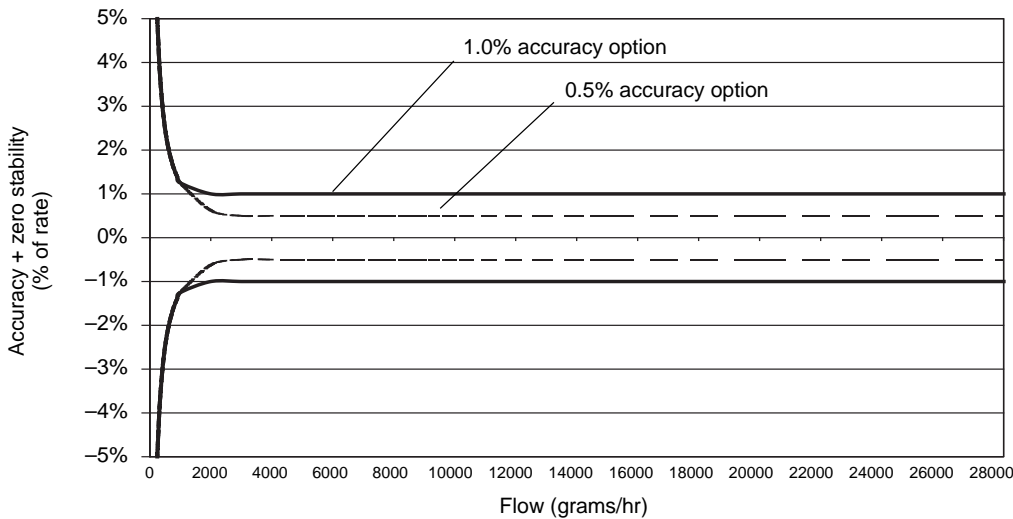
#2 size tube



#3 size tube



#4 size tube



Specifications *continued*

LFC (controller)

Controller turndown		100:1 or down to the minimum measurable flow, whichever is greater
Controller setting time		Less than 2 seconds within 2% full scale of final value, $\pm \left[\left(\frac{\text{zero stability}}{\text{flow rate}} \right) \times 100 \right] \%$ of rate per SEMI Guidelines
Maximum operating pressure	Standard	3.4 MPa, 35 bar (500 psi)
	Optional	10 MPa, 100 bar (1500 psi)

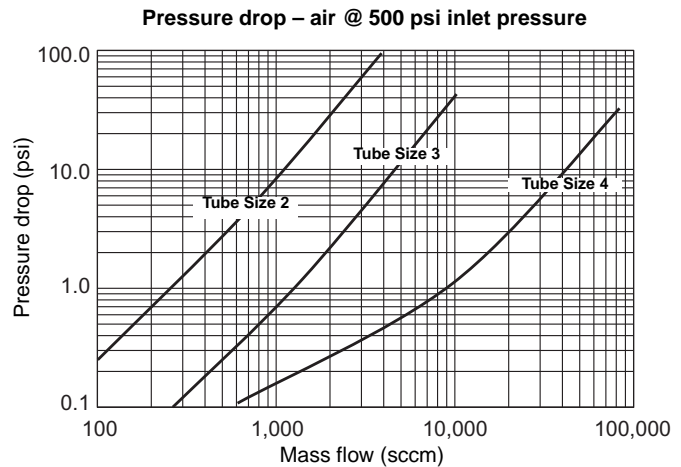
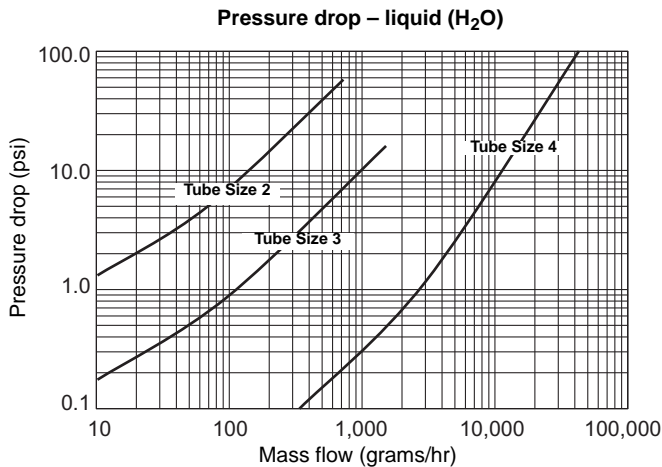
LFC differential pressure requirements⁽⁷⁾ (min-max)

Tube size		kPa		mbar		psi	
		min	max	min	max	min	max
2	liquid	69	1034	0.7	10.3	10	150
	gas	69	1724	0.7	17.2	10	250
3	liquid	69	1379	0.7	13.8	10	200
	gas	69	1724	0.7	17.2	10	250
4	liquid	69	1034	0.7	10.3	10	150
	gas	69	1724	0.7	17.2	10	250

LFM (meter)

Meter turndown		100:1
Maximum operating pressure	Standard	3.4 MPa, 35 bar (500 psi)
	Optional	10 MPa, 100 bar (1500 psi)

LFM differential pressure




Specifications *continued*

Certifications and approvals

Ambient temperature: 0 °C to 65 °C

Enclosure: Type 1/IP40

UL	Non Incendive, Class I, Division 2, Groups A, B, C, and D; T4 Per UL 1604
CSA	Non Incendive, Class I, Division 2, Groups A, B, C, and D; T4 Per CSA 213 Ex nC IIC T4 Per CSA E79-15
ANSI/ISA and ANSI/UL	Class I, Zone 2, AEx nC IIC T4 Per ANSI/ISA 12.12.02-2003 and ANSI/UL 60079-15
ATEX	 II 3 G EEx nA II T4 Per EN 50021

Physical specifications

Materials of construction	Process wetted	316L, 316L VAR and high alloy ferritic stainless 17-7PH
	Process seals	Nickel or Teflon® and Viton® fluoroelastomer ⁽¹⁾ , Buna, Kalrez or EPDM
	Housing	Polyurethane-painted aluminum
Inlet filter		10 micron inlet filter supplied with size 2 tube equipped devices
		1 micron filter optionally available on size 2 tube equipped devices
		20, 30, and 40 micron filters optionally available on sizes 3 and 4 equipped devices
Weight		1.6 kg (3.5 lbs)
Moisture content		Purged to exhaust dew point less than –40 °C (–40 °F) prior to shipment to remove calibration liquid, preventing process contamination. Then vacuum bagged at ambient room conditions
Process fitting options		1/16", 1/8", 1/4", or 6 mm tube compression, VCR, VCO, or NPT (F), downport ANSI/ISA 76.00.02
Electrical connections		15-pin D-type connector
Dimensions		See page 9

(1) Viton is a registered trademark of DuPont Performance Elastomers.

Specifications *continued*

Functional specifications

Output signals		4–20 mA or 0–5 VDC active outputs represent mass flow or volume flow Simultaneously available 4–20 mA active output, represents on-line density or temperature
Input signals	Command (setpoint)	Supplies input parameters to the (internally) installed valve P.I.D. control system via either 4–20 ma or 0–5 VDC input signals
	Valve override function	<ul style="list-style-type: none">• Left floating/unconnected: instrument controls valve to command setpoint• Connected to signal at or above 5.0 V: valve is forced open• Connected to signal at or below 0.0 V: valve is forced closed
Voltage input		13 to 30 VDC
Current requirement	Controller	300 to 400 mA
	Meter	100 to 150 mA

Additional functions and outputs

Damping		Factory selected time constant from 0 to 10 seconds
LEDs ⁽¹⁾	Status	<ul style="list-style-type: none">• Solid green: system operative• Solid red: system fault
	Alarm	7 red flashes: diagnostic failure
Pushbutton ⁽²⁾		ZERO setting pushbutton

(1) *IP65 and IP65XP series external housing cover must be removed to gain access to the status LEDs.*

(2) *IP65XP series external housing cover must be removed to gain access to the zero push button.*

Environmental effects

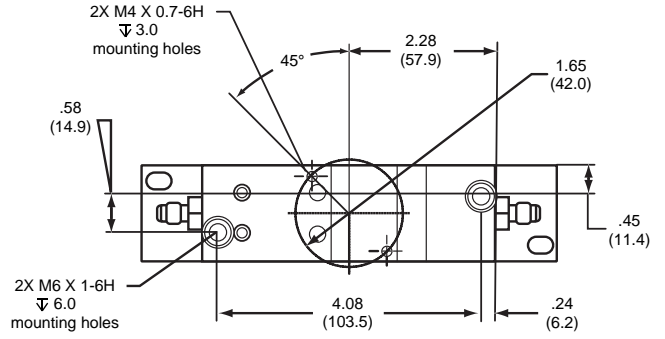
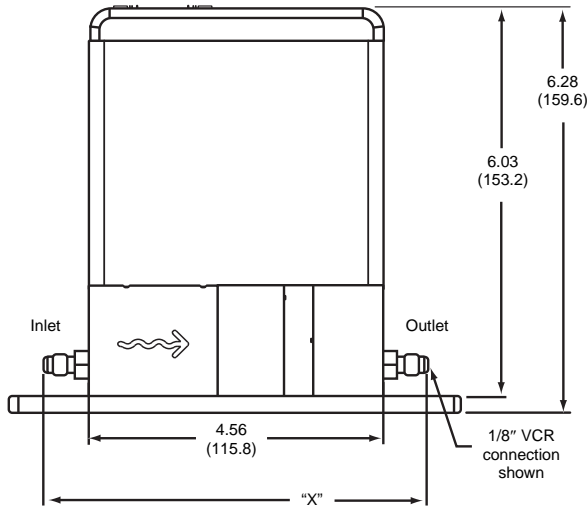
EMC effect		The Micro Motion LF-Series meter/controller meets the requirements of the EMC directive 89/336EEC per EN 50081-2 and EN 61326-1. To meet these specifications, the Micro Motion LF-Series device must be directly connected to a low impedance (less than 1 Ohm) earth ground. Signals must use a standard twisted-pair, shielded instrument wire.
Pressure effects		The Micro Motion LF-Series meter/controller meets the requirements of the Pressure Equipment Directive 97/23/EC. The unit falls into the category “Sound Engineering Practice.”

Specifications *continued*

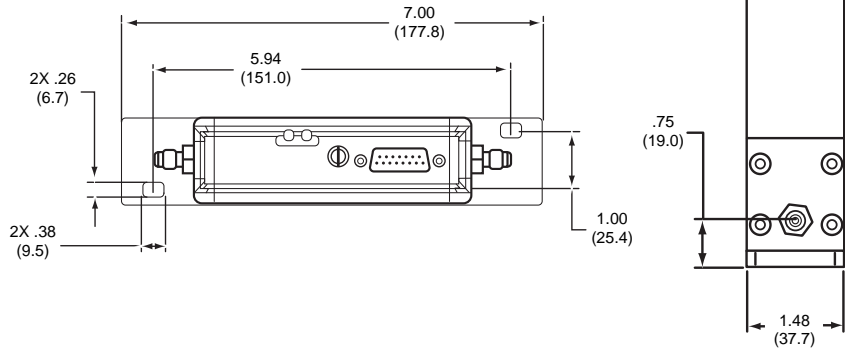
Dimensions

Dimensions in *inches*
(*mm*)

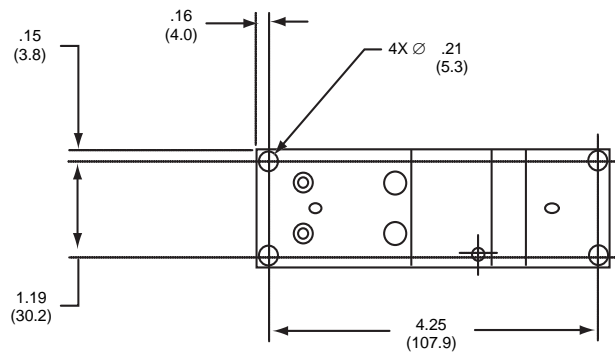
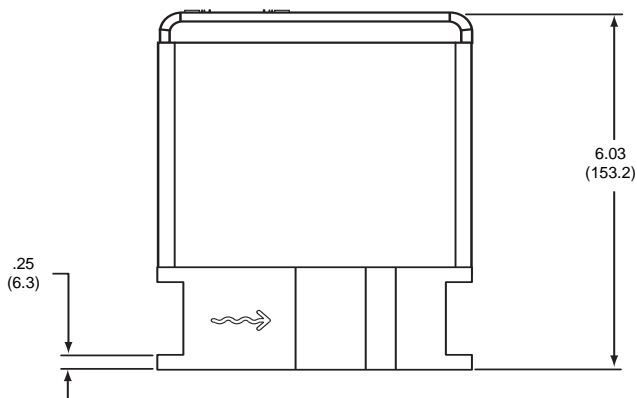
ThruFlow connection



Fitting	"X" dimension inches (mm)
1/8" VCR	5.92 (150.4)
1/4" VCR	6.64 (168.7)
1/16" tube compression	5.98 (151.9)
1/8" tube compression	5.80 (147.3)
1/4" tube compression	6.50 (165.1)
6 mm tube compression	6.51 (165.4)
1/8" NPT	5.81 (147.6)
1/4" NPT	6.18 (157.0)
1/4" VCO	6.14 (156.0)



Downport ANSI/ISA 76.00.02 connection



Ordering information

Low flow meter

Code	Product description
LFM2M	Micro Motion Coriolis Low Flow meter, 0.001 kg/hr, 316L stainless steel
LFM3M	Micro Motion Coriolis Low Flow meter, 0.01 kg/hr, 316L stainless steel
LFM4M	Micro Motion Coriolis Low Flow meter, 0.10 kg/hr, 316L stainless steel
Code	Process connection
324	1/4" tube compression fittings
328	1/8" tube compression fittings
326	1/16" tube compression fittings
327	1/8" VCR
322	1/4" VCR
323	1/4" VCO
325	6 mm tube compression fittings
340	1/8" NPT (F)
341	1/4" NPT (F)
001	Standard body connections – 5/16" – 24 LNF
200	Downport ANSI/ISA–76.00.02
998	ETO fittings
Code	Enclosure type and area classification
A	NEMA 1/IP40, no area classification
B	NEMA 1/IP40, UL Divisions 2/ATEX Zone 2 (not available on 1500 psi unit)
Code	Surface finish
1	32 Ra
Code	Pressure rating
1	35 bar or 500 psi
2	100 bar or 1500 psi
Code	Electrical I/O
A	0–5 VDC
B	4–20 mA
H	HART/4–20 mA
Code	Electrical connector
1	15 pin D-connector
Continued on next page	

Ordering information *continued*

Low flow meter

Code	O-rings ⁽¹⁾
K	Kalrez
V	Viton
B	Buna
E	EPDM
Code	Filters
A	None ⁽²⁾
B	10 Micron ⁽³⁾
C	20 Micron ⁽²⁾
D	30 Micron ⁽²⁾
E	40 Micron ⁽²⁾
F	1 Micron ⁽³⁾
Code	Calibration options
A	0.5% factory calibration
Z	No special calibration (1.0%)
Code	Factory options
Z	Standard product
X	ETO product
Typical model number: LFM4M 324 A 1 1 A 1 V B Z Z	

(1) Downport has no fitting O-ring.

(2) Not available for Model LFM2M.

(3) B or F required for Model LFM2M.

Ordering information *continued*

Low flow controller

Code	Product description
LFC2M	Micro Motion Coriolis Low Flow controller, 0.001 kg/hr, 316L stainless steel
LFC3M	Micro Motion Coriolis Low Flow controller, 0.01 kg/hr, 316L stainless steel
LFC4M	Micro Motion Coriolis Low Flow controller, 0.1 kg/hr, 316L stainless steel
Code	Fluid type
L	Liquid
G	Gas
Code	Process connection
324	1/4" tube compression fittings
328	1/8" tube compression fittings
326	1/16" tube compression fittings
327	1/8" VCR
322	1/4" VCR
323	1/4" VCO
325	6 mm tube compression fittings
340	1/8" NPT (F)
341	1/4" NPT (F)
001	Standard body connections – 5/16" – 24 LNF
200	Downport ANSI/ISA–76.00.02
998	ETO fittings
Code	Enclosure type and area classification
A	NEMA 1/IP40, no area classification
B	NEMA 1/IP40, UL Divisions 2/ATEX Zone 2 (not available on 1500 psi unit)
Code	Pressure rating
1	35 bar or 500 psi
2	100 bar or 1500 psi
Code	Electrical I/O
A	0–5 VDC
B	4–20 mA
H	HART/4–20 mA
Code	Electrical connector
1	15 pin D-connector
Continued on next page	

Ordering information *continued*

Low flow controller

Code		O-rings ⁽¹⁾			
	Sensor	Orifice	Valve stem	Fitting	Valve seat material
K	Kalrez	Stainless steel	Kalrez	Kalrez	Metal 17-7 pH stainless steel
V	Viton	Stainless steel	Viton	Viton	Metal 17-7 pH stainless steel
B	Buna	Stainless steel	Buna	Buna	Metal 17-7 pH stainless steel
E	EPDM	Stainless steel	EPDM	EPDM	Metal 17-7 pH stainless steel
H	Nickel	Nickel	Nickel	Kalrez	Metal 17-7 pH stainless steel
F	Nickel	Nickel	Nickel	Viton	Metal 17-7 pH stainless steel
G	Nickel	Nickel	Nickel	Buna	Metal 17-7 pH stainless steel
J	Nickel	Nickel	Nickel	EPDM	Metal 17-7 pH stainless steel
Code		Filters			
A	None ⁽²⁾				
B	10 Micron ⁽³⁾				
C	20 Micron ⁽²⁾				
D	30 Micron ⁽²⁾				
E	40 Micron ⁽²⁾				
F	1 Micron ⁽³⁾				
Code		Calibration options			
A	0.5% factory calibration				
Z	No special calibration (1.0%)				
Code		Factory options			
Z	Standard product				
X	ETO product				
Typical model number: LFC4M 324 A 1 A 1 V B Z Z					

(1) Downport has no fitting O-ring.

(2) Not available for Model LFC2M.

(3) B or F required for Model LFC2M.

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