McMillan
FLOW PRODUCTS

GAS

LIQUID

PRECISION FLOW METERS FOR GAS & LIQUID APPLICATIONS

10X Series
Microturbine Flow Sensors

APPLICATION IDEAS

Analysis sample rate verification
Totalizing chemical injection streams
Test stand flow monitoring
Upgrading rotameters to monitor flow rate

Product Description

McMillan 10X Series Flow Sensors are capable of measuring extremely low flow rates. Units are available that measure gas flow as low as 20 mL/min and as high as 500 L/min. Liquid flow can be measured as low as 13 mL/min and as high as 50 L/min. Full scale accuracies of ± 1.0% or better are available on select models.

A wide variety of liquids and gases may be measured. Repeatable results are achieved using a Pelton-type microturbine wheel. This proven design has been providing precision results since 1988 and has earned a reputation for continuous operational service without failure.

Because of the compact size and affordable cost of these products, the 10X Series Flow Sensors are suitable for a wide variety of industrial, commercial, laboratory and OEM applications. Some examples include measurement of air, nitrogen, stack gases, hydrocarbon fluids, fuels, light oils, solvents, coolants, pesticides, mild acids, alkalis, and deionized water. Several power and output configurations are available, including both pulse and analog outputs. NIST traceable certificates are available on most models.

Features and Options

FLOW RANGES*

Units are available that measure gas flow as low as 20 mL/min and as high as 500 L/min. Liquid flow can be measured as low as 13 mL/min and as high as 50 L/min.

POWER

Most units may be specified to operate with either 12 VDC or 24 VDC power. Various power adapters are also available for use with 12 VDC versions.

SIGNAL OUTPUTS

Some units may be ordered with a 0-5 VDC output, a pulse output, or with both. The Model 107 is only available with a 4-20 mA output, and the Model 106 | 106S | 106F have multiple options including 0-10 VDC output.

ACCURACY / LINEARITY

All liquid models have a standard accuracy specification of ± 1% full scale including linearity. An improved accuracy specification of ± 0.5% is available on some liquid models. NIST traceable calibration certificates are standard for improved accuracy (“H”) models and optional for standard units. All gas models have a standard accuracy specification of ± 3% full scale including linearity.

FLUID CONNECTIONS

Units feature either tube fittings or male integrated flare fittings, depending upon the model. Many alternate fitting types and sizes may be selected as noted in the Fitting Availability Chart on pages 6 and 7 for each model.

ELECTRICAL CONNECTIONS

Models 100 | 101 | 102 | 104 | 107 have an integrated 4-pin male connector. To complete connections, either a cable assembly or power adapter should be ordered. Units where the circuit board has been epoxy potted for increased chemical resistance feature an integrated cable with pigtail leads. Models 106 | 106S | 106F have an integrated cable with pigtail leads.

DISPLAYS*

A variety of remote displays are available for use with the 10X Series Flow Sensors. McMillan also offers a comprehensive range of flow meters with integrated displays.

*Consult the factory or an authorized representative for additional information.

Principle of Operation

McMillan's microturbine wheel technology utilizes the Pelton turbine wheel concept. This design allows for the use of a miniature turbine wheel to measure flow. The wheel is supported by a very small sapphire shaft held in position by two maintenance-free bearings. Due to the light weight of both the wheel and the shaft, the microturbine wheel is virtually suspended in the flow path. This suspension effect relieves friction on the shaft and bearings, eliminating wear.

As flow passes through the device, it is directed onto the very small teeth of the wheel using a high precision nozzle (see the blue arrows in Figures 1 and 2). This nozzle is sized according to the flow range of the unit. The rotational speed of the turbine wheel increases proportionally to the volumetric flow rate.

On some 10X models (see Figure 1), the microturbine wheel has alternating white and black sections evenly spaced on it's surface. As the wheel rotates (as shown with green arrows), an infrared beam (as shown with red arrows) is reflected off each white section and directed to a phototransistor which detects each reflected beam and converts them into measured pulses.

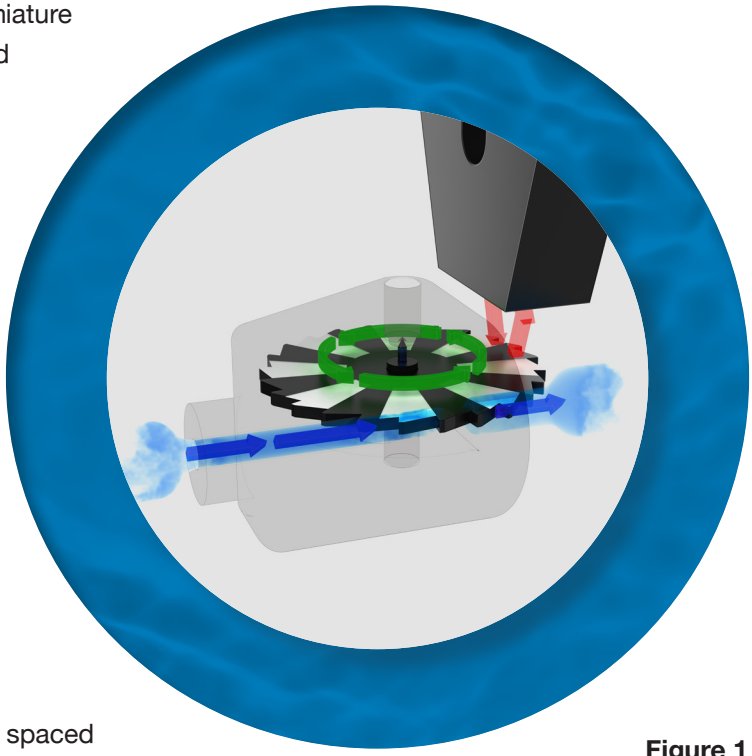


Figure 1
Representation of microturbine technology for 100 | 101 | 102 | 104 | 107

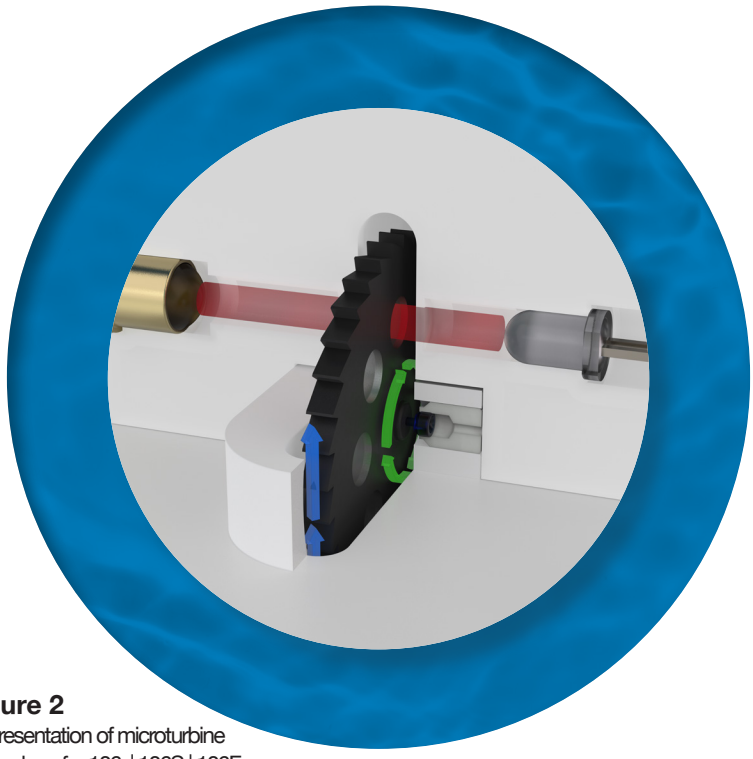


Figure 2
Representation of microturbine technology for 106 | 106S | 106F

On other 10X models (see Figure 2), the microturbine wheel has integrated translucent sections. An infrared emitter is located on one side of the wheel and a sensor on the other. As the wheel rotates (as shown with green arrows), the infrared beam (as shown in red) is alternately interrupted and passed through the translucent sections, detecting wheel speed, and generating a pulse based on flow.

Increased flow causes the wheel to spin faster, increasing the pulse rate. When the wheel stops (under zero flow conditions), no pulses are generated. This eliminates the possibility of "zero drift" and the need for adjustments to the instrument's zero reading. Processing circuitry provides analog and/or pulse outputs that are linearly proportional to the flow rate.

Specifications

Except where noted, all specifications apply to operation at 25°C

	100	101	102	104	106	106S	106F	107
Accuracy (including linearity, best fit straight line)	± 3.0% full scale	Analog Output: ± 1.0% full scale "H" Option (Analog Output): ± 0.5% full scale Pulse Output: ± 3.0% full scale			Analog Output: ± 1.0% full scale Pulse Output: ± 3.0% full scale			Analog Output: ± 1.0% full scale
Repeatability	± 0.5% full scale	± 0.2% full scale						
Pressure Rating	40 psig [2.7 barg]	100 psig [6.8 barg]	500 psig [34 barg]		Working Pressure: 60 psig [4 barg] * Overpressure Limit: 85 psig [5.8 barg]			500 psig [34 barg]
Temperature Rating (Operating Range)	41 to 131 °F [5 to 55 °C]				41 to 122 °F [5 to 50 °C] *			41 to 131 °F [5 to 55 °C]
Temperature Rating (Storage Range)	32 to 158 °F [0 to 70 °C]							
Temperature Sensitivity	± 0.2% full scale or less per °C							
Wetted Materials	PPS 304 SS Epoxy Glass Sapphire FKM Acetal (fittings)		Brass PPS 316L SS 303 SS Epoxy Glass Sapphire FKM	316L SS 303 SS Epoxy Glass Sapphire FKM	PTFE Sapphire FFKM PFA (fittings, 106 only) Ruby			316L SS 303 SS Epoxy Glass Sapphire FKM
Recommended Filtration	25 microns or less							
Compatible Media	Non-condensing gases	Low viscosity (< 15 cSt), translucent or transparent, degassed						
0-5 VDC Output Signal	Non-isolated, 2500 ohm minimum load							Not available
Pulse Output Signal	Not available	7.5 VDC peak buffered square wave, 0 - 400 Hz typical						Not available
4-20 mA Output Signal	Not available				Non-isolated, current loop should not exceed 500 ohms			
Power	12 VDC units: 11.5-15 VDC @ 35 mA 24 VDC units : 22-25 VDC @ 35 mA				12 VDC units: 11.5-15 VDC @ 55 mA 24 VDC units: 22-25 VDC @ 55 mA add 20 mA for 4-20 mA output		22-25 VDC @ 65 mA	
Response Time	Typically < 30 seconds to 67% of final value	Typically < 1 second to 67% of final value						
Certifications	CE Approved; 89 / 336 / EEC (EN 55011 & EN 50082-1) 73 / 23 / EEC Low Voltage Directive UKCA							
Ratings	IP10 (NEMA 1)				IP53 (NEMA 2) "Y" Option IP67 (NEMA 6)			IP10 (NEMA 1)
Warranty	1 Year Limited							

*Other pressure/temperature ratings may be available; Contact the factory or an authorized representative for additional information.

Ordering Information for Model 100

Form part number as follows:

(Base Model) - (Flow Range) (Power/Signal) - (Cable/Connector) - (Fittings) - (Options)

Example: 100-3D-CM-A2

100 – ___ ___ – CM – ____ – ____

OPTIONS

NIST	NIST Certificate (air only)*

FITTINGS

A2	1/8” acetal tube (flow ranges 3-6)
A4	1/4” acetal tube (flow ranges 3-9)
A6	3/8” acetal tube (flow ranges 8-11)
A7	1/2” acetal tube (flow ranges 11-14)

CABLE / CONNECTOR

CM	4 Pin Male

POWER / SIGNAL OUTPUT

B	22-25 VDC / 0-5 VDC
D	12-15 VDC / 0-5 VDC

FLOW RANGE (ML/MIN)

3	20 – 100
4	40 – 200
5	100 – 500
6	200 – 1000
7	400 – 2000
8	1000 – 5000

FLOW RANGE (L/MIN)

9	2.0 – 10.0
10	4.0 – 20.0
11	10.0 – 50.0
12	20.0 – 100.0
13	40.0 – 200.0
14	100.0 – 500.0

MODEL

100	Plastic microturbine flow sensor for gases

EXAMPLE

100-3D-CM-A2 would provide a PPS-bodied microturbine flow sensor that provides an analog 0-5 VDC output signal, requires 12 VDC power, includes 1/8” acetal tube fittings, and would measure flow rates from 20 – 100 mL/min of air.

*Contact the factory or an authorized representative for other media options.

Ordering Information for Models 101 | 102 | 104 | 107

Form part number as follows:

(Base Model) - (Flow Range) (Power/Signal) - (Cable/Connector) - (Fittings) - (Options)

Example: 104-6T-CM-S4-H

10_ – ___ ___ – CM – ____ – ____

OPTIONS

NIST	NIST Certificate (water only)*
H	Improved ± 0.5% full scale accuracy (ranges 3-8 only), includes NIST (101 | 102 | 104)

FITTINGS (SEE FITTING AVAILABILITY CHART BELOW FOR AVAILABLE SIZES BASED ON FLOW RANGE)

A2	1/8" acetal tube
A4	1/4" acetal tube
A6	3/8" acetal tube
B2	1/8" brass tube
B4	1/4" brass tube
B6	3/8" brass tube
S2	1/8" 316L stainless steel tube
S4	1/4" 316L stainless steel tube
S6	3/8" 316L stainless steel tube

CABLE / CONNECTOR

CM	4 Pin Male

POWER / SIGNAL OUTPUT

B	22-25 VDC / 0-5 VDC (101 | 102 | 104)
C	15-25 VDC / 4-20 mA (107)
D	12-15 VDC / 0-5 VDC (101 | 102 | 104)
T	12-15 VDC / 0-5 VDC, Pulse (101 | 102 | 104)

FLOW RANGE

3	13 – 100 mL/min
4	20 – 200 mL/min
5	50 – 500 mL/min
6	100 – 1000 mL/min
7	200 – 2000 mL/min
8	500 – 5000 mL/min
9	1.0 – 10.0 L/min

MODEL

101	Plastic microturbine flow sensor for liquids
102	Brass microturbine flow sensor for liquids
104	Stainless steel microturbine flow sensor for liquids
107	Stainless steel microturbine flow sensor for liquids

FITTING AVAILABILITY

	101			102			104 | 107		
CODE	A2	A4	A6	B2	B4	B6	S2	S4	S6
SIZE	1/8"	1/4"	3/8"	1/8'	1/4"	3/8"	1/8"	1/4"	3/8"
MATERIAL	ACETAL			BRASS			316L SS		
RANGE 3	✓	✓		✓	✓		✓	✓	
RANGE 4		✓			✓			✓	
RANGE 5		✓	✓		✓	✓		✓	✓
RANGE 6		✓	✓		✓	✓		✓	✓
RANGE 7		✓	✓		✓	✓		✓	✓
RANGE 8			✓			✓			✓
RANGE 9			✓			✓			✓

EXAMPLE

104-6T-CM-S4-H would provide a stainless steel-bodied microturbine flow sensor with both analog 0-5 VDC and pulse outputs, requires 12 VDC power, includes 1/4" stainless steel tube fittings, is calibrated to ± 0.5% linearity (full scale), and measures flow rates from 100 – 1,000 mL/min.

*Contact the factory or an authorized representative for other media options.

Ordering Information for Models 106 | 106S | 106F

Form part number as follows:

(Base Model) - (Flow Range) (Power/Signal) - (Cable/Connector) - (Fittings) - (Options)

Example: 106F-5A-C6-F4

10__ – ___ ___ – ____ – ____ – ____

OPTIONS

Y	Epoxy-potted PC Board (Model 106 only)
FN	Add pair of PVDF flare nuts
NIST	NIST Certificate (water only) **

FITTINGS (SEE FITTING AVAILABILITY CHART BELOW FOR AVAILABLE SIZES BASED ON FLOW RANGE)

T2	1/8" PFA Tube
T4	1/4" PFA Tube
T6	3/8" PFA Tube
F4	1/4" Flare
F6	3/8" Flare
F4	1/4" Integrated PFA Flare
F6	3/8" Integrated PFA Flare
F7	1/2" Integrated PFA Flare
F8	3/4" Integrated PFA Flare

CONNECTOR / CABLE LENGTH

C3	Pigtail Leads, 3ft [0.92m]
C6	Pigtail Leads, 6ft [1.85m]
C25	Pigtail Leads, 25ft [7.7m]

POWER / SIGNAL OUTPUT

A	12-15 VDC / Pulse
B	22-25 VDC / 0-5 VDC
C	15-25 VDC / 4-20 mA
D	12-15 VDC / 0-5 VDC
E	22-25 VDC / Pulse
J	22-25 VDC / 0-10 VDC
K	12-15 VDC / 0-10 VDC

FLOW RANGE

3	13 – 100 mL/min*
4	20 – 200 mL/min
5	50 – 500 mL/min
6	100 – 1000 mL/min
7	200 – 2000 mL/min
8	500 – 5000 mL/min
9	1.0 – 10.0 L/min
10	2.0 – 20.0 L/min (106S and 106F only)
11	5.0 – 50.0 L/min (106S and 106F only)

MODEL

106	PTFE microturbine flow sensor for liquids
106S	PTFE microturbine flow sensor with flare connections for liquids
106F	PTFE microturbine flow sensor with flare connections for liquids

FITTING AVAILABILITY

	106					106S | 106F			
CODE	T2	T4	T6	F4	F6	F4	F6	F7†	F8
SIZE	1/8'	1/4"	3/8"	1/4"	3/8"	1/4"	3/8"	1/2"	3/4"
MATERIAL	PFA TUBE			PFA FLARE		INTEGRATED FLARE			
RANGE 3	✓	✓		✓		✓	✓		
RANGE 4		✓		✓		✓	✓		
RANGE 5		✓	✓	✓	✓	✓	✓		
RANGE 6		✓	✓	✓	✓	✓	✓		
RANGE 7		✓	✓		✓		✓		
RANGE 8			✓		✓		✓		
RANGE 9			✓		✓		✓	✓	
RANGE 10								✓	✓
RANGE 11									✓

EXAMPLE

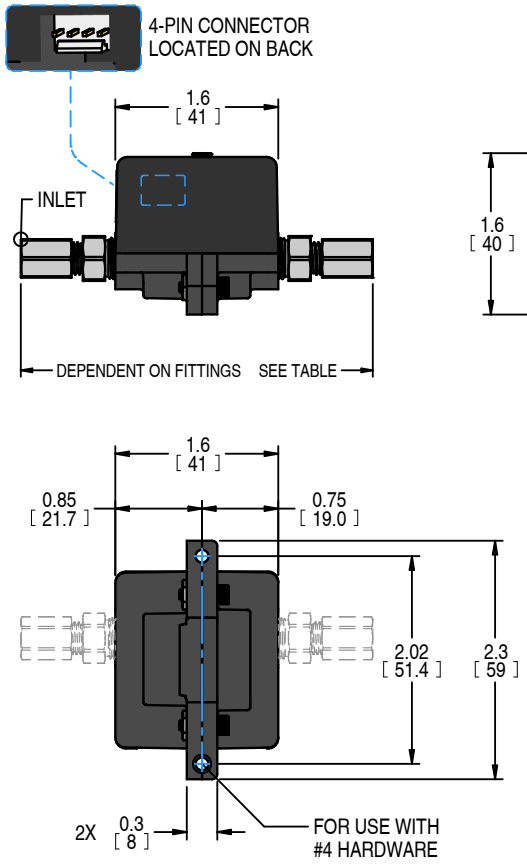
106F-5A-C6-F4 would provide a PTFE-bodied microturbine flow sensor that provides a pulse output signal, requires 12 VDC power, includes a 6 foot [1.85 m] cable terminated with pigtail leads, integrates 1/4" male flare fluid connections, and would measure flow rates from 50 – 500 mL/min of water (or similar fluid).

*Best performance from 20 – 100 mL/minute. Response below 20 mL/minute will vary depending on application.
** Contact the factory or an authorized representative for other media options.
† F7 fittings only available for the 106S.

Dimensions

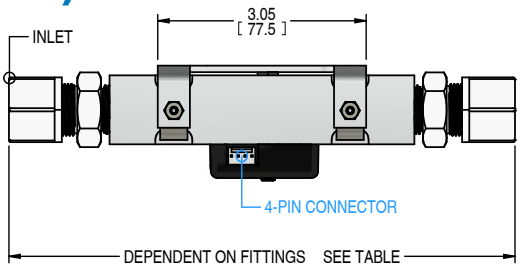
Basic unit configurations are shown. Contact the factory or an authorized representative for dimensions of units not shown.
All dimensions shown in inches [mm] unless otherwise noted.

100 | 101 (RANGES 3-9):

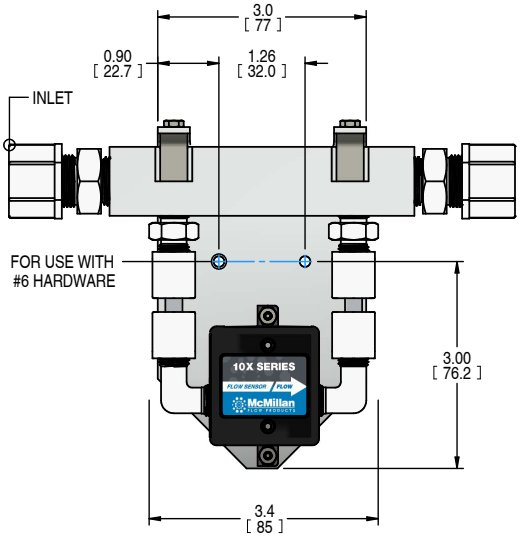


OVERALL LENGTH TABLE			
FITTING	A2	A4	A6
LENGTH	3.5 [87.9]	3.9 [99.3]	4.4 [111.5]

100 (RANGES 10-14):



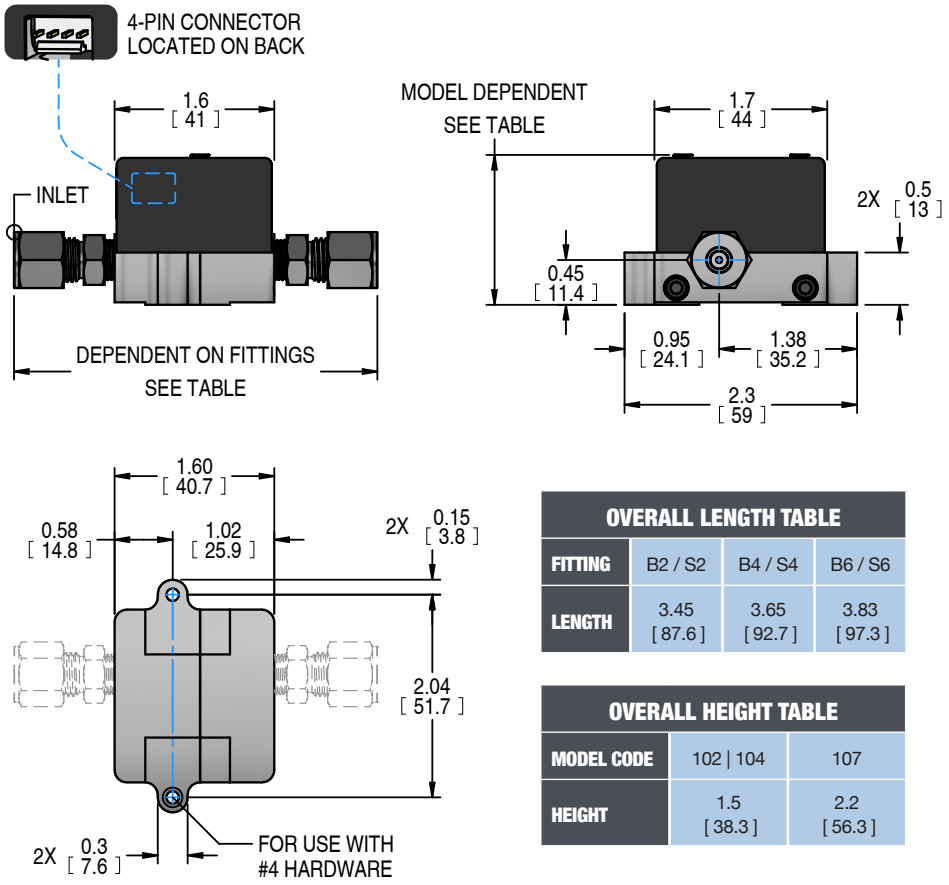
OVERALL LENGTH TABLE		
FITTING	A6	A7
LENGTH	7.0 [177.5]	7.4 [188.1]



Dimensions

Basic unit configurations are shown. Contact the factory or an authorized representative for dimensions of units not shown.
All dimensions shown in inches [mm] unless otherwise noted.

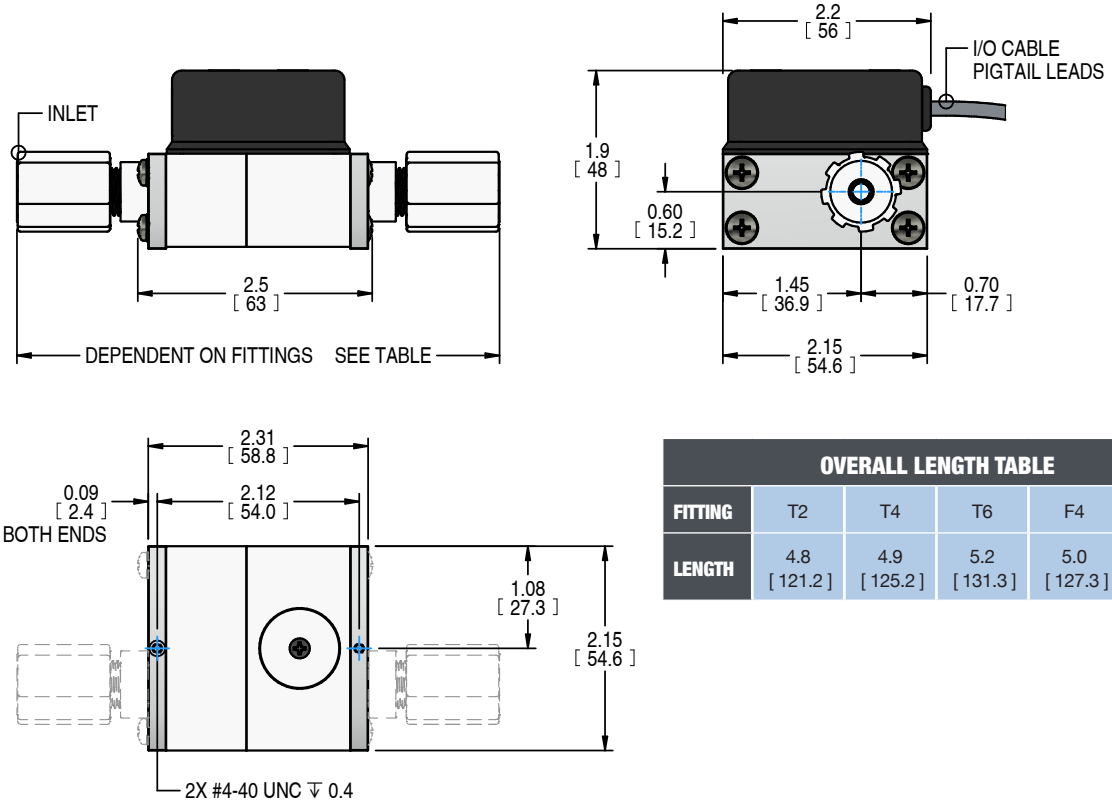
102 | 104 | 107:



OVERALL LENGTH TABLE			
FITTING	B2 / S2	B4 / S4	B6 / S6
LENGTH	3.45 [87.6]	3.65 [92.7]	3.83 [97.3]

OVERALL HEIGHT TABLE		
MODEL CODE	102 | 104	107
HEIGHT	1.5 [38.3]	2.2 [56.3]

106:

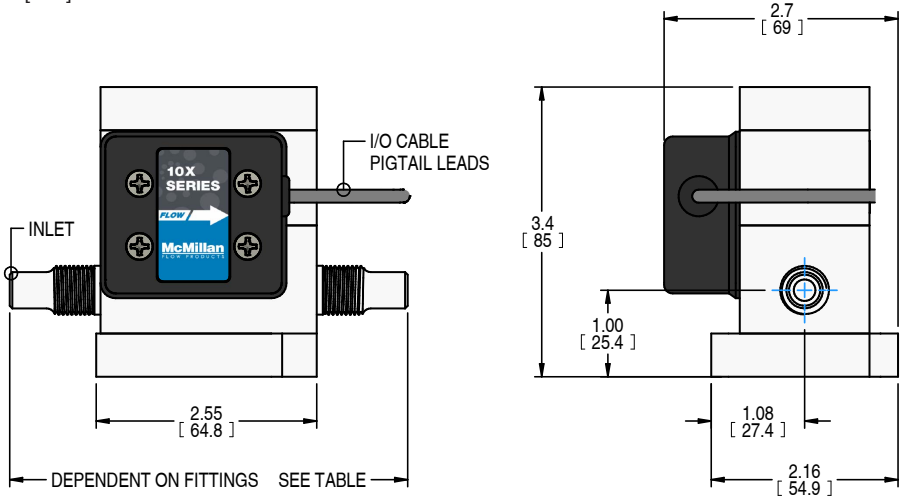


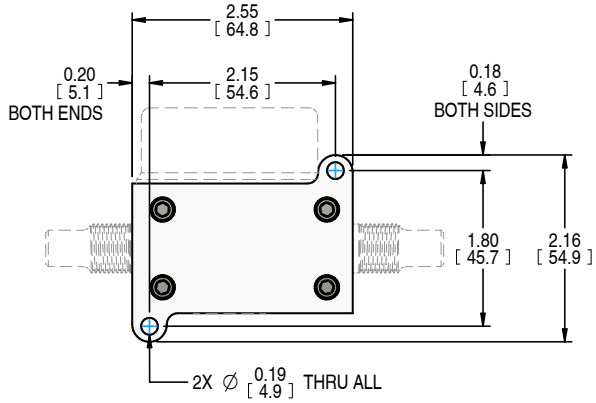
OVERALL LENGTH TABLE					
FITTING	T2	T4	T6	F4	F6
LENGTH	4.8 [121.2]	4.9 [125.2]	5.2 [131.3]	5.0 [127.3]	5.2 [132.3]

Dimensions

Basic unit configurations are shown. Contact the factory or an authorized representative for dimensions of units not shown.
All dimensions shown in inches [mm] unless otherwise noted.

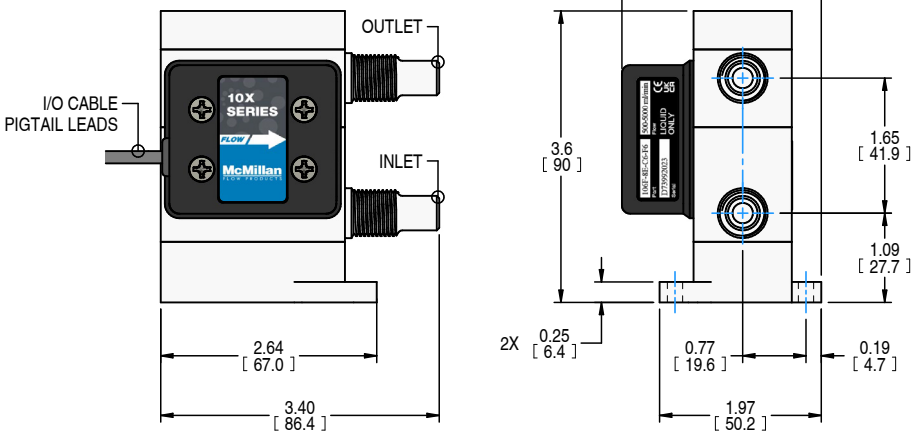
106S:

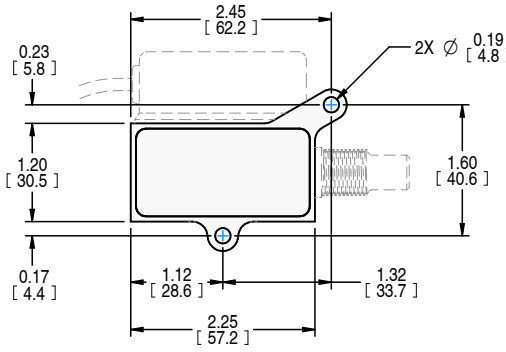




OVERALL LENGTH TABLE				
FITTING	F4	F6	F7	F8
LENGTH	4.6 [121.2]	4.6 [121.2]	4.6 [121.2]	5.1 [129.5]

106F:





GENERAL DIMENSIONS FOR MODEL 106F F4 AND F6 FITTING OPTIONS ONLY CONTACT FACTORY OR AN AUTHORIZED REPRESENTATIVE FOR F8 OPTIONS

Related Accessories
(100 | 101 | 102 | 104 | 107)

CODE	DESCRIPTION
100-17T	Mating cable for CM option with pigtail leads, 36” length [92 cm]
110-00-08T	115 VAC power adapter, includes signal cable
110-00-18T	230 VAC power adapter, includes signal cable

Related Products

S Series Flow Meters
Flow meters with
integrated flow rate display

Model 275 Display
Digital panel display
for use with the 10X

50X Flow Meters
Thermal mass flow sensors
and meters for gases

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