

# User's Guide

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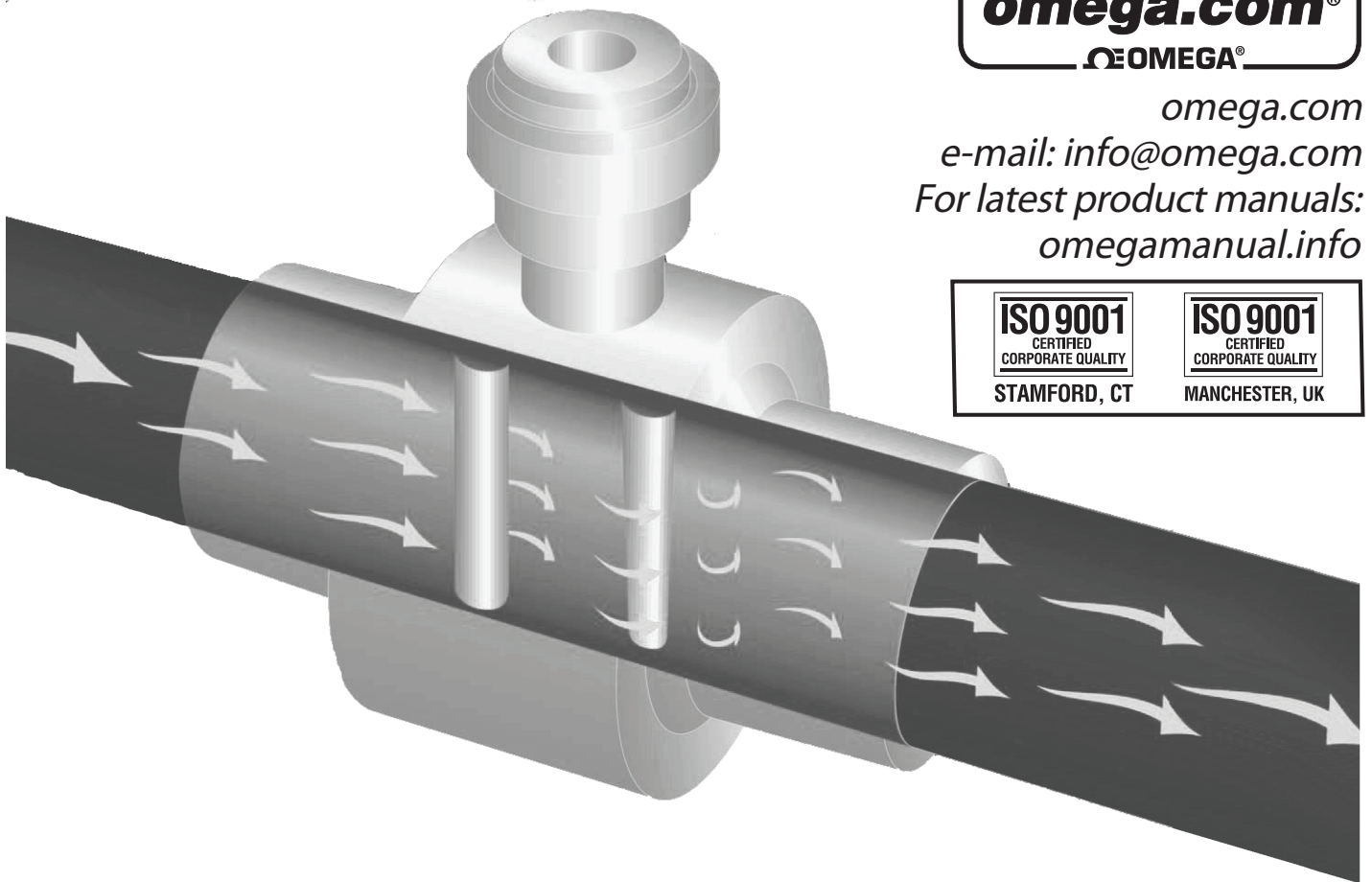
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## Series FV-200 Vortex Shedding Flow Meter



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The information contained in this document is believed to be correct, but OMEGA accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.

**WARNING:** These products are not designed for use in, and should not be used for, human applications.

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# INTRODUCTION

## DESCRIPTION

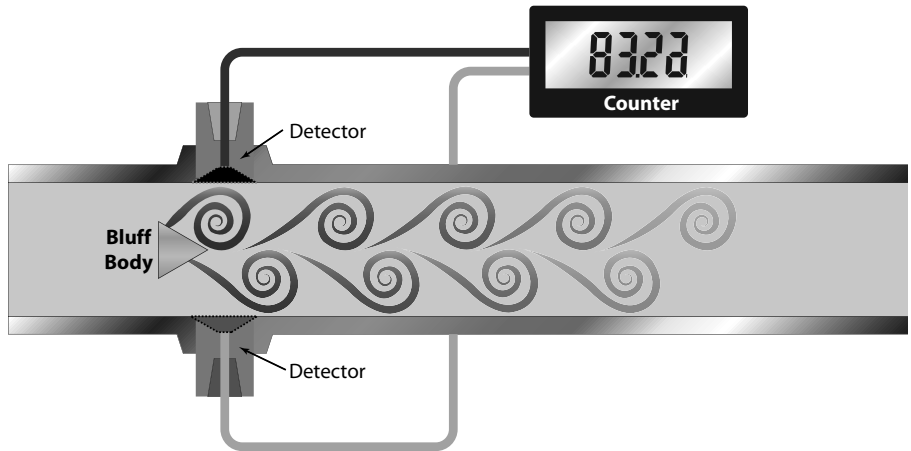
The FV-200 series vortex-shedding flow meter is a general-purpose electronic liquid flow meter. Three outputs are available. The standard output is a two wire (loop powered) 4-20 mA current. Options for a 0 to 5 VDC or a frequency output proportional to the volumetric flow rate are also available. The choice of output must be made at the time of ordering. High accuracy is assured by individual flow testing. Since it uses no moving parts, maintenance is minimized.

The FV-200 is available in several types of plastics allowing them to be used in a wide variety of chemical applications.

## OPERATING PRINCIPLE

An everyday example of a vortex shedding phenomenon is a flag waving in the breeze: the flag waves due to the vortices shed by air moving across the flagpole.

Within the flow meter, as a fluid moves across a tiny strut or "bluff body", vortices are also shed but on a smaller scale. The vortices form alternately, from one side to the other, causing pressure fluctuations. These are detected by the crystals in the sensor tube, and are converted to an analog signal or pulse output. The frequency of the vortices is directly proportional to the flow. This results in extremely accurate and repeatable measurements with no troublesome moving parts (*see figure 1*).



**FIGURE 1**

## FLUIDS

Any clean liquid compatible with the plastic material of construction that does not contain significant amounts of fibers or abrasive materials can be used.



**Danger** - Do not use with: explosive or flammable materials, food or beverages, or gaseous fluids.

Viscosities above 1 cSt will raise the minimum usable flow rate (in effect reducing range-ability). This effect is linear to viscosity. No adjustments are required for viscosities up to 2.0 cSt. Liquids with higher viscosities will adversely affect the permissible amount and duration of over range flow (*see table 1*).

Viscosity and Rangeability			
Viscosity	Minimum	Maximum	Flow Range
1 cSt	1	12	12:1
2 cSt	2	12	6:1
3 cSt	3	12	4:1
4 cSt	4	12	3:1
5 cSt	5	12	2.4:1
6 cSt	6	12	2:1

**TABLE 1**

# GENERAL INSTALLATION INFORMATION

Prior to installation, the following items should be considered.

- 1) The vortex transmitter contains electronic circuitry which can be affected by high electromagnetic or electrostatic fields. Care should be taken to locate the installation in an area away from large electrical motors, transformers, or other devices which can produce such interference.
- 2) Proper grounding is required to eliminate electrical noise which may be present within the fluid and piping system or in the near vicinity of the vortex transmitter. For non-conductive piping systems, an exterior grounding strap should be used to provide a path to earth ground. For conductive piping systems, a properly grounded pipe will require no additional preparation.

## FLOW RATE AND RANGE REQUIREMENTS

Most manufacturers state flow range capabilities by publishing the maximum allowed flow rates. Then they provide a turndown ratio to determine minimum flow rate. To use the turndown ratio, simply divide the maximum rate by the ratio to determine the minimum rate. The FV-200 vortex flow meters have a 12:1 turndown ratio at a viscosity of 1 cSt. Higher viscosities will reduce the turndown.

**NOTE:** *The ¼" NPT and ½" Flare meters have a standard turndown ratio of 8:1*

## PIPING REQUIREMENTS

Turbulence in the pipe line can affect the accuracy of most flow meters. Sources of turbulence are pumps, valves, or changes-in-direction in the line. To avoid these potential problems, it is standard practice to place the meter a certain distance from the turbulence source. These distances are indicated in Pipe Diameters (PD). For example, 10 PD means place the flow meter ten times its inside diameter away from the source of turbulence. Downstream distances between the meter and a valve or a change-in-direction must also be followed.

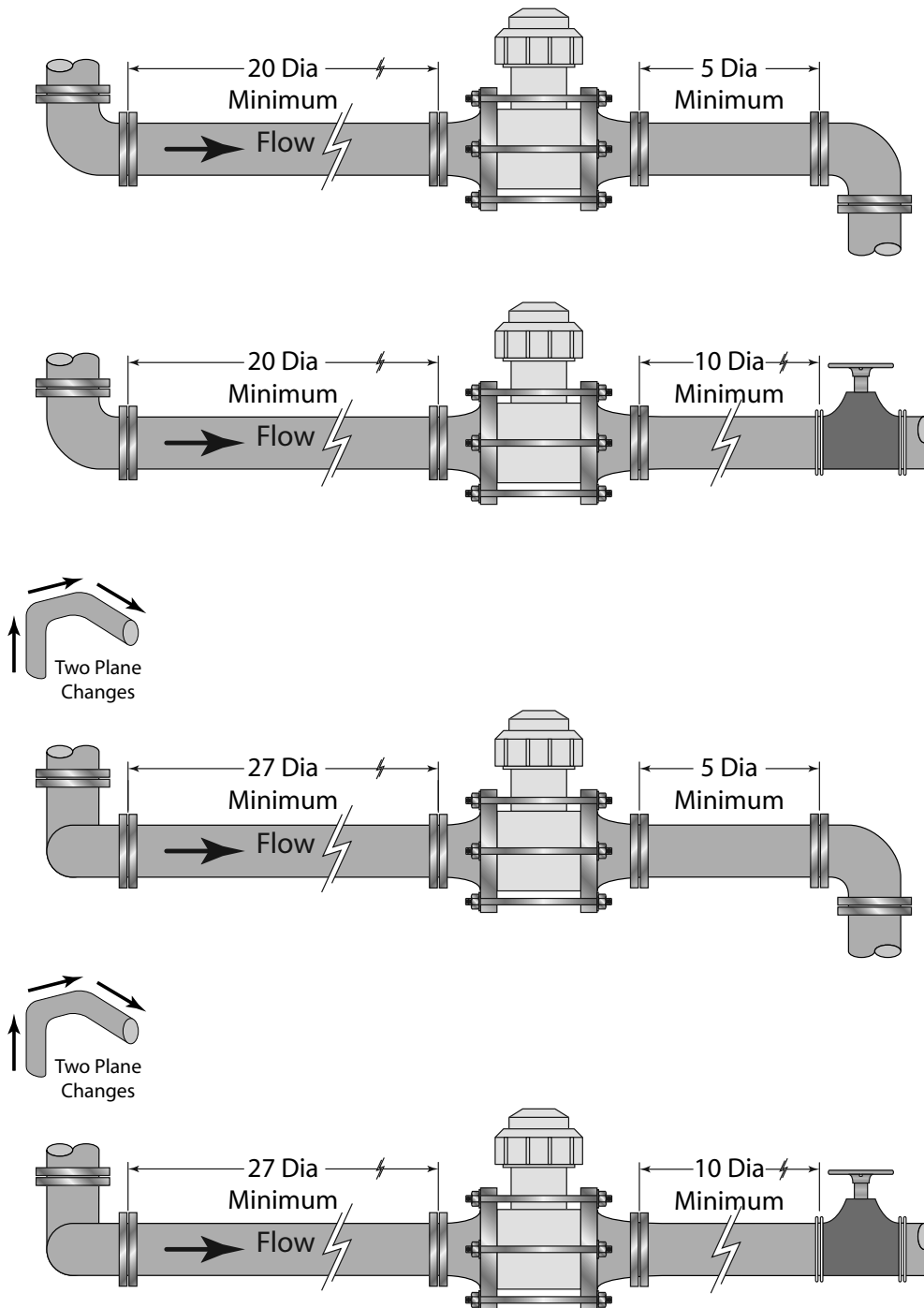
The best accuracy is achieved with at least 20 PD upstream and 5 PD downstream for FV-200 vortex flow meters. If an upstream elbow is closely coupled to another elbow creating a change in plane, 27 PD is required upstream and 10 PD downstream. **(see Figure 2, 3, and 4)**

When the diameter of the meter is smaller than the pipe line, at least 20 PD of pipe with the same diameter as the meter upstream, and 2 PD downstream is needed. Overall, 25 PD of straight run prior to the meter is required **(see Figure 5)**. If there is a plane change in the installation, this IN OUT requirement increases to 25 PD upstream (30 overall). The downstream requirement is now 2 PD of pipe with the same diameter as the meter, and a minimum of 5 PD overall of straight run. If there is a valve downstream the usual 10 PD between the meter and a valve is still required.

If the required piping parameters are not met, there will be a reduction in accuracy.

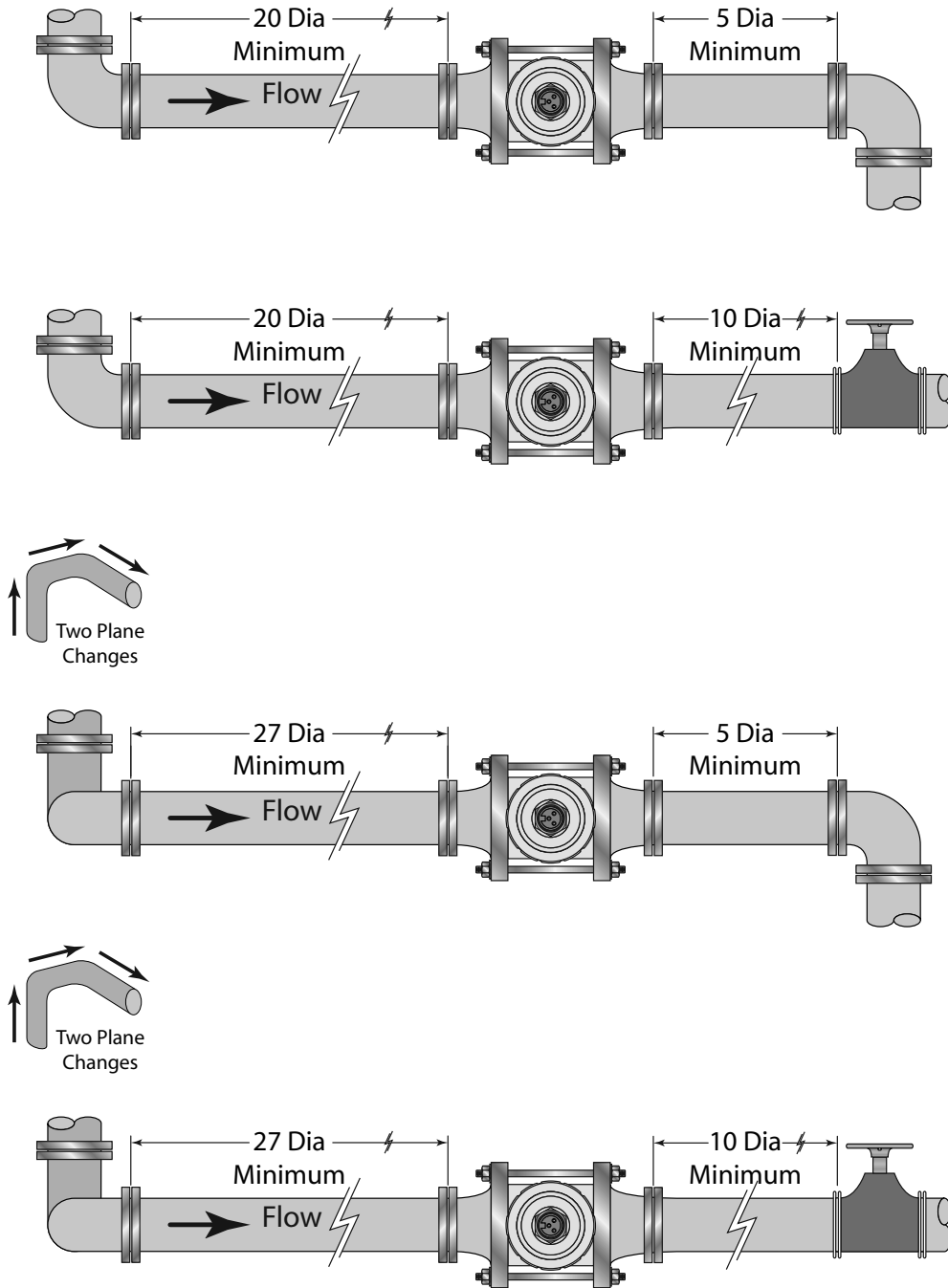
**NOTE:** *Pulsating flow will affect accuracy (pressure pulses will not).*

HORIZONTAL FLOW - (Sensing element in vertical orientation)				
Configuration	Piping Requirements (pipe diameters)		Accuracy (full scale)	Repeatability (of point)
	Inlet	Outlet		
1 plane change	20	5	±1.00%	0.25%
1 plane change w/outlet valve		10		
2 plane changes	27	5		
2 plane changes w/outlet valve		10		



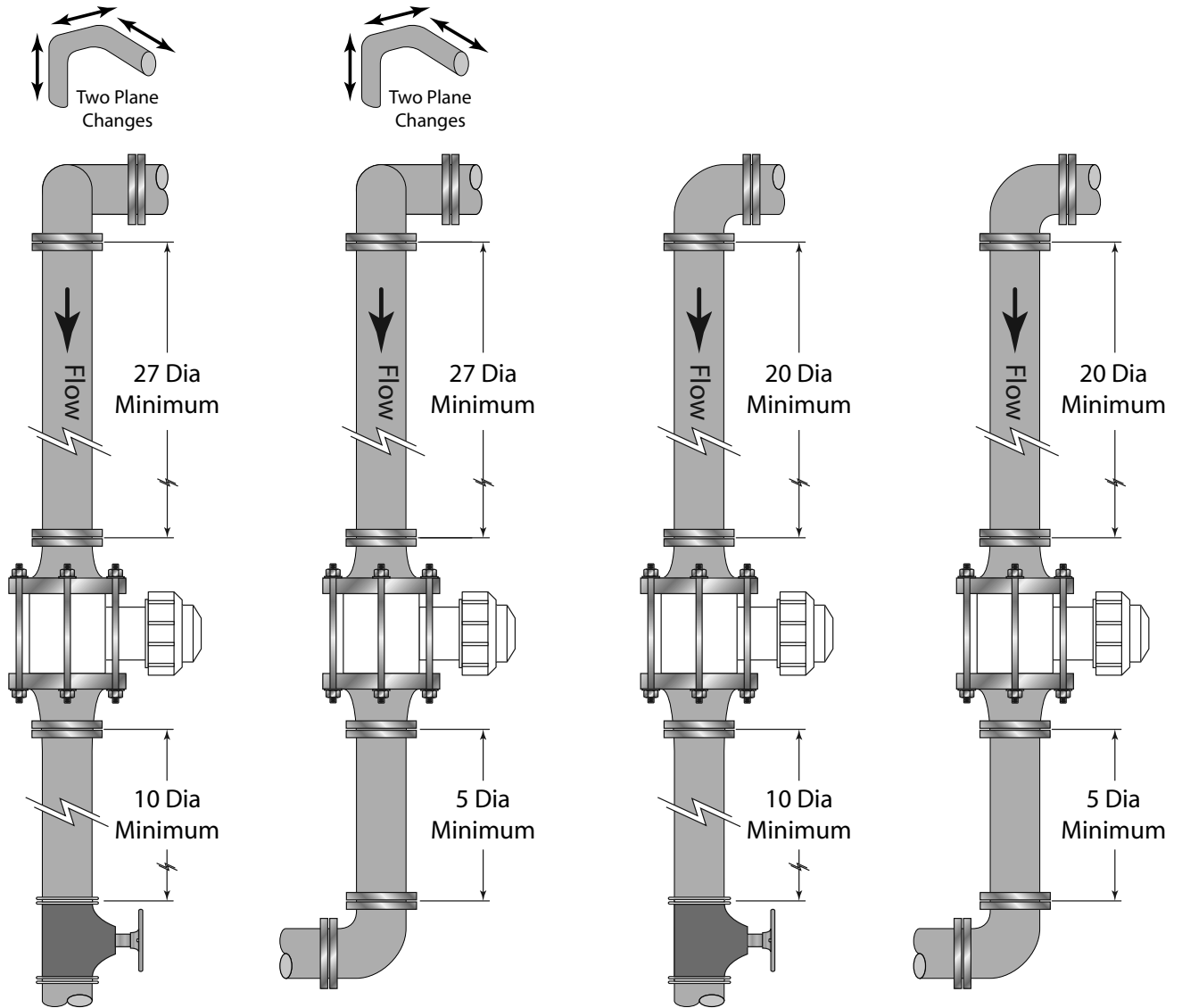
**FIGURE 2**

HORIZONTAL FLOW - (Sensing element in horizontal orientation)				
Configuration	Piping Requirements (pipe diameters)		Accuracy (full scale)	Repeatability (of point)
	Inlet	Outlet		
1 plane change	20	5	±1.50%	0.25%
1 plane change w/outlet valve		10		
2 plane changes	27	5		
2 plane changes w/outlet valve		10		



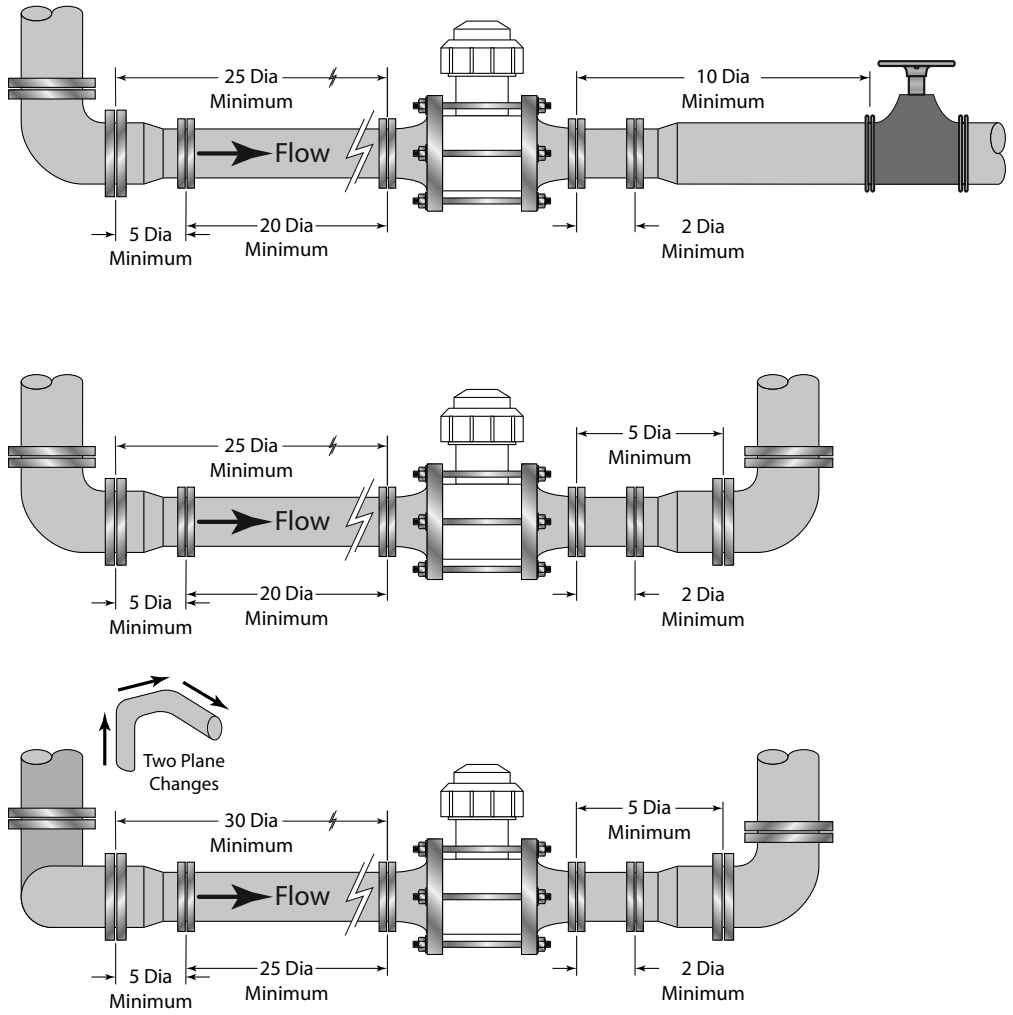
**FIGURE 3**

VERTICAL FLOW - (upward or downward flow and sensor in any orientation)				
Configuration	Piping Requirements (pipe diameters)		Accuracy (full scale)	Repeatability (of point)
	Inlet	Outlet		
1 plane change	20	5	±1.00%	0.25%
1 plane change w/outlet valve		10		
2 plane changes	27	5		
2 plane changes w/outlet valve		10		



**FIGURE 4**





**FIGURE 5**

## BACK PRESSURE

Back pressure (the pressure immediately downstream of the meter) must be maintained above a minimum level in order to avoid cavitation. For most applications, this may be ignored if the flow rate is less than 75% of maximum.

$$\text{Back Pressure} = 2.75 \Delta P + 1.25 PV - 14.7$$

Where:

- $\Delta P$  = Pressure drop in psi at max flow
- PV = Vapor pressure in psia of the liquid at operating temp.  
(eg. the PV of water at 100 °F is 0.42.)
- BP = Back pressure (downstream of meter) in psig.

For example the back pressure required for water, at 100 °F (37 °C) in a ½" meter, where the maximum pressure drop is 8 psi, 7.8 psig back pressure is sufficient. For other liquids, use the following formula to calculate the minimum back pressure.

$$\begin{aligned} BP &= (2.75 \times 8) + (1.25 \times 0.42) - 14.7 \\ BP &= 22 + 0.525 - 14.7 \\ BP &= 7.825 \end{aligned}$$

## TEMPERATURE

To protect the internal crystals in each unit, temperature limitations must be adhered to. All permissible operating temperatures are identified by meter and material type. Additionally fluid temperature will affect maximum working pressures. For de-rating information see the maximum fluid operating pressures for the specific flow meter model.

## OUTPUTS

The FV-200 series meters can be obtained with either an analog output or a rate frequency output. The standard analog output is a 4-20 mA current an optional 0-5 VDC is also available. The analog output can also be re-configured in the field using a PC communications cable and programming software which are both available from Omega.

The analog current output varies between 4 mA (0 flow) and 20 mA (maximum flow). The 0 to 5 VDC analog output is also continuously variable between 0 V (0 flow) and 5 V (maximum flow).

**NOTE:** One of the two analog output options (4-20 mA or 0-5 VDC) are hardware selected at the factory and can not be changed in the field.

The rate frequency output produces pulses whose frequency is proportional to the flow going through the meter. Each meter has a slightly different output frequency which is listed on the calibration sheet that accompanies the meter. **Table 2** shows the long term average full scale output frequency for standard size meters.

Meter Size in (mm)	Average Full Scale Frequency (Hz)	Pulse Width (msec)
¼ (6.4)	1055	0.47
½ (12.7)	820	0.61
½ (12.7)	570	0.88
¾ (19.1)	284	1.76
1 (25.4)	292	1.71
1½ (38.1)	144	3.47
2 (50.8)	148	3.38
3 (76.2)	61	8.20
<b>TABLE 2</b>		

The frequency output option generates a square wave with an amplitude that matches the input power level. The pulse width varies with frequency and is found by using the following formula. The result is in seconds.

$$PW = \frac{1}{2 \times \text{Maximum Frequency (Hz)}}$$

## K-FACTORS

The K-factor (with regards to flow) is the number of pulses that must be accumulated to equal a particular volume of fluid. Think of each pulse as representing a small fraction of the totalizing unit.

Calibration reports that accompany FV-200 series meters include a nominal K-factor in both gallons and liters. See the sample calibration sheet in the appendix of this manual.

## ELECTRICAL INSTALLATION

### POWER

The meter requires an 8 to 28 VDC power supply. The specific connections depend upon which output is option is used. See wiring details for the specific output option .

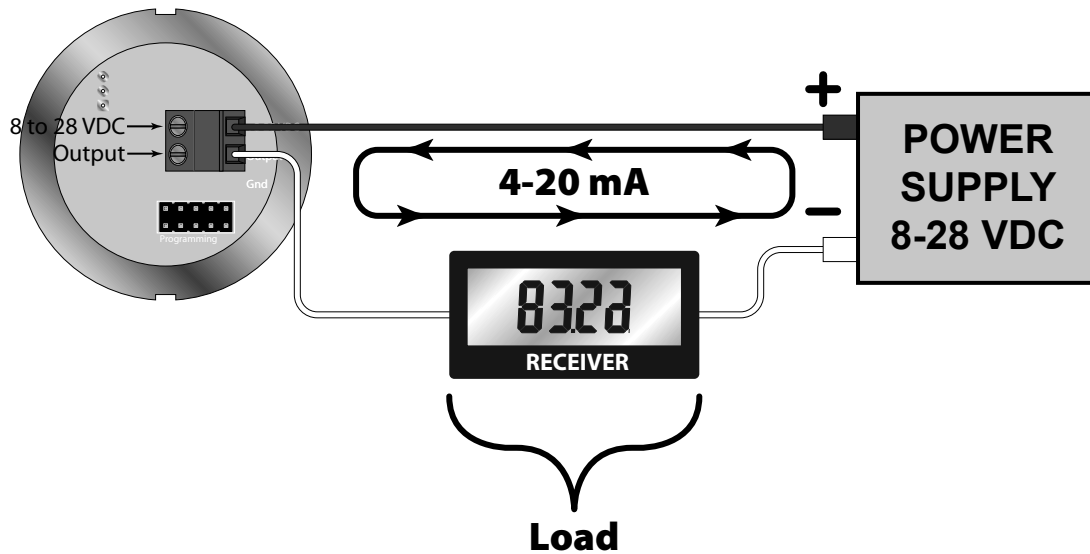
**NOTE:** *This instrument requires clean electrical line power. Do not operate this unit on circuits with noisy components (i.e. Fluorescent lights, relays, compressors, variable frequency drives, etc.) Linear power supplies are also much preferable to switching power supplies.*

**NOTE:** *The power and output connections share a common ground.*

### WIRING

#### 4-20 mA LOOP

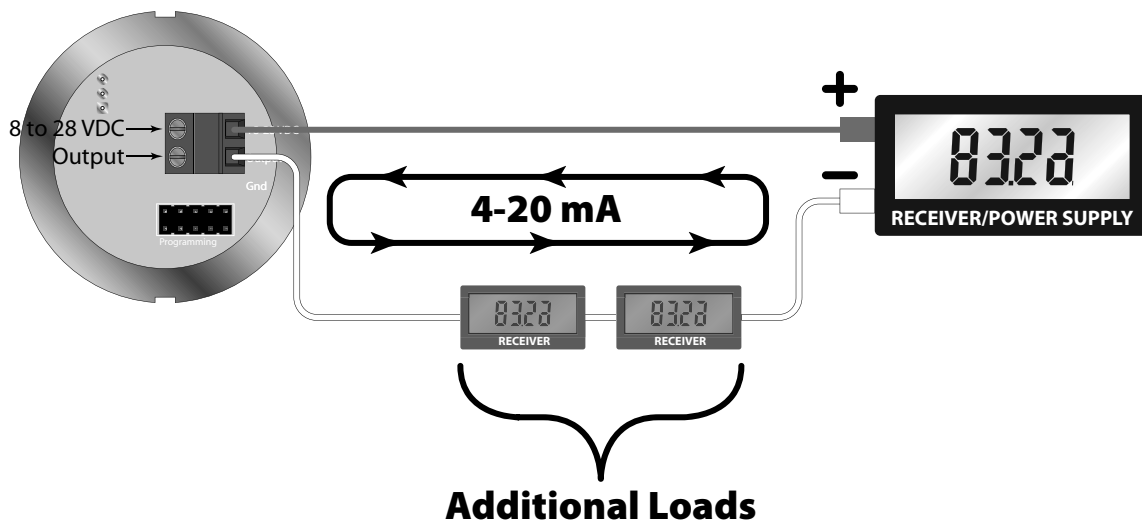
Connect a twisted pair wire (not provided) to the terminals of the transmitter marked +8-28 VDC and Output. If the twisted pair wire is shielded, do not connect the shield to the transmitter. The shield should be grounded at the receiver only (**see figure 6**). The transmitter is reverse-polarity protected.



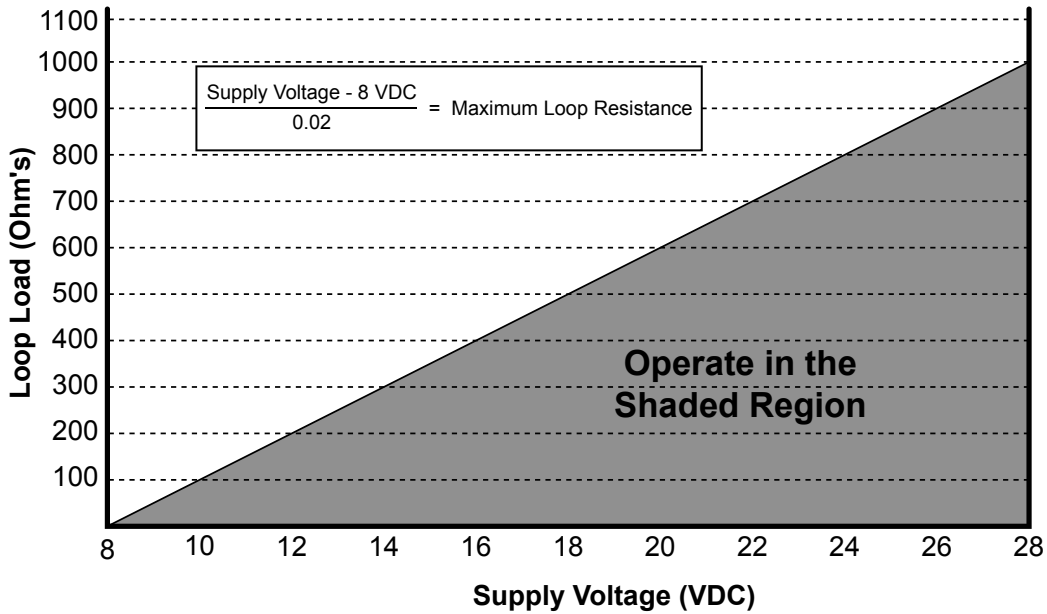
**FIGURE 6**

The receiving equipment must accept industry standard “true two-wire” or “loop powered” 4-20 mA process transmitter inputs. This means that the receiving equipment, such as a recorder or controller, must supply power for the transmitter along the twisted wire pair. If the receiving equipment does not provide power, a separate power supply, typically 24 VDC and at least 30 mA, must be used, as shown in **figure 6**. There are many brands of receivers which provide 24 VDC for this purpose.

Several receivers may be connected in a series as shown in **figure 7**, but only one should provide power, and all should have isolated inputs. The voltage provided by the receiver must be within the limits shown in the Supply Voltage chart (**see figure 8**).



**FIGURE 7**



**FIGURE 8**

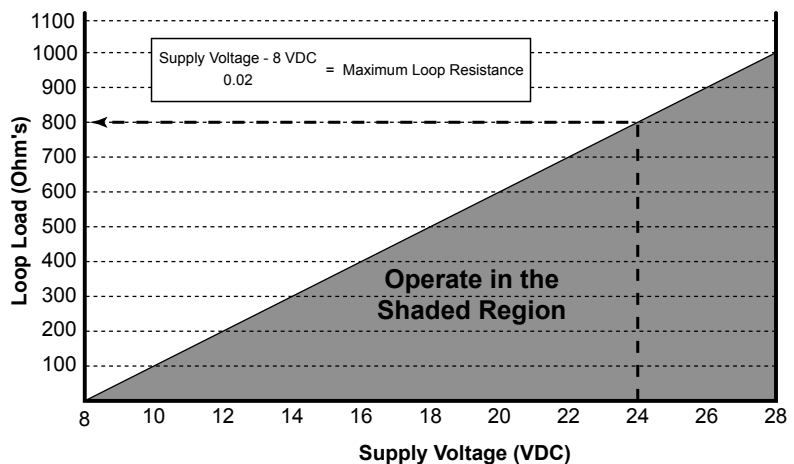
To use this figure, first add the resistance of all the receivers, indicators, etc., and the wire in the loop. If the wire resistance is unknown, use a value of 50 Ohm for a twisted wire of 1,000 feet or less with a gauge of #22 AWG or heavier.

Find the total load (in ohms) on the left hand side of the chart in **figure 8** and follow that value horizontally until it intersect with the shaded area.

From the intersection point look straight down to where a vertical line would intersect the voltage scale. This is the minimum voltage needed for the transmitter to operate properly under the specific load conditions.

**Example:** After checking the specification for all the loads in an application the total amounted to 800 ohms. Following the 800 ohm line in **figure 9** to the right the intersection point is about  $\frac{3}{4}$  of the way across the chart in **figure 9**.

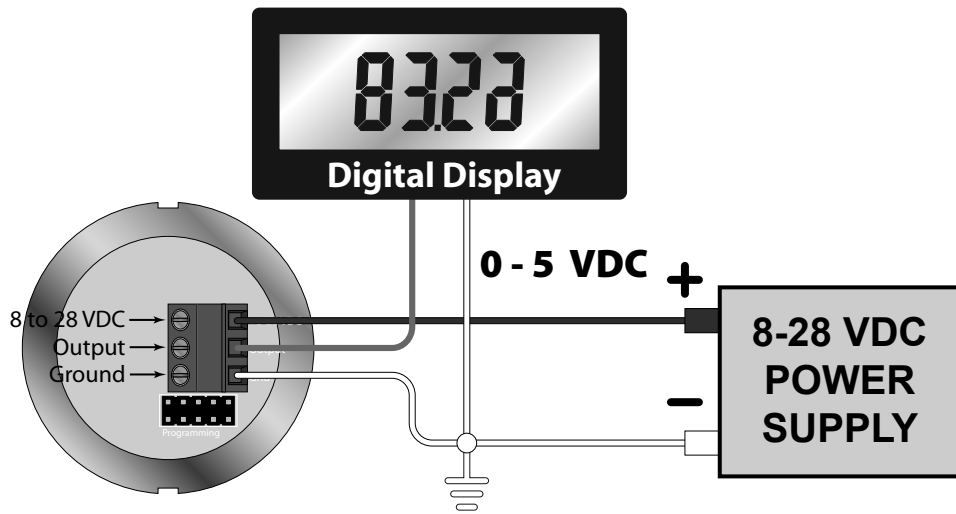
A vertical line through the intersection point crosses the voltage axis at about 24 VDC so with a load of 800 ohms a standard 24 volt power supply would be used.



**FIGURE 9**

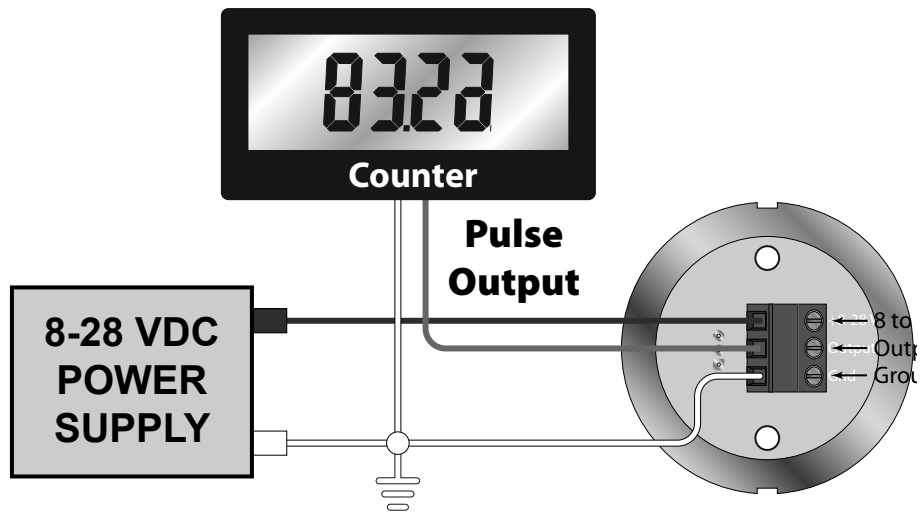
**Figure 10** and **figure 11** show typical connections for the 0-5 VDC and pulse output options.

**0 - 5 VDC OUTPUT**



**FIGURE 10**

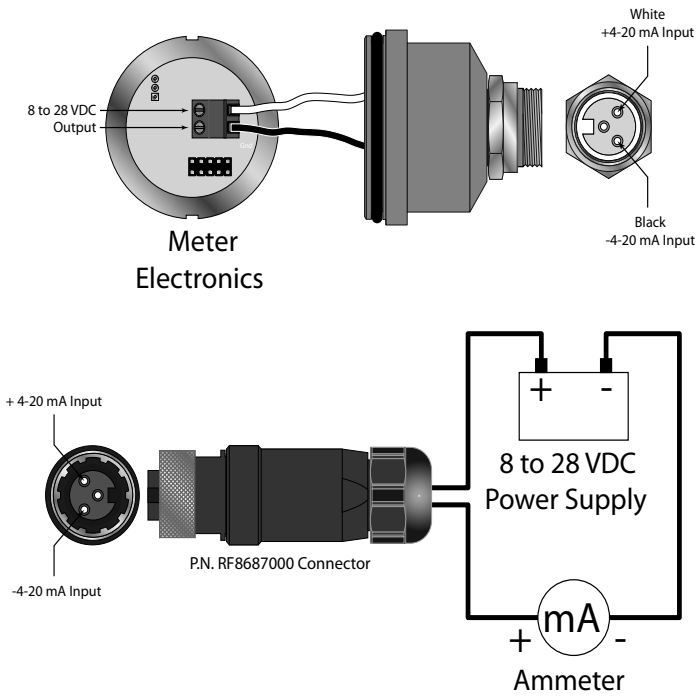
**PULSE OUTPUT**



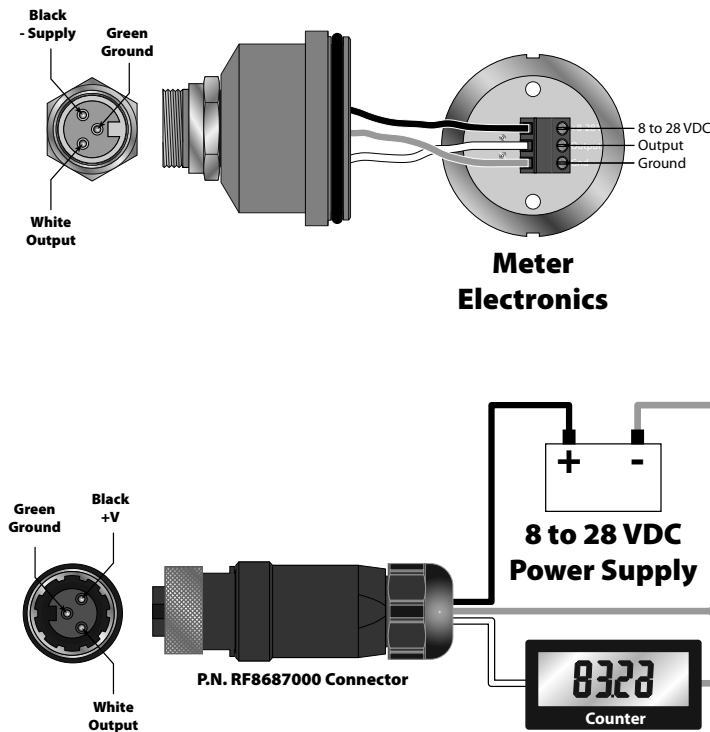
**FIGURE 11**

### 3 PIN CONNECTION OPTION

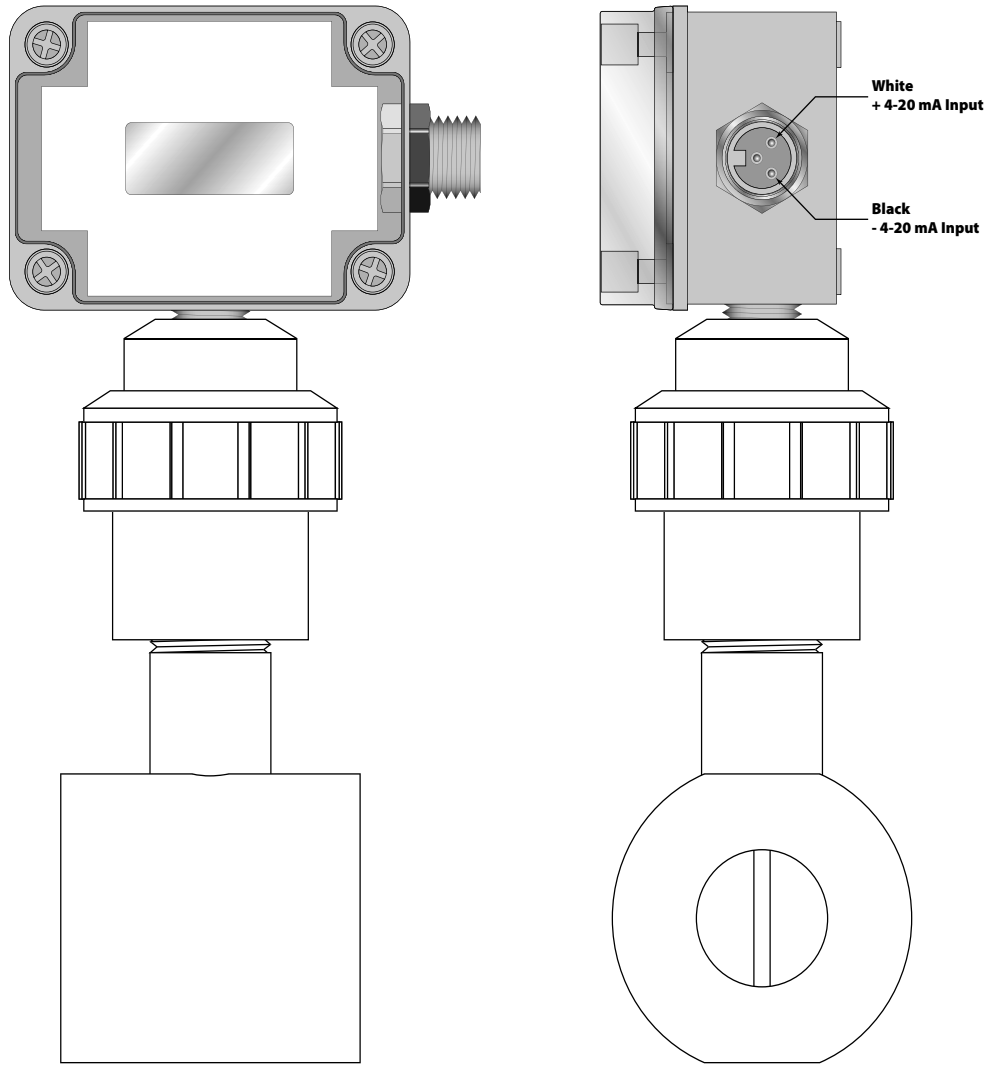
An optional 3 pin connection is available for when the transmitter/meter combination are to be mounted remotely from the power source/receiver. The mating connector is P.N. RF8687000.



**FIGURE 12**



**FIGURE 13**



**FIGURE 14**



## FV-200 (INLINE) SERIES

FV-200 (Inline) Specifications	
<b>Fluid:</b>	Liquids
<b>Connection:</b>	NPT Female or Butt (PVDF only)
<b>Turndown Ratio:</b>	12:1 (½" - 2") 8:1 (¼")
<b>Accuracy:</b>	±1% of full scale (4-20 mA or 0-5 VDC) ±2% of full scale, frequency pulse
<b>Repeatability:</b>	±0.25% of actual flow
<b>Materials</b>	PVC standard CPVC, PVDF optional
<b>Output Signals:</b>	4-20 mA standard 0-5 VDC or frequency pulse optional (Push - Pull Driver) 150 mA Sink or Source
<b>Power Supply:</b>	8 to 28 VDC
<b>Response Time</b>	2 seconds minimum, step change in flow.
<b>Enclosure:</b>	Type 4X (IP 66)

FV-200 (Inline) Nominal Flow Rates				
Tube Size (inches)	Minimum Flow gpm (lpm)	Maximum Flow gpm (lpm)	Nominal Full Scale Frequency Hz	Weight lbs (Kg)
¼	0.6 (2.3)	5 (18.9)	1052	1.5 (0.68)
½	1.3 (4.7)	15 (56.8)	570	1.6 (0.72)
¾	2.1 (7.9)	25 (94.6)	284	1.7 (0.77)
1	4.2 (15.8)	50 (189.3)	292	1.8 (0.80)
1½	8.3 (31.5)	100 (378.5)	144	3.1 (1.40)
2	16.7 (63.1)	200 (757.1)	142	2.7 (1.22)

### MECHANICAL INSTALLATION

This meter will provide years of accurate service if good flow meter installation practices are followed. The flow meter should be installed where pipe vibration is minimal.

Observe the upstream piping requirements listed under "Piping requirements". Upstream valves should not be used to control flow rate. They should always be kept fully open. Good quality ball valves with integral unions may be connected directly to the flow meter if the valves are fully open during operation. This allows easy isolation and removal of the flow meter, should maintenance be required. Cavitation and flow rate pulsation will adversely affect flow meter performance.

**Diaphragm or piston pumps may not be used. Do not use Teflon® tape or any kind of pipe dope when piping.**

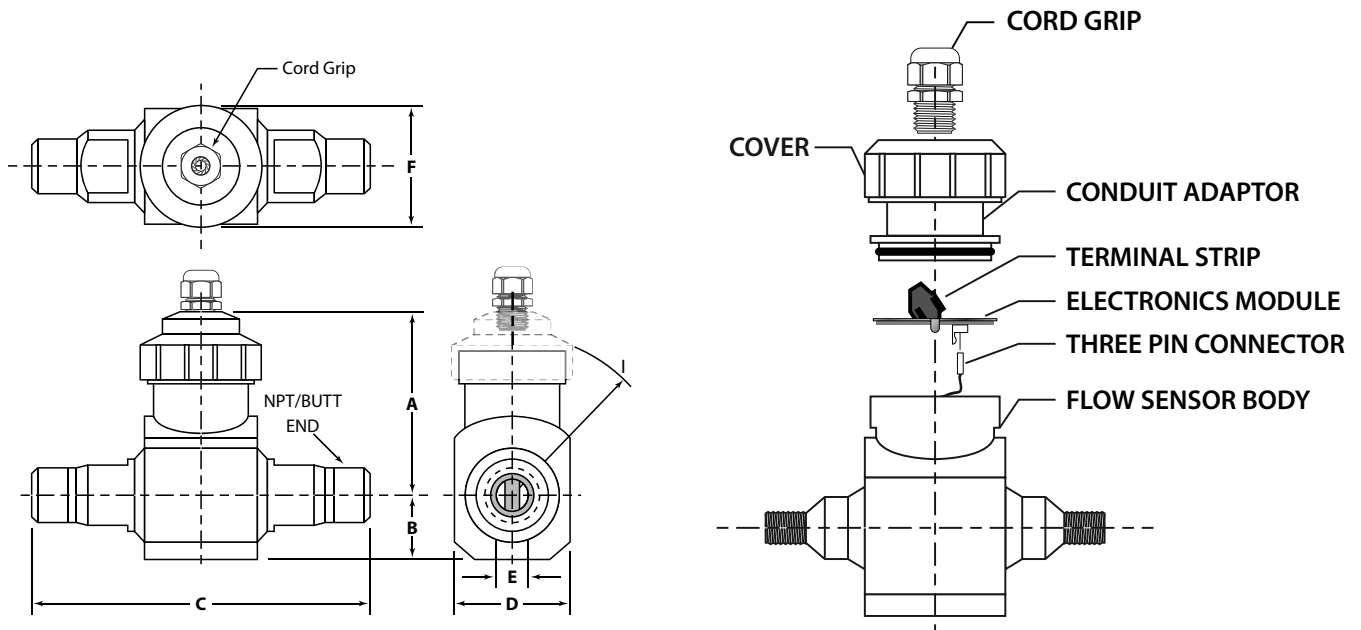
The simple appearance of the flow meter may tempt an installer to handle it as an ordinary nipple. Remember, it is a precision electronic instrument. Treat it with care.

Do not use excessive force. Mating fittings (FNPT) and flanges should be screwed into meter hand tight; then tighten an additional ½ to ¾ turn.

Always use two wrenches when turning the flow meter into a fitting, one across the flats on the flow meter end, close to the fitting, and one on the fitting.

Do not use tools inside the flow meter, as this may damage the vortex sensor, and invalidate the warranty.

The flow meter may be mounted in any orientation. Three holes, tapped ¼-20 UNC-2B, .375-inch deep, on ¾ inch centers are provided on the ¾ inch and smaller flow meters. These holes may be used (at the user's discretion) to provide support for the flow meter should pipe supports not be practical.

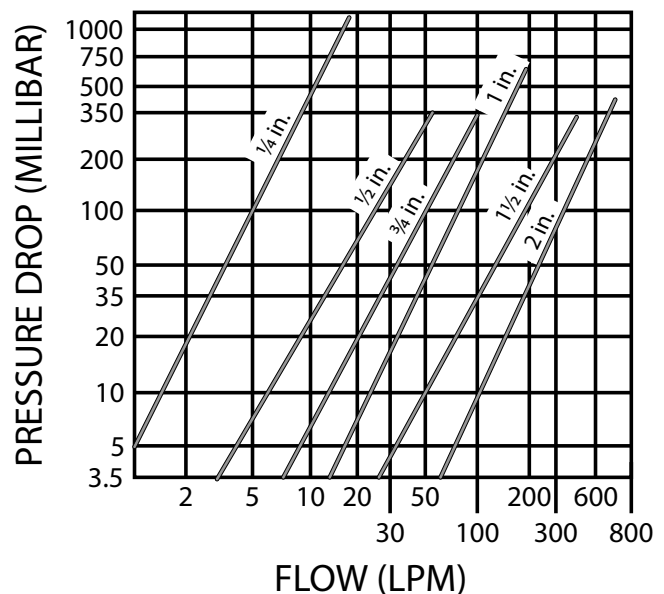
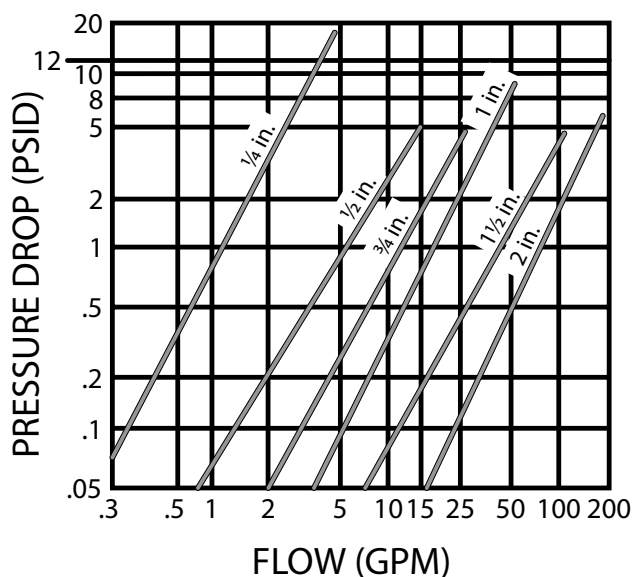


**FIGURE 11**

Size inches (mm)	FV-200 (Inline) Dimensions PVC/CPVC						
	A	B	C	D	E	F	I
¼	3.81 (97)	1.75 (45)	5.25 (133)	2.50 (64)	0.30 (8)	2.88 (73)	3.00 (76)
½	3.81 (97)	1.75 (45)	7.13 (181)	2.50 (64)	0.55 (14)	2.88 (73)	3.00 (76)
¾	3.81 (97)	1.75 (45)	7.63 (194)	2.50 (64)	0.74 (19)	2.88 (73)	3.00 (76)
1	3.92 (100)	1.75 (45)	8.03 (204)	2.50 (64)	0.96 (24)	2.88 (73)	3.00 (76)
1½	3.90 (99)	2.00 (51)	8.37 (213)	2.50 (64)	1.50 (38)	2.88 (73)	3.38 (86)
2	4.31 (109)	2.00 (51)	8.37 (213)	2.50 (64)	1.94 (49)	2.88 (73)	3.38 (86)

Size inches (mm)	FV-200 (Inline) Dimensions PVDF (BUTT Fusion Only)						
	A	B	C	D	E	F	I
¼	5.90 (150)	0.63 (16)	4.87 (124)	1.31 (33)	0.30 (8)	2.88 (73)	3.00 (76)
½	5.75 (146)	0.78 (20)	4.87 (124)	1.31 (33)	0.55 (14)	2.88 (73)	3.00 (76)
¾	5.75 (146)	0.94 (24)	4.87 (124)	1.44 (37)	0.74 (19)	2.88 (73)	3.00 (76)
1	5.88 (149)	1.19 (30)	5.09 (129)	2.00 (51)	0.96 (24)	2.88 (73)	3.00 (76)
1½	6.21 (158)	1.50 (38)	6.24 (158)	2.50 (64)	1.50 (38)	2.88 (73)	3.38 (86)
2	6.60 (168)	1.88 (48)	6.77 (172)	3.00 (76)	1.94 (49)	2.88 (73)	3.38 (86)

Maximum Fluid Temperature °F (°C)	FV-200 (Inline) Maximum Operating Pressure PSIG (KPa)		
	PVC	CPVC	PVDF
203 (95)	Not Recommended	Consult Factory	Consult Factory
150 (66)	Not Recommended	63 (434)	130 (896)
100 (38)	93 (641)	120 (827)	150 (1034)
70 (21)	150 (1034)	150 (1034)	150 (1034)



**FIGURE 12**

## FV-200 (WAFER) SERIES

FV-200 (Wafer) Specifications	
<b>Fluid:</b>	Liquids
<b>Connection:</b>	Wafer
<b>Turndown Ratio:</b>	12:1
<b>Accuracy:</b>	±1% of full scale (4-20 mA or 0-5 VDC) ±2% of full scale, frequency pulse
<b>Repeatability:</b>	±0.25% of actual flow
<b>Materials</b>	PVC standard CPVC, Polypropylene, PVDF optional
<b>Output Signals:</b>	4-20 mA standard 0-5 VDC or frequency pulse optional (Push - Pull Driver) 150 mA Sink or Source
<b>Power Supply:</b>	8 to 28 VDC
<b>Response Time</b>	2 seconds minimum, step change in flow.
<b>Enclosure:</b>	Type 4X (IP 66)

FV-200 (Wafer) Nominal Flow Rates				
Tube Size (inches)	Minimum Flow gpm (lpm)	Maximum Flow gpm (lpm)	Nominal Full Scale Frequency Hz	Weight lbs (Kg)
½	1.3 (4.7)	15 (56.8)	570	0.8 (0.36)
¾	2.1 (7.9)	25 (94.6)	284	0.9 (0.41)
1	4.2 (15.8)	50 (189.3)	292	1.1 (0.50)
1½	8.3 (31.5)	100 (378.5)	144	1.7 (0.77)
2	16.7 (63.1)	200 (757.1)	148	2.6 (1.17)
3	25.0 (94.6)	300 (1136)	61	4.8 (2.16)

## MECHANICAL INSTALLATION

The FV-200 (Wafer) series transmitters are designed with wafer style flow bodies, which mount easily between standard ANSI style pipe flanges.

Observe the upstream piping requirements listed under "Piping requirements". Upstream valves should not be used to control flow rate. They should always be kept fully open. Good quality ball valves with integral unions may be connected directly to the flow meter if the valves are fully open during operation. This allows easy isolation and removal of the flow meter, should maintenance be required. Cavitation and flow rate pulsation will adversely affect flow meter performance.

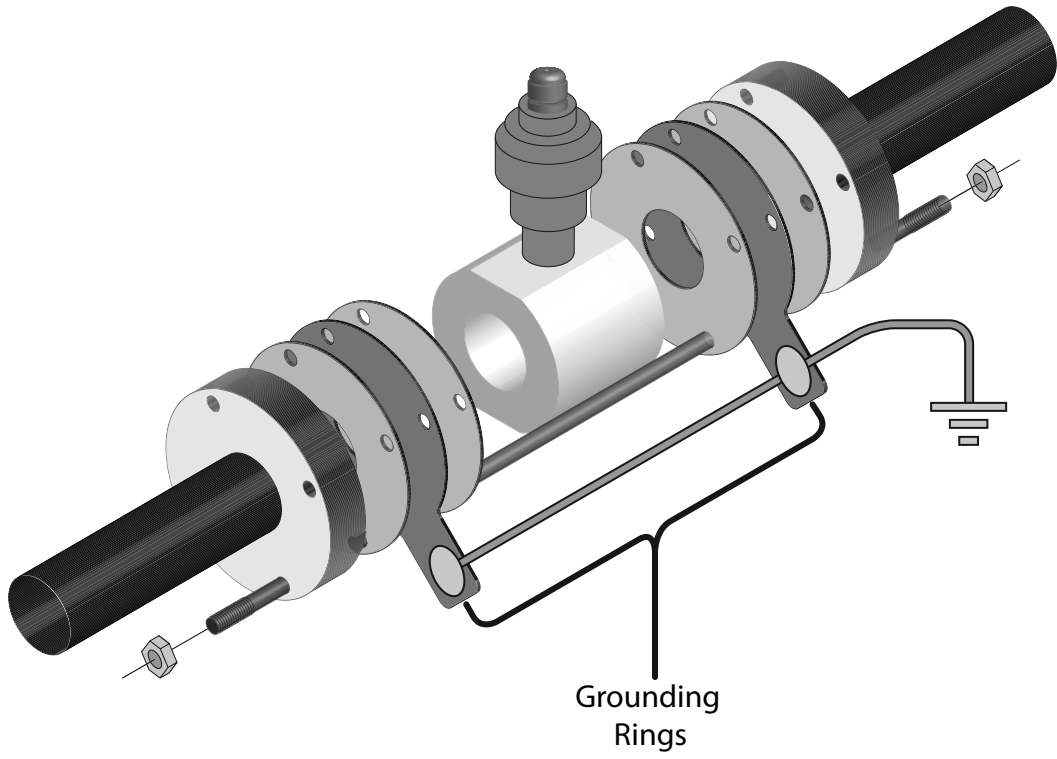
Diaphragm or piston pumps may not be used. Do not use Teflon® tape or any kind of pipe dope vawhen piping. For flanged meters, do not allow gaskets to protrude into the flow stream.

The following steps will insure proper installation and operation.

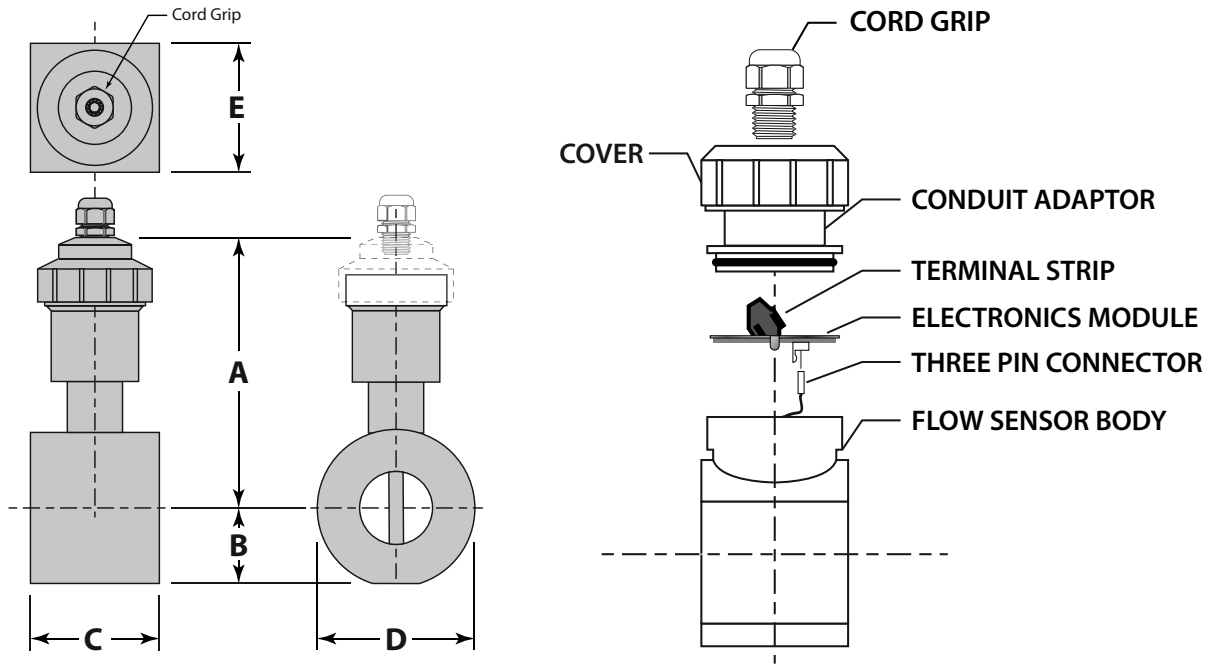
- 1) A uniform flow profile is required to assure proper vortex shedding. This requires a non-pulsating flow along with the proper length of straight pipe run before and after the transmitter. **Figures 2,3,4 and 4** shows the proper piping requirements and dimensions.

FLANGE SIZE	RECOMMENDED TORQUE
½ -1½"	10-15 ft. lbs.
2-3"	20-30 ft. lbs.

- 2) Flanges are to be spaced to accommodate the width of the flow body. Dimensions are listed on **page 20**.
- 3) Align the flow body centered with respect to flanges and gaskets, insert threaded rods, retaining nuts and lock washers.
- 4) Install all retaining nuts hand tight, and then uniformly tighten the nuts in an alternating sequence, diametrically opposed to each other. Uniform stress across the flange will prevent leakage at the gasket. Torque ratings are listed below.
- 5) The use of grounding rings is recommended when metal pipes are used in conjunction with this meter. **See figure 13**



**FIGURE 13**

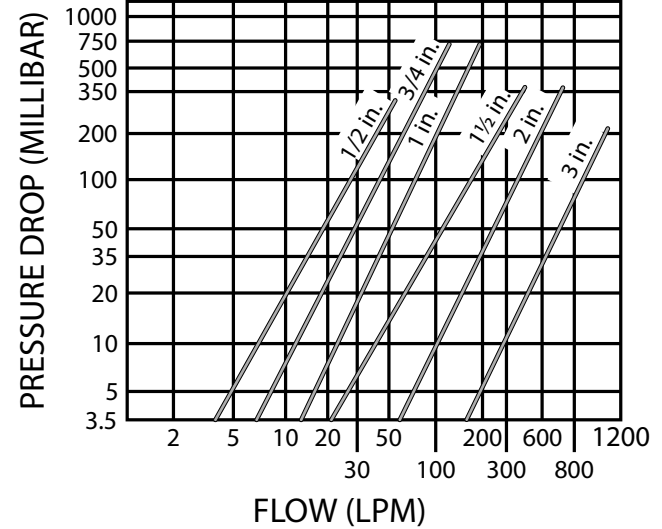
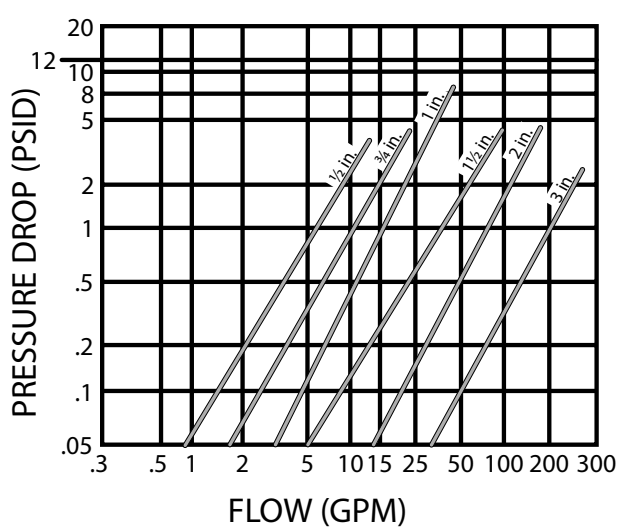


**FIGURE 14**

Size inches	FV-200 (Wafer) Dimensions PP/PVC/CPVC/PVDF				
	A	B	C	D	E
1/2	5.85 (149)	0.78 (20)	2.03 (52)	1.75 (45)	2.88 (73)
3/4	5.90(150)	0.94 (24)	2.03 (52)	1.75 (45)	2.88 (73)
1	5.69 (145)	1.19 (30)	2.25 (57)	1.75 (45)	2.88 (73)
1 1/2	6.00 (152)	1.50 (38)	2.63 (67)	1.75 (45)	2.88 (73)
2	6.37 (162)	1.88 (48)	3.22 (82)	1.75 (45)	2.88 (73)
3	6.88 (175)	2.50 (64)	4.25. (108)	1.75 (45)	2.88 (73)

FV-200 (Wafer) Standard Specifications				
Maximum Fluid Temperature °F (°C)	Maximum Operating Pressure PSIG (KPa)			
	PVC	CPVC	Polypropylene	PVDF
203 (95)	Not Recommended	Consult Factory	Not Recommended	Consult Factory
150 (66)	Not Recommended	63 (434)	90 (621)	130 (896)
100 (38)	100 (690)	120 (827)	130 (896)	150 (1034)
70 (21)	150 (1034)	150 (1034)	150 (1034)	150 (1034)

<b>FV-200 (Wafer) High Pressure Specifications</b>				
<b>Maximum Fluid Temperature °F (°C)</b>	<b>Maximum Operating Pressure PSIG (KPa)</b>			
	<b>PVC</b>	<b>CPVC</b>	<b>Polypropylene</b>	<b>PVDF</b>
<b>203 (95)</b>	Not Recommended	Not Recommended	Not Recommended	Consult Factory
<b>150 (66)</b>	Consult Factory	Consult Factory	90 (621)	300 (2068)
<b>100 (38)</b>	Consult Factory	Consult Factory	130 (896)	400 (2750)
<b>70 (21)</b>	Consult Factory	Consult Factory	150 (1034)	400 (2750)



**FIGURE 15**



## FV-200 (TUBE) SERIES

FV-200 (Tube) Specifications	
<b>Fluid:</b>	Liquids
<b>Connection:</b>	Tube (Flare end)
<b>Turndown Ratio:</b>	12:1 (¾", 1") 8:1 (½")
<b>Accuracy:</b>	±1% of full scale (4-20 mA or 0-5 VDC) ±2% of full scale, frequency pulse
<b>Repeatability:</b>	±0.25% of actual flow
<b>Materials</b>	PVC standard CPVC, Polypropylene, PVDF optional
<b>Output Signals:</b>	4-20 mA standard 0-5 VDC or frequency pulse optional (Push - Pull Driver) 150 mA Sink or Source
<b>Power Supply:</b>	8 to 28 VDC
<b>Response Time</b>	2 seconds minimum, step change in flow.
<b>Enclosure:</b>	Type 4X (IP 66)

FV-200 (Tube) Nominal Flow Rates			
Tube Size (inches)	Minimum Flow gpm (lpm)	Maximum Flow gpm (lpm)	Weight lbs (Kg)
½	0.6 (2.3)	5 (18.9)	1.5 (0.68)
¾	1.3 (4.7)	15 (56.8)	1.6 (0.72)
1	2.1 (7.9)	25 (94.6)	1.7 (0.77)

## MECHANICAL INSTALLATION

This meter will provide years of accurate service if good flow meter installation practices are followed. The flow meter should be installed where pipe vibration is minimal.

Observe the upstream piping requirements listed under "Piping requirements". Upstream valves should not be used to control flow rate. They should always be kept fully open. Good quality ball valves with integral unions may be connected directly to the flow meter if the valves are fully open during operation.

This allows easy isolation and removal of the flow meter, should maintenance be required. Cavitation and flow rate pulsation will adversely affect flow meter performance.

Diaphragm or piston pumps may not be used. Do not use Teflon® tape or any kind of pipe dope when piping.

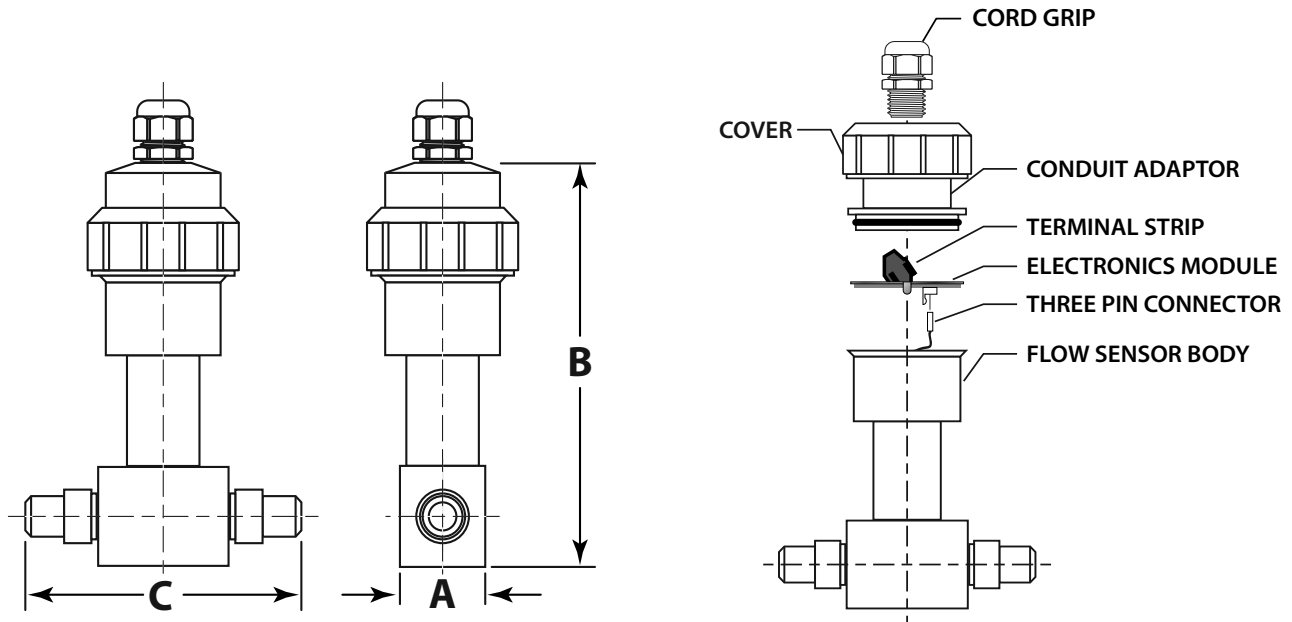
The simple appearance of the flow meter may tempt an installer to handle it as an ordinary nipple. Remember, it is a precision electronic instrument. Treat it with care.

- 1) To install a flare fitting, first remove any burrs from the pipe ends, then slide the flare nut onto the pipe. Push it back far enough so that it will be out of the way when you use the flaring tool.
- 2) Clip the pipe in the flaring tool, keeping the end flush with the face of the tool.
- 3) Slowly turn the handle on the tool until it bottoms out.
- 4) Unscrew the handle and remove the tool to check the quality of the flare. (If the flare isn't smooth or even the first time, cut off the end with your pipe cutter, and try the technique again.)
- 5) Line up and tighten the nut and flared pipe to the fitting body. Make the connection as tight but not so tight as to distort the flow meter body.

Always use two wrenches when turning a fitting onto the flow meter, one across the flats on the flow meter end, close to the fitting, and one on the fitting.

Do not use tools inside the flow meter, as this may damage the vortex sensor, and invalidate the warranty.

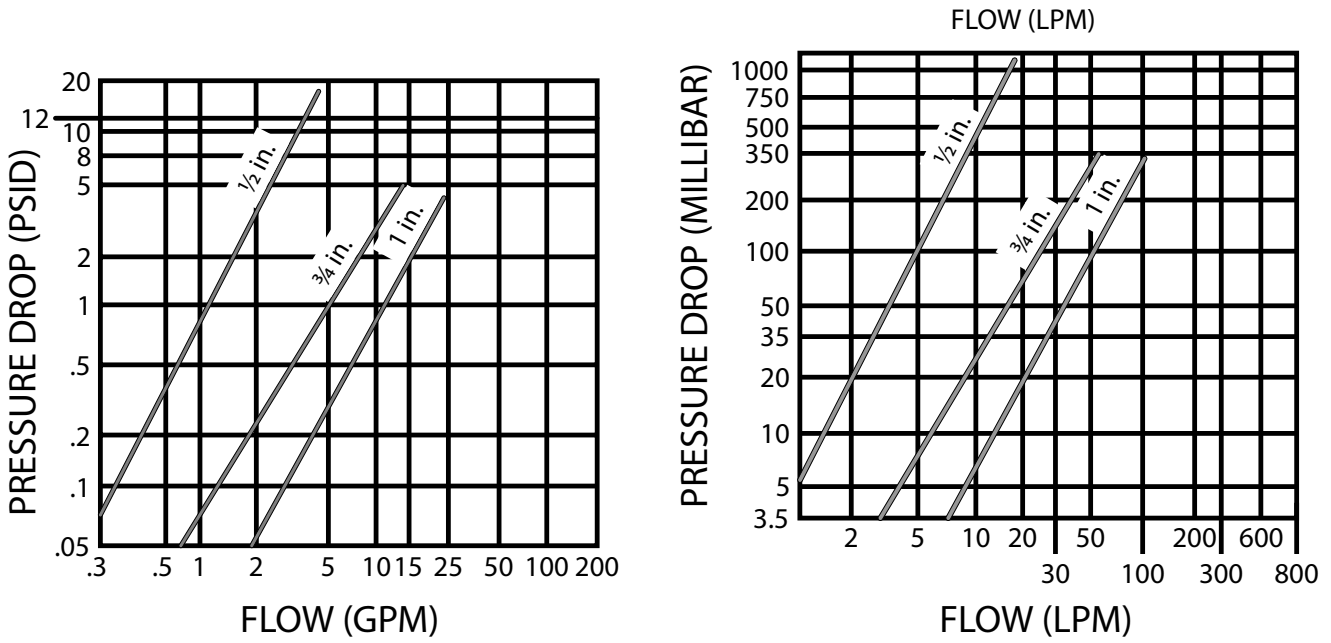
The flow meter may be mounted in any orientation.



**FIGURE 16**

<b>FV-200 (Tube) Dimensions</b>			
<b>Tube Size (inches)</b>	<b>A</b>	<b>B)</b>	<b>C</b>
<b>1/2</b>	1.31 (33.3)	6.25 (158.8)	4.87 (123.7)
<b>3/4</b>	1.31 (33.3)	6.25 (158.8)	4.66 (118.4)
<b>1</b>	1.44 (36.6)	6.59 (167.4)	5.42 (137.7)

FV-200 (Tube) Specifications	
Maximum Fluid Temperature °F (°C)	Maximum Operating Pressure PSIG (KPa)
150 (66)	130 (896)
100 (38)	150 (1034)
70 (21)	150 (1034)



**FIGURE 17**

## MAINTENANCE

This flow meter requires no maintenance in normal service if properly installed. If the flow tube should become clogged with debris, it will be necessary to remove the meter from service for cleaning. Significant clogging will often result in high (up to 20%) and/or erratic output. Do not stick tools into the tube, as this may permanently damage the vortex sensor. The vortex sensor can not be repaired in the field. To clean the flow tube, run hot (up to 160 °F) soapy water into the downstream end of the flow tube. Large objects jammed against the bluff body maybe dislodged by lightly tapping the upstream end of the flow tube against a firm surface.



**WARNING:** *Do not remove vortex meter during operation.  
Always disconnect primary power source before inspection of service.  
Do not tap the flow tube so hard that the threads, on threaded units, become damaged*

A schedule of maintenance checks should be determined based upon environmental conditions and frequency of use. Inspect the meter at least once a year.

The inspection should consist of performing visual, electrical, and mechanical checks on all components.

- 1) Visually check for evidence of overheating by noting discoloration of wires or other components.
- 2) Check for damaged or worn parts, especially the bluff body, or indications of corrosion.
- 3) Check for tight , clean electrical connections and that the device is operating properly.

## TROUBLESHOOTING

If difficulty is encountered, locate the symptom most likely present and follow the appropriate instructions.

### CURRENT LOOP

#### ***SYMPTOM - NO CURRENT OUTPUT***

- 1) Place a DC voltmeter across the two terminal block screws. With the electronics module powered there must be at least 8 VDC present. If there is less than 8 VDC, but more than 0 VDC, check the power source for sufficient voltage to drive the loop, as shown on page 10, in **Figure 8**. If there is 0 VDC present check for a broken wire or connector in the loop.
- 2) Check for the proper polarity of the current loop connections.
- 3) Make sure the receiving device is configured to provide (source) current to the electronics module.

#### ***SYMPTOM - ZERO FLOW INDICATION (4 mA IN LOOP).***

- 1) Check that the flow is greater than the minimum specified for the particular size flow meter in use. If the flow rate is too low, replace the flow meter with the proper size flow meter.
- 2) If the flow rate is sufficient, partially remove the electronic module. Check that the three pin connector that connects the electronics module to the flow transducers is positively connected (**See Figure 18**). If it is disconnected, align and insert the connector on to the bottom of the electronics module.

## ***SYMPTOM - Erratic Flow Indication***

Check that there is at least 8 VDC present across the two terminal block screws.

Check for material clogging the flow meter and in the upstream piping.

Check for erosion of the bluff body by sighting down the meters bore. Erosion or damage to the bluff body will cause erratic readings and compromise accuracy. If the erosion continues, the flow meter will need to be periodically replaced.

Check upstream piping to assure that the required piping is used. (See the piping requirements specifications starting on **page 2** for this information.)

Check for pipe vibration. Normal amounts of pipe vibration are easily tolerated. In addition to this, the transmitter module contains a highly effective active filter that rejects false signals caused by pipe vibration. This filter is most effective under flowing conditions. If vibration is causing the meter to indicate flow when the flow is stopped it will most likely not cause error under flowing conditions. The false flow indication may be ignored, or the pipe may be restrained by firm clamps, or the noise adjustment may be readjusted. Be sure to read the noise adjustment instructions.

Check for electrical noise. Under some conditions there can be high common mode AC noise present between the fluid and the power supply ground. The flow meter is designed to reject up to 50 volts of AC common mode noise without loss of accuracy. If metal piping is used, place a ground strap on the pipe on both sides of the flow meter (the flow meter is made of non-conductive plastic) and connect them both to the one point where the loop is grounded (see wiring diagrams starting on **page 9**). If plastic piping is used, a grounding orifice should be used. The transmitter module contains a highly effective active filter that will reject false signals due to high common mode voltage. This filter is most effective under flowing conditions. If a false indication of flow is encountered at zero flow, it will probably not cause error under flowing conditions. In addition, the noise adjustment may be used, but it will reduce the ability of the flow meter to measure low flow rates. See the noise adjustment instructions before attempting to make this adjustment.

## **OVER-STRESSED SENSOR**

If the maximum permitted flow rate of 125% of Recommended capacity (100% of HT meters) is exceeded, it is possible to over-stress the sensor.

# APPENDIX

## CALIBRATION CERTIFICATE SAMPLE

### Calibration Report

**Unit Under Test (UUT) Information:**

**Description:** 3/4" In-Line NPT End Flow Meter  
**Model Number:** FV-201  
**Serial Number:** 99999  
**Sensor Type:** Vortex Shedding  
**Output type:** 0-5V  
**Minimum Flow:** 2.1 GPM 7.9 LPM  
**Maximum Flow:** 25 GPM 94.6 LPM  
**Calibration Date:** October 24, 2007  
**Calibration Interval:** 12 Months  
**Cal. Liquid:** Water  
**Ambient Temperature:** 71.74 °F  
**Ambient Humidity:** 31.39 %RH  
**Linear Points:** 5

**Master Meter:**

**Std uncertainty:** ±0.25%  
**Traceability No:** 30400/31801  
**Model No:** FT8-8N EXW-LEG-5/FT-16 NEXW-LEG-1  
**Serial No:** 806890/16011903

**Customer Information:**

**Customer Name:**  
**Customer No.:**  
**Order No.:**

**UUT Calibration Data Table In GPM:**

Flow Standard	Actual GPM	UUT Hz	UUT Temp °F	Visc. cSt	UUT F/V Hz/cSt	UUT K CYC/GAL	(Hz*60)/NK GPM	Linear COEFF.	Raw Err % FS	Calc. 0-5V	Meas. 0-5V	Output Err % FS
1	25.00	100.000	72.00	0.949	105.406	240.00	24.57	1.0174	1.71	5.000	5.000	0.00
1	18.00	75.000	72.00	0.949	79.055	250.00	18.43	0.9767	-1.71	3.600	3.680	0.40
1	12.00	50.000	72.00	0.949	52.703	250.00	12.29	0.9767	-1.14	2.400	2.420	0.10
1	6.00	25.000	72.00	0.949	26.352	250.00	6.14	0.9767	-0.57	1.200	1.200	0.00
1	2.10	10.000	72.00	0.949	10.541	285.71	2.46	0.8547	-1.43	0.420	0.420	0.00

**Nominal K (NK) 244.186**

**UUT Calibration Data Table In LPM:**

Flow Standard	Actual GPM	UUT Hz	UUT Temp °F	Visc. cSt	UUT F/V Hz/cSt	UUT K CYC/GAL	(Hz*60)/NK GPM	Linear COEFF.	Raw Err % FS	Calc. 0-5V	Meas. 0-5V	Output Err % FS
1	94.64	100.000	72.00	0.949	105.406	63.40	93.01	1.0174	1.71	5.000	5.000	0.00
1	68.14	75.000	72.00	0.949	79.055	66.04	69.76	0.9767	-1.71	3.600	3.680	0.40
1	45.42	50.000	72.00	0.949	52.703	66.04	46.51	0.9767	-1.14	2.400	2.420	0.10
1	22.71	25.000	72.00	0.949	26.352	66.04	23.25	0.9767	-0.57	1.200	1.200	0.00
1	7.95	10.000	72.00	0.949	10.541	75.48	9.30	0.8547	-1.43	0.420	0.420	0.00

**Nominal K (NK) 64.507**

<b>Status:</b>	PASS
<b>Meter Accuracy (of FS):</b>	± 0.4 %
<b>Average Calib. Temperature :</b>	72 F
<b>Average Calib. Specific Gravity :</b>	1
<b>Average Calib. Viscosity :</b>	0.95 cSt
<b>Flow Direction :</b>	Forward

**Calibrated By:** Ramon Benedict

**Certified By:** Larry Perez

Calibrations are performed using standards traceable to National Institute of Standards and Technology. The equipment and calibration procedures complies with ISO 9001

# NOTES

# NOTES



# NOTES

## WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

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Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

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