Flow Rate Monitoring – RFO Type

4.5 to 24 VDC Pulsed Output

GEMS Sensors popularized the RotorFlow's paddlewheel design by combining high visibility rotors with solid-state electronics that are packaged into compact, panel mounting housings. They provide accurate flow rate output with integral visual confirmation...all with an unprecedented price/performance ratio. RFO Types feature a VDC pulsed output.



Typical Applications

- Water Purification/Dispensing Systems
- Chemical Metering Equipment
- Lasers and Welders
- Water Injection Systems
- Semiconductor Processing Equipment
- Chillers and Heat Exchangers

Specifications

Wetted Materials	
Body	Brass, 316 Stainless Steel or Polypropylene (Hydrolytically Stable, Glass Reinforced)
Rotor Pin	Ceramic
Rotor	PPS Composite, Black
Lens	Polysulfone[1]
O-Ring	Viton® (Alloy Bodies); Buna N (Polypropylene Body)
Low Flow Adaptor	Glass Reinforced Polypropylene
Operating Pressure, Maximum	Optional SS Face Plate 500 PSI
Brass or Stainless Steel Body	200 PSIG (13.8 bar) @ 70°F (21°C), 100 PSI (6.9 bar) Max. @ 212°F (100°C)[1]
Polypropylene Body	100 PSIG (6.9 bar) @ 70°F (21°C), 40 PSI (2.8 bar) Max. @ 180°F (82°C)
Operating Temperature,	
Brass or Stainless Steel Body	-20°F to 212°F (-29°C to 100°C)
Polypropylene Body	-20°F to 180°F (-29°C to 82°C)
Electronics	150°F (65°C) Ambient
Viscosity, Maximum	200 SSU
Input Power	4.5 VDC to 24 VDC
Output Signal	4.5 VDC to 24 VDC Pulse. (Sourcing) Pulse Rate Dependent on Flow Rate, Port Size and Range.
Current Consumption	8 mA, No Load
Current Source Output, Max.	70 mA
Frequency Output Range	15 Hz (Low Flow) to 225 Hz (High Flow)
Accuracy	See Table Below
Electrical Termination	22 AWG PVC-Jacketed, 24″ Cable. Color Coded: Red = +VDC; Black = Ground; White = Signal Output

Notes:
1. For higher pressure/temperature ratings, stainless face plates are available. Consult factory.

How To Order

For standard configurations, specify Part Number based on desired body material and port size.

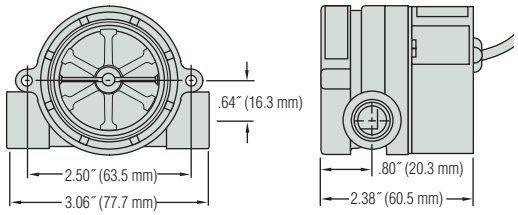
Body Material	Port Size NPT	Flow Range – GPM		Part Number
		Low Range* (Accuracy)	Standard Range (Accuracy)	
Polypropylene	.25″	0.1 to 1.0 (±7.0%)	0.5 to 5.0 (±7.0%)	**155421** ⚡
	.50″	1.5 to 12.0 (±7.0%)	4.0 to 20.0 (±15.0%)	**155481** ⚡
Brass	.25″	0.1 to 1.0 (±7.0%)	0.5 to 5.0 (±7.0%)	**156261** ⚡
	.50″	1.5 to 12.0 (±7.0%)	4.0 to 20.0 (±15.0%)	**156262** ⚡
	.75″	—	5.0 to 30.0 (±15.0%)	**194761** ⚡
	1.00″	—	8.0 to 60.0 (±15.0%)	**194762** ⚡
Stainless Steel	9/16″-18**	0.1 to 1.0 (±7.0%)	0.5 to 5.0 (±7.0%)	**165071** ⚡
	.50″	1.5 to 12.0 (±7.0%)	4.0 to 20.0 (±15.0%)	**165075** ⚡
	.75″	—	5.0 to 30.0 (±15.0%)	**194763**
	1.00″	—	8.0 to 60.0 (±15.0%)	**194764**

⚡ – Stock Items.

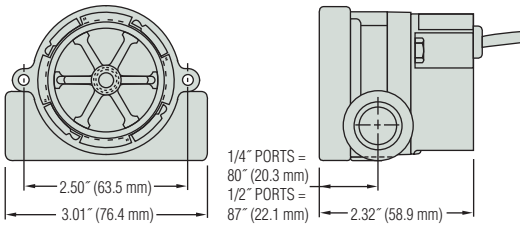
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Dimensions

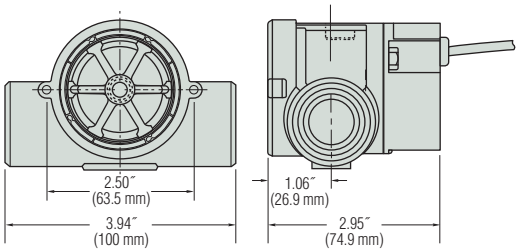
Polypropylene Bodies



Brass and Stainless Steel Bodies - .25″ and .50″ Ports



Brass Bodies – .75″ and 1.00″ NPT Ports



High Resolution Black Rotor

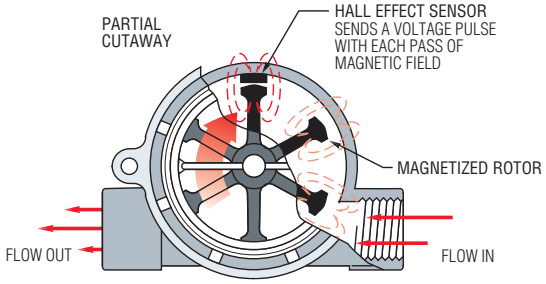
PPS composite. Each of the six rotor arms is magnetized. A PTFE loaded bushing ensures long life.



Note: Improved accuracy can be achieved by calibrating the individual RFO unit.

*With use of Low Flow Adapter supplied.
See Page F-8 for more information.
**Straight thread with O-ring seal.

Operating Principle



1. As liquid passes through the RotorFlow body, the magnetic rotor spins at a rate proportional to flow. This causes a series of magnetic fields (the rotor vanes) to excite the Hall Effect sensor, producing a series of voltage pulses.

2. The output pulses (RFO) are at the same voltage level as the input (4.5 - 24 VDC) with a frequency proportional to the flow rate. The output signal can be utilized by digital rate meters totalizers or other electronic controllers. RFA Type analog sensors condition the output signal to 0-10 VDC.

3. RotorFlow Indicators may be mounted with flow entering either port. Performance is optimized by positioning ports at the top of the unit, in a horizontal plane.

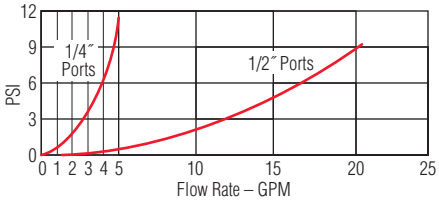
Frequency vs. Flow Rate-Typical

	Output Frequency – Hz					
	RFO Model – Based on Port Size					
Flow Rate (GPM)	**.25″**	**.25″ with Adapter***	**.50″**	**.50″ with Adapter***	**.75″**	**1″**
0.10		13				
0.25		41				
0.50	15	90				
0.75		137				
1.0	34	186				
1.5	54			17		
2.0	73			25.9		
2.5	90			34		
3.0	110			43		
3.5	128					
4.0	148		34	60		
4.5	168					
5.0	185		44.8	76.7	24	
6.0			55	94		
7.0			65.9	111		
8.0			76	129		22
9.0			87.5	147		
10			99	165	61	30
11			110	185		
12			122	204		
13			135			
14			147			
15			158		93	43
16			170			
17			183			
18			195			
19			207			
20			220		128	60
25					163	74
30					196	91
35						107
40						123
45						137
50						153
55						170
60						185

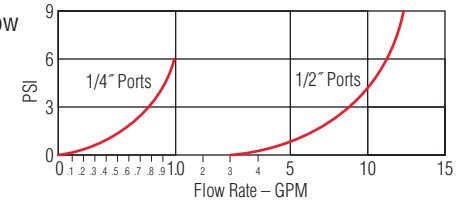
*Low Flow Adapter

Pressure Drop-Typical

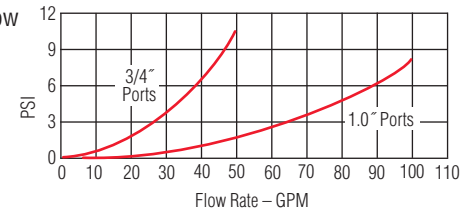
Standard Flow Range Units



Low Flow Range Units



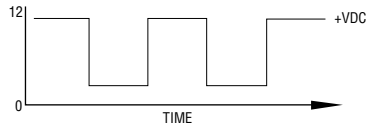
High Flow Units



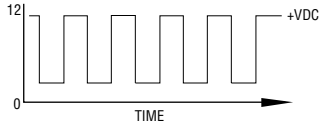
Signal Output

Output signal for RFO Types is an on/off pulse of the DC voltage supplied to the unit, it is compatible with all digital logic families. Input voltage range is 4.5 to 24 VDC. Frequency of the output pulse is proportional to the flow rate and ranges from approximately 15 Hz at low flow to 225 Hz at high flow.

Example:
Low Flow



High Flow

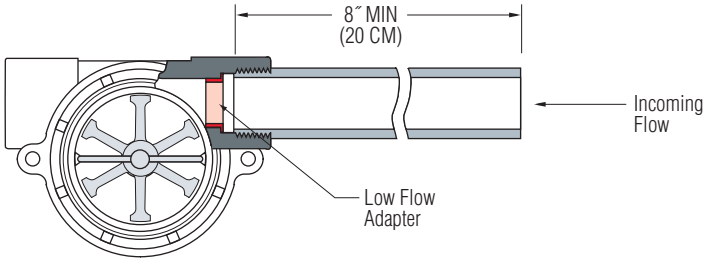


Note: Consult factory for flow rate/frequency curves.

Easy Installation and Maintenance

A proper installation will enhance RotorFlow sensor performance. Install using standard pipe fitting tools; horizontal fluid lines are recommended. For further installation and maintenance recommendations, refer to one of the following instruction bulletins: RFO Types–Part Number 157258; RFI Types–Part Number 157259; RFS Types–Part Number 157261.

Since their function is to monitor dynamic fluid flow, naturally the rotor will react to turbulence, pulsation, entrained air, and other flow anomalies induced in the flow stream by other process hardware. For optimum performance, install RotorFlow units where nominal flow conditions exist with ports located at the top. Incoming flow may be placed to either port; a minimum of 8 inches (20 cm) of straight pipe on the inlet side is required. When operating in the low flow range, the supplied Low Flow Adapter must be installed in the incoming port.



Except for straight-thread versions, RotorFlow sensors connect to piping via NPT mating thread forms. The use of an appropriate thread sealant is necessary to assure a leak-tight connection. Permatex “No More Leaks®” or 2 wraps of Teflon® tape are the only sealants recommended for GEMS flow sensors. Straight-thread versions require an O-ring for sealing.

150 micron filtration is recommended. However, should foreign particles enter the RotorFlow sensor, accumulation is easily cleared by removing the lens from the body. The lens is removed by turning its 7/16˝ hex center hub 45° counter-clockwise with a standard socket wrench. To reinstall the lens, simply reverse the process. Pressure must be relieved from the system prior to sensor clean-out. O-rings should be lubricated prior to re-assembly.

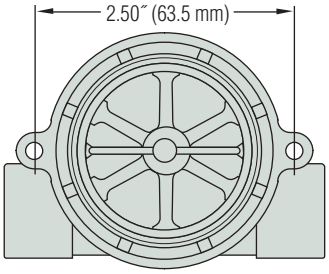
Low Flow Applications

A low flow adapter is supplied with all Rotorflow units. It is used to produce accurate response at low flow rates. Install the adapter, as shown above, in the port selected for incoming flow.

Panel Mounting

Plastic Bodies. Two (2) mounting ears are provided at the body center line to receive #8 self-tapping screws to accommodate panel mounting of the plastic RotorFlow units. Note: ANSI T type 23 self-tapping screws are recommended. They may be replaced with standard machine screws if re-installation should be required.

Brass and Stainless Steel Bodies. Two (2) mounting holes are provided on the body centerline, as shown below. #8-32UNC-2B screws are required for mounting.



RotorFlow® Maintenance Kits

Rebuild your RotorFlow® Sensors and Switches in less than 5 minutes with one of these kits.

Includes:

- Ceramic Rotor Pin
- 6-Pole Magnetic Rotor with PPS/PTFE Bushing
- Buna N or Viton® O-Ring
- Polysulfone Lens

Rotorflow® Type		O-Ring Material in Kit	Part Numbers	
Line Size	Body Material		RFA/RFO/ RFS	RFI
1/4˝ & 1/2˝	Plastic	Buna-N	**155870** ⚡	**155872**
	Brass/SS	Viton®	**167364** ⚡	**166267**
3/4˝ & 1˝	Brass/SS	Viton®	**182695**	**157187**

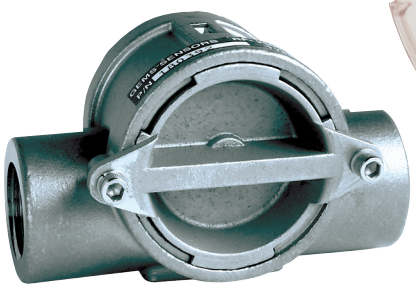
⚡ – Stock Items.

RotorFlow® Sensor Special Capabilities are Yours for the Asking.

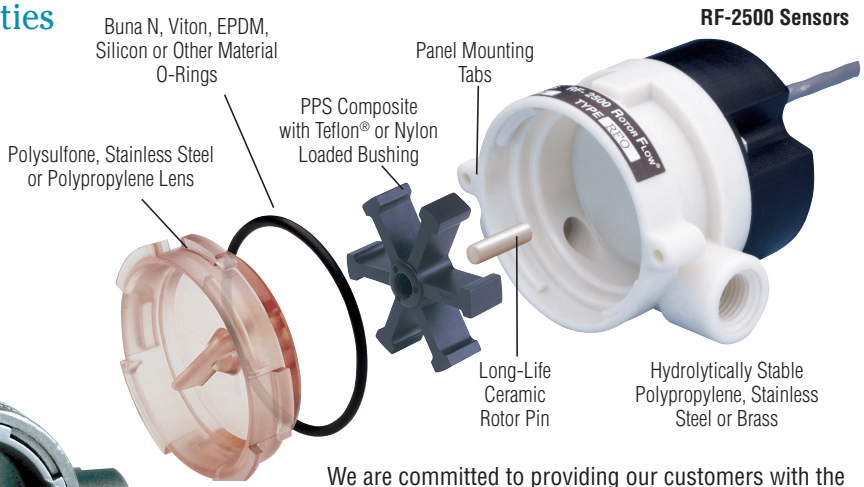
Gems caters to OEM needs with special configurations that go beyond the standards in this catalog. We can provide RotorFlow sensors with enhanced chemical compatibility, higher temperature and pressure capabilities, and alternate electrical terminations.

Other Capabilities Available to OEMs:

- Electrical outputs: Combined switch and frequency; transistor switching; 0-10 VDC analog.
- Custom face plate (cast stainless steel face plate pictured)



RF-2500 Sensors



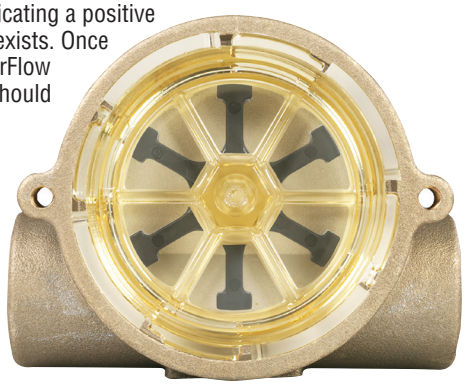
We are committed to providing our customers with the product that best meets the requirements of their applications. Please call us and tell us what you need, and ask us about Swagelok® tube fittings, faceplate options, and 9/16˝ and 3/4˝ straight-thread versions.

Call 800-378-1600

Flow Set Point Switching – RFS Types

- Combines visual confirmation of flow with dynamic, electronic switch operation
- Easy, adjustable switch point calibration: a local LED signals when set point is reached

RotorFlow® Switches build an extra level of reliability and protection into your equipment. By principle of operation, the rotor cannot be deceived into indicating a positive flow situation when no flow actually exists. Once set to a desired actuation point, RotorFlow will switch to a "no-flow" condition should the rotor stop for any reason.



Typical Applications

Protect expensive electronic equipment from coolant flow failure on...

- Semiconductor Processing Equipment
- Lasers • Medical Equipment
- X-Ray and Other High Power Tubes
- Robotic Welding Equipment

File No. E45168

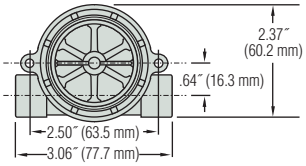
Specifications

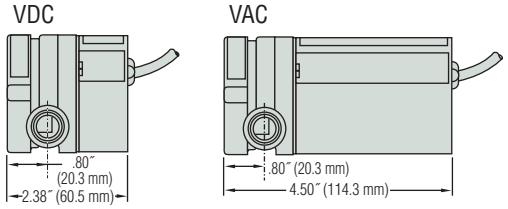
Wetted Materials		
Body	Brass, 316 Stainless Steel or Polypropylene (Hydrolytically Stable, Glass Reinforced)	
Rotor Pin	Ceramic	
Rotor	PPS Composite, Black	
Lens	Polysulfone	
O-Ring	Viton® (Alloy Bodies); Buna N (Polypropylene Body)	
Low Flow Adaptor	Glass Reinforced Polypropylene	
Operating Pressure, Maximum		
Brass or Stainless Steel Body	200 PSIG (13.8 bar) @ 70°F (21°C), 100 PSIG (6.9 bar) Max. @ 212°F (100°C)[1]	
Polypropylene Body	100 PSIG (6.9 bar) @ 70°F (21°C), 40 PSI (2.8 bar) Max. @ 180°F (82°C)	
Operating Temperature,		
Brass or Stainless Steel Body	-20°F to 212°F (-29°C to 100°C)	
Polypropylene Body	-20°F to 180°F (-29°C to 82°C)	
Electronics	150°F (65°C) Ambient	
Viscosity, Maximum	200 SSU	
Input Power	24 VDC or 115 VAC	
Relay Contact Ratings (SPDT)	1 Amp, 24 VDC Resistive; 0.3 Amp, 110 VAC	
Current Consumption	**No Load**	**Load (Relay Energized)**
24 VDC	20mA	35mA
115 VAC	45mA	95mA
Repeatability	2% Maximum Deviation	
Set Point Accuracy (Factory Set)	± 5%	
Set Point Differential	15% Maximum	
Electrical Termination	20 AWG PVC-Jacketed, 24″ Cable. Color Codes: Red = +VAC/VDC, Black = Ground, White = N.O. Contact, Brown = N.C. Contact, Green = Common	

Note:
1. Optional pulsed output available with RFS. Consult factory.

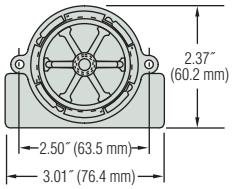
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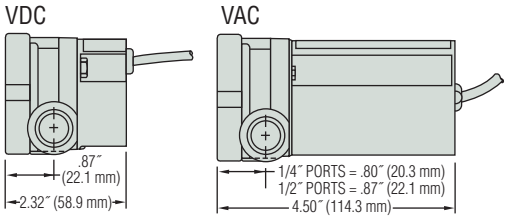
Polypropylene Bodies



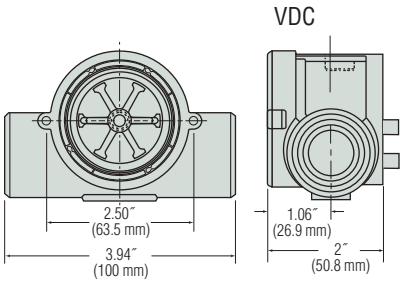


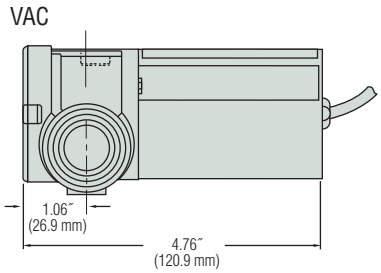
Brass and Stainless Steel Bodies - .25″ and .50″ Port





Brass and Stainless Steel Bodies - .75″ and 1.00″ Port

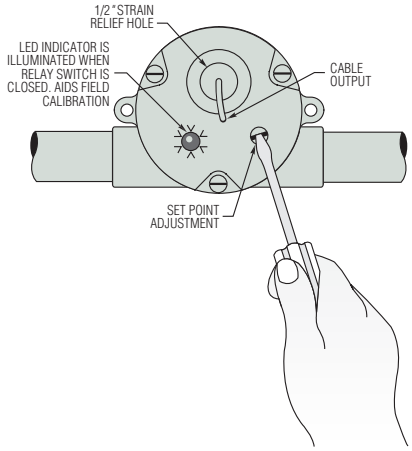




Switch Set Point Calibration With LED Signal (RFS Type)

With the unit installed in the line and power supplied, complete the following steps to calibrate switch actuation point with proper flow rate. A small flat-blade screwdriver is the only tool required.

1. Adjust liquid flow in the line to the rate at which switch actuation is desired.
2. Insert screwdriver into opening on backside of housing and fit blade into the potentiometer adjustment screw inside.
3. If LED is not illuminated, slowly turn screwdriver counterclockwise and stop as soon as LED illuminates.
4. If LED is illuminated, turn screwdriver clockwise until LED light goes out. Then, slowly turn screwdriver counterclockwise and stop as soon as LED illuminates.



How To Order

Specify Part Number based on desired body material, port size and input power rating.

Body Material	Port Size NPT	Flow Ranges – GPM		Input Power	Part Number
		Low Range*	Standard Range		
Polypropylene	.25˝	0.1 to 1.0	0.5 to 5.0	24 VDC	**155425** ⚡
				115 VAC	**155876** ⚡
	.50˝	1.5 to 12.0	4.0 to 20.0	24 VDC	**155485** ⚡
				115 VAC	**155886** ⚡
Brass	.25˝	0.1 to 1.0	0.5 to 5.0	24 VDC	**156265** ⚡
				115 VAC	**156266** ⚡
	.50˝	1.5 to 12.0	4.0 to 20.0	24 VDC	**156268** ⚡
				115 VAC	**156269** ⚡
	.75˝	–	5.0 to 30.0	24 VDC	**180395** ⚡
				115 VAC	**180396** ⚡
	1.00˝	–	8.0 to 60.0	24 VDC	**181688**
				115 VAC	**181689** ⚡
Stainless Steel	9/16-18**	0.1 to 1.0	0.5 to 5.0	24 VDC	**165073** ⚡
				115 VAC	**165074**
	.50˝	1.5 to 12.0	4.0 to 20.0	24 VDC	**165077** ⚡
				115 VAC	**165078**
	.75˝	–	5.0 to 30.0	24 VDC	**181691**
				115 VAC	**181692**
	1.00˝	–	8.0 to 60.0	24 VDC	**181693**
				115 VAC	**181694**

* With use of Low Flow Adapter supplied. See Page F-8 for more information.
** Straight thread with O-ring seal.

⚡ – Stock Items.

Special Requirements:

GEMS caters to OEM needs with special configurations for potable water and enhanced chemical capabilities. Consult factory for further details.

For higher pressure/temperature ratings, stainless face plates are available. Consult factory.

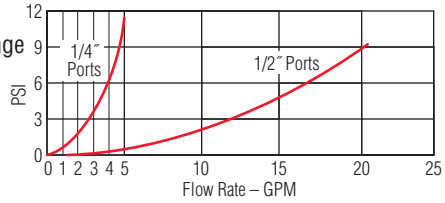
High Resolution Black Rotor

PPS composite. Each of the six rotor arms is magnetized. A PTFE loaded bushing ensures long life.

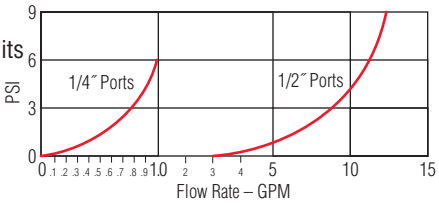


Pressure Drop-Typical

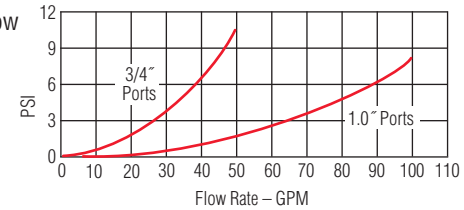
Standard Flow Range Units



Low Flow Range Units



High Flow Units



Visit www.GemsSensors.com for most current information.