Flo-tech
Hydraulic Diagnostic Products

# Turbine Flow Sensors

## Activa, Ultima, Classic and Quad

Badger Meter

SEN-UM-00987-EN-04 (March 2019)

# User Manual

# CONTENTS

# INTRODUCTION

Flo-tech turbine flow sensors measure the flow rate of hydraulic fluid and compatible liquids. Built to withstand rigorous hydraulic applications, these flow sensors are available in anodized aluminum and zinc plated Stressproof® steel bodies. Port types vary by body material, but include a choice of SAE, BSPP, Code 61 and Code 62, 4-bolt flanged options.

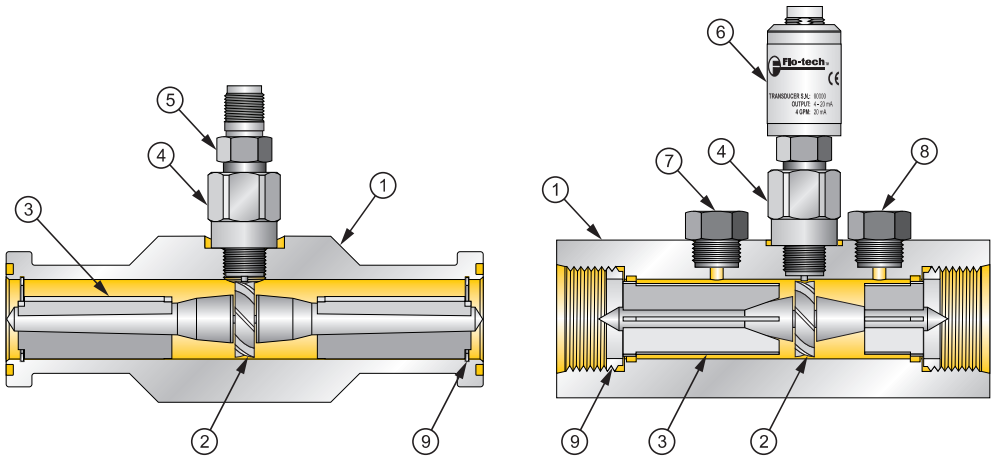
Typical applications for the turbine flow sensors include:

- Fluid characteristic measurement on test stands
- Stationary hydraulic system monitoring
- Feedback for hydraulic system control
- Advance warning of impending component failure
- Mobile hydraulic system diagnosis

Flo-tech offers four different flow sensor models. Each of these models is available in a wide selection of flow ranges and port sizes.

| Activa Sensor Array | Classic Flow Sensor |
|---|---|
|  |  |
| **Features:**<br>• Four flow ranges<br>• Four port sizes<br>• Accuracy of ±1% reading @ 32 cSt<br>• Pressures up to 5800 psi (400 bar)<br>• Temperatures up to 300° F (150° C)<br>• 4…20 mA or 0…5V DC output for flow<br>• 4…20 mA output for pressure and temperature | **Features:**<br>• Eight flow ranges<br>• Eight port sizes<br>• Accuracy of ±1% full scale<br>• Pressures up to 6000 psi (414 bar)<br>• Temperatures up to 300° F (150° C)<br>• Frequency output for flow |
| **Ultima Sensor Array** | **Quad Flow Sensor** |
|  |  |
| **Features:**<br>• Four flow ranges<br>• Four port sizes<br>• Accuracy of ±1% full scale<br>• Pressures up to 5800 psi (400 bar)<br>• Temperatures up to 300° F (150° C)<br>• Frequency output for flow<br>• 4…20 mA output for pressure and temperature | **Features:**<br>• Four flow ranges<br>• Two port sizes<br>• Accuracy of ±1% full scale<br>• Pressures up to 6000 psi (414 bar)<br>• Temperatures up to 300° F (150° C)<br>• Frequency output for flow |

# OPERATING PRINCIPLE




| | | | |
|---|---|---|---|
| **1** | Housing | **6** | Signal Converter (analog output) |
| **2** | Turbine Rotor | **7** | Pressure Port Adapter |
| **3** | Rotor Supports | **8** | Temperature Port Adapter |
| **4** | Lock Nut | **9** | Retaining Rings |
| **5** | Magnetic Pickup (frequency output) | | |

Turbine flow sensors measure the flow rate of hydraulic fluid and compatible liquids. As fluid flows through the sensor it turns the turbine rotor, and as the turbine blades pass the magnetic pickup a frequency signal is generated. This frequency signal is proportional to the flow rate and can be transmitted to Flo-tech's digital displays or converted to an analog output. Optional sensors allow measurement of pressure and temperature.

# INSTALLATION

**⚠CAUTION**

***THIS PRODUCT SHOULD BE INSTALLED AND SERVICED BY TECHNICALLY QUALIFIED PERSONNEL TRAINED IN MAINTAINING INDUSTRIAL CLASS FLOW INSTRUMENTATION AND PROCESSING EQUIPMENT.***

**⚠CAUTION**

***READ INSTRUCTIONS THOROUGHLY BEFORE INSTALLING THE FLOW SENSOR. IF YOU HAVE ANY QUESTIONS REGARDING PRODUCT INSTALLATION OR MAINTENANCE, CALL YOUR LOCAL SUPPLIER OR THE FACTORY FOR MORE INFORMATION.***

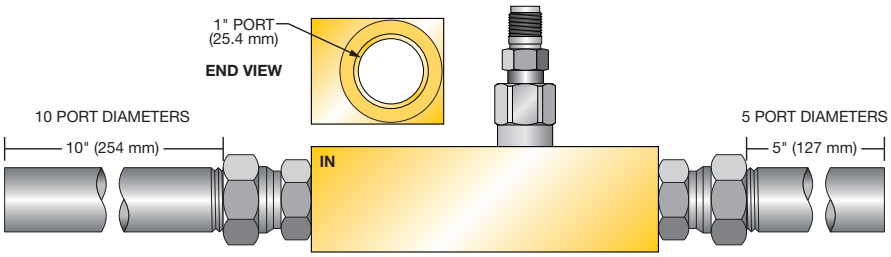
**⚠WARNING**

***DO NOT USE MALE PIPE THREADS (NPT) INTO SAE STRAIGHT THREAD PORTS. USING MALE PIPE THREADS (NPTF) WITH A FLOW SENSOR POSSESSING SAE STRAIGHT THREAD O-RING PORTS WILL NOT CREATE A PROPER SEAL AND IS POTENTIALLY DANGEROUS. PIPE THREADS INSERTED INTO AN SAE STRAIGHT THREAD PORT ONLY ALLOW THE ENGAGEMENT OF ONE OR TWO THREADS. NO AMOUNT OF TIGHTENING OR THREAD SEAL WILL STOP THE LEAKING OR MAKE THE INSTALLATION SAFE. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH AND/OR DAMAGE TO THE EQUIPMENT.***

## Installation Recommendations

The in-line flow sensor is a simple device to install. However, the following measures are recommended for reliable, trouble-free operation:

1. Provide at least 10 port diameters of upstream straight pipe with no obstructions to the flow sensor and at least 5 diameters of downstream pipe. The pipe should be of the same diameter as the nominal port size.

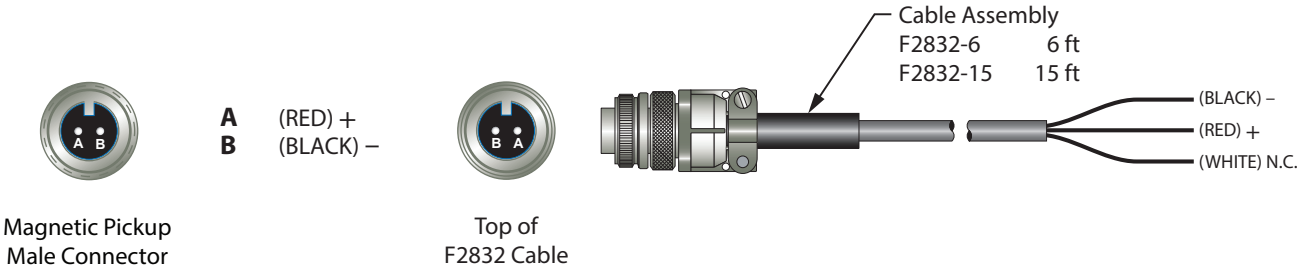



*Example:*
An FSC-1000 has a 1 in. (25.4 mm) port. The unobstructed upstream length should be at least 10 in. (254 mm) and the downstream length should be at least 5 in. (127 mm).

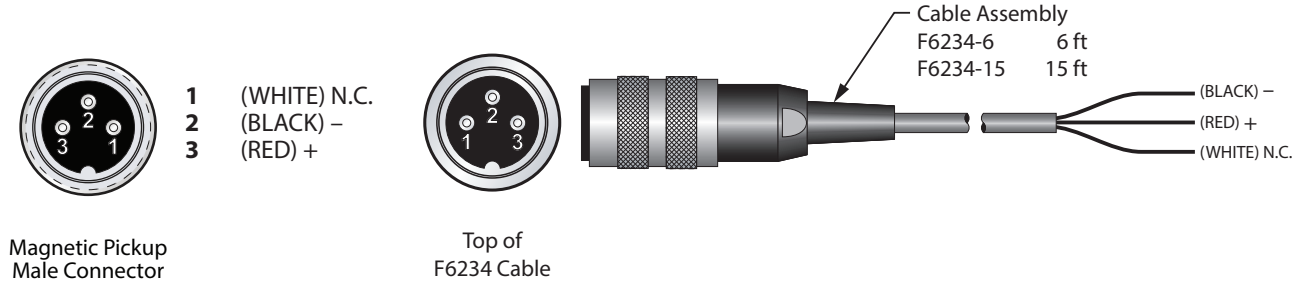
2. Choose a position for the flow sensor that is not at the lowest level in the system. Placing the flow sensor at a higher elevation in the system will avoid collection of debris, sediment and dirt in the flow sensor.
3. Use a filter. All applications should be filtered to at least 40 micron.
4. Do not install a flow sensor directly in-line with the outlet of a pump, as pressure pulsations can react with the turbine. Install the sensor after another component, observing the 10 port diameter rule.
5. Do not adjust the magnetic pickup on the flow sensor. This is calibrated at the factory. Further adjustment will cause a decrease in performance or damage to the sensor.
6. Do not exceed the working temperature range of –4…300° F (–20…150° C). Higher temperatures will damage the magnetic pickup and lower temperatures will limit the rotation of the turbine.

## Electrical Connections for Standard Magnetic Pickup

**Standard Magnetic Pickup with Frequency Output, 2-pin Connector**

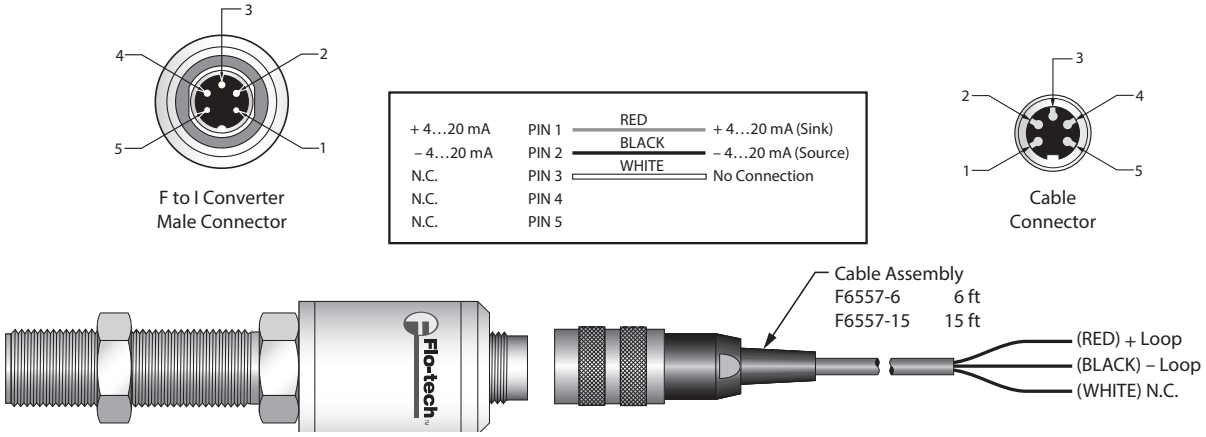



**Standard Magnetic Pickup with Frequency Output, 3-pin Connector**



## Electrical Connections for IFC (Intelligent Frequency Converter)

**IFC with 4…20 mA Output (F to I), 5-pin Connector**




The 4…20 mA output can drive auxiliary devices (resistive loads) such as displays, recorders and computers, provided that the voltage supplied by the power supply is adequate. Devices must be wired in series with the F to I converter and power supply. The voltage drop across the load(s) and the 6V DC minimum needed to drive the F to I converter determine the minimum voltage required from the power supply.

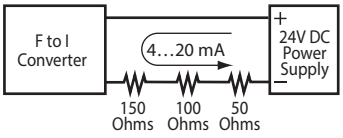
Determine the necessary voltage required to adequately drive the F to I converter and auxiliary device(s).

The F to I converter acts as a current controlling device keeping the current output the same even if the power supply voltage fluctuates or the load resistance changes. The current varies only with respect to the flow rate from the turbine flow sensor, as long as the voltage drop across the F to I converter is at least 6V DC.

The load(s) in the circuit will generally have some electrical resistance, 100 Ohms for this example. The 4…20 mA loop current will produce a voltage drop across each load. The maximum voltage drop across a load(s) will exist when the loop current is 20 mA. The power supply must provide enough voltage for the load(s) plus the 6V DC minimum insertion loss of the F to I converter.

### Example 1

Sufficient Power Supply Voltage

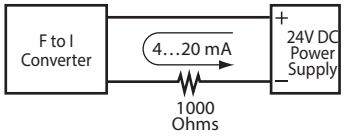



Total Load Resistance = 300 Ohms
At 20 mA loop current, the voltage drop across the load(s) is 6 volts:
300 Ohms × 20 mA = 6000 mV or 6 volts

Subtract 6 volts from the 24 volt source to determine that 18 volts is available to power the F to I converter. The 18 volts is within the specified 10…30 volt range and is sufficient to power the F to I converter.

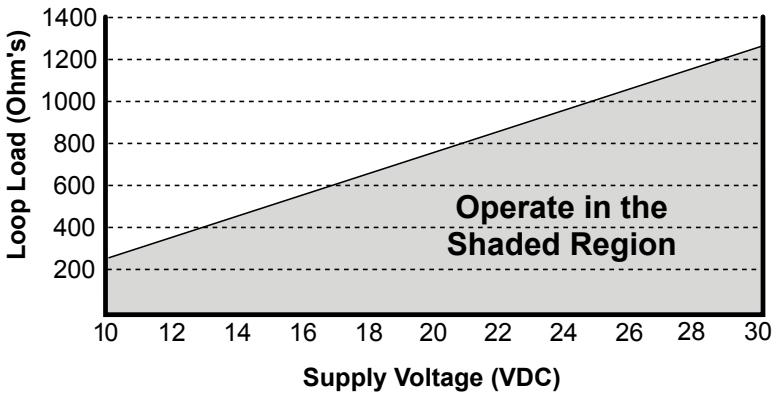
### Example 2

Insufficient Power Supply Voltage

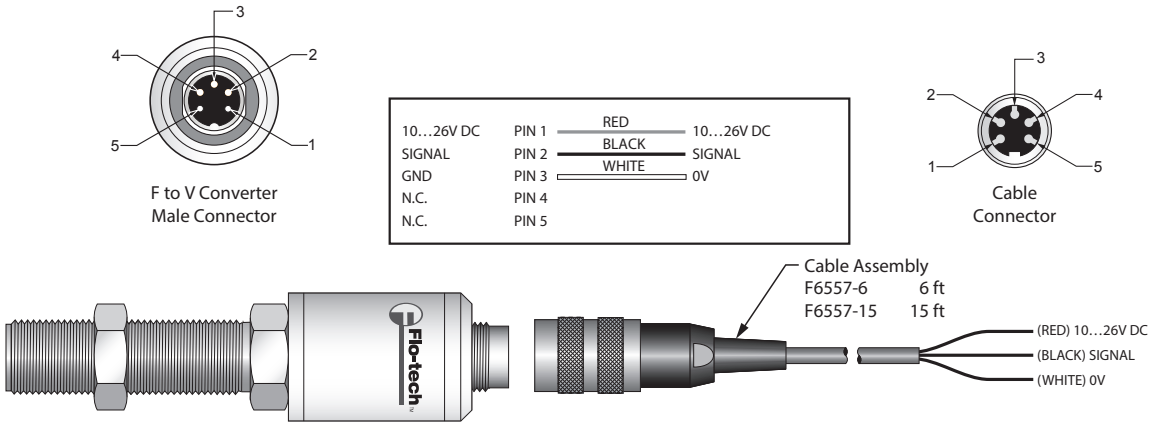



Total Load Resistance = 1000 Ohms
At 20 mA loop current, the voltage drop across the load(s) is 14 volts:
1000 Ohms × 20 mA = 20,000 mV or 20 volts

Subtract 20 volts from the 24 volt source to determine that 4 volts is available to power the F to I converter. The 4 volts is below the specified 10…30 volt range and is not adequate to power the F to I converter. If for example, the power supply voltage was 30 volts instead of 24 volts, the voltage available to power the F to I converter would be 10 volts and within the specified range.

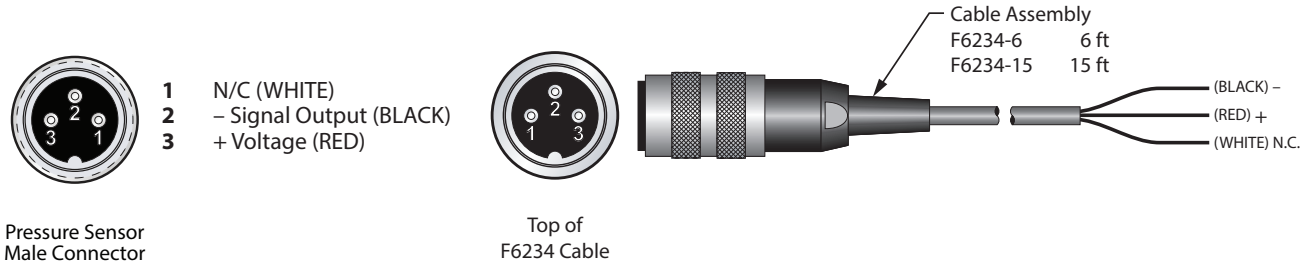



**IFC with 0…5V DC Output (F to V), 5-pin Connector**

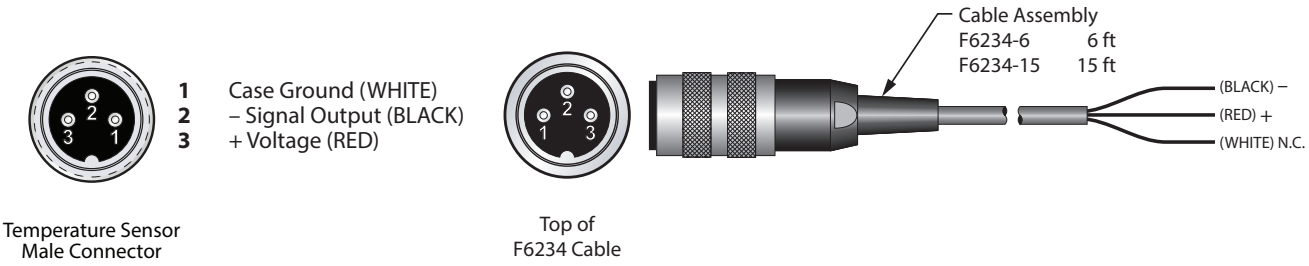



## Electrical Connections for Optional Pressure and Temperature Sensors

**Pressure Sensor, Optional, 3-pin Connector**




**Temperature Sensor, Optional – 3-pin Connector**



# OPERATION

## General

**⚠ WARNING**

***DO NOT EXCEED ALLOWABLE PRESSURE RATINGS. PRESSURE IN EXCESS OF THE MAXIMUM ALLOWABLE RATINGS MAY CAUSE THE TURBINE BODY TO FAIL. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH AND/OR DAMAGE TO THE EQUIPMENT.***

1. Allow fluids to warm to operating temperatures before critical measurements are taken.
2. Maintain a flooded condition in the flow sensor at all times. Air and turbulence will result in erroneous readings.
3. Do not exceed the working temperature range of –4…300° F (–20…150° C). Higher temperatures will damage the magnetic pickup and lower temperatures will limit the rotation of the turbine.

## Flow Sensors with IFC Option

As soon as power is applied, the IFC will begin to output an analog value representative of the measured frequency from the turbine meter. See the wiring diagram that corresponds to the IFC being used.

# MAINTENANCE

**⚠ WARNING**

***ALWAYS DISCONNECT THE PRIMARY POWER SOURCE BEFORE INSPECTION OR SERVICE. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH AND/OR DAMAGE TO THE EQUIPMENT.***

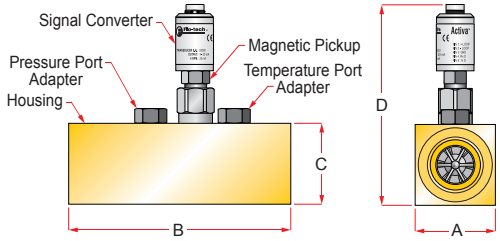
1. A schedule for maintenance checks should be determined based on environmental conditions and frequency of use. Inspect the sensors at least once a year.
2. Perform visual, electrical and mechanical checks on all components.
   a. Visually check for undue heating evidenced by discoloration of wires or other components, damaged or worn parts, or excessive corrosion of the device.
   b. Electrically check to make sure that all connections are clean and tight and that the device is operating properly.

# TROUBLESHOOTING

| Issue | Possible Cause | Remedy |
|---|---|---|
| Sensor indicates higher than actual flow rate | • Cavitation<br>• Debris on straightening section<br>• Build-up of foreign material on sensor bore<br>• Gas in liquid | • Increase back pressure<br>• Clean sensor<br>• Clean sensor<br>• Install gas eliminator ahead of sensor |
| Sensor indicates lower than actual flow rate | • Debris on turbine<br>• Worn bearing | • Clean sensor and add filter<br>• Have sensor serviced and add filter |
| Erratic indications on readout | • Any of the above<br>• Ground loop problem<br>• Turbulence in fluid stream | • Any of the above<br>• Be sure only one system ground is present. Reroute cables away from electrical noise<br>• Redo plumbing per instructions |
| Readout shows flow when pumps are not running | • Mechanical vibration or pump dither causes turbine to oscillate even though there is no flow | • Isolate flow sensor |
| No flow indication at any flow rate | • Foreign material stopping turbine rotation<br>• Damaged turbine and/or bearing<br>• Magnetic pickup stopping turbine rotation<br>• Magnetic pickup shorted or open | • Clean sensor and add filter<br>• Have sensor or magnetic pickup replaced |
| Erratic indications at low flows, but good indications at high flows | • Foreign material wrapped around turbine | • Clean sensor and add filter |
| System works except readings are lower than expected | • Flow is being bypassed<br>• System has a leak | • Repair or replace faulty valves<br>• Find and repair any system leaks |
| No current output | • Low or missing supply voltage<br>• Broken / disconnected wires<br>• Incorrect wiring polarity | • Check polarity of the current loop connections for proper orientation<br>• Make sure receiving device is configured to provide loop current |
| Analog output reads a constant reading all the time | • Electrical noise in vicinity<br>• Damaged electronics | • Make sure there is flow in the system<br>• Verify that the rotor inside the turbine meter turns freely<br>• Check shield<br>• Remove noise producing device |
| Analog output is not stable | • Electrical noise in vicinity<br>• Entrained gas in liquid<br>• Damaged meter rotor<br>• Foreign matter lodged in turbine | • External noise is being picked up by the sensor. Keep all AC wires separate from DC wires.<br>• Check for radio antenna in close proximity. This usually indicates a weak signal.<br>• Clean meter<br>• Recalibrate meter |

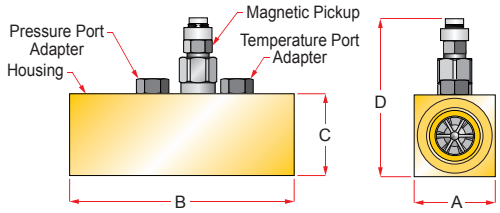
# DIMENSIONS

## Activa Series




| Series | A in. (mm) | B in. (mm) | C in. (mm) | D in. (mm) | Weight lbs (kg) |
|---|---|---|---|---|---|
| F6202 / F6222 | 1.23 (31.2) | 4.72 (120.0) | 1.47 (37.3) | 5.74 (145.6) | 1.60 (0.73) |
| F6204 / F6224 | 1.48 (37.6) | 5.08 (129.0) | 1.80 (45.7) | 6.04 (153.0) | 1.90 (0.86) |
| F6206 / F6226 | 1.98 (50.3) | 5.87 (149.0) | 2.20 (56.0) | 6.50 (164.0) | 2.80 (1.27) |
| F6208 / F6228 | 2.46 (62.5) | 6.81 (173.0) | 2.48 (63.0) | 6.74 (171.0) | 4.20 (1.91) |

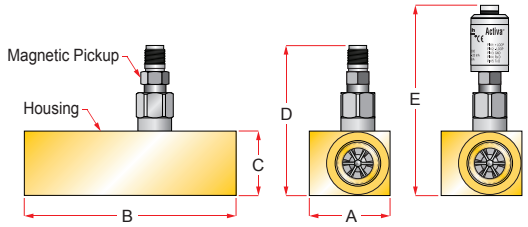
## Ultima Series



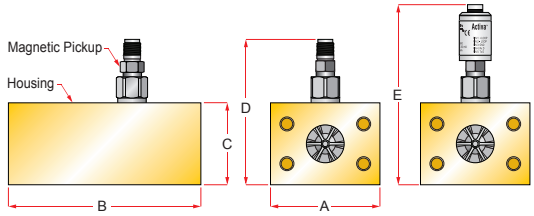

| Series | A in. (mm) | B in. (mm) | C in. (mm) | D in. (mm) | Weight lbs (kg) |
|---|---|---|---|---|---|
| F6202 / F6222 | 1.23 (31.2) | 4.72 (120.0) | 1.47 (37.3) | 5.74 (145.6) | 1.60 (0.73) |
| F6204 / F6224 | 1.48 (37.6) | 5.08 (129.0) | 1.80 (45.7) | 6.04 (153.0) | 1.90 (0.86) |
| F6206 / F6226 | 1.98 (50.3) | 5.87 (149.0) | 2.20 (56.0) | 6.50 (164.0) | 2.80 (1.27) |
| F6208 / F6228 | 2.46 (62.5) | 6.81 (173.0) | 2.48 (63.0) | 6.74 (171.0) | 4.20 (1.91) |

## Classic Series

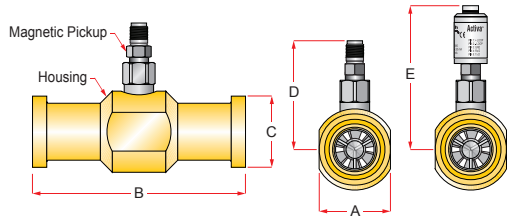
### FSC




### FSB

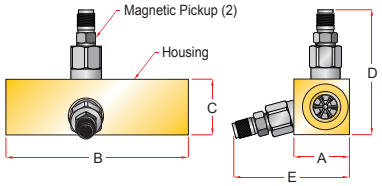



### FSD




| Series | A in. (mm) | B in. (mm) | C in. (mm) | D W/Mag in. (mm) | E W/IFC in. (mm) | Weight lbs (kg) |
|---|---|---|---|---|---|---|
| FSC-375 | 1.25 (32) | 5.00 (127) | 1.50 (38) | 3.91 (99) | 5.48 (139) | 1.25 (0.57) |
| FSC-500 | 2.00 (51) | 6.50 (165) | 2.00 (51) | 4.16 (106) | 5.84 (148) | 2.75 (1.25) |
| FSC-750 | 2.00 (51) | 6.50 (165) | 2.00 (51) | 4.25 (108) | 5.93 (151) | 2.87 (1.30) |
| FSC-1000 | 2.50 (64) | 6.50 (165) | 2.00 (51) | 4.34 (110) | 5.97 (152) | 3.25 (1.48) |
| FSC-1005 | 2.50 (64) | 6.50 (165) | 2.00 (51) | 4.34 (110) | 5.97 (152) | 3.25 (1.48) |
| FSB-1250 | 4.00 (102) | 7.00 (178) | 3.00 (76) | 4.94 (126) | 6.43 (165) | 7.75 (3.52) |
| FSB-1500 | 4.00 (102) | 7.00 (178) | 3.00 (76) | 5.10 (130) | 6.59 (167) | 7.40 (3.36) |
| FSD-1250 | 2.12 (54) | 7.50 (190) | 2.125 (54) | 4.50 (114) | 5.17 (131) | 6.12 (2.78) |
| FSD-1500 | 2.50 (64) | 7.50 (190) | 2.500 (64) | 4.85 (123) | 5.34 (135) | 6.75 (3.06) |
| FSD-2000 | 3.12 (79) | 8.25 (209) | 3.125 (79) | 5.39 (137) | 5.45 (138) | 8.55 (3.88) |

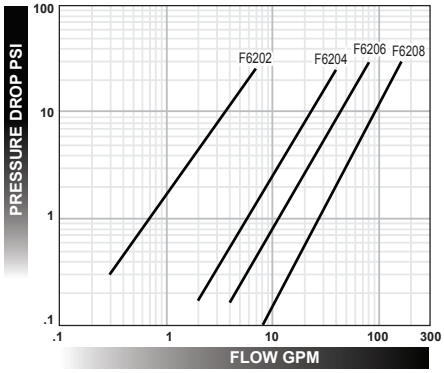
## Quad Series

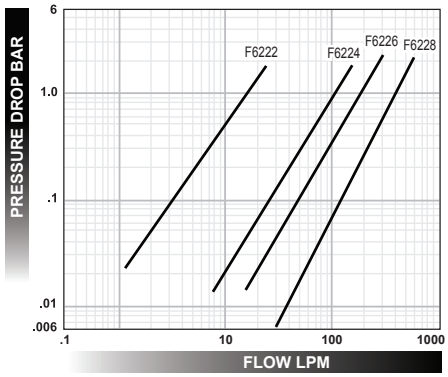



| Series | A in. (mm) | B in. (mm) | C in. (mm) | D W/Mag in. (mm) | E W/Mag in. (mm) | Weight lbs (kg) |
|---|---|---|---|---|---|---|
| FSC-2005 | 2.00 (51) | 6.50 (165) | 2.00 (51) | 4.16 (106) | 4.05 (102) | 2.75 (1.25) |
| FSC-2075 | 2.00 (51) | 6.50 (165) | 2.00 (51) | 4.25 (108) | 4.05 (102) | 2.87 (1.30) |
| FSC-2100 | 2.50 (64) | 6.50 (165) | 2.00 (51) | 4.34 (110) | 4.59 (117) | 3.25 (1.47) |
| FSC-2150 | 2.50 (64) | 6.50 (165) | 2.00 (51) | 4.34 (110) | 4.59 (117) | 7.75 (3.52) |

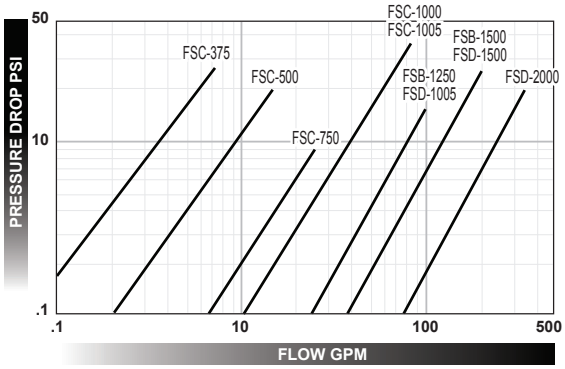
# FLOW VS. PRESSURE DROP CHARTS

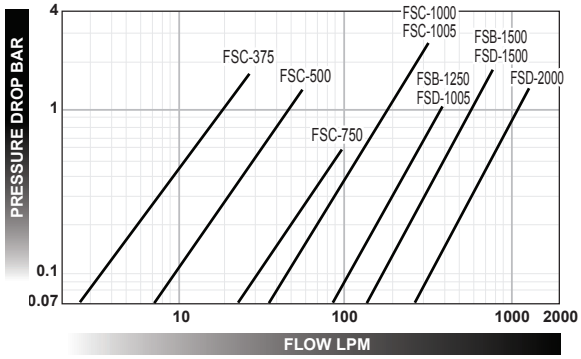
## Activa and Ultima Series



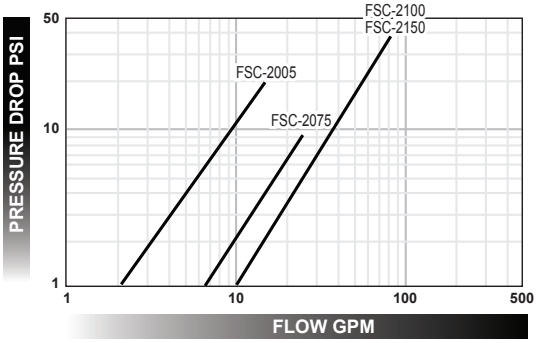



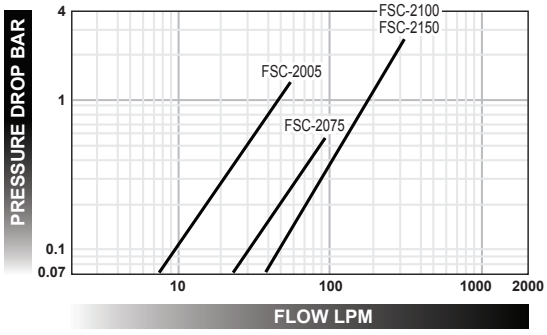

## Classic Series




## Quad Series



# SPECIFICATIONS

## Activa and Ultima Sensor Arrays

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Material** | Housing | | 6013-T651 Anodized aluminum | | | | |
| | Turbine rotor | | T416 Stainless steel | | | | |
| | Rotor supports | | 6061-T6 Aluminum | | | | |
| | | | C360 Brass for 1/4 in. models | | | | |
| | Rotor shaft | | T303 Stainless steel | | | | |
| | Ball bearings | | 440 C Stainless steel | | | | |
| | Hub cones | | 6061-T6 Aluminum alloy | | | | |
| | Retaining rings | | 6061-T6 Aluminum alloy | | | | |
| | Adapters/plugs | | 6061-T6 Anodized aluminum | | | | |
| | Seals | | Buna N standard | | | | |
| | | | Viton® and EPR optional | | | | |
| | Magnetic pickup | | Body | T303 Stainless Steel | | | |
| | | | Nut | T303 Stainless Steel | | | |
| | IFC (Intelligent Frequency Converter) Activa only | | Body | 6061-T6 Aluminum, nickel plate | | | |
| | | | Connector | Brass, nickel plate | | | |
| | Temperature probe | | 12L14 Steel, electroless nickel finish | | | | |
| | Pressure Sensor | | Case | 300 Series stainless steel | | | |
| | | | Diaphragm | 17-4 PH stainless steel | | | |
| | Ports | | SAE Straight thread O-ring boss, female, J1926/1; ISO1179 (BSPP) | | | | |
| **Performance** | Flow accuracy | | Activa | ±1% of reading @ 32 cSt | | | |
| | | | Ultima | ±1% of full scale | | | |
| | Repeatability | | ±0.2% | | | | |
| | Pressure rating | | 5800 psi (400 bar) maximum, 5000 psi (345 bar) maximum for 1-1/4 in. models | | | | |
| | Turbine response | | ≤200 ms | | | | |
| | Fluid temperature | | –4…300° F (–20…150° C) | | | | |
| | Ambient temperature | | –4…131° F (–20…55° C) | | | | |
| **Electrical** | Activa | 4…20 mA | Power | Loop-powered, 6V insertion loss max, 10…30V DC supply | | | |
| | | | Inputs | Mag pickup | Frequency | 0…3500 Hz | |
| | | | | | Trigger sensitivity | 30 mV p-p | |
| | | | | | Frequency measure accuracy | ±1% | |
| | | | Analog out | Resolution | 1:4000 | | |
| | | | | Temp Drift | 50 ppm/° C max | | |
| | | | Environmental | | Ambient temp. | –22…158° F (–30…70° C) | |
| | | | | | Humidity | 0…90% non-condensing | |
| | | 0…5V DC | Power | 10…26V DC | | | |
| | | | Inputs | Mag pickup | Frequency | 0…3500 Hz | |
| | | | | | Trigger sensitivity | 30 mV p-p | |
| | | | | | Frequency measure accuracy | ±1% | |
| | | | Analog out | Resolution | 1:4000 | | |
| | | | | Temp. drift | 50 ppm/°C max | | |
| | | | Environmental | | Ambient temp. | –22…158° F (–30…70° C) | |
| | | | | | Humidity | 0…90% non-condensing | |
| | Ultima | Magnetic Pickup | Self-generating alternating pulse; 100 mV RMS (100 Hz) minimum. | | | | |
| | | | F6202 & F6222 only | 10 mV RMS (200Hz) minimum | | | |
| **Calibration** | Flow sensors are calibrated with 0.876 specific gravity, 140 SUS (32 cSt) hydraulic oil. Standard calibration is done using 3-points and is traceable to NIST, ISO 9001/ANSI Z540-1 & MIL-STD 45662A. | | | | | | |

## Classic Flow Sensor

| | | | | | | |
|---|---|---|---|---|---|---|
| **Materials** | Housing | | FSC, FSB | 6013-T651 Anodized aluminum | | |
| | | | FSD | Stressproof® steel, zinc plated | | |
| | Turbine rotor | | T416 Stainless steel | | | |
| | Rotor supports | | FSC-375, 500, 750 | C360 Brass | | |
| | | | FSC-1000, 1005 | 6061-T6 Aluminum | | |
| | | | FSD | Tungsten carbide | | |
| | Rotor shaft | | FSC, FSB | T303 Stainless steel | | |
| | | | FSD | Tungsten carbide | | |
| | Bearings | | FSC, FSB | 440 C Stainless steel ball bearings | | |
| | | | FSD | Tungsten carbide | | |
| | Hub cones | | FSC, FSB | 6061-T6 Aluminum alloy | | |
| | Retaining rings | | FSC | T303 Stainless steel | | |
| | | | FSC-500, 750, 1000, 1005; FSB; FSD | Steel, zinc plate | | |
| | Adapters/plugs | | 6061-T6 Anodized aluminum | | | |
| | Seals | | Buna N standard, Viton® and EPR optional | | | |
| | Magnetic pickup | | Body | T303 Stainless Steel | | |
| | | | Nut | T303 Stainless Steel | | |
| | IFC (Intelligent Frequency Converter): | | Body | 6061-T6 Aluminum, nickel plate | | |
| | | | Connector | Brass, nickel plate | | |
| | Ports: | | SAE Straight thread O-ring boss, female, J1926/1; Code 61 and Code 62: SAE J518 | | | |
| **Performance** | Flow accuracy | | Standard magnetic pickup | ±1% of full scale | | |
| | | | IFC converter option | ±1% of reading @ 32 cSt | | |
| | Repeatability | | ±0.2% | | | |
| | Pressure rating | | FSC, FSB | 5000 psi (345 bar) maximum, | | |
| | | | FSD | 6000 psi (414 bar) maximum | | |
| | Pressure drop | | See *"Flow vs. Pressure Drop Charts" on page 11* | | | |
| | Turbine response | | ≤200 ms | | | |
| | Fluid temperature | | –4…300° F (–20…150° C) | | | |
| | Ambient temperature | | –4…131° F (–20…55° C) | | | |
| **Electrical** | Magnetic Pickup | | Self-generating alternating pulse; 100 mV RMS (100 Hz) minimum. | | | |
| | | | FSC-375 only | 10 mV RMS (200 Hz) minimum | | |
| | IFC Converter | 4…20 mA | Power | Loop-powered, 6V insertion loss max 10…30V DC supply | | |
| | | | Inputs | Mag pickup | Frequency | 0…3500 Hz |
| | | | | | Trigger sensitivity | 30 mV p-p |
| | | | | | Frequency measure accuracy | ±1% |
| | | | Analog out | 4…20 mA current loop | Resolution | 1:4000 |
| | | | | | Temp. drift | 50 ppm/°C max |
| | | | Environmental | | Ambient temp. | –22…158° F (–30…70° C) |
| | | | | | Humidity | 0…90% non-condensing |
| | | 0…5V DC | Power | 10…26V DC | | |
| | | | Inputs | Mag pickup | Frequency | 0…3500 Hz |
| | | | | | Trigger sensitivity | 30 mV p-p |
| | | | | | Frequency measure accuracy | ±1% |
| | | | Analog out | 0…5V DC | Resolution | 1:4000 |
| | | | | | Temp drift. | 50 ppm/°C max |
| | | | Environmental | | Ambient temp | –22…158° F (–30…70° C) |
| | | | | | Humidity | 0…90% non-condensing |
| **Calibration** | Flow sensors are calibrated with 0.876 specific gravity, 140 SUS (32 cSt) hydraulic oil. Standard calibration is done using 3-points and is traceable to NIST, ISO 9001/ANSI Z540-1 & MIL-STD 45662A | | | | | |

### Quad Flow Sensors

| | | | |
|---|---|---|---|
| **Material** | Housing | 6013-T651 Anodized aluminum | |
| | Turbine rotor | T416 Stainless steel | |
| | Rotor supports | 6061-T6 Aluminum | |
| | Rotor shaft | T303 Stainless steel | |
| | Bearings | 440 C Stainless steel ball bearings | |
| | Hub cones | 6061-T6 Aluminum alloy | |
| | Retaining rings | Steel, zinc plate | |
| | Seals | Buna N standard, Viton® and EPR optional | |
| | Magnetic pickup | Body | T303 Stainless Steel |
| | | Nut | T303 Stainless Steel |
| | Ports | SAE Straight thread O-ring boss, female, J1926/1 | |
| **Performance** | Flow accuracy | ±1% of full scale | |
| | Repeatability | ±0.2% | |
| | Pressure rating | 5000 psi (345 bar) maximum | |
| | Pressure drop | See *"Flow vs. Pressure Drop Charts" on page 11* | |
| | Turbine response | ≤200 ms | |
| | Fluid temp. | –4…300° F (–20…150° C) | |
| | Ambient temp. | –4…131° F (–20…55° C) | |
| **Electrical** | Magnetic Pickup | Self-generating alternating pulse; 100 mV RMS (100 Hz) minimum | |
| **Calibration** | Flow sensors are calibrated with 0.876 specific gravity, 140 SUS (32 cSt) hydraulic oil. Standard calibration is done using 3-points and is traceable to NIST, ISO 9001/ANSI Z540-1 & MIL-STD 45662A. | | |

# MODEL NUMBERS

### Activa and Ultima Flow Sensors

| Nominal Port Size | Flow Rate | Model | IFC Converter or Mag Pickup | Seals | Sensor Ports | |
|---|---|---|---|---|---|---|
| | | | | | Temperature | Pressure |
| SAE 8 | 0.4…7 gpm | F6202 | **Activa Models:**<br>**AI** 4…20 mA Out<br>**AV** 0…5V DC Out<br>**Ultima Models:**<br>**F** Frequency Out | **B** Buna N<br>**V** Viton<br>**E** EPR | **T** with Sensor<br>**N** 1/4 NPT(F) Plugged<br>**S** SAE 2 Plugged<br>**G** G 1/4 Plugged<br>**D** SAE 4 Plugged | **1** 1000 psi<br>**3** 3000 psi<br>**5** 5000 psi<br>**6** 6000 psi *<br>**N** 1/4 NPT(F) Plugged<br>**S** SAE 2 Plugged<br>**F** G 1/4 Plugged |
| SAE 12 | 2…40 gpm | F6204 | | | | |
| SAE 16 | 4…80 gpm | F6206 | | | | |
| SAE 20 | 8…160 gpm | F6208 | | | | |
| G 1/4 | 1.5…26 lpm | F6222 | | | | |
| G 3/4 | 7.5…151 lpm | F6224 | | | | |
| G 1 | 15…302 lpm | F6226 | | | | |
| G 1-1/2 | 30…605 lpm | F6228 | | | | |

* Not available with Models F6208 or F6228

*Example*

**F6204-AIB-T6** =

- SAE 12 ports, 2…40 gpm flow range
- Buna N seals, Temperature sensor
- 6000 psi (414 bar) pressure sensor

**F6208-FV-TN** =

- SAE 20 ports, 8…160 gpm flow range
- Viton seals, Temperature sensor
- 1/4 NPT (F) plugged pressure port

## Classic Flow Sensors

| Nominal Port Size | Flow Rate | Series | Model with Frequency Out | Model with 4…20 mA Out | Model with 0…5V DC Out |
|---|---|---|---|---|---|
| SAE 8 | 0.4…7 gpm | FSC-375 | F2945-ASCM | F2945-ASCI | F2945-ASCV |
| SAE 12 | 1…15 gpm | FSC-500 | F2082-ASCM | F2082-ASCI | F2082-ASCV |
| SAE 12 | 2…25 gpm | FSC-750 | F2083-ASCM | F2083-ASCI | F2083-ASCV |
| SAE 16 | 3…60 gpm | FSC-1000 | F2084-ASCM | F2084-ASCI | F2084-ASCV |
| SAE 16 | 4…85 gpm | FSC-1005 | F2084-ASCM8 | F2084-ASCI8 | F2084-ASCV8 |
| SAE 20, Code 61 | 5…100 gpm | FSB-1250 | F2085-ASBM | F2085-ASBI | F2085-ASBV |
| SAE 24, Code 61 | 7…200 gpm | FSB-1500 | F2086-ASBM | F2086-ASBI | F2086-ASBV |
| SAE 20, Code 62 | 5…100 gpm | FSD-1250 | F2085-SCDM | F2085-SCDI | F2085-SCDV |
| SAE 24, Code 62 | 7…200 gpm | FSD-1500 | F2086-SDCM | F2086-SCDI | F2086-SCDV |
| SAE 32, Code 62 | 10…350 gpm | FSD-2000 | F2998-SCDM | F2998-SCDI | F2998-SCDV |

## Quad Flow Sensors

| Nominal Port Size | Flow Rate | Series | Model |
|---|---|---|---|
| SAE 12 | 1…15 gpm | FSC-2005 | F2082-ASCQ4 |
| SAE 12 | 2…25 gpm | FSC-2075 | F2083-ASCQ4 |
| SAE 16 | 3…60 gpm | FSC-2100 | F2084-ASCQ4 |
| SAE 16 | 4…85 gpm | FSC-2150 | F2085-ASCQ4 |

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