Proteus Industries Inc.

FluidVision® 4000

Flow, Temperature & Pressure Measuring Instruments

Technical Reference Manual

Contents

Important Safety Information

NOTE and **CAUTION** statements are used throughout this manual to highlight important operational and safety information.

	**NOTE** statements provide details that are important to the successful understanding and application of the system.
	**CAUTION** statements identify conditions or practices that could result in damage to the equipment or other property. **WARNING** statements identify conditions or practices that could result in personal injury or loss of life.

Taking proper precautions to avoid damage to your instrument's sensors during installation helps ensure consistent, error-free installations, which lowers costs and assists on-time completion of your work.

The **CAUTION** statements inserted in these instructions provide an alert to installers and operators to take sensible steps to allow the instrument's sensors to operate correctly the first time and every time.

Technical Support

For technical or applications assistance, contact:

Proteus Industries Inc.
340 Pioneer Way
Mountain View, CA 94041

Phone: (650) 964-4163
Fax: (650) 965-0304
E-mail: tech@proteusind.com

	**NOTE** **Product warranty does NOT cover the repair of installation errors** Proteus FluidVision 4000 instruments are manufactured by ISO 9001-registered processes and are warranted to be free from material and workmanship defects. The full text of the warranty is available on the Proteus Industries website at www.proteusind.com/warranty. The costs of cleaning flow sensors, recalibration or repair of mechanical damage incurred during installation of the product are NOT covered by the warranty. A Purchase Order will be required to allow the recovery of such service costs.

	**CAUTION!** **This product contains lead solder. Disposal of this product should be carried out in compliance with local regulations.**

Section 1: Introduction & How They Work

FluidVision 4000 instruments measure the flow rate, temperature and pressure of water, water/glycol mixtures, Galden®, Fluorinert® and other liquids. All sensors are combined in one unit for an easy and compact installation.

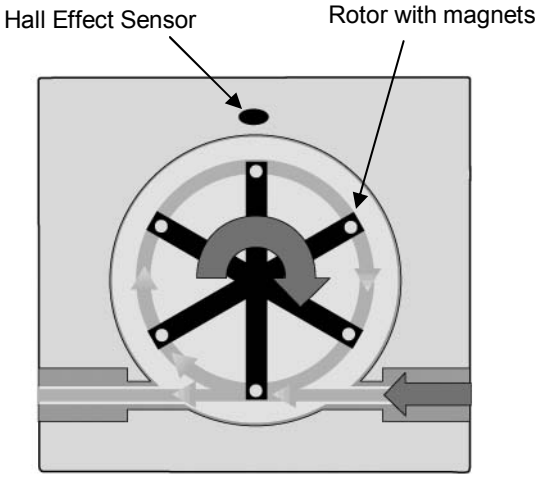
FluidVision 4000 sensors provide accurate and precise measurement of these parameters, providing 0–5 VDC, 0–10 VDC or 4–20 mA outputs. Trip points for all three parameters are individually selectable and can be linked to a switching relay.

This manual provides information to help you install FluidVision 4000 instruments into your fluid system.

	NOTE
	Installation of this product should be performed by qualified service personnel.

How Do They Work?

Flow Rate



A rotor spins when liquid moves through the flow sensor body. Magnets in the rotor switch a Hall-effect sensor mounted in the sensor body.

The flow range of the sensor is determined by the diameter of the precisely-formed orifice. The maximum range is selected to be the flow at which the rotor spins at a rate of 40 revolutions per second or that flow at which pressure drop across the sensor is 10 psi.

The frequency of the pulse train from the Hall-effect sensor is converted to a flow rate by calibration against traceable flow standards. The flow output is made available as 0–5 VDC, 0–10 VDC or 4–20 mA signals.

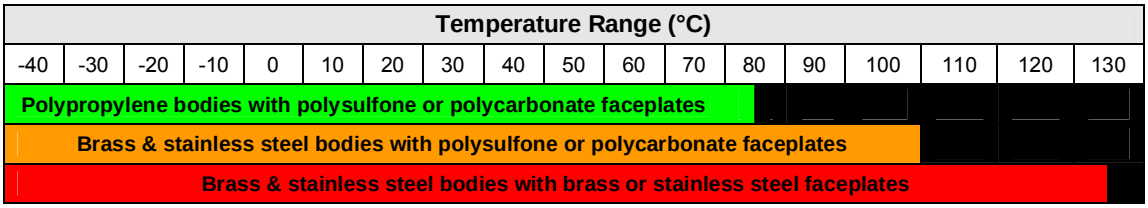
The resulting outputs have excellent linearity. The user-adjusted flow trip point is linked to a relay output. The measured flow rate can be visually displayed on an optional LCD display. A bright tri-color LED indicates flow status.

Flow range data for FluidVision 4000 instruments are listed in Section 2 of this manual. Information on how to obtain flow response curves is provided in Section 8.

Temperature

A semiconductor transducer embedded in a stainless steel housing senses the temperature of the flowing liquid over the range of -40 to 125°C. The device produces an output current proportional to absolute temperature, producing 1 µA/°K. This current is converted to produce an output voltage of 1 mV/°K.

- The temperature range of FluidVision 4000 instruments depends on the materials from which the flow sensor and faceplate are formed.



For applications in which temperatures are always above the freezing point of water, an output voltage of 0V represents 0°C. For applications in which temperatures can drop below the freezing point of water, an output voltage of 0V represents -50°C.

The selected output range is made available as 0–5 VDC, 0–10 VDC or 4–20 mA signals.

The user-adjusted temperature trip point is linked to a relay output. The measured temperature can be visually displayed on an optional LCD display.

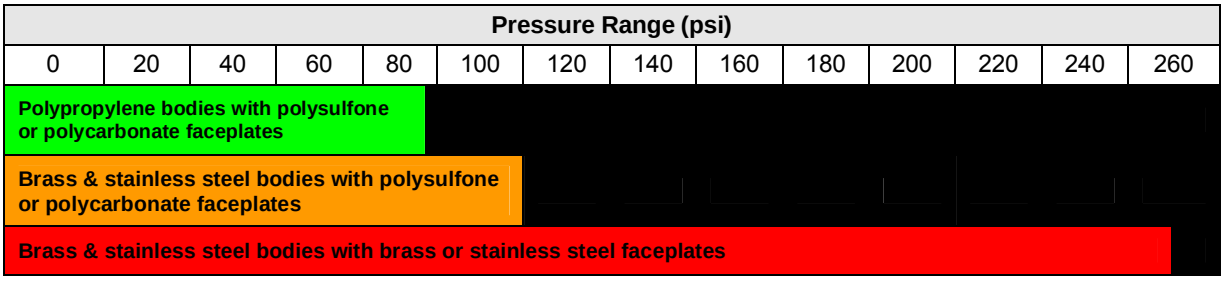
A bright tri-color LED indicates temperature status.

Information on how to obtain temperature response curves is provided in Section 8 of this manual.

Pressure

A temperature-compensated device with an operating range of > 250 psi measures pressure.

The pressure range over which the device is calibrated is determined by the materials from which the flow sensor is formed. Pressure response is calibrated during final testing against traceable pressure standards.



Pressure outputs are made available as 0–5 VDC, 0–10 VDC or 4–20 mA signals.

The user-adjusted pressure trip point is linked to a relay output. The measured pressure can be visually displayed on an optional LCD display. A bright tri-color LED indicates pressure status.

Information on how to obtain pressure response curves is provided in Section 8 of this manual.

LED Status Indicators

Bright tri-color LEDs indicate the statuses of flow, temperature and pressure. Each sensor's trip point comparator circuit directly controls the color of the corresponding LED.

The LEDs function as traffic lights to provide an instant indication of the state of each monitored parameter.

A GREEN LED indicates the sensor is in its normal state.
An AMBER LED provides a CAUTION warning – the sensor is in its normal state, but the measured value is within 15% of the selected trip point value.
A RED LED indicates the sensor is in its alarm state.

FLOW LED STATUS	
GREEN	Flow is > 1.15x trip point flow
AMBER	Flow is 1.0 to 1.15x trip point flow
RED	Flow is < trip point flow
TEMPERATURE LED STATUS	
GREEN	Temperature is < 0.85x trip point temperature
AMBER	Temperature is 0.85 to 1.0x trip point temperature
RED	Temperature is > trip point temperature
PRESSURE LED STATUS	
GREEN	Pressure is < 0.85x trip point pressure
AMBER	Pressure is 0.85 to 1.0x trip point pressure
RED	Pressure is > trip point pressure

Over-Range Warning Indicator

To prevent a FluidVision 4000 instrument from being continually operated in a manner that could become unsafe or induce excessive wear, the instrument is fitted with an over-range warning circuit that senses when flow, temperature or pressure reaches a level more than 8% above the recommended operating limit.

When an over-range state is detected, the parameter output is switched to 0 VDC or 4 mA, signaling an alarm condition to the controller.

The LED Status Indicator will be GREEN.

The LCD display, if installed, will indicate the actual measured value of the over-ranged parameter.

Relay Output

A relay allows the user to set alarm levels for low flow rate, high temperature and high pressure.

The state of a SPDT 1A 48 VDC relay is controlled by the trip point status of all installed sensors. A system controller or PLC can monitor the relay's state, and the relay may be connected to other control relays to provide redundant interlock capability.

The relay is in its alarm state if it is not energized, the same condition as when there is no power applied to it.

Relay State	Current in Coil	NO (Normally Open) Contact	NC (Normally Closed) Contact
Energized	Current flowing	Connected to RELAY COM contact	OPEN
Normal	NO current flowing	OPEN	Connected to RELAY COM contact

- The control relay can be in the energized state if and only if ALL installed sensors are measuring non-alarm conditions.
- The relay will be in its NORMAL state if ONE OR MORE of the installed sensors measures an alarm condition.

LCD Display

An optional digital display unit provides continuous display of flow rate on the top line and either temperature or pressure on a second line if one other sensor is installed.

If both temperature and pressure sensors are installed, the values of each of these parameters is alternately displayed on the second line along with the unit of measure for each parameter.

Certifications

FluidVision 4000 instruments are CE marked for compliance with the EU Directive 89/336/EEC for electromagnetic compatibility.

Section 2: Specifications & Performance

The most current information on the performance capability of these sensors is available on the Proteus Industries website at www.proteusind.com.

Flow Ranges		Connection	Part Numbers		
GPM	LPM		Brass	Stainless Steel	Polypropylene
0.06 – 0.6	0.2 – 2.2	¼" FNPT	04004BN06-XXX	04004SN06-XXX	04004PN06-XXX
0.1 – 1.4	0.4 – 5.3	¼" FNPT	04004BN1-XXX	04004SN1-XXX	04004PN1-XXX
0.2 – 2.5	0.8 – 9.5	¼" FNPT	04004BN2-XXX	04004SN2-XXX	04004PN2-XXX
0.2 – 2.5	0.8 – 9.5	9/16 -18 SAE		04006SA2-XXX	
0.3 – 4.5	1.1 – 17	¼" FNPT	04004BN4-XXX	04004SN4-XXX	04004PN4-XXX
0.3 – 4.5	1.1 – 17	9/16 -18 SAE		04006SA4-XXX	
0.6 – 9.0	2.2 – 34	⅜" FNPT	04006BN9-XXX	04006SN9-XXX	
0.6 – 10	2.2 – 38	⅜" FNPT			04006PN10-XXX
0.8 – 10	3.0 – 38	¾ -16 SAE		04008SA10-XXX	
1.0 – 14	3.8 – 53	½" FNPT	04008BN14-XXX	04008SN14-XXX	04008PN14-XXX
1.2 – 16	4.5 – 60	¾" FNPT	04012BN16-XXX	04012SN16-XXX	
1.2 – 16	4.5 – 60	1 1/16 -12 SAE		04012SA16-XXX	
1.5 – 19	5.7 – 72	¾" FNPT			04012PN19-XXX
3.0 – 40	11 – 151	¾" FNPT	04012BN40-XXX	04012SN40-XXX	
4.0 – 40	15 – 151	1" FNPT	04016BN40-XXX	04016SN40-XXX	
4.0 – 40	15 – 151	1 5/16 -12 SAE		04016SA40-XXX	
4.0 – 50	15 – 189	1" FNPT			04016PN50-XXX
5.0 – 60	19 – 227	1" FNPT	04016BN60-XXX	04016SN60-XXX	

Temperature & Pressure Operating Limits

Flow Sensor Material	Faceplate Material	Temperature Range		Pressure Range	
		°C	°F	psi	kPA
Brass	Clear Polysulfone	-40 to 100	-40 to 212	100	690
Brass	Brass	-40 to 125	-40 to 257	250	1723
04016BXX	Clear Polycarbonate	-40 to 100	-40 to 212	100	690
Stainless Steel	Clear Polysulfone	-40 to 100	-40 to 212	100	690
Stainless Steel	Stainless Steel	-40 to 125	-40 to 257	250	1723
04016SXX	Clear Polycarbonate	-40 to 100	-40 to 212	100	690
Polypropylene	Clear Polysulfone	-40 to 70	-40 to 158	75	517
04016PXX	Clear Polycarbonate	-40 to 70	-40 to 158	75	517

Notes:

1. Electronics are rated for operation to 85°C (185°F). At higher temperatures, the electronics unit must be mounted remotely from the flow, temperature and pressure sensor unit. Contact Proteus Technical Support for additional information.
2. The compensated calibration range of the pressure sensor in standard FluidVision 4000 Series instruments is 0°C to 82°C (32°F to 180°F). Custom calibration for higher or lower temperatures is available. Contact Proteus Technical Support for information.
3. If operated below 0°C, ice will normally form on the flow sensor and electronics unit. Contact Proteus Applications Support for information on insulation kits to restrict ice build-up.
4. The kinematic viscosity of the circulating liquid must be sufficiently low to allow the rotor to spin freely. Contact Proteus Applications Support for information on system performance with specialized materials for use at high- and low-temperature extremes.

Wetted Materials

Flow Sensor Body	Brass, 316 Stainless Steel or Polypropylene
Faceplates	Clear polysulfone for 04004XXX to 04012XXX instruments; polycarbonate for 04016X instruments. Brass faceplates are optionally available for 04004BXXX to 04012BXXX instruments. Stainless steel faceplates are optionally available for 04004SXXX to 04012SXXX instruments.
Sealing O-Ring	Viton® standard; Buna-N, EPDF and silicone rubber are optionally available.
Rotor	PPS standard; Kynar® and Nylon 66 are optionally available.
Rotor Shaft	316 stainless steel standard; alumina and sapphire are optionally available.

Flow Measurement Capability

Voltage Output	0–5 VDC, 0–10 VDC or 4–20 mA outputs can be operator-selected for each measured parameter.
Accuracy	Device accuracy is the measurement capability of the sensor. The following statement should be read in conjunction with the Calibration information below: Improved accuracy and linearity performance over smaller flow ranges can be achieved by specialized NIST-traceable calibration procedures.
Linearity	Flow: ± 1.5% of full scale Temperature: ± 1°C (0–100°C) Pressure: ± 1 psi (0–100 psi) ± 3 psi (0–250 psi)
Repeatability	Flow: ± 0.5% of full scale Temperature: ± 0.3°C (0–100°C)
Calibration	A statement of Conformance is provided with each instrument. Flow and pressure calibrations are performed with water at ambient temperature. Our calibration accuracy is maintained by statistical comparison with NIST-traceable standards.

Flow Measurement Capability

Measurement capability of the FluidVision 4000 is stated on a Certificate of Conformance delivered with each instrument. A Certificate of Calibration providing improved accuracy at a single calibration point is available at additional cost.

Accuracy ± 3% of full scale is stated on a Certificate of Conformance. Flow response is adjusted at high- and low-reference flows selected on production standards whose response is controlled to ± 1% of their range.	**Linearity** ± 1.5% of full scale from 0.1 to 1.0x the flow range.
Accuracy of ± 1% of reading can be stated for a single flow point on a Calibration Certificate. This calibration adjustment is referenced to a flow standard whose response is controlled to ± 0.5% of the selected flow point.	**Repeatability** ± 1% of full scale from 0.1 to 1.0x the flow range.

Temperature Measurement Capability

Accuracy ± 3% of full scale is stated on a Certificate of Conformance. Temperature response is adjusted at high and low reference temperatures selected on production standards whose response is controlled to ± 1% of their value.	**Linearity** ± 1% of full scale from 0.1 to 1.0x the temperature range
Accuracy of ± 1% of reading can be stated for a single temperature point on a Calibration Certificate. This calibration adjustment is referenced to a temperature standard whose response is controlled to ± 0.2% of the selected value.	**Repeatability** ± 0.5% of full scale from 0.1 to 1.0x the temperature range

Pressure Measurement Capability

Accuracy ± 3% of full scale is stated on a Certificate of Conformance. Pressure response is adjusted at high and low reference pressures selected on production standards whose response is controlled to ± 0.5% of their value.	**Linearity** ± 1% of full scale from 0.1 to 1.0x the pressure range
Accuracy of ± 1% of reading can be stated for a single pressure on a Calibration Certificate. This calibration adjustment is referenced to a pressure standard whose response is controlled to ± 0.2% of the selected value.	**Repeatability** ± 0.5% of full scale from 0.1 to 1.0x the pressure range

Calibration and Measurement Uncertainty

Accuracy specifications for the FluidVision 4000 instruments INCLUDE the uncertainty of our calibration process. This inclusion results in a higher number than would be stated for the uncertainty ascribed to the reference standards.

Switch Performance

Trip Point Selection	A 16-position rotary switch divides the flow, temperature and pressure ranges into 17 equal steps. A single-turn potentiometer provides fine adjustment of parameter values: ▪ When the potentiometer is set to the 12 o'clock position, the trip point values are as indicated in the Range and Trip Point Tables on pages 29 (Flow), 31 (Temperature) and 33 (Pressure) of this manual. ▪ When the potentiometer is turned clockwise to its maximum position (5 o'clock), the trip point is the mid-point value plus 1 step. ▪ When the potentiometer is turned counterclockwise to its minimum position (7 o'clock), the trip point is the mid-point value minus ⅓ step. Step size can be determined from the Range and Trip Point Tables.
Switch Type	Relay Closure, Normally Open and Normally Closed contacts are provided.
Relay Rating	SPDT 1 A at 48 VDC

Electrical

Power Requirements	24 ± 10% VDC, 200 mA
Over-Voltage Protection	A thermal resettable fuse turns unit OFF if input voltage exceeds 29 VDC.
Electrical Connection	2 m 8/24 AWG PVC insulated cable, rated 1.5 A at 36 VDC

Section 3: Installing FluidVision 4000 Instruments

Physical Installation

Selecting Instrument Location

When selecting the location and method of mounting of the FluidVision 4000 instruments consider the following factors:

- Size of instrument – Information on how to obtain product dimensions is provided in Section 9 of this manual.

- Proximity to unprotected electronics – It is undesirable to mount any plumbing connections directly over electronic controls or other unprotected instrumentation because of the potential for leaks or condensation to cause damage. While the NEMA 4 packaging preserves the integrity of your FluidVision 4000 instrument, it cannot prevent leakage or condensation from damaging other devices!

- Weight of instrument – The weight of the instrument may to be too high to allow the unit to be reliably mounted on rigid pipe or by panel-mounting using the faceplate-securing screws.

- Access to cables – Information on how to obtain outline drawings is provided in Section 9 of this manual. Check these for the location of the electrical connections.

- Visibility of digital display – If your FluidVision 4000 instrument is fitted with an optional digital display, the unit should be situated so that the displayed information is viewable by an operator in the available ambient light.

- Orientation
  - Ideally, the unit should be mounted with the faceplate of the flow sensor in a vertical plane.
  - Mounting the unit with the flow path horizontal and uppermost will assist in removing entrained air from the flow sensor.
  - If mounting with the flow path vertical, ensure that the flow direction is upwards to eliminate errors arising from vortex formation or other effects from an incompletely-filled pipe.

- Flow Direction – The flow direction through 04004PN06-XXX instruments MUST be from Port A to Port B.

  All other FluidVision 4000 instruments can be installed with liquid entering the flow sensor through either port.

- Proximity to other devices – The flow response of FluidVision 4000 instruments and thus their calibration may be affected by the form of any device attached to the inlet connection as well as on the form of nearby upstream devices.

  Elbows, T-pieces, valves and filters located immediately upstream from the flow sensor can introduce swirling motion to the liquid flow, reducing the linear velocity of the flow stream.

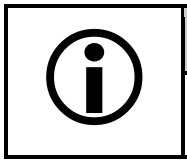
  We recommend that a straight run of pipe of more than 10x pipe ID be used between the flow sensor and any upstream devices to minimize these effects.

  Appropriate calibration procedures must be used to provide an accurate flow measurement with elbows or T-pieces that must be attached directly to the inlet connection. Contact Proteus Technical Support for assistance.

  FluidVision 4000 instruments are typically unaffected by the form or proximity of downstream devices.

- ID of connection or pipe

The flow response of a FluidVision 4000 instrument, and thus its calibration, may be dependent on the internal diameter (ID) of the incoming pipe or the ID of a connecting device.



NOTE

If the ID of your pipe or tube fitting where it connects to the inlet port is LESS than the Orifice ID listed in Tables 1 and 2 below, calibration values may be invalid.

Appropriate calibration procedures can be applied to allow the FluidVision 4000 instruments to be used with pipes and connections with IDs smaller than those shown in Tables 1 and 2 below. Contact Proteus Technical Support for assistance.

Flow Ranges		Connection	Orifice ID		Part Numbers	
GPM	LPM		inch	cm	Stainless Steel	Brass
0.06 – 0.6	0.2 – 2.2	¼" FNPT	0.063	0.16	04004SN06-XXX	04004BN06-XXX
0.1 – 1.4	0.4 – 5.3	¼" FNPT	0.118	0.30	04004SN1-XXX	04004BN1-XXX
0.2 – 2.5	0.8 – 9.5	¼" FNPT	0.188	0.48	04004SN2-XXX	04004BN2-XXX
0.2 – 2.5	0.8 – 9.5	9/16 -18 SAE	0.188	0.48	04006SA2-XXX	
0.3 – 4.5	1.1 – 17	¼" FNPT	0.27	0.68	04004SN4-XXX	04004BN4-XXX
0.3 – 4.5	1.1 – 17	9/16 -18 SAE	0.27	0.68	04006SA4-XXX	
0.6 – 9.0	2.2 – 34	⅜" FNPT	0.37	0.94	04006SN9-XXX	04006BN9-XXX
0.8 – 10	3 – 38	¾ -16 SAE	0.40	1.02	04008SA10-XXX	
1.0 – 14	3.8 – 53	½" FNPT	0.46	1.17	04008SN14-XXX	04008BN14-XXX
1.2 – 16	4.5 – 60	¾" FNPT	0.61	1.55	04012SN16-XXX	04012BN16-XXX
1.2 – 16	4.5 – 60	1 1/16 -12 SAE	0.61	1.55	04012SA16-XXX	
3 – 40	11 – 150	¾" FNPT	0.80	2.03	04012SN40-XXX	04012BN40-XXX
4 – 40	15 – 150	1" FNPT	0.87	2.21	04016SN40-XXX	04016BN40-XXX
4 – 40	15 – 150	1 5/16 -12 SAE	0.80	2.03	04016SA40-XXX	
5 – 60	18 – 225	1" FNPT	1.00	2.54	04016SN60-XXX	04016BN60-XXX

Table 1: Flow Ranges, Part Numbers and Orifice IDs for Brass & Stainless Steel instruments.

Flow Ranges		Connection	Orifice ID		Part Numbers
GPM	LPM		inch	cm	Polypropylene
0.06 – 0.6	0.2 – 2.2	¼" FNPT	0.063	0.16	04004PN06-XXX
0.1 – 1.4	0.4 – 5.3	¼" FNPT	0.118	0.30	04004PN1-XXX
0.2 – 2.5	0.8 – 9.5	¼" FNPT	0.188	0.48	04004PN2-XXX
0.3 – 4.5	1.1 – 17	¼" FNPT	0.27	0.48	04004PN4-XXX
0.6 – 10	2.2 – 38	⅜" FNPT	0.37	0.94	04006PN10-XXX
1.0 – 14	3.8 – 53	½" FNPT	0.46	1.17	04008PN14-XXX
1.5 – 19	5.7 – 72	¾" FNPT	0.61	1.55	04012PN19-XXX
4.0 – 50	15 – 189	1" FNPT	0.87	2.21	04016PN50-XXX

Table 2: Flow Ranges, Part Numbers and Orifice IDs for Polypropylene Instruments.

- Material compatibility

  It is recommended that connections be made with material similar to that of the flow sensor body to avoid potential corrosion effects.

	**CAUTION!**
	Over-tightening of metal fittings in polypropylene bodies can permanently damage the NPT threads and prevent the creation of a leak-free connection.

- Filtering

  Your circulating fluid may contain particles. While not essential to the operation of the flow sensor, it is good practice to filter your fluid. A 100-micron filter is often used to remove rust and other particles from the fluid. This can increase the lifetime of pumps and other fluid system components as well as reduce wear in the sensor.

  If fitted with a clear polysulfone or polycarbonate faceplate, your FluidVision 4000 instrument sensor may provide the only view you have of the cleanliness of your circulating fluid!

  Protection of the proper operation of your FluidVision 4000 instruments sensor also provides an additional level of protection to the more expensive equipment being cooled!

- Low liquid temperature

  Ice will form on the FluidVision 4000 instrument when liquid temperature is below 0°C. The NEMA 4 casing of the instrument will prevent moisture from entering the unit.

  Ice will prevent observation of the digital display. Remote mounting of the electronics unit with its digital display can provide a solution. Contact Proteus Technical Support for information.

- High liquid temperature

  If liquid temperature will exceed 85°C, the electronics must be located separate from the sensor unit. Contact Proteus Technical Support for information.

Making Plumbing Connections

CAUTION!

Before connecting your FluidVision 4000 instrument to your liquid supply line, verify that the normal flow rates expected are within the operating range of the sensor as listed in Tables 1 and 2.

EXTENDED USE ABOVE THE RATED MAXIMUM FLOW RATE OF THE INSTRUMENT WILL REDUCE ITS USEABLE LIFE!

The FluidVision 4000 instrument will NOT provide an output signal for flow rates more than 1.08 x the rated flow – see page 5 of this manual for details about the Over-Range Warning indicator.

WARNING!

Before connecting your FluidVision 4000 instrument to your liquid supply line, verify that the system's peak operating temperature will NOT exceed the measurement range of the instrument.

OPERATION ABOVE THE RATED TEMPERATURE CAN CAUSE FAILURE AND CREATE A HAZARD TO OPERATORS AND EQUIPMENT!

WARNING!

Before connecting your FluidVision 4000 instrument to your liquid supply line, verify that the system's peak operating pressure will NOT exceed the measurement range of the instrument.

OPERATION ABOVE THE RATED PRESSURE CAN CAUSE FAILURE AND CREATE A HAZARD TO OPERATORS AND EQUIPMENT!

CAUTION!

Do NOT use anaerobic pipe sealants such as Loctite® or Swak® brand sealants with FluidVision 4000 instruments fitted with polysulfone or polycarbonate faceplates.

The aggressive chemical nature of solvent vapors arising from these materials can cause cracking of the polysulfone or polycarbonate faceplates.

Use Teflon® (PTFE) tape or PTFE-based liquid sealants to provide leak-tight and lubricated junctions at all connection points.

Real-Tuff® and Hercules® are two of many suitable brands of PTFE-based sealants.

Making NPT pipe thread connections

Pipe threads sealed by metal-to-metal contact between male and female components are particularly prone to the damaging effects of galling, which occurs when two surfaces move against each other under pressure. When installing pipe threads, it is essential to use high-quality lubricating and sealing material.

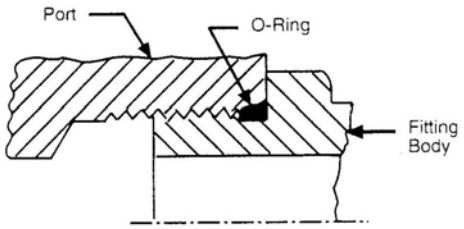
- Use Teflon tape or a PTFE-based liquid sealant to provide lubrication for the junction and a leak-tight connection at both the input and output connections.
- Do not over-tighten the connection. Refer to instructions for installation of the mating fittings for information on torque requirements.
- Leak testing of all connections in your flow circuit is recommended. Pressurizing the system with air and external testing with a dilute soap solution can help identify leaking connections.
- Plastic pipe or fitting should be used with polypropylene instruments. Improper connections of metal pipe or fittings into polypropylene flow sensors can cause stripping of the polypropylene threads and potentially split the flow sensor body.

Making SAE straight thread connections

With these connectors, an O-ring makes the seal while the threads hold the connecting assembly in place. Straight thread connections should receive a small amount of high-pressure lubricant before installation to prevent galling.

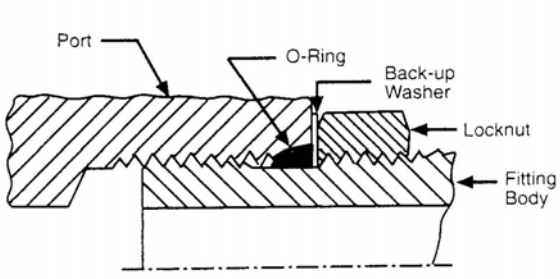
Non-adjustable fittings

1. Bring the non-adjustable fitting into firm contact with the face of the port using a wrench.
2. Check to be certain that the O-ring fits easily into the non-threaded receiving area of the port and is not pinched.



Adjustable fittings

1. Ensure that the locknut is positioned so that the back-up washer is in contact with the beginning of the threads farthest from the end of the fitting.
2. Screw the fitting into the port until the back-up washer contacts the sealing face.
3. Check to be certain that the O-ring fits easily into the non-threaded receiving area of the port, and is not pinched or damaged.
4. Unscrew the fitting a maximum of one turn to position it in the desired direction.
5. Tighten the locknut firmly against the back-up washer so that the fitting assembly is held securely in place.



Starting Up your FluidVision 4000 Instrument

1. Check for Leaks

- Turn ON the liquid supply to a low flow rate and check that ALL connections are watertight.

  Make adjustments to pipes or fittings to ensure that there are no leaks from the connection ports.

- Turn ON the liquid supply to its full pressure rating and again check that there are no leaks from the connections ports.

2. Eliminate Entrained Air from the Flow Sensor

Air bubbles entrained between the rotor arms reduce resistance to rotation of the rotor and allow the rotor to spin FASTER. Subsequently, the instrument will register a higher than actual flow rate until ALL air bubbles have been eliminated from the flow sensor.

- The air bubbles may disperse out of the flow sensor over several hours of operation.
- In a closed-loop system the air will eventually accumulate in the highest space in the system. Provision for collection and bleeding of the entrained air can be made during system design.
- The rate of dispersion is speeded by mounting the flow sensor so that the flow path is uppermost.
- Pulsing flow by rapidly increasing and decreasing flow through the system can assist by accelerating the bubbles towards the exit port.

Section 4: Electrical Installation

NOTE
Electrical installation should be performed by personnel familiar with the electrical circuit and control functions of the system in which the FluidVision 4000 instrument is to be installed.

CAUTION!
The electronics in a FluidVision 4000 instrument are sensitive to electrostatic discharge (ESD). Proper ESD precautions should be taken when handing the instrument's electronic components.

Section 4.1: Selecting Output Formats & Ranges

The output formats and ranges for each of flow rate, temperature and pressure are switch-selectable.

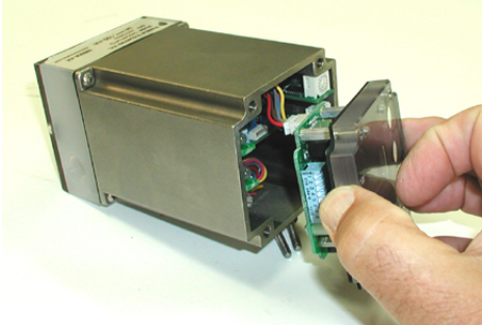
NOTE
Unless otherwise specified on your Purchase Order, all FluidVision 4000 instruments are shipped with 0–5 VDC output mode selected for all installed sensors.

To select an output mode of 0–10 VDC or 4–20 mA, proceed as follows:

1. Ensure that electrical power is OFF.
2. Remove the clear plastic window and its sealing gasket from the electronics unit.

   2.1. With a Philips head screwdriver, remove and retain the four (4) screws securing the window.

   2.2. Carefully remove the window and the attached digital display unit (if installed) to gain access to the electronics.



   2.3. Place the window and digital display so you can see and adjust the switches located on the edge of the electronic circuit boards.

NOTE
If the switches in your FluidVision 4000 instrument do NOT look like those in the photographs below, please contact Proteus Technical Support at (650) 964-4163 or tech@proteusind.com to obtain instructions for selecting output flow, temperature and pressure output ranges.

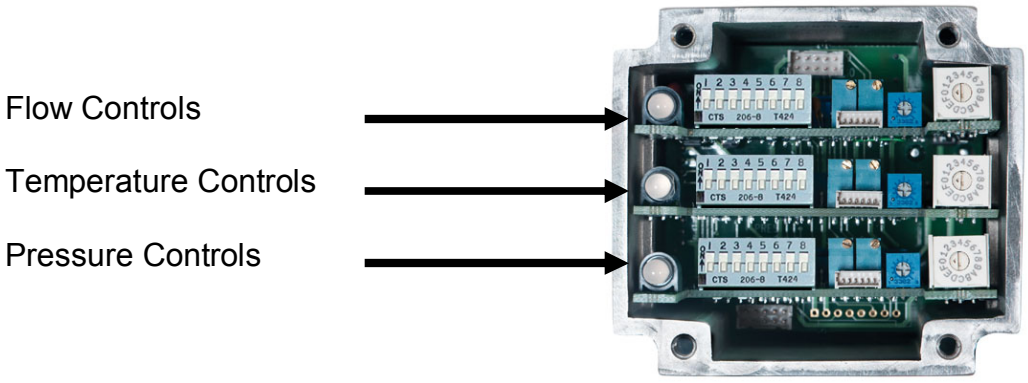


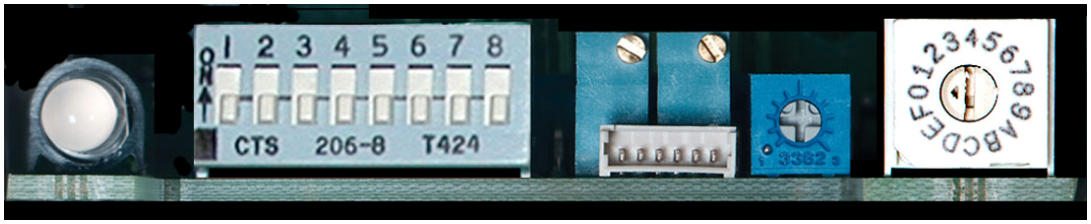
Figure 1: Location of flow, temperature and pressure controls

3. Setting the FLOW output

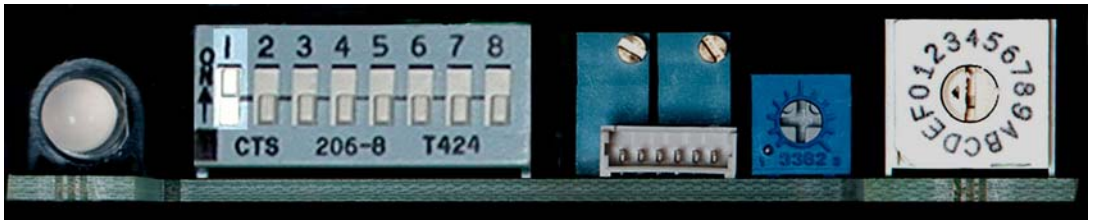
3.1. Identify the FLOW electronics board from Figure 1.

3.2. With a fine flat-head screwdriver, move switches 1, 2 and 3 down to the OFF position.

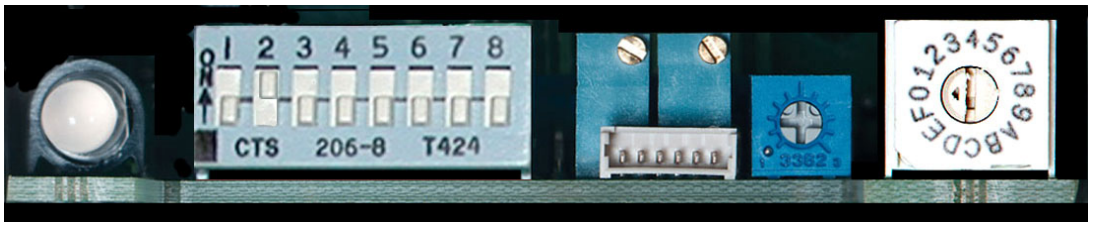
NOTE
Do NOT change the positions of switches 4 through 8!



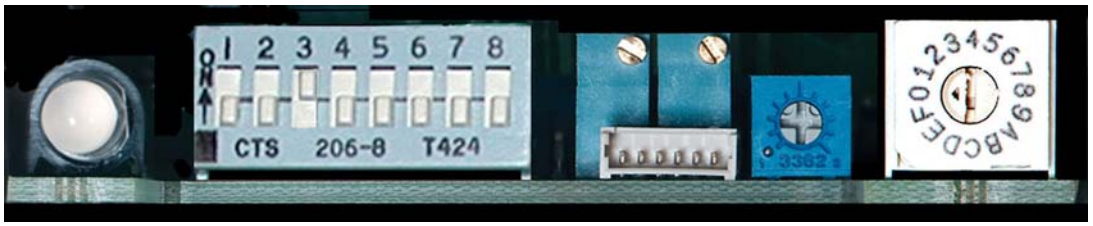
3.3. To select an output range of 0–5 VDC, move Switch 1 up to the ON position (default).



3.4. To select an output range of 0–10 VDC, move Switch 2 up to the ON position.



3.5. To select an output range of 4–20 mA, move Switch 3 up to the ON position.

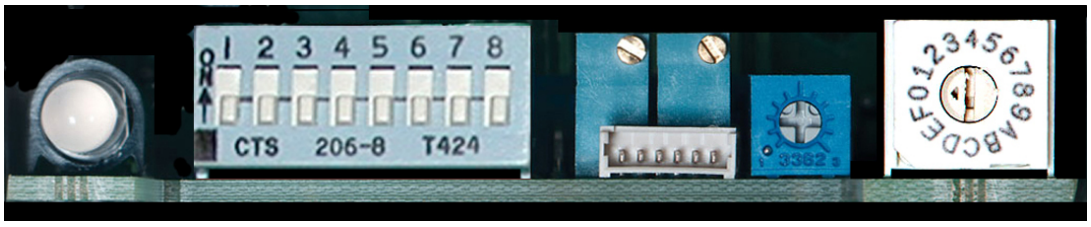


4. Setting the TEMPERATURE output

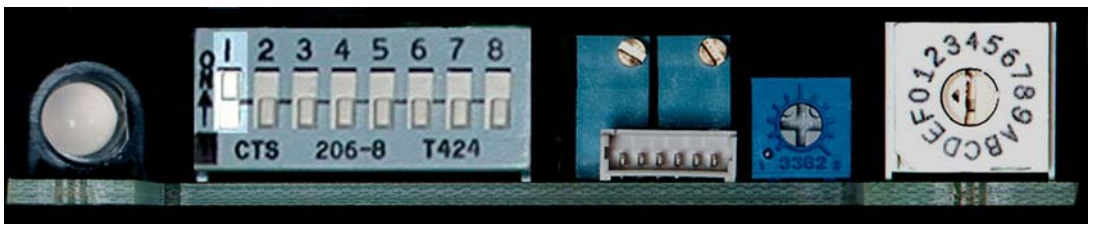
4.1. Identify the TEMPERATURE electronics board from Figure 1.

4.2. With a fine flat-head screwdriver, move switches 1, 2 and 3 down to the OFF position.

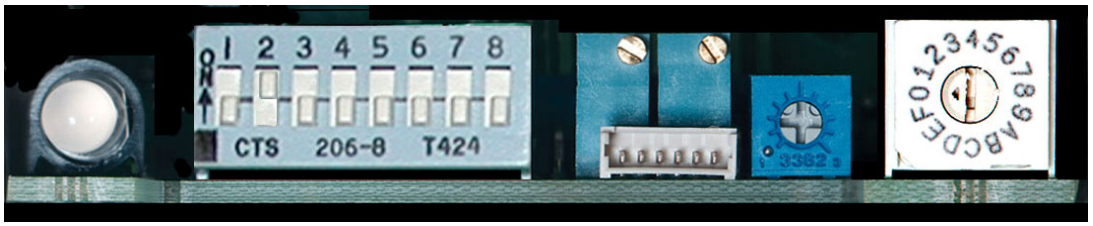
	NOTE
	Do NOT change the positions of switches 4 through 8!



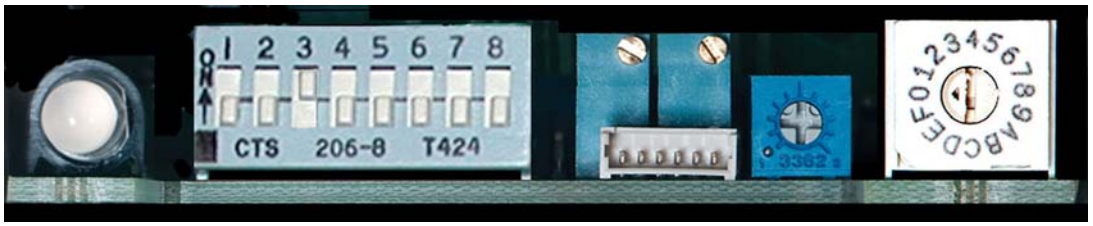
4.3. To select an output range of 0–5 VDC, move Switch 1 up to the ON position (default).



4.4. To select an output range of 0–10 VDC, move Switch 2 up to the ON position.



4.5. To select an output range of 4–20 mA, move Switch 3 up to the ON position.

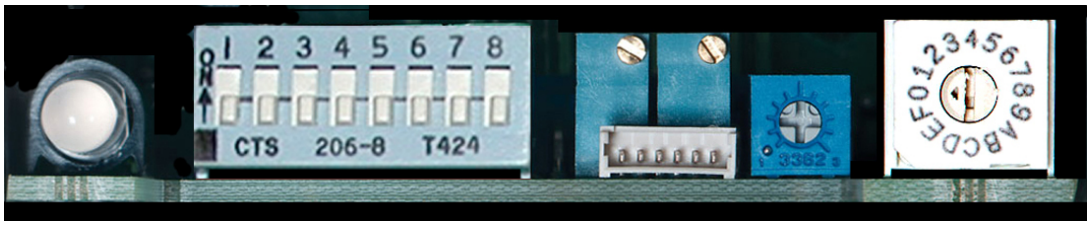


5. Setting the **PRESSURE** output

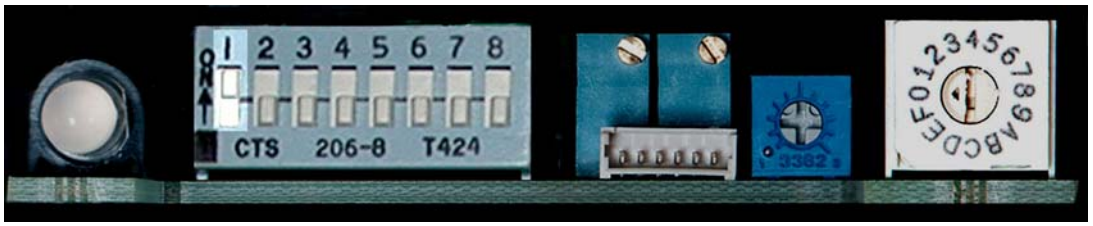
5.1. Identify the PRESSURE electronics board from Figure 1.

5.2. With a fine flat-head screwdriver, move switches 1, 2 and 3 down to the OFF position.

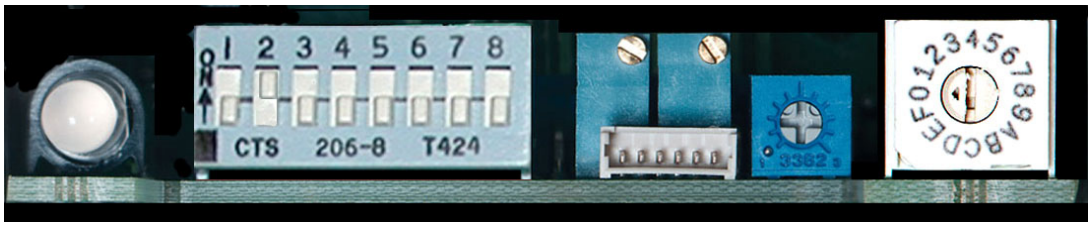
	NOTE
	Do NOT change the positions of switches 4 through 8!



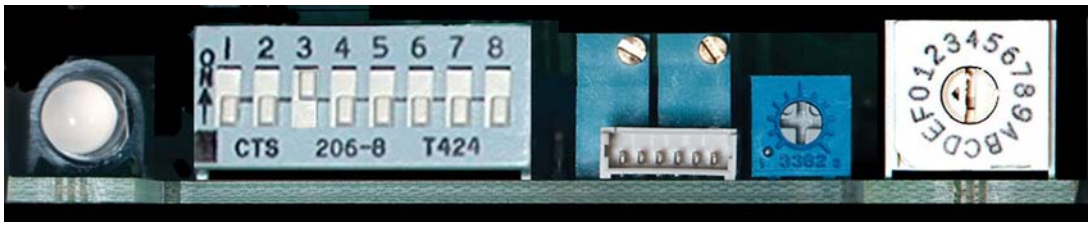
5.3. To select an output range of 0 – 5 VDC, move Switch 1 up to the ON position.



5.4. To select an output range of 0 – 10 VDC, move Switch 2 up to the ON position.



5.5. To select an output range of 4 – 20 mA, move Switch 3 up to the ON position.



6. If no other adjustments need to be made, replace and secure the clear plastic window (see page 25 of this manual) or proceed to Section 5 to select Flow, Temperature and Pressure Trip Points.

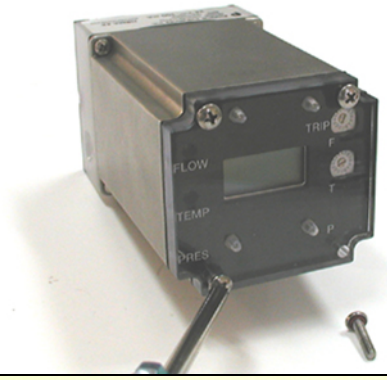
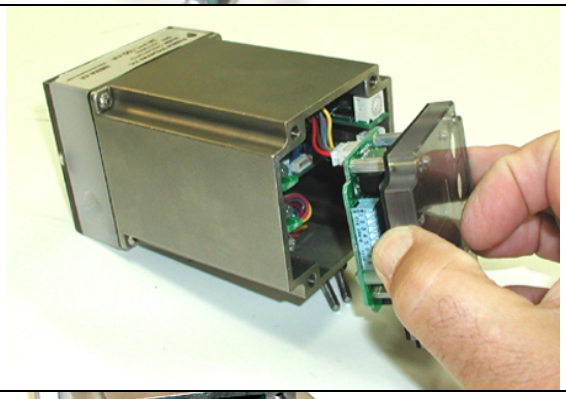
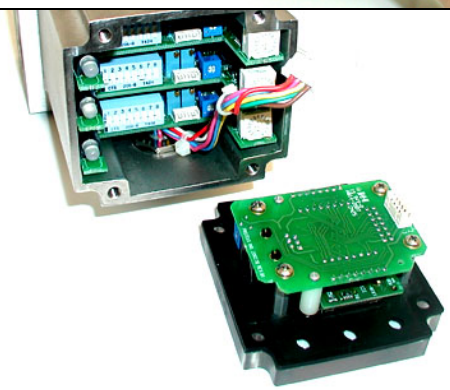
Section 4.2: Selecting Display Units

The optional digital display can present flow, temperature and pressure values in user-selected units. Unless otherwise stated on the Calibration Conformance document, the display will be factory-set as follows:

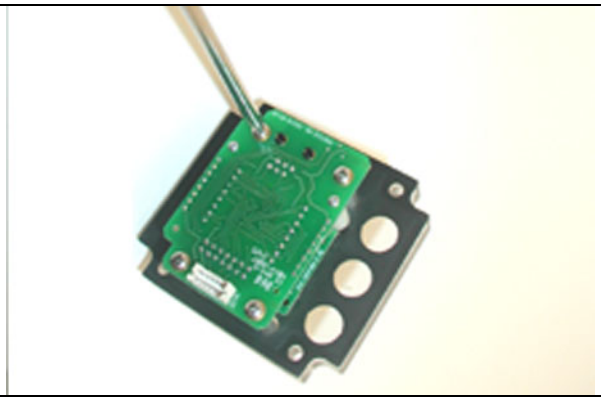
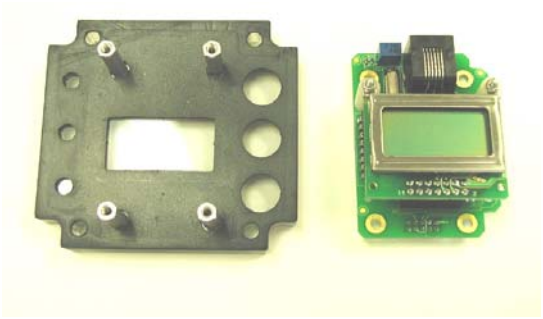
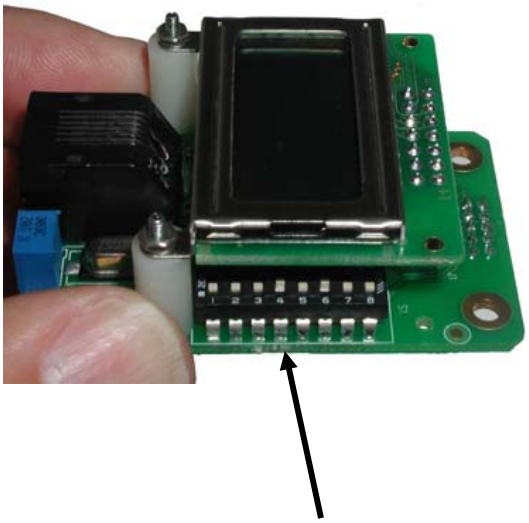
Parameter	Standard	Alternate
Flow Rate	GPM	LPM
Temperature	°C	°F
Pressure	psi	kPa

The selection of the flow units is controlled by changing the status of a toggle on switch S1 located underneath the display electronics module. The selection of temperature and pressure units is controlled by changing the status of two toggles on switch S2 located underneath the display electronics module.

1. Disconnect the display from the instrument

1.1. With a Philips head screwdriver, remove and retain the four (4) screws securing the window.	
1.2. Carefully remove the window and the attached digital display unit (if installed) to gain access to the electronics.	
1.3 Disconnect the cable linking the display unit to the electronics and place the display unit face down on a clean, smooth surface.	

2. Separate the display unit from the window

2.1 With a Philips head screwdriver, remove and retain the four (4) screws that attach the circuit board to the display assembly.	
2.2 Separate the display electronics assembly from the window and place on a **clean, flat surface**.	
To Display Flow in LPM: **Identify S1** S1 is the switch you see in front of you when you have the display module in this orientation with the black connector pointing to the left. **Identify Switch Position 4** The small toggle key should be in the ON condition (away from the edge). To change from display from GPM to LPM, use a small screwdriver or other probe to move the toggle towards you. **DO NOT CHANGE THE POSITION OF ANY OF THE OTHER TOGGLES ON S1.**	 **S1 Position 4**

To Display Temperature in °F:

Identify S2

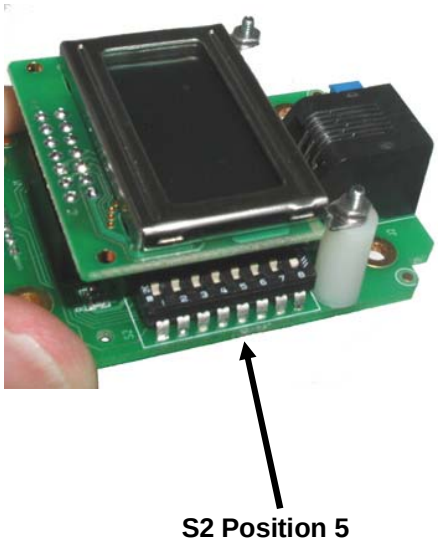
S2 is the switch you see in front of you when you have the display module in this orientation with the black connector pointing to the right.

Identify Switch Position 5

The small toggle key should be in the ON condition (away from the edge).

To change from display from °C to °F, use a small screwdriver or other probe to move the toggle towards you.

DO NOT CHANGE THE POSITION OF ANY OF THE OTHER TOGGLES ON S2.



S2 Position 5

To Display Pressure in kPa:

Identify S2

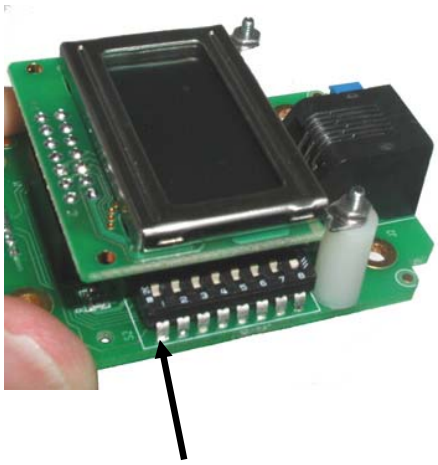
S2 is the switch you see in front of you when you have the display module in this orientation with the black connector pointing to the right.

Identify Switch Position 1

The small toggle key should be in the ON condition (away from the edge).

To change from display from psi to KPa, use a small screwdriver or other probe to move the toggle towards you.

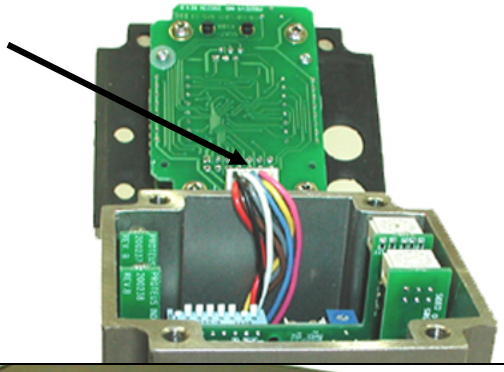
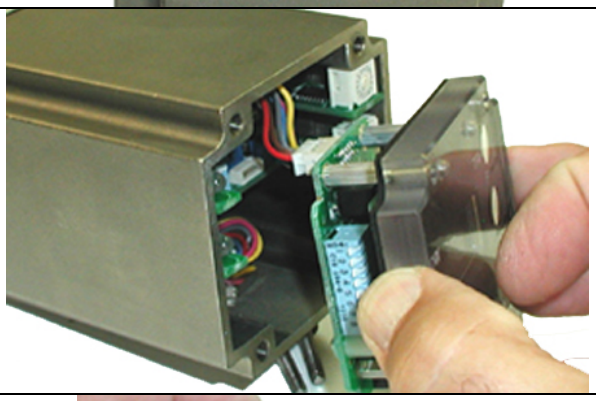
DO NOT CHANGE THE POSITION OF ANY OF THE OTHER TOGGLES ON S2.



S2 Position 1

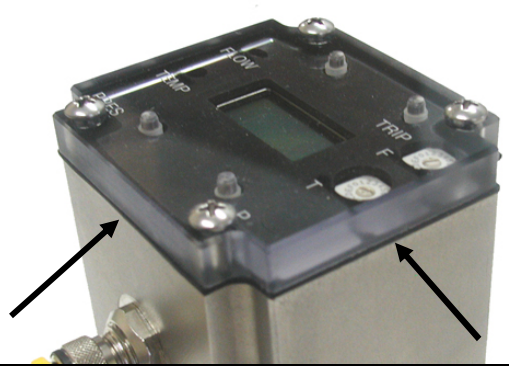
3.3 Reposition the display circuit board on the window assembly and refasten with the four (4) retained screws.

Replacing window and digital display

1. Ensure that the cable to the digital display is properly connected.	
2. Carefully replace the window and digital display (if installed) in the electronics housing.	
3. Align the window so the LED status lights and 16-position switches are visible through the holes in the sealing gasket.	
4. Replace and fully engage the four (4) screws. The screws should be secured with a torque of 10 ft-lbs. This is as much force as can normally be applied by tightening by hand.	

5. Observe the seal created when replacing the faceplate.

   Check that the gasket is uniformly compressed on all four sides of the window.



Section 4.3: Electrical Connections

Electrical input and outputs are made through an 8-core insulated cable.

Pin #	Color	Function
1	White	Common/Ground
2	Brown	24 VDC Supply Voltage
3	Green	Relay – Normally Open
4	Yellow	Relay – Common
5	Grey	Relay – Normally Closed
6	Pink	Flow Output
7	Blue	Temperature Output
8	Red	Pressure Output

Figure 2: Pin assignments and color codes for electrical input and outputs.

1. Locate the connection cable and separate the free ends of the connecting wires.
2. Turn the 24 VDC power source OFF.
3. Identify the conductors by their color and make connections to your control system using the information in Figure 2.
4. Turn the 24 VDC power source ON and confirm that there is 24 VDC between pins 1 and 2. If input voltage is in the range 21.6 to 26.4 VDC, unit will function correctly.

NOTE

A resettable thermal fuse will turn the FluidVision 4000 instrument OFF if the input voltage exceeds 29 VDC.

If this should occur, turn the power source OFF, wait a few minutes for the unit to cool to allow the fuse to reset, adjust the input voltage to 24 VDC and turn the power source back ON.

5. Turn 24 VDC power source OFF.
6. When all connections have been made, connect the cable to the instrument.
7. Make the securing screw finger-tight to ensure that a waterproof connection is achieved.

When all connections have been made, turn the 24 VDC power source ON.

Result:

- The status-indicating LEDs will turn ON.

  The LEDs may be RED, AMBER or GREEN depending on the measured flow rate, temperature and pressure and the factory-selected trip points for each of these parameters.

- If your FluidVision 4000 instrument is fitted with an optional digital display, the display will show measured values for flow, temperature and pressure sensors.

Section 5: Selecting Trip Points

Trip points for flow, temperature and pressure can be adjusted in steps of approximately 6% of their rated ranges with the adjustment of a 16-step switch. A single-turn potentiometer allows finer adjustment of trip points between adjacent positions of the 16-position switch.

There are two alternate methods of trip point adjustment:

1. Predictive Method – This method allows trip points to be selected without requiring adjustment of flow, temperature or pressure. Response curves and tables provide values to switch values to allow trip points to be selected without having to control coolant flow or to subject the cooled system to low flows or high temperature and pressure.

2. Measurement Method – This method requires that flow, temperature or pressure be adjustable to the required trip point values. Contact Proteus Technical Support for information on this method.

Setting the FLOW TRIP POINT

Tools Required: Medium Philips-head screwdriver to remove clear plastic window
Fine flat-head screwdriver to set switch and potentiometer adjustments
Flashlight to illuminate the switch and potentiometer during adjustment

CAUTION!

The electronics in a FluidVision 4000 instrument are sensitive to electrostatic discharge. Proper ESD precautions should be taken when handing the instrument's electronic components.

1. Identify the Flow Range of your FluidVision 4000 instrument from the product label or Calibration Certificate.

2. Refer to Table 4 on page 29 of this manual. Read ACROSS the top row of the table to locate the flow range of your instrument.

3. Read DOWN the table to identify your desired Trip Point flow rate.

   We suggest that you select a flow rate that is just HIGHER than your desired trip point flow.

4. Read ACROSS the row to identify the Switch Setting corresponding to this trip point.

   4.1. Make a note of this switch position – you will need this information in Step 8 below.

5. If necessary, remove the clear plastic window from the instrument as described on page 16 of this manual.

6. Identify the Flow Control Electronics board from Figure 2.

Figure 2: Flow electronics

7. Confirm that the FINE ADJUST POTENTIOMETER is in the 12 o'clock position.

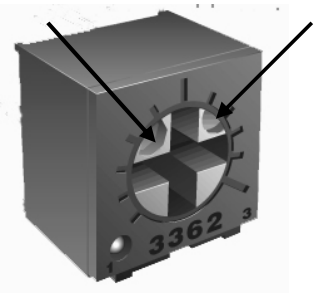


Figure 3: Fine adjustment potentiometer

   7.1. If necessary, use a flashlight and magnifying glass to view the face of the fine adjustment potentiometer.

   7.2. If necessary, use a fine screwdriver to rotate the dial of the potentiometer to the position shown in Figure 3.

   The arrows point to small insets in the dial. These insets should be at the 2 and 10 o'clock positions.

8. Unless otherwise specified, the 16-position switch is shipped with the alignment arrow in position 3.

   8.1. Identify the alignment arrow on the 16-position switch.

   8.2. Insert the fine screwdriver into the slot and rotate the switch so that the alignment arrow is pointing towards the switch position identified in Step 4 above.

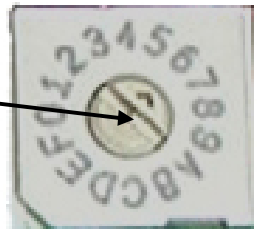


Figure 4: 16-position switch

9. Continue to select Temperature and Pressure Trip Points
   - OR -
   Refit the clear plastic window to the instrument as described in on page 25 of this manual.

Identifying the Flow Trip Point Switch Setting

1. Look ACROSS the Flow Range row to locate the flow range of your instrument.
2. Look DOWN the Flow Range column to locate a trip point equal to or just higher than your desired trip point.
3. Look back ACROSS the row to identify the Switch Setting corresponding to the selected trip point flow.

FLOW RANGES AND TRIP POINT FLOWS (GPM)												
Flow Range	0.6	1.4	2.5	4.5	9	10	14	16	19	40	50	60
Switch Setting												
0	0.04	0.09	0.16	0.28	0.56	0.63	0.88	1.0	1.2	2.5	3.1	3.8
1	0.08	0.18	0.31	0.56	1.1	1.3	1.8	2.0	2.4	5.0	6.3	7.5
2	0.11	0.26	0.47	0.84	1.7	1.9	2.6	3.0	3.6	7.5	9.4	11.3
3	0.15	0.35	0.63	1.1	2.3	2.5	3.5	4.0	4.8	10.0	12.5	15.0
4	0.19	0.44	0.78	1.4	2.8	3.1	4.4	5.0	5.9	12.5	15.6	18.8
5	0.23	0.53	0.94	1.7	3.4	3.8	5.3	6.0	7.1	15.0	18.8	23
6	0.26	0.61	1.1	2.0	3.9	4.4	6.1	7.0	8.3	17.5	22	26
7	0.30	0.70	1.3	2.3	4.5	5.0	7.0	8.0	9.5	20	25	30
8	0.34	0.79	1.4	2.5	5.1	5.6	7.9	9.0	10.7	23	28	34
9	0.38	0.88	1.6	2.8	5.6	6.3	8.8	10.0	11.9	25	31	38
A	0.41	0.96	1.7	3.1	6.2	6.9	9.6	11.0	13.1	28	34	41
B	0.45	1.0	1.9	3.4	6.8	7.5	10.5	12.0	14.3	30	38	45
C	0.49	1.1	2.0	3.7	7.3	8.1	11.4	13.0	15.4	33	41	49
D	0.53	1.2	2.2	3.9	7.9	8.8	12.3	14.0	16.6	35	44	53
E	0.56	1.3	2.3	4.2	8.4	9.4	13.1	15.0	17.8	38	47	56
F	0.60	1.4	2.5	4.5	9.0	10	14.0	16.0	19.0	40	50	60

FLOW RANGES AND TRIP POINT FLOWS (LPM)												
Flow Range	2.3	5.3	9.5	17	34	38	53	61	72	151	189	227
Switch Setting												
0	0.14	0.33	0.59	1.1	2.1	2.4	3.3	3.8	4.5	9.5	11.8	14.2
1	0.28	0.66	1.2	2.1	4.3	4.7	6.6	7.6	9.0	18.9	24	28
2	0.43	0.99	1.8	3.2	6.4	7.1	9.9	11.4	13.5	28	35	43
3	0.57	1.3	2.4	4.3	8.5	9.5	13.2	15.1	18.0	38	47	57
4	0.71	1.7	3.0	5.3	10.6	11.8	16.6	18.9	22	47	59	71
5	0.85	2.0	3.5	6.4	12.8	14.2	20	23	27	57	71	85
6	0.99	2.3	4.1	7.5	14.9	16.6	23	26	31	66	83	99
7	1.1	2.6	4.7	8.5	17.0	18.9	26	30	36	76	95	114
8	1.3	3.0	5.3	9.6	19.2	21	30	34	40	85	106	128
9	1.4	3.3	5.9	10.6	21	24	33	38	45	95	118	142
A	1.6	3.6	6.5	11.7	23	26	36	42	49	104	130	156
B	1.7	4.0	7.1	12.8	26	28	40	45	54	114	142	170
C	1.8	4.3	7.7	13.8	28	31	43	49	58	123	154	185
D	2.0	4.6	8.3	14.9	30	33	46	53	63	132	166	199
E	2.1	5.0	8.9	16.0	32	35	50	57	67	142	177	213
F	2.3	5.3	9.5	17.0	34	38	53	61	72	151	189	227

Table 4: Flow Trip Point selection table

Setting the TEMPERATURE TRIP POINT

Tools Required: Medium Philips-head screwdriver to remove clear plastic window
Fine flat-head screwdriver to set switch and potentiometer adjustments
A flashlight to illuminate switch and potentiometer during adjustment

CAUTION!

The electronics in a FluidVision 4000 instrument are sensitive to electrostatic discharge (ESD). Proper ESD precautions should be taken when handing the instrument's electronic components.

Identify the Temperature Range of your FluidVision 4000 instrument from the Calibration Certificate and from the setting of the temperature range offset switch (see page 19 of this manual).

1. Refer to Table 5 on page 31 of this manual.

   Read ACROSS the top row of the table to locate the temperature range of your instrument.

2. Read DOWN the table to identify your desired Trip Point temperature.

NOTE

It is suggested that you select a temperature that is just BELOW your desired trip point temperature.

3. Read ACROSS the row to identify the Switch Setting corresponding to this trip point.
   3.1. Make a note of this switch position – you will need this information in Step 8 below.

4. If necessary, remove the clear plastic window from the instrument as described on page 16.

5. Identify the Temperature Control Electronics board from Figure 5.

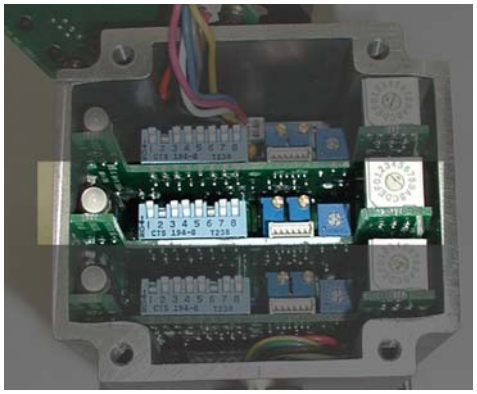


Figure 5: Temperature electronics

6. Confirm that the FINE ADJUST POTENTIOMETER is in the 12 o'clock position.

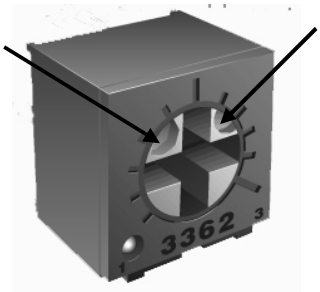


Figure 6: Fine adjustment potentiometer

   6.1. If necessary, use a flashlight and magnifying glass to view the face of the fine adjustment potentiometer.

   6.2. If necessary use a fine screwdriver to rotate the dial of the potentiometer to the position shown in Figure 6.

   The arrows point to small insets in the dial.

   6.3. These insets should be at the 2 and 10 o'clock positions.

7. Unless otherwise specified, the 16-position switch is shipped with the alignment arrow in position C.
   7.1. Identify the alignment arrow on the 16-position switch.
   7.2. Insert the fine screwdriver into the slot and rotate the switch so that the alignment arrow is pointing towards the switch position identified in Step 3 above.

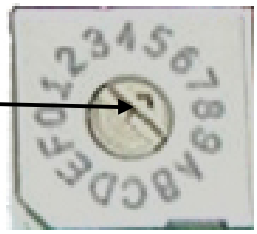


Figure 7: 16-position switch

8. Continue to select Pressure and Flow Trip Points
   - OR -
   Refit the clear plastic window to the instrument as described on page 25 of this manual.

How to Identify the Temperature Switch Setting

1. Look ACROSS the Temperature Range row to locate the temperature range of your instrument.
2. Look DOWN the Temperature Range column to locate a trip point equal to or just LOWER than your desired trip point.
3. Look back ACROSS the row to identify the Switch Setting corresponding to the selected trip point temperature.

NOTE: Refer to point 5 on page 19 of this manual to select a temperature range offset of -50°C.

TEMPERATURE RANGES and TRIP POINT TEMPERATURES (°C)					
Temperature Range	**-40 to 50**	**-40 to 25**	**0 to 75**	**0 to 100**	**0 to 140**
Polypropylene flow bodies with clear plastic faceplates					
Brass & stainless steel flow bodies with clear plastic faceplates					
Brass & stainless steel flow bodies with brass or stainless steel faceplates					
Switch Setting					
0	**Under Range**		5	6	9
1	-38	-41	9	13	19
2	-31	-36	14	19	28
3	-25	-31	19	25	38
4	-19	-27	23	31	47
5	-13	-22	28	38	56
6	-6	-17	33	44	66
7	0	-13	38	50	75
8	6	-8	42	56	84
9	13	-3	47	63	94
A	19	2	52	69	103
B	25	6	56	75	113
C	31	11	61	81	122
D	38	16	66	88	131
E	44	20	70	94	140
F	50	25	75	100	**Over Range**

TEMPERATURE RANGES and TRIP POINT TEMPERATURES (°F)					
Temperature Range	**-40 to 122**	**-40 to 77**	**32 to 167**	**32 to 212**	**32 to 284**
Polypropylene flow bodies with clear plastic faceplates					
Brass & stainless steel flow bodies with clear plastic faceplates					
Brass & stainless steel flow bodies with brass or stainless steel faceplates					
Switch Setting					
0	**Under Range**		41	42	48
1	-36	-42	48	55	66
2	-24	-33	57	66	82
3	-13	-24	66	77	100
4	-2	-17	73	88	117
5	9	-8	82	100	133
6	21	1	91	111	151
7	32	9	100	122	167
8	43	18	108	133	183
9	55	27	117	145	201
A	66	36	126	156	217
B	77	43	133	167	235
C	88	52	142	178	251
D	100	61	151	190	268
E	111	68	158	201	284
F	122	77	167	212	**Over Range**

Table 5: Temperature Trip Point selection table

Setting the PRESSURE TRIP POINT

Tools Required: Medium Philips-head screwdriver to remove clear plastic window
Fine flat-head screwdriver to set switch and potentiometer adjustments
Flashlight to illuminate the switch and potentiometer during adjustment

CAUTION!

The electronics in a FluidVision 4000 instrument are sensitive to electrostatic discharge (ESD). Proper ESD precautions should be taken when handing the instrument's electronic components.

1. Identify the Pressure Range of your FluidVision 4000 instrument from the Calibration Certificate.

2. Refer to Table 6 on page 33 of this manual. Read ACROSS the top row of the table to locate the pressure range of your instrument.

3. Read DOWN the table to identify your desired Trip Point pressure.

NOTE

It is suggested that you select a pressure that is just BELOW your desired trip point pressure.

4. Read ACROSS the row to identify the Switch Setting corresponding to this trip point.
   4.1. Make a note of this switch position – you will need this information in Step 8 below.

5. If necessary, remove the clear plastic window from the instrument described on page 16 of this manual.

6. Identify the Pressure Control Electronics board from Figure 8.

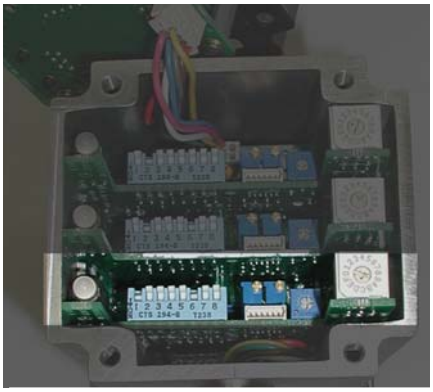


Figure 8: Pressure electronics.

7. Confirm that the FINE ADJUST POTENTIOMETER is in the 12 o'clock position.

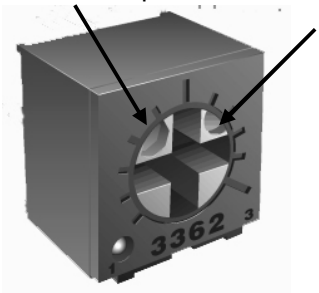


Figure 9: Fine adjustment potentiometer

   7.1. If necessary, use a flashlight and magnifying glass to view the face of the adjustment potentiometer.

   7.2. If necessary, use a fine screwdriver to rotate the dial of the potentiometer to the position shown in Figure 9.

   7.3. The arrows point to small insets in the dial. These insets should be at the 2 and 10 o'clock positions.

8. Unless otherwise specified, the 16-position switch is shipped with the pointer arrow in position C.
   8.1. Identify the alignment arrow on the 16-position switch.
   8.2. Insert the fine screwdriver into the slot and rotate the switch so the alignment arrow is pointing towards the switch position identified in Step 4 above.

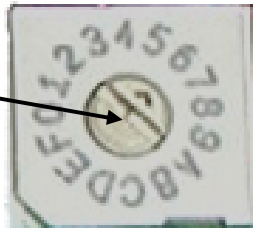


Figure 10: 16-position switch

9. Continue to selecting Temperature and Flow Trip Points
   - OR -
   Refit the clear plastic window to the instrument as described on page 25 of this manual.

Identifying the Pressure Switch Setting

1. Look ACROSS the Pressure Range row to locate the pressure range of your instrument.

2. Look DOWN the Pressure Range column to locate a trip point equal to or just LOWER than your desired trip point.

3. Look back ACROSS the row to identify the Switch Setting corresponding to the selected trip point pressure.

PRESSURE RANGES and TRIP POINT PRESSURES (psi)			
Pressure Range	**0 to 70**	**0 to 100**	**0 to 250**
Polypropylene flow bodies with clear plastic faceplates			
Brass & stainless steel flow bodies with clear plastic faceplates			
Brass & stainless steel flow bodies with brass or stainless steel faceplates			
Switch Setting			
0	4	6	16
1	9	13	31
2	13	19	47
3	18	25	63
4	22	31	78
5	26	38	94
6	31	44	109
7	35	50	125
8	39	56	141
9	44	63	156
A	48	69	172
B	53	75	188
C	57	81	203
D	61	88	219
E	66	94	234
F	70	100	250

PRESSURE RANGES and TRIP POINT PRESSURES (kPa)			
Pressure Range	**0 to 483**	**0 to 689**	**0 to 1724**
Polypropylene flow bodies with clear plastic faceplates			
Brass & stainless steel flow bodies with clear plastic faceplates			
Brass & stainless steel flow bodies with brass or stainless steel faceplates			
Switch Setting			
0	28	41	110
1	62	90	214
2	90	131	324
3	124	172	434
4	152	214	538
5	179	262	648
6	214	303	751
7	241	345	862
8	269	386	972
9	303	434	1076
A	331	476	1186
B	365	517	1296
C	393	558	1400
D	421	607	1510
E	455	64	1613
F	483	689	1724

Table 6: Pressure Trip Point selection table

Section 6: Cleaning & Maintenance

Maintenance of FluidVision 4000 instruments is normally limited to cleaning the chamber in which the rotor spins and annual recalibration.

Cleaning FluidVision 4000 Instruments

The frequency of cleaning will vary with the type of fluid being run through the instrument and the cleanliness of the fluid. In most cases, annual cleaning immediately prior to recalibration is sufficient.

Tools required:

Wrenches to disconnect the instrument from your flow circuit
A flat-head screwdriver to remove screws securing the faceplate to the flow sensor
A soft cleaning cloth, alcohol, water or a dilute detergent solution to clean the flow chamber

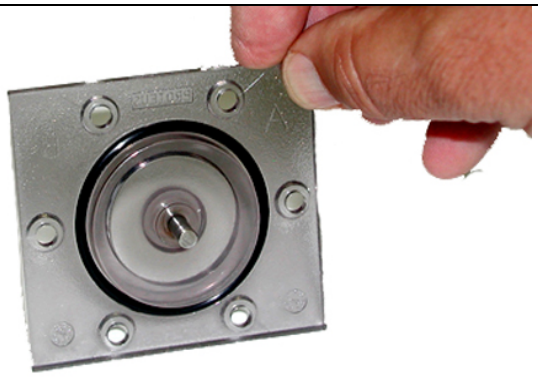
Replacement parts required:

Rebuild kits are available to replace the components that are prone to wear and degradation during normal operation. Should your instrument be operating with dirty coolants, or if there are solids suspended in the coolant, it is possible that the rotor and stainless steel shaft will need replacement after 12 months of normal operation. If silica or sand particles are in the coolant, rotor and shaft wear can be greatly accelerated!

	NOTE
ⓘ	**Check instrument flow calibration!**

Flow response will change as the rotor and its bearing shaft wear. Replacing these components will enhance the flow response of the instrument. Flow calibration is required to restore the validity of the instrument's flow measuring capability – see Section 7.

Cleaning FluidVision 4000 Instruments with Plastic Faceplates	
1 Turn OFF the 24 VDC power and disconnect the power/interface cable from the instrument. Turn OFF liquid flow. If necessary, close off flow above and below the flow sensor and remove the instrument from your system. Place the instrument on a clean surface with the faceplate of the flow sensor visible.	
2. Remove and retain the six (6) screws and locking washers securing the faceplate.	

Cleaning FluidVision 4000 Instruments with Plastic Faceplates (Continued)	
3. Remove the faceplate from the flow sensor body.	
4. Remove the rotor and stainless steel shaft from the flow cavity. Remove the O-ring from the faceplate	
5. Using a soft cloth dampened with water, alcohol or a dilute detergent solution, remove any debris and dirt from the rotor, the stainless steel shaft, the inside surfaces of faceplate and the surfaces of the flow cavity	
6. Inspect the bearing surface of the rotor. If the bearing surface is worn or not round, replace the rotor. Inspect the stainless steel shaft. If the shaft shows signs of scoring or other wear, replace the stainless steel shaft or the whole faceplate assembly.	
7. Inspect the O-ring to ensure that it is not brittle, cracked or otherwise damaged. If necessary, replace with a #132 O-ring of a material compatible with the liquid being run through the flow sensor. Position the O-ring on the inner rim of the faceplate.	

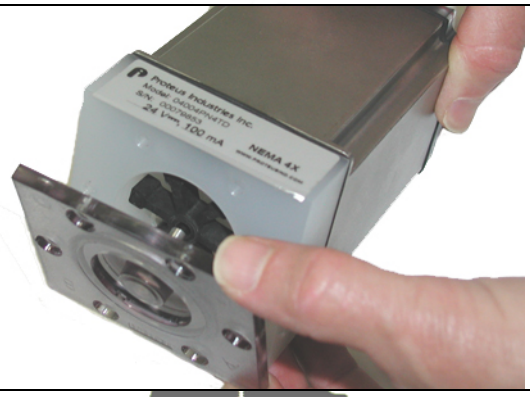
Cleaning FluidVision 4000 Instruments with Plastic Faceplates (Continued)

8. Place the rotor in the flow cavity.

Note: For 04004XXX, 04006XXX and 04008XXX instruments, position the faceplate to situate the shaft in the rotor.

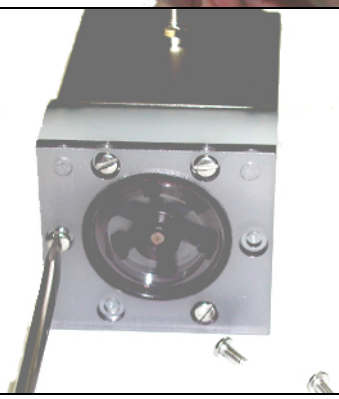
The stainless steel shaft for 4012XXX instruments is asymmetric. Place the LONG end of the shaft through the rotor axis.

The faceplate cannot be sealed if the shaft is not inserted correctly.



9. Position the faceplate so that the holes in the faceplate are aligned with the screw holes in the front of the flow sensor body. Replace the six (6) securing screws.

Tighten the screws to a torque of 10 in-lbs (hand-tighten with a normal screwdriver).



10. Reconnect the FluidVision 4000 instrument to your system. Replace Teflon tape or thread lubricant at all liquid connections.

Turn ON liquid flow and check for leaks at the faceplate and connection ports.

Tighten all connections as required to eliminate leaks.

Eliminate air bubbles from the flow sensor chamber.

11. Reconnect the power/interface to the instrument.

Turn ON the 24 VDC power supply.

Confirm that flow rate, temperature and pressure indications are normal.

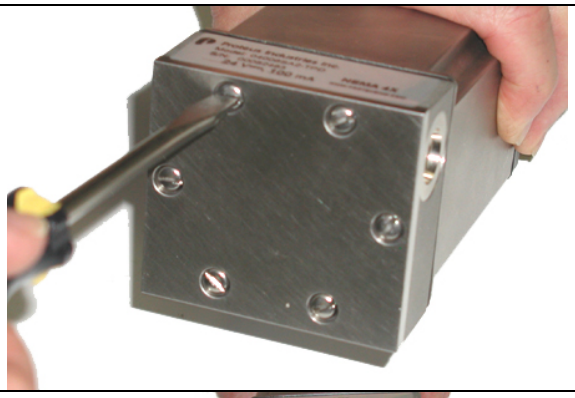
Cleaning FluidVision 4000 Instruments with Metal Faceplates

1. Turn OFF the 24 VDC power and disconnect the power/interface cable from the instrument.

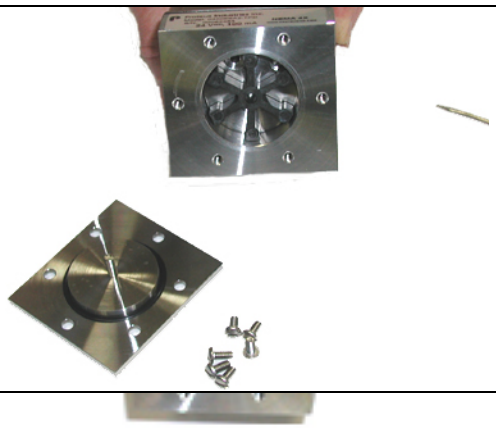
   Turn OFF liquid flow. If necessary, close off flow above and below the flow sensor and remove the instrument from your system.

   Place the instrument on a clean surface with the faceplate of the flow sensor visible.

2. Remove and retain the six (6) screws and locking washers securing the faceplate.



3. Remove the faceplate from the flow sensor body.

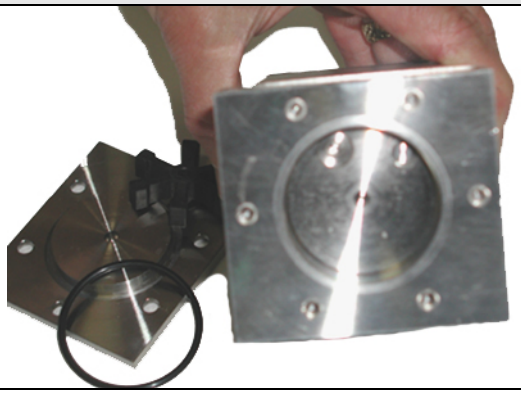


4. Remove the rotor and stainless steel shaft from the flow cavity.

   Remove the O-ring from the faceplate

Cleaning FluidVision 4000 Instruments with Metal Faceplates (Continued)

5. Using a soft cloth dampened with water, alcohol or a dilute detergent solution, remove any debris and dirt from the rotor, the stainless steel shaft, the inside surfaces of faceplate and the surfaces of the flow cavity



6. Inspect the bearing surface of the rotor.

   If the bearing surface is worn or not round, replace the rotor.

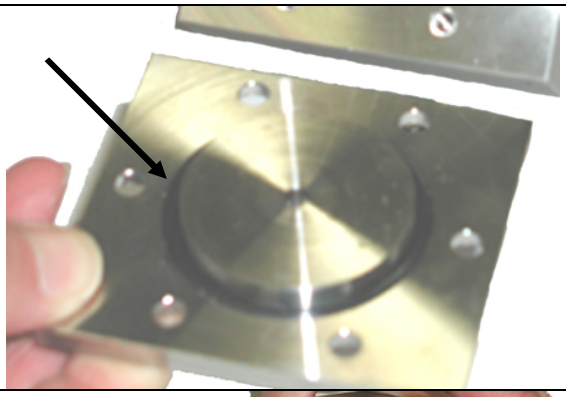
   Inspect the stainless steel shaft.

   If the shaft shows signs of scoring or other wear, replace the stainless steel shaft or the whole faceplate assembly.

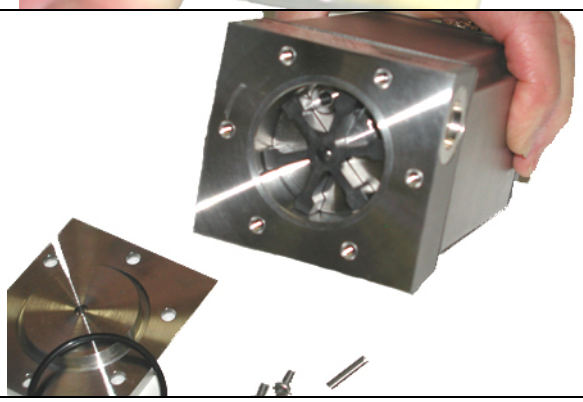
7. Inspect the O-ring to ensure that it is not brittle, cracked or otherwise damaged.

   If necessary replace with a #132 O-ring of a material compatible with the liquid being run through the flow sensor.

   Position the O-ring on the inner rim of the faceplate.



3. Place the rotor in the flow cavity.

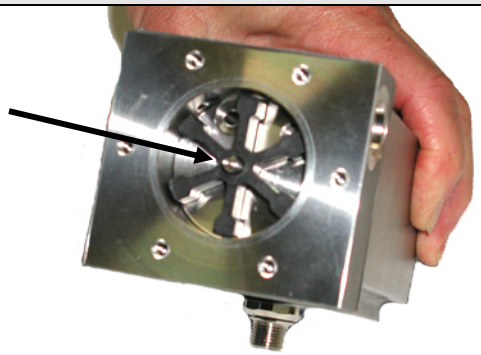


Cleaning FluidVision 4000 Instruments with Metal Faceplates (Continued)

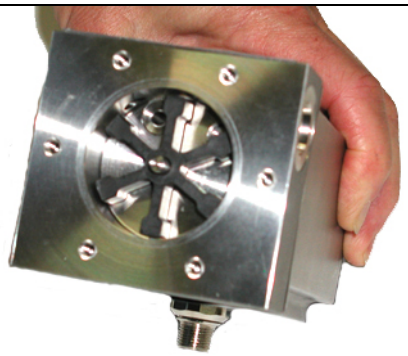
Position the shaft in the rotor.

Note: The stainless steel shaft for 4012XXX instruments is asymmetric. Place the LONG end of the shaft through the rotor axis.

The faceplate cannot be sealed if this shaft is not inserted correctly.

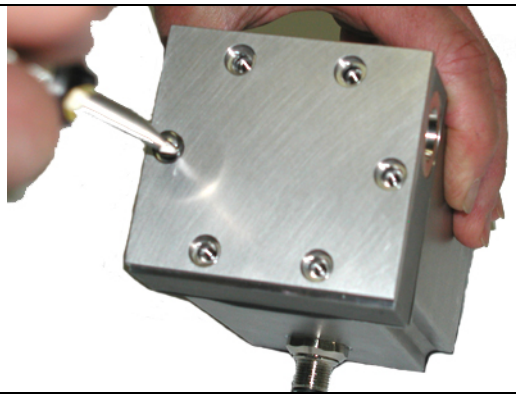


9. Position the faceplate so that the holes in the faceplate are aligned with the screw holes in the front of the flow sensor body.



Place a locking washer in each of the screw locations and replace the six (6) securing screws.

Tighten the screws to a torque of 10 in-lbs (hand tight with a normal screwdriver).



10. Reconnect the FluidVision 4000 instrument to your system. Replace the Teflon tape or thread lubricant at all liquid connections.

    Turn ON liquid flow and check for leaks at the faceplate and connecting ports.

    Tighten all connections as required to eliminate leaks.

    Eliminate air bubbles from the flow sensor chamber.

11. Reconnect the power/interface cable to the instrument.

    Turn ON the 24 VDC power supply.

    Confirm that flow rate, temperature and pressure indications are normal.

Section 7: Calibration & Recalibration

NOTE
FluidVision 4000 instruments are calibrated by Proteus with water temperatures ranging from 22° to 28°C. **Changes in fluid type can alter the calibrated flow response of the sensor. Large changes in liquid temperature can alter the calibrated flow response of the sensor.** Please contact Proteus Technical Support if a specialized calibration is needed.

NOTE
As described in the Plumbing Connections section on pages 13-14 of this manual, the flow response of FluidVision 4000 instruments may be affected by the way in which the sensor is connected to your system.

- FluidVision 4000 instruments are calibrated by adjusting amplifier response at selected high and low flow rates.

  Unless otherwise requested, this calibration is made with straight pipe connections.

- Customized calibration procedures can be performed to change the flow rate corresponding to 5 VDC for fluids other than water and with connections with internal diameters less than those used in the flow sensors. (See Tables 1 and 2 on page 11 of this manual).

Recalibration

As with any process-monitoring device, the calibration response of FluidVision 4000 instruments should be checked at 12-month intervals and recalibrated as required. Recalibration may be accomplished in either of two ways:

Calibration by Proteus

To obtain a price quotation and a Return Material Authorization (RMA) number for the recalibration of your FluidVision 4000 instrument, contact Proteus Sales at (650) 964-4163 or sales@proteusind.com.

When received at Proteus, your instrument will be recalibrated as follows:

- Response of the flow sensor will be measured and recorded in the as-received state.
- The rotor, stainless steel shaft and sealing O-ring will be replaced.
- The flow cavity will be cleaned and the device reassembled.
- The flow-measuring electronics will be recalibrated against controlled reference standards.

- Response of the temperature sensor will be measured and recorded in the as-received state.
- The temperature-measuring electronics will be calibrated against controlled reference standards.

- Response of the pressure sensor will be measured and recorded in the as-received state.
- The pressure-measuring electronics will be calibrated against controlled reference standards.

- A new calibration certificate will be issued.
- A new calibration label will be attached to the FluidVision 4000 instrument.

Calibration by another laboratory

The calibrating laboratory will issue certificates and labels identifying the calibration status of your FluidVision 4000 instrument. Your selected calibration laboratory should contact Proteus Technical Support to obtain detailed calibration procedures.

Section 8: Flow, Temperature & Pressure Response Curves

The data listed below is typical of each type of product. The calibration values of a single instrument are recorded on the Certificate of Conformance provided with each FluidVision 4000 instrument. An electronic copy of this information can be provided.

Contact Proteus Technical Support at (650) 964-4163 or tech@proteusind.com with the Model Number and Serial Number of the instrument for which the calibration values are required.

Flow Ranges		Connection	Part Numbers		
GPM	LPM		Brass	Stainless Steel	Polypropylene
0.06 – 0.6	0.2 – 2.2	¼" FNPT	04004BN06-XXX	04004SN06-XXX	04004PN06-XXX
0.1 – 1.4	0.4 – 5.3	¼" FNPT	04004BN1-XXX	04004SN1-XXX	04004PN1-XXX
0.2 – 2.5	0.8 – 9.5	¼" FNPT	04004BN2-XXX	04004SN2-XXX	04004PN2-XXX
0.2 – 2.5	0.8 – 9.5	9/16 -18 SAE		04006SA2-XXX	
0.3 – 4.5	1.1 – 17	¼" FNPT	04004BN4-XXX	04004SN4-XXX	04004PN4-XXX
0.3 – 4.5	1.1 – 17	9/16 -18 SAE		04006SA4-XXX	
0.6 – 9.0	2.2 – 34	⅜" FNPT	04006BN9-XXX	04006SN9-XXX	
0.6 – 10	2.2 – 38	⅜" FNPT			04006PN10-XXX
0.8 – 10	3.0 – 38	¾ -16 SAE		04008SA10-XXX	
1.0 – 14	3.8 – 53	½" FNPT	04008BN14-XXX	04008SN14-XXX	04008PN14-XXX
1.2 – 16	4.5 – 60	¾" FNPT	04012BN16-XXX	04012SN16-XXX	
1.2 – 16	4.5 – 60	1 1/16 -12 SAE		04012SA16-XXX	
1.5 – 19	5.7 – 72	¾" FNPT			04012PN19-XXX
3.0 – 40	11 – 151	¾" FNPT	04012BN40-XXX	04012SN40-XXX	
4.0 – 40	15 – 151	1" FNPT	04016BN40-XXX	04016SN40-XXX	
4.0 – 40	15 – 151	1 5/16 -12 SAE		04016SA40-XXX	
4.0 – 50	15 – 189	1" FNPT			04016PN50-XXX
5.0 – 60	19 – 227	1" FNPT	04016BN60-XXX	04016SN60-XXX	

Section 9: Dimensions & Outline Drawings

Outline and 3-dimensional drawings of all FluidVision 4000 instruments are available on the Proteus Industries website at www.proteusind.com/4000.

If you are unable to access this information, please contact Proteus Technical support at (650) 964-4163 or tech@proteusind.com to obtain the needed information.

Information in this document was correct at the time of printing; however, specifications are subject to change as Proteus Industries' continuous improvement processes establish new capabilities.