



500 SERIES

METERING FLOW SWITCHES

TECHNICAL REFERENCE MANUAL

Proteus 5-Year Warranty

A full statement of our warranty is available on our website at www.proteusind.com/warranty/.

Table of Contents

	Page
1. Introduction	3
2. Features and functions	3
3. How the flow sensor works	6
4. Specifications and performance	7
5. Product certifications	8
6. Installation	8
7. Selecting Trip Points	12
8. Measuring Flow Rate	16
9. Digital Displays	17
10. Cleaning and Maintenance	18
11. Calibration & Recalibration	21
12. Replacement Parts	22

Section 1 Introduction

500 Series Metering Flow Switches have been created to provide a more effective monitoring and control capability for applications in which liquid flow rates up to 4.5 GPM (17 LPM) must be monitored and controlled over extended temperature and pressure ranges.

Capabilities required for extreme operating conditions have been incorporated in the basic product, allowing the size-reduced metering flow switch to be used in situations in which specialized products were previously required.

The 500 Series Metering Flow Switches have been developed from Proteus' experience in satisfying the needs of thousands of demanding users in widely diverse applications since 1978.

Section 2 Features and Functions

- **Flow ranges from 0.15 to 4.5 GPM, 0.6 to 17 LPM.**

Two flow ranges are provided in the 500 Series. Refer to Specifications on page 7.

Proteus 800 Series Metering Flow Switches formed in brass, polypropylene or stainless steel provide similar measurement and control capabilities for higher flow ranges than the 500 Series.

- **Calibrated 0-5VDC output**

The 500 Series' is calibrated to provide a 5 VDC output for 2.0 or 4.5 GPM (7.5 or 17 LPM). Actual flow rate can be determined by attaching a voltmeter. An optional scaleable digital voltmeter can be calibrated to provide a direct local display of flow rate.

- **Compact design**

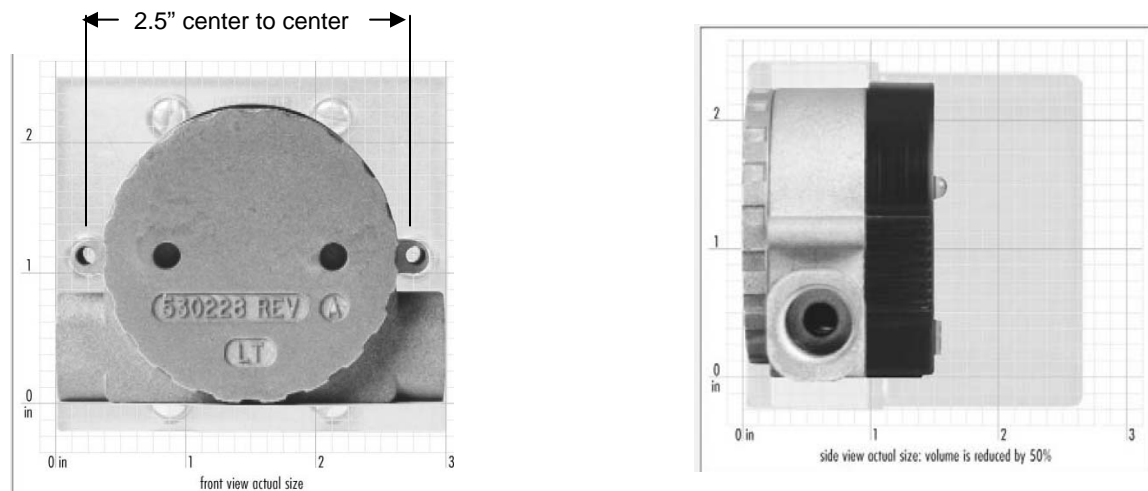
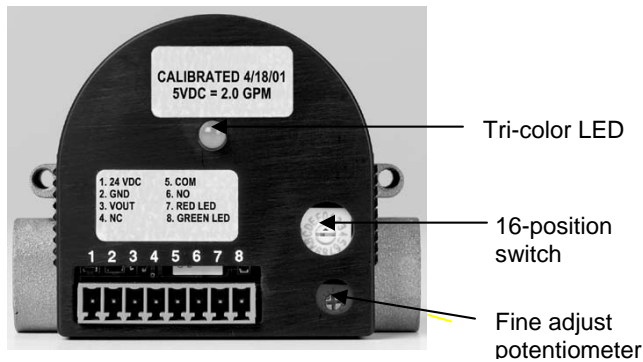


Figure 1: Dimensions of 500 Series Flow Sensor

- **Compact design is easily retrofittable**

- ❖ Mechanical and electrical interfaces are identical to those of hundreds of thousands of Proteus 24VDC flow switches and flow meters already in use.
- ❖ The 500 Series is completely retrofittable in place of an existing Proteus flow switch with 1/4" NPT or 9/16" SAE connections.

- ❖ The distance between the 500 Series pipe or fitting connections is identical to those of previous Proteus flow sensors.
- ❖ Weighing only 16.8 oz (470 g), the metering flow switch can be mounted directly to your pipe or tubing.
- ❖ Mounting lugs are located at the place of previously used panel mounting screws. The 500 Series metering flow switch can be panel mounted with two screws and appropriate standoffs.
- **Stainless Steel faceplate extends operating range**
 - ❖ The rugged stainless steel faceplate permits operation from –40 to 140°C and 250 psi(1720 kPa).
 - ❖ A Viton® O-ring provides the liquid seal. Other materials are optionally available for enhanced chemical compatibility with specialized coolants.
- **Space requirements reduced by more than 50%**
- **Trip point is user selectable.**



Trip points are selected by adjusting a 16-position switch as shown in Table 1.

This feature provides the ability to change trip point settings predictably, accurately and precisely without the use of complex instrumentation.

See Section 7 for instructions on selecting trip points.

- **Optional potentiometer provides fine tuning capability**

If your trip point must be set with finer control than is provided by the 16-position switch a potentiometer provides the adjustment you need. This potentiometer can be adjusted from 7.00 o'clock to 5.00 o'clock positions. Refer to Section 7 for instructions on selecting trip points.

Model Number	Switch Position															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0504SA2 0504SN2	0.12	0.24	0.35	0.47	0.59	0.71	0.82	0.94	1.06	1.18	1.29	1.41	1.53	1.65	1.76	1.88
0504SA4 0504SN4	0.26	0.53	0.79	1.06	1.32	1.59	1.85	2.12	2.38	2.65	2.91	3.18	3.44	3.71	3.97	4.24

Table 1: Flow Rate in GPM at selected Switch Positions with straight connection to inlet port and fine adjustment potentiometer in the 12 o'clock position.

Note

Elbows and other devices installed that induce swirling motion in the flowing liquid that are installed within 4 inches (16 cm) of the inlet port reduce the linear velocity of liquid through the flow sensor.

When such devices are present the actual flow rate through the flow sensor may be HIGHER than is suggested in Table 1.

- **LED provides instant status information.**

Like a traffic signal, the green, amber and red lights indicate flow status so that problems are easily detected. Green, amber and red lights provide instant indication of the status the flow switch and the flow rate. An additional LED monitor can be remotely mounted at your control panel.

- ❖ If the three-color LED is ON you know that 24VDC power is being delivered to the flow switch and the flow switch is functional.
- ❖ The color of the LED changes depending on the ratio of the actual flow rate to the Trip Point

LED Color	Flow Rate Status	Example Trip Point 1.0 GPM	Relay State	
			NO contact	NC contact
Green	Greater than 1.15 x flow rate at selected trip point	Actual Flow > 1.15 GPM	Closed	Open
Amber	Between 1x and 1.15 x flow rate at selected trip point	1.0 < Actual Flow < 1.15 GPM	Closed	Open
Red	Less than flow rate at selected trip point	Actual Flow < 1.0 GPM	Open	Closed

- **Multiple outputs provide control flexibility**

The 8-pin connector provides a range of control options and delivers 24VDC power to the metering flow switch. See Section 6, Installation for connection details.

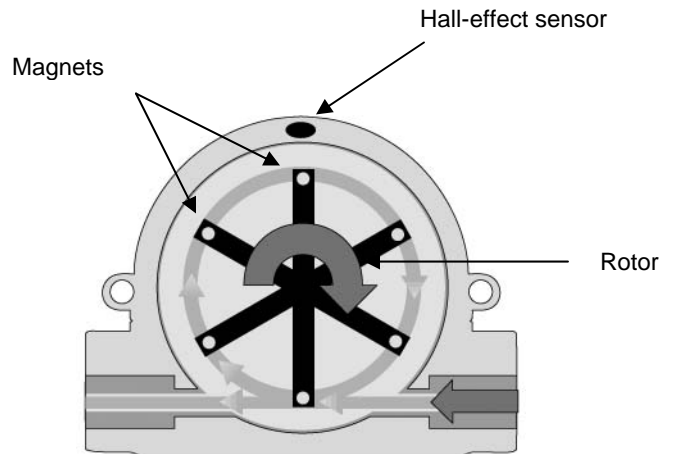
Position	Function	Notes
1	Power input	24 VDC \pm 10%
2	Ground connection for power & output signals	Should be connected to a valid system ground
3	Output Voltage	Calibrated to provide 5VDC for 2.0 or 4.5 GPM. Custom calibrations are available.
4	Normally Closed relay contact	Connects to NC contact of relay.
5	Common relay contact	Connects to Common contact of relay
6	Normally Open relay contact	Connects to NO contact of relay
7	Red LED anode	Connections for a remote tri-color LED indicator. Common cathode of tri-color LED should be connected to ground
8	Green LED anode	

Section 3 How the flow sensor works

The rotor spins when liquid flows through the meter.

Magnets in the rotor switch a Hall-effect sensor mounted in the meter body.

The resulting pulse train is converted by the electronics to a voltage that is proportional to the linear velocity at which the liquid flows through the meter.



Switching

The measured output voltage is continuously compared to a user-selected trip point voltage. When the measured voltage is above the trip point, the built-in relay remains in its active state. If the measured voltage falls below the trip point due to reduced or stopped flow, the relay contacts open, signaling an alarm condition to your control system.

Metering

Accuracy of calibration to $\pm 2\%$ of range is established against a flow standard with a certified accuracy of $\pm 0.5\%$. Calibration is traceable to a NIST reference. Linearity is better than $\pm 0.5\%$.

Section 4 Specifications and performance

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

Flow Range		
GPM	0.15 - 2.0	0.3 – 4.5
LPM	0.6 – 7.5	1.2 – 17.0
Connections		
	Part Number	
⁹ / ₁₆ -18 SAE	0504SA2	0504SA4
¹ / ₄ " FNPT	0504SN2	0504SN4
Liquid operating Limits		
Temperature	-40 to 140°C	-40 to 284°F
	Electronics must be thermally isolated from flow sensor at temperatures above 85°C and below dew point.	
Pressure	1720 kPa	250 psi
Kinematic Viscosity	To 120 centistokes	
Wetted Materials		
Flow Sensor Body	304 Stainless Steel	
Faceplate	316 Stainless Steel	
Sealing O-ring	Viton ® . Other materials are available.	
Rotor	Carbon fiber-filled Nylon. Other materials are available.	
Rotor Shaft	316 Stainless Steel. Other materials are available.	
Meter Performance		
Voltage Output	0 - 5 VDC for the 2.0 GPM or 4.5 GPM.	
Accuracy	± 2 % of range. <i>Improved accuracy and linearity performance over smaller flow ranges can be achieved by specialized NIST-traceable calibration procedures.</i>	
Linearity	Better than ± 1% from 10 to 100% of nominal flow range	
Repeatability	Better than ± 0.5% above 10% of nominal flow range	
Switch Performance		
Trip Point Selection	16 position changes trip points in steps of 6% of nominal flow range with fine adjustment between steps.	
Hysteresis / Dead Band	< 5% of actual flow rate	
Switch type	Relay Closure	
Relay rating	SPDT 48 VDC, 1.0 A	
Electrical		
Power Requirements	24 VDC, 40 mA	
Electrical Connection	Plug type EDZ1550/8 with screw fastening of 8 conductors up to #16 gauge.	
Remote Electronics	Optional mounting locates electronics up to 30 ft from flow sensor. Required for operation above 85°C.	
Flow Certification	Standard products are provided with certificates of compliance. Specialized calibration certificates are optionally available.	
Digital Display	Optional panel mounted displays flow rate GPM or LPM on 3½ digits.	

Section 5 Product certifications

500 Series Metering Flow Switches are CE marked for compliance with the EU Directive 89/336/EEC for Electromagnetic Compatibility.

500 Series Metering Flow Switches have been Safety Certified by RWTUV as a low voltage, Class III devices.

Section 6 Installation

CAUTION!

It is generally undesirable to mount any plumbing connections directly over electronic controls or instruments.

WARNING!

If the 500 Series flow sensor is mounted in a vertical pipeline, any leakage from the topmost connection could enter the unit and cause permanent damage to the electronics.

Pipe or tubing mounting

If rigid piping or tubing is used, the 500 Series metering flow switch may be supported by direct connection to the pipe or tubing.

Panel mounting

Locate holes for 8-32 screws in the panel with 2.5" between centers. Spacing sleeves placed over the shaft of the securing screws are recommended to prevent the faceplate or rear cover of the sensor from making contact with the panel. Refer to Figure 1 for dimensions.

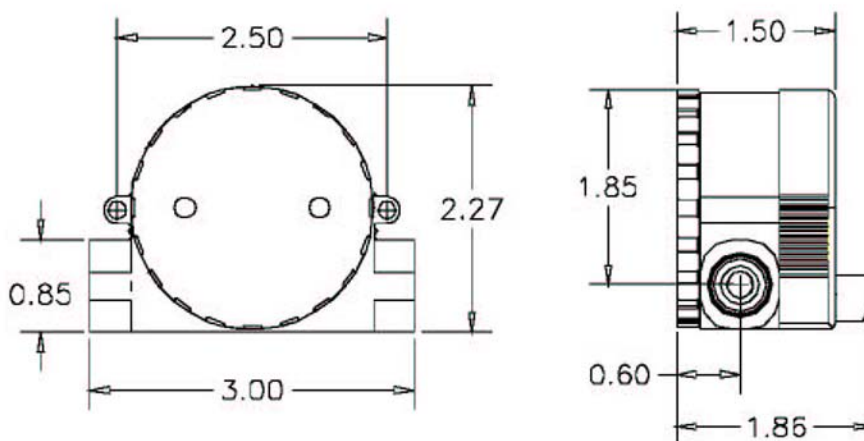


Figure 1: Dimensions of 500 Series Metering Flow Switch.

Contact sales@proteusind.com should you require DWG files for integration with your drawings.

Plumbing Connections

Note

Before connecting a sensor into your fluid line, verify that the normal flow rates expected in that line are within the operating range of the sensor.

Extended use above the rated maximum flow rate of the sensor will reduce its useable life.

Note

It is recommended that connections to the stainless steel flow sensor be made with stainless steel or materials of similarly chemical inertness to minimize potential corrosion damage.

Note

The flow response of the sensor, and thus its calibration may be dependent on the internal diameter (ID) of an incoming pipe, or the ID of a tube connection.

If the ID of your pipe or tube fitting where it connects to the inlet port is LESS than the value shown in Table 2, calibration values may be invalid.

Appropriate calibration procedures can be applied to allow the 500 Series flow sensor to be used with pipes and connections with ID's smaller than those shown in Table 2. Contact Proteus for assistance.

Model #	Flow Range		Orifice ID	
	GPM	LPM	inches	mm
0504SA2	0.1 – 2.0	0.6 – 7.5	0.187	4.76
0504SN2	0.1 – 2.0	0.6 – 7.5	0.187	4.76
0504SA4	0.3 – 4.5	1.2 – 17.0	0.270	6.86
0504SN4	0.3 – 4.5	1.2 – 17.0	0.270	6.86

Table 2: Minimum ID of pipe or connection for calibrations to be valid.

Note

The flow response of 500 Series sensors and thus their calibration may be dependent on the form of the device attached to the inlet connection and other closely located up-stream devices.

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

We recommend that a straight run of pipe of more than 10 x pipe ID (~4 inches or 10 cm) be used between the flow sensor and any up-stream 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.

The 500 Series sensor is typically unaffected by the form or proximity of devices on its downstream side.

Sensor Orientation

For the best results, 500 Series sensors should be mounted with the faceplate in the vertical plane.

Mounting the device with the flow connections uppermost can help eliminate entrained air from your system.

Flow Direction

The 500 Series Metering Flow Switch is not sensitive to flow direction. Flow can be introduced to the sensor from either side.

NPT pipe thread connections

Pipe threads seal by making metal-to-metal contact between male and female components. Consequently they 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 a high quality lubricating and sealing material.

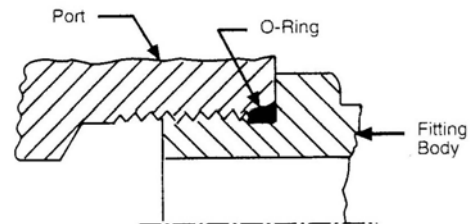
- Use Teflon tape or a PTFE-based liquid sealant to provide lubrication for the junction and a leak-tight connection at both input and output connections. Real-Tuff and Hercules are two of many suitable brands of PTFE-based sealants.
- Do not over-tighten the connection. Refer to instructions for installation 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.

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.

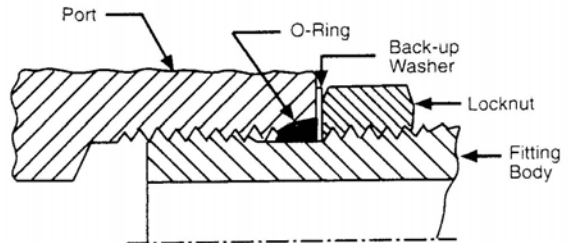
Non-adjustable fittings

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 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 the fitting assembly is held securely in place.



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 reducing wear in the sensor.

Fluid Temperature Range & Remote Mounting Electronics

If fluid temperatures will be outside the range of 0 - 85°C, the electronics package must be mounted remotely from the sensor.

Remote mounting may require customized changes to the sensors.

Please contact Proteus Applications for additional information.

Electrical Connections

Note

Only personnel familiar with the electrical circuit and control functions of the system in which the sensor is to be included should perform installation of this product.

WARNING!

Do NOT connect 24 VDC power to connection 3.

Connecting power to the output contact may cause permanent damage to the electronics.



Electrical inputs and outputs are provided at a single eight-pin socket. An 8-pin connector providing screw fastening of up to #16 gauge conductors is provided with the 500 Series metering flow switch.

Replacement 8-pin connectors can be obtained from Proteus, P/N 440157 or from electrical distributors, On-Shore Technology P/N EDZ1550/8, or Digi-Key P/N ED1966-ND.

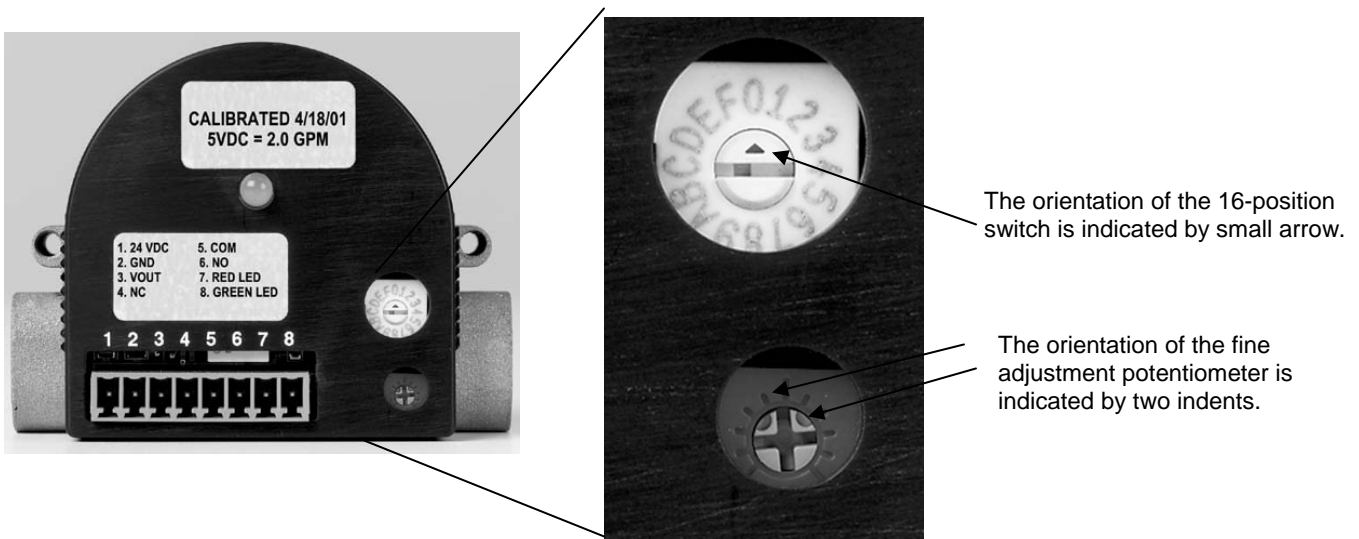
See Section 10 for installation of Digital Display units.

Section 7 Selecting Trip Points

Adjustment of trip points in steps of 6% of the rated flow range is made with a 16-step switch and a single turn potentiometer accessed through the cover of the electronics.

Tool Required: A fine flat screwdriver

1. Identify the Part Number of the 500 Series metering flow switch being adjusted. This is noted on the product label.
2. Select the Trip Point Flow chart that applies to your metering flow switch.
3. Look across the row to identify the flow rate that is immediately higher than your required trip point.
4. Look up the column with the selected trip point flow rate to identify the required switch position.
5. Peel away the protective label covering the 16-step switch and the fine adjustment potentiometer.



Trip point adjustment controls.

6. Check that the indicator of the fine adjustment potentiometer is pointed towards the 12 o'clock position. If necessary, use the screwdriver to turn the fine adjustment potentiometer so that the indicator is pointed towards the 12 o'clock position.
7. With the screwdriver, turn the 16-step switch so that its indicating arrow points towards the selected position switch position.

Turning the switch CLOCKWISE selects a HIGHER trip point.
Turning the switch ANTI-CLOCKWISE selects a LOWER trip point.

8. Adjust the position of the fine potentiometer as required.

When the potentiometer is turned clockwise the trip point is
INCREASED.
When the potentiometer is turned fully counter-clockwise the trip point is
DECREASED.

9. Replace the protective label. Write the selected trip point on the label.

Part Numbers 0504SN2 & 0504SA2

Setting of 16-Position switch	Position of Fine Adjustment Potentiometer										
	7:00	8:00	9:00	10:00	11:00	12:00	1:00	2:00	3:00	4:00	5:00
	Flow Rate in GPM at the selected position										
0	0.09	0.09	0.09	0.10	0.11	0.12	0.13	0.15	0.17	0.20	0.24
1	0.21	0.20	0.21	0.21	0.22	0.24	0.25	0.27	0.29	0.32	0.35
2	0.32	0.32	0.33	0.33	0.34	0.35	0.37	0.39	0.41	0.43	0.47
3	0.44	0.44	0.44	0.45	0.46	0.47	0.49	0.50	0.53	0.55	0.59
4	0.56	0.56	0.56	0.57	0.58	0.59	0.60	0.62	0.64	0.67	0.71
5	0.68	0.68	0.68	0.68	0.69	0.71	0.72	0.74	0.76	0.79	0.82
6	0.79	0.79	0.80	0.80	0.81	0.82	0.84	0.86	0.88	0.91	0.94
7	0.91	0.91	0.91	0.92	0.93	0.94	0.96	0.98	1.00	1.02	1.06
8	1.03	1.03	1.03	1.04	1.05	1.06	1.07	1.09	1.12	1.14	1.18
9	1.15	1.15	1.15	1.15	1.16	1.18	1.19	1.21	1.23	1.26	1.29
A	1.26	1.26	1.27	1.27	1.28	1.29	1.31	1.33	1.35	1.38	1.41
B	1.38	1.38	1.38	1.39	1.40	1.41	1.43	1.45	1.47	1.49	1.53
C	1.50	1.50	1.50	1.51	1.52	1.53	1.55	1.56	1.59	1.61	1.65
D	1.62	3.63	3.64	3.65	3.68	1.65	3.74	3.79	3.84	3.90	1.76
E	1.73	3.89	3.90	3.92	3.94	1.76	4.01	4.05	4.10	4.16	1.88
F	1.85	1.85	1.85	1.86	1.87	1.88	1.90	1.92	1.94	1.96	2.00

Part Numbers 0504SN4 & 0504SA4

Setting of 16-Position switch	Position of Fine Adjustment Potentiometer										
	7:00	8:00	9:00	10:00	11:00	12:00	1:00	2:00	3:00	4:00	5:00
	Flow Rate in GPM at the selected position										
0	0.18	0.19	0.20	0.21	0.23	0.26	0.30	0.35	0.40	0.46	0.53
1	0.45	0.45	0.46	0.48	0.50	0.53	0.57	0.61	0.66	0.72	0.79
2	0.71	0.72	0.72	0.74	0.76	0.79	0.83	0.88	0.93	0.99	1.06
3	0.98	0.98	0.99	1.01	1.03	1.06	1.10	1.14	1.19	1.25	1.32
4	1.24	1.25	1.25	1.27	1.29	1.32	1.36	1.41	1.46	1.52	1.59
5	1.51	1.51	1.52	1.53	1.56	1.59	1.63	1.67	1.72	1.78	1.85
6	1.77	1.77	1.78	1.80	1.82	1.85	1.89	1.94	1.99	2.05	2.12
7	2.04	2.04	2.05	2.06	2.09	2.12	2.16	2.20	2.25	2.31	2.38
8	2.30	2.30	2.31	2.33	2.35	2.38	2.42	2.46	2.52	2.58	2.65
9	2.57	2.57	2.58	2.59	2.62	2.65	2.68	2.73	2.78	2.84	2.91
A	2.83	2.83	2.84	2.86	2.88	2.91	2.95	2.99	3.05	3.11	3.18
B	3.10	3.10	3.11	3.12	3.15	3.18	3.21	3.26	3.31	3.37	3.44
C	3.36	3.36	3.37	3.39	3.41	3.44	3.48	3.52	3.58	3.63	3.71
D	3.63	3.63	3.64	3.65	3.68	3.71	3.74	3.79	3.84	3.90	3.97
E	3.89	3.89	3.90	3.92	3.94	3.97	4.01	4.05	4.10	4.16	4.24
F	4.16	4.16	4.17	4.18	4.20	4.24	4.27	4.32	4.37	4.43	4.50

Table 3: 500 Series trip point flow selection chart - GPM.

Part Numbers 0504SN2 & 0504SA2

Setting of 16-Position switch	Position of Fine Adjustment Potentiometer										
	7:00	8:00	9:00	10:00	11:00	12:00	1:00	2:00	3:00	4:00	5:00
	Flow Rate in LPM at the selected position										
0	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.6	0.7	0.8	0.9
1	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.1	1.1	1.3	1.4
2	1.3	1.3	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.4	1.8
3	1.3	1.3	1.3	1.3	1.4	1.4	1.5	1.6	1.6	1.7	1.8
4	1.8	1.8	1.8	1.8	1.8	1.9	2.0	2.0	2.1	2.2	2.3
5	2.2	2.2	2.3	2.3	2.3	2.4	2.4	2.5	2.5	2.7	2.8
6	2.7	2.7	2.7	2.8	2.8	2.8	2.9	3.0	3.0	3.2	3.3
7	3.2	3.2	3.2	3.2	3.3	3.3	3.4	3.4	3.5	3.6	3.7
8	3.7	3.7	3.7	3.7	3.7	3.8	3.8	3.9	4.0	4.1	4.2
9	4.1	4.1	4.2	4.2	4.2	4.3	4.3	4.4	4.5	4.6	4.7
A	4.6	4.6	4.6	4.6	4.7	4.7	4.8	4.9	5.0	5.0	5.2
B	4.6	4.6	4.6	4.6	4.7	4.7	4.8	4.9	5.0	5.0	5.2
C	5.1	5.1	5.1	5.1	5.2	5.2	5.3	5.3	5.5	5.5	5.6
D	5.6	5.6	5.6	5.6	5.6	5.7	5.7	5.8	6.0	6.0	6.1
E	6.0	6.0	6.0	6.1	6.1	6.2	6.2	6.3	6.5	6.5	6.6
F	6.5	6.5	6.5	6.5	6.6	6.6	6.7	6.8	7.0	6.9	7.1

Part Numbers 0504SN4 & 0504SA4

Setting of 16-Position switch	Position of Fine Adjustment Potentiometer										
	7:00	8:00	9:00	10:00	11:00	12:00	1:00	2:00	3:00	4:00	5:00
	Flow Rate in LPM at the selected position										
0	0.8	0.8	0.8	0.9	1.0	1.1	1.2	1.4	1.6	1.8	2.0
1	1.9	1.9	1.9	1.9	2.0	2.1	2.3	2.4	2.5	2.8	3.1
2	2.9	2.9	3.0	3.0	3.1	3.2	3.3	3.5	3.6	3.9	4.2
3	4.0	4.0	4.0	4.1	4.2	4.3	4.4	4.6	4.6	5.0	5.2
4	5.1	5.1	5.1	5.1	5.2	5.3	5.5	5.6	5.7	6.0	6.3
5	6.1	6.1	6.1	6.2	6.3	6.4	6.5	6.7	6.8	7.1	7.3
6	7.2	7.2	7.2	7.3	7.3	7.5	7.6	7.8	7.9	8.2	8.4
7	8.3	8.3	8.3	8.3	8.4	8.5	8.7	8.8	9.0	9.2	9.5
8	9.3	9.3	9.3	9.4	9.5	9.6	9.7	9.9	10.1	10.3	10.5
9	10.4	10.4	10.4	10.5	10.5	10.6	10.8	10.9	11.2	11.4	11.6
A	10.4	10.4	10.4	10.5	10.5	10.6	10.8	10.9	11.3	11.4	11.6
B	11.4	11.4	11.5	11.5	11.6	11.7	11.8	12.0	12.4	12.4	12.7
C	12.5	12.5	12.5	12.6	12.7	12.8	12.9	13.1	13.5	13.5	13.7
D	13.6	13.6	13.6	13.7	13.7	13.8	14.0	14.1	14.6	14.6	14.8
E	14.6	14.6	14.7	14.7	14.8	14.9	15.0	15.2	15.8	15.6	15.9
F	15.7	15.7	15.7	15.8	15.9	16.0	16.1	16.3	16.9	16.7	16.9

Table 4: 500 Series trip point flow selection chart - LPM.

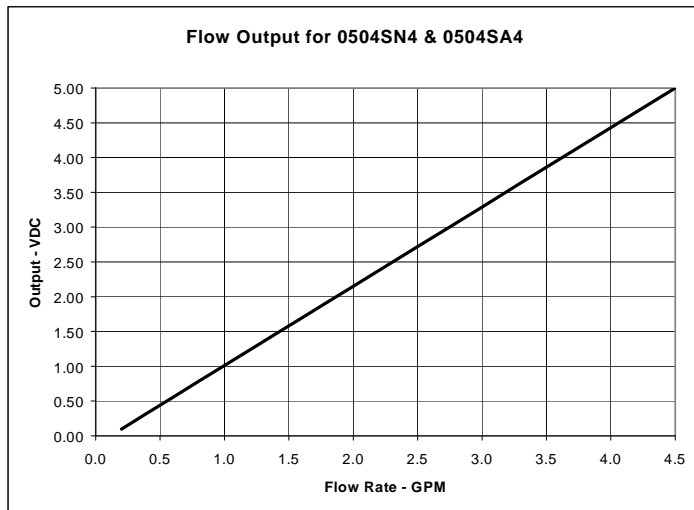
Section 8 Measuring Flow Rate

The voltage output by the 500 Series metering flow switches allows the flow rate of the liquid passing through the device to be estimated.

While the flow response curves of the 500 Series metering flow switches are extremely linear, they do NOT pass through zero, requiring the use of a linear regression formula or calibration graphs to derive the actual flow rate from the measured output voltage.

Calibration curves and derived look-up tables obtained from measurement of multiple sensors are shown below.

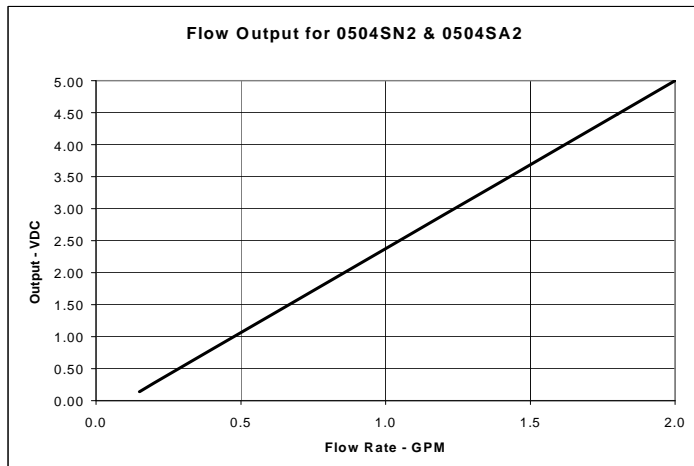
The equations under each graph may be used with PLC or other control devices to obtain a more accurate measure of flow.



Measured Voltage	Flow Rate	
	GPM	LPM
5.00	4.50	17.03
4.50	4.06	15.37
4.00	3.62	13.71
3.50	3.18	12.05
3.00	2.74	10.39
2.50	2.31	8.73
2.00	1.87	7.07
1.50	1.43	5.41
1.00	0.99	3.75
0.50	0.55	2.09
0.25	0.33	1.26
0.1	0.20	0.76

$$\text{Flow in GPM} = (\text{Voltage} + 0.13) / 1.14$$

$$\text{Flow in LPM} = (\text{Voltage} + 0.13) \times 3.32$$



Measured Voltage	Flow Rate	
	GPM	LPM
5.00	2.00	7.57
4.50	1.81	6.85
4.00	1.62	6.13
3.50	1.43	5.41
3.00	1.24	4.69
2.50	1.05	3.97
2.00	0.86	3.25
1.50	0.67	2.53
1.00	0.48	1.80
0.50	0.29	1.08
0.25	0.19	0.72
0.1	0.13	0.51

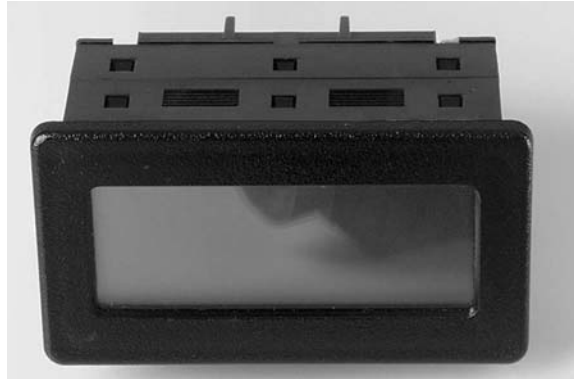
$$\text{Flow in GPM} = (\text{Voltage} + 0.252) / 2.626$$

$$\text{Flow in LPM} = (\text{Voltage} + 0.252) \times 1.44$$

Section 9 Digital Displays

Digital display units

Digital panel display meters are available to provide a direct local display of flow rate in selected engineering units. Each unit has a 3½ digit LCD display with 0.6 inch high digits and a DIP switch-selectable decimal point. The digital display unit requires 4 mA at 9 to 28VDC.



Flow Range – GPM	Part Number	Flow Range - LPM	Part Number
0.15 –2.0	0G502D	1.2 – 4.5	0L502D
0.3 – 4.5	0G504D	1.2 – 17.0	0L504D

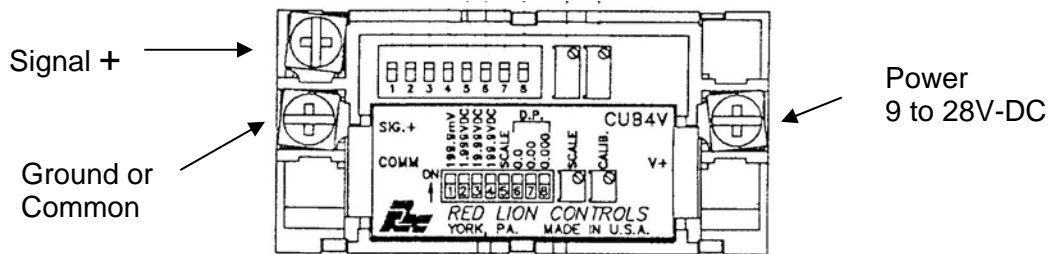
Table 5: Part Numbers and flow ranges for Digital Displays for 500 Series

Note

Switches and potentiometers have been set to fit the range of your devices.
Changing these settings may invalidate the calibration!

Connecting the Digital Display Unit

The electrical connections are made via screw-clamp terminals located on the back of the Digital Display unit.



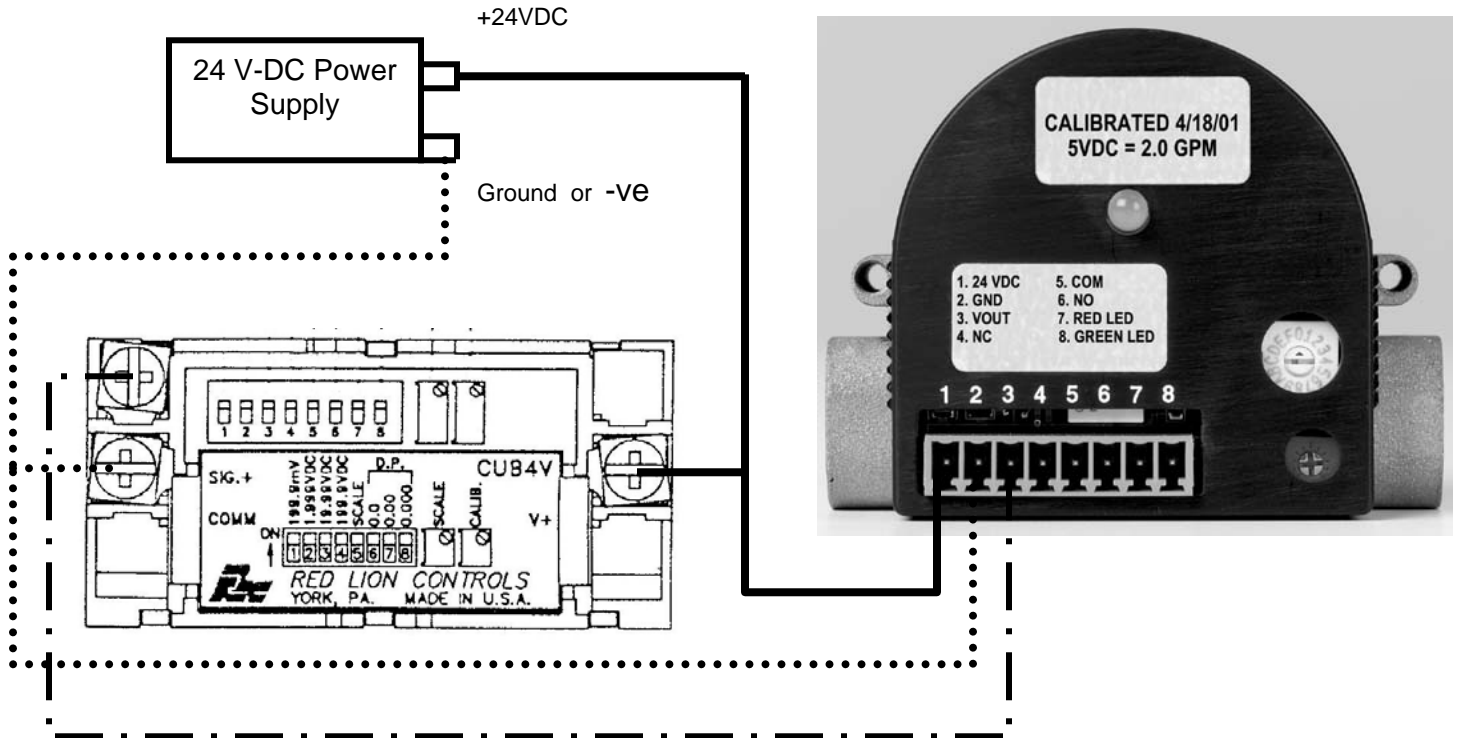
Rear view of Digital Display Unit

Note

When wiring the unit check the wiring label on the back of the flow meter to ensure you connect to the proper terminals.

Connection instructions:

1. Strip connecting wire leaving approximately ¼" bare wire exposed. Stranded wire should be tinned with solder.
2. Insert the wire into the screw-clamp terminal and tighten the wire until the wire is clamped tightly. Each terminal will accept up to two #14 AWG wires.



Section 10 Cleaning and Maintenance

Maintenance of the 500 Series Metering flow switch is normally limited to cleaning the chamber in which the rotor spins and an annual recalibration.

Cleaning the 500 Series flow sensor

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

Tools required:

Wrenches to disconnect the flow meter from your flow circuit.
Adjustable face spanner wrench similar to Eugene Ernst Products P/N EEPS5400 Medium
Soft cleaning cloth
Alcohol, water or a dilute detergent solution.

Refer to Section 12 for replacement parts that may be required during maintenance.

Cleaning the 500 Series Flow Sensor

1. Turn OFF the liquid flow in your flow circuit and remove the 500 Series sensor from your system. Place the sensor on a clean surface.



- Remove the faceplate from the sensor body using a face-spanner wrench.







3. Remove the faceplate from the flow meter.



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 light detergent solution, clean 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 shaft.

<p>7. Inspect the O-ring to ensure that it is not brittle, cracked or otherwise damaged.</p> <p>If necessary replace with a #132 O-ring of a material compatible with the liquid being passed through the flow meter.</p> <p>Position the O-ring on the inner rim of the faceplate.</p>	
<p>8. Position the stainless steel shaft in the hole in the center of the rotor cavity.</p> <p>Position the rotor over the shaft</p>	
<p>9. Position the faceplate so the shaft fits into the hole in its center, and start screwing the faceplate into position.</p> <p>Note A small amount of high pressure lubricant applied to the threads may simplify assembly.</p> <p>Caution It should not be necessary to use high force to secure the faceplate. If you find resistance remove the faceplate and restart the threads</p>	
<p>10. After the faceplate has been hand-tightened, fit the face wrench.</p> <p>Tighten the faceplate into position by taking a half-turn from the hand-tight position or tighten to a torque of 40 in-lbs.</p>	
<p>11. Install the flow meter in your system. Turn on liquid flow and check for leaks at the faceplate and connecting ports. Tighten all connections as required to eliminate leaks</p>	

Section 11 Calibration & Recalibration

Note

500 Series sensors are calibrated at Proteus with water at temperatures ranging from 22 to 28C.

***Changes in fluid type can alter the calibrated response of the sensor.
Large changes in liquid temperature can alter the calibrated response of the sensor.***

Please contact Proteus Technical Support if a specialized calibration is needed.

Note

As described in the Plumbing Connections section on page 10, the response of the 500 Series flow sensor may be affected by the way in which the sensor is connected to your system.

The 500 Series metering flow switch has been calibrated during manufacture to provide an output of 5.0 VDC for 2.00 GPM or 4.5 GPM with straight pipe connections..

Customized calibration procedures can be performed to change the flow rate corresponding to 5.0 VDC, for fluids other than water and with connections with internal diameters less than those used in the flow sensors. (See Table 2, page 10).

Recalibration

The calibration of the 500 metering flow switch should be checked at 12-month intervals, and recalibrated as required. Re-calibration may be accomplished in either of two ways:

Calibration by Proteus

To obtain a price quotation and a Return Material Authorization number for recalibration of your flow meter, contact sales@proteusind.com or call (650) 964-4163.

When received at Proteus your flow meter will:

1. Have its output measured and recorded in the as-received state.
2. The rotor, stainless steel shaft and sealing O-ring will be replaced.
3. The flow cavity will be cleaned and the device reassembled..
4. The unit will be recalibrated to its original specification against reference standards whose calibrations are statistically controlled against NIST-traceable standards.
5. A new calibration certificate will be issued.
6. A new calibration label will be attached to the flow meter.

Direct calibration against NIST-traceable standards is optionally available.

Calibration by another laboratory.

The calibrating laboratory will issue certificates and labels identifying the calibration status of your metering flow switch.

Please advise your selected calibration laboratory to contact Proteus for calibration instructions.

Section 12 Replacement Parts

Same day shipment is available for orders for replacement parts received by Proteus by 1:00 pm PST.

Prices for these items can be found on the Proteus website at www.proteusind.com or obtained by contacting Proteus Sales (650) 964-4163 or sales@proteusind.com.

Part Number	Description
500MK1	Maintenance Kit, includes 1 x 530002 stainless steel rotor shaft, 1 x 530217 Viton® O-ring and 1 x 530219 rotor.
118045R-4	24 VDC electronics assembly, including Hall-effect sensor, calibrated for use with 0504SN4 and 0504SA4.
118045R-2	24 VDC electronics assembly, including Hall-effect sensor, calibrated for use with 0504SN2 and 0504SA2.
530228	Stainless Steel faceplate for 500 Series
610073R	Back cover for 500 Series

® Nylon, Real-Tuff and Hercules are trademarks of their respective holders

500 Series electronics are sensitive to Electro Static Discharge. There is normally no need to open the electronics case, but if it is opened, proper ESD precautions should be taken.

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

© Proteus Industries Inc. March 2007



Proteus Industries Inc.

340 Pioneer Way, Mountain View, CA 94041
Tel: (650) 964-4163 Fax: (650) 965-9355
www.proteusind.com sales@proteusind.com