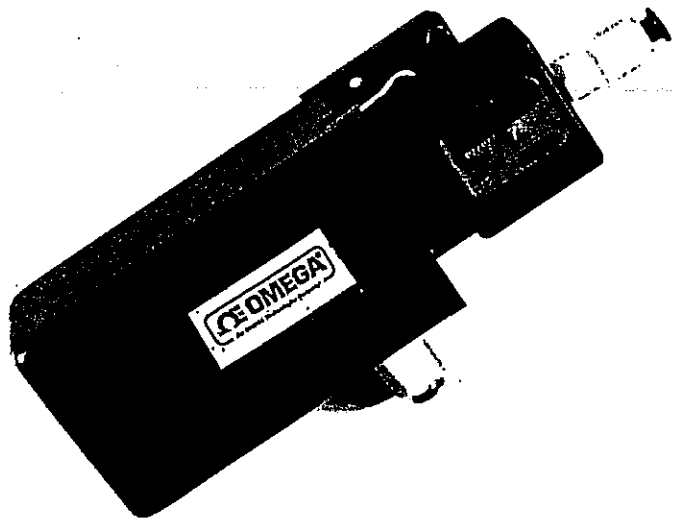
OMEGA®

An OMEGA Technologies Company

MODEL FLV401 Liquid Flow Controller

(For Series FLV 401 thru 404)

Operation and Installation



Omega Rev. A 4/2002 Patent 4,467,660 (other patents pending)

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Installation and Operating Instructions for
MODEL FLV401 LIQUID FLOW CONTROLLER

General Description

The Model FLV401 FLOW CONTROLLER accurately measures and controls liquid flow rates over a wide range of conditions.

A Pelton micro-turbine flow sensor is integrated with a micro-stepping servo valve assembly to provide continuous flow control. The micro-turbine rotational speed is detected electro-optically and translated to an electronic signal that is sent to the servo control electronics.

Flows of low viscosity, non-corrosive liquids can be controlled typically from flow rates as low as 20 mL/min and as high as 2 L/min. The user can provide a control input signal (usually from 0.5 to 5.0 VDC) to specify the desired control point – for example an input of 2.5 VDC will indicate the desire for the controller to maintain 50% of the Flow Range, despite pressure fluctuations and variable restrictions such as a filter slowly restricting system flow rate. Zero Volts means 0% of range and 5.0V means 100% of range. Normal operation will be from **10% to 100%** - below 10% the flow may not be well controlled as it may be out of the flow sensor most accurate detection range. The 100 mL/min range works best from 15 to 20 mL/min up to 100 mL/min.

At the point the pressure & flow is too restricted for normal controlled operation then the Model FLV401 servo system determines the Set point of 50% can no longer be maintained and the logic level ERROR output will indicate an error condition with a +5 Volt CMOS output signal.

All calibration is done at the factory with water. Most low viscosity liquids will have a similar calibration to water.

Flow direction is uni-directional. Differential pressure range has limitations as is true of all flow control systems. Too much pressure reduces the valve resolution and may contribute to "bouncing". Also if pressures are quite low it may not be possible to achieve full flow rates thru the Model FLV401 Flow Controller . This will cause the Error to be detected also as noted above.

The Model FLV401 can be used with a user provided Control Input (SETPOINT) D.C. voltage – see Figure 2 & 3. The Power Supply can be provided from a stable, low ripple D.C. power supply 12 to 15 VDC and the pigtail attach cable which mates with the Model FLV401 cable & 9 pin connector. The power negative (or ground side) is NOT isolated from the signal ground wires.

1.a First things first

Your Model FLV401 Flow Controller was packed by the manufacturer in such a way that you should receive it with no damage. If external damage is noted upon receipt of the package, please contact the shipping ___ (*not OMEGA*) immediately. OMEGA will not be liable for damage to the device once it has left the manufacturing premises.

1.b Unpacking the Flow Controller

After external inspection of the product, proceed to open the package from the top, taking care not to cut too deep. Remove all documentation (if any) resting on top of the packing material. Inspect all products for concealed shipping damage. If damage is noted, please contact the shipping carrier and/or OMEGA to resolve the problem.

When unpacking the products from the shipment, please take care to remove *all* products from the box. Check thoroughly for extra cables, power adapters, and other options listed on the packing slip, if any.

1.c CAUTIONS and WARNINGS

Take care not to drop the Model FLV401. Keep the inlet and outlet ports covered and protected from foreign particles. Read the INSTALLATION section before providing power to the Model FLV401. Any damage inflicted by the customer will not be repaired under warranty. Wiring should be carefully verified as correct and any un-used leads Must be insulated – or taped to eliminate shorts **Before** power is applied. Take care when attaching tubing to the Inlet & Outlet – fittings may leak if threads are rotated while attaching tubing.

2.a SAFETY CONSIDERATIONS

Be careful not to exceed pressure, temperature, or voltage as specified under SPECIFICATIONS. It is best to provide safety shut-off valves in the flow path prior to the Model FLV401 inlet port and to use reliable pressure regulators and (not included). Make certain that the Model FLV401 wetted materials are compatible with your liquids. The Model FLV401 will provide flow rates from approx. 10 or 15% to 100% of full scale. To ensure zero flow, use a separate shut-off solenoid valve or manual valve. Particles should be removed (filtered) before reaching the Model FLV401..

2.b SPECIFICATIONS

Operating Pressure Range:	100 PSI maximum (at or below ambient +25°C) – *must have Power of 15 VDC for this Pressure* Differential pressure typical 5 to 40 psi (see test sheet with each unit)
Liquid & Ambient Temperature:	+10°C to +50°C operating range , non-condensing atmosphere
Input Power:	+12 to +15 VDC, 300 mA (4.5 watts maximum)
Wetted Materials:	PPS, PTFE, Viton O-rings, Stainless steel, sapphire, epoxy, Acetal compression tube fittings standard, (other fittings & o'rings optional)
Inlet & Outlet Porting:	1/8" NPT female threads, Acetal compression tube fittings standard Tube Fittings supplied (standard) all ¼ inch tube O.D. except 100 mL/min range is 1/8 inch
Flow Rates:	See label on unit for flow range. Standard ranges are from 100 mL/min to 2 L/min full scale.. Standard Ranges - 15-100 mL/min , 20-200 mL/min , 50-500 mL/min , 100-1000 mL/min , 0.2-2.0 L/min
Control Input:	0 to 5.0 VDC standard. (Useable range is typically 0.5V to 5.0V for most ranges)
Output Signal:	0 to 5.0 VDC standard. (Keep load resistance higher than 2500 ohms)
Mechanical Dimensions:	2 "H x 7"L x 2.5"W (Plus fitting dimensions) , See Drawing Page 9
Weight:	1.3 lb. with acetal fittings , (3 lbs. Shipping)

MORE INSTALLATION Information
3.0

1) **Electrical**

The Model FLV401 is supplied with a short cable and a terminating 9 Pin connector. This can plug into the mating pigtail cable. At the end of the Pigtail cable (color –coded) you may attach to a suitable wire or connection block. The pigtail cable is shipped with a chart to describe the function of each color wire (See figures 1, 2, 3 & 4) BE CAREFUL when attaching power – any unused leads must be insulated and taped down to prevent shorts. (See Page 6)

2) **Tubing attachment**

Care must be exercised when using the supplied tube fitting connections. Any foreign material in the tubing may damage the Flow Controller. Take care when attaching tubing, best to use 2 wrenches with one to hold tube body from any rotation (else it will damage the seal of the threads for this fitting) Watch for any leaks near the fittings when is first installed. **Remove all entrapped air** for best results. Position the outlet tube higher than the Flow Controller, at least for a short distance to keep air from coming into the outlet side of the flow controller. Restricted lines and needle valves before the Flow Contoller should be avoided for best performance. Good pressure regulation also can improve performance.

3) **Mounting Information**

Figure 5 shows dimensions and the 2 mounting holes in the 'L: bracket.
It suggested that a 6-32 screw be used to mount the Flow Controller through the 2 holes provided.
It can be mounted to a panel or plate. Choose an area away from heat, moisture and vibration for best performance. Factory calibration is done using water with the Serial Number plate facing upwards. Other mounting positions can be used also, the Flow Controller is not very sensitive to position. Take care to keep liquids out of the Flow Controller Housing as it may interfere with the electronic performance.

REPAIR and Servicing INFORMATION.....

To return a product for repair or calibration to OMEGA , please request a AR number.

RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA ENGINEERING Customer Service Department: call Toll Free 1-800-622-2378, FAX 203-359-7811; International: 203-359-1660, FAX: 203-359-7807.

BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, YOU MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OUR CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

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

1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems you are having with the product.

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

1. Your P.O. number to cover the COST of the repair/calibration,
2. Model and serial number of product, and
3. Repair instructions and/or specific problems you are having with the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. That way our customers get the latest in technology and engineering.

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FLOW CALIBRATION

- It is possible to make minor adjustments to the electrical output versus flow rate. Adjust the small trimpot (¾ turn) located near the output flow connector on the side of the flow sensor (through a small hole) (See FIG. 5).
- The normal output is set to produce 5.0 volts [wire 5 and wire 2 (GND)] corresponding to the maximum flow of the liquid
- Turn the pot (carefully) clockwise to increase the voltage output for a given flow rate. Use small flat blade screwdriver (Adjustment range is limited, DO NOT turn beyond ¾ turn range of trimpot.)

WIRING INFORMATION: MODEL **FLV401** LIQUID FLOW CONTROLLER

A schematic showing wiring hook-up is shown in FIGURE 1. BELOW.

CAUTION:

1) Before connection to power supply verify that all leads are properly connected as noted below. (See Figures 2, 3, 4 for wiring details.)

2) Insulate any unused leads and be sure leads do not short to each other or to power or ground.

3) Damage may result if this caution is not heeded.

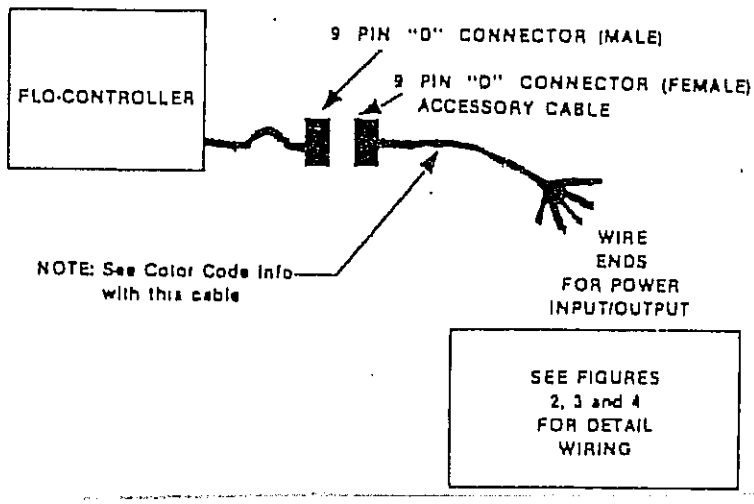


FIGURE 1

WIRING SCHEMATIC (GENERAL)

Power source must have D.C. (filtered) from **12 volts** minimum to **15 volts** maximum. 12 volts is recommended. If the 15 volt supply is used, power consumption will be slightly higher than at 12 volt operation.

CAUTION: WIRING YOUR FLO-CONTROLLER (See FIGURE 2, 3, 4.)
NOTE:

(1) Damage may result if wires are allowed to contact each other or to be shorted to power or ground while power is on.

(2) Before applying power carefully secure and tape/insulate all connections.

(3) Do NOT reverse power input polarity or damage WILL result.

(4) Do NOT connect +5V to less than 5Kohm load or damage may result.

(5) Use of wires 6, 7 wires is optional — if NOT in use insulate wire ends to avoid accidental shorts.

(#4 wire (+5V) is not needed if external 0 to 5V set point voltage is supplied to (input) #3, and #5 (GND).

GENERAL FUNCTIONAL DESCRIPTION
SERVO CONTROLLER (See FIG. 2)

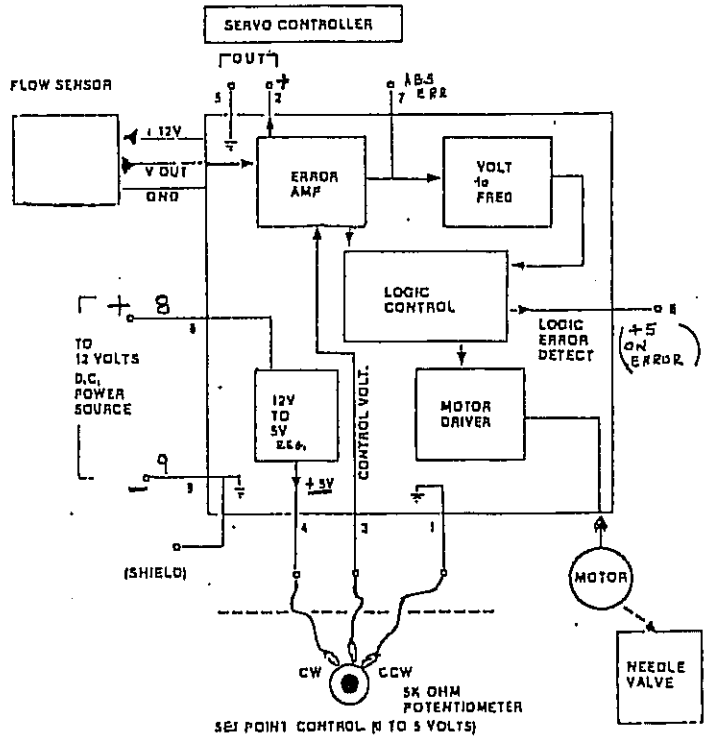
The Flow Sensor output signal is compared to set point control voltage. The absolute value of this error voltage is used as an input to a voltage to frequency converter.

The logic control acts as continuous error sampler, power conservation controller, and determines best servo response for linear stepper motor/needle valve.

Unresolved servo errors, or out of range conditions result in a logic high (+5V) (Wire 9). These may be due to insufficient input pressure to control valve, or incorrect flow sensor or set point voltages. Blocked flow valve, leaks may also cause a logic error output. During this error condition power to motor is inhibited.

A control pot (10 turn), or a coarse and fine dual pot arrangement may be used (See FIG. 3) to provide for set point control. A typical range is +0.5 to +5.0 volts. A +5 volt (Wire 4) supply is available for a 5K pot if needed. (Pot is NOT included).

FIGURE 2:
FUNCTIONAL BLOCK DIAGRAM



MODEL **FLV401** LIQUID FLOW CONTROLLER

FIGURE 3:

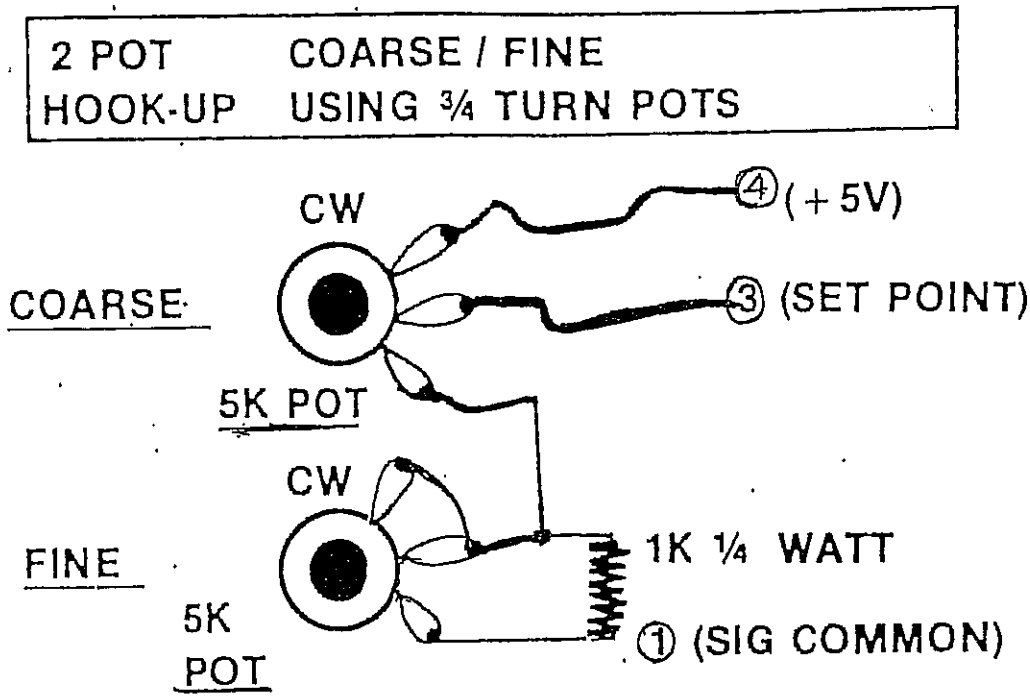
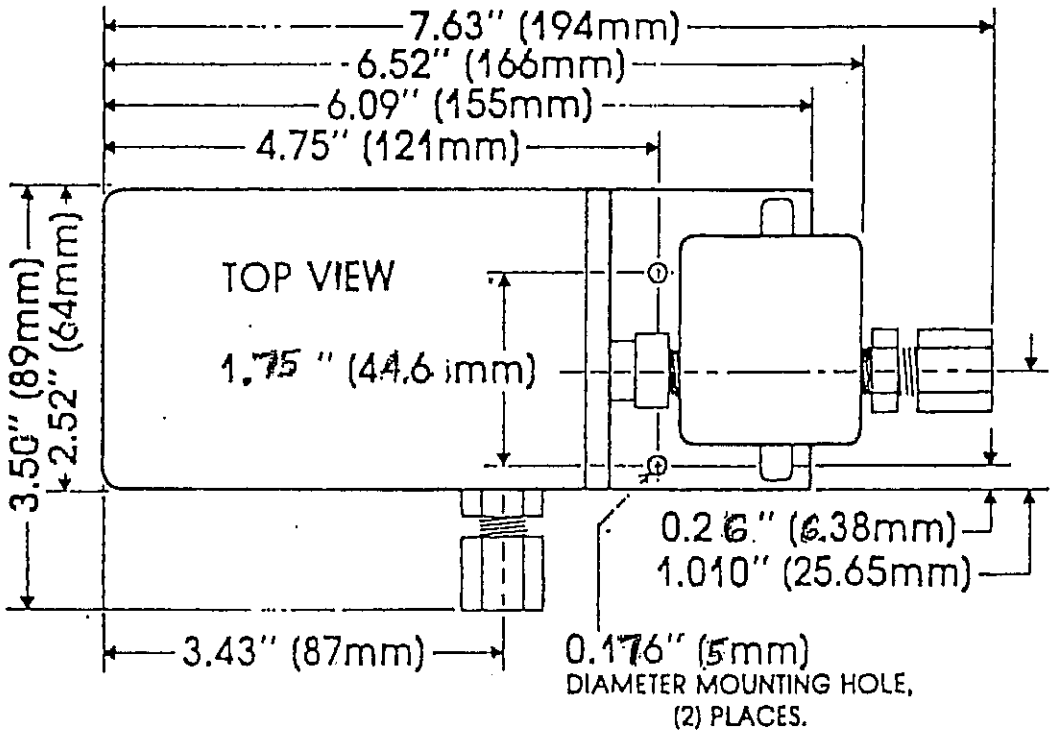
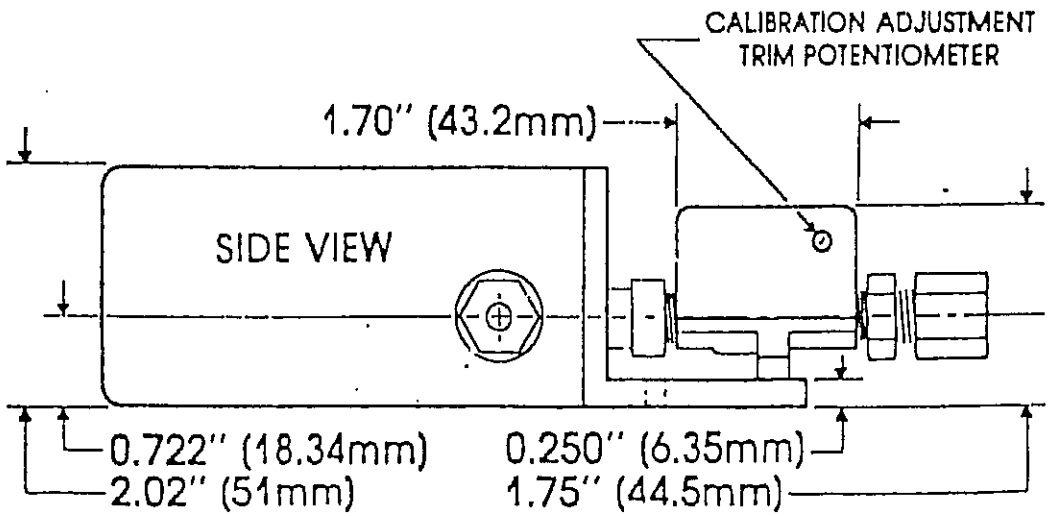


FIGURE 4:

TYPICAL COLORS	WIRE	OUTPUT / INPUT DESCRIPTIONS (See Cable Color Code with Cable)
BLACK	9	Power Ground (—)
GREY	8	+12 Volt Power Input (Typically 0.15 AMPS), 0.3 MAX (Maximum is +15 Volts) (Minimum is +12 Volts)
GREEN	5	Signal Ground
RED	2	Signal Output from Flow Sensor
BROWN	1	Signal Ground
ORANGE	3	Set Point reference voltage input (Maximum is 5 volts) (Minimum is 0 volts) * * Control of valve for input below 0.5V may be inconsistent
YELLOW	4	+5 Volt output for use with control pot Do NOT load with less than 5Kohm, 1ma
VIOLET	7	Absolute value of difference voltage; 10Kohm min. load (Flow sensor output vs. set point) (ANALOG DIFFERENCE)
BLUE	6	Logic error detect; if error condition will output 5V, else 0V logic level. (Minimum load is 5Kohm, 1ma to power ground (BLK) Typical error conditions: a) Pressure input too low or too high for servo control, b) reference set point is out of control range, c) valve blocked, d) sensor failure.

FIGURE 5:





MECHANICAL DIMENSIONS

(SHOWN WITH ¼" (6,35mm) TUBE
SIZE FITTINGS INSTALLED)

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