

Electrical connections for Unit mass flow controllers

UNIT

Technology Update

The electrical connections to mass flow controllers must follow proper instrumentation practice to achieve the best results. Improper connections and inappropriate grounding contribute to inaccuracies in actual and electrically indicated flow. Failure to follow recommended connection specifications contained within this document may even cause irreparable damage to the mass flow device.

grounding issues

Celerity's Unit mass flow controllers utilize both power and signal commons. The power common is the path that the majority of the current will use to return to the power supply. Both the mass flow sensor as well as the MFC control valve, consume significant current during their normal operation. All Unit mass flow devices are equipped with a power common, also known as valve return common, so as to allow a current path to the power supply that is independent to that of the instruments' signal common. It is possible that the mass flow device is consuming up to 150 mA and therefore any resistance of the cabling between the power supply common and the power common will have a proportional voltage drop across it. The signal common is the reference point that the mass flow device will use as a local instrumentation common. This is the reference point for the setpoint input and flow output. Very little current will pass between the signal common and the power supply common because the majority of all current returns through the power common, and therefore makes for an ideal instrumentation common.

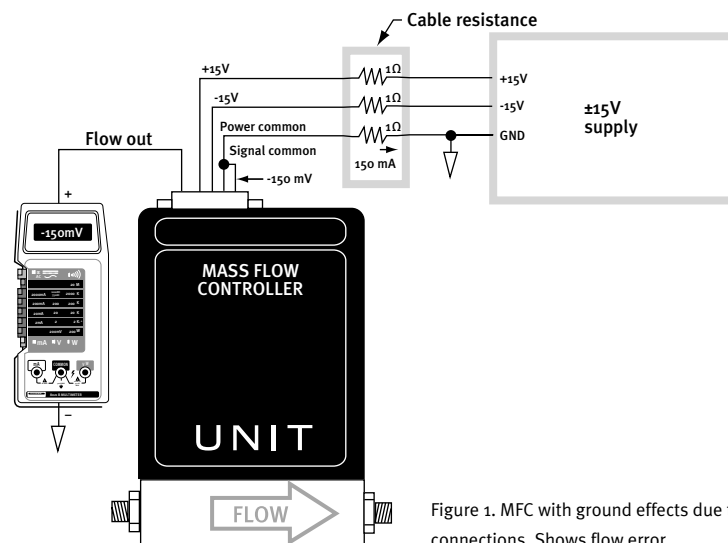


Figure 1. MFC with ground effects due to lack of individual common connections. Shows flow error.

If only a single device common were present, the voltage at the common point on the mass flow device would differ from that of the power supply common (see Figure 1). In a multiple mass flow device situation, each device would have its common at different and uncontrolled voltage levels, and thus overall accuracy is compromised.

Even if the system is wired with two commons, if both signal and power commons are shorted together near the MFC connector, the result is still a significant instrumentation error (see Figure 1.1).

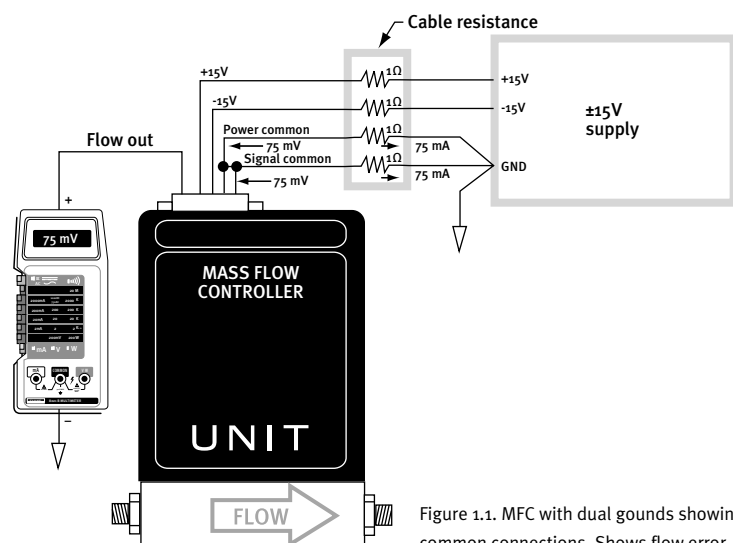


Figure 1.1. MFC with dual grounds showing effects due to lack of individual common connections. Shows flow error.

If the signal common is totally omitted from the instrument system, the local instrument common voltage will be undefined, and will float to ± 0.6 volts depending upon the valve condition (see Figure 1.2). The signal common will float at ± 0.6 volts because diodes clamp the voltage difference between the power and signal commons to the forward operation voltage of the clamping diodes.

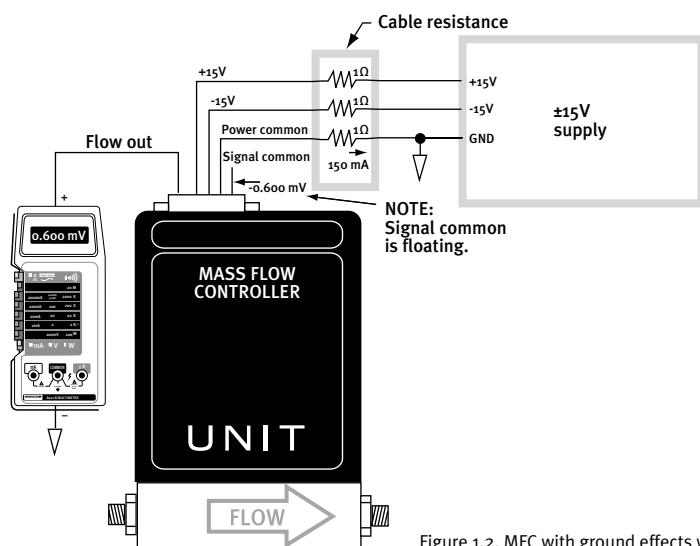


Figure 1.2. MFC with ground effects without any signal common. Shows flow error.

Instrumentation problems are overcome however by connecting both a power common as well as a signal common to each mass flow device (see Figure 1.3). This works because the Unit mass flow device does not consume any significant current through the signal common and thus the voltage at the mass flow device's signal common relative to the power supply common is essentially 0.00 V. The voltage at the mass flow device's power common however is whatever the $I \cdot R$ drop across the cabling between the supply and the mass flow device is. The actual voltage at the device's power common relative to the power supply common is unimportant provided it is less than ± 0.6 V relative to the signal common. It is therefore imperative to connect two separate connections between the power supply common to the mass flow device power commons and from the power supply common to the mass flow device signal common.

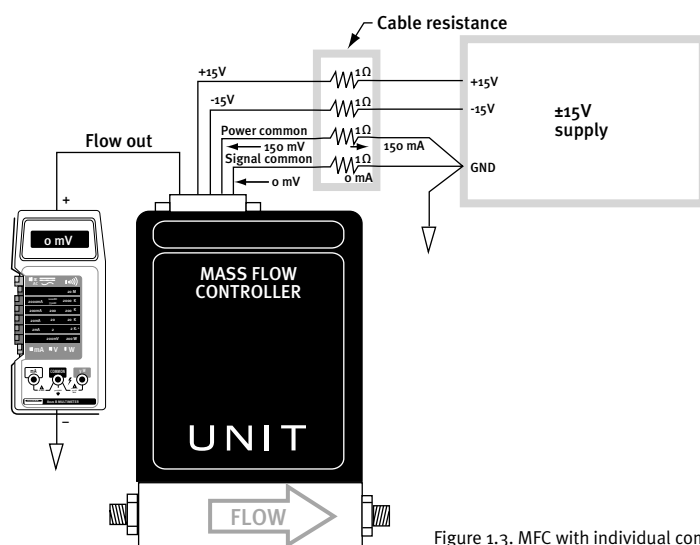


Figure 1.3. MFC with individual common connections. Shows no flow error.

analog signal issues

The analog signals both going to as well as coming from the mass flow device must be set to and measured with respect to the system signal common. This signal is generally at the power supply common. This means that setpoints should be injected at the setpoint pin with respect to the system signal common and the mass flow device flow signal is measured from the flow output pin with respect to the system signal common (see Figure 1.3).

valve voltage monitoring/purging

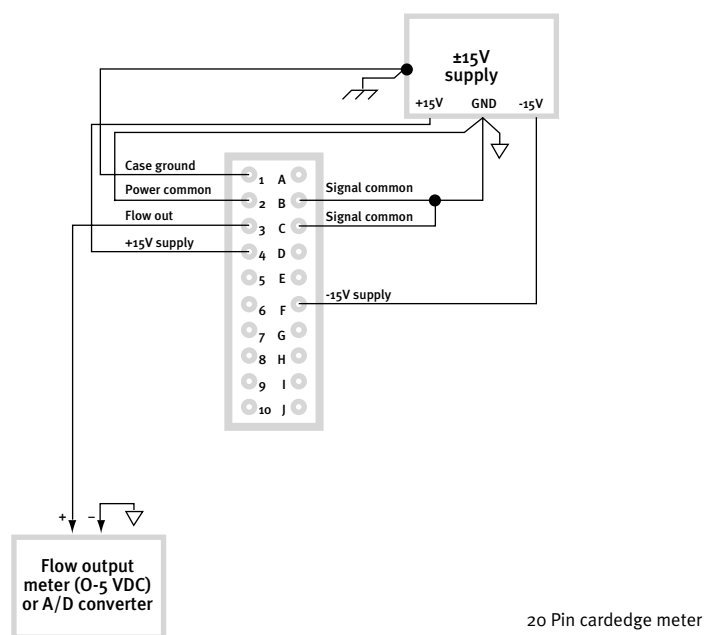
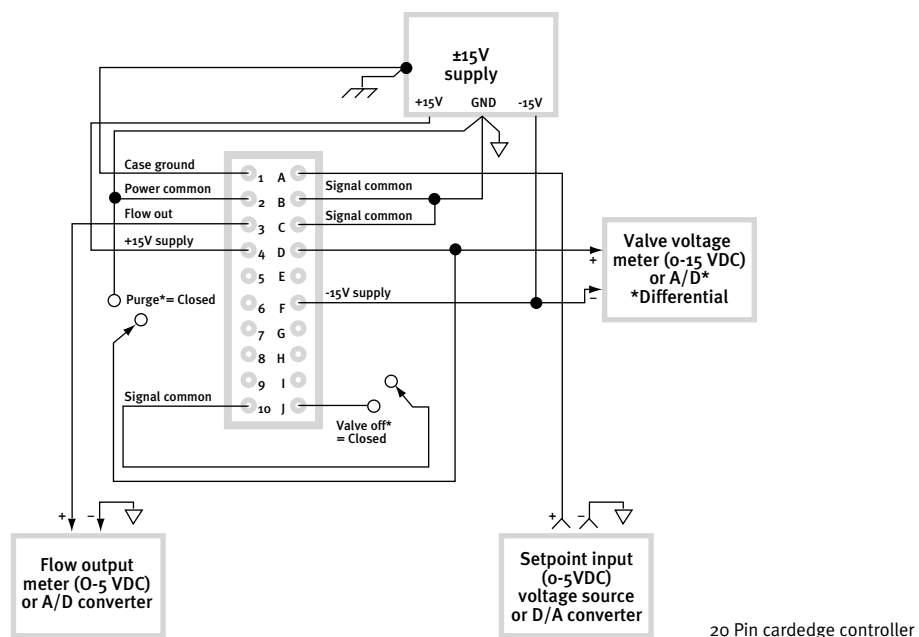
On mass flow controllers, valve voltage may be monitored from the valve test point pin “VTP” with respect to the -15V supply voltage pin. Also on mass flow controllers, the valve may be fully overridden to a purge “normally closed valve” or closed “normally opened valve” by shorting the VTP pin to the power common (see Figure 1.1).

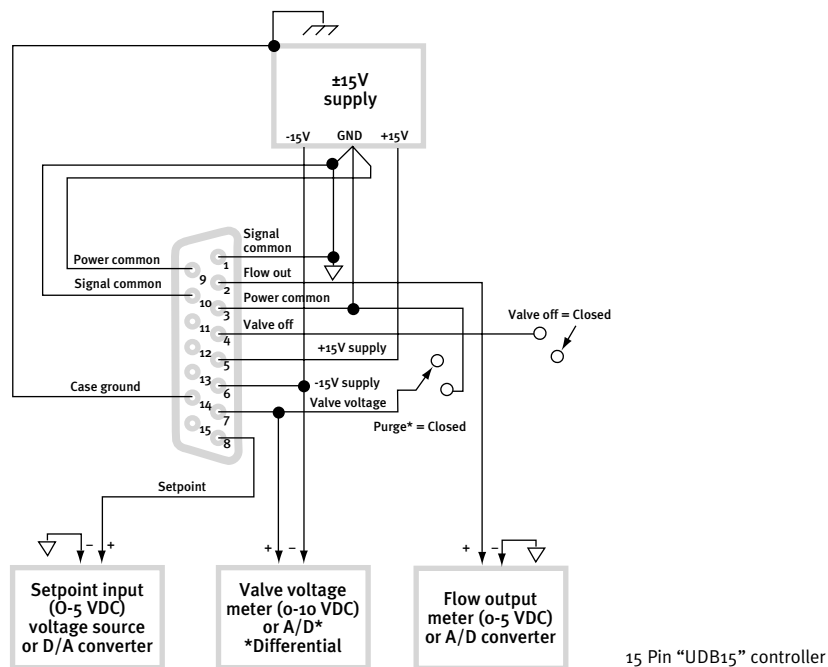
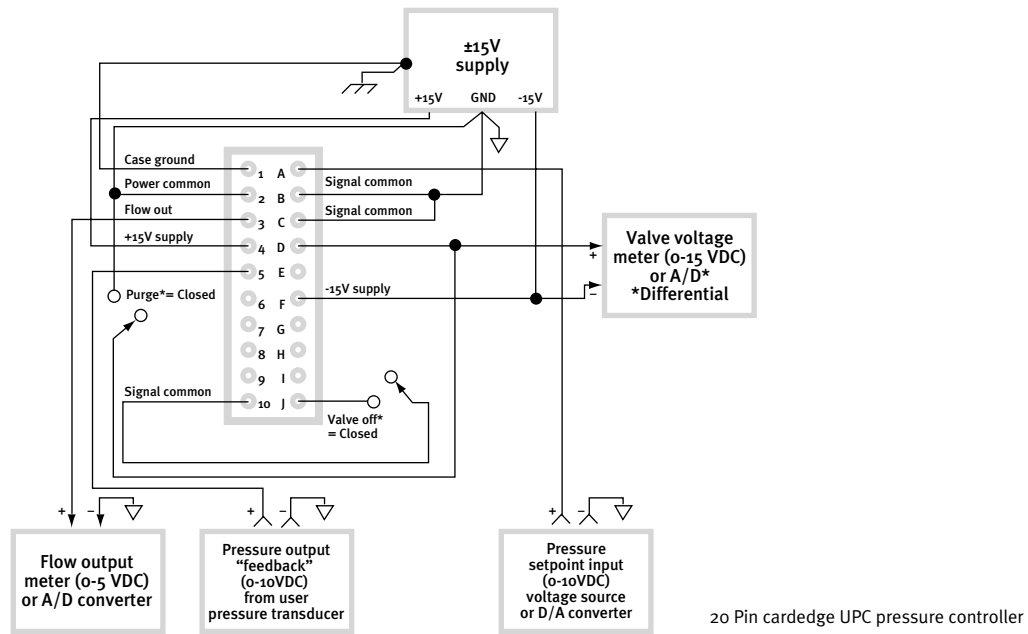
other electrical features

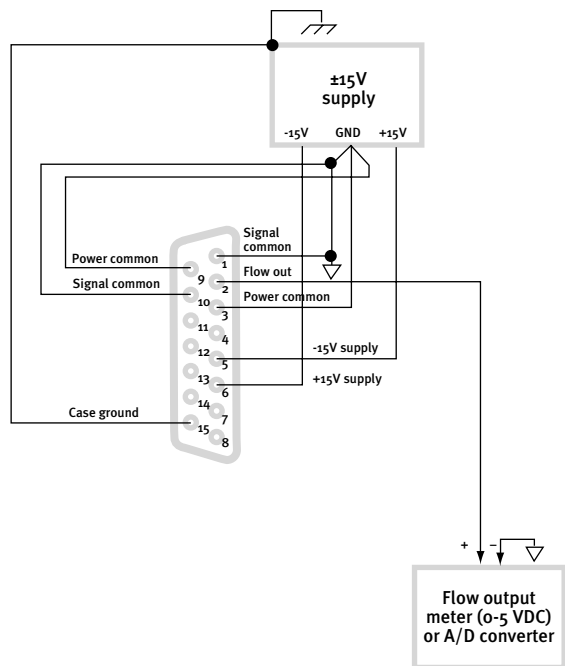
Some connectors that are available on Unit mass flow devices have special functions or special features that may not be available on other electrical connectors. For this reason these features are not explained here, but information on all electrical connector features are available from applications engineering.

suggested electrical connections

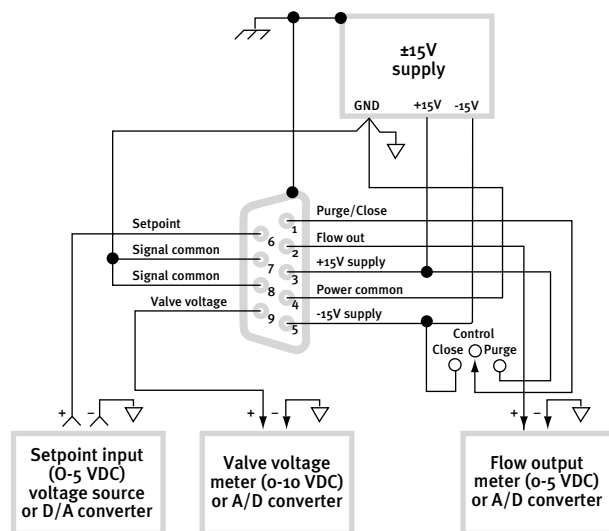
For purposes of elimination of wiring errors it is recommended that the following schematics be utilized in the design of user electronic systems.



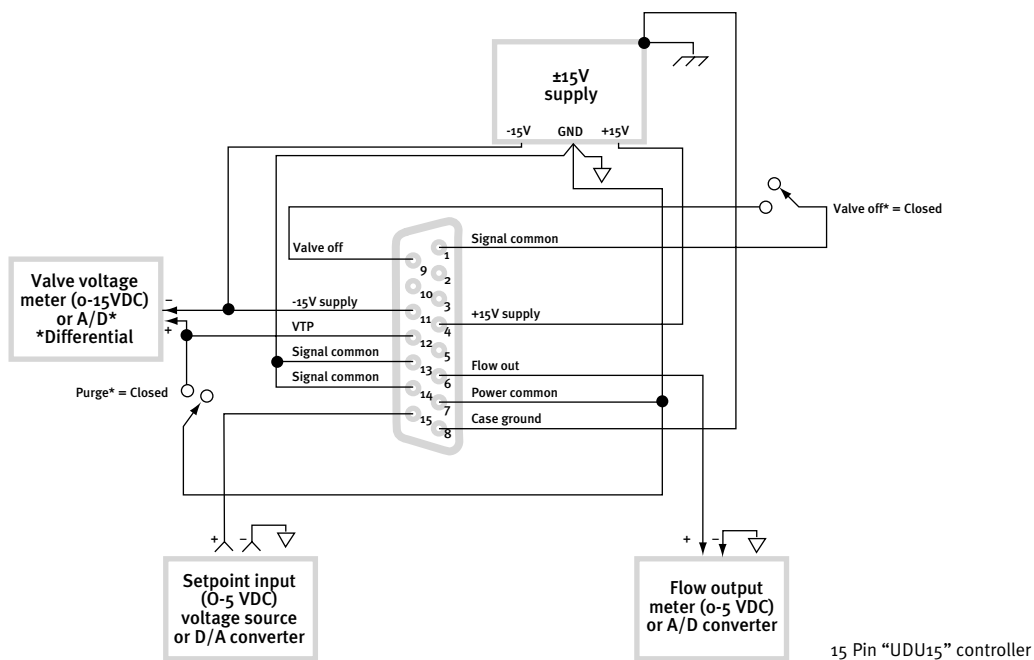
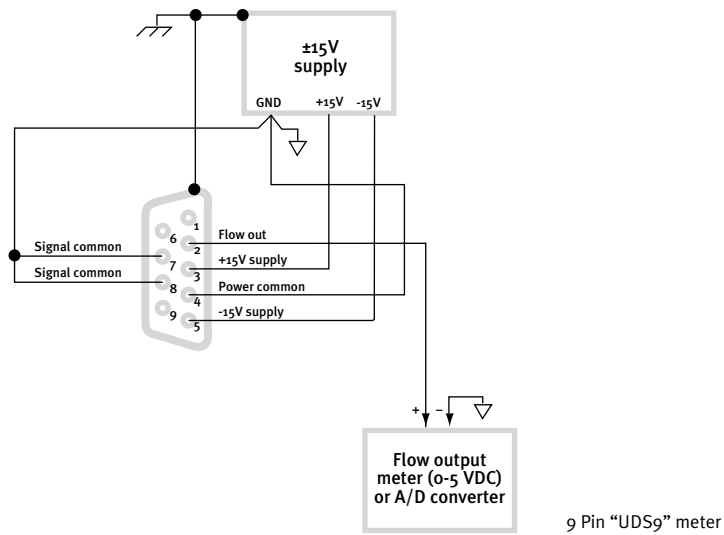


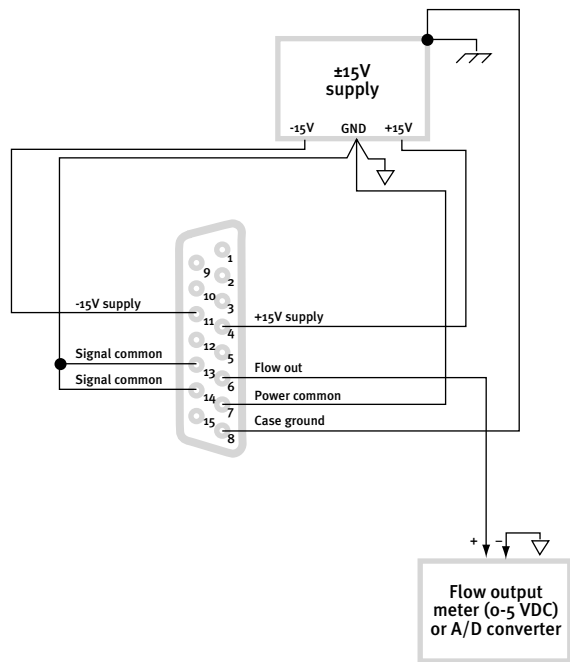


15 Pin "UDB15" meter

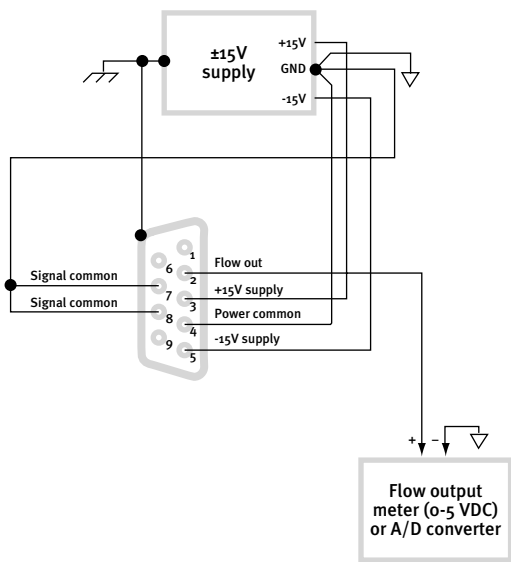


9 Pin "UDS9" controller

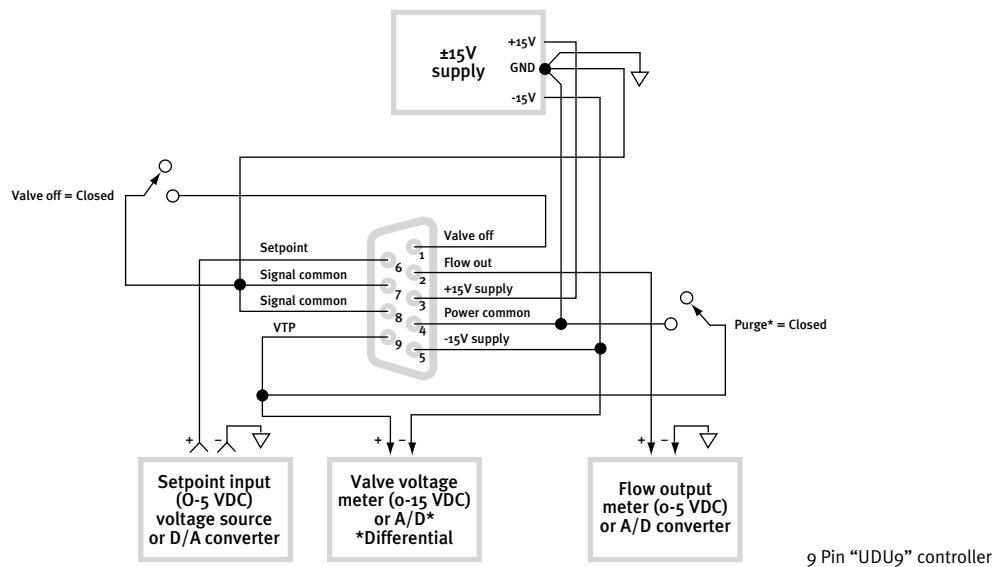




15 Pin “UDU15” meter



9 Pin “UDU9” meter



conclusion

Since overall instrument accuracy is directly affected by ground offsets, it is of the utmost importance to wire connections to the mass flow device as described above. Incorrect connections to the mass flow device can cause gross errors in read flow as well as cause permanent device damage. If you have any questions on the proper electrical connections of mass flow devices or if you need assistance with any applications, please call the Celerity Applications Engineering Department at (714) 921-2640 or visit us at www.celerity.net.



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