



C1 Controller & Driver

User's Guide



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Warnings & Notices

WARNING:

Installation and operation of electric and high pressure systems (fluids and compressed gas) involves risk including property damage and personal injury or death.

Installers and users should be properly trained or certified and take safety precautions. This product may cause death, personal injury, or property damage if improperly used or installed.

The information in this document and other information from Enfield Technologies and its authorized representatives are intended for use by persons having technical expertise in selecting and using these products. Product owners ("you") should analyze all technical and safety requirements of your specific application, including the consequences of any possible failure, before selecting a product. This product may not be suitable for all applications, such as those acting upon people. Suitability is solely your responsibility. Because the requirements for each application may vary considerably, you are solely responsible for conducting any testing or analysis that may be required to determine the suitability of the product for your application, and to ensure that all performance, safety and warning requirements for your application are met.

Caution:

While the product is low voltage, it contains open-frame electronic components and care should be taken to prevent unintentional contact with the product to avoid damage to person or property.

The C1 is an electro-static sensitive device. Use appropriate electro-static discharge (ESD) procedures during handling and installation.

Notice:

Use and purchase of this product is subject to Enfield Technologies' Terms and Conditions of Sale and Use. Improper installation or use voids warranty. Consult factory regarding special applications. Specifications are subject to change. Reasonable efforts have been made to provide useful and correct information in this document, but this document may contain errors and omissions, and it is subject to change.

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Quick Start Procedure

1. Configure Jumpers
 - a. Configure the left side of Jumpers 2 and 3 to select a command input of 0...10Vdc or 4...20mA
 - b. Configure the right side of Jumpers 2 and 3 to select a command input of 0...10Vdc or 4...20mA
 - c. Configure Jumper 1 to select control algorithm
2. Wire Feedback
 - a. For 4...20mA signals: 4mA should correspond to the minimum feedback value and 20mA should correspond to the maximum feedback value. Also, for 4...20mA signals, low side should connect to ground.
 - b. For 0...10V signals: 0V should correspond to the minimum feedback value and 10V should correspond to the maximum feedback value
3. Wire Command
4. Wire Power
5. Connect Pneumatic Lines
 - a. Connect valve as shown in "system setup"
 - b. Inlet air should be dry (-40F dew point) non-lubricated air, non-flammable & non-corrosive dry gases (0.3 micron fine grade coalescing filter with 5 micron pre-filter) at 0-150psig.
6. Tune System
 - a. Restore potentiometers to factory default settings
 - b. Tune System
7. Troubleshooting
 - a. See "Troubleshooting"
 - b. Contact Enfield Technologies for additional help

Factory Default Setting

Potentiometer

RP1 – Proportional Gain
RP2 – Ramp Rate
RP3 – Minimum Feedback
RP4 – Maximum Feedback

Factory Default Condition

Fully Counter Clockwise
Fully Counter Clockwise
Fully Counter Clockwise
Fully Clockwise

Setting

Proportional gain is zero
Command is not being ramped
No Adjustment to Minimum Position
No Adjustment to Maximum Position

Jumper

J1 – Control Algorithm
J2 (left side) - Command
J3 (left side) - Command
J2 (right side) - Feedback
J3 (right side) - Feedback

Factory Default Condition

Configuration #1
Jumper Off
Jumper Off
Jumper Off
Jumper Off

Setting

RP1 = Proportional Gain; RP2 = Ramp Rate RP3 = Minimum Feedback; RP4 = Maximum Feedback
0...10V Command
0...10V Command
0...10V Feedback
0...10V Feedback

LED

Power
Status

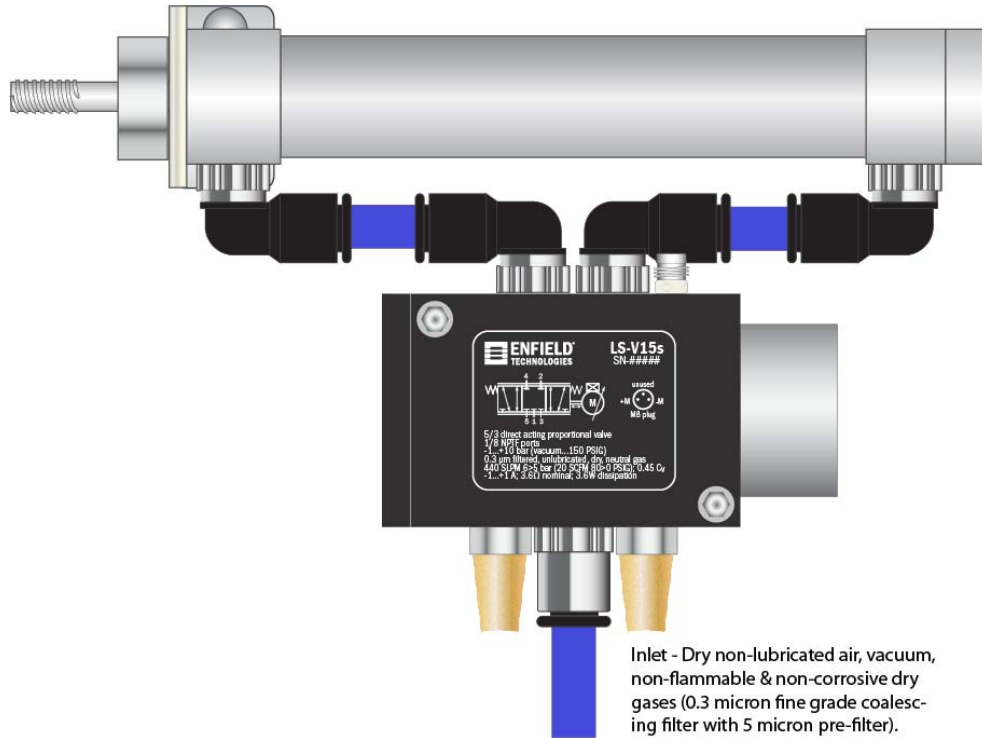
Factory Default Condition

On
Off

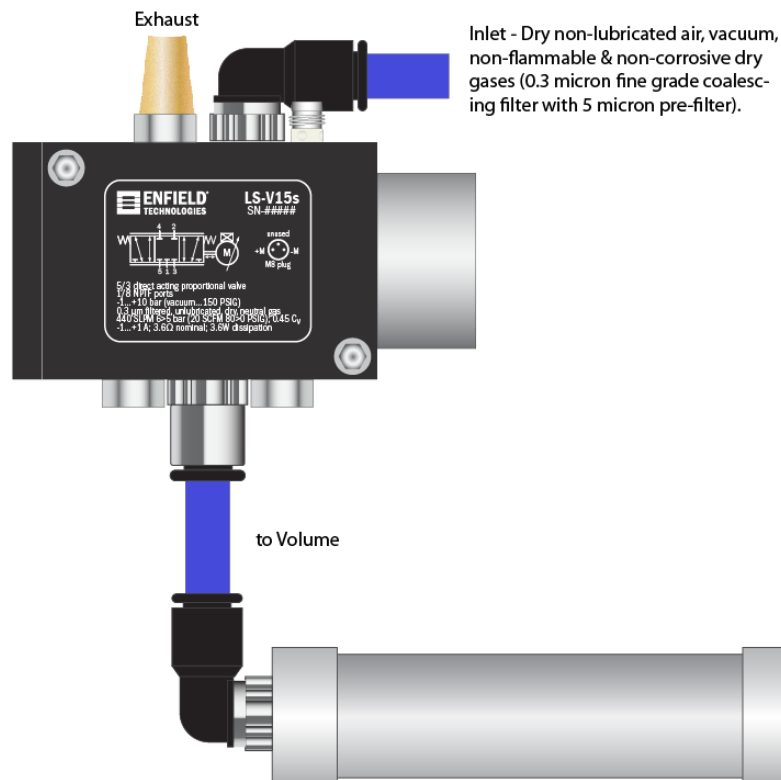
Setting

Power is On
Not Status or Fault Indications

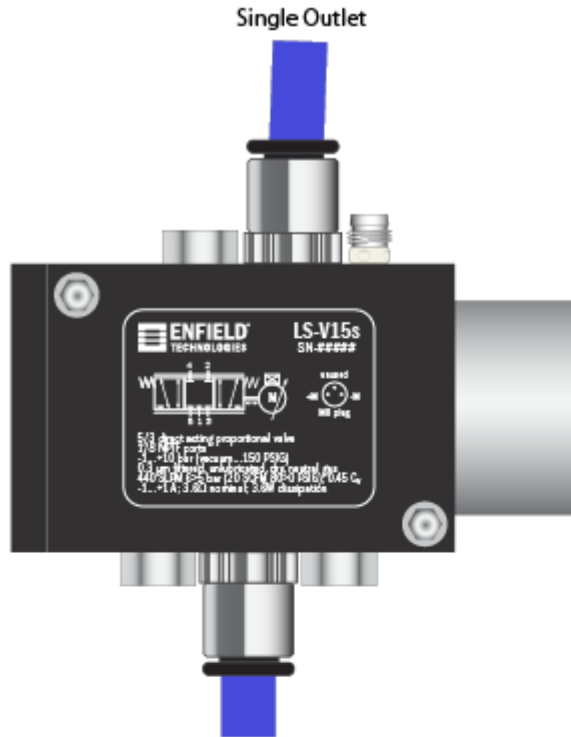
Position or Force Control



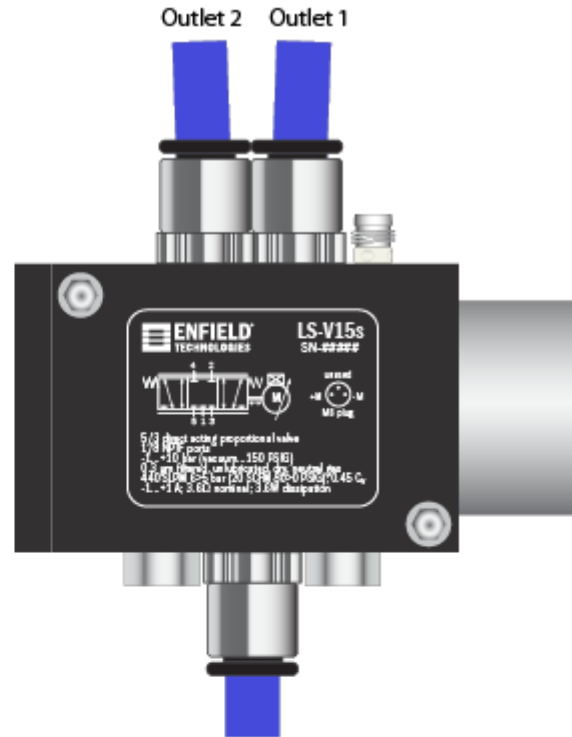
Pressure Control



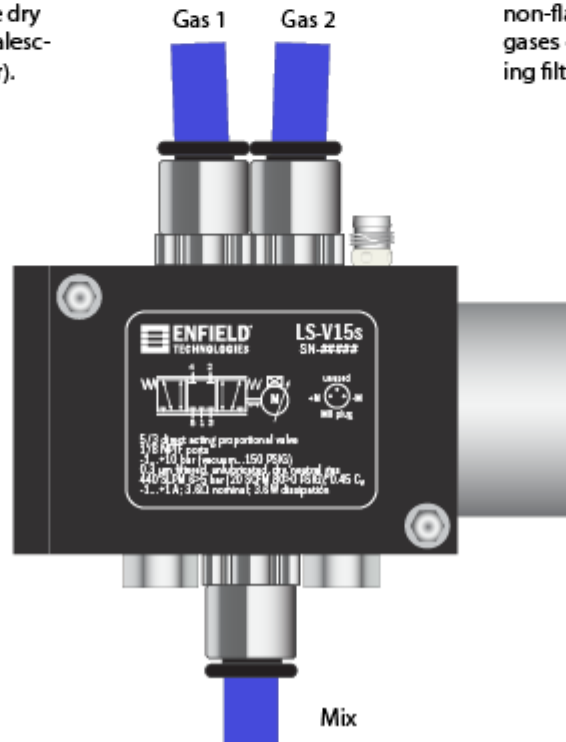
Flow Control



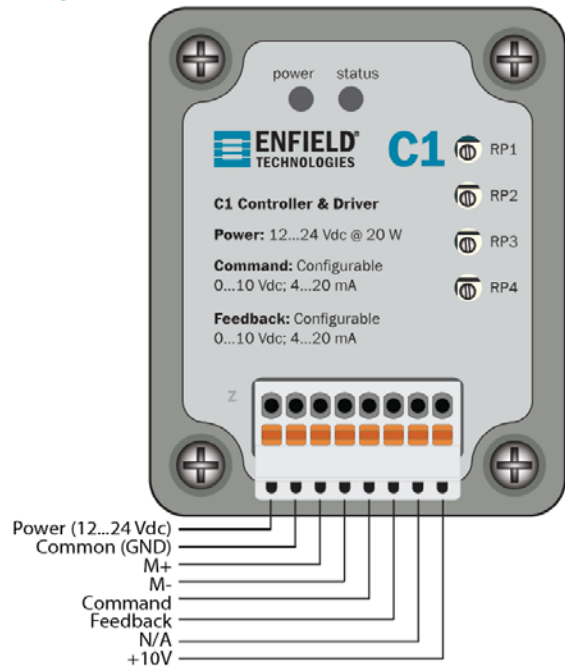
Inlet - Dry non-lubricated air, vacuum, non-flammable & non-corrosive dry gases (0.3 micron fine grade coalescing filter with 5 micron pre-filter).



Inlet - Dry non-lubricated air, vacuum, non-flammable & non-corrosive dry gases (0.3 micron fine grade coalescing filter with 5 micron pre-filter).

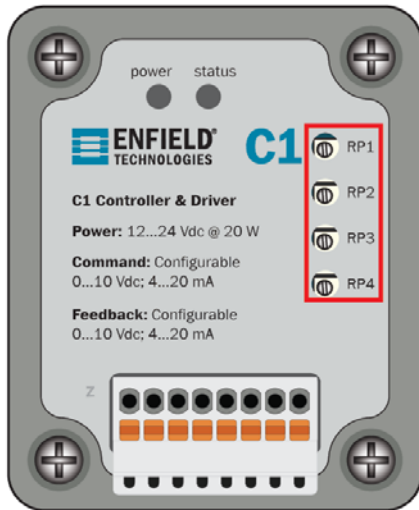


Wiring



Pin	Label	Function
1	+Pwr	+12...24VDC, power supply connection
2	Gnd	common (dc ground), connect to power supply common
3	M+	Valve+ (brown)
4	M-	Valve- (blue)
5	Cmd	Command Input
6	Fbk	Feedback Input
7	N/A	Not Used
8	+10	+10Vdc Excitation

Potentiometers/Tuning



The C1 has 4 potentiometers (RP1, RP2, RP3 and RP4) which allow the user to adjust different gains depending on jumper configuration. For instructions on how to switch between configurations see the Jumper Configurations section. A polymer non-conductive screwdriver is the preferred method for adjusting the potentiometers. Care should be taken not to allow metal screwdrivers to touch other components on the board.

Proportional Gain – By adjusting the proportional gain, the user can adjust the responsiveness of the system to changes in command or feedback. The responsiveness of the system can be increased or decreased by turning the proportional gain clockwise or counterclockwise, respectively. A gain that is too low can result in an unresponsive system while a gain that is too high can cause the system to become unstable.

Derivative Gain – By adjusting the derivative gain, the user can set the damping applied to the system. This damping can be increased or decreased by turning derivative gain clockwise or counterclockwise, respectively. Damping helps reduce overshoot and smoothes out system performance. However, too

much derivative can cause the system to undershoot and “creep” into the target position or become unstable.

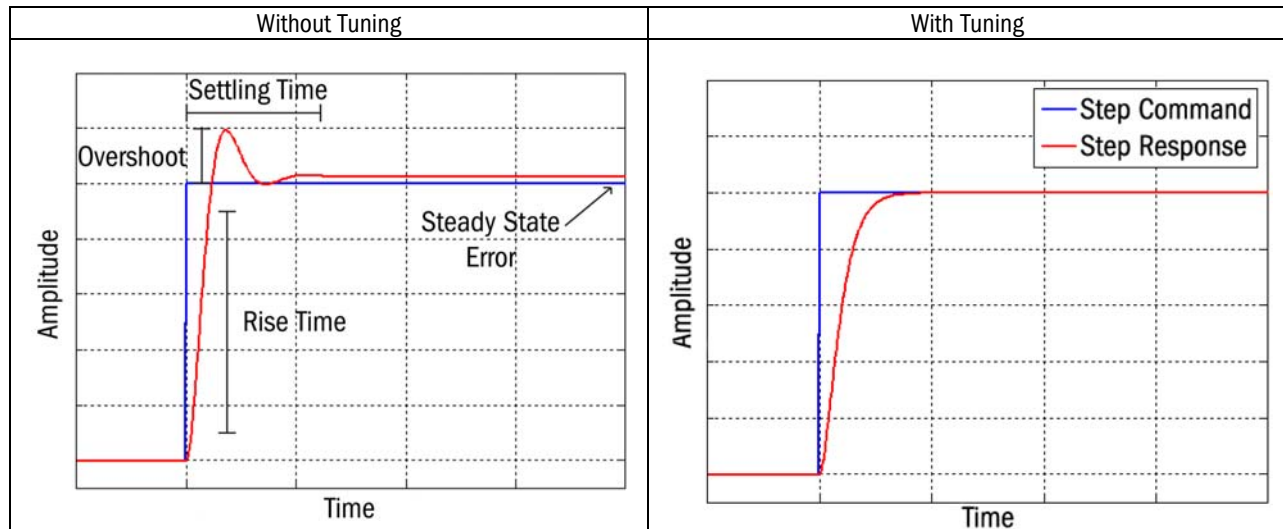
Integral Gain – By adjusting the integral gain, the user can reduce the steady state error of the system. Integral gain be increased or decreased by turning the potentiometer clockwise or counterclockwise, respectively. Too little integral gain can result in steady state error while too much integral gain can cause oscillations and overshoot.

Ramp Rate – By adjusting the ramp rate, the user can set the ramp rate of the command input to the controller. The ramp rate be increased or decreased by turning the potentiometer clockwise or counterclockwise, respectively. A high ramp rate results in a slower rise time while a lower ramp rate results in a faster rise time.

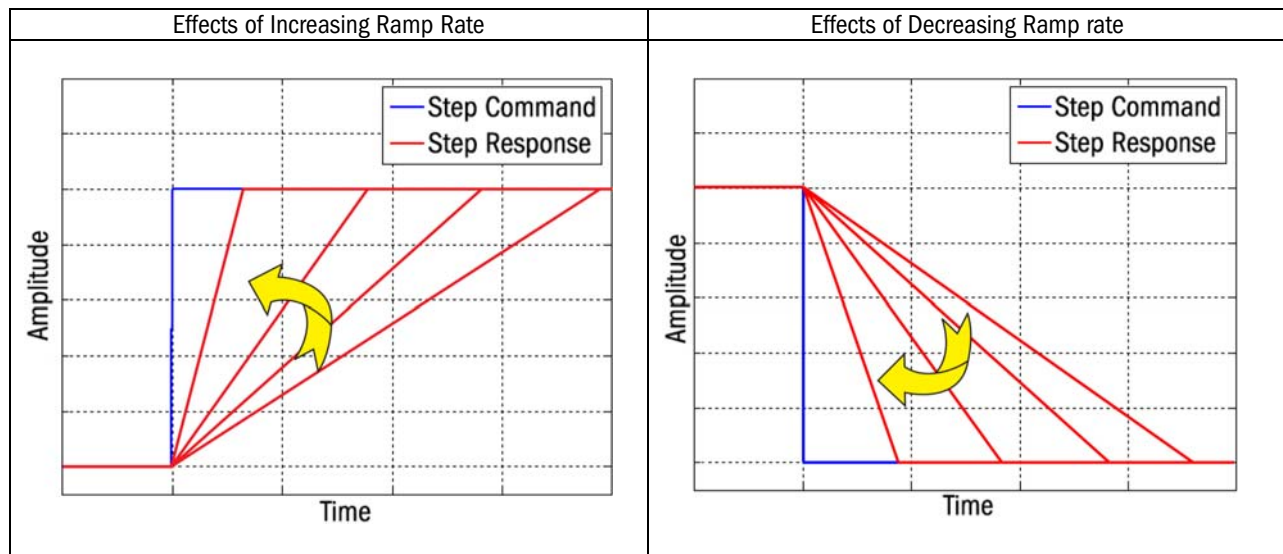
Minimum Feedback – By adjusting minimum feedback, the user can offset the minimum feedback value for the controller. For feedback sensor with a minimum output greater than 0V or 4mA, this adjustment should be used. The minimum feedback be increased or decreased by turning the potentiometer clockwise or counterclockwise, respectively. For sensors that do not require any offset, this potentiometer should be set fully counter clockwise.

Maximum Feedback – By adjusting maximum feedback, the user can offset the maximum feedback value for the controller. For feedback sensor with a maximum output less than 10V or 20mA, this adjustment should be used. The maximum feedback be increased or decreased by turning the potentiometer clockwise or counterclockwise, respectively. For sensors that do not require any offset, this potentiometer should be set fully clockwise.

For a more detailed explanation of PID controls see effects of increasing gains below.

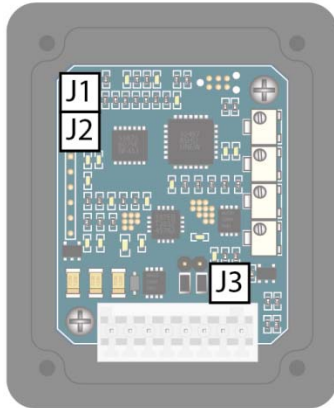


Effects of Increasing Gains				
Parameter	Rise time	Overshoot	Settling time	Steady State Error
Proportional Gain	Decrease	Increase	Small change	Decrease
Integral Gain	Decrease	Increase	Increase	Eliminate
Derivative Gain	Small Change	Decrease	Decrease	None

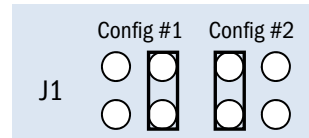


Jumper Configurations

To configure jumpers remove lid for access



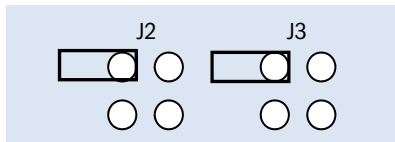
Configure Potentiometers



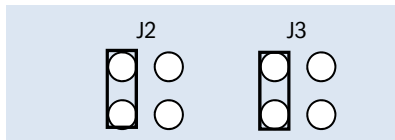
To switch between control configurations

1. Remove air from the system.
2. Turn power off.
3. Move jumper to desired configuration.
4. Turn power back on.
5. Upon powering, the red LED will be blinking quickly.
6. Turn all potentiometers fully counter clockwise.
7. Green LED will blink four times slowly. This will indicate that the driver has switched configurations.

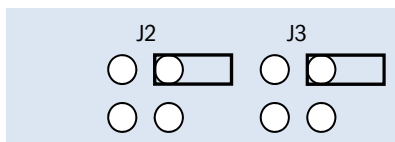
Configure Command for 0...10Vdc



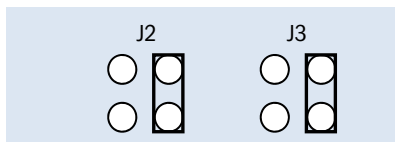
Configure Command for 4...20mA



Configure Feedback for 0...10Vdc



Configure Feedback for 4...20mA



Troubleshooting

Symptom	Probable Causes	Corrective Action
System Totally Unresponsive	Power Not Applied	Apply power, check all power wiring
	Air Off	Turn air on
	Proportional Gain too Low	Turn Proportional Gain Clockwise
	Inverted Polarity	Verify signal wiring for command and feedback; also verify mechanical system polarity
	Signal Wiring	Verify all Wiring
System Mildly Responsive or Sluggish	Proportional Gain too Low	Turn Proportional Gain Clockwise
	Power Supply Voltage not Stable	Check power wiring; change power supply
System 'Pegs' or 'Rails'	No Feedback Signal	Connect Feedback Signal
	Feedback Connected Improperly	Verify all wiring is as shown in application examples and as described in the "System Setup" section of this document
System Fails to Converge or is Inaccurate	Incorrect Wiring	Verify all wiring is as shown in application examples and as described in the "Installation" section of this document
	Mechanical System	Consult Factory for Suggestions
	Proportional Gain too Low	Turn Proportional Gain Clockwise
	Increase Integral Gain	Turn Integral Gain Clockwise
	Maximum Feedback Set Incorrectly	Adjust the Maximum Feedback Potentiometer
	Minimum Feedback Set Incorrectly	Adjust the Maximum Feedback Potentiometer
	Air Leaks	Insure there are no air leaks in the system
	Valve Sticking	Insure that inlet air meets valve specifications.
System Oscillates	Proportional Gain too High	Turn Proportional Gain Counter Clockwise
	Integral Gain too High	Turn Integral Gain Counter Clockwise
	Valve Oversized for System	Consult Factory
System 'Buzzes'	Input Signal Noise (possibly 60Hz)	Verify that large or high power machinery is not operating nearby. Also, verify input signal integrity by examining the signal with an oscilloscope.
	Input Signals not connected	Verify all wiring as shown in the "System Setup" section of this document
	DC Common not connected	Verify all DC common connections
High Pitched Tone or Whine from Valve	Dither	This is an artifact of the built-in dither and is intended to keep the electro-mechanical device in constant motion.

Warranty: This product is covered by a 1 year Enfield Technologies limited warranty. Contact Enfield Technologies or visit website for more details.

Notice: Use and purchase of this product is subject to Enfield Technologies' Terms and Conditions of Sale and Use. Improper installation or use voids warranty. This product may not be suitable for all applications, such as those acting upon people, and suitability is solely the buyer's responsibility. Consult factory regarding special applications.