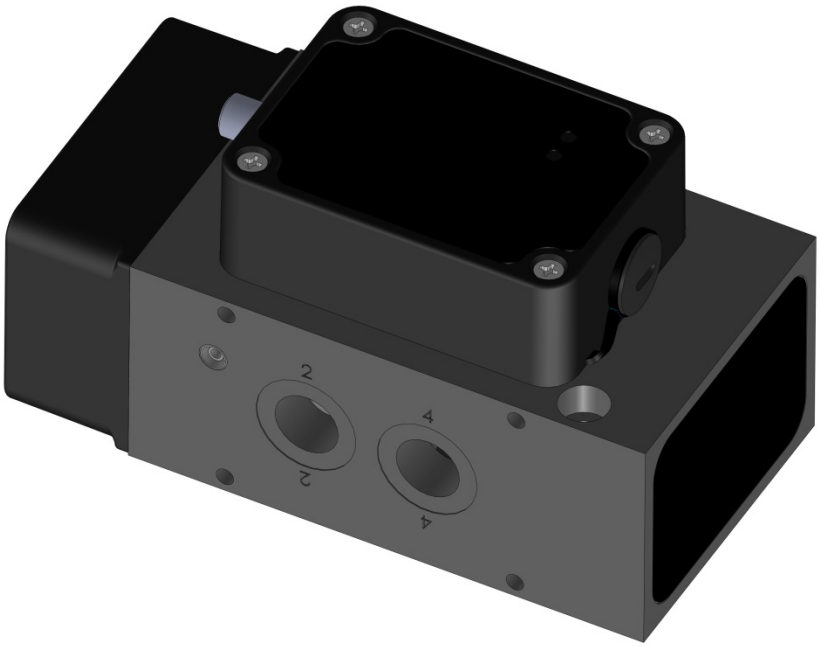
ENFIELD TECHNOLOGIES

# S2-025-U-04 (USB S2)
# Servo Pneumatic Proportional Control System

## User's Guide



## Table of Contents

## 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 un-intentional contact with the product to avoid damage to person or property.

The S2-025-U-04 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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## Factory Default Setting

| Initial Signals Configuration | Factory Default Condition | Setting |
|---|---|---|
| Command | 0-10V | Command input setup for 0-10V |
| Feedback | 0-10V | Feedback input setup for 0-10V |
| Invert Feedback Sensor Polarity | Unchecked | Force Damping gain is zero |

| Cylinder Configuration | Factory Default Condition | Setting |
|---|---|---|
| Cylinder Bore | 2.000 in | Cylinder bore size set to 2.000 inches |
| Rode Diameter | 1.000 in | Cylinder rod size set to 1.000 inch |
| Area Ratio | 0.8920 | Area Ratio set to 0.8920 |
| Port Connection | Standard | Port 2 connects to back of cylinder and port 4 to front |

| Basic Settings | Factory Default Condition | Setting |
|---|---|---|
| Proportional Gain | 0% | Proportional gain set to zero |
| Derivative Gain | 0% | Derivative gain set to zero |
| Force Damping Gain | 0% | Force Damping gain set to zero |
| Offset | 0% | Offset set to zero |

| Advanced Settings | Factory Default Condition | Setting |
|---|---|---|
| Minimum Position | 0% | No adjustment to minimum position |
| Maximum Position | 100% | No adjustment to maximum position |
| Ramp Up | 0% | Command input is not ramped in extend direction |
| Ramp Down | 0% | Command input is not ramped in retract direction |

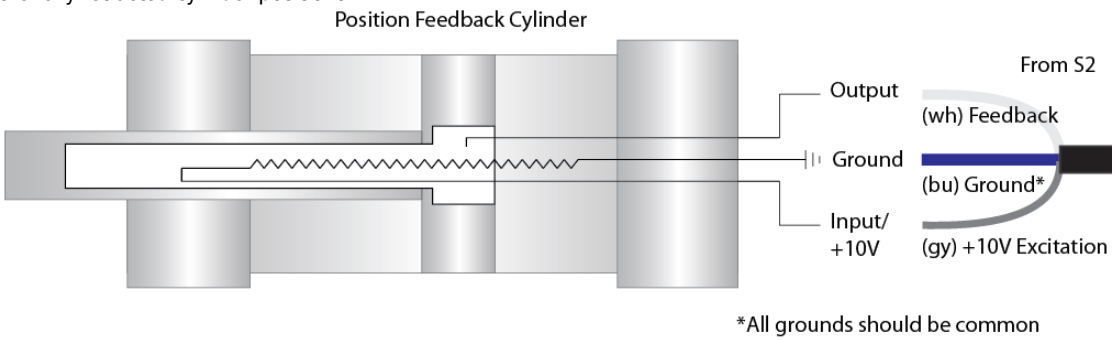
| Valve Settings | Factory Default Condition | Setting |
|---|---|---|
| Deadband | 0% | No deadband elimination is being implemented |
| Dither Amplitude | 75% | Dither amplitude is set at 75% of maximum |
| Valve Offset | 0% | Valve's spool position is not offset in either direction |

| LED | Factory Default Condition | Setting |
|---|---|---|
| Power LED | Red | Power is on |
| Status LED | Green | Offset ≈ 0 (RP4 is centered) |

## Quick Start Procedure

1. Wire Feedback

    a. Resistive Feedback Devices - For Resistive Feedback devices: the grey wire of the S2-025-U-04, +10V, should be connected to the high side of the resistor, the blue wire, ground, should be connected to the low side of the resistor, and the white wire, feedback, should be connected to the output. Ensure proper polarity with a +10V output corresponding to the fully extended position and a 0V output corresponding to the fully retracted cylinder positions.




*All grounds should be common

    b. Powered Feedback Devices - when using a powered feedback sensor, use manufacturer's requirements for powering the sensor. The output of the sensor should be connected to the white wire, feedback, of the S2-025-U-04. For 4...20mA feedback signals, ensure that the low side is connected to ground, the blue wire of the S2-025-U-04. For 0...10Vdc sensors, ensure proper polarity with a +10V output corresponding to the fully extended position and a 0V output corresponding to the fully retracted cylinder positions. For 4...20mA sensors, ensure proper polarity with a 20mA output corresponding to the fully extended position and a 4mA output corresponding to the fully retracted cylinder positions

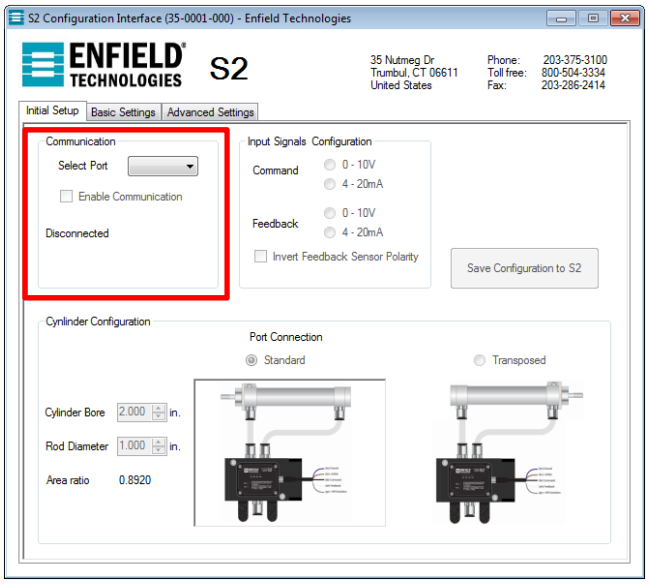
    Note: The input impedance for 0...10Vdc inputs is 100kΩ while the input impedance for 4...20mA signals is 210Ω

2. Wire Command
    a. "Command +" (0...10V or 4...20m input) should be connected to the black wire of the S2-025-U-04 and "Command –" (0V) should be connected to the blue wire of the S2-025-U-04.

3. Wire Power
    a. "Power +" (+12 or +24V) should be connected to the brown wire of the S2-025-U-04 and "Power –" (0V) should be applied to the blue wire.

4. Connect to Valve

   a. Connect Enfield Technologies'' USB cable, A-CBL-SAUB-0405P-MM-XXXX, or equivalent from the computer to the S2-025-U-04 valve.
   b. Launch the S2-025-U-04 Configuration Interface.
   c. Click on the Initial Setup Tab
   d. In the Communication section, shown in the red box below, select the COM port associated with the valve from the Select Port drop down.

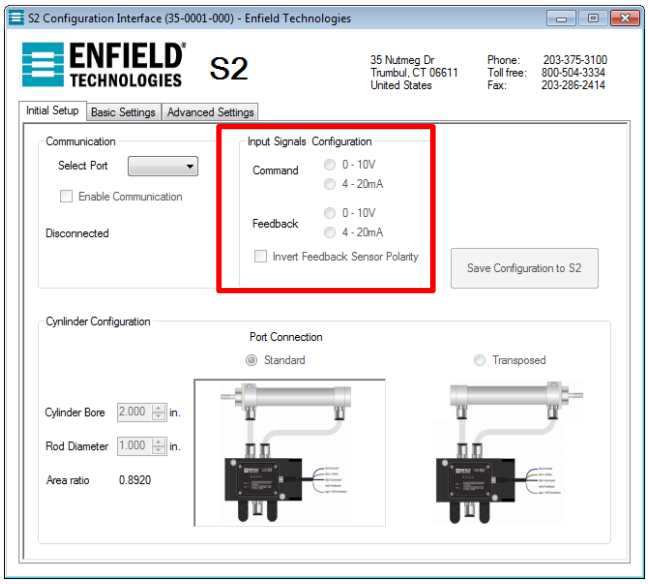



   e. Once the COM port has been selected, click the "Enable Communication" checkbox.
   f. The valve should now be connected. Valve serial number and software version will now be displayed.

5. Confirm the feedback signal is working properly

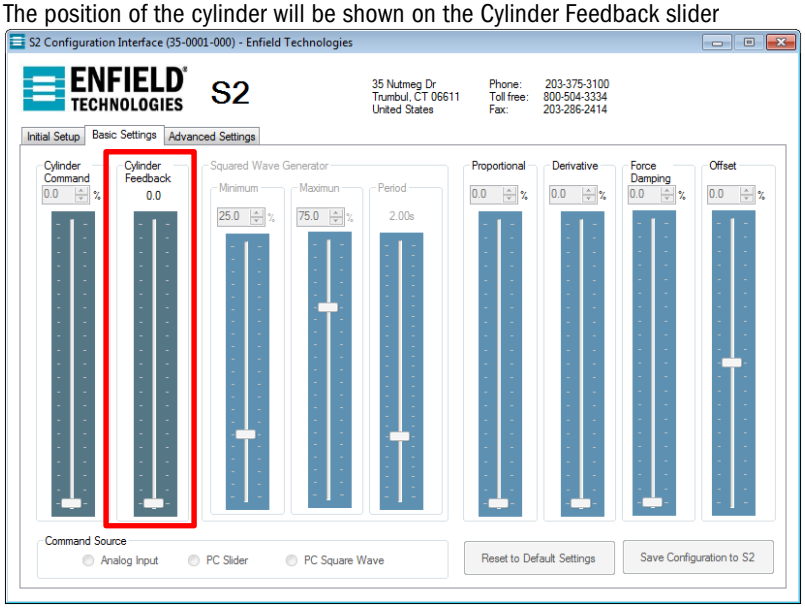
   a. Click on the Initial Setup Tab

   b. In the input signals configuration, shown in the red box below, select whether the feedback input is 4...20mA or 0...10V



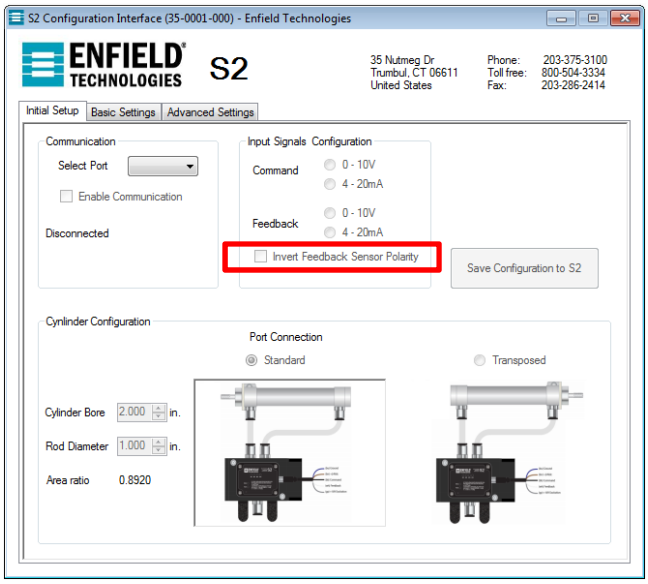

   c. Click on the Basic Settings Tab

   d. The position of the cylinder will be shown on the Cylinder Feedback slider




   e. Move the cylinder by hand and confirm that the valve is receiving the feedback signal. The Cylinder Feedback slider should proportionally increase from 0...100% as the cylinder is extended.

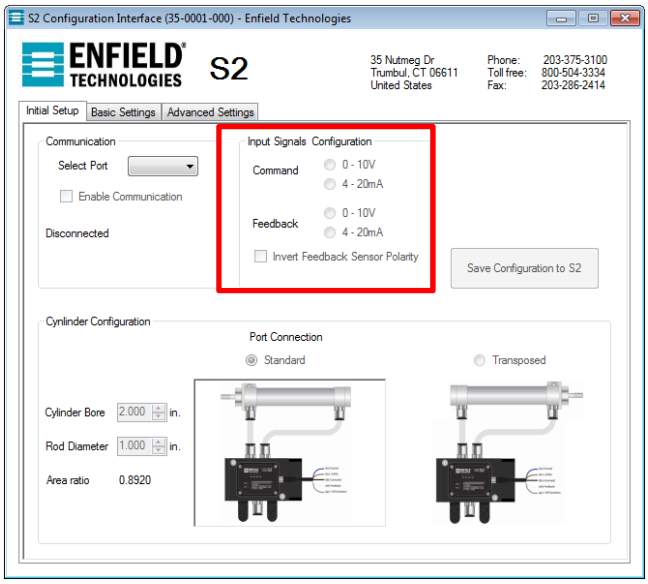
f. If the Cylinder Feedback slider decreases from 100% to 0% as the cylinder is extended, the polarity of the feedback sensor is transposed. To correct this, click the "Invert Feedback Sensor Polarity" checkbox, shown in the red box below



6. Confirm the command signal is wired properly

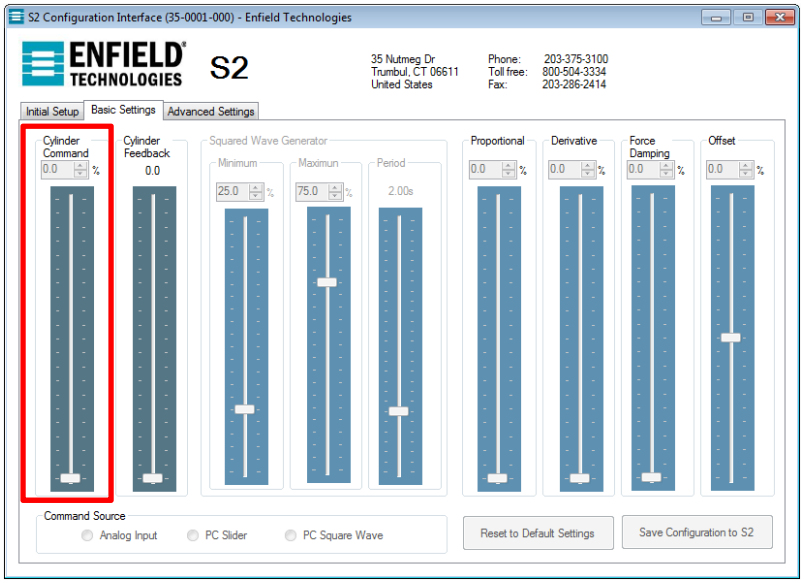
   a. Click on the Initial Setup Tab

   b. In the input signals configuration, shown in the red box below, select whether the command input is 4...20mA or 0...10V



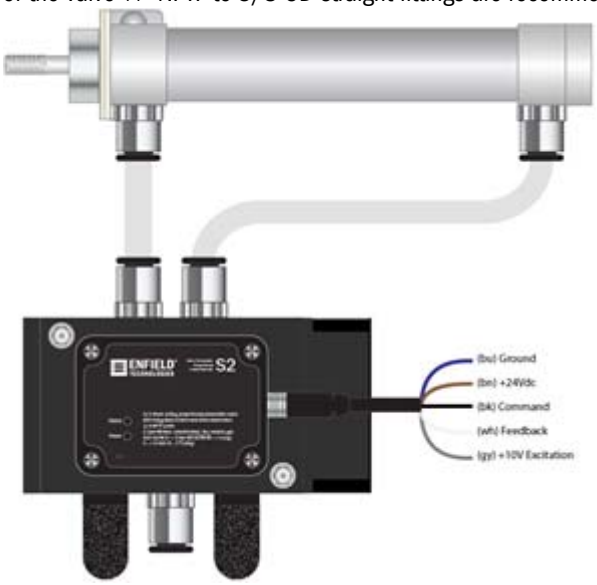

   c. Click on the Basic Settings Tab

   d. The command signal from the PLC analog output or other analog input source will be shown on the Cylinder Command slider

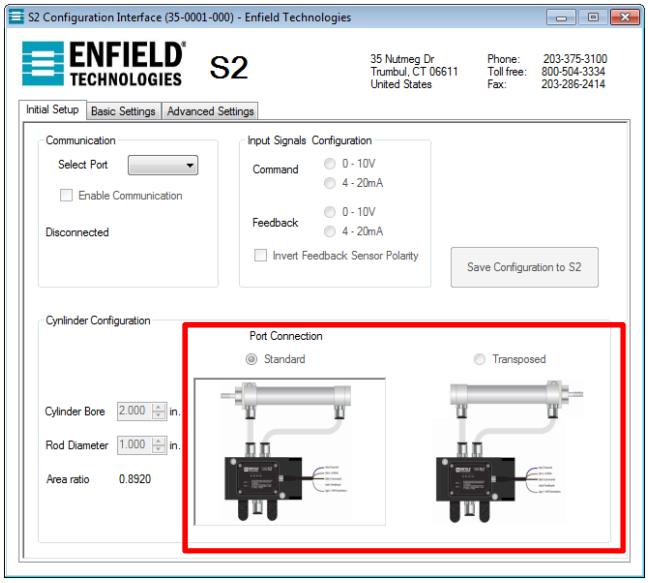



   e. Vary this output to confirm that the valve is receiving the command signal. The Cylinder Command slider should move from 0...100% as the command from the PLC is increased from 0...10V or 4...20mA.

7. Connect Pneumatic Lines
    a. Connect port 2 of the valve to the back of the cylinder and port 4 to the front as shown below. It is recommended that the valve be placed as close as possible to the cylinder. To minimize pressure drop out of the valve ¼" NPTF to 3/8 OD straight fittings are recommended.




    b. If it desirable to connect port 4 of the valve to the back of the cylinder and port 2 to the front, go to the initial setup tab and select the "Transposed" checkbox in the Port Connection area, shown in the red box below.



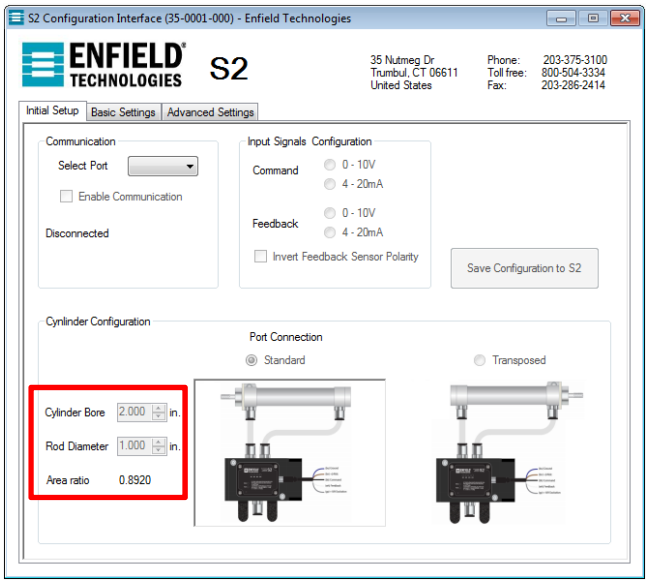

    c. Inlet air should be dry (-40C dew point) non-lubricated air, non-flammable & non-corrosive dry gases (0.3 micron fine grade coalescing filter with 5 micron pre-filter) at 0-150psig (80-120 typical with minimal pressure fluctuation).

    d. Once air filtration specification has been confirmed, connect inlet air to port 1

8. Set Cylinder Area Ratio

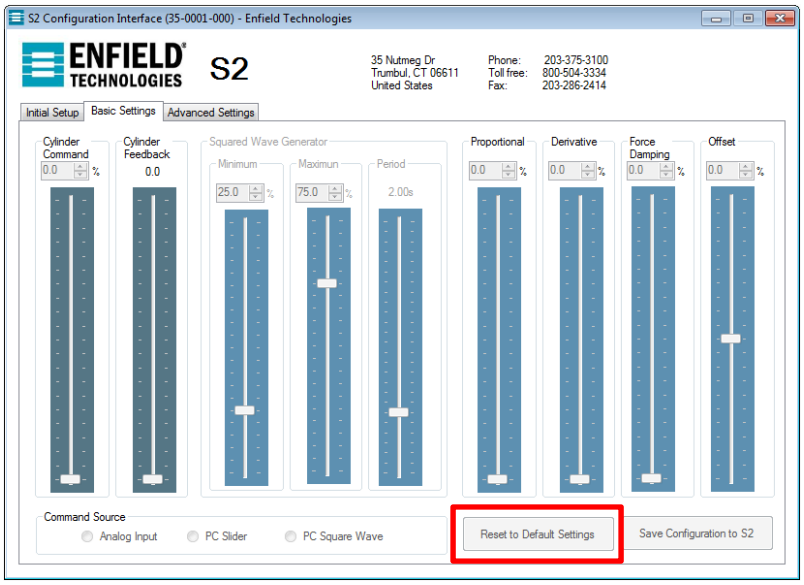
   a. Click on the Initial Setup tab

   b. In the Cylinder Configuration section, shown in the red box below, enter the diameter in inches of the cylinder bore and rod diameter.



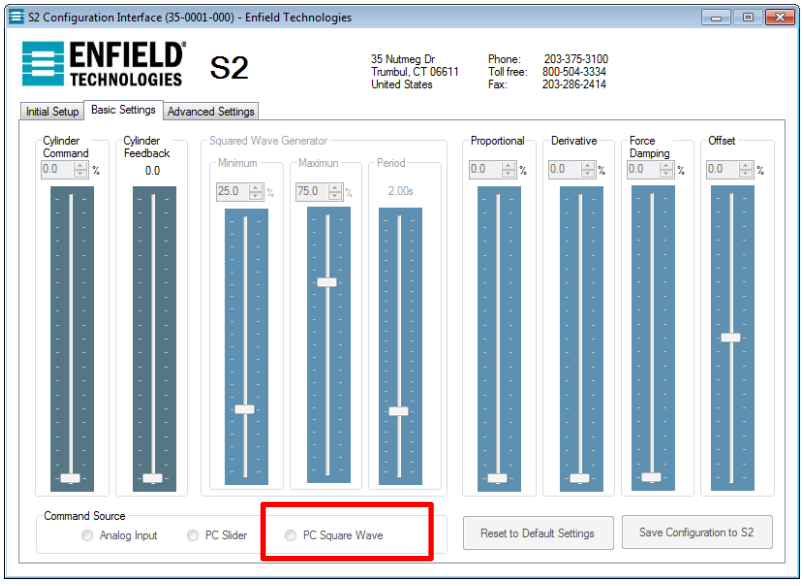

   c. Once entered, the Area ratio will be calculated automatically.

9. Tune System
    a. Restore to factory default settings by clicking the box highlighted in red below.

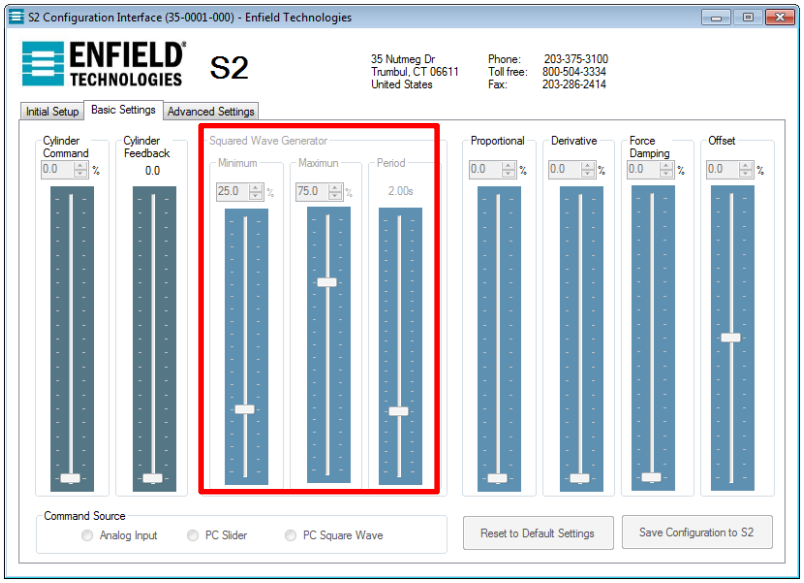



    b. Turn on air to the system

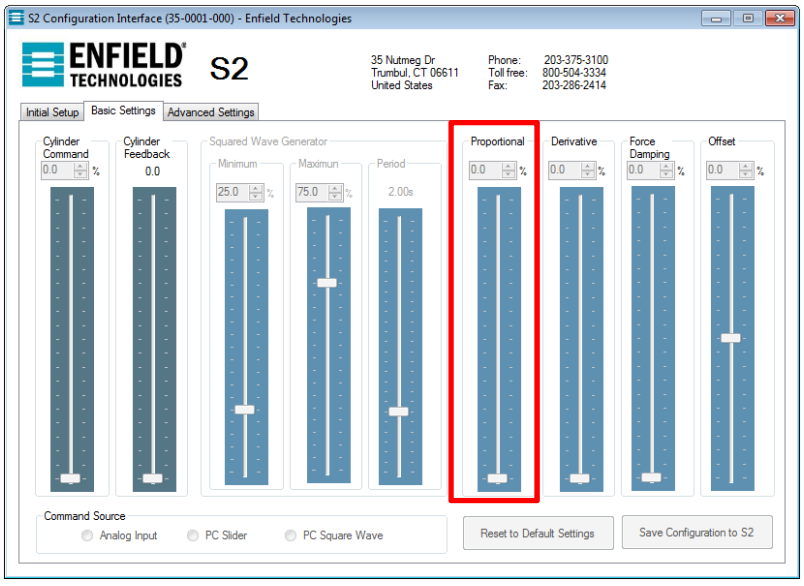
    c. Select the PC Square wave check box from the Command Source selection, shown, show in the red box below.



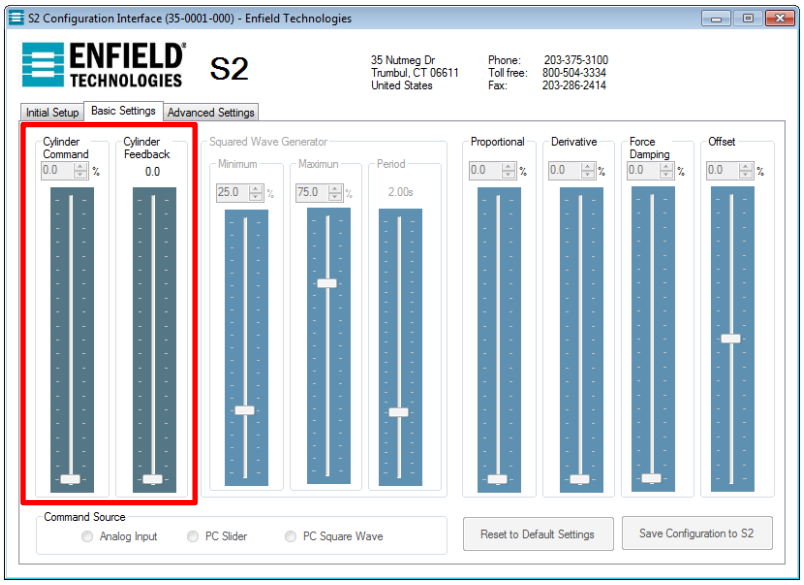

    d. This will provide a text command signal that alternates between the two positions set by the Minimum and Maximum sliders, shown in the red box below. The Period slider will determine the amount of time for each cycle. To begin testing, use a signal such as 25% Minimum, 75% maximum and 4.00 Second for Period.



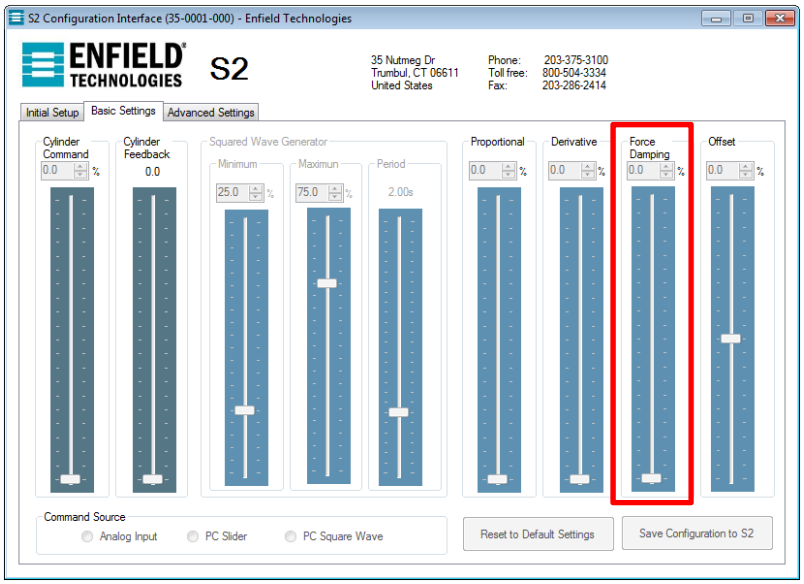

e. Increase the Proportional slider slowly (1% increments). The system should begin to move. If the system is not responding or is stuck in the fully extended or retracted position check tubing and feedback sensor polarity.



f. Continue increasing the Proportional Slider until the Cylinder Feedback slider begins to follow the Cylinder Command Slider.

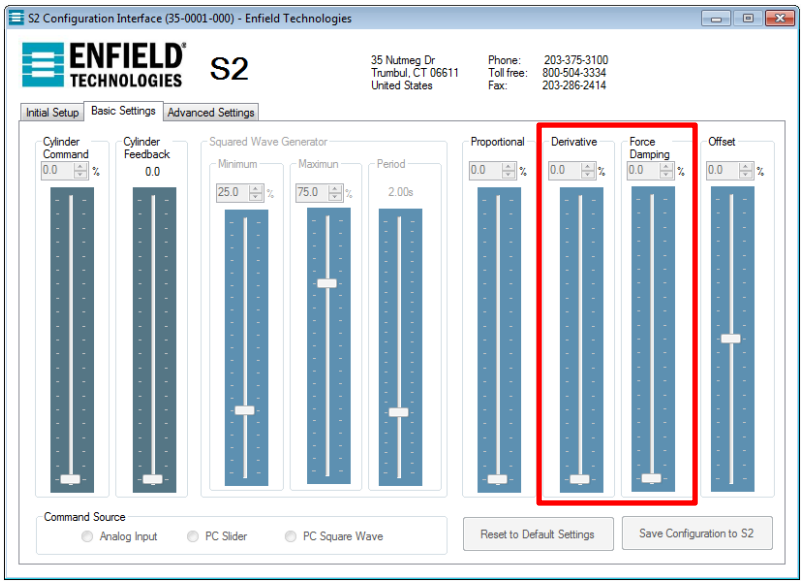



g. If the system begins to oscillate or overshot, increase the Force Damping slider until the oscillation or overshoot has been removed.

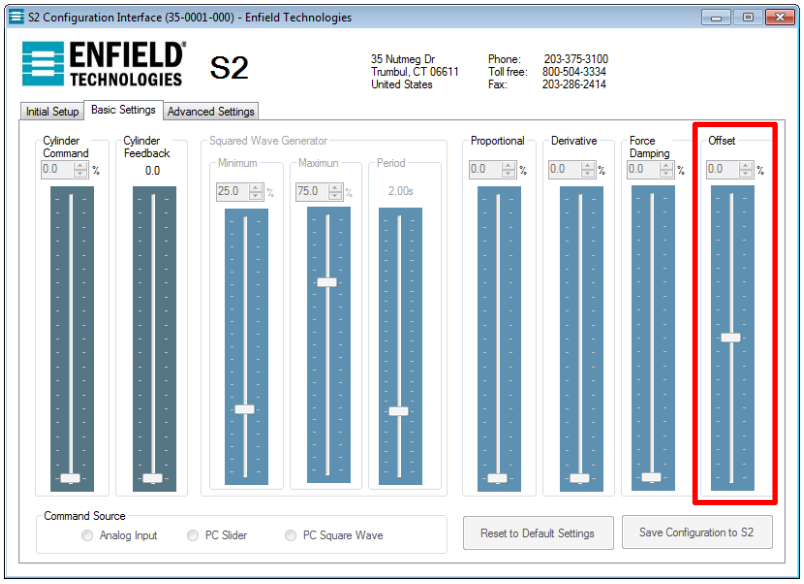



h. Repeat the two previous steps as necessary, until the system exhibits the desired dynamics.

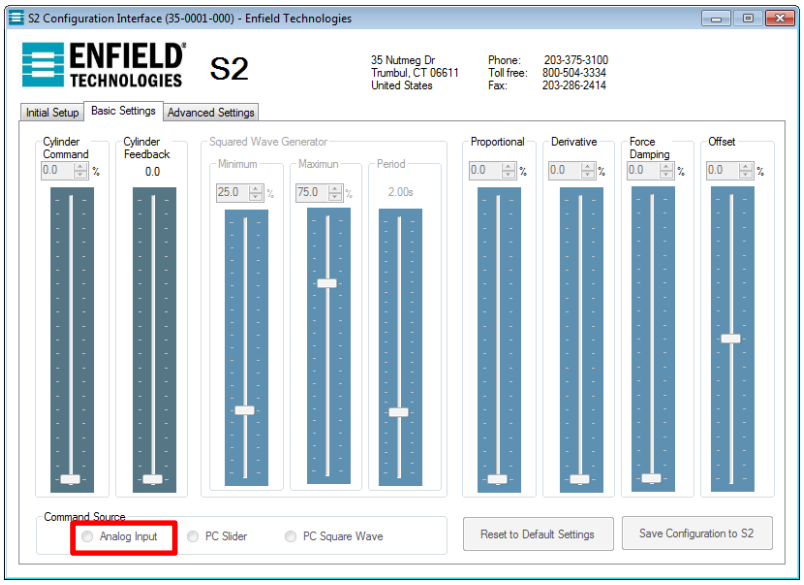
i. To optimize system performance, slowly decrease the Force Damping slider and increase the Derivative slider until optimum system performance is reached.



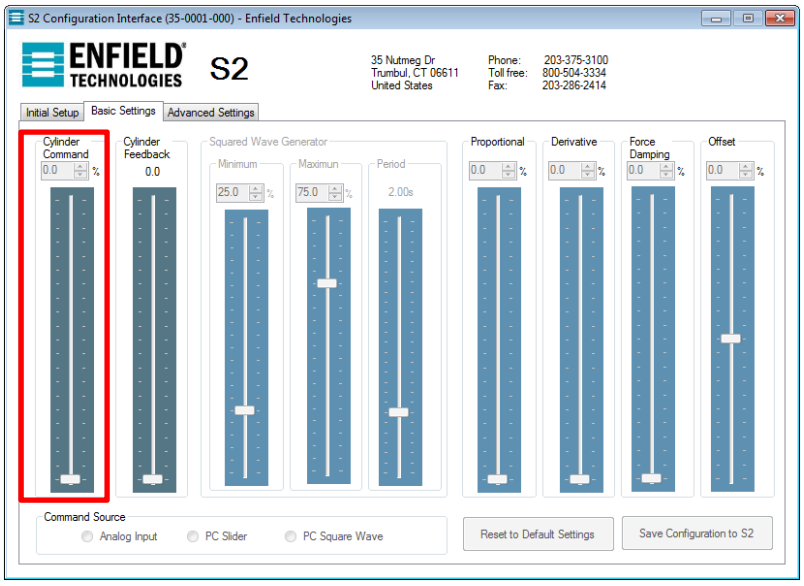

j. If an offset is noticed between the Cylinder Command and Cylinder Feedback sliders, the Offset slider can be adjusted to compensate. This is most likely the case in vertical applications. Assuming no mechanical linkages reversing direction of motion: for cylinder with rods facing up, increase the offset and for cylinders with rods facing down decrease the offset.



k. Select the Analog Input checkbox, shown in the red box below, to switch the command back to your external input.




l. Confirm that the system is responding to your analog input signal. You will be able to see the Cylinder Command slider moving in unison with your command signal. If this does not happen, confirm your command source and wiring.



10. Troubleshooting
    a. Check to see if probable cause and corrective action is listed in the table below

| 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 | Increase the Proportional Slider |
| | 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 | Increase the Proportional Slider |
| | Force Damping Gain too High | Decrease Force Damping Slider |
| | Power Supply Voltage not Stable | Check power wiring; change power supply |
| | Cylinder too Small | Decrease moving mass, increase cylinder size, or increase inlet pressure. |
| 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 "Wire Feedback" section of this document |
| | Cylinder Connected Improperly | Verify Polarity of Cylinder as shown in "Connect Pneumatic Lines" |
| 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 | Insure mechanical system is free from binding and high friction. |
| | Proportional Gain too low | Increase the Proportional Slider |
| | Force Damping too high | Decrease Force Damping Slider |
| | Offset Gain adjusted incorrectly | Adjust the offset slider |
| | Wrong Area Ratio | Check the "Cylinder Bore" and "Rod Diameter" settings |
| | Air Leaks | Insure there are no air leaks in the system |
| | S2-025-U-04 Sticking | Insure that inlet air meets valve specifications. See "Connect Pneumatic Lines" |
| System Oscillates | Proportional Gain too high | Decrease Proportional gain slider |
| | Not Enough Force Damping | Increase Force Damping slider |
| | Derivative Gain too high | Decrease Derivative gain slider |
| 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 "Wire Command" and "Wire Feedback" sections of this document |
| | DC Common not connected | Verify all DC common connections |

    b. Contact Enfield Technologies for additional help

## Maximum Moving Mass

The table below recommends the maximum moving mass for a cylinder controlled by a S2-025-U-04 for horizontal and vertical applications. Actual mass will vary based on cylinder speed and mechanical assembly (e.g. friction in cylinder or system, air pressure, etc.)

| Cylinder Bore Size (Inches) | Maximum Weight (Pounds) | |
|---|---|---|
| | Horizontal | Vertical |
| 1-1/16 | 55 | 15 |
| 1-1/4 | 75 | 20 |
| 1-1/2 | 110 | 25 |
| 1-3/4 | 150 | 35 |
| 2 | 200 | 50 |
| 2-1/2 | 240 | 80 |
| 3 | 330 | 110 |
| 4 | 400 | 200 |
| 5 | 500 | 310 |
| 6 | 800 | 450 |
| 8 | 1200 | 800 |