ENFIELD TECHNOLOGIES

TR Electronic Pressure Regulator Series

User's Manual

Table of Contents

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Warnings, Cautions & 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 TR-series 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 Settings

Configuration	Factory Default Condition	Setting
Command Input Signal Type	0...10V	Command input set for 0...10V
Invert Command Signal Polarity	Unchecked	Pressure increases as command input increases
Calibrated Range (models with internal sensor – TR-###-g10-s)	0...10 bar (0...145 psi)	Commanded range is setup for 0...10 bar (0...145psi)
Pressure Range (models with external sensor – TR-###-v-ex)	-1...10 bar (-14.5...145 psi)	Commanded range is setup for -1...10 bar (-14.5...145 psi)

Setup	Factory Default Condition	Setting
Proportional Gain	40%	Proportional gain set to a default of 40
Integral Gain #1	10%	Integral gain set to a default of 10
Derivative Gain	10%	Derivative gain set to a default of 10
Command Ramp Rate Up	0%	In response to an increase in command pressure, the TR will increase outlet pressure as quickly as possible.
Command Ramp Rate Down	0%	In response to a decrease in command pressure, the TR will decrease outlet pressure as quickly as possible.

Advanced	Factory Default Condition	Setting
Integral Window	5%	Integral gain #2 will be used until outlet pressure is within 5% of the commanded signal. Within 5%, Integral Gain #1 is used.
Integral Gain #2	0%	Integral gain used when control error is outside of the Integral Window.
Filter	1500	Filter gain set for 1L volume at the end of a 1 m of 3/8" tubing.

LED	Factory Default Condition	Setting
Power LED	Red	Power is on
Status LED	Green	No Fault Codes

Filtration and Plumbing

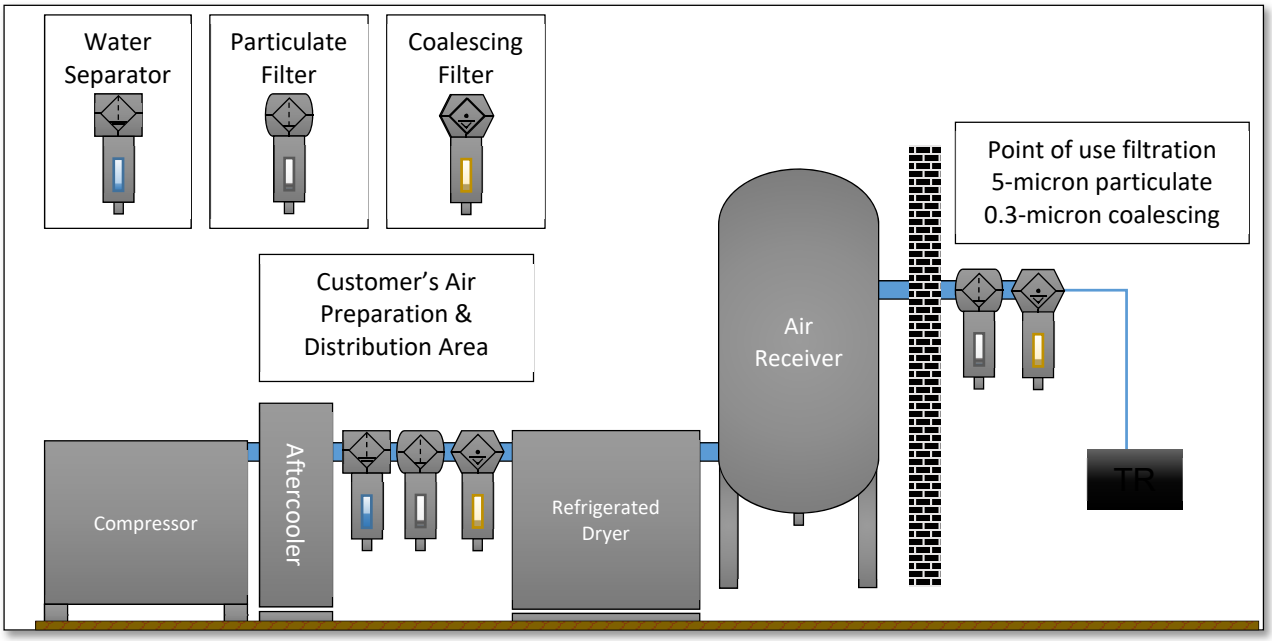

Figure 1: Air Preparation: The TR-025-v-ex requires compressed air in accordance with ISO 8573-1:2010 (2:3:2).

Typical point of use filtration is a 5-micron particulate filter and a 99.5% efficient coalescing filter.

If the TR electronic pressure regulator is controlling pressure in a volume where debris (or other contamination) may be present, appropriate inline filtration should be placed in between the TR valve and control volume.

Quick Start Diagram

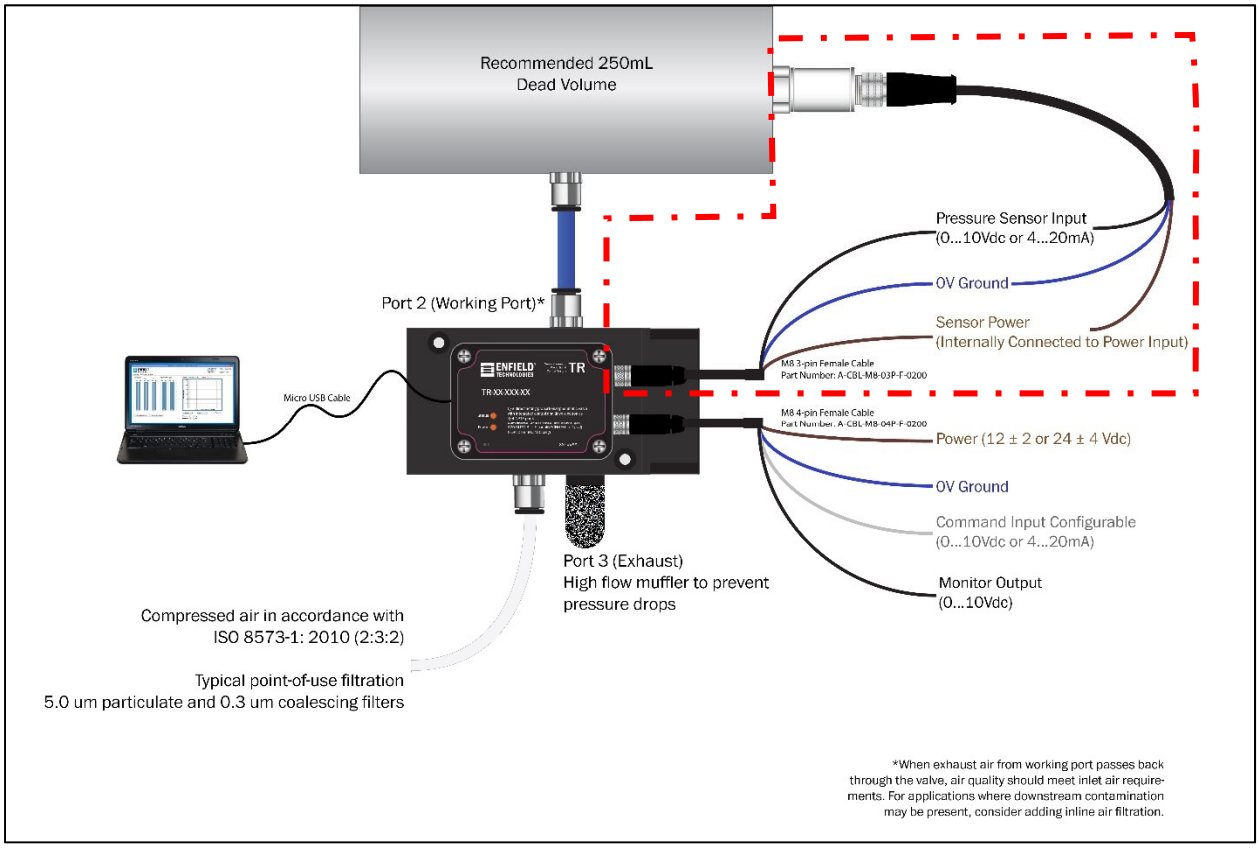

Figure 2: TR-series plumbing and wiring diagram.

Note: The red outlined area wiring is only for the TR-###-v-ex versions.

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Quick Start Electrical Setup

The 4-pin m8 signal cable (Part #: A-CBL-M8-04P-F-XX00) carries power, ground, command and a 0…10Vdc monitor output signal.

Note: Use the appropriate Enfield Technologies' 4-pin m8 cable part #: A-CBL-M8-04P-F-XX00. Test and ensure the correct power is applied with a multi-meter before connecting to the TR. Do not apply ANY power unless called out in the step. This 4-pin cable has the same wiring schematic across all TR electronic pressure regulator internal/external wiring.

1. Wire Power
    a. Locate the brown and blue leads on the 4-pin m8 cable. The brown lead is the Power+ input and the blue lead is the DC Common.
    b. Connect the blue lead to the DC common 0Vdc of the power supply. Then, connect the brown lead to the positive side of a +12Vdc or +24Vdc source.
        i. Maximum power consumption 20 Watts. (Typical is much lower)

2. Wire Command Signal
    a. Locate the white and blue leads on the 4-pin m8 cable. The white lead is the Command+ input and the blue lead is the Command- reference.
    b. Ensure the blue lead is connected to the DC common 0Vdc of the power supply. Then, connect the white lead to the positive side of the 0…10Vdc or 4…20mA (or any subrange) output.

3. Wire Monitor Output *Optional*
    a. Locate the black and blue leads on the 4-pin m8 cable. The black lead is the 0…10Vdc Monitor Output+ and the blue lead is the DC Common reference.
    b. Ensure the blue lead is connected to the DC common 0Vdc of the power supply. Then, connect the black lead to the source measuring the +0…10Vdc.

External Feedback Wiring – TR-###-v-ex

TR-###-v-ex wiring diagrams for two options.

The diagram below, in Figure 3, shows the Enfield cable part #: A-CBL-M8M12-0304P-FF-0050 pin out when it is connected the TR's 3-pin m8 port. This cable connects the TR via an m12 pressure sensor with the industry standard pin-out (see below).

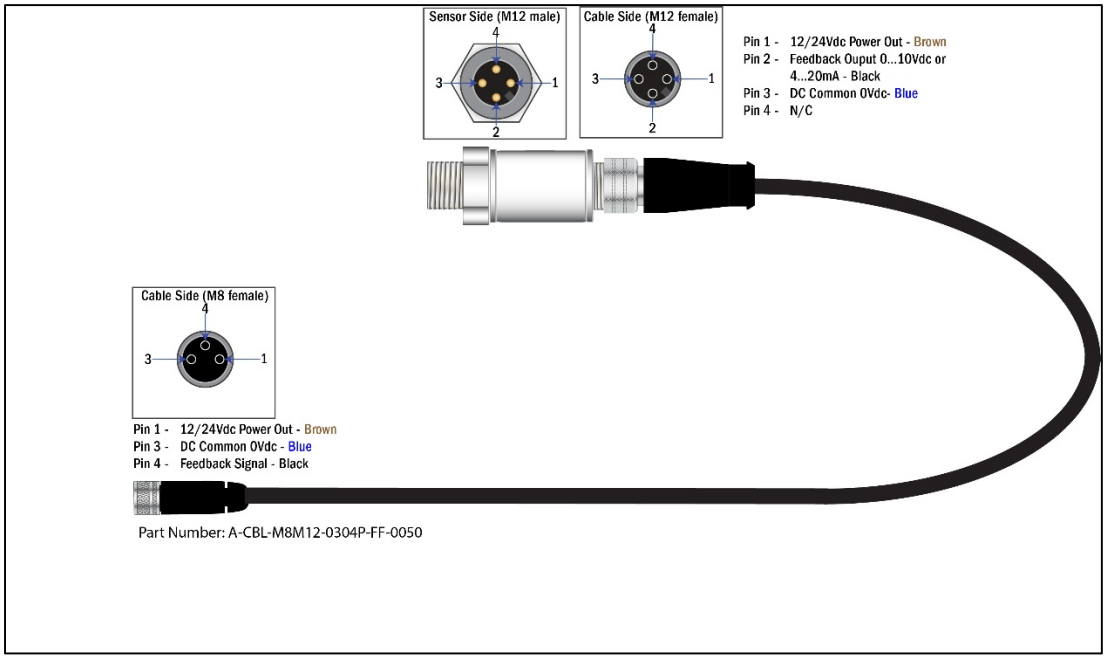


Figure 3: A-CBL-M8M12-0304P-FF-0050

Below in Figure 4 is the 3-pin m8 flying lead option. Use these flying leads to wire in sensor to the external 3-pin m8 connector.

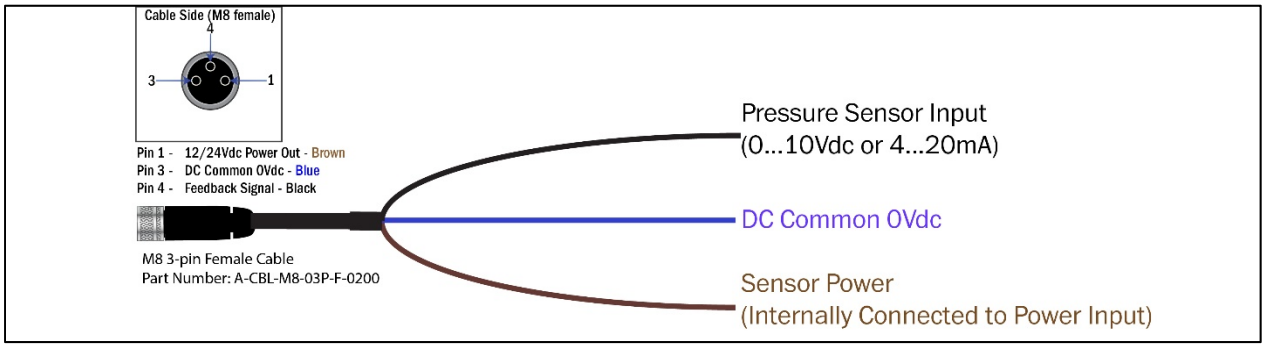


Figure 4: A-CBL-M8-03P-F-##00

WARNING: Installation and operation of electronic and high-pressure systems (fluids and compressed gas) involves risk including property damage and personal injury or death. Users should be properly trained or certified and take safety precautions.

Software and Plumbing

1. Download and install the correct TR User Interface available on the SKU product page for free download from enfieldtech.com. To find the correct user interface, search the product SKU in the top search bar. (ex. TR-025-v-ex)

2. Connect the USB connection to the TR.

    a. Remove the debris cap using a flathead screw driver and connect an Enfield USB cable, A-CBL-SAUB-0405P-MM-XXXX, or equivalent from the computer to the digital signal port of the TR.

Figure 5: USB Port

3. After confirming connections are within specified ranges with a multimeter, connect the A-CBL-M8-04P-F-XX00 to the TR then apply POWER only, DO NOT supply command signal or connect the optional external pressure sensor at this time.

4. Launch the TR Configuration Interface.

    a. Under the Configuration Tab, click the button "Scan for connected devices", shown in the red box below.

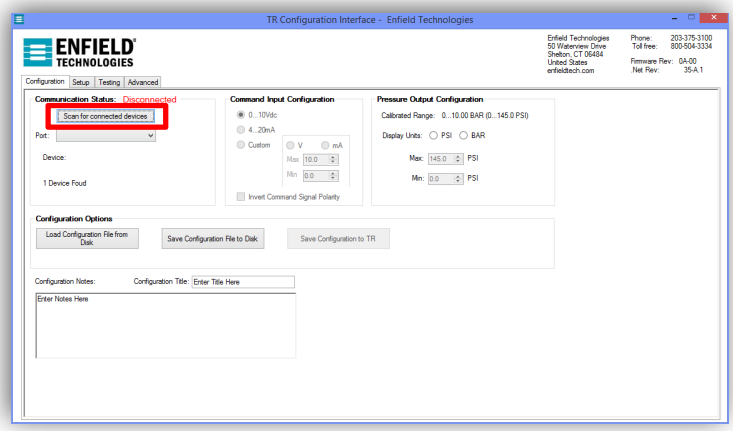


Figure 6: TR Software Display Disconnected

WARNING: Installation and operation of electronic and high-pressure systems (fluids and compressed gas) involves risk including property damage and personal injury or death. Users should be properly trained or certified and take safety precautions.

5. Once connected, the software should display "Connected" in green and display device information, as shown below in the red box.

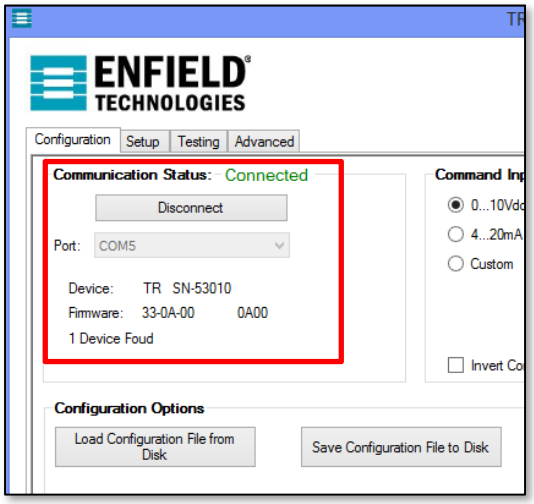


Figure 7: TR Software Display Connected

   a. If you are unable to connect to the TR try the following steps:
      i. Disconnect the TR USB cable.
      ii. Close and reopen the interface.
      iii. Note the COM ports displayed with the TR disconnected.
      iv. Cycle power to the TR.
      v. Reconnect the TR via USB cable.
      vi. Make sure TR has power – 'Power' LED should illuminate red.
      vii. Confirm new COM port is displayed in drop-down menu.
      viii. Further troubleshooting can be found in the Driver Installation guide or by contacting Enfield Technologies support.

6. Connect a pressure vessel, greater than the minimum control volume of 100mL, to port 2 on the TR.

   Note: When controlling the pressure on pneumatic actuators where the control volume becomes less than the minimum volume of 100mL connect an accumulator to port 2 of the TR to ensure the minimum control volume is met.

7. Connect air to the TR: Inlet and working port air should be clean, dry (-40C dew point) non-lubricated, non-flammable & non-corrosive dry gases (recommended point of use filtration: 0.3-micron fine grade coalescing filter with 5-micron pre-filter).

   Pressure Range for **TR-0##-g10-s** = 0…10 bar (0…145 psi)
   Pressure Range for **TR-0##-v-ex** = vac…10 bar (vac…145psi) or sensor range (smaller of the two)

Configuration Tab for TR-###-g10-s (Internal Sensor) – Software TR Configuration Interface

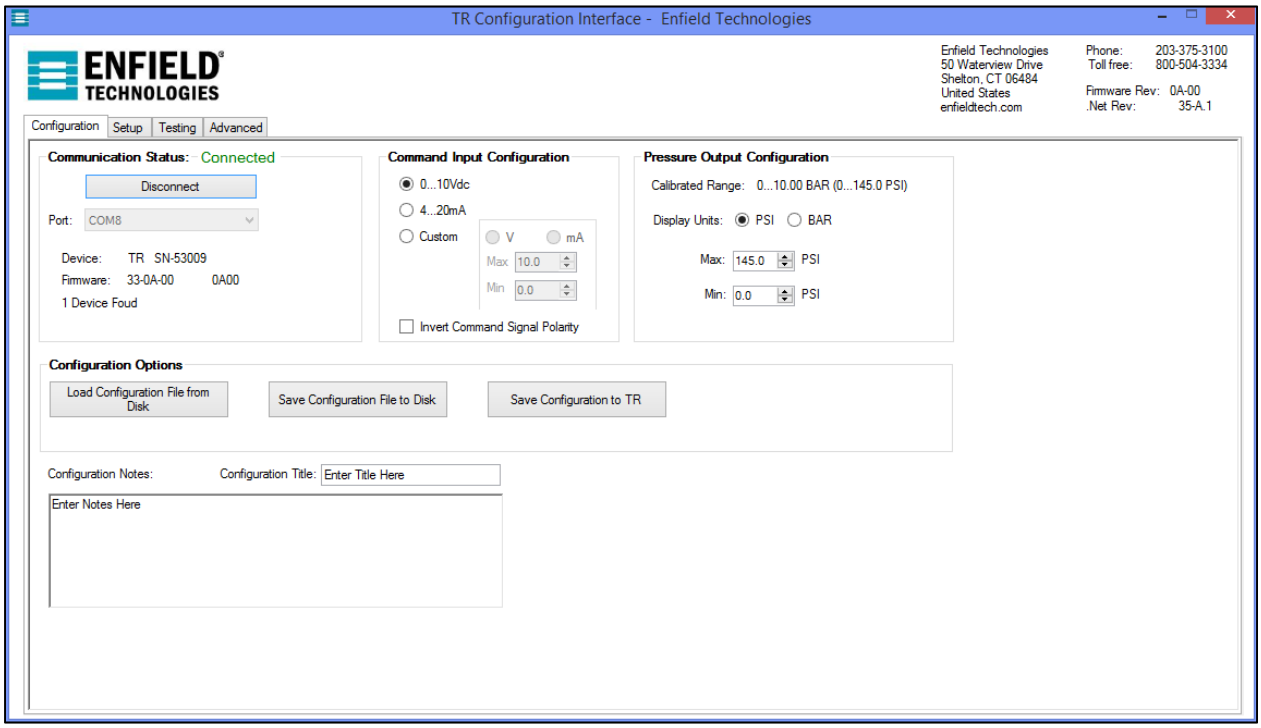


Figure 8: TR Internal Sensor Configuration Interface

1. Configuration Options:
    a. Load Configuration File from Disk – This feature loads a previously saved .txt configuration file from the connected computer.
    b. Save Configuration File to Disk – This feature saves a .txt file to the computer for documentation, duplication or record keeping purposes.
    c. Save Configuration to TR – This feature flashes the configuration from the user interface to the TR. Use this feature before disconnecting the USB cable or cycling power.

2. Set the command signal:
    a. Select the bubble for either 0…10Vdc or 4…20mA.
    b. *Optional* – Custom – This feature defines a custom sub-range within the 0…10Vdc or 4…20mA selection (i.e. 1…5Vdc or 6…12mA).
    c. Invert signal polarity – Check this box to enabled to turn a 0…10Vdc command signal into a 10…0Vdc where 10Vdc controls the minimum operating pressure and 0Vdc commands the maximum command signal.
    d. Click "Save Configuration to TR" to save command signal settings.

3. Once the proper command signal is set up in the software, power can be applied to the TR's command+ input wire (white wire).

4. Set the pressure range:

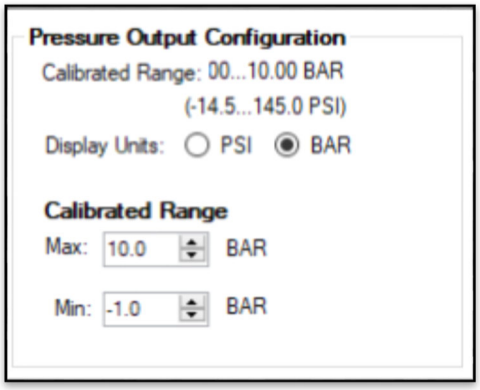


Figure 9: Pressure Range Configuration TR-###-g10-s

   a. Choose the bubble display units for the graph and sliders: psi or bar.
   b. Set maximum and minimum controlled output pressures to a sub-range, if desired.

5. Configuration Notes – This section allows the user to title for internal notes such as location, date of service and usage.

Configuration Tab for TR-###-v-ex (External Sensor)

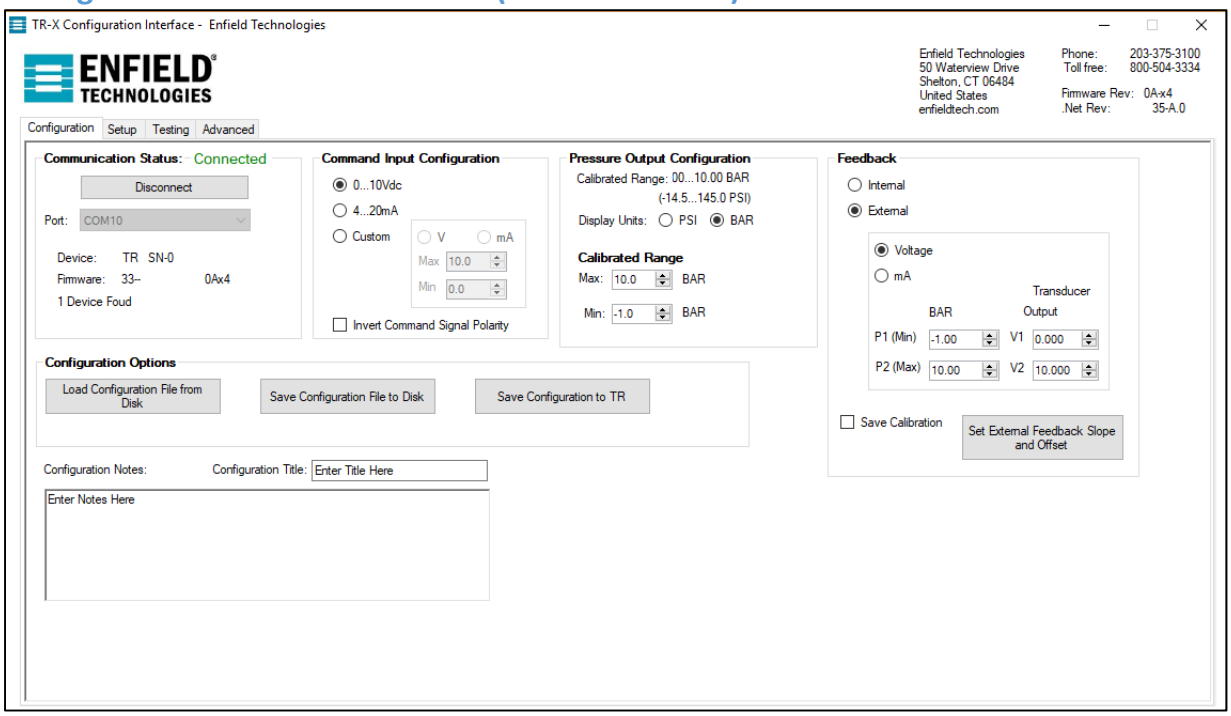


Figure 10: TR-###-v-ex Software Configuration Tab

1. Configuration Options:
    a. Load Configuration File from Disk – This feature loads a previously saved .txt configuration file from the connected computer.
    b. Save Configuration File to Disk – This feature saves a .txt file to the computer for documentation, duplication or record keeping purposes.
    c. Save Configuration to TR – This feature flashes the configuration from the user interface to the TR. Use this feature before disconnecting the USB cable or cycling power.

2. Set the command signal:
    a. Select the bubble for either 0…10Vdc or 4…20mA.
    b. *Optional* Custom – This feature defines a custom sub-range within the 0…10Vdc or 4…20mA selection (i.e. 1…5Vdc or 6…12mA).
    c. Invert signal polarity – Leave blank for standard configuration or check this box to turn a 0…10Vdc command signal into a 10…0Vdc within the software where 10Vdc controls the minimum operating pressure and 0Vdc commands the maximum command signal.
    d. Click "Save Configuration to TR" to save command signal settings.

3. Configuration Options:
    a. Load Configuration File from Disk – This feature loads a previously saved .txt configuration file from the connected computer.

b. Save Configuration File to Disk – This feature saves a .txt file to the computer for documentation, duplication or record keeping purposes.
c. Save Configuration to TR – This feature flashes the configuration from the user interface to the TR. Use this feature before disconnecting the USB cable or cycling power.

4. Set the pressure range:

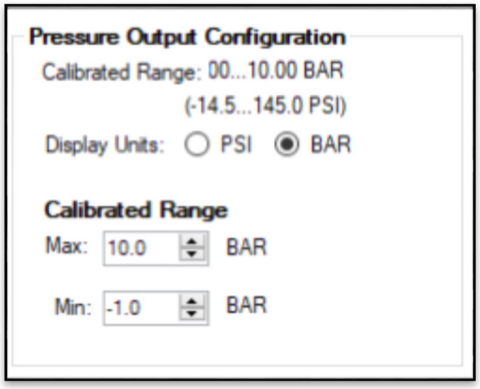


Figure 11: TR-###-v-ex Pressure Output Configuration

a. Choose the display units for the graph and sliders: psi or bar.
b. Set maximum and minimum controlled output pressures.

5. Feedback Sensor Configuration– This area programs the TR's feedback input for the sensor's output. The pressure range of the valve is vac…10 bar (vac…145 psi) and any subrange of sensor's pressure ranges. This scaling is used internally to display the pressure and externally in the monitor output signal (+0…10Vdc).

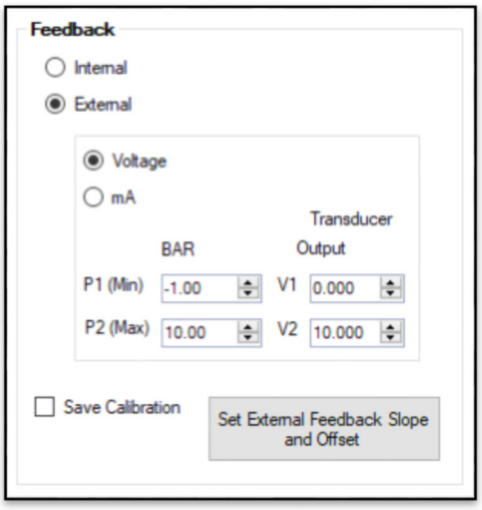


Figure 12: TR-###-v-ex Feedback Sensors Configuration

a. Ensure the bubble is set to "External" – This will enable the 3-pin m8 sensor circuit to be used.
b. Check the Voltage or mA bubble to choose between a voltage or current feedback sensor source.
c. Set Pressure and Scale
    i. P1 (Min) – (%/psi/bar) - Use this to set the lowest pressure of the sensor
    ii. V1 (Max) – (V1/I1) – Use this to set the voltage/current for the lowest pressure of the sensor.
    iii. P2 (Min) – (%/psi/bar) - Use this to set the highest pressure of the sensor
    iv. V2 (Max) – (V1/I1) – Use this to set the voltage/current for the highest pressure of the sensor.
d. Once the values are input into the boxes, check the 'Save Configuration' box and click on the 'Set External Feedback Slop and Offset' button.

6. Once the proper command signal is set up in the software, power can be applied to the TR's command+ input wire (white wire).

7. Configuration Notes – This section allows the user to title for internal notes such as location and usage.

Setup Tab

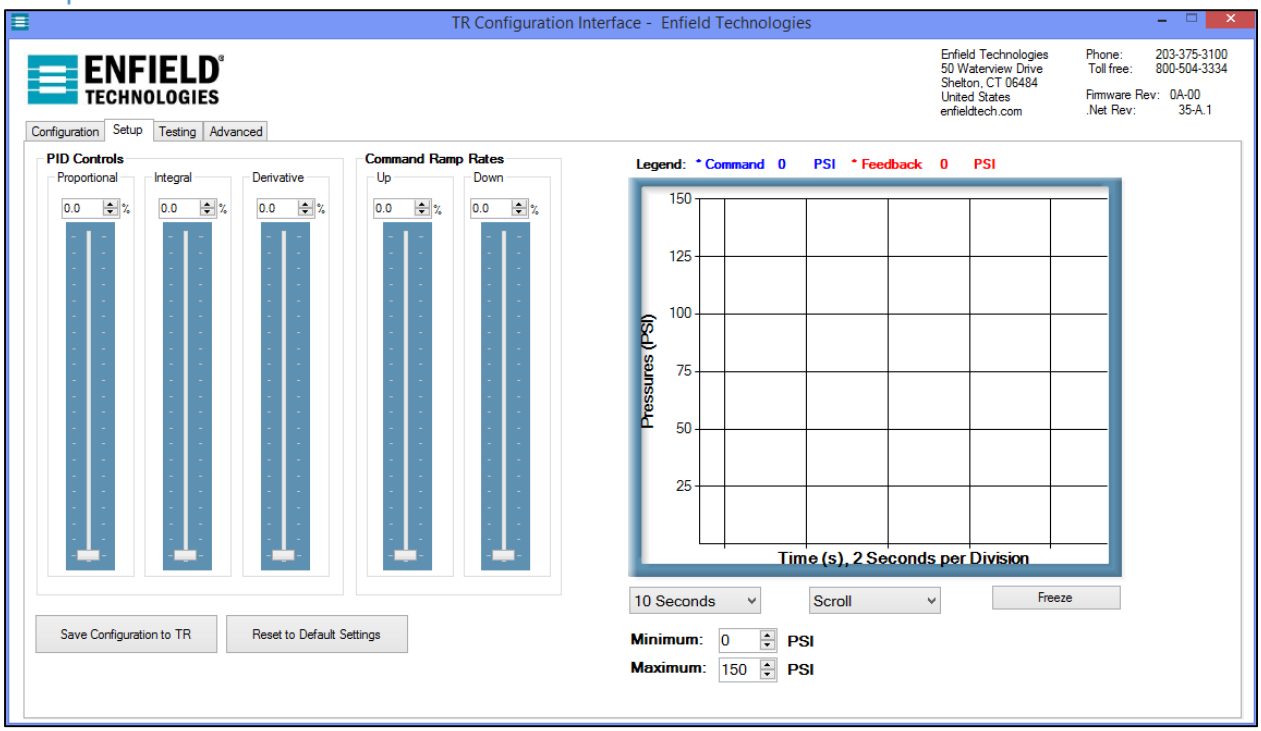


Figure 13: TR Setup Tab

Proportional Gain - The proportional gain is adjusted first. Increase until the outlet pressure of the valve begins to follow the pressure set-point (command signal). An increase in proportional gain increases the accuracy and speed at which the valve is able to follow the commanded pressure. Too much proportional gain may result in an unstable, oscillatory system identified by an audible "buzzing" sound.

Integral Gain - Integral gain is used to remove small differences between the input pressure command and the valve's output pressure resulting in a more accurate system. Integral gain is also useful to compensate for system leaks or flow out from the controlled volume. Too much integral gain can result in sine-wave-like oscillations or "hunting" about the set pressure.

Derivative Gain - Derivative gain helps to prevent overshoot in a system; however, too much derivative may lead to oscillations in the system sounding like the proportional audible "buzzing" sound.

Ramp Up - Set the fastest rate at which the commanded pressure will increase per second (speed limit). The higher the gain the longer it takes to pressurize a volume.

Ramp Down - Set the fastest rate at which the commanded pressure will decrease per second (speed limit). The higher the gain the longer it takes to exhaust a volume.

Internal Oscilloscope

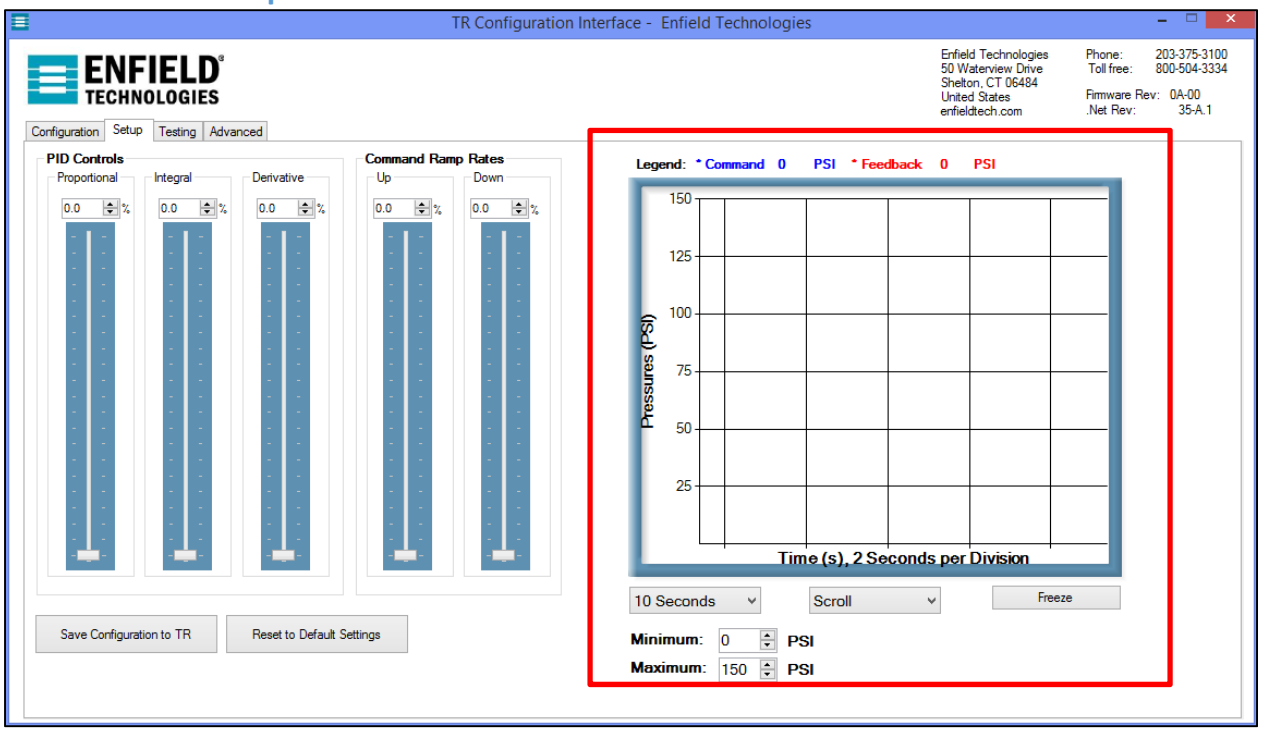


Figure 14: TR Oscilloscope Overview

Interface Oscilloscope – This section tracks the command signal vs. the internal pressure sensor. The legend at the top of the oscilloscope displays the pressure commanded (**blue**) and feedback sensors (**red**) reading in the units chosen on the Configuration tab.

Time Scale - Adjustments can be made to the time scale (x-axis) for 2,5,10 or 20 second divisions.

Scroll - The "scroll" option may perform slower on some computers/laptops. Use Auto-Repeat or Single Capture for better performance.

Freeze/Start - The freeze button stops the oscilloscope from scrolling, to allow the user to capture an image and record events using Windows screen imaging tools for documentation purposes.

Testing Tab

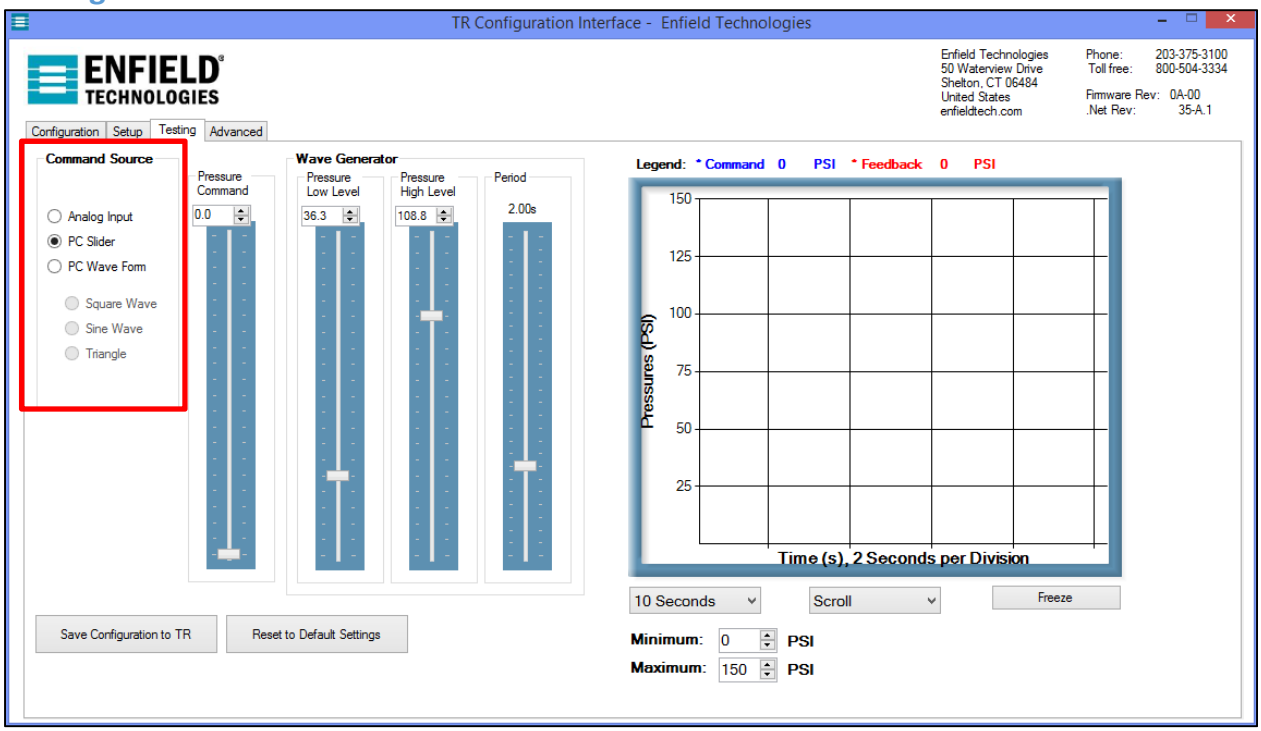


Figure 15: TR Testing Tab Overview

Command source:

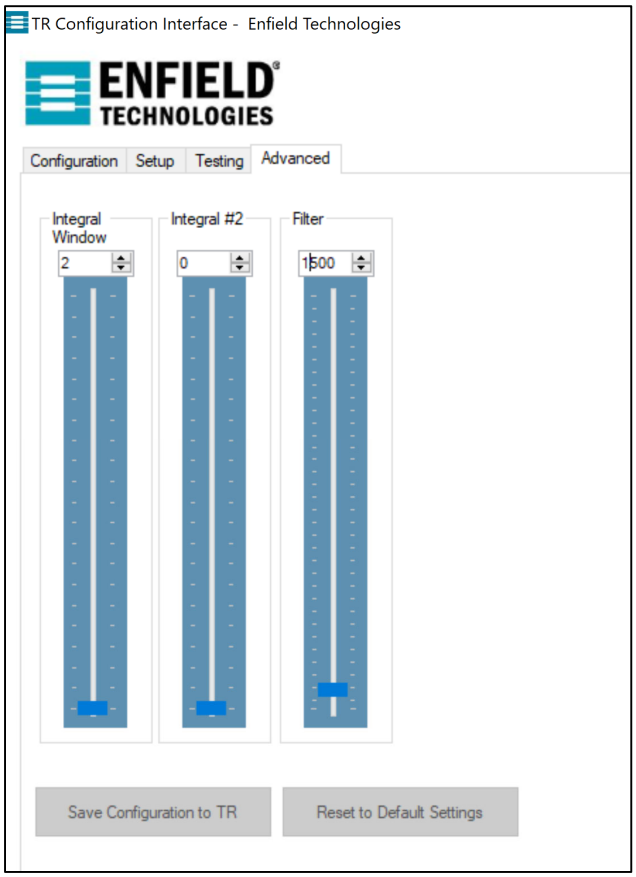
Analog Input – When the analog input button is selected, the command source will be the analog command signal on the white wire.

PC Slider – When the PC Slider button is selected, the Pressure Command slider will appear and can be used to control the pressure of the system by adjusting up and down.

PC Wave Form - When the "PC Wave Form" button is selected, an internal square, sine or triangle waveform will be generated for the valve to follow. From the Wave Generator sliders, the high pressure, low pressure and period can all be selected.

Note: Use the Configuration Tab to switch between psi and bar when testing with PC Slider/PC Wave Form.

Advanced Tab



Integral Window – When the output pressure of the valve is far away from the set point, integral #2 will be used, (command – feedback > integral indow). Once the output pressure of the regulator gets close to the command set point, integral #1 will be used, (command – feedback < integral window).

Integral #2 – This gain is used when the difference between the pressure commanded and feedback is outside the integral window.

Filter: Feedback ramp rate adjustments limits the system's response to ANY change in pressure. The lower the gain, the slower the control algorithm will respond to changes in downstream pressure. Volumes with a restriction near port 2 (pressure sensor region) inducing a backpressure are easier to tune using a lower feedback ramp rate gain. Filter gain 1500 is set for a 1L volume at the end of 1 m of 3/8" tubing.

Troubleshooting

Symptom	Probable Causes	Corrective Action
No Red LED Illumination	No Power	Confirm correct power and polarity applied to brown and blue wires.
	Inverted Polarity	Verify signal wiring for command and feedback; also verify mechanical system polarity
	Incorrect Wiring	Verify all wiring
Unable to Connect with Software	TR is not Powered	Apply proper power to the TR, make sure red LED is illuminated
	Incorrect Programming Cable	Ensure you are using an Enfield Technologies A-CBL-SAUB-0405P-MM-XXXX cable
	USB Driver Problems	Follow instructions to hard (re)install driver.
	Com Port Incorrectly Identified	Disconnect and Reconnect USB cable to identify the TR COM port.
System Unresponsive to Command	Lack of supply air pressure	Ensure port 1 has correct air pressure
	Confirm correct plumbing	Port 1 = Supply Air Pressure, Port 2 = Working Port and Port 3 = Exhaust
	Proportional gain too low	Increase Proportional Gain
	Confirm command signal	Measure the voltage across the command input wire (white wire) and 0V ground wire (blue wire) to confirm TR software command signal vs. voltage applied.
	Confirm feedback signal	Check the feedback wire output (black wire)
	Integral Gain Too High	Decrease Integral gain/Integral Window slider/Increase Integral #2
Slow Oscillations	Incorrect Wiring/Noise	Verify all wiring, confirm DC Common grounds are connected.
	Electrical Noise	Check for electrical noise in the system
System Fails to Converge or is Inaccurate	Integral Gain Too Low	Increase the Integral Gain/Integral Window to achieve less error without oscillations.
	Proportional Gain Too low	Increase the Proportional Slider
	Air Leaks	Insure there are no air leaks in the system
	Contamination	Confirm that inlet air and working port air meets valve specifications and is maintained.
	Proportional Gain too high	Decrease Proportional gain slider
	Derivative Gain too high	Decrease Derivative gain slider
Pressure Oscillates	Input Signal Noise (possibly 60Hz)	Verify that large or high-power machinery is not operating nearby.
	Wire Connections Are Loose	Verify all wiring connections are secure.
System 'Buzzes'/Vibrates	Dither	This is a functionality of the valve that allows the valve to maintain dynamic friction increasing accuracy. If this property of the valve is undesired for an application, please contact Enfield support via chat, phone or email.