Director SCS

User Manual

Power Flame Inc.

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Director-SCS User Manual

Revision 12.7.22.8.5

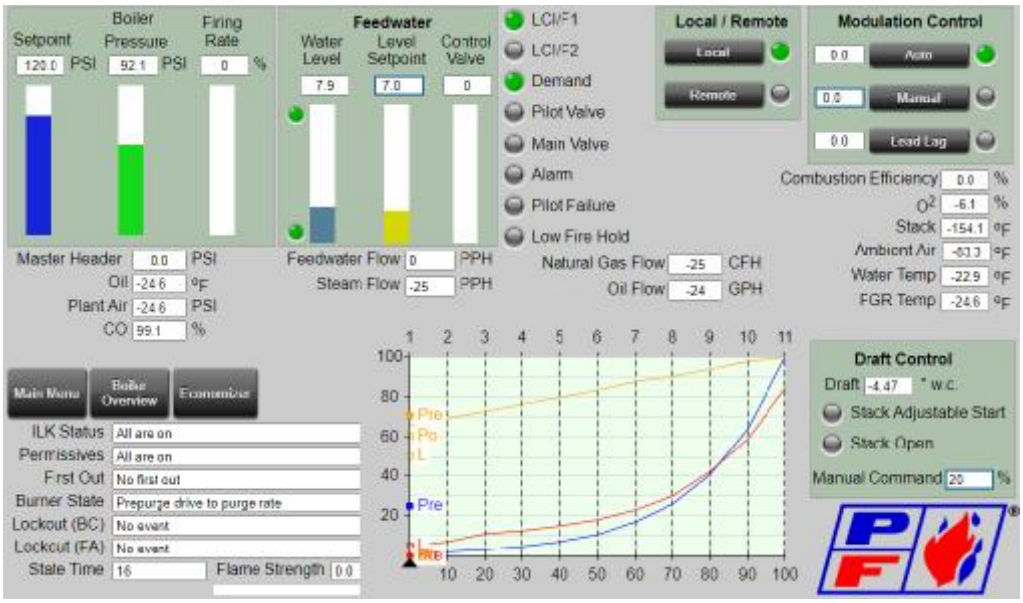
System Overview

The Director SCS, or Supervisory Control System, is powered by Honeywell SLATE and programmed, configured and vetted by Power Flame Inc. It is a module-based PLC system that is fully configurable and programmable. The platform has been developed to give users a solution for fully integrated burner controls. These controls not only allow burner operation and monitoring but encompass boiler vessel components and more. When used with a Director SCS Deaerator Panel and Director SCS Master Panel, this system can fully integrate a complete boiler room.

Burner Management System Sequence of Operations

The burner has the capability to fire any number of fuels. The Burner Management System is designed to fire any number of fuels, supporting a dual fuel application.
The Burner Management System will be operated from the panel mounted touchscreen or from a locally connected computer using the Chrome web browser in addition to physical switches and pushbuttons on the remote-control panel. All status information will be available to the operator at the computer or touchscreen with start and stop functions relegated to the Control Switch on the Control Panel.

A “Power On” light, “Demand” light, “Main Fuel” light, “Low Water Trip” light, “Aux. Low Water Trip” light, “Low Water Alarm” light, “High Water Trip” light, “High Water Alarm” light, “Flame Failure” light, On/Off Control Switch, “Slate Reset” Pushbutton, or an “Alarm Silencing” Pushbutton can be mounted on the remote Control Panel.
The “Power On” light indicates that power is on in the panel. The “Demand” light shows that the burner permissives (including Control Switch) are all made, and the burner can begin its light off sequence. The “Main Fuel” light indicates when the main fuel valves are energized. The “Low Water Trip”, “Aux. Low Water Trip”, “High Water Trip”, “Low Water Alarm”, and “High Water Alarm” all energize when their various probes have entered an unsatisfactory state. The Control Switch is the main method to turn the burner on and off. Leaving the switch in the on position will also allow the burner to cycle automatically based on setpoint as needed. The “Slate Reset” pushbutton allows for the Burner Management System to be reset from lockout on the exterior of the panel. The “Alarm Silencing” pushbutton will silence the alarm horn for the duration of current lockout(s).



Pre-Startup Procedure

1. Perform all pre-operations boiler safety checks (refer to boiler manufacture guidelines).
2. Verify the Emergency Stop pushbutton is in the correct operating position.
3. Ensure that power to the Control Panel is established by observation of the Power On light.
4. Verify the boiler feedwater system is operating correctly.

Startup Procedure

1. Verify that a satisfactory operating setpoint is set in the control and that the process variable is below the setpoint.
2. Turn Control Switch to the “On” position
3. Observe the “Demand” light on the HMI for confirmation that boiler Setpoint and Process Variable are different enough to create a demand.
4. Burner will start its sequence within a few seconds, driving its actuators to the prepurge position.

Burner Startup Procedure: Burner Startup Sequence

The following common safety interlocks must be in their normal (non-tripped) in order to begin the prepurge period:

- Low Gas Pressure Switch
- High Gas Pressure Switch
- Low Water Trip
- Aux. Low Water Trip
- High Water Trip
- High Limit
- Combustion Air Switch (not always in ILK)
- Blower motor starter contact (not always in ILK)
- Stack Damper OK status (not always in ILK)

Additionally, the Main and Auxiliary gas valves need to read shut per their respective proof of closure switches internally to the valves.

If the interlocks are not satisfied by the time prepurge position is reached, the control will lockout and the screen will display "ILK is off when it should be ON".
If all interlocks are satisfied, the burner will continue its sequence and start the countdown for prepurge. This may also include Valve Proving depending on what is required by the system. Once the timer is completed, the system will drive the actuators to their light off positions.

Once all actuators read that they are in their light off positions, the ignition sequence begins.

When the Igniter (Pilot) Trial for Ignition begins the:

- Ignition Transformer will energize.
- Pilot Safety Shut-off Valves will energize.
- Burner Status area will indicate the igniter (pilot) valves has been energized with an Indicator Status Light
- Ignition Transformer de-energizes.
- Burner Status area will indicate that the flame scanners detect a flame with an Indicator Status Light and a signal strength

If the scanner has indicated a flame is present, the Igniter (Pilot) Trial for Ignition begins. During the Main Trial for Ignition the:

- Burner Status message will indicate "Main Trial For Ignition (Gas)", or "Main Trial For Ignition (Oil)".
- Main Gas Safety Shut-off Valves will energize.
- The "Main Fuel" light will energize to show status of main valves.
- Ten seconds after the Main Trial for Ignition, the Pilot Safety Shut-off Valves de-energize.
- Five second flame stabilization occurs to verify the igniter flame is lit successfully, without the igniter energized, before introducing the main fuel.

The burner will release to modulation after the main trial is over, turning modulation control over to the main PID loop or the user, as appropriate.

Burner Trips

A boiler trip will cause the Burner Control to lockout and sound the alarm horn or buzzer (if applicable) . The following conditions can cause a lockout:

- Low Gas Pressure
- High Gas Pressure
- Low Water Trip
- High Water Trip
- High Limit reached
- Combustion Air Switch lost
- Blower motor starter contact lost
- Stack Damper OK status lost
- No flame detected
- Proof of Closure switch detected
- Parallel Positioning Actuator off curve

When a lockout occurs, the main fuel valves are immediately closed, the horn sounds, the burner enters post purge then standby, and the stack damper (If equipped with Draft Control) is held open until the fault is cleared. The "Slate Reset" pushbutton will clear lockouts in the control.

The following conditions will cause the burner to shut-down in a normal manner with no alarm:

- Setpoint Exceeded
- Operating Control setpoint reached
- Control Switch Turned Off
- First Low Water Cutoff

In the event of a normal shutdown, the fuel valves shut and the burner enters post purge. Upon exiting post purge, the stack damper shuts to retain heat in the boiler (with Draft Control Option). No reset is required.

User Log In Credentials

To keep user data secure there is support for 3 user roles for Director SCS. Director SCS does not implement typical user accounts with an account for each user. Instead there is an account for each user role. Some actions and functionality of the HMI may be disabled until the correct user account has been successfully logged into.

USER ACCOUNT LEVEL	ALLOWED OPERATIONS
No password	• Read any data in system • Modify unprotected registers
Operator	• All unrestricted operations • Setup logging features • Export log data • Export/import curve set data (optional) • Modify operator-restricted registers
Installer	• All operator-restricted operations • Install configuration packages • Install service packs • Install SSL certificates • Perform safety verification • Modify installer-restricted registers
Designer	• All installer-restricted operations • Modify designer-restricted registers

Each account role is password protected. When the system is installed, Power Flame Inc. changes the default passwords to limit system access only to authorized personnel. The Operator Password for Director SCS is: 'SlateOperatorPassword' please note this is case sensitive. If Installer or Designer passwords are required, please contact Power Flame Inc., Customer Support or Controls Engineering Dept.

When a user tries to log in with an invalid password more than 10 times in succession, further user account access is denied for 10 minutes. During this time period the account cannot be used and all attempts to log in are automatically rejected (whether or not the correct password is provided). Only one session can be active at a time. When a user is already logged in, any additional login requests are automatically rejected.

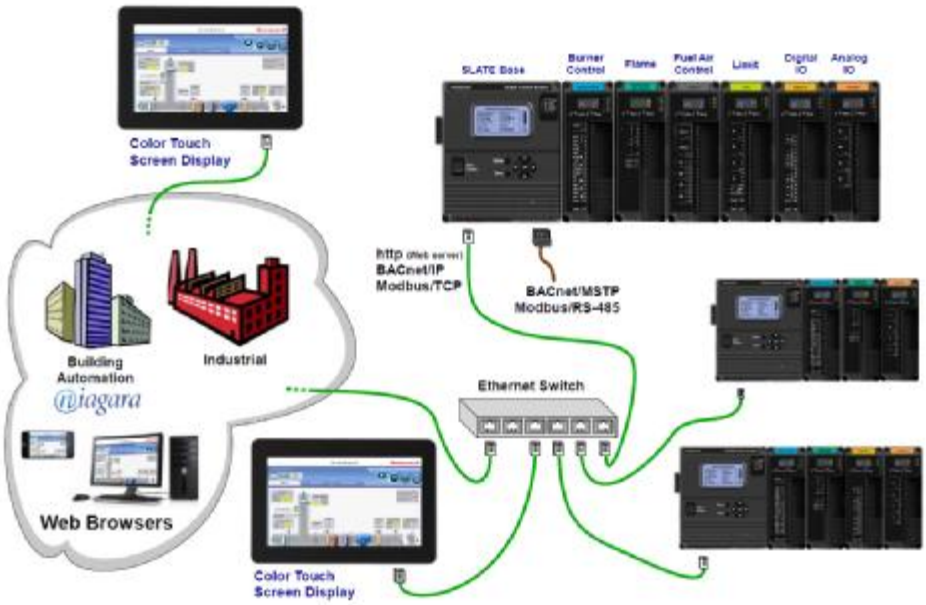
Remote Identification Number (RIN) The RIN is a random number used to prove physical presence of the user near the unit. This number is random and is generated at the user's request by pressing the "Request RIN" button on a login web page. The RIN is displayed on the system local display (Base Module LCD) and its value needs to be typed into the RIN field in the logon dialog.

Burner Management Panel Summary:

The Director-SCS (Supervisory Control System) is a PLC based platform designed to simplify the setup and operation of your burner. It can be expanded to encompass the burner, boiler, deaerator, multiple boiler lead/lag or customer driven requirements. This manual will explain the HMI (Human Machine Interface) graphics pages and their purpose.

Network Configuration

Communication protocols include BACnet/IP, BACnet/MSTP, Modbus/TCP and RS485. The Base Module connects to the Touchscreen via Ethernet (Cat5) Cable, and using a network switch, allows extended communication to the outside world.



In addition to various communications options, the Director SCS system allows USB backup of the fuel curves, safety verification files, and allows easy installation of service packs, firmware upgrades and kit loading via the USB port located at the bottom of the Base Module.

For secure device usage keep in mind the following recommendations when installing the device as well as after installation when doing any modifications. Although the system is designed to be secure, it is obvious that remote disturbances can affect performance in an unpredictable way caused by threats that are found after the device release date. It is recommended that the Director SCS (or any Slate based platforms) be installed on an isolated network. Isolation can be achieved by the following methods:

1. Physical Separation of the Network
2. Firewall Isolation (Access to Network through Secured Gateway)
3. Network Address Translation (Access to internet through Router with NAT)
4. VLAN (Access to Network via Virtual Local Area Network, partitioned and isolated)

Network Settings:

On base Module, follow these steps using the arrow keys:

- Menu
  - Base Setup
  - Network
  - Ethernet

All Network settings can be changed once logged in. 4-digit numeric password is: 1111

On Touchscreen, click 'Slate Generic Pages' button.

- Click Login in upper right corner.
  - Select Installer for User ID
  - Password as shown: Setup123
  - Request RIN (this number will be displayed on base module screen)
- Once logged in, make sure you are in Module Pages.
  - Click on Base (view/edit Base Module)
  - Click Communication Setup
  - This section allows you to configure the Modbus and BACnet, as well as the Router, etc.

To back out of any page on the touchscreen, click the option in the very upper left-hand corner.

On touchscreen, for touchscreen setup, double tap the screen anywhere.

Click Display Control in lower left corner.

Click Network Settings on screen.

To assign the touchscreen to the base module once network has been configured on both devices, click Discover Devices on Display Control screen.

- Click Discover. This allows you to search a set range of IP addresses (make sure the base module IP address is within this range) Once done, click search.
- Once search has finished, click the Set Home Page box, as well as 'Selected Device will be the Startup Page.
- Click the IP address associated with the Base Module.

User Pages:

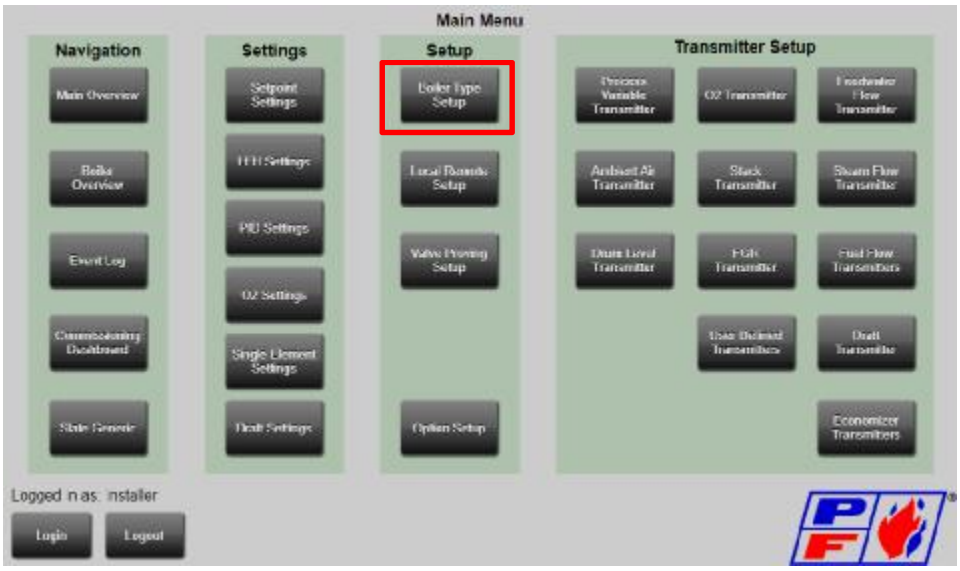
User pages include Boiler Overview, Main Overview, Main Menu, Options Setup, etc. These pages are created to provide visibility of the system to the user, as well as provide the ability to make adjustments as needed.

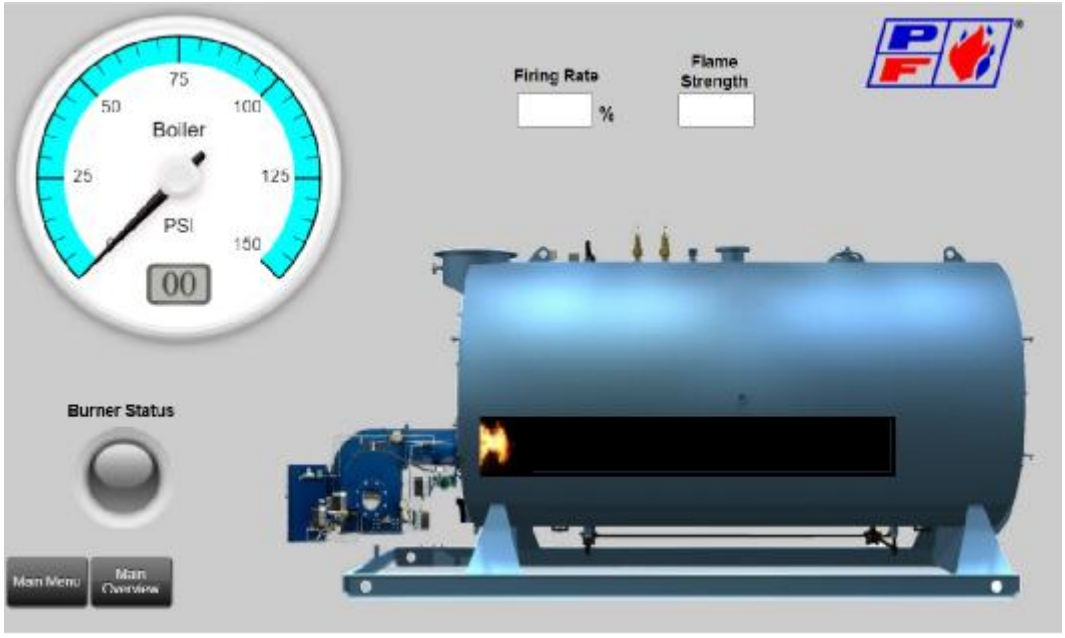
Boiler Overview

1. This area will show an animated flame depending on if a flame is present. The flame will increase in size depending on the firing rate of the burner.
2. Burner Status will show green when burner is in a normal run state. It will show darkened (greyed out) when burner in Standby. It will show red in the case of a lockout/fault condition.
3. A Visual gauge that will display PSI/Temp depending on what type of operation is required (Steam / Hot Water) This will allow a digital and analog reading of the current condition of the boiler.
4. Current Firing Rate of Burner.
5. Current Flame Strength.
6. Current Stack Temperature.
7. Cycles/Hours

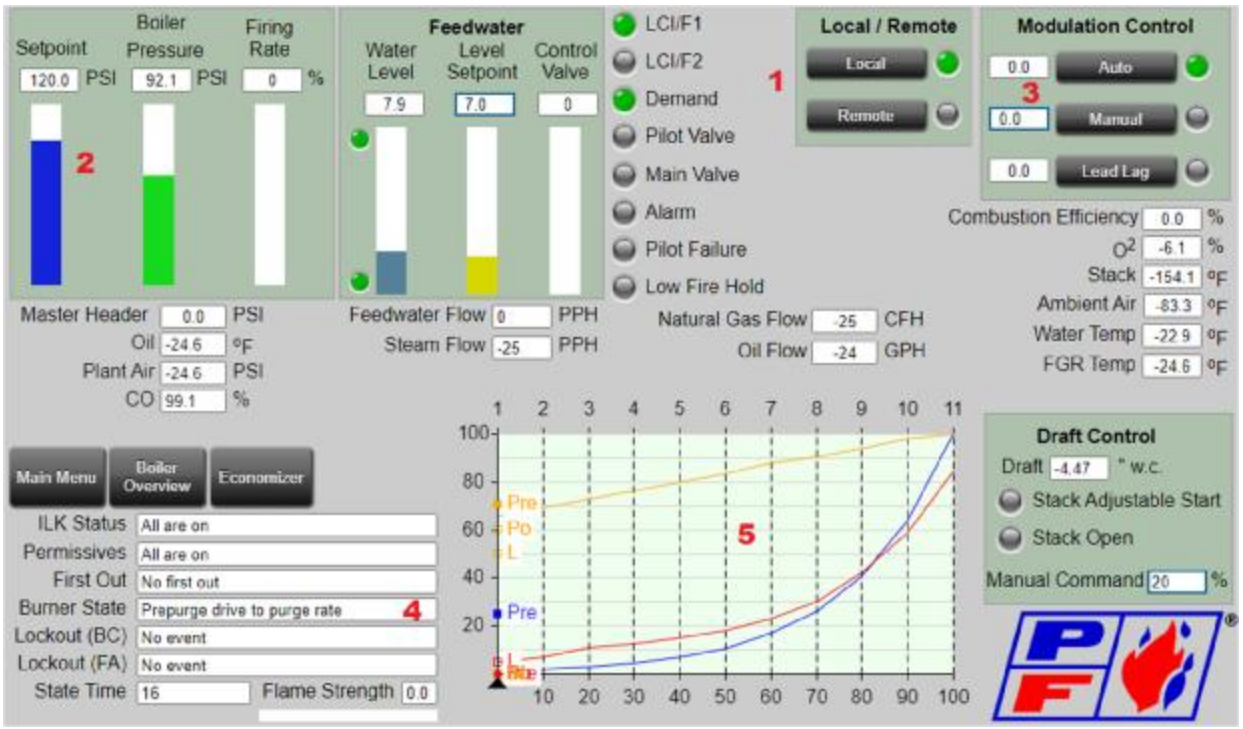
This screen can be customized to show different style boilers; i.e. Scotch Marine, Flex Tube, Water Tube. It can also be customized to show other information that might be relevant to the end user or fulfill the requests of the end user. On the Main Menu screen, you can select the

Boiler Type option, which will allow you to select from several boiler images. These images are generic in nature but may reflect actual make/model boilers.





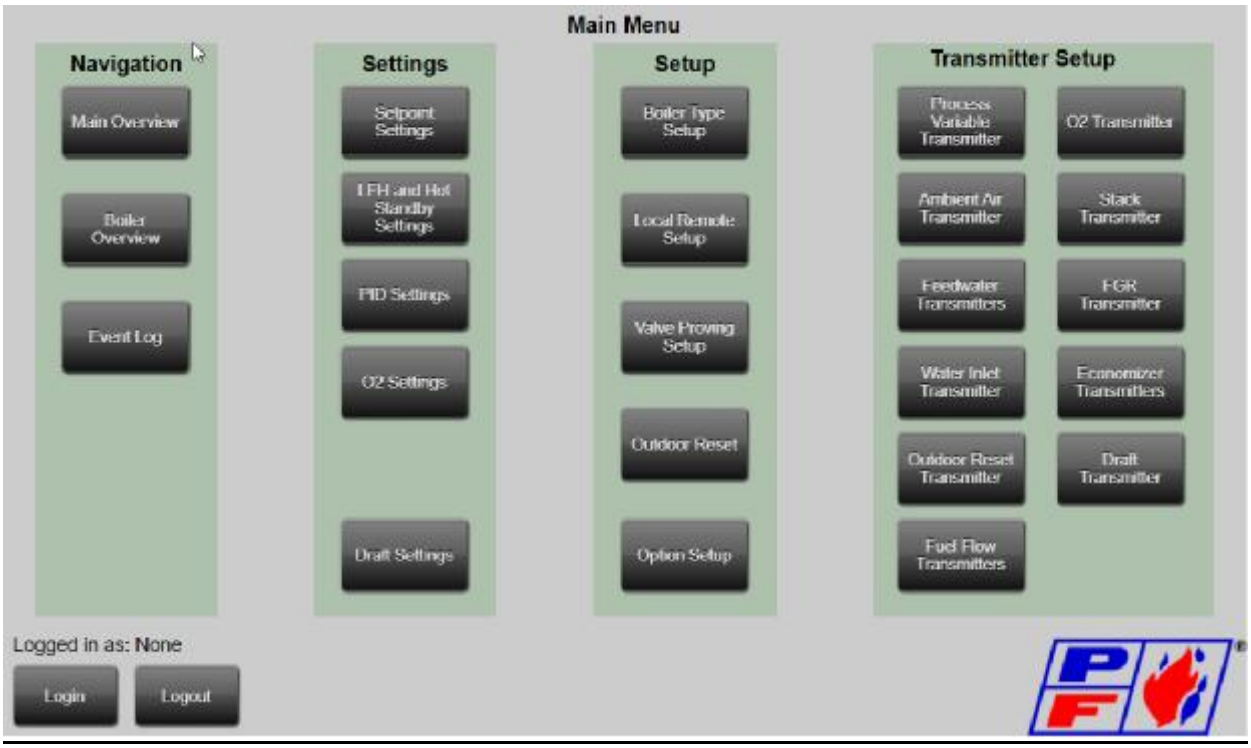
Main Overview



1. Local / Remote switch allows the burner to operate using a local setpoint (#2) and operating signal (PSI or Temp) or look to a Building Management System or outside source for Demand and Setpoint. (Must be enabled in Option Setup)
2. Setpoint can be adjusted by simply touching the setpoint box and changing via keypad that appears on page.
3. Auto / Manual control allows you to let the burner follow its own modulation or give you manual control of firing rate. In Manual mode, the firing rate is adjustable using the input box to the side of the Manual button. There is also the Lead/Lag Function found here. (Lead/Lag must be enabled in Option Setup)
4. Burner State will explain what state the burner control is in, as well as explain the Lockout or current state in text form. Also displayed is any lockout activity with the Fuel Air module, current run time and flame strength. See Appendix
5. Fuel Air Curve Set graph will show in real time the position of each actuator on the curve, as well as position of throttle (Firing Rate)

Other information is provided on page including fuel valve status, flow rates, temperatures, feedwater information, etc. Only text boxes outlined with blue, such as the Manual (#3) throttle box can be edited on the screen. ILK status reads last device in the running interlocks that is not made.

Main Menu

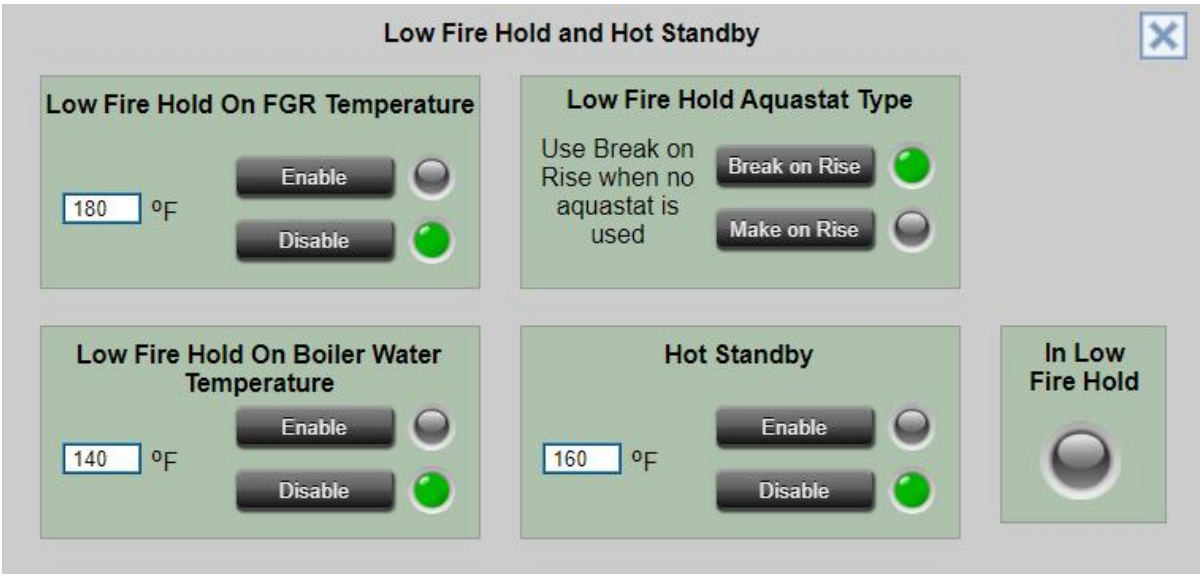


Main Menu page allows technicians to configure different options and sensors that may be connected to the Director-SCS. Most of the options, such as "Setpoint Settings" will utilize a small popup window in which the device or function can be scaled. This will allow you to set your Modulating Setpoint, as well as the Cut-In and Cut-Out settings.

Other important settings are:

- PID Settings (This is regarding the PID Loop for throttle and modulation)
- O2 Settings (This is regarding scaling of the O2 sensor, and the trim PID loop)
- Outdoor Reset Settings (This is only used for hot water applications)
- Fuel Flow Transmitter (Used for scaling a Fuel Flow Meter)
- Pv Transmitter (This is the selection and scaling of the sensor used to modulate)
- Transmitter Setup Group (This allows you to scale any of the connected transmitters)
- Stack Transmitter (This allows you to set up the scaling on a 4-20mA stack temp sensor)
- Drum Transmitter (This allows scaling of the Single Element DP Transmitter for Modulated Water Level.)
- 3E Transmitters (This allows scaling of the Drum Level, Steam Flow and Feedwater Flow Transmitters for 3 Element operation)
- Draft Control Settings (Allows configuration and scaling of Draft Control settings)

Low Fire Hold & Hot Standby (No Log-in Required)



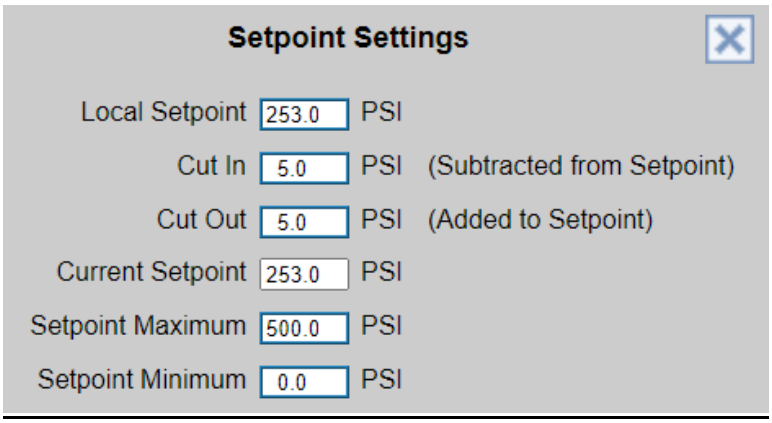
Low Fire Hold and Hot Standby both share a common temperature sensor in the belly of the vessel. This temperature sensor is a 4-20mA enabled RTD. When using the 4-20mA sensor, you are able to set the scale of sensor to match actual transmitter used.

Low fire Hold will keep a burner at Low Fire position until the water temperature exceeds the setpoint (as shown in Low Fire Hold & Hot Standby image above). This protects the vessel from thermal shock. Thermal Shock results from the tubes within the boiler heating up faster than the vessel itself. This leads to tubes unseating from premature expansion, causing water leaks. By slowly heating the vessel, the expansion of the tubes and vessel are more uniform.

Hot Standby keeps a vessel at a setpoint for quicker startup when a Run Demand is issued by the control or personnel. Typically the Hot Standby on a Steam Boiler will be at least 212F. In regards to a Hot Water Boiler, the Hot Standby is not available.

Setpoint Settings

The Setpoint settings screen allows users to input the desired operating setpoint of the system in Local operation. It also allows the user to determine Cut In (how far below the setpoint before triggering a call to run) and Cut Out (how far above the setpoint before triggering a shutdown). When logged in under Installer or Designer, the user is able to set limits to what the setpoint can be, both minimum and maximum.

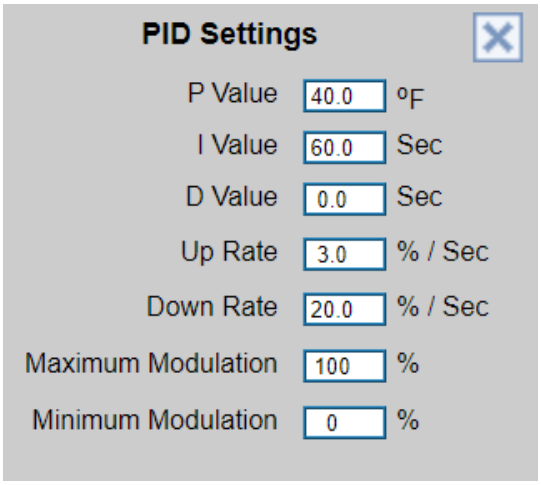


PID Settings

The P value or Proportional value is the range of modulation. Example: Setpoint is 200 PSI, P=40, I=0, D=0. This will cause modulation from 100% at 160 PSI to 0% at 200 PSI in a liner fashion with a 50% output (process variable) at 180 PSI. When only using the P value the firing rate is always equal to (Setpoint – Process variable / Proportional value). A smaller value here reacts faster.

The I value or Integral value is the time in seconds it takes to add the firing rate calculated by (Setpoint – Process variable / Proportional value) to the current firing rate. Example: Setpoint is 200 PSI, P=40, I=60, D=0 and process variable at 190 PSI. Modulation rate will be 25% and will add an additional 25% over the span of the I value of 60 seconds. A smaller value here is faster reacting.

The D value or Derivative value is the time in seconds the controller waits to make further adjustments to the output to reduce the amount of error from the process variable to the setpoint. This correction tries to predict future conditions. Because boilers are so slow to react it is recommended to keep this value at zero to disable this function as it can cause oscillation issues. This applies to other PID loops in Slate.



Minimum and Maximum Modulation setpoints can only be adjusted if logged in as Installer or Designer.

Transmitter Setup:
All transmitters used with Director SCS must be 4-20mA.

The following is the list of pre-wired transmitter inputs for the Director SCS:

- Process Variable Transmitter (Steam or Hot Water)
- O2 Transmitter
- Feedwater Flow Meter
- Ambient Air Transmitter
- Drum Level (Diff. Pressure) Transmitter
- Stack Temp Sensor (Main)
- Stack Temp Sensor (Economizer)
- Water Inlet Transmitter
- Water Outlet Transmitter (Economizer)
- Draft (Diff. Pressure) Transmitter
- FGR Temp Sensor
- Steam Flow Transmitter
- Fuel 1 Flow Transmitter
- Fuel 2 Flow Transmitter
- (3) User Defined Transmitters
- Outdoor Reset Transmitter

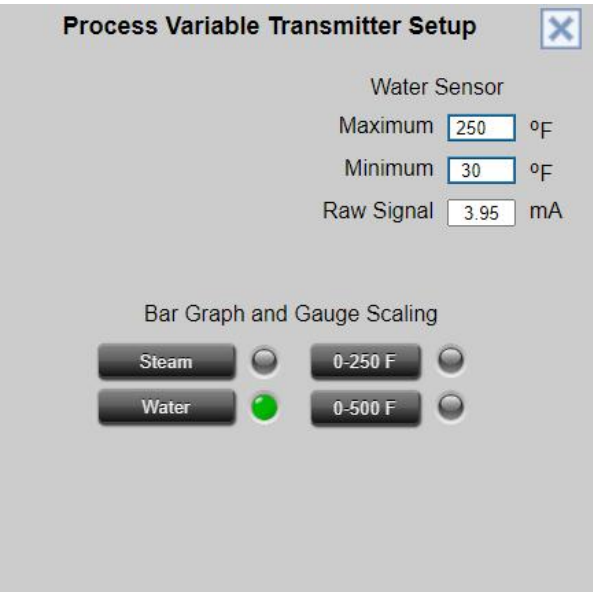
All Transmitters can be custom scaled (4-20mA) to allow usage of replacement or similar transmitters to be used with the system. For example, if the system currently uses a 0-150PSIG pressure transmitter, and that transmitter fails, you can re-scale the signal to utilize a hypothetical 0-300PSIG pressure transmitter.
Transmitters can be enabled or disabled using the Options Screen as mentioned on page 15. This allows for expansion of the system over time.

Transmitters are wired to a specific fused terminal block within the panel to make installation in the field simple. Wiring diagram provided with the burner will show what terminal is used for a specific transmitter.

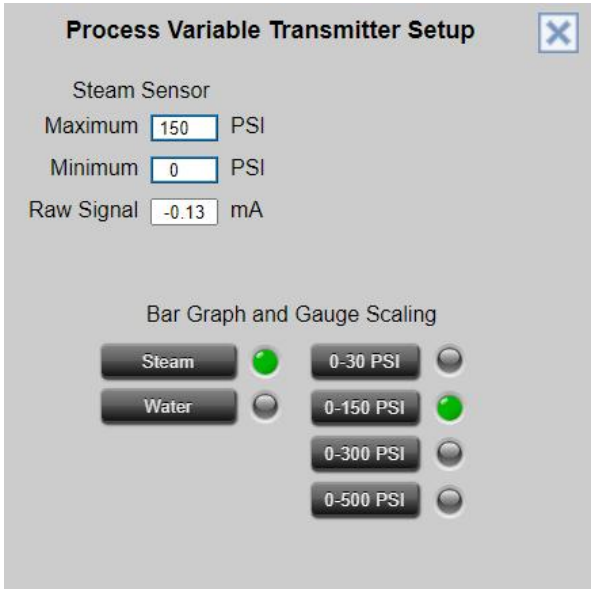
Process Variable Transmitter:

The Process Variable Transmitter, or PV is the sensor or transmitter in which the system uses as the operator. There are two methods for Operation: Hot Water (F) and Steam (PSI). This is done within the Process Variable Transmitter Setup screen. The Process Variable Transmitter Setup screen also allows the user to configure the operation of the system for either Steam or Hot Water, and custom scale a sensor, or pick a pre-configured setup.

PV Hot Water Example



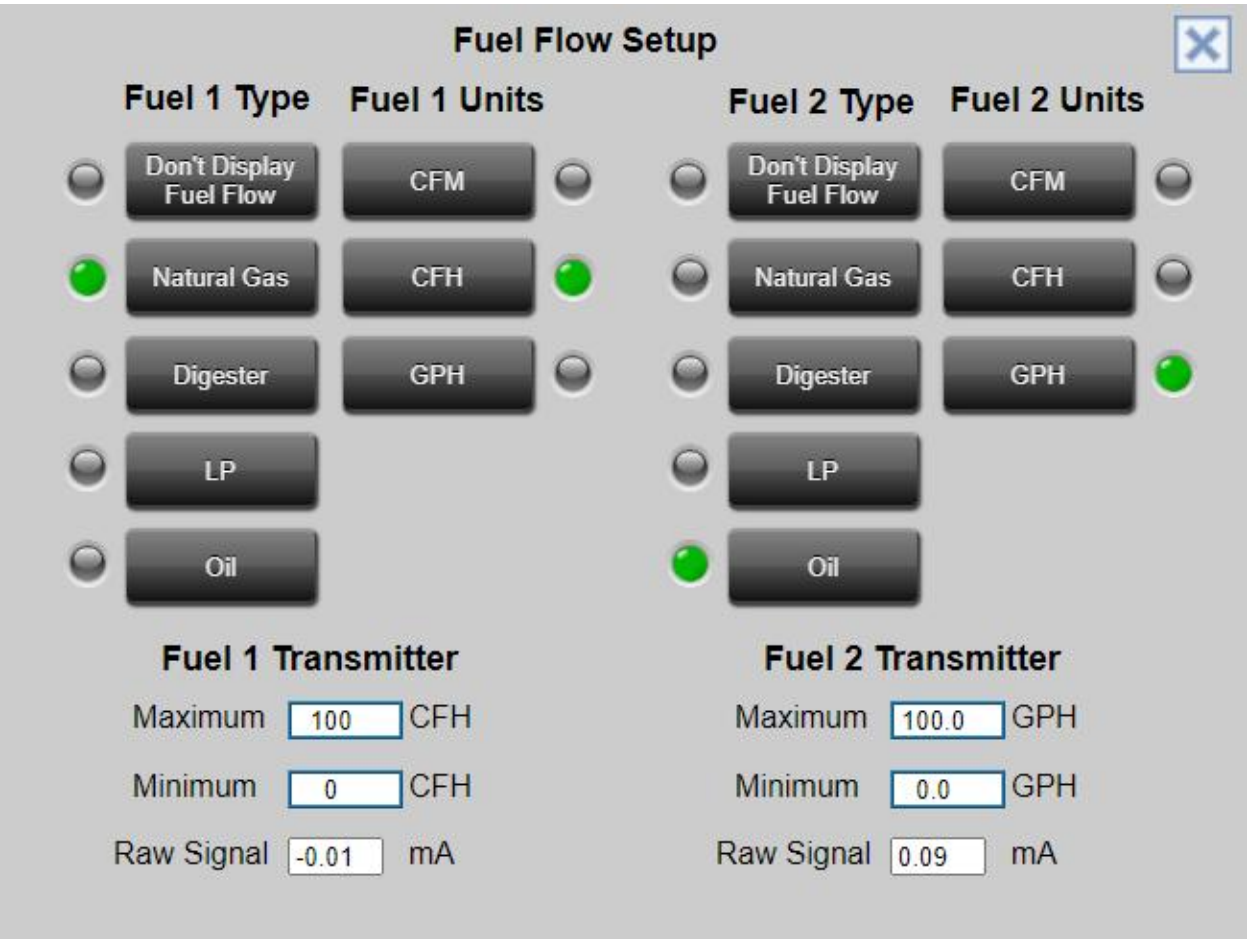
PV Steam Setup Example



Minimum is the lowest scale of the 4-20mA Transmitter, or 4mA equivalent. Maximum is the highest scale of the 4-20mA Transmitter, or 20mA. For example, if using a 30-250F temp sensor, Minimum would be set to 30, and Maximum would be set to 250.

The bar graph and gauge scaling are for adjusting the bar graph and gauge on Main Overview and Boiler Overview screens.

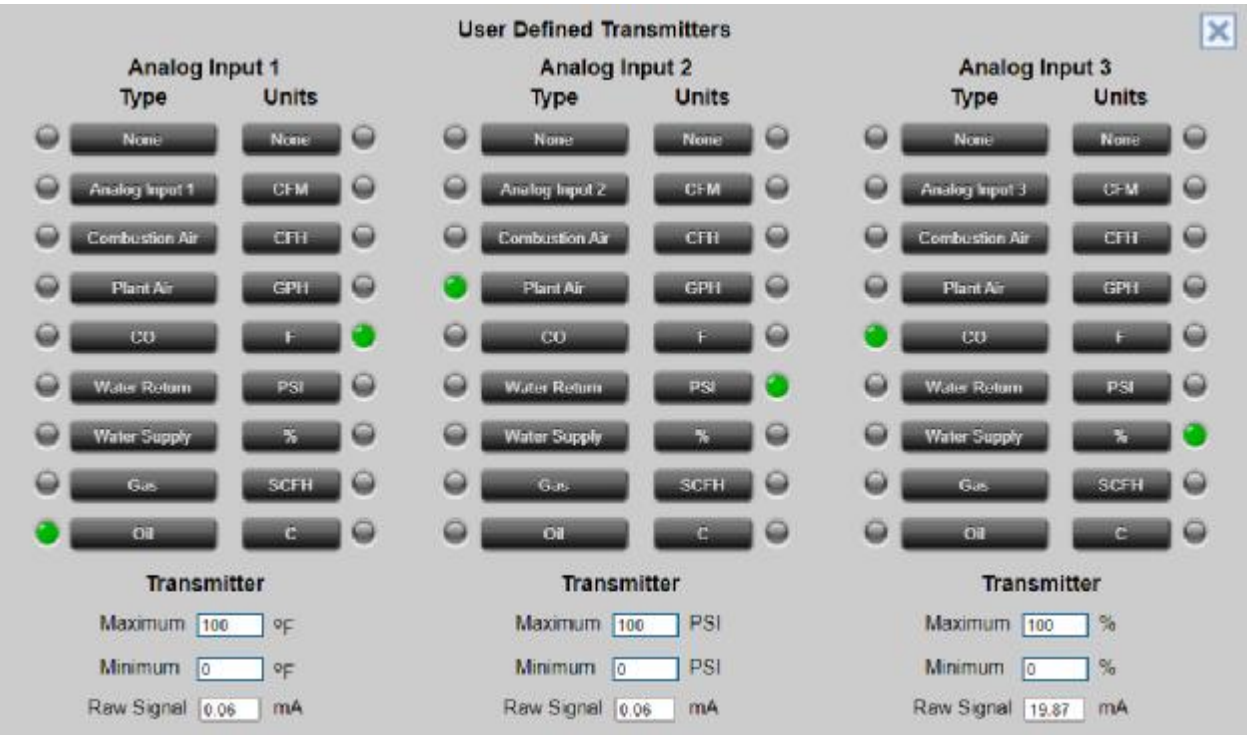
Fuel Flow Transmitter:



The Fuel Flow Transmitter Setup allows user to define the type of fuel being used, units of measure and adjustable scaling of 4-20mA signal to match the provided transmitter.
If an application requires more than one of the same fuel flow transmitters, the User Defined Transmitters allow for additional flow meters to be connected to the system for monitoring purposes.

User Defined Transmitters:

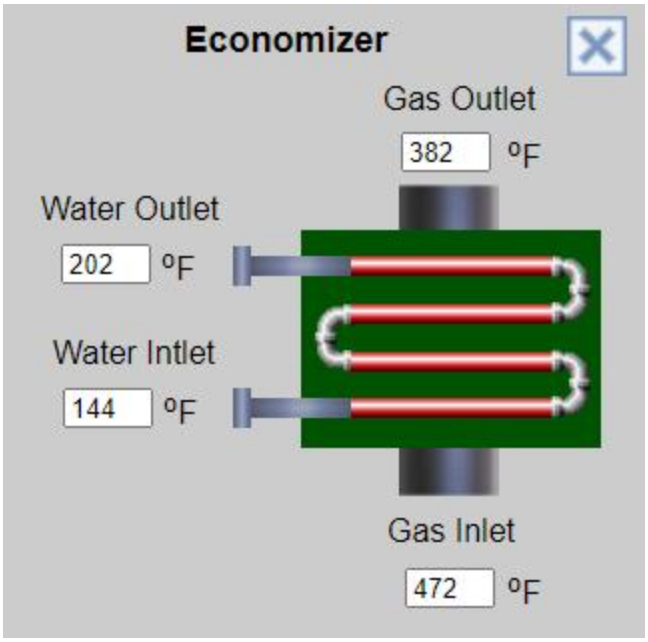
For other transmitters that may reside within the boiler room, or on the boiler itself, the User Defined Transmitters allow a user to add a custom transmitter so that it may be remotely monitored as the rest of the burner.



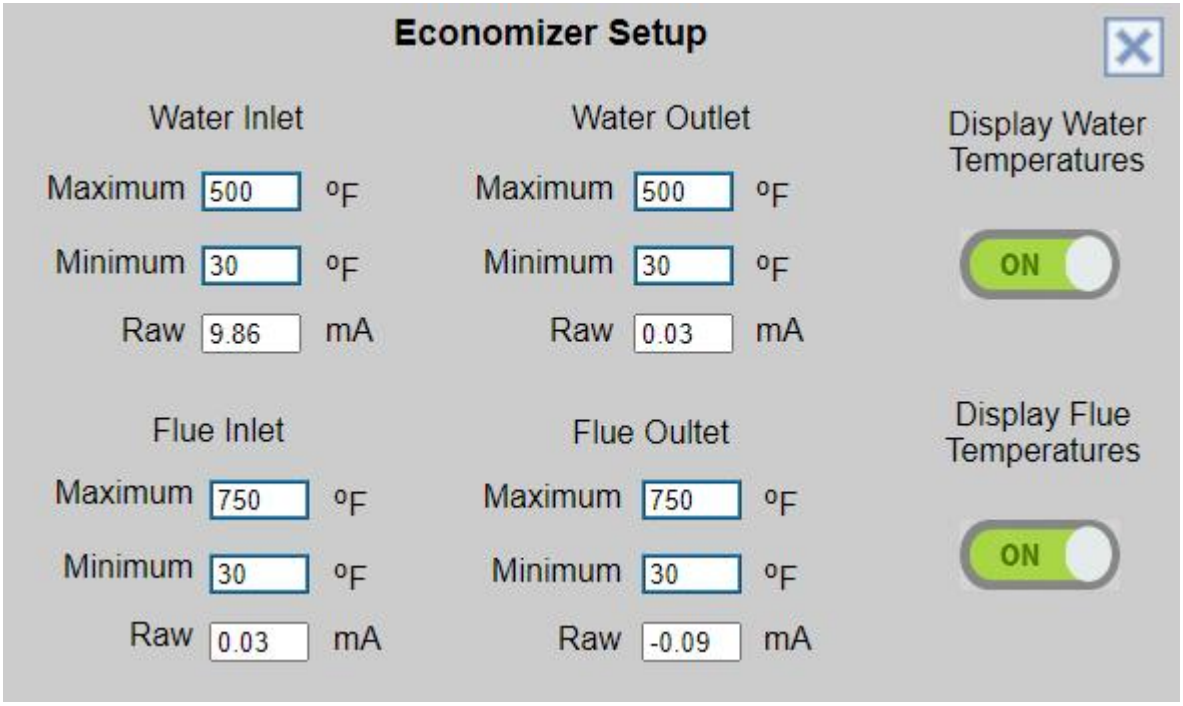
The setup screen allows for a selection of possible types of inputs, units of measure, and a way to scale the 4-20mA signal.

Economizer:

When enabled on the Options Screen, an Economizer Button will populate on the Main Overview Screen, allowing access to the following image:



Enabling Economizer will also populate Economizer Setup button under Transmitter Setup on Main Menu Screen. This will allow you to scale (4) temp sensors for water inlet, water outlet, stack inlet and stack outlet temperatures of the economizer so they will be displayed on previous image.



Draft Control:

The Director SCS Draft Control System is fully integrated into the Director SCS Burner Management System by Power Flame Inc.

FEATURES & BENEFITS

- Saves fuel and improves safety.
- Multiple draft control functions.
- Optional flue gas temperature indicator/control (FGR LFH)
- Graphical draft gauge.
- Menu-driven setup.
- Economical: long-term returns on low Initial investment.
- Modbus or BacNet Communications.
- Field configurable for all control & monitoring functions.
- Input/output diagnostic graphics

INTRODUCTION

The Power Flame Director SCS Draft Control System is a state-of-the-art product that combines, in one package, all the components of draft control, flue gas monitoring and safety:

- High performance microprocessor for accurate draft control.
- Damper command readout.
- Draft range signal for monitoring.
- Electronic draft reading.
- Flue gas temperature reading. (Optional)
- Flue gas temperature alarm. (Optional)
- Low draft or high-pressure cutoff switch.

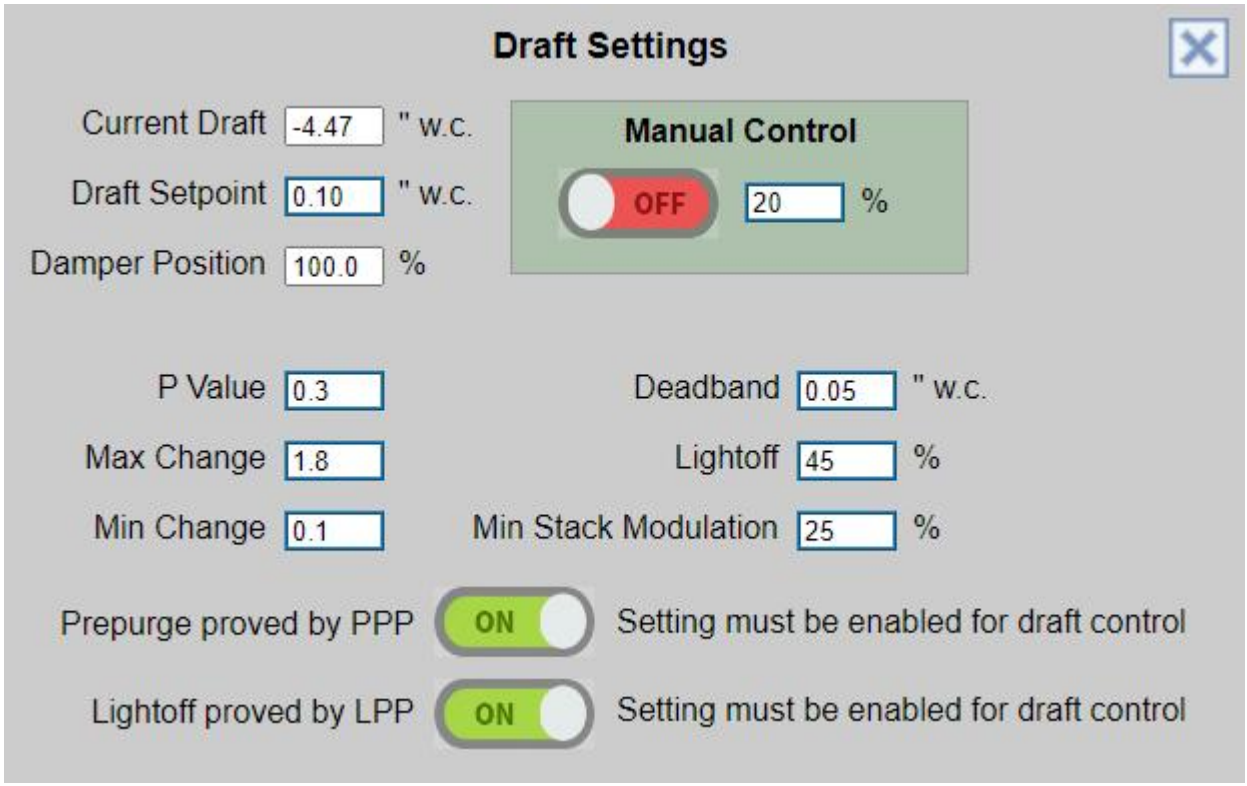
The Director SCS Draft Control System's many standard features provide a simple operator interface and accurate control. The unit is field-configured by means of the Director SCS Touchscreen Draft control logic functions include:

Sequencing, pre-and post-purge, and adjustable start. A Manual/Auto selection on the touchscreen allows manual damper positioning. Modbus and BacNet communications are standard with the Director SCS, showing settings, input & output states & draft valve - 3.0" w.c. to + 3.0" w.c.

The draft sensor can measure positive or negative pressure directly. The sensor produces an electrical signal directly proportional to the pressure in the boiler. The controller output through zero-crossover-switching relays is selectable for bi-directional, switched 4-20mA to operate the damper electric actuator. Adjustable dead band and damping circuit's filter out process noise, eliminating cycling.

Draft control is essential to both fire tube and water tube boiler applications. Boilers with stack heights of 25–30 feet (or even boilers with stub stacks) benefit from proper draft control and monitoring: it improves heat transfer and combustion efficiency, reduces room heat loss, improves flame stability, reduces pilot light failure and improves flame retention. Efficiency improves dramatically when a Power Flame Director SCS Draft Control System is applied to a Director SCS Burner Management System.

Once Draft Control is enabled on the Options Screen, you can scale the Draft Transmitter under Transmitter Setup on Main Menu screen. You can also set the field adjustable draft settings on the screen below, found under Settings on Main Menu Screen:



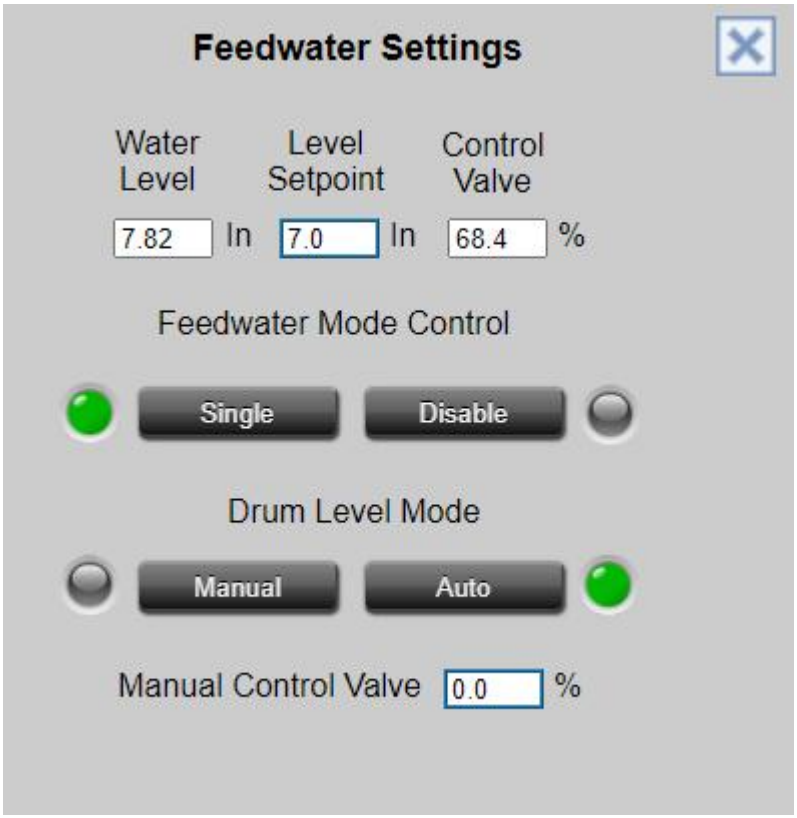
Modulated Feedwater Control:

The Director SCS has two modes for Modulated Feedwater control. Single Element Feedwater utilizes a Differential Pressure Transmitter to see the level of water in a vessel, communicate that level to the control, and allow the control to modulate an electric or electro-pneumatic valve via 4-20mA to maintain a setpoint.

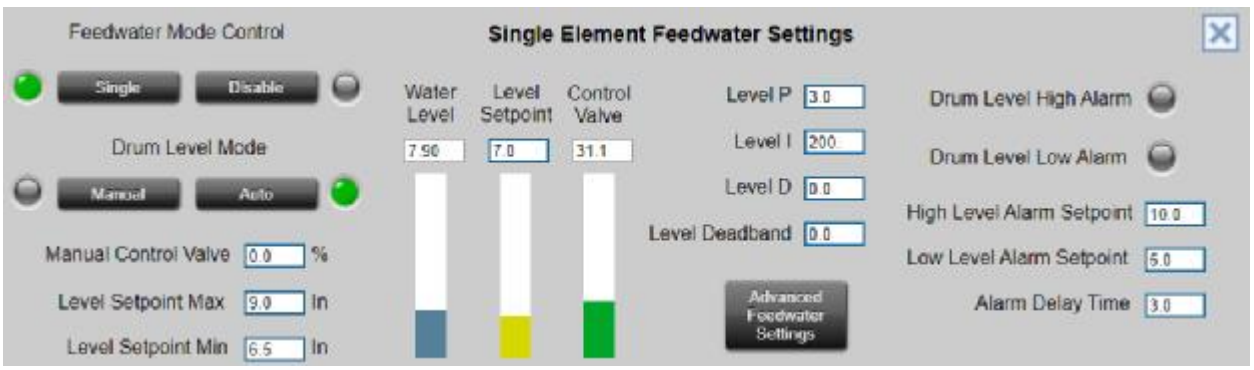
This transmitter can be scaled via 4-20mA under Transmitter Setup on Main Menu. It will be the Drum Level Transmitter.

There will be Level Control Settings found under Settings on Main Menu. It will be called Single Element Settings:

Not Logged In:

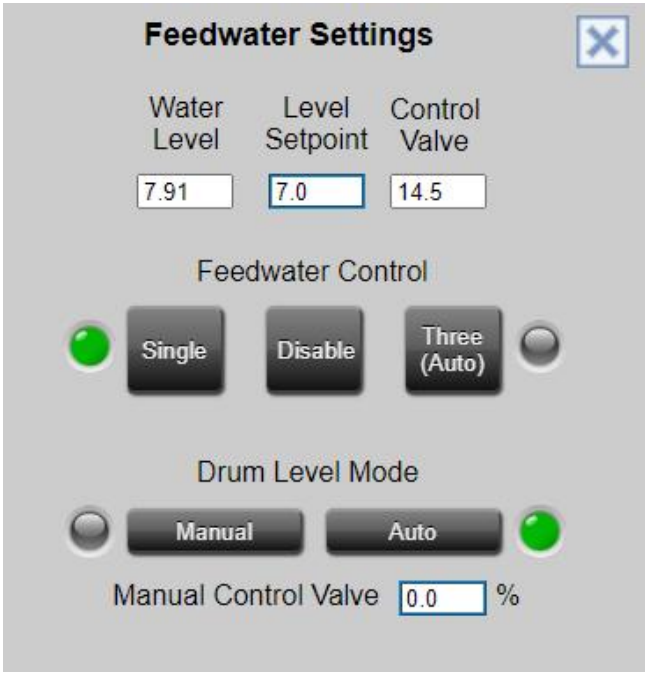


Logged in:

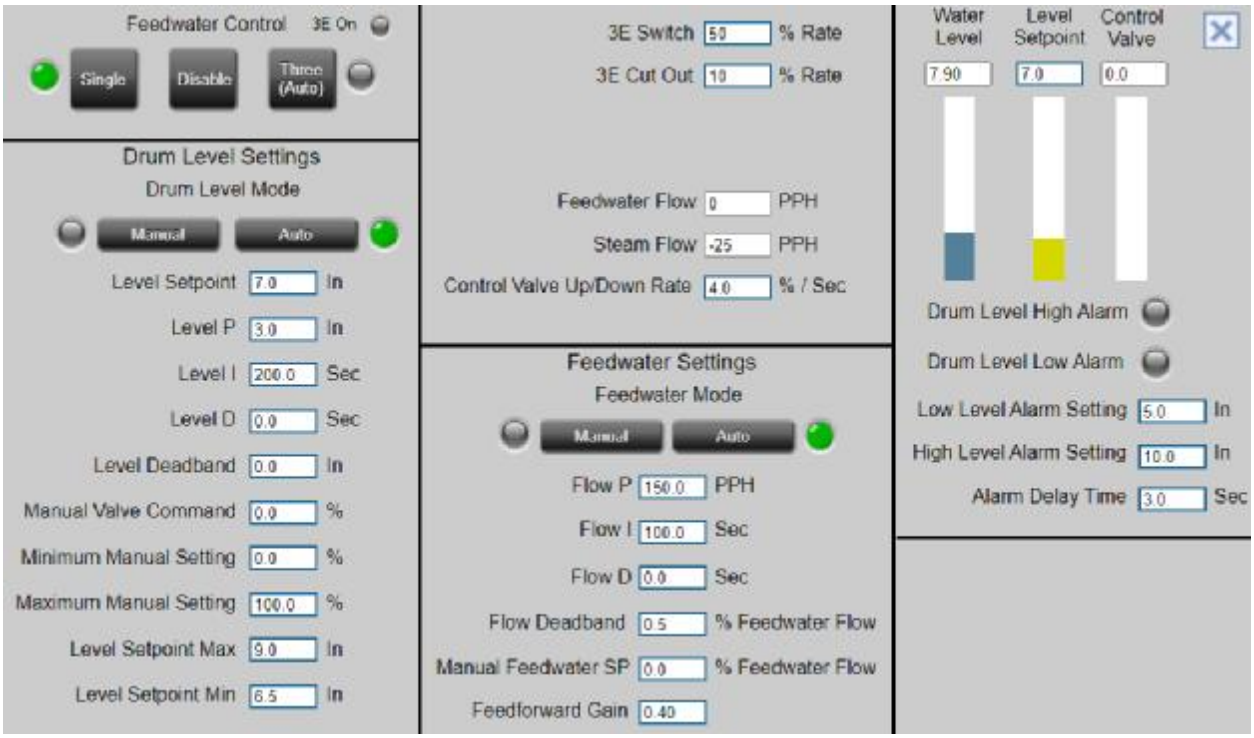


The second mode of Modulated Feedwater Control is 3 Element Feedwater. This uses the DP Transmitter of the Single Element system and incorporates a Steam Flow meter and Feedwater Flow meter. The 3 Element Feedwater system not only looks at current water level via DP transmitter, but the amount of steam leaving the vessel and the amount of water entering the vessel.

Not Logged In:

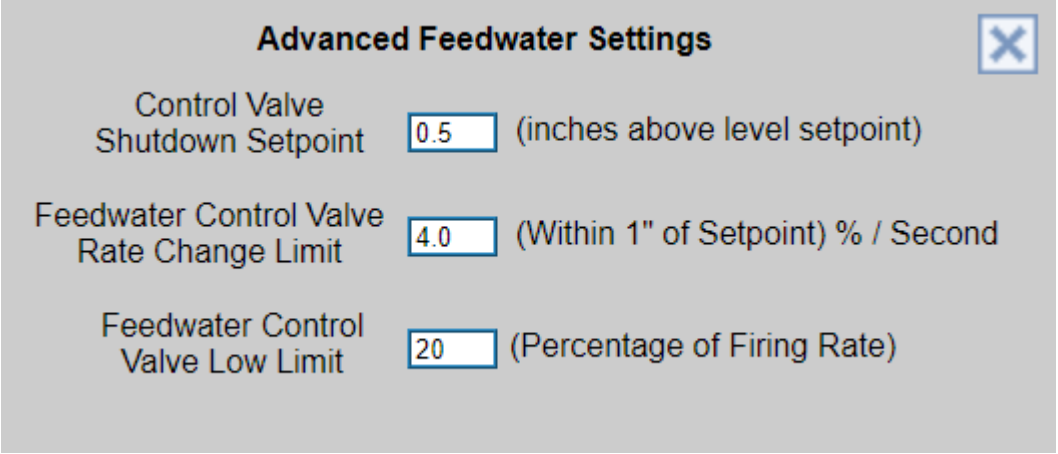


Logged In:



Advanced Feedwater Settings

Control Valve Shutdown Setpoint – This keeps the feedwater valve open after the current water level has exceeded setpoint until this value above setpoint to prevent the PID loop from closing the valve. This helps reduce issues from frequently fully closing and opening the feedwater valve.

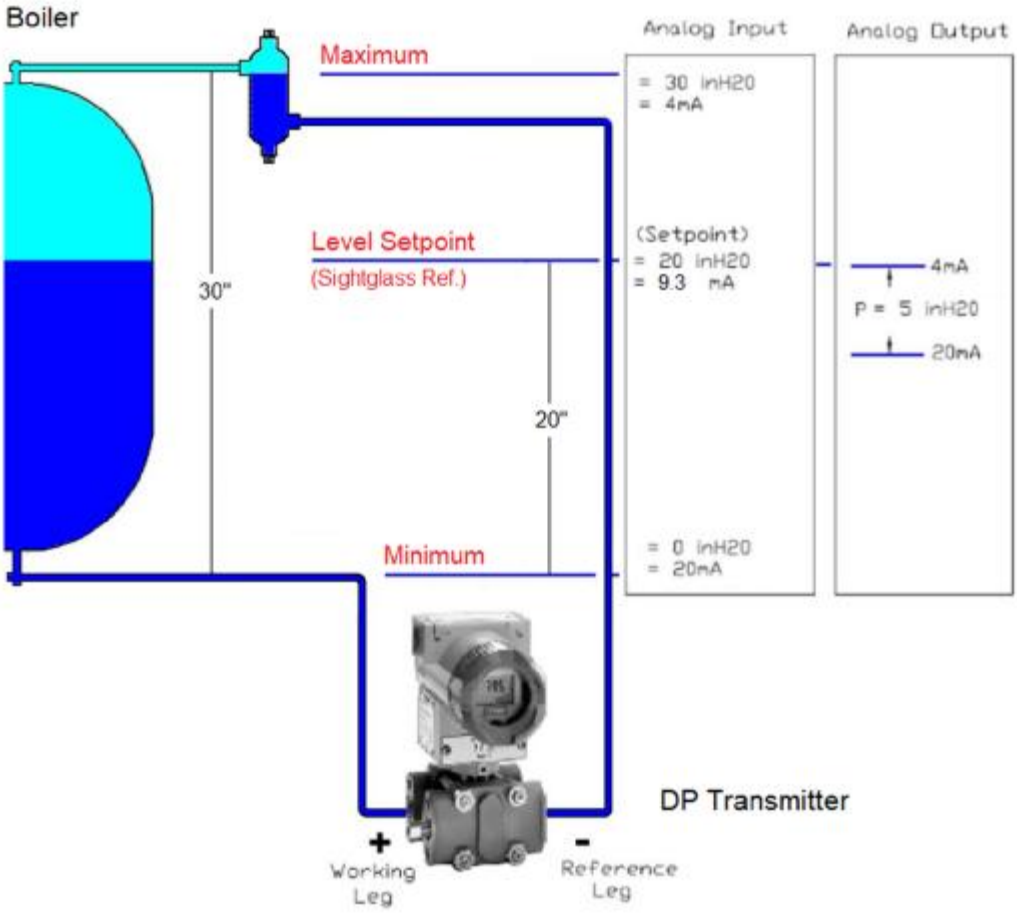


Feedwater Control Valve Rate Change Limit – The feedwater valve runs at full speed until within 1” of setpoint. This value is the speed in % / second it travels.

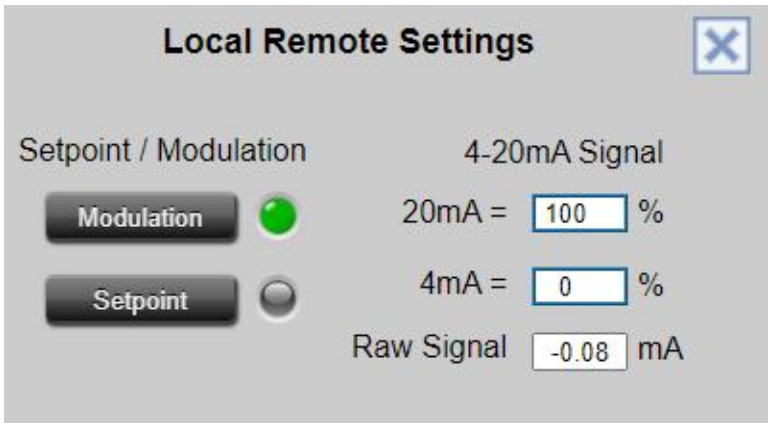
Feedwater Control Valve Low Limit – The feedwater valve is held by this minimum percentage multiplied by the firing rate until the value in Control Valve Shutdown Setpoint is met. Example: a value of 20 with firing rate at 40% would produce an 8% valve position.

Scaling the DP Transmitter:

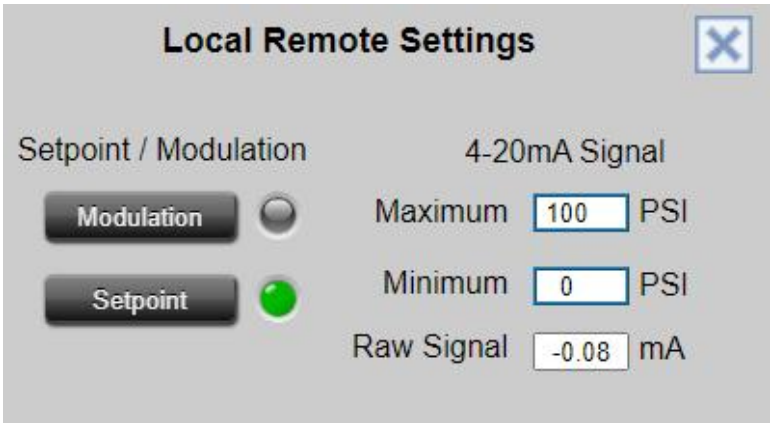
Please refer to example figure below



Remote Signal Settings (Requires Installer Log-in)



The Remote Modulation Signal Settings allows you to choose from a Remote Setpoint Input or a Modulating 4-20mA Input. The Modulation signal is typically transmitted from a PID Controller external from the Director SCS, such as a Universal Digital Controller, Master Panel, SCADA System or Building Automation System. When the touchscreen selector knob is set to Modulation, the scaling on the right-hand side (Maximum & Minimum) sets the modulation of the burner. If you wanted to limit the firing rate of the burner, you can lower the Maximum % to desired high firing rate of burner.



The Remote Setpoint Signal Setting allows you to work from a remote 4 or 20mA signal and set the Minimum and Maximum Parameter to use as a setpoint from the remote signal. This setting is not for a modulating signal, but a fixed signal. For instance, assuming the desired temperature of a hot water boiler is 200F, we set the Maximum to 200F. This will represent the 20mA signal we will receive from the external controller. We can also set the Minimum to a lower parameter, say 160F. This will represent 4mA signal from the external controller. This allows the user to have a day/night setback, or weekday/weekend setback depending on how the 4mA signal is utilized. If the controller were to send a 12mA signal, that would scale to 180F.

Most of the settings and configurations within the Main Menu page will require an Installer or Designer Level login in and password. These are typically preconfigured at the factory. The ability to configure and setup these functions in the field is designed for startup & commissioning, future system expansion or when a component fails, and a new component is installed that may not be an exact replacement.
The Main Menu page also has links to the Slate Generic pages where the various module setups are completed, as well as the Commissioning Dashboard where the fuel curve editing is completed. The Option Setup will be covered below.
Annunciation button is also found on the Main Menu page. This will navigate you to the device annunciation. The Annunciation Status will be covered later in the manual.

Option Setup (Requires Installer or Designer Log-in)

The Option Setup page allows technicians to toggle various items on and off depending on the customer or system requirements. This page only enables/disables functions. You will need to make sure the devices or functions you are enabling have been configured on the Main Menu page. The Option Setup page requires a high-level login credential of Installer or Designer to make changes. Options include:
Display Economizer, Display Stack Temp, O2 Trim, Ambient Air Temp, Combustion Efficiency, Water Temp and Enable Outdoor Reset, Draft Control, Valve Proving, Local Remote Switch, Feedwater, Three Element (Feedwater). To view newly enabled options, go to Main Overview Page.

Annunciator

From the Main Overview page, click Main Menu shown in figure 1.

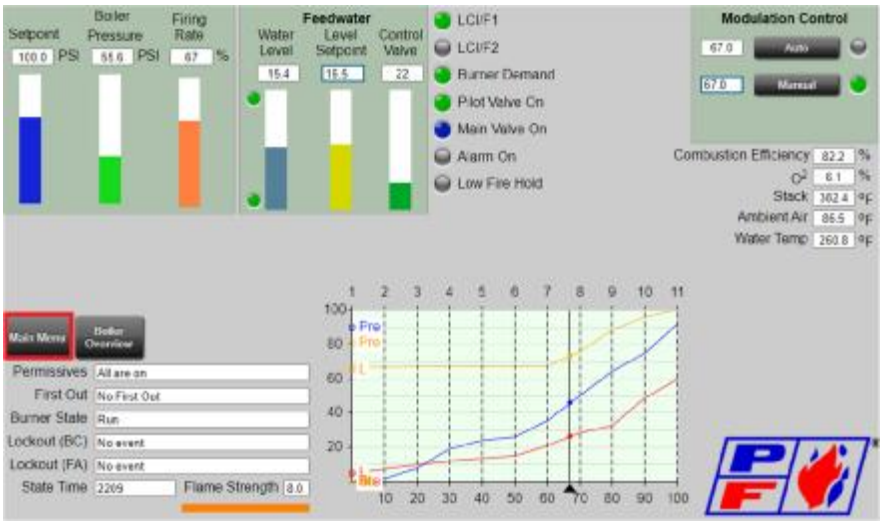


Figure 1

Once on Main Menu page, click Login shown in Figure 2.

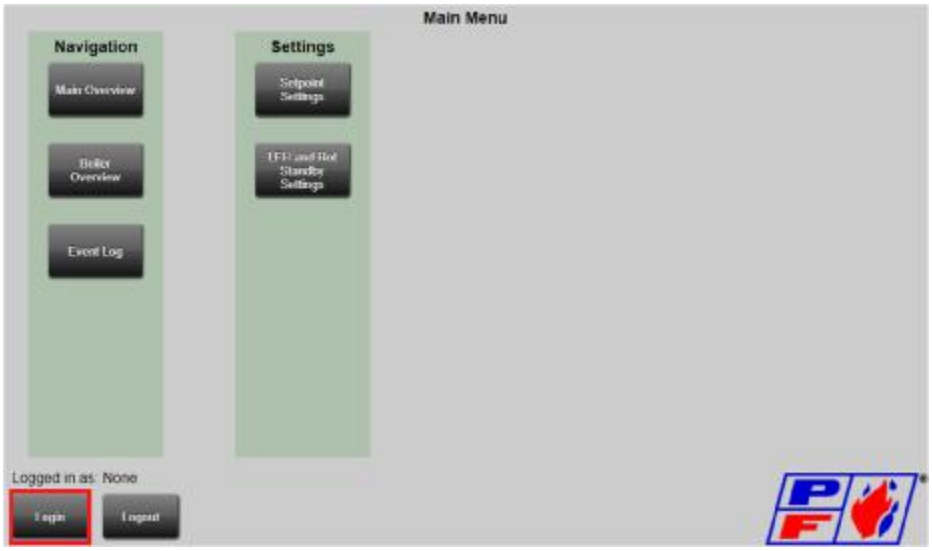


Figure 2

The login screen will appear as shown in Figure 3. You must be logged in as Installer or Designer. When you request the RIN the 6-digit number will be displayed on the Base unit.

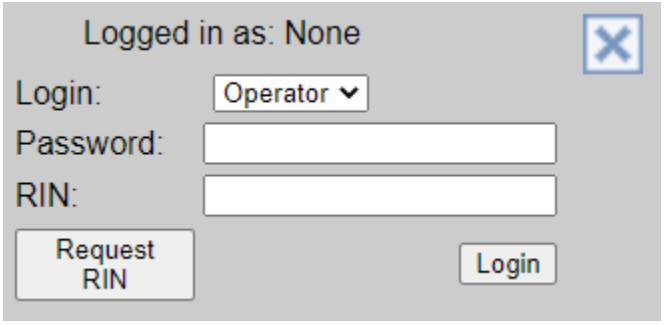


Figure 3

Once logged in, click Slate Generic as shown in Figure 4.

Generic Pages:

Generic pages are background pages built into the Slate platform for use by qualified technicians to save and load fuel curves, configure annunciation, establish the setup points within the modules, configure components, and commissioning. The commissioning is done via the Commissioning Dashboard. The Commissioning Dashboard provides a location for VFD setup, Actuator setup, and Curve Edit. They also allow you to set up trend sets for specific registers, configure burner control settings, and set up communications protocols.

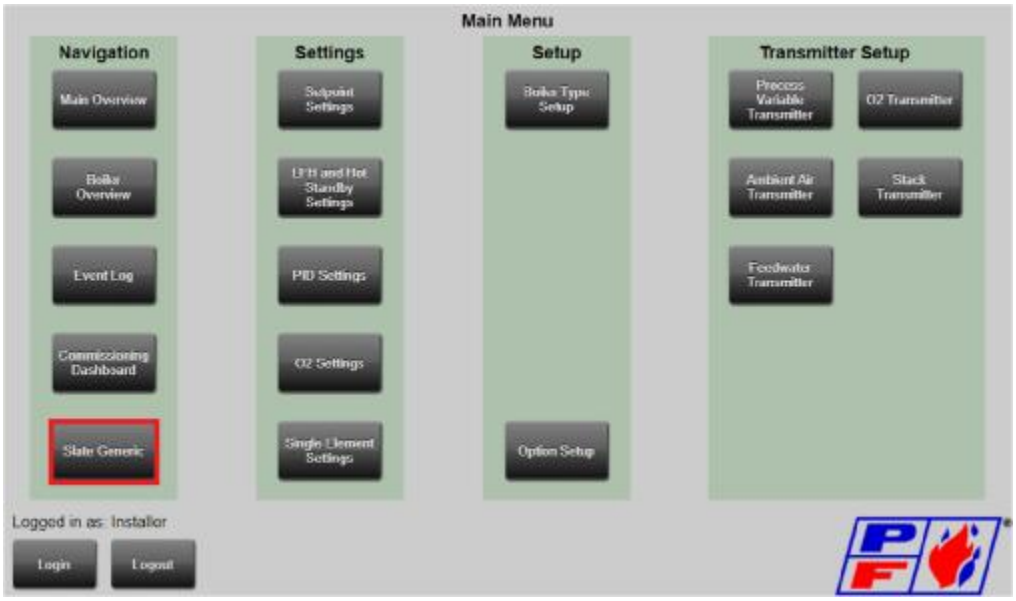


Figure 4

From the Modules Pages click ANNUNCIATOR as shown in Figure 5.

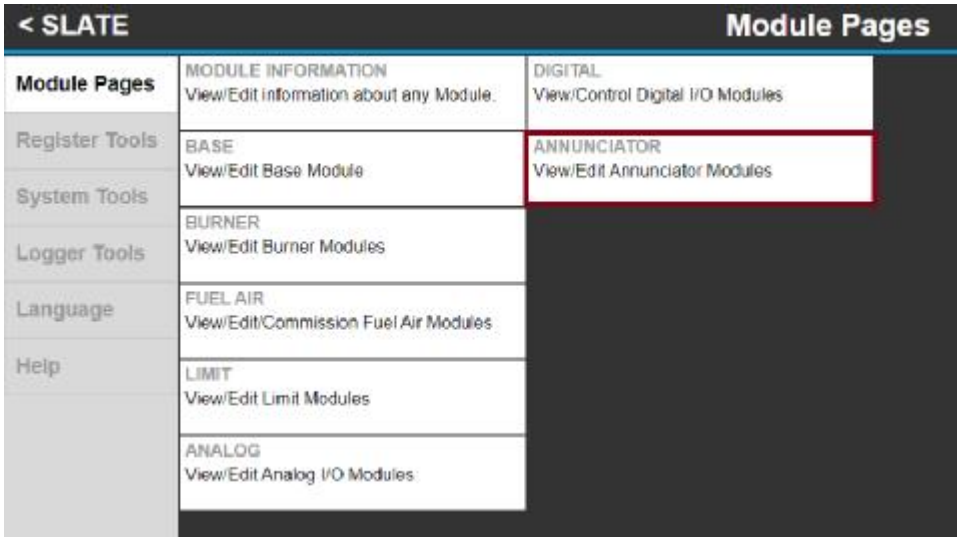


Figure 5

From SLATE Annunciator – Status page click Setup Analyzers as shown in Figure 6.

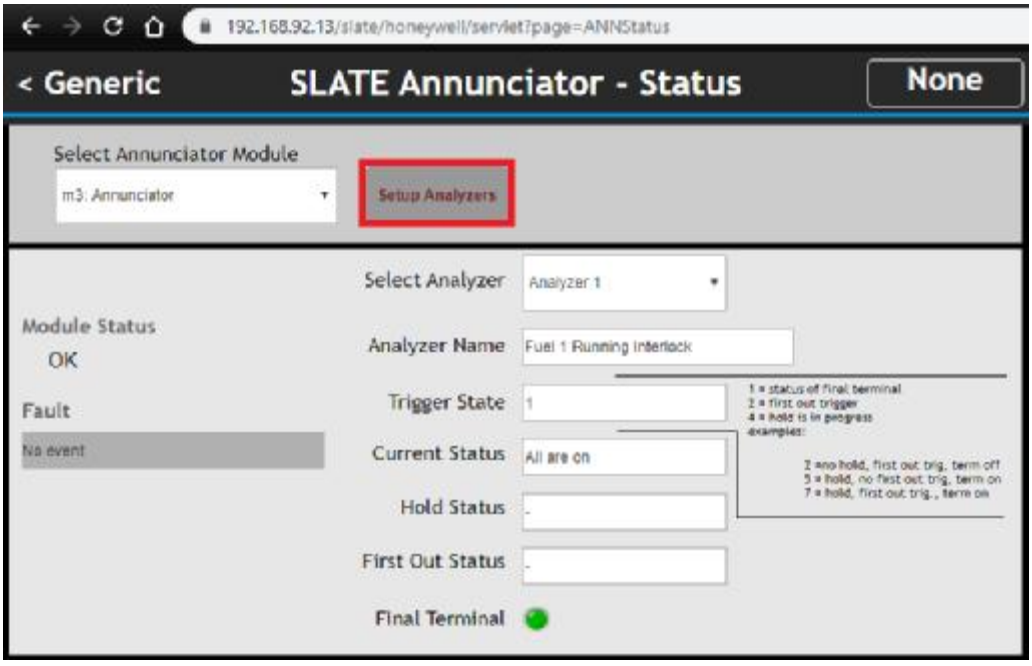


Figure 6

Single Fuel Running Interlocks Setup:
Analyzer 1 is used for the burners running interlocks.
All used terminals on the annunciator will get the setting of “Common” in the Input Setup drop-down. All unused terminals on the annunciator will get the setting of “X” in the Input Setup drop-down. See Figure 7 on next page for an example.

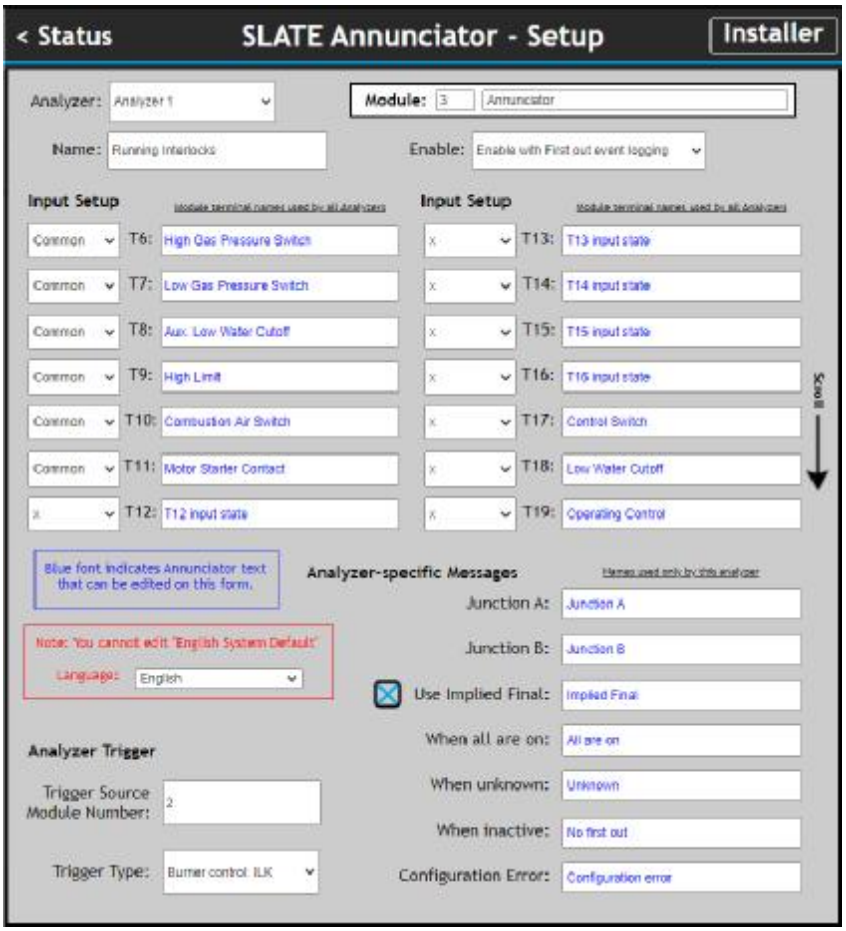


Figure 7

Dual Fuel Running Interlocks Setup:

Analyzer 1 is used for the burners running interlocks. Under Input Setup “First A” is the connection after the first devices on fuel 1. “First B” is the connection after the fuel switch or relay and doesn’t run through a device rather is a place holder so SLATE knows this is the start of the second fuel. Naming this terminal is not important as no devise is connected here. All other devices that are only in fuel 1 will get the setting of “A” and all other devises only in fuel 2 will get the setting of “B”. The connection where both fuels meet in the running interlock is called the “Junction”. The terminal name is not needed here but rather is entered in under “Junction A:” and “Junction B:”. All other devices in the running interlock are common to both fuels will get the setting of “Common”. Unused terminals for the running interlock get the setting of “X”. If there is a device between the last terminal used in the running interlock of the annunciator and terminal ILK on the Burner Control Module, then “Used Implied Final” will need to be checked and named. See Figure 8 for an example.

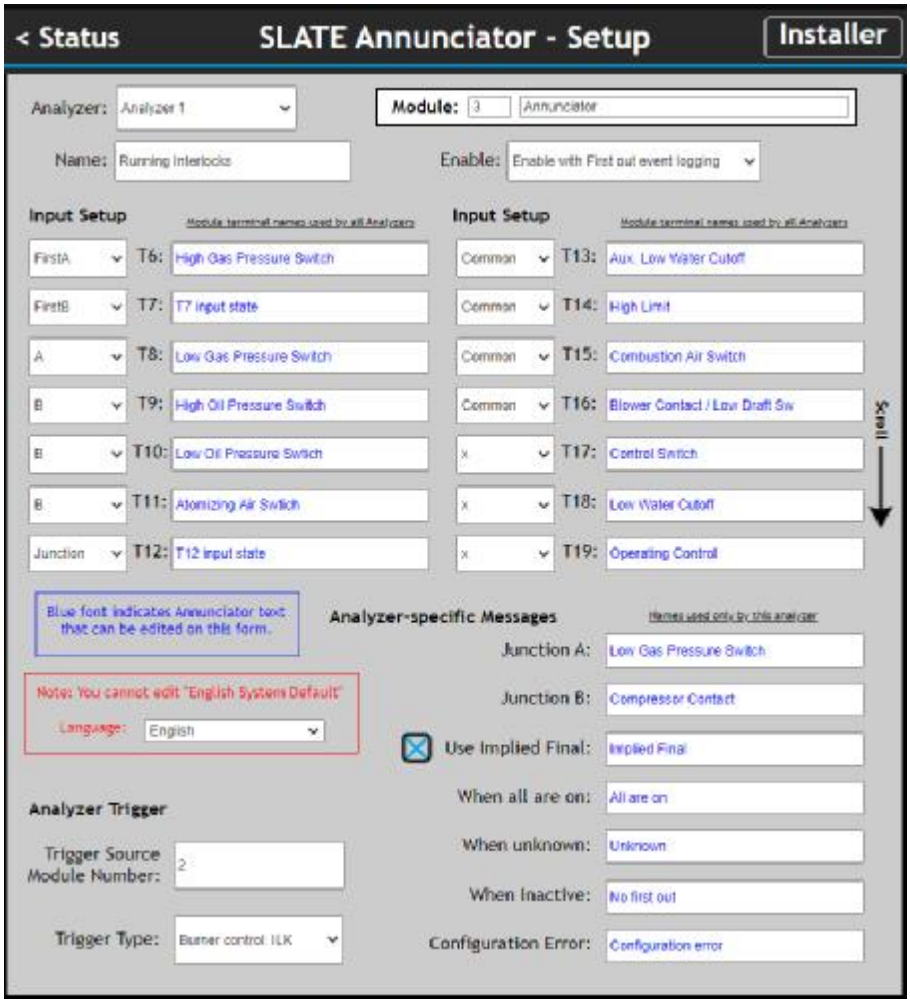


Figure 8

Permissives Setup:

Analyzer 2 is used for the burners permissives. In this example the Control Switch, Low Water Cutoff and Operating Control get “Common” in the Input Setup drop-down and everything else gets “X”. See Figure 9 on next page for an example.

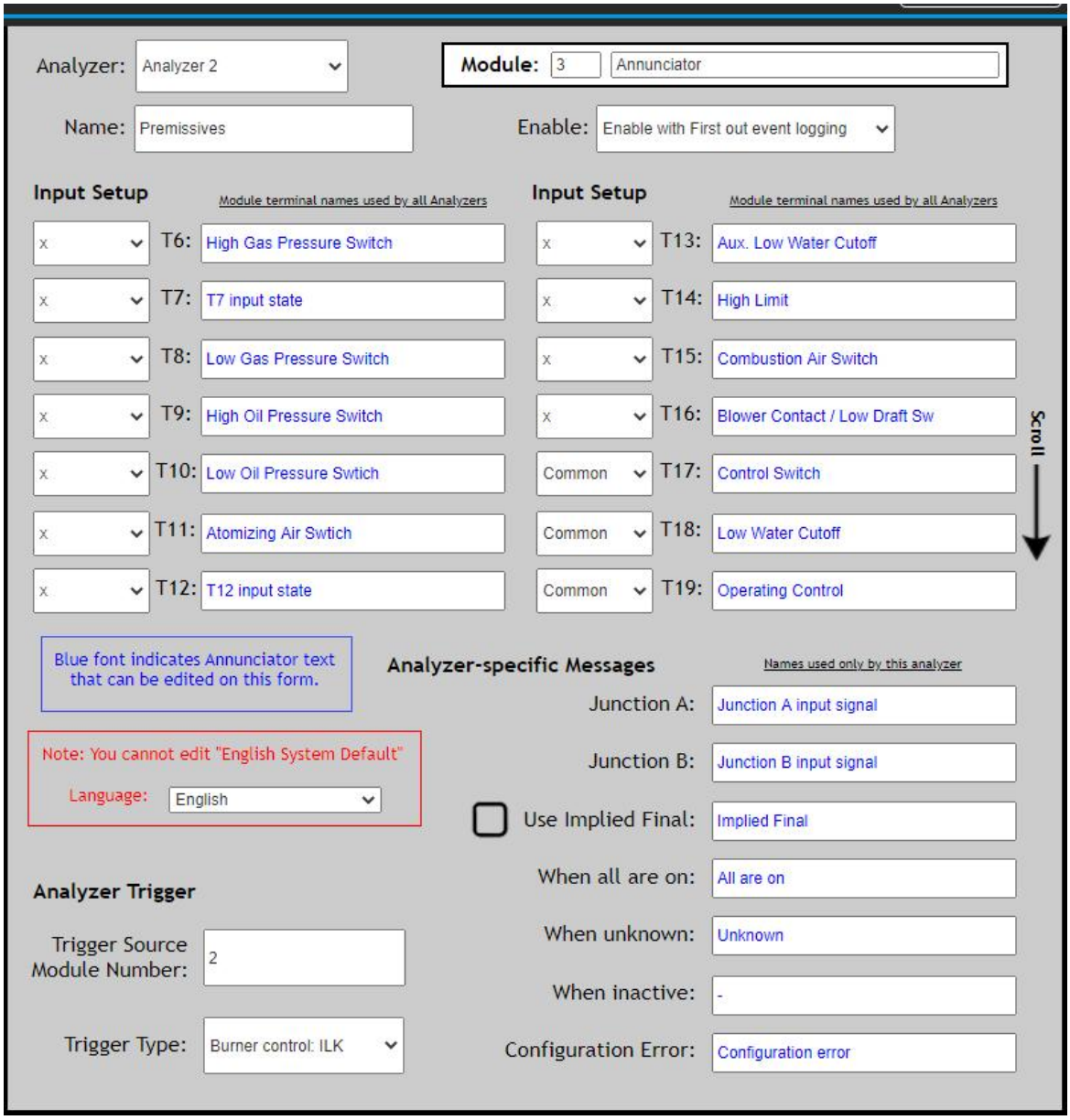
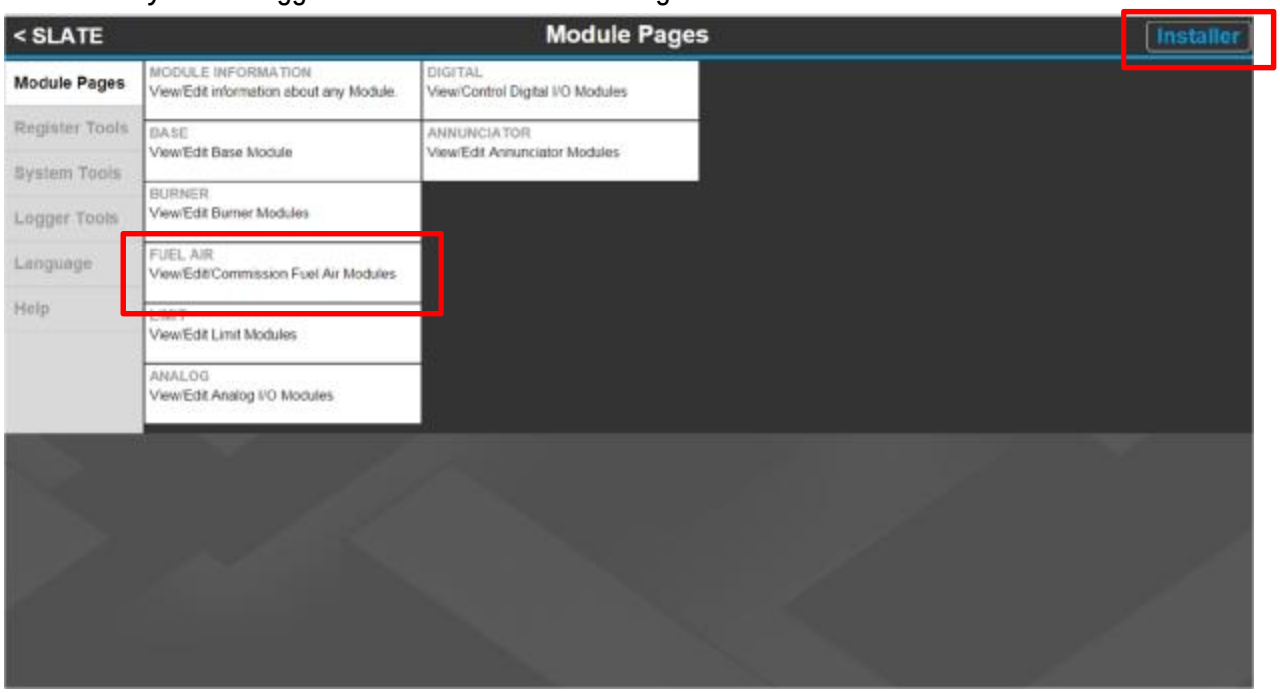

Analyzer: Analyzer 2
Module: 3 Annunciator
Name: Premissives
Enable: Enable with First out event logging
Input Setup
Module terminal names used by all Analyzers
x T6: High Gas Pressure Switch
x T7: T7 input state
x T8: Low Gas Pressure Switch
x T9: High Oil Pressure Switch
x T10: Low Oil Pressure Swtich
x T11: Atomizing Air Swtich
x T12: T12 input state
Input Setup
Module terminal names used by all Analyzers
x T13: Aux. Low Water Cutoff
x T14: High Limit
x T15: Combustion Air Switch
x T16: Blower Contact / Low Draft Sw
Common T17: Control Switch
Common T18: Low Water Cutoff
Common T19: Operating Control
Scroll
Blue font indicates Annunciator text that can be edited on this form.
Note: You cannot edit "English System Default"
Language: English
Analyzer-specific Messages
Names used only by this analyzer
Junction A: Junction A input signal
Junction B: Junction B input signal
Use Implied Final: Implied Final
When all are on: All are on
When unknown: Unknown
When inactive: -
Configuration Error: Configuration error
Analyzer Trigger
Trigger Source Module Number: 2
Trigger Type: Burner control: ILK

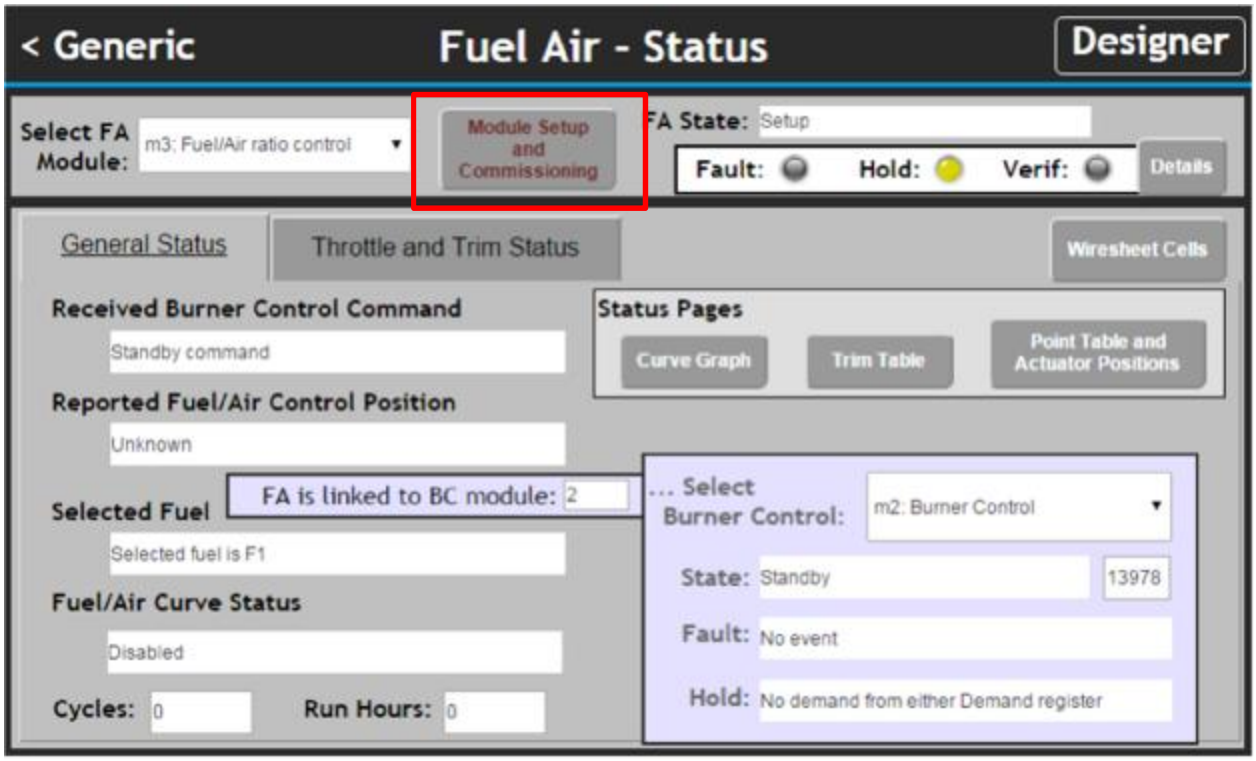
Figure 9

Commissioning and Tuning

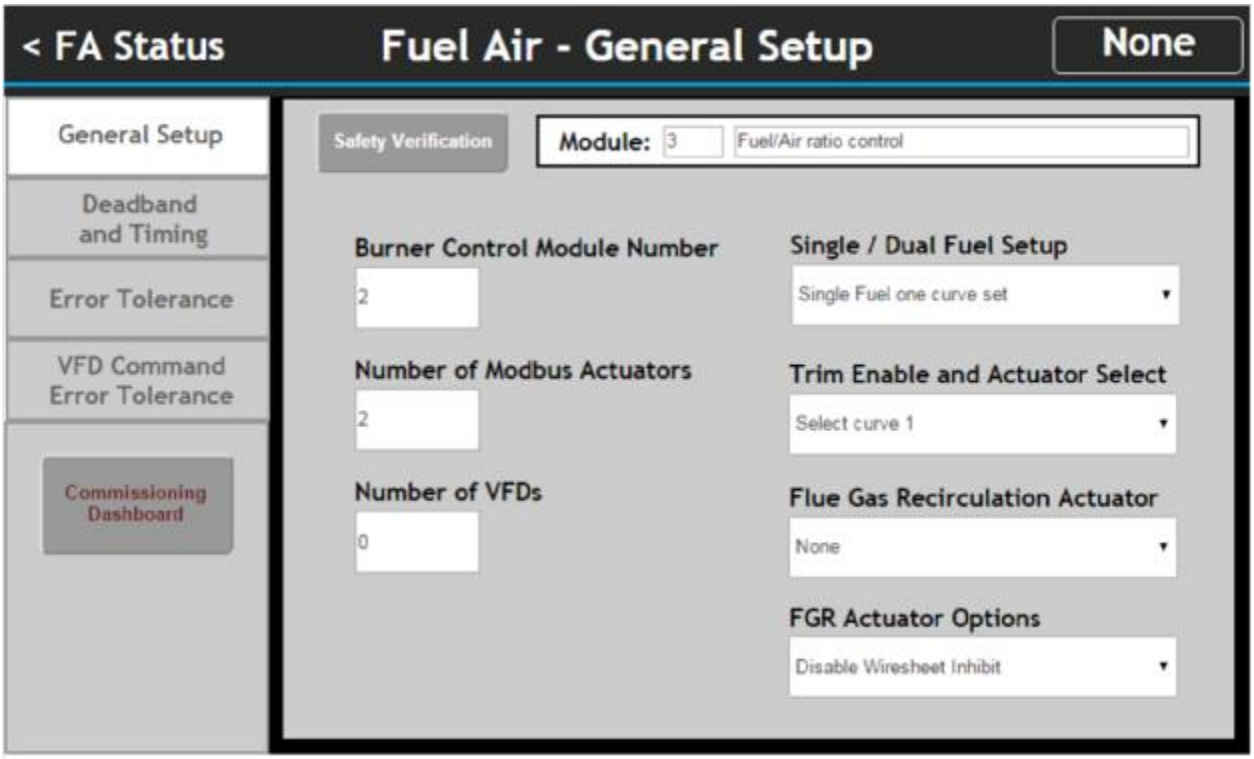
Fuel Air Commissioning begins at the SLATE Generic Pages. To begin you will need to make sure you are logged in as an Installer or Designer. Click on the Fuel Air section.



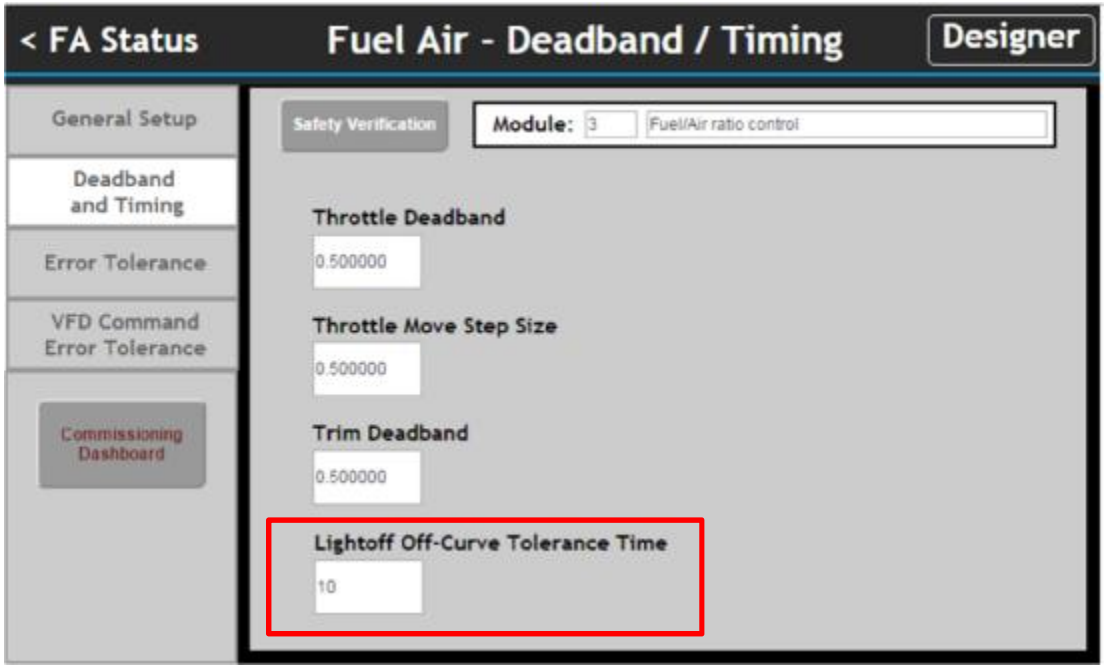
Clicking on the Fuel Air Commissioning screen takes you to the Fuel Air Status screen. Here you can see any faults, which Burner Control the Fuel Air is linked to and other important information. To move to Commissioning select Module Setup and Commissioning.



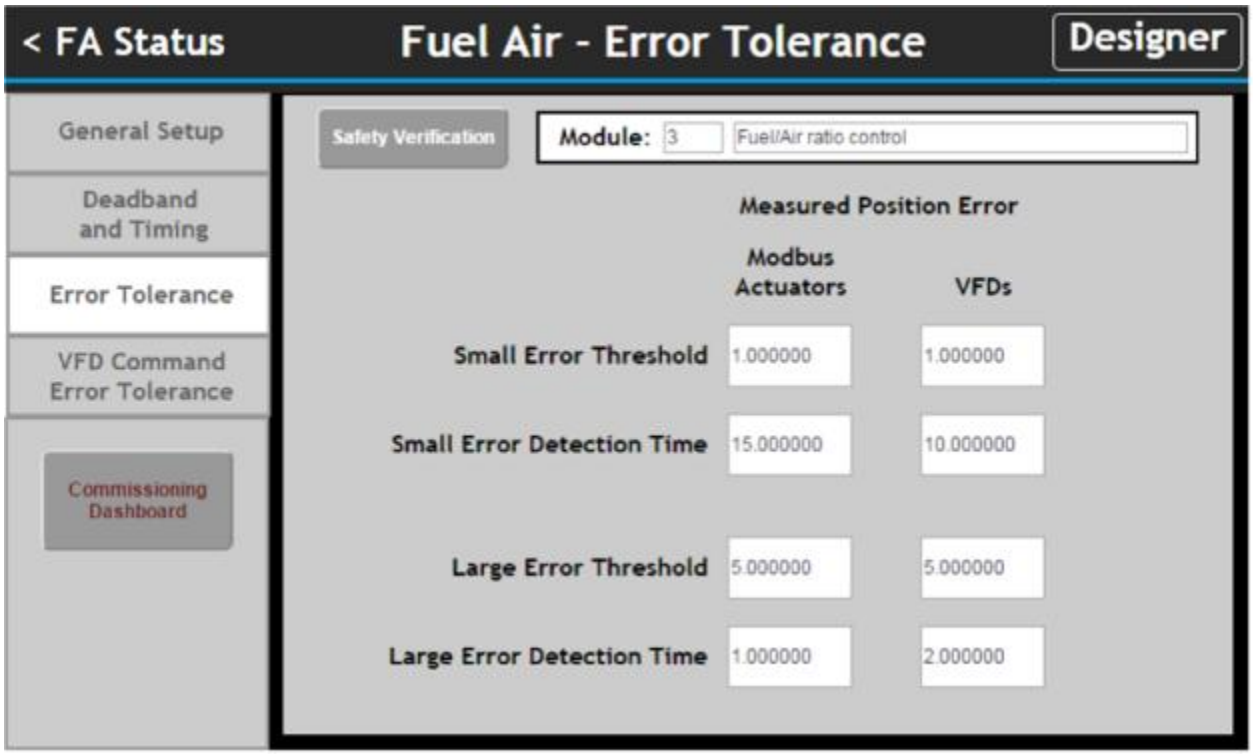
General setup allows you to set up information about the Burner Control and Fuel Air device environment.



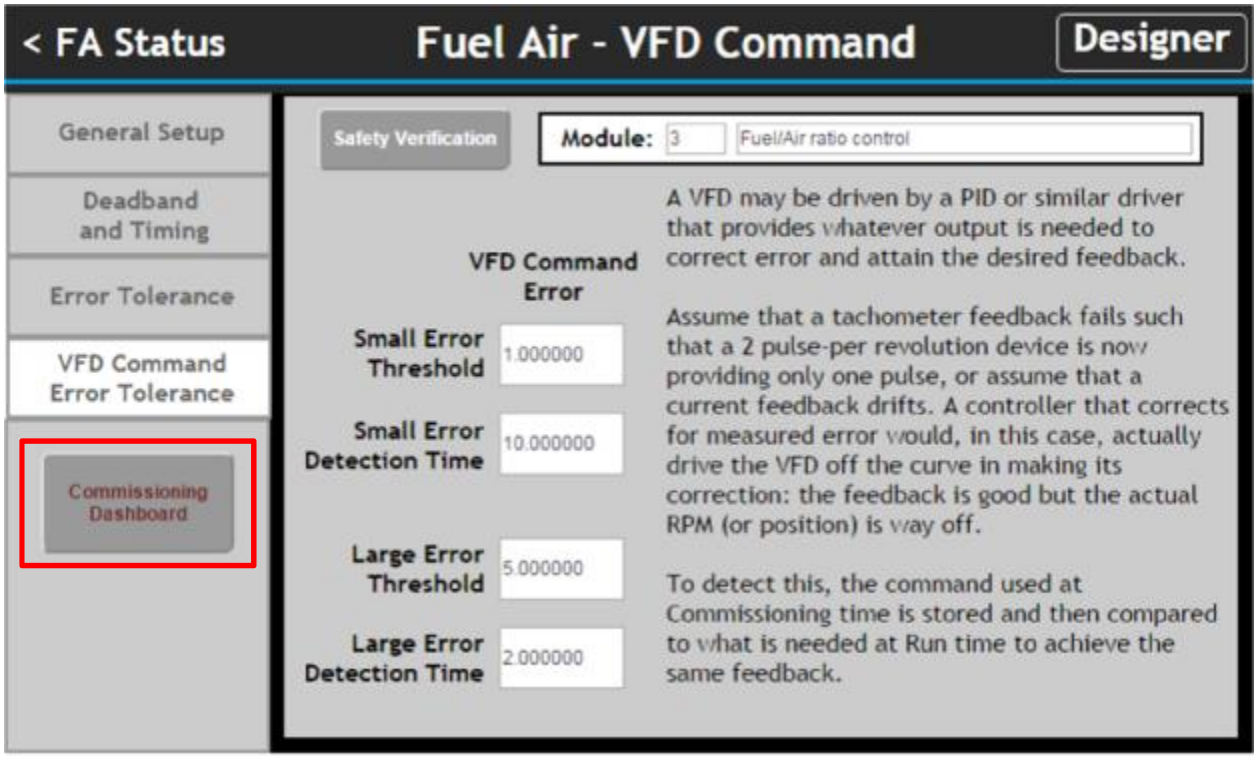
Dead band and Timing are used to set the throttle dead band, move step size and light off-curve tolerance time. The light off curve tolerance time is important because it's the time allotted for the actuators to reach the curve after light off, when the light off is not on the curve. (Recommend 45 Seconds)



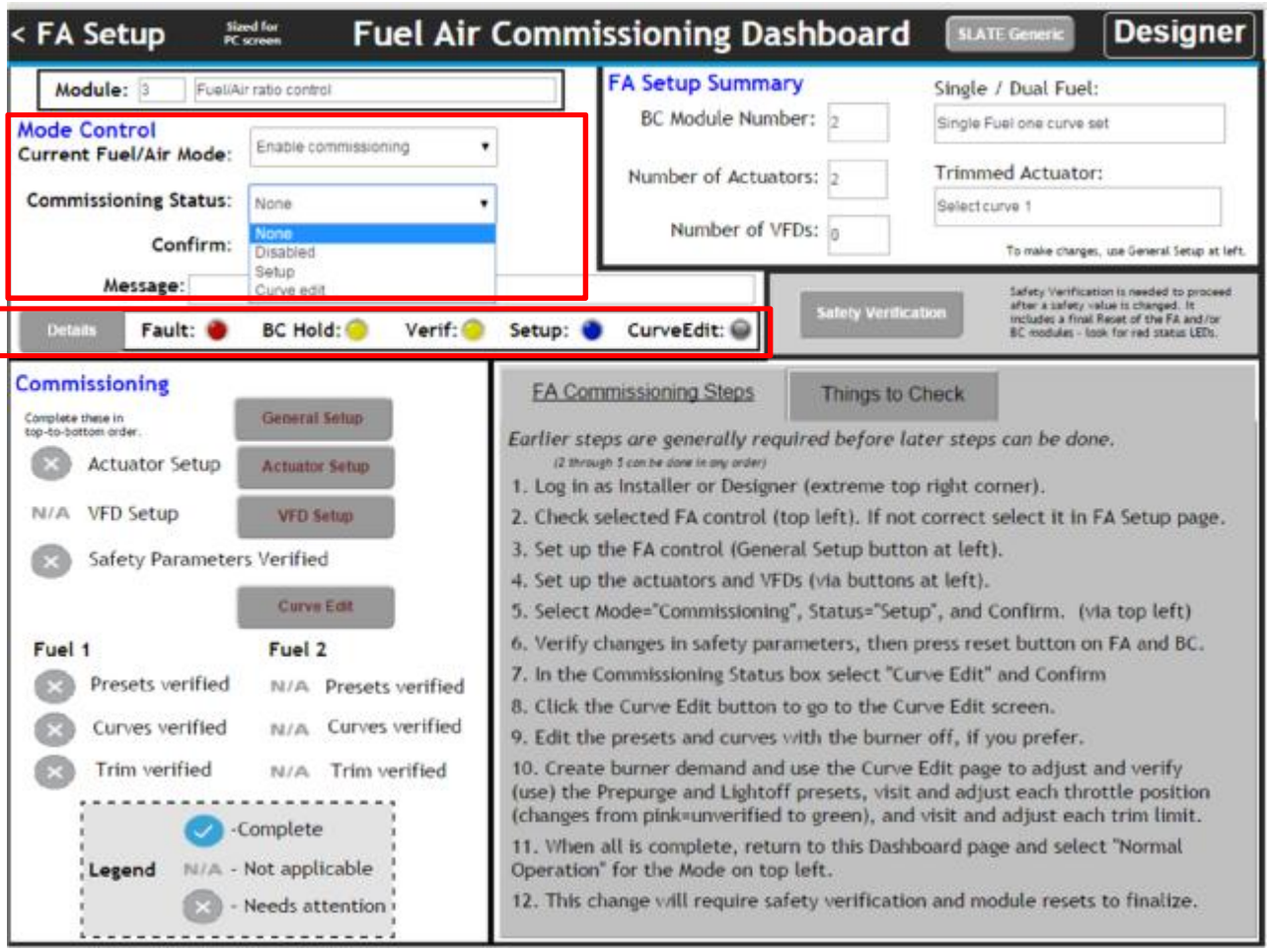
The Error Tolerance defines the large and small errors, position wise. It also defines how much time is you will be in the large error or small error zone before and error occurs.



Allows the user to set small and large error tolerances with the VFD. For our next step, click the Commissioning Dashboard.



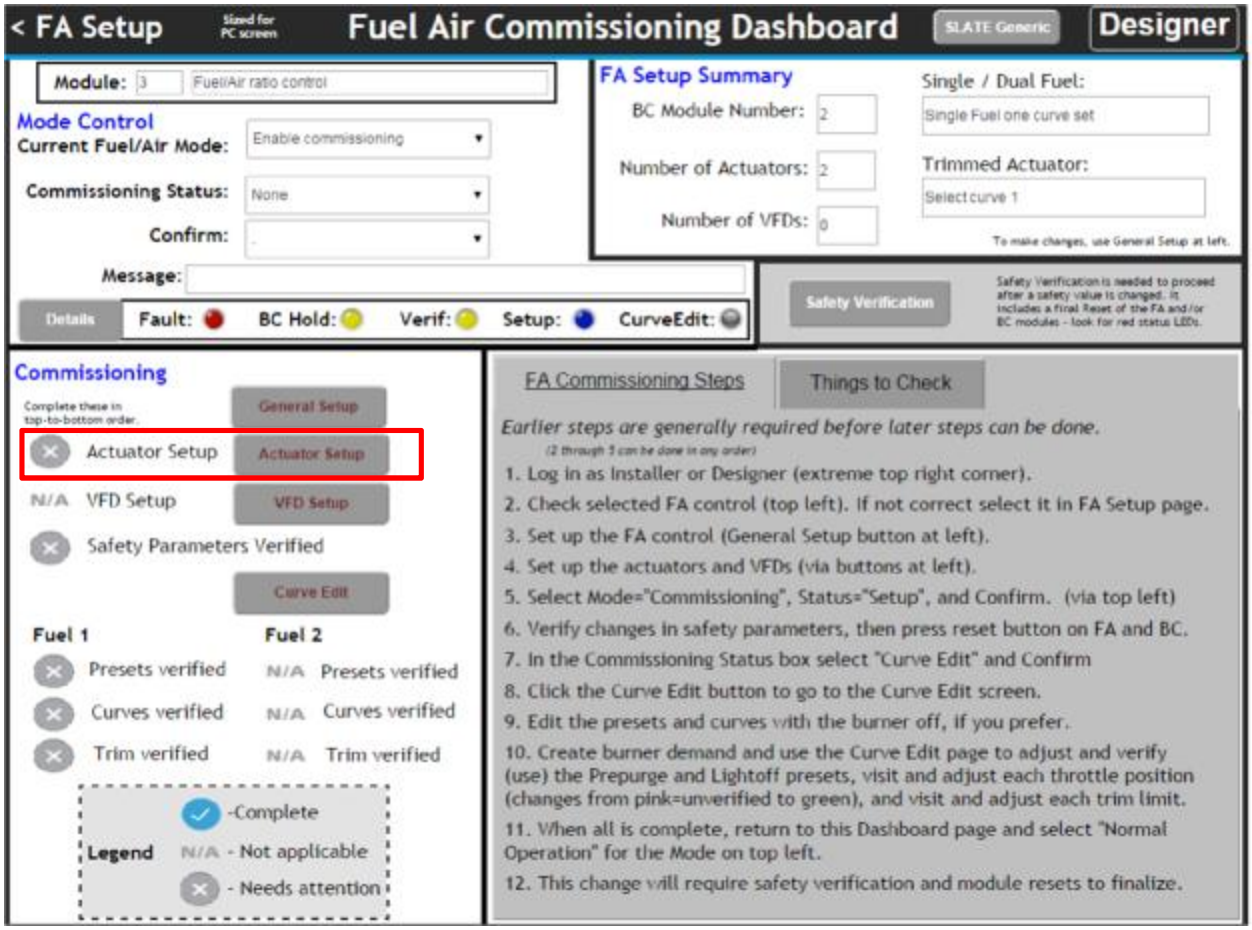
The commissioning Dashboard is where we begin. The highlighted area shows the current state of the Fuel Air Ratio System. This is for placing the fuel air ratio commissioning into the desired mode via a drop-down list. Here we are showing that we can Enable Commissioning.



Within Commissioning, the Commissioning Status allows you to select either setup or curve edit. Once you make your selection, you will need to confirm your decision with the next selection box.

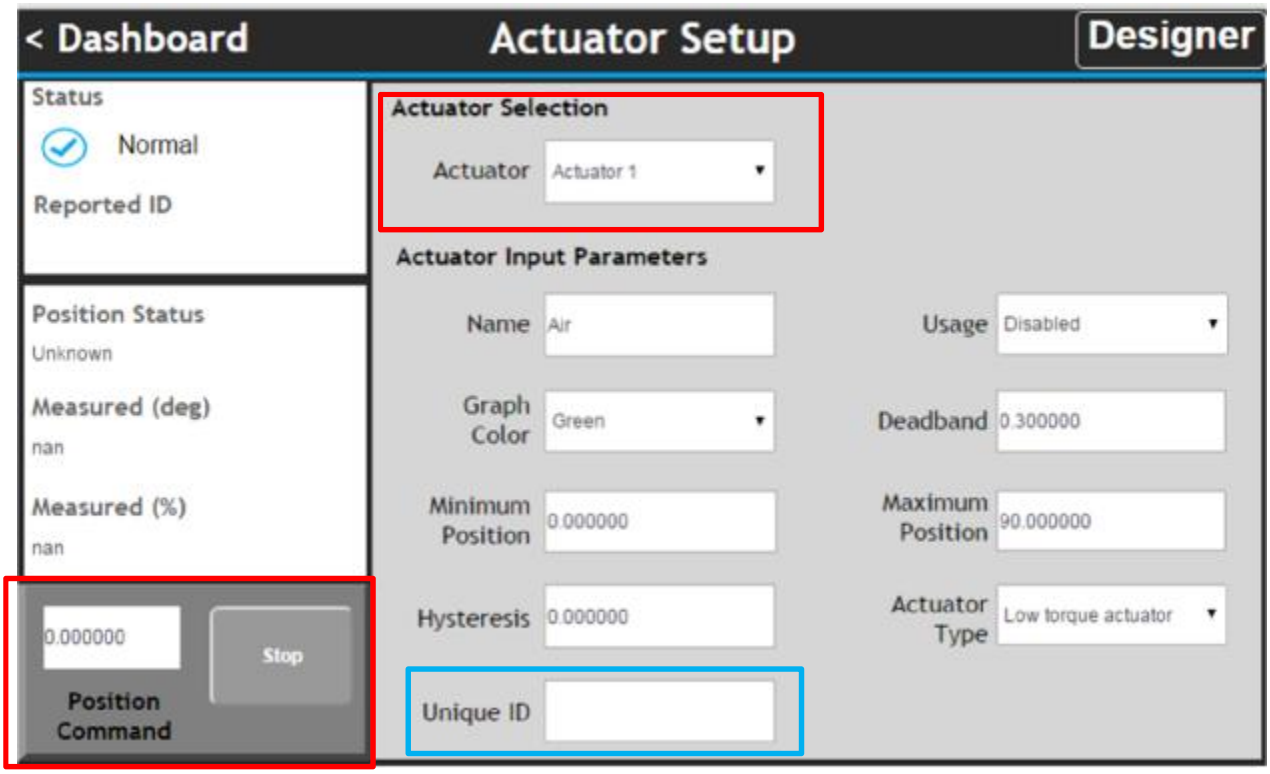
The Details section shows you the current state of your system. It is a good tool to use to understand what item is holding up the commissioning. Clicking the Details Section shows more detail.

The Commissioning Section will be used to setup the actuators, the VFD, and do the curve edit. The gray area to the right of that sections will contact help information that will walk you through the process. Since we have already completed the General Setup let's click the Actuator Setup.



Begin with the Actuator Selection, as highlighted below.
Also notice the Position Command Section. This section will allow you to enter a value to drive the motor to that position.

You can also use this to determine the values of the min and max positions located in the middle of the screen.

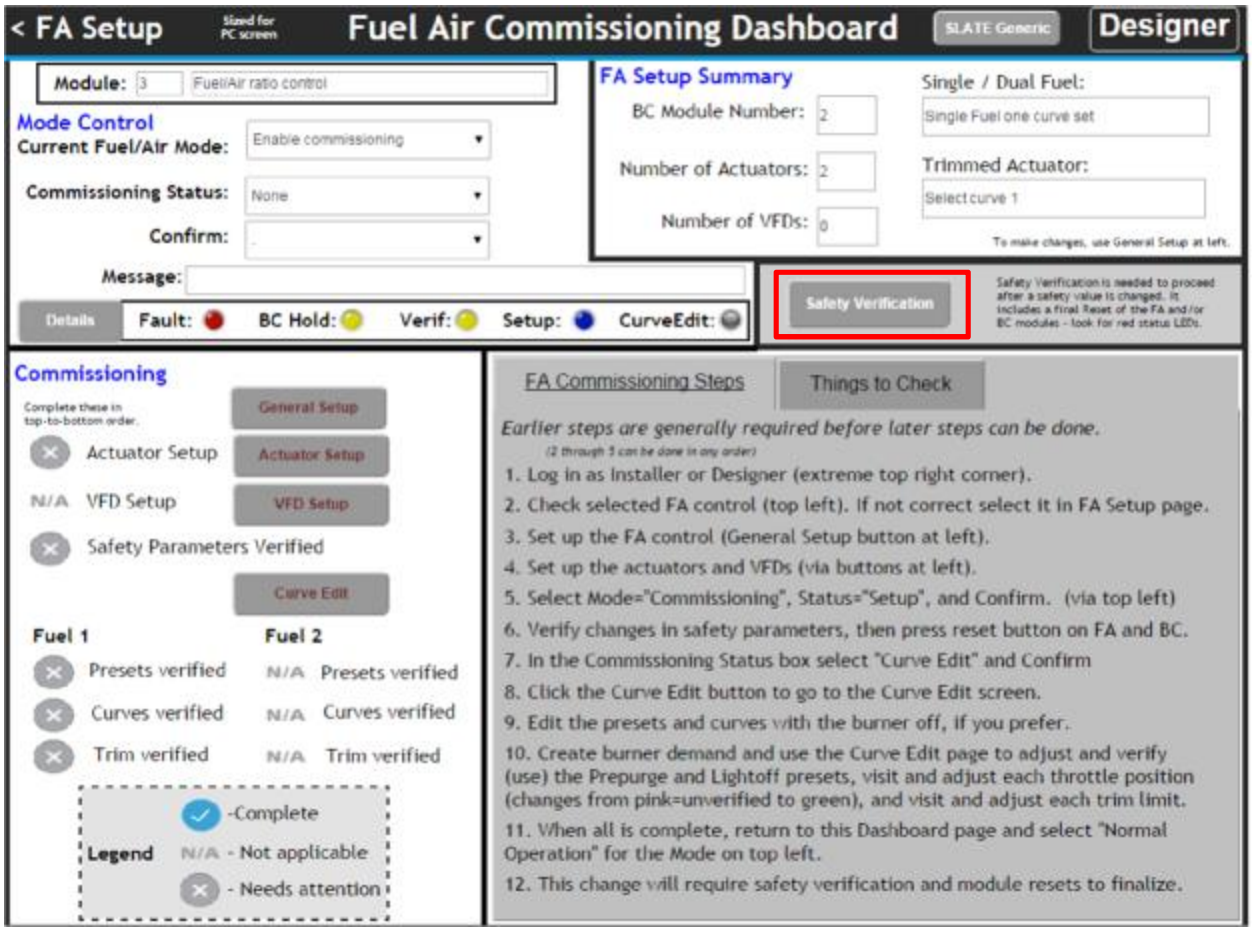


The Blue highlighted section is the Unique ID for the actuator. It is found on the actuator label. If this unavailable at the time of designing, SLATE will automatically get it from the motor at commissioning time. The Unique ID should be displayed under Reported ID in upper left-hand corner.
It is important to note that when replacing an existing actuator with a new actuator due to failure, etc. the Actuator Setup is where re-commissioning of new actuator takes place.

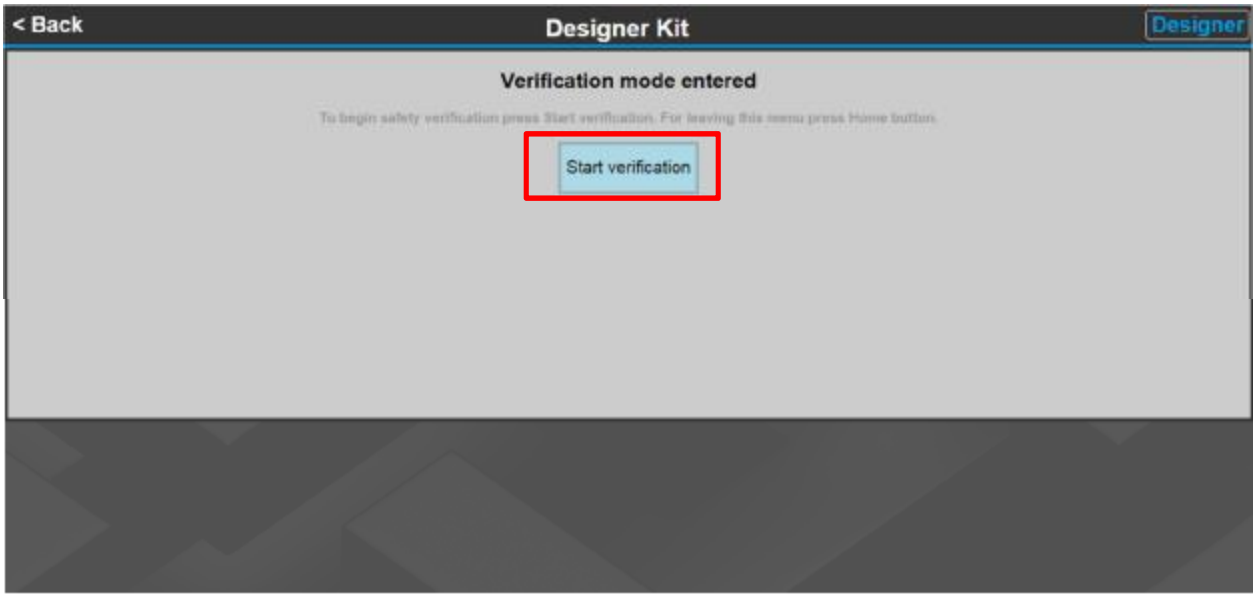
If Measured Position reads anything other than a number between 0-90 Degrees or 0-100%, the actuator is out of quadrant, and will need to be rotated by hand. You can do this by unplugging the 24VDC power to the actuator. Once rotated and powered, with numbers reading within limits, you can zero out the actuator by using the position command. Once Actuator is zeroed, you can re-clamp coupling or linkage arm.

Any change to a setting in the Burner Control or Fuel Air Module requires a Safety Verification. See Below.

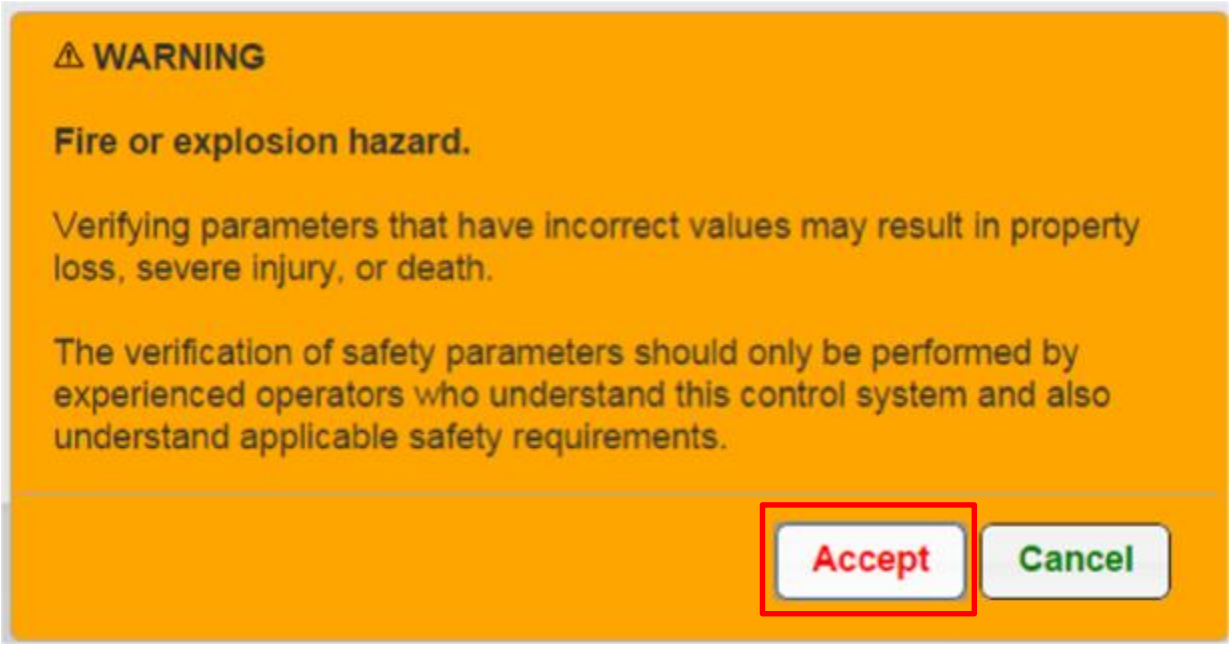
After you have setup your actuators, you will need to do a Safety Verification. Click the Safety Verification button.



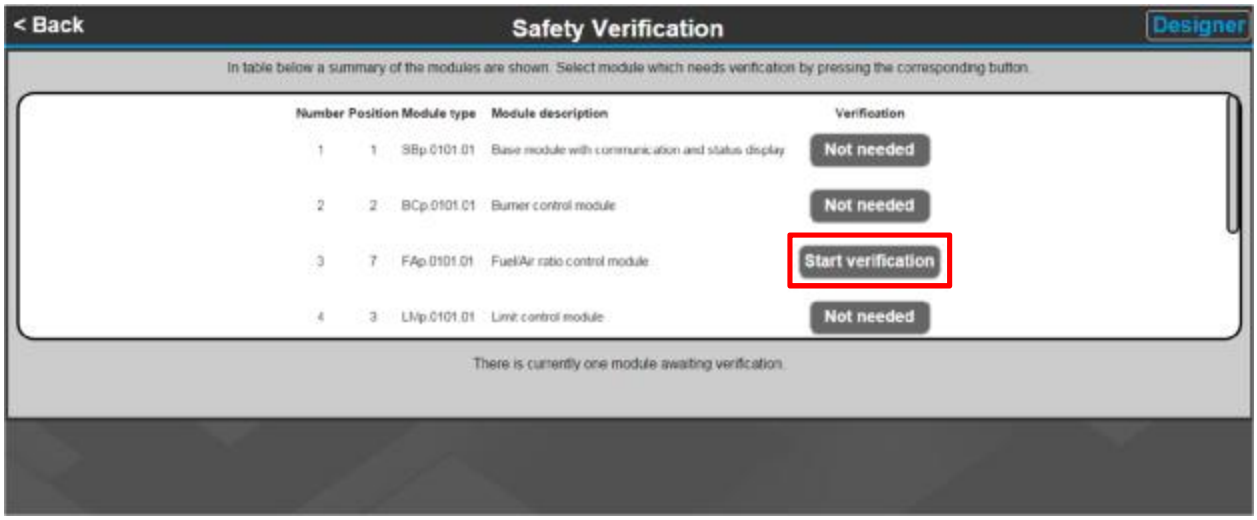
The Safety Verification screen allows the user to start the verification. Press the Start Verification button.



You will be alerted to a warning that you will need to accept. Press Accept to continue.



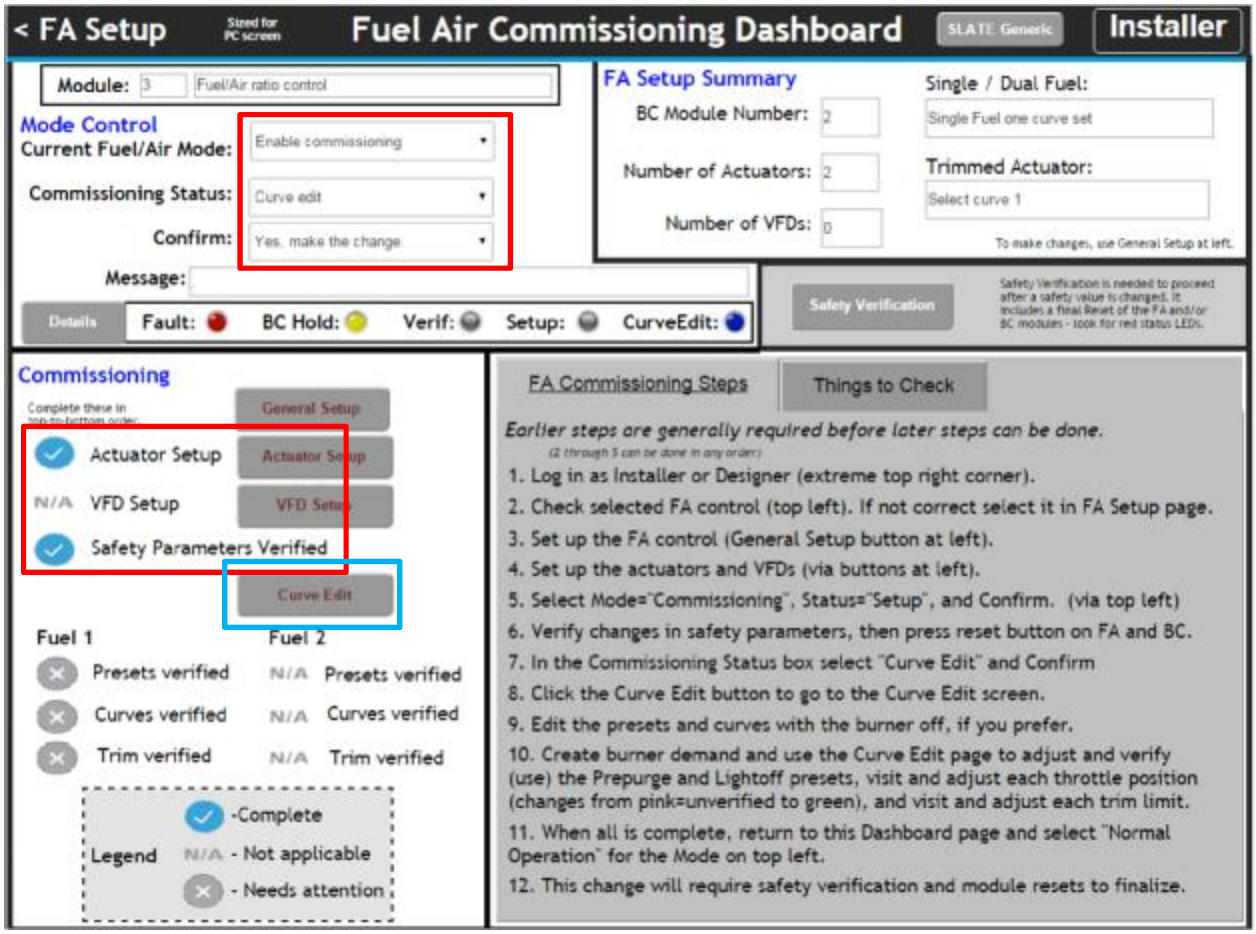
Click the Start Verification button of the module desired or needed.



After the Safety Verification steps, you will need to push the Reset button on the module that was verified to complete the verification. In this case, it will be the Fuel Air Module.

Click the <Back button in the upper left hand of the window to go back to the dashboard.

You should see two blue circles with checks to indicate that this step has been completed and verified. You can now move onto the next step.



Next select and confirm “Curve Edit” mode using the selections on the top left. You must confirm with ‘Yes, make the change’ or you will not be able to complete your task.

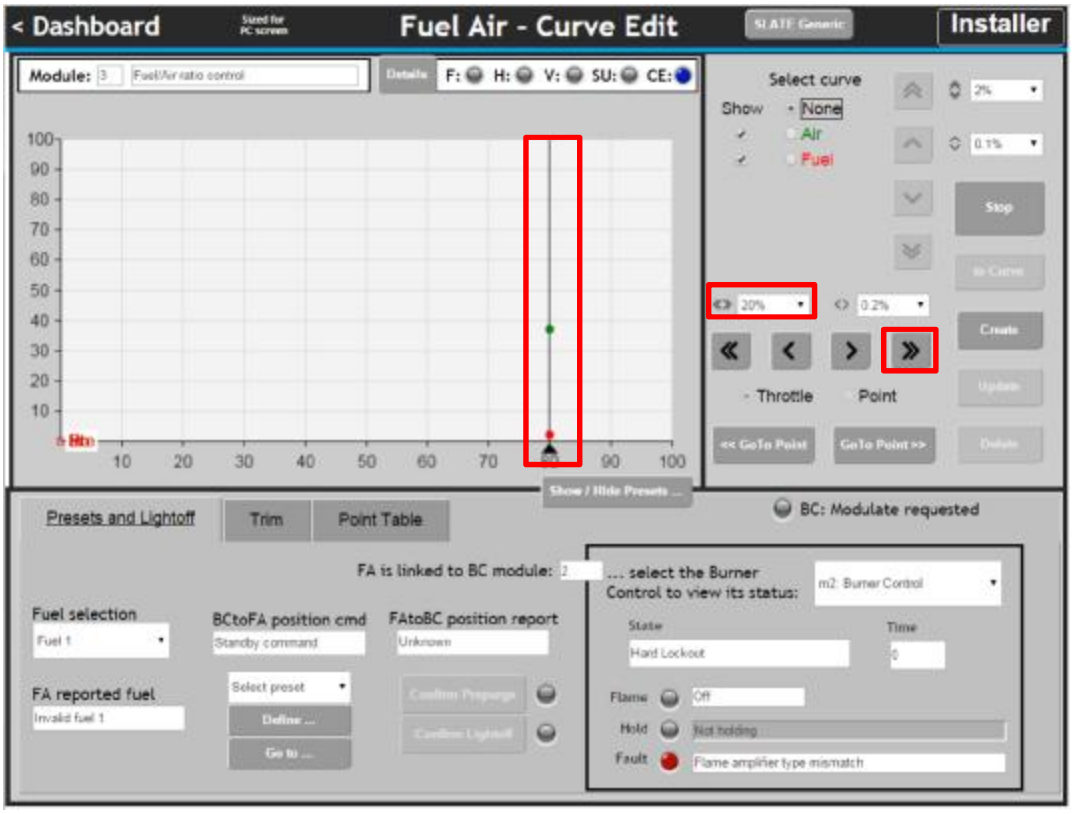
This will allow you to enter Curve Edit by clicking the Blue highlighted button.

Once in the Curve Edit Page, you will notice a graph that is scaled 0-100 on the left-hand side. This is Actuator position in %.
The scaling along the bottom of the graph is Throttle Position. This is also in %.

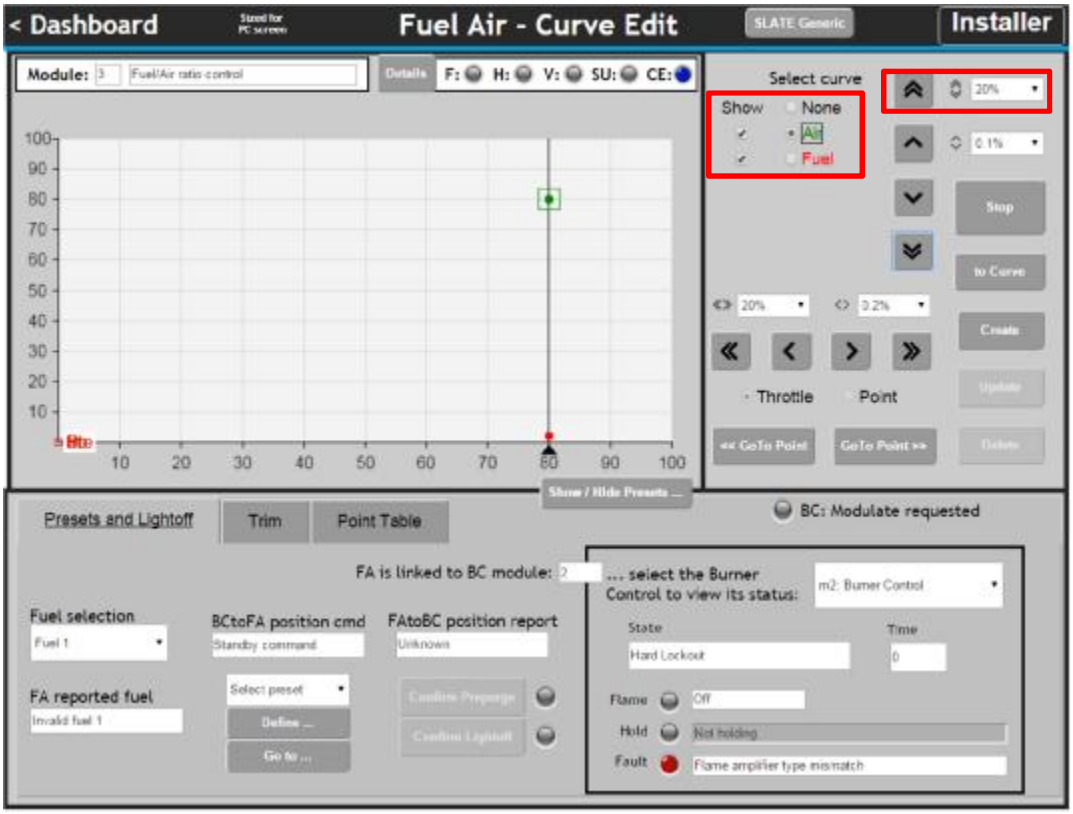
When constructing a fuel curve set, try to position low fire at 0% Throttle, and high fire at 100% Throttle.

If there is an existing fuel curve upon initial startup, this is a factory fire test curve, and should be deleted. Use the Go To Point buttons on the right-hand side of graph, and Delete each point using the Delete button. Once curve is blank, you may start creating your curve.

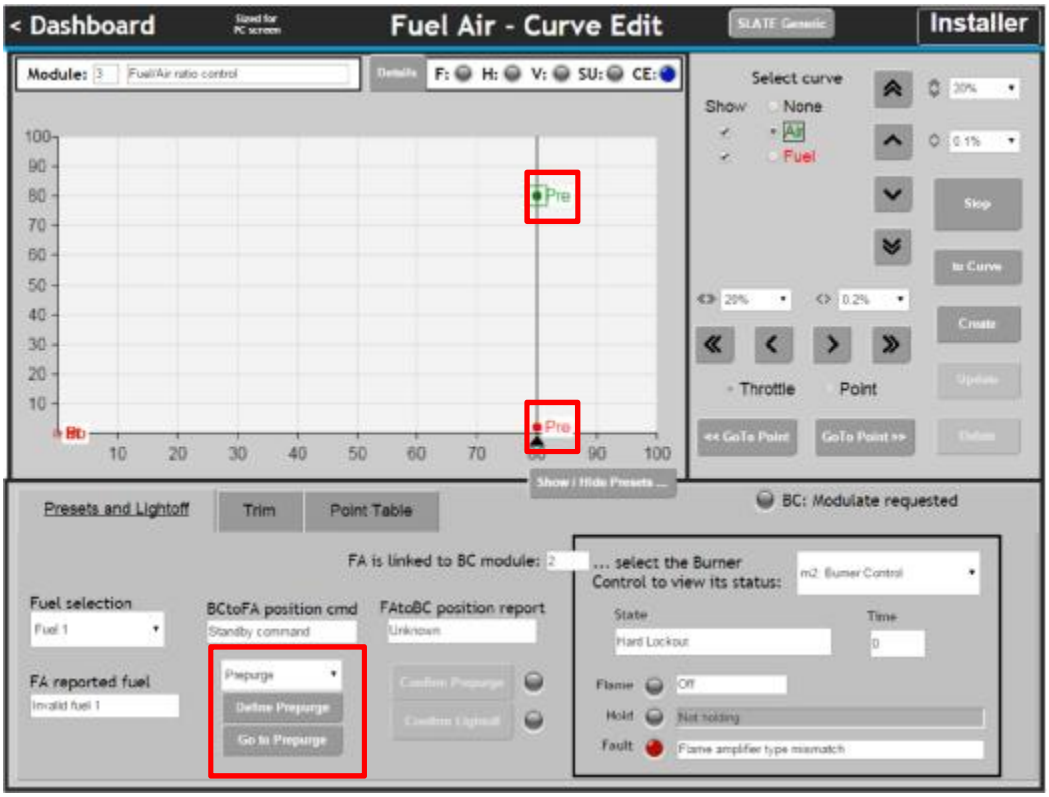
First set a Prepurge Preset. Use the drop-down to set a larger left-right motion of 20%, then click the >> button several times to move the throttle cursor over to about the 80% position.



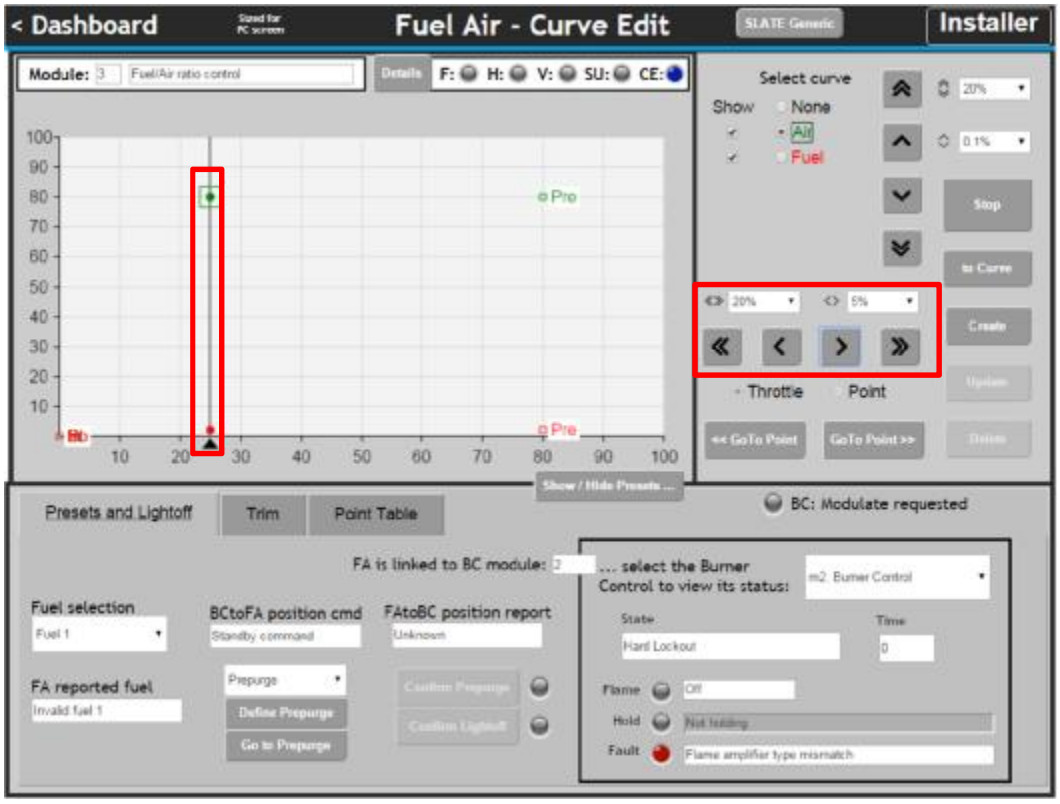
Select the Air actuator using the radio button, set the large up/down motion to 20%, and use the double-up-arrow button to move it up to around desired position (on the Y axis).



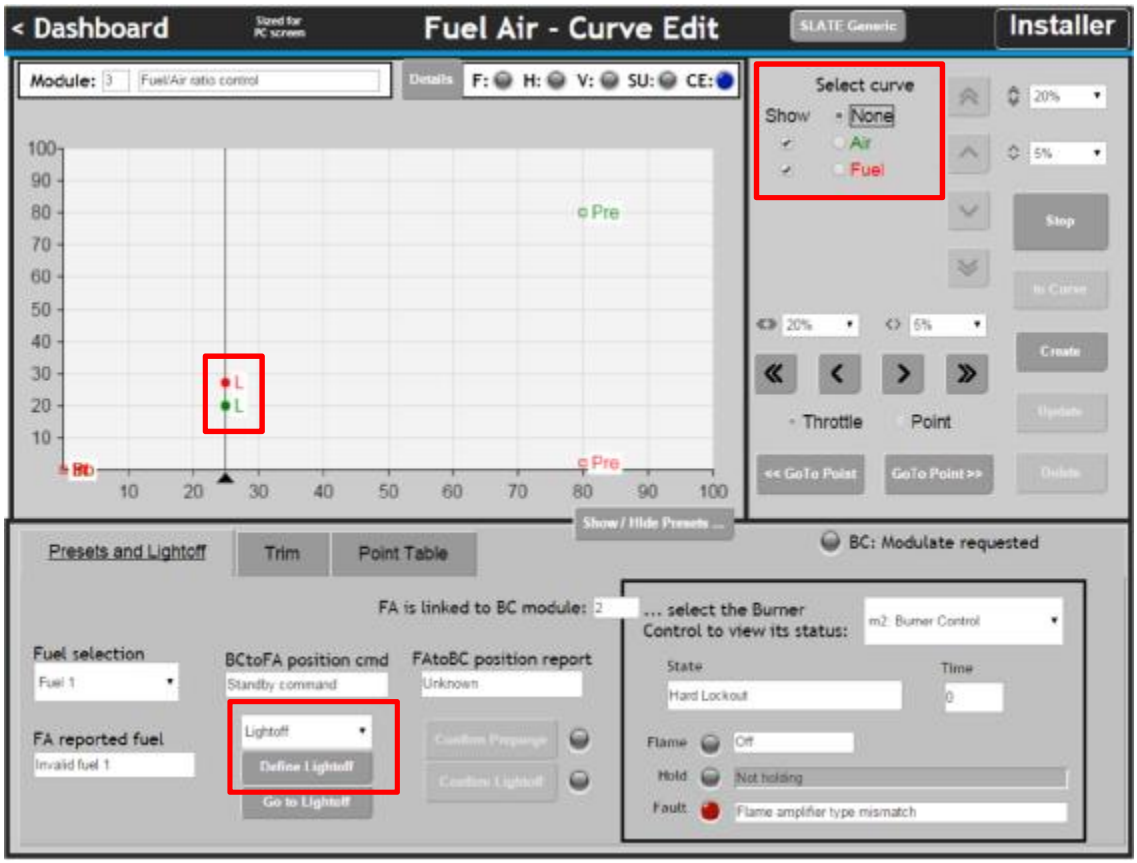
Select the Prepurge Preset from the drop-down list, then click the Define Prepurge button. Note that the label “Pre” now shows next to the air and fuel positions.



In a similar way, now set the estimated Lightoff position. First move the throttle cursor over to desired position. (using the small and large movement selectors and buttons.) It is recommended to place Lightoff at same Throttle Position as Low Fire Position (Typically 0%).



Next use the curve select and the up/down movement selectors and buttons to move the air actuator and the fuel actuator to desired position. (on the Y axis). PLEASE REFER TO BURNER SPECIFIC RECOMMENDATIONS IN REGARD TO LIGHTOFF POSITIONS. CONTACT FACTORY FOR GUIDANCE.

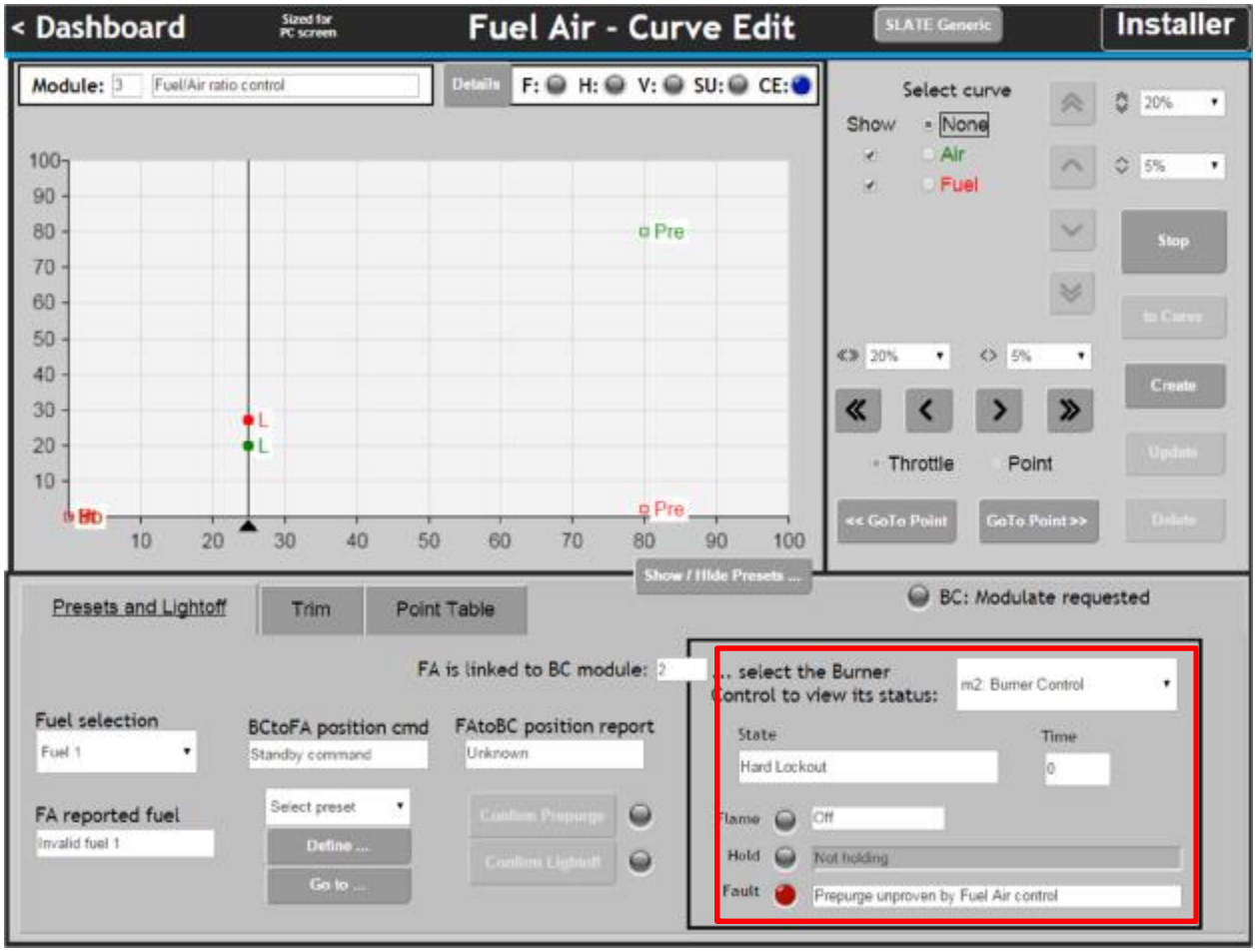


Now define the Lightoff Preset by selecting “Lightoff” and clicking “Define Lightoff”. Note that L appears next to these positions (below “None” has been chosen for the curve select to hide the selector box and show this more clearly).

Once Prepurge, Postpurge, Standby and Lightoff have been defined, we are ready to start the burner and proceed with commissioning.

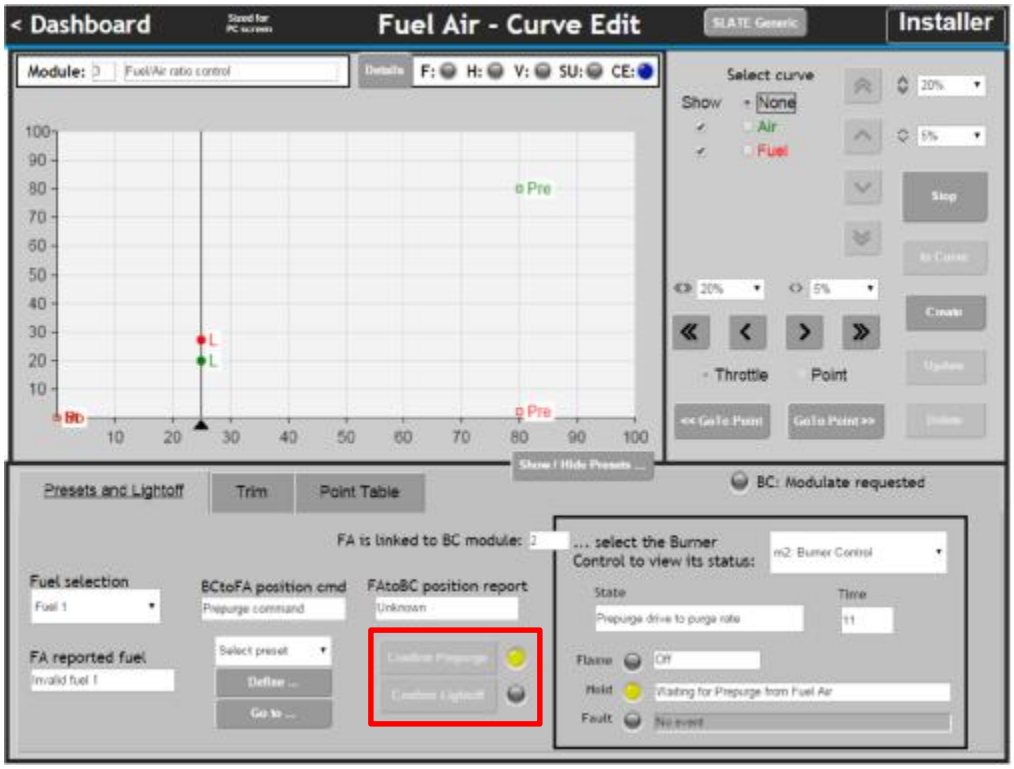
The Lightoff Position may need refined a few times. Follow the previous steps we discussed but moving the fuel and air actuators to adjust accordingly. Do not forget to Define Lightoff when changes are made to the preset.

We are now ready to start up the Burner. The FA (Fuel Air Module) reports the BC (Burner Control Module) that it is linked to, but you must select it to show its status (if there is only one BC it will be correct automatically).

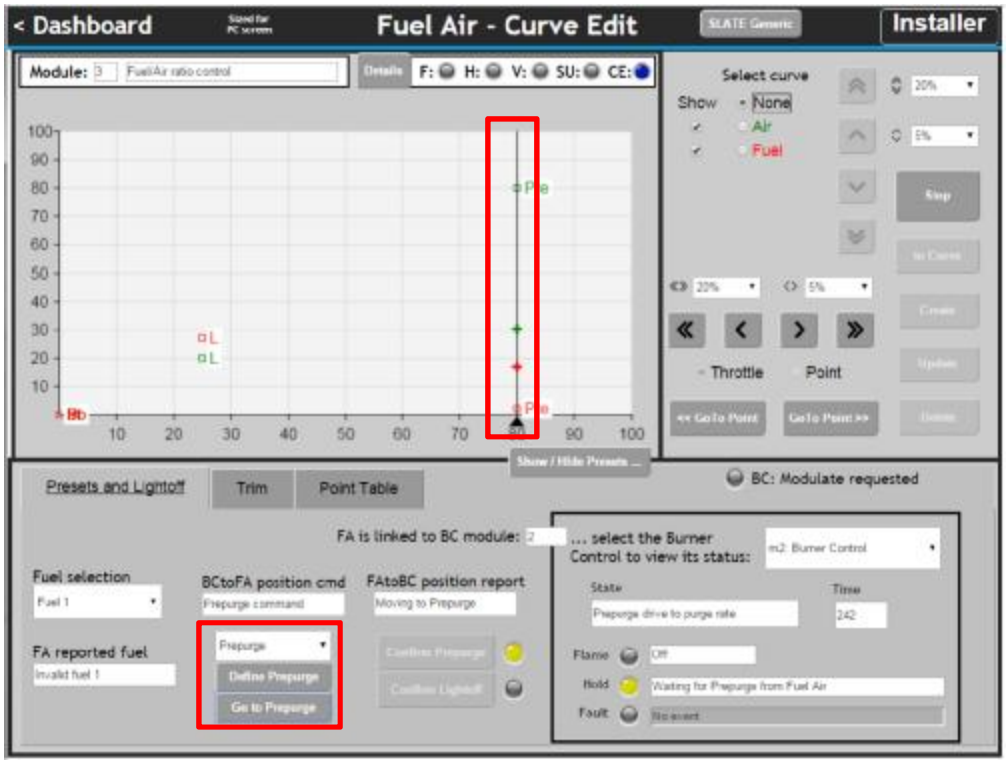


What is needed now is to fix problems and clear (press Reset on Burner Module) any lockouts in the BC, and then give it a demand signal in whatever way it is configured to accept a call for heat.
It is common that a change was made in the Burner Control Setup, and Safety Verification was not performed, or after Safety Verification was performed, Burner Control was not Reset.

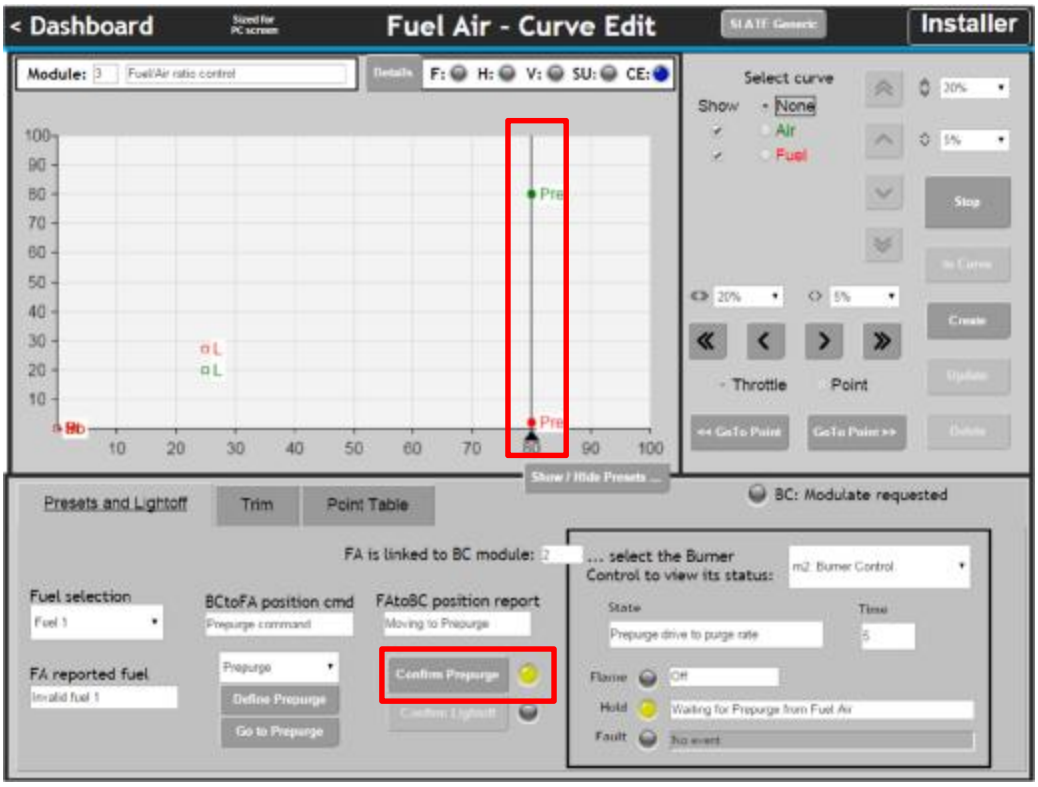
When demand is on, the BC will go through Initiate (10sec), Standby and Safe Start Check (briefly) and then request the FA to go to Prepurge. The amber LED is on next to the “Confirm Prepurge” button indicating that it is required, but the button is grayed because the FA is not at that position.



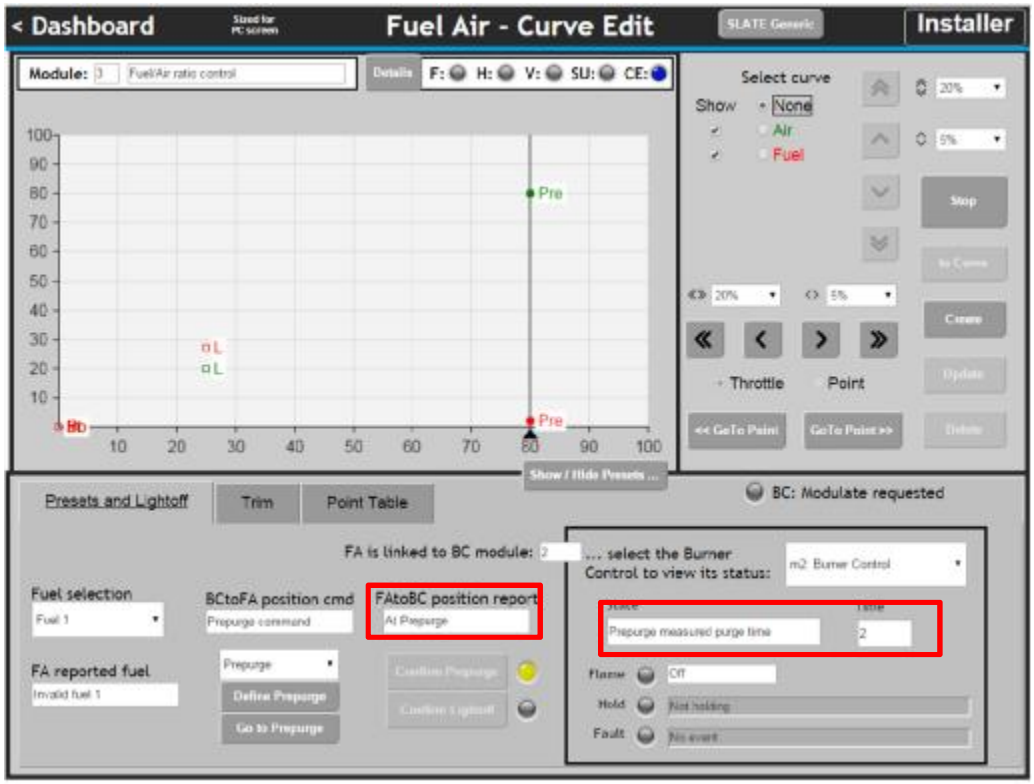
To send the BC to the Prepurge position, select Prepurge in the drop-down list and then click the “Go to Prepurge” button. The commanded position will move, and the actuators will move to the Prepurge position.



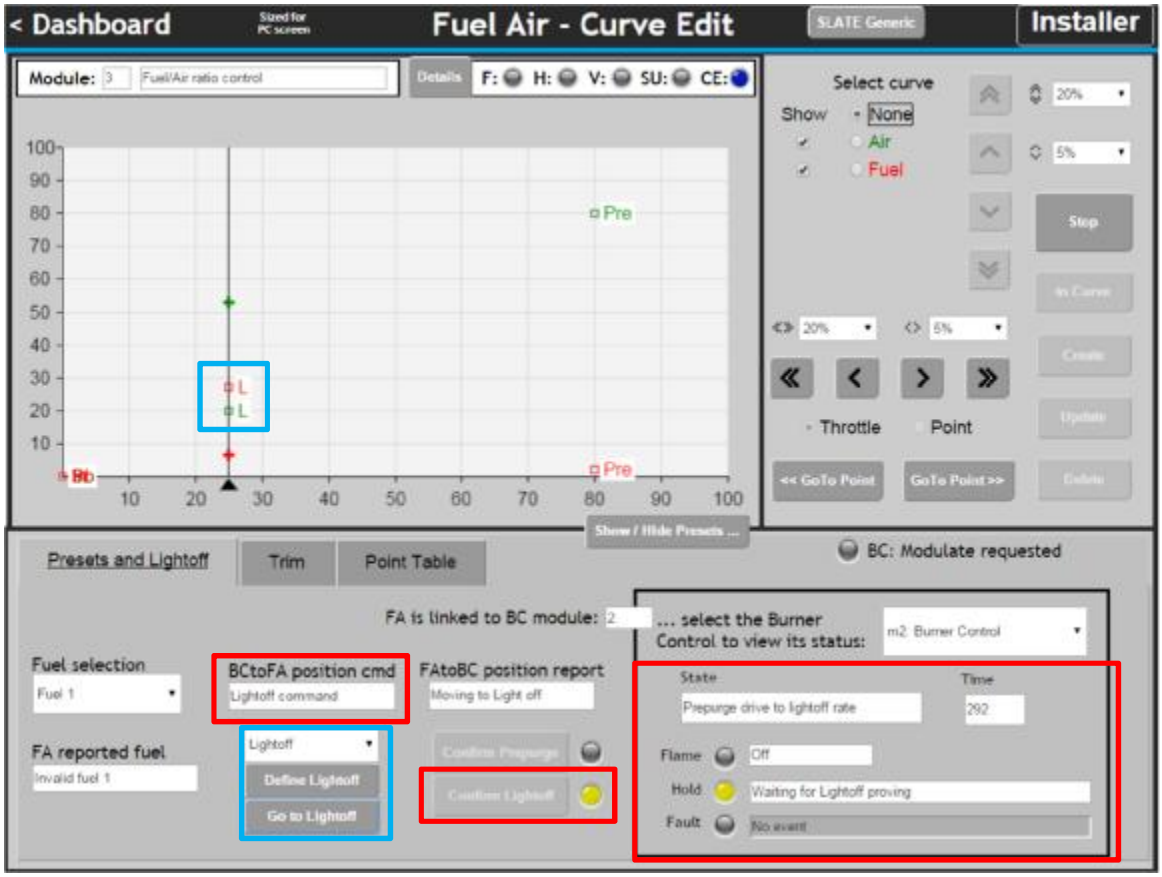
When the actuators have stopped the Confirm Prepurge button will become enabled. During commissioning, none of the steps occur automatically, the installer is always in control. Click the Confirm Prepurge button.



With Prepurge confirmed, the FA reports that it is “At Prepurge” and this causes the BC to measure the Prepurge time.



When Prepurge is done the BC will next request the Lightoff position. The yellow light is on next to the Confirm Lightoff button, but again it is gray because the actuators are not there.

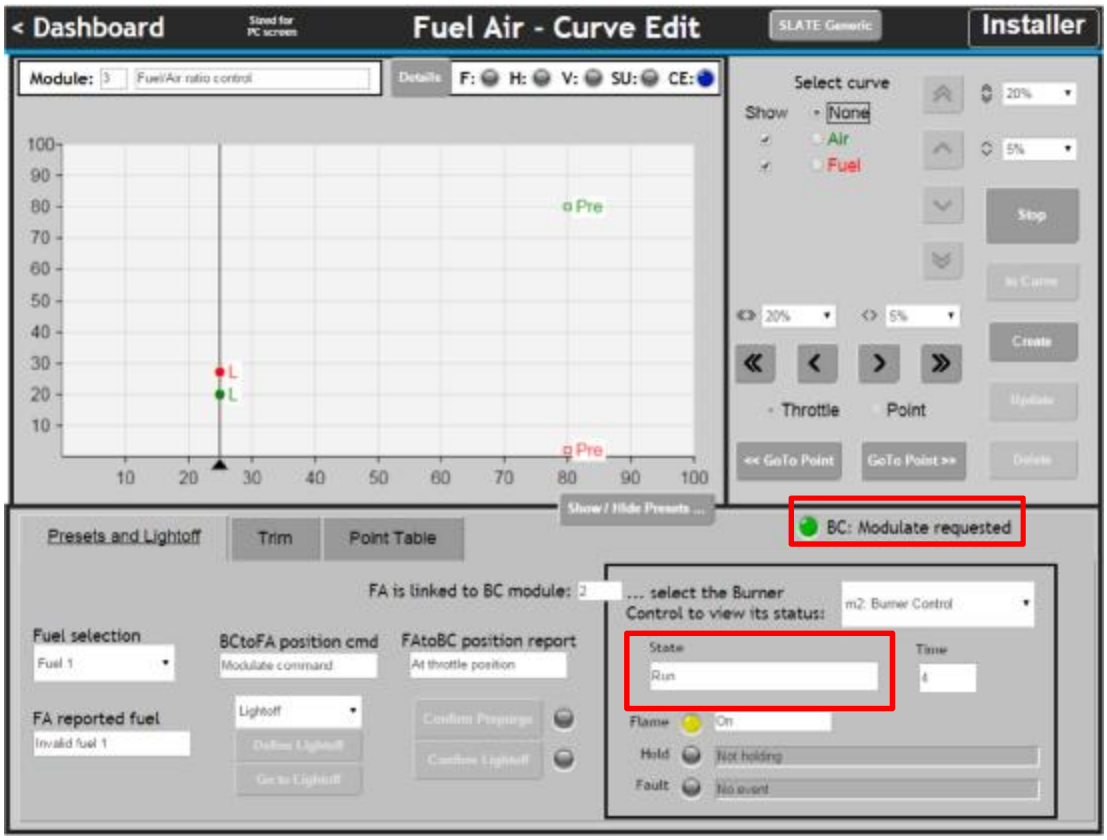


Note the Blue Highlighted section. Select “Lightoff” from the drop-down list and click the Go to Lightoff button to move the actuators to the Lightoff positions.

Once the Lightoff position has been reached, the Confirm Lightoff button will become enabled. Click it to confirm that you want the BC to light the burner.

Note: You may have just a few seconds to get the flame turned on at just the right time, after clicking this button, so read ahead to understand what is next.

After Pilot and Main flame establishing periods have completed, the BC will be in the Run condition and will request modulation from the FA control. It is now time to start building the fuel/air curve. See Below.



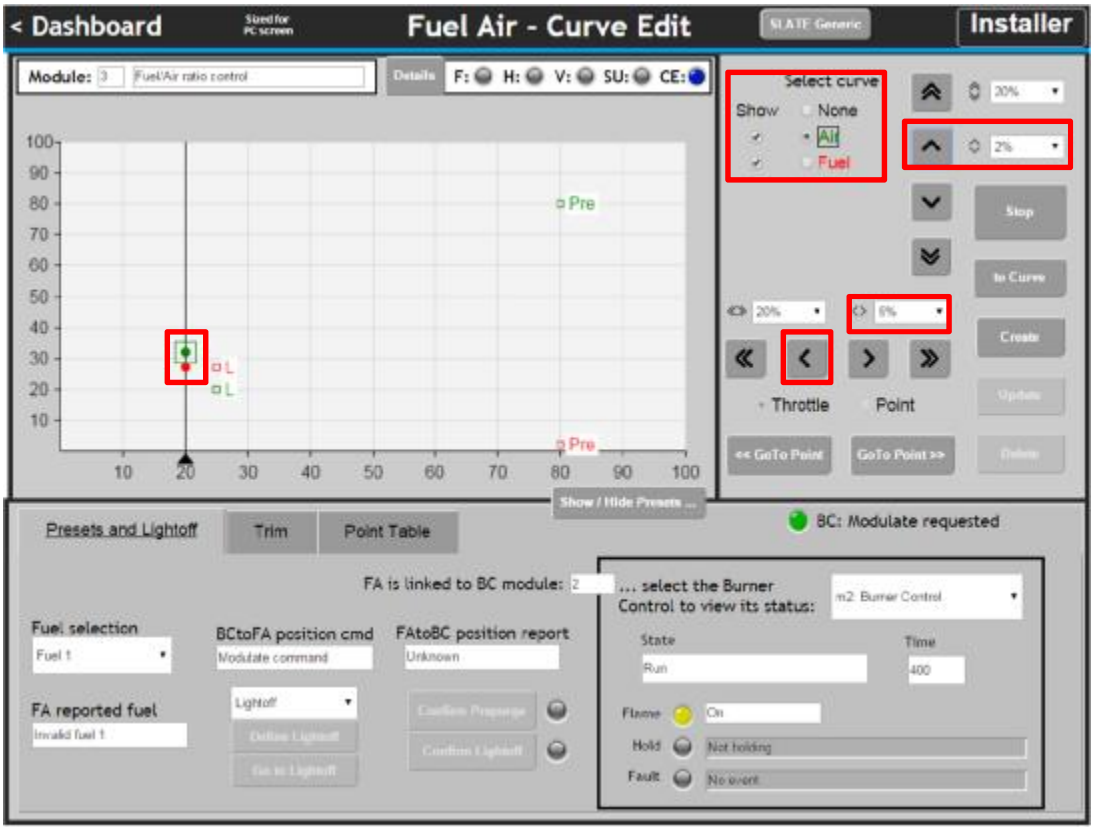
Start by moving the throttle down to Desired Low Fire Position % and select and move the air up to above the Fuel by a bit.

Typically set the small movement button to .2% and the large movement button to 2%. This may need to be changed depending on the situation.

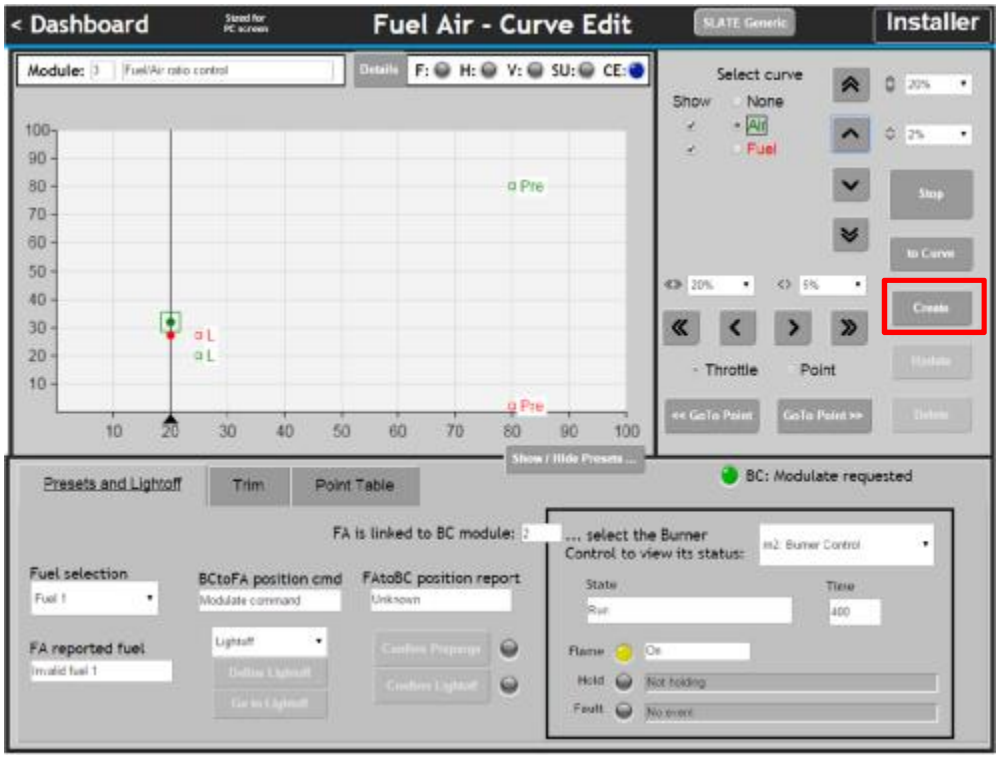
Always move air up before gas, and Gas down before air. This helps ensure you don't run too rich when setting points. The first point should be placed low on the Throttle scale.

The actuators can also be set lower than Lightoff depending on the burner and turndown requirements. (Setting combustion is done while watching a combustion analyzer.)

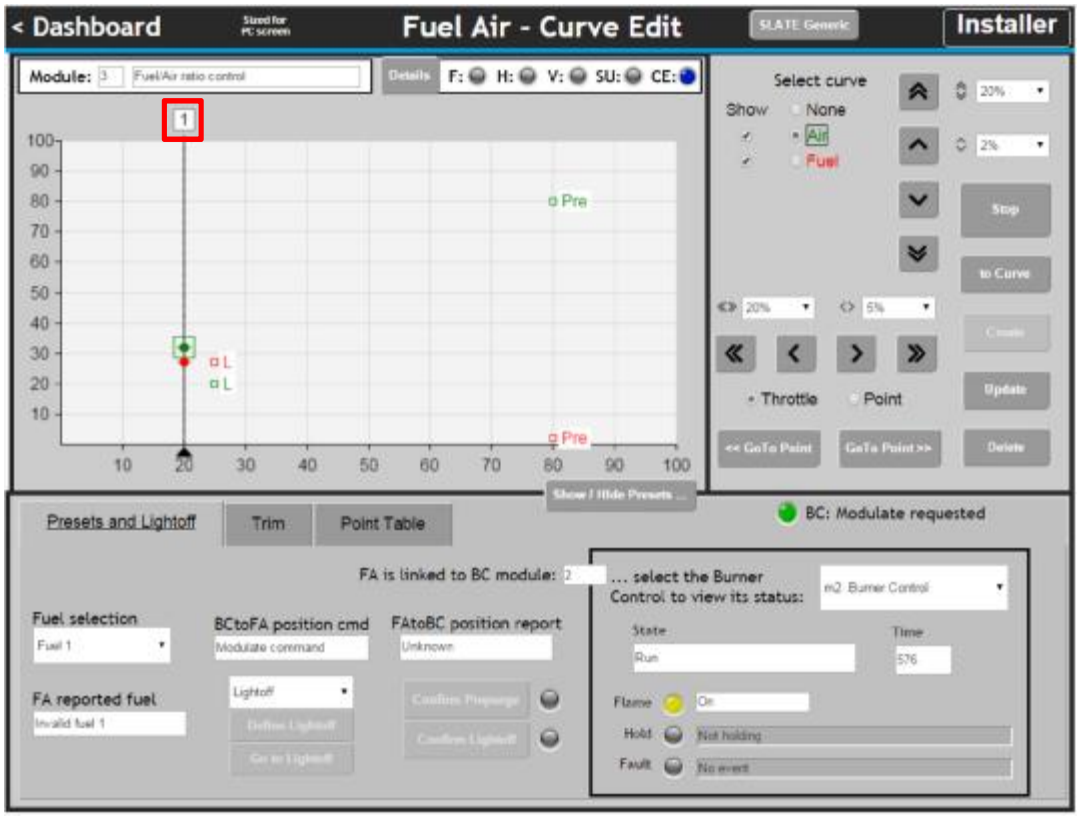
The next image shows the actuator selection and movement buttons, as well as the actuator and throttle position on the graph.



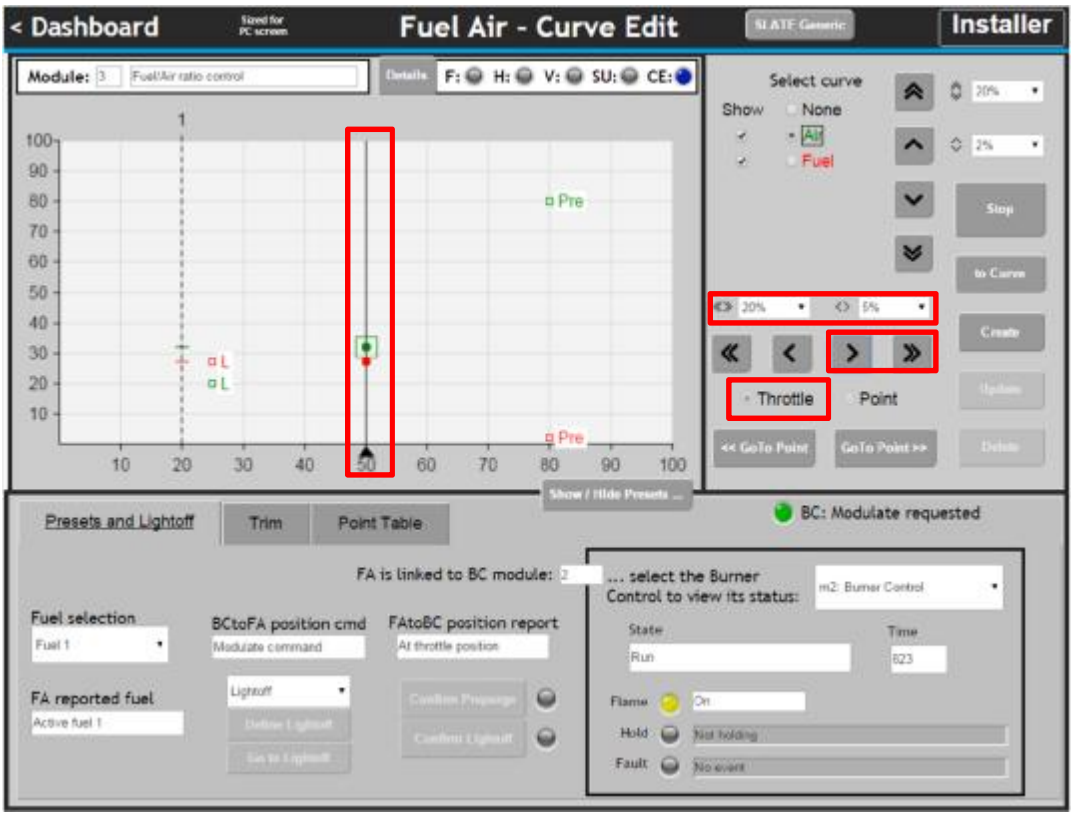
Once low fire position (Point #1) has been established, click the Create button to create a point.



Point 1 now exists. (It is also selected because the throttle is close to the point, as-shown by the box around the number.)



Move the commanded throttle over to desired next throttle position (x axis). Note that the actuators do not change position (y axis) because there is no curve to follow yet.



Select the Air and move it up a few percent (y axis). Select the Fuel and move it up few percent as well. It is helpful to know what BTU/HR each point should be, and how many points you would like to put into the burner.

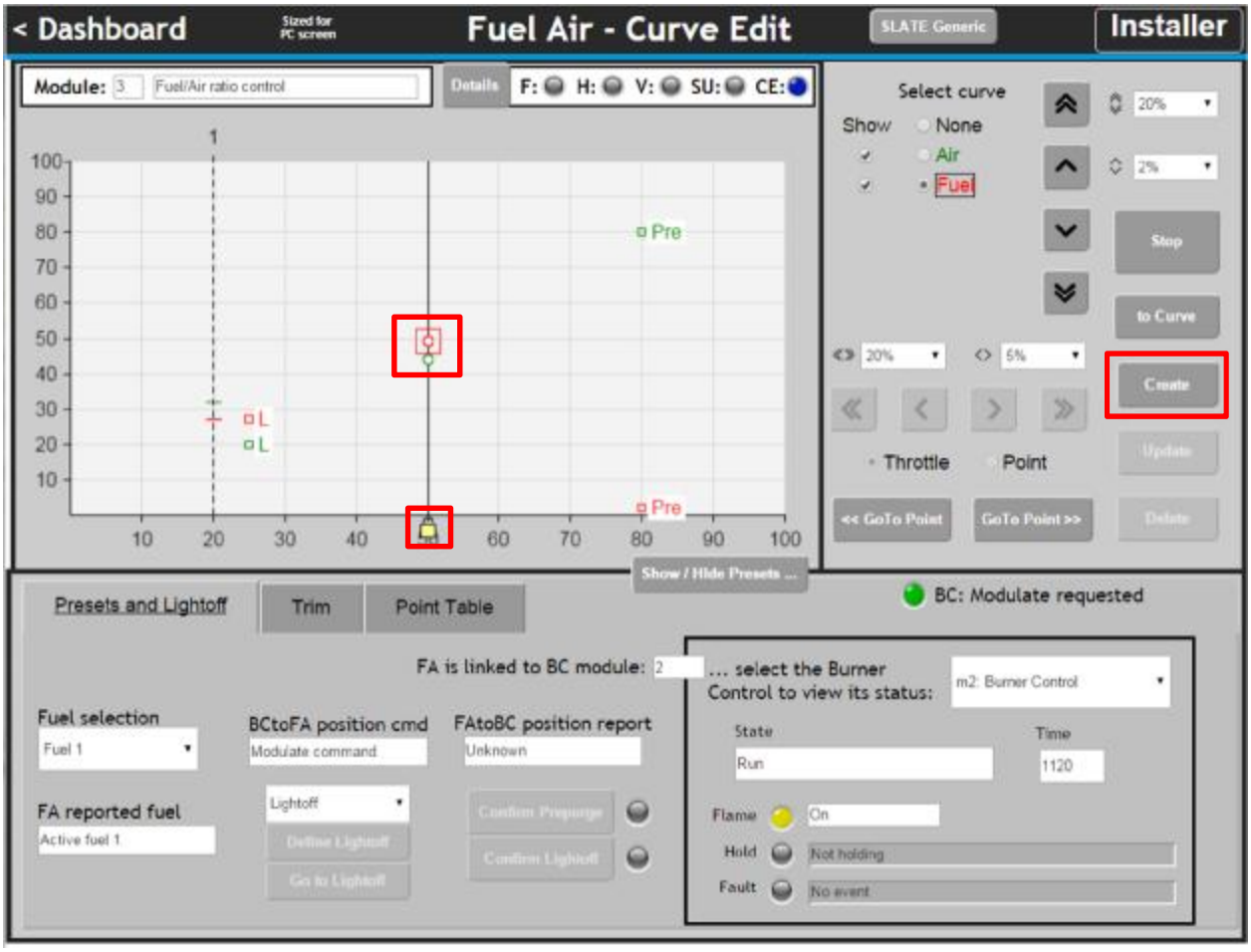
Example:

Burner With 4:1 Turndown, 10,000 MBH Output Rating

- Point #1 (and Lightoff) at 25% Throttle, 2,500 MBH output
- Point #2 at 50% Throttle, 5,000 MBH output
- Point #3 at 75% Throttle, 7,500 MBH output
- Point #4 at 100% Throttle, 10,000 MBH output

You will set each point based on O2 Level, CO level, NOx Level, or any other required emissions settings by using a combustion gas analyzer.

Note that the throttle is locked (padlock icon) and the stopped actuator icons are circles instead of dots, indicating an off-curve condition. When done, click Create to create a second point.



Point 2 now exists (and is selected). The curve segment between the points is pink colored because it has not been verified yet: there are ratios of fuel and air within the region that have not been visited and confirmed as OK. The throttle is unlocked because the actuators are now on-curve.

It is possible to move a selected point. Choose the "Point" radio button (Highlighted in blue) and move point 2 to the left or right depending on desired outcome.

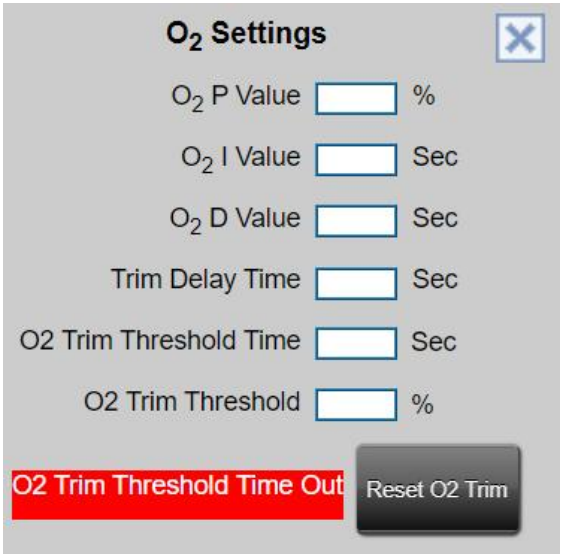
Repeat the steps provided in creating points to build your curve. Once curve is completed with the necessary points, you need to "Walk" the curve by moving from one point to the next, up and down the curve. Use the buttons highlighted in Yellow.

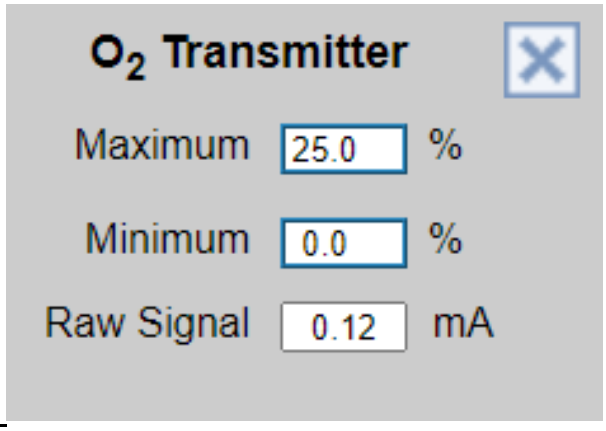
This will help identify trouble spots in the curve. Some indications of trouble spots include a rumble in the harmonics of the burner, or a rich or lean condition. This may require adding points within the trouble spots to help fine tune and correct the problem.

Once curve is to your satisfaction, ensure the curve is blue by walking curve from point first to last point. <u>If Trim is enabled, your curve will not turn blue until trim parameters have been set.</u>

Setting Trim (O2)

O2 Sensor PID Settings (*refer to PID Settings section on page 14)*



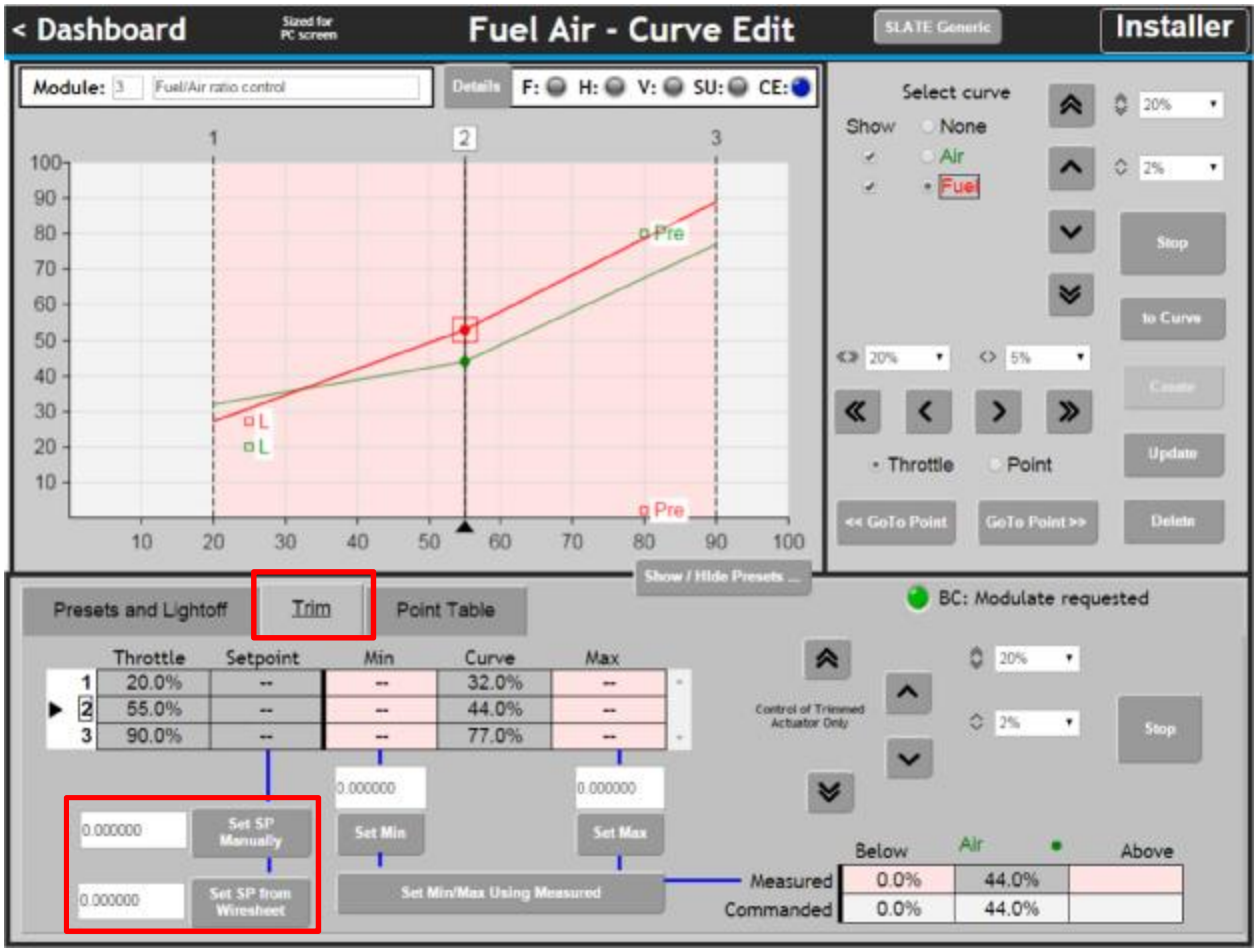


O2 Sensor Setup

The O2 Trim Threshold is the amount of O2 that is allowed to deviate from setpoint. The O2 Trim Threshold Time is the amount of time allowing the O2 Trim Threshold deviation to take place before reverting to curve and requiring an O2 Trim Reset.

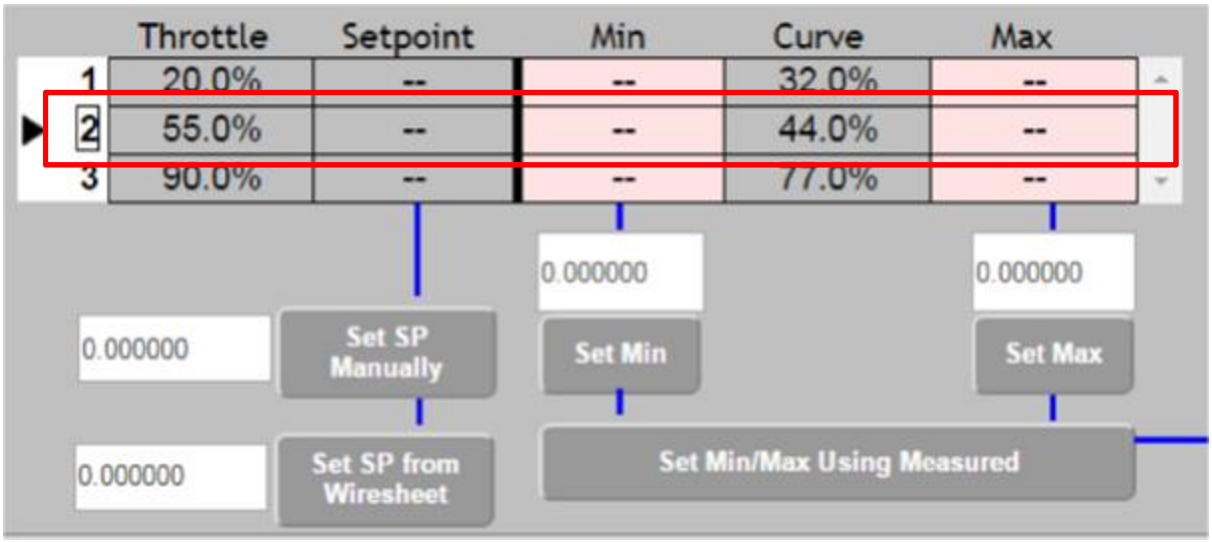
Because Trim is enabled, every point also has:

- Trim limits – constrains the maximum movement of the actuator above and below curve
- Trim setpoint – the desired operating condition (e.g. a percent of O2)
- Click the "Trim" tab to show the Trim control panel:



Points are again shown on the left, with a selected point shown by a box around the number. Trim settings must be performed when a point is selected: the buttons are gray and disabled otherwise.

- Above, nothing has been entered yet.
- At each point, there must be a Setpoint value. There are two ways to provide it: 1) Enter a number into the top box and click the “Set SP Manually” button, or 2) Wire sheet logic exists to read one or more sensors and provide a measurement. It will be shown in the bottom box and can be entered using the “Set SP from Wiresheet” button.



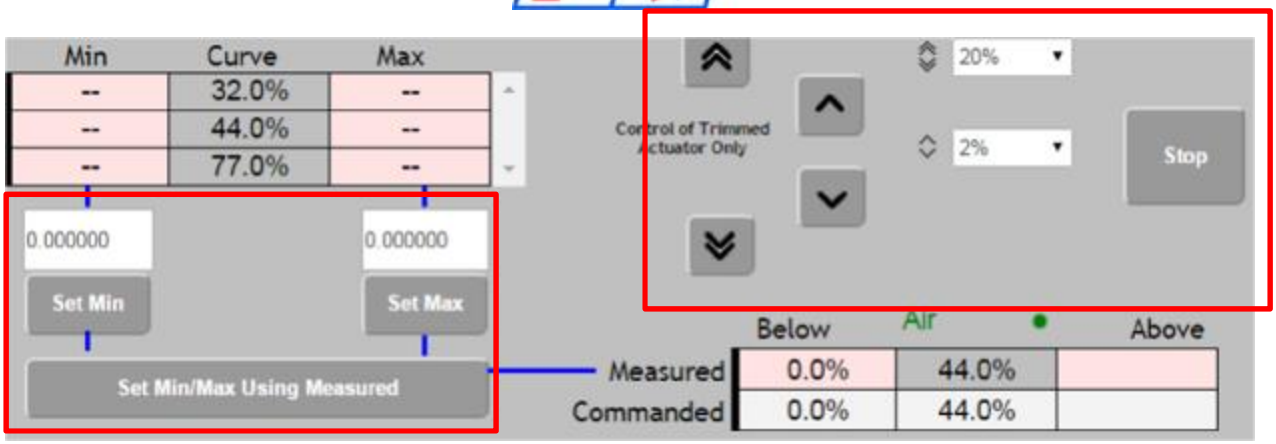
At each point, there must be a Min and a Max actuator deviation. These provide safety limits as a percent of actuator travel (e.g. the maximum amount it is allowed to deviate such as 5% or 2% (Both Min and Max are positive numbers: they are the magnitude of offset that is allowed.)

• The Min limit is mapped to a -100.0 (negative 100%) trim request coming from the wire sheet, and the Max is mapped to +100.0 (positive 100%). For example, assume that Min for point 2 is set to 3% and as-shown, the curve says 44.0% is the on-curve value for the trimmed actuator at point 2.

• If the wire sheet then asked for maximum negative trim (-100.0) the actuator would move to its 41% position, which is 44% minus the full 3% deviation that is allowed. If it asked for -50.0 (-50%) the actuator would move to its 42.5% position (44% minus half of 3%, or 1.5%). Two different uses of percent are occurring here: maximum actuator deviation is in percent of actuator travel and is a safety limit. Trim requests are a pure number between minus 100% and plus 100% and are non-safety requests.

• The controls shown above move the Trimmed actuator. The drop-down selectors are actually just a repeat of those that you have already used. The normal up/down buttons that you have used can be used to move any selected actuator. However, the four up/down buttons shown below are special: As the text says they always moved the Trimmed actuator, no matter what actuator is selected.

• A table shows the status of the Trimmed actuator, Air in this case. The table automatically fills in and shows values on one side or the other, depending on whether the actuator is Below or Above the curve.



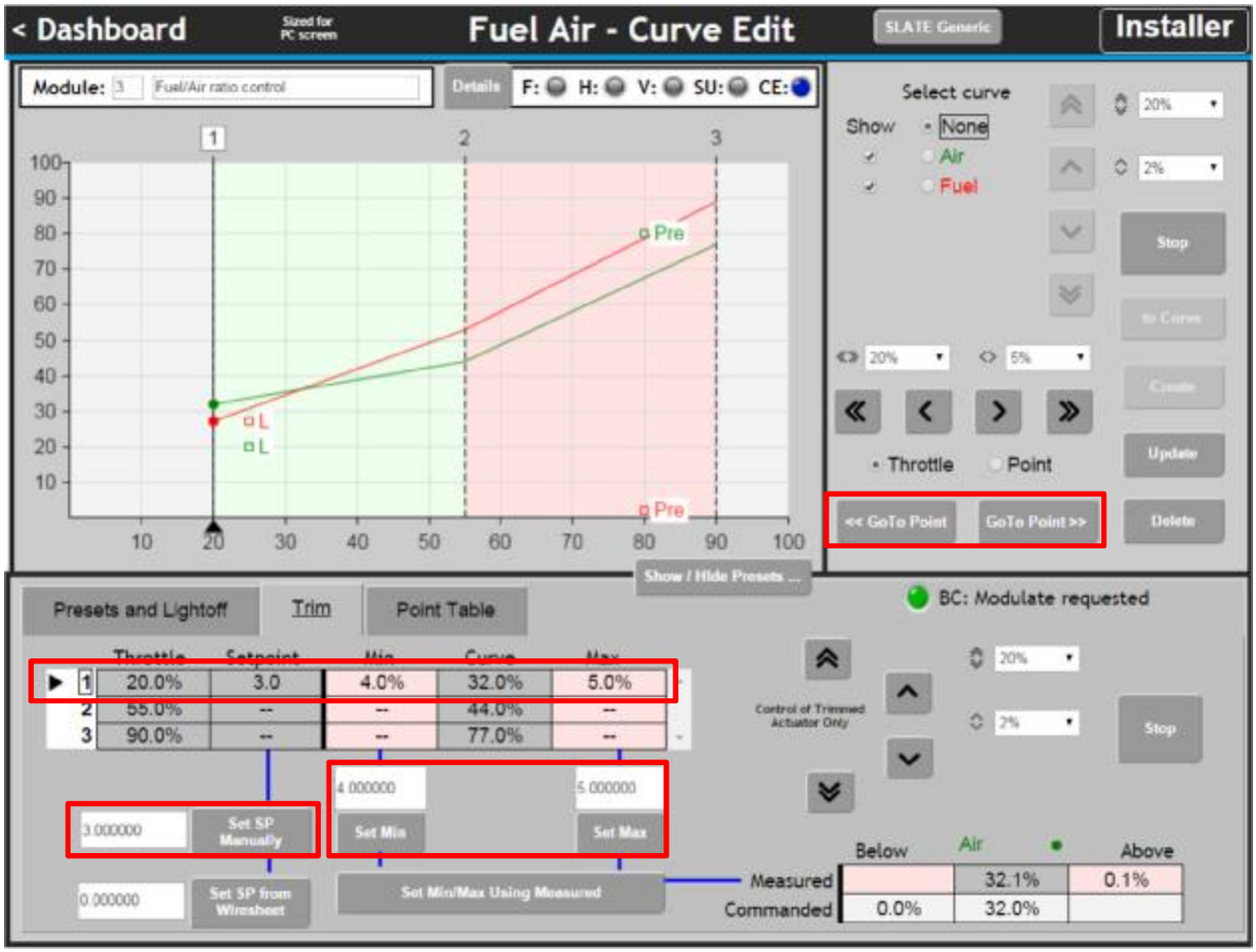
• There are two ways to enter trim limit Min and Max values: 1) Enter numbers into the boxes and click the Set Min and/or Set Max buttons, or 2) Click the “Set Min/Max Using Measured” button.

• The latter button uses the measured value and it knows which to set: if the actuator is Below the curve it sets the Min value, and if it is Above the curve it sets Max. Normally Trim limits are set while watching a gas analyzer and making small adjustments to determine how far an actuator can deviate and still remain safe.

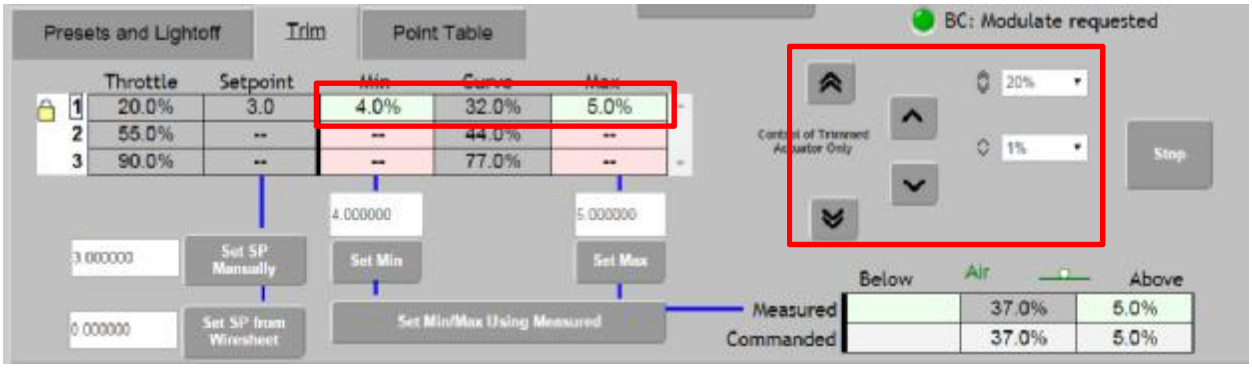
• Trim also must be verified before the FA can be set for normal operation, that is, each limit extreme must be “visited” to turn the boxes from pink to green.

• Use the “<< Go To Point” button to move to point 1. Wait for the actuators to get there and the point to be selected. Your graph segment may stay pink or turn green; either is OK.

• Manually enter a Trim Setpoint of 3.0 and click “Set SP Manually”. Manually enter a Min of 4 and a Max of 5 and click “Set Min” and “Set Max”

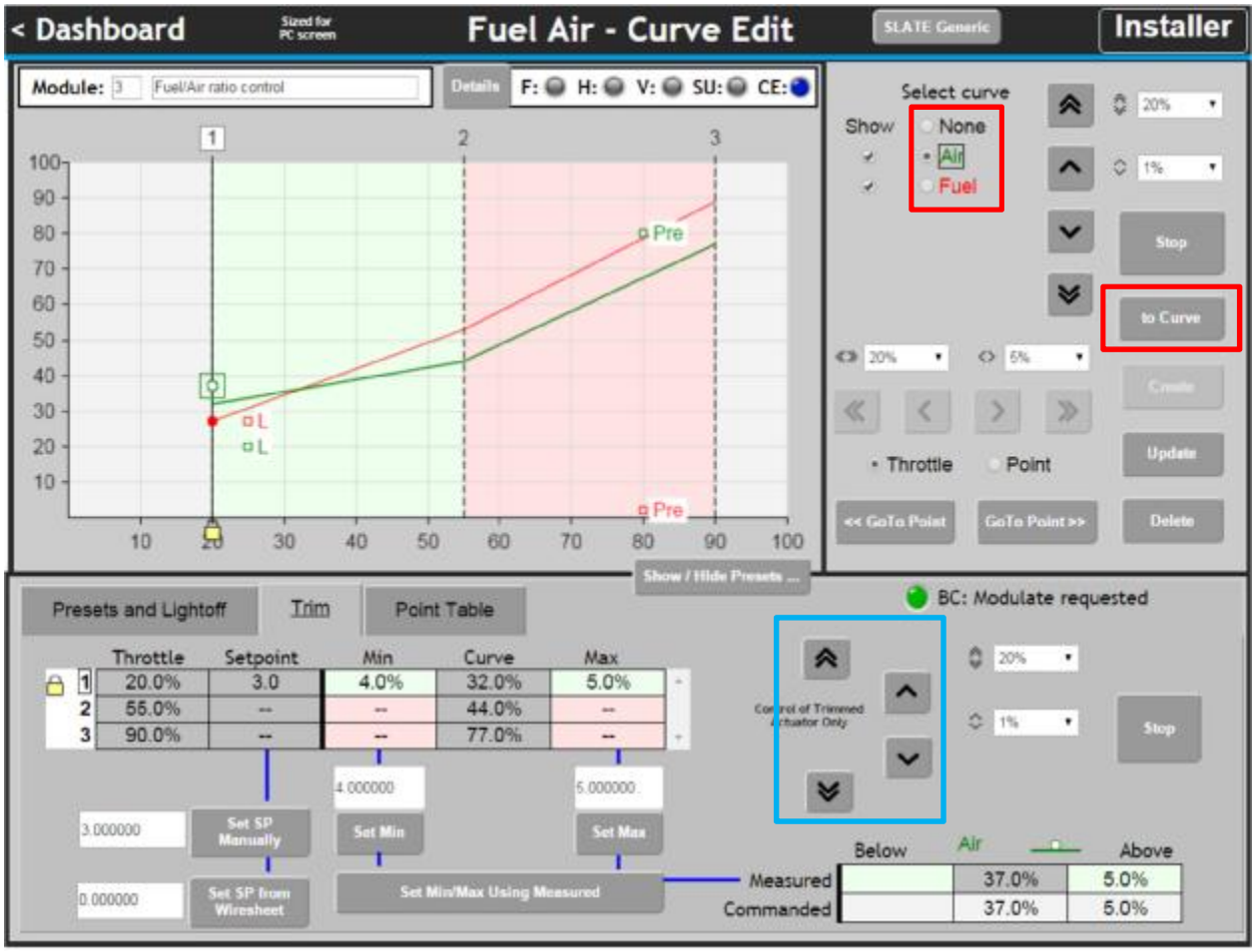


Next visit these two limits by using the trimmed actuator controls. Move the trimmed actuator up to the Above limit (32 plus 5 = 37) and down the Below Limit (32 minus 4 = 28). You'll have to stop right on the limiting value … going past it doesn't count. The boxes should turn green as shown below. Watch and confirm using Gas Analyzer when confirming trim Min/Max.



Tip: after visiting the second extreme (either below or above) to get the actuator back to the curve quickly:

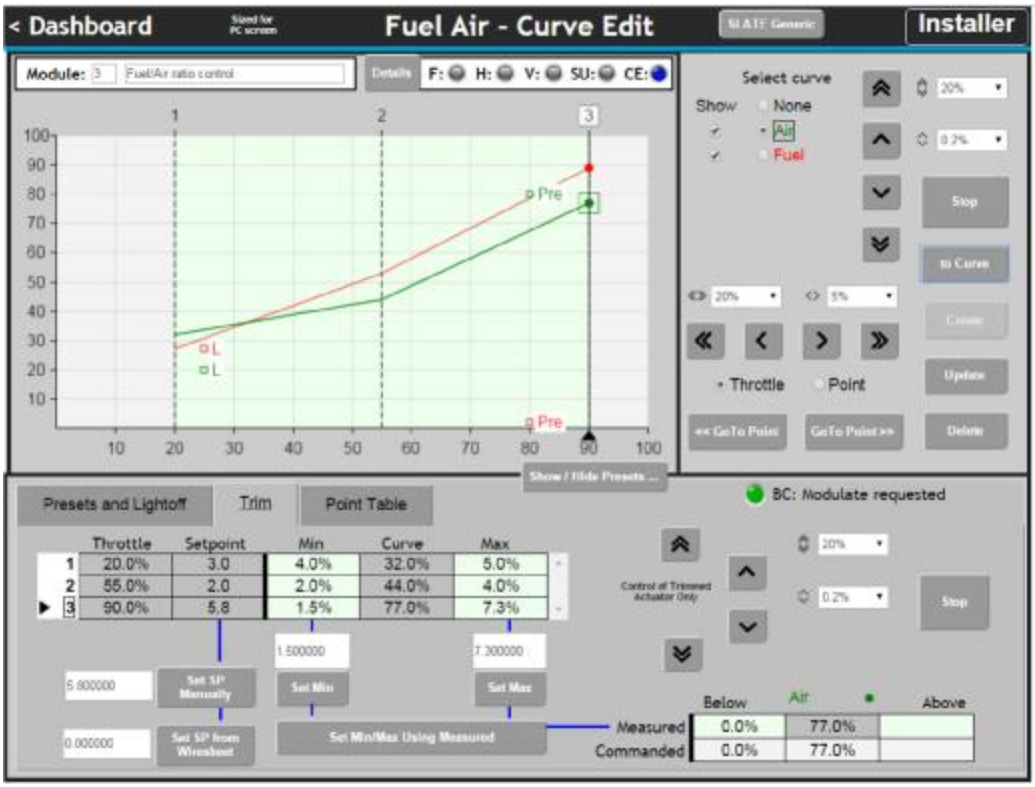
• In the selector at the top, select the trimmed actuator (Air in this case). This will enable the "to Curve" button in the top section. Click that button to send the actuator back to the Curve and unlock the throttle. This button may be located in a different area of the screen based on what version SLATE Firmware is being used.



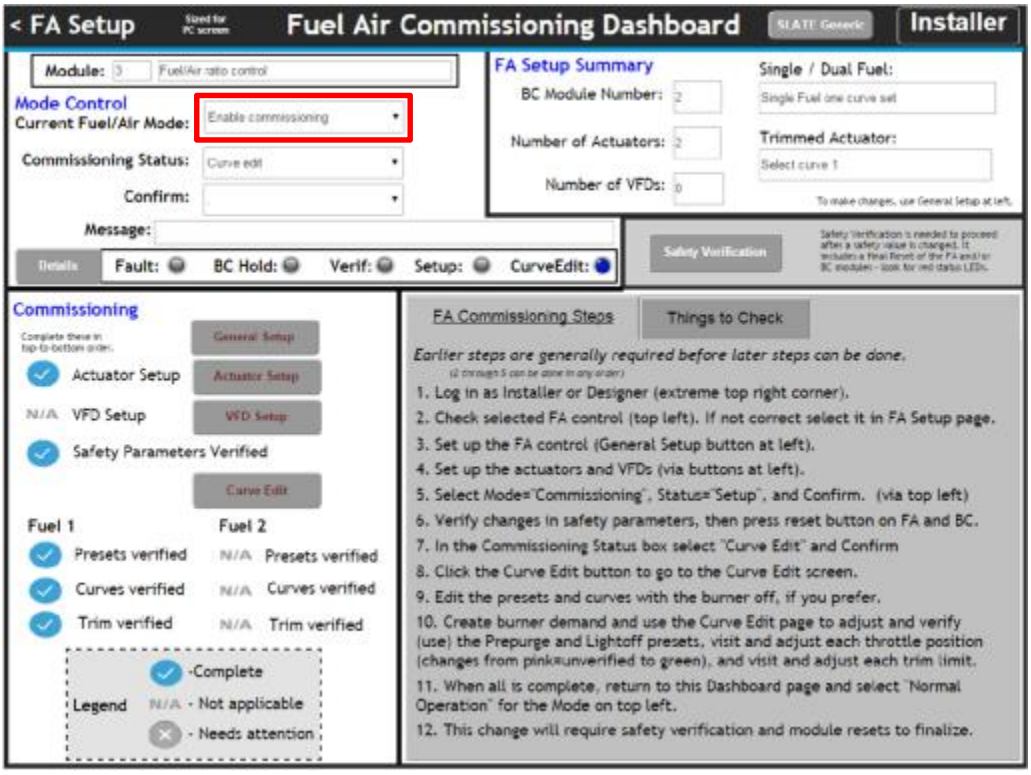
• Use “Go To Point>>” to move the throttle to point 2. (Again, normally this would be done slowly and a step at a time, while watching a gas analyzer.)
• If the segment between points 1 and 2 was pink before, it should now be green since all positions between 1 and 2 have been visited.

<u>Alternatives to Setting Min/Max:</u>
You can move the Trimmed Actuator above and below the curve using the buttons (highlighted in blue). Move trimmed actuator above curve position until you reached a desired Max level (based on Gas Analyzer) then click the ‘Set Min/Max Using Measured’ button. This will set the Max % for selected Point. Repeat this process, but in reverse, moving below actuator curve position until reaching the desired Min level (based on Gas Analyzer). Click the ‘Set Min/Max Using Measured’ button again, setting your Min %.

Once your curve set has been “Walked” or confirmed, and trim setpoints have been verified, your completed curve should be blue, including your Trim Table.



You're done! except for one final step … Click the top left button in the title bar to go back to the Dashboard … Note that all the blue checkmark circles are complete. The final step is to select "Enable normal operation" in the Current Fuel/Air Mode dropdown.



VFD Configuration

Purpose:

The SLATE Fuel Air Module supports many possible configurations of Variable Frequency Drives (VFD) and speed sensor feedback. With flexibility comes some complexity in the setup process. This guide will step through two examples in an attempt to eliminate some confusion. This guide assumes that the designer has selected a VFD and speed sensor that is compatible with the SLATE system (reference F/A Control module lit) and has properly setup the VFD itself. This document focuses on how to setup SLATE to work with the selected system components.

VFD Setup:

When using a VFD with the SLATE Fuel/Air Module, the VFD should have a measurement of speed feedback. It is not enough for the VFD control to simply mirror back the command signal (without measuring the actual speed from the motor being driven). Simply reflecting back the commanded signal can result in unsafe conditions. Typically, the VFD has a measured 4-20mA output that will feed back into the Fuel Air Module to compare against the measured 4-20mA speed to the VFD.

Two examples of VFD Setup are discussed in this document:

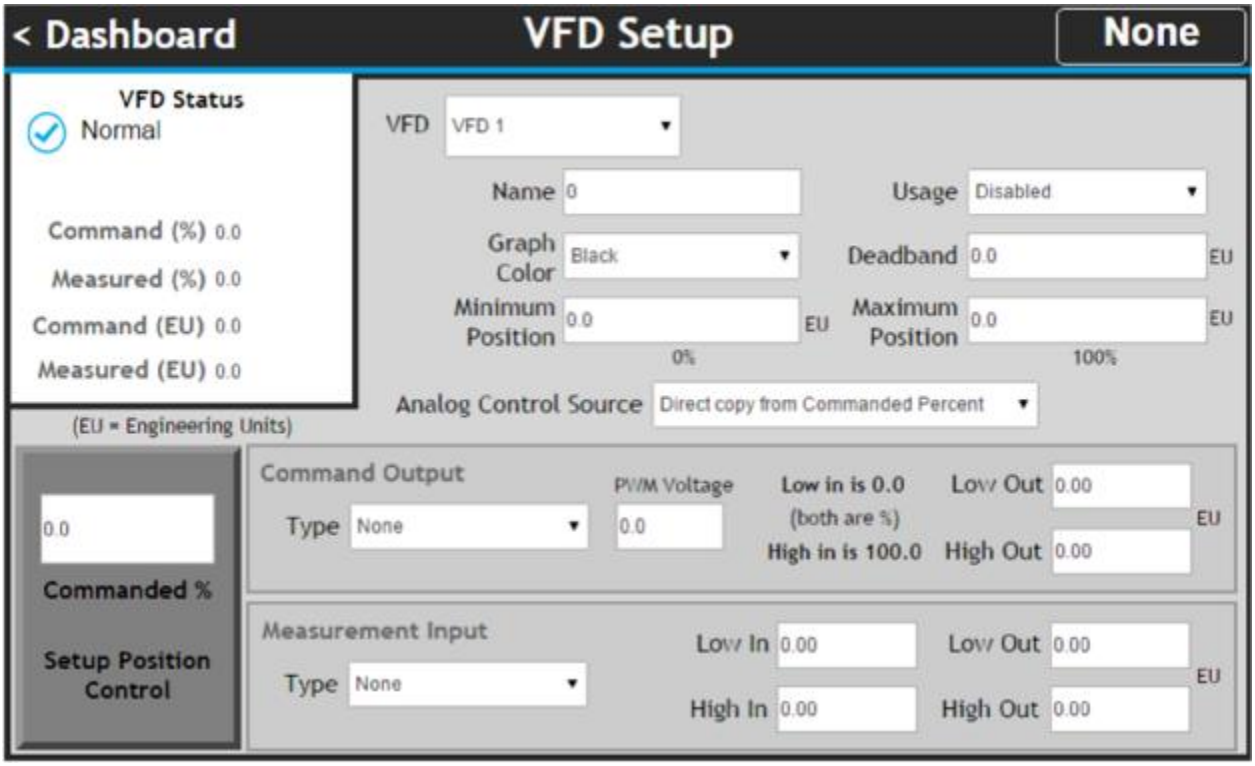
- A Basic Example that drives the VFD with the Commanded Percent defined by the Curve Data. What does this mean??? A VFD that is following a Commanded Percent source must always be on the defined curve within the configured tolerances.
- A more advanced and recommended example is one which uses wire sheet logic to drive the VFD. A designer would likely implement logic that compares the desired position and the measured position and attempts to eliminate any error. This method is more tolerant of error and reduces the possibility of nuisance shutdowns. (Not used by PFI.)

The advanced example of using wire sheet logic to control the VFD is slightly more involved, but it is the recommended practice to allow small errors in the VFD control / feedback relationship to be essentially continuously calibrated out.

Basic Example – "Direct Copy from Commanded Percent"

System Components

Assume we have a VFD that takes a 4-20 mA input from the Fuel Air Module to set the desired speed of the motor. The VFD is configured to drive 0 RPM at 4 mA and 3000 RPM at 20 mA.



Step 1 – "Actuator" Common Registers
A VFD has many of the same configuration registers that the LTA and DuraStep actuators include. These are configured in a somewhat self-explanatory way:

- Name – Text description of the VFD
- Usage – Which Fuels the VFD is enabled for
- Graph Color – The color to use for displaying the VFD on graphs
- Deadband – Acceptable deviation from desired position (speed)
  **The Minimum Position and Maximum Position registers are common with Actuator Setup but will be discussed further in an upcoming step.

Step 2 – Analog Control Source
The register "Analog Control Source" allows a user to define their own control logic to drive the Analog signal to the VFD. This is provided to allow designers to fully control their equipment as needed based on expected system response times. A designer may choose to use Adaptive Integral Action (AIA) or PID blocks to control the analog signal that is ultimately driven to their VFD. This is not used by PFI.

"Direct copy from Commanded Percent" – This example assumes this is the chosen approach. ("Use Wiresheet Logic" – This is a more advanced option that requires Wiresheet logic to implement the connection between the desired VFD position (feedback) and the actual commanded analog output value. Although it is more advanced, this option is more flexible and robust to slight shifts in the system response. The next example covers this option. Not used by PFI)

Step 3 – VFD Command Output

This section defines the Analog Signal from the Fuel Air Module to the VFD. Available options include:

- Voltage Output (T1)
- Current Output (T1)
- PWM Output (T1)

The register labeled "PWM Voltage" is only used in the PWM Output selection and is used to set the "high" level of the PWM Output. For example, a value of 5.00 would set the PWM Output to be a 0 – 5V PWM. Low Out and High Out are provided to set the minimum and maximum values of the Analog Output. For Voltage and Current they are self-explanatory. For example, 4.00 and 20.00 for a 4-20 or 0.00 and 10.00 for a 0-10 V drive signal.

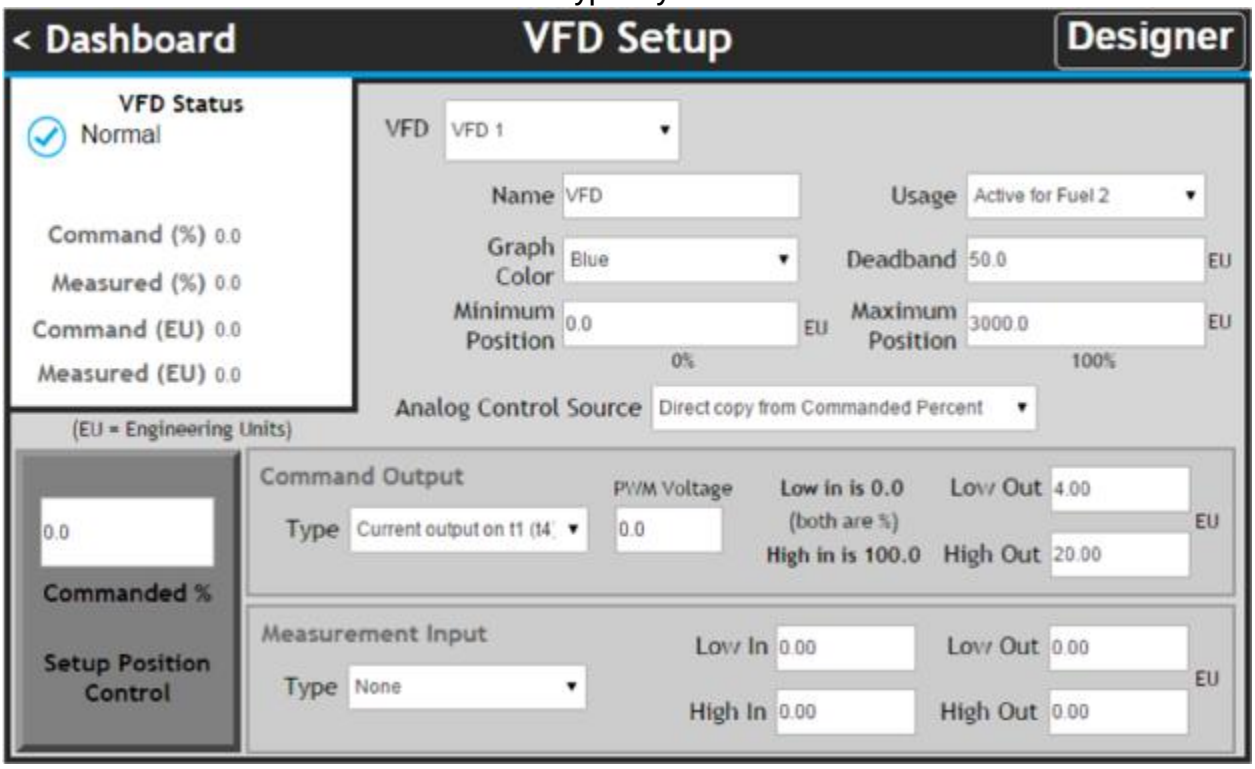
**Note in PWM Output mode the Low Out register specifies the PWM Frequency (in Hz) and the High Out is not used. The PWM Output range is not specified as it is always 0.00 and 100.0 (percent).

! Important Note!

When using "Direct Copy from Commanded Percent" it is critical to set the Minimum Position and Maximum Position to match the feedback received at the corresponding Low Out and High Out values!

For our example:

Our VFD takes 4 – 20 mA so we setup Low Out and High Out to 4.00 and 20.00 respectively. Our VFD drives 0 RPM with a 4-mA input and 3000 RPM with a 20-mA input, so 0 and 3000 are our Minimum and Maximum Positions. PFI typically uses 0-60HZ.



Step 4 – VFD Measurement Input

Once the Command Output is configured (and the matching Minimum and Maximum Position registers) we can configure the Measurement Input. The Measurement Input is the feedback signal from the VFD. It must be an independent measurement of the motor's actual status – it cannot simply be a signal from the VFD mirroring back the commanded position! For example, if the load connection between the VFD controller and the motor was disconnected, a simple "mirrored" signal would not indicate a problem. The Measurement Input does not have any special connections to the Command Output or Minimum and Maximum Position registers except that it must scale its measurement into the same Engineering Units used for the Minimum and Maximum position. Thus, if the Minimum and Maximum Positions are in RPM then the result of the Measurement Input must also result in RPM after unit scaling.

Available Measurement Input Options Include:

- Voltage Input (T3)
- Current Input (T3)
- PWM Input (T2)
- Tach Input (T2)

The setup of each type is very similar to setting up the same type for an Analog I/O module. For example:

<u>Current Input, Voltage Input and PWM Input</u>

Low In and High In are used to linearly scale to Low Out and High Out. Our example (below) will illustrate this.

<u>Tach Input</u>

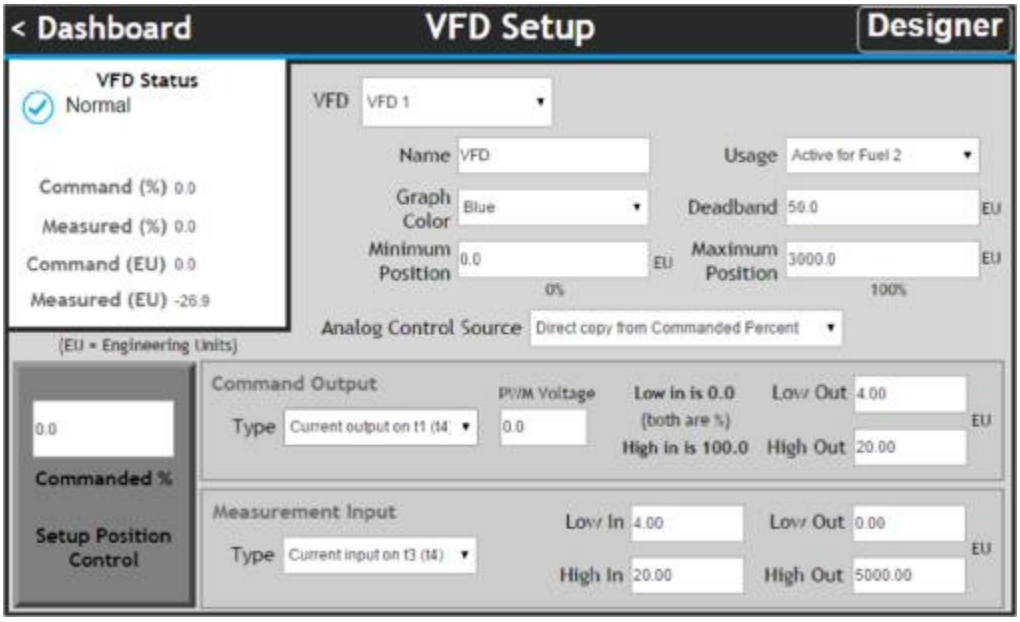
Low In is used to set the number of pulses per revolution of the motor. The other registers are unused and the resulting unit is RPM.

For our example:

The speed sensor selected provides a 4-20 mA signal to the FA Module. The sensor sends 4 mA at 0 RPM and 20 mA at 5000 RPM.

We will set:

Low In = 4.00 (mA)
High In = 20.00 (mA)
Low Out = 0 (RPM)
High Out = 5000 (RPM)



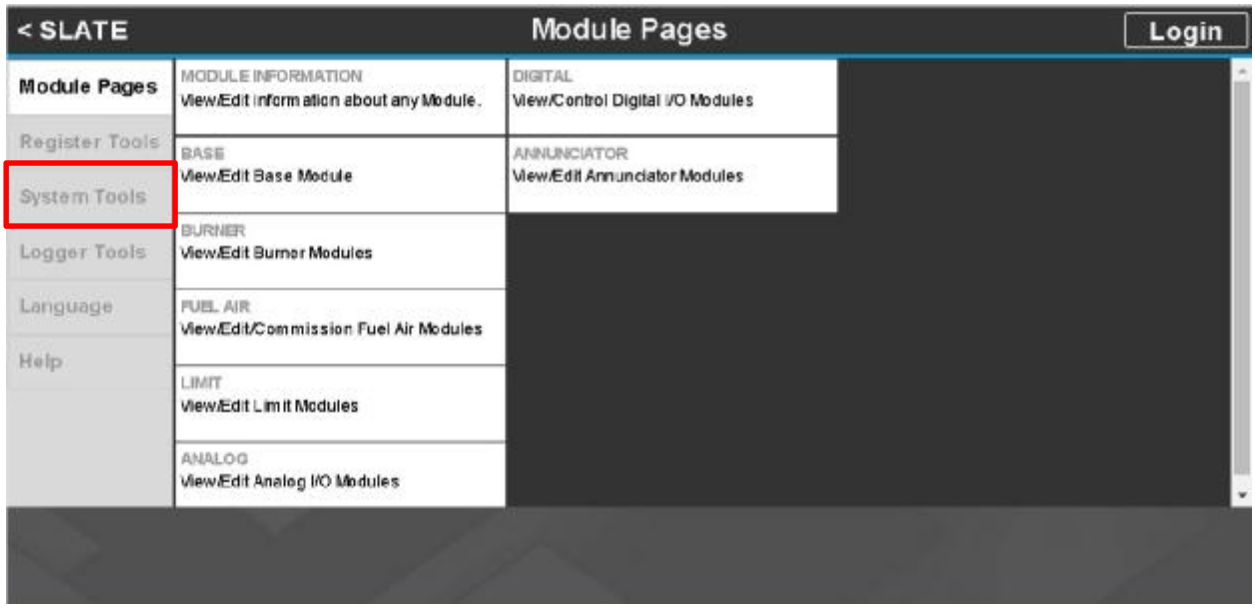
Once setup, be sure to verify your measurement is working correctly with an independent strobe or other speed sensor during installation and commissioning.

Kit Loading & Fuel Curve Backup

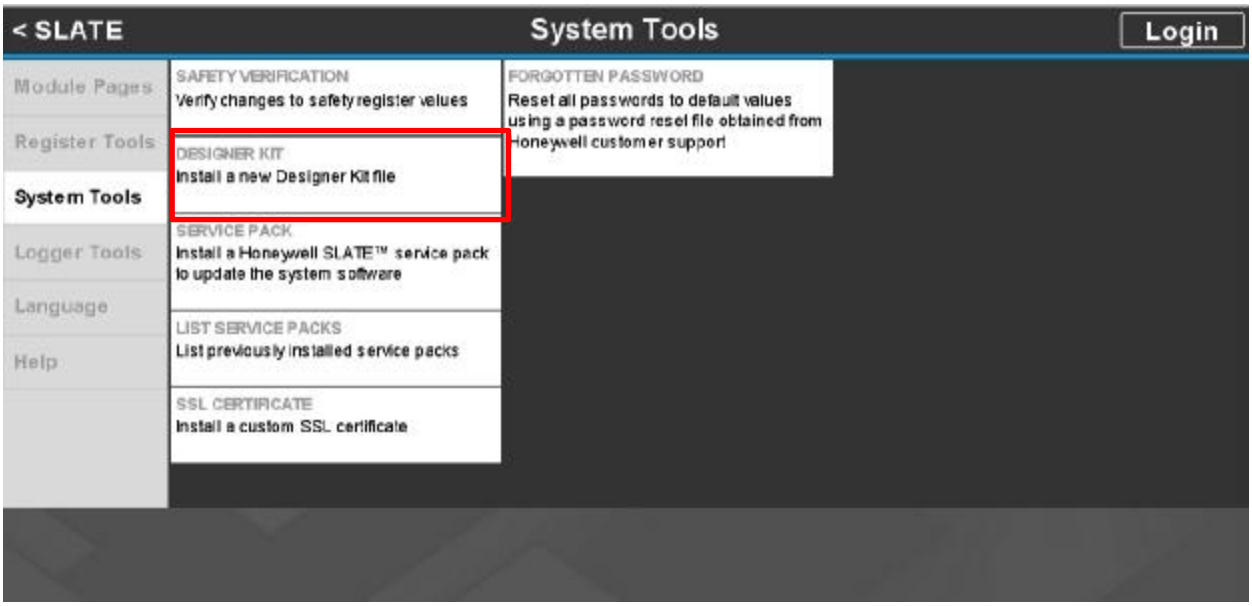
A kit is a copy of the software program that is loaded into a Slate Base Module that contains all logic and programming needed for the system to function as intended. If a Base Module has been corrupted, damaged or has failed, it may be necessary to load the factory kit into the new base to resume operation. The kit can be obtained from the factory depending on the situation. Typically, if a Base Module needs replaced, the factory will pre-load the needed kit before shipping to final destination. The kit is also loaded on the provided flash drive. If a kit needs to be loaded in the field, the following instructions will help guide you.

Before loading a kit, on the Base Module, go to Menu, Installation, the Save Config Set. This will save data like servo setup information. It also notes setpoints, PID values and etc. that have been configured, as Kit Loading will wipe them.

Navigate to the Generic Pages, and Click the System Tools Tab



Click ‘Designer Kit’



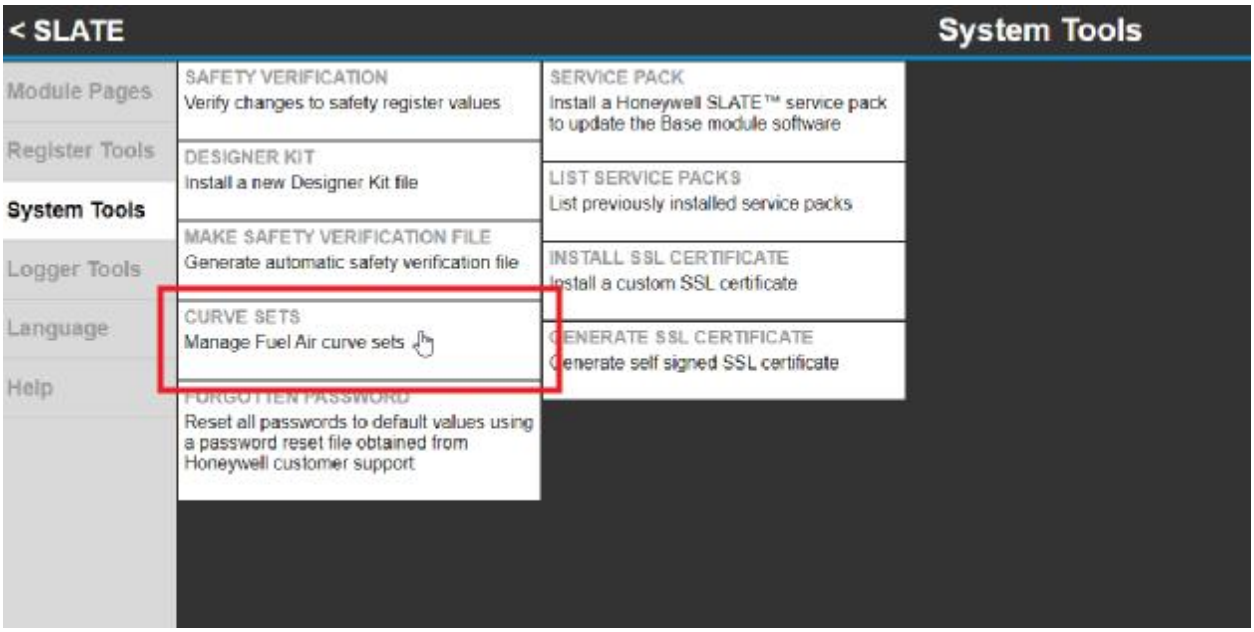
At this point, the user must have either Designer or Installer access to load a kit into the SLATE base. Logging in with the appropriate credentials is required.
Find your project in the “File” field and click the “Install Designer Kit” button. If loading from a USB device, make sure the file name says USB in front of it. It is possible to re-load the existing kit that is saved on the SD card (The SD card acts as a hard drive for the Base Module)

Allow the kit to load. This process may take a few minutes so be patient! At the end of a successful load you will see "Kit Loaded Successfully".

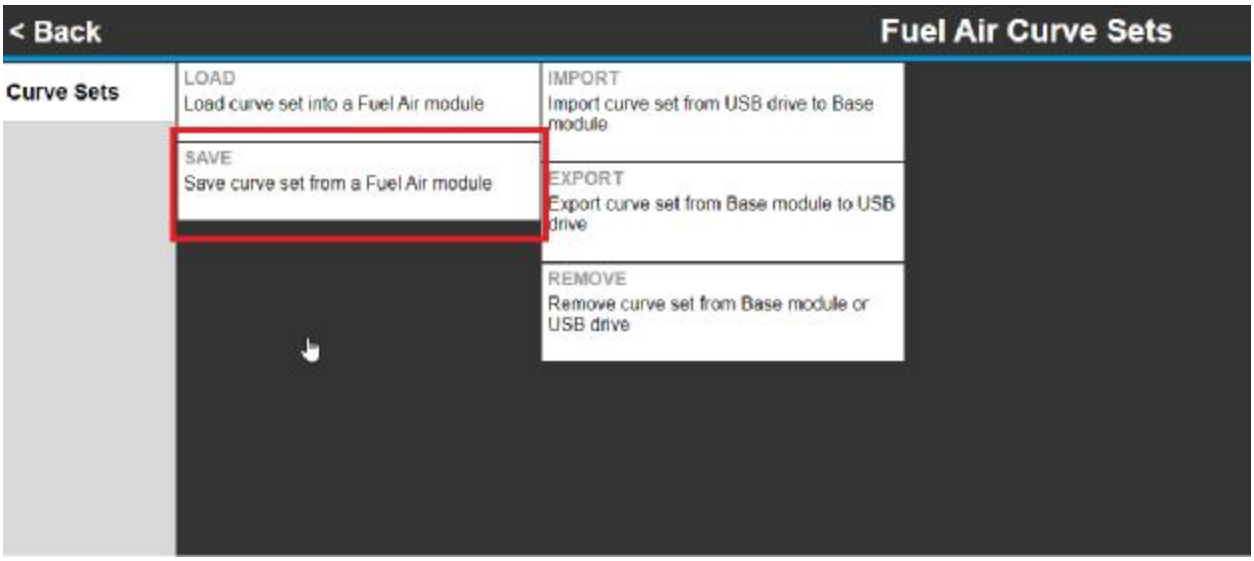
Once a kit is loaded, you will need to re-visit Burner Module setup, Fuel Air Setup & Commissioning and safety verify all settings, as well as confirm, or "walk" the curves. You can now upload the Config Set File to retain register data that have been changed to default.

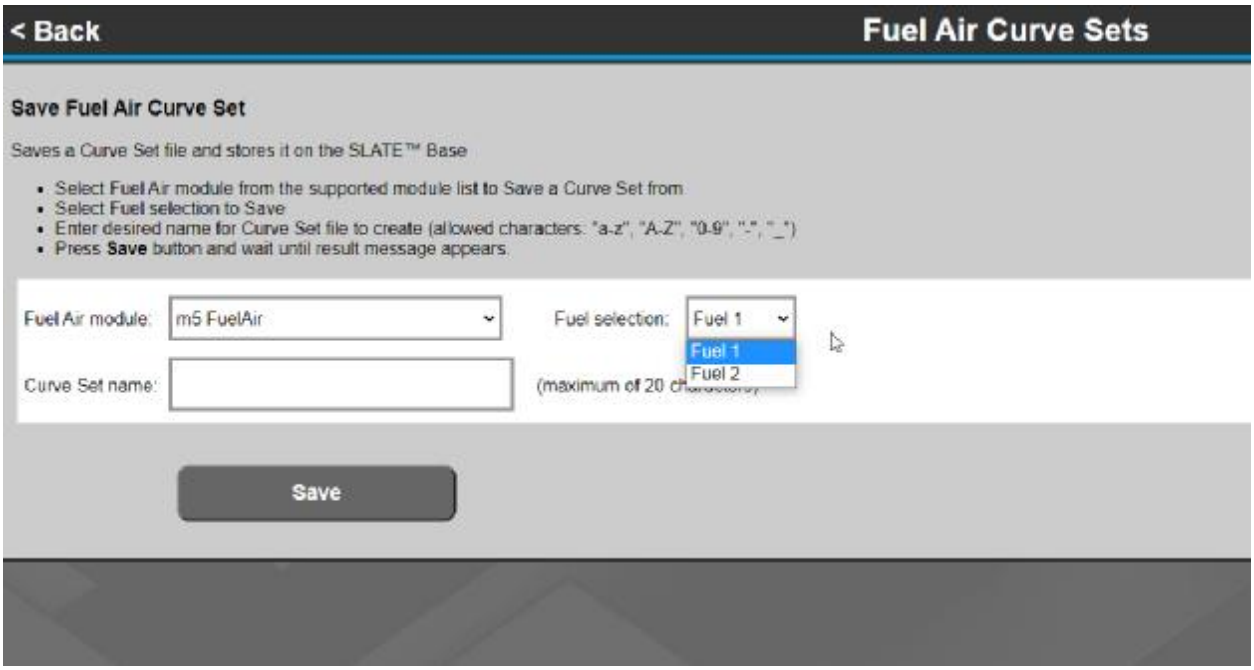
Fuel Curve Saving & Loading

Under System Tools, you have the option to Save and Load fuel curve sets. This can be done using the internal SD Card or a USB device. The Slate Base Module can only have two fuel curves loaded at any time. If you require more fuel curves, you may create and save as many as needed onto a USB Device, then load them as needed.

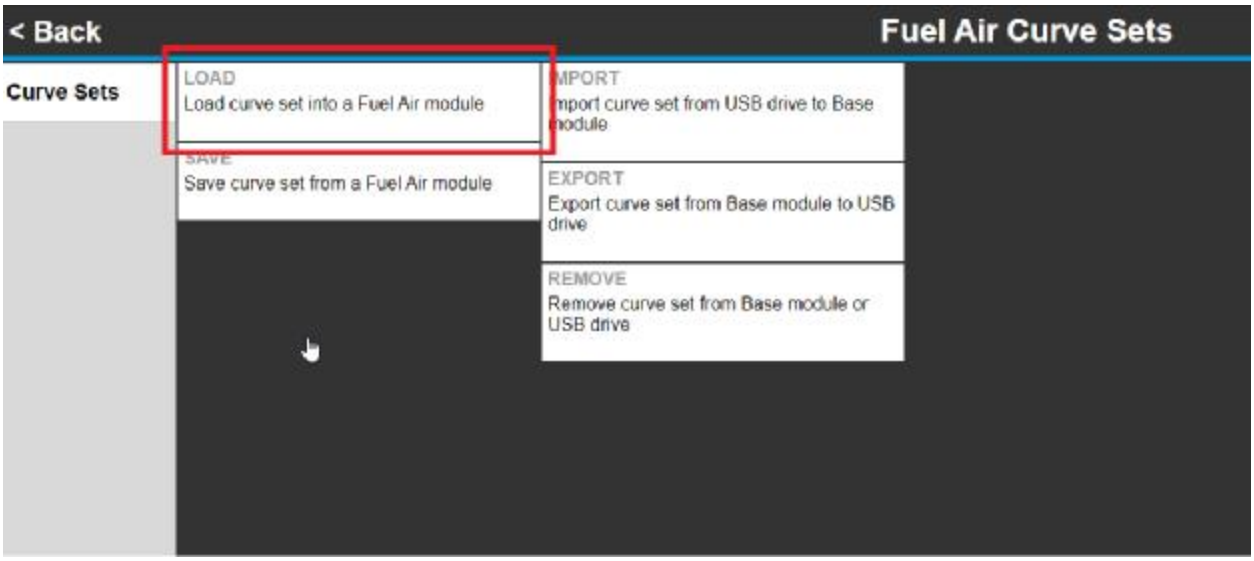


To save curve set, make sure Fuel One (typically Natural Gas) is selected via Fuel Selector Switch on panel (If dual fuel). Turn On burner. This will engage the Fuel One curve. Navigate to the fuel curve save/load screen. Save fuel curve as fuel 1. You must create a file name for curve set. Once saved (to Base module) you can then export to a USB thumb drive for backup.
To save a second fuel curve for Fuel Two (typically Fuel Oil, Propane, etc.) Follow the aforementioned steps, but select the correct fuel using fuel selector switch (Oil, etc.) and engage burner on. Save as Fuel 2. Create a filename as before. Once saved, export to USB.





To import fuel curves, you must import from USB to Base Module using the Import function of the Fuel Curve Save/Load menu. Once curves have been imported, you can load them using the Load function and assign them to the corresponding fuel (Fuel 1, Fuel 2).


< Back
Fuel Air Curve Sets
Curve Sets
LOAD
Load curve set into a Fuel Air module
SAVE
Save curve set from a Fuel Air module
IMPORT
mport curve set from USB drive to Base
odule
EXPORT
Export curve set from Base module to USB drive
REMOVE
Remove curve set from Base module or USB drive

Appendix:
Burner Control Fault Codes

Director SCS Slate Burner Module Fault Code Master List		
Code Number	Reason For Fault	Description of Fault
1	No event	No event is currently being reported.
2	NV storage not initialized	Non-volatile storage is not initialized.
3	Configuration parameters mismatch	Configuration parameters do not match with Base module.
4	Configuration file received	Configuration parameter setting file has been received by this module.
5	Service disabled	This module's service has been disabled.
6	Service enabled	This module's service has been enabled.
7	Safety verification file received	Safety verification file received by this module.
8	Module powered up %s	This module has just powered up and is initializing.
9	User: %s	User initiated event
10	Module number changed %s	This module has been re-numbered
11	Setting error for parameter %d "%s"	Invalid configuration parameter setting for this register has been detected.
12	Safety verification needed	Verification of one or more safety parameter changes is needed.
13	Safety relay not in correct state	Safety relay output was ON when it should be off or OFF when it should be on.
14	Safety relay optocoupler error	Safety relay optocoupler feedback was not valid.
15	Safety relay test failure	Safety relay failed during self-test.
16	Interlock is OFF when it should be ON	Interlock (ILK) string is OFF when it should be ON.
17	Preignition is OFF when it should be ON	Preignition (PII) string is OFF when it should be ON.
18	Main valve is NOT in correct state	Main valve (MV1) is ON when it should be off or is OFF when it should be on.
19	Second Main valve is NOT in correct state	Second Main valve (MV2) is ON when it should be off or is OFF when it should be on.
20	Pilot valve is NOT in correct state	Pilot valve is OFF when it should be on or ON when it should be off.
21	Purge position is NOT proven by PPP	Purge position is NOT proven according to the PPP terminal.
22	Purge position is NOT proven by fan	Purge position is NOT proven by fan speed.
23	Lightoff position is NOT proven by LPP	Lightoff position is NOT proven according to the LPP terminal.

24	Lightoff position NOT proven by Fuel Air control	Lightoff position is NOT proven according to the Fuel Air control module.
25	Flame is ON when it should be off	Flame is present when no flame should be.
26	IAS/LOI input is OFF when it should be ON	IAS/LOI input is OFF when it should be ON
27	IAS input is ON during start check	IAS input is ON during start check
28	Flame ON when no flame should be present	Persistent flame is present during period when there should be no flame.
29	Manual Open Switch is OFF	Manual open switch (MOS) is OFF when it should be ON.
30	Forced recycle	Forced recycle time was exceeded in run
31	Flame is OFF	Flame is not present when it should be.
32	Safety relay feedback is OFF	Safety relay feedback is off when it should be on.
33	Reset button pressed	Reset button was pressed.
34	Fuel Air lockout requested	Fuel Air control module has requested a lockout. (%d)
35	Fuel Air hold requested	Fuel air control module requested a hold.
36	LCI/F1 and LCI/F2 were both ON	Both Fuel 1 and Fuel 2 inputs were ON simultaneously.
37	Fuel Air communications timeout	Communication with Fuel Air control module has timed out.
38	LCI/F1 was OFF	LCI/F1 input was OFF.
39	Purge time expired	Purge time has expired.
40	No demand	No demand is present.
41	Prepurge unproven by Fuel Air control	Prepurge rate was not proven by Fuel Air control module.
42	Flame is OFF early in run	Flame is OFF too early during run.
43	Ignition feedback error	Ignition relay is NOT in correct state.
44	PII start check failure	Preignition (PII) start check has failed.
45	Valve proving required	Valve proving is required.
46	VP leaky upstream	Upstream valve was leaky during valve proving.
47	VP leaky downstream	Downstream valve was leaky during valve proving.
48	ILK start check failure	ILK start check has failed.
49	Lightoff unproven by TACH	Lightoff unproven by tachometer feedback
50	Soft lockout expired	Soft lockout timer has expired.
51	Limit %d %s exceeded	Limit %d has been reached.
52	Limit %d %s communications failure	No communications or error in communication with limit %d socket.
53	Reset switch is stuck	It has been detected that the Reset switch is stuck in a pressed condition.

54	Weak flame in flame amp %d exiting PFEP	Weak flame detected by flame amplifier %d when exiting PFEP.
55	Weak flame in flame amp %d exiting DBI	Weak flame detected by flame amplifier %d when exiting DBI.
56	Weak flame in flame amp %d in Run	Weak flame detected by flame amplifier %d during Run.
57	IR flame amplifier NV storage not initialized	IR flame amplifier NV storage is not initialized.
58	IR flame amplifier DC voltage error	IR flame amplifier DC voltage error.
59	False flame in IR flame amplifier	False flame detected in IR flame amplifier.
60	IR flame amplifier HW error	IR flame Amplifier hardware error.
61	UV/VIS flame amplifier NV storage not initialized	UV/VIS flame amplifier NV storage is not initialized.
62	False flame in UV/VIS flame amplifier	False flame detected in UV/VIS flame amplifier.
63	UV/VIS flame amp invalid flame signal	Invalid flame signal in UV/VIS flame amplifier.
64	UV/VIS flame amplifier low duty	UV/VIS flame amplifier low duty cycle.
65	UV tube flame amplifier NV storage not initialized	UV tube amplicheck flame amplifier NV storage is not initialized.
66	False flame in UV tube amplicheck flame amplifier	False flame detected in UV tube amplicheck flame amplifier.
67	False flame in UV tube flame amplifier	False flame detected in UV tube flame amplifier.
68	UV tube shutter flame amp NV storage not init	UV tube shutter flame amplifier NV storage is not initialized.
69	False flame in UV tube shutter flame amplifier	False flame detected in UV tube shutter flame amplifier.
70	False flame in UV tube flame amplifier	False flame detected in UV tube flame amplifier.
71	Flame amplifier %d communications timeout	Communication with flame amplifier %d has timed out after several attempts.
72	Unknown internal flame fault	Internal flame fault is unknown.
73	Burner was in %s state	Burner was in this state during the lockout, fault, or recycle.
74	Burner state time: %d seconds	Burner was in this state for this period of time (in seconds) at the time of the lockout, fault, or recycle.
75	Burner cycle count: %d	Burner had these many cycles at the time that the lockout, fault, or recycle occurred.
76	Burner run time: %d hours	Lockout, fault, or recycle occurred when burner had been running this many hours.

77	Burner state: %s	Burner was performing this function at the time of the lockout, fault, or recycle.
78	Burner Soft lockout	Burner lockout is a Soft lockout.
79	Burner Hard lockout	Burner lockout is a Hard lockout.
80	LCI/F2 was OFF	LCI/F2 was OFF.
81	Opto strobe off test failure	Opto strobe off test has failed.
82	Vref terminal unpowered	Vref terminal is unpowered.
83	Timing cross check failure	Timing cross check has failed.
84	Limit %d %s sensor failed	Limit %d sensor failure has occurred.
85	External reset switch stuck	External reset input is stuck in the ON condition.
86	Flame sensor timing cross check failure	Flame sensor has timing cross check fault
87	Fuel/air position mismatch	Fuel Air control module has a position mismatch.
88	Fuel Air module challenge response failure	Fuel Air control module has a challenge response failure.
89	Fuel Air module timing cross check failure	Fuel air module has a timing cross check failure.
90	Safety relay pulse test failure	Safety relay pulse test has failed.
91	Safety relay key feedback failure	Safety relay key feedback test has failed.
92	Flame amplifier communications fault %d	Communication fault(s) %d with flame amplifier has occurred.
93	Secondary flame sensor fault	Secondary flame sensor has a fault.
94	Both LCI/F1 and LCI/F2 were OFF	LCI/F1 and LCI/F2 are configured as fuel select limits, and both were off.
95	Fuel mismatch with Fuel Air control	Fuel Air control module has a fuel mismatch with the burner control.
96	Rectification flame amp NV storage not initialized	Rectification flame amplifier NV storage is not initialized.
97	Rectification flame amplifier 18V fault	Rectification flame amplifier 18V power supply fault.
98	False flame in Rectification flame amplifier	False flame detected in Rectification flame amplifier.
99	Rectification flame amplifier HW error	Rectification flame amplifier hardware error.
100	UV/VIS flame amplifier HW error	SSUV flame amplifier hardware error
101	UV/VIS flame amplifier Low 18V	SSUV flame amplifier Low 18V
102	UV tube flame amplifier HW error	UV tube flame amplifier hardware error
103	UV tube flame amplifier Low 18V	UV tube flame amplifier Low 18V
104	Fuel Air module disabled	Fuel Air control module is disabled.

105	Fuel changed during cycle	Fuel selection has changed during a running cycle.
106	Interlock glitch detected	Interlock momentarily went OFF.
107	Invalid flame fault code	Invalid flame amplifier event/fault code.
108	Non-volatile storage not initialized in flame amp	Non-volatile storage not initialized in flame amplifier.
109	Conflict with parameter %d "%s"	Setting conflict with this configuration parameter and another one.
110	UV/VIS flame amp flame on threshold out of range	Flame on threshold for SSUV flame amplifier %d is out of range.
111	UV/VIS flame amp weak flame threshold out of range	Weak flame threshold for SSUV flame amplifier %d is out of range.
112	SSIR flame amp flame on threshold out of range	Flame on threshold for SSIR flame amplifier %d is out of range.
113	SSIR flame amp weak flame threshold out of range	Weak flame threshold for SSIR flame amplifier %d is out of range.
114	UV tube flame amp flame on threshold out of range	Flame on threshold for UV tube flame amplifier %d is out of range.
115	UVtube flame amp weak flame threshold out of range	Weak flame threshold for UV tube flame amplifier %d is out of range.
116	RECT flame amp flame on threshold out of range	Flame on threshold for rectification flame amplifier %d is out of range.
117	RECT flame amp weak flame threshold out of range	Weak flame threshold for rectification flame amplifier %d is out of range.
118	Flame amplifier type mismatch	Flame amplifier selected type does not match with installed flame amplifier.
119	Cross check setting error for parameter %d "%s"	Setting of this parameter is not consistent with the setting of another related parameter.
120	Interrupted ignition with zero MFEP	Control is configured for interrupted ignition, but a main flame establishing period time of zero seconds is specified.
121	Flame amplifier %d packet response %s	Flame amplifier packet response
122	Flame amplifier %d packet shutter error %s	Shutter command error has been found in flame amplifier packet.
123	Flame amplifier %d packet timeout %s	Flame amplifier packet has not been received within timeout period.
124	Flame amplifier %d packet challenge error %s	Challenge error in flame amplifier packet.
125	Flame amplifier %d reported unknown fault %s	Unknown fault reported in flame amplifier packet.
126	Flame amplifier configuration fault	A flame amplifier configuration fault has been detected.
127	Flame amplifier %d packet threshold %s	Flame amplifier packet threshold fault

128	Lightoff unproven - neither LPP nor Fuel Air	Lightoff unproven by both LPP input and Fuel Air control
129	Lightoff unproven - neither LPP nor Fan RPM	Lightoff unproven by both LPP input and Fan RPM (tachometer)
130	Lightoff unproven - neither Fuel Air nor Fan RPM	Lightoff unproven by both Fuel Air control and Fan RPM (tachometer)
131	Lightoff unproven - neither LPP nor FA nor Fan RPM	Lightoff unproven by all sources - LPP input and Fuel Air control and Fan RPM (tachometer)
132	Prepurge unproven - neither PPP nor Fuel Air	Prepurge unproven by both PPP input and Fuel Air control
133	Prepurge unproven - neither PPP nor Fan RPM	Prepurge unproven by both PPP input and Fan RPM (tachometer)
134	Prepurge unproven - neither Fuel Air nor Fan RPM	Prepurge unproven by both Fuel Air control and Fan RPM (tachometer)
135	Prepurge unproven - neither PPP nor FA nor Fan RPM	Prepurge unproven by all sources - PPP input and Fuel Air control and Fan RPM (tachometer)

Fuel Air Module Fault Codes

Director SCS Slate Fuel Air Module Fault Code Master List		
1	No event	No event is currently being reported.
2	NV storage not initialized	Non-volatile storage is not initialized.
3	Configuration parameters mismatch	Configuration parameters do not match with Base module.
4	Configuration file received	Configuration parameter setting file has been received by this module.
5	Service disabled	This module's service has been disabled.
6	Service enabled	This module's service has been enabled.
7	Safety verification file received	Safety verification file received by this module.
8	Module powered up %s	This module has just powered up and is initializing.
9	User: %s	User initiated event
10	Module number changed %s	This module has been re-numbered
11	Safety verification needed	Verification of safety parameter change is needed.
12	Number of configured Modbus actuators mismatch	Number of Modbus actuators configured for the system do not match the number expected.
13	Number of configured VFD actuators mismatch	Number of VFD actuators configured for the system do not match the number expected.
14	Actuator positioning timeout	Actuators did not reach their commanded position in time.
15	Burner control communication timeout	Communication with the burner control module has timed out.
16	Entered actuator setup	Entered actuator setup mode.
17	Entered curve edit	Entered curve edit mode.
18	Entered normal operation	Entered normal operation mode.
19	Actuator %d safety packet timeout	Safety packet has not been received from actuator %d within an acceptable time.
20	Actuator %d off curve	Actuator %d is located off the curve.
21	Actuator %d fault. %s	Fault is indicated in actuator %d.
22	VFD command verification error in actuator %d	A VFD command verification error has occurred with actuator %d.
23	Power supply 18V voltage low	Power supply 18V voltage is low.
24	Analog cell ID check failure	Analog cell ID check has failed.
25	ADC Vref check failure	ADC Vref check has failed.
26	Analog cell communication failure	Analog cell communication has failed.
27	Fault reset by user	Fault condition has been cleared by the user.
28	Fault auto reset by timer expiration	Fault condition has been cleared due to timeout.
29	Actuator %d is out-of-quadrant	Actuator %d is located out of it's quadrant.
30	Actuator %d is not calibrated	Actuator %d is not calibrated.

31	Actuator %d A/D hardware fault	Analog to digital hardware has reported a fault condition in actuator %d.
32	Actuator %d feedback fault	Feedback fault has been detected in actuator %d.
33	Actuator %d position control alarm	Position control in actuator %d has been alarmed.
34	Actuator %d motor sync alarm	Motor synchronization in actuator %d has alarmed.
35	Actuator %d input DC voltage is low	Low input DC voltage has been detected in actuator %d.
36	Actuator %d motor drive fault	Motor drive fault in actuator %d has been detected.
37	Actuator %d NV memory fault	Non-volatile memory fault in actuator %d has been detected.
38	Actuator %d over temperature	Over temperature in actuator %d has been detected.
39	Actuator %d NTC connection fault	Connection with NTC has faulted in actuator %d.
40	Actuator %d safety system lockout	Safety system lockout with actuator %d has occurred.
41	Actuator %d user lockout	User lockout with actuator %d has occurred.
42	Curve verification needed: data mismatch	Loaded curve set created from another system or fuel type. Presets and segments need verification.
43	Curve verification retained	Loaded curve set complete. Verification status retained.
44	Analog cell %s low and high limits reversed	Analog cell %s has reversed low and high limits.
45	Actuator %d EEPROM fault	Actuator %d has reported an error with its external EEPROM storage.
46	Actuator %d reported unknown fault	Actuator %d has reported an unknown fault.