Injection Systems

Alcohol Controller

Installation And Instruction Manual 1.0

Introduction:

Thank you for purchasing the Injection Systems Alcohol Controller (ISAC). The ISAC is an advanced methanol injection controller designed to replace the existing controllers in the majority of the methanol injection systems on the market today. The ISAC features a non linear injection design, which allows you to create a progressive injection curve which can be further fine tuned based on RPM. The ISAC also incorporates wideband tracking for further tuneability, allowing you to set target air/fuel ratios which the unit attempts to correct back to with its control over the methanol pump. The unit also has a full featured boost controller which works either via manifold pressure or CO2. Boost can be controlled based off of time, gear selection or RPM. With various failsafes in place, the ISAC provides several different options for protecting your engine when utilized with the boost control option.

Finally, the unit incorporates a built in data logging option which allows you to monitor the system from a laptop. All logging parameters are adjustable by the end user and logs can be saved and loaded for future review.

Kit Contents:

The ISAC controller package includes the following:

1 – ISAC controller

1 – 8 Pin Sensor Harness

1 – 6 Pin Boost Control/Wideband Harness

1 – USB Cable

1 – 5 Pin Pump Control Harness

1 – Manual/System Software CD

Optional solenoids for boost control are available from your place of purchase. The system will operate in a low/high solenoid configuration (2 solenoids) or a bleeder/blocker configuration (1 solenoid). Please

make sure you order the correct solenoid for the method of control you plan to use.

Installation:

The ISAC is fairly complex for a methanol injection system controller. As such, it would be advantageous to decide in advance how you plan to use the feature set of the unit. This will make installation much easier as you will most likely end up with wires you do not use and knowing in advance what features you will not utilize will allow you to remove those wires from consideration. We recommend taping back unused wires instead of cutting them from the harness in case you decide to use them later. We strongly advise making your own wiring chart on a separate piece of paper based on the information below. This will be beneficial when you begin your installation. As some wires have more than 1 use, you will need to decide how you want to utilize some of the controller functions before you begin installation.

Choose a mounting location for the controller. Keep in mind that you will need access to the controller to connect a USB cable to it. Also, there are operational LEDs on the front of the unit as well as a trim knob. If you would choose a location for the unit that is out of sight, one of the solenoid outputs may be used to drive a light to let you know that the unit is activated. We recommend leaving the unit in a viewable location until you have verified that the system works correctly.

Listed below are the wire colors and their functions.

<u>Connector J1</u>

This is the sensor/input harness.

Black – Sensor ground. This wire should be grounded to the engine.

Green – Main Input. This is your pressure sensor wire. This wire should be connected to the signal wire on your MAP sensor.

Red – 5V Sensor Wire. This wire can be used if you need a 5V reference for any sensors. Most TPS and MAP sensors work on a 5V reference so if you are adding a MAP sensor, this is the wire that would power the sensor.

Grey/Orange – Switch Input 1. This wire serves 3 purposes. This sensor works from a ground input. For example, if using a low level indicator, one wire of the sensor should be attached to ground and the other wire on the sensor attached to this wire.

- Low level input. For use with a low level sensor.
- Alcohol arming. This allows you to enable/disable the system with a switch.
- Stage/Brake. This is used for enabling launch boost with the boost controller. It can be used with a transbrake or a switch on your brake pedal.

Yellow/Green – Mode/Gear/Arm. This wire serves 5 purposes.

- Gear sensor. This is a linear based input for what gear you are in (Not currently implemented)
- Gear shift. Ground this wire to upshift one gear on the boost controller.
- Gear switch. Open circuit or voltage puts the boost controller in first gear. Grounding the wire puts the boost controller in second gear.
- Stage mode. Grounding this wire puts the controller in stage mode, which resets the timer on the boost controller and activates the stage boost level.
- Alcohol flow. For use with an alcohol flow monitor. This allows another method of protection when utilized.

Grey/Violet – TPS. This wire needs to be connected to your TPS wire that sends TPS voltage to the ECM.

White/Blue – RPM. This wire should be connected to the wire that sends engine rev pulses back to the ECM. On some vehicles, you will need to use a tach adapter to get a signal that the ISAC can recognize.

It is known at this time that all Fords with one coil per cylinder require a tach adapter to function with the ISAC. The unit has been tested with the Autometer tach adapter but should work equally as well with the Ford Motorsport adapter.

As more vehicles become known, we will expand this section.

Brown – Switch Input #2. This wire serves 2 purposes.

- Alc Pressure Switch. This selection is used with pumps that have a pressure switch on the pump head. The system can be configured to pull boost from the engine if pressure drops. If possible, a low level indicator is a better form of protection as the pressure required to trip the pressure switches are usually very low and you will most likely have suffered engine lean out by the time the switch trips.
- Boost Gear Reset. This selection resets the gear indicator in the boost controller back to 1st. When using the boost controller in gear based mode, this wire should be used. Please note that if you prefer to use the Alc Pressure Switch option, the unit will automatically reset your gear selection back to 1st when the engine returns to idle speed.

<u>Connector J2</u>

This harness is the boost control harness. It also has a wire for wideband input. Please note that when operating boost solenoids, the ISAC applies a ground. The other wire on your boost solenoid should be connected to a switched 12V power source.

Brown – Solenoid 1. If you are using a blocker or bleeder single solenoid for boost control, use this wire for connecting to your boost solenoid. If you are using dual solenoids in a low/high configuration, connect one of your solenoids to this wire. If you are not using the

boost controller, this wire can be used either as a window switch, a boost enabled switch, an injection enabled switch, a boost enabled switch or an error or no error switch.

Grey/Orange – Solenoid 2. If you are going to be using a low/high solenoid configuration, connect your second solenoid to this wire. If you are not using this wire for boost control, it can be used either as a window switch, a boost enabled switch and an injection enabled thread.

Purple – Wideband ground. If you are using a wideband O2 sensor, this wire needs to be grounded to the same point that your wideband controller is grounded to. For the readings to be consistent, it's imperative that this wire is connected this way.

Yellow/Green – Solenoid 3. If your methanol system uses a solenoid for flow control, connect this wire to your flow control solenoid.

Green – Secondary Pressure Input. If you need a secondary pressure input for boost control, such as when utilizing CO2 for boost control, connect your secondary sensor's signal line to this wire.

Violet/Orange – Wideband Input. This wire should be connected to the wideband signal wire.

<u>Connector J3</u>

This harness supplies power to the ISAC and drives your pump(s).

Pink/Dark Green – 12 volts. This wire should be connected to a switched 12V power source.

Brown/Light Green – Pump 1. This wire should be connected to the ground wire on your pump. If you are using dual pumps, this will be your primary pump.

There are two black wires in this harness. Both should be connected as follows.

Black – Ground. This wire should be connected to an engine ground. Actual grounding to the engine is the preferred method of grounding. Be aware that the ISAC REQUIRES good grounding. Failure to provide the ISAC with an adequate ground could result in unpredictable behavior by the controller.

Grey – Pump 2. If you intend to use dual pumps, this wire should be connected to the ground wire of your second pump.

This concludes the installation instructions. Please proceed to the configuration section of the manual.

Configuration

In this section we will cover the configuration of the ISAC controller. Please note that although at this point we have installed the unit, the unit can be powered by your PC's USB port and as such can be programmed outside of your vehicle.

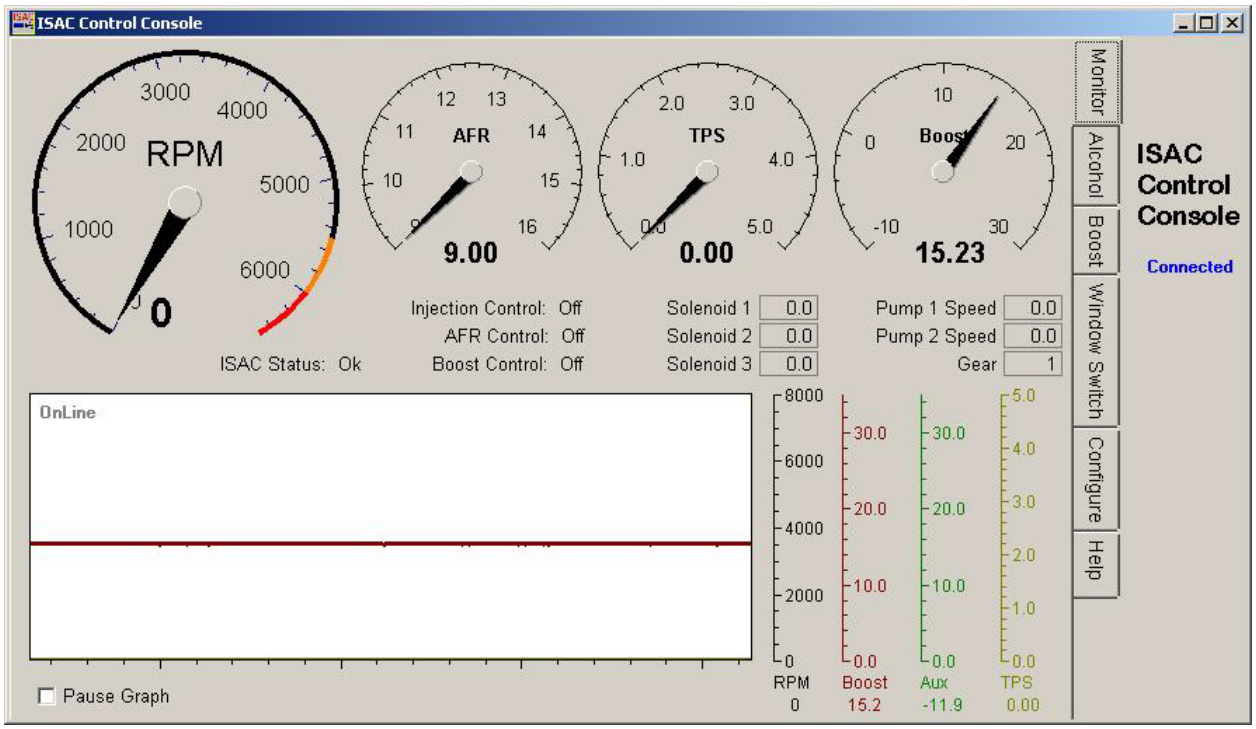
Connect one of of the USB cable to the USB plug on the ISAC. Plug the other end into a USB port on your computer. It is recommended you do not go through a USB hub.

After connecting the unit to your PC, you will see a “Windows found new hardware” message, followed by “ISAC Alcohol Injection System” and then “Installing Device Drivers”. The ISAC uses Windows native drivers so there are no drivers that need to be installed. The unit has been verified to work with Windows 98 SE (NOT Windows 98 first edition), Windows 2000, Windows XP, Windows Vista and Windows 7.

Once the driver installation has concluded, run the software found on the CD included with your unit. The filename is ICC.EXE. Again, there is no installation required. The software is a self contained executable. Please be sure to run the software from a write enabled source, however so that your configuration file can be saved. We recommend copying it to your hard drive or a USB flash drive.

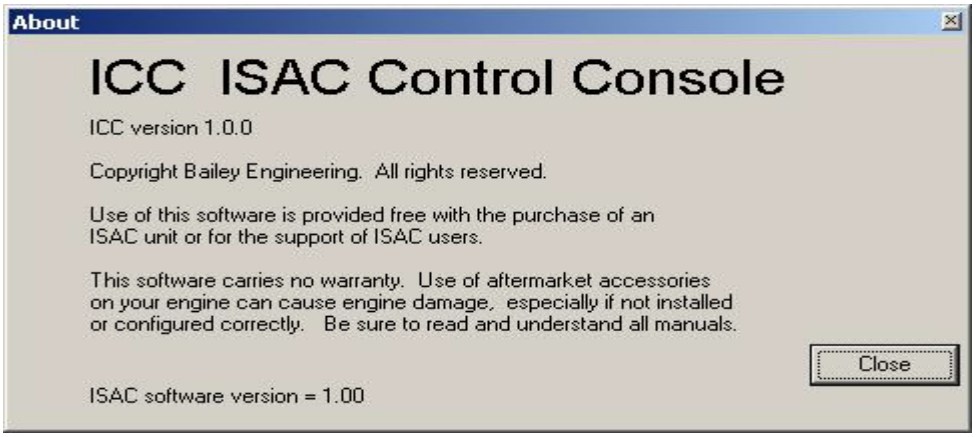
When the software loads, you will be presented with the logging screen. Press the space bar to establish communication between the software and the ISAC. You should see “CONNECTED” in the upper right hand corner as shown in the below image.

Note that when you connect to the ISAC, any changes you made in to software in offline mode will be lost. If you wish to edit your configuration offline, be sure to save your work from the Configure tab and reload it into the ISAC after connecting with the unit.



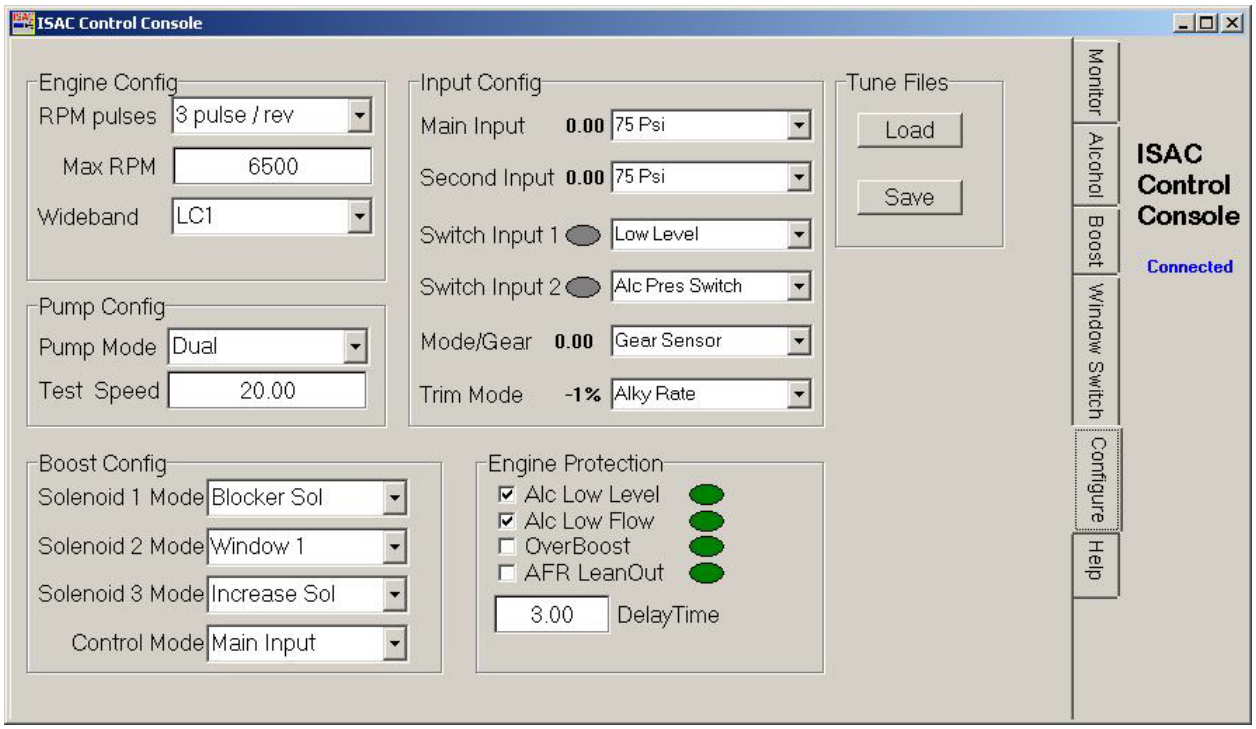
As you can see in the above screen shot, the unit is communicating with the PC software. At this point, we strongly recommend checking your software version to make sure you are running the latest ISAC software. From time to time, new ISAC software and firmware updates will be released. Updates can be found on our website.

To check your version, select the Help tab and click on the About ICC button. You will be presented with a screen like below.



This displays the firmware version (ICC version x.x.x) as well as the ISAC PC software version (ISAC software version = x.x.x). If your unit requires a firmware update, please see the “Updating Your Units Firmware” section found in the back of the manual.

Move your mouse to the Configure tab and click on it. You will be presented with the screen below.



This is the main configuration screen for the ISAC. In this section, the configurations options will be explained.

Engine Config:

- RPM Pulses. This is the number of pulses per revolutions that is being returned back to the ECM.
- Max RPM. This value is the maximum RPMs that your engine is revved to. What you put in this value will rescale the tachometer display on the logging screen. The boost and injection RPM parameters are independent of this value as they can be independently configured.
- Wideband. If you are using a wideband, select the model wideband you are using from the list. If your wideband is not on the list, please contact tech support as widebands can be added via firmware updates. We have attempted to add the popular widebands to the software but will be adding additional wideband options in the future.

Pump Config:

- Pump Mode. Dual or Staged are the options available here. If you are running a single pump, select dual as your pump mode. The two modes of operation work as follows. Dual mode runs

both pumps simultaneously at the same duty cycle. Staged mode runs one pump up to 100% duty cycle and then brings in the secondary pump. This is a gradual transition as the second pump is brought on gradually as the primary pump reaches 100%. Staged mode is useful for dual nozzle systems if you wish to stagger the delivery between the two nozzles.

- Test Speed. This is the percentage duty cycle that the pump will run at when you press the Test button on the front of the unit.

Boost Config:

- Solenoid 1 Mode. If you are running a single solenoid for boost control, you will want to select Bleeder or Blocker from the drop down menu. As the options names imply, bleeder will bleed pressure to increase boost while blocker will retain pressure to increase boost. How your wastegate system is plumbed will depend on which option you select. If you are using a dual solenoid boost control setup, you will need to select either Increase Sol or Decrease Sol, depending on how your solenoids were installed and wired. If you are not using the ISAC for boost control, this channel can be configured for other options. It can be utilized as either Window 1 or Window 2 window switch, an injection or boost enabled output or an error/no error output.

- Solenoid 2 Mode. For a dual solenoid boost control setup, select Increase Sol or Decrease Sol based on how Solenoid 1 Mode is configured. If you are not using a dual solenoid configuration, this output may be utilized with the same options as Solenoid 1 Mode.

- Solenoid 3 Mode. The purpose of this channel is for driving a flow control solenoid. This is useful is you are using a methanol injection kit that uses a solenoid to keep alcohol from being sucked out of the lines by engine vacuum. To utilize this mode for that purpose, select Injection Enabled. Otherwise, like the other Solenoid modes, this output may be used for window switches or condition specific outputs.

- Control Input. This option specifies which pressure sensor input you want to use for boost control. If you are using CO2 for boost control, a separate sensor to read CO2 pressure is required. This should be installed on your secondary input.

Non Boost Control Outputs Explained:

Window 1 and Window 2 are window switch outputs which can be configured through the Window Switch tab in the software. That will be covered later in the manual.

Injection Enabled will activate the output when all the conditions to activate the injection are met.

Boost Enabled will activate when the system sees boost pressure on the main pressure input.

Error will activate with the system sees an error from any of the failsafes such as alcohol low level, alcohol low flow, air/fuel leanout and overboost.

No Error will be engaged at all times unless one of the above mentioned failsafes trips.

Input Config:

- Main Input. This is where the MAP sensor being used is specified. Select your MAP sensor from the dropdown list . If your vehicle does not come equipped with a MAP sensor, you can install one using the 5V output from the ISAC. This is the pressure input that will be used for alcohol delivery and by default, boost control. If a secondary pressure sensor is selected in the boost control configuration, it will need to be selected in the next option.

- Secondary Input. If you require a secondary pressure sensor such as when utilizing CO2 for boost control, this is where the secondary sensor should be selected.

- Switch 1. This option allows you to select either low level, alcohol arming or stage/brake. You will need to select the option you wired the Switch 1 wire to perform.
- Switch 2. This option allows you to select either alcohol pressure switch or boost/gear reset. You will need to select the option you wired Switch 2 to perform.
- Mode/Gear. This option allows you to select gear sensor, gear shift, gear switch, stage mode or alcohol flow. You will need to select the option you wired Mode/Gear to perform.
- Trim mode. This option allows you to select the function of the trim knob on the front of the unit. It also shows you the current position of the knob, which is helpful in zeroing it out. The selections are Off, Boost, Boost Rate, Alky Rate and AFR.

Trim Modes Explained:

Off disables the knob entirely.

Boost allows you to adjust the specified boost level, either raising or lowering the boost level depending on which direction the knob is turned. The boost can be raised or lowered +/-25% based on the position of the knob.

Boost Rate adjusts the ramp speed that the boost is raised. Ramp speed can be raised or lowered +/-25% based on the position of the knob.

Alky Rate skews your alcohol delivery +/-25% based on which direction the knob is positioned. This is a global adjustment based off of your values in the alcohol configuration page.

AFR Rate skews the target air/fuel ratios +/-25% based on the direct the knob is positioned. This is based off of the values you specified in the air/fuel configuration page.

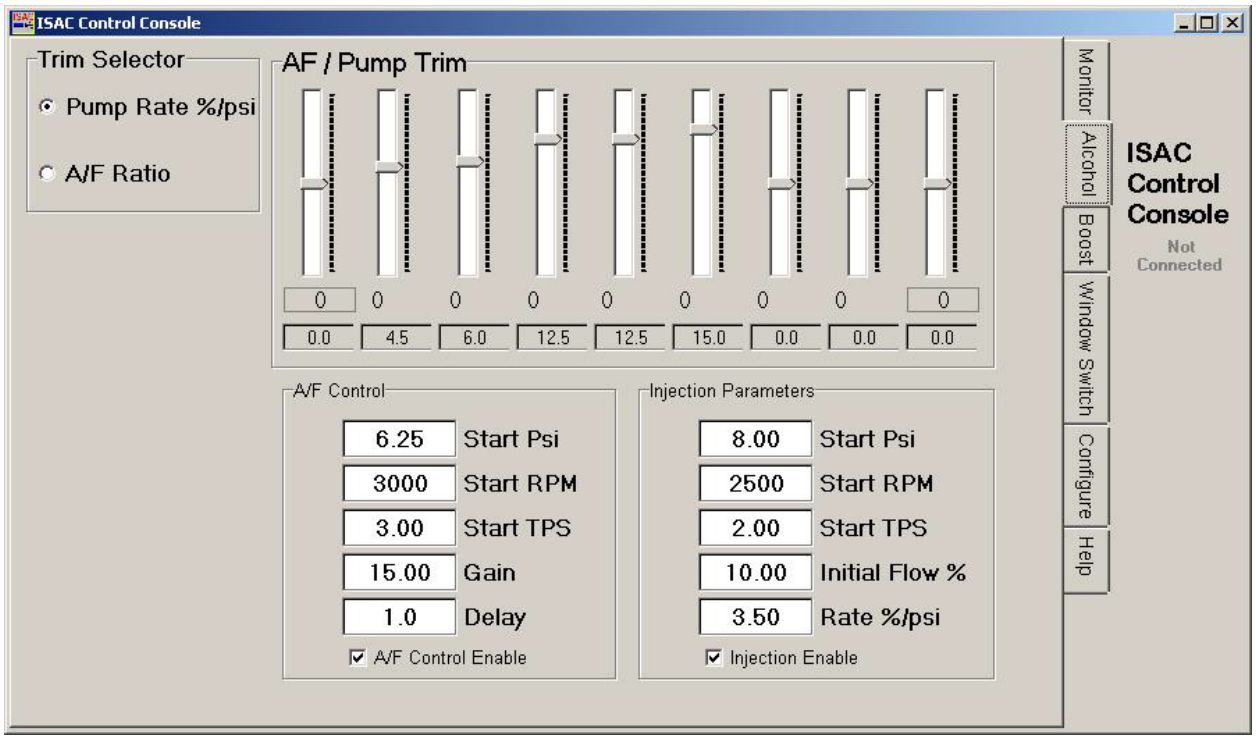
Engine Protection:

This set of parameters allows you to which failsafes the system uses. When any of the below conditions are met, the ISAC will lower boost levels as far as mechanically allowed.

- Alc Low Level. This triggers when your low level sensor engages.
- Alc Low Flow. This options is triggered
- Overboost. This option is triggered when your boost level exceeds 1 PSI of your target boost.
- AFR leanout. This option is triggered when your air/fuel ratio goes above your target air/fuel ratio by half of an AR point. For example, if your target AFR was 11.0 when the unit reaches 11.5, it will lower boost.
- Delay Time. This is the time, in seconds that the unit waits before activating engine protection.

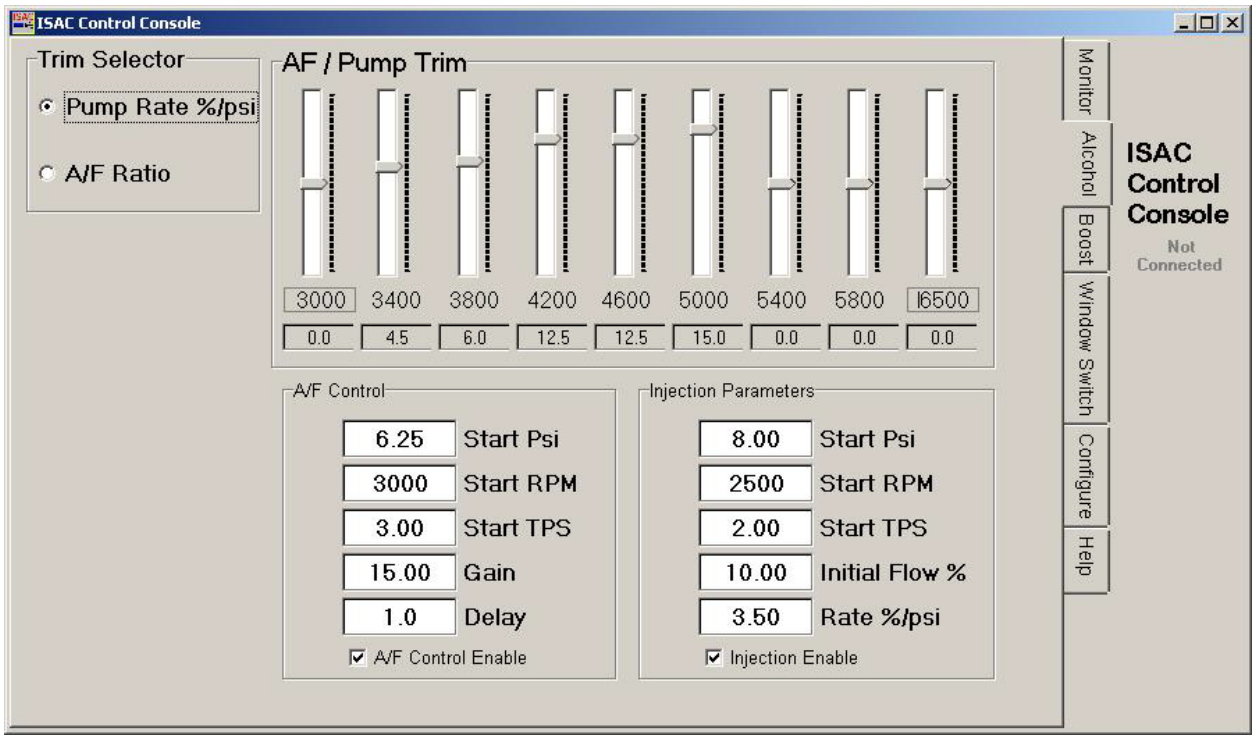
Tune Files. Load and Save dialog for loading and saving your tunes. As was mentioned earlier, if you make any offline changes, they will need to be saved while offline and reloaded into the unit when you have the ISAC connected to a PC and Connected mode.

<u>Air Fuel/Pump Trim Configuration</u>



In this section, tuning the injection parameters and the air/fuel control will be explained.

The first thing that needs to be done when initially setting up the system is configure your RPM thresholds. This is done by clicking on the leftmost and right most boxes underneath the sliders. Notice in the example above that the the boxes have squares around them. Click the leftmost box and enter the lowest RPM you would like to have tune-ability over. It is recommended to go 400-500RPM higher than your start RPM. Click the rightmost box and enter the highest RPM you would like to have tune-ability over.



As you can see in the screenshot above, we used 3000 for the lowest value and 6500 for the highest value. The ISAC software will automatically configure the RPM spacing on the sliders in between your low and high point.

Please note that these values will also be used for air/fuel control as well as boost control if you elect to use RPM control.

Each slider allows you to adjust methanol delivery +/-25% at that given RPM range.

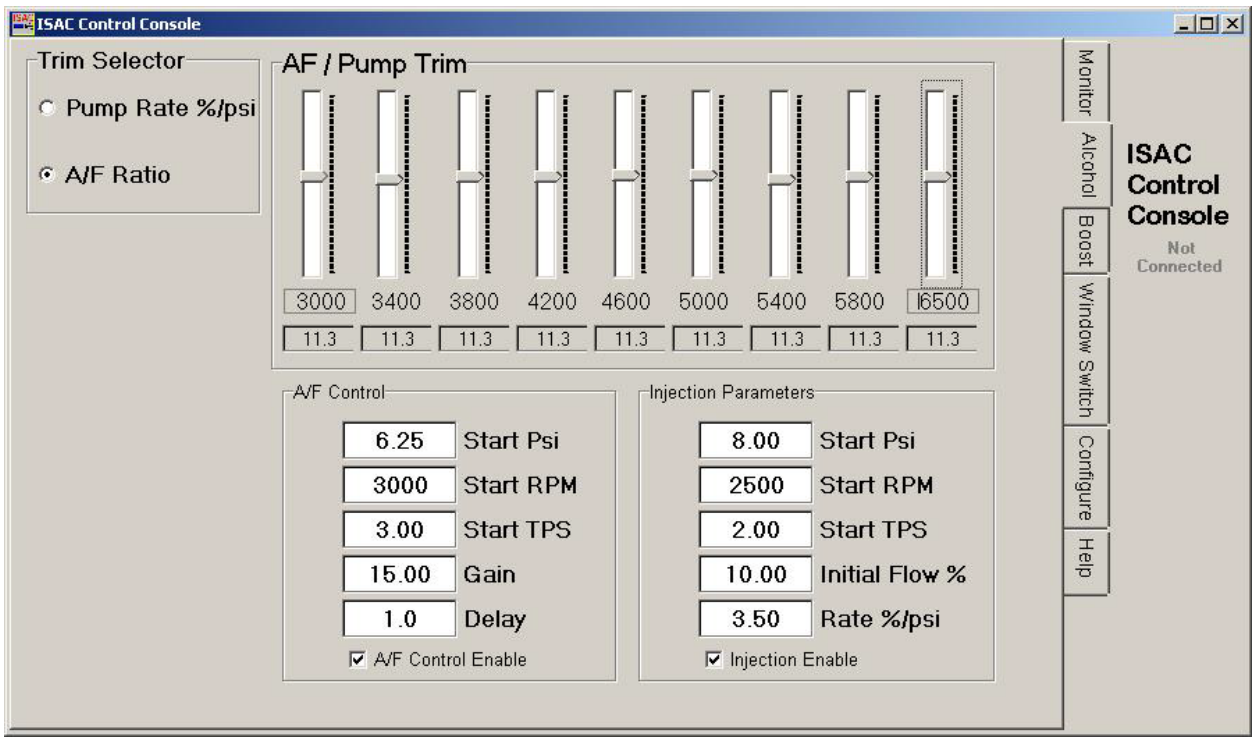
Below are the injection parameters explained.

- Start PSI. This is the boost pressure that must be met for the system to activate.
- Start RPM. This is the RPM that must be reached for the system to activate.
- Start TPS. This is the TPS value that must be reached for the system to activate. This value is in volts. Please note that all 3 conditions must be met for the injection to activate.
- Initial Flow %. This is the initial duty cycle (pump speed) that the pump will engage at.

- Rate %/PSI. This is the rate per psi that the pump speed will be increased.

- Injection Enabled. This box must be checked for the injection to be active.

It is recommended that when you are configuring these values, you calculate your pump speed to be between 90-100% at your highest boost level. For example, if you were running 20 PSI and bringing the system on at 8 PSI and using an initial flow rate of 10%, you would want your rate per PSI to be around 7.5%. This will give you around 100% pump speed on the pump at your highest boost level. If this ends up being too much methanol, changing the jet sizing or backing off the rate per PSI is recommended.



Above is the air/fuel ratio correction screen. As with the injection control, the sliders allow you to specify a target air/fuel ratio you would like the ISAC to try to maintain. Moving the sliders up lowers (richens) the commanded air/fuel (a/f) ratio while moving the slider down raises the commanded a/f ratio. Please keep in mind that when configuring your sliders, the ISAC will only correct +/-15%.

Here is an explanation of how the A/F Control values operate.

- Start PSI. This is the boost level that must be reached for the system to begin a/f correction.
- Start RPM. This is the RPM that much be reached for the system to begin a/f correction.
- Start TPS. This is the TPS value that must be reached for the system to begin a/f correction. As with the injection parameters, all 3 conditions must be met for air/fuel correction to activate.
- Gain. This is the speed at which the ISAC attempts to correct based off of wideband feedback. Higher numbers will give faster correction speeds. We recommend starting around 15 and going no higher than 30.
- Delay – This is a delay, in seconds that the system will wait to engage after all the above triggering conditions are met. This is useful if your activation threshold is close to your staging threshold. It allows you to delay air/fuel correction while launching the car.

While it might seem that you would want the fastest possible gain, this is not the case. If your gain is set too fast, the ISAC will be continuously correcting as widebands tend to return a jittery signal while reading the air/fuel ratio.

Boost Control

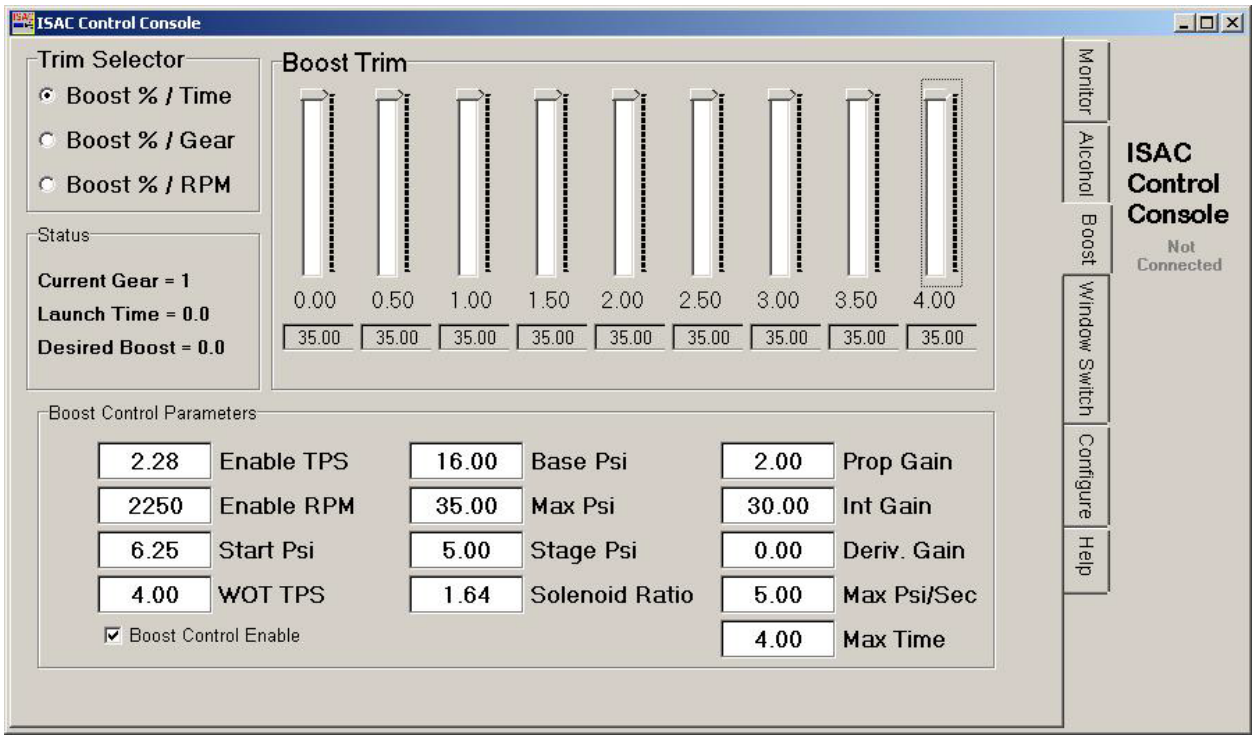
The ISAC has a built in closed loop boost controller. The controller can be utilized in a bleeder configuration, a blocker configuration with our high boost solenoid or a high/low configuration using two solenoids for raising and lowering the boost. Your method of boost control is selected on the device configuration screen. Once you have selected which method of boost control you wish to use, you will need to decide how you would like to adjust the boost. Boost can be adjusted based on time, gear selection or RPM. Choosing your method works as follows:

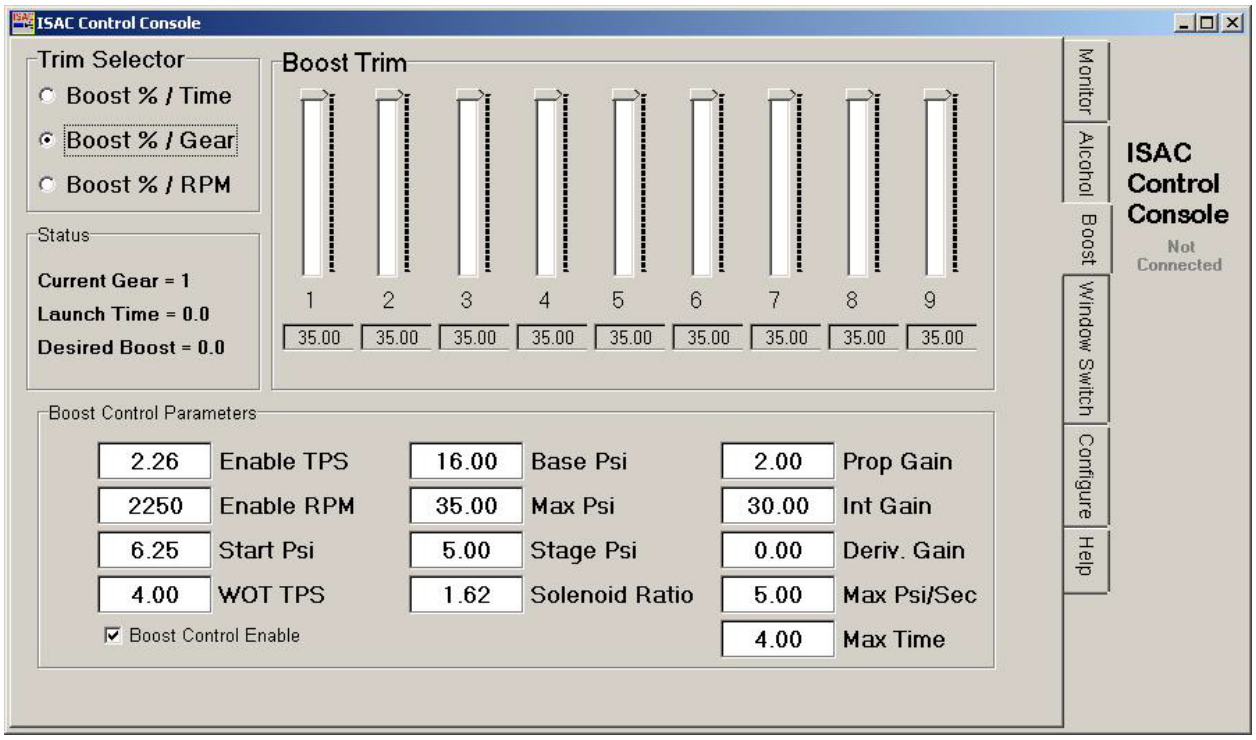
For my example, I am going to be using boost versus RPM. To configure the unit this way, you need to do the following steps.

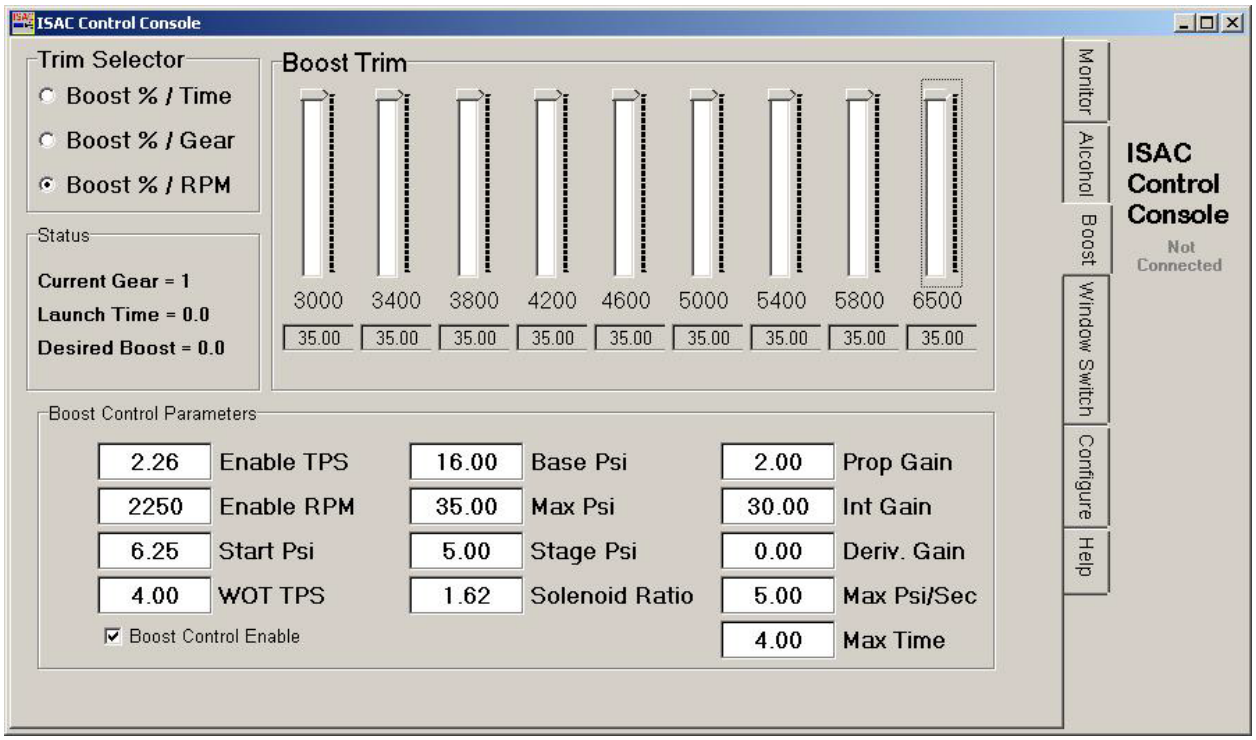
Set your max boost level (Max PSI) to a few PSI over what your actual max boost level is going to be. For my example, I am working with a max boost level of 30 so I will enter 35 in my Max PSI field. After setting your Max PSI field, switch to each boost control field and move ALL the sliders to the top.

If you elected to use the stage boost feature of the ISAC, go ahead and set your staging boost in the Stage PSI field. For this example, we are using a 5 PSI staging boost level.

See the illustrations below.

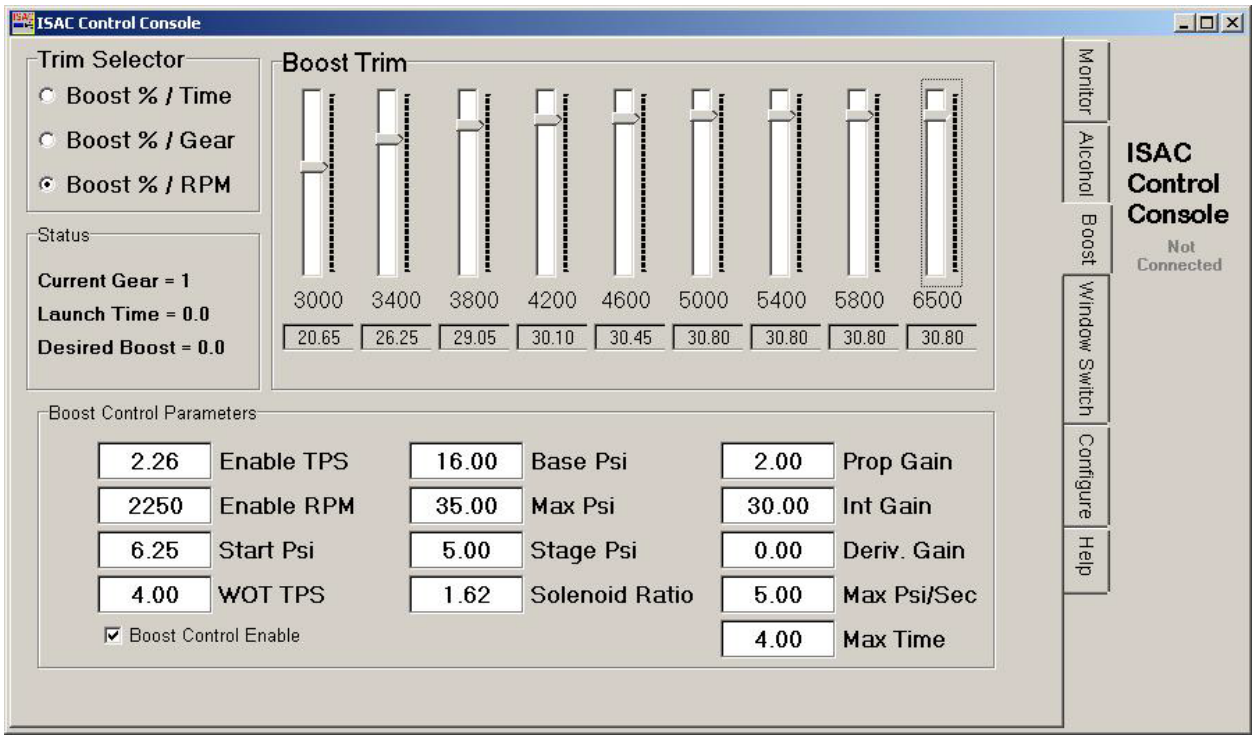






At this point, after setting all the sliders to maximum, you should take the time to save your tune file so you have a boost template to come back to later. The Load/Save dialog can be found under the Configure tab.

After saving, go back to the Boost tab and select Boost %/RPM and select your target boost values as in the example below.



Please note that the ISAC controls boost based off of the lowest slider value. As we have maxed out the Boost %/Time and the Boost %/Gear sliders and set Boost %/RPM to our desired boost levels, the unit will use these sliders since they are the lowest.

After setting these values up, go back and fill in the other values. Below is a list of each value and what it's purpose is.

- Enable TPS. This is the TPS voltage that must be reached for the boost control function to engage.
- Enable RPM. This is the RPM that must be reached for the boost control function to engage.
- Start PSI. This is the boost level that must be reached before the boost control function will engage.
- WOT TPS. Set this to your maximum TPS voltage the ISAC will see when the car is at wide open throttle (WOT.
- Base PSI. This is the base spring pressure of your wastegate. Most external gates come with multiple springs that can be swapped out to set your base pressure. If you are using an actuator setup, please contact your place of purchase for your actuators base PSI.

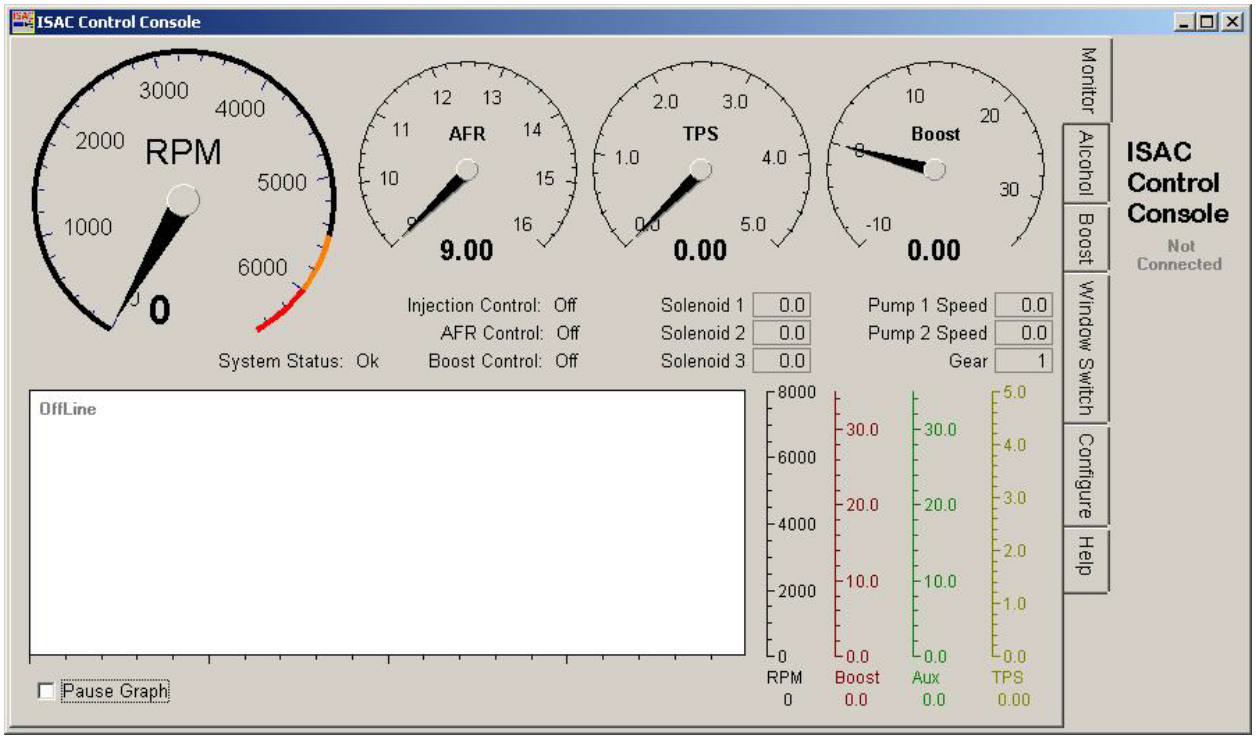
- Max PSI. As previously discussed, this is your maximum PSI level you expect to run. We suggest adding a few PSI to make configuring the sliders easier.
- Stage PSI. This is the boost level the boost controller will attempt to maintain when the staging feature is activated.
- Solenoid Ratio. This is an estimate of what the pulse width modulation (PWM) should be for a desired boost level. It is calculated from base boost, target boost and solenoid ratio. For starting points when setting the boost control function up, we recommend using values between 1.5 and 2.5 for this field when using standard wastegate control and 0 if using CO2 control.
- Prop Gain. The PWM is adjusted by a factor of Gain*PSI difference. This correction does not creep, it stays the same. We recommend using a value of 5 as a starting point both when using standard wastegate control as well as CO2.
- Int Gain. The PWM is adjusted by a factor of Gain*PSI difference. This correction keeps getting added periodically, so the PWM will go to its limits if the psi difference does not resolve. We recommend using values of 15 as a starting point when using standard wastegate control as well as CO2.
- Deriv Gain. The PWM is adjusted by a factor of Gain*PSI rate. If the boost is changing fast, then derivative gain can help slow it. This can be helpful for overshoots, but can be very touchy. We recommend using 0 as a starting point for this field and increasing in small increments if boost overshoots are present.
- Max PSI/Sec. This is the desired boost level change rate. We recommend using a value of 5 as a starting point for this field.
- Max Time. When using the boost/versus time method of boost control, this is the time, in seconds, that it takes the ISAC to move from the first slider to the last. The ISAC will rescale all the sliders equally starting at 0 and going to the value entered

here. Note that once the last slider is released, that boost level will be maintained until the function is reset.

- Boost Control Enable. This checkbox enabled or disables the boost control function.

Data Logging

The data logging feature of the ISAC can be found under the Monitor tab. Below is a screenshot of the logging feature.



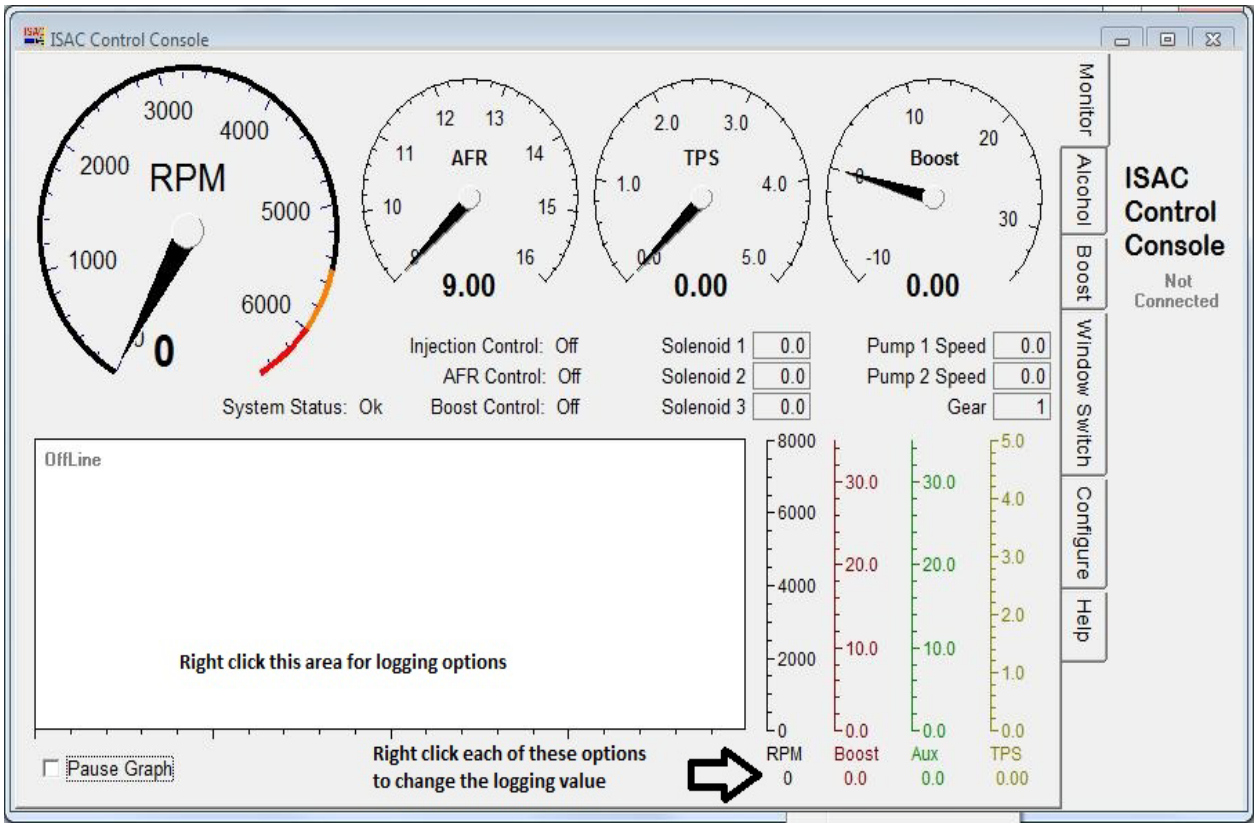
As you can see, the dashboard features dedicated tach, air/fuel, TPS and boost gauges. These are not user configurable. Below the gauges are various fields of feedback for the ISAC's operation. Here is a list of these fields and their functions.

- System Status. If the system encounters a fault or engine protection engages, this value will reflect that.

- Injection Control. When the injection function is activated, this value will display On.

- AFR Control. When the air/fuel control function is activated, this value will display On.
- Boost Control. When the boost controller function is activated, this value will display On.
- Solenoid 1. This displays the duty cycle that Solenoid 1 is operating at.
- Solenoid 2. This displays the duty cycle that Solenoid 2 is operating at.
- Solenoid 3. This displays the duty cycle that Solenoid 3 is operating at.
- Pump 1 Speed. This displays the duty cycle that Pump 1 is operating at.
- Pump 2 Speed. This displays the duty cycle that Pump 2 is operating at.
- Gear. This displays current gear position (If utilitzed).

Below the gauges and fields is where the graph data from the 4 user configurable fields are displayed. In the screenshot above, they are selected as RPM, Boost, Aux and TPS. Moving your mouse to one of the fields and right clicking it opens a menu where you can choose another value to be displayed. See the photo below.



To the left of the user configurable values is the logging screen. This displays the values of the 4 user configurable channels in a line graph format. The unit will log approximately 40 seconds on the logging screen. When you wish to save your log file, simply check the “Pause Graph” option, which will cause data logging to stop. From there, right click in the area shown above and you will be prompted to load or save your log files as well as reset the graph. Keep in mind that you must be disconnected from the unit to view a log file. Simply press the space bar to disconnect from the ISAC, right click in the logging area, load your log file and at that point you can scroll through the logs. The gauges on top will also be recorded in your log file as will all of the informational fields.

Troubleshooting:

This section will be expanded as support issues are brought to our attention.

Disclaimer:

CAGE Racing shall not be liable for any consequential or incidental damage, personal injury, or replacement of equipment and or property resulting from the misuse or improper installation of CAGE Racing products.