IMPACT
WIRING SOLUTIONS

Tuner’s Handbook and Documentation

Index

Section 1: Introduction to Impact ECU and Tunerstudio

Congratulations on choosing Impact ECU, a powerful & versatile Plug'n'Play Engine Control Module designed for high-performance tuning and customization.

With the Tunerstudio software, Impact ECU provides you with advanced control, real-time monitoring, and precision tuning for a range of applications; from daily riding to competitive motorsports.

This section provides a foundation for understanding the functionality and scope of the Impact ECU & TunerStudio system. Continue through this manual to explore detailed instructions on software features, diagnostics, and maintenance guidelines.

Overview

Impact ECU integrates seamlessly with Tunerstudio's software, offering a comprehensive suite for engine management and data analysis. TunerStudio’s intuitive interface & robust features allow both novices and professionals to monitor, tune, and optimize their engine parameters in real time.

Key Features and Benefits:

- **Real-Time Engine Monitoring**
  Tunerstudio provides live data on critical engine parameters, including RPM, fuel pressure, air-fuel ratio, boost levels, and more, helping you monitor performance at a glance.

- **Customized Tuning Options**
  Tailor engine settings to specific performance goals. Adjust fuel maps, ignition timing, and boost levels to meet the demands of each riding condition.

- **Advanced Data Logging and Analysis**
  Record and review key performance data to gain insights into engine behavior. Analyze data logs to refine tuning parameters and improve overall efficiency.

- **User-Friendly and Configurable Interface**
  TunerStudio’s interface allows for a customizable dashboard where you can arrange critical readouts to suit your preferences, ensuring ease of access to essential data.

System Requirements and Installation

To use Tunerstudio with Impact ECU, ensure :your setup meets the following ***minimum Requirements:***

- Operating System: Windows 10 or higher.
- Hardware: Minimum 4GB RAM, 2GHz processor, and 500MB available storage.
- Connection: USB port for direct communication with Impact ECU.

How To Link Your PC With The Impact ECU

Tunerstudio by EFI Analytics is a third party commercial tuning application application needed while working with Impact ECU. TunerStudio is available on Windows, Mac and Linux.

Download Tunerstudio

Tunerstudio can be downloaded and installed by navigating in your computer's web browser to the following links:

Windows:
http://go.impactwiringsolutions.com/windows

MacOS:
https://go.impactwiringsolutions.com/macos

Connecting Your ECM With Tunerstudio

Step 1: Open Tunerstudio Software

Open the TunerStudio software and click ***"Create New Project"*** as shown in the image below.

TunerStudio 3.0

Create New Project - A project is required to connect your ECU

Open Last Project
(MSII_BG_2.905_Example)

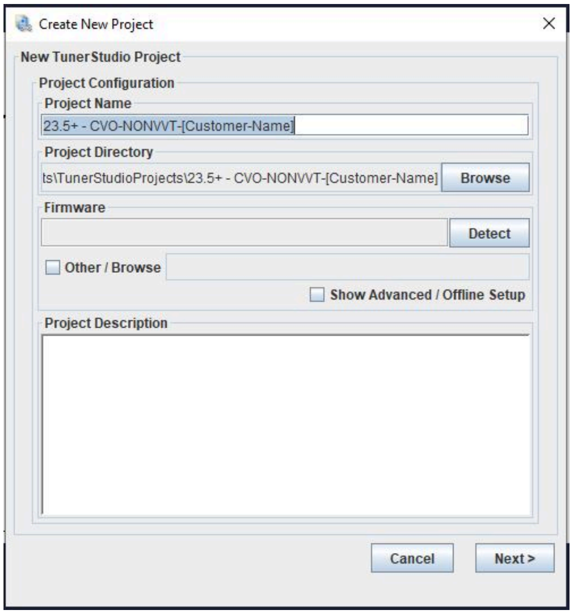
Open other recently used Projects:
Open Project

copyright 2020 EFIAnalytics.com

Step 2: Project Settings

After clicking ***"Create New Project",*** you will see a screen where you can name the project. We recommend creating a separate project for each unique vehicle. This is also an ideal time to ***connect the USB cable to both the ECM and your PC.***

Ensuring that your ECM is connected to your PC via USB, click "Detect" and wait a few moments for the software to detect the ECM. When Tunerstudio has successfully detected your ECM, just click ***"Accept"*** as shown in the images below.



Project Name: 23.5+ - CVO-NONVVT-[Customer-Name]

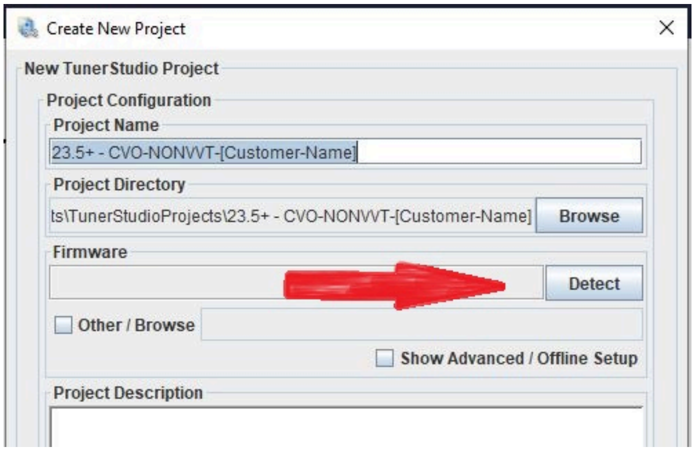
Project Directory: ts\TunerStudioProjects\23.5+ - CVO-NONVVT-[Customer-Name]

Firmware:

☐ Other / Browse

☐ Show Advanced / Offline Setup

Project Description:



Project Name: 23.5+ - CVO-NONVVT-[Customer-Name]

Project Directory: ts\TunerStudioProjects\23.5+ - CVO-NONVVT-[Customer-Name]

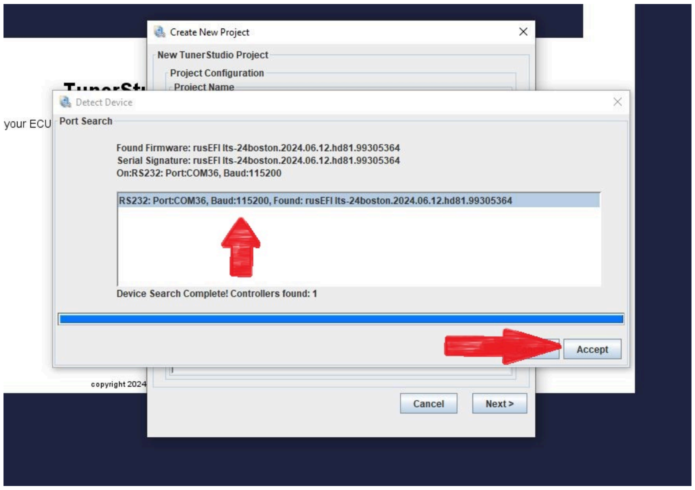
Firmware:

☐ Other / Browse

☐ Show Advanced / Offline Setup

Project Description:

After this, hit **“Next >”**, select your preferences, and then click **“Finish”** to complete the project setup.



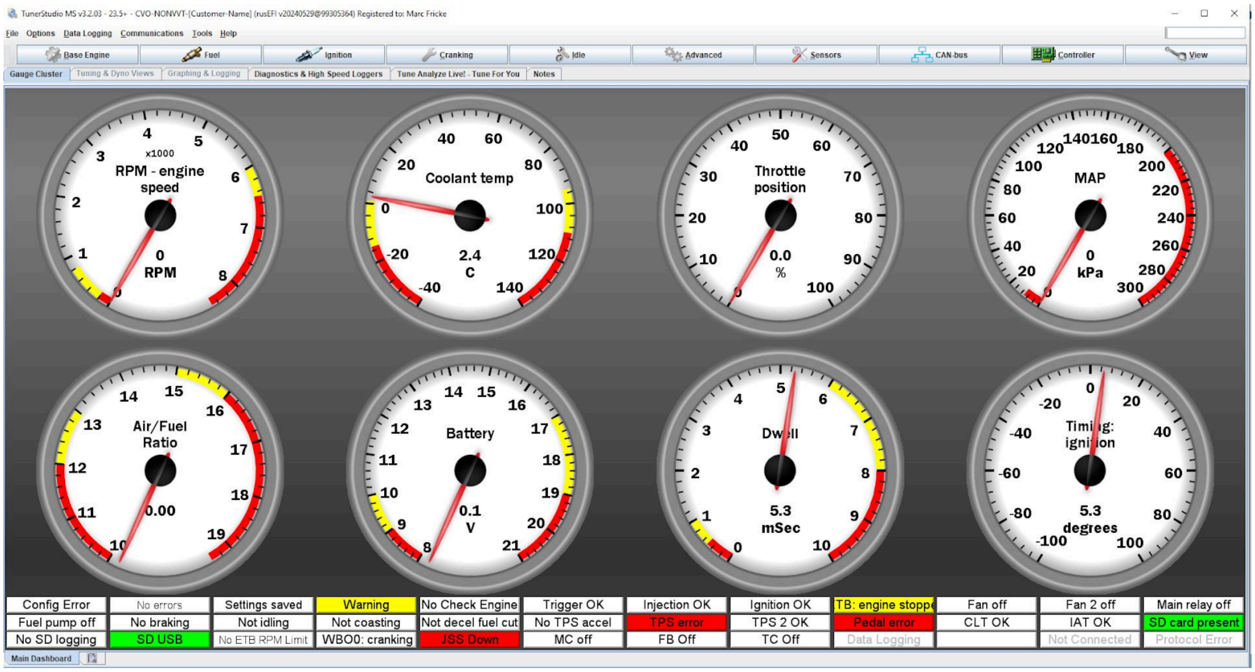
Found Firmware: rusEFI lts-24boston.2024.06.12.hd81.99305364
Serial Signature: rusEFI lts-24boston.2024.06.12.hd81.99305364
On:RS232: Port:COM36, Baud:115200

RS232: Port:COM36, Baud:115200, Found: rusEFI lts-24boston.2024.06.12.hd81.99305364

Device Search Complete! Controllers found: 1

Step 3 - Tunerstudio Interface

If you see the screen below, you have successfully created a Project and connected to the ECM.



Important Safety and Compliance Information

Important: Please remove your motorcycle’s Main Fuse prior to installation of your Impact ECU

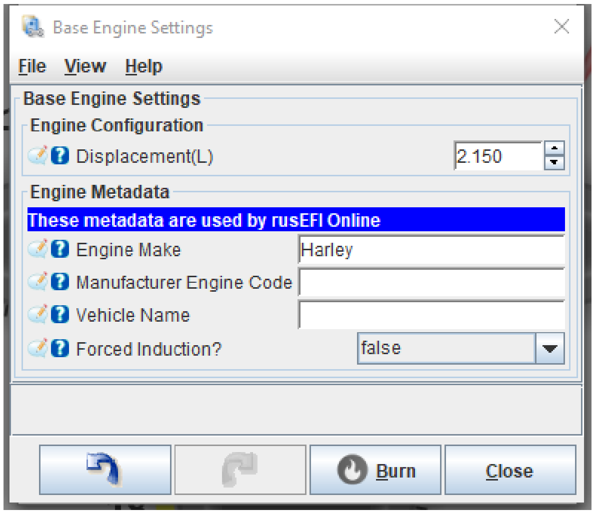
Compliance and Updates: Periodically check for firmware updates from Impact Wiring Solutions to ensure optimal performance and compliance with the latest standards.

Quick Start Guide

This is intended to help you get up and running quickly, please continue reading the manual if you would like to have more indepth knowledge of Tunerstudio and the tuning process.

Step 1: Set Engine Displacement

Under the ***Base Engine tab***, Click the ***"Base Engine"*** Menu tab, set your engine displacement (in liters), as shown below.



Base Engine Settings

Engine Configuration

Displacement(L): 2.150

Engine Metadata

These metadata are used by rusEFI Online

Engine Make: Harley

Manufacturer Engine Code:

Vehicle Name:

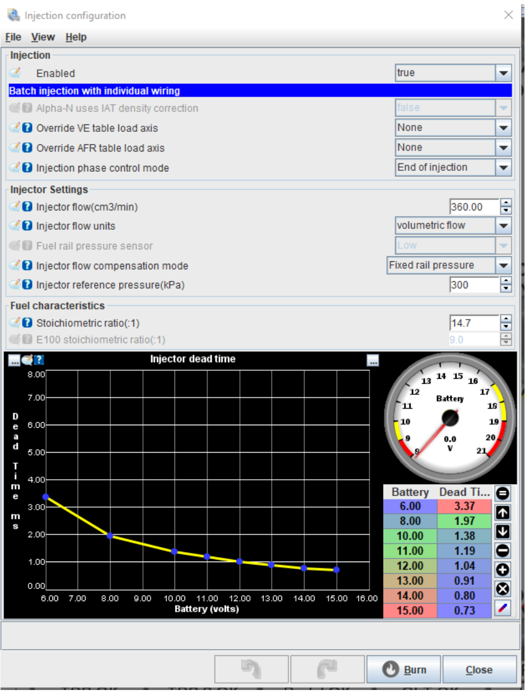
Forced Induction?: false

Step 2: Configure Your Injectors

Under ***"Fuel → Injection Configuration"***, the default pre-populated settings are setup for a stock 2023.5+ CVO, 2024 CVO ST, or 2024 Road Glide. ***<u>If you do not have larger injectors installed</u>*** on your vehicle, then these values can be left to the default settings.

If you have aftermarket injectors, you must make the following changes:

1. Set your ***"Injector Flow"*** to the rated flow of your aftermarket injectors in cc/min. (You can use the following the following calculator to



Injection

Enabled: true

Batch injection with individual wiring

Alpha-N uses IAT density correction: false

Override VE table load axis: None

Override AFR table load axis: None

Injection phase control mode: End of injection

Injector Settings

Injector flow(cm3/min): 360.00

Injector flow units: volumetric flow

Fuel rail pressure sensor: Low

Injector flow compensation mode: Fixed rail pressure

Injector reference pressure(kPa): 300

Fuel characteristics

Stoichiometric ratio(:1): 14.7

E100 stoichiometric ratio(:1): 9.0

Battery	Dead Ti...
6.00	3.37
8.00	1.97
10.00	1.38
11.00	1.19
12.00	1.04
13.00	0.91
14.00	0.80
15.00	0.73

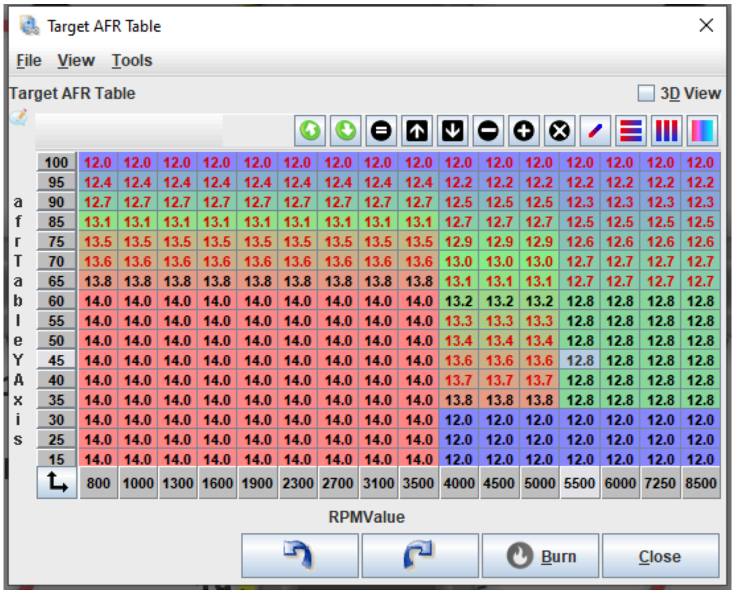
convert from grams/second to cc/min, https://tinyurl.com/iws-inj-calc)

2. Consult the documents that were provided with your injectors & set your ***"Injector Reference Pressure"***, to the pressure at which your injectors are flow rated at, (typically 300 kPA or 400 kPA). If this information is not provided on your injector's data sheet, set the value to 400 kPA
3. Consult the injector's data sheet and set your injector dead times in the ***"Injector Dead Time"*** table, if this data is not available then leave the default values or reach out to us.

Step 3: Set Your Target AFRs

Under ***"Fuel → Target AFR"*** you will be able to set the Air/Fuel Ratios that you would like our Closed Loop Fuel Correction feature to target.

Below is the default Target AFR table that comes preloaded on the ECU, your tuner may decide to change these values based on the fuel you are running or their preferences

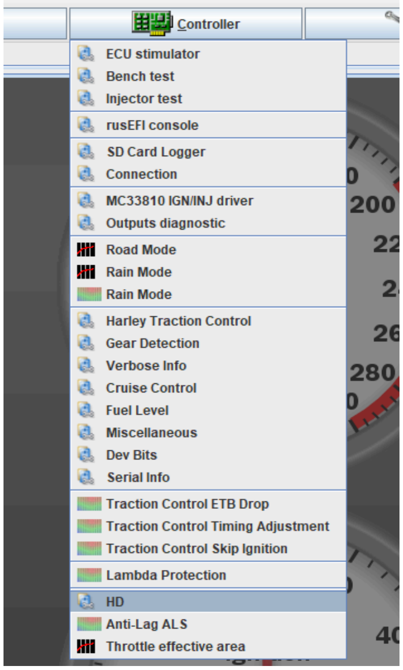


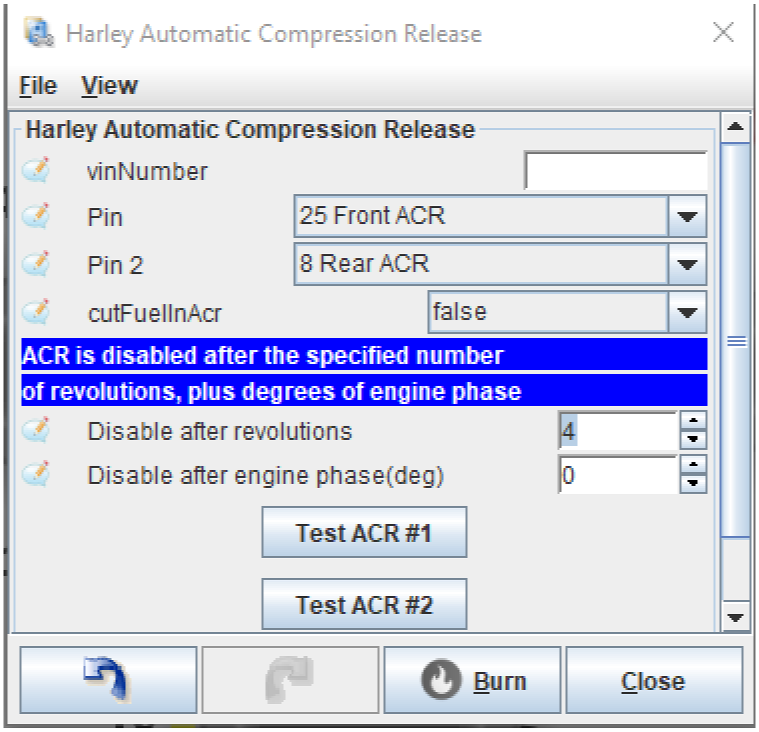
100	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
95	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.2	12.2	12.2	12.2	12.2	12.2	12.2
90	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.5	12.5	12.5	12.3	12.3	12.3	12.3
85	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	12.7	12.7	12.7	12.5	12.5	12.5	12.5
75	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	12.9	12.9	12.9	12.6	12.6	12.6	12.6
70	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.0	13.0	13.0	12.7	12.7	12.7	12.7
65	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.1	13.1	13.1	12.7	12.7	12.7	12.7
60	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	13.2	13.2	13.2	12.8	12.8	12.8	12.8
55	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	13.3	13.3	13.3	12.8	12.8	12.8	12.8
50	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	13.4	13.4	13.4	12.8	12.8	12.8	12.8
45	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	13.6	13.6	13.6	12.8	12.8	12.8	12.8
40	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	13.7	13.7	13.7	12.8	12.8	12.8	12.8
35	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	13.8	13.8	13.8	12.8	12.8	12.8	12.8
30	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
25	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
15	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
↳	800	1000	1300	1600	1900	2300	2700	3100	3500	4000	4500	5000	5500	6000	7250	8500

Step 4: Program VIN To ECM

Next you must input the bike's VIN number to the ECM.

To do this, navigate to ***"Controller Menu → VIN / ACR Settings"*** in newer firmwares, or ***"HD"*** as shown in the images below, in older firmwares. Then insert your VIN number in the text box labeled ***"vinNumber".*** The VIN is case sensitive, make sure it is all capital letters.





vinNumber

Pin 25 Front ACR

Pin 2 8 Rear ACR

cutFuelInAcr false

ACR is disabled after the specified number of revolutions, plus degrees of engine phase

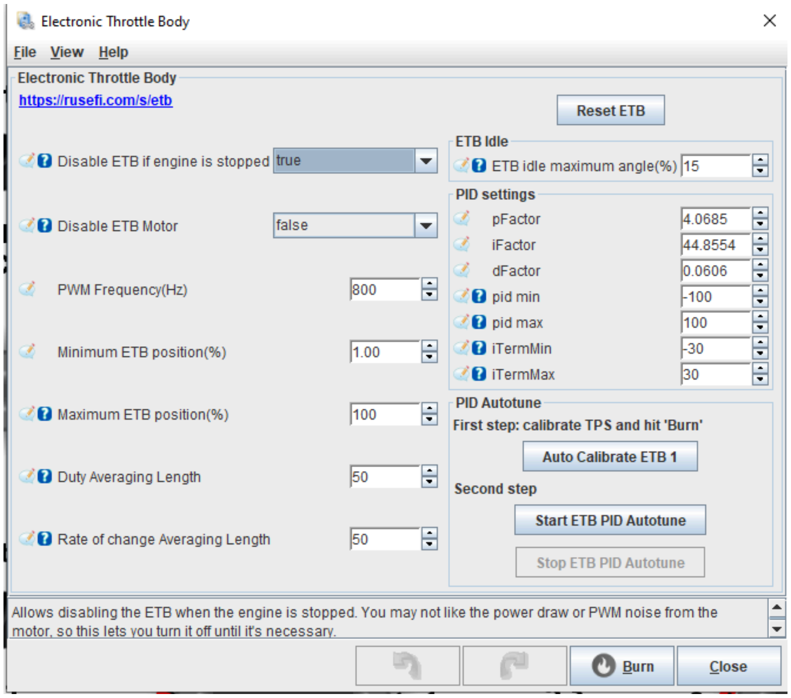
Disable after revolutions 4

Disable after engine phase(deg) 0

Step 5: Calibrate Your Electronic Throttle Body

NOTE: If you are running a throttle body that is the stock size or close to the stock size, then you can skip this step.

With your bike's ignition on, and the ***ENGINE IS OFF.*** Then navigate to ***"Advanced Menu → Electronic Throttle Body"*** inside of Tunerstudio & follow the these steps:



Electronic Throttle Body
https://rusefi.com/s/etb
Disable ETB if engine is stopped: true
Disable ETB Motor: false
PWM Frequency(Hz): 800
Minimum ETB position(%): 1.00
Maximum ETB position(%): 100
Duty Averaging Length: 50
Rate of change Averaging Length: 50

ETB Idle
ETB idle maximum angle(%): 15

PID settings
pFactor: 4.0685
iFactor: 44.8554
dFactor: 0.0606
pid min: -100
pid max: 100
iTermMin: -30
iTermMax: 30

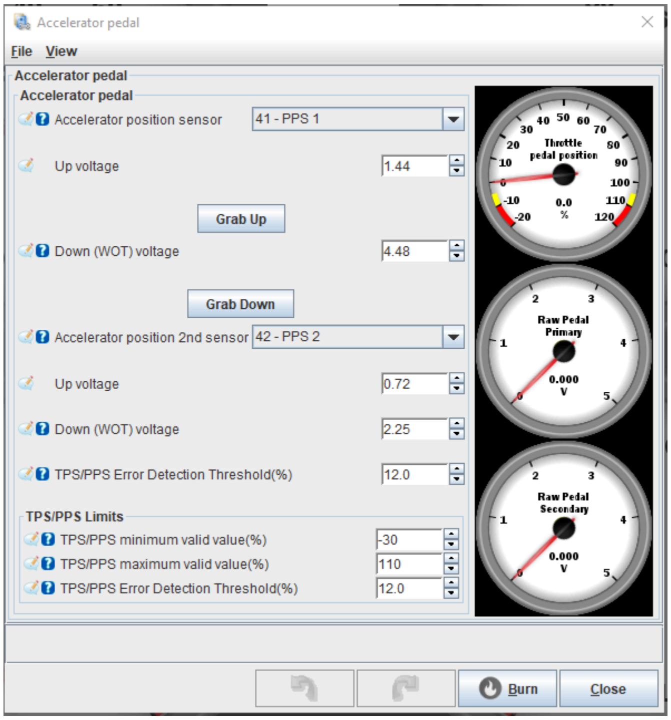
PID Autotune
First step: calibrate TPS and hit 'Burn'
Second step

Allows disabling the ETB when the engine is stopped. You may not like the power draw or PWM noise from the motor, so this lets you turn it off until it's necessary.

1. Set the dialog labeled ***"Disable ETB if engine is stopped"*** from ***"True"*** to ***"False".***
2. Under ***"PID AutoTune",*** click ***"Auto Calibrate ETB 1".*** Let the ECM go through it's calibration process it should only take 10 seconds.
3. Hit ***"Burn".***
4. Then click ***"Start ETB PID Autotune",*** you will see the pFactor, iFactor, & dFactor values begin to change, this is the ECM finding the most suitable values for your throttle body.
5. Once the values have stabilized, and are not moving as quick, you can click ***"Stop ETB PID Autotune".***
6. Set the dialog labeled ***"Disable ETB if engine is stopped"*** from ***"False"*** to ***"True".***
7. Hit ***"Burn".***

Step 6: Calibrate Your Twist Grip

With your bike's ignition on, and the ***ENGINE IS OFF.*** Then navigate to ***"Sensors Menu → Accelerator Pedal"*** inside of Tunerstudio.



Accelerator pedal
Accelerator position sensor: 41 - PPS 1
Up voltage: 1.44
Down (WOT) voltage: 4.48
Accelerator position 2nd sensor: 42 - PPS 2
Up voltage: 0.72
Down (WOT) voltage: 2.25
TPS/PPS Error Detection Threshold(%): 12.0

TPS/PPS Limits
TPS/PPS minimum valid value(%): -30
TPS/PPS maximum valid value(%): 110
TPS/PPS Error Detection Threshold(%): 12.0

After making sure your bike's ignition is on and the following prompt is on your computer screen, proceed with following steps to calibrate your Twist Grip Sensor.

1. With your hand completely off the twist grip, click on the ***"Grab Up"*** button, this will pull the voltage your

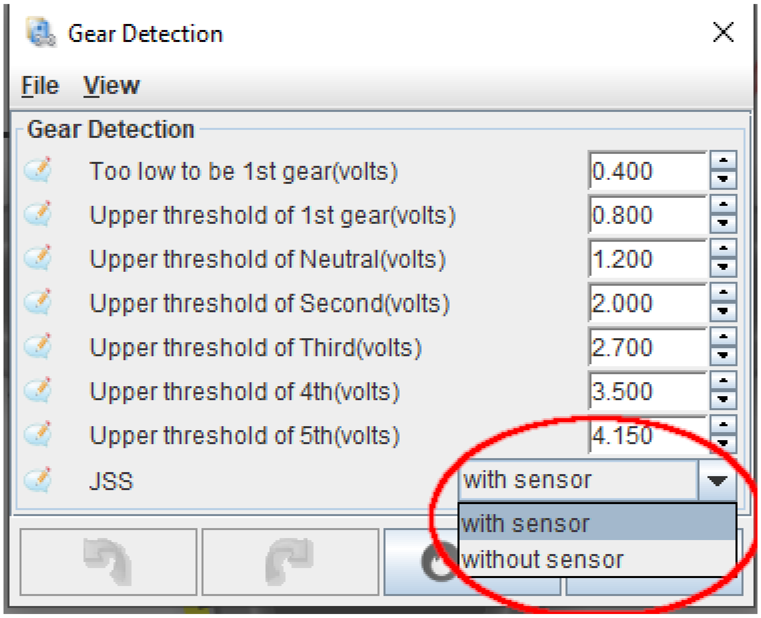
twist grip sensor rests at when no throttle is applied.

2. Twist & Hold your Twist Grip Sensor at Wide Open Throttle, while still holding the Twist Grip Wide Open, click the ***"Grab Down"*** button to grab the calibration for when the throttle is fully open
3. Click ***"BURN"*** to save your calibrations.

Step 7: Kickstand (JSS) Sensor

Some models such as the 2024 Road Glide do not come equipped with a Kickstand sensor from the factory, for this reason you must define whether or not your bike has a Kickstand position sensor installed.

You can do this by navigating to ***"Controller Menu → Gear Detection",*** once in that menu, at the very bottom of the prompt in the field labeled ***"JSS",*** you can define if your bike comes equipped ***"With Sensor"*** or ***"Without Sensor".***

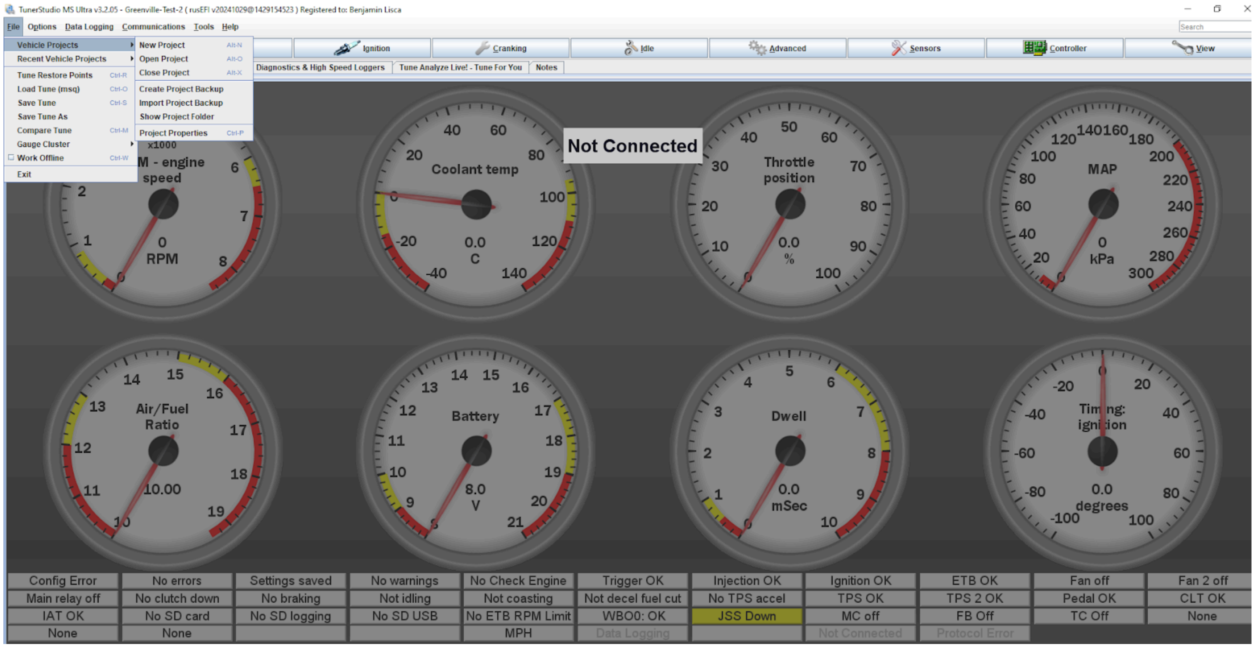


Gear Detection

Too low to be 1st gear(volts) 0.400
Upper threshold of 1st gear(volts) 0.800
Upper threshold of Neutral(volts) 1.200
Upper threshold of Second(volts) 2.000
Upper threshold of Third(volts) 2.700
Upper threshold of 4th(volts) 3.500
Upper threshold of 5th(volts) 4.150
JSS with sensor

Section 2: Software Setup and Usage

File Menu Options in TS



1. New Project:

- Use this option to create a new project, which will guide you through setting up a fresh configuration for a new ECU.

2. Open Project:

- Allows you to open an existing project saved on your computer, letting you switch to different project setups as needed.

3. Close Project:

- Closes the currently open project, returning you to the main screen or allowing you to select another project.

4. Load Tune (.msq):

This option allows you to load a saved tuning configuration (.msq file) from your computer directly to the ECU. It’s useful for applying previously saved settings or switching between different tunes.

5. Save Tune:

- This option saves the current tuning configuration by overwriting the saved tune on your computer. Use this to update the existing .msq file with any changes that have been made.

6. Save Tune As:

- This allows you to create a new .msq file for storing the current tune, enabling you to save different configurations separately. It’s helpful for keeping a library of various tunes.

Note: Tune Restore Points and Compare Tune are features available only in the paid versions of TS and are outside the scope of this manual.

7. Recent Vehicle Projects:

- Lists recently used projects, so you can quickly reopen any recent configurations without searching through files. This is handy for accessing frequently used setups.

8. Gauge Cluster:

- This option lets you customize the gauge layout on the dashboard. You can adjust the arrangement and type of gauges to display the information that matters most to you.

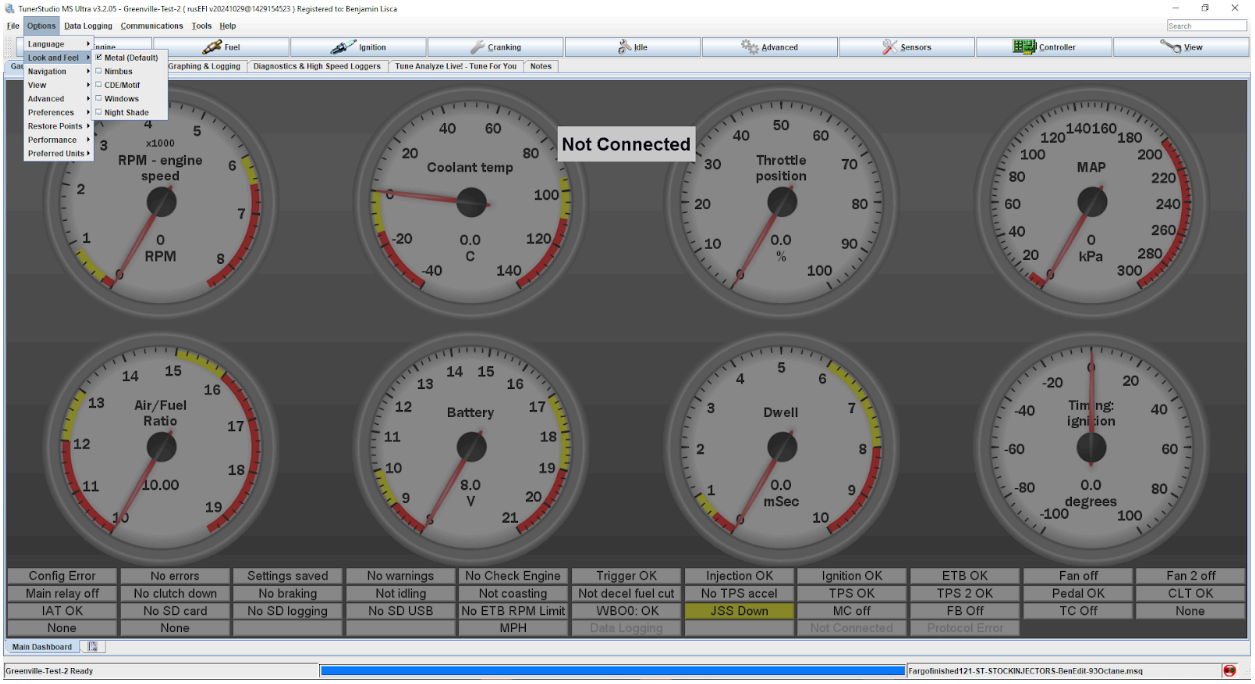
9. Work Offline:

- Allows you to switch to offline mode, which is useful if you want to access and modify settings without needing an active connection to the ECU.

10. Exit:

- Closes TS completely.

Options Menu in TS



1. Language:

- Allows you to change the display language for TS. Simply select your preferred language from the list.

2. Look and Feel:

- This option lets you customize the appearance of the TS interface, including button styles and layout.
- It also includes a Dark Mode option, which may be preferable for low-light environments or user preference.

3. Navigation:

- The Navigation setting enables you to modify the arrangement of buttons. You can consolidate them into a single row or convert them to a basic dropdown menu layout, allowing for a cleaner interface if desired.

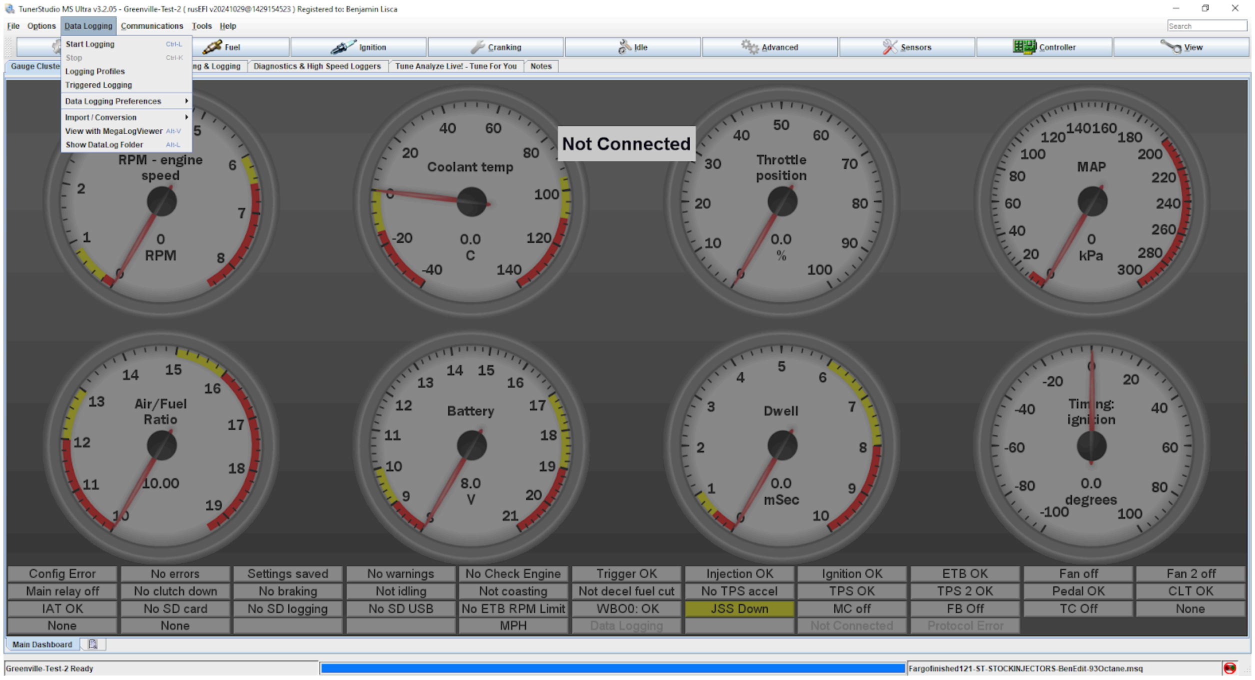
4. View, Advanced, Preferences, and Performance:

- These contain various settings, most of which are less relevant to basic users, and can typically be left at their default values.

5. Preferred Units:

- Here, you can adjust units for certain parameters. For example, you can change the Y-axis Manifold Absolute Pressure units from kPa to PSI if that's your preferred measurement.

Data Logging Menu in TS



1. Start Logging:

- Begins recording data from the ECU. Data logging allows you to capture real-time performance metrics, which can later be analyzed for tuning or troubleshooting purposes.

2. Stop:

- Stops the active data logging session. Use this when you've captured enough data or wish to end the recording.

3. Logging Profiles:

- Allows you to select or create specific logging profiles. Profiles can be customized to capture particular parameters or configurations based on your tuning needs.

4. Triggered Logging:

- Enables data logging to begin automatically when specific conditions are met (e.g., a particular RPM or throttle position). This feature is useful for capturing data only when certain events occur.

5. Data Logging Preferences:

- Opens the preferences for data logging, where you can adjust settings related to how data is recorded and stored. These options can help you manage file sizes, data formats, and other logging details.

6. Import / Conversion:

- Provides options for importing or converting data logs, allowing you to work with logs from other sources or formats, if necessary.

7. View with MegaLogViewer:

- Opens the current data log in MegaLogViewer, a separate application designed for analyzing TS data logs. This tool allows for more detailed review and analysis of logged data (available if you have MegaLogViewer installed).

8. Show DataLog Folder:

- Opens the folder where TS stores all recorded data logs by default. This is useful for quickly accessing or organizing log files.

Communications Menu in TS

1. Settings:

- Opens the communication settings for TS. This option allows you to adjust parameters related to the connection between your computer and the ECU, such as baud rate or COM port if needed.

2. Data Rate:

- Adjusts the data rate for the connection, which can influence how quickly data is transmitted and received from the ECU. Higher data rates provide faster updates but may impact stability depending on connection quality.

3. GPS Configuration:

- Allows you to configure GPS settings if your setup includes GPS data. This can be useful for logging location-based data in addition to engine parameters, often used in performance or tracking applications.

4. Mini Terminal:

- Opens a terminal interface within TS, allowing for direct communication with the ECU via commands. This can be helpful for advanced users needing to troubleshoot or send specific instructions to the ECU.

5. Comm Debug Log:

- Enables the communication debug log, which records details of the ECU-to-TS communication. This is valuable for troubleshooting communication issues or understanding data transmission behaviors.

Tools Menu in TS

1. Protocol Stats:

- Displays statistics related to the communication protocol between TS and the ECU. This information can be helpful for diagnosing communication issues or verifying data transfer quality.

2. Update / Install Firmware:

- This option allows firmware updates or new installations for compatible ECUs.

Note: This function does not work with Impact ECU, so you should avoid using it with Impact ECU setups.

3. Add Custom Channel Wizard:

- Enables the addition of custom data channels. This feature is useful if you want to monitor additional parameters that aren't included by default in TS, allowing for a more customized tuning experience.

4. Custom Channel Editor:

- Opens the editor for custom channels, where you can modify or manage any custom data channels you've set up. This is beneficial for advanced users looking to tailor their data tracking.

5. Action Management:

- Provides options for configuring actions in TS, allowing you to set up automated responses or alerts based on specific conditions. This feature enhances the monitoring experience with customizable actions.

6. Calculators:

- Offers various tools and calculators that assist with tuning calculations, such as air-fuel ratios, fuel injector sizes, or engine displacement. These calculators are helpful for making precise adjustments during tuning.

7. TunerStudio Plug-ins:

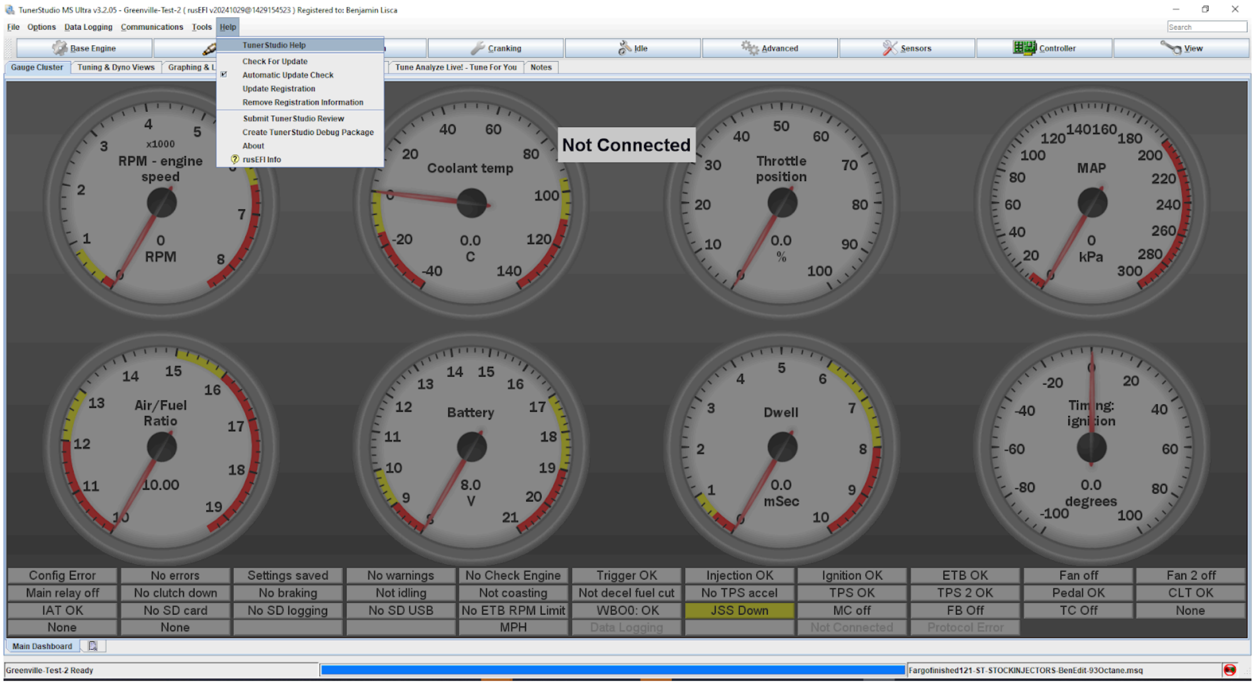
- Allows you to manage and install plugins for TS. Plugins extend the functionality of TS, adding new features or tools that can further enhance your tuning capabilities.

8. Calibrate TPS:

- Opens the Throttle Position Sensor (TPS) calibration tool, which is essential for ensuring that the ECU correctly interprets throttle position.

Note: This function is only compatible with cable throttles. For electronic throttles, a specific calibration procedure is required, which will be covered when we discuss the Advanced button.

Help Menu in TS



1. TunerStudio Help:

- Opens the main help documentation for TS. This is a valuable resource for users needing guidance on features, troubleshooting, or learning more about the software.

2. Check For Update:

- Allows you to manually check for software updates to ensure that TS is up-to-date with the latest features and improvements.

3. Automatic Update Check:

- Toggles the automatic update feature on or off. When enabled, TS will periodically check for updates and notify you when a new version is available.

4. Update Registration:

- Provides options to update or modify your software registration. Use this if you need to adjust registration details or upgrade your software license.

5. Remove Registration Information:

- Clears the stored registration details for TS. This is useful if you need to deregister the software or transfer the license to another user or device.

6. Create TunerStudio Debug Package:

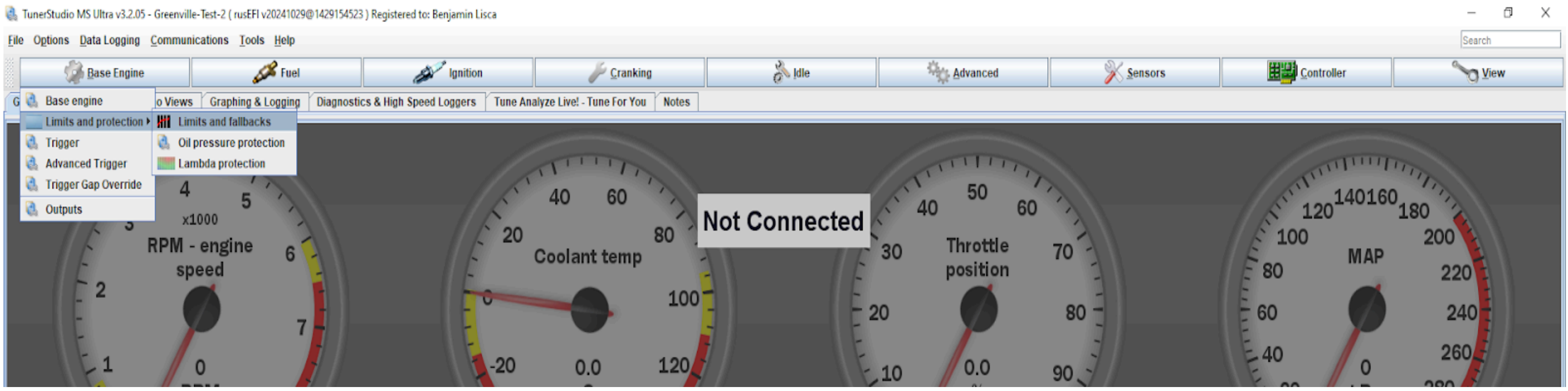
- Generates a debug package that includes diagnostic information. This package can be sent to support for assistance in troubleshooting software or ECU-related issues.

7. About:

- Displays information about the current version of TS, including licensing details, credits, and other relevant information about the software.

Section 3: Tuning Overview

Base Engine Button in TS



1. Base Engine:

- This section contains essential settings related to the engine's fundamental configurations, such as displacement, firing order, and other parameters crucial for proper ECU operation.

2. Limits and Fallbacks:

- Allows you to set safety limits for engine parameters, such as RPM, coolant temperature, and oil pressure. This ensures the ECU can take protective actions if these values exceed safe thresholds, helping prevent engine damage.

3. Trigger:

- Contains settings for configuring the engine's crankshaft or camshaft position sensor (also known as the trigger). These settings are essential for synchronizing the ECU with the engine's rotation.

4. Advanced Trigger:

- This provides more detailed configurations for the trigger system, including settings for advanced triggering modes. This is usually required for engines with more complex timing needs or custom setups.

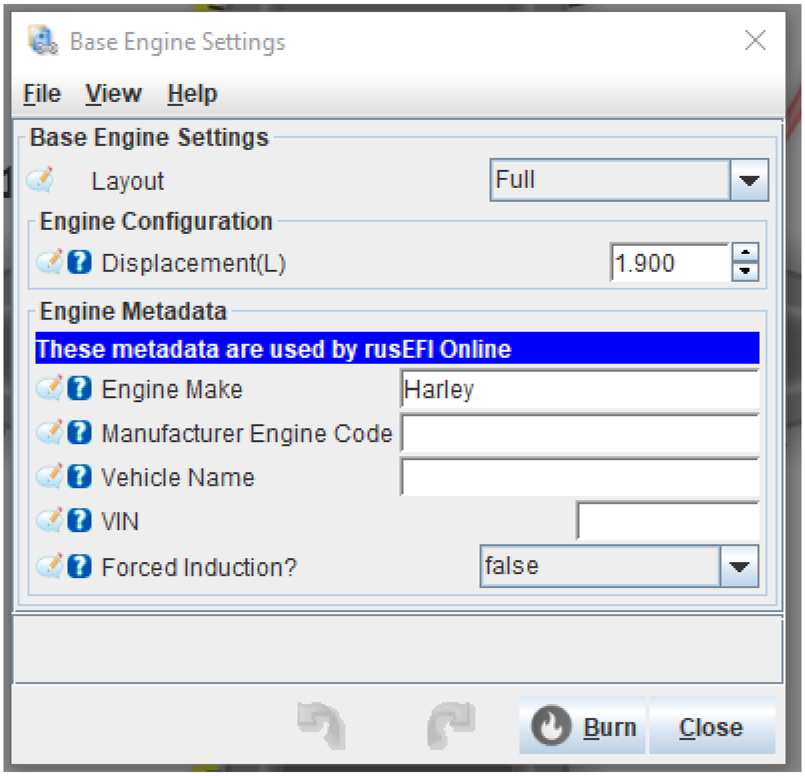
5. Trigger Gap Override:

- Allows you to manually set a gap override for the trigger signal. This option is useful if the standard trigger setup does not accurately detect gaps, which could affect engine timing.

6. Outputs:

- Configures various ECU outputs that control engine components, such as fuel injectors, ignition coils, and auxiliary devices. These settings allow customization of how the ECU controls each output signal.

Base Engine Settings Window



Base Engine Settings

Layout: Full

Engine Configuration

Displacement(L): 1.900

Engine Metadata

These metadata are used by rusEFI Online

Engine Make: Harley

Manufacturer Engine Code:

Vehicle Name:

VIN:

Forced Induction?: false

1. Layout:

- This dropdown lets you choose the complexity of the settings display. For most users, the Tuning layout is recommended as it hides some less commonly used buttons, creating a cleaner interface. However, we will explain everything using the Full layout in this manual to ensure clarity.

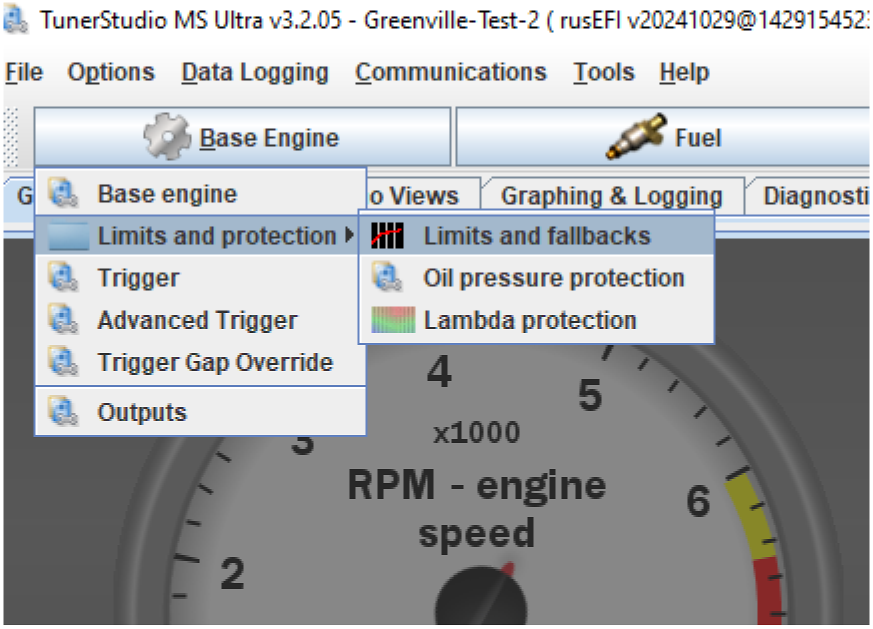
2. Engine Configuration

- Displacement (L): Enter the engine displacement in liters, an essential input for calculating air-fuel ratios and other tuning parameters.

3. Engine Metadata:

- These fields are primarily used to provide additional context, though they aren't necessary for basic Impact ECU functionality.
- Engine Make: Enter the manufacturer or brand of the engine (e.g., Harley).
- Manufacturer Engine Code: Enter the engine code (e.g., M8).
- Vehicle Name: A custom name for the vehicle (e.g., "Chris's Harley"), useful if managing multiple vehicles.
- VIN: in newer firmware versions the VIN input box is located here, input your VIN in all caps to get rid of any "VIN ERR" on your bike's dash
- Forced Induction: Toggle this option if the engine has forced induction (e.g., turbo or supercharger).

Limits and Fallbacks (Base Engine Menu)



Limits and Protection (Base Engine Menu)

The **"Limits and Protection"** submenu under **"Base Engine"** includes essential settings for protecting the engine by setting operational limits. This section is crucial for safeguarding the engine against conditions that could lead to damage. The available options are:

1. Limits and Fallbacks

- This setting allows users to define maximum operational limits for various engine parameters, such as RPM, boost pressure, and temperature.

- When limits are reached, fallback strategies (like reducing power or triggering a safe mode) are activated to prevent damage.
  Example: Setting an RPM limit to ensure the engine doesn't exceed a specified threshold, which can prevent mechanical failure.

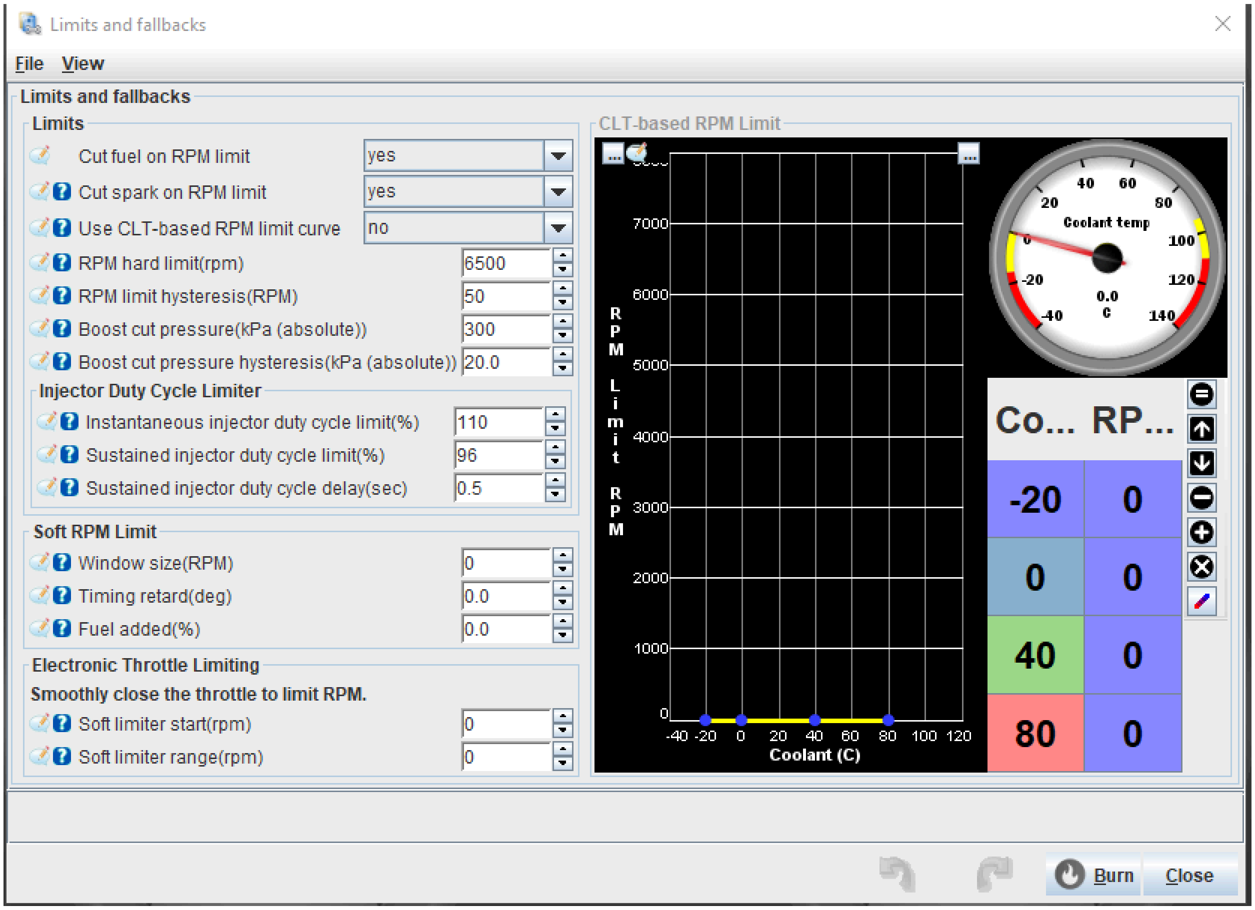
2. Oil Pressure Protection

- Monitors oil pressure levels to protect the engine from insufficient lubrication, which can cause severe damage. This is typically, not used on Harleys as they operate with an Oil Pressure Switch as opposed to an oil pressure sensor.

3. Lambda Protection

- This feature monitors air-fuel ratios (AFR) to ensure the engine operates within safe combustion parameters.
- If AFR deviates from the safe range (either too lean or too rich), it can trigger corrective actions.
- Tip: Lambda protection is essential for turbocharged or high-performance engines that require precise fuel control to avoid detonation or poor performance.

Limits and Fallbacks



Limits and fallbacks

Limits

Cut fuel on RPM limit: yes
Cut spark on RPM limit: yes
Use CLT-based RPM limit curve: no
RPM hard limit(rpm): 6500
RPM limit hysteresis(RPM): 50
Boost cut pressure(kPa (absolute)): 300
Boost cut pressure hysteresis(kPa (absolute)): 20.0

Injector Duty Cycle Limiter

Instantaneous injector duty cycle limit(%): 110
Sustained injector duty cycle limit(%): 96
Sustained injector duty cycle delay(sec): 0.5

Soft RPM Limit

Window size(RPM): 0
Timing retard(deg): 0.0
Fuel added(%): 0.0

Electronic Throttle Limiting

Smoothly close the throttle to limit RPM.

Soft limiter start(rpm): 0
Soft limiter range(rpm): 0

Co...	RP...
-20	0
0	0
40	0
80	0

Main Options

1. Cut fuel on RPM limit:

When enabled, this option cuts the fuel supply when the RPM limit is reached. Cutting fuel provides a smoother limiting action; however, it may lead to slightly higher combustion chamber temperatures since unburned fuel is not present to cool the combustion process.

2. Cut spark on RPM limit:

When selected, this option cuts the spark to limit RPM. Cutting spark can produce flames from the exhaust due to unburned fuel igniting in the exhaust system. Additionally, this unburned fuel can help cool the combustion chamber, which may be beneficial in high-performance applications.

3. Use CLT-based RPM limit curve:

Setting this to "yes" enables the RPM limit to vary with coolant temperature (CLT), utilizing the control panel on the right. This feature allows you to set different RPM limits based on the engine's coolant temperature, providing a temperature-dependent RPM control.

RPM Limits

- **RPM hard limit (RPM)**: The maximum RPM before cut actions (fuel or spark) are triggered.
- **RPM limit hysteresis (RPM):** Sets a buffer below the RPM hard limit, helping avoid rapid cycling of cut actions by defining a range within which RPM must drop before cut actions are re-enabled.

Boost Cut Limits:

- **Boost cut pressure (kPa absolute):** Specifies the absolute maximum boost pressure allowed before triggering a cut.
- **Boost cut pressure hysteresis (kPa absolute):** Defines a pressure range below the cut limit at which boost can resume, providing smoother control over boost cut actions.

Injector Duty Cycle Limiter

- **Instantaneous injector duty cycle limit (%):** This sets an immediate limit on injector duty cycle. If this threshold is reached, the system will immediately cut the injectors to prevent excessive fuel delivery.
- **Sustained injector duty cycle limit (%) & Sustained injector duty cycle delay(seconds):** This limit allows injectors to operate up to the specified duty cycle percentage for a short period (as defined by the delay). After this delay, if the duty cycle remains above the limit, it will trigger a cut. This setting helps balance performance by allowing temporary high fuel demands while protecting the injectors from prolonged stress.

Soft RPM Limit

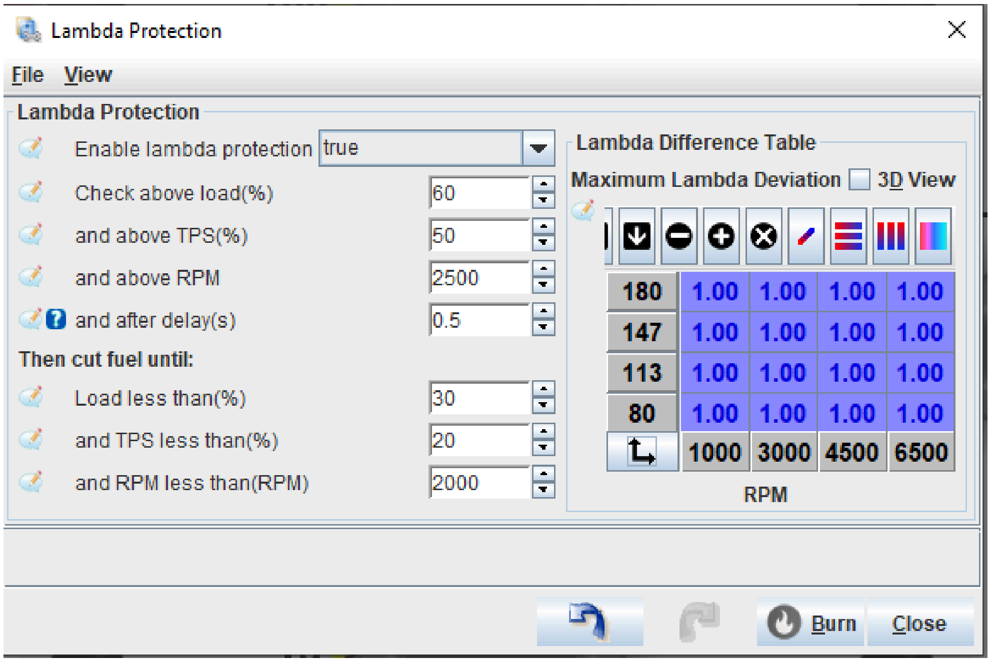
- **Window size (RPM), Timing retard (degrees), and Fuel added (%):** These options allow you to create a "soft" limiter that gradually engages, rather than abruptly cutting fuel or spark. This can help prevent sudden drops in power, making the limiter response smoother.

Electronic Throttle Limiting

- **Soft limiter start RPM and Soft limiter range (RPM):** Gradually closes the throttle as the RPM approaches the limit, helping to provide a smooth limiter response for electronically controlled throttles.

This section provides fine-tuned control over RPM, pressure, and throttle limits, with options for different limiter styles that balance performance and protection. For instance, using spark cut can add a visual effect with exhaust flames, while fuel cut keeps the action smooth and consistent.

Lambda Protection



Lambda Protection

Enable lambda protection: true

Check above load(%): 60

and above TPS(%): 50

and above RPM: 2500

and after delay(s): 0.5

Then cut fuel until:

Load less than(%): 30

and TPS less than(%): 20

and RPM less than(RPM): 2000

Lambda Difference Table

Maximum Lambda Deviation ☐ 3D View

180	1.00	1.00	1.00	1.00
147	1.00	1.00	1.00	1.00
113	1.00	1.00	1.00	1.00
80	1.00	1.00	1.00	1.00
	1000	3000	4500	6500

RPM

The **Lambda Protection** window enables protection based on the Lambda values, which help in monitoring air-fuel ratio (AFR) deviations and ensuring safe engine operation under specific conditions. Here's a breakdown of the options:

Settings:

- **Enable lambda protection:** Allows you to toggle Lambda Protection on or off.
- **Check above load (%):** The system will check Lambda values only when the engine load exceeds this percentage threshold.
- **and above TPS (%):** Lambda values will only be monitored if the throttle position sensor (TPS) exceeds this percentage.
- **and above RPM:** Lambda protection activates only when the RPM is above this specified threshold.
- **and after delay (s)**: Sets a delay time (in seconds) before Lambda Protection engages after the above conditions are met.

Cut Fuel Until:

This section determines the conditions under which fuel will be cut when Lambda Protection is active.

- **Load less than (%):** Fuel will be cut until engine load drops below this percentage.
- **and TPS less than (%):** Fuel cut will continue until the TPS is below this percentage.

- **and RPM less than (RPM):** Fuel cut remains active until the RPM falls below this threshold.

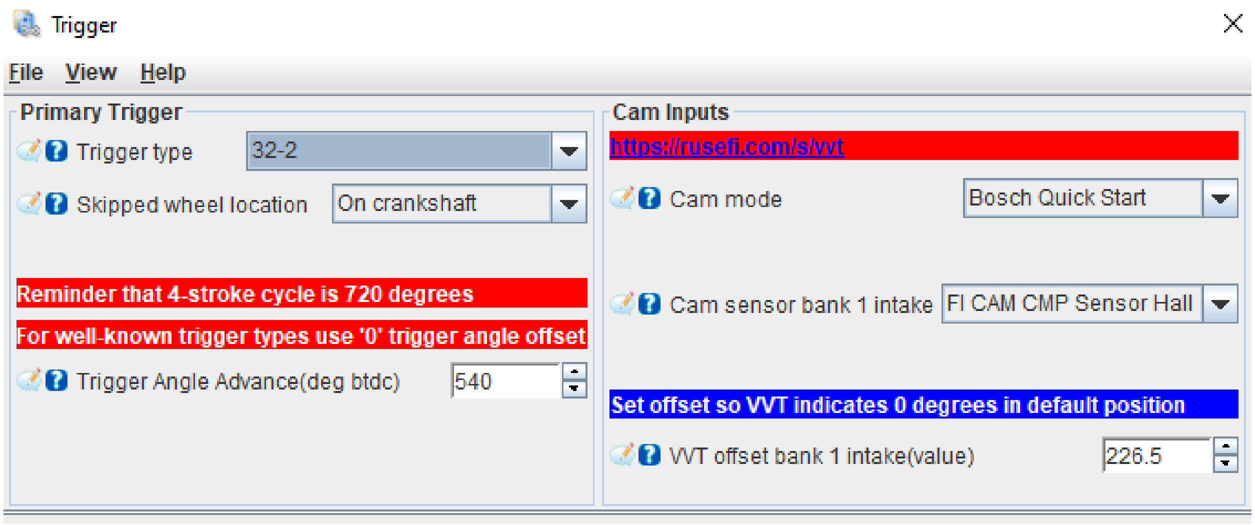
Lambda Difference Table:

The Lambda Difference Table (right side of the window) allows you to set a maximum allowable deviation in Lambda values.

- **Y-axis represents Load.**
- **X-axis represents RPM.**
- **Z-axis values represent Lambda values (not AFR)**.

This table helps define the Lambda deviation limits under various engine loads and RPMs, enabling finer control over protection levels based on actual engine performance conditions.

Trigger



Primary Trigger

Trigger type: 32-2

Skipped wheel location: On crankshaft

Reminder that 4-stroke cycle is 720 degrees

For well-known trigger types use '0' trigger angle offset

Trigger Angle Advance(deg btdc): 540

Cam Inputs

https://rusefi.com/s/vvt

Cam mode: Bosch Quick Start

Cam sensor bank 1 intake: FI CAM CMP Sensor Hall

Set offset so VVT indicates 0 degrees in default position

VVT offset bank 1 intake(value): 226.5

Here’s an explanation of the Trigger configuration based on the provided example. This setup uses a 32-2 trigger wheel, the trigger pattern for an HD M8. ***THESE SETTINGS WILL COME PRE-LOADED, AND IN MOST CASES WILL NEVER HAVE TO BE CHANGED!***

Primary Trigger Section

- **Strokes:** Set to Four Stroke for engines that operate on the standard four-stroke cycle.
- **Trigger Type:** The example uses 32-2, meaning a 32-tooth wheel with 2 missing teeth, which is often mounted on the crankshaft.
- **Skipped Wheel Location:** Set to On Crankshaft to indicate that this trigger wheel is located on the crankshaft.
- **Trigger Angle Advance (deg BTDC):** Configured to 540 degrees in this setup. This setting depends on the engine's requirements.

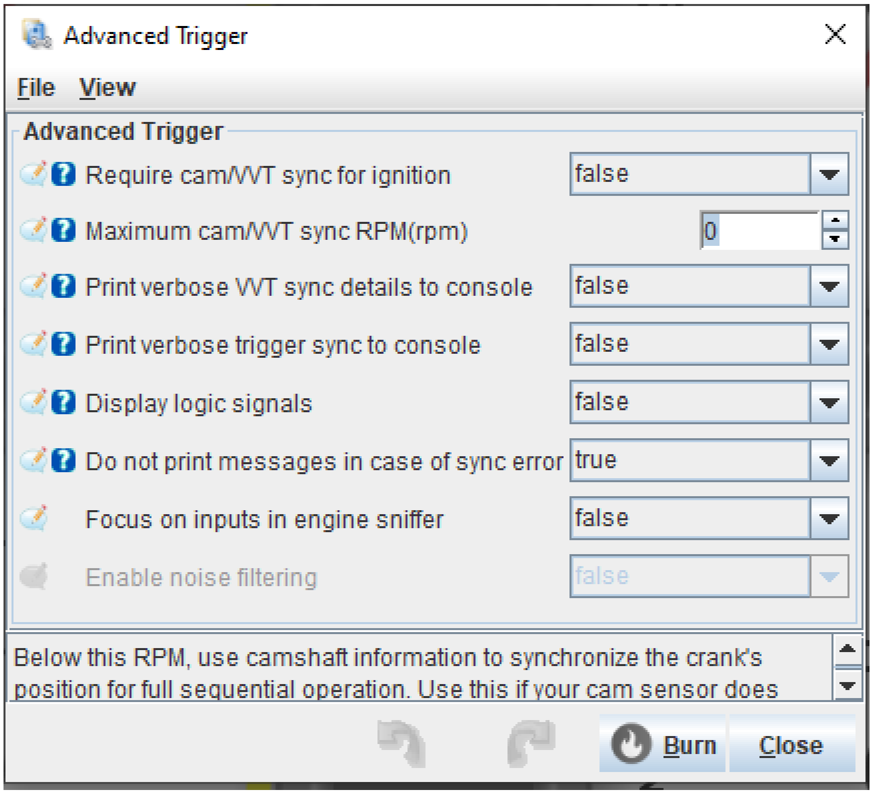
Cam Inputs Section

Cam Mode: Set to **“Bosch Quick Start”** to indicate a Bosch Quick Start Cam Sensor Pickup Pattern is used. Can Also be set to **“Sync By Map”** to sync using a map dip threshold or **“Inactive”** to allow the bike to run in wasted spark.

Cam Sensor Bank 1 Intake: Defines which input is being Cam Sensor input. When running wasted spark or sync by map this is typically set to “NONE” otherwise the above setting is correct.

VVT Offset Bank 1 Intake: This ensure proper timing alignment when VVT is active and is set so that VVT Cam Timing Value reads “0” When we are are commanding “0” cam timing.

Advanced Trigger Options



Advanced Trigger

Require cam/VVT sync for ignition: false

Maximum cam/VVT sync RPM(rpm): 0

Print verbose VVT sync details to console: false

Print verbose trigger sync to console: false

Display logic signals: false

Do not print messages in case of sync error: true

Focus on inputs in engine sniffer: false

Enable noise filtering: false

Below this RPM, use camshaft information to synchronize the crank's position for full sequential operation. Use this if your cam sensor does

<u>Like the trigger settings, this section will come with pre-loaded settings that will typically never have to be changed by the end user.</u>

1. Require cam/VVT sync for ignition:

- Default: False.
- If set to True, the engine will require camshaft or variable valve timing (VVT) synchronization before ignition events are allowed. This is typically only used in engines with dual VVT setups.

2. Maximum cam/VVT sync RPM (rpm):

- Default: 0 (disabled).
- This option sets a maximum RPM limit for synchronization attempts. This is generally left as 0 unless a specific use case for a limit exists.

3. Print verbose VVT sync details to console:

- Default: False.
- This option enables detailed logging of VVT synchronization events in the Console, an advanced development application for diagnostics. Not typically needed for general users.

4. Print verbose trigger sync to console:

- Default: False.
- Similar to the above, this logs detailed trigger synchronization data in the Console. Again, this is intended for developers and advanced debugging.

5. Display logic signals:

- Default: False.
- If enabled, it shows internal logic signals in the Console, helpful for in-depth diagnostics and development.

6. Do not print messages in case of sync error:

- Default: True.
- If enabled, sync error messages will not appear in the Console, which can help reduce noise during development.

7. Focus on inputs in engine sniffer:

- Default: False.
- The Engine Sniffer, available in the Console, visualizes inputs and outputs for advanced tuning and diagnostics. Enabling this option focuses on inputs during sniffer sessions.

8. Enable noise filtering:

- Default: False.
- This option enables additional noise filtering on signal inputs to handle interference or signal degradation. Use this if signals are noisy and causing sync issues.

Notes

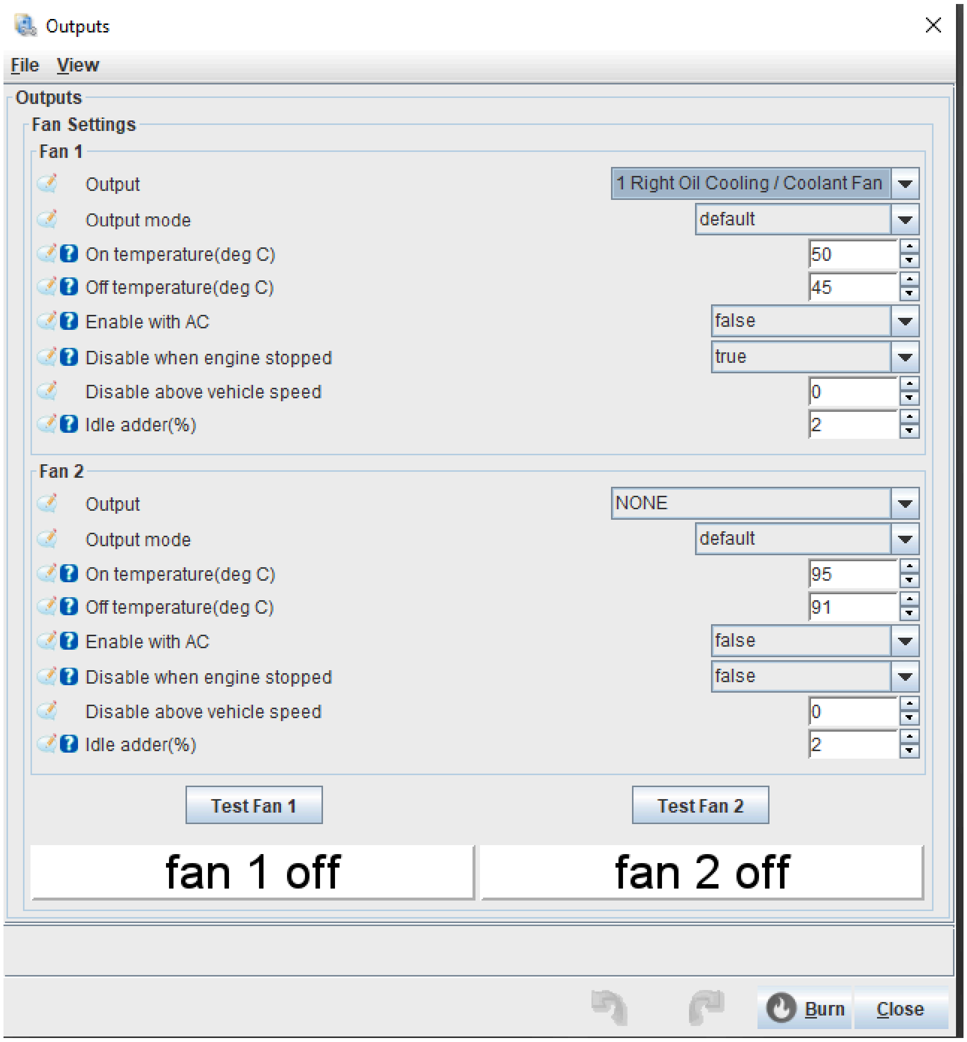
- Any mention of "console" or "print" in these options refer to features from a development tool separate from TunerStudio. These options are generally onlyused by developers for diagnostics, debugging, and advanced configurations.

- For regular Impact ECU users, most of these settings are not needed and can be left at their defaults unless directed otherwise for troubleshooting purposes.

Trigger Gap Override

Trigger Gap Override settings are primarily intended for developers and are used to adjust trigger gap tolerances in unique setups or development scenarios. These settings are advanced and out of the scope of this manual, as they are not typically needed for standard Impact ECU users.

Outputs



Outputs

Fan Settings

Fan 1

Output	1 Right Oil Cooling / Coolant Fan
Output mode	default
On temperature(deg C)	50
Off temperature(deg C)	45
Enable with AC	false
Disable when engine stopped	true
Disable above vehicle speed	0
Idle adder(%)	2

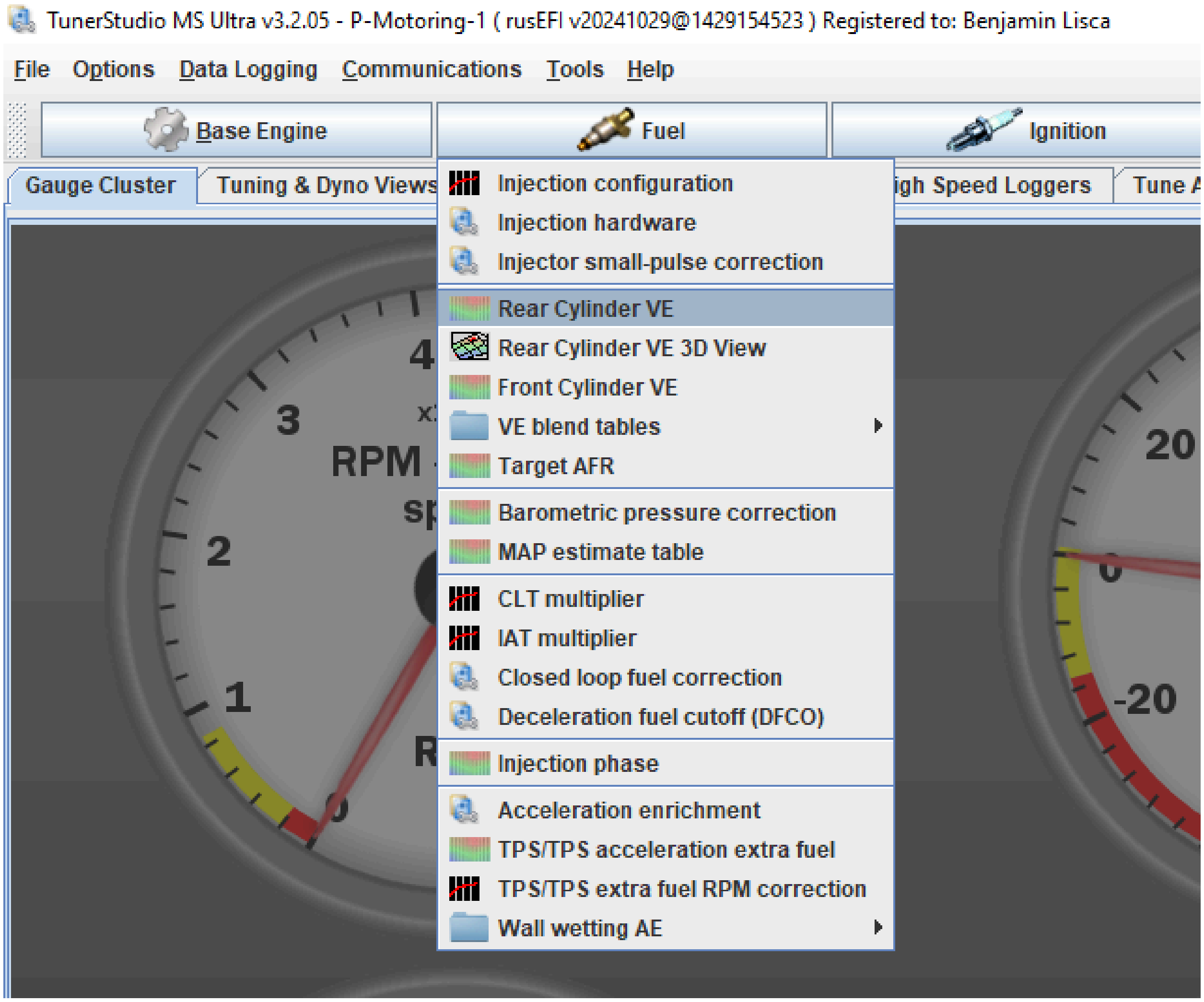
Fan 2

Output	NONE
Output mode	default
On temperature(deg C)	95
Off temperature(deg C)	91
Enable with AC	false
Disable when engine stopped	false
Disable above vehicle speed	0
Idle adder(%)	2

Fan Settings:

- **Fan 1 and Fan 2:** Configure the control of two separate fans, including:
- **On/Off Temperature (°C):** Sets the activation and deactivation temperatures for each fan.
- **Disable When Engine Stopped:** Prevents fan operation when the engine is off.
- **Disable Above Vehicle Speed:** Prevents fan operation when the vehicle exceeds a specified speed.
- **Idle Adder (%):** Adds a specified duty cycle at idle to assist with cooling at low RPMs.
- **Test Fan 1 and Fan 2 Button:** Allows you to test functionality of the fans with just the ignition on.

Fuel Button in TS



Under the Fuel button, users can access various settings that control fuel injection, enrichment, correction factors, and fuel-related compensations. Here’s a breakdown of each option shown:

1. Injection Configuration:

Configures the physical aspects of the fuel injectors, including flow rate and injector characterization.

2. Injection Hardware:

Configures which injectors belong to which bank for optimal fuel delivery as well as a “Test” Button to test injector functionality.

3. Injector Small-Pulse Correction:
Adjusts for injector behavior at low pulse widths, ensuring smooth and consistent fuel delivery during light load or idle.

4. Rear Cylinder VE (Volumetric Efficiency) Table: A fuel table where you adjust VE values for different RPM and load conditions to calibrate the rear cylinder’s air-fuel mixture.

5. Rear Cylinder VE 3D View: A visual representation of the Rear Cylinder VE table in 3D, making it easier to spot irregularities or trends in fuel delivery.

6. Front Cylinder VE (Volumetric Efficiency) Table: A fuel table where you adjust VE values for different RPM and load conditions to calibrate the Front cylinder’s air-fuel mixture.

7. VE Blend Tables: Allows the setup of secondary VE tables for blending purposes, enabling smooth transitions between different fuel demands or operating modes.

8. Target AFR: Defines the target air-fuel ratio (AFR) for various operating conditions, which the ECU uses to adjust fuel delivery.

9. Barometric Pressure Correction: Corrects fuel delivery based on ambient air pressure, useful for varying altitudes.

10. MAP Estimate Table: Calculates estimated MAP (manifold absolute pressure) values based on RPM and load, aiding in fuel adjustment in case of MAP Sensor Failure.

11. CLT (Coolant Temperature) Multiplier: Adjusts fuel delivery based on coolant temperature, adding enrichment during warm-up or reducing it during high temperatures.

12. IAT (Intake Air Temperature) Multiplier: Compensates for intake air temperature, which affects air density and, consequently, the air-fuel mixture.

13. Closed Loop Fuel Correction: Enables closed-loop control using feedback from the oxygen sensor to maintain target AFR.

14. Deceleration Fuel Cutoff (DFCO): Cuts fuel during deceleration to save fuel and improve emissions, typically activated when throttle is closed and RPM is above a certain threshold.

15. Injection Phase: Adjusts the timing of the injection event relative to the intake stroke, enhancing fuel atomization and engine efficiency.

16. Acceleration Enrichment: Adds extra fuel when the throttle is opened quickly, compensating for the sudden influx of air.

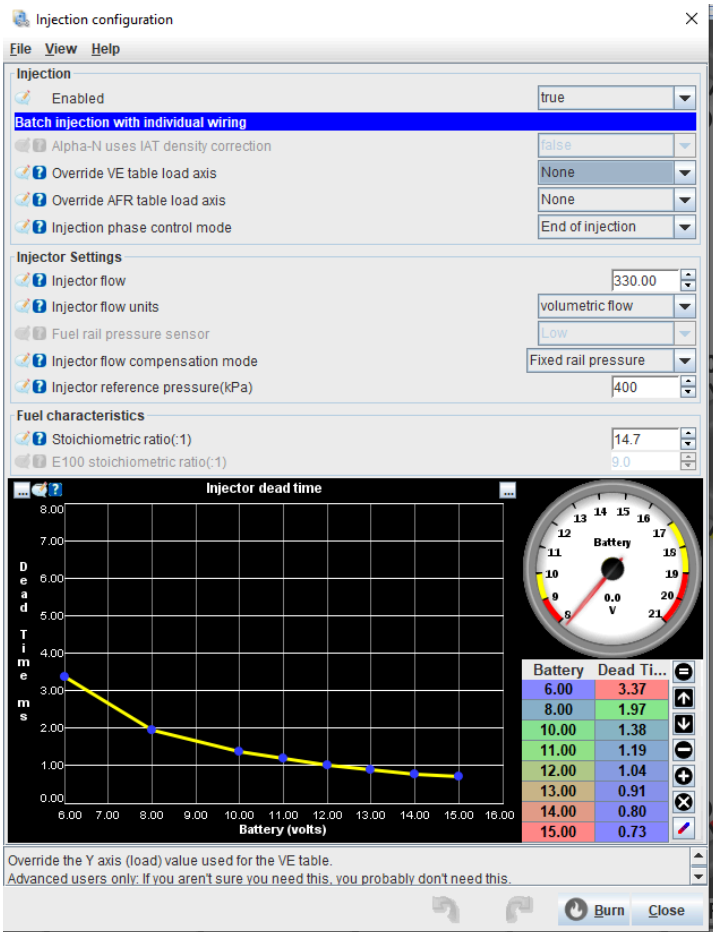
17. TPS/TPS Acceleration Extra Fuel: Provides additional fuel enrichment based on current throttle position and target throttle position, helping to maintain AFR during rapid throttle changes.

18. TPS/TPS Extra Fuel RPM Correction: Further refines the amount of fuel added during acceleration based on RPM, providing smoother transitions.

19. Wall Wetting AE: Compensates for fuel that sticks to the intake manifold walls during sudden changes in throttle, ensuring accurate fuel delivery.

Each of these settings offers precise control over fuel delivery, allowing tuners to optimize engine performance, fuel economy, and emissions.

Injection Configuration:



Injection

Enabled: true

Batch injection with individual wiring

Alpha-N uses IAT density correction: false

Override VE table load axis: None

Override AFR table load axis: None

Injection phase control mode: End of injection

Injector Settings

Injector flow: 330.00

Injector flow units: volumetric flow

Fuel rail pressure sensor: Low

Injector flow compensation mode: Fixed rail pressure

Injector reference pressure(kPa): 400

Fuel characteristics

Stoichiometric ratio(:1): 14.7

E100 stoichiometric ratio(:1): 9.0

Battery	Dead Ti...
6.00	3.37
8.00	1.97
10.00	1.38
11.00	1.19
12.00	1.04
13.00	0.91
14.00	0.80
15.00	0.73

Override the Y axis (load) value used for the VE table.
Advanced users only: If you aren't sure you need this, you probably don't need this.

In the ***Injector Configuration*** dialog box, you can configure the settings that control fuel injector behavior and fuel delivery.

By default Impact ECU is set to use a true speed density fueling model, here you will also have the ability to swap to Alpha-N if that is your preference.

Here are the key components:

Injection

- **Enabled:** Set to true to enable fuel injection.
- **Mode:** Options include Sequential (individual injector timing) or Batch (all injectors fire simultaneously).
- **Batch Injection with Individual Wiring**: For applications where

injectors are wired separately but operate in batch mode.

- **Alpha-N Uses IAT Density Correction:** When set to true, it enables intake air temperature-based corrections for Alpha-N tuning strategies.
- **Override VE Table Load Axis:** Allows you to change the default load axis used for the VE table, which is typically MAP (manifold absolute pressure).
- **Override AFR Table Load Axis**: Allows you to override the default load axis for the target AFR table.
- **Injection Phase Control Mode:** Defines when fuel is injected relative to the intake valve opening. Options include End of Injection or other timing references.

Injector Settings

- **Injector Flow:** Specifies the flow rate of the injector, typically in cc/min or lbs/hr.
- **Injector Flow Units:** Choose between Volumetric Flow (e.g., cc/min) or other units.

Injector Flow Compensation Mode:

- **None:** For setups with a MAP-referenced fuel pressure regulator.
- **Fixed Rail Pressure:** For systems with an atmosphere-referenced fuel pressure regulator, typically in returnless systems. **(Typical Setting For HD Touring Models)**
- **Sensed Rail Pressure**: For systems equipped with a fuel pressure sensor, which dynamically adjusts for pressure variations.

- Fuel Rail Pressure Sensor: Only used when "Sensed Rail Pressure" is selected.

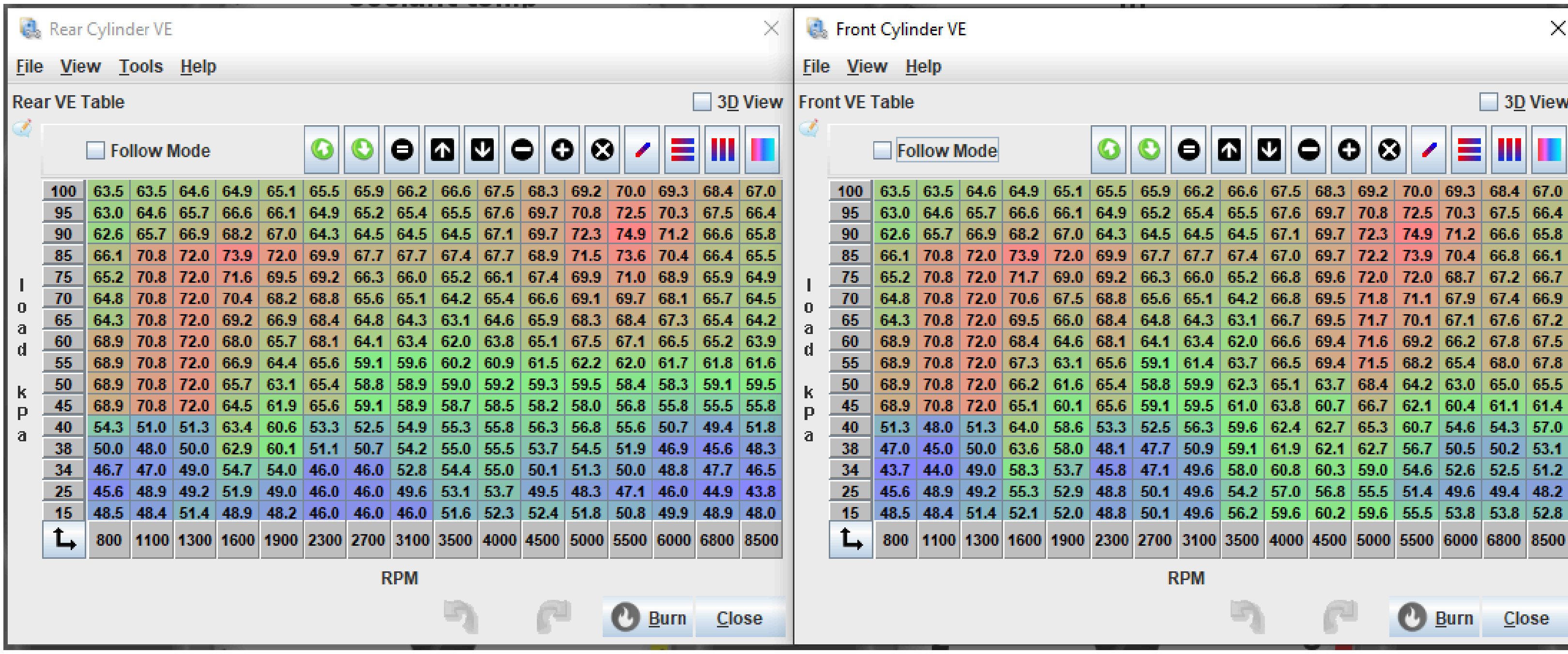
Fuel Characteristics

- **Stoichiometric Ratio**: Defines the stoichiometric air-fuel ratio (AFR) for the fuel type in use.
- **E100 Stoichiometric Ratio:** Defines the stoichiometric AFR for E100 (pure ethanol), useful for ethanol blends.

Injector Dead Time

Displays a graph showing injector dead time (in milliseconds) as a function of battery voltage. Dead time decreases as voltage increases, ensuring precise injector control under varying electrical conditions.

Front & Rear VE (Volumetric Efficiency) Tables



Rear VE Table

load kPa

100	63.5	63.5	64.6	64.9	65.1	65.5	65.9	66.2	66.6	67.5	68.3	69.2	70.0	69.3	68.4	67.0
95	63.0	64.6	65.7	66.6	66.1	64.9	65.2	65.4	65.5	67.6	69.7	70.8	72.5	70.3	67.5	66.4
90	62.6	65.7	66.9	68.2	67.0	64.3	64.5	64.5	64.5	67.1	69.7	72.3	74.9	71.2	66.6	65.8
85	66.1	70.8	72.0	73.9	72.0	69.9	67.7	67.7	67.4	67.7	68.9	71.5	73.6	70.4	66.4	65.5
75	65.2	70.8	72.0	71.6	69.5	69.2	66.3	66.0	65.2	66.1	67.4	69.9	71.0	68.9	65.9	64.9
70	64.8	70.8	72.0	70.4	68.2	68.8	65.6	65.1	64.2	65.4	66.6	69.1	69.7	68.1	65.7	64.5
65	64.3	70.8	72.0	69.2	66.9	68.4	64.8	64.3	63.1	64.6	65.9	68.3	68.4	67.3	65.4	64.2
60	68.9	70.8	72.0	68.0	65.7	68.1	64.1	63.4	62.0	63.8	65.1	67.5	67.1	66.5	65.2	63.9
55	68.9	70.8	72.0	66.9	64.4	65.6	59.1	59.6	60.2	60.9	61.5	62.2	62.0	61.7	61.8	61.6
50	68.9	70.8	72.0	65.7	63.1	65.4	58.8	58.9	59.0	59.2	59.3	59.5	58.4	58.3	59.1	59.5
45	68.9	70.8	72.0	64.5	61.9	65.6	59.1	58.9	58.7	58.5	58.2	58.0	56.8	55.8	55.5	55.8
40	54.3	51.0	51.3	63.4	60.6	53.3	52.5	54.9	55.3	55.8	56.3	56.8	55.6	50.7	49.4	51.8
38	50.0	48.0	50.0	62.9	60.1	51.1	50.7	54.2	55.0	55.5	53.7	54.5	51.9	46.9	45.6	48.3
34	46.7	47.0	49.0	54.7	54.0	46.0	46.0	52.8	54.4	55.0	50.1	51.3	50.0	48.8	47.7	46.5
25	45.6	48.9	49.2	51.9	49.0	46.0	46.0	49.6	53.1	53.7	49.5	48.3	47.1	46.0	44.9	43.8
15	48.5	48.4	51.4	48.9	48.2	46.0	46.0	46.0	51.6	52.3	52.4	51.8	50.8	49.9	48.9	48.0
⮡	800	1100	1300	1600	1900	2300	2700	3100	3500	4000	4500	5000	5500	6000	6800	8500

RPM

Front VE Table

load kPa

100	63.5	63.5	64.6	64.9	65.1	65.5	65.9	66.2	66.6	67.5	68.3	69.2	70.0	69.3	68.4	67.0
95	63.0	64.6	65.7	66.6	66.1	64.9	65.2	65.4	65.5	67.6	69.7	70.8	72.5	70.3	67.5	66.4
90	62.6	65.7	66.9	68.2	67.0	64.3	64.5	64.5	64.5	67.1	69.7	72.3	74.9	71.2	66.6	65.8
85	66.1	70.8	72.0	73.9	72.0	69.9	67.7	67.7	67.4	67.0	69.7	72.2	73.9	70.4	66.8	66.1
75	65.2	70.8	72.0	71.7	69.0	69.2	66.3	66.0	65.2	66.8	69.6	72.0	72.0	68.7	67.2	66.7
70	64.8	70.8	72.0	70.6	67.5	68.8	65.6	65.1	64.2	66.8	69.5	71.8	71.1	67.9	67.4	66.9
65	64.3	70.8	72.0	69.5	66.0	68.4	64.8	64.3	63.1	66.7	69.5	71.7	70.1	67.1	67.6	67.2
60	68.9	70.8	72.0	68.4	64.6	68.1	64.1	63.4	62.0	66.6	69.4	71.6	69.2	66.2	67.8	67.5
55	68.9	70.8	72.0	67.3	63.1	65.6	59.1	61.4	63.7	66.5	69.4	71.5	68.2	65.4	68.0	67.8
50	68.9	70.8	72.0	66.2	61.6	65.4	58.8	59.9	62.3	65.1	63.7	68.4	64.2	63.0	65.0	65.5
45	68.9	70.8	72.0	65.1	60.1	65.6	59.1	59.5	61.0	63.8	60.7	66.7	62.1	60.4	61.1	61.4
40	51.3	48.0	51.3	64.0	58.6	53.3	52.5	56.3	59.6	62.4	62.7	65.3	60.7	54.6	54.3	57.0
38	47.0	45.0	50.0	63.6	58.0	48.1	47.7	50.9	59.1	61.9	62.1	62.7	56.7	50.5	50.2	53.1
34	43.7	44.0	49.0	58.3	53.7	45.8	47.1	49.6	58.0	60.8	60.3	59.0	54.6	52.6	52.5	51.2
25	45.6	48.9	49.2	55.3	52.9	48.8	50.1	49.6	54.2	57.0	56.8	55.5	51.4	49.6	49.4	48.2
15	48.5	48.4	51.4	52.1	52.0	48.8	50.1	49.6	56.2	59.6	60.2	59.6	55.5	53.8	53.8	52.8
⮡	800	1100	1300	1600	1900	2300	2700	3100	3500	4000	4500	5000	5500	6000	6800	8500

RPM

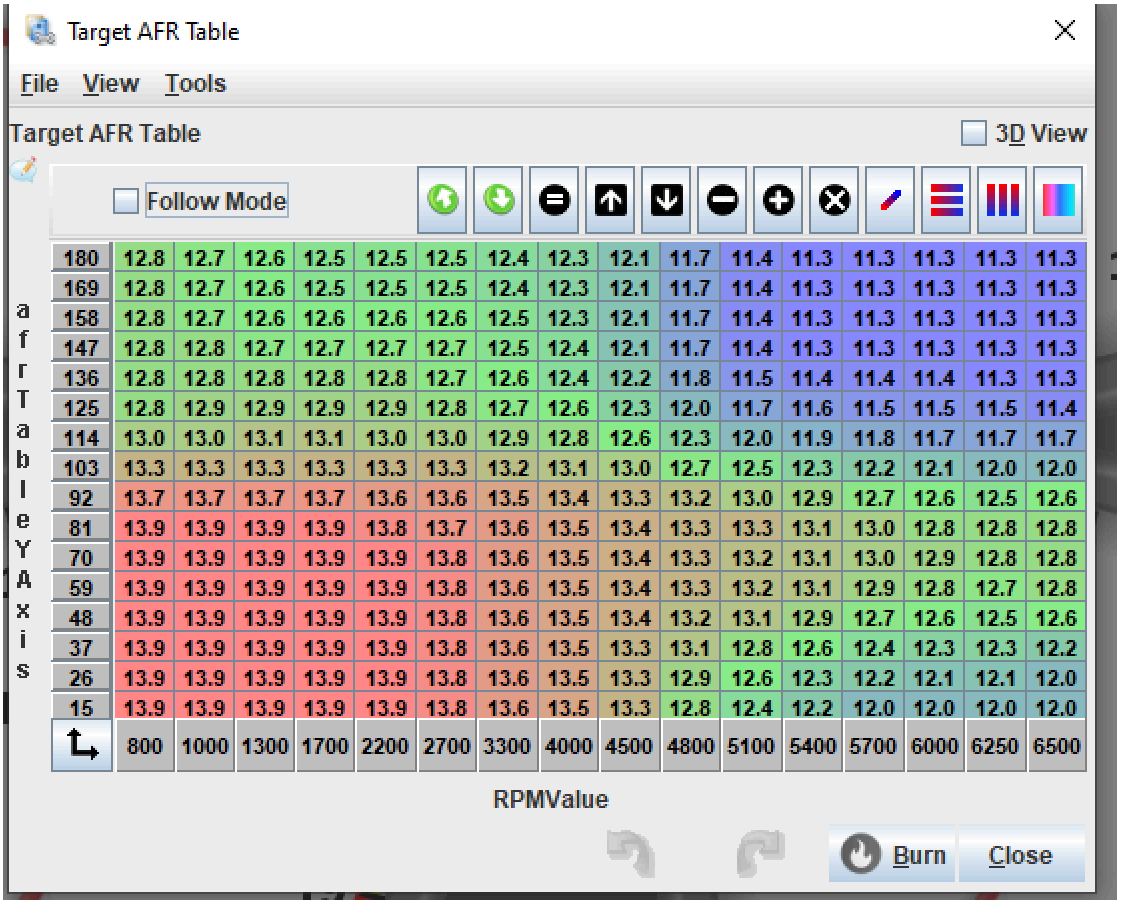
The **Front & Rear VE (Volumetric Efficiency) Tables** display the engine's volumetric efficiency values as a function of **MAP load (kPa)** and **RPM**. These values determine how much fuel is needed based on the engine's airflow characteristics at different operating points. Here's a breakdown of the table and typical values:

Typical VE Values

- **Idle Conditions:** At idle, typically around 30-50 kPa and 950-1100 RPM, most engines have VE values in the range of 30-50%. This represents the relatively low airflow when the engine is running at low RPM and without load.
- **High Load Conditions:** At high loads (e.g., 100-250 kPa) and higher RPMs (e.g., 4000-7000 RPM), VE values can range from 80-100% or even higher. Engines with forced induction may have values exceeding 100% due to the additional air being forced into the cylinders.

If you see VE values that are significantly different from these ranges (e.g., extremely high at idle or unusually low at high load), **it may indicate that the injectors haven't been correctly modeled**. This could be due to incorrect injector flow rates, dead time settings, or other calibration errors, leading to inconsistent fueling.

Target AFR Table



180	12.8	12.7	12.6	12.5	12.5	12.5	12.4	12.3	12.1	11.7	11.4	11.3	11.3	11.3	11.3	11.3
169	12.8	12.7	12.6	12.5	12.5	12.5	12.4	12.3	12.1	11.7	11.4	11.3	11.3	11.3	11.3	11.3
158	12.8	12.7	12.6	12.6	12.6	12.6	12.5	12.3	12.1	11.7	11.4	11.3	11.3	11.3	11.3	11.3
147	12.8	12.8	12.7	12.7	12.7	12.7	12.5	12.4	12.1	11.7	11.4	11.3	11.3	11.3	11.3	11.3
136	12.8	12.8	12.8	12.8	12.8	12.7	12.6	12.4	12.2	11.8	11.5	11.4	11.4	11.4	11.3	11.3
125	12.8	12.9	12.9	12.9	12.9	12.8	12.7	12.6	12.3	12.0	11.7	11.6	11.5	11.5	11.5	11.4
114	13.0	13.0	13.1	13.1	13.0	13.0	12.9	12.8	12.6	12.3	12.0	11.9	11.8	11.7	11.7	11.7
103	13.3	13.3	13.3	13.3	13.3	13.3	13.2	13.1	13.0	12.7	12.5	12.3	12.2	12.1	12.0	12.0
92	13.7	13.7	13.7	13.7	13.6	13.6	13.5	13.4	13.3	13.2	13.0	12.9	12.7	12.6	12.5	12.6
81	13.9	13.9	13.9	13.9	13.8	13.7	13.6	13.5	13.4	13.3	13.3	13.1	13.0	12.8	12.8	12.8
70	13.9	13.9	13.9	13.9	13.9	13.8	13.6	13.5	13.4	13.3	13.2	13.1	13.0	12.9	12.8	12.8
59	13.9	13.9	13.9	13.9	13.9	13.8	13.6	13.5	13.4	13.3	13.2	13.1	12.9	12.8	12.7	12.8
48	13.9	13.9	13.9	13.9	13.9	13.8	13.6	13.5	13.4	13.2	13.1	12.9	12.7	12.6	12.5	12.6
37	13.9	13.9	13.9	13.9	13.9	13.8	13.6	13.5	13.3	13.1	12.8	12.6	12.4	12.3	12.3	12.2
26	13.9	13.9	13.9	13.9	13.9	13.8	13.6	13.5	13.3	12.9	12.6	12.3	12.2	12.1	12.1	12.0
15	13.9	13.9	13.9	13.9	13.9	13.8	13.6	13.5	13.3	12.8	12.4	12.2	12.0	12.0	12.0	12.0
	800	1000	1300	1700	2200	2700	3300	4000	4500	4800	5100	5400	5700	6000	6250	6500

The **Target AFR (Air-Fuel Ratio) Table** sets the desired air-fuel mixture for various **RPM** and **MAP load (kPa)** conditions. The values in this table influence how rich or lean the mixture will be across different operating conditions.

Example Breakdown

In this specific table example:

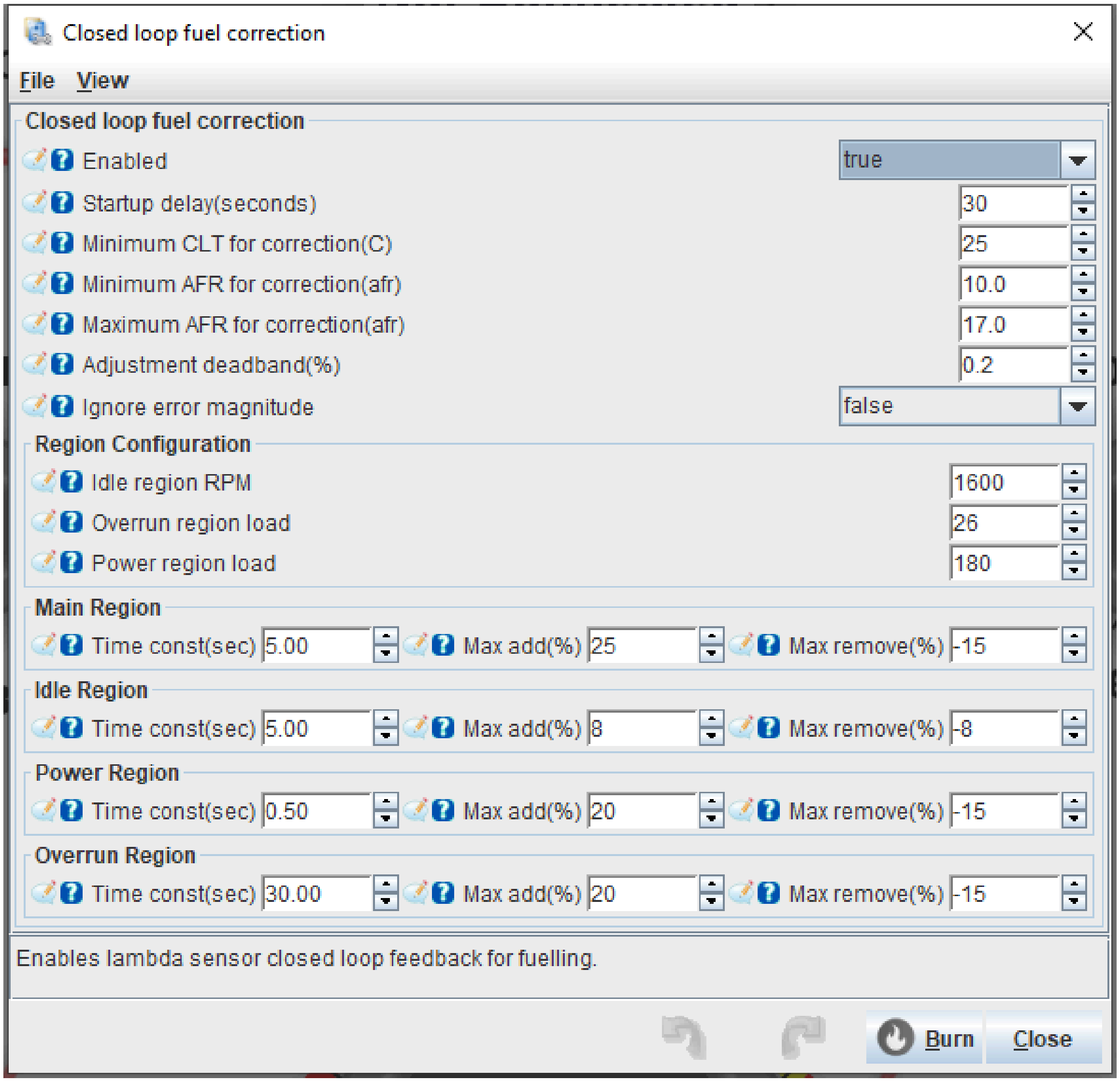
This **Target AFR** Table is set up for a turbocharged, cammed engine, with idle AFR targeted at 13.9 - 14.0 AFR to provide a smoother idle, a common practice for cammed engines.

The Y-axis values exceed 100 kPa to account for boost pressure, which is typical for turbocharged engines.

At higher boost levels (130–180 kPa), the AFR targets are richer, around 11.5–11.3 AFR, to reduce the risk of detonation and keep combustion temperatures safe, ensuring reliable performance under high load. This setup balances smoother idle operation with enhanced protection and power during boosted conditions.

This AFR table example is tuned for a cammed engine, but the ideal values vary based on modifications and performance goals.

Closed Loop Fuel Correction Settings



Closed loop fuel correction

Enabled: true
Startup delay(seconds): 30
Minimum CLT for correction(C): 25
Minimum AFR for correction(afr): 10.0
Maximum AFR for correction(afr): 17.0
Adjustment deadband(%): 0.2
Ignore error magnitude: false

Region Configuration

Idle region RPM: 1600
Overrun region load: 26
Power region load: 180

Main Region

Time const(sec) 5.00 Max add(%) 25 Max remove(%) -15

Idle Region

Time const(sec) 5.00 Max add(%) 8 Max remove(%) -8

Power Region

Time const(sec) 0.50 Max add(%) 20 Max remove(%) -15

Overrun Region

Time const(sec) 30.00 Max add(%) 20 Max remove(%) -15

Enables lambda sensor closed loop feedback for fuelling.

- **Enabled:** Activates the closed-loop correction system.
- **Startup delay:** Sets the delay (in seconds) after startup before the correction begins.
- **Minimum CLT for correction:** Sets the minimum coolant temperature (in °C) required to start corrections.

- **Minimum AFR for correction and Maximum AFR for correction:** Define the AFR range within which corrections will be applied.
- **Adjustment deadband:** Specifies a threshold within which no corrections will be made to avoid minor fluctuations.
- **Ignore error magnitude:** Accepts a numerical value, typically set to 0. This value controls how much AFR error is ignored before corrections are applied, helping to smooth out minor fluctuations.

Region Configuration allows customization of RPM and load thresholds for Idle, Overrun, and Power regions:

- **Idle region RPM:** Defines the RPM considered as the idle threshold.
- **Overrun region load and Power region load:** Set load limits to differentiate between normal operation, deceleration (overrun), and high load (power) conditions.

Each region (Main, Idle, Power, Overrun) has specific time constants and maximum add/remove percentages:

- **Time constant:** Controls the responsiveness of corrections, with lower values resulting in faster adjustments.
- **Max add/remove:** Limits the maximum fuel adjustment in either direction (adding or removing fuel) to prevent excessive correction.

These settings allow for tailored fuel correction, maintaining optimal AFR across different operating conditions.

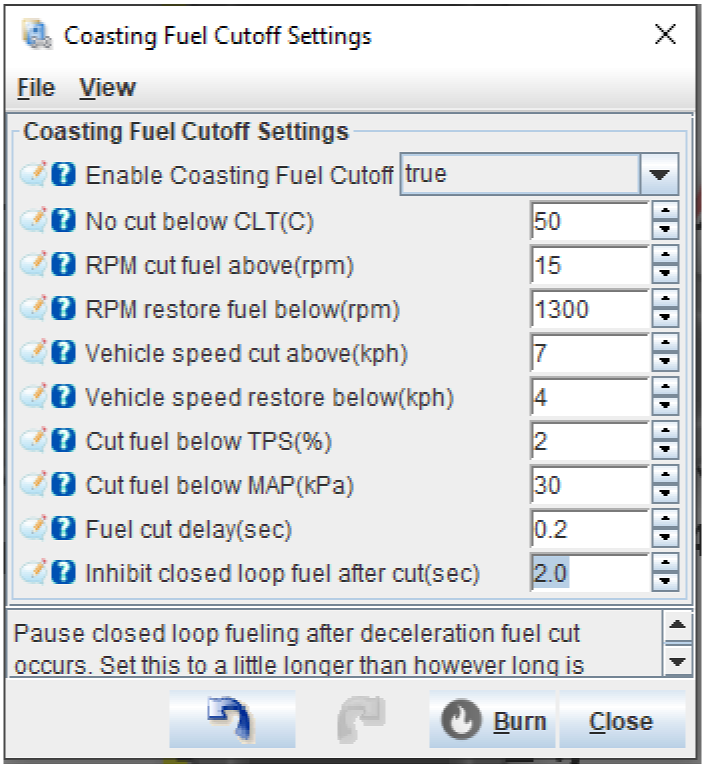
Deceleration Fuel Cutoff (DFCO):

In the **Deceleration Fuel Cutoff (DFCO) Settings**:

- **Enable Coasting Fuel Cutoff:** Activates fuel cutoff during coasting.

- **No cut below CLT(C):** Sets a minimum coolant temperature below which fuel cutoff won’t occur, ensuring smoother engine operation when the engine is cold.

- **RPM cut fuel above:** Defines the RPM threshold above which fuel cutoff will engage during deceleration.



Coasting Fuel Cutoff Settings

Enable Coasting Fuel Cutoff: true
No cut below CLT(C): 50
RPM cut fuel above(rpm): 15
RPM restore fuel below(rpm): 1300
Vehicle speed cut above(kph): 7
Vehicle speed restore below(kph): 4
Cut fuel below TPS(%): 2
Cut fuel below MAP(kPa): 30
Fuel cut delay(sec): 0.2
Inhibit closed loop fuel after cut(sec): 2.0

Pause closed loop fueling after deceleration fuel cut occurs. Set this to a little longer than however long is

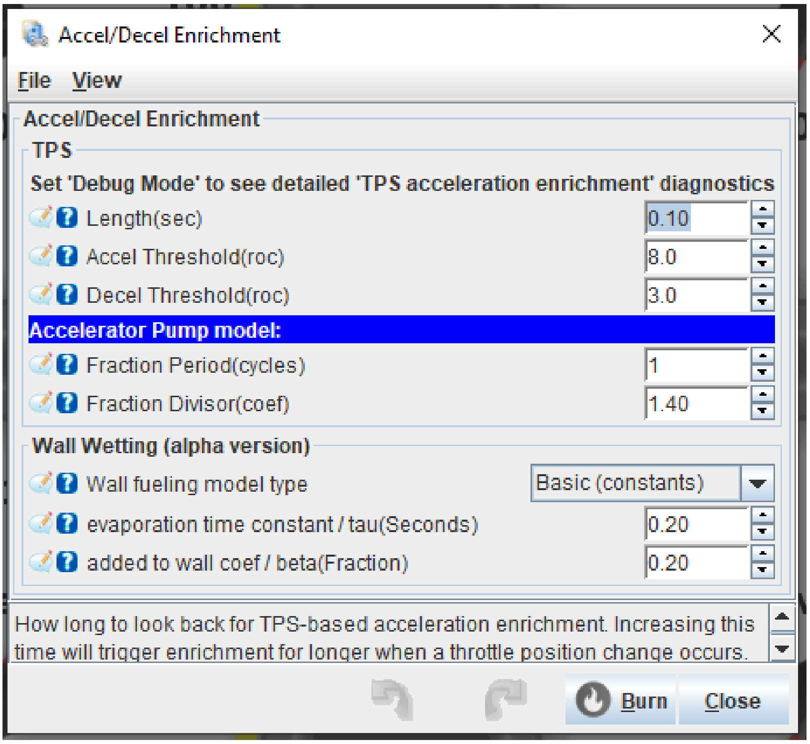
- **RPM restore fuel below:** Sets the RPM at which fuel is restored after cutoff, helping prevent stalling.
- **Vehicle speed cut above and Vehicle speed restore below:** Define speed thresholds for activating and deactivating fuel cutoff. This prevents cutoff at very low speeds where it may be unnecessary.
- **Cut fuel below TPS(%):** Sets a throttle position threshold below which fuel cutoff will activate, typically when the throttle is fully closed during deceleration.
- **Cut fuel below MAP(kPa):** Establishes a manifold pressure threshold to activate fuel cutoff.
- **Fuel cut delay:** Adds a delay (in seconds) before fuel cutoff is engaged after conditions are met, helping prevent premature cutoff.
- **Inhibit closed loop fuel after cut:** Temporarily disables closed-loop fuel correction after fuel is restored, providing a smoother transition.
-

These settings help optimize fuel efficiency by cutting fuel during coasting while ensuring smooth re-engagement under specific conditions.

Accel/Decel Enrichment Settings:

TPS:

- **Length (sec):** Defines the duration of the enrichment pulse when throttle movement is detected.
- **Accel Threshold (roc):** Sets the rate of change (roc) threshold to trigger acceleration enrichment based on throttle position.
- **Decel Threshold (roc):** Sets the roc threshold to trigger deceleration enrichment, helping prevent engine stalling or surging during throttle release.



Set 'Debug Mode' to see detailed 'TPS acceleration enrichment' diagnostics

Length(sec) 0.10

Accel Threshold(roc) 8.0

Decel Threshold(roc) 3.0

Accelerator Pump model:

Fraction Period(cycles) 1

Fraction Divisor(coef) 1.40

Wall Wetting (alpha version)

Wall fueling model type Basic (constants)

evaporation time constant / tau(Seconds) 0.20

added to wall coef / beta(Fraction) 0.20

How long to look back for TPS-based acceleration enrichment. Increasing this time will trigger enrichment for longer when a throttle position change occurs.

Accelerator Pump Model:

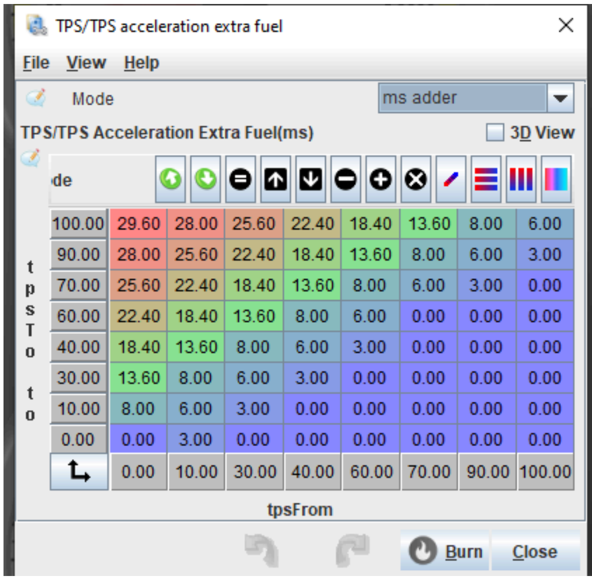
- **Fraction Period (cycles) and Fraction Divisor (coef):** Control how enrichment is delivered during rapid throttle changes, mimicking a carbureted engine's accelerator pump action.

Wall Wetting:

- **Wall fueling model type:** Defines the model used for calculating wall wetting fuel adjustments. The "Basic (constants)" model assumes simpler evaporation dynamics.
- **Evaporation time constant / tau (Seconds):** Sets the time constant for fuel evaporation from intake walls, impacting how long the added fuel remains available for combustion.
- **Added to wall coef / beta (Fraction):** Controls the proportion of fuel adhering to the intake walls versus being drawn directly into the engine.

These settings fine-tune fuel delivery during rapid throttle changes, enhancing responsiveness and stability by simulating fuel behavior dynamics in response to throttle input.

TPS/TPS Acceleration Extra Fuel



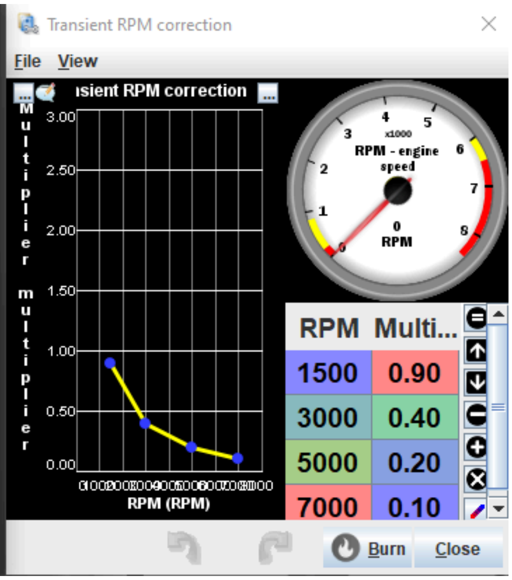
Mode: ms adder

TPS/TPS Acceleration Extra Fuel(ms) ☐ 3D View

tpsTo

100.00	29.60	28.00	25.60	22.40	18.40	13.60	8.00	6.00
90.00	28.00	25.60	22.40	18.40	13.60	8.00	6.00	3.00
70.00	25.60	22.40	18.40	13.60	8.00	6.00	3.00	0.00
60.00	22.40	18.40	13.60	8.00	6.00	0.00	0.00	0.00
40.00	18.40	13.60	8.00	6.00	3.00	0.00	0.00	0.00
30.00	13.60	8.00	6.00	3.00	0.00	0.00	0.00	0.00
10.00	8.00	6.00	3.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00
↳	0.00	10.00	30.00	40.00	60.00	70.00	90.00	100.00

tpsFrom



RPM	Multi...
1500	0.90
3000	0.40
5000	0.20
7000	0.10

The **TPS/TPS Acceleration Extra Fuel table** (shown on the left) provides additional fuel based on the rate of change in throttle position.

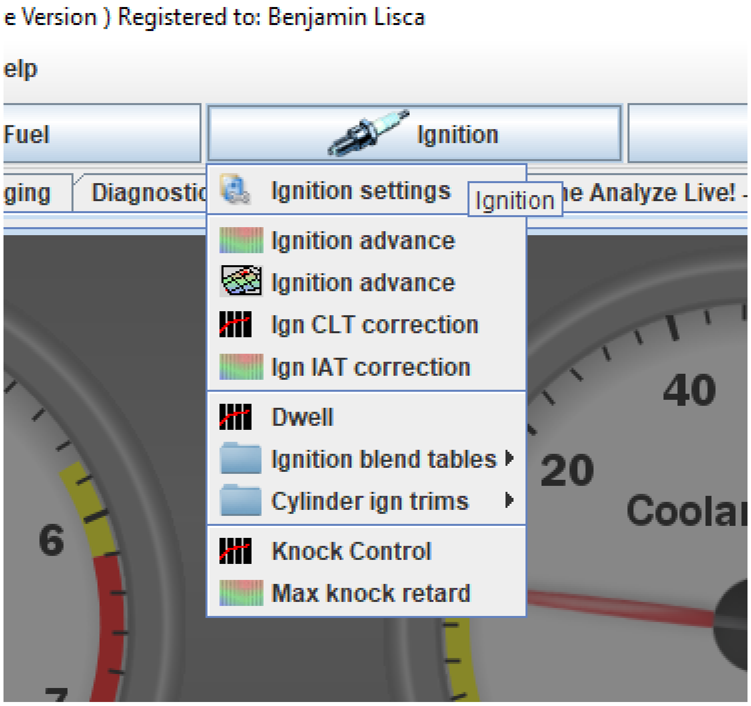
Each cell specifies the amount of extra fuel (in milliseconds) added when moving from one throttle position (TPS from) to another (TPS to).

Note: If you change your injector size, this table should be adjusted accordingly. For example, if you're switching from 300cc injectors to 600cc injectors, you should halve the values in this table to maintain similar behavior with the larger injectors.

Transient RPM Correction

The **Transient RPM Correction** chart (shown on the right) applies a multiplier to fuel delivery based on RPM. This adjustment accounts for varying transient conditions, with the multiplier decreasing as RPM increases. This configuration typically provides more enrichment at low RPMs, where transient fuel needs are higher.

Ignition Button in TS



Ignition Dropdown Options

The Ignition dropdown offers multiple configuration options for tuning various ignition-related settings in the ECU.

Here's a breakdown of each option:

1. Ignition Settings: Primary configuration settings for ignition, including the type of ignition system and any specific settings related to timing control.

2. Ignition Advance: Adjusts the ignition timing advance table based on engine load (measured in kPa or throttle position) and RPM. This table typically has values representing degrees of timing advance, which can vary across different load and RPM conditions.

3. Ign CLT Correction: Allows timing adjustments based on Coolant Temperature (CLT). This correction is useful for optimizing ignition timing based on engine temperature, particularly to prevent detonation when the engine is running hot.

4. Ign IAT Correction: Adjusts timing based on Intake Air Temperature (IAT), compensating for changes in air density that can affect combustion efficiency and engine safety.

5. Dwell: Controls the dwell time, which is the amount of time the ignition coil is energized before firing. Proper dwell time can help optimize spark strength and protect the ignition coil from overheating.

6. Ignition Blend Tables: Used to create custom tables that blend ignition timing values based on certain conditions or parameters, which can be useful for advanced tuning scenarios.

7. Cylinder Ign Trims: Allows individual cylinder ignition timing adjustments. This feature is useful to fine-tune each cylinder independently for optimal performance and to account for any variances in cylinder behavior.

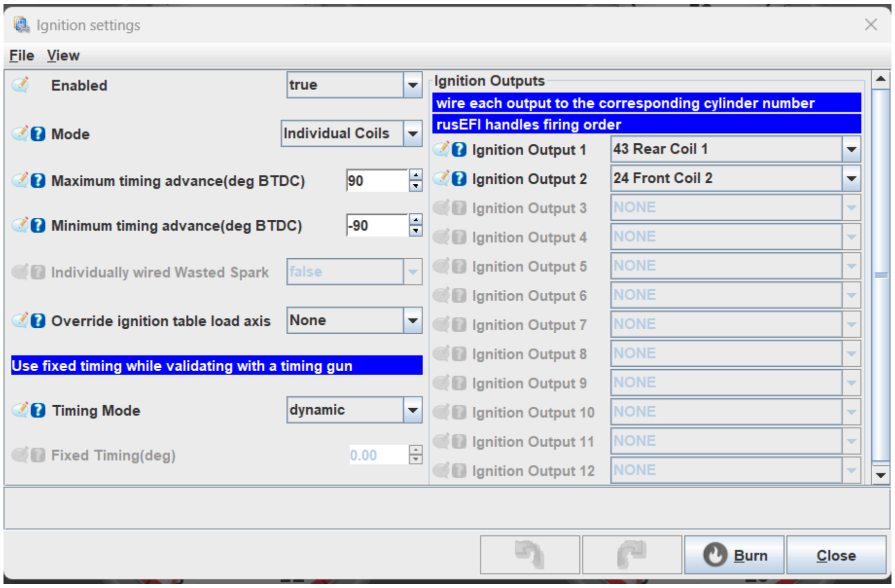
8. Knock Control: Configuration for knock detection and response. This setting allows you to adjust sensitivity and response to knock events, potentially adjusting timing to prevent engine damage.

9. Max Knock Retard: Sets the maximum degree of timing retardation allowed in response to detected knock. This helps protect the engine by reducing timing aggressively if knock is detected within safe limits.

Each of these options provides specific control over different aspects of the ignition system, allowing you to tailor the ignition timing and behavior to meet the performance, efficiency, and safety requirements of your setup.

Ignition Settings

The **Ignition Settings** window provides configuration for the type of ignition system, timing parameters, and output settings. Here's a detailed explanation of each option:



Enabled: true

Mode: Individual Coils

Maximum timing advance(deg BTDC): 90

Minimum timing advance(deg BTDC): -90

Individually wired Wasted Spark: false

Override ignition table load axis: None

Use fixed timing while validating with a timing gun

Timing Mode: dynamic

Fixed Timing(deg): 0.00

Ignition Outputs

wire each output to the corresponding cylinder number

rusEFI handles firing order

Ignition Output 1: 43 Rear Coil 1
Ignition Output 2: 24 Front Coil 2
Ignition Output 3: NONE
Ignition Output 4: NONE
Ignition Output 5: NONE
Ignition Output 6: NONE
Ignition Output 7: NONE
Ignition Output 8: NONE
Ignition Output 9: NONE
Ignition Output 10: NONE
Ignition Output 11: NONE
Ignition Output 12: NONE

Ignition Mode

Under the **Mode** dropdown, you can select the ignition configuration type.

The available options are:

- **Single Coil:**
  Suitable for distributor-based systems, where a single coil serves all cylinders.
- **Individual Coils:** One coil per cylinder (coil-on-plug or coil-near-plug setups). This mode requires sequential injection mode.
- **Wasted Spark:** Fires paired cylinders together, either using one coil per pair or one coil per cylinder. This is common in simpler ignition systems.
- **Two Distributors:** A pair of distributors,

Timing Parameters

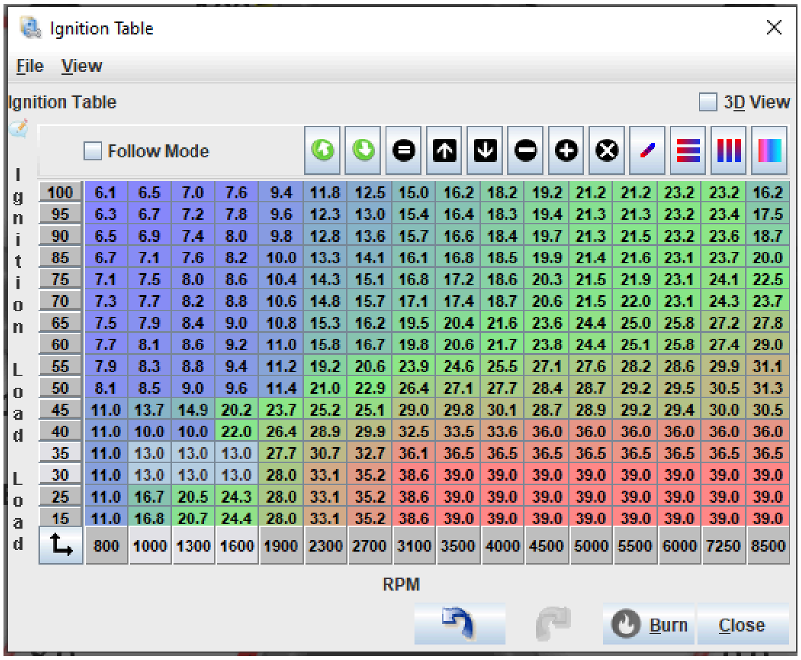
- **Maximum Timing Advance (deg BTDC):** Limits the maximum timing advance to ensure safe ignition settings during tuning.
- **Minimum Timing Advance (deg BTDC):** Prevents the timing from retarding too far, protecting the engine during operations like starting.
- **Use Fixed Timing While Validating:** Enables the use of fixed timing (set in the "Static Timing" mode) for validating timing with a timing gun.
- **Override Ignition Table Load Axis:** Allows the ignition table's load axis to be overridden with a custom axis, which is useful for advanced tuning.

Timing Mode

The **Timing Mode** dropdown has two options:

- **Dynamic:** Uses the ignition timing map to determine timing dynamically during engine operation.
- **Static:** Fixes the timing to the specified value (set in the "Fixed Timing" field). This mode is typically used for verifying static timing with a timing light during setup.

Ignition Advance Table



100	6.1	6.5	7.0	7.6	9.4	11.8	12.5	15.0	16.2	18.2	19.2	21.2	21.2	23.2	23.2	16.2
95	6.3	6.7	7.2	7.8	9.6	12.3	13.0	15.4	16.4	18.3	19.4	21.3	21.3	23.2	23.4	17.5
90	6.5	6.9	7.4	8.0	9.8	12.8	13.6	15.7	16.6	18.4	19.7	21.3	21.5	23.2	23.6	18.7
85	6.7	7.1	7.6	8.2	10.0	13.3	14.1	16.1	16.8	18.5	19.9	21.4	21.6	23.1	23.7	20.0
75	7.1	7.5	8.0	8.6	10.4	14.3	15.1	16.8	17.2	18.6	20.3	21.5	21.9	23.1	24.1	22.5
70	7.3	7.7	8.2	8.8	10.6	14.8	15.7	17.1	17.4	18.7	20.6	21.5	22.0	23.1	24.3	23.7
65	7.5	7.9	8.4	9.0	10.8	15.3	16.2	19.5	20.4	21.6	23.6	24.4	25.0	25.8	27.2	27.8
60	7.7	8.1	8.6	9.2	11.0	15.8	16.7	19.8	20.6	21.7	23.8	24.4	25.1	25.8	27.4	29.0
55	7.9	8.3	8.8	9.4	11.2	19.2	20.6	23.9	24.6	25.5	27.1	27.6	28.2	28.6	29.9	31.1
50	8.1	8.5	9.0	9.6	11.4	21.0	22.9	26.4	27.1	27.7	28.4	28.7	29.2	29.5	30.5	31.3
45	11.0	13.7	14.9	20.2	23.7	25.2	25.1	29.0	29.8	30.1	28.7	28.9	29.2	29.4	30.0	30.5
40	11.0	10.0	10.0	22.0	26.4	28.9	29.9	32.5	33.5	33.6	36.0	36.0	36.0	36.0	36.0	36.0
35	11.0	13.0	13.0	13.0	27.7	30.7	32.7	36.1	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5
30	11.0	13.0	13.0	13.0	28.0	33.1	35.2	38.6	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0
25	11.0	16.7	20.5	24.3	28.0	33.1	35.2	38.6	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0
15	11.0	16.8	20.7	24.4	28.0	33.1	35.2	38.6	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0
	800	1000	1300	1600	1900	2300	2700	3100	3500	4000	4500	5000	5500	6000	7250	8500

RPM

The **Ignition Table** configures the spark timing based on RPM (horizontal axis) and engine load (vertical axis). It is essential for fine-tuning engine performance, efficiency, and safety.

1. High Compression and Turbocharged Timing: In (higher load), the ignition timing is conservative (lower values) to avoid pre-ignition or detonation.

2. Deceleration Pops: The lower rows (lower load values) have higher timing values during deceleration. This intentionally advanced ignition helps remove any deceleration pops/bangs commonly seen with some pipes.

3. Mid-Range Efficiency: In mid-load and mid-RPM regions (e.g., 50-65 kPa, 2700 RPM), timing values are optimized for fuel efficiency and smooth power delivery, typically between 20-30 degrees BTDC.

4. High RPMs: At higher RPMs and moderate loads, timing is slightly advanced, to maintain performance without causing knocking.

Notes for Tuning

- **Turbocharged Engines:** Timing must be carefully monitored and adjusted for safety in high-boost areas. Use knock sensors and data logging to detect potential detonation.
- **Engine-Specific**: Timing values depend heavily on engine design, fuel type, and compression ratio.

This table is a guideline and may not apply to all setups.

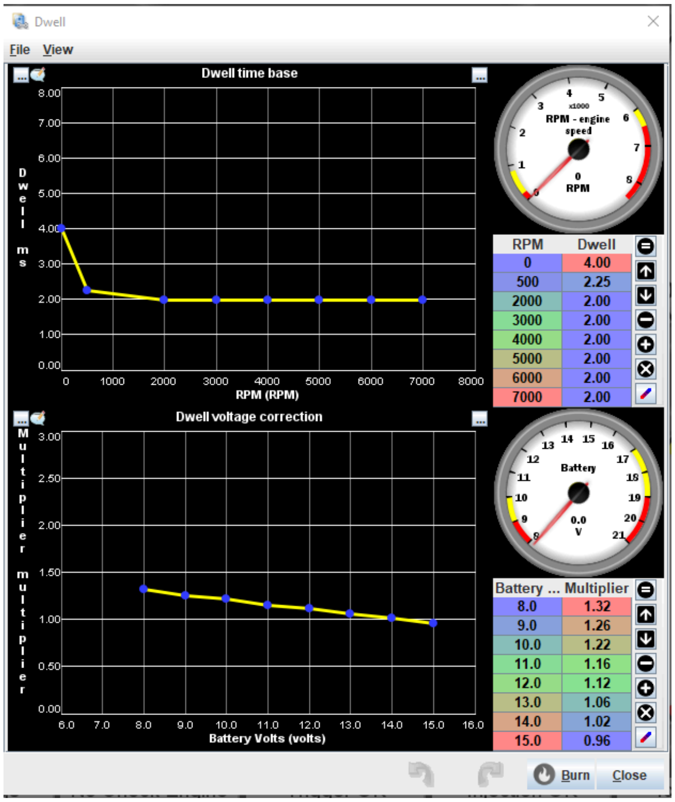
Final Advice

Before using this table, ensure your injectors, fuel map, and load axis are correctly configured.

Fine-tune values with data logging and dynamometer testing to align with your specific engine's requirements and desired performance characteristics.

Dwell Settings

The **Dwell Settings** section provides critical control over ignition coil charge time, which impacts spark energy and ignition system performance. These tables ensure proper ignition timing and spark strength across different RPM and voltage conditions.



RPM	Dwell
0	4.00
500	2.25
2000	2.00
3000	2.00
4000	2.00
5000	2.00
6000	2.00
7000	2.00

Battery ...	Multiplier
8.0	1.32
9.0	1.26
10.0	1.22
11.0	1.16
12.0	1.12
13.0	1.06
14.0	1.02
15.0	0.96

Dwell Time Base (Top Graph)

Purpose: Adjusts the base dwell time (in milliseconds) relative to engine RPM.

Explanation:

- At lower RPMs, dwell time is higher (e.g., 4 ms at 0 RPM) to fully charge the ignition coil.
- As RPM increases, dwell time decreases (e.g., 2.00 ms at 7000 RPM) to ensure the coil can charge and discharge within the shorter cycle times.

Tuning Note:

- Excessively high dwell times at higher RPMs can cause coil saturation and heat damage.
- Too low dwell times can lead to weak sparks or misfires.

Dwell Voltage Correction (Bottom Graph)

Purpose:
Modifies dwell time based on battery voltage to maintain consistent spark energy.

Explanation:

- At lower battery voltages, dwell time is increased (multiplier > 1.0) to compensate for reduced coil charging efficiency.
- At higher voltages, dwell time is reduced (multiplier < 1.0) to prevent overheating or overcharging the coil.
- **Example:** At 8.0 volts, the multiplier is 1.40; at 16.0 volts, the multiplier drops to 0.80.

General Notes

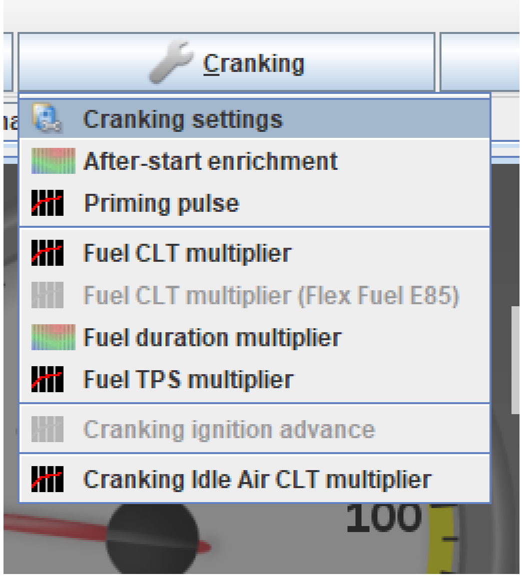
RPM Table: Values typically start around 2.0-4.0 ms at idle and reduce as RPM rises.

Battery Voltage Table: Correct compensation is vital for engines with weak electrical systems or those running additional electrical loads.

Tuning Advice: These settings typically will never have to be changed unless switching to aftermarket ignition coils.

Cranking Button in TS

Cranking Button Dropdown



The Cranking dropdown provides a set of configuration options focused on engine startup conditions. Proper tuning of these settings ensures smooth and reliable engine starts across various conditions.

Options Overview

1. Cranking Settings: Configures the parameters used during the cranking phase of engine startup, such as cranking RPM thresholds and duration.

2. After-Start Enrichment: Fine-tunes fuel delivery immediately after the engine starts to stabilize idle and warm-up conditions.

3. Priming Pulse: Controls the initial fuel injection pulse when the key is turned on, which helps to pressurize the fuel system and prepare for engine start.

4. Fuel CLT Multiplier: Adjusts fuel delivery based on coolant temperature (CLT) during cranking to account for cold or warm starts.

5. Fuel CLT Multiplier (Flex Fuel E85): Provides additional adjustments for engines using E85 or other ethanol-based fuels, allowing for temperature-based enrichment.

6. Fuel TPS Multiplier: Alters fuel delivery during cranking based on throttle position (TPS), useful for adjusting startup enrichment during open-throttle starts.

7. Cranking Ignition Advance: Configures the ignition timing used during cranking. This is critical for achieving smooth engine starts without backfires or misfires.

8. Cranking Idle Air CLT Multiplier: Modifies idle air control settings during cranking based on coolant temperature, ensuring optimal airflow for various startup conditions.

Tuning Notes

Fuel CLT Multiplier: Higher enrichment (higher multiplier) is typically required for cold starts, while warm starts require lower enrichment.

Cranking Ignition Advance: Advance settings should be conservative to avoid kickback but optimized for smooth ignition.

Flex Fuel Adjustments: If using ethanol-based fuels, ensure the Flex Fuel CLT multiplier matches the fuel's temperature-dependent characteristics.

Cranking Settings

This dialog box allows you to configure the parameters for the engine's cranking phase. Proper configuration ensures efficient starts under various operating conditions.

Cranking Settings

Cranking RPM Limit (RPM): Defines the RPM threshold below which the engine is considered to be in cranking mode.

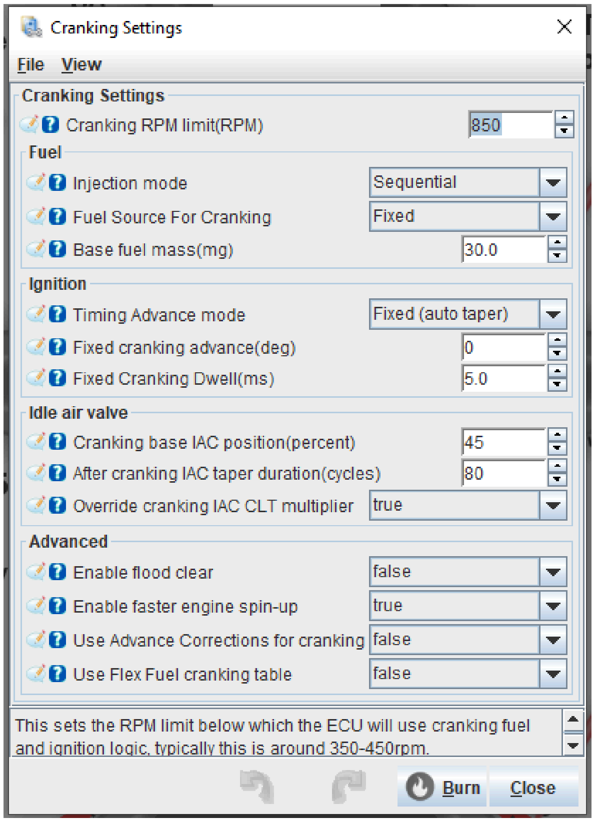
- Default: 850 RPM. Adjust as needed for different starter speeds.

Fuel Settings

Injection Mode: Specifies how fuel is injected during cranking:

- **Simultaneous:** All injectors fire together.
- **Batch:** Injectors fire in pairs.
- **Sequential:** Injectors fire in sync with engine timing (requires crank/cam sync).

Default is typically Sequential and won't usually need to be changed



Cranking Settings

Cranking RPM limit(RPM): 850

Fuel

Injection mode: Sequential

Fuel Source For Cranking: Fixed

Base fuel mass(mg): 30.0

Ignition

Timing Advance mode: Fixed (auto taper)

Fixed cranking advance(deg): 0

Fixed Cranking Dwell(ms): 5.0

Idle air valve

Cranking base IAC position(percent): 45

After cranking IAC taper duration(cycles): 80

Override cranking IAC CLT multiplier: true

Advanced

Enable flood clear: false

Enable faster engine spin-up: true

Use Advance Corrections for cranking: false

Use Flex Fuel cranking table: false

This sets the RPM limit below which the ECU will use cranking fuel and ignition logic, typically this is around 350-450rpm.

Fuel Source for Cranking:

- **Fixed:** Uses a predefined fuel mass for cranking.
- **Fuel Map:** Uses a fuel map to calculate fuel delivery.

Note: The **Base Fuel Mass (mg**) setting is disabled when using the Fuel Map option, because the VE tables are used for cranking

Base Fuel Mass (mg): Specifies the base amount of fuel injected during cranking when the Fixed fuel source is selected. Typical values range from 20 - 35 mg

Ignition Settings

Timing Advance Mode: Controls how ignition timing is handled during cranking

- **Fixed (auto taper):** Starts with a fixed timing and transitions to dynamic timing as RPM increases.
- **Table:** Uses the Cranking Ignition Advance Table for ignition timing (accessible through the dropdown menu under the Cranking button).

Fixed Cranking Advance (deg): The ignition timing in degrees before top dead center (BTDC) during cranking. **NOTE:** This setting is only used in the Fixed (auto taper) mode.
Example: A typical value is 0 degrees BTDC.

Fixed Cranking Dwell (ms): The dwell time for ignition coils during cranking.

Idle Air Valve Settings

Cranking Base IAC Position (percent): Sets the idle air control (IAC) valve position during cranking. Higher values allow more airflow to help the engine start.

After Cranking IAC Taper Duration (cycles): Determines how long the IAC valve gradually returns to its normal position after the engine starts.

Override Cranking IAC CLT Multiplier: When enabled, uses the coolant temperature (CLT) multiplier to adjust the IAC position during cranking.

Advanced Settings

Enable Flood Clear: Allows the driver to clear a flooded engine by fully pressing the throttle during cranking. Fuel injection is cut off until the throttle is released.

Enable Faster Engine Spin-Up: Reduces cranking timing delay to help the engine spin up faster.
Use Advance Corrections for Cranking: Allows the application of timing advance corrections during cranking.
Use Flex Fuel Cranking Table: Enables specific cranking fuel adjustments for engines running on ethanol-based fuels (e.g., E85).

Cranking Coolant Temperature Multiplier

This table adjusts the amount of fuel delivered during cranking based on the engine's coolant temperature.

The multiplier values ensure that the engine receives the appropriate amount of fuel for starting in different temperature conditions.

Understanding the Graph

X-Axis (Coolant Temperature):

- Ranges from -20°C to 90°C in this example.
- Represents the engine's coolant temperature.

Y-Axis (Multiplier Ratio):

- Represents the scaling factor applied to the base fuel mass during cranking.

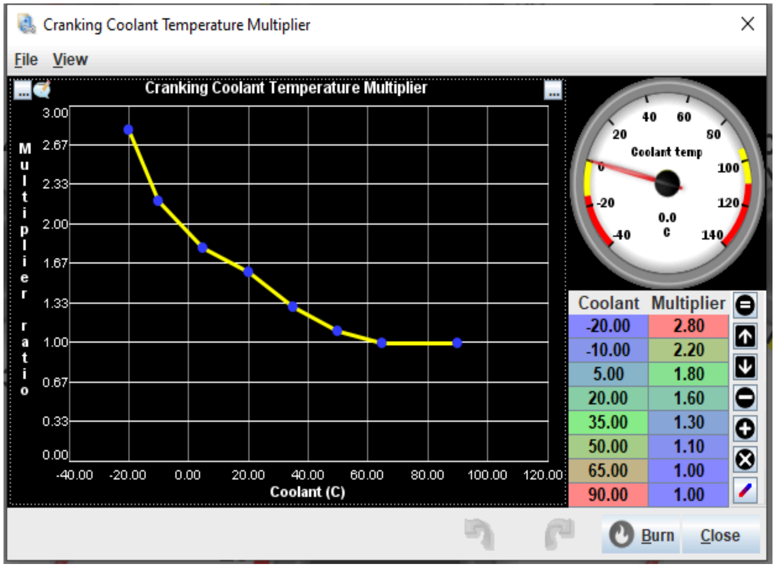
Typical Behavior

Cold Starts:

- At lower temperatures (e.g., -20°C), the multiplier is higher (e.g., 3.00).
- This delivers significantly more fuel to compensate for poor fuel atomization in cold conditions.

Warm Starts:

- As the temperature increases, the multiplier gradually decreases.
- Around ~60°C and above, the multiplier typically stabilizes at 1.00, indicating no additional fueling is required for starting.

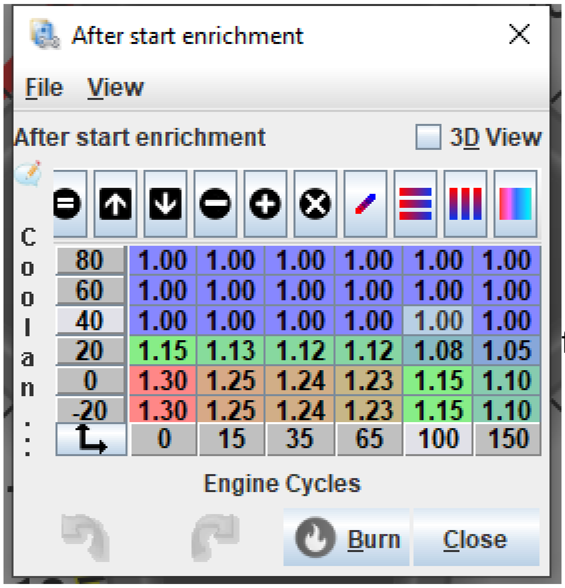


Coolant	Multiplier
-20.00	2.80
-10.00	2.20
5.00	1.80
20.00	1.60
35.00	1.30
50.00	1.10
65.00	1.00
90.00	1.00

Recommendations

- These values are preconfigured for most engines but may require fine-tuning for modified setups or extreme climates.
- For modified engines, particularly those with larger injectors, adjust the multiplier values proportionally to match the fuel system's characteristics.

After Start Enrichment



80	1.00	1.00	1.00	1.00	1.00	1.00
60	1.00	1.00	1.00	1.00	1.00	1.00
40	1.00	1.00	1.00	1.00	1.00	1.00
20	1.15	1.13	1.12	1.12	1.08	1.05
0	1.30	1.25	1.24	1.23	1.15	1.10
-20	1.30	1.25	1.24	1.23	1.15	1.10
	0	15	35	65	100	150

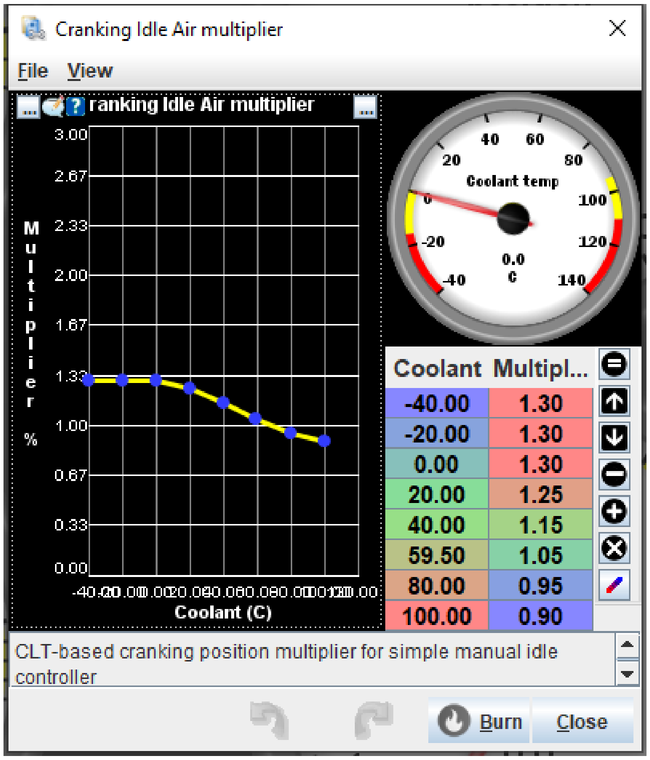
- Ensure higher multipliers at very low temperatures to facilitate reliable cold starts.

Warm Conditions:

- Multipliers near or at 1.00 are suitable for warm engine starts to prevent over-fueling.

This table, like others, is essential for achieving reliable starts and maintaining consistent cranking performance across a range of temperatures.

Cranking Idle Air Multiplier



Coolant	Multipl...
-40.00	1.30
-20.00	1.30
0.00	1.30
20.00	1.25
40.00	1.15
59.50	1.05
80.00	0.95
100.00	0.90

CLT-based cranking position multiplier for simple manual idle controller

This table controls the multiplier applied to the idle air control valve (IAC) during engine cranking, based on the coolant temperature. It ensures that the engine receives the appropriate amount of air for reliable starts in varying thermal conditions.

X-Axis (Coolant Temperature):

- Ranges from -40°C to 100°C in this example.
- Represents the engine's coolant temperature.

Y-Axis (Multiplier):

- Represents the scaling factor applied to the base IAC position during cranking.

Typical Behavior

Cold Starts

- At very low temperatures (e.g., -40°C), the multiplier is highest (e.g., 1.30).
- This opens the idle air control valve more to provide additional airflow for starting in cold conditions.

Warm Starts:

- As the temperature increases, the multiplier gradually decreases.
- Above 40°C, the multiplier stabilizes at lower values (e.g., 1.15 or less), indicating reduced airflow adjustment is required.

Recommended Adjustments:

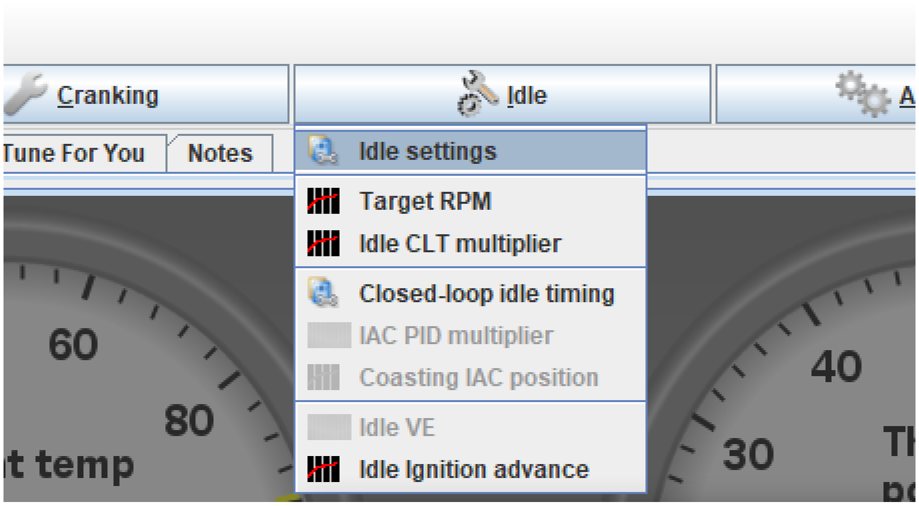
- These values are pre-tuned in Impact ECU Plug and Play units but may need tuning for modified setups or extreme temperature environments.
- Ensure higher multipliers for very cold starts to allow sufficient airflow for smooth ignition.
- For warm starts, adjust the table to avoid unnecessary over-compensation, which could lead to excessive RPM during cranking.

Cold Start Behavior:

- Multipliers greater than 1.30 at very low temperatures help offset increased engine friction and reduced air density.

Idle Button in TS

The **Idle menu** contains options that govern how the ECU manages idle speed and idle-related parameters. These settings allow fine-tuning of idle stability, responsiveness, and performance under various conditions.



Menu Options

1. Idle Settings: General configuration for idle control, including modes of operation and idle valve control.

2. Target RPM: A table that specifies the desired idle RPM for various operating conditions (e.g., coolant temperature, load).

3. Idle CLT Multiplier: Adjusts idle air flow based on coolant temperature using a multiplier.

4. Closed-Loop Idle Timing: Enables closed-loop control for idle stabilization through ignition timing adjustments.

5. IAC PID Multiplier: Configures the proportional-integral-derivative (PID) controller for IAC valve operation.

6. Coasting IAC Position: Adjusts the IAC valve's behavior during deceleration to prevent engine stalling.

7. Idle VE: Refines the volumetric efficiency (VE) table for idle-specific regions.

8. Idle Ignition Advance: Fine-tunes ignition advance during idle to stabilize engine RPM and improve
responsiveness.

Idle Settings

Idle Control Mode

Options:

- **Open Loop:** Sets a fixed idle position without sensor feedback.
- **Open Loop + Closed Loop:** Combines a fixed base position with real-time adjustments using sensor feedback.

Recommendation:
Use Open Loop + Closed Loop for optimal idle stability, especially for engines with varying loads.

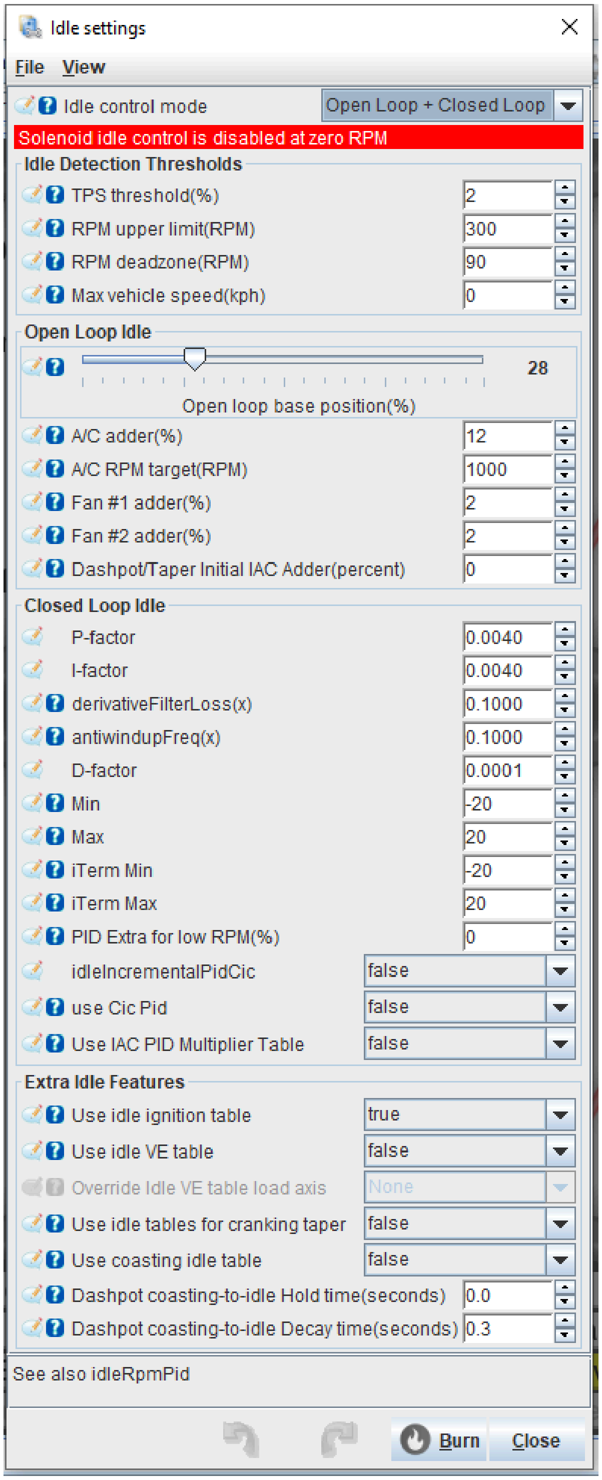
Idle Detection Thresholds

These thresholds define when the ECU determines the engine is in an idle state

- **TPS Threshold (%):** Maximum throttle position to consider the engine idling.
- **RPM Upper/Lower Limits:** Define the RPM range for idle control activation.
- **Max Vehicle Speed (kph):** Sets a speed threshold below which idle control is active.

Open Loop Idle

- **Open Loop Base Position (%):** Controls the fixed airflow position for open-loop mode.
- **Fan Adders (%):** Compensate for additional electrical loads when fans are active.



Idle control mode	Open Loop + Closed Loop

Solenoid idle control is disabled at zero RPM

Idle Detection Thresholds

TPS threshold(%)	2
RPM upper limit(RPM)	300
RPM deadzone(RPM)	90
Max vehicle speed(kph)	0

Open Loop Idle

Open loop base position(%)	28
A/C adder(%)	12
A/C RPM target(RPM)	1000
Fan #1 adder(%)	2
Fan #2 adder(%)	2
Dashpot/Taper Initial IAC Adder(percent)	0

Closed Loop Idle

P-factor	0.0040
I-factor	0.0040
derivativeFilterLoss(x)	0.1000
antiwindupFreq(x)	0.1000
D-factor	0.0001
Min	-20
Max	20
iTerm Min	-20
iTerm Max	20
PID Extra for low RPM(%)	0
idleIncrementalPidCic	false
use Cic Pid	false
Use IAC PID Multiplier Table	false

Extra Idle Features

Use idle ignition table	true
Use idle VE table	false
Override Idle VE table load axis	None
Use idle tables for cranking taper	false
Use coasting idle table	false
Dashpot coasting-to-idle Hold time(seconds)	0.0
Dashpot coasting-to-idle Decay time(seconds)	0.3

See also idleRpmPid

- **Dashboard/Taper IAC Adder (%):** Adds airflow to stabilize transitions during open-loop operation.

Closed Loop Idle

These parameters are pre-set in the Impact ECU and should typically never be modified unless instructed otherwise by our support team!

- **PID Parameters:** These control how the ECU stabilizes idle RPM dynamically:
- **P-factor, I-factor, D-factor:** Parameters that tune proportional, integral, and derivative control.
- **Min/Max and I-Term Ranges:** Restrict corrections to prevent over- or under-compensation.
- **Anti-windup Frequency:** Prevents integral overshoot during large deviations.

Extra Idle Features

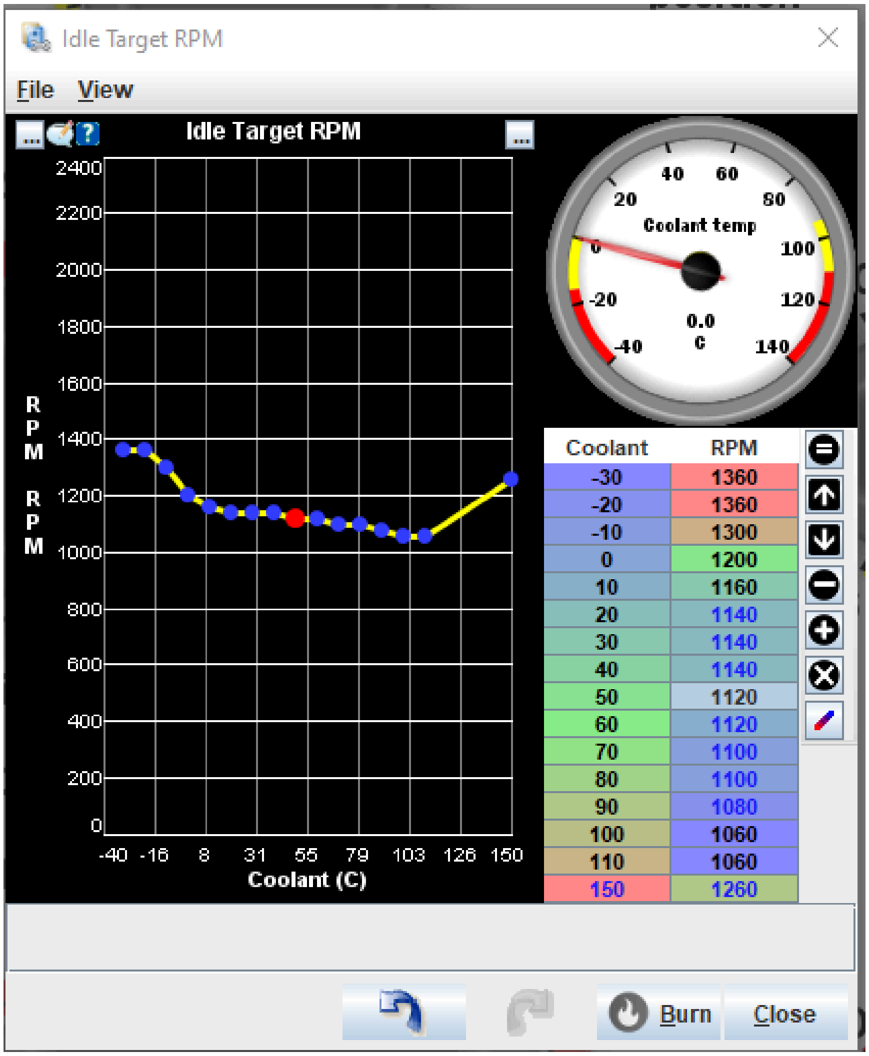
1. Use Idle Ignition Table: Uses a specific ignition map to improve idle stability.
2. Use Idle VE Table: Activates a separate VE table for idle conditions, offering precise control.
3. Override Idle VE Table Load Axis: Advanced option; typically left at default.
4. Dashpot Settings:

- **Dashpot Coasting-to-Idle Hold Time (seconds):** Controls how long the idle valve holds an elevated position during a transition from coasting to idle. This helps prevent a sharp RPM drop that could stall the engine.

- **Dashpot Coasting-to-Idle Decay Time (seconds):** Determines how quickly the idle valve returns to its normal position after coasting.

Idle Target RPM

Under the **"Idle Target RPM"** settings, the table shown allows for adjustment of the target idle RPM based on coolant temperature.



Coolant	RPM
-30	1360
-20	1360
-10	1300
0	1200
10	1160
20	1140
30	1140
40	1140
50	1120
60	1120
70	1100
80	1100
90	1080
100	1060
110	1060
150	1260

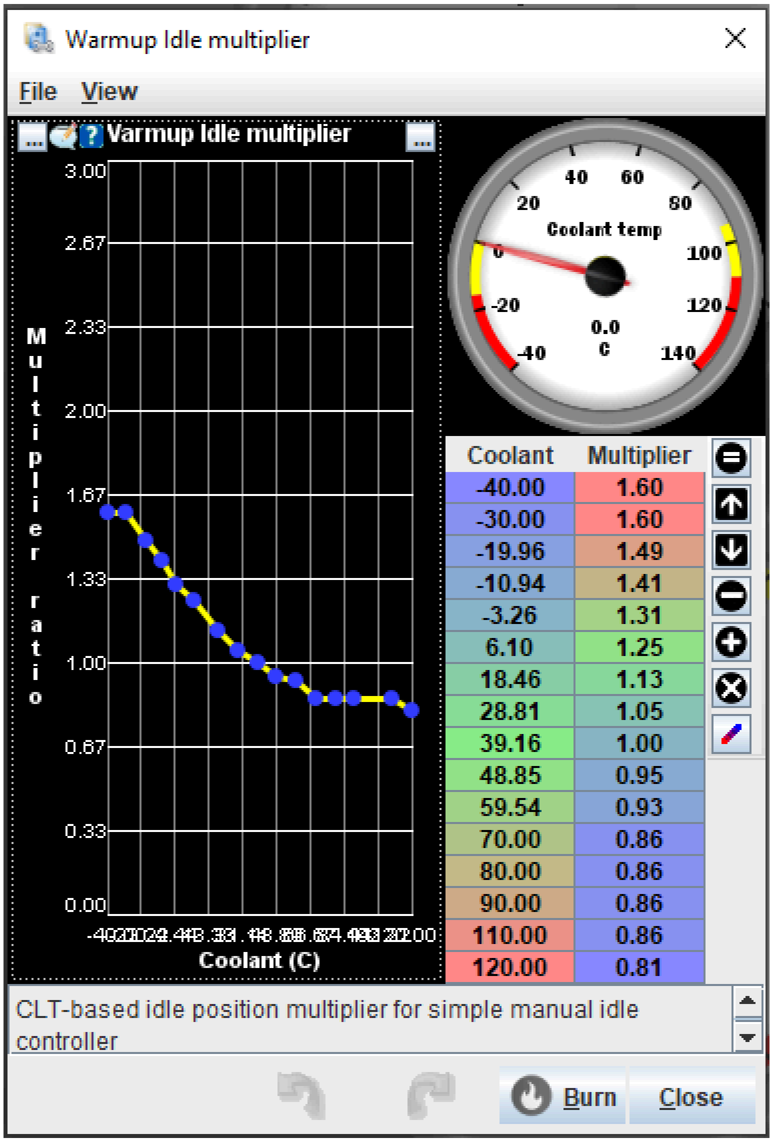
In this example:

- **Colder Temperatures:** Higher RPMs are set for colder temperatures to help the engine warm up more quickly. As coolant temperature rises, the target RPM gradually decreases.
- **Warmer Temperatures:** The target RPM lowers to a stable idle speed as the engine reaches normal operating temperature, typically around 1000 –1060 RPM.
- **High Coolant Temperatures:** In this configuration, the idle RPM is set to increase slightly above 100°C as an extra precaution to cool the engine.

This setup ensures that the engine operates smoothly across various temperature conditions and helps avoid stalling when the engine is cold.

Warmup Idle Multiplier

This table adjusts the open-loop idle position based on coolant temperature, providing a
multiplier to the base "Open Loop Value" set in the Idle Settings.



Coolant	Multiplier
-40.00	1.60
-30.00	1.60
-19.96	1.49
-10.94	1.41
-3.26	1.31
6.10	1.25
18.46	1.13
28.81	1.05
39.16	1.00
48.85	0.95
59.54	0.93
70.00	0.86
80.00	0.86
90.00	0.86
110.00	0.86
120.00	0.81

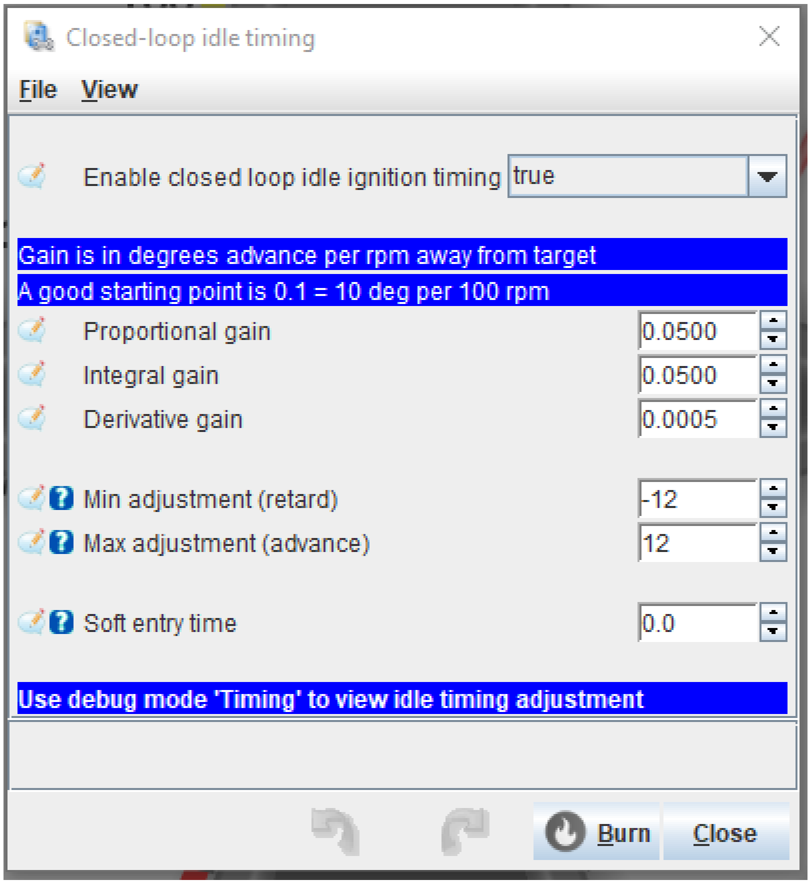
CLT-based idle position multiplier for simple manual idle controller

- **Colder Temperatures:** The multiplier is higher (e.g., 1.60 in this example) to increase the idle position for cold starts, helping the engine warm up faster and maintain stability during initial operation.
- **Warmer Temperatures:** The multiplier decreases as the engine reaches operating temperature, typically leveling to 1.00 at normal operating conditions.
- **Hot Temperatures:** In this example, a slight reduction below 1.00 is applied when the engine is above 50°C to help reduce idle air and avoid excess load on the cooling system.

This table allows fine-tuning for varying coolant temperatures to ensure smooth idle transitions during warmup and at different temperature ranges.

Closed-Loop Idle Timing

This configuration adjusts ignition timing dynamically to help maintain a stable idle speed in closed-loop control mode. Timing adjustments are calculated based on the RPM deviation from the idle target.



Enable closed loop idle ignition timing	true

Gain is in degrees advance per rpm away from target

A good starting point is 0.1 = 10 deg per 100 rpm

Proportional gain	0.0500
Integral gain	0.0500
Derivative gain	0.0005
Min adjustment (retard)	-12
Max adjustment (advance)	12
Soft entry time	0.0

Use debug mode 'Timing' to view idle timing adjustment

Enable Closed-Loop Idle Ignition Timing: When set to true, the system dynamically adjusts ignition timing based on RPM deviations.

Proportional Gain:

- Specifies how much timing will be adjusted per RPM away from the target.
- A suggested starting point is 0.1, equating to 10° of adjustment for every 100 RPM of deviation.

Integral Gain: Adjusts the timing over time to account for sustained errors. Typically left at 0.0500 unless advanced tuning is required.

Derivative Gain: Helps to predict and counteract RPM changes based on the rate of change. The example value is 0.0050.

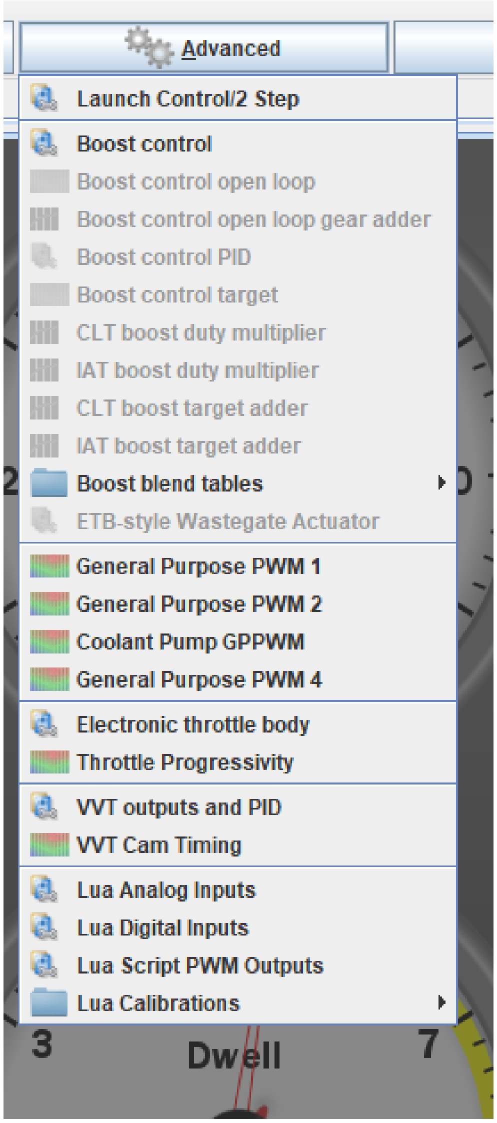
Min Adjustment (Retard) and Max Adjustment (Advance): Defines the allowable timing range for adjustments.
Example:

- Retard: -12° (timing can retard by up to 10°)
- Advance: +12° (timing can advance by up to 10°)

Soft Entry Time (sec): Introduces a delay to smoothly enable timing adjustments when transitioning into closed-loop idle control. The example value is 0.0 seconds.

Advanced Button in TS

Advanced Button Options - Overview



1. **Launch Control:** Configures the two-step launch control system, which holds the engine at a specific RPM for consistent launches. Parameters such as RPM limit and activation conditions can be adjusted.

2. **Shift Torque Reduction (Flat Shift):** Reduces torque during gear shifts by cutting ignition or retarding timing, designed for sequential or dog-box transmissions. This feature reduces stress and helps maintain boost during shifts. **NOTE: This is only available in firmware versions Greenville or Newer!**

3. **Boost Control:**

- **Open Loop:** Configures a fixed duty cycle for the boost control solenoid, operating without sensor feedback.
- **Open Loop Gear Adder:** Adjusts duty cycle based on the selected gear, enabling progressive boost control.
- **Duty Multiplier:** Dynamically scales the solenoid's duty cycle to modify boost behavior under various conditions.
- **Target:** Uses a closed-loop control system to achieve a specific boost pressure by monitoring the MAP sensor.

4. **Boost Blend Tables:** Allows blending between multiple boost control maps, determined by conditions such as load or RPM. Ideal for applications requiring different boost settings, such as varying fuel types or driving conditions.

5. **ETB-Style Wastegate Actuator:** Manages an electronic wastegate actuator, providing precise boost regulation beyond traditional vacuum-controlled wastegate systems.

6. **General Purpose PWM 1, 2, & 4:** Configures auxiliary PWM outputs for devices like boost control or airshift solenoids, nitrous control, or additional fans. Each output can be individually customized for the intended purpose.

7. **Coolant Pump GPPWM:** Configures control parameters for the water pump on 23.5+ models

8. **Electronic Throttle Body (ETB):** General throttle body settings, this is where the ETB voltages are set and ETB PIDs are Auto Calibrated.

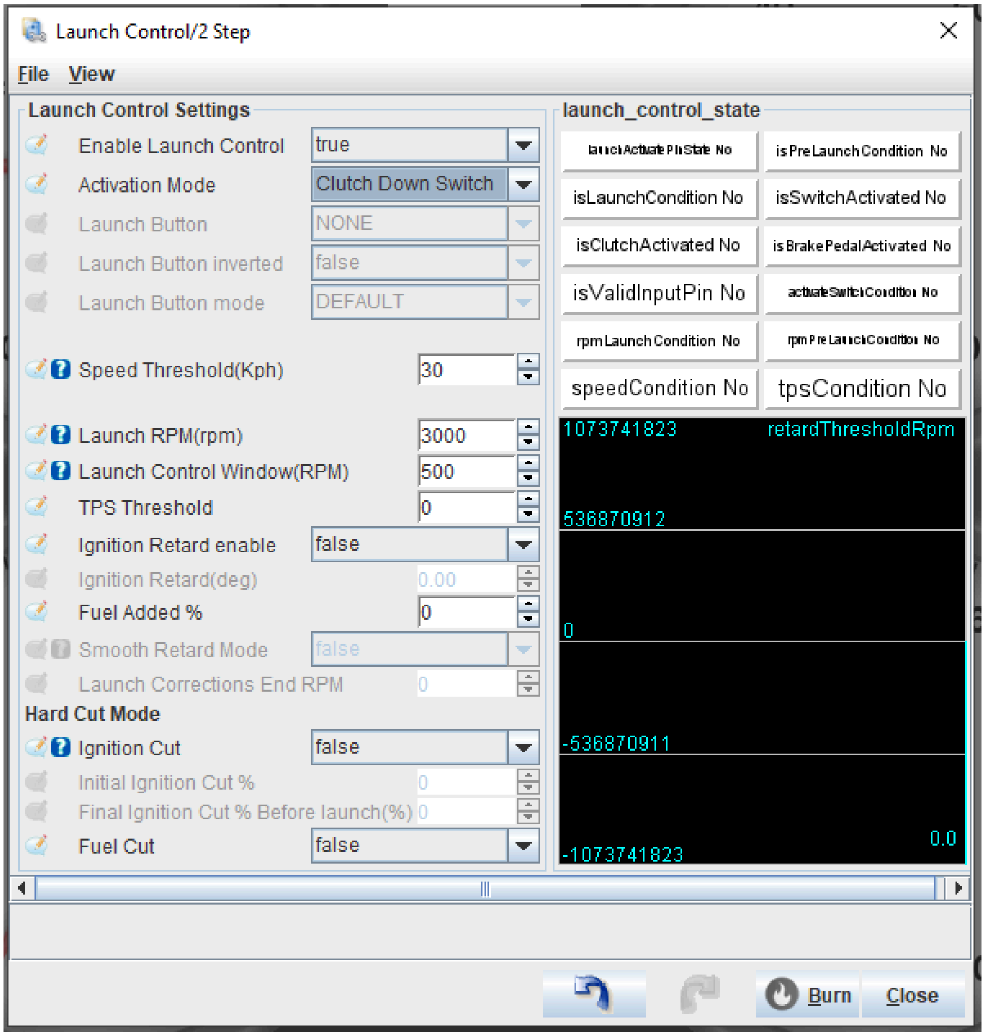
9. **Throttle Progressivity:** Configures the relationship between pedal position and throttle plate movement.

10. **VVT Outputs and PID**

11. **VVT Cam Timing:** Configures the target position for variable valve timing (VVT) on the camshaft.

Launch Control Settings

The **Launch Control** system ensures consistent and controlled launches by holding the engine at a specified RPM under specific conditions. Below is an explanation of the settings and functionalities:



Launch Control Settings

Enable Launch Control	true
Activation Mode	Clutch Down Switch
Launch Button	NONE
Launch Button inverted	false
Launch Button mode	DEFAULT
Speed Threshold(Kph)	30
Launch RPM(rpm)	3000
Launch Control Window(RPM)	500
TPS Threshold	0
Ignition Retard enable	false
Ignition Retard(deg)	0.00
Fuel Added %	0
Smooth Retard Mode	false
Launch Corrections End RPM	0
Hard Cut Mode	
Ignition Cut	false
Initial Ignition Cut %	0
Final Ignition Cut % Before launch(%)	0
Fuel Cut	false

launch_control_state

launchActivatePinState No	isPreLaunchCondition No
isLaunchCondition No	isSwitchActivated No
isClutchActivated No	isBrakePedalActivated No
isValidInputPin No	activateSwitchCondition No
rpmLaunchCondition No	rpmPreLaunchCondition No
speedCondition No	tpsCondition No

Settings Overview

1. Enable Launch Control: Toggles the activation of the launch control system.

- Options: true (enabled) or false (disabled).

2. Activation Mode: Determines how launch control is activated.

Options:

- **Launch Button:** Activated by pressing a designated button.
- **Clutch Down Switch:** Activated when the clutch is fully pressed.
- **Brake Pedal Activated:** Activated by pressing the brake pedal.
- **Speed Based:** Launch control is always active below the Speed Threshold, as long as other conditions (e.g., throttle position) are met.

3. Launch Button Settings:

- **Launch Button**: Assigns the input pin for the launch button.
- **Launch Button Inverted**: Inverts the button signal if necessary.
- **Launch Button Mode:** Configures signal behavior (e.g., DEFAULT, PULLDOWN).

4. Clutch Down Settings:

- **Clutch Down:** Assigns the clutch input pin if this activation mode is used.
- **Clutch Down Inverted:** Inverts the clutch signal if needed.
- **Clutch Down Mode:** Configures the clutch input behavior (PULLDOWN, PULLUP, etc.).

5. Speed Threshold (Kph): Launch control is only active below this speed when using Speed Based or other activation modes.

6. Launch RPM (RPM): Sets the target RPM during launch control. For example, a value of 3000 will hold the engine at 3000 RPM.

7. Launch Control Window (Rpm): Defines the range of RPM around the Launch RPM where the system engages corrections (e.g., ignition retard, fuel cut).

8. TPS Threshold: Specifies the minimum throttle position required to activate launch control.

Ignition Retard Options

Ignition Retard Enable: Toggles ignition retard during launch.

Ignition Retard (Deg): Amount of ignition retard applied in degrees (BTDC).

Fuel Added (%): Adjusts additional fueling during ignition retard.

Smooth Retard Mode: Gradually applies ignition retard for smoother launches.

Launch Corrections End RPM: This defines the amount of RPM before the Launch RPM where corrections like ignition retard and the final ignition cut percentage complete their transition. After this point, these corrections reach their final values and remain constant until the hard cut at Launch RPM.

Hard Cut Mode

- **Ignition Cut**: Toggles ignition cut functionality during launch.
- **Initial Ignition Cut (%):** Percentage of ignition cut when launch begins.
- **Final Ignition Cut % Before Launch (%):** Ignition cut applied just before the hard cut at Launch RPM.
- **Fuel Cut:** Toggles fuel cut functionality during launch control.

Launch Control States (Diagnostics)

The white indicators on the right turn red to show the current states of the launch control system, such as:

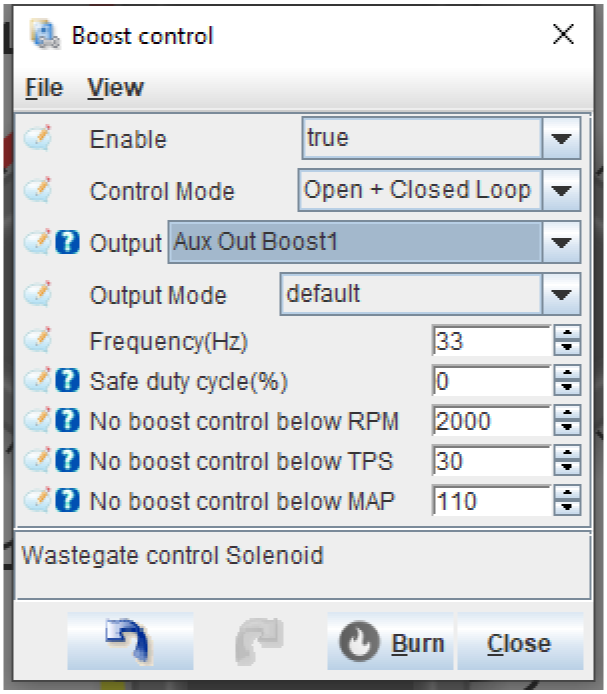
- **isLaunchCondition:** Launch conditions are met.
- **isClutchActivated:** Clutch is engaged.
- **speedCondition:** Speed threshold is met.
- **tpsCondition:** Throttle position threshold is met.

Boost Control

The **Boost Control** interface allows precise management of turbocharger or supercharger boost levels.

Below is a breakdown of the settings:

Boost Control Settings Overview



Enable: true
Control Mode: Open + Closed Loop
Output: Aux Out Boost1
Output Mode: default
Frequency(Hz): 33
Safe duty cycle(%): 0
No boost control below RPM: 2000
No boost control below TPS: 30
No boost control below MAP: 110

Wastegate control Solenoid

1. **Enable:** Toggles the boost control system.

- **Options:** true (enabled) or false (disabled).

2. **Control Mode:** Defines the method used to control boost levels.

Options:

- **Open Loop:** Boost is managed directly by the duty cycle specified in the boost tables or other settings without feedback.
- **Closed Loop:** Adjusts boost dynamically based on the desired target and sensor feedback

3. **Output:** Specifies the pin used to control the boost solenoid (e.g., AUX Out Boost 1 in this example).

4. **Output Mode:** Configures the electrical behavior of the boost output.

5. **Frequency (Hz):** The PWM frequency used to drive the boost solenoid. Typical values are between 15 and 30 Hz.

6. **Safe Duty Cycle (%):** The maximum duty cycle allowed in error conditions. This acts as a safety feature.

Boost Control Activation Thresholds
These thresholds define the conditions under which the boost control system becomes active.

Boost control will not function until all conditions are met:

- **No Boost Control Below RPM:** Minimum engine speed for activating boost control.

Example: 2000 RPM.

- **No Boost Control Below TPS (%):** Minimum throttle position for activating boost control.

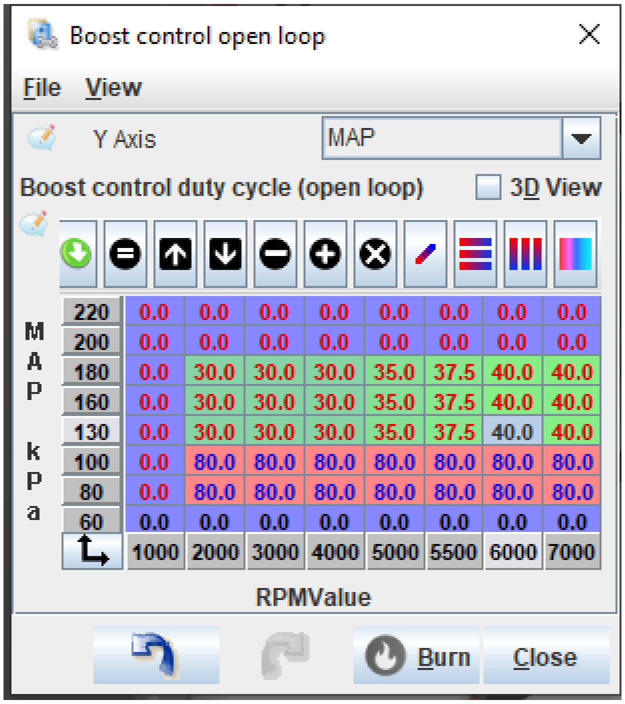
Example: 30%.

- **No Boost Control Below MAP (kPa):** Minimum manifold pressure required to activate boost control.

Example: 110 kPa.

Boost Control Open Loop Table

The **Boost Control Open Loop** table configures the PWM duty cycle for the boost solenoid based on engine RPM (X-axis) and a configurable secondary axis (Y-axis). In this example, the Y-axis is set to MAP (Manifold Absolute Pressure), though by default, it is TPS (Throttle Position Sensor).



Y Axis: MAP

Boost control duty cycle (open loop)

☐ 3D View

MAP kPa								
220	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
180	0.0	30.0	30.0	30.0	35.0	37.5	40.0	40.0
160	0.0	30.0	30.0	30.0	35.0	37.5	40.0	40.0
130	0.0	30.0	30.0	30.0	35.0	37.5	40.0	40.0
100	0.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
80	0.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1000	2000	3000	4000	5000	5500	6000	7000

RPMValue

Table Overview

1. Y-Axis (MAP in Example): Represents the selected secondary parameter for tuning boost.
Common options include:

- **MAP (Manifold Absolute Pressure)**: Used for tuning based on engine load and boost levels.
- **TPS (Throttle Position Sensor):** Used for throttle-based boost control.

In this example, MAP ranges from 60 kPa (vacuum) to 220 kPa (boost pressure).

2. X-Axis (RPM)
Represents engine RPM, ranging from idle (1000 RPM) to high engine speeds (7000 RPM).

3. Cell Values (Duty Cycle)

- Each cell determines the duty cycle (%) applied to the boost solenoid.
- Higher duty cycle values increase boost pressure, while lower values decrease it.

Key Notes for Open Loop Tuning

1. Axis Configuration: The Y-axis can be switched between MAP, TPS, or other parameters depending on your tuning needs. The flexibility of this configuration allows for different boost control strategies.

2. Boost Curve Adjustment

- Lower RPMs or MAP/TPS values generally require lower duty cycles (e.g., 0% to 30%) to prevent over-boosting during turbo spool-up.

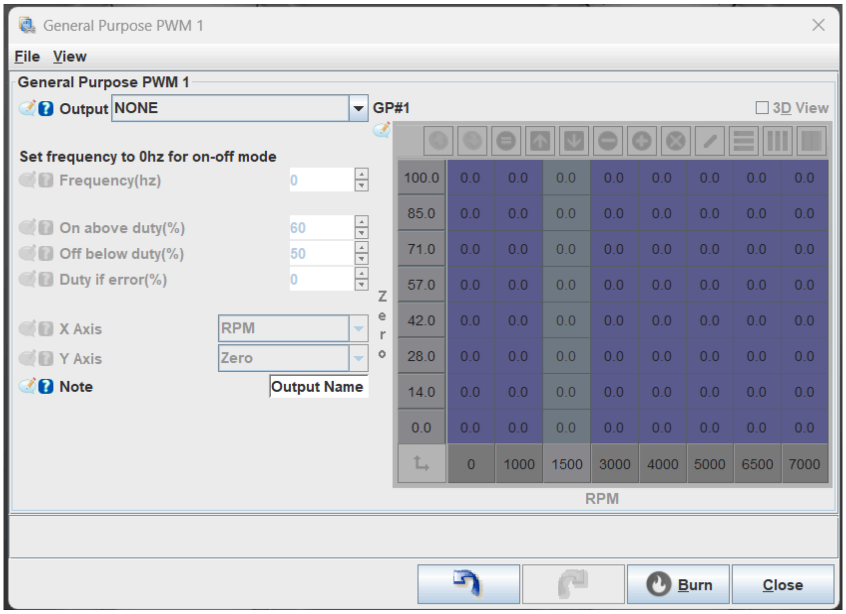
- At higher RPMs or MAP values, duty cycles typically increase (e.g., 40% to 80%) to sustain or achieve desired boost levels.

3. Safe Practices: Start with conservative duty cycles in all cells and gradually increase values during tuning to prevent excessive boost.

4. Closed Loop Transition: In systems that transition to closed-loop boost control, this table serves as the baseline. Closed-loop settings use feedback to refine control dynamically.

General Purpose PWM Table

The **General Purpose PWM** Table (GP PWM) allows configuring Pulse Width Modulation (PWM) outputs for custom control scenarios. This table is highly versatile and can be used for applications like nitrous solenoids, cooling fans, or additional auxiliary systems.



Output NONE

Set frequency to 0hz for on-off mode

Frequency(hz) 0

On above duty(%) 60

Off below duty(%) 50

Duty if error(%) 0

X Axis RPM

Y Axis Zero

Note Output Name

100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
85.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
71.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
↳	0	1000	1500	3000	4000	5000	6500	7000

Zero

RPM

Configuration Options

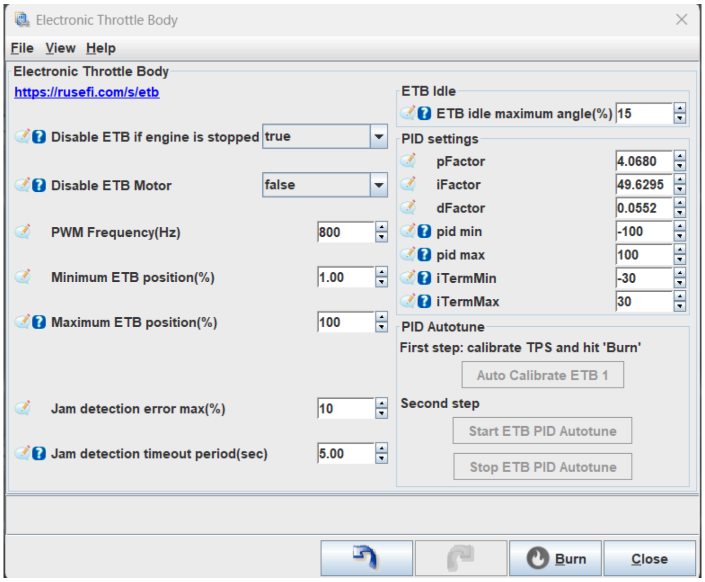
1. **Output:** Specifies the output pin to control. Set to NONE if the PWM feature is not being used.
2. **Frequency (Hz):** Sets the operating frequency of the PWM signal.
    - Set to 0 Hz if using the output in an on/off mode (not variable).
3. **Duty Cycle Thresholds:**
    - **On Above Duty (%):** The output is activated when the duty cycle exceeds this value.
    - **Off Below Duty (%):** The output is deactivated when the duty cycle drops below this value.
    - **Duty if Error (%):** Sets the fallback duty cycle in case of an error.
4. **X and Y Axes:** Define the parameters for the table axes, such as RPM, MAP, TPS, or custom inputs.
    - In this example, the X-axis is set to RPM, and the Y-axis is set to Zero.
5. **Duty Cycle Table:** The table allows configuring duty cycle values based on the selected X and Y axes.
    - Example: The highlighted 100% duty cycle in the table could be used for specific conditions like engaging a reverse lockout mechanism.

Notes for Use

- This table can adapt to a wide range of applications:
- Control solenoids or actuators (e.g., boost solenoids, nitrous, airshift solenoid).
- Operate fans or auxiliary pumps based on environmental conditions.
- The example shows a note specifying "reverse lockout," indicating its use to manage the activation of a reverse gear safety mechanism.

Electronic Throttle Body (ETB) Settings

The **Electronic Throttle Body (ETB)** configuration provides control over drive-by-wire throttle systems, enabling precise throttle control and customization for various applications.



Disable ETB if engine is stopped: true
Disable ETB Motor: false
PWM Frequency(Hz): 800
Minimum ETB position(%): 1.00
Maximum ETB position(%): 100
Jam detection error max(%): 10
Jam detection timeout period(sec): 5.00
ETB idle maximum angle(%): 15
pFactor: 4.0680
iFactor: 49.6295
dFactor: 0.0552
pid min: -100
pid max: 100
iTermMin: -30
iTermMax: 30
First step: calibrate TPS and hit 'Burn'
Second step

Main ETB Configuration

1. **Disable ETB if Engine is Stopped:** When enabled (true), the ETB is disabled when the engine is not running to conserve power and prevent unintentional movement.

2. **Disable ETB Motor:** When set to true, the throttle motor is disabled. Used for testing or diagnostics.

3. **PWM Frequency (Hz):** Defines the frequency for throttle motor control. Commonly set to 1000 Hz for optimal response.

4. **Minimum/Maximum ETB Position (%):** Restricts the range of throttle plate movement.
    - Example: Set 1% to 100% to define the fully closed and open positions

5. **Jam Detection Error Max (%) and Timeout Period (sec):** Sets thresholds for detecting and reacting to throttle plate jams.
    - The "Temporarily Disable Jam Detection" button disables detection for testing purposes until the next power cycle.

ETB Idle

ETB Idle Maximum Angle (%): Defines the maximum throttle angle allowed during idle control.

PID Settings:

- **Proportional (pFactor)**, **Integral (iFactor)**, and **Derivative (dFactor)** gains are adjustable for precise throttle control.

- **PID Min/Max:** Limits for PID output to avoid excessive or insufficient corrections.
- **iTerm Min/Max:** Boundaries for the integrative term to stabilize control without overshooting.

PID Autotune

Step 1:

- Auto-calibrate TPS to learn the fully open and closed positions.
- Hit Burn after calibration to save settings.

Step 2:

- Use Start ETB PID Autotune to let the system automatically fine-tune PID values based on throttle response.
- Stop the process when adjustments are complete, after about 30 seconds.

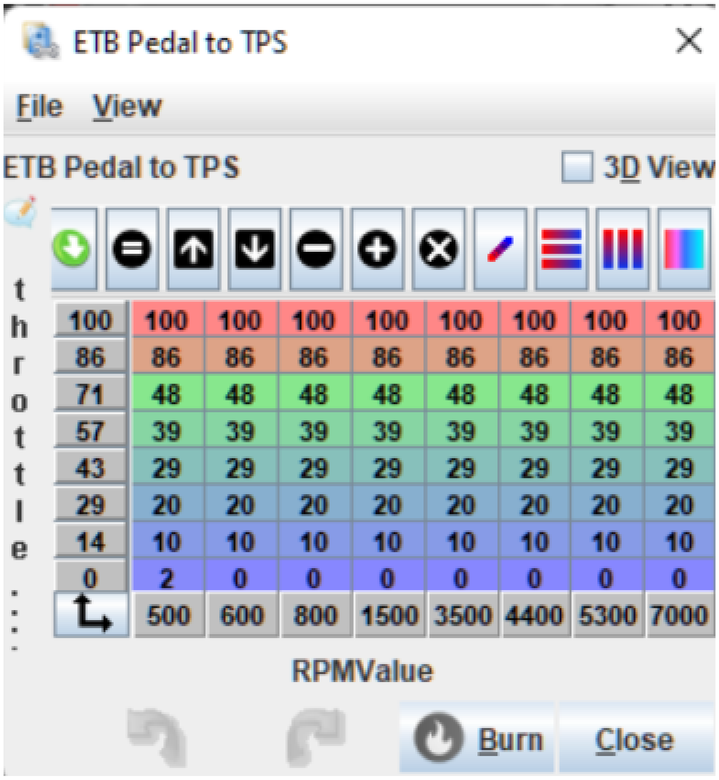
This section allows tuning the ETB system for smooth and accurate throttle control.

Throttle Progressivity

This table defines the relationship between **Twist Grip Sensor position** (input) and **throttle position sensor (TPS)** output based on **engine RPM.**

Explanation

1. **Columns (X-Axis):** Represent engine RPM values ranging from idle to the redline (e.g., 500 to 7000 RPM).
2. **Rows (Y-Axis):** Represent pedal position as a percentage from 0% (no pedal input) to 100% (full pedal input).
3. **Cells:** Define the throttle opening percentage for each combination of pedal position and engine RPM.
    - **Example:** At 50% pedal input and 1500 RPM, the throttle opens to 29%.



ETB Pedal to TPS

100	100	100	100	100	100	100	100	100
86	86	86	86	86	86	86	86	86
71	48	48	48	48	48	48	48	48
57	39	39	39	39	39	39	39	39
43	29	29	29	29	29	29	29	29
29	20	20	20	20	20	20	20	20
14	10	10	10	10	10	10	10	10
0	2	0	0	0	0	0	0	0
	500	600	800	1500	3500	4400	5300	7000

Notable Features

Nonlinear Throttle Response: Allows for custom throttle response curves based on user preference or engine requirements.

- Example: At lower pedal positions, throttle openings can be reduced for smoother driving.

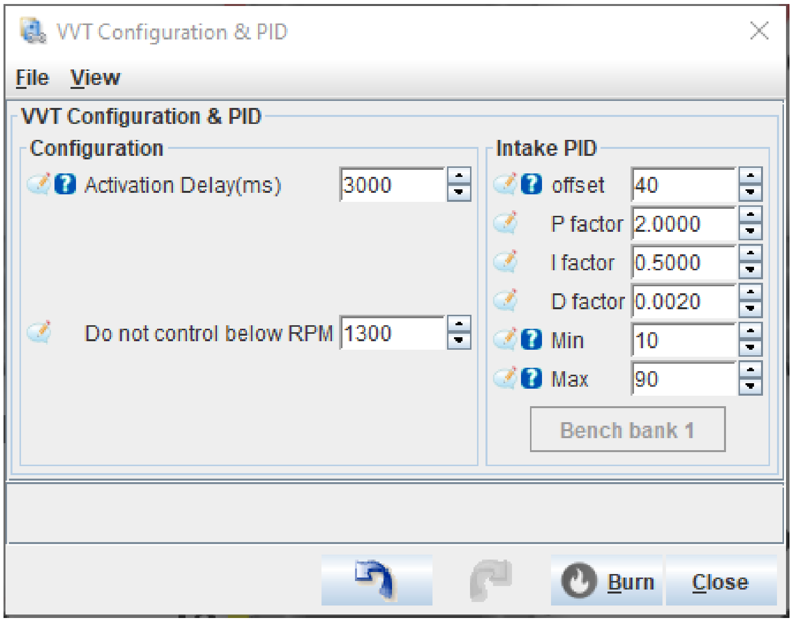
High RPM Full Opening: At higher RPMs and full pedal input, throttle position is usually set to 100% for maximum engine output.

Tuning Notes

- **Smoothness:** Ensure gradual transitions between cells to prevent abrupt throttle behavior.
- **RPM Dependency:** Adjust the table for specific engine characteristics or driving scenarios. For example, turbocharged engines may benefit from limiting throttle opening at lower RPMs to manage boost.

VVT Configuration & PID

This menu configures **Variable Valve Timing (VVT**) settings, and for Impact ECU should typically never need to be modified unless directed by our support team.



Activation Delay(ms) 3000

Do not control below RPM 1300

offset 40

P factor 2.0000

I factor 0.5000

D factor 0.0020

Min 10

Max 90

Configuration Section

1. Activation Delay (ms): Sets the delay before VVT activation after the engine meets the specified conditions. In this example, it’s set to 3000 milliseconds (3 seconds).

2. Do Not Control Below RPM: Prevents VVT control below a specific RPM.

- **Example:** 1300 RPM ensures no VVT engagement during cranking or idle.

Intake VVT PID Settings

These parameters fine-tune the control of the VVT solenoids

1. Offset: Compensates for mechanical inaccuracies in camshaft positioning.
2. PID Values:

- P (Proportional): Adjusts the solenoid duty cycle based on the magnitude of the error.
- I (Integral): Addresses accumulated error over time for smoother adjustments.
- D (Derivative): Reacts to the rate of error change, reducing overshooting.

3. Min/Max:
Defines the maximum and minimum solenoid duty cycle limits.
Example: 10 to 90% ensures the solenoids operate within safe ranges to avoid overloading or insufficient movement.

4. Bench Testing Options:
Manual testing allows direct control of the solenoids for:

- Bank 1

Tuning Notes

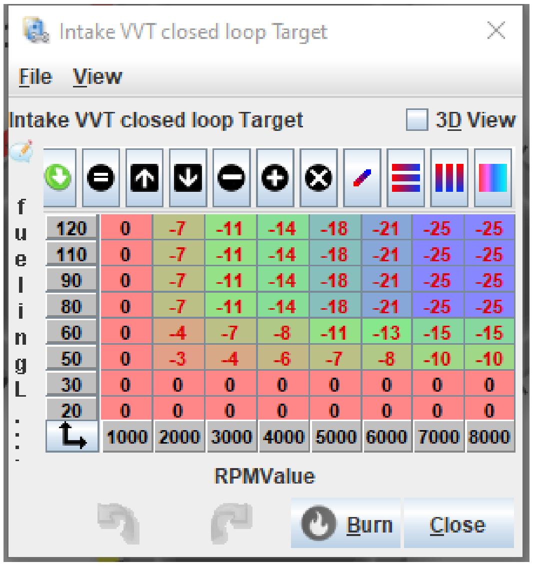
- Proper RPM thresholds prevent VVT interference with idle or cranking operations.
- Carefully adjust PID values to match the specific solenoid and camshaft behavior for optimal performance.

VVT Cam Timing

This table defines the target **Cam Timing** at various **MAP Loads** and **engine RPMs.**

Table Explanation

- **Columns (X-Axis):** Represents engine RPM values ranging from idle to the redline (e.g., 1000 to 7000 RPM).
- **Rows (Y-Axis):** Represents Engine Load as MAP (kpa) value.
- **Cells:** Represents Cam Retard as a negative degree value.
  - **Example:** At 90 kpa MAP Load and 3000 RPM, the Cam Phaser retards the cam timing from full advance to -11 degrees.



Intake VVT closed loop Target

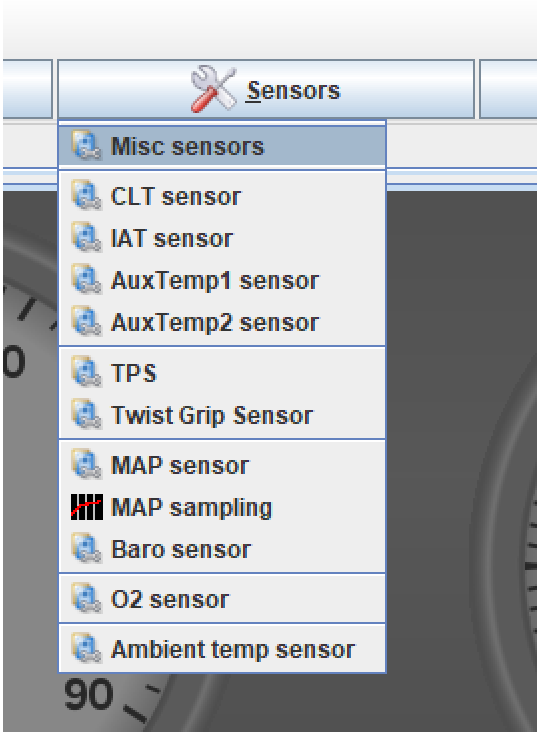
120	0	-7	-11	-14	-18	-21	-25	-25
110	0	-7	-11	-14	-18	-21	-25	-25
90	0	-7	-11	-14	-18	-21	-25	-25
80	0	-7	-11	-14	-18	-21	-25	-25
60	0	-4	-7	-8	-11	-13	-15	-15
50	0	-3	-4	-6	-7	-8	-10	-10
30	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
	1000	2000	3000	4000	5000	6000	7000	8000

RPMValue

Sensors Button In TS

The Sensors dropdown menu provides access to configure specific sensors for your ECU setup. Each option is dedicated to a particular sensor or type of measurement and allows fine-tuning of sensor parameters.

Available Configuration Options



1. **Misc Sensors:** Configure various non-standard sensors or general-purpose inputs.
2. **CLT Sensor (Coolant Temperature):** Set calibration for the coolant temperature sensor, crucial for cold start enrichment and fan control.
3. **IAT Sensor (Intake Air Temperature):** Configure intake air temperature sensor parameters, which help in calculating air density for fueling.
4. **Auxiliary Temperature Sensors (1 & 2):** Assign and calibrate extra temperature sensors for monitoring additional components.
5. **TPS (Throttle Position Sensor):** Adjust settings for the throttle position sensor, vital for acceleration enrichment and idle control.
6. **Twist Grip Sensor:** Set calibration for drive-by-wire systems where the pedal position is electronically monitored.
7. **MAP Sensor (Manifold Absolute Pressure):** Configure the MAP sensor for load calculation, turbo boost management, or barometric correction.
8. **MAP Sampling:** Refine MAP sensor sampling intervals for consistent and accurate readings.
9. **Barometric Pressure Sensor:** Configure a barometric sensor for altitude-based fueling adjustments.

10. **O2 Sensor:** Configure oxygen sensors for monitoring air-fuel ratios.

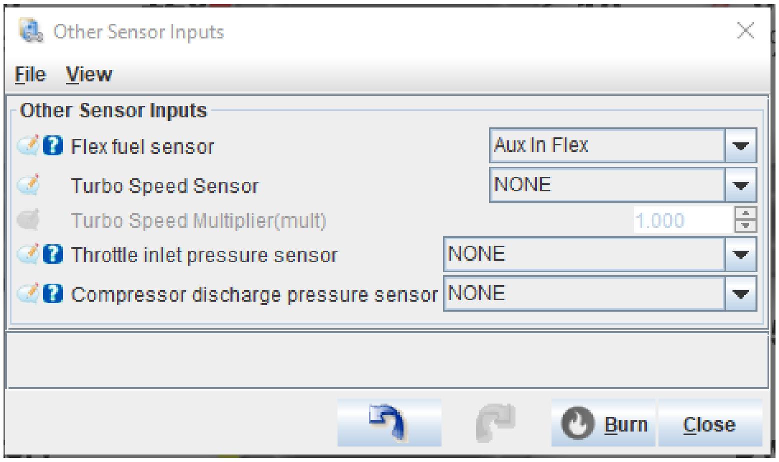
11. **Ambient Temperature Sensor**: Configure the sensor for environmental temperature monitoring.

Usage Notes:

- Each sensor dialog provides detailed configuration options for calibration curves, thresholds, and functional assignments.
- Ensure proper calibration using the manufacturer's specifications to avoid inaccurate readings or performance issues.

Misc Sensors

The **Misc Sensor Inputs** dialog allows configuring additional sensors that play a role in specialized engine control or advanced features. These include inputs for flex fuel, turbo, and various pressure-related sensors. Below is a breakdown of the available configurations:



Other Sensor Inputs

Flex fuel sensor: Aux In Flex

Turbo Speed Sensor: NONE

Turbo Speed Multiplier(mult): 1.000

Throttle inlet pressure sensor: NONE

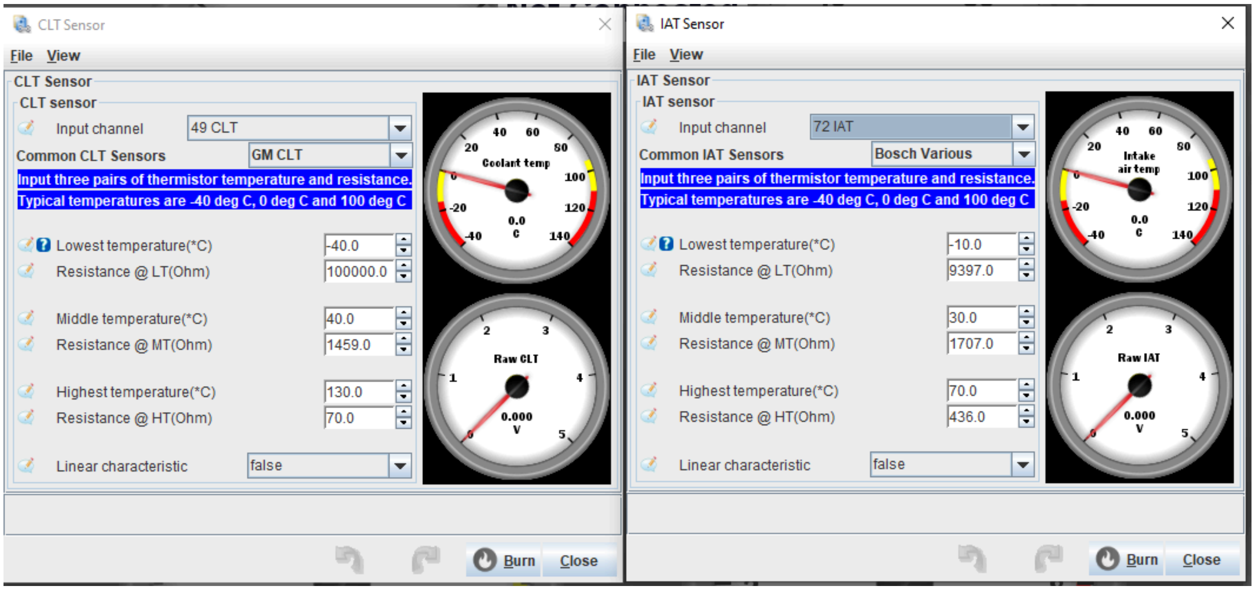
Compressor discharge pressure sensor: NONE

1. **Flex Fuel Sensor:** Assigns the signal for ethanol content monitoring to enable dynamic fuel adjustments.
2. **Turbo Speed Sensor:** Assigns the sensor input for turbocharger RPM monitoring.
    - **Turbo Speed Multiplier:** Allows calibration based on the specific turbocharger setup.
3. **Throttle Inlet Pressure Sensor:** Configures a dedicated pressure sensor for measuring manifold pressure before the throttle body.
4. **Compressor Discharge Pressure Sensor:** Calibrates a sensor for monitoring the output pressure from the turbocharger or supercharger.

Usage Notes:

- Flex Fuel and Turbo Sensors: These are optional but recommended for setups requiring precise ethanol or turbocharger management.
- Proper calibration is crucial for sensors like turbo speed and pressure sensors to ensure accuracy and avoid performance issues.

CLT / IAT Sensor



CLT Sensor

CLT sensor

Input channel: 49 CLT

Common CLT Sensors: GM CLT

Input three pairs of thermistor temperature and resistance.

Typical temperatures are -40 deg C, 0 deg C and 100 deg C

Lowest temperature(*C): -40.0

Resistance @ LT(Ohm): 100000.0

Middle temperature(*C): 40.0

Resistance @ MT(Ohm): 1459.0

Highest temperature(*C): 130.0

Resistance @ HT(Ohm): 70.0

Linear characteristic: false

IAT Sensor

IAT sensor

Input channel: 72 IAT

Common IAT Sensors: Bosch Various

Input three pairs of thermistor temperature and resistance.

Typical temperatures are -40 deg C, 0 deg C and 100 deg C

Lowest temperature(*C): -10.0

Resistance @ LT(Ohm): 9397.0

Middle temperature(*C): 30.0

Resistance @ MT(Ohm): 1707.0

Highest temperature(*C): 70.0

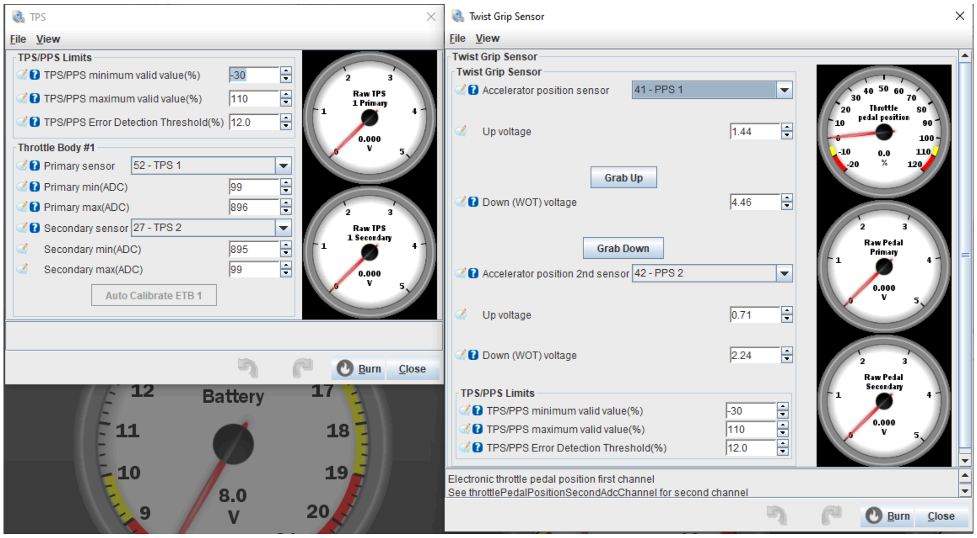
Resistance @ HT(Ohm): 436.0

Linear characteristic: false

This menu item is fairly self explanatory, here you are able to define the calibration for the CLT / IAT Sensor if using something other than stock.

TPS and Twist Grip Sensor Setup

The **TPS (Throttle Position Sensor)** and Twist Grip Sensor (TGS) windows are used for calibrating and configuring sensors required when using **electronic throttle bodies (ETB).** Proper calibration in these sections is essential for the engine's functionality, as incorrect or incomplete setups can result in the ECU throwing errors and refusing to run until the issue is resolved.


TPS

TPS/PPS Limits

TPS/PPS minimum valid value(%): -30

TPS/PPS maximum valid value(%): 110

TPS/PPS Error Detection Threshold(%): 12.0

Throttle Body #1

Primary sensor: 52 - TPS 1

Primary min(ADC): 99

Primary max(ADC): 896

Secondary sensor: 27 - TPS 2

Secondary min(ADC): 895

Secondary max(ADC): 99

Twist Grip Sensor

Twist Grip Sensor

Accelerator position sensor: 41 - PPS 1

Up voltage: 1.44

Down (WOT) voltage: 4.46

Accelerator position 2nd sensor: 42 - PPS 2

Up voltage: 0.71

Down (WOT) voltage: 2.24

TPS/PPS Limits

TPS/PPS minimum valid value(%): -30

TPS/PPS maximum valid value(%): 110

TPS/PPS Error Detection Threshold(%): 12.0

Electronic throttle pedal position first channel
See throttlePedalPositionSecondAdcChannel for second channel

TPS/PPS Limits:

- **Minimum Valid Value (%):** The lowest acceptable sensor value.
- **Maximum Valid Value (%):** The highest acceptable sensor value.
- **Error Detection Threshold (%):** Determines when the ECU flags a fault based on the deviation from the expected values.

Throttle Body #1 Sensors:

- Calibration involves setting the minimum (ADC) and maximum (ADC) values using the Auto Calibrate buttons.
- Ensure the sensor inputs are assigned correctly (e.g., TPS1 Primary, TPS1 Secondary).

Note: If the calibration is incomplete or incorrect, the ECU will flag an error and refuse to function until it is cleared.

Twist Grip Setup

1. Make sure that the Ignition is in the “ON” Position with the engine off
2. Assign inputs for the primary and secondary pedal sensors. **(Pre-Configured On Impact ECU)**

3. Use the **Grab Up** button to record the voltage when the Twist Grip is at rest with ***no throttle applied.***
4. Use the **Grab Down** button to record the voltage when the twist grip is ***fully rolled back.***
5. Ensure the calibration is precise; deviations can trigger ECU errors.

Important Notes

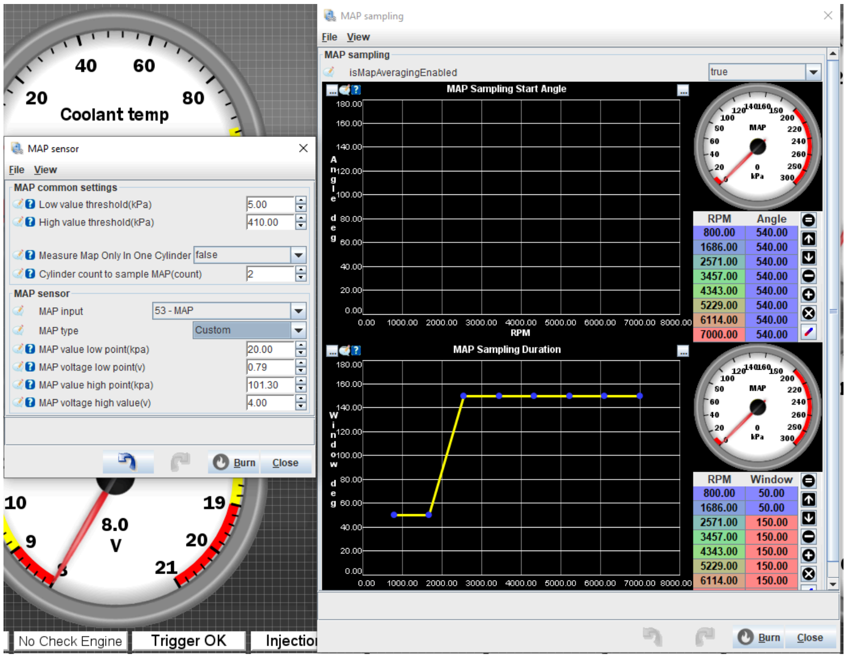
- **Calibration Requirement**: Both the TPS and PPS calibrations must be completed successfully for the ECU to function properly with an ETB.

- **Error Handling:** If the calibration fails or settings are incorrect, the ECU will display an error and prevent the engine from running until the issue is resolved and the error is cleared.

These settings are only required for ETB setups. For traditional cable-driven throttle setups, these configurations are not applicable.

Map Sensor & Map Sampling

The Map Sensor and Map Sampling windows are used for calibrating and configuring sensors required when using a Speed Density tuning strategy . Proper calibrations in these sections is essential for the engine's functionality and proper fueling. However, these settings will typically come pre-configured in your Impact ECU.



MAP common settings

Low value threshold(kPa) 5.00

High value threshold(kPa) 410.00

Measure Map Only In One Cylinder false

Cylinder count to sample MAP(count) 2

MAP sensor

MAP input 53 - MAP

MAP type Custom

MAP value low point(kpa) 20.00

MAP voltage low point(v) 0.79

MAP value high point(kpa) 101.30

MAP voltage high value(v) 4.00

MAP sampling

isMapAveragingEnabled true

RPM	Angle
800.00	540.00
1686.00	540.00
2571.00	540.00
3457.00	540.00
4343.00	540.00
5229.00	540.00
6114.00	540.00
7000.00	540.00

RPM	Window
800.00	50.00
1686.00	50.00
2571.00	150.00
3457.00	150.00
4343.00	150.00
5229.00	150.00
6114.00	150.00

Map Sensor Window

Map Common Settings

Low & High Value Thresholds (kPA):
These parameters define map sensor pressure readings that are too low or too high to be real and are used to identify a broken/defective map sensor or map sensor wiring.

Measure Map Only In One Cylinder: Set To **"False"**, this should left set to false unless using

Cylinder Count To Sample Map (Count): This many MAP samples are used to estimate the current MAP. This many samples are considered, and the minimum taken. **Recommended value is 2.**

mapEXPAvgAlpha: Additional MAP sensor filtering to allow for easier tuning. **Recommended value is 1**.

Map Sensor

MAP Input: Defines which pin the MAP sensor is wired to, this will typically never have to be changed by Impact ECU users

MAP Type: Defines the type of MAP sensor used, it is set to custom in this example which is the correct value for the factory MAP sensor, there are options for other MAP sensors in the drop down if going to an aftermarket MAP sensor for say a boosted application.

Note: Custom **"MAP Type"** is used when using a map sensor that is not predefined, you will need high and low voltages and pressures for the voltages in kPA

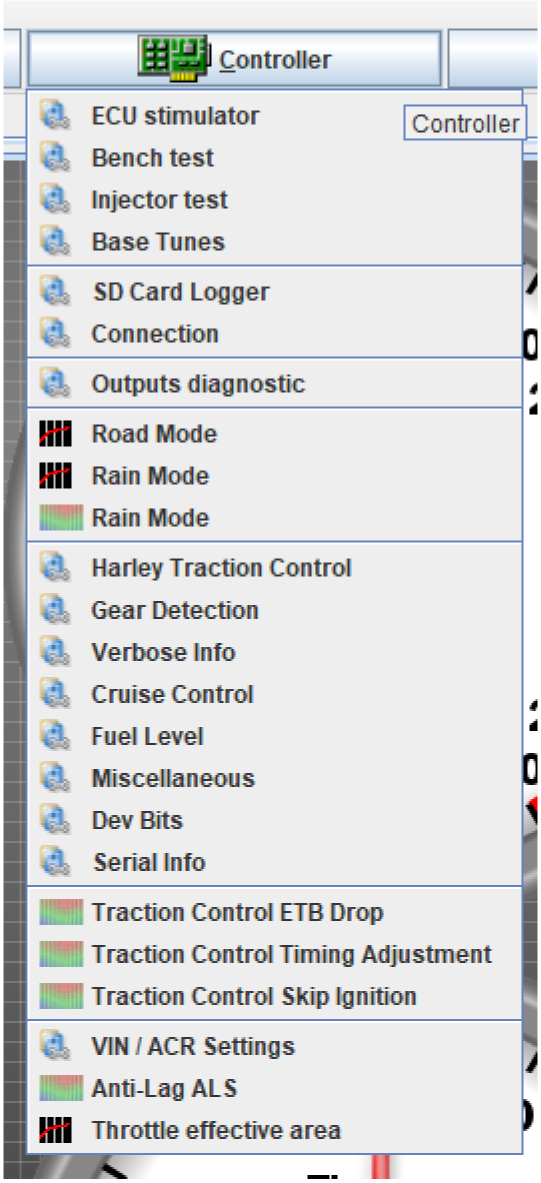
MAP Sampling

Map Sampling Start Angle: Crank angle at which sampling for MAP Averaging starts. Typically should stay at around 540.

Map Sampling Duration: The sampling duration for MAP sensor reading in Crank Angle degrees.

Note: Changing any of the values in these tables have the potential to drastically change your fuel mapping, potentially putting your engine at risk. These settings are only to be modified by ***ADVANCED*** users.

Controller Button In TS



Here is the revised explanation of each option in the

Controller dropdown:

1. **ECU Stimulator:** Simulates various inputs to test ECU functionality without a running engine.
2. **Bench Test:** Allows testing of outputs, such as injectors and ignition coils, for troubleshooting or setup.
3. **Injector Test:** Provides a controlled way to test injector performance and flow rates.
4. **Base Tunes:** Predefined configurations for common setups, simplifying initial setup.
5. **SD Card Logger:** Manages onboard logging settings for data storage and retrieval.
6. **Connection:** Configures connection parameters between the ECU and software, such as baud rate.
7. **Outputs Diagnostics:** Helpful diagnostic tool to help determine if you have a faulty output
8. **Road Mode:** Road Mode throttle table multiplier can be customized here.
9. **Rain Mode:** Rain Mode throttle table multiplier can be customized here.
10. **Rain Mode (IGN Timing):** Modifications to the ignition timing in rain mode can be made here
11. **Gear Detection:** Define Voltage Thresholds of the analog gear position sensor in 2023.5+ Harley Touring bikes. With or Without Kickstand Sensor switch can also be found here.

12. **Cruise Control:** Cruise control engage / disengage & control settings can be found here.

13. **Fuel Level:** Fuel Level Sensor resistance settings as well as other fuel level settings such as fuel gauge refresh speed can be found here.

14. **Miscellaneous:** Miscellaneous settings such as defining whether Impact should use 1 or 2 VE tables.

15. **Traction Control ETB Drop:** Reduces throttle position to manage wheel slip during traction control events.

16. **Traction Control Timing Adjustment:** Adjusts ignition timing dynamically for wheel slip control.

17. **Traction Control Skip Ignition:** Skips ignition events to reduce engine power and manage traction.

18. **VIN / ACR Settings:** In this Menu item, you define your ACR Settings. You also input your VIN here.

19. **Anti-Lag ALS:** Configures anti-lag systems for turbocharged engines to maintain boost pressure.

20. **Throttle Effective Area:** Calibrates the effective area of the throttle body for airflow modeling.

Bench Test

The **Bench Test** contains multiple groups of buttons, each allowing you to test specific outputs by pulsing them according to the configured settings:

1. **Spark Test:** Gives the ability to test Front or Rear ignition outputs by pulsing them.
2. **Injector Test:** Gives the ability to test Front or Rear injector outputs by pulsing them.
3. **Lua Out Test:** Pulses Lua-configured outputs.
4. **Miscellaneous:** Commands: Activates specific functions like stopping the engine, rebooting the ECU, or resetting configurations.

The configurable settings allow precise control over these tests:
- Count: Specifies how many pulses will be generated. For example, setting this to 3 will result in 3 pulses.
- On Time (ms): Determines how long each output stays active per pulse. For instance, a setting of 4 ms will activate the output for 4 milliseconds.

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- Off Time (ms): Specifies the duration of inactivity between pulses. For example, setting this to 500 ms will create a 500-millisecond delay before the next pulse.

These controls ensure consistent and repeatable testing of outputs for diagnostic and validation purposes.