

# 034 EFI

## TUNING MANUAL

### Introduction

The 034EFI “ Electronic Control Unit “ is a highly advanced DSP (Digital Signal Processor) based engine management system. When tuned and implemented properly, this system will provide highly refined and advanced fuel and ignition control over a wide variety of engine configurations. Though its electronic control is highly advanced, tuning the 034EFI systems can be relatively simple to configure and tune for intended results, and quickly. There is certain methodology and considerations that should be used when tuning a fuel and ignition management system. *This document has been created not as a step-by-step tuning manual, but to address some frequently asked questions about tuning as well as giving an overall theory or understanding as to how tuning the ECU should be approached.*

***\*\*Important - this tuning manual should be used in conjunction with the 034EFI ECU manual and other “Support Documents” provided. These documents address different aspects of the product and thus should be used in conjunction.***

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# Installation Considerations

## Sensor Requirements

The 034EFI ECU requires certain and specific inputs in order to measure, manage and output to different engine functions - including fuel injection, ignition timing, auxiliary and idle control. If the sensors used do not have the same calibration as the ECU, then the measurement will be incorrect. Below is a list of inputs and their requirements:

### Water Temperature

The water temp sensor should be a GM specification or what your dealer provides. Resistance should be 2700ohm @ 25° C or room temperature. The sensor should be installed in the cylinder head water jacket return “ to the cooling system” area as an accurate gauge of engine temperature.

### Air Temperature

The air temp sensor should be a GM specification or what your dealer provides. Resistance should be 2700ohm @ 25° C or room temperature. The sensor should be installed after the intercooler in turbo charged application or after the air filter in the intake system in normally aspirated applications.

### Throttle Position

Any standard 3-wire TPS will work with the system and should be wired as according to the connector wiring pin-out chart. The two outside pins will determine if the TPS reads from closed to open, or from open to closed. The sensor should be wired to reflect a closed position at idle and an open position at WOT (wide-open throttle). Not all sensors will register across the full range of the TPS matrix, this is normal, and the ECU can compensate for this. TPS Blend is intended for idle and part throttle fuel mapping only, especially in applications with abnormally low vacuum (more than 80kpa at idle for example). Also, if the polarity of the TPS is reversed, this can be “flipped” in the configuration screen for Engine Setup so no rewiring is necessary.

### Oxygen Sensor

#### *Narrowband*

Standard narrow-band or wide-band (0-1v) sensors should be used with the system. Though a 1-wire or 3-wire sensor can technically be used, it is highly recommended that a 4-wire sensor be used for the highest accuracy and most reliable signal. The narrow band O2 sensor voltage curve has been developed for a specific NTK-style sensor available through [www.034efi.com](http://www.034efi.com), for the more accurate closed loop programming, this sensor should be used. Universal Bosch style sensors work well also. Though the narrow band sensors can be considered more inaccurate when compared to the wide-band (0-5v) sensor, it will provide a very good feedback loop for tuning and closed loop operation (too rich, too lean, or stoich). The sensor should be placed relatively close to the exhaust source, typically after the exhaust manifold and turbo (if used). If a location

further down the exhaust is required, the use of a heated 4-wire sensor will ensure that the sensor is properly heated for an accurate signal.

### *Wideband*

With the advent of affordable Wide Band O2 kits, Wide Band accuracy can now be implemented with any of the systems.

If the kit you have provides a “translated 0-1v output” such as those provided by [www.innovativemotorsports.com](http://www.innovativemotorsports.com), this can be fed directly into the ECU to replace the narrowband 0-1v input. Note that the 0-1v output may need to be calibrated to ensure the EGO values of the controller and 034efi ECU are the same (the shape of the voltage curve). Follow the wide-band manufacturer’s instructions for calibration. Also consider the Innovate Motorsports LC1 which allows wide band accuracy for 034EFI standalone systems, for under \$200.

By far the best and most accurate closed loop EGO options is to run the standard 0-1v linear EGO curve out of the Innovate directly into the 034EFI EGO circuit. Voltage relative to Lambda ( $\text{Lambda} = \text{a/f ratio} \cdot 14.7$ ) can be fine tuned under the Configuration>Closed Loop Setup>EGO Type field of the tuning software. For example, Innovate systems default a 10:1 a/f at 0v, and 18:1 at 1v, thus Lambda values of 1.224 (18@14.7) at 0v and .680 (10@14.7) at 1v would be a good starting point.

### **Timing Phase Angle Reference (TRGIDX)**

The 034EFI systems can use one TDC timing reference for camshaft position. Though this signal is not required for simple sequential function, for true valve-timed sequential function this timing reference should be used, even for waste spark applications. Coil on plug systems must determine the correct phase (intake or exhaust stroke) when the engine starts, and unless each coil is fired on both phases, a TDC trigger is required. Thus the user can calculate individual fuel injector activation based on a camshaft trigger reference. Any proper hall-sender will trigger off a steel pin mounted in the cam gear pulley or even off of a camshaft lobe for example.

The Stage ‘C’ systems are degree based, thus injector firing can be determined in degrees from TDC. Thus, the only need for the timing reference is for starting, the TRGIDX lets the ECU know which TDC cycle is the compression stroke, not exhaust. This input can be deleted, however, as the ECU has a 50% chance of determining this on its own. In this situation it is recommended that the coils be configured to fire in a ‘wasted spark’ firing method. This will ensure that regardless of the phase the ECU syncs to you will have spark happening at the combustion stroke.

## RPM Reference (VRA/TRA)

The Stage c ECUs requires a crankshaft, or in some cases camshaft, mounted toothed wheel to trigger RPM. Due to newer factory (Audi, BMW, Porsche, etc) and Bosch applications running a 60-tooth wheel, the current ECU is compatible with a 60 minus-two tooth wheel, actually 58 teeth - more applications will be developed in the future (Also supported 60-1, 36-2, 36-1, 24-1, 12-1, full listing provided later in this manual). Missing teeth tell the ECU that TDC is coming, the # of teeth between TDC and the missing teeth is configurable inside the ECU under Configuration>Engine Setup. The “C” ECU will run either a Hall sender or VR sender, to determine which sensor should be used, contact the dealer or specify at the time of order. If you have any doubt that you have the right ECU, jumpers on the ECU circuit board can be moved to correct “VR” or “HS” positions (see below). Mounting of either sensor is critical, and should meet the following criterion:

- The mounting bracket must be VERY rigid, if it is moveable by force of the hand, then the bracket should be strengthened.
- The air gap target range for hall senders should be in .02 to .04”, for VR senders should be approximately .05”. When using a VR sensor, if a miss or backfire is detected, the airgap may be too small, or the missing teeth may not be low enough, contact your dealer for technical advice (see below)
- Runout for the toothed wheel should be less than .003”, excessive runout will cause the ECU to lose its reference and may result in a backfire miss or complete loss of spark.
- Wheel material should be magnetic steel and very rigidly mounted.
- Hall or VR sensor wiring must be shielded and routed away from any injector, coil, or alternator wiring, never loop or coil wire as this creates electro-magnetic waves that cause electrical interference.
- Internal jumpers MUST BE CORRECT ( J-3 & J-4 ) when using a VR sensor as opposed to Hall Sensor, ensure that both jumpers are changed, and that any board protective coating is removed from the board pins with a solvent on a rag. The ECU cover must first be removed (using 1/6” allen) to access the jumpers.
- Reference synch can be verified in the “Monitor” screen of the 882C software. “#Trigs” is the actual teeth being counted by the ECU, “#Cam” is the number of cam TDC references being counted, “Wdbg” is the calculated # of teeth the ECU reads per revolution, thus, if a 60 minus-two wheel is being used, the ECU will count 58 teeth and the 2 missing teeth as one tooth, thus a “59” should be observed. If this value varies AT ALL, EVEN THE SLIGHTEST, then there is a synch error, and the VR sensor and air-gap and wiring should be verified. “Cdbg” is the ECU’s calculated cam triggers; this value should be steady as well, never changing.

## Vehicle Speed Sensor

The ECU supports a vehicle speed input for gear-based functions, such as boost control. The vehicle speed input must be a square-wave style input, such as a hall sensor, or VSS signal from the stock instrument cluster on some vehicles. The speed input can be configured for any number of pulses per wheel revolution, but less than a dozen triggers per wheel revolution are recommended to leave the CPU processing

power to more important tasks. The speed input can be used on either the TRIGIDX, or TRIGB pins on the ECU.

## Output Component Requirements

The ECU creates electronic output signals to several components. To ensure proper operation, these components should be of the proper specification:

### Electronic Injectors

For proper operation all Electronic “solenoid style” injectors can be used. These should measure approximately from 2-14 ohms. Sizing should be determined by the user or with the assistance of your dealer. 034EFI uses the most powerful 8 Amp injector drivers on the market, current draw per injector can be calculated using the formula:

Amperage = Voltage/Resistance

-Thus, a 4 ohm injector will draw 3.5 Amps at 14 Volts, well within the capabilities of the 034EFI Injector driver current.

### Idle Air Control Motor

For proper operation the user should source the dealer specified IAC. Though this IAC appears to be standard “GM”, there are many different units with different pin-outs. To avoid confusion and mis-operation the proper unit should be sourced from your 034EFI dealer. Also, some 2-wire PWM idle motors can also be used driven off one of the GPO's.

### Fuel Pump Relay Trigger

The unit will trigger ground to any standard 12v relay via one of the GPO's. The fuel pump should always be triggered via a relay, as the output has not been designed to support the amperage required by a high output fuel pump, and battery voltage and current will allow the pump to work at maximum and consistent flow. Using a Bosch relay, pin 86 will be supplied switched 12v+, Pin 85 will be the GPO Ground trigger, pin 87 will supply ground to the fuel pump, pin 30 will go to chassis ground. The fuel pump will be supplied with constant ignition switched 12v, and will run when the relay closes to provide chassis ground to the pump.

## Other Component Installation Considerations

### Fuel Pressure Regulator

Any manifold referenced fuel pressure regulator can be used to regulate pressure to a minimum of 3 Bar or 40-45psi (typically the lowest operating pressure for EFI recommended). An adjustable regulator is recommended, though not required, for an added level of tune-ability. DO NOT use a rising rate regulator as they are unnecessary and will render many of the delicate volumetric efficiency algorithms useless.

## **Fuel Pump**

There are many considerations for the system fuel pump. Typically a fuel pump provided originally on any EFI equipped or Bosch CIS (Continuous Injection System) will provide good flow at the lower EFI pressures. Carburetor pumps are NOT suitable for the 3-7BAR pressures required by EFI. If an upgraded pump is needed, CIS pumps came OEM on many VW, Audi and other European cars and provide excellent flow for up to 500HP. To determine proper fuel pump capacity fuel pressure should be monitored under max output. There are also many aftermarket options as well. Also, be hesitant to crank fuel pressure to remedy injectors that are too small, fuel pump flow drops proportionately as pressure rises, keep pressure as low as possible while maximizing fuel injector size.

## **Boost Control**

Boost can be controlled by manually manipulating the pressure signal to the wastegate or by using an outside electronic boost controller.

As of the 1.02 software release the GPO will precisely control boost pressure to a wastegate via an open, or closed loop strategy. As well as gear or input based boost levels. Many different strategies can be applied, but most will involve pulsing a frequency valve to bleed or modify the wastegate pressure signal. This can be mapped via a GPO using various parameters. Most popular boost control values will work well, including OEM valves, though each will have different operating responses, and limits. Test with different duty cycle values until the desired boost pressure is reached.

## **Tachometer**

A standard tachometer output, high side (12v plus), is provided in the ECU that can be connected to the factory or aftermarket tachometer input. Note that the tachometer will operate independently from the "tach full scale" setting in the ECU software. Also, older tachs originally triggered off the coil negative side may not function properly as they run off high voltage spikes and high current. Contact your dealer for more information.

## **Ignition Coil**

Most factory type and aftermarket ignition coils can be used with the ECU since the ignition output is configurable and can drive high-current 'dumb' coils with drivers built into the ECU, or the ECU can be configured to trigger TTL level coils with built-in drivers. If there is any concern with coil compatibility, 034Motorsport also stocks a full line of custom, high performance coils for virtually any application. Very high boosted applications will require the highest quality coil available; experimenting with some different models will prove the best results.

For the “ C “ system, most factory type coils can be used, all 2-wire coils are compatible, most 3-wire will be that have a ground. Most 4-wire coils that contain an integral driver can also be supported by 034EFI ECU's, contact your dealer or 034EFI for more information. The 034EFI can supply the proper ECU with drivers (different hardware) that can fire newer coils - email [contact@034motorsport.com](mailto:contact@034motorsport.com) for more information.

### **Ignition Components**

Standard factory type or aftermarket replacement parts will work well in distributor and spark components (such as Ignition wires, plugs, etc)

### **OEM Idle Motors**

Standard factory type idle motors will work driven by the GPO, especially in the 3-D mapping portion of the ECUs. 2-wire motors are compatible, and can be pulsed with a PWM signal from the GPO in open loop, or controlled in a closed loop operation as well.

# Tuning Functions

Please familiarize yourself with the various tuning functions contained within the 034EFI ECU tuning software. Each area of input gives the tuner valuable control over tuning parameters and ultimately engine control. Measurement of the engine system, careful identification of tuning deficiencies (ie: lean, overly advanced, missing, bogging, rough running, etc) and the addressing of these problem areas using the proper tuning function will make engine tuning effective, simple and rewarding.

NOTE - There are several types of input fields used in the ECU interface software to setup your maps/configuration. These can either be:

- 1 - Direct input field, what you enter is what you get. For instance, in the Phase Configuration screen there are boxes to enter the degree of crank revolution where you want an event to occur. This field has no other modifications done to it, what you enter in here is the exact value you're working with.
- 2 - Multiplier fields, these fields are a value that multiplies another value by a set amount. For instance, if you enter 1.5 in a coolant enrichment multiplier field, this will multiply the current injection pulse width by 1.5. These numbers generally can range from 0 to 2.0, unless otherwise noted.
- 3 - Offset fields, these are used to add or subtract an amount to a variable. Commonly used in the timing maps where you want to subtract or add timing based on map pressure, temperature, etc.

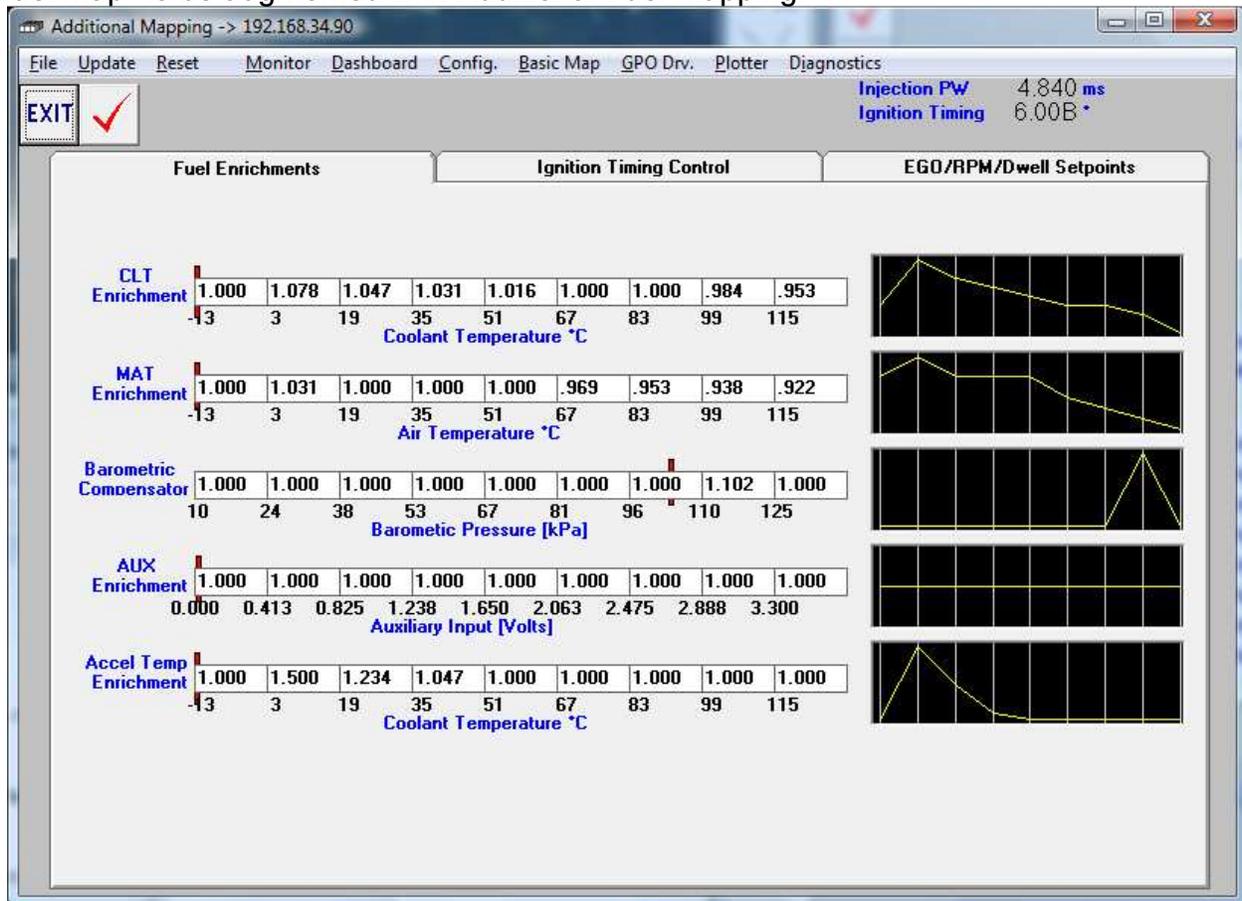
NOTE - 034EFI is not responsible for damage of person or property as the result of tuning any of its Engine Management Systems. Users tuning the system accept full responsibility of the result of tuning and running the system.

## Additional Map Tuning

Additional Map tuning are supplementary tuning functions to the Basic Mapping screen. Compensation for EGO (Exhaust Gas Oxygen), air and water temp, idle and active dwell settings, as well as basic ignition maps are programmed here. The Additional Mapping Screen contains 3 tabs with different tuning emphasis, described below:

### Additional Fuel Enrichments

Though the base fuel map is set in Basic Mapping, certain conditions require the “base fuel map” to be augmented with Additional Fuel Mapping.



#### CLT Enrichment

This map allows a fuel multiplier to be applied to the base fuel calculation based on coolant temperature. This is mostly useful for tuning the fuel curve on initial start up to overcome fuel condensation in the ports due to cold temperatures below running temp. This field does NOT tune “Cold Start” per se, that is the function of the Configuration>Powerup/Options>Cold Priming and Configuration>Engine Startup values. CLT Enrichments modify base fueling, depending on coolant temperature.

### *MAT Enrichment*

This map allows a fuel multiplier based on air temperature, mainly to compensate for the increase in the density of air at lower temperatures, and visa-versa. If the engine is running on a “good tune” and air temperature fluctuates dramatically, use this field to compensate for any fuel curve changes.

### *Barometric Compensator*

This field allows a fuel multiplier based on barometric pressure as a result of elevation change. Typically, add more fuel as elevation decreases, take away as elevation increases.

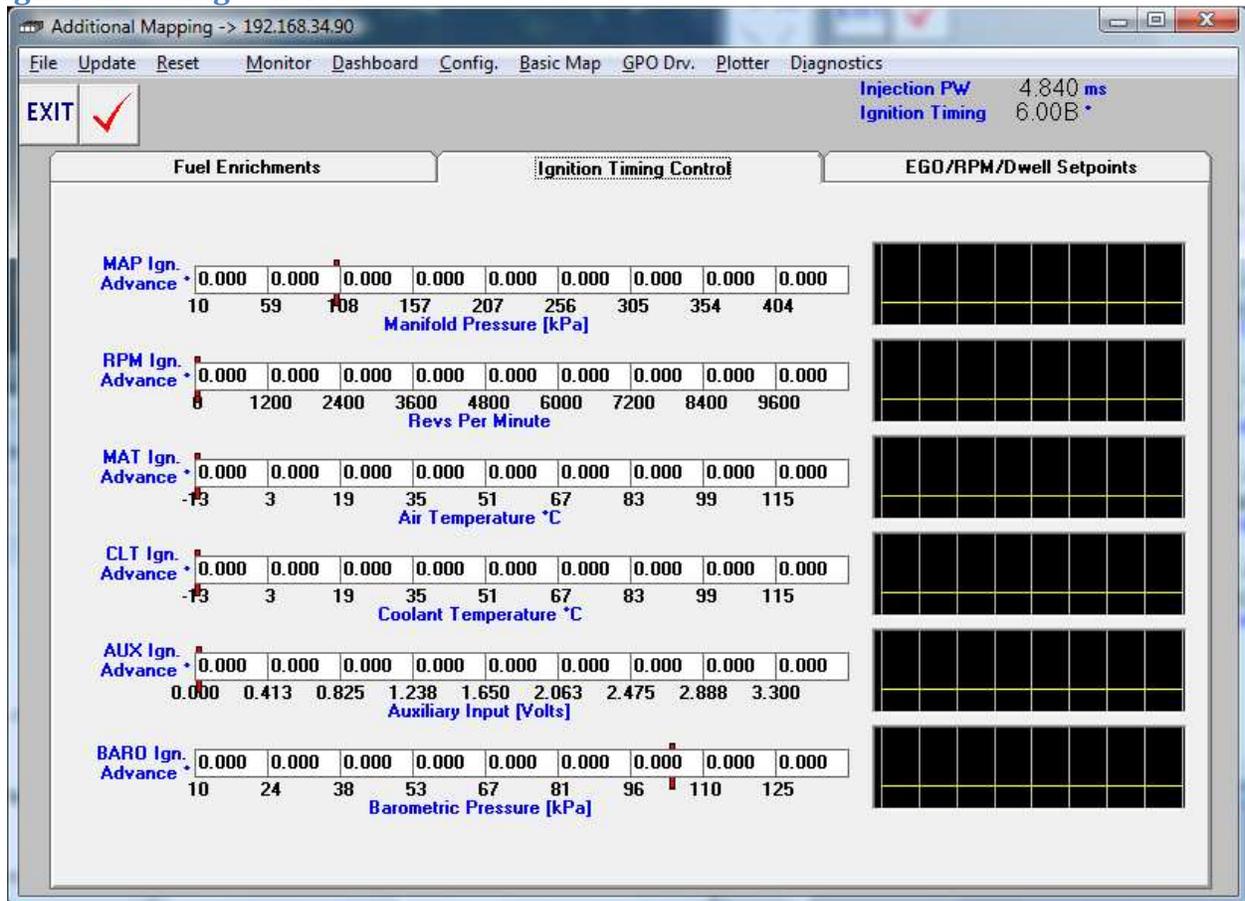
### *AUX Enrichment*

This field allows a fuel multiplier based on the auxiliary 0-5v input, or is used by the launch control/anti-lag system for triggering when aux input voltage rises or drops below 1.67 volts.

### *Accel Temp Enrichment*

This field gives multipliers that modify the Accel Max PW value under the Configuration>Acceleration Enrichments field. Cold engines require more acceleration enrichment, thus adjustments can be made based on coolant temperature.

## Ignition Timing Control



This tab allows most “mass” changes to ignition timing and the definition of the base ignition timing curve/s. Use the below maps to create conditional timing curves.

### *MAP Ign. Advance*

This map sets an ignition curve based on manifold pressure or engine load; this is especially useful for forced induction applications where timing retard needs to be added under specific boost pressures. This map is not as useful for NA applications where the base timing curve should be augmented mostly with RPM, not Manifold pressure, however, it is useful for small timing changes based on load of the motor. Always set the base timing curve using RPM, only using MAP to augment the curve as influenced by load.

Note the graphical representation of each map series, this, again, can be used to verify any problems in mapping, for example if accidentally 8 degrees of advance are entered under full boost instead of 8 degrees of retard! Always visually verify tuning changes before implementing them to the actual running engine.

### *RPM Ign. Advance*

This map will allow the base timing curve to be set across RPM to allow the engine to accelerate, most motors require a “curve” across rpm, where timing at idle is lower,

advanced at part throttle, pre-torque-peak, retarded across the torque-peak, then advanced again to redline after the torque-peak. Don't forget that the field value applies to the left hand side of the cell, thus a 20d retard in the 0-1000 field would result in -20 at 0 RPM, and interpolated across that field to 1000 RPM with the value in the cell to the right. This allows very fine-tuning of the curve and the use of different strategies.

#### *MAT Ign. Advance*

This field allows ignition timing advance or retard due to varying air temperatures of the induction system. Typically, lower than normal temps will allow some advance, and retard as temps increase. (Note: "B" ECU's can only retard timing from some set mechanical advance).

#### *CLT Ign. Advance*

This field allows timing changes based on coolant or engine temperature, this is especially helpful by allowing some timing advance when the engine is cold to raise idle speed, or to retard timing to allow the engine to warm up faster. It can also be used as a safety device on engine over or under heating.

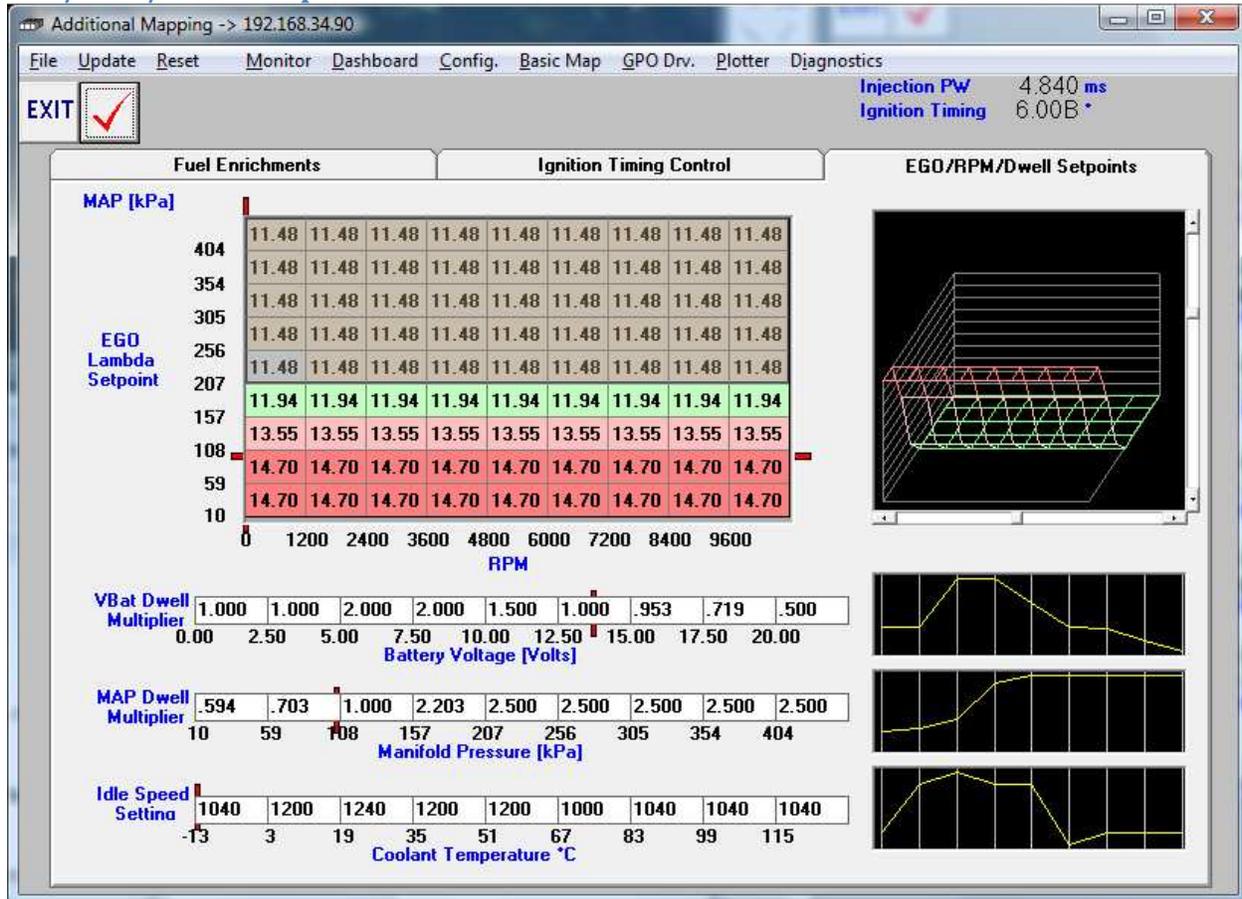
#### *AUX Ign. Advance*

This field allows timing changes based on Aux input voltage, it is especially useful for timing augmentation when used with turbo anti-lag strategies or even use with Nitrous.

#### *BARO Ign. Advance*

This field allows ignition timing advance or retard due to varying barometric pressures, due to mass elevation changes.

## EGO/RPM/Dwell Setpoints



### EGO Lambda Setpoint Table

This 3-D map allows the preferred EGO value to be entered into a matrix of RPM and Pressure. The closed loop fuel control system will use this map in the fuel feedback it provides.

### VBat Dwell Multiplier

This feature provides a multiplier map for the base coil dwell setting based on input voltage, typically, as voltage drops, dwell can be increase to compensate for lost spark energy due to lower coil input voltage.

### MAP Dwell Multiplier

This is an extremely valuable feature for heavily turbocharged engines that can develop an ignition miss under very high combustion pressures. The value in the cell multiplies the base Dwell setting (under Configuration Ignition Parameters) to change with varying MAP values. Thus, at idle and part throttle conditions, a minimal, suitable amount of dwell can be used, since that's all that is required. However, under heavy boost, coil dwell can be multiplied for longer and longer periods to keep spark firing under the high

combustion pressures. This also helps protect the coils from saturating or burning out, preventing the maximum coil dwell setting under all conditions.

### Idle Speed Setting

This is set in the 2-D map screen under “Idle Speed Setting”. It is quite straightforward, idle speed is set according to water temperature. Colder temperatures may require a higher idle speed and can be entered here. NOTE: This feature only modifies the control parameters of Configuration>Idle Control, unless the closed loop idle circuit is being used, changes to this field will not change idle speed.

## Configuration Screen Tuning

The Configuration Screen features 13 separate tabs for tuning basic settings of the ECU

### Engine Setup

The screenshot shows the 'Engine Setup' tab with the following parameters:

Parameter	Value	Parameter	Value
Crank Wheel Code #	60	Tach Full Scale	9600 RPM
Index Teeth Till TDC	13	Ign Limit Max Retard	0.00 °
TDC trim Advance	0.00 °	Soft Ign Limit 1	6000 RPM
		Soft Ign Limit 2	8000 RPM
		Hard Ign Limit 1	6500 RPM
		Hard Ign Limit 2	8000 RPM
		Fuel Limit 1	8600 RPM
		Fuel Limit 2	8600 RPM

**Hard Stutter Table**

255	253	251	247
239	255	253	247

**Stutter Generator Tool**

Skips: 3  
Hits: 1

Buttons: Create Stutter 1, Create Stutter 2

Buttons: Use Bit Pattern for Stutter 1, Use Bit Pattern for Stutter 2

### *Crank Wheel Code #*

The number of crank wheel teeth is entered here for the VRA input crank tooth profile. Currently supported wheel code numbers are:

- **11** 12-1 (24-1 CAM), missing tooth once every other crank rev
- **12** 12-1 crank
- **20** 20-1 crank
- **22** 24-2 crank
- **24** 24-1 crank
- **25** GM LS1 24X target
- **26** 24-1 (48-1 CAM)
- **27** 24-1 (48-1 CAM)
- **28** 24-1 (48-1 CAM)
- **34** 36-2 crank
- **36** 36-1 crank
- **37** subaru 36-2-2 (hi-res wheel)
- **38** chrysler hemi 36-2-2
- **46** 48-2 crank "experimental"
- **48** 48-1 crank
- **59** 60-1 crank
- **60** 60-2 crank
- **160** 60-2 (strict)
- **61** 60-2 with new GM cam sensor
- **135** audi flywheel TDC Pin w/hall sensor on flywheel must be used.
- **121** 12-1 crank
- **122** 12-1 crank
- **123** 12-1
- **126** 24-1 (48-1 CAM)
- **127** 24-2 (48-2 CAM)
- **128** 24-3 (48-3 CAM)

Add 100 to any of them and the synchronization becomes "strict", meaning that the ECU will not recognize an RPM input until a completely valid, full wheel revolution has been detected first. Without the strict coding the ECU will begin to fire drivers as soon as it detects the missing tooth section. This can provide quicker startup, but if there is an error in the trigger pickup it can result in the ECU 'losing sync' and possibly firing events when it shouldn't be. With the strict coding if there is an error in the wheel pattern detected all events will stop until the wheel pattern is valid again.

### *Index Teeth Till TDC*

The # of teeth between the missing teeth and the crank position sensor with the engine at cylinder 1 TDC position.

### *TDC Trim Advance*

Running the "C" system will also require trimming off any ignition error in the "TDC trim Advance" field. By clicking the "Set timing to 0" field in the Dashboard, a timing light can be used to determine the actual timing error between what the ECU is calculating and what the motor is actually getting. This can effectively be reduced to 1/4 degree or less.

### *Rev-Limiter settings*

“C” ECU’s include a highly advanced rev-limiting circuit to ensure safe, precise limiting of RPM. There are 2 separate rev-limiters which can be switched between with an external switch, or button, typically used for launch control.

Each rev limiter has several limiting strategies, Soft Ign Limit, Hard Ign Limit, and Fuel Limit.

#### Soft Ign Limit

The soft ignition limit is a timing retard only to limit the torque output of the engine, typically all that is needed to suppress the torque output of most motors is bringing timing back to before 0 degrees. Thus, if 20d of advance exist at full load and RPM, then -50 degrees for the Rev-Limiter will be enough to slow the motor down.

The rpm window in which first the timing retard is applied, is determined by the formula below, and is dependent on the full scale tach being used:

soft\_rev\_rpm\_start = soft\_limit value entered  
RPM\_FS=Full Scale Tach RPM  
soft\_rev\_rpm\_end = “soft\_limit” + (.032 \* RPM\_FS)

#### Hard Ign Limit

The hard ignition limit will shut off ignition coils according to the Stutter Table to the right of the hard limit being used. The stutter table is a pattern of 1’s and 0’s to indicate how many coils in a row to either fire, or skip. To simplify the setup the generator tool below the rev limiters can be used to populate this table by simply entering the total number of events to skip, and how many to fire. A pattern of 3 skips and 1 hit with result in 3 consecutive ignition events being skipped, followed by one cylinder firing, followed by the next 3 events being skipped.

*Note: If this is your primary rev limiter and you want to ensure that no ignition events occur beyond this limiter set the tables to all skips, no hits.*

#### *Fuel Limit*

All injectors will be disabled if the engine RPM exceeds the entered value, the fuel will be disabled until the revs drop below the entered RPM, and have been below that RPM for the amount of time specified in the seconds field to the right of the fuel limiters.

#### *TPS Closed and Opened Values*

These fields allow the tuner to set 0% and 100% throttle position, simply position the throttle at either the Open or Closed value and click “Cal.” for the appropriate field. If TPS reads backwards, it can easily be flipped by entering opposite values.

## Phase Setup

	Base * (0-720)	Use	Ignition Driver Num.								Injector Driver Num.								Drv. Tach	
			1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8		
Eng. Phase 1	0.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Eng. Phase 2	120.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Eng. Phase 3	240.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Eng. Phase 4	360.00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Eng. Phase 5	480.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Eng. Phase 6	600.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Eng. Phase 7	30.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
Eng. Phase 8	150.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Eng. Phase 9	270.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Eng. Phase 10	390.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Eng. Phase 11	510.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Eng. Phase 12	630.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Eng. Phase 13	0.00	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
Eng. Phase 14	0.00	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
Eng. Phase 15	0.00	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
Eng. Phase 16	0.00	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				

The configuration of the ignition and fuel drivers must be set up to ensure the right coil and injector fires on the right cylinder at the right time - this feature is what separates 034EFI systems from much of the other product offerings on the market, which don't allow any flexibility in this area of tuning. For example, many systems are setup with "hard programmed" firing orders and cylinder #'s, meaning only a 4-cyl ECU can be used on a 4-cyl and cannot be configured differently. This is done by determining engine phase degree timing and correlating this to the proper driver.

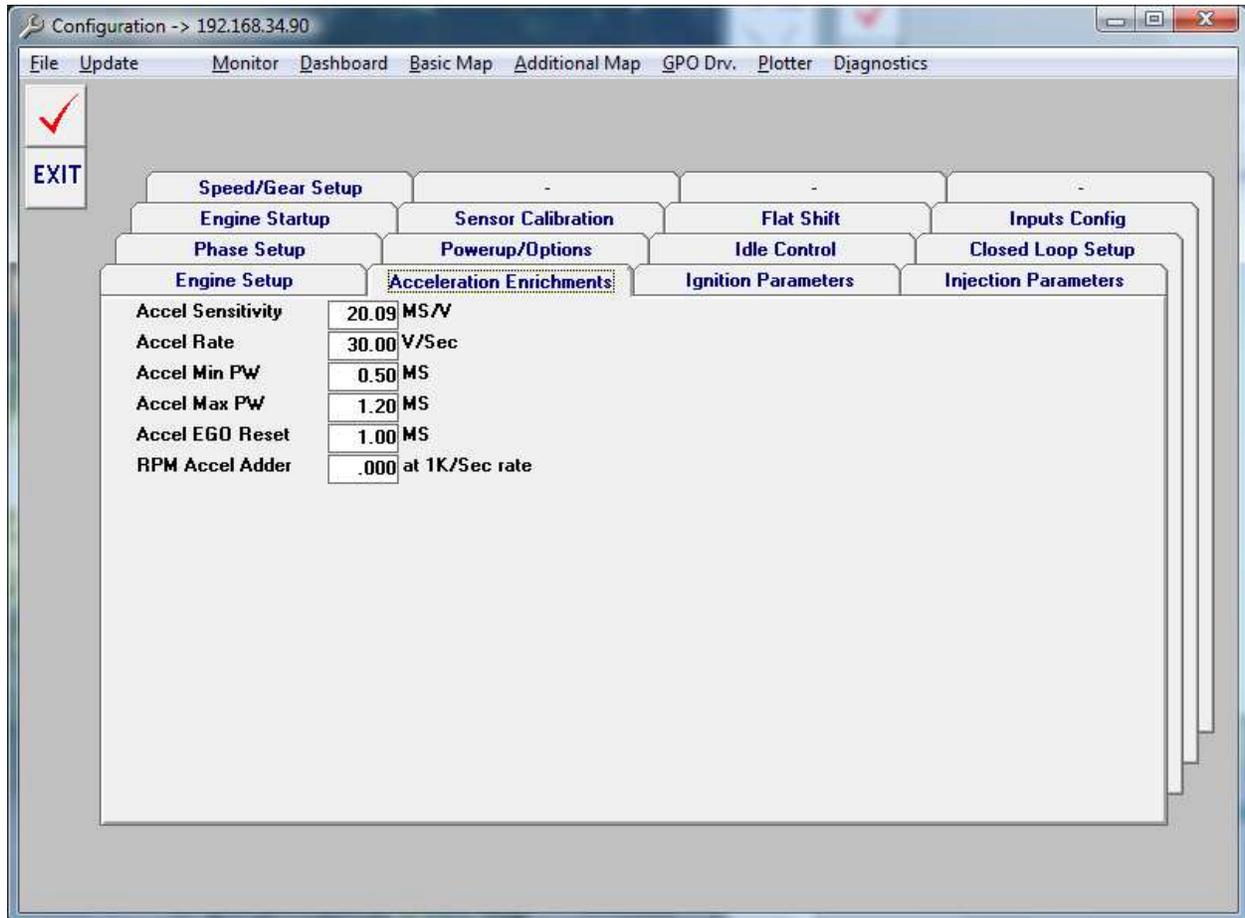
Drivers must be setup for 720 degrees of crank rotation, usually degree separations are calculated by dividing 720 by the # of cylinders. To calculate the degree breaks for each phase of a sequentially fired engine, divide 720 degrees by the number of cylinders.

The example above shows a 6 cylinder (with a firing order of 1, 5, 3, 6, 2, 4), with injection firing 390 deg off from ignition. Using the Base degree individual cylinder timing trim can easily be accomplished as well by adding or taking away degree timing from each phase. Because the ECU can be set up with "virtual phases", and the ECU determines RPM by the # of active phases, driver tach check marks are provided to ensure accurate RPM readings.

### *Drv. Tach*

is used to include a given phase in the tachometer calculation, thus even a 4 cyl. Tach can be run off a setting for a V8 motor.

## Acceleration Enrichments



When the throttle is quickly engaged the motor is challenged to accelerate as a large amount of air enters the intake manifold. Thus, a corresponding amount of fuel must be injected to feed this demand. Acceleration enrichment is tuned in the Configuration window. The 5 fields determine the acceleration fuel PW, and are described in the ECU Manual. Careful tuning of these parameters will ensure fast engine response to acceleration conditions and smooth drivability. Use the settings described below:

### *Accel Sensitivity*

Sets the amount of throttle opening enrichment. Higher numbers gives more fuel when the throttle is opened rapidly. Use values of 10.0 or greater

### *Accel Rate*

Sets the length of time that the acceleration enrichment will operate. Lower numbers will give longer enrichment times. Use values of 5.0 or greater.

*Accel Min PW*

Sets the minimum calculated acceleration pulse width that will be used. This prevents small throttle changes from causing unwanted enrichments. Larger numbers will give lower emissions, but poorer response.

*Accel Max PW*

Sets a limit on the amount of acceleration enrichment that can be used. Larger numbers will allow higher enrichments.

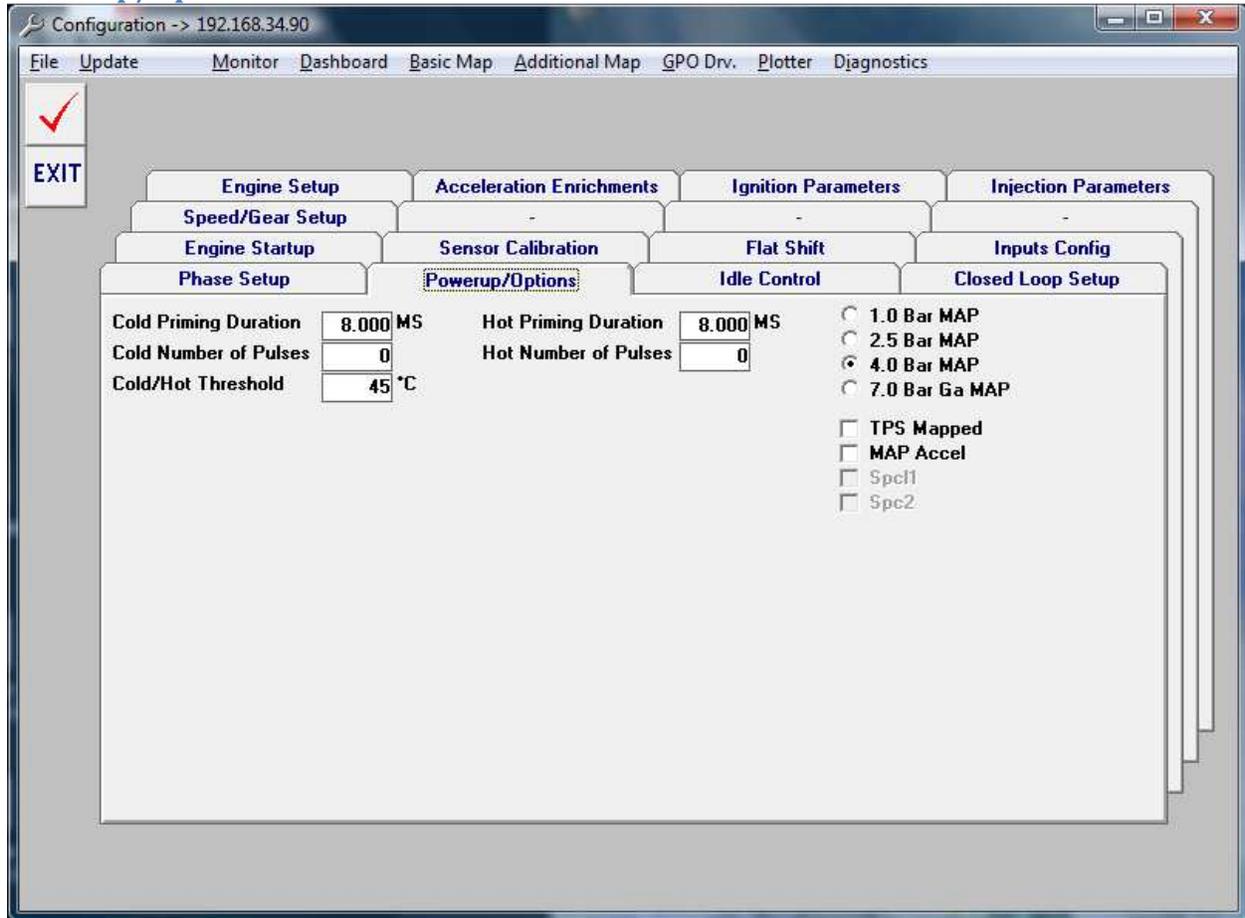
*Accel EGO Reset*

Sets the amount of enrichment that will disable then reset the closed loop (EGO) operation. Lower numbers will reset the EGO algorithm and prevent closed loop operation during transients. Setting this value too low can cause problems with normal or static closed loop operation.

*RPM Accel Adder*

This field will increase the calculated base pulsewidth for a rapidly accelerating engine. This can be very useful for motors with non-linear acceleration rates, and extremely fast revving engines.

## Powerup/Options



### *Cold/Hot Priming Duration*

The length of the pulsewidth, in milli-seconds, of fuel to be injected for priming.

### *Cold/Hot Number of Pulses*

Number of a set injections can be programmed to fire as the ignition is turned on for priming the engine with fuel for startup. These parameters should only be tuned when cold or hot starting. Typically it takes quite a bit of fuel to get a motor started, don't be afraid to use a lot of fuel here if necessary (5 pulsed of 9.0 for example).

### *1.0, 2.5, 4.0 or 7.0 BAR MAP*

These values calibrate the ECU to the proper MAP sensor that is being used, this should be pre-set from the factory, if any changes to the MAP sensor are made, they can be adjusted here.

### *TPS Mapped*

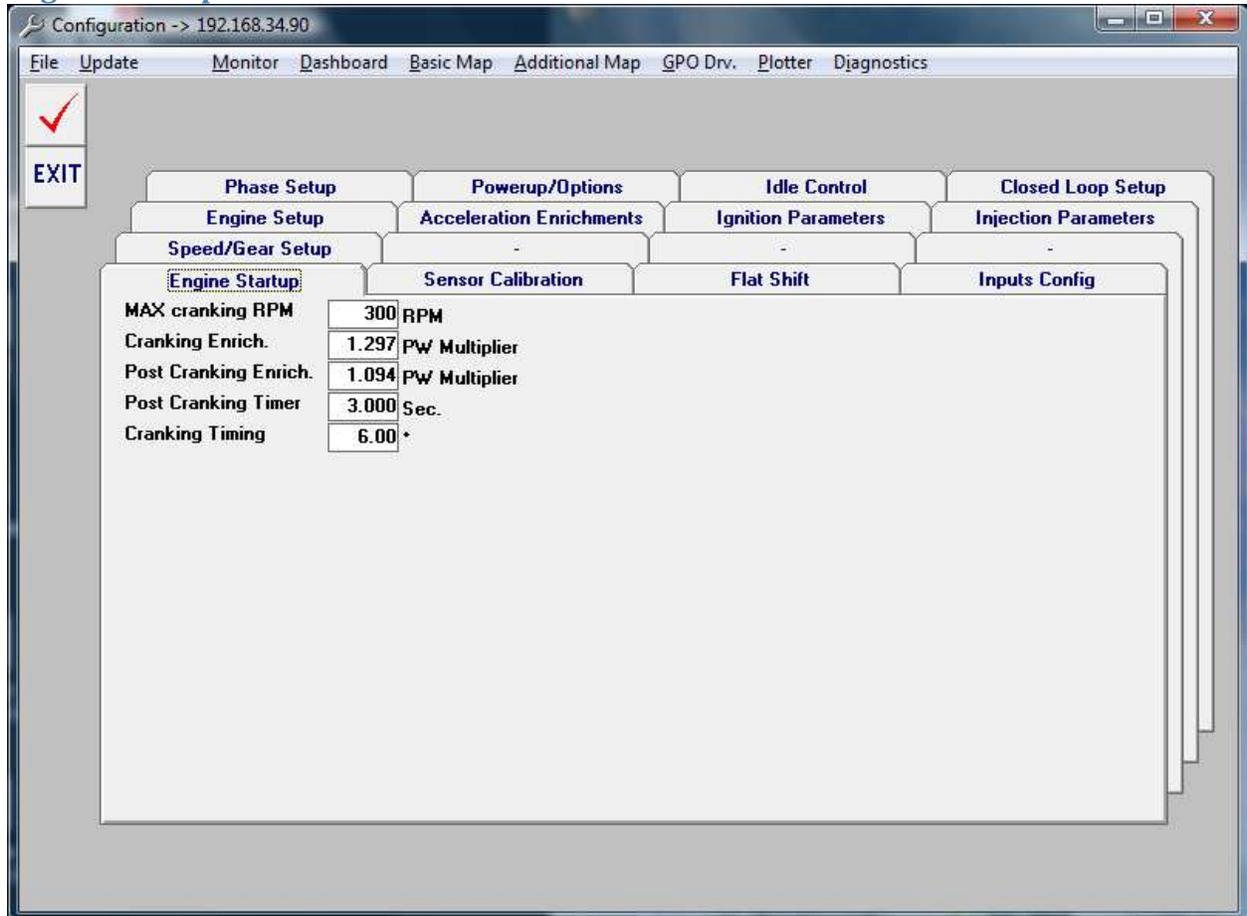
The basic mapping screen, by default, is set up with MAP on the Y-axis, this can be changed to TPS or Throttle position in the event where intake manifold vacuum is so low

that it's not useful. As long as the motor makes less than 75kPa at idle, leave the default setting. \*\*\* Note this is a legacy setting, the new 3d TPS blending maps make this feature redundant. \*\*\*

### Map Accel

In the event that a TPS Sensor is not available, acceleration enrichments can be set up using the MAP Sensor output.

## Engine Startup



### MAX Cranking RPM

The ECU will consider the engine to be in 'engine start' mode, all subsequent fields in this tab will be activated if the ECU senses RPM, and it is below this threshold.

### Cranking Enrich.

This is a fueling multiplier which will alter the calculated fueling during cranking conditions. Typically a motor will need a lot more fuel while cranking.

### Post Cranking Enrich.

This fueling multiplier will be applied *after* the motor RPM's have exceeded the MAX Cranking RPM. The purpose of this field is to temporarily enrich the fueling for the motor until the engine and/or manifold pressures stabilize.

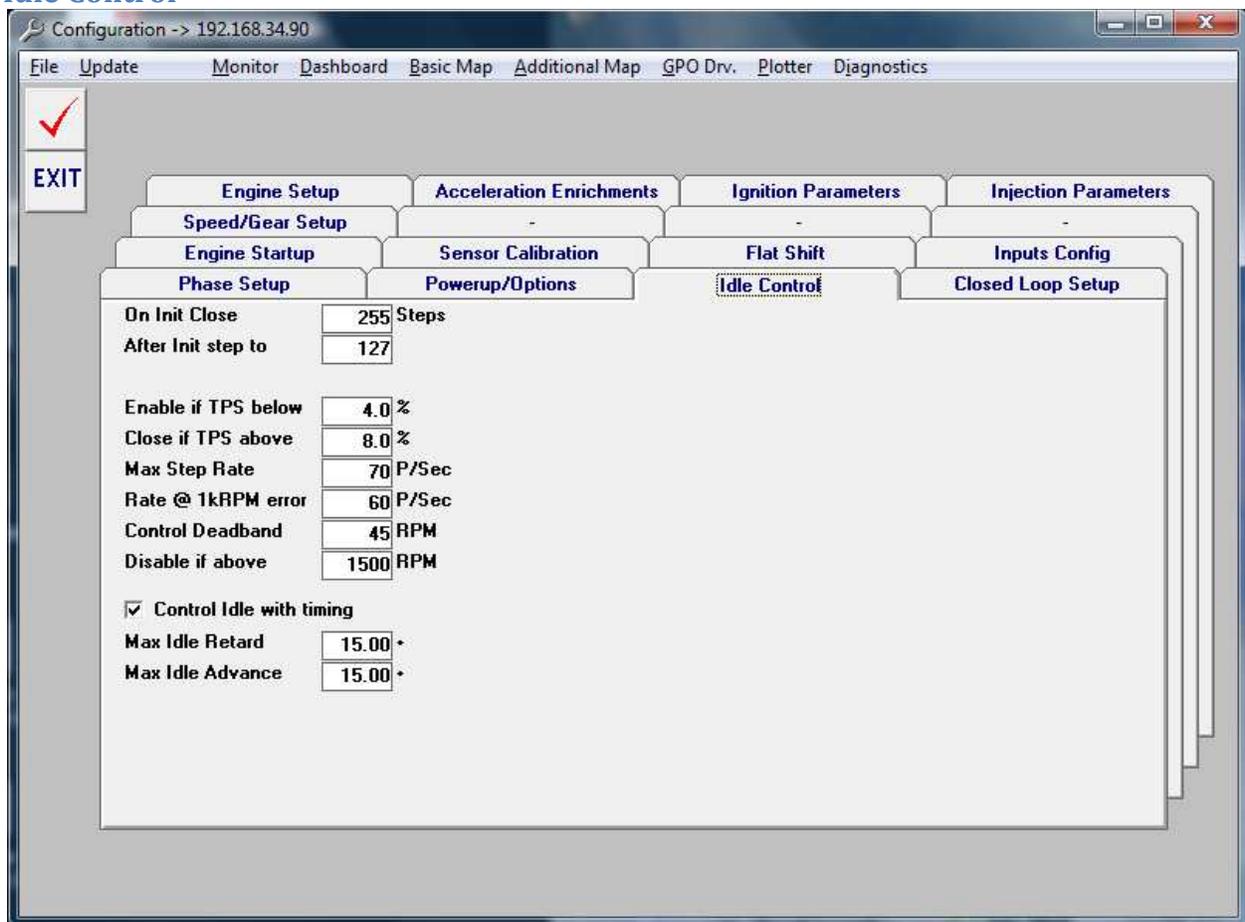
*Post Cranking Timer*

Duration of time to apply the Post Cranking Enrichment, after the engine has exceeded the MAX Cranking RPM.

*Cranking Timing*

Fixed timing value to use while the engine is cranking for startup. To high of a value here can lead to ignition 'stalling' where the mixture gets ignited too early and the engine stalls against the starter.

**Idle Control**



The ECU can control idle with a variety of devices. The most advanced uses a “GM Style” idle air motor. This is a stepper motor and controls the throttle-body-bypass of air by stepping a plunger in small increments, thus giving it great accuracy and control. If tuned properly the ECU will control this motor as accurately as any factory type system. IAC Parameter explanations below.

A simple 2-wire idle motor can also be used on GPO 1 or 2, and mapped in the corresponding GPO table, in addition to the settings found here.

The Idle can also be controlled by altering the timing of the engine at idle.

#### *On Init Close*

The IAC will close this many steps on startup. This value should be more than the After Init Open parameter. The valid range for the control loop when using a GPO based idle motor, or ignition timing is 0-255, for stepper idle motors this value is dependent on the total number of steps required to move the motor it's complete length of travel. This parameter ensures the IAC is fully closed upon startup and gives a repeatable reference point for the IAC to work off of.

#### *After Init Open*

This is the target IAC position to start the car. The IAC will open this many steps. This will depend on your throttle stop setting, the lower the throttle-stop-idle setting you have the more steps will need to be opened to enable the proper idle speed.

#### *Enable if TPS Below*

The IAC is only adjusted when the throttle is closed. It detects that the throttle is closed when the TPS value is less than this parameter. If the closed throttle reading "on the monitor" says 15%, set the Enable if TPS Below to 17% or so. Do not make this value too close to the TPS closed point or temperature or small mechanical changes will haunt idle performance. Set to 0% if it's desired to disable the IAC adjustment.

#### *Close if TPS is Above*

The IAC will quickly and automatically close if the TPS goes above this value. This will keep ensure from loosing boost out of the IAC. When the TPS drops below the "Enable if TPS Below" value, the IAC will reopen to the "After Init Open" position, and idle will resume. Set to 101% to disable IAC closure, like if there are problems with stalling on throttle closure. Generally on boosted motors this value should be set close to 40% or the throttle point where real boost begins to build.

#### *Max Step Rate*

This sets the speed at which the idle control is adjusted when during Init, and sets the max rate that it will ever be allowed to step. Generally most IACs won't move properly for values above 500 "Hz", so be careful. This value shouldn't be set too close to the IACs capabilities because it may not work at higher temperatures or under some boost conditions when the IAC is loaded more.

#### *Rate at 1K error*

This sets the speed that the idle control will move as a function of the error between the actual engine speed, and the speed set point table in Additional Mapping. Any value in here is generally fine since the ECU will never try to move the IAC faster than the Max Step Rate value. This parameter controls how the idle stability versus correction speed compromise is made. If the value is too high, the idle will oscillate or bounce, too low and the engine speed adjustments may be sluggish or stall the engine before the adjustments can be carried out. Start with small numbers 20 or so, then move up to higher values until there are stability problems, then divide the number by 2.

### Control Deadband

This sets the minimum error in RPM that must exist in order for adjustment to be performed. Setting it to 50 with a RPM set point of 1000 would disable idle control corrections from 950 to 1050 RPM. If this value is set too low, the idle might oscillate - also stepper motor IAC's may overheat if it is continuously adjusted when with only trivial errors in idle speed.

### Injection Parameters

The screenshot shows a software configuration window titled "Configuration -> 192.168.34.90". The window has a menu bar with "File", "Update", "Monitor", "Dashboard", "Basic Map", "Additional Map", "GPO Drv.", "Plotter", and "Diagnostics". On the left side, there is a red checkmark icon and an "EXIT" button. The main area contains several overlapping panels. The "Injection Parameters" panel is the most prominent and contains the following data:

Engine Setup		Acceleration Enrichments		Ignition Parameters		Injection Parameters		
Battery Offset Time	60.8 $\mu\text{sec/V}$			Injector Channel 1	1.000	0.000	1.000	50.000 MS
Engine Decel	35.0 kPa			Injector Channel 2	1.000	0.000	1.000	50.000 MS
Max TPS for Decel	2.0 %			Injector Channel 3	1.000	0.000	1.000	50.000 MS
Max/Cut Pressure	395.1 kPa			Injector Channel 4	1.000	0.000	1.000	50.000 MS
				Injector Channel 5	1.000	0.000	1.000	50.000 MS
				Injector Channel 6	1.000	0.000	1.000	50.000 MS
				Injector Channel 7	1.000	0.000	1.000	50.000 MS
				Injector Channel 8	1.000	0.000	1.000	50.000 MS
					Main Gain	Idle Trim	P.W. Min.	P.W. Clamp

This screen is used to modify injection settings. The base fuel parameter is the Injector Main value in the basic mapping; however, this value can be offset cylinder-by-cylinder using the Main Gain and Idle Trim values to compensate for different cylinder combustion conditions. Certain channels can also be setup to be "staged" so that two sets of injectors can be used, one set for idle and low power conditions, and another set "staged" to turn on under boost, nitrous or a heavy cam, for example.

### Battery Offset Time

This will offset the injection time based on battery voltage to compensate for fuel injector response time.

### *Engine Decel*

Is a setting for fuel deceleration shut off, under high vacuum, coasting conditions; fuel will be turned off for drivability, emissions and economy reasons. Ensure it is not set too high as to cut fuel during normal driving or idle.

### *Max TPS for Decel*

Is used to fine tune the fuel cutoff on deceleration. The fuel will not be cut based on **Engine Decel** unless the TPS signal is below this value. Some engines can draw a large amount of vacuum under light load, this can cause a higher than desired setting for the fuel cutoff on deceleration. Using this value you can raise the decel kPa for quicker RPM drops, and less popping/wasted fuel on true deceleration, and maintain high-vacuum drivability.

### *Max/Cut Pressure*

This value is an 'overboost' safety measure. Any time the MAP value is above this limit the fuel will be cut to avoid engine or turbo damage.

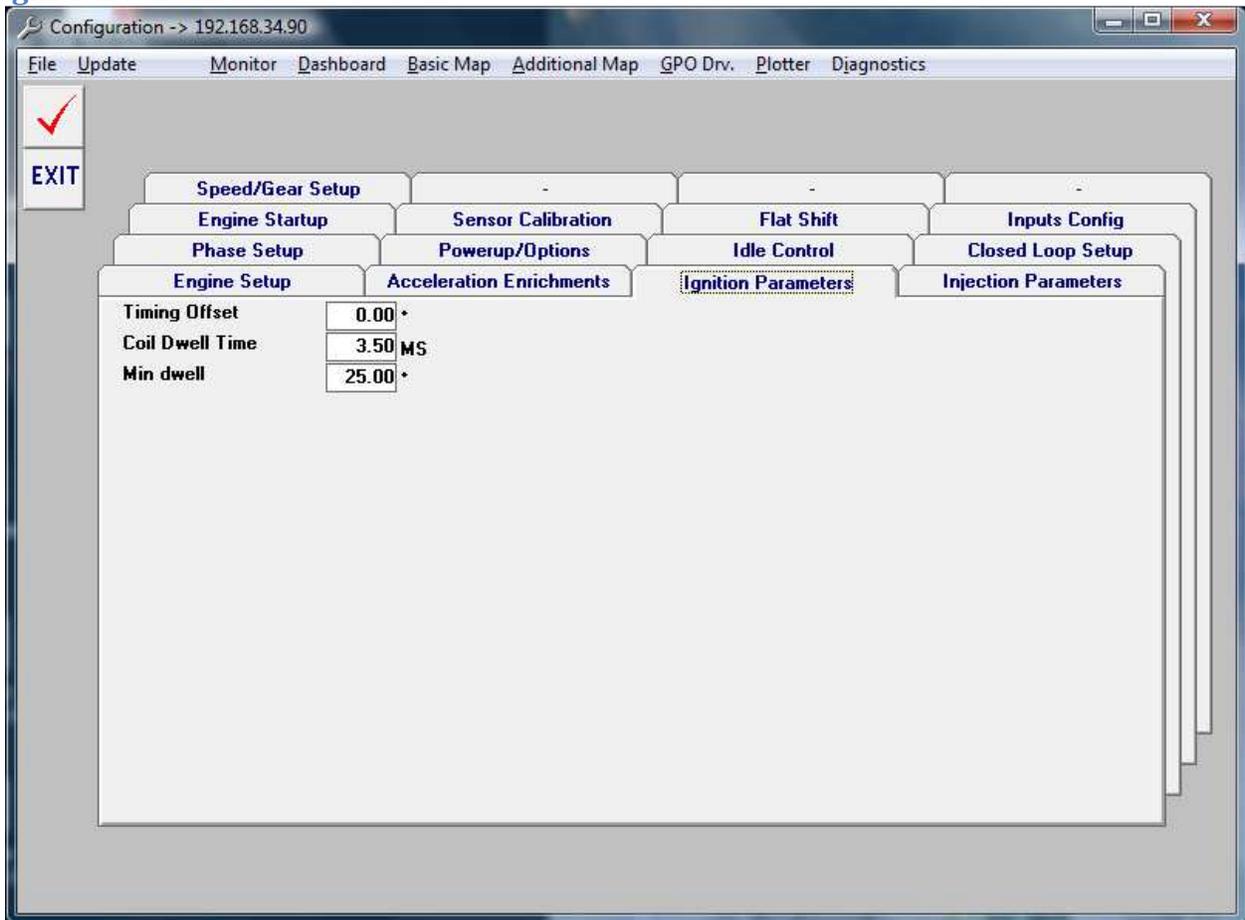
### *Pulsewidth Min*

This limit can be placed on certain channels to keep them from falling below the specified PW value, in milliseconds. This can be extremely useful for engines with large injectors operating at or near the physical opening time limit on the injectors. Most modern injectors take between 1-1.5ms to open and properly meter fuel. If your calculated pulsewidths are dropping below these values in your basic mapping the engine will typically stall or misfire.

### *Pulsewidth clamp*

This limit can be placed on certain channels to keep them from turning on below a given PW value. Remember, more than 1 high or low impedance injector can be run off per channel, thus in a 5 cyl application, 5 channels can be used for the main injectors sequentially, and 5 more injectors can be run staged in a batch fire mode from the remaining channels. Thus, the primary injectors can be "clamped off" at a certain PW and allow the larger set of injectors to blend it transitioning over under boost and higher power conditions. Especially useful for heavily turbocharged applications where a smooth, stock like idle is desired.

## Ignition Parameters



### *Timing Offset*

This value will globally add/subtract timing. Can be used for quick adjustments to the entire timing curve for testing or troubleshooting.

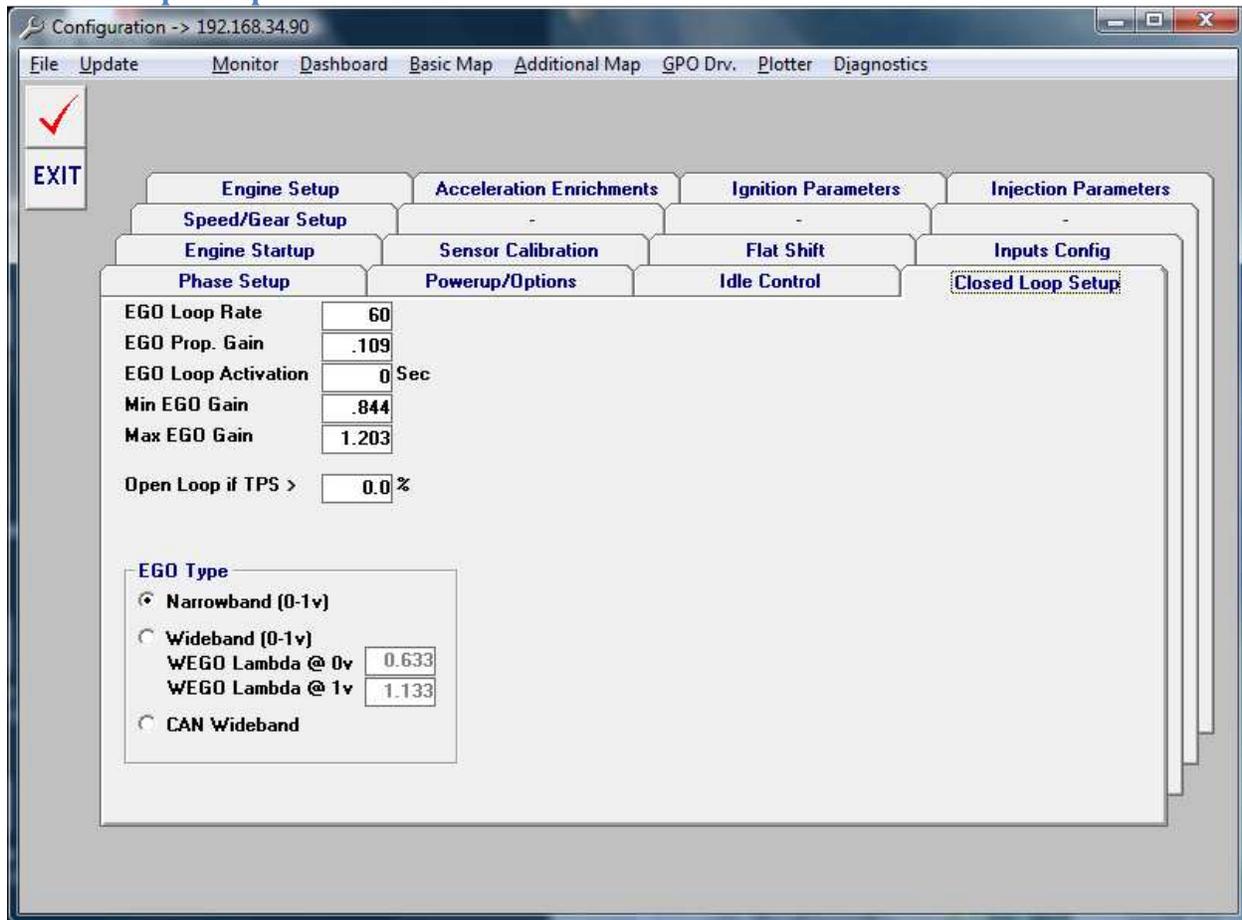
### *Coil dwell*

This is the amount of time the coil is charged before a spark event. Typically, a coil dwell time of 3MS is safe and useable for most applications, in heavily turbocharged or ultra-high specific output motors (above 150hp/l), increases in coil dwell time may be needed. It is recommended to use the lowest possible dwell settings, while still ensuring you have reliable spark performance. The dwell time is altered based on MAP pressure in the additional mapping pages, typically more dwell is required with higher cylinder pressures, and less dwell can be used with lighter loads.

### *Min Dwell*

A Min dwell setting of 10-15 degrees is almost always acceptable, higher values lower the minimum dwell calculated and will ensure more spark at starting and low RPM conditions.

## Closed Loop Setup



### *EGO Loop Rate*

This field determines the speed at which the EGO loop is calculated, higher the number means the less often its calculated. The default loop rate setting is 200 times per second, the EGO Loop Rate Value divides the default setting for the calculated loop rate. For example, to set the loop rate at 10 times per second, a value of 20 would calculate  $200 / 20 = 10$  loops per second.. Generally values between 5 and 15 will give the best results.

### *EGO Prop. Gain*

This field is the instantaneous calculated value that will be applied to the fuel parameter based upon the difference between the EGO output and the EGO set point target. This value is a percentage, for example, a value of .5 represents 50%, thus 50% of the difference between the actual EGO and the target field will be multiplied against the base fuel calculation. Thus, smaller values or “percentages” will cause a smaller change as a function of closed loop.

For example, if actual lambda is .9, and the EGO target setpoint value is 1.0, a value of .5 will multiply the difference of Lambda .1 by 50% for a value of .05. Thus, a multiplier of .95 (or a 5% decrease) will be applied to the base fuel parameter to lean it out and bring it closer to the target value of 1.0. Generally values of .25 to .75 work well, choose

a value that causes gradual yet effective cycling of actual EGO around the targeted setpoint value.

#### *EGO Loop Activation*

This value determines how long it takes for closed loop function to begin once the engine is started. A value of 0 turns off closed loop completely.

#### *Min/Max EGO Gain*

These values limits the minimum/maximum EGO gain that the ECU will use, generally, if EGO gain values are too large, its indicative of a base map that is not tuned enough. Typically target EGO gain values of .9 to 1.1, of more than this is needed, chances are more base tuning is required.

#### *Open Loop if TPS>*

TPS values above the entered value will disable closed loop operation; this is useful for only using closed loop at idle and lower load conditions, and turning it off under full load where the base fuel map is well tuned.

#### *EGO Type*

##### **Narrowband:**

When using a standard Bosch/NTK narrow band oxygen sensor, choose this option for normal closed loop operation.

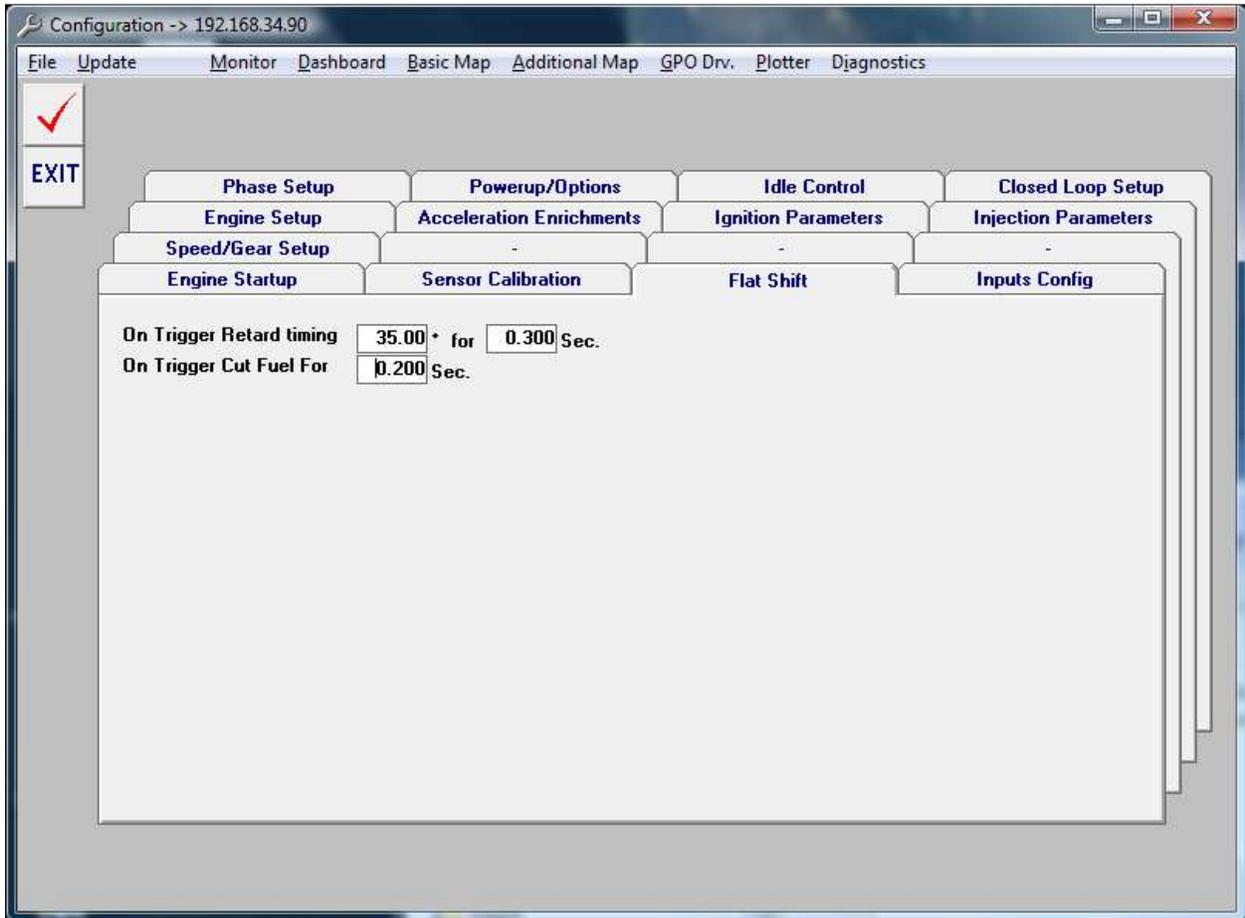
##### **Wideband (0-1v)**

When using the 0-1v analog output of a Wide Band controller such as those offered by Innovate Motorsports, use this function. By far the best and most accurate closed loop EGO options is to run the standard 0-1v linear EGO curve out of the Innovate directly into the 034EFI EGO circuit. Voltage relative to Lambda ( $\text{Lambda} = \text{a/f ratio} \cdot 14.7$ ) can be fine tuned under the Configuration>Closed Loop Setup>EGO Type field of the tuning software. For example, Innovate systems default a 10:1 a/f at 0v, and 18:1 at 1v, thus Lambda values of 1.224 ( $18 \cdot 14.7$ ) at 0v and .680 ( $10 \cdot 14.7$ ) at 1v would be a good starting point.

##### **CAN Wideband**

Enable this when using the 034EFI specific wideband control unit for direct digital communication over the CAN bus to retrieve AFR and wideband control measurements directly from the control unit.

## Flat Shift



'Flat Shifting' is used when you want the ability to cut fueling and alter ignition for a specified time based on an external input. This is commonly used in drag racing configurations.

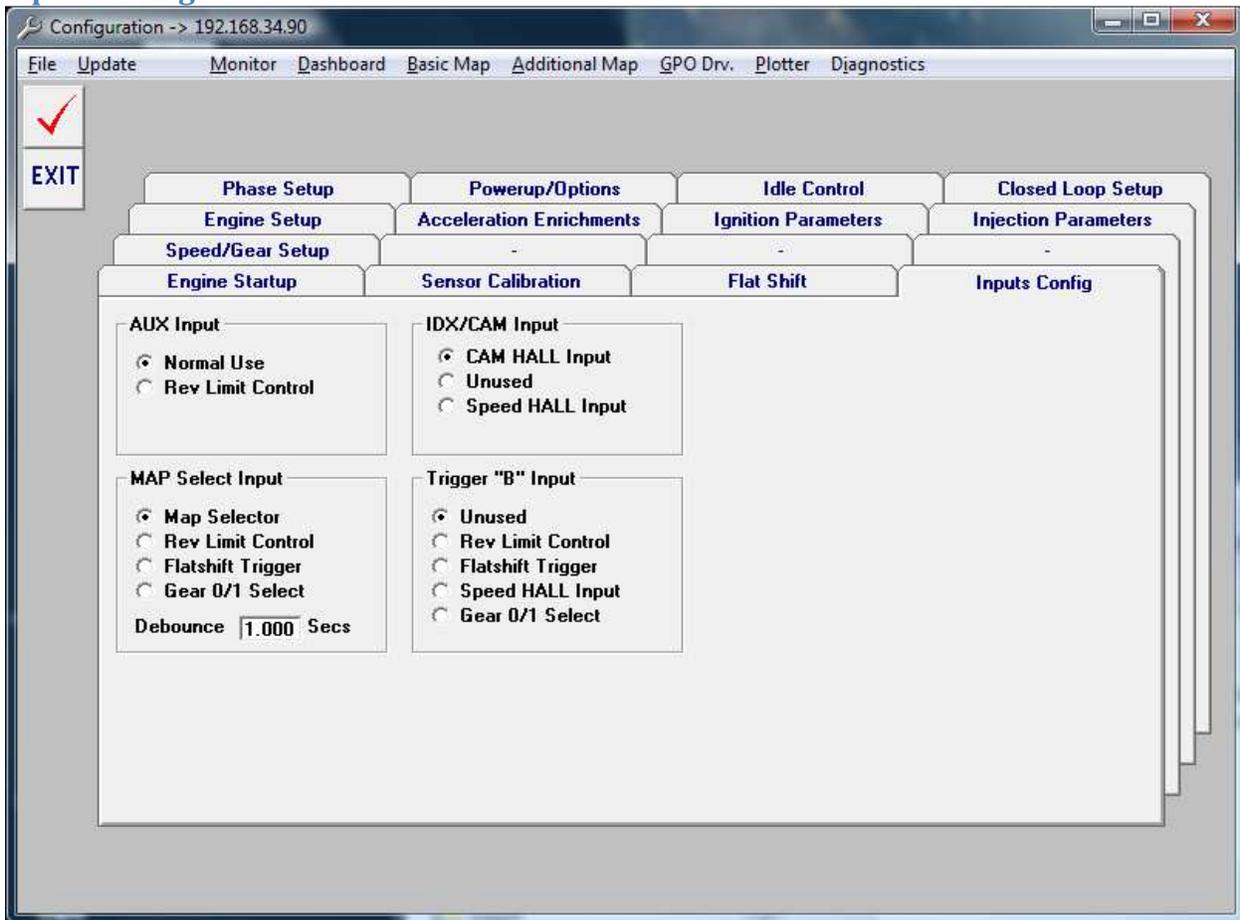
### *On Trigger Retard timing*

Specify the amount of timing retard to apply when the flat shift system is activated. This timing retard will be applied for the amount of time in the seconds field. This value will typically be equal to the physical amount of time it takes to change gears.

### *On Trigger Cut Fuel For*

Specify the amount of time to (optionally) turn off the injectors for on a flat shift event.

## Inputs Config

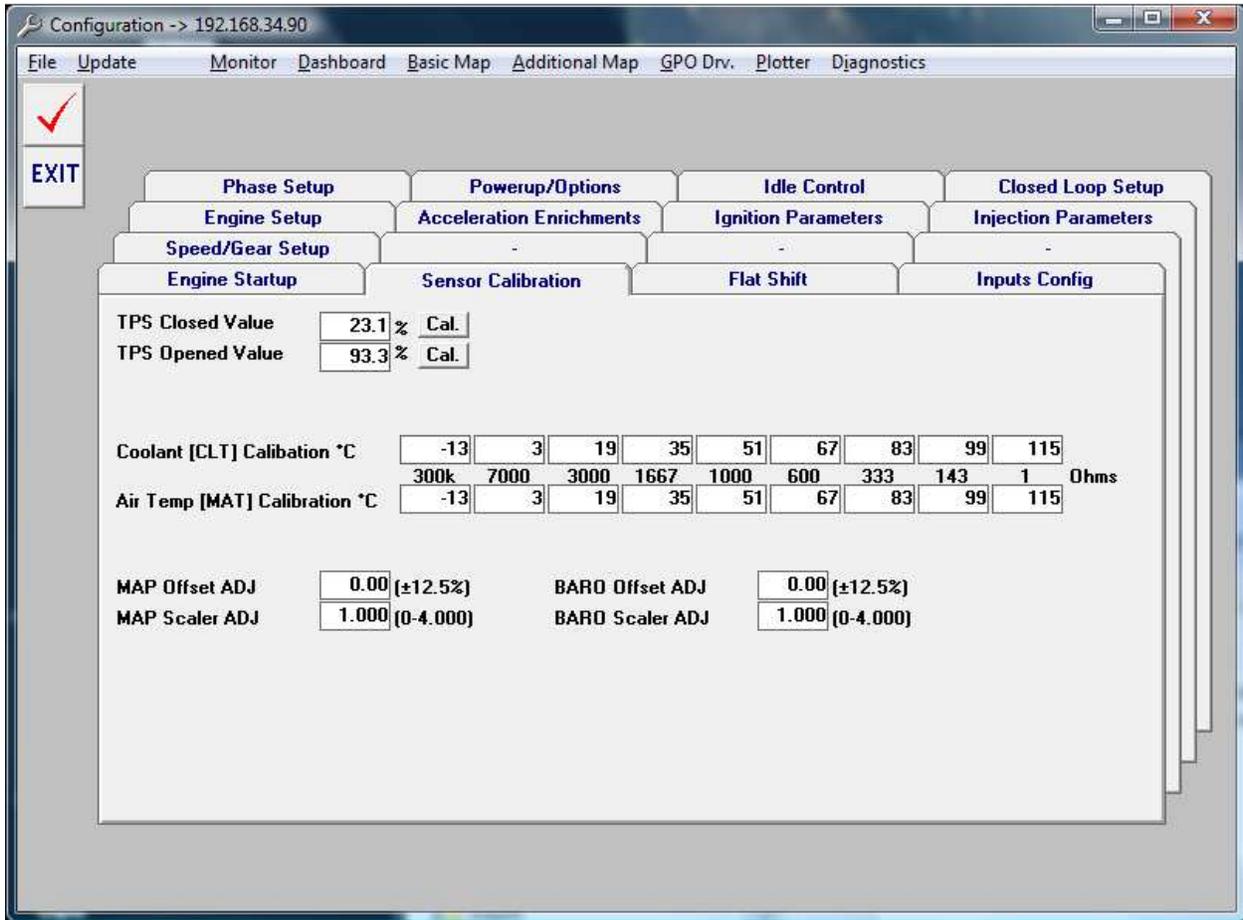


This screen allows the tuner to 'map' various input pins to specific functions.

### Functions

- Rev Limit Control: Switches between rev limit 1 and rev limit 2
- Map Selector: Allows use of 2 discrete maps to be used on the ECU
- Flatshift trigger: When this is activated the ECU will enable the flat-shift control algorithm
- CAM HALL Input: Cam reference signal, used for valve timing injection, and single coil firing on the combustion stroke only.
- Speed HALL Input: Used for vehicle speed input.
- Gear 0/1 Select: Used to switch directly from gear 0 maps to gear 1 maps. The most common use for this is to run two different open or closed loop boost control GPO maps.

## Sensor Calibration



### *TPS Closed Value*

Used to calibrate the TPS sensor with the throttle at rest.

### *TPS Opened Value*

Used to calibrate the TPS sensor with the throttle fully opened.

### *CLT/MAT Calibration Tables*

Can be used to calibrate the temperature sensor curves to match the sensors installed in your car. The numbers listed above are the default 'GM' style temp sensor curves.

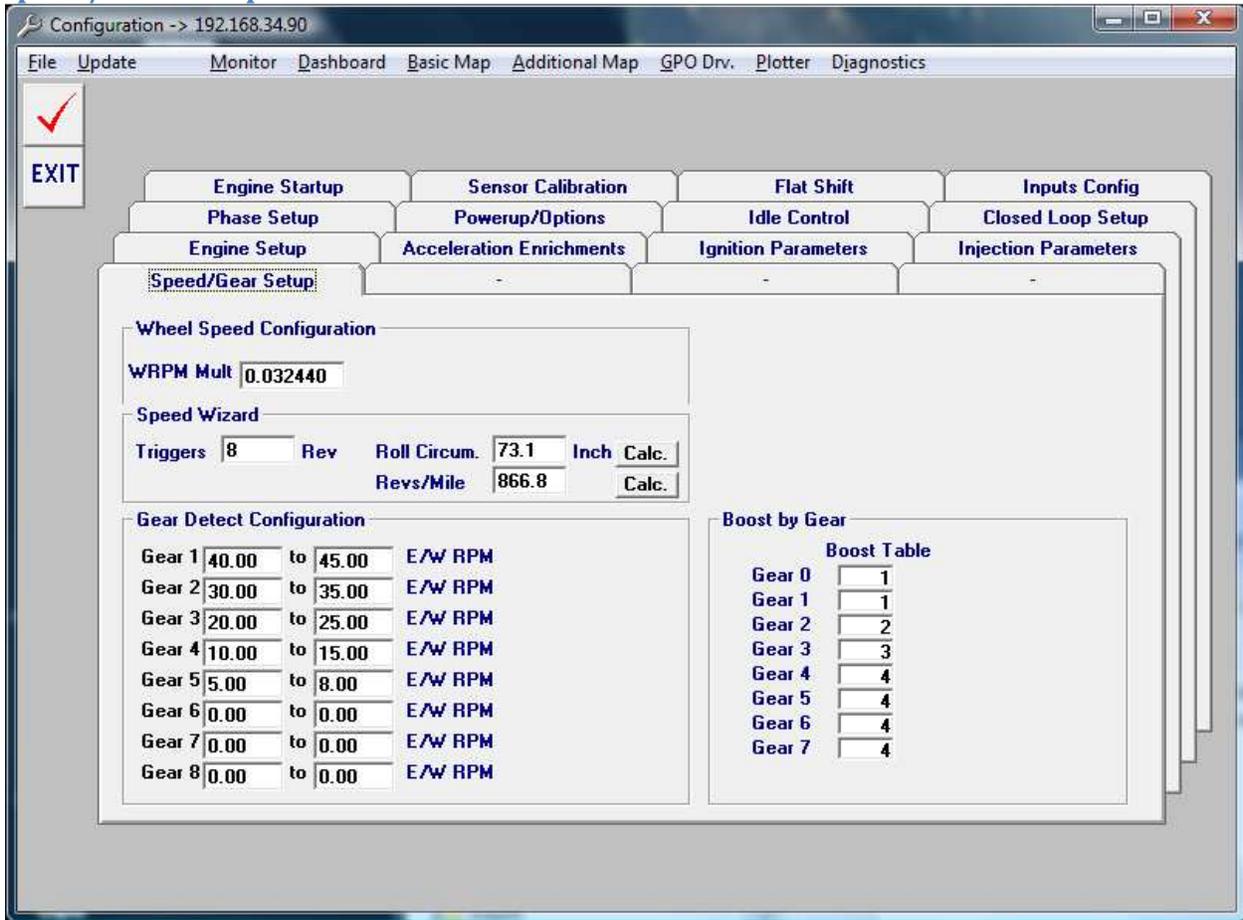
### *MAP/BARO Offset Adjust*

Can be used when non-standard sensors are installed, or to correct for some variance in sensor readings. This will shift the entire map sensor reading by the specified percent.

### *MAP/BARO Scaler ADJ*

Can be used to change the scaling of the MAP sensor for non-standard installs, this number is a multiplier on the current sensor's settings.

## Speed/Gear Setup



Use the Speed Wizard to determine your WRPM Multiplier. These fields allow you to specify the number of triggers per 1 wheel revolution, and with the circumference of the wheel the vehicle speed can then be calculated.

### *Gear Detect Configuration*

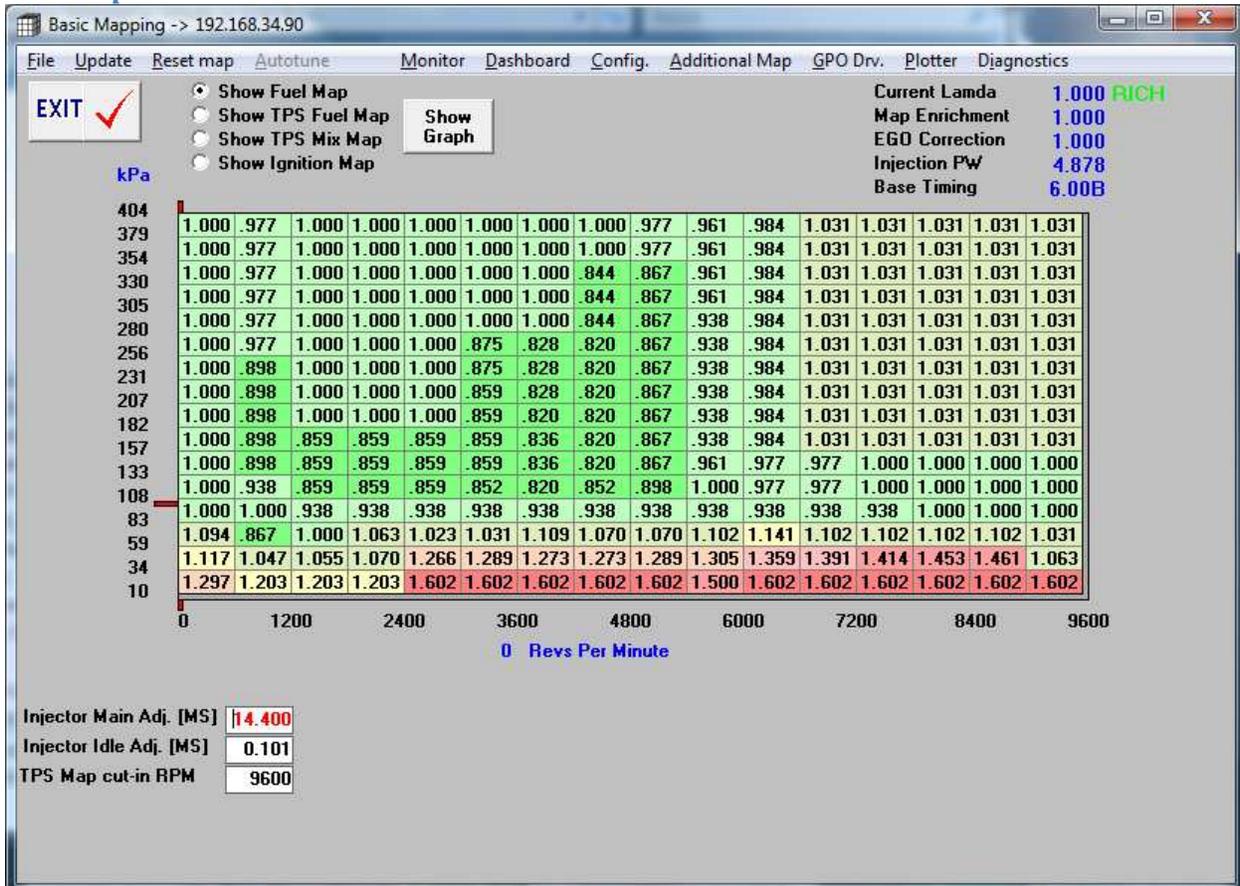
These are ranges that define what engine RPM correlates to the Wheel RPM's. The range allows for some error to more accurately detect which gear is selected, even with some clutch slip, or tire size changes with speed.

### *Boost by Gear*

This table allows you to map any gear to one of 4 possible boost control tables. This enables you to run 4 completely independent boost tables based on gear selected. If no vehicle speed input is available the gear 0/1 switch can be enable to select the boost tables that are set in the Gear 0 or Gear 1 bins.

## Basic Mapping

### Fuel Map



#### Injector Main Adj. Value

This is the main fuel parameter, similar to the function of main jets on a carbureted engine. This number equates to the basic “unmapped” pulse width that the controller would calculate at the maximum manifold pressure. Increasing this number will generally give more fuel at a give pressure/engine load. Be careful to correctly select your fuel injector rates, as if the injection pulse width gets too long, the injectors can be opened for 100% of their duty, at which point the engine will lean out, and likely become damaged. For more information of injector selection, please call or email technical support.

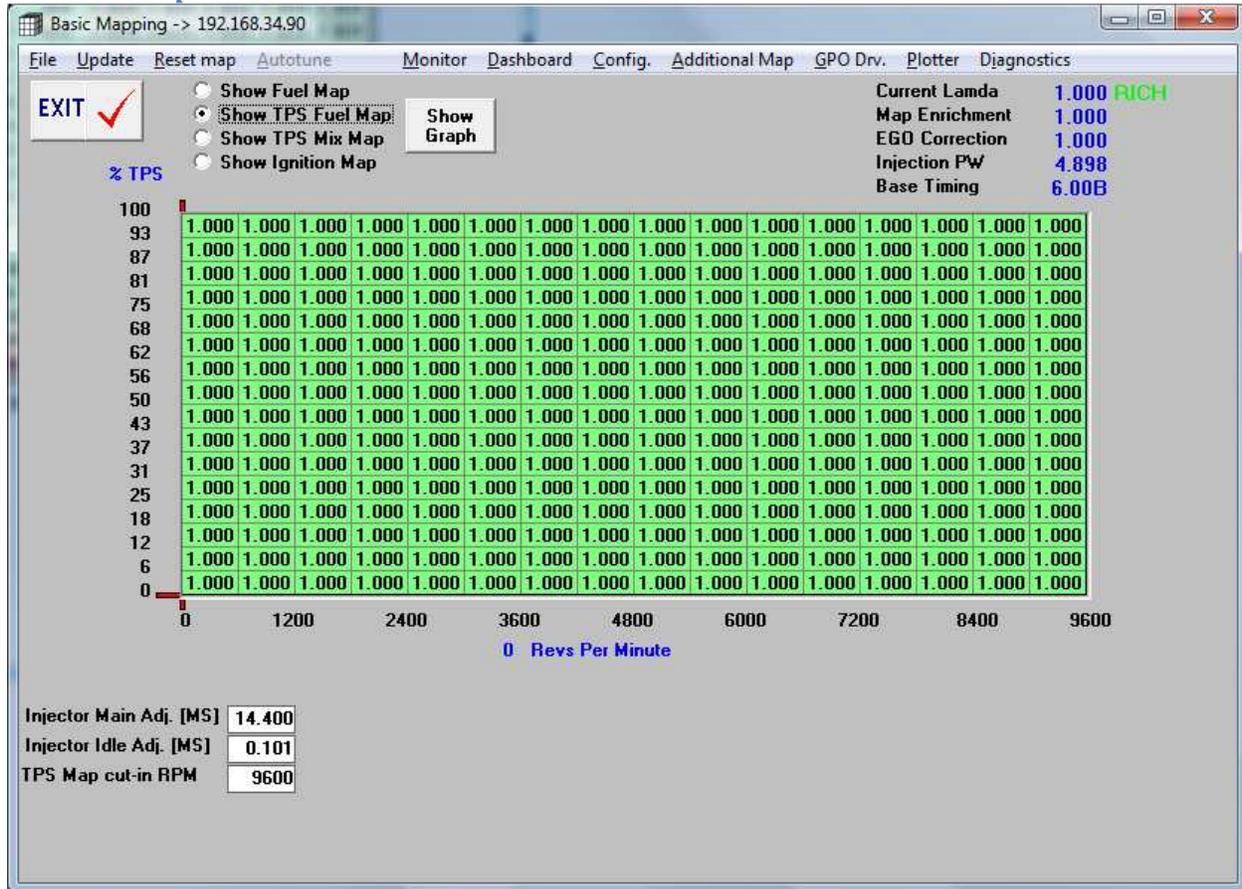
#### Injector Idle Adj. Value

This parameter is usually considered a trim adjustment, similar to the idle and progression circuit in a carbureted engine. This parameter is typically near zero, or even slightly negative in many medium performance applications. In higher performance applications, where the idle manifold vacuum is low, this parameter can be somewhat more negative, where the calculated pulse width at idle is too high due to higher manifold pressure (poor vacuum). The negative Injector Offset parameter subtracts “if negative” from the basic pulse width so that the resultant pulse width is what is needed to control the engine.

### *MAP x RPM Matrix*

The MAP x RPM matrix is the second most important tuning parameter after the Injector Main and Idle settings. This matrix allows fine-tuning of the fuel curve based on precise and narrow pressure and engine speed points. Values across the matrix are interpolated between cells (not stair-stepped as it appears) and have a percentage influence over the final PW calculation. Thus if a .95 is entered into a particular cell, as the engine speed and manifold pressure reference lines intersect in that cell the .95 value will be interpolated (as a percentage calculation) with the values of the cells adjacent to it to effect a leaner PW calculation. Conversely, if a 1.05 were entered it would interpolate into a richer calculation. Thus, if specific tuning points are either lean or rich after the best scaler and offset inputs, this matrix can be used to address those narrow ranges of fueling. All initial scaler and offset tuning should be done with the matrix values at 1.0. A good tuning benchmark should be to keep values in these cells between .8 and 1.2, and 1.0 at WOT, full power.

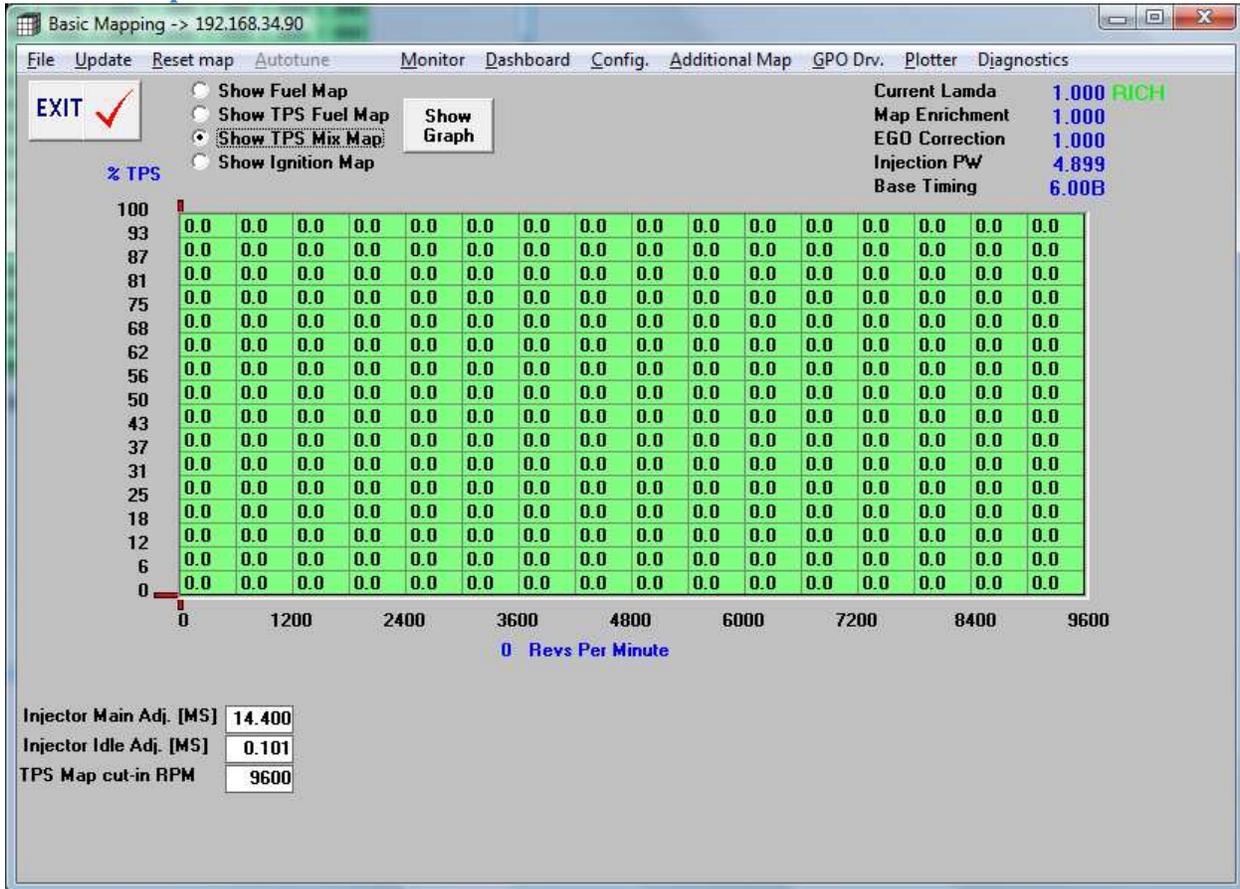
## TPS Fuel Map



### TPS x RPM Matrix

The TPS x RPM matrix can be used on motors with unstable manifold pressures to specify an injection amount based on the main scaler in the same method as the MAP based mapping.

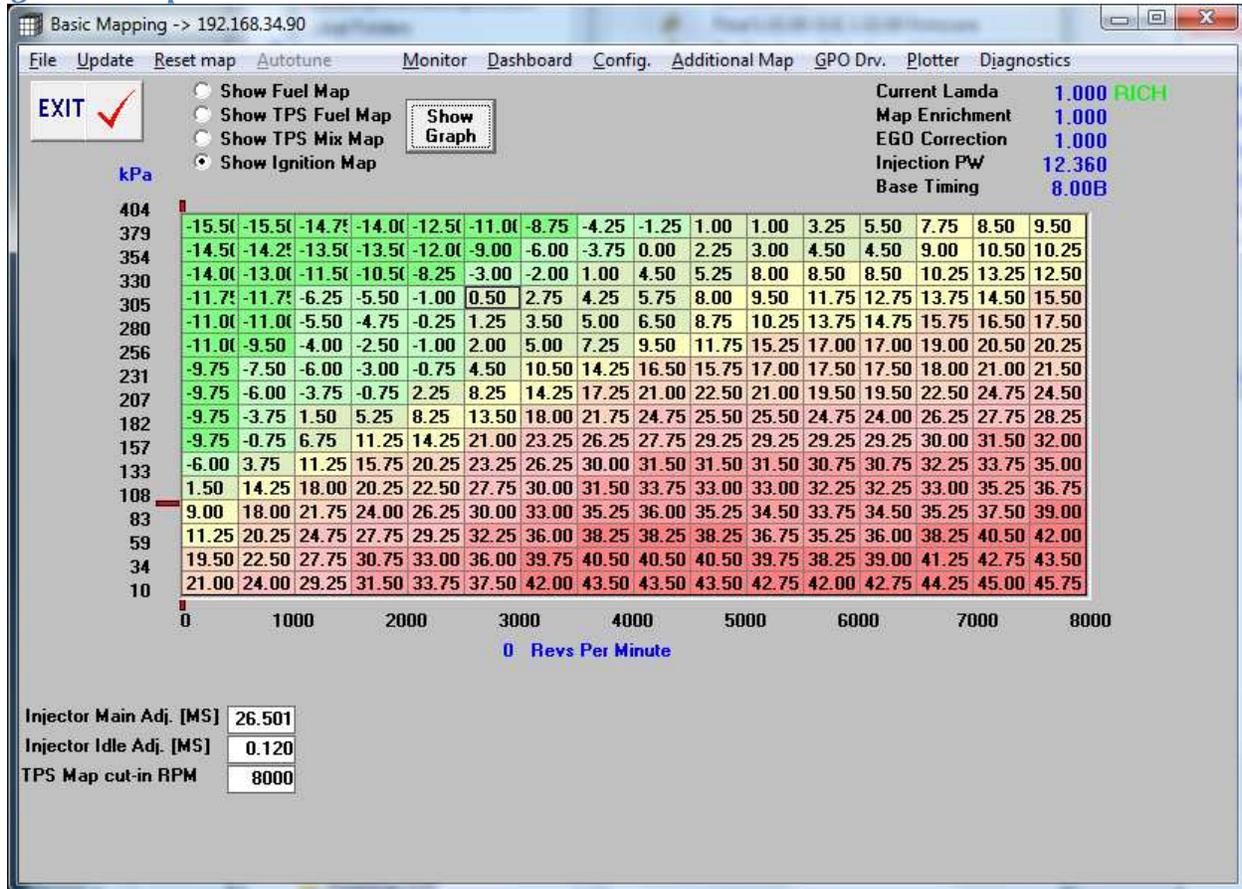
## TPS Mix Map



### TPS x RPM Matrix

The TPS x RPM matrix is used to determine how much of the TPS calculated fueling is used versus the MAP based fueling table. Valid entries are 0-100%. If the entire table is 100% then only the TPS based fueling table will be used for calculations, similarly, values of 0 will not use the TPS Fueling table at all. Typically there will be a smooth transition from the TPS table to the MAP based table as the manifold pressures stabilize.

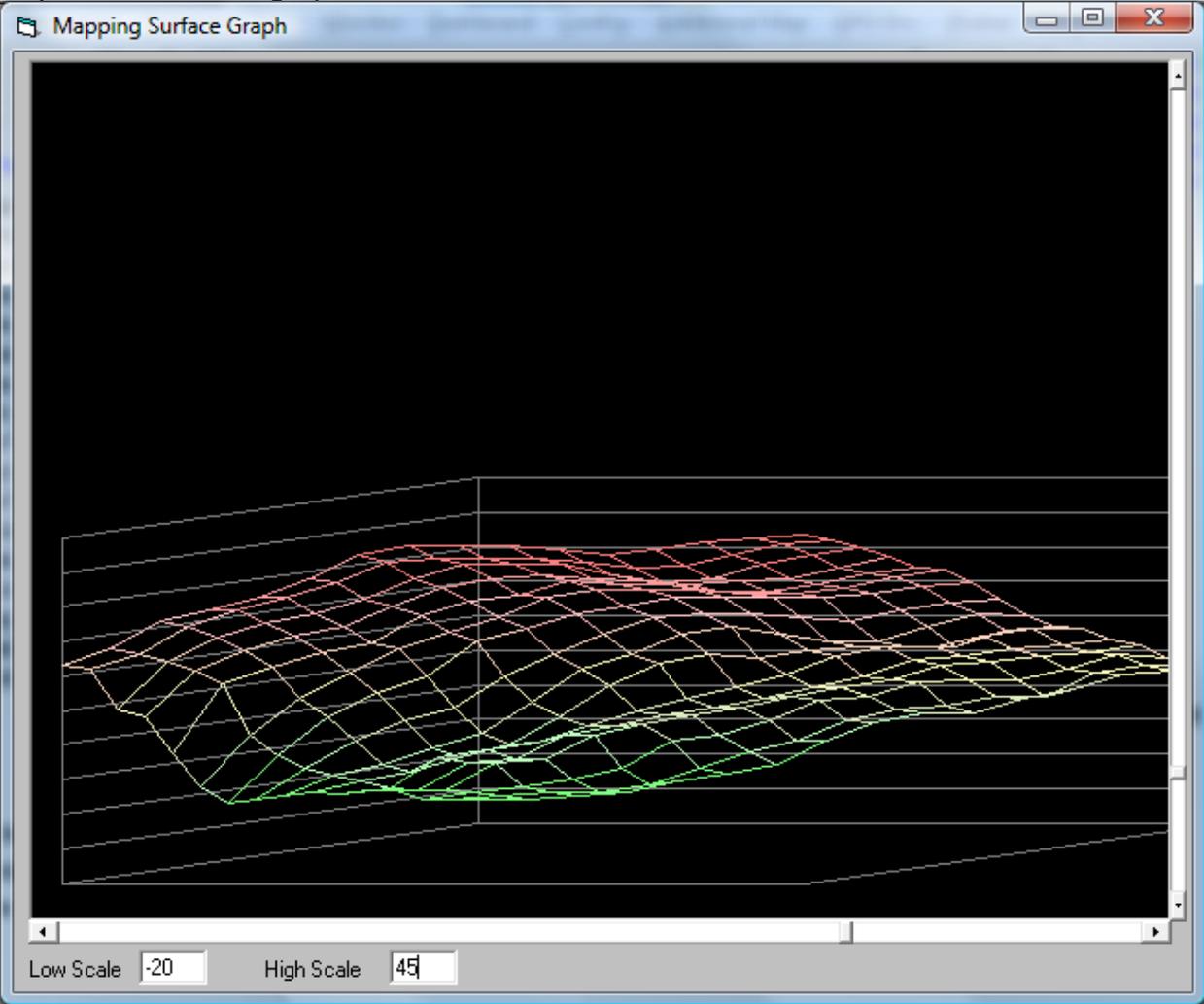
## Ignition Map



### MAP x RPM Matrix

This 3d table can be used as a complete 3d ignition timing map, or as a supplemental map to the 2d timing tables in the additional mapping screen. Values here are added or subtracted from the calculated timing.

Also, note that basic mapping matrix values can be graphically verified for all the 3d maps - below is the graph manifest of screen shot above.



## GPO Tuning

General Purpose Output Driver Mapping -> 192.168.34.90

File Update Reset map Monitor Dashboard Config. Basic Map Additional Map Plotter Diagnostics

EXIT

Gear/Boost Map-1 Gear/Boost Map-2 Gear/Boost Map-3 Gear/Boost Map-4

GPO-1 GPO-2 GPO-3 GPO-4

GPO-1 Parameters

MAP	0	1200	2400	3600	4800	6000	7200	8400	9600
404.0	60.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
354.8	39.8	0.0	70.3	70.3	70.3	70.3	70.3	70.3	70.3
305.5	32.0	0.0	70.3	70.3	70.3	70.3	70.3	70.3	70.3
256.3	28.1	0.0	70.3	70.3	70.3	70.3	70.3	70.3	70.3
207.0	25.0	99.6	70.3	70.3	70.3	70.3	70.3	70.3	70.3
157.8	19.9	99.6	70.3	70.3	70.3	70.3	70.3	70.3	70.3
108.5	18.0	99.6	99.6	76.2	76.2	76.2	76.2	76.2	76.2
59.3	17.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.0	14.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

0 1200 2400 3600 4800 6000 7200 8400 9600 RPM

Mapping Input Source

X=RPM / Y=MAP  
 X=RPM / Y=CLT  
 X=RPM / Y=TPS  
 X=RPM / Y=MAT  
 X=MAT / Y=MAP  
 Fuel Pump Relay  
 Coolant Fan Relay 80 °C  
 Gear Based GPO  
 RPM Switch Above 8000 RPM  
 2 Wire Idle  
 Disabled  
 Dont Interpolate

All Stage IIc ECU's come with 4-GPO drivers. A GPO is a pulswidth modulated output operating at 38Hz. The Stage "C" ECU's allow full 3-D mapping (where applicable) of different parameters in conjunction with each other. Fields can be setup with varying pulswidth percentage values to drive supplementary functions such as Vtec, fuel pump, water injection, nitrous, boost control, cooling fans, etc, etc.

### Fuel Pump Relay

By selecting this checkmark, the GPO will prime the fuel pump for up to 8 seconds on initial powerup, run the fuel pump when RPM is detected, and shut off the fuel pump when RPM stops for safety in the case of an accident or engine shutoff.

### Coolant Fan Relay

By selecting this checkmark, the GPO will activate when the target temperature value is reached.

## Gear Based GPO

Selecting this will activate the current GPO output for controlling a solenoid valve to manipulate pressure to the wastegate, or any other device you want manipulated based on vehicle gear. Details on the gear based functions can be found later in this article.

## RPM Switch Above

By selecting this checkmark, the GPO will activate above the targeted RPM value entered, there is a 250 RPM window before the GPO will deactivate. This prevents rapid cycling of the device if the engine is operating very close to the switching point.

## 2-Wire Idle

The screenshot shows the 'General Purpose Output Driver Mapping' software interface. The window title is 'General Purpose Output Driver Mapping -> 192.168.34.90'. The menu bar includes 'File', 'Update', 'Reset map', 'Monitor', 'Dashboard', 'Config.', 'Basic Map', 'Additional Map', 'Plotter', and 'Diagnostics'. An 'EXIT' button with a checkmark is located in the top left corner. The main area is divided into four tabs: 'Gear/Boost Map-1', 'Gear/Boost Map-2', 'Gear/Boost Map-3', and 'Gear/Boost Map-4'. The 'Gear/Boost Map-1' tab is active, showing 'GPO-1 Parameters' with a table of IAC values and a 'Mapping Input Source' section with radio buttons for various options.

IAC	Value
256.0	60.2
224.0	39.8
192.0	32.0
160.0	28.1
128.0	25.0
96.0	19.9
64.0	18.0
32.0	17.2
0.0	14.8

Mapping Input Source

- X=RPM / Y=MAP
- X=RPM / Y=CLT
- X=RPM / Y=TPS
- X=RPM / Y=MAT
- X=MAT / Y=MAP
- Fuel Pump Relay
- Coolant Fan Relay
- Gear Based GPO
- RPM Switch Above
- 2 Wire Idle
- Disabled

80 °C  
8000 RPM  
 Dont Interpolate

When using a GPO for closed loop idle control select 2-wire idle. Once selected, the left-most column is used to determine the duty cycle output for the idle motor. IAC control ranges from 0 (least amount of air), to 255 (highest amount of air). This duty cycle range can be non-linear, and inverted, for motors that require less duty cycle to provide more air.

## Disabled

Choose this field when the GPO is not being used.

### **Don't Interpolate**

The ECU algorithms automatically blend or interpolate between cells, choose this field when this is not desired, as in when a “hard” turn on/off is desired, not a “blended” function.

## Gear/Boost Control

034EFI systems now feature multiple maps based on vehicle gear, or a switched input. Typically this is used to manipulate boost per gear. This can be done via an open loop method, or in closed loop PID (Proportional Integral Derivative) boost control algorithm. This is a complex mathematical control strategy that allows one GPO driver to target a programmable boost target. What this means to the tuner is that boost can be controlled to a precise pressure target regardless of engine load, flow, air temperature, outside air pressure or your significant other's hormonal swings. There are few boost controllers on the market that allow closed loop control, this control system allows the tuner to implement one of the most accurate and advanced boost control systems available anywhere.

Closed loop operation:

The screenshot shows the 'Boost Control Map' configuration window in the software. The window title is 'General Purpose Output Driver Mapping -> 192.168.34.90'. The interface includes a menu bar (File, Update, Reset map, Monitor, Dashboard, Config, Basic Map, Additional Map, Plotter, Diagnostics) and an 'EXIT' button with a checkmark. The main area is divided into four tabs: GPO-1, GPO-2, GPO-3, and GPO-4. The 'Gear/Boost Map-1' tab is selected, showing a 'Boost Control Map' table. The table has 9 rows (MAT values: 115, 99, 83, 67, 51, 35, 19, 3, -13) and 9 columns (RPM values: 0, 1200, 2400, 3600, 4800, 6000, 7200, 8400, 9600). Below the table are control parameters: 'Enable if MAP above' (99.6 kPa), 'Integrator Preset' (50 %), 'Proportional Gain' (0.400), 'Loop Rate' (80), 'Integral Gain' (0.010), and 'Derivative Gain' (0.000). There are also checkboxes for 'Invert Control Loop' and 'Use open loop as PWM'.

MAT	0	1200	2400	3600	4800	6000	7200	8400	9600
115	180.0	180.0	180.0	190.8	200.0	200.0	200.0	200.0	200.0
99	180.0	180.0	180.0	190.8	200.0	200.0	200.0	200.0	200.0
83	209.3	209.3	209.3	218.6	229.4	229.4	229.4	229.4	229.4
67	209.3	209.3	209.3	218.6	229.4	229.4	229.4	229.4	229.4
51	209.3	209.3	209.3	218.6	229.4	229.4	229.4	229.4	229.4
35	237.1	237.1	237.1	246.4	257.2	257.2	257.2	257.2	257.2
19	237.1	237.1	237.1	246.4	257.2	257.2	257.2	257.2	257.2
3	237.1	237.1	237.1	246.4	257.2	257.2	257.2	257.2	257.2
-13	237.1	237.1	237.1	246.4	257.2	257.2	257.2	257.2	257.2

Enable if MAP above: 99.6 kPa  
 Integrator Preset: 50 %  
 Proportional Gain: 0.400  
 Loop Rate: 80  
 Integral Gain: 0.010  
 Derivative Gain: 0.000  
 Invert Control Loop  
 Use open loop as PWM

### 9x9 Boost Target Matrix

This 81 cell matrix allows boost pressure targets, in kPa, to be entered based upon RPM and MAT (Manifold Air Temp). Boost curve strategies can be implemented here as well, for example an overboost or underboost at 4000 RPM to maximize turbo performance or traction issues. Fields interpolate with each other to ensure a smooth transition to different values.

### *Enable If Above*

Set this value typically above 100kPa but below the targeted boost value. This prevents the valve from cycling needlessly below boost and also arms the valve with sufficient time to anticipate the boost control PWM loop. Since the control loop will go 100% until the target pressure is reached (to prevent wastegate creep), there is no need to try to implement this value too late as doing so will actually slow down boost response.

### *Proportional Gain*

This value sets the PWM to go up or down in proportion to the error, if the value is too large, then the PWM change will overcompensate for the amount of error present, causing the PWM to go too far in either direction to regulate the targeted boost pressure. Typically start with a value between 1 and 4, this value will need to be lowered if large oscillations or cycles in boost pressure are observed.

### *Integral Gain*

This value is used to correct small the steady state errors that the P term cannot. Start with very small values, typically .01-.05 in most cases will be sufficient, the greater the size the faster the correction, but can lead to instability, as well as a larger overshoot on initial boost onset, if too much I term is used.

### *Derivative Gain*

This value moves the PWM up or down in proportion to the rate of change of the error, it acts as a dampener or “shock” the control loop, the higher this value, the slower PWM changes will happen. Typically start with a value of 0, try small values and move up from there. If large overshoots are observed, this value may not be needed and can be left at 0.

### *Integrator Preset*

This value sets the integrator, which is the controller’s “memory” for where the PWM sits when boost is controlled. This value is a percentage, and can be set above or below the actual control percentage duty-cycle to influence the control loop. Typically set to 50%, however if the entered value is larger than the actual control percentage, then an overshoot can be implemented. Play with different values until you are happy with the under or overshoot of the control loop.

### *Loop Rate*

This value determines how many times per second the control loop will be analyzed and implemented. This field is a divisor of the default value is 200, thus a value of 1 would allow 200 times per second, a value of 10 would equal 20 times per second, etc. Too many or too few times per second will result in an unstable boost control, typical values are between 10 and 40.

### *Invert Control Loop*

This value should only be checked when 100% duty cycle

equals the minimum boost level and not the maximum. If 0% is the peak level of boost, then check this field.

*Open Loop Operation:*

The screenshot shows a software window titled "General Purpose Output Driver Mapping -> 192.168.34.90". The interface includes a menu bar with "File", "Update", "Reset map", "Monitor", "Dashboard", "Config.", "Basic Map", "Additional Map", "Plotter", and "Diagnostics". A toolbar contains an "EXIT" button and a red checkmark icon. The main area displays four tabs for "GPO-1", "GPO-2", "GPO-3", and "GPO-4", each with a sub-tab for "Gear/Boost Map-1" through "Gear/Boost Map-4". The "Boost Control Map" window is active, showing a 9x9 matrix of values. The y-axis is labeled "MAP" with values 404, 354, 305, 256, 207, 157, 108, 59, and 10. The x-axis is labeled "RPM" with values 0, 1200, 2400, 3600, 4800, 6000, 7200, 8400, and 9600. Below the matrix are control parameters: "Enable if MAP above" (404.0 kPa), "Integrator Preset" (50 %), "Proportional Gain" (0.000), "Loop Rate" (0), "Integral Gain" (0.000), "Derivative Gain" (0.000), and checkboxes for "Invert Control Loop" (unchecked) and "Use open loop as PWM" (checked).

MAP	0	1200	2400	3600	4800	6000	7200	8400	9600
404	25.4	25.4	25.4	35.5	45.3	45.3	45.3	45.3	45.3
354	25.4	25.4	25.4	35.5	45.3	45.3	45.3	45.3	45.3
305	25.4	25.4	25.4	35.5	45.3	45.3	45.3	45.3	45.3
256	25.4	25.4	25.4	35.5	45.3	45.3	45.3	45.3	45.3
207	45.3	45.3	45.3	55.5	65.2	65.2	65.2	65.2	65.2
157	55.5	55.5	55.5	55.5	65.2	65.2	65.2	65.2	65.2
108	65.2	65.2	65.2	65.2	65.2	65.2	65.2	65.2	65.2
59	94.5	94.5	94.5	94.5	94.5	94.5	94.5	94.5	94.5
10	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2

*Use open loop as PWM*

With this selected the 9x9 matrix values are the GPO duty cycle output directly, not boost targets. None of the PID terms are used.

## 3D Table Shortcuts

Several keystroke and mouse input options are available in the 3D maps.

### *Per cell Keystroke changes*

Click on any cell, hold down shift and Up Arrow or Down Arrow, the cell value will increment the cell value up or down.

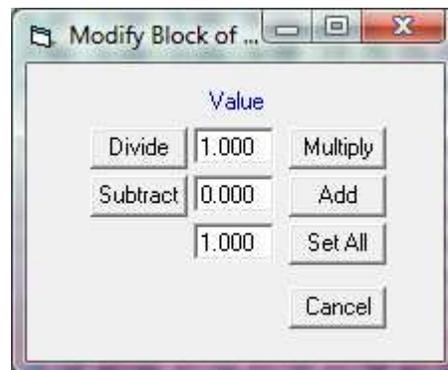
### *Mass Cell-Block Changes*

#### *Via Mouse:*

Click on any cell, drag the selection to cover all cells you wish to modify. Release the mouse button, then right-click within the selection, a text box will appear giving options to multiply, divide, add or enter cell values to quickly change a range or “cellblock” of cells easily and quickly. You will see the window below to manipulate the selected cells.

#### *Via Keystroke:*

Arrow to the cell you want to start your selection, press Ctrl->S to define your start point and release, arrow to the opposite corner, press Ctrl->F to finish your selection, you will then see the window below to manipulate the selected cells.



## Using the Monitor

The screenshot shows the 'Real Time Monitor' window for IP address 192.168.34.90. The interface includes a menu bar (File, Dashboard, Config, Basic Map, Additional Map, GPO Drv., Plotter, Diagnostics) and an 'EXIT' button. The main display is divided into several sections:

- Left Column (Parameters):**
  - Comm Group Delay: 34.7 MS
  - Engine Speed: 0 RPM
  - A/F Ratio: 14.70 AFR
  - Lambda Setpoint: 14.70 AFR
  - Coolant Temp.: -13 °C
  - AirTemp.: -13 °C
  - Throttle Position: -13.7 %
  - Manifold Pressure: 104.5 kPa
  - Barometric Pressure: 104.2 kPa
  - Base Injection PW: 4.859 ms
  - Accel Enrichment: .000 ms
  - EGO Correction: 1.000 Gamma
  - MAP Enrichment: 1.000 Gamma
  - CLT Enrichment: 1.000 Gamma
  - Battery Voltage: 13.65 Volts DC
  - AUX Input: 0.013 Volts DC
  - IAC State: SHTDWN
  - IAC Error: OK
  - IAC Position: 127
  - IAC RPM Setpoint: 1040 RPM
  - Timing: 6.00B °
- Right Column (Status/Inputs):**
  - Map#= 0
  - #Trigs= 0
  - #Cam= 0
  - WDbg= 0
  - CDbg= 0
  - MPH= 0.00
  - R/M= 4095.94
  - Gear= 0
  - CPU= 160
  - TErrs= 0
  - AUX= LOW
  - MapSel= HIGH
  - TrigB= HIGH
  - Rev Lim= RPM2
  - Flat Shift= flat-
  - CAN RX= 0
- Injection and Ignition Table:**

	Injection		Ignition	
	Inj ms	Duty%	Dwell	Duty%
Chan1	4.859	0	3.280	0
Chan2	4.859	0	3.280	0
Chan3	4.859	0	3.280	0
Chan4	4.859	0	3.280	0
Chan5	4.859	0	3.280	0
Chan6	4.859	0	3.280	0
Chan7	4.859	0	3.280	0
Chan8	4.859	0	3.280	0
- Bottom Right:**
  - TXB 1176
  - RXB 6201

The monitor is simply a screen that can be used to monitor many of the ECU's inputs and outputs. Use this screen when something appears to be wrong (to quickly troubleshoot a bad sensor, etc), to monitor RPM synch with the trigger wheel and the sensor, quickly see changing ignition timing, etc, etc. No inputs or parameters can be configured here.

### *Some Fields Identified:*

- Map# - This shows the status of the map select input, either map #1 or #2. To change maps, ground the appropriate ECU pinout (see the wiring diagram provided).
- #Trigs - the actual teeth as the ECU counts them (Stage C only)
- #Cam - The actual cam TDC pulses as they happen. (Stage C only)
- Wdbg - The calculated number of teeth on the reference wheel. Missing teeth are counted as one tooth, thus a 60-2 wheel will register 59 teeth. ANY fluctuation of this # means there are synch errors.

- Cdbg - The calculated position of the cam trigger reference, this # should remain stable.
- MPH - Calculated vehicle speed, if vehicle speed sensor is being used
- R/M - Current engine RPM to MPH value, this value is used to determine the gear selection ranges in the gear configuration screen.
- AUX - Shows the state of the AUX input if being used as a switch pin LOW/HIGH
- MapSel - Shows the state of the Map Select pin LOW/HIGH
- TribG - Shows the state of the TrigB pin LOW/HIGH
- Rev Lim - Displays the currently active rev limiter
- Flat Shift - Displays if the flat shift control has been activated
- Lambda Setpoint - current target AFR for closed loop operation
- Accel Enrichment - amount of enrichment being added to the base pulsewidth
- EGO Correction - adjustment made by the closed loop EGO system to reach targeted lambda value
- Timing - the actual ignition timing that the ECU is calculating.

## Using the Plotter



The Plotter is a useful datalogging feature of the 034EFI “C” ECU’s, it allows ECU data to be recorded and saved to the laptop hard drive for future analysis. This is especially useful as there is typically a large amount of hard-drive space available for extended, almost unlimited amounts of datalogging time.

To start the Plotter, click the large “Start” button, this will create and record a .csv file to the hard drive of the laptop with the name entered in the plotter screen. Up to 12 different ECU input/output streams can be selected. Choose the logging interval, for values like MAP, RPM and other quickly changing values, 100MS or “As Fast as the Comm Will Allow” are recommended for the best resolution.

To access this .csv file, go to the installation directory of ECU882C in the Program Files folder. .csv files can be opened and manipulated in Excel and other programs.

# Connecting to the ECU

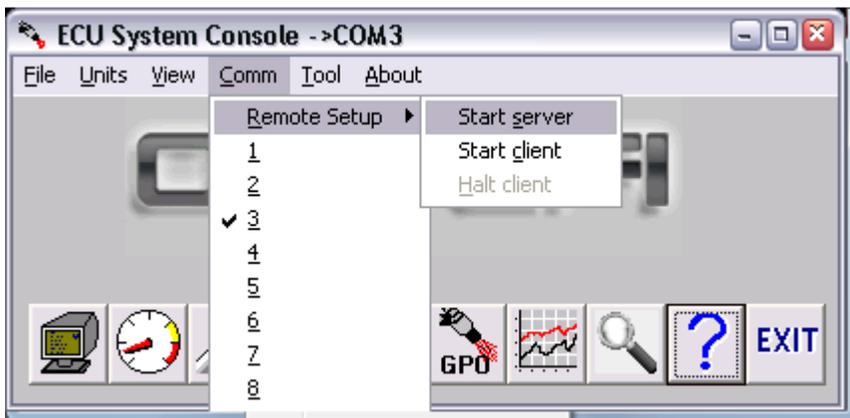
## *Serial Comm Port Selection*

The ECU requires a serial communication port on the computer to send and receive data on. The computer connected to the ECU must have a serial port assigned between COM1 and COM10. This can be checked on a windows computer by opening the device manager and looking in the 'Ports' section. If you are using a USB->Serial adapter you will need to ensure the proper drivers are installed, and if necessary reassign the serial com port number to be within the 1-10 range. Once you have determined what comm. port your serial connection is on used the Comm menu on the ECU serial console to select the proper port.

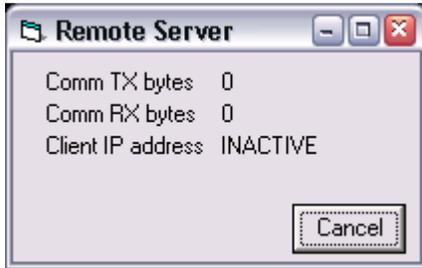


## *Remote Network Connection*

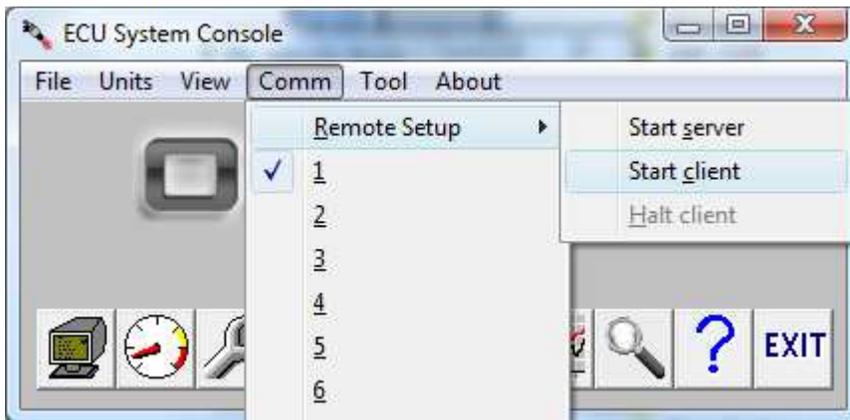
The ECU tuning interface now supports remote network connections as well. This is typically used when the tuning must be done remotely, or it is not feasible to be in or near the ecu being tuned. To enable remote tuning the laptop or computer physically connected to the ECU must be setup as the server. To do this select the remote setup option from the comm. menu, then 'Start Server'



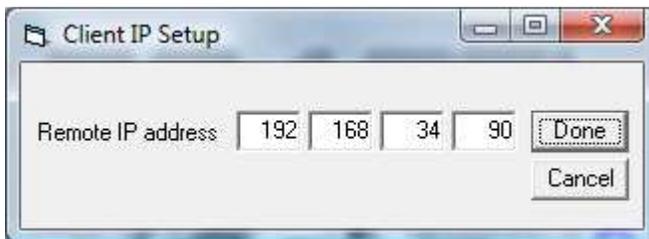
After the server is started the host computer will display a connection status window displaying communication information and link activity.



On the remote client computer the operator must select Comm->Remote Setup->Start client.



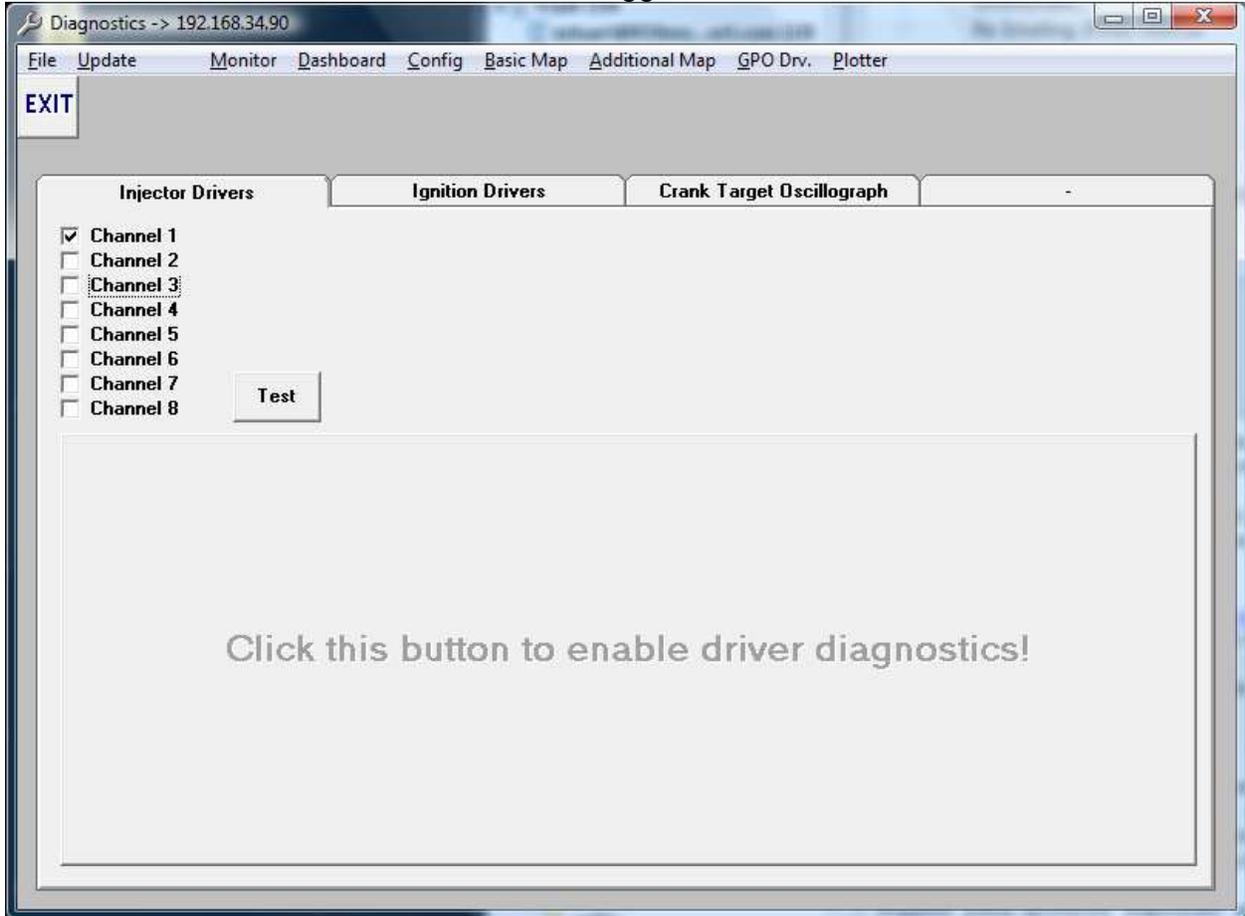
At which point a connection dialog is displayed and the server's IP address must be entered.



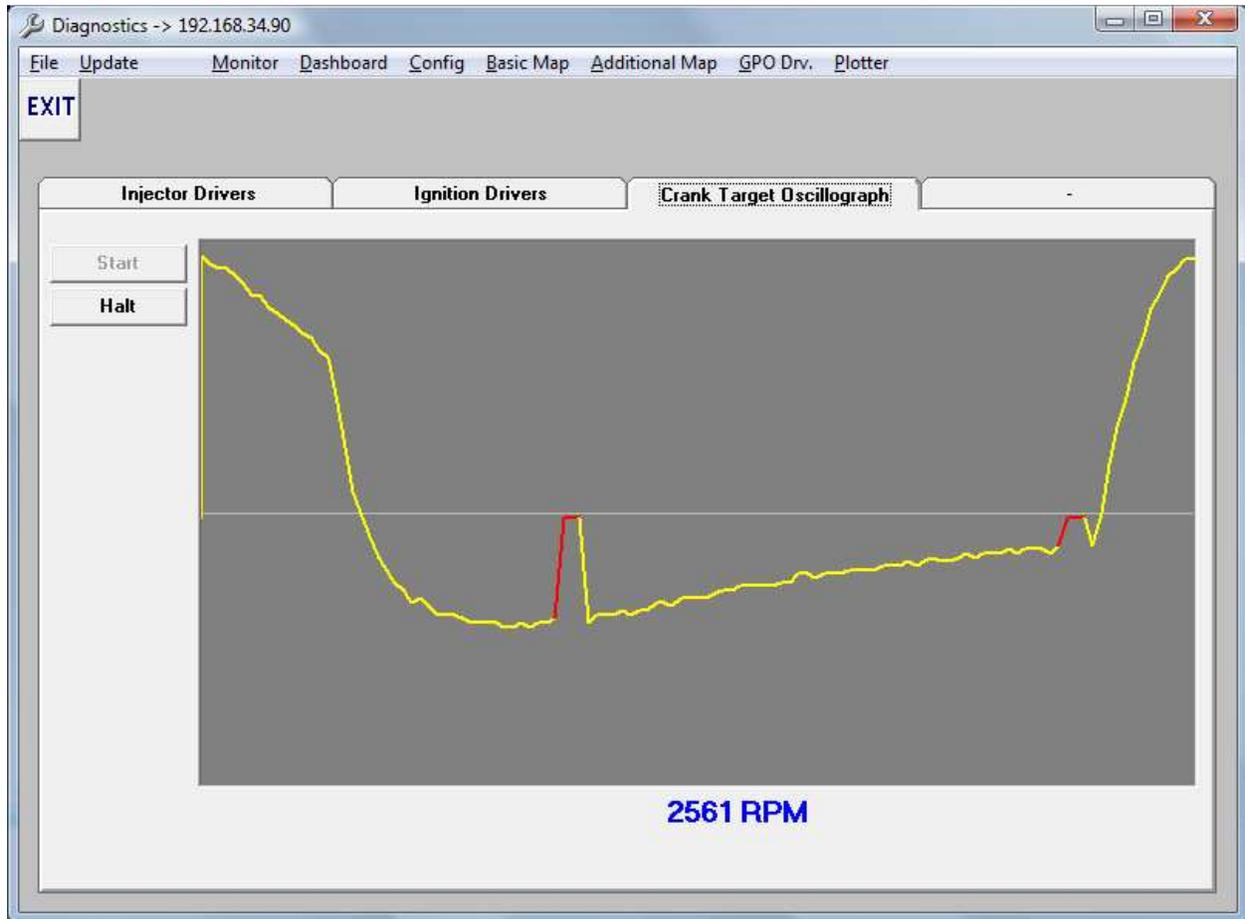
Once the connection is established all tuning parameters, logging, map loading/saving can be done from the remote computer.

# Diagnostics

Since version firmware 1.02 the ECU now supports simple diagnostic screens for testing some of the critical outputs of the ECU to verify wiring and component status. All 8 of the injection, and coil channels can be tested independently. Once the diagnostics page is enabled each click of the 'Test' button will trigger the channels selected.



The crank target Oscilligraph is a visual representation of the crank sensor output. This can be used to determine signal quality.



# Tuning Philosophy

Every ECU is provided with a sample map (with firing order configured) that should get the motor fired on more or less the first try (assuming all inputs and outputs are installed correctly). If all inputs are provided properly getting a motor to fire should be quite simple. Every motor and application is different, however, and requires specific and precise tuning. This section will attempt to outline the basic steps and methodology behind tuning the ECU. It needs to be emphasized, however, that each user needs to interact with the software, over time, to gain a more intimate understanding of the effect of different inputs the many tuning fields that the "882" software interface provides. Tuning an engine is much like playing a musical instrument, no written document can give simple steps that guarantee ability - only practice will make perfect! Consider this experience an investment in gaining a valuable skill that few have, which will allow you to develop engine systems to any desired output.

## Initial Adjustments

Before any tuning is attempted, closed loop programming should be disabled, this can be done in the Dashboard window or by entering a 0 for EGO loop activation in the Configuration window. In order to estimate current air/fuel ratio the "Cur Lamda" value in either the Dashboard or Basic Map should be referenced. Generally, values of .85 are very rich and values of 1.0 or higher are very lean WHEN USING A NARROW BAND SENSOR. Generally, using a narrow band O2 sensor, values in the .9-.95 will be best for idle and part throttle, and .84-.9 for WOT.

Running the linear 0-1v EGO input from a Wideband controller will result in extremely accurate a/f inputs, typically Lambda of .8-.83 are safe for WOT, and Lambda of 1.0 are Stoich.

Before attempting to start the car, ensure your computer is communicating with the ECU. Though each ECU comes with a sample map, certain fields may need to be modified according to the installation. One of the primary adjustments may relate to ignition timing. Preferably set the ignition distributor to TDC or 0 degrees of advance. Stock settings can be used as well, but in the case the distributor does not use any mechanical advance or retard, 0 degrees will be best until the motor can be started and timing set dynamically with the motor running

If running a "C" system with distributorless ignition, review the timing curve in the ECU, ensure that nothing is overly advanced or retarded, most any motor will run with a safe 10-15d of constant advance, remember, error on the side of conservative when tuning ignition, tuning to the "ragged edge" brings minimal gains for the massive safety risk it poses to damaging your motor.

### Ignition Timing Control:

During this time it's important to consider ignition timing as well. Generally ignition timing can be advanced at idle and light load conditions, and retarded at higher RPM and full load conditions. Up to 30-40d of advance under light load conditions will give excellent fuel mileage and smooth running. The best emissions will be created with minimal advance, use about 5 degrees of advance at idle for good emissions. All timing fields bot 2d and 3d are interpolated between cells, this smoothly blends the timing values from one cell to it's neighboring cell(s). This strategy can be used in all the ignition-timing fields to produce a smooth timing curve that can anticipate full load conditions while providing excellent response, smoothness and efficiency at low load conditions. For example at 2000 RPM with a light load 40 kPa the full 35 degrees of advance is applied, but under full load higher RPM conditions a full 15 degrees of retard is applied. Generally high output turbocharged engines will run well on low octane fuel with somewhere under 15-20 degrees of advance.

### Getting the motor started:

This is the first tuning step. A fully charged battery is important and proper wiring and installation of the unit is implied. Also ensure that the cooling system is functioning and that the engine installation is complete. If the motor cranks but will not start, it likely needs more fuel. The two main fueling parameters for the ECU are the Injector Main and Idle Adj, seen in the page view below:

NOTE: BEFORE ANY OTHER FIELDS ARE CHANGED, USE THE INJECTOR MAIN AND IDLE VALUES TO GET THE MOTOR RUNNING AND UNDER LOAD, ONLY THEN SHOULD OTHER ACCEL, BASIC MAP AND ADDITIONAL MAPPING FUNCTIONS BE USED

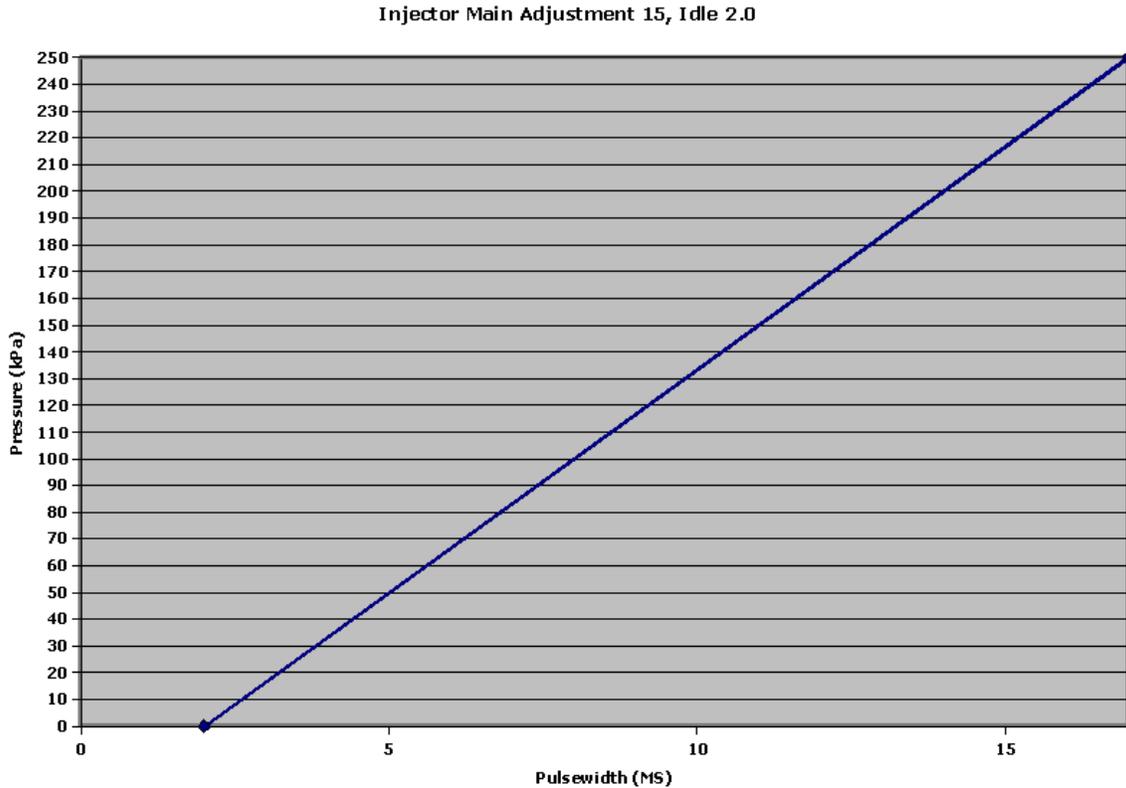
The injector scaler or "The Injector Main Adjustment" is the primary fueling parameter for the ECU, and determines the base maximum pulsewidth (PW) at the maximum MAP pressure, and across the pressure range. Thus, if 10.2 is entered as the main value, the base MAP based PW will be 10.2 at 255 kPa (for the 2.5BAR ECU). If more fuel is needed to start the car, slowly increase the main value until the motor starts to catch and starts. Once the motor is running, the idle value can be manipulated to create a more stable idle for the time being.

The Idle Adj. value is usually considered a trim adjustment, similar to the idle and progression circuit in a carbureted engine. This parameter is typically near zero, or even slightly negative in many medium performance applications. In a typical intake manifold application with throttle body and a mild cam, tune this value between 0 and .5. In higher performance applications, where the idle manifold vacuum is low (not below 90 kPa), this parameter can be somewhat more negative, where the calculated pulse width [at idle] is too high due to higher manifold pressure (poor vacuum). The negative Injector Idle parameter subtracts "if negative" from the basic pulse width so that the resultant pulse width is what is needed to control the engine. Usually a value greater than .5 in the offset field (in a 1 or 2.5BAR ECU, 5BAR ECU's may require much higher idle values) indicates that the overall Injector Main # is off (too low) and should be increased

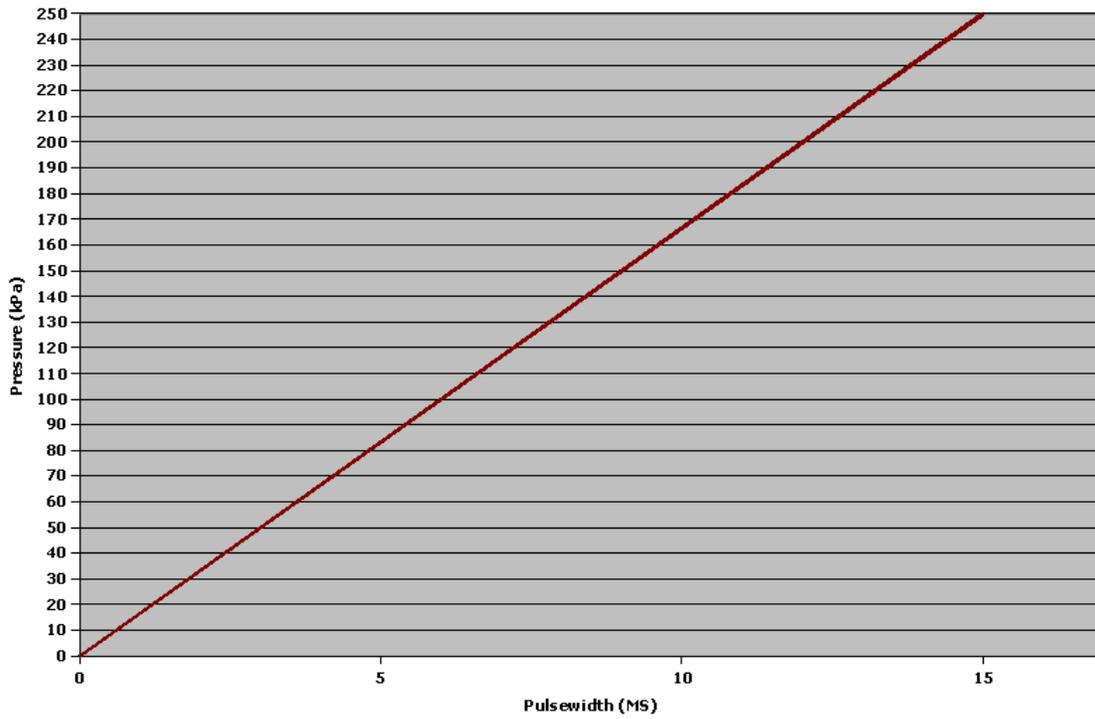
to deliver more fuel at all rpm and MAP levels. Generally a Lambda of .9-.95 is required to achieve a good idle.

Note that the Idle Adj value adds this value to the calculated PW at all times, across all pressure ranges - thus a .5 will add .5MS of fuel at all times. The purpose of this value is that at low PW values, such as idle, it will be a much larger percentage of the PW than at high pressure levels, where proportionately it will be almost insignificant. For example, .5 at 1MS is a much larger increase than .5 at 20MS.

Below are graphical examples of the Injector Main and Injector Idle values manifest in a 2.5BAR application:



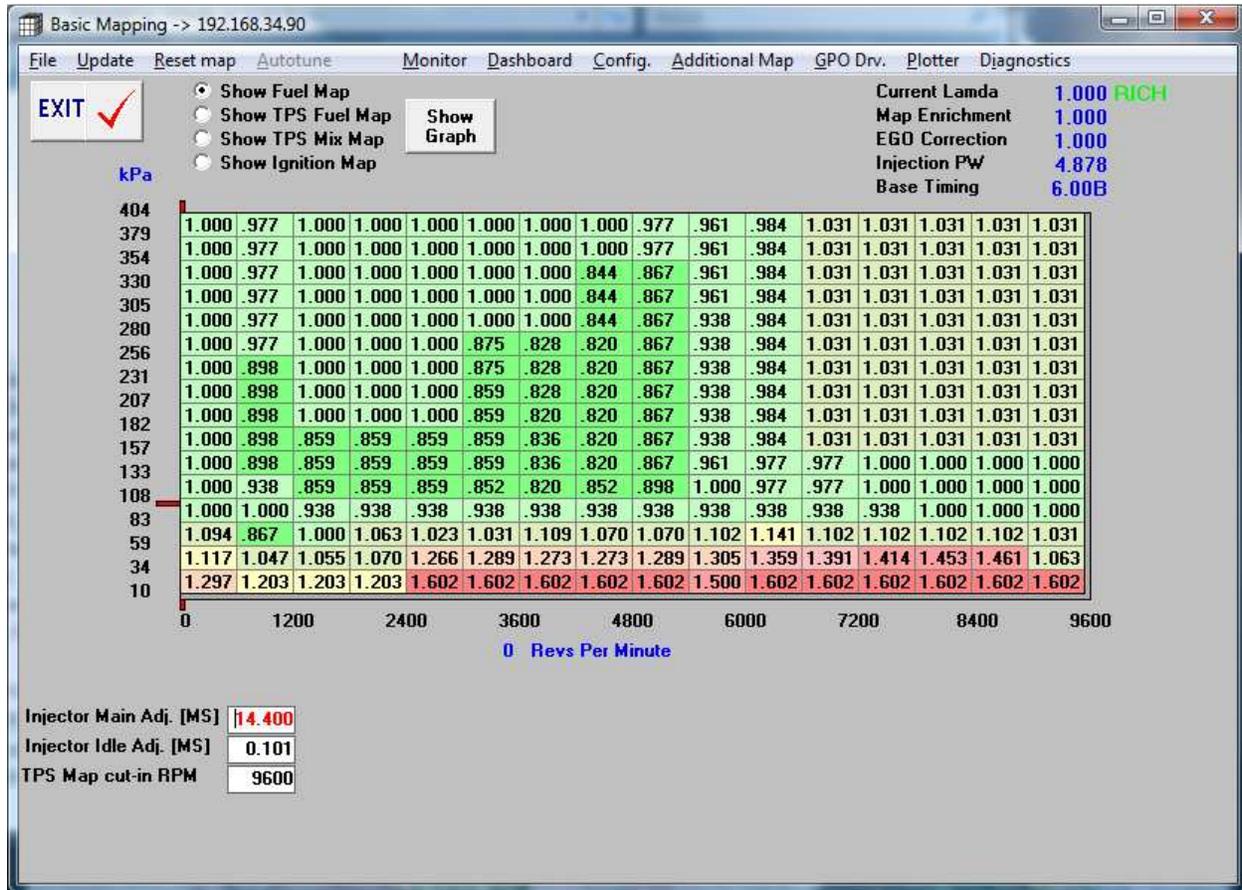
Injector Main Adjustment 15, Idle 0.0



Note how the two settings manifest across the pressure range, this is the speed density method of fuel calculation. The Idle Adjustment simply adds the programmed value across all pressure ranges, in this case, 2 MS.

## Getting the motor running through the RPM range

Once the motor is at normal running temps, and a stable idle has been achieved, attempt to run the motor in gear, additional adjustments to the Main Injector value can be made to get good fueling throughout the RPM range. Keep all the values in the large kPa x RPM field 1.0 for now, as they should only be used for fine-tuning in the later stages. Once the motor runs acceptably through the lower RPM range at lighter loads, slowly the scalar can be continually adjusted for higher RPM and full load conditions.



## Tuning for WOT and full load

At this point, it's wise to find a long stretch of road or a rolling road dyno for these stages of tuning. If on the road, often a long, uphill stretch of road can help in loading up the motor while keeping speeds down. Again, carefully throttle into WOT and build up load and power to the peak. Carefully observe the EGO, most turbocharged applications should tune for an EGO of .88 to .90, this correlates to approximately a 12:1 air fuel ratio. The main fueling parameter for WOT max power should be the Injector Main value. Once full power fueling is set, then part throttle, light load and idle mixtures can continue to be fine-tuned and modified from the WOT/Max Power settings.

## Other Tuning Considerations

### Tuning with Closed Loop [EGO] Parameters:

Closed loop parameters are set in the Configuration Window as seen below is Screen Shot F. Tuning for the closed loop programming is done in the Additional Map window. The desired EGO value is entered into the matrix based on MAP and RPM. The closed loop tuning parameters should be integrated once a good base-tuning map has been created, or in other words, the best possible parameters for engine running, excluding the involvement of the Closed Loop programming. In the ideal tuning situation, the ECU would function without the assistance of the closed loop programming. In order to program a good performing motor in as many varied conditions as possible, the base tuning maps must be complete and compensate as well as possible without the involvement of closed loop. Once this kind of map has been created, then and only then should the Closed Loop Parameters be integrated to compensate for the conditions that were not addressable with the base maps. All initial tuning should be done with a 0 in the EGO Loop Activation field to disable EGO correction. Once EGO correction is activated, the Min and Max EGO Gain measurements should be help to a range of 10% on either side. In other words, the Min EGO gain should be held to .9 and Max to 1.1. If the EGO correction does not perform well with these parameters, then the base tuning maps likely need further adjustment. This is a good tuning benchmark to maintain.

### Cold Running Tuning

The main parameters for adjustment for cold start tuning are the CLT Enrichment in the Additional Mapping field. A cold motor needs more fuel to overcome fuel condensation on cold metal surfaces and cold, high viscosity oil. These parameters should be tuned during the relevant temperature range. MAT (Manifold Air Temp) calculations should be made for ambient running conditions (increased air density) but not so much for “cold starting” fueling.

### Tuning with Throttle Position

(Note: In applications with high intake manifold vacuum, running either a 1 or 2.5BAR MAP Sensor, TPS tuning is not recommended or practically useful. All part throttle fuel programming can easily be done in the basic map matrix. TPS mix table values should be set to 0.00. Applications running individual throttle bodies with low intake vacuum, or running the 5 BAR MAP will benefit from TPS tuning). The software allows tuning for throttle position as a 3d table in the basic mapping pages. Tuning using the throttle position input is exactly the same as the MAP based screens, however the mix table allows you to define how much of each map (MAP vs TPS) gets used. If you enter values of .5 in the TPS mix map, this will be the average of the calculated TPS value and the calculated MAP based value. A value of 1.0 in the Mix table would use only the TPS based values.

Generally the TPS matrix should only be tuned to address part throttle and lighter load conditions. Typically the strategy should show a taper off into higher RPM and load conditions to prevent drivability problems. Initial tuning should be done with all zeros in the TPS mix matrix, and once base tuning is accomplished slowly integrated to fine tune idle and part throttle fueling conditions. The TPS blend table may not be used in motors with strong vacuum at idle and part throttle conditions, which respond very well to MAP Matrix tuning only.

### Using EGT's (Exhaust Gas Temperatures)

Though 034efi ECU's do not have a dedicated EGT input, this is a valuable operating parameter to observe during the tuning process, especially for the use of ignition timing calculations under power or WOT. Typically, overly retarded (from the ideal) ignition will cause high EGT's due to the delaying of combustion relative to the exhaust valve opening. By starting with conservative, retarded timing and moving towards advance, EGT temps should be observed as lowering with each degree or two of advance. At a certain point of advance, EGT's will stabilize, then begin to grow again, at this point, ideal, safe ignition advance should be realized. This also assumes acceptable, safe Air/Fuel Ratios of about 12.5:1 consistently through testing.

## Conclusion

This concludes the 034EFI ECU tuning manual. You should have received an in-depth idea how to approach the overall tuning effort required to create a smooth running, powerful and responsive motor. No manual can replace cause and effect tuning experience, so don't be afraid to try different tuning values and strategies. By keeping many different maps saved this can be done easily and safely.

It is important to remember that no factory system will give the flexibility of tuning like the 034EFI ECU will, and excellent results will await the patient and perceptive tuner. This ECU can fuel and time any engine up past 20k rpm, it is immensely capable, as you will be with some experience and increased knowledge. The important thing to remember is that all tuning experiences, good and bad, will add to your knowledge and experience base - use this to improve your tuning aptitude, and enjoy the learning process!