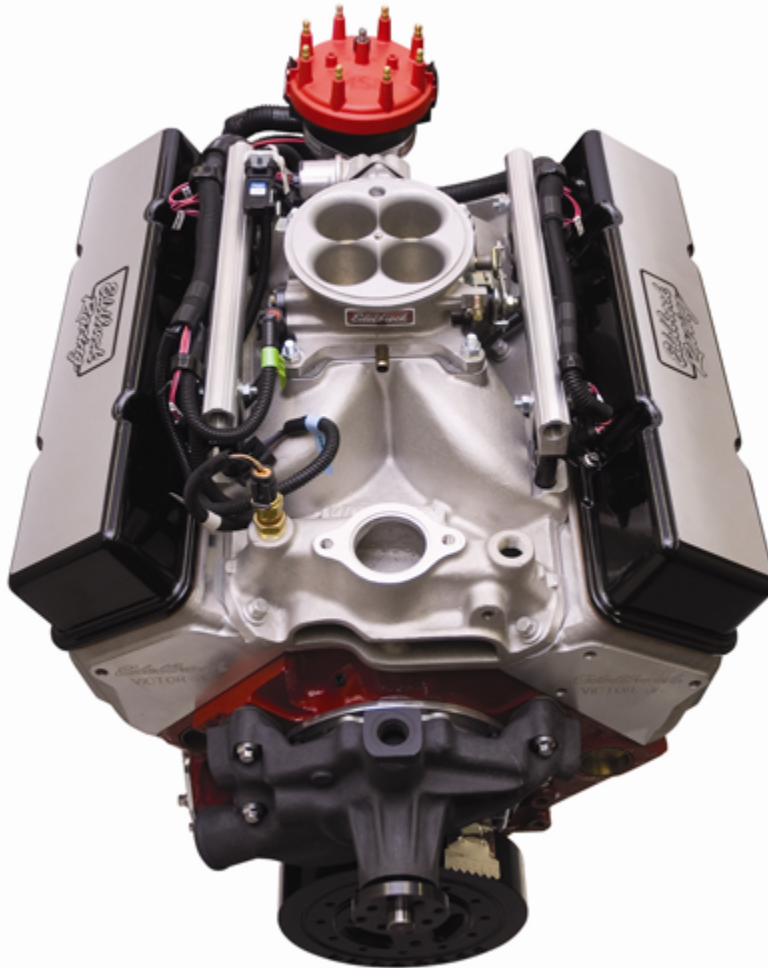




Pro-Tuner Users Guide



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1 Introduction



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Edelbrock Pro-Tuner Series Electronic Fuel Injection (EFI)

"Total Engine Management"

That's the slogan for Edelbrock's Pro-Tuner EFI Systems, powered by Mototron Electronic Control Units (ECU).

Pro-Tuner EFI Systems include everything needed to convert any engine to powerful electronic fuel injection; with user programmable features and full ignition control as well as fuel delivery. Two performance levels are available: Victor and Super Victor. Both versions include an Edelbrock Victor or Super Victor EFI intake manifold, fuel rails, throttle body, wiring harness, injectors, Pro-Tuner software, sensors, fuel pump regulator, and Mototron ECU with Power PC, 32-bit micro controller.

Victor Systems include a Mototron ECM for semi-sequential injection, while Super Victor Systems feature fully sequential operation and individual cylinder adjustment of spark and fuel for complete optimization, plus a software upgradeable Mototron PCM with advanced features - and expandability for exciting future options. Through your laptop computer, all critical aspects of engine tuning are adjustable to suit your application. The simplified user interface allows a tuner to dial-in the behavior of the state of the art control strategies running within the ruggedized Engine Control Module (ECM).

The proprietary Mototron ECU is extremely durable. It's completely sealed making it waterproof and ideal for not only competition vehicles but for marine as well. Once up and running, Edelbrock's Pro-Tuner EFI software offers easy-to-use, yet sophisticated tuning control with user-friendly pull down menus and screens.

Available separately, Edelbrock offers a Pro USB key which allows access to enhanced tuning parameters for more experienced calibrators. A Basic USB key is included standard.

Before reading this manual and installing your new system, it is important to understand that your Edelbrock EFI system is more than fuel injection. It is an **Engine Management System**. In addition to controlling the fueling of your engine, the system will also be controlling ignition, idle airflow, monitoring sensor health, and running other optional actuator outputs.

While every effort is made to simplify the installation and calibration process, the most important tool is the knowledge and experience of the person tuning the engine. Just as with carbureted engines; the tuner must know the fueling and ignition limits of the specific engine he or she is calibrating to avoid engine damage and provide the best reliability and drivability possible. In addition to reading this manual, there are many other sources of engine management theory, as well as experienced tuners and Edelbrock experts available to assist with questions that you have. See the "Additional Resources" section of this manual for more sources of EFI information. It is highly recommended that the Tuner educate themselves as much as possible in the area of electronic engine control and calibration theory and technique.

If you run into problems, you may contact our EFI Technical Hotline at 800-416-8628 from 7:00 am to 5:00 pm PST Monday through Friday. You may also contact us by email at: EFItech@edelbrock.com

- **READ THROUGH ENTIRE MANUAL BEFORE BEGINNING SYSTEM INSTALLATION!**
 - **THIS CONTROL SYSTEM IS INTENDED FOR OFF-ROAD APPLICATIONS ONLY. THE USER ASSUMES ALL RESPONSIBILITY FOR THE INSTALLATION AND APPLICATION OF THE SYSTEM AND MUST COMPLY WITH ALL APPLICABLE RULES AND REGULATIONS GOVERNING USAGE AND EMISSION REQUIREMENTS.**
-

2 Kit Contents



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Kit #3670 Contents:

Part No.	Description	Qty.
22-3601	Firewall Bulkhead Plate Kit	1
	38-1515 Bulkhead Plates	2
	68-0410 Self-Tapping Screws	4
	72-1516 Grommet 1 3/4" O.D.	1
24-0301	Ignition Amplifier Kit	1
	68-0410 Self-Tapping Screws	3
37-3517	Victor Pro-Tuner Kit	1
	37-0004 RS485 Comms Cable	1
	37-0006 USB Software Key (Basic Key)	1
	37-0007 Controller ECM (48 Pin)	1
	72-1517 ECM Rubber Grommet	3
	82-0111 ECM Mounting Washers	3
	82-3519 ECM Mounting Bushing	3
38-1600	Mounting Bracket for 48 pin PCM	1
68-4005	1/4-20 x 7/8" PCM Socket Head Screw	3
37-3545	Main Engine Harness w/ 2-Power Relays	1
	N/A Padded J-Clamps	4
37-3546	Distributor Harness	1
37-3547	Fuel Pump Harness	1
63-3670	Instruction Sheet - Quick Start Guide	1
63-3615	Instruction Sheet - Distributor	1
63-0507	CD-ROM	1
37-3518	MAT Sensor GM (AC Delco #12160244)	1
72-9952	MAT Sensor Grommet	1
37-1520	Serial to USB Converter	1
63-9114	Serial to USB Converter Instructions	1
7		

37-3548	Malfunction Indicator Light w/ Clip	1
37-7119	1 Bar Map Sensor (Remove Orange Rubber)	1
38-3601	Gen III Map Sensor Bracket	1
37-3528	60 lb/hr High Impedance Injectors	8
67-1570	Injector O-ring Lube	1
37-3529	MSD Distributor w/ Cam Sync MSD PN 23451	1
37-3543	Temperature Sensor	1
37-3542	Oxygen Sensor Switching	1
52-9710	Oxygen Sensor Bung	1

Kit #3690 Contents:

Part No.	Description	Qty.
22-3601	Firewall Bulkhead Plate Kit	1
	38-1515 Bulkhead Plates	2
	68-0410 Self-Tapping Screws	4
	72-1516 Grommet 1 3/4" O.D.	1
24-0301	Ignition Amplifier Kit	1
	68-0410 Self-Tapping Screws	3
37-3523	Victor Pro-Tuner Kit	1
	37-0004 RS485 Comms Cable	1
	37-3524 USB Software Key (Pro Key)	1
	37-0005 Controller PCM (80 Pin)	1
	72-1517 PCM Rubber Grommet	3
	82-0111 PCM Mounting Washers	3
	82-3519 PCM Mounting Bushing	3
38-1601	Mounting Bracket for 80 pin PCM	1
68-4005	1/4-20 x 7/8" PCM Socket Head Screw	3
37-3550	Main Engine Harness w/ 2-Power Relays	1
	N/A Padded J-Clamps	4
37-3546	Distributor Harness	1
37-3547	Fuel Pump Harness	1
63-3670	Instruction Sheet - Quick Start Guide	1
63-3615	Instruction Sheet - Distributor	1
63-0507	CD-ROM	1
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37-3542	Oxygen Sensor Switching	1
52-9710	Oxygen Sensor Bung	1

3 Installation and Setup



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Installation and Setup

In this section, you will have access to information on how to physically install the system in your vehicle, install the sensors and ECU, and begin the setup process to get your vehicle on the road!

BEFORE BEGINNING!

A clean and trouble free installation of the Pro-Tuner System is greatly enhanced by taking the time to organize and plan your installation before beginning. Perform the following:

- Unpack and inventory the system to ensure that you have all the parts, sensors, and wiring that are listed on the packing list
- Lay the harness and wiring out on a table or the floor to help visualize the placement of the sensors, connectors and components
- Take your battery to a local auto parts store and have them test it for proper voltage and current carrying capacity.
- Be sure your engine is in good mechanical condition. Fouled spark plugs, vacuum leaks, etc. will prevent you from properly tuning your engine!

3.1 Engine Management Concepts



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Engine Management Concepts

In this section, we will discuss the general operation of the Engine Management system, including strategies, controls and methods used to enable the engine to be efficient,

clean, and reliable.

IMPORTANT!

TO AVOID SERIOUS OR FATAL INJURY, NEVER ATTEMPT TO WORK WITH THE CALIBRATION LAPTOP COMPUTER WHILE DRIVING VEHICLE.

NEVER PERFORM CALIBRATION ACTIVITIES ON PUBLIC STREETS OR HIGHWAYS! DISTRACTION AND/OR INADVERTENT CALIBRATION CHANGES COULD RESULT IN SERIOUS ACCIDENTS.

Calibration Introduction

Calibration of an EFI system, presents many challenges and opportunities. The opportunities are to improve the throttle response, drivability, start ability, fuel economy, reliability, and reduce emissions of almost any engine. The challenge centers around optimizing a myriad of variables for every operating condition of the engine to achieve the desired results. While certain parameters can be "learned" by the engine control computer through various strategies and algorithms; it ultimately becomes the responsibility of the calibrator or tuner to decide what the ECM should learn, and to make critical decisions about how the particular engine he/she is calibrating will behave under various conditions. Just as it takes time and effort to become a proficient carburetion calibrator; so it will take as much or more time and practice to become a good EFI calibrator. Do not become discouraged or intimidated. Start with the basics of fuel and spark control, then gradually work up to cold starting, transient calibration, idle control, individual cylinder control, and advanced functions and setups. Always remember to start with conservative values for spark, fuel, etc. to avoid damaging the engine. (Minimal spark advance with fueling on the rich side of optimum)

Most tuners agree there is great personal satisfaction when an engine with their own "optimized" calibration is running well. This calibration guide assumes the reader to be familiar with general engine tuning and concepts, and experienced in the requirements and limits of the engine being calibrated. Since each engine and application differ; this manual does not attempt to dictate detailed tuning specifications (such as dictating "X degrees of spark advance at 5% load and 800 rpm") rather; its purpose is to familiarize the calibrator with the interface software, techniques for tuning various strategies, and provide background information on how they are used. The user assumes all responsibility for the application and use of the information and Edelbrock system software & hardware.

While this guide should prove helpful; it is significantly condensed and simplified to allow the calibrator to quickly reference specific sections. Depending on your specific system

and the method of interfacing to the engine; some of the strategies described in this guide may not be visible or may be pre-calibrated for you. Systems also vary as to their configuration: mass airflow, speed density or speed-throttle, oxygen sensors, ECU, and so on – slightly altering the calibration process. Descriptions of the functions are usually available next to the item or in the header of the map to aid the calibrator. The “HELP” menu in the calibration software also contains much useful information; as well as the documentation for your system, and can be selected at any time during software usage. Always use the documentation for your exact system as the primary reference for system setup and questions.

Ideally, calibration is performed with the vehicle on a chassis dyno where all loads and speeds may be calibrated under controlled conditions. In cases where dynamometer running is not possible, the tuner should enlist the help of another to drive the vehicle while the tuner makes adjustments with the laptop between runs or make table adjustments based on recorded logger data. **Vehicle calibration should ONLY be done on a closed road-course or drag strip with helmets and all other proper safety gear in place. Be aware also that some adjustments may be necessary even after an engine is dyno tuned. Different engine dynos will load the engine differently and they do not always accurately simulate vehicle conditions. This is especially true for transient operation (throttle snaps, etc.).**

3.1.1 Strategies and Methods



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Strategies and Methods

Control System Concepts

The Engine Management System functions by receiving inputs from various sensors, making calculations and operational decisions, and sending appropriate instructions to outputs that control devices and actuators. In order to do this, the Engine Control Module (ECM) converts the analog inputs to digital signals and processes them within the 32 bit microprocessor. Outputs are conditioned as required for the assigned purpose.

Your Edelbrock system is capable of three different fuel/timing control strategies. **Modeled speed density** uses sensor inputs along with a volumetric efficiency (VE) table

to estimate the airflow through the engine. The air fuel target table is used in conjunction with this calculated airflow to control the injector pulsewidth. The **MAP-N** strategy uses a base fuel map that varies as a function of engine speed and manifold pressure. The desired base injector pulsewidth is displayed in the table. The Alpha-N strategy uses a base fuel map that varies with engine speed and throttle position. The desired base injector pulsewidth is displayed in the table. The **Alpha-N** strategy works very well for engines with very large camshafts that exhibit very low idle vacuum. The table below summarizes the advantages and disadvantages to each control strategy.

	Modeled Speed Density	MAP-N	Alpha-N
Advantages	<ul style="list-style-type: none"> • If properly setup, does not require tuning of temperature based trim tables • Direct measurement of engine load (assuming the VE table is accurately defined) • Can adjust for changes in engine tuning requirements if used with optional mass airflow sensor • If properly setup, will be more consistent as operating conditions change 	<ul style="list-style-type: none"> • Relatively quick and easy to tune • Base fuel map in units of injector pulsewidth • Very common tuning method used in many available aftermarket EFI systems. • Works well and easy to tune for boosted applications • Easy to modify calibration if larger injectors installed 	<ul style="list-style-type: none"> • Works well for large overlap camshafts Not affected by low idle vacuum signal • Relatively quick and easy to tune • Base fuel map in units of injector pulsewidth • Easy to modify calibration if larger injectors installed
Disadvantages	<ul style="list-style-type: none"> • Requires an accurate volumetric efficiency table • Fuel control units more difficult to understand • Mass airflow sensor (if used) difficult to retrofit onto older engines 	<ul style="list-style-type: none"> • Does not work well with large overlap camshafts due to low idle vacuum • Requires temperature based trim tables • Indirect measurement of load • Calibration could be inconsistent if trim tables are not properly tuned 	<ul style="list-style-type: none"> • Idle mixture affected by closed throttle TPS voltage drift • Requires temperature based trim tables • Indirect measurement of load • Does not work well with idle air control motors. • Calibration could be inconsistent if trim tables are not properly tuned

The engine management system requires sensor data to maintain efficient operation under various conditions, and to provide feedback to the ECM regarding the current operating conditions. The sensors needed for basic operation include: ECT (Engine Coolant Temperature), **IAT** (Intake Air Temperature) or (Charge Air Temperature), **TPS** (Throttle Position Sensor), **CTS** (Crankshaft Trigger Sensor), **MAP** (Manifold Absolute Pressure) sensor, and **O2** (oxygen sensor). Other sensors can be added for additional control information or data acquisition; however, the sensors listed are the minimum ones required for basic engine control with this system.

When calibrating an engine, the basic goals are to optimize torque and minimize fuel consumption at every speed and load point. However, there are limits to how far one can go with this in actual application. In practice, you will be constrained by other factors and may be limited to values that insure running quality and reliability. This is called the "calibration window" for that condition. We will discuss cal windows later on. As you proceed, It is very important to understand that engines will attempt to run in

many conditions in which they should not be exposed – such as detonation or excessive temperatures. It is your job as a calibrator to balance all of the factors for your specific combination and program the best target values into the ECM that you can while keeping the engine in a safe operating window. There is a desired order in which an engine control system should be calibrated. A general order of activities is listed below:

- 1. Verify correct system installation and insure the method of wire and hose routing will prevent any chance of wear, fraying, or proximity to high temperatures. Insure software and communication to the ECM is functioning properly.**
2. Perform preliminary calibration activities: load proper sensor and engine configuration calibrations and limits, set crank trigger offset (& cam offset if available), scale sensors and map ordinates. It is preferable if the tuner starts with a known calibration for a similar combination whenever possible; as it greatly speeds the setup and calibration process.
3. Calibrate under steady state conditions for every engine speed and throttle position (load) - while optimizing fuel, ignition timing, and airflow – and completing the various maps at each point.
4. Optimize starting, warm-up, and idle calibrations for various temperatures and conditions. (Cold starts, hot restart, etc.)
5. Calibrate transient fueling (acceleration and deceleration) parameters if needed to optimize fuel during non-steady state conditions.

Fundamental Steady-State Engine Calibration Goals

1. Minimize BSFC at part-throttle operating conditions.
2. Maximize Torque at WOT.
3. Stay within emissions constraints.
5. Stay within EGT limits
6. Minimize drastic or erratic map value changes between cells

The important thing to remember is to balance all of the factors to create the best compromise between them.

For example: as a calibrator, you may be personally focused on running quality. You may find that running quality continues to improve as you advance the spark at a particular operating point. Even though running quality may actually improve as spark is advanced into the knock region – one should not cross those limits in pursuit of optimizing one variable, because doing so could cause engine damage.

The best calibration attempts to keep each variable in the middle of the window for every operating point. While this may not always be possible due to operating conditions or engine hardware and design; every effort should be made to keep away from the edges of the window. For example, let's say you calibrated your engine on the lean side of the wide open throttle air/fuel window to reduce fuel consumption during the race. While it may be OK for that specific combination at that time, you would have to ask yourself,

1. Is the calibration robust enough if my crew chief advances the cam 2 degrees?

2. Will the engine be OK if fuel quality varies?

3. Will the engine detonate if lugged in gear?

For these reasons and others, it is desirable to stay in the center of the variable's window

whenever practical.

Further calibration tips are contained within this manual and associated with the Pro Tuner function or map that they correspond to.

3.2 Vehicle Installation



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Installing the Victor System in the Vehicle

Installing the Victor system in a vehicle is a straight-forward procedure that is not difficult; particularly if you have experience replacing intake manifolds and basic automotive electrical knowledge. During this stage, it is helpful to consult a factory service manual (if available) as well as your system documentation.

Since specific procedures may vary with application, a factory manual should be used to identify and assist in installation in those instances. Some items that may be unique depending on the applications are:

1. Firing order
2. Location of #1 cylinder
3. Proper idle vacuum, RPM and ignition timing
4. Ignition advance curve

For proper system function and warranty coverage, it is very important that all installation instructions be followed during installation and operation. If you do not understand a procedure, contact the Edelbrock hotline. If you do not have the necessary skill or tools to perform any of the operations, consult a professional dealer/installer for assistance.

CHEVROLET V8

System Components:

- System ECU (ECM/PCM)
- Software
- Ignition Module
- Wiring harness w/Fuel pump and Main Power relays
- Fuel Pump harness
- Ignition Harness
- MSD/Edelbrock HEI distributor

- Intake Manifold - Fuel Rail Assembly
- Edelbrock High Flow 60 pph Fuel Injectors
- Four barrel Throttle Body w/integrated TPS sensor & Idle Air Control valve
- Heated Oxygen sensor w/mounting bung
- 1 bar Manifold Absolute Pressure (MAP) sensor
- Intake Air Temperature (IAT) sensor
- Engine Coolant Temperature (ECT) sensor
- Firewall bulkhead grommet/cover plate assembly

Additional Hardware and Parts needed:

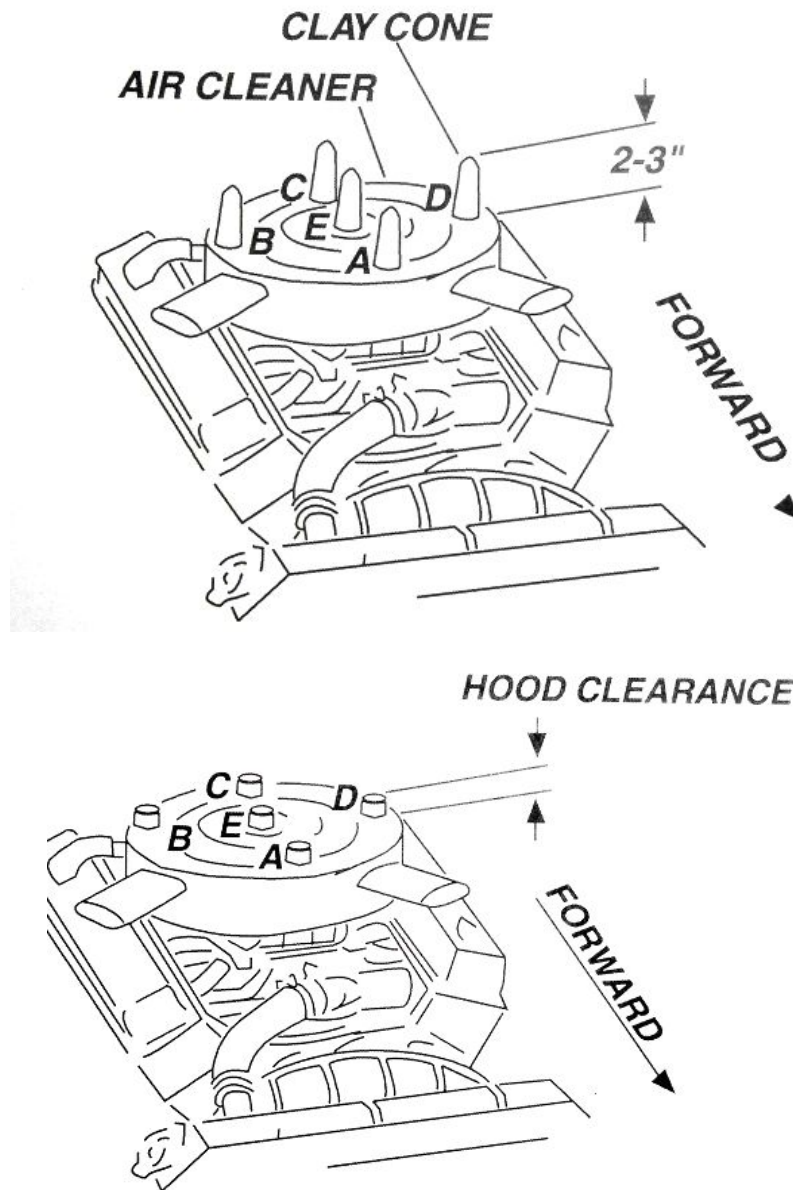
- Intake Gaskets / other engine gaskets as required
- Edelbrock/GM/or equivalent
- 5/16" steel tubing (approximate equal length to fuel pickup in tank)
- Edelbrock Gasgacinch #9300
- Loctite 598 OEM High Temperature Silicone gasket (O2 sensor compatible)
- Radiator Coolant - Teflon paste thread sealant
- Manifold bolt kit
- Factory service manual & wiring diagrams

Preliminary Checklist:

- **CAREFULLY STUDY AND UNDERSTAND ALL INSTRUCTIONS.**
- Examine the system components and packaging for shipping damage. (If damaged, contact your dealer immediately)
- Check all threaded manifold holes.
- Check all internal manifold passages with a light and wire, making sure they are clean and unobstructed.
- Check automatic transmission shift points before removal of the stock system, and adjust linkage after Edelbrock manifold installation for same shift points if needed.

Determining Hood Clearance

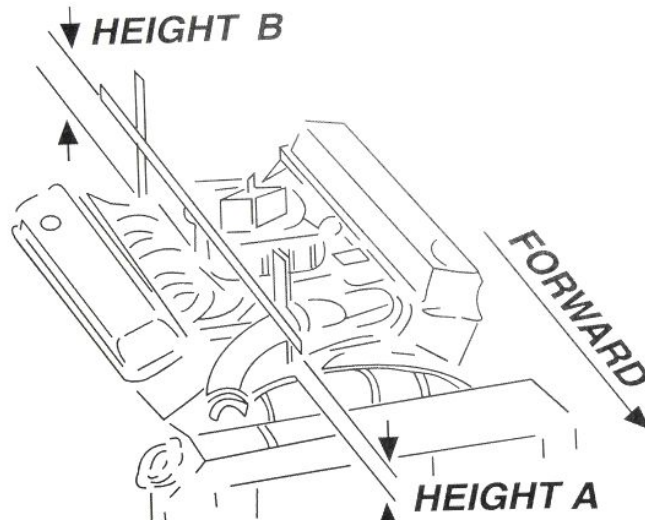
- 1. CHECK HOOD CLEARANCE BEFORE REMOVING STOCK MANIFOLD.**
 - 2.** Use modeling clay or putty to make five small cones 2-3" high.
 - 3.** Position cones on air cleaner at front, rear, each side, and on center stud.
 - 4.** Close hood fully and reopen.
 - 5.** The heights of the cones indicate the amount of clearance between the hood and the air cleaner. Record the measurements.
-



AFTER MEASUREMENT:

COMPARING HEIGHT OF STOCK INTAKE ASSEMBLY AND VICTOR PRO TUNER ASSEMBLY.

1. Remove air cleaner from stock assembly.
2. Lay a straightedge across top of carburetor flange front to rear.
3. Measure from bottom of straightedge to manifold/block sealing surface of manifold at front and rear of engine. Record measurements (A & B).
4. Add "A" and "B" and divide by 2 to get average height.
5. Measure your Victor assembly using the same method.
6. Compare the measurements. If the Victor dimensions are taller, subtract the difference from the current hood clearance to determine the new hood clearance.



***CAUTION:** You must maintain a minimum of ½" clearance between air cleaner and hood due to engine torque movement. If you have insufficient clearance, a low profile air cleaner may solve the problem.

EMISSION CONTROLS:

The Edelbrock Victor and Super Victor Engine Management Systems will not accept stock emission control systems. Check local laws for requirements before installing this system. Not legal on pollution controlled applications.

FUEL REQUIREMENTS:

Because the Victor and Super Victor systems use an oxygen sensor, you must use unleaded fuel only to avoid damaging the sensor. If you use leaded fuel in your application, do not install the O2 sensor and configure the system for no O2 sensors through the setup Wizard. Fueling will then be managed open loop.

The driver's side sensor is always the primary sensor. Always plug into the driver side only when using a single sensor. If using dual sensors, the system will use the leanest bank's sensor to provide closed loop feedback.

AUTOMATIC TRANSMISSION CHECK:

For best performance, economy, and emissions, the shift points must be checked before and after the manifold change.

***NOTE:** This check should only be performed on the drag strip or test track.

With the shifter in drive, accelerate to wide open throttle from a standing start. Hold in this position, noting speedometer reading when the transmission makes the 1-2 shift. Run the test again after the manifold change. The shift point should be the same. If the shift point is not the same – adjustment is necessary. We recommend use of the Edelbrock Throttle, Cruise control, & Transmission Kick-down Mounting Bracket #8031 or #8032 with Vortec heads. The Turbo 350 and Turbo 200 feature a window to accommodate user adjustment of shift points at WOT (Wide Open Throttle).

The 200R4 and 700R4 transmissions require precise adjustments. We recommend that you consult a reputable transmission shop for final adjustment once the Victor system has been installed.

INCORRECT SHIFT POINTS CAN RESULT IN TRANSMISSION DAMAGE!

ENGINE CLEANING:

Always perform the installation with a clean engine and engine compartment. Use utmost care in the cleanliness of **ALL** parts during the process.

EXHAUST MANIFOLD HEAT RISER:

If your vehicle is equipped with an exhaust manifold heat riser (typically located on the passenger side of the vehicle under the exhaust manifold), remove the valve for proper operation.

HEADERS:

For best performance, headers are recommended. Consult Edelbrock or your exhaust supplier for recommendations on header, pipe, and muffler specifications for your combination.

INSTALLING THE EFI INTAKE MANIFOLD:

The procedure for installing your new EFI manifold is nearly identical to installing a carbureted manifold. Always install new gaskets per manufacturer recommendation and follow the Edelbrock torque specifications for your particular manifold.

PRE-INSTALLATION

Before installing the induction system, take the following steps to ensure successful installation and performance:

1. Check all components thoroughly for damage when unpacking.
2. Make sure all throttle linkages open entirely and close freely.
3. Make sure all fuel inlet and vacuum ports are free from packing material.
4. Check the installation kit for proper parts.

REMOVING THE STOCK CARBURETOR AND MANIFOLD

1. Disconnect battery.
2. For ease of installation, keep all parts in order.

CAUTION: Do not remove manifold if engine is hot.

3. Drain radiator coolant (radiator drain plug is typically located on lower right facing engine).
4. Remove gas cap to relieve pressure. Disconnect fuel line and plug. Replace gas cap.
5. Disconnect all linkage from carburetor such as throttle, throttle springs, transmission, cruise control and automatic choke.
6. Tag and remove coil wires and sensor wires.
7. Remove previously marked vacuum lines.
8. Remove radiator hose, thermostat housing and thermostat, if mounted on manifold.
9. Remove all brackets from the manifold.
- 10 Loosen or remove valve cover bolts for manifold removal and replacement. It may be necessary to replace valve cover gaskets if broken, to prevent oil leakage.

PORT SURFACE CLEANING

1. When cleaning old gaskets from head surfaces, lay rags in the lifter valley and stuff paper into the ports, to prevent pieces of the old gasket from falling into ports and combustion chambers or valley.
2. When clean, remove paper, making sure that all particles fall on the rags in the lifter valley.
3. Remove rags, and wipe surfaces clean with rags soaked in lacquer thinner in order to remove oil or grease.

NOTE: This procedure is necessary to ensure proper sealing.

INSTALLING FITTINGS, PIPE PLUGS, AND STUDS

Do not over-tighten or cross-thread fittings, pipe plugs, studs, or bolts in your aluminum manifold. Damage to threads or a cracked mounting boss may result unless caution is used when installing accessories. Use Teflon sealant on all pipe threads.

GASKET SURFACE PREPARATION

CAUTION: Replace all gaskets as recommended. Do not use race-type non-embossed gaskets for street applications. Due to material deterioration under street driving conditions, internal vacuum and oil leaks may occur. We recommend Fel-Pro Printoseal gaskets or equivalent. Do not use Fel-Pro Perma torque Blue gaskets, which are designed for use on stock cast iron intake manifolds only.

1. Check gaskets on head surface and manifold to make sure they are correct. Embossed side faces up. NOTE: In some cases, there may be a different right and left side gasket. Make sure both are placed correctly.
2. Coat head surface and both sides of gaskets with Edelbrock Gasgacinch #9300.
3. Apply Loctite 598 OEM High Temperature Silicone Gasket around water passages on head surface.
4. Gaskets and surface will become tacky to the touch within a few minutes. Carefully place gaskets on head surface, aligning ports and bolt holes.
5. Edelbrock recommends the use of Loctite 598 OEM High Temperature Silicone Gasket instead of end seal gaskets. Apply a 1/4-inch thick bead of sealant across each end seal surface, overlapping the intake gasket at the four corners.

NOTE: Use the ONLY recommended O2 SENSOR SAFE sealer . Others may damage the O2 sensor. This method eliminates end seal slippage and deterioration. For ease of installation, we recommend using an Edelbrock Manifold Bolt and Washer Kit.

6. Apply Edelbrock Gasgacinch #9300 or equivalent to port surface of the manifold and to the head surfaces to ensure a good seal.
7. Apply RTV gasket sealer around water passages on the manifold.
8. Surfaces will become tacky to the touch within a few minutes.

INDUCTION SYSTEM INSTALLATION

1. Carefully position manifold and air valve on engine, centering bolt holes with the bolt holes in the head.
2. Apply thread sealer or Teflon tape to bolt threads where exposed to water or oil.
3. Hand tighten all bolts.
4. Torque all manifold bolts to Edelbrock specifications.

-
5. Re-connect throttle linkage and springs, transmission, cruise control, and fuel lines. Check all linkage for smooth throttle operation from idle to Wide Open Throttle (WOT).

Note: Do not install with a throttle rod, use a cable actuated throttle. Throttle rods can transfer engine movement to the throttle and possible lead to binding.

6. Re-tighten the valve cover bolts.
-

3.2.1 Fuel System Installation



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Fuel System

FUEL SYSTEM BASICS

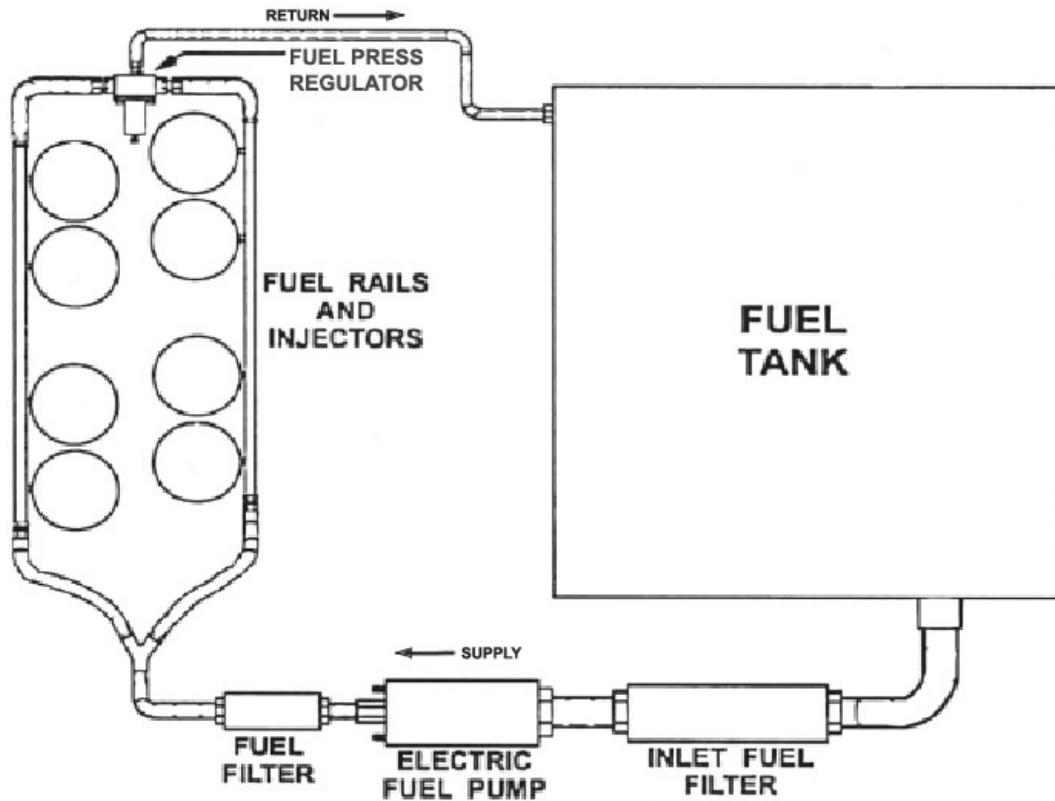
Because your Edelbrock Pro Tuner system controls fuel delivery very differently than a carburetor, some conversions to your fuel system may be necessary. Victor/Super Victor Pro-Tuner electronic fuel injection requires high and constant fuel volume and fuel pressure. For this reason, a good primary fuel line is critical. A 3/8-inch (minimum) **HIGH PRESSURE** fuel line must be used as the primary fuel line.

The fuel that bypasses the injectors must be returned to the fuel tank via a return fuel line. If your vehicle is already equipped with a fuel pump bypass line, this line can be used as the return fuel line. If not, the original primary line may be used as the return line or a new return line plumbed with 5/16" ID steel or high pressure line.

Many late-model cars are equipped with an additional fuel line which runs to a charcoal canister mounted on the driver side of the vehicle. This line **MUST** be re-installed after the fuel system conversion and **MUST NOT** be used as the return fuel line.

FUEL SYSTEM PLUMBING

Edelbrock recommends parallel plumbing for performance applications. Parallel plumbing is accomplished by teeing the feed hose from the pump into both fuel rails and connecting the two outlets to the fuel pressure regulator. See Fig. 2 below. This gives twice the capacity of series configuration plumbing. It also reduces the fuel velocity in the fuel rail when compared to series plumbing. If the fuel velocity is too high it may cause flow disturbance in the fuel rails. A parallel configuration is recommended to achieve the best cylinder to cylinder distribution.

**Figure 2**

FUEL PUMP AND FILTER

The Victor/Super Victor Pro-Tuner system uses a single Edelbrock high-pressure electric fuel pump which is capable of pumping 50 or more psi (depending upon the pump). The pump relay will prime the system on key-up and shut down the pump if it does not receive an engine-run signal from the ECU, as in the case of a stall. This safety precaution is necessary when using a high-pressure fuel system. It is very important that the fuel flow capacity of the EFI pump exceed your peak demand by 20-25% to avoid engine damage due to loss of pressure. Electrical connectors should face the front of vehicle when mounting. Consult your Edelbrock representative for assistance in pump selection. A high pressure/high volume EFI fuel filter should be mounted between the engine compartment and the fuel pump. A high quality inlet filter should also be installed to protect the fuel pump from contamination. See Fig. 2. Consult your Edelbrock representative for assistance in filter selection. Use the mounting instructions for the pump and filters that you are using.

RECOMMENDED FUEL PUMP AND REGULATOR KITS

Up to 600 HP

Edelbrock P/N 35943 - Kit includes fuel pump #3594 and regulator #1728

Up to 800 HP

Edelbrock P/N 17903 - Kit includes fuel pump #1790 and regulator #1729

Up to 1500 HP

Edelbrock P/N 17943 - Kit includes fuel pump #1794 and regulator #1729

FUEL PRESSURE REGULATOR

Fuel pressure is as important as fuel volume, particularly in fuel injection. The Victor/ Super Victor Pro-Tuner system requires that the fuel pressure regulator maintains a constant pressure at the injectors. It is recommended that Manifold Absolute Pressure references the regulator diaphragm to maintain constant pressure across all 8 injectors, regardless of fluctuating manifold pressure (vacuum) level. The fuel that is not injected is returned to the fuel tank via the return fuel line. Recommended pressure settings vary with application. Consult your Edelbrock representative for pressure recommendations. A typical regulator installation is shown in Figure 3.



Figure 3

FUEL LINE SIZES

A high pressure EFI system does not need the same size lines as a low pressure carbureted engine. A 3/8" diameter (-6 AN) is adequate for engines to at least 750 HP. A 1/2" diameter line should be used on engines over 750 HP.

RETURN FUEL LINE

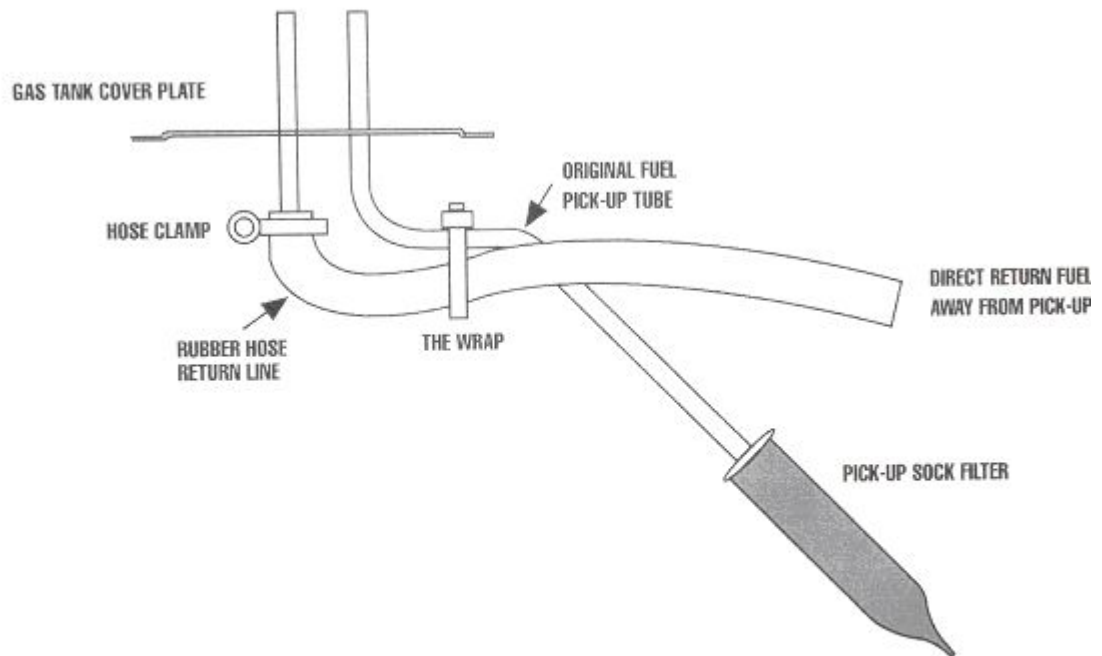
There are three options for installing a bypass return line.

1. Use the 5/16 rubber fuel line provided with the system as the fuel return line.

2. Use the vehicle's existing primary line as the fuel return line with modification to the pick up as described below.
3. Use the vehicle's existing return line (if so equipped) as the fuel return line. This option applies only to vehicles previously equipped with fuel injection. If the vehicle is not already equipped with a return line, some fuel tank modifications are required for routing the return line through the sending unit plate back into the tank. The first two methods listed below require some welding and should be done by a professional radiator or fuel system repair shop.

RUBBER RETURN LINE METHOD

Drill a 5/16-inch hole in the sending unit plate adjacent to where the main line enters the tank. This will be the hole for your return line. Insert a short length of 5/16-inch hard line (available at most radiator shops) into the hole and weld it to the sending unit plate. The hard line should extend through the hole 1 to 2 inches on each side of the plate. Connect a length (at least 4 inches) of 5/16-inch rubber return line hose to the hard line that will extend into the tank. Connect the rubber line to the fuel pickup line using tie wraps.



RUBBER HOSE METHOD

Figure 4

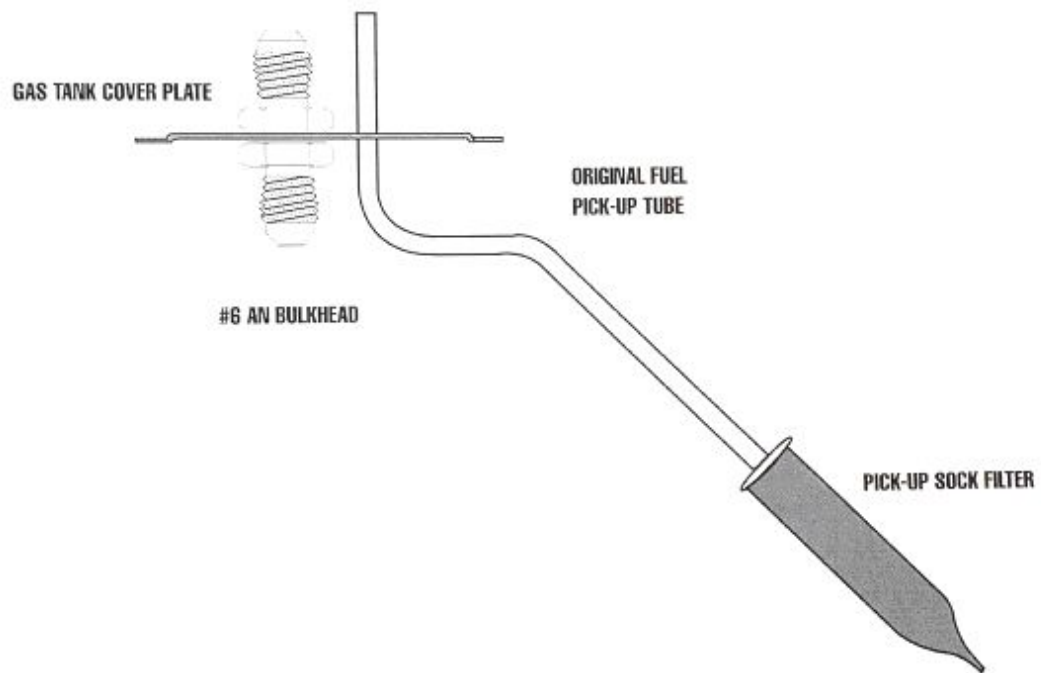
BULKHEAD FITTING METHOD

Drill a 9/16-inch hole in the sending unit plate adjacent to where the main line enters the tank. This will be the hole for your return line. Insert a #6 AN bulkhead fitting (available at most radiator shops) into the hole, the narrow end of the fitting on the inside of the plate. Apply a rubber washer or RTV sealant and fasten the fitting to the plate with the

nut. Connect a length (at least 4 inches) of flexible return line (rubber or braided hose) to the fitting end. Connect the return line to the fuel pickup line using tie wraps.

NOTE: *THIS METHOD REQUIRES NO WELDING OF THE FUEL SYSTEM.*

NOTE: Whichever method you use to install the return fuel line, be careful to keep the end of the line away from the fuel pickup, as shown. Otherwise, aerated return fuel can be drawn into the pickup.

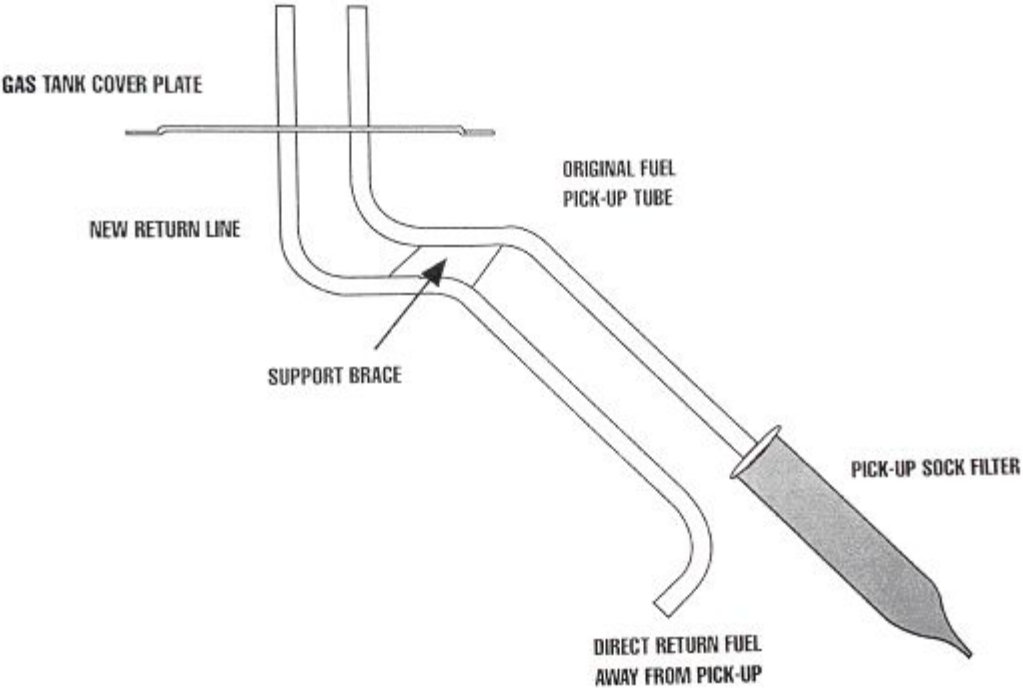


BULKHEAD FITTING METHOD

Figure 5

HARD RETURN LINE METHOD

Drill a 5/16-inch hole in the sending unit plate adjacent to where the main line, enters the tank. This will be the hole for your return line. Insert a length of 5/16-inch hard line (available at most radiator shops) into the hole and weld it to the sending unit plate. The hard line should extend through the hole 1 to 2 inches on the outside of the plate. On the inside of the plate, the hard line should follow the contours of the fuel pickup line. Bend the end of the return line away from the sock on the end of the fuel pickup line.



HARDLINE METHOD

Figure 6

Solder or weld the return hard line to the fuel pickup line.



Figure 7 - Completed return line installation

FUEL SYSTEM INSTALLATION

1. Disconnect the vehicle battery.
2. Drain the fuel tank.
3. Remove all lines from the tank and carburetor.
4. Remove the fuel tank if sender plate is inaccessible. While fuel tank is removed from vehicle, it is recommended that it be professionally cleaned in order to remove any rust or dirt that may have accumulated inside which could damage the injectors.
5. Remove the sending unit from the fuel tank. Refer to RETURN FUEL LINE METHODS above for installing the bypass fuel return line.
6. Install the high pressure fuel line next to the original line, which may now serve as the return line. Use large radius bends. Avoid exhaust components, sharp edges, and possible wear points. Mount the lines firmly and high in the underbody to insure that they will not be exposed to ground clearance obstacles or road debris hazards that could catch or damage the line.
7. If you do not use the original fuel as the return line, route the return line directly alongside the provided primary fuel line.
8. Mount the fuel pump between the tank and the fuel filter as low and as close to the fuel tank as possible. The pump is directional. Electrical connectors should face the front of vehicle. The fuel pump needs to be at or below the level of fuel in the tank.

9. Mount the fuel filter between the fuel pump and the engine.
- 10 Re-install the modified sending unit plate to the clean fuel tank.
- .
- 11 Reinstall the fuel tank.
- .
- 12 Attach the primary line and return line to the sending unit plate on the tank.
- .
- 13 Re-attach all other fuel lines at the tank (vapor purge lines, etc., if so equipped).
- .
- 14 Secure the primary and return fuel lines with the provided tie-wraps, or with Adel clamps if available.
- 15 Re-attach all fuel lines to the induction system once it has been installed.
- .

NOTE: REMOVE FUEL SENDING UNIT FROM TANK BEFORE MODIFYING. ALL WELDING AND SOLDERING OF THE FUEL SYSTEM MUST BE PERFORMED BY A PROFESSIONAL RADIATOR OR FUEL SYSTEM REPAIR SHOP.

INJECTOR INSTALLATION

DO NOT INSTALL FITTINGS WITH RAIL INSTALLED. TORQUE APPLIED TO THE ASSEMBLY COULD DAMAGE PARTS AND CAUSE FUEL LEAKS!

1. Fasten fuel rail stands (if applicable) to manifold per Edelbrock instructions; making sure the stands are parallel with the injector bosses in the manifold.
2. Lightly grease the injector O-rings at the top and bottom of injector per Figure 5. using supplied o-ring lube.



Figure 8

3. Install the top of each injector into the fuel rail; carefully inserting the injector to avoid pinching or damaging the sealing O-ring. Orient the injector so that the connector is facing outward. (The outside of the rail has the Edelbrock logo on the side).
4. Carefully insert the rail w/injectors into the manifold, insuring that each injector enters the manifold straight and lower O-rings do not get pinched or damaged.
5. Align mounting holes in rail with the rail mounts.
6. Install with hardware provided.
7. Remember to attach the coated injector harness clips to each rail mount, orienting so the clip is above the mounting hole.

NOTE: If O-rings are damaged even slightly, they MUST be replaced before pressurizing system!

Injectors should not bind in the ports. You should be able to rotate them slightly.

A typical rail installation is illustrated in Figure 9.



Figure 9

3.2.2 ECU and Main Harness Installation



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ECU and Main Harness



Installing the Main harness and ECU

To install the system harness, you should first layout the harness in your vehicle to determine the best layout and routing for your application. Of primary concern, is the mounting location of the Engine Control Module (ECM/PCM), relays, interface connectors, and system fusing.

You may choose to mount the ECM inside the passenger compartment similar to OEM practice. However, the ruggedized ECM also gives you the option of mounting it under hood. Layout the harness with the appropriate injector connectors corresponding with the injectors on the engine. Within the available length of the harness, determine potential mounting locations for the ECM and relays.

Improper installation may cause system failure and void your warranty.

To mount the ECM and relays correctly, the following rules should be followed:

1. Keep ECM, components, and wiring as far away from heat and exhaust parts as possible. You may need to install heat shields over certain areas in the engine compartment to prevent excessive heat from reaching the electrical components.
2. Mount the ECM and relays using only the grommets, bushing's, and washers provided. Use the Edelbrock ECU mounting bracket shown below for proper mounting and flexible orientation. These parts are specially engineered to insure proper isolation of the ECM. Locate the fuse pack so that it can be accessed conveniently. The fuse pack is shown in Figure 10 below:

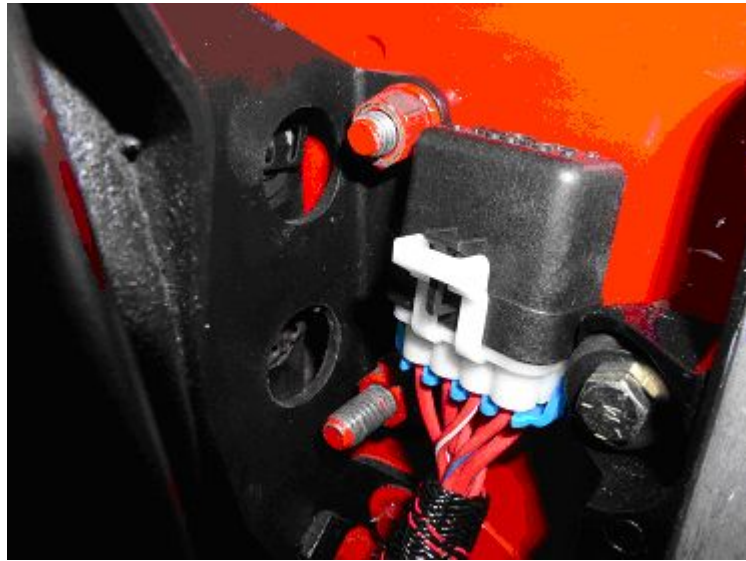


Figure 10

3. **Insure that the ECM case does not touch or rub against anything, particularly metal or wiring. The case **MUST** be isolated from grounds and voltage sources.**
4. Do not mount hardware in such a manner as to cause stress on the harness. Do not pull, stretch, or kink wires and connectors. Minimize effect of engine torque movement on short sections of harness. Improper installation can cause intermittent wire or connector failure or total loss of connection.
5. Route harnessing to avoid sharp edges, heat, and wear points. Clamp harnessing with approved clamps and clips. - Do ALL installation work with the vehicle battery disconnected.
6. A typical PCM under-hood mounting installation is shown in Figure 11.

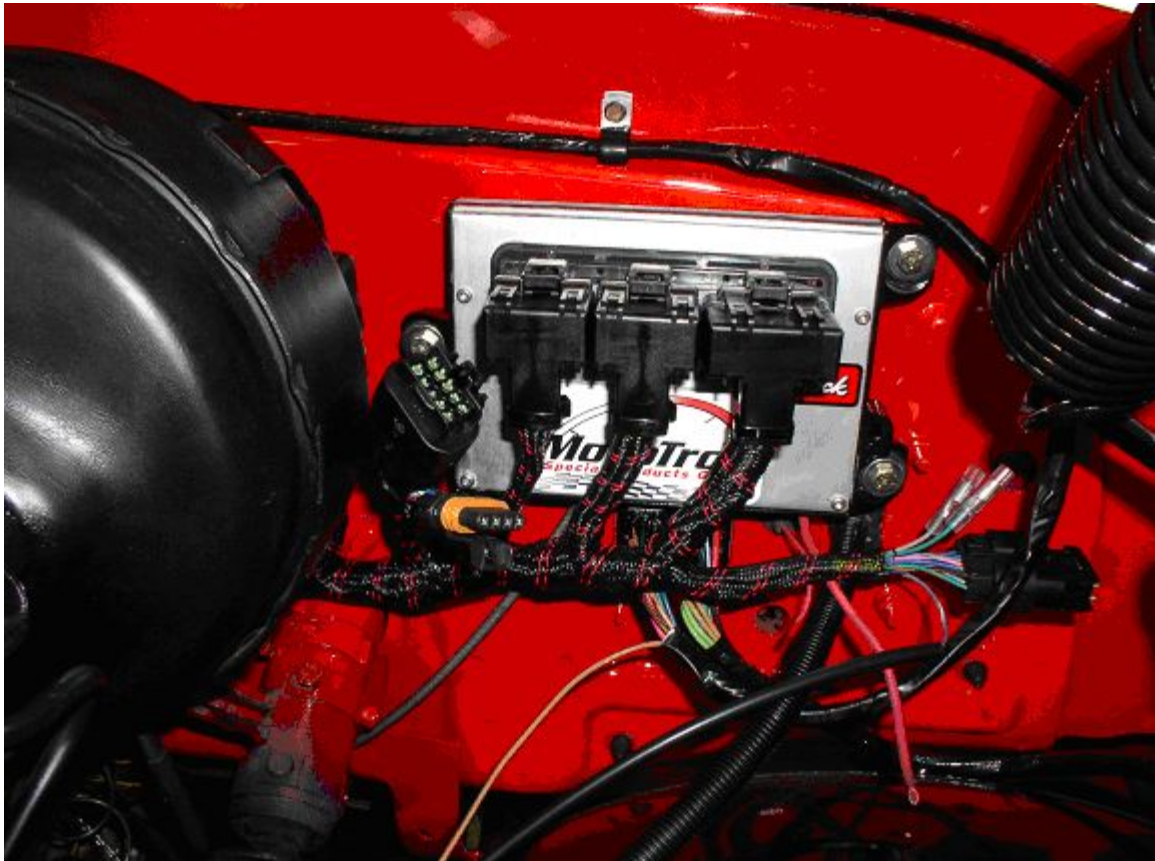


Figure 11 - 80 pin Super Victor PCM

The ECM (48 pin) or PCM (80 pin) controllers mount using specially designed bushing's and isolation grommets.

When installing the mounts, first install the rubber grommets into the 3 mounting holes. Insert the bushing from the **BACKSIDE** of the grommet. Finally, mount to the desired surface using the provided retaining washer on the top side of the grommet and a 6mm X 1.0 or ¼-20 screw. Figure 12 below shows the 48 pin ECM with mount installed without the top retaining washer yet added.



Figure 12

To mount the ECM or PCM inside the vehicle, a hole will have to be made in the firewall for the harness and connectors to pass through. A firewall bulkhead grommet and cover plate is included to seal the hole and support the harness where it passes through the firewall, or you can make your own.

1. To run the harness into the passenger compartment, select the appropriate location for the harness to pass through for your vehicle – making sure you have access from the inside of the vehicle and that no components are in the way or can be damaged during the process.
2. Use the grommet and cover plate assembly as a template. Mark the outline on the firewall. - Using a hole saw, nibbler, or chassis punch, create a 2" x 2-3/8" rectangular hole in the firewall – being sure to center the hole in the template outline. De-burr all edges when finished.
3. Carefully work the harness through the firewall, passing the 32 pin (PCM only) connector through first, followed by the other connectors. The ECU connector covers may need to be temporarily removed in some cases to get them through easily. - Install the firewall plate with the screws provided by slicing the O-ring and wrapping it around the main harness bundle. Slide each side over the grommet and harness until the mounting holes line up as in figure 8. Fasten to the firewall. Use of a silicone sealant between the plate and the firewall is optional. See Figure 13.

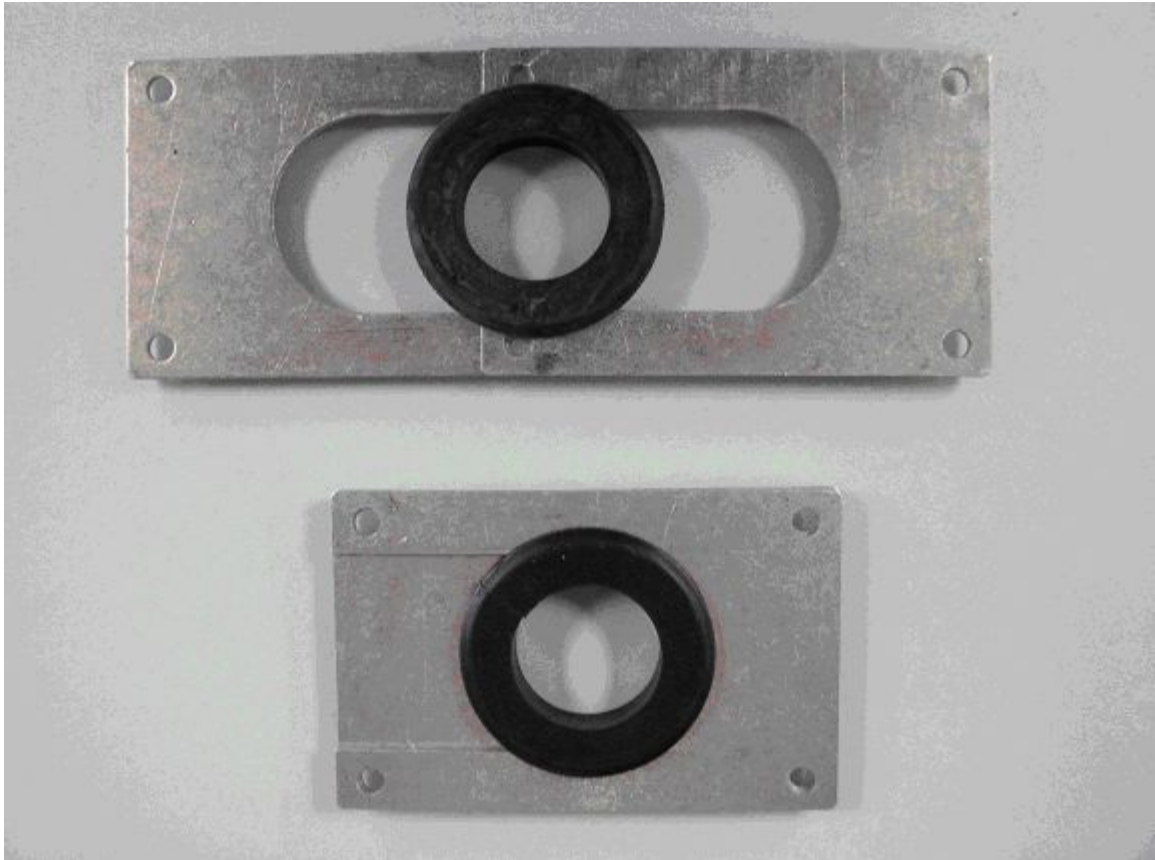


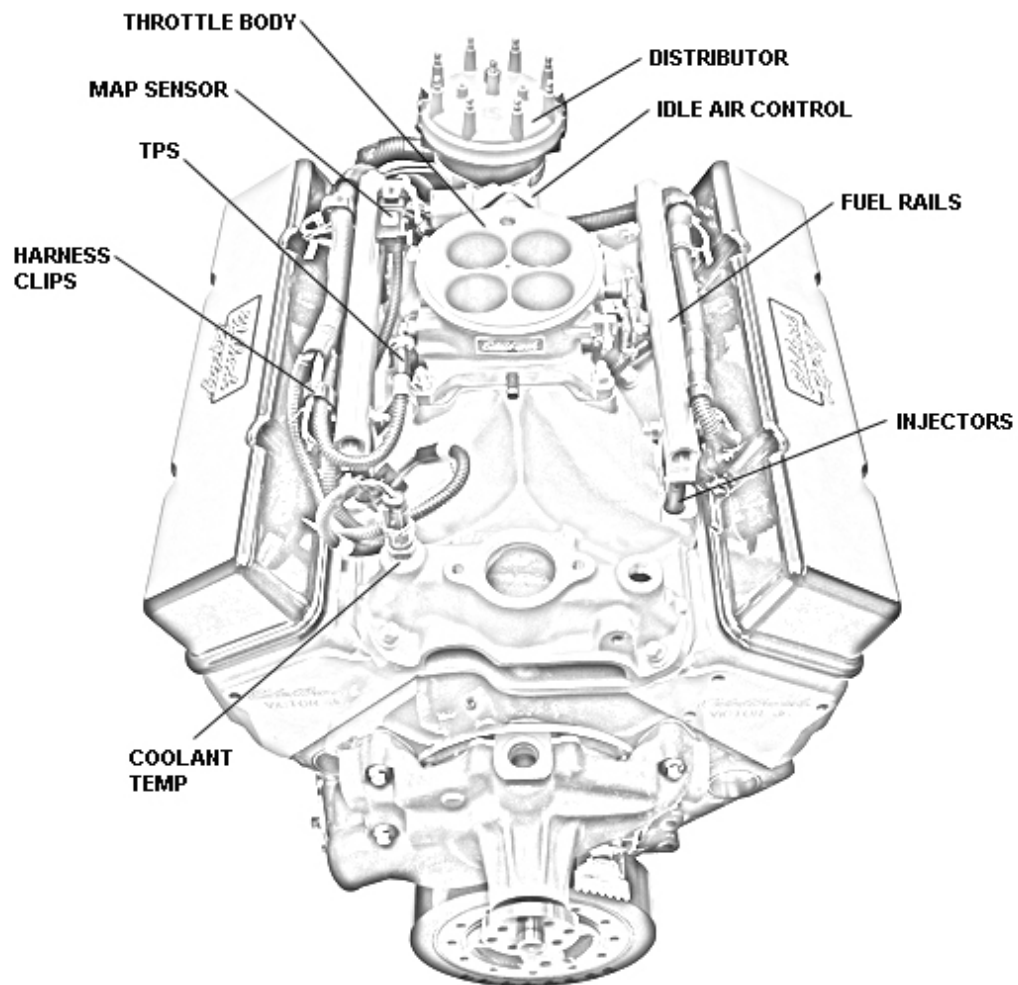
Figure 13

Before proceeding further with harness installation, install and mount all sensors and components.

3.2.3 Component and Sensor Installation

COMPONENT AND SENSOR OVERVIEW:

The diagram below identifies the location of the major components of the Pro-Tuner electronics. Not shown below is the air temperature sensor as it is normally mounted in the air cleaner base.



3.2.3.1 Distributor and Ignition



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Distributor and Ignition



The Pro-Tuner Distributor with Cam-Sync is designed for use with our Victor Pro-Tuner EFI systems for the Small Block and the Big Block Chevrolet. The distributor includes an adjustable hold down collar (to accommodate various deck heights and custom intake manifolds), a large distributor cap, and the mechanical advance is locked out. It is equipped with a steel distributor drive gear. The Pro-Tuner distributor also features a Magnetic Crank Pickup and uses a Hall-Effect Cam-Sync Pickup with LED indicator for the Camshaft Sensor. The Cam Sync has a 12" lead and a 3-prong Weatherpak connector. The crank trigger has an 8" lead and 2-prong Weatherpak connector.

DISTRIBUTOR KIT CONTENTS

- 1 Pro-Tuner Distributor
- 1 Rotor (MSD #8421) Installed
- 1 Distributor Cap (MSD #8408) Installed
- 1 Wire Retainer
- 2 1.5" Long, Self Tapping Screws
- 1 Distributor Gasket
- 2 O-Rings
- 1 Tube of Assembly Lube

IMPORTANT INSTALLATION NOTES

- **DO NOT** use a Solid-Core type spark plug wire set, such as copper core, etc. You must use a suppression type spark plug wire. Failure to use the correct wires will cause electrical interference with the Engine Control Module.
- When installing the distributor, make sure to disconnect the vehicle's battery **BEFORE** beginning the installation.
- If the drive gear is ever replaced, you must use a MSD #8531 distributor drive gear due to the .500" diameter drive shaft.
- HALL-EFFECT PICKUP LED OPERATION: The **LED** is on whenever the magnet is **NOT** in front of the pickup. The **LED** Turns off when the magnet passes over the center of the pickup (approximately 40°)
- This Distributor has a steel drive gear, check with your camshaft manufacturer for cam compatibility with this gear.
- **A white dot is located on the distributor base directly under the #1 cylinder post. See figure 14 below for proper orientation.**

INSTALLATION PROCEDURE

1. Loosen the adjustable slip collar, Install the Distributor into the engine without the gasket installed, make sure the oil pump shaft is fully engaged, slide the slip the collar down to sit against the manifold. Tighten the collar and remove the distributor. Tighten the set screws on the collar and install the gasket.
2. Rotate the crankshaft in the direction of normal rotation until cylinder #1 is coming up on the compression stroke. Stop turning when the crankshaft is at 22° BTDC.
3. Install the distributor, with gasket and cam gear lubricated, so that the rotor comes to rest pointing at what will be the #1 terminal on the cap. Position the cap such that #1 is in the Location shown on the drawing below. You may need to remove and reinsert the distributor a few times to get the alignment correct. Make sure that the distributor seats down completely and has fully engaged the oil pump drive. You may need to rotate the oil pump shaft to ensure it is engaged properly.
4. Lift the rotor by hand to make sure that there is adequate end play. Lack of end play indicates that the rotor shaft is bottomed out on the oil pump shaft. If there is no end play readjust the Slip Collar as mentioned above.
5. Align Distributor cap clips parallel with the firewall, Hall Effect sensor should be pointing toward the forward drivers side of the engine. See Figure 14.
6. Tighten Distributor hold down clamp.

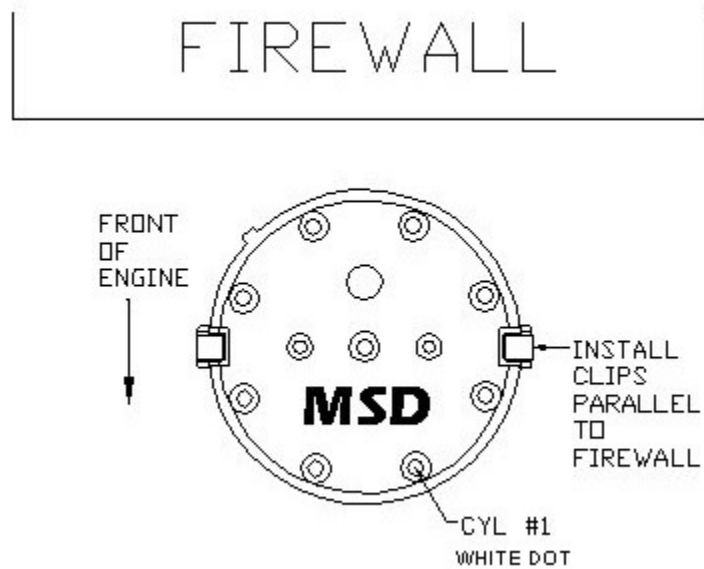


Figure 14

INSTALLATION PROCEDURE O-RING SEALS

The Pro-Tuner Distributor features an o-ring groove in the uppermost bottom land of the housing in order to seal the oil gallery. The o-ring should only be installed if the block has been modified. See Distributor Specifications for procedure.

CHECKING THE DISTRIBUTOR DRIVE GEAR MESH

It is recommended to check for proper gear mesh between the drive gear on the camshaft and the drive gear on the distributor. In order to check the mesh, coat the distributor gear with the supplied assembly lube and install the distributor into the engine. Rotate the engine several revolutions and remove the distributor. The mesh pattern in the lube should be even and in the middle of the gear. Adjust the slip collar to obtain the proper mesh, if necessary.

CHECKING THE OIL PUMP TO DISTRIBUTOR SHAFT OVERLAP

After checking the drive gear mesh, it is very important to have the proper overlap between the the distributor shaft and the oil pump shaft.

The tongue of the distributor shaft should sit into the oil pump shaft groove by a minimum of 1/4". Check this measurement according to the procedure below:

1. Measure the distance between the base of the slip collar and the tip of the distributor shaft.
2. Using a straight edge, measure the distance from the intake manifold distributor flange to the top of the oil pump intermediate shaft.
3. Subtract the measurement from Step 1 from the measurement taken in Step 2. This difference is the overlap. If there is too much, or not enough clearance, a shorter or longer oil pump drive shaft will be required.
4. Lightly tighten the hold down clamp so that the distributor can still be turned to determine final setting when checking the timing.
5. Re-attach the distributor cap. Make sure the rotor is still pointing to #1.
6. Install your spark plug and coil wires and connect the distributor to the wiring harness.

Make sure to install the spark plug wires one at a time and verify they are in the correct position. A wire retainer is supplied to secure the wires to the cap. Align the retainer with the mounting bosses, and use the supplied 1.5" self-tapping screws to secure the retainer.

ROTOR PHASING

Rotor phasing is defined as the alignment between the rotor tip and the distributor cap terminal when the spark occurs. This position can be very important to your engine's performance. If the alignment is incorrect, the spark will jump to the next closest terminal, or another ground resulting in a misfire and loss of power. In applications with extreme cylinder pressures, such as with nitrous or forced induction, correct rotor phasing increases in importance. More voltage is required to ionize the plug gap and if rotor phasing is off, the spark is more apt to find an easier path to ground rather than the correct cap terminal. This may result in severe engine damage.

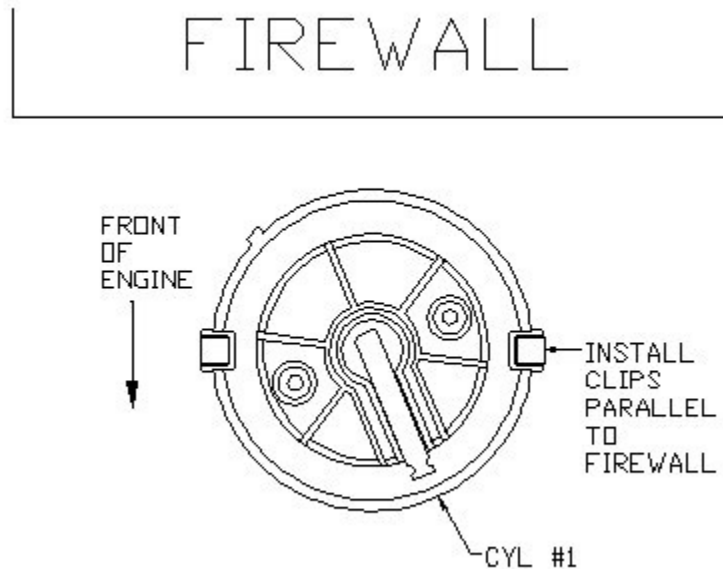


Figure 15

CARE AND MAINTENANCE

Periodically, visually inspect the cap terminals and rotor tip for wear and look for traces of carbon tracking where spark scatter occurs. Check your spark plug wires for burns or tears. It is also recommended to periodically test the resistance of the wires. See for an exploded view of the distributor and its parts.

3.2.3.2 Intake Air Temperature Sensor (IAT)



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Intake Air Temperature Sensor



Installing / Replacing the Intake Air Temperature (IAT) sensor

The Intake Air Temperature sensor is a thermistor device which measures air temperature. This sensor must be installed into the air cleaner base. Drill the air cleaner base with a 3/4" drill, deburr any sharp edges, install the sensor grommet, then slide the air temp sensor into the grommet. This sensor is usually placed in the rear of the base for best appearance.

3.2.3.3 Engine Coolant Temperature Sensor (ECT)



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Engine Coolant Temperature Sensor (ECT)



Installing / Replacing the Engine Coolant Temperature (ECT) sensor

The engine coolant temperature sensor is a thermistor device which measures coolant temperature. It should be screwed into the coolant passage of the intake manifold near the thermostat housing to measure coolant before it exits the engine on its way to the radiator. It has 3/8 NPT pipe thread and comes with a thread sealant pre-applied.

3.2.3.4 Manifold Absolute Pressure Sensor (MAP)



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Manifold Absolute Pressure (MAP)



Installing / Replacing the Manifold Absolute Pressure (MAP) sensor

The MAP sensor measures pressure in the intake manifold. (A pressure below atmospheric is typical in a running engine, and is sometimes called vacuum when the value is referenced to atmospheric baseline.) The manifold pressure is low (high-vacuum) in a light load condition, while in a high load condition – the pressure will rise (low vacuum). Manifold pressure provides the ECM information that helps the system determine the load on the engine so the appropriate output changes are calculated and executed.

The MAP sensor must have an unobstructed signal to the intake manifold plenum: either at the throttle body below the throttle blades, or in the plenum itself. A small bracket is supplied to mount the MAP sensor to one of the 4 throttle body hold down bolts/studs. A

small length of vacuum line (not supplied) should be installed between the MAP sensor and the vacuum port reference location. Replacement of sensor should be done using the original mounting hardware.

Note: If the MAP sensor has an orange ribbed sleeve on the reference port, remove it prior to installation. It is not necessary for proper operation.

3.2.3.5 Idle Air Control Valve (IAC)



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Idle Air Control Valve



Installing / Replacing the Idle Air Control valve (IAC)

The Idle Air Control (IAC) valve is controlled by the ECM and tailors airflow to help maintain a set point speed at idle. The behavior of the valve can be calibrated for your combination through the laptop Pro Tuner software. The IAC comes installed on your system throttle body. Replacement of the valve is through removal of the 2 mounting screws, remove old valve, replace gasket, and install new valve.

3.2.3.6 Fuel Pressure Sensor (optional)



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Fuel Pressure Sensor



Figure 16

Installing / Replacing the optional Fuel Pressure Sensor

An optional fuel pressure sensor may be used with your system to provide additional information to the ECU and for readout on digital smart gauges and displays over the CAN network. It is also used by the system for automatic fuel pressure compensation if the sensor is in the system. The pressure sensor should be mounted in the fuel rail or crossover line prior to the fuel regulator. In all cases, but especially if the rail is drilled and tapped for the 1/8" NPT thread: cleanliness is a must to avoid contamination of the fuel system and potential engine or injector damage. After machining and during assembly/disassembly – clean the rail assembly and associated lines thoroughly. Make sure there are no chips, particles, or overhanging burrs that could break loose.

A typical sensor installation is shown in figure 16.

3.2.3.7 Oil Pressure Sensor (optional)



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Oil Pressure Sensor



Figure 17

Installing / Replacing the optional Oil Pressure Sensor

An optional Oil pressure sensor may be used with your system to provide additional information to the ECU and for readout on digital smart gauges and displays over the CAN network.

The sensor also enables the low pressure warning limit array. This table allows you to set the minimum oil pressure for your engine over the RPM range. If the pressure drops below your calibrated value, the MIL (Malfunction Indicator Lamp) will light to alert the driver of the condition.

The sensor should be installed as close to an engine oil gallery as possible and away from exhaust heat.

The sensor features a 1/8" NPT thread and can be used in addition to standard oil pressure sender units. Use every precaution to prevent dirt or debris from entering lubrication system during installation. A typical sensor installation is shown in figure 17.

3.2.3.8 Mass Air Flow (MAF) Sensor (optional)



Visit us at: <http://www.edelbrock.com>

Mass Air Flow (MAF) Sensor



Figure 18

Installing / Replacing the optional Mass Airflow (MAF) Sensor

Your Victor or Super Victor System has the capability to run a GM digital Mass Airflow sensor (MAF). A MAF sensor will feed the ECM airflow information which is used in the control calculations and used to auto-calibrate the Volumetric Efficiency map.

The MAF can be used only for the auto-cal OF VE during dyno testing, or it can be run all of the time; constantly adjusting for changes in airflow due to wear or engine modifications. The sensor that should be used is a **1999-2002 GM # 25318411 or the 25341604** 85 mm sensor from the '02 Corvette Z06. If the sensor is only enabled for the tuning session, be sure to turn the sensor off by selecting "none" in the MAF section of the setup wizard. This will prevent Mass Airflow sensor faults during later operation.

In high horsepower applications, your system is capable of running two of these sensors in parallel to keep restriction to a minimum. *Consult your Edelbrock representative for information regarding adding and using a second sensor.*

The mounting of the sensor is very important to accurate measurement and operation. The sensor should be mounted as far away from the throttle body as possible (a minimum of 12") and between the air filter and throttle body. All tubing and bends should be smooth with even cross-sectional area. Allow a minimum of 8" of straight tubing in front of the sensor so that airflow is entering as straight as possible into the sensor. Follow the factory method of plumbing where possible. Figure 18 shows a sensor

with a recommended sensor inlet tube installed.

3.2.3.9 Throttle Position Sensor (TPS)



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Throttle Position Sensor (TPS)



The Throttle Position Sensor (TPS) comes installed on your throttle body and should require no mechanical adjustment. Scaling of the sensor is accomplished through the Setup Wizard.

When replacing the sensor, the TPS scaling of the min and max values should be recalibrated through the Setup Wizard. **It is also a good idea to reset the TPS calibration in the setup wizard or from the TOOLS menu (SUPER only) a second time after the engine idle is tuned in and your final throttle blade setting is reached.**

3.2.3.10 Main Wiring Harness and Engine Wiring



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Main Wiring Harness and Engine Wiring



Figure 19

Once all sensors have been placed, the harness can be routed and connected to each. Lay the harness out and become familiar with each connection. Do not rush the harness installation. Take some time to plan the routing of each branch. This will improve both the look and reliability of the installation. See Figure 19. Before installing the harness, be sure vehicle battery is disconnected. For all GM applications, odd numbered injectors go along the driver side fuel rail and should be retained by the clips at each rail mount screw. Bend the clamp as required to hold the conduit. Even numbered injectors, along with the TPS, ECT, and MAF sensor connector branch go along the passenger side rail and should be retained the same way. Route & retain wiring to protect it from heat and vibration and for a clean, professional looking installation. A little extra time spent routing the harnessing can make a big difference. This includes spark plug wire routing as well. Plug in injectors and sensors into the connectors labeled for each. On a GM engine model, the 1,3,5,7 cylinders are front-to-back on the driver side; while the 2,4,6,8 cylinders are on the passenger side.

It is important that the system has reliable power and ground connections. Attach the

ground wires, fuel pump harness and ignition harness ground black leads to the same point using clean & paint-free bell housing bolt connection. Alternatively, you may connect the system grounds to the same point on the engine as the battery negative lead. Insure that the engine/transmission is grounded to the chassis and body as well. See Figure 20 for system Grounding at bell housing. Note Negative battery cable and paint removed from bell housing under terminal contact area.



Figure 20

If space is confined, an alternative method is to run system power to a firewall mounted insulated hot-stud and a single 6/8 gauge wire to the starter solenoid.

- Connect ignition key-switch lead to the operator ignition switch. The switch should be capable of maintaining uninterrupted +12V power to the system in the "On" position, "Crank" position, as well as the transition between the two. Many older vehicles (pre 1974) have ignition switches that bypass power from a ballast resistor during crank and these systems typically have a momentary "dropout" between the Run and Crank positions.

These types of ignition switches ARE NOT COMPATIBLE with your Edelbrock Pro-Tuner system.

If you have such a switch; it must be replaced with a newer non-interruptible version for proper operation.

- Connect remaining wires, including fuel pump and ignition harnesses. Unused connectors should be coiled and secured away from dirt, debris, and heat.

-
- Once all connections are made. Verify that all fuel lines and fittings are tight. Reconnect vehicle battery. *If you have questions regarding wiring and connections; refer to the wiring diagrams included in the help section and your vehicle wiring schematics.*
 - Turn key switch to “**On**” or “Run” position. The fuel pump will turn on and run for approximately 4 seconds. It will then shut off. Turn key switch off for 15 seconds. Turn on again and inspect the system for fuel leaks.
 - Set fuel pressure regulator to desired pressure (if regulator is an adjustable type) while pump is running. Repeat key-off and key-on cycle as many times as required to purge air, set pressure, and verify fuel system is leak free. Fuel pressure should be rechecked at idle after engine has been configured.

Do not crank the engine until the system has been configured using the Setup Wizard in your Pro-Tuner software.

3.2.3.11 Oxygen Sensors



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Oxygen Sensors



Figure 21

Installing / Replacing Oxygen Sensor(s)

The exhaust gas oxygen content is determined by the oxygen sensor. The sensor signals the ECU, which compensates when the air/fuel mixture is either rich or lean. If the exhaust system is already configured for an oxygen sensor port, simply replace existing sensor with the Edelbrock 4 wire sensor. Route and secure wire and connector away from exhaust heat. Allow enough slack for exhaust pipe movement.

If your exhaust system does not have an O2 port, you will need to weld the included threaded bung into the exhaust pipe. See Figure 21.

It is recommended that the O2 sensor installation be performed by a professional muffler shop.

1. Double check header gaskets, replacing if necessary.
2. Drill a 1/2-inch to 9/16-inch hole in the driver-side header collector reducer, as close to the engine as possible in the header collector (1" to 3" forward of flange minimum)

NOTE: Before drilling, make sure the O2 sensor will be mounted at a slight downward angle in the top half of the exhaust pipe and within reach of the harness connector. Check to insure adequate clearance for the sensor, taking into consideration engine movement.

3. Fit the provided fitting into the hole in the exhaust pipe and weld into place.
4. Once it has been welded into place, clean the threads in the center of the fitting. If your exhaust is coated tap bung threads to ensure a good ground for the O2 sensor.
5. Thread the O2 sensor into the fitting. A high-heat anti-seize compound has been applied to the sensor threads.

NOTE: The O2 sensor has 18mm x 1.25 spark plug threads.

6. Attach the O2 sensor to the main system harness driver side connector. Refer to the MAIN SYSTEM HARNESS section of this manual

NOTE: UNLEADED FUEL MUST BE USED ONCE THE O2 SENSOR HAS BEEN INSTALLED.

COATED HEADERS: Use a digital OHM meter to measure the resistance between cylinder head bolt and the body of the installed O2 sensor. The reading should be less than 2 OHMS. If it is more, you need to provide a ground to the O2 sensor mount.

Wideband (UEGO) Installation

A wideband oxygen sensor is an optional feature which allows very accurate AFR measurements across a wide range of air/fuel ratios. The appropriate sensor must be chosen in the setup wizard. With the 48 pin ECM the sensor and conditioning module are a plug-in installation. To install a wideband/s in the 80 pin PCM controller, follow the instructions below:

****IMPORTANT****

If you decide to use a single or dual MotoTron or Edelbrock wideband oxygen sensor (UEGO) with external 0-5V conditioning - instead of the standard heated switching style (HEGO) with your 80 pin PCM, you must move 2 wires to different pins in the PCM connector.

While this procedure is straight forward, it is critical that the procedure is followed exactly to insure proper connection and prevent damage to your wiring harness.

The wideband sensor installs into the exhaust collector exactly the same way as the standard O2 sensor. The sensor bung should be welded as close to the engine as the collector allows to insure adequate heat is present at the sensor during idle and light load conditions.

Connect the conditioning module to the sensor per the kit instructions. Next, the module's output needs to be connected to the PCM/ECM. The module plugs into the same connector/s on the engine harness as the standard switching style oxygen sensor. **For the 48 pin ECM, no other modifications are necessary.**

For the 80 pin PCM however, 2 wires need to be moved in the PCM connector. To move the wires, follow the steps below:

(NOTE: to unplug the connectors from the ECM/PCM, simply squeeze the connector releases on each side of the connector to release it from the ECM/PCM and pull straight out). See Figure 22.

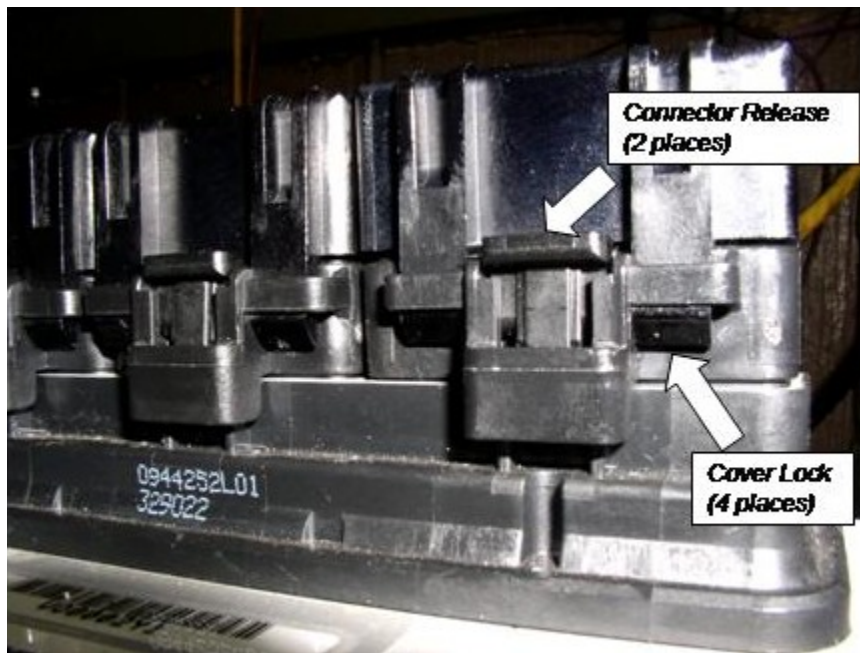


Figure 22

- 1) Locate the "A" connector on the PCM harness plugs. It is the largest of the 3 connectors and contains 32 pins. The pins are numbered on the bottom side. Remove from PCM.
- 2) The cover of the connector must now be removed. Cut the tie-strap holding the harness bundle to the cover.
- 3) Four lock tabs retain the cover to the connector. Press 2 tabs on the same side; unlocking one side at a time – and remove the cover.
- 4) Note the backside of the connector and the numbers in each corner to help identify pin numbers. Note also the blue plugs sealing the connector where no wires are present. With small pliers, grab the plug firmly and pull the plug from the number A7 position. If 2 sensors are installed, also pull the plug from the number A10 position. Save the plugs for re-installation. See Figure 23.

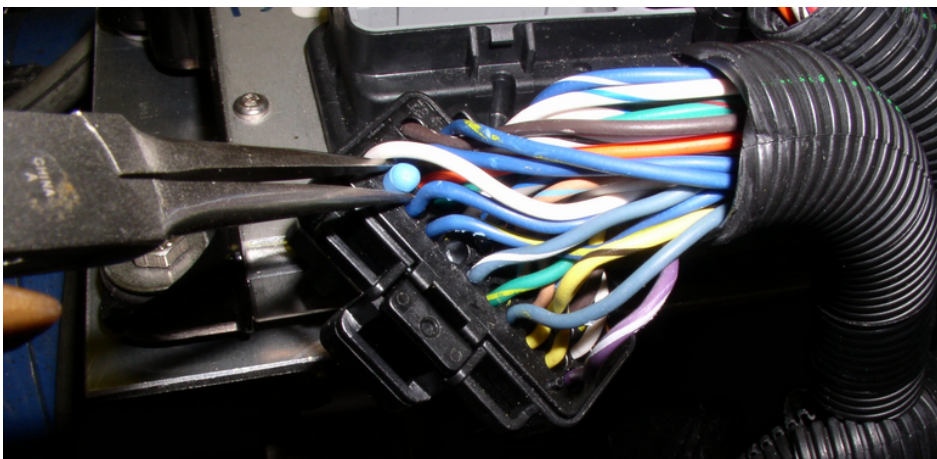
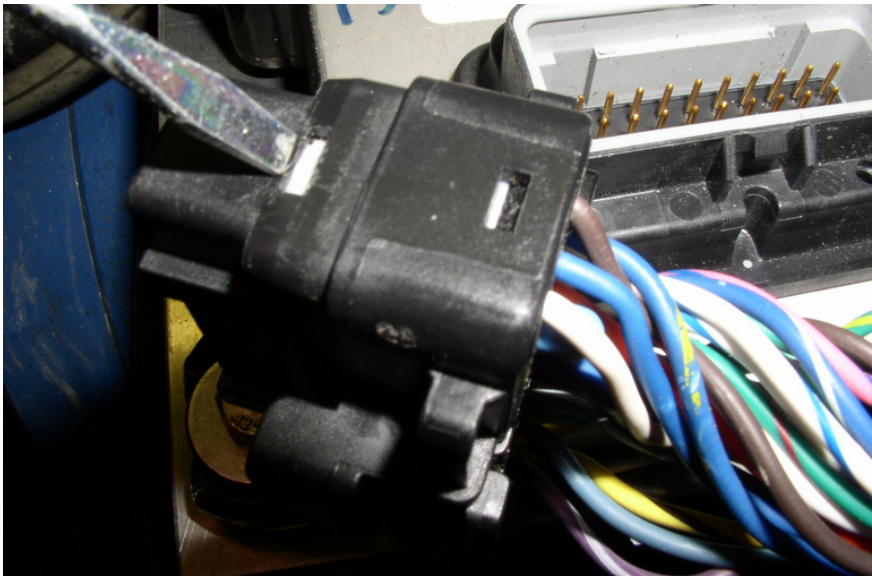


Figure 23

5) Before the signal wire/s can be relocated, they must be unlocked from the connector. On one end of the connector there is a white tab and on the other end is 2 white tabs. With a small screwdriver – push in on the single white tab as shown. You will feel it unlock as the dual white tabs on the other end protrude out. Now the terminals are unlocked. See Figure 24.

**Figure 24**

6) At this point it is important to handle the connector and wires gently to avoid damage or having a wire pull partially out without realizing it. Locate the wire in A13 (it will be the same color as the wire in your driver O2 sensor connector). **With great care, pull the wire STRAIGHT out of the connector.** Do not jerk the wire or it may pull out of the terminal, leaving the terminal stuck in the connector. A good method is to install some soft rubber onto the jaws of a needle-nosed pliers and grasp the wire close to the connector to aid in pulling the wire & terminal straight out. With the soft-jawed pliers you must use extreme caution not to squeeze too hard and crush the delicate wire. For installers who do the conversion often, a special pin removal tool is available to make the task easier.

7) Relocate the loose wire/terminal from A13 to the A7 position. Push the wire all of the way in. You should feel it seat into position. To be sure, check the underside of the connector and note if the shiny terminal in A7 is fully seated. Install a blue plug into A13 to seal the connector.

8) If 2 sensors are used, a second wire must be moved. Using the same procedure, pull the wire/terminal from A2 and insert it into A10. Install a blue plug in A2 to seal the connector.

9) Check the underside of the connector to be sure ALL wires are still fully seated. While gently squeezing the wires into the connector to keep the wires seated; use the side of a screwdriver to push in on the dual white lock tabs on the side of the connector. When the lock is snapped into place – recheck the underside to insure all terminals have been captured fully seated. See Figure 25.

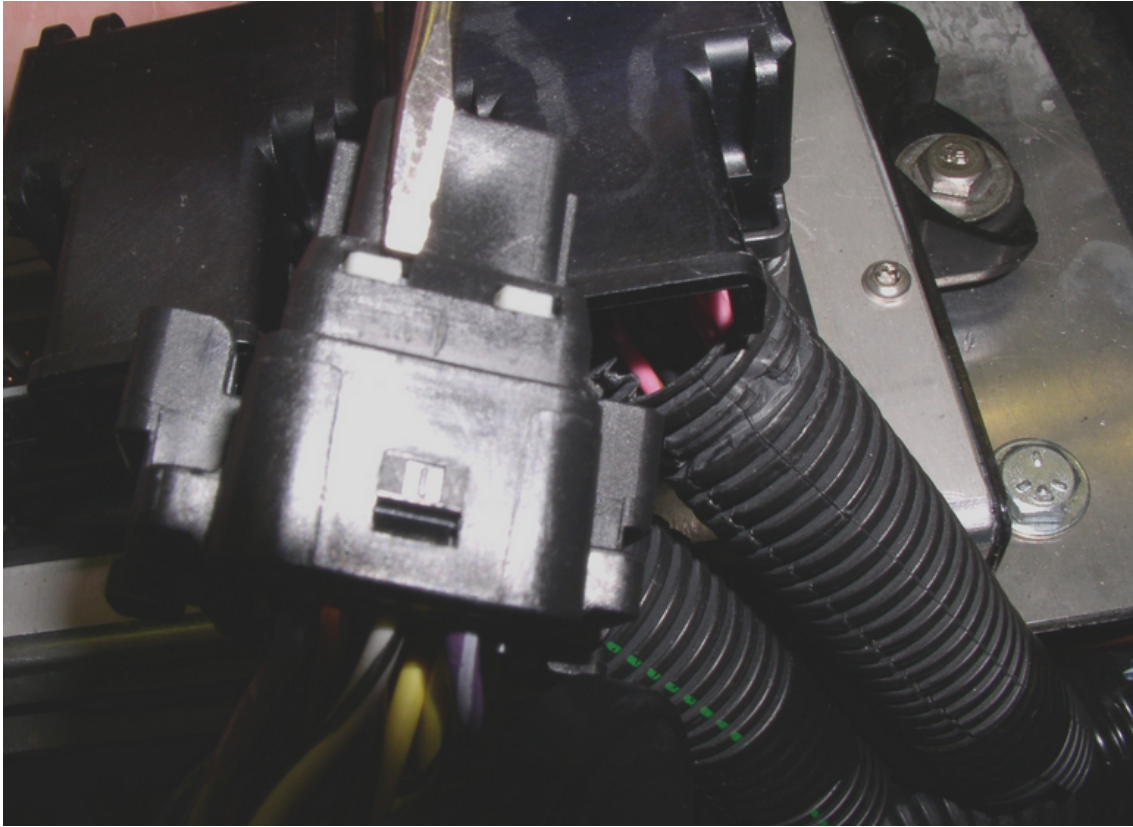


Figure 25

Plug the connector/s back into the PCM. Reinstall the connector cover and re-strap the harness bundle to the cover.

To return to the switching style sensor, reverse the procedure to put the wires in their original location. Check the wiring schematics for guidance if needed.

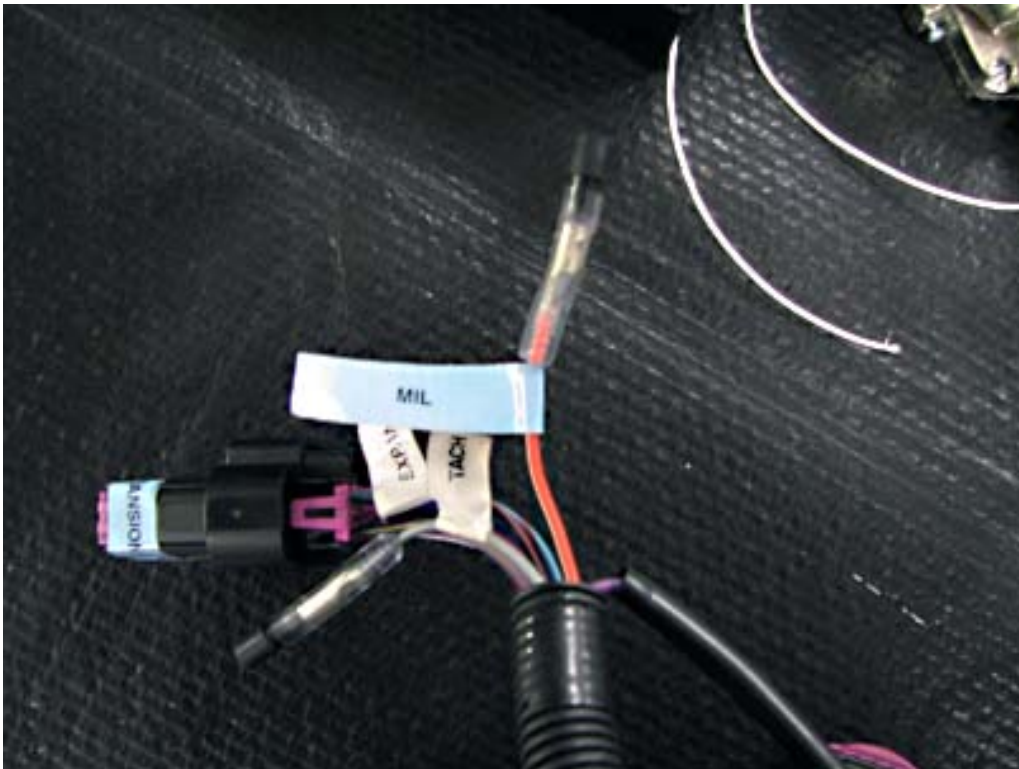
3.2.3.12 Malfunction Indicator Light



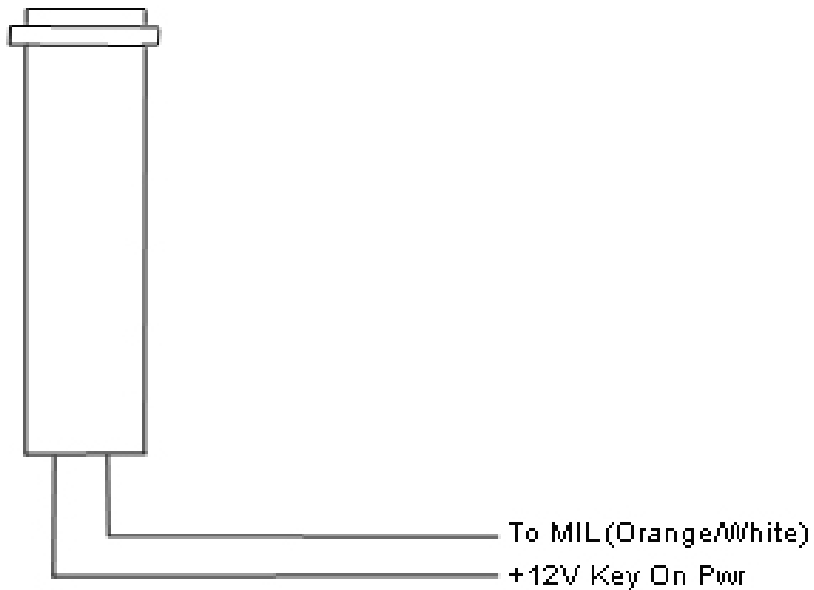
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Malfunction Indicator Light Installation

To mount the Malfunction Indicator Light (MIL), drill a 5/16" hole in a suitable panel. Insert the MIL into the hole with the orange light facing toward you. Locate the MIL circuit in the engine harness. It is near the expansion connector. See picture below.



Connect one wire of the MIL to the orange/white wire labeled "MIL" in the harness. Connect the other MIL wire to a key-on 12V power source. Polarity does not matter. See diagram below.

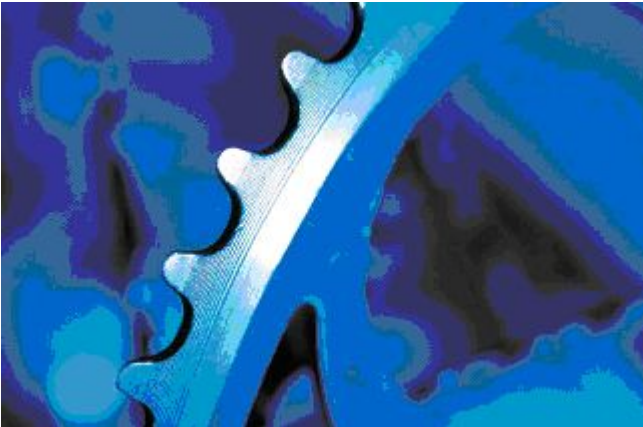


3.3 Installing and Configuring the Software



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Installing and Configuring the Software



Installation and configuration of the software is much like any other Windows based application. It uses Install Shield and will prompt you for choices during the installation. In most cases choosing the "NEXT" button will give you the recommended default values.

3.3.1 System Requirements



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System Requirements

Listed below are minimum requirements for the software, hardware and operating system for the Pro Tuner Laptop installed software:

Hardware:

1. Pentium Processor 500 MHz or better
 2. One Serial Port and one USB port
- OR**
3. Two USB ports (using the optional USB to Serial Adapter)
 4. 128 Mb or more of memory (RAM)
 5. 250 Mb of free disk space

Operating System:

1. Microsoft Windows 2000 with all Microsoft updates and patches applied
- OR**
2. Microsoft Windows 2000 Professional with all Microsoft updates and patches applied
- OR**
3. Microsoft Windows XP Home Edition with all Microsoft updates and patches applied
- OR**
4. Microsoft Windows XP Professional Edition with all Microsoft updates and patches applied

IT IS HIGHLY RECOMMENDED THAT YOU OBTAIN/USE A LAPTOP WITH THE NEWEST POSSIBLE MICROSOFT OPERATING SYSTEM AND THE FASTEST PROCESSOR SPEED WITH AS MUCH RAM AS POSSIBLE. THE PERFORMANCE OF YOUR PRO-TUNER SOFTWARE WILL BE MUCH IMPROVED WITH A HIGH PERFORMANCE PC; IN ADDITION, MICROSOFT DISCONTINUES SUPPORT OF THE OLDER OPERATING SYSTEMS - WHICH MAY CAUSE SOFTWARE RELATED PROBLEMS WITH THE PRO-TUNER INTERFACE. LATER MICROSOFT

OPERATING SYSTEMS ALSO HAVE IMPROVED HANDLING OF PERIPHERALS, USB PORTS, AND BETTER STABILITY THAN WIN98SE SYSTEMS.

3.3.2 Installing the Software



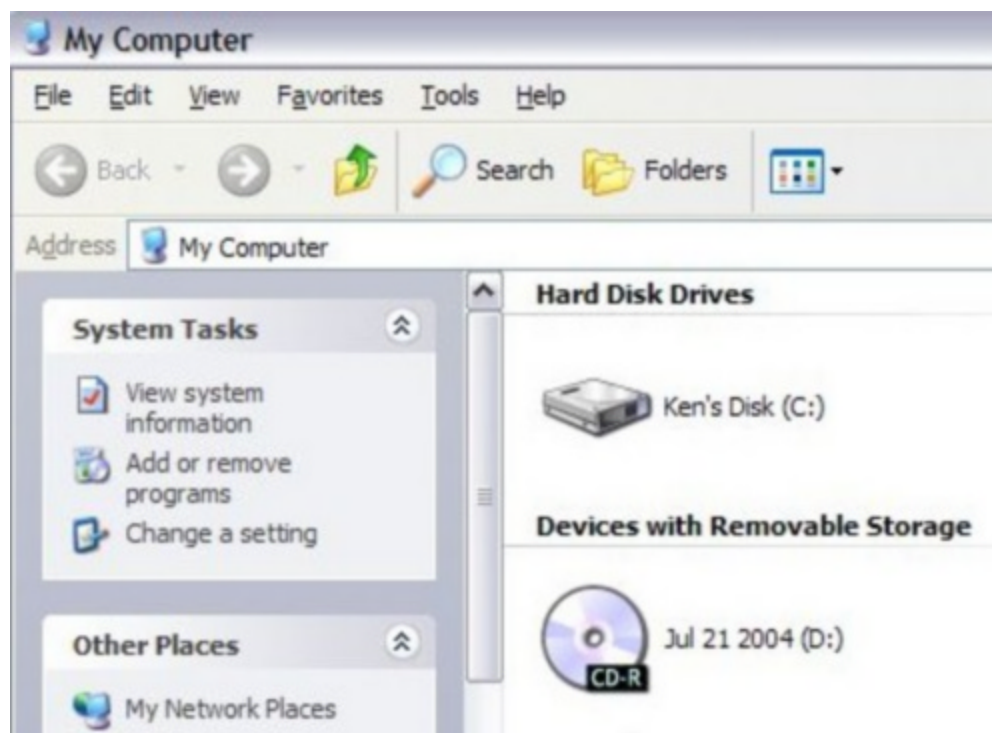
Visit us at: <http://www.edelbrock.com>

Installing the Software

Software installation steps:

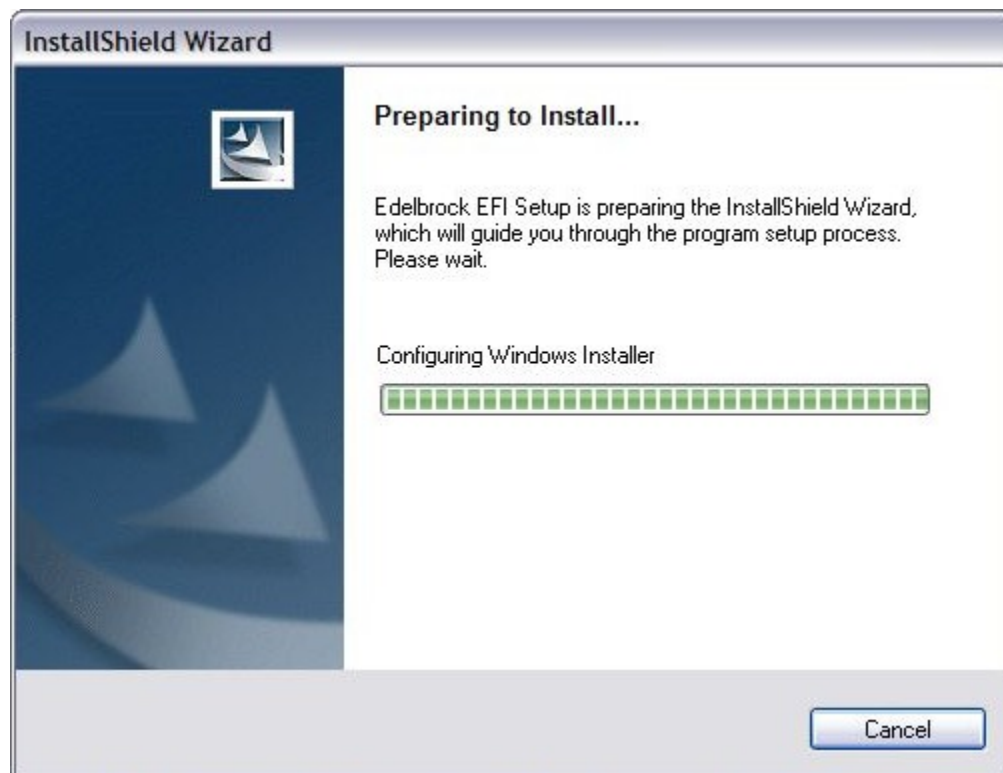
1. Insert the CD in the CD drive
2. The installer should Auto Play. Once you see the installer welcome screen, go to step 3. Some virus protection programs do not allow Auto Play, so if that is the case:

1. Double click on "**My Computer**"
2. Double click on the **CD ROM drive icon**



3. Double click on the **EDELEFI_2_3_4_X.msi** file on the CD ROM (*the numbers may be different, depending on version and build*)

3. You will see installer start and prepare your computer for installation:



4. Once the computer is ready, the installation will start:



5. Click **NEXT >**

- The license agreement is displayed. **CAREFULLY READ THIS AGREEMENT. IT WILL EXPLAIN YOUR RIGHTS AND LIABILITIES IN THE USE OF THIS PRODUCT!**



- Click **NEXT >** once you have read and understand the license agreement
- Choose the folder in which you want the Edelbrock Victor Pro Tuner software installed.

IT IS HIGHLY RECOMMENDED YOU ACCEPT THE DEFAULT LOCATION PRESENTED IN THE INSTALLER.

To accept the default, just click **NEXT >**



9. The installer will now ask one more time to confirm the installation process. This will allow you to cancel the installation if you wish:

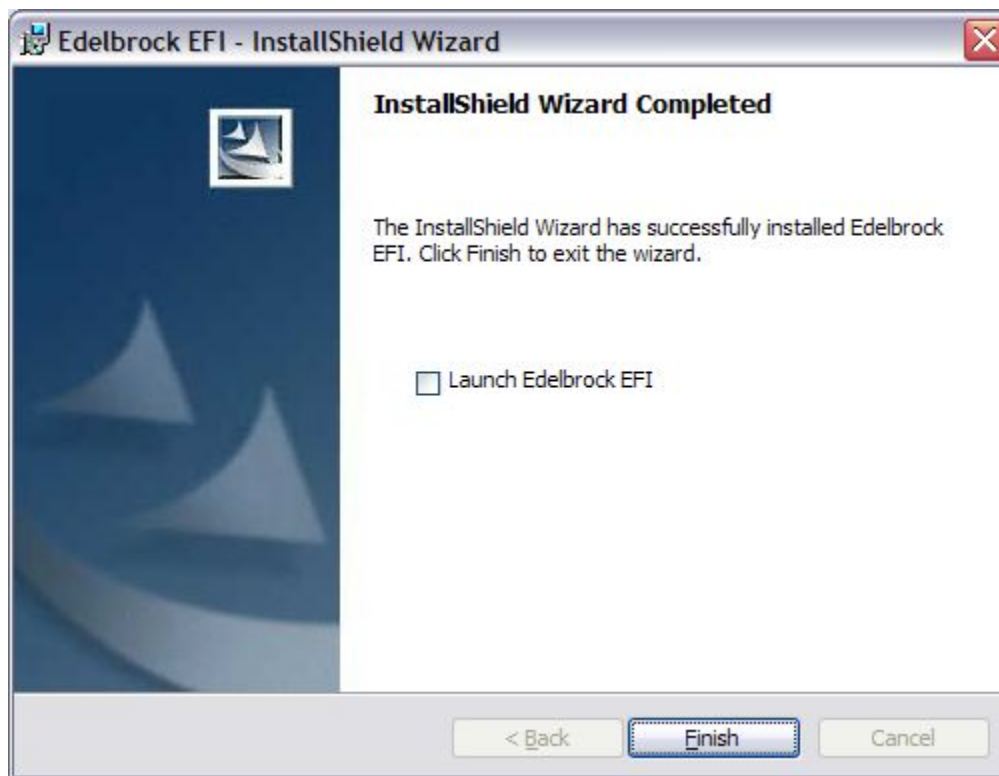


10 To proceed, click "**Install**"

11 The installer will proceed to install the necessary files on your computer ... the status will be displayed during the install:



12 Once the install is completed, click the **FINISH** button and you are ready to use your new software!



3.3.3 Installing the Communications Hardware



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Connecting the Laptop to the Vehicle

Inventory:

1. Laptop running Windows 2000 or newer OS with at least 128 Mb of memory and a 500 MHz processor. The computer speed and memory will greatly affect the performance of the application. Run the latest Microsoft Operating System and most powerful PC possible to avoid windows related issues such as USB port driver problems.
2. Computer Connection cable



3. USB Key (or "dongle") The key will be either a "Base" system key or a "Pro" level key. The key is required for the software to connect to the ECU.



Connection:

Before hooking up the laptop, be sure the following conditions are met:

2. The laptop is booted and ready
3. The USB Key is plugged into an available USB slot on the computer



3. The Computer Connection cable is plugged into the Interface connector on the harness



4. The Computer Connection cable is plugged into the PC's serial port



5. The ignition key is in the **ON** position

Once everything is hooked up to the PC and the harness, look for an LED light (steady) on the gray colored interface module (part of the Computer Connection cable). This indicates a powered connection and the PC is ready to communicate. As the computer communicates to the vehicle ECU, a few cables may have additional **red** and **green** LEDs that will blink. This indicates data is flowing back and forth between the PC and the ECU.

Note: Avoid repeated unplugging or disconnect of the USB adapter or serial cable. Microsoft windows will occasionally not reconnect properly. If you have trouble reconnecting after plugging in hardware, or after hibernation. Rebooting the machine will usually clear it up.

3.3.3.1 USB/Serial Converters



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USB to Serial Converters

Some laptops may not have a serial port (pictured below)



Serial Port

However, you can use one of the PC's USB ports and a USB/Serial Adapter (not included) that is readily available from many sources, including local consumer electronics stores.



USB Ports



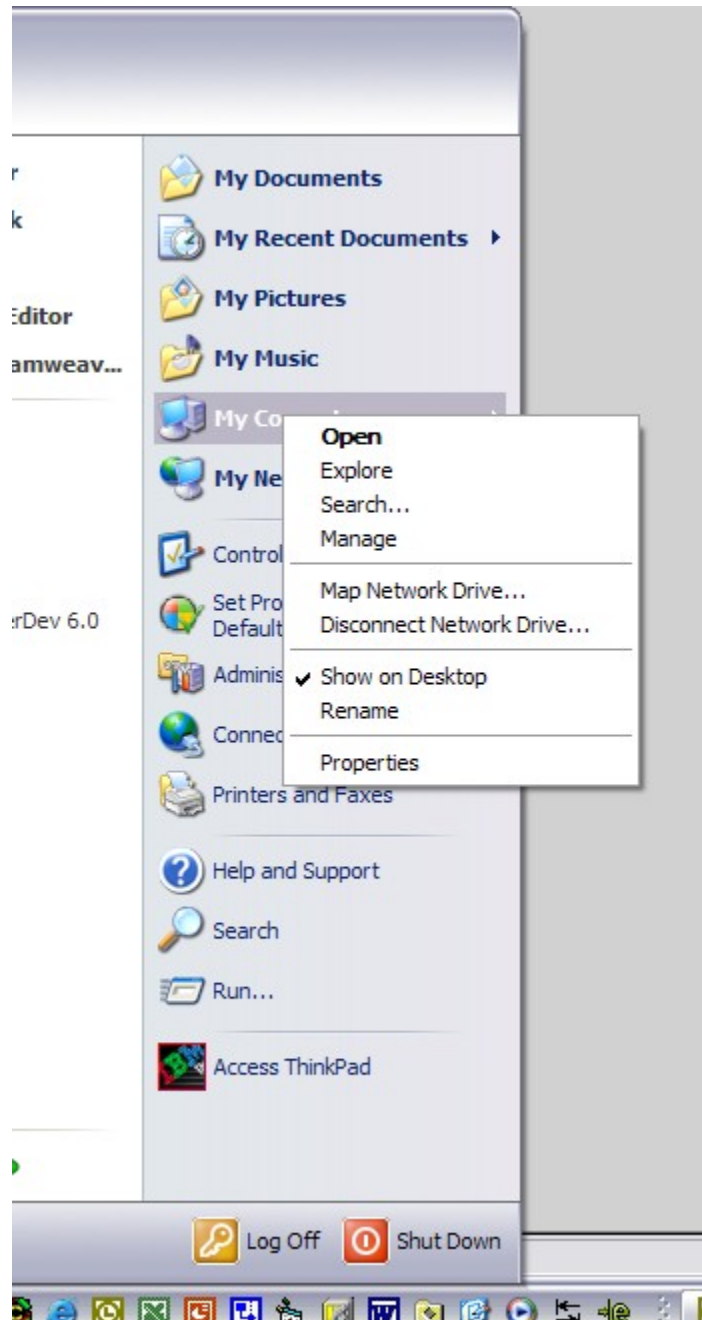
Typical USB/Serial Adapter

Follow the Serial/USB Adapter manufacturer's instructions to install and configure the device for your PC. Once the software has been successfully installed, **and the device is**

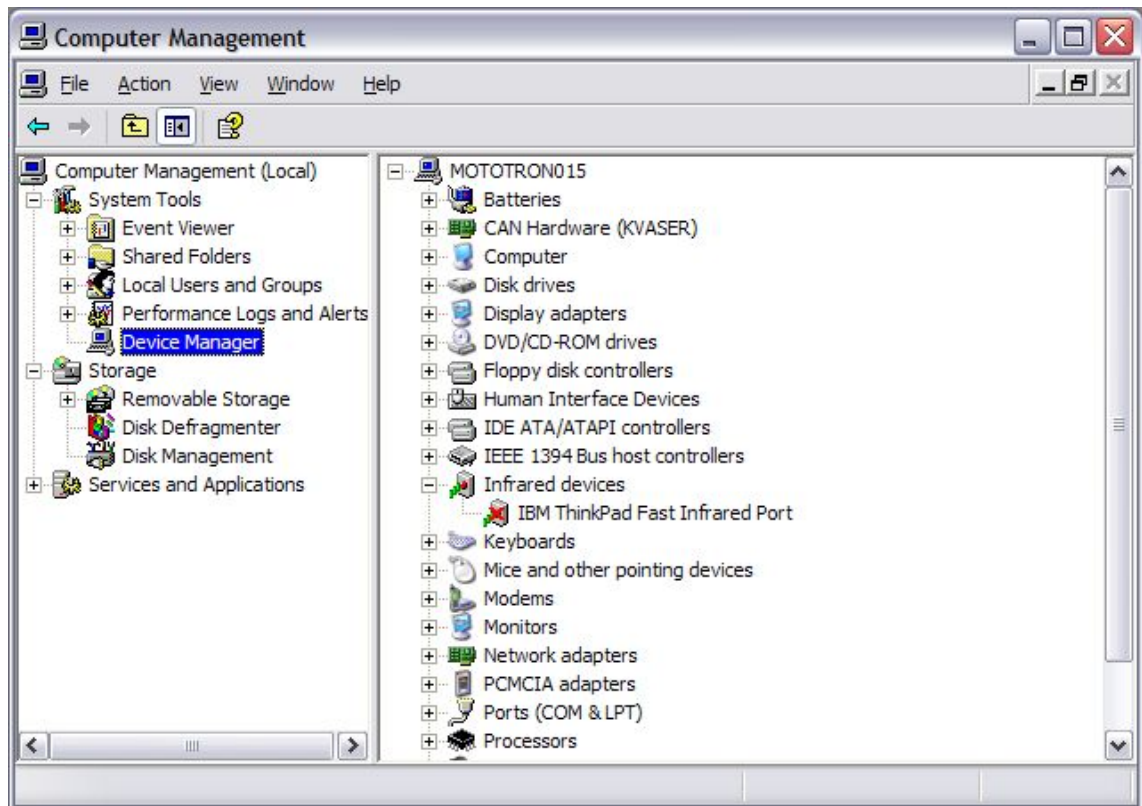
plugged in, if you run the Edelbrock Pro Tuner software installation for the first time, the connection wizard will automatically detect and configure to use the appropriate device.

If you already have the Pro Tuner software installed, you can manually add the new device to the list of communication ports for Pro Tuner by performing the following:

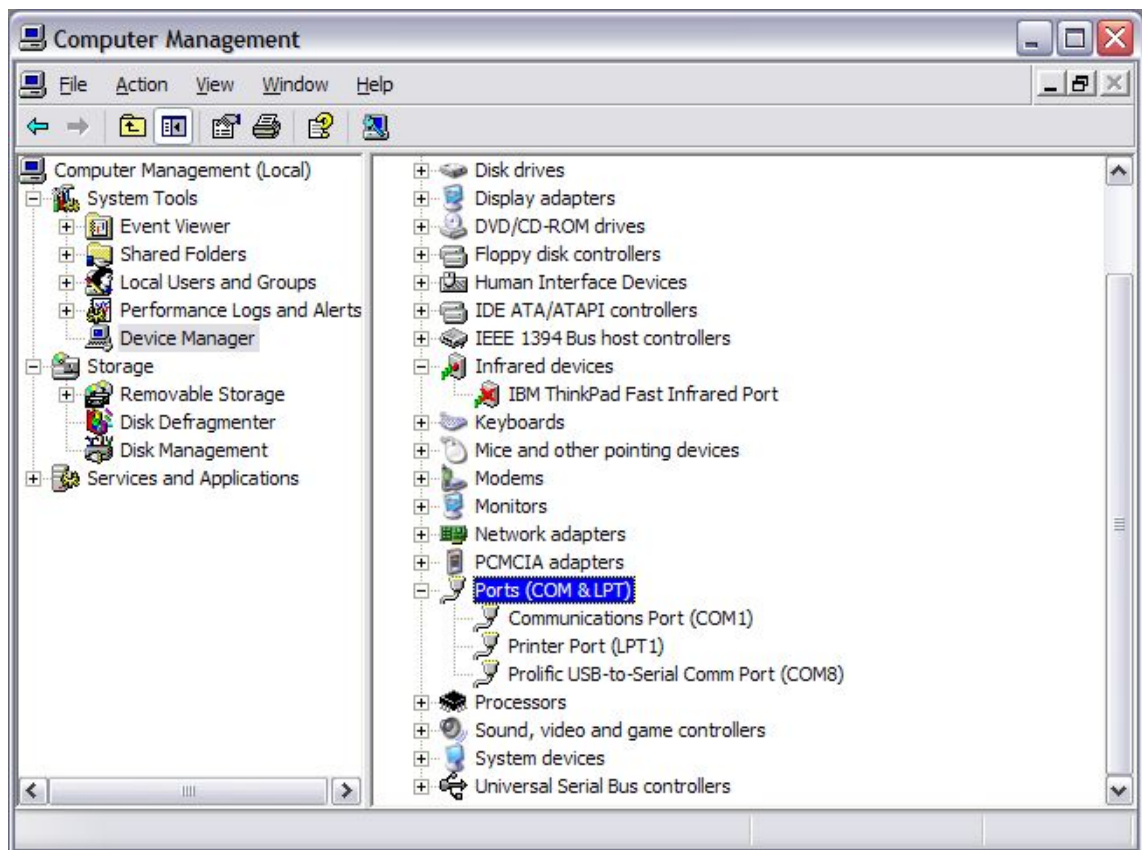
1. First, we need to know which port was configured by the adapter manufacturer for use with that particular device. This is a function of Microsoft Windows, so we will first RIGHT CLICK on "**My Computer**" and then choose "**MANAGE**".



2. Now choose "**DEVICE MANAGER**" to get a list of the installed and active devices for your PC.



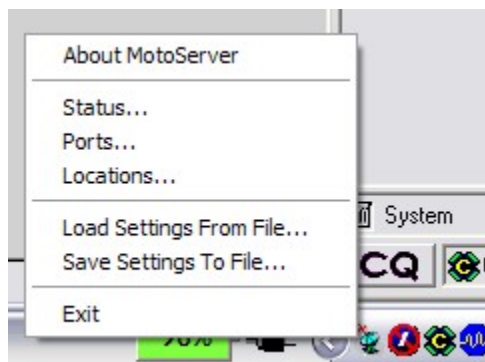
3. Click on the "**PORTS**" Icon to expand the list of communications ports. You should see your USB to Serial Adapter in the list of ports. Often times, it will be assigned to **COM4** if you don't have a lot of other devices attached to your PC. In this example, we see the "**Prolific USB-to-Serial Com Port**" on **COM8**.



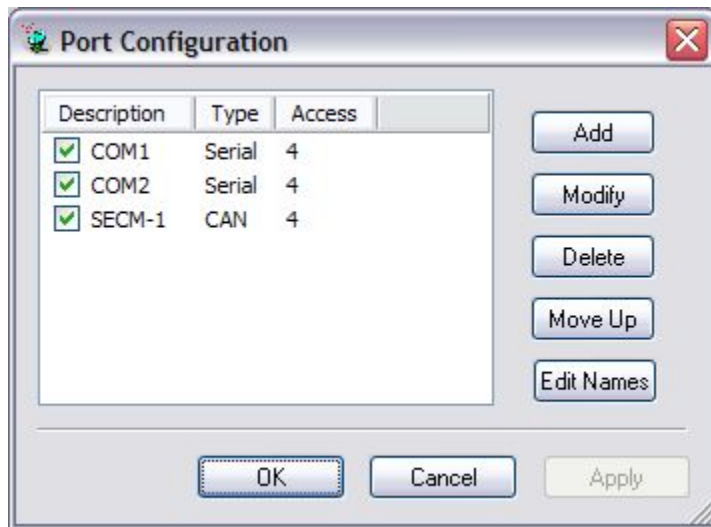
4. Make a note of the COM port assignment and close the Computer Management window.
5. Now, **RIGHT** click on the MotoServer icon (the satellite dish) in the System Tray (lower right hand corner of your screen)



6. A menu will appear for MotoServer. Choose "**Ports...**"



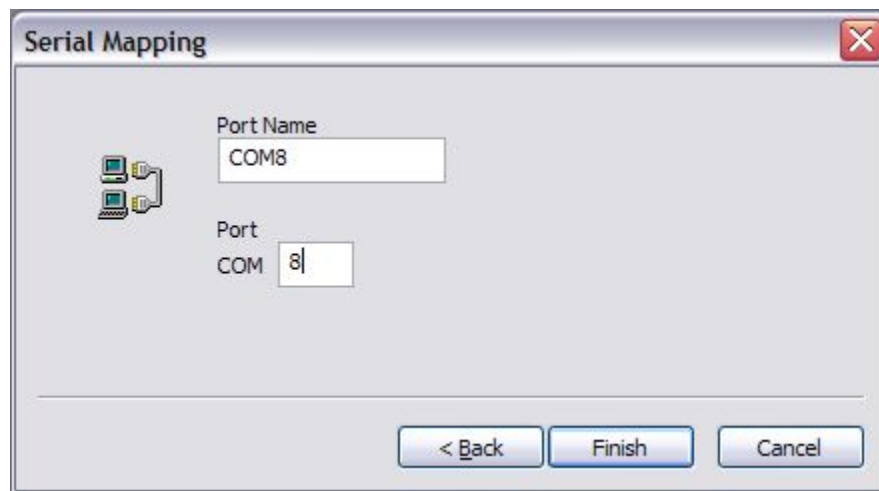
7. A list of the configured ports will appear. To add the port that the USB/Serial Adapter manufacturer's software configured, click on "**Edit Names**".



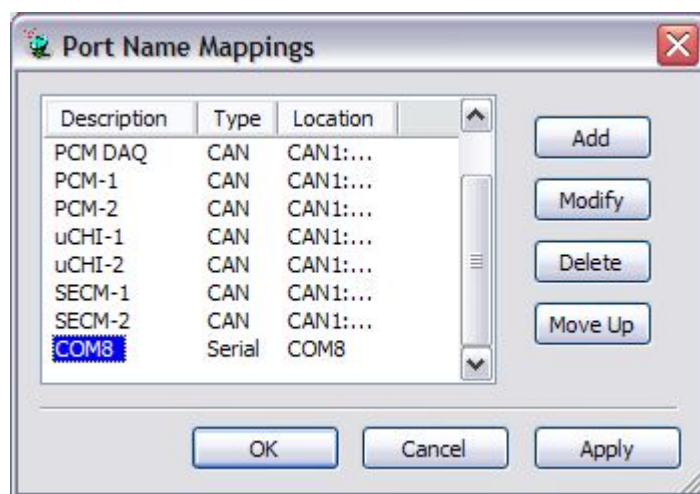
- When you click "**Edit Names**", you will be presented a choice of pre configured ports. If the COM port you need is in the list, simply select that port and then click "OK". If it does not exist, click "**Add**" to add your new port.
- When you click "**Add**", you will be asked what kind of port is to be added. Select "**Serial**" and then click "**Next**".



- Type your new COM port name and number in the space provided. In this example, we will call the port "**COM8**" and put "**8**" in the Port text box, since that's what we noted earlier in the **Device Manager**.

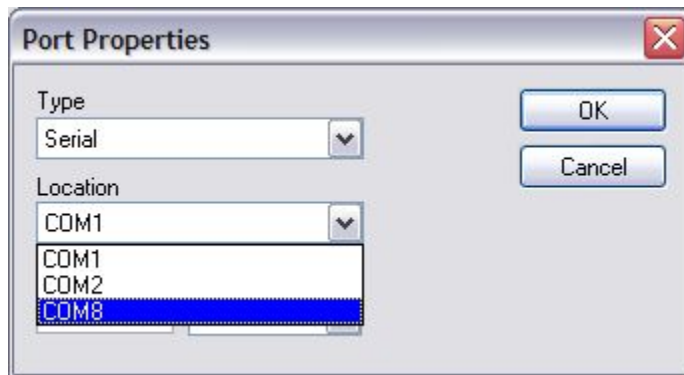


11 The new port name then appears in the Port Name listing.

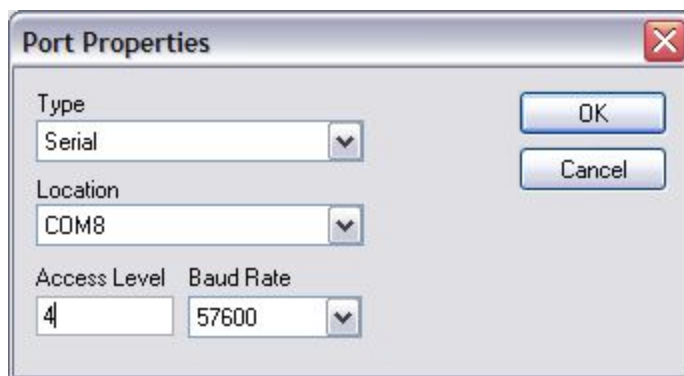


Make sure the new port is selected and then choose "**OK**" (or "**Apply**" if you have more ports to add).

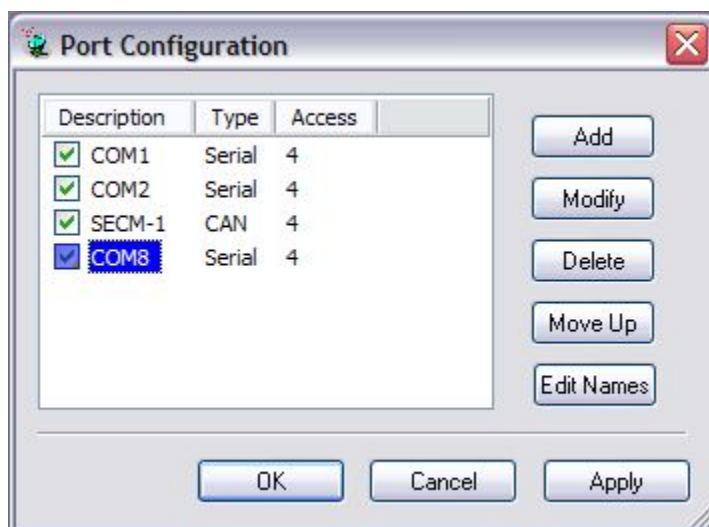
12 You will now be back at the Port Configuration window. Choose "**Add**" and then select the Type and Location with the drop down lists.



Be sure the Access Level is set to "4".



13 Click **"OK"** and you will see the new Port Added to the Ports List.



14 From now on, the Pro Tuner system will check to see if communications cable is plugged into any of the devices listed in the Ports Configuration List every time you start the program. You can add a large number of pre configured ports as necessary to support your needs.

15 Click "**OK**" to complete the set up.

.

3.3.4 Connecting to the Vehicle



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Connecting to the Vehicle

Once you have successfully installed and configured your software and communications cables, you are now ready to start communicating with the Vehicle ECU.

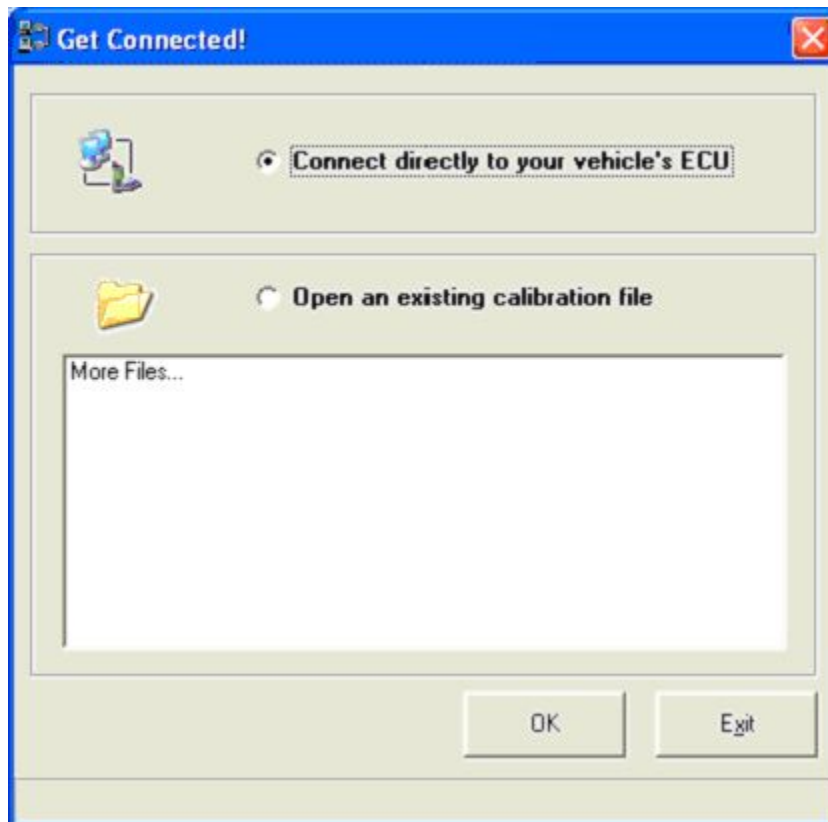
Steps:

1. Start the Edelbrock EFI Application by double clicking on the Icon on your desktop:



Edelbrock EFI

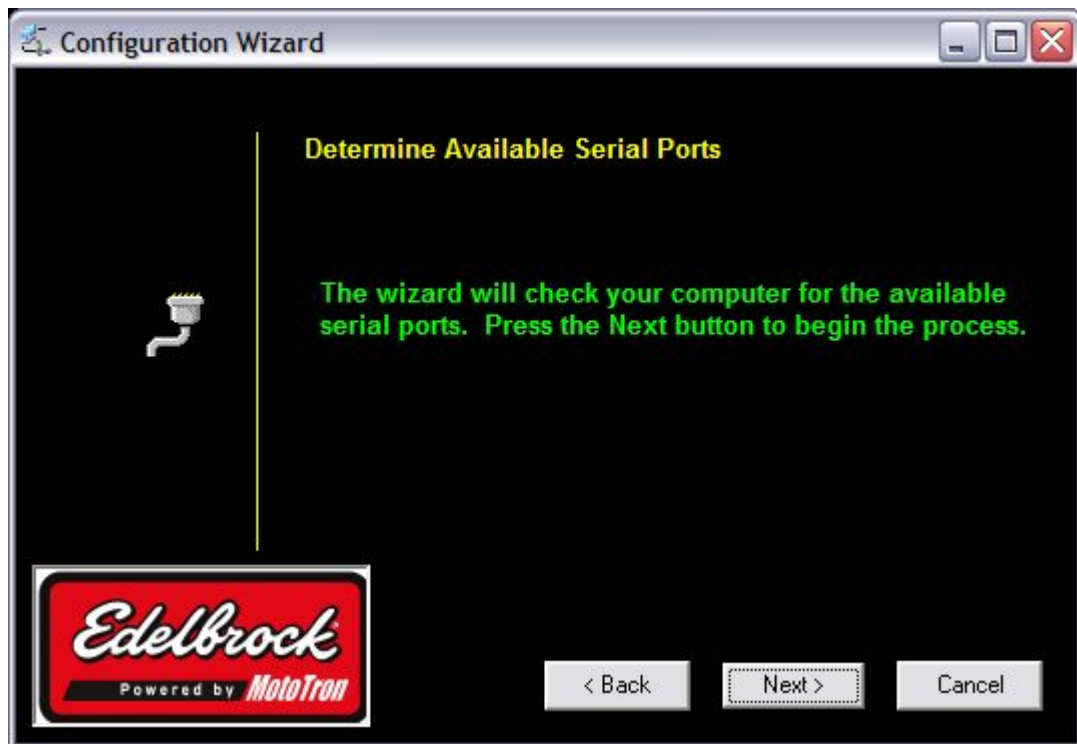
2. The application will start up and when it loads completely you will have a dialog that looks like:



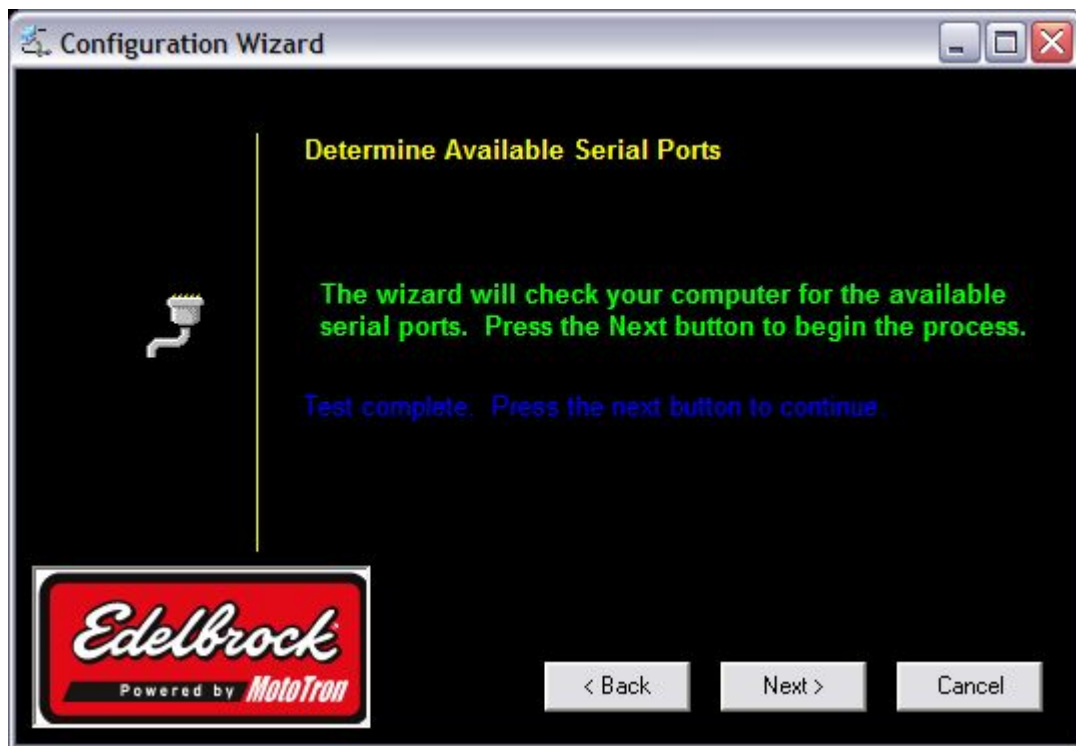
- Be sure the ignition key is in the ON position and your USB key is installed in an available USB port on your laptop.** To connect directly to the ECU, click on **"Connect directly to your Vehicle's ECU"** and then click on **"OK"**. To go into **OFFLINE** mode click **"Open an existing calibration"** file and the *OFFLINE Control Panel* will be displayed. More information about **OFFLINE** can be found later on in the **HELP** in the **OFFLINE mode** help section.
3. If this is your first time connecting to the ECU, you will be led through several steps that determine the correct port for your software to communicate with on your computer.



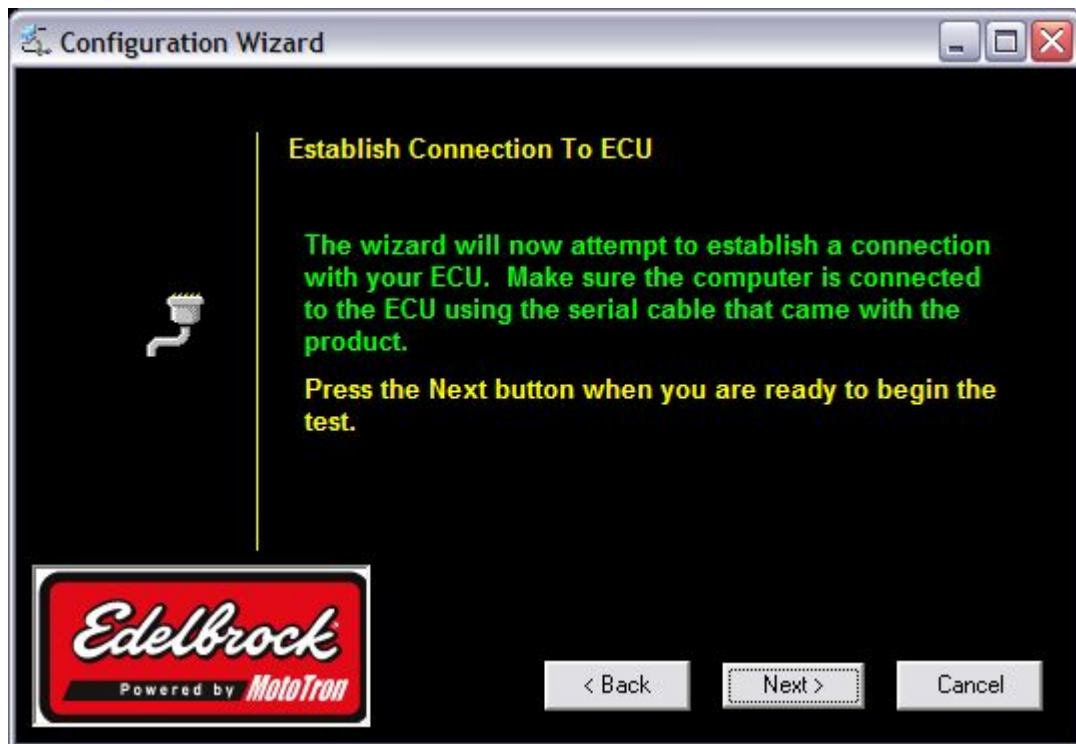
Click **NEXT**



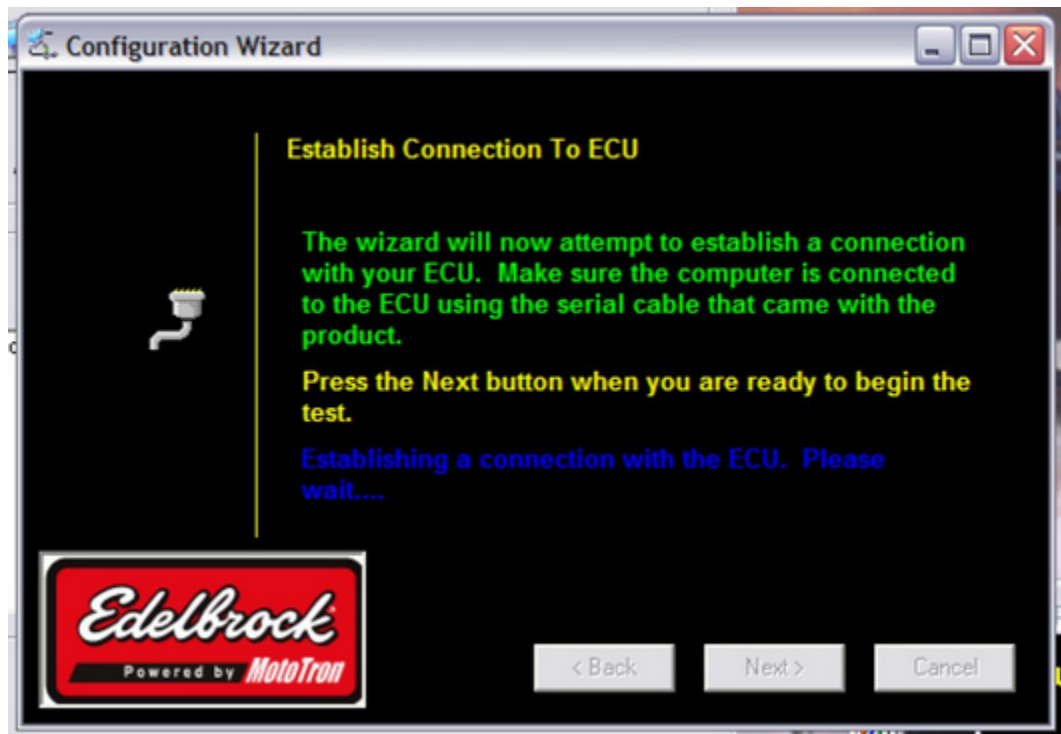
Click **NEXT**



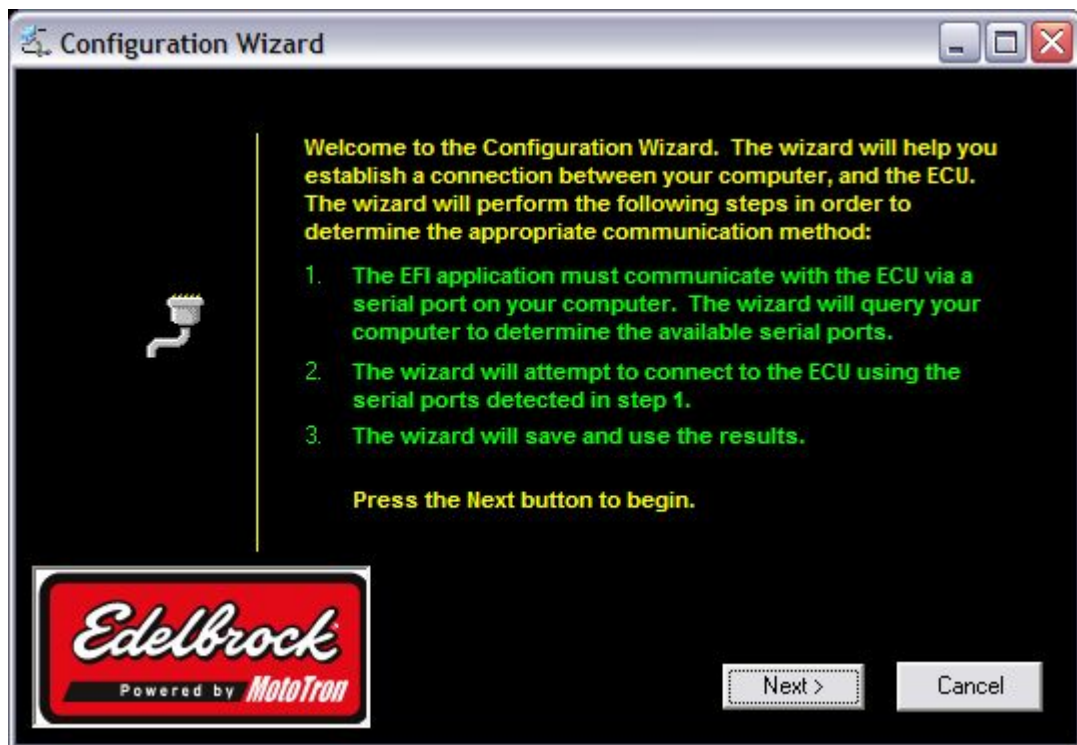
The computer has now found the proper port. Click **NEXT**.



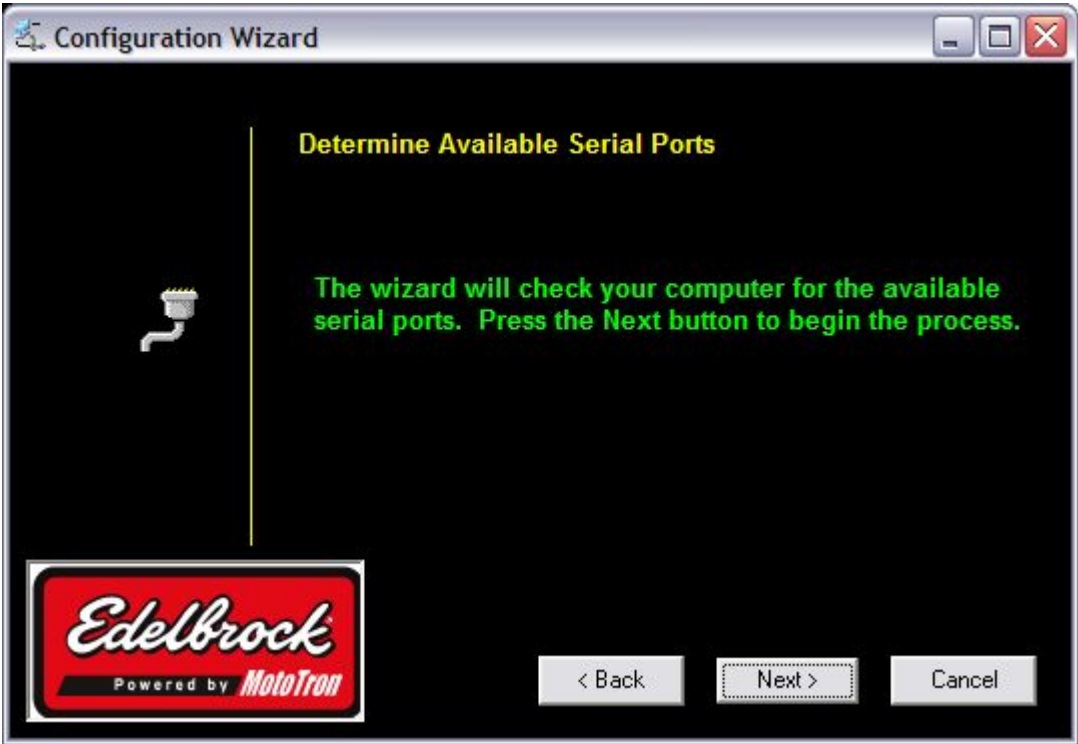
The computer is now ready to attempt to "talk" to the ECU. Click **NEXT**.



Once a connection is established successfully, click **NEXT**.



Click **NEXT** to get the final results dialog.



Click **FINISH**.

4. The software will now connect to the ECU and bring up the **DASHBOARD** screen:



3.3.5 Application Settings and Preferences

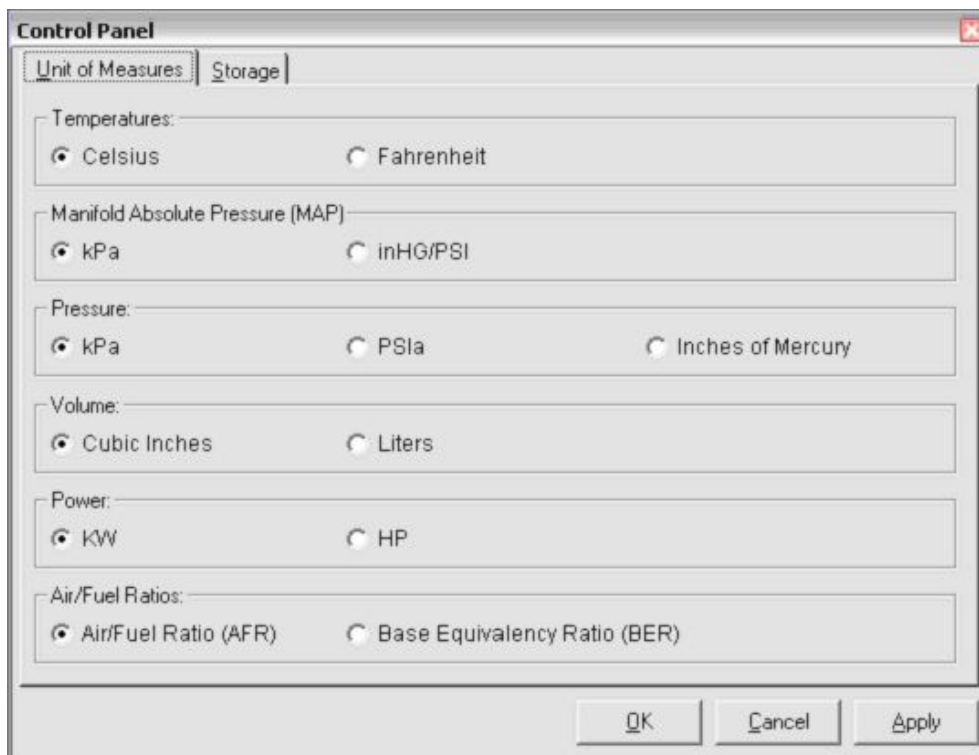


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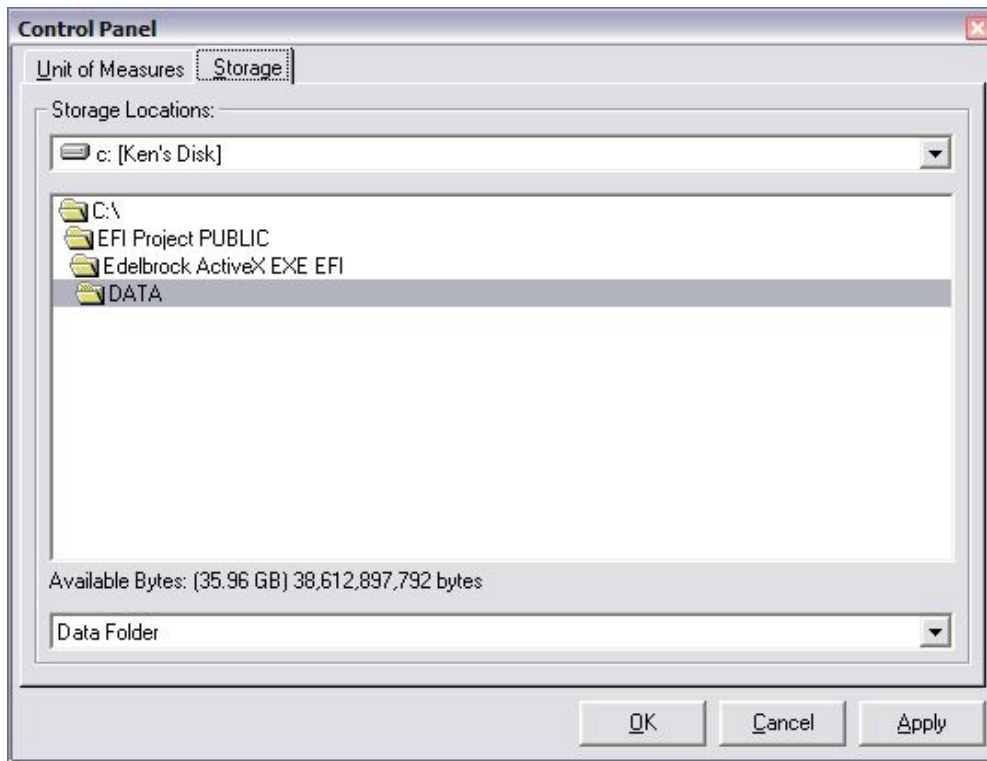
Application Settings and Preferences

Use this control panel to customize the application settings to your preferences. This control panel allows you to choose preferred units and default paths for files on your computer.

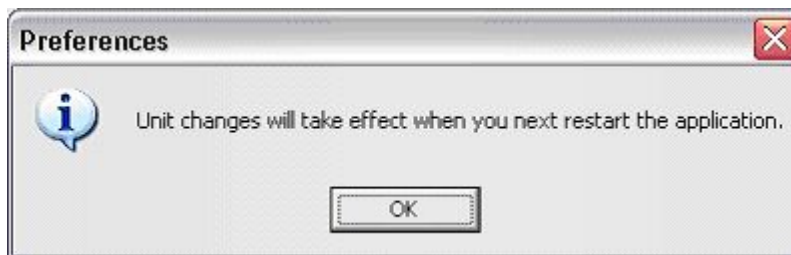
To choose your desired units, go to "**TOOLS**" menu and choose "**Application Settings**". You will see the following Control Panel:



Choose your desired units of measure for each category (Temperature, MAP, Pressure (such as oil pressure, fuel pressure, etc.), Volume, and A/F ratio). Once you have chosen your desired units, you can also set your Storage preferences or apply your choices by choosing either the Apply button (which will simply apply the changes) or the OK button (which will apply the changes and close the control panel). If you choose to change Storage Settings, click on the "Storage" tab and you will then see:



Navigate to the desired storage location for calibration files and click "Apply" or "OK". You will then be advised with the following:



Close all application windows and then restart the application. This will apply your new choices to the gauges, tables, MAP's and controls.

4 Basic Tuning with the Pro Tuner System



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Basic Tuning with the Pro Tuner System

The Pro Tuner System is extremely powerful; however, a significant effort has been made to simplify the way information is presented to you to allow you to concentrate on the reason you bought the system - mainly reliability, horsepower, and drivability.

It is very important that you understand the basic principles of the system so that you can effectively use the PC software to configure and run your combination.

4.1 Setup Wizard

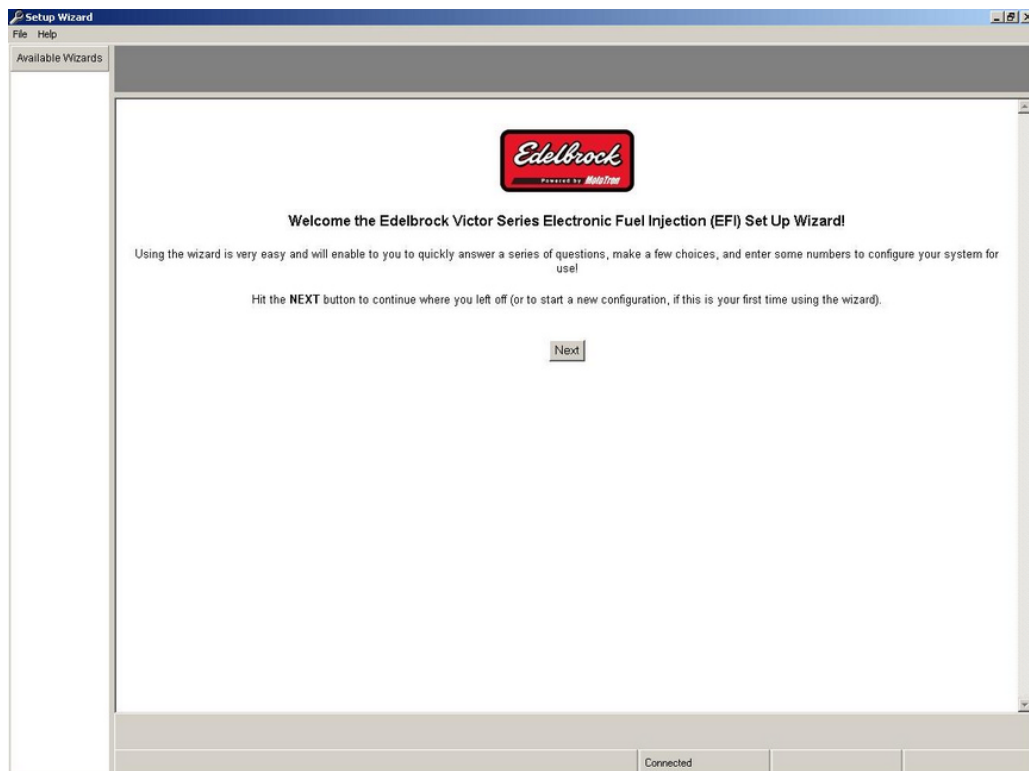


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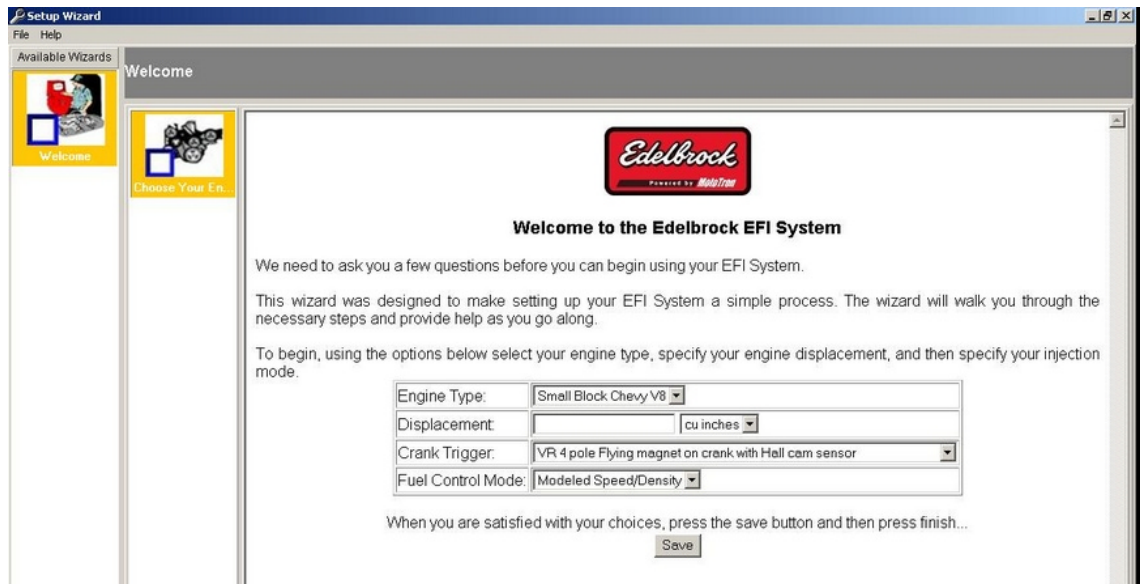
Initial Setup Wizard with Laptop Connected

The Setup Wizard functionality is used to make fundamental changes to your system configuration, such as new fuel injectors, different distributor or coil, new sensors, etc. It is also a good way to setup a "bare" system for first time use.

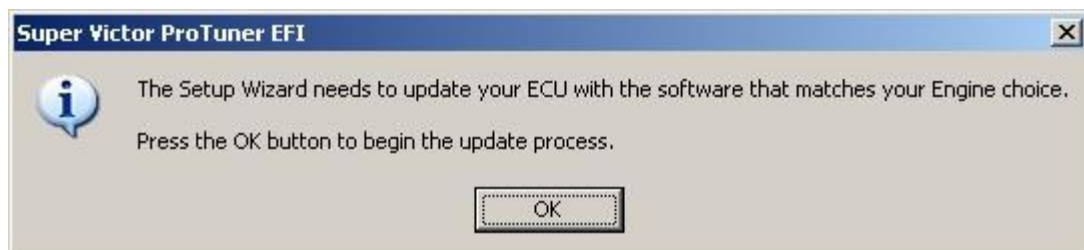
1. To start the wizard, go to TOOLS in the top menu of the main application.
2. Choose "**Setup Wizard**"
3. The wizard will start up and you will be asked to make various choices to set up your system. If this is NOT your first time into the wizard, it will go to the last thing you successfully executed (a BOOKMARK). At that point, you can go directly to the area that you need to make changes to without stepping through the rest of the wizard.
4. Assuming this is the first time through, you will first see this screen:



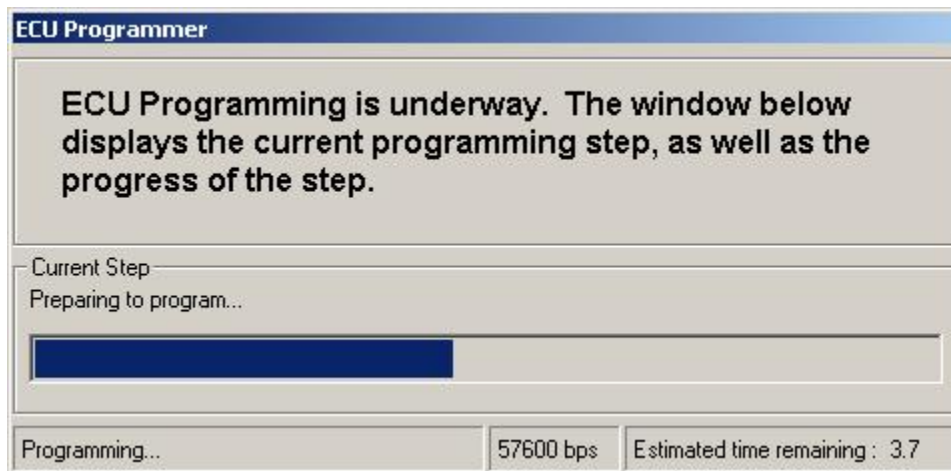
5. Click **NEXT** and watch the status bar at the bottom of the screen as it establishes a new connection to the ECU and configures it for programming.
6. The next screen will show you the Engine Setup wizard to help you configure your basic engine parameters:



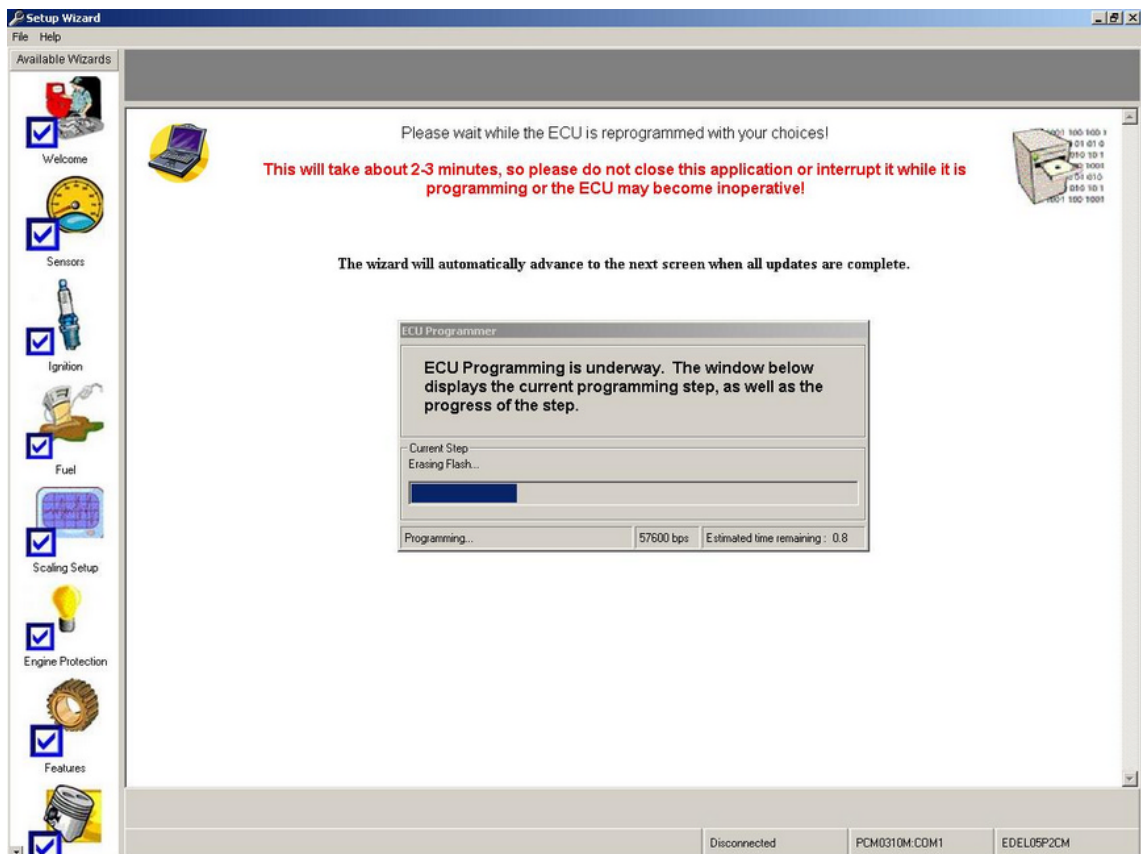
7. **Choose your basic engine type and then enter it's displacement in cubic inches (default) or liters (chosen via the drop down)**
8. **Choose the type of crank trigger you are using in your kit**
9. **Select your fueling control method:** Speed/Density or Alpha-N(Speed/Throttle). *Note: You may also choose MAP-N (Speed/Pressure), but you must select Alpha-N and the system will then program the ECU and give you the MAP-N option in the following screen. MAP-N uses similar lookup tables and trim tables as Alpha-N.*
- 10 **Click "SAVE" to commit your changes.**
- 11 **The "FINISH" button will then replace the "NEXT" button. Click "FINISH" if you are satisfied with your choices.**
- 12 **The ECU will now be reprogrammed with your "base" system setup. Please click OK to continue.**



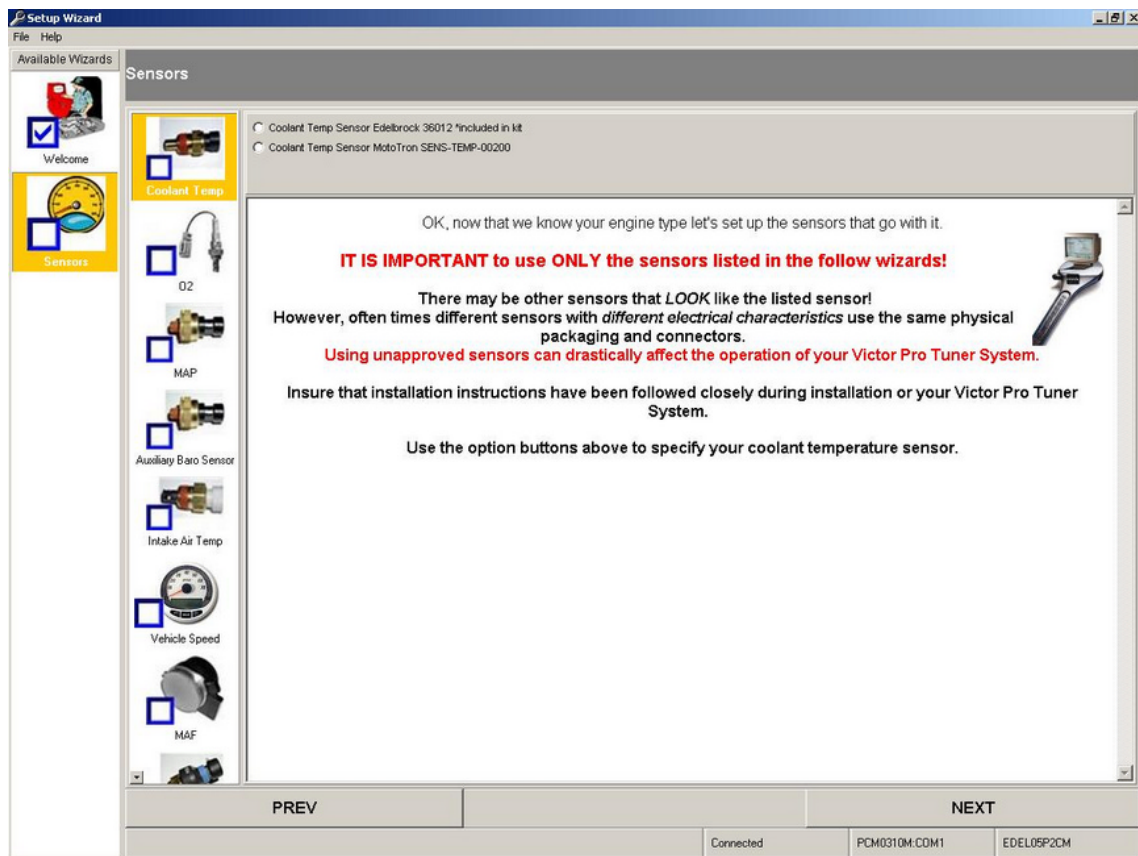
- 13 The wizard will prepare the ECU:



14 The wizard will then program the ECU. Please wait for it to finish completely:



15 When programming is completed, you will be presented with the next wizard section to configure/choose your sensors. The **WELCOME** section will show a **CHECK MARK** to show that it has been completed:



- 16 Continue to progress through the various section and choices, using the **NEXT** buttons and **FINISH** buttons (as they are presented) to configure your system.
- 17 Once you have finished all the sections, the wizard will save your changes/choices and reprogram the ECU a final time before exiting.

Note: Only for users who select the MAP-N tuning strategy from the Wizard setup: Once the Wizard programming steps are completed, you must load the supplied MAP-N file into your ECU. To do this, go to the file menu and select "Load Calibration from Disk". Navigate to the installed calibrations folder located at /Program Files/Edelbrock/EFI/ECUFiles/Cals. The MAP-N calibration file for the P/N 3670 Kit is identified as EDEL07E1EB_V004XDC_MAPN.hcal. The MAP-N calibration for the P/N 3690 Kit is identified as EDEL07P1EB_V004XDC_MAPN.hcal. Choose the appropriate calibration for your kit to load into the ECU.

4.1.1 Scaling Setup - Custom Load and RPM Axis

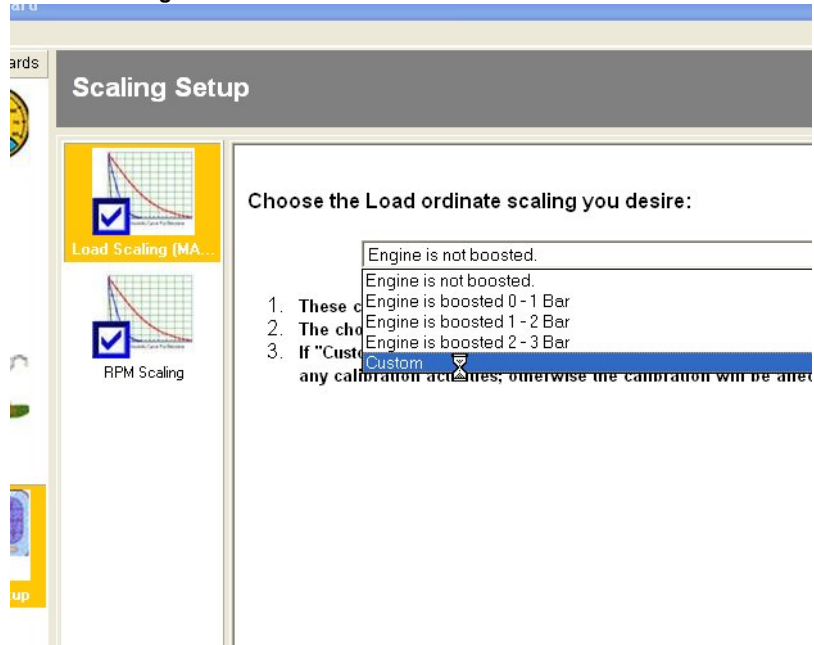


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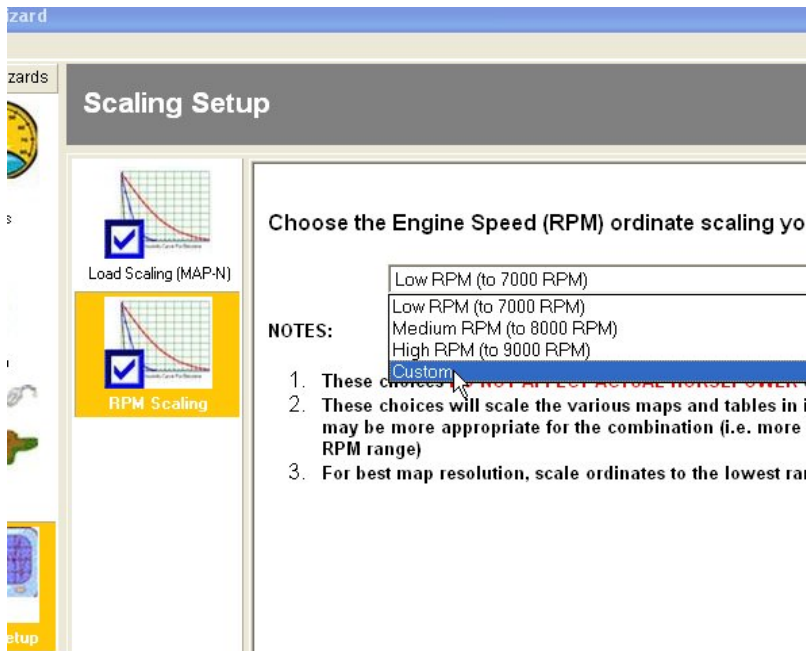
Scaling Setup - Custom Load and RPM Axis

If desired, the setup wizard can be used to define custom load and RPM axis. These 2-D tables define the breakpoints of any Pro-Tuner tables that vary as a function of engine load or speed. The breakpoints do not have to be linear or evenly spaced. You can define more closely spaced breakpoints at lower engines speeds and wider spaced ones at higher speeds where the engine will likely spend less time. To customize your load or RPM axis, begin by selecting "Custom" from the following menu selections in the wizard.

Custom Scaling selection for load ordinate:



Custom Scaling selection for RPM ordinate:



zard

zards

Scaling Setup

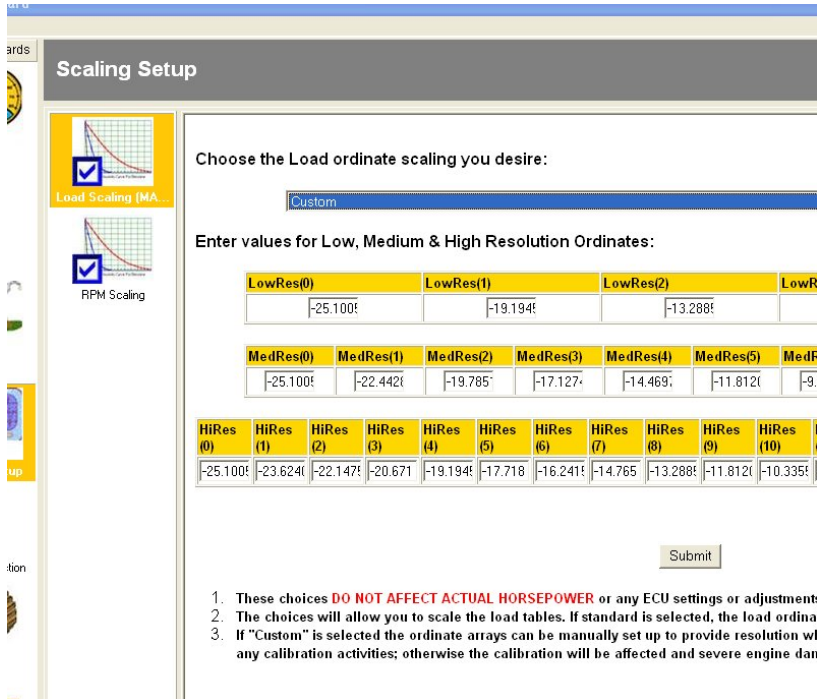
Choose the Engine Speed (RPM) ordinate scaling you desire:

Low RPM (to 7000 RPM)
 Low RPM (to 7000 RPM)
 Medium RPM (to 8000 RPM)
 High RPM (to 9000 RPM)
 Custom

NOTES:

1. These choices **DO NOT AFFECT ACTUAL HORSEPOWER**...
2. These choices will scale the various maps and tables in i... may be more appropriate for the combination (i.e. more RPM range)
3. For best map resolution, scale ordinates to the lowest ra...

Custom tables for load ordinate:



zards

Scaling Setup

Choose the Load ordinate scaling you desire:

Custom

Enter values for Low, Medium & High Resolution Ordinates:

LowRes(0)	LowRes(1)	LowRes(2)	LowRes(3)
-25.100%	-19.194%	-13.288%	-9.383%

MedRes(0)	MedRes(1)	MedRes(2)	MedRes(3)	MedRes(4)	MedRes(5)	MedRes(6)
-25.100%	-22.442%	-19.785%	-17.127%	-14.469%	-11.812%	-9.154%


HiRes (0)	HiRes (1)	HiRes (2)	HiRes (3)	HiRes (4)	HiRes (5)	HiRes (6)	HiRes (7)	HiRes (8)	HiRes (9)	HiRes (10)
-25.100%	-23.624%	-22.147%	-20.671%	-19.194%	-17.718%	-16.241%	-14.765%	-13.288%	-11.812%	-10.335%


Submit

1. These choices **DO NOT AFFECT ACTUAL HORSEPOWER** or any ECU settings or adjustments
2. The choices will allow you to scale the load tables. If standard is selected, the load ordinate...
3. If "Custom" is selected the ordinate arrays can be manually set up to provide resolution wh... any calibration activities; otherwise the calibration will be affected and severe engine da...

Custom tables for RPM ordinate:

Scaling Setup


 Load Scaling (MAP-N)


 RPM Scaling

Choose the Engine Speed (RPM) ordinate scaling you desire:

Custom

Enter values for Low, Medium & High Resolution Ordinates:

LowRes(0)			LowRes(1)			LowRes(2)		
500			1500			3500		

MedRes(0)	MedRes(1)	MedRes(2)	MedRes(3)	MedRes(4)	MedRes(5)
500	1500	2000	2500	3000	3500

HiRes (0)	HiRes (1)	HiRes (2)	HiRes (3)	HiRes (4)	HiRes (5)	HiRes (6)	HiRes (7)	HiRes (8)	HiRes (9)	HiRes (10)
500	750	1000	1250	1500	1750	2000	2250	2500	3000	3500

NOTES:

- These choices **DO NOT AFFECT ACTUAL HORSEPOWER** or any ECU settings or adju

Enter your desired load or RPM axis breakpoints in the above tables. Use the tab key to move from one location to another. When finished hit the "Submit" button. Three different resolution levels must be defined. Depending on the particular table in the software, the resolution can be high, medium or low. Examples of high resolution breakpoints are the base fuel and spark maps.

4.2 Screens, Indicators and Tools



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Screens, Indicators and Tools

In this section, the various graphical screens, indicators and tools will be discussed in detail. In general, there are some consistent concepts in the way that the software presents information and allows you to manipulate various parameters. The application has a main or "home" view that includes a window that allows you to see various gauges and displays with a simple click of a tab. This is referred to as the **DASHBOARD**.



By clicking on the **TABS** along the top of the screen, you can see several other functions available for quick reference.

At the bottom of the main screen, you will see a Status Bar. Watch this area for alerts, current activity, Faults, and user information.

AT ANY TIME YOU CAN HIT THE 'F1" Key and activate help for the function that you are working with!



By holding your mouse pointer over a gauge, text box, or indicator, often times you will get a "**Tool Tip Help**" bubble that gives you a brief description of what you are looking

at.

Several specialized tools are available as Menu Options and can be activated by selecting them from the drop down menu bar at the top of the window.



4.2.1 Dashboard



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Dashboard TAB



The **DASHBOARD** Tab is considered the "HOME" screen. From here you can monitor most critical engine functions quickly at a glance.

The function of most of the gauges are self-explanatory, however there are a couple of

important point to note:

- Certain gauges will not appear in all configurations. For example, the optional oil and fuel pressure gauges may or may not be on the screen, depending on your configuration (set in the **Setup Wizard**).
 - The scaling of gauges (including the Tach) will adjust based on your **Setup Wizard** choices.
 - The scaling and labeling of the gauges and some map ordinates will change based on your **USER PREFERENCES** picked from the **APPLICATION SETTINGS** portion of the menu bar.
-

4.2.2 MAPs



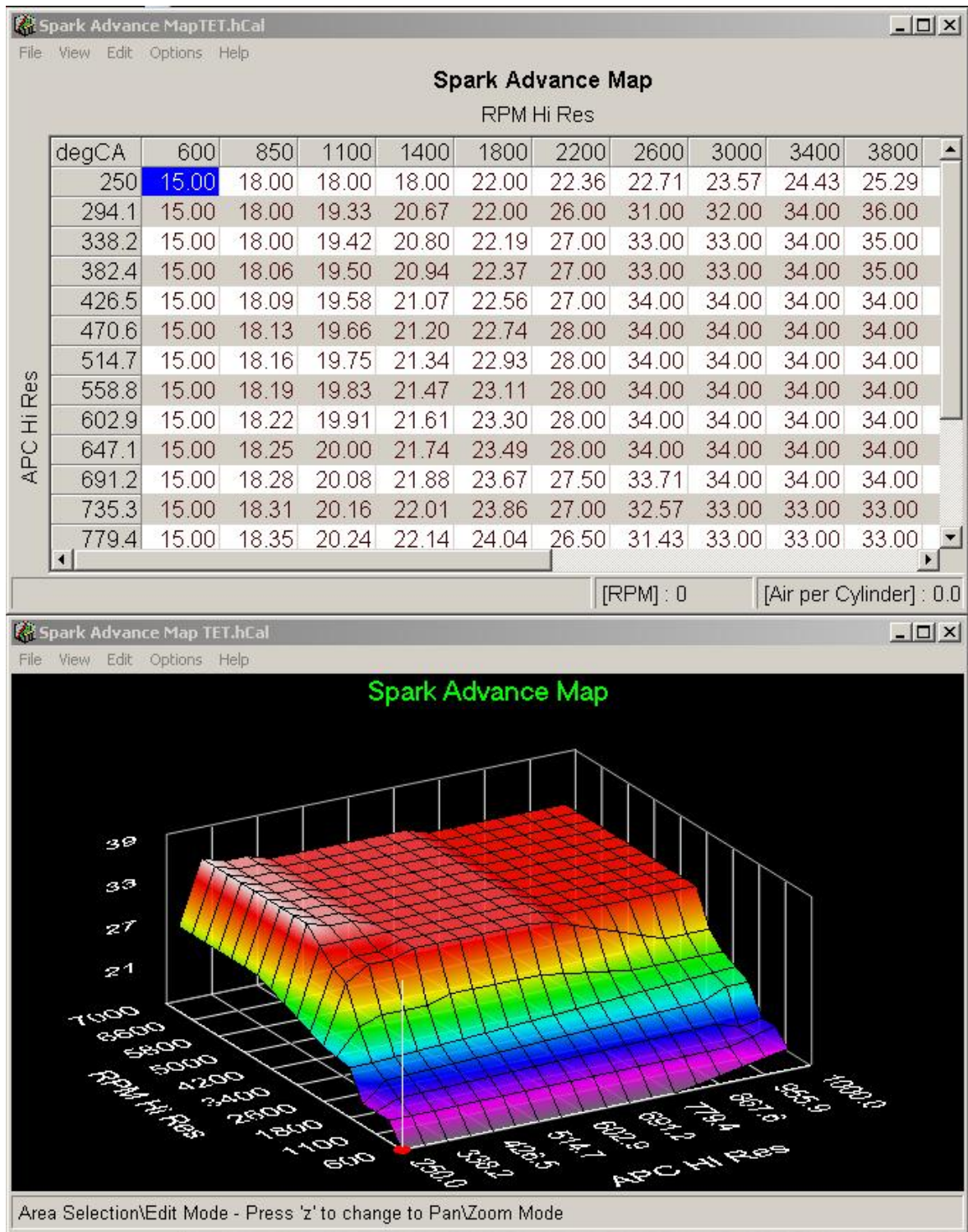
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MAP's Tab



The **MAP's** tab gives you an abbreviated dashboard to use while you edit one of the available maps by either picking it from the drop down or by clicking on one of the buttons.

This will give you a MAP for editing as shown below:



You may edit one or more maps at a time. You can make changes by editing either the table or the 3D chart. Right clicking on the desired cell or group of cells will bring up choices for the actions you can take. The list is also available under the Edit menu in the header bar. In addition, you can also manipulate the font and chart views for your convenience. For a full description of graphical functions, see the section on 3D chart

manipulation .

4.2.3 Details



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Details TAB

The screenshot displays the 'Details' tab of the Super Victor ProTuner EFI software. The interface is organized into several functional areas:

- Ignition:** Spark Advance (0.0), Dwell in ms (3.5ms), Battery (14.58 V), Sensors (5.04 V).
- General:** RPM (0), IAT (77), Coolant (77), WarmUp Mult (0.00).
- Status:** Engine state (RUN, IDLE, CRANK, Fan Active), Ignition Sync Errors (0), Injector Duty Cycle (0.0%), Fuel Pres (43.5), Oil Pres (43.5).
- Fuel System:** Feedback AFR (14.7:1), Target AFR (0.0:1), Closed Loop, Steady State, Pulse Width 1-8 (all 1.673ms), Injector 1-8 DC (all 0.0%).
- Indicators:** TPS % (1%), Injector Duty Cycle (0%), Spark Advance (0).

At the bottom of the window, a status bar shows 'Connected | CDM1 | EDEL05P2CM_V004-DC_P_SDens_000 | FAILT | RECV | Stall'.

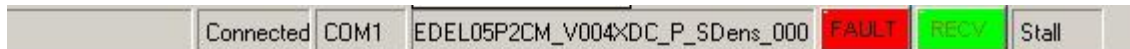
The **DETAILS** tab gives you a more "in depth" numerical view of the various engine parameters and allows you to monitor several parameters (such as pulse width) that aren't available via other screens. Current conditions are displayed for Individual cylinder timing, injector duty cycle, and pulse widths. The various fuel trim multipliers and engine state parameters are also numerically viewable. As with the main Dashboard window, the information displayed on this page will vary based upon the setup of the engine and features which are enabled. You may have numerous tuning maps open while monitoring specific data from the Details window.

4.2.4 Status Bar



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Main Status Bar



At the bottom of the main screen is the **STATUS BAR**. This status bar provides a "quick glance" look at events that are happening in the application. The bar is divided in PANES to separate the various information presented. The panes (from left to right) are as follows:

- **Connection Status** - Connected or Disconnected
- **PC Port** - COM port used to communicate with the ECU (usually COM1 through COM16)
- **Calibration being used** - name of the calibration file being used on the ECU
- **FAULT indicator** - Dark with "No Fault" when no faults are active/occurred. YELLOW when a warning fault has occurred. RED if a serious fault has been encountered. CLICK on the Fault indicator to bring up the fault display.
- **Connection Indicator** - blinks green to indicate data is being received from the ECU
- **Engine State** - Stall, Crank, Run

4.2.5 About



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About Screen



This screen is accessed from the **HELP** menu bar option. It will give you basic information about the application (such as version number, Super Victor or Victor, etc.) This can be very helpful when contacting customer support or comparing with other people.

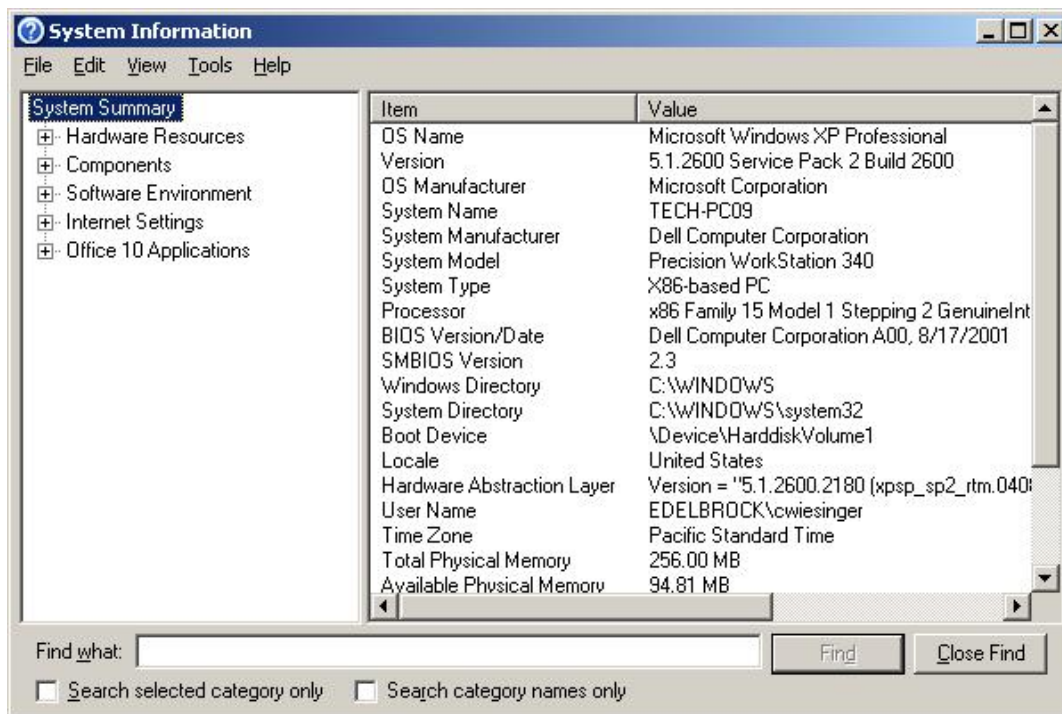
4.2.6 System Information



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System Information

The "**System Information**" is available from the main menu **HELP**. This is the same as the "**System Info**" button on the **ABOUT** screen and is used to tell you about your PC configuration. Again, this can help when contacting customer support. Be aware that it can take up to a minute or more for the software to gather the information about your PC, such as Operating System, Hardware Configuration, etc. Once the information has been gathered, you will see a screen similar to this:

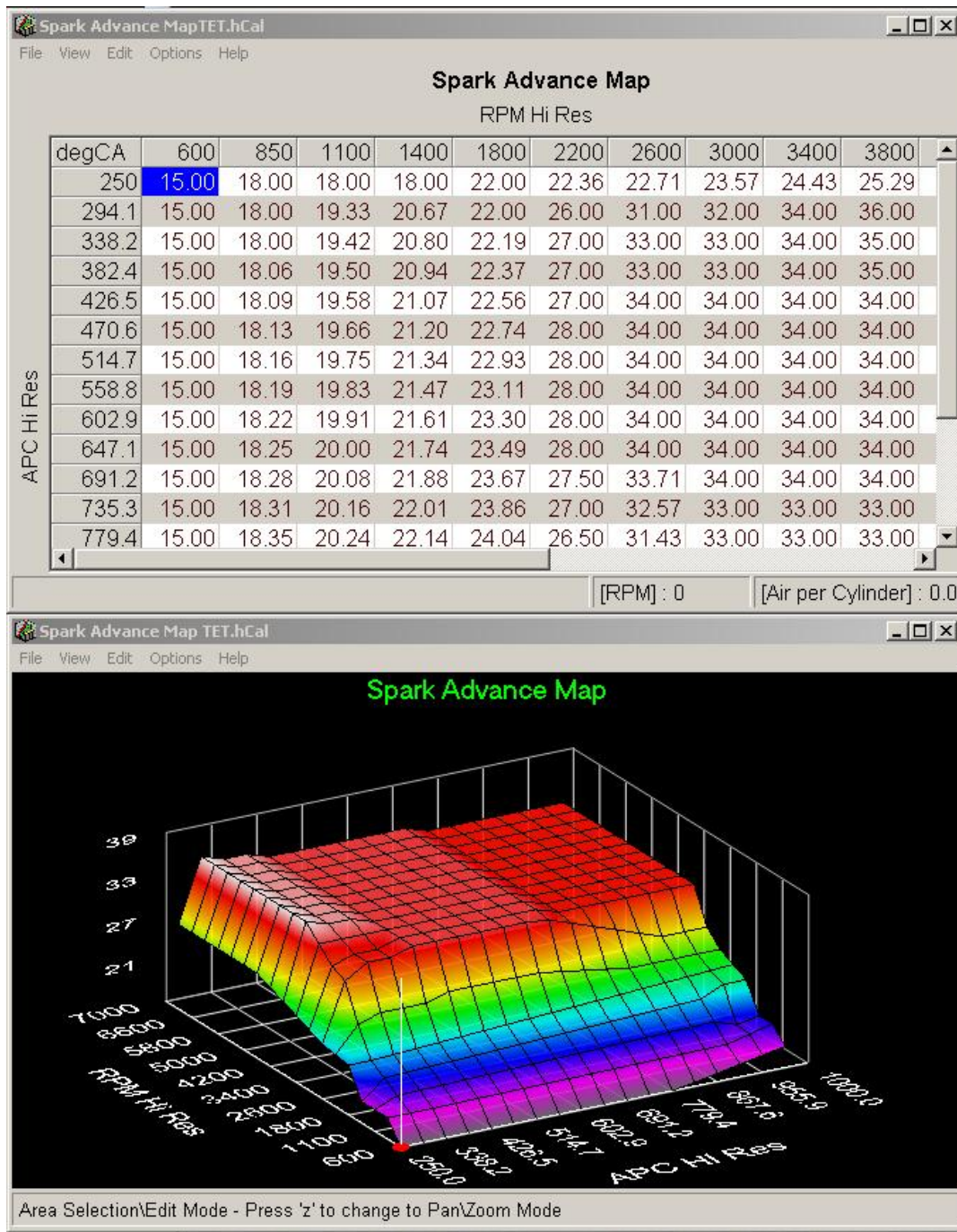


4.3 Tuning Maps



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Tuning Maps



Maps are basically tables that control a variety of fuel, air, timing, and behaviors necessary to define the limits and targets for various aspects of the engine operation.

MAP TYPES

In the Pro Tuner system, these Maps basically consist of two types:

- **Simple tables** - (such as coolant temp vs. idle RPM target) These tables often actually a set of sliders such as the coolant temp vs. Idle RPM sliders in the Startup/Warm up Settings screen. Each slider actually represents a cell in the table and if you view the sliders from left to right, they form a "curve" that defines the behavior.

Crank IAC DC% vs Coolant Temp

ECT (F)	0 RPM	100 RPM	200 RPM	300 RPM	400 RPM
-22F	80%	80%	80%	80%	80%
41F	80%	80%	80%	80%	80%
95F	80%	80%	80%	80%	80%
158F	80%	80%	80%	80%	80%
221F	80%	80%	80%	80%	70%

Crank Spark Advance (degrees) vs RPM

RPM	0	100	200	300	400
0	13 d	16 d	18 d	20 d	22 d
100	13 d	16 d	18 d	20 d	22 d
200	13 d	16 d	18 d	20 d	22 d
300	13 d	16 d	18 d	20 d	22 d
400	13 d	16 d	18 d	20 d	22 d

Normal Operating Temperature Set Point

300 F

CrankFuelMap

ECT (F)	0 RPM	100 RPM	200 RPM	300 RPM	400 RPM
-22F	140.000	130.000	120.000	110.000	100.000
41F	130.000	112.500	103.750	95.000	85.000
95F	110.000	105.000	95.000	80.000	70.000
158F	83.750	77.500	71.250	65.000	55.000
221F	65.000	60.000	55.000	50.000	40.000

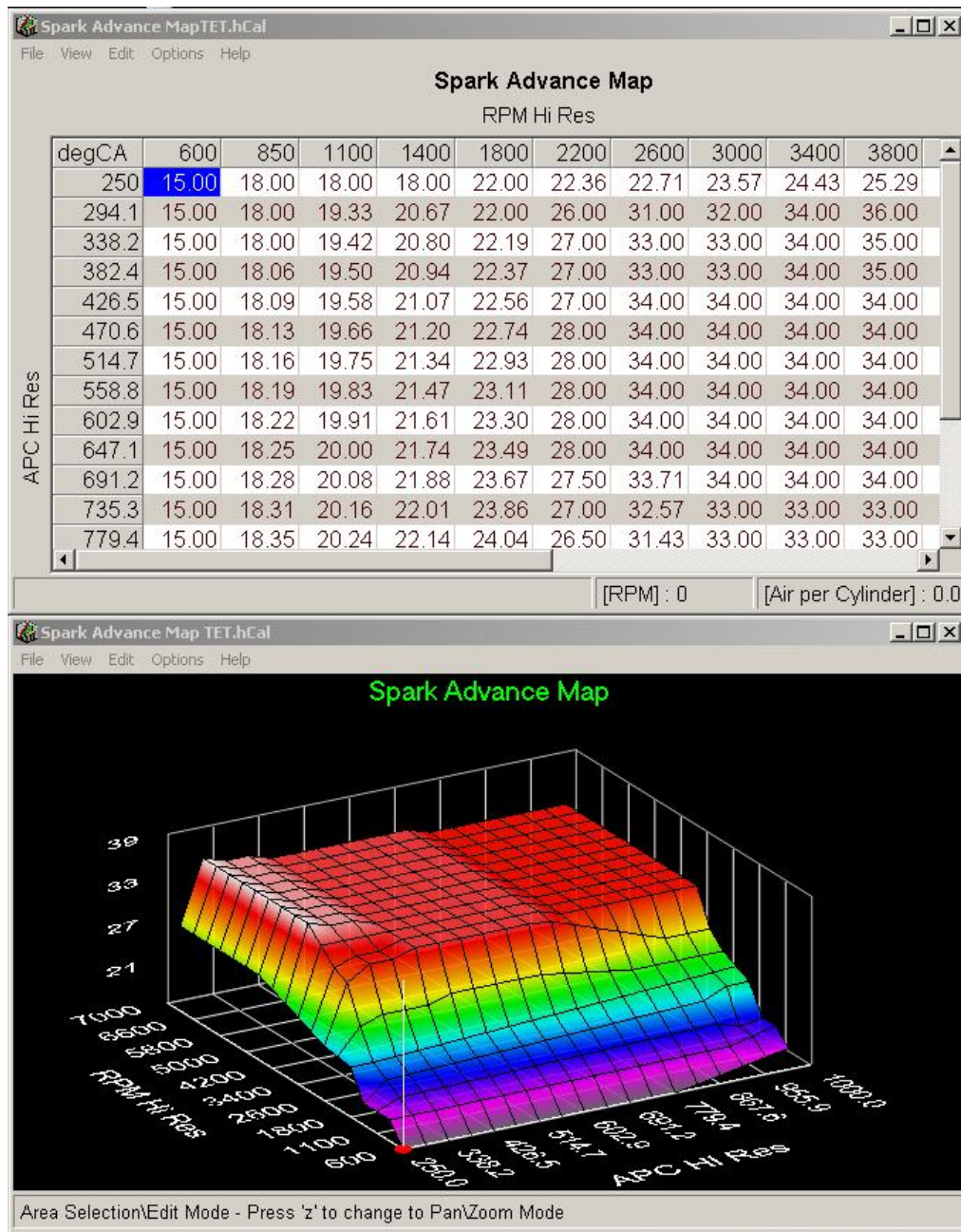
WarmUp Initial Mult

ECT (F)	0 RPM	100 RPM	200 RPM	300 RPM	400 RPM
0	1.25	1.22	1.18	1.15	1.08
100	1.04	1.02	1.00	1.00	1.00
200	1.00	1.00	1.00	1.00	1.00
300	1.00	1.00	1.00	1.00	1.00
400	1.00	1.00	1.00	1.00	1.00

WarmUp Filt Const

ECT (F)	0 RPM	100 RPM	200 RPM	300 RPM	400 RPM
0	180	143	107	70	58
100	45	33	20	5	0
200	0	0	0	0	0
300	0	0	0	0	0
400	0	0	0	0	0

- **3D table/charts** -(such as Volumetric Efficiency, Spark Advance, Fuel/Air Target, etc) Due to the fact that these behaviors are more complex, another axis is added to show this relationship. This results in a table with a set of values on the left and on the top and the cell value being the third axis. Most of the time, you will be entering numbers in the table. However, the 3D chart that opens with the table is a valuable tool for visualizing the entire set of values at a glance. You can easily spot trends and possible "problem areas" by looking at the 3D chart.



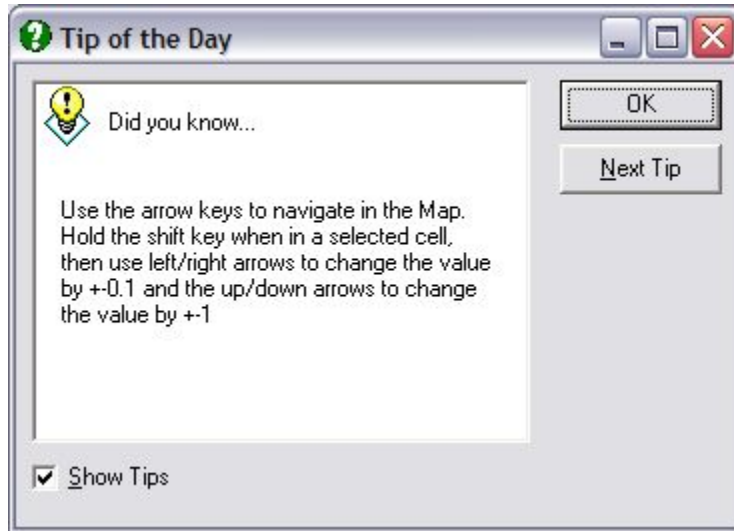
Simple tables are fairly intuitive in the way that you navigate and change values. The 3D tables/charts are also fairly intuitive, but they have some unique features that are worth noting, as shown in the following section:

3D CHARTS

- Specific *Table of Contents* items in **HELP** section "*3D Chart Manipulation*" enumerate the various advanced ways to interact with the 3D charts. List below are some of the basic features.

A "**Tip of the Day**" hint will pop up when you first activate a Map. This hint will

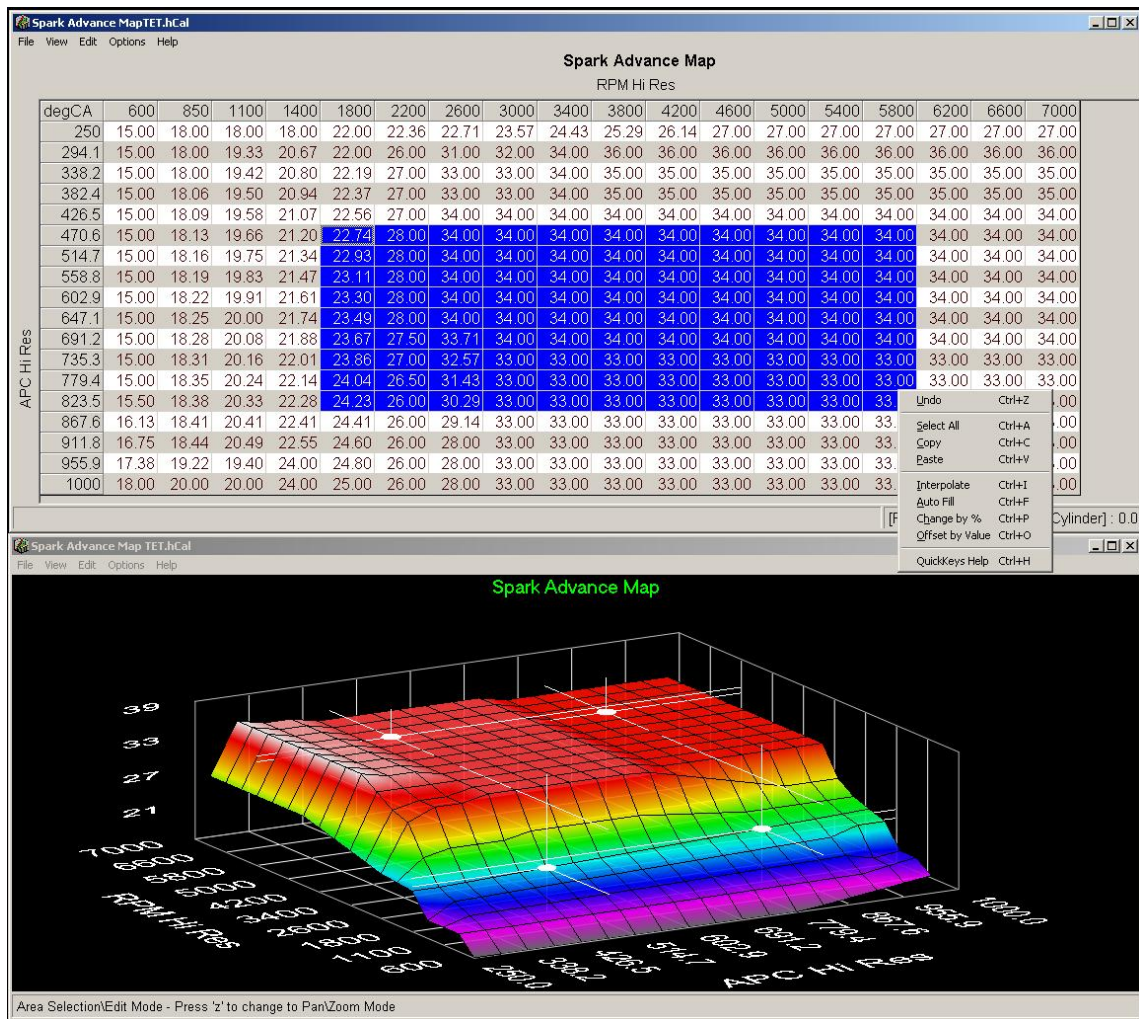
remind you of some of the powerful editing features available in the Maps. To disable this feature, click "**Show Tips**" check box.



- You can select a single cell in the table for editing by clicking on it. To modify the value, you can type in a new number OR you can hold down the use the **V,B,N,M** keys to change the values. The outer V,M keys increment the value by +/- .1 or the B,N keys to change the value by +/- 0.01.

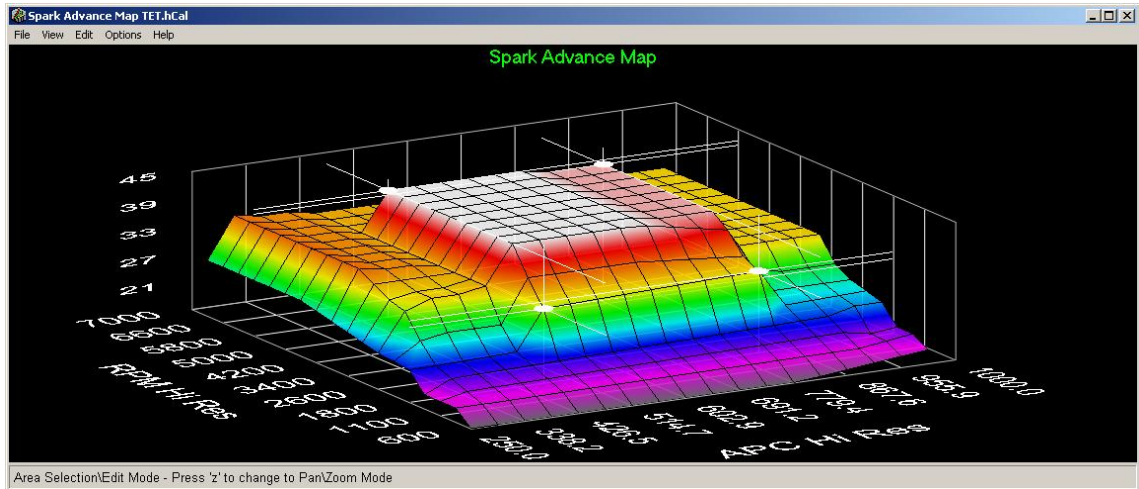
Spark Advance MapTET.hCal																		
Spark Advance Map																		
RPM Hi Res																		
degCA	600	850	1100	1400	1800	2200	2600	3000	3400	3800	4200	4600	5000	5400	5800	6200	6600	7000
250	15.00	18.00	18.00	18.00	22.00	22.36	22.71	23.57	24.43	25.29	26.14	27.00	27.00	27.00	27.00	27.00	27.00	27.00
294.1	15.00	18.00	19.33	20.67	22.00	26.00	31.00	32.00	34.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00
338.2	15.00	18.00	19.42	20.80	22.19	27.00	33.00	33.00	34.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00
382.4	15.00	18.06	19.50	20.94	22.37	27.00	33.00	33.00	34.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00
426.5	15.00	18.09	19.58	21.07	22.56	27.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
470.6	15.00	18.13	19.66	21.20	22.74	28.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
514.7	15.00	18.16	19.75	21.34	22.93	28.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
558.8	15.00	18.19	19.83	21.47	23.11	28.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
602.9	15.00	18.22	19.91	21.61	23.30	28.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
647.1	15.00	18.25	20.00	21.74	23.49	28.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
691.2	15.00	18.28	20.08	21.88	23.67	27.50	33.71	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
735.3	15.00	18.31	20.16	22.01	23.86	27.00	32.57	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
779.4	15.00	18.35	20.24	22.14	24.04	26.50	31.43	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
823.5	15.50	18.38	20.33	22.28	24.23	26.00	30.29	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
867.6	16.13	18.41	20.41	22.41	24.41	26.00	29.14	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
911.8	16.75	18.44	20.49	22.55	24.60	26.00	28.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
955.9	17.38	19.22	19.40	24.00	24.80	26.00	28.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
1000	18.00	20.00	20.00	24.00	25.00	26.00	28.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00

- You can select a group of cells in either the table or the chart and then **RIGHT CLICK** to enable extended options, such **Auto Fill, Extrapolate, Change by %**, etc.



Alternatively, you can use the EDIT menu in the menu bar to use the extended options.

- You can directly edit the 3D chart by selecting one or more intersections and using the V,B,N,M keys. The corresponding cell in the table will also be updated.



- At any time you can close the 3D chart viewer. To reopen it, go to the **VIEW** menu on the table and choose "**3D chart**"

		1100	1400	1800	2200	2600	3000	3400	3800	4200	4600	5000	5400	5800	6200	6600	7000		
APC Hi Res	250	15.00	18.00	18.00	18.00	22.00	22.36	22.71	23.57	24.43	25.29	26.14	27.00	27.00	27.00	27.00	27.00	27.00	
	294.1	15.00	18.00	19.33	20.67	22.00	26.00	31.00	32.00	34.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00
	338.2	15.00	18.00	19.42	20.80	22.19	27.00	33.00	33.00	34.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00
	382.4	15.00	18.06	19.50	20.94	22.37	27.00	33.00	33.00	34.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00
	426.5	15.00	18.09	19.58	21.07	22.56	27.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
	470.6	15.00	18.13	19.66	21.20	31.14	36.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	34.00	34.00	34.00
	514.7	15.00	18.16	19.75	21.34	31.33	36.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	34.00	34.00	34.00
	558.8	15.00	18.19	19.83	21.47	31.51	36.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	34.00	34.00	34.00
	602.9	15.00	18.22	19.91	21.61	31.70	36.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	34.00	34.00	34.00
	647.1	15.00	18.25	20.00	21.74	31.89	36.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	34.00	34.00	34.00
	691.2	15.00	18.28	20.08	21.88	32.07	35.90	42.11	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	34.00	34.00	34.00
	735.3	15.00	18.31	20.16	22.01	32.26	35.40	40.97	41.40	41.40	41.40	41.40	41.40	41.40	41.40	41.40	33.00	33.00	33.00
	779.4	15.00	18.35	20.24	22.14	32.44	34.90	39.83	41.40	41.40	41.40	41.40	41.40	41.40	41.40	41.40	33.00	33.00	33.00
	823.5	15.50	18.38	20.33	22.28	32.63	34.40	38.69	41.40	41.40	41.40	41.40	41.40	41.40	41.40	41.40	33.00	33.00	33.00
	867.6	16.13	18.41	20.41	22.41	24.41	26.00	29.14	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
	911.8	16.75	18.44	20.49	22.55	24.60	26.00	28.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
955.9	17.38	19.22	19.40	24.00	24.80	26.00	28.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	
1000	18.00	20.00	20.00	24.00	25.00	26.00	28.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	

[RPM] : 0 [Air per Cylinder] : 0.0

- You can also turn on and off the **ROW HIGHLIGHTING** in the **VIEW** menu.
- To Start/Stop the MOTOBALL functionality, use the **OPTIONS** menu. The MOTOBALL is a red highlighted cell that shows you the current position in the Map that the ECU is using. It will move around as the engine conditions and strategies dictate.

Spark Advance MapTET.hCal

File View Edit Options Help

Start MotoBall Ctrl+S
Stop MotoBall Ctrl+Q

Spark Advance Map
RPM Hi Res

degCA	600	850	1100	1400	1800	2200	2600	3000	3400	3800	4200	4600	5000	5400	5800	6200	6600	7000
250	15.00	18.00	18.00	18.00	22.00	22.36	22.71	23.57	24.43	25.29	26.14	27.00	27.00	27.00	27.00	27.00	27.00	27.00
294.1	15.00	18.00	19.33	20.67	22.00	26.00	31.00	32.00	34.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00
338.2	15.00	18.00	19.42	20.80	22.19	27.00	33.00	33.00	34.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00
382.4	15.00	18.06	19.50	20.94	22.37	27.00	33.00	33.00	34.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00
426.5	15.00	18.09	19.58	21.07	22.56	27.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
470.6	15.00	18.13	19.66	21.20	31.14	36.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	34.00	34.00
514.7	15.00	18.16	19.75	21.34	31.33	36.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	34.00	34.00
558.8	15.00	18.19	19.83	21.47	31.51	36.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	34.00	34.00
602.9	15.00	18.22	19.91	21.61	31.70	36.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	34.00	34.00
647.1	15.00	18.25	20.00	21.74	31.89	36.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	34.00	34.00
691.2	15.00	18.28	20.08	21.88	32.07	35.90	42.11	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	42.40	34.00	34.00
735.3	15.00	18.31	20.16	22.01	32.26	35.40	40.97	41.40	41.40	41.40	41.40	41.40	41.40	41.40	41.40	41.40	33.00	33.00
779.4	15.00	18.35	20.24	22.14	32.44	34.90	39.83	41.40	41.40	41.40	41.40	41.40	41.40	41.40	41.40	41.40	33.00	33.00
823.5	15.50	18.38	20.33	22.28	32.63	34.40	38.69	41.40	41.40	41.40	41.40	41.40	41.40	41.40	41.40	41.40	33.00	33.00
867.6	16.13	18.41	20.41	22.41	24.41	26.00	29.14	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
911.8	16.75	18.44	20.49	22.55	24.60	26.00	28.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
955.9	17.38	19.22	19.40	24.00	24.80	26.00	28.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
1000	18.00	20.00	20.00	24.00	25.00	26.00	28.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00

APC Hi Res

[RPM] : 0 [Air per Cylinder] : 0.0

In the status bar at the bottom of the table, you will see the right hand panes show ***the current speed/load condition*** .

- When the ECU is "**Learning/Auto Adapting**", the parameters in the table may change without user intervention (most evident on the Volumetric Efficiency map). This adaptation is based on the O2 sensor feedback and the Intake Air Adaptation strategy and can happen over a period of time as the ECU adapts the Map to current conditions. To monitor this, the system will periodically refresh the dynamic maps automatically.

4.3.1 Base Fuel Map



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Base Fuel Map

The Base Fuel Map is used to define fuel injector pulsewidth as a function of either manifold absolute pressure (MAP) or Throttle Position (TPS). A MAP-N tuning strategy uses MAP as the load axis. An Alpha-N tuning strategy uses TPS as the load axis.

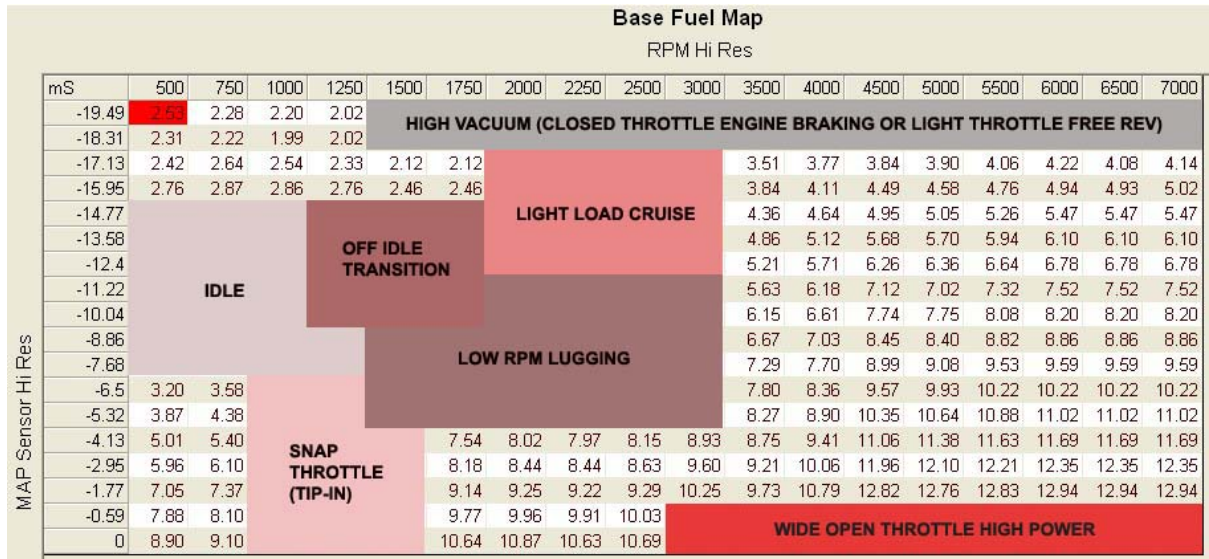
The screenshot shows a software window titled "Base Fuel Map Table" with a menu bar (File, View, Edit, Options, Help) and a title bar. The main content is a table titled "Base Fuel Map" with the subtitle "RPM Hi Res". The table has 12 columns for RPM (500, 750, 1000, 1250, 1500, 1750, 2000, 2250, 2500, 3000, 3500) and 12 rows for TPS% Hi Res (0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 80, 90). The values represent fuel pulsewidth in milliseconds (mS). A mouse cursor is visible over the cell for 10% TPS and 2500 RPM.

mS	500	750	1000	1250	1500	1750	2000	2250	2500	3000	3500
0	2.76	2.70	2.90	2.76	2.32	2.32	2.32	2.20	2.20	2.23	2.23
5	2.92	2.84	3.10	2.82	2.53	2.13	2.03	2.00	2.13	2.19	2.19
10	3.32	3.19	2.54	2.57	2.57	2.29	2.37	2.45	2.07	2.39	2.39
15	3.57	3.56	3.75	4.04	4.12	3.47	2.81	3.61	3.11	3.40	3.40
20	3.75	3.88	4.22	4.55	4.78	4.95	4.71	4.41	4.11	4.44	4.44
25	3.93	4.21	4.48	4.76	5.04	5.77	5.61	5.21	4.81	4.41	4.41
30	4.11	4.53	4.95	5.37	5.79	6.80	6.65	6.17	6.26	5.73	5.73
35	4.37	4.72	5.07	5.41	5.76	7.20	7.20	6.87	7.19	7.55	7.55
40	4.63	4.91	5.18	5.46	5.74	6.57	7.32	7.05	7.47	7.17	7.17
45	4.89	5.09	5.30	5.50	5.71	6.57	7.44	7.23	7.73	7.50	7.50
50	5.15	5.35	5.55	5.75	5.96	6.76	7.57	7.42	8.01	7.84	7.84
55	5.41	5.61	5.81	6.01	6.21	7.01	7.69	7.60	8.27	8.17	8.17
60	5.68	5.88	6.07	6.27	6.47	6.97	7.81	7.79	8.54	8.51	8.51
65	5.94	6.14	6.33	6.53	6.72	7.22	7.93	7.97	8.81	8.86	8.86
70	6.21	6.40	6.59	6.79	6.98	7.47	8.05	8.15	9.08	9.19	9.19
80	6.47	6.66	6.85	7.05	7.24	7.73	8.18	8.34	9.35	9.53	9.53
90	6.74	6.92	7.11	7.30	7.49	7.98	8.30	8.52	9.61	9.86	9.86

Complete the mapping by manually smoothing points and blending in the corners (which are often difficult to operate at when calibrating.) Avoid step changes or inconsistent values, as this will cause erratic running. Another tip to optimize the idle is to flatten the map slightly in the area that the engine typically idles in. This smoothes the idle by preventing major airflow changes as the engine moves around the cells at idle. Use the MotoBall feature to see where the engine is operating in the map.

Typical Fuel Map areas of operation

Although these areas vary somewhat with engine design, the following diagram will give you an idea of where the engine will be operating under certain conditions.



Once cranking / starting performance is acceptable, the areas most tuners will address next are:

1. Idle
2. Light Throttle Free Rev
3. Off Idle Transition
4. Light Load Cruise

Properly tuning these areas will allow the vehicle to be driven safely. The next areas of attention are typically the snap throttle (tip-in) and wide open throttle (high power) areas. Once these are finished, more attention can be paid to the light load cruise and low RPM lugging areas. Again, these are only guidelines. Different tuners may proceed through these steps in a different order.

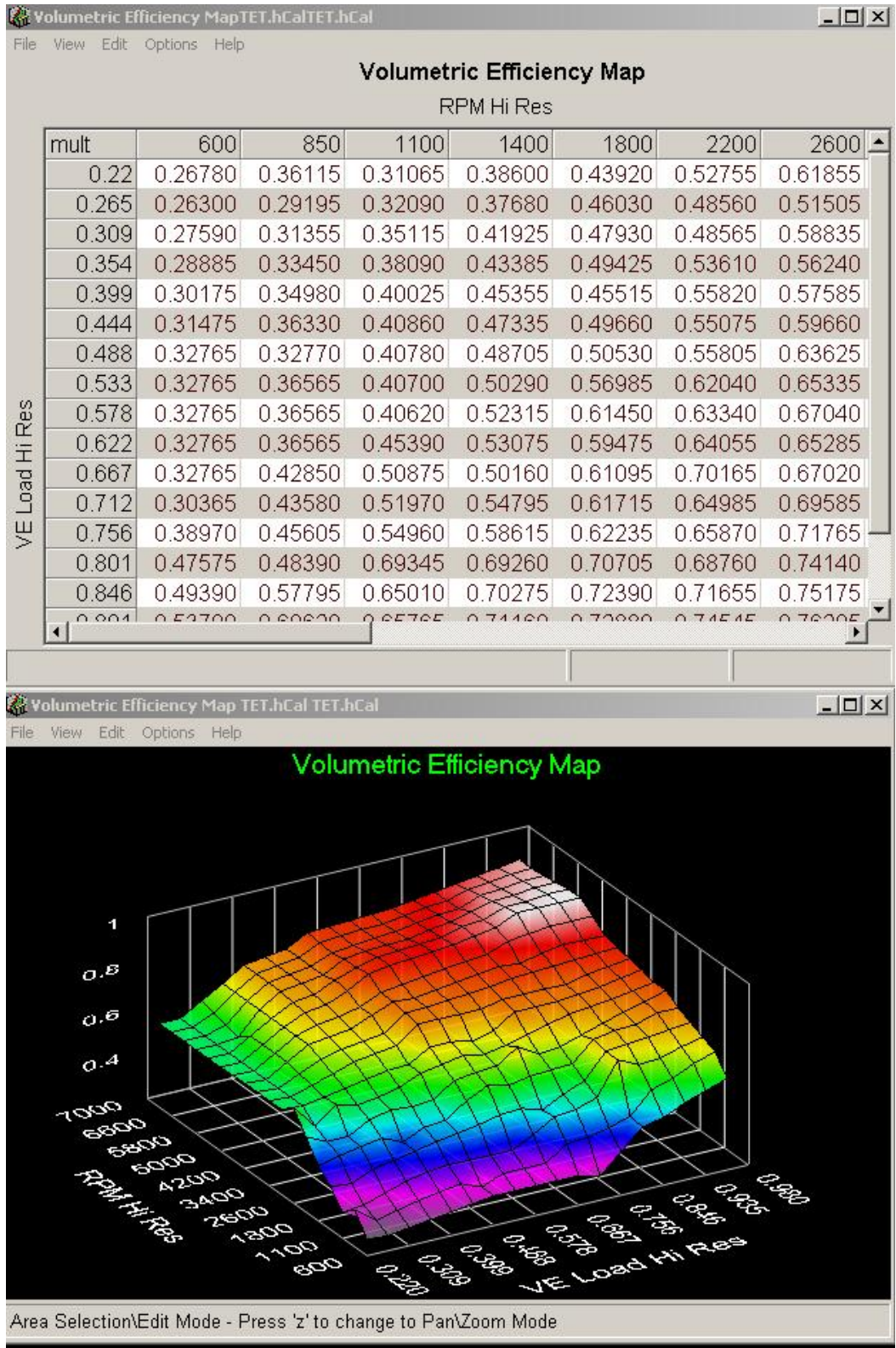
4.3.2 Volumetric Efficiency Map



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Volumetric Efficiency Map

The Volumetric Efficiency map is a representation of your engine's airflow characteristics. It needs to be properly calibrated for the control strategies to accurately determine fueling under all speed and load conditions, and to provide accurate altitude compensation. Your system has a base VE map that should get you up and running quickly. Volumetric efficiency is the amount of air that a cylinder retains vs the amount that it can theoretically hold (displacement). At speed, a cylinder is generally not able to fill to 100% or a VE of 1.00; due to intake & exhaust restriction, throttle blade restriction, and pumping efficiency influenced mainly by RPM and camshaft characteristics. Naturally aspirated engines that have extremely strong tuning may exceed 100% volumetric efficiency, but generally only supercharged engines exceed one atmosphere by a significant amount. If you are running a boosted engine, you will need to select the appropriate MAP sensor in the setup wizard. When you do, the application will automatically rescale the pressure ratio ordinates to reflect the additional pressure range.



The map is ordinated against RPM and Pressure Ratio. Pressure ratio is defined as manifold pressure over baro. It can be thought of as an indicator of load. As the pressure

ratio goes up, the load is also increasing, and manifold vacuum is decreasing.

To manipulate the map image and map functions, see 3D chart manipulation .

Tuning Tips:

The tuner has 3 methods of tuning the VE map. Once it is dialed in, you do not need to change it unless you change the engine airflow significantly.

- The first is manually changing the cells. It is recommended when doing this method to reference a mass airflow sensor in the system or an external airflow measurement and VE calculation to match the measured VE value to the calculated value from the VE map in the ECM.
- The second is to install a mass airflow sensor and let the system calibrate the majority of the VE map. The adaptive VE is a very powerful function that takes work and time out of a calibration. You can actually see the map grow and dial itself in. Although the engine will be running via the MAF sensor, map adaptation will only occur during steady state operation. (see the Adaptive Tuning section for more information.) You may keep the MAF on the engine continuously, or use it to tune the VE and remove it (don't forget to deselect it in the setup wizard).
- The third (and most common) method for the average tuner beyond using the default map, is to generate a VE map using the VE estimator. (see VE estimator page for operation info). With the estimator, you can enter some basic engine data and come up with a VE map that is adequate for most applications and a very good starting point. You may also modify the existing base map that comes with your factory calibration. For most average users, the VE estimator can be used, and the tuner can focus primarily on the AFR map and Spark map for base calibration and the closed loop adaptation will "learn out" minor inconsistency.

When using any of the methods, complete the mapping by manually smoothing points and blending in the corners (which are often difficult to operate at when calibrating.) Avoid step changes or inconsistent values, as this will cause erratic running. Another tip to optimize the idle is to flatten the map slightly in the area that the engine typically idles in. This smooths the idle by preventing major airflow changes as the engine moves around the cells at idle. Use the MotoBall feature to see where the engine is operating in the map.

4.3.3 Spark Advance Map



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Spark Advance Map

The spark map is one of the three main base combustion maps. The others are the VE or Base Fuel map, and the Air/Fuel target map. These three maps need to be calibrated throughout the range before significant work is put into tuning transients, idle, starting, or warm up. To manipulate the chart and map functions, see the 3D chart manipulation section.

Spark Advance Map Table502_MAP-N_PCMCal_111306_001.HCAL

File View Edit Options Help

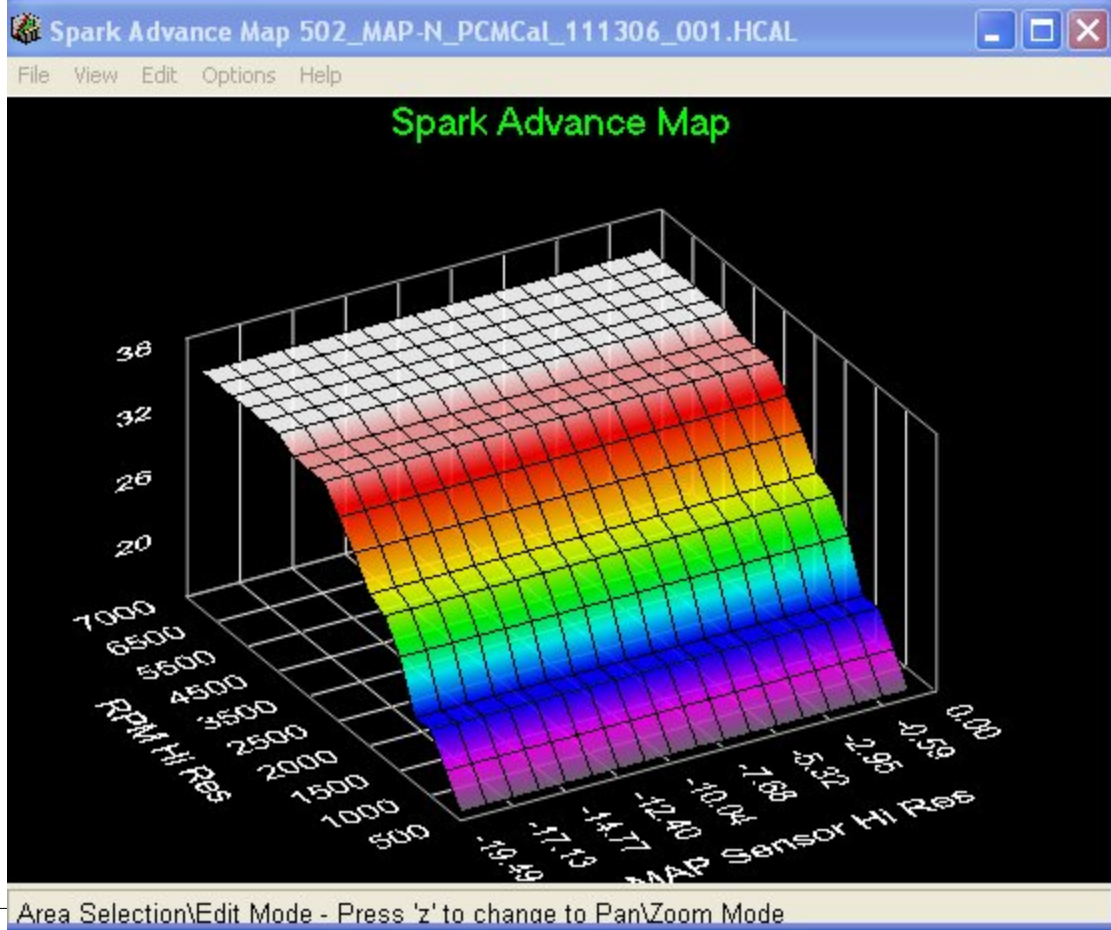
Spark Advance Map

RPM Hi Res

degCA	500	750	1000	1250	1500	1750	2000	2250
-19.49	14.70	17.37	20.03	20.00	24.47	27.13	28.00	30.67
-18.31	14.70	17.37	20.03	20.00	24.47	27.13	28.00	30.67
-17.13	14.70	17.37	20.03	20.00	24.47	27.13	28.00	30.67
-15.95	14.70	17.37	20.03	20.00	24.47	27.13	28.00	30.67
-14.77	14.70	17.37	20.03	20.00	24.47	27.13	28.00	30.67
-13.58	14.70	17.37	20.03	20.00	24.47	27.13	28.00	30.67
-12.4	14.70	17.37	20.03	20.00	24.47	27.13	28.00	30.67
-11.22	14.70	17.37	20.03	20.00	24.47	27.13	28.00	30.67
-10.04	14.70	17.37	20.03	20.00	24.47	27.13	28.00	30.67
-8.86	14.70	17.37	20.03	20.00	24.47	27.13	28.00	30.67
-7.68	14.70	17.37	20.03	20.00	24.47	27.13	28.00	30.67
-6.5	14.70	17.37	20.03	20.00	24.47	27.13	28.00	30.67

MAP Sensor Hi Res

[RPM]: 0 [Load]: -29.53



Tuning Tips:

Spark advance is specific to the engine combination. However, trends can be applied across various engines. The goal in determining optimum spark advance is to use the minimum spark advance required to maintain best torque at each speed/load point.

Note that you can draw a comparison between a typical mechanical advance curve (for a carbureted application) and a fully programmable 3-D table as shown above. The table above is set up such that engine vacuum has no influence on the ignition advance. The ignition timing increases as RPM rises. The advantage to a fully programmable table is you have no mechanical constraints. You simply enter the exact ignition timing desired at each RPM/load point on the 3-D table.

Light load conditions will require more spark and allow leaner air/fuel ratios for improved part throttle economy. Heavy loads will need less because the richer mixture required for best power will have a faster burn rate. Many engines will also be limited by detonation limits.

For best idle, have the cells immediately around the base idle point to be "Flat", in other words, use the same value or minimally sloped values in the cells that the engine typically idles in. Steep spark changes around the idle point will cause instability and surging that cannot be tuned out with the idle controller settings.

As the tuner you will have to optimize the fueling and ignition advance by scanning the parameters as described in the concepts section. Start at low speed and conservative values. Optimize these values and work your way to higher loads and speeds. As the map takes shape, with experience you will be able to determine how the map will contour. If you have a good spark curve from a standard distributor for your engine, you can use that data to create a "backbone" for the map which you can work outward from. As with the fuel maps and individual cylinder maps; the more instrumentation you have, the better you will be able to generate an optimized calibration.

4.3.4 Target Air/Fuel Ratio Map



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Target Air/Fuel Ratio Map

The Target AFR map is where you input your desired fueling based on speed and load. To learn about chart and map functions and features, see the 3D chart manipulation section.

Air Fuel Target Ratio MapTET.hCal

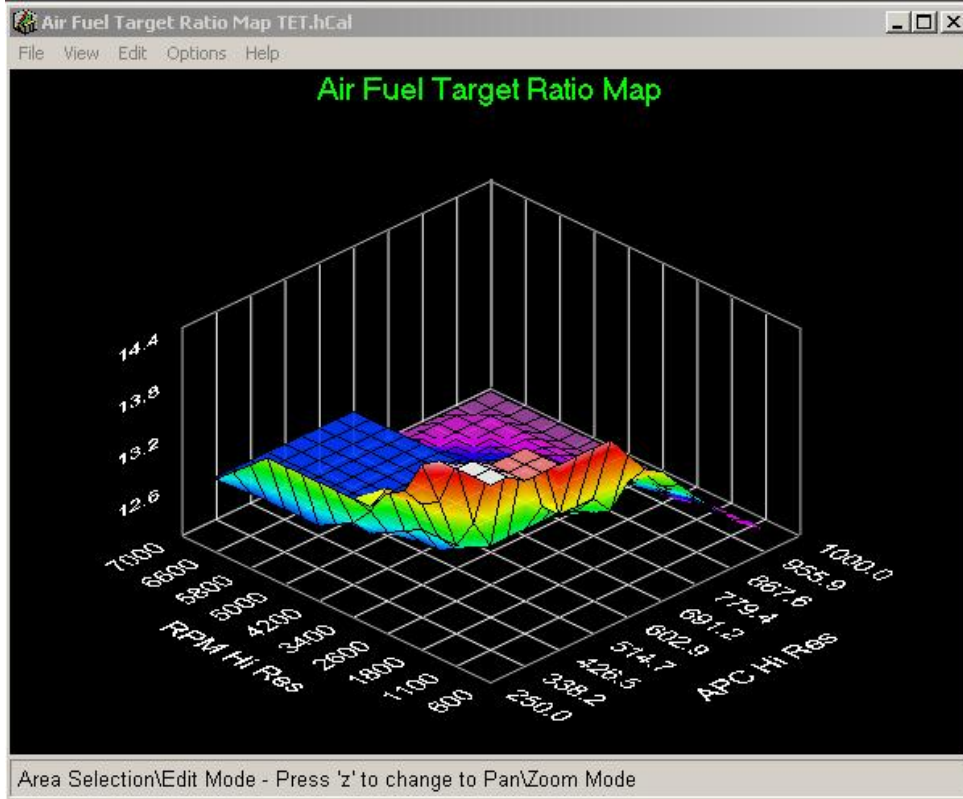
File View Edit Options Help

Air Fuel Target Ratio Map

RPM Hi Res

	600	850	1100	1400	1800	2200	2600	3000
250	14.272	14.272	14.272	14.272	14.135	13.738	13.611	13.364
294.1	14.272	14.272	14.272	14.135	13.611	13.486	13.486	13.243
338.2	14.135	14.135	14.135	13.364	13.009	13.009	13.009	12.783
382.4	14.135	14.135	14.135	13.009	12.895	12.783	12.672	12.672
426.5	14.135	14.135	14.135	13.009	12.895	12.783	12.672	12.672
470.6	14.135	13.364	13.364	13.009	12.895	12.783	12.672	12.672
514.7	14.135	13.364	13.364	13.009	12.895	12.783	12.672	12.672
558.8	14.135	13.364	13.125	13.009	12.895	12.783	12.672	12.672
602.9	13.868	13.125	13.009	12.895	12.783	12.672	12.672	12.672
647.1	13.611	13.364	13.364	12.895	12.783	12.672	12.672	12.672
691.2	13.486	13.364	13.243	13.243	13.125	13.009	13.009	12.895
735.3	13.243	13.125	13.125	13.009	13.009	12.895	12.895	12.783
779.4	13.009	13.009	12.895	12.895	12.783	12.783	12.672	12.672
823.5	12.783	12.783	12.783	12.672	12.672	12.672	12.564	12.564

APC Hi Res



Tuning Tips:

A stoichiometric ratio is 14.7:1. If you have your preferences set to display in equivalence ratio, 1.0 is a stoichiometric ratio. Generally, high performance engines will run best at that ratio or less (richer). At idle and light load, the AFR can usually be at or near 14.0-14.8. As the load goes up, the ratio must be richen-ed (lowered) for best power and possibly to avoid detonation limits. At Wide Open Throttle (WOT) ratios as rich as 12-12.8:1 are not uncommon. If you are working in equivalence ratio, you would increase the number to richen and decrease the number to lean.

As with the spark map, start conservatively (slightly rich), and start out at light load & low speed - optimizing the map as you go up in speed and load. Use as much instrumentation as available to help you generate an optimized map that does not jeopardize reliability. Try to keep the map fairly "flat" around the idle cells to help with a smooth idle. Use the MotoBall to track where you are running. You can see from the main display the current target AFR. This may not agree exactly with your map value because you may actually be running between cells, where the ECM interpolates or calculates a target value between the mapped values. Keep this in mind as you tune all of the maps.

Below is a chart comparing mixture values for gasoline. Note that Lambda is similar to equivalence ratio, but works opposite:

Equiv Ratio	Lambda	Gasoline AFR
1.458	0.686	10.08
1.437	0.696	10.23
1.416	0.706	10.38
1.397	0.716	10.53
1.376	0.727	10.69
1.353	0.739	10.86
1.333	0.75	11.03
1.312	0.762	11.2
1.292	0.774	11.38
1.271	0.787	11.57
1.250	0.8	11.76
1.229	0.814	11.96
1.208	0.828	12.17
1.188	0.842	12.38
1.167	0.857	12.6
1.145	0.873	12.83
1.125	0.889	13.07
1.105	0.905	13.31
1.083	0.923	13.57
1.063	0.941	13.84
1.042	0.96	14.11
1.020	0.98	14.4
1.000	1	14.7
0.964	1.037	15.25
0.928	1.078	15.84
0.892	1.121	16.48
0.855	1.169	17.18
0.820	1.22	17.93
0.784	1.276	18.76
0.748	1.337	19.66

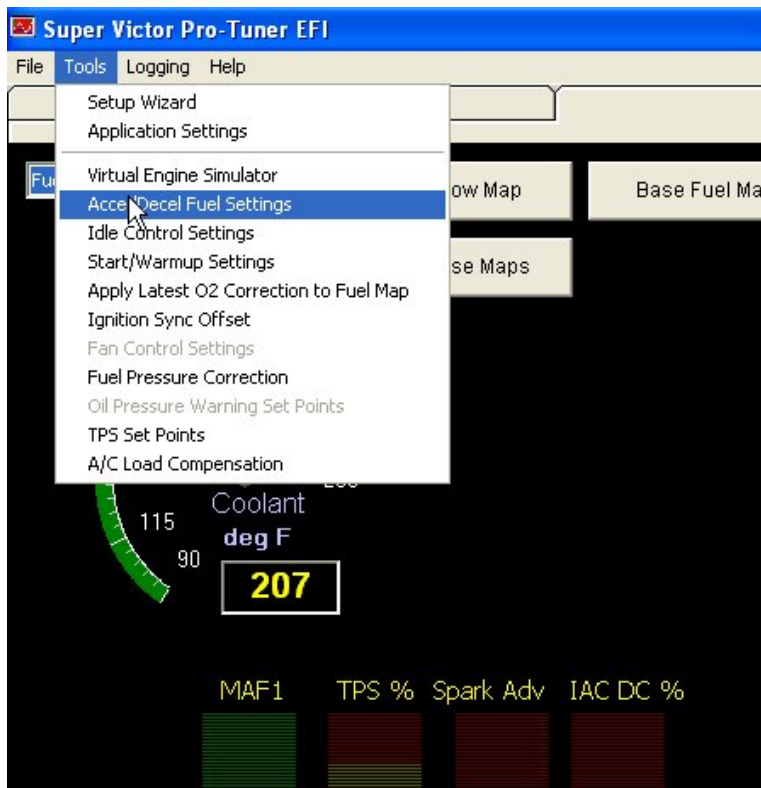
0.712 1.405 20.66

4.3.5 Accel / Decel Fuel Settings

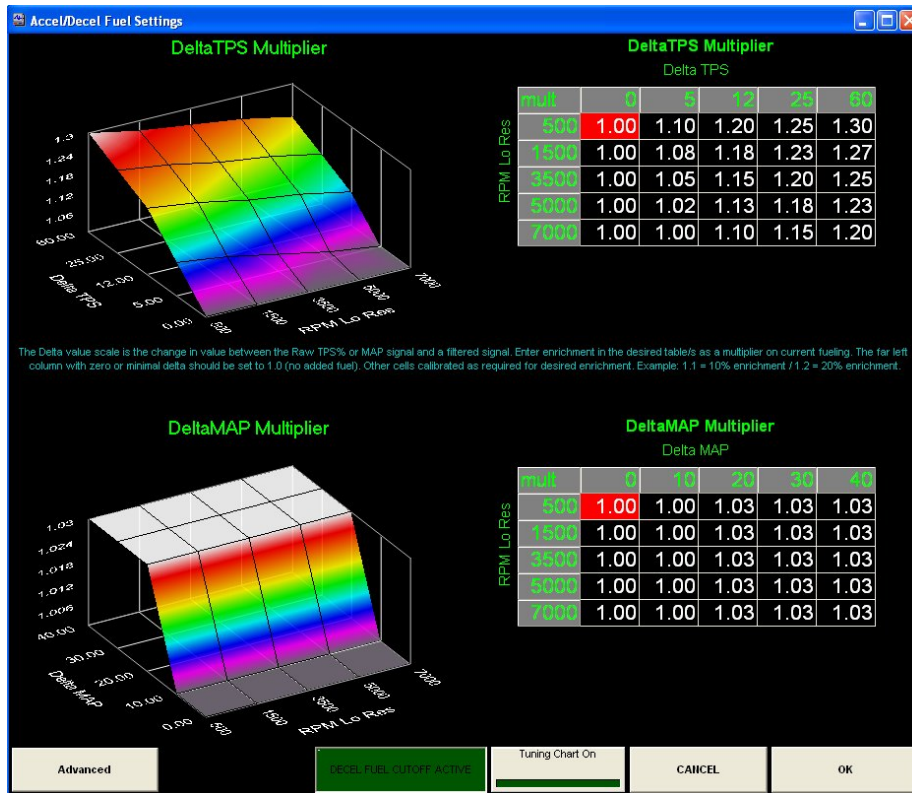


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Accel/Decel Fuel Settings



To access the Transient Fuel Map, select the **Accel/Decel Fuel Settings** from the drop down list in the **Tools** menu.



Tips for Tuning:

It is important to remember that the Accel/Decel strategy will tune deceleration as well as acceleration and load dump fueling.

Start modifications conservatively!

ALWAYS complete and optimize ALL steady state mapping and idle calibration before tuning transient running! Otherwise your base fueling may be affected by transient settings. You do not want transient fueling hiding deficiencies in the base steady state calibration.

Start by opening the Accel/Decel tuning chart. For ease of tuning, the tuning chart will give you a running graph of Delta MAP and Delta TPS and shows the A/F ratio from the oxygen sensor. You will want to perform throttle stabs and adjust the fuel multiplier to eliminate momentary lean out compared to your steady state Air/Fuel ratio. Continue this procedure over various speeds and loads until the Delta TPS and/or Delta MAP tables have been optimized. NEVER enter a value of less than 1.0 in the tables.

The Delta MAP ordinate which is across the top of the Delta MAP table; is defined as the difference between the raw or instant MAP sensor value and a filtered value (in kPa). Thus, a faster rate of change will result in a larger Delta MAP value since the filtered value will "lag" behind the raw or instant value. The same principle applies to the Delta TPS table, where the Delta TPS = TPS Raw minus TPS Filtered. This type of ordination emulates the magnitude and rate of load change that the engine is seeing during a particular throttle change. A fast throttle change from idle to wide open will appear as a large delta. A slow rate of change, or a change from one part throttle position to another - will yield a small delta value. Based upon that delta ordinate and the engine speed; the

controller will lookup a calibrated value in the table/s and multiply the fueling by that amount and decreasing until there is no meaningful difference between the Raw and Filtered values. So if the Raw sensor value has changed a great deal in a short period, the delta (or difference) will be large, which will require a greater amount of transient fueling in that cell of the table to maintain the desired AFR for that period than a small delta would.

You may use either table, or a combination of both. (Many users rely primarily on Delta TPS). To tune either table, set the first column to 1.00 and calibrate your base maps in steady state condition. Then, for the columns to the right of the first one, watch or log the delta for each RPM range as you perform throttle changes from various speeds and loads. Set the multiplier in the corresponding table cell so that the O2 value doesn't go leaner than your desired value and provides maximum acceleration and no tendency for knock. A value of 1.10 equals 10% more fuel, 1.25 equals 25% more, etc. When properly calibrated - the map will generally have the following characteristics: the values will be small in the left *columns* of the table, and increasing to the right under the larger delta columns. Also when looking at the table horizontally, the values in the speed *rows* will decrease with higher speeds.

Do not go richer than needed, or misfire and poor performance will occur.

Advanced Accel/Decel Functions:

Pressing the "Advanced" button on the Accel/Decel Fuel Settings screen will bring up the following additional functions:

In certain cases, you may need to adjust the Delta MAP and Delta TPS filters. Adjusting this is ***only recommended for very experienced tuners***. The filter constants will affect the magnitude of the delta between Raw and Filtered signals and rarely needs to be changed from the default values. If you need to adjust the advanced parameters, do so with small changes! Changing the filters will require recalibration of the Transient map/s.

The system will also cut fueling completely under hard deceleration. The decel fuel cut will be active until the engine nears the desired speed and load. "Decel Fuel Cut active" light will come on. Fueling will automatically be re-enabled by the system. Engines in different applications may need different levels of decel fuel cut, and *others may not tolerate cutting the fuel at all*. To accommodate the different fuel cut tolerances, the threshold for decel fuel cut can be set by the user for the application. The decel fuel cut must be entered as a negative number. To disable the decel fuel cut, set the threshold to minus 100. Do not set the threshold closer to zero than -10% or fuel may be cut too quickly and for too long - causing erratic running and engine stalling on deceleration. *Note: if many maps are open at once, or your PC is not fast enough - the decel fuel active indicator may not light; even though it may be active for a brief period. The PC may also not respond fast enough to show quick changes in the cell position highlight. Note: The ECU calculation speed and transient operation is **not** affected by this. Close any unrelated maps while tuning the fuel cut threshold and transient maps to minimize the effect.

Engines may also need different transient fueling depending upon the temperature of the engine. A cold engine will need more transient fuel for acceleration than the same engine needs once it is hot. The Advanced screen contains a table for multiplying Transient Fueling level based upon Engine Coolant Temperature (ECT). This table is called the ECT Trans Fuel Mult table. do not enter values lower than 1.00. **Make sure that the values in the cells near your normal hot operating temperature are set to 1.00: any**

value other than that will act as a global transient multiplier. It is better to only use the main delta tables to tune the transient at operating temperature!

A multiplier value in the transient maps or ECT Trans Fuel Mult Tbl is a function of percentage. A value of 1.10 equals 10% rich, 1.25 equals 25% rich, etc. **Do not enter values less than 1.00.** If on rare occasion, a value of less than 1.0 is required at normal operating temperature, it means that your base fuel map is too rich. To correct, you should reduce the fueling of your base fuel map and reset the ECT Trans Fuel Mult Map to 1.0 in that cell.

Verify satisfactory transient tuning under both acceleration and deceleration conditions.

4.3.6 Closed Loop Compensation (CLC) map

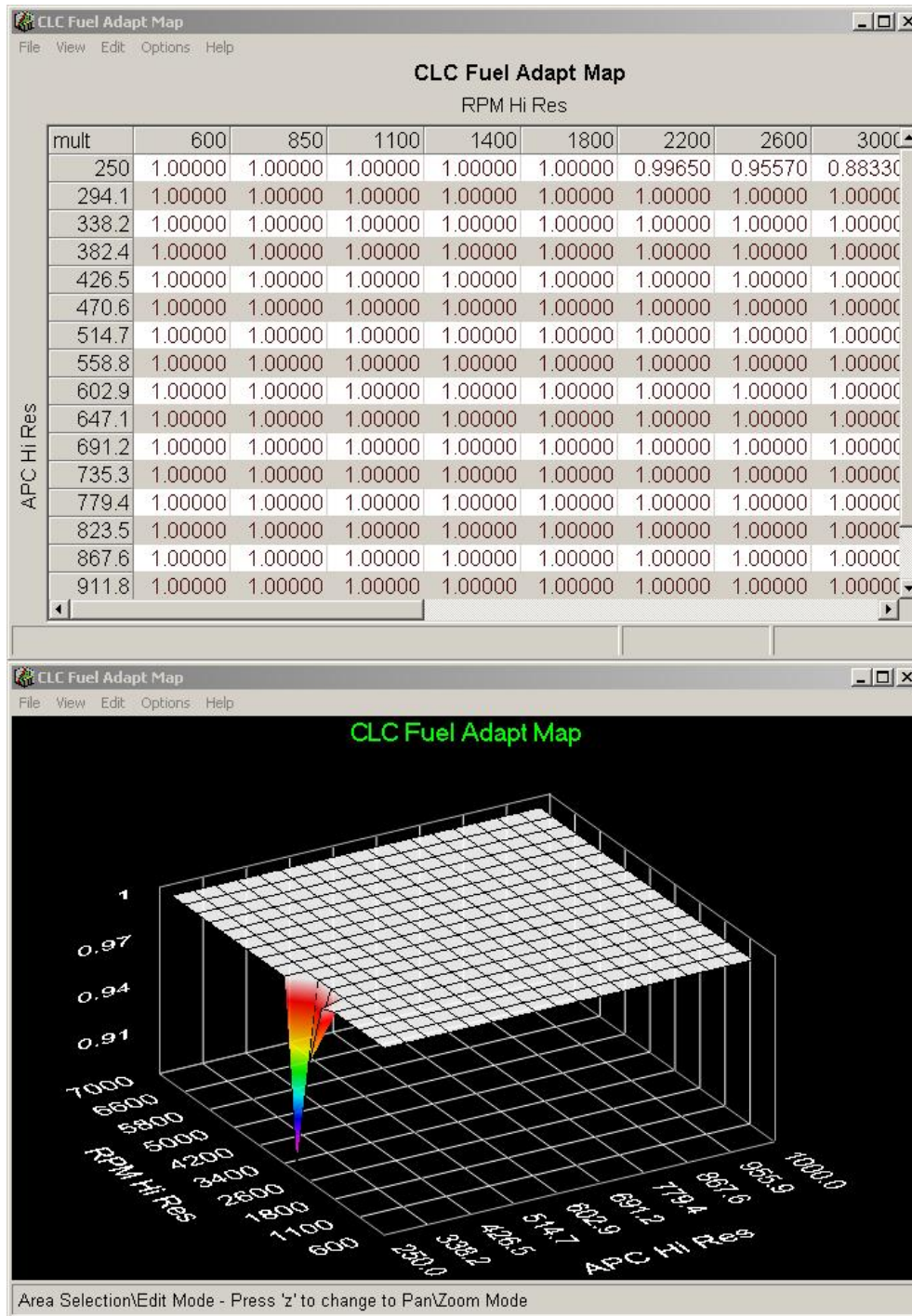


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Closed Loop Compensation (CLC) map

Closed Loop Compensation (CLC) map - Fuel Adaption

The **Closed Loop Compensation (CLC) map** is a map where the fuel pulse width is dynamically adjusted to provide the engine the desired air/fuel ratio by applying a multiplier to the fueling to correct for any error which may exist in the base fuel map or dynamic flow changes in the rails or injectors. It can be continuously adapted via the O2 sensor, or it can be manually calibrated for open loop operation or to speed the process for pro users.



The map can be edited just like any of the other main maps. See 3D chart Manipulation.

Tips for tuning:

The CLC map is adapted at the rate dictated by the Fuel Adapt Gain table. It is desirable to adapt the map slowly over time so that the system will capture evolving changes in the engine's condition and not adapt instantaneous values that may not be accurate. You can use this table to adjust for changes in injectors or other flow characteristics. The

table is a function of speed and load, and is calibrated manually or adapted as a multiplier on base fueling. This means that a value of 1.00 equals the calibrated base fueling and no change is being applied to the end pulse width of the injector. A value of 1.10 equals 10% more fuel is being delivered than is mapped to make the actual AFR equal the desired mapped AFR. A value of .93 equals 7% less fuel is being delivered, and so forth. The map allows a typical range of values between .700 and 1.400; if the map has values near either of these limits, you should adjust the VE map (Speed/Density mode) or Base Fuel Map (Speed/Throttle mode) to deliver the required fuel the Air/Fuel Map is asking for and bring the CLC mapped value back near 1.00 so that the O2 sensor is not limited in its authority to correct for fueling related changes.

If you are running Speed/Throttle control mode - you can apply the adaptation in the CLC map to your Base Fuel Map to bring your open loop fueling pulse width into tune by using the "Apply O2 Adaptation to Base Fuel Map" function under the tools menu. You may need to do that several times if the CLC map reaches its upper or lower limit for any cell. In Speed/Density mode, you need to adjust the VE map to prevent the CLC map from being near its upper or lower limit. For more information about closed loop control or adaptive VE using mass airflow, see the Help section on Adaptive Tuning .

4.3.7 ECT Fuel Trim Table



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ECT Fuel Trim Table

ECT Fuel Trim Table (Not Available in Speed Density Mode)

In Speed/Throttle (Alpha-N) mode *or* Speed/Pressure (MAP-N) mode, there is the ability to adjust a global trim for fuel based upon ECT. This can be useful if fueling characteristics change greatly with engine coolant temperature. While not often needed, the **ECT Fuel Trim table** can be helpful in providing a global fuel offset for a variety of engine operating temperatures.

ECT Fuel Trim										
ECTMidResIdxArr										
mult	-22	14	50	77	104	131	158	185	212	239
	1.20	1.10	1.05	1.03	1.00	1.00	1.00	1.00	1.00	1.00

Tips for tuning :

The table is a *multiplier* to the base fuel map. It is based on coolant temperature in degrees C. or degrees F. (Whichever you have chosen as your desired units of pressure in the application settings.) A value of "1.00" means that no change is being applied to the base map. This means that a value of 1.00 equals the calibrated base fueling and no change is being applied to the end pulse width of the injector. A value of 1.10 equals 10% more fuel is being delivered than is mapped. 1.15 means that 15% more fuel is being delivered, and so on. Keep the values small. If a large value is required, it probably means that your base fuel map calibration is not optimized, and you should adjust the base fuel map further with a representative coolant temperature. Set the value to 1.00 at normal operating temperature. Calibrate your base fuel map. Retest at various coolant temperatures and adjust the corresponding trim cell to have the system deliver the fueling required to match your desired mapped AFR at those points.

4.3.8 A/C Load Compensation



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A/C Load Compensation

A/C Load Compensation

Insure that the ECU input wire for A/C clutch sensing is correctly configured before continuing. **Note: When wiring A/C load compensation, Pin M (PCM80) / Pin A (ECM48) in expansion connector must be pulled to ground when A/C compressor is energized.**

Load compensation is available for the purpose of preventing or minimizing RPM droop when a load is put on the engine such as when an air conditioning compressor turns on. There are two tables in the drop down list for this function. They are called, "**Load Comp IAC Ofst**" and "**Load Comp Spk Ofst**". The Load Comp IAC Ofst applies an offset to the Idle Air Control valve to supply extra air when the load is applied. The Load Comp Spk Ofst provides an extra few degrees of spark advance to also minimize speed loss or stalling during a load switch. Both tables are a function of throttle position in percent.

Load Comp IAC Ofst

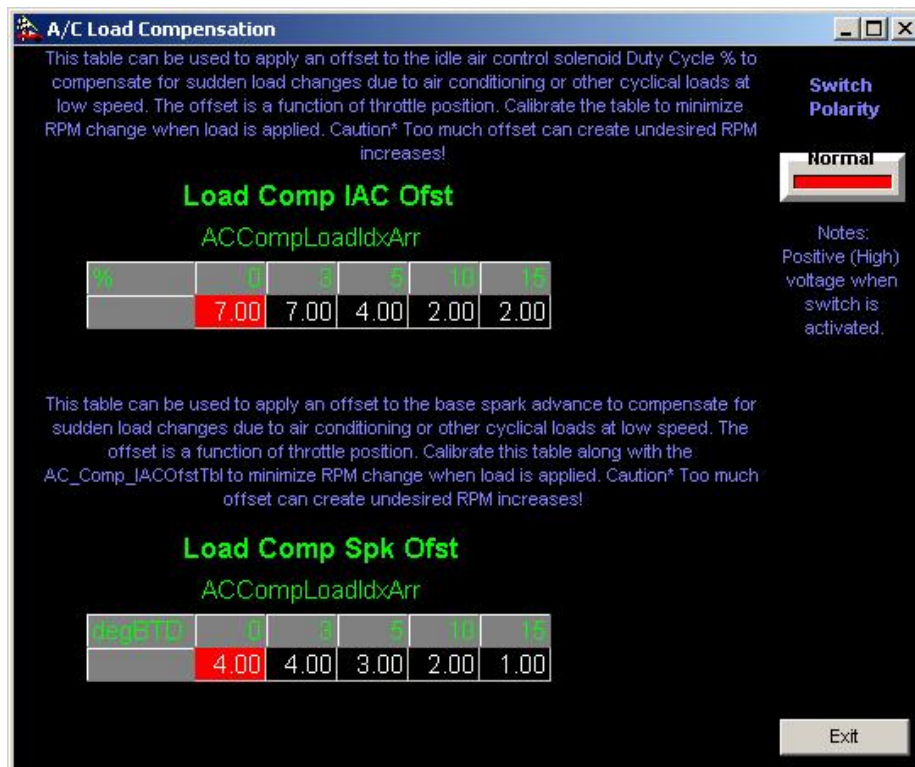
%	0	3	5	10	15
	7.00	7.00	4.00	2.00	2.00

Load Comp Spk Ofst

degBT	0	3	5	10	15
	4.00	4.00	3.00	2.00	1.00

Tips for tuning:

These tables are also available together under the Tools menu when connected for easy tuning. You can set the polarity of the switch if needed.



Generally, the most compensation is required at the lowest speeds & loads. In the tables this would mean the low percentages of throttle opening. The amount of load compensation required decreases with an increase in throttle opening. The tables work together to maintain engine speed when a sudden load is applied. The spark offset table provides the fastest reaction to a load change, and the IAC offset table will provide the extra air required for extended load cycling. Start with the values that are in the tables and make small changes as required to minimize RPM drop. *It is better to have some speed drop than to be too aggressive in tuning these tables.*

WARNING: Do NOT make these table values too large or an RPM increase could result during a load cycling; which could cause undesired acceleration!

4.3.9 IAT Fuel Trim Table



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IAT Fuel Trim Table

IAT Fuel Trim Table (Not Available in Speed density Mode)

In Speed/Throttle (Alpha-N) mode or Speed/Pressure (MAP-N) mode, there is the ability to adjust a global trim for fuel based upon IAT. This can be useful if fueling characteristics change greatly with engine coolant temperature. While not often needed, the **IAT Fuel Trim table** can be helpful in providing a global fuel offset for a variety of intake charge temperatures. This table is not necessary in Speed/Density mode, as charge temperature is automatically compensated for.

IAT Fuel Trim										
IATMidResIdxArr										
mult	-4	23	51.8	78.8	107.6	136.4	163.4	192.2	219.99	248
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Tips for tuning :

The table is a *multiplier* to the base fuel map. It is based on intake air temperature in degrees C. or degrees F. (Whichever you have chosen as your desired units of pressure in the application settings.) A value of "1.00" means that no change is being applied to the base map. This means that a value of 1.00 equals the calibrated base fueling and no change is being applied to the end pulse width of the injector. A value of 1.10 equals 10% more fuel is being delivered than is mapped. 1.15 means that 15% more fuel is being delivered, and so on. Keep the values small. If a large value is required, it probably means that your base fuel map calibration is not optimized, and you should adjust the base fuel map further with a representative coolant temperature. Set the value to 1.00 at normal operating temperature. Calibrate your base fuel map. Retest at various air temperatures and adjust the corresponding trim cell to have the system deliver the fueling required to match your desired mapped AFR at those points.

4.4 3D Chart Manipulation

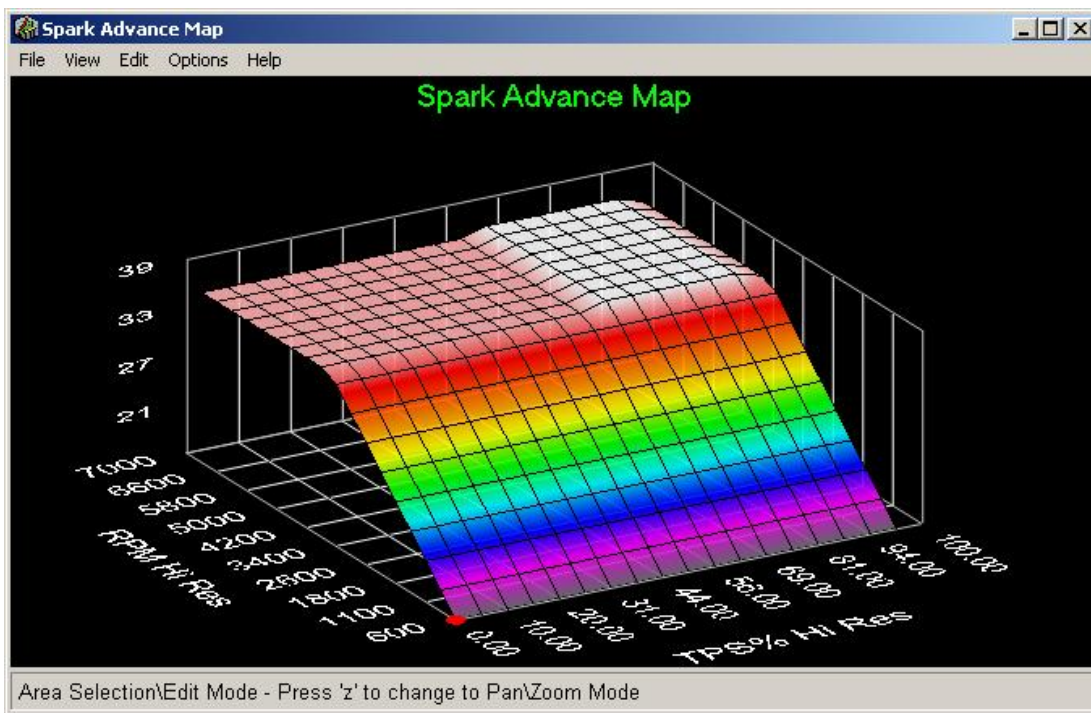


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3D Chart Manipulation

In the following subsections, you will learn the various powerful ways you can interact with a 3D chart to get the view that you need to interpret the data. These methods are easy to use and involve using the correct combination mouse buttons and keyboard keys.

In general, these methods apply to any 3D chart regardless of content.



4.4.1 EDIT Chart Point

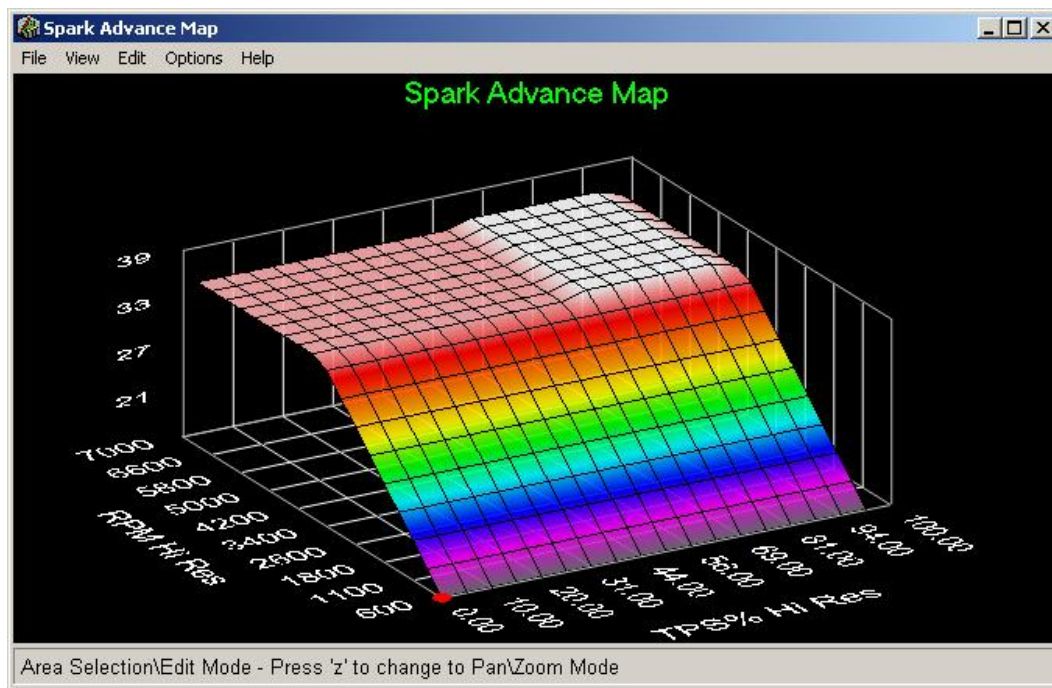


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3D Chart EDIT

You can directly edit the 3D chart by selecting an intersection or group of cells and using the V,B,N, & M keys to increase or decrease the value. The corresponding cell in the table will also be updated. The axis of the chart will automatically scale to the range of values in a chart. You may open multiple charts and tables at once for easy editing. You can resize them as desired, and the software will remember the size and location of each from when they were last closed. The MotoBall will also remember if the user preferred to have it on or off. If it is turned on and a map or table is resized, the system will auto-scroll the table to keep the current running position in the window.

You can use the right click functions to smooth or change whole areas of a chart or table.



You may rotate the chart in any direction to see details of the chart. It is also possible to zoom in on specific areas of interest. Below is the list of functions available with almost every chart and table in the Pro-Tuner system. You can also bring up this menu under the Help section of the online interface, or by pressing Ctrl-H while in any table or chart.

- M - Increments the value(s) of a selected region by 0.1
- V - Decrements the value(s) of a selected region by 0.1
- N - Increments the value(s) of a selected region by 0.01

B - Decrements the value(s) of a selected region by 0.01

CTRL-S - Starts MotoBall (this is the tracking highlight)

CTRL-Q - Stops MotoBall

CTRL-A - Select all.

CTRL-I - Interpolate a selected region. (Interpolate smooths a column, row, or surface based on the value in each corner of the selected area)

CTRL-F - Auto-fill a selected region with a value.

CTRL-O - Offset the value(s) of a selected region by a value. (This would be in the units of the map you are working in: i.e. +2 degrees of spark)

CTRL-P - Offset the value(s) of a selected region by some percentage. (for example; -10% of base fuel pulse width)

CTRL-C - Copy the value(s) of a selected region (to be pasted later)

CTRL-V - Paste copied value(s) into a region

CTRL-Z - Undo

On a Table:

CTRL-T - Increases the font size.

CTRL-Y - Decreases the font size.

CTRL-B - Toggles the bold font.

CTRL-W - Auto fits the table.

On a Chart:

CTRL-R - Resets view.

x - Switches to select/edit mode.

z - Switches to pan/zoom mode. (Hold down ALT to zoom.)

In pan/zoom mode arrow keys rotate and zoom.

Note: When editing a table, you can select all of the cells by clicking in the upper left hand corner of the table.

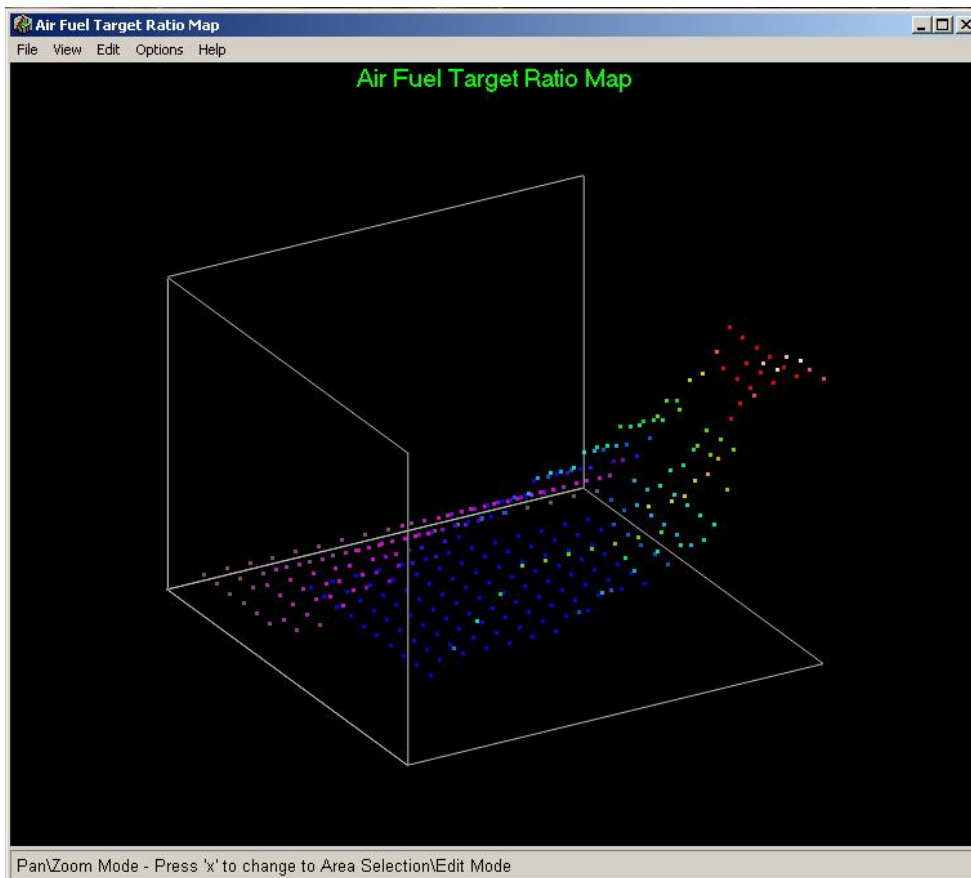
4.4.2 ROTATE



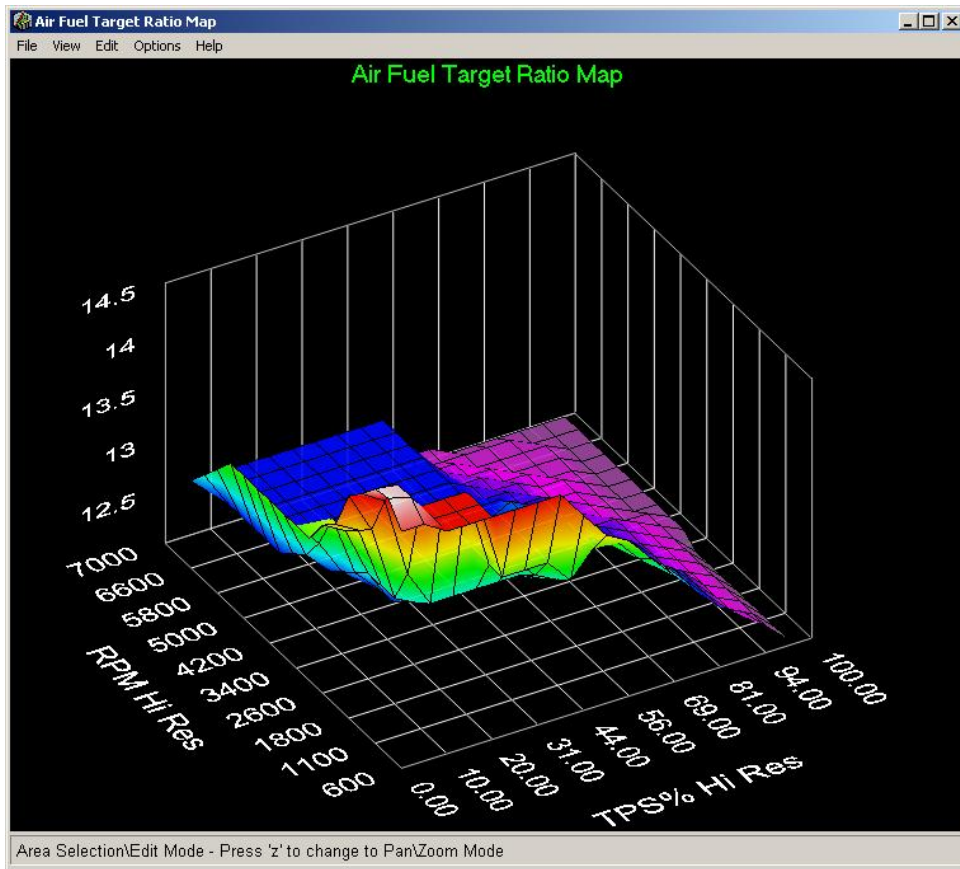
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3D Chart ROTATION

The 3D chart can be **ROTATED** by pressing **Z**. You can then orient the chart view in any direction by holding down the left mouse button while moving the mouse to change the view. While rotating, the grid will take on the appearance below. Releasing the mouse button will redraw the chart in your chosen position.



You can put the view back to the original position by selecting **VIEW / Reset View** or selecting **Ctrl+R**.



4.4.3 ZOOM chart

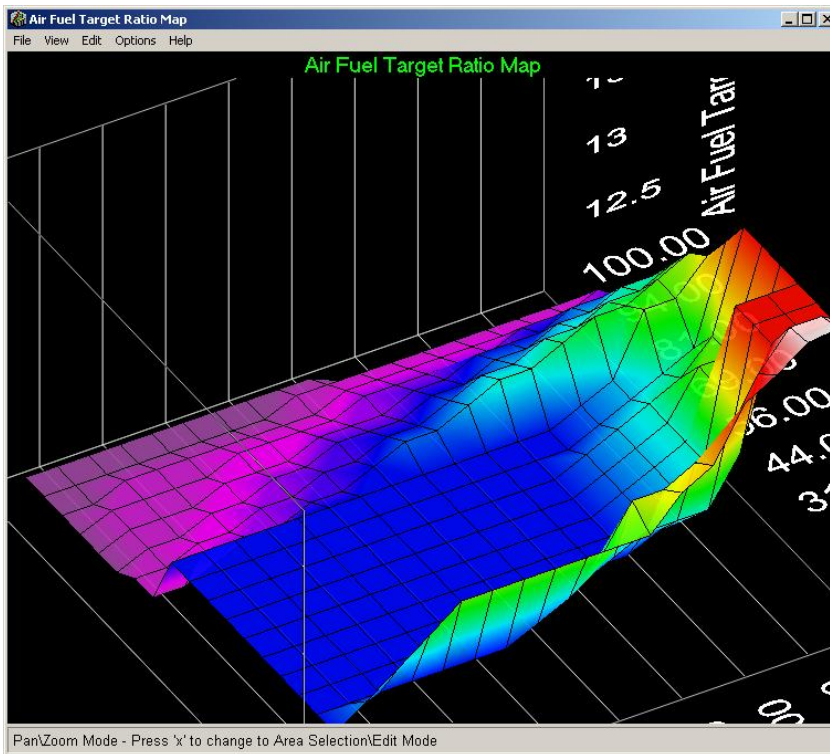


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3D Chart ZOOM

To **ZOOM** the entire chart within the window, hold down the **ALT KEY** and click the **LEFT MOUSE** button and drag. The wire frame cube will show your current zoom level.

Upon releasing the mouse buttons, the window will redraw at your zoom rate.



At anytime you can choose **RESET VIEW** and the view will be rotated and resized to the default view. To **RESET** the view to the previous view, select **View / Reset View "**.

4.4.4 MOVE view



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3D Chart MOVE

To **MOVE** the chart position within the window, hold down the **SHIFT** key and then click the **LEFT MOUSE BUTTONS** and drag it to the desired position within the chart window.

When you release the mouse buttons, the chart will be in the new position. This works particularly well to scroll around a **ZOOMED** chart.

4.4.5 RESET View



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3D Chart RESET VIEW

- At anytime you can choose **RESET VIEW** and the chart view will be rotated and resized to the default view. To **RESET** the view to the previous view, type "**Ctrl +R**" or select **view/reset view**.

4.5 Logging and Data Viewing

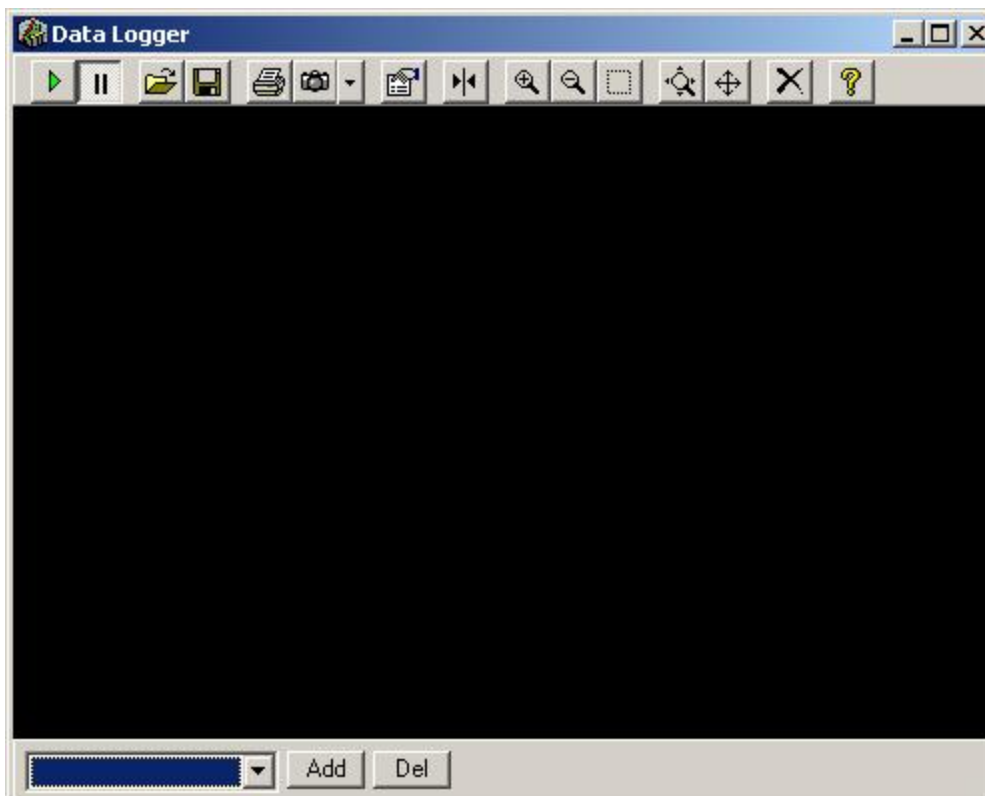


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Data Logging and Data Viewing

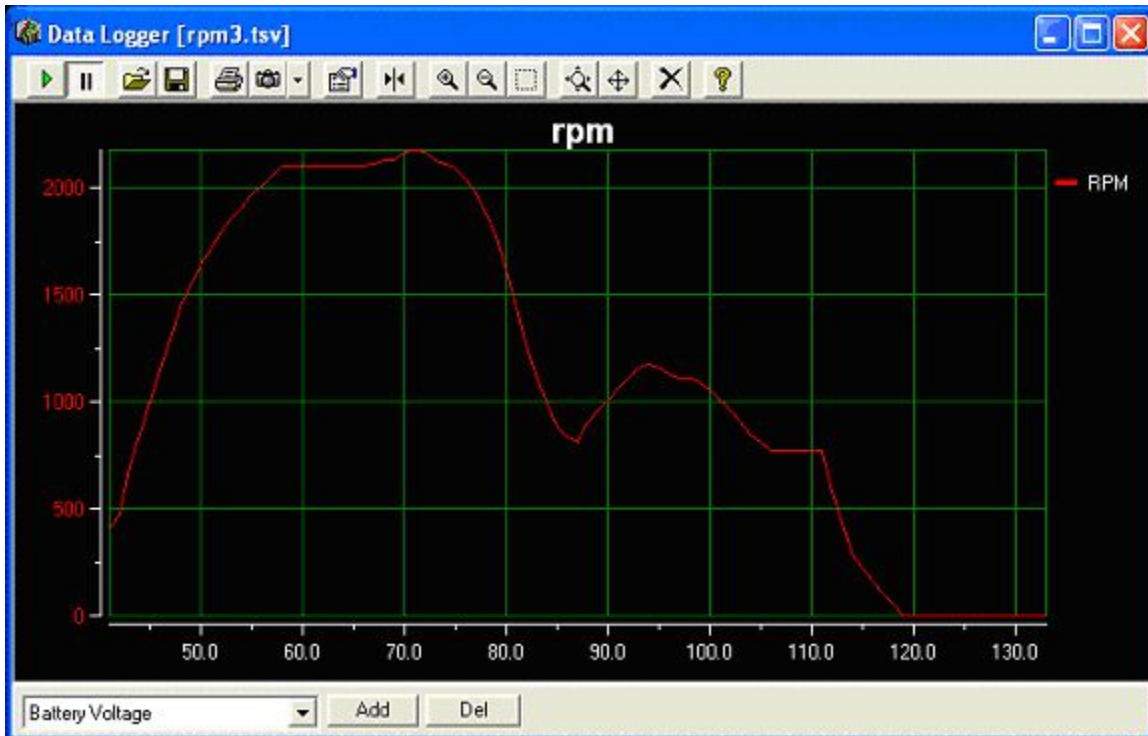
The **Logging** tool is a very powerful and useful way to see what is going on in your system. This tool is available from the main Dashboard by choosing the "**PC DATA LOGGING**" menu option. The same charting functions are also available from the "Flight Recorder" function, which is accessed by choosing the "**FLIGHT RECORDER**" menu option from the "**LOGGING**" menu.

A new Logging window will pop up:



ADD PARAMETER(S)

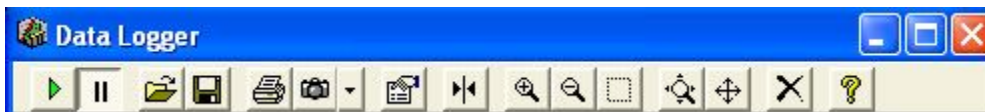
This window allows you to display, save, load and print data captured from the ECU. To get started, choose a parameter from the drop down list in the lower left corner. Then click on the "ADD" button to add it to the plot. Repeat for all the parameters you wish to display.



DELETE PARAMETER(S)

To remove a parameter from the display, click on the parameter on the right side of the display, then click on the "DEL" button.

TOOL BAR BUTTONS



Along the top of the window, you will see several buttons that affect the way the chart displays and helps you manipulate the data. At anytime, you can rest your mouse pointer over one of the buttons for a few seconds and a "TOOL TIP" will display with a short description of the button function.



PLAY/PAUSE LOGGING

Click the green arrow to start a display/recording or to resume display of your chart data after you pause the display (using the || button). When **PAUSED**, the logger is not saving data to the file for later viewing.



OPEN SAVED DATA LOG

Use this button to open a file dialog and pick a previously saved data log for viewing.



SAVE TO FILE

This button will save your data as a tab separated text (TSV) file. Enter a file name and choose a folder in which to save the data.



PRINT

This button will print your data as text output. Choose your printer and printer options to print the data.



IMAGE OPTIONS

This button will present you with options to save the screenshot, print the screen shot or save the screen shot to the clipboard for use in other applications (Word, Excel, email, etc.).



FORMAT OPTIONS

This button will allow you to modify the appearance of your chart by labeling the chart title, etc.



CURSOR

The cursor is a function that shows "markers" in a chart area for a dataset. The cursor will appear as a vertical line with a "tag" that tells position and value on the chosen dataset. To use it, click on the dataset you want to see the cursor for (right side of the screen), the cursor will appear in the color of the dataset on the display. You can "grab" the cursor line and move it left and right to see different values and points in the dataset.



ZOOM IN/OUT

Use these two buttons to ZOOM IN and ZOOM OUT on the entire chart display. Repeatedly clicking on one of the buttons will zoom a magnification step at a time. To use it, click on chart area and then one

or the other button. The entire chart area will then zoom in or out.



ZOOM BOX

To selectively zoom in on a particular area of the chart or dataset, use the ZOOM BOX. To use it, click on button and then click and drag to select the area of data you are interested in on the chart. The chart will zoom in on that area. You can repeatedly "zero in" on an area of the chart by using this button. Each time you zoom in, the precision of the data display increases.



ZOOM AXIS

This button allows you to zoom in and out on an axis and the attached data set. To use it, first click the button. Now click on the axis on the left side of the screen (vertical axis) or the bottom of the screen (horizontal axis) and drag it up or down (vertical axis) or left and right (horizontal axis). The axis will "stretch" or "shrink" in accordance to your mouse movement. This is useful to rescale data and realign it with other displayed datasets.



SCROLL AXIS

Use this button to move an axis and shift your data display on that axis. To use it, first click the button. Now click on the axis (on the left side or bottom of the screen) and drag it up/down (vertical axis) or left/right (horizontal axis).

On a vertical axis, notice how the axis and the data displayed on that axis shift up or down. This is useful when you want to offset a data set to align with a different data set.

On a horizontal axis, this allows you to scroll through the data from front to back and locate items of interest easily.

Other options are available with a **RIGHT CLICK ON THE AXIS**. Particularly useful can be the ZOOM axis feature to zoom the range of the axis to fit the data.



CLEAR CHART DATA

This button will clear the chart data from the screen and allow you to start a fresh recording/display.



HELP

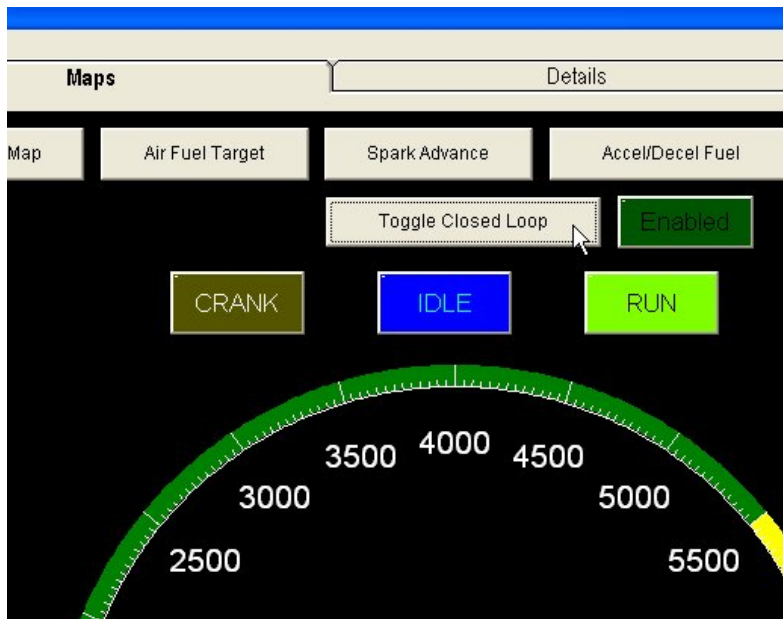
This button displays this HELP file.

4.6 Initial Start Up and Idle Tuning

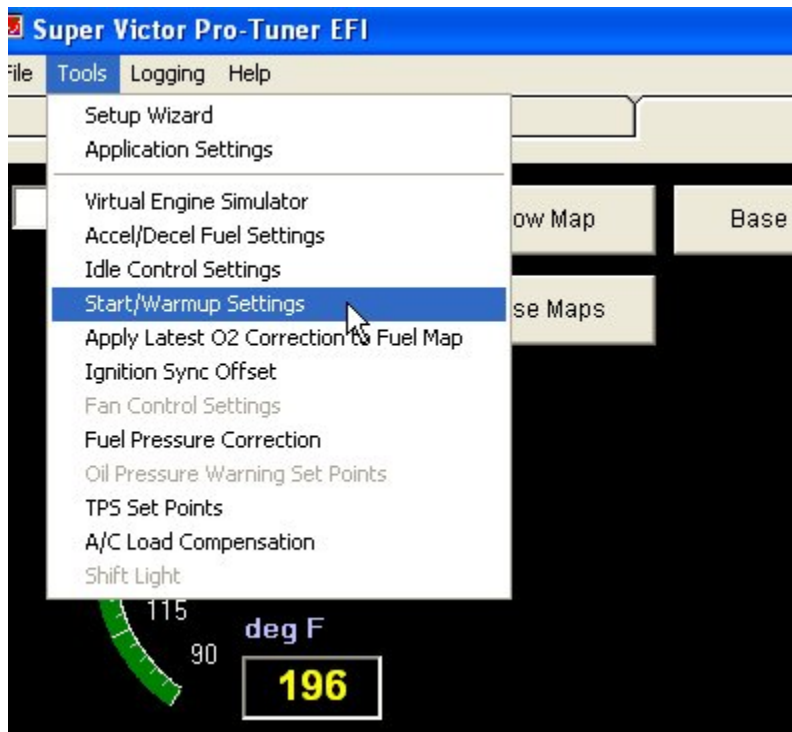


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1. With the key in the on position and the PC connected to the ECU, view the dashboard tab in Pro-Tuner and verify that the intake air temperature and engine coolant temperature indications make sense (indicate near ambient if the engine is cold).
2. Verify that the manifold absolute pressure (MAP) sensor indication makes sense (reads near 0" vacuum).
3. Open and close the throttle and verify that the TPS % indication reads zero at closed throttle and 100% at wide open throttle. If not, repeat the TPS set points procedure outlined in the previous section.
4. Save the calibration by going to "File" and choose "Save Current Calibration to Disk". Choose a filename and save the file as a baseline.
5. Verify correct fuel pressure (40-45 psi).
6. In the "Maps" tab, Click on the "Toggle Closed Loop" button to disable O2 feedback for initial setup and tuning. Verify that the "Enabled" indicator is dark and not turned ON.



7. Go to the "Tools" menu and choose "Start/Warmup Settings".



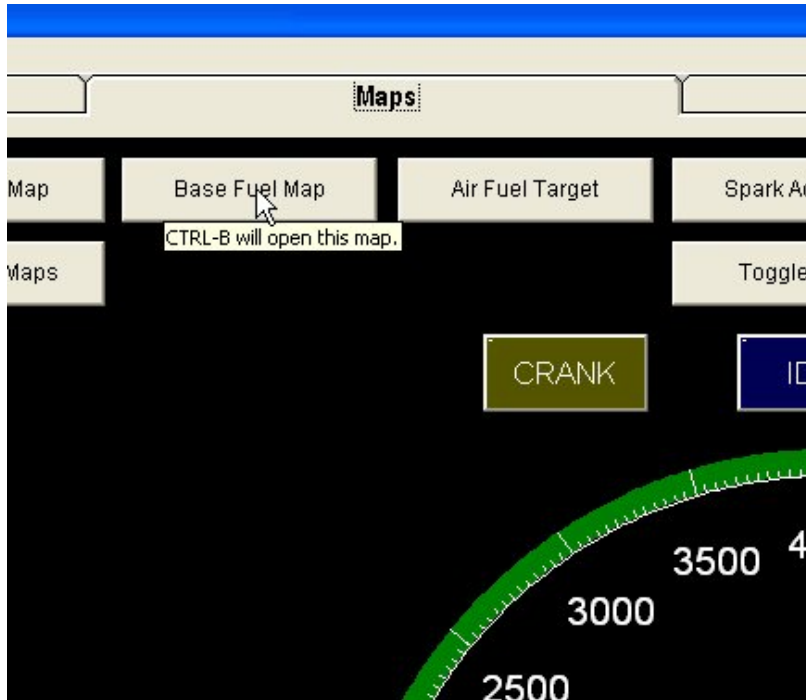
8. Highlight the entire CrankFuelMap table as shown.

83 F		0%		14.7:1		0%		0.0 d	
CrankFuelMap									
Crank RPM									
		0		100		200			
ECT Lo Res	-22	30.000	27.500	25.000	2				
	41	23.750	21.880	20.000	1				
	95	17.500	16.250	15.000	1				
	158	11.250	10.630	10.000					
	221	10.000	9.250	8.500					
WarmUp Initial Mult									
ECT WarmUp									

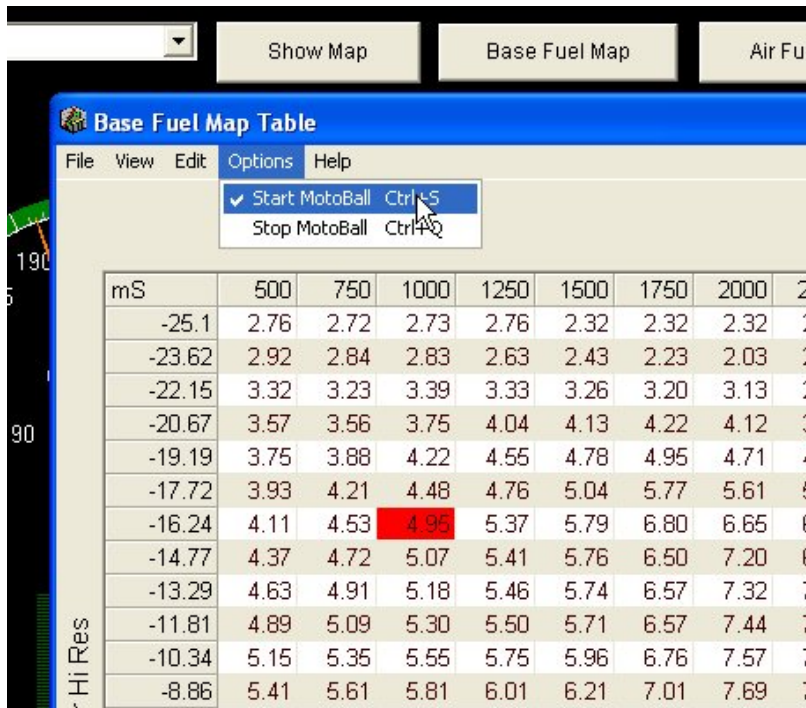
9. Crank the engine. If it doesn't start after approximately 5 seconds, use the V, B, N or M keys to increase or decrease the values in the CrankFuelMap. Repeat until the engine starts and runs.

10. If it starts and dies after a few seconds, click on the "Maps" tab at the top of the

screen then click on the "Base Fuel Map" button.



11. In either the base fuel map table or graph view, go to "Options" and select 'Start Motoball'. This will give you a graphical indication of where the ECU is accessing the table values.

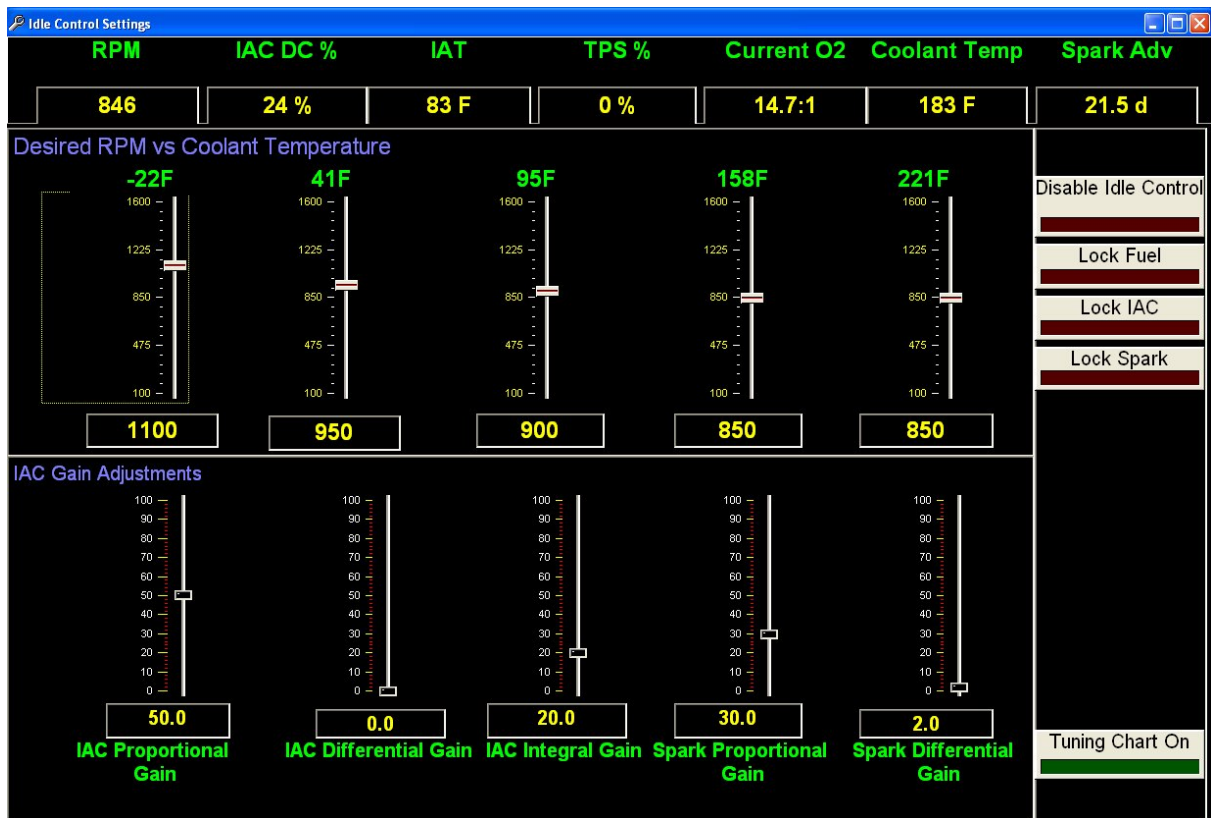


12. In the table view of the main fuel map, highlight the low RPM area of the map by left

clicking and dragging to select table values.

Base Fuel Map Table										
File View Edit Options Help										
Base Fuel										
RPM										
mS	500	750	1000	1250	1500	1750	2000	2250	2500	3000
-25.1	2.76	2.72	2.73	2.76	2.32	2.32	2.32	2.20	2.20	2.20
-23.62	2.92	2.84	2.83	2.63	2.43	2.23	2.03	2.00	2.13	2.13
-22.15	3.32	3.23	3.39	3.33	3.26	3.20	3.13	2.45	2.07	2.07
-20.67	3.57	3.56	3.75	4.04	4.13	4.22	4.12	3.61	3.11	3.11
-19.19	3.75	3.88	4.22	4.55	4.78	4.95	4.71	4.41	4.11	4.11
-17.72	3.93	4.21	4.48	4.76	5.04	5.77	5.61	5.21	4.81	4.81
-16.24	4.11	4.53	4.95	5.37	5.79	6.80	6.65	6.17	6.26	6.26
-14.77	4.37	4.72	5.07	5.41	5.76	6.50	7.20	6.87	7.19	7.19
-13.29	4.63	4.91	5.18	5.46	5.74	6.57	7.32	7.05	7.47	7.47
-11.81	4.89	5.09	5.30	5.50	5.71	6.57	7.44	7.23	7.73	7.73
-10.34	5.15	5.35	5.55	5.75	5.96	6.76	7.57	7.42	8.01	8.01
-8.86	5.41	5.61	5.81	6.01	6.21	7.01	7.69	7.60	8.27	8.27
-7.38	5.68	5.88	6.07	6.27	6.47	6.97	7.81	7.79	8.54	8.54
-5.91	5.94	6.14	6.33	6.53	6.72	7.22	7.93	7.97	8.81	8.81
-4.43	6.21	6.40	6.59	6.79	6.98	7.47	8.05	8.15	9.08	9.08
-2.95	6.47	6.66	6.85	7.05	7.24	7.73	8.18	8.34	9.35	9.35
-1.48	6.74	6.92	7.11	7.30	7.49	7.98	8.30	8.52	9.61	9.61
0	7.00	7.19	7.37	7.56	7.75	8.24	8.42	8.70	9.89	10.00

13. Use the V, B, N or M keys to increase or decrease the values in the table until the engine starts and idles smoothly.
14. As the engine warms up, continue to adjust the values in the low RPM / idle area of the main fuel map to maintain the desired air/fuel ratio.
15. While the engine is warming up, check for leaks.
16. An engine coolant temperature indication is included in all Pro-Tuner screen tabs. Monitor your engine temperature as the engine is warming up. If it begins to overheat, shut down and resolve the problem before continuing the tuning process.
17. When the engine is warm and idling smoothly, go to "Tools" and select "Idle Control Settings".



18. Compare the desired RPM vs Coolant Temperature value to the actual RPM value. If they are very close to one another and the IAC DC% is varying between 20% and 30%, the idle control system is tuned and functioning properly. If the actual RPM is lower than the desired value and the IAC DC% is very high (greater than 50%), adjust your throttle blade set screw to open the blades slightly. If the actual RPM is higher than the desired value and the IAC DC% is very low (less than 10%), adjust your throttle blade set screw to close the blades slightly. Keep adjusting and checking until the actual engine RPM is very near the target and the IAC DC% is varying between 20 and 30%.

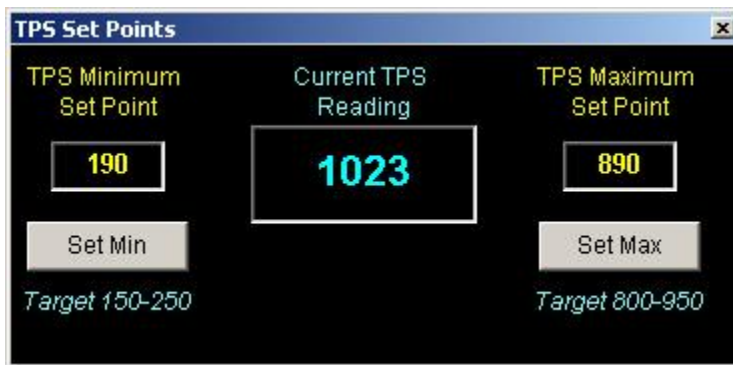
4.7 TPS Set Points



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Throttle Position Sensor Set Points



This tool is accessed via the **TOOLS** Menu and selecting **TPS Set Points**. This tool is used to ensure the Throttle Position Sensor (TPS) is correctly adjusted for the system "Baseline". It changes the voltage value of the sensor into a percentage for easy reference during calibration. The system needs an accurate measure of the throttle position to determine the throttle blade angle for VE calculations and scaling the TPS range.

To adjust the set points, first ensure that the throttle linkage is correctly adjusted (no tension at idle with throttle position closed and **AGAINST THE THROTTLE STOP SCREW**) and no binding or obstructions with the throttle at Wide Open Throttle (WOT).

MINIMUM SET POINT

- Make sure the throttle is fully closed and there is not linkage binding or excess throttle stop adjustment.
- You should see an A/D count in the **Current TPS Reading** somewhere in the range of **150 - 250 A/D counts** .
- **IF YOU DO NOT SEE 150 - 250 counts**, carefully check for mechanical binding or jammed throttle blades. If there is no mechanical binding or jamming, then adjust the THROTTLE STOP SCREW until you see a value of about 200 A/D counts (as a starting point).
- Once you are satisfied the reading is stabilized in the 150-250 A/D range, click the **"Set Min"** button to lock in the value.

MAXIMUM SET POINT

- Be sure to remove any obstructions to Wide Open Throttle, such as floor mats, binding linkage, transmission kick down cable too tight, etc.
- Floor the throttle (allowing the throttle blades to fully open). Visually check that the blades are **fully** open and the linkage is not binding.
- The reading now should be **875- 950 counts** with the linkage correctly adjusted (throttle blades fully open) .
- Once you are satisfied that the reading is within the accepted range, click the "**Set Max** " button **WHILE HOLDING THE THROTTLE AT THE WIDE OPEN POSITION!**

4.8 Ignition Sync Offset

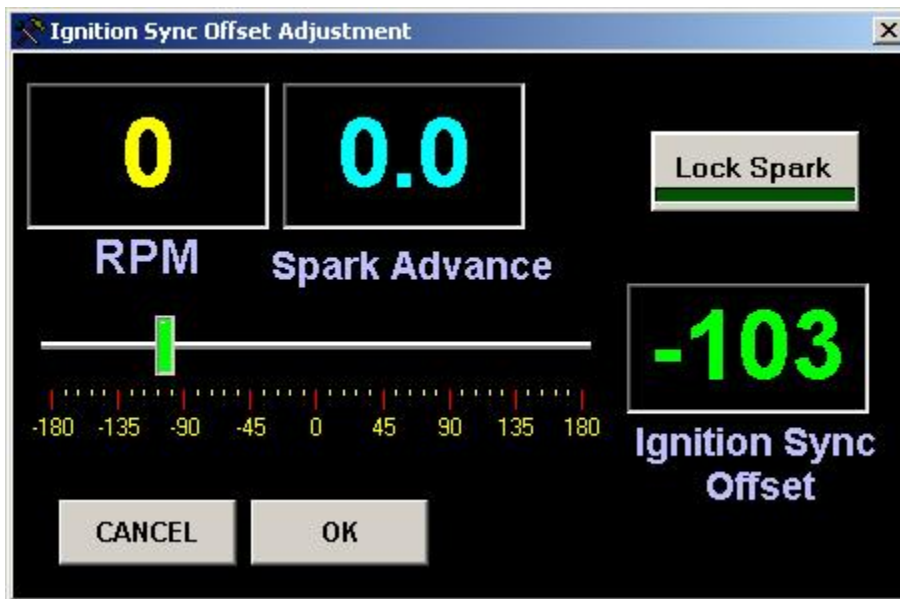


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Ignition Sync Offset Tool

It is necessary before beginning any calibration efforts to set the ignition timing reference (Ignition Sync). The function of the Ignition synchronization is to match the actual Top Dead Center location of the #1 cylinder - to the software so that the system displays the timing events that the engine actually sees. (The timing light should agree with the laptop). The Ignition Sync offset tool is used to make the adjustments to the Ignition Sync offset even while the engine is running. While you are able to set the offset in the setup wizard; there may be instances where you might need to make a minor adjustment of the offset "on the fly" to make up for errors in the degree wheel, timing markings, or erroneous timing light.

The control panel allows you to change the offset by either typing in the Ignition Sync Offset text box or by moving the slider. RPM and Spark Advance are displayed to help you synchronize with a timing light (if necessary). In addition, you can lock the spark advance by clicking the "Lock Spark" button. This insures that the timing will not be changed by the ecu while you synchronize the offset.



Tuning Tips:

Make sure your distributor is setup per instructions before setting the ignition sync!

Run engine at about 2200 rpm with timing light on #1 cylinder and an accurately setup timing pointer on the damper. Lock the spark by depressing the Lock Spark button. Note

the spark advance value displayed. Check the actual spark advance with the timing light. Move the slider or type in the value higher or lower by moving the number of degrees of difference between the readings. For example, if the display shows 18 degrees and the timing light shows the engine at 22 degrees, move the offset 4 degrees to bring the actual timing into agreement with the display. Recheck timing and adjust until both readings agree. Unlock spark. Save calibration.

No further adjustment should be necessary unless the distributor is removed for service. Always recalibrate the offset if distributor is disturbed for any reason.

4.9 OFFLINE Mode



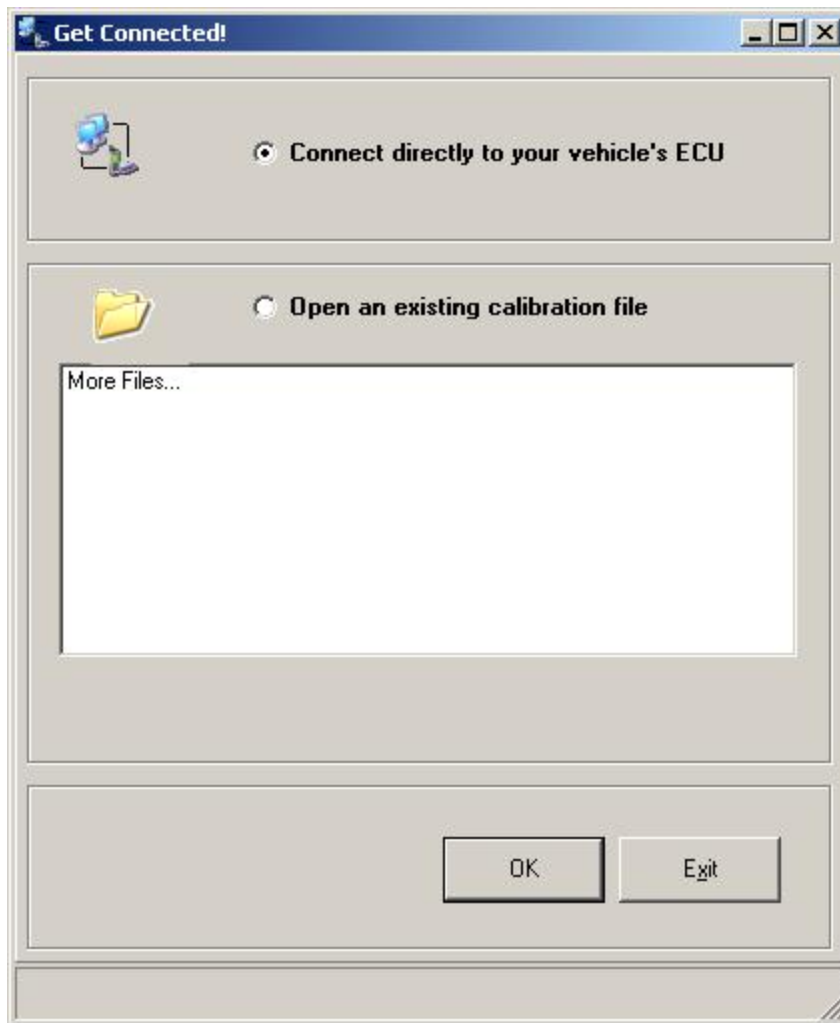
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OFFLINE Mode

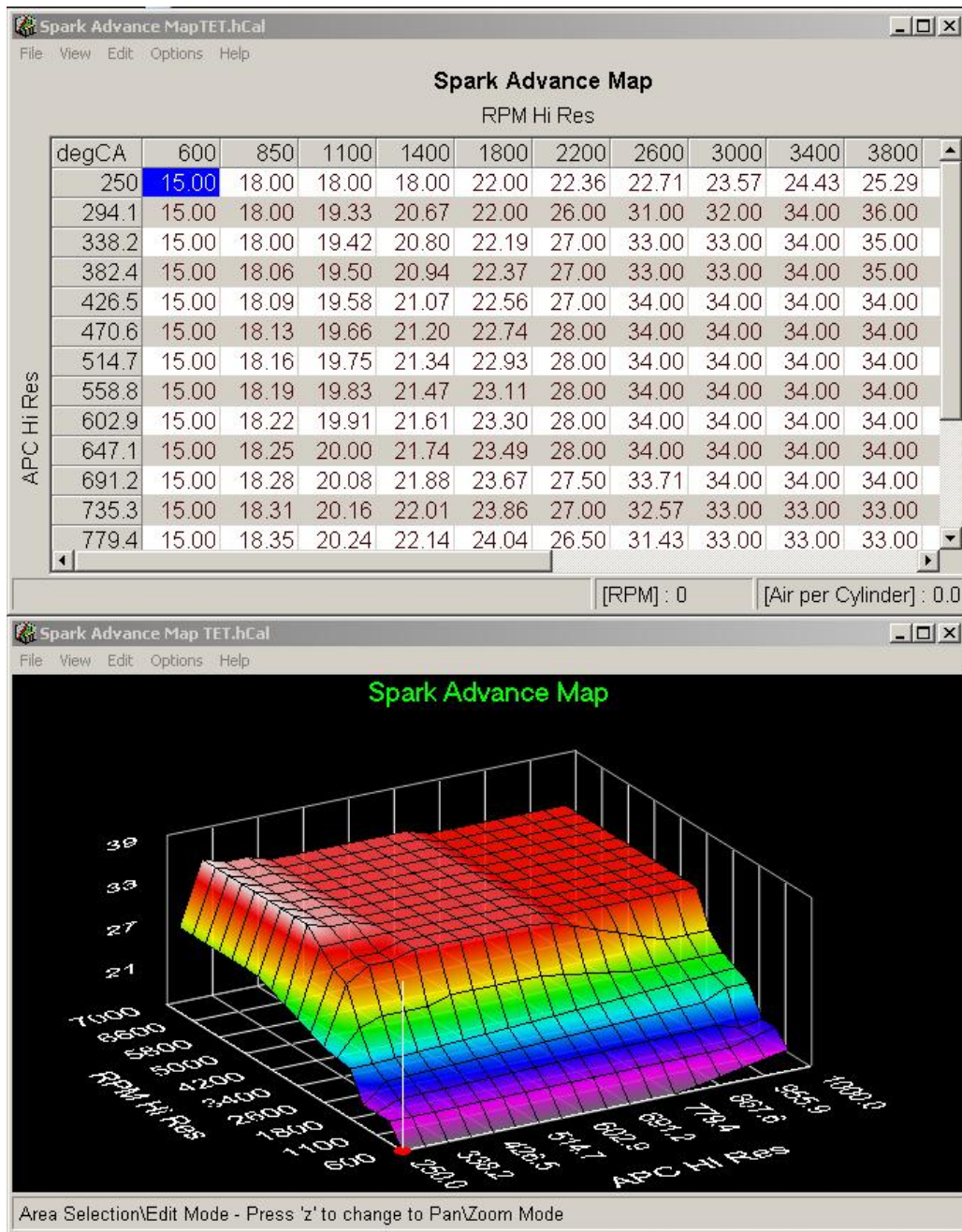
OFFLINE mode is used to edit a "tune" or "HCAL" without the laptop connected to the vehicle. It allows you to **LOAD** an HCAL, edit various maps and parameters, save it to disk and then use it later when connected to the vehicle. You can also send the HCAL files to another Pro Tuner User to share a "tune".

To go **OFFLINE**, start the application normally, and then choose "**Open an existing Calibration File**". You can choose a file that has been previously opened from the list or click on "More files ..." to browse your hard disk for the desired file(s).



Once the desired file has been chosen, you will be presented with a Control Panel that allows you to Edit elements of an HCAL file.

To edit the various parameters, click on the desired button. The "**EDIT ... Map**" buttons will allow you to edit the various tuning Maps just like you do when online.



Some of the options (such as Auto Refresh) are not available offline (for obvious reasons); so they may inform you that they are not available **OFFLINE**.

The "**EDIT ... Settings**" buttons allow you to use the same interface as you use online to set various parameters. Again, some items are not available **OFFLINE** so they are either grayed out or not on the form. For example, in the **OFFLINE Startup/Warm up screen**, you'll notice the readings along the top are grayed out, since you are not connected to the ECU. Similarly, the various buttons along the right hand side are also grayed out.

Startup / Warmup Settings

RPM: 0 | Coolant: 0 F | Intake Air: 0 F | TPS: 0% | AFR: 0.0:1 | IAC DC %: 0% | Spark Adv: 0.0 d | Warm Up Fuel Multiplier: 0.00

Crank IAC DC% vs Coolant Temp

Sliders: 80%, 80%, 80%, 80%, 70%

Crank Spark Advance (degrees) vs RPM

Sliders: 13 d, 16 d, 18 d, 20 d, 22 d

Normal Operating Temperature Set Point: 300 F

CrankFuelMap
CrankRPMLoResIdxArr

	0	100	200	300	400
ECTLoResIdxArr	30.000	27.500	25.000	22.500	20.000
22	23.750	21.880	20.000	18.120	16.250
44	17.500	16.250	15.000	13.750	12.500
66	11.250	10.630	10.000	9.380	8.750
88	10.000	9.250	8.500	7.750	7.000

WarmUp Initial Mult
ECT_KeyUpIdxArr

	40	110	160	210	260	310	360	410	460	510
	1.25	1.22	1.18	1.15	1.08	1.04	1.02	1.00	1.00	1.00

WarmUp Filtr Const
ECT_KeyUpIdxArr

	40	110	160	210	260	310	360	410	460	510
	180	143	107	70	53	45	33	20	5	0

Offline

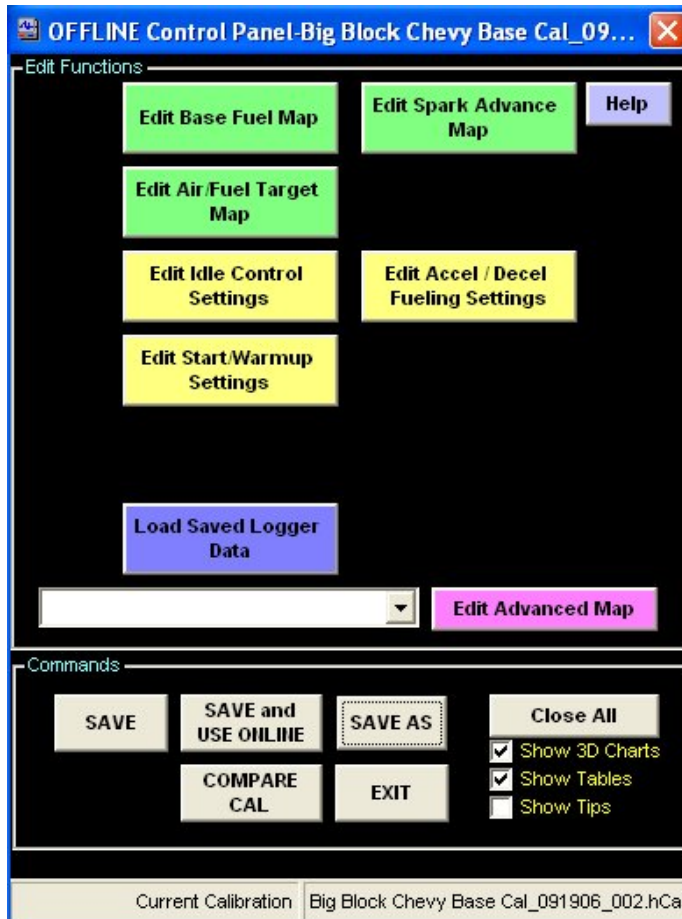
OFFLINE editing and behavior is discussed in more detail in the following sections.

4.9.1 OFFLINE LOAD



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OFFLINE LOAD



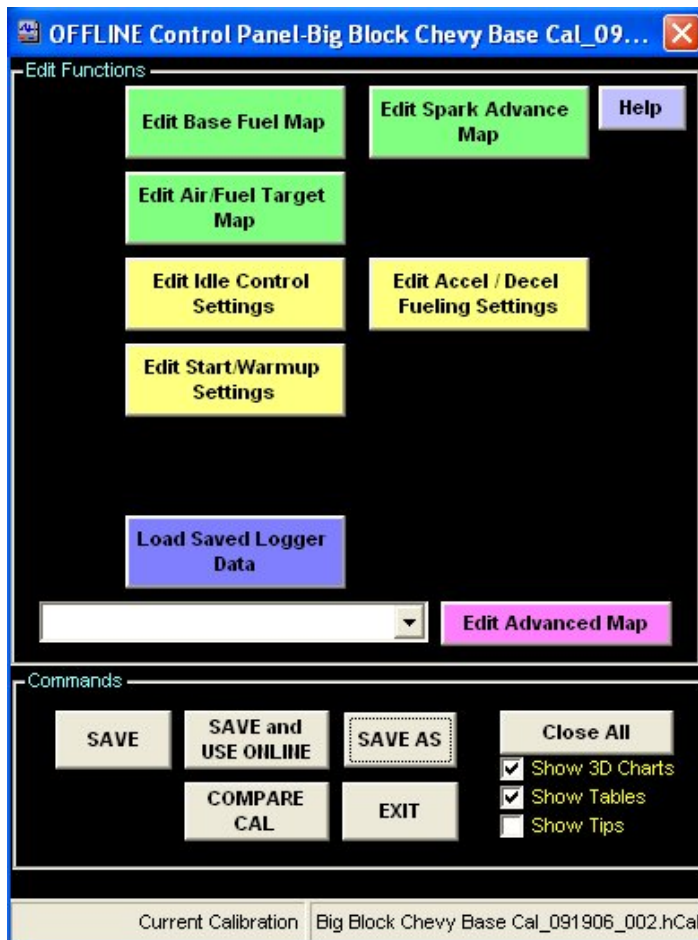
While in the **OFFLINE** mode, you can load any save HCAL file by choosing the "**LOAD**" button. This will populate the MAP's and other editable parameters and allow you to manipulate them. You not only can make and save changes to a calibration offline, but you can open multiple cal's offline with the compare cal button. With two or more calibrations open, you may copy and paste maps from one cal to another if desired. You can also edit advanced maps from the drop down list and select display preferences in the lower right corner of the panel.

4.9.2 OFFLINE SAVE AS

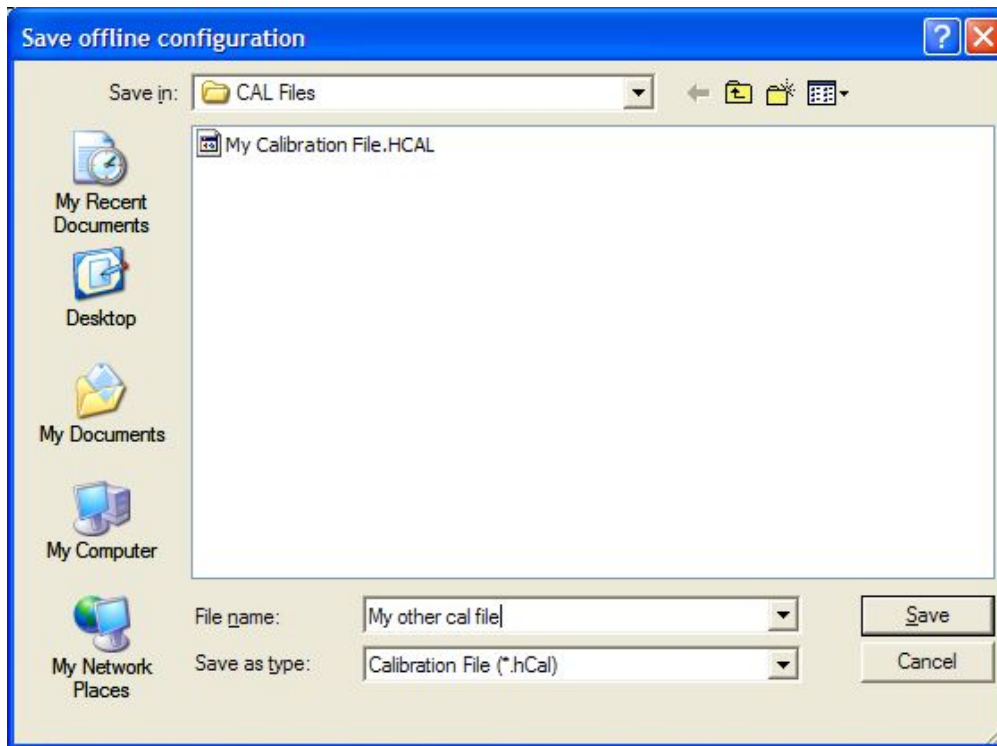


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OFFLINE SAVE AS



To **SAVE** changes you have made to a calibration with a new file name, choose the "**SAVE AS**" button. This will prompt you to enter a filename and save it to the disk.



4.9.3 OFFLINE SAVE



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OFFLINE SAVE

To **SAVE** your calibration changes to the same file as you loaded or imported, choose **SAVE**.

4.9.4 OFFLINE SAVE and USE ONLINE



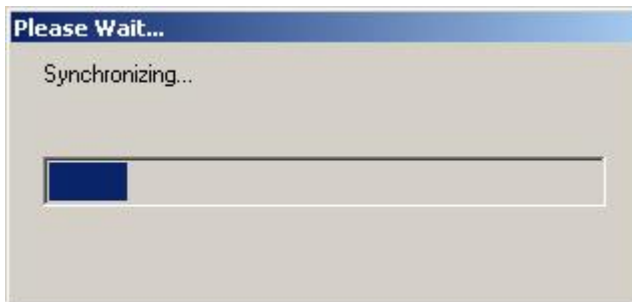
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OFFLINE SAVE AND USE ONLINE

To **SAVE** your calibration changes and then use them with a connected ECU, choose the **SAVE and USE ONLINE** button. You will first be notified that the file has been saved reminded to check your connection.



The calibration will be applied to the ECU ...



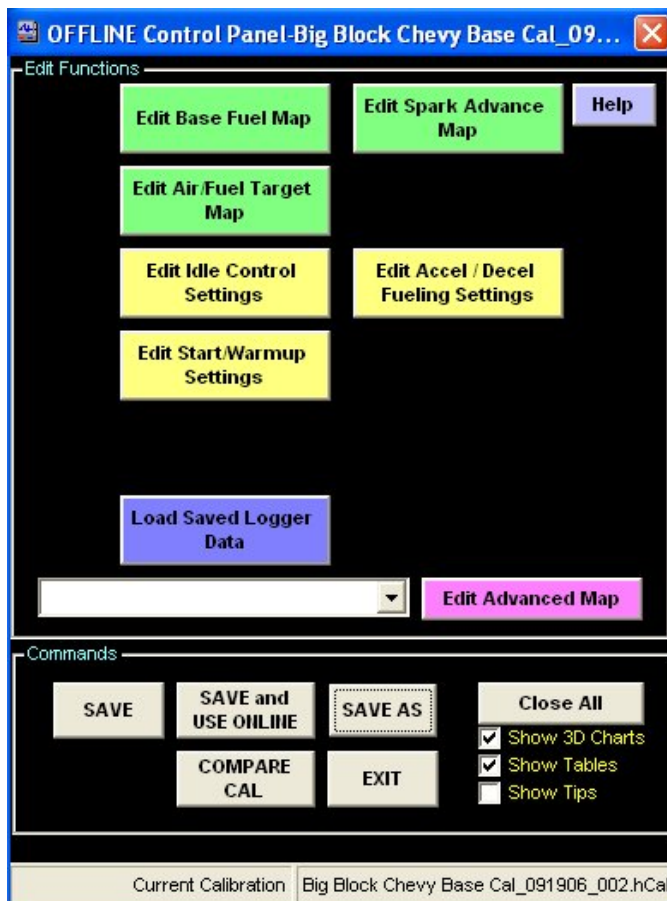
You will then be connected to the ECU and ready for online operation.

4.9.5 View Logger Data

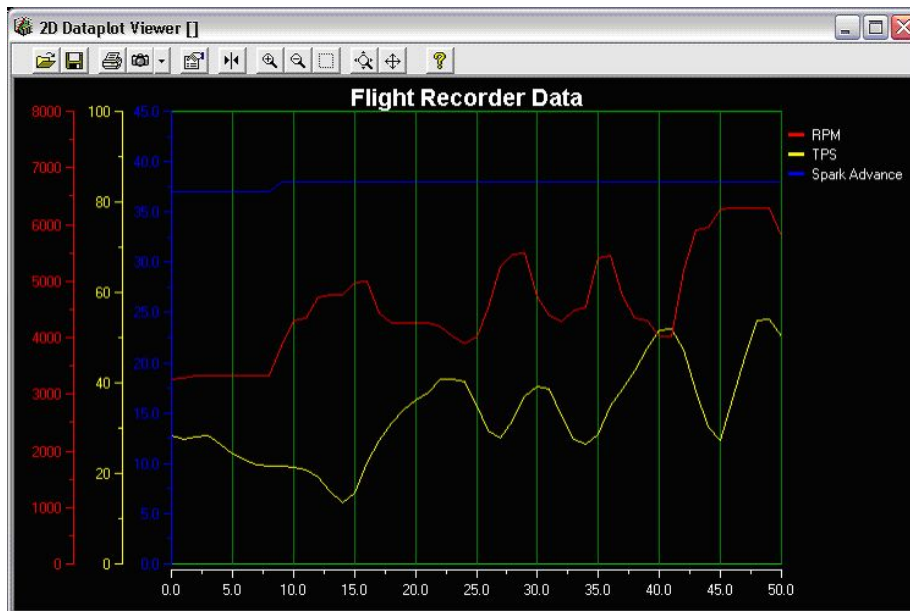


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Viewing Logger Data



To view previously captured **PC Logger Data** or **Flight Recorder Data**, simply choose "Load Saved Logger Data" from the **OFFLINE control panel**. A viewer window will then allow you to load and view any previously saved data.



5 Advanced Tuning with the Pro Tuner System



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Advanced Tuning with the Pro Tuner System

This section deals with many of the more advanced tools and techniques to use with your Pro Tuner system.

5.1 Warm Up Fine Tuning



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Warm Up Fine Tuning

Starting and Warm up calibration is done through the following screen:

Startup / Warmup Settings

RPM: 0 | Coolant: 77 F | Intake Air: 77 F | TPS: 1% | AFR: 14.7:1 | IAC DC %: 0% | Spark Adv: 0.0 d | Warm Up Fuel Multiplier: 0.00

Crank IAC DC% vs Coolant Temp

Sliders for temperatures: -22F, 41F, 95F, 158F, 221F. Values: 80%, 80%, 80%, 80%, 70%.

Crank Spark Advance (degrees) vs RPM

Sliders for RPM: 0, 100, 200, 300, 400. Values: 13 d, 16 d, 18 d, 20 d, 22 d.

Normal Operating Temperature Set Point

Slider: 300 F

CrankFuelMap

ECTLoResidArr	0	100	200	300	400
100	140.000	130.000	120.000	110.000	100.000
110	130.000	112.500	103.750	95.000	85.000
120	110.000	105.000	95.000	80.000	70.000
130	83.750	77.500	71.250	65.000	55.000
140	65.000	60.000	55.000	50.000	40.000

WarmUp Initial Mult

ECT_KeyUpldxArr	0	10	15	20	25	30	35	40	45
1	1.25	1.22	1.18	1.15	1.08	1.04	1.02	1.00	1.00

WarmUp Filtr Const

ECT_KeyUpldxArr	0	10	15	20	25	30	35	40	45
1	180	143	107	70	58	45	33	20	5

Stall | COM1

The Crank IAC slide controls will set the amount of crank airflow vs. engine coolant temperature.

The Crank Spark Advance will set the amount of spark advance during cranking. It can be varied according to crank rpm. Start by tuning the 0-100 sliders conservatively, this will reduce cranking loads on your starter. Adjust the other sliders as required for best start ability. The 100 and 200 rpm sliders are most critical, as that is generally the cranking speed range of most engines.

In the upper right hand side of the page is the crank fueling map. Crank fuel is mapped against rpm and coolant temperature. The units are in FPC (Fuel Per Cycle) in mg/cyl. when running Speed/Density mode. In Alpha-n and MAP-n modes, the crank fueling is entered as a pulse width. Adjust as needed to provide the most reliable starting and minimum start times. Remember too much fuel could flood the engine. Again, focus on the values closest to your crank speed. Taper down fueling as speed increases and as temperature increases. Too much fuel at the higher speeds can cause instability during the initial start and flare.

Below the crank fueling map is the Warm Up fueling multiplier map. This map controls fuel enrichment during warm up. It is oriented against startup coolant temperature. The rate at which the multiplier decays is set in the table below the mult table and is defined in Seconds. The mapped value for the Warm Up Initial Mult is a multiplier with a value of 1.00 not applying any change to base fuel target, 1.05 is 5% rich, and so on.

NEVER put a value of less than 1.0 in the map.

Reduce warm up fueling as load and temperature increase.

ALWAYS keep a value of 1.00 in the far right column.

A value other than 1.00 will offset fueling during normal operation!

Set the Normal operating temperature set point slide control to your thermostat's value.

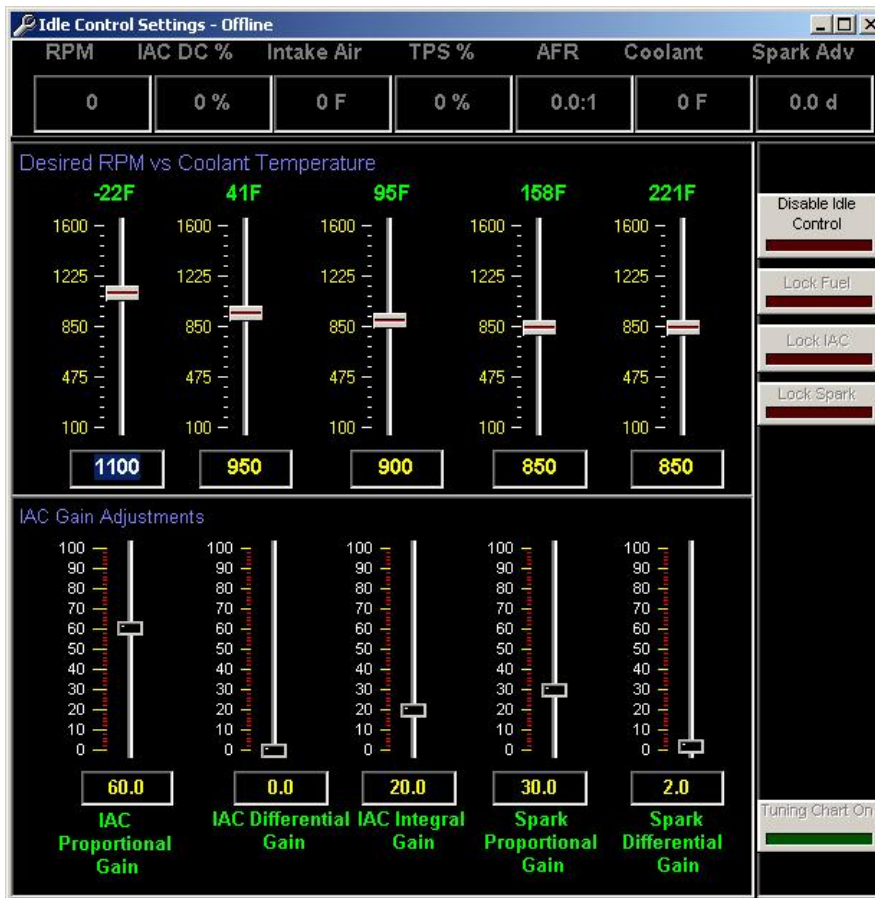
5.2 Idle Fine Tuning



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Idle Fine Tuning

Idle calibration is one of the most important tuning parameters in achieving good stability and optimum drive-ability. The Edelbrock idle tuning interface allows great flexibility while in an easy to use format.



The idle screen contains 3 major areas:

- **The idle speed control panel** - (top array of slide controls) Lets you control the idle speed set point of your engine. The speed can be set for different operating temperatures. Usually, a cold start engine will run best with the set point slightly elevated. As the engine warms up, the set point will change - depending upon how you have the values calibrated.

- **The idle control gains** - (bottom array of slide controls) will tune the behavior of the idle controller. During idle mode, your ECM will control the idle speed by automatically adjusting spark advance and idle airflow. These sliders let you tune the system for your combination.

As you increase the gains, the controller will become more aggressive. If the idle droops severely and the controller is slow, you may want to increase the gain to prevent stalling or other problems. If the gains are too aggressive, the engine will become unstable, surge, or otherwise be too erratic.

You need to experiment with your engine to find the right combination of gains for the Idle Air Control valve (IAC) and the Spark control.

- **The user command buttons** on the right side of the panel contain important aids to tuning your idle. By depressing the Tuning Chart button, a tuning chart will come up - displaying your spark, idle speed, and IAC duty cycle.

This running chart should be used to aid you in deriving the most stable idle your engine is capable of. you can monitor the rpm fluctuation and use the gain sliders to minimize it.

Also available are buttons to lock fuel and/or lock the spark. This is very helpful to isolate the interaction of one or the other. For instance, by depressing the spark and fuel lock button, the spark will not be allowed to move; letting you see the tuning effect of the IAC only on the engine's stability. The theory behind the PID gains is not covered within this document, but many resources are available for those interested in learning more about it.

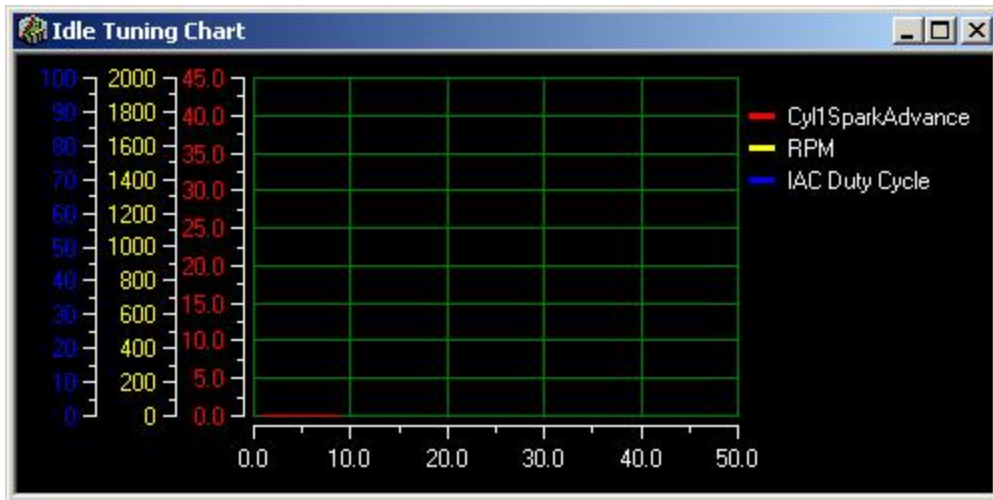
Tuning Tips:

- **Tune only enough to get the engine idling reasonably.**
- **Set the throttle blade to provide 30% IAC duty cycle when at operating temperature and no load on engine.**
- **Rescale the TPS sensor using the TPS SETUP feature under the "Tools" menu.**
- **Then complete ALL base calibration mapping on the spark, AFR target, and VE maps.**

The values in these base maps will affect your idle tune, so you will want to finalize them before spending a lot of time fine tuning idle quality. Make sure spark, fuel, and VE are smooth and relatively flat at the idle set point.

Once you have completed all base map calibrations and are ready to optimize the idle, start by having the P,I, and D gains as low as possible.

The most common error is tuning the controller too aggressively. Gains too high will cause unstable running. If the gains are too low, the idle controller will not react fast enough; causing instability, RPM variation, or engine stalling on hard deceleration. USE THE TUNING CHART BUTTON TO DISPLAY A RUNNING CHART OF IDLE PARAMETERS. TUNE THE PARAMETERS TO OBTAIN THE LEAST RPM VARIATION (SMOOTHEST IDLE).



Generally, you will want to use very little if any D gain, slightly more P gain, and fairly small I gains. Small adjustments make significant changes. Tune the gains at operating temperature. Use the minimal gains required to provide smooth idle and prevent surging or stalling.

Gain (Differential)

This controls the dampening affect of a system. Example: Increasing the Differential gain for an IAC will control how much the IAC anticipates a change and how fast it reacts to an input. The D term deals with the "rate of change" of the parameter. The faster the parameter is nearing or going away from set point - the D term output will increase.

Gain (Integral)

This controls the acceleration based on change, or basically the how fast the rate of change is adapted or integrated. Example: Increasing the Integral Gain on an IAC will make it change faster and be more "sensitive".

Gain (Proportional)

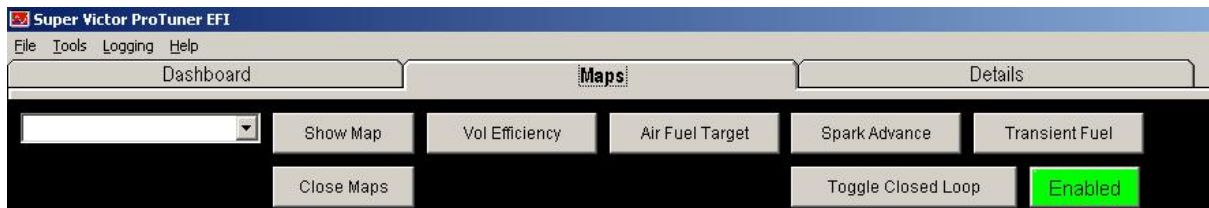
This controls the resistance to change or "stiffness" of the system. Example: Increasing the Proportional gain for an IAC will affect how long it takes to react or change. The larger the change (or "error" based on current position) the harder the actuator is driven. The P output is proportional to the error.

5.3 Toggle Closed Loop



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Toggle Closed Loop



This feature toggles on/off the **Closed Loop Correction (CLC)** feature.

The driver's side sensor is always the primary sensor. Always plug into the driver side only when using a single sensor. If using dual sensors, the system will perform the closed loop correction based upon the leanest bank's feedback.

The **Closed Loop** feature uses the O2 sensor to make fueling corrections as part of the Learning/Adaptation feature. There may be situations where you wish to **DISABLE** this feature so that you can make adjustments to the VE map or Air Fuel Target map without the system adapting the CLC map.

In that case, you would toggle the Closed Loop Feature to *DISABLED* (Green LED will be dark) and then make your changes. This will disable the Closed Loop control until you toggle the button back on.

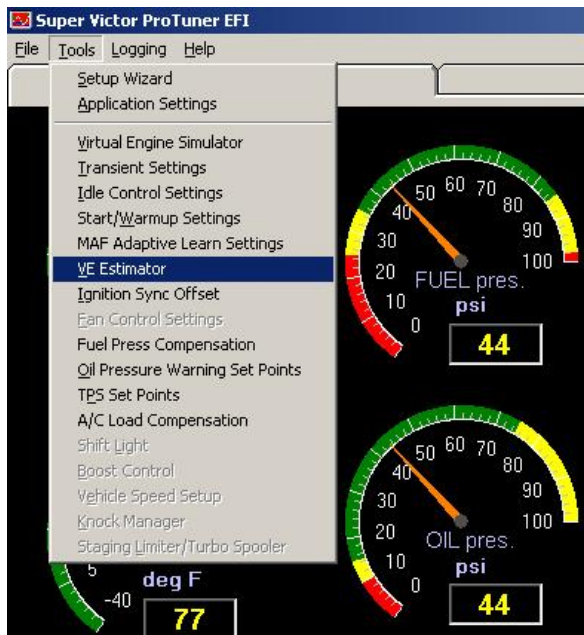
5.4 VE Estimator Tool



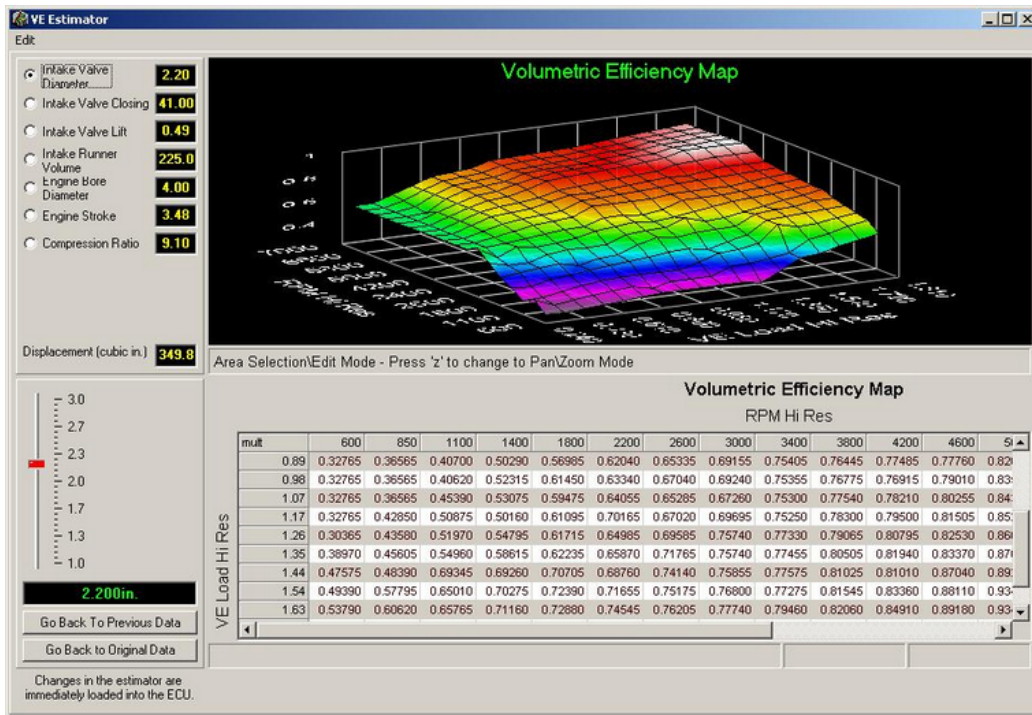
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VE Estimator Tool

In most cases, the Volumetric Efficiency map in the Pro-Tuner default calibration provides a good base for initial startup and tuning. Alternatively, the **VE Estimator** Tool can be used as a good way to quickly get a base *Volumetric Efficiency Map* in the calibration for initial tuning. To activate the **VE Estimator**, go to **TOOLS** and then choose "**VE Estimator**".



The **VE Estimator** will then appear and you can adjust the various settings using the input slider/text boxes on the left. Select each parameter you wish to adjust by clicking on the button next to it. The **VE Estimator** will generate a VE curve as you make your adjustments and show it both in the table and on the 3D Map.



Use the normal 3D Map manipulation methods to rotate and scale the 3D display or change the font size of the table. The map immediately applies changes to the VE map in the ecu calibration. You can revert to the previous map, or reload the original map. Unless you have an unusual combination - for which you would need to use the VE Estimator, the VE map that is in your ECU after initial programming is usually very good to get started with.

5.5 Adaptive Fuel "AutoTuning" Capabilities



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Adaptive Fuel "Auto Tuning" Capabilities

In addition to (or instead of) adaptation of airflow (VE) with MAF sensor/s in Speed/Density mode, the system can be setup to run single or dual approved switching *OR* wideband oxygen sensors in all control modes: Alpha-N (speed/throttle), MAP-N (Speed/Pressure), or true Speed/Density modes. The oxygen sensor provides feedback on the engine's current air/fuel ratio, which provides the ECU with the data needed for adaptation of the fueling in order for the system to deliver the calibrated air/fuel ratio.

Oxygen Sensor Adaptation & Interface

The driver's side sensor is always the primary sensor. Always plug into the driver side only when using a single sensor. If using dual sensors, the passenger's side sensor values are averaged into the compensation calculations. If dual sensors are used and one sensor fails, or goes into a fault condition - the system will automatically revert to the known good sensor.

As with adaptation of volumetric efficiency when using a mass airflow sensor, the oxygen sensor will constantly adapt the fueling model to compensate for small changes in fuel delivery or airflow, providing the engine with an air/fuel ratio equal to the mapped value.

The fueling will be adapted with or without mass airflow: mass airflow is not required to run closed loop, as the fueling adaptation routine is separate from the airflow adaptation.

As the engine runs, the O2 sensor will provide feedback to the ECM. This feedback is compared with what the ECM is commanding. Any difference between the two is calculated and adapted out as the engine runs. This will not only help the engine run at the desired AFR, it will also let the tuner enter actual AFR values and not simply fuel pulse width in speed/density mode. (Alpha-N / MAP-N modes also adapt in closed loop; however, Alpha-N or MAP-N mode requires that the base fuel pulse width values be calibrated to deliver air:fuel ratios that are closer to your mapped air:fuel target values, so that the difference between mapped and actual is within the adaptive range of the system. You also want to have the mapped values very close to actual to minimize abrupt transitions or surging when the system goes in and out of closed loop during

normal operation.

Although the fuel injectors are characterized for the system, small variations occur because of fuel rail dynamics (causing pressure pulses in the system), pressure delta differences between cylinders, system wear, etc. Closed loop fuel adaptation is meant to adjust for these inconsistencies. The system includes a single heated switching style oxygen sensor. This will provide satisfactory closed loop operation and adaptation. For closed loop operation over a greater range of air/fuel ratios, a single or dual "wideband" style sensor may be used. These sensors may be selected through the setup wizard.

Large adapted values in the fuel flow compensation map generally indicate incorrect system setup, injector characterization, or incorrect values in the VE or Base Fuel map: which the system will try to overcome by increasing/decreasing the fuel adaptation value. If it cannot adapt due to the base calibration in the VE or Base Fuel Map being too far out, you will have to tune the base calibrations much closer before the adaptation will be allowed to occur.

No tuning is required for the closed loop behavior or sensor operation, Although the band of air/fuel ratios over which the system is allowed to go into closed loop operation can be adjusted to suit the user in the "Equiv Ratio Delta Map". The band is calibrated as a function of equivalence ratio. This map is pre calibrated based upon the oxygen sensor choice made in the setup wizard, so no calibration is usually necessary. This table should only be adjusted under certain circumstances. For a full explanation of the Equiv Ratio Delta Map, see the Help section on Additional maps

If desired, the tuner can see or manually adjust the fuel adaptive map by opening the **Closed Loop correction (CLC)** map in the drop down list of maps on the "maps" page. As stated earlier, the adapted values may be applied to the Base Fuel map and the CLC map reset to its baseline if the values appear to be at their high or low limit. This function is under the tools menu and can be invoked by the tuner in Alpha-N (speed/throttle) or MAP-N (speed/pressure) modes.

If a MAF sensor is used in Speed/Density mode, the MAF will adapt the VE (Volumetric efficiency) map directly and the O2 fueling correction values will remain in the CLC map and not be applicable to the VE map.

Manual adjustments to this map will be over-written if closed loop is active. To retain manually tuned Fuel Flow compensation in the CLC map, deselect oxygen sensor in setup wizard and run open loop.

The **"Toggle Closed Loop"** function on the main dashboard can be used to manually tune the fuel flow compensation to tune actual AFR to equal mapped AFR. The toggle function will disable the O2 adaptation until button is toggled back.

The closed loop operation will only be active and adapting the compensation map under certain conditions. This is to insure accurate adaptation. Note the closed loop indicator will be lit when active. The closed loop adaptation is only active under steady state running conditions. It will NOT be active under the following:

- During warm up
- During initial start until the sensor/s have been deemed "ready".
- During any transient rpm or load condition
- If the desired air/fuel ratio is outside of the sensor's capability. (In such cases, a wideband UEGO sensor should be installed)

If continuous open loop operation is desired, simply select "None" for oxygen sensors in

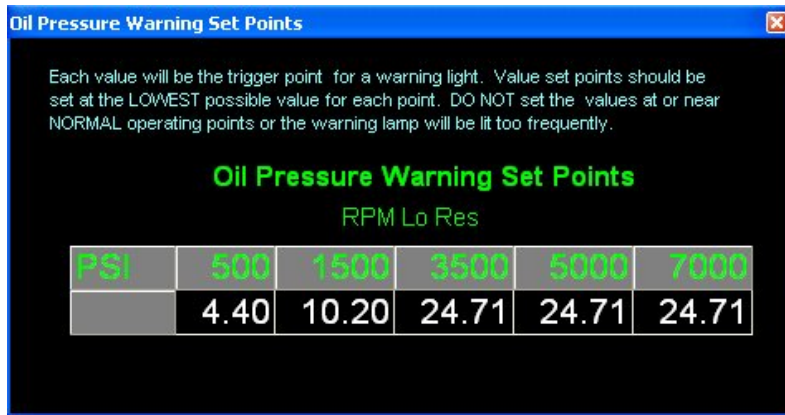
the setup wizard. This will deselect the sensor and set the system for open loop (no O2 feedback) operation. Open loop is generally recommended for dedicated drag racing.

5.6 Oil Pressure Warning Set Points



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Oil Pressure Warning Set Points



This tool is accessed via the **TOOLS** Menu and selecting **Oil Pressure Warning Set Points**. To change the warning set point for each RPM, simply type your desired pressure in the input box.

Each value will be the trigger point for the **physical warning light** (in the harness) and the **FAULT** light on the laptop. You should set each point to the **LOWEST** value for each point. **DO NOT** set the values at or near NORMAL operating pressures, or the warning lamp will be lit too frequently.

5.7 Coolant Fan Output



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Coolant Fan Output

NOTE 1: To use this feature, you MUST use an approved high current fan relay. DO NOT attempt to drive the fan directly from the ECM output wire or ECM damage will occur!

NOTE 2: To use the fan control feature, you must add the Edelbrock fan relay wire to your ECM. On 48 pin units, the wire must be inserted into pin A3 (pin 3 of the A connector). On 80 pin systems, the fan relay wire must be inserted into pin B8 (pin 8 of the center connector). See harness schematics. The pin numbers are indicated on the face of the ECM connector.

Wire the ECM output wire to one of the trigger (signal) terminals of the relay. Supply +12V to the other trigger (signal) wire using 18 gauge wire. The ECM will pull its output low when activated to switch the relay on. Use a minimum 12 gauge wire from 12V supply to relay SWITCHED terminals and to fan. Provide appropriate fuse protection per fan manufacturer instructions.

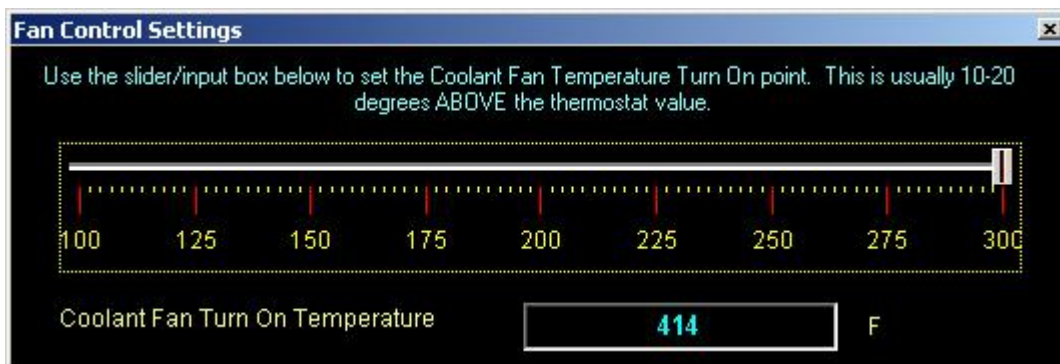
**SEE WIDEBAND O2 INSTALLATION FOR INSTRUCTIONS ON INSTALLING/
ADDING A WIRE INTO THE ECM CONNECTOR.**

5.8 Coolant Fan Set Points



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Coolant Fan Temperature Turn On Threshold



This tool is accessed via the **TOOLS** Menu and selecting **Coolant Fan Settings**. To change the Fan Turn On Temperature, simply move the slider or type your desired temperature in the input box. Enable the coolant fan control through the setup wizard, and wire the fan relay per instructions. It is normal for the fan to continue to run until the temperature has dropped 10-15 degrees *below* your turn on temperature before shutting off.

5.9 Fault Detection and Troubleshooting



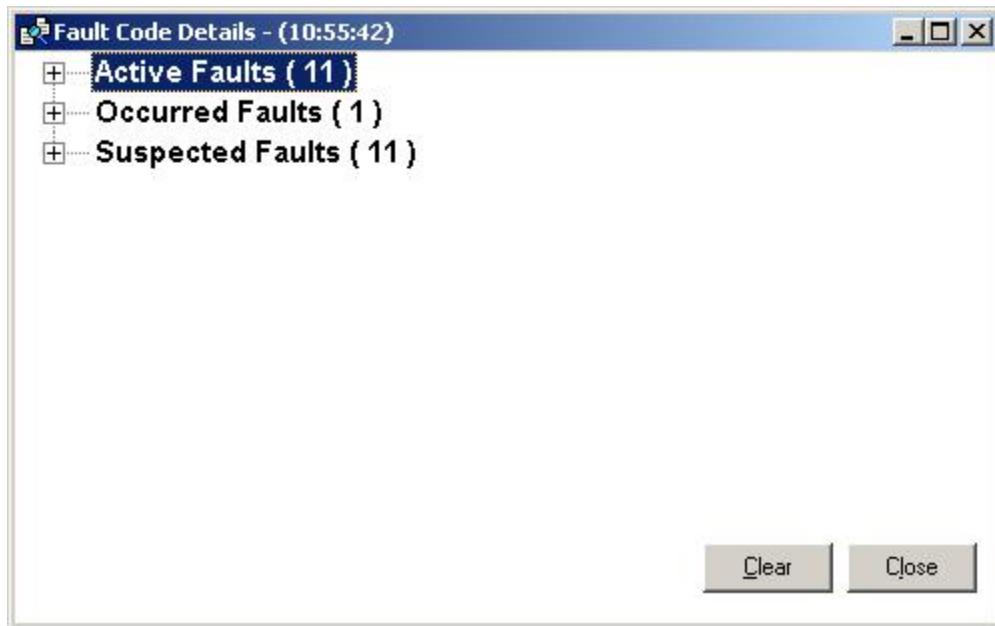
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Trouble Codes/Faults

Trouble Codes or Fault Codes are indicated by the **FAULT** indicator at the bottom right hand corner of the screen status bar. This indicator will light up either YELLOW for warnings or RED for faults.



By clicking on this indicator, you can open the **Fault Code Viewer** .



You can expand any category of fault by clicking on the "+" next to the category.



This view will show you three categories of Fault Codes:

Active Faults

Active Faults are faults that are currently being reported by the ECU and the ECU is reacting to these faults according to the strategies in place.

Occurred Faults

The Occurred Faults category is basically a history of faults that have been detected and Active at one point or another. This category can help you find and diagnose intermittent or momentary faults.

Suspected Faults

Suspected Faults represent possible fault codes that have been detected, but the

condition to make them "Active" has yet to be confirmed. This category can be helpful to spot potential momentary or intermittent faults or incorrect calibration values.

In any category of fault, if you click on the fault text, it will take you to the appropriate section of the HELP file to further explain the code and to suggest possible causes and diagnostic procedures, if available.

Buttons



The "**CLEAR**" button will clear all the faults from the categories. If the faults persist, they will reoccur and show up in the list again. Each fault has a timestamp showing the last time it was detected. Active faults will show a constantly updating timestamp.

The "**CLOSE**" button simply closes the fault viewer.

5.10 Reset ECU to last programmed setup



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Reset to Last Programmed Setup



This feature is accessed via the **File Menu** from any of the main screens. **It will reset all the MAP's, values, and wizard choices back to the preset values that the user started with after the wizard last programmed the ECU.** This function can assist the user to begin the calibration process again if needed. The user can program the default factory setup by stepping through the setup wizard for the fuel control mode that you desire (Speed/Density or Alpha-N) and choosing the default or standard settings.

Resetting to the originally programmed setup using this function will take the settings and choices back to the ones **you** last programmed into the ECU when you completed the setup wizard. Use this feature with the engine NOT RUNNING, but with the ignition ON. After confirming your selection, turn the ignition switch off for 10 seconds. The values should then be reset.

6 Features Available with Pro option only



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Features Available with Pro option only

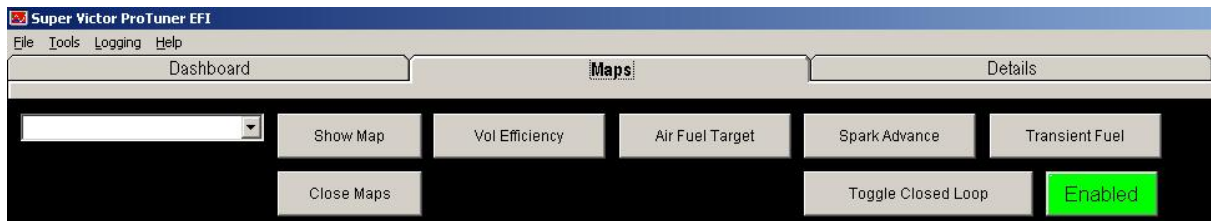
In this section, you will learn about several advanced features available with the Pro Option option only.

6.1 Additional Maps

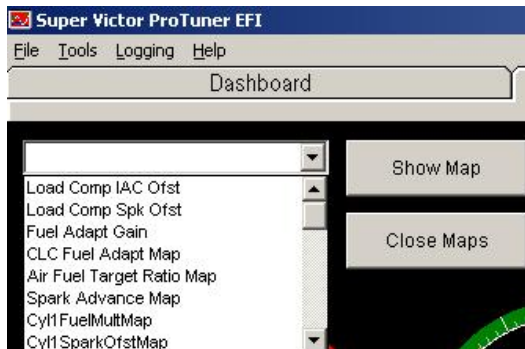


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Additional Maps (Pro Option Only)



This drop down list gives you access to other Maps that aren't frequently used in normal tuning, but can give you advanced capability and flexibility in adjusting your system for optimal operation and maximum performance.



The maps listed in the drop down mostly deal with individual cylinder spark or fuel multiplication/offsets, advanced transient tuning, or advanced sensor characteristics.

It should be noted that not all maps are available in all cases. The optional "Pro" USB key will allow more access to advanced maps and tables.

In addition, system setup may not allow use of certain features; for example, *individual cylinder offsets for ignition and fuel are not compatible with a distributor triggered ignition without a cam sensor*. For individual cylinder control, the cam sensor equipped distributor which is included with your Pro-Tuner system can be used, or an encoded crankshaft trigger is required: (A distributor may be used in conjunction with an encoded crank trigger, with individual cylinder spark control available with a distributor.) With an encoded crank trigger or cam sensor distributor, the ECM can determine exactly where each cylinder is located - thereby allowing individual cylinder tuning. A cam sensor may also be used in certain applications in addition to the encoded trigger to define which stroke the cylinder is on.

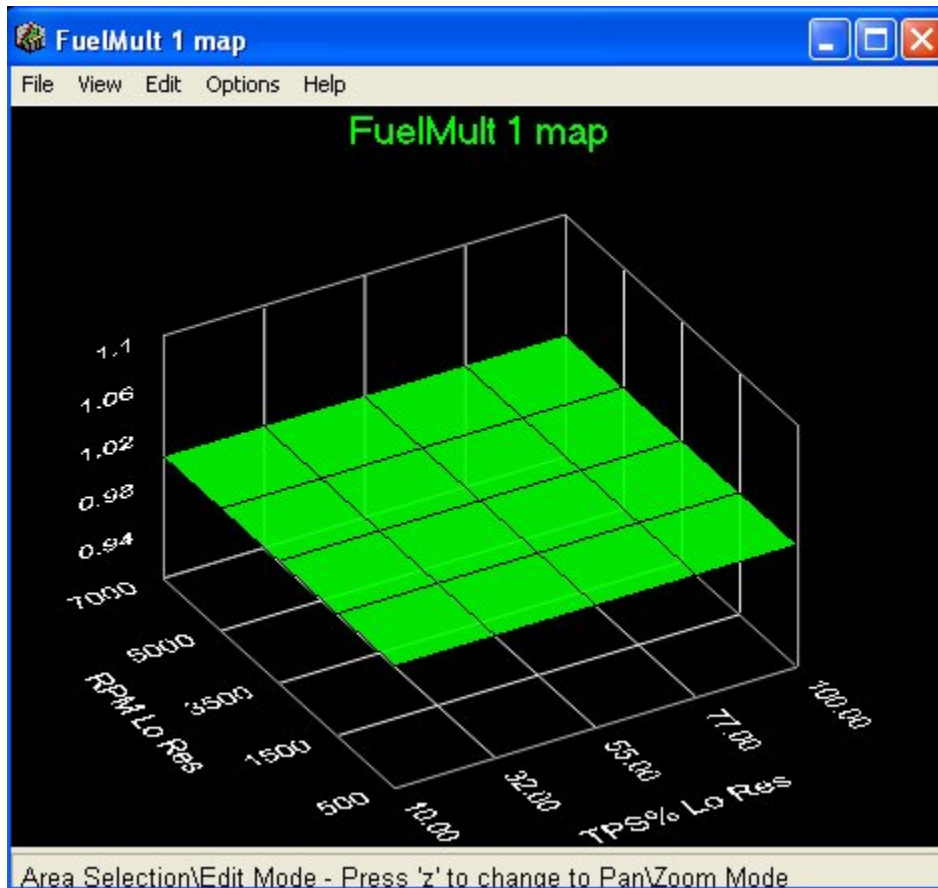
**** An MSD Flying Magnet crank trigger is NOT an encoded trigger**** Electrically, it provides the same 4X Ignition Sync pattern as a standard GM internal distributor and is

not capable of individual cylinder control. However, if it is used with an approved cam sensor it can provide individual cylinder control. Discuss the cam sensor options for use with the flying magnet trigger with your Edelbrock support expert.

Individual Cylinder Fueling Control (Pro Option Only)

The **FuelMult1-4 Maps** provide individual cylinder offset to optimize power and economy. (encoded crank trigger required). For example, the fueling maps allow the tuner to richen a cylinder that tends to run hot at a certain load and speed. It can also lean out a cylinder that runs richer than the others at part throttle.

It's purpose is to optimize each cylinder to help overcome distribution and exhaust tuning variations between cylinders and it increases power as well as reliability when properly tuned.



		RPM Lo Res				
TPS% Lo Res		500	1500	3500	5000	7000
mult		500	1500	3500	5000	7000
	10	1.00	1.00	1.00	1.00	1.00
	32	1.00	1.00	1.00	1.00	1.00
	55	1.00	1.00	1.00	1.00	1.00
	77	1.00	1.00	1.00	1.00	1.00
	100	1.00	1.00	1.00	1.00	1.00

Tips for tuning:

The fueling maps for each cylinder act as multipliers, offsetting the fuel from the base value. That is, a value of 1.0 is **NO** change from the base fueling. A multiplier greater or less than 1.0 will change the fueling for that cylinder by that percentage from the base value. Do not attempt to adjust cylinders individually until the overall base fuel and ignition calibration is complete, otherwise you will not get an accurate picture of what each cylinder may need for minor adjustment.

When ready to tune individual cylinders, only adjust the furthest ones away from the average. For example, if you want to richen the #4 cylinder (pictured) at 1800 rpm/ light load by 4.0%; you would enter 1.04 into the map at 1800 rpm and the corresponding load's cell. If you want to lean it out 5%, you would enter .95 in that cell. You can think of the "1.00" value as 100% of base fueling. You would go richer and leaner from that point, treating the change as a percentage value. **DO NOT ENTER "0" INTO THE MAP!** This will effectively shut off fuel to the affected cylinder at that point, and severely lean it out near that point. **Engine damage could result!**

Be conservative. Make small incremental changes and note the effect. **Never offset cylinders before completing good base map calibrations.**

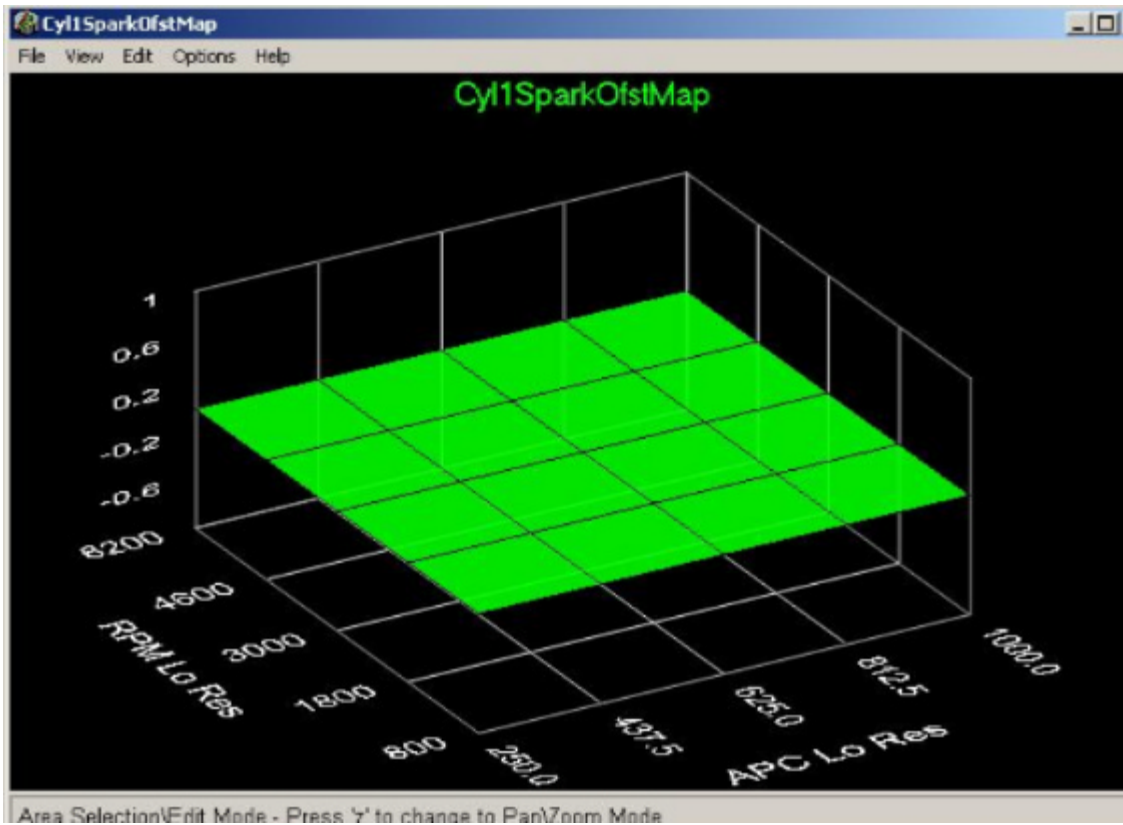
It is strongly advised not to tune individual cylinders without proper instrumentation in place to provide tuner feedback. EGT, per cylinder O2 sensors, or other combustion pressure analysis is recommended to measure each cylinder and its response to map changes. Without instrumentation, you are only guessing - and could easily cause damage to your engine!

Note that the load scaling of ALL maps will be automatically be based upon the type of fueling method which you have chosen. ECM48 systems have injectors "Paired" together in 4 pairs. Any change in fuel mult maps will affect BOTH cylinders in that pair. Tune to be within the safe limits of the leanest cylinder in the pair.

Individual Cylinder Spark Control (Pro Option Only)

With the Pro USB key, individual cylinder control of ignition timing is available by adjusting the **Cyl1-8SparkOfstMaps**. These maps apply an offset (positive or negative)

to the base spark map values for the cylinder being adjusted. This feature can help compensate for differences between cylinders due to fueling or airflow differences, or exhaust, combustion chamber, or temperature variation of a cylinder from the other cylinders. When used properly in combination with the individual fueling control; the engine can be tuned for optimum performance and reliability.



dBTDC	800	1800	3000	4600	6200
250	0.0	0.0	0.0	0.0	0.0
437.5	0.0	0.0	0.0	0.0	0.0
625	0.0	0.0	0.0	0.0	0.0
812.5	0.0	0.0	0.0	0.0	0.0
1000	0.0	0.0	0.0	0.0	0.0

Tips for tuning:

Unlike the individual fuel maps; the individual spark tables are NOT a multiplier table. The entered value represents a number of crankshaft degrees of timing difference from the main spark advance map for the load/speed point. So, if no change from base advance is desired - simply enter "0" in the cell/s. If a cylinder is slightly lazy at a particular point, you may want to add advance by inserting a degree or two into that cell. Conversely, if a cylinder is prone to detonation at a point, you can take away a bit of advance by entering a small *negative* number into the cell.

Be conservative. Make small incremental changes and note the effect. **Never offset cylinders before completing good base map calibrations.**

It is strongly advised not to tune individual cylinders without proper instrumentation in place to provide tuner feedback. EGT, per cylinder O2 sensors, or other combustion pressure analysis is recommended to measure each cylinder and its response to map changes. Without instrumentation, you are only guessing - and could easily cause damage to your engine!

Fuel Adapt Gain (Pro Option Only)

The rate at which the oxygen sensor adapts the Closed Loop Compensation (CLC) map should not need to be adjusted. However, in special circumstances such as when an extremely high output engine is on the dyno for calibration - there may be cases where the tuner desires to adapt the CLC map faster to minimize the running time put on the engine. The ***Fuel Adapt Gain*** table provides this flexibility of adjustment. **NOTE: This table does NOT affect the operation or response of the closed loop control - only the rate at which map adaptation occurs!**

The screenshot shows a software window titled "Fuel Adapt Gain" with a menu bar (File, View, Edit, Options, Help). The main area displays the title "Fuel Adapt Gain" and the variable "O2Error_BankAldxArr". Below this is a table with 11 columns and 2 rows. The first row contains error values from -0.3 to 0.3 in increments of 0.05. The second row contains adaptation gain values, which are 0.0020 for all error values except 0, where it is 0.0000.

	-0.3	-0.2	-0.15	-0.07	0	0.07	0.15	0.2	0.25	0.3
	0.0020	0.0020	0.0020	0.0000	0.0000	0.0000	0.0020	0.0020	0.0020	0.0020

Tips for tuning:

It is recommended only VERY experienced tuners change the values in the Fuel Adapt Gain table. Gains too aggressive will cause instability or non-typical values to be adapted to the CLC map, particularly if an O2 sensor begins to fail. Small gains are strongly recommended.

The table is ordinated as a function of error between the desired and actual air/fuel ratios. The cells in the center represent a very low error, thus no CLC map adaptation is necessary when the fueling is that close. (zeroes in the calibration cells). As the error increases positively or negatively toward each end of the table, an adapt rate is entered which represents a percentage of error which will be "adapted out" or applied to the CLC map every 5 mS. These values should be very small. Note that even *if* the O2 error is very large, with the calculations running every 5 mS (.005 of a second) - the error will be adapted out very quickly.

If you are running a mass airflow sensor, you also have the ability to adapt the VE map (airflow) while the O2 sensor adapts the CLC map (fuel flow). This can provide a very accurate base calibration. If you are not running a mass airflow sensor, you can still achieve a very accurate calibration through the O2 sensor alone. If you are running Speed/Throttle control mode - you can apply the adaptation in the CLC map to your Base Fuel Map to bring your open loop fueling pulse width into tune by using the "Apply O2 Adaptation to Base Fuel Map" function under the tools menu. For more information about closed loop control or adaptive VE using mass airflow, see the Help section on Adaptive Tuning .

ECT Spark Trim Table (Pro Option Only)

In Speed/Throttle (Alpha-N) mode, Speed/Pressure (MAP-N) mode, *or* Speed/Density mode - there is the ability to adjust a global trim for spark advance based upon ECT. This can be useful if ignition characteristics change greatly with coolant temperature. While not often needed, the **ECT Spark Trim Table** can be helpful in providing a global spark retard for a very hot engine in order to help avoid detonation.

	-22	14	50	77	104	131	158	185	212	239
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Tips for tuning:

The table is an offset to the main Spark Advance map. It is based on coolant temperature in degrees C. or degrees F. (Whichever you have chosen as your desired units of temperature in the application settings.) A value of "0" means that no change is being applied to the base map. Enter the values in degrees positive (more advance) or negative (less advance). Keep the values small. If a large value is required, it probably means that your base spark advance calibration is not optimized, and you should adjust the main spark map further.

IAT Spark Trim Table (Pro Option Only)

In Speed/Throttle (Alpha-N) mode, Speed/Pressure (MAP-N) mode, or Speed/Density mode - there is the ability to adjust a global trim for spark advance based upon IAT. This can be useful if ignition characteristics change greatly with ambient air temperature. While not often needed, the ***IAT Spark Trim Table*** can be helpful in providing a global spark retard for a very hot intake charge in order to help avoid detonation.

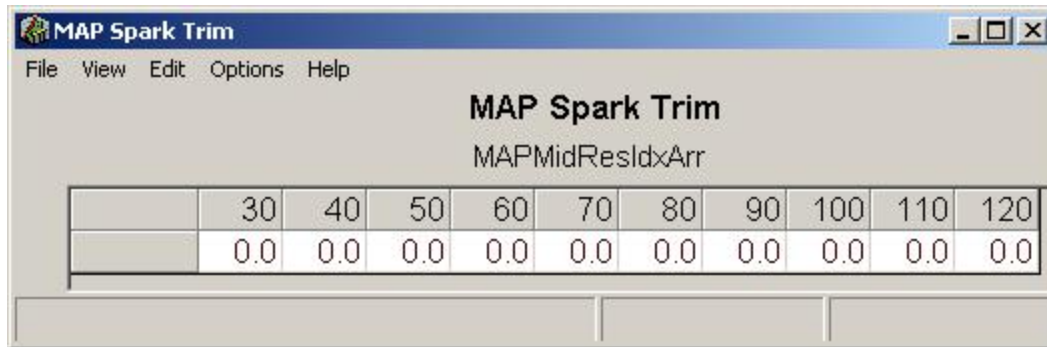
	-4	23	51.8	78.8	107.6	136.4	163.4	192.2	219.99	248
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Tips for tuning:

The table is an offset to the main Spark Advance map. It is based on intake air temperature in degrees C. or degrees F. (Whichever you have chosen as your desired units of temperature in the application settings.) A value of "0" means that no change is being applied to the base map. Enter the values in degrees positive (more advance) or negative (less advance). Keep the values small. If a large value is required, it probably means that your base spark advance calibration is not optimized, and you should adjust the main spark map further with a representative charge temperature.

MAP Spark Trim Table (Pro Option Only)

In Speed/Throttle (Alpha-N) mode *or* Speed/Density mode, there is the ability to adjust a global trim for spark advance based upon MAP. This can be useful if ignition characteristics change greatly with ambient air pressure. While not often needed, the **MAP Spark Trim table** can be helpful in providing a global spark retard for a very hot intake charge in order to help avoid detonation.



Tips for tuning:

The table is an offset to the main Spark Advance map. It is based on manifold pressure in KpA or in-Hg. (Whichever you have chosen as your desired units of pressure in the application settings.) A value of "0" means that no change is being applied to the base map. Enter the values in degrees positive (more advance) or negative (less advance). Keep the values small. If a large value is required, it probably means that your base spark advance calibration is not optimized, and you should adjust the main spark map further with a representative charge pressure. **NOTE: This table is not recommended to be used in Speed/Density mode as the control algorithm accounts for pressure changes automatically.**

O2 Equiv Ratio Delta Table (Pro Option Only)

The **O2 Equiv Ratio Delta Table** may sound complex, but it really is not. The function of this table is to define part of the criteria for going into closed loop operation. There are several conditions that need to be met in order for the engine to go into closed loop operation and perform any adaptation. The engine coolant temperature must reach a predefined level, the warm up cycle must be complete, and the engine must be in a steady state operating condition. In addition to these conditions, the desired Air/Fuel ratio commanded by the user must be within a certain band of stoichiometric (14.7:1 with gasoline). This is because the user may want to disable closed loop operation at some loads, or narrow the band (particularly at idle) because a standard switching oxygen sensor can become inaccurate and lazy at low flows and exhaust temperatures; allowing a switching sensor to have a wide band of authority will cause deterioration of the calibration as the system tries to adapt fueling based on those inaccurate values.

The table is ordinated as a function of throttle position in percent. The cell values entered represent a band **in equivalence ratio** from stoichiometry. The stoich value for a given fuel is 1.000 A higher value such as 1.040 is *richer* than stoich and a value of less than 1.000 like .992 is *leaner* than stoich.

ratio	0	5	10	15	20	25	35	50	75	90
	0.020	0.120	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200

Tips for tuning:

Note: This table should only be adjusted by experienced tuners!

In general, this table should need no adjustment and the calibration will be loaded for you by the setup wizard based upon your O2 sensor selection. Although the table defines a band around stoich, as a performance tuner - you generally only have to think about the rich limit that you want to allow closed loop operation to occur, since performance engines very seldom are tuned leaner than stoichiometric anyway.

Entering "0" in a cell will disable closed loop operation at that throttle position. The table above shows the typical values pre loaded for a wideband O2 sensor. A true wideband O2 sensor has the capability of being accurate over a much broader range than factory switching style sensors. The values in the above table will allow the engine to go closed loop if the desired AFR is anywhere between about 9.5:1 and 25.0:1 if the sensor is capable. In a switching sensor at idle, you generally cannot accurately go richer than 14.0:1 or 1.040 equivalence ratio. (Many performance tuners will prevent closed loop operation at idle with a switching sensor). At higher loads, a switching sensor can provide accurate feedback at much richer Air/Fuel ratios than it can at idle. for example, if you wanted to allow the engine to go closed loop at idle with a switching sensor because your desired air/fuel ratios are calibrated to be 14.4:1 (which is within the accuracy range for the sensor), you would calculate the equivalence ratio or refer to the table below to find the equivalence ratio. In this example, the equivalence ratio is 1.020. To define the band and enter the proper value in the O2 Equiv Ratio Table - simply subtract 1.0 from the desired value and enter it in the cell at the "0" position (idle position equals 0% TPS).

In this case, the entered value would be $1.020 - 1.000 = .020$ Enter .020 in the table.

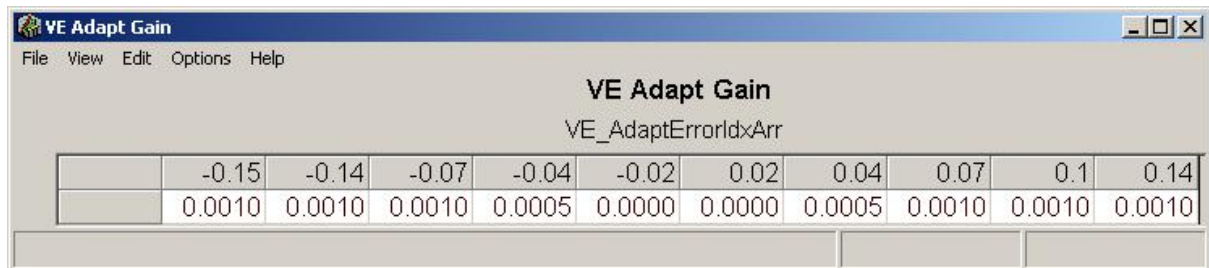
Equiv Ratio	Lambda	Gasoline AFR
1.458	0.686	10.08
1.437	0.696	10.23
1.416	0.706	10.38
1.397	0.716	10.53
1.376	0.727	10.69
1.353	0.739	10.86
1.333	0.75	11.03
1.312	0.762	11.2
1.292	0.774	11.38
1.271	0.787	11.57
1.250	0.8	11.76
1.229	0.814	11.96

1.208	0.828	12.17
1.188	0.842	12.38
1.167	0.857	12.6
1.145	0.873	12.83
1.125	0.889	13.07
1.105	0.905	13.31
1.083	0.923	13.57
1.063	0.941	13.84
1.042	0.96	14.11
1.020	0.98	14.4
1.000	1	14.7
0.964	1.037	15.25
0.928	1.078	15.84
0.892	1.121	16.48
0.855	1.169	17.18
0.820	1.22	17.93
0.784	1.276	18.76
0.748	1.337	19.66
0.712	1.405	20.66

For more information regarding closed loop operation and adaptive functions, see the section on Adaptive Tuning Capabilities.

VE Adapt Gain Table (Pro Option Only)

(Speed/Density only). Like the O2 Equiv ratio Delta table, the **VE Adapt Gain** table should need no adjustment in most cases. There may be occasion where the rate of Volumetric Efficiency map adaptation could be changed to speed dyno adaptation using a mass airflow meter and then remove the meter or slow the adapt gain down for normal usage.



The screenshot shows a window titled "VE Adapt Gain" with a menu bar (File, View, Edit, Options, Help). The main area displays the title "VE Adapt Gain" and the variable name "VE_AdaptErrorIdxArr". Below this is a table with 11 columns and 2 rows of data.

	-0.15	-0.14	-0.07	-0.04	-0.02	0.02	0.04	0.07	0.1	0.14
	0.0010	0.0010	0.0010	0.0005	0.0000	0.0000	0.0005	0.0010	0.0010	0.0010

Tips for tuning:

You can adjust the *speed or rate at which adaptation occurs to the VE Map* by increasing the values in the *VE Adapt Gain table* (available in the maps drop down list on the MAPS tab). The index or ordinates in this table is the VE error, and the number you calibrate in the cells is the amount of error that is adapted out every 5 mS. As you can imagine, even very small numbers will adapt rather quickly at this rate. The **VE Adapt Gain Table** should either be left in the default condition, or calibrated so that there are zeroes (no adaptation) in the center cells of the table and an increasing number at each end of the table. The reason for putting zeroes in the center cells is that with very low error, no adaptation is needed. Also, there will naturally be some slight error variation during

adapted operation where it is unnecessary to attempt to adapt further. When entering values in the other cells: TAKE GREAT CARE - DO NOT PUT TOO LARGE OF VALUE IN THIS TABLE! A large value can cause erratic adaptation and poor running because it can adapt a false value captured during a misfire, IAC modulation, or other nearly instant or non-typical running condition. Generally, the slower the adaptation - the better; because it will adapt based on a larger sample size and give the ECU a more complete picture of true airflow.

If you are only running MAF during tuning, **be sure to deselect the sensor in the setup wizard after the adaptive learn has been completed to return to normal speed/density operation and prevent sensor faults from being displayed when MAF is unplugged.** It is recommended that you then open the VE map and manually smooth any surfaces that were not fully adapted. Such as in the corners of the map where it may be difficult to run.

In addition to (or instead of) adaptation of airflow (VE) with MAF sensor/s in Speed/Density mode, the system can be setup to run single or dual approved switching *OR* wideband oxygen sensors in all control modes: Alpha-N (speed/throttle), MAP-N (Speed/Pressure), or true Speed/Density modes. The oxygen sensor provides feedback on the engine's current air/fuel ratio, which provides the ECU with the data needed for adaptation of the fueling in order for the system to deliver the calibrated air/fuel ratio.

For more information regarding closed loop operation and adaptive functions, see the section on Adaptive Tuning Capabilities.

MAP Fuel Trim Table (Pro Option Only, Not Available in Speed Density or MAP-N Mode)

In Speed/Throttle (Alpha-N) mode, there is the ability to adjust a global trim for fuel based upon MAP. This can be useful if fueling characteristics change greatly with ambient pressure. An example would be drag racing with a large air inlet where there is a "ram effect" as the car gains ground speed. This table can be used to compensate fueling for such conditions.

While not often needed, the **MAP Fuel Trim table** can be helpful in providing a global fuel offset for a variety of intake charge pressures. This table is not necessary in Speed/Density mode, as charge pressure is automatically compensated for. The table is viewable in MAP-N mode and values can be entered. Changes will have no influence on tuning though.

MAP Fuel Trim										
MAPMidResIdxArr										
mult	-22.15	-14.77	-7.38	0	3.63	8.7	13.78	18.85	23.93	29.01
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

[MAP]: -9.48

Tips for tuning :

The table is a *multiplier* to the base fuel map. It is based on manifold pressure in KpA or in-Hg. (Whichever you have chosen as your desired units of pressure in the application settings.) A value of "1.00" means that no change is being applied to the base map. This means that a value of 1.00 equals the calibrated base fueling and no change is being applied to the end pulse width of the injector. A value of 1.10 equals 10% more fuel is being delivered than is mapped. 1.15 means that 15% more fuel is being delivered, and so on. Keep the values small. If a large value is required, it probably means that your base fuel map calibration is not optimized, and you should adjust the base fuel map further with a representative coolant temperature. Set the value to 1.00 at normal operating pressure. Calibrate your base fuel map. Retest at various air pressures and adjust the corresponding trim cell to have the system deliver the fueling required to match your desired mapped AFR at those points.

Other Maps & Tables

There are other maps and tables available which simply provide another way to access main maps or features listed in other tabs of your Pro-Tuner software; such as the transient maps, Base Fuel map, Main spark Advance map, etc. See the section on the specific main map in question for assistance with those maps.

6.2 Flight Recorder

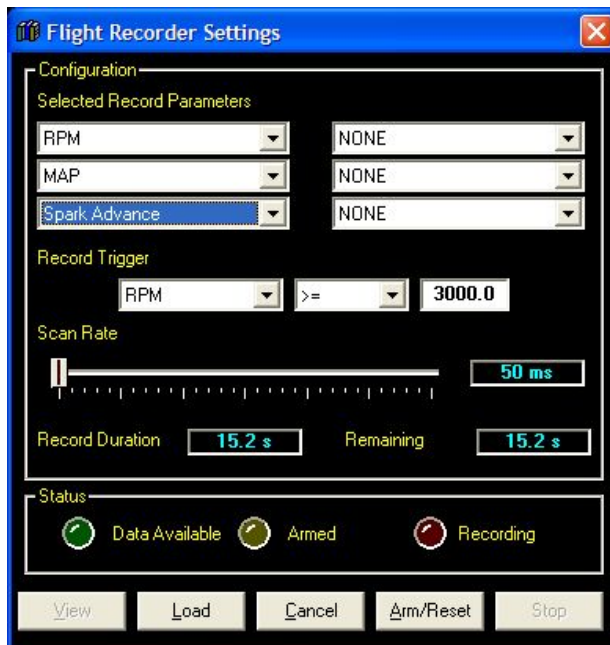


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Onboard Flight Recorder (Pro Option Only)

The **Flight Recorder** function is used to control the ECU data capture system that is resident on the ECU. This recorder is available for use without a PC, so is a valuable tool for logging during an event or a driving session.

You must setup the recorder and view the data using your laptop/PC, but once it is setup it will trigger and record automatically. To activate the **Flight Recorder**, go to the **LOGGING** menu and choose "**Flight Recorder**".



This control panel will allow you to set up the parameters you wish to record, scan rate,

and trigger. First, check the *STATUS* indicators.

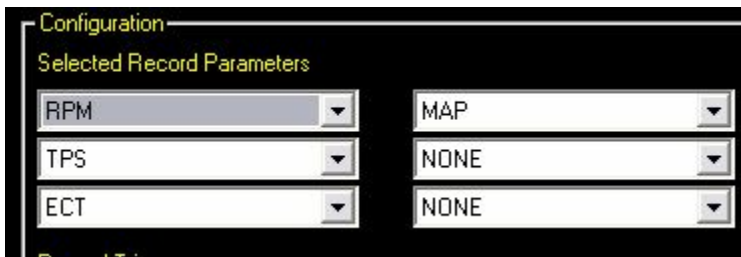


If you see the GREEN "Data Available" light lit, it indicates that you have a previously recorded data. You can click on the "**VIEW**" button to view this data, or you can ignore it, set up new parameters and re ARM the trigger (which will erase the previously recorded data). If you decide to save the data after you've start to choose new parameters, you can "**CANCEL**" and it will not affect the recorded data.

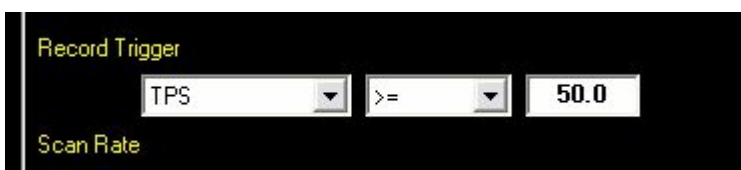
The YELLOW "Armed" light indicates the ECU is waiting to trigger and will start recording based on the parameters and trigger you have selected. The light will BLINK while the ECU erases the on board data log and resets the trigger. It will then light a constant YELLOW when Armed.

The RED "Recording" light indicates the ECU has been triggered and is actively recording.

To choose the parameters you wish to record, use the drop down lists to choose any variety of parameters up to a maximum of six (6). The fewer parameters logged, the longer the available time is for the chosen parameters.



Next, set your record trigger condition. This will tell the ECU what to use as a "trigger" to start recording. The parameters available are RPM, TPS (in %) or an External Switch. After you've chose the parameter choose the "operator" (greater than equal or less than equal) and then type in the desired value.



Once you have chosen your parameters and record trigger, use the slider bar for "Scan Rate" to select the frequency at which these parameters will be recorded.

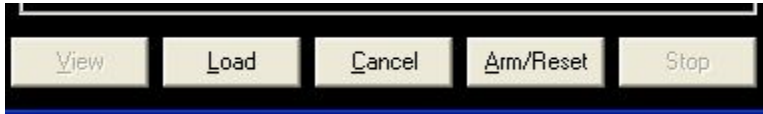


As you move the slider, notice that the record duration and remaining displays will adjust accordingly. The faster you scan and the more parameters you choose, the shorter the duration until the log fills up. The slower you scan and the fewer number of parameters, the longer the duration. The "Remaining" display will count down as the buffer fills up (if you have the laptop connected).

Once you are **VIEWING** the recorded log, a chart is displayed and you can manipulate the view, print, scale, scroll and save/load as described in **Logging and Data Viewing** section.

BUTTONS

The buttons at the bottom of the Flight Recorder control the operation and depending on what is occurring, may be "grayed out".



In general the button functions consist of:

View - View previously recorded data. This will display the current data in a 2D graph.

Load - Load a save data log from disk. This will display the data in a 2D graph. You can load several data logs at one time (including the current one via "**VIEW**") for comparison.

Cancel - Cancel the Flight Recorder without changing Trigger, Parameters, or state.

Arm/Reset - ARM the trigger if it isn't set, or RESET the trigger (and erase the buffer) and re ARM.

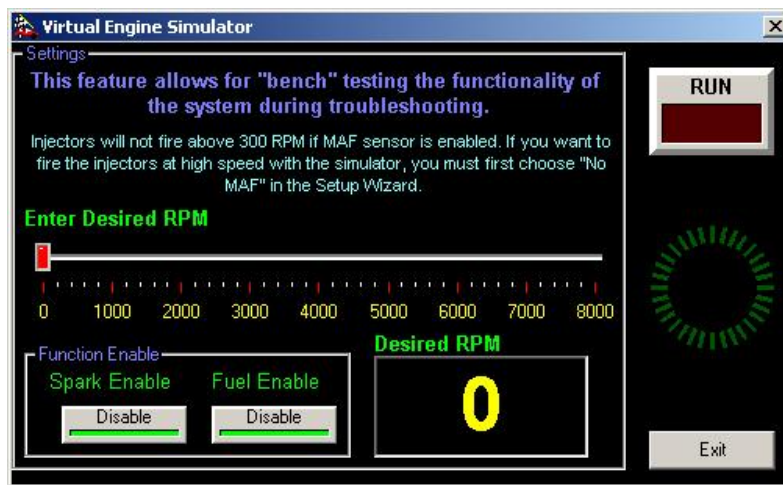
Stop - Stop a recording in progress and allow VIEWING (via the VIEW button) of the current data.

6.3 Virtual Engine Simulator

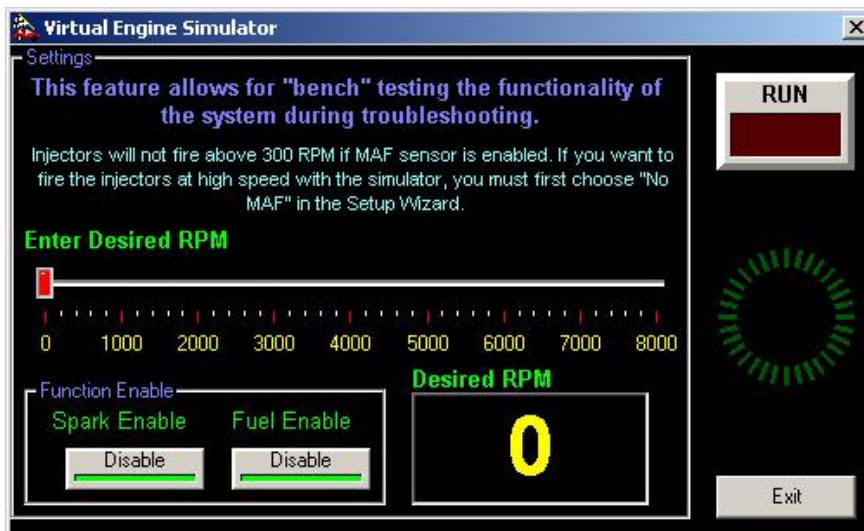


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Virtual Engine Simulator (Pro Option Only)

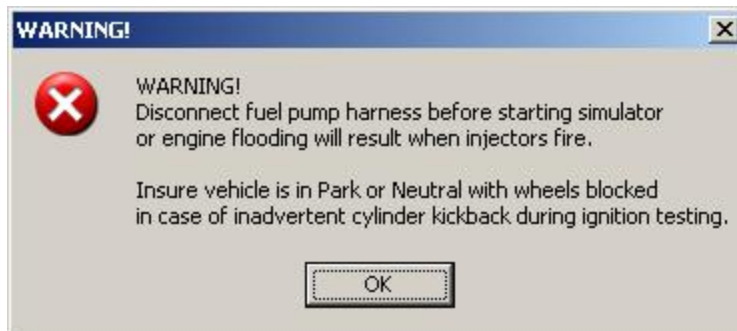


The **Virtual Engine Simulator** functions is accessed by going to the "**TOOLS**" menu and selecting "**Virtual Engine Simulator** " menu option.



This tool is very valuable when troubleshooting or verifying proper operation of the system in a "test" mode or before firing the engine. It can help identify a bad injector or ignition component.

When you first open the simulator, you will be reminded to disconnect the fuel pump harness to prevent flooding of the engine:



To use the simulator, click on the slider and select the RPM you wish to have the engine to simulate. Once you've selected the RPM, click on the **RUN** button to start/stop the simulator.

You will then be able to enable and disable spark and fuel to check the actual operation of injectors and ignition components by clicking on the two buttons. You should hear the injectors start/stop and the spark to start/stop. You will also see the gauges and MAP's on the main displays update just as if the engine was really running.

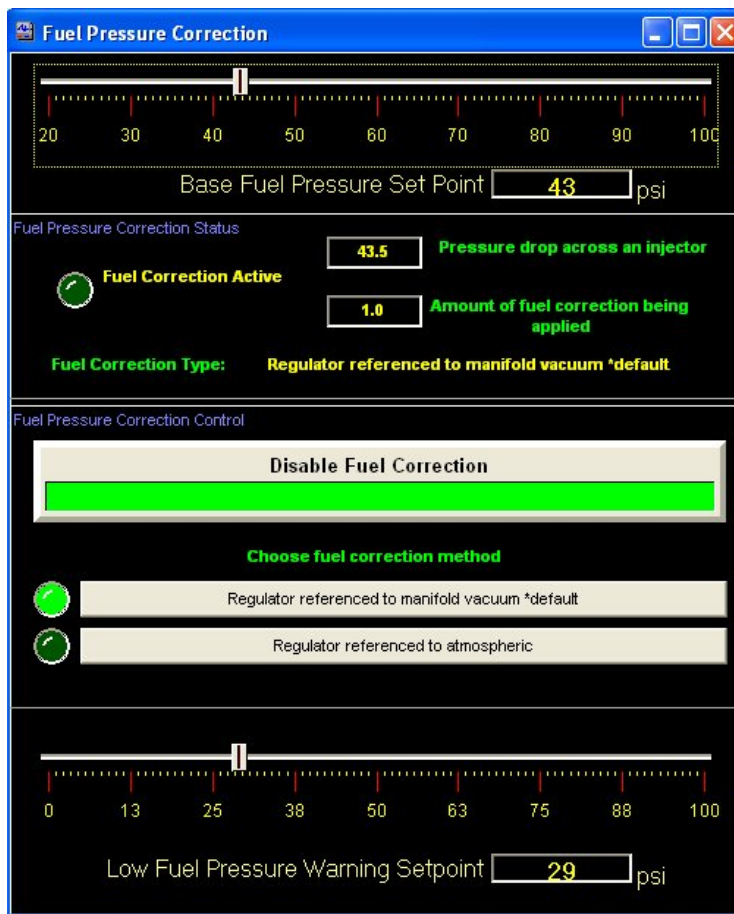
When you have completed testing, choose "**EXIT**" and the simulator will reset the ignition and fuel to operational and close the window.

6.4 Base Fuel Pressure Set Point



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Base Fuel Pressure Set Point (Pro Option Only)



This tool is accessed via the **TOOLS** Menu and selecting **Fuel Pressure Correction** .

Base Pressure Set point: To change the Base Fuel Pressure (which is the pressure that the system will normally operate at); simply move the slider or type your system pressure in the input box.

Pressure Correction: The Pro-Tuner system can automatically correct your fuel injector pulse width for changes in base fuel pressure. Fuel pressure correction will increase or decrease the injector open time if fuel pressure drops or increases for any reason. This is a very useful feature to help the engine run consistently. Unlike other systems that

require a table be manually calibrated for fuel pressure compensation - the Pro-Tuner system can perform this automatically for any base pressure that you set.

In some cases, tuners decide to change overall fuel delivery by adjusting the pressure regulator. This is not the recommended procedure, but for tuners wishing to do this or other fuel pressure manipulation to affect global air/fuel ratio - the automatic Fuel Correction can be disabled while still using the pressure sensor for monitoring purposes.

Fuel regulation Method: The Fuel Pressure regulator operates by referencing the desired pressure to a base pressure. Most regulators give the user the option of referencing to atmospheric pressure (open air), or manifold vacuum. Manifold vacuum referencing is the recommended method; but the user may choose either method here as well as in the setup wizard.

Low Fuel Pressure Warning Set point: When a pressure sensor is present, the Pro-Tuner system can alert the tuner or vehicle operator of a low fuel pressure situation by turning on the warning light. In a critical situation such as low oil pressure, Fuel pressure, or severe fault within the system - the warning lamp will blink very rapidly. The user can then take desired action to protect the engine or troubleshoot the fuel system.

It is recommended that your preferred setup be set during the initial programming when the setup wizard programs your default choice into the ECU. That way, if you use the feature to "Reset to Original User Setup", your choice will be retained. If you only set it through the tuning screen - you will have to verify your regulation setup if you revert to different "original" settings.

Tuning Tips:

Fuel pressure should be determined by evaluating the required flow, horsepower, and RPM of the engine. The more pressure, the more fuel flow. The change in flow can be calculated by the following:

Pressure vs Flow Conversion: $\text{NEW INJECTOR FLOW} = \text{SQUARE ROOT}(\text{new pressure}/\text{old pressure}) \times \text{injector rated flow}$

Although flow calculations and injector selection are not specifically covered in this manual, there are many sources of that information available to the tuner. To avoid running problems and injector/injector driver failures - the injector duty cycle should be watched closely. As a general rule, adjust pressure to obtain a maximum of 80-85% duty cycle of the injector with your desired air/fuel ratio. This calculation is directly displayed on the details page for easy reference.

Run the minimum pressure required to achieve 80-85% maximum duty cycle.

This will generally be between 250 - 500 kPa (36-72 psi). Make sure you do not exceed the recommended pressure of your fuel pump, and that the pump has adequate flow capacity at the desired pressure. Consult your Edelbrock representative for fuel pump, pressure, and injector recommendations.

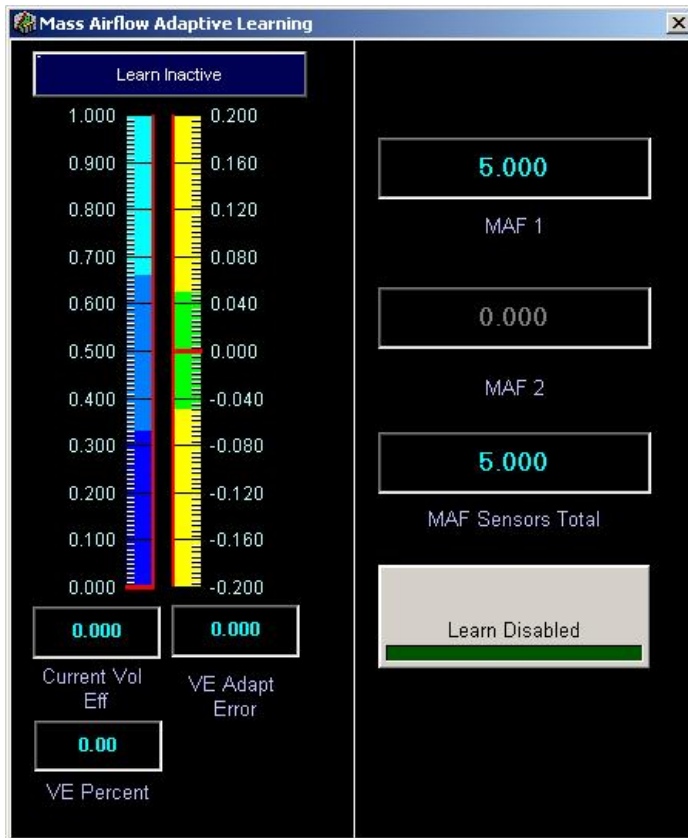
6.5 Adaptive Air "AutoTuning" Capabilities



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Adaptive Air "AutoTuning" Capabilities (Pro Option Only)

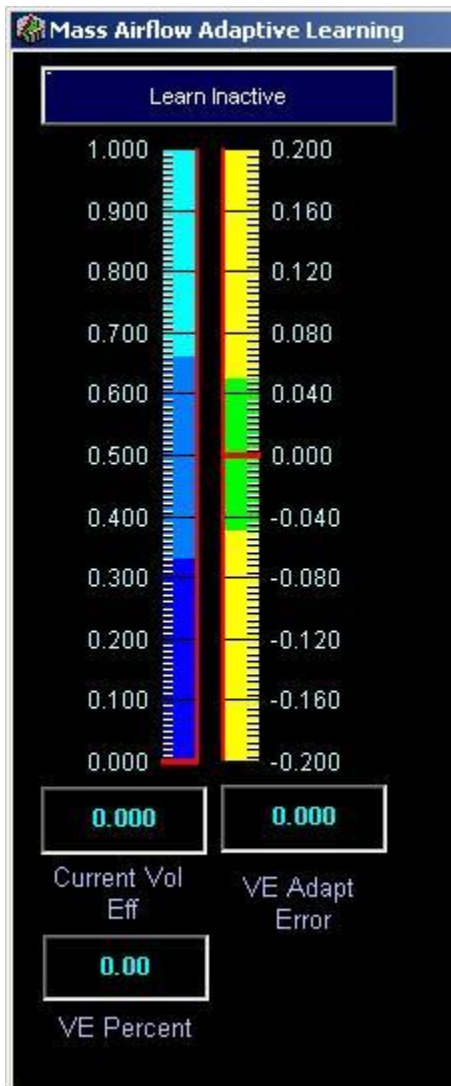
Mass Air Flow (MAF) Adaptation



This tool allows you to monitor and control the Mass Airflow Adaptation capabilities of the Pro Tuner system. This functionality basically "learns" via an advanced ECU strategy how to keep the air/fuel mixture at your requested Target Air Fuel Ratio. It teaches (adapts) the volumetric efficiency map the airflow characteristics of the engine when running in Speed/Density mode.

You may run single or dual GM digital mass airflow sensors in Speed/Density, greatly increasing the adaptability of your system. You may choose to run MAF sensor/s as a permanent installation for continuous learning of the VE map and compensation for engine airflow mods or engine wear and degradation. Alternatively, You may also use this tool to run one or two mass airflow sensor/s during dyno tuning sessions and remove the sensor after the adaptive learn has completed; thus returning to an extremely accurate calibration for true speed/density operation. To use this feature, you must have the MAF enabled through the setup wizard and have selected speed/density as the control method.

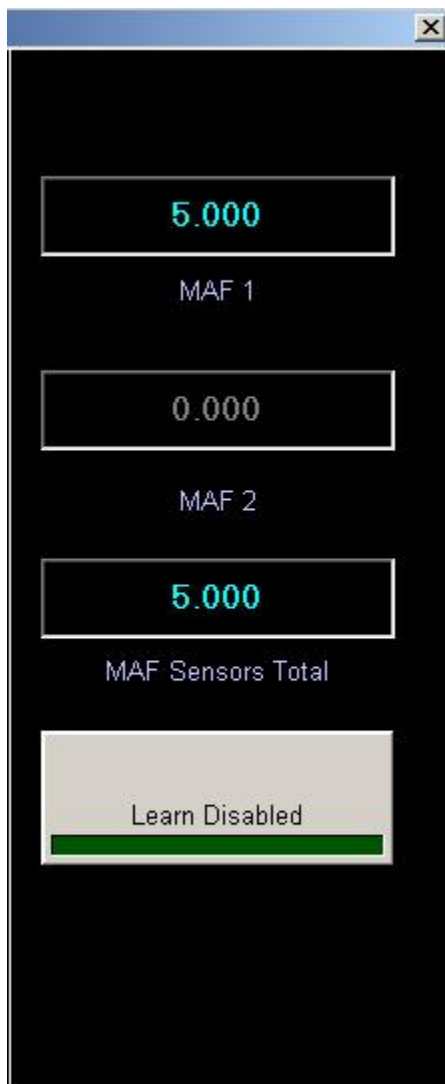
The **Mass Airflow Adaptive Learning** screen has a few different displays, as follows:



This portion of the display shows you the *Current Volumetric Efficiency* on the left and the *Normalized VE Error* on the right. This gives you an idea of how the adaptive learning is working, since the error values will get closer to zero as the "learning" takes place for every speed and load. A low error (readings in the green band) indicate that the VE values calculated are the same as the actual airflow measured by the sensor. Readings above the green band indicate that the VE mapped values are too low. Conversely, when

the indicator is below the green band, it indicates that the system is "taking out" airflow and the values in the map are too high. The **LEARN / LEARN INACTIVE** LED will light when the ECU is actively adapting.

Typically, adaptation will take several minutes to "hone in" at different steady state loads and speeds before it is complete. (You can let the system adapt it out, or manually change the VE map to bring the error down.) The system will only adapt when the engine is in a steady state operating condition. This provides the most accurate adaptation and eliminates error due to excessive MAF tube length. Many cells of the VE map may never be 100% adapted since they are loads and speeds that are very seldom reached in "real world" situations; or do so only for a moment. (i.e. high RPM with no load or very low RPM with very high load). Very often you end up with a "football" shaped area of adaptation, since that's where the engine spends almost all of its time during normal operation. This is why a VE map should be manually smoothed with reasonable values in the corners and overall map if the MAF sensor is going to be removed after initial tuning, and even if it will remain on the engine permanently. If the MAF sensor is kept on engine and enabled; VE adaptation will continue indefinitely.



The "Learn Disabled" button allows for user override of the adaptation behavior. There may be cases where you have a calibration that is tuned for a very specific purpose and you don't want the ECU VE adaptation changing this. In that case you can turn the adaptation off by using the **Learn Enable/Disable Button**. MAF total display equals MAF1 if only one sensor is used; and the total of MAF1 + MAF2 if two sensors are used.

You can adjust the *speed or rate at which adaptation occurs to the VE Map* by increasing the values in the *VE Adapt Gain table* (available in the maps drop down list on the MAPS tab). The index or ordinates in this table is the VE error, and the number you calibrate in the cells is the amount of error that is adapted out every 5 mS. As you can imagine, even very small numbers will adapt rather quickly at this rate. The **VE Adapt Gain Table** should either be left in the default condition, or calibrated so that there are zeroes (no adaptation) in the center cells of the table and an increasing number at each end of the table. The reason for putting zeroes in the center cells is that with very low error, no adaptation is needed. Also, there will naturally be some slight error variation during adapted operation where it is unnecessary to attempt to adapt further. When entering values in the other cells: TAKE GREAT CARE - DO NOT PUT TOO LARGE OF VALUE IN THIS TABLE! A large value can cause erratic adaptation and poor running because it can adapt a false value captured during a misfire, IAC modulation, or other nearly instant or non-typical running condition. Generally, the slower the adaptation - the better; because it will adapt based on a larger sample size and give the ecu a more complete picture of true airflow.

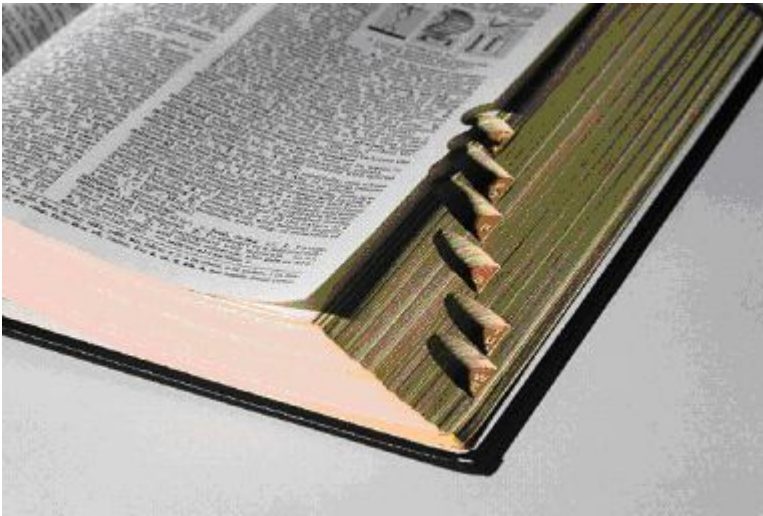
If you are only running MAF during tuning, **be sure to deselect the sensor in the setup wizard after the adaptive learn has been completed to return to normal speed/density operation and prevent sensor faults from being displayed when MAF is unplugged**. It is recommended that you then open the VE map and manually smooth any surfaces that were not fully adapted. Such as in the corners of the map where it may be difficult to run.

7 Appendices



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Appendices



These sections provide more detailed and helpful information that will help you enjoy your new Pro Tuner System.

7.1 Engine Controller Pinout Sheets



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ECM Pinout

	Pin	Mototron Name	Channel Type	Channel Name
Connector A				
	A1	FI-3	Injector	Injectors 4/7
	A2	FI-2	Injector	Injectors 5/8
	A3	SPARE(Relay)	Switched ground	N/C
	A4	CAN1+	CAN1+	Customer Interface pin J
	A5	SCL-	Comms-	Diagnostic pin C
	A6	EK0N	Knock sensor #1	Knock pin 1
	A7	EK1N	Knock sensor #2	Knock pin 2
	A8	DG2	Expansion pin K	Expansion pin K
	A9	MIL	MIL connector pin 1	MIL connector pin 1
	A10	TACH	Tach pin 1	Tach pin 1
	A11	CAN1-	Customer Interface pin K	Customer Interface pin K
	A12	SCL+	Diagnostic pin B	Diagnostic pin B
	A13	EK0P	Knock sensor #1	Knock pin 2
	A14	EK1P	Knock sensor #2	Knock pin 2
	A15	ESTOP	Switched input	N/C
	A16	DRVG-A	Power Ground	Driver Ground lug/Interface pin B
	A17	FI-1	Injector	Injectors 1/6
	A18	FI-4	Injector	Injectors 2/3
	A19	FULEP	Switched ground	Fuel pump relay pin 86
	A20	LIAC	IAC pin 1	IAC pin 1
	A21	DG1	Digital input	Expansion pin C
	A22	MPRD	Switched ground	Main Relay pin 86
	A23	DRVP	Vbatt	Perm +12V
	A24	DRVG-B	Power Ground	Power Ground
Connector B				
	B1	XDRG	Sensor Ground	Sensor Ground
	B2	CAT-AN9	Analog 9 input	Charge Air Temp pin A
	B3	MAP-AN1	Analog 1 input	MAP pin B
	B4	LEVEL-AN14	Analog 14 input	ss
	B5	VR-CNK+	Speed input signal (VR)	Ignition Interface pin H
	B6	VR-CNK-	Speed input ground (VR)	Ignition Interface pin G
	B7	XDR-AN18	Analog 18 input	Oil Pressure
	B8	O2 PASS-AN5	Analog 5 input	Passenger side O2 pin B
	B9	DG MAF-DG4	Digital input (MAF)	MAF pin D

B10	CAM DG	CAM input	Ignition Interface pin C
B11	O2 DRV AN2	Analog 2 input	Drivers Side O2 pin B
B12	XDR-AN3	Analog 3 input	Fuel Press pin C
B13	THERM-AN11	Analog 11 input	Expansion Pin A
B14	CLNT-AN10	Analog 10 input	Coolant Temp pin A
B15	EST 3	Coil 3	N/C
B16	EST 4	Coil 4	N/C
B17	EST RTN	Coil return	Ignition Interface Pin K
B18	ECUP	Switched +12v	Switched +12v
B19	51K PU-AN15	Analog 15 input	Ext. Baro Sensor Expansion Pin B
B20	TPS-AN4	Analog 4 input	TPS pin C
B21	XDRP	VREF +5v	REF +5v
B22	THERM-AN19	Analog 9 input	N/C
B23	EST 1	Coil 1	Ignition 1?
B24	EST 2	Coil 2	Coil 2

PCM Pinout

	Pin	Mototron Name	Channel Type	Channel Name
Connector A				
	A1	ECUP	Switched +12V	ECU power
	A2	O2A+ (AN16)	Analog 16 input	O2A signal Passanger Side
	A3	AN1	Analog 1 input	MAP signal
	A4	AN2	Analog 2 input	Oil Pressure signal
	A5	AN3	Analog 3 input	Fuel Pressure signal
	A6	AN4	Analog 4 input	TPS signal
	A7	AN5	Analog 5 input	UEGO #1
	A8	AN6	Analog 6 input	Spare Position signal
	A9	AN7	Analog 7 input	External Baro Sensor
	A10	AN8	Analog 8 input	UEGO #2
	A11	CAN1+	CAN1+	CAN1+
	A12	O2A- (AN17)	Analog 17 input	O2A signal return Passanger
	A13	O2B+ (AN19)	Analog 19 input	O2B signal Driver Side
	A14	AN9	Analog 9 input	Air Temp
	A15	AN10	Analog 10 input	Coolant Temp
	A16	AN11	Analog 11 input	Spare Temp
	A17	AN12	Analog 12 input	Spare Temp
	A18	SCL-	Comms -	Comms -
	A19	EK0N	Knock Sensor#1	Knock Sensor#1
	A20	EK1N	Knock Sensor#2	Knock Sensor#2
	A21	CAN1-	CAN1-	CAN1-
	A22	XDRG	Sensor ground	Sensor ground
	A23	XDRP	VREF +5v	REF +5v
	A24	O2B+ (AN18)	Analog 18 input	O2B signal return Driver Side
	A25	AN13	Analog 13 input	N/C
	A26	AN14	Analog 14 input	Fuel Level
	A27	AN15	Analog 15 input	Spare Temp
	A28	SCL+	Comms +	Comms +

	A29	EK0P	Knock Sensor#1	Knock Sensor#1
	A30	EK1P	Knock Sensor#2	Knock Sensor#2
	A31	CAN2+	CAN2+	CAN2+
	A32	CAN2-	CAN2-	CAN2-
Connector B				
	B1	EST RTN	Coil Return	Coil 1 Return
	B2	EST1	COIL 1	COIL 1
	B3	DG4	Digital input	MAF (frequency)
	B4	MPRD	Switched ground	Main Relay
	B5	CNK-	Timing ground	Crank signal ground (VR)
	B6	CAM DG	Speed input	Cam signal (Hall)
	B7	OILP	????	IAC OUTPUT
	B8	START	Fan Control	Fan Output
	B9	EST5	COIL 5	COIL 5
	B10	EST3	COIL 3	N/C
	B11	FUEL P	Switched ground	FUEL PUMP Relay
	B12	TACH	Switched ground	Tach
	B13	CNK+	Speed input	Crank signal (VR)
	B14	CNK DG	Speed input	Crank signal (Hall)
	B15	DG1	switched input	Neutral switch
	B16	DG2	switched input	Level switch
	B17	DRV P	Switched Power	Switched +12V
	B18	DRV P	Switched Power	Switched +12V
	B19	AI4	Switched ground	Shift Light output
	B20	FI4	Switched ground	Injector 4
	B21	AI3	Switched ground	MIL/check engine light
	B22	FI3	Switched ground	Injector 3
	B23	ESTOP	Switched input	Stop Switch/Kill Switch
	B24	XDRP B	VREF +5v	REF +5v
Connector C				
	C1	HSOL1	Switch to ground	Rev Batt Prot-no Freewheel
	C2	ETC B	H-Bridge (Motordrive)	N/C (Elect. Throttle)
	C3	AI2	Switched ground	Injector 8
	C4	ETC A	H-Bridge (Motordrive)	N/C (Elect. Throttle)
	C5	AI1	Switched ground	Injector 7
	C6	FI1	Switched ground	Injector 1
	C7	EST4	COIL 4	N/C
	C8	EST2	COIL 2	N/C
	C9	HSOL3	Switch to ground	N/C
	C10	HSOL4	Switch to ground	N/C
	C11	FI2	Switched ground	Injector 2
	C12	EST6	COIL 6	COIL 6
	C13	EST7	COIL 7	COIL 7
	C14	EST8	COIL 8	COIL 8
	C15	DRVG A	Power ground	Power ground
	C16	DRVG B	Power ground	Power ground
	C17	ESC A	PWM Out	N/C (Shift solenoid control)
	C18	ESC B	PWM Out	N/C (Shift solenoid control)
	C19	HSOL2	N/C	Rev Batt Prot-no Freewheel
	C20	AI6	Switched ground	Boost Solenoid PWM

	C21	FI6	Switched ground	Injector 6
	C22	AI5	Switched ground	N/C
	C23	FI5	Switched ground	Injector 5
	C24	DRVG C	Power ground	Power ground

7.2 Frequently Asked Questions (FAQs)



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Frequently Asked Questions (FAQ)

Engine won't start, what should I check?

- Check that the 2 & 3 pin ignition connectors are connected to the Distributor. The injectors will not operate without a Distributor Reference Pulse supplied by the distributor. Insure you are showing RPM during cranking.
- Check the wire splices you installed as part of the conversion. Disconnect any one of the eight injectors and check for +12V to ground on the terminal connected to the pink wire, This is battery power. Use the Engine Simulator function to verify the injectors are firing, ignition is supplying spark, and no serious faults exist.

How do I check the fuel pressure and what should the pressure be?

You should install a Schrader valve on the front of the passenger side fuel rail for testing or install the optional fuel pressure sensor for the Pro-Tuner system.

To test for system leaks, (internal or external):

Connect a fuel pressure gauge to the Schrader valve.

Turn the ignition to run. (do not start).

The pump will run for a few seconds and quit.

Check the pressure, it should be 42 to 44 PSI, (*Depending on altitude and regulator setup*).

Note & repair any leakage points.

Why is my fuel pressure too high?

- Check for a fouled fuel return line or stuck pressure regulator.
- Check the return fuel line for kinks or blockage.

What is the recommended spark plug for the Small Block Power package?

- The #6085 head needs a long reach gasket spark plug, we recommend the Champion RC12YC.
- This is a 3/4" reach. Do not use stock GM plugs, they are designed for a tapered seat.

7.3 Trouble Codes/Faults



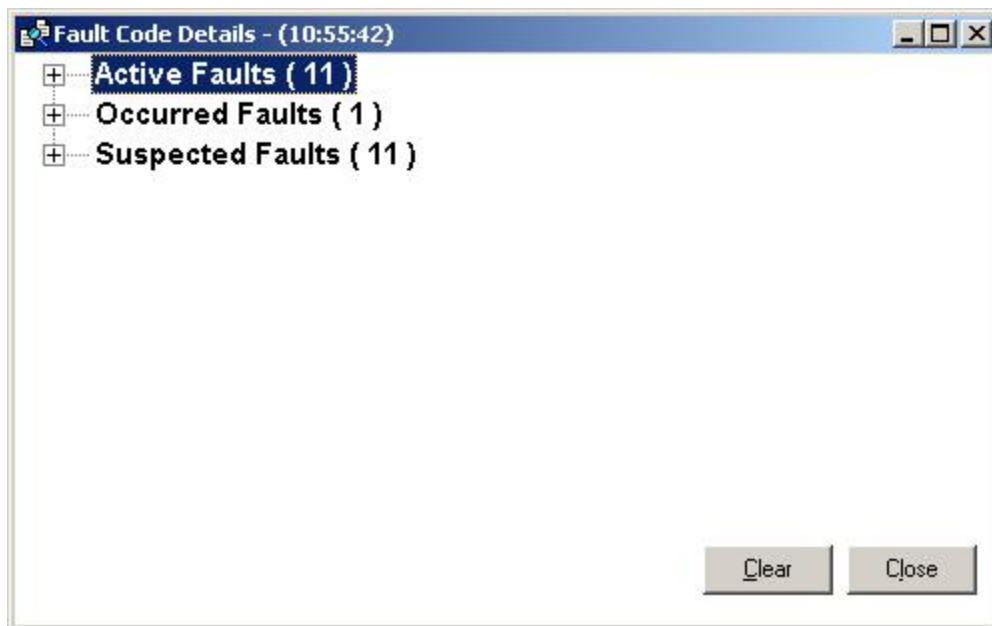
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Trouble Codes/Faults

Trouble Codes or Fault Codes are indicated by the **FAULT** indicator at the bottom right hand corner of the screen status bar. This indicator will light up either YELLOW for warnings or RED for faults.



By clicking on this indicator, you can open the **Fault Code Viewer** .



You can expand any category of fault by clicking on the "+" next to the category.



This view will show you three categories of Fault Codes:

Active Faults

Active Faults are faults that are currently being reported by the ECU and the ECU is reacting to these faults according to the strategies in place.

Occurred Faults

The Occurred Faults category is basically a history of faults that have been detected and Active at one point or another. This category can help you find and diagnose intermittent or momentary faults.

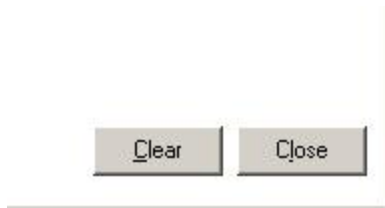
Suspected Faults

Suspected Faults represent possible fault codes that have been detected, but the

condition to make them "Active" has yet to be confirmed. This category can be helpful to spot potential momentary or intermittent faults or incorrect calibration values.

In any category of fault, if you click on the fault text, it will take you to the appropriate section of the HELP file to further explain the code and to suggest possible causes and diagnostic procedures, if available.

Buttons



The "**CLEAR**" button will clear all the faults from the categories. If the faults persist, they will reoccur and show up in the list again. Each fault has a timestamp showing the last time it was detected. Active faults will show a constantly updating timestamp.

The "**CLOSE**" button simply closes the fault viewer.

7.4 Maintenance Procedures



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Maintenance Procedures

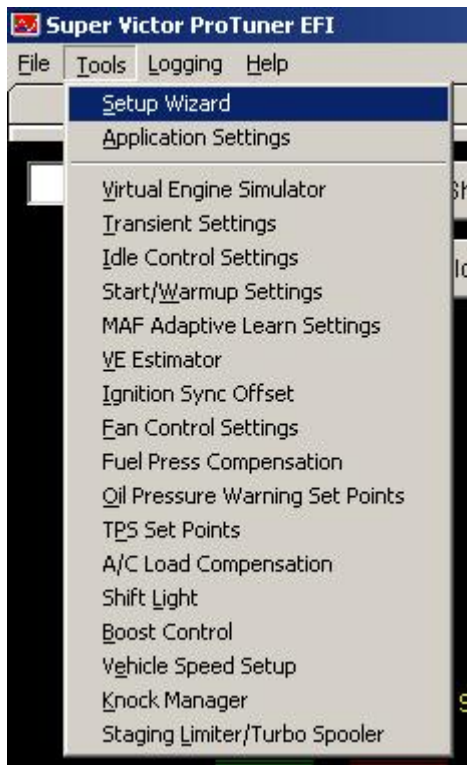
In this section, you will find several helpful maintenance procedures, including sensor replacement procedures and periodic maintenance procedures for your Victor Series EFI kit.

7.4.1 TPS Replacement



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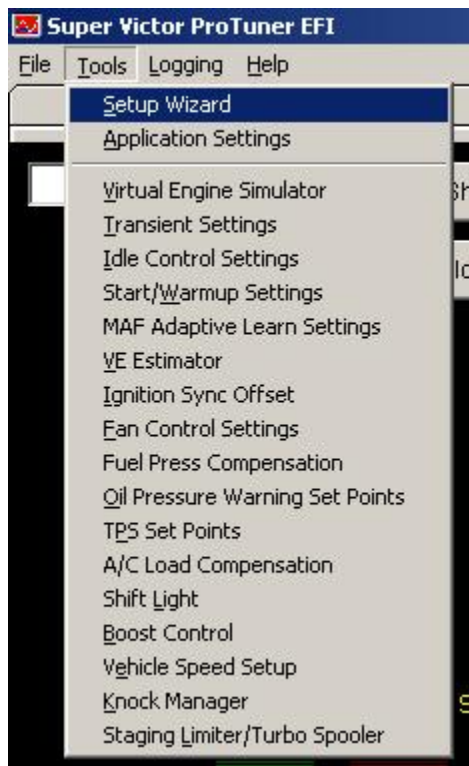
TPS Replacement Procedure



To replace the Throttle Position Sensor on your Victor Series Throttle Body, perform the following procedure:

FOR ADJUSTABLE SENSOR MODELS ONLY. NONADJUSTABLE MODELS SIMPLY NEED TO RESET THE MIN/MAX VALUES IN THE SOFTWARE.

1. Back off the minimum air bleed screw (see Figure x) until the throttle blade is completely closed. **BE SURE TO COUNT THE NUMBER OF TURNS ON THE SCREW AND WRITE IT DOWN.** This will allow you to restore the idle position when the procedure is complete.
2. Unplug the TPS electrical connection from the wiring harness (see Figure X1)
3. Remove the screws on the TPS holding it to the throttle body (see Figure X2)
4. Remove the sensor
5. Insert the new TPS into the throttle body (see Figure X3)
6. Bring up the Edelbrock Victor Series EFI application and choose the Setup Wizard from the Tools menu



7. Choose the "TPS Set Up" tab in the Setup Wizard
8. Reconnect the wiring harness to the sensor.
9. Adjust the new TPS as necessary to achieve a minimum TPS setting of YY-ZZ counts. Once this is achieved, tighten the screws to secure the sensor.
- 10 Turn the minimum air bleed screw the number of turns discovered in step one to . reset the idle.

7.5 Glossary



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Glossary of Terms

Term	Definition
A	
Adaptive Learn	An advanced engine control strategy that performs adjustment of volumetric efficiency map based on feed forward information from a Mass Air Flow (MAF) sensor and feedback information from the Oxygen sensor.
Air Fuel Ratio	Ratio of air to fuel being ingested by the engine.
Alpha N	A simplistic strategy that uses throttle angle and RPM to look up an injector pulse width from a table. A simple compensation scheme is used based on MAP, Air Inlet Temperature (IAT), and coolant temperature (ECT). This mostly used if the engine has very low engine vacuum, causing a weak MAP signal. Oftentimes, the Speed/Density strategy is a better fit for all around drivability and ease of tuning.
Auto Table Refresh	Optional feature that is especially useful in the Volumetric Efficiency Map. The entire table values (and associated 3D chart) are refreshed to show any Adaptation that may have occurred.
B	
Baro	<i>Barometric Pressure</i> : Local atmospheric pressure.
Battery Volts	Electrical voltage as measured by the ECU.
Bottom Dead Center	<i>(BDC)</i> : Piston at its lowest point of travel.
Brake Specific Fuel Consumption	<i>(BSFC)</i> : Brake Specific Fuel Consumption; in an engine, the ratio of the rate at which fuel is flowing into the engine to the brake horsepower being generated
C	
Cam Sensor	Sensor that indicates camshaft position and used to determine cylinder intake events and position of the engine cylinders within its cycle (compression stroke or overlap), since the camshaft is rotating at 1/2 crank speed in a 4 cycle automotive engine. This allows for individual cylinder control.
CAN	Controller Area Network: An electronic communications method for connecting various controllers.

CLC	<i>Closed Loop Compensation:</i> This is the strategy that involves adapting the fuel delivery based on the Oxygen Sensor feedback. Small variations in fuel delivery are compensated for and adapted out during closed loop operation so that actual AFR equals the desired mapped AFR.
Closed Loop	An operating mode of the PCM enabling adapting fuel and spark based on a feedback system. By constant exhaust sampling via the oxygen sensor, a closed loop system allows engine adjustments to occur while running - in order to minimize exhaust emissions and provide the desired AFR.
Coil Energy	Amount of energy that a coil outputs. Typically specified in units of millijoule's.
Combustion Chamber	The space remaining at the top of the cylinder when the piston is at the top dead center position. Where the fuel-air mixture begins to burn with the valves closed.
Compression Ratio	The ratio of the cylinder volume with the piston at bottom dead center (BDC) to the cylinder volume with the piston at top dead center (TDC).
Crank Angle	The value (in degrees) of the crankshaft revolution. When referred to in the Pro-Tuner Setup Wizard, it describes the individual crank pin offset from the #1 cylinder. With the Pro USB key, the user can program custom firing orders for flexibility in crankshaft designs, including "odd fire" crankshaft's and "180 degree" crankshaft's.
Crank Sensor	Sensor that indicates crankshaft position to the ECU. This may be integrated into a distributor or a separate sensor on the crank (either internal or external to the engine)
CTS	<i>Coolant Temperature Sensor:</i> Sensor that indicates Coolant Temperature of the engine. Referred to in the Pro-Tuner system as the <i>ECT sensor</i> . Provides input into engine operation model for fueling and spark.
D	
Data Logger	Recording capability to save chosen parameters for later review.
DC	<i>Duty Cycle:</i> Percentage of usage based on the devices capacity. Essentially the duration an actuator is functioning vs. the total duration possible. Examples would be injector DC and IAC DC.
Dwell	<i>Ignition Dwell:</i> Traditionally, it was the number of degrees of distributor rotation with the contacts in the closed position. More specifically in electronic control, it is the amount of time (in milliseconds) allowed for the coils to saturate before firing the spark plug.
E	

ECU	<p><i>Engine Control Unit:</i> The electronic "box" that controls the engine functions. Sometimes referred to as the PCM (Power train Control Module) or ECS (Engine Control System). Various manufacturers have a variety of acronyms for the controller. The Pro-Tuner refers to the ECU specifically as "ECM" for the 48 pin ECU and "PCM" for the 80 pin ECU.</p>
Equivalence Ratio	<p>Actual air/fuel ratio divided by the air/fuel ratio at stoichiometry. Example: 1.0 would be stoichiometric for the fuel being used (~14.7:1 for gasoline). 1.1 would represent 10% Richer, and 0.90 would represent 10% Leaner than stoichiometric.</p> <p>This is the inverse of <i>Lambda</i>.</p>
Even Row Highlight	<p>Feature in the Maps to turn on and off the alternating gray and white rows. This feature makes cell location easier to determine.</p>
F	
Fault Code	<p>The ECU continually monitors sensors and actuators for possible faults. If you click on the "FAULT" light in the bottom status bar, a list of fault codes and reasons will be listed.</p>
Fault Code (Active)	<p>A fault code that is currently being detected by the ECU. Once a fault becomes active, it will also be triggered as "Occurred".</p>
Fault Code (Occurred)	<p>A fault code that has occurred since the last time the ignition key was turned on. It may not be currently Active and may have been a momentary fault.</p>
Fault Code (Suspected)	<p>A fault code that is "possible" and may become active. The ECU has detected some intermittent conditions that may be diagnosed as a marginal or failing component.</p>
Feedback AFR/EqR	<p>Air Fuel Ratio (or Equivalency Ratio) as calculated from readings from the O2 sensor</p>
Flight Recorder	<p>Capability that allows for recording chosen parameters for later review. This differs from <i>Data Logging</i> by the fact that the parameters are saved physically in the ECU, thus allowing recording even without a PC or laptop connected.</p>
Forced Induction	<p>An engine that uses a device to force additional air into the cylinders, such as a turbocharger or supercharger.</p>
G	
Gain	<p>The ratio of a system's output magnitude to its input magnitude.</p>
Gain (Differential)	<p>This controls the dampening affect of a system. Example: Increasing the Differential gain for an IAC will control how much the IAC anticipates a change and how fast it reacts to an input. The D term deals with the "rate of change" of the parameter. The faster the parameter is nearing or going away from set point - the D term output will increase.</p>

Gain (Integral)	This controls the acceleration based on change, or basically the how fast the rate of change is adapted or integrated. Example: Increasing the Integral Gain on an IAC will make it change faster and be more "sensitive".
Gain (Proportional)	This controls the resistance to change or "stiffness" of the system. Example: Increasing the Proportional gain for an IAC will affect how long it takes to react or change. The larger the change (or "error" based on current position) the harder the actuator is driven. The P output is proportional to the error.
H	
Horsepower	The amount of work done per unit of time. 1 HP = 33,000 ft lbs/min or ~746 watts. $HP = \text{Torque} \times (\text{RPM}/5,252)$
I	
IAC	<i>Idle Air Control</i> : actuator used to control air around the throttle blade. Affects idle speed and quality and is controlled by the ECU.
IAT	Intake Air Temperature: Sensor that indicates Intake Air Temperature. Provides input into air density equations for fueling.
Ignition Sync Offset	This is the number of degrees from TDC #1 that the crank sensor is offset.
Injector	Device used to inject fuel into the intake manifold. Injectors come in high impedance (saturated or peak and hold) and low impedance (peak and hold).
J	
K	
L	
Lambda	Value in percentage of the chemically correct air-to-fuel ratio for any type of fuel. If the air fuel ratio measured in the exhaust pipe of an engine is at the chemically correct (stoichiometric) ratio of air-to-fuel, lambda is equal to 1.0. In the case of gasoline, 1.0 is equivalent to 14.7:1 air-to-fuel. Values less than 1.0 indicate the engine is running RICHER , while values greater than 1.0 indicate the engine is running LEANER . Example: 1.2 Lambda means that the AFR is 20% LEAN . 0.9 Lambda means that the AFR is 10% RICH . This is the inverse of the <i>Equivalency Ratio</i> .
Load	Indicated as Torque in the engine model.
M	
MAF	Mass Air Flow: measurement either calculated by the engine model (if no sensor is used) or directly measured by a MAF sensor.

MAF Sensor	Sensor used to measure mass of incoming combustion air. Oftentimes, Mass Airflow sensors contain a thin-film, thermally isolated bridge structure containing heater and temperature sensing elements. The bridge structure provides a sensitive and fast response to the flow of air over the chip.
MAP	Manifold Absolute Pressure: Pressure in the engine manifold measured in reference to a perfect vacuum. 0kPa would refer to a perfect vacuum and ~100 kPa (+- depending on altitude and barometric conditions) usually represents atmospheric normal.
MotoBall	A feature that traces the current cell being used by the ECU/ Engine while in the various Maps.
Multiplier	A factor used to multiply a value. Usually used to increase or decrease a value by a percentage. Example: A Warm Up Fueling Multiplier of 1.32 will increase fueling at the specified coolant temperature by 32%.
N	
Nitrous Oxide	An oxide of nitrogen that is injected under pressure into the engine, usually in the manifold as a power adder due to a chemical release of extra oxygen. Sometimes referred to a "supercharger in a bottle".
Normally Aspirated	(<i>NA</i>): An engine that has no forced induction (i.e. no turbo/ supercharger) and relies on atmospheric pressure for cylinder filling
O	
Offline	Mode in which you are not connected to the ECU, but can make calibration changes to various tables and values.
Offset	A constant value that is added or subtracted to a value or equation.
Ordinate	Values on a grid axis. Example: RPM and Torque are <i>ordinates</i> on the Spark Map.
Oxygen Sensor	(<i>O2 Sensor</i>): Device that monitors the oxygen levels of the exhaust gases and feeds the data back to the engine computer. A <i>switching style</i> O2 sensor has a narrow range of accuracy centered around the stoichiometric point of the fuel being used. Sensors can be heated or unheated. The heated sensor in the Pro-Tuner system provides better control than unheated sensors. A <i>wide band</i> style O2 sensor has a linear curve representing a wide range of air fuel ratios, usually reading from 10:1 up to 18:1 for gasoline. Wide band oxygen sensors are very accurate, and the preferred choice for dialing in a perfect tune.
P	
Port Air	Calculated air flow at the intake port.

Pressure Ratio	<i>(PR)</i> : Ratio of Engine manifold pressure to barometric (ambient) pressure. An example would be 50kPa of manifold absolute pressure (MAP) and a barometric pressure of 100 kPa would result in a PR of 0.50
Q	
R	
Rev Limit (Hard)	RPM at which both ignition and fuel are totally cut off
Rev Limit (Med)	RPM at which ignition cut off pattern is more aggressive than in the "soft" pattern to try to limit RPM
Rev Limit (Soft)	RPM at which ignition and fuel are cut off in a "soft" pattern to limit RPM
RPM	<i>Revolutions Per Minute</i> : number of crankshaft revolutions per minute
S	
Semi-Sequential Injection	Two (or more) cylinder's injectors are triggered at the same time during the engine's cycle. (batch fire). Typically this provides more control over the injection event for cylinders and results in better midrange torque than bank firing injectors.
Sequential Injection	With a cam sensor or other method of determining and synchronizing with cylinder #1 intake cycle, each injector can be fired sequentially at the precise time needed for each cylinder (independent of other cylinders). This allows for customizing the injection event for each cylinder.
Sequential Spark	With a cam sensor or other method of determining and synchronizing with cylinder #1, each spark plug can be fired sequentially at the precise time needed for each cylinder (independent of other cylinders). This allows for customizing the ignition event for each cylinder, or pair of cylinders in a waste spark Coil Near Plug system.
Serial	Serial Data: Method of connection to a laptop or PC that involves transmitting and receiving data in a serial method.
SOI	<i>Start of Injection</i> : The point that the injection event begins in relation to crankshaft position of that cylinder.
Spark Advance	In degrees, how far before Top Dead Center the spark plug fires.
Speed Density	A method of calculating the inducted mass airflow of an internal-combustion engine-based MAP RPM, and mapped volumetric efficiency at a constant temperature. Self compensates for variation in environment.
Stoichiometric	The theoretical air/fuel ratio for perfect combustion; it enables exactly all of the fuel to burn using exactly all of the oxygen in the air. This will be 14.7:1 Air Fuel Ratio for gasoline.
Supercharger	A mechanically driven air pump (usually from the crankshaft with belts or gears) used to force more air into the cylinders.
T	

Target AFR/EqR	Current fueling target, based on the inputs to the ECU model. The ECU will be adjusting to this value as necessary to based on this target (from the Target AFR map).
Tau X	An advanced transient fuel strategy that calculates and maintains the Air Fuel Ratio during rapid changes in air movement or engine load.
TDC	Top Dead Center: The reference point where Cylinder #1 is at the top of the compression stroke.
Throttle Air (Thrtl) Torque	Calculated air flow at the throttle body. The twisting or rotational force on the crankshaft. Used as an ordinate in the engine model. It has a direct relationship to horsepower (or kilowatts) based on RPM and gives an indication of LOAD on the motor.
TPS	<i>Throttle Position Sensor:</i> Sensor located on the throttle body that indicates throttle blade angle, in volts.
Transient Fuel	Controlling the air fuel ratio during rapid changes in air volume or engine load.
Turbocharger	A supercharger driven by exhaust gases.
U	
USB	Universal Serial Bus: A connection and communication standard used in many PC's and laptops.
V	
Virtual Engine Simulator	Available from the TOOLS menu. This allows you to pulse the injectors or fire the coil(s) without the engine running. It can be useful for checking injectors/ignition boxes/coils for proper operation.
Volumetric Efficiency	(<i>VE</i>): The efficiency of the engine in filling the cylinders with air on the intake cycle. Example: A typical at idle volumetric efficiency might be around 30%, which would be represented as 0.30 in the VE Map. It is possible for VE to exceed 100% (or 1.0 pressure ratio) in supercharged/turbocharged applications or extreme normally aspirated race engines (due to intake manifold design to take advantage of harmonics and high speed air sources)
W	
Waste Spark	Waste Spark refers to firing a the coil (or coils) for two cylinders at the same time, one on the power stroke and the other on the exhaust stroke (thus "wasting" the exhaust stroke spark).
X	
Y	
Z	

7.6 Additional Resources/Service



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Additional Resources

SERVICE

In the event that your Edelbrock Victor/Super Victor Pro Tuner System should need servicing, return the unit pre-paid to the Edelbrock Service and Repair facility at 2700 California Street, Torrance, CA 90503 after receiving a return authorization number. Do not attempt to disassemble or service the components of the system yourself. Doing so may void the warranty.

WARRANTY

It is the constant endeavor of the Edelbrock Corp. to provide our customers with the highest quality performance products. Edelbrock warrants the Edelbrock Victor/Super Victor Pro Tuner Systems to be free from defects in both workmanship and materials for a period of one year from date of purchase, provided that the product is properly installed and subjected to normal use and service, is not used for racing or competition purposes and that the product is not modified or altered in any way unless specified by our instructions. Our warranty service and repair facility is located at 2700 California Street, Torrance, CA 90503. Customers requiring warranty assistance should contact the dealer from whom they purchased the product. In turn, the dealer will contact Edelbrock, and we will determine the method of satisfying the warranty. Should Edelbrock determine that the product be returned to the factory, it should be accompanied by proof of purchase and a clear description of the exact problem. The product must be returned freight pre-paid. If a thorough inspection of the product by the factory indicates defects in workmanship or material, our sole obligation shall be to repair or replace the product. This warranty covers only the product itself and not the cost of installation or removal.

EDELBRÖCK CORP. SHALL NOT BE LIABLE FOR ANY AND ALL CONSEQUENTIAL DAMAGES OCCASIONED BY THE BREACH OF ANY WRITTEN OR IMPLIED WARRANTY PERTAINING TO THIS SALE, IN EXCESS OF THE PURCHASE PRICE OF THE PRODUCT SOLD.

If you have any questions regarding this product or installation, please contact our Technical Department from 8:00am-12:30; 1:30-5:00pm, Pacific Standard Time, Monday through Friday at:

Tech Telephone: (800) 416-8628
Office Telephone: (310) 781-2222
Fax: (310) 320-3964
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