TABLE OF CONTENTS

ECU INSTALLATION INSTRUCTIONS

1.1 Introduction

Congratulations on your purchase of the Accel/DFI Sequential Engine Management System, one of the most advanced systems on the market today. The new 7.0 ECU offers enhanced control, extended versatility, and improved reliability over our previous 6.0 unit. Utilizing the all-new Calmap software, spark and fuel delivery can be precisely matched to engine requirements, unlocking lost horsepower. This manual is written to assist you with the installation of your new system. This installation should be performed by a qualified technician that has a thorough knowledge of automobile electrical and mechanical systems, such as an Accel Engine Management Installation Center (EMIC). Accel has numerous EMIC's, that can install your new system, calibrate your engine, and fabricate or modify your intake manifold if necessary. Call Mr. Gasket at 1 (888) 674-2753 for an EMIC location nearest you for more details.

1.2 Kit Contents

Description / Part Number
   Generation 7.0 Electronic Control Module (ECM)
   Main Wiring Harness (MWH)
   Injector Wire Harness (IWH)
   Manifold Absolute Pressure (MAP) sensor
   Heated Oxygen Sensor (HEGO)
   Coolant Temperature Sensor (CTS)
   Intake Air Temperature Sensor (IAT)
   Manifold Surface Temperature Sensor (MST)
   Manifold Surface Temperature Sensor Bracket
   Ignition Harness Adapter (IADP)
   Calmap Software package with 5ft. communication cable

Note: If you are missing any item, please contact your dealer immediately.

1.3 Required Tools

These are the tools that you will need to properly install your Accel/DFI engine management system:

terminal crimping tool or long nose pliers
wire stripping tool
Adjustable Crescent Wrench
Electric Drill (optional*)
Green Lee Punch (optional*)

#2 standard screwdriver
_" nut driver or socket equivalent
Solder and Soldering Iron (recommended)

(*) - Needed only when mounting the ECU in the engine compartment)

1.4 Installation

These installation instructions are general recommendations intended as a basic starting reference point. The statistics and information shown below will vary with application. Consult your dealer for further details on your application.

1.4.1 Manifold Setup

1.4.1.1 Obtaining your manifold.
From the ultra high performance, single plane, Pro-Ram manifold, to the torque monster, tuned-port, StreetRam manifold. Accel has a wide variety of fuel injection manifolds available for your big block and small block Chevrolet. For the applications that would not be satisfied by our proven manifold designs, Accel has the hardware necessary to modify a non-EFI style intake for multi-port injection. Contact a dealer, or reference our catalog for part numbers. Accel/DFI also has Engine Management Installation Centers (EMIC's) that can not only install and tune your system, but also can also fabricate or modify an intake for you as well. For an EMIC nearest you, please call 1 (888) 674-2753.

1.4.1.2 Setting up your manifold
Prior to installing your manifold, make sure that gasket surfaces are clean. Accel recommends using a 180* thermostat. Place your thermostat and gasket on your manifold, put your thermostat housing on the manifold, and bolt it into place. If you are using a TPI manifold, you will have to place the injectors into the fuel rail and bolt them on to your manifold before you bolt the runners and install the injector harness. When installing the fuel injectors, be careful not to cut the O-rings. A small amount of oil on each O-ring will aid in the assembly. If you are using a factory 1985-1989 plenum, you will need to plug off the Cold Start Injector port, use an Accel part number 74820.
If you are using old or used parts, prior to bolting the throttle body to the plenum, we recommend cleaning the throttle blade, bore, and IAC valve seat area.   A significant amount of gum can accumulate in these areas which could effect the idle characteristics of an engine, and create calibration issues when tuning.

NOTE: Accel recommends the use of a Holesaw (i.e. Green Lee punches) to cut a hole in the firewall. This will accommodate the main wiring harness, when mounting the ECU inside the passenger compartment.

1.4.2 Vacuum Plumbing Connections

      1. A vacuum line must be attached between the fuel pressure regulator and the side of the intake plenum. Sometimes on four-barrel throttle bodies, this source is located on the bottom part of the throttle body.   Do not splice into this vacuum line, this can promote an erratic vacuum signal.

      2. Use a 7/16" diameter hose to connect the oil breather on the valve cover to the right side of the throttle body, if so equipped. If not, plug the corresponding port off on the throttle body.

      3. Use a 5/32" diameter vacuum line from the bottom of the throttle body to the vacuum advance canister on the distributor. This is a ported vacuum source, and should be used with non-computer-controlled distributors, or fuel only control setups.

      4. Connect the PCV valve to an intake vacuum source using a 3/8" hose. If you are not using a PCV valve, block off the vacuum source.

      5. Using a 3/8" or larger diameter vacuum line connect the brake booster unit to the plenum.

      6. Next, mount the MAP sensor on the firewall away from any heat or RFI source, such as a distributor, ignition wires, or ignition coil. Make sure the map sensor is above the level of the plenum to ensure any condensation will not collect in the line and harm the sensor. Connect the MAP sensor to the intake plenum with a vacuum hose. Always install the MAP port source at least 1" away from any intake port, preferably on the side of the plenum. Never use the intake floor area on a single or dual plane manifold for a MAP port source.   The MAP sensor is extremely sensitive, and will pick up individual port intake pulses, making tuning very difficult. Also DO NOT splice into this line, inaccurate sensor readings could result.

If you have an installation on a boosted application, such as a turbo or supercharger, use tie wraps to secure all vacuum lines. Severe engine damage could occur if, for example, the vacuum line to the fuel regulator were to blow off under pressure. The regulator would no longer maintain a static pressure referenced to manifold pressure, therefore, the engine would lean out as boost in the manifold increases.

1.4.3 Fuel Pump Mounting, Wiring, and Plumbing

1.4.3.1 General

There are four high-pressure fuel pumps available from the Accel and Mallory divisions of Mr. Gasket. Accel offers two fuel pumps that can be mounted in the gas tank, or externally on the frame rail. An Accel part number 74701 will support ~500 horsepower at 45 psi in non-boosted or normally aspirated application, and approximately ~400 horsepower at 45 psi in a boosted, or turbocharged environment. An Accel part number 74702 will support ~800 HP at 45 psi, non-boosted, and approximately ~675 HP in a boosted application. You can also use a part number 74710 fuel pump, mounting bracket if your Accel 74702 pump is mounted outside the tank. Mallory offers two external, frame rail mount only, fuel pumps. A Mallory part number 4060FI will support ~550HP unboosted, and ~450HP boosted. A part number 5110FI will support ~1000HP,

unboosted, and ~800HP boosted.

Regardless of the fuel pump used, be sure to mount your fuel pump near the gas tank, and at a point below tank level if possible. Fuel pumps and plumbing should be protected and shielded from exhaust and engine heat, and road damage.

1.4.3.2 Fuel Pump Wiring

Locate the fuel pump wire in the main wiring harness. It is a pink wire with black tracer that runs out of Relay #2, pin 30. Connect this wire to the fuel pump (+) terminal. The ECM will control the relay that supplies the 12 volts necessary to operate the pump. The pump will draw roughly 4 to 10 amps, or more, depending on pump size and fuel system pressures. If you need to lengthen the wire between the pump and the relay, use 14 gauge wire. Solder and shrink-wrap all your connections. If you are using an ultra high performance pump such as a Weldon, replace the 14-gauge wire supplied, with a 10 gauge GXL or TXL rated wire. This wire, depending on length, is rated to carry up to 30 amps if your application merits. Next, ground the fuel pump negative (-) terminal to a clean, paint-free point on the frame rail, or run the proper gauge wire to the battery negative. Make sure the wiring between the fuel pump and the engine compartment does not hang below the vehicle, interfere with rotating parts, or become exposed to excess heat.

1.4.3.3 Mechanical Pump Removal

If your engine had a carburetor, be sure to remove your mechanical fuel pump, the fuel pump-actuating rod, and cover the opening with a block off plate.

1.4.3.4 Fuel Filter Mounting

Two filters should be used when installing your high-pressure fuel delivery system. First, install a high pressure, 10-micron, paper filter between the high-pressure discharge of your fuel pump and the fuel rails. Accel offers a #74720, 10 micron, filter that utilizes –6 AN fittings, #74721. For maximum flow applications, -8AN fittings are available, #74721-H. Second, on the suction side of the pump, install a 35-micron low restriction filter. For intank applications, a fuel sock can be installed on the inlet of the pump. If you do not use a filter or sock on the suction side of the pump, debris from the tank will seize the vane assembly causing complete pump failure. This type of pump failure is not covered under warranty. For more installation details see Figures A1and A2.

1.4.3.5 Routing Fuel Hose

Unlike your low-pressure carburetor (7-PSI) fuel system, your Accel high-pressure (45PSI) fuel injection system requires high-pressure fuel hose. Typically, use any fuel hose with a continuous operating pressure of 150 PSI and a burst strength rating, of at least 330 PSI. Hose diameter should be at least 3/8" feed, and 5/16" return for street systems, or larger for performance race systems. For maximum flow applications, limit the use of 90* fittings. If possible, use bent tube or 45* fittings in place of right angle fittings. Also avoid any sharp bends in your fuel line that could cause premature failure or seepage leaks. As a general rule, always match the proper hose diameter to the fuel pump output. When using (2) high-pressure pumps, mount pumps as close to the fuel tank, and low on the frame rail as possible. Be careful not to interfere with any suspension components, or exhaust components in the process. See Figure A1 and A2.

1.4.3.6 Dual Tanks

For dual tank applications, such as trucks or RV's, a primer pump must be installed in each fuel tank. The primer pump will feed a multi-port switching valve which draws and returns fuel to the tank that is selected. The implementation of the switching valve is important to ensure the feed and return lines operate on the same gas tank. Failure to use this method on dual tank applications will cause the tank to overflow or run dry. These primer pumps are commercially available through your factory dealer for most light and heavy trucks with dual tanks.

1.4.3.7 Sending Unit Modifications

To install a return line in your tank, remove the sender assembly from the fuel tank and drill a 5/16" hole through the top of the flange. Be sure to give yourself enough room to weld the tube into place. Use an Accel/DFI jumper kit, #74731, and a pre-bent 5/16" line to facilitate the installation. Position the 5/16" return tube roughly 2" off the floor of the tank. Before welding the tube, make sure the tube does not interfere with any of the sending unit floats. Secure the tube to the sending unit cap by welding or brazing with low heat, so that flange warpage and electrical wire abrasion does not occur. Always check for minor cracks or leaks in the welding area.

1.4.3.8 Return Fuel Line Installation

If your vehicle was originally equipped with a carburetor than you must run a return fuel line to the tank. The fuel regulator discharge on all Accel kits utilizes –6AN fittings, so Accel recommends using a –6AN line or equivalent when installing the return line. Even though most vehicles came equipped with a _" vent line as part of the evaporative containment system. Accel strongly recommends that you do not use the vent line as a return line. These lines usually have a restrictor orifice built into the line near the tank. The restrictor orifice will cause excessive backpressure in the fuel line making tuning very difficult. Always make sure the gas tank is vented in an environmentally safe manner as per service manual requirements for you make and model vehicle.

1.4.4 Mounting the Exhaust Sensor

The Accel/DFI system uses a four wire Heated oxygen sensor (HEGO) to monitor exhaust oxygen levels. This sensor and a M18x1.5 hex nut or bung is part of your kit. Prior to mounting the O2 nut, drill a 5/8" diameter hole perpendicular to the exhaust pipe or header collector, then weld the O2 nut on the pipe. In turbocharging applications, mount the O2 nut roughly 8" from the turbo exhaust discharge if possible. When using large diameter exhaust tubing, such as 3" or larger, make sure the O2 is mounted within 12" of an exhaust collector. Never mount the O2 on an inside radius of a 45* or 90* elbow. At low engine speeds, the exhaust gas will travel along the outside radius of the elbow giving the O2 sensor erratic or improper readings, making calibration efforts difficult at best. See Figure A3.

1.4.5 Choosing and installing your distributor, crank sensor, or cam sensor

1.4.5.1 Ignition systems with Computer Controlled Timing

1.4.5.1.1 Selection
   There are numerous types of distributors and trigger wheels available on the market today. The Accel ecu can control timing using these types of distributors and crank triggers:
   GM (HEI), High Energy Ignition, coil in cap
   GM (HEI), High Energy Ignition, with separate coil (i.e. F-Body)
   Universal (IPU), Inductive Pickup, or Magnetic Pickup distributor
   Universal (IPU), dual sync with cam sensor
   Inductive Pickup Cam Sensor
   Universal Hall Effect distributor
   Universal Hall Effect, dual sync with cam sensor
   Hall Effect Cam Sensor
   GM (LT1) optical spark distributor
   Ford (TFI), Thick Film Ignition distributor
   Honda (VTEC), dual sync, IPU distributor
   Buick V6, DIS, coil pack ('87 and earlier)
   Universal Flying Magnet or Lug Crank Triggers with non-magnetic, magnetic Inductive Pickup sensors, or Hall Effect sensors
   Hall Effect Crank Sensors
Note: All the above sensor triggers must have one tooth per spark event. For example, you would use a symmetric 4-tooth crank trigger wheel or an 8-tooth distributor reluctor on an 8 cylinder. A symmetric 3 tooth crank trigger wheel or a 6- tooth distributor reluctor on a 6 cylinder. And a symmetric 2- tooth crank trigger wheel or a 4- tooth distributor reluctor on a 4-cylinder engine. The Accel ECU does not recognize 36-1 tooth Ford EDIS wheels, or 24- tooth late model Chevrolet wheels. Call the Accel Fuel Injection Tech Line for more application information. 1 (216) 688-8300.

All the distributors listed above should have no mechanical advance mechanism or the mechanical advance locked out. Always select a distributor that does not incorporate a vacuum advance canister. Many different engine combinations are possible using these distributor types. For example, to have complete ignition control on a Chevrolet motor with a points distributor, you would need to replace the points distributor with an IPU distributor (available from Accel or Mallory). Then install a spark enhancer box, such as an Accel 300+, Mallory Hyfire, or MSD. This scenario also holds true if you own an Oldsmobile, Pontiac, Ford, Chrysler, or any application, where a distributor from the list above, is available. All of the above distributor combinations will operate the fuel injectors in TBI (Throttle Body Injection), Staggered Batch SDF (bank to bank), Batch Fire (SDF), and Staged Batch SDF modes. However, a dual sync distributor, or a combination crank trigger with a modified IPU, Hall effect distributor, or cam sensor is needed for sequential

fuel operation. If a cam sync is not used while the ECM is in sequential operation, the injectors will fire according to the order set in Calmap, Configuration, Injector Firing Order table. Every time the engine starts, a new or random cylinder position will begin this firing order. Accel recommends that you set your Injection Type to a batch mode of operation, if you do not have a cam sync signal. Serious driveability issues will result that cannot be tuned out with the use of Calmap. (Note: The Buick DIS coil pack has an integral sync output for sequential operation. No external cam inputs are required). Please, consult your dealer for applications not listed above.

1.4.5.1.2 Installation

Chose an ignition type that best fits your application.

Chevrolet HEI distributors, Non - sequential fuel mode
Set the ignition timing at the engine harmonic balancer timing mark to approximately 0*
BTDC on #1 cylinder. Consult your shop manual for more information on this procedure.
Align the magnetic pickup to the nearest reluctor. Next, set the ignition timing at the
engine harmonic balancer timing mark to approximately 25*-30* BTDC on #1 cylinder.
The distributor rotor is pointing at the #1 cylinder terminal tower. Install the spark plug
wires on the distributor starting with #1 wire in this location. Snug down the distributor
lockdown bolt. This is your macro adjustment. The micro or fine adjustment occurs upon
engine startup.
Next, connect the distributor to the 8-pin ignition connector on the main wiring harness;
use the HEI large cap or small cap adapter supplied with your kit. Refer to Figure B1.1
and B1.2.

Chevrolet LT1, non-sequential* fuel mode
There are no external adjustments on the LT1 optical spark system. All clocking
positions are preset at the factory. Connect the ignition interface adapter harness to the
8-pin connector on the main wiring harness. See Figure B2.1 and B2.2 for adapter
harness connections.
(*) - This application can run in sequential mode if using a special adapter harness/box
available through specific dealers. Call the Accel Fuel Injection Tech Line for more
details. 1 (216) 688-8300.

Ford Thick Film Distributor, Non sequential fuel mode
 Set the ignition timing at the engine harmonic balancer timing mark to approximately 0*
BTDC on #1 cylinder. Consult your shop manual for more information on this procedure.
Align the falling edge of the reluctor wheel to the pickup. Next, set the ignition timing at the
engine harmonic balancer timing mark to approximately 25*-30* BTDC on #1 cylinder.
The distributor rotor is pointing at the #1 cylinder terminal tower. Install the spark plug
wires on the distributor starting with #1 wire in this location. Snug down the distributor
lockdown bolt. This is your macro adjustment. The micro or fine adjustment occurs upon
engine startup.
Next, connect the distributor to the 8-pin ignition connector on the main wiring harness
using the Ford adapter supplied with your kit. See Figure B3.1 and B3.2.

Buick GN, DIS, Coil Pack, Sequential fuel mode

There are no external crank sensor adjustments on the Buick GN, DIS system. However, the Cam sensor must be oriented correctly so that the spark module will provide the proper signal to the Accel ECM. Using a Voltmeter, place the meter leads across the sensor jumper wire and ground. Adjust the timing mark on the balancer to 25* ATDC #1 cylinder. Rotate the cam sensor until the voltmeter reads 5 to 7 volts. Rotate the sensor counterclockwise until the reading drops to 0 volts. Lock down your sensor. This is an OEM factory adjustment. For further details on setting this sensor, reference your shop manual. Connect the ignition interface adapter harness to the 8-pin connector on the main wiring harness. See Figure B4 for adapter harness connections.

Honda (VTEC) distributor, Sequential operation

A Honda distributor has no adjustments for its position in the engine block. Set the ignition timing to approximately 10* BTDC on #1 cylinder. Install the distributor in the engine aligning the distributor rotor to the corresponding #1 spark plug wire, terminal tower. Tighten the distributor lockdown bolt. The macro adjustment occurs before engine startup. This is completed through the crank index offset table in Calmap. Next, connect the distributor to the 8- pin ignition connector on the main wiring harness using the Honda ignition adapter supplied with your kit. Locate the orange wire w/blue tracer, Crank (+) reference, the black wire w/orange tracer, Crank (-) ground, the blue wire w/green tracer, cam(+) reference, the black wire w/blue tracer, cam (-) ground, in the stock distributor. Terminate the wires from the stock connector. Crimp and solder the new Packard terminals to these wires. Position A on the four way Packard connector is crank (+), position B is crank (-), position C is cam (+), and position D is cam (-). See Figure B5.1 and B5.2.

Inductive Pick-Up (IPU) or Hall Effect distributors, Non-sequential mode

Set the ignition timing at the engine harmonic balancer timing mark to approximately 0* BTDC on #1 cylinder. Consult your shop manual for more information on this procedure. Align the magnetic pickup to the nearest reluctor. Next, set the ignition timing at the engine harmonic balancer timing mark to approximately 25*-30* BTDC on #1 cylinder. The distributor rotor is pointing at the #1 cylinder terminal tower. Install the spark plug wires on the distributor starting with #1 wire in this location.
Snug down the distributor lockdown bolt. This is your macro adjustment. The micro or fine adjustment occurs upon engine startup. Next, connect the distributor to the 8 -pin ignition connector on the main wiring harness, using the IPU adapter supplied with your kit. Terminate the two wire leads from the stock distributor connector. Crimp and solder the new Packard terminals to these wires. Position A on the four way Packard connector is a purple wire, crank (+) reference, position B is an orange wire, crank (-) ground, position C and D are not used. See Figure B6.

Dual Sync, Inductive Pick-Up (IPU) or Hall Effect distributors, seq mode

Set the ignition timing at the engine harmonic balancer timing mark to approximately 0* BTDC on #1 cylinder. Consult your shop manual for more information on this procedure. Align the magnetic pickup to the nearest reluctor. Next, set the ignition timing at the

engine harmonic balancer timing mark to approximately 25*-30* BTDC on #1 cylinder. The distributor rotor is pointing at the #1 cylinder terminal tower. Install the spark plug wires on the distributor starting with #1 wire in this location.

Snug down the distributor lockdown bolt. This is your macro adjustment. The micro or fine adjustment occurs upon engine startup. Next adjust the engine balancer timing mark to 45* BTDC #1 on a V8, 60* BTDC #1 on a V6, and 90* BTDC on a L4. Use a timing tape if necessary to gain an accurate reading. Tapes are available through your local Mr. Gasket Dealer. Center the pickup over the falling edge of the cam reluctor. Lock down the cam pickup or pickup collar. Next, connect the distributor to the 8- pin ignition connector on the main wiring harness, using the IPU adapter supplied with your kit. Terminate the four wire leads from the stock distributor connectors. Crimp and solder the new packard terminals to these wires. Position A on the four way packard connector is a purple wire, crank (+), position B is an orange wire, crank (-), position C is a black wire with a green tracer, cam (+), position D is an orange wire with black tracer, cam(-). See Figure B7 and B7.1.

Crank Trigger/ Distributor combinations, sequential fuel mode

Set the ignition timing at the engine harmonic balancer timing mark to approximately 0* BTDC on #1 cylinder. Position the crank sensor directly over the falling edge of one of the crank trigger wheel teeth. If the bracket arrangement does not allow this, align the sensor as close a possible to the trigger tooth. This difference between the sensor and trigger wheel tooth in crank degrees should not exceed the total advance of the engine in crank degrees minus 6. The difference in crank position can be compensated through the crank index position table in Calmap. Next, obtain an Inductive Pickup or Hall Effect distributor. Remove all but one of the reluctors. Leaving the reluctor closest to the rotor discharge point. Rotate the engine so that the timing mark is set to ~45* BTDC #1 on an eight cylinder, ~60* BTDC #1 on a six cylinder, or ~90* BTDC #1 on a four cylinder. Use a timing tape if necessary to gain an accurate reading. Tapes are available through your local Mr. Gasket Dealer. Install the distributor. Rotate the distributor, aligning the pickup over the reluctor wheel. Tighten down the distributor lockdown bolt. Rotate the engine back to TDC #1 cylinder. The distributor rotor is now pointing to the corresponding #1 spark plug wire, terminal tower. Referencing your firing order, install your plug wires using this terminal as a starting position. Next, connect the distributor cam signal wires and the trigger wheel crank sensor wires to the 8 pin ignition connector on the main wiring harness, using the IPU adapter supplied with your kit. Terminate the four wire leads from the stock sensor connectors. Crimp and solder the new packard terminals to these wires. Position A on the four way packard connector is a white wire, crank (+), position B is an black wire, crank (-), position C is a purple wire, cam (+), position D is an orange wire, cam(-). Refer to Figure B8.1, B8.2, B8.3.

Important:

If you have computer controlled ignition timing, or if you are using an enhancer box such as a Accel 300+, MSD, or Mallory, <u>NEVER</u> hook the crank reference (+) wire to the coil(-). This could result in serious damage to the ECU.

Accel has encountered problems with various ignition wires available on the market

such as helically wound or solid core that have a very high (RFI) electrical noise emission. Even though the ECU utilizes the latest in noise suppression technology, Accel strongly urges the use of a good quality suppression wire such as an Accel Ferro core RFI Suppression wire. Further, some high energy aftermarket ignitions produce electrical fields, which will interfere with the ECM's operation. Use of these units is strictly at the risk of the owner. Call Accel for ignition system compatibility.

Finally, verify that the system part number that you ordered is compatible with the ignition system on the vehicle. If not, reference the ignition chart (Figure C) for further details. (Note: To change ignition input and output parameters, Calmap software is needed. Refer to the Tuning instructions for more details.)

1.4.5.2 Non-Computer Controlled Timing

1.4.5.2.1 Installation

Set the ignition timing at the engine harmonic balancer timing tab to approximately 8* BTDC on #1 cylinder. Install the distributor in the engine aligning the distributor rotor to the corresponding #1 spark plug wire, terminal tower. Snug down the distributor lockdown bolt.

b. Setting vacuum and mechanical advance

First, estimate a total timing value for your motor. The total timing value is the static or base advance added to the dynamic or mechanical advance. Most normally aspirated motors need about 30-38* of total timing at wide open throttle. Excessive total timing will result in major engine damage, consult with your engine builder for optimum timing numbers.   Adjust the base or static advance to 10*-20*BTDC depending on your camshaft selection and compression ratio. Usually, a higher duration camshaft profile, and low compression ratio tend to require more timing lead, or more base advance. Next, set the mechanical advance. Rev the motor to at least 3500 RPM, verify timing. (Note: If you do not have an adjustable timing light, use timing tape over the harmonic balancer.) Adjust, the springs on the mechanical advance mechanism to obtain the proper total timing advance. Consult you distributor manufacturer for more details.

The vacuum advance can now be adjusted for optimum driveablity. The vacuum canister can be modulated by the EGR port of the throttle body. For performance applications, adjust the vacuum advance to achieve the maximum amount of spark advance without engine knock or ping. Look for a max value of 40-50* BTDC advance under light load high vacuum conditions.

1.4.5.2.2 Distributor Wiring

In all non-computer controlled applications, the ignition system works independently of the engine control unit, so wire the distributor and coil per manufacturers recommendations. The only ignition signal needed by the Accel/DFI ECU is the engine rpm or tachometer output signal. Connect the Crank (+) or purple wire (Position A on the 4 pin ignition adapter) to the coil (-) terminal. If you are using an aftermarket enhancer box (ie. Accel 300+, Mallory Hyfire, MSD) connect the crank reference (+) wire directly to the tach lead of the enhancer box. DO NOT connect the ECU crank (+) wire to coil(-) terminal if using an enhancer box, extensive ECU damage will result.   Tachometer signal output strength varies with ignition manufacturer depending on the enhancer box used. If

you do not see a RPM signal in your Calmap, Instrument view mode while cranking, a tachometer amplifier should be used. Again, confer with your ignition manufacturer for availability.

1.4.6 Main wiring harness and ECU installation

1.4.6.1 Mounting the Accel ECM

The ECM comes with four (4) 3/8" holes designed for a #6 sheetmetal screw. It is recommended to mount the ECM in a cool, dry place usually in the passenger side, kickpanel, in the dashboard behind the glove box, or under the passenger seat. If these areas are not convenient, mount the ECM under the hood. Even though the ECU utilizes a water-resistant enclosure, Accel recommends mounting the ECU away from any direct moisture contact. (i.e. from wheel well openings, or behind the grill). It is also important to mount the ECU away from any direct radiant heat source such as exhaust manifolds or headers. Failure to do so may result in a void warranty, as well as, damage to the ECU.

1.4.6.2 Wiring harness installation

There are various main wiring harness (MWH) combinations available for your Accel / DFI system. From the list below, select the MWH that best fits your application. Also, choose your ignition from the following listing. Reference the proper figures to aid in installation.

1. Small and B.B Chevrolet, (HEI) High Energy Ignition, Figure   B1.1, B1.2
2. Small Block, (LT1), early and late model, Figures B2.1, B2.2
3. Small Block Ford , (TFI), Thick Film Ignition, Figures B3.1, B3.2
4. Buick V6, (DIS), Distributorless Ignition System, Figures B4
5. Honda L4, (N/A) and (VTEC) engines, Figures B5
6. Universal V8, (IPU), distributor, Figures B6, B7
7. Universal V8, Crank Trigger (Flying Magnet and Hall Effect),
    Figures B8.1, B8.2, B8.3
8. Universal V4-6-8, Fuel Control ONLY

1.4.6.2.1 Injector harness installation

When using a StreetRam or SuperRam intake manifold, Accel advises that the injector harness be installed prior to mounting the plenum.   In all fuel modes, whether you use sequential or batch fire, placement of the injector connector is critical. Each injector connector should plug into the corresponding cylinder it controls. Locate the cylinder tag on above each injector connector. Refer to Figure C for the proper placement on your engine.

1.4.6.2.2 Main wiring harness installation

The main wiring harness can be routed and connected as follows: When mounting the ECU in the passenger compartment. Drill a hole in the firewall using a hole saw, or Green Lee punches. Starting on the engine side of the firewall, route the (2) 30 pin ECM

connectors through the hole in the firewall. Pull the harness through the firewall until the rubber grommets seats in the firewall.   For all other under hood applications, start by attaching the 30-way connectors to the ECU. Using a _" nut driver, fasten the two connectors (P1&P2) to the ECM. Using drawings (B1-B8) as a reference, route each leg of the harness to the appropriate sensor. Make sure to connect the switched +12volt wire (long pink wire), to a switched ignition accessory in the fuse box. The switched ignition accessory must maintain a constant ignition voltage while cranking, if it does not, the vehicle will not start. Some older vehicles (pre '75) do not have a constant (12V) switched ignition voltage supply while cranking. This can be verified with a test light or voltmeter. Next, connect the positive and negative terminals of the main wiring harness directly to the battery. Using the frame as a grounding plane is not recommended. Grounding loops have occurred using this method. Accel suggests that these connections be free of any paint, grease, or debris. If for any reason, any one of these wires need to be lengthened, make sure the wire is at least the same gauge or larger, and that all connections are soldered.

The main wiring harness contains the following connections:
    Idle Air Control Motor (4-pin female, black connector)
    Throttle Position Sensor (3-pin male, black connector)
    Main Injector Connector (10-pin male, black connector)
    Manifold Absolute Pressure Sensor (3-pin male, green or orange)
    Intake Air Temperature Sensor(2-pin male, grey connector)
    Engine Coolant Temperature Sensor (2-pin male, black connector)
    Main Ignition Connector (8-pin male, black connector)
    Main Accessories connector (5-pin male, black connector)
    Heated Exhaust Gas Oxygen sensor (4-pin, square, micro connector)
    NOS connector (5-pin, micro, black connector)
    Malfunction Indicator Lamp (2-pin, micro, black connector)
    Calmap connector (4-pin, micro black connector)
    Knock (ESC) connector (3-pin, black connector)
    Manifold Surface Temperature (2-pin, black connector)

Select from the ignition listing above an ignition type that best suits your application. Using figures B1-B8 as a reference, attach each connector to the appropriate sensor. Refer to Figure D for additional connector descriptions and header pinouts.   Note: For LT-1 engine kits there are multiple adapter harnesses for the TPS, IAC, and ignition connections. Refer to figure B2.2 for further details.

1.4.7 Starting the Engine

1.4.7.1 Configuring the ECU before startup

1.4.7.1.1 Load Calmap software
 Locate and load the **Calmap** software package into your laptop or PCM. For proper Calmap loading procedures, table editing, and general instructions, refer to the Calmap

section of this manual. With the ignition key on, engine off, select edit ECU, then File. Next, select Download Calibration from ECM. This will save the entire global file to your computer. Use this file as a backup.

1.4.7.1.2 Edit Configure Tables

Edit online the **Engine Configuration, tables 1 & 2.** Do not be alarmed if these numbers change slightly from your original value when sending information to the ECU. The computer will round these values to the nearest acceptable range recognized by the ECM. For all engine configuration tables, use the F10 key to send information to the ECU. Select and adjust, if necessary, the following tables:

1. **Reference Inputs – Spark Output**
   Using the ignition chart, figure E1 & E2, select the ignition type that best fits your application. Select and adjust, if necessary, the crank and cam reference input type, edge location, ignition output type, and edge location to match the table criteria.
2. **Number of Cylinders**
   Enter the number of cylinders. Select 4,6, or 8 cylinders.
3. **MAP Configuration**
   Enter 1,2, or 3 Bar, or Alpha-N. The 1 Bar Map is for normally aspirated engines, and can measure up to 0 PSIa or atmospheric pressure.   The 2 and 3 Bar sensors are for supercharged or turbocharged applications. The 2 Bar MAP can measure up to 15 PSIa manifold pressure, and the 3 Bar MAP can measure up to 30 PSIa manifold pressure. In Alpha-N mode, the VE table is based on Throttle Position vs. RPM. This mode is recommended when tuning race engines with extremely low or erratic idle vacuum.
4. **Exhaust Feedback Sensor**
   Select HEGO or UEGO. HEGO is a standard four wire, heated O2 sensor. This lambda sensor can correct to a stoichiometric, or 14.51:1 A/F Ratio. The HEGO, four wire, O2 sensor is part of your standard kit. On the other hand, a UEGO is a five wire, wide band, or linear O2 sensor. A wide band sensor can measure and correct to actual A/F ratios from 10:1 to 20:1. The UEGO, wide band O2 is an accessory option.
5. **Ignition system delay**
   This delay period will compensate for the delay associated with electronic filtering. For most applications, set this period to 100us.
6. **Ignition Limit Status**
   The 2-Step Rev Limit utilizes a sequential ignition rev limiting strategy, that when activated, will not allow the engine speed to surpass a user defined, or preset RPM. Enter an engine speed in this table, from 2250 to 15,000 RPM. To enable this feature, a 12-volt source, usually from a trans brake solenoid, must be applied to Pin C on the five way accessory connector or K3 on the main header. This function will deactivate when this 12-volt source is removed or grounded.
7. **Ignition Cut-Off Speed**
   When the engine speed exceeds this value, sparks begin to be eliminated. The number of sparks dropped is a function of how far above the rev limit value that the actual RPM is. The RPM range is 2000-12,750.

9. ***Fuel Cut-Off Speed***

When the engine speed exceeds this value fuel will be turned off. It will be turned back on once the engine speed falls below the Fuel Restore Speed. Note: This feature is not recommended for supercharged and turbocharged applications. Do not invoke the fuel shutoff function when manifold pressure is positive; <u>unless</u> the max, fuel on value is set very low (i.e. idle). This will give time for the impeller speed to slow down, decreasing manifold pressure, and the occurrence of a lean condition. The RPM range is 2000-12,750.

10. ***Fuel Restore Speed***

Once the fuel is shut-off due to exceeding the engine speed specified for fuel cut-off speed, it will remain off until the engine speed falls below this value. Always enter a value lower than Fuel Cut-Off Speed. The RPM range is 2000-12,750.

11. ***Engine Displacement***

Enter your engine displacement in cubic inches. The range is 58 to 825cid.

12. ***TPS Set Point***, ***Closed Throttle Offset Voltage***

 Click on the TPS Setpoint button. A pop-up screen will be displayed. In the bottom center of this display current TPS voltage and TPS percent are monitored. With the ignition key on or in the switched position, engine off, and the throttle in a closed position. Enter a TPS voltage, from 0.00V to 4.98V in the Low Setpoint table. Click on the Store Low Setpoint button to enter this value automatically. Coupled with the W.O.T. Offset Voltage, it will create a smooth or linear TPS curve that transitions from 0 to 100 percent. This function will offset any non-linearity in the throttle linkage. This feature will be beneficial when setting other functions dependent on throttle position. These values will always be displayed in percent TPS.

13. ***TPS Set Point, Wide Open Throttle Offset Voltage***

With the ignition key on, or in the switched position, engine off, and the throttle floored, or in a fully open position. Enter a TPS voltage, from 0.00V to 4.98V in the High Setpoint table. Click on the Store High Setpoint button to store this value automatically.

14. ***Return or Returnless Fuel System Select***

In order to set this parameter properly, you must first determine if your fuel rail pressure is referenced to manifold pressure. Most applications are return fuel systems. These systems have a fuel regulator mounted in the engine compartment. The regulator is usually referenced to the intake manifold via a vacuum line, with a fuel return line plumbed back to the gas tank. In returnless fuel systems, the regulator is located near the pump, usually in the gas tank. These fuel systems are typically found in newer cars, ('97 and up) and do not reference fuel rail pressure to manifold pressure.

15. ***Fuel Injection Type***

Enter the fuel injection mode or strategy in which you want the injectors to fire.

15.1 In the ***Sequential*** injection mode, injectors fire once every two crank revolutions.   The injectors fire in a predetermined order defined in the Injector Firing Order menu. A Cam input must be used to start the injector sequence accurately. If no cam input is detected, the ECU will set an error code #72, and force a cam trigger. Accel recommends using a batch mode when a cam sensor is not available. Also in sequential mode, the injector timing can also be adjusted

through the use of two injector timing tables in the fuel menu. All injectors must be the same size and there should always be one injector per cylinder.

15.2 In the **Staggered Batch** injection mode, no cam signal is needed. This method of injection is sometimes referred to as bank to bank injection. Each bank of injectors will fire once per crankshaft revolution, and will be out of phase 180 crankshaft degrees. For example, on an eight cylinder engine, referencing the Injector Firing Order table, the first four injectors listed will fire, then the second four will fire, 180* out of phase from the first bank. All injectors must be the same size and there should be one injector per cylinder.

15.3 In the **Batch** fire injection mode, all injectors fire simultaneously, once per crankshaft revolution. All injectors must be the same size and there should be one injector per cylinder. Again, no cam signal is needed.

15.4 In the **TBI** injection mode, two banks of two injectors are used, or a total of four injectors. This TBI or Throttle Body Injection strategy, fires each bank of injectors twice per crank revolution. Referencing the Injector Firing Order table, the order of primary and secondary bank firing will be determined. The primary bank will operate until the duty cycle reaches 80%. At this point the primary and secondary bank will begin to operate at half the rated duty cycle. This strategy delivers a seamless transition of fueling between primary and secondary banks. As soon as duty cycle decreases below 30%, the secondary bank ceases to function and the primary bank takes over. This fueling scheme is very helpful when calibrating a progressive linkage throttle body. It decreases the circumstance of injecting fuel on a closed throttle butterfly, thereby lowering the chance of fuel puddling. This 'fuel puddling' phenomenon could cause the engine to misfire upon tip-in of the throttle. TBI mode does not require a cam signal, and all injectors must be the same size.

15.5 In the **Staged Batch** injection mode, two banks of injectors fire once per crankshaft revolution. The number of injectors must be exactly two times the number of cylinders. For example, on an eight-cylinder engine, there should be 16 injectors. All the injectors should be the same size and impedance. No cam signal is necessary in this mode of operation. Referencing the Injector Firing Order table, the order of primary and secondary bank firing will be determined. The same 80%, 30% TBI fuel strategy is used to transition between primary and secondary banks.

16. **Crank Index Offset (degrees)**

Enter a number in crank degrees. This number should be the distance in crank degrees, between the pickup sensor and trigger tooth. The maximum value should not exceed the total advance of the engine in crank degrees minus 6. This table is especially handy when timing engines with fixed trigger inputs (i.e. Buick GN applications). This application would have a built-in advance of 10 crank degrees; therefore the value in the offset table should be set to 10 degrees. A simple method to set this value is, once the engine is running, match the total timing advance value (SPK) in your Calmap instrument screen, to the timing mark on your harmonic balancer by entering a value in the Crank Pickup Offset table. If the distributor reluctor is installed at 0*, then the Crank Index Offset should be set to 0*.

17. **Injector Firing Order**

This table establishes the sequence in which your injectors will fire. To determine this sequence, identify the physical placement of each injector. Above each injector connector on the injector harness, there is a white identifying tab with a number. Match this number (1-8) to a corresponding number in your Injector Firing table. Always enter '1' as your first number in this sequence, and always list as many numbers as the number of cylinders in all modes, except for TBI. For example, a typical Chevrolet application would have an injector firing order of 18436572. Enter this number as a text string, with no spaces or hyphens. This table is interpreted differently for different fuel modes. In sequential fuel mode, the first component of the table will correspond to the first injector (1). This injector will fire after receiving a cam pulse. In Batch mode, sequence is not relevant. The important point is that you have all the numbers in the table filled out. For all multiple bank modes, TBI, Staggered Batch, and Staged Batch injection, the sequence in the table will correspond to the primary and secondary banks. For example, in Staggered Batch mode, if you have a Chevrolet eight cylinder engine, the primary bank would have injectors 1-3-5-7, the secondary bank would have injectors 2-4-6-8. You would enter 13572468 in the Injector Firing Order table. Using this same example, in Staged Batch mode, both the primary and secondary banks each would fire eight injectors. In this configuration, each injector output is wired to two, high impedance, similar flow rate injectors. The primary bank would consist of injectors 1-2-3-4, and the secondary bank would consist of 5-6-7-8. Enter in the table 12345678. In TBI mode, always assume a total of four injectors. The primary bank would have injectors 1-2, secondary bank would have injectors 3-4. Enter 1234 in the table. See more information see Figure F. NOTE: This table must be accurate upon startup. It is up to the operator to ensure that the firing order configuration is valid. If this table is not accurate, complete, or valid, the ECU will not function properly, or the engine will not start.

18. **Injector Flow Rate**

Enter a value in pounds per hour. This value should be the actual flow rate of the injector at 45 psi or 3 BAR. Some of the injectors on the market are underrated on this value. During the speed density calculation process, this condition could cause abnormally low numbers in the base VE table.

19. **Compression Ratio**

Enter the compression ratio of the engine. For example, if the ratio is 8.50:1, enter 8.50, 11.25:1, enter 11.25.

20. **Fuel Line Pressure**

Enter the static fuel line pressure in pounds per square inch (PSI). Measure this value with an accurate test instrument. Typically, this value can be measured two ways. First, with the vacuum line removed from the fuel regulator and engine idling. And second, with the engine off and the fuel pump energized for more than 15 seconds. Do not attempt to set the regulator during the priming cycle of the ECM, erroneous measurements will occur due to the brevity of this cycle period.

21. **Fan On Temperature**

Enter a number in degrees (F). This is the high temperature threshold, or point at which the coolant fan relay is activated.

22. **Fan Off Temperature**

Enter a number in degrees (F). This is the low temperature threshold, or point at which the coolant fan relay is de-activated. This table value must always be lower than the Fan On Temperature value. Typically, a value 9* to 15* lower than the Fan On Temperature is acceptable.

23a. ***Base Offset Injector timing (sequential fuel mode only)***

This value, displayed in crank angle degrees, specifies the offset point that the Injector Target timing table indexes. This value generally would be the intake valve closing angle, in crank degrees. In order to set this value, obtain the Camshaft Information Card for your engine. As an example, we will use the Accel 74219 camshaft for a small block Chevrolet V8. Locate the angle at 0.050 tappet lift at which the intake valve closes. This is usually read in crank degrees, (ABDC) after bottom dead center. Since the cam card shows the intake valve closing point at 41*ABDC, and we know the crank angle at BDC intake stroke is 540* on a Chevrolet V8, we can calculate the exact angle in crank degrees at which the intake valve closes. Simply combine these figures, 41* and 540* to net a crank angle intake closing timing of 581* @ 0.050" valve lift. Enter 581 in the table. The ECM will round this value to the nearest factor of 10, so the ECM will display 580. Enter a value between 0 and 720. See Figure G for further illustrations.

23b. ***Target Injector timing (sequential fuel mode only)***

This table contains fuel injector target timing values for all possible engine speeds and engine loads. Enter a number between 0 and 720 degrees. This value, displayed in crank angle degrees, designates the end of inject point of the fuel injector. Using the injector target timing we are assured that the injection event will not coincide with the intake valve, opening event, unless the duty cycle of the injector overlaps the event. Typically, end of inject point should occur before the intake valve opens. Under light load conditions, if the intake valve is open during an inject cycle, poor atomization, or improper mixing of fuel will occur. This could cause driveability and exhaust emission related problems that can not be tuned out by the operator. In order to set this value accurately, obtain the Camshaft Information Card for your engine. As an example, we will use the Accel 74219 camshaft for a small block Chevrolet. Locate the intake valve duration at 0.050 tappet lift. The value, 218*, plus the lead-time (in crank degrees), should be used as the base target timing index throughout 4x4 table. This 'lead' time would depend on the distance of the injector to the valve, the size of the injector, the RPM range of the motor, the physical angle in which the injector is mounted to the manifold, and emission restrictions. To promote better atomization of the fuel, you would normally lead this opening event by 90* or more. For this example, we will lead the event by 90*, assuming we are using an Accel SuperRam manifold. This manifold utilizes 30#/hr injectors, located in close proximity to the intake valve. Take this lead-time angle, 90*, add it to the original target timing value of 218* to obtain the new target timing of 308*. Enter 308 in the table. . The ECM will round this value to the nearest factor of 10, so the ECM will display 310. The End of inject timing is calculated by the ECM as, Injector Base Offset Timing minus Injector Target timing. In this case the value is (580* - 310*) or 270 crank degrees. This relationship is also illustrated in Figure F1 and F2.

24. ***Exhaust Closed Loop Enable/Disable***

This is a master on/off switch for closed loop oxygen sensor operation. Normally, this switch would be left in the closed loop or enabled position for most street applications running unleaded fuel. Depending on the O2 sensor selected, in closed loop, the ECU will add or subtract fuel to maintain a Stoichimetric or Target A/F ratio set in Calmap. In the off or disabled position, no fuel corrections are made. Depending on the sensor, O2 voltage or A/F ratio can be monitored in the disabled or open loop mode. This is very helpful in performance applications using leaded fuel. The O2 feedback can be viewed or data-logged to help calibrate the combination.

      25. ***Idle Spark min % TPS***

Enter a TPS value from 0 to 100. This is the TPS threshold at which the Idle Spark table becomes disabled. The Idle Spark table corrects for small changes in idle speed error by adding or subtracting timing. This is very helpful when calibrating engines with high overlap camshafts. This table is located in the Idle menu. A recommended starting point is 1 to 2 percent.

      1.4.7.2 Create a new VE Table, *Utilities*

If you have purchased an Accel Manifold Kit with matching camshaft, such as a SuperRam, or StreetRam, it is probable that the VE table provided will likely start and run the engine fairly well. For most other combinations, if you are starting from scratch, the Utilities menu can help provide you with a starter VE table to get the engine running. Select the Utilities table located in the Fuel Menu. Select and enter the following values. Engine Bore, Engine Stroke, Compression Ratio, Intake Valve Closing event, Intake Valve Size, Runner Length, and Cylinder Head Type, A, B, or C. Click the CREATE VE TABLE button. A new VE table will be generated based on the information you provided. This is only a starting point. It allows the operator to start and run the engine. Further calibration or tuning will be necessary to make this table more accurate. Refer to the Calmap Tuning instructions for further details, or visit an Accel Engine Management Installation Center (EMIC). For the closest dealer in your area, call 1 (888) MRGASKET.

      1.4.7.3 Pre-check and starting the engine

Turn the ignition key to the run position. You should hear the fuel pump cycle on, and then off in 4 seconds. Turn the key off. Repeat this procedure until your fuel system is primed. This usually takes about four repetitions, depending on location of the pump, size, fuel pressure, and length of the fuel lines. If necessary, fuel pressure can be easily measured with a fuel gauge available through your Accel dealer. Before you start the engine, check for leaks throughout the entire fuel system. Start the engine. If the engine does not start after 10-15 seconds, depress the accelerator pedal about a _", to crack the throttle blades open if the engine is slightly rich. Continue cranking. If the engine does not start after 30- 60 seconds, check for the following.

    Check all electrical connections, especially the fuel pump wiring.

    Make sure there are no Fuel Leaks.

    Affirm the fuel lines are full of fuel, and that fuel system retains pressure. Some high performance fuel pumps do not incorporate a fuel check valve. In this situation

the fuel system will lose pressure when cranking stops.

Check the initial idle setting of the throttle blades. Open or close slightly if needed.

After checking the items above, if the engine still does not start, reference the Troubleshooting Flowcharts in this manual.

1.4.7.4 Timing Adjustments

With the engine running, and Calmap on-line, access the instrument panel. Locate and monitor the Ignition Timing value on the bottom, right side of your screen. The goal here is to synchronize the timing between the engine and the ECM. To do this, locate a timing light and engage the timing light pickup on #1 spark plug wire. Run engine, until (ECT) coolant reaches operating temperature. This is usually between 160 to 195 degrees. Raise the engine speed to approximately 2500 RPM, and maintain this speed. Rotate the distributor or move the ignition pickup to match the timing on the harmonic balancer to the ignition timing value shown in Calmap. If the front dress of the motor does not permit movement of the pickup on crank trigger systems, or the manifold interferes with the rotation of the distributor, access and modify the Crank Offset table in the Engine Configuration menu until these values match. The maximum value in this table should not exceed, the total advance of the engine in crank degrees minus 6.

1.4.7.5 Throttle Adjustments

The position of the throttle blades relative to the position of the Idle Air Control Motor actuator plug must be set correctly. The relationship between the two is critical in controlling idle, acceleration, and deceleration characteristics of the motor. A brief description of operation will help you understand how to adjust this function. The function of the IAC motor is to bypass air around the throttle blades. Since the starting position of the throttle blades does not change, the IAC valve position changes to compensate for changes in Idle demand or load. When the IAC opens, it bypasses more air around the throttle blades and when it closes, less air is bypassed. Under certain conditions, usually during cold idle, the throttle body will emit a high frequency hissing sound. This is actually caused by the air reaching sonic velocity traversing through the entry hole in the throttle body. This phenomenon can be monitored as the engine warms up. As coolant temperature (ECT) rises, demand or load decreases, causing the IAC to close. The ideal setup would bypass the least amount of air during no load conditions.

To properly set this relationship, make sure the engine is warm and at operating temperature. Access the Target Idle Speed table in Calmap. Adjust the values in the table to best fit your application. Ordinarily, idle speeds will generally increase as coolant temperature decreases. Target idle speeds will also need to increase with increased camshaft duration. Consult your cam supplier for further information. Next, check and verify that all accessories are off, the transmission is in neutral or park, and the parking brake is set. Select the Minimum IAC position vs. Coolant temperature table. Set the value at current engine temperature to 5%. Monitor the IAC position value at the right side of your screen. Adjust the throttle blades to bring the IAC position value to 6%. If the target idle speed does not match the engine idle

speed when the IAC position is set, then the throttle bores are distorted, a vacuum leak is present in the intake manifold, or the throttle blades need to be drilled. Once the throttle blades have been adjusted, the TPS Set Points must be re-calibrated. To reset these tables, refer to the TPS Set Point, Low, and High Offset Voltage tables in the Configure ECU section. For further tuning or calibration information, reference the Calmap Tuning section in this manual.

1.5 Troubleshooting

   1.5.1 Diagnostic Troubleshooting Chart, End of Inject Profiles
   1.5.2 Troubleshooting Trees
     1.5.2.1 No Fuel to Engine
     1.5.2.2 No Spark at Plugs
     1.5.2.3 Engine Runs Rich
     1.5.2.4 Engine Runs Lean

Code	DESCRIPTION	THRESHOLD	DEFAULT RESPONSE
21	Low ignition (Vigt) voltage	If voltage is less than 8.9V for more than 2 seconds after engine speed exceeds 650 RPM for more than 50 crankshaft revolutions.	MIL set, no default action
22	High ignition voltage	If voltage is greater than 17.9 volts for more than 2 seconds.	MIL set, no default action
23	Low throttle position (TPS) voltage	TPS voltage less than .20V for more than 2 seconds	MIL set, TPS defaults to 1.3V
24	High throttle position voltage	TPS voltage greater than 4.88V for more than 2 seconds	MIL set, TPS defaults to 1.3V
25	Low manifold pressure (MAP)	If MAP voltage drops below .10V for more than 2 seconds	MIL set, MAP defaults to half of full scale.
26	High manifold pressure	If MAP is greater than 4.92V (1 Bar), 3.98V (2 Bar), 3.04V (3Bar) for more than 2 seconds, after engine speed is below 900 RPM	MIL set, MAP defaults to half of full scale.
31	Low barometric pressure (BAR)	If Barometer threshold trigger is less than 2.5V (~66kPa) for more than 1 second	MIL set, Barometric pressure default to 102 kPa
32	High barometric pressure	If Barometer threshold trigger is greater than 4.94V (~107kPa) for more than 1 second.	MIL set, Barometric pressure default to 102 kPa
33	Exhaust sensor stuck low	If sensor voltage remains less than .10V for more than 32 seconds. (In Closed Loop operation only)	MIL set, default to Open Loop Fueling
34	Exhaust sensor stuck high	If sensor voltage remains above .96V (HEGO),or 4.75V (UEGO) for more than 32 seconds. (In Closed Loop operation only.)	MIL set, default to Open Loop Fueling
35	Exhaust sensor inactive	If exhaust sensor voltage does not change by more than .06V in 32 seconds.	MIL set, default to Open Loop Fueling
36	Knock module stuck low	If the Knock ignition retard limit is not equal to 0, and the signal remains low for more then 15 seconds.	MIL set, default to 0 Knock retard, ignore Knock module.
41	High ECT(Engine Coolant Temperature) signal	The coolant temperature sensor voltage remains below .06V for more than 1 second.	MIL set, default ECT to 50 F.
42	Low ECT (Engine Coolant Temperature) signal	The coolant temperature sensor voltage remains above 4.94V for more than 1 second.	MIL set, default ECT to 50 F.
43	Low IAT (Intake Air Temperature) signal	The IAT sensor voltage remains below .06V for more than 2 seconds.	MIL set, default IAT to 50 F.
44	High IAT (Intake Air Temperature) signal	The IAT sensor voltage remains above 4.94V for more than 2 seconds.	MIL set, default IAT to 50 F.
45	Low MST (Manifold Surface Temp.) signal	The MST sensor voltage remains below .06V for more than 2 seconds.	MIL set, default MST to 50 F.
46	High MST (Manifold Surface Temp.) signal	The MST sensor voltage remains above 4.94V for more than 2 seconds.	MIL set, default MST to 50 F.

51	5 Volt Reference out of range	5 Volt reference exceeds 5.5V or drops below 4.5V.	MIL set, set all sensors to default values
52	Air Conditioning Clutch (ACC) relay driver over current	Driver current exceeds .5 Amps	MIL set, shut output driver off
53	Malfunction Indicator Lamp (MIL) over current	Driver current exceeds .5 Amps	MIL set, shut output driver off
54	Shift Light driver over current	Driver current exceeds .5 Amps	MIL set, shut output driver off
55	Torque Converter Clutch (TCC) control relay driver over current	Driver current exceeds .5 Amps	MIL set, shut output driver off
56	Fan control relay driver over current	Driver current exceeds .5 Amps	MIL set, shut output driver off
61	Program Execution, illegal interupt	ECM program error	MIL set, no default action
62	Program Execution, illegal operation	ECM program error	MIL set, no default action
63	Program Execution, (COP), Computer operating properly	ECM program error	MIL set, no default action
64	Stage #1 NOS driver over current	Driver current exceeds .5 Amps	MIL set, shut output driver off
65	Stage #2 NOS driver over current	Driver current exceeds .5 Amps	MIL set, shut output driver off
66	Ignition output driver over current	Driver current exceeds .5 Amps	MIL set, shut ignition off
71	Static Injector Condition	Injector duty cycle exceeds 100% on at least one injector	MIL set, Disable NOS operation, No default under standard operation
72	Cam / Crank Error	Cam or Crank error is detected	MIL set, ECM forces CAM position. If ECM is restarted before error is cleared, cam startup sequence is random.

END OF INJECT PROFILE

POWER STROKE → EXHAUST STROKE → INTAKE STROKE → COMPRESSION STROKE →

310*Target

580*
Base Offset

| TDC 0* | BDC 180* | TDC 360* | BDC 540* | TDC 720* |

218* duration   218* duration

41* BBDC

270* END OF INJECT

-3* BTDC

41* ABDC

EXHAUST
VALVE OPENS

INTAKE OPENS
EXHAUST CLOSES

INTAKE
CLOSES

BEGIN

No

No → R & R Injectors

Yes → Does output signal (S3) pull to ground when switch is activated?

Yes

Repair or replace harness.

No

Check continuity between ecu and injector. OK?

Send ecu in for inspection.

Yes

Yes → Replace Relay.

Yes

In the calmap instrument screen does RPM register>100r while cranking?

Yes

Replace pump. ← Yes — Is fuel pump inlet or pickup clean?

Yes — Isfuel pump electrical polarity correct?

No

Refer to Ignition No Spark Flowchart.

Clean pickup, filter and fuel lines. ← No

No

Reverse wires.

END

34

Is Crk+ signal > 3.8V while cranking?

Yes

No

In vie... RPM... wh...

air gap on ...or or crank ... Is signal >.4V?

Replace sensor or mag trigger.

Close airgap on reluctor or replace ignition module.

Reconfigure ECU.

Repair or Replace wiring.

Yes

Does pin L3 recieve 12V while cranking?

Yes

No

Yes

Check your wiring to the ECU. Is continuity good?

No

Yes

Using an scope, determine if ECU has a signal output at Pin K2(EST).

No

In Calmap, is ignition configured properly?

No

Reconfigure ignition output. Refer to ignition chart.

Yes

Yes

Inspect ignition enhancer box and coil, wiring and connections. Replace if necessary.

No

Remove the points wire (K2) from the enhancer box, touch to ground. Does coil discharge?

No

Yes

Does your system incorporate an ignition enhancer box?

Yes

Send ECU in for inspection.

Position Rotor Properly. See Accel service bulletin.

Do you have spark at the plugs.

Yes

No

Yes

Is there >9V at the Coil (+) and module, during cranking?

No

Rewire to ensure 12V during cranking.

Yes

Is rotor position and/ or phasing correct?

Yes

END

Yes

Replace the Coil.

```
┌─────────┐                                    ╔═══════════════════════════════════╗
│  BEGIN  │                                    ║         Engine Runs Lean          ║
└────┬────┘                                    ╚═══════════════════════════════════╝
     │
     ▼
  ╱╲                    ┌──────────────────────┐
 ╱  ╲   Is the injector │ Select and adjust    │              ╱╲
╱    ╲  size table set  │ size in engine       │             ╱  ╲  Is the fuel     ┌──────────────┐
╲    ╱  properly?  ─No─▶│ configuration table. │──────────▶ ╱    ╲ regulator       │ Adjust       │
 ╲  ╱                   │ Make sure the        │            ╲    ╱ adjusted  ─No─▶ │ regulator to │
  ╲╱                    │ injectors are sized  │             ╲  ╱  properly?       │ baseline     │
   │                    │ properly for the     │              ╲╱                  │ (45PSI)      │
   │                    │ application.         │                                   └──────────────┘
   │                    └──────────────────────┘
   │──────────────────Yes──────────────────
   ▼
  ╱╲                    ┌──────────────────────────────────────────────────────┐
 ╱  ╲  Is the fuel      │ Using .5BSFC as a baseline determine fuel needed.     │
╱    ╲ pump sized  ─No─▶│ For example, 500HP requires 250lbs/hr flow at .5BSFC  │
╲    ╱ properly?        │                                                        │
 ╲  ╱                   └──────────────────────────────────────────────────────┘
  ╲╱
   │─────────────────────Yes──────────────────
   ▼
  ╱╲                 ┌──────────────┐
 ╱  ╲ Is the fuel    │ Install a    │        ╱╲
╱    ╲ line sized    │ minimum      │       ╱  ╲ If using multiple fuel  ┌──────────────┐
╲    ╱ properly. ─No▶│ diameter -6  │────▶ ╱    ╲ pumps, does each   ─No▶│ Install      │
 ╲  ╱                │ line for     │      ╲    ╱ pump have a check       │ check valves │
  ╲╱                 │ 500-750HP,   │       ╲  ╱ valve?                   └──────────────┘
   │                 │ -8 for       │        ╲╱
   │                 │ 750-1000+HP  │
   │                 └──────────────┘
   │───────Yes───────
   │──────────────────────Yes──────────────
   ▼
  ╱╲               ┌──────────────┐          ╱╲                            ┌─Yes─┐
 ╱  ╲ Are the      │ Replace fuel │         ╱  ╲ Are the injectors         ▼     │
╱    ╲ fuel filters│ filters,     │        ╱    ╲ plugged with debris  ┌──────────────┐
╲    ╱ clean?  ─No▶│ flush fuel   │──────▶ ╲    ╱ from the fuel cell   │ Clean or     │
 ╲  ╱              │ lines if     │         ╲  ╱  or tank?             │ replace      │
  ╲╱               │ necessary.   │          ╲╱                        │ fuel         │
   │               └──────────────┘                                   │ injectors.   │
   │───────Yes──────────                                              └──────────────┘
   │────────────────────No──────────────
   ▼
  ╱╲               ┌──────────────┐  ┌──────────────┐
 ╱  ╲ Is the base  │ Adjust the VE│  │ Lower or     │
╱    ╲ VE table    │ number until │  │ enrichen the │        ╱╲
╲    ╱ set     ─No▶│ the actual   │─▶│ target ratio │       ╱  ╲ Is the O2
 ╲  ╱ correctly?   │ A/F ratio    │  │ A/F.         │      ╱    ╲ sensor
  ╲╱               │ matches the  │  └──────────────┘      ╲    ╱ responding
   │               │ target A/F   │                         ╲  ╱ properly?
   │               │ ratio.       │                          ╲╱
   │               └──────────────┘                           │
   │───────────────────Yes──────────────                     No
   ▼                                                          ▼
┌──────────────┐        ╱╲                              ┌──────────────┐
│ Sensor       │       ╱  ╲ Is the O2                   │ Check the O2 │
│ inactive     │      ╱    ╲ varing       ─Yes─────────│ placement or │
│ possibly due │◀─No─ ╲    ╱ between .2                 │ installation │
│ to exhaust   │       ╲  ╱ & .8V?                      │ angle.       │
│ contamination.│       ╲╱                              └──────────────┘
│ Replace      │         │
│ sensor.      │         │
└──────────────┘        Yes
                         │      ┌─────────┐
                         └─────▶│   END   │◀────────────Yes──────
                                └─────────┘
```


36

Engine Runs Rich

BEGIN

Is theInjector size table set properly? — No → **Select and adjust size in engine configuration table.** — No → (back to Yes path)

↓ Yes

Is the vacuum to the regulator connected ? — Yes → **Connect a intake vacuum source to the regulator.** → **Does fuel pressure drop when vacuum is applied?** — No → **Check for spring coil bind in Fuel Regualtor.** — No → (loop back) — Yes →

↓ No

Is the MAP sensor vacuum line connected to any other accessories — Yes → **Remove any vacuum opperated accessories from MAP line.** → **Is the MAP vacuum line pinched?** — Yes → **Remove obstruction in line or install new line.**

No →

No →

Is the return fuel line restrictive, causing high fuel pressure? — Yes → **Remove restriction or install a larger fuel ine Check orifice size of fuel regualtor if using a ultra high performance fuel pump.**

↓ No

Is the base VE table set correctly? — No → **Adjust the VE table until the actual A/F matches the target A/F.** → **Check O2 placement and installation angle.** — No → **Is the O2 voltage operating between .2 & .8V?** — No → **Sensor inactive possibly due to exhaust contamination. Replace sensor.**

↓ Yes

Raise or lean target A/F Ratios → **Is the O2 sensor operating properly?** — Yes → **END**

**END**

Distributor or Crank Trigger Type	Reference Input Signal Type	Reference Input CRK Trigger Edge	Reference Input CAM Trigger Edge_	Spark Out Trigger Edge	Spark Out Trigger Type
GM (HEI), High Energy Ignition	5V/Vigt - Digital Square Wave	Falling	N/A	Falling	5 Volt Digital Square Wave
Universal (IPU), Inductive Pickup	Bipolar pulse (IPU, Flying Magnet)	Falling	N/A	Rising	Sink, Points (Open Collector)
Universal (IPU) with cam sync signal	Bipolar pulse (IPU, Flying Magnet)	Falling	Falling	Rising	Sink, Points (Open Collector)
Universal (HE), Hall Effect	Hall Effect	Falling	N/A	Rising	Sink, Points (Open Collector)
Universal Hall Effect with cam sync	Hall Effect	Falling	Falling	Rising	Sink, Points (Open Collector)
GM (LT1) with opti-spark	Hall Effect	Rising	N/A	Falling	5V Digital Square Wave
Ford (TFI), Thick Film Ignition	5V/Vigt - Digital Square Wave	Rising	N/A	Rising	Vigt Unipolar Digital Square Wave
Honda VTEC, (IPU distributor)	Bipolar pulse (IPU, Flying Magnet)	Falling	Falling	Rising	Sink, Points (Open Collector)
Buick GN V6,DIS, coil packs	5V/Vigt- Digital Square Wave	Rising	Rising	Rising	5V Digital Square Wave
Universal Crank Trigger (includes Flying Magnet, Flying Lug)	Bipolar pulse (IPU, Flying Magnet)	Falling	Falling	Rising	Sink, Points (Open Collector)
Universal Hall Effect Crank Trigger	Hall Effect	Falling	Falling	Rising	Sink, Points (Open Collector)
Enhancer Ignition Box (ie. 300+,MSD) Tach Output Signal (Fuel ONLY)	5V/Vigt -Digital Square Wave	Rising	Falling	N/A	N/A
Ignition Coil -Neg. Terminal (Fuel ONLY)	5V/Vigt -Digital Square Wave	Rising	Falling	N/A	N/A

12 Volt Square Wave

5 Volt Square Wave

Vigt Open Collector

Bipolar Pulse (VRS)
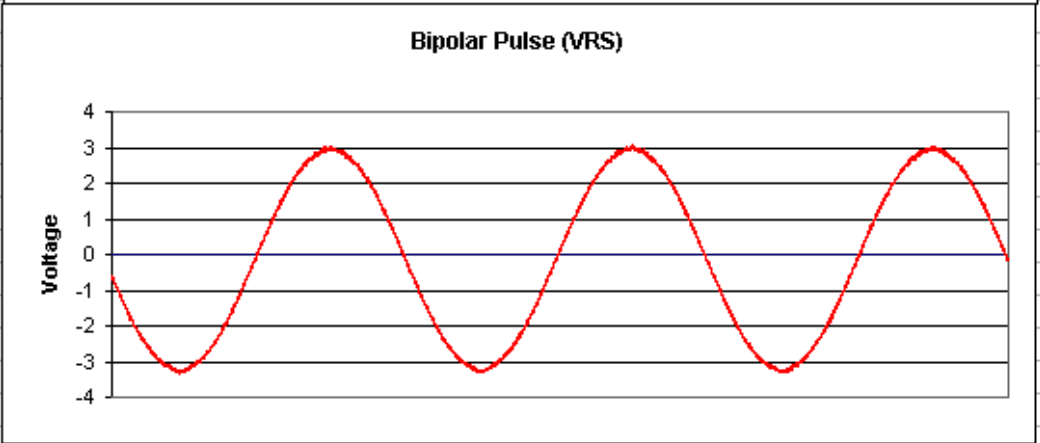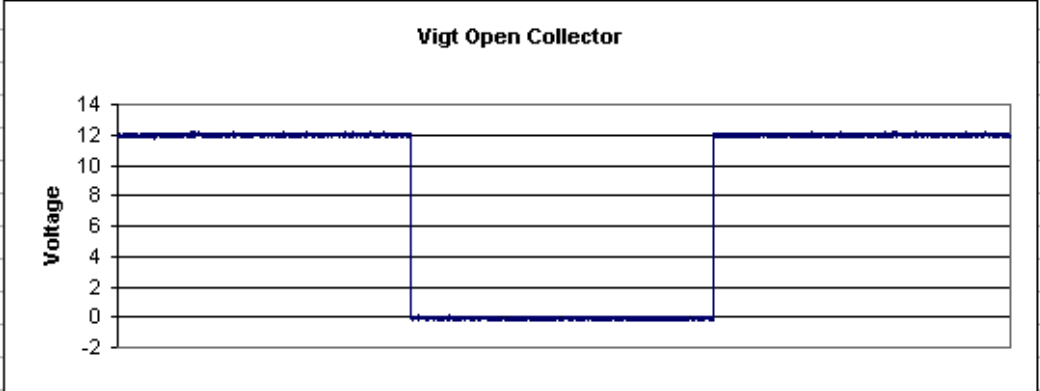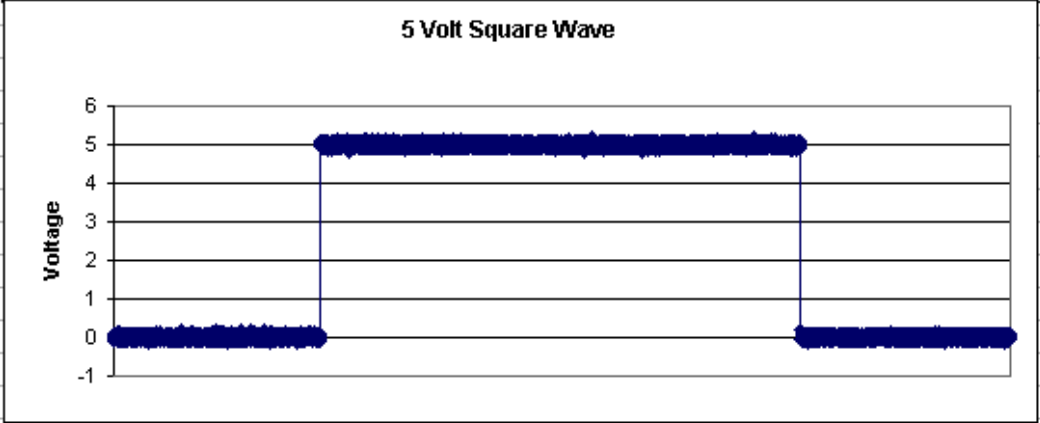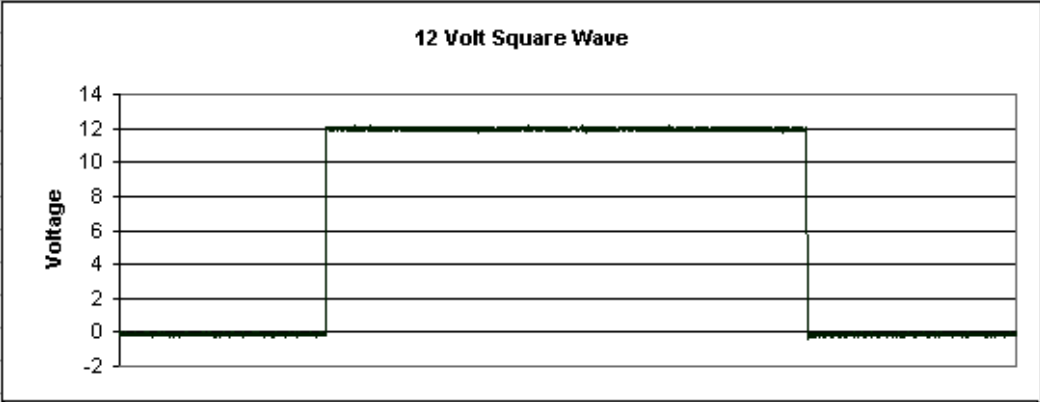
CalMap minimum system requirements:

- Microsoft Windows operating system, version 95,98,NT, or 2000.
- Intel Pentium processor or better, 166 MHz or faster.
- 32 MB of RAM, 64 MB recommended.
- Monitor Resolution of 640x480 pixels, 800x600 recommended.

If installing CalMap from a CD, execute the program 'Setup.EXE' from your computer's CD-ROM Drive. If installing from a floppy disk set, insert the installation disk and execute the program 'Setup.EXE' from your computer's floppy disk drive.

Select the desired location to install CalMap and the associated run-time engine into.

Click the 'Finish' button on the screen after selecting the installation locations. If installing from a floppy disk set, insert additional disks as the computer asks for them. When installation has been completed, a message will be displayed indicating that the installation has been successful. A window on the screen will appear with a shortcut to the CalMap executable, as well as to the error code description file, and an Uninstall program for CalMap. Double click on the shortcut to CalMap to run the program.

In order to communicate to an ECM, the CalMap Communication Cable must be connected to COM1 on the Computer, and to the ECM. The ECM must be powered up in a 'key on' or 'running' mode in order to communicate properly with CalMap .

Getting Started with CalMap:

After double clicking on the CalMap Icon, the splash screen shown in Figure 1 will be displayed. Data can be edited in one of two modes: directly from the Engine Control Module, or in a 'virtual ECM' stored in your computer's memory.

Edit data from ECM:

The 'Edit data from ECM' option requires that a functioning Engine Control Module be connected to the computer via the COM1 serial port. The engine is not required to be running, but the key must be in the on position. Data is changed directly in the ECM memory, and in most cases engine operation is immediately affected by the changes.

Edit data from File:

The 'Edit data from File' option does not attempt to communicate directly with an Engine
Control Module. Data is loaded from a global calibration disk file into a 'virtual ECM' stored in Random Access memory inside your computer. Changes made to ECM data are stored in memory, and must be saved to the global calibration disk file before CalMap is exited. At some later time, the same calibration file may be sent to the ECM, changing all the data values at one time.

Using the Mouse or the Keyboard, select the appropriate button to determine the source of the ECM data that you wish to edit, or select the 'Quit CalMap' option to exit CalMap and return to the computer operating system.

Figure 1: CalMap Startup Splash Screen

Editing data directly from an Engine Control Module:

Once the 'Edit Data From ECM' option has been selected, the Engine Operation Monitoring Screen shown in Figure 2 will be displayed. CalMap will now be attempting to communicate with the ECM via COM1 on the computer. If communication is successfully established, there will be no messages displayed on the screen. If communication with the ECM could not be established, a message box will be displayed and communication with the ECM will be terminated. In this

case, be sure that the communication cable is connected to COM1 on the computer, and the ECM in the vehicle. Also be sure that the ECM is receiving power from a proper supply, and that the ignition switch is in the on or run position. Press the 'F9' key to try to re-establish communications with the ECM after the cable and power connections have been verified.

When communication with the module is established, the instrument panel indicators will display real-time values as monitoring data is imported from the ECM. The ECM monitor screen is divided into three distinct sections: Menu Bar, Instrument Panel, and Monitor Panel.

The CalMap Menu Bar:

Program navigation is achieved through the use of a menu bar just like any application that uses a version of the Microsoft Windows Operating system. To perform an operation via the menu bar, select an item using the mouse or via keyboard shortcuts such pressing as the 'ALT' key and the 'F' key to access the file menu. See the Keyboard Shortcuts section for more on key combinations and their functions.

Figure 2: CalMap Instrument Panel, Monitor panel, and Menu Bar.

The CalMap Instrument Panel:

Many critical operating parameters of the Engine Control Module are displayed in real-time on the instrument panel while the ECM is powered up, with or without the engine being in operation. Engine Speed, Manifold Pressure, Throttle Position, Injector Pulse Width, Injector Duty Cycle, and Ignition Voltage are all displayed graphically and numerically, in easy to read gauges which accurately simulate expensive instrumentation that is normally found in the vehicle. Engine Coolant and Intake Air temperatures are also displayed both graphically and numerically in an easy to read format. Other key parameters that would normally be difficult to display such as HEGO Voltage, O2 Air to Fuel Ratio, Engine Timing, and Knock Retard are shown in quick updating, easy to read bar graphs. Other convenient functions, such as Nitrous Oxide system enable, Cooling Fan, Air Conditioner Clutch Disable, and Torque Converter Lock signal indicators are provided in order to give the user as much information as possible during driving, troubleshooting, and tuning operations. A brightness adjustment knob is provided to change the background color of the white gauges to make them easier to read in the wide variety of light conditions that may be found inside a moving vehicle. The orange indicator labeled 'RX' in the lower right corner of the instrument panel flashes periodically as valid monitor data is received from the ECM to indicate that valid bi-directional communications is present between CalMap and the module.

The CalMap Monitor Panel:

The blue strip along the bottom of the CalMap screen consists of a short summary of key operating data from the Instrument Panel, along with critical operating data not displayed on the instrument panel. It is intended to keep the user informed of critical operating information when editing tables, graphs, or ECM operating parameters. It will be visible and active on most of the screens involved in CalMap. The first 5 black boxes on the left side of the Monitor Panel display Engine Speed, Ignition Timing, Manifold Pressure, Engine Coolant Temperature, and Oxygen Sensor values taken from the Instrument Panel. Next is a set of numeric and graphical indicators that display data about the Closed Loop Fuel Feedback system. The 'O2' box displays the Closed Loop Fuel Feedback Coefficient numerically, and the sliding bar graph displays the same data graphically for easy operating point reference while the engine is in operation. Error Code information is displayed both graphically and numerically on the Monitor Panel by an LED which flashes red when an error code has been detected, and a numeric display which shows the first error code generated by the ECM. Viewing and clearing Error codes can be accomplished by clicking on the numeric display with the mouse or pressing CTRL-E to see a list of the active codes. Alternately, all codes can be cleared at any time by pressing the F8 key on the keyboard. Finally, an LED displays the communication status with the ECM graphically and textually, which is red, when the ECM is off-line, and green when the ECM is on-line with CalMap.

Editing ECM Data with CalMap:

CalMap offers several different methods to change data values in the engine control
       module. Depending on the size of the data table selected, the data will be
       displayed in one of several standardized formats. Large tables are displayed
       numerically with the option to change one, some, or all of the table's values at
       once. Smaller tables are displayed graphically, and offer a visual representation of
       the function being edited. Single cell tables are displayed as a sliding control that
       can be edited numerically, or graphically with both keyboard and mouse control.
       Configuration data has been grouped into several large screens that offer editing of
       multiple interrelated parameters at once.

      16x16 Table Editing Screen:

Large data functions, such as the Base Volumetric Efficiency table shown in Figure 3, are
       displayed numerically in a spreadsheet-like table format. The horizontal and vertical
       axes are displayed with their appropriate units, along the left and left side and
       bottom of the table respectively. Essential information about the data currently
       being edited and Current operating points are displayed in real time along the right
       side of the screen. Data values are changed directly by entering a new value in the
       numeric cell edit box highlighted in blue in Figure 3, and pressing the ENTER key.
       This cell highlight box can be moved by using the arrow cursor keys on the
       keyboard or by using the mouse to click in any cell on the table. Data in the cell
       edit box can be incremented or decremented directly by pressing the '[' and ']' keys
       respectively. The rate of change can be toggled between 1 and 10X by pressing
       the '\' key. More than one data value may be changed at a time through use of the
       Mathematical Options Cell Editor. First, cells must be surrounded with the blue
       border shown on the upper left portion of the table in Figure 3. The border is
       moved by using the arrow cursor keys to move around the table while at the same
       time, holding down the SHIFT key on the keyboard. Once the desired cells are
       surrounded by the blue border, the Mathematical Options Cell Editor can be
       displayed through the keyboard shortcut CTRL-M, or by selecting the 'Modify Cell
       Values' option from the appropriate menu in the CalMap menu bar. The
       Mathematical Options edit box is shown on the right side of Figure 3. Existing data
       values may be scaled, for example, by +10% by entering 1.1 in the Multiply by field,
       and then entering 0 in the Add to field, then pressing the OK button. Global data
       value assignments may be made for example, by entering 0 in the Multiply By box,
       and 1.00 in the Add To box in order to set all the highlighted values to 1.00. The
       current operating point for the function being displayed is indicated by a light blue
       box that floats around the table as the operating point changes. It is located near
       the top center of the table in Figure 3. Since the actual operating point may not be
       located in the exact center of the cell the indicator lies above, there are two
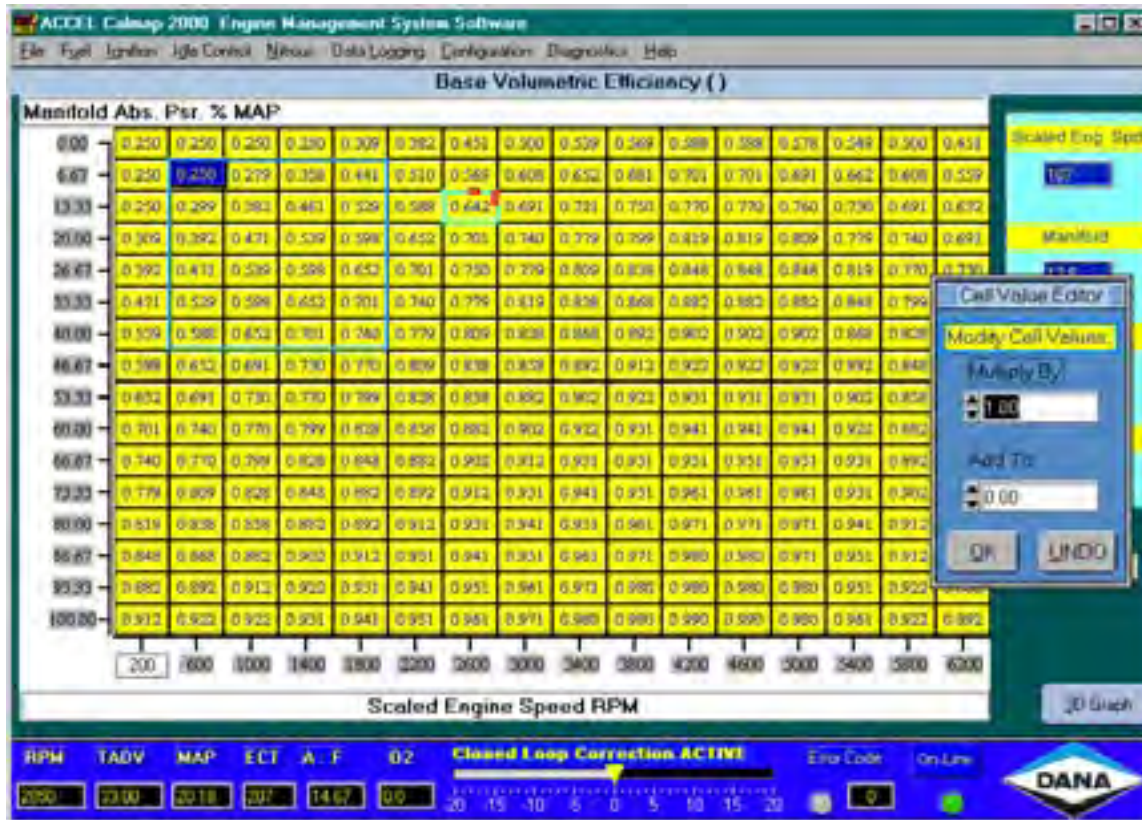
Figure 3: 16x16 Table Editor

red indicator bars, which help to determine the exact operating, point. The horizontal and vertical red bar graph shows the approximate point along the vertical axis that the current function is operating at. The horizontal red bar graph does the some for the horizontal axis. As the operating point changes, the length of the bar graph will grow or shrink to indicate the changes. When the operating point of the function falls exactly in the center of a table cell, both the horizontal and vertical bar graphs will disappear.

Pressing the command button on the lower right side of the screen labeled AutoCal will change the value of the current operating point highlighted in the tracking box by the amount of O2 correction being added by the fuel feedback system. This option is only available when editing the 16x16 Base Volumetric Efficiency table, and only has an effect when the ECM is actively operating in Closed Loop Fuel Feedback mode.

Pressing the command button on the lower right side of the screen labeled 3D Graph will generate a 3 dimensional plot of the data displayed in the 16x16 table. Various aspects of the plot can be changed by following the on-screen instructions for that graph.

8x8 and 4x4 Table Editing Screens:

8x8 and 4x4 sized tables are displayed and manipulated in much the same way as described for the 16x16 tables, with the following exceptions:

There is no 3D-graph option available for smaller tables.
2.)   The Mathematical Options Edit Box is displayed constantly on the right side of the screen.
3.)   Essential monitoring information about the current function being edited is displayed along the bottom of the screen instead of the right side of the screen.

2-Dimensional Graph Editing Screen:

Many functions in CalMap are displayed graphically as a 2 dimensional line plot in order to make editing the data more intuitive. A typical editable graph plot is displayed in figure 4. Data is displayed in a line plot with the value being edited displayed on the vertical axis, and the dependent variable for that function being displayed on the horizontal axis. Two lines are actually displayed on each graph, a red one and a black one. The black line represents the original data that resided in the function before it was loaded into the graph. The red line represents the actual data points on the graph. Changes made to the data will be reflected in the position of the red line, while the black line will remain unchanged for use as a reference point. Essential monitor data associated with the current function being edited is displayed along the bottom edge of the screen. The vertical orange line indicates the current operating point for the function

Figure 4: 2-Dimensional Graph Editor

In Figure 4. This point will constantly move as the operating point of the function being edited changes. The bold yellow vertical line indicates the current edit point on the graph. This edit point can be changed either by clicking to a new location with the mouse, or using the Left/Right arrow keys to move in the desired direction along the plot. The values displayed on the graph may be changed in one of several ways:

Using the mouse, click the desired data point on the plot, and the red line will snap to that point. Press the ENTER key to send the changes to the ECM.

Using the Up and Down cursor keys, change the data to the new desired values, then press the ENTER key to send the changes to the ECM. Pressing the F (fast) key will make the data value change at a faster incremental rate, and pressing the S (Slow) key will make the data value change at a slower incremental rate.

Data can be changed numerically by pressing the TAB key until the red edit box along the top of the blue strip under the graph is highlighted. Enter a new numeric value into the box and press the ENTER key to change the data on the graph and in the ECM.

1x1 Table Editing Screen:

Smaller data tables are displayed as single numeric values, which are changed by using the 1x1 Table Editing Screen displayed in Figure 5.

Figure 5: The Single Cell Table Editor Screen

Data values are displayed in a Bar Graph format, and can be changed in one of the following ways:

Using the mouse, change the sliding data point indicator to the desired position, and then press the F10 key to send the data to the ECM.
Using the Left and Right arrow cursor keys, change the position of the data indicator to the desired position, then press the F10 key to send the data to the ECM.
Enter the new data value in the numeric edit box (highlighted in red in Figure 5), press the Enter key, then press the F10 key to send the changes to the ECM.

Essential monitoring data is displayed in real-time along the bottom of the Editor box when appropriate.

System Configuration Screen:

Figure 5: The CalMap System Configuration Screen

In CalMap, it is much easier to configure your ECM to match the parameters of the engine to which it is mated. There are different configuration screens for each area of functionality within the ECM. The System Configuration Screen, displayed in Figure 5, contains data about the basic operating parameters of the system. Engine Displacement, Number of Cylinders, Fuel Injection Strategy, Cam and Crank signal data, and other essential operating settings are contained on a single, easy to understand screen. Each control parameter can be accessed via both the mouse and the keyboard. After a new value has been entered, simply press the F10 key to send the individual changes to the ECM. The name of each parameter will flash briefly to a red background to indicate that the data has been successfully transmitted to the ECM.

Controls Configuration Screen:

Similar to the System Configuration, the Control Configuration Screen sets up the parameters within the ECM related to different control strategies used to constrain the operation of the engine. Ignition and Fueling Rev Limiters, instrumentation setpoints, and feedback parameters are all controlled from this screen. Navigation and operation of the controls on this screen is identical to that of the System screen.

CALMAP KEYBOARD SHORTCUTS

F1   Activates the CalMap Help subsystem.
F2   Loads the Base Volumetric Efficiency vs. MAP/RPM table.
F3   Loads the Base Ignition Advance vs. MAP/RPM table.
F4   Loads the Target Air:Fuel Ratio vs. MAP/RPM table.
F5   Loads the Data Logging subsystem with the preset 'Autolog' configuration.
F6   Saves or Downloads Global calibration from ECM.
F7   Programs or Uploads Global calibraiton to ECM.
F8   Clears all the Error Codes in the ECM.
F9   Attempts to re-establishes communication with the ECM.
F10   Sends control data to ECM from various configuration/parameter-editing
                screens.
F11   Loads the Tau vs. MAP/ECT table.
F12   Loads the Acceleration Threshold editor.

ESC   Closes the current screen/window.
CTRL-C   Loads the ECM Control Configuration Screen.
CTRL-E   Loads the ECM Active Error Code Acknowledge screen.
CTRL-F   Loads the Data Logging Fuel Analysis Subsystem
CTRL-G   Loads the Data Logging Analysis subsystem.
CTRL-L   Loads the Data Logging subsystem with the currently loaded configuration.
CTRL-M   Activates the Mathematical Options box on Table editing screens only.
CTRL-N   Loads the ECM Sensor Measurement Configuration Screen.
CTRL-R   Loads the Data Logging Replay subsystem.
CTRL-S   Loads the ECM System Configuration Screen.
CTRL-X   Exits the CalMap Engine Monitoring Environment.

ALT-F   Begins navigation in the File menu.
ALT-U   Begins navigation in the Fuel menu.
ALT-I   Begins navigation in the Ignition menu.
ALT-D   Begins navigation in the Idle menu.
ALT-N   Begins navigation in the Nitrous menu.
ALT-L   Begins navigation in the Data Logging menu.
ALT-C   Begins navigation in the Configuration menu.
ALT-G   Begins navigation in the Diagnostics menu.
ALT-H   Begins navigation in the Help menu.

16x16 Table Editing Screen:

ALT-3   Displays 3-Dimensional graph of table data.

Arrow Keys Moves Individual Cell Edit Box around on table data.
ENTER Sends current Cell Edit Box value to the ECM.
Shift-Arrow Moves Highlight Border around table cells.
CTRL-M Selects Mathematical Options box for currently highlighted data.
ALT-F-S Sends ALL current table data to the ECM.
[(Left Bracket) Decrements the value of the cell inside the Cell Edit Box.
] (Right Bracket) Increments the value of the cell inside the Cell Edit Box.
\ (Backslash) Toggles the incremental change value for [and] commands between 1 and 10X.

8x8 and 4x4 Table Editing Screens:

Arrow Keys Moves Individual Cell Edit Box around on table data.
ENTER Sends current Cell Edit Box value to the ECM.
Shift-Arrow Moves Highlight Border around table cells.
CTRL-M Selects Mathematical Options box for currently highlighted data.
ALT-F-S Sends current table data to the ECM.
[(Left Bracket) Decrements the value of the cell inside the Cell Edit Box.
] (Right Bracket) Increments the value of the cell inside the Cell Edit Box.
\ (Backslash) Toggles the incremental change value for [and] commands between 1 and 10X.

Single Value Editing Screen:

Up/Dn Arrows Up/Down Keys raise or lower the value of the table.
F10 Sends the current data value to the ECM.

Graph Editing Screen:

Up/Dn Arrows Changes the data value of the graph located at the yellow editing cursor.
L/R Arrows Changes the location of the yellow editing cursor on the graph.
Shift-L/R Arrow Moves the location of the editing cursor forward or backward by 10 steps.
F Increases the Incremental data change via an arrow key by 10x.
S Resets the incremental data change via an arrow key to the minimum value.

ENTER Sends data from the current graph to the ECM.

Configuration Screens:

TAB Moves control to the next editable field on the screen.
Shift-TAB Moves control to the previous editable field on the screen.

F10   Sends data to the ECM from the Active Edit Control on the screen.

Up/Dn Arrows   Changes the value of numeric controls, but does not send data to the ECM.

ENTER   Activates some controls such as switches, but does not send data to the ECM.

CALMAP TABLE DESCRIPTIONS

FILE

View Table/Graph Data from a file

This option will load a previously saved individual table or graph from a disk file having the suffix .TBL. Data is not immediately sent to the ECM until either the next command in the file menu is used, or some kind of change is made to the data table and sent to the ECM.

Save Current Screen Data to a file

This option will save the entire contents of an individual table or graph screen to a disk file having the suffix .TBL. This command is not valid for configuration screens.

Send Current Screen Data to the ECM

This option will send the entire contents of an individual table or graph screen to the ECM. It is useful after using the previous command to load a table or graph from a disk file. This command is not valid for configuration screens.

Download Global Calibration from ECM

This will save the current state of all editable tables and graphs from the ECM into a disk file with the suffix .ECM.

Upload Global Calibration to the ECM

This command will load the all editable tables and graphs in the ECM from data stored in a disk file with the suffix .ECM.

Edit Global Calibration Comments

This is a table that is intended to contain notes pertaining to the application. The user can enter any text. It is recommended that engine and calibration descriptions be kept here for future reference.

Password Options

This command brings up the CalMap password options edit box. The user password can be entered, modified, and cleared from this screen.

Print Current Screen

This will print the current screen using the default printer selected through your operating system.

Close Current Screen

This will close the current CalMap screen, and is equivalent to pressing the ESC key.

Exit

This will leave the monitoring mode of CalMap, and exit to the startup splash screen.

FUEL

FUEL – STARTING

After-Start Fuel Coefficient vs Engine Coolant Temperature

The values in this table specify the amount of fuel adjustment for initial engine running conditions. Engine coolant temperature is used to select an adjustment value to be applied to the fuel delivery. The normal amount of fuel that the ECM calculates is multiplied by the value from this table before being delivered to the engine. This table serves to compensate for a variety of phenomena that occur when an engine is first started (e.g. poor fuel atomization when cold, fuel vapor when hot, loose piston clearance when cold, etc..). This adjusting coefficient is decayed out after the engine runs for some period of time. Refer also to After-Start Decay tables.

Index: Engine coolant temperature

Range: 0.5 to 1.5
Units: None (Coefficient)
Resolution: 0.00392

Base After-Start Decay

The values in this table specify the rate at which the initial After-Start fuel adjusting coefficient is decayed out. Engine speed and manifold absolute pressure are used to select the values from this table. The table value is the number of camshaft rotations between After-Start decay steps. Each decay step is 0.39%. If the After-Start adjusting coefficient is less than 1.0 it will be increased until it reaches 1.0 and then it will stop. If the After-Start adjusting coefficient is greater than 1.0 it will be reduced to 1.0 and then stop. Once the adjusting coefficient is 1.0 it will no longer affect the fuel delivered to the engine. See also the After-Start Fuel Decay Modifier vs Engine Coolant Temperature table.

X Index: Engine Speed, Base Ve Table RPM Scale
Y Index: Manifold absolute pressure
Range: 1 to 255
Units: Camshaft rotations between decay steps
Resolution: 1.0

After-Start Fuel Decay Modifier vs Engine Coolant Temperature (Pro Version only)

The values in this table specify an adjustment to the rate that the After-Start fuel coefficient is decayed out. Engine coolant temperature is used to select the value used from the table. The number of camshaft rotations between After-Start decay steps is multiplied by the value from this table to yield the actual number of camshaft rotations between decay steps. Generally a cold engine requires a longer duration of After-Start then a hot engine, hence table values in the cold range of this table are larger then the hot portion of the table.

Index: Engine coolant temperature
Range: 0.0 to 1.0
Units: None (Coefficient)
Resolution: 0.00392

Starting Fuel Coefficient

This table contains correction values that are applied to the fuel delivery during engine starting. Engine coolant temperature is used to select the correction value from this table. When the engine is first cranked to start the normal amount of fuel is multiplied by the

value selected from this table. The fuel decays out after initial starting. Refer also to the After-Start Fuel Coe. table. Generally colder engines need more fuel to start then when hot.

Index: Engine coolant temperature
Range: 0.5 to 1.5
Units: None, Coefficient
Resolution: 0.00392

FUEL – TRANSIENT

Tau vs.MAP/ECT and X vs.MAP model

The ECM employs a fueling strategy that models the actual flow of fuel in an engine. The model is often times referred to as the Tau-X model. Its Greek letter usually represents tau - τ. Figure 1 illustrates the basic concept.
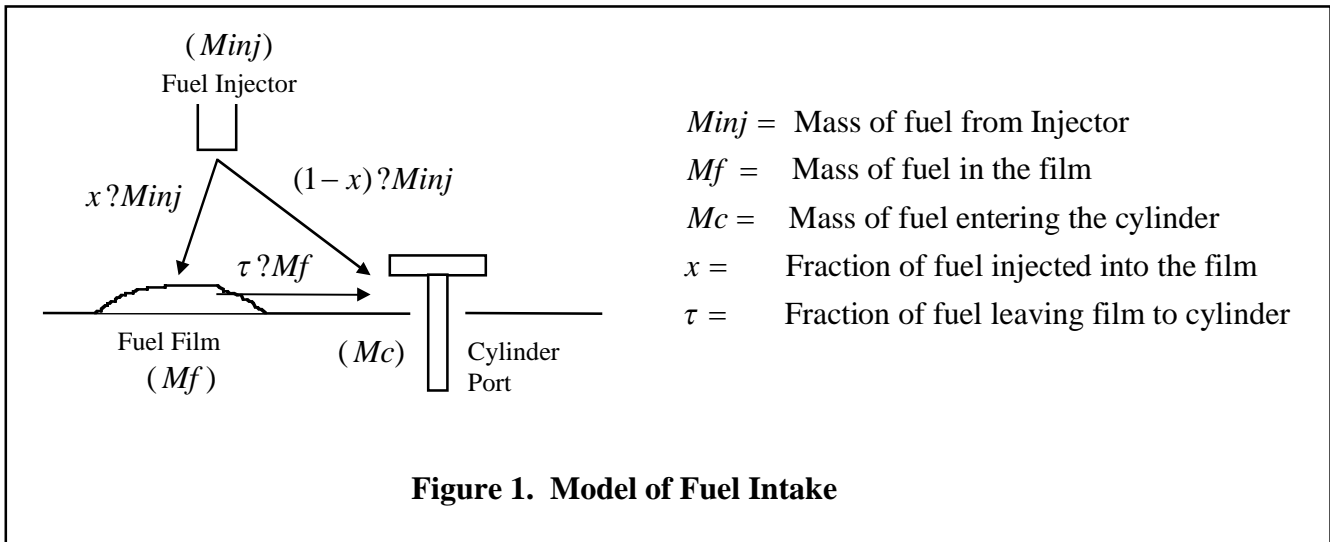
Figure 1. Model of Fuel Intake

The model describes the fuel behavior in the intake manifold. The process of delivering fuel to an engine's cylinder is that first the fuel leaves the injector. Some of the injected fuel, X-amount, is deposited on the surfaces surrounding the intake valve. The rest of the injected fuel, (1-X)-amount, is pulled into the intake valve. When the intake valve opens it also pulls in some part of the fuel that has been deposited on the surrounding surfaces, τ-amount.

Both X and τ are fractions. That is, a value of 1 means all of the fuel. A value of 0.5, for example, would mean only _ of the fuel. As an illustration, if X=0.8 and τ=0.2 then 8/10ths

of the fuel leaving the injector would be deposited on the surrounding surface. 2/10ths of the injected fuel would go directly into the intake valve. An additional amount of fuel would also go into the intake valve from the film deposited on the surface. In this case 2/10ths of the film would be pulled into the cylinder.

To further illustrate the idea and bring forward an understanding of the dynamics of fuel flow in a fuel injected engine the case of a sudden injector pulse-width change on an engine is presented. If X=0.6 and τ=0.2 and 12 milliseconds of injected fuel is laying on the walls from past injects then, when the injector pulse-width changes from 5 to 20 milliseconds, the following series of calculations shows the actual fuel ingested into the cylinder at each intake valve opening.

Usually there is a delay from the time that the fuel injector changes flow to the time that the cylinder actually receives the same amount of flow. Also note that the amount of film on the wall increases as injector flow increases. The strategy in the ECM takes all of this into account when controlling the injector pulse width. In order to achieve correct transient response fueling it is important that the τ and X values be calibrated to match the engine

.
Tau vs. MAP/ECT
X Index: engine coolant temperature
Y Index: Manifold absolute pressure
Range: 0 to 100
Units: %
Resolution: 0.392

X vs. MAF
Index: Estimated mass airflow
Range: 0 to 100
Units: %
Resolution: 0.392

Acceleration Threshold

When the engine requires a change in instantaneous fueling, the ECU will calculate an asynchronous fueling value based upon various table inputs. This mass fuel value is scaled to 0 to 100 mass units. 0 represents the maximum amount of asynchronous fuel that can be injected into the engine, and 100 represents the least amount injected. For example, if the table had a value of 15 units and the ECM requests 20 units, then ECM would ignore the request for the first 15 mass fuel units thereby injecting only the remaining 5 units. The function of this table is to disregard very small requests for fuel, primarily caused by minute changes in MAP. Generally, cam overlap plays a large roll in MAP fluctuations. So the higher the overlap, or the hotter the cam, the higher the number that should be entered. A value of 10 to 20 would be a good starting point.

Range: 0 to 100
Units: Fuel Mass
Resolution: 0.392

Acceleration Modifier

The value in this table specifies the amount of adjustment to be applied to the acceleration fueling as a function of Engine Coolant Temperature. This coefficient modifier is multiplied by the additive, fuel mass to achieve a new asynchronous fuel amount. A value of 1.0 is recommended as a starting point. The Acceleration Modifier is a secondary trim table for adjusting asynchronous fueling. Refer to the Tau and X tables for initial acceleration and deceleration fuel requirements.

Range: 0.5 to 3.5
Units: None (Coefficient)
Resolution: 0.117

Acceleration Cutoff

This table contains a value, in MAP(%). When the manifold absolute pressure exceeds this value, no further asynchronous fueling is injected into the motor. The purpose of this table is to prevent any asynchronous fueling during small changes in manifold pressure.

Range: 0 to 100
Units: None (Coefficient)
Resolution: 0.39

FUEL – STEADY STATE

Cylinder #1 - #8 Fuel Coefficient

The values in these tables specify a fuel adjustment for each of the cylinders. The tables are only used when the ECM is configured for sequential fuel injection. Engine speed and manifold absolute pressure are used to select the adjustment value for each cylinder. The fuel delivered to each cylinder is the normally calculated fuel times the associated cylinder's adjusting value.

X Index: Engine Speed, Base Ve Table RPM Scale
Y Index: Manifold absolute pressure
Range: 0.5 to 1.5
Units: None (Coefficient)

Resolution: 0.00392

Injector Correction vs. Voltage (Pro Version only)

The values in this table specify an amount of adjustment to be applied to the fuel injector pulse to compensate for the system voltage. The voltage measured by the switched ignition signal to the ECM is used to select an amount of time to add to the injector pulse. Generally as the voltage decreases the amount of injector correction increases. Voltages over 12.0 V usually do not require any additional injector time. The amount of correction is dependent on the injector type and manufacturer.

Index: Switched ignition voltage
Range: 0.0 to 2.04
Units: milliseconds
Resolution: 0.008

Base Offset Injector timing (sequential fuel mode only)

This value, displayed in crank angle degrees, specifies the offset point that the Injector Target timing table indexes. This value generally would be the intake valve closing angle, in crank degrees. In order to set this value, obtain the Camshaft Information Card for your engine. As an example, we will use the Accel 74219 camshaft for a small block Chevrolet V8. Locate the angle at 0.050 tappet lift at which the intake valve closes. This is usually read in crank degrees, (ABDC) after bottom dead center. Since the cam card shows the intake valve closing point at 41*ABDC, and we know the crank angle at BDC intake stroke is 540* on a Chevrolet V8, then we can calculate the exact angle in crank degrees at which the intake valve closes. Simply combine these figures, 41* and 540* to net a crank angle intake closing timing of 581* @ 0.050" valve lift. Enter 581 in the table. The ECM will round this value to the nearest factor of 10, so the ECM will display 580.

Range: 0 to 720
Units: crank angle degrees
Resolution: 10

Target Injector timing (sequential fuel mode only)

This table contains fuel injector target timing values for all possible engine speeds and engine loads. This value, displayed in crank angle degrees, designates the end of inject point of the fuel injector. In order to set this value accurately, obtain the Camshaft Information Card for your engine. As an example, we will use the Accel 74219 camshaft for a small block Chevrolet V8. Locate the intake valve duration at 0.050 tappet lift. The value, 218*, should be used as the base target timing index throughout 4x4 table. Using this target timing we are assured that the injection event will not coincide with the intake

valve opening event. Typically, end of inject point should occur before the intake valve opens. Under light load conditions, if the intake valve is open during an inject cycle, poor atomization, or improper mixing of fuel will occur. This could cause driveability and exhaust emission related problems that can not be tuned out by the operator. To promote better atomization of the fuel, you would normally lead this opening event by 90* or more. This 'lead' time would depend on the distance of the injector to the valve, the size of the injector, the RPM range of the motor, the physical angle in which the injector is mounted to the manifold, and emission restrictions. For this example, we will lead the event by 90*, assuming we are using an Accel SuperRam manifold. This manifold utilizes 30#/hr injectors, located in close proximity to the intake valve. Take this lead time angle, 90*, add it to the original target timing value of 218* to obtain the new target timing of 308*. Enter 308 in the table. . The ECM will round this value to the nearest factor of 10, so the ECM will display 310. The End of inject timing is calculated by the ECM as, Injector Base Offset Timing minus Injector Target timing. In this case the value is (580* - 310*) or 270 crank degrees.

Range: 0 to 720
Units: crank angle degrees
Resolution: 10

Target Air to Fuel ratio

This table contains values of target air to fuel ratios for all possible speeds and manifold pressures. The strategy in the ECM calculates fuel delivery based upon the settings in this and other tables. The calculation performed in the ECM for fuel delivery is basically:

Fuel to Engine = Measured Air In / Target Air to Fuel Ratio

Air into the engine is based upon the manifold pressure, port air temperature and volumetric efficiency. When intake port temperature is measured accurately and volumetric efficiency is calibrated properly then the entries in this table will match the actual fuel to air mixture delivered to the engine.

The values in this table are also used for closed loop fuel control. Closed loop fuel control is when the ECM adjusts fuel delivery based upon the signal it receives from the exhaust oxygen sensor. The standard exhaust sensor used is a Heated Exhaust Gas Oxygen sensor (HEGO). This sensor switches from approximately 0.1 volts to 0.9 volts at the stoichemetric air to fuel ratio (for gasoline this is approximately 14.5 to 1. Linear exhaust sensors, with associated signal conditioning circuitry, are available that supply a signal that is proportional to air to fuel ratio. These sensors are typically referred to as UEGO sensors (Universal Exhaust Gas Oxygen).

When the ECM operates in the open loop fuel mode fuel delivered to the engine is a direct result of the above calculation. When in closed loop fuel mode the fuel delivery is the

result of the above calculation multiplied by a correction value that is derived from the signal of the exhaust sensor. Refer to the various closed loop fuel control calibration tables for description of the fuel response to the exhaust sensor signal.

X Index: Engine Speed, Base Ve Table RPM Scale
Y Index: Manifold absolute pressure
Range: 10 to 20
Units: ratio, air to fuel
Resolution: 0.00784

VE Correction vs Target Air to Fuel Ratio (Pro Version only)

This table contains values that specify how the volumetric efficiency is affected by the richness of the air/fuel mixture. The target air to fuel mixture is used to select a correction amount from this table. The correction is applied to the base volumetric efficiency. Usually as the air/fuel mixture becomes richer (lower air to fuel ratio) the volumetric efficiency of the engine decreases. Essentially the air pumping capability of the engine is reduced because the additional fuel increases intake mass. The additional mass is more difficult for the engine to pull through.

Index: Target air to fuel ratio
Range: 0.5 to 1.5
Units: None (Coefficient)
Resolution: 0.00392

VE Correction Coefficient vs Estimated Intake Port Temperature (Pro Version only)

This table contains values that specify an amount of correction to be applied to the base volumetric efficiency value. The intake port temperature is used to select the correction value from this table. The base volumetric efficiency is multiplied by this value, as well as other correcting values, to produce the final volumetric efficiency value that is used for calculating the amount of air entering the engine.

As the temperature of the air entering the engine increases the volumetric efficiency increases. Usually the values in this table increase with intake port temperature. This correction should not be confused with air density change over temperature. While higher air temperatures reduce air density, hence less mass of air, the reduced density makes it easier for the engine to pump it through.

Note also that the estimated intake port temperature is used to select this correction not the intake air temperature sensor reading. The temperature of the air and fuel mixture entering the cylinder is not necessarily the temperature of the temperature at the intake air temperature sensor. Refer to the intake port temperature estimating calibration tables for more detail.

Index: Estimated intake port temperature
Range: 0.5 to 1.5
Units: None (Coefficient)
Resolution: 0.00392

VE Correction vs Engine Coolant Temperature

This table contains values that specify an amount of correction to be applied to the base volumetric efficiency value. The engine coolant temperature is used to select the correction value from this table. The base volumetric efficiency is multiplied by this value, as well as other correcting values, to produce the final volumetric efficiency value that is used for calculating the amount of air entering the engine.

As the temperature of the engine increases the volumetric efficiency decreases. Usually the values in this table decrease with increasing engine temperature. This correction should not be confused with start-up fuel corrections. Start-up corrections are used to compensate for initial conditions and driveability not steady state pumping characteristics.

Note also that the correction value from this table is multiplied by a compensating coefficient based on engine speed and manifold pressure. The actual amount of volumetric efficiency compensation for engine temperature is the combination of this table's value and the value from the ECT VE correction compensation vs MAP/RPM table. By combining the corrections from the two tables effects of engine friction and air velocity can be captured.

Index: Engine coolant temperature
Range: 0.5 to 1.5
Units: None (Coefficient)
Resolution: 0.00392

ECT VE Correction vs MAP/RPM (Pro Version only)

The values in this table specify an amount of correction to be applied to the volumetric efficiency compensating value for engine coolant temperature. Engine speed and manifold pressure are used to select a value from this table. The base volumetric efficiency correction value for engine coolant temperature is multiplied by the value from this table to yield the total actual correction to the volumetric efficiency for engine temperature.

Generally, as engine speed and load increases the effects on volumetric efficiency from engine temperature decrease. The values in this table are usually near 1.0 at low speeds and manifold pressures and closer to 0.0 at high speeds and high manifold pressures.

X Index: Engine Speed, Base Ve Table RPM Scale

Y Index: Manifold absolute pressure
Range: 0.0 to 1.0
Units: None (Coefficient)
Resolution: 0.00392

Base Volumetric Efficiency

The values in this table specify the air pumping efficiency of the engine at all of its' speeds and loads. The engine pumping efficiency is called the volumetric efficiency. It is a measure of how well the engine can pump air through it. Basically it is the ratio of the volume of the available air passing through the engine to the displacement volume of the engine. Engine speed and manifold pressure are used to select the volumetric efficiency at any given speed and load.

This table contains base VE values. The value that is used from this table for any given speed and load is then corrected for a number of other factors (e.g. intake port temperature, engine coolant temperature, etc.). Note also that the ECM uses the values in this table to calculate the mass of air actually entering the engines' cylinders. The ECM calculates the actual fuel to be delivered to the engine by:

Mass of Fuel = Target Air:Fuel Ratio / Mass of Air entering the engine

Either modifying the target air to fuel ratio table or the base VE table will change engine fueling. In order to truly model engine operation, generate an accurate calibration, The air and fuel must be treated separately. The VE table should be adjusted to produce air to fuel ratio values that match the target air to fuel ratio table values. Once the volumetric efficiency is calibrated then the ECM will be able to accurately measure air mass from the air mass then it can calculate the proper amount of fuel to deliver. When volumetric efficiency is calibrated properly then whatever is entered into the target air to fuel ratio table will be the actual air to fuel mixture in the engine.

At operating points near engine peak torque VE's are generally highest. At high intake manifold vacuums VE's are usually smallest.

X Index: Engine Speed, Base Ve Table RPM Scale
Y Index: Manifold absolute pressure
Range: 0.25 to 1.25
Units: None (Ratio)
Resolution: 0.00392

Alpha-N MAP vs Percent Throttle

The values in this table specify an estimated manifold absolute pressure for a given throttle position. When the ECM is configured for Alpha-N operation the signal from the throttle position sensor is converted into a percentage of full throttle. The percentage of throttle is then used to select an estimate of the manifold pressure from this table. The ECM then treats the estimated manifold pressure as it would if it were actually reading it.

All of the calibration tables and calculations in the ECM use the estimated manifold pressure in the place of the real pressure when configured for Alpha-N operation.

Index: % of throttle
Range: 0 to 100
Units: % MAP
Resolution: 0.373

ECT – IAT Difference (Pro Version only)

This table contains coefficients that are used to estimate the intake port temperature. The coefficients are looked up from a table that is based upon intake mass airflow. For a given mass airflow a corresponding coefficient is retrieved from this table. The coefficient is then applied to the calculation:

IPT = ECT - IAT Coef x (ECT-IAT) - MST Coef x (ECT-MST)

Where:
          IPT = Estimated Intake Port Temperature
          ECT = Engine Coolant Temperature
          MST = Manifold Surface Temperature

The purpose of this table is to capture the effects of the various heat flow elements in the intake manifold. Sensing of the intake air at a point that is not near to where the fuel and air mix can potentially cause substantial errors in the calculation of air density. Air density is proportional to air temperature.

The cylinder head temperature is at near the coolant temperature and the temperature of the air at the throttle body is at near outside ambient temperature. The temperature at the port, where the air and fuel mix, is something in between. In the case of small airflow's (i.e. idle) the incoming air picks up much of the heat from the cylinder head while at high airflow rates the outside temperature dominates.

As the values in the table increase the measurement of intake port air temperature is more influenced by the intake air temperature sensor reading.

Range: 0 to 1.0
Units: None
Resolution: 0.0392

MST – IAT Difference (Pro Version only)

This table contains coefficients that are used to estimate the intake port temperature. The coefficients are looked up from a table that is based upon intake mass airflow. For a given mass airflow a corresponding coefficient is retrieved from this table. The coefficient is then applied to the calculation:

IPT = ECT - IAT Coef x (ECT-IAT) - MST Coef x (ECT-MST)

Where:
> IPT = Estimated Intake Port Temperature
> ECT = Engine Coolant Temperature
> MST = Manifold Surface Temperature

The purpose of this table is to capture the effects of the various heat flow elements in the intake manifold. Sensing of the intake air at a point that is not near to where the fuel and air mix can potentially cause substantial errors in the calculation of air density. Air density is proportional to air temperature.

The cylinder head temperature is at near the coolant temperature and the intake manifold surface temperature that surrounds the incoming air is at near the under hood temperature. The temperature at the port, where the air and fuel mix, is something in between. In the case of small airflow's (i.e. idle) the incoming air picks up much of the heat from the cylinder head while at high airflow rates the incoming air from the throttle dominates.

As the values in the table increase the measurement of intake port air temperature is more influenced by the manifold surface temperature sensor reading.

Range: 0 to 1.0
Units: None
Resolution: 0.0392

FUEL – FEEDBACK

Fuel Control Proportional Gain

This is the value placed on the O2 correction control that amplifies the error to drive the position towards the desired response. If set too high, proportional control can produce excessive amounts of overshoot and oscillation. To a degree, it can reduce but not eliminate steady state error. Generally, the proportional gain will be low at low mass air flow values, such as idle, escalating to an increased value with high mass air flow

numbers. This table allows the end user to calibrate the desired weight applied to closed loop error at low and high engine air flow rates.

Range: 0 to 100
Units: None (Coefficient)
Resolution: 0.0392

Fuel Control Integral Gain

This is the value placed on the O2 correction control that acts on the history of the error, balancing the positive and negative portions of the response. Typically, small integral gains produce gradual changes that are used to avoid destabilizing the closed loop system. On the other hand, high gains achieve a faster response with decreased stability. If set accurately, this control can eliminate steady state error. This table allows the end user to calibrate the preferred relatively, stable, slow response at idle, and the preferred stable, fast response while at higher engine air flows.

Range: 0 to 100
Units: None (Coefficient)
Resolution: 0.0392

Fuel Control Differential Gain

This is the value placed on the O2 correction control that reacts to the slope of the error, thereby minimizing overshoot. It provides rate feedback that results in more dampening. High differential gains can increase rise time, settling time, and instability during steady state feedback. This table allows the end user to calibrate the desired dampened error response at idle, and as well as, high engine air flows.

Range: 0 to 100
Units: None (Coefficient)
Resolution: 0.0392

UEGO Maximum Fuel Feedback Coefficient

This table contains values that determine the limits of fuel correction when operating in the closed loop fuel control mode. The index is the limit of the amount of fuel correction vs engine load and RPM that the ECM will provide when it is in closed loop. The limit is both plus and minus. That is, if the limit is 10% then the closed loop fuel control coefficient will be allowed to change between 0.90 and 1.10. If the coefficient is 1.0 then the correction is 0%. In some cases, the application might call for open loop status under extreme conditions. This can be accomplished by entering 0 percent at that given speed and load value.

This table only applies when the ECM is configured for the Wide Band, or Universal Exhaust Gas Oxygen (UEGO) type sensor. The UEGO sensor is for the most part a linear sensor. Sensor input comes from a conditioning module. This module sends information to the ECU that can correlate the information into an air to fuel ratio. When the mixture in the exhaust is leaner or richer than the designated target air to fuel ratio, then the ECM will correct the fueling requirements up to the specified limit set in this table.

Range: 0 to 25
Units: Percent
Resolution: 0.196

HEGO Maximum Fuel Feedback Coefficient

This Table contains values that specify the limits of fuel correction vs mass air flow when operating in the closed loop fuel control mode. The value selected is the limit of the amount of fuel correction that the ECM will provide when it is closed loop. The limit is both plus and minus. That is, if the limit is 10% then the closed loop fuel control coefficient will be allowed to change between 0.90 and 1.10. In some cases, the application might call for open loop status under extreme conditions. This can be accomplished by entering 0 percent at that given mass air flow value or by setting the target ratio table to a value other then the stoichimetric ratio. Refer to the Hego Modifier for further corrections.

This table only applies when the ECM is configured for the Heated Exhaust Gas Oxygen (HEGO) type sensor. The HEGO sensor is for the most part a digital type sensor. When the mixture in the exhaust is leaner than the stoichemetric ratio, then the sensor signal is below stoich voltage. When the mixture is richer than the stoichemetric ratio, then the sensor signal is above the stoich voltage. The Stoichemetric ratio is the air to fuel ratio that results in the most complete combustion of the fuel. For gasoline this is about 14.5 parts of air to 1 part of fuel.

Range: 0 to 25
Units: Percent
Resolution: 0.196

HEGO Stoichiometric Air to Fuel Ratio (Pro Version only)

The Stoichemetric ratio is the air to fuel ratio that results in the most complete combustion of the fuel. For gasoline this is about 14.5 parts of air to 1 part of fuel. This must be set to 14.5 when running gasoline.

Range: 10 to 20
Units: Air to Fuel mixture ratio
Resolution: 0.0784

Closed Loop ECT Threshold

This table is designed to prevent closed loop correction under engine warmup conditions. The value in this table specifies the engine coolant temperature the engine must exceed before beginning closed loop fueling correction. The ECU must also satisfy the parameter in the   Closed Loop Delay vs. starting ECT table before commencing closed loop corrections.

Range: -40 to 266
Units: Engine Coolant Temperature (*F)
Resolution: 1.2

Closed Loop Delay vs. Starting ECT

This table was designed to allow the oxygen sensor ample time to warm up to prevent erroneous O2 feedback corrections. The value in this table specifies the delay time in seconds the engine must run before beginning closed loop fueling correction. This delay time in seconds is factored as a function of the engine coolant temperature at startup. Refer to the closed loop ECT threshold for the other closed loop parameter. The recommended *minimum* time for a HEGO sensor would be approximately 420-600 seconds on a cold engine to 180-300 seconds for a warm engine. A UEGO or wide band sensor typically would require less time, about 180-360 seconds for a cold engine and 60-180 seconds for a hot engine.

Range: 0 to 1275
Units: seconds
Resolution: 5

HEGO Modifier (Pro Version Only)

This table is intended to provide a smooth transition between open and closed loop fuel control. The absolute value indexed in this table is the difference between the stoichimetric fuel ratio and the target air fuel ratio. Typically, the table would range from 100 index at 0.0 difference to, 0 index at specified stoich –target difference. Refer to the Target A:F table and the Lambda stoichimetric A:F ratio values when setting this table.

Index: Difference between Stoich A:F ratio and Target A:F ratio

Range: 0 to 100
Units: None, Coefficient
Resolution: 0.392

IGNITION

IGNITION – STARTING

Ignition Start-up Term

The values in this table specify a base amount of ignition advance to be added to the base ignition advance during initial engine starting. The engine coolant temperature serves as a pointer into this table. The pointer selects an amount of ignition advance to be added to the base advance during or shortly after the engine is started. The actual ignition advance angle during start-up proceeds through two phases, phase-in and decay-out.

When the engine is initially cranked to start the ignition advance is set to the base amount that is determined by the Advance Offset value. As the engine turns the advance delivered to the engine increases at a rate specified by the Ignition Start-up Phase-in Interval table. Once the advance reaches the total amount specified by the sum of all of the values of the contributing tables (Including Start-up Advance) the Start-up advance term then begins to be phased-out. The start-up advance term is phased out at a rate that is specified by the Ignition Start-up Decay Interval table.

Index: Engine Coolant Temperature
Range: -32.0 to +32.75
Units: Crankshaft degrees
Resolution: 0.25

Ignition Start-up Decay Interval (Pro Version only)

The values in this table specify the time between start-up ignition advance term decay steps. Once the engine begins to crank for start-up, ignition advance is ramped up to the total advance value. The total advance is specified by the base advance value with all of the various adjusting terms, including the start-up term added to it. Once the advance reaches this total, composite value the start-up term begins to decay out. The values of this table specify how much time is between each 0.25 degrees of start-up advance decay steps. If the start-up advance term is greater than zero then the term is reduced towards zero. If the term is negative then the term is advanced towards zero.

X Index: Engine coolant temperature
Y Index: Manifold absolute pressure

Range: 0.0 to 6.2
Units: Seconds
Resolution: 0.024

Ignition Start-up Phase-in Interval (Pro Version only)

The values in this table specify the amount of time between ignition advance increase steps after initial crank to start. When the engine is first cranked to start the ignition advance delivered to the engine is the value specified by the crank offset value. As the engine cranks the advance increases until it reaches the total advance. The base advance with all of the various correction terms, including the start-up term, added to it calculates the total advance. The time between 1.0 degree advance increment steps is contained in this table.

X Index: Engine coolant temperature
Y Index: Manifold absolute pressure
Range: 0 to 790
Units: milliseconds
Resolution: 4.1

IGNITION – STEADY STATE

Port Air Temperature Ignition Compensation

The values in this table specify an advance term that is added to the base ignition advance as a function of intake port air temperature. The intake air port temperature serves as a pointer into this table. The pointer selects the amount of advance to be added to the base timing value. Generally, as intake port air temperature increases this term should become more negative.

Index: Estimated Intake Port Air Temperature
Range: -32.0 to +32.75
Units: Crankshaft degrees
Resolution: 0.25

Patm / Ve Ignition Compensation (Pro Version only)

The values in this table specify an advance term that is added to the base ignition advance as a function of the amount of atmospheric pressure volumetric efficiency correction. The atmospheric pressure volumetric efficiency coefficient serves as a pointer into this table. The pointer selects the amount of advance to be added to the base timing

value. Generally, as volumetric efficiency increases this term should become more negative.

Index: Atmospheric Pressure Volumetric Efficiency Coefficient
Range: -32.0 to +32.75
Units: Crankshaft degrees
Resolution: 0.25

Base ECT Ignition Compensation (Pro Version only)

The values in this table specify a base amount of ignition advance to be added to the base ignition advance as a function of engine coolant temperature. The engine coolant temperature serves as a pointer into this table. The pointer selects the base engine temperature ignition advance term. The term is then corrected based on engine speed and load. The value that is looked-up from the Ignition ECT Compensation Power Modifier table adjusts the base coolant temperature ignition term to yield the final amount of coolant temperature ignition advance to be added to the base ignition advance. The calculation is:

  ECT Advance Term = Base ECT Term x ECT Power Compensation Coefficient

Index: Engine Coolant Temperature
Range: -32.0 to +32.75
Units: Crankshaft degrees
Resolution: 0.25

ECT Compensation Power Modifier (Pro Version only)

The values in this table specify how much the ignition advance term for coolant temperature is trimmed for speed and load. The base ignition correction term for ECT is adjusted based upon speed and load. This table's values specify a number that is used to multiply the base ECT ignition term by. Generally as speed and load increase the amount of ignition correction for coolant temperature decreases. At idle and light loads when the engine is cold additional ignition advance increases response and driveability. At higher engine power output however the additional advance could be detrimental to the engine.

X Index: Engine Speed, Base Ve Table RPM Scale
Y Index: Manifold Absolute Pressure
Range: 0.0 to 1.0
Units: None (Multiplier)
Resolution: 0.00392

Idle Spark Control Compensation

The values in this table specify how much ignition advance is added to the base advance to assist in idle speed control. When the throttle is below the idle throttle position value the ignition timing is adjusted by these table values. Both the error in engine idle speed and the engine temperature are used to select an amount of ignition advance to be added to the base advance. The X-axis (across the screen direction) is the difference between the set, target idle engine speed and the actual engine speed. The Y-axis (up and down the screen) is the engine coolant temperature.

Typically, when the engine speed is above the target idle speed (to the right in the table) the ignition advance is reduced by adding negative advance values. This slows the engine speed. When the engine speed is below the target idle speed (In the left portion of the table) positive advance values will help the engine to accelerate to the target idle speed.

Engine temperature generally affects the rate at which the engine responds to ignition advance. It also will effect the target idle speed based upon the values in the target idle speed table and the base total ignition advance based upon the ECT ignition compensation table values.

X Index:	Idle speed error
Y Index:	Engine coolant temperature
Range:	-32.0 to 31.75
Units: Crankshaft degrees
Resolution:	0.25

Base Advance - Ignition

This table contains values that specify the base ignition advance to be delivered to the engine. Engine speed and manifold absolute pressure are used to select the base ignition advance. A number of compensating terms (i.e. Engine coolant temperature, Intake port temperature, etc..) are added to this value to yield the total ignition advance. Generally as volumetric efficiency increases the base advance decreases.

Note: Although values from 0 to 50 can be entered into this table, the actual amount of advance that can be delivered is limited by the Crank Offset value. Actual engine advance will not go below the Crank Offset value.

X Index:	Engine Speed, Base Ve Table RPM Scale
Y Index:	Manifold absolute pressure
Range:	Crank Index offset to 50 degrees before TDC
Units: Crankshaft degrees
Resolution:	0.25

IGNITION – KNOCK

Knock Feedback Retard Limit (Pro Version only)

The values in this table specify the maximum amount of ignition advance that can be pulled out of the total when knock is sensed. When the knock-input signal goes low (below 2.0V) the ECM considers the engine to be spark knocking. The ECM does not check the knock sensor module signal until coolant temperature has exceeded 120 F.

X Index: Engine Speed, Base Ve Table RPM Scale
Y Index: Manifold absolute pressure
Range: 0 to 31.75
Units: Crankshaft degrees
Resolution: 0.25

Knock Feedback Retard Interval (Pro Version only)

This table contains values that specify the time period between ignition advance reduction steps when knock is sensed. The ECM recognizes knock when the knock sensor input signal falls below approximately 2.0 Volts. Once knock is sensed, if the knock feedback limit allows it, the total ignition advance will be reduced by 1 degree at the time intervals specified in the table. Ignition advance will continue to reduce while the signal input is low until it reaches the limit specified by the Knock Feedback Retard Limit. Speed and manifold pressure are used to select the retard interval.

X Index: Engine Speed, Base Ve Table RPM Scale
Y Index: Manifold absolute pressure
Range: 0 to 12.5
Units: Seconds
Resolution: 0.049

Knock Feedback Advance Interval (Pro Version only)

This table contains values that specify the time period between ignition advance increase steps when knock no longer sensed. The ECM recognizes no knock when the knock sensor input signal rises above approximately 6.0 Volts. Once knock is no longer sensed, if the knock feedback term has not reached 0, the total ignition advance will be increased by .5 degrees at the time intervals specified in the table. The knock feed back term will continue to decrease while the signal input is high until it reaches 0. Speed and manifold pressure are used to select the retard interval.

X Index: Engine Speed, Base Ve Table RPM Scale

Y Index: Manifold absolute pressure
Range: 0 to 12.5
Units: Seconds
Resolution: 0.049

IGNITION – DWELL CONTROL

Ignition Voltage Dwell Compensation (Pro Version only)

The values in this table specify an amount of time to be added to the base ignition dwell period as a function of ignition voltage. As the ignition voltage drops, the length of time required for the coil to reach the desired level increases. In order to maintain a constant peak ignition coil current over the range of ignition voltage the values in this table need to be entered. The characteristics of the ignition coil determine the shape of the curve that this table forms.

Index: System Voltage
Range: 0.0 to 16.0
Units: milliseconds
Resolution: 0.064

Ignition Dwell Period

The values in this table specify the length of time that the ignition coil dwells as a function of engine speed. The dwell period is the length of time that current conducts through the primary side of the ignition coil. The peak current in the coil increases as the values in this table increase. Note however that the ignition module that the ECM drives typically has a built in current limiting circuit. If the dwell is made too large higher stresses are placed on the ignition module which could lead to premature ignition module failure.

HEI and TFI coils typically require approximately 5.3 milliseconds of dwell. CD ignition units generally do not require more than 1.0 to 2.5 milliseconds.

Index: Engine Speed
Range: 0 to 16.3
Units: milliseconds
Resolution: 0.064

IDLE CONTROL

Target Idle Speed

The values in this table specify the desired engine speed when the throttle is closed. Engine coolant temperature is used to select a value from this table. The ECM controls the position of a plunger that regulates airflow around the throttle blade (Idle Air Control Motor) when the throttle is closed to regulate engine speed. The value selected from this table is the speed that the ECM tries to maintain through control of the air bypass plunger when the throttle is closed. Generally, at lower temperatures, idle speeds are set several hundred RPM higher than the normal hot engine idle speed.

Index: Engine coolant temperature
Range: 0 to 2550
Units: engine speed (RPM)
Resolution: 10

Maximum % Throttle Idle Mode (Pro Version only)

This value specifies the throttle position that identifies idle mode to the ECM. Throttle positions below this value allow the ECM to try to control idle speed. Once the throttle opens over this value the ECM relinquishes control of idle. The percentage of throttle is used as the measurement of throttle, not throttle voltage. Refer to fully closed and fully open TPS calibration values for the determination of percent throttle.

A reasonable starting point for this value is approximately 3%.

Range: 0 to 100
Units: percent (%)
Resolution: 0.392

Maximum % Throttle Idle Spark (Pro Version only)

This value specifies the throttle position that identifies the Ignition Idle Spark Compensation mode to the ECM. Throttle positions below this value allow the ECM to try to control idle speed using ignition timing. Once the throttle opens over this value the ECM relinquishes control of this compensation table. The percentage of throttle is used as the measurement of throttle, not throttle voltage. Refer to fully closed and fully open TPS calibration values for the determination of percent throttle.

A reasonable starting point for this value is approximately 1 to 3%.

Range: 0 to 100
Units: percent (%)
Resolution: 0.392

Idle Control Proportional Gain

This value specifies the idle bypass air response to the error in idle speed. The idle speed error is the difference between the actual and the target idle speed. Idle air bypass is the amount of air that is leaked passed the throttle blade by the idle air control (IAC) motor. The error in idle speed is multiplied by the Idle Control Proportional Gain value. The result is then applied to the idle air motor to command it in the opposite direction of the idle error. The result of the multiplication is a number that is proportional to the amount of idle error. The movement of the IAC motor then is proportional to the amount of idle speed error.

Larger values of proportional gain cause the idle bypass response to idle speed error to be large. Smaller gain values cause smaller changes in bypass air for changes in idle speed error. Too large of a gain value will cause idle speed to fluctuate wildly (oscillate). Too small a value will not pull idle speeds close to the target idle speed. Refer also to Idle Control Integral and Derivative gain and Maximum % Throttle Idle Mode calibration values. This value should be tuned first, prior to the Integral and Derivative gains.

Range: 0 to 100
Units: None (Coefficient)
Resolution: 0.392

Idle Control Integral Gain

This value specifies the idle bypass air response to the total of past errors in idle speed added together. The idle speed error is the difference between the actual and the target idle speed. Idle air bypass is the amount of air that is leaked passed the throttle blade by the idle air control (IAC) motor. The most recent past idle speed errors are summed, added together, to form a number that integrates past errors into a single value. The integrated idle error value is multiplied by the Idle Control Integral Gain value. The result is then applied to the idle air motor to command it in the opposite direction of the integrated idle speed error.

Integral error response is helpful in obtaining precise idle speeds. In many cases proportional gain values can not be made large enough to pull the idle speed close enough to the target speed value. Proportional gains, if made large to make large idle bypass response to speed errors, can cause drastic over/under shoots. The integral control tends to act upon average speed errors and therefore does not respond as quickly allowing its effects to be more gradual.

The gradual response to error that the integral control gives however can cause instability as well. Because idle air responds slowly to idle speed error its inherent lag causes idle air changes to occur after the actual change in idle speed. The tardiness of the response can cause over and undershoots in idle speed. Refer also to Idle Control Proportional and Derivative gain and Maximum % Throttle Idle Mode calibration values.

Range: 0 to 100
Units: None (Coefficient)
Resolution: 0.392

Idle Control Differential Gain

This value specifies the amount that the idle air bypass changes in response to a sudden change in engine speed while idling. Idle air bypass is the amount of air that is leaked passed the throttle blade by the idle air control (IAC) motor. When a sudden change in idle speed occurs the rate of the change is multiplied by the derivative gain value and then applied to the IAC motor. At high rates of RPM change then the IAC, air passed around the throttle, is moved more than at slower rates of RPM change.

The derivative portion of the idle control strategy in the ECM is used to counteract the affects of putting the vehicle in to gear or taking it out of gear. It is intended to smooth out dips and peaks in the idle speed caused by sudden load changes. Refer also to Idle Control Proportional and Integral gain and Maximum % Throttle Idle Mode calibration values.

Range: 0 to 100
Units: None (Coefficient)
Resolution: 0.392

Minimum IAC Position vs Coolant Temperature (Pro Version only)

The values in this table specify the minimum limit of throttle bypass air that the ECM allows. Engine coolant temperature is used to select the minimum idle air. The values in this table should be set at a level just below that of the idle air position for the given engine coolant temperature and associated idle speed. The purpose of this table is to prevent large speed undershoots upon rapid decelerations. Refer also to target idle speed and Idle Proportional, Integral and Derivative gain and Maximum % Throttle Idle Mode tables.

Index: Engine coolant temperature
Range: 0 to 100
Units: % of Idle bypass air
Resolution: 0.392

Maximum IAC Position vs Coolant Temperature (Pro Version only)

The values in this table specify the maximum limit of throttle bypass air that the ECM allows. Engine coolant temperature is used to select the maximum idle air. The values in this table should be set at about twice the level of the idle air position for the given engine coolant temperature and associated idle speed. The purpose of this table is to prevent

large delays in resuming idle speed control when returning to idle from off-idle conditions. Refer also to target idle speed and Idle Proportional, Integral and Derivative gains and Maximum % Throttle Idle Mode tables.

Index: Engine coolant temperature
Range: 0 to 100
Units: % of idle bypass air
Resolution: 0.392

IAC Starting Position vs Engine Temperature

The values in this table specify what amount of air that will be bypassed around the throttle when starting the engine. Engine coolant temperature is used to select a value from this table. The Idle Air Control (IAC) motor is controlled by the ECM to regulate the amount of air that is leaked around the throttle blade. Upon starting the ECM places the IAC in a position to bypass the amount of air specified by the table value that is selected by the coolant temperature.

Generally at colder engine temperatures the starting position of the IAC is higher than at warm engine temperatures. High initial starting speeds usually indicate that the starting position is too high. Low initial starting speeds indicate too low a starting position. For best initial start and driveability it is often best to set the starting position to allow slightly higher than target idle speed at initial start-up.

Index: Engine coolant temperature
Range: 0 to 100
Units: % of idle bypass air
Resolution: 0.392

Idle Control Delay (Pro Version only)

This calibration table contains values that specify how long after initial crank to start the ECM will wait to begin idle control. Engine coolant temperature is used to select a value from this table. When the engine begins to crank the Idle Air Control (IAC) motor is placed in its starting position. It will remain there until the number of crankshaft rotations specified by the value selected from this table has elapsed. Once enough crankshaft rotations have occurred normal idle control will begin. Refer also to Idle Control Proportional, Integral and Derivative gains, Maximum % Throttle Idle Mode and IAC Starting Position calibration values.

Index: Engine coolant temperature
Range: 0 to 255
Units: Crankshaft rotations
Resolution: 1

Throttle Follower

The values in this table specify the throttle bypass air that the ECM sets as a function of throttle position. The recommended minimum index in this table should be set at about 5% for 0% throttle opening, and the maximum index about 35-40% at 50% throttle opening. The purpose of this table is to employ smooth transitions in resuming idle speed control when returning to idle from off-idle conditions. Refer also to target idle speed and Idle Proportional, Integral and Derivative gains and Maximum % Throttle Idle Mode tables.

Range: 0 to 100
Units: % throttle
Resolution: .39

NITROUS

NITROUS – STAGE 1

STAGE 1 – CONFIGURATION

Stage 1 - Nitrous System Enable

This is a master ON/OFF switch for Stage 1 nitrous. If this switch is in the off position the nitrous functions will not activate even if the 12 Volt enable to NOS port 1 is energized. Always use the F10 function key to send the information to the ECU.

Linear O2 Sensor Enable – All stages

This is an ON/OFF switch to enable or disable the Lean Linear O2 Threshold table. This switch activates the UEGO sensor to monitor the O2 lean limit. The ECM must be equipped, and configured with an UEGO (linear) sensor in order for this function to operate. Refer to the O2 Threshold table below for setting these limits.

Stage 1 - Lean Linear O2 Threshold (A:F)

When the ECM is configured for a Universal Exhaust Gas Oxygen (UEGO) sensor fuel feedback control, this value specifies what the leanest air to fuel ratio, to leave stage 1 NOS active. The UEGO module provides the ECM with a signal that is proportional to the air to fuel mixture of the engine. If the ECM sees an air to fuel ratio that is leaner than the

Lean Linear O2 Threshold the NOS is turned off and will not be re-enabled until the ignition switch is cycled off and then back on. This setting is not active unless the NOS Linear O2 sensor switch is enabled.

Range: 10 to 20
Units: Ratio, air to fuel
Resolution: 0.0392

NOS BSFC – All stages

This value specifies the Break Specific Fuel Consumption (BSFC) of the engine when nitrous oxide is delivered. BSFC is a measure of how much power is generated per fuel flow. It is measured in horsepower per pounds of fuel flow per hour. The ECM uses this value to determine how much extra fuel is delivered when nitrous oxide is flowing. It uses the values provided in the number of NOS orifices, size of NOS orifices and NOS pressure to calculate the additional amount of fuel required. Calibration tables are also provided for trimming the calculated fuel addition.

A reasonable starting value is approximately 0.50.

Range: 0.39 to 0.66
Units: HP per lbs./hr
Resolution: 0.0026

NOS Stage 1 - Number of Orifices

This value specifies how many Nitrous Oxide engine feed orifices, or pills that are controlled by the stage 1 NOS relay.

Range: 0 to 8
Units: number of orifices
Resolution: 1

Stage 1 - NOS Diameter

This value specifies the diameter, in inches, of each of the stage 1 nitrous oxide orifices. The ECM assumes that all of the orifices in stage 1 are this value.

Range: 0 to 0.14
Units: inches
Resolution: 0.00055

NOS Stage 1 - Line Pressure

This value specifies what the Nitrous Oxide bottle pressure is that connects to stage 1 NOS orifices.

Range: 550 to 1500
Units: pounds per square inch (PSI)
Resolution: 3.73

NOS Stage 1 - Delay

This value specifies the time delay for energizing the stage 1 nitrous oxide control relay. When the NOS arming signal provided to the ECM is above 6.0 volts and the engine speed and throttle position are over their respective NOS enable limits, the stage 1 NOS relay is activated after the time period specified by this value. All three conditions, Enabled, RPM and TPS, must be satisfied before the delay timer starts. If any one of the conditions is not true the delay timer will be reset to 0.

Range: 0 to 33.4
Units: Seconds
Resolution: 0.13

NOS Stage 1 - Minimum %Throttle

This value specifies the minimum throttle that the stage 1 nitrous oxide relay can be energized. Throttle opening percentages below this value disable the stage 1 NOS relay. Refer also to stage 1 delay and minimum RPM calibration values and fully closed/open throttle voltage calibration settings.

Range: 0 to 100
Units: % of throttle range
Resolution: 0.392

NOS Stage 1 - Minimum RPM

This value specifies the minimum engine speed that the stage 1 nitrous oxide relay can be energized. Engine RPM's below this value disable the stage 1 NOS relay. Refer also to stage 1 delay and minimum throttle calibration values.

Range: 2000 to 12700
Units: RPM
Resolution: 50

Total Fuel Enrichment (lbs./hr) – monitor

This is a monitor function that displays the total fuel in lbs/hr that is used by the engine. This would include the NOS fuel when NOS is active.

NOS Fuel Enrichment (lbs./hr) – monitor

This is a monitor function that displays the nitrous fuel in lbs/hr only when NOS is active. This value contains the calculated fueling number obtained from the nitrous configuration tables, as well as, the nitrous fuel trim table.

STAGE 1 - IGNITION RETARD

Ignition Compensation NOS1

The values in this table specify the amount of ignition advance to be added to the base ignition advance when the first stage of NOS is activated. The engine RPM is used as a pointer into this table to select the advance term.

Index: Engine Speed
Range: -32.0 to +32.75
Units: Crankshaft degrees
Resolution: 0.25

STAGE 1- FUEL TRIM

Stage 1 – Fuel Trim

The values in this table specify the amount of positive or negative fuel trim, in lbs/hr, that is added to the main NOS fuel flow. This table is intended to compensate for overall NOS fuel efficiency. Some of the factors that effect NOS efficiency are engine size, cylinder bore diameter, combustion chamber layout, restrictions or pressure drops in NOS plumbing, and NOS solenoids, the injection point of the nitrous, and overall bottle layout.

Range: -50 to 180
Units: lbs./hr
Resolution: 0.90

NITROUS- STAGE 2

STAGE 2- CONFIGURATION

Stage 2 - Nitrous System Enable

This is a master ON/OFF switch for Stage 2 nitrous. If this switch is in the off position the nitrous functions will not activate even if the 12 Volt enable to NOS port 2 is energized. Always use the F10 function key to send the information to the ECU.

Linear O2 Sensor Enable – All stages

This is an ON/OFF switch to enable or disable the Lean Linear O2 Threshold table. This switch activates the UEGO sensor to monitor the O2 lean limit. The ECM must be equipped, and configured with an UEGO (linear) sensor in order for this function to operate. Refer to the O2 Threshold table below for setting these limits
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Stage 2 - Lean Linear O2 Threshold (A:F)

When the ECM is configured for a Universal Exhaust Gas Oxygen (UEGO) sensor fuel feedback control, this value specifies what the leanest air to fuel ratio, to leave stage 2 NOS active. The UEGO module provides the ECM with a signal that is proportional to the air to fuel mixture of the engine. If the ECM sees an air to fuel ratio that is leaner than the Lean Linear O2 Threshold the NOS is turned off and will not be re-enabled until the ignition switch is cycled off and then back on. This setting is not active unless the NOS Linear O2 sensor switch is enabled.

Range: 10 to 20
Units: Ratio, air to fuel
Resolution: 0.0392

NOS BSFC – All stages

This value specifies the Break Specific Fuel Consumption (BSFC) of the engine when nitrous oxide is delivered. BSFC is a measure of how much power is generated per fuel flow. It is measured in horsepower per pounds of fuel flow per hour. The ECM uses this value to determine how much extra fuel is delivered when nitrous oxide is flowing. It uses the values provided in the number of NOS orifices, size of NOS orifices and NOS pressure to calculate the additional amount of fuel required. Calibration tables are also provided for trimming the calculated fuel addition.

A reasonable starting value is approximately 0.50.

Range: 0.39 to 0.66

Units: HP per lbs./hr
Resolution: 0.0026

NOS Stage 2 - Number of Orifices

This value specifies how many Nitrous Oxide engine feed orifices are controlled by the stage 2 NOS relay.

Range: 0 to 8
Units: number of orifices
Resolution: 1

Stage 2 - NOS Diameter

This value specifies the diameter, in inches, of each of the stage 2 nitrous oxide orifices. The ECM assumes that all of the orifices in stage 2 are this value.

Range: 0 to 0.14
Units: inches
Resolution: 0.00055

NOS Stage 2 - Line Pressure

This value specifies what the Nitrous Oxide bottle pressure is that connects to Stage 2 NOS orifices.

Range: 550 to 1500
Units: pounds per square inch (PSI)
Resolution: 3.73

NOS Stage 2 - Delay

This value specifies the time delay for energizing the stage 2 nitrous oxide control relay. When the NOS arming signal provided to the ECM is above 6.0 volts, the engine speed and throttle position are over their respective NOS stage 2 enable limits and the stage 1 NOS delay has elapsed, the stage 2 NOS relay is activated after the time period specified by this value. All four conditions, Enabled, RPM, TPS and stage 1 delay, must be satisfied before the delay timer starts. If any one of the conditions is not true the delay timer will be reset to 0.

Range: 0 to 33.4
Units: Seconds
Resolution: 0.13

NOS Stage 2 - Minimum %Throttle

This value specifies the minimum throttle that the stage 2 nitrous oxide relay can be energized. Throttle opening percentages below this value disable the stage 2 NOS relay. Refer also to stage 2 delay and minimum RPM calibration values and fully closed/open throttle voltage calibration settings.

Range: 0 to 100
Units: % of throttle range
Resolution: 0.392

NOS Stage 2 - Minimum RPM

This value specifies the minimum engine speed that the stage 2 nitrous oxide relay can be energized. Engine RPM's below this value disable the stage 2 NOS relay. Refer also to stage 2 delay and minimum throttle calibration values.

Range: 2000 to 12700
Units: RPM
Resolution: 50

Total Fuel Enrichment (lbs./hr) – monitor

This is a monitor function that displays the total fuel in lbs/hr that is used by the engine. This would include the NOS fuel when NOS is active.

NOS Fuel Enrichment (lbs./hr) – monitor

This is a monitor function that displays the nitrous fuel in lbs./hr only when NOS is active. This value contains the calculated fueling number obtained from the nitrous configuration tables, as well as, the nitrous fuel trim table.

STAGE 2- IGNITION RETARD

Ignition Compensation NOS2

The values in this table specify the amount of ignition advance to be added to the base ignition advance when the second stage of NOS is activated. The engine RPM is used as a pointer into this table to select the advance term.

Index: Engine Speed
Range: -32.0 to +32.75
Units: Crankshaft degrees
Resolution: 0.25

STAGE 2- FUEL TRIM

Stage 2 – Fuel Trim

The values in this table specify the amount of positive or negative fuel trim, in lbs./hr, that is added to the main NOS fuel flow. This table is intended to compensate for overall NOS fuel efficiency. Some of the factors that effect NOS efficiency are engine size, cylinder bore diameter, combustion chamber layout, restrictions or pressure drops in NOS plumbing, and NOS solenoids, the injection point of the nitrous, and overall bottle layout.

Range: -50 to 180
Units: lbs./hr
Resolution: 0.90

NITROUS- STAGE 3

STAGE 3– CONFIGURATION

Stage 3 - Nitrous System Enable

This is a master ON/OFF switch for Stage 3 nitrous. If this switch is in the off position the nitrous functions will not activate even if the 12 Volt enable to NOS port 3 is energized. Always use the F10 function key to send the information to the ECU.

Linear O2 Sensor Enable – All stages

This is an ON/OFF switch to enable or disable the Lean Linear O2 Threshold table. This switch activates the UEGO sensor to monitor the O2 lean limit. The ECM must be equipped, and configured with an UEGO (linear) sensor in order for this function to operate. Refer to the O2 Threshold table below for setting these limits.

Stage 3 - Lean Linear O2 Threshold (A:F)

When the ECM is configured for a Universal Exhaust Gas Oxygen (UEGO) sensor fuel feedback control, this value specifies what the leanest air to fuel ratio, to leave stage 3 NOS active. The UEGO module provides the ECM with a signal that is proportional to the

air to fuel mixture of the engine. If the ECM sees an air to fuel ratio that is leaner than the Lean Linear O2 Threshold the NOS is turned off and will not be re-enabled until the ignition switch is cycled off and then back on. This setting is not active unless the NOS Linear O2 sensor switch is enabled.

Range: 10 to 20
Units: Ratio, air to fuel
Resolution: 0.0392

NOS BSFC – All stages

This value specifies the Break Specific Fuel Consumption (BSFC) of the engine when nitrous oxide is delivered. BSFC is a measure of how much power is generated per fuel flow. It is measured in horsepower per pounds of fuel flow per hour. The ECM uses this value to determine how much extra fuel is delivered when nitrous oxide is flowing. It uses the values provided in the number of NOS orifices, size of NOS orifices and NOS pressure to calculate the additional amount of fuel required. Calibration tables are also provided for trimming the calculated fuel addition.

A reasonable starting value is approximately 0.50.

Range: 0.39 to 0.66
Units: HP per lbs./hr
Resolution: 0.0026

NOS Stage 3 - Delay

This value specifies the time delay for energizing both the stage 1 and stage 2 nitrous oxide control relays. When the NOS arming signal provided to the ECM is above 6.0 volts, the engine speed and throttle position are over their respective NOS stage 3 enable limits, and the stage 2 NOS delay has elapsed, both stage 1 and stage 2 NOS relays are activated after the time period specified by this value. All four conditions, Enabled, RPM, TPS and stage 2 delay, must be satisfied before the delay timer starts. If any one of the conditions is not true the delay timer will be reset to 0.

Range: 0 to 33.4
Units: Seconds
Resolution: 0.13

NOS Stage 3 - Minimum %Throttle

This value specifies the minimum throttle that the stage 3 nitrous oxide relays can be energized. Stage 3 NOS is when both the stage 1 and stage 2 relays are energized. Throttle opening percentages below this value disable the stage 3 NOS relays. Refer also

to stage 3 delay and minimum RPM calibration values and fully closed/open throttle voltage calibration settings.

Range: 0 to 100
Units: % of throttle range
Resolution: 0.392

NOS Stage 3 - Minimum RPM

This value specifies the minimum engine speed that the stage 3 nitrous oxide relay can be energized. Stage 3 NOS is when both stage 1 and stage 2 relays are energized. Engine RPM's below this value disable the stage 3 NOS. Refer also to stage 3 delay and minimum throttle calibration values.

Range: 2000 to 12700
Units: RPM
Resolution: 50

Total Fuel Enrichment (lbs./hr) – monitor

This is a monitor function that displays the total fuel in lbs/hr that is used by the engine. This would include the NOS fuel when NOS is active.

NOS Fuel Enrichment (lbs./hr) – monitor

This is a monitor function that displays the nitrous fuel in lbs./hr only when NOS is active. This value contains the calculated fueling number obtained from the nitrous configuration tables, as well as, the nitrous fuel trim table.

STAGE 3– IGNITION RETARD

Ignition Compensation NOS3

The values in this table specify the amount of ignition advance to be added to the base ignition advance when both the first and second stages of NOS are activated. The engine RPM is used as a pointer into this table to select the advance term.

Index: Engine Speed
Range: -32.0 to +32.75
Units: Crankshaft degrees
Resolution: 0.25

STAGE 3- FUEL TRIM

Stage 3 – Fuel Trim

The values in this table specify the amount of positive or negative fuel trim, in lbs./hr, that is added to the main NOS fuel flow. This table is intended to compensate for overall NOS fuel efficiency. Some of the factors that effect NOS efficiency are engine size, cylinder bore diameter, combustion chamber layout, restrictions or pressure drops in NOS plumbing, and NOS solenoids, the injection point of the nitrous, and overall bottle layout.

Range: -50 to 180
Units: lbs./hr
Resolution: 0.90

DATA LOGGING

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CONFIGURATION

There are 2 steps involved with Data Logging in CalMap. First, a configuration must be established based on the data that you wish to retrieve from the Engine Control Module. To create a configuration, select the Data Logging menu from the CalMap menu bar, then select the sub item labeled Configuration. Several options exist on this level:

Configure

This menu item allows you to configure the CalMap data logging subsystem to track the variables that you choose, set the sampling rate, and edit the triggering conditions that will start the data recording process. Pre-made configurations can be loaded, created and saved using this menu.

Load Configuration

This will load a pre-existing configuration into the Data Logging subsystem, and then load the Data Logging subsystem.

Save Configuration

This will save the current settings to a user-specified filename.

Set Autolog to Fuel

Set the CalMap Autolog system to log pre-defined fueling variables.

Set Autolog to Ignition

Sets the CalMap Autolog system to log pre-defined ignition variables.

Set Autolog to Other

Sets the CalMap Autolog system to log according to any pre-defined user-defined configuration.

Configuring a CalMap Data Logging Session

Begin configuration by selecting which variables that you wish to log from the ECM in a real-time manner. Using the mouse, click on the Log Variable 1 pull down selection box. Highlight the desired variable and press the ENTER key. Do this for as many variables as you wish to log (up to 6 variables). Next, select the data sample rate from the Sample Rate pull down selection box. Note that data from sample rates higher than 10 samples/sec are not drawn on the screen in real-time mode. Data from these rates must be saved in a logging file, and viewed using the CalMap Data Analysis subsystem. Next, select the duration in seconds of the sample you want to log. Up to 1/2 hour of data can be logged per session. Select the triggering mode from the Triggering drop down selection box. If Manual Triggering of the data logging function is enabled, you will have to press the ENTER key on the keyboard to begin data acquisition. If Automatic Triggering is enabled, the Automatic Trigger Options will become enabled, and you may select the conditions upon which Data Logging is enabled. Single variable triggering, and an algebraic combination of two variables may be used to begin data acquisition. If data is to be saved to disk, you must select a logging file by pressing the appropriate button on the screen. A standard Windows dialog box will pop up and ask for filename and path data. Data may be saved anywhere on your computer's hard disk. Once the configuration is finished, it is recommended that you save your settings for future use. This is accomplished by pressing the yellow Save Configuration button on the screen. Again, a dialog box will appear, prompting you for a file name for this configuration. To get started running the configuration that you just created, press the Run Data Log button on the screen.

Running a CalMap Data Logging Session

After a configuration has been created or loaded, you are now ready to gather data from the ECM as it operates your engine. If you are not already in the Data Logging Environment, load it by pressing CTRL-L or selecting Data Logging -> Run ->

Current Configuration from the CalMap menu bar. The Data Logging Virtual Stripchart is displayed on the screen, with the current variable names and values shown to the left of the grid. Data point information is displayed on the bottom of the screen and is updated once the logging session has actually been triggered. The logging file, if one has been selected, will be displayed in yellow text on the lower right side of the screen. If no file has been selected, <NONE> will be displayed. Before data has begun to be recorded, you are in the Data Logging Monitor Mode. The data values for the logging variables are updated in real time to the left of the screen, but data is not yet being recorded and/or graphed until the session has been triggered. If manual triggering has been enabled, simply press the ENTER key on the keyboard, or the Trigger button on the screen with your mouse, and data will begin to be saved. Note that data from sample rates higher than 10 samples/sec are not drawn on the screen in real-time mode. Data from these rates must be saved in a logging file, and viewed using the CalMap Data Analysis subsystem. After the data has been recorded from the ECM, if the data has been saved to disk in a logging file, it is now time to use CalMap's Data Analysis Subsystem to analyze the data.

The CalMap Autolog Feature

CalMap has a built-in single keypress shortcut to load and execute the Data Logging subsystem called Autolog. To activate the Autolog feature, simply press the F5 key on the keyboard, or select Data Logging -> Run -> Autolog from the CalMap menu bar. The Data Logging subsystem will immediately load and be configured for the last selection that was saved as the Autolog configuration. Filenames will be based on the date and time of the logging session. Each file is named in the format MMDDYYYY_HHMMSS.LOG where MMDD represent the two-digit month and day, YYYY is the 4 digit year, and HHMMSS represent the time of day in hours, minutes, and seconds. Pressing the F5 key automatically begins a new logging session with the filename changed to the current time/date values.

In the Data Logging menu structure, there are 3 options allowing you to set the Autolog feature to Fuel, Ignition, or Other. Additionally, on the Data Logging Configuration Screen, there is a button labeled Make Autolog which will save the current configuration as the Autolog configuration.

Setting the Autolog Feature to log Fueling Variables

Selecting this option will set up the Autolog feature to record 6 of the most critical variables involved in the engine's fueling control strategy. Engine Speed and Percent Manifold Pressure, are some of the pre-defined variables for this configuration. This option must be selected if you intend to use the CalMap Data Logging Fueling Analysis option, but it is not necessary to use the Fueling Analysis to look at data logged using this configuration.

Setting the Autolog Feature to log Ignition Variables

Selecting this option will set up the Autolog feature to record 6 of the most critical variables involved in the engine's ignition control strategy. Engine Speed and Percent Manifold Pressure are some of the pre-defined variables for this configuration.

Setting the Autolog Feature to Other

Selecting this option will bring up a standard dialog box prompting you for the Data Logging configuration that you would like to set up as the Autologging configuration. Any previously defined configuration may be used, just enter the appropriate filename and press the ENTER key, or press the Load button on the screen.

Using the CalMap Data Logging Analysis Subsystem

There are three options for analyzing data that was previously recorded using the CalMap Data Logging Subsystem.

1.)   Replay a Data Log Session: This option will play back the selected Data Logging Session in real-time, just as it was recorded. Playback can be suspended, or single-stepped through to enable analysis of each individual data frame.
Graph a Data Log Session: This option will graph the entire contents of a Data Logging Session at one time. The cursor arrow keys can be used to step back and forth across the data plot in order to allow very detailed analysis of the data.
Fueling Analysis: This is a special mode, which requires that the first two logging variables be Engine Speed (RPM) and Manifold Pressure (%). The Base Volumetric Efficiency table is loaded, and the cell edit box indicates the operating points of the engine as it steps through the table during playback of a session. Changes to the volumetric efficiency data can be made during this data analysis session in order to aid in the tuning and calibration of an engine.

Replaying a CalMap Data Logging Session

The CalMap Data Logging Analysis Replay subsystem can be accessed either via pressing CTRL-R on the keyboard, or selecting Data Logging -> Analyze Data -> Replay Session from the CalMap menu bar. A dialog box will appear prompting you to enter the name of the session that you want to replay. Enter the appropriate file and press ENTER or the Load button on the screen. A screen will be displayed that looks very similar to the Data Logging screen. Press the Play/Stop button to control the automatic playback of the

session, or press the Step button to step through the session frame by frame. Once the analysis is complete, press the ESC key to exit the Data Logging Replay subsystem.

Graphing a CalMap Data Logging Session

The CalMap Data Logging Analysis Graphing subsystem can be accessed either via pressing CTRL-G on the keyboard, or selecting Data Logging -> Analyze Data -> Graph Session from the CalMap menu bar. A dialog box will appear prompting you to enter the name of the session that you want to plot. Enter the appropriate file and press ENTER or the Load button on the screen. A screen similar to that of the Replay Session will appear. Data is plotted from left to right, with the first 100 points shown on the first screen. If your session has more than 100 data points, you can press the << and >> buttons on the screen to scroll backward and forward on the plotted data. The left and right cursor arrow keys can be used to move the vertical yellow cursor around on the plots. The data values shown on the left side of the screen are accurate for the data at the yellow cursor bar. To overlay a second trace over the first trace and compare data values, press the button on the screen labeled Add Trace. A dialog box will appear, prompting you for the name of the second plot to add to the analysis. Enter the filename and press OK or the Enter key on the keyboard. The second trace is overlaid upon the first trace, and a new button on the screen appears with the label Toggle. Pressing the Toggle button switches the numeric data values between the first trace (indicated by a '1' next to the toggle button), the second trace (a '2' by the button), and the differences between traces 1 and 2 (indicated by a 'd' in the space next to the button). As before, the << >> buttons can be used to scroll through the data plots. Once your analysis is complete, press the ESC key to exit the Data Logging Replay Subsystem.

Performing a CalMap Fueling Analysis

The CalMap Data Log Fueling Analysis subsystem can be accessed either via pressing CTRL-F on the keyboard, or selecting Data Logging -> Analyze Data -> Fueling Analysis from the CalMap menu bar. A dialog box will appear prompting you to enter the name of the session that you want to analyze. Enter the appropriate file and press ENTER or the Load button on the screen. There will be a short pause while the Volumetric Efficiency data is read from the ECM, then a screen resembling the 16x16 table editing screen will appear as displayed in Figure 8. Immediately, the blue/yellow numeric cell edit box will begin tracing around the screen, showing the path that the engine took through the fueling map as your session progressed. Once playback of the entire session has completed, the buttons labeled << and >> may be used to step through the session, and data maybe changed as needed in the same manner as editing the actual Volumetric Efficiency table. Once your analysis is complete, press the ESC key to exit the Data Logging Fueling Analysis subsystem.

CONFIGURATION

CONFIGURATION - SYSTEM

Number of Cylinders

When this value is changed the ECM must be turned off for no less than 20 seconds before the new setting is recognized. This is to protect against accidental changes while performing calibrations on a running engine.

Range: 4 to 8
Resolution: 1

Engine Displacement

When this value is changed the ECM must be turned off for no less than 20 seconds before the new setting is recognized. This is to protect against accidental changes while performing calibrations on a running engine.

Range: 58 to 825
Units: Cubic Inches
Resolution: 3.2

Ignition Delay (Pro Version only)

The circuitry in the ECM contains some amount of filtering on the ignition inputs and outputs which cause some delay in measuring the actual crank pick-up signal and pulsing the output ignition coil driver. The ignition pick-up and ignition coil driver module likewise has some inherent response delays.

This value allows for the compensation of all of the ignition delays in the system. If the measured ignition advance tends to diverge from the total advance setting displayed on CALMAP as speed increases then this value needs to be modified. If the advance becomes increasingly less than the total advance displayed on CALMAP as engine speed increases then this value should be increased. If the advance becomes increasingly more than the total advance displayed on CALMAP as engine speed increases then this value should be decreased. A starting point of 110 is recommended.

Range: 0 to 999

Units: microseconds
Resolution: 4.0

Crank Index Offset

The ECM measures the ignition advance relative to the point where the crankshaft wheel passes the crankshaft pick-up. The ECM can not produce ignition advance angles less than where the pick-up/wheel position is established. The crankshaft pick-up can not be positioned after top-dead-center of compression.

It is recommended that the crankshaft wheel and pick-up be positioned to produce a pulse somewhere between 5 and 10 degrees before top-dead-center of compression. Once the wheel and pick-up are physically established the Index offset should be set to produce a match between the measured timing value and the total ignition advance value displayed on CALMAP at 2000 RPM.

Range: 0 to 20
Units: crankshaft degrees
Resolution: 0.25

Compression Ratio

This value is the ratio of the pressure in the cylinder at TDC of compression to reference atmospheric pressure at sea level.

Range: 5 to 20
Units: ratio
Resolution: 0.059

Fuel Injector Rate

This value specifies the flow rate of the injector in pounds per hour. The injector flow rate is assumed to be rated at a 3 Bar (45 psi) pressure. Most manufacturers specify flow rate of their injectors at this pressure. If the flow rate of the injector being used is rated at a pressure other than 3 Bar then apply the formula:

> When pressure is specified in Bar
> CIFR = MFR x square root of (3/MFP)

When pressure is specified in PSI
> CIFR = MFR x square root of (45/MFP)

> Where:

CIFR = Corrected injector flow rate to be entered
MFR = Manufacturers advertised injector flow rate.
MFP = Manufacturers pressure used to specify injector flow rate.

to calculate the pressure to be entered.

Range: 12 to 160
Units: pounds per hour
Resolution: 0.63

Fuel Rail Pressure

This value is the gauge pressure that is read when measuring the fuel rail pressure while the engine is not running. The pressure should be measured while the fuel pump is running and the engine is not. When the ignition is first switched on the fuel pump will run for 4 seconds. To measure the pressure switch the ignition on without cranking the engine and use the gauge reading that is present just prior to fuel pump turn off. This will give the best accuracy by allowing the fuel pressure to stabilize and not leak down once the pump is turned off.

Range: 0 to 120
Units: pounds per square inch (PSI)
Resolution: 0.47

Fully Closed TPS Voltage

This value specifies what the voltage of the throttle position sensor is when the throttle is fully closed. This value is used by the ECM to calculate Throttle opening percent. Throttle percentage is used for various calibration and control responses in the ECM. This value must be accurately entered in order for proper control operation. Refer also to the Fully Open TPS Voltage calibration value. Enter the value of the Throttle Position Sensor (TPS) voltage when the throttle is fully closed.

Range: 0 to 5.0
Units: Volts
Resolution: 0.0196

Fully Open TPS Voltage

This value specifies what the voltage of the throttle position sensor is when the throttle is fully opened. This is used by the ECM to calculate throttle opening percent. Throttle

percentage is used for various calibration and control responses in the ECM. This value must be accurately entered in order for proper control operation. Refer also to the Fully Open TPS Voltage calibration value. Set this value while the ignition key is on and the engine is not running. Press the throttle to the floor and enter the Throttle Position Sensor (TPS) voltage.

Range: 0 to 5.0
Units: Volts
Resolution: 0.0196

Ignition Input/Output References

In order for the ECU to process spark and fuel timing properly, the ECU must recognize the signal waveforms from your cam and crank sensors. The ECU must also have the proper output to drive an ignition module or spark enhancer box. These reference switches should be adjusted, so that input or output, waveform type and signal edge, match the corresponding switch or table. Always use an oscilloscope to verify these settings or refer to the Ignition chart in the installation section for your application. When any of these settings are altered, the ECM must be turned off for no less than 20 seconds before the new setting is recognized.

Map Configuration

1, 2, or 3 Bar Map, or Alpha-N can be selected. If Alpha-N is selected, a 1 Bar Map range is assumed, and the Alpha-N, TPS vs. RPM table should be calibrated.

Return or Returnless Fuel System

Select Return if the fuel pressure regulator is referenced to manifold vacuum. If the regulator is not referenced to manifold vacuum, or is mounted in the fuel tank, select returnless. In this mode of operation the ECU will automatically calculate the pressure differential across the injector.

Fuel Injector Firing Order

This table establishes the sequence in which your injectors will fire. To determine this sequence, identify the physical placement of each injector. Above each injector connector on the injector harness, there is a white identifying tab with a number. Match this number (1-8) to a corresponding number in your Injector Firing table. Always enter '1' as your first

number in this sequence, and list as many numbers as the number of cylinders in all modes, except for TBI. For example, a typical Chevrolet application would have an injector firing order of 18436572. Enter this number as a text string, with no spaces or hyphens. This table is interpreted differently for different fuel modes. In sequential fuel mode, the first component of the table will correspond to the first injector (1). This injector will fire after receiving a cam pulse. In Batch mode, sequence is not relevant. The important point is that you have all the numbers in the table filled out. For all multiple bank modes, TBI, Staggered Batch, and Staged Batch injection, the sequence in the table will correspond to the primary and secondary banks. For example, in Staggered Batch mode, if you have a Chevrolet eight cylinder engine, the primary bank would have injectors 1-3-5-7, the secondary bank would have injectors 2-4-6-8. You would enter 13572468 in the Injector Firing Order table. Using this same example, in Staged Batch mode, both the primary and secondary banks each would fire eight injectors. In this configuration, each injector output is wired to two, high impedance, similar flow rate injectors. The primary bank would consist of injectors 1-2-3-4, and the secondary bank would consist of 5-6-7-8. Enter in the table 12345678. In TBI mode, always assume a total of four injectors. The primary bank would have injectors 1-2, secondary bank would have injectors 3-4. Enter 1234 in the table. See more information see Figure F. NOTE: This table must be accurate upon startup. It is up to the operator to ensure that the firing order configuration is valid. If this table is not accurate, complete, or valid, the ECU will not function properly, or the engine will not start.

Injection Type

Enter the fuel injection mode or strategy in which you want the injectors to fire.
In the *Sequential* injection mode, injectors fire once every two crank revolutions. A Cam input must be used to start the injector sequence accurately. The injectors fire in a predetermined order defined in the Injector Firing Order menu. Also in sequential mode, the injector timing can also be adjusted through the End of injector timing table in the fuel menu. All injectors must be the same size and there should always be one injector per cylinder.
In the *Staggered Batch* injection mode, no cam signal is needed. This method of injection is sometimes referred to as bank to bank injection. Each bank of injectors will fire once per crankshaft revolution, and will be out of phase 180 crankshaft degrees. For example, on an eight cylinder engine, referencing the Injector Firing Order table, the first four injectors listed will fire, then the second four will fire, 180* out of phase from the first bank. All injectors must be the same size and there should be one injector per cylinder.
In the *Batch* fire injection mode, all injectors fire simultaneously, once per crankshaft revolution. All injectors must be the same size and there should be one injector per cylinder. Again, no cam signal is needed.
In the *TBI* injection mode, two banks of two injectors are used, or a total of four injectors. This TBI or Throttle Body Injection strategy, fires each bank of injectors twice per crank revolution. Referencing the Injector Firing Order table, the order of primary and secondary bank firing will be determined. The primary bank will operate until the duty cycle reaches

80%. At this point the primary and secondary bank will begin to operate at half the rated duty cycle. This approach delivers a seamless transition of fueling between primary and secondary banks. As soon as duty cycle decreases below 30%, the secondary bank ceases to function and the primary bank takes over. This fueling scheme is very helpful when calibrating a progressive linkage throttle body. It decreases the circumstance of injecting fuel on a closed throttle butterfly, thereby lowering the chance of fuel puddling. This 'fuel puddling' phenomenon could cause the engine to misfire upon tip-in of the throttle. TBI mode does not require a cam signal and again, all injectors must be the same size.

In the *Staged Batch* injection mode, two banks of injectors fire once per crankshaft revolution. The number of injectors must be exactly two times the number of cylinders. For example, on an eight cylinder engine, there should be 16 injectors. All the injectors should be the same size and impedence. No cam signal is necessary in this mode of operation. Referencing the Injector Firing Order table, the order of primary and secondary bank firing will be determined. The same 80%, 30% TBI fuel strategy is used to transition between primary and secondary banks.

CONFIGURATION – CONTROLS

AC Clutch Disable Threshold

When the throttle is opened more than this value the relay that connects the air conditioning clutch solenoid to its control source is energized. The relay is configured in the normally closed position so that when it is not energized normal air conditioning functions are maintained. Once the relay is energized it will not be turned off until the throttle falls below 10% of the disable threshold value for 5 Seconds.

A value of 90% is recommended.

Range: 0 to 100
Units: % Throttle Position
Resolution: 0.392

Fan On Temperature

This is the temperature, as sensed by the engine coolant temperature sensor, that the fan relay is energized.

A value of 205 F is recommended.

Range: 150 to 250

Units: Degrees Fahrenheit
Resolution: 1.2

Fan Off Temperature

This is the temperature, as sensed by the engine coolant temperature sensor that the fan relay is turned off.

A value of 185 F is recommended.

Range: 150 to 250
Units: Degrees Fahrenheit
Resolution: 1.2

Shift Light Threshold

This is the engine speed, in RPM, that the shift light is turned on. When engine speed falls below this value the light is turned off.

Range: 0 to 12000
Units: RPM
Resolution: 50

Ignition Limit Status

When the switch is set for Max RPM, sequential ignition rev limiting is continuously active. Rev limiting will commence 100 RPM before the value set in the Ignition Cut-Off Speed table. When 2-Step is selected, rev limiting will commence at the value set in the Ignition Cut-Off Speed table ONLY when the ECM has an input signal in excess of 6 volts at position K3(Stage). If this input is grounded or floating, no 2-Step Rev Limiting will occur.

Ignition Cut-Off Speed

When the engine speed exceeds this value sparks begin to be eliminated. The number of sparks dropped is a function of how far above the rev limit value that the actual RPM is.

Range: 2000 to 12,750
Units: RPM
Resolution: 50

Fuel Cut-Off Speed

When the engine speed exceeds this value fuel will be turned off. It will be turned back on once the engine speed falls below the Fuel Restore Speed.

Range: 2000 to 12,750
Units: RPM
Resolution: 50

Fuel Restore Speed

Once the fuel is shut-off due to exceeding the engine speed specified for Fuel Cut-Off Speed, it will remain off until the engine speed falls below this value.

Range: 2000 to 12,750
Units: RPM
Resolution: 50

Exhaust Closed Loop Mode Enable

This master or global switch, will enable or disable O2 feedback functions. When the switch is enabled or ON, the ECM will activate the parameters stored in all of the O2 related tables. Refer to these tables for further O2 feedback adjustments.

Exhaust Feedback Sensor

Two types O2 sensors will operate with your ECM. A HEGO sensor, which is a four-wire, heated unit, with a grounded signal input. This sensor will operate within a voltage range of 0 to 1 volt. Using this input, the ECM can adjust the fueling requirements to a set stoichimetric ratio. This ratio is preset at 14.5 to match the sensor. When the target A:F table is set to this Stoich ratio(14.5), and the other closed loop table parameters have been satisfied, the ECU closed loop status function will become active.
Secondly, a UEGO, linear, or wide band sensor can be used with the ECM. When selecting this mode of operation, a linear 'brick', or adapter box must be used in conjunction with the linear sensor. These parts are part of a linear, wide band kit that is available through your Accel dealer. When the ECM is in closed loop, the ECM will adjust the fueling requirements to meet the values set in the target A:F Ratio table.

TORQUE CONVERTER - TCC CONFIGURATION

Performance Mode

When this table is activated, the TCC relay is energized under all conditions. Note: Due to certain mechanical conditions, in some transmissions, TCC will not engage in first gear even though the relay is energized.

4th Gear Indicator Signal

Enter the status, 12 volts (high), or 0 volts (low), of the 4th gear signal from the transmission. The output from the transmission will be active in 4th gear only.

TCC Minimum (%) Throttle Position

Once the torque converter clutch (TCC) relay is energized, if the throttle falls below this value, the TCC relay will be turned off.

A starting value of approximately 5% is suggested.

Range: 0 to 100
Units: % of Total Throttle Range
Resolution: 0.392

TCC Maximum (%) Throttle Position

When in the normal Torque Converter Clutch (TCC) control mode the throttle must be opened more than this value, the engine speed must be over some minimum RPM, the coolant temperature must be over 120 degrees F and 4th gear is sensed to activate the TCC relay. Once the relay is energized it will not turn off until the speed drops below a minimum level or the throttle exceeds the TCC WOT throttle level or the throttle falls below the minimum TCC throttle level or 4th gear is no longer active.

A starting value of approximately 10% is suggested.

Range: 0 to 100
Units: % of Total Throttle Range
Resolution: 0.392

TCC Minimum RPM

Once the torque converter clutch (TCC) relay is energized, if the engine speed falls below this value, the TCC relay will be turned off.

A starting value of approximately 1500 RPPM is suggested.

Range: 0 to 12,000
Units: RPM
Resolution: 50

TCC Maximum RPM

When in the normal Torque Converter Clutch (TCC) control mode the engine speed must be greater than this value, the throttle position must be over some minimum opening, the coolant temperature must be over 120 degrees F and 4th gear is sensed to activate the TCC relay. Once the relay is energized it will not turn off until the speed drops below a minimum level or the throttle exceeds the TCC WOT throttle level or the throttle falls below the minimum TCC throttle level or 4th gear is no longer active.

A starting value of approximately 2500-RPM is suggested.

Range: 0 to 12,000
Units: RPM
Resolution: 50

TCC Wide Open Throttle Unlock - (%) Throttle Position

When in the normal torque converter clutch control mode when the throttle exceeds this value the torque converter clutch (TCC) control relay is turned off. The relay will remain off for the amount of time specified by the TCC WOT Unlock Period. The relay will be energized again after the WOT unlock period if the engine speed and throttle position are over their respective thresholds and 4th gear is still active.

A starting value of approximately 90% is suggested.

Range: 0 to 100
Units: % of Total Throttle Range
Resolution: 0.392

TCC Exit Wide Open Throttle Unlock – (%) Throttle Position

When in the normal torque converter clutch (TCC) control mode the toque converter clutch relay is turned off for some amount of time when over the WOT Unlock TCC Throttle value. The TCC control strategy reverts back to normal cruise TCC control mode when the throttle is below this value.

A starting value of approximately 70% is suggested.

Range: 0 to 100
Units: % of Total Throttle Range
Resolution: 0.392

TCC Wide Open Throttle Unlock Period (secs)

When in the normal torque converter clutch (TCC) control mode the toque converter clutch relay is turned off for this amount of time when over the WOT Unlock TCC Throttle value. The TCC control relay will be turned back on once this time has elapsed and the engine speed and the throttle and engine speed is over the their respective minimum amounts and 4th gear is active.

A starting value of approximately 5 Seconds is suggested.

Range: 0 to 40
Units: Seconds
Resolution: 0.16

TORQUE CONVERTER – TCC DELAY

TCC Load Delay

The values in this table specify the amount of time that the ECM will wait to activate the torque converter clutch control relay after all of the conditions are satisfied to require its activation (Refer to TCC RPM and TPS threshold tables and TCC configurations). The manifold pressure is used as an index into this table. The amount of time to delay the converter lock is selected based on the value of the intake manifold pressure.

Index: Manifold Absolute Pressure
Range: 0 to 40.8
Units: Seconds
Resolution: 0.16

SENSOR MEASUREMENTS

Ignition Voltage Filter Rate (Pro Version only)

The ECM is connected to the ignition voltage. The ECM strategy employs a filtering algorithm that works to smooth the signal and eliminate noise. The cleaner this signal is the more reliable the results of the ECM control strategy are.

The ignition voltage is used to determine a variety of correction factors for some of the control functions. It is also used to determine when the ignition switch is turned on/off. This value establishes how much the voltage signal is filtered. The larger the value the slower the signal looks to the control strategy. Smaller values allow the ECM to recognize the signal quicker but also allow more noise to be passed as well. A value of approximately 50 is recommended.

Range: 9 to 900
Units: milliseconds
Resolution: varies from 4 to 400 (logarithmic function)

Throttle Position Filter Rate (Pro Version only)

The ECM is connected to a throttle position sensor (TPS). The ECM strategy employs a filtering algorithm that works to smooth the sensor's signal and eliminate noise. The cleaner this signal is the more reliable the results of the ECM control strategy are.

The throttle position is used by the ECM strategy to determine a number of fueling, NOS, torque converter, fan, air conditioning clutch and idle control responses. This value establishes how much the throttle position signal is filtered. The larger the value the slower the signal looks to the control strategy. Smaller values allow the ECM to recognize the signal quicker but also allow more noise to be passed as well. A value of approximately 20 is recommended.

Range: 9 to 900
Units: milliseconds
Resolution: varies from 4 to 400 (logarithmic function)

Manifold Pressure Filter Rate (Pro Version only)

The ECM is connected to an intake manifold absolute pressure sensor (MAP). The ECM strategy employs a filtering algorithm that works to smooth the sensor's signal and

eliminate noise. The cleaner this signal is the more reliable the results of the ECM control strategy are.

The manifold pressure is used by the ECM strategy to determine a number of fueling, ignition and torque converter control responses. This value establishes how much the manifold pressure signal is filtered. The larger the value the slower the signal looks to the control strategy. Smaller values allow the ECM to recognize the signal quicker but also allow more noise to be passed as well. A value of approximately 20 is recommended.

Range: 9 to 900
Units: milliseconds
Resolution: varies from 4 to 400 (logarithmic function)

Atmospheric Pressure Filter Rate (Pro Version only)

The ECM is connected to an atmospheric pressure sensor. The ECM strategy employs a filtering algorithm that works to smooth the sensor's signal and eliminate noise. The cleaner this signal is the more reliable the results of the ECM control strategy are.

The atmospheric pressure is used by the ECM strategy to determine a number of fueling and ignition control responses. This value establishes how much the atmospheric pressure signal is filtered. The larger the value the slower the signal looks to the control strategy. Smaller values allow the ECM to recognize the signal quicker but also allow more noise to be passed as well. A value of approximately 150 is recommended.

Range: 9 to 900
Units: milliseconds
Resolution: varies from 4 to 400 (logarithmic function)

Engine Temperature Sensor Filter Rate (Pro Version only)

The ECM is connected to an engine coolant temperature sensor (ECT). The ECM strategy employs a filtering algorithm that works to smooth the sensor's signal and eliminate noise. The cleaner this signal is the more reliable the results of the ECM control strategy are.

The coolant temperature is used by the ECM strategy to determine a number of fueling, ignition, torque converter and fan control responses. This sensor is also used for estimating the intake port temperature. This value establishes how much the coolant temperature sensor signal is filtered. The larger the value the slower the signal looks to the control strategy. Smaller values allow the ECM to recognize the signal quicker but also allow more noise to be passed as well. A value of approximately 150 is recommended.

Range: 9 to 900
Units: milliseconds
Resolution: varies from 4 to 400 (logarithmic function)

Intake Air Temperature Sensor Filter Rate (Pro Version only)

The ECM is connected to an intake air temperature sensor (IAT). The ECM strategy employs a filtering algorithm that works to smooth the sensor's signal and eliminate noise. The cleaner this signal is the more reliable the results of the ECM control strategy are.

The intake air temperature is used by the ECM strategy to determine a number of fueling and ignition control responses. This sensor is also used for estimating the intake port temperature. This value establishes how much the intake air temperature sensor signal is filtered. The larger the value the slower the signal looks to the control strategy. Smaller values allow the ECM to recognize the signal quicker but also allow more noise to be passed as well. A value of approximately 150 is recommended.

Range: 9 to 900
Units: milliseconds
Resolution: varies from 4 to 400 (logarithmic function)

Manifold Surface Temperature Sensor Filter Rate (Pro Version only)

The ECM is connected to an intake manifold skin/surface temperature sensor (MST). The ECM strategy employs a filtering algorithm that works to smooth the sensor's signal and eliminate noise. The cleaner this signal is the more reliable the results of the ECM control strategy are.

The manifold surface temperature is used along with the engine coolant and intake air temperature by the ECM strategy to calculate the intake port temperature. This value establishes how much the manifold surface temperature sensor signal is filtered. The larger the value the slower the signal looks to the control strategy. Smaller values allow the ECM to recognize the signal quicker but also allow more noise to be passed as well. A value of approximately 150 is recommended.

Range: 9 to 900
Units: milliseconds
Resolution: varies from 4 to 400 (logarithmic function)

HEGO/UEGO FILTER RATE

HEGO/UEGO Filter Rate

The ECM can be connected to either a Heated Exhaust Gas Oxygen (HEGO) sensor or a Universal Exhaust Oxygen (UEGO) sensor-conditioning module. Both sensors measure oxygen levels in the exhaust. Exhaust oxygen content in turn is proportional to the air to fuel ratio of combustion. The ECM strategy employs a filtering algorithm that works to smooth the sensor's signal and eliminate noise. The cleaner this signal is the more reliable the results of the ECM control strategy are.

The exhaust oxygen sensor is used by the ECM strategy to determine a number of fueling control responses. This value establishes how much the exhaust oxygen sensor signal is filtered. The larger the value the slower the signal looks to the control strategy. Smaller values allow the ECM to recognize the signal quicker but also allow more noise to be passed as well. This table allows the user to modify the response as a function of mass air flow. Generally, the values would be low at low levels of mass air flow, with increasing response as mass air flow increases.

Range: 9 to 1048
Units: milliseconds
Resolution: varies from 4 to 400 (logarithmic function)

DIAGNOSTICS

Clear Error Codes

This menu selection will bring up a list of current error codes generated by the ECM. A brief explanation of each code is present, and all of the codes can be cleared at once from this screen by clicking on the Acknowledge and clear square.

View Error Codes

This menu item loads a list of all possible error codes that can be generated by the ECM. No information on current error codes residing in the ECM is displayed here.

Establish Communication

This menu selection (F9) will attempt to re-establish communications with the ECM in the event of any kind of communication system failure. If no communication with the ECM can be maintained, there may be a problem with your computer, cables, or the ECM. If the

ECM is changed after experiencing a communication failure, you must re-establish communications through the splash screen, Edit Data from ECM.

HELP

About CalMap

This menu item brings up the CalMap splash screen and identification data about the program.

Calibration Tool Help

This menu item loads the CalMap ONLINE help subsystem.