INSTRUCTIONS

EZ-EFI® Fuel
Self-Tuning Fuel Injection System

Thank you for choosing FAST™ products; we are proud to be your manufacturer of choice. Please read this instruction sheet carefully before beginning installation, and also take a moment to review the included limited warranty information. Contact us toll free at 1.877.334.8355, or visit us online at www.fuelairspark.com under Tech Help with any questions.

System Components Overview

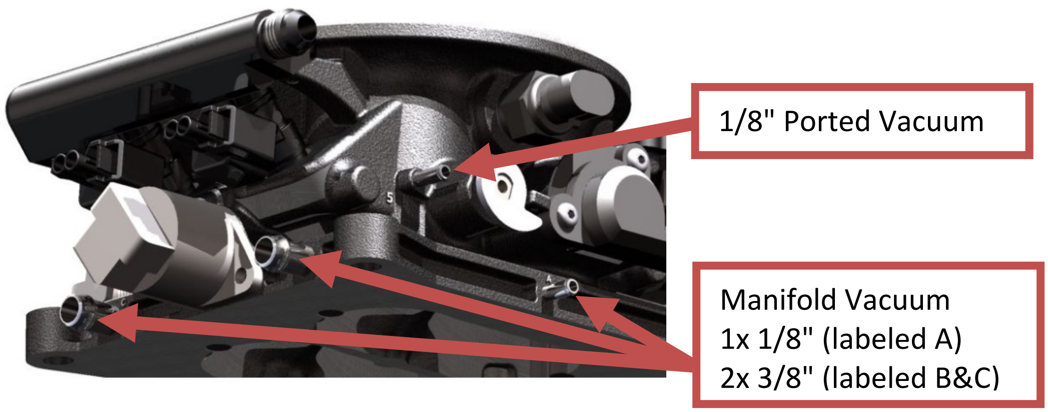
The EZ-EFI® Fuel system is made up of several main components: a throttle body, an ECU (Electronic Control Unit), a wiring harness, a handheld user interface, several loose sensors and an RPM module. Please read through all of the installation notes before beginning the installation.

Throttle Body

Throttle Body Installation Notes:

- The throttle body will bolt on in place of a carburetor on an intake manifold with a 4150 square flange. If your carburetor had a Holley-style linkage, you can reuse the same cable stops and return springs. Otherwise, you will need a cable mount and return spring kit such as FAST™ PN 304147. Be sure to utilize a cable corrector plate (included with the 304147 kit) if using a 700R4 transmission. A common size throttle ball stud and nylock nut are included for connecting the throttle cable to the linkage.

- When installing the throttle body, use the supplied throttle body gasket.
- There are three manifold vacuum ports (1 x 1/8” and 2 x 3/8”) on the base of the throttle body. There is also a ported vacuum port (1/8”) near the secondary throttle shaft on the side opposite of the throttle linkage. Before removing the existing carburetor, note where any existing vacuum lines are connected (either to manifold or to ported vacuum) so that they can be transferred to the appropriate ports on the throttle body. Be sure to cap any unused vacuum ports.



- Even though the throttle shafts on the throttle body feature return springs, a stronger extension-style throttle return spring is also required.
- An air cleaner should be used. The throttle body is compatible with standard carburetor air cleaners. FAST™ PN 30420 is an attractive option. Be sure to account for hood clearance issues when choosing an air cleaner.

- There is some adjustability built into the linkage between the throttle shafts. It should be set up as close to a one-to-one arrangement as reasonably possible – as opposed to a progressive setup. Having all four blades open at the same time gives the best fuel distribution.

ECU (Electronic Control Unit)

ECU Installation Notes:

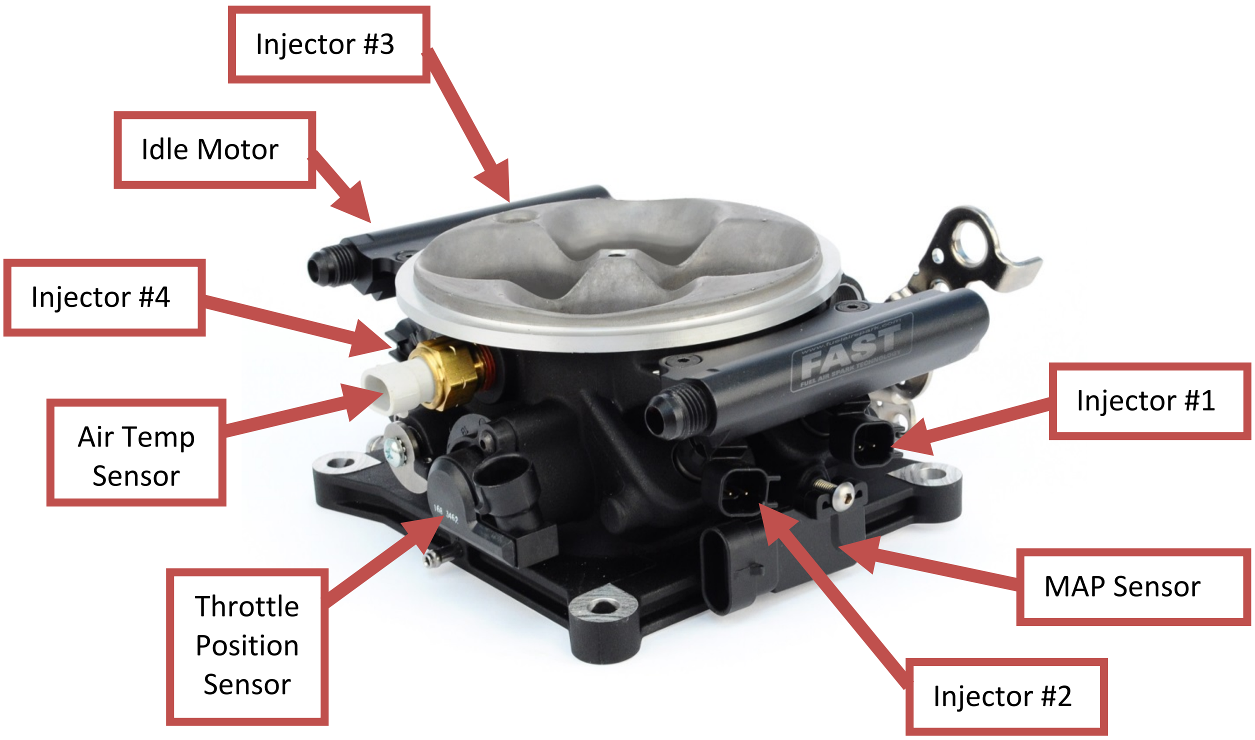
- The ECU is water tight when connected to the wiring harness. It can be mounted in the engine compartment or in the vehicle's interior. Avoid mounting locations that expose the ECU to extreme heat or that confine it to a closed area with no air circulation. It is good practice to mount the ECU with the connector facing down. This way, there is less chance of moisture getting into the ECU if it needs to be disconnected in wet conditions.
- The ECU should not be mounted close to other electrically "noisy" components. In particular, keep good spacing (try for two feet minimum) from ignition components (ignition boxes, coils, distributors, etc.).
- If mounting in the engine compartment, selecting a location towards the rear will make it easier to route the communications cable to the interior to allow the handheld to be monitored while driving. (After the initial setup, use of the handheld is optional. It does not need to remain connected for the engine to run.)
- There is an LED on the front face of the ECU – the side with the logo. It will flash if the on-board diagnostics detects a problem. (The LED will normally remain off at key-on and will then come on when the ECU detects an RPM input. It will be lit solid while the engine is running normally.) To take advantage of this feature, the ECU will need to be mounted so that the front face of the ECU is visible. The handheld will also indicate if any problems have been detected.
- Self-tapping screws are included for mounting the ECU.

Wiring Harness

Wiring Harness Installation Notes:

- The main battery wires, labeled "BATTERY POS" and "BATTERY NEG" **MUST BE CONNECTED DIRECTLY** to the battery. Connecting them anywhere else invites problems with electrical noise. These kinds of problems are difficult to diagnose. The wires may be extended if needed using automotive grade 12 gauge (or larger) wire.

- Be sure the "12V SWITCHED" wire is connected to a source that is hot with the key in the On/Run and Crank positions. Do **NOT** connect to the positive side of an ignition coil.
- The wiring harness should be kept away from ignition components (ignition boxes, coils, distributors, etc.) as much as possible. There will be places where plug wires run past the wiring harness. That is often unavoidable and not a problem. Just try to keep them – or other parts of the ignition system's wiring – from running parallel to the wiring harness. And do not bundle the wiring harness together with other "noisy" wiring in the vehicle.
- As with any wiring, it is good practice to avoid routing the wiring harness around sharp edges or near high temperature components such as headers.
- A length of loose wire covering is included. It can be used as needed to protect the loose wires in the wiring harness once they have been routed and cut to length. After cutting the wire covering, use a cigarette lighter or other heat source to seal the cut and prevent fraying.

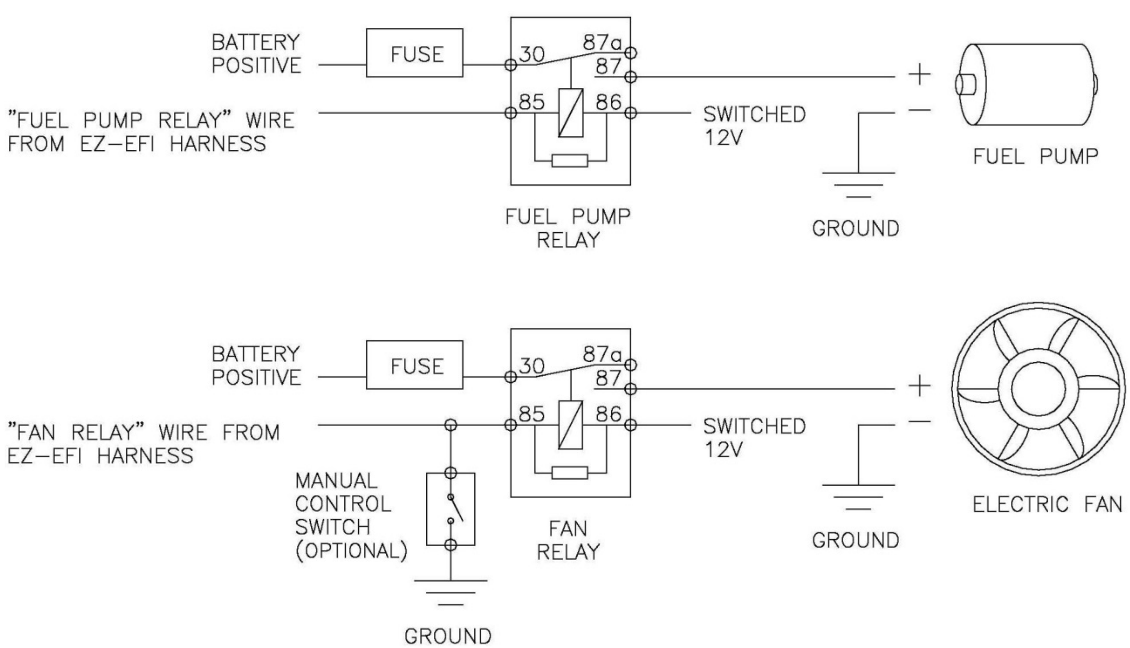


The connections on the wiring harness are all clearly labeled. They are connected as follows:

LABEL	CONNECTS TO...
Inj 1	Injector #1 in throttle body. (Driver side front)
Inj 2	Injector #2 in throttle body. (Passenger side front)
Inj 3	Injector #3 in throttle body. (Driver side rear)
Inj 4	Injector #4 in throttle body. (Passenger side rear)
Idle Motor	Idle Air Control motor (IAC) in rear of throttle body.
Throttle	Throttle Position Sensor (TPS) on passenger side of throttle body.
Air Temp	Air Temperature Sensor (ATS) on passenger side of throttle body.

MAP	Manifold Absolute Pressure sensor (MAP) on front of throttle body.
Coolant Temp	Coolant Temperature Sensor (CTS) typically installed in intake manifold.
Oxygen Sensor	Wideband oxygen sensor (O2) mounted in exhaust.
Tach In/RPM Module	A tach output from an ignition box or other source. Or the EZ-EFI® RPM Module. Depends on application. See RPM Module notes. Do **NOT** connect directly to the ignition coil.
Fuel Pump Controller	EZ-EFI® Fuel Pump Relay Harness included in the optional EZ-EFI® Fuel Pump Kit.
Fuel Pump Relay	Negative control side of a relay for powering a fuel pump. Do **NOT** wire directly to fuel pump. (Not used with optional EZ-EFI® Fuel Pump Kit.)
Handheld	Handheld cable that links the main wiring harness to the handheld user interface.
Battery POS	**DIRECTLY** to positive post of battery.
Battery NEG	**DIRECTLY** to negative post of battery.
12V Switched	Switched ignition source (hot in On/Run and Crank). This turns the ECU on and off. Do **NOT** connect to the positive side of an ignition coil.
Fan Relay	Negative control side of a relay for powering an electric fan. Do **NOT** wire directly to fan.
A/C Input	Air conditioner switch. Feeding power to this wire tells the ECU that the air conditioner has been switched on. Idle speed will be bumped up and the fan output will be activated.

FUEL PUMP / FAN RELAY WIRING



RPM Module

EZ-EFI® is an advanced fuel injection system. Engine speed is one of the fundamental elements of its fueling calculations. In order for it to operate properly, it relies on the ignition system for a steady, reliable RPM signal. An inconsistent or noisy RPM signal can appear to the ECU as erratic engine speed. Spikes, dropouts and general instability of the RPM signal fed into the ECU can have an adverse effect on the running of the engine. It can also interfere with proper learning or prevent learning altogether.

There are several options for supplying the EZ-EFI® ECU with an RPM input.

1. **Aftermarket capacitive discharge (CD) ignition –** an aftermarket capacitive discharge (CD) ignition box (such as the FAST™ E6 Ignition - PN 306401) is recommended. This form of ignition is beneficial to just about any application. Having a known good, strong spark prevents a host of potential running issues. This type of ignition is also well suited for use with EZ-EFI® because it typically has a "Tach" output, which is a clean, processed signal. This is the preferred RPM source for the EZ-EFI® system.

   If using one of these ignitions, the "TACH IN/RPM MODULE" wire in the EZ-EFI® wiring harness is connected directly to the "Tach" output from the ignition box. The RPM Module included with the kit is not used in this case. And no part of the EZ-EFI® system is connected to the coil.

   NOTE: Some aftermarket ignitions have a feature for displaying their programmed rev limit. This is accomplished by briefly outputting an RPM signal on their tach output wire soon after key-on. The intent is to have the vehicle's tachometer display the rev limit setting. This feature is not well suited for some fuel injection systems – including EZ-EFI® – as it appears the engine is actually running at that speed. This can lead to the ECU rapidly pulsing the injectors (injecting a large quantity of fuel) and flooding the engine. Contact your ignition vendor to verify whether or not your ignition product has this feature and for details on disabling it. (The FAST™ E6 Ignition does not have this feature and requires no special setup to work well with EZ-EFI®.) Keep in mind that it is normal for the EZ-EFI® System's "pre-squirt" feature (discussed in the EZ-EFI® SYSTEM FEATURES section) to pulse the injectors for a second or two right at key-on. This feature can be distinguished from a potential ignition issue in several ways:

- The "pre-squirt" feature will inject a measured amount of fuel – it will not come anywhere near flooding the engine.
- The "pre-squirt" feature will not continue to occur on subsequent key cycles unless the engine has been started.
- The "pre-squirt" feature will not cause the LED on the face of the ECU to come on solid when the engine isn't running as a false RPM signal would. It also won't cause a tachometer or the handheld to display a non-zero RPM value.

2. **Inductive coil –** Another source for an RPM signal is the negative side of the ignition coil in a traditional dwell controlled inductive ignition system. One in which the coil is fed power on one side and is charged by grounding the other side – either by "points" or some form of electronic module. An HEI is one example of this type of ignition system.

   To use this RPM signal option, the **RPM Module is required**. The RPM Module connects to the negative side of the coil and outputs a "Tach" signal to the ECU. The RPM Module is connected as follows:

WIRE COLOR	CONNECTION
Black	Engine block
Black	Engine block
White	Negative side of coil
Yellow	"TACH IN/RPM MODULE" wire in EZ-EFI® wiring harness

The RPM Module is provided to allow this convenient installation option. But keep in mind that it has limitations. The negative side of an ignition coil is one of the noisiest points on the engine. There are large voltage spikes and ringing when the coil fires. Different coils will have different noise characteristics. And this noise can change as the engine runs. Anything that affects how hard the coil has to work to fire the spark plug – changing cylinder pressure, worn plugs or plug wires, etc. – will affect this signal.

In most applications, the RPM Module will be able to deal with these challenges and feed a clean RPM signal to the ECU. But the old saying – garbage in, garbage out – applies here. If the inductive ignition system is just too noisy or inconsistent, it may need to be abandoned in favor of an aftermarket ignition box.

RPM Module Installation Notes:

- HEI distributors (and possibly others) have a terminal labeled "TACH". However, that is not a clean, processed tach signal like an aftermarket ignition box would supply. Instead, it is simply another terminal connected to the negative side of the coil. Do **NOT** connect the "TACH IN/RPM MODULE" wire in the EZ-EFI™ wiring harness directly to that terminal. The ECU will be damaged. In a case like that, the RPM Module is required since what you are really doing is connecting to the negative side of a dwell controlled coil.

- Do **NOT** bypass the RPM Module and connect the "TACH IN/RPM MODULE" wire in the EZ-EFI® wiring harness directly to the negative side of the coil. It may actually start up and run that way. But the ECU will be damaged and system performance will degrade.
- Do **NOT** connect anything from the EZ-EFI® system to the coil – RPM Module or "TACH IN/RPM MODULE" wire – when using an aftermarket ignition box.
- Use resistor type spark plugs. Non-resistor plugs are very noisy and interfere with electronics – including the EZ-EFI® system.
- Do **NOT** use solid core spark plug wires. These are also very noisy.
- Mechanical issues such as a worn distributor gear can make the time between coil firings inconsistent – possibly causing the ECU to see an erratic RPM signal. That would apply to any type of ignition that takes its input from a distributor-mounted pickup. This is another example of how a deficiency in the ignition system can affect the performance of the EZ-EFI® system.

Sensors

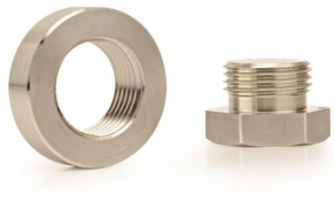
Most of the sensors are contained in the throttle body itself. There are only a few extra sensors that will need to be mounted.

Coolant Temperature Sensor

The coolant temperature sensor monitors engine coolant temperature. It is typically installed in an existing mounting hole on the top of the intake manifold. The sensor has 3/8" NPT threads. The supplied adapter may be required to install the sensor in some manifolds with 1/2" NPT threads. The engine block or cylinder head may have a provision for mounting a coolant temperature sensor. Just be aware that heat radiated from headers may be absorbed by the metal sensor body and skew the temperature readings to the ECU. The sensor should be installed upstream from the thermostat so that the sensor is exposed to engine-temperature coolant as the engine warms up. Use thread sealant or tape when installing the sensor and the adapter.

Wideband Oxygen Sensor

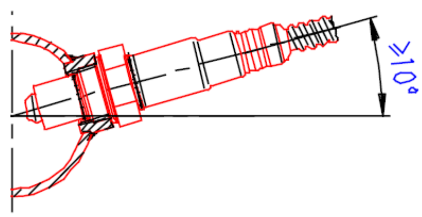
The wideband oxygen sensor needs to be mounted in the exhaust system. A threaded fitting and block off plug are provided. The fitting needs to be welded into place. To install the fitting, drill a 7/8" diameter hole and weld the fitting centered on the hole. If you do not have access to a welder, any competent exhaust shop can install the fitting for you. Use the supplied block off plug (not your actual sensor) to cap off your new oxygen sensor fitting until you are ready to complete the rest of the EZ-EFI® installation. Wideband oxygen sensors use a built in heater. If the sensor is installed, but not connected, it will not be heated and deposits may build up in the sensor and cause damage.



NOTE: Installing the threaded oxygen sensor fitting should be the first step in the installation process. It should be done before you begin removing your existing fuel/induction system. That way, you can still drive to an exhaust shop if needed.

Wideband Oxygen Sensor Installation Notes:

- Install the sensor just upstream of the catalytic converter (if present). The sensor can be installed after the converter, but the readings will register slightly leaner than if measured before the converter.
- Ideally, the sensor should be mounted at least 10* above horizontal (wire side up, sensor tip down). This prevents moisture from collecting in the sensor.



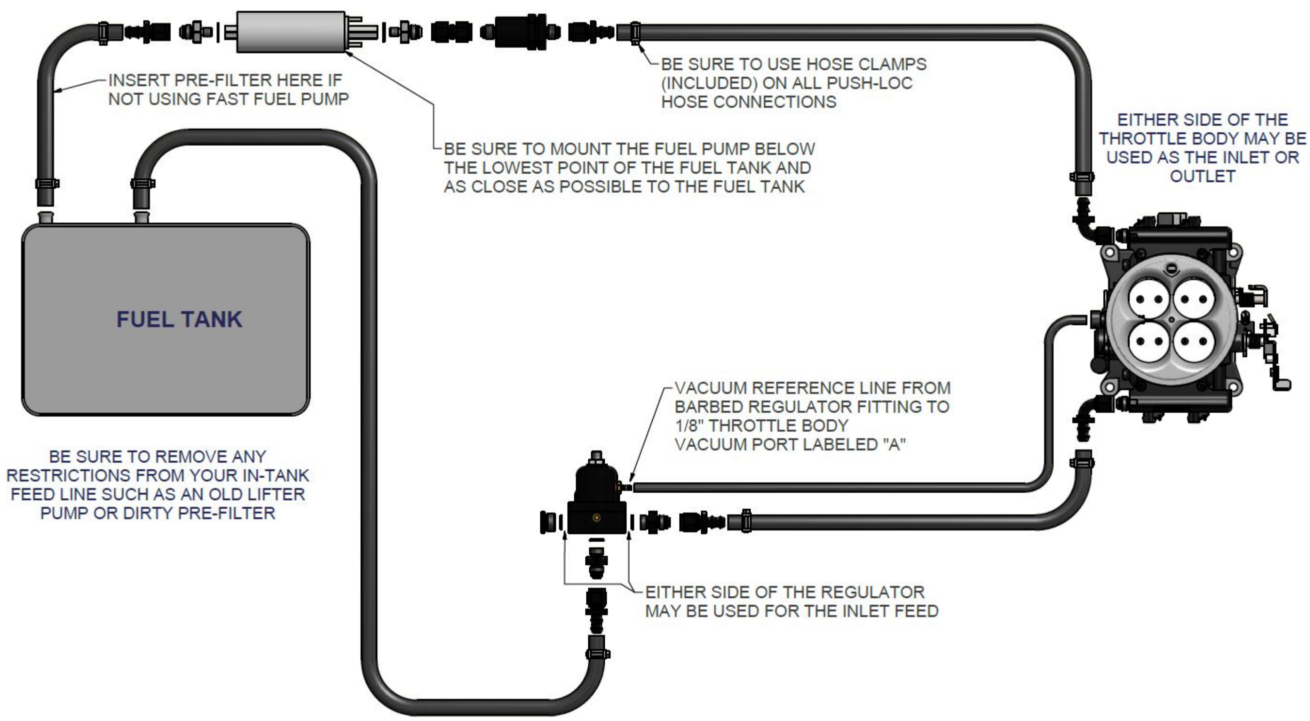
- The sensor should not be installed closer than 20 inches from the cylinder head to ensure excessive heat does not damage the sensor.
- The sensor should be installed in or after the collector. This gives the ECU an average reading across an entire bank instead of from just one cylinder.
- The sensor should not be mounted near the open end of the exhaust system. At low engine speeds, free air may reverberate into the exhaust and cause false readings.
- The system will not function properly if there are any exhaust leaks. Any fresh air that gets to the sensor will cause false lean readings. The ECU will respond by adding fuel that the engine doesn't really need.

  NOTE: The use of leaded fuel will significantly reduce the lifespan of the sensor.

Fuel System

The EZ-EFI® System needs a high pressure, fuel injection rated fuel system. An optional EZ-EFI® Fuel Pump Kit is available that includes the required hardware and wiring. Fuel line and fittings are also available in an optional EZ-EFI® Hose and Fitting Kit. These parts are shown in the diagram below. Whether using these kits or building a fuel system with other components, the basic layout will be as follows:

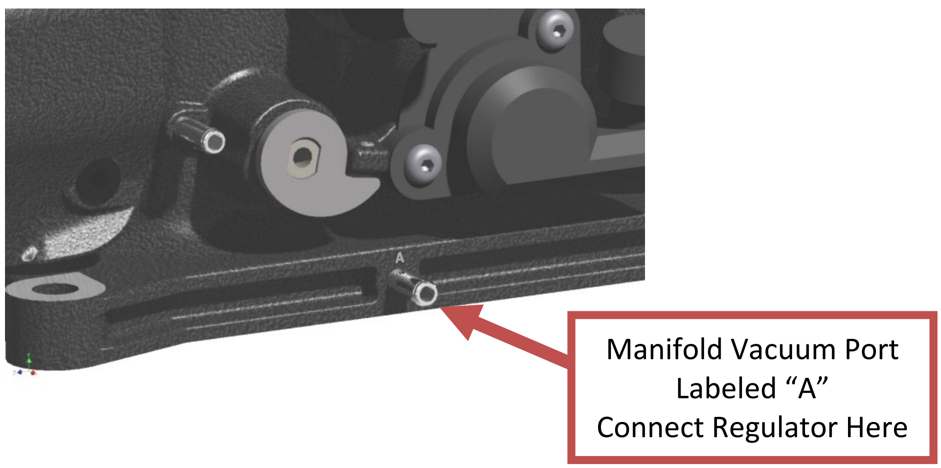
1. Starting at the tank, a fuel line will run to a pre-filter. (The pump included in the EZ-EFI® Fuel Pump kit features a built in strainer in its inlet so a pre-filter is not required.)
2. From the pre-filter (if used), a fuel line will connect to the fuel pump inlet. The fuel pump should be mounted near the fuel tank and below its lowest point; otherwise, the pump will not be able to properly prime if the fuel level is low.
   NOTE: To avoid damage to the pump, do not allow it to run dry.
   Depending on the fittings being used, the pre-filter may attach directly to the fuel pump.
3. From the fuel pump outlet, a fuel line will connect to a post-filter. Depending on the fittings being used, the fuel pump outlet may attach directly to the post-filter. This is the case with the EZ-EFI® Fuel Pump kit.
4. From the post-filter, a fuel line will connect to one of the fuel rails on the throttle body.
5. The throttle body has an integrated crossover to carry the fuel from one rail to the other.
6. From the outlet of the second fuel rail, a fuel line will connect to the inlet of the fuel pressure regulator. If using a dual inlet fuel pressure regulator, be sure to cap the unused port. (The fuel pressure regulator also needs a vacuum line connecting its vacuum reference port to manifold vacuum).
7. From the outlet of the fuel pressure regulator, a fuel line will return bypassed fuel back to the fuel tank.



CAUTION: Installation of this product requires detailed knowledge of automotive systems and repair procedures. Installation of fuel system parts and any fuel tank modifications must be carried out by a qualified automotive technician. Installation of fuel system parts requires handling of gasoline. Ensure that work is performed in a well-ventilated area with an approved fire extinguisher nearby. Extinguish all open flames, prohibit smoking and eliminate all sources of ignition in the area of the vehicle before proceeding with the installation. When working with fuel systems, eye goggles and other safety apparel as needed should be worn to protect against debris and sprayed gasoline. The finished work must be checked carefully to ensure there are no fuel leaks.

Fuel System Installation Notes:

- Use fuel injection rated fuel line, filters, pump, etc. to deal with the higher fuel pressures associated with fuel injection. Do not use any factory hard lines as part of your installation unless the ends allow for the proper connection to high pressure systems.
- The fuel pump should be mounted near the fuel tank and below its lowest point; otherwise, the pump will not be able to properly prime if the fuel level is low. To avoid damage to the pump, do not allow it to run dry.
- The fuel tank must be vented. When connecting the fuel return line to the tank, be sure not to use any existing vent fittings that are necessary for proper operation of the fuel tank.
- Keep fuel system components away from heat and moving parts.
- Use a fuel pressure regulator with a vacuum reference port.
- Run a vacuum hose from a manifold vacuum port on the throttle body to the reference port on the fuel pressure regulator. This will raise and lower fuel pressure with changes in manifold vacuum.



- If using a dual inlet fuel pressure regulator, be sure to cap the unused port.
- Carefully inspect the fuel system for leaks – especially when it is pressurized.
- It is good practice to install a fuel pressure gauge so fuel pressure can be verified later if needed. At the very least, a fuel pressure gauge must be available during initial setup so the fuel pressure can be set. A fuel pressure gauge is included with the optional EZ-EFI® Fuel Pump kit.
- If there is a fuel pump already installed in your tank from a previous fuel system, it is recommended that you remove it. Also, many stock systems have a sock type pre-filter installed in-tank. If your application does, check that the sock filter is clean.

Fuel Pressure

Fuel pressure should be set to 43 psi. This is the baseline setting for the EZ-EFI® System. This fuel pressure with the four injectors in the EZ-EFI® throttle body will support about 550 HP.

Higher fuel pressure will increase the injector flow rates and support more power if needed. For example, the injectors are rated at 88 lb/hr @ 60 psi. That is enough fuel for about 650 HP if the fuel system being used can supply that much fuel at that pressure. The EZ-EFI® Fuel Pump kit can supply that much fuel.

Fuel pressure can be checked with the engine not running. (If you check it with the engine running, be sure to disconnect the vacuum line from the reference port. Don't forget to reconnect it when you are done! Also keep in mind that the loose vacuum line will become a vacuum leak unless you cap it off.) Watch the fuel pressure gauge at key-on as the ECU commands the fuel pump on to prime the fuel system. If the fuel pump needs to be run again, turn the ignition off for approximately 10 seconds and then back on again.

To manually keep the pump running while setting the fuel pressure, locate in the EZ-EFI® wiring harness the green wire labeled "FUEL PUMP RELAY" or the green wire in the "FUEL PUMP CONTROLLER" connector. These are both connected to the ECU's fuel pump control. And one of them should be going to a fuel pump relay (either your own or the one built into the relay harness in the optional EZ-EFI® Fuel Pump kit). Ground whichever of those two wires is not connected. With the ignition on, that should trip the relay and run the pump.

Turning the adjustment screw on the fuel pressure regulator changes the fuel pressure. Be sure to tighten down the jam nut when finished adjusting the fuel pressure.

EZ-EFI® Fuel Pump Kit / EZ-EFI® Hose and Fitting Kit

Optional kits are available that include all of the components needed to assemble a high quality, fuel injection rated fuel system. The EZ-EFI® Fuel Pump Kit consists of all the basic hardware (pump, filter, regulator, gauge, etc.) and wiring (plug in fuel pump harness with relay) needed to assemble the fuel system.

For connecting everything together, an EZ-EFI® Hose and Fitting Kit is available. It includes fuel line and -6 AN fittings to mate to the hardware from the EZ-EFI® Fuel Pump Kit.

Pump

The EZ-EFI® Fuel Pump kit includes a high pressure, high flow fuel pump along with copper washers and -6 AN fittings.

Regulator

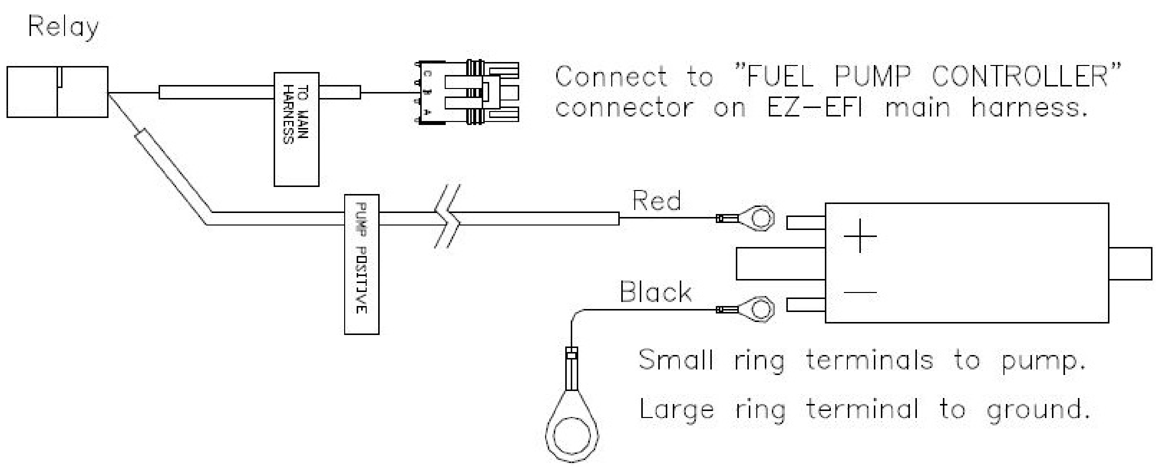
The EZ-EFI® Fuel Pump Kit includes a fuel pressure regulator and associated parts.

Regulator Assembly:

1. Install the two supplied -6 AN o-ring fittings. One will be installed in the bottom of the regulator (outlet/return port), and the other will be installed in one of the inlet ports on the side of the regulator (choose either side based on easiest hose routing in your application.) The unused inlet port on the other side should be blocked off with the included plug.
   NOTE: Since these fittings have o-rings, thread tape/sealant is not required or recommended.
2. Install the 1/8" barb fitting in the port on the side of the top half of the regulator and the pressure gauge in the port on the front of the regulator.
   NOTE: Both of these parts have 1/8" NPT threads and DO require thread sealant or tape.
3. Use 1/8" vacuum hose to connect the barb fitting on the regulator to a manifold vacuum port on the base of the throttle body.

Pump Wiring

The EZ-EFI® Fuel Pump Kit includes a relay harness that mates directly to the "FUEL PUMP CONTROLLER" connector on the main wiring harness. It is packaged with a loose ring terminal and a butt splice. The butt splice will not be used.



Wiring Assembly:

1. The relay harness has a long, loose red wire that feeds power to the pump. Route this wire to the fuel pump and cut it to the desired length.

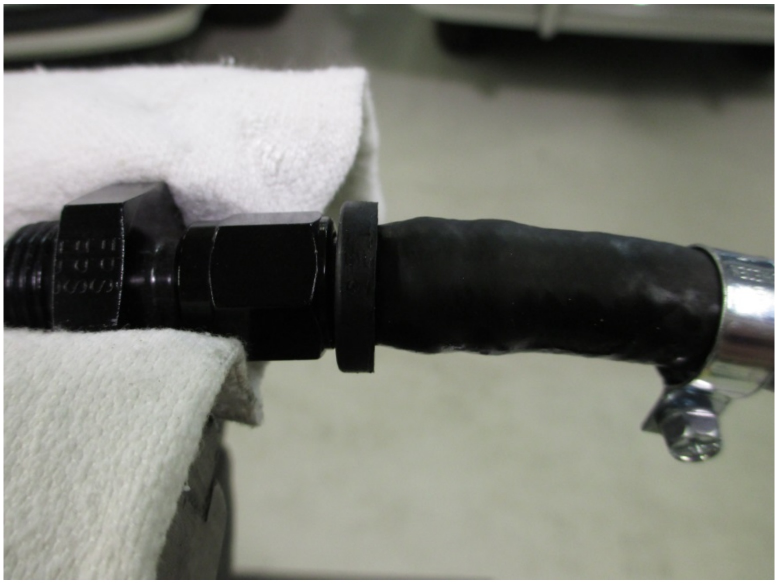
2. Strip some insulation from the end of the red wire and from one end of the supplied length of loose black wire.
3. The kit includes two small, blue ring terminals. Crimp one onto the red wire and the other to the stripped end of the black wire.
4. Install these small ring terminals onto the threaded wiring studs on the fuel pump. Polarity is marked on the fuel pump. Secure the red wire to the positive (+) post and the black wire to the negative (-) post using the supplied lock washers and nuts.
5. The remaining loose end of the black wire needs to be connected to ground. A larger ring terminal is included for this purpose. Cut the black wire to a convenient length, strip off some insulation and install the ring terminal. One of the fuel pump mounting bolts is often a convenient ground location. A good ground connection is important for proper operation. Be sure that the ring terminal touches clean, bare metal.

Hose and Fittings

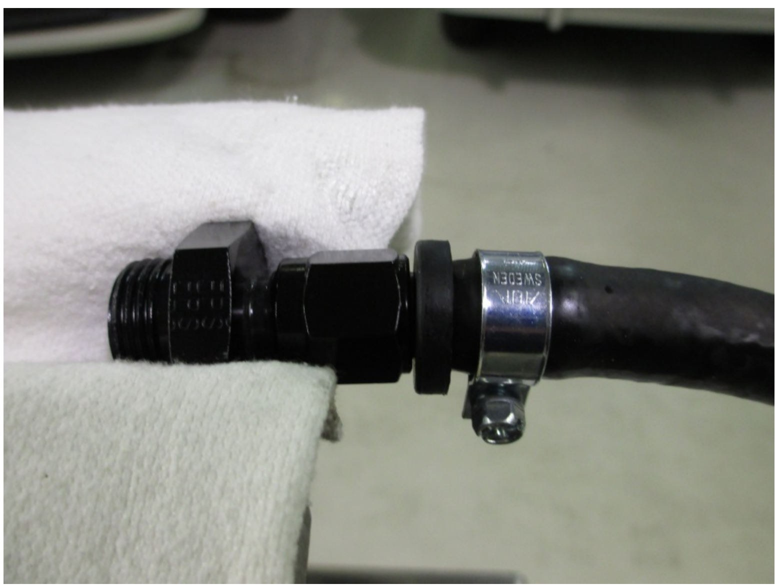
Hose Assembly:

1. Cut hose to the desired length using a fine tooth saw or cut-off wheel. Be sure to clean the cut edges of any loose material.
2. Lube the barbed end of the fitting with a light oil such as WD-40.
3. Slide a loose hose clamp over the hose so that it is ready to use when the hose has been installed.

4. Place the fitting in a vise. Take care to not scratch the finish on the fitting. Placing a shop rag over the vise jaws can be helpful. For straight female fittings, it is easiest to attach them to a male and clamp the male fitting in the vise. This helps prevent the fitting from spinning during installation.
5. Push the hose onto the fitting until the hose is flush with the plastic finisher.



6. Slide the hose clamp over the barbed section and tighten.



Handheld

The EZ-EFI® handheld serves as the user interface with the EZ-EFI® System. It has a straightforward menu system that offers advanced features without requiring a laptop or any computer skills. Its first task is to take you through the Setup Wizard. It also serves as a scan tool by displaying live data and diagnostics information. Beyond basic setup, you can also adjust other settings to suit your engine - target air/fuel ratios, fan control, etc. After the initial setup, use of the handheld is optional. It does not need to remain connected for the engine to run.

Handheld Notes:

- The handheld communicates with the ECU via the short pigtail exiting from the bottom. A separate, long handheld cable connects the handheld to the main harness. The handheld cable provides power to the handheld from the same 12V switched source used for the ECU. So the handheld will power on and off with the ignition switch.
- The mini-USB port on the top of the handheld is used to connect the handheld to a computer in the event that a handheld update becomes available.
- Do not attempt to operate the handheld while driving. For safety, have a passenger monitor live data or adjust settings as needed if the vehicle is moving.
- The handheld is compatible with mounting brackets that fit a Garmin Nuvi 2455LT GPS unit. A suction cup mount for the handheld is included in the kit.
- The handheld has a touch screen calibration procedure that can be accessed by pressing and continuing to hold anywhere on the screen as the handheld is powered on. After about four seconds, the calibration screen will appear and walk you through the short calibration process. The purpose of this calibration is to sync up the touch-sensitive screen with the graphics on the display. The result is that where you see a “button” on the screen is also where you need to touch to select it. This calibration is performed at the factory. It is unlikely that it will ever need to be repeated.

Installation Sequence

This is a general outline of the installation process. Read all the component specific installation notes for more detail before beginning the installation.

1. Install the threaded oxygen sensor fitting in the exhaust system and cap it off with the block off plug. Once you are ready to complete the EZ-EFI® installation, remove the block off plug and install the wideband oxygen sensor.
2. Install the throttle body. Attach your return spring and throttle linkage.
3. Install the coolant temperature sensor.

4. Install the fuel system.
5. Determine the appropriate method for getting an engine speed input into the ECU. Install RPM Module if needed.
6. Connect the wiring harness to all of the sensors/injectors/idle motor on the throttle body.
7. Connect the wiring harness to the coolant temperature sensor and wideband oxygen sensor. And to a digital tach signal or the RPM Module.
8. Find a suitable location and mount the ECU. Make sure the wiring harness will reach the mounting location.
9. If using the optional EZ-EFI® Fuel Pump Kit, connect the "FUEL PUMP CONTROLLER" connection on the main wiring harness to the included relay harness. Route the relay harness back to the fuel pump and make the final connections. Otherwise, connect the "FUEL PUMP RELAY" wire on the main wiring harness to the negative side of a relay that feeds power to the fuel pump.
10. If you would like to have the ECU control an electric fan, connect the "FAN RELAY" wire to the negative side of a relay that feeds power to the fan.
11. If you would like the ECU to bump up the idle speed and activate the fan output when an air conditioning compressor is switched on, connect the "A/C INPUT" wire to the A/C switch so that it sees power when the A/C is turned on.
12. Connect the "BATTERY POS" and "BATTERY NEG" wires **DIRECTLY** to the battery. Extend the wires if necessary to reach the battery. Use automotive grade 12 gauge (or larger) wire.
13. Connect the "12V SWITCHED" wire to a switched ignition source (hot in On/Run and Crank). Do **NOT** connect to the positive side of an ignition coil.
14. Connect the wiring harness to the ECU
15. Switch on the ignition. The ECU will run the fuel pump for several seconds. Inspect the fuel system for leaks and set the fuel pressure.

Setup/Initial Cranking

1. Connect the handheld to the main wiring harness using the handheld cable.
2. Switch on the ignition.
3. Select SETUP WIZARD in the handheld. It will walk you through initial setup and cranking.

Handheld User Interface

Home Screen

Setup Wizard
The Setup Wizard is a guided configuration utility used for initial setup. This can also be used to reset the ECU and handheld back to stock settings.

Live Data
Pressing the Live Data icon navigates to a series of dashes that display live ECU data such as engine RPM and current sensor values.

Diagnostics
The Diagnostics area offers access to error codes and other system information and tools.

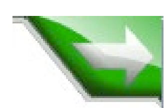
Advanced
The Advanced menu allows access to individual settings – some that were part of the Setup Wizard as well as other optional settings and adjustments.

 **Power Button**
This button places the handheld into a standby mode. In this mode, the screen will be off and no information will be displayed. To exit standby mode, touch the screen anywhere and the unit will resume normal operation.

Setup Wizard

Setup Wizard Notes

- Running the Setup Wizard will overwrite the previous configuration and any user adjustments that have been made. It will also erase any learning that has taken place. The ECU will be restored to its factory "stock" settings.
- Depending on the application, not all Setup Wizard screens will be accessed; only the needed settings are visited.
- To navigate through the Setup Wizard, use the red and green arrow buttons found in the corners of the screen. Pressing the "Next" button will save the settings of that screen to the ECU and proceed to the next screen. Pressing the "Back" button will discard any changes made to the current screen and return to the previous screen. If the "Next" button is not available, then this screen requires more input before continuing.

Navigation Buttons			
"BACK" Discard changes. Retreat to previous screen.			"NEXT" Save changes. Proceed to next screen.

Engine Parameters

To adjust a setting, touch the Engine Cubic Inches, Idle RPM or Rev Limit textbox. Then enter the desired numbers on the keypad. If the value is out of range, the value will appear red and the "Next" button will be disabled until all issues are resolved.

- **Number of cylinders** – Choose from 4, 6 or 8. The button's LED will indicate the selection.
- **Engine Cubic Inches** – To convert from liters to cubic inches use the following formula: $Cubic\ Inches = Liters \times 61.0237$
- **Idle RPM** – The target idle speed maintained by the IAC motor.

  Some engines like to idle higher than others do. This setting allows you to easily try different idle speeds to see what works best for yours. Keep in mind that this is setting the idle speed for a fully warmed-up engine. If the engine is cold, the ECU will try to maintain a slightly higher idle than called for here. If you return to this setting from the Advanced menu and make large changes, you may want to use the IAC Calibration option (also accessed through the Advanced menu). This will help you adjust the resting position of the throttle blades so that the idle motor is operating in the preferred range.

  Keep in mind that once the idle motor is in its fully closed position (the Live Dashes show IAC at 5), it cannot bring the idle speed down any further no matter what setting is entered here. If this happens, you will need to adjust the idle screw on the throttle body to close the blades more. (Again, you'll want to use the IAC Calibration option afterwards.) The other extreme is if the Live Dashes show IAC at 180. At that point, the idle motor is fully open and is unable to let any more air into the engine to raise the idle speed.

  If, for some reason, an IAC is not being used in a custom application, the Idle RPM setting is still important. Besides serving as a target for the IAC to maintain, this setting also helps the ECU determine when the engine is idling. For an application without an IAC, set Idle RPM to match the engine's actual idle speed.

- **Rev Limit** - To protect the engine from an over speed condition, the maximum allowable speed can be restricted with this setting. When RPM reaches this value, the injectors will be disabled. Once RPM has dropped, injection will resume.

  NOTE: Keep in mind that the Rev Limiter will prevent the engine from spinning itself too fast under its own power. But it does not protect against something else spinning the engine too fast – such as a downshift into a gear that is too low.

<u>Fuel Pressure</u>

Use the plus and minus buttons to select the base fuel pressure being used. Press the "Next" button to continue.

NOTE: Entering a fuel pressure at this prompt is telling the ECU what pressure the fuel system is set to. It does not actually set the fuel pressure. Fuel pressure must be set/verified with a fuel pressure regulator and gauge.

Select System

Select the system type installed and press the "Next" button to continue.

- **Single** – Select this option if using one EZ-EFI® four-injector throttle body.
- **Dual** – Select this option if using two EZ-EFI® four-injector throttle bodies.
- **Jeep** – Select this option if using an EZ-EFI® two-injector throttle body.
- **Inglese** – Select this option if using any Inglese™ kit.
- **Multiport** – Select this option for port-injected applications where fuel is supplied by injectors near each intake port instead of from an EZ-EFI® throttle body.
- **Other** – Select this option for any special case not covered above.

Inglese Setup

If Inglese™ was selected on the Select System screen, more information is required. There are two main styles of Inglese™ systems: Down Draft (Eight Stack) and Side Draft. If using a Down Draft system, select the kit based on rated horsepower of the kit or the injector part number. If a Side Draft system is used, choose between Single and Dual. Press the "Next" button to continue.

Injector Specs

If Multiport or Other was selected on the Select System screen, more information is required. Injectors are rated for a certain flow rate (lb/hr) at a given pressure (psi). Enter this information for the injectors that are being used. To adjust a setting, touch a textbox. Then enter the desired numbers on the keypad. If the value is out of range, the value will appear red and the "Next" button will be disabled until all issues are resolved.

Also, touch one of the buttons to select the number of injectors being used. Press the "Next" button to continue.

<u>TPS Calibration</u>

The throttle position sensor (TPS) sends a voltage to the ECU that varies with throttle movement. The ECU needs to know what voltage corresponds to closed and full throttle. This process gives it that information. Note that the "Next" button will not become available until the full calibration process is complete.

1. While the red text displays "RELEASE", leave the throttle in its fully closed resting position. Press the "Calibrate" button. The button's LED will be on while the throttle's closed voltage is being captured. When completed, the LED will turn off.
2. The red text will then display "DEPRESS". Press the throttle all the way to its wide open throttle (WOT) position. Hold it there and press the "Calibrate" button again. The LED will come back on as the throttle's WOT voltage is being captured. When completed, the LED will turn off for the final time and the throttle can be released. The "Next" button will become available.

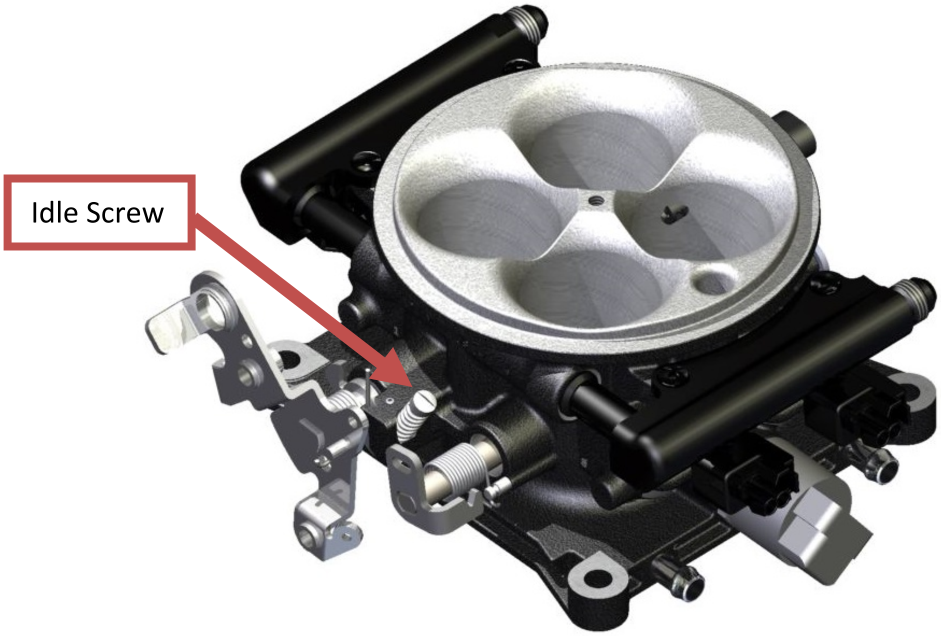
NOTE: The full throttle procedure must be performed with the engine NOT running!

The basic setup is complete! The next step is to start the engine and let it warm up. If necessary, open the throttle blades (by adjusting the idle screw on the throttle body) enough to keep the engine running. The handheld will display the Engine Warmup screen.

IAC Calibration

Adjust the idle screw on the throttle body until the indicator in the slider is in the green target box. This is adjusting the resting position of the throttle blades so that the idle motor (an electronically controlled stepper motor that allows air to bypass the throttle blades) is operating in the preferred position. This ensures that the idle motor has enough range of motion to help bring the idle speed up or down as needed.

TURNING IDLE SCREW…	THROTTLE BLADES	IAC	INDICATOR IN SLIDER
Clockwise	Open	Closes	Moves to the left
Counter-clockwise	Closes	Opens	Moves to the right



NOTE FOR 500C.I.D. or LARGER ENGINES: The idle motor's entire range of movement is from 5 to 180 "counts". Higher counts mean the idle motor is open more and allowing more air to bypass the throttle blades. Adjusting the throttle blade so that the bar is roughly centered on the "target" will put the idle motor at approximately 20 counts. This setting will work well for most engines. For larger engines, the throttle blades may need to be adjusted differently. If the engine struggles or stalls when the gas pedal is released, the throttle blades may need to be opened up slightly. That means shooting for the indicator to be shaded to the left side of the "target" on this screen. This will cause the idle motor to operate at a more closed position (lower counts) at idle. Since it will have more room to open if engine speed dips, it will be able to bypass more air to keep the engine running.

After setting the blades and pressing the "Next" button, the TPS Calibration screen will be revisited. The throttle position sensor is connected to the throttle shaft. So adjusting the resting position of the throttle blades may have changed the voltage the ECU is receiving from the TPS at idle. (The wide open throttle reading will not have changed.) To account for this, the throttle's closed voltage needs to be recaptured.

That's it! The ECU is configured for your engine and is ready to get to work learning more about it.

Advanced

EZ-EFI® is simple for the user to configure, and only requires running the Setup Wizard to begin operating. However, for the user that wants the extra control, many additional features can be found in the Advanced menu.

Some settings found here will have already been configured in the Setup Wizard. (And have already been discussed.) They can be accessed here individually. Other settings are only accessible through the Advanced menu.

Enrichment Fuel

Accel Fuel

When the throttle is opened quickly, the engine needs an extra dose of fuel for smooth operation. In electronic fuel injection, this is commonly referred to as Acceleration Enrichment or Accel Fuel. It is very similar to the accelerator pump on a carburetor. The ECU is preloaded with typical settings for Accel Fuel. This feature allows you to adjust those settings for more or less Accel Fuel by selecting a positive or negative adjustment factor. Selecting zero leaves the ECU to use the preloaded values.

Accel Fuel is a fine-tuning detail to adjust how the engine responds to throttle changes. In general, it should only be adjusted after the ECU has had some time to learn and the engine is running well in steady-state operation - throttle not changing. An exception to this is when the EZ-EFI® system is installed on a port-injected application where fuel is supplied by injectors near each intake port instead of from an EZ-EFI® throttle body. These applications often require less Accel Fuel than a throttle body injection setup. It may help to start out with Accel Fuel set to a negative value for port-injection applications.

Tuning Accel Fuel is a subjective process. You may be able to feel that it's not quite right, but it can sometimes be difficult to tell which way the adjustment needs to go. You may notice it when free-revving the engine in neutral, pulling away from a stop or any time the throttle is opened quickly. The Accel Fuel adjustment applies to all of these situations. The best setting will be the one that works well for all of them. It is not necessarily the setting that makes one specific situation absolutely perfect, as that may require too much compromise in the others.

If there is too much Accel Fuel, when the throttle is opened quickly the engine will sometimes feel as if it is struggling and/or generally not running cleanly. If there is too little Accel Fuel, you may notice a delay from when you open the throttle to when the engine responds.

The Live Dash screens may be useful in tuning Accel Fuel. Having somebody watch the live air/fuel ratio (A/F Ratio) data (either a numeric display or the bar graph) while you drive and make quick throttle changes may reveal whether the engine is getting too much or too little Accel Fuel. When the throttle is opened quickly, there is a lot going on. Air/fuel ratio will often swing back and forth. You want to watch for an overall trend.

As with most settings, it is good practice to make small, incremental changes and see what happens. If you make large changes to Accel Fuel, it is possible that you can go from too little to too much fuel without realizing you've passed right over the setting that makes the engine the happiest.

The Accel Fuel setting can also be used as a troubleshooting tool for a specific type of installation problem. If the EZ-EFI® system does not have a good ground connection to the battery, it is possible for the various sensor readings to appear jumpy to the ECU. (This jumpiness in the sensor readings may or may not show up on the handheld's Live Dashes.) This can fool the ECU into repeatedly invoking the Accel Fuel feature, causing extra fuel to be injected. This could lead to an overly rich and unstable idle and prevent the ECU from learning. Once the engine is fully warmed up, if temporarily turning the Accel Fuel setting all the way down makes the engine idle noticeably better (or conversely, if turning it all the way up makes it idle worse), that could indicate a bad ground or some other source of noise. After the test, remember to set the Accel Fuel setting back to its previous value.

SETTING	EFFECT
Positive	More Accel Fuel
Negative	Less Accel Fuel

Cranking Fuel

The ECU is programmed to inject extra fuel during cranking. Most engines should be able to crank and start with the pre-programmed amount of cranking fuel. However, if the engine seems to want more or less cranking fuel, that adjustment can be made here.

SETTING	EFFECT
Positive	More cranking fuel
Negative	Less cranking fuel

Cold Start

After the engine has started, the ECU's closed-loop fuel control will begin altering fueling to maintain the target air/fuel ratio. When the engine is cold, the target air/fuel ratio is adjusted to a richer (lower number) value. As the engine warms up, this adjustment is tapered out to zero by the time coolant temperature reaches approximately 125° F.

This setting can be used to make this coolant temperature-based adjustment to target air/fuel ratio more or less aggressive.

SETTING	EFFECT
Positive	Target air/fuel ratio richened more
Negative	Target air/fuel ratio richened less

<u>AFR Targets</u>

The ECU is constantly working to keep the air/fuel ratio at the current target air/fuel ratio. It is preloaded with typical targets. This is where those targets can be adjusted if desired. Keep in mind that a higher number means a "leaner" air/fuel ratio – less fuel. And a lower number means a "richer" air/fuel ratio – more fuel.

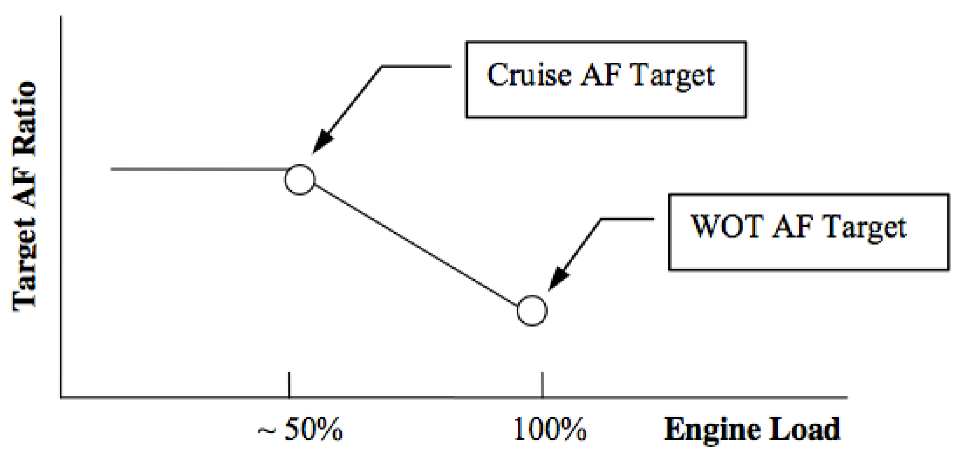
To adjust a setting, touch the IDLE, CRUISE or WOT textbox. Then enter the desired value on the keypad using three digits. For example, enter "135" for a 13.5 air/fuel ratio. If the value is out of range, the value will appear red and the "Next" button will be disabled until all issues are resolved.

Different operating conditions require different air/fuel ratios. The EZ-EFI® system distills these different requirements down to three simple settings. Any of them can be adjusted while the engine is running so different settings can be evaluated.

- **Idle Air/Fuel Target** – This is the target when the engine is idling. This can have a pronounced effect on idle quality. It is worth experimenting with to see what your engine likes. If you notice the engine struggle or if RPM dips considerably with load changes at idle (going into gear or turning steering wheel to full lock, for example), it may prefer a richer Idle Air/Fuel Target.

- **Cruise Air/Fuel Target** – Once the engine is above idle, it will switch to using this target. The engine will spend the vast majority of its time in this area. This setting has the largest effect on your fuel mileage. A leaner target (higher number) will use less fuel.

- **WOT Air/Fuel Target** – Once the engine starts to see more load (Load % value around 50% or higher), the ECU will start transitioning from using the Cruise Air/Fuel Target to using this Wide Open Throttle Air/Fuel Target. By the time the engine is under full load, the ECU will be using this target. For intermediate loads, the ECU interpolates between the Cruise and WOT targets. That is, it changes its target from the Cruise setting to the WOT setting in proportion to how much the load has changed from a cruising load to full load.



Just as the Cruise Air/Fuel Target can be adjusted for fuel economy, the WOT Air/Fuel Target can be adjusted for maximum power. It is quite possible that the engine can make more power at an air/fuel ratio that is leaner (higher number) than the preloaded WOT Air/Fuel Target. Or it might prefer a richer (lower number) air/fuel ratio. This is less likely, but it all depends on the engine.

Remember that an air/fuel ratio that is too lean (higher number) can cause severe engine damage – especially at WOT! When changing any of the targets to a leaner value, do so in small increments and pay close attention for any signs of detonation, etc.

Fan Control

EZ-EFI® has an electric fan output. When coolant temperature goes above the Fan On Temp setting, the fan output becomes active and its output wire goes to ground to trigger a fan relay. When coolant temperature drops below the Fan Off Temperature setting, the output is disabled.

Use the plus and minus buttons to adjust the Fan On Temp. Fan Off Temp is automatically adjusted up or down along with the Fan On Temp.

Startup Screen

By default, when the handheld powers on, it displays the Home Screen. This setting can be changed to automatically bypass the Home Screen and go directly to any of the Live Dashes when it powers on.

Warning Indicator

The Warning Indicator is a small red LED on the face of the handheld to the left of the screen. This indicator can be configured to show several different conditions.

- **Any error code** – The Warning Indicator will act like the “Error” LED on the Live Dashes.
- **CTS above threshold** – The Warning Indicator will come on if coolant temperature exceeds the adjustable threshold.
- **Shift light** – The Warning Indicator will come on if RPM exceeds the adjustable threshold.

Multiple choices can be selected. Use the plus and minus buttons to adjust the warning temperature and shift light RPM. Once configured, the Warning Indicator works no matter which screen is being displayed on the handheld.

Select Tach RPM

Many of the Live Dashes display an analog tachometer. This screen sets the maximum displayed RPM. The initial setting is based on the Rev Limit entered on the Engine Parameters screen.

Temperature Units

Select the preferred units to be used when displaying temperature throughout the handheld.

Live Data

The Live Data section of the handheld consists of a series of dashes that display live ECU data.

To switch between dashes or to return to the home screen, use the tabs at the bottom of the screen. The tab text will highlight green to indicate the current screen.

Across the top of every dash are three LEDs that indicate the following:

LABEL	DESCRIPTION	OFF	ON
Learning	This indicates that all of the enable conditions for learning are met and that learning is currently enabled. This can be used as feedback to give the driver a feel for when the ECU will or will not learn.	Learning Gray	Learning Green
O2 On	The wideband oxygen sensor has been initialized and is providing feedback to the ECU. This must be ON before closed loop fuel control is possible.	O2 On Gray	O2 On Green
Error	The ECU's on-board diagnostics has detected a problem. Refer to the Codes screen in the Diagnostics section of the handheld to determine which code has been set. Or touch the lit Error LED to go directly to the Codes screen.	Error Gray	Error Red

Dashes 1 – 4 are configurable. Sensors can be swapped out. Touching a sensor brings up a menu of available sensors. Touching a sensor name puts that sensor onto the dash.

Dashes 1-4

Master Dash

The Master Dash is designed for easy viewing of all sensors. For example, this dash may be used as an overview to quickly verify that all sensors are reading expected values.

DATA LABEL	DESCRIPTION
A/F Ratio	Air/Fuel Ratio. The reading from the wideband oxygen sensor.
A/F Target	Air/Fuel Target. The ratio the ECU is working to maintain. This is determined by engine load and the settings on the AFR Targets screen found on the Advanced menu.
Air Temp	This is the temperature of the air entering the throttle body. It can be displayed in Fahrenheit or Celsius.
Battery	Battery voltage.
Coolant	This is the temperature of the engine. It can be displayed in Fahrenheit or Celsius.
Fuel Pump	This shows when the fuel pump output is active. 0 means the output is off. 100 means it is on.
IAC	Idle Air Control. This is the position of the idle motor. At idle, it will move around to maintain the target idle speed. Displayed in “counts”. Higher counts mean the idle motor is open more and allowing more air to bypass the throttle blades. Its range is from 5 to 180. Generally, this will be around 20 idling out of gear with a fully warmed up engine.
Inj DC %	Injector duty cycle. This is a comparison of how long the injectors are open compared to how much total time is available for them to be open. At higher RPM, there is less time between injector openings. If this reaches 100%, it means the injectors physically cannot flow any more fuel. They are already being held wide open.
Lb/Hr	Current total fuel flow rate into the engine. Given in pounds per hour. This can be used to get a rough approximation of current engine power. Horsepower = Fuel Flow (lb/hr) x 2
Load %	Calculated Load. A comparison of the current manifold pressure vs. the ambient atmospheric pressure. Unlike the reading from the MAP sensor – which is affected by altitude – Load should always be consistent. That is, wide open throttle should always be around 100% regardless of altitude and ambient atmospheric pressure.
MAP	Manifold Absolute Pressure. This is a measure of the load on the engine. It is displayed in kPa (kilopascals). Its range is from 0 kPa to 105 kPa. With the engine off, this will read around 100 kPa. Then drop down when the engine is started.
O2 Corr. %	Current closed loop correction based on the reading from the wideband oxygen (O2) sensor. This is the percent of fuel being added (displays as a positive number) or removed (displays as a negative number) to achieve the target air/fuel ratio. As the ECU learns more and more, this will tend to get smaller and smaller in steady state driving.
RPM	Engine speed
TPS %	Throttle position sensor. This tells you how far the throttle blades are open. The Setup Wizard takes care of calibrating this sensor. It can easily be verified using this display. If you ever notice the TPS reading is not 0 at idle, it should be re-calibrated. This can be done by selecting TPS Calibration from the Advanced menu.
TPS Volts	The current signal voltage being returned from the throttle position sensor to the ECU. It should sweep smoothly from a lower value to a higher value as the throttle is opened. The ECU uses this value to determine TPS %.

Diagnostics

Codes

When an error code is set, the LED on the ECU will flash rapidly and the "Error" LED displayed on the handheld's Live Dashes will turn on. (The Warning Indicator LED on the face of the handheld can also be configured to come on.) If that happens, use this screen to find out which code has been set. Codes can also be cleared here.

Note that the LED on the ECU will normally remain off at key-on. Then come on when the ECU detects an RPM input. It will be lit solid while the engine is running normally.

The Codes screen can be accessed through the Diagnostics menu or directly from any of the Live Dashes by touching the "Error" LED on the Live Dashes when it is lit.

Master Dash

This button brings up the Master Dash for a quick overview of all available sensor readings. See the Live Data section for more detail.

Tech Support

This screen provides a list of resources for getting answers to your questions.

System Info

Handheld
This section shows the handheld firmware revision number.

ECU
This section shows information about the ECU.

The Ignition Reliability Monitor number (IRM Counts) gives a relative indication of the stability of the RPM signal being fed into the ECU. It is a running total of RPM signal errors the ECU has detected. A higher number indicates a noisier RPM signal. This value is stored until it is viewed on this screen. It is reset back to zero upon leaving this screen. It will then begin to count up again if the RPM signal remains noisy.

Settings Overview
This section shows a summary of the settings entered in the Setup Wizard.

Inputs / Outputs

This screen shows the analog voltages the ECU is receiving from the listed sensors. It can be used to verify if sensors are connected and working properly.

Three LEDs on the left side of the screen show if the ECU is currently activating the fuel pump or fan outputs. And if the ECU has detected that the A/C compressor is on.

Handheld Guide

This screen gives quick tips to help get the most out of the handheld.

EZ-EFI® SYSTEM FEATURES

Adaptive Learning

In their most basic form, electronic fuel injection (EFI) systems compare various inputs (primarily engine speed and load) to pre-programmed “base fuel tables” stored in the ECU. These fixed base fuel tables tell the ECU how much fuel to inject for a given engine speed and load.

All competent EFI systems use an oxygen sensor to monitor the resulting air/fuel ratio in real time. The better systems use a “wideband” oxygen sensor as used in the EZ-EFI® system. The reading from the wideband oxygen sensor provides very accurate feedback to the ECU so it knows if more or less fuel is needed to achieve the desired air/fuel ratio. Adjusting the fueling based on feedback from a wideband oxygen sensor is commonly referred to as “closed loop” fuel control.

Closed loop fuel control is a very powerful feature. It constantly makes fueling adjustments to compensate for different engine conditions. It is at its best when operating with well-tuned base fuel tables. Developing good base fuel tables requires significant time and experience. Closed loop fuel control can help compensate for less than perfect base fuel tables. However, there are limits to what it can do. It is not a substitute for proper tuning. The more work closed loop has to do, the less efficiently it can keep the actual air/fuel ratio close to the target ratio.

The Adaptive Learning feature of the EZ-EFI® system goes beyond normal closed loop fuel control. Besides using the wideband oxygen sensor feedback to adjust instantaneous fueling, it also uses it to adjust the underlying base fuel table so that over time, it tunes itself. Closed loop fuel control is happily left with only fine adjustments to make.

The theory of the Adaptive Learning feature is pretty straightforward. Actually implementing it is rather complicated. But all of that work is built into the ECU already. All that is left to do is drive.

Operational Notes:

- The EZ-EFI® system has a "pre-squirt" feature that helps starting by injecting a measured amount of fuel into the manifold at key-on. A clicking sound can be heard from the throttle body as the injectors pulse. Once this feature has been activated (key-on, fuel injectors cycled), it will be disabled until the engine has run. This prevents flooding the engine if the ignition has to be cycled on and off for whatever reason.
- A "flood clear" mode is available if the engine does somehow become flooded and does not want to start. If the throttle is held open past 80% while cranking, no fuel will be injected. Continue to hold the throttle open while cranking. Once the extra fuel is purged and the engine starts to fire, release the throttle and allow the engine to settle on its own.
- In normal conditions, it is good practice (but not strictly required) to key-on and listen for the "pre-squirt" feature (injectors clicking in the throttle body) to finish before cranking the engine. This takes about two seconds to complete.
- The wideband oxygen sensor has an internal heater to keep it at the correct operating temperature. The warm up process begins at key-on. If the engine has cooled completely in particularly cold weather, giving the sensor some time to heat up (allowing 10-15 seconds between key-on and cranking) may contribute to smoother starting. The "O2 On" LED displayed on the Live Dashes will indicate when the wideband oxygen sensor has warmed up and begun functioning properly. Until then, there will be no closed loop fuel control.
- Moving the pedal during the first several seconds after key-on (as the fuel pump is being primed) will cause additional fuel to be injected. This has the effect of adding additional "pre-squirt" fuel. This is typically not required. Care should be taken to avoid accidentally moving the pedal during this time.
- Learning does not begin until the engine is warmed up. Coolant temperature must be above 140* F for learning to begin.
- Various qualifying conditions must be satisfied for learning to take place. This prevents the ECU from learning from inappropriate feedback. Many of the learning qualifiers have to do with making sure the engine is in a steady state condition – no rapid changes. The "Learning" LED displayed on the Live Dashes will indicate when learning is enabled. This can be used as feedback to give the driver a feel for when the ECU will or will not learn.
- Learning will take place automatically as the vehicle is driven. No special procedures need to be followed. Just drive normally. However, it is possible to help speed up the learning process on a fresh installation. A good method is to open the throttle a small amount and hold the pedal steady. Let the vehicle accelerate up through the gears. Hold the pedal steady as long as reasonably possible. Slow down and repeat the process several times using larger throttle openings each time. It is NOT required that you go through this process with every throttle position. Don't do anything to risk your safety or that of other motorists!
- While the ECU is still going through the initial learning process, you may discover driving conditions where the engine is not perfectly happy. This is a natural part of the learning process. Unless the engine is really unhappy, don't try to avoid those conditions. Instead, gently return there and allow the ECU to learn what the engine wants. It should soon feel much better.

- Changes made to the tune in the ECU – through learning or handheld adjustments – are held in short term memory within the ECU until the next key-off. At that time, the changes are saved into long-term memory. This is another reason why the “BATTERY POS” and “BATTERY NEG” wires must be connected directly to the battery. If all power (“12V SWITCHED” and “BATTERY POS”) is cut to the ECU at one time, any new learning will be lost. Once a proper power down sequence has occurred (approximately 5-10 seconds from key-off), the battery leads can be disconnected, or the ECU can be disconnected from the wiring harness if necessary. Once saved into long-term memory, your tune can remain in an un-powered ECU for years.
- Using nitrous oxide injection with the EZ-EFI® system is not recommended. Keep in mind that the ECU is using closed loop fuel control. If will faithfully do all it can to keep the air/fuel ratio at the targets you’ve set. If additional fuel is delivered through a wet nitrous system, the ECU will see that the air/fuel ratio is richer than you’ve requested. The ECU will begin reducing the amount of fuel it is injecting itself to compensate for the extra fuel from the wet system. The result could be a dangerously lean condition. Technically, it would be possible to temporarily adjust the WOT Air/Fuel Target to a suitably rich mixture if a nitrous system was going to be used. However, this should only be attempted with great caution and is NOT recommended. Keep in mind that the richer air/fuel target will be in effect whether or not the nitrous system is activated. This can adversely affect how the engine runs and how the ECU learns.
- The EZ-EFI® system is intended for naturally aspirated engines only – no turbos or superchargers.
- The EZ-EFI® system does not control ignition timing. Along with air/fuel ratio, timing also plays a large role in how an engine runs. Be sure your ignition system has an appropriate timing curve. Don’t forget to consider factors like mechanical and vacuum advance. For example, if the engine has a surging idle, it might want a richer (lower number) Idle Air/Fuel Target. Or it might want less timing. Or, the cause could be oscillating timing caused by overly light springs in the distributor. Another example would be if idle speed often dips and threatens to stall. The engine may prefer a different Idle Air/Fuel Target. Or, it could be that more base timing or more vacuum advance would give the engine a more robust idle. These examples happen to be about idle, but of course, timing affects all modes of engine operation – tip-in, acceleration, cruise, etc. The point is that both air/fuel ratio and timing need to be optimized for the engine to run at its best.

On-Board Diagnostics

The EZ-EFI® system includes a robust self-diagnostics feature. The ECU constantly monitors various inputs and outputs for any deviations from normal operation. If any is detected, the LED on the front face of the ECU flashes rapidly as a warning that there is a problem. (The LED will normally remain off at key-on. Then come on when the ECU detects an RPM input. It will be lit solid while the engine is running normally.) Also, the “Error” LED displayed on the Live Dashes acts like a Check Engine Light. It will signal if an error code has been set. The Warning Indicator LED on the face of the handheld can also be configured to work this way. The handheld Codes screen can be used to read any error codes that have been set.

Once an error code is set, it is saved in the ECU until the ECU is reset by keying-off and allowing the ECU to complete is shutdown procedure (takes approximately 5-10 seconds). Or error codes can be cleared with the handheld at any time.

The following error codes are possible:

Codes	MONITORS
Battery Voltage	Battery voltage below 7V or above 19V for 10 seconds
O2 Sensor	Wideband oxygen sensor unable to initialize, disconnected or malfunctioning
IAC Control	Idle Air Control motor malfunctioning
Inj Duty Limit	Injector duty cycle maxed out at 100% (an indication that injectors cannot supply enough fuel. The ECU has determined that the injectors need to be open longer than the time available.)
MAP Voltage	Manifold Absolute Pressure sensor signal voltage too high or too low
TPS Voltage	Throttle Position Sensor signal voltage too high or too low
ATS Voltage	Air Temperature Sensor signal voltage too high or too low
CTS Voltage	Coolant Temperature Sensor signal voltage too high or too low

Troubleshooting CTS, ATS, MAP, TPS, O2 and IAC Codes

1. Verify that the offending sensor is installed and connected to the wiring harness.
2. With the ECU keyed-on, use the handheld to look for a valid reading from the offending sensor. (For IAC, watch for a changing reading with the engine idling.)
3. Verify that the wiring harness itself is not damaged. Visually inspect the wiring harness from the sensor back to the ECU looking for cut, pinched, abraded or melted sections. Using a multi-meter, check continuity from the sensor connector back to the ECU. Also make sure no pins in a particular sensor connector are shorted to each other.
4. For the wideband oxygen sensor, also check to see if the sensor tip gets hot (check carefully!) with the ECU keyed-on.
5. If no other problems can be found, try replacing the sensor.

Troubleshooting Battery Code

1. Verify that the battery and charging system are in good condition.
2. Verify solid, corrosion free connections at the battery and switched ignition source.
3. Verify that the wiring harness itself is not damaged. Visually inspect the wiring harness looking for cut, pinched, abraded or melted sections.
4. Verify that the battery fuse in the wiring harness is installed and in good condition.

Troubleshooting Inj Duty Limit Code

1. Verify there is plenty of fuel in the tank.
2. Verify static fuel pressure – watch the fuel pressure gauge at key-on as the ECU turns on the fuel pump to prime the fuel system. 43 psi of fuel pressure with a single EZ-EFI® Throttle Body and injectors will support 550 HP.

3. Verify fuel pressure during a wide open throttle run. Have an assistant monitor the reading on a remote fuel pressure gauge while you drive. For safety, the remote fuel pressure gauge should not be routed inside the vehicle. Fuel pressure at wide open throttle should equal the static pressure (fuel pressure with the fuel pump on and the engine off). If it is significantly lower, the fuel system is not keeping up with the engine's fuel demand.
4. De-pressurize the fuel system. Remove the fuel rails and check for any debris in the top side of the injectors.
5. Check for any debris in the fuel pump/fuel filters including any filters that may be in the tank.
6. If the engine is legitimately capable of making more than 550 HP, the fuel pressure can be increased to get more flow out of the injectors. For example, the injectors are rated at 88 lb/hr @ 60 psi. That is enough fuel for about 650 HP if the fuel system being used can supply that much fuel at that pressure. If the fuel pressure is physically changed, remember to also change the fuel pressure setting in the handheld so that the ECU's fueling calculations will be accurate.
7. Going to a dual quad setup (2 throttle bodies, 8 total injectors) will double the injector flow capacity and supported horsepower rating. If a second throttle body is added, remember to also change the throttle body type setting in the handheld.

   NOTE: If the injectors really are undersized, it is likely only a problem at high RPM and high load. Unless there is a major, fundamental failure in the fuel system, an Inj Duty Limit code should not mean it is unsafe to run the engine. Just be careful to avoid high RPM/high load until the injector sizing issue has been resolved.

When an error code is set, learning will be disabled until it is cleared. The two exceptions to this are the IAC and Inj Duty Limit codes. An IAC code does not disable learning because a failed IAC does not affect the fueling calculations. An Inj Duty Limit code does not permanently disable learning. Instead, it only temporarily disables learning while injector duty cycle is at 100%. Once injector duty cycle drops back below 100%, learning can resume.

Engine Protection/Limp Mode

Besides being a powerful troubleshooting tool, the on-board diagnostics also protect the engine. Contingency plans are built into the ECU so that if a sensor fails, protective action can be taken. If, for example, there is a problem with the coolant temperature sensor, the ECU's electric fan control output will be switched on to guard against overheating.

Also, if the ECU detects a problem with a sensor, it will switch to using pre-programmed default values in the affected part of the fueling calculations. This puts the ECU into "limp" mode. If there is a problem with any of the sensors, the engine can still run so the vehicle will not be stranded. (The exception is the RPM signal feeding into the "TACH IN/RPM MODULE" wire. Without an engine speed input, the engine will not run.) Depending on circumstances and which sensor has failed, the change in the engine's behavior may be very obvious or it may be hardly noticeable. If you notice any change in how the engine is running, it's a good idea to check the LED on the ECU (to see if it is flashing) or the "Error" LED displayed on the Live Dashes. These both signal that an error code has been set. (The Warning Indicator LED on the face of the handheld can also be configured to come on when an error code has been set.) Or you can go directly to the Codes screen in the Diagnostics section of the handheld. Even if the engine is running well, an error code will prevent further learning. Also, the problem that caused the error code to be set may have a larger effect later under different conditions.

Keep in mind that the error codes are cleared when the ECU is reset (key-off for approximately 5-10 seconds). So if you suspect a problem, it is best to check for error codes before powering down the ECU. A persistent problem (sensor disconnected, for example) will set an error code when the ECU is keyed-on. But an intermittent problem may only be detected while the engine is running.

Load Indexed Speed Density

The EZ-EFI® system operates with a fuelling strategy known as Load Indexed Speed Density. Just like a traditional Speed Density system, it uses manifold pressure, air temperature and engine speed along with other considerations to calculate the proper amount of fuel to inject. At wide open throttle, manifold pressure is equal to the ambient atmospheric pressure. If you drive at high altitude, the ECU would see a lower manifold pressure at wide open throttle (since atmospheric pressure is lower) than it would at sea level. A traditional Speed Density strategy uses manifold pressure to locate values in various lookup tables. So the engine would operate differently at high altitude than it would at sea level. The EZ-EFI® system's Load Indexed Speed Density avoids this inconsistency by using a calculated "Load" for table look ups instead of raw manifold pressure. This "Load" is a comparison of the current manifold pressure vs. the ambient atmospheric pressure. This means that at any altitude, full throttle (or any other throttle position) operates on the same parts of the look up tables. At full throttle at high altitude, the ECU will still see manifold pressure that is lower than it would at sea level. But because that lower manifold pressure is equal to the ambient atmospheric pressure, it is still considered 100% load.

This all happens behind the scenes and requires no special attention from the driver.

FAST™
LIMITED LIFETIME WARRANTY AND LIMITED WARRANTY

FAST™ warrants that its EZ-EFI™ products are free from defects in material and workmanship for the lifetime of the product. This **Limited Lifetime Warranty** shall cover **only** the original purchaser. All other FAST™ products are covered by a **Limited Warranty** which covers defects in material and workmanship for a period of **one year** from the date of purchase.

FAST's obligation under this warranty is limited to the repair or replacement of its product. To make a warranty claim, the part must be returned directly to FAST™ at the address listed below with a valid Return Merchant Authorization Number (RMA), freight prepaid. Items covered under warranty will be returned to you freight collect. To obtain an RMA, call 877-334-8355 to report the issue you are experiencing. At that time, FAST™ will attempt to trouble shoot your issue.

It is the responsibility of the installer to ensure that all of the components are correct before installation. We assume no liability for any errors made in tolerances, component selection or installation.

There is absolutely no warranty on the following:

A. **Any parts used in racing applications or subject to excessive wear;**

B. **Any product used in marine applications, unless that product is listed by FAST™ as a specific marine product;**

C. **Any product that has been physically altered improperly installed or maintained;**

D. **Any product used in improper applications, abused, or not used in conjunction with the proper parts.**

<u>There are no implied warranties of merchantability or fitness for a particular purpose.</u> There are no warranties which extend beyond the description of the face hereof. **FAST™ will not be responsible for incidental and consequential damages, property damage or personal injury damages**. Where required by law, implied warranties or merchantability and fitness are limited to terms outline above.

This warranty gives you specific legal rights and you may also have other legal rights which vary from state to state.

CALIFORNIA PROPOSITION 65 WARNING

This product may contain one or more substances or chemicals known to the state of California to cause cancer, birth defects or other reproductive harm.