



## INSTRUCTIONS

### EZ-EFI™ 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.

## INSTALLATION

### System Components Overview

The EZ-EFI™ 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. It accepts a standard Holley-style throttle linkage.
- When installing the throttle body, it is good practice to replace the throttle body gasket.
- There are three manifold vacuum ports on the base of the throttle body. And one ported vacuum port on the body – near the air temperature sensor. Be sure to cap any unused vacuum ports.
- A throttle return spring should be used.
- An air cleaner should be used. The throttle body is compatible with standard carburetor air cleaners. Be sure to account for hood clearance issues when choosing an air cleaner.



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Part # FAST4-152  
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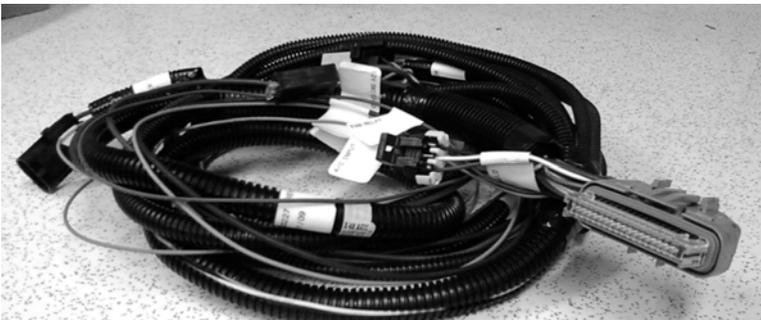
## ECU



### 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. 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 2 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. Optional, longer communications cables are available if needed.
- 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 is 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 faults have been detected.

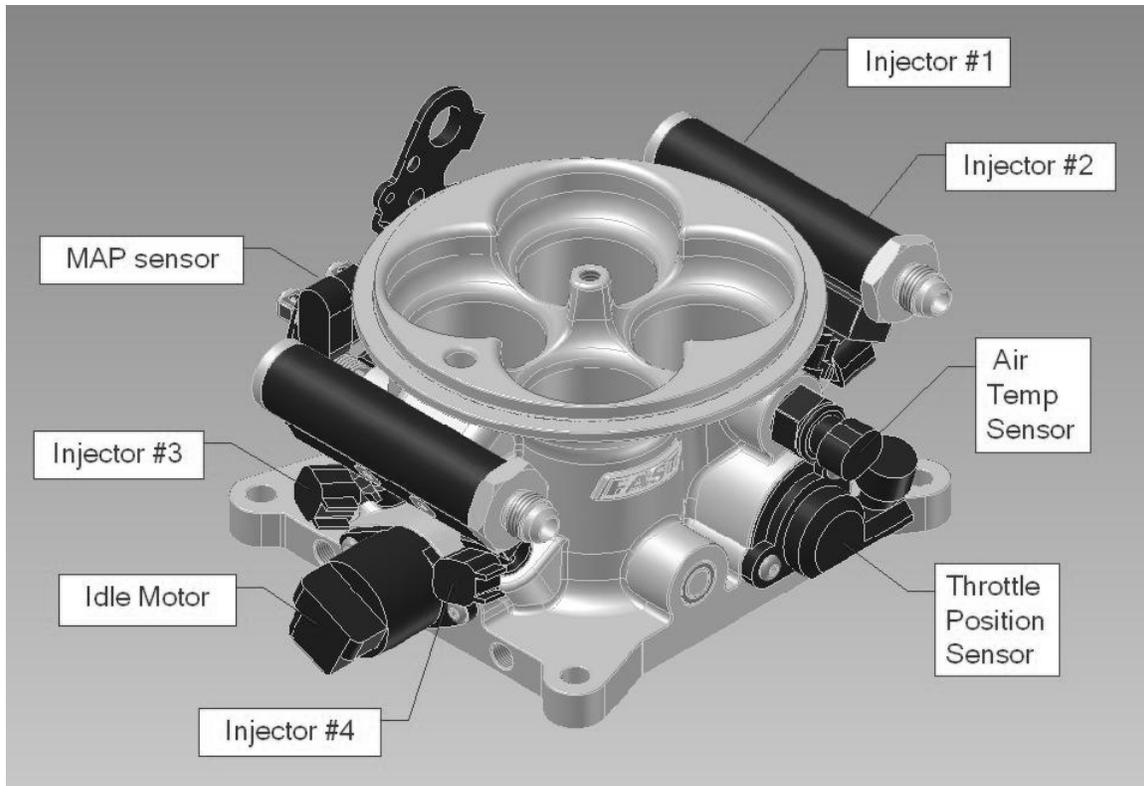
## Wiring Harness



### 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.
- 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.

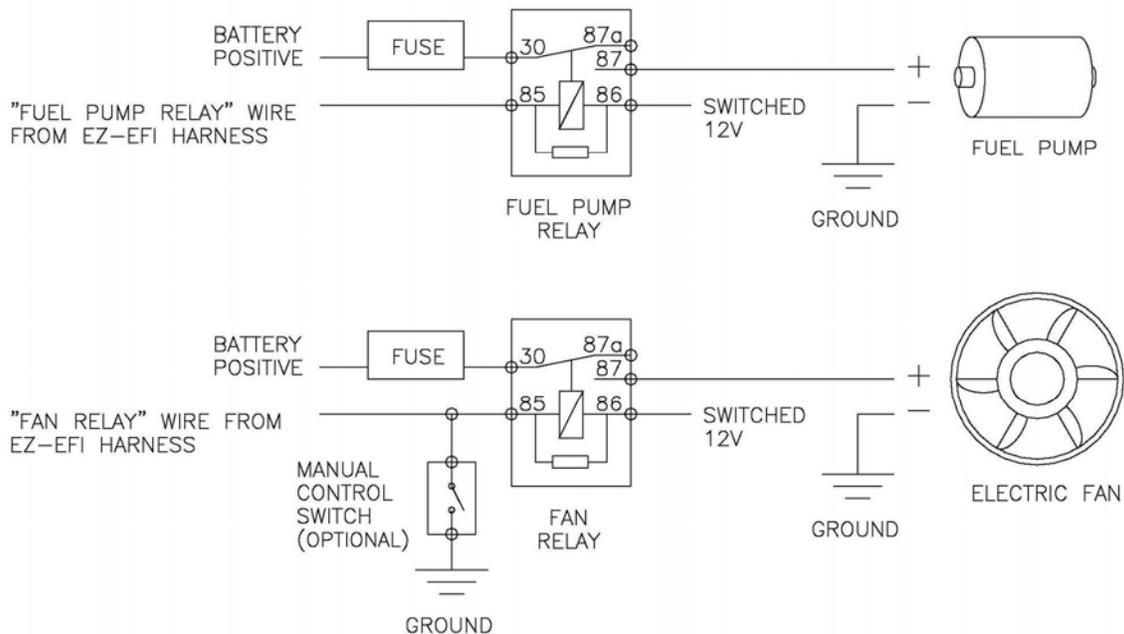


The connections on wiring harness are all clearly labeled. They are connected as follows:

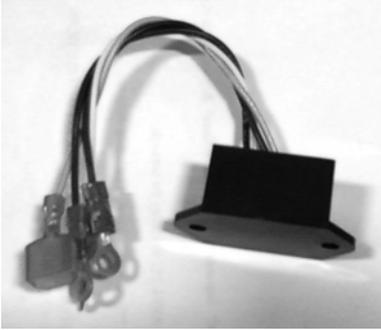
<b><u>Label</u></b>	<b><u>Connects to</u></b>
Inj 1	Injector #1 in throttle body. (Driver side front)
Inj 2	Injector #2 in throttle body. (Passenger side front)
Inj 3	Injector #3 in throttle body. (Driver side rear)
Inj 4	Injector #4 in throttle body. (Passenger side rear)
Idle Motor	Idle Air Control 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 driver side 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.
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	Communications cable that links the main wiring harness to the handheld user interface.
Battery Pos	Positive post of battery.
Battery Neg	Negative post of battery.
12V Switched	Switched ignition source (hot in On/Run <u>and</u> Crank). This turns the ECU on and off.
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.

### FUEL PUMP / FAN RELAY WIRING



## RPM Module



The EZ-EFI™ ECU requires an engine speed input. There are two options for accomplishing this depending on application:

1. Most aftermarket capacitive discharge (CD) ignition boxes provide a “Tach” output. 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.
2. If a traditional, dwell controlled ignition system (the coil is charged by having one side of it grounded – either by “points” or some form of electronic module) is being used, the RPM Module will be needed. 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:

<u>Wire color</u>	<u>Connection</u>
Black	Engine block
Black	Engine block
White	Negative side of coil
Yellow	“TACH IN / RPM MODULE” wire in EZ-EFI™ wiring harness

(NOTE: 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 that terminal directly to the “TACH IN / RPM MODULE” wire in the wiring harness. The ECU may be damaged. In a case like that, option 2 using the RPM Module is required since what you are really doing is connecting to the negative side of a dwell-controlled coil.)

## Sensors

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

## Coolant Temperature Sensor



This sensor monitors engine coolant temperature. It is typically installed in an existing mounting hole on the top of the intake manifold. The sensor fits a 3/8" NPT hole. 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.

## Wideband Oxygen Sensor



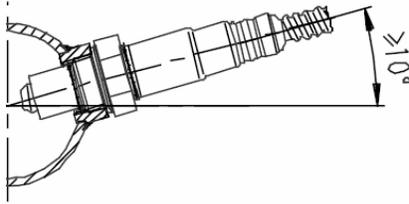
The wideband oxygen sensor needs to be mounted in the exhaust system. A threaded fitting and block off plug are provided. The fitting needs to be welded into place. To install the fitting, drill a .750" diameter hole and weld the fitting centered on the hole. If you do not have access to a welder, any competent exhaust shop can install the fitting for you. Use the supplied block off plug (not your actual oxygen sensor) to cap off your new oxygen sensor fitting until you are ready to complete the rest of the EZ-EFI™ installation. 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.

(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.

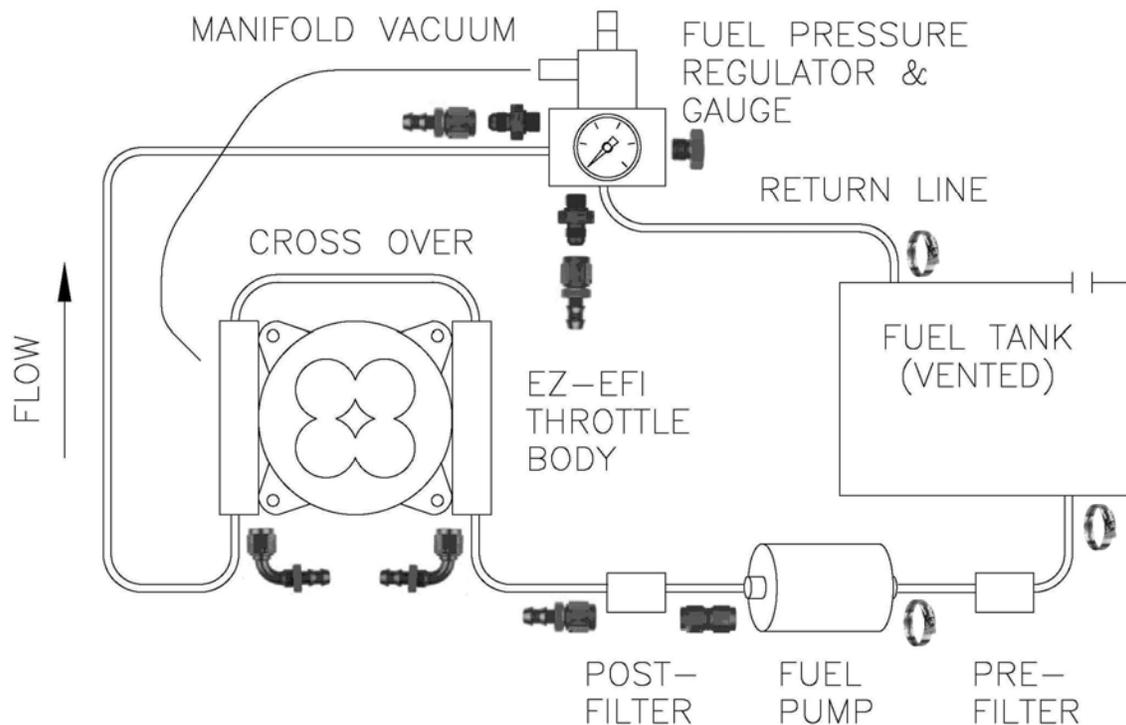
(NOTE: The use of leaded fuel will significantly reduce the lifespan of the oxygen sensor.)

## 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. Whether using these kits or building a fuel system with other components, the basic layout will be as follows:

- 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.)
- From the pre-filter (if used), a fuel line will connect to the fuel pump inlet. The fuel pump should be mounted near the tank and low so that it is gravity fed. Depending on the fittings being used, the pre-filter may attach directly to the fuel pump.
- 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.
- From the post-filter, a fuel line will connect to one of the fuel rails on the throttle body.
- The throttle body comes with a crossover to carry the fuel from one rail to the other.
- 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).
- From the outlet of the fuel pressure regulator, a fuel line will return bypassed fuel back to the fuel tank.

## BASIC FUEL SYSTEM LAYOUT



### Fuel System Installation Notes:

- Use fuel injection rated fuel line, filters, pump, etc. to deal with the higher fuel pressures associated with fuel injection.
- Mount pump close to the fuel tank. Mount pump low so it is gravity fed from the fuel tank.
- The fuel tank must be vented.
- 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.

### 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 4 injectors in the EZ-EFI™ throttle body will support 550 hp.

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 fittings to mate to the hardware from the EZ-EFI™ Fuel Pump Kit. The fuel pump inlet uses a hose barb fitting. All other fittings are -6 AN.

### **EZ-EFI™ Fuel Pump Kit - Pump and Fittings**

The EZ-EFI™ Fuel Pump kit includes a high pressure, high flow fuel pump along with the associated fittings and O-rings. There is a hose barb inlet fitting and a -6 AN outlet fitting. A third fitting is included but will not be used.



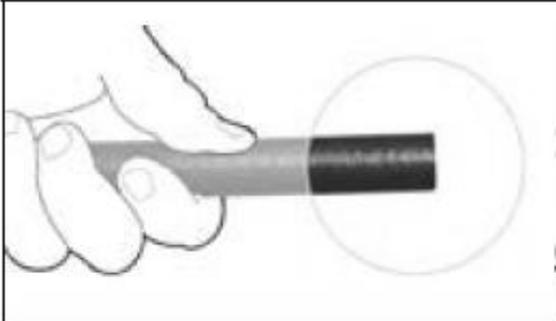
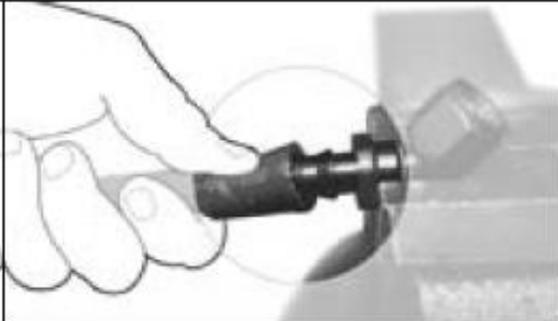
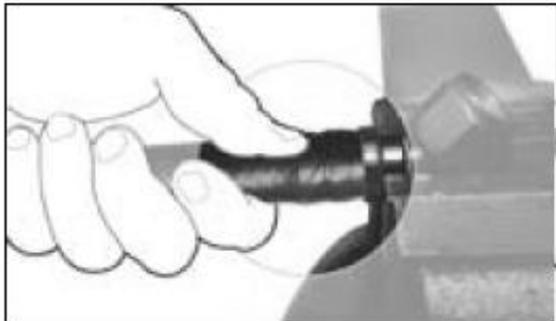
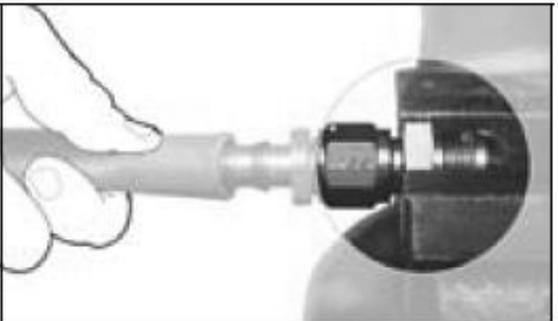
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**EZ-EFI™ Hose and Fitting Kit**

The EZ-EFI™ Hose and Fitting kit includes hose clamps for securing fuel line to the fuel tank’s outlet and return and to the inlet of the fuel pump. A -6 AN female coupling is used to connect the fuel pump outlet to the post-filter. Push fit -6 AN fittings are used for all other connections. The ‘Basic Fuel System Layout’ diagram shows where the different fittings are used.

	
<p><b>STEP 1</b></p>	<p><b>STEP 2</b></p>
<p>Cut hose at the required length using a fine tooth saw blade or cut off wheel. Clean any loose debris from both the cut ends and inside the hose.</p>	<p>Hold the fitting in a bench vice, lubricate the fitting tail and inside the hose. (to make for easier fitting gently heat the hose with a hot air gun).</p>
	
<p><b>STEP 3</b></p>	<p><b>STEP 4</b></p>
<p>Push the hose over the fitting tail until it is tight behind the red hose finisher.</p> 	<p>Please Note: Straight female fittings require the use of a male adaptor during hose assembly to stop the fitting tail turning.</p>

## Installation Sequence

This is a general outline of the installation process. Read all of 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 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, Wideband Oxygen Sensor and an ignition box 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 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).
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. Switch on the ignition.
2. Connect the handheld to the main wiring harness using the communications cable. And to power by connecting the power cable to the handheld and to a cigarette lighter plug.
3. Select SETUP WIZARD in the handheld. It will walk you through initial setup and cranking.

## HANDHELD

The EZ-EFI™ Handheld serves as the user interface with the EZ-EFI™ system. It has a straight forward 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



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data and diagnostics information. Beyond basic setup, you can also adjust other settings to suit your engine – rev limiter, target air/fuel ratios, etc.



#### Handheld Notes:

- The handheld has two cables that must be connected. A power cable that goes to a cigarette lighter receptacle. And a communications cable that links the handheld to the “HANDHELD” connector on the main wiring harness.
- To turn off the handheld, disconnect the power cable either at the handheld itself or from the cigarette lighter receptacle. This can also be done to restart the handheld if something interrupts you as you go through the Setup Wizard (or any of the other handheld functions).
- If the handheld displays a “COMM ERROR” message, make sure the handheld’s communication cable is connected and that the ECU is powered on. Then press the RESET button on the handheld.
- If you will be monitoring live data or making adjustments while driving, be safe and bring a friend along to operate the handheld while you drive.



## Setup Wizard

The EZ-EFI™ Setup Wizard will walk you through the initial ECU setup. Once you select SETUP WIZARD from the main menu, you will be asked...

- **START A NEW TUNE? YES** will let you continue the setup wizard. **NO** will take you back to the main menu.
- **RESET ECU TO BASE TUNE?** The Setup Wizard takes the answers to several basic questions and configures the ECU for your engine. Through the Advanced Options menu in the handheld, you can adjust specific settings to your liking. Selecting **YES** at this prompt will overwrite those adjustments back to the pre-programmed starting points already contained in the ECU. It will also erase any learning the ECU has already done. Selecting **NO** will leave those adjustments and any learning in place and only perform the basic setup procedures – fueling and TPS calibration and setting idle speed.

The settings that will be reset by selecting **YES** are:

Learning  
 Rev Limiter  
 Air/Fuel Ratio Targets  
 Accel Fuel adjustments  
 Electric Fan turn on temperature

On a fresh installation, either response is appropriate and gives the same results since there will have been no learning or adjustments made yet.

- **ENGINE CUBIC INCHES.** Enter your engine size.
- **IDLE SPEED.** Enter your desired idle speed. This can be adjusted independently later through the Advanced Options menu.
- **EZ-EFI™ THROTTLE BODY?** If using the EZ-EFI™ throttle body, select **EZEFI SINGLE**. If using a dual quad setup with two EZ-EFI™ throttle bodies, select **EZEFI DUAL**. If using an Inglese™ induction system, select **INGLESE EFI**. If using some other arrangement of throttle body and injectors (such as a port fuel injection setup), select **OTHER**.
- **INGLESE KIT PART NUMBER.** (Skipped if not using an Inglese™ induction system.) Select the injector kit part number purchased with the Inglese™ induction system.
- **NUMBER OF INJECTORS.** (Skipped if using EZ-EFI™ throttle bodies or an Inglese™ induction system) Enter the number of injectors you are using.
- **INJECTOR FLOW AT 43 PSI.** (Skipped if using EZ-EFI™ throttle bodies or an Inglese™ induction system). Injectors are rated for a certain flow rate (in lbs/hr) at a



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given pressure. 43 psi (or 3 Bar) is a common pressure for injector flow ratings. If your injectors were rated at a different pressure their flow rating needs to be converted to 43 psi. The formula for converting the flow rate is:

New flow = Old flow \* square root of (New pressure / Old pressure)

As an example, assume your injector's flow rating is 65 lb/hr @ 58 psi. The flow rating @ 43 psi is calculated as follows...

New flow = 65 \* square root of (43/58)

New flow = 56

- **FUEL PRESSURE.** Enter the fuel pressure you will be using. For the EZ-EFI™ throttle bodies, 43 psi is the recommended pressure. At this fuel pressure, the injectors included with a single EZ-EFI™ Throttle Body can deliver enough fuel to support 550 hp.

(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.)

- **NUMBER OF CYLINDERS.** Enter the number of cylinders your engine has.
- **TPS CALIBRATION SCREENS.** 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. You will be asked to leave the throttle at the idle / closed position. Once that value is captured, you'll be asked to hold the throttle wide open. The Setup Wizard will tell you how long to hold the throttle open while it captures that value.

(NOTE: The full throttle procedure is meant to be performed with the engine NOT running!)

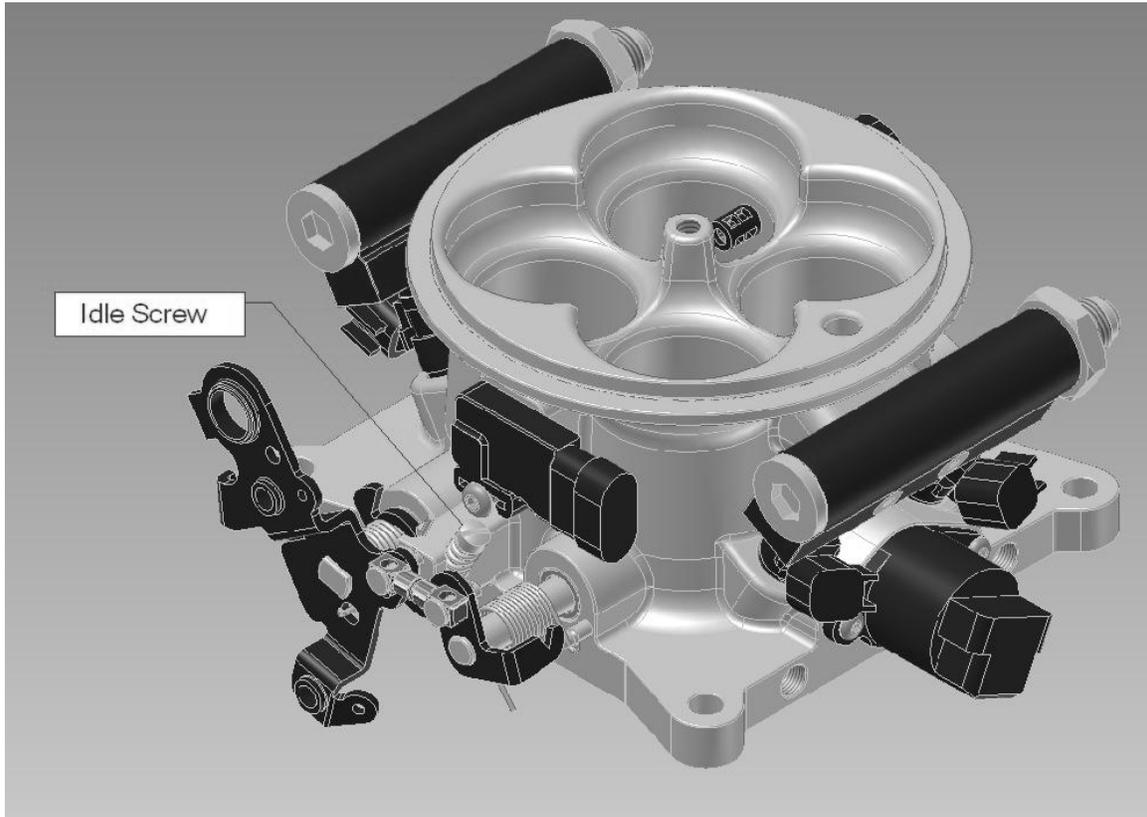
The basic setup is complete! The next step is to start the engine and let it warm up. If necessary, open the throttle blades (by adjusting the idle screw on the throttle body) enough to keep the engine running. The handheld will display a warm up screen. A bar graph will move toward a "target" as the engine warms up. Once it has warmed up, the handheld will automatically advance to the Throttle Blade Adjustment screen.

(NOTE: There is also an upper temperature limit. If the engine has been run and is too hot, the handheld will wait for it to cool before advancing to the Throttle Blade Adjustment screen.)

- **THROTTLE BLADE ADJUSTMENT.** This screen shows another bar and a "target". It also shows the current engine speed. Adjust the idle screw on the throttle body until the engine is idling close to the idle speed you entered earlier and the bar is roughly centered on the "target". This is adjusting the resting position of the throttle blades so



that the Idle Motor 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.



- **TPS IDLE RE-CALIBRATION.** The throttle position sensor is connected to the throttle shaft. So adjusting the resting position of the throttle blades in the previous step may have changed the voltage the ECU is receiving from the TPS. To account for this, you will again be asked to leave the throttle at the idle / closed position and let the ECU capture that voltage.

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

### Live Data

The Live Data feature allows you to monitor various engine parameters in real time. There are several screens that can be selected using the UP and DOWN arrows. To return to the main menu, press the ENTER/POWER button.

In addition to live data readings, the Live Data screens also feature several “virtual LED” indicators. They “light up” to show when certain conditions are met. In this picture, the AL indicator is “off”. The O2 indicator is “on”.



<u>Virtual LED</u>	<u>Meaning</u>
SE	System Error. This indicates that an error code has been set. It acts like a Check Engine Light. Select Error Codes from the main menu to check and clear error codes.
AL	Adaptive 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.
O2	Wideband oxygen (O2) sensor. This indicates the sensor is warmed up and functioning. The 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. Until the oxygen sensor has warmed up and begun functioning properly, there will be no closed loop fuel control.
AC	Air Conditioning input. This indicates that power is applied to the “A/C INPUT” wire in the wiring harness. This tells the ECU that the A/C compressor has been turned on. The ECU will bump up the idle speed to compensate for the extra load.



- **DASH 1**  
RPM Engine speed in Revolutions Per Minute.

- O2C% Current closed loop correction based on the reading from the wideband oxygen (O2) sensor. This is the percent of fuel being added 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.
- AF Air/Fuel ratio. The reading from the wideband oxygen sensor. This should be close to the Target Air/Fuel ratio. The right side of the scale is leaner.
- TAF Target Air/Fuel ratio. The ratio the ECU is working to maintain. This is determined by the AF TARGETS settings available in the ADVANCED OPTIONS section of the handheld. The right side of the scale is leaner.



- **DASH 2**

- RPM Engine speed in Revolutions Per Minute.
- CTS(F) Coolant Temperature Sensor. Displayed in \*F. This is the temperature of the engine. Being above 140°F is one of the enable conditions for learning to become active.
- 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”. Lower numbers mean the idle motor is more closed and allowing less air to bypass the throttle blades. It’s range is from 5 to 180. Generally, this will be around 20 idling out of gear.
- TPS% Throttle Position Sensor. This tells you how far the throttle blades are open. It’s range is from 0 (resting idle position) to 100 (full open position). 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 going back through the Setup Wizard or by selecting CALIBRATE TPS in the ADVANCED OPTIONS section of the handheld.



- **DASH 3**

- AF Air/Fuel Ratio. This is the current reading from the wideband oxygen sensor.
- BAT(V) Battery voltage.
- 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 (a perfect vacuum) to 105 kPa. 101 kPa is atmospheric pressure in standard conditions. With the engine off, this will read around 101 kPa. Then drop down when the engine is started.
- ATS(F) Air Temperature Sensor. Displayed in \*F. This is the temperature of the air entering the throttle body.



- **DASH 4**

- 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. If this reaches 100%, it means the injectors physically cannot flow any more fuel. They are already open for as long as they possibly can be given the current engine RPM.
- 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.

**FUEL LB** 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.

$$\text{Horsepower} = \text{Fuel Flow (lbs/hr)} \times (\# \text{ of injectors}) \times 2$$

**RPM** Engine speed in Revolutions Per Minute.

### Advanced Options

The Advanced Options menu allows you make adjustments beyond the basic settings configured by the Setup Wizard. These changes can be made at any time – including while the engine is running.



- **IDLE SPEED.** Some engines like to idle higher than others. 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 make large changes here, you may want to run back through the basic Setup Wizard (you can answer NO on the “RESET ECU TO BASE TUNE?” screen to retain any other adjustments you’ve made through the Advanced Options menu and any learning that has already occurred.) This will ensure the idle motor is operating in the preferred range.

It is worth noting that once the idle motor is in its fully closed position (the Live Data displays shows IAC at 5), it can not 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 run back through the basic Setup Wizard afterwards.) The other extreme is if the Live Data display shows 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.

- **CALIBRATE TPS.** The throttle position sensor is calibrated in the Setup Wizard. This lets you repeat that process by itself. Just like in the Setup Wizard, you will be asked to leave the throttle at the idle / closed position. Once that value is captured, you'll be asked to hold the throttle wide open.

(NOTE: The full throttle procedure is meant to be performed with the engine NOT running!)

- **REV LIMITER.** 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.)

The Rev Limiter can act as a form of “valet mode”. You can temporarily set the limiter to a lower RPM if you have to turn your keys over to someone who shouldn't be using full engine power. Just remember to set it back afterwards to avoid a surprise the next time you drive!

- **AF TARGETS.** The ECU is constantly working to keep the air/fuel ratio at the current target air/fuel ratio. The ECU 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.

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.

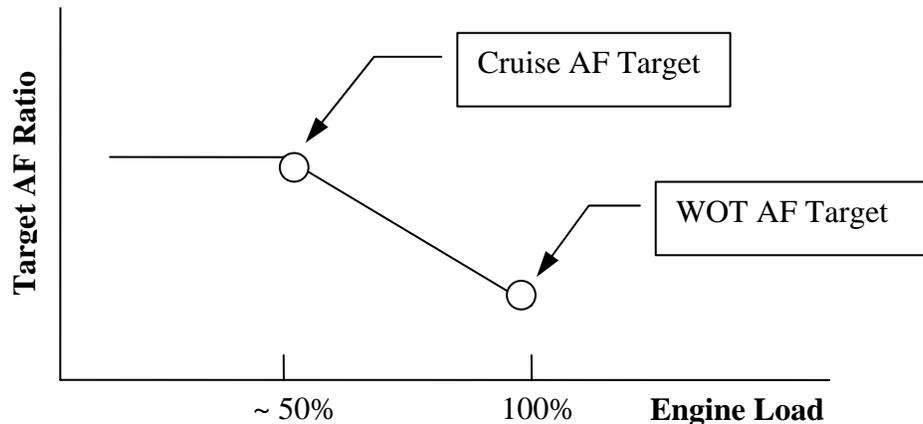
**Idle AF** – This is the target when the engine is idling. This can have a pronounced effect on idle quality. It is worth experimenting with to see what your engine likes. If you notice the engine struggle or if RPM dips considerably with load changes at idle (going into gear or turning steering wheel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

**Cruise AF** – 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. So this setting has the largest effect on your fuel mileage. A leaner target (higher number) will use less fuel.

Because these settings are so simple to adjust, you may consider changing them for special situations. If you were going on a long, relaxed highway run, you could temporarily set this a little bit leaner to maximize fuel economy. Then set it back for normal around town driving.



**WOT AF** – Once the engine starts to see more load (MAP values around 50 kPa 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 AF target can be adjusted for fuel economy, the WOT AF 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 AF 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.

- **ACCEL FUEL.** When the throttle is opened quickly, the engine needs an extra dose of fuel for smooth operation. In electronic fuel injection, this 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.

(NOTE: Accel Fuel is a fine tuning detail to adjust how the engine responds to throttle changes. 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.)

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. The places you may notice it are free-revving the engine in neutral, pulling away from a

stop or anytime 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. 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 Data feature may be useful in tuning Accel Fuel. Having somebody watch the live Air/Fuel Ratio (AFR) data (either the 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. AFR 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.

- **MORE.** This brings up another page of Advanced Options.



- **FAN ON TEMP.** This sets the engine temperature that will activate the Fan output. When the temperature exceeds this limit, the Fan output wire switches to ground to control a relay. Do NOT wire the Fan output directly to a fan. Once the temperature has dropped 20\*, the Fan output will be deactivated.
- **INFO.** This screen displays information about software versions, etc. Technical support staff may request this information.
- **DONE.** This will take you back to the main menu.

## Error Codes

The EZ-EFI™ system includes advanced Diagnostics and Engine Protection / Limp Mode features. These features are described in detail elsewhere in these instructions. This screen is where any error codes will be displayed. It is also where they can be cleared.

If an error code has been set, the LED on the front face of the ECU flashes rapidly as a warning that there is a problem (the LED is lit solid while the engine is running normally). Also, the SE “virtual LED” displayed on the Live Data screens acts like a Check Engine Light. It will “light up” if an error code has been set.

The picture on the left is showing error codes. After clearing them, the picture on the right shows what the Error Codes screen normally looks like.



## 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 an 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 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 straight forward. 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 2 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 “virtual LED” in the Live Data screens will indicate when the oxygen sensor has warmed up and begun functioning properly. Until then, there will be no closed loop fuel control.
- The ECU is programmed to inject extra fuel during cranking. This is sufficient to allow most engines to start on their own. However, if the engine seems to want it, pressing the gas pedal while cranking will add more fuel. If using this feature, start with small pedal movements to avoid adding too much fuel and flooding the engine.
- Moving the pedal during the first several seconds after key-on (as the fuel pump is being primed) will also 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.
- There are various qualifying conditions that 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 AL “virtual LED” in the Live Data screens 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. (The ECU is small enough to be easily carried around. That makes for a great theft deterrent. If your vehicle moves from where you left it, it won't be under its own power!) 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. It 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 ratio 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.

## 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 is lit solid while the engine is running normally). Also, the SE “virtual LED” displayed on the Live Data screens acts like a Check Engine Light. It will “light up” if an error code has been set. The handheld 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 its shutdown procedure (takes approximately 5-10 seconds). Or error codes can be cleared with the handheld at any time.



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The following error codes are possible:

<u>Fault</u>	<u>Monitors</u>
CTS	Coolant temperature sensor open or short
ATS	Air temperature sensor open or short
MAP	Manifold absolute pressure sensor open or short
TPS	Throttle position sensor open or short
Wideband O2	Wideband oxygen sensor open or short or malfunctioning
Voltage	Battery voltage below 7V or above 19V for 10 seconds
IAC	Idle motor fault reported by IAC control chip
Crank Sync	RPM input signals occurring at unexpected times
Inj DC Limit	Injector duty cycle over 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.)

Troubleshooting CTS, ATS, MAP, TPS, Wideband O2 and IAC faults

- Verify that the offending sensor is installed and connected to the wiring harness.
- 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.)
- 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.
- For the wideband oxygen sensor, also check to see if the sensor tip gets hot (check carefully!) with the ECU keyed-on.
- If no other problems can be found, try replacing the sensor.

Troubleshooting Voltage fault

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

Troubleshooting Crank Sync fault

- Verify that the distributor / coil or ignition box is in good condition.



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- Verify that the “TACH IN / RPM MODULE” wire is securely attached to the ignition box or RPM Module as appropriate. If used, also make sure the RPM Module has good connections to block ground and the negative side of the coil.
- Verify that the wiring harness itself is not damaged. Visually inspect the wiring harness from the “TACH IN / RPM MODULE” wire back to the ECU looking for cut, pinched, abraded or melted sections. Using a multi-meter, check continuity from that wire back to the ECU.
- Try to move any other ignition related wiring as far away as possible from the RPM Module and “TACH IN / RPM MODULE” wire.

#### Troubleshooting Inj DC Limit fault

- Verify there is plenty of fuel in the tank.
- 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.
- De-pressurize the fuel system. Remove the fuel rails and check for any debris in the top side of the injectors.
- Check for any debris in the fuel pump / fuel filters.
- If the engine is legitimately making more than 550 hp, the fuel pressure can be increased to get more flow out of the injectors. The EZ-EFI™ injectors will operate with pressures at least up to 60 psi. At that pressure, they will support 650 hp. If the fuel pressure is changed, you MUST go back through the handheld’s setup wizard.
- 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, you MUST go back through the handheld’s setup wizard.

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

#### Engine Protection / Limp Mode

Besides being a powerful trouble shooting 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 over heating.

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 “Tach” 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 (it will flash) or the SE virtual LED on the Live Data screens (it will “light up”). These both signal that an error code has been set. Or you can do directly to the Error Code 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.

If you’d rather not leave the engine running while you check for error codes, there is a trick that can be used. Turn the ignition briefly to the Off position so that the engine stops. Then quickly switch the ignition back to the On/Run position - being careful not to go all the way to the Crank position. This will allow the engine to stop without the ECU completely powering down and resetting the error codes. If you hear the injectors cycling when you switch the ignition back on (“pre-squirt” feature), you have waited too long. The ECU has reset and the error codes have been cleared.

(NOTE: Using this technique will often cause a Wideband O2 fault as the engine is stopping. This Wideband O2 fault can usually be ignored. Be sure to clear the error codes and/or key-off and allow the ECU to complete its shutdown procedure (takes approximately 5-10 seconds) before re-cranking the engine. If you suspect a real problem with the Wideband O2 sensor, you should check for error codes with the engine still 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.



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### Limited Warranty

FAST, Inc. warrants that all of its products are free from defects in material and workmanship for a period of 1 year from the date of purchase. This limited warranty shall cover the original purchaser.

FAST, Inc.'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 within 1 year of purchase to the address listed below, freight prepaid. Items covered under warranty will be returned to you freight collect. 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:**

- Any parts used in racing applications.**
- Any product that has been physically altered, improperly installed or maintained.**
- Any product used in improper applications, abused, or not used in conjunction with the proper parts.**
- Damage due to excessive manifold pressure, i.e. nitrous backfires, engine misfire, etc.**

**There are no implied warranties of merchantability or fitness for a particular purpose.** There are no warranties, which extend beyond the description of the face hereof. FAST, Inc. will not be responsible for incidental and consequential damages, property damage or personal injury damages to the extent permitted by law. Where required by law, implied warranties or merchantability and fitness are limited to a term of 1 year from the date of original purchase.

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



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