GEN III DBW Installation Instructions

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Unit B
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Congratulations on the purchase of your *Affordable Fuel Injection*™ Gen III Drive By Wire (DBW) system. We are confident that this purchase will give you the performance and driveability you deserve from your GSE equipment. The following instructions are intended to provide you with thorough description for installing your DBW system. Please read through the instructions completely before beginning your installation. Many of your questions may be covered within this manual.

Verify that all of the components are included in your shipment.

1. Wiring Harness
2. ECM
3. ECM bracket and mounting hardware
4. Throttle Body, Electronic Control (ETC)
5. Injector Block and Injector
6. Electronic Pedal w/cover
7. ECT sensor (Engine Coolant Temp)
8. IAT sensor (Installed in Injector Block)
9. MAP Sensor (Manifold Absolute Pressure)
10. Heated O2 Sensor
11. Fuel Pressure sensor (installed in injector block)
12. Hall Effect distributor
13. Ignition module assembly
14. Fuel filter
15. Inline Fuel Pump
16. Oil Pressure Switch
17. Ignition Coil
18. Fuel Level Sensor
19. Dash Panel w/ gauges and ignition switch
20. Tractor harness w/fuse block
21. Alternator wire

INSTALLATION INSTRUCTIONS

NOTE: THIS IS A CUSTOM FUEL INJECTION SYSTEM BUILT FOR YOUR GSE EQUIPMENT. AS WITH ALL CUSTOM PROJECTS SOME FABRICATION MAY BE REQUIRED. YOU MAY ALSO REQUIRE SOME SMALL PARTS THAT ARE NOT INCLUDED IN THE KIT.

ECM

The ECM is the central unit of the fuel injection system. This unit provides the signals that trigger the injectors, advances the ignition timing and actuates the throttle control. The ECM is mounted in the same location as the mechanical fuel pump was located. An extra thick gasket is supplied to insure a secure seal at this location.

This is a state of the art ECM which is weatherproof, shockproof and high temperature resistant.

A three piece mounting bracket is included for mounting the ECM to the engine block. The bracket is built for installations which position the ECM horizontal to the block or perpendicular to the block. Typically Tug MA units are mounted perpendicular and Clark and other similar units are mounted horizontal due to the tightness of fit.

WIRING HARNESS

The wiring harness included with this kit has been specially built for your unique application. This harness only includes the connectors and leads that are required to run your particular engine based upon the order specifications. Therefore, if there are leftover parts this indicates that an error has been made during assembly and installation of the system. Each connector will be marked with a label to the correct sensor that it is to be connected too. In the following section we will describe each sensor and the connector that attaches to it. The wiring harness is fabricated to allow the proper sensor to be hooked up to the respective connector. The "keying" of the connector will not allow for an improper connection.

There is a fuseable link attached to a red wire which is to be securely connected to the starter or starter solenoid.

This red wire is to be connected to a direct battery lead which has 12v always feeding it; a direct connection to the battery or starter relay is optimal. It is important that this wire is connected to the indicated source or your fuel injection system will not operate properly.

It is very important that the ECM and components be supplied with proper voltage at all times. Improper operation of the charging system can result in system malfunctions and drivability issues.

Included in the vehicle harness are two relays, a power relay and Park/Neutral Start relay (explained further below). These relays are of the same design and can be used for any of the applications.

Options Connector

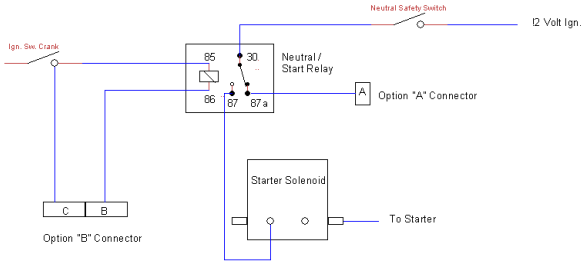
An eight (8) pin connector is included in the EFI harness which is used to connect the options ordered with the system. For this application, the mating connector will be part of the vehicle harness and include the Oil Pressure, Low Fuel Light, Fuel level sending unit and engine crank input and output from the ECM. This connector is located at the back side of the engine on the tappet cover side. Any remaining unused cavities of the connector will be plugged to insure no environment influence on the connector.

Power Relay

The power relay is used to ensure proper voltage is supplied to your system so as not to tax the current wiring of the vehicle with undue voltage requirements. The power relay is controlled by the ECM and provides voltage to components of the system based on commands of the ECM. For most units this relay is a standard "cube" relay. In cabbed vehicle applications, this is a large isolated silver solenoid which will control all accessories. The input to the relay is direct to the battery power wire and outputs to the fuse block and EFI harness.

Neutral Safety/Crank Relay

This DBW unit has the ability and needs to determine when the vehicle is in drive/reverse or neutral. In order to keep things as simple as possible and not have to change/modify or add any more sensors, the unit uses the current neutral safety switch to allow this. Your harness will need to tie into this switch for proper operation. Two wires, one Green and one White will be marked neutral safety in and neutral safety out splice into the neutral safety switch wires. This relay also includes the proper wires to operate both the crank function (crank only in neutral) and allow the ability to signal the ECM what the position of the shift lever is in. (See diagram 1) below.



1) Remove wire from the crank side of ignition switch.
2) Remove wire from starter solenoid which "triggers" the solenoid. (this isolates the park/neutral switch.)
3) Connect white wire from neutral relay (pin 85) to crank side of ignition switch.
4) Connect White wire from Pin C of options "B" Connector to crank side of ignition switch.
5) Connect tan wire (pin 87) to starter solenoid "trigger."
6) Splice wire removed from starter solenoid to gray (pin 30) wire of neutral / start relay.
7) Connect wire removed from crank side of ignition switch to 12v ignition.
8) Connect black/white wire (pin 86) to Purple wire Pin "B" of Option "B" Connector
9) Install supplied terminal to gray wire coming out of harness labeled "to neutral safety" and insert into black cavity of relay base (pin87a.)
10) Insert relay into black base.
11) Mount relay into appropriate location.

Title: ECM Crank / Neutral Relay		
Author: N. Witte		
File: on\Gen III System\ECM Crank_Neutral Relay.dsn		Document
Revision: 1.0	Date: 11/18/2015	Sheets: 1 of 1

Battery Lead

This battery lead is labeled and can be attached directly to the battery, the starter solenoid, or any other appropriate full time 12-volt supply. We wire

provided is terminated with a fuseable link and any eyelet. The length is sufficient to attach it directly to the starter solenoid be it on the firewall or the starter itself.

OBDII Connector
An OBDII connector is another extension of the harness which is located in your wiring harness at the back side of the engine. This connector allows the use of a C.A.N. based OBDII scan tool to read operational data of the unit as well as read and clear diagnostic codes.

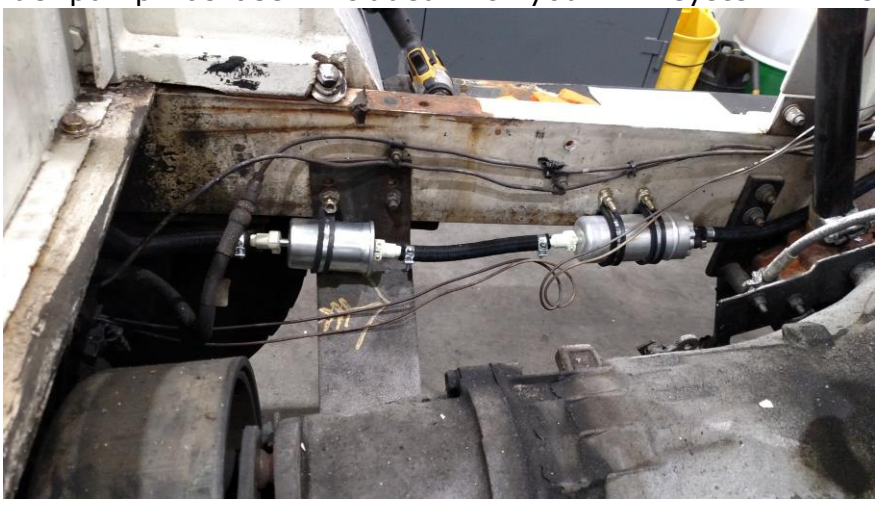
Check Engine Light
The check engine light is an LED installed in the dash and is wired into the main vehicle wire harness. The end is terminated with Deutsch connector for service purposes.

The wire from the ECM is the ground for the light. When a fault exists, or the system is in diagnostic mode, or the engine is not running with the key on, the light is illuminated. The other side of the light is connected to a 12v ignition feed that has been supplied in the main vehicle harness.

Ground Wires
Several black wires with an eyelet on the end are to be bolted to an appropriate engine ground. Insure that you have cleaned the surface where this wire will mate to. Empty threaded holes in the intake manifold are the best for this connection. Your wire harness will place these wires in the ideal location based on proper routing of the harness. Two star washers have been provided to insure a good continuity to ground.

It is advisable to run a separate ground wire from the battery to the frame of the vehicle. It is also advisable to run another ground wire from the location of the ground wire from the harness to the frame at the same mounting location as the wire from the battery.

FUEL PUMP
An external inline fuel pump has been included with your TBI system. This pump delivers a variable fuel pressure to the throttle body through variable voltage provided through the ECM. A fuel pressure sensor is installed in the injector block which measures the fuel pressure



and is fed back into the ECM. The ECM then regulates the voltage to the fuel pump to maintain the proper pressure. The fuel pump should be mounted to the frame of your GSE equipment. The fuel pump also requires a good constant gravity feed of fuel to the pump in order for it to work properly. If necessary weatherproof the pump by mounting a cover over it.

A fuel filter is to be installed in the fuel line **PRIOR** to the fuel pump. Premature failure of the pump can be the result of improper fuel filter installation. A high quality EFI fuel filter is provided along with quick connects for ease of installation and service.

A 12 or 14 Ga. pink wire labeled "Fuel Pump", with sufficient length has been included with the wiring harness for the pump power feed; this wire comes from the power relay previously discussed. A black wire coming from the ECM is attached to the negative or "-" side of the fuel pump. Mount the fuel pump in the bracket supplied or similar, to keep the pump noise from radiating into the vehicle. You may want to "prime" the fuel feed line with gasoline to aid in the priming of the pump for proper operation.

FUEL LINES & FUEL PRESSURE SENSOR
NOTE: Only use fuel line rated for fuel injection. Steel line or braided fuel line is the most desirable for this application.

Your DBW fuel injection system only requires one fuel line to the injector block for proper operation. This fuel line comes directly to the fuel pump and requires no regulators. (See Picture next section) Insure that any factory fittings that are on the fuel tank are free flowing and do not restrict the flow of fuel.

Some stations have chosen to install a shut off valve in the feed line prior to the fuel filter for easier fuel filter service purposes.

THROTTLE BODY
The throttle body used for your DBW system is a production Bosch throttle body and is used to both allow the fuel flow and govern the speed of the engine. The throttle body mounts between the injector block and the lower adapter plate attached to the intake manifold. A single plug attaches to the throttle body and controls the throttle plate and sends two throttle position signals back to the ECM. These two signals are constantly compared to each other to insure a good and proper signal is used for the control. If one signal goes bad it uses the other signal and may put the vehicle into a reduced power mode so that the situation is taken care of. The TPS units are not serviceable and are serviced only as a complete throttle body assembly.

Connect the fuel line to the injector block and direct to the back side of the engine. This is a barbed pipe thread fitting and is sufficient for the pressures encountered with the fuel injection system.

INJECTOR BLOCK AND ADAPTER PLATES

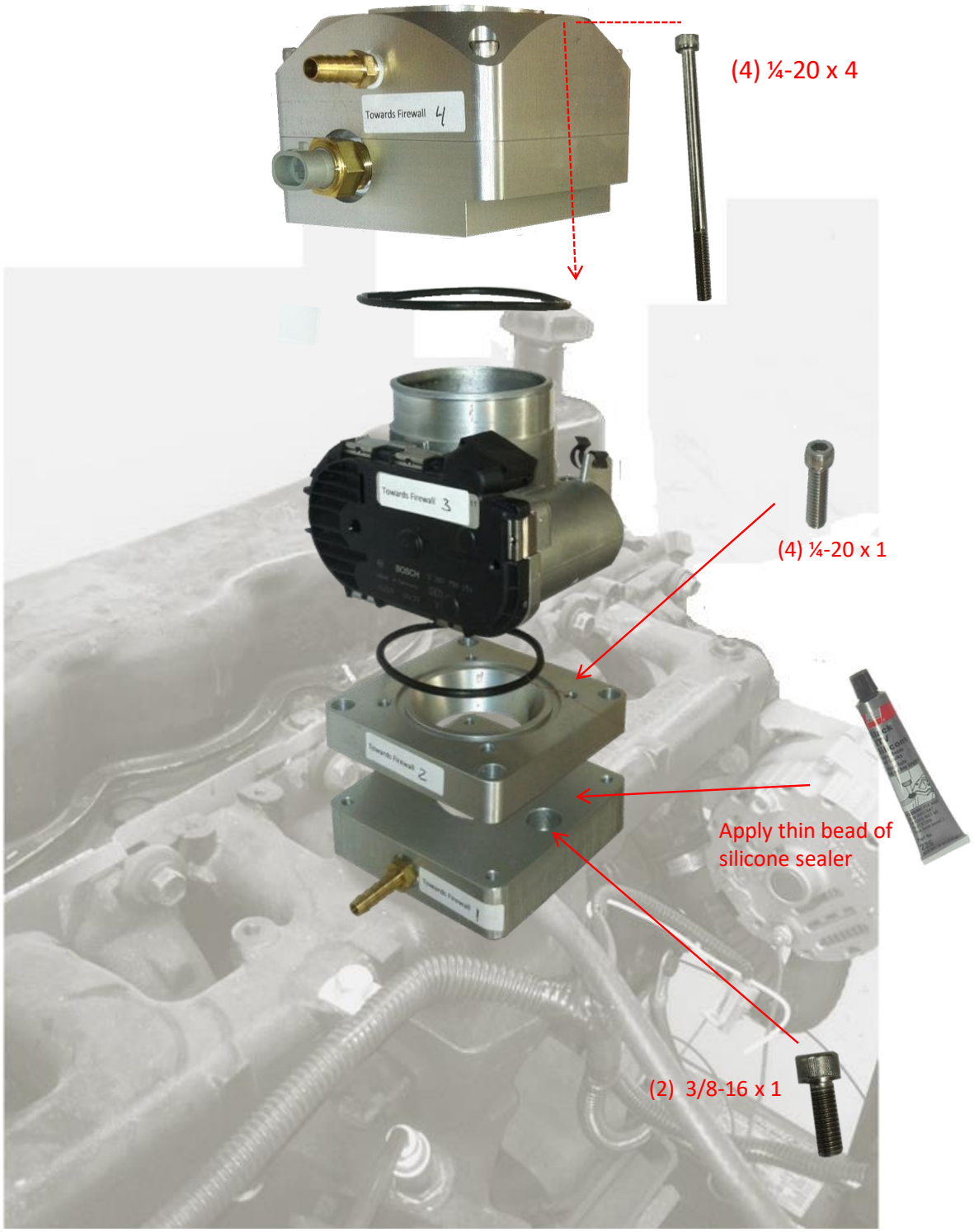
The throttle body mounts in between the adapter plate and an injector block. As received the two pieces of the injector block are already assembled together with the injector installed. The IAT and Fuel Pressure sensor are also part of the injector block. Four (4) 4 x ¼" x 20 bolts are supplied which are used to attach the injector block to the lower adapter plate with the throttle body sandwiched in-between the two components.

In order to allow for proper flow and hold down of the throttle body, two lower adapter plates are used. The bottom plate uses a gasket to mount on the intake manifold along with two (2) 3/8" x 1" bolts to fasten it to the intake manifold. It may be necessary to remove the studs which held down the carburetor to the intake manifold if this is that type of conversion.

A second lower adapter plate fastens down to plate attached to the intake. A thin layer of sealer such as silicone is to be spread thinly between the two plates before tightening down the bolts holding the two plates. The plate is then fastened to the lower plate with four (4) ¼" x 1" bolts which are provided. A supplied O-ring is to be placed in the groove which has been machined into that second adapter plate. This O-ring is a seal for the throttle body when installed.

With the two lower plates installed and the O-ring in the groove, place the throttle body onto the plate. Place the upper injector block over the throttle body and insert the four (4) ¼" x 4" socket head bolts to hold the injector block to the throttle body and to seal the entire assembly. Insure that thread sealer is used on all threads to prevent the bolts from backing off.

AFI Gen 3 Throttle Body



THROTTLE PEDAL

DBW systems require an electronic pedal to produce the input needed to actuate the throttle plate. The pedal that is provide with the Gen III DBW system is a Cummings Diesel pedal and is of the highest of quality. Just as with the throttle body, the pedal has 2 sensors which constantly are matched with each other to maintain the proper signal. These signals are designated as APP1 and APP2 (Accelerator Pedal Position). The pedal position sensor is serviceable as a separate unit from the peda if the APP has a fault. During an APP fault the ECM will stop control of the throttle and go to a standard spring position.

The Pedal is to be mounted in a location which makes it easily actuated by the operator and allows for 100% throttle actuation. Different Tug MA applications seem to have different angles to the floor so best judement is needed to mount properly. There are two holes needed to mount the pedal bracket to the firewall of your equipment. Simply mark place the pedal in the location you want, mark the holes and drill accordingly. Use proper length bolts with safety nuts or lock washers accordingly.

ENGINE SENSORS

MAP SENSOR

The MAP sensor is a very important part of the fuel injection system. This sensor sends a voltage to the ECM in relation to the amount of vacuum (pressure) the engine is creating. This signal is used in conjunction with the engine speed to infer the amount of air that is being used by the engine. This is what is called a speed/density system. Because fuel control is very

dependent upon this signal it is very important to install correctly. This sensor is to be installed as close to the manifold vacuum source as possible. The port on the sensor is to face down with the vacuum line attached. This vacuum line should have no sags or dips and the length should be as short as possible. Some people install this sensor in the center of the firewall towards the cowl, under the cowl itself or even under the air cleaner at times. Attention needs to be given to the connection of the vacuum line ensuring no leaks. A port of its own is supplied on the bottom adapter plate which allows for the proper signal. See picture in illustration section.

COOLANT SENSOR

The coolant sensor is just like it sounds; it sends an electrical signal to the ECM in proportion to the engine coolant temperature. This sensor is to be installed before the thermostat preferably or in the block itself. (See picture in illustration section) There is a plug in the rear of the block that can be used for the ECT sensor or anywhere on the engine side of the thermostat. Connect the two-wire connector when installed. Ensure that there are no coolant leaks from the threads of the sensor. It is also important that a continuous flow of coolant is present at the tip of the sensor or a false reading and engine damage can occur.

Units with cabs and cab heaters require special attention to this sensor installation. A 3/8 NPT "T" is provided with the proper size hose nipple for the heater hose. The sensor needs to be mounted 90 degrees to the flow of coolant in this "T". There needs to be constant flow past this sensor so no shut off valves are to be installed in this type of application. If there is a desire to shut the coolant off to the heater in warm weather operation the hose will need to be routed to the inlet of the water pump or removed all together and the ECT sensor mounted in the block.

INTAKE AIR TEMPERATURE SENSOR

The IAT is just like it sounds; it sends an electrical signal to the ECM in proportion to the air temperature in the throttle body. This sensor is already mounted in the injector block. Connect the two-wire connector when installed. Ensure that there are no leaks from the threads of the sensor if replacing the sensor. This sensor does not cause any significant operational issues so if an IAT sensor code is found, determine if the sensor has been unplugged during servicing. The sensor does need to be replaced if faulty in order to keep the CEL off and operating under its normal condition.

FUEL PRESSURE SENSOR

This AFI system incorporates the latest Electronic Returnless Fuel system technology. This system uses a fuel pressure sensor in the fuel delivery system as the input for its control. The ECM varies the amount of fuel to the fuel pump to maintain a predetermined fuel pressure to the system. The system operates at 45 psi under

most conditions and 55 or more psi under maximum load conditions. The fuel pressure sensor has a 3 pin connector which is placed in the harness for accurate connection.

HEATED OXYGEN SENSOR

The oxygen sensor is installed in the exhaust manifold or exhaust pipe and samples the exhaust to determine if the engine is running rich or lean of 14.7:1 air/fuel ratio. The O2 sensor should be installed as close to the engine as possible. Many replacement manifolds have a boss already tapped that will accept an O2 sensor. It is preferable to use this location or drill and tap that location on the manifold.

ENGINE GROUND

An eye terminal with 1-3 black wires and labeled "engine ground" needs to be properly attached to the engine block. It is very critical that a proper ground is used for this input to the ECM and that it is mounted to the engine itself. ***It is most critical that this is a connection going to a bare grounding surface and not a painted surface. It is good practice to run an extra ground wire from the negative (-) on the battery to the ground wire coming from the ECM (from the wire harness Engine ground). Make sure that the ground from the engine to the body of the vehicle is intact. An improper ground will not allow the system to operate properly.***

DISTRIBUTOR MODULE

This GEN III AFI fuel injection system includes full ECM control of the spark advance. A distributor module is mounted inside of a high temperature plastic box and mounted to an aluminum base plate.

Two connectors are located on the side of the distributor module box. A four (4) pin connector from the wiring harness will attach to the appropriate place on the module. An additional 2 pin connector is included on the vehicle harness and is the power supply and trigger for the ignition coil. The pink wire labeled 12v ign. is supplied 12 volt ign. from the fuse block. The white

wire connects to the negative terminal of the coil and is also part of the vehicle harness.

Your system includes a coil supplied by AFI it will have two connectors on it. Both connectors will be part of the vehicle harness and can only be installed one way, with one attaching to the distributor module and the other being power from the vehicle harness.

DISTRBUTOR

AFI's GEN III EFI system for the I-6 Ford engine uses a Hall Effect distributor which has been supplied with your kit to deliver the appropriate spark ignition. This distributor has been modified to work with your AFI conversion kit. The distributor supplied with your kit is to replace your current distributor.

Insure that after your new distributor has been installed that the appropriate timing mark is used to set the initial ignition timing. Bring #1 cylinder up to TDC with the spark plug removed and verify the timing mark you will use is lined up with this mark. Some engines that have been updated can have two different timing mark locations. If not properly set the engine will not operate correctly.

There is a 3 pin weatherpak® connector that will attach directly to the mating 3 pin weatherpak® connector coming from the wire harness and marked distributor. After installing the distributor and running the engine set the base ignition timing to 14 deg. BTDC.[1]

NEUTRAL DRIVE INPUT

For mobile unit applications such as Tugs and Belt loaders the neutral safety switch can be used to insure proper operation. This allows for individual ECM control of the engine RPM at idle in neutral and drive respectively. This input also locks out the "RPM Lift" if incorporated for Belt Loaders and other equipment that may require RPM increase to operate auxiliary hydraulic pumps etc.

To accomplish this, a 5 pin relay directs a 12 volt signal to the ECM to "tell" the ECM whether the lever is in neutral or drive; 12 volts to the ECM

[1] Weatherpak is a Registered Trademark of Delphi Corporation.

indicates that the unit is in neutral while an open signal indicates drive. To accomplish this also and to allow for neutral safety input for engine crank the relay is incorporated into the system. Three connections from the vehicle are required and are part of the options connector and vehicle harness.

If this relay is not working there will not be two different top speeds available during operation of the engine. Maximum neutral idle speed is 2,000 RPM's and drive will be 2,350 RPM's which equates to 15 mph vehicle speed.

CRANK INPUT

This input is part of the vehicle harness and attached to the appropriate connectors in the system. See wiring diagrams for more info. This signal is used to engage the starter but also limit the starters use during low fuel or out of range engine running conditions.

LOW FUEL LEVEL SHUT DOWN

This feature is part of your system and will shut the engine down and lock out the starter (comes with smart start above) if the fuel level reaches a critically low level. This protects the fuel pump from running dry and premature failure.

A single wire marked "FUEL LEVEL INDICATOR" attaches to the provided fuel tank sending unit. For TUG Inc. vehicles simply remove the 4 screws holding down the current level indicator and replace with the provided sending unit. It may be necessary to attach an additional ground wire to the fuel tank or fuel sending unit. Insure that this wire is located in an area that is remote and attaches to a good ground.

LOW OIL PRESSURE SHUT DOWN

This feature will shut the engine down if the oil pressure drops below 4 psi while running or after a start. Included is a bushing that will screw into the current tapped block location for oil pressure. Screw this bushing into the engine using thread sealer to reduce the possibility of an oil leak from the threads. The oil pressure switch will then screw into the bushing. Plug the single wire connector labeled "Oil Pressure Switch" into the appropriate connection on the pressure switch.

FINAL CHECKS AND START UP

After you have finished the above installations you are ready to check the system for operation. Turn the ignition key to the "ON" position, but do not start the engine. The fuel pump should turn on for about 2 seconds and then turn off. If this does not happen see #8 below in troubleshooting. Disconnect the connector from the injector and crank the engine for about 5 seconds; reinstall the injector connector after this operation Leave the ignition in the "ON" position until the fuel pump has turned off. Turn the ignition off for at least 10 seconds and repeat the ignition cycle. Perform this operation 2 or 3 times to allow fuel to fill the system preparing to start. Inspect all fuel lines and connections to ensure there are no fuel leaks. It would also be appropriate at this time to install your scan tool and read the fuel pressure on the scanner and insure the proper fuel pressure of 42 -55 psi is being delivered. It is possible if the key has been cycled on and off several times and the engine not cranked that the fuel pressure will indicate higher until the engine is cranked and started.

Assuming no fuel leaks, you are ready to start the engine. Do not press on the accelerator pedal to start the engine. The throttle body will provide the proper amount of air for the vehicle to start and run. Start the engine and let it idle; it may take a bit to run smoothly. At this point the control system has not "learned" the engine and the throttle plate has not learned its proper position. These are all functions of the fuel injection system that happen after the engine has been running. It may be necessary to adjust the ignition timing close to the final setting of 14 deg. BTDC.

Restart the engine and let it idle for a while. Insure that there are no fuel or vacuum leaks while running and that the idle appears to be controlled by the ECM. The engine speed will be higher while cold and first started and will come down to a base idle on its own. If the engine will not idle properly check for vacuum leaks, proper timing setting, or a check engine light illuminated. When you are confident that all is running properly, you may shut it down and complete the remainder of the installation.

Set ignition timing to 14 deg. BTDC with the engine fully warmed up and at base idle RPM. Insure that the timing is in fact being set with the proper TDC indicator. We have found on some engines that two different indicators are present and that the timing was set to the incorrect indicator. This causes operational issues with the engine if the timing is not set correctly. It is best to verify ignition timing with an advance meter timing light with the engine running at its maximum neutral RPM. This is accomplished by simply pushing the pedal to the floor and it will rest at 2,000 RPM's. Read the timing on the scan tool and the timing on the engine with the timing light should match. If not, set the timing accordingly so that the timing on the engine matches what the timing request from the ECM is. Once set there are no other adjustments to the timing necessary and good unless serviced.

Secure any wires that you may choose, ensuring they are routed away from exhaust manifolds, cables, etc.

Install the air cleaner and you should be ready for operation.

A final check with a scan tool should be performed. Your OBDII enabled scan tool can be used in Generic OBDII mode to access the sensor data. Your sensors fully warmed up should read close to the following values.

ECT > 180
IAT ambient temperature to 40 deg. or so above ambient.
MAP 8 – 13 in. / 16 – 21 in. HG.
TPS 3-5%
Closed loop operation
Idle speed 625 - 750 RPM
STFT dither about 0%
LTFT 0 to + or – 15% idle at times is offset more. Call tech support for any further questions or clarification.

Once you have installed your Affordable Fuel Injection system you will enjoy the modern technology of fuel injection for years to come. You will benefit from a low maintenance system that provides good drivability and adjusts for towing, altitude and other normal drive situations. The greatest advantage to EFI is dependability and drivability. EFI for the most part is relatively maintenance free once installed and working properly. The sensors are robust and provide for many hours of maintenance free operation. EFI also provides seamless drivability. The system supports all of your engine functions whether it is –20 deg. Or 100 deg, at sea level or 5,000 ft.

Thank you from Affordable Fuel Injection.

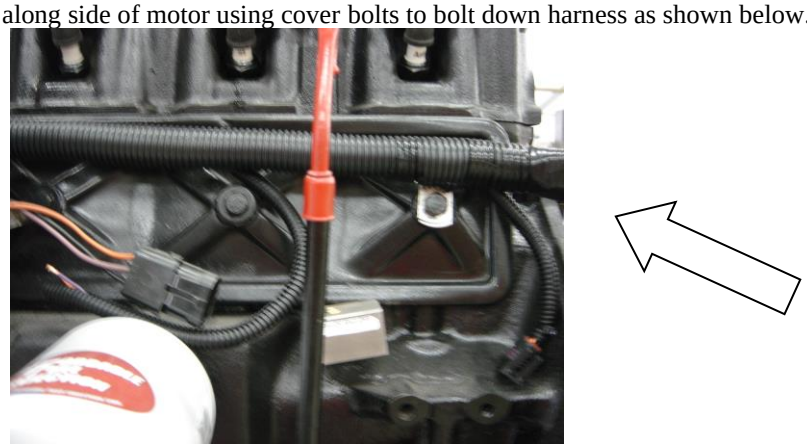
FINAL INSTALLATION QUICK CHECK LIST

1. **MAP sensor is installed with port down and to full manifold vacuum source on the adapter plate.**
2. **All fuel lines are tight and no fuel leaks are present.**
3. **Thermostat is 190-195 deg. and operational.**
4. **Extra grounds supplied to the frame and the block.**
5. **Insure no oil leaks from oil pressure sending unit.**
6. **Timing set to 14 deg. BTDC.**

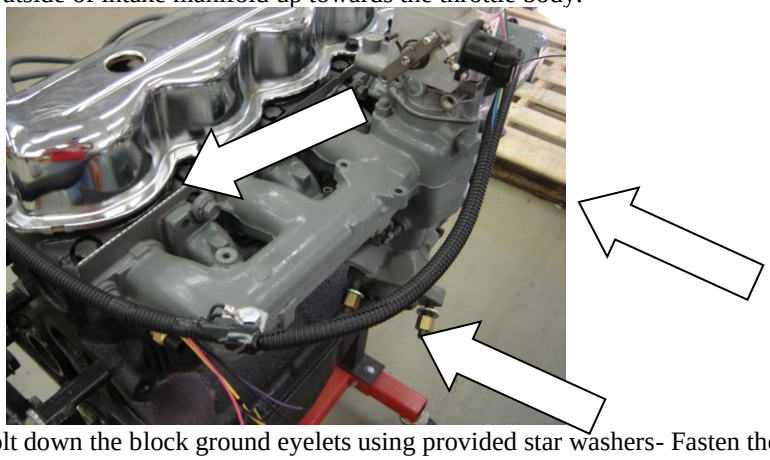
Affordable Fuel Injection Gen 3 Harness/ECM Installation Instructions

Mount the ECM Bracket in place of the mechanical fuel pump. Note: DO NOT forget gasket

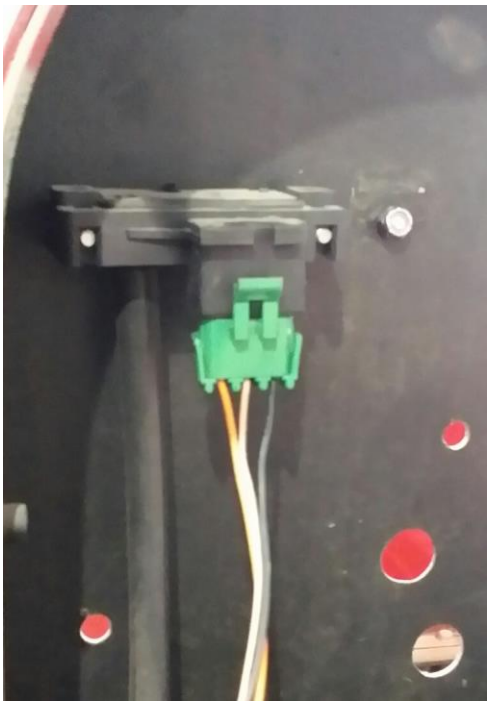
Run the harness trunk along side of motor using cover bolts to bolt down harness as shown below.



Run the portion of harness that goes to the throttle body up using back valve cover bolt and run harness to outside of intake manifold up towards the throttle body.



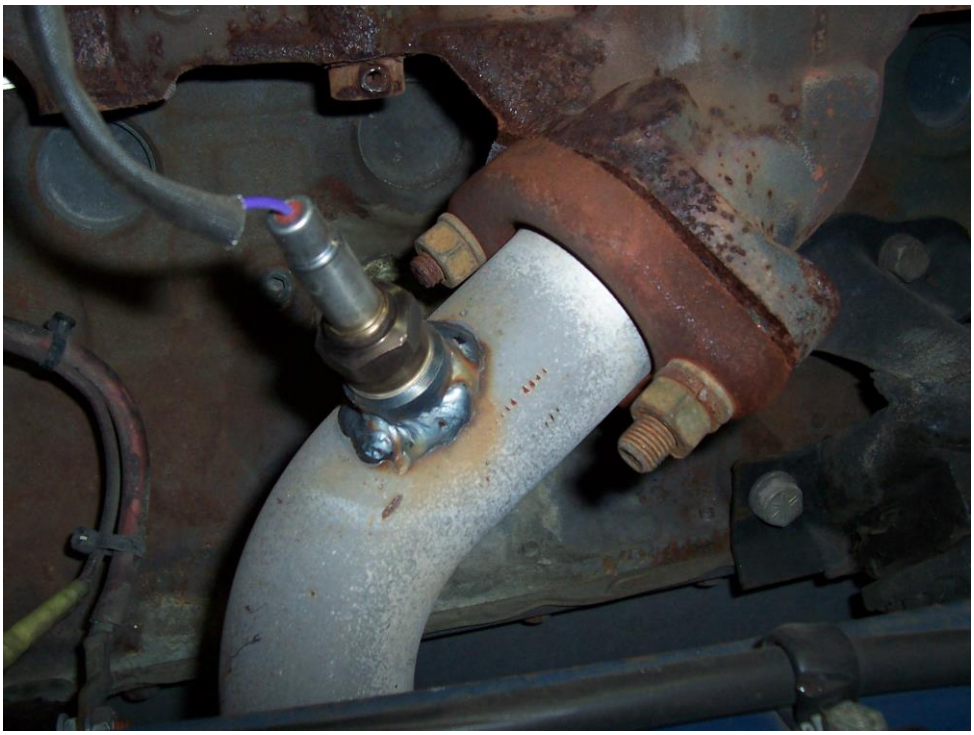
Note: Do NOT forget to bolt down the block ground eyelets using provided star washers- Fasten the eyelets under the provided clamp using both star washers on the TOP OUTSIDE CORNER of the INTAKE Manifold.



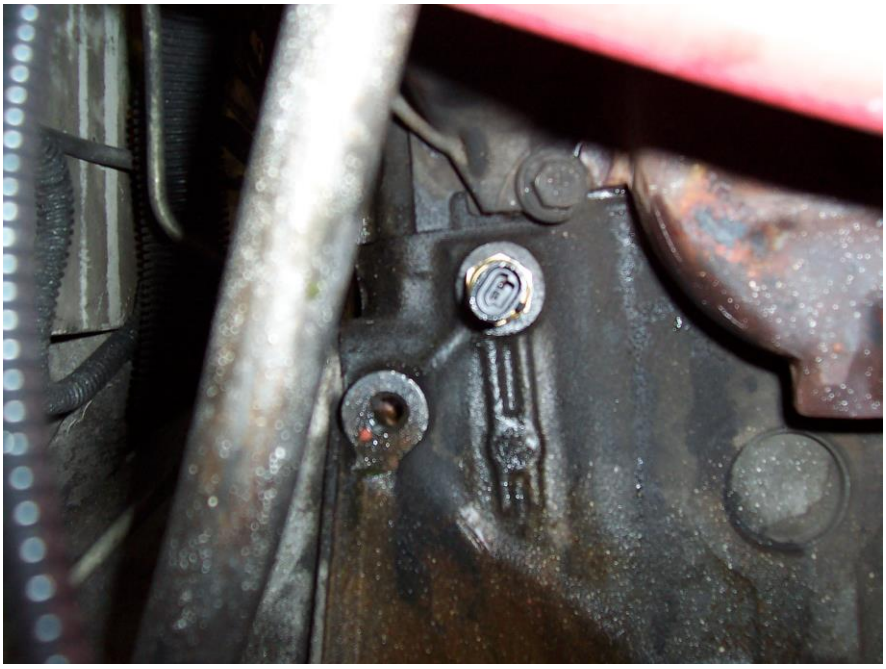
Preferred MAP sensor orientation

MAP sensor vacuum line attachment

Typical O2 installation when tapped hole is not available in the exhaust manifold. An 18mm hole can be drilled and tapped into the standard O2 location in the exhaust manifold.

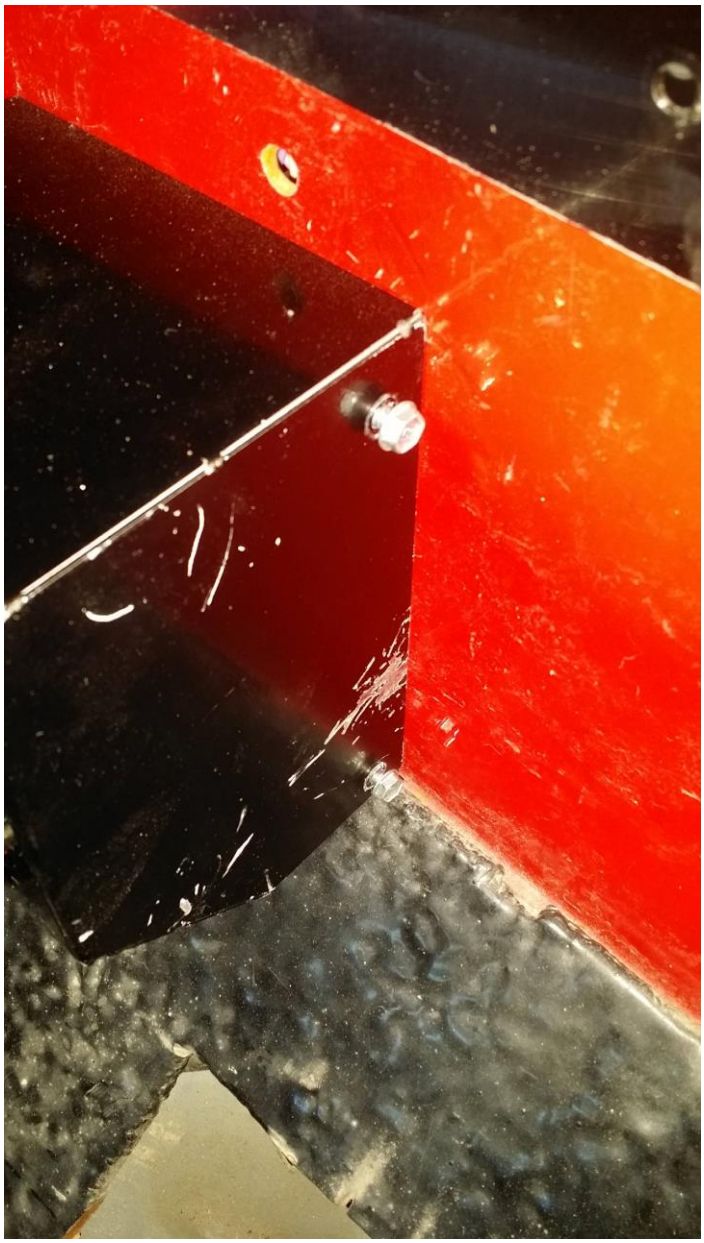


Below typical ECT installation at the rear of the block under the intake manifold. ECT needs to have constant flow of coolant on the sensor.

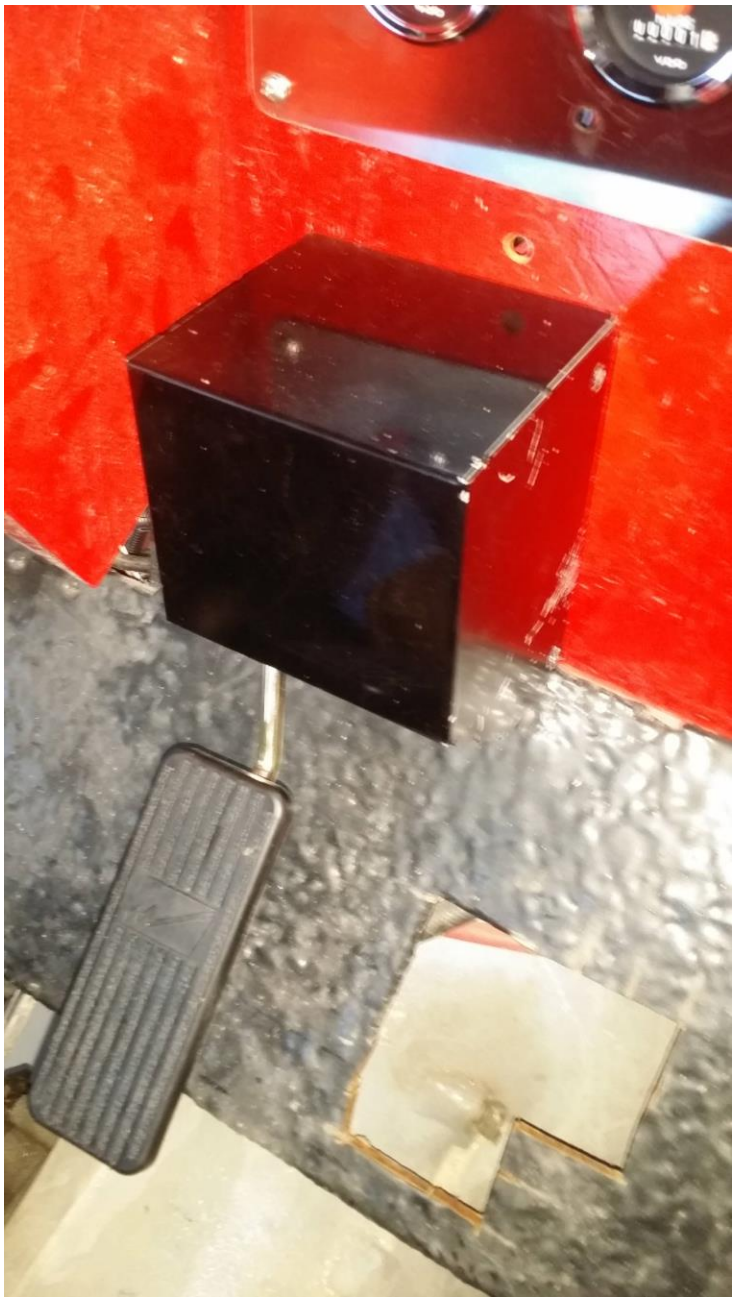


Pedal and pedal bracket

Pedal Position Sensor Connector



Pedal Cover attachment



Pedal installed with cover

Tug Pedal Installation

Distributor module connections. Pink – 12v white to coil neg.

Component Parts and Part Numbers

Harness *	8610
ECM	7203D
IAT	7303
ECT	7302
MAP	7300
O2 (Heated)	7301H3
Upper Throttle Body O' ringl	7611UOR
Lower Throttle Body o' ring	7611LOR
Electronic Throttle Body	7611ETC
Injector	7660
Flange Gasket	7621
Fuel Pressure Sensor	7318
Fuel Pump	7703
Electronic Pedal	7317HD
Fuel Pump Hold Down Clamp	7703-cl
Relay	7311h
CE Light	7313
Low Fuel Light	7315
Fuse Link	7314
Fuel Filter	G7092
Distributor	7815
Distributor Cap	7815-cap
Distributor Rotor	7815-rot
Oil Pressure Switch	7319
Fuel Level Switch	7320
Distributor Module	7820

* Base system

Troubleshooting your Gen III ETC Fuel Injection System

Quick Troubleshooting Guide

Connect Scan tool to the engine:
Verify proper value of each sensor with Key on Engine Off.

- TPS 3-8%
- MAP 90 – 100 dependent on altitude, will be less at high altitude.
- ECT consistent with engine temperature whether cold or warm
- IAT ambient temperature or higher

If any of the above sensors are broadcasting default values work to that problem
Default values are as follows:

- TPS 10%
- MAP 40
- IAT & ECT 77 deg. F or 25 deg. C.

If all the above checks are OK, install fuel pressure gauge.

- Turn key on and observe fuel pressure. Fuel pump should cycle on and then off and pressure should be approximately 43 psi. It is not unusual for the initial pressure before the engine is running to be much higher. Running however it should be 43 $\pm$ 3 psie. If fuel pump does not turn on or pump does not provide full pressure repair fuel system or the code which is preventing the fuel pump from coming on.
- If pump cycles on and off, determine if pump comes back on when the engine is cranked. Fuel pump should come back on when engine is cranked.
- Verify that fuel pressure registers between 40 - 46 with the engine running. Repair fuel system if pressures are not in line or pressure drops on acceleration.

When all of these checks have been made continue to step by step guide to further diagnose operational issues.

Troubleshooting guide

Most of the problems encountered while installing your fuel injection system or after a time of operation are very simple. If your check engine light is on you more than likely have a hard fault meaning something is grounded out, unplugged, operating out of range or has gone bad. See below for how to determine what the fault may be and code definitions.

With the addition of Fuel Injection to your engine it is important to remember that the basics are still there, necessary and have not changed. Batteries must be fully charged, charging systems fully operational, the ignition system is fully operational and the integrity of the engine is intact. All of these items are common to an engine and need to be in full operational condition regardless of the fuel system that has been added to your engine.

The OBDII connector allows for full diagnostics of your unit.

If you have installed a Fuel Injection system in your vehicle and are having some initial issues here is a quick checklist to work from to get you started.

Pink Ignition wire MUST be connected to 12 volt switched ignition that receives power during crank and key on.

1. Check to make sure your check engine light is not on, or that it is on with the key on but the engine is not running.
2. Make sure that the red battery wire is connected to a battery source (It is highly recommended that this wire is connected directly to the battery) and the pink wire is connected to an ignition 1 source. If your ignition wire is not connected to an ignition 1 source your ECM will not be powered while cranking the engine.
3. Check that the ground wire is securely fastened to the block and that the interface between the block and the terminal is clean.
4. Ensure that there are **NO** vacuum leaks.
5. Ensure that your MAP sensor is connected to a full manifold vacuum source and not being influenced by PCV valves or other vacuum components. A vacuum port is located on the back side of the lower adapter plate and should be used for the MAP sensor signal.
6. Set the ignition timing correctly making sure that you have the engine fully warmed up and operating less than 800 RPM's.
7. Check your fuel pressure to ensure that you are providing the proper pressure to the system.

Fuel Pressure is critical for proper operation. Fuel tank must be free from debris and fuel pressure needs to be constant and consistent.

Some aftermarket high density fuel filters can cause a large drop in fuel pressure under load and are not recommended for use with your system. If you are using one of these types of filters insure that you have proper fuel pressure during all modes of operation.

99% of all issues are usually taken care of with one or more of these 8 steps of diagnosis.

First and foremost the engine and fuel injection system must be free of vacuum leaks. Vacuum leaks are the leading cause of installation issues with your fuel injection system. Check all sources of potential vacuum leaks including components not related to the fuel injection system.

Another common issue is a lack of good grounding. Many issues have been resolved simply by making sure that the ground path is secure and clean.

Fuel System Checks

Fuel Pressure is critical to the operation of a fuel injection system. Always check to insure that you have the proper fuel pressure. Fuel pressure should vary between about 42 – 55 PSI. At idle the fuel injection system is typically around 40 - 46 psi. Higher pressure than 55 psi indicates that there is an issue with the installation. The initial key on engine not running the fuel pressure may be higher until the unit is

running and the injector has triggered the fuel. (See Part 3 of Troubleshooting guide #3)

Fuel pressure on your Gen III TBI unit should vary between 40 – 55 psi based on the amount of vacuum from the engine and the RPM of the engine.

Your Gen III ERFS system will

With retrofit fuel injection systems many times we are drawing fuel from gas tanks that are many years old; hence many years have passed where contamination can settle into the fuel tank. The electric fuel pump installed for a fuel injection system will drawing a greater volume of fuel from your tank than your old system did. If there are any contaminants in the tank this many times will plug up or greatly restrict the flow of fuel to the system causing many issues.

ETC Information

AFI's Gen III DBW (Drive By Wire) Electronic Throttle Control incorporates the latest technology in throttle and engine speed control. This brief document is intended to provide you with some basic information about the system.

There are two main components to the DBW system, the throttle body and electronic pedal. The throttle body contains the electric motor which actuates the throttle plate and two throttle position sensors. None of these parts are serviceable and require replacement of the complete throttle body if any of these parts go bad.

The electronic pedal also has a double sensor and can be serviced either as a unit or the sensor individually.

The two sensors in each unit constantly monitor the other sensor to insure the integrity of the signal going to the ECM. Internally one sensor reads high to low while the other sensor reads low to high. For this reason while the same fault with one sensor may read high the other sensor may read low. In most cases if one of the sensors goes bad, the ECM will either use the other sensor or stop the ECM throttle control. If you find the throttle not working it is more than likely a sensor or ETC circuit fault in which the ECM has turned off ECM control of the throttle. This can be triggered by either a sensor failure or sensor out of range. A sensor code or sensor conflict code will be stored in the ECM. Some of these codes must be cleared, not just repaired for the ECM to return to throttle control. With any service the codes need to be cleared and insured that they do not return.

The following codes (DTC's) are stored with ETC faults.
TPS =Throttle Position Sensor
APP=Accelerator Pedal Position (Sensor)

P0122	TPS1 Circuit Low	Open Circuit
P0123	TPS1 Circuit High	Shorted to 12 volts high voltage output
P0222	TPS2 Circuit Low	
P0223	TPS2 Circuit High	
P0227	APP1 Circuit Low	
P0228	APP1 Circuit High	
P1121	TPS1 Adapt Low Min	
P1122	TPS1 Adapt Low Max	
P1123	TPS1 Adapt High Min	
P1124	TPS1 Adapt High Max	
P1125	TPS Intermittent	
P1215	APP2 Circuit Low	
P1216	APP2 Circuit High	
P1252	APP1 Adapt Low Min	
P1253	APP1 Adapt Low Max	
P1254	APP1 Adapt High Min	
P1255	APP1 Adapt High Max	
P1256	APP2 Adapt Low Min	
P1257	APP2 Adapt Low Max	
P1258	APP2 Adapt High Min	
P1259	APP2 Adapt high Max	
P1574	TPS Sensors Disagree	Shuts down ETC control
P1577	Pedal Sensors Disagree	Shuts down ETC control
P1585	Throttle Control Unit malfunction	Shuts down ETC control
P1586	ETC Sticking	Shuts down ETC control
P1587	ETC open circuit	Shuts down ETC control
P1588	ETC Spring test failed	Shuts down ETC control and no start of engine
P2121	TPS2 Adapt Low Min	
P2122	TPS2 Adapt Low Max	
P2123	TPS2 Adapt High Min	
P2124	TPS2 Adapt High Max	

Step by Step Troubleshooting guide.
Your fuel injection system has been pre calibrated to your particular vehicle. However from time to time problems are encountered with your fuel injection system. Here are a few commonly asked questions about fuel injection problems. Match the issue # with the chart below for an explanation of the issue and use the troubleshooting fault tree.

Use of this section requires a digital voltmeter, test light, fuel pressure gauge, timing light, tachometer and a diagnostic scan tool. If you are familiar with vehicles and how they are serviced you should be able to work through this section with no issues. In many instances you may want to have a professional automotive technician familiar with fuel injection repair to help you.

1. **My engine cranks but will not start.**
2. **Nothing happens when I push the accelerator pedal.**
3. **My engine is running to lean, or is backfiring on acceleration.**
4. **My engine is running rich.**
5. **I do not seem to have as much power as I should.**
6. **I am getting a sag when I accelerate.**
7. **My engine takes longer to start than I think it should.**
8. **The fuel pump is not coming on when I first turn the key on.**
9. **The RPM on my engine does not come down when I come to an idle.**
10. **I am not getting as good of fuel economy as I think I should.**
11. **The engine is revving up and down when I come down to an idle.**
12. **The engine stalls coming to an idle.**
13. **My fuel pump is real noisy.**
14. **My check engine light does not come on when I turn the key on.**
15. **My check engine light is on when the engine is running.**
16. **Engine shuts down and sometimes restarts and sometimes it doesn't.**

1. Engine cranks but will not start.

There is an assumption that the battery is at a full state of charge, the fuel tank has fuel in it and that all sensors are correctly connected and there are no trouble codes in the ECM. Low Oil pressure shutdown, low fuel shut down and some ETC faults will not allow the engine to start or the fuel pump to run. Insure that all of these are taken care of before going through any of the following checks.

1. Does the injector spray fuel when cranking the engine?

Yes – Go to step 2.
No – Check to insure there are no codes in the ECM, especially ETC codes. Certain DTC's associated with the ETC system will shut the system down and not turn on the fuel pump or inject fuel. If all of this is OK, continue with the next line.

- Remove the injector connector from the injector. With a voltmeter or test light measure the voltage or validate power to the pink wire of the connector with the key on.

Yes – Pink wire has voltage, go to step 1a.

No – There is no power getting to the system. Check for proper connection to the battery, fuses are good, relays have been connected and seated properly. Correct the power issue; if there is still no fuel spray when cranking the engine after this has been corrected go to step 1a.

1a. With the voltmeter or test light still connected crank the engine and verify voltage to the pink wire on the injector connector.

Results: "0" volts or the light goes out when cranking the engine.
The primary (pink) ignition wire is incorrectly connected to the vehicle. This is to be an ignition 1 (ING1) source which is power in both the key run and crank position. Correct the connection of this wire and verify voltage to the pink wire on the injector connector. Test again for fuel spray during crank. If the engine still cranks, is spraying fuel, but will not start go to step 2.

"Low volts, < 8" This is an indication of either a battery in a state of very low charge, a bad battery or too much resistance in the system.
-record the battery voltage while cranking at the battery.
-record the voltage at the pink wire of the injector connector while cranking the engine.
-compare these two voltages, they should be within .2 (2/10) volts of each other. If these voltages are greater than .2 there is a bad connection or too much resistance in the wire feeding the ECM.
-Correct the issue with low voltage. If cranking voltage is above 9 volts while cranking and there is still no fuel spraying the issue is in the fuel delivery system.

"9 volts or higher" this is normal cranking voltage. If there is no fuel spraying while cranking the issue is in the fuel delivery system or ignition system Trouble shoot the fuel system for improper operation (See Fuel System checks at the beginning of this guide). Troubleshoot ignition system, go to 1b.

1b. Your TBI fuel injection system fueling is "triggered" from the ignition system. It is assumed that the coil is operational, a 12 volt ignition 1 (IGN1) source is connected to the positive terminal of the coil.

Remove plug wire and check for spark while cranking.

No Spark – Repair ignition system.

Has spark – Insure wire continuity between the ECM and the distributor . If fuel is still not spraying go to fuel system troubleshooting before replacing any components. If all wires are in tact and routed correctly and all fuel system checks are correct, replace distributor module.

2. Perform the fuel system checks found at the beginning of this troubleshooting Guide. If the fuel pressure and fuel system are operating as required Insure that the check engine light is on with the key on but the engine not running and there are no stored codes.
If you have installed a new distributor, removed the distributor for any reason your ignition timing may be off too much to operate the engine properly. Disconnect the connector from the injector and set the ignition timing to its proper setting while cranking the engine. Assumption here also is that the timing mark on the balancer is lined up with TDC of #1 cylinder and that the distributor is seated properly and not 180 degrees off. If all of this checks OK go to step 3.

3. Using a scan tool you can read TPS. TPS should be between 3- 8%. If TPS is at 10% the TPS is most likely bad and broadcasting this default value.

If you have gone through all of the above procedures and the engine still will not start you will need to call tech support. When you call tech support you will need to have the following information available.

Fuel pressure at the inlet of the TBI unit_____
Voltage measured at the battery while cranking_____
Voltage measured at the pink wire on the injector while cranking_____
Codes stored in the ECM
Any information that you feel is important for diagnosing the issue at hand.

2. Nothing happens when I push the accelerator pedal.

This indicates that there has been a fault detected in the ETC system. The check engine light should be on and a trouble code or codes will be set indicating the fault.

The fault should come from one of two things be it the throttle body or the pedal sensor. These items are mostly serviced as an assembly and as such require replacement in the event that something goes wrong with them.

3. My engine is running to lean, or is backfiring on acceleration.

Assumption here is that all plug wires are installed properly, the secondary ignition system (plug wires, coil, cap and rotor) is in good operating order and the engine is in good order.

Perform fuel system checks found at the beginning of this guide and make any corrections as necessary.

Check initial ignition timing again.

If the timing is OK check to insure that the timing is advancing as it should with accelerator pedal actuation.

If the fuel system checks performed are OK and the initial ignition timing is OK you will need to call tech support.

If you have gone through all of the above procedures and the engine is still running lean or is backfiring on acceleration you will need to call tech support. When you call tech support you will need to have the following information available.

Fuel pressure at idle_____
Fuel pressure while briefly accelerating the engine to WOT_____
Voltage measured at the battery while running_____
Engine operational temperature_____
Initial ignition timing_____
Timing at 2000 RPM_____
Any information that you feel is important for diagnosing the issue at hand.

4. Engine runs too rich.

Check for vacuum leaks and insure that all vacuum leaks are corrected and sealed. If the engine is also running at a higher than expected idle this is a good indication of a vacuum leak as well. Repair any engine diagnostic codes found in the ECM.

The most common items which cause the engine to run rich are O2 sensors and MAP sensors. The guide below directs the repair person to other items which can have faults causing the same issue.

1. Is the vacuum line to the MAP sensor securely fastened to both the MAP sensor port and a full manifold vacuum port on the adapter plate?

Yes, If engine is still running rich go to step 2.
No – Repair leak, kink or routing, is engine still running rich? If yes go to step 2.

2. Is the MAP sensor connected to a full manifold vacuum port?

Yes – If engine is still running rich go to step 3.
No – Correct the vacuum source issue, if the engine is still running rich go to step 3.

3. Is the fuel pressure measured at 40 - 46 psi while idling?

Yes – If the engine is still running rich go to step 4.
No – Is the fuel line restricted between the fuel pump and the throttle body?
Many fuel tanks have a port on the fuel tank that is for a fuel vent. These ports are not adequate for a fuel feed. There is an orifice in these ports that will restrict the flow of fuel. Check that you have not used a vent port for the fuel line or there are no restrictions is the fuel lines including fuel filter.

4. Does the engine have a fully operational thermostat?

Yes – insure that the engine will reach 190 deg. in a reasonable time, go to step 5.
No – Install new thermostat, proper size thermostat will be 190- 195. 160 degree thermostat is not acceptable for this application and will not comply with AFI warranty or emissions requirements. If you are running a 180 degree thermostat contact AFI about your application. If still running rich go to step 5.

5. Is the coolant sensor installed in a portion of the engine or the cylinder block which provides a constant flow of coolant over the tip of the sensor?

Yes –Go to step 6.
No – Reinstall the coolant sensor in a different location to insure constant flow of coolant over the sensor. If still running rich go to step 6.

6. Is the charging system operating properly and is the voltage measured at the battery and the injector 13 volts or higher with the engine running?

Yes – Go to step 7.
No – Repair charging system. If still running rich after reparing go to step 7.

7. If you have gone through all of the above procedures and the engine is still running rich you will need to call tech support. When you call tech support you will need to have the following information available.

Fuel pressure at idle_____
Voltage measured at the battery while running_____
Voltage measured at the pink wire on the injector while cranking.
Engine RPM at start up idle on a cold start_____
Engine RPM at idle with stabilized temperature_____
Engine operational temperature_____
Initial ignition timing_____
Any information that you feel is important for diagnosing the issue at hand.

5. I do not seem to have as much power as I should.

Verify that you have set your timing properly, timing should be set to 12 deg. BTDC with the engine fully warmed up and RPM below 800.

Verify that the timing mark for TDC of #1 cylinder that is being used to set the timing lines up properly with TDC of #1 cylinder (#1 piston at TDC with spark plug removed).

Ensure that your plug wires are properly connected with the correct firing order.

Your fuel pressure may be insufficient; see fuel system checks at the beginning of this guide.

Verify that there are no vacuum leaks and that the MAP sensor is properly connected.

6. I am getting a sag when I accelerate.

Insure that the MAP, TPS and Pedal sensors are working properly with scan tool. Default values for MAP and TPS are a single value and can cause a sag if not operating properly.

Timing is a critical issue with sags. Verify that your timing is set correctly. see #4 also.

Fuel pressure is not adequate for proper operation, make sure that there is no contamination in the tank or your fuel filter is plugged. (See Fuel System check above). A plugged fuel filter may be an indication of a contaminated tank.

Bad ground to the block, insure that the surface that you are making the connection to on the block is clean and making a positive connection.

Your O2 sensor may be contaminated, bad or not properly installed in the exhaust.

If you have gone through all of the above procedures and the engine is still sagging on acceleration you will need to call tech support. When you call tech support you will need to have the following information available.

Fuel pressure at idle_____
Fuel pressure when throttle is blipped to WOT _____
Voltage measured at the battery while running_____
Voltage measured at the pink wire on the injector while cranking.
Engine RPM at start up idle on a cold start_____
Engine RPM at idle with stabilized temperature_____
Engine operational temperature_____
Initial ignition timing_____
Any information that you feel is important for diagnosing the issue at hand.

7. My engine takes longer to start than I think it should.

Your AFI DBW system may take a slightly longer time to crank and start than what you may be used to. If you Check for vacuum leaks, this is the most common cause.

Make sure that your timing is set correctly; see Troubleshooting point #4.
Fuel pressure is not adequate for proper operation. See Fuel System Checks at the beginning of this guide.

Check that the MAP sensor is properly connected to a full manifold vacuum source. Ensure that the vacuum source to your MAP sensor is free from restrictions and has a secure connection.

If you have gone through all of the above procedures and the engine is still sagging on acceleration you will need to call tech support. When you call tech support you will need to have the following information available.

Fuel pressure at idle_____
Voltage measured at the battery while running_____
Voltage measured at the pink wire on the injector while cranking_____
Voltage measured between the black wire and brown wire on the TPS with the key on engine not running_____
Engine RPM at start up idle on a cold start_____
Engine RPM at idle with stabilized temperature_____
Engine RPM at idle with IAC fully blocked off._____
IAC counts at stabilized idle in drive if using a scan tool_____
Engine operational temperature_____
Initial ignition timing_____
Any information that you feel is important for diagnosing the issue at hand.

8. The fuel pump is not coming on when I first turn the key on.

Verify first that there are no DTC's stored in the ECM. Some codes associated with low oil shut down, low fuel shut down and the ETC system direct the ECM to shut down the system. These need to be repaired before moving on.

Is the check engine light on with the key on engine off? (Assumes check engine light is connected properly, see installation instructions to verify check engine light installation)

Yes - Go to step 1.
No – Check for proper installation of check engine light.

a. Check fuses to insure that they are not blown. If fuses are OK go to b.
b. Check voltage at check engine light, if 12 volt are not present the check engine light is not connected properly. If 12 volts are present either the ECM is not powered properly or is defective.

1. Insure that the IGN1 wire is not connected to a battery feed.
   a. Check pink wire to the power relay and/or the pink wire powering up the injector(s) to insure there is no voltage with the key off. If voltage is present with the key off the pink wire is not properly connected or the power relay is bad.
   a. Check fuel pump for proper operation.
      - Install fuel pressure gauge.
      - Turn ignition off for at least 15 seconds.
      - Turn ignition on, fuel pump should turn on for a short period of time and fuel pressure should be between 40 – 100 psi.
      - Fuel pump should turn off and turn back on when the engine cranks.

- The fuel pump is powered through the ECM, both power and ground. A voltmeter placed across the terminals of the fuel pump will verify voltage to the fuel pump.

If you have gone through all of the above procedures and the fuel pump is still not coming on when you turn the key on you will need to call tech support. When you call tech support you will need to have the following information available.

Voltage measured at the check engine light with key on engine off_____
Voltage measured at the pink wire on the injector while cranking_____
Voltage measured at the pink wire on the injector with the key off_____
Voltage measured at the pink wire to the fuel pump at the first 3 seconds of the key on_____
Voltage measured with voltmeter between the black wire and pink wire on the fuel pump for the first 3 seconds of the key on_____
Any information that you feel is important for diagnosing the issue at hand.

9. The RPM on my engine does not come down when I come to an idle.

- More than likely you have a large vacuum leak, verify that your system is free from vacuum leaks.
- Check that all non used vacuum ports are plugged.
- Your ignition wire is connected to a battery source and not an ignition 1 source.
- The engine has not come to full operating temperature as of yet.
- Your thermostat is inoperable or opens at too low of a temperature. A 190^{o} stat is required for this application.
- Throttle plate is binding in the throttle bores, will set a DTC and check engine light will be on.

If you have gone through all of the above procedures and the engine is still idling too high you will need to call tech support. When you call tech support you will need to have the following information available.

Engine RPM at start up idle on a cold start_____
Engine RPM at idle with stabilized temperature_____
TPS percent at stabilized idle in neutral and drive on scan tool_____
Engine operational temperature_____
Initial ignition timing_____
Any information that you feel is important for diagnosing the issue at hand.

10. I am not getting as good of fuel economy as I think I should.

If all is set up properly with the installation of your fuel injection system you are probably getting as good of fuel economy as you are going to get.

1. Insure that your timing is set properly

2. Your thermostat is in good working order and is 190 degree or above.
3. Your fuel pressure is at the specified pressure (see fuel system check at the beginning of this guide.
4. You may have other factors such as tires, brake drag or other external issue from the fuel injection system that is not working properly.

If you have gone through all of the above procedures and you still feel that you should be getting better fuel economy you will need to call tech support. When you call tech support you will need to have the following information available.

What is the Fuel Economy that you are getting_____
What is the Fuel Economy that you are expecting_____
Voltage measured at the battery while running_____
Engine RPM at idle with stabilized temperature_____
Engine operational temperature_____
Initial ignition timing_____
Trouble Codes from the ECM (see #14)_____
Any information that you feel is important for diagnosing the issue at hand.

7. The engine is revving up and down when I come down to an idle. My engine stalls or almost stalls when I come down to an idle.

This is usually an indication of a vacuum leak; again make sure that you have no vacuum leaks.

This could also be an indication of the wrong base ignition timing. Verify that you have set your ignition timing correctly (see #4).

- Make sure your engine temperature is at full operating temperature.
- Check that the RPM is 675 – 750 in neutral with the engine fully warmed up.
- If you have a fast idle after 1 minute of operation you have a vacuum leak that is not repaired, or the throttle plates are in a default position. A check engine light will be on and a code associated with the ETC system will be present.
- Check fuel pressure. If fuel pressure is oscillating up and down there is an issue with the ERFS system that needs to be repaired. See fuel system checks above.

If you have gone through all of the above procedures and the engine is still idling too high you will need to call tech support. When you call tech support you will need to have the following information available.

Engine RPM at start up idle on a cold start_____
Engine RPM at idle with stabilized temperature_____

Fuel Pressure at idle and 2000 RPM _____
TPS percent at stabilized idle in neutral and drive on a scan tool_____
Engine operational temperature_____
Initial ignition timing_____
Any information that you feel is important for diagnosing the issue at hand.

8. The engine stalls coming to an idle.

Verify all ignition system components are operating properly, including cap, rotor, secondary ignition wires and coil.

Verify that the ETC is operating properly.

a. Shut engine off
b. Throttle plates should go closed, open up to 75% and then drop down.
c. Turn key on for 10 seconds and turn off again.
d. Throttle plates should activate as above.
e. Verify no ETC related codes are present. Service as necessary.

Start up engine, RPM should be significantly higher than the base RPM. If the engine RPM did not increase the IAC is bad or the wiring is faulty to the IAC or the ECM is bad. Repair as necessary.

Verify proper fuel pressure, perform above fuel system checks.

Verify timing is proper

Verify that the EGR is working properly and not sticking. (if equipped)
Sticking EGR valve will cause a stall.

13. My fuel pump is real noisy.

If your fuel pump is real noisy you may not have isolated it from the body or the frame real well. Isolation brackets were provided with your fuel pump. If these are properly installed it should isolate any radiated noise from the pump. If this is insufficient you may need to isolate it more with some rubber grommets.

We have also diagnosed noisy fuel pumps with fuel return lines being too small. By stepping up the size of the return line you may eliminate fuel pump noise after the other items have been addressed. Fuel pump noise also can radiate through the fuel lines to the frame or body of the vehicle. Insure that the fuel lines are isolated as well if need be to eliminate the noise.

A noisy fuel pump can also be an indication that it is starving for fuel. Insure that all filters are in good order and that the fuel tank sock is clean. Prolonged fuel starvation will damage the fuel pump and not allow proper flow; it may also radiate a lot of noise.

14. My check engine light does not come on when I turn the key on.

Your check engine light should illuminate when you turn the key to the on position for a bulb check.
Check for proper installation of check engine light.

a. Check fuses to insure that they are not blown. If fuses are OK go to b.
b. Check voltage at check engine light, if 12 volt are not present the check engine light is not connected properly. If 12 volts are present either the ECM is not powered properly or is defective.
c. If the fuse is OK insure that you are receiving 12 volts to the ECM where indicated (see wiring diagram provided) If you are not receiving 12 volts to the ECM something in the vehicle's power circuit is not connected properly.
d. If 12 volts is available at the proper cavities of the ECM please check that you have a proper ground circuit to the engine block.

If you have gone through all of the above procedures and the fuel pump is still not coming on when you turn the key on you will need to call tech support. When you call tech support you will need to have the following information available.

Voltage measured at the check engine light with key on engine off_____
Voltage measured at the pink wire on the injector while cranking_____
Voltage measured at the pink wire on the injector with the key off_____
Any information that you feel is important for diagnosing the issue at hand.

15. Engine shuts down and sometimes restarts and sometimes it doesn't.

Your AFI Injection system is equipped with several integrated automatic shutdown features. With the addition of Electronic Throttle Control, there are additional build in safety actions and shut downs. See "ETC Information" section for more info. Some are standard and others are optional. Each shut down will set a DTC and store the code in the ECM. Insure that you clear any code after diagnosing that your issue was an automatic shut down feature.
The shut down features are as follows:

High engine coolant shut down. (standard)
The ECM will cause the engine to shut down if the temperature reaches 248 deg F. It will not run until the temperature is below 244 deg F.

- A code P0217 will set under this condition.
- Insure that you clear the code if this code has been present.
- This same condition will be present if the ECT is defective.
- If your vehicle is continually setting this code and/or shutting down, determine the cooling system issues which are causing it and repair accordingly.
- Engines need to be equipped with the proper size radiator, fan and a fan shroud to provide proper cooling.

Low Oil Pressure Shut Down (optional, standard with complete engines)

The ECM will cause the engine to shut down if the oil pressure falls to a dangerous level. A bypass switch is not required for this operation. The engine however will start and run for a few seconds when a low oil pressure condition exists.

- A code P0521 will set under this condition.
- Determine the cause of the low oil pressure and repair as necessary.
- Insure that you clear the DTC if this code has be present.
- An unplugged Oil Pressure Sensor will also cause this condition and code P0522 will set.

Low Fuel Shut Down (optional)

The ECM along with a fuel level sensor will shut the engine down and not allow a re crank of the engine if the fuel falls below 10 - 15% fill. This feature is incorporated to reduce damage which can be caused to the electric fuel pump if the vehicle is run out of fuel.

A red light installed on the dash panel will illuminate when the fuel tank begins to get below 25%. At first the light will flash on and off at irregular intervals staying off longer than it stays on and the staying on longer than it stays off if the vehicle is not refueled.

At one point the light will come on and stay on at which time a 30 minute timer will begin to count up. Turning off the vehicle will not clear the timer. If after 20 minutes of operation with the low fuel light on the vehicle is not refueled the light will begin to flash. At this point also the rev limiter on the engine may be reduced to 2000 RPM. If the vehicle is still not serviced after 10 minutes of operation with the low fuel light flashing the ECM will shut the engine down. When equipped with "Smart Start" the engine will not crank at this time either so that the operator does not damage the starter and the ring gear on the transmission from cranking with no start.

The only way to correct this condition is to fill the tank up. Once the tank is filled up you may have to wait 10 seconds or so with the ignition turned on to clear the timer and allow for normal operation again.

Low Fuel Level will set a code P1462 and store it in the ECM. Clear this code if you have it stored in the ECM. This will also tell you how the operators are using the equipment.

Smart Start (optional)

This feature controls the engine cranking through the ECM. Used with Low Fuel Shut Down and other shut down features as a feature to not do damage to the engine or other components on the engine.

Smart start does not allow the engine to crank under the adverse conditions and/or does not allow the engine to crank for more than 10 seconds if it does not start.

Simply turning the key off and back on resets everything and allows the engine to crank unless it is in a protection mode.

Unattended Idle Shut Down (optional)

This feature will shut the engine down if it is left running at idle for a predetermined period of time. This will allow for compliance with regulatory agencies for length of idle time or to increase the fuel economy of the vehicle. The feature is also temperature activated so that the engine will be allowed to fully warm up before this feature is activated.

16. My check engine light is on when the engine is running.

A check engine light indicates a hard fault with your fuel injection system.

Insure that all of your sensors are connected, you have a good ground and that no wires are pinched.

Also insure no vacuum leaks and that your MAP sensor is connected to a full manifold vacuum source.

If all of these steps indicate a proper installation and no issues you will need to read the codes from the memory area of the ECM and follow the diagnostic procedures for that particular code.

Your AFI fuel injection system is equipped with the latest OBDII level software to retrieve trouble codes. Using any OBDII CAN protocol scan tool you can display the trouble codes. If you have the service software for your ECM this is very easy as well. Simply connect the laptop and any trouble faults will be listed under trouble faults.

An OBDII connector is provided that will plug into the CAN (ALDL) connector in your harness. This connector is not supplied with every kit but to every location. Larger locations will have several connectors based on the # of Scan tools available to the location. These connectors should be kept with the scan tool. The ALDL connector (ALDL) should be kept sealed with the appropriate connector at all time the vehicle is in operation and not using the diagnostic tools.

TROUBLE CODES

All trouble codes are standard OBDII level and values.

OBDII Code	OBDII Desc.
P0106	MAP Range Performance Problem-Sticking
P0107	MAP Circuit Low Input
P0108	MAP Circuit High Input
P0111	IAT Range Performance Problem
P0112	IAT Circuit Low Input
P0113	IAT Circuit High Input
P0115	ECT Range Performance Problem
P0117	ECT Circuit Low Input
P0118	ECT Circuit High Input
P0122	TPS 1 Circuit Low Input
P0123	TPS 1 Circuit High Input
P0130	O2 Sensor Circuit malfunction
P0131	O2 Sensor Low Voltage
P0132	O2 Sensor High Voltage
P0171	Fuel Trim Lean - At adaptive maximum
P0172	Fuel Trim Rich - At adaptive maximum
P0200	Injector Circuit Malfunction
P0217	Engine Over Temp Condition
P0219	Engine Overspeed Condition
P0222	TPS 2 Low Input
P0223	TPS 2 High Input
P0227	APP 1 Low Input (Pedal)
P0228	APP 1 High input (Pedal)
P0230	Fuel Pump Circuit Malfunction
P0231	Fuel Pump Relay Malfunction
P0322	EST Circuit Open
P0460	Fuel Level Circuit Malfunction
P0462	Fuel Level Circuit Low
P0463	Fuel Level Circuit High
P0521	Engine Oil Pressure Low
P0522	Oil Pressure Circuit Low
P0523	Oil Pressure Circuit High
P0562	System Voltage Low
P0563	System Voltage High
P0650	MIL circuit malfuction

P1102	MAP In-Range Indicates Low
P1103	MAP In-Range Indicates High
P1121	TPS 1 Adapt Low Min
P1122	TPS 1 Adapt Low Max
P1123	TPS 1 Adapt High Min
P1124	TPS 1 Adapt High Max
P1125	TPS Intermittent
P1131	O2 In-Range Indicates Low
P1132	O2 In-Range Indicates High
P1201	Injector PW Overflow
P1215	APP 2 Low Input (Pedal)
P1216	APP 2 High Input (Pedal)
P1220	Medium engine overspeed
P1241	Output Voltage Range Low
P1242	Output Voltage Range High
P1252	APP 1 Adapt Lo Min
P1253	APP 1 Adapt Lo Max
P1254	APP 1 Adapt Hi Min
P1255	APP 1 Adapt Hi Max
P1256	APP 2 Adapt Lo Min
P1257	APP 2 Adapt Lo Max
P1258	APP 2 Adapt Hi Min
P1259	APP 2 Adapt Hi Max
P1350	EST Bypass Circuit Open
P1460	Fuel Level Is Low
P1461	Fuel Level is nearing empty
P1462	Fuel Level is Empty-engine shut down
P1478	Fan Circuit Malfunction
P1574	TPS Sensors Disagree
P1577	Pedal Sensors Disagree
P1579	Power Limiting Mode Active
P1585	Throttle control Unit malfunction
P1588	ETC Spring Test Failed
P1587	ETC Open
P1586	ETC Sticking
P1655	Smart Start circuit malfunction
P2121	TPS 2 Adapt Lo Min
P2122	TPS 2 Adapt Lo Max
P2123	TPS 2 Adapt Hi Min
P2124	TPS 2 Adapt Hi Max
P2201	Hydraulic Temp Range Low

P2122	Hydraulic Temp Range High
P2123	Hydraulic Temp High Shut Down
P2124	Hydraulic Pressure Low

P0106 **MAP sticking, voltage not changing.**

P0107 **Low voltage (high vacuum) at MAP sensor.**

P0108 **High voltage (low vacuum) at MAP sensor.**

P1103 **MAP in range error high.**

P1102 **MAP in range error low.**

P0111 **IAT in range error. IAT has failed but is not an open or shorted circuit.**

P0112 **IAT Low, Sensor could be unplugged Resistance will be high with this issue.**

P0113 **IAT High, Sensor could be grounded out. Resistance will be low with an issue.**

P0115 **ECT in range error. ECT has failed but is not an open or shorted circuit. An ECT not installed in the proper location can cause this code also. A bad or weak thermostat can also cause this code.**

P0117 **ECT Low, sensor can be unplugged, engine will run very rich with this issue. Resistance will be high or open circuit.**

P0118 **ECT High, sensor can be shorted or bad and engine will run lean with this issue. Bad sensor will have low risistance.**

P0217 **ECT over temperature. Set when engine is over 248 deg. F (120 deg. C). Overheating of the engine causes this code.**

P0122 **Low voltage at throttle positon sensor**

P0123 **High voltage at throttle positon sensor. Sensor could be unplugged.**

P1121 **TPS adjusted at too low of a voltage.**

P1122 **TPS adjusted at too high of a voltage.**

P1123 **TPS not reaching high enough voltage.**

P1124 **TPS voltage too high at part throttle.**

P0130 **Oxygen sensor signal stays lean during warm engine cruise, your O2 sensor could be unplugged.**

P0131 **O2 sensor failed lean (low voltage)**

P0132 **O2 sensor failed rich (high voltage)**

P1131 **O2 sensor lean, does not mean sensor is bad, can set with large vacuum leak, low fuel pressure or other event causing a lean condition. Contaminated sensor can cause this code.**

P1132 **O2 sensor rich, does not mean sensor is bad, can set with contaminated sensor, too high of fuel pressure or any event causing a rich condition.**

P0172 **Internal fuel memory is at its rich limit**

P0171 **Internal fuel memory is at its lean limit**

P0200 **Injector or injector circuit fault**

P1201 Injector PW overflow
P0230 Low voltage at fuel pump or Low voltage at Fuel pump relay
P0322 Low voltage at electronic spark timing circuit
P1350 Fault at electronic spark timing bypass circuit
P0460 Fuel level circuit malfunction
P0462 Fuel level circuit low
P0463 Fuel level circuit high
P1460 Fuel level is low, low fuel light is on
P1461 Fuel level is at a critical level, low fuel light is flashing
P1462 Engine has shut down due to low fuel level, low fuel light is Flashing
P0521 Oil pressure low, engine will shut down after a short start up or will shut down if the engine loses oil pressure.
P0522 Oil pressure circuit low
P0523 Oil pressure circuit high
P0563 High voltage at battery
P0562 Low voltage at battery
P0650 MIL circuit malfunction
P1241 Sensor voltage is Low
P1242 Sensor voltage is High
P1506 IAC circuit error
P1507 IAC circuit error
P0219 Engine has been operated at the rev. limiter
P1220 Medium engine over speed
P1655 Smart Start circuit malfunction

ECM Connector Pin Out and Wire Coding

Connector A

Pin #	Wire Color	Connect to:
1	Black	Fuel Pump
3	Blue	Oil Press Switch(option)
4	Yellow	Low Fuel Light (option)
5	Green	Injector
6		RPM Decrement Down (option)
7	White	EGR Solenoid(option)
8	Yellow	Smart Start Relay(option)
9	Clear or Red	Dist Mod D
10	Black	Dist Mod B
11	Green	Fan Relay(option)
12	Gray	Neutral Safety Switch
14	Gray	Fuel Pump Relay(option)
15	Brown	RPM Lift (option)
16	Black	Ground
17	Yellow	ETC
18	Purple	ETC
19	White	RPM Increment Up (option)
21	Red	Fuel Level
22	Black	Power Relay control
23	Pink	Power Relay output
24	White	C E Light

Connector B

Pin #	Wire Color	Connect to:
1	Blk/Wht	Sensor Gnd
2	Green	APP1
3	Blue	APP2
4	Brown	TPS1
5	Orange	Dist. A
7	Green	TPS2 (704 ECM)
8	Pink	Ign. 12v
12	Yellow	ECT
13	Purple	O2 - C
14	Purple	Aux Temp(option)
15	Tan	IAT
16	Green	TPS2
17	Black	Ground
18	Brown	MAP - B
20	Blue	ALDL - J
21	White	ALDL - K
22	Red	Battery
23	Green	Fuel Press - C
24	Orange	5v Ref.