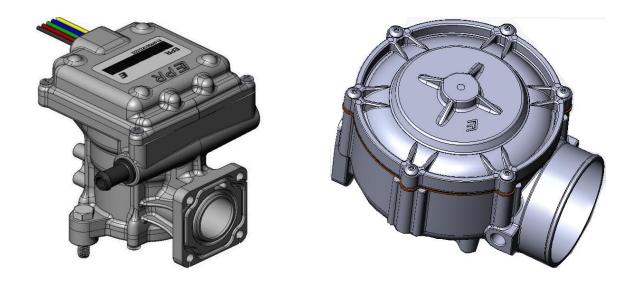


## Tier 3 Certified Mobile Diagnostic and Troubleshooting Manual





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# **General Information**

#### INTRODUCTION

This service manual has been developed to provide the service technician with the basic understanding of the PSI certified fuel and emission systems for their GM engine line. This manual should be used in conjunction with the base engine manual and the OEM service manual when diagnosing fuel or electrical problems.

#### SERVICING YOUR EMISSIONS CERTIFIED ENGINE

Any maintenance and repair should be performed by trained and experienced service technicians. Proper tools and equipment should be used to prevent injury to the servicing technician and damage to the vehicle or components. Service repairs should always be performed in a safe environment and the technician should always wear protective clothing to prevent injury.

#### FUEL QUALITY

PSI LPG engines and fuel systems are designed to operate on HD-5 or HD-10 specification LPG fuel. Fuel other than HD-5 or HD-10 may cause harm to the engine's emission control system and a warranty claim may be denied on this basis if operators can readily find the proper fuel. Gasoline engines should use 87 octane or higher. E85 fuel is not permitted for use in the gasoline engine. Use of any other fuel may result in your engine no longer operating in compliance with CARB or EPA emissions requirements.

#### FUEL SYSTEM CAUTIONS



### CAUTION

Do not smoke, carry lighted tobacco or use a lighted flame of any type when working on or near any fuel related component. Highly flammable air-fuel mixtures may be present and can be ignited causing personal injury

## CAUTION

Do not allow LPG to contact the skin. LPG is stored in the fuel tank as a liquid. When LPG contacts the atmosphere, it immediately expands into a gas, resulting in a refrigeration effect that can cause severe burns to the skin.

## CAUTION

Do not allow LPG to accumulate in areas below ground level such as in a service pit or underground ventilation systems. LPG is heavier than air and can displace oxygen, creating a dangerous condition

### CAUTION

Do not make repairs to the LPG fuel system if you are not familiar with or trained to service LPG fuel system. Contact the dealer who sold you the vehicle to locate a repair facility with trained technicians to repair your fuel system

#### WARNINGS, CAUTIONS AND NOTES

This manual contains several different Warnings, Cautions, and Notes that must be observed to prevent personal injury and or damage to the vehicle, the fuel system or personal property.

A "WARNING" is an advisement that by performing a process or procedure listed in this manual improperly may result in serious bodily injury, death and/or serious damage to the vehicle or property.

### PROPER USE OF THIS SERVICE MANUAL, TOOLS AND EQUIPMENT

To reduce the potential for injury to the technician or others and to reduce damage to the equipment during service repairs the technician should observe the following steps:

- The service procedures defined in this manual, when followed, have been found to be a safe and efficient process to repair the fuel system. In some cases special tools may be required to perform the necessary procedures to safely remove and replace a failed component.
- The installed PSI fuel system has been certified with the Environmental Protection Agency (EPA) and complies with the regulation in effect at the time of certification. When servicing the fuel and emission control system you should follow all the recommended service and repair procedures to insure the fuel and emissions system is operating as designed and certified. Purposely or knowingly defeating or disabling any part or the fuel and emission system may be in violation of the anti-tampering provision of the EPA's Clean Air Act.
- Tools identified in this manual with the prefix "J" or "BT" can be procured through SPX in Warren, Michigan.
- Other special tools identified in this manual can be acquired through the equipment OEM or PSI.

#### IMPORTANT

It is important to remember that there may be a combination of Metric and Imperial fasteners used in the installation of the PSI fuel system. Check to insure proper fit when using a socket or wrench on any fastener to prevent damage to the component being removed or injury from "slipping off" the fastener.

### WARNING

Always leak check any fuel system connection after servicing! Use an electronic leak detector and/or a liquid leak detection solution. Failure to leak check could result in serious bodily injury, death, or serious property damage.

# Maintenance

#### MAINTENANCE

The maintenance of an engine and related components are critical to its operating performance and lifespan. Industrial engines operate in environments that often include hot and cold temperatures and extreme dust. The recommended maintenance schedule is listed in this section, however, environmental operating conditions and additional installed equipment may require more frequent inspection and servicing. The owner and/or service agent should review the operating conditions of the equipment to determine the inspection and maintenance intervals.



### WARNING

When performing maintenance on the engine, turn the ignition OFF and disconnect the battery negative cable to avoid injury or damage to the engine.

The engine installed in this equipment uses a drive belt that drives the water pump, alternator and additional pumps or devices. It is important to note that the drive belt is an integral part of the cooling and charging system and should be inspected according to the maintenance schedule in this section. When inspecting the belts check for:

- Cracks
- Chunking of the belt
- Splits
- Material hanging loose from the belt
- Glazing, hardening

If any of these conditions exist the belt should be replaced with the recommended OEM replacement belt.

#### SERPENTINE BELT SYSTEM

Serpentine belts utilize a spring-loaded tensioner to keep the belt properly adjusted. Serpentine belts should be checked according to the maintenance schedule in this section.

#### **IMPORTANT:**

The use of "belt dressing" or "anti-slipping

agents" on belts is not recommended.

#### **COOLING SYSTEM**

It is important that the cooling system of the engine be maintained properly to ensure proper performance and longevity.



Do not remove the cooling system pressure cap (radiator cap) when the engine is hot. Allow the engine to cool and then remove the cap slowly to allow pressure to vent. Hot coolant under pressure may discharge violently.

Note that there may be an LPG vaporizer connected to the cooling system and the fuel system may be adversely affected by low coolant levels and restricted or plugged radiator cores. Therefore, the cooling system must be maintained according to the recommend maintenance schedule in this section and also include:

- The regular removal of dust, dirt and debris from the radiator core and fan shroud.
- Inspection of coolant hoses and components for leaks, especially at the radiator hose connections. Tighten hose clamps if necessary.
- Check radiator hoses for swelling, separation, hardening, cracks or any type of deterioration. If any of these conditions exist the hose should be replaced with a recommended OEM replacement part.
- Inspect the radiator cap to ensure proper sealing.

#### COOLANT

The engine manufacturer recommends the cooling system be filled with a 50/50 mixture of antifreeze and water. The use of DexCool "Long Life" type coolant is required. This antifreeze is typically a bright orange in color and should meet the requirements issued by PSI. Coolant should have a minimum boiling point of 300F (149c) and a freezing point no higher than -34F (-37c).

Do not add plain water. Replace coolant per the recommended schedule.

#### **IMPORTANT:**

The manufacturers of the engine and fuel system do not recommend the use of "stop leak" additives to repair leaks in the cooling system. If leaks are present the radiator should be removed and repaired or replaced.

#### ENGINE ELECTRICAL SYSTEM MAINTNANCE

The engine's electrical system incorporates an electronic control module (ECM) to control various related components. The electrical system connections and ground circuits require good connections. Follow the recommended maintenance schedule in this section to maintain optimum performance. When inspecting the electrical system check the following:

- Check Positive and Negative cables for corrosion, rubbing, chafing, burning and to ensure tight connections at both ends.
- Check battery for cracks or damage to the case and replace if necessary.
- Inspect engine wire harness for rubbing, chafing, pinching, burning, and cracks or breaks in the wiring.
- Verify that engine harness connectors are correctly locked in by pushing in and then pulling the connector halves outward.
- Inspect ignition coil wire for hardening, cracking, arcing, chafing, burning, separation, split boot covers.
- Check spark plug wires for hardening, cracking, chafing, arcing or burning, separation, and split boot covers.
- Replace spark plugs at the required intervals per the recommended maintenance schedule.
- Verify that all electrical components are securely mounted to the engine or chassis.
- Verify that any additional electrical services

installed by the owner are properly installed in the system.

• Verify that the MIL, charging, and oil pressure lights illuminate momentarily during engine start.

#### ENGINE CRANKCASE OIL

#### OIL RECOMMENDATION

It is recommended to use GM Specification GM6094M. To achieve proper engine performance and durability, it is important that you only use engine lubricating oils displaying the American Petroleum Institute (API) "Starburst" Certification Mark 'FOR GASOLINE ENGINES' on the container.



Gasoline engines that are converted to run on LPG or NG fuels must use oils labeled for gasoline engines. Oils specifically formulated for Heavy Duty or Natural Gas Engines are not acceptable

#### **IMPORTANT:**

Oils recommended by the engine manufacturer already contain a balanced additive treatment. Oils containing "solid" additives, non-detergent oils, or low quality oils are not recommended by the engine manufacturer. Supplemental additives added to the engine oil are not necessary and may be harmful. The engine and fuel system supplier do not review, approve or recommend such products.

#### SYNTHETIC OILS

Synthetic oils have been available for use in industrial engines for a relatively long period of time and may offer advantages in cold and hot temperatures. However, it is not known if synthetic oils provide operational or economic benefits over conventional petroleum-based oils in industrial engines. Use of synthetic oils does not permit the extension of oil change intervals.

#### CHECKING/FILLING ENGINE OIL LEVEL

#### **IMPORTANT:**

Care must be taken when checking engine oil level. Oil level must be maintained between the "ADD" mark and the "FULL" mark on the dipstick. To ensure that you are not getting a false reading, make sure the following steps are taken before checking the oil level.

- 1. Stop engine.
- 2. Allow approximately several minutes for the oil to drain back into the oil pan.
- 3. Remove the dipstick. Wipe with a clean cloth or paper towel and reinstall. Push the dipstick all the way into the dipstick tube.
- 4. Remove the dipstick and note the amount of oil on the dipstick. The oil level must be between the "FULL" and "ADD" marks.

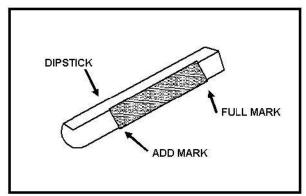


Figure 2 Engine Oil Dip tick (Typical)

- 5. If the oil level is below the "ADD" mark reinstall the dipstick into the dipstick tube and proceed to Step 6.
- 6. Remove the oil filler cap from the valve cover.
- 7. Add the required amount of oil to bring the level up to, but not over, the "FULL" mark on the dipstick Reinstall the oil filler cap to the valve rocker arm cover and wipe any excess oil clean.

#### CHANGING THE ENGINE OIL

#### **IMPORTANT:**

When changing the oil, always change the oil filter.

1. Start the engine and run until it reaches normal operating temperature.



An overfilled crankcase (oil level being too high) can cause an oil leak, a fluctuation or drop in oil pressure. When overfilled, the engine crankshafts splash and agitate the oil, causing it to aerate or foam.

#### IMPORTANT:

Change oil when engine is warm and the old oil flows more freely.

2. Stop engine

#### **IMPORTANT:**

Engine oil will be hot. Use protective gloves to prevent burns. Engine oil contains chemicals which may be harmful to your health. Avoid skin contact.

- 3. Remove drain plug and allow the oil to drain.
- 4. Remove and discard oil filter and its sealing ring.
- Coat sealing ring on the new filter with clean engine oil, wipe the sealing surface on the filter mounting surface to remove any dust, dirt or debris. Tighten filter securely (follow filter manufacturers instructions). Do not over tighten.
- Check sealing ring on drain plug for any damage, replace if necessary, wipe plug with clean rag, wipe pan sealing surface with clean rag and re-install plug into the pan. Tighten to specification.
- 7. Fill crankcase with oil.
- 8. Start engine and check for oil leaks.
- 9. Dispose of oil and filter in a safe manner.

#### FUEL SYSTEM INSPECTION AND MAINTENANCE

#### GASOLINE AND LPG FUEL SYSTEM

The fuel system installed on this industrial engine has been designed to meet the mobile engine emission standard applicable for the 2010 and later model years. To ensure compliance to these standards, follow the recommended maintenance schedule contained in this section.

### INSPECTION AND MAINTENANCE OF THE FUEL STORAGE CYLINDER

The fuel storage cylinder should be inspected daily or at the beginning of each operational shift for any leaks, external damage, adequate fuel supply and to ensure the manual service valve is open. Fuel storage cylinders should always be securely mounted, inspect the securing straps or retaining devices for damage ensure that all locking devices are closed and locked. Check to ensure that the fuel storage cylinder is positioned with the locating pin in the tank collar on all horizontally mounted cylinders this will ensure the proper function of the cylinder relief valve.

When refueling or exchanging the fuel cylinder, check the quick fill valve for thread damage. Also verify O-ring is in place and inspect for cracks, chunking or separation. If damage to the o-ring is found, replace prior to filling. Check the service line quick coupler for any thread damage.

#### **IMPORTANT:**

When refueling the fuel cylinder, wipe both the female and male connection with a clean rag prior to filling to prevent dust, dirt and debris from being introduced to the fuel cylinder.

### INSPECTION AND REPLACEMENT OF THE FUEL FILTER

The fuel system on this emission certified engine may utilize an in-line replaceable fuel filter element. This element should be replaced, at the intervals specified in the recommended maintenance schedule. When inspecting the fuel filter check the following:

• Check for leaks at the inlet and outlet fittings, using a soapy solution or an electronic leak detector and repair if necessary.

- Check to make sure filter is securely mounted.
- Check filter housing for external damage or distortion. If damaged replace fuel filter.

#### **REPLACING THE FUEL FILTER:**

- 1. Move the equipment to a well ventilated area and verify that sparks, ignition and any heat sources are not present.
- 2. Start the engine.
- 3. If the engine operates on a positive pressure fuel system, run the engine with the fuel supply closed to remove fuel from the system.

#### **IMPORTANT:**

A small amount of fuel may still be present in the fuel line. Use gloves and proper eye protection to prevent burns. If liquid fuel continues to flow from the connections when removed, make sure the manual valve is fully closed.

- 4. Slowly loosen the inlet fitting and disconnect.
- 5. Slowly loosen the outlet fitting and disconnect.
- 6. Remove the filter housing form the equipment.
- 7. Check for contamination.
- 8. Tap the opening of the filter on a clean cloth.
- 9. Check for debris.
- 10. Check canister for proper mounting direction.
- 11. Reinstall the filter housing to the equipment.
- 12. Tighten the inlet and outlet fittings to specification.
- Check for leaks at the inlet and outlet fittings, and the filter housing end connection using a soapy solution or an electronic leak detector, if leaks are detected make repairs

#### DIRECT ELECTRONIC PRESSURE REGULATOR (DEPR) MAINTENANCE AND INSPECTION

#### **IMPORTANT:**

The Direct Electronic Pressure Regulator (DEPR) components have been specifically designed and calibrated to meet the fuel system requirements of the emission certified engine.

If the DEPR fails to operate or develops a leak, it should be repaired or replaced with the OEM recommended replacement parts. When inspecting the system check for the following items:

- Check for any fuel leaks at the inlet and outlet fittings.
- Check for any fuel leaks in the IEPR body.
- Check the inlet and outlet fittings of the coolant supply lines for water leaks if applicable.
- Check to ensure the IEPR is securely mounted and the mounting bolts are tight.
- Check IEPR for external damage.
- Check IEPR electrical connection to ensure the connector is seated and locked.

### CHECKING/DRAINING OIL BUILD-UP IN THE VAPORIZER REGULATOR

During the course of normal operation for LPG engines oil or "heavy ends" may build inside the secondary chamber of the Vaporizer Regulator. These oil and heavy ends may be a result of poor fuel quality, contamination of the fuel, or regional variation of the fuel make up. A significant build up of oil can affect the performance of the secondary diaphragm response. The Recommended Maintenance Schedule found in this section recommends that the oil be drained periodically. This is the minimum requirement to maintain the emission warranty. More frequent draining of the Vaporizer Regulator is recommended where substandard fuel may be a problem. PSI recommends the Vaporizer Regulator be drained at every engine oil change if contaminated or substandard fuel is suspected or known to be have been used or in use with the emission complaint fuel system. This is known as special maintenance, and failure to follow this recommendation may be used to deny a warranty claim.

#### **IMPORTANT:**

Draining the regulator when the engine is warm

will help the oils to flow freely from the regulator.

To drain the regulator, follow the steps below:

- 1. Move the equipment to a well ventilated area and ensure no external ignition sources are present.
- 2. Start the engine.
- 3. With the engine running close the manual valve.
- 4. When the engine runs out of fuel turn OFF the key when the engine stops and disconnect the negative battery cable.

#### **IMPORTANT:**

A small amount of fuel may still be present in the fuel line, use gloves to prevent burns, wear proper eye protection. If liquid fuels continues to flow from the connections when loosened check to make sure the manual valve is fully closed.

- 5. Loosen the hose clamp at the inlet and outlet hoses and remove the hoses.
- 6. Remove the regulator mounting bolts.
- 7. Place a small receptacle in the engine compartment.
- 8. Rotate the regulator to 90° so that the outlet fitting is pointing down into the receptacle and drain the regulator.
- 9. Inspect the secondary chamber for any large dried particles and remove.
- 10. Remove the receptacle and reinstall the regulator retaining bolts and tighten to specifications.
- 11. Reinstall the fuel hoses..
- 12. Reconnect any other hoses removed during this procedure.

13. Slowly open the manual service valve. IMPORTANT:

The fuel cylinder manual valve contains an "Excess Flow Check Valve" open the manual valve slowly to prevent activating the "Excess Flow Check Valve."

- Check for leaks at the inlet and outlet fittings using a soapy solution or an electronic leak detector. If leaks are detected make repairs. Check coolant line connections to ensure no leaks are present.
- 15. Start engine recheck for leaks at the regulator.
- 16. Dispose of any drained material in safe and proper manner.

#### AIR FUEL MIXER/THROTTLE CONTROL DEVICE MAINTENANCE AND INSPECTION

#### IMPORTANT:

The Air Fuel Mixer components have been specifically designed and calibrated to meet the fuel system requirements of the emission certified engine. The mixer should not be disassembled or rebuilt. If the mixer fails to operate or develops a leak the mixer should be replaced with the OEM recommended replacement parts.

When inspecting the mixer check for the following items:

- Leaks at the inlet fitting.
- Fuel inlet hose for cracking, splitting or chaffing, replace if any of these condition exist.
- Ensure the mixer is securely mounted and is not leaking vacuum at the mounting gasket or surface.
- Inspect air inlet hose connection and clamp. Also inspect inlet hose for cracking, splitting or chafing. Replace if any of these conditions exist.
- Inspect Air cleaner element according to the Recommended Maintenance Schedule found in this section.
- Check Fuel lines for cracking, splitting or chafing. Replace if any of these conditions exist.
- Check for leaks at the throttle body and intake manifold.

#### EXHAUST SYSTEM AND CATALYTIC CONVERTER INSPECTION AND MAINTENANCE

#### IMPORTANT:

The exhaust system on this emission certified engine contains a Heated Exhaust Gas Oxygen Sensor (HEGO) which provides feed back to the ECM on the amount of oxygen present in the exhaust stream after combustion.

The oxygen in the exhaust stream is measured in voltage and sent to the ECM. The ECM then makes corrections to the fuel air ratio to ensure the proper fuel charge and optimum catalytic performance. Therefore, it is important that the exhaust connections remain secured and air tight.

#### **IMPORTANT:**

The HEGO sensor is sensitive to silicone based products. Do not use silicone sprays or hoses which are assembled using silicone lubricants. Silicone contamination can cause severe damage to the HEGO.

When inspecting the Exhaust system check the following:

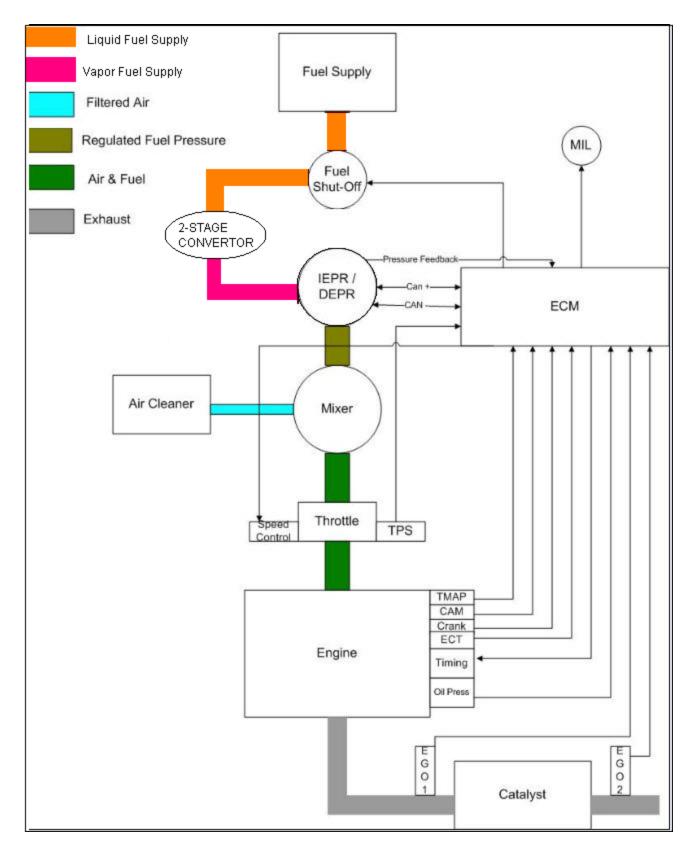
- Exhaust manifold at the cylinder head for leaks and that all retaining bolts and shields (if used) are in place.
- Manifold to exhaust pipe fasteners to ensure they are tight and that there are no exhaust leaks repair if necessary.
- HEGO electrical connector to ensure connector is seated and locked, check wires to ensure there is no cracking, splits chafing or "burn through." Repair if necessary.
- Exhaust pipe extension connector for leaks tighten if necessary
- If the engine is equipped with a catalytic converter inspect the converter to ensure it is securely mounted.
- Check for any leaks at the inlet and outlet of the converter.

### TIER 3 CERTIFIED MOBILE ENGINE MAINTENANCE REQUIREMENTS

Perform the following maintenance on th	e engine at	the hours i	ndicated and	d at equival	ent hour int	ervals there	eafter.		
				In	iterval Ho	urs			
	Daily	200	400	800	1000	1250	1500	1750	2000
General Maintenance Section									
Visual check for fluid leaks	Х								
Check engine oil level	Х								
Check coolant level	Х								
Change engine oil and filter			Every 1	50 hours	s or 120 c	lays of o	peration	•	
Check LPG system for leaks			Prior to	any serv	vice or ma	intenance	e activity		
Inspect accessory drive belts for cracks, breaks, splits or glazing					Х				
Inspect electrical system wiring for cuts, abrasions or corrosion									Х
Inspect all vacuum lines and fittings for cracks, breaks or hardening									Х
Engine Coolant Section									
Clean debris from radiator core			Every	100 hour	s or 60 d	ays of op	peration		
Change coolant				Х					
Inspect coolant hoses for cracks, swelling or deterioration					Х				
Engine Ignition System									
Replace spark plugs									Х
Inspect battery case for damage					Х				
Check spark plug wires for cuts abrasions or hardening									Х
Replace distributor cap and rotor				Х					
Replace spark plug wires				Х					
Fuel System Maintenance									
Inspect air cleaner		Every	200 hour	s, or eve	ry 100 hc	ours in du	usty envir	onment	
Replace filter element	Every 400 hours, or every 200 hours in dusty enviroment								
Replace fuel filter			Х						
Inspect Shut-off Valve for leaks and closing									Х
Leak check fuel lines									Х
Check air induction for leaks									Х
Check manifold for vacuum leaks									Х
Drain LPG Vaporizer oil build up	Every 150 hours or 120 days of operation								
Engine Exhaust System									
Inspect exhaust manifold for leaks									Х
Inspect exhaust piping for leaks									Х
Check HEGO sensor(s) connector and wires for burns, cuts or damage									Х
Inspect catalyst for mechanical damage									Х
The Maintenance schedule erpresents manufacturers recommend									
federal regulations may require equipment opeatos to conduct co	ompreshens	sive engin	e/equipmer	nt inspection	ons at more	e periodic i	intervals th	an thost sp	ecified
above.									

# **LPG Fuel System**

### **MOBILE ENGINE LPG FUEL SYSTEM SCHEMATIC**



## DESCRIPTION AND OPERATION OF THE FUEL SYSTEMS

#### NG & LPL FUEL SYSTEM

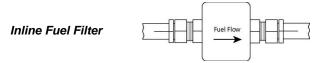
The primary components of the fuel system are the fuel supply, direct electronic pressure regulator (DEPR), fuel mixer, electronic throttle control (ETC) device, 2-Stage convertor, engine control module (ECM), and a catalytic converter. The system operates on a slightly positive fuel pressure. Primary fuel pressure can be measured at the LD 2-Stage convertor. Secondary fuel pressure command and actual fuel pressure is monitored by the ECM. You can view these pressures using the diagnostic service tool.

#### SERVICE LINES

Fuel flows from the fuel supply to the electric lock off valve. The service lines are not supplied by the engine manufacturer. Please contact the equipment manufacturer regarding fuel service lines

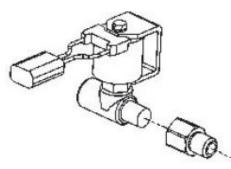
#### FUEL FILTER

LP, fuel like all other motor fuels is subject to contamination from outside sources. Refueling of the equipment tank and removal of the tank from the equipment can inadvertently introduce dirt and other foreign matter into the fuel system. It is therefore necessary to filter the fuel prior to entering the fuel system components down stream of the tank. An inline fuel filter has been installed in the fuel system to remove the dirt and foreign matter from the fuel, which is replaceable as a unit only. Maintenance of the filter is critical to proper operation of the fuel system and should be replaced according to the maintenance schedule or more frequently under severe operating conditions.



#### ELECTRIC FUEL LOCK-OFF VALVE

The Electric Fuel lock-off valve is an integrated assembly consisting of a 12 volt solenoid and a normally closed valve. When energized, the solenoid opens the valve and allows the fuel to flow through the device. The valve opens during cranking and engine run cycles.



ELECTRIC FUEL LOCK-OFF

Voltage to the Electric Lock-Off Valve is controlled by the engine control module (ECM).

### DIRECT ELECTRONIC PRESSURE REGULATOR (DEPR)

The ECI engine management system uses the DEPR to control fuel delivery for the precise fuel metering necessary for optimum combustion, fuel economy and transient response. The DEPR is available in either a 19 or a 28 mm size.

The DEPR is a single-stage microprocessor based electromechanical fuel pressure regulator that incorporates a high speed/fast acting actuator. It communicates with the Engine Control Module (ECM) over a Controller Area Network (CAN) link, receiving fuel pressure commands and broadcasting DEPR operating parameters back to the ECM. The DEPR can regulate fuel pressure from -18 to +13 inches of water column above the Mixer air inlet pressure, providing sufficient control authority to stall an engine either rich or lean. When the DEPR receives an output pressure command from the ECM, the valve is internally driven to attain targeted fuel pressure, the DEPR then closes the loop internally using a built in fuel pressure sensor to maintain target fuel pressure/fuel flow rate, until another external command from the ECM is received (intervals < 10 ms). The DEPR has an integral fuel temperature sensor that is used by the ECM to correct for variations in fuel density. This strategy provides an extremely accurate method for open loop fuel control. Then with the addition of the preand post-cat oxygen sensors, the pressure command transmitted form the ECM can be further adjusted using closed loop feedback



Direct Electronic Pressure Regulator



The IEPR is an emission control device and should only be serviced by qualified technicians.

#### AIR FUEL MIXER

The air valve mixer is a self-contained air-fuel metering device. The mixer is an air valve design, utilizing a relatively constant pressure drop to draw fuel into the mixer from cranking speeds to full load. The mixer is mounted in the air stream ahead of the throttle control device.

When the engine begins to crank it draws in air with the air valve covering the inlet, and negative pressure begins to build. This negative pressure signal is communicated to the top of the air valve chamber through vacuum ports in the air valve assembly. A pressure/force imbalance begins to build across the air valve diaphragm between the air valve vacuum chamber and the atmospheric pressure below the diaphragm. The vacuum being created is referred to as Air Valve Vacuum (AVV). As the air valve vacuum reaches the imbalance point, the air valve begins to lift against the air valve spring. The amount of AVV generated is a direct result of the throttle position. At low engine speed the air valve vacuum and the air valve position is low thus creating a small venturi for the fuel to flow. As the engine speed increases the AVV increases and the air valve is lifted higher thus creating a much larger venturi. This air valve vacuum is communicated from the mixer venturi to the IEPR via the fuel supply hose.

The mixer is equipped with a low speed mixture adjustment retained in a tamper proof housing. The mixer has been preset at the factory and should not require adjustment. In the event that the idle adjustment should need to be adjusted refer to the Fuel System Repair section of this manual.



CAUTION

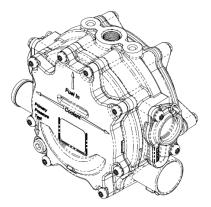
The air/fuel mixer is an emission control device. Components inside the mixer are specifically calibrated to meet the engine's emissions requirements and should never be disassembled or rebuilt. If the mixer fails to function correctly, replace with an OEM replacement part.



Air Valve Mixer

#### Light Duty 2-Stage Vaporizer

The tier 3 certified mobile products utilize a 2stage vaporizer as part of the fuel system. The primary function of this part is to convert liquid LP fuel into a propane vapor. The vapor is then introduced into the DEPR where the pressures are regulated. Converting the fuel from a liquid to a vapor is accomplished by passing the propane through a heat exchanger inside the convertor. Coolant flows through the convertor as part of the heat exchange process.



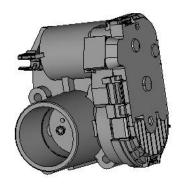
LD 2-Stage Vaporizer

### ELECTRONIC THROTTLE CONTROL DEVICE (ETC)—

Engine speed is controlled by the ECM and the Electronic Throttle Control device which is an automotive style throttle. The ECM controls engine speed one of several ways depending on the equipment manufacturer's requirement. Engine speed can be controlled by discrete speed governing, whereby the OEM sends an open, high or low voltage signal to an ECM pin. The ECM then targets the preprogrammed speed for that pin. The other two modes are through the use of a foot pedal or a hand throttle controller. In both cases the foot pedal or hand throttle controller will send a 0-5 volt signal to the ECM. The ECM is programmed with an idle and high speed and interprets speed in between the two based on voltage.

When the engine is running electrical signals are sent from the foot pedal position sensor to the

engine ECM when the operator depresses or release the foot pedal. The ECM then sends an electrical signal to the motor on the electronic throttle control to increase or decrease the angle of the throttle blade thus increasing or decreasing the air/fuel charge to the engine. The electronic throttle control device incorporates two internal Throttle Position Sensors (TPS) which provide output signals to the ECM as to the location of the throttle shaft and blade. The TPS information is used by the ECM to correct for speed and load control as well as emission.

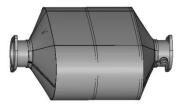


#### **Electronic Throttle Control Device**

#### THREE-WAY CATALYTIC CONVERTER

The Catalytic Converter is a component of the emissions system which is designed to meet the emission standards in effect for the Tier 3 mobile certified product.

The exhaust gases pass through the honeycomb catalyst which is coated with a mixture of precious group metals to oxidize and reduce CO, HC and NOX emission gases.



Three Way Catalytic Converter ENGINE CONTROL MODULE

To obtain maximum effect from the catalyst and accurate control of the air fuel ratio, the emission certified engine is equipped with an onboard computer or Engine Control Module (ECM). The ECM is a 32 bit controller which receives input data from sensors mounted to the engine and fuel system and then outputs various signals to control engine operation.



Engine Control Module (ECM)

One specific function of the controller is to maintain a closed loop fuel control which is accomplished by use of the Heated Exhaust Gas Oxygen sensor (HEGO) mounted in the exhaust system. The HEGO sensor sends a voltage signal to the controller which then outputs signals to the EPR to change the amount of fuel being delivered from the regulator or mixer to the engine.

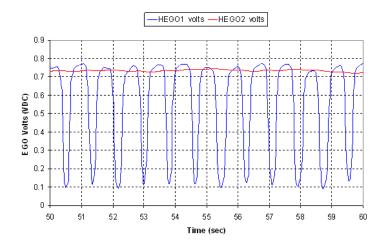
The controller also performs diagnostic functions on the fuel system and notifies the operator of engine malfunctions by turning on a Malfunction Indicator Light (MIL) mounted in the dash. Malfunctions in the system are identified by a Diagnostic Trouble Code (DTC) number. In addition to notifying the operator of the malfunction in the system, the controller also stores the information about the malfunction in its memory. A technician can than utilize a computerized diagnostic scan tool to retrieve the stored diagnostic code and by using the diagnostic charts in this manual to determine the cause of the malfunction. In the event a technician does not have the computerized diagnostic tool, the MIL light can be used to identify the diagnostic code to activate the "blink" feature and count the number of blinks to determine the diagnostic code number to locate the fault in the system.

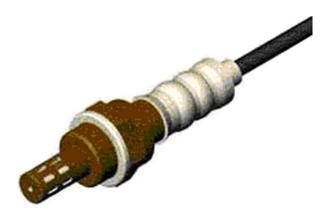
#### HEATED EXHAUST GAS OXYGEN SENSORS

The Heated Exhaust Gas Oxygen (HEGO) Sensors are mounted in the exhaust system, one upstream and one downstream of the catalytic converter. Models that do not use a catalyst assembly will only use one HEGO sensor.

The HEGO sensors are used to measure the amount of oxygen present in the exhaust stream to determine whether the air-fuel ratio is to rich or to lean. It then communicates this measurement to the ECM. If the HEGO sensor signal indicates that the exhaust stream is too rich, the ECM will decrease or lean the fuel mixture during engine operation. If the mixture is too lean, the ECM will richen the mixture. If the ECM determines that a rich or lean condition is present for an extended period of time which cannot be corrected, the ECM will set a diagnostic code and turn on the MIL light in the dash.

By monitoring output from the sensor upstream and the sensor downstream of the catalytic converter, the ECM can determine the performance of the catalyst.





The Heat Exhaust Gas Oxygen (HEGO) Sensor

HEGO1 (upstream or before the catalytic converter) and HEGO2 (downstream) voltage output.



### CAUTION

The Heated Exhaust Gas Oxygen Sensor (HEGO) is an emissions control component. In the event of a failure, the HEGO should only be replaced with the recommended OEM replacement part. The HEGO is sensitive to silicone based products and can become contaminated. Avoid using silicone sealers or air or fuel hoses treated with a silicone based lubricant.

#### TMAP SENSOR

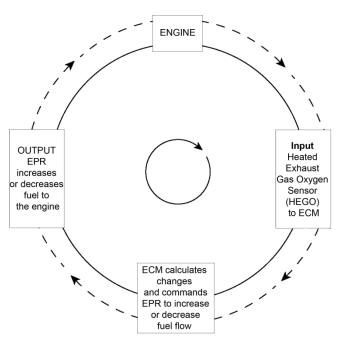
The Temperature Manifold Absolute Pressure or TMAP sensor is a variable resistor used to monitor the difference in pressure between the intake manifold and outside or atmospheric pressure and the temperature. The ECM monitors the resistance of the sensor to determine engine load (the vacuum drops when the engine is under load or at wide open throttle). When the engine is under load, the computer may alter the fuel mixture to improve performance and emissions. The temperature is also monitored by the ECM, primarily to richen the fuel/air mixture during a cold start.

#### COOLANT TEMPERATURE SENSOR

The Engine Coolant Temperature sensor or ECT is a variable resistance thermistor that changes resistance as the engine's coolant temperature changes. The sensor's output is monitored by the ECM to determine a cold start condition and to regulate various fuel and emission control functions via a closed loop emission system.

#### **OIL PRESSURE SENDER**

The Engine Oil Pressure sensor is designed to ensure adequate lubrication throughout the engine. It provides a pressure value for the oil pressure gauge and is monitored by the ECM. If the pressure drops, an MIL will occur.



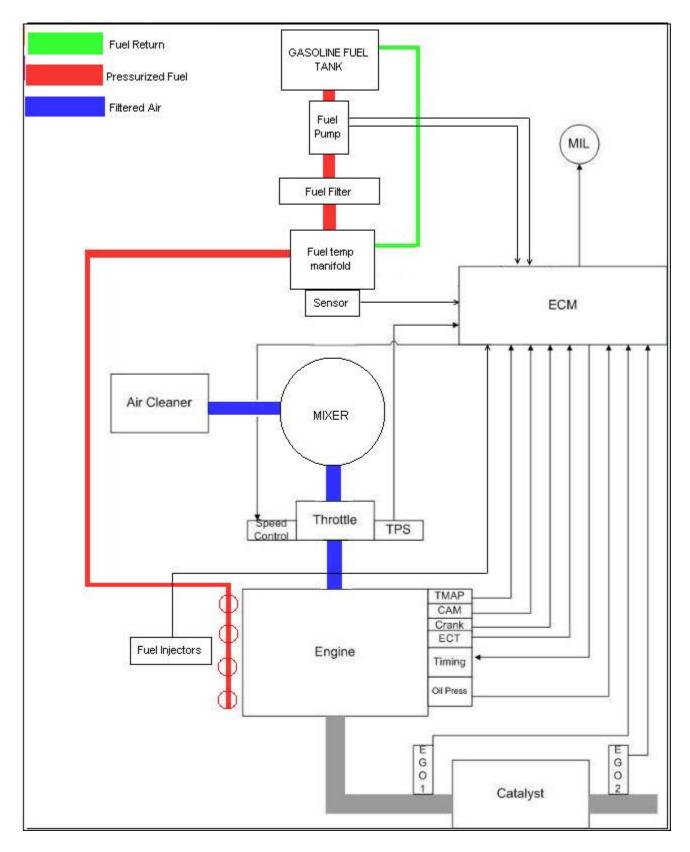
**Closed-Loop Fuel Control** 

## LD 2-Stage Regulator Nominal Pressure Specifications

Secondary Stage	15.25 ±10 inches H20
Primary Stage	2.6 ±1.45PSI

# **Gasoline Fuel System**

### MOBILE ENGINE GASOLINE FUEL SYSTEM SCHEMATIC



### GASOLINE MULTI POINT FUEL INJECTON (3.0L Engine)

The primary components of the Gasoline Multi Point Fuel Injection (MPFI) fuel system are the gasoline fuel tank, electric fuel pump, fuel pressure and temperature sensor manifold, fuel filter and fuel rail.

#### **GASOLINE FUEL STORAGE TANK**

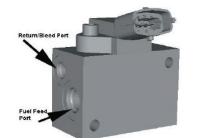
The gasoline fuel storage tank location may very on equipment applications. The fuel tank may be integrated into the chassis frame or may be a stand alone vessel mounted on the equipment. For precise location for the equipment application refer to the OEMs vehicle manual.

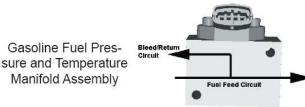
#### **GASOLINE FUEL PUMP**

The Gasoline is stored as a liquid in the fuel tank and in drawn into the fuel system by a 12 volt electric fuel pump. Depending on the vehicle application the fuel pump may be mounted in the fuel tank or as a stand alone component. In either case the fuel pump will receive a signal from the ECM at Key On to prime the fuel system for approximately 2 seconds prior to start. Priming of the fuel system provides for a quicker start, when the engine begins to crank. Consult the OEM for the location of the fuel pump.

#### GASOLINE PRESSURE AND TEMPERATURE SENSOR MANIFOLD

This engine is equipped with a fuel injector rail that does not have a pressure regulator or a return circuit to the fuel tank. Fuel pressure for this engine is regulated by the engine's ECM. The ECM receives fuel pressure and temperature feedback from the gasoline fuel sensor manifold and uses this information to control the ground side of the fuel pump. Fuel pressure is regulated by the ECM pulse width modulating (PWM) the fuel pump. The fuel pressure and temperature sensor manifold has a return or "bleed" circuit that connects back to the equipment fuel tank. This circuit is used to bleed off any vapor that develops in the line and returns a small amount of fuel to the tank. The fuel comes from the fuel pressure and temperature manifold assembly. Fuel flows through the feed circuit and is delivered to the fuel pressure and temperature that enters the bleed circuits through the by-pass valve in the manifold is returned to the fuel tank.



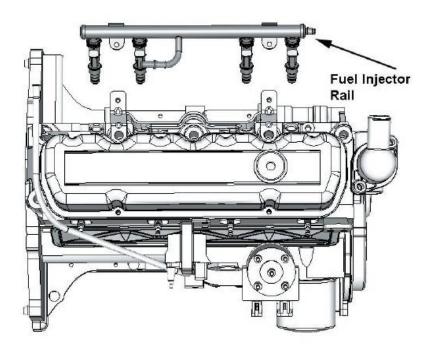


#### **FUEL FILTER**

After the fuel is drawn into the fuel pump, the fuel flows through the gasoline fuel filter. The fuel filter will trap small particles. The fuel passes through the filter to remove debris which prevents the fuel pressure and temperature manifold and fuel injectors from becoming damaged. Maintenance of the fuel filter is required as indicated in the *Recommended Maintenance Schedule*. A more frequent replacement of the filter may be required if the equipment operates in a dusty or dirty environment.

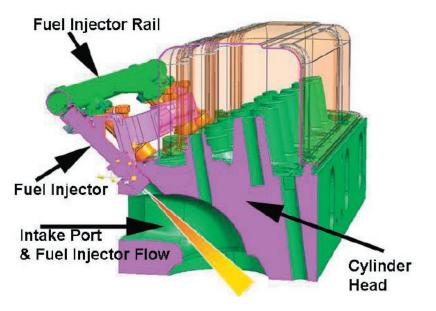
#### FUEL INJECTOR RAIL

The fuel flows from the fuel pressure and temperature manifold assembly to the fuel rails where the fuel is delivered to the fuel injectors. The fuel rail also contains a Schrader valve which is utilized to test the regulated pressure of the fuel system.



#### **FUEL INJECTOR**

The fuel supply is maintained on the top of the injector from the injector rail. The injector is fed a "pulse" signal through the wire harness which causes the injector to open. During regular operating conditions the ECM controls the opening and duration of opening of the injector. During lower RPM operation the injector signals or "pulses" are less frequent then when the engine is operating at higher RPMs. The certified engine has been calibrated to deliver the precise amount of fuel for optimum performance and emission control.



### GASOLINE IAFM Manifold (4.3L Engine)

The primary components of the Gasoline IAFM fuel system are the gasoline fuel tank, electric fuel pump, fuel pressure and temperature sensor manifold, Intake manifold, and IAFM.

#### **GASOLINE FUEL STORAGE TANK**

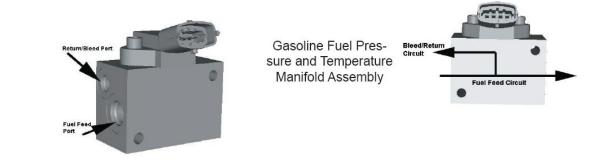
The gasoline fuel storage tank location may very on equipment applications. The fuel tank may be integrated into the chassis frame or may be a stand alone vessel mounted on the equipment. For precise location for the equipment application refer to the OEMs vehicle manual.

#### **GASOLINE FUEL PUMP**

The Gasoline is stored as a liquid in the fuel tank and in drawn into the fuel system by a 12 volt electric fuel pump. Depending on the vehicle application the fuel pump may be mounted in the fuel tank or as a stand alone component. In either case the fuel pump will receive a signal from the ECM at Key On to prime the fuel system for approximately 2 seconds prior to start. Priming of the fuel system provides for a quicker start, when the engine begins to crank. Consult the OEM for the location of the fuel pump.

#### GASOLINE PRESSURE AND TEMPERATURE SENSOR MANIFOLD

This engine is equipped with a fuel injector rail that does not have a pressure regulator or a return circuit to the fuel tank. Fuel pressure for this engine is regulated by the engine's ECM. The ECM receives fuel pressure and temperature feedback from the gasoline fuel sensor manifold and uses this information to control the ground side of the fuel pump. Fuel pressure is regulated by the ECM pulse width modulating (PWM) the fuel pump. The fuel pressure and temperature sensor manifold has a return or "bleed" circuit that connects back to the equipment fuel tank. This circuit is used to bleed off any vapor that develops in the line and returns a small amount of fuel to the tank. The fuel comes from the fuel tank and passes through the fuel pump. Fuel exits the fuel pump, passes through the filter and then enters the fuel pressure and temperature manifold assembly. Fuel flows through the feed circuit and is delivered to the fuel injector rail. Fuel that enters the bleed circuits through the by-pass valve in the manifold is returned to the fuel tank.

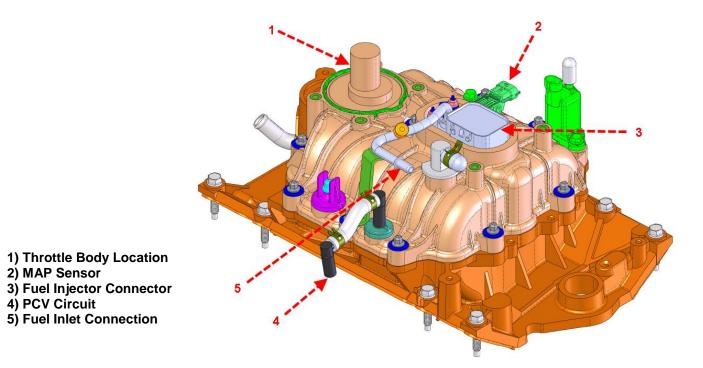


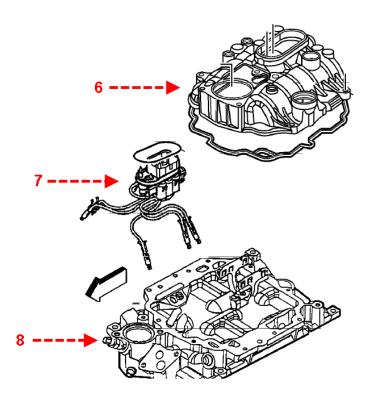
#### FUEL FILTER

After the fuel is drawn into the fuel pump, the fuel flows through the gasoline fuel filter. The fuel filter will trap small particles. The fuel passes through the filter to remove debris which prevents the fuel pressure and temperature manifold and fuel injectors from becoming damaged. Maintenance of the fuel filter is required as indicated in the *Recommended Maintenance Schedule*. A more frequent replacement of the filter may be required if the equipment operates in a dusty or dirty environment.

#### **IAFM Intake Manifold**

IAFM is the acronym for Intake Air Fuel Module. This style intake manifold incorporates the air intake manifold and gasoline fuel delivery system into one module. The IAFM is used on the 4.3L GM engine.





#### **Fuel Injectors**

The IAFM system uses one fuel injector per cylinder. The injectors are routed to each intake port internally as shown in number 7. The nominal fuel pressure is typically in the range of 74 psia.

6) Upper Intake 7) Fuel Injectors 8) Lower Intake

# **Fuel System Diagnosis**

### **FUEL SYSTEM DIAGNOSIS**



Direct Electronic Pressure Regulator Assembly

#### FUEL SYSTEM DESCRIPTION

The Engine Control Module (ECM) receives information from various engine sensors in order to control the operation of the Direct Electronic Pressure Regulator (DEPR) and lock-off Valve. The lock-off Valve solenoid prevents fuel flow unless the engine is cranking or running.

At Key ON, the DEPR valve receives a two (2) second prime pulse from the ECM, allowing time for the fuel to flow through the fuel filter and fuel lines to the DEPR.

Fuel travels from the lock-off to the light duty 2stage regulator into the DEPR.

Engine cranking generates vacuum which provided lift for the mixer air valve and is commonly referred to as air valve vacuum. Once in the mixer, the fuel is combined with air and is drawn into the engine for combustion.

#### **DIAGNOSTIC AIDS**

This procedure is intended to diagnose equipment operating on LPG. If the equipment will not continue to run, refer to Hard Start for preliminary checks.

- Inspect the fuel supply lines to verify they are properly connected and do not have any kinks or damage
- Verify the fuel lock off valve is operating properly. Refer to the OEM for information on the fuel shut off valve.

#### **TOOLS REQUIRED:**

#### DST

• Diagnostic Scan Tool (DST)

#### PRESSURE GAUGES

ITK-2 Test Kit

#### **TEST DESCRIPTION**

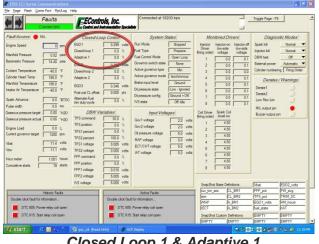
The basis of the fuel system test is to determine if the fuel is operating within proper fuel control parameters. This fuel control system operates on the basis of short term and long term fuel correction to compensate for the normal operation and aging of the engine. Abnormal operation of the engine, due to a component issue or lack of maintenance will cause fuel system control parameters to operate outside of the normal range.

The fuel system correction factors are viewable using the laptop based Diagnostic Service Tool (DST).

The short term correction factor is a percentage based fuel correction that will immediately be applied once the engine reaches the closed loop fuel control mode. The short term correction factor is known as "Closed Loop 1" on the DST.

The long term correction factor writes the short term correction into long term memory so it is available immediately on the next start/run cycle. The long term correction factor is known as "Adaptive 1" on the DST.

Closed Loop 1 and Adaptive 1 can be viewed on the Closed Loop Control panel on the Faults Page of the DST.



Closed Loop 1 & Adaptive 1

Any parameter found to be out of conformance will require additional diagnosis.

#### HOW THE CORRECTION FACTORS WORK

The correction factors are displayed in the DST as a positive or negative percent. The numbers will range between -35% and +35%. A negative fuel correction number indicates the removal of fuel.

An outside condition causing the system to be rich, such as a restricted air cleaner, can cause a negative short term and long term fuel correction. An outside condition causing the system to be lean, such as a vacuum leak, can cause a positive fuel correction.

#### DETERMINING TOTAL FUEL CORRECTION

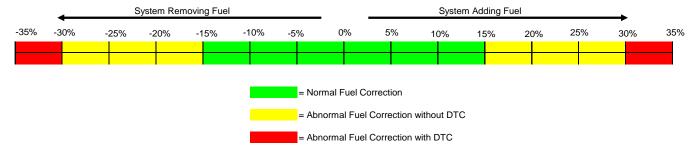
The total fuel correction is the sum of the short term correction (Closed Loop 1) and the long term correction (Adaptive 1).

For instance, a Closed Loop 1 reading of -1.5% and an Adaptive 1 reading of -3.5% would mean a total fuel correction of -5% was taking place at that time. The system is removing 5% fuel at that time.

A Closed Loop 1 reading of 1.5% and an Adaptive 1 reading of 3.5% (note both are positive numbers) would mean that a total fuel correction of 5% was taking place at that time. The system is adding 5% fuel.

#### NORMAL & ABNORMAL FUEL CORRECTION

Generally, the system is operating within specification when total fuel correction falls between -15% and +15%. Operation outside of this range will require further diagnosis to determine the system level issue affecting fuel control. The system will set Diagnostic Trouble Codes (DTC's) for correction factors in the +/- 30%-35% range. If total fuel correction is found to be operating outside of the normal range additional diagnostic procedure will be required to determine the cause. Follow the appropriate Symptom Routine or DTC Chart for additional help.



#### **Total Fuel Correction Chart**

#### FUEL SYSTEM SYMPTOM DIAGNOSTICS

Checks	Action
Before Using This Section	<ul> <li>Before using this section, you should have performed On Board Diagnostic (OBD) Check and determined that:</li> <li>1. The ECM and MIL are operating correctly.</li> <li>2. There are no Diagnostic Trouble Codes (DTCs) stored, or a DTC exists but without a MIL.</li> </ul>
	Several of the following symptom procedures call for a careful visual and physical check. These checks are very important as they can lead to prompt diagnosis and correction of a problem.
Fuel System Check	<ol> <li>Verify the customer complaint.</li> <li>Locate the correct symptom table.</li> <li>Check the items indicated under that symptom.</li> <li>Operate the equipment under the conditions the symptom occurs. Verify HEGO switching between lean and rich. IMPORTANT! Normal HEGO switching indicates the fuel system is in closed loop and operating correctly at that time.</li> <li>Take a data snapshot using the DST under the condition that the symptom occurs to review at a later time.</li> </ol>
Visual and Physical Checks	<ul> <li>Check all ECM system fuses and circuit breakers.</li> <li>Check the ECM ground for being clean, tight and in its proper location.</li> <li>Check the vacuum hoses for splits, kinks and proper connections.</li> <li>Check thoroughly for any type of leak or restriction.</li> <li>Check for air leaks at all the mounting areas of the intake manifold sealing surfaces.</li> <li>Check for proper installation of the mixer assembly.</li> <li>Check the ignition wires for the following conditions:</li> <li>Cracking</li> <li>Hardening</li> <li>Proper routing</li> <li>Carbon tracking.</li> <li>Check the wiring for the following items: proper connections, pinches or cuts.</li> <li>The following symptom tables contain groups of possible causes for each</li> </ul>
	symptom. The order of these procedures is not important. If the DST read- ings do not indicate a problem, then proceed in a logical order, easiest to check or most likely to cause the problem.

#### INTERMITTENT

Checks	Action
<b>DEFINITION:</b> The proble	em may or may not turn ON the (MIL) or store a Diagnostic Trouble Code (DTC)
Preliminary Checks	Do not use the DTC tables. If a fault is an intermittent, the use of the DTC tables with this condition may result in the replacement of good parts.
	Faulty electrical connections or wiring can cause most intermittent problems. Check the suspected circuit for the following conditions:
	<ul> <li>Faulty fuse or circuit breaker, connectors poorly mated, terminals not fully seated in the connector (backed out). Terminals not properly formed or damaged.</li> <li>Wire terminals poorly connected.</li> </ul>
Faulty Electrical Con- nections or Wiring	<ul> <li>Terminal tension is insufficient.</li> <li>Carefully remove all the connector terminals in the problem circuit in order to ensure the proper contact tension.</li> </ul>
	• If necessary, replace all the connector terminals in the problem circuit in order to ensure the proper contact tension (except those noted as "Not Serviceable"). See section <i>Wiring Schematics</i> .
	Checking for poor terminal to wire connections requires removing the terminal from the connector body.
Operational Test	If a visual and physical check does not locate the cause of the problem, op- erate the vehicle with the DST connected. When the problem occurs, an abnormal voltage or scan reading indicates a problem circuit.
	The following components can cause intermittent MIL and no DTC(s):
Intermittent MIL Illumination	<ul> <li>A defective relay.</li> <li>Switch that can cause electrical system interference. Normally, the problem will occur when the faulty component is operating.</li> <li>The improper installation of add on electrical devices, such as lights, 2-way radios, electric motors, etc.</li> <li>The ignition secondary voltage shorted to a ground.</li> <li>The MIL circuit or the Diagnostic Test Terminal intermittently shorted to ground.</li> <li>The MIL wire grounds.</li> </ul>
Loss of DTC Memory	<ol> <li>To check for the loss of the DTC Memory:</li> <li>Disconnect the TMAP sensor.</li> <li>Idle the engine until the MIL illuminates.</li> <li>The ECM should store a TMAP DTC which should remain in the memory when the ignition is turned OFF. If the TMAP DTC does not store and remain, the ECM is faulty.</li> </ol>

#### **NO START**

Checks	Action
<b>DEFINITION:</b> The engine	e cranks OK but does not start.
Preliminary Checks	None
ECM Checks	<ul> <li>Use the DST to :</li> <li>Check for proper communication with both the ECM</li> <li>Check all system fuses engine fuse holder. Refer to <i>Engine Controls Schematics.</i></li> <li>Check battery power, ignition power and ground circuits to the ECM. Refer to <i>Engine Control Schematics.</i> Verify voltage and/or continuity for each.</li> </ul>
Sensor Checks	<ul><li>Check the TMAP sensor.</li><li>Check the cam angle sensor for output (RPM).</li></ul>
Fuel System Checks	<ul> <li>Important: A closed LPG manual fuel shut off valve will create a no start condition.</li> <li>Check for air intake system leakage between the mixer and the throttle body. Verify proper operation of the low pressure lock-off solenoids.</li> <li>Verify proper operation of the fuel control solenoids.</li> <li>Check the fuel system pressures.</li> <li>Refer to the <i>LPG Fuel System Diagnosis</i>.</li> <li>Check for proper mixer air valve operation.</li> </ul>
Ignition System Checks	<ul> <li>Note: LPG being a gaseous fuel requires higher secondary ignition system voltages for the equivalent gasoline operating conditions.</li> <li>1. Check for the proper ignition voltage output with <i>J 26792</i> or the equivalent.</li> <li>2. Verify that the spark plugs are correct for use with LPG.</li> <li>Check the spark plugs for the following conditions: <ul> <li>Wet plugs.</li> <li>Cracks.</li> <li>Wear.</li> <li>Improper gap.</li> <li>Burned electrodes.</li> <li>Heavy deposits.</li> <li>Check for bare or shorted ignition wires.</li> <li>Check for loose ignition coil connections at the coil.</li> </ul> </li> </ul>

#### **NO START**

Checks	Action
Engine Mechanical Checks	<ul> <li>Important: The LPG Fuel system is more sensitive to intake manifold leakage than the gasoline fuel system.</li> <li>Check for the following: <ul> <li>Vacuum leaks.</li> <li>Improper valve timing.</li> <li>Low compression.</li> <li>Improper valve clearance.</li> <li>Worn rocker arms.</li> <li>Broken or weak valve springs.</li> </ul> </li> <li>Worn camshaft lobes.</li> </ul>
Exhaust System Checks	<ul> <li>Check the exhaust system for a possible restriction:</li> <li>Inspect the exhaust system for damaged or collapsed pipes:</li> <li>Inspect the muffler for signs of heat distress or for possible internal failure.</li> <li>Check for possible plugged catalytic converter. Refer to <i>Restricted Exhaust System Diagnosis.</i></li> </ul>

#### HARD START

Checks	Action
<b>DEFINITION:</b> The engine or may start but immediat	e cranks OK, but does not start for a long time. The engine does eventually run, tely dies.
Preliminary Checks	Make sure the vehicle's operator is using the correct starting procedure.
Sensor Checks	<ul> <li>Check the Engine Coolant Temperature sensor with the DST. Compare the engine coolant temperature with the ambient air temperature on a cold engine. If the coolant temperature reading is more than 10 degrees greater or less than the ambient air temperature on a cold engine, check for high resistance in the coolant sensor circuit. Check the cam angle sensor.</li> <li>Check the Throttle Position (TPS) and Foot Pedal Position (FPP) sensor connections.</li> </ul>
	<b>Important</b> : A closed LPG manual fuel shut off valve will create an extended crank OR no start condition.
	• Verify the excess flow valve is not tripped or that the manual shut-off valve is not closed.
Fuel System Checks	<ul> <li>Check mixer assembly for proper installation and leakage.</li> <li>Verify proper operation of the low pressure lock-off solenoid.</li> <li>Verify proper operation of the EPR.</li> <li>Check for air intake system leakage between the mixer and the throttle body. Check the fuel system pressures. Refer to the <i>Fuel System Diagnosis</i>.</li> </ul>
Ignition System Checks	<ul> <li>Note: LPG being a gaseous fuel requires higher secondary ignition system voltages for the equivalent gasoline operating conditions.</li> <li>Check for the proper ignition voltage output with <i>J 26792</i> or the equivalent.</li> <li>Verify that the spark plugs are the correct type and properly gapped.</li> <li>Check the spark plugs for the following conditions: <ul> <li>Wet plugs.</li> <li>Cracks.</li> <li>Wear.</li> <li>Burned electrodes.</li> <li>Heavy deposits</li> <li>Check for bare or shorted ignition wires.</li> <li>Check for loose ignition coil connections.</li> </ul> </li> </ul>
	<ol> <li>If the engine starts but then immediately stalls, check the cam angle sen-</li> </ol>
	sor. 2. Check for improper gap, debris or faulty connections.

#### HARD START

Checks	Action
Engine Mechanical Checks	<ul> <li>Important: The LPG Fuel system is more sensitive to intake manifold leakage than the gasoline fuel supply system.</li> <li>Check for the following: <ul> <li>Vacuum leaks</li> <li>Improper valve timing</li> <li>Low compression</li> <li>Improper valve clearance.</li> <li>Worn rocker arms</li> <li>Broken or weak valve springs</li> <li>Worn camshaft lobes.</li> </ul> </li> <li>Check the intake and exhaust manifolds for casting flash.</li> </ul>
Exhaust System Checks	<ul> <li>Check the exhaust system for a possible restriction:</li> <li>Inspect the exhaust system for damaged or collapsed pipes.</li> <li>Inspect the muffler for signs of heat distress or for possible internal failure.</li> <li>Check for possible plugged catalytic converter. Refer to <i>Restricted Exhaust System Diagnosis</i>.</li> </ul>

## CUTS OUT, MISSES

increases, but normally fe	Action r jerking that follows engine speed, usually more pronounced as the engine load alt below 1500 RPM. The exhaust has a steady spitting sound at idle, low speed, the fuel starvation that can cause the engine to cut-out.
Preliminary Checks	None
Ignition System Checks	<ol> <li>Start the engine.</li> <li>Check for proper ignition output voltage with spark tester J 26792.</li> <li>Check for a cylinder misfire.</li> <li>Verify that the spark plugs are the correct type and properly gapped.</li> <li>Remove the spark plugs and check for the following conditions:         <ul> <li>Insulation cracks.</li> <li>Wear.</li> <li>Improper gap.</li> <li>Burned electrodes.</li> <li>Heavy deposits.</li> </ul> </li> <li>Visually/Physically inspect the secondary ignition for the following:         <ul> <li>Ignition wires for arcing and proper routing.</li> <li>Cross-firing.</li> <li>Ignition coils for cracks or carbon tracking</li> </ul> </li> </ol>
Engine Mechanical Checks	<ul> <li>Perform a cylinder compression check. Check the engine for the following:</li> <li>Improper valve timing.</li> <li>Improper valve clearance.</li> <li>Worn rocker arms.</li> <li>Worn camshaft lobes.</li> <li>Broken or weak valve springs.</li> <li>Check the intake and exhaust manifold passages for casting flash.</li> </ul>
Fuel System Checks	<ul> <li>Check the fuel system:</li> <li>Plugged fuel filter.</li> <li>Low fuel pressure, etc. Refer to LPG Fuel System Diagnosis.</li> <li>Check the condition of the wiring to the low pressure lock-off solenoid.</li> </ul>
Additional Check	Check for Electromagnetic Interference (EMI), which may cause a misfire con- dition. Using the DST, monitor the engine RPM and note sudden increases in rpms displayed on the scan tool but with little change in the actual engine rpm. If this condition exists, EMI may be present. Check the routing of the second- ary wires and the ground circuit.

## **HESITATION, SAG, STUMBLE**

Checks	Action
	has a momentary lack of response when putting it under load. The condition peed. The condition may cause the engine to stall if it's severe enough.
Preliminary Checks	None.
Fuel System Checks	<ul> <li>Check the fuel pressure. Refer to <i>LPG Fuel System Diagnosis</i>.</li> <li>Check for low fuel pressure during a moderate or full throttle acceleration. If the fuel pressure drops below specification, there is possibly a faulty low pressure regulator or a restriction in the fuel system.</li> <li>Check the TMAP sensor response and accuracy.</li> <li>Check Shut-Off electrical connection.</li> <li>Check the mixer air valve for sticking or binding.</li> <li>Check the mixer assembly for proper installation and leakage. Check the EPR.</li> </ul>
Ignition System Checks	<ul> <li>Note: LPG being a gaseous fuel requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. If a problem is reported on LPG and not gasoline, do not discount the possibility of a LPG only ignition system failure and test the system accordingly.</li> <li>Check for the proper ignition voltage output with <i>J 26792</i> or the equivalent. Verify that the spark plugs are the correct type and properly gapped.</li> <li>Check for faulty spark plug wires.</li> <li>Check for fouled spark plugs.</li> </ul>
Additional Check	<ul><li>Check for manifold vacuum or air induction system leaks.</li><li>Check the alternator output voltage.</li></ul>

### BACKFIRE

Checks	Action
<b>DEFINITION:</b> The fuel ign noise.	nites in the intake manifold, or in the exhaust system, making a loud popping
Preliminary Check	None.
	Important! LPG, being a gaseous fuel, requires higher secondary igni- tion system voltages for the equivalent gasoline operating conditions. The ignition system must be maintained in peak condition to prevent backfire.
Ignition System Checks	<ul> <li>Check for the proper ignition coil output voltage using the spark tester <i>J26792</i> or the equivalent.</li> <li>Check the spark plug wires by connecting an ohmmeter to the ends of each wire in question. If the meter reads over 30,000 ohms, replace the wires.</li> <li>Check the connection at ignition coil.</li> <li>Check for deteriorated spark plug wire insulation.</li> <li>Remove the plugs and inspect them for the following conditions:</li> <li>Wet plugs.</li> <li>Cracks.</li> <li>Wear.</li> <li>Improper gap.</li> <li>Burned electrodes.</li> <li>Heavy deposits.</li> </ul>
Engine Mechanical Check	<ul> <li>Important! The LPG Fuel system is more sensitive to intake manifold leakage than a gasoline fuel supply system.</li> <li>Check the engine for the following: <ul> <li>Improper valve timing.</li> <li>Engine compression.</li> <li>Manifold vacuum leaks.</li> <li>Intake manifold gaskets.</li> <li>Sticking or leaking valves.</li> <li>Exhaust system leakage.</li> <li>Check the intake and exhaust system for casting flash or other restrictions.</li> </ul> </li> </ul>
Fuel System Checks	Perform a fuel system diagnosis. Refer to LPG Fuel System Diagnosis.

### LACK OF POWER, SLUGGISHNESS, OR SPONGINESS

Checks	Action
Preliminary Checks	<ul> <li>Refer to the LPG Fuel system OBD System Check.</li> <li>Compare the customer's vehicle with a similar unit to verify customer has an actual problem. Do not compare the power output of the vehicle operating on LPG to a vehicle operating on gasoline as the fuels do have different drive feel characteristics.</li> <li>Remove the air filter and check for dirt or restriction.</li> <li>Check the vehicle transmission.</li> <li>Refer to the OEM transmission diagnostics.</li> </ul>
Fuel System Checks	<ul> <li>Check for a restricted fuel filter, contaminated fuel, or improper fuel pressure. Refer to <i>LPG Fuel System Diagnosis</i>.</li> <li>Check for the proper ignition output voltage with the spark tester <i>J 26792</i> or the equivalent.</li> <li>Check for proper installation of the mixer assembly. Check all air inlet ducts for condition and proper installation.</li> <li>Check for fuel leaks between the EPR and the mixer.</li> <li>Verify that the LPG tank manual shut-off valve is fully open.</li> <li>Verify that liquid fuel (not vapor) is being delivered to the EPR.</li> </ul>
Sensor Checks	<ul> <li>Check the Heated Exhaust Gas Oxygen Sensors (HEGO) for contamination and performance. Check for proper operation of the TMAP sensor.</li> <li>Check for proper operation of the TPS and FPP sensors.</li> </ul>
Exhaust System Checks	<ul> <li>Check the exhaust system for a possible restriction:</li> <li>Inspect the exhaust system for damaged or collapsed pipes.</li> <li>Inspect the muffler for signs of heat distress or for possible internal failure.</li> <li>Check for possible plugged catalytic converter.</li> </ul>
Engine Mechanical Check	<ul> <li>Check the engine for the following:</li> <li>Engine compression.</li> <li>Valve timing.</li> <li>Improper or worn camshaft.</li> <li>Refer to <i>Engine Mechanical</i> in the Service Manual.</li> </ul>
Additional Check	<ul> <li>Check the ECM grounds for being clean, tight, and in their proper locations.</li> <li>Check the alternator output voltage.</li> <li>If all procedures have been completed and no malfunction has been found, review and inspect the following items:</li> <li>Visually and physically, inspect all electrical connections within the suspected circuit and/or systems.</li> <li>Check the DST data.</li> </ul>

## ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING

Checks	Action
<b>DEFINITION:</b> The engine	runs unevenly at idle. If severe enough, the engine may shake.
Preliminary Check	None.
Sensor Checks	<ul> <li>Check the Heated Exhaust Gas Oxygen Sensors (HEGO) performance:</li> <li>Check for silicone contamination from fuel or improperly used sealant. If contaminated, the sensor may have a white powdery coating result in a high but false signal voltage (rich exhaust indication). The ECM will reduce the amount of fuel delivered to the engine causing a severe driveability problem.</li> </ul>
	Check the Temperature Manifold Absolute Pressure (TMAP) sensor re- sponse and accuracy.
Fuel System Checks	<ul> <li>Check for rich or lean symptom that causes the condition.</li> <li>Drive the vehicle at the speed of the complaint.</li> <li>Monitoring the oxygen sensors will help identify the problem.</li> <li>Check for a sticking mixer air valve.</li> <li>Verify proper operation of the EPR.</li> <li>Perform a cylinder compression test. Refer to <i>Engine Mechanical</i> in the Service Manual.</li> <li>Check the EPR fuel pressure. Refer to the <i>LPG Fuel System Diagnosis</i>.</li> <li>Check mixer assembly for proper installation and connection.</li> </ul>
Ignition System Checks	<ul> <li>Check for the proper ignition output voltage using the spark tester <i>J26792</i> or the equivalent.</li> <li>Verify that the spark plugs are the correct type and properly gapped.</li> <li>Remove the plugs and inspect them for the following conditions: <ul> <li>Wet plugs.</li> <li>Cracks.</li> <li>Wear.</li> <li>Improper gap.</li> <li>Burned electrodes.</li> <li>Blistered insulators.</li> <li>Heavy deposits.</li> </ul> </li> <li>Check the spark plug wires by connecting an ohmmeter to the ends of each wire in question. If the meter reads over 30,000 ohms, replace the wires.</li> </ul>
Additional Checks	<ul> <li>Important: The LPG Fuel system is more sensitive to intake manifold leakage than the gasoline fuel supply system.</li> <li>Check for vacuum leaks. Vacuum leaks can cause a higher than normal idle and low throttle angle control command.</li> <li>Check the ECM grounds for being clean, tight, and in their proper locations. Check the battery cables and ground straps. They should be clean and secure. Erratic voltage may cause all sensor readings to be skewed resulting in poor idle quality.</li> </ul>

## ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING

Checks	Action
Engine Mechanical Check	<ul> <li>Check the engine for:</li> <li>Broken motor mounts.</li> <li>Improper valve timing.</li> <li>Low compression.</li> <li>Improper valve clearance.</li> <li>Worn rocker arms.</li> <li>Broken or weak valve springs.</li> <li>Worn camshaft lobes.</li> </ul>

# **Electrical Section**

NOTE: YOU CAN OBTAIN A FULL SIZE ELECTRONIC WIRE DIAGRAM BY CONTACTING THE OEM.

# **ECM Header Connectors**

## 1.6L LPG

EG01		_	
FGO1	~	1	DK GREEN/ORANGE 18
	5	2	DK GREEN/WHITE 18
FCI EGO2		3	
211 PC 98 25 8889 CONNECTOR EGO3		ă.	
211 A 96 6887 LOCKING CAN EGO4			
111 A 00 0000 000/00 TDE1		5	PURPLE/LT BLUE 18
211 CC 25 1468 TERMINAL (GOLD) TPS2	ŝ	6	LT BLUE/DK BLUE 18
	-	7	LT GREEN 18
MAP	<		ORANGE/YELLOW 18
AUX ANA PD1		9	DK BLUE/ORANGE 18
FPP1			
FPP2 IVS		10	PURPLE/YELLOW 18
	ŝ	11	
AUX ANA PUD2	_	12	
AUX ANA PUD3		13	WHITE/ORANGE 18
CAN TERM +			
CAN1 +		14	BLUE/PINK 18
CAN1 -	25	15	BLUE/WHITE 18
	20	16	
CAN2-		17	
CAN2 +		18	
CAN2 TERM +			
5V EXT 1		19	LT GREEN/RED 18
5V RTN		20	BLK/LT_GREEN_18
		21	PURPLE/WHITE 18
CRANK +	· · ·	22	WHITE/PURPLE 18
CRANK -		23	
CAM +			
CAM -		24	
SPEED +		25	RED/WHITE 18
		26	RED/BLACK 18
SPED -		27	
KNOCK1 +		28	
KNOCK1 -			
KNOCK2 +		29	
KNOCK2 -		38	
	20	31	YELLOW 18
SPARK COIL 1A		32	
SPARK COL 18		33	YELLOW/RED 18
SPARK COIL 2A			
SPARK COL 28		34	
SPARK COLL 3A	5	35	
	< .	36	
SPARK COL 38	~	37	
SPARK COIL 4A			
SPARK COL 48		38	
IAT		39	YELLOW/GRAY 18
	$\geq$	48	TAN/WHITE 18
ECT		41	
EGT			DK GREEN/PURPLE 18
AUX DIG 1			
AUX DIG 2	-	43	TAN/RED 18
	-	44	TAN/BLACK 18
AUX DIG 3	-	45	PINK/TAN 18
VSW		46	DK BLUE/YELLOW 18
AUX ANA PU1		47	YELLOW/DK BLUE 18
AUX ANA PU2			TELLOW/DK BLUE TO
(FRT) AUX ANA PU3	_	48	
	1	49	LT GREEN/PURPLE 18
(FPP2 ONLY) 5V EXT 2	-	50	LT GREEN/BLACK 18
5V RTN		51	GRAY/DK BLUE 18
GOV1		52	
GOV2			GRAY/RED 18
OIL PRESS		53	LT BLUE 18
(FRP) AUX ANA PUD1	2	54	
	2	55	DK GREEN 18
PC TX		56	ORANGE 18
PC RX			
ALT EXCITE		57	CD4× 18
TACH		58	GRAY 18
VBAT PROT	5	59	
		68	RED/TAN 16
VBAT		61	
	-		
NJ1 LS		62	
INJ1 LS INJ2 LS		62	
NJ2 LS	$\sim$	63	
NJ2 LS NJ3 LS	$\sim$	63 64	
NJ2 LS NJ3 LS NJ4 LS	$\sim$	63	
NJ2 LS NJ3 LS NJ4 LS NJ5 LS	rψψ	63 64	
NJ2 LS NJ3 LS NJ4 LS NJ5 LS NJ6 LS	www.	63 64 65 66	
NJ2 LS NJ3 LS NJ4 LS NJ5 LS NJ6 LS NJ7 LS	~~~~	63 64 65 66 67	
NJ2 LS NJ3 LS NJ4 LS NJ5 LS NJ6 LS	///////	63 64 65 66 67 68	
NJ2 LS NJ3 LS NJ3 LS NJ5 LS NJ5 LS NJ6 LS NJ7 LS NJ8 LS	///////////////////////////////////////	63 64 65 66 67 68 69	BLACK 16
NJ2 LS NJ3 LS NJ4 LS NJ6 LS NJ6 LS NJ7 LS NJ8 CROUND	///////////////////////////////////////	63 64 65 66 67 68 69 70	BLACK 16
NJ2 LS NJ3 LS NJ4 LS NJ6 LS NJ7 LS NJ7 LS GROUND STARTER	///////////////////////////////////////	63 64 65 66 67 68 69	
NJ2 LS NJ3 LS NJ5 LS NJ5 LS NJ6 LS NJ6 LS NJ8 LS GROUND STARTER RELAY	///////////////////////////////////////	63 64 65 66 67 68 69 70	BLACK 16
NJ2 LS NJ3 LS NJ5 LS NJ5 LS NJ6 LS NJ6 LS GROUND STARTER RELA EGOH 1	///////////////////////////////////////	63 64 65 66 67 68 69 70 71 72	BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18
NJ2 LS NJ3 LS NJ4 LS NJ6 LS NJ8 LS NJ8 LS NJ8 LS SR0UND STARTER RELAY EGOH 2	///////////////////////////////////////	63 64 65 66 67 68 69 70 71 72 73	BLACK 16 WHITE/LT BLUE 18
NJ2 LS NJ3 LS NJ5 LS NJ5 LS NJ6 LS NJ6 LS GROUND STARTER RELA EGOH 1	*****	63 64 65 66 67 68 69 70 71 72 73 74	BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18 BLACK/YELLOW 18
NJ2 LS NJ3 LS NJ3 LS NJ5 LS NJ5 LS NJ6 LS NJ8 LS GROUND STARTER RELAY EGOH 1 EGOH 2 EGOH 3	*********	63 64 65 66 68 69 70 72 72 73 74 75	BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18
INJ2 LS INJ3 LS INJ5 LS INJ5 LS INJ6 LS INJ6 LS GROUND STARTER RELAY EGOH 1 EGOH 2 EGOH 3 (LOCKOFF) EGOH 4	*********	63 64 65 66 67 68 69 70 71 72 73 74	BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18 BLACK/YELLOW 18
INJ2 LS INJ3 LS INJ5 LS INJ5 LS INJ6 LS INJ6 LS INJ8 LS INJ8 LS GROUND STATTER RELAY EGOH 1 EGOH 2 EGOH 2 EGOH 3 (LOCKOFF) EGOH 4 BUZZER		63 64 65 66 68 69 70 72 72 73 74 75	BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18 BLACK/YELLOW 18 WHITE/BLACK 18
INJ2 LS INJ3 LS INJ5 LS INJ5 LS INJ6 LS INJ7 LS INJ8 LS GROUND STARTER RELAY EGOH 1 EGOH 2 EGOH 3 UZZER BUZZER PWM5		63 64 65 66 67 70 72 73 75 76 77 77 77 77	BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18 BLACK/YELLOW 18 WHITE/BLACK 18 BROWN/WHITE 16
INJ2 LS INJ3 LS INJ5 LS INJ5 LS INJ6 LS INJ6 LS INJ8 LS INJ8 LS GROUND STATTER RELAY EGOH 1 EGOH 2 EGOH 2 EGOH 3 (LOCKOFF) EGOH 4 BUZZER	*****	63 64 65 66 67 68 69 70 72 73 74 75 77 77 77 77 77 77 77	BLACK 16 BLACK/WHITE 18 BLACK/WHITE 18 BLACK/YELLOW 18 WHITE/BLACK 18 BROWN/WHITE 16 WHITE/BROWN 16
INJ2 LS INJ3 LS INJ5 LS INJ5 LS INJ6 LS INJ7 LS INJ8 LS GROUND STARTER RELAY EGOH 1 EGOH 2 EGOH 3 UZZER BUZZER PWM5		63 64 65 66 66 66 70 77 77 77 77 77 77 77 77 77 77 77 77	BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18 BLACK/YELLOW 18 WHITE/BLACK 18 BROWN/WHITE 16 WHITE/BROWN 16 RED/TAN 16
INJ2 LS INJ3 LS INJ5 LS INJ5 LS INJ6 LS INJ6 LS GROUND STARTER RELAY EGOH 1 EGOH 2 EGOH 2 EGOH 2 EGOH 2 EGOH 2 EGOH 2 EGOH 3 UZZER PWMS RECON	****	63 64 65 66 66 66 70 77 77 77 77 77 77 77 77 77 77 77 77	BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18 BLACK/YELLOW 18 WHITE/BLACK 18 BROWN/WHITE 16 WHITE/BROWN 16 RED/TAN 16 GREEN/YELLOW 18
INJ2 LS INJ3 LS INJ5 LS INJ5 LS INJ6 LS INJ7 LS INJ8 LS GROUND STARTER RELAY EGOH 1 EGOH 2 EGOH 3 (LOCKOFF) E3OH 4 BUZZER PWM5 RECRC VBAT WM5	****	63 64 65 66 66 66 70 77 77 77 77 77 77 77 77 77 77 77 77	BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18 BLACK/YELLOW 18 WHITE/BLACK 18 BROWN/WHITE 16 WHITE/BROWN 16 RED/TAN 16
INJ2 LS INJ3 LS INJ5 LS INJ5 LS INJ5 LS INJ7 LS GROUND STARTER RELAY EGOH 1 EGOH 2 EGOH 2 EGOH 3 UZZER PWM5 PWM5 RECIRC VBAT GROUND	****	63 64 65 66 66 66 77 77 77 77 77 77 77 77 77 77	BLACK 16 BLACK/WHITE 18 BLACK/WHITE 18 BLACK/YELLOW 18 WHITE/BLACK 18 BROWN/WHITE 16 WHITE/BROWN 16 RED/TAN 16 GREEN/YELLOW 18 BLACK 16
INJ2 LS INJ3 LS INJ5 LS INJ5 LS INJ6 LS INJ7 LS INJ8 LS GROUND STARTER RELAY EGOH 1 EGOH 2 EGOH 3 (LOCKOFF) E3OH 4 BUZZER PWM5 RECRC VBAT ML	*****	63 64 65 66 66 66 77 77 77 77 77 77 77 77 77 77	BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18 BLACK/YELLOW 18 WHITE/BLACK 18 BROWN/WHITE 16 WHITE/BROWN 16 RED/TAN 16 GREEN/YELLOW 18 BLACK 16 PINK/WHITE 18
INJ2 LS INJ3 LS INJ5 LS INJ5 LS INJ5 LS INJ7 LS GROUND STARTER RELAY EGOH 1 EGOH 2 EGOH 2 EGOH 3 UZZER PWM5 PWM5 RECIRC VBAT GROUND	*****	63 64 65 66 66 66 77 72 77 77 77 77 77 77 77 77 77 77 77	BLACK 16 BLACK/WHITE 18 BLACK/WHITE 18 BLACK/YELLOW 18 WHITE/BLACK 18 BROWN/WHITE 16 WHITE/BROWN 16 RED/TAN 16 GREEN/YELLOW 18 BLACK 16
INJ2 LS INJ3 LS INJ5 LS INJ5 LS INJ6 LS INJ7 LS INJ8 LS GROUND STARTER RELAY EGOH 1 EGOH 2 EGOH 3 (LOCKOFF) E3OH 4 BUZZER PWM5 PWM5 RECIRC VBAT MIL GROUND DBW + DBW + DBW +	*****	63 64 65 66 66 66 77 72 77 77 77 77 77 77 77 77 77 77 77	BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18 BLACK/YELLOW 18 WHITE/BLACK 18 BROWN/WHITE 16 WHITE/BROWN 16 RED/TAN 16 GREEN/YELLOW 18 BLACK 16 PINK/WHITE 18
NJ2 LS NJ3 LS NJ3 LS NJ5 LS NJ5 LS NJ5 LS NJ5 LS NJ5 LS NJ5 LS NJ5 LS NJ5 LS NJ5 LS CROUND STARTER RELAY EGOH 1 EGOH 2 EGOH 2 EGOH 3 (LOCKOFF) EGOH 4 BUZZER PWM5 RECIRC VBAT MIL GROUND DBW + DBW + DBW + DBW - FPUMP	*****	63 64 65 66 66 66 77 72 77 77 77 77 77 77 77 77 77 77 77	BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18 BLACK/YELLOW 18 WHITE/BLACK 18 BROWN/WHITE 16 WHITE/BROWN 16 RED/TAN 16 GREEN/YELLOW 18 BLACK 16 PINK/WHITE 18
INJ2 LS INJ3 LS INJ5 LS INJ5 LS INJ5 LS INJ5 LS INJ5 LS GROUND STARTER RELAY EGOH 1 EGOH 2 EGOH 1 EGOH 2 EGOH 3 (LOCKOFF) EGOH 4 BUZZER PWM5 RECIRC VBAT MIL GROUND DBW + DBW - FPUMP AUX PWM3 RECIRC	******	63 64 65 66 66 66 77 72 77 77 77 77 77 77 77 77 77 77 77	BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18 BLACK/YELLOW 18 WHITE/BLACK 18 BROWN/WHITE 16 WHITE/BROWN 16 RED/TAN 16 GREEN/YELLOW 18 BLACK 16 PINK/WHITE 18
INJ2 LS INJ3 LS INJ5 LS INJ5 LS INJ5 LS INJ5 LS INJ5 LS INJ5 LS INJ8 LS GROUND STARTER RELAY EGOH 1 EGOH 2 EGOH 3 (LOCKOFF) E3OH 4 BUZZER PWM5 RECRC VBAT MIL GROUND D6W + D6W - FPUMP AUX PWM3 RECRC	*****	63 64 65 66 66 70 77 77 77 77 77 77 77 77 77 77 77 77	BLACK 16 BLACK/WHITE 18 BLACK/YELLOW 18 WHITE/BLACK 18 BROWN/WHITE 16 WHITE/BROWN 16 RED/TAN 16 GREEN/YELLOW 18 BLACK 16 PINK/WHITE 18 TAN/ORANGE 18
INJ2 LS INJ3 LS INJ5 LS INJ5 LS INJ5 LS INJ5 LS INJ5 LS GROUND STARTER RELAY EGOH 1 EGOH 2 EGOH 1 EGOH 2 EGOH 3 (LOCKOFF) EGOH 4 BUZZER PWM5 RECIRC VBAT MIL GROUND DBW + DBW - FPUMP AUX PWM3 RECIRC		63 64 66 66 66 66 77 72 77 77 77 77 77 79 80 81 23 84 58 85 85 85 85 85 85 85 85 85 85 85 85	BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18 BLACK/YELLOW 18 WHITE/BLACK 18 BROWN/WHITE 16 WHITE/BROWN 16 RED/TAN 16 GREEN/YELLOW 18 BLACK 16 PINK/WHITE 18 TAN/ORANGE 18 TAN 18
INJ2 LS INJ3 LS INJ5 LS INJ5 LS INJ5 LS INJ5 LS INJ5 LS INJ5 LS INJ8 LS GROUND STARTER RELAY EGOH 1 EGOH 2 EGOH 3 (LOCKOFF) E3OH 4 BUZZER PWM5 RECRC VBAT MIL GROUND D6W + D6W - FPUMP AUX PWM3 RECRC	******	63 64 65 66 66 77 72 77 77 77 77 77 79 80 81 23 88 88 88 88 88 88 88 88 88 88 88 88 88	BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18 BLACK/YELLOW 18 WHITE/BLACK 18 BROWN/WHITE 16 WHITE/BROWN 16 RED/TAN 16 RED/TAN 16 BLACK 16 PINK/WHITE 18 TAN/ORANGE 18 TAN 18 DK BLUE 16
INJ2 LS INJ3 LS INJ5 LS INJ5 LS INJ5 LS INJ5 LS INJ5 LS INJ8 LS GROUND STARTER RELAY EGOH 1 EGOH 2 EGOH 2 EGOH 3 (LOCKOFF) EGOH 4 BUZZER PWM5 RECIRC VBAT MAL GROUND DBW + DBW - FPUMP AUX PWM3 RECIRC AUX PWM3	**********	63 64 66 66 66 66 77 72 77 77 77 77 77 79 80 81 23 84 58 85 85 85 85 85 85 85 85 85 85 85 85	BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18 BLACK/YELLOW 18 WHITE/BLACK 18 BROWN/WHITE 16 WHITE/BROWN 16 RED/TAN 16 GREEN/YELLOW 18 BLACK 16 PINK/WHITE 18 TAN/ORANGE 18 TAN 18

## 1.6L Duel Fuel

EG01         1         DK GREEN/ORANGI           211 AC 98 25 6689 CONNECTOR 211 A 96 6887 LOOKING CAN         EG03         3           211 A 96 6887 LOOKING CAN         EG04         5         PURPLE/LT BLUE 1           211 A 96 6887 LOOKING CAN         EG04         5         PURPLE/LT BLUE 1           211 A 96 6887 LOOKING CAN         EG04         5         PURPLE/LT BLUE 1           211 A 96 6888 COVER         TPS1         6         LT BLUE/DK BLUE 1           211 CC 25 1468 TEMMINAL (SOLD) TPS2         7         LT GREEN 18           AUX ANA PD1         9         DK BLUE/ORANGE 18           FPP1         10         PURPLE/YELLOW 1           FPP2 IVS         10         PURPLE/YELLOW 1           AUX ANA PUD2         11         AUX ANA PUD3           AUX ANA PUD2         12         AUX ANA PUD3           AUX ANA PUD2         12         AUX ANA PUD3           AUX ANA PUD3         13         WHITE/ORANGE 18           CAN1 -         21         BLUE/WHITE 18           CAN2 +         17         CAN2 +           CAN2 +         20         BLK/LT GREEN 18           SV EXT 1         20         BLK/LT GREEN 18           CAN +         22         WHITE 18	E 18
EUG1         22         DK GREEN/WHITE 1           211 PC 98 25 8680 CONNECTOR         EG03         3           211 A 58 6687 LOCHNE CAN         EG04         4           211 A 58 6687 COCHNECTOR         EG03         4           211 A 58 6687 COCHNECTOR         EG04         5         PURPLE/LT BLUE 7           211 A 58 6688 COVER         TPS1         6         LT BLUE7DK BLUE           211 A 52 6688 COVER         TPS1         6         LT BLUE7DK BLUE           211 CC 25 1468 TEIMINAL (SOLD) TPS2         7         LT GREEN 18         NAP           AUX ANA PD1         9         DK BLUE/ORANGE         FPP1         10         PURPLE/YELLOW 1           FIPP1 VI         10         PURPLE/YELLOW 1         FIP2         11         AUX ANA PUD3         11           AUX ANA PUD3         13         WHITE/ORANGE 18         CAN1 +         14         BLUE/PINK 18           CAN TERM +         14         BLUE/PINK 18         CAN2 +         17           CAN2 +         19         LT GREEN 18         5V EXT 1         20         BLK/LT GREEN 18           SV EXT 1         20         BLK/LT GREEN 18         SV EXT 1         20         BLK/LT GREEN 18           CAN +         22         WHITE/PUR	18
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$\begin{array}{c c c c c c c c c c c c c c c c c c c $	
211 A SE BERS COVER         TPS1          3         PURYLE/LI BLUE           211 CC 25 1469 TENMINAL (SOLD) TPS2          6         LT BLUE/DK BLUE           MAP          8         ORANGE/YELOW 1           AUX ANA PD1          9         DK BLUE/DK BLUE           FPP1         10         PURYLE/LI BLUE         MAP           AUX ANA PD12         11         9         DK BLUE/DRANGE           FPP2 IVS         10         PURPLE/YELLOW 1         FUE/ORANGE           CAN TERM +         13         WHITE/ORANGE 18         CAN1 +           CAN TERM +         15         BLUE/VINK 18         CAN12 +           CAN1 +          15         BLUE/VINK 18         SV EXT 1           CAN2 +          18         SV EXT 1         19         LT GREEN 18           SV RTN          22         BLK/LT GREEN 18         SV EXT 1         22         BLK/LT GREEN 18           SV RTN          22         UNTRE/WHITE 18         CAM +         22         WHITE/20URPLE 18           CAM +          22         RED/WHITE 18         SPEED +         25         RED/WHITE 18           SPEED +	
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$\begin{array}{c c c c c c c c c c c c c c c c c c c $	18
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AUX ANA PUD2 $\leftarrow$ 11 AUX ANA PUD2 $\leftarrow$ 12 AUX ANA PUD2 $\leftarrow$ 12 CAN TERM + $\leftarrow$ 13 WHITE/ORANGE 18 CAN1 + $\leftarrow$ 14 BLUE/PINK 18 CAN1 + $\leftarrow$ 15 BLUE/WHITE 18 CAN2 + $\leftarrow$ 16 CAN2 + $\leftarrow$ 17 CAN2 + $\leftarrow$ 17 CAN2 + $\leftarrow$ 17 CAN2 + $\leftarrow$ 18 SV EXT 1 20 BLK/LT GREEN/RED 18 SV EXT 1 20 BLK/LT GREEN/RED 18 SV EXT 1 20 BLK/LT GREEN/RED 18 CRANK + $\leftarrow$ 22 WHITE/PURPLE 18 CRANK + $\leftarrow$ 22 WHITE/PURPLE 18 CRANK + $\leftarrow$ 22 WHITE/PURPLE 18 CRANK + $\leftarrow$ 22 KHITE/PURPLE 18 CRANK + $\leftarrow$ 23 CHIE/PURPLE 20 CHIE/PUR	
AUX ANA PUD2 AUX ANA PUD2 CAN TERM + $213$ WHITE/ORANGE 18 CAN TERM + $213$ BLUE/PINK 18 CAN1 + $214$ BLUE/PINK 18 CAN1 + $215$ BLUE/WHITE 18 CAN2 + $217$ CAN2 + $217$ CAN2 + $219$ BLK/LT GREEN/RED 18 5V EXT 1 20 BLK/LT GREEN 18 5V EXT 1 20 BLK/LT GREEN 18 5V EXT 1 20 BLK/LT GREEN 18 CRANK + $21$ PURPLE/WHITE 18 CRANK + $22$ WHITE/PURPLE 18 CRANK + $223$ CAM + $224$ CAM + $224$ CAM + $225$ RED/WHITE 18 SPEED + $226$ RED/WHITE 18 SPEED + $226$ RED/WHITE 18 SPEED + $226$ RED/BLACK 1	<u> </u>
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CAN2 + 2 17 CAN2 + 18 CAN2 TERM + 19 LT GREEN/RED 18 5V EXT 1 20 BLK/LT GREEN 18 5V RTN 21 PURPLE/WHITE 18 CRANK + 22 WHITE/PURPLE 18 CRANK + 23 CAM + 23 CAM + 24 CAM + 24 CAM + 25 RED/WHITE 18 SPEED + 25 RED/WHITE 18 SPEED + 25 RED/WHITE 18 SPEED + 25 RED/WHITE 18 SPEED + 26 RED/BLACK 18 SPEED + 28 KNOCK1 + 28 KNOCK1 + 29 KNOCK2 + 29 KNOCK2 + 29 KNOCK2 + 29	
CAN2 + 18 CAN2 TERM + 19 5V EXT 1 20 5V EXT 1 20 EXX/LT GREEN/RED 18 5V RTN 20 CRANK + 21 CRANK + 21 CRANK + 22 CAM + 22 CAM + 23 CAM + 23 CAM + 24 CAM + 24 CAM + 22 CAM + 23 CAM + 24 CAM +	
CAN2 TERM + 5V EXT 1 20 BLX/LT GREEN/RED 18 5V RTN 20 BLX/LT GREEN 18 5V RTN 21 PURPLE/WHITE 18 CRANK + 22 WHITE/PURPLE 18 CRANK + 22 WHITE/PURPLE 18 CRANK + 22 RED/WHITE 18 CRANK + 22 RED/WHITE 18 SPEED + 25 RED/WHITE 18 SPEED + 25 RED/WHITE 18 SPEED + 26 RED/BLACK 18 SPEED + 27 KNOCK1 + 28 KNOCK1 + 29 KNOCK2 + 29 KNOCK2 + 29	
SV EXT 1         20         BLK/LT GREEN 18           SV RTN         21         PURPLE/WHITE 18           CRANK         -         22           WHITE 21         CRANK         -           CRANK         -         23           CAM         -         23           CAM         -         25           RED/WHITE 18         SPEED         -           SPEED         -         26           KNOCK1         -         27           KNOCK1         -         28           KNOCK2         +         29           KNOCK2         -         30	
SV RIN         21         PURPLE/WHITE 18           CRANK         -         22         WHITE/PURPLE 18           CAM +         23         23           CAM +         24         24           CAM +         25         RED/WHITE 18           SPEED +         25         RED/WHITE 18           SPEED +         25         RED/BLACK 18           SPEED +         27         KNOCK1 +           KNOCK1 +         28         KNOCK2 +           KNOCK2 +         29         X0	
CRANK + 22 WHITE/PURPLE 18 CRANK + 23 CAM + 24 CAM - 24 CAM - 25 RED/WHITE 18 SPEED + 25 RED/WHITE 18 SPEED + 26 RED/BLACK 18 SPEED - 28 KNOCK1 + 28 KNOCK1 - 29 KNOCK2 + 29 KNOCK2 + 29 KNOCK2 + 20	
CAM + 22 CAM + 22 CAM - 22 CAM - 22 RED/WHITE 18 SPEED + 26 RED/BLACK 18 SPEED - 27 KNOCK1 + 28 KNOCK1 - 29 KNOCK2 + 29 KNOCK2 + 29 KNOCK2 + 20 KNOCK2 + 20 KNOC	
CAM	
SPEED + < 25 KED/WHILE 18 SPEED - <> 26 RED/BLACK 18 KNOCK1 + < 27 KNOCK1 + <> 28 KNOCK2 + < 29 KNOCK2 + < 30	
SPEED	
KNOCK1 + 28 KNOCK1 - 28 KNOCK2 + 29 KNOCK2 + 30	
KNOCK1	
KNOCK2 - <> 31 YELOW 18	
SPARK COLL 1A 30	
SPARK CUL 18 38 VELLOW/BED 18	
SPARK COL 24 33 10000 Hz 10 SPARK COL 28 34	
SPARK COLL 3A 30	
SPARK COL TR - 35	
SPARK COLL AA > 3/	
SPARK COL 48 - 35	
IAT 39 YELLOW/GRAY 18	
	18
AUX DIG 1 AX TANZED 18	
AUX DIG 2 A4 TAN / BLACK 18	
AUX DIG 3 45 PINK/TAN 18	
ALIX ANA PULL 45 DK BLUE/TELLOW	
4/ TELLOW/DK DLUE	18
(FRT) AUX ANA PU3 < 40 IT OREEN / PUIDOLE	3
(FPP2 UNLT) SV EXT 2 59 IT OPEEN/PLACK	
SV KIN 51 CRAV/DK BUIE 18	
52 GRAY/RED 18	
GOV2 53 LT BLUE 18	
(FRP) AUX ANA PUD1 54 WHITE/LT GREEN 1	8
DO TV SO DA GREEN 18	
PC PV S0 UKANGE 10	
TACH SB GRAY 18	
VBALPROT 69 RED/TAN 16	
VBAL S 61 DDOWN/IT DUIE 1	8
NJ1 LS 62 BROWN/LT CREDU	
NIA IS - 64	
N.IS IS 60	
NJ7 LS < 62	
NJ6 LS 60 BLACK 16	
GROUND 70	
STARTER 71 WHITE/LT BLUE 18	
72 BLACK/WHITE 18	
EGOH 2 73 BLACK/YELLOW 18	
DU77EP ~ /0	
DWWS // BROWN/WHITE 16	
PWMS RECIRC 70 RED/TAN 16	
VEAL BA OPEN/VELLOW 18	1
ML 81 BLACK 16	-
GROOND 82 PINK/WHITE 18	
DBW + SS 83 TAN/ORANGE 18	
EPILINE 84 TAN/BLACK 18	
ALIX PWW3 RECIPC BD PINK/TELLOW 16	
ALLY DWAYS SO BLACK/ KED TO	
ALLY DWM1 S 57 TAN 10	
(STARTER) AUX PWM4 GA	
AUX_PWM4_RECIRC <	

# 1.6L Gasoline

		1	1	DK GREEN/ORANGE 18
	EGO1	5	ż	DK GREEN/WHITE 18
FCI	EGO2 EGO3	$\sim$	3	
211 PC 98 25 8689 CONNECTOR 211 A 96 6887 LOCKING CAM	EGO4	2	4	
211 A 98 6888 COVER	TPS1	<	5	PURPLE/LT BLUE 18
211 CC 2S 1468 TERMINAL (GOLD)	1. 10.00	<	7	LT BLUE/DK BLUE 18 LT GREEN 18
	MAP	5	8	ORANGE/YELLOW 18
AUX AN	FPP1	2	9	DK BLUE/ORANGE 18
EPP	2 IVS	2	10	PURPLE/YELLOW 18
AUX ANA		<	.11	
AUX ANA		<	12	WHITE/ORANGE 18
CAN TE		5-	14	BLUE/PINK 18
	W1 + W1 -	<u>&gt;</u> >	15	BLUE/WHITE 18
	AN2-	~~	16	
	N2 +	<>	17	
CAN2 TE		<	19	LT GREEN/RED 18
	EXT 1 V RTN	2	20	BLK/LT GREEN 18
	NK +	Ň	21	PURPLE/WHITE 18
	NK -	<>	22	WHITE/PURPLE 18
	:AM +	<	24	
	<u>- MA</u>	>>	25	RED/WHITE 18
	王D + 王D -	2-	26	RED/BLACK 18
	<del>x</del> 1 +	<	27	
KNOC	жı –	$\Leftrightarrow$	28	
	ж2 +	5.	30	
KNOC SPARK CO		~	31	YELLOW 18
SPARK CO SPARK CO		5	32	
SPARK CO		>	33	YELLOW/RED 18
SPARK CO		>	34 35	
SPARK CO		2	36	
SPARK CO SPARK CO		\$	37	
SPARK CO		5	38	NEL 00 (00 00 00 40
	IAT	<	39 40	YELLOW/GRAY 18 TAN/WHITE 18
	ECT	5	41	ISAV WHITE 10
ALIX	EGT DIG 1	1	42	DK GREEN/PURPLE 18
	DIG 2	5	43	TAN/RED 18
	DIG 3	>	44	TAN/BLACK 18 PINK/TAN 18
	VSW	<	45	DK BLUE/YELLOW 18
AUX ANA AUX ANA		5	47	YELLOW/DK BLUE 18
(FRT) AUX ANA		Ň	48	LT GREEN/WHITE 18
(FPP2 ONLY) 5V		>	49 50	LT GREEN/PURPLE 18 LT GREEN/BLACK 18
5	V RTN	5	51	GRAY/DK BLUE 18
	GOV1 GOV2	5	52	GRAY/RED 18
OIL P	RESS	2	53	LT BLUE 18
(FRP) AUX ANA		<	54 55	WHITE/LT GREEN 18 DK GREEN 18
	PC TX	>	56	ORANGE 18
	PC RX	2	57	
Acre	TACH	5	58	GRAY 18
VBAT	PROT	>	59 60	RED/TAN 16
	VBAT	5	61	BROWN/LT BLUE 18
	J1 LS J2 LS	2	62	BROWN/LT GREEN 18
	J3 LS	2	63	
IN	J4 LS	<	64 65	
	J5 LS	5	66	
	J6 LS J7 LS	2	67	
	US LS	2	68	DI 101/ 10
GR	OUND	<	69 70	BLACK 16
	ARTER	2	71	WHITE/LT BLUE 18
		2	72	BLACK/WHITE 18
	30H 1 30H 2	5	73	BLACK/YELLOW 18
EC	SOH 3	>	74	
(LOCKOFF) EC	GOH 4	2	76	
	JZZER	2	77	BROWN/WHITE 16
PWM5 R	PWM5 ECIRC	÷.	78	WHITE/BROWN 16
1.1.10	VBAT	<	79	RED/TAN 16
	ML	>	80 81	GREEN/YELLOW 18 BLACK 16
	OUND	5.	82	PINK/WHITE 18
	8W + 8W -	25	83	TAN/ORANGE 18
	PUMP	>	84	TAN/BLACK 18
AUX PWM3 R	ECIRC	<	85 86	PINK/YELLOW 16 BLACK/RED 16
	PWM3	2	87	TAN 18
	PWM1 PWM2	<	88	DK BLUE 16
(STARTER) AUX		5	89	PINK/BLACK 18
	ECIRC	<	90	

## 3.0L Duel Fuel

	EG01	-	1	DK GREEN/ORANGE 18
FCI	EG02	~	2	DK GREEN/WHITE 18
211 PC 98 25 6889 CONNECTOR 211 A 98 6887 LOCKING CAN	EG03	5	4	
211 A 98 8888 COVER	EGO4 TPS1	2	5	PURPLE/LT BLUE 18
211 CC 25 1468 TERMINAL (COLD)	TPS2	2	6	LT BLUE/DK BLUE 18
	MAP	<	7 8	DRANGE/YELLOW 18
AUX A	NA PD1	5	9	DK BLUE/ORANGE 18
F	FPP1 PP2 IVS	2	10	PURPLE/YELLOW 18
AUX AN		2	11	
AUX AN		<	13	WHITE/ORANGE 18
	TERM + CAN1 +	25	14	BLUE/PINK 18
	CAN1 -	~~	15	BLUE/WHITE 18
	CAN2-	$\leq >$	-16	
	CAN2 + TERM +	~	18	
	VEXT 1	2	19	LT GREEN/RED 18
	5V RTN	<	20	BLK/LT GREEN 18 PURPLE/WHITE 18
	RANK + RANK -	5.	22	WHITE/PURPLE 18
	CAM +	<^	23	GRAY/BROWN 18
	CAM -	<>	24 25	PURPLE/ORANGE 18 RED/WHITE 18
	PEED +	5.	26	RED/BLACK 18
	PEED - DCK1 +	~	27	
	DCK1 -	<>	28	
	DCK2 +	5	30	
KN0 SPARK (	COL 14	$\sim$	31	YELLOW 18
SPARK (		5	32	
SPARK	COIL 2A	>	33	
SPARK (		2	35	
SPARK		5	36	
SPARK	COIL 4A	>	37 38	
SPARK (		>	39	YELLOW/GRAY 18
	IAT ECT	2	40	TAN/WHITE 18
	EGT	~	41	DK GREEN/PURPLE 18
	X DIG 1	>	43	TAN/RED 18
	X DIG 2 X DIG 3	2	44	TAN/DK GREEN 18
	VSW	<	45	PINK/TAN 18
	NA PU1	<	46	DK BLUE/YELLOW 18 YELLOW/DK BLUE 18
AUX A (FRT) AUX A	NA PU2	5	48	LT GREEN/WHITE 18
(FPP2 ONLY) 5		>	49	LT GREEN/PURPLE 18
	5V RTN	<	50 51	LT GREEN/BLACK 18 GRAY/DK BLUE 18
	GOV1 GOV2	5	52	GRAY/RED 18
OIL	PRESS	2	53	LT BLUE 18
(FRP) AUX AN		<	54 55	WHITE/LT GREEN 18 DK GREEN 18
	PC TX PC RX	>	56	ORANGE 18
ALT	EXCITE	2	57	00000 400
	TACH	>	58 59	GRAY 18
VBA	T PROT	2	60	RED/TAN 16
	VBAT INJ1 LS	2	61	BROWN/LT BLUE 18
	NJ2 LS	<	62 63	BROWN/LT GREEN 18 BROWN/YELLOW 18
	INJ3 LS INJ4 LS	5	64	BROWN/WHITE 18
	INJ4 LS INJ5 LS	2	65	
	INJ6 LS	<	66 67	
	INJ7 LS		68	
	INJ8 LS ROUND		69	BLACK 16
	TARTER		70	WHITE /17 DUTIE 10
	RELAY		71	WHITE/LT BLUE 18 BLACK/WHITE 18
	EGOH 1 EGOH 2	<	73	BLACK/YELLOW 18
	EGOH 3	5	-74	
(LOCKOFF)	EGOH 4	>	75 76	WHITE/BLACK 18
f	BUZZER		77	BROWN/WHITE 16
PWM5	PWM5 RECIRC	<	78	WHITE/BROWN 16
	VBAT	<	79 80	RED/TAN 16 GREEN/YELLOW 18
	MIL	>	81	BLACK 16
G	ROUND DBW +	25	82	PINK/WHITE 18
	DBW -	<>	83	TAN/ORANGE 18
	FPUMP	>	84 85	TAN/BLACK 18 PINK/YELLOW 16
AUX PWM3		5	86	BLACK/RED 16
	K PWM3 K PWM1		87	TAN 18
AUX	K PWM2	>	88 89	DK BLUE 18 PINK/BLACK 18
(STARTER) AUX		>	90	C100/04/Wh 10
AUX_PWM4_	REGIRC	~		

## 3.0L LPG

EGG	)1 <	2	DK GREEN/ORANGE 18 DK GREEN/WHITE 18
FCI EGG	2 <	3	DK GREENZWHITE TO
211 PC 98 25 6889 CONNECTOR EGG		-4	
211 A 98 8807 LOCKING CAN EGG		-3	PURPLE/LT BLUE 18
211 A SE EBSE COVER TPS	S1 <	6	LT BLUE/DK BLUE 18
211 CC 25 1468 TERMINAL (COLD) TP:		7	LT GREEN 18
M		8	ORANGE/YELLOW 18
AUX ANA PO	)1 <	9	DK BLUE/ORANGE 18
FPE		10	PURPLE/YELLOW 18
FPP2 I	/s <del>&lt;</del>	11	PORPLEZ TELLOW TO
AUX ANA PUL		-12	
AUX ANA PUT	)3 <	-13	WHITE CORANCE 19
CAN TERM	+ <	14	WHITE/ORANGE 18
CAN1	+ <>	15	BLUE/PINK 18 BLUE/WHITE 18
CAN1		16	BLOD WHITE 18
CAN2	- <>	-12	
CAN2		-1á	
CAN2 TERM	+ <	19	LT GREEN/RED 18
5V EXT		20	BLK/LT GREEN 18
5V R		21	PURPLE/WHITE 18
CRANK		22	WHITE/PURPLE 18
CRANK		23	GRAY/BROWN 18
CAM		24	PURPLE/ORANGE 18
CAM		25	RED/WHITE 18
SPEED	+ <	26	
SPEED		20	RED/BLACK 18
KNOCK1		28	
KNOCK1		29	
KNOCK2		-38	
KNOCK2		31	YELLOW 18
SPARK COIL		32	
SPARK COIL		-33	
SPARK COIL		-34	
SPARK COIL 2	28 >	35	
SPARK COIL		36	
SPARK COIL 3		37	
SPARK COIL	**	-38	
SPARK COIL 4	18 >	-39	YELLOW/GRAY 18
	AT <del>&lt;</del>	40	TAN/WHITE 18
E 5	π <del>&lt;</del>	41	ANZ WHILE 18
E		-42	DK GREEN/PURPLE 18
AUX DIG	1>	43	TAN/RED 18
AUX DIG		44	TAN/DK GREEN 18
AUX DIG		45	PINK/TAN 18
VS		46	DK BLUE/YELLOW 18
AUX ANA PU			
AUX ANA PI	12 <	47	YELLOW/DK BLUE 18
AUX ANA PU (FRT) AUX ANA PU	12	47	YELLOW/DK BLUE 18
AUX ANA PU (FRT) AUX ANA PU (FPP2 ONLY) 5V EXT		47 -48 49	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18
AUX ANA PU (FRT) AUX ANA PU (FPP2 ONLY) 5V EXT 5V R		47 48 49 50	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO		47 48 49 50 51	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18
AUX ANA PU (FRT) AUX ANA PU (FPP2 ONLY) 5V EXT 5V R GO GO GO	12 13 2 13 2 13 2 13 2 13 2 12 12 12 12 12 12 12 12 12 12 12 12 1	47 48 49 50	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18 GRAY/RED 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OL PRE	12 13 2 13 2 13 2 12 13 2 12 13 2 12 12 12 12 12 12 12 12 12 12 12 12 1	47 48 49 50 51 52	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18
AUX ANA PU (FRT) AUX ANA PU (FPP2 ONLY) 5V EXT 5V R GO OU OIL PRE (FRP) AUX ANA PUI	VVAVVVV	47 48 49 50 51 52 53	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18 GRAY/RED 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC		47 48 49 50 51 52 53 53 54 55	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18 GRAY/RED 18 LT BLUE 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PREI (FRP) AUX ANA PU PC F		47 48 49 50 51 52 53 54	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18 GRAY/RED 18 LT BLUE 18 DK GREEN 18
AUX ANA PU (FRT) AUX ANA PU (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC I ALT EXCI	VVAVVVVAVA 2320/1/20010000	47 48 49 50 51 52 53 54 55 56 57 58	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18 GRAY/RED 18 LT BLUE 18 DK GREEN 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC ALT EXCI TAL	VVAVVVVVAVA	47 48 49 50 51 52 53 54 55 56 57 58 59	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18 GRAY/RED 18 LT BLUE 18 DK GREEN 18 ORANGE 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC ALT EXCI TAC VBAT PR		47 48 49 50 51 52 53 54 55 56 57 58	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18 GRAY/RED 18 LT BLUE 18 DK GREEN 18 ORANGE 18
AUX ANA PU (FRT) AUX ANA PU (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC I ALT EXCI TAL VBAT PR	<u>~~~~</u> 2322 232 257 2232 257 2232 257 2232 257 2232 257 257 257 257 257 257 257 257 257 25	47 48 49 50 51 52 53 54 55 56 57 58 59	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 LT BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC AUX ANA PU PC ALT EXCI VBAT PR VB VB VB VB	<u>~~~~~</u> 213 22 1 23 5 1 2 35 1 35 1	47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 LT BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC I ALT EXCI TAC VBAT PR VBAT PR INJ1 INJ2	2322723528528E25459	47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 LT BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC I ALT EXCI TAL VBAT PR VBAT PR VBAT PR VBAT PR INJI INJ2 INJ2	232272322248444444444	47 48 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 LT BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC AUX ANA PU PC ALT EXCI VBAT PR VB INJ1 INJ2 INJ3 INJ4	232272237237237237444444444444444444444	47 48 50 51 52 53 55 55 56 57 58 59 60 61 62 63 64 65	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 LT BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC AUX EXC PC I ALT EXC VBAT PR VB INJ1 INJ2 INJ3 INJ4 INJ5	232272337224444444444444444444444444444	47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 LT BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC ALT EXCI VBAT PR VBAT PR VBAT PR INJ1 INJ2 INJ3 INJ4 INJ5 INJ5	232222222222222222222222222222222222222	47 48 50 51 52 53 54 55 56 57 58 60 61 62 65 65 65 65 65 65 65 65 65 65 65 65 65	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 LT BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC AUX ANA PU PC ALT EXCI VBAT PR VB INJ1 INJ2 INJ3 INJ4 INJ5 INJ6 INJ7	232222232222222222222222222222222222222	47 48 50 51 52 53 54 55 55 57 58 60 62 63 64 66 66 66 67 68	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 LT BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18 RED/TAN 16
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC PC I ALT EXCI VBAT PR VB INJ1 INJ2 INJ3 INJ4 INJ5 INJ6 INJ7	232222222222222222222222222222222222222	47 48 50 51 52 53 54 55 57 58 57 58 57 58 60 61 62 63 64 65 66 66 66 66 68 69	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 LT BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC ALT EXCI VBAT PR VBAT PR VBAT PR VBAT PR INJ1 INJ2 INJ3 INJ3 INJ5 INJ6 INJ6 INJ7 INJ8 INJ8 INJ8 INJ8 INJ8 INJ8 INJ8 INJ8	232222232222222222222222222222222222222	47 48 59 51 52 53 55 55 56 57 58 60 61 62 63 64 65 66 67 66 67 68 9 70	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 GRAY/RD 18 LT BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18 RED/TAN 16 BLACK 16
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PREI (FRP) AUX ANA PU PC AUX ANA PU PC AUX ANA PU PC AUX EXCI VBAT PR VB INJ1 INJ2 INJ3 INJ4 INJ5 INJ6 INJ7 INJ8 INJ7 INJ8 INJ7	232223322222222222222222222222222222222	47 48 59 51 52 53 54 55 55 56 57 58 61 62 63 64 65 66 65 66 67 68 67 70 71	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18 RED/TAN 16 BLACK 16 WHTE/LT BLUE 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC ALT EXCI VBAT PR VBAT PR VBAT PR VBAT PR INJ1 INJ2 INJ3 INJ3 INJ5 INJ6 INJ6 INJ7 INJ8 INJ8 INJ8 INJ8 INJ8 INJ8 INJ8 INJ8	232222322222222222222222222222222222222	47 48 59 51 52 53 55 55 55 55 55 55 55 55 55 55 55 55	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 OK GREEN 18 OK GREEN 18 ORANGE 18 GRAY 18 RED/TAN 16 BLACK 16 WHTE/LT BLUE 18 BLACK 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R OO OIL PRE (FRP) AUX ANA PU PC ALT EXC VBAT PR VBAT PR VBAT PR VBAT PR NU3 INU4 INU5 INU5 INU5 INU6 INU7 INU8 INU8 INU8 INU8 INU8 INU8 INU8 INU8	232222322222222222222222222222222222222	47 48 59 51 52 53 54 55 56 57 57 58 60 62 63 64 65 66 66 67 66 67 66 67 67 67 77 73	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18 RED/TAN 16 BLACK 16 WHTE/LT BLUE 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC PC I ALT EXCI VBAT PR VB INJ1 INJ2 INJ3 INJ4 INJ5 INJ4 INJ5 INJ4 INJ5 INJ6 INJ7 INJ8 INJ7 INJ8 INJ8 INJ8 INJ8 INJ8 INJ8 INJ8 INJ8	232222322222222222222222222222222222222	47 48 59 51 52 53 54 55 55 56 55 56 55 56 55 62 63 64 65 66 66 66 67 66 67 66 70 77 77 74	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 LT GREEN/BLACK 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 DK GREEN 18 ORANGE 18 ORANGE 18 GRAY 18 RED/TAN 16 BLACK 16 WHTE/LT BLUE 18 BLACK/VELLOW 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC AUX ANA PU PC AUX ANA PU PC AUX EXCI VBAT PR INJ INJ INJ INJ INJ INJ INJ INJ INJ INJ	232222322222222222222222222222222222222	47 48 50 51 52 53 55 55 57 58 59 60 61 62 63 64 65 66 66 66 66 66 66 66 67 70 72 73 4 75	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 OK GREEN 18 OK GREEN 18 ORANGE 18 GRAY 18 RED/TAN 16 BLACK 16 WHTE/LT BLUE 18 GLACK/WHITE 18
AUX ANA PI (FRT) AUX ANA PI (FRP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC AUX ANA PU PC PC I AUX ANA PU PC PC I PC I AUX ANA PU PC PC I PC I AUX ANA PU PC I PC I P	232222322222222222222222222222222222222	47 48 50 51 52 53 54 55 57 58 56 60 61 62 63 64 66 66 67 66 67 66 67 70 77 77 77 77 77 77 77 77	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18 RED/TAN 16 BLACK 16 WHITE/LI BLUE 18 BLACK/YELLOW 18 WHITE/BLACK 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC PC I ALT EXCI VBAT PR VB INJ1 INJ2 INJ3 INJ4 INJ5 INJ5 INJ6 INJ7 INJ8 GROUD START REL EGOH EOOH	232222222222222222222222222222222222222	47 48 50 51 52 53 55 55 55 55 55 55 55 55 55 55 55 55	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18 RED/TAN 16 BLACK 16 WHTE/LT BLUE 18 BLACK/YELLOW 18 WHTE/BLACK 18 BROWN/WHTE 16
AUX ANA PI (FRT) AUX ANA PI (FRP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC AUX ANA PU PC PC I AUX ANA PU PC PC I PC I AUX ANA PU PC PC I PC I AUX ANA PU PC I PC I P	232222222222222222222222222222222222222	47 48 50 51 55 55 55 55 55 55 55 55 55 55 55 60 61 62 63 64 56 65 66 66 66 66 66 67 77 77 77 77 77 77 77	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 GRAY/RED 18 LT BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18 RED/TAN 16 BLACK 16 WHTE/LT BLUE 18 BLACK/YELLOW 18 WHTE/BLACK 18 BROWN/WHTE 16 WHTE/BROWN 16
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC PC I ALT EXCI VBAT PR VB INJ1 INJ2 INJ3 INJ4 INJ5 INJ5 INJ6 INJ7 INJ8 GROUD START REL EGOH EOOH	2322-232222222222222222223222222222222	47 48 50 51 52 53 55 55 57 8 59 60 61 62 65 66 67 68 67 70 77 77 77 77 77 77 77 77	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18 RED/TAN 16 BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18 BLACK/WHITE 18 BLACK/WHITE 18 BROWN/WHITE 16 WHITE/BLACK 18 BROWN/WHITE 16 WHITE/BLACK 16
AUX ANA PI (FRT) AUX ANA PI (FRP2 ONLY) 5V EXT 5V R GO OIL PREI (FRP) AUX ANA PU PC AUX ANA PU AUX ANA PU AUX ANA PU AUX ANA PU PC AUX ANA PU AUX ANA PU AUX ANA PU AUX ANA PU PC AUX ANA PU AUX AUX ANA PU AUX AUX AUX AUX AUX AUX AUX AUX AUX AUX	2322-232222222222222222223222222222222	47 48 50 51 53 54 55 57 57 59 60 61 62 63 65 66 66 66 70 71 72 74 75 66 77 77 78 980	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 DK GREEN 18 ORANGE 18 ORANGE 18 GRAY 18 RED/TAN 16 BLACK 16 WHTE/LT BLUE 18 BLACK/YELLOW 18 WHTE/BLACK 18 BROWN/WHTE 16 WHTE/BROWN 16 RED/TAN 16
AUX ANA PI (FRT) AUX ANA PI (FRP2 ONLY) 5V EXT 5V R GO OIL PREI (FRP) AUX ANA PU PC AUX ANA PU AUX ANA PU AUX ANA PU AUX ANA PU PC AUX ANA PU AUX ANA PU AUX ANA PU AUX ANA PU PC AUX ANA PU AUX AUX ANA PU AUX AUX AUX AUX AUX AUX AUX AUX AUX AUX	232222232222222222222222222222222222222	47 48 50 51 52 53 55 55 56 55 60 61 62 62 64 65 66 67 68 9 70 71 77 77 77 77 77 80 81	YELLOW/DK BLUE 18 LT GREEN/PLACK 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18 RED/TAN 16 BLACK 16 WHTE/LT BLUE 18 BLACK/YELLOW 18 WHTE/BLACK 18 BROWN/WHTE 16 WHTE/BROWN 16 RED/TAN 18 BLACK 16
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC AUX ANA PU PC AUX ANA PU PC AUX ANA PU PC AUX ANA PU PC PC I AUX ANA PU PC AUX ANA PU PC AUX ANA PU PC PC I AUX ANA PU PC AUX ANA PU PC AUX ANA PU PC PC I AUX ANA PU PC PC I PC I P	232222322222222222222222222222222222222	47 48 50 51 52 53 55 55 55 55 55 55 55 55 55 55 55 55	YELLOW/DK BLUE 18 LT GREEN/PLACK 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 DK GREEN 18 ORANGE 18 ORANGE 18 GRAY 18 RED/TAN 16 BLACK 16 WHITE/LT BLUE 18 BLACK/YELLOW 18 BROWN/WHITE 18 BROWN/WHITE 16 WHITE/BROWN 16 RED/TAN 16 GREEN/YELLOW 18 BLACK 16 PINK/WHITE 18 BLACK 16 PINK/WHITE 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC PC I ALT EXCI VBAT PR VB INJ1 INJ2 INJ3 INJ4 INJ5 INJ5 INJ6 INJ5 INJ6 INJ7 INJ8 GROUD START REL EGOH EGOH BUZZI PMMS RECI VB DZZ PMMS RECI N CROUD DBW	232222322222222222222222222222222222222	47 48 50 51 53 54 55 58 57 89 60 61 62 63 65 66 62 63 66 66 70 77 77 77 77 78 980 812 83	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18 RED/TAN 16 BLACK 16 WHTE/LT BLUE 18 BLACK/YELLOW 18 WHTE/BLACK 18 BROWN/WHTE 16 WHTE/BROWN 16 RED/TAN 18 BLACK 16
AUX ANA PI (FRT) AUX ANA PI (FRP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC AUX ANA PU PC AUX ANA PU PC AUX ANA PU PC AUX ANA PU PC PC I AUX ANA PU PC AUX ANA PU PC AUX ANA PU PC AUX ANA PU PC AUX ANA PU AUX ANA PU PC AUX ANA PU AUX ANA PU PC AUX ANA PU AUX ANA PU PC AUX ANA PU AUX AUX ANA PU AUX AUX ANA PU AUX AUX AUX AUX AUX AUX AUX AUX AUX AUX	232222322222222222222222222222222222222	47 48 50 51 52 53 55 55 56 55 56 55 66 62 66 4 65 66 62 66 66 66 67 66 70 71 77 77 77 77 77 77 77 77 77 77 80 81 82 83 84	YELLOW/DK BLUE 18 LT GREEN/PLACK 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 DK GREEN 18 ORANGE 18 ORANGE 18 GRAY 18 RED/TAN 16 BLACK 16 WHITE/LT BLUE 18 BLACK/YELLOW 18 BROWN/WHITE 18 BROWN/WHITE 16 WHITE/BLACK 18 BROWN/WHITE 16 GREEN/YELLOW 18 BLACK 16 PINK/WHITE 18 PINK/WHITE 18 BLACK 16 PINK/WHITE 18 PINK/WHITE
AUX ANA PI (FRT) AUX ANA PI (FRP) AUX ANA PI SV R GO OIL PRE (FRP) AUX ANA PU PC PC I ALT EXCI VBAT PR VB INJ1 INJ2 INJ3 INJ4 INJ5 INJ5 INJ5 INJ5 INJ6 INJ7 INJ8 GROUD START REL EGOH EGOH BUZZI PMMS RECI VB DBW	232222322222222222222222222222222222222	47 48 50 51 52 53 55 55 55 55 55 55 55 55 55 55 55 55	YELLOW/DK BLUE 18 LT GREEN/PLACK 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 DK GREEN 18 ORANGE 18 ORANGE 18 GRAY 18 RED/TAN 16 BLACK 16 WHITE/LT BLUE 18 BLACK/YELLOW 18 BROWN/WHITE 18 BROWN/WHITE 16 WHITE/BLACK 18 BROWN/WHITE 16 GREEN/YELLOW 18 BLACK 16 PINK/WHITE 18 PINK/WHITE 18 BLACK 16 PINK/WHITE 18 PINK/WHITE
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU (FRP) AUX ANA PU PC ALT EXCI VBAT PR VBAT PR VBAT PR VBAT PR INJ1 INJ2 INJ3 INJ3 INJ3 INJ4 INJ5 INJ5 INJ7 INJ6 GROU START REL EGOH EGOH EGOH EGOH EGOH EGOH EGOH EGOH EGOH EGOH CLOCKOFF) EGOH BUZZ PWMS RECI VB N PWMS RECI PWMS RECI PDM	23252222222222222222222222222222222222	47 48 50 51 53 54 55 58 57 89 60 61 62 63 65 66 62 66 64 65 66 70 77 77 78 980 812 777 78 980 812 83 84 56 83 84 56 777 777 78 980 812 83 84 85 83 84 85 85 85 85 85 85 85 85 85 85 85 85 85	YELLOW/DK BLUE 18 LT GREEN/PURPLE 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 GRAY/RED 18 LT BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18 RED/TAN 16 ELACK 16 WHTE/LT BLUE 18 BLACK/YELLOW 18 WHTE/BLACK 18 BROWN/WHITE 16 WHTE/BLACK 18 BROWN/WHITE 16 WHITE/BROWN 16 RED/TAN 16 RED/TAN 16 RED/TAN 18 BLACK 16 PINK/WHITE 18 BLACK 16 PINK/WHITE 18 TAN/ORANGE 18 TAN/ORANGE 18
AUX ANA PI (FRT) AUX ANA PI (FRP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC AUX ANA PU PC AUX ANA PU PC AUX ANA PU PC AUX ANA PU PC AUX ANA PU AUX ANA PU NUT INJE IN	2322723272327232723275459999999999999272222223272327244444444444	47 48 50 512 55 55 55 55 55 55 55 55 55 55 55 55 55	YELLOW/DK BLUE 18           LT GREEN/PLACK 18           GRAY/DK BLUE 18           GRAY/RD 18           LT BLUE 18           DK GREEN 18           ORANGE 18           GRAY 18           RED/TAN 16           BLACK 16           WHTE/LT BLUE 18           BLACK/YELLOW 18           WHTE/BLACK 18           BROWN/WHITE 16           WHTE/BROWN 16           RED/TAN 16           SCOMN/WHITE 18           BLACK/YELLOW 18           WHTE/BLACK 18           BROWN/WHITE 16           WHTE/BROWN 16           RED/TAN 16           SCOTAN 16           RED/TAN 16           TAN 18
AUX ANA PI (FRT) AUX ANA PI (FRP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC I AUX ANA PU PC I AUX ANA PU PC I AUX ANA PI INJ1 INJ2 INJ3 INJ4 INJ5 INJ4 INJ5 INJ5 INJ5 INJ5 INJ6 INJ7 INJ8 INJ8 IN 1 INJ8 IN 1 IN 1 IN 1 IN 1 IN 1 IN	⊻₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩	47 48 50 51 55 55 55 55 55 55 55 55 55 55 55 55	YELLOW/DK BLUE 18 LT GREEN/PLACK 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 GRAY/RED 18 LT BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18 RED/TAN 16 BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18 BLACK/WHITE 18 BLACK/YELLOW 18 BROWN/WHITE 16 WHITE/BLACK 18 BROWN/WHITE 16 GREEN/YELLOW 18 BLACK 16 WHITE/BLACK 18 BROWN/WHITE 16 GREEN/YELLOW 18 BLACK 16 TAN 18 DK BLUE 18
AUX ANA PI (FRT) AUX ANA PI (FPP2 ONLY) 5V EXT 5V EXT 5V EXT 5V EXT 60 01L PRE (FRP) AUX ANA PUL PC AUX ANA PUL PC PC PC PC PC PC PC PC PC PC	⊻₽≯₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽	47 48 55 55 55 55 55 55 55 55 55 55 55 55 55	YELLOW/DK BLUE 18           LT GREEN/PURPLE 18           LT GREEN/PLACK 18           GRAY/DK BLUE 18           GRAY/RED 18           LT BLUE 18           DK GREEN 18           ORANGE 18           GRAY 18           RED/TAN 16           BLACK 16           WHTE/LT BLUE 18           BLACK/YELLOW 18           WHTE/BLACK 18           BROWN/WHITE 16           WHTE/BROWN 16           RED/TAN 16           BROWN/WHITE 18           BLACK/YELLOW 18           WHTE/BLACK 18           BROWN/WHITE 16           WHTE/BROWN 16           RED/TAN 16           BLACK 18           BROWN/WHITE 18           TAN 18
AUX ANA PI (FRT) AUX ANA PI (FRP2 ONLY) 5V EXT 5V R GO OIL PRE (FRP) AUX ANA PU PC I AUX ANA PU PC I AUX ANA PU PC I AUX ANA PI INJ1 INJ2 INJ3 INJ4 INJ5 INJ4 INJ5 INJ5 INJ5 INJ5 INJ6 INJ7 INJ8 INJ8 IN 1 INJ8 IN 1 IN 1 IN 1 IN 1 IN 1 IN	⊻₽≯₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽	47 48 50 51 55 55 55 55 55 55 55 55 55 55 55 55	YELLOW/DK BLUE 18 LT GREEN/PLACK 18 GRAY/DK BLUE 18 GRAY/DK BLUE 18 GRAY/RD 18 LT BLUE 18 DK GREEN 18 ORANGE 18 GRAY 18 RED/TAN 16 BLACK 16 WHITE/LT BLUE 18 BLACK/WHITE 18 BLACK/WHITE 18 BLACK/YELLOW 18 BROWN/WHITE 16 WHITE/BLACK 18 BROWN/WHITE 16 GREEN/YELLOW 18 BLACK 16 WHITE/BLACK 18 BROWN/WHITE 18 BLACK 16 MHITE/BLACK 18 BROWN/WHITE 18 BLACK 16 TAN 18 DK BLUE 18

## 3.0L Gasoline

FCI         EU01         22         DK GREEN/WHTE 18           211 PC BE 36 8889 CONSIDER         E003        3           211 A 58 8889 CONSIDER         E004        5         PURPLEZIT BLUE 18           211 A 58 8889 CONSIDER         E004         -5         PURPLEZIT BLUE 18           211 A 58 8889 COME         E004         -5         PURPLEZIT BLUE 18           AUX AWA PUID3         -7         CI CREEN 18         -7           AUX AWA PUID3         -11         PURPLEZYELLOW 18           AUX AWA PUID3         -12         AUX AWA PUID3         -11           AUX AWA PUID3         -12         PURPLEZYELLOW 18         -7           AUX AWA PUID3         -13         WHTEZORANCE 18         -7           CAN1         +> 14         EULEZORANCE 18         -7           CAN2         -7         CREEN 18         -7           CAN2         -7         CREEN 18         -7           CAN2         -7         TO REEN 18         -7           CAN2         -7         TO REEN 18         -7           CAN4         -22         WHTEZORANCE 18         -7           CAN2         -21         WHTEZORANCE 18         -7           CAN4         -2				1	DK GREEN/ORANGE 18
11         10         0 = 25 sease coversorme         EU02	ECI		<		
11 × 18 8887 LOSBNO 2001         EU03         4           211 × 88 8897 LOSBNO 2001         FD14         5         PURPLEZ/LIBUE 18           211 × 68 8897 LOSBNO 2001         FD14         8         ORANGEZ/FELLOW 18           AUX AMA PUIS         9         DK BLUZ/CRANGE 18         ORANGEZ/FELLOW 18           AUX AMA PUIS         11         WITTEZORANGE 18         ORANGEZ/FELLOW 18           AUX AMA PUIS         12         WITTEZORANGE 18         CAN 14           CAN 14         >14         BLUZ/PANCHE 18         CAN 14           CAN 14         >15         BLUZ/PINKT 18         CAN 14           CAN 24         >17         CRANK 4         21         PURPLEZ/VIRTE 18           CAN 24         21         PURPLEZ/VIRTE 18         CAN 24         PURPLEZ/VIRTE 18           CAN 24         21         PURPLEZ/VIRTE 18         CAN 4         22         WITTZ/PURPLE 18           CAN 4         22         WITTZ/PURPLE 18         CAN 4         22         WITTZ/PURPLE 18           CAN 4         22         WITTZ/PURPLE 18         CAN 4         22         WITTZ/PURPLE 18           CAN 4         22         WITTZ/PURPLE 18         CAN 4         22         WITTZ/PURPLE 18           CAN 4 <t< th=""><th></th><th></th><th>&lt;</th><th></th><th>DR GIGLEO INTE TO</th></t<>			<		DR GIGLEO INTE TO
111 A 16 800 CORE         EUDS         5         PURPLE/LT BLUE 18           211 CC 25 1460 TEMANAL (SOLD)         TS22         7         T GREEN 18           AUX ANA PDD         9         OK BLUE/ORANGE 18         BUFP2 IVS           AUX ANA PUD3         11         AUX ANA PUD3         12           AUX ANA PUD3         13         WHTE/ORANGE 18         CAN TERM +           AUX ANA PUD3         13         WHTE/ORANGE 18         CAN TERM +           CAN TERM +         14         BLUE/PIKK 18         CAN TERM +           CAN TERM +         15         BLUE/PIKK 18         CAN TERM +           CAN TERM +         18         SV EXT 1         20         BKA/LT GREEN 18           CAN TERM +         21         PURPLE/ORANGE 18         CAN +         22           CAN +         22         REA/LT GREEN 18         SV EXT 18           SV EXT +         28         RED/WREE 18         CAN +           CAN +         22         RED/WREE 18         SV EXT 18           SV EXT +         28         RED/WREE 18         SV EXT +           CAN +         22         RED/WREE 18         SV EXT +           SPARK COL 18         31         YELLOW 18         SV EXT +			<		
111 A 10 MOR COLO       TPS1       6       LT TEUE/DK BUE TB         211 CC 25 1460 TEMANA [00.0]       TPS1       7       LT CREEN 1B         AUX ANA PUD2       10       PURPLE/YELLOW 1B         AUX ANA PUD2       12       AUX ANA PUD2       12         AUX ANA PUD2       12       AUX ANA PUD2       12         AUX ANA PUD2       13       WHITE/ORANGE 18       CAN TERM +         CAN TERM +       14       HULE/PINK 1B       CAN TERM +         CAN TERM +       15       BLK/LT CREEN 1B       CAN TERM +         CAN TERM +       14       HULE/PINK 1B       CAN TERM +         CAN TERM +       15       BLK/LT CREEN 1B       CAN TERM +         CAN TERM +       22       BLK/LT CREEN 1B       CAN TERM +         CAN TERM +       22       BLK/LT CREEN 1B       CAN TERM +         CAN TERM +       22       BLK/LT CREEN 1B       CAN TERM +         CAN TERM +       22       BLK/LT CREEN 1B       CAN TERM +         CAN TERM +       22       BLK/LT CREEN 1B       CAN TERM +         CAN TERM +       22       BLK/LT CREEN 1B       CAN TERM +         CAN TERM +       23       BLK/LT CREEN 1B       CAN TERM +         CAN TERM +			5		PURPLE/LT BLUE 18
AUX ANA PDT     B     ORANGE/YELLOW 18       AUX ANA PDD     9     DK BLL/CORANGE 18       PPP 18     PURPLE/YELLOW 18       AUX ANA PDD3     13       AUX ANA PDD3     13       CAN TERM +     14       AUX ANA PDD3     13       CAN TERM +     14       CAN TERM +     15       BLUE/PINK 18       CAN1 +     16       CAN2 TERM +     19       J CAN2 TERM +     19       CAN2 TERM +     19       SV EXT 1     20       BL/L CORENT 18       SV EXT 1     20       CAN2 TERM +     22       SV EXT 18       CAN2 TERM +       22     BL/L CORENT 18       SV EXT 19       CAN +     22       BL/L CORENT 18       SPED +     28       SPED +     28       KNOCK1 +     28       KNOCK2 +     29       KNOCK2 +     30       SPARK COLL 28     34       SPARK COLL 28     34       SPARK COLL 48     37			<		
AUX ANA PUD PPP IN PPP IN PPP IN AUX ANA PUD2 AUX ANA PUD2 AUX ANA PUD2 AUX ANA PUD2 AUX ANA PUD2 CAN TERM + CAN TER	211 CC 25 1468 TENENAL (COLD)		<	ž	
AUX AVA PUD PPP2 IVS PPRPLE/VELLOW 18 PURPLE/VELLOW 18 AUX AVA PUDD VIIII AUX AVA PUDD VIIII AUX AVA PUDD VIIII CAN TERM + CAN TERM + VIIII CAN1 + CAN1 + CAN1 + CAN1 + CAN1 + CAN1 + CAN2 - CAN2 + CAN2 + CAN + 22 GBX/2BOWN 18 CAN + 22 GBX/2BOWN 18 SPARK COLL 28 - 33 SPARK COLL 28 - 33 SPARK COLL 28 - 34 SPARK COLL 28 - 35 SPARK COLL 28 - 35 SPARK COLL 28 - 35 SPARK COLL 28 - 34 SPARK COLL 48 - 37 SPARK COLL 48 -			<	<u>é</u>	
HPP         18         PURPLE/YELLOW 18           AUX ANA PUD2         12         AUX ANA PUD2         12           AUX ANA PUD2         13         WHTZ/OBANGE 18         CAN TERM +         15           CAN TERM +         15         BLUE/PINK 18         CAN TERM +         16           CAN TERM +         16         DLT OREEN/RED 18         SV EXT +         16           SV EXT +         16         DLK/T GRED 18         SV EXT +         17           SV EXT +         18         DLR/T CRED 18         SV EXT +         17           CRANK +         21         PURPLE/ORAGE 18         SV EXT +         28           CRANK +         21         PURPLE/ORAGE 18         SV EXT +         28           CAN +         22         GRAY/BROWN 18         CAN +         22           CAN +         22         RED/BURCH 18         SV EXT +         28           SPARK COLL 18         57         SPARK COLL 28         33         SPARK COLL 38         36           SPARK COLL 38         37         SPARK COLL 38         36         SPARK COLL 38         36           SPARK COLL 48         38         SPARK COLL 38         36         SPARK COLL 38         36           SPARK CO	AUX		<		
AUX ANA PUDD         11 AUX ANA PUDD         12 AUX ANA PUDD           CAN TERM +         14         HULE/PINK 18           CAN1 +         15         BLUE/PINK 18           CAN2 =         17         CAN2 =           CAN2 =         18         BLUE/PINK 18           CAN2 =         19         LT OREEN/#DD 18           SV EXT 1         20         BLK/LT GRED 18           SV EXT 1         22         BLM/LT GRED 18           CAN2 =         28         BL/LT OREEN/#DD 18           CAN +         22         BL/MITE 10           CRANK +         22         BL/MITE 18           CRANK +         22         BL/MITE 18           SPEED +         22         BED/WITE 18           SPERK COLL 18         32         SPARK COLL 28           SPARK COLL 28         34           SPARK COLL 28         35           SPARK COLL 28         36           SPARK COLL 48         38           SPARK COLL 48         39           YELLOW/CRAY 18 <td< th=""><th></th><th></th><th>&lt;</th><th></th><th></th></td<>			<		
AUX ANA PUD2 AUX ANA PUD2 CAN TERM + CAN T + S + S + S + CAN T + S + S + CAN T + S + S + CAN + CAN + CAN + S + CAN		PP2 IVS	<		FORFLEZ TELLOW 10
ADX APP FUG         13         WHITE / ORANGE 18           CAN TERM +         15         BLUEZPIKK 16           CAN2         17         CAN2           CAN2         18         BLUEZPIKK 16           CAN2         19         LT GREEN/RD 18           SV EXT         20         BLK/LT CBREN 18           SV EXT         22         BLK/LT CBREN 18           CAN2         ERN         22           CAN2         24         PURPLE/WHTE 18           CRANK         22         BLC/LT CBREN 18           CAN         22         BLC/WHTE 18           CRANK         22         BLC/WHTE 18           CAN         22         BLC/WHTE 18           CAN         22         BLC/WHTE 18           CAN         22         BLC/WHTE 18           CAN         22         BLC/WHTE 18           SPARK COLL 18         33         YELLOW/BACK 18           SPARK COLL 28         34         SPARK COLL 28         35           SPARK COLL 28         34         SPARK COLL 28         36           SPARK COLL 28         36         SPARK COLL 28         37           SPARK COLL 28         36         SPARK COLL 28         36	AUX AU	NA PUD2	<		
CAN I         I 4         ELLE/PINK 18           CAN I         I 5         BLUZWHITE 18           CAN I         I 5         BLUZWHITE 18           CAN I         I 7         BLUZWHITE 18           CAN I         I 8         DURUEVICATORED 18           SV ETN         I 9         LT OREDN/RED 18           SV ETN         I 9         DURUEVICATORED 18           CAN I         I 10         REAL VALUE VALUE 18           CRANK         I 10         REAL VALUE VALUE 18           CRANK         I 10         REAL VALUE VALUE 18           CAN I         I 10         REAL VALUE 18           SPEED         I 28         RED/BUCK 18           SPARK COLL 18         I 10         I 10           SPARK COLL 28         I 10         I 10           SPARK COLL 48	AUX AI	NA PUD3	<		WHITE (ORANGE 18
CAN1 + → 15 BLLEZ/HITE 18 CAN2 - → 16 CAN2 - → 17 CAN2 TERH + → 18 SV EXT + → 19 LT GREEN/RED 18 SV EXT + → 22 RED/FURPLE 18 CRANK + → 22 WHITE/PURPLE 18 CRANK + → 22 WHITE/PURPLE 18 CRANK + → 22 WHITE/PURPLE 18 CRANK + → 22 RED/FURPLE 18 SPEED + → 26 RED/FURPLE 18 SPEED + → 26 RED/FURPLE 18 SPARK COLL 14 SPARK COLL 24 SPARK COLL 2	CAN	TERM +	<		
CAN1			<>		
CAN2         →         17           CAN2         TERN +         18           SV RTN         28         BLK/LT GREDN 18           SV RTN         21         PURPLE/VRPLE 18           CRANK +         22         WHTC/PURPLE 18           SPED +         26         RED/PILZ/ORANCE 18           SPARK COLL 18         32           SPARK COLL 18         33           SPARK COLL 28         34           SPARK COLL 48         33           SPARK COLL 44         33           SPARK COLL 48         34           SPARK COLL 48         34           SPARK COLL 48         34           SPARK COLL 48         34           SPARK COLL 48         36           SPARK COLL 48         37           SPARK COLL 48         36           SPARK COLL 48         37			<>		BLUE/WHITE 18
CAN2 + → 16 CAN2 TERM + → 19 UT GREEN/RED 18 SV RTN + 21 CRANK + 21 CRANK + 22 CRANK + 22 CRAN		CAN2-	$\leq >$		
CAV2 TERM + 10 SV EXT 1 20 SV EXT 1 20 CRANK + 21 CRANK + 21 CRANK + 21 CRANK + 22 WHTC/PURPLE 18 CRANK + 22 CRANK +			$\leq >$		
SP RT         19         LI OREEN/RED 18           SF RTN         228         BLK/LT GREEN 18           CRANK         223         GRAY/BROWN 18           CAN         223         GRAY/BROWN 18           CAN         223         GRAY/BROWN 18           CAN         223         GRAY/BROWN 18           CAN         224         PURPLE/ORANGE 18           SPED         28         RED/BLACK 16           SKNOCK1         28         RED/BLACK 16           KNOCK1         28         SA           SPARK COLL 2A         33         SPARK COLL 2A           SPARK COLL 2B         34           SPARK COLL 4A         38           SPARK COLL 4B         39           YELLOW/CRAY 18           LAT         40           AUX DIG 1         42           AUX DIG 2         43           AUX NIG 3         44           AUX ANA PU2         44           AUX ANA PU2         45           CROX2         52 <th>CAN2</th> <th></th> <th>&lt;</th> <th></th> <th></th>	CAN2		<		
SV RTN         420         BURDL SIGELDT 10           CRANK         421         PURPLEZ/ORANGE 18           CRANK         222         WHITE 710 KRPLE 18           CAN         422         PURPLEZ/ORANGE 18           SPEED         228         RED//BLACK 18           SPEED         228         RED//BLACK 18           SPEX         229         KNOCK1           KNOCK2         423         33           SPARK COLL 18         332           SPARK COLL 28         33           SPARK COLL 34         36           SPARK COLL 34         37           SPARK COLL 34         36           SPARK COLL 34         37           SPARK COLL 34         38           SPARK COLL 34         39           YELLOW/ORAY			>		
$\begin{array}{c c} CRANK + <21 PURPLE/WHITE 18 \\ CRANK + <22 GRAY/BROWN 18 \\ CAN + <23 GRAY/BROWN 18 \\ CAN + <23 GRAY/BROWN 18 \\ SPED + 28 RED/BLACK 18 \\ SPED + 28 RED/BLACK 18 \\ SPED + 28 RED/BLACK 18 \\ SPEC + 28 \\ KNOCK1 + 29 \\ KNOCK2 + 29 \\ KNOCK2 + 29 \\ KNOCK2 + 29 \\ KNOCK2 + 29 \\ SPARK COLL 28 - 34 \\ SPARK COLL 28 - 34 \\ SPARK COLL 28 - 35 \\ SPARK COLL 28 - 35 \\ SPARK COLL 28 - 35 \\ SPARK COLL 28 - 37 \\ SPARK COLL 48 - 38 \\ SPARK COLL 48 - 38 \\ SPARK COLL 48 - 36 \\ SPARK COLL 48 - 36 \\ SPARK COLL 48 - 37 \\ SPARK COLL 48 - 38 \\ SPARK COLL 48 - 38 \\ SPARK COLL 48 - 37 \\ SPARK COLL 48 - 38 \\ SPARK COLL 48 - 37 \\ SPARK COLL 48 - 37 \\ AUX AVA PU1 - 46 \\ AUX COL 2 - 44 \\ AUX COL 2 - 44 \\ AUX AVA PU1 - 46 \\ AUX AVA PU1 - 48 \\ AUX AVA PU1 - 48 \\ AUX AVA = 48 \\ AUX$			<		
CRANK - → 22 WILLEPEDRELE 18 CAM + 22 PURPLEYORANGE 18 SPEED + 28 RED/BLACK 18 SPARK COLL 14 → 31 SPARK COLL 14 → 33 SPARK COLL 24 → 33 SPARK COLL 24 → 35 SPARK COLL 24 → 36 SPARK COLL 24 → 37 SPARK COLL 48 → 36 SPARK COLL 48 → 37 SPARK COLL 48 → 38 SPARK 20 → 45 SPARK 20 → 45			ć.		
CAM + ⇒ 224 PURPLEMINIS CAM + ⇒ 224 PURPLEMINIS SPEED + ⇒ 26 RED/BLACK 18 SPEED + ⇒ 26 RED/BLACK 18 SPEED + ⇒ 26 RED/BLACK 18 SPARK COLL 14 ⇒ 31 SPARK COLL 14 ⇒ 32 SPARK COLL 24 ⇒ 33 SPARK COLL 24 ⇒ 35 SPARK COLL 24 ⇒ 37 SPARK 20 SPARK 20 SPAR			<>		
CAM			-		
SPEED         →         26         RED/BLACK 15           SPEED         →         26         RED/BLACK 15           SPEED         →         28           KNOCK1 +         →         29           KNOCK2 +         →         38           SPARK COLL 18         →         31           SPARK COLL 28         →         35           SPARK COLL 28         →         35           SPARK COLL 48         →         37           AUX 016 1         →         →         17           AUX 016 1         →         →         17           AUX 016 1         →         17         PELOW/REBUE 18			25		
SPEED         →         27           KNOCK1 + →         28           KNOCK2 + →         29           KNOCK2 + →         31           SPARK COLL 1A         31           SPARK COLL 2B         33           SPARK COLL 2B         34           SPARK COLL 2B         34           SPARK COLL 3B         36           SPARK COLL 4B         39           YELLOW/GRAY 18           L         40           AUX DIG 1         42           AUX DIG 2         43           AUX DIG 3         44           AUX DIG 3         44           AUX DIG 3         44           AUX DIG 3         44           AUX ANA PU2         47           YELLOW/GREN 18           AUX ANA PU2         48           LT CREEN/PURPLE 18           (FPP2 ONLY) 5V EXT 2         48           SV RTN         51           GRAY/DK BLUE 18           GRAY 2B         54           WHTE/LT GREEN 18           (FPP2 ONLY) 5V EXT 2         55           SV RTN         51           GRAY/DK BLUE 18           GRAY 2B         18           GRAY 2B<					
KNOCK1 +         228           KNOCK2 +         38           SPARK COLL 1A         31           SPARK COLL 1B         32           SPARK COLL 2A         33           SPARK COLL 3A         35           SPARK COLL 4A         39           YELLOW/GRAY 18           LT         41           AUX DIG 1         43           AUX DIG 2         44           AUX DIG 2         44           AUX DIG 3         45           AUX ANA PU1         46         DK GREEN/PURPLE 18           AUX ANA PU2         47         YELLOW/CK BLUE 18           GOV1         51         GRAY/DK BLUE 18           GOV1         52         GRAY/RED 18           GOV1         55         DK GREN 18           YEN         52         GRAY/RED 18           GOV1         55         DK GREN 18           YEN         52         GRAY/RED 18           GOV1         55         DK GREN 18           YEN         52         GRAY 18 <th></th> <th></th> <th>22</th> <th></th> <th>RED/BLACK 18</th>			22		RED/BLACK 18
KNOCK1					
KNOCK2 +         38         YELLOW 18           SPARK COLL 18         33         SPARK COLL 28         33           SPARK COLL 28         34         SPARK COLL 28         35           SPARK COLL 38         35         SPARK COLL 38         37           SPARK COLL 38         37         SPARK COLL 38         37           SPARK COLL 48         39         YELLOW/GRAY 18         47           AUX DIG 1         42         TAN/WHITE 18         18           EGT         41         EGT         41           AUX DIG 2         44         TAN/RED 18         18           AUX DIG 3         44         TAN/RED 18         18           AUX ANA PU2         44         TAN/RED 18         18           AUX ANA PU2         44         TAN/RED 18         18           (FRT) AUX ANA PU2         44         TCREN/PURPLE 18         16           (FPP2 ONLY) 5V EXT 2         52         CL CREN/PURPLE 18         16           GOV1         55         DK GRAY/DK BLUE 18         18           GOV2         53         LT BLUE 18         18           GOV2         53         LT BLE 18         18           YEX         56         GRAY 18			22		
KNOCK2 -         38         YELLOW 18           SPARK COLL 1A         33         32           SPARK COLL 2B         33           SPARK COLL 3B         36           SPARK COLL 3B         36           SPARK COLL 3B         36           SPARK COLL 4B         38           Control 4B         38           SPARK COLL 4B         38           SPARK 2CL 2F         31           SPARK 2CL 2F         31           SPARK 2CL 2F         31           SPARK 2CL 2F         3			2	29	
SPARK COIL 18         31         TELLOW 18           SPARK COIL 2A         33           SPARK COIL 2A         33           SPARK COIL 3A         35           SPARK COIL 3A         36           SPARK COIL 3A         37           SPARK COIL 4A         37           AUX 010 2         43           AUX 016 3         44           AUX 016 2         43           AUX ANA PU3         45           AUX ANA PU3         46           CRVPEN/PURPLE 18           (FRT) AUX ANA PU3         48           COUL PRESS         55           CRED/7AN 16           WHTE-IT GREEN 18 <th></th> <th></th> <th>25</th> <th></th> <th></th>			25		
SPARK COIL 18         333           SPARK COIL 2A         333           SPARK COIL 2B         353           SPARK COIL 3B         36           SPARK COIL 4B         38           SPARK 2CUL 4B         38           SPARK 2CUL 4B         38           SPARK 2CUL 4B         41           ALT EXTREMANT 4B         45           SPARK 2CUL 4B         45           SPARK 2CUL 4B         47           SPARK 2CUL 4B         54 <tr< th=""><th></th><th></th><th>~</th><th>31</th><th>YELLOW 18</th></tr<>			~	31	YELLOW 18
SPARK COIL 2A         33           SPARK COIL 3A         35           SPARK COIL 3B         36           SPARK COIL 3B         37           SPARK COIL 4A         37           SPARK COIL 4B         38           SPARK COIL 4B         38           SPARK COIL 4B         38           SPARK COIL 4B         38           SPARK 201 4B         31           SPARK 201 4B         31           SPARK 201 4B         21           SPARK 201 4B         21           SPARK 201 5D         31           SPARK 201 5D         31 <t< th=""><th></th><th></th><th></th><th></th><th></th></t<>					
SPARK COIL 28         35           SPARK COIL 38         35           SPARK COIL 38         36           SPARK COIL 48         37           SPARK COIL 44         38           SPARK COIL 44         37           SPARK COIL 44         37           SPARK COIL 44         37           SPARK COIL 44         37           SPARK 2010         44           AUX ANA PU2         45           SPARK 2011         44           SPARK 2012         48           SPARK 2012         52           SPARK 2012         53           SPARK 2012         54           SPARK 2012         55           SPARK 2012					
SPARK COIL 3A         36           SPARK COIL 3A         36           SPARK COIL 3B         37           SPARK COIL 4A         37           SPARK COIL 4A         37           SPARK COIL 4A         37           SPARK COIL 4A         38           SPARK COIL 4A         37           SPARK COIL 4A         37           SPARK COIL 4B         37           SPARK COIL 4A         37           SPARK COIL 4B         37           SPARK COIL 4B         37           SPARK COIL 4B         37           AUX 016 1         42           AUX 016 2         43           AUX ANA PU1         45           AUX ANA PU2         47           YELOW/DR BLUE 18           GOV1         50           GOV1         52           GOV1         53           GOV1         54           WHTE/LT GREEN 18           GOV1         55           DK GREN 18           GOV1         56			<		
SPARK COIL 38         36           SPARK COIL 48         37           SPARK COIL 48         38           ECT         40           AUX DIG 1         42           AUX DIG 2         43           AUX DIG 3         42           AUX DIG 4         40           AUX DIG 5         42           AUX DIG 6         44           AUX DIG 7         44           AUX ANA PU1         44           AUX ANA PU2         44           AUX ANA PU2         48           LT CREEN/PURPLE 18           (FFT) AUX ANA PU3         48           GOV1         52           GOV1         52           GOV1         52           GOV1         52           GOV1         55           GOV1         55           GOV2         52           GRAY/DK BLUE 18           GOV2         52           GRAY/DK BLUE 18           OIL PRESS           GOV2         54           WHTE/LT GREEN 18           NU1 LS         62           BROWN/LT BLUE 18           INJ LS         63           BROWN/LT BLUE 18	SPARK	COIL 28	<		
SPARK COLL 4A         37           SPARK COLL 4A         39         YELLOW/GRAY 18           IAT         40         TAN/WHITE 18           ECT         41         42           AUX DIG 1         42         DK GREEN/PURPLE 18           AUX DIG 2         43         TAN/RK 018           AUX DIG 3         45         EINK/TAN 18           YSW         45         EINK/TAN 18           AUX ANA PU1         46         DK BUE/YELLOW 18           AUX ANA PU2         48         LT GREEN/PURPLE 18           (FRT) AUX ANA PU3         48         LT GREEN/PURPLE 18           (FRT) AUX ANA PU3         48         LT GREEN/PURPLE 18           (FRP) AUX ANA PU3         52         GRAY/DK BLUE 18           GOV1         51         GRAY/DK BLUE 18           (FRP) AUX ANA PU3         55         DK GREEN 18           (FRP) AUX ANA PU3         55         DK GREEN 18           (FRP) AUX ANA PU3         56         DR GRAY 18           (FRP) AUX ANA PU3         56         DR G			2		
SPARK COIL 48         38         YELLOW/GRAY 18           LAT         40         TAN/WHITE 18           EGT         41         AUX DIG 1         42           AUX DIG 2         43         TAN/RED 18         AUX DIG 2           AUX DIG 3         44         TAN/RED 18         AUX DIG 3           AUX DIG 3         44         TAN/RED 18         AUX DIG 3           AUX ANA PU1         45         PINK/TAN 18           AUX ANA PU2         47         YELLOW/DK BLUE 18           AUX ANA PU3         48         LT CREEN/PURPLE 18           (FRP) AUX ANA PU3         49         LT CREEN/PURPLE 18           (FPP2 ONLC) SV EXT 2         50         LT CREEN/BLACK 18           GOV1         51         GRAY/DK BLUE 18           (FRP) AUX ANA PU3         54         WHITE/LT GREEN 18           (FRP) AUX ANA PU1         55         DK GREN 18           GOV2         53         LT BLUE 18           (FRP) AUX ANA PU1         54         WHITE/LT GREEN 18           (FRP			2		
SPARK CULL 48         39         YELLOW/GRAY 18           ECT         40         TAN/WHITE 18           ECT         41           ECT         42         DK GREEN/PURPLE 18           AUX DIG 1         43         TAN/RED 18           AUX DIG 3         45         FINK/TAN 18           YSW         46         DK BLUE/YELLOW 18           AUX ANA PU3         46         DK BLUE/YELLOW 18           AUX ANA PU3         48         LT GREEN/PURPLE 18           (FRT) AUX ANA PU3         48         LT GREEN/PURPLE 18           (FRT) AUX ANA PU3         48         LT GREEN/PURPLE 18           (FRP) AUX ANA PU3         59         RED/TAN 18           GOV1         52         GRAY/RED 18           GOV1         55         DK GREEN 18           YBAT         56         ORAVERD 18           YBAT         56         GRAY/18           YBAT         56         GRAY/18           YBAT         58         GRAY 18           YBAT         56         RED/TAN 16           YBAT         56         REDWN/LT GREEN 18           INJ1 LS         52         BROWN/LT BLUE 18           INJ1 LS         52         BROWN/V			-		
IAI         40         TAN/WHITE 18           ECT         41         CK         CREM/PURPLE 18           AUX DIG 1         43         TAN/RED 18           AUX DIG 2         43         TAN/RED 18           AUX DIG 3         44         TAN/ZK CREEN 18           AUX DIG 3         44         TAN/ZK CREEN 18           AUX ANA PU1         45         PINK/TAN 18           AUX ANA PU2         46         LT GREEN/PURPLE 18           (FRT) AUX ANA PU3         48         LT GREEN/PURPLE 18           (FT) AUX ANA PU3         50         LT GREEN/PURPLE 18           GOV1         51         GRAY/DK BLUE 18           GOV2         52         GRAY/DK BLUE 18           GOV1         51         GRAY/DK BLUE 18           GOV2         52         GRAY 18           GOV2         56         GRANDE 18           YBAT PROT         56         GRAY 18           YBAT PROT         52         BROWN/TI BLUE 18           INJ1 LS         52         BROWN/TI GREEN 13           INJ2 LS         63         BROWN/TI GREEN 13           INJ3 LS         64         BROWN/TI BLUE 18           INJ3 LS         66         BROWN/TI BLUE 18	SPARK		~		YELLOW/CRAY 18
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			<		
LUI         42         DK GREEN/PURPLE 15           AUX DIG 1         43         TAN/7RED 18           AUX DIG 2         44         TAN/7RE OREN 18           AUX DIG 3         45         PINK/TAN 18           VSW         46         DK BULEYRELOW 18           AUX ANA PU1         47         YELOW/CK BLUE 18           AUX ANA PU2         48         LT GREEN/WHITE 18           (FRT) AUX ANA PU2         49         LT GREEN/WHITE 18           (FRT) AUX ANA PU3         48         LT GREEN/WHITE 18           (FRP) AUX ANA PU3         50         LT GREEN/BLACK 18           OUL PRESS         54         WHITE/LT GREEN 18           OUL PRESS         54         WHITE/LT GREEN 18           OL PRESS         54         WHITE/LT GREEN 18           PC RX         55         DK GREEN 18           YBAT         56         ORANGE 18           YBAT         56         ORANGE 18           VBAT         56         BROWN/T BLUE 18           INJ1 LS         56         BROWN/T GREEN 18           INJ2 LS         66         BROWN/T GREEN 18           INJ3 LS         56         BROWN/T GREEN 18           INJ3 LS         67         BLACK 16<		ECT	<		THE BUILT IS
AUX DIG 1 → 43 TAN/RED 18 AUX DIG 2 → 43 TAN/RED 18 AUX DIG 3 → 44 TAN/DK GREEN 18 AUX ANA PU1 AUX ANA PU2 45 DIK/TAN 18 AUX ANA PU2 46 DK BLUE/YELLOW 18 AUX ANA PU2 47 YELOW/DK BLUE 18 (FRT) AUX ANA PU3 49 LT GREEN/PURPLE 18 (FRP) AUX ANA PU3 50 RTN 50 CREEN/BLACK 18 600 Z2 GRAY/RED 18 61 BROWN/LT GREEN 18 100 Z5 GRAY 18			<		DK CREEN/PURPLE 18
AUX DIG 2 AUX DIG 3 445 TIAN/DK GREEN 18 VSW AUX ANA PU1 AUX ANA PU2 455 PINK/TAN 18 AUX ANA PU2 477 YELOW/DK BLUE 18 AUX ANA PU2 48 LT GREEN/WHTE 18 (FRT) AUX ANA PU3 49 LT GREEN/PURPLE 18 (FRP) AUX ANA PU01 51 GRAY/DK BLUE 18 OIL PRESS 01L PRESS 01L PRESS 52 GRAY/RED 18 01L PRESS 01L PRESS 53 GRAY 18 PC RX 54 WHTE/LT GREEN 18 PC RX 55 DK GREEN 18 PC RX 56 GRANGE 18 PC RX 56 GRANGE 18 VBAT PROT 56 RED/TAN 16 VBAT PROT 56 RED/TAN 16 VBAT PROT 56 BROWN//T BLUE 18 INJ1 LS 56 BROWN//T GREEN 18 INJ2 LS 56 BROWN//T GREEN 18 INJ3 LS 56 BROWN/WHITE 18 INJ3 LS 57 10 CC COFF 10 10 CC			>		
AUX ANA PU1         45         PINK/TAN 18           AUX ANA PU1         46         DK BUJE/YELLOW 18           AUX ANA PU2         47         YELOW/CK BLUE 18           (FRT) AUX ANA PU3         48         LT GREEN/WHTE 18           (FRT) AUX ANA PU3         48         LT GREEN/WHTE 18           (FRP) AUX ANA PU3         49         LT GREEN/WHTE 18           (FPP2 ONLY) SV EXT 2         50         LT GREEN/WHTE 18           (GOV1         51         GRAY/DK BLUE 18           (GV1         51         GRAY/DK BLUE 18           (GV2         53         LT GREEN/BLACK 18           (FRP) AUX ANA PU01         55         DK GREEN 18           (FRP) AUX ANA PU01         55         DK GREEN 18           (FRP) AUX ANA PU01         55         DK GREEN 18           YBAT         56         GRAY 18           YBAT         56         GRAY 18           YBAT         56         GRAY 18           YBAT         56         BROWN/TI BLUE 18           INJ2 LS         66         BROWN/TI GREEN 18           INJ3 LS         64         BROWN/TI GREEN 18           INJ3 LS         56         BROWN/TI GREEN 18           INJ3 LS         67			>		
AUX         ANA         PUI         46         DK         BLUE/YELLOW 18           AUX         ANA         PU2         47         YELLOW/CK         BLUE 18           (FRT)         AUX         ANA         PU2         48         LT         GREN/PURPLE 18           (FRT)         AUX         ANA         PU3         49         LT         GREN/PURPLE 18           (FRP)         AUX         ANA         PU3         49         LT         GREN/PURPLE 18           (GV1         51         GRAY/DK         BLUE 18         GOV1         51         GRAY/DK         BLUE 18           GOV1         55         DK         GREEN 18         GOV1         55         DK         GREEN 18           GOV1         55         DK         GREEN 18         GRAY 18         TACH         59           VBAT         FROT         59         VBAT         61         BROWN/TI         BLUE 18           INJ1 LS         62         BROWN/TI BLUE 18         INJ2 LS         62         BROWN/WHITE 18           INJ3 LS         64         BROWN/WHITE 18         INJ3 LS         66         INJ6 LS         67           INJ7 LS         66         GROUND         72 <th>AI</th> <th></th> <th>&gt;</th> <th></th> <th></th>	AI		>		
AUX ANA PU3 AUX ANA PU3 AUX ANA PU3 48 LT GREEN/WHTE 18 (FRP) AUX ANA PU3 49 LT GREEN/PURPLE 18 (FPP2 ONLY) SV EXT 2 50 LT GRAY/DK BLUE 18 OV1 51 GRAY/DK BLUE 18 OV1 52 GRAY/RED 18 OV2 53 LT BLUE 18 OV2 54 WHTE/LT GREEN 18 PC TX 55 DK GREEN 18 PC TX 56 GRANGE 18 PC TX 57 ALT EXCITE 57 ALT EXCITE 58 GRAY 18 VBAT PROT 59 VBAT PROT 59 VBAT PROT 50 VBAT PROT 50 CED/TAN 16 VBAT NU3 LS 56 INJ3 LS 56 INJ3 LS 56 INJ3 LS 56 INJ3 LS 56 INJ3 LS 56 INJ3 LS 57 CLOCKOFF) EXCHANCE 18 EGOH 1 71 WHTE/LT BLUE 18 INJ3 LS 56 INJ3 LS 57 CLOCKOFF) EXCHANCE 18 EGOH 1 71 WHTE/LT BLUE 18 EGOH 1 72 51 CLOCKOFF) EXCHANCE 18 PWMS 75 CLOCKOFF) EXCHANCE 18 FD WHS 76 BUZZER 76 BUZZER 77 BUZZER 77 BUZZER 76 BUZZER 77 BUZZER 77 BUZZER 76 BUZZER 77 BUZZER 76 BUZZER 77 BUZZER 76 BUZZER 77 BUZZER 76 BUZZER 77 BUZZER 76 BUZZER 76 BUZZER 77 BUZZER 76 BUZZER 76 BUZZER 76 BUZZER 77 BUZZER 76 BUZZER 76 BUZZER 76 BUZZER 76 BUZZER 76 BUZZER 76 BUZZER 76 BUZZER 76 BUZZER 76 BUZZER 76 BUZZER 76 BUZZER 77 BUZZER 76 82 PIMK/20LLOW 18 BLACK 16 COX 78 82 PIMK/20LLOW 18 BLACK 18 AUX PWM2 83 74 AUX PWM2 84 BLACK/202 18 AUX PWM2 84 74 85 BLACK/202 16 AUX PWM2 86 BLACK/202 16 AUX PWM2 80 20 BUKZER 16 20 20 20 20 20 20 20 20 20 20			<		
ADX ANA PU2         48         LT GREEN/WHITE 18           (FRT) AUX ANA PU3         49         LT GREEN/WHITE 18           (FPP2 ONLY) SV EXT 2         50         LT GREEN/PURPLE 18           SV RTN         51         GRAY/DK BLUE 18           GOV2         52         GRAY/RED 18           GOV2         53         LT GREEN/PURPL 18           GOV2         52         GRAY/RED 18           GOV2         53         LT BUE 18           OIL PRESS         54         WHITE/LT GREEN 18           PC RX         55         DK GREEN 18           PC RX         56         ORANGE 18           PC RX         56         ORANGE 18           PC RX         56         ORANGE 18           VBAT         68         RED/TAN 16           VBAT         68         RED/TAN 16           VBAT         61         BROWN/TE BLUE 18           INJ1 LS         62         BROWN/TE GREEN 18           INJ2 LS         63         BROWN/TE GREEN 18           INJ3 LS         64         BROWN/TE BLUE 18           INJ3 LS         66         INJ3 LS           GROUND         59         BLACK 16           STARTER         71 <th></th> <th></th> <th>&lt;</th> <th></th> <th></th>			<		
(FRI) ADX ANA PUS         45         LT GREEN/PURPLE 18           (FPP2 ONLY) 5V EXT 2         50         LT GREEN/PLACK 18           GOV1         51         GRAY/DK BLUE 18           GV2         52         GRAY/RED 18           GV1         51         GRAY/RED 18           GV2         52         GRAY/RED 18           GV2         52         GRAY/RED 18           OIL PRESS         53         LT BLUE 18           OIL PRESS         55         DK GREEN 18           PC TX         55         DK GREEN 18           PC TX         55         DK GREEN 18           PC TX         55         DK GREEN 18           VBAT         68         RED/TAN 16           VBAT PROT         59         VBAT           VBAT         61         BROWN/TI BLUE 18           INJ1 LS         62         BROWN/TI BLUE 18           INJ2 LS         63         BROWN/WHITE 18           INJ3 LS         64         BROWN/WHITE 18           INJ4 LS         68         BLACK 16           GROUND         76         STARTER           PWM5         73         BLACK/YELLOW 18           BUZZER         76         SUZZER <th></th> <th></th> <th>2</th> <th></th> <th></th>			2		
SV RTN         Stell Status			-	49	LT GREEN/PURPLE 18
SV KIN         S1         GRAY/DK BLUE 18           GOV1         S2         GRAY/RED 18           GUL PRESS         S3         LT BLUE 18           OIL PRESS         S5         DK GREEN 18           PC RX         S5         DK GREEN 18           PC RX         S5         DK GREEN 18           PC RX         S6         ORANGE 18           PC RX         S6         ORANGE 18           VBAT         FACH         S6           VBAT         S6         RED/TAN 16           VBAT         S6         BROWN/TI BLUE 18           INJ1 LS         S1         BROWN/TI GREEN 18           INJ2 LS         S63         BROWN/TI GREEN 18           INJ3 LS         S64         BROWN/TI GREEN 18           INJ3 LS         S66         INJ6 LS           INJ7 LS         S67         INJ7 LS           GROUND         S9         BLACK 16           GROUND         S69         BLACK 18           INJ8 LS         S66           INJ8 LS         S67           INJ8 LS         S68           INJ8 LS         S69           BLACK 16         GROUND           GROUND         S75	(FPP2 ONLY) :		-	50	LT GREEN/BLACK 18
GOV2         S3         LT BLUE 18           OIL PRESS         S5         UT BLUE 18           (FRP) AUX ANA PUD1         S5         DK GREEN 18           PC TX         S5         DK GREEN 18           PC TX         S5         ORANGE 18           PC TX         S5         ORANGE 18           PC TX         S6         ORANGE 18           ALT EXCITE         S7         ALT           TACH         S8         GRAY 18           VBAT         S6         RED/TAN 16           VBAT         S6         BROWN/LT BLUE 18           INJ1 LS         S64         BROWN/TELLOW 18           INJ2 LS         S65         INJ6 LS           INJ4 LS         S66         INJ6 LS           INJ5 LS         S6         BLACK 16           GROUND         S9         BLACK 16           STARTER         71         WHTE/LT BLUE 18           EGOH 1         72         BLACK/WHITE 18           EGOH 3         75         BUZZER           GLOCKOFF) ECOH 4			$\geq$		
OIL PRESS         53         LT BLUE 18           OIL PRESS         54         WHITE/LT GREEN 18           PC TX         55         DK GREEN 18           PC RX         56         ORANGE 18           ALT EXCITE         57         TACH           S8         GRAY 18         BROWN/TE BLUE 18           INJ1 LS         52         BROWN/T BLUE 18           INJ1 LS         52         BROWN/T BLUE 18           INJ2 LS         52         BROWN/T BLUE 18           INJ3 LS         64         BROWN/WHITE 18           INJ3 LS         66         INJ3 LS           GRUND         59         BLACK 16           STARTER         76         BLACK 16           STARTER         71         WHITE/LT BLUE 18           EGOH 3         75         BLACK/WHITE 18           EGOH 4         75         BROWN/WHITE 16           PWMS         77         BROWN /WHITE 16           PWMS         77         BROWN /WHITE 18           BUZZER         77         BROWN /WHITE 16 <th></th> <th></th> <th>2</th> <th>52</th> <th>GRAY/RED 18</th>			2	52	GRAY/RED 18
(FRP) AUX ANA PUDI       ≤ 54       WHITE/LT GREEN 18         PC RX       > 56       DK GREEN 18         PC RX       > 56       ORANGE 18         PC RX       > 56       GRAY 18         TACH       > 58       GRAY 18         VBAT PROT       > 60       RED/TAN 16         VBAT       < 61       BROWN/T BLUE 18         INJ1 LS       < 61       BROWN/T GREEN 18         INJ2 LS       < 63       BROWN/T GREEN 18         INJ2 LS       < 63       BROWN/T GREEN 18         INJ3 LS       < 64       BROWN/WHITE 18         INJ3 LS       < 66       INJ6 LS         INJ7 LS       < 67       INJ7 LS         INJ7 LS       < 68       BLACK 16         GROUND       < 69       BLACK 16         STARTER       < 70       STARTER         RLAY       < 72       BLACK/WHITE 18         EGOH 1       < 72       BLACK/WHITE 18         EGOH 3       < 75       BUZZER       < 76         BUZZER       < 77       BROWN/WHITE 16       PWM5         PWM5       < 78       WHITE/DROWN 16          GROUND       < 81       BLACK 15			$\sim$	53	LT BLUE 18
PC RX PC RX PC RX ALT EXCITE 57 ALT EXCITE 57 ALT EXCITE 57 ALT EXCITE 58 GRAY 18 VBAT VBAT PROT 68 RED/TAN 16 VBAT 61 BROWN/T BLUE 18 INJ3 LS 63 BROWN/YELLOW 18 INJ3 LS 64 BROWN/WHITE 18 INJ4 LS 65 INJ6 LS 66 INJ6 LS 66 INJ7 LS 66 INJ7 LS 67 INJ7 LS 68 INJ8 LS 66 INJ7 LS 66 INJ7 LS 67 INJ7 LS 68 INJ8 LS 66 INJ7 LS 67 INJ7 LS 68 INJ8 LS 66 INJ7 LS 67 INJ7 LS 67 INJ7 LS 67 INJ7 LS 68 INJ8 LS 69 BLACK 16 GROWND 71 WHTE/LT BLUE 18 EGOH 1 72 51 62 73 64 64 18 18 18 18 18 18 18 18 18 18			$\geq$	54	
PC RX         56         ORANGE 18           PC RX         57         TACH         58         GRAY 18           TACH         59         59         VBAT         59           VBAT         60         RED/TAN 16         VBAT         51         BROWN/LT BLUE 18           INJ1 LS         62         BROWN/LT GREEN 18         INJ2 LS         62         BROWN/LT GREEN 18           INJ2 LS         63         BROWN/WHITE 18         INJ3 LS         66           INJ3 LS         66         BROWN/WHITE 18         INJ3 LS         66           INJ4 LS         66         INJ6 LS         67           INJ7 LS         68         INJ8 LS         66           INJ8 LS         68         INJ8 LS         68           INJ7 LS         68         INJ8 LS         66           INJ8 LS         69         ELACK 16         STARTER           RELAY         72         ELACK/WHITE 18         E0OH 1           EGOH 3         75         BUZZER         76           BUZZER         77         BROWN/WHITE 16         BUZZER           PWM5         78         WHITE/DROWN 16         VBAT           WB4         80         GREN	(FRP) AUX A			55	
ALT EXCITE S7 ALT EXCITE S7 TACH S8 GRAY 18 VBAT VBAT VBAT VBAT VBAT VBAT S9 VBAT VBAT S1 NUJ LS S1 S1 S1 S1 S1 S1 S1 S1 S1 S			-		
ALT EXCILE       58       GRAY 18         TACH       599         VBAT       60       RED/TAN 16         VBAT       61       BROWN/LT GREEN 18         INJ1 LS       62       BROWN/LT GREEN 18         INJ2 LS       63       BROWN/ELLOW 18         INJ3 LS       64       BROWN/WHITE 18         INJ3 LS       65       BROWN/WHITE 18         INJ3 LS       66       INJ3 LS         GROUND       76       STARTER         RELAY       72       BLACK 16         GROUND       77       BLACK/WHITE 18         EGOH 1       73       BLACK/WHITE 18         EGOH 2       73       BLACK/YELLOW 18         EGOH 3       76       BUZZER         PWM5       78       WHITE/DROWN 16         VBAT       79       RED/TAN 16         VBAT       79       RED/TAN 16         PWM5       78       WHITE/BROWN 16         GROUND       81       BLACK 16         GROUND       82       PINK/WHITE 18         DBW +       83       TAN/ORANGE 18         FPUMP       84       TAN/ORANGE 18         AUX PWM3<>       87       TAN 18 <th></th> <th></th> <th>-</th> <th></th> <th></th>			-		
IACH         59           VBAT         FRO         59           VBAT         61         BROWN/LT BLUE 18           INJ LS         62         BROWN/LT GREEN 18           INJ LS         63         BROWN/LT GREEN 18           INJ LS         63         BROWN/TI GREEN 18           INJ LS         64         BROWN/WHITE 18           INJ LS         66         BROWN/WHITE 18           INJ LS         66         INJ LS           GROUND         78         GROUND           STARTER         71         WHTE/LT BLUE 18           EGOH 1         72         BLACK 16           GROUND         78         BLACK/WHITE 18           EGOH 2         77         BROWN/WHITE 18           EGOH 3         75         BLOCK/WHITE 16           PWMS         77         BROWN/WHITE 16           PWMS         77         BROWN 16           PWMS         77         BROWN 16           VBAT         79         RED/TAN 16           VBAT         79         RED/TAN 16           VBAT         80         GREEN/YELLOW 18           GROUND         81         BLACK 15           GROUND         82<	AL		$\leq$		GRAY 18
VBAT         60         RED/TAN 16           VBAT         61         BROWN/LT BLUE 18           INJ1 LS         62         BROWN/LT GREEN 18           INJ2 LS         63         BROWN/YELLOW 18           INJ3 LS         64         BROWN/WHITE 18           INJ3 LS         65           INJ4 LS         65           INJ5 LS         66           INJ5 LS         66           INJ6 LS         66           INJ7 LS         68           INJ7 LS         68           INJ8 LS         66           GROUND         69           EGOH 1         72           BLACK 16         GROUND           STARTER         71           WHTE/LT BLUE 18         EGOH 1           EGOH 2         73           EGOH 3         75           GLOCKOFF EGOH 4         75           BUZZER         77           PWM5         78           WHTE/BROWN 16         90           BUZZER         77           BOUZER         77           BOUZER         78           PWM5         80           GROUND         81			<	59	
VBAI         C         61         BROWN/LT         BLUE         18           INJ1 LS         62         BROWN/LT         GREEN 18         18           INJ3 LS         63         BROWN/VELLOW 18         18         18           INJ3 LS         63         BROWN/WHITE 18         18           INJ3 LS         66         18         18           INJ3 LS         66         18         18           INJ4 LS         66         18         18           INJ7 LS         66         18         18           INJ7 LS         68         18         18           GROUND         59         BLACK 16         67           GROUND         72         BLACK 16         18           EGOH 1         72         BLACK/WHITE 18         18           EGOH 2         74         BLOCK/WHITE 18         18           EGOH 3         74         5         10         18           PWM5         77         BROWN/WHITE 16         18           PWM5         77         BROWN 16         18           PWM5         77         BROWN 16         18           PWM5         77         BROWN 16	V8		-		RED/TAN 16
INUL IS         62         BROWN/LT GREEN 18           INU2 LS         63         BROWN/YELLOW 18           INU3 LS         64         BROWN/WHITE 18           INU3 LS         65           INU3 LS         65           INU3 LS         66           INU3 LS         66           INU3 LS         66           INU3 LS         68           GROUND         70           RELAY         71           WHTE/LT BLUE 18         18           EGOH 1         72           SLACK/YELLOW 18         18           BUZZER         76           BUZZER         77           BUXER         78           WM5         78           BUZZER         77           BUZZER         77           BUS         78           BUZE			2		
INJ2 LS     63     BROWN/YELLOW 18       INJ3 LS     64     BROWN/WHITE 18       INJ4 LS     65       INJ5 LS     66       INJ7 LS     67       INJ7 LS     67       INJ8 LS     68       INJ7 LS     69       BCOUND     69       BLACK 16     67       STARTER     71       WHTE/LT BLUE 18     80       EGOH 1     72       BLACK/WHITE 18     80       EGOH 3     75       OLOCKOFF) EGOH 4     75       BUZZER     77       BWM5     78       WM5     78       WM5     79       RECIRC     79       REDUTAN 16     79       WB4T     80       GROUND     81       BLACK 16     18       GROUND     81       BLACK 16     18       AUX PWM3     87       AUX PWM3     87       AUX PWM3     80       AUX PWM4     80       AUX PWM2     80       AUX PWM3     87			$\geq$	62	
INJ3 LS < 64 BROWN/WHITE 18 INJ4 LS < 65 INJ5 LS < 66 INJ5 LS < 67 INJ7 LS < 67 INJ7 LS < 68 INJ8 LS < 68 INJ8 LS < 68 INJ8 LS < 69 ELACK 16 GROUND > 70 STARTER > 71 WHITE/LT BLUE 18 EGOH 1 > 72 ELACK/WHITE 18 EGOH 2 > 74 EGOH 3 > 74 EGOH 3 > 74 EGOH 4 > 75 GUZZER > 77 BUZZER > 77 BUZZER > 77 BROWN/WHITE 16 PWM5 RECIRC < 78 WHITE/BROWN 16 PWM5 RECIRC < 78 WHITE/BROWN 16 VBAT < 80 GREEN/YELLOW 18 ILL & 81 BLACK 15 GROUND < 81 BLACK 15 DBW + DBW + DBW + AUX PWM3 RECIRC < 85 PINK/YELLOW 16 AUX PWM3 > 87 TAN 18 AUX PWM2 > 88 DK BLUE 15 AUX PWM2 > 80 DK BL			$\geq$		
INJ4 LS ← 66 INJ5 LS ← 66 INJ5 LS ← 66 INJ7 LS ← 68 INJ8 LS ← 68 I			$\geq$		
INJ5 LS     66       INJ6 LS     67       INJ7 LS     67       INJ8 LS     68       GROUND     69       STARTER     70       STARTER     71       WHTE/LT BLUE 18       EGOH 1     72       BLACK / WHITE 18       EGOH 2     73       EGOH 3     75       GLOCKOFF) EGOH 4     75       BUZZER     76       BUZZER     77       BUZZER     78       WMS RECIRC     78       BUZ     79       REDUNC     79       REDUNC     79       BUX PWM3     80       GROUND     81       BLACK 16     18       BUW +     83       TAN/ORANGE 18       FPUMP     84       AUX PWM3     87       AUX PWM3     87       AUX PWM4     88       DNUC/20 LOC 18			$\geq$	65	
INJ6 LS         67           INJ7 LS         68           INJ8 LS         68           GROUND         70           STARTER         70           RELAY         71           WHTE/LT BLUE 18         E00H 1           E00H 1         72           E00H 2         74           E00H 3         75           (LOCKOFF) E00H 4         75           BUZZER         77           BUZZER         78           WM5 RECIRC         79           RED/TAN 16         WBAT           VBAT         78           ROUND         81           BLACK 15           GROUND         82           PIWMS         85           PBW +         84           AUX PWM3         87           AUX PWM3         87           AUX PWM2         88           AUX PWM2         80			2		
INJJ LS         68           INJJ LS         69           GROUND         70           STARTER         71           WHTE/LT BLUE 18           EGOH 1         72           EGOH 2         72           EGOH 3         75           EGOH 3         75           BUZZER         76           PWM5         77           BUZZER         76           PWM5         77           BUZZER         76           PWM5         77           BUZZER         76           PWM5         77           BUZZER         77           BUZZER         77           BUZER         78           WHTE/BROWN 16         16           VBAT         80           GROUND         81           BLACK 18         18           BUW +         83           BUX PWM3         87           AUX PWM3			2		
INJ8 LS         69         ELACK 16           GROUND         70           STARTER         71           WHTE/LT BLUE 18           EQOH 1         72           EQOH 1         72           EQOH 1         72           EQOH 2         73           EQOH 3         75           GLOCKOFF) EDOH 4         75           BUZZER         76           BUZZER         77           BUZZER         78           WMS         80           PWMS         80           BUZZER         78           PWMS         80           GROUND         81           BLACK 16         16           BUW         83           BUW         84           AUX PWM3         87			$\geq$		
GROUD         76           STARTER         71         WHTE/LT BLUE 18           RELAY         71         BLACK/WHTE 18           EGOH 1         73         BLACK/WHTE 18           EGOH 2         73         BLACK/YELLOW 18           EGOH 3         75           GUZZER         76           PWMS         77           BUZZER         77           BUZZER         77           BUZZER         77           BUZZER         77           BUZZER         77           BUZZER         78           PWMS RECIRC         79           REDUND         81           BLACK 16           GROUND         82           PINK/PALLOW 18           AUX PWM3           87         TAN /8           AUX PWM3         87           AUX PWM4         88           AUX PWM2         90           AUX PWM3         87			2		BLACK 16
STARTER → 21 WHTE/LT BLUE 18 RELAY → 72 BLACK/WHTE 18 EGOH 1 → 72 BLACK/WHTE 18 EGOH 2 → 74 EGOH 3 → 75 BUZZER → 76 BUZZER → 76 BUZZER → 76 BUZZER → 76 BUZZER → 76 BUZZER → 77 BROWN/WHTE 16 PWM5 RECIRC ← 78 WHTE/BROWN 16 VBAT ← 79 RED/TAN 16 VBAT ← 79 RED/TAN 16 WBAT ← 79 RED/TAN 16 MIL → 80 GREN/YELLOW 18 MIL → 81 BLACK 18 GROUND ← 82 PINK/WHTE 18 DBW + DBW + DBW + DBW + AUX PWM3 → 87 TAN 18 AUX PWM3 → 87 TAN 18 AUX PWM2 → 88 DK BLUE 18 AUX PWM2 → 88 DK			2		
KELAT         72         ELACK/WHITE 18           EGOH 1         73         #LACK/YELLOW 18           EGOH 3         73         #LACK/YELLOW 18           EGOH 3         75           (LOCKOFF) EDOH 4         75           BUZZER         76           PWM5         77           BUZZER         77           BWM5         78           WHTE/BROWN 16         79           PWM5         79           RED/TAN 16         79           VBAT         80           GROUND         81           BW#         82           PIMK/WHITE 18           DBW +         83           AUX PWM3         85           AUX PWM3         87           AUX PWM4         88           DBW +         88           AUX PWM2         80           AUX PWM2         80           AUX PWM2         80           BUX P1 ACK 18			<		WHITE/LT BLUE 18
EUGH 1 EGOH 2 EGOH 3 EGOH 3 74 EGOH 3 75 902ZER 76 902ZER 77 902ZER 77 902ZER 77 902ZER 77 902ZER 77 902ZER 77 902ZER 77 902ZER 76 902ZER 76 9			<		BLACK/WHITE 18
EUGH 2 74 EGGH 3 75 (LOCKOFF) EGOH 4 76 BUZZER 77 BWM5 77 BWM5 77 BWM5 77 BROWN/WHITE 16 PWM5 77 BROWN/WHITE 16 PWM5 RECIRC 78 WHITE/BROWN 16 VBAT 880 GREN/YELLOW 18 MIL 881 BLACK 15 CROUND 81 BLACK 15 DBW + DBW + DBW + BW 584 TAN/BLACK 18 FPUMP 84 TAN/BLACK 18 FPUMP 84 TAN/BLACK 18 FPUMP 84 TAN/BLACK 18 FPUMP 84 TAN/BLACK 18 FPUMP 84 TAN/BLACK 18 BLACK/RED 16 AUX PWM3 87 TAN 18 BLACK/RED 16 AUX PWM3 87 TAN 18 BLACK/RED 16 AUX PWM2 88 BLACK/RED 16 AUX PWM2 88 BLACK/FED 16 AUX PWM2 88 BLACK/FED 16 AUX PWM2 88 BLACK/FED 16 AUX PWM2 88 FFUMP 16 BLACK/FED 16 FFUMP 16 BLACK/FED			$\leq$		
LOCKOFF) ECOH 3 75 BUZZER 76 BUZZER 77 BWM5 RECIRC 78 WHTE/BROWN 16 PWM5 RECIRC 78 WHTE/BROWN 16 PWM5 RECIRC 78 WHTE/BROWN 16 BUK/YELLOW 18 CROWND 81 BLACK 15 BUK/YELLOW 16 AUX PWM3 85 AUX PWM3 87 AUX PWM3 87 AUX PWM2 80 BUK/YELLOW 18 BUK/YELLOW 16 BUK/YELLOW 16 BUK/YELOW 16			5		
(LOCKOFF) EUCH ≠         76           BUZZER ≠         77           BROWN/WHITE 16         PWM5           PWM5         78           WHTE/BROWN 16           PWM5         79           RED/TAN 16           VBAT         80           GROUND         81           BLACK 16           DBW +         83           TAN/ORANGE 18           DBW +           BLACK 18           FPUMP           84           AUX PWM3           87           AUX PWM3           B1           AUX PWM2           80           AUX PWM2	0 eeke	EGOH 3	$\leq$		
BUZZER         77         BROWN/WHITE 16           PWM5         78         WHITE/BROWN 16           PWM5         79         RED/TAN 16           VBAT         80         GREEN/YELLOW 18           MIL         80         GREEN/YELLOW 18           MIL         82         PINK/WHITE 18           DBW         +<>83         TAN/ORANGE 18           DBW         +         84         TAN/ZEANGE 18           PUMP         84         TAN/ZEANGE 18           AUX PWM3         86         BLACK/RED 16           AUX PWM3         87         TAN 18           AUX PWM2         88         DK BLUE 15	(LOCKOFF)		<		
PWMS         78         WHTE/BROWN 16           VBAT         79         RED/TAN 16           VBAT         80         GREDN/VELLOW 18           BI         BLACK 15         BLACK 15           GROUND         81         BLACK 15           DBW +         82         PINK/WHITE 18           DBW +         83         TAN/ORANGE 18           FPUMP         84         TAN/ZRANGE 18           AUX PWM3         85         PINK/YELLOW 16           AUX PWM3         87         TAN 18           AUX PWM3         87         TAN 18           AUX PWM2         80         DK BLUE 15           AUX PWM2         80         DK BLUE 16			<		BROWN/WHITE 16
PWMS RELIRG         79         RED/TAN 16           VBAT         80         GREEN/YELLOW 18           MIL         81         BLACK 15           GROUND         82         PINK/WHITE 18           DBW         83         TAN/ORANGE 18           DBW         84         TAN/ORANGE 18           FPUMP         84         TAN/ORANGE 18           AUX PWM3 RECIRC         85         PINK/YELLOW 16           AUX PWM3         87         TAN 18           AUX PWM2         88         DK BLACK 18			-		
VBAI         38         GREEN/YELLOW 18           MIL         31         BLACK 15           GROUND         31         BLACK 15           DBW         -         32         PINK/WHITE 18           DBW         -         33         TAN/ORANGE 18           FPUMP         -         84         TAN/DLACK 18           FPUMP         -         85         PINK/YELLOW 16           AUX PWM3         RECIRC         -         85         PINK/YELLOW 16           AUX PWM3         -         87         TAN 18         -           AUX PWM2         -         83         DK BLUE 15         -	PWMS		2		
AUX PWM2 > 80 DK 64 CY 18			2		
AUX PWM3 > 87 TAN 18 AUX PWM3 PWM3 > 87 TAN 18 AUX PWM3 PWM3 > 87 TAN 18 AUX PWM3 PWM3 > 87 TAN 18 AUX PWM2 > 88 DK BLUE 18 AUX PWM3 AUX PWM3 AUX PWM3 AUX PWM3 AUX PWM4 AUX			-		
DBW         C         83         TAN/ORANGE 18           DBW         FPUMP         84         TAN/BLACK 18           FPUMP         85         PINK/YELLOW 16           AUX PWM3         86         BLACK/RED 16           AUX PWM3         87         TAN 18           AUX PWM2         88         DK BLUE 15           AUX PWM2         80         DK BLUE 15			2.		
AUX PWM3 > 88 DK BLUE 15 AUX PWM2 > 88 DK BLUE 15 AUX PWM3 AUX PWM3 > 87 TAN 18 AUX PWM2 > 88 DK BLUE 15 AUX PWM2 > 88 DK			22		
AUX PWM3 RECIRC 85 PINK/YELLOW 16 AUX PWM3 RECIRC 86 BLACK/RED 16 AUX PWM1 87 TAN 18 AUX PWM1 88 DK BLUE 18 AUX PWM2 88 DK BLUE 18					
AUX PWM3 RELIRC 86 BLACK/RED 15 AUX PWM3 87 TAN 18 AUX PWM2 88 DK BLUE 18 AUX PWM2 88 DK BLUE 18			2		
AUX PWM3 > 87 TAN 18 AUX PWM3 > 88 DK BLUE 18 AUX PWM2 > 88 DK BLUE 18			2		
AUX PWM1 S8 DK BLUE 18 AUX PWM2 S80 DNM / PLACK 18			<		
AUX PWM2 BO DINK (PLACK 19			<		
			<		
(STARTER) AUX PWM4 > 00			2		
AUX_PWM4_RECIRC <	AUX_PWM4	RECIRC	~		

## 4.3L Duel Fuel

		1	1	DK GREEN/ORANGE 18
	EGO1	<		
FCI			2	DK GREEN/WHITE 18
	EG02		3	
211 PC 98 25 6669 CONNECTOR	EGO3	<		
211 A 98 6887 LOCKING CAM		2	4	
	EG04	<	5	DUDDIE/LT DULE 18
211 A 98 8888 COVER	TPS1	-		PURPLE/LT BLUE 18
211 CC 25 1468 TERMINAL (GOLD)		2	6	LT BLUE/DK BLUE 18
THE OF SECTION INCOMENT (OPEN)	TPS2	~	7	LT GREEN 18
	MAP	~		
			8	ORANGE/YELLOW 18
AUX AI	VA PD1	<	9	
	FPP1	~	э	DK BLUE/ORANGE 18
		· ·	10	PURPLE/YELLOW 18
FF	*P2 NS	<		1 9/11 19
AUX ANA	DI ID2	1	11	
		~	12	
AUX ANA	A PUD3	<		
			13	WHITE/ORANGE 18
	ERM +		14	BLUE/PINK 18
(	:AN1 +	$\leq >$		
	AN1 -		15	BLUE/WHITE 18
	- 1966, AN	~	16	
	CAN2-	$\leq >$		
	AN2 +		17	
			18	
CAN2 T	ERM +	<		
		-	19	LT GREEN/RED 18
	EXT 1	_	20	BLK/LT GREEN 18
	5V RTN	<		
05	ANK +	-	21	PURPLE/WHITE 18
		-	22	WHITE/PURPLE 18
CR	EANK —	$\leq >$		
	CAM +	-	23	GRAY/BROWN 18
		_	24	PURPLE/ORANGE 18
	CAM -	$\sim$		
90	EED +	-	25	RED/WHITE 18
			26	RED/BLACK 18
SF	ΈED –	$\leq >$		14_01_0_001_10
	CK1 +	-	27	
		2	28	
KNC	CK1 -	$\sim$		
	CK2 +	-	29	
		2.5	30	
KNC	CK2 -	$\leq >$		VELLOW 18
SPARK C		-	31	YELLOW 18
			32	
SPARK C	20IL 18	>		
SPARK C			33	
			34	
SPARK C	:0IL 2B	>		
SPARK C			35	
			36	
SPARK C	:0IL 38	>		
SPARK C			_37	
			38	
SPARK C	XIL 4B	>		VELLOW CORVERSE
	AT		39	YELLOW/GRAY 18
			40	TAN/WHITE 18
	ECT	<		19 10 11 19
	EGT	-	41	
		~	42	DK GREEN/PURPLE 18
AUD	CDIG 1	>		
	CDIG 2	-	43	TAN/RED 18
		-	44	TAN/DK GREEN 18
AUD	(DIG 3	>		
		-	45	PINK/TAN 18
	VSW	_	46	DK BLUE/YELLOW 18
AUX AN	VA PU1	< .		
			47	YELLOW/DK BLUE 18
AUX AT	NA PU2	~	48	LT GREEN/WHITE 18
(FRT) AUX AN	VA PU3	<		
		_	49	LT GREEN/PURPLE 18
(FPP2 ONLY) 5V	EXT2	~	50	LT GREEN/BLACK 18
	5V RTN	-		
		-	51	GRAY/DK BLUE 18
	GOV1	~	52	GRAY/RED 18
	GOV2	<		
01		-	53	LT BLUE 18
OL	PRESS	~	54	WHITE/LT GREEN 18
(FRP) AUX AN	PUD1	<		
(1.4.)		-	55	DK GREEN 18
	PC TX	-	56	ORANGE 18
	PC RX	<		
			57	
ALI	EXCITE	-	58	GRAY 18
	TACH	>		
1004	T PROT		59	
VBA		-	60	RED/TAN 16
	VBAT	<		
	NJ1 LS	-	61	TAN/LT BLUE 18
		2	62	GRAY/YELLOW 18
	NJ2 LS		63	
1	NJ3 LS	-		TAN/BROWN 18
			64	GRAY/WHITE 18
	NJ4 LS	-	65	TAN/YELLOW 18
1	NJ5 LS	<		
			66	GRAY/ORANGE 18
	NJ6 LS		67	
1	NJ7 LS	<		
	NJ8 LS		68	
			69	BLACK 16
G	ROUND	<		
	TARTER		70	
5			71	WHITE/LT BLUE 18
	RELAY	>		
E	GOH 1		72	BLACK/WHITE 18
			73	BLACK/YELLOW 18
	COH 2		74	
	GOH 3			
			75	WHITE/BLACK 18
(LOCKOFF)			76	
E E	UZZER	>		Province and the second
			77	BROWN/WHITE 16
	PWM5	-	78	
DAMAS.	RECIRC	-		WHITE/BROWN 16
CMM5			79	RED/TAN 16
	VBAT			GREEN/YELLOW 18
	MIL	>	88	
		-	81	BLACK 16
-		-		
	ROUND			
	ROUND	~~	82	PINK/WHITE 18
	ROUND DBW +	<>	83	
	ROUND	⇒	83	TAN/ORANGE 18
	ROUND DBW + DBW -	$\langle \rangle$	83 84	TAN/ORANGE 18 TAN/BLACK 18
	ROUND DBW + DBW - FPUMP	∻	83 84	TAN/ORANGE 18 TAN/BLACK 18
	ROUND DBW + DBW - FPUMP	∻	83 84 85	TAN/ORANGE 18 TAN/BLACK 18 PINK/YELLOW 16
AUX PWM3	ROUND DBW + DBW - FPUMP RECIRC		83 84 85 86	TAN/ORANGE 18 TAN/BLACK 18 PINK/YELLOW 16 BLACK/RED 16
AUX PWM3 AUX	ROUND DBW + DBW - FPUMP RECIRC PWM3		83 84 85 86	TAN/ORANGE 18 TAN/BLACK 18 PINK/YELLOW 16 BLACK/RED 16
AUX PWM3 AUX	ROUND DBW + DBW - FPUMP RECIRC		83 84 85 86 87	TAN/ORANGE 18 TAN/BLACK 18 PINK/YELLOW 16 BLACK/RED 16 TAN 18
AUX PWM3 AUX AUX	ROUND DBW + DBW - FPUMP RECIRC PWM3 PWM1	\$***	83 84 85 86 87 88	TAN/ORANGE 18 TAN/BLACK 18 PINK/YELLOW 16 BLACK/RED 16 TAN 18 DK BLUE 18
AUX PWM3 AUX AUX AUX	ROUND DBW + DBW - FPUMP RECIRC PWM3 PWM1 PWM2	\$ <sub>^</sub> ,	83 84 85 86 87	TAN/ORANGE 18 TAN/BLACK 18 PINK/YELLOW 16 BLACK/RED 16 TAN 18
AUX PWM3 AUX AUX (STARTER) AUX	ROUND DBW + DBW - FPUMP RECIRC PWM3 PWM1 PWM2 PWM4	****	83 84 85 86 87 88 89	TAN/ORANGE 18 TAN/BLACK 18 PINK/YELLOW 16 BLACK/RED 16 TAN 18 DK BLUE 18
AUX PWM3 AUX AUX (STARTER) AUX	ROUND DBW + DBW - FPUMP RECIRC PWM3 PWM1 PWM2 PWM4	****	83 84 85 86 87 88	TAN/ORANGE 18 TAN/BLACK 18 PINK/YELLOW 16 BLACK/RED 16 TAN 18 DK BLUE 18
AUX PWM3 AUX AUX AUX	ROUND DBW + DBW - FPUMP RECIRC PWM3 PWM1 PWM2 PWM4	****	83 84 85 86 87 88 89	TAN/ORANGE 18 TAN/BLACK 18 PINK/YELLOW 16 BLACK/RED 16 TAN 18 DK BLUE 18

## 4.3L LPG

FCI         E001 E002 E003 E003 E004 E004 E004 E004 E004 E004	4.JL L		•		
FCI         EGG2         ≤         DK GREENZHTE: 15           211 Do base core:         EGG2         ≤         DK GREENZHTE: 15           211 A see eeser core:         TPS1         5         LT GREEN: 18           211 A see eeser core:         TPS1         5         LT GREEN: 18           211 Co 23 1460 TEMANL (cot.0)         TPS2         7         LT GREEN: 18           AUX ANA PUD2         12         AUX ANA PUD3         12           AUX ANA PUD3         12         WHTE/ORANGE 18           CAN TERM +         14         BLUE/PINK 18           CAN TERM +         15         BLUE/PINK 18           CAN TERM +         16         PURPLE/VAINTE 18           CAN TERM +         21         PURPLE/VAINTE 18           CAN TERM +         22         PURPLE/VAINTE 18           CAN +         23         RED/VAINTE 18           CAN +         24         PURPLE/ORANGE 18           CAN +         23         RED/VAINTE 18           CAN +         24         PURPLE/VAINTE 18           CAN +         23         RED/VAINTE 18           SPARK COLL 1A         33         SPARK COLL 14         33           SPARK COLL 2A         34         SPARK COLL 2A		Eco1	-		DK GREEN/ORANGE 18
211 PG Set 25 8886 CONNECTOR         ECOG3	FCI		$\geq$	2	DK GREEN/WHITE 18
211 A see ever codes     =     =     PURPLE/LT BLUE 18       211 OC 25 1460 TEMINEL (20L0)     TES2     =     D T BLUE/OK BLUE 18       211 OC 25 1460 TEMINEL (20L0)     TES2     =     0       AUX ANA PO1     =     3     TALCAK GEP21 18       AUX ANA PUD3     =     12       CAN1 +     =     16       CAN1 +     =     16       CAN1 +     =     16       CAN1 +     =     16       CAN2 +     =     17       CAN2 +     =     18       SV EXT 1     =     22       PURPLE/ORANCE 18     CRAVK       CAN +     =     22       CAN +     =     22       CAN +     =     22       RED/PLE/ORANCE 18     CRAVK       CAN +     =     22       CAN +     =     23       CAN +     =     24       PURPLE/ORANCE 18     CRAVKER       CAN +     =     24       CAN +     =     28       RED/PLE/ORANCE 18     CRAVKER       SPARK COLL 24     = <t< th=""><th>211 PC 98 25 6889 CONNECTOR</th><th></th><th>2</th><th></th><th></th></t<>	211 PC 98 25 6889 CONNECTOR		2		
211 A 98 8086 COVET 211 OC 25 1460 TEMANE (CDI TES) 4 UX ANA PD1 52 4 UT CREEN TB AUX ANA PD1 5 4 UX ANA	211 A 98 6887 LOCKING CAM		2		
211 00 25 1469 TBMINEL (2010) TPS2 ↓ 0 LT CREEN TB MAP AUX ANA PD1 ↓ 0 TO CREEN TB AUX ANA PD1 ↓ 0 PURPLE/TELLOW 1B AUX ANA PD1 ↓ 0 PURPLE/TELLOW 1B AUX ANA PD1 ↓ 1 PURPLE/TELLOW 1B AUX ANA PD1 ↓ 1 PURPLE/TELLOW 1B AUX ANA PD1 ↓ 1 PURPLE/TELLOW 1B CAN 1 + ↓ 1 PURPLE/TELLOW 1B SV EXT 1 2 PURPLE/TELLOW 1B SV EXT 1 2 PURPLE/TELLOW 1B CAN 2 PURPLE/TELLOW 1B SV EXT 1 2 PURPLE/TELLOW 1B CAN 4 ↓ 2 PURPLE/TELLOW 1B CAN 4 ↓ 2 PURPLE/TELLOW 1B SV EXT 1 2 PURPLE/TELLOW 1B CAN 4 ↓ 2 PURPLE/TELLOW 1B SV EXT 1 2 PURPLE/TELLOW 1B SPARK COLL 24 ≥ 33 SPARK COLL 24 ≥ 32 SPARK COLL 24 ≥ 32 SPARK COLL 24 ≥ 32 SPARK					
AUX ANA PD1         8         TAK/CR GREAT 18           PP2 IVS         9         DK BLLE/CORANGE 18           PP2 IVS         10         PURTE/VELLOW 18           AUX ANA PUD2         11           AUX ANA PUD3         12           CAN TERM +         13           CAN2 +         16           CAN2 +         19           CAN2 +         19           CAN4 +         22           CAN +         23           CAN +         24           CAN +         24           CAN +         24           CAN +         25           RED/BLACK 18           SPARK COL 14         33           SPARK COL 24         34           SPARK COL 44         38	211 CC 25 1468 TERMINAL (COLD)		2		
AUX ANA PD1 - 2 DEVCID CARAGE 18 PPP2 IVS - 10 PURPLE/VELLOW 18 AUX ANA PUD3 - 12 AUX ANA PUD3 - 12 CAN TERM + -13 WHITE/CORANGE 18 CAN 1 + -14 EULE/PINK 18 CAN 1 + -15 BLUE/WHITE 18 CAN 1 + -15 BLUE/WHITE 18 CAN 1 + -16 BLUE/WHITE 18 CAN 2 + -17 CAN 2 TERM + -18 S V EXT 1 - 20 BL/C/T CRED/ 18 S V EXT 1 - 20 BL/C/T CRED/ 18 S V EXT 1 - 20 BL/C/T CRED/ 18 CAN 4 + -22 WHITE/D/BR/E 18 CRANK + -22 BL/SUACK 18 CRANK + -22 BL/SUACK 18 S PEED + -22 RED/SUACK 18 S PARK COL 14 S SPARK COL 14 S SPARK COL 28 - 33 S SPARK COL 28 - 34 S SPARK COL 28 - 35 S SPARK COL 38 - 36 S SPARK COL 38 - 37 S SPARK COL 38 - 36 S SPARK COL 38 - 36 S SPARK COL 38 - 36 S SPARK COL 48 - 39 Y ELLOW 18 S SPARK COL 48 S SPARK 201 28 S SPARK 201 28			÷		
PPP1         3         Dit BLUE/VIEUW 18           AUX ANA PUD2         11           AUX ANA PUD2         11           AUX ANA PUD2         11           AUX ANA PUD2         13           CAN TERM +         14           CAN TERM +         15           CAN TERM +         16           CAN TERM +         17           CAN TERM +         18           SV EXT 1         28           CAN TERM +         21           CAN TERM +         21           CAN TERM +         22           SPARK COLL 1A         33           SPARK COLL 2A         34	AUX AN		~		TAN/DK GREEN 18
FPP2 INS         -18         PURPLE/FELLIM 15           AUX ANA PUD3         -12         WITE/OSANGE 15           CAN 1         -3         # ULE/PINK 15           CAN 2         -5         6           CAN 2         -7         6           CAN 2         -7         20           CAN 2         -7         20           CAN 4         -2         WITE/PURPLE/WHTE 18           CRANK +         -2         WITE/PURPLE/ORANGE 18           CRANK +         -2         WITE/PURPLE/0RANGE 18           CRANK +         -2         WITE/PURPLE/0RANGE 18           CAM +         -2         WITE/PURPLE 18           CRANK COLL 48         -33         YELLOW 18           SPARK COLL 28         -35           SPARK COLL 48         -36			2		
AUX ANA PUD2 AUX ANA PUD2 CAN TERM +	FP FP		~		PURPLE/YELLOW 18
AUX ANA PUD3 - 13 WHITE/ORANGE 18 CAN 1 + 4 BLLE/PINK 18 CAN 1 + 5 BLLE/WHITE 18 CAN 1 + 5 BLLE/WHITE 18 CAN 2 + 19 CAN 2 TERM + 19 S V EXT 1 - 20 BLK/LT GREEN/RED 18 S V EXT 1 - 20 BLK/LT GREEN/RED 18 CAN 4 + 22 PURPLE/WHITE 18 CRANK + 22 WHITE/PURPLE 18 CRANK + 22 WHITE/PURPLE 18 CRANK + 22 WHITE/PURPLE 18 CRANK + 22 WHITE/PURPLE 18 CRANK + 22 BLK/LT GREEN 18 S PEED + 22 RED/BLACK 18 S PEED + 22 RED/BLACK 18 S PARK COLL 18 + 32 S PARK COLL 18 + 32 S PARK COLL 28 + 34 S PARK COLL 24 + 38 S PARK COLL 44 + 38 S PARK 20 RC COL 44 + 38 S PARK 20 RC COL 44 + 38 S PARK 20			2		
CAN TERM + - 12 WILLE/PIRK 18 CAN1 15 BULE/PIRK 18 CAN1 15 BULE/PIRK 18 CAN2 + - 17 CAN2 TERM + - 18 SV ETN - 28 FUL/LT GREEN/RED 18 SV ETN - 22 FUL/LT GREEN/RED 18 CRANK + - 21 PURPLE/WITTE 18 CRANK + - 22 FUL/LT GREEN/RED 18 SV EED 226 RED/WITTE 18 SFEED + - 226 RED/WITTE 18 SFEED + - 226 RED/WITTE 18 SPACK COL 14 23 KNOCK1 + - 28 KNOCK1 + - 28 KNOCK2 + - 29 KNOCK2 + - 20 KNOCK2 + - 29 KNOCK2 + - 20 KNOCK2 + - 20			-		
CAN1 + → 13 ELLE/WINTE 18 CAN2 - → 13 CAN2 + → 17 CAN2 TERM + → 19 SV EXT 1 22 ELL/LT GREEN 18 SV EXT 22 CRANK + → 22 KNOCK1 + → 22 KNOCK2 + → 30 SPEED + → 22 KNOCK2 + → 31 SPARK COL 18 → 32 SPARK COL 18 → 33 SPARK COL 28 → 34 SPARK COL 28 → 35 SPARK COL 28 → 35 SPARK COL 28 → 35 SPARK COL 48 → 36 SPARK COL 48 → 37 SPARK COL 48 → 38 SPARK COL 48 → 39 VELLOW 18 SPARK COL 48 → 39 SPARK COL 48 → 39 SPARK COL 48 → 39 SPARK COL 48 → 30 SPARK COL 48 →					
CAN1			25		
CAN2 + → 17 CAN2 TERM + → 19 SV EXT 1 → 19 CRANK + → 22 RELX/LT CREEN 18 SV EXT 1 → 22 RELX/LT CREEN 18 CRANK + → 22 RED/URPLE 18 CRANK + → 22 WHTE/PURPLE 18 CRAVE + → 22 RED/WHTE 18 SPEED + → 22 RED/WHTE 18 SPEED + → 22 RED/WHTE 18 SPEED + → 22 RED/WHTE 18 SPARK COLL 18 → 32 SPARK COLL 18 → 33 SPARK COLL 18 → 33 SPARK COLL 28 → 33 SPARK COLL 48 → 34 SPARK COLL 48 → 34 SPARK COLL 48 → 36 SPARK COLL 48 → 37 SPARK COLL 48 → 36 SPARK COLL 48 → 36 SPARK COLL 48 → 37 SPARK COLL 48 → 37 SPARK COLL 48 → 36 SPARK 20 → 27 SPARK COLL 48 → 37 SPARK COLL 48 → 38 SPARK 18 SPARK 19 SPARK 18 SPARK 18 SPARK 19 SPARK 19 SPARK 18 SPARK 19 SPARK 19 SPARK 18 SPARK 18 SPA			~~		BLUE/WHITE 18
CAN2 1 → 19 CAN2 TERM + 19 SV FTN - 20 FULL CREEN/RED 18 SV FTN - 22 FULL CREEN 18 CRANK + 21 CRANK + 22 CRANK + 22 FULL CREEN 18 SFEED + 22 KNOCK + 22 KNOCK + 22 KNOCK + 22 KNOCK + 22 KNOCK + 22 SPARK COLL 18 SFARK COLL 18 SFARK COLL 28 SPARK			<>		
CAN2 TERM + SV EXT 1 SV EXT 1 CRANK + 21 PURPLEVITE 18 CRANK + 22 RURPLEYURPLE 18 CRANK + 22 WHTE/PURPLE 18 CRAVE + 22 CAM + 22 WHTE/PURPLE 18 CAM + 22 MURPLEYURANDE 18 CAM + 22 RED/BLACK 18 SFEED + 26 RED/BLACK 18 SFEED + 26 RED/BLACK 18 SFEED + 27 KNOCK1 + 28 KNOCK2 + 39 KNOCK2 + 39 KNOCK2 + 39 SPARK COLL 18 - 31 SPARK COLL 28 - 33 SPARK COLL 28 - 34 SPARK COLL 48 - 37 SPARK COLL 48 - 37 SPARK COLL 48 - 37 SPARK COLL 48 - 36 SPARK COLL 48 - 36 COV1 - 51 COV1 - 51 RUE 28 - 62 NU3 LS - 66 NU3 LS - 67 NU3 LS - 66 NU3 LS - 66 NU3 LS - 66 NU3 LS - 66 NU3 LS - 67 NU3 LS - 66 NU3 LS - 67 NU3			<>		
9V EVT 1         > 13         EL GREEV/RED 18           SV RTN         -22         ELV/LT GREEV/RED 18           CRANK +         > 22         PURPLE/WHITE 18           CRANK +         > 22         RED/WHITE 18           CAM +         > 22         RED/WHITE 18           CAM +         > 22         RED/WHITE 18           SPEED +         > 22         RED/WHITE 18           SPEED +         > 22         RED/WHITE 18           SPARK COLL 18         > 33           SPARK COLL 28         > 33           SPARK COLL 28         > 33           SPARK COLL 28         > 33           SPARK COLL 48         > 34           AUX DIG 1         42           AUX DIG 2         44           AUX DIG 3         45           PC TX         54           AUX DIG 3         45           AUX ANA PU2         47			<		
SV RTN         22         PLACL Latters 10           CRANK         22         WHTE/PURPLE 18           CRANK         22         RED/BLACK 18           CAM         22         RED/BLACK 18           SPEED         22         RED/BLACK 18           SPEED         22         RED/BLACK 18           SPEED         22         RED/BLACK 18           SPARK COLL 14         23         SPARK COLL 24           SPARK COLL 24         33         SPARK COLL 24           SPARK COLL 24         33         SPARK COLL 24           SPARK COLL 24         33           SPARK COLL 24         36           SPARK COLL 24         37           SPARK COLL 44         38           AUX DIG 1         40           AUX DIG 2         41           AUX DIG 3         44           AUX DIG 4         48           GOV1         51 </th <th></th> <th></th> <th>&gt;</th> <th></th> <th></th>			>		
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	5	SV RTN	<		
CHARK - 23 GRAY/BROWN 18 CAM + 26 BED/WHITE 18 SPEED + 26 RED/BLACK 18 SPEED + 26 RED/BLACK 18 KNOCK1 + 27 KNOCK1 + 27 KNOCK2 + 29 KNOCK2 + 29 KNOCK2 + 29 KNOCK2 + 33 SPARK COLL 28 - 33 SPARK COLL 28 - 35 SPARK COLL 38 - 36 SPARK COLL 48 - 37 SPARK 20 - 37 SPARK 20 - 78 SPARK 20	CR	ANK +	<		
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	CR	ANK -	$\leq >$		
CHM         25         RED/WHITE 18           SPEED         26         RED/BLACK 16           SPEED         27           KNOCK1         28           KNOCK2         29           KNOCK2         30           SPARK COLL 1A         31           SPARK COLL 2B         33           SPARK COLL 2B         35           SPARK COLL 4B         38           SPARK COLL 4B         39           YELLOW/ORAY 1B         11           ECT         40           AUX DIG 1         42           AUX DIG 2         44           AUX ANA PU2         41           AUX ANA PU2         41           AUX ANA PU2         41           AUX ANA PU2         41           GOV2         52         LT GREPN/PURPLE 18           (FPP2 ONLY) 5V EVT 2         55         DK GREPN 18           GOV2         52         LT GREPN/PURPLE 18      <		CAM +	<		
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		CAM -	$\leq >$		
SPELD         27           KNOCK1 +         28           KNOCK2 +         29           KNOCK2 +         29           KNOCK2 +         29           SPARK COLL 1A         31           SPARK COLL 2B         34           SPARK COLL 2B         35           SPARK COLL 2B         35           SPARK COLL 2B         35           SPARK COLL 2B         37           SPARK COLL 2B         37           SPARK COLL 2B         37           SPARK COLL 4B         38           AUX DIG 1         42           AUX DIG 2         41           AUX ANA PU1         46           VSW         45           AUX ANA PU3         48           SV RT         50           GOV1         52           GOV1         52           GOV1         52           GOV1         52           GOV2	SP	EED +	<		
NNOCK1 +       28         KNOCK2 +       39         SPARK COLL 1A       31         SPARK COLL 2B       33         SPARK COLL 2A       33         SPARK COLL 2A       35         SPARK COLL 2A       35         SPARK COLL 3A       36         SPARK COLL 4A       37         SPARK COLL 4A       38         SPARK COLL 4A       39         YELLOW 1A       SPARK COLL 4A	SP	EED -	$\leq >$		NEW/BEAUN 10
KNOCK1			<		
KNOCK2 T         38           KNOCK2 T         31           SPARK COLL 1A         32           SPARK COLL 2B         33           SPARK COLL 2B         35           SPARK COLL 3B         36           SPARK COLL 4A         38           SPARK COLL 4A         39           YELLOW/GRAY 18         41           AUX DIG 1         42           AUX DIG 2         44           AUX ANA PU1         46           COVI         51           GOV2         52           SP REVENUE         54           COVI         51           GOV2         52           SI IT BLUE 18           COVI         54           PC TX         56           SPARK COLL 55           SIARTER	KNO	СК1 —	$\leq >$		
SPARK COLL 1A         S1         YELLOW 18           SPARK COLL 18         32           SPARK COLL 2A         33           SPARK COLL 2B         34           SPARK COLL 3B         35           SPARK COLL 3B         37           SPARK COLL 4B         39           YELLOW/GRAY 18         44           AUX DIG 1         43           AUX DIG 2         44           AUX DIG 3         45           AUX DIG 4         45           AUX DIG 51         43           AUX ANA PU1         46           AUX ANA PU2         47           AUX ANA PU2         47           AUX ANA PU2         47           AUX ANA PU2         48           (FRT) AUX ANA PU2         48           (FRP) AUX ANA PU2         48           (FRP) AUX ANA PU2         48           (FRP) AUX ANA PU01         55           SV RTN         52           OIL PRESS         54           (FRP) AUX ANA PU01         55           NJ LS         61           NJ LS         62           NJ LS         62           NJ LS         62           NJ LS			<		
SPARK COLL 18         32           SPARK COLL 28         33           SPARK COLL 28         34           SPARK COLL 38         35           SPARK COLL 38         36           SPARK COLL 48         39           YELLOW/GRAY 18         41           AUX DIG 1         42           AUX DIG 2         43           AUX DIG 3         45           YSW         46           AUX DIG 3         44           AUX ANA PU2         47           (FRT) AUX ANA PU2         49         LT GREEN/PURPLE 18           (FPP2 ONLY) 5V EXT 2         50         LT GREEN/PURPLE 18           GOV1         51         GOV2         52           GOV2         53         LT BLUE 18           OLL PRESS         53         LT BLUE 18           VBAT PROT         58         GRANGE 18           YEAT PROT         58         RED/TAN 16           NU1 LS         61         INJ1 LS           NU2 LS         62         INJ1 LS           NU3 LS         63         INJ1 LS           RELAY         71         WHTE/LT BLUE 18           INJ1 LS         66           INJ2 LS			<>		YELLOW 18
SPARK COLL 2A         33           SPARK COLL 2A         35           SPARK COLL 3A         35           SPARK COLL 3B         36           SPARK COLL 4B         37           SPARK COLL 4B         39           YELLOW/GRAY 18           LT         40           AUX DIG 1         42           AUX DIG 2         43           AUX DIG 2         44           AUX ANA PU1         46           AUX ANA PU2         47           (FRT) AUX ANA PU2         48           (FRT) AUX ANA PU2         50           SV RTN         51           GOV1         51           GOV1         55           MAR ANA PU0           PC RX         56           ALT EXCITE         57           TACH         58           VBAT PROT         59           VBAT PROT         68           INJ3 LS         63			>		
SPARK COLL 28         33           SPARK COLL 38         33           SPARK COLL 38         36           SPARK COLL 48         37           SPARK COLL 48         39           YELLOW/GRAY 18         41           AUX DIG 1         42           AUX DIG 2         44           AUX DIG 3         45           YSW         46           AUX ANA PU1         46           AUX ANA PU2         47           AUX ANA PU2         47           AUX ANA PU1         48           CRT AUX ANA PU2         47           AUX ANA PU2         47           AUX ANA PU2         47           AUX ANA PU2         47           GRV1         51           GOV1         51           GOV1         51           GOV1         55           DK GREEN 18           PC TX         56           ALT EXCITE         57           TACH         59           VBAT FROT         58           INJ3 LS         63           INJ2 LS         62           INJ2 LS         63           INJ2 LS         64					
SPARK COIL 2A         36           SPARK COIL 3B         36           SPARK COIL 4A         37           SPARK COIL 4B         38           SPARK COIL 4A         37           SPARK COIL 4B         38           SPARK COIL 4A         38           AUX DIG 1         42           AUX DIG 2         43           AUX ANA PU3         45           FIT ALX ANA PU3         46           COVI 5V EXT 2         50					
SPARK COIL 3A         38           SPARK COIL 3B         39           YELLOW/GRAY 18         141           LAT         49           ECT         41           AUX DIG 1         42           AUX DIG 2         43           AUX DIG 3         44           AUX DIG 3         44           AUX DIG 3         44           AUX DIG 3         44           AUX ANA PU1         45           AUX ANA PU2         47           AUX ANA PU3         48           (FPP2 ONLY) SV EXT 2         50           GOV1         51           GOV1         52           OIL PRESS         53           LT BLUE 18           (FRP) AUX ANA PU0         55           DK GREEN 18           PC TX         56           ALT EXCITE         57           TACH         58           NUA IS S         66           INJ3 LS         68           RECACK 16					
SPARK COL 4A         38           SPARK COL 4B         38           JAT         40           LT         40           AUX DIG 1         42           AUX DIG 2         43           AUX DIG 3         44           AUX DIG 3         45           PINK/TAN 18         VSW           VSW         46           AUX ANA PU3         47           AUX ANA PU3         48           (FPP2 ONL') SV EXT 2         58           SV RTN         58           SV RTN         58           SV RTN         59           SV RTN         55           SV RTN         56           OIL PRESS         53           LT BLUE 18         11           GOV1         55           VBAT         66           INJ3 LS         65           INJ3 LS         65           INJ3 LS         66           INJ3 LS         66           INJ3 LS	SPARK C	OIL 3A	>		
SPARK COIL 44 SPARK COIL 44 39 40 40 40 40 40 40 40 40 40 40					
SPARK COLL 48         39         YELLOW/GRAY 18           ECT         40         TAV/WHITE 18           ECT         41           AUX DIG 1         42           AUX DIG 2         43           AUX DIG 3         44           VSW         45           PINK/TAN 18           VSW         45           AUX ANA PU1         47           (FRT) AUX ANA PU2         48           (FRT) AUX ANA PU3         48           (FRT) AUX ANA PU3         48           (FRP) AUX ANA PU3         50           GOV1         51           GOV2         52           UI PRESS         53           UT BLUE 18           OIL PRESS         54           PC RX         58           ORANGE 18           PC RX         58           ORANGE 18           PC RX         58           VBAT         62           INJ1 LS         66           INJ2 LS         66           INJ3 LS         66           INJ3 LS         67           INJ3 LS         66           INJ3 LS         67           INJ3 LS					
IAI         40         TAN/WHITE 18           ECT         41           AUX DIG 1         42           AUX DIG 2         43           AUX DIG 3         44           AUX DIG 3         44           AUX DIG 4         43           AUX ANA PU1         46           AUX ANA PU1         47           AUX ANA PU2         47           AUX ANA PU3         48           (FRT) AUX ANA PU3         54           GOV1         52           GOV2         52           OIL PRESS         53           LT BLUE 18           (FRP) AUX ANA PU3           GOV2         52           OIL PRESS         55           OIL PRESS           GOV2         52           OIL PRESS         56           ALT EXCITE         57           TACH         58           PC RX         56           NUX ANA PU3         61           INJ1 LS         62           INJ2 LS         63           INJ3 LS         64           INJ3 LS         65           INJ3 LS         67           INJ3 LS         67 </th <th>SPARK C</th> <th></th> <th>&gt;</th> <th></th> <th>YELLOW/ORAY 18</th>	SPARK C		>		YELLOW/ORAY 18
LC31         41           AUX DIG 1         42           AUX DIG 2         43           AUX DIG 3         45           PINK/TAN 18         VSW           AUX ANA PU1         46           AUX ANA PU2         48           (FRT) AUX ANA PU3         48           (FRT) AUX ANA PU3         48           (FRP2 ONLY) SV EXT 2         50           GOV1         51           GOV1         51           GOV1         51           GOV1         51           GOV1         51           GOV1         51           GOV2         53           LT BLUE 18           (FRP) AUX ANA PU3           GOV2         53           LT EXCITE           S8           YBAT PROT           YBAT PROT           S9           YBAT PROT           YBAT           HNJ LS           GROUND           YBAT           HIV2 LS           GC2           HNJ LS           GROUND           S1AS           GROUND           S1AS           EGOH 1 <td></td> <td></td> <td>&lt;</td> <td></td> <td></td>			<		
List         42           AUX DIG 1         43           AUX DIG 3         45           AUX DIG 3         45           AUX ANA PU1         46           AUX ANA PU1         47           AUX ANA PU2         48           (FRT) AUX ANA PU3         49           AUX ANA PU3         48           (FRT) AUX ANA PU3         49           SV RTN         50           GOV1         51           GOV2         53           LT GREEN/PURPLE 18           (FRP) AUX ANA PU3           SV RTN           GOV1         51           GOV1         51           GOV2         53           LT BLUE 18           (FRP) AUX ANA PU3           PC RX         56           PC RX         58           PC RX         58           VBAT PROT         59           RELAY         56           INJ3 LS         62           INJ3 LS			<	_	1210 BUILT 10
AUX DIG 1 AUX DIG 2 AUX ANA PU2 AUX ANA PU3 AUX ANA PU3 CFRP AUX ANA PU3 AUX ANA PU3 CFRP AUX ANA PU3 AUX EXCITE STARTER AUX EXCITE STARTER AUX ANA PU3 AUX ANA AUX PU3 AUX ANA PU3 AUX PWA3 AUX PWA4 AUX PWA5 AUX PWA5 AUX PWA5 AUX PWA4 AUX PWA4 AUX PWA4 AUX PWA4 AUX PWA4 AUX PWA4 AUX PWA4 AUX PWA5 AUX PWA5 AUX PWA5 AUX PWA5 AUX PWA4 AUX PWA4 AUX PWA4 AUX PWA4 AUX PWA4 AUX PWA4 AUX PWA4 AUX PWA4 AUX PW44 AUX PW44 AUX PW44 AUX PW44 AUX PU44 AUX PU44			<		
AUX DIG 2 AUX DIG 3 VSW AUX ANA PU3 AUX PWA3 AUX PW33 AUX PU3 AUX PU3 AUX PU3 AUX			-		
AUX DIG 3 VSW 46 DK BLUE/YELLOW 18 AUX ANA PU1 AUX ANA PU2 47 (FRT) AUX ANA PU2 48 (FRP) AUX ANA PU2 50 CNV 51 COV1 51 COV1 51 COV1 51 COV1 51 COV1 51 COV1 51 COV1 51 COV1 55 01L PRESS 54 FC RX 55 01L PRESS 54 FC RX 55 ALT EXCITE 57 ALT EXCITE 57 ALT EXCITE 57 ALT EXCITE 57 ALT EXCITE 57 ALT EXCITE 56 INJ1 LS 62 INJ2 LS 66 INJ5 LS 66					
AUX ANA PU1         46         DK BLUE/YELLOW 18           AUX ANA PU2         47           (FRT) AUX ANA PU3         49         LT GREEN/PURPLE 18           (FRT) AUX ANA PU3         49         LT GREEN/PURPLE 18           (FRP) AUX ANA PU3         50         LT GREEN/PURPLE 18           GOV1         51         GOV1         51           GOV1         55         DK GREEN 18         PC TX           PC TX         56         ORANGE 18         PC TX           ALT EXCITE         58         TACH         58           VBAT         76         RED/TAN 16         NU1 LS           VBAT         60         RED/TAN 16         NU3 LS           VBAT         66         RED/TAN 16         NU3 LS           NU3 LS         65         NU3 LS         66           INJ3 LS         66         NU3 LS         66           INJ3 LS         66         REAY         71           WHTE/LT BLUE 18         REAY         71         WHTE/LT BLUE 18           CLOCKOFF) ECOH 4         77         BLACK /VELLOW 18         BUZZER           PWMS RECIRC         79         RED/TAN 16         PMMS           PWMS RECIRC         79 <td< th=""><th>AUX</th><th></th><th>~</th><th></th><th>PINK/TAN 18</th></td<>	AUX		~		PINK/TAN 18
AUX ANA PU2 AUX ANA PU2 47 (FRT) AUX ANA PU3 48 (FPP2 ONLY) 5V EXT 2 50 LT GREEN/PURPLE 18 50 RTN 60V1 51 60V2 52 60L PRESS 54 (FRP) AUX ANA PUD 55 64 FC RX 57 ALT EXCITE 57 ALT EXCITE			5	_	
(FRT) AUX ANA PU3         49         LT GREEN/PURPLE 18           (FPP2 ONLY) 5V EXT 2         50         LT GREEN/BLACK 18           SV RTN         51         GOV1         51           GOV1         51         GOV2         53         LT BLUE 18           OIL PRESS         53         LT BLUE 18         PC RX         56           PC TX         55         DK GREEN 18         PC RX         57           ALT EXCITE         57         ALT EXCITE         57           ALT EXCITE         57         62         RED/TAN 16           VBAT PROT         68         RED/TAN 16         NU3 LS           VBAT         61         INJ3 LS         62           INJ3 LS         63         INJ3 LS         64           INJ5 LS         66         INJ7 LS         68           GRUND         59         BLACK 16         SGRUND           STARTER         70         WHTE/LT BLUE 18         BLACK 16           GRUND         72         SLACK/WHITE 18         BUZZER           EGOH 1         72         BLACK/YELLOW 18         BUZZER           EGOH 2         78         REU/TAN 16         SA           PWM5 RECIRC         78				47	
(FPP2 ÓNLY) 5V EXT 2         49         LI GREEN/BLACK 18           SV RTN         51           GOV1         51           GOV2         52           OIL PRESS         53           OIL PRESS         54           PC TX         55           DK GREEN 18           PC TX         56           ORANGE 18           PC TX         56           OK GREEN 18           PC TX         57           ALT EXCITE         57           ALT EXCITE         58           VBAT         60           NU1 LS         62           INJ3 LS         63           INJ3 LS         64           INJ5 LS         65           INJ5 LS         66           INJ5 LS         66           INJ5 LS         67           INJ5 LS         68           INJ5 LS         67           INJ5 LS         68           INJ5 LS         68           INJ5 LS         78 <t< th=""><th></th><th></th><th>2</th><th>48</th><th></th></t<>			2	48	
5V RTN         38         EL OKLENZ/BLACK 10           GOV1         51           GOV2         52           OIL PRESS         53         LT BLUE 18           (FRP) AUX ANA PUD1         55         DK GREEN 18           PC TX         56         ORANGE 18           PC RX         56         ORANGE 18           VBAT         61         FACH           NU2 LS         62           INU2 LS         63           INU3 LS         64           INU3 LS         65           INU3 LS         66           INU3 LS         67           INU3 LS         68           BLACK 16         GROUND           STARTER         78           BLACK 16         GROUND           CLOCKOFF) ECOH 4         75           WHTE/BLACK 18         BUZZER           PWMS RECIRC         78           RDUTAN 16         80           BW PWMS RECIRC			-	49	LT GREEN/PURPLE 18
GOV1         52           GU PRESS         53           LT BLUE 18           OIL PRESS           PC TX           PC TX           S56           ORANCE 18           PC TX           S56           ALT EXCITE           VBAT PROT           VBAT PROT           VBAT           REVAT           GROUND           STARTER           RELAY           Z           BUCKOFF           EGOH 1           Z           ST           BUCKOFF           BUA			-	50	LT GREEN/BLACK 18
G0V2         52         LT BLUE 18           OIL PRESS         54           (FRP) AUX ANA PUDI         55         DK GREEN 18           PC TX         56         ORANGE 18           PC RX         57           ALT EXCITE         57           VBAT         59           VBAT PROT         58           VBAT         61           INJ LS         62           INJ LS         63           INJ LS         66           INJ S LS         66           INJ S LS         66           INJ S LS         66           INJ S LS         67           INJ S LS         68           BROUND         78           CLOCKOFF) ECOH 4         71           WHTE/LI BLUE 18         80           BUZZER         77           PWMS         72           SECOND         78           BUZZER         77           PWMS         78           PWMS         78           AUZ PWMS RE				51	
OIL PRESS         S3         CI BLOE 18           (FRP) AUX ANA PUDI         S5         DK GREEN 18           PC RX         S6         ORANGE 18           PC RX         S6         ORANGE 18           ALT EXCITE         S7           TACH         S8           VBAT PROT         68           RED/TAN 16           VBAT         61           INJ2 LS         62           INJ2 LS         63           INJ2 LS         65           INJ3 LS         66           INJ5 LS         66           INJ5 LS         66           INJ5 LS         67           INJ5 LS         68           BLACK 16         GROUND           STARTER         71           WHTE/LT BLUE 18         BEACK 16           GROUND         STARTER           PWMS         73           BLACK 18         BUZZER           PWMS         77           BROWN/WHITE 18           BUZZER         77           PWMS         77           BROWN/WHITE 18           BUZZER         77           PWMS         80           GROUND				52	
(FRP) AUX ANA PUD1         → 55         DK GREEN 18           PC TX         → 56         ORANGE 18           PC RX         → 57           ALT EXCRE         → 57           VBAT PROT         → 60           INJ1 LS         → 61           INJ2 LS         → 63           INJ3 LS         → 64           INJ4 LS         → 64           INJ5 LS         → 66           INJ7 LS         → 67           STARTER         → 70           STARTER         → 70           RELAY         → 71           WHTE/LT BLUE 18         =           EGOH 1         → 73           EGOH 2         → 74           EGOH 3         → 74           EGOH 4         → 75           WHTE/LDW 18         =           BUZZER         → 78           PWMS RECIRC         → 78           PWMS RECIRC         → 78           BUACK 16	01		2		LT BLUE 18
PC TX PC TX PC TX PC TX PC RX PC RX P			$\sim$		
PC RX ALT EXCITE ALT EXCITE TACH 58 VBAT PROT VBAT VBAT PROT VBAT VBAT NUL LS 61 INJ2 LS 62 INJ3 LS 63 INJ4 LS 64 INJ5 LS 66 INJ5 LS 66 INJ5 LS 66 INJ5 LS 66 INJ5 LS 66 INJ5 LS 66 INJ5 LS 67 INJ7 LS 68 INJ6 LS 69 BLACK 16 GROUND 70 81ACK/VHITE 18 EGOH 1 EGOH 2 71 WHTE/LT BLUE 18 8 CLOCKOFF) ECOH 4 77 8LACK/VHITE 18 EGOH 3 75 WHTE/BLACK 18 80 77 80 78 78 78 78 78 78 78 78 78 78	(167) 606 666				
ALT EXCITE TACH VBAT PROT 60 RED/TAN 16 VBAT PROT 61 NU1 LS 62 INU2 LS 63 INU3 LS 64 INU3 LS 65 INU4 LS 66 INU5 LS 66 INU5 LS 66 INU5 LS 67 INU5 LS 68 INU5 LS 69 ILACK 16 CROUND 71 WHTE/LT BLUE 18 RELAY 72 EGOH 1 73 ELACK/YELLOW 18 EGOH 2 74 EGOH 2 77 BROWN/WHITE 18 80 GREEN/YELLOW 18 18 18 29 PWM5 RECIRC 78 PWM5 RECIRC 78 80 GREEN/YELLOW 18 80 GREEN/YELLOW 18 80 GREEN/YELLOW 18 81 BLACK 16 18 78 80 78 80 78 81 80 80 80 81 81 81 81 81 81 81 81 81 81					ORANGE 18
TACH         59           VBAT PROT         60         RED/TAN 16           VBAT         61         INJ1 LS           INJ1 LS         62           INJ3 LS         63           INJ3 LS         64           INJ4 LS         65           INJ5 LS         66           INJ5 LS         66           INJ5 LS         66           INJ5 LS         66           INJ5 LS         68           GROUND         69           STARTER         70           STARTER         71           WHTE/LT BLUE 18         EGOH 1           EGOH 1         72           EGOH 2         74           EGOH 3         75           WHTE/BLACK 18           BUZZER         76           PWMS         77           BROWN/WHITE 16           PWMS         77           BROWN/WHITE 16           PWMS         81           BLACK 16           GROUND         81           BLACK 16           OBW +         83           BUX         84           AUX PWM3         86           AUX PWM3 <th>ALTI</th> <th></th> <th></th> <th></th> <th></th>	ALTI				
VBAT         PROT VBAT         39 (ED/TAN 16)           NU1 LS         60 (NU2 LS         61 (NU2 LS         62 (STARTER)           NU3 LS         63 (NU3 LS         63 (STARTER)         64 (STARTER)           NU3 LS         66 (STARTER)         67 (STARTER)         67 (STARTER)           RELAY         70 (LOCKOFF)         50 (LACK/WHITE 18)           EGOH 1         73 (LOCKOFF)         74 (COCKOFF)           EGOH 3         75 (LOCKOFF)         77 (STARTER)           PWMS         77 (COCKOFF)         80 (STARTER)           PWMS         77 (STARTER)           PWMS         78 (LOCKOFF)           PWMS         77 (STARTER)           PWMS         77 (STARTER)           PWMS         81 (STARTER)           AUX PWM2         89 (STARTER)	201				
VBAT         68         RED/TAN 16           INJ1 LS         62           INJ2 LS         63           INJ3 LS         64           INJ3 LS         65           INJ5 LS         66           INJ6 LS         67           INJ7 LS         68           GROUND         59           STARTER         70           RELAY         71           WHTE/LT BLUE 18           EGOH 1         72           BLACK /VELLOW 18           EGOH 3         75           WHTE/BLACK 18           BUZZER         76           PWMS         77           BROWN/WHITE 16           PWMS RECIRC         78           PWMS RECIRC         78           PWMS RECIRC         78           PWMS RECIRC         78           PWMS RECIRC         81           BUX PWM3         81           AUX PWM3         85           AUX PWM3         86           AUX PWM3         87      <	VBAT		>		DED (TAN) 44
INJ1 LS         62           INJ2 LS         63           INJ3 LS         64           INJ5 LS         65           INJ5 LS         66           INJ5 LS         66           INJ5 LS         66           INJ5 LS         67           INJ7 LS         68           INJ7 LS         67           INJ7 LS         68           GROUND         71           WHTE/LT BLUE 18         80           EGOH 1         73           EGOH 2         76           WMS         77           BUZZER         78           PWMS RECIRC         78           PWMS RECIRC         78           BOW         77           BROWN/WHTE 16           BW         80           GROUND         81           BLACK 16           DBW + <th></th> <th></th> <th>&lt;</th> <th></th> <th>KEU/TAN 16</th>			<		KEU/TAN 16
INJ2 LS         63           INJ3 LS         64           INJ4 LS         65           INJ5 LS         66           INJ7 LS         67           INJ7 LS         68           INJ7 LS         69           EGOH 1         70           RELAY         71           WHTE/LT BLUE 18         EGOH 1           EGOH 2         73           BUZZER         76           PWMS RECIRC         78           PWMS RECIRC         78           REU/TAN 16         80           OROUND         81           BLACK 15         80           GROUND         81           BUZER         78           PWMS RECIRC         78           REU/TAN 16         80           BW - FUMP         81           BLACK 15         81           BUZEN         82           PINK/WHITE 18         81           AUX PWM3<	"		<		
INJ3 LS         64           INJ4 LS         65           INJ5 LS         66           INJ5 LS         66           INJ5 LS         67           INJ6 LS         69           BLACK 16         GROUND           STARTER         71           WHTE/LT BLUE 18         BLACK 16           STARTER         71           WHTE/LT BLUE 18         BLACK 16           COOH 1         72           BLACK 78         74           EGOH 3         75           WHTE/BLACK 18         BUZZER           PWMS <recirc< td="">         77           BUZZER         77           BROWN/WHITE 16         BUZZER           PWMS<recirc< td="">         79           RED/TAN 16         80           GROUND         81           BLACK 15         BUW 1           BW -         83           FUMP         85           AUX PWM3         86           AUX PWM3         87           AUX PWM4         89           AUX PWM4         89</recirc<></recirc<>			<		
INJ4 LS         65           INJ5 LS         66           INJ5 LS         66           INJ5 LS         67           INJ7 LS         68           INJ8 LS         69           GROUND         78           STARTER         71           WHTE/LT BLUE 18         80           EGOH 1         73           EGOH 2         74           EGOH 3         76           BUZZER         77           BUX PWM5         78           PWM5 RECIRC         78           RECINC         78           BUW         78           BUW         78           BUW         80           GROUND         81           BLACK 16           GROUND         82           BW         83           BW         83           BW         84           BW         85           AUX PWM3			<		
INJ5 LS         66           INJ5 LS         67           INJ7 LS         68           GROUND         69           STARTER         70           RELAY         71           WHTE/LT BLUE 18         EGOH 1           RELAY         72           STARTER         71           WHTE/LT BLUE 18         EGOH 1           EGOH 1         73           BLACK/WHITE 18         EGOH 2           EGOH 2         74           EGOH 3         75           WHTE/BLACK 18           BUZZER         76           PWMS         77           BROWN/WHITE 16           PWMS         77           BOUZER         78           PWMS RECIRC         78           RECINC         78           BLACK 16         0           GROUND         80           DBW +         80           BLACK 16         0           GROUND         81           BLACK 16         0           AUX PWM3         82           PINK/WHITE 18           AUX PWM3         86           AUX PWM3         87			<		
INJO LS         67           INJO LS         68           INJO LS         68           GROUND         69           STARTER         70           RELAY         71           WHTE/LT BLUE 18         EGOH 1           FEGOH 1         73           EGOH 2         74           EGOH 3         75           WHTE/LT BLUE 18           EGOH 4         75           WMS         77           BUZZER         76           PWMS         77           BUZZER         78           PWMS         77           BUZZER         78           PWMS         77           BOW/THE 16         90           PWMS         77           BED/TAN 16         90           VBAT         80           GROUND         81           BLACK 16         90           DBW +         83           BA         74           BUZ         90           BUM         85           AUX PWM3         86           AUX PWM3         87           AUX PWM4         89           BUX PWM4			<		
INJ7 LS         68           INJ8 LS         69         BLACK 16           GROUND         70           STARTER         71         WHTE/LT BLUE 18           EGOH 1         72         SLACK/WHITE 18           EGOH 2         73         BLACK/YELLOW 18           EGOH 3         75         WHTE/BLACK 18           EGOH 4         75         WHTE/BLACK 18           BUZZER         76         PWMS           PWM5         77         BROWN/WHITE 16           PWM5         77         BROWN/WHITE 16           PWM5         79         RED/TAN 16           VBAT         80         GREEN/YELLOW 18           ML         81         BLACK 16           OBW +         83         TAN/ORANGE 18           PUMP         84         AUX PWM3           AUX PWM3         86         AUX PWM3           AUX PWM3         87         TAN 18           AUX PWM3         89         PINK/BLACK 18			<		
INVE LS         69         BLACK 16           GROUND         76           STARTER         71         WHTE/LT BLUE 18           RELAY         72         SLACK/WHITE 18           EGOH 1         73         BLACK/YELLOW 18           EGOH 2         73         BLACK 18           EGOH 3         75         WHTE/BLACK 18           EGOH 4         75         WHTE/BLACK 18           BUZZER         76         PWMS           PWMS         77         BROWN/WHITE 16           PWMS         77         BROWN/WHITE 16           PWMS         79         RED/TAN 16           VBAT         80         GREEN/YELLOW 18           MIL         81         BLACK 16           DBW +         82         PINK/WHITE 18           DBW +         83         TAN/ORANGE 18           PUMP         84         AUX PWM3           AUX PWM3         86         AUX PWM3           AUX PWM3         87         TAN 18           AUX PWM4         89         PINK/BLACK 18		NJ7 LS	<		
GROUND 70 STARTER 71 WHTE/LT BLUE 18 RELAY 71 WHTE/LT BLUE 18 RELAY 72 BLACK/WHTE 18 EGOH 1 73 BLACK/YELLOW 18 EGOH 2 74 EGOH 3 75 WHTE/BLACK 18 OUZER 77 PWM5 RECIRC 78 PWM5 RECIRC 78 AUX PWM3 RECIRC 86 AUX PWM3 RECIRC 85 AUX PWM3 87 TAN 18 AUX PWM4 88 DK BLUE 18 AUX PWM4 99 PINK/BLACK 18			<		FLACK 16
STARTER RELAY RELAY 22 SLACK/WHITE 18 EGOH 1 23 SLACK/YELLOW 18 EGOH 2 24 73 BLACK/YELLOW 18 EGOH 3 75 WHTE/BLACK 18 BUZZER 77 BROWN/WHITE 16 PWMS PWMS RECIRC 78 PWMS RECIRC 78 PWMS RECIRC 78 PWMS RECIRC 78 PWMS RECIRC 78 PWMS RECIRC 78 PWMS 80 GREEN/YELLOW 18 ML 31 BLACK 15 BW - 78 84 AUX PWM3 85 AUX PWM3 85 AUX PWM3 87 TAN 18 AUX PWM3 80 DK BLUE 18 AUX PWM4 89 PINK/BLACK 18 9 89 PINK/BLACK 18 89 PINK/BLACK 18 89 PINK/BLACK 18 80 STARTER) AUX PWM2 89 PINK/BLACK 18 9 80 STARTER 80 STARTER 81 STA					
KELAT         72         ELACK/WHITE 18           EGOH 1         73         BLACK/YELLOW 18           EGOH 2         74         EGOH 3           EGOH 3         75         WHTE/BLACK 18           BUZZER         76         BROWN/WHITE 16           PWMS         77         BROWN/WHITE 16           PWMS         78         RED/TAN 16           PWMS RECIRC         79         RED/TAN 16           PWMS RECIRC         78         RED/TAN 16           PWMS RECIRC         78         RED/TAN 16           PWMS RECIRC         78         RED/TAN 16           PWMS RECIRC         80         GREEN/YELLOW 18           MIL         88         GREEN/YELLOW 18           MIL         81         BLACK 16           GROUND         82         PINK/WHITE 18           DBW -         83         TAN/ORANGE 18           DBW -         85         AUX PWM3           AUX PWM3         87         TAN 18           AUX PWM2         89         PINK/BLACK 18           QSTARTER)         AUX PWM2         89	ST		>		WHITE/LT BLUE 18
EGOH 1 73 BLACK.YELLOW 18 EGOH 3 74 EGOH 3 75 WHTE/BLACK 18 BUZZER 76 PWM5 RECIRC 79 RED/TAN 16 VBAT 80 GREEN/YELLOW 18 MIL 81 BLACK 16 OBW + DBW + DBW + DBW + DBW + AUX PWM3 RECIRC 85 AUX PWM4 99 STATISTIC 75 STATISTIC 75			>		
EGOH 2         74           EGOH 3         75         WHTE/BLACK 18           BUZZER         76           PWMS         77         BROWN/WHITE 16           PWMS         77         BROWN/WHITE 16           PWMS         77         RED/TAN 16           VBAT         80         GREEN/YELLOW 18           ML         81         BLACK 16           OBW +         83         TAN/ORANGE 18           PUMP         84           AUX PWM3         86           AUX PWM3         87           AUX PWM3         87           AUX PWM4         89           PINK/BLACK 18			2		
LOCKOFF)         EGOH 3         75         WHTE/BLACK 18           BUZZER         76         9000000000000000000000000000000000000			2		
(LUCKOFF) ECOR 4         76           BUZZER         77           BROWN/WHITE 16           PWM5           RECIRC           PUW           PUM9           83           PUM9           84           AUX PWM3           BECIRC           AUX PWM4           BE           BE <tr< th=""><th></th><th></th><th>&lt;</th><th></th><th>WHITE/BLACK 18</th></tr<>			<		WHITE/BLACK 18
BOZZDK         77         BROWN/WHITE 16           PWM5         RECIRC         78           VBAT         79         RED/TAN 16           VBAT         80         GREEN/YELLOW 18           ML         81         BLACK 16           OBW +         83         TAN/ORANGE 18           DBW +         83         TAN/ORANGE 18           PUMP         84           AUX PWM3         86           AUX PWM3         87           AUX PWM4         88           AUX PWM4         89           PINK/BLACK 18           (STARTER)         AUX PWM2			<		
PWM5 RECIRC VBAT VBAT VBAT VBAT WBAT BIACK 16 GROUND DBW + DBW - S3 TAN/ORANGE 18 DBW + VBAT AUX PWM3 RECIRC AUX PWM3 86 AUX PWM3 86 AUX PWM3 87 TAN 18 AUX PWM4 88 AUX P	8		<		BROWN/WHITE 16
PWMS RECIRC         79         RED/TAN 16           VBAT         80         GREEN/YELLOW 18           MIL         81         BLACK 16           GROUND         82         PINK/MHTE 18           DBW +         83         TAN/ORANGE 18           DBW +         84         85           AUX PWM3 RECIRC         85           AUX PWM3         87         TAN 18           AUX PWM1         88         DK BLUE 18           AUX PWM2         89         PINK/BLACK 18           (STARTER)         AUX PWM2         99			2		
VBAI         380         GREEN/YELLOW 18           MIL         81         BLACK 15           GROUND         82         PINK/WHITE 18           DBW +         83         TAN/ORANGE 18           DBW -         84         84           AUX PWM3 RECIRC         85           AUX PWM3 RECIRC         85           AUX PWM3         87           AUX PWM4         88           AUX PWM4         89           AUX PWM4         99           PINK/BLACK 18	PWM5 F		2		RED/TAN 16
ML         81         BLACK 16           GROUND         82         PINK/WHITE 18           DBW +         83         TAN/ORANGE 18           FPUMP         84           AUX PWM3         86           AUX PWM3         87           AUX PWM3         87           AUX PWM4         88           AUX PWM4         89           AUX PWM4         89           AUX PWM4         99			2		
GROUND DBW + 2 82 PINK/WHITE 18 DBW + 2 83 TAN/ORANGE 18 PPUMP AUX PWM3 RECIRC 85 AUX PWM3 86 AUX PWM3 87 TAN 18 AUX PWM3 87 TAN 18 AUX PWM3 88 DK BLUE 18 AUX PWM4 89 PINK/BLACK 18 98			-		
DBW + 25 83 TAN/ORANGE 18 DBW - 84 FPUMP 84 AUX PWM3 RECIRC 85 AUX PWM3 86 AUX PWM3 87 TAN 18 AUX PWM1 88 DK BLUE 18 AUX PWM2 89 PINK/BLACK 18 QC 200 PINK/BLACK 18			22		
AUX PWM3 RECIRC AUX PWM3 RECIRC AUX PWM3 AUX PWM3 AUX PWM4 AUX PWM4 AUX PWM4 AUX PWM4 AUX PWM4 AUX PWM4 AUX PWM4 B8 DK BLUE 18 AUX PWM4 B9 PINK/BLACK 18			25		
AUX PWM3 RECIRC 85 AUX PWM3 86 AUX PWM3 87 TAN 18 AUX PWM1 88 DK BLUE 18 AUX PWM2 89 PINK/BLACK 18 (STARTER) AUX PWM4 99					
AUX PWM3 - 87 TAN 18 AUX PWM1 - 88 DK BLUE 18 AUX PWM2 - 88 DK BLUE 18 AUX PWM2 - 89 PINK/BLACK 18 (STARTER) AUX PWM4 - 99			1		
AUX PWM3 87 TAN 18 AUX PWM1 88 DK BLUE 18 AUX PWM2 89 PINK/BLACK 18 (STARTER) AUX PWM4 99			2	86	
AUX PWM1 88 DK BLUE 18 AUX PWM2 89 PINK/BLACK 18 (STARTER) AUX PWM4 90					TAN 18
(STARTER) AUX PWM4 S 89 PINK/BLACK 18			<	88	DK BLUE 18
			<	89	PINK/BLACK 18
			1	90	
		Colleg	-		

# 4.3L Gasoline

	EG01	<	1	DK GREEN/ORANGE 18
FCI	EG02	<	2	DK GREEN/WHITE 18
211 PC 98 25 6889 CONNECTOR 211 A 98 6887 LOCKING CAN	EG03 EG04		ă.	
211 A SE BB28 COVER	TPS1		5	PURPLE/LT BLUE 18
211 CC 25 1468 TERMINAL (COLD)	TPS2	<	5	LT BLUE/DK BLUE 18 LT GREEN 18
	MAP	5	8	ORANGE/YELLOW 18
AUX A	NA PD1 FPP1	2	9	DK BLUE/ORANGE 18
F	PP2 IVS	<	10	PURPLE/YELLOW 18
	A PUD2		11	
	ia pud3 Term +		13	WHITE/ORANGE 18
	CAN1 +		14	BLUE/PINK 18
	CAN1 -	$\sim$	15	BLUE/WHITE 18
	CAN2-	~~	17	
	CAN2 + TERM +	ž	18	
	VEXT 1	>	19 20	LT GREEN/RED 18 BLK/LT GREEN 18
	5V RTN		21	PURPLE/WHITE 18
	RANK + RANK -		22	WHITE/PURPLE 18
, °	CAM +		23 24	GRAY/BROWN 18 PURPLE/ORANGE 18
	CAM -	$\leq >$	25	RED/WHITE 18
	PEED + PEED -	25	26	RED/BLACK 18
	OCK1 +	<~	27	
	OCK1 -		28	
	ОСК2 + ОСК2 -	5.	38	
	COIL 1A	2	31	YELLOW 18
SPARK	COIL 1B	>	32 33	
	COIL 2A		34	
	COIL 2B COIL 3A		35	
	COIL 3B		36	
	COIL 4A		38	
SPARK	COIL 4B		39	YELLOW/GRAY 18
	ECT		40	TAN/WHITE 18
	EGT		42	
	X DIG 1 X DIG 2		43	TAN/RED 18
	X DIG 3		44	TAN/DK GREEN 18
	VSW		46	PINK/TAN 18 DK BLUE/YELLOW 18
	NA PU1 NA PU2		47	YELLOW/DK BLUE 18
(FRT) AUX A			48	LT GREEN/WHITE 18
(FPP2 ONLY) 5			50	LT GREEN/BLACK 18
	5V RTN GOV1		51	GRAY/DK BLUE 18
	GOV2		52 53	GRAY/RED 18 LT BLUE 18
	PRESS		54	WHITE/LT GREEN 18
(FRP) AUX AN	PC TX		55	DK GREEN 18
	PC RX		56 57	ORANGE 18
ALT	EXCILE		58	GRAY 18
VBA	TACH AT PROT		59	
	VBAT		60	RED/TAN 16 TAN/LT BLUE 18
	INJ1 LS		62	GRAY/YELLOW 18
	INJ2 LS INJ3 LS		63	TAN/BROWN 18
	INJ4 LS	<	64 65	GRAY/WHITE 18 TAN/YELLOW 18
	INJ5 LS		66	GRAY/ORANGE 18
	INJ6 LS INJ7 LS		67	
	NJ8 LS	<	-68 69	BLACK 16
	ROUND		70	MEAND IN
2	RELAY		71	WHITE/LT BLUE 18
	EGOH 1		72	BLACK/WHITE 18 BLACK/YELLOW 18
	EGOH 2		74	SCHORT IELLOW 18
(LOCKOFF)	EGOH 3 EGOH 4		75	
· · · · · · · · · · · · · · · · · · ·	BUZZER		76	BROWN/WHITE 16
provide and	PWM5		78	WHITE/BROWN 16
PWM5	RECIRC VBAT		79	RED/TAN 16
	MIL		80	GREEN/YELLOW 18
(	GROUND	<	82	BLACK 16 PINK/WHITE 18
	DBW +		83	TAN/ORANGE 18
	FPUMP		84	TAN/BLACK 18
AUX PWM3	RECIRC	<	85 86	PINK/YELLOW 16 BLACK/RED 16
	X PWM3		87	TAN 18
	X PWM1 X PWM2		88	DK BLUE 18
(STARTER) AU	X PWM4	>	89 90	PINK/BLACK 18
AUX PWM4	RECIRC	<		

# **Diagnostic Scan Tool (DST)**

#### CONTENTS

- Installation of the DST package to a personal computer (PC).
- Software login and password functionality.
- DST service pages.
- Updating the ECM calibration using a MOT file.
- DTC pages.

Examples and snapshots used in this manual are based off of the initial DST tool release as of July, 2007. This tool is frequently updated and the illustrations may vary depending on the changes included in any updated DST display Interface. For example, the Electronic Pressure Regulator (EPR) may be referred to as the "megajector." Terms, names and descriptions of parts and servicing procedures will be updated based on trade, brand, or common description to more accurately describe the part or service procedure.

#### **DST INSTALLATION INSTRUCTIONS**

Before installing the DST software, please be sure your computer meets the minimum system requirements.

Supported operating systems are:

- Windows Vista
- Windows XP
- Windows 2000

Minimum processor speed:

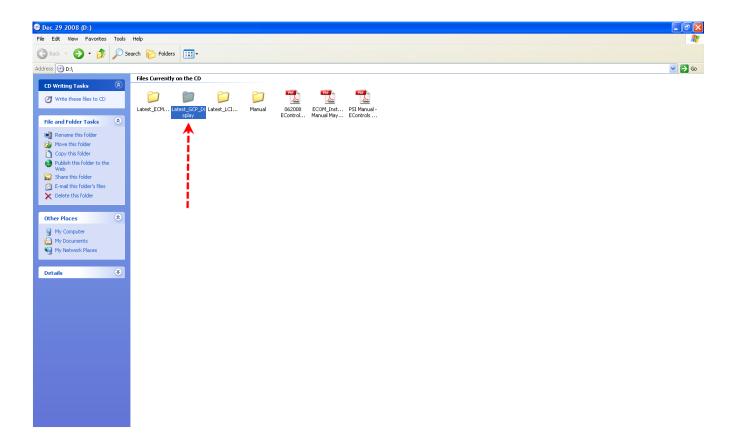
- Pentium II 450 MHz
- Pentium III 1.0 GHz for Windows Vista

Minimum RAM requirement:

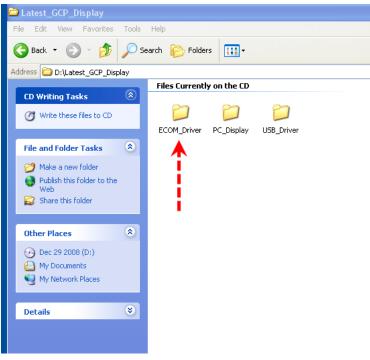
- Windows Vista 512 MB
- Windows XP 256 MB
- Windows 2000 128 MB

\* At least one available RS232 serial or USB port.

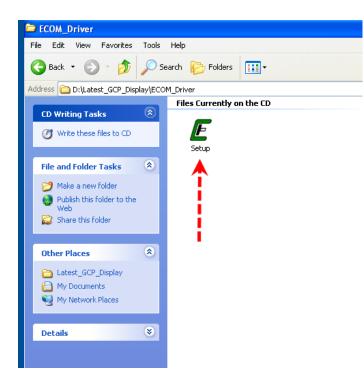
\* ECOM cable supports USB port only.



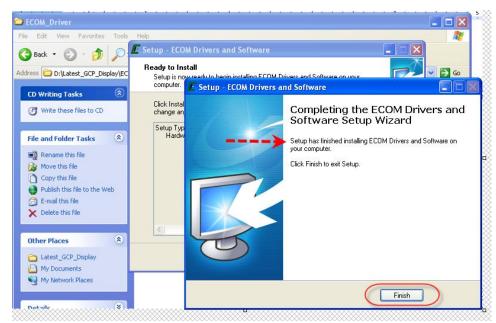
Insert the CD into your computer and select LATEST\_GCP\_DISPLAY



• Open the **ECOM\_Driver** Folder

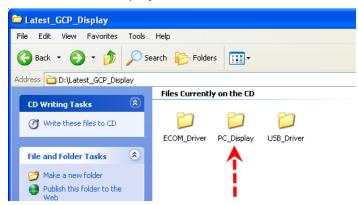


- Double Click the setup.exe file - > This will launch the installation wizard
- Select "NEXT" until you finish the installation as shown below

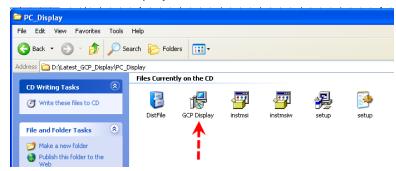


• Return to the LATEST\_GCP\_DISPLAY folder

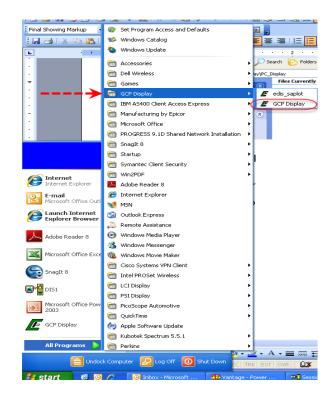
• Select the PC Display folder



• Select the GCP Display icon



- Select the GCP Display icon - > This will launch the installation wizard
- Select NEXT until it says you are finish
- Restart your PC
- Go to the START button on the lower left corner and find the GCP Display Program



#### PASSWORD LOGIN

Figure 1 shows the password dialog box, which is displayed when a software session begins. Login can be accomplished in two ways.

- 1. Enter an "All S/N Password" which is a password applicable to all ECMs of a given original equipment manufacture (OEM).
- 2. Enter a "Single S/N Password" and corresponding ECM serial number for a single ECM. A Single Serial Number password is unique to a specific ECM serial number and permits authorized service personnel to make changes or view information for a specific ECM.
- 3. In most instances the top "all" serial number boxes should be used for password entry. In this case, do not check the single serial number box. Each password is a 16-character alphanumeric string specific to each Spectrum customer and determines which pages and variables are visible through the software. Passwords are assigned by the OEM support group and may change periodically. Check the "save password" box to automatically retain the password for future use.

Note: The password is printed on the CD disk. If it does not have a password or you have questions please contact the OEM.

Enter Password		×
Password: ****	- **** - ****	
Clear Password	Single Serial Number Access	
OK	Save password and S/N	Quit

Figure 1: Populated Password Dialog Box PASSWORD DIALOG BOX FUNCTIONS

- Clear Password Button Erases the current password from the password field.
- **Paste Password Button Allows** the user to copy a 16-character string from any word processor and paste the string in the password field.
- Single Serial Number Access Checkbox Tells the software that the password is applicable for single serial number access.
- Serial Number Field Only applicable when Single Serial Number Access Checkbox is checked. The entry field must be populated for the 6-digit serial number for which the Single Serial Number Access password applies (NOTE: Leading zeros included in the serial number are not required).
- Save Password and S/N Checkbox Retains the password, and serial number (if applicable) for the next software session.

Should an invalid password be entered, the error prompt shown in figure (2) will be displayed and the software will not load. This prompt signifies the following:

- The All S/N password is invalid.
- The Single S/N password is incorrect for the Single Serial Number entered.
- An All S/N password is entered for Single Serial Number use.
- The Single Serial Number password is valid; however, the Single Serial Number Access Checkbox is not checked.

Password Error!	×
Password is invalid! Exiting	
OK	

Figure 2: Password Error Prompt

If the Single S/N password entered is correct for the software but does not match the entered S/N of the targeted ECM, the prompt in *Figure 3* will be displayed.

Incorrect Serial Number!	
The serial number of the connected module does not agree with the serial number for which you enterred a password on program start. Hit the exit key below to quit the program, or connect to the correct module to continue.	
Password Verified S/N 0 Connected Module S/N 0 Exit Program	

Figure 3: Incorrect Serial Number Message

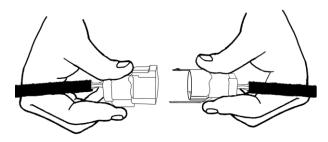
Figure 4 shows the communication status if a valid software password is entered when attempting to connect to an ECM with a different key. In this instance the software will load but will not connect to the target (ECM).

EDIS ECI Serial Communications	
<u>File Page</u> Flash Comm Port Plot/Log Help	
Gauges Not Connected	Not authorized to connect to this target Not authorized to connect to this target

Figure 4: Not Authorized to Connect Message

In the event you receive this error message call your OEM support group for more information.

#### CONNECTING THE PC TO THE ENGINE WIRE HARNESS



Connecting the DST cable

A laptop computer, with the diagnostic cable and software is the required tool for performing proper diagnostic testing of the fuel system. It is also used to monitor sensor and actuator values and to read and clear Diagnostic Trouble codes. The DST software also performs several special tests.

- Connect the system diagnostic cable to the USB port on the back of the computer.
- Connect the diagnostic cable to the DLC (diagnostic link connector) labeled in the electrical schematic. The DLC is located on the engine harness. The new 8 pin DLC requires the use of the 4 to 8 pin adapter.
- Turn the computer ON.
- Start Windows.
- From the start menu select Programs  $\rightarrow$  PSI GCP Display  $\rightarrow$  PSI GCP Display
- Place the ignition key in the ON position.

EDIS ECI Targ	et Communications		Ν
<u>File</u> Page Flas	h <u>C</u> ommPort P <u>l</u> ot/Log Help		43
	Gauges	Connected at 19200 bps	<u></u>
	Connected		· · ·

Within several seconds the system Gauge screen should now appear and a green banner in the upper left hand will read "Connected."

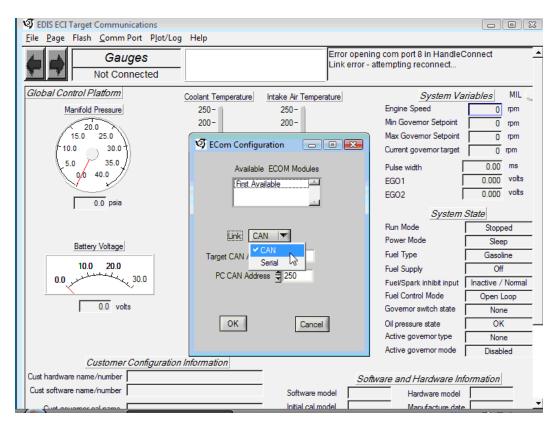
EDIS ECI Target Communica	 ations			
File Page Flash Comm Por	rt P <u>l</u> ot/Log Help			
Automat	tic COM		r opening ECom module in Han	dleConnect, (error,
COM1		251)	)	
COM2				
Global Control PI COM3	nt Temperatur	e Intake Air Temperature	System Va	<i>riables</i> MIL _
Manifold   COM4	50-1	250 -	Engine Speed	0 rpm
20. COM5	00 -	200 -	Min Governor Setpoint	0 rpm
<sup>15.0</sup> COM6	50-	150 -	Max Governor Setpoint	0 rpm
COM7	00-	100-	Current governor target	0 rpm
5.0 COM8	50 -	50 -	Pulse width	0.00 ms
CAN CAN	0-	0-	EGO1	0.000 volts
	50-	-50 - 👗	EGO2	0.000 volts
( Conligui	re CAN 0 deg F	0 deg F	Cuatam	Ctata
✓ ECOM			System Bun Mode	
Configur	re ECOM Redal Positi	on Throttle Position	Power Mode	Stopped
Battery Show Sta		80-	Fuel Type	Sleep Gasoline
10.0 20.0	60-	60 -		Off
1 1 1 1	0.0 40-	40-	Fuel Supply	Inactive / Normal
	20-	20-	Fuel/Spark inhibit input Fuel Control Mode	Open Loop
0.0 volts	0-~1	0-<1	Governor switch state	None
,	0 %	0 %	Oil pressure state	OK
	J U %	j U %	Active governor type	None
			Active governor mode	Disabled
Customer Co	onfiguration Information		A MARCO GOVERNMENTING	Disabled
Cust hardware name/number		_	Software and Hardware Inf	ormation
Cust software name/number		 Software model	Hardware model	
		Initial cal model	Manufactum date	

### • Connecting to the PC using the ECOM cable

• To connect using the ECOM cable you must select ECOM from the COM Port drop down menu.

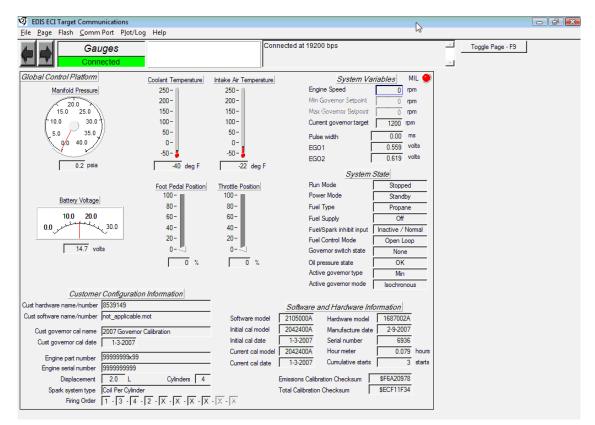
<u>File Page Flash</u> <u>Comm Port</u> Plot/Log H	elp			
Automatic COM			opening ECom module in Han	dleConnect, (error 🔺
Сом1		251)		
Global Control Pl				
COM3	nt Temperature	Intake Air Temperature	System Va	<i>riables</i> MIL 🤤
Manifold I COM4	50 - 1	250 -	Engine Speed	0 rpm
20. COM5	00 -	200 -	Min Governor Setpoint	0 rpm
15.0 COM6	50 -	150 -	Max Governor Setpoint	0 rpm
Сом7	00-	100-	Current governor target	0 rpm
5.0 COM8	50-	50-	Pulse width	0.00 ms
CAN CAN	0- 50-	0- -50-	EGO1	0.000 volts
Configure CAN			EGO2	0.000 volts
	0 deg F	0 deg F	System	State
✓ ECOM		T ut D av	Run Mode	Stopped
Configure ECOM	ot Pedal Position 100 - ■	Throttle Position	Power Mode	Sleep
Battery Show Stats Ctrl+S		80-	Fuel Type	Gasoline
10.0 20.0	60-	60 -	Fuel Supply	Off
0.0 , 30.0	40-	40-	Fue/Spark inhibit input	Inactive / Normal
	20-	20-	Fuel Control Mode	Open Loop
0.0 volts	0-	0	Governor switch state	None
	0 %	0 %	Oil pressure state	ок _
			Active governor type	None
			Active governor mode	Disabled
Customer Configuration Info	ormation			
Cust hardware name/number			Software and Hardware Inf	ormation
Cust software name/number		Software model	Hardware model	
Cust courses and pame		Initial cal model	Manufacture date	

• You will now need to configure the ECOM communication protocol.



• Select the CAN for systems with CAN enabled or serial for all others. Then select OK. You are now ready to connect using the ECOM USB DLC cable.

#### **DST SERVICE PAGES**



#### Gauge Page

Provides system data in large easy to read displays. Displays ECM configuration information for the ECM software, hardware, serial numbers and calibration dates.

File Page Flash Communications		d X
RawVolts Connected	Connected at 19200 bps Toggle Page - F9	<u>_</u>
Raw Voltage Inputs         ●         MIL           Engine Speed         npm         psia           Colant Temperature         190.0         deg F           Cylinder Head Temp         190.0         deg F           Manfold Pressure         190.0         deg F           Intake Air Temperature         110.0         deg F           Intake Air Temperature         110.0         deg F           Vbat         14.7         volts           Gov1 voltage         2.0         volts           Gov2 voltage         2.0         volts           Oil pressure voltage         5.0         volts           1         0.0         38.3           2         0.0         41.6           3         0.0         50.8           4         0.0         39.3           5         0.0         48.2           8         0.0         40.7	TPS1_raw         0.005         voits         EGO1_raw         2.356         voits         GOV1_raw         0.474         voits           FPP1_raw         0.015         voits         EGO3_raw         0.000         voits         GOV2/DIG4_raw         0.474         voits           FPP1_raw         5.000         voits         EGO4_raw         0.000         voits         AUX_DIG1_raw         0.479         voits           MAP_raw         5.000         voits         EGO4_raw         0.000         voits         AUX_DIG3_raw         0.484         voits           MAP_raw         5.000         voits         Vaw_raw         2.615         voits         AUX_PVM2_LIS_raw         0.000         voits           BP_raw         0.000         voits         Vast_raw         2.610         voits         AUX_PVM2_LIS_raw         0.000         voits           RFP_raw         0.000         voits         Vast_raw         4.231         voits         AUX_PVM3_LIS_raw         0.000         voits           RFP_raw         0.000         voits         AUX_PU2_raw         5.000         voits         AUX_PVM3_LIS_raw         0.000         voits           RFP_raw         5.000         voits         AUX_PU2_raw         5.	

#### Raw Volts Page

The raw volts page displays the sensor inputs and outputs in a raw voltage format. This page is most commonly used to check values in the diagnostic trouble shooting charts.

EDIS ECI Target Communications		- đ 🔀
<u>File Page</u> Flash <u>CommPort Plot/Log</u> Help		
Service1	Connected at 19200 bps	Toggle Page - F9
Connected		
Service Screen	Clear Faults	
Engine Speed		
RPM	Rich	
Coolant Temperature		
190 ∘⊧		
Spork Advance		
Spark Advance		
CAD BTDC		
	Lean	
	Ecun	
	Mixture	
Fuel Control Open Loop		
Mode		
Adaptive Learn State	Fuel Turos Propana	
Clear Adaptive Cleared	Fuel Type Propane •	

Service 1

The Service 1 screen is used to clear the adaptive learn, shows the MIL status and provides a display for rpm, coolant temperature and spark advance. It also provides a large display to monitor the closed loop mixture control.

EDIS ECI Target Communications					- # ×
Eile Page Flash Comm Port Plot/Log	Help				
Tests Connected		Connected at 19200 bps		Toggle Page -	F9
User Tests 🔮 MIL	System States	Monitored Drive	r Status	Throttle / IAC Variab	Ves
Engine Speed         0         gm           Mardold Pressure         0.24         psia           Barmetric Pressure         8.30         psia           Coldrat Temperature         1900         'F           Marfold Temperature         1900         'F           Marfold Temperature         220         'F           Speik Advance         3.5         'BTDC           Pulse width         0.0         ms           Vbat         14.7         volts           Vaw         14.8         volts	Run Mode Stopped Power Mode Standby Four Type Propare Fuel Control Mode Open Loop Active governor type Min. Active governor type Min. Active governor mode Stockronous Oil pressure state Oil pressure state Oil pressure control Oil pressure control Oil generate Oik Oil pressure control Oil generate Control State	Power relay electical status Stat relay electrical status FPump relay electrical status Buzzer electrical status MIL electrical status Tach output electrical status <i>Crank-Cam Da</i>	Open load         Open load           Open load         Open load           Open load         Open load           OK         Halog           Halog         Halet           Frace         Troper	FPP position         0.0           FPP votage         0.0           IVS votage         5.0           IVS votage         5.0           TPS command         3           TPS position         1           TPS position         1           TPS position         10           TPS position         10           TPS position         0.0           US votage         0.0           LAC driver power         00           LAC command position         3	0.0 % 0.0 % 0.0 % 0.0 % 0.0 % 0.0 % 0.0 % 0.0 vots
Spark Kill Test           Spark kill command         Normal           Spark kill test status         Test Net Skart           Bpark kill tenocut         0.0 av           Spark kill smoot         Spark Advance Test           Spark kill smoot         Externer           Spark kalvance test status         Test Net Skart           Tagnostic sank advance test         Software Status           Dagrandic sank advance         0.0 d	Injector kill command     Injector kill command     Injector kill test status     Injector kill teneout     Injector kill teneout     Injector firing test status     Injector firing test status	Test Not Started	DBW test status DBW test status IAC test status IAC test status IAC test status IAC test status	DBW Test Of Test Not State Linabled Test Not State dle Speed Test Doabled	

Tests Page

Provides diagnostic information voltages and sensor outputs and includes diagnostic engine tools such as spark and injector kill controls. Please note that not all features are available for all applications. The disabled item menus are grayed out or rendered inoperative.

#### SPARK KILL

The spark kill mode allows the technician to disable the ignition on individual cylinders. If the Spark Kill diagnostic mode is selected with the engine running below 1000 rpm, the minimum throttle command will lock into the position it was in when the test mode was entered. If the Spark System Test mode is selected with the engine running above 1000 rpm, the throttle will continue to operate normally. Disabling Ignition Outputs to disable the ignition system for an individual cylinder, use the mouse to highlight the "Spark Kill" button and select the desired coil. The spark output can be re-enabled by using the mouse to highlight the "Spark output will stay disabled for 15 seconds and then re-set. If the engine is running above 1000 rpm, the spark output will stay disabled for 5 seconds and then re-set. This test mode has a timeout of 10 minutes. Record the rpm drop related to each spark output disabled. The spark outputs are arranged in the order which the engine fires, not by cylinder number.

#### **INJECTOR KILL**

The Injector Kill mode is used to disable individual fuel injectors. If the Injector Kill mode is selected with the engine running below 1000 rpm, the minimum throttle command will lock into the position it was in when the test mode was entered. If the Injector Kill mode is selected with the engine running above 1000 rpm, the throttle will continue to operate normally. To disable an injector, use the mouse to select the desired injector. The word "Normal" will change to the Injector you have selected. The injector driver can be re-enabled by selecting again. If the engine is running below 1000 rpm, the injector driver will stay disabled for 15 seconds and then reset. If the engine is running above 1000 rpm, the injector driver will stay disabled for 5 seconds and then re-set. Record the change in rpm while each driver is disabled.

#### DBW TEST MODE

The DBW (Drive by Wire) test mode allows the technician to control the throttle directly with the foot pedal or throttle input and is used during the diagnostic routines specified for FPP and TPS for systems that use DBW control. FPP position displays the current position of the foot pedal as a percentage. FPP volts display the voltage which the ECM is reading from the FPP sensor. TPS Command displays the commanded throttle position expressed as a percentage, which is being sent to the throttle. TPS Position is the actual percent of throttle opening being sent to the ECM from the throttle. TPS volts display the actual TPS signal voltage the ECM is receiving from the throttle. To select this test mode the engine must be off and the key must be in the ON position.

#### EXTERNAL POWER TEST

The external power test manually activates relays (relay power, fuel pump, and drive-by wire power) controlled by the ECM while the engine is in the "Stopped" or "Running" states. Reverts to normal operation if "Automatic" state is selected or ignition voltage is cycled from high to low.

EDIS ECI Target Communications				_ # <b>*</b>
<u>File Page</u> Flash <u>Comm</u> Port Plot/Lo	g Help			
Faults Connected		Connected at 19200 bps	 	Toggle Page - F9
Fault Access         MIL           Engine Speed         0         mm           Manfold Pressure         0.24         paia           Barometric Pressure         0.24         paia           Barometric Pressure         0.24         paia           Coolant Temperature         40.0         'F           Cylinder Head Temp         190.0         'F           Manfold Temperature         190.0         'F           Itake Air Temperature         120.0         'F           Fuel all pressure         108.5         paia           Fuel all pressure         177.0         deg F           Gaseous pressure actual         0.00         'H2O           Current governor target         1200         pm           Engine Load         0.0         ',           Current estimated torque         0.0         ',           Current estimated torque         0.0         ',	Closed-Loop Control           EG01         0.652         volts           Closed-loop 1         0.0         %           Adaptive 1         0.0         %           EG02         0.702         volts           Closed-loop 2         0.0         %           Adaptive 2         0.0         %           EG03         0.000         volts           Post-cat CL offset         0.00         whith           Altemate-Fuel         0.0         %           DBW Variables         TPS command         30.0           TPS1 percent         0.0         %           TPS2 percent         100.0         %           TPS1 percent         0.005         volts           TPS2 uvoltage         0.005         volts	System States           Run Mode         Stopped           Power Mode         Standby           Fuel Type         Propane           Fuel Supply         Off           FuelSupply         Off           Governors witch state         None           Active governor mode         Isochronous           Brake input level         Ground           Off Ide         Off Ide           Input Voltages         Gov           Gov         voltage	Monitored Drivers           Injector Driver (fing orde)         injector-off vortage           1         0.0         37.3           2         0.0         41.6           3         0.0         50.7           4         0.0         43.6           5         0.0         32.4           6         0.0         42.2           7         0.0         48.2           8         0.0         40.4           Col Driver         Spark Coll           1         2.50         3           2         2.50         3           5         5.0         5	Diagnostic Modes Spark kill Normal V Injector kill Normal V DBW test Off V External power Automatic V Cylinder numbering Fining Order Derates / Warnings Derate 1 0 Derate 2 0 Low Rev-Lim 0 MIL output pin 0 Buzzer output pin 0
Vbattery 14.7 vots Vbattery 14.7 vots Hour meter 0.079 hours Cumulative starts 3 starts Double click fault for information DDUble click fault for information	TPS2 voltage         0.000         volts           FPP command         1.2         %           FPP position         0.0         %           FPP losation         0.015         volts           FPP1 voltage         0.015         volts           FVP2 voltage         5.005         volts           IVS voltage         5.000         volts	Gov2 voltage         2.0         volta           OI pressure voltage         5.0         volts           MAP voltage         0.0         volts           ECT/CHT voltage         5.0         volts           IAT voltage         5.0         volts           Active Faults         Active Faults         Active Faults	5         250           6         250           7         250           8         250           SnapShot Base Definitions:           Inu_tmr_sec         IAT           HM_hours         TPS_pct           Ipm         FPP_pct           MAP         Voat           SnapShot Custom Definitions:         EMPTY	CL_BM1         EGO1_volts           A_BM1         EGO2_volts           MJ_P_act         PW_avg           MJ_P_cmd         BP           Fuel_state         FECT           EMPTY         EMPTY

#### Faults Page

Stores DTC codes that may have occurred in the past (Historic Faults) or current set codes (Active Faults). Includes useful system voltages and sensor readings used while working with the fuel and emission trouble shooting charts. Shows power derate mode status. To erase a historic DTC code, double click on the code with the left mouse button. Then choose to "Clear All Faults."

#### PLOT/LOG MENU FUNCTIONS

The Plot/Log menu allows the user to graphically plot or numerically log variables that have been tagged for plotting/logging. To plot or log variables, a tag must be assigned to each variable of interest. A variable is tagged for plotting/logging through a single right-mouse click in the variable's vicinity. Once a variable has been tagged for plotting/logging, it is highlighted in green.

*Figure 5* shows an example of variables that have been tagged. A maximum of twenty (20) variables may be tagged for logging and a maximum of ten (10) variables may be tagged for plotting. The maximum achievable sample frequency/minimum period is dependent on the number of variables tagged.

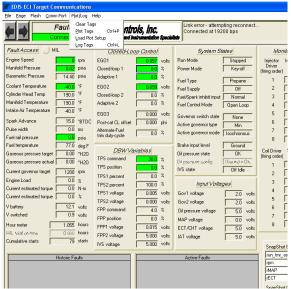


Figure 5: Tagged Variables for Plot/Log

Once the variables have been tagged as highlighted by the green color fill, select the "Plot/Log" function in the top menu bar as shown below in figure 6.

🖉 EDIS ECI Serial Communications						
<u>File Page Flash Comm Port Plot/Log H</u>	Help					
Fauli Plot Tags	Connected at 19200 bps					
Fault Access 🥥 MIL	Closed-Loop Control	System States	Monitored Drivers			
Engine Speed 528 rpm Manifold Pressure 0.24 psia	Closed-loop 1 0.0 %		Injector Injector-on Injector-off Driver Iow-side Iow-side (firing order) voltage voltage			
Barometric Pressure 8.30 psia	EG02 0.332 v	olts Governor switch state None	1 0.0 0.1 2 0.0 0.1			
Coolant Temperature -40.0 °F Cylinder Head Temp 190.0 °F	Closed-loop 2         0.0 %           Adaptive 2         0.0 %	Active governor mode Isochronous	3 0.0 0.0 4 0.0 0.1			
Manifold Temperature 147.5 °F Intake Air Temperature -22.0 °F	EG03 0.321 vi Post-cat CL offset 0.000 pl	bits Dil pressure state DK Dil pressure confin Ground Dil creasure confin Ground = DK	5 0.0 0.1 6 0.0 0.1			
Spark Advance         22.0         *BTDC           Pulse width         0.0         ms	Alternate-Fuel 0.0 %		7 0.0 0.1 8 0.0 0.1			
Gaseous pressure target -1.02 "H20	DBW Variables	Input Voltages	Coil Driver Spark Coil (firing order) dwell ms			
Gaseous pressure actual 0.00 "H20 Engine Load 0.0 % Current governor target 800 rpm	TPS command         30.4         %           TPS position         0.0         %           TPS1 percent         0.0         %           TPS2 percent         100.0         %	Gov2 voltage 2.0 volts Dil pressure voltage 5.0 volts	1 2.50 2 2.50 3 2.50			
Vbat         14.5         volts           Vsw         14.6         volts	TPS2 voltage 0.000 v	blts ECT/CHT voltage 5.0 volts blts IAT voltage 5.0 volts	4 2.50 5 2.50 6 2.50			
Hour meter 0.428 hours Cumulative starts 6 starts		olts	7 2.50 8 2.50			
		olts	SnapShot Base Definitions:			

Figure 6

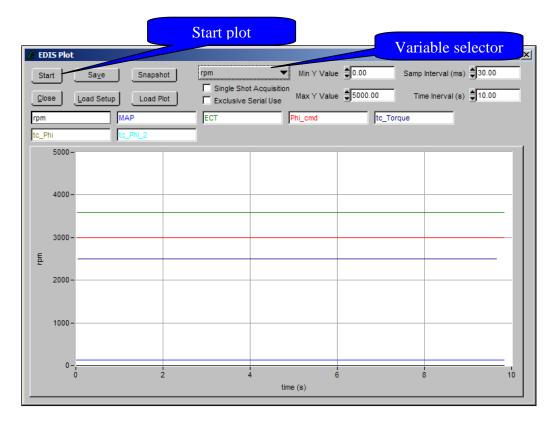
• Select "Plot Tags" to open the snapshot window

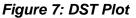
Other functions available from the Plot/Log menu include:

- Clear Tags: Releases all plot/log variables.
- Plot Tags (Ctrl + P, or P): Graphically plot all tagged variables.
- Load Plot Setup: Loads and tags variables for plotting/logging that have been stored in a plot file (.plt).
- Log Tags (Ctrl + L): Numerically log all variables that have been tagged for plotting/logging.

Once the Plot Tags menu item has been selected, tagged variables are graphically plotted in a strip chart interface. An example of a plot is shown in Figure 7. Capabilities of the plotter are outlined in Table 1.

Start/Stop Button	Start or stop plotting of selected variables				
Save Button	Save plotted data displayed in the plot to a comma-separated value file (CSV) on the PC hard drive. Format must not be altered if the <i>Load</i> function is to be used.				
Snapshot Button	Convert the plot into a snapshot that may be panned, zoomed, scrolled, <b>and</b> saved				
Close Button	Close the DST Plot interface				
Load Setup Button	Load tags from a previously saved plot (.plt) file to allow for similar plots and logs to be generated				
Load Plot Button	Load a previously saved plot from the PC into the DST Plot inter- face				
Variable Selector Menu	Selects the active variable for axis scaling				
Single Shot Acquisition Checkbox*	When checked, this does not allow the plot to scroll past the 'Time Interval' thereby preserving plotted data for post-processing.				
<i>Exclusive Serial Use</i> Checkbox*	When checked, this allows exclusive serial communication for the plot variables. Other variables on the active page are not updated.				
Min Y Value Field*	Specify the minimum Y-axis scaling for the active variable				
Max Y Value Field*	Specify the maximum Y-axis scaling for the active variable				
Sample Interval (ms) Field*	Define the sample period for recording and display <i>Frequency</i> ( <i>Hz.</i> ) = 1000/Sample Interval (ms)				
Time Interval (s) Field*	Defines the total sample acquisition time for the plot.				
*Accessible only when plotter is not running.					





- Click on the "Start" button to start the DST plot function.
- · Click on the variable selector button to view selected sensors

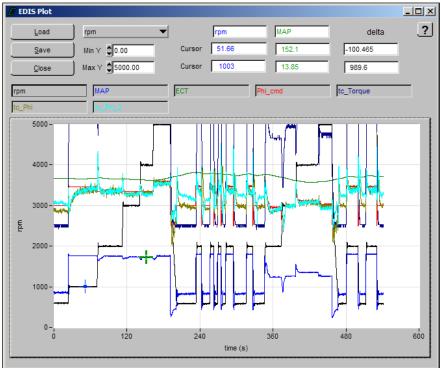
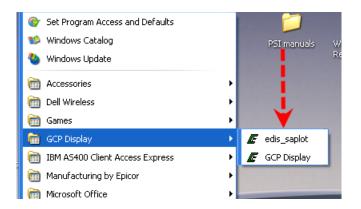


Figure 8: DST Plot Snapshot

• Click on the "Save" button to save the snapshot as a file. To replay the saved file, open the edis\_saplot program from the windows start menu.



• Start Menu  $\rightarrow$  Programs  $\rightarrow$  PSI GCP Display  $\rightarrow$  edis\_saplot

#### DST PLOT INTERFACE FUNCTIONS

A graphic tool incorporated in the plotter is the snapshot function. This function allows data collected in a plot to be transferred into a second window for quick graphical post-processing. The snapshot allows the user to zoom in/out, pan left/right, and move cursors along the signal traces to measure the variable values in virtual real-time. An example of a snapshot is shown in Figure 8. Any CSV file in plot format (.plt) may be loaded into the snapshot. Table 2 outlines the available hot key functions of the snapshot screen.

#### **SNAPSHOT HOT KEY FUNCTIONS**

Command	Function
<single, left-click="" on="" trace=""></single,>	Snap closest cursor to data
<ctrl +="" arrows="" down="" up=""></ctrl>	Move/pan plot along y axis
<ctrl +="" arrows="" left="" right=""></ctrl>	Move/pan plot along t axis
<ctrl+shift +="" arrows="" down="" up=""></ctrl+shift>	Zoom plot in and out in y axis
<ctrl+shift +="" arrows="" left="" right=""></ctrl+shift>	Zoom plot in and out in t axis
<ctrl +="" home=""></ctrl>	Resize plot to default settings
<ctrl +="" page="" up=""></ctrl>	Zoom out by 10%
<ctrl +="" down="" page=""></ctrl>	Zoom in by 10%
<page up=""></page>	Toggle to previous cursor
<page down=""></page>	Toggle to next cursor
<left arrow="" right=""></left>	Follow selected data along trace
<up arrow="" down=""></up>	Follow selected data along trace
<shift +="" arrow="" left="" right=""></shift>	Move 10 points along trace
<shift +="" arrow="" down="" up=""></shift>	Move 10 points along trace
<home></home>	Go to first visible point on current plot
<end></end>	Advance to last visible point on current plot
<shift +="" arrow="" down="" up=""></shift>	Toggle between traces/variables

#### Table 1

#### DST LOGGER

Another data capture function incorporated in the software is the DST logger. This tool serves as a PC data logger for any variable available in the ECM through the interface software. Figure 9 shows the interface display for configuring the DST Log. The interface allows the user to create the filename, set the sample rate for acquisition, set the time interval for sampling, and display the progress of acquisition. A maximum of twenty (20) variables may be tagged for the log. The amount of data stored is only limited by available PC RAM. The resulting text file may then be viewed by any standard Windows text editor/reader program. To create a log file select the "Log Tags" in the drop down menu as shown in figure 6.

/ EDis Log								×
Log File: edis.log	_	_	_	_	_		Browse	
Sampling Interval (ms) 量	30.00		Time Ine	rval (s)	\$10.00	_		
Progress					1	-		
	Ó	20	40	60	80	100		
C	Start	)				Close		

Figure 9: DST Log Interface

#### MALFUNCTION INDICATOR LAMP (MIL)

The Fuel system has built-in diagnostics for system trouble shooting. The system has a dash mounted malfunction indicator lamp (MIL) that provides indications of engine or fuel system related problem. Most engine control system related problems that affect emissions or driveability of the vehicle will set a (DTC) diagnostic trouble code and illuminate the MIL.

The MIL serves as notification to the operator of a problem related to the emission control system so the driver can arrange for service as soon as possible. It will also display DTCs that have been stored due to a system malfunction.

The MIL should illuminate when the key is in the ON position and the engine is not running. This feature verifies that the lamp is in proper working order. If the MIL does not illuminate with the vehicle key ON/engine OFF, repair it as soon as possible. Once the engine is in start or run mode, the MIL should turn off. If the lamp remains on while the engine is in the start or run mode a diagnostic trouble code may be set.

The MIL will be turned OFF after three (3) consecutive run cycles or by clearing the active code with the Diagnostic Scan Tool (DST).

#### DIAGNOSTIC TROUBLE CODES (DTC)

Diagnostic Trouble Codes are set when the Spectrum ECM (Electronic Control Module) runs a diagnostic self test and the test fails. When a DTC is set, the ECM will illuminate the MIL on the instrument panel and also save the DTC in memory. The ECM will continue to run the self test. If the system continues to fail the test, the lamp will stay illuminated and the DTC is stored as an active DTC. If the self test runs and passes, the DTC will be stored as historic DTC. All DTCs are stored as historic faults until they are cleared. Most DTCs will automatically clear from memory if the DTC does not reset within 50 to 100 consecutive engine run cycles.

While a Diagnostic Trouble Code is current for a sensor, the ECM may assign a default "limp home" value and use that value in its control algorithms. All of the system diagnostic self-tests run continuously during normal vehicle operation.

The Diagnostic Trouble Codes can be read by using either the MIL lamp or a laptop computer. Diagnostic Trouble Codes can be cleared from memory with a laptop computer, or by turning the ignition key to the OFF position and removing the ECM power fuse or battery cable for at least 15 seconds.

If more than one DTC is detected, start the diagnostic repair with the lowest DTC number set. Diagnose each problem to correction unless directed to do otherwise by the diagnostic chart. The DTCs are numbered in order of importance. Both DTC 112 and DTC122 pertain to the oxygen sensor, so it is possible that a repair that corrects DTC 112 may also correct the problem causing the DTC 122.

Diagnostic test charts contained in this manual refer to the DST to be connected and in the "System Data Mode." This simply means that the DST is connected and communicating with the PC. In some instances the chart will call out a special test mode. An example of this would be instructions for the DST to be connected and in the DBW (drive by wire) mode. Always be sure to follow the special instructions to avoid a false diagnosis of fuel system components.

#### **DLC COMMUNICATION ERROR**

The ECM 5 volt reference circuit powers the diagnostic link cable. In the event that the 5 volt reference signal is open or shorted to ground, you will not be able to connect to the system. If you are unable to connect, follow the quick checks listed below:

Be sure you are using the correct password and latest software for the system you are connecting to.

Check the ECM system power and ground circuits. Refer to DTC 562 for the power schematic. Also check for +12 volts switched power at ECM pin 45 with the ignition key ON.

Check for power at the DLC connector for + 5 volts between pin 1 (BLK /LT GRN) and pin 2 (LT GRN RED) with the ignition key in the ON position.

You may still be able to retrieve a code using the blink code function if none of the above recommendations prove useful. In the event of a 5 volt reference signal malfunction, DTC 642 or DTC 643 should set. If you find one of these codes using the blink code function, follow the DTC diagnostic chart recommendations for that specific DTC.

#### **BLINK CODE FUNCTION**

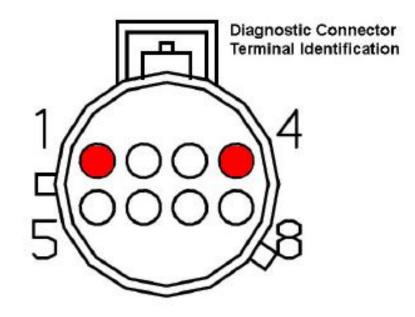
Although the DST is considered a required tool to access the DTC codes, codes may be retrieved without a laptop computer using the blink code function. To enable this function follow the steps below:

- Jump pins 1 and 4 at the DLC connector (see illustration below)
- Turn the ignition key to the on position
- The system will now enter the self diagnostic blink code mode. Be ready with pen and paper to write down any codes that may be stored.
- The ECM will flash the MIL indicator with a pause between represented numbers that represent DTC codes. The sequence starts with code 1654. Code 1654 confirms the system has entered the blink code mode. The ECM will flash code 1654 (3) times before displaying the actual DTC code that may be set.

#### Example:

# <u>One short blink</u> (pause) <u>six short blinks</u> (pause) <u>five short blinks</u> (pause) <u>four short blinks</u>.

- If no DTC codes are found, the ECM will continue to flash 1654 only. This means no stored DTC codes were found.
- If one of the numbers in the DTC code is zero (0), no flash will occur to represent the zero value—it will be represented as a short pause.



EDIS ECI Target Communications						
File Page Flash Comm Port Plot/Log Help						
Faults Connected	Link error - attempting reconnect Connected at 19200 bps					
Fault Access       MIL         Engine Speed       0       rpm         Manifold Pressure       2.26       psia         Barometric Pressure       8.30       psia         Coolant Temperature       -40.0       °F         Cylinder Head Temp       165.0       °F         Manifold Temperature       165.0       °F         Intake Air Temperature       -40.0       °F         Spark Advance       4.5       °BTDC         Pulse width       2.8       ms         Fuel rail pressure       47.9       psia         Fuel temperature       77.0       deg F         Gaseous pressure target       0.00       "H20	Closed-Lacp Control     System States       EG01     0.401 volts     Run Mode     Stopped       Closed-loop 1     00 %     Power Mode     Standbu       Adaptive     Historic Fault Information     EG02       Closed-loo     Fault Description:     DTC 2128: FPP2 voltage high       J1939 SPN = 0, FMI = 0     Post-cat       Alternate trim duty-     Image: State	Manitored Drivers Injector on Injector-off Driver Injector-on Injector-off 000-side 000 40.7 550 44.1 36.0 0.0 52.7 40.8 1				
Gaseous pressure actual     0.00     "H20       Current governor target     800     rpm       Engine Load     1.4     %       Current estimated tarque     0.0     N-m       Current estimated tarque     0.0     %       V battery     13.4     volts       V switched     13.4     volts       Hour meter     0.000     hours       Cumulative starts     0     starts	TPS posi     Image: State in the state in t	ł				
		run_tmr_sec CL_BM1				
Historic Faults	Active Faults					

Diagram 1

When using the DST program to clear a DTC, always select the "Clear All Faults" function to immediately turn the MIL OFF after a successful repair (as shown in diagram 1 above).

#### INTERMITTENT PROBLEMS

Intermittent fuel system problems can prove to be the most challenging to repair. It is most important to remember when looking to find the cause of these problems, to operate the system in the condition when and where the problem occurs. An example of this would be, if the DST showed a lean fuel mixture at full load, one of the first things to look at would be the fuel pressure. The fuel pressure would need to be monitored while the machine is operating at full load, not at idle because the leaning effect does not occur at idle. Electrical problems should be treated the same way. One excellent tool for finding intermittent electrical problems is the DST plot/log function. Set up the plot for the code that sets. An example of this would be if an intermittent IAT code set, tag the IAT voltage and watch the plot. While watching the plot, agitate the electrical wire connection at the sensor and ECM connector. The resolution of the plot screen is such that you will be able to see any unstable voltages that you would otherwise not see with a standard DVOM.

Caution should be used when pressure washing the under hood of any electrical system. Avoid direct pressure spray on the system electrical connectors. They are splash proof, but if water is sprayed directly at the connector moisture can become trapped behind the connector seal and cause serious system problems.

Extra care must be taken when probing electrical pins and terminals. Do not bend or spread these terminals as this can also be a source of intermittent problems cause by improper handling of these connectors.

# **Engine Wire Harness Repair**

### **ON-VEHICLE SERVICE** WIRE HARNESS REPAIR

The ECM harness electrically connects the ECM to a various components in both the engine and passenger compartments.

Wire harnesses should be replaced with proper part number harnesses. When wires are spliced into a harness, use wire with high temperature insulation only.

Low current and voltage levels are used in the system, so it is important that the best possible bond at all wire splices be made by soldering the splices.

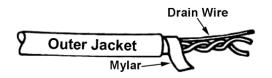
### CONNECTORS AND TERMINALS

Use care when probing a connector or replacing terminals in them to prevent shorting opposite terminals and damage certain components. Always use jumper wires between connectors, for circuit checking. Do not probe through the Weather-Pack seals with oversized wire probes. Use tachometer adapter J 35812 (or equivalent) which provides an easy hook up of the tach lead. The connector test adapter kit J 35616 (or equivalent), contains an assortment of flexible connectors used to probe terminals during diagnosis. Fuse remover and test tool BT 8616, or equivalent, is used for removing a fuse and to adapt fuse holder, with a meter, for diagnosis. Do not solder oxygen sensor wire terminals as these wire ends are used for the sensors oxygen reference.

Open circuits are often difficult to locate by sight due to dirt, oxidation, or terminal misalignment. Merely wiggling a connector on a sensor, or in the wiring harness, may correct the open circuit condition. This should always be considered, when an open circuit, or failed sensor is indicated. Intermittent problems may also be caused by oxidized or loose connections.

Before making a connector repair, be certain of the type of connector. Weather-Pack and Compact Three connectors look similar, but are serviced differently.

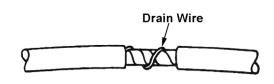
### **REPAIRING TWISTED/SHIELDED CABLE**



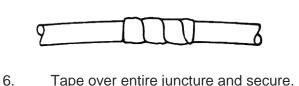
- Remove outer jacket 1.
- 2. Unwrap aluminum/Mylar tape. Do not remove Mylar.



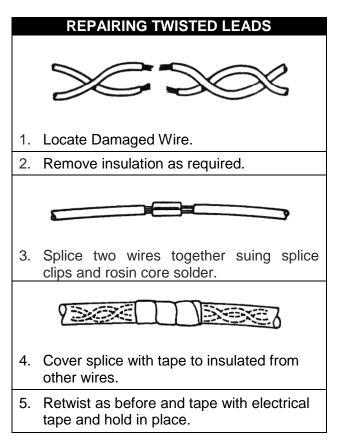
3. Untwist conductors, strip insulation as necessary.



- 4. Splice wire using splice clips and rosin core solder. Wrap each splice to insulate.
- 5. Wrap with Mylar and drain wire (uninsulated) wire.

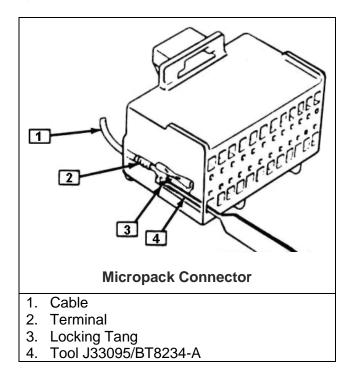


Tape over entire juncture and secure.



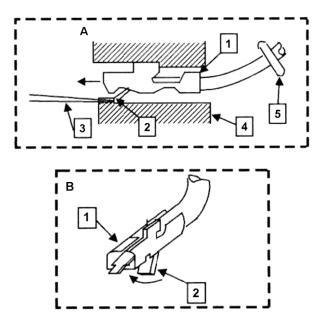
### **MICRO-PACK**

Refer to Figure 2 and repair procedure for replacement of a Micro-Pack terminal.



### **METRI-PACK**

Some connectors use terminals called Metri-Pack Series 150. They are also called "Pull-To-Seat" terminals because of the method of installation. The wire is inserted through the seal and connector, the terminal is crimped on the wire and then pulled back into the connector to seat it in place.



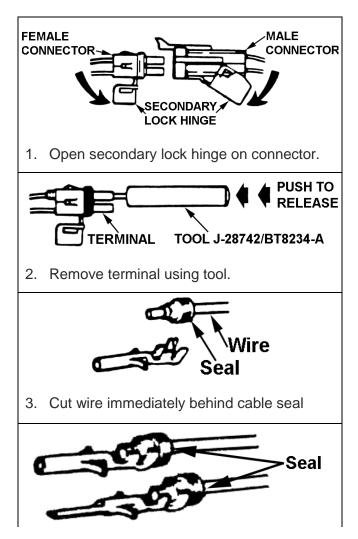
### Metri-Pack Series 150 Terminal Removal

- 1. Slide the seal back on the wire.
- 2. Insert tool BT-8518, or J 35689, or equivalent, as shown in insert "A" and "B" to release the terminal locking tab (2).
- 3. Push the wire and terminal out through the connector. If reusing the terminal, reshape the locking tab (2).

### WEATHER-PACK

A Weather-Pack connector can be identified by a rubber seal, at the rear of the connector. The connector is used in the engine compartment to protect against moisture and dirt that may oxidize and/or corrode the terminals. Given the low voltage and current levels found in the electronic system, this protection is necessary to ensure a good connection.

#### WEATHER-PACK TERMINAL REPAIR



- 4. Replace terminal.
  - a. Slip new seal onto wire
    - b. Strip 5 mm (.2") of insulation from wire.
  - c. Crimp terminal over wire and seal.
- 5. Push terminal and connector and engage locking tangs.
- 6. Close secondary lock hinge.

Use tool J M28742, or BT8234-A or equivalent to remove the pin and sleeve terminals. If the removal is attempted with an ordinary pick, there is a good chance that the terminal will be bent, or deformed. Unlike standard blade type terminals, these terminals cannot be straightened once they are bent.

Verify that the connectors are properly seated and all of the sealing rings in place, when connecting leads. The hinge type flap provides a backup, or secondary locking feature for the connector. They are used to improve the connector reliability by retaining the terminals, if the small terminal lock tabs are not positioned properly.

Weather-Pack connections cannot be replaced with standard connections. Additional instructions are provided with Weather-Pack connector and terminal packages.

# Diagnostic Trouble Codes (DTCs)

# Malfunction Indicator Lamp (MIL) Operation

### How does my MIL work?

The emissions control system utilizes a MIL to warn the operator or technician of a possible issue with the engine or emissions control system. The system will keep the MIL illuminated for the entire key cycle in which the trouble code was set. It will keep the MIL illuminated for three additional engine run cycles under the following two circumstances: (1) The fault caused the engine to shut down or (2) the fault is related to the exhaust gas oxygen (EGO) sensors. This function is called MIL persistence.

### How does MIL persistence work?

In the event the DTC <u>is</u> related to either an engine shutdown fault OR an oxygen sensor fault the following statement applies: If the vehicle is not serviced by a technician and the condition causing the MIL illumination (DTC) no longer exists, the MIL will remain illuminated for the 3 additional start cycles. The MIL will go out on the 4<sup>th</sup> start cycle if the condition does not reoc-cur.

In the event the DTC <u>is not</u> related to an engine shut down or an oxygen sensor fault and the condition causing the MIL illumination (DTC) no longer exists, the MIL will go out at the next run cycle.

If the condition is serviced by a technician and the DTC is cleared using a Diagnostic Service Tool (DST), the MIL will go out immediately.

Diagnostic Trouble Codes (DTC) are permanently retained in the historic DTC section until cleared with a DST or the auto clear requirements are met. The auto clear feature will clear out historic faults after 40 run cycles.

#### What are the requirements for a run cycle?

A run cycle is when the engine speed is above the "run speed" set point for 1.5 seconds or longer. The "run speed" is the transition point when the ECM recognizes the engine is going from the cranking parameters to the engine running parameters. The run speed is typically set at 450 rpm.

## DIAGNOSTIC TROUBLE CODE (DTC) CHART – SORTED BY DTC # (1 of 4)

		Set 2		DTC Set 2	
Description	SPN-2	FMI-2	Description	SPN-2	FMI-2
DTC 11: Intake cam / distributor position error	520800	7	DTC 268: Injector 3 coil shorted	653	6
DTC 16: Crank and/or cam could not synchronize during start	636		DTC 270: Injector 4 open or short to ground	654	5
DTC 24: Exhaust cam position error	520801		DTC 271: Injector 4 coil shorted	654	6
DTC 87 Fuel pressure lower than expected	94		DTC 273: Injector 5 open or short to ground	655	5
DTC 88 Fuel pressure higher than expected	94		DTC 274: Injector 5 coil shorted	655	6
DTC 91: FP low voltage	94		DTC 276: Injector 6 open or short to ground	656	5
DTC 92: FP high voltage	94		DTC 277: Injector 6 coil shorted	656	6
DTC 107: MAP voltage low	106		DTC 279: Injector 7 open or short to ground	657	5
DTC 108: MAP pressure high	106		DTC 280: Injector 7 coil shorted	657	6
DTC 111: IAT higher than expected stage 1	105		DTC 282: Injector 8 open or short to ground	658	5
DTC 112: IAT voltage low	105		DTC 283: Injector 8 coil shorted	658	6
DTC 113: IAT voltage high	105		DTC 285: Injector 9 open or short to ground	659	5
DTC 116: ECT higher than expected stage 1	110		DTC 286: Injector 9 coil shorted	659	6
DTC 117: ECT voltage low	110		DTC 288: Injector 10 open or short to ground	660	5
DTC 118: ECT voltage high	110		DTC 289: Injector 10 coil shorted	660	6
DTC 121: TPS1-2 lower than expected	51		DTC 1631: PWM1-Gauge1 open / ground short	697	5
DTC 122: TPS1 voltage low	51		DTC 299: Boost control underboost failure	1692	1
DTC 123: TPS1 voltage high	51		DTC 301: Cylinder 1 emissions/catalyst damaging misfire	1323	31
DTC 127: IAT higher than expected stage 2	105		DTC 302: Cylinder 2 emissions/catalyst damaging misfire	1324	31
DTC 129: BP pressure low	108		DTC 303: Cylinder 3 emissions/catalyst damaging misfire	1325	31
DTC 134: EGO1 open / lazy	724		DTC 304: Cylinder 4 emissions/catalyst damaging misfire	1326	31
DTC 140: EGO3 open / lazy	520209		DTC 305: Cylinder 5 emissions/catalyst damaging misfire	1327	31
DTC 154: EGO2 open / lazy	520208		DTC 306: Cylinder 6 emissions/catalyst damaging misfire	1328	31
DTC 160: EGO4 open / lazy	520210		DTC 307: Cylinder 7 emissions/catalyst damaging misfire	1329	31
DTC 171: Adaptive-learn gasoline bank1 high	520200		DTC 308: Cylinder 8 emissions/catalyst damaging misfire	1330	31
DTC 172: Adaptive-learn gasoline bank1 low	520200		DTC 326: Knock1 excessive or erratic signal	731	2
DTC 174: Adaptive-learn gasoline bank2 high	520201		DTC 327: Knock1 sensor open or not present	731	4
DTC 175: Adaptive-learn gasoline bank2 low	520201		DTC 331: Knock2 excessive or erratic signal	520241	2
DTC 182: FT low voltage	174		DTC 332: Knock2 sensor open or not present	520241	4
DTC 183: FT high voltage	174		DTC 336: CRANK input signal noise	636	2
DTC 187: Gaseous fuel temperature sender low voltage	520240		DTC 337: Crank signal loss	636	4
DTC 188: Gaseous fuel temperature sender high voltage	520240		DTC 341: CAM input signal noise	723	2
DTC 217: ECT higher than expected stage 2	110		DTC 342: Loss of CAM input signal	723	4
DTC 219: RPM higher than max allowed govern speed	515		DTC 359: Fuel run-out longer than expected	1239	7
DTC 221: TPS1-2 higher than expected	51		DTC 420: Catalyst inactive on gasoline (Bank 1)	520211	10
DTC 222: TPS2 voltage low	520251		DTC 430: Catalyst inactive on gasoline (Bank 2)	520212	10
DTC 223: TPS2 voltage high	520251		DTC 502: Roadspeed input loss of signal	84	1
DTC 234: Boost control overboost failure	1692		DTC 508: IAC ground short	520252	6
DTC 236: TIP active	1692		DTC 509: IAC coil open/short	520252	5
DTC 237: TIP low voltage	1127		DTC 520: Oil pressure sender low pressure stage 1	100	18
DTC 238: TIP high voltage	1127		DTC 521: Oil pressure sender high pressure	100	0
DTC 261: Injector 1 open or short to ground	651		DTC 522: Oil pressure sender low voltage	100	4
DTC 262: Injector 1 coil shorted	651		DTC 523: Oil pressure sender high voltage	100	3
DTC 264: Injector 2 open or short to ground	652		DTC 524: Oil pressure low	100	1
DTC 265: Injector 2 coil shorted	652		DTC 562: Vbat voltage low	168	17
		<b>U</b>			

# DIAGNOSTIC TROUBLE CODE (DTC) CHART – SORTED BY DTC # (2 of 4)

		Set 2		DTC Set 2	
Description	SPN-2	FMI-2	Description	SPN-2	FMI-2
DTC 601: Microprocessor failure - FLASH	628	13	DTC 1175: MegaJector voltage supply low	520260	4
DTC 604: Microprocessor failure - RAM	630		DTC 1176: MegaJector internal actuator fault detection	520260	12
DTC 606: Microprocessor failure - COP	629		DTC 1177: MegaJector internal circuitry fault detection	520260	12
DTC 615: Start relay coil open	1321		DTC 1178: MegaJector internal comm fault detection	520260	12
DTC 616: Start relay ground short	1321		DTC 1182: Fuel impurity level high	520401	0
DTC 617: Start relay coil short to power	1321		DTC 1183: MegaJector autozero / lockoff failure	520803	31
DTC 627: Fuel pump relay coil open	1348		DTC 1311: Cylinder 1 misfire detected	1323	11
DTC 628: Fuel-pump high-side open or short to ground	1347		DTC 1312: Cylinder 2 misfire detected	1324	11
DTC 628: Fuel pump relay control ground short	1348		DTC 1313: Cylinder 3 misfire detected	1325	11
DTC 629: Fuel-pump high-side short to power	1347		DTC 1314: Cylinder 4 misfire detected	1326	11
DTC 629: Fuel pump relay coil short to power	1348		DTC 1315: Cylinder 5 misfire detected	1327	11
DTC 642: Sensor supply voltage 1 low	1079		DTC 1316: Cylinder 6 misfire detected	1328	11
DTC 643: Sensor supply voltage 1 high	1079		DTC 1317: Cylinder 7 misfire detected	1329	11
DTC 650: MIL open	1213		DTC 1318: Cylinder 8 misfire detected	1330	11
DTC 652: Sensor supply voltage 2 low	1080		DTC 1411: EMWT1 voltage high	441	3
DTC 653: Sensor supply voltage 2 high	1080		DTC 1412: EMWT2 voltage high	442	3
DTC 685: Power relay coil open	1485		DTC 1413: EMWT1 voltage low	441	4
DTC 686: Power relay ground short	1485		DTC 1414: EMWT2 voltage low	442	4
DTC 687: Power relay coil short to power	1485		DTC 1415: EMWT1 higher than expected stage 1	441	15
DTC 916: Shift actuator feedback out-of-range	520226		DTC 1416: EMWT2 higher than expected stage 1	442	15
DTC 919: Shift unable to reach desired gear	520226		DTC 1417: EMWT1 higher than expected stage 2	441	0
DTC 920: Shift actuator or drive circuit failed	520226		DTC 1418: EMWT2 higher than expected stage 2	442	0
DTC 1111: RPM above fuel rev limit level	515		DTC 1419: ERWT1 voltage high	443	3
DTC 1112: RPM above spark rev limit level	515		DTC 1420: ERWT2 voltage high	444	3
DTC 1121: FPP1/2 simultaneous voltages out-of-range (redundar			DTC 1421: ERWT1 voltage low	443	4
DTC 1122: FPP1/2 do not match each other or IVS (redundancy lo			DTC 1422: ERWT2 voltage low	444	4
DTC 1131: WGP voltage high	1192		DTC 1423: ERWT1 higher than expected stage 1	443	15
DTC 1132: WGP voltage low	1192		DTC 1424: ERWT2 higher than expected stage 1	444	15
DTC 1151: Closed-loop LPG high	520206		DTC 1425: ERWT1 higher than expected stage 2	443	0
DTC 1152: Closed-loop LPG low	520206		DTC 1426: ERWT2 higher than expected stage 2	444	0
DTC 1153: Closed-loop NG high	520207		DTC 1511: AUX analog Pull-Up 1 high voltage	520216	3
DTC 1154: Closed-loop NG low	520207		DTC 1512: AUX analog Pull-Up 1 low voltage	520216	4
DTC 1155: Closed-loop gasoline bank1 high	520204		DTC 1513: AUX analog Pull-Up 2 high voltage	520217	3
DTC 1156: Closed-loop gasoline bank1 low	520204	1	DTC 1514: AUX analog Pull-Up 2 low voltage	520217	4
DTC 1157: Closed-loop gasoline bank2 high	520205	0	DTC 1515: AUX analog Pull-Down 1 high voltage	520215	3
DTC 1158: Closed-loop gasoline bank2 low	520205	1	DTC 1516: AUX analog Pull-Down 1 low voltage	520215	4
DTC 1161: Adaptive-learn LPG high	520202	0	DTC 1517: AUX analog Pull-Up 3 high voltage	520218	3
DTC 1162: Adaptive-learn LPG low	520202		DTC 1518: AUX analog Pull-Up 3 low voltage	520218	4
DTC 1163: Adaptive-learn NG high	520203		DTC 1521: CHT higher than expected stage 1	110	16
DTC 1164: Adaptive-learn NG low	520203		DTC 1522: CHT higher than expected stage 2	110	0
DTC 1165: Catalyst inactive on LPG	520213		DTC 1531: Gov1/2/3 interlock failure	520270	31
DTC 1166: Catalyst inactive on NG	520214		DTC 1541: AUX analog Pull-Up/Down 1 high voltage	520219	3
DTC 1171: MegaJector delivery pressure higher than expected	520260	0	DTC 1542: AUX analog Pull-Up/Down 1 low voltage	520219	4
DTC 1172: MegaJector delivery pressure lower than expected	520260	1	DTC 1543: AUX analog Pull-Up/Down 2 high voltage	520220	3
DTC 1173: MegaJector comm lost	520260	31	DTC 1544: AUX analog Pull-Up/Down 2 low voltage	520220	4
DTC 1174: MegaJector voltage supply high	520260		DTC 1545: AUX analog Pull-Up/Down 3 high voltage	520221	3

## DIAGNOSTIC TROUBLE CODE (DTC) CHART – SORTED BY DTC # (3 of 4)

DTC Set 2			DTC	Set 2	
Description	SPN-2	FMI-2	Description	SPN-2	FMI-2
DTC 1546: AUX analog Pull-Up/Down 3 low voltage	520221	4	DTC 1662: PWM6 short to power	925	3
DTC 1547: AUX analog Pull-Up/Down 4 high voltage	713		DTC 1663: PWM7 open / ground short	926	5
DTC 1548: AUX analog Pull-Up/Down 4 low voltage	713	4	DTC 1664: PWM7 short to power	926	3
DTC 1551: AUX digital 1 high voltage	520222	3	DTC 1665: PWM8 open / ground short	2646	5
DTC 1552: AUX digital 1 low voltage	520222	4	DTC 1666: PWM8 short to power	2646	3
DTC 1553: AUX digital 2 high voltage	520223	3	DTC 1669: PWM9 open / ground short	2647	5
DTC 1554: AUX digital 2 low voltage	520223	4	DTC 1670: PWM9 short to power	2647	3
DTC 1555: AUX digital 3 high voltage	520224	3	DTC 2111: Unable to reach lower TPS	51	7
DTC 1555: Water Intrusion Detection	520224	3	DTC 2112: Unable to reach higher TPS	51	7
DTC 1556: AUX digital 3 low voltage	520224	4	DTC 2115: FPP1 higher than IVS	91	0
DTC 1561: AUX analog Pull-Down 2 high voltage	0	3	DTC 2116: FPP2 higher than IVS	29	0
DTC 1561: AUX analog Pull-Down 3 high voltage	0	3	DTC 2120: FPP1 invalid voltage and FPP2 disagrees with IVS	520250	31
DTC 1561: AUX analog Pull-Down 2 low voltage	0		DTC 2121: FPP1-2 lower than expected	91	18
DTC 1561: AUX analog Pull-Down 3 low voltage	0		DTC 2122: FPP1 voltage high	91	3
DTC 1611: Sensor supply voltage 1 and 2 out-of-range	1079		DTC 2123: FPP1 voltage low	91	4
DTC 1612: Microprocessor failure - RTI 1	629		DTC 2125: FPP2 invalid voltage and FPP1 disagrees with IVS	520250	31
DTC 1613: Microprocessor failure - RTI 2	629		DTC 2126: FPP1-2 higher than expected	91	16
DTC 1614: Microprocessor failure - RTI 3	629		DTC 2127: FPP2 voltage low	29	4
DTC 1615: Microprocessor failure - A/D	629		DTC 2128: FPP2 voltage high	29	3
DTC 1616: Microprocessor failure - Interrupt	629		DTC 2130: IVS stuck at-idle, FPP1/2 match	558	5
DTC 1621: RS-485 Rx inactive	0		DTC 2131: IVS stuck off-idle, FPP1/2 match	558	6
DTC 1622: RS-485 Rx noise	0		DTC 2135: TPS1/2 simultaneous voltages out-of-range	51	31
DTC 1623: RS-485 Rx bad packet format	0		DTC 2139: FPP1 lower than IVS	91	1
DTC 1624: RS-485 remote shutdown request	0		DTC 2140: FPP2 lower than IVS	29	1
DTC 1625: J1939 shutdown request	1384		DTC 2229: BP pressure high	108	0
DTC 1626: CAN-J1939 Tx fault	639		DTC 2300: Spark coil 1 primary open or short to ground	1268	5
DTC 1627: CAN-J1939 Rx fault	639		DTC 2301: Spark coil 1 primary shorted	1268	6
DTC 1628: J1939 CAN address / engine-number conflict	639		DTC 2303: Spark coil 2 primary open or short to ground	1269	5
DTC 1629: J1939 TSC1 message receipt loss	639		DTC 2304: Spark coil 2 primary shorted	1269	6
DTC 1630: J1939 ETC message receipt loss	91		DTC 2306: Spark coil 3 primary open or short to ground	1270	5
DTC 1632: PWM1-Gauge1 short to power	697		DTC 2307: Spark coil 3 primary shorted	1270	6
DTC 1633: PWM2-Gauge2 open / ground short	698		DTC 2309: Spark coil 4 primary open or short to ground	1271	5
DTC 1634: PWM2-Gauge2 short to power	698		DTC 2310: Spark coil 4 primary shorted	1271	6
DTC 1635: PWM3-Gauge3 open / ground short	699		DTC 2312: Spark coil 5 primary open or short to ground	1272	5
DTC 1636: PWM3-Gauge3 short to power	699		DTC 2313: Spark coil 5 primary shorted	1272	6
DTC 1637: PWM4 open / ground short	700		DTC 2315: Spark coil 6 primary open or short to ground	1273	5
DTC 1638: PWM4 short to power	700		DTC 2316: Spark coil 6 primary shorted	1273	6
DTC 1639: PWM5 open / ground short	520230		DTC 2318: Spark coil 7 primary open or short to ground	1274	5
DTC 1640: PWM5 short to power	520230		DTC 2319: Spark coil 7 primary shorted	1274	6
DTC 1641: Buzzer control ground short	920	4	DTC 2321: Spark coil 8 primary open or short to ground	1275	5
DTC 1642: Buzzer open	920		DTC 2322: Spark coil 8 primary shorted	1275	6
DTC 1643: Buzzer control short to power	920		DTC 2324: Spark coil 9 primary open or short to ground	1276	5
DTC 1644: MIL control ground short	1213		DTC 2325: Spark coil 9 primary shorted	1276	6
DTC 1645: MIL control short to power	1213		DTC 2327: Spark coil 10 primary open or short to ground	1277	5
DTC 1651: J1939 ETC message receipt loss while in-gear	91		DTC 2328: Spark coil 10 primary shorted	1277	6
DTC 1661: PWM6 open / ground short	925		DTC 2428: EGT temperature high	173	0

# DIAGNOSTIC TROUBLE CODE (DTC) CHART – SORTED BY DTC # (4 of 4)

		Set 2
Description	SPN-2	FMI-2
DTC 2618: Tach output ground short	645	4
DTC 2619: Tach output short to power	645	3
DTC 8901: UEGO microprocessor internal fault	3221	31
DTC 8902: UEGO heater supply high voltage	3222	3
DTC 8903: UEGO heater supply low voltage	3222	4
DTC 8904: UEGO cal resistor voltage high	3221	3
DTC 8905: UEGO cal resistor voltage low	3221	4
DTC 8906: UEGO return voltage shorted high	3056	3
DTC 8907: UEGO return voltage shorted low	3056	4
DTC 8908: UEGO pump voltage shorted high	3218	3
DTC 8909: UEGO pump voltage shorted low	3218	4
DTC 8910: UEGO sense cell voltage high	3217	3
DTC 8911: UEGO sense cell voltage low	3217	4
DTC 8912: UEGO pump voltage at high drive limit	3225	3
DTC 8913: UEGO pump voltage at low drive limit	3225	4
DTC 8914: UEGO sense cell slow to warm up	3222	10
DTC 8915: UEGO pump cell slow to warm up	3225	10
DTC 8916: UEGO sense cell impedance high	3222	0
DTC 8917: UEGO pump cell impedance high	3225	0
DTC 8918: UEGO pump cell impedance low	3225	1

## DIAGNOSTIC TROUBLE CODE (DTC) CHART – SORTED BY SPN:FMI (1 of 4)

	DTC Set 2			DTC	Set 2
Description	SPN-2	FMI-2	Description	SPN-2	FMI-2
DTC 1561: AUX analog Pull-Down 2 high voltage	0	3	DTC 107: MAP voltage low	106	4
DTC 1561: AUX analog Pull-Down 3 high voltage	0		DTC 108: MAP pressure high	106	16
DTC 1561: AUX analog Pull-Down 2 low voltage	0		DTC 2229: BP pressure high	108	0
DTC 1561: AUX analog Pull-Down 3 low voltage	0		DTC 129: BP pressure low	108	1
DTC 1621: RS-485 Rx inactive	0		DTC 1522: CHT higher than expected stage 2	110	0
DTC 1622: RS-485 Rx noise	0		DTC 217: ECT higher than expected stage 2	110	0
DTC 1623: RS-485 Rx bad packet format	0		DTC 118: ECT voltage high	110	3
DTC 1624: RS-485 remote shutdown request	0		DTC 117: ECT voltage low	110	4
Undefined DTC - Index 10297	0	31	DTC 116: ECT higher than expected stage 1	110	15
Undefined DTC - Index 10298	0	31	DTC 1521: CHT higher than expected stage 1	110	16
Undefined DTC - Index 10299	0	31	DTC 563: Vbat voltage high	168	15
DTC 2116: FPP2 higher than IVS	29		DTC 562: Vbat voltage low	168	17
DTC 2140: FPP2 lower than IVS	29	1	DTC 2428: EGT temperature high	173	0
DTC 2128: FPP2 voltage high	29		DTC 183: FT high voltage	174	3
DTC 2127: FPP2 voltage low	29		DTC 182: FT low voltage	174	4
DTC 221: TPS1-2 higher than expected	51	0	DTC 1417: EMWT1 higher than expected stage 2	441	0
DTC 121: TPS1-2 lower than expected	51	1	DTC 1411: EMWT1 voltage high	441	3
DTC 123: TPS1 voltage high	51	3	DTC 1413: EMWT1 voltage low	441	4
DTC 122: TPS1 voltage low	51		DTC 1415: EMWT1 higher than expected stage 1	441	15
DTC 2112: Unable to reach higher TPS	51	7	DTC 1418: EMWT2 higher than expected stage 2	442	0
DTC 2111: Unable to reach lower TPS	51	7	DTC 1412: EMWT2 voltage high	442	3
DTC 2135: TPS1/2 simultaneous voltages out-of-rar	51	31	DTC 1414: EMWT2 voltage low	442	4
DTC 502: Roadspeed input loss of signal	84	1	DTC 1416: EMWT2 higher than expected stage 1	442	15
DTC 2115: FPP1 higher than IVS	91	0	DTC 1425: ERWT1 higher than expected stage 2	443	0
DTC 2139: FPP1 lower than IVS	91	1	DTC 1419: ERWT1 voltage high	443	3
DTC 1630: J1939 ETC message receipt loss	91	2	DTC 1421: ERWT1 voltage low	443	4
DTC 2122: FPP1 voltage high	91	3	DTC 1423: ERWT1 higher than expected stage 1	443	15
DTC 2123: FPP1 voltage low	91	4	DTC 1426: ERWT2 higher than expected stage 2	444	0
DTC 1651: J1939 ETC message receipt loss while in	91		DTC 1420: ERWT2 voltage high	444	3
DTC 2126: FPP1-2 higher than expected	91		DTC 1422: ERWT2 voltage low	444	4
DTC 2121: FPP1-2 lower than expected	91		DTC 1424: ERWT2 higher than expected stage 1	444	15
DTC 1121: FPP1/2 simultaneous voltages out-of-ran	91		DTC 1112: RPM above spark rev limit level	515	0
DTC 88 Fuel pressure higher than expected	94		DTC 219: RPM higher than max allowed govern speed	515	15
DTC 87 Fuel pressure lower than expected	94		DTC 1111: RPM above fuel rev limit level	515	16
DTC 92: FP high voltage	94		DTC 2130: IVS stuck at-idle, FPP1/2 match	558	5
DTC 91: FP low voltage	94		DTC 2131: IVS stuck off-idle, FPP1/2 match	558	6
DTC 521: Oil pressure sender high pressure	100		DTC 601: Microprocessor failure - FLASH	628	13
DTC 524: Oil pressure low	100		DTC 606: Microprocessor failure - COP	629	31
DTC 524: Oil pressure sender low pressure	100		DTC 1612: Microprocessor failure - RTI 1	629	31
DTC 523: Oil pressure sender high voltage	100		DTC 1613: Microprocessor failure - RTI 2	629	31
DTC 522: Oil pressure sender low voltage	100		DTC 1614: Microprocessor failure - RTI 3	629	31
DTC 520: Oil pressure sender low pressure stage 1	100		DTC 1615: Microprocessor failure - A/D	629	31
DTC 127: IAT higher than expected stage 2	105		DTC 1616: Microprocessor failure - Interrupt	629	31
DTC 113: IAT voltage high	105		DTC 604: Microprocessor failure - RAM	630	12
DTC 112: IAT voltage low	105		DTC 336: CRANK input signal noise	636	2
DTC 111: IAT higher than expected stage 1	105	15	DTC 337: Crank signal loss	636	4

## DIAGNOSTIC TROUBLE CODE (DTC) CHART – SORTED BY SPN:FMI (2 of 4)

		Set 2			Set 2
Description	SPN-2	FMI-2	Description	SPN-2	FMI-2
DTC 16: Crank and/or cam could not synchronize du	636	8	DTC 1661: PWM6 open / ground short	925	5
DTC 1629: J1939 TSC1 message receipt loss	639	9	DTC 1664: PWM7 short to power	926	3
DTC 1626: CAN-J1939 Tx fault	639	12	DTC 1663: PWM7 open / ground short	926	5
DTC 1627: CAN-J1939 Rx fault	639	12	DTC 643: Sensor supply voltage 1 high	1079	3
DTC 1628: J1939 CAN address / engine-number co	639	13	DTC 642: Sensor supply voltage 1 low	1079	4
DTC 2619: Tach output short to power	645	3	DTC 1611: Sensor supply voltage 1 and 2 out-of-range	1079	31
DTC 2618: Tach output ground short	645	4	DTC 653: Sensor supply voltage 2 high	1080	3
DTC 261: Injector 1 open or short to ground	651	5	DTC 652: Sensor supply voltage 2 low	1080	4
DTC 262: Injector 1 coil shorted	651	6	DTC 238: TIP high voltage	1127	3
DTC 264: Injector 2 open or short to ground	652	5	DTC 237: TIP low voltage	1127	4
DTC 265: Injector 2 coil shorted	652	6	DTC 1131: WGP voltage high	1192	3
DTC 267: Injector 3 open or short to ground	653	5	DTC 1132: WGP voltage low	1192	4
DTC 268: Injector 3 coil shorted	653	6	DTC 1645: MIL control short to power	1213	3
DTC 270: Injector 4 open or short to ground	654	5	DTC 1644: MIL control ground short	1213	4
DTC 271: Injector 4 coil shorted	654	6	DTC 650: MIL open	1213	5
DTC 273: Injector 5 open or short to ground	655	5	DTC 359: Fuel run-out longer than expected	1239	7
DTC 274: Injector 5 coil shorted	655	6	DTC 2300: Spark coil 1 primary open or short to ground	1268	5
DTC 276: Injector 6 open or short to ground	656	5	DTC 2301: Spark coil 1 primary shorted	1268	6
DTC 277: Injector 6 coil shorted	656	6	DTC 2303: Spark coil 2 primary open or short to ground	1269	5
DTC 279: Injector 7 open or short to ground	657	5	DTC 2304: Spark coil 2 primary shorted	1269	6
DTC 280: Injector 7 coil shorted	657	6	DTC 2306: Spark coil 3 primary open or short to ground	1270	5
DTC 282: Injector 8 open or short to ground	658	5	DTC 2307: Spark coil 3 primary shorted	1270	6
DTC 283: Injector 8 coil shorted	658	6	DTC 2309: Spark coil 4 primary open or short to ground	1271	5
DTC 285: Injector 9 open or short to ground	659	5	DTC 2310: Spark coil 4 primary shorted	1271	6
DTC 286: Injector 9 coil shorted	659	6	DTC 2312: Spark coil 5 primary open or short to ground	1272	5
DTC 288: Injector 10 open or short to ground	660	5	DTC 2313: Spark coil 5 primary shorted	1272	6
DTC 289: Injector 10 coil shorted	660	6	DTC 2315: Spark coil 6 primary open or short to ground	1273	5
DTC 1631: PWM1-Gauge1 open / ground short	697	5	DTC 2316: Spark coil 6 primary shorted	1273	6
DTC 1632: PWM1-Gauge1 short to power	697	6	DTC 2318: Spark coil 7 primary open or short to ground	1274	5
DTC 1633: PWM2-Gauge2 open / ground short	698	5	DTC 2319: Spark coil 7 primary shorted	1274	6
DTC 1634: PWM2-Gauge2 short to power	698	6	DTC 2321: Spark coil 8 primary open or short to ground	1275	5
DTC 1635: PWM3-Gauge3 open / ground short	699	5	DTC 2322: Spark coil 8 primary shorted	1275	6
DTC 1636: PWM3-Gauge3 short to power	699	6	DTC 2324: Spark coil 9 primary open or short to ground	1276	5
DTC 1637: PWM4 open / ground short	700	5	DTC 2325: Spark coil 9 primary shorted	1276	6
DTC 1638: PWM4 short to power	700	6	DTC 2327: Spark coil 10 primary open or short to ground	1277	5
DTC 1547: AUX analog Pull-Up/Down 4 high voltage	713	3	DTC 2328: Spark coil 10 primary shorted	1277	6
DTC 1548: AUX analog Pull-Up/Down 4 low voltage	713	4	DTC 617: Start relay coil short to power	1321	3
DTC 341: CAM input signal noise	723	2	DTC 616: Start relay ground short	1321	4
DTC 342: Loss of CAM input signal	723	4	DTC 615: Start relay coil open	1321	5
DTC 134: EGO1 open / lazy	724	10	DTC 1311: Cylinder 1 misfire detected	1323	11
DTC 326: Knock1 excessive or erratic signal	731	2	DTC 301: Cylinder 1 emissions/catalyst damaging misfire	1323	31
DTC 327: Knock1 sensor open or not present	731	4	DTC 1312: Cylinder 2 misfire detected	1324	11
DTC 1643: Buzzer control short to power	920	3	DTC 302: Cylinder 2 emissions/catalyst damaging misfire	1324	31
DTC 1641: Buzzer control ground short	920	4	DTC 1313: Cylinder 3 misfire detected	1325	11
DTC 1642: Buzzer open	920	5	DTC 303: Cylinder 3 emissions/catalyst damaging misfire	1325	31
DTC 1662: PWM6 short to power	925	3	DTC 1314: Cylinder 4 misfire detected	1326	11

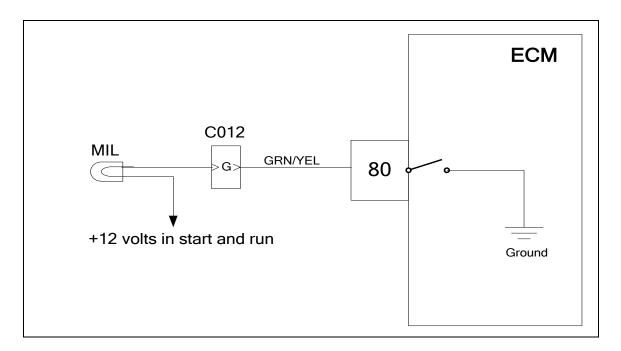
## DIAGNOSTIC TROUBLE CODE (DTC) CHART – SORTED BY SPN:FMI (3 of 4)

	DTC Set 2			DTC	Set 2
Description	SPN-2	FMI-2	Description	SPN-2	FMI-2
DTC 304: Cylinder 4 emissions/catalyst damaging m	1326	31	DTC 175: Adaptive-learn gasoline bank2 low	520201	1
DTC 1315: Cylinder 5 misfire detected	1327	11	DTC 1161: Adaptive-learn LPG high	520202	0
DTC 305: Cylinder 5 emissions/catalyst damaging m	1327	31	DTC 1162: Adaptive-learn LPG low	520202	1
DTC 1316: Cylinder 6 misfire detected	1328	11	DTC 1163: Adaptive-learn NG high	520203	0
DTC 306: Cylinder 6 emissions/catalyst damaging m	1328	31	DTC 1164: Adaptive-learn NG low	520203	1
DTC 1317: Cylinder 7 misfire detected	1329	11	DTC 1155: Closed-loop gasoline bank1 high	520204	0
DTC 307: Cylinder 7 emissions/catalyst damaging m	1329	31	DTC 1156: Closed-loop gasoline bank1 low	520204	1
DTC 1318: Cylinder 8 misfire detected	1330	11	DTC 1157: Closed-loop gasoline bank2 high	520205	0
DTC 308: Cylinder 8 emissions/catalyst damaging m	1330	31	DTC 1158: Closed-loop gasoline bank2 low	520205	1
DTC 628: Fuel-pump high-side open or short to grou	1347	5	DTC 1151: Closed-loop LPG high	520206	0
DTC 629: Fuel-pump high-side short to power	1347	6	DTC 1152: Closed-loop LPG low	520206	1
DTC 629: Fuel pump relay coil short to power	1348	3	DTC 1153: Closed-loop NG high	520207	0
DTC 628: Fuel pump relay control ground short	1348	4	DTC 1154: Closed-loop NG low	520207	1
DTC 627: Fuel pump relay coil open	1348	5	DTC 154: EGO2 open / lazy	520208	10
DTC 1625: J1939 shutdown request	1384	31	DTC 140: EGO3 open / lazy	520209	10
DTC 687: Power relay coil short to power	1485	3	DTC 160: EGO4 open / lazy	520210	10
DTC 686: Power relay ground short	1485	4	DTC 420: Catalyst inactive on gasoline (Bank 1)	520210	10
DTC 685: Power relay coil open	1485	5	DTC 430: Catalyst inactive on gasoline (Bank 2)	520212	10
DTC 234: Boost control overboost failure	1692	0	DTC 1165: Catalyst inactive on LPG	520212	10
DTC 299: Boost control underboost failure	1692	1	DTC 1166: Catalyst inactive on NG	520210	10
DTC 236: TIP active	1692	2	DTC 1515: AUX analog Pull-Down 1 high voltage	520215	3
DTC 1666: PWM8 short to power	2646	3	DTC 1516: AUX analog Pull-Down 1 low voltage	520215	4
DTC 1665: PWM8 open / ground short	2646	5	DTC 1511: AUX analog Pull-Up 1 high voltage	520216	3
DTC 1670: PWM9 short to power	2647	3	DTC 1512: AUX analog Pull-Up 1 low voltage	520216	4
DTC 1669: PWM9 open / ground short	2647	5	DTC 1513: AUX analog Pull-Up 2 high voltage	520217	3
DTC 8906: UEGO return voltage shorted high	3056	3	DTC 1514: AUX analog Pull-Up 2 low voltage	520217	4
DTC 8907: UEGO return voltage shorted low	3056	4	DTC 1517: AUX analog Pull-Up 3 high voltage	520218	3
DTC 8910: UEGO sense cell voltage high	3217	3	DTC 1518: AUX analog Pull-Up 3 low voltage	520218	4
DTC 8911: UEGO sense cell voltage low	3217	4	DTC 1541: AUX analog Pull-Up/Down 1 high voltage	520210	3
DTC 8908: UEGO pump voltage shorted high	3218	3	DTC 1542: AUX analog Pull-Up/Down 1 low voltage	520219	4
DTC 8909: UEGO pump voltage shorted low	3218	4	DTC 1543: AUX analog Pull-Up/Down 2 high voltage	520210	3
DTC 8904: UEGO cal resistor voltage high	32210		DTC 1544: AUX analog Pull-Up/Down 2 low voltage	520220	4
DTC 8905: UEGO cal resistor voltage low	3221	4	DTC 1545: AUX analog Pull-Up/Down 3 high voltage	520220	3
DTC 8901: UEGO microprocessor internal fault	3221	31	DTC 1546: AUX analog Pull-Up/Down 3 low voltage	520221	4
DTC 8916: UEGO sense cell impedance high	3222	0	DTC 1551: AUX digital 1 high voltage	520221	3
DTC 8902: UEGO heater supply high voltage	3222	3	DTC 1552: AUX digital 1 low voltage	520222	4
DTC 8902: UEGO heater supply high voltage	3222	4	DTC 1553: AUX digital 2 high voltage	520222	3
DTC 8903. DEGO fleater supply low voltage DTC 8914: UEGO sense cell slow to warm up	3222	10	DTC 1554: AUX digital 2 low voltage	520223	4
DTC 8914. DEGO sense cell slow to warm up DTC 8917: UEGO pump cell impedance high	3225	0	DTC 1555: AUX digital 3 high voltage	520223	3
DTC 8917: DEGO pump cell impedance high DTC 8918: UEGO pump cell impedance low	3225		DTC 1555: Water Intrusion Detection	520224	3
	3225	1 3		520224	3 4
DTC 8912: UEGO pump voltage at high drive limit DTC 8913: UEGO pump voltage at low drive limit	3225	4	DTC 1556: AUX digital 3 low voltage	520224	3
DTC 8913: DEGO pump voltage at low drive limit DTC 8915: UEGO pump cell slow to warm up	3225	4 10	DTC 916: Shift actuator feedback out-of-range DTC 919: Shift unable to reach desired gear	520226	
			<u> </u>		31
DTC 171: Adaptive-learn gasoline bank1 high	520200	0	DTC 920: Shift actuator or drive circuit failed	520226	5
DTC 172: Adaptive-learn gasoline bank1 low	520200	1	DTC 1639: PWM5 open / ground short	520230	
DTC 174: Adaptive-learn gasoline bank2 high	520201	0	DTC 1640: PWM5 short to power	520230	6

### DIAGNOSTIC TROUBLE CODE (DTC) CHART – SORTED BY SPN:FMI 4 of 4)

	DTC S	Set 2
Description	SPN-2	FMI-2
DTC 188: Gaseous fuel temperature sender high vo	520240	3
DTC 187: Gaseous fuel temperature sender low volt	520240	4
DTC 331: Knock2 excessive or erratic signal	520241	2
DTC 332: Knock2 sensor open or not present	520241	4
DTC 2120: FPP1 invalid voltage and FPP2 disagree	520250	31
DTC 2125: FPP2 invalid voltage and FPP1 disagree	520250	31
DTC 1122: FPP1/2 do not match each other or IVS (	520250	31
DTC 223: TPS2 voltage high	520251	3
DTC 222: TPS2 voltage low	520251	4
DTC 509: IAC coil open/short	520252	5
DTC 508: IAC ground short	520252	6
DTC 1171: MegaJector delivery pressure higher that	520260	0
DTC 1172: MegaJector delivery pressure lower than	520260	1
DTC 1174: MegaJector voltage supply high	520260	3
DTC 1175: MegaJector voltage supply low	520260	4
DTC 1176: MegaJector internal actuator fault detect	520260	12
DTC 1177: MegaJector internal circuitry fault detection	520260	12
DTC 1178: MegaJector internal comm fault detection	520260	12
DTC 1173: MegaJector comm lost	520260	31
DTC 1531: Gov1/2/3 interlock failure	520270	31
DTC 1182: Fuel impurity level high	520401	0
DTC 11: Intake cam / distributor position error	520800	7
DTC 24: Exhaust cam position error	520801	7
DTC 1183: MegaJector autozero / lockoff failure	520803	31

# **OBD System Check/MIL (Malfunction Indicator Lamp)**



### **Circuit Description**

The fuel system is equipped with OBD (On-Board Diagnostics). The system has a dash mounted MIL (Malfunction Indicator Lamp). The MIL serves as notification of an engine or fuel system related problem. The MIL also has the ability to flash DTC codes in what is referred to as the blink code mode. It will display DTCs that have been stored due to a possible system malfunction. The following DTC charts in this manual will instruct the technician to perform the OBD system check. This simply means to verify the operation of the MIL. The lamp should illuminate when the key is in the ON position, and the engine is not running. This feature verifies that the lamp is in proper working order. If the lamp does not illuminate with the vehicle key ON and engine OFF, repair it as soon as possible. Once the engine is in start or run mode, the lamp should go off. If the lamp stays on while the engine is in the Start or run mode, a current diagnostic trouble code may be set or a problem may exist with the MIL electrical wiring. The electrical schematic above shows the MIL power source supplied to the lamp. The ECM completes the circuit to ground to turn the lamp ON.

# **OBD System Check**

Step	Action	Value(s)	Yes	No
1	Key ON engine Off		Go to Step (2)	Go to Step (3)
	Start the engine		MIL is working	Go to Step (10)
	Does the MIL Lamp Turn off?		properly. OBD System	
			Check is	
2			complete	
	Key ON engine OFF		Go to Step (4)	Repair MIL voltage source.
	• Check for voltage between MIL power source and engine ground.			Refer to OEM
				body and
3	Do you have voltage?			chassis wiring diagrams
	Replace the MIL Lamp		Go to Step (1)	Go to Step (5)
4	Did that solve the problem?			
	Key OFF		Go to Step(6)	Go to Step (8)
	Disconnect ECM wire harness connector			
	Using a DVOM check for continuity between MIL side of the customer interface connector and			
	ECM pin 80			
5	Do you have continuity?			
	Inspect the MIL lamp socket, the customer		Repair the	Go to Step (7)
	interface connector, and ECM pin 80 for damage, corrosion, or contamination		circuit as nec- essary. Refer	
			to wiring re-	
6	Did you find a problem?		pairs section in the manual	
0	Replace ECM		Go to Step (1)	-
			,	
7	Is the replacement complete?			
	Backprobe both MIL and ECM side of termi-		Go to Step (9)	Repair the
	nal G at the customer interface connector			open circuit
	Using a DVOM check for continuity through			
	the customer interface connector			
8	Do you have continuity?			
	• Inspect the MIL lamp socket, customer inter- face connector, and ECM terminal number 80 for		Repair the damaged	Repair the wire harness open
	damage, corrosion, or contamination		socket or ter-	circuit as nec-
	Did you find a problem?		minal as	essary
9	Active DTC (Diagnostic Trouble Code) is stored		required	
	in memory. Proceed with DTC diagnosis. If no			
10	active DTC is found in ECM memory return to this			
10	page step (11)			

# OBD System Check

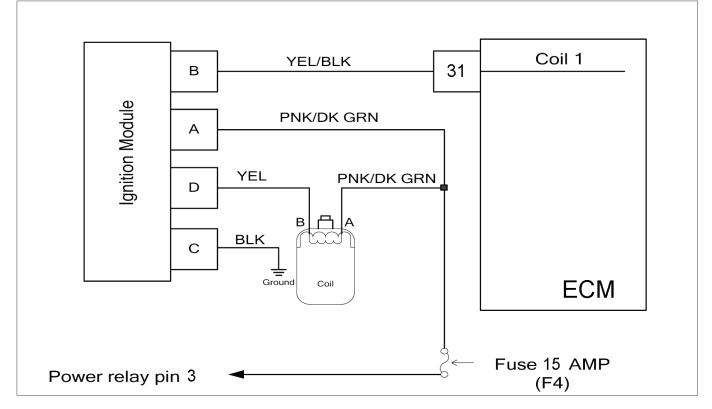
Step	Action	Value(s)	Yes	Νο
11	<ul> <li>Key is off</li> <li>Disconnect ECM wire harness connector at customer interface connector</li> <li>Using a DVOM check for continuity between ECM terminal 80 and battery voltage</li> <li>Do you have continuity?</li> </ul>		Repair the shorted ground circuit as necessary. Refer to wiring repairs in en- gine electrical	Go to Step (7)

# **Starter Circuit System Diagnostics**

STEP	Action	Value(s)	Yes	No
1	Remove the back off of the fuse and relay block assembly. Locate and inspect all wires/terminals for the starter relay circuit. Insure that all crimps are good and that all terminals are completely engaged into the block. Look for push back terminals or bad crimps.	All Okay	Go to Step (2)	Repair the wiring issue.
2	<ul> <li>Using a DVOM, back probe the starter relay coil terminal 85 to a +12V while cranking the engine</li> <li>Does the DVOM have a 12v signal while cranking?</li> </ul>	12v	Go to Step (3)	Check wire from the relay terminal 85 to pin 89 on the ECM. Check all terminals for spread condition or push back. Repair harness.
3	<ul> <li>Using a DVOM, back probe the starter relay coil terminal 86 to a Ground source while cranking the engine</li> <li>Does the DVOM have a 12v signal while cranking?</li> </ul>	12v	Go to Step (4)	Go to step (6)
4	<ul> <li>Using a DVOM, back probe starter relay contact feed terminal 87 to a Ground source</li> <li>Does the DVOM have a 12v signal at all times?</li> </ul>	12V	Go to Step (5)	Go to step (7)
5	Using a DVOM, back probe relay contact terminal 30 to a Ground source . Does the DVOM have a 12v signal while cranking?	12V	Go to Step (8)	Replace starter relay
6	<ul> <li>Check terminals at the CIC pin F and terminal 86 at the relay.</li> <li>Check for continuity between pin F at terminal 86 of the relay</li> <li>Do you have continuity? Are the pins fully seated and not spread?</li> </ul>	Yes	Issue with switched 12v supply from OEM. Consult OEM	Repair the wiring issue.
7	<ul> <li>Check circuit between terminal 87 and the 20A starter fuse.</li> <li>Check for pushed back pins, broken or cracked fuses.</li> </ul> Did the circuit have a fault between terminal 87 and the 20A fuse?		Repair the fault in the circuit	Possible internal harness issue.
8	<ul> <li>Check circuit between terminal 30 at the relay and the starter solenoid</li> <li>Check terminal 30 for spread terminals and pushback</li> <li>Is the circuit between terminal 30 and the starter okay?</li> </ul>		Replace Starter	Repair the wiring issue.

# **HVS Ignition Control System Diagnostics**

### 4.3L, 5.0L, 5.7L - SHOWN BELOW



#### Before using the Ignition Control Diagnostic chart be sure to check the following items:

#### Spark plug wires:

Be sure spark plug wires are in good condition. Check for cuts, breaks, burns, hardness or swelling. LPG fuel requires much higher peak firing voltages compared to gasoline. Check spark pug electrical continuity using a DVOM. Wires should ohm out to no more than 1,000 ohms per foot of wire length.

#### Distributor cap and rotor:

Check the cap and rotor assembly for moisture, corrosion or carbon tracking. The ignition timing is not adjustable. Turning the distributor assembly will not change the ignition timing, but will alter the rotor phase. Wipe away dust and debris from the ignition coil tower.

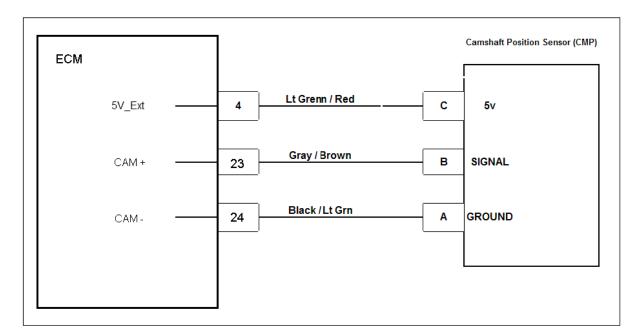
#### System power fuses:

Check the system power fuses. These sources supply the ignition coil and module system power. Check that the power and ground terminals are clean and in the proper location.

# Ignition Control System Diagnostic Chart

Step	Action	Value(s)	Yes	Νο
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD Sys- tem Check Section
2	<ul> <li>DST connected and in the system data mode.</li> <li>Crank the engine and observe the engine speed signal on the DST</li> <li>Is the value greater than the specified value?</li> </ul>	125 RPM	Go to Step (5)	Go to Step (3)
3	<ul> <li>Check the DST for historical code sets.</li> <li>(Always diagnose and repair codes with the lowest numerical value first).</li> <li>Run the diagnostic chart for DTC 337 Did you find and correct the problem?</li> </ul>		Go to Step (16)	Go to Step (4)
4	Run the diagnostic chart for DTC 342 Did you find and correct the problem?		Go to Step (16)	Go to Step (5)
5	<ul> <li>Disconnect the ignition module connector C011</li> <li>Using an LED type test lamp check for a sig- nal between the ignition module connector pin B and battery positive</li> <li>Crank the engine Does the LED test lamp flash while cranking the engine?</li> </ul>		Go to Step(6)	Go to Step (10)
6	<ul> <li>Using a DVOM check for power between the ignition module connector pin A and engine ground</li> <li>Do you have power?</li> </ul>		Go to Step (7)	Repair the sys- tem power circuit. Check all system fuses and power relay connections
7	<ul> <li>Disconnect the ignition coil connector C009</li> <li>Using a digital LED test lamp check for a signal between the ignition coil connector pin B and battery positive</li> <li>Crank the engine Does the LED test lamp flash while cranking the engine?</li> </ul>		Go to Step (8)	Go to Step (13)
8	<ul> <li>Using a DVOM check for voltage between the ignition coil connector pin A and engine ground</li> <li>Does the DVOM show voltage?</li> </ul>	System voltage	Go to Step (9)	Repair the sys- tem power circuit. Check all system fuses and power relay connections
9	<ul> <li>Replace the ignition coil Is the replacement complete?</li> </ul>		Go to Step (16)	_
10	<ul> <li>Key OFF</li> <li>Disconnect the ECM connector C001</li> <li>Using a DVOM check for continuity between ignition module connector pin B and ECM connector pin 31</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (11)	Repair the open ignition control circuit. See wir- ing harness repair section.

Step	Action	Value(s)	Yes	No
11	<ul> <li>Using a DVOM check for continuity between ignition module connector pin B and engine ground</li> <li>Do you have continuity between them?</li> </ul>		Repair the shorted to ground igni- tion control circuit. See wiring harness repair section.	Go to Step (12)
12	Replace ECM Is the replacement complete?		Go to Step (16)	-
13	<ul> <li>Disconnect coil. Using a DVOM check for continuity between the ignition module con- nector pin C and engine ground</li> <li>Do you have continuity?</li> </ul>		Go to Step (14)	Repair the open ignition module ground circuit. See wring har- ness repair.
14	<ul> <li>Using a DVOM check for continuity between the ignition module connector pin D and igni- tion coil connector pin B</li> <li>Do you have continuity?</li> </ul>		Go to Step (15)	Repair the open ignition module circuit. See wir- ing harness repair.
15	<ul> <li>Replace the ignition module.</li> <li>Is the replacement complete?</li> </ul>		Go to Step (16)	-
16	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD Sys- tem Check



### DTC 11 – Intake cam / distributor position error (SPN 520800:FMI 7)

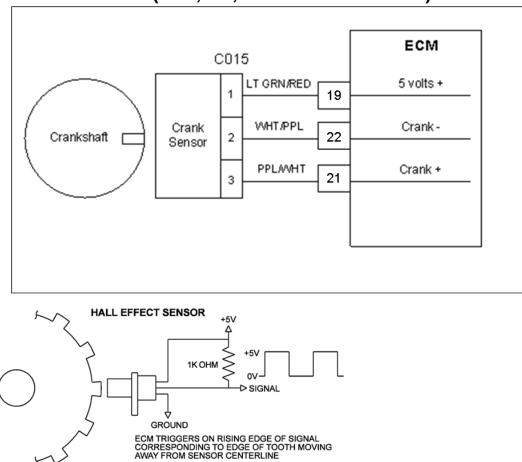
### Conditions for setting the DTC

- Camshaft Position sensor
- Check Condition- Engine cranking
- Fault Condition- Engine RPM's greater than 2,000 and difference between the desired CAM position and actual CAM position is greater than 30 CAD
- MIL Command-ON

### **Circuit Description**

The CAM position sensor is utilized to distinguish the cylinder event (compression or exhaust), thus making the cylinder identification available to the ECM. The camshaft position sensor is a 3 wire hall effect sensor. One wire for current feed (5v), one for ground, and one for the output signal (CAM 1). The sensor must have a good 5v reference and ground to operate properly. The CAM position and CAM Position desired value is displayed on the "TESTS" page in the GCP display software. This code will set when these two values are more than 30 CAD BTDC apart.

To change the CAM position you should rotate the distributor. If rotating the distributor does not correct the issue you should troubleshoot sensor, wiring, and ECM for issues.



### (4.3L, 5.0, & 5.7L Shown Below)

### Conditions for setting the DTC

- Crankshaft Position sensor
- Check Condition- Engine cranking
- Fault Condition- Cranking rpm above 90 and more than 4 cranking revolutions without synchronization
- Adaptive Disabled
- MIL Command-ON

#### **Circuit Description**

The Crankshaft position sensor is a 5 volt powered sensor mounted to the lower front engine block. A pulse wheel located on the crankshaft is used to measure engine rpm and its signal is used to synchronize the ignition and fuel systems. This fault will set if the ECM detects cranking revolutions without synchronization of the CMP and CKP sensors.

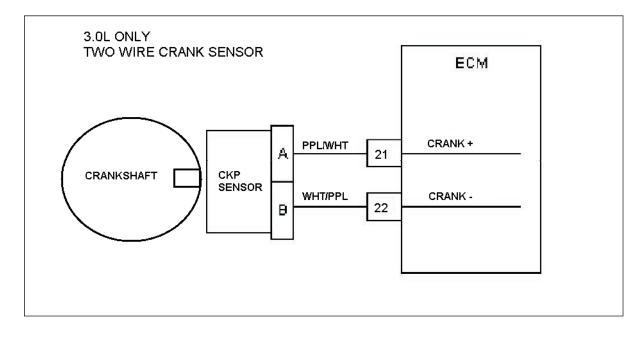
Reversed sensor wires, poor wire connections or a faulty system ground are most frequently the cause of this code set.

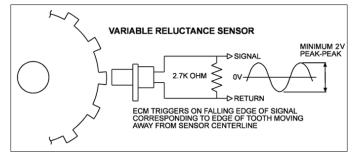
# DTC 16-Never Crank Synchronized at Start (SPN 636:FMI 8)

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	- -	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Check that the ECM ground terminals C010, C022 and C023 are clean and tight Are the ground terminals clean and tight?</li> </ul>		Go to Step (3)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
3	<ul> <li>Key On, Engine OFF</li> <li>Disconnect the CKP (Crankshaft position) Sensor connector C015</li> <li>Using A DVOM check for voltage at the CKP sensor connector pin 1 and engine ground (CHECK THIS BEFORE THE POWER RELAY SHUTS OFF)</li> <li>Do you have voltage?</li> </ul>	5.0 volts	Go to Step (4)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
4	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Using a DVOM check for continuity between CKP connector pin 2 and ECM connector pin 22</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (5)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
5	<ul> <li>Using a DVOM check for continuity between CKP connector pin 3 and ECM connector pin 21</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (6)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
6	<ul> <li>Inspect the CKP connector C015 terminals for damage, corrosion or contamination Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (7)
7	<ul> <li>Inspect the ECM connector C001 terminals 19, 21 and 22 for damage, corrosion or con- tamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to step (8)

Step	Action	Value(s)	Yes	No
8	<ul> <li>Replace CKP sensor</li> <li>Is the replacement complete?</li> </ul>		Go to Step (10)	-
9	Replace ECM Is the replacement complete?		Go to Step (11)	-
10	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-16 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to Step (9)
11	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-16 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 16-Never Crank Synced At Start (3.0L ONLY) (SPN 636:FMI 8)





### Conditions for setting the DTC

- Crankshaft Position sensor
- Check Condition- Engine cranking
- Fault Condition- Cranking RPM above 90 and more than 4 cranking revolutions without sync
- MIL Command-ON

### NOTE: The 3.0L engine has a 2 wire Variable Reluctance Sensor

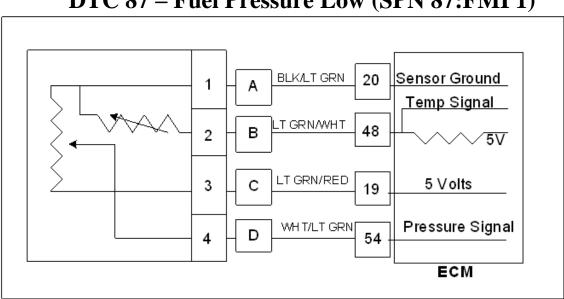
#### **Circuit Description**

The CKP (crankshaft position sensor) is a magnetic transducer mounted on the engine block adjacent to a pulse wheel located on the crankshaft. It determines crankshaft position by monitoring the pulse wheel. The Crankshaft Position sensor is used to measure engine RPM and its signal is used to synchronize the ignition and fuel systems. This fault will set one or

more crank re-sync occur within 800 ms.

Step         Did you perform the On-Board (OBD) System Check?         Value(s)         Yes         No.           2         • Check to be sure that the ECM ground terminals C014 and C023 are clean and tight. Are terminals C014 and C023 clean and tight?         Go to Step (2)         Go to Step (2)         Repair the section           3         • Key OFF         Over .5 volts         Go to Step (4)         Repairs in Engine Flactrical           3         • Key OFF         Over .5 volts         Go to Step (4)         Go to Step (1)           4         • Disconnect the CKP sensor connector C017         Using a DVOM check for voltage output directly from the CKP sensor while cranking the engine         Go to Step (5)         Repair the circuit as necessary. Refer to           4         • ReyOrF         Go to Step (5)         Repair the circuit as necessary. Refer to Wiring Repairs in Engine           5         • Using a DVOM check for continuity between CKP connector pin A and ECM connector pin 21         Go to Step (5)         Repair the circuit as necessary. Refer to Wiring Repairs in Engine           5         • Using a DVOM check for continuity between CKP connector pin B and ECM connector pin 22         Go to Step (5)         Repair the circuit as necessary. Refer to           6         • Inspect the CKP connector C017 pins for damage, corrosion or contamination         Repair the circuit as necessary. Refer to         Go to Step (7)           7         • Inspect the					
2       • Check to be sure that the ECM ground terminals C014 and C023 are clean and tight. Are terminals C014 and C023 clean and tight?       Go to Step (3)       Repair the circuit as necessary. Refer to         3       • Key OFF       Over 5 volts       Go to Step (4)       Go to Step (4)         4       • Disconnect the CKP sensor connector C017       Over 5 volts       Go to Step (4)       Go to Step (4)         4       • Do you have voltage output directly from the CKP sensor while cranking the engine       Over 5 volts       Go to Step (5)       Repair the circuit as necessary. Refer to         4       • ReyOFF       Over 5 volts       Go to Step (5)       Repair the circuit as necessary. Refer to         5       • Disconnect ECM connector pin 21       Go to Step (6)       Repair the circuit as necessary. Refer to         5       • Using a DVOM check for continuity between CKP connector pin B and ECM connector pin 22       Go to Step (6)       Repairs in Engine         6       • Inspect the CKP connector CU17 pins for damage, corrosion or contamination       Refer to       Wiring Repairs in Engine         7       • Inspect the ECM connector C001 pins 21 and 22       Repair the circuit as necessary. Refer to       Go to Step (8)         7       • Inspect the ECM connector C001 pins 21 and 22       Repairs in in Engine       Go to Step (8)         7       • Inspect the ECM connector C001 pins 21 and 22	Step	Action	Value(s)		
2     • Check to be sure that the ECM ground terminals C014 and C023 are clean and tight. Are terminals C014 and C023 clean and tight.     Go to Step (3)     Go to Step (3)     Section recessary. Refer to Wiring Repairs in Engine       3     • Key OFF     Over .5 volts     Go to Step (4)     Go to Step (4)     Go to Step (4)       4     • Disconnect the CKP sensor connector C017     • Using a DVOM check for voltage output directly from the CKP sensor while cranking the engine     Go to Step (5)     Repair the circuit as necessary. Refer to Wiring Repairs in Engine       4     • Key OFF     Go to Step (5)     Repair the circuit as       5     • Do you have voltage output?     Go to Step (6)     Repair the circuit as       6     • Inspect the CKP connector C011     Go to Step (6)     Repair the circuit as       5     • Using a DVOM check for continuity between CKP connector pin B and ECM connector pin 22     Go to Step (6)     Repair the circuit as necessary. Refer to       5     • Using a DVOM check for continuity between them?     Go to Step (6)     Repair the circuit as necessary. Refer to       6     • Inspect the CKP connector C017 pins for damage, corrosion or contamination     Repair the circuit as necessary. Refer to     Go to Step (7)       7     • Inspect the ECM connector C001 pins 21 and 22 for damage, corrosion or contamination     Repair the circuit as necessary. Refer to     Go to Step (8)       7     • Inspect the ECM connector C001 pins 21 and 22 for dama	'	Did you perform the On-board (OBD) System Check?	-	Go to Step (2)	
2       • Check to be sure that the ECM ground terminals C014 and C023 are clean and tight. Are terminals C014 and C023 clean and tight?       Go to Step (3)       Repair the circuit as necessary. Refer to Wiring Repairs in Engine         3       • Key OFF       Over .5 volts       Go to Step (4)       Go to Step (4)         4       • Ley OFF       Over .5 volts       Go to Step (5)       Repair the circuit as necessary. Refer to Wiring Repairs in Engine         4       • Key OFF       • Dayou have voltage output?       Go to Step (5)       Repair the circuit as necessary. Refer to Wiring Repairs in Engine         4       • Key OFF       Over .5 volts       Go to Step (5)       Repair the circuit as necessary. Refer to Wiring Repairs in Engine         5       • Using a DVOM check for continuity between CKP connector pin B and ECM connector pin 21       Go to Step (6)       Repair the circuit as necessary. Refer to Wiring Repairs in Engine         5       • Using a DVOM check for continuity between CKP connector pin B and ECM connector pin 22 Do you have continuity between them?       Go to Step (6)       Repair the circuit as necessary. Refer to Wiring Repairs in Engine         6       • Inspect the CKP connector C017 pins for damage, corrosion or contamination       Repair the circuit as necessary. Refer to Wiring Repairs in Engine       Go to step (8)         7       • Inspect the ECM connector C001 pins 21 and 22 for damage, corrosion or contamination Did you find a problem?       Go to Step (10)       <					
4       Free terminals C014 and C023 are clean and tight?       Over .5 volts       Go to Step (4)       Circuit as necessary. Refer to Wring Repairs in Engine         3       •       Key OFF       Over .5 volts       Go to Step (4)       Go to Step (4)         4       •       Do you have voltage output directly from the CKP sensor while cranking the engine       Go to Step (5)       Repair the circuit as necessary. Refer to Wring Repairs in Engine         4       •       Rey OFF       Over .5 volts       Go to Step (5)       Repair the circuit as necessary. Refer to Wring Repairs in Engine         5       •       Do you have voltage output?       Go to Step (5)       Repair the circuit as necessary. Refer to Wring Repairs in Engine         5       •       Using a DVOM check for continuity between CKP connector pin 21       Do you have continuity between them?       Go to Step (6)       Repair the circuit as necessary. Refer to Wring Repairs in Engine         5       •       Using a DVOM check for continuity between CKP connector pin 22 Do you have continuity between them?       Go to Step (6)       Electrical Repair the circuit as necessary. Refer to Wring Repairs in Engine         6       •       Inspect the CKP connector C017 pins for damage, corrosion or contamination       Repair the circuit as necessary. Refer to Wring Repairs in Engine       Go to step (8)         7       •       Inspect the ECM connector C001 pins 21 and 22 for damage, corros	2	<ul> <li>Check to be sure that the ECM ground</li> </ul>		Go to Step (3)	Repair the
Are terminals C014 and C023 clean and tight?       necessary. Refer to Wiring Repairs in Engine         3       • Key OFF       Over .5 volts       Go to Step (4)       Go to Step (4)         4       • Disconnect the CKP sensor connector C017       Over .5 volts       Go to Step (5)       Repair the circuit as necessary. Refer to         4       • Key OFF       Over .5 volts       Go to Step (5)       Repair the circuit as necessary. Refer to         4       • Ley OFF       Over .5 volts       Go to Step (5)       Repair the circuit as necessary. Refer to         5       • Using a DVOM check for continuity between CKP connector pin B and ECM connector pin 21       Go to Step (6)       Repair the circuit as necessary. Refer to         5       • Using a DVOM check for continuity between CKP connector pin B and ECM connector pin 22 Do you have continuity between them?       Go to Step (6)       Repair the circuit as necessary. Refer to         6       • Inspect the CKP connector C017 pins for damage, corrosion or contamination       Repair the circuit as necessary. Refer to       Go to Step (7)         7       • Inspect the ECM connector C001 pins 21 and 22 for damage, corrosion or contamination       Repair the circuit as necessary. Refer to       Go to step (8)         11       • Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground Do you have continuity?       Repair the circuit as neceesary. Refer to       Go to Step (10) </th <th>_</th> <th>,</th> <th></th> <th></th> <th></th>	_	,			
3       • Key OFF       Over .5 volts       Go to Step (4)       Refer to Wiring Repairs in Engine Flectrical Go to Step (4)         3       • Key OFF       • Disconnect the CKP sensor connector C017       • Using a DVOM check for voltage output directly from the CKP sensor while cranking the engine • Do you have voltage output?       Go to Step (5)       Repair the circuit as necessary. Refer to Wiring Repairs in Engine         4       • Key OFF       • Disconnect ECM connector C001       Go to Step (5)       Repair the circuit as necessary. Refer to Wiring Repairs in Engine         5       • Using a DVOM check for continuity between CKP connector pin B and ECM connector pin 22 Do you have continuity between them?       Go to Step (6)       Repair the circuit as necessary. Refer to Wiring Repairs in Engine         6       • Inspect the CKP connector C017 pins for damage, corrosion or contamination Did you find a problem?       Repair the circuit as necessary. Refer to Wiring Repairs in Engine       Go to step (6)         7       • Inspect the ECM connector C001 pins 21 and 22 for damage, corrosion or contamination Did you find a problem?       Go to step (8) circuit as necessary. Refer to Wiring Repairs in Engine       Go to step (8)         8       • Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground Do you have continuity?       Repair the circuit as necessary. Refer to Wiring Repairs in Engine       Go to Step (10)		5			
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• Using a DVOM check for voltage output directly from the CKP sensor while cranking the engine       • Go to Step (5)       Repar the circuit as necessary. Refer to         • Key OFF       • Disconnect ECM connector C001       • Go to Step (5)       Repar the circuit as necessary. Refer to         • Using a DVOM check for continuity between CKP connector pin A and ECM connector pin 21       • Go to Step (6)       Repar the circuit as necessary. Refer to         • Using a DVOM check for continuity between CKP connector pin B and ECM connector pin 22 Do you have continuity between them?       Go to Step (6)       Repair the circuit as necessary. Refer to         • Inspect the CKP connector C017 pins for damage, corrosion or contamination       Repair the circuit as necessary. Refer to       Go to Step (6)       Go to Step (7)         • Inspect the ECM connector C001 pins 21 and 22 for damage, corrosion or contamination       Repair the circuit as necessary. Refer to       Go to step (8)         • Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground       Repair the circuit as necessary. Refer to       Go to step (8)         • Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground       So to Step (10)       So to Step (10)         8       Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground       So to Step (10)         bo you have continuity?       Engine Flactrical Repairs in Engine       Go to Step (10)	3	Key OFF	Over .5 volts	Go to Step (4)	Go to Step (11)
a directly from the CKP sensor while cranking the engine       • Do you have voltage output?       Go to Step (5)       Repar the circuit as necessary.         4       • Key OFF       • Disconnect ECM connector C001       Go to Step (5)       Repair the circuit as necessary.         • Do you have continuity between them?       • Do you have continuity between them?       Go to Step (5)       Repair the circuit as necessary.         5       • Using a DVOM check for continuity between CKP connector pin B and ECM connector pin 22       Go to Step (6)       Repair the circuit as necessary.         5       • Using a DVOM check for continuity between them?       Go to Step (6)       Repair the circuit as necessary.         6       • Inspect the CKP connector C017 pins for damage, corrosion or contamination       Repair the circuit as necessary.       Go to Step (7)         7       • Inspect the ECM connector C001 pins 21 and 22       Repair the circuit as necessary.       Go to step (8)         6       • Using a DVOM check for continuity between ECM       Refer to Wiring Repairs in Engine Electrical       Go to step (9)         7       • Inspect the ECM connector C001 pins 21 and 22       Refer to Wiring Repairs in Engine       Go to step (8)         8       • Using a DVOM check for continuity between ECM       Repair the circuit as necessary.       Refer to Wiring Repairs in Engine         8       • Using a DVOM check for continuity between ECM <td></td> <td><ul> <li>Disconnect the CKP sensor connector C017</li> </ul></td> <td></td> <td></td> <td></td>		<ul> <li>Disconnect the CKP sensor connector C017</li> </ul>			
a directly from the CKP sensor while cranking the engine       • Do you have voltage output?       Go to Step (5)       Repar the circuit as necessary.         4       • Key OFF       • Disconnect ECM connector C001       Go to Step (5)       Repair the circuit as necessary.         • Do you have continuity between them?       • Do you have continuity between them?       Go to Step (5)       Repair the circuit as necessary.         5       • Using a DVOM check for continuity between CKP connector pin B and ECM connector pin 22       Go to Step (6)       Repair the circuit as necessary.         5       • Using a DVOM check for continuity between them?       Go to Step (6)       Repair the circuit as necessary.         6       • Inspect the CKP connector C017 pins for damage, corrosion or contamination       Repair the circuit as necessary.       Go to Step (7)         7       • Inspect the ECM connector C001 pins 21 and 22       Repair the circuit as necessary.       Go to step (8)         6       • Using a DVOM check for continuity between ECM       Refer to Wiring Repairs in Engine Electrical       Go to step (9)         7       • Inspect the ECM connector C001 pins 21 and 22       Refer to Wiring Repairs in Engine       Go to step (8)         8       • Using a DVOM check for continuity between ECM       Repair the circuit as necessary.       Refer to Wiring Repairs in Engine         8       • Using a DVOM check for continuity between ECM <td></td> <td><ul> <li>Using a DVOM check for voltage output</li> </ul></td> <td></td> <td></td> <td></td>		<ul> <li>Using a DVOM check for voltage output</li> </ul>			
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Did you find a problem?       necessary. Refer to Wiring Repairs in Engine         7       • Inspect the ECM connector C001 pins 21 and 22 for damage, corrosion or contamination       Repair the circuit as necessary. Refer to       Go to step (8)         Did you find a problem?       Refer to Wiring Repairs in Engine       Go to step (10)         8       • Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground Do you have continuity?       Repair the shorted circuit as necessary. Refer to Wiring Repairs in Engine       Go to Step (10)	6	<ul> <li>Inspect the CKP connector C017 pins for damage,</li> </ul>		Repair the	
7       • Inspect the ECM connector C001 pins 21 and 22 for damage, corrosion or contamination       Refer to         9       • Inspect the ECM connector C001 pins 21 and 22 for damage, corrosion or contamination       Repair the circuit as necessary.         1       • Inspect the ECM connector C001 pins 21 and 22 for damage, corrosion or contamination       Refer to         1       • Using a problem?       Refer to         8       • Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground       Repair the shorted circuit as necessary.         8       • Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground       Go to Step (10)         1       Bo you have continuity?       Refer to         1       Wiring Repairs in Engine       Go to Step (10)		corrosion or contamination		circuit as	
7       • Inspect the ECM connector C001 pins 21 and 22 for damage, corrosion or contamination       Refer to         9       • Inspect the ECM connector C001 pins 21 and 22 for damage, corrosion or contamination       Repair the circuit as necessary.         9       • Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground       Repair the connector contamination       Go to Step (10)         8       • Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground       Repair the connector continuity?       Go to Step (10)         8       • Using Repairs in Engine       Filectrical connector pins 21 and 22 to engine ground       Shorted circuit as necessary.       Go to Step (10)         9       • Using Repairs in Engine       Integration of the continuity is the second of the continuity is the second of the circuit as necessary.       Refer to       Wiring Repairs in Engine         8       • Using Repairs in Engine       Integration of the circuit as necessary.       Integration of the circuit as necessary.       Integration of the circuit as necessary.         9       • Using Repairs in Engine		Did you find a problem?		necessary.	
7       • Inspect the ECM connector C001 pins 21 and 22 for damage, corrosion or contamination Did you find a problem?       Go to step (8) circuit as necessary. Refer to Wiring Repairs in Engine Electrical         8       • Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground Do you have continuity?       Go to Step (10) shorted circuit as necessary. Refer to Wiring Repairs in Engine Electrical				Refer to	
7       Inspect the ECM connector C001 pins 21 and 22 for damage, corrosion or contamination       Repair the circuit as necessary.       Go to step (8)         Did you find a problem?       Refer to       Wiring Repairs in Engine       Go to Step (10)         8       Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground       Repair the Shorted circuit as necessary.       Go to Step (10)         9       Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground       Repair the Shorted circuit as necessary.       Go to Step (10)         0       you have continuity?       Refer to       Wiring Repairs in Engine       Go to Step (10)				Wiring Repairs	
7       • Inspect the ECM connector C001 pins 21 and 22 for damage, corrosion or contamination       Repair the circuit as necessary. Refer to       Go to step (8)         Did you find a problem?       Refer to       Wiring Repairs in Engine       Flectrical         8       • Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground       Repair the shorted circuit as necessary. Refer to       Go to Step (10)         8       • Using a DVOM check for continuity between ECM in Engine       Repair the shorted circuit as necessary. Refer to       Go to Step (10)         8       • Using Repairs in Engine       In Engine       Shorted circuit as necessary. Refer to       Shorted circuit as necessary. Refer to         9       • Using Repairs in Engine       In Engine       Shorted circuit as necessary. Refer to       Shorted circuit as necessary. Refer to				in Engine	
for damage, corrosion or contamination       circuit as         Did you find a problem?       necessary.         Refer to       Wiring Repairs         in Engine       Electrical         8       Using a DVOM check for continuity between ECM         8       Using a DVOM check for continuity between ECM         0       Repair the         0       shorted circuit         as necessary.       Refer to         Wiring Repairs       Shorted circuit         as necessary.       Refer to         Wiring Repairs       Shorted circuit         as necessary.       Refer to         Wiring Repairs       in Engine				Electrical	Cata day (D)
Did you find a problem?       necessary. Refer to Wiring Repairs in Engine Electrical         8       Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground Do you have continuity?       Repair the shorted circuit as necessary. Refer to Wiring Repairs in Engine	l (				Go to step (8)
8       • Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground       Refer to Repair the So to Step (10) shorted circuit as necessary. Refer to Wiring Repairs in Engine         8       • Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground       Repair the So to Step (10) shorted circuit as necessary. Refer to Wiring Repairs in Engine	1	<b>U</b>		1	
8       • Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground Do you have continuity?       Wiring Repairs in Engine Go to Step (10) shorted circuit as necessary. Refer to Wiring Repairs in Engine	1	Did you find a problem?		1 2	
8       • Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground Do you have continuity?       Repair the Go to Step (10) shorted circuit as necessary. Refer to Wiring Repairs in Engine	1				
8       • Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground       Repair the shorted circuit as necessary. Refer to Wiring Repairs in Engine	1				
<ul> <li>Using a DVOM check for continuity between ECM connector pins 21 and 22 to engine ground Do you have continuity?</li> <li>Repair the Go to Step (10) shorted circuit as necessary. Refer to Wiring Repairs in Engine</li> </ul>	1			. <u> </u>	
connector pins 21 and 22 to engine ground Do you have continuity? Refer to Wiring Repairs in Engine	8	<ul> <li>Using a DVOM check for continuity between ECM</li> </ul>		Repair the	Go to Step (10)
Do you have continuity?  Do you have continuity?  as necessary.  Refer to  Wiring Repairs in Engine					
Refer to Wiring Repairs in Engine	1				
Wiring Repairs in Engine	1	bo you have continuity:			
in Engine	1				
				Electrical	

Step	Action	Value(s)	Yes	No
- 9-	Replace CKP sensor		Go to Step (12)	-
	Is the replacement complete? • Replace ECM			
10			Go to Step (12)	-
4.4	Is the replacement complete?     Key OFF		Dessisting	Cala Star (0)
11	-		Repair the	Go to Step (9)
	<ul> <li>Inspect the pulse wheel and CKP sensor</li> </ul>		component	
	for mechanical damage, corrosion or		as necessary.	
	contamination.		Refer to	
	Did you find a problem?		Engine Repairs	
			in Engine	
12	Remove all test equipment except the DST.		Section System OK	Go to OBD
12	<ul> <li>Connect any disconnected components, fuses,</li> </ul>		oystem or	System Check
	etc.			System Oneck
	<ul> <li>Using the DST clear DTC information from the</li> </ul>			
	ECM.			
	<ul> <li>Turn the ignition OFF and wait 30 seconds.</li> </ul>			
	<ul> <li>Start the engine and operate the vehicle to full operating temperature</li> </ul>			
	After operating the engine within the test			
	parameters of DTC-16 check for any stored codes			
	Does the engine operate normally with no stored			
	codes?			



DTC 87 – Fuel Pressure Low (SPN 87:FMI 1)

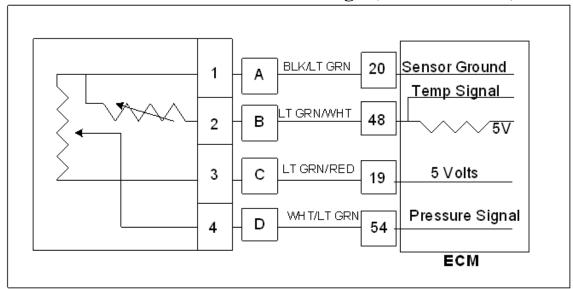
### **Conditions for setting the DTC**

- Fuel Pressure is less than 55 psia
- Fault must be active for 3.0 seconds to activate DTC
- MIL light on during fault
- Forced idle is enabled

### **Circuit Description**

This engine is equipped with a fuel injector rail that does not have a pressure regulator or a return circuit to the fuel tank. Fuel pressure for this engine is regulated by the engine's ECM. The ECM receives fuel pressure and temperature feedback from the gasoline fuel sensor manifold and uses this information to control the ground side of the fuel pump. Fuel pressure is regulated by the ECM pulse width modulating (PWM) the fuel pump. The fuel pressure and temperature sensor manifold has a return or "bleed" circuit that connects back to the equipment fuel tank. This circuit is used to bleed off any vapor that develops in the line and returns a small amount of fuel to the tank. The fuel comes from the fuel tank and passes through the fuel pump. Fuel exits the fuel pump, passes through the filter and then enters the fuel pressure and temperature manifold assembly. Fuel flows through the feed circuit and is delivered to the fuel injector rail. Fuel that enters the bleed circuits through the by-pass valve in the manifold is returned to the fuel tank.

STEP	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	,	Go to Step (2)	Go to OBD System Check Section
2	<ul> <li>Key On</li> <li>DST (Diagnostic Scan Tool) connected</li> <li>On the FAULTS page, check the value for fuel rail pressure</li> <li>Does the DST display 55 psia or less?</li> </ul>	55 psia or less?	Go to Step (3)	Intermittent problem. Go to intermittent section
3	Check the fuel pressure using a manual fuel pressure gauge Does the manual gauge display 55 psi or less?	55 psia or less?	Go to Step (4)	Go to step (5)
4	Check for an open in the fuel pump ground circuit (OEM supplied) Is there an open in the ground circuit?		Repair the open circuit	Go to step (6)
5	<ul> <li>Jumper pins C and D at the fuel pressure sensor connector</li> <li>Monitor the FRP_Raw volts on the VOLTAGE page.</li> </ul> Does FRP_Raw display 5 volts?	5 volts	Replace the Fuel pressure Sensor	Repair the wiring between the fuel pump pressure sensor and the ECM
6	<ul> <li>Check the OEM fuel hoses for proper installation and routing</li> <li>Check the OEM fuel hoses for blockages</li> <li>Were the OEM fuel hoses improperly installed or have a blockage?</li> </ul>		Repair the OEM fuel hose issue	Replace ECM



DTC 88 – Fuel Pressure High (SPN 94:FMI 0)

### **Conditions for setting the DTC**

- Fuel Pressure is greater than 90 psia
- Fault must be active for 3.0 seconds to activate DTC
- MIL light on during fault
- Forced idle is enabled

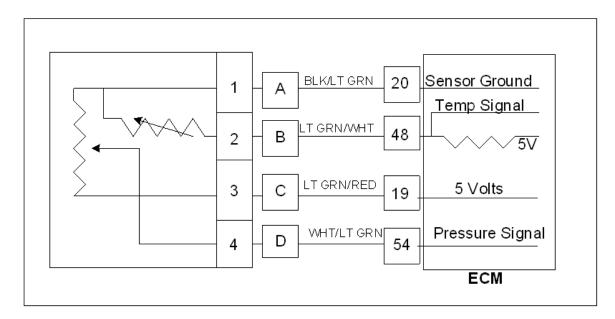
### **Circuit Description**

This engine is equipped with a fuel injector rail that does not have a pressure regulator or a return circuit to the fuel tank. Fuel pressure for this engine is regulated by the engine's ECM. The ECM receives fuel pressure and temperature feedback from the gasoline fuel sensor manifold and uses this information to control the ground side of the fuel pump. Fuel pressure is regulated by the ECM pulse width modulating (PWM) the fuel pump. The fuel pressure and temperature sensor manifold has a return or "bleed" circuit that connects back to the equipment fuel tank. This circuit is used to bleed off any vapor that develops in the line and returns a small amount of fuel to the tank. The fuel comes from the fuel tank and passes through the fuel pump. Fuel exits the fuel pump, passes through the filter and then enters the fuel pressure and temperature manifold assembly. Fuel flows through the feed circuit and is delivered to the fuel injector rail. Fuel that enters the bleed circuits through the by-pass valve in the manifold is returned to the fuel tank.

# DTC 88 – Fuel Pressure High

STEP	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	<ul> <li>Key On</li> <li>DST (Diagnostic Scan Tool) connected</li> <li>On the FAULTS page, check the value for fuel rail pressure</li> <li>Does the DST display 90 psia or greater?</li> </ul>	90 psia or greater	Go to Step (3)	Intermittent problem. Go to intermittent section
3	<ul> <li>Check the fuel pressure using a manual fuel pressure gauge</li> <li>Does the manual gauge display 90 psi or greater?</li> </ul>	90 psia or greater	Go to Step (4)	Go to step (5)
4	Check for a short to ground in the fuel pump ground circuit (OEM supplied) Is the ground circuit shorted to a ground?		Repair the short to ground	Go to step (6)
5	<ul> <li>Jumper pins C and D at the fuel pressure sensor connector</li> <li>Monitor the FRP_Raw volts on the VOLTAGE page.</li> <li>Does FRP_Raw display 5 volts?</li> </ul>	5 volts	Replace the Fuel pressure Sensor	Repair the wiring between the fuel pump pressure sensor and the ECM
6	<ul> <li>Check the OEM fuel hoses for proper installation and routing</li> <li>Check the OEM fuel hoses for blockages</li> <li>Were the OEM fuel hoses improperly installed or have a blockage?</li> </ul>		Repair the OEM fuel hose issue	Replace ECM

# DTC 91-Gasoline Fuel Pressure Sensor Low Voltage (SPN 94: FMI 4)



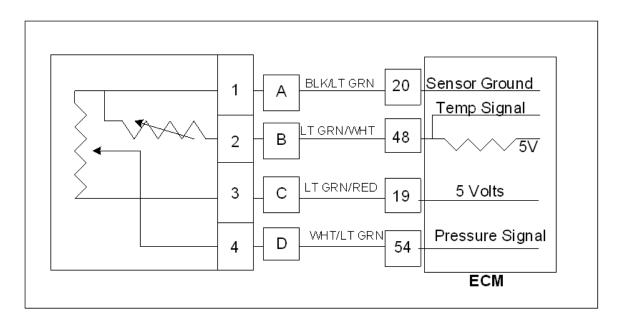
### Conditions for Setting the DTC

- Gasoline fuel temperature sensor voltage
- Fuel pressure sensor voltage less than 0.2v for greater than 1 second
- MIL-On for active fault and for 2 seconds after active fault
- Adaptive Learn is disabled during fault condition
- Forced idle is enabled

### **Circuit Description**

Note: The fuel pressure and temperature sensor is wired via Equipment Manufacturer supplied harness jumper. The terminals A, B, C, D & 19, 20, 48, 54 are engine wiring harness terminals at the fuel sensor interface connector C002 and the ECM header connector C001. You may need to consult additional wiring information supplied by the OEM. The gasoline fuel pressure sensor voltage is read at less than 0.2v. This indicates a low voltage fault from the sensor or circuit. This fault can occur when a ground is lost on the black/Lt Green circuit.

# DTC 92-Gasoline Fuel Pressure Sensor High Voltage (SPN 94:FMI 3)



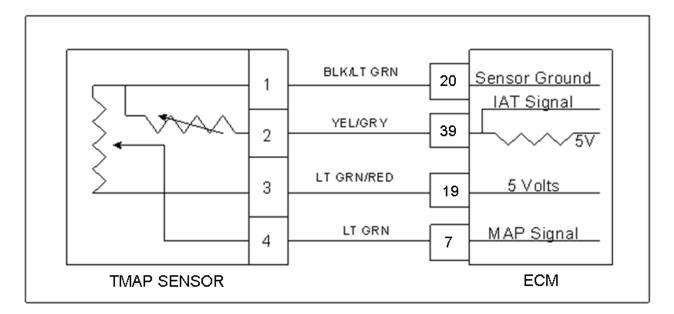
### **Conditions for Setting the DTC**

- Gasoline fuel temperature sensor voltage
- Fuel pressure sensor voltage greater than 4.8v for greater than 1 second
- MIL-On for active fault and for 2 seconds after active fault
- Adaptive Learn is disabled during fault condition
- Forced Idle is enabled

### **Circuit Description**

Note: The fuel pressure and temperature sensor is wired via Equipment Manufacturer supplied harness jumper. The terminals A, B, C, D & 19, 20, 48, 54 are engine wiring harness terminals at the fuel sensor interface connector C002 and the ECM header connector C001. You may need to consult additional wiring information supplied by the OEM. The gasoline fuel pressure sensor voltage is reading greater than 4.8v. This indicates a high voltage fault from the sensor or circuit.

# DTC 107-MAP Low Voltage (SPN 106:FMI 4)



### **Conditions for Setting the DTC**

- Manifold Absolute Pressure Sensor
- Check Condition-Engine cranking or running
- Fault Condition-MAP voltage less than 0.050 with throttle position greater than 2.0% and engine RPM less than 3000.
- MIL-ON
- Adaptive-Disabled
- Fueling is based on RPM and TPS Limp-Home Condition during this fault.

### **Circuit Description**

The Manifold Absolute Pressure sensor is a pressure transducer connected to the intake manifold. It is used to measure the pressure of air in the manifold prior to induction. The pressure reading is used in conjunction with other inputs to estimate the airflow rate to the engine, which determines the fuel flow rate. This fault will set if the MAP voltage is less than 0.050 with TPS greater than 2% and engine RPM is less than 3000. The Adaptive Learn will be disabled for the remainder of the key on cycle and the MIL command is on.

# DTC 107-MAP Low Voltage

Stop	Action		Vee	No
Step		Value(s)	Yes	Νο
	Did you perform the On-Board (OBD) System	-	Go to Step	Go to OBD
1	Check?		(2)	System Check Sec-
				tion
	Key ON, Engine running.		Go to Step	Intermittent
	<ul> <li>DSC (Diagnostic Scan Tool) connected in</li> </ul>		(3)	problem
_	System Data Mode			Go to Inter-
2	Does DST display MAP voltage of 0.050 or			mittent
	less with the engine running below 3000 rpm			section
	and TPS above 2.0 %?			
	Key OFF		Go to Step	Go to Step
	Disconnect the MAP sensor connector		(4)	(8)
	C006 from the wiring harness			
3	• Jump the 5 volt reference pin 3 and MAP			
_	signal circuit pin 4 together			
	Key ON     Deep the DOT display MAD yeakars of 4.5			
	Does the DST display MAP voltage of 4.5 volts or greater?			
	Inspect MAP connector and pins for cor-		Repair the	Go to Step
	rosion, contamination or mechanical		circuit as	(5)
	damage		necessary.	(-)
4	Any problems found?		Refer to Wir-	
			ing Repairs	
			in Engine Electrical.	
	Key OFF		Go to Step	Repair the
	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> </ul>		(6)	circuit as
	<ul> <li>Check for continuity between MAP sensor</li> </ul>		(-)	necessary.
5	connector signal pin 4 and ECM MAP sig-			Refer to Wir-
	nal pin 7.			ing Repairs
	Do you have continuity between them?			in Engine
	Obeels for continuity is a true or MAD		Co to Stor	Electrical.
	Check for continuity between MAP sensor connector 5 volt supply signal pin 3 and		Go to Step (7)	Repair the circuit as
	ECM 5 volt supply pin 19			necessary.
6	Do you have continuity between them?			Refer to Wir-
				ing Repairs
				in Engine
			Co to Stor	Electrical.
	Check for continuity between MAP sensor     connector ground pip 1 and ECM sensor		Go to Step (17)	Repair the circuit as
	connector ground pin 1 and ECM sensor ground pin 20			necessary.
7	Do you have continuity between them?			Refer to Wir-
				ing Repairs
				in Engine
				Electrical.

Step	Action	Value(s)	Yes	No
8	<ul> <li>Probe MAP connector signal circuit pin 4 with a test light connected to battery volt- age.</li> <li>Does the DST display MAP voltage of 4.0 or</li> </ul>		Go to Step (9)	Go to Step (13)
9	<ul> <li>greater?</li> <li>Key OFF</li> <li>Disconnect ECM connector</li> <li>Check for continuity between MAP sensor connector pin 3 and ECM 5 volt pin 19.</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (10)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Electrical.
10	<ul> <li>Check for continuity between MAP sensor connector 5 volt reference pin 3 and en- gine ground</li> <li>Do you have continuity?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Electrical.	Go to Step (11)
11	<ul> <li>Inspect ECM and MAP wire harness con- nector and terminals for corrosion, contamination or mechanical damage Any problems found?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Electrical.	Go to Step (16)
12	<ul> <li>Replace ECM. Refer to ECM replacement in the Engine Controls Section.</li> <li>Is the replacement complete?</li> </ul>		Go to Step (17)	-
13	<ul> <li>Disconnect ECM connector</li> <li>Check for continuity between MAP sensor connector signal circuit pin 4 and ECM signal pin 7.</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (14)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Electrical.
14	<ul> <li>Check for continuity between MAP sensor connector signal pin 4 and engine ground Do you have continuity?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Electrical.	Go to Step (15)
15	<ul> <li>Inspect ECM connector and wire harness connector terminals for corrosion, con- tamination or mechanical damage</li> <li>Any problems found?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Electrical.	Go to Step (16)

Step	Action	Value(s)	Yes	Νο
16	<ul> <li>Replace ECM. Refer to ECM replacement in the Engine Controls Section.</li> <li>Is the replacement complete?</li> </ul>		Go to Step (18)	-
17	Replace MAP sensor Is the replacement complete?		Go to Step (18)	-
18	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-107 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

#### DTC 108-MAP High Pressure (SPN 106:FMI 16) BLK/LT GRN Sensor Ground 20 1 IAT Signal YEL/GRY 39 2 5V LT GRN/RED 3 5 Volts 19 LT GRN MAP Signal 4 7 ECM TMAP SENSOR

### Conditions for Setting the DTC

- MAP pressure test
- Check condition-engine running
- Fault Condition-MAP greater than 17.00 psia with TPS less than 10% and engine rpm greater than 800.
- MIL-ON
- Adaptive-disabled

### **Circuit Description**

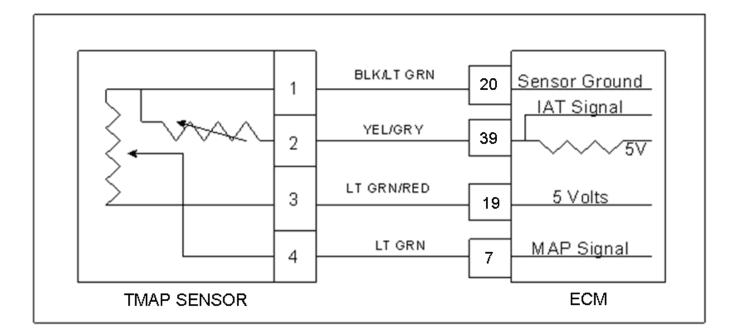
The MAP (Manifold Absolute Pressure) is estimated from the MAP sensor. The MAP pressure value is used for fuel, airflow and spark calculations. This fault will set in the event the MAP value is greater than 17.00 psia when the TPS is less than 10% with engine rpm greater than 800.

## DTC 108-MAP High Pressure

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine running at full operating temperature.</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Does DST display MAP pressure of 17 psia or greater with the engine running above 800 rpm with a TPS value less than 10%?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	<ul> <li>Key OFF</li> <li>Disconnect the MAP sensor connector C006</li> <li>Key ON</li> <li>Does the DST display MAP pressure less than 0.05 psia?</li> </ul>		Go to Step (4)	Go to Step (6)
4	<ul> <li>Probe MAP connector ground pin 1 with a test light connected to battery voltage.</li> <li>Does the test light come on?</li> </ul>		Go to Step (5)	Go to Step (8)
5	<ul> <li>Check MAP mechanical vacuum connection for correct mounting or possible damage causing leakage.</li> <li>Is the MAP sensor mechanical connection OK?</li> </ul>		Go to Step (6)	Go to Step (10)
6	<ul> <li>Key OFF</li> <li>Disconnect ECM connector and inspect terminals for damage corrosion or contamination.</li> <li>Is the connection OK?</li> </ul>		Go to Step (7)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
7	Replace MAP sensor. Is the repair complete?		Go to Step (11)	-

Step	Action	Value(s)	Yes	No
8	<ul> <li>Disconnect ECM connector and check for continuity between MAP connector sensor ground pin 1 and ECM sensor ground pin 20.</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (9)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
9	<ul> <li>Replace ECM. Refer to ECM replacement in the Engine Controls Section.</li> <li>Is the replacement complete?</li> </ul>		Go to Step (11)	-
10	Correct MAP mechanical connection Has the MAP mechanical connection problem been corrected?		Go to Step (11)	-
11	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-108 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 111-IAT Higher Than Expected 1 (SPN 105:FMI 15)



### Conditions for Setting the DTC

- Intake Air Temperature
- Check Condition-Engine Running
- Fault Condition-Intake Air Temperature greater than 200 degrees F. with engine rpm greater than 700
- Condition must be present for a minimum of 60 seconds
- MIL-ON
- Adaptive-Disabled during active fault
- Derate level 1 will occur

#### **Circuit Description**

The TMAP is a combined IAT (Intake Air Temperature) and MAP (Manifold Absolute Pressure) sensor. A temperature sensitive resistor is used in the TMAP located in the air intake manifold of the engine. It is used to monitor incoming air temperature, and the output in conjunction with other sensors is used to determine the airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower when warm. This fault will set if the Intake Air Temperature is greater than 200 degrees F. with engine speed greater than 700 rpm. The engine will go into a level 1 derate mode to prevent engine damage.

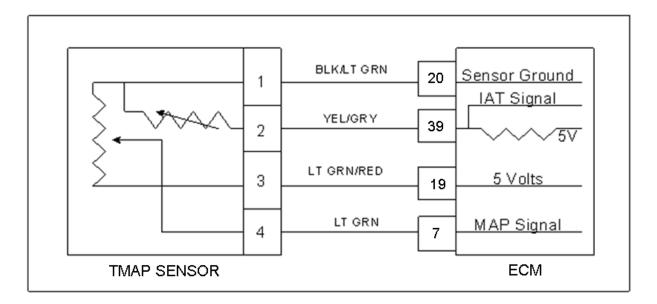
### DTC 111-IAT Higher Than Expected 1 (SPN 105:FMI 15)

### **Diagnostic Aid**

This fault will set when inlet air is much hotter than normal. The most common cause of high inlet air temperature is a problem with the inlet air system.

- Ensure that the air inlet is not obstructed, modified or damaged.
- Inspect the air inlet system for cracks or breaks that may allow unwanted under hood air in to the air inlet system
- If none of the above can be found, follow the diagnostic steps for DTC 112-IAT Low Voltage.

### DTC 112-IAT Low Voltage (SPN 105:FMI 4)



### **Conditions for Setting the DTC**

- Intake Air Temperature
- Check Condition Engine Cranking or Running
- Fault Condition-IAT Sensor Voltage less than 0.050
- MIL-ON during active fault
- Adaptive-Disabled during active fault

### **Circuit Description**

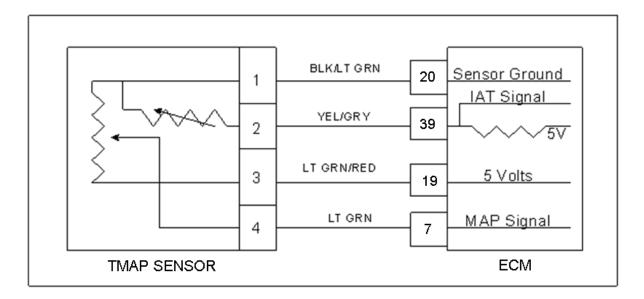
The TMAP is a combined IAT (Intake Air Temperature) and MAP (Manifold Absolute Pressure) sensor. A temperature sensitive resistor is used in the TMAP is located in the engine's air intake or intake manifold. It is used to monitor incoming air temperature, and the output in conjunction with other sensors is used to determine the airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool the signal reads higher voltage, and lower when warm. This fault will set if the signal voltage is less than 0.050 volts for 1 second anytime the engine is cranking or running. The ECM will use the default value for the IAT sensor in the event of this fault.

## DTC 112-IAT Voltage Low

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	_	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Does DST display IAT voltage of 0.050 or less?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	<ul> <li>Key OFF</li> <li>Disconnect the TMAP sensor connector.</li> <li>Key ON</li> <li>Does the DST display IAT voltage of 4.90 volts or greater?</li> </ul>		Go to Step (4)	Go to Step (5)
4	Replace TMAP sensor. Is the replacement complete?		Go to Step (9)	_
5	<ul> <li>Key OFF</li> <li>Disconnect ECM wire harness connector C001</li> <li>Check for continuity between TMAP sensor connector ground pin 1 and TMAP sensor connector signal pin 2</li> <li>Do you have continuity between them?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (6)
6	<ul> <li>Check for continuity between TMAP sensor connector signal circuit pin 2 and engine ground.</li> <li>Do you have continuity?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (7)

Step	Action	Value(s)	Yes	No
7	<ul> <li>Replace ECM. Refer to ECM replacement in the Engine Controls Section.</li> <li>Is the replacement complete?</li> </ul>	-	Go to Step (8)	_
8	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-112 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

## DTC 113-IAT High Voltage (SPN 105:FMI 3)



### Conditions for Setting the DTC

- Intake Air Temperature
- Check Condition-Engine Running
- Fault Condition-IAT Sensor Voltage greater than 4.950 volts
- MIL-ON during active fault
- Adaptive-Disabled during active fault

#### **Circuit Description**

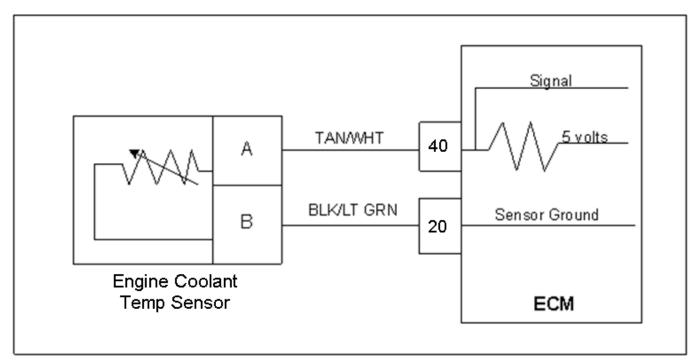
The TMAP is a combined IAT (Intake Air Temperature) and MAP (Manifold Absolute Pressure) sensor. A temperature sensitive resistor is used in the TMAP is located in the engine's air intake or intake manifold. It is used to monitor incoming air temperature, and the output in conjunction with other sensors is used to determine the airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower when warm. This fault will set if the signal voltage is greater than 4.950 volts for 1 second or longer. The ECM will use a default value for the IAT sensor in the event of this fault.

# DTC 113-IAT Voltage High

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Does DST display IAT voltage of 4.950 or great- er?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	<ul> <li>Key OFF</li> <li>Disconnect the TMAP sensor connector C006 and jump pins 1 and 2 together</li> <li>Key ON</li> <li>Does the DST display IAT voltage of 0.1 volts or less?</li> </ul>		Go to Step (9)	Go to Step (4)
4	<ul> <li>Key OFF</li> <li>Jump TMAP sensor connector signal pin 2 to engine ground</li> <li>Key ON</li> <li>Does DST display IAT voltage of 0.1 volts or less?</li> </ul>		Go to Step (7)	Go to Step (6)
5	Replace TMAP sensor. Is the replacement complete?		Go to Step (11)	_
6	<ul> <li>Key OFF</li> <li>Disconnect the ECM wire harness connector C001.</li> <li>Check for continuity between TMAP sensor connector signal pin 2 and ECM IAT signal pin 39</li> <li>Do you have continuity between them?</li> </ul>	—	Go to Step (10)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
7	<ul> <li>Check for continuity between TMAP sensor connector ground circuit pin 1 and ECM sensor ground circuit pin 20</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (10)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.

Step	Action	Value(s)	Yes	No
8	<ul> <li>Replace the ECM.</li> <li>Is the replacement complete?</li> </ul>	_	Go to Step (11)	_
9	<ul> <li>Re-check wire harness and TMAP sensor connector for damage corrosion or contami- nation Any problems found?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical	Go to Step (5)
10	<ul> <li>Re-check wire harness and TMAP sensor connectors for damage corrosion or contam- ination Any problems found?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical	Go to Step (8)
11	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-113 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 116-ECT Higher Than Expected 1 (SPN 110:FMI 15)



#### **Conditions for Setting the DTC**

- Engine Coolant Temperature
- Check Condition-Engine Running
- Fault Condition-Engine Coolant Temperature reading or estimate greater than 236 degrees F. for greater than 20 seconds
- MIL-On
- Power derate (level 1)
- Adaptive-Disabled during active fault

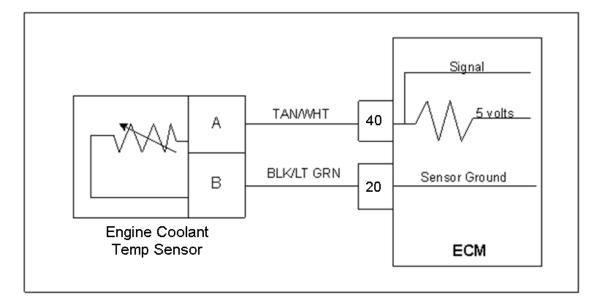
#### **Circuit Description**

The ECT (Engine Coolant Temperature) sensor is a temperature sensitive resistor located in the engine coolant sensor that is located in the coolant passage. The ECT is used for engine airflow calculation, fuel enrichment, and ignition timing control and to enable certain other temperature dependant operations. This code set is designed to help prevent engine damage from overheating. The ECM provides a voltage divider circuit so when the sensor reading is cool the sensor reads higher voltage, and lower when warm. This fault will set when the coolant exceeds 236 degrees F. for more than 20 seconds. Power derate level one will be enforced during this fault limiting the maximum throttle position to 50%.

## DTC 116-ECT Higher Than Expected 1

STEP	Action	Value(s)	Yes
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)
	<ul> <li>Key ON</li> <li>DST (Diagnostic Scan Tool) connected in system data mode</li> </ul>		Go to Step (3)
2	Warm engine to normal operating temperature, then run the engine above 1200 rpm for at least 60 seconds		
	Does the DST display ECT temperture of 236 degrees F or greater?		
3	Verify with a temperature gauge that the engine coolant is over 236 degrees F.		Repair cooling system.
	Does the temperature gauge indicated 236 degrees F. or greater?		
4	Verify ECT Circuit function. Follow diagnostic test procedure for DTC 217 (ECT Higher than expected 2)		-

### DTC 117-ECT/CHT Low Voltage (SPN 110:FMI 4)



### Conditions for Setting the DTC

- Engine Coolant Temperature
- Check Condition-Engine Running
- Fault Condition-ECT sensor voltage less than 0.050
- MIL-ON during active fault
- Adaptive-Disabled during active fault

#### **Circuit Description**

The ECT (Engine Coolant Temperature) sensor is a temperature sensitive resistor located in the engine coolant passage. It is used for the engine air-flow calculation, cold fuel enrichment and to enable other temperature dependant features. The ECM provides a voltage divider circuit so that when the coolant is cool, the signal reads higher voltage, and lower when warm (see table). This fault will set if the signal voltage is less than 0.050 volts for any period longer than 1 second. The ECM will use a default value for the ECT sensor in the event of this fault.

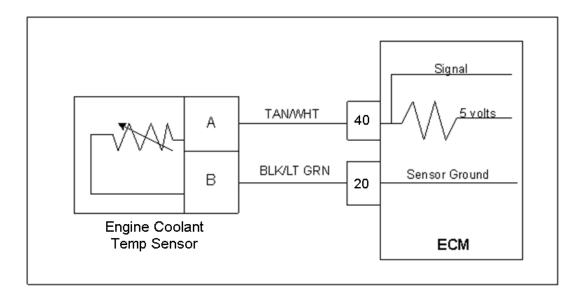
Temp	Ohms
(deg F)	+/-10%
242.4	101
231.9	121
211.6	175
201.4	209
181.9	302
163.1	434
144.9	625
127.4	901
102.4	1,556
78.9	2,689
49.9	5,576
23.5	11,562
-5.7	28,770
-21.2	49,715
-30.8	71,589
-40.0	99,301

# DTC 117-ECT/CHT Voltage Low

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON</li> <li>DST (Diagnostic Scan Tool) connected in</li> <li>System Data Mode</li> <li>Does DST display ECT voltage of 0.050 or less?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	<ul> <li>Key OFF</li> <li>Disconnect the ECT wire harness connector C007</li> <li>Key ON</li> <li>Does the DST display ECT voltage of 4.90 volts or greater?</li> </ul>		Go to Step (4)	Go to Step (5)
4	Replace ECT sensor. Is the replacement complete?		Go to Step (8)	_
5	<ul> <li>Key OFF</li> <li>Disconnect ECM wire harness connector C001</li> <li>Check for continuity between ECT sensor connector signal pin A and ECT sensor ground pin B</li> <li>Do you have continuity between them?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (6)
6	<ul> <li>Check for continuity between ECT sensor connector signal circuit pin A and engine ground.</li> <li>Do you have continuity?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (7)

Step	Action	Value(s)	Yes	No
7	<ul> <li>Replace ECM. Refer to ECM replacement in the Engine Controls Section.</li> <li>Is the replacement complete?</li> </ul>	-	Go to Step (8)	_
8	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-117 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 118-ECT/CHT High Voltage (SPN 110:FMI 3)



### **Conditions for Setting the DTC**

- Engine Coolant Temperature
- Check Condition-Engine Running
- Fault Condition-ECT sensor voltage exceeds 4.950 volts
- MIL-ON during active fault
- Adaptive-Disabled

### **Circuit Description**

The ECT (Engine Coolant Temperature) sensor is a temperature sensitive resistor located in the engine coolant passage. It is used for the engine airflow calculation, cold fuel enrichment and to enable other temperature dependant features. The ECM provides a voltage divider circuit so that when the coolant is cool, the signal reads higher voltage, and lower when warm (see table). This fault will set if the signal voltage is greater than 4.950 volts anytime the engine is running. The ECM will use a default value for the ECT sensor in the event of this fault.

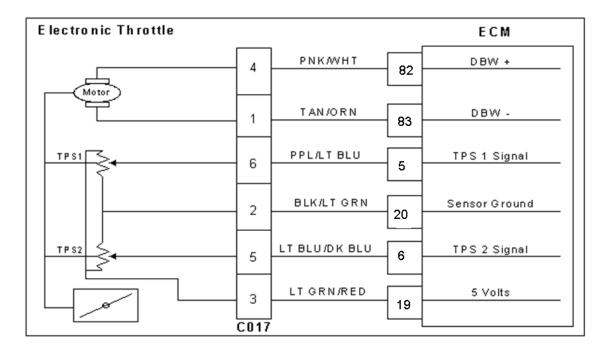
Temp	Ohms
(deg F)	+/-10%
242.4	101
231.9	121
211.6	175
201.4	209
181.9	302
163.1	434
144.9	625
127.4	901
102.4	1,556
78.9	2,689
49.9	5,576
23.5	11,562
-5.7	28,770
-21.2	49,715
-30.8	71,589
-40.0	99,301

## DTC 118-ECT/CHT Voltage High

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Does DST display ECT voltage of 4.95 or great- er?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	<ul> <li>Key OFF</li> <li>Disconnect the ECT sensor connector C007 and Jump terminals A and B together</li> <li>Key ON</li> <li>Does the DST display ECT voltage of 0.05 volts or less?</li> </ul>		Go to Step (4)	Go to Step (8)
4	<ul> <li>Using a DVOM check the resistance be- tween the two terminals of the ECT sensor and compare the resistance reading to the chart</li> <li>Is the resistance value correct?</li> </ul>	See re- sistance chart vs. temperature in the DTC 118 circuit description	Go to Step (6)	Go to Step (5)
5	Replace ECT sensor     Is the replacement complete?		Go to Step (14)	-
6	<ul> <li>Inspect the ECT wire harness connector ter- minals A and B for damage, corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (7)
7	<ul> <li>Key OFF</li> <li>Disconnect ECM wire harness connector C001</li> <li>Inspect ECM connector pins 10 and 20 for damage corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Intermittent problem Go to Inter- mittent section

Step	Action	Value(s)	Yes	No
8	Jump the ECT signal pin A at the ECT con- nector to engine ground		Go to Step (9)	Go to Step (12)
	Does DST display ECT voltage of 0.05 or less?			
9	<ul> <li>Key OFF</li> <li>Disconnect ECM wire harness connector</li> <li>Using a DVOM check for continuity between ECT sensor ground pin B and ECM connector pin 20</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (10)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
10	<ul> <li>Inspect ECM connector pins 40 and 20 for damage, corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (11)
11	Replace ECM Is the replacement complete?		Go to Step (14)	-
12	<ul> <li>Key OFF</li> <li>Disconnect ECM wire harness connector</li> <li>Using a DVOM check for continuity between ECT connector signal pin A and ECM con- nector terminal 40</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (13)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
13	<ul> <li>Inspect ECM connector pins 40 and 20 for damage, corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (11)
14	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-118 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 121-TPS 1 Lower Than TPS 2 (SPN 51:FMI 1)



### Conditions for Setting the DTC

- Throttle Position Sensor 1 & 2
- Check Condition-Key ON
- Fault Condition-TPS 1 20% lower than TPS 2
- MIL-ON for remainder of key on cycle
- Engine shutdown

#### **Circuit description**

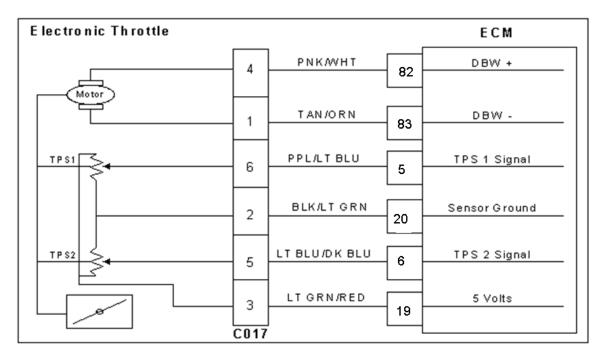
Dual throttle Position Sensors are used within the throttle that use variable resistors to determine signal voltage based on throttle plate position. TPS 1 will read low voltage when closed and TPS 2 will read high voltage when closed. The TPS 1 and TPS 2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded. This fault will set if TPS 1 is 20% (or more) lower than TPS 2. At this point the throttle is considered to be out of specification, or there is a problem with the TPS signal circuit. The MIL command is on and the engine will shutdown.

# DTC 121 TPS 1 Lower Than TPS 2

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	<ul> <li>Key ON, Engine OFF</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Does the DST display more than a 20% differ- ence between TPS 1 and TPS 2 voltage?</li> </ul>		Go to Step (3)	Intermittent problem Go to Intermit- tent section
3	<ul> <li>Key OFF</li> <li>Disconnect electronic throttle connector C017</li> <li>Key ON</li> <li>Change DST mode to DBW (drive by wire) test mode</li> <li>Is the voltage for TPS 1 less than 0.1 volts?</li> </ul>		Go to Step (5)	Go to Step (4)
4	<ul> <li>Key OFF</li> <li>Disconnect ECM wiring harness connector C001</li> <li>Key ON</li> <li>Using a DVOM check for voltage between ECM connector TPS 1 signal pin 5 and en- gine ground</li> <li>Do you have voltage?</li> </ul>		Repair the TPS 1 circuit shorted to voltage as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (9)
5	<ul> <li>Jump TPS 1 signal pin 6 to the 5 volt reference pin 3 at connector C017</li> <li>Does DST display TPS 1 voltage over 4.90 volts</li> </ul>		Go to Step (6)	Go to Step (8)
6	<ul> <li>Inspect wire terminals at throttle connector for damage corrosion or contamination Any problems found?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (7)
7	Replace the electronic Throttle     Is the replacement complete?		Go to Step (12)	-
8	<ul> <li>Key OFF</li> <li>Disconnect ECM wire harness connector C001</li> <li>Using a DVOM check for continuity between throttle connector TPS 1 signal pin 6 and ECM connector TPS 1 signal pin 5 Do you have continuity between them?</li> </ul>		Go to Step (9)	Repair the open circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.

Step	Action	Value(s)	Yes	No
9	<ul> <li>Using a DVOM check for continuity between throttle connector signal ground pin 2 and ECM connector signal ground pin 20</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (10)	Repair the open circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
10	<ul> <li>Inspect ECM connector terminals for damage corrosion or contamination.</li> <li>Any problems found?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical	Go to Step (11)
11	<ul> <li>Replace ECM</li> <li>Is the replacement complete?</li> </ul>		Go to Step (12)	-
12	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-121 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 122-TPS 1 Low Voltage (SPN 51:FMI 4)



#### Conditions for Setting the DTC

- Throttle Position Sensor 1
- Check Condition-Cranking or Running
- Fault Condition-TPS sensor less than 0.200 volts
- MIL-ON during active fault
- Engine shutdown

#### **Circuit Description**

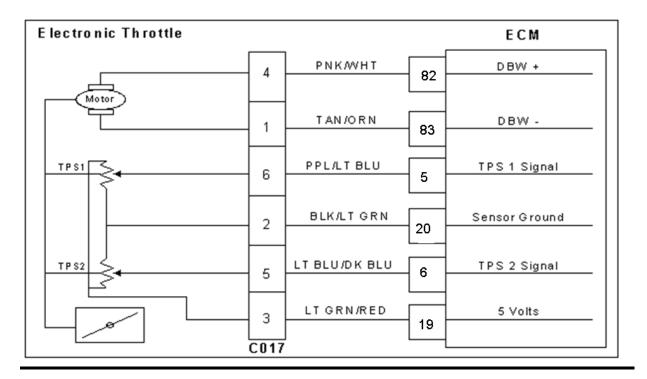
Dual throttle Position Sensors are used within the throttle that use variable resistors to determine signal voltage based on throttle plate position. TPS1 will read lower voltage when closed and TPS2 will read higher voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded. The TPS is not serviceable and in the event of a failure the electronic throttle assembly must be replaced. This fault will set if the TPS 1 voltage is less than 0.200 volts. The MIL command is ON and the engine will shut down.

# DTC 122 TPS 1 Signal Voltage Low

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	<ul> <li>Key ON, Engine OFF</li> <li>DST (Diagnostic Scan Tool) connected in DBW (Drive by Wire) throttle test mode</li> <li>Does the DST display TPS 1 voltage of 0.200 volts or less with the throttle closed?</li> </ul>		Go to Step (4)	Go to Step (3)
3	<ul> <li>Slowly depress Foot Pedal while observing TPS 1 voltage</li> <li>Does TPS 1 voltage ever fall below 0.200 volts?</li> </ul>		Go to Step (4)	Intermittent problem Go to Intermit- tent section
4	<ul> <li>Key OFF</li> <li>Disconnect the electronic throttle connector C017</li> <li>Jump the 5 volt reference circuit pin 3 and TPS 1 signal circuit pin 6 together at the throttle connector</li> <li>Key ON</li> <li>Does DST display TPS 1 voltage of 4.0 volts or greater?</li> </ul>		Go to Step (7)	Go to Step (5)
5	<ul> <li>Key OFF</li> <li>Disconnect ECM wire harness connector C001</li> <li>Using a DVOM check continuity between the electronic throttle connector signal pin 6 and ECM connector TPS 1 signal pin 5 Do have continuity between them?</li> </ul>		Go to Step (6)	Repair the circuit as nec- essary. Refer to Wiring Re- pairs in Engine Elec- trical.
6	Replace ECM Is the replacement complete?		Go to Step (9)	-
7	<ul> <li>Inspect the throttle wire harness connector terminals for damage, corrosion or contami- nation</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (8)
8	<ul> <li>Replace the electronic throttle Is the replacement complete?</li> </ul>		Go to Step (9)	-

Step	Action	Value(s)	Yes	Νο
	Remove all test equipment except the DST. Connect any disconnected components, fus- es, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and driveability After operating the engine within the test pa- rameters of DTC-122 check for any stored codes.		System OK	Go to OBD System Check

### DTC 123-TPS 1 High Voltage (SPN 51:FMI 3)



### Conditions for Setting the DTC

- Throttle Position Sensor 1
- Check Condition-Cranking or Running
- Fault Condition-TPS sensor voltage exceeds 4.800 volts
- MIL-ON during active fault
- Engine shutdown

### **Circuit Description**

Dual throttle Position Sensors are used within the throttle that use variable resistors to determine signal voltage based on throttle plate position. TPS1 will read lower voltage when closed and TPS2 will read higher voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded. The TPS is not serviceable and in the event of a failure the electronic throttle assembly must be replaced. This fault will set if the TPS 1 voltage exceeds 4.800 volts. The MIL command is ON and the engine will shut down.

## DTC 123 TPS 1 Signal Voltage High

Step	Action Did you perform the On-Board (OBD) System	Value(s) -	Yes Go to Step	No Go to OBD
1	Check?		(2)	System Check Section
2	<ul> <li>Key ON, Engine OFF</li> <li>DST (Diagnostic Scan Tool) connected</li> <li>Does the DST display TPS 1 voltage of 4.800</li> <li>volts or greater with the throttle closed?</li> </ul>		Go to Step (4)	Go to Step (3)
3	<ul> <li>Slowly depress Foot Pedal while observing TPS 1 voltage</li> <li>Does TPS 1 voltage ever exceed 4.800 volts?</li> </ul>		Go to Step (4)	Intermittent problem Go to Intermit- tent section
4	<ul> <li>Key OFF</li> <li>Disconnect electronic throttle connector</li> <li>Key ON</li> <li>Does DST display TPS 1 voltage less than 0.2 volts?</li> </ul>		Go to Step (7)	Go to Step (5)
5	<ul> <li>Key OFF</li> <li>Disconnect ECM wire harness connector C001</li> <li>Key ON</li> <li>Using a DVOM check for voltage between TPS 1 signal at the ECM connector pin 5 and engine ground</li> <li>Do you have voltage?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (6)
6	Replace ECM Is the replacement complete?		Go to Step (11)	-
7	<ul> <li>Back probe sensor ground circuit at the ECM side of the wire harness pin 3 with a test light connected to battery voltage</li> <li>Does the test light come on?</li> </ul>		Go to Step (8)	Go to Step (10)
8	<ul> <li>Inspect the electronic throttle connector ter- minals for damage, corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (9)
9	Replace the electronic throttle     Is the replacement complete?		Go to Step (11)	-
10	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Using a DVOM check for continuity between the electronic throttle connector sensor ground pin 2 and ECM connector TPS 1 sensor ground pin 20</li> <li>Do have continuity between them?</li> </ul>		Go to Step (6)	Repair the circuit as nec- essary. Refer to Wiring Re- pairs in Engine Elec- trical.

Step	Action	Value(s)	Yes	Νο
	Remove all test equipment except the DST. Connect any disconnected components, fus- es, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and driveability After operating the engine within the test pa- rameters of DTC-123 check for any stored codes.		System OK	Go to OBD System Check

#### DTC 127-IAT Higher Than Expected 2 (SPN 105:FMI 0) BLK/LT GRN Sensor Ground 20 1 IAT Signal YEL/GRY 39 2 LT GRN/RED 3 5 Volts 19 LT GRN MAP Signal 4 7 ECM TMAP SENSOR

### Conditions for Setting the DTC

- Intake Air Temperature
- Check Condition-Engine Running
- Fault Condition-Intake Air Temperature greater than 210 degrees F. with engine speed greater than 700 rpm
- Fault condition must be active for longer than 120 seconds
- MIL-ON for active fault
- Engine will de-rate to 1,400 rpms.

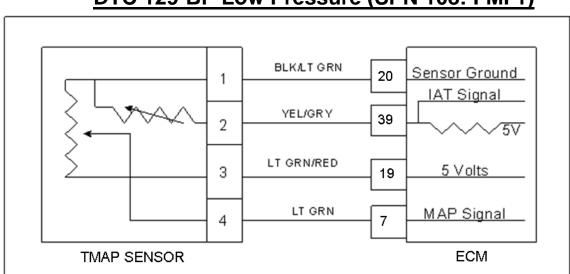
### **Circuit Description**

The TMAP is a combined IAT (Intake Air Temperature) and MAP (Manifold Absolute Pressure) sensor. A temperature sensitive resistor is used in the TMAP located in the intake manifold of the engine. It is used to monitor incoming air temperature, and the output in conjunction with other sensors is used to determine the airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads a higher voltage, and lower when warm. This fault will set if the intake air temperature is greater than 210 degrees F. with engine speed greater than 700 rpm. The MIL light command is on during this active fault and the engine will derate to 1,400 rpms.

### DTC 127-IAT Higher Than Expected 2

### **Diagnostic Aid**

- This fault will set when inlet air is much hotter than normal. The most common cause of high inlet air temperature is a problem with the inlet air system. Ensure that the air inlet is not obstructed, modified or damaged.
- Inspect the air inlet system for cracks or breaks that may allow unwanted under hood air in to the air inlet system
- If none of the above can be found, follow the diagnostic steps for DTC 112-IAT Low Voltage.



### DTC 129-BP Low Pressure (SPN 108: FMI 1)

### **Conditions for Setting the DTC**

- Barometric Pressure
- Check Condition-Key ON
- Fault Condition-BP less than 8.30 psia
- MIL-ON for active fault
- Adaptive-Disabled

#### **Circuit Description**

The BP (Barometric Pressure) is estimated from the TMAP sensor. The barometric pressure value is used for fuel and airflow calculations. This fault sets in the event the BP value is out of the normal range.

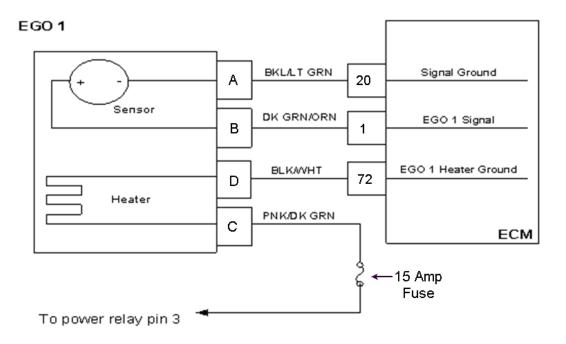
## DTC 129-BP Low Pressure

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON.</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Does DST display BP pressure of 8.30 psia or less?</li> </ul>		Go to Step (3)	Intermittent problem. Go to Intermittent section
3	<ul> <li>Key OFF</li> <li>Disconnect the TMAP sensor connector</li> <li>Jump the 5 volt reference pin 3 and MAP signal pin 4 together</li> <li>Key ON</li> <li>Does the DST display BP pressure of 16.00 psia or greater?</li> </ul>		Go to Step (4)	Go to Step (8)
4	<ul> <li>Inspect TMAP connector and wire harness connector terminals for corrosion, contamina- tion or mechanical damage Any problems found?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (5)
5	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Check for continuity between TMAP sensor connector pin 4 and ECM connector pin 7</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (6)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
6	<ul> <li>Check for continuity between TMAP sensor connector 5 volt supply pin 3 and ECM con- nector pin 19</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (7)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
7	<ul> <li>Check for continuity between TMAP sensor connector ground pin 1 and ECM connector pin 20</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (17)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.

Step	Action	Value(s)	Yes	No
8	<ul> <li>Remove the Jumper that was installed during step 3</li> <li>Probe TMAP connector signal circuit pin 4 with a test light connected to battery voltage Does the DST display BP pressure of 16.00 psia or greater?</li> </ul>		Go to Step (9)	Go to Step (13)
9	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Check for continuity between TMAP sensor connector pin 3 and ECM connector pin 19 Do you have continuity between them?</li> </ul>		Go to Step (10)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
10	<ul> <li>Check for continuity between TMAP sensor connector 5 volt reference pin 3 and engine ground</li> <li>Do you have continuity?</li> </ul>		Repair the open ground circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (11)
11	<ul> <li>Inspect TMAP and ECM connector pins for corrosion, contamination or mechanical damage</li> <li>Any problems found?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (16)
12	<ul> <li>Replace ECM. Refer to ECM replacement in the Engine Controls Section.</li> <li>Is the replacement complete?</li> </ul>		Go to Step(17)	-
13	<ul> <li>Disconnect ECM connector C001</li> <li>Check for continuity between TMAP sensor connector pin 4 and ECM pin 7</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (14)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
14	<ul> <li>Check for continuity between TMAP sensor connector pin 4 and engine ground Do you have continuity?</li> </ul>		Repair the open ground circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (15)

Step	Action	Value(s)	Yes	No
15	<ul> <li>Inspect ECM connector and wire harness connector pins for corrosion, contamination or mechanical damage</li> <li>Any problems found?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (16)
16	<ul> <li>Replace ECM. Refer to ECM replacement in the Engine Controls Section.</li> <li>Is the replacement complete?</li> </ul>		Go to Step (18)	-
17	<ul> <li>Replace TMAP sensor</li> <li>Is the replacement complete?</li> </ul>		Go to Step (18)	-
18	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-129 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 134-EGO 1 Pre Cat Open/Lazy (SPN 724:FMI 10)



### **Conditions for Setting the DTC**

- Heated Oxygen Sensor
- Check condition-Engine running
- Fault condition-EGO 1 pre catalyst persistently cold for more than 120 seconds
- MIL-ON during active fault
- Adaptive-Disabled during active fault
- Closed Loop-Disabled during active fault

### **Circuit Description**

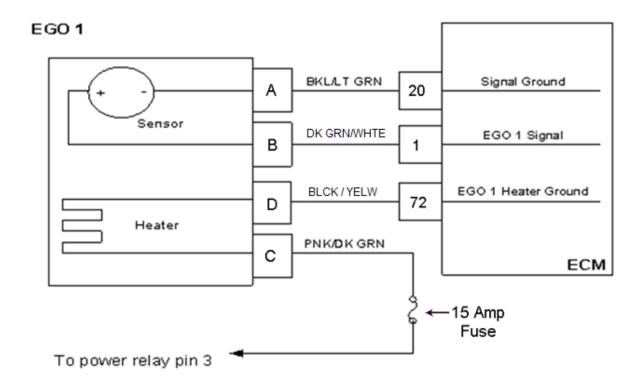
The EGO 1 sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the Adaptive multiplier. This fault will set if EGO 1 is cold, non-responsive, or inactive for more than 120 seconds.

# DTC 134-EGO 1 Open/Inactive

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Run engine to full operating temperature and then idle for a minimum of 2 minutes</li> <li>Does DST display EGO 1 voltage fixed between 0.4 and 0.5 volts after at least 2 minutes of idle run time?</li> </ul>		Go to Step (3)	Intermittent problem. See Electrical Section In- termittent Electrical Di- agnosis
3	<ul> <li>Key OFF</li> <li>Disconnect EGO 1 connector C005</li> <li>Key ON</li> <li>Using a DVOM check for voltage between EGO 1 connector pins C and D</li> <li>(Check must be made within 30 seconds or be- fore power relay shuts down)</li> <li>Do you have voltage?</li> </ul>		Go to Step (8)	Go To Step (4)
4	<ul> <li>Key OFF</li> <li>Using a DVOM check for voltage between EGO 1 connector pin C and engine ground</li> <li>Key ON</li> <li>(Check must be made within 30 seconds or be- fore power relay shuts down)</li> <li>Do you have voltage?</li> </ul>	System Voltage	Go to Step (5)	Repair sys- tem power relay open circuit
5	<ul> <li>Disconnect ECM connector C001</li> <li>Using a DVOM check for continuity between EGO 1 connector pin D and ECM connector pin 72</li> <li>Do you have continuity?</li> </ul>		Go to Step (6)	Repair open heater ground circuit
6	<ul> <li>Inspect wire harness connector C005 pins B and D and C001 pins 1 and 72 for damage, corrosion or contamination</li> <li>Did You find a problem?</li> </ul>		Correct the problem as required see Electrical Section wire harness re- pair	Go to Step (7)
7	<ul> <li>Replace ECM Is the replacement complete?</li> </ul>		Go to Step (11)	-

Step	Action	Value(s)	Yes	No
8	<ul> <li>Key OFF</li> <li>Disconnect ECM wire harness connector C001</li> <li>Using a DVOM check for continuity between EGO 1 pin B and ECM connector pin 1</li> <li>Do you have continuity?</li> </ul>		Go to Step (9)	Repair open EGO 1 circuit
9	<ul> <li>Using a DVOM check for continuity between EGO 1 pin A and ECM connector pin 20 Do you have continuity?</li> </ul>		Go to Step (10)	Repair open EGO 1 signal ground
10	Replace EGO 1 sensor     Is the replacement complete?		Go to Step (11)	-
11	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-134 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 154-EGO 2 Post Cat Open/Lazy (SPN 520208:FMI 10)



- Heated Oxygen Sensor
- Check condition- Engine running
- · Fault condition- EGO 2 cold persistently more than 120 seconds
- MIL- On during active fault and for 1 second after active fault
- Adaptive- Disabled during active fault
- Closed Loop- Disabled during active fault

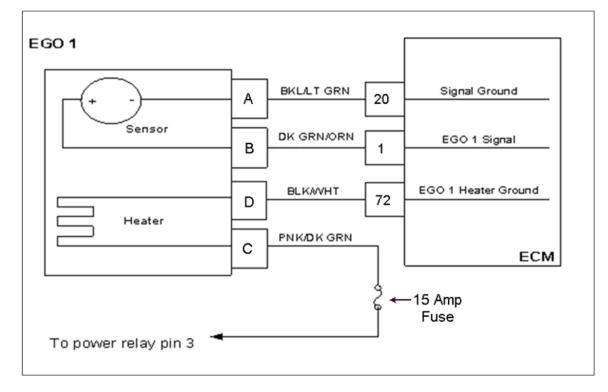
#### **Circuit Description**

The EGO 2 sensor is used to monitor the efficiency of the catalytic converter. The ECM compares the EGO 1 and EGO 2 voltage signals to determine this. This fault will set if EGO 2 is cold, non-responsive, or inactive for more than 120 seconds.

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to step (2)	Go to OBD
				System Check
2			Go to Step (3)	Section Intermittent
-	<ul> <li>Key ON, Engine Running</li> </ul>		00100000000000	problem. See
				Electrical
	<ul> <li>DST (Diagnostic Scan Tool) connected in</li> </ul>			Section
	System Data Mode			Intermittent
	<ul> <li>Run engine to full operating temperature and</li> </ul>			Electrical
	then idle for a minimum of 2 minutes			Diagnosis
	Does DST display EGO 2 voltage fixed between 0.4			
	and 0.5 volts after at least 2 minutes of idle run time?			
3	Key OFF		Go to step (8)	Go To Step (4)
<b>1</b>	<ul> <li>Disconnect EGO 2 connector C005</li> </ul>		50 to step (0)	50 10 Step (4)
	Key ON			
	<ul> <li>Using a DVOM check for voltage between</li> </ul>			
	EGO 2 connector pins C and D			
	(Check must be made within 30 seconds or before			
	power relay shuts down)			
	Do you have voltage?			
	<ul> <li>Key OFF</li> </ul>	System	Go to step (5)	Repair system
4	<ul> <li>Using a DVOM check for voltage between</li> </ul>	Voltage		power relay
	EGO 2 connector pin C and engine ground			open circuit
	Key ON			
	(Check must be made within 30 seconds or before			
	power relay shuts down)			
	Do you have voltage?			
5	<ul> <li>Disconnect ECM connector C001</li> </ul>		Go to step (6)	Repair open
	<ul> <li>Using a DVOM check for continuity between</li> </ul>			heater ground
	EGO 2 connector pin D and ECM connector			circuit
	pin 73			
6	<ul> <li>Do you have continuity?</li> <li>Inspect wire harness connector C005 pins C</li> </ul>		Correct the	Go to step (7)
ľ	and D and C001 pins 1 and 72 for damage,		problem as	00 10 810p (1)
	corrosion or contamination		required see	
	Did You find a problem?		Electrical	
	and the main provident.		Section wire	
1			harness repair	

Stor	Action	Value(s)	Vac	
Step	Replace ECM	value(s)	Go to step (11)	No
'	· ·			
	Is the replacement complete?			
8	Key OFF		Go to step (9)	Repair open
° I	Disconnect ECM wire harness connector		00 to step (3)	EGO 2 circuit
	C001			
	<ul> <li>Using a DVOM check for continuity between</li> </ul>			
	EGO 2 connector pin B and ECM connector			
	pin 1			
	Do you have continuity?			
9	<ul> <li>Do you have continuity?</li> <li>Using a DVOM check for continuity between</li> </ul>		Go to step (10)	Repair open
	EGO 2 pin A and ECM connector pin 20			EGO 2 signal
				ground
	Do you have continuity?			giouna
	Do you have continuity?			
10	Replace EGO 2 sensor		Go to step (11)	
10	- Replace 200 2 Sensor			
	In the newland mean late 2			
11	<ul> <li>Is the replacement complete?</li> <li>Remove all test equipment except the DST.</li> </ul>		System Ok	Go to OBD
	Connect any disconnected components, fuses,			System Check
	etc.			Oystern Oneek
	Using the DST clear DTC information from the			
	ECM.			
	<ul> <li>Turn the ignition OFF and wait 30 seconds.</li> </ul>			
	<ul> <li>Start the engine and operate the vehicle to full</li> </ul>			
	operating temperature			
	Observe the MIL			
	Observe engine performance and driveability			
	After operating the engine within the test			
	parameters of DTC-154 check for any stored			
	codes.			
	Does the engine operate normally with no stored			
	codes?			
	4			

## DTC 171-Adaptive Learn High Gasoline (SPN 520200:FMI 0)



### **Conditions for Setting the DTC**

- Heated Oxygen Sensor
- Check Condition-Engine Running
- Fault Condition-Adaptive multiplier out of range greater than 30%
- MIL-ON

#### **Circuit Description**

The EGO 1 sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and Adaptive multiplier. This fault will set if the adaptive multiplier exceeds the limits of normal operation. Always run the fuel system diagnostic checks before using the following diagnostic chat.

#### **Diagnostic Aid**

**Oxygen Sensor Wire** Heated Oxygen sensor wires may be mis-routed and contacting the exhaust manifold.

<u>Vacuum Leaks</u> Large vacuum leaks and crankcase leaks can cause a lean exhaust condition at especially at light load.

**<u>Fuel Pressure</u>** Low fuel pressure, faulty fuel pressure sensor, faulty pump, or contaminated fuel filter can cause fuel the system to run lean

**Exhaust Leaks** If there is an exhaust leak, outside air can be pulled into the exhaust and past the 02 sensor causing a false lean condition.

Fuel Quality Contaminated or spoiled fuel can cause the fuel system to be lean.

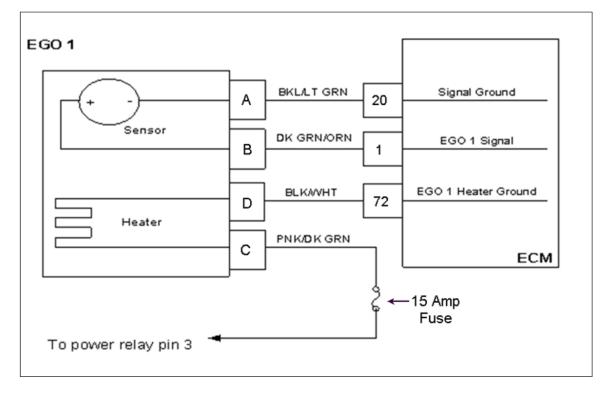
**Ground Problem** ECM grounds must be clean, tight and in the proper location.

# DTC 171-Adaptive Learn High Gasoline

Step	Action	Value(s)	Yes	No
1	• Perform the On-Board (OBD) System Check? Are any other DTCs present?		Go to Step (3)	Go to Step (2)
2	<ul> <li>Visually and physically check the following items:</li> <li>The air intake duct for being collapsed or restricted</li> <li>The air filter for being plugged</li> <li>System power fuses are good and in the proper location</li> <li>The EGO 1 sensor installed securely and the wire leads not contacting the exhaust manifold or ignition wires</li> <li>ECM grounds must be clean and tight. Refer to Engine Electrical Power and Ground Distribution</li> <li>Fuel System Diagnostics. Refer to Fuel Sys-</li> </ul>		Go to Step (9)	Go to Step (4)
	tem Diagnostics Was a repair made?			
3	<ul> <li>Diagnose any other DTC codes before proceeding with this chart. Always repair existing codes starting with the lowest numerical code set first.</li> <li>Have any other DTC codes been detected, diagnosed and repaired?</li> </ul>		Go to Step (9)	Go to Step (4)
4	<ul> <li>Disconnect EGO1 connector C005</li> <li>Using a DVOM check for voltage between EGO 1 connector pin B and engine ground</li> <li>Key ON</li> <li>(CHECK MUST BE MADE WITHIN 30 SECONDS OR BEFORE POWER RELAY SHUTS DOWN)</li> <li>Do you have voltage?</li> </ul>	System voltage	Go to Step (5)	Repair the open EGO power circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
5	<ul> <li>Key OFF</li> <li>Disconnect EGO 1 sensor wire harness connector C005</li> <li>Disconnect ECM wire harness connector C001</li> <li>Key ON</li> <li>Using a high impedance DVOM check for continuity between EGO 1 connector signal pin A and engine ground</li> <li>Do you have continuity?</li> </ul>		Repair the shorted circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (6)

Step	Action	Value(s)	Yes	No
6	<ul> <li>Using a high impedance DVOM check for continuity between EGO 1 connector signal ground pin C and EGO 1 signal pin A</li> <li>Do you have continuity?</li> </ul>		Repair the shorted circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (7)
7	<ul> <li>Using a high impedance DVOM check for continuity between EGO 1 heater ground pin D and ECM pin 49</li> <li>Do you have continuity?</li> </ul>		Go to Step (8)	Repair the open EGO heater ground
8	Replace EGO 1 sensor     Is the replacement complete?		Go to Step (9)	-
9	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1161 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

## DTC 172-Adaptive Learn Low (Gasoline) (SPN 520200:FMI 1)



#### **Conditions for Setting the DTC**

- Heated Oxygen Sensor
- Check Condition-Engine running
- Fault Condition-Adaptive multiplier out of range greater than -30%
- MIL-ON

### **Circuit Description**

The EGO1 sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and Adaptive multiplier. This fault will set if the adaptive multiplier exceeds the limits of normal operation. Always run the fuel system diagnostics before using the following diagnostic chart.

#### **Diagnostic Aid**

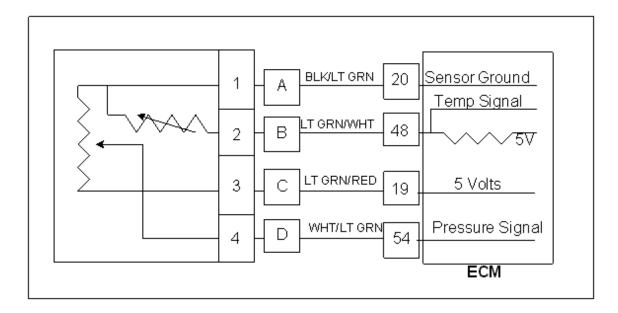
**Fuel System** High fuel pressure will cause the system to run rich. Fuel pressure is controlled by the ECM using a ground side driver. If the fuel pump is turned on all the time the fuel pressure will increase. Open or leaking injector will cause a rich condition.

**Fuel Quality** A drastic variation in fuel quality may cause the fuel system to run rich. **Air Filter** A plugged, damaged or modified air filter may cause the system to run rich.

## DTC 172-Adaptive Learn Low (Gasoline)

Step	Action	Value(s)	Yes	No
1	• Perform the On-Board (OBD) System Check? Are any other DTCs present?		Go to Step (3)	Go to Step (2)
2	<ul> <li>Visually and physically check the following items:</li> <li>The air intake duct for being collapsed or restricted</li> <li>The air filter for being plugged</li> <li>The EGO sensor is installed securely and the wire leads not damaged or contacting the secondary ignition wires</li> <li>ECM grounds for being clean and tight.</li> <li>Fuel system diagnostic checks</li> <li>Was a repair made?</li> </ul>		Go to Step (6)	Go to Step (4)
3	<ul> <li>Diagnose any other DTC codes before pro- ceeding with this chart.</li> <li>Have any other DTC codes been detected, diag- nosed and repaired?</li> </ul>		Go to Step (6)	Go to Step (4)
4	<ul> <li>Key OFF</li> <li>Disconnect EGO sensor wire harness connector C005</li> <li>Disconnect ECM wire harness connector C001</li> <li>Key ON</li> <li>Using a DVOM check for voltage at EGO 1 connector signal pin A and engine ground Do you have voltage?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (5)
5	Replace EGO sensor     Is the replacement complete?		Go to Step (6)	-
6	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1162 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 182-Gasoline Fuel Temperature Low (SPN 174:FMI 4)



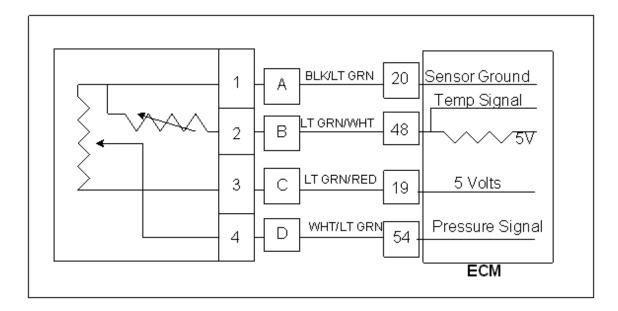
### Conditions for Setting the DTC

- Gasoline fuel temperature low
- Faulty fuel temp sensor
- Fuel temperature sensor voltage lower than .05v for 5 seconds or greater
- Fuel temperature is -35F or less for 5 seconds or greater
- MIL-On for active fault and for 2 seconds after active fault
- Adaptive Learn is disabled while this fault is active.

#### **Circuit Description**

Note: The fuel pressure and temperature sensor is wired via Equipment Manufacturer supplied harness jumper. The terminals A, B, C, D & 19, 20, 48, 54 are engine wiring harness terminals at the fuel sensor interface connector C002 and the ECM header connector C001. You may need to consult additional wiring information supplied by the OEM. The gasoline fuel temperature sensor voltage is read at less than 0.05v. This indicates a low voltage fault from the sensor or circuit. This could also indicate a low fuel temperature reading. Inspect the fuel temperature for extreme cold.

## DTC 183-Gasoline Fuel Temperature High (SPN 174:FMI 3)



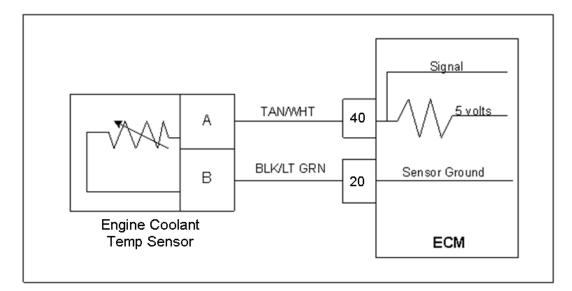
### Conditions for Setting the DTC

- Gasoline fuel temperature high
- Faulty fuel temp sensor
- Fuel temperature sensor voltage greater than 4.95v for 5 seconds or greater
- Fuel temperature is 130F or higher for 5 seconds or greater
- MIL-On for active fault and for 2 seconds after active fault
- Adaptive Learn is disabled while this fault is active.

### **Circuit Description**

Note: The fuel pressure and temperature sensor is wired via Equipment Manufacturer supplied harness jumper. The terminals A, B, C, D & 19, 20, 48, 54 are engine wiring harness terminals at the fuel sensor interface connector C002 and the ECM header connector C001. You may need to consult additional wiring information supplied by the OEM. The gasoline fuel temperature sensor voltage is read at less than 0.05v. This indicates a high voltage fault from the sensor or circuit. This could also indicate a high fuel temperature reading. Inspect the fuel temperature for extreme hot temperatures.

## DTC 217-ECT Higher Than Expected 2 (SPN 110:FMI 0)



### **Conditions for Setting the DTC**

- Engine Coolant Temperature
- Check Condition-Engine Running
- Fault Condition-Engine Coolant Temperature reading or estimate greater than 250 degrees F. for greater than 5 seconds while engine is above 700 rpms
- MIL-On
- Engine will derate to 1,400 rpms

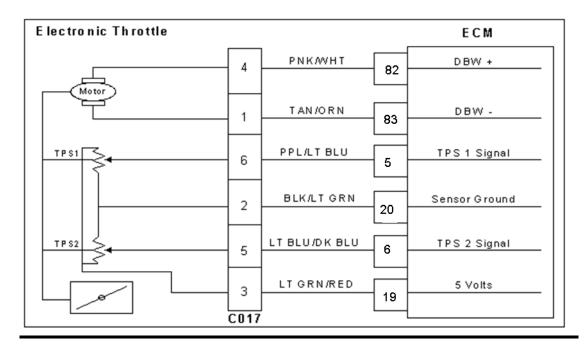
#### **Circuit Description**

The ECT (Engine Coolant Temperature) sensor is a temperature sensitive resistor located in the engine coolant sensor that is located in the coolant passage. The ECT is used for engine airflow calculation, fuel enrichment, and ignition timing control and to enable certain other temperature dependant operations. This code set is designed to help prevent engine damage from overheating. The ECM provides a voltage divider circuit so when the sensor reading is cool the sensor reads higher voltage, and lower when warm. This fault will set when the coolant exceeds 250 degrees F. for more than 5 seconds. Engine shutdown will occur if this code occurs.

# DTC 217-ECT Higher Than Expected 2

STEP	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	<ul> <li>Key ON</li> <li>DST (Diagnostic Scan Tool) connected in system data mode</li> <li>Warm engine to normal operating temperature, then run the engine above</li> <li>1200 rpm for at least 60 seconds</li> <li>Does the DST display ECT temperture of 250 degrees F or greater?</li> </ul>		Go to Step (3)	Intermittent problem Go to Intermittent section
3	Verify with a temperature gauge that the engine coolant is over 250 degrees F. Does the temperature gauge indicated 250 degrees F. or greater?		Repair cooling system.	Go to step (4)
4	Verify ECT Circuit function.		-	-

## DTC 219-Max Govern Speed Override (SPN 515:FMI 15)



#### Conditions for Setting the DTC

- Max Govern Speed Override
- Check Condition-Engine Running
- Fault Condition-Engine rpm greater than 2,850
- Fault condition active for 2 or more seconds
- MIL-ON during active fault

#### **Circuit description**

This fault will set anytime the engine rpm exceeds 2,850 for longer than 2 seconds. The MIL command is ON during this active fault

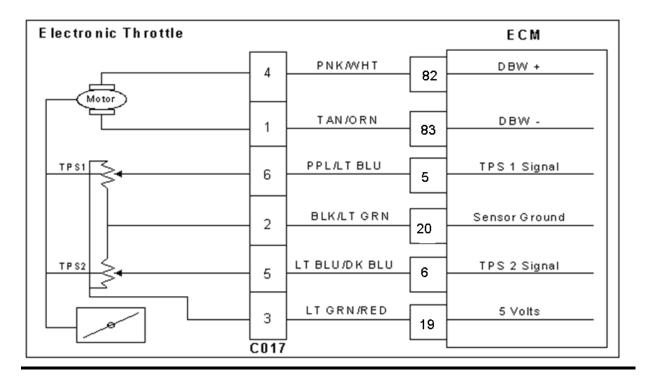
#### **Diagnostic Aid**

Check for other stored DTC codes before using the following DTC chart for this code set. Always diagnose and repair any existing codes starting with the lowest numerical code first.

# DTC 219-Max Govern Speed Override

Step	Action	Value(s)	Yes	Νο
1	Did you perform the On-Board (OBD) System - Check?		Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine OFF</li> <li>DST connected</li> <li>Are any other DTC codes present with DTC 219?</li> </ul>	Go to Step (3)	Go to Step (4)	
3	<ul> <li>Diagnose and repair any other DTC codes stored before proceeding with this chart.</li> <li>Have any other DTC codes been diagnosed and repaired?</li> </ul>		Go to Step (4)	-
4	Check the service part number on the ECM to ensure the correct calibration is in use Is the Service Part Number Correct?		Go to Step (6)	Go to Step 5
5	Replace ECM with correct service part num- ber Is the replacement complete?		Go to Step (9)	-
6	Check the mechanical operation of the throttle     Is the mechanical operation of the throttle OK?		Go to Step (8)	Go to Step (7)
7	<ul> <li>Correct mechanical operation of the throttle. Refer to Engine &amp; Component section</li> <li>Has the mechanical operation of the throttle been corrected?</li> </ul>		Go to Step (9)	-
8	Check engine for large manifold vacuum leaks. Refer to Symptom Diagnostic section Did you find and correct the vacuum leak?		Go to Step (9)	Go to OBD System Check Sec- tion
9	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-219 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 221-TPS 1 Higher Than TPS 2 (SPN 51:FMI 0)



### Conditions for Setting the DTC

- Throttle Position Sensor 1 & 2
- Check Condition-Key ON
- Fault Condition-TPS 1 20% higher than TPS2
- MIL-ON for remainder of key on cycle
- Engine shutdown

### **Circuit Description**

Dual throttle Position Sensors are used within the throttle that use variable resistors to determine signal voltage based on throttle plate position. TPS 1 will read lower voltage when closed and TPS 2 will read higher voltage when closed. The TPS 1 and TPS 2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded. The TPS is not serviceable and in the event of a failure the electronic throttle assembly must be replaced. This fault will set if TPS 1 is 20% (or more) higher than TPS 2. At this point the throttle is considered to be out of specification, or there is a problem with the TPS signal circuit. The MIL command is ON and the engine will shutdown.

# DTC 221 TPS 1 Higher Than TPS 2

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	<ul> <li>Key ON, Engine OFF</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Does the DST display more than a 20% differ- ence between TPS 1 and TPS 2?</li> </ul>		Go to Step (3)	Intermittent problem Go to Intermit- tent section
3	<ul> <li>Key OFF</li> <li>Disconnect electronic throttle connector C017</li> <li>Key ON</li> <li>Change DST mode to DBW (drive by wire) test mode</li> <li>Is the voltage for TPS 1 less than 0.1 volts?</li> </ul>		Go to Step (5)	Go to Step (4)
4	<ul> <li>Key OFF</li> <li>Disconnect ECM wiring harness connector C001</li> <li>Key ON</li> </ul>		Repair the TPS 1 circuit shorted to voltage as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (9)
5	<ul> <li>Jump TPS 1 signal pin 6 to the 5 volt reference pin 3 at connector C017</li> <li>Does DST display TPS 1 voltage over 4.900 volts?</li> </ul>		Go to Step (6)	Go to Step (8)
6	<ul> <li>Inspect wire terminals at throttle connector for damage corrosion or contamination Any problems found?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (7)
7	Replace the electronic Throttle Is the replacement complete?		Go to Step (12)	-
8	<ul> <li>Key OFF</li> <li>Disconnect ECM wire harness connector C001</li> <li>Using a DVOM check for continuity between throttle connector TPS 1 signal pin 6 and ECM connector TPS 1 signal pin 5</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (9)	Repair the open circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.

Step	Action	Value(s)	Yes	Νο
9	<ul> <li>Using a DVOM check for continuity between throttle connector signal ground pin 2 and ECM connector signal ground pin 3</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (10)	Repair the open circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
10	<ul> <li>Inspect ECM connector terminals for damage corrosion or contamination.</li> <li>Any problems found?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical	Go to Step (11)
11	Replace ECM Is the replacement complete?		Go to Step (12)	-
12	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-221 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 222-TPS 2 Signal Voltage Low (SPN 520251:FMI 4)

Electronic Throttle				ECM
	4	PNKAVHT	82	DBW +
	1	T AN /O R N	83	DBW -
	6	PPL/LT BLU	5	TPS 1 Signal
	2	BLK/LT GRN	20	Sensor Ground
	5	LT BLU/DK BLU	- 6	TPS 2 Signal
	3 C017	LT GRN/RED	- 19	5 Volts

### Conditions for Setting the DTC

- Throttle Position Sensor 2
- Check Condition-Cranking or Running
- Fault Condition-TPS 2 sensor voltage less than 0.200 volts
- MIL-ON during active fault
- Engine will Shutdown

### **Circuit Description**

Dual throttle Position Sensors are used within the throttle that use variable resistors to determine signal voltage based on throttle plate position. TPS1 will read lower voltage when closed and TPS2 will read higher voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded. The TPS is not serviceable and in the event of a failure the electronic throttle assembly must be replaced. This fault will set if the TPS 2 voltage is less than 0.200 volts. The MIL command is ON and engine will shutdown.

# DTC 222 TPS 2 Signal Voltage Low

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	<ul> <li>Key ON, Engine OFF</li> <li>DST (Diagnostic Scan Tool) connected in DBW (Drive by Wire) throttle test mode</li> <li>Does the DST display TPS 2 voltage of 0.200 volts or less with the throttle closed?</li> </ul>		Go to Step (4)	Go to Step (3)
3	<ul> <li>Slowly depress Foot Pedal while observing TPS 2 voltage</li> <li>Does TPS 2 voltage ever fall below 0.200 volts?</li> </ul>		Go to Step (4)	Intermittent problem Go to Intermit- tent section
4	<ul> <li>Key OFF</li> <li>Disconnect electronic throttle connector C017</li> <li>Jumper the 5 volt reference circuit pin 3 and TPS 2 signal circuit pin 5 together at the throttle connector</li> <li>Key ON</li> <li>Does DST display TPS 2 voltage of 4.0 volts or greater?</li> </ul>		Go to Step (7)	Go to Step (5)
5	<ul> <li>Key OFF</li> <li>Disconnect ECM wire harness connector C001</li> <li>Using a DVOM check continuity between TPS 2 connector signal pin 5 and ECM con- nector TPS 2 Signal pin 6</li> <li>Do have continuity between them?</li> </ul>		Go to Step (6)	Repair the circuit as nec- essary. Refer to Wiring Re- pairs in Engine Elec- trical.
6	Replace ECM Is the replacement complete?		Go to Step (9)	-
7	<ul> <li>Inspect the electronic throttle wire harness connector terminals for damage, corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (8)
8	<ul> <li>Replace the electronic throttle Is the replacement complete?</li> </ul>		Go to Step (9)	-

Step	Action	Value(s)	Yes	Νο
	Remove all test equipment except the DST. Connect any disconnected components, fus- es, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and driveability After operating the engine within the test pa- rameters of DTC-222 check for any stored codes.		System OK	Go to OBD System Check

## DTC 223-TPS 2 Signal Voltage High (SPN 520251:FMI 3)

E lectronic Throttle			ECM	
Motor	4		82 DBW +	
	1	TAN/ORN E	83 DBW -	
	6		5 TPS 1 Signal	
	2	BLK/LTGRN 2	Sensor Ground	
	5		6 TPS 2 Signal	
	3		19 5 Volts	
C017				

### Conditions for Setting the DTC

- Throttle Position Sensor 2
- Check Condition-Cranking or Running
- Fault Condition-TPS 2 sensor exceeds 4.800 volts
- MIL-ON during active fault
- Engine will shutdown

### **Circuit Description**

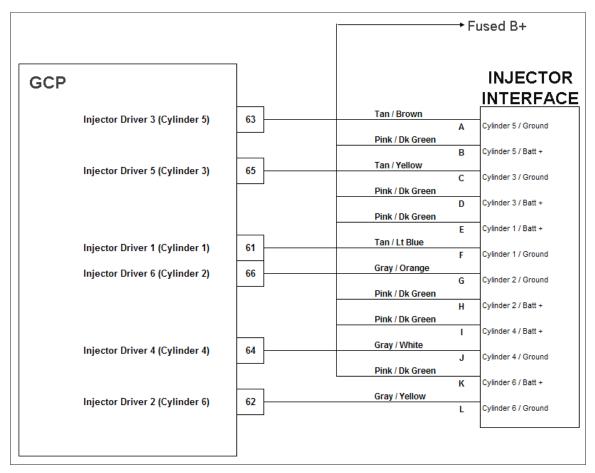
Dual throttle Position Sensors are used within the throttle that use variable resistors to determine signal voltage based on throttle plate position.TPS1 will read lower voltage when closed and TPS2 will read higher voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded. The TPS is not serviceable and in the event of a failure the electronic throttle assembly must be replaced. This fault will set if the TPS 2 voltage is greater than 4.800 volts. The MIL command is ON and the engine will shutdown.

# DTC 223 TPS 2 Signal Voltage High

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	<ul> <li>Key ON, Engine OFF</li> <li>DST (Diagnostic Scan Tool) connected in DBW (Drive by Wire) throttle test mode</li> <li>Does the DST display TPS 2 voltage of 4.800</li> <li>volts or greater with the throttle closed?</li> </ul>		Go to Step (4)	Go to Step (3)
3	<ul> <li>Slowly depress Foot Pedal while observing TPS 2 voltage</li> <li>Does TPS 2 voltage ever exceed 4.800 volts?</li> </ul>		Go to Step (4)	Intermittent problem Go to Intermit- tent section
4	<ul> <li>Key OFF</li> <li>Disconnect electronic throttle connector C017</li> <li>Key ON</li> <li>Does DST display TPS 2 voltage less than 0.2 volts?</li> </ul>		Go to Step (7)	Go to Step (5)
5	<ul> <li>Key OFF</li> <li>Disconnect ECM wire harness connector C001</li> <li>Key ON</li> <li>Using a DVOM check for voltage between electronic throttle connector TPS 2 signal pin 5 and engine ground</li> <li>Do you have voltage?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (6)
6	Replace ECM Is the replacement complete?		Go to Step (11)	-
7	<ul> <li>Probe sensor ground circuit at the ECM side of the wire harness pin 3 with a test light connected to battery voltage</li> <li>Does the test light come on?</li> </ul>		Go to Step (8)	Go to Step (10)
8	<ul> <li>Inspect the electronic throttle wire harness connector and terminals for damage, corro- sion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (9)
9	<ul> <li>Replace electronic throttle Is the replacement complete?</li> </ul>		Go to Step (11)	-
10	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Using a DVOM check for continuity between throttle connector C017 sensor ground pin 2 and ECM connector sensor ground pin 20 Do have continuity between them?</li> </ul>		Go to Step (6)	Repair the circuit as nec- essary. Refer to Wiring Re- pairs in Engine Elec- trical.

Step	Action	Value(s)	Yes	Νο
	Remove all test equipment except the DST. Connect any disconnected components, fus- es, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and driveability After operating the engine within the test pa- rameters of DTC-223 check for any stored codes.		System OK	Go to OBD System Check

### DTC 261: Injector driver 1 (cyl 1) open or short to ground SPN 651:FMI 5



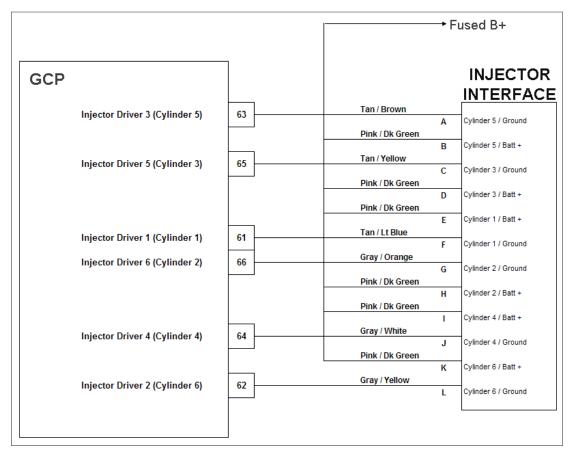
### Conditions for Setting the DTC

- Injector is in the Off State
- Low side voltage is less than 4.0 volts
- Battery voltage is above 9.0 volts
- MIL Light turned on
- Closed Loop is disabled while this fault is active
- Adaptive Learn is disabled while this fault is active.

### **Circuit Description**

The fuel injectors turn on when the GCP provides a ground circuit to the injector. Battery positive is constantly provided through the ignition fuse and the Pink / DK Green wire. Each Injector has a ground side driver assigned to it inside the GCP. The driver number does not match up with the mating cylinder number in each case. The driver is assigned in numerical order according to the engine firing order (4.3L = 1, 6, 5, 4, 3, 2). The ECM is monitoring the low side voltage internally in the ECM. This code will set if it sees a low voltage on the low side during an "injector off" state. This indicates the injector is open or there is a short to ground in the circuit.

### DTC 264: Injector driver 2 (Cyl 6) open or short to ground SPN 264:FMI 5



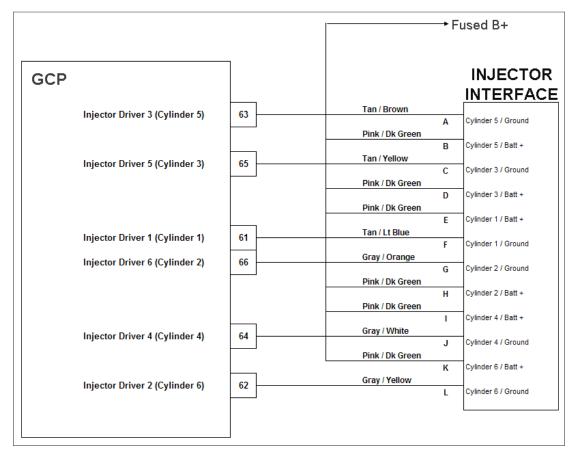
### **Conditions for Setting the DTC**

- Injector is in the Off State
- Low side voltage is less than 4.0 volts
- Battery voltage is above 9.0 volts
- MIL Light turned on
- Closed Loop is disabled while this fault is active
- Adaptive Learn is disabled while this fault is active.

### **Circuit Description**

The fuel injectors turn on when the GCP provides a ground circuit to the injector. Battery positive is constantly provided through the ignition fuse and the Pink / DK Green wire. Each Injector has a ground side driver assigned to it inside the GCP. The driver number does not match up with the mating cylinder number in each case. The driver is assigned in numerical order according to the engine firing order (4.3L = 1, 6, 5, 4, 3, 2). The ECM is monitoring the low side voltage internally in the ECM. This code will set if it sees a low voltage on the low side during an "injector off" state. This indicates the injector is open or there is a short to ground in the circuit.

### DTC 267: Injector driver 3 (Cyl 5) open or short to ground SPN 653:FMI 5



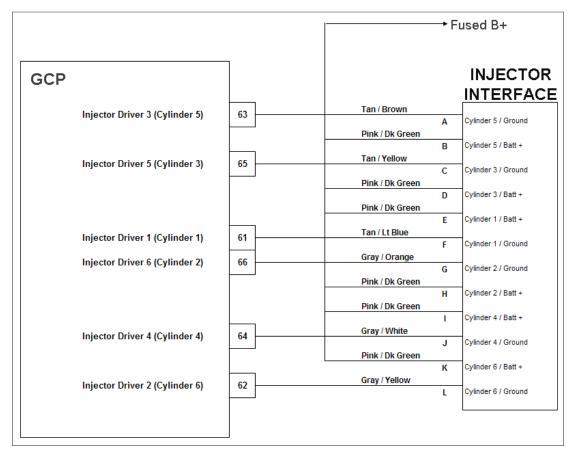
### **Conditions for Setting the DTC**

- Injector is in the Off State
- Low side voltage is less than 4.0 volts
- Battery voltage is above 9.0 volts
- MIL Light turned on
- Closed Loop is disabled while this fault is active
- Adaptive Learn is disabled while this fault is active.

### **Circuit Description**

The fuel injectors turn on when the GCP provides a ground circuit to the injector. Battery positive is constantly provided through the ignition fuse and the Pink / DK Green wire. Each Injector has a ground side driver assigned to it inside the GCP. The driver number does not match up with the mating cylinder number in each case. The driver is assigned in numerical order according to the engine firing order (4.3L = 1, 6, 5, 4, 3, 2). The ECM is monitoring the low side voltage internally in the ECM. This code will set if it sees a low voltage on the low side during an "injector off" state. This indicates the injector is open or there is a short to ground in the circuit.

### DTC 270: Injector driver 4 (Cyl 4) open or short to ground SPN 654:FMI 5



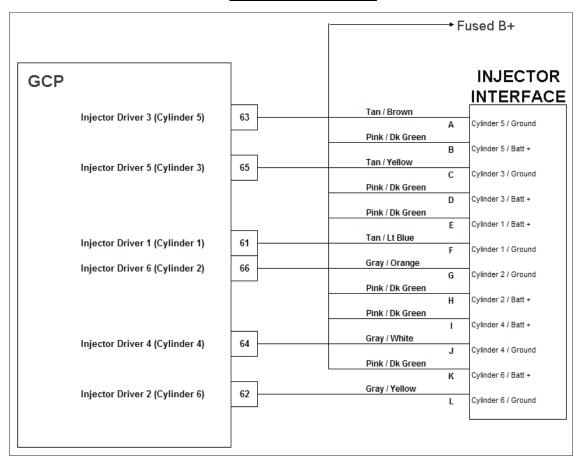
### **Conditions for Setting the DTC**

- Injector is in the Off State
- Low side voltage is less than 4.0 volts
- Battery voltage is above 9.0 volts
- MIL Light turned on
- Closed Loop is disabled while this fault is active
- Adaptive Learn is disabled while this fault is active.

### **Circuit Description**

The fuel injectors turn on when the GCP provides a ground circuit to the injector. Battery positive is constantly provided through the ignition fuse and the Pink / DK Green wire. Each Injector has a ground side driver assigned to it inside the GCP. The driver number does not match up with the mating cylinder number in each case. The driver is assigned in numerical order according to the engine firing order (4.3L = 1, 6, 5,4, 3, 2). The ECM is monitoring the low side voltage internally in the ECM. This code will set if it sees a low voltage on the low side during an "injector off" state. This indicates the injector is open or there is a short to ground in the circuit.

### DTC 273: Injector driver 5 (Cyl 3) open or short to ground SPN 655:FMI 5



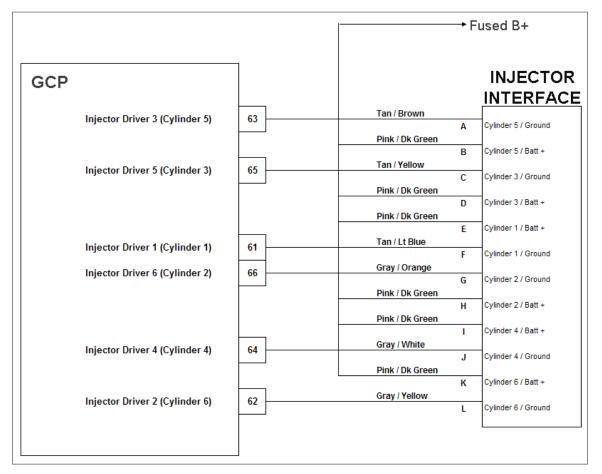
### Conditions for Setting the DTC

- Injector is in the Off State
- Low side voltage is less than 4.0 volts
- Battery voltage is above 9.0 volts
- MIL Light turned on
- Closed Loop is disabled while this fault is active
- Adaptive Learn is disabled while this fault is active.

### **Circuit Description**

The fuel injectors turn on when the GCP provides a ground circuit to the injector. Battery positive is constantly provided through the ignition fuse and the Pink / DK Green wire. Each Injector has a ground side driver assigned to it inside the GCP. The driver number does not match up with the mating cylinder number in each case. The driver is assigned in numerical order according to the engine firing order (4.3L = 1, 6, 5,4, 3, 2). The ECM is monitoring the low side voltage internally in the ECM. This code will set if it sees a low voltage on the low side during an "injector off" state. This indicates the injector is open or there is a short to ground in the circuit.

### DTC 276: Injector driver 6 (Cyl 2) open or short to ground SPN 656:FMI 5

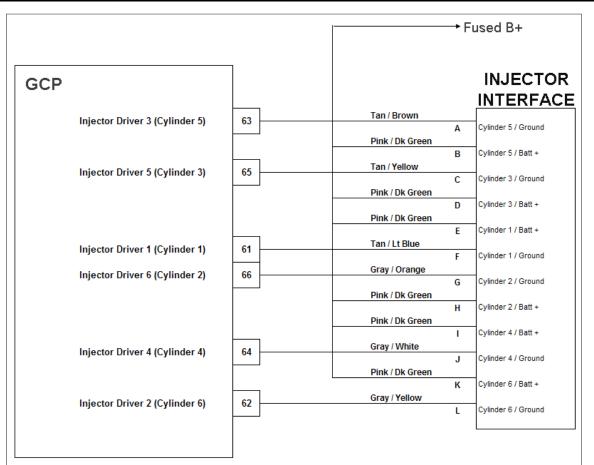


### **Conditions for Setting the DTC**

- Injector is in the Off State
- Low side voltage is less than 4.0 volts
- Battery voltage is above 9.0 volts
- MIL Light turned on
- Closed Loop is disabled while this fault is active
- Adaptive Learn is disabled while this fault is active.

#### **Circuit Description**

The fuel injectors turn on when the GCP provides a ground circuit to the injector. Battery positive is constantly provided through the ignition fuse and the Pink / DK Green wire. Each Injector has a ground side driver assigned to it inside the GCP. The driver number does not match up with the mating cylinder number in each case. The driver is assigned in numerical order according to the engine firing order (4.3L = 1, 6, 5,4, 3, 2). The ECM is monitoring the low side voltage internally in the ECM. This code will set if it sees a low voltage on the low side during an "injector off" state. This indicates the injector is open or there is a short to ground in the circuit.



## DTC 262: Injector driver 1 (Cyl 1) Coil Shorted (SPN 651:FMI 6)

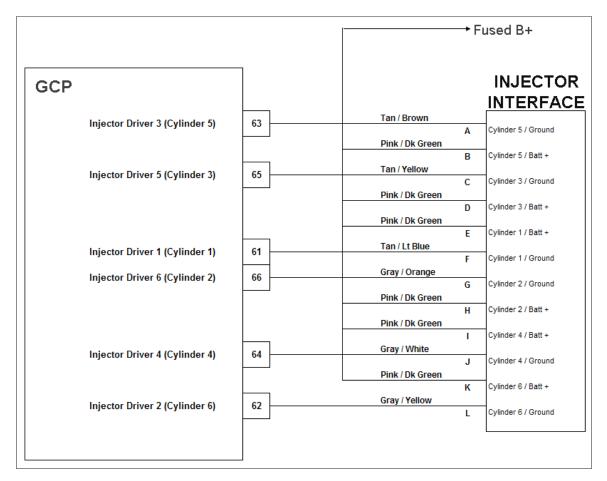
### **Conditions for Setting the DTC**

- Injector is in the On State
- Low side voltage is greater than 4.0 volts
- Battery voltage is less than 16.0 volts
- MIL Light turned on
- Closed Loop is disabled while this fault is active
- Adaptive Learn is disabled while this fault is active.

#### **Circuit Description**

The fuel injectors turn on when the GCP provides a ground circuit to the injector. Battery positive is constantly provided through the ignition fuse and the Pink / DK Green wire. Each Injector has a ground side driver assigned to it inside the GCP. The driver number does not match up with the mating cylinder number in each case. The driver is assigned in numerical order according to the engine firing order (4.3L = 1, 6, 5,4, 3, 2). The ECM is monitoring the low side voltage internally in the ECM. This code will set if it sees a high voltage on the low side during an "injector on" state. This indicates the injector likely has a short circuit internal to the injector. It could also be a result of a short from power to the ground circuit.

## DTC 265: Injector driver 2 (Cyl 6) Coil Shorted (SPN:652:FMI 6)

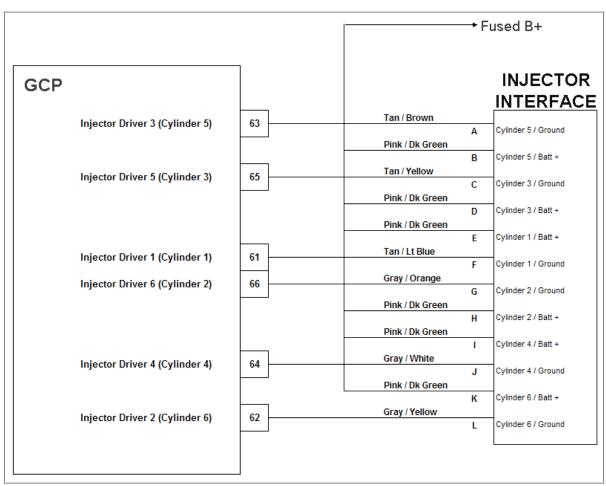


### Conditions for Setting the DTC

- Injector is in the On State
- Low side voltage is greater than 4.0 volts
- Battery voltage is less than 16.0 volts
- MIL Light turned on
- Closed Loop is disabled while this fault is active
- Adaptive Learn is disabled while this fault is active.

#### **Circuit Description**

The fuel injectors turn on when the GCP provides a ground circuit to the injector. Battery positive is constantly provided through the ignition fuse and the Pink / DK Green wire. Each Injector has a ground side driver assigned to it inside the GCP. The driver number does not match up with the mating cylinder number in each case. The driver is assigned in numerical order according to the engine firing order (4.3L = 1, 6, 5, 4, 3, 2). The ECM is monitoring the low side voltage internally in the ECM. This code will set if it sees a high voltage on the low side during an "injector on" state. This indicates the injector likely has a short circuit internal to the injector. It could also be a result of a short from power to the ground circuit.



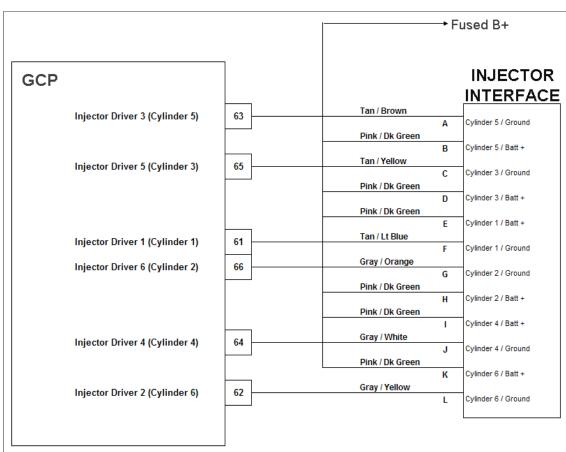
## DTC 268: Injector driver 3 (Cyl 5) Coil Shorted (SPN 653:FMI 6)

### Conditions for Setting the DTC

- Injector is in the On State
- Low side voltage is greater than 4.0 volts
- Battery voltage is less than 16.0 volts
- MIL Light turned on
- Closed Loop is disabled while this fault is active
- Adaptive Learn is disabled while this fault is active.

#### **Circuit Description**

The fuel injectors turn on when the GCP provides a ground circuit to the injector. Battery positive is constantly provided through the ignition fuse and the Pink / DK Green wire. Each Injector has a ground side driver assigned to it inside the GCP. The driver number does not match up with the mating cylinder number in each case. The driver is assigned in numerical order according to the engine firing order (4.3L = 1, 6, 5,4, 3, 2). The ECM is monitoring the low side voltage internally in the ECM. This code will set if it sees a high voltage on the low side during an "injector on" state. This indicates the injector likely has a short circuit internal to the injector. It could also be a result of a short from power to the ground circuit.



## DTC 271: Injector driver 4 (Cyl 4) Coil Shorted (SPN 654:FMI 6)

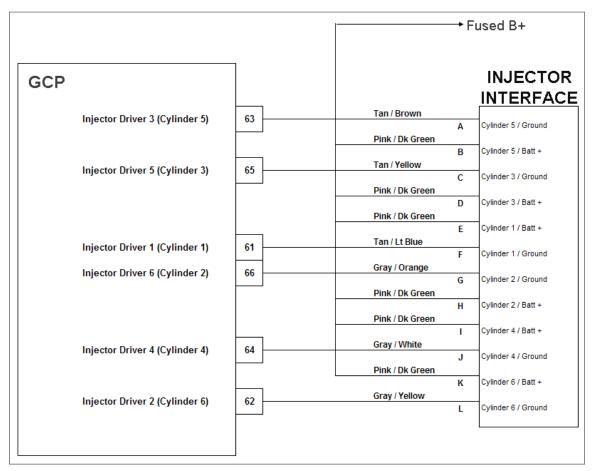
### **Conditions for Setting the DTC**

- Injector is in the On State
- Low side voltage is greater than 4.0 volts
- Battery voltage is less than 16.0 volts
- MIL Light turned on
- Closed Loop is disabled while this fault is active
- Adaptive Learn is disabled while this fault is active.

#### **Circuit Description**

The fuel injectors turn on when the GCP provides a ground circuit to the injector. Battery positive is constantly provided through the ignition fuse and the Pink / DK Green wire. Each Injector has a ground side driver assigned to it inside the GCP. The driver number does not match up with the mating cylinder number in each case. The driver is assigned in numerical order according to the engine firing order (4.3L = 1, 6, 5, 4, 3, 2). The ECM is monitoring the low side voltage internally in the ECM. This code will set if it sees a high voltage on the low side during an "injector on" state. This indicates the injector likely has a short circuit internal to the injector. It could also be a result of a short from power to the ground circuit.

## DTC 274: Injector driver 5 (Cyl 3) Coil Shorted (SPN 655: FMI 6)



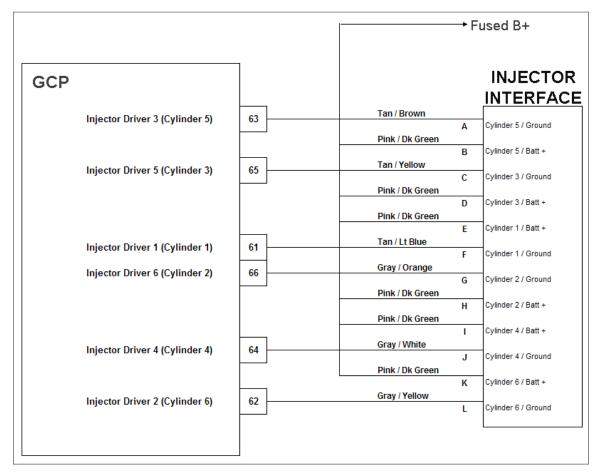
### **Conditions for Setting the DTC**

- Injector is in the On State
- Low side voltage is greater than 4.0 volts
- Battery voltage is less than 16.0 volts
- MIL Light turned on
- Closed Loop is disabled while this fault is active
- Adaptive Learn is disabled while this fault is active.

#### **Circuit Description**

The fuel injectors turn on when the GCP provides a ground circuit to the injector. Battery positive is constantly provided through the ignition fuse and the Pink / DK Green wire. Each Injector has a ground side driver assigned to it inside the GCP. The driver number does not match up with the mating cylinder number in each case. The driver is assigned in numerical order according to the engine firing order (4.3L = 1, 6, 5, 4, 3, 2). The ECM is monitoring the low side voltage internally in the ECM. This code will set if it sees a high voltage on the low side during an "injector on" state. This indicates the injector likely has a short circuit internal to the injector. It could also be a result of a short from power to the ground circuit.

## DTC 277: Injector driver 6 (Cyl 2) Coil Shorted (SPN 656:FMI 6)



### Conditions for Setting the DTC

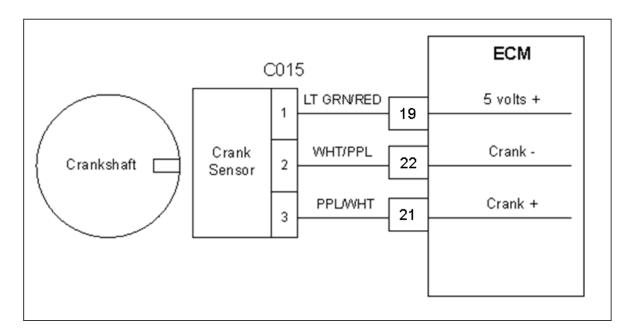
- Injector is in the On State
- Low side voltage is greater than 4.0 volts
- Battery voltage is less than 16.0 volts
- MIL Light turned on
- Closed Loop is disabled while this fault is active
- Adaptive Learn is disabled while this fault is active.

#### **Circuit Description**

The fuel injectors turn on when the GCP provides a ground circuit to the injector. Battery positive is constantly provided through the ignition fuse and the Pink / DK Green wire. Each Injector has a ground side driver assigned to it inside the GCP. The driver number does not match up with the mating cylinder number in each case. The driver is assigned in numerical order according to the engine firing order (4.3L = 1, 6, 5, 4, 3, 2). The ECM is monitoring the low side voltage internally in the ECM. This code will set if it sees a high voltage on the low side during an "injector on" state. This indicates the injector likely has a short circuit internal to the injector. It could also be a result of a short from power to the ground circuit.

The technician should check the wiring and the injector resistance. If the resistance is out of specification on the DVOM you should replace the injector. If there is a short from a power circuit to the ground circuit you should repair the faulty circuit in accordance with the recommended wire repair instructions provided in this manual.

## DTC 336-Crank Sync Noise (SPN 636:FMI 2)



### Conditions for setting the DTC

- Crankshaft Position sensor
- Check Condition- Engine running
- Fault Condition- 1 invalid crank re-sync in less than 800 ms
- Adaptive- Disabled
- MIL- On during active fault

### **Circuit Description**

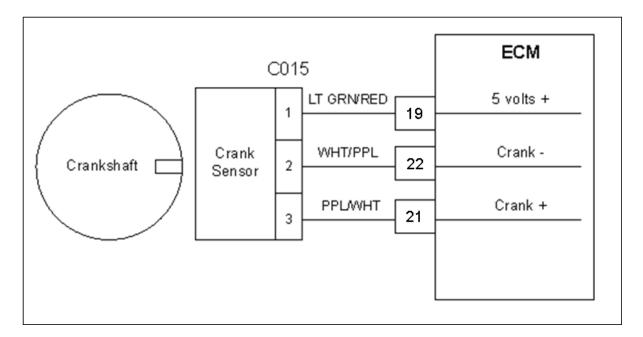
The Crankshaft position sensor is a 5 volt powered sensor mounted to the lower front engine block. A pulse wheel located on the crankshaft is used to measure engine rpm and its signal is used to synchronize the ignition and fuel systems. This fault will set If no signal is present for 800ms or longer.

## DTC 336 Crank Sync Noise

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Check that the ECM ground terminals C010, C022 and C023 are clean and tight Are the ground terminals clean and tight?</li> </ul>		Go to Step (3)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
3	<ul> <li>Key On, Engine OFF</li> <li>Disconnect the CKP (Crankshaft position) Sensor connector C015</li> <li>Using A DVOM check for voltage at the CKP sensor connector pin 1 and engine ground</li> <li>(CHECK THIS BEFORE THE POWER RELAY SHUTS OFF)</li> <li>Do you have voltage?</li> </ul>	5.0 volts	Go to Step (4	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
4	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Using a DVOM check for continuity between CKP connector pin 2 and ECM connector pin 22</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (5)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
5	<ul> <li>Using a DVOM check for continuity between CKP connector pin 3 and ECM connector pin 21</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (6)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
6	<ul> <li>Inspect the CKP connector C015 terminals for damage, corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (7)
7	<ul> <li>Inspect the ECM connector C001 terminals 19, 22, and 21 for damage, corrosion or con- tamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to step (8)

Step	Action	Value(s)	Yes	No
8	Replace CKP sensor Is the replacement complete?		Go to Step (10)	-
9	Replace ECM Is the replacement complete?		Go to Step (11)	-
10	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-336 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to Step (9)
11	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-336 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

## DTC 337-Crank Loss (SPN 636:FMI 4)



### Conditions for setting the DTC

- Crankshaft position sensor
- Check Condition- Engine cranking
- Fault Condition- 6 cam pulse signals without crankshaft activity
- MIL- On during active fault
- Adaptive- Disabled

### **Circuit Description**

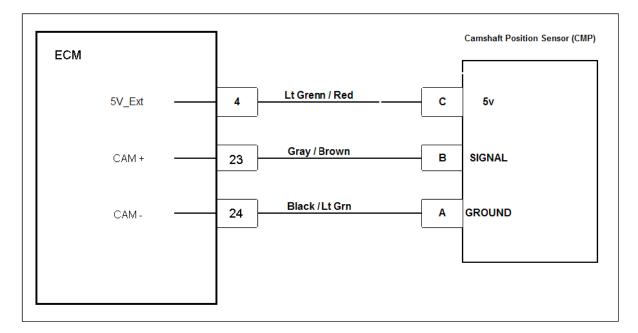
The Crankshaft position sensor is a 5 volt powered sensor mounted to the lower front engine block. A pulse wheel located on the crankshaft is used to measure engine rpm and its signal is used to synchronize the ignition and fuel systems. The ECM must see a valid Crankshaft position signal while cranking. If no crankshaft signal is present for 6 cam pulses this fault will set.

# DTC 337-Crank Loss

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Check that the ECM ground terminals C010, C022 and C023 are clean and tight</li> <li>Are the ground terminals clean and tight?</li> </ul>		Go to Step (3)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
3	<ul> <li>Key OFF</li> <li>Disconnect the CKP (Crankshaft Position) Sensor connector C015</li> <li>Using A DVOM check for voltage at the CKP sensor connector pin 1 and engine ground</li> <li>(CHECK THIS BEFORE THE POWER RELAY SHUTS OFF)</li> <li>Do you have voltage?</li> </ul>	5.0 volts	Go to Step (4	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
4	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Using a DVOM check for continuity between CKP connector pin 2 and ECM connector pin 22</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (5)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
5	<ul> <li>Using a DVOM check for continuity between CKP connector pin 3 and ECM connector pin 21</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (6)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
6	<ul> <li>Inspect the CKP connector C015 terminals for damage, corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (7)
7	<ul> <li>Inspect the ECM connector C001 terminals 19, 22, and 21 for damage, corrosion or con- tamination</li> <li>Did you find a problem</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to step (8)

Step	Action	Value(s)	Yes	No
8	Replace the CKP sensor Is the replacement complete?		Go to Step (10)	-
9	Replace ECM Is the replacement complete?		Go to Step (11)	-
10	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-337 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to Step (9)
11	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-337 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 341-Camshaft Sync Noise (SPN 723:FMI 2)



### **Conditions for Setting the DTC**

- Camshaft position sensor
- Check Condition-Cranking or Running
- Fault Condition-1 invalid cam re-sync in 700ms or less
- Adaptive Learn disabled
- MIL-ON

### **Circuit Description**

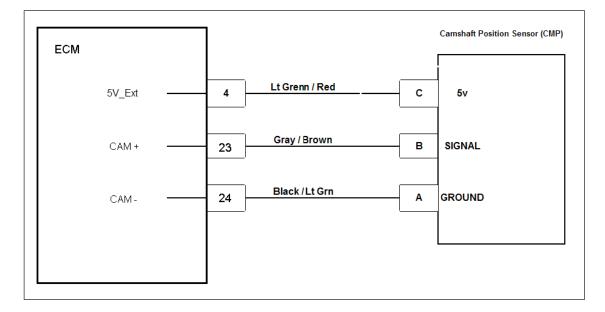
The CMP (Camshaft Position Sensor) is used to synchronize the fuel and ignition systems. This fault will set if the ECM detects erroneous pulses from the camshaft position sensor causing invalid cam re-sync. MIL light will become active and Adaptive Learn will be disabled.

## DTC 341-Camshaft Sensor Noise

Step	Action Did you perform the On-Board (OBD) System Check?	Value(s) -	Yes Go to Step (2)	No Go to OBD System Check Sec-
				tion
2	<ul> <li>Check that the ECM ground terminal C010 is clean, tight and in the proper location</li> <li>Are the ground terminals clean and tight?</li> </ul>		Go to Step (3)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
3	<ul> <li>Key OFF</li> <li>Disconnect the CMP (Camshaft position) Sensor connector C016</li> <li>Using A DVOM check for voltage at the CMP sensor connector pin C and engine ground Do you have voltage?</li> </ul>	5.0 volts	Go to Step (4)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
4	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Using a DVOM check for continuity between CMP connector pin A and ECM connector pin 24</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (5)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
5	<ul> <li>Using a DVOM check for continuity between CMP connector pin B and ECM connector pin 23</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (6)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
6	<ul> <li>Inspect the CMP connector terminals for damage, corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (7)
7	<ul> <li>Inspect the ECM connector C001 terminals 4, 23, and 24 for damage, corrosion or con- tamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (8)
8	<ul> <li>Replace CMP sensor</li> <li>Is the replacement complete?</li> </ul>		Go to Step (10)	-

Step	Action	Value(s)	Yes	No
9	<ul> <li>Replace ECM Is the replacement complete?</li> </ul>		Go to Step (11)	-
10	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-341 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to Step (9)
11	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-341 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

## DTC 342-Camshaft Sensor Loss (SPN 723:FMI 4)



### Conditions for Setting the DTC

- CMP (Camshaft Position Sensor)
- Check Condition-Engine Cranking or Running
- Fault Condition-No cam pulse in 2.5 cycles with engine speed greater than 100 rpm
- MIL-ON for active fault
- Adaptive-Disabled

### **Circuit Description**

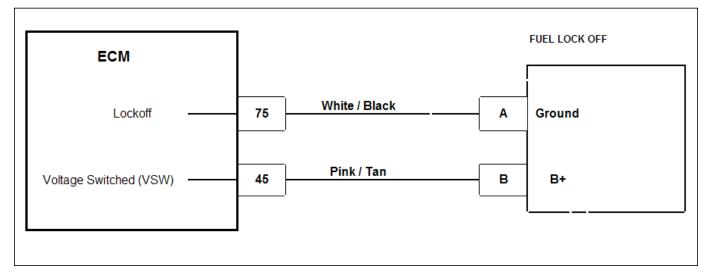
The CMP (Camshaft Position Sensor) is used to synchronize the fuel and ignition systems. This fault will set if the ECM does not detect a cam pulse in 2.5 engine cycles whenever the engine is greater than 100 rpm. The engine may not run with this fault present.

## DTC 342-Camshaft Sensor Loss

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Check that the ECM ground terminal C010 is clean, tight and in the proper location</li> <li>Is the ground terminal clean tight and in the proper location?</li> </ul>		Go to Step (3)	Repair the circuit as necessary. Refer to wir- ing harness repair sec- tion.
3	<ul> <li>Key OFF</li> <li>Disconnect the CMP (Camshaft Position) Sensor connector C016</li> <li>Key ON</li> <li>Using A DVOM check for voltage at the CMP sensor connector pin C and engine ground (RUN THIS VOLTAGE CHECK BEFORE THE POWER RELAY SHUTS OFF) Do you have voltage?</li> </ul>	5.0 volts	Go to Step (4)	Repair the circuit as necessary. Refer to wir- ing harness repair sec- tion.
4	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Using a DVOM check for continuity between CMP connector pin A and ECM connector pin 24</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (5)	Repair the circuit as necessary. Refer to wir- ing harness repair sec- tion.
5	<ul> <li>Using a DVOM check for continuity between CMP connector pin B and ECM connector pin 23</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (6)	Repair the circuit as necessary. Refer to wir- ing harness repair sec- tion.
6	<ul> <li>Inspect the CMP connector terminals for damage, corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to wir- ing harness repair sec- tion.	Go to Step (7)
7	<ul> <li>Inspect the ECM connector terminals 2, 23 and 24 for damage, corrosion or contamina- tion</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to wir- ing harness repair sec- tion.	Go to Step (8)

Step	Action	Value(s)	Yes	No
8	Replace the CMP.		Go to Step	-
0	Is the replacement complete?		(10)	
9	Replace ECM		Go to Step	-
9	Is the replacement complete?		(11)	
10	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-342 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to Step (9)
11	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-342 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

## DTC-359 Fuel Run-out Longer Than Expected (SPN 1239:FMI 7)



### Conditions for Setting the DTC

- LPG lock-off valve
- Check Condition-Key OFF
- Fault Condition-Engine run down time greater than 20 seconds
- MIL-ON

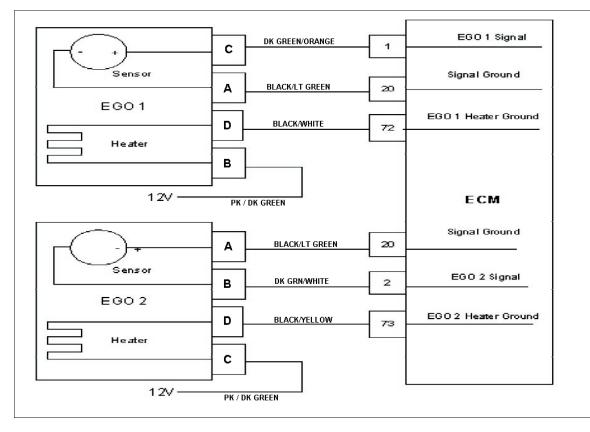
### **Circuit Description**

The LPG lock off valve is supplied system battery power from the VSW fused source. The ECM then provides a path to ground to turn the valve on. This fault will set in the event the engine continues to run for more than 20 seconds after the key is turned off. This fault indicates a possible problem with the electric LPG lock off solenoid.

# DTC-359 Fuel Run-out Longer Than Expected

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	
2	<ul> <li>Disconnect the LPG shut off solenoid connector C003</li> <li>Using a DVOM check for power across terminals A and B while cranking the engine, then turn the key to the OFF position</li> <li>Did the voltage immediately turn OFF with the key cycle?</li> </ul>	System Voltage	Go to Step (3)	Go to Step (5)
3	<ul> <li>Turn off the LPG manual valve at the fuel tank</li> <li>Start the engine and let it idle until the engine stops.</li> <li>(THIS MAY TAKE SEVERAL MINUTES)</li> <li>Did the engine ever stop?</li> </ul>		Intermittent problem. See intermittent problems in the electrical section of this manual.	Go to Step (4)
4	Replace the LPG shut off solenoid Is the replacement complete?		Go to Step (8)	_
5	<ul> <li>Key OFF</li> <li>Disconnect the ECM wire harness connector C001</li> <li>Using a DVOM check for continuity between ECM pin 12 and engine ground</li> <li>Do you have continuity?</li> </ul>		Repair the LPG solenoid control short to ground	Go to Step (6)
6	<ul> <li>Inspect the ECM wire harness and connect- or for damage corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Correct the problem as required. See wire harness repair.	Go to Step (7)
7	<ul> <li>Replace the ECM Is the replacement complete?</li> </ul>		Go to Step (8)	_
8	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and drivability</li> <li>After operating the engine within the test parameters of DTC-359 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

## DTC 420 Gasoline Catalyst Monitor (SPN 520211:FMI 10)



### **Conditions for Setting the DTC**

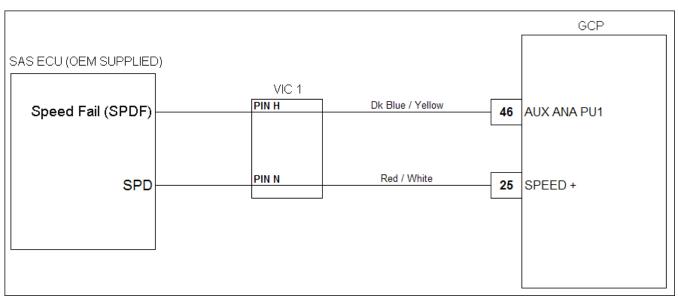
- Catalyst Function
- Check condition- Engine running
- Fault condition- EGO 1 signal = EGO 2 signal for 100 updates
- MIL- On during active fault and for 1 second after active fault
- Adaptive- Disabled during active fault

### **Circuit Description**

The ECM uses EGO 1 and EGO 2 sensor signals to diagnose problems with the catalyst muffler. When the signals for EGO 1 & EGO 2 are similar it may indicate a problem with the catalyst.

### **Diagnostic Aids**

Always diagnose any other troubles, stored along with DTC 420 first. Check for and eliminate any exhaust leaks prior to replacing catalyst muffler. Look for exhaust leaks at the catalyst muffler inlet and tail pipes. Clear this trouble code after repairing exhaust leaks, and recheck for code. If there are no exhaust leaks or other exhaust related issues there may be a problem internally with the catalyst muffler.



### DTC 502 - Loss of Road Speed (SPN 84:FMI 1)

### **Conditions for setting the DTC**

- Road speed input is less than 0.1 km/hr
- Fault must be active for 5.0 seconds to activate DTC
- Engine speed is greater than 1,500 rpms
- MAP pressure is greater than 10.00 PSIA
- SPDF signal indicates vehicle is moving
- MIL light on during fault
- Power Derate 2 enabled

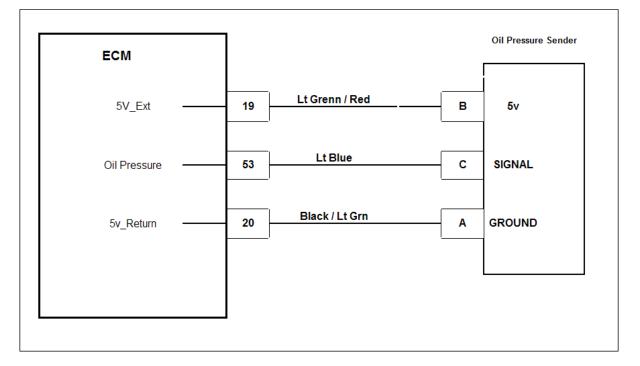
### **Circuit Description**

The ECM is provided a pulse width modulation (PWM) signal from the OEM vehicle controller to determine the road speed of the vehicle. The PWM signal is supplied to the engine VIC1 Pin N and finally to pin 25 at the GCP connector. The DTC will set when the PWM signal is lost and the engine speed is greater than 1,500 rpms , MAP pressure is greater than 10.0 psia and the SPDF signal indicates the vehicle is moving. The technician should check the OEM system including vehicle speed controller along with circuit between the vehicle speed controller and the engine ECM.

## DTC 502 – Loss of Road Speed

STEP	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	<ul> <li>Key Off</li> <li>Check the wiring for continuity between terminals 25 at the GCP Connector and Pin N of the VIC 1</li> <li>Do you have continuity between the terminals?</li> </ul>	No Resistance	Go to Step (3)	Repair wire circuit between Pin N and Pin 25.
3	Check Pin N and Pin 25 for spread terminals or poor connections with the mating terminals.  Are the pins acceptable for use?	-	Go to Step (4)	Repair damaged terminal
4	<ul> <li>Key off</li> <li>Disconnect battery</li> <li>Install Test GCP</li> <li>Reconnect battery</li> <li>Start engine and check for fault</li> </ul>	-	Replace GCP Module	Refer to OEM wiring and/or speed detection system

## DTC 520-Oil Pressure Low Stage 1 (SPN 100:FMI 18)

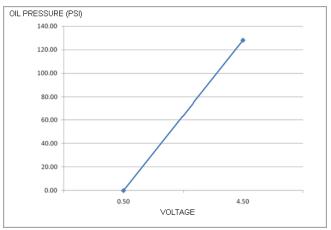


### Conditions for Setting the DTC

- Engine Oil Pressure low.
- Engine running with engine speed less than 1200 rpm and oil pressure is less than 15 psi for 5 or more seconds
- Engine running with engine speed greater than 1450 rpm and oil pressure is less than 20 psi for 5 or more seconds
- MIL is active

### **Circuit Description**

The Oil Pressure Sender is used to communicate the oil pressure condition to the ECM. Engine damage can occur if the engine is operated with low oil pressure. The ECM sends a 5v signal to the oil pressure sender. The sender will report a signal back to the ECM on the signal wire depending on the pressure that is applied on its diaphragm. The voltage is linear in comparison to the pressure applied (see chart below). The MIL command is ON.

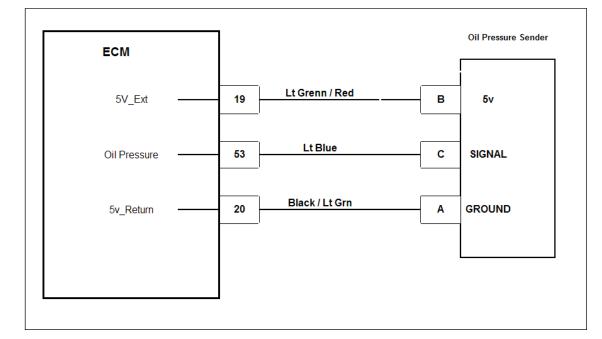


# DTC 520-Oil Pressure Low Stage 1

Step		Value(s)	Yes	Νο
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Verify that the engine has oil pressure using a mechanical oil pressure gauge before pro- ceeding with this chart. See Engine Specifications Section 1F.</li> <li>Does the engine have oil pressure above 15 psi?</li> </ul>	15 psi	Go to Step (3)	Repair faulty Oiling System
3	<ul> <li>Key ON, Engine Running DST connected in System Data Mode</li> <li>Clear DTC 524</li> <li>Warm the engine by idling until the ECT tem- perature is above 160 degrees F. and has been running for at least 20 seconds or more</li> <li>Increase engine speed above 600 RPM Does DTC 524 reset and cause the engine to shut down?</li> </ul>		Go to Step (4)	Intermittent problem Go to Intermittent section
4	<ul> <li>With a volt meter, check terminal B on the sensor for a 5 volt reference from the ECM.</li> <li>Do you have 5 volts on terminal B?</li> </ul>	5v	Go to Step (6)	Go to Step (5)
5	<ul> <li>With a volt meter, check terminal 19 on the ECM for a 5 volt reference.</li> <li>Do you have a 5v reference coming out of the ECM?</li> </ul>	5v	Repair faulty wiring be- tween ECM and Oil pres- sure sensor	Go to Step (8)
6	<ul> <li>With the oil pressure sender connected check for a signal coming out of terminal C.</li> <li>Do you have a voltage signal coming out of ter- minal C?</li> </ul>		Go to Step (7)	Replace faulty oil pressure sender
7	<ul> <li>With the oil pressure sender connected check for a signal at terminal 53 of the ECM.</li> <li>Do you have a signal voltage at pin 53 of the ECM?</li> </ul>		Go to Step (8)	Repair faulty wiring be- tween terminal C and Terminal 25.

Step	Action	Value(s)	Yes	No
8	<ul> <li>Replace ECM Is the replacement complete?</li> </ul>		Go to Step (9)	-
9	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-524 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

## DTC 521- Oil Pressure High (SPN 100:FMI 0)

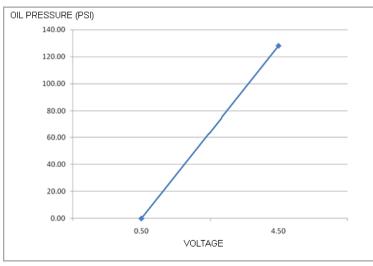


### **Conditions for Setting the DTC**

- Engine Oil Pressure high.
- Check Condition-Engine running for 5 seconds.
- Fault Condition- Oil pressure greater than 95 psi for 5 or more seconds
- Forced idle is active

### **Circuit Description**

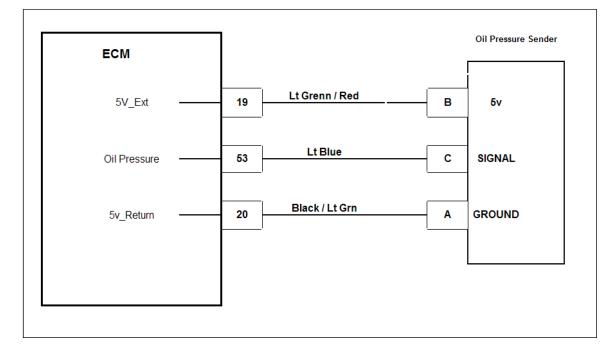
The Oil Pressure Sender is used to communicate the oil pressure condition to the ECM. Engine damage can occur if the engine is operated with low oil pressure. The ECM sends a 5v signal to the oil pressure sender. The sender will report a signal back to the ECM on the signal wire depending on the pressure that is applied on its diaphragm. The voltage is linear in comparison to the pressure applied (see chart below). The MIL command is ON and the engine will go into a forced idle condition in the event of this fault to help prevent possible engine damage.



## DTC 521-Oil Pressure High

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Verify that the engine has oil pressure using a mechanical oil pressure gauge before pro- ceeding with this chart. See Engine Specifications Section 1F.</li> <li>Does the engine have oil pressure above 95 psi?</li> </ul>		Repair faulty oiling system	Go to step (3)
3	<ul> <li>With the engine running measure the signal voltage on terminal C of the oil pressure sender.</li> <li>Do you have more than 3.8v?</li> </ul>	> 3.8v.	Replace faulty oil pressure sender.	Go to step (4)
4	<ul> <li>With the engine running measure the signal voltage on terminal 53 of the ECM.</li> <li>Do you have more than 3.8v?</li> </ul>	> 3.8v.	Repair faulty wiring be- tween terminal C and 25.	Replace faulty IEPR / ECM

### DTC 522- Oil Pressure Sender low voltage (SPN 100:FMI 4)

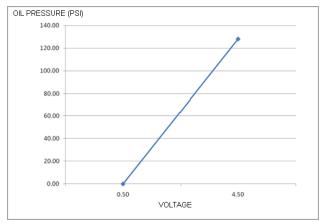


### **Conditions for Setting the DTC**

- Engine Oil Pressure low.
- Check Condition-Engine running for 20 seconds or more with engine speed greater than 600 rpm.
- Fault Condition- Voltage on terminal 25 is less than 0.2v for more than 1 second
- MIL-ON during active fault and for 2 seconds after active fault.
- Forced idle active

### **Circuit Description**

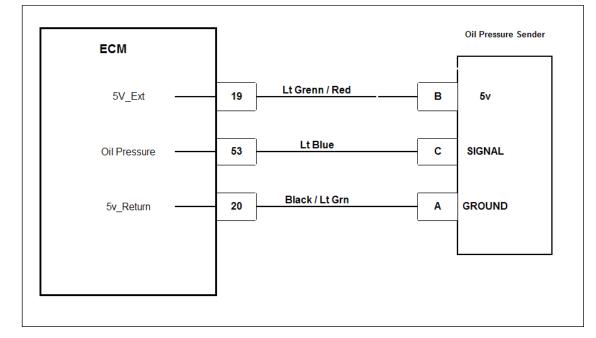
The Oil Pressure Sender is used to communicate the oil pressure condition to the ECM. Engine damage can occur if the engine is operated with low oil pressure. The ECM sends a 5v signal to the oil pressure sender. The sender will report a signal back to the ECM on the signal wire depending on the pressure that is applied on its diaphragm. The voltage is linear in comparison to the pressure applied (see chart below). The MIL command is ON and the engine will go into a forced idle in the event of this fault to help prevent possible engine damage.



## DTC 522- Oil Pressure Sender low voltage

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Using the Diagnostic Service Tool (DST) with the key on engine running, check the OILP_raw value on the "RAW VOLTS" page.</li> <li>Is the voltage less than 0.2 volts</li> </ul>	< 0.2v	Go to Step (3)	Check for faulty harness or intermittent ECM issue.
3	<ul> <li>Using a voltmeter measure the voltage at terminal 53 of the ECM</li> <li>Key on engine running</li> <li>Is the voltage less than 0.2 volts?</li> </ul>	< 0.2v	Go to Step (4)	Replace faulty ECM
4	<ul> <li>Key on engine running</li> <li>Check for the voltage supply signal to the oil pressure switch at terminal B of the pressure switch.</li> <li>Does the terminal have 5 volts?</li> </ul>	5v	Go to step (4)	Go to step (6)
5	<ul> <li>Using a voltmeter measure the voltage at terminal C at the oil pressure sender.</li> <li>Key on engine running</li> <li>Is the voltage less than 0.2 volts?</li> </ul>	< 0.2v	Replace faulty oil pressure sender.	Intermittent problem, go to intermittent section
6	<ul> <li>Key on</li> <li>Check for voltage supply signal at terminal 19 of the ECM</li> <li>Does the ECM terminal 19 provide a 5v signal?</li> </ul>	5v	Replace ECM.	Repair wiring issue be- tween pin 19 and oil pres- sure sender terminal B

### DTC 523- Oil Pressure Sender high voltage (SPN 100:FMI 3)

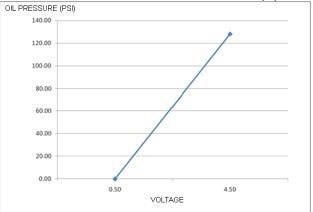


### **Conditions for Setting the DTC**

- Engine Oil Pressure sender voltage is high
- Check Condition-Engine running for 20 seconds or more with engine speed greater than 600 rpm.
- Fault Condition- Voltage on terminal 25 is greater than 4.8v for more than 1 second
- MIL-ON during active fault and for 2 seconds after active fault.
- Forced idle active

### **Circuit Description**

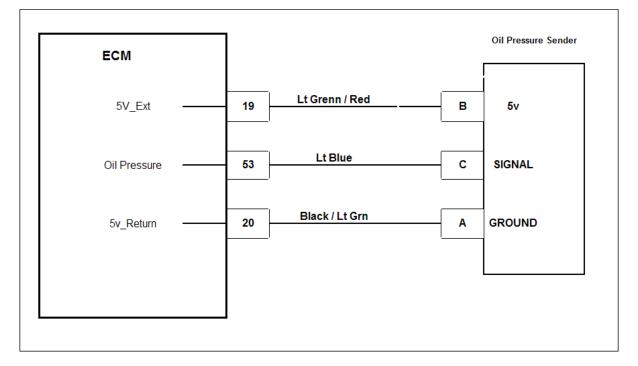
The Oil Pressure Sender is used to communicate the oil pressure condition to the ECM. Engine damage can occur if the engine is operated with low oil pressure. The ECM sends a 5v signal to the oil pressure sender. The sender will report a signal back to the ECM on the signal wire depending on the pressure that is applied on its diaphragm. The voltage is linear in comparison to the pressure applied (see chart below). The MIL command is ON and the engine will go into forced idle in the event of this fault to help prevent possible engine damage.



# DTC 523- Oil Pressure Sender high voltage

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Using the Diagnostic Service Tool (DST) check the OILP_raw value on the "RAW VOLTS" page.</li> <li>Is the voltage over 4.8 volts</li> </ul>	> 4.8v	Go to Step (3)	Check for faulty harness or intermittent ECM issue
3	<ul> <li>Using a voltmeter measure the voltage at terminal 53 of the ECM</li> <li>Is the voltage over 4.8 volts?</li> </ul>	> 4.8v	Go to Step (4)	Replace faulty IEPR / ECM
4	<ul> <li>Using a voltmeter measure the voltage at terminal C at the oil pressure sender.</li> <li>Is the voltage over 4.8 volts?</li> </ul>	> 4.8v	Replace faulty oil pressure sender.	Intermittent problem, go to intermittent section

## DTC 524-Oil Pressure Low Stage 2 (SPN 100:FMI 1)

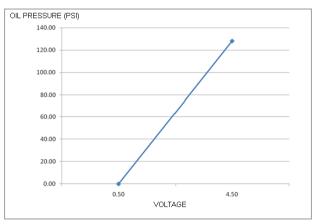


### **Conditions for Setting the DTC**

- Engine Oil Pressure low.
- Fault Condition- Oil pressure less than 8 psi for 5 or more seconds
- Engine Shut Down.

### **Circuit Description**

The Oil Pressure Sender is used to communicate the oil pressure condition to the ECM. Engine damage can occur if the engine is operated with low oil pressure. The ECM sends a 5v signal to the oil pressure sender. The sender will report a signal back to the ECM on the signal wire depending on the pressure that is applied on its diaphragm. The voltage is linear in comparison to the pressure applied (see chart below). The MIL command is ON and the engine will shut down in the event of this fault to help prevent possible engine damage.

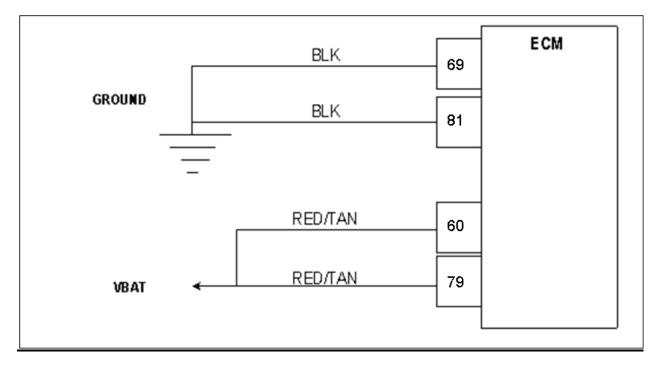


## DTC 524-Oil Pressure Low

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Verify that the engine has oil pressure using a mechanical oil pressure gauge before pro- ceeding with this chart. See Engine Specifications Section 1F.</li> <li>Does the engine have oil pressure above 8 psi?</li> </ul>	8 psi	Go to Step (3)	Repair faulty Oiling System
3	<ul> <li>Key ON, Engine Running DST connected in System Data Mode</li> <li>Clear DTC 524</li> <li>Warm the engine by idling until the ECT tem- perature is above 160 degrees F. and has been running for at least 20 seconds or more</li> <li>Increase engine speed above 600 RPM Does DTC 524 reset and cause the engine to shut down?</li> </ul>		Go to Step (4)	Intermittent problem Go to Intermittent section
4	<ul> <li>With a volt meter, check terminal B on the sensor for a 5 volt reference from the ECM.</li> <li>Do you have 5 volts on terminal B?</li> </ul>	5∨	Go to Step (6)	Go to Step (5)
5	<ul> <li>With a volt meter, check terminal 19 on the ECM for a 5 volt reference.</li> <li>Do you have a 5v reference coming out of the ECM?</li> </ul>	5v	Repair faulty wiring be- tween ECM and Oil pres- sure sensor	Go to Step (8)
6	<ul> <li>With the oil pressure sender connected check for a signal coming out of terminal C.</li> <li>Do you have a voltage signal coming out of ter- minal C?</li> </ul>	See Linear graph on page 204 for expected approx Volt- age	Go to Step (7)	Replace faulty oil pressure sender
7	<ul> <li>With the oil pressure sender connected check for a signal at terminal 53 of the ECM.</li> <li>Do you have a signal voltage at pin 53 of the ECM?</li> </ul>		Go to Step (8)	Repair faulty wiring be- tween terminal C and Terminal 25.

Step	Action	Value(s)	Yes	No
8	<ul> <li>Replace ECM Is the replacement complete?</li> </ul>		Go to Step (9)	-
9	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-524 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

## DTC 562-System Voltage Low (SPN 168:FMI 17)



### **Conditions for Setting the DTC**

- System Voltage to ECM
- Check Condition-Key on with engine speed greater than 1000 RPM
- Fault Condition-Battery voltage at ECM less than 9.0
- Fault Condition is present for longer than 5 seconds.
- MIL-ON for active fault
- Adaptive-Disabled

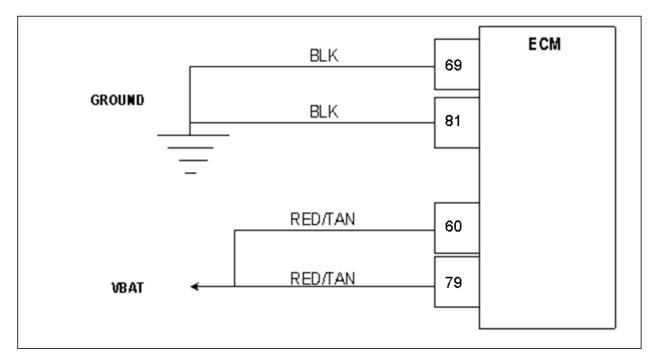
### **Circuit Description**

The battery voltage powers the ECM and must be measured to correctly to properly operate injector drivers, solenoid valves and ignition coils. This fault will set if the ECM detects system voltage less than 9.00 volts while the alternator should be charging. The adaptive learn is disabled during this fault.

## DTC 562-System Voltage Low

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Does DST display system voltage greater than 9.50 volts?</li> </ul>	-	Intermittent problem Go to Engine Electrical In- termittent section	Go to Step (3)
3	Check battery condition Is it OK?	-	Go to Step (4)	Replace Bat- tery
4	Check charging system Is it OK?	-	Go to Step (5)	Repair charg- ing System
5	<ul> <li>Key OFF</li> <li>Disconnect the ECM connector C001</li> <li>Check the voltage between ECM connector C001 pins 60, 79 and engine ground.</li> <li>Measure voltage with DVOM between each pin and engine ground</li> <li>Is the voltage greater than for each pin 9.50 volts?</li> </ul>	-	Repair ECM Ground cir- cuit. Go to Power and Ground sec- tion in engine Electrical	Go to Step (6)
6	<ul> <li>Check the voltage at ECM connector pins 69 and 81</li> <li>Measure voltage with DVOM between each pin and battery positive</li> <li>Is the voltage greater than 9.50 volts?</li> </ul>	-	Repair ECM power circuit. Go to Power and Ground section in en- gine Electrical	Go to Step (7)
7	Replace ECM Is the replacement complete?	-	Go to Step (8)	-
8	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-562 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>	-	System OK	Go to OBD System Check

## DTC 563-System Voltage High (SPN 168:FMI 15)



### **Conditions for Setting the DTC**

- System Voltage to ECM
- Check Condition-Cranking or Running
- Fault Condition-System battery voltage at ECM greater than 18 volts
- Fault must be present for 3 or more seconds
- MIL-ON for active fault
- Adaptive-Disabled

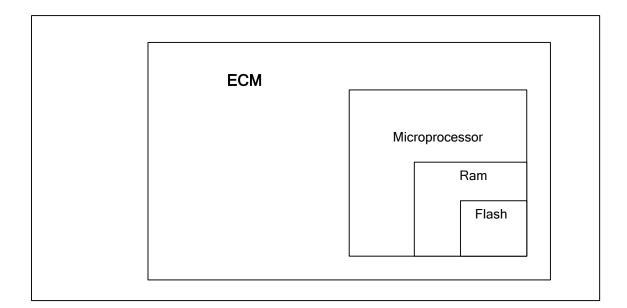
### **Circuit Description**

The battery voltage powers the ECM and must be measured to correctly operate injector drivers, trim valves and ignition coils. This fault will set if the ECM detects voltage greater than 18 volts anytime the engine is cranking or running. The adaptive learn function is disabled during this fault. The ECM will shut down with internal protection if the system voltage ever exceeds 26 volts.

## DTC 563-System Voltage High

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Run engine greater than 1500 rpm.</li> <li>Does DST display system voltage greater than 18 volts?</li> </ul>	_	Go To Step (3)	Intermittent problem Go to Engine Electrical In- termittent section
3	<ul> <li>Check voltage at battery terminals with DVOM with engine speed greater than 1500 rpm</li> <li>Is it greater than 18 volts?</li> </ul>	-	Go to Step (4)	Go to Step (5)
4	<ul> <li>Repair the charging system</li> <li>Has the charging system been repaired?</li> </ul>	-	Go to Step (6)	-
5	Replace ECM Is the replacement complete?		Go to Step (6)	-
6	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-563 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

## DTC 601-Flash Checksum Invalid (SPN 628:FMI 13)



## **Conditions for Setting the DTC**

- Engine Control Module
- Check Condition-Key on
- Fault Condition-Internal microprocessor error
- MIL-ON
- Engine Shutdown will occur

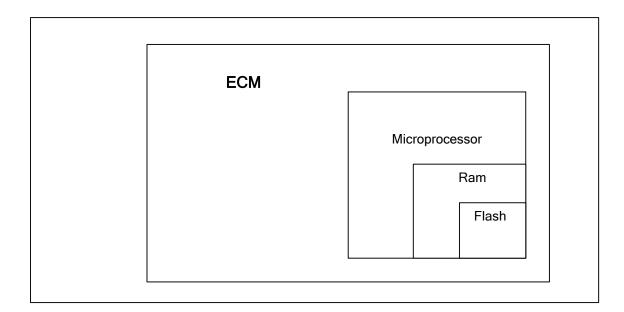
## **Circuit Description**

The ECM has several internal checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will attempt to reset itself in the event this fault is set. The MIL command is on and will remain on until the code is cleared using the DST. The engine will shutdown when this fault occurs.

# DTC 601-Flash Checksum Invalid

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Clear system fault code</li> <li>Does DTC 601 reset with the engine idling?</li> </ul>		Go to Step (3)	Intermittent problem Go to In- termittent section
3	Check ECM power and ground circuits Did the power and ground circuits check OK?		Go to Step (4)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
4	Replace ECM Is the replacement complete?		Go to Step (5)	-
5	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-601 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 604-RAM Failure (SPN 630:FMI 12)



## **Conditions for Setting the DTC**

- Engine Control Module
- Check Condition-Key on
- Fault Condition-Internal microprocessor error
- MIL-ON
- Engine Shutdown will occur

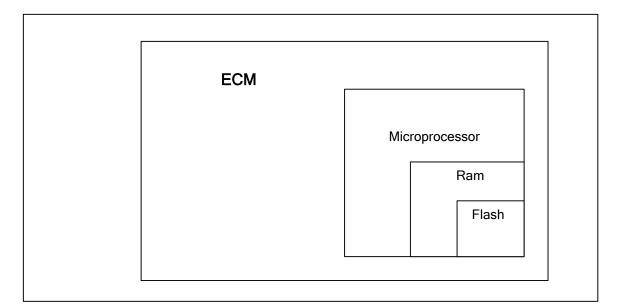
## **Circuit Description**

The ECM has several internal checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will attempt to reset itself in the event this fault is set. The MIL command is on and will remain on until the code is cleared using the DST. The engine will shutdown if this fault occurs.

# DTC 604-RAM Failure

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Clear system fault code</li> <li>Does DTC 604 reset with the engine idling?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	• Check ECM power and ground circuits Did the power and ground circuits check OK?		Go to Step (4)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
4	Replace ECM Is the replacement complete?		Go to Step (5)	-
5	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-604 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 606-COP Failure (SPN 629:FMI 31)



## **Conditions for Setting the DTC**

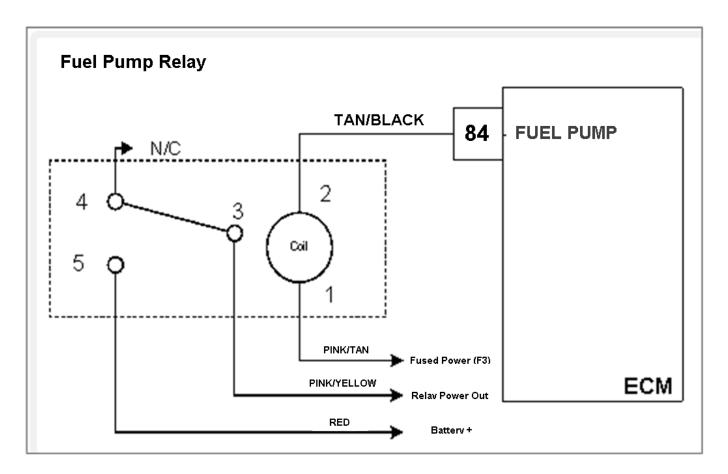
- Engine Control Module
- Check Condition-Key on
- Fault Condition-Internal microprocessor error
- MIL-ON
- Engine Shutdown will occur

#### **Circuit Description**

The ECM has several internal checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will attempt to reset itself in the event this fault is set. The MIL command is on and will remain on until the code is cleared using the DST. The engine will shutdown if this fault occurs.

# DTC 606-COP Failure

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Clear system fault code</li> <li>Does DTC 606 reset with the engine idling?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	Check ECM power and ground circuits     Are the power and ground circuits OK?		Go to Step (4)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
4	Replace ECM Is the replacement complete?		Go to Step (5)	-
5	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-606 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check



## **Conditions for Setting the DTC**

- Fuel Pump relay check
- Check Condition-Key ON
- Fault Condition-Relay coil open

## **Circuit Description**

The fuel pump relay switches power out to the gasoline fuel pump. This fault will set if the ECM detects an open circuit on the relay control output.

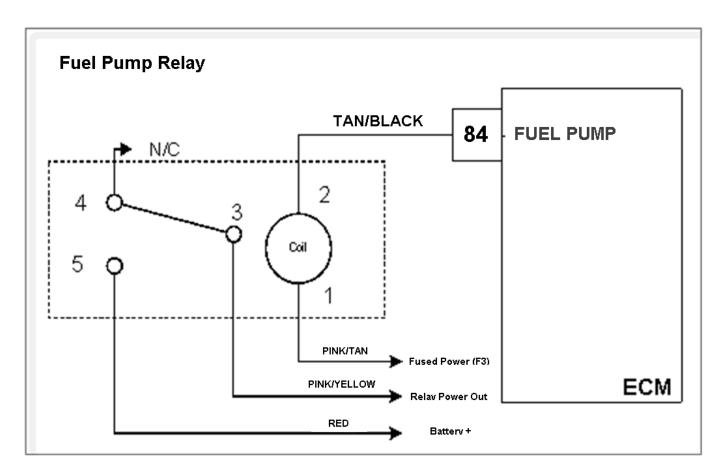
#### **Diagnostic Aid**

# DTC 627-Fuel Pump Relay Coil Open

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>DST connected and in the system data mode</li> <li>Key OFF</li> <li>Remove the power relay from the fuse block</li> <li>Using a DVOM check the resistance of the relay coil between terminals 1 and 2</li> <li>Is the resistance value less than 100 ohms?</li> </ul>		Go to Step (4)	Go to Step (3)
3	Replace the fuel pump relay Is the replacement complete?		Go to Step (9)	_
4	Check fuse F3 Is the fuse open?		Replace fuse F2	Go to Step (5)
5	<ul> <li>Disconnect ECM connector C001</li> <li>Using a DVOM check for continuity between ECM pin 84 and fuse block cavity for relay terminal 2</li> <li>Do you have continuity?</li> </ul>		Go to Step (6)	Repair the open circuit as required. See wiring harness re- pairs
6	<ul> <li>Remove fuse F3</li> <li>Using a DVOM check for continuity between fuse block cavity for relay terminal 1 and the power out of the F3 fuse holder</li> <li>Do you have continuity?</li> </ul>		Go to Step (7)	Repair the open circuit as required. See wiring harness re- pairs
7	<ul> <li>Check all system fuses.</li> <li>Check all relay placement positions in fuse block.</li> <li>Run complete pin to pin checks on chassis wiring to fuel system harness.</li> <li>See complete fuel system schematic for further details</li> <li>Did you find the problem?</li> </ul>		Go to Step (9)	Go to Step (8)

Step	Action	Value(s)	Yes	No
8	Replace the ECM Is the replacement complete?		Go to Step (9)	_
9	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-627 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

## DTC 628- Fuel Pump Relay Control Ground Short (SPN 1347:FMI 5)



## **Conditions for Setting the DTC**

- Fuel Pump relay ground control
- Check Condition-Key ON
- Fault Condition-Relay control shorted to ground

#### **Circuit Description**

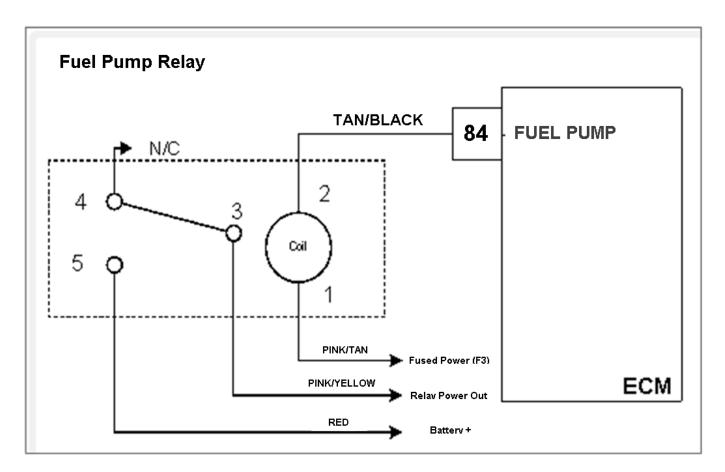
The fuel pump relay switches power out to the gasoline fuel pump. This fault will set if the ECM detects an open circuit on the relay control output

#### **Diagnostic Aid**

# DTC 628- Fuel Pump Relay Control Ground Short

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, DST connected in the System Data mode</li> <li>Clear DTC 628</li> <li>Start the engine Does DTC 628 re-set?</li> </ul>		Go to Step (4)	Intermittent problem Go to Inter- mittent section
3	<ul> <li>Disconnect ECM connector C001</li> <li>Using a DVOM check the resistance value between ECM pin 84 and engine ground</li> <li>Is the resistance less than 60 ohms?</li> </ul>		Go to Step (5)	Go to Step (7)
4	<ul> <li>Remove the fuel pump relay from the fuse block</li> <li>Using a DVOM check the resistance value again between ECM pin 84 and engine ground</li> <li>Is the resistance less than 60 ohms?</li> </ul>		Repair the shorted to ground relay control circuit as necessary. See wiring harness re- pairs	Go to Step (6)
5	<ul> <li>Replace the fuel pump relay Is the replacement complete?</li> </ul>		Go to Step (8)	_
6	Replace ECM Is the replacement complete?		Go to Step (8)	_
7	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-628 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

## DTC 629- Fuel Pump Relay Coil Short to Power (SPN 1347:FMI 3)



## Conditions for Setting the DTC

- Fuel pump relay check
- Check Condition-Key ON
- Fault Condition-Relay coil shorted to power

#### **Circuit Description**

The fuel pump relay switches power out to the gasoline fuel pump. This fault will set if the ECM detects an open circuit on the relay control output

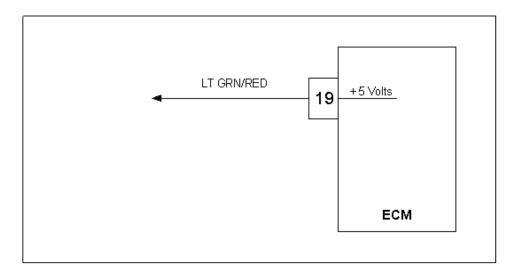
#### **Diagnostic Aid**

# DTC 629- Fuel Pump Relay Coil Short to Power

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>DST connected and in the system data mode</li> <li>Key OFF</li> <li>Remove the power relay from the fuse block</li> <li>Using a DVOM check the resistance of the relay coil between terminals 1 and 2</li> <li>Is the resistance value less than 60 ohms?</li> </ul>		Go to Step (3)	Go to Step (4)
3	<ul> <li>Replace the power relay</li> <li>Is the replacement complete?</li> </ul>		Go to Step (9)	_
4	<ul> <li>Using a DVOM check for continuity between relay terminals 2 and 3</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (3)	Go to Step (5)
5	<ul> <li>Key OFF</li> <li>Disconnect ECM wire harness connector C001</li> <li>Using a DVOM check for power between ECM pin 84 and engine ground with the key ON</li> <li>Do you have power?</li> </ul>	System bat- tery voltage	Repair the short to pow- er. See wiring harness re- pair.	Go to Step (6)
6	Replace the power relay     Is the replacement complete?		Go to Step (7)	_
7	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-629 check for any stored codes.</li> <li>Does DTC 629 still re-set?</li> </ul>		Go to Step (8)	Go to Step (9)

Step	Action	Value(s)	Yes	No
8	Replace the ECM Is the replacement complete?		Go to Step (9)	_
9	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-629 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 642-External 5 Volt 1 Reference Low (SPN 1079:FMI 4)



## **Conditions for Setting the DTC**

- External 5 volt reference
- Check Condition-Engine cranking or running
- Fault Condition-5 volt reference voltage lower than 4.60 volts
- MIL-ON during active fault
- Adaptive-Disabled during active fault

## **Circuit Description**

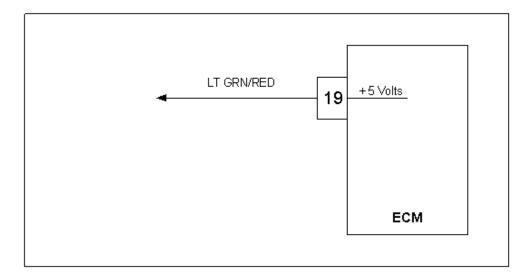
The External 5 volt supply powers many of the sensors and other components of the fuel system. The accuracy of the 5 volt supply is very important to the accuracy of the powered sensors and fuel control by the ECM. The ECM is able to determine if they are overloaded, shorted, or otherwise out of specification by monitoring the 5 volt supply. This fault will set if the 5 volt reference is below 4.60 volts. Adaptive Learn will be disabled during this fault

# DTC 642 External 5 Volt 1 Reference Low

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Fault Mode</li> <li>Does DST display DTC 642?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Using DVOM check for continuity between ECM 5 volt reference pin 19 and engine ground</li> <li>Do you have continuity?</li> </ul>		Go to Step (5)	Go to Step (4)
4	Replace ECM Is the replacement complete?		Go to Step (7)	-
5	<ul> <li>While monitoring DVOM for continuity be- tween ECM 5 volt reference and engine ground</li> <li>Disconnect each sensor (below) one at a time to find the shorted 5 volt reference. When continuity to ground is lost the last sensor disconnected is the area of suspicion. Inspect the 5 volt reference supply wire leads for shorts before replacing the sensor.</li> <li>TMAP</li> <li>Electronic Throttle</li> <li>FPP</li> <li>Crankshaft Sensor</li> <li>Camshaft Sensor</li> <li>While disconnecting each sensor one at a time did you loose continuity?</li> </ul>		Go to Step (6)	Repair short- ed wire harness
6	Replace the last disconnected sensor     Is the replacement complete?		Go to Step (7)	-

Step	Action	Value(s)	Yes	No
7	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-642 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 643-External 5 Volt 1 Reference High (SPN 1079:FMI 3)



## Conditions for Setting the DTC

- External 5 volt reference
- Check Condition-Engine cranking or running
- Fault Condition-5 volt reference higher than 5.40 volts
- MIL-ON during active fault
- Adaptive-Disabled during active fault

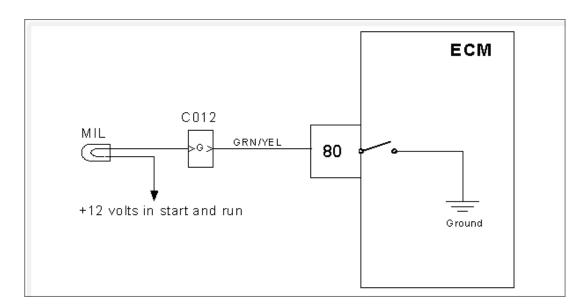
## **Circuit Description**

The External 5 volt supply powers many of the sensors and other components in the fuel system. The accuracy of the 5 volt supply is very important to the accuracy of the powered sensors and fuel control by the ECM. The ECM is able to determine if they are overloaded, shorted, or otherwise out of specification by monitoring the 5volt supply. This fault will set if the 5 volt reference is greater than 5.40 volts anytime the engine is cranking or running. Adaptive Learn will be disabled during this fault

# DTC 643 External 5 Volt 1 Reference High

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Does DST display DTC 643?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	<ul> <li>Check all ECM ground connections</li> <li>Refer to Engine electrical power and ground distribution.</li> <li>Are the ground connections OK?</li> </ul>		Go to Step (4)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
4	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Key ON</li> <li>Using DVOM check for Voltage between ECM harness wire pin 19 and engine ground Do you have voltage?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (5)
5	Replace ECM Is the replacement complete?		Go to Step (6)	-
6	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-643 check for any stored codes.</li> <li>Does the vehicle engine normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 650-MIL Control Open (SPN:1213:FMI 5)



## Conditions for setting the DTC

- MIL check
- Check Condition-Key ON engine OFF
- Fault Condition-ECM MIL circuit open
- MIL Command-ON

## **Circuit Description**

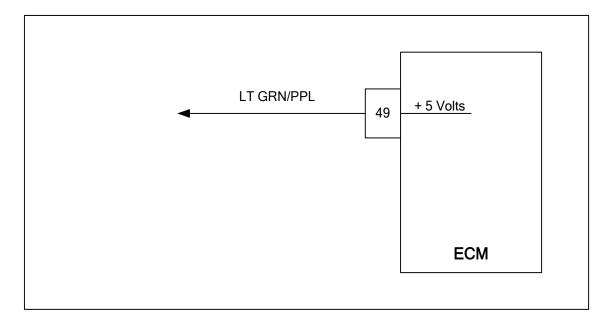
The fuel system is equipped with OBD (On-Board Diagnostics). The system has a dash mounted MIL (Malfunction Indicator Lamp). The MIL serves as notification of an emissions related problem. The MIL also has the ability to flash DTC codes in what is referred to as the blink code mode. It will display DTCs that have been stored due to a possible system malfunction. The following DTC charts in this manual will instruct the technician to perform the OBD system check. This simply means to verify the operation of the MIL. The lamp should illuminate when the key is in the ON position, and the engine is not running. This feature verifies that the lamp is in proper working order. If the lamp does not illuminate with the vehicle key ON and engine OFF, repair it as soon as possible. Once the engine is in start or run mode, the lamp should go off. If the lamp stays on while the engine is in the MIL electrical wiring. The electrical schematic above shows the MIL power source supplied to the lamp. The ECM completes the circuit to ground to turn the lamp ON. This fault will set if the ECM MIL control circuit is open.

# DTC 650-MIL Control Open

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Clear system fault code</li> <li>Key OFF</li> <li>Key ON</li> <li>Does DTC 650 reset?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	<ul> <li>Remove the MIL bulb or driver circuit</li> <li>Using a DVOM check for continuity through the bulb or driver device</li> <li>Do you have continuity?</li> </ul>		Go to Step (5)	Go to Step (4)
4	<ul> <li>Replace the open bulb or driver device Is the replacement complete?</li> </ul>		Go to Step (8)	_
5	<ul> <li>Key OFF</li> <li>Re-install the bulb or driver device</li> <li>Disconnect vehicle interface connector C012</li> <li>Using a DVOM check for continuity between vehicle interface connector pin G and battery positive</li> <li>Key ON</li> <li>Do you have continuity?</li> </ul>		Go to Step (6)	Repair the open circuit as required. See wire har- ness repair
6	<ul> <li>Disconnect ECM wire harness connector C001</li> <li>Using a DVOM check for continuity between ECM harness connector pin 80 and vehicle interface connector pin G</li> <li>Do you have continuity?</li> </ul>		Go to Step (7)	Repair the open circuit as required. See wire har- ness repair
7	<ul> <li>Inspect ECM wire harness connector pin 80 and vehicle interface connector pin G for damage, corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Correct the problem as required. See wiring har- ness repair	Go to Step (8)

Step	Action	Value(s)	Yes	Νο
8	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-650 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System check

# DTC 652-External 5 Volt 2 Reference Low (SPN 1080:FMI 4)



## Conditions for Setting the DTC

- External 5 volt reference
- Check Condition-Engine cranking or running
- Fault Condition-5 volt reference voltage lower than 3.00 volts
- MIL-On during active fault
- Adaptive-Disabled during active fault

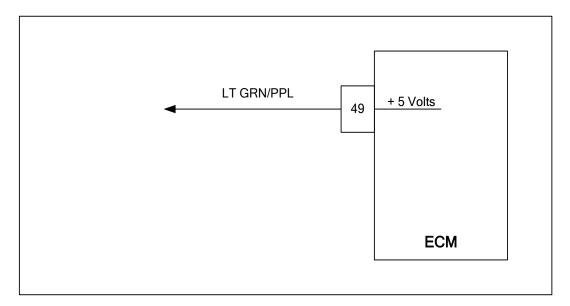
#### **Circuit Description**

The External 5 volt supply is normally dedicated to the FPP sensor 5 volt supply circuit. The accuracy of the 5 volt supply is very important to the accuracy of the FPP sensor circuit. The ECM is able to determine if the circuit is open, shorted, or otherwise out of specification by monitoring this 5 volt supply. This fault will set if the 5 volt reference is below 3.00 volts. Adaptive Learn will be disabled during this fault.

# DTC 652 External 5 Volt 2 Reference Low

Step	Action Did you perform the On-Board (OBD) System	Value(s)	Yes Go to Step	<b>No</b> Go to OBD
1	Check?		(2)	System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Fault Mode</li> <li>Does DST display DTC 652?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Using DVOM check for continuity between ECM 5 volt reference pin 49 and engine ground</li> <li>Do you have continuity?</li> </ul>		Go to Step (5)	Go to Step (4)
4	Replace ECM Is the replacement complete?		Go to Step (7)	-
5	<ul> <li>While monitoring DVOM for continuity be- tween ECM 5 volt reference and engine ground</li> <li>Disconnect each sensor (below) one at a time to find the shorted 5 volt reference. When continuity to ground is lost the last sensor disconnected is the area of suspicion. Inspect the 5 volt reference supply wire leads for shorts before replacing the sensor.</li> <li>FPP While disconnecting each sensor one at a time did you loose continuity?</li> </ul>		Go to Step (6)	Repair short- ed wire harness
6	Replace the last disconnected sensor     Is the replacement complete?		Go to step (7)	-
7	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-652 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 653-External 5 Volt 2 Reference High (SPN 1080:FMI 3)



## **Conditions for Setting the DTC**

- External 5 volt reference
- Check Condition-Engine cranking or running
- Fault Condition-5 volt reference higher than 5.40 volts
- MIL-On during active fault
- Adaptive-Disabled during active fault

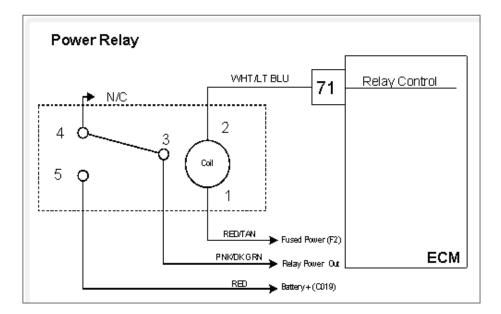
## **Circuit Description**

The External 5 volt supply is normally dedicated to the FPP sensor 5 volt supply circuit. The accuracy of the 5 volt supply is very important to the accuracy of the FPP sensor circuit. The ECM is able to determine if the circuit is open, shorted, or otherwise out of specification by monitoring this 5 volt supply. This fault will set if the 5 volt reference is above 5.40 volts. Adaptive Learn will be disabled during this fault.

# DTC 653 External 5 Volt 2 Reference High

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Does DST display DTC 653?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	<ul> <li>Check all ECM ground connections. Refer to Engine electrical power and ground distribu- tion.</li> <li>Are the ground connections Ok?</li> </ul>		Go to Step (4)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
4	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Key ON</li> <li>Using DVOM check for Voltage between ECM harness wire pin 49 and engine ground Do you have voltage?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (5)
5	Replace ECM Is the replacement complete?		Go to Step (6)	-
6	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-653 check for any stored codes.</li> <li>Does the vehicle engine normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 685-Relay Coil Open (SPN 1485:FMI 5)



## Conditions for Setting the DTC

- Power relay check
- Check Condition-Key ON
- Fault Condition-Relay coil open

## **Circuit Description**

The power relay switches power out to various sensors, actuators and solenoids in the fuel system. This fault will set if the ECM detects an open circuit on the relay control output.

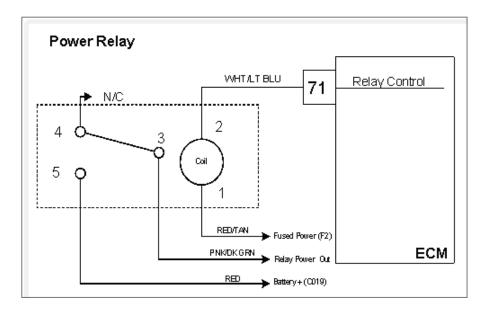
#### **Diagnostic Aid**

# DTC 685-Relay Coil Open

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>DST connected and in the system data mode</li> <li>Key OFF</li> <li>Remove the power relay from the fuse block</li> <li>Using a DVOM check the resistance of the relay coil between terminals 1 and 2</li> <li>Is the resistance value less than 100 ohms?</li> </ul>		Go to Step (4)	Go to Step (3)
3	<ul> <li>Replace the power relay Is the replacement complete?</li> </ul>		Go to Step (9)	_
4	Check fuse F2 Is the fuse open?		Replace fuse F2	Go to Step (5)
5	<ul> <li>Disconnect ECM connector C001</li> <li>Using a DVOM check for continuity between ECM pin 71 and fuse block cavity for relay terminal 2</li> <li>Do you have continuity?</li> </ul>		Go to Step (6)	Repair the open circuit as required. See wiring harness re- pairs
6	<ul> <li>Remove fuse F2</li> <li>Using a DVOM check for continuity between fuse block cavity for relay terminal 1 and the power out of the F2 fuse holder</li> <li>Do you have continuity?</li> </ul>		Go to Step (7)	Repair the open circuit as required. See wiring harness re- pairs
7	<ul> <li>Check all system fuses.</li> <li>Check all relay placement positions in fuse block.</li> <li>Run complete pin to pin checks on chassis wiring to fuel system harness.</li> <li>See complete fuel system schematic for further details</li> <li>Did you find the problem?</li> </ul>		Go to Step (9)	Go to Step (8)

Step	Action	Value(s)	Yes	No
8	Replace the ECM Is the replacement complete?		Go to Step (9)	_
9	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-685 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 686-Relay Control Ground Short (SPN 1485:FMI 4)



## Conditions for Setting the DTC

- Power relay ground control
- Check Condition-Key ON
- Fault Condition-Relay control shorted to ground

## **Circuit Description**

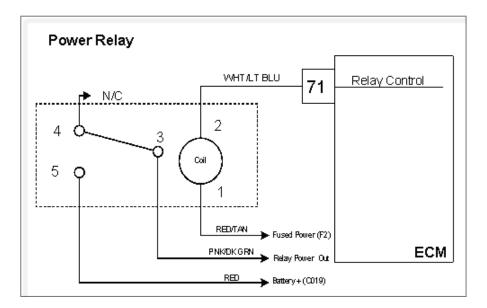
The power relay switches power out to various sensors, actuators and solenoids in the fuel system. This fault will set if the ECM detects a short to ground on the relay control output.

#### **Diagnostic Aid**

# DTC 686-Relay Control Ground Short

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, DST connected in the System Data mode</li> <li>Clear DTC 686</li> <li>Start the engine Does DTC 686 re-set?</li> </ul>		Go to Step (4)	Intermittent problem Go to Inter- mittent section
3	<ul> <li>Disconnect ECM connector C001</li> <li>Using a DVOM check the resistance value between ECM pin 71 and engine ground Is the resistance less than 60 ohms?</li> </ul>		Go to Step (5)	Go to Step (7)
4	<ul> <li>Remove the power relay from the fuse block</li> <li>Using a DVOM check the resistance value again between ECM pin 71 and engine ground</li> <li>Is the resistance less than 60 ohms?</li> </ul>		Repair the shorted to ground relay control circuit as necessary. See wiring harness re- pairs	Go to Step (6)
5	Replace the power relay Is the replacement complete?		Go to Step (8)	_
6	Replace ECM Is the replacement complete?		Go to Step (8)	_
7	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-686 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

## DTC 687-Relay Coil Short to Power (SPN 1485:FMI 3)



## **Conditions for Setting the DTC**

- Power relay check
- Check Condition-Key ON
- Fault Condition-Relay coil shorted to power

#### **Circuit Description**

The power relay switches power out to various sensors, actuators and solenoids in the fuel system. This fault will set if the ECM detects a short circuit to power on the relay control output.

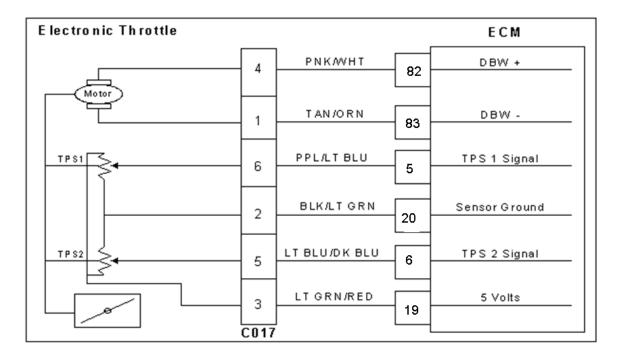
#### **Diagnostic Aid**

# DTC 687-Relay Coil Short to Power

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>DST connected and in the system data mode</li> <li>Key OFF</li> <li>Remove the power relay from the fuse block</li> <li>Using a DVOM check the resistance of the relay coil between terminals 1 and 2</li> <li>Is the resistance value less than 60 ohms?</li> </ul>		Go to Step (3)	Go to Step (4)
3	<ul> <li>Replace the power relay</li> <li>Is the replacement complete?</li> </ul>		Go to Step (9)	_
4	<ul> <li>Using a DVOM check for continuity between relay terminals 2 and 3</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (3)	Go to Step (5)
5	<ul> <li>Key OFF</li> <li>Disconnect ECM wire harness connector C001</li> <li>Using a DVOM check for power between ECM pin 71 and engine ground with the key ON</li> <li>Do you have power?</li> </ul>	System bat- tery voltage	Repair the short to pow- er. See wiring harness re- pair.	Go to Step (6)
6	Replace the power relay     Is the replacement complete?		Go to Step (7)	_
7	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-687 check for any stored codes.</li> <li>Does DTC 687 still re-set?</li> </ul>		Go to Step (8)	Go to Step (9)

Step	Action	Value(s)	Yes	No
8	Replace the ECM Is the replacement complete?		Go to Step (9)	_
9	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-687 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 1111-Fuel Rev Limit (SPN 515:FMI 16)



### **Conditions for Setting the DTC**

- Fuel Rev Limit
- Check Condition-Engine Running
- Fault Condition-Engine rpm greater than set limit
- MIL-ON during active fault

#### **Circuit Description**

This fault will set anytime the engine rpm exceeds the specified speed settings in the calibration. This is generally set at 3000 rpms. The MIL command is ON during this active fault

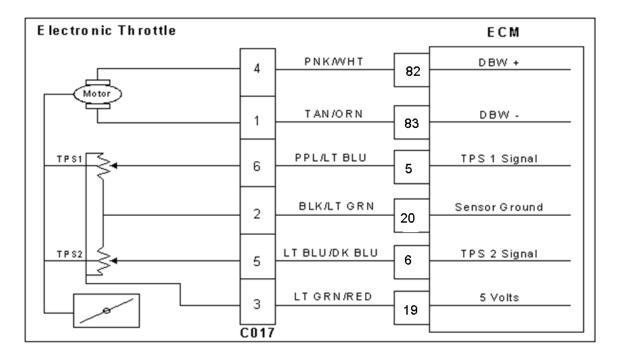
#### **Diagnostic Aid**

Always check for other stored DTC codes before using the following DTC chart for this code set. Repair any existing codes starting with the lowest numerical code first.

# DTC 1111-Fuel Rev Limit

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine OFF</li> <li>DST in Active Fault Mode</li> <li>Are any other DTC codes present with DTC 1111?</li> </ul>		Go to Step (3)	Go to Step (4)
3	<ul> <li>Diagnose and repair any other DTC codes before proceeding with this chart.</li> <li>Have any other DTC codes been diagnosed and repaired?</li> </ul>		Go to Step (4)	-
4	Check the service part Number on the ECM to ensure correct calibration is in use Is the service part Number Correct?		Go to Step (6)	Go to Step 5
5	<ul> <li>Replace ECM with the correct service part number</li> <li>Is the replacement complete?</li> </ul>		Go to Step (9)	-
6	• Check the mechanical operation of the throttle Is the mechanical operation of the throttle OK?		Go to Step (8)	Go to Step (7)
7	<ul> <li>Correct mechanical operation of the throttle. Refer to Engine &amp; Component section</li> <li>Has the mechanical operation of the throttle been corrected?</li> </ul>		Go to Step (9)	-
8	<ul> <li>Check engine for large manifold vacuum leaks. Refer to Fuel Systems symptom diag- nostics</li> <li>Did you find and correct the vacuum leak?</li> </ul>		Go to Step (9)	Go to OBD System Check Sec- tion
9	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1111 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 1112-Spark Rev Limit (SPN 515: FMI 0)



### Conditions for Setting the DTC

- Spark Rev Limit
- Check Condition-Engine running
- Fault Condition-Engine rpm greater than set limit
- MIL-ON during active fault
- Engine Shut Down

#### **Circuit description**

This fault will set anytime the engine rpm exceeds the specified speed settings installed in the calibration. This is generally set at 3200 rpms. The MIL command is ON during this active fault and the engine will shut down.

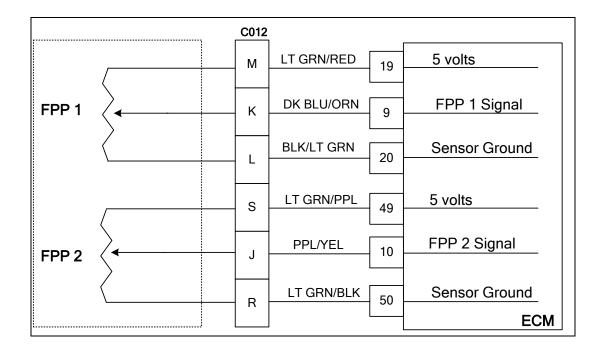
#### **Diagnostic Aid**

Always check for other stored DTC codes before using the following DTC chart for this code set. Repair any existing codes starting with the lowest numerical code first.

# DTC 1112-Spark Rev Limit

Step	Action	Value(s)	Yes	Νο
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine OFF</li> <li>DST connected</li> <li>Are any other DTC codes present with DTC 1112?</li> </ul>		Go to Step (3)	Go to Step (4)
3	<ul> <li>Diagnose any other DTC codes before pro- ceeding with this chart.</li> <li>Have any other DTC codes been diagnosed and repaired?</li> </ul>		Go to Step (4)	-
4	<ul> <li>Check the service part number on the ECM to ensure correct calibration is in use Is the service part number correct?</li> </ul>		Go to Step (6)	Go to Step 5
5	<ul> <li>Replace ECM with correct service part number</li> <li>Is the replacement complete?</li> </ul>		Go to Step (9)	-
6	• Check the mechanical operation of the throttle Is the mechanical operation of the throttle OK?		Go to Step (8)	Go to Step (7)
7	<ul> <li>Correct mechanical operation of the throttle. Refer to Engine &amp; Component section</li> <li>Has the mechanical operation of the throttle been corrected?</li> </ul>		Go to Step (9)	-
8	<ul> <li>Check engine for large manifold vacuum leaks. Refer to Fuel Systems section Symp- tom Diagnostics</li> <li>Did you find and correct the vacuum leak?</li> </ul>		Go to Step (9)	Go to OBD System Check Sec- tion
9	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1112 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 1121 FPP 1 And 2 Redundancy Lost (SPN 91: FMI 31)



## **Conditions for Setting the DTC**

- Foot pedal position sensor 1 and 2
- Check Condition-Key ON
- Fault Condition-FPP1 and FPP 2 redundancy lost
- MIL-ON
- Force idle
- Low rev limit

## **Circuit Description**

The foot pedal position sensor uses variable resistors to determine signal voltage based on foot pedal position. Although the voltage outputs are different, the calculated throttle position values should be very close to the same. This fault will set if FPP 1 or FPP 2 positions are 20% greater or 20% less than the expected throttle position target. The MIL command is ON. Forced idle and low rev limit are in effect during this fault limiting full power output.

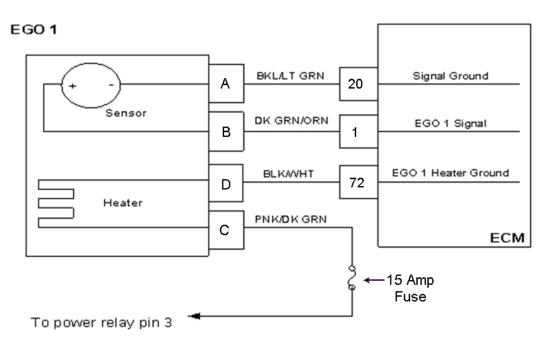
## Diagnostic Aid

It is very likely that in the event this code sets, other codes will set along with it. Always diagnose and repair codes starting with the lowest numerical value first. It is possible that by correcting the lower code sets first the problem will be corrected. FPP sensors are OEM specific and vary in configuration. The exact wire color and pin numbers for the FPP must be verified in the OEM chassis wiring schematic. The FPP sensor used in this system provides two sensors in one packaged assembly. FPP1 and FPP 2 are not serviceable individually, and in the event of a failure the complete FPP assembly must be replaced.

# DTC-1121 FPP 1 And 2 Redundancy Lost

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?		Go to Step (2)	Go to OBD System Check
2	<ul> <li>Diagnose any other lower numerical value codes that may be present first</li> <li>Did this resolve the problem?</li> </ul>		Go to Step (7)	Go to Step (3)
3	• Follow the diagnostic chart for DTC 2126 Did the chart resolve the problem?		Go to Step (7)	Go to Step (4)
4	• Follow the diagnostic chart for DTC 2121 Did the chart resolve the problem?		Go to Step (7)	Go to Step (5)
5	<ul> <li>Inspect FPP and C012 connector pins for damage corrosion or contamination</li> <li>Did you find the problem?</li> </ul>		Correct the problem as required. See wiring har- ness repair.	Go to Step (6)
6	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Inspect pins 9, 10, 19, 20, 49 and 50 for damage corrosion or contamination.</li> <li>Did you find a problem?</li> </ul>		Correct the problem as required. See wiring har- ness repair.	-
7	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1121 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 1151-Closed Loop Multiplier High LPG (SPN 520206:FMI 0)



### **Conditions for Setting the DTC**

- Heated Oxygen Sensor
- Check Condition-Engine running
- Fault Condition-Closed Loop multiplier out of range (greater than 35%)
- MIL-ON

### **Circuit description**

The EGO sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the adaptive multiplier. This fault sets if the Closed Loop multiplier exceeds the limits of normal operation and cannot correctly modify the fuel flow within its limits.

## **Diagnostic Aid**

**Oxygen Sensor Wire** Heated Oxygen sensor wires may be mis-routed and contacting the exhaust manifold. **Vacuum Leaks** Large vacuum leaks and crankcase leaks can cause a lean exhaust condition at especially at light load.

Fuel Mixer System can be lean due to faulty EPR (Electronic Pressure Regulator) or faulty fuel mixer.

Fuel Pressure Low fuel pressure, faulty fuel regulator or contaminated fuel filter can cause fuel the system to run lean

<u>Exhaust Leaks</u> If there is an exhaust leak, outside air can be pulled into the exhaust and past the 02 sensor causing a false lean condition.

**Fuel Quality** Contaminated or spoiled fuel can cause the fuel system to be lean.

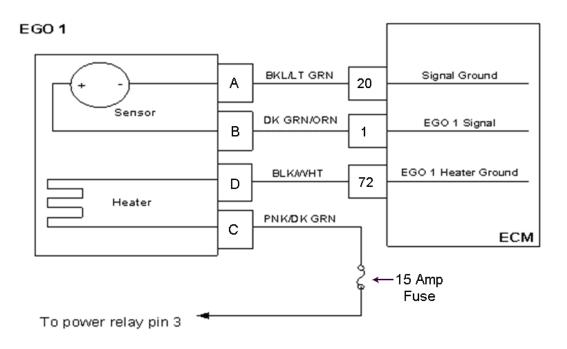
Ground Problem ECM grounds must be clean, tight and in the proper location.

# DTC 1151-Closed Loop High LPG

Step	Action	Value(s)	Yes	No
1	• Perform the On-Board (OBD) System Check? Are any other DTCs present?		Go to Step (3)	Go to Step (2)
2	<ul> <li>Visually and physically check the following items:</li> <li>The air intake duct for being collapsed or restricted</li> <li>The air filter for being plugged</li> <li>System power fuses are good and in the proper location</li> <li>The EGO 1 sensor installed securely and the wire leads not contacting the exhaust manifold or ignition wires</li> <li>ECM grounds must be clean and tight. Refer to Engine Electrical Power and Ground Distribution</li> <li>Fuel System Diagnostics. Refer to Fuel System Diagnostics</li> <li>Was a repair made?</li> </ul>		Go to Step (9)	Go to Step (4)
3	<ul> <li>Diagnose any other DTC codes before proceeding with this chart. Always repair existing codes starting with the lowest numerical code set first.</li> <li>Have any other DTC codes been detected, diagnosed and repaired?</li> </ul>		Go to Step (9)	Go to step (4)
4	<ul> <li>Disconnect EGO1 connector C005</li> <li>Using a DVOM check for voltage between EGO 1 connector pin D and engine ground</li> <li>Key ON</li> <li>(CHECK MUST BE MADE WITHIN 30 SECONDS OR BEFORE POWER RELAY SHUTS DOWN)</li> <li>Do you have voltage?</li> </ul>	System voltage	Go to Step (5)	Repair the open EGO power circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
5	<ul> <li>Key OFF</li> <li>Disconnect EGO 1 sensor wire harness connector C005</li> <li>Disconnect ECM wire harness connector C001</li> <li>Key ON</li> <li>Using a high impedance DVOM check for continuity between EGO 1 connector signal pin A and engine ground</li> <li>Do you have continuity?</li> </ul>		Repair the shorted circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (6)

Step	Action	Value(s)	Yes	No
6	<ul> <li>Using a high impedance DVOM check for continuity between EGO 1 connector signal ground pin A and EGO 1 signal pin B.</li> <li>Do you have continuity?</li> </ul>		Repair the shorted circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (7)
7	<ul> <li>Using a high impedance DVOM check for continuity between EGO 1 heater ground pin D and ECM pin 72</li> <li>Do you have continuity?</li> </ul>		Go to step (8)	Repair the open EGO heater ground
8	Replace EGO 1 sensor     Is the replacement complete?		Go to Step (9)	-
9	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1151 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 1152-Closed Loop Multiplier Low LPG (SPN 520206:FMI 1)



## **Conditions for Setting the DTC**

- Heated Oxygen Sensor
- Functional Fault-Closed Loop multiplier out of range (at limit of -35%)
- MIL Disabled

## **Circuit Description**

The EGO 1 sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the adaptive multiplier. This fault sets if the Closed Loop multiplier exceeds the limits of normal operation. When the multiplier cannot correctly modify the fuel flow within its limits, it is limited at -35%.

## **Diagnostic Aid**

**<u>Fuel System</u>** High secondary fuel pressure will cause the system to run rich. A worn fuel mixer, faulty EPR (Electronic Pressure Regulator) may also cause the system to run rich.

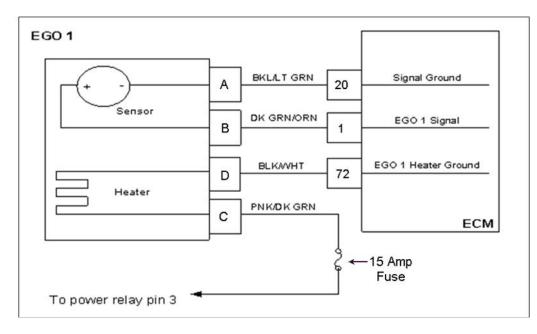
**Fuel Quality** A drastic variation in fuel quality (very high butane content) may cause the fuel system to run rich. Be sure that the specified HD-5 or HD-10 motor fuel grade LPG is used.

Air Filter A plugged, damaged or modified air filter may cause the system to run rich.

# DTC 1152 – Closed Loop Low LPG

Step	Action	Value(s)	Yes	No
1	• Perform the On-Board (OBD) System Check? Are any other DTCs present?		Go to Step (3)	Go to Step (2)
2	<ul> <li>Visually and physically check the following items:</li> <li>The air intake duct for being collapsed or restricted</li> <li>The air filter for being plugged</li> <li>The EGO sensor installed securely and the wire leads not damaged contacting the secondary ignition wires</li> <li>ECM grounds for being clean and tight.</li> <li>Run the fuel system diagnostic checks</li> <li>Was a repair made?</li> </ul>		Go to Step (6)	Go to Step (4)
3	<ul> <li>Diagnose any other DTC codes before pro- ceeding with this chart.</li> <li>Have any other DTC codes been detected, diag- nosed and repaired?</li> </ul>		Go to Step (6)	Go to Step (4)
4	<ul> <li>Key OFF</li> <li>Disconnect EGO sensor wire harness connector</li> <li>Disconnect ECM wire harness connector</li> <li>Key ON</li> <li>Using a DVOM check for voltage at the EGO 1 connector C005 signal pin C and engine ground</li> <li>Do you have voltage?</li> </ul>		Repair the circuit short to voltage as necessary. Refer to wir- ing harness repair.	Go to Step (5)
5	Replace EGO sensor     Is the replacement complete?		Go to Step (6)	-
6	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1152 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 1155-Closed Loop Multiplier High Gasoline (SPN 520204 :FMI 0)



## **Conditions for Setting the DTC**

- Heated Oxygen Sensor
- Check Condition-Engine running
- Fault Condition-Closed Loop multiplier out of range (greater than 35%)
- MIL-ON

## **Circuit description**

The EGO sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the adaptive multiplier. This fault sets if the Closed Loop multiplier exceeds the limits of normal operation and cannot correctly modify the fuel flow within its limits.

### Diagnostic Aid

**Oxygen Sensor Wire** Heated Oxygen sensor wires may be mis-routed and contacting the exhaust manifold.

<u>Vacuum Leaks</u> Large vacuum leaks and crankcase leaks can cause a lean exhaust condition at especially at light load.

<u>Fuel Mixer</u> System can be lean due to faulty EPR (Electronic Pressure Regulator) or faulty fuel mixer.

<u>Fuel Pressure</u> Low fuel pressure, faulty fuel regulator or contaminated fuel filter can cause fuel the system to run lean

**Exhaust Leaks** If there is an exhaust leak, outside air can be pulled into the exhaust and past the 02 sensor causing a false lean condition.

**Fuel Quality** Contaminated or spoiled fuel can cause the fuel system to be lean.

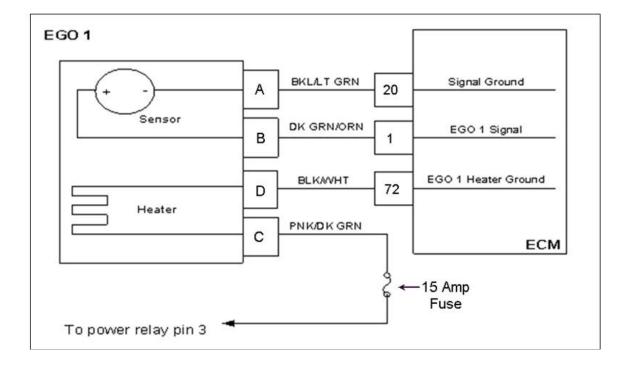
Ground Problem ECM grounds must be clean, tight and in the proper location.

# DTC 1155-Closed Loop Multiplier High Gasoline

Step	Action	Value(s)	Yes	No
1	• Perform the On-Board (OBD) System Check? Are any other DTCs present?		Go to Step (3)	Go to Step (2)
2	<ul> <li>Visually and physically check the following items:</li> <li>The air intake duct for being collapsed or restricted</li> <li>The air filter for being plugged</li> <li>System power fuses are good and in the proper location</li> <li>The EGO 1 sensor installed securely and the wire leads not contacting the exhaust manifold or ignition wires</li> <li>ECM grounds must be clean and tight. Refer to Engine Electrical Power and Ground Distribution</li> <li>Fuel System Diagnostics. Refer to Fuel System Diagnostics</li> <li>Was a repair made?</li> </ul>		Go to Step (9)	Go to Step (4)
3	<ul> <li>Diagnose any other DTC codes before proceeding with this chart. Always repair existing codes starting with the lowest numerical code set first.</li> <li>Have any other DTC codes been detected, diagnosed and repaired?</li> </ul>		Go to Step (9)	Go to step (4)
4	<ul> <li>Disconnect EGO1 connector C005</li> <li>Using a DVOM check for voltage between EGO 1 connector pin B and engine ground</li> <li>Key ON</li> <li>(CHECK MUST BE MADE WITHIN 30 SECONDS OR BEFORE POWER RELAY SHUTS DOWN)</li> <li>Do you have voltage?</li> </ul>	System voltage	Go to Step (5)	Repair the open EGO power circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
5	<ul> <li>Key OFF</li> <li>Disconnect EGO 1 sensor wire harness connector C005</li> <li>Disconnect ECM wire harness connector C001</li> <li>Key ON</li> <li>Using a high impedance DVOM check for continuity between EGO 1 connector signal pin A and engine ground</li> <li>Do you have continuity?</li> </ul>		Repair the shorted circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (6)

Step	Action	Value(s)	Yes	No
6	<ul> <li>Using a high impedance DVOM check for continuity between EGO 1 connector signal ground pin C and EGO 1 signal pin A</li> <li>Do you have continuity?</li> </ul>		Repair the shorted circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (7)
7	<ul> <li>Using a high impedance DVOM check for continuity between EGO 1 heater ground pin D and ECM pin 72</li> <li>Do you have continuity?</li> </ul>		Go to step (8)	Repair the open EGO heater ground
8	Replace EGO 1 sensor     Is the replacement complete?		Go to Step (9)	-
9	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1151 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 1156-Adaptive Learn Low (Gasoline) (SPN 520204:FMI 1)



## **Conditions for Setting the DTC**

- Heated Oxygen Sensor
- Check Condition-Engine running
- Fault Condition-Adaptive multiplier out of range greater than -30%
- MIL-ON

### **Circuit Description**

The EGO1 sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and Adaptive multiplier. This fault will set if the adaptive multiplier exceeds the limits of normal operation. Always run the fuel system diagnostics before using the following diagnostic chart.

### **Diagnostic Aid**

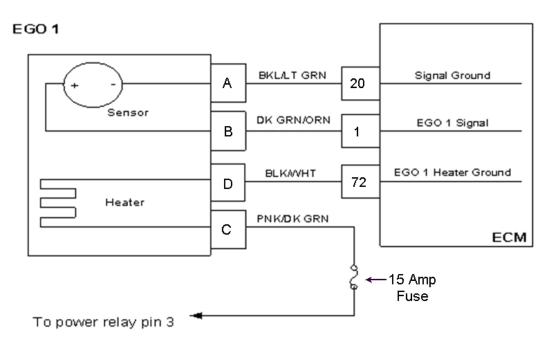
**Fuel System** High fuel pressure will cause the system to run rich. Fuel pressure is controlled by the ECM using a ground side driver. If the fuel pump is turned on all the time the fuel pressure will increase. Open or leaking injector will cause a rich condition.

**Fuel Quality** A drastic variation in fuel quality may cause the fuel system to run rich. **<u>Air Filter</u>** A plugged, damaged or modified air filter may cause the system to run rich.

# DTC 1156-Adaptive Learn Low (Gasoline)

Step	Action	Value(s)	Yes	No
1	• Perform the On-Board (OBD) System Check? Are any other DTCs present?		Go to Step (3)	Go to Step (2)
2	<ul> <li>Visually and physically check the following items:</li> <li>The air intake duct for being collapsed or restricted</li> <li>The air filter for being plugged</li> <li>The EGO sensor is installed securely and the wire leads not damaged or contacting the secondary ignition wires</li> <li>ECM grounds for being clean and tight.</li> <li>Fuel system diagnostic checks</li> <li>Was a repair made?</li> </ul>		Go to Step (6)	Go to Step (4)
3	<ul> <li>Diagnose any other DTC codes before pro- ceeding with this chart.</li> <li>Have any other DTC codes been detected, diag- nosed and repaired?</li> </ul>		Go to Step (6)	Go to Step (4)
4	<ul> <li>Key OFF</li> <li>Disconnect EGO sensor wire harness connector C005</li> <li>Disconnect ECM wire harness connector C001</li> <li>Key ON</li> <li>Using a DVOM check for voltage at EGO 1 connector signal pin A and engine ground Do you have voltage?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (5)
5	Replace EGO sensor     Is the replacement complete?		Go to Step (6)	-
6	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1162 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 1161-Adaptive Learn High LPG (SPN 520202:FMI 0)



# Conditions for Setting the DTC

- Heated Oxygen Sensor
- Check Condition-Engine Running
- Fault Condition-Adaptive multiplier out of range greater than 30%
- MIL-ON

## **Circuit Description**

The EGO 1 sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and Adaptive multiplier. This fault will set if the adaptive multiplier exceeds the limits of normal operation. Always run the fuel system diagnostic checks before using the following diagnostic chat.

## Diagnostic Aid

**Oxygen Sensor Wire** Heated Oxygen sensor wires may be mis-routed and contacting the exhaust manifold.

<u>Vacuum Leaks</u> Large vacuum leaks and crankcase leaks can cause a lean exhaust condition at especially at light load.

**<u>Fuel Mixer</u>** System can be lean due to faulty EPR (Electronic Pressure Regulator) or faulty fuel mixer.

<u>Fuel Pressure</u> Low fuel pressure, faulty fuel regulator or contaminated fuel filter can cause fuel the system to run lean

**Exhaust Leaks** If there is an exhaust leak, outside air can be pulled into the exhaust and past the 02 sensor causing a false lean condition.

Fuel Quality Contaminated or spoiled fuel can cause the fuel system to be lean.

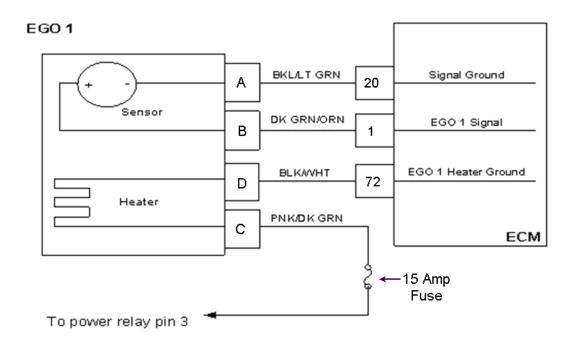
Ground Problem ECM grounds must be clean, tight and in the proper location.

# DTC 1161 Adaptive Learn High LPG

Step	Action	Value(s)	Yes	No
1	• Perform the On-Board (OBD) System Check? Are any other DTCs present?		Go to Step (3)	Go to Step (2)
2	<ul> <li>Visually and physically check the following items:</li> <li>The air intake duct for being collapsed or restricted</li> <li>The air filter for being plugged</li> <li>System power fuses are good and in the proper location</li> <li>The EGO 1 sensor installed securely and the wire leads not contacting the exhaust manifold or ignition wires</li> <li>ECM grounds must be clean and tight. Refer to Engine Electrical Power and Ground Distribution</li> <li>Fuel System Diagnostics. Refer to Fuel System Diagnostics</li> </ul>		Go to Step (9)	Go to Step (4)
3	<ul> <li>Was a repair made?</li> <li>Diagnose any other DTC codes before proceeding with this chart. Always repair existing codes starting with the lowest numerical code set first.</li> <li>Have any other DTC codes been detected, diagnosed and repaired?</li> </ul>		Go to Step (9)	Go to Step (4)
4	<ul> <li>Disconnect EGO1 connector C005</li> <li>Using a DVOM check for voltage between EGO 1 connector pin B and engine ground</li> <li>Key ON</li> <li>(CHECK MUST BE MADE WITHIN 30 SECONDS OR BEFORE POWER RELAY SHUTS DOWN)</li> <li>Do you have voltage?</li> </ul>	System voltage	Go to Step (5)	Repair the open EGO power circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
5	<ul> <li>Key OFF</li> <li>Disconnect EGO 1 sensor wire harness connector C005</li> <li>Disconnect ECM wire harness connector C001</li> <li>Key ON</li> <li>Using a high impedance DVOM check for continuity between EGO 1 connector signal pin A and engine ground</li> <li>Do you have continuity?</li> </ul>		Repair the shorted circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (6)

Step	Action	Value(s)	Yes	No
6	<ul> <li>Using a high impedance DVOM check for continuity between EGO 1 connector signal ground pin C and EGO 1 signal pin A</li> <li>Do you have continuity?</li> </ul>		Repair the shorted circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (7)
7	<ul> <li>Using a high impedance DVOM check for continuity between EGO 1 heater ground pin D and ECM pin 49</li> <li>Do you have continuity?</li> </ul>		Go to Step (8)	Repair the open EGO heater ground
8	Replace EGO 1 sensor     Is the replacement complete?		Go to Step (9)	-
9	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1161 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 1162-Adaptive Learn Low (LPG) (SPN 520202:FMI 1)



## **Conditions for Setting the DTC**

- Heated Oxygen Sensor
- Check Condition-Engine running
- Fault Condition-Adaptive multiplier out of range greater than -30%
- MIL-ON

## **Circuit Description**

The EGO1 sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and Adaptive multiplier. This fault will set if the adaptive multiplier exceeds the limits of normal operation. Always run the fuel system diagnostics before using the following diagnostic chart.

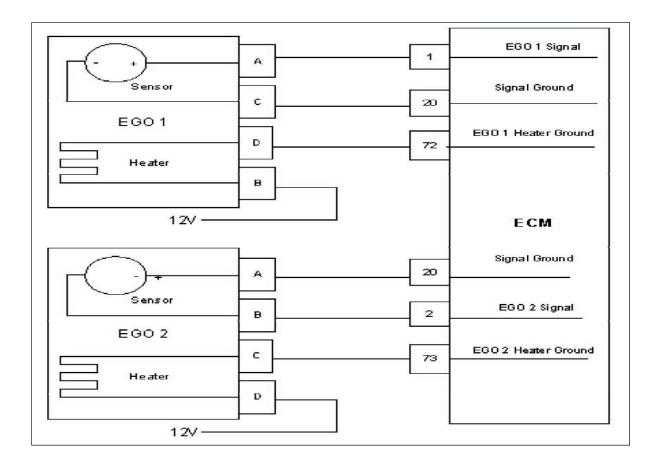
### **Diagnostic Aid**

**Fuel System** High secondary fuel pressure will cause the system to run rich. A worn fuel mixer, faulty EPR (Electronic Pressure Regulator) may also cause the system to run rich. **Fuel Quality** A drastic variation in fuel quality (very high butane content) may cause the fuel system to run rich. Be sure that the specified HD-5 or HD-10 motor fuel grade propane is used. **A plugged**, damaged or modified air filter may cause the system to run rich.

# DTC 1162-Adaptive Learn Low LPG

Step	Action	Value(s)	Yes	No
1	• Perform the On-Board (OBD) System Check? Are any other DTCs present?		Go to Step (3)	Go to Step (2)
2	<ul> <li>Visually and physically check the following items:</li> <li>The air intake duct for being collapsed or restricted</li> <li>The air filter for being plugged</li> <li>The EGO sensor is installed securely and the wire leads not damaged or contacting the secondary ignition wires</li> <li>ECM grounds for being clean and tight.</li> <li>Fuel system diagnostic checks</li> <li>Was a repair made?</li> </ul>		Go to Step (6)	Go to Step (4)
3	<ul> <li>Diagnose any other DTC codes before pro- ceeding with this chart.</li> <li>Have any other DTC codes been detected, diag- nosed and repaired?</li> </ul>		Go to Step (6)	Go to Step (4)
4	<ul> <li>Key OFF</li> <li>Disconnect EGO sensor wire harness connector C005</li> <li>Disconnect ECM wire harness connector C001</li> <li>Key ON</li> <li>Using a DVOM check for voltage at EGO 1 connector signal pin A and engine ground Do you have voltage?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (5)
5	Replace EGO sensor     Is the replacement complete?		Go to Step (6)	-
6	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1162 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 1165-LPG Catalyst Monitor (SPN 520213:FMI 10)



## **Conditions for Setting the DTC**

- Catalyst Function
- Check condition- Engine running
- Fault condition- EGO 1 signal = EGO 2 signal for 100 updates
- MIL- On during active fault and for 1 second after active fault
- Adaptive- Disabled during active fault

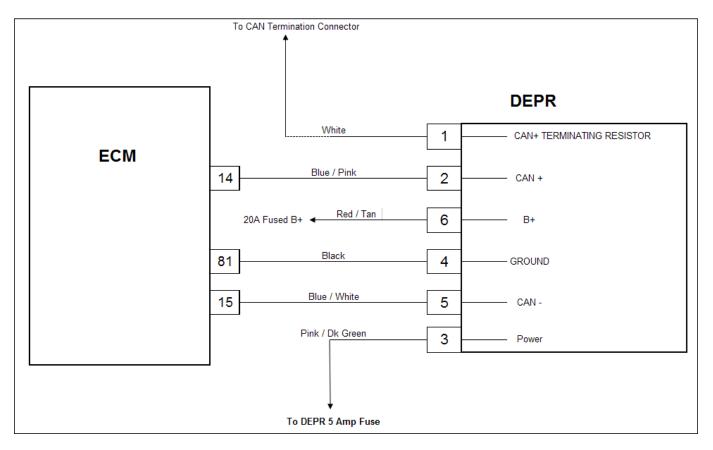
#### **Circuit Description**

The ECM uses EGO 1 and EGO 2 sensor signals to diagnose problems with the catalyst muffler. When the signals for EGO 1 & EGO 2 are similar it may indicate a problem with the catalyst.

#### **Diagnostic Aids**

Always diagnose any other troubles, stored along with DTC 420 first. Check for and eliminate any exhaust leaks prior to replacing catalyst muffler. Look for exhaust leaks at the catalyst muffler inlet and tail pipes. Clear this trouble code after repairing exhaust leaks, and recheck for code.

# DTC 1171-EPR Pressure Higher Than Expected (SPN 520260:FMI 0)



# **Conditions for Setting the DTC**

- EPR delivery pressure
- Check condition-Engine running or cranking
- MIL-ON during active fault
- Fault condition-EPR actual pressure greater than 1.5 inches above commanded pressure
- Adaptive disabled
- Closed loop disabled

### **Circuit Description**

The EPR (Electronic Pressure Regulator) unit measures and controls the amount of fuel that is able to pass to the fuel mixer. This code will set in the event the actual pressure is 1.5 inches water pressure higher than the actual commanded pressure. Adaptive learn is disabled and the MIL command is ON during this fault.

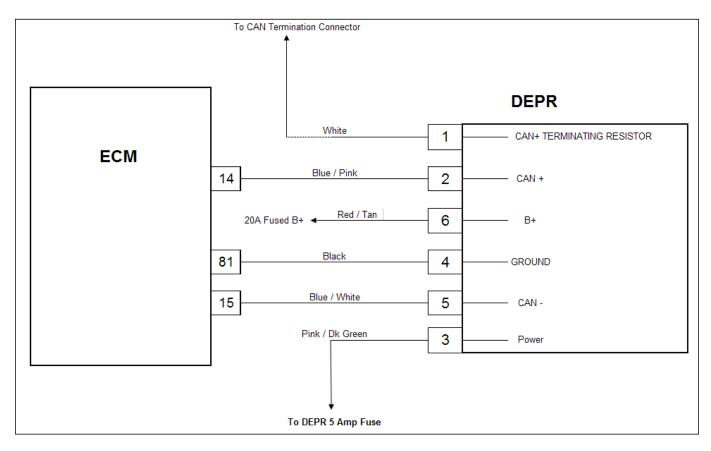
### **Diagnostic Aid**

Always run the fuel system diagnostic pressure check before proceeding with the following diagnostic chart. High secondary fuel pressure due to a worn or damaged primary or secondary seat may cause this fault to set

# DTC 1171-EPR Pressure Higher Than Expected

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	Did you run the fuel pressure diagnostic test in the fuel system diagnostic section with no prob- lems found?		Go to Step (4)	Go to Step (3)
3	<ul> <li>Run the EPR pressure test in the fuel system diagnostic section</li> <li>Did the EPR pass the fuel pressure test specifi- cations?</li> </ul>		Go to Step (4)	Follow the EPR service recommenda- tions from the fuel pressure test chart.
4	<ul> <li>Inspect the EPR electrical connector pins C018 for damage, corrosion or contamina- tion.</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to wire harness re- pair section.	Go to Step (5)
5	Replace or repair the EPR Is the replacement complete?		Go to Step (6)	_
6	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC1171 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 1172-EPR Pressure Lower Than Expected (SPN 520260:FMI 1)



# **Conditions for Setting the DTC**

- EPR delivery pressure
- Check condition-Engine running or cranking
- MIL-ON during active fault
- Fault condition-EPR actual pressure less than 1.5 inches below commanded pressure
- Adaptive disabled
- Closed loop disabled

### **Circuit Description**

The EPR (Electronic Pressure Regulator) unit measures and controls the amount of fuel that is able to pass to the fuel mixer. This code will set in the event the actual pressure is 1.0 inches water pressure lower than the actual commanded pressure. Adaptive is disabled and the MIL command is ON during this fault.

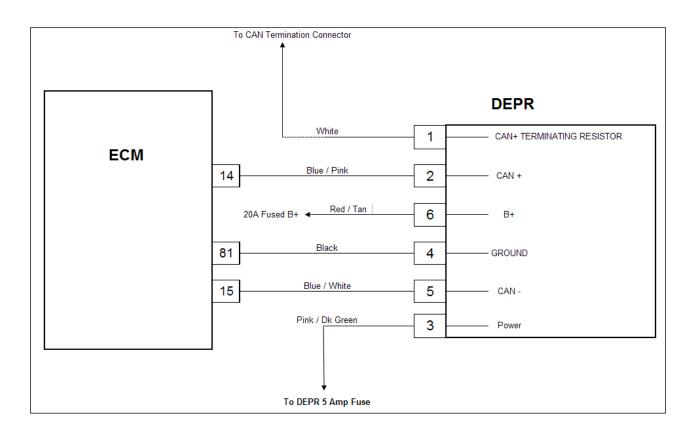
### **Diagnostic Aid**

Always run the fuel system diagnostic pressure check before proceeding with the following diagnostic chart. Low secondary fuel pressure due to a fuel restriction or faulty regulator may cause this fault.

# DTC 1172-EPR Pressure Lower Than Expected

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	Did you run the fuel pressure diagnostic test in the fuel system diagnostic section with no prob- lems found?		Go to Step (4)	Go to Step (3)
3	<ul> <li>Run the EPR pressure test in the fuel system diagnostic section</li> <li>Did the EPR pass the fuel pressure test specifi- cations?</li> </ul>		Go to Step (4)	Follow the EPR service recommenda- tions from the fuel pressure test chart.
4	<ul> <li>Inspect the EPR electrical connector C018 for damage, corrosion or contamination.</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to wire harness re- pair section.	Go to Step (5)
5	Replace or repair the EPR Is the replacement complete?		Go to Step (6)	_
6	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC1172 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 1173-EPR Communication Lost (SPN 520260:FMI 31)



# **Conditions for Setting the DTC**

- EPR CAN communication
- Check condition-Engine running or cranking
- MIL-On during active fault
- Fault condition-No packets received within 500 ms
- Adaptive disabled

### **Circuit Description**

The EPR (Electronic Pressure Regulator) unit measures and controls the amount of fuel that is able to pass to the fuel mixer. This code will set in the event communication with the ECM is lost. The MIL command is on.

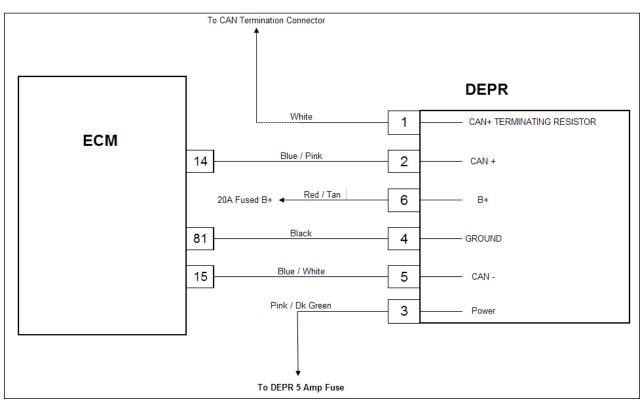
# DTC 1173-EPR Communication Lost

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON</li> <li>DST (Diagnostic Scan Tool) connected in the system data mode</li> <li>Clear DTC1173</li> <li>Key OFF</li> <li>Key ON, and attempt to start the engine Does DTC1173 re-set?</li> </ul>		Go to step (3)	Intermittent problem. Go to Intermittent Problem sec- tion in the electrical sec- tion of this manual.
3	<ul> <li>Key OFF</li> <li>Disconnect EPR electrical connector C018</li> <li>Key ON</li> <li>Using a DVOM check for system power between EPR connector pin 7 and engine ground</li> <li>(Be sure to activate relay control ON using the DST function or check before ECM relay control times out)</li> <li>Do you have power?</li> </ul>	System bat- tery voltage	Go to step (7)	Go to step (4)
4	Check the 10A (F5) fuse Is the fuse open?		Go to step (5)	Go to step (6)
5	Replace the F5 fuse Is the replacement complete?		Go to step (17)	_
6	<ul> <li>Using a DVOM check for system power at power relay terminal 3</li> <li>(Be sure to activate relay control ON using the DST function or check before ECM relay control times out)</li> <li>Do you have power?</li> </ul>	System bat- tery voltage	Repair the open circuit between power relay pin 3 and EPR pin 7 Go to step (17)	Repair the power relay circuit as re- quired Go to step (17)
7	<ul> <li>Using a DVOM check for continuity between EPR connector pin 6 and engine ground Do you have continuity?</li> </ul>		Go to step (8)	Repair the open ground circuit as necessary. Refer to wir- ing repairs in engine elec- trical

Step	Action	Value(s)	Yes	No
8	<ul> <li>Key OFF</li> <li>Disconnect the EPR connector C018</li> <li>Disconnect the ECM connector C001</li> <li>Using a DVOM check for continuity between EPR pin 5 and ECM pin 15</li> <li>Do you have continuity?</li> </ul>		Go to step (9)	Repair the open circuit as necessary. Refer to wir- ing repairs in engine elec- trical
9	<ul> <li>Using a DVOM check for continuity between EPR pin 2 and ECM pin 14</li> <li>Do you have continuity?</li> </ul>		Go to step (10)	Repair the open circuit as necessary. Refer to wir- ing repairs in engine elec- trical
10	<ul> <li>Using a DVOM check for continuity between EPR pin 4 and ECM pin 81</li> <li>Do you have continuity?</li> </ul>		Go to step (11)	Repair the open circuit as necessary. Refer to wir- ing repairs in engine elec- trical
11	<ul> <li>Using a DVOM check for continuity between EPR pin 3 and B+ Do you have continuity?</li> </ul>		Go to step (12)	Repair the open circuit as necessary. Refer to wir- ing repairs in engine elec- trical
12	<ul> <li>Using a DVOM check for continuity between EPR pin 6 and B+ Do you have continuity?</li> </ul>		Go to step (13)	Repair the open circuit as necessary. Refer to wir- ing repairs in engine elec- trical
13	<ul> <li>Disconnect DST from the DLC connector C014</li> <li>Using a DVOM check for continuity between engine ground and EPR pin 4</li> <li>Do you have continuity?</li> </ul>		Repair the shorted to ground CAN circuit as necessary. Refer to wir- ing repairs in engine elec- trical	Go to step (14)
14	Replace the EPR Is the replacement complete?		Go to step (15)	_

Step	Action	Value(s)	Yes	No
15	<ul> <li>Remove all test equipment and reconnect the DST.</li> <li>Connect any disconnected components, fus- es, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test pa- rameters of DTC1173 check for any stored codes.</li> <li>Does DTC1173 still re-set?</li> </ul>		Go to step (16)	System OK
16	Replace the ECM Is the replacement complete?		Go to step (17)	_
17	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC1173 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 1174-EPR Supply Voltage High (SPN 520260:FMI 3)



# Conditions for Setting the DTC

- EPR supply voltage
- Check condition-Engine running or cranking
- MIL-ON during active fault
- Fault condition-internal EPR supply voltage too high
- Adaptive disabled
- Closed loop disabled

## **Circuit Description**

The EPR (Electronic Pressure Regulator) unit measures and controls the amount of fuel that is able to pass to the fuel mixer. Pressure readings are sent over the CAN to the ECM and in return the ECM sends back a control signal to the EPR to increase or decrease pressure for precise mixture control. This code will set if the EPR internal supply voltage is too high.

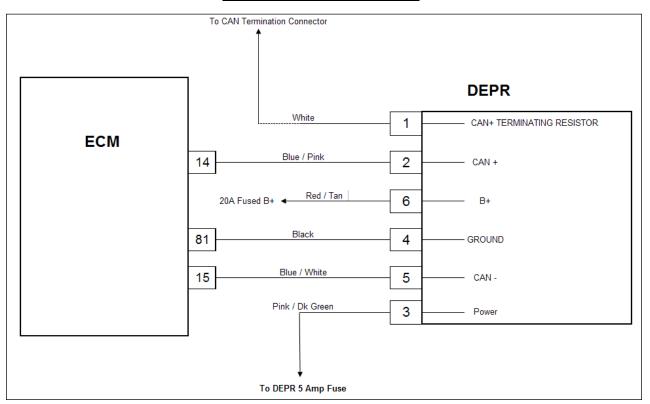
## **Diagnostic Aid**

This DTC indicates abnormal EPR internal voltages that are not measurable externally. Check the system charging voltage to be sure this DTC and other over voltage DTCs are not present. Repair the charging system if it is found to be out of specification for high charge voltage. In the event of multiple code sets, always start the diagnostic repair with the lowest numerical value DTC first.

# DTC 1174-EPR Voltage Supply High

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>DST connected and in the system data mode</li> <li>Engine running</li> <li>Check the system battery voltage.</li> <li>Is the charging voltage within specifications?</li> </ul>		Go to Step (3)	Repair the charging sys- tem
3	<ul> <li>Using a DVOM compare the system battery voltage to the DST display.</li> <li>Is the voltage reading within 1 volt between the two of them?</li> </ul>	1 volt	Go to Step (4)	Go to Step (5)
4	Replace the EPR     Is the replacement complete?		Go to Step (6)	_
5	<ul> <li>Replace the ECM Is the replacement complete?</li> </ul>		Go to Step (6)	_
6	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC1174 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 1175-EPR Supply Voltage Low (SPN 520260:FMI 4)



# **Conditions for Setting the DTC**

- EPR supply voltage
- Check condition-Engine running or cranking
- MIL-ON during active fault
- Fault condition-EPR internal supply voltage low
- Adaptive disabled

## **Circuit Description**

The EPR (Electronic Pressure Regulator) unit measures and controls the amount of fuel that is able to pass to the fuel mixer. Pressure readings are sent over the CAN to the ECM and in return the ECM sends back a control signal to the EPR to increase or decrease pressure for precise mixture control. This code will set if the internal EPR supply voltage is low. Adaptive is disabled and the MIL command is ON.

### **Diagnostic Aid**

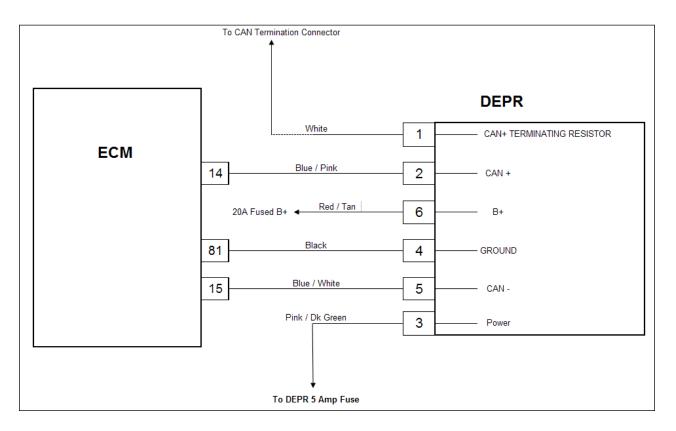
This DTC indicates abnormal EPR internal voltages that are not measurable externally. Check the system charging voltage to be sure this DTC and other low voltage DTCs are not present. Repair the charging system if it is found to be out of specification for low charge voltage. In the event of multiple code sets, always start the diagnostic repair with the lowest numerical value DTC first.

# DTC 1175-EPR Voltage Supply Low

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>DST connected and in the system data mode</li> <li>Engine running</li> <li>Check the system battery voltage.</li> <li>Is the charging voltage within specifications?</li> </ul>		Go to Step (3)	Repair the charging sys- tem
3	<ul> <li>Key OFF</li> <li>Disconnect the EPR electrical connector C018</li> <li>Using a DVOM check for power between the EPR connector pin 7 and engine ground.</li> <li>Key ON</li> <li>Record the voltage reading.</li> <li>(Be sure to activate relay control ON using the DST function or check before ECM relay control times out)</li> <li>Using a DVOM check the system battery power at the battery terminals and record the voltage reading.</li> <li>Are the recorded voltage readings within 1 volt of each other?</li> </ul>		Go to Step (6)	Go to Step (4)
4	<ul> <li>Inspect the EPR connector and F5 fuse holder terminals for damage corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Correct the problem as necessary. See wiring harness re- pair in the electrical sec- tion of this manual	Go to Step (5)
5	<ul> <li>Check the power relay circuit. Check the power relay connections for damage corro- sion or contamination</li> <li>Did you find a problem?</li> </ul>		Correct the problem as necessary. See wiring harness schematic in the electrical section of this manual	_

Step	Action	Value(s)	Yes	No
6	<ul> <li>Key OFF</li> <li>Disconnect the ECM connector C001</li> <li>Using a DVOM check the resistance reading between EPR connector pin 6 and ECM connector pin 69 and 81.</li> <li>(Do not forget to subtract any resistance value that may be present in your test cables)</li> <li>Is the resistance reading less than 0.5 ohms?</li> </ul>	Less than 0.5 ohms	Go to Step (7)	Repair the poor EPR power ground circuit. See wiring har- ness repair in the electrical section of this manual
7	Replace the EPR Is the replacement complete?		Go to Step (8)	_
8	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC1175 check for any stored codes.</li> <li>Does DTC 1175 still re-set?</li> </ul>		Go to Step (9)	System OK
9	Replace the ECM Is the replacement complete?		Go to Step (10)	_
10	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC1175 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 1176-EPR Internal Actuator Fault (SPN 520260:FMI 12)



# Conditions for Setting the DTC

- EPR internal actuator test
- Check condition-Engine running or cranking
- MIL-ON during active fault
- Fault condition-Failed actuator
- Adaptive disabled

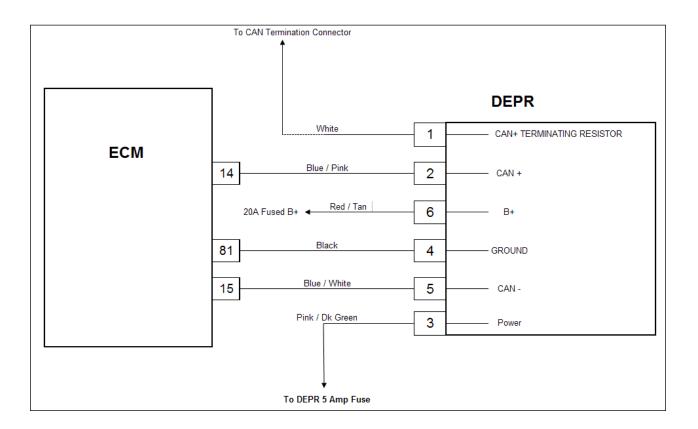
## **Circuit Description**

The EPR (Electronic Pressure Regulator) unit measures and controls the amount of fuel that is able to pass to the fuel mixer. Pressure readings are sent over the CAN to the ECM and in return the ECM sends back a control signal to the EPR to increase or decrease pressure for precise mixture control. This code will set if the ECM detects an internal actuator fault with the EPR. In the event of multiple code sets, always start the diagnostic repair with the lowest numerical value DTC first. In most instances the EPR will need to be replaced in the event of this code set.

# DTC 1176-EPR Internal Actuator Fault

Step	Action	/alue(s) Yes	No
1	Did you perform the On-Board (OBD) System Check?	- Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>DST connected and in the system data mode.</li> <li>Check for any other current or active DTCs Does the DST show any other codes set?</li> </ul>	Go to Step (3)	Go to Step (6)
3	<ul> <li>Repair any other DTCs set starting with the lowest DTC number first.</li> <li>Have the other DTCs set been corrected?</li> </ul>	Go to Step (4)	_
4	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature.</li> <li>Observe the MIL.</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC1176 check for any stored codes.</li> <li>Does DTC 1176 still re-set?</li> </ul>	Go to Step (5)	System OK
5	Replace the EPR     Is the replacement complete?	Go to Step (6)	_
6	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature.</li> <li>Observe the MIL.</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC1176 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>	System OK	Go to OBD System Check

# DTC 1177-EPR internal Circuitry Fault (SPN 520260:FMI 12)



# **Conditions for Setting the DTC**

- EPR internal circuitry test
- Check condition-Engine running or cranking
- MIL-ON during active fault
- Fault condition-
- Adaptive disabled

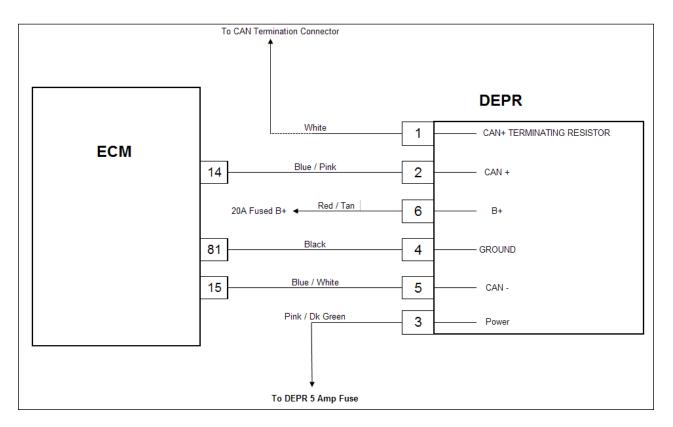
### **Circuit Description**

The EPR (Electronic Pressure Regulator) unit measures and controls the amount of fuel that is able to pass to the fuel mixer. Pressure readings are sent over the CAN to the ECM and in return the ECM sends back a control signal to the EPR to increase or decrease pressure for precise mixture control. This code will set if the ECM detects an internal circuitry fault in the EPR. In the event of multiple code sets, always start the diagnostic repair with the lowest numerical value DTC first. In most instances the EPR will need to be replaced in the event of this code set.

# DTC 1177-EPR Internal Circuitry Failure

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>DST connected and in the system data mode</li> <li>Check for any other current or active DTCs Does the DST show any other codes set?</li> </ul>		Go to Step (3)	Go to Step (6)
3	<ul> <li>Repair any other DTCs set starting with the lowest DTC number first</li> <li>Have the other DTCs set been corrected?</li> </ul>		Go to Step (4)	-
4	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC1177 check for any stored codes.</li> <li>Does DTC 1177 still re-set?</li> </ul>		Go to Step (5)	System OK
5	Replace the EPR Is the replacement complete?		Go to Step (6)	_
6	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC1177 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 1178-EPR Internal Communication Error (SPN 520260:FMI 12)



# **Conditions for Setting the DTC**

- EPR internal communication test
- Check condition-Engine running or cranking
- MIL-ON during active fault
- Fault condition-
- Adaptive disabled

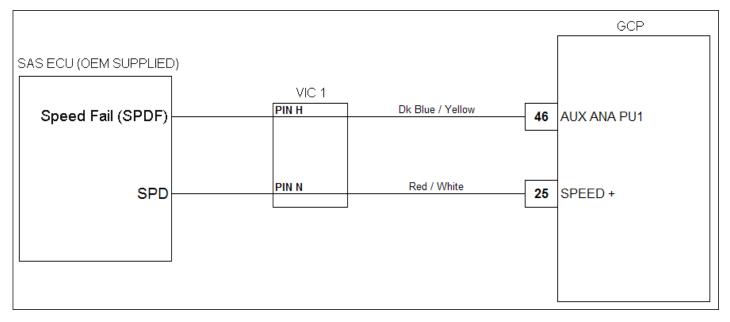
### **Circuit Description**

The EPR (Electronic Pressure Regulator) unit measures and controls the amount of fuel that is able to pass to the fuel mixer. Pressure readings are sent over the CAN to the ECM and in return the ECM sends back a control signal to the EPR to increase or decrease pressure for precise mixture control. This code will set if the ECM detects an internal communication error in the EPR. In the event of multiple code sets, always start the diagnostic repair with the lowest numerical value DTC first. In most instances the EPR will need to be replaced in the event of this code set.

# DTC 1178-EPR Internal Comm Fault

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>DST connected and in the system data mode.</li> <li>Check for any other current or active DTCs Does the DST show any other codes set?</li> </ul>		Go to Step (3)	Go to Step (6)
3	<ul> <li>Repair any other DTCs set starting with the lowest DTC number first.</li> <li>Have the other DTCs set been corrected?</li> </ul>		Go to Step (4)	_
4	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature.</li> <li>Observe the MIL.</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC1178 check for any stored codes.</li> <li>Does DTC 1178 still re-set?</li> </ul>		Go to Step (5)	System OK
5	Replace the EPR Is the replacement complete?		Go to Step (6)	_
6	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature.</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC1178 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 1511 – Auxiliary Analog PU 1 High Voltage (SPN 520216:FMI 3)



### **Conditions for setting the DTC**

- Voltage on Aux Analog PU1 is 5.0v or greater for longer than 1 second
- Wiring issue between Vehicle Interface Connector 1 (VIC 1) and pin 46 at ECM
- Wiring issue between VIC 1 and OEM supplied speed computer
- MIL light on during fault
- Power Derate 2 enabled

#### **Circuit Description**

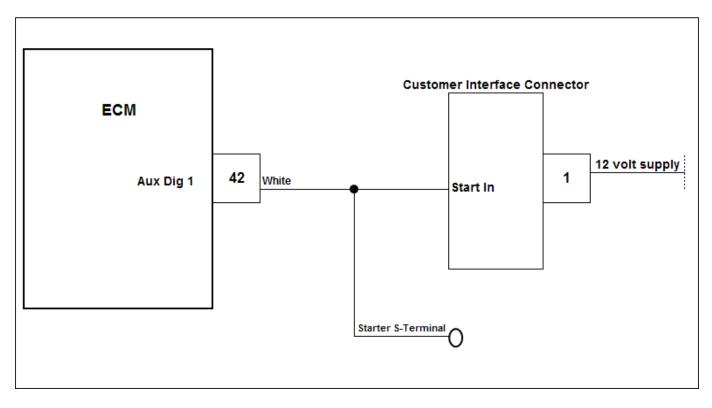
The AUX PU1 is pulled-up to 5 VDC inside the ECM therefore; if SPDF input becomes an open-circuit into the ECU the input will remain at 5 VDC. The OEM supplied controller grounds the SPDF circuit when the vehicle is stopped. As a result, the fault

is configured in the ECU on an AUX PU1 High Voltage state if voltage reached 5.0v for longer than 1 second. This informs the technician that the circuit is open. The technician should verify the wiring is good from the OEM supplied speed computer to the GCP module. If the wiring is ok, the problem is likely in the OEM system.

# DTC 1511 – Auxiliary Analog PU 1 High Voltage

STEP	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	<ul> <li>Key ON</li> <li>DST (Diagnostic Scan Tool) connected</li> <li>On the Raw Volts page, check the value for Aux_ana_PU1</li> <li>Does the DST display 4.9v or greater?</li> </ul>	4.9v or Greater	Go to Step (3)	Intermittent problem Go to Intermittent section Check for bad wiring in the circuit
3	<ul> <li>Key off and battery disconnected</li> <li>Provide a good ground circuit to pin H at VIC 1</li> <li>Reconnect battery and turn the key on, does the page still indicate 4.9v or greater?</li> </ul>	4.9v or Greater	Go to Step (4)	Repari circuit issue between OEM supplied speed computer and Pin H at the VIC 1
4	<ul> <li>Key off and battery disconnected</li> <li>Remove ground circuit installed in step 3, reinstall OEM wiring</li> <li>Provide a good ground circuit to Pin 46 at the GCP Connector</li> <li>Reconnect battery and turn the the key on, does the raw volts page still indicate 4.9v or greater?</li> </ul>	4.9v or Greater	Refer to OEM for diagnosis of speed control system	Repair wire circuit issue between VIC 1 and GCP pin 46

### DTC 1552: AUX digital 1 low voltage (SPN 520222: FMI 04)



### Conditions for setting the DTC

- Engine RPM between 60 rpm and 220 rpm
- Voltage at Aux Dig 1 at the ECM (Pin 42) is less than 4 volts for greater than 1 second
- Check Condition- Engine cranking

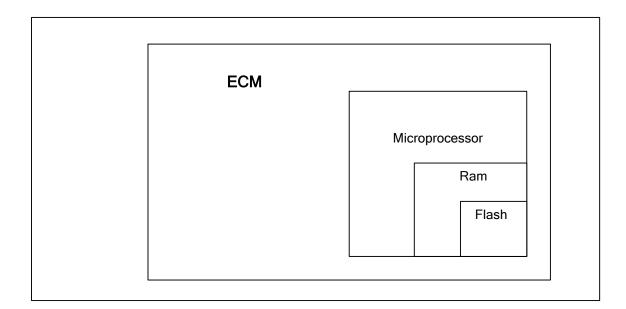
#### **Circuit Description**

Aux Digital 1 is used to detect when the operator is cranking the engine by monitoring the key switch "start" position voltage potential. When the operator attempts to start the engine a 12 volt signal is sent through the customer interface connector "start in" terminal. The circuit carries the voltage to the S-Terminal of the starter which will begin engine cranking. The circuit has a splice which also carries the voltage to terminal 42 of the ECM "Aux Dig 1". When B+ voltage is present at terminal 42 Aux Dig 1, the ECM knows the engine is cranking. This fault code is used to detect a circuit malfunction in which the engine is cranking and there is less than 4 volts at terminal 42 at the ECM.

# DTC 1552: AUX digital 1 low voltage (SPN 520222: FMI 04)

STEP	Action	Value(s)	Yes	Νο
1	Did you perform the On-Board (OBD) System Check?	_	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Engine Cranking</li> <li>DST (Diagnostic Scan Tool) connected on the Raw volts page</li> <li>Does AUX_DIG1_Raw Display less than 4 volts?</li> </ul>	< 4 Volts	Go to Step (3)	ECM De- fective, Replace ECM
3	<ul> <li>Engine Cranking</li> <li>Connect DVOM as instructed below</li> <li>Backprobe Aux Dig 1 White wire at terminal 42 of the ECM header connector and ground other DVOM lead</li> <li>Do you get greater than 4 volts?</li> </ul>	> 4 Volts	Repair faulty terminal at pin 42 of the wire har- ness Aux dig 1 White wire	Repair open circuit from starter solenoid splice to terminal 42 at the ECM header connector
			-	-

### DTC 1612-RTI 1 Loss (SPN 629:FMI 31)



### **Conditions for Setting the DTC**

- Engine Control Module
- Check Condition-Key on
- Fault Condition-Internal microprocessor error
- MIL-ON
- Adaptive-Disabled for the remainder of the key-ON cycle

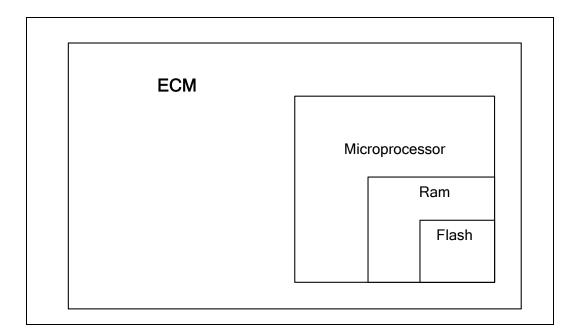
### **Circuit Description**

The ECM has several internal checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will attempt to reset itself in the event this fault is set. The MIL command is on and will remain on until the code is cleared using the DST.

# DTC 1612-RT 1 Loss

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Clear system fault code</li> <li>Does DTC 1612 reset with the engine idling?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	Check ECM power and ground circuits Did the power and ground circuits check OK?		Go to Step (4)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
4	Replace ECM Is the replacement complete?		Go to Step (5)	-
5	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1612 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 1613-RTI 2 Loss (SPN 629:FMI 31)



### Conditions for Setting the DTC

- Engine Control Module
- Check Condition-Key on
- Fault Condition-Internal microprocessor error
- MIL-ON
- Adaptive-Disabled for the remainder of the key-ON cycle

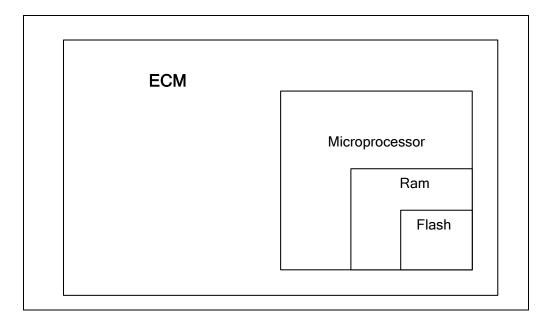
### **Circuit Description**

The ECM has several internal checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will attempt to reset itself in the event this fault is set. The MIL command is on and will remain on until the code is cleared using the DST.

## DTC 1613-RTI 2 Loss

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Clear system fault code</li> <li>Does DTC 1613 reset with the engine idling?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	Check ECM power and ground circuits Did the power and ground circuits check OK?		Go to Step (4)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
4	Replace ECM Is the replacement complete?		Go to Step (5)	-
5	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1613 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 1614-RTI 3 Loss (SPN 629:FMI 31)



### **Conditions for Setting the DTC**

- Engine Control Module
- Check Condition-Key on
- Fault Condition-Internal microprocessor error
- MIL-ON
- Adaptive-Disabled for the remainder of the key-ON cycle

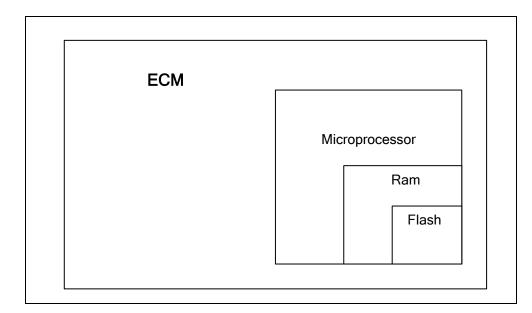
### **Circuit Description**

The ECM has several internal checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will attempt to reset itself in the event this fault is set. The MIL command is on and will remain on until the code is cleared using the DST.

## DTC 1614-RTI 3 Loss

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Clear system fault code</li> <li>Does DTC 1614 reset with the engine idling?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	Check ECM power and ground circuits Did the power and ground circuits check OK?		Go to Step (4)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
4	Replace ECM Is the replacement complete?		Go to Step (5)	-
5	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1614 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 1615-A/D Loss (SPN 629:FMI 31)



### Conditions for Setting the DTC

- Engine Control Module
- Check Condition-Key on
- Fault Condition-Internal microprocessor error
- MIL-ON
- Adaptive-Disabled for the remainder of the key-ON cycle

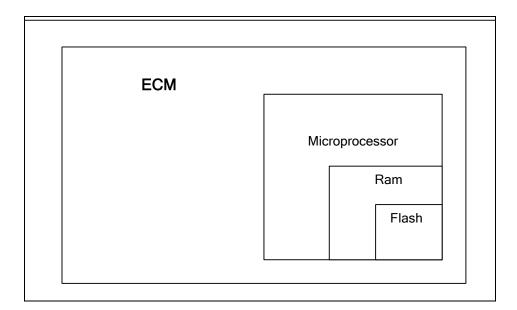
#### **Circuit Description**

The ECM has several internal checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will attempt to reset itself in the event this fault is set. The MIL command is on and will remain on until the code is cleared using the DST.

### DTC 1615-A/D Loss

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Clear system fault code</li> <li>Does DTC 1615 reset with the engine idling?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	Check ECM power and ground circuits Did the power and ground circuits check OK?		Go to Step (4)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
4	Replace ECM Is the replacement complete?		Go to Step (5)	-
5	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1615 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 1616-Invalid Interrupt (SPN 629:FMI 31)



### **Conditions for Setting the DTC**

- Engine Control Module
- Check Condition-Key on
- Fault Condition-Internal microprocessor error
- MIL-ON
- Adaptive-Disabled for the remainder of the key-ON cycle

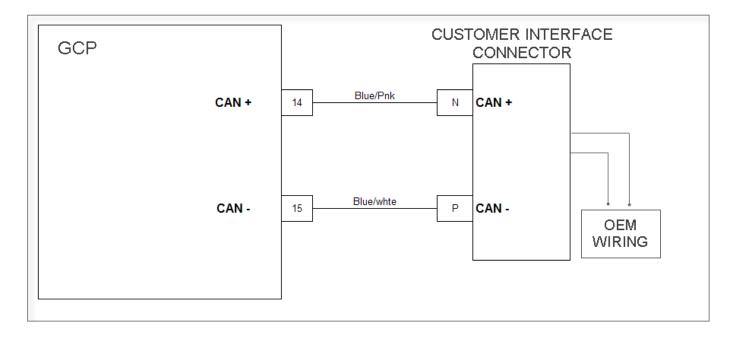
### **Circuit Description**

The ECM has several internal checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will attempt to reset itself in the event this fault is set. The MIL command is on and will remain on until the code is cleared using the DST.

# DTC 1616-Invalid Interrupt

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Clear system fault code</li> <li>Does DTC 1616 reset with the engine idling?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	Check ECM power and ground circuits Did the power and ground circuits check OK?		Go to Step (4)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
4	Replace ECM Is the replacement complete?		Go to Step (5)	-
5	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1616 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 1625 - J1939 Shutdown Request (SPN 1384:FMI 31)



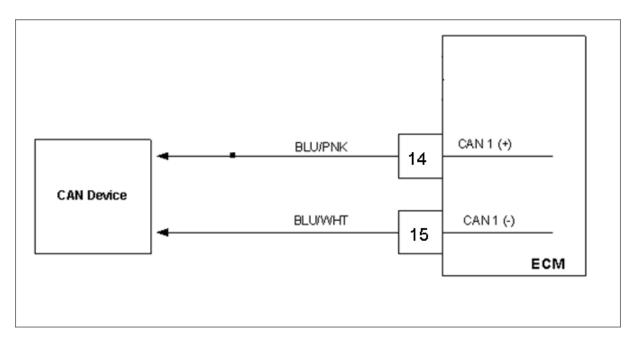
### **Conditions for Setting the DTC**

- Fault signal from OEM device
- Check Condition-Engine running
- MIL-ON

### **Circuit description**

The OEM can connect to the J1939 circuit (CAN circuit) at the customer interface connector 2. The terminals are N and P and continue through the engine wire harness into the GCP header connector. The terminals at the GCP for J1939 are pins 14 and 15. This DTC will set if the OEM device hooked into terminals N and P at the customer interface connector commands the engine to shutdown.

### DTC 1626-CAN Tx Failure



### **Conditions for Setting the DTC**

- CAN Tx
- Check Condition-Engine running
- Fault Condition-CAN Tx error 120 packets lost within 1 second
- MIL-ON

#### **Circuit description**

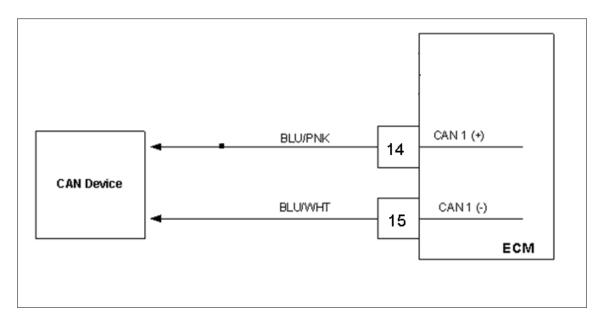
The CAN bus (controller area network) is used by the ECM to communicate with other digital devices used throughout the fuel system. Information is sent over the CAN bus in digital information "packets" that contain information for various control functions. This fault will set if the ECM detects 120 packets lost within a one second time period. The MIL command is ON.

# DTC 1626-CAN Tx Failure

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Clear system fault code</li> <li>Does DTC1626 reset with the engine idling?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	<ul> <li>Check that the ECM power connection C019 is clean, tight and in the proper location.</li> <li>Check that the ECM ground connection C010 is clean, tight and in the proper location.</li> <li>Are the power and ground circuits OK?</li> </ul>		Go to Step (4)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
4	<ul> <li>Using a DVOM check for continuity between ECM pins 14 and 15</li> <li>Do you have continuity between them?</li> </ul>		Repair the shorted circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (5)
5	<ul> <li>Using a DVOM check for continuity to engine ground on pins 69 and 81</li> <li>Do have continuity to engine ground?</li> </ul>		Repair the shorted to ground circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (6)
6	<ul> <li>Using a DVOM check for continuity to battery positive on pins 69 and 81</li> <li>Do have continuity them?</li> </ul>		Repair the shorted to ground circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (7)
7	Replace the ECM Is the replacement complete?		Go to Step (8)	_

Step	Action	Value(s)	Yes	No
8	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1626 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 1627-CAN Rx Failure (SPN 639:FMI 12)



### **Conditions for Setting the DTC**

- CAN Rx
- Check Condition-Engine running
- Fault Condition-CAN Rx error 120 packets lost within 1 second
- MIL-ON

### **Circuit description**

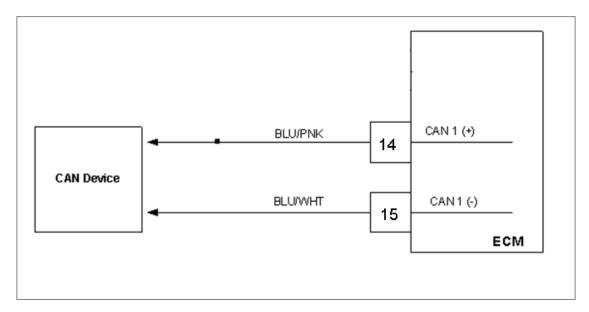
The CAN bus (controller area network) is used by the ECM to communicate with other digital devices used throughout the fuel system. Information is sent over the CAN bus in digital information "packets" that contain information for various control functions. This fault will set if the ECM detects 120 packets lost within a one second time period. The MIL command is ON.

# DTC 1627-CAN Rx Failure

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Clear system fault code</li> <li>Does DTC1627 reset with the engine idling?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	<ul> <li>Check that the ECM power connection C019 is clean, tight and in the proper location.</li> <li>Check that the ECM ground connection C010 is clean, tight and in the proper location.</li> <li>Are the power and ground circuits OK?</li> </ul>		Go to Step (4)	Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
4	<ul> <li>Using a DVOM check for continuity between ECM pins 14 and 15</li> <li>Do you have continuity between them?</li> </ul>		Repair the shorted circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (5)
5	<ul> <li>Using a DVOM check for continuity to engine ground on pin 14.</li> <li>Do have continuity to engine ground?</li> </ul>		Repair the shorted to ground circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (6)
6	<ul> <li>Using a DVOM check for continuity to battery positive on pin 14.</li> <li>Do have continuity between them?</li> </ul>		Repair the shorted to ground circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (7)
7	Replace the ECM Is the replacement complete?		Go to Step (8)	_

Step	Action	Value(s)	Yes	No
8	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1627 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 1628-CAN Address Conflict (SPN 639:FMI 13)



### Conditions for Setting the DTC

- CAN Rx
- Check Condition-Engine running
- Fault Condition-5 or more address conflict errors
- MIL-ON

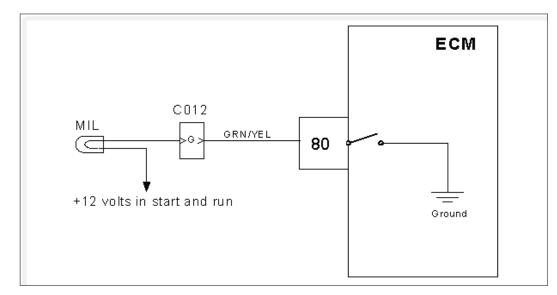
#### **Circuit description**

The CAN bus (controller area network) is used by the ECM to communicate with other digital devices used throughout the fuel system. Information is sent over the CAN bus in digital information "packets" that contain information for various control functions. Individual devices are assigned network addresses. This fault will set if the ECM detects an address conflict, such as two devices with the same address. This is usually not due to an in field failure and may be the results of "add on" CAN devices

## DTC 1628-CAN Address Conflict

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Clear system fault code</li> <li>Does DTC1628 reset with the engine idling?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	<ul> <li>Key OFF</li> <li>Disconnect one CAN device</li> <li>Clear DTC 1628</li> <li>Key ON (start engine if possible if not continue cranking for at least 3 seconds)</li> <li>Wait 5 seconds</li> <li>Does DTC 1628 re-set?</li> </ul>		Repeat step 3 until all CAN devices have been discon- nected one at a time	Contact the CAN device manufacturer for additional CAN address information Go to Step (4)
4	Has the CAN device been replaced or address conflict resolved?		Go to Step (5)	_
5	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1628 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 1644-MIL Control Ground Short (SPN 1213:FMI 4)



### Conditions for setting the DTC

- MIL
- Check Condition-Key ON engine OFF
- Fault Condition-ECM MIL output shorted to ground
- MIL Command-ON

### **Circuit Description**

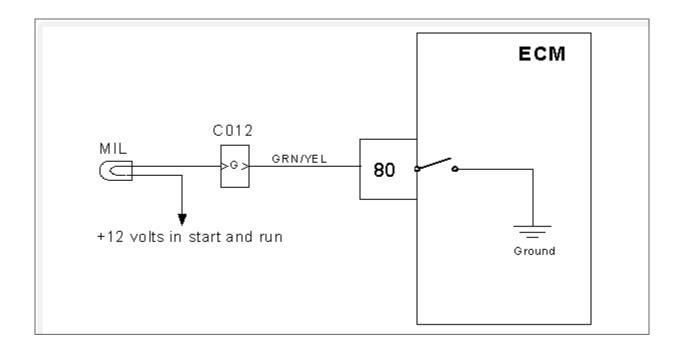
The Spectrum Fuel system is equipped with OBD (On-Board Diagnostics). The system has a dash mounted MIL (Malfunction Indicator Lamp). The MIL serves as notification of an emissions related problem. The MIL also has the ability to flash DTC codes in what is referred to as the blink code mode. It will display DTCs that have been stored due to a possible system malfunction. The following DTC charts in this manual will instruct the technician to perform the OBD system check. This simply means to verify the operation of the MIL. The lamp should illuminate when the key is in the ON position, and the engine is not running. This feature verifies that the lamp is in proper working order. If the lamp does not illuminate with the vehicle key ON and engine OFF, repair it as soon as possible. Once the engine is in start or run mode, the lamp should go off. If the lamp stays on while the engine is in the start or run mode, a current diagnostic trouble code may be set or a problem may exist with the MIL electrical wiring. The electrical schematic above shows the MIL power source supplied to the lamp. The ECM completes the circuit to ground to turn the lamp ON. This fault will set if the ECM MIL control is shorted to ground.

# DTC 1644-MIL Control Ground Short

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Clear system fault code</li> <li>Key OFF</li> <li>Key ON</li> <li>Does DTC 1644 reset?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	<ul> <li>Key OFF</li> <li>Disconnect the ECM wire harness connector C001</li> <li>Using a DVOM check for continuity between ECM connector pin 5 and engine ground Do you have continuity?</li> </ul>		Go to Step (4)	Intermittent problem Go to Inter- mittent section
4	<ul> <li>Disconnect vehicle interface connector C012</li> <li>Using a DVOM check for continuity between ECM connector pin 80 and engine ground Do you have continuity?</li> </ul>		Repair the shorted to ground circuit between the ECM con- nector and engine ground. Then go to step (6)	Repair the MIL control wire short to ground be- tween the vehicle inter- face connector and vehicle chassis. Then go to step (6)
5	Replace the ECM Is the replacement complete?		Go to Step (7)	_
6	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1644 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to Step (5)

Step	Action	Value(s)	Yes	No
7	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1644 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System check

### DTC 1645-MIL Control Ground Short To Power (SPN 1213:FMI 3)



### Conditions for setting the DTC

- MIL check
- Check Condition-Key ON engine OFF
- Fault Condition-ECM MIL output shorted to voltage
- MIL Command-ON

### **Circuit Description**

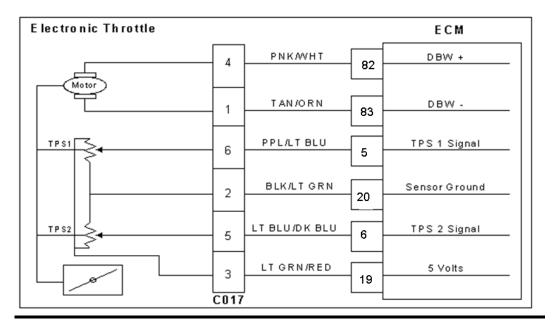
The Spectrum Fuel system is equipped with OBD (On-Board Diagnostics). The system has a dash mounted MIL (Malfunction Indicator Lamp). The MIL serves as notification of an emissions related problem. The MIL also has the ability to flash DTC codes in what is referred to as the blink code mode. It will display DTCs that have been stored due to a possible system malfunction. The following DTC charts in this manual will instruct the technician to perform the OBD system check. This simply means to verify the operation of the MIL. The lamp should illuminate when the key is in the ON position, and the engine is not running. This feature verifies that the lamp is in proper working order. If the lamp does not illuminate with the vehicle key ON and engine OFF, repair it as soon as possible. Once the engine is in start or run mode, the lamp should go off. If the lamp stays on while the engine is in the start or run mode, a current diagnostic trouble code may be set or a problem may exist with the MIL electrical wiring. The electrical schematic above shows the MIL power source supplied to the lamp. The ECM completes the circuit to ground to turn the lamp ON. This fault will set if the ECM MIL control is shorted to voltage.

## DTC 1645-MIL Control Short to Power

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine Running</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Clear system fault code</li> <li>Key OFF</li> <li>Key ON</li> <li>Does DTC 1644 reset?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	<ul> <li>Key OFF</li> <li>Disconnect the ECM wire harness connector C001</li> <li>Using a DVOM check for voltage between ECM connector pin 80 and engine ground</li> <li>Key ON</li> <li>Do you have voltage?</li> </ul>		Go to Step (4)	Intermittent problem Go to Inter- mittent section
4	<ul> <li>Disconnect vehicle interface connector C012</li> <li>Using a DVOM check for voltage between ECM connector pin 80 and engine ground Do you have voltage?</li> </ul>		Repair the shorted to voltage circuit between the ECM con- nector and engine ground. Then go to step (6)	Repair the MIL control wire short to volt- age between the vehicle interface con- nector and vehicle chas- sis. Then go to step (6)
5	<ul> <li>Replace the ECM Is the replacement complete?</li> </ul>		Go to Step (7)	_
6	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1645 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to Step (5)

Step	Action	Value(s)	Yes	No
	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-1645 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System check

### DTC 2111-Unable To Reach Lower TPS (SPN 51:FMI 7)



#### **Conditions for Setting the DTC**

- Throttle Position Sensor
- Check Condition-Cranking or Running
- Fault Condition-Actual throttle position is 20% greater than the throttle command
- MIL-ON during active fault
- Engine shutdown

### **Circuit Description**

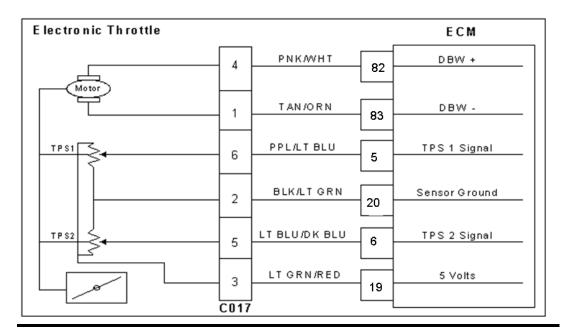
Dual throttle Position Sensors are used within the throttle that use variable resistors to determine signal voltage based on throttle plate position. TPS 1 will read low voltage when closed and TPS 2 will read high voltage when closed. The TPS 1 and TPS 2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded. This fault will set if the actual throttle position is 20% greater than the throttle command. During this active fault the MIL command is ON and the engine will shutdown.

# DTC 2111 Unable To Reach Lower TPS

Step	Action	Value(s)	Yes	Νο
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	<ul> <li>Key ON, Engine OFF</li> <li>DST (Diagnostic Scan Tool) connected in DBW (Drive By Wire) test mode</li> <li>Depress foot pedal until the throttle com- mand is between 63%-68%</li> <li>Is the TPS 1 voltage greater than 2.0 volts?</li> </ul>		Go to Step (3)	Intermittent problem Go to Intermit- tent section
3	<ul> <li>Key OFF</li> <li>Disconnect electronic throttle connector C017</li> <li>Probe TPS 1 signal pin 6 with a test light connected to battery voltage</li> <li>Key ON</li> <li>Does DST display TPS 1 voltage less than 0.2 volts?</li> </ul>		Go to Step (6)	Go to Step (4)
4	<ul> <li>Key OFF</li> <li>Disconnect ECM wire harness connector C001</li> <li>Key ON</li> <li>Using a DVOM check for voltage between throttle connector TPS 1signal pin 6 and en- gine ground</li> <li>Do you have voltage?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (5)
5	Replace ECM     Is the replacement complete?		Go to Step (13)	-
6	<ul> <li>Probe sensor ground circuit at ECM con- nector C001 with a test light connected to battery voltage</li> <li>Does the test light come on?</li> </ul>		Go to Step (9)	Go to Step (7)
7	<ul> <li>Key OFF</li> <li>Disconnect ECM wire harness connector C001</li> <li>Using a DVOM check for continuity between throttle connector signal ground pin 2 and ECM signal ground circuit pin 20</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (8)	Repair the circuit as nec- essary. Refer to Wiring Re- pairs in Engine Elec- trical.
8	Replace ECM Is the replacement complete?		Go to Step (13)	-
9	Check throttle for foreign object in bore Did you find a foreign object in the bore?		Go to Step (10)	Go to Step (11)
10	Remove foreign object Is the removal complete?		Go to Step (13)	-

Step	Action	Value(s)	Yes	No
11	<ul> <li>Inspect the throttle wire harness connector terminals for damage, corrosion or contami- nation</li> <li>Did you find the problem?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (12)
12	<ul> <li>Replace throttle</li> <li>Is the replacement complete?</li> </ul>		Go to Step (13)	-
13	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-2111 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

### DTC 2112-Unable To Reach Higher TPS (SPN 51:FMI 7)



### Conditions for Setting the DTC

- Throttle Position Sensor
- Check Condition-Cranking or Running
- Fault Condition-Actual throttle position is 20% less than the throttle command
- MIL-ON during active fault
- Engine shutdown

### **Circuit Description**

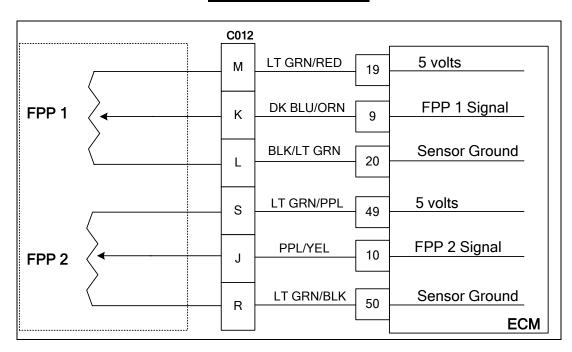
Dual throttle Position Sensors are used within the throttle that use variable resistors to determine signal voltage based on throttle plate position. TPS 1 will read low voltage when closed and TPS 2 will read high voltage when closed. The TPS 1 and TPS 2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded. This fault will set if the actual throttle position is 20% less than the throttle command. The MIL command is ON and the engine will shutdown.

# DTC 2112-Unable To Reach Higher TPS

01			N	
Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	<ul> <li>Key ON, Engine OFF</li> <li>DST (Diagnostic Scan Tool) connected in DBW (Drive By Wire) test mode</li> <li>Depress foot pedal until the throttle com- mand is 63%-68%</li> <li>Is the TPS voltage less than 2.0 volts?</li> </ul>		Go to Step (3)	Intermittent problem Go to Intermit- tent section
3	<ul> <li>Key OFF</li> <li>Disconnect electronic throttle connector C017</li> <li>Probe TPS 1 signal circuit pin 6 with test light connected to battery voltage</li> <li>Key ON</li> <li>Is TPS voltage 4.0 volts or greater?</li> </ul>		Go to Step (4)	Go to Step (8)
4	<ul> <li>Check throttle bore for foreign object</li> <li>Did you find a problem?</li> </ul>		Go to Step (5)	Go to Step (6)
5	<ul> <li>Remove the foreign object</li> <li>Has the object been removed?</li> </ul>		Go to Step (11)	-
6	<ul> <li>Check the electronic throttle connector ter- minals for damage corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (7)
7	<ul> <li>Replace throttle Is the replacement complete?</li> </ul>		Go to Step (11)	-
8	<ul> <li>Key OFF</li> <li>Disconnect ECM wire harness connector C001</li> <li>Using a DVOM check for continuity between throttle connector TPS 1 signal pin 6 and ECM TPS 1 signal pin 5</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (9)	Repair the circuit as nec- essary. Refer to Wiring Re- pairs in Engine Elec- trical.
9	<ul> <li>Using a DVOM check for continuity between throttle connector TPS 1 signal pin 6 and en- gine ground</li> <li>Do you have continuity between them?</li> </ul>		Repair the shorted to ground circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (10)
10	Replace ECM Is the replacement complete?		Go to Step (11)	-

Step	Action	Value(s)	Yes	Νο
	Remove all test equipment except the DST. Connect any disconnected components, fus- es, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and driveability After operating the engine within the test pa- rameters of DTC-2112 check for any stored codes.		System OK	Go to OBD System Check

## DTC 2121-FPP 1 Lower Than FPP 2 (SPN 91:FMI 18)



#### **Conditions for Setting the DTC**

- Foot pedal position sensor 1 and 2
- Check Condition-Key ON
- Fault Condition-FPP1 sensor higher than FPP 2
- MIL-ON
- Force idle
- Low rev limit

#### **Circuit Description**

The foot pedal position sensor uses variable resistors to determine signal voltage based on foot pedal position. Although the voltage outputs are different, the calculated throttle position values should be very close to the same. This fault will set if FPP 1 is 20% or greater than the FPP 2. The MIL command is ON. Forced idle and low rev limit are in effect during this fault limiting full power output.

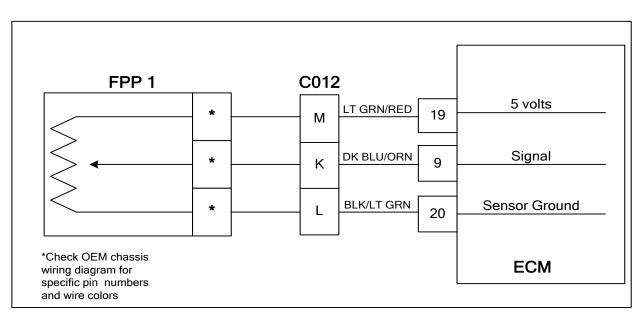
#### **Diagnostic Aid**

FPP sensors are OEM specific and vary in configuration. The exact wire color and pin numbers for the FPP must be verified in the OEM chassis wiring schematic. The FPP sensor used in this system provides two sensors in one packaged assembly. FPP1 and FPP 2 are not serviceable individually, and in the event of a failure the complete FPP assembly must be replaced.

# DTC 2121 FPP 1 Lower than FPP 2

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>DST (Diagnostic Scan Tool) connected and in the system data mode</li> <li>Clear DTC 2126</li> <li>Start and run the engine to full operating temperature</li> <li>Depress the foot pedal from idle to the wide open position several times</li> <li>Does DTC 2121 re-set?</li> </ul>		Go to Step (4)	Go to Step (3)
3	<ul> <li>Key OFF</li> <li>Slowly depress the foot pedal from idle to the wide open position while observing the FPP1 and FPP 2 calculated percentage positions</li> <li>Does the DST display a 20% or more difference between FPP1 and FPP2 calculated positions?</li> </ul>		Go to Step (4)	Intermittent problem Go to Inter- mittent section
4	<ul> <li>Disconnect FPP sensor connector</li> <li>Jump the pins that that lead from the FPP sensor connector to C012 signal pin K and 5 volt supply pin M pin 3</li> <li>Does the DST show FPP 1 voltage above 0.200 volts?</li> </ul>	Greater than 0.200 volts	Go to Step (5)	Go to Step (7)
5	<ul> <li>Inspect the FPP and vehicle interface connectors for damage corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as re- quired. See wiring har- ness repair section	Go to Step (6)
6	Replace the FPP sensor     Is the replacement complete?		Go to Step (12)	-
7	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Using a DVOM check for continuity between C017 pin 3 and ECM 5 volt pin 19</li> <li>Do you have continuity?</li> </ul>		Go to Step (8)	Repair the open 5 volt circuit as re- quired. See wiring har- ness repair section
8	<ul> <li>Using a DVOM check for continuity between C012 signal pin K and ECM signal pin 9.</li> <li>Do you have continuity?</li> </ul>		Go to Step (9)	Repair the open signal circuit as re- quired. See wiring har- ness repair section

Step	Action	Value(s)	Yes	No
9	<ul> <li>Using a DVOM check for continuity between ECM connector signal pin 9 and engine ground</li> <li>Do you have continuity?</li> </ul>		Repair the signal shorted to ground cir- cuit as required. See wiring har- ness repair section	Go to Step (10)
10	<ul> <li>Inspect FPP connector and ECM connector pins for damage corrosion or contamination Did you find a problem?</li> </ul>		Repair the circuit as re- quired. See wiring har- ness repair section	Go to Step (11)
11	Replace ECM Is the replacement complete?		Go to Step (12)	-
12	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-2121 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check



## DTC 2122-FPP 1 High Voltage (SPN 91:FMI 3)

#### **Conditions for Setting the DTC**

- Foot Pedal Position
- Check Condition-Key On
- Fault Condition-FPP1 sensor voltage exceeds 4.800 volts
- MIL-On during active fault
- Low rev limit
- Forced idle

#### **Circuit Description**

The Foot Pedal Position sensor uses a variable resistor to determine signal voltage based on pedal position. This fault will set if the FPP 1 voltage exceeds 4.800 volts for longer than 0.5 seconds. If the voltage exceeds 4.800 volts the FPP is considered to be out of specification. The MIL command is ON. Forced idle will be in effect during this code set limiting full power output.

#### **Diagnostic Aid**

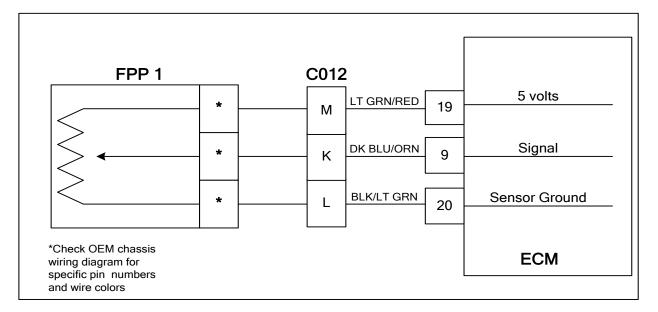
FPP sensors are OEM specific and vary in configuration. The exact wire color and pin numbers for the FPP connection must be verified in the OEM chassis wiring schematic. The FPP sensor used in this system provides two sensors in one packaged assembly. FPP1 and FPP 2 are not serviceable individually, and in the event of a failure the complete foot pedal sensor assembly must be replaced.

# DTC 2122 FPP 1 Voltage High

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine OFF</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Does the DST display FPP voltage of 4.800 volts or greater with the foot pedal in the idle position?</li> </ul>	Greater than 4.800 volts	Go to Step (3)	Go to Step (3)
3	<ul> <li>Slowly increase FPP while observing FPP 1 voltage</li> <li>Does DST FPP voltage ever exceed 4.800 volts?</li> </ul>		Go to step (4)	Intermittent problem Go to Inter- mittent section
4	• Disconnect the FPP sensor connector Does the DST now show FPP 1 voltage below 0.200 volts?	0.200 volts or less	Go to step (5)	Go to step (6)
5	Replace FPP sensor     Is the replacement complete?		Go to step (10)	-
6	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Disconnect vehicle interface connector C012 Using a DVOM check continuity between connector C012 pin L and ECM sensor ground pin 20</li> <li>Do you have continuity?</li> </ul>		Go to step (7)	Repair the open ground circuit as re- quired
7	<ul> <li>Key ON</li> <li>Using a DVOM check for voltage between the FPP connector pin K and engine ground Do you have voltage?</li> </ul>	No voltage	Repair the signal shorted to voltage cir- cuit	Go to step (8)
8	<ul> <li>Inspect ECM and FPP connectors for dam- age corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as re- quired. See wire harness repair section	Go to step (9)
9	Replace ECM Is the replacement complete?		Go to step (10)	-

Step	Action	Value(s)	Yes	No
	<ul> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> </ul>		System OK	Go to OBD System Check

## DTC 2123-FPP 1 Low Voltage (SPN 91:FMI 4)



#### **Conditions for Setting the DTC**

- Foot Pedal Position
- Check Condition-Key On
- Fault Condition-FPP sensor voltage less than 0.200
- MIL-On during active
- Low rev limit
- Force idle

#### **Circuit Description**

The Foot Pedal Position sensor uses a variable resistor to determine signal voltage based on pedal position. This fault will set if the FPP 1 voltage is less than 0.200 volts at any operating condition while the key is on. If the voltage drops below 0.200 volts the FPP is considered to be out of specification. The MIL command is ON. Forced idle will be in effect during this code set limiting full power output.

#### **Diagnostic Aid**

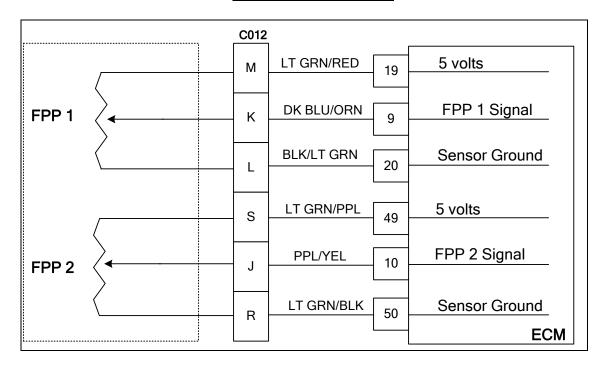
FPP sensors are OEM specific and vary in configuration. The exact wire color and pin numbers for the FPP connection must be verified in the OEM chassis wiring schematic. The FPP sensor used in this system provides two sensors in one packaged assembly. FPP1 and FPP 2 are not serviceable individually, and in the event of a failure the complete foot pedal sensor assembly must be replaced.

# DTC 2123 FPP 1 Voltage Low

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine OFF</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Does the DST display FPP 1 voltage of 0.200 volts or less with the foot pedal in the idle posi- tion?</li> </ul>	0.200 volts or less	Go to Step (3)	Go to Step (3)
3	<ul> <li>Slowly increase FPP while observing the FPP 1 voltage</li> <li>Does the DST ever display FPP voltage below</li> <li>0.200 volts?</li> </ul>		Go to step (4)	Intermittent problem Go to Inter- mittent section
4	<ul> <li>Disconnect the FPP sensor connector</li> <li>Jump the FPP sensor pins at the FPP 1 connector that lead to C012 5 volt pin M and signal pin K</li> <li>Does the DST now show FPP 1 voltage above 0.200 volts?</li> </ul>	Greater than 0.200 volts	Go to step (5)	Go to step (7)
5	<ul> <li>Inspect FPP 1 and C012 connectors for damage corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as re- quired. See wiring har- ness repair section	Go to step (6)
6	<ul> <li>Replace FPP 1 sensor</li> <li>Is the replacement complete?</li> </ul>		Go to step (12)	-
7	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Using a DVOM check for continuity between ECM 5 volt pin 19 and FPP connector pin that leads to C012 pin M</li> <li>Do you have continuity?</li> </ul>		Go to step (8)	Repair the open circuit as required. See wiring harness re- pair section
8	<ul> <li>Using a DVOM check for continuity between ECM signal pin 9 and FPP connector pin that leads to C012 pin K</li> <li>Do you have continuity?</li> </ul>		Go to step (9)	Repair the open circuit as required. See wiring harness re- pair section

Step	Action	Value(s)	Yes	No
9	<ul> <li>Key ON</li> <li>Using a DVOM check for continuity between ECM connector signal pin 9 and engine ground</li> <li>Do you have continuity?</li> </ul>		Repair the signal shorted to ground cir- cuit as required. See wiring har- ness repair section	Go to step (10)
10	<ul> <li>Inspect FPP1, C012 and ECM connectors for damage corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as re- quired. See wiring har- ness repair section	Go to step (11)
11	<ul> <li>Replace ECM Is the replacement complete?</li> </ul>		Go to step 12	-
12	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-2123 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

## DTC 2126-FPP 1 Higher Than FPP 2 (SPN 91:FMI 16)



#### Conditions for Setting the DTC

- Foot pedal position sensor 1 and 2
- Check Condition-Key ON
- Fault Condition-FPP 1 20% higher than FPP 2
- MIL-ON
- Force idle
- Low rev limit

#### **Circuit Description**

The foot pedal position sensor uses variable resistors to determine signal voltage based on foot pedal position. Although the voltage outputs are different, the calculated throttle position values should be very close to the same. This fault will set if FPP 1 is 20% or more higher that FPP 2. The MIL command is ON. Forced idle and low rev limit are in effect during this fault limiting full power output.

#### **Diagnostic Aid**

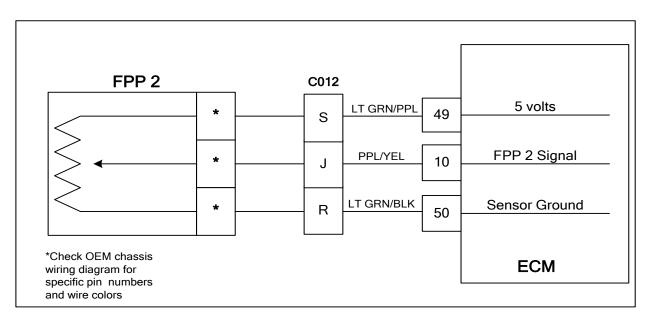
FPP sensors are OEM specific and vary in configuration. The exact wire color and pin numbers for the FPP must be verified in the OEM chassis wiring schematic. The FPP sensor used in this system provides two sensors in one packaged assembly. FPP1 and FPP 2 are not serviceable individually, and in the event of a failure the complete FPP assembly must be replaced.

# DTC 2126 FPP 1 Higher Than FPP 2

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	- -	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Clear DTC 2126</li> <li>Start the engine and run to full operating temperature.</li> <li>Depress the foot pedal from idle to wide open throttle several times.</li> <li>Does DTC 2126 re-set?</li> </ul>		Go to Step (4)	Go to Step (3)
3	<ul> <li>Key OFF</li> <li>Slowly depress the foot pedal from idle to the wide open position while observing the FPP1 and FPP 2 calculated percentage positions</li> <li>Does the DST display a 20% or more difference between FPP1 and FPP2 calculated positions?</li> </ul>		Go to Step (4)	Intermittent problem Go to Inter- mittent section
4	Disconnect FPP sensor connector Does the DST now show FPP 1 voltage below 0.200 volts?	Below 0.200 volts	Go to Step (5)	Go to Step (6)
5	Replace the FPP sensor     Is the replacement complete?		Go to Step (10)	-
6	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Disconnect vehicle interface connector C012</li> <li>Using a DVOM check continuity between the interface connector pin L and ECM sensor ground pin 20</li> <li>Do you have continuity?</li> </ul>		Go to Step (7)	Repair the open ground circuit as re- quired
7	<ul> <li>Key ON</li> <li>Using a DVOM check for voltage between the FPP connector that leads to the vehicle interface connector signal pin K and engine ground</li> <li>Do you have voltage?</li> </ul>	No voltage	Repair the signal shorted to voltage	Go to Step (8)
8	<ul> <li>Inspect ECM and FPP connectors for dam- age corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as re- quired. See wire harness repair section	Go to Step (9)
9	<ul> <li>Replace ECM Is the replacement complete?</li> </ul>		Go to Step (10)	-

Step	Action	Value(s)	Yes	No
	<ul> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> </ul>		System OK	Go to OBD System Check

## DTC 2127-FPP 2 Low Voltage (SPN 29:FMI 4)



#### Conditions for Setting the DTC

- Foot Pedal Position
- Check Condition-Key On
- Fault Condition-FPP sensor voltage less than 0.400
- MIL-On
- Low Rev Limit
- Force Idle

#### **Circuit Description**

The Foot Pedal Position sensor uses a variable resistor to determine signal voltage based on pedal position. This fault will set if the FPP 2 voltage is less than 0.200 volts at any operating condition while the key is on. If the voltage drops below 0.400 volts the FPP is considered to be out of specification. The MIL command is ON. Low rev limit and forced idle will be effect during this fault limiting power output.

#### **Diagnostic Aid**

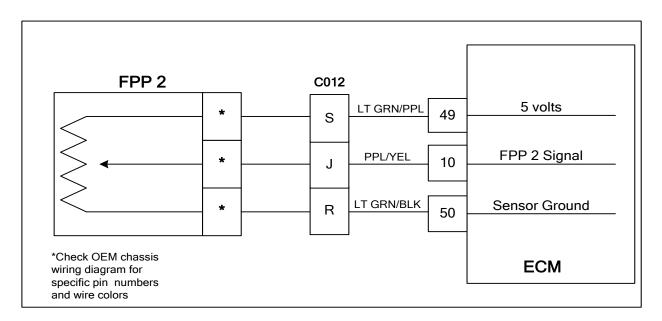
FPP sensors are OEM specific and vary in configuration. The exact wire color and pin numbers for the FPP must be verified in the OEM chassis wiring schematic. The FPP sensor used in this system provides two sensors in one packaged assembly. FPP1 and FPP 2 are not serviceable individually, and in the event of a failure the complete FPP assembly must be replaced.

# DTC 2127 FPP 2 Voltage Low

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine OFF</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Does the DST display FPP 2 voltage of less than 0.400 volts with the foot pedal in the idle posi- tion?</li> </ul>	Less than 0.400 volts	Go to Step (3)	Go to Step (3)
3	<ul> <li>Slowly increase the FPP while observing the FPP 2 voltage</li> <li>Does the DST ever display FPP voltage below</li> <li>0.400 volts?</li> </ul>		Go to step (4)	Intermittent problem Go to Inter- mittent section
4	<ul> <li>Disconnect the FPP sensor connector</li> <li>Jump the pins from the FPP sensor connect- or that leads to C012 signal pin J and 5 volt supply pin S</li> <li>Does the DST now show FPP 1 voltage above 0.400 volts?</li> </ul>	Greater than 0.400 volts	Go to step (5)	Go to step (7)
5	<ul> <li>Inspect the FPP and C012 connectors for damage corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as re- quired. See wiring har- ness repair section	Go to step (6)
6	<ul> <li>Replace FPP sensor</li> <li>Is the replacement complete?</li> </ul>		Go to step (12)	-
7	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Disconnect the vehicle interface connector C012</li> <li>Using a DVOM check for continuity between C012 pin S and ECM 5 volt pin 49</li> <li>Do you have continuity?</li> </ul>		Go to step (8)	Repair the open 5 volt circuit as re- quired. See wiring har- ness repair section
8	<ul> <li>Using a DVOM check for continuity between C012 signal pin J and ECM signal pin 10 Do you have continuity?</li> </ul>		Go to step (9)	Repair the open signal circuit as re- quired. See wiring har- ness repair section

Step	Action	Value(s)	Yes	No
9	<ul> <li>Using a DVOM check for continuity between ECM connector signal pin 10 and engine ground</li> <li>Do you have continuity?</li> </ul>		Repair the signal shorted to ground cir- cuit as required. See wiring har- ness repair section	Go to step (10)
10	<ul> <li>Inspect FPP connector C012 and ECM con- nector pins for damage corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as re- quired. See wiring har- ness repair section	Go to step (11)
11	Replace ECM Is the replacement complete?		Go to step 12	-
12	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-2127 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

## DTC 2128-FPP 2 High Voltage (SPN 29:FMI 3)



#### Conditions for Setting the DTC

- Foot pedal position sensor 2
- Check Condition-Key On
- Fault Condition-FPP2 sensor voltage exceeds 4.800 volts
- MIL-On
- Forced idle
- Low rev limit

#### **Circuit Description**

The Foot Pedal Position sensor uses a variable resistor to determine signal voltage based on foot pedal position. This fault will set if the FPP 2 voltage exceeds 4.800 volts at any operating condition while the key is on. If the voltage exceeds 4.800 volts the FPP is considered to be out of specification. The MIL command is ON. Forced idle and low rev limit will be in effect limiting power output during this fault.

#### **Diagnostic Aid**

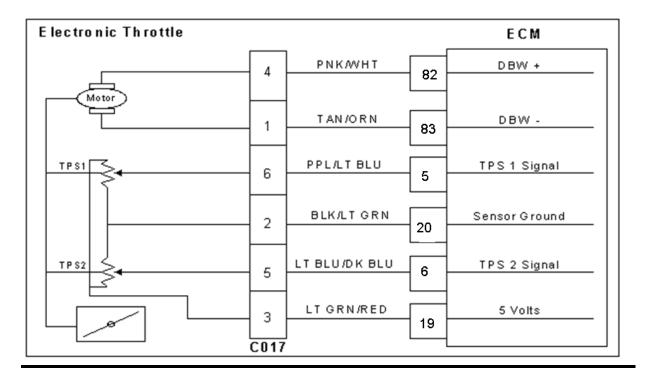
FPP sensors are OEM specific and vary in configuration. The exact wire color and pin numbers for the FPP must be verified in the OEM chassis wiring schematic. The FPP sensor used in this system provides two sensors in one packaged assembly. FPP1 and FPP 2 are not serviceable individually, and in the event of a failure the complete FPP assembly must be replaced.

# DTC 2128 FPP 2 Voltage High

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON, Engine OFF</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Does the DST display FPP voltage of 4.800 volts or greater with the foot pedal in the idle position?</li> </ul>	4.800 volts or greater	Go to Step (3)	Go to Step (3)
3	<ul> <li>Slowly increase FPP while observing FPP 2 voltage</li> <li>Does DST FPP voltage ever exceed 4.800 volts?</li> </ul>		Go to step (4)	Intermittent problem Go to Inter- mittent section
4	<ul> <li>Disconnect the FPP sensor connector</li> <li>Does the DST now show FPP 2 voltage below</li> <li>0.200 volts?</li> </ul>	Below 0.200 volts	Go to step (5)	Go to step (6)
5	<ul> <li>Replace FPP sensor</li> <li>Is the replacement complete?</li> </ul>		Go to step (10)	-
6	<ul> <li>Key OFF</li> <li>Disconnect ECM connector C001</li> <li>Disconnect vehicle interface connector C012</li> <li>Using a DVOM check continuity between connector C012 pin R and ECM sensor ground pin 50</li> <li>Do you have continuity?</li> </ul>		Go to step (7)	Repair the open ground circuit as re- quired
7	<ul> <li>Key ON</li> <li>Using a DVOM check for voltage between the FPP connector pin J and engine ground Do you have voltage?</li> </ul>	No voltage	Repair the signal shorted to voltage cir- cuit	Go to step (8)
8	<ul> <li>Inspect ECM and FPP connectors and pins for damage corrosion or contamination</li> <li>Did you find a problem?</li> </ul>		Repair the circuit as re- quired. See wire harness repair section	Go to step (9)
9	Replace ECM Is the replacement complete?		Go to step (10)	-

Step	Action	Value(s)	Yes	Νο
10	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-2128 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

## DTC 2135: TPS1/2 simultaneous voltages out-of-range (SPN 51:FMI 31)



#### **Conditions for Setting the DTC**

- Throttle Position Sensor 1 & 2
- Check Condition-Key ON
- Fault Condition-TPS 1 20% higher than TPS2
- MIL-ON for remainder of key on cycle
- Engine shutdown

#### **Circuit Description**

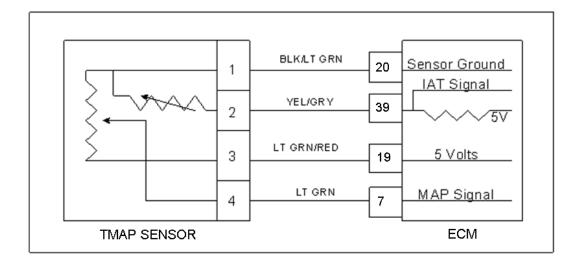
Dual throttle Position Sensors are used within the throttle that use variable resistors to determine signal voltage based on throttle plate position. TPS 1 will read lower voltage when closed and TPS 2 will read higher voltage when closed. The TPS 1 and TPS 2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded. The TPS is not serviceable and in the event of a failure the electronic throttle assembly must be replaced. This fault will set if TPS 1 is 20% (or more) higher than TPS 2. At this point the throttle is considered to be out of specification, or there is a problem with the TPS signal circuit. The MIL command is ON and the engine will shutdown.

# DTC 2135: TPS1/2 simultaneous voltages out-of-range

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	<ul> <li>Key ON, Engine OFF</li> <li>DST (Diagnostic Scan Tool) connected in System Data Mode</li> <li>Does the DST display more than a 20% differ- ence between TPS 1 and TPS 2?</li> </ul>		Go to Step (3)	Intermittent problem Go to Intermit- tent section
3	<ul> <li>Key OFF</li> <li>Disconnect electronic throttle connector C017</li> <li>Key ON</li> <li>Change DST mode to DBW (drive by wire) test mode</li> <li>Is the voltage for TPS 1 less than 0.1 volts?</li> </ul>		Go to Step (5)	Go to Step (4)
4	<ul> <li>Key OFF</li> <li>Disconnect ECM wiring harness connector C001</li> <li>Key ON</li> <li>Using a DVOM check for voltage between ECM connector TPS 1 signal pin 5 and en- gine ground</li> <li>Do you have voltage?</li> </ul>		Repair the TPS 1 circuit shorted to voltage as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (9)
5	<ul> <li>Jump TPS 1 signal pin 6 to the 5 volt reference pin 3 at connector C017</li> <li>Does DST display TPS 1 voltage over 4.900 volts?</li> </ul>		Go to Step (6)	Go to Step (8)
6	<ul> <li>Inspect wire terminals at throttle connector for damage corrosion or contamination Any problems found?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.	Go to Step (7)
7	Replace the electronic Throttle Is the replacement complete?		Go to Step (12)	-
8	<ul> <li>Key OFF</li> <li>Disconnect ECM wire harness connector C001</li> <li>Using a DVOM check for continuity between throttle connector TPS 1 signal pin 6 and ECM connector TPS 1 signal pin 5</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (9)	Repair the open circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.

Step	Action	Value(s)	Yes	Νο
9	<ul> <li>Using a DVOM check for continuity between throttle connector signal ground pin 2 and ECM connector signal ground pin 3</li> <li>Do you have continuity between them?</li> </ul>		Go to Step (10)	Repair the open circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical.
10	<ul> <li>Inspect ECM connector terminals for damage corrosion or contamination.</li> <li>Any problems found?</li> </ul>		Repair the circuit as necessary. Refer to Wir- ing Repairs in Engine Elec- trical	Go to Step (11)
11	Replace ECM Is the replacement complete?		Go to Step (12)	-
12	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-221 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# DTC 2229-BP High Pressure (SPN 108:FMI 0)



#### **Conditions for Setting the DTC**

- Barometric Pressure
- Check Condition-Key ON
- Fault Condition-BP greater than 16 psia
- MIL-ON for active fault
- Adaptive-Disabled

#### **Circuit Description**

The BP (Barometric Pressure) is estimated from the TMAP sensor. The barometric pressure value is used for fuel and airflow calculations. This fault sets in the event the BP value is out of the normal range.

## DTC 2229-BP High Pressure

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Sec- tion
2	<ul> <li>Key ON</li> <li>DST (Diagnostic Scan Tool) connected in</li> <li>System Data Mode</li> <li>Does DST display MAP pressure of 16 psia or greater?</li> </ul>		Go to Step (3)	Intermittent problem Go to Inter- mittent section
3	Replace TMAP sensor. Is the repair complete?		Go to Step 4	-
4	<ul> <li>Remove all test equipment except the DST.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the DST clear DTC information from the ECM.</li> <li>Turn the ignition OFF and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature</li> <li>Observe the MIL</li> <li>Observe engine performance and driveability</li> <li>After operating the engine within the test parameters of DTC-2229 check for any stored codes.</li> <li>Does the engine operate normally with no stored codes?</li> </ul>		System OK	Go to OBD System Check

# Definitions

- Air Valve Vacuum (AVV): The vacuum signal taken from below the air valve assembly and above the throttle butterfly valve.
- ADP: Adaptive Digital Processor.
- **Air/Fuel Ratio:** The amount or balance of air and fuel in the air fuel mixture that enters the engine.
- **Analog Voltmeter:** A meter that uses a mechanical needle to point to a value on a scale of numbers. It is usually of the low impedance type and used to measure voltage and resistance.
- **Aromatics:** Pertaining to or containing the sixcarbon ring characteristic of the benzene series. Found in many petroleum distillates.
- **Backfire:** Combustion of the air/fuel mixture in the intake or exhaust manifolds. A backfire can occur if the intake or exhaust valves are open when there is a mis-timed ignition spark.
- **Benzene:** An aromatic  $(C_6H_6)$ . Sometimes blended with gasoline to improve anti-knock value. Benzene is toxic and suspected of causing cancer.
- **Bi-Fueled:** A vehicle equipped to run on two fuels. **Blow-By:** Gases formed by the combustion of fuel and air, which ordinarily should exert pressure
- only against the piston crown and first compression ring. When rings do not seal, these gases escape or "blow by" the side of the piston into the crankcase.
- **BTU:** British Thermal Unit. A measurement of the amount of heat required to raise the temperature of 1lb. of water 1 degree F.
- **Butane:** An odorless, colorless gas, C<sub>4</sub>H<sub>10</sub> found in natural gas and petroleum. One of the five LP gases.
- **CĂFE:** Corporate Average Fuel Economy.
- CARB: California Air Resources Board.
- **Carbon Monoxide (CO):** A chemical compound of a highly toxic gas that is both odorless and colorless.
- **Carburetor:** An apparatus for supplying an internal-combustion engine a mixture of vaporized fuel and air.
- **Cathode Ray Tube:** A vacuum tube in which cathode rays usually in the form of a slender beam are projected on a fluorescent screen and produce a luminous spot.
- **Circuit:** A path of conductors through which electricity flows.
- **Closed Loop Operation**: Applies to systems utilizing an oxygen sensor. In this mode of operation, the system uses oxygen sensor information to determine air/fuel ratio. Adjustments are made accordingly and checked by comparing the new oxygen sensor to previous signals. No stored information is used.

CNG: Compressed Natural Gas.

CKP: Crankshaft Position Sensor

CMP: Camshaft Position Sensor

- **Conductor:** A material, normally metallic, that permits easy passage of electricity.
- **Contaminants:** Impurities or foreign material present in fuel.
- **Control Module:** One of several informal names for a solid state microcomputer which monitors engine conditions and controls certain engine functions; i.e. air/fuel ratio, injection and ignition time, etc. The formal name and the one used throughout this manual is ECM, or Engine Control Module.
- **Converter:** A LPG fuel system component containing varying stages of fuel pressure regulation combined with a vaporizer.
- **Cryogen:** A refrigerant used to obtain very low temperatures.
- **Current:** The volume or flow of electrons through a conductor. Measured in amperes or amps.
- DBW: Drive By Wire
- **Dedicated Fuel System:** A motor fuel system designed to operate on only one fuel type.
- **Diaphragm:** A thin, flexible membrane that separates two chambers. When the pressure in one chamber is lower than in the other chamber, the diaphragm will move toward the side with the low pressure.
- **Diaphragm Port:** The external port located at the fuel inlet assembly and connected to the vacuum chamber above the air valve diaphragm.
- DLC: Data Link Connector.
- **DTC:** Diagnostic Trouble Code
- **DST:** Diagnostic Scan Tool.
- **DVOM:** Digital Volt/ohm Meter. A meter that uses a numerical display in place of a gauge and is usually of the high impedance type.
- **ECT:** Engine Coolant Temperature.
- ECM: Electronic Control Module
- **ECOM**: A DLC cable supporting CAN and serial communication with a PSI/EControls ECM.
- **EFI:** Electronic Fuel Injection. A fuel injection system, which uses a microcomputer (ECM) to determine and control the amount of fuel, required by, and injected into, a particular engine.
- **EGO:** Exhaust Gas Oxygen, used to describe a sensor. Also known as "HEGO" (Heat Exhaust Gas Oxygen) sensor, "O<sub>2</sub>" or "Oxygen sensor.
- EGR: Exhaust Gas Recirculation.
- **EPA:** Environmental Protection Agency: A regulating agency of the Federal government which, among other duties, establishes and enforces automotive emissions standards.

**Ethanol:** Grain alcohol (C<sub>2</sub>H<sub>5</sub>OH), generally produced by fermenting starch or sugar.

- **Evaporative Emissions Controls:** An automotive emission control system designed to reduce hydrocarbon emissions by trapping evaporated fuel vapors from the fuel system.
- **Excess Flow Valve:** A check valve that is caused to close by the fuel when the flow exceeds a predetermined rate.

FTV: Fuel Trim Valve.

FFV: Flexible Fuel Vehicle.

- **Firing Line:** The portion of an oscilloscope pattern that represents the total amount of voltage being expended through the secondary circuit.
- **FMVSS:** Federal Motor Vehicle Safety Standards. **FPP:** Foot Pedal Position Sensor
- **Fuel Injector:** a spring loaded, electromagnetic valve which delivers fuel into the intake manifold, in response to an electrical input from the control module.
- **Fuel Lock:** A solenoid-controlled valve located in the fuel line to stop the flow when the engine stops or the ignition switch is off.
- **Gasohol:** 10 percent ethanol, 90 percent gasoline. Often referred to as E-10.
- **Gasoline:** A motor vehicle fuel that is a complex blend of hydrocarbons and additives. Typical octane level is 89.

GCP: Spectrum III (90-pin) ECM.

- **Greenhouse Effect:** A scientific theory suggesting that carbon dioxide from the burning of fossil fuels is causing the atmosphere to trap heat and cause global warming.
- HC: Hydrocarbon. An organic chemical compound.
- **HD 10:** A fuel of not less than 80% liquid volume propane and not more than 10% liquid volume propylene.
- **HD 5:** A fuel of not less than 90% liquid volume propane and not more than 5% liquid volume propylene.

HDV: Heavy Duty Vehicle.

- **Heavy Ends:** A term used to describe the build up of wax-like impurities that fall out of LPG when vaporized.
- **HEGO:** Heated Exhaust Gas Oxygen, used to describe a sensor. Also known as "EGO" (Exhaust Gas Oxygen sensor), "O<sub>2</sub>" or "Oxygen sensor.
- **Hg:** Chemical symbol for the element mercury. Used in reference to a measure of vacuum (inches of Hg).
- **Histogram:** The graphical version of a table which shows what proportion of values fall into specific categories over a specific period of time.

- **Hydrocarbon:** A chemical compound made up of hydrogen and carbon (HC). Gasoline and almost all other fuels are hydrocarbons.
- **Hydrostatic Relief Valve:** A pressure relief device installed in the liquid LPG hose on a LPG fuel system.

**IAT:** Intake Air Temperature

- **Ideal Mixture:** The air/fuel ratio at which the best compromise of engine performance to exhaust emissions is obtained. Typically 14.7:1.
- **Ignition Reserve:** The difference between available voltage and the required voltage.
- ILEV: Inherently Low Emission Vehicle.
- **Impedance**: A form of opposition of AC electrical current flow (resistance) measured in ohms.
- **Insulation:** A nonconductive material used to cover wires in electrical circuits to prevent the leakage of electricity and to protect the wire from corrosion.
- **Intercept:** An electrical term for a type of splice where the original circuit is interrupted and redirected through another circuit.
- **Knock:** Sound produced when an engine's air/fuel mixture is ignited by something other than the spark plug, such as a hot spot in the combustion chamber. Also caused by a fuel with an octane rating that is too low and/or incorrect ignition timing. Also called detonation or ping.
- Lambda Sensor: A feedback device, usually located in the exhaust manifold, which detects the amount of oxygen present in exhaust gases in relation to the surrounding atmosphere. (See HEGO).
- LDV: Light Duty Vehicle.
- Lean Mixture: An air to fuel ratio above the stoichiometric ratio; too much air.
- **LEV:** Low Emission Vehicle.
- **Limp-in or Limp Home:** A mode where the ECM or a component has failed, but the vehicle remains operational although the engine may operate minimally. This term may also describe the drivability characteristics of a failed computer system.
- **Liquid Petroleum Gas (LPG):** A fuel commonly known as propane consisting mostly of propane  $(C_3H_8)$ , derived from the liquid components of natural gas stripped out before the gas enters the pipeline, and the lightest hydrocarbons produced during petroleum refining. Octane level of LPG is 107.
- **LPG**: Liquified Petroleum Gas.
- **M85:** A blend of gasoline and methanol consisting of 85% methanol and 15% gasoline.

Measurements of Pressure: 1 PSI=2.06" Hg

(mercury) = 27.72" H<sub>2</sub>O (water column). At sea level atmospheric pressure is 29.92" Hg.

**Methanol:** Known as wood alcohol (CH<sub>3</sub>OH), a light, volatile, flammable alcohol commonly made from natural gas.

MIL: Malfunction Indicator Lamp.

**Misfire:** Failure of the air/fuel mixture to ignite during the power stroke.

- **Mixer:** Fuel introduction device that does not include a throttle plate.
- **MFI:** Multiport Fuel Injection. A fuel injection system that uses one injector per cylinder mounted on the engine to spray fuel near the intake valve area of combustion chamber.
- **MSV:** Manual Shut-Off Valve. Refers to the manually operated valve on the LPG tank.
- **MTBE**: Methyl Tertiary Butyl Ether. Oxygenate add to gasoline to reduce harmful emissions and to improve the octane rating.
- **Multi-fuel System:** A motor fuel system designed to operate on two different fuels, such as LPG and gasoline.
- **Natural Gas:** A gas formed naturally from buried organic material, composed of a mixture of hydrocarbons, with methane (CH<sub>4</sub>) being the dominant component.
- NGV: Natural Gas Vehicle.

NOX: See Oxides of Nitrogen.

- **OBD:** On Board Diagnostic
- Octane Rating: The measurement of the antiknock value of a motor fuel.
- **OEM:** Original Equipment Manufacturer, the vehicle manufacturer.
- **Open-Loop:** An operational mode during which control module memory information is used to determine air/fuel ratio, injection timing, etc., as opposed to actual oxygen sensor input.
- **Orifice:** A port or passage with a calibrated opening designed to control or limit the amount of flow through it.
- **Oscilloscope:** An instrument that converts voltage and frequency readings into traces on a cathode ray tube (also see Cathode Ray Tube).
- **Oxides of Nitrogen:** Chemical compounds of nitrogen bonded to various amounts of oxygen (NOX). A chief smog forming-agent.
- **Oxygen Sensor:** An automotive fuel system that produces a signal in accordance with the oxygen content of the exhaust gas. (See Lambda Sensor).
- **Oxygenate:** Oxygenates (such as MTBE, ethanol and methanol) added to gasoline to increase the oxygen content and therefore reduce exhaust emissions.

- **Ozone:** A radical oxygen module  $(O_3)$  that is found in the upper atmosphere and filters out ultraviolet radiation from the sun. Ground level ozone is formed by NOX, during the formation of photochemical smog.
- **Particulates:** Microscopic pieces of solid or liquid substances such as lead and carbon that are discharged into the atmosphere by internal combustion engines.
- **Positive Crankcase Ventilation (PCV):** An automotive emission control system designed to reduce hydrocarbon emissions by routing crankcase fumes into the intake manifold rather than to the atmosphere.
- **Power Derate:** A mode of reduced engine power output for the purposes of protecting engine components during a failure or malfunction.
- **Pressure Differential:** The differential between atmospheric pressure and intake manifold (referred to as vacuum) pressure.
- **Pressure Regulator:** A device to control the pressure of fuel delivered to the fuel injector(s).
- **Primary Circuit:** The low-voltage or input side of the ignition coil.
- **Propane:** An odorless and colorless gas, C<sub>3</sub>H<sub>8</sub>, found in natural gas and petroleum.
- Psia: pounds per square inch absolute
- PTV: Pressure Trim Valve
- **Reactivity:** Refers to the tendency of an HC in the presence of NOX and sunlight to cause a smogforming reaction. The lighter the HC, the lower reactivity tends to be.
- **Regulator:** An assembly used to reduce and control the pressure of a liquid or vapor.
- **Resistance:** The opposition to the flow of current in an electrical circuit. Measured in ohms.
- **Rest Pressure:** Fuel pressure maintained within the system after engine shutdown.
- **Rich Mixture:** An air to fuel ratio below the stoichiometric ratio; too much fuel.
- **SAE:** Society of Automotive Engineers.
- **Secondary Circuit:** The high-voltage output side of the ignition coil.
- **SEFI or SFI:** Sequential Electronic Fuel Injection or Sequential Fuel Injection.
- **Sensors:** Devices that provide the control module with engine information as needed to properly control engine function.

- **Spark Line:** The portion of an oscilloscope pattern that represents the time during which the air/fuel mixture is being burned in the combustion chamber.
- **Splice:** An electrical term for the joining of two or more conductors at a single point.
- **Stoichiometric Ratio:** An ideal fuel/air ratio for combustion in which all of the fuel and most of the oxygen will be burned.
- Sulfur Oxides: Chemical compounds where sulfur is bonded to oxygen produced by the combustion of gasoline or any other fuel that contains sulfur. As sulfur oxides combine with water in the atmosphere to form sulfuric acid.
- **System Pressure:** The fuel pressure maintained in the system during normal engine operation.
- **Tap:** An electrical term for a type of splice where the original circuit is not interrupted.
- **TBI:** Throttle Body Injection. Any of several injection systems that have the fuel injector(s) mounted in a centrally located throttle body.
- **Throttle Body:** Controls engine RPM by adjusting the engine manifold vacuum to the mixer. Consists of a housing shaft, throttle liner and butterfly valve.
- TLEV: Transitional Low Emission Vehicle.
- **TMAP**: Combined Air Inlet and Manifold Pressure Sensor.
- **Toluene:** A liquid aromatic hydrocarbon  $C_7H_8$ . **TPS:** Throttle Position Sensor.

- **TSB:** Technical Service Bulletin.
- ULEV: Ultra Low Emission Vehicle.
- **USB:** Universal Serial Bus. A plug or interface supplied on most personal computers.
- Vaporization: A process in which liquid changes states into gas.
- Venturi Air Valve Vacuum (VAVV): An amplified air valve vacuum signal coming from the venturi area of the mixer, directly exposed to airflow before the addition of vaporized LPG.
- **Volt/ohmmeter** (VOM): A combination meter used to measure voltage and resistance in an electrical circuit. Available in both analog and digital types. May also referred to as AVOM and DVOM.
- **Voltage:** The electrical pressure that causes current to flow in a circuit. Measured in volts.
- **Voltage Drop:** A lowering of the voltage in a circuit when resistance or electrical load is added.
- **Voltmeter:** A meter that uses a needle to point to a value on a scale of numbers usually of the low impedance type; used to measure voltage and resistance.
- VSS: Vehicle Speed Sensor
- Xylene: C<sub>6</sub>H<sub>4</sub> (CH<sub>3</sub>)<sub>2</sub>. Any of three toxic, flammable, and oily isomeric aromatic hydrocarbons that are dimethyl homologues of benzene and usually obtained from petroleum or natural gas distillates.
   ZEV: Zero Emission Vehicle.