SECTION 1F

ENGINE CONTROLS

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

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DESCRIPTION AND OPERATION

IGNITION SYSTEM OPERATION

This ignition system does not use a conventional distributor and coil. It uses a crankshaft position sensor input to the Engine Control Module (ECM). The ECM then determines Electronic Spark Timing (EST) and triggers the electronic ignition system ignition coil.

This type of distributorless ignition system uses a "waste spark'' method of spark distribution. Each cylinder is individural with coil per cylinder.

These systems use the EST signal from the ECM to control the EST. The ECM uses the following information:

- Engine load (manifold pressure or vacuum).
- Atmospheric (barometric) pressure.
- Engine temperature.
- Intake air temperature.
- Crankshaft position.
- Engine speed (rpm).

ELECTRONIC IGNITION SYSTEM IGNITION COIL

The Electronic Ignition (EI) system ignition coil is mounted near on the cylinder head.

A terminals of the EI system ignition coil provides the spark for each spark plug. The EI system ignition coil is not serviceable and must be replaced as an assembly.

CRANKSHAFT POSITION SENSOR

This Electronic Ignition (EI) system uses a magnetic crankshaft position sensor. This sensor protrudes through its mount to within approximately 1.3 mm (0.05 inch) of the crankshaft reluctor. The reluctor is a special wheel attached to the crankshaft with 58 slots machined into it, 57 of which are equally spaced in 6-degree intervals. The last slot is wider and serves to generate a "sync pulse." As the crankshaft rotates, the slots in the reluctor change the magnetic field of the sensor, creating an induced voltage pulse. The longer pulse of the 58th slot identifies a specific orientation of the crankshaft and allows the Engine Control Module (ECM) to determine the crankshaft orientation at all times. The ECM uses this information to generate timed ignition and injection pulses that it sends to the ignition coils and to the fuel injectors.

CAMSHAFT POSITION SENSOR

The Camshaft Position (CMP) sensor sends a CMP signal to the Engine Control Module (ECM). The ECM uses this signal as a "sync pulse" to trigger the injectors in the proper sequence. The ECM uses the CMP signal to indicate the position of the #1 piston during its power stroke. This allows the ECM to calculate true sequential fuel injection mode of operation. If the ECM detects an incorrect CMP signal while the engine is running, Diagnostic Trouble Code (DTC) P0341 will set. If the CMP signal is lost while the engine is running, the fuel injection system will shift to a calculated sequential fuel injection mode based on the last fuel injection pulse, and the engine will continue to run. As long as the fault is present, the engine can be restarted. It will run in the calculated sequential mode with a 1-in-6 chance of the injector sequence being correct.

IDLE AIR SYSTEM OPERATION

The idle air system operation is controlled by the base idle setting of the throttle body and the Idle Air Control (IAC) valve.

The Engine Control Module (ECM) uses the IAC valve to set the idle speed dependent on conditions. The ECM uses information from various inputs, such as coolant temperature, manifold vacuum, etc., for the effective control of the idle speed.

FUEL CONTROL SYSTEM OPERATION

The function of the fuel metering system is to deliver the correct amount of fuel to the engine under all operating conditions. The fuel is delivered to the engine by the individual fuel injectors mounted into the intake manifold near each cylinder.

The main fuel control sensors are the Manifold Absolute Pressure (MAP) sensor, the oxygen sensor (O2S), and the heated oxygen sensor (HO2S).

The MAP sensor measures or senses the intake manifold vacuum. Under high fuel demands, the MAP sensor reads a low vacuum condition, such as wide open throttle. The Engine Control Module (ECM) uses this information to enrich the mixture, thus increasing the fuel injector on-time, to provide the correct amount of fuel. When decelerating, the vacuum increases. This vacuum change is sensed by the MAP sensor and read by the ECM, which then decreases the fuel injector on-time due to the low fuel demand conditions.

The O2S is located in the exhaust manifold. The HO2S is located in the exhaust pipe. The oxygen sensors indicate to the ECM the amount of oxygen in the exhaust gas, and the ECM changes the air/fuel ratio to the engine by controlling the fuel injectors. The best air/fuel ratio to minimize exhaust emissions is 14.7:1, which allows the catalytic converter to operate most efficiently. Because of the constant measuring and adjusting of the air/fuel ratio, the fuel injection system is called a "closed loop" system.

The ECM uses voltage inputs from several sensors to determine how much fuel to provide to the engine. The fuel is delivered under one of several conditions, called “modes.’’

Starting Mode

When the ignition is turned ON, the ECM turns the fuel pump relay on for 2 seconds. The fuel pump then builds fuel pressure. The ECM also checks the Engine Coolant Temperature (ECT) sensor and the Throttle Position (TP) sensor and determines the proper air/fuel ratio for starting the engine. The ECM controls the amount of fuel delivered in the starting mode by changing how long the fuel injector is turned on and off. This is done by “pulsing” the fuel injectors for very short times.

Run Mode

The run mode has two conditions called “open loop’’ and “closed loop.’’

Open Loop

When the engine is first started and it is above 400 rpm, the system goes into “open loop’’ operation. In “open loop,’’ the ECM ignores the signal from the O2S and calculates the air/fuel ratio based on inputs from the ECT sensor and the MAP sensor. The ECM stays in ”open loop” until the following conditions are met:

- The O2S has a varying voltage output, showing that it is hot enough to operate properly.
- The ECT sensor is above a specified temperature.
- A specific amount of time has elapsed after starting the engine.

Closed Loop

The specific values for the above conditions vary with different engines and are stored in the Electronically Erasable Programmable Read-Only Memory (EEPROM). When these conditions are met, the system goes into “closed loop” operation. In “closed loop,” the ECM calculates the air/fuel ratio (fuel injector on-time) based on the signals from the oxygen sensors. This allows the air/fuel ratio to stay very close to 14.7 to 1.

Acceleration Mode

The ECM responds to rapid changes in throttle position and airflow and provides extra fuel.

Deceleration Mode

The ECM responds to changes in throttle position and airflow and reduces the amount of fuel. When deceleration is very fast, the ECM can cut off fuel completely for short periods of time.

Battery Voltage Correction Mode

When battery voltage is low, the ECM can compensate for a weak spark delivered by the ignition module by using the following methods:

- Increasing the fuel injector pulse width.
- Increasing the idle speed rpm.
- Increasing the ignition dwell time.

Fuel Cut-Off Mode

No fuel is delivered by the fuel injectors when the ignition is off. This prevents dieseling or engine run-on. Also, the fuel is not delivered if there are no reference pulses received from the CKP sensor. This prevents flooding.

EVAPORATIVE EMISSION CONTROL SYSTEM OPERATION

The basic Evaporative Emission (EVAP) control system used is the charcoal canister storage method. This method transfers fuel vapor from the fuel tank to an activated carbon (charcoal) storage canister which holds the vapors when the vehicle is not operating. When the engine is running, the fuel vapor is purged from the carbon element by intake airflow and consumed in the normal combustion process.

Gasoline vapors from the fuel tank flow into the tube labeled TANK. These vapors are absorbed into the carbon. The canister is purged by Engine Control Module (ECM) when the engine has been running for a specified amount of time. Air is drawn into the canister and mixed with the vapor. This mixture is then drawn into the intake manifold.

The ECM supplies a ground to energize the controlled charcoal canister purge solenoid valve. This valve is Pulse Width Modulated (PWM) or turned on and off several times a second. The controlled charcoal canister purge PWM duty cycle varies according to operating conditions determined by mass airflow, fuel trim, and intake air temperature.

Poor idle, stalling, and poor driveability can be caused by the following conditions:

- An inoperative controlled canister purge valve.
- A damaged canister.
- Hoses that are split, cracked, or not connected to the proper tubes.

CONTROLLED CHARCOAL CANISTER

The controlled charcoal canister is an emission control device containing activated charcoal granules. The controlled charcoal canister is used to store fuel vapors from the fuel tank. Once certain conditions are met, the Engine Control Module (ECM) activates the controlled charcoal canister purge solenoid, allowing the fuel vapors to be drawn into the engine cylinders and burned.

POSITIVE CRANKCASE VENTILATION CONTROL SYSTEM OPERATION

A Positive Crankcase Ventilation (PCV) control system is used to provide complete use of the crankcase vapors. Fresh air from the air cleaner is supplied to the crankcase. The fresh air is mixed with blowby gases which then pass through a vacuum hose into the intake manifold.

Periodically inspect the hoses and the clamps. Replace any crankcase ventilation components as required.

A restricted or plugged PCV hose may cause the following conditions:

- Rough idle
- Stalling or low idle speed
- Oil leaks
- Oil in the air cleaner
- Sludge in the engine

A leaking PCV hose may cause the following conditions:

- Rough idle
- Stalling
- High idle speed

ENGINE COOLANT TEMPERATURE SENSOR

The Engine Coolant Temperature (ECT) sensor is a thermistor (a resistor which changes value based on temperature) mounted in the engine coolant stream. Low coolant temperature produces a high resistance (100,000 ohms at –40°C [–40°F]) while high temperature causes low resistance (70 ohms at 130°C [266°F]).

The Engine Control Module (ECM) supplies 5 volts to the ECT sensor through a resistor in the ECM and measures the change in voltage. The voltage will be high when the engine is cold and low when the engine is hot. By measuring the change in voltage, the ECM can determine the coolant temperature. The engine coolant temperature affects most of the systems that the ECM controls. A failure in the ECT sensor circuit should set a Diagnostic Trouble Code (DTC) P0117 or P0118. Remember, these DTC indicate a failure in the ECT circuit, so proper use of the chart will lead either to repairing a wiring problem or to replacing the sensor to repair a problem properly.

THROTTLE POSITION SENSOR

The Throttle Position (TP) sensor is a potentiometer connected to the throttle shaft of the throttle body. The TP sensor electrical circuit consists of a 5-volt supply line and a ground line, both provided by the Engine Control Module (ECM). The ECM calculates the throttle position by monitoring the voltage on this signal line. The TP sensor output changes as the accelerator pedal is moved, changing the throttle valve angle. At a closed throttle position, the output of the TP sensor is low, about 0.4–0.8 volt. As the throttle valve opens, the output increases so that, at Wide Open Throttle (WOT), the output voltage will be about 4.5–5 volts.

The ECM can determine fuel delivery based on throttle valve angle (driver demand). A broken or loose TP sensor can cause intermittent bursts of fuel from the injector and an unstable idle, because the ECM thinks the throttle is moving. A problem in any of the TP sensor circuits should set a Diagnostic Trouble Code (DTC) P0122 or P0123. Once the DTC is set, the ECM will substitute a default value for the TP sensor and some vehicle performance will return.

CATALYST MONITOR OXYGEN SENSORS

Three-way catalytic converters are used to control emissions of hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx). The catalyst within the converters promotes a chemical reaction. This reaction oxidizes the HC and CO present in the exhaust gas and converts them into harmless water vapor and carbon dioxide. The catalyst also reduces NOx by converting it to nitrogen. The ECM can monitor this process using the oxygen sensor (O2S) and heated oxygen sensor (HO2S). These sensors produce an output signal which indicates the amount of oxygen present in the exhaust gas entering and leaving the three-way converter. This indicates the catalyst's ability to efficiently convert exhaust gasses. If the catalyst is operating efficiently, the O2S signals will be more active than the signals produced by the HO2S. The catalyst monitor sensors operate the same way as the fuel control sensors. The sensors' main function is catalyst monitoring, but they also have a limited role in fuel control. If a sensor output indicates a voltage either above or below the 450 mV bias voltage for an extended period of time, the Engine Control Module (ECM) will make a slight adjustment to fuel trim to ensure that fuel delivery is correct for catalyst monitoring.

A problem with the O2S circuit will set DTC P0131, P0132, P0133 or P0134 depending on the special condition. A problem with the HO2S signal will set DTC P0137, P0138, P0140 or P0141 depending on the special condition.

A fault in the heated oxygen sensor (HO2S) heater element or its ignition feed or ground will result in lower oxygen sensor response. This may cause incorrect catalyst monitor diagnostic results.

ELECTRIC EXHAUST GAS RECIRCULATION VALVE

The Electric Exhaust Gas Recirculation (EEGR) system is used on engines equipped with an automatic transaxle to lower oxides of nitrogen (NOx) emission levels caused by high combustion temperature. The main element of the system is the EEGR valve, controlled electrically by the Engine Control Module (ECM). The EEGR valve feeds small amounts of exhaust gas into the intake manifold to decrease combustion temperature. The amount of exhaust gas recirculated is controlled by variations in vacuum and exhaust back pressure. If too much exhaust gas enters, combustion will not take place. For this reason, very little exhaust gas is allowed to pass through the valve, especially at idle.

The EEGR valve is usually open under the following conditions:

- Warm engine operation.
- Above idle speed.

Results of Incorrect Operation

Too much EEGR flow tends to weaken combustion, causing the engine to run roughly or to stop. With too much EEGR flow at idle, cruise, or cold operation, any of the following conditions may occur:

- The engine stops after a cold start.
- The engine stops at idle after deceleration.
- The vehicle surges during cruise.
- Rough idle.

If the EEGR valve stays open all the time, the engine may not idle. Too little or no EEGR flow allows combustion temperatures to get too high during acceleration and load conditions. This could cause the following conditions:

- Spark knock (detonation)
- Engine overheating
- Emission test failure

INTAKE AIR TEMPERATURE SENSOR

The Intake Air Temperature (IAT) sensor is a thermistor, a resistor which changes value based on the temperature of the air entering the engine. Low temperature produces a high resistance (100 kohms at –40°C [–40°F]), while high temperature causes a low resistance (70 ohms at 130°C [266°F]).

The Engine Control Module (ECM) provides 5 volts to the IAT sensor through a resistor in the ECM and measures the change in voltage to determine the IAT. The voltage will be high when the manifold air is cold and low when the air is hot. The ECM knows the intake IAT by measuring the voltage.

The IAT sensor is also used to control spark timing when the manifold air is cold.

A failure in the IAT sensor circuit sets a diagnostic trouble code P0112 or P0113.

IDLE AIR CONTROL VALVE

Notice: Do not attempt to remove the protective cap and readjust the stop screw. Misadjustment may result in damage to the Idle Air Control (IAC) valve or to the throttle body.

The IAC valve is mounted on the throttle body where it controls the engine idle speed under the command of the Engine Control Module (ECM). The ECM sends voltage pulses to the IAC valve motor windings, causing the IAC valve pintle to move in or out a given distance (a step or count) for each pulse. The pintle movement controls the airflow around the throttle valves which, in turn, control the engine idle speed.

The desired idle speeds for all engine operating conditions are programmed into the calibration of the ECM. These programmed engine speeds are based on the coolant temperature, the park/neutral position switch status, the vehicle speed, the battery voltage, and the A/C system pressure, if equipped.

The ECM "learns" the proper IAC valve positions to achieve warm, stabilized idle speeds (rpm) desired for the various conditions (park/neutral or drive, A/C on or off, if equipped). This information is stored in ECM "keep alive" memories (information is retained after the ignition is turned off). All other IAC valve positioning is calculated based on these memory values. As a result, engine variations due to wear and variations in the minimum throttle valve position (within limits) do not affect engine idle speeds. This system provides correct idle control under all conditions. This also means that disconnecting power to the ECM can result in incorrect idle control or the necessity to partially press the accelerator when starting until the ECM relearns idle control.

Engine idle speed is a function of total airflow into the engine based on the IAC valve pintle position, the throttle valve opening, and the calibrated vacuum loss through accessories. The minimum throttle valve position is set at the factory with a stop screw. This setting allows enough airflow by the throttle valve to cause the IAC valve pintle to be positioned a calibrated number of steps (counts) from the seat during "controlled" idle operation. The minimum throttle valve position setting on this engine should not be considered the "minimum idle speed," as on other fuel injected engines. The throttle stop screw is covered with a plug at the factory following adjustment.

If the IAC valve is suspected as being the cause of improper idle speed, refer to "Idle Air Control System Check" in this section.

MANIFOLD ABSOLUTE PRESSURE SENSOR

The Manifold Absolute Pressure (MAP) sensor measures the changes in the intake manifold pressure which result from engine load and speed changes and converts these to a voltage output.

A closed throttle on engine coast down produces a relatively low MAP output. MAP is the opposite of vacuum. When manifold pressure is high, vacuum is low. The MAP sensor is also used to measure barometric pressure. This is performed as part of MAP sensor calculations. With the ignition ON and the engine not running, the Engine Control Module (ECM) will read the manifold pressure as barometric pressure and adjust the air/fuel ratio accordingly. This compensation for altitude allows the system to maintain driving performance while holding emissions low. The barometric function will update periodically during steady driving or under a wide open throttle condition. In the case of a fault in the barometric portion of the MAP sensor, the ECM will set to the default value.

A failure in the MAP sensor circuit sets a diagnostic trouble codes P0107, P0108 or P0106.

ENGINE CONTROL MODULE

The Engine Control Module (ECM), is the control center of the fuel injection system. It constantly looks at the information from various sensors and controls the systems that affect the vehicle's performance. The ECM also performs the diagnostic functions of the system. It can recognize operational problems, alert the driver through the Malfunction Indicator Lamp (MIL), and store diagnostic trouble code(s) which identify the problem areas to aid the technician in making repairs.

There are no serviceable parts in the ECM. The calibrations are stored in the ECM in the Programmable Read Only Memory (PROM).

The ECM supplies either 5 or 12 volts to power the sensors or switches. This is done through resistance in the ECM which are so high in value that a test light will not come on when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. You must use a digital voltmeter with a 10 megohm input impedance to get accurate voltage readings. The ECM controls output circuits such as the fuel injectors, the Idle Air Control (IAC) valve, the A/C clutch relay, etc., by controlling the ground circuit through transistors or a device called a "quad-driver."

FUEL INJECTOR

The Multi-port Fuel Injection (MFI) assembly is a solenoid-operated device controlled by the Engine Control Module (ECM) that meters pressurized fuel to a single engine cylinder. The ECM energizes the fuel injector or solenoid to a normally closed ball or pintle valve. This allows fuel to flow into the top of the injector, past the ball or pintle valve, and through a recessed flow director plate at the injector outlet.

The director plate has six machined holes that control the fuel flow, generating a conical spray pattern of finely atomized fuel at the injector tip. Fuel from the tip is directed at the intake valve, causing it to become further atomized and vaporized before entering the combustion chamber. A fuel injector which is stuck partially open would cause a loss of fuel pressure after the engine is shut down. Also, an extended crank time would be noticed on some engines. Dieseling could also occur because some fuel could be delivered to the engine after the ignition is turned off.

FUEL CUT-OFF SWITCH

The fuel cutoff switch is a safety device. In the event of a collision or a sudden impact, it automatically cuts off the fuel supply and activates the door lock relay. After the switch has been activated, it must be reset in order to restart the engine. Reset the fuel cutoff switch by pressing the rubber top of the switch. The switch is located near the right side of the passenger's seat.

KNOCK SENSOR

The knock sensor detects abnormal knocking in the engine. The sensor is mounted in the engine block near the cylinders. The sensor produces an AC output voltage which increases with the severity of the knock. This signal is sent to the Engine Control Module (ECM). The ECM then adjusts the ignition timing to reduce the spark knock.

VARIABLE RELUCTANCE (VR) SENSOR

The variable reluctance sensor is commonly refered to as an "inductive" sensor.

The VR wheel speed sensor consists of a sensing unit fixed to the left side front macpherson strut, for non-ABS vehicle.

The ECM uses the rough road information to enable or disable the misfire diagnostic. The misfire diagnostic can be greatly affected by crankshaft speed variations caused by driving on rough road surfaces. The VR sensor generates rough road information by producing a signal which is proportional to the movement of a small metal bar inside the sensor.

If a fault occurs which causes the ECM to not receive rough road information between 30 and 70 km/h (1.8 and 43.5 mph), Diagnostic Trouble Code (DTC) P1391 will set.

OCTANE NUMBER CONNECTOR

The octane number connector is a jumper harness that signal to the engine control module (ECM) the octane rating of the fuel.

The connector is located on the next to the ECM. There are two different octane number connector settings available. The vehicle is shipped from the factory with a label attached to the jumper harness to indicate the octane rating setting of the ECM. The ECM will alter fuel delivery and spark timing based on the octane number setting. The following table shows which terminal to jump on the octane number connector in order to achieve the correct fuel octane rating. Terminal 2 is ground on the octane number connector. The find the appropriate wiring diagram. Refer to “ECM Wiring Diagrams” in this Section.

	95	91
Terminal 49	Ground	Open

STRATEGY-BASED DIAGNOSTICS

Strategy-Based Diagnostics

The strategy-based diagnostic is a uniform approach to repair all Electrical/Electronic (E/E) systems. The diagnostic flow can always be used to resolve an E/E system problem and is a starting point when repairs are necessary. The following steps will instruct the technician on how to proceed with a diagnosis:

Verify the customer complaint. To verify the customer complaint, the technician should know the normal operation of the system.

- Perform preliminary checks as follows:
- Conduct a thorough visual inspection.
- Review the service history.
- Detect unusual sounds or odors.
- Gather Diagnostic Trouble Code (DTC) information to achieve an effective repair.
- Check bulletins and other service information. This includes videos, newsletters, etc.
- Refer to service information (manual) system check(s).
- Refer to service diagnostics.

No Trouble Found

This condition exists when the vehicle is found to operate normally. The condition described by the customer may be normal. Verify the customer complaint against another vehicle that is operating normally. The condition may be intermittent. Verify the complaint under the conditions described by the customer before releasing the vehicle.

Re-examine the complaints.

When the complaints cannot be successfully found or isolated, a re-evaluation is necessary. The complaint should be re-verified and could be intermittent as defined in “intermittents,” or could be normal.

After isolating the cause, the repairs should be made. Validate for proper operation and verify that the symptom has been corrected. This may involve road testing or other methods to verify that the complaint has resolved under following conditions:

- Conditions noted by the customer.
- If a DTC was diagnosed, verify the repair be duplicating conditions present when the DTC was set as noted in Failure Records or Freeze Frame data.

Verifying Vehicle Repair

Verification of the vehicle repair will be more comprehensive for vehicles with Euro On-Board Diagnostic (EOBD) system diagnostics. Following a repair, the technician should perform the following steps:

Important: Follow the steps below when you verify repairs on EOBD systems. Failure to follow these steps could result in unnecessary repairs.

- Review and record the Failure Records and the Freeze Frame data for the DTC which has been diagnosed (Freeze Fame data will only be stored for an A, B and E type diagnostic and only if the Malfunction Indicator Lamp has been requested).
- Clear the DTC(s).
- Operate the vehicle within conditions noted in the Failure Records and Freeze Frame data.
- Monitor the DTC status information for the specific DTC which has been diagnosed until the diagnostic test associated with that DTC runs.

EOBD SERVICEABILITY ISSUES

Based on the knowledge gained from Euro On-Board Diagnostic (OBD) experience in the 1994 and 1995 model years in United Status, this list of non-vehicle faults that could affect the performance of the Euro On-Board Diagnostic (EOBD) system has been compiled. These non-vehicle faults vary from environmental conditions to the quality of fuel used. With the introduction of EOBD across the entire passenger car, illumination of the Malfunction Indicator Lamp (MIL) due to a non-vehicle fault could lead to misdiagnosis of the vehicle, increased warranty expense and customer dissatisfaction. The following list of non-vehicle faults does not include every possible fault and may not apply equally to all product lines.

Fuel Quality

Fuel quality is not a new issue for the automotive industry, but its potential for turning on the MIL with EOBD systems is new.

Fuel additives such as “dry gas” and “octane enhancers” may affect the performance of the fuel. If this results in an incomplete combustion or a partial burn, it will set Diagnostic Trouble Code (DTC) P0300. The Reed Vapor Pressure of the fuel can also create problems in the fuel system, especially during the spring and fall months when severe ambient temperature swings occur. A high Reed Vapor Pressure could show up as a Fuel Trim DTC due to excessive canister loading.

Using fuel with the wrong octane rating for your vehicle may cause driveability problems. Many of the major fuel companies advertise that using “premium” gasoline will improve the performance of your vehicle. Most premium fuels use alcohol to increase the octane rating of the fuel. Although alcohol-enhanced fuels may raise the octane rating, the fuel's ability to turn into vapor in cold temperatures deteriorates. This may affect the starting ability and cold driveability of the engine.

Low fuel levels can lead to fuel starvation, lean engine operation, and eventually engine misfire.

Non-OEM Parts

The EOBD system has been calibrated to run with Original Equipment Manufacturer (OEM) parts. Something as simple as a high performance-exhaust system that affects exhaust system back pressure could potentially interfere with the operation of the Electric Exhaust Gas Recirculation (EEGR) valve and thereby turn on the MIL. Small leaks in the exhaust system near the heated oxygen sensor (HO2S) can also cause the MIL to turn on.

Aftermarket electronics, such as cellular phones, stereos, and anti-theft devices, may radiate Electromagnetic Interference (EMI) into the control system if they are improperly installed. This may cause a false sensor reading and turn on the MIL.

Environment

Temporary environmental conditions, such as localized flooding, will have an effect on the vehicle ignition system. If the ignition system is rain-soaked, it can temporarily cause engine misfire and turn on the MIL.

Vehicle Marshaling

The transportation of new vehicles from the assembly plant to the dealership can involve as many as 60 key cycles within 2 to 3 miles of driving. This type of operation contributes to the fuel fouling of the spark plugs and will turn on the MIL with a set DTC P0300.

Poor Vehicle Maintenance

The sensitivity of the EOBD will cause the MIL to turn on if the vehicle is not maintained properly. Restricted air filters, fuel filters, and crankcase deposits due to lack of oil changes or improper oil viscosity can trigger actual vehicle faults that were not previously monitored prior to EOBD. Poor vehicle maintenance can not be classified as a "non-vehicle fault," but with the sensitivity of the EOBD, vehicle maintenance schedules must be more closely followed.

Severe Vibration

The Misfire diagnostic measures small changes in the rotational speed of the crankshaft. Severe driveline vibrations in the vehicle, such as caused by an excessive amount of mud on the wheels, can have the same effect on crankshaft speed as misfire and, therefore, may set DTC P0300.

Related System Faults

Many of the EOBD system diagnostics will not run if the Engine Control Module (ECM) detects a fault on a related system or component. One example would be that if the ECM detected a Misfire fault, the diagnostics on the catalytic converter would be suspended until the Misfire fault was repaired. If the Misfire fault is severe enough, the catalytic converter can be damaged due to overheating and will never set a Catalyst DTC until the Misfire fault is repaired and the Catalyst diagnostic is allowed to run to completion. If this happens, the customer may have to make two trips to the dealership in order to repair the vehicle.

SERIAL DATA COMMUNICATIONS

Keyword 2000 Serial Data Communications

Government regulations require that all vehicle manufacturers establish a common communication system. This vehicle utilizes the "Keyword 2000" communication system. Each bit of information can have one of two lengths: long or short. This allows vehicle wiring to be reduced by transmitting and receiving multiple signals over a single wire. The messages carried on Keyword 2000 data streams are also prioritized. If two messages attempt to establish communications on the data line at the same time, only the message with higher priority will continue. The device with the lower priority message must wait. The most significant result of this regulation is that it provides scan tool manufacturers with the capability to access data from any make or model vehicle that is sold.

The data displayed on the other scan tool will appear the same, with some exceptions. Some scan tools will only be able to display certain vehicle parameters as values that are a coded representation of the true or actual value. On this vehicle, the scan tool displays the actual values for vehicle parameters. It will not be necessary to perform any conversions from coded values to actual values.

EURO ON-BOARD DIAGNOSTIC (EOBD)

Euro On-Board Diagnostic Tests

A diagnostic test is a series of steps, the result of which is a pass or fail reported to the diagnostic executive. When a diagnostic test reports a pass result, the diagnostic executive records the following data:

- The diagnostic test has been completed since the last ignition cycle.
- The diagnostic test has passed during the current ignition cycle.
- The fault identified by the diagnostic test is not currently active.

When a diagnostic test reports a fail result, the diagnostic executive records the following data:

- The diagnostic test has been completed since the last ignition cycle.

- The fault identified by the diagnostic test is currently active.
- The fault has been active during this ignition cycle.
- The operating conditions at the time of the failure.

Remember, a fuel trim Diagnostic Trouble Code (DTC) may be triggered by a list of vehicle faults. Make use of all information available (other DTCs stored, rich or lean condition, etc.) when diagnosing a fuel trim fault.

COMPREHENSIVE COMPONENT MONITOR DIAGNOSTIC OPERATION

Comprehensive component monitoring diagnostics are required to monitor emissions-related input and output powertrain components.

Input Components

Input components are monitored for circuit continuity and out-of-range values. This includes rationality checking. Rationality checking refers to indicating a fault when the signal from a sensor does not seem reasonable, i.e. Throttle Position (TP) sensor that indicates high throttle position at low engine loads or Manifold Absolute Pressure (MAP) voltage. Input components may include, but are not limited to, the following sensors:

- Vehicle Speed Sensor (VSS).
- Crankshaft Position (CKP) sensor.
- Throttle Position (TP) sensor.
- Engine Coolant Temperature (ECT) sensor.
- Camshaft Position (CMP) sensor.
- MAP sensor.

In addition to the circuit continuity and rationality check, the ECT sensor is monitored for its ability to achieve a steady state temperature to enable closed loop fuel control.

Output Components

Output components are diagnosed for proper response to control module commands. Components where functional monitoring is not feasible will be monitored for circuit continuity and out-of-range values if applicable. Output components to be monitored include, but are not limited to the following circuit:

- Idle Air Control (IAC) Motor.
- Controlled Canister Purge Valve.
- A/C relays.
- Cooling fan relay.
- VSS output.
- Malfunction Indicator Lamp (MIL) control.

Refer to *"Engine Control Module"* and the sections on Sensors in General Descriptions.

Passive and Active Diagnostic Tests

A passive test is a diagnostic test which simply monitors a vehicle system or component. Conversely, an active test, actually takes some sort of action when performing diagnostic functions, often in response to a failed passive test. For example, the Electric Exhaust Gas Recirculation (EEGR) diagnostic active test will force the EEGR valve open during closed throttle deceleration and/or force the EEGR valve closed during a steady state. Either action should result in a change in manifold pressure.

Intrusive Diagnostic Tests

This is any Euro On-Board test run by the Diagnostic Management System which may have an effect on vehicle performance or emission levels.

Warm-Up Cycle

A warm-up cycle means that engine at temperature must reach a minimum of 70°C (160°F) and rise at least 22°C (40°F) over the course of a trip.

Freeze Frame

Freeze Frame is an element of the Diagnostic Management System which stores various vehicle information at the moment an emissions-related fault is stored in memory and when the MIL is commanded on. These data can help to identify the cause of a fault.

Failure Records

Failure Records data is an enhancement of the EOBD Freeze Frame feature. Failure Records store the same vehicle information as does Freeze Frame, but it will store that information for any fault which is stored in Euro On-Board memory, while Freeze Frame stores information only for emission-related faults that command the MIL on.

COMMON EOBD TERMS

Diagnostic

When used as a noun, the word diagnostic refers to any Euro On-Board test run by the vehicle's Diagnostic Management System. A diagnostic is simply a test run on a system or component to determine if the system or component is operating according to specification. There are many diagnostics, shown in the following list:

- Misfire.
- Oxygen sensors (O2S)
- Heated oxygen sensor (HO2S)
- Electric Exhaust Gas Recirculation (EEGR)
- Catalyst monitoring

Enable Criteria

The term "enable criteria" is engineering language for the conditions necessary for a given diagnostic test to run. Each diagnostic has a specific list of conditions which must be met before the diagnostic will run.

"Enable criteria" is another way of saying "conditions required."

The enable criteria for each diagnostic is listed on the first page of the Diagnostic Trouble Code (DTC) description under the heading “Conditions for Setting the DTC.” Enable criteria varies with each diagnostic and typically includes, but is not limited to the following items:

- Engine speed.
- Vehicle speed
- Engine Coolant Temperature (ECT)
- Manifold Absolute Pressure (MAP)
- Barometric Pressure (BARO)
- Intake Air Temperature (IAT)
- Throttle Position (TP)
- High canister purge
- Fuel trim
- A/C on

Trip

Technically, a trip is a key-on run key-off cycle in which all the enable criteria for a given diagnostic are met, allowing the diagnostic to run. Unfortunately, this concept is not quite that simple. A trip is official when all the enable criteria for a given diagnostic are met. But because the enable criteria vary from one diagnostic to another, the definition of trip varies as well. Some diagnostics are run when the vehicle is at operating temperature, some when the vehicle first starts up; some require that the vehicle cruise at a steady highway speed, some run only when the vehicle is at idle. Some run only immediately following a cold engine start-up.

A trip then, is defined as a key-on run-key off cycle in which the vehicle is operated in such a way as to satisfy the enable criteria for a given diagnostic, and this diagnostic will consider this cycle to be one trip. However, another diagnostic with a different set of enable criteria (which were not met) during this driving event, would not consider it a trip. No trip will occur for that particular diagnostic until the vehicle is driven in such a way as to meet all the enable criteria.

Diagnostic Information

The diagnostic charts and functional checks are designed to locate a faulty circuit or component through a process of logical decisions. The charts are prepared with the requirement that the vehicle functioned correctly at the time of assembly and that there are not multiple faults present.

There is a continuous self-diagnosis on certain control functions. This diagnostic capability is complimented by the diagnostic procedures contained in this manual. The language of communicating the source of the malfunction is a system of diagnostic trouble codes. When a malfunction is detected by the control module, a DTC is set, and the Malfunction Indicator Lamp (MIL) is illuminated.

Malfunction Indicator Lamp (MIL)

The Malfunction Indicator Lamp (MIL) is required by Euro On-Board Diagnostics (EOBD) to illuminate under a strict set of guidelines.

Basically, the MIL is turned on when the Engine Control Module (ECM) detects a DTC that will impact the vehicle emissions.

The MIL is under the control of the Diagnostic Executive. The MIL will be turned on if an emissions-related diagnostic test indicates a malfunction has occurred. It will stay on until the system or component passes the same test for three consecutive trips with no emissions related faults.

Extinguishing the MIL

When the MIL is on, the Diagnostic Executive will turn off the MIL after three consecutive trips that a “test passed” has been reported for the diagnostic test that originally caused the MIL to illuminate. Although the MIL has been turned off, the DTC will remain in the ECM memory (both Freeze Frame and Failure Records) until forty (40) warm-up cycles after no faults have been completed.

If the MIL was set by either a fuel trim or misfire-related DTC, additional requirements must be met. In addition to the requirements stated in the previous paragraph, these requirements are as follows:

- The diagnostic tests that are passed must occur with 375 rpm of the rpm data stored at the time the last test failed.
- Plus or minus ten percent of the engine load that was stored at the time the last test failed. Similar engine temperature conditions (warmed up or warming up) as those stored at the time the last test failed.

Meeting these requirements ensures that the fault which turned on the MIL has been corrected.

The MIL is on the instrument panel and has the following functions:

- It informs the driver that a fault affecting the vehicle’s emission levels has occurred and that the vehicle should be taken for service as soon as possible.
- As a system check, the MIL will come on with the key ON and the engine not running. When the engine is started, the MIL will turn OFF.
- When the MIL remains ON while the engine is running, or when a malfunction is suspected due to a driveability or emissions problem, an EOBD System Check must be performed. The procedures for these checks are given in EOBD System Check. These checks will expose faults which may not be detected if other diagnostics are performed first.

Data Link Connector (DLC)

The provision for communicating with the control module is the Data Link Connector (DLC). The DLC is used to connect to a scan tool. Some common uses of the scan tool are listed below:

- Identifying stored DTCs.
- Clearing DTCs.
- Performing output control tests.
- Reading serial data.

DTC TYPES

Each Diagnostic Trouble Code (DTC) is directly related to a diagnostic test. The Diagnostic Management System sets DTCs based on the failure of the tests during a trip or trips. Certain tests must fail two consecutive trips before the DTC is set. The following are the three types of DTCs and the characteristics of those codes:

Type A

- Emissions related.
- Requests illumination of the Malfunction Indicator. Lamp (MIL) of the first trip with a fail.
- Stores a History DTC on the first trip with a fail.
- Stores a Freeze Frame (if empty).
- Stores a Fail Record.
- Updates the Fail Record each time the diagnostic test fails.

Type B

- Emissions related.
- “Armed” after one trip with a fail.
- “Disarmed” after one trip with a pass.
- Requests illumination of the MIL on the second consecutive trip with a fail.
- Stores a History DTC on the second consecutive trip with a fail (The DTC will be armed after the first fail).
- Stores a Freeze Frame on the second consecutive trip with a fail (if empty).

Type Cnl

- Non-Emissions related.
- Does not request illumination of any lamp.
- Stores a History DTC on the first trip with a fail .
- Does not store a Freeze Frame.
- Stores Fail Record when test fails.
- Updates the Fail Record each time the diagnostic test fails.

Type E

- Emissions related.
- “Armed” after two consecutive trip with a fail.
- “Disarmed” after one trip with a pass.
- Requests illumination of the MIL on the third consecutive trip with a fail.
- Stores a History DTC on the third consecutive trip with a fail (The DTC will be armed after the second fail).
- Stores a Freeze Frame on the third consecutive trip with a fail (if empty).

Important: For 0.8 SOHC engine eight fail records can be stored. Each Fail Record is for a different DTC. It is possible that there will not be Fail Records for every DTC if multiple DTCs are set.

Special Cases of Type B Diagnostic Tests

Unique to the misfire diagnostic, the Diagnostic Executive has the capability of alerting the vehicle operator to potentially damaging levels of misfire. If a misfire condition exists that could potentially damage the catalytic converter as a result of high misfire levels, the Diagnostic Executive will command the MIL to “flash” as a rate of once per seconds during those the time that the catalyst damaging misfire condition is present.

Fuel trim and misfire are special cases of Type B diagnostics. Each time a fuel trim or misfire malfunction is detected, engine load, engine speed, and Engine Coolant Temperature (ECT) are recorded.

When the ignition is turned OFF, the last reported set of conditions remain stored. During subsequent ignition cycles, the stored conditions are used as a reference for similar conditions. If a malfunction occurs during two consecutive trips, the Diagnostic Executive treats the failure as a normal Type B diagnostic, and does not use the stored conditions. However, if a malfunction occurs on two non-consecutive trips, the stored conditions are compared with the current conditions. The MIL will then illuminate under the following conditions:

- When the engine load conditions are within 10% of the previous test that failed.
- Engine speed is within 375 rpm, of the previous test that failed.
- ECT is in the same range as the previous test that failed.

READING DIAGNOSTIC TROUBLE CODES

The procedure for reading Diagnostic Trouble Code(s) (DTC) is to use a diagnostic scan tool. When reading DTC(s), follow instructions supplied by tool manufacturer.

Clearing Diagnostic Trouble Codes

Important: Do not clear DTCs unless directed to do so by the service information provided for each diagnostic procedure. When DTCs are cleared, the Freeze Frame and Failure Record data which may help diagnose an intermittent fault will also be erased from memory. If the fault that caused the DTC to be stored into memory has been corrected, the Diagnostic Executive will begin to count the "warm-up" cycles with no further faults detected, the DTC will automatically be cleared from the Engine Control Module (ECM) memory.

To clear DTCs, use the diagnostic scan tool.

It can't cleared DTCs without the diagnostic scan tool. So you must use the diagnostic scan tool.

Notice: To prevent system damage, the ignition key must be OFF when disconnecting or reconnecting battery power.

- The power source to the control module. Examples: fuse, pigtail at battery ECM connectors, etc.
- The negative battery cable. (Disconnecting the negative battery cable will result in the loss of other Euro On-Board memory data, such as preset radio tuning.)

DTC Modes

On Euro On-Board Diagnostic (EOBD) passenger cars there are five options available in the scan tool DTC mode to display the enhanced information available. A description of the new modes, DTC Info and Specific DTC, follows. After selecting DTC, the following menu appears:

- DTC Info.
- Specific DTC.
- Freeze Frame.
- Fail Records (not all applications).
- Clear Info.

The following is a brief description of each of the sub menus in DTC Info and Specific DTC. The order in which they appear here is alphabetical and not necessarily the way they will appear on the scan tool.

DTC Information Mode

Use the DTC info mode to search for a specific type of stored DTC information. There are seven choices. The service manual may instruct the technician to test for DTCs in a certain manner. Always follow published service procedures.

To get a complete description of any status, press the "Enter" key before pressing the desired F-key. For example, pressing "Enter" then an F-key will display a definition of the abbreviated scan tool status.

DTC Status

This selection will display any DTCs that have not run during the current ignition cycle or have reported a test failure during this ignition up to a maximum of 33 DTCs. DTC tests which run and pass will cause that DTC number to be removed from the scan tool screen.

Fail This Ign. (Fail This Ignition)

This selection will display all DTCs that have failed during the present ignition cycle.

History

This selection will display only DTCs that are stored in the ECM's history memory. It will not display Type B DTCs that have not requested the Malfunction Indicator Lamp (MIL). It will display all type A, B and E DTCs that have requested the MIL and have failed within the last 40 warm-up cycles. In addition, it will display all type C and type D DTCs that have failed within the last 40 warm-up cycles.

Last Test Fail

This selection will display only DTCs that have failed the last time the test ran. The last test may have run during a previous ignition cycle if a type A or type B DTC is displayed. For type C and type D DTCs, the last failure must have occurred during the current ignition cycle to appear as Last Test Fail.

MIL Request

This selection will display only DTCs that are requesting the MIL. Type C and type D DTCs cannot be displayed using this option. This selection will report type B and E DTCs only after the MIL has been requested.

Not Run SCC (Not Run Since Code Clear)

This option will display up to 33 DTCs that have not run since the DTCs were last cleared. Since the displayed DTCs have not run, their condition (passing or failing) is unknown.

Test Fail SCC (Test Failed Since Code Clear)

This selection will display all active and history DTCs that have reported a test failure since the last time DTCs were cleared. DTCs that last failed more than 40 warm-up cycles before this option is selected will not be displayed.

Specific DTC Mode

This mode is used to check the status of individual diagnostic tests by DTC number. This selection can be accessed if a DTC has passed, failed or both. Many EOBD DTC mode descriptions are possible because of the extensive amount of information that the diagnostic executive monitors regarding each test. Some of the many possible descriptions follow with a brief explanation.

The "F2" key is used, in this mode, to display a description of the DTC. The "Yes" and "No" keys may also be used to display more DTC status information. This selection will only allow entry of DTC numbers that are supported by the vehicle being tested. If an attempt is, made to enter DTC numbers for tests which the diagnostic executive does not recognize, the requested information will not be displayed correctly and the scan tool may display an error message. The same applies to using the DTC trigger option in the Snapshot mode. If an invalid DTC is entered, the scan tool will not trigger.

Failed Last Test

This message display indicates that the last diagnostic test failed for the selected DTC. For type A, B and E DTCs, this message will be displayed during subsequent ignition cycles until the test passes or DTCs are cleared. For type C and type D DTCs, this message will clear when the ignition is cycled.

Failed Since Clear

This message display indicates that the DTC has failed at least once within the last 40 warm-up cycles since the last time DTCs were cleared.

Failed This Ig. (Failed This Ignition)

This message display indicates that the diagnostic test has failed at least once during the current ignition cycle. This message will clear when DTCs are cleared or the ignition is cycled.

History DTC

This message display indicates that the DTC has been stored in memory as a valid fault. A DTC displayed as a History fault may not mean that the fault is no longer present. The history description means that all the conditions necessary for reporting a fault have been met (maybe even currently), and the information was stored in the control module memory.

MIL Requested

This message display indicates that the DTC is currently causing the MIL to be turned ON. Remember that only type A B and E DTCs can request the MIL. The MIL request cannot be used to determine if the DTC fault conditions are currently being experienced. This is because the diagnostic executive will require up to three trips during which the diagnostic test passes to turn OFF the MIL.

Not Run Since CI (Not Run Since Cleared)

This message display indicates that the selected diagnostic test has not run since the last time DTCs were cleared. Therefore, the diagnostic test status (passing or failing) is unknown. After DTCs are cleared, this message will continue to be displayed until the diagnostic test runs.

Not Run This Ig. (Not Run This Ignition)

This message display indicates that the selected diagnostic test has not run during this ignition cycle.

Test Ran and Passed

This message display indicates that the selected diagnostic test has done the following:

- Passed the last test.
- Run and passed during this ignition cycle.
- Run and passed since DTCs were last cleared.

If the indicated status of the vehicle is “Test Ran and Passed” after a repair verification, the vehicle is ready to be released to the customer.

If the indicated status of the vehicle is “Failed This Ignition” after a repair verification, then the repair is incomplete and further diagnosis is required.

Prior to repairing a vehicle, status information can be used to evaluate the state of the diagnostic test, and to help identify an intermittent problem. The technician can conclude that although the MIL is illuminated, the fault condition that caused the code to set is not present. An intermittent condition must be the cause.

PRIMARY SYSTEM-BASED DIAGNOSTICS

There are primary system-based diagnostics which evaluate the system operation and its effect on vehicle emissions. The primary system-based diagnostics are listed below with a brief description of the diagnostic function:

Oxygen Sensor Diagnosis

The fuel control oxygen sensor (O2S) is diagnosed for the following conditions:

- Few switch count (rich to lean or lean to rich).
- Slow response (average transient time lean to rich or rich to lean).
- Response time ratio (ratio of average transient time rich(lean) to lean(rich)).
- Inactive signal (output steady at bias voltage approximately 450 mV).
- Signal fixed high.
- Signal fixed low.

The catalyst monitor heated oxygen sensor (HO2S) is diagnosed for the following conditions:

- Heater performance (current during IGN on).
- Signal fixed low during steady state conditions or power enrichment (hard acceleration when a rich mixture should be indicated).
- Signal fixed high during steady state conditions or deceleration mode (deceleration when a lean mixture should be indicated).
- Inactive sensor (output steady at approx. 438 mV).

If the O2S pigtail wiring, connector or terminal are damaged, the entire O2S assembly must be replaced. Do not attempt to repair the wiring, connector or terminals. In order for the sensor to function properly, it must have clean reference air provided to it. This clean air reference is obtained by way of the O2S wire(s). Any attempt to repair the wires, connector or terminals could result in the obstruction of the reference air and degrade the O2S performance.

Misfire Monitor Diagnostic Operation

The misfire monitor diagnostic is based on crankshaft rotational velocity (reference period) variations. The Engine Control Module (ECM) determines crankshaft rotational velocity using the Crankshaft Position (CKP) sensor and the Camshaft Position (CMP) sensor. When a cylinder misfires, the crankshaft slows down momentarily. By monitoring the CKP and CMP sensor signals, the ECM can calculate when a misfire occurs.

For a non-catalyst damaging misfire, the diagnostic will be required to monitor a misfire present for between 1000–3200 engine revolutions.

For catalyst-damaging misfire, the diagnostic will respond to misfire within 200 engine revolutions.

Rough roads may cause false misfire detection. A rough road will cause torque to be applied to the drive wheels and drive train. This torque can intermittently decrease the crankshaft rotational velocity. This may be falsely detected as a misfire.

A rough road sensor, or “G sensor,” works together with the misfire detection system. The rough road sensor produces a voltage that varies along with the intensity of road vibrations. When the ECM detects a rough road, the misfire detection system is temporarily disabled.

Misfire Counters

Whenever a cylinder misfires, the misfire diagnostic counts the misfire and notes the crankshaft position at the time the misfire occurred. These “misfire counters” are basically a file on each engine cylinder. A current and a history misfire counter are maintained for each cylinder. The misfire current counters (Misfire Current #1–4) indicate the number of firing events out of the last 200 cylinder firing events which were misfires. The misfire current counter will display real time data without a misfire DTC stored. The misfire history counters (Misfire Histtory #1–4) indicate the total number of cylinder firing events which were misfires. The misfire history counters will display 0 until the misfire diagnostic has failed and a DTC P0300 is set. Once the misfire DTC P0300 is set, the misfire history counters will be updated every 200 cylinder firing events. A misfire counter is maintained for each cylinder.

If the misfire diagnostic reports a failure, the diagnostic executive reviews all of the misfire counters before reporting a DTC. This way, the diagnostic executive reports the most current information.

When crankshaft rotation is erratic, a misfire condition will be detected. Because of this erratic condition, the data that is collected by the diagnostic can sometimes incorrectly identify which cylinder is misfiring.

Use diagnostic equipment to monitor misfire counter data on EOBD compliant vehicles. Knowing which specific cylinder(s) misfired can lead to the root cause, even when dealing with a multiple cylinder misfire. Using the information in the misfire counters, identify which cylinders are misfiring. If the counters indicate cylinders numbers 1 and 4 misfired, look for a circuit or component common to both cylinders number 1 and 4.

The misfire diagnostic may indicate a fault due to a temporary fault not necessarily caused by a vehicle emission system malfunction. Examples include the following items:

- Contaminated fuel.
- Low fuel.
- Fuel-fouled spark plugs.
- Basic engine fault.

Fuel Trim System Monitor Diagnostic Operation

This system monitors the averages of short-term and long-term fuel trim values. If these fuel trim values stay at their limits for a calibrated period of time, a malfunction is indicated. The fuel trim diagnostic compares the averages of short-term fuel trim values and long-term fuel trim values to rich and lean thresholds. If either value is within the thresholds, a pass is recorded. If both values are outside their thresholds, a rich or lean DTC will be recorded.

The fuel trim system diagnostic also conducts an intrusive test. This test determines if a rich condition is being caused by excessive fuel vapor from the controlled charcoal canister. In order to meet EOBD requirements, the control module uses weighted fuel trim cells to determine the need to set a fuel trim DTC. A fuel trim DTC can only be set if fuel trim counts in the weighted fuel trim cells exceed specifications. This means that the vehicle could have a fuel trim problem which is causing a problem under certain conditions (i.e., engine idle high due to a small vacuum leak or rough idle due to a large vacuum leak) while it operates fine at other times. No fuel trim DTC would set (although an engine idle speed DTC or HO2S DTC may set). Use a scan tool to observe fuel trim counts while the problem is occurring.

A fuel trim DTC may be triggered by a number of vehicle faults. Make use of all information available (other DTCs stored, rich or lean condition, etc.) when diagnosing a fuel trim fault.

Fuel Trim Cell Diagnostic Weights

No fuel trim DTC will set regardless of the fuel trim counts in cell 0 unless the fuel trim counts in the weighted cells are also outside specifications. This means that the vehicle could have a fuel trim problem which is causing a problem under certain conditions (i.e. engine idle high due to a small vacuum leak or rough due to a large vacuum leak) while it operates fine at other times. No fuel trim DTC would set (although an engine idle speed DTC or HO2S DTC may set). Use a scan tool to observe fuel trim counts while the problem is occurring.

DIAGNOSTIC INFORMATION AND PROCEDURES

SYSTEM DIAGNOSIS

DIAGNOSTIC AIDS

If an intermittent problem is evident, follow the guidelines below.

Preliminary Checks

Before using this section you should have already performed the "Euro On-Board Diagnostic (EOBD) System Check."

Perform a thorough visual inspection. This inspection can often lead to correcting a problem without further checks and can save valuable time. Inspect for the following conditions:

- Engine Control Module (ECM) grounds for being clean, tight, and in their proper location.
- Vacuum hoses for splits, kinks, collapsing and proper connections as shown on the Vehicle Emission Control Information label. Inspect thoroughly for any type of leak or restriction.
- Air leaks at the throttle body mounting area and the intake manifold sealing surfaces.
- Ignition wires for cracks, hardness, proper routing, and carbon tracking.
- Wiring for proper connections.
- Wiring for pinches or cuts.

Diagnostic Trouble Code Tables

Do not use the Diagnostic Trouble Code (DTC) tables to try and correct an intermittent fault. The fault must be present to locate the problem.

Incorrect use of the DTC tables may result in the unnecessary replacement of parts.

Faulty Electrical Connections or Wiring

Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful inspection of suspect circuits for the following:

- Poor mating of the connector halves.
- Terminals not fully seated in the connector body.
- Improperly formed or damaged terminals. All connector terminals in a problem circuit should be carefully inspected, reformed, or replaced to insure contact tension.
- Poor terminal-to-wire connection. This requires removing the terminal from the connector body.

Road Test

If a visual inspection does not find the cause of the problem, the vehicle can be driven with a voltmeter or a scan tool connected to a suspected circuit. An abnormal voltage or scan tool reading will indicate that the problem is in that circuit.

If there are no wiring or connector problems found and a DTC was stored for a circuit having a sensor, except for DTC P0171 and DTC P0172, replace the sensor.

Intermittent Malfunction Indicator Lamp (MIL)

An intermittent Malfunction Indicator Lamp(MIL) with no DTC present may be caused by the following:

- Improper installation of electrical options such as lights, two way radios, sound, or security systems.
- MIL driver wire intermittently shorted to ground.

Fuel System

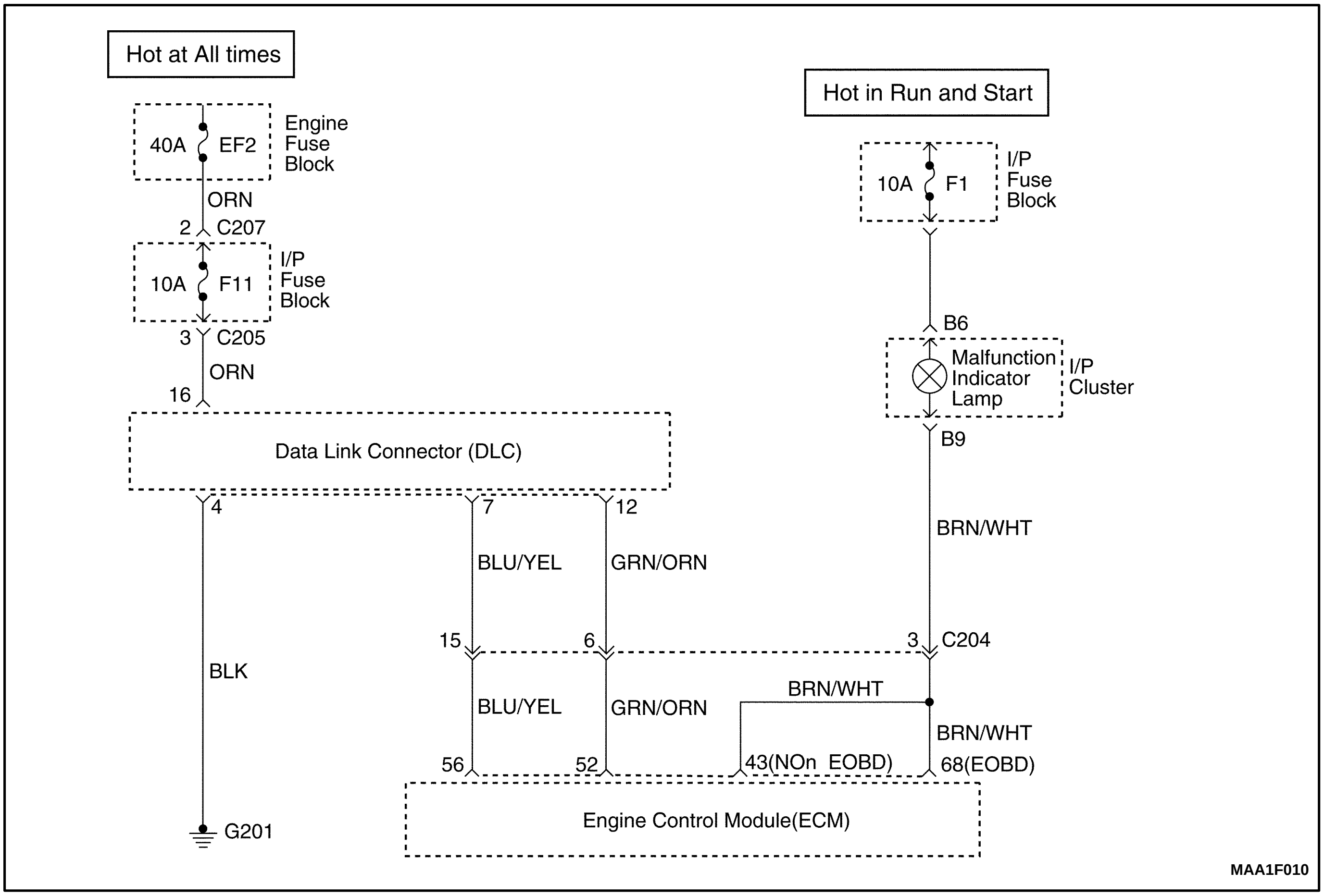
Some intermittent driveability problems can be attributed to poor fuel quality. If a vehicle is occasionally running rough, stalling, or otherwise performing badly, ask the customer about the following fuel buying habits:

- Do they always buy from the same source? If so, fuel quality problems can usually be discounted.
- Do they buy their fuel from whichever fuel station that is advertising the lowest price? If so, check the fuel tank for signs of debris, water, or other contamination.

IDLE LEARN PROCEDURE

Whenever the battery cables, the Engine Control Module (ECM), or the fuse is disconnected or replaced, the following idle learn procedure must be performed:

1. Turn the ignition ON for 10 seconds.
2. Turn the ignition OFF for 10 seconds.



EURO ON-BOARD DIAGNOSTIC (EOBD) SYSTEM CHECK

Circuit Description

The Euro On-Board Diagnostic (EOBD) System Check is the starting point for any driveability complaint diagnosis. Before using this procedure, perform a careful visual/physical check of the Engine Control Module (ECM) and the engine grounds for cleanliness and tightness.

The EOBD system check is an organized approach to identifying a problem created by an electronic engine control system malfunction.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed-through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connections for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connections, and damaged harness.

Euro On-Board Diagnostic (EOBD) System Check

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition ON with the engine OFF. 2. Observe the Malfunction Indicator Lamp (MIL). Is the MIL on?	–	Go to *Step 2*	Go to “No Malfunction Indicator Lamp”
2	1. Turn the ignition OFF. 2. Install the scan tool. 3. Turn the ignition ON. 4. Attempt to display the Engine Control Module (ECM) engine data with the scan tool. Does the scan tool display the ECM engine data?	–	Go to *Step 3*	Go to *Step 8*
3	1. Using the scan tool output test function, select the MIL lamp control and command the MIL off. 2. Observe the MIL. Does the MIL turn off?	–	Go to *Step 4*	Go to “Malfunction Indicator Lamp on Steady”
4	Attempt to start the engine. Does the engine start and continue to run?	–	Go to *Step 5*	Go to “Engine Cranks But Will Not Run”
5	Select DISPLAY DTC with the scan tool. Are any Diagnostic Trouble Codes stored?	–	Go to *Step 6*	Go to *Step 7*
6	Check the display for DTCs P0107, P0108, P0113, P0118, P0122, P0123, P0172, P1392. Are two or more of the following DTCs stored?	–	Go to “Multiple ECM Information Sensor DTCs Set”	Go to applicable DTC table
7	Compare the ECM data values displayed on the scan tool to the typical engine scan data values. Are the displayed values normal or close to the typical values?	–	Go to “ECM Output Diagnosis”	Go to indicated component system check
8	1. Turn the ignition OFF and disconnect the ECM. 2. Turn the ignition ON with the engine OFF. 3. Check the serial data circuit for an open, short to ground, or short to voltage. Also check the Data Link Connector (DLC) ignition feed circuit for an open or short to ground, and check the DLC ground circuits for an open. Is a problem found?	–	Go to *Step 9*	Go to *Step 10*
9	Repair the open, short to ground, or short to voltage in the serial data circuit or the DLC ignition feed circuit. Is the repair complete?	–	System OK	–
10	1. Attempt to reprogram the ECM. 2. Attempt to display the ECM data with the scan tool. Does the scan tool display ECM engine data?	–	Go to *Step 2*	Go to *Step 11*
11	Replace the ECM. Is the repair complete?	–	System OK	–

ECM OUTPUT DIAGNOSIS

Circuit Description

The Engine Control Module (ECM) controls most components with electronic switches which complete a ground circuit when turned on. These switches are arranged in groups of 4 and 7, and they are called either a Surface Mounted Quad Driver Module, which can independently control up to 4 output terminals or an Output Driver Module (ODM), which can independently control up to 7 outputs. Not all of the outputs are always used.

Drivers are fault protected. If a relay or solenoid is shorted, having very low or zero resistance, or if the control side of the circuit is shorted to voltage, it would allow too much current flow into the ECM. The driver senses this and the output is either turned OFF or its internal resistance increases to limit current flow and protect the ECM and driver. The result is high output terminal voltage when it should be low. If the circuit from B+ to the component or the component is open, or the control side of the circuit is shorted to ground, terminal voltage will be low. Either of these conditions is considered to be a driver fault.

Drivers also have a fault line to indicate the presence of a current fault to the ECM's central processor. A scan tool displays the status of the driver fault lines as 0=OK and 1=Fault.

Diagnostic Aids

The scan tool has the ability to command certain components and functions ON and OFF. If a component or function does not have this capability, operate the vehicle during its normal function criteria to check for an open or shorted circuit.

An open or short to ground will appear in the open positions on the scan tool only when it is not commanded by the ECM or the scan tool, while a short to voltage will appear in the short positions on the scan tool only while the component is being commanded by the ECM or scan tool.

ECM Output Diagnosis

Step	Action	Value(s)	Yes	No
1	Perform an Euro On-Board Diagnostic (EOBD) System Check. Is the check complete.	–	Go to *Step 2*	Go to "Euro On-Board Diagnostic System Check"
2	Install the scan tool. Is there a number 1 (=fault) below any of the numbered positions in the OUTPUT DRIVERS?	–	Go to *Step 3*	Go to *Step 4*
3	Check for an open or shorted circuit in any corresponding position (circuit) that contained a number 1 and repair as necessary. Is a repair necessary?	–	Go to *Step 9*	Go to *Step 7*
4	Command the output being checked with a scan tool while watching the corresponding position for each circuit. Do any of the position changed to a 1?	–	Go to *Step 6*	Go to *Step 5*
5	Command the output being checked with a scan tool while watching the corresponding position for each circuit. Does the component or function operate when commanded?	–	Go to *Step 9*	Go to the appropriate component table for repair
6	Repair the short to voltage in the corresponding circuit for position (circuit) that displayed at a 1. Is the repair complete?	–	Go to *Step 9*	–
7	Disconnect the electrical connector to the component connected to the fault circuit. Is a 1 still displayed in the corresponding OUTPUT DRIVER position?	–	Go to *Step 8*	Go to the appropriate component table for repair
8	Replace the Engine control Module (ECM). Is the repair complete?	–	Go to *Step 9*	–
9	Operate the vehicle within the conditions under which the original symptom was noted. Does the system now operate properly?	–	System OK	Go to *Step 2*

MULTIPLE ECM INFORMATION SENSOR DTCS SET

Circuit Description

The Engine Control Module (ECM) monitors various sensors to determine engine operating conditions. The ECM controls fuel delivery, spark advance, transaxle operation, and emission control device operation based on the sensor inputs.

The ECM provides a sensor ground to all of the sensors. The ECM applies 5 volts through a pull-up resistor and monitors the voltage present between the sensor and the resistor to determine the status of the Engine Coolant Temperature (ECT) sensor, the Intake Air Temperature (IAT) sensor. The ECM provides the Electric Exhaust Gas Recirculation (EEGR) Pintle Position Sensor, the Throttle Position (TP) sensor, the Manifold Absolute Pressure (MAP) sensor, and the Fuel Tank Pressure Sensor with a 5 volt reference and a sensor ground signal. The ECM monitors the separate feedback signals from these sensors to determine their operating status.

Diagnostic Aids

Be sure to inspect the ECM and the engine grounds for being secure and clean.

A short to voltage in one of the sensor circuits can cause one or more of the following DTCs to be set: P0108, P0113, P0118, P0123, P1106.

If a sensor input circuit has been shorted to voltage, ensure that the sensor is not damaged. A damaged sensor will continue to indicate a high or low voltage after the affected circuit has been repaired. If the sensor has been damaged, replace it.

An open in the sensor ground circuit between the ECM and the splice will cause one or more of the following DTCs to be set: P0108, P0113, P0118, P0123, P1106.

A short to ground in the 5 volt reference circuit or an open in the 5 volt reference circuit between the ECM and the splice will cause one or more of the following DTCs to be set: P0107, P0112, P0117, P0122, P1107.

Check for the following conditions:

- Inspect for a poor connection at the ECM. Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Inspect the wiring harness for damage. If the harness appears to be OK, observe an affected sensor's displayed value on the scan tool with the ignition ON and the engine OFF while moving connectors and wiring harnesses related to the affected sensors. A change in the affected sensor's displayed value will indicate the location of the fault.

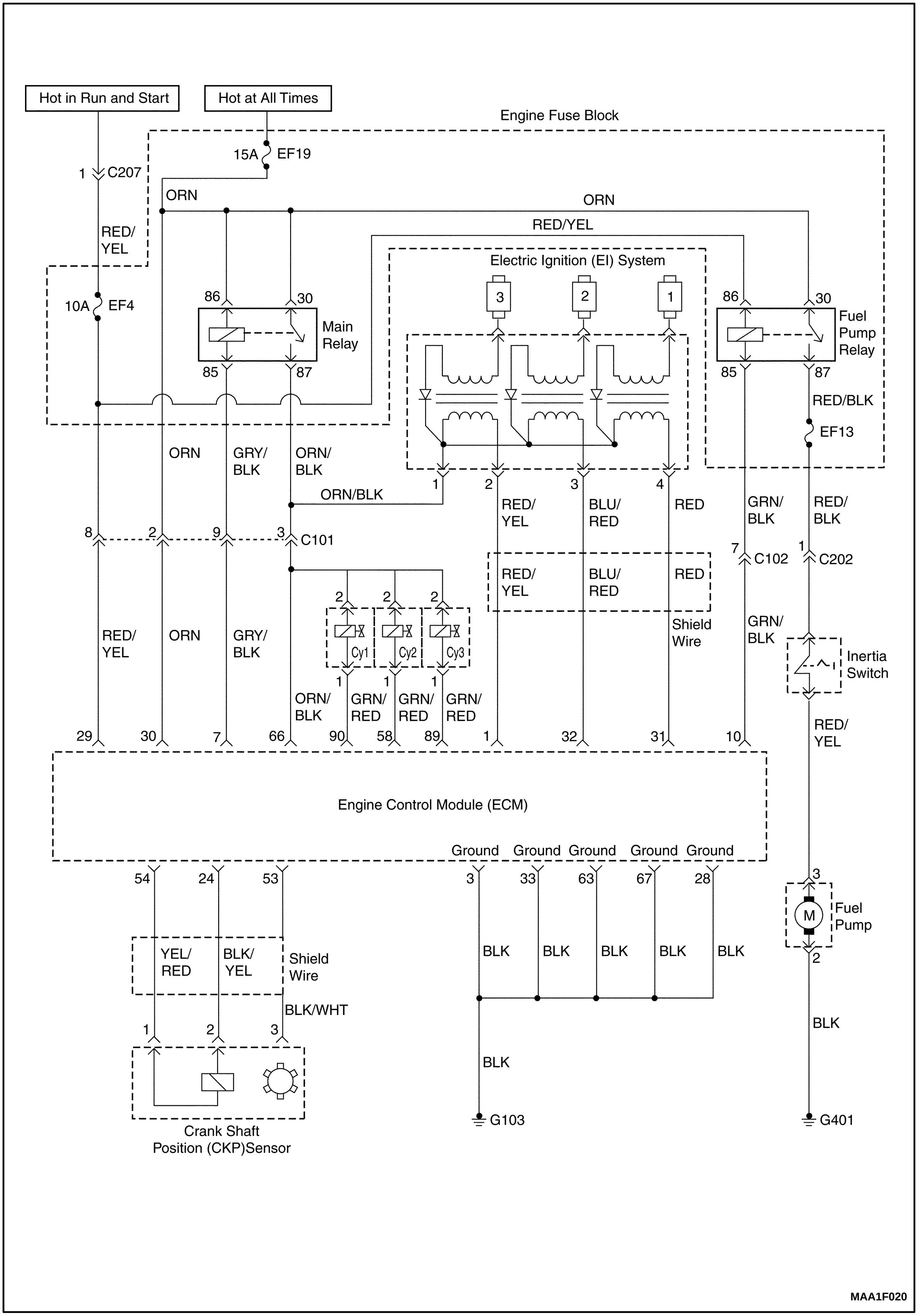
Multiple ECM Information Sensor DTCs Set

Step	Action	Value(s)	Yes	No
1	Perform an Euro On-Board Diagnostic (EOBD) System Check. Is the check complete.	–	Go to *Step 2*	Go to "Euro On-Board Diagnostic System Check"
2	1. Turn the ignition OFF and disconnect the Engine Control Module (ECM). 2. Turn the ignition ON and check the 5 volt reference circuit for the following conditions: • Poor connection at the ECM. • Open between the ECM connector affected sensors shorted to ground or voltage. 3. If a problem is found, locate and repair the open or short circuit as necessary. Is a problem found?	–	Go to *Step 19*	Go to *Step 3*
3	1. Check the sensor ground circuit for the following conditions: • Poor connection at the ECM or affected sensors. • Open between the ECM connector and the affected sensors. 2. If a problem is found, repair it as necessary. Is a problem found?	–	Go to *Step 19*	Go to *Step 4*
4	Measure the voltage of the Electric Exhaust Gas Recirculation (EEGR) Pintle Position Sensor signal circuit between ECM harness connector and ground. Does the voltage measure near the specified value?	0 V	Go to *Step 5*	Go to *Step 9*
5	Measure the voltage of the Manifold Absolute Pressure (MAP) sensor signal circuit between the ECM harness connector and ground. Does the voltage measure near the specified value?	0 V	Go to *Step 6*	Go to *Step 11*
6	Measure the voltage of the Throttle Position (TP) sensor signal circuit between the ECM harness connector and ground. Does the voltage measure near the specified value?	0 V	Go to *Step 7*	Go to *Step 12*
7	Measure the voltage of the Intake Air Temperature (IAT) sensor signal circuit between the ECM harness connector and ground. Does the voltage measure near the specified value?	0 V	Go to *Step 8*	Go to *Step 13*
8	Measure the voltage of the Engine Coolant Temperature (ECT) sensor signal circuit between the ECM harness connector and ground. Does the voltage measure near the specified value?	0 V	Go to *Step 16*	Go to *Step 14*
9	1. Disconnect the EEGR valve. 2. Measure the voltage of the EEGR Pintle Position sensor signal circuit between the ECM harness connector and ground. Does the voltage measure near the specified value?	0 V	Go to *Step 10*	Go to *Step 15*
10	Replace the EEGR valve. Is the repair complete?	–	Go to *Step 19*	–
11	Locate and repair the short to voltage in the MAP sensor signal circuit. Is the repair complete?	–	Go to *Step 19*	–

Multiple ECM Information Sensor DTCs Set (Cont'd)

Step	Action	Value(s)	Yes	No
12	Locate and repair the short to voltage in the TP sensor signal circuit. Is the repair complete?	–	Go to *Step 19*	–
13	Locate and repair the short to voltage in the IAT sensor signal circuit. Is the repair complete?	–	Go to *Step 19*	–
14	Locate and repair the short to voltage in the ECT sensor signal circuit. Is the repair complete?	–	Go to *Step 19*	–
15	Locate and repair the short to voltage in the EEGR Pintle Position sensor circuit. Is the repair complete?	–	Go to *Step 19*	–
16	Measure the voltage of the Fuel Tank Pressure sensor signal circuit between the ECM harness connector and ground. Does the voltage measure near the specified value?	0 V	Go to *Step 18*	Go to *Step 17*
17	Locate and repair the short to voltage in the Fuel Tank Pressure sensor signal circuit. Is the repair complete?	–	Go to *Step 19*	–
18	Replace the ECM. Is the repair complete?	–	Go to *Step 19*	–
19	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting the DTCs as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 20*	Go to *Step 2*
20	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to Applicable DTC table	System OK

ENGINE CRANKS BUT WILL NUT RUN



ENGINE CRANKS BUT WILL NOT RUN

Caution: Use only electrically insulated pliers when handling ignition wires with the engine running to prevent an electrical shock.

Caution: Do not pinch or restrict nylon fuel lines. Damage to the lines could cause a fuel leak, resulting in possible fire or personal injury.

Important: If a no start condition exists, ensure the fuel cutoff switch has not been tripped prior to further diagnosis.

Engine Cranks But Will Not Run

Step	Action	Value(s)	Yes	No
1	Perform an Euro On-Board Diagnostic (EOBD) System Check. Is the check complete.	–	Go to *Step 2*	Go to "Euro On-Board Diagnostic System Check"
2	Crank the engine. Does the engine start and continue to run?	–	System Ok	Go to *Step 3*
3	Perform a cylinder compression test. Is the cylinder compression for all of the cylinders at or above the value specified?	1250 kPa (181 psi)	Go to *Step 7*	Go to *Step 4*
4	Inspect the timing belt alignment. Is the timing belt in alignment?	–	Go to *Step 6*	Go to *Step 5*
5	Align or replace the timing belt as needed. Is the repair complete?	–	Go to *Step 2*	–
6	Repair internal engine damage as needed. Is the repair complete?	–	Go to *Step 2*	–
7	Inspect the fuel pump fuse. Is the problem found?	–	Go to *Step 8*	Go to *Step 9*
8	Replace the fuse. Is the repair complete?	–	Go to *Step 2*	–
9	Check for the presence of spark from all of the ignition wires while cranking the engine. Is spark present from all of the ignition wires?	–	Go to *Step 23*	Go to *Step 10*
10	1. Measure the resistance of the ignition wires. 2. Replace any of the ignition wire(s) with a resistance above the value specified. 3. Check for the presence of spark from all of the ignition wire. Is spark present from all of the ignition wires?	5 kΩ	Go to *Step 2*	Go to *Step 11*
11	1. Turn the ignition OFF. 2. Disconnect the crankshaft position (CKP) sensor connector. 3. Turn the ignition ON. 4. Measure the voltage between following terminals: ● Terminal 1 and 3 of the CKP sensor connector. ● Terminal 2 and 3 of the CKP sensor connector. ● Terminal 1 of the CKP sensor connector and ground. ● Terminal 2 of the CKP sensor connector and ground. Are the voltage measure within the value specified?	≈ 0.4 V	Go to *Step 13*	Go to *Step 12*

Engine Cranks But Will Not Run (Cont'd)

Step	Action	Value(s)	Yes	No
12	Check for an open or short in the wires between CKP sensor connector and ECM connector and repair as need. Is the repair complete?	–	Go to *Step 2*	–
13	1. Disconnect electronic Ignition (EI) system ignition coil connector to prevent the vehicle from starting. 2. Measure the voltage at ECM connector terminal 24 and 54 by backprobing the ECM connector. Are the voltage readings near the value specified?	0.4 V with ignition ON, 2.0 V during cranking	Go to *Step 15*	Go to *Step 14*
14	Replace the CKP sensor. Is the repair complete?	–	Go to *Step 2*	–
15	1. Turn the ignition OFF. 2. Disconnect the electrical connector at EI system ignition coil. 3. Connect a test light between terminal 1 of the EI system ignition coil connector and ground. 4. Turn the ignition ON. Is the test light on?	–	Go to *Step 17*	Go to *Step 16*
16	Check for open in wire between the battery and EI system ignition coil connector terminal 1 and repair as needed. Is the repair complete?	–	Go to *Step 2*	–
17	1. Turn the ignition OFF. 2. Disconnect ECM connector and EI system ignition coil connector. 3. Measure the resistance between following terminals: • Terminal 2 of ignition coil and terminal 1 of ECM connector. • Terminal 3 of ignition coil and terminal 32 of ECM connector. • Terminal 4 of ignition coil and terminal 31 of ECM connector. Are the resistance within the value specified?	0 Ω	Go to *Step 19*	Go to *Step 18*
18	Check for open circuit and repair as needed. Is the repair complete?	–	Go to *Step 2*	–
19	1. Measure the resistance between following terminals: • Terminal 1 and 2 of ignition coil. • Terminal 3 and 4 of ignition coil. Are the resistance within the value specified? 2. Remove the high tension cable. 3. Measure the resistance between second coil. • Between 1 and 4 • Between 2 and 3 Are the resistance within the value specified?	0.9Ω 5.3 kΩ	Go to *Step 21*	Go to *Step 20*
20	Replace the EI system ignition coil. Is the repair complete?	–	Go to *Step 2*	–

Engine Cranks But Will Not Run (Cont'd)

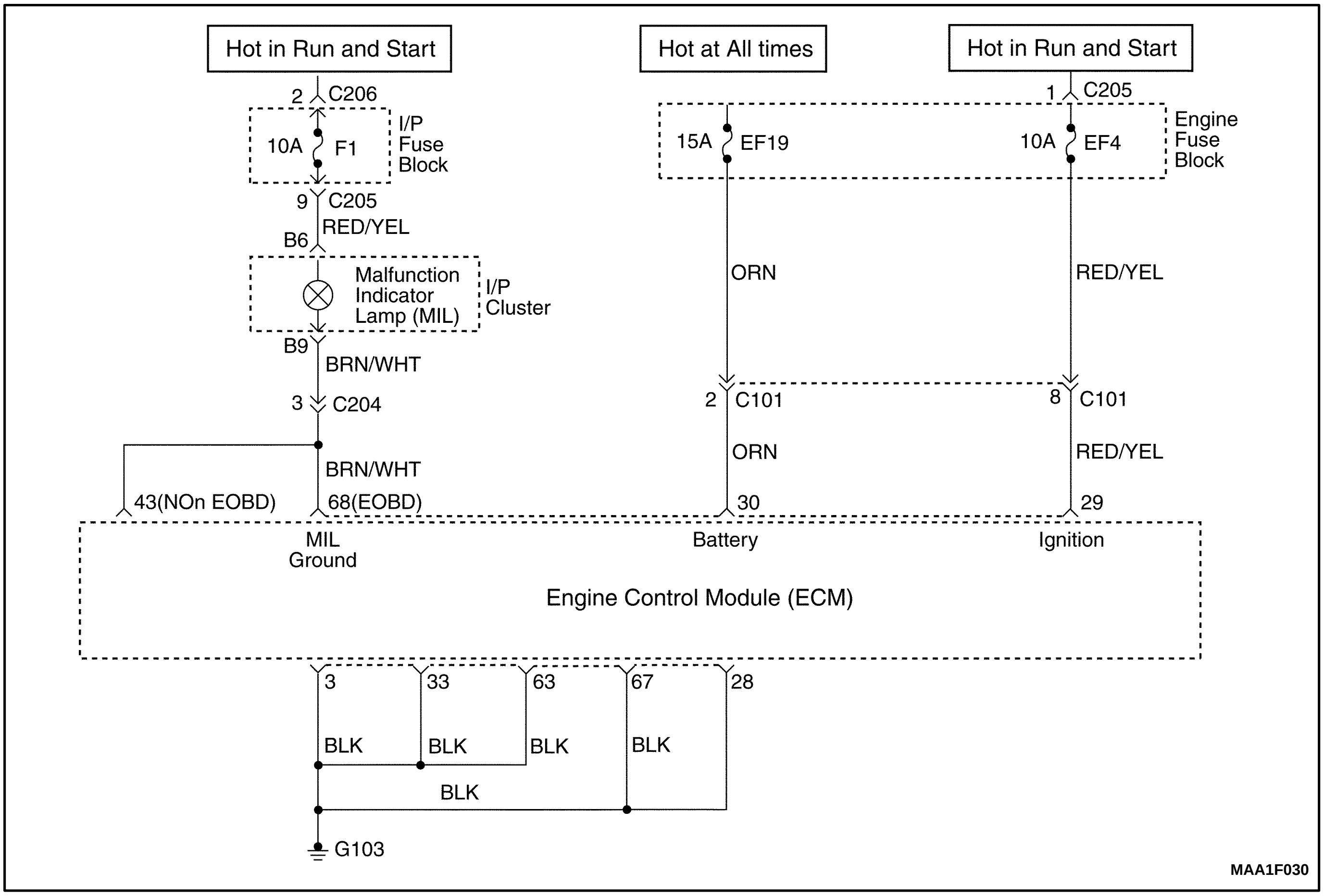
Step	Action	Value(s)	Yes	No
21	1. Check for any damages or poor connection in ignition wires and repair as needed. 2. Connect the Ei system ignition coil connector and ECM connector. 3. Check for the presence of spark from all of the ignition wires. Is the spark present from all of the ignition wires?	–	Go to *Step 2*	Go to *Step 22*
22	Replace ECM Is the repair complete?	–	Go to *Step 2*	–
23	1. Turn the ignition OFF. 2. Connect a fuel pressure gauge. 3. Crank the engine. Is any fuel pressure present?	–	Go to *Step 26*	Go to *Step 24*
24	1. Turn the ignition OFF. 2. Disconnect the electrical connector at the fuel pump. 3. Connect a test light between the fuel pump terminals 2 and 3. 4. Turn the ignition ON. 5. With the ignition ON, the test light should light for the time specified. Is the test light on?	2 sec.	Go to *Step 25*	Go to *Step 32*
25	Replace the fuel pump. Is the repair complete?	–	Go to *Step 2*	–
26	Is the fuel pressure within the value specified?	380 kPa (55 psi)	Go to *Step 27*	Go to *Step 29*
27	Check the fuel for contamination. Is the fuel contaminated?	–	Go to *Step 28*	Go to *Step 41*
28	1. Remove the contaminated fuel from the fuel tank. 2. Clean the fuel tank as needed. Is the repair complete?	–	Go to *Step 2*	–
29	1. Check the fuel filter for restriction. 2. Inspect the fuel lines for kinks and restrictions. 3. Repair or replace as needed. 4. Measure the fuel pressure. Is the fuel pressure within the value specified?	380 kPa (55 psi)	Go to *Step 2*	Go to *Step 30*
30	1. Disconnect vacuum line from the fuel pressure regulator. 2. Inspect the vacuum line for the presence of fuel. 3. Inspect the fuel pressure regulator vacuum port for the presence of fuel. Is any fuel present?	–	Go to *Step 31*	Go to *Step 32*
31	Replace the fuel pressure regulator. Is the repair complete?	–	Go to *Step 2*	–
32	1. Remove the fuel pump assembly from the fuel tank. 2. Inspect the fuel pump sender and the fuel coupling hoses for a restriction. 3. Inspect the in-tank fuel filter for restriction. Is the problem found?	–	Go to *Step 33*	Go to *Step 25*

Engine Cranks But Will Not Run (Cont'd)

Step	Action	Value(s)	Yes	No
33	Replace the fuel pump sender, the in-tank fuel filter, and/or the fuel coupling hoses as needed. Is the repair complete?	–	Go to *Step 2*	–
34	1. Turn the ignition OFF. 2. Disconnect the electric connector at the fuel pump. 3. Connect a test light between fuel pump connector terminal 3 and ground. 4. Turn the ignition ON. 5. With the ignition ON, the test light should illuminate for the time specified. Is the test light on?	2 sec	Go to *Step 35*	Go to *Step 36*
35	Repair the open circuit between the fuel pump connector terminal 2 and ground. Is the repair complete?	–	Go to *Step 2*	–
36	1. Turn the ignition OFF. 2. Disconnect the fuel pump relay. 3. Turn the ignition ON. 4. Measure the voltage at terminal 30 and 85 of fuel pump relay. Is the voltage within the value specified?	11 – 14 V	Go to *Step 38*	Go to *Step 37*
37	Repair open or short circuit for power supply. Is the repair complete?	–	Go to *Step 2*	–
38	1. Turn the ignition OFF. 2. Disconnect ECM connector. 3. Using an ohmmeter, measure the resistance between following terminals. ● Terminal 10 of ECM and terminal 85 of fuel pump relay. ● Terminal 87 of fuel pump relay and terminal 3 of fuel pump. Does the resistance within the value specified?	0 Ω	Go to *Step 40*	Go to *Step 39*
39	1. Check for open circuit and fuel cut–off switch. 2. Reset fuel cut-off switch or repair open circuit as needed. Is the repair complete?	–	Go to *Step 2*	–
40	Replace the fuel pump relay. Is the repair complete?	–	Go to *Step 2*	–
41	1. Turn the ignition OFF. 2. Disconnect the fuel inject harness connectors from all of the fuel injectors. 3. Turn the ignition ON. 4. Connect test light between fuel injector harness connector 1 and ground. 5. Repeat step 4 for each of the remaining fuel injectors. Does the test light on at all of the fuel injectors?	–	Go to *Step 42*	Go to *Step 45*

Engine Cranks But Will Not Run (Cont'd)

Step	Action	Value(s)	Yes	No
42	1. Turn the ignition OFF. 2. Connect test light between fuel injector harness connector 2 and battery positive. 3. Crank the engine. 4. Repeat step 2 and 3 for each of the remaining fuel injectors. Does the test light flash for all of the fuel injectors?	–	Go to *Step 43*	Go to *Step 46*
43	Measure the resistance of each fuel injectors. Is the resistance within the value specified. **Note:** the resistance will increase slightly at higher temperature.	13.75–15.25 Ω	System OK	Go to *Step 44*
44	Replace any of the fuel injectors with a resistance out of specification. Is the repair complete?	–	Go to *Step 2*	–
45	1. Inspect the fuse EF19 in engine fuse block. 2. Check for an open between the circuit from terminal 2 of the three fuel injectors and terminal 87 of main relay. Is the problem found?	–	Go to *Step 48*	Go to "Main Relay Circuit Check"
46	Measure the resistance between following terminals. • Terminal 1 of injector 1 connector and terminal 30 of ECM connector. • Terminal 1 of injector 2 connector and terminal 58 of ECM connector. • Terminal 1 of injector 3 connector and terminal 89 of ECM connector. Does the resistance within the specified value?	0 Ω	Go to *Step 49*	Go to *Step 47*
47	Repair the open fuel injector harness wire(s). Is the repair complete?	–	Go to *Step 2*	–
48	Replace the fuse or repair the wiring as needed. Is the repair complete?	–	Go to *Step 2*	–
49	Replace the ECM. Is the repair complete?	–	Go to *Step 2*	–



NO MALFUNCTION INDICATOR LAMP

Circuit Description

When the ignition is turned ON, the Malfunction Indicator Lamp (MIL) will be turned ON and remain ON until the engine is running, if no Diagnostic Trouble Codes (DTCs) are stored. Battery voltage is supplied through the ignition switch directly to the MIL telltale. The Engine Control Module (ECM) controls the MIL by providing a ground path through the MIL control circuit to turn ON the MIL.

Diagnostic Aids

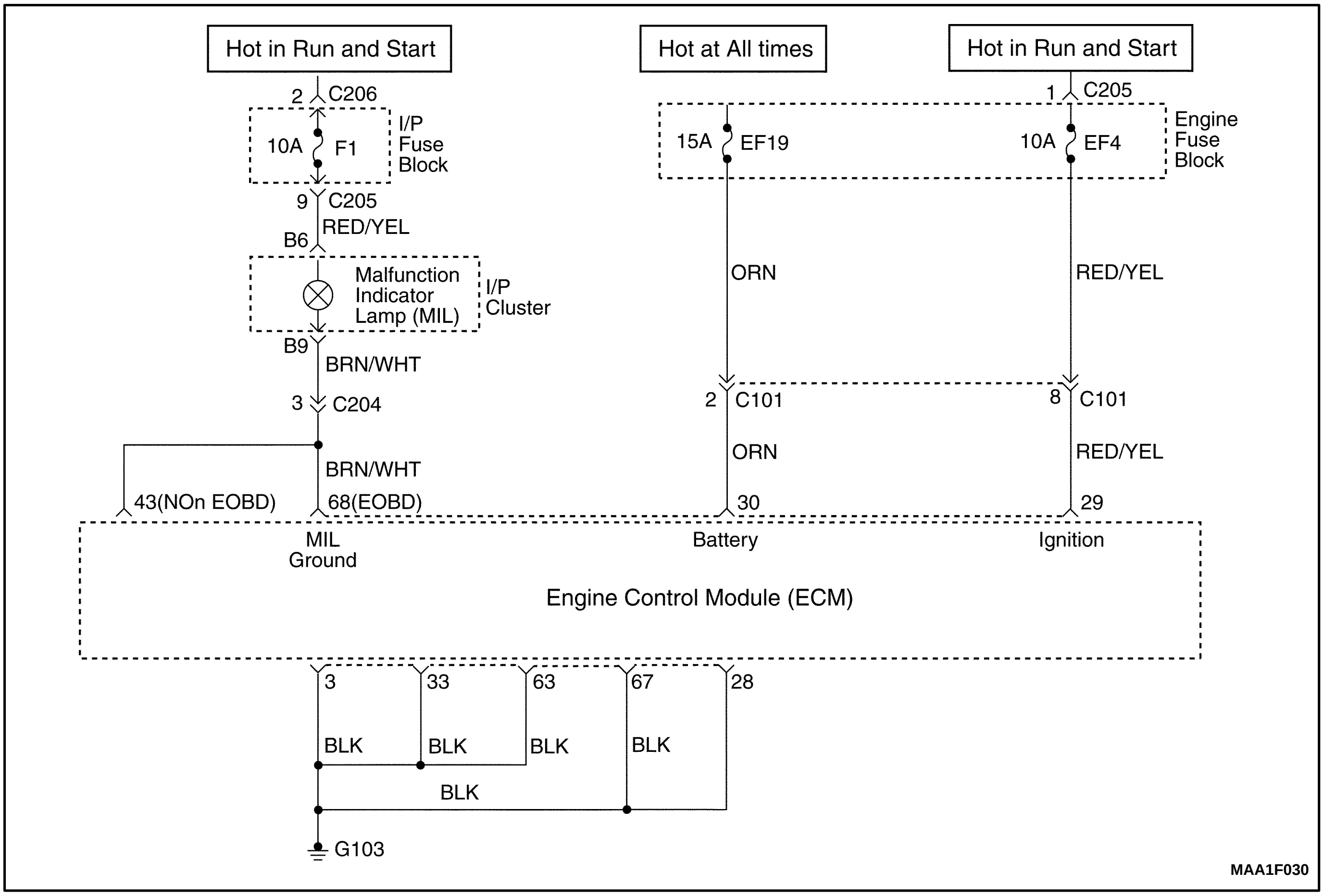
An open ignition F16 fuse will cause the entire cluster to be inoperative.

Check the battery and ignition feed circuits for poor connections if the MIL is intermittent.

Any circuitry, that is suspected as causing an intermittent complaint, should be thoroughly checked for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections or physical damage to the wiring harness.

No Malfunction Indicator Lamp

Step	Action	Value(s)	Yes	No
1	Attempt to start the engine. Does the engine start?	–	Go to *Step 2*	Go to “Engine Cranks But Will Not Run”
2	1. Turn the ignition OFF. 2. Disconnect the engine control module (ECM) connector. 3. Turn the ignition ON. 4. Connect a test light between terminal 68 of ECM connector and ground. Is the test light on?	–	Go to *Step 3*	Go to *Step 6*
3	Check terminals for damage or poor connection. Does any problem found?	–	Go to *Step 5*	Go to *Step 4*
4	Replace ECM Is the repair complete?	–	Go to “On Board Diagnostic System Check”	–
5	Repair any damaged terminals or poor connection. Is the repair complete?	–	Go to “On Board Diagnostic System Check”	–
6	Check the fuse F1. Is the fuse blown?	–	Go to *Step 7*	Go to *Step 8*
7	1. Check for a short to ground in the circuit and repair as needed. 2. Replace the blown fuse. Is the repair complete?	–	Go to “On Board Diagnostic System Check”	–
8	1. Check for an open circuit between fuse F16 and terminal 68 of ECM connector and repair as needed. 2. Check the MIL bulb and replace if blown. Is the repair complete?	–	Go to “On Board Diagnostic System Check”	–



MALFUNCTION INDICATOR LAMP ON STEADY

Circuit Description

When the ignition is turned ON, the Malfunction Indicator Lamp (MIL) will be turned ON and remain ON until the engine is running, if no Diagnostic Trouble Codes (DTCs) are stored. Battery voltage is supplied through the ignition switch directly to the MIL telltale. The Engine Control Module (ECM) controls the MIL by providing a ground path through the MIL control circuit to turn ON the MIL.

Malfunction Indicator Lamp On Steady

Step	Action	Value(s)	Yes	No
1	Perform an Euro On-Board Diagnostic (EOBD) System Check. Is the check complete.	–	Go to *Step 2*	Go to "Euro On-Board Diagnostic System Check"
2	1. Turn the ignition OFF. 2. Install the scan tool. 3. Command the Malfunction Indicator Lamp (MIL) on and off. Does the MIL turn on and off when commanded?	–	Go to *Step 7*	Go to *Step 3*
3	1. Turn the ignition OFF. 2. Disconnect the engine control module (ECM) connector. 3. Turn the ignition ON. Is the MIL off?	–	Go to *Step 6*	Go to *Step 4*
4	Check the MIL control circuit for a short to ground and repair as needed. Is a repair necessary?	–	Go to *Step 7*	Go to *Step 5*
5	Replace the instrument panel cluster. Refer to *Section 9E, Instrumentation/Driver Information.* Is the repair complete?	–	Go to *Step 7*	–
6	Replace the ECM. Is the repair complete?	–	Go to *Step 7*	–
7	1. Using the scan tool, clear the Diagnostic Trouble Codes(DTCs). 2. Attempt to start the engine. Does the engine start and continue to run?	–	Go to *Step 8*	Go to *Step 1*
8	Allow the engine to idle until normal operating temperature is reached. Check if any DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

FUEL SYSTEM DIAGNOSIS

Circuit Description

The fuel pump is an in-tank type mounted to a fuel sender assembly. The fuel pump will remain on as long as the engine is cranking or running and the Engine Control Module (ECM) is receiving reference pulses from the crankshaft position (CKP) sensor. If there are no reference pulses, the ECM will turn off the fuel pump two seconds after the ignition switch is turned ON or two seconds after the engine stops running. The fuel pump delivers fuel to the fuel rail and the fuel injectors, where the fuel system pressure is controlled from 380 kPa (55 psi) by the fuel pressure regulator. The excess fuel is returned to the fuel tank.

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

Caution: Do not pinch or restrict nylon fuel lines. Damage to the lines could cause a fuel leak, resulting in possible fire or personal injury.

Fuel Pressure Relief Procedure

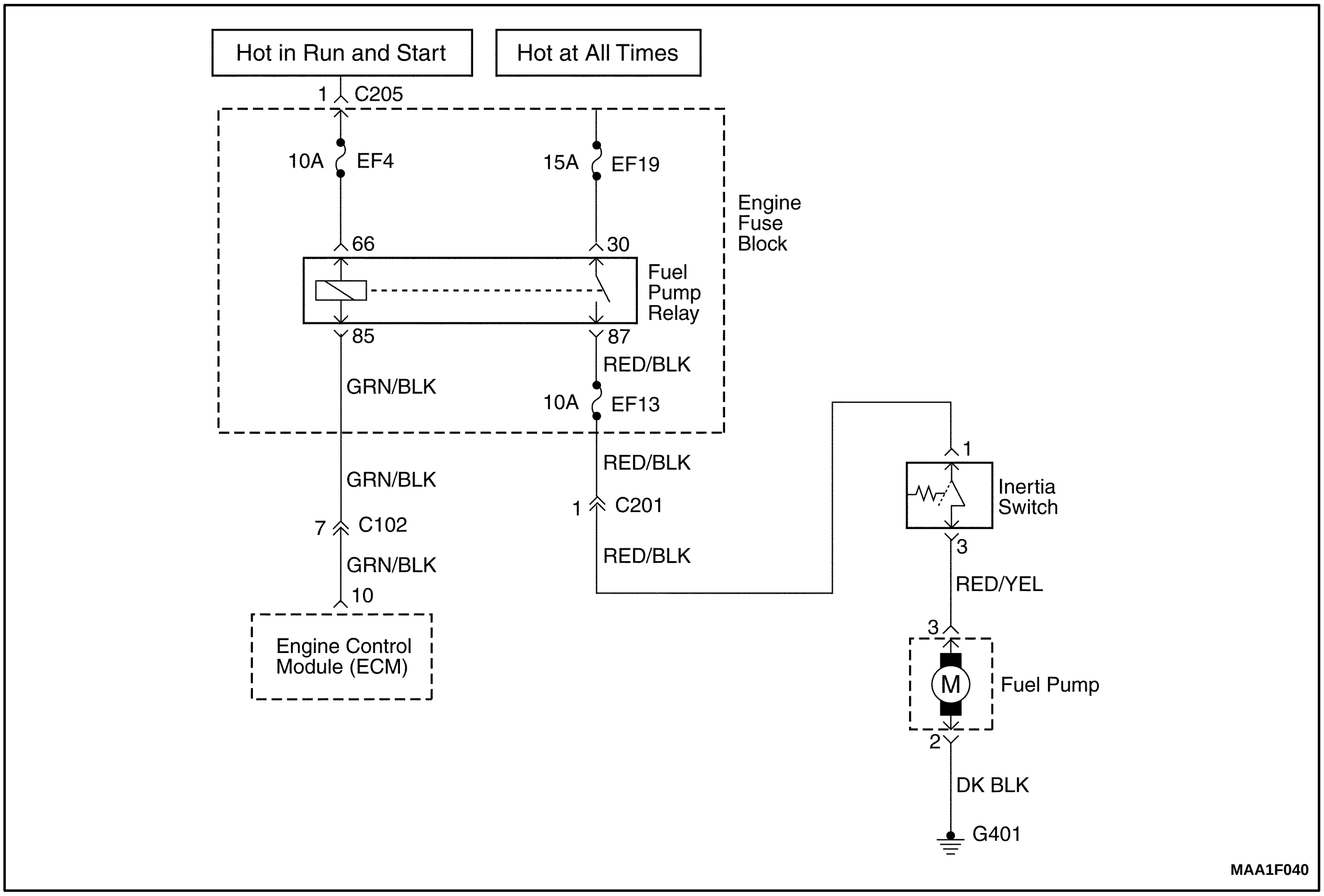
1. Remove the fuel cap.
2. Remove the fuel pump fuse EF23 from the engine fuse block.
3. Start the engine and allow the engine to stall.
4. Crank the engine for an additional 10 seconds.

Fuel System Pressure Test

Step	Action	Value(s)	Yes	No
1	1. Relieve the fuel system pressure. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure around the values specified and holding steady?	380 kPa (55 psi)	System OK	Go to *Step 2*
2	1. Relieve the fuel system pressure. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure around the values specified but not holding steady?	380 kPa (55 psi)	Go to *Step 13*	Go to *Step 3*
3	Inspect the fuel lines for a leak. Is the problem found?	–	Go to *Step 4*	Go to *Step 5*
4	1. Replace the fuel line(s) as needed. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure around the values specified and holding steady?	380 kPa (55 psi)	System OK	–
5	1. Remove the fuel pump assembly. 2. With the fuel pump under pressure, inspect the fuel pump coupling hoses for leaking. Is the problem found?	–	Go to *Step 6*	Go to *Step 7*
6	1. Tighten or replace the fuel pump coupling hoses as needed. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure around the values specified and holding steady?	380 kPa (55 psi)	System OK	Go to Step 8
7	With the fuel system under pressure, inspect the fuel return outlet for leaking. Is the problem found?	–	Go to *Step 8*	Go to *Step 9*

Fuel System Pressure Test (Cont'd)

Step	Action	Value(s)	Yes	No
8	1. Replace the fuel pressure regulator. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure around the values specified and holding steady?	380 kPa (55 psi)	System OK	–
9	With the fuel system under pressure, inspect the fuel return inlet for leaking. Is the problem found?	–	Go to *Step 10*	Go to *Step 11*
10	1. Replace the fuel pump assembly. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure around the values specified and holding steady?	380 kPa (55 psi)	System OK	–
11	1. Remove the fuel rail and the fuel injectors as an assembly. 2. With the fuel system under pressure, inspect all of the fuel injectors for leaking. Is the problem found?	–	Go to *Step 12*	–
12	1. Replace the leaking fuel injector(s). 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure around the values specified and holding steady?	380 kPa (55 psi)	System OK	–
13	1. Replace the fuel pressure regulator. 2. Start the engine. 3. Allow the engine to idle. Is the fuel pressure around the values specified and holding steady?	380 kPa (55 psi)	System OK	–



FUEL PUMP RELAY CIRCUIT CHECK

Circuit Description

When the ignition switch is turned ON, the Engine Control Module (ECM) will supply battery voltage to activate the fuel pump relay and run the in-tank fuel pump. The fuel pump will operate as long as the engine is cranking or running and the ECM is receiving ignition reference pulses.

If there are no reference pulses, the ECM will shut off the fuel pump within 2 seconds after the ignition switch is turned ON.

Diagnostic Aids

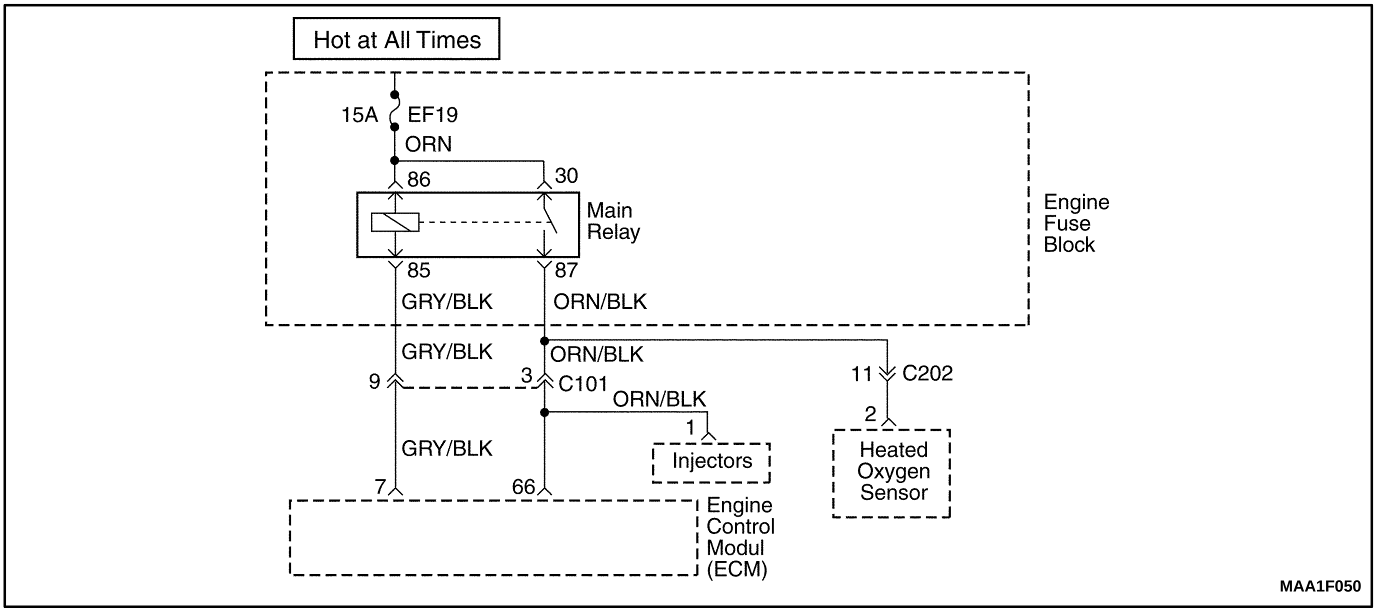
An intermittent problem may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.

Fuel Pump Relay Circuit Check

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition OFF for 10 seconds. 2. Turn the ignition ON. 3. Listen for in-tank fuel pump operation. Does the fuel pump operate for the time specified?	2 sec	System OK	Go to *Step 2*
2	1. Turn the ignition OFF. 2. Connect battery positive to fuel pump test connect. 3. Listen for in-tank fuel pump operation. Does the fuel pump operate?	–	Go to *Step 4*	Go to *Step 3*

Fuel Pump Relay Circuit Check (Cont'd)

Step	Action	Value(s)	Yes	No
3	1. Check for an open circuit between fuel pump test connector and ground G401, and repair as needed. 2. Check for the fuel cut-off switch and reset or replace the fuel cut off switch. Is the repair complete?	–	System OK	Go to *Step 4*
4	1. Turn the ignition OFF. 2. Disconnect the fuel pump relay. 3. Connect a test light between the fuel pump relay connector terminal 66 and battery positive. 4. Turn the ignition ON. Is the test light on?	–	Go to *Step 6*	Go to *Step 5*
5	Check for an open circuit between terminal 66 of fuel pump relay and battery positive and repair as needed. Is the repair complete?	–	System OK	–
6	1. Turn the ignition OFF. 2. Connect a test light between the fuel pump relay connector terminal 85 and ground. 3. Turn the ignition ON. Is the test light on?	2 sec	Go to *Step 8*	Go to *Step 7*
7	Check for an open circuit between terminal 85 of fuel pump relay and terminal 10 of ECM, and repair as needed. Is the repair complete?	–	System OK	–
8	1. Turn the ignition OFF. 2. Connect a test light between the fuel pump relay connector terminal 30 and ground. Is the test light on?	–	Go to *Step 10*	Go to *Step 9*
9	1. Check the fuse EF19, if blown, repair short circuit between fuel pump relay 30 terminal. 2. Replace the fuse as needed. 3. Repair an open circuit as needed. Is the repair complete?	–	System OK	–
10	1. Turn the ignition OFF. 2. Measure the resistance between following terminals: • Terminal 87 of fuel pump relay and terminal 1 of the fuel cut-off switch(or terminal 1 of connector C201). Does the resistance within the value specified.	0 Ω	Go to *Step 12*	Go to *Step 11*
11	Repair an open circuit as needed. Is the repair complete?	–	System OK	–
12	Replace the fuel pump relay. Is the repair complete?	–	System OK	Go to *Step 13*
13	Replace the ECM. Is the repair complete?	–	System OK	–



MAIN RELAY CIRCUIT CHECK

Circuit Description

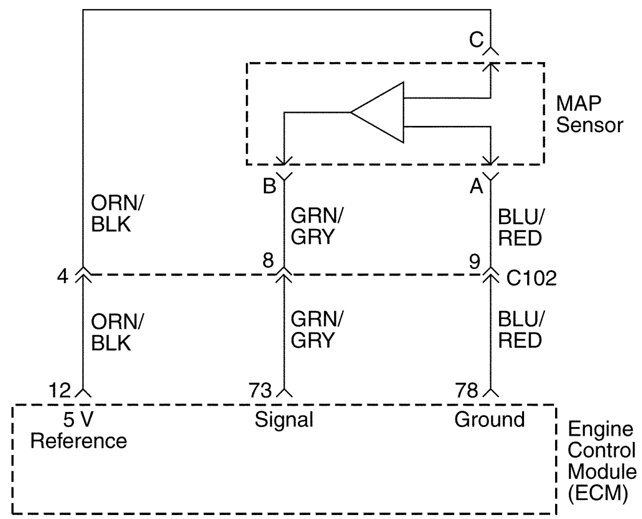
When the ignition is turned On or to the START position, the main relay is energized. The main relay then supply voltage to the engine fuse block fuse EF25 and EF26. The Electronic Ignition (EI) system ignition coil is supplied voltage through the engine fuse block fuse EF26. The fuel injectors are supplied voltage through the engine fuse block fuse EF25.

Diagnostic Aids

- An intermittent problem may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.
- A fault main relay will cause a no start condition. There will be no voltage supplied to the EI system ignition coil, or the fuel injectors. Without voltage supplied to these components, they will not operate.

Main Relay Circuit Check

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition OFF. 2. Disconnect the engine fuse block fuse EF26. 3. Turn the ignition ON. 4. With a test light connected to the ground, probe the fuse terminals nearest the main relay for fuse EF19. Is the light on at both terminal?	–	System OK	Go to *Step 2*
2	Is the light on at only one terminal?	–	Go to *Step 3*	Go to *Step 4*
3	Repair the open in the wiring between the main relay connector terminal 30 and the fuse EF19 as needed. Is the repair complete?	–	System OK	–
4	1. Turn the ignition OFF. 2. Remove the main relay. 3. Turn the ignition ON. 4. With a test light connected to the ground, probe the main relay terminals 85 and 30. Is the light on at both terminals.	–	Go to *Step 8*	Go to *Step 5*
5	1. Turn the ignition OFF. 2. Check engine fuse block fuse EF19. Is one or both fuse blown?	–	Go to *Step 6*	Go to *Step 7*
6	1. Repair short circuit between terminal 87 of main relay and heated oxygen sensor 2. Replace fuse EF19. Is the repair complete?	–	System OK	–
7	Repair open circuit between terminal 30 of main relay and fuse EF19. Is the repair complete?	–	System OK	Go to *Step 8*
8	1. Turn the ignition OFF. 2. Measure the resistance between following terminals. ● Terminal 86 of main relay and ground. ● Terminal 87 of main relay and ground. Is the resistance within the specified value	0 Ω	Go to *Step 10*	Go to *Step 9*
9	Repair open circuit. Is the repair complete?	–	System OK	–
10	Replace the main relay. Is the repair complete?	–	System OK	–



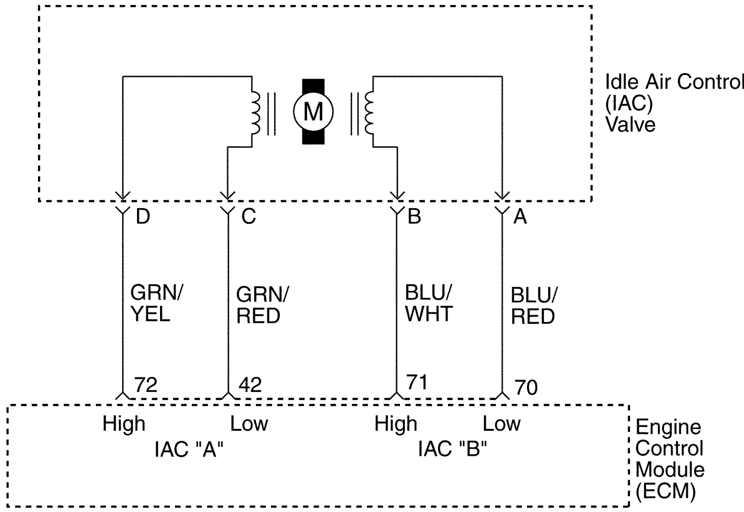
MANIFOLD ABSOLUTE PRESSURE CHECK

Circuit Description

The Manifold Absolute Pressure (MAP) sensor measure the changes in the intake manifold pressure which result from engine load (intake manifold vacuum) and rpm changes. The MAP sensor converts these changes into voltage output. The Engine Control Module (ECM) send a 5-volt reference voltage to the MAP sensor. As the intake manifold pressure changes, the output voltage of MAP sensor also changes. A low voltage (high vacuum) output of 1 to 1.5 volts is present at idle. A high voltage (low vacuum) output of 4.5 to 5.0 volts is present at wide open throttle. The MAP sensor is also used under certain conditions to measure barometric attitude changes. The ECM uses the MAP sensor for the delivery and ignition timing changes.

Manifold Absolute Pressure Check

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition OFF. 2. Connect a scan tool to the Data Link Connector (DLC). 3. Turn the ignition ON. 4. Compare the Manifold Absolute Pressure (MAP) sensor voltage reading from scanner with that from known good vehicle. Is the difference in the two voltage reading less than the value specified?	0.4 V	Go to *Step 2*	Go to *Step 5*
2	1. Turn the ignition OFF. 2. Connect a scan tool to the DLC. 3. Disconnect the MAP sensor vacuum line. 4. Connect a hand vacuum pump to the Map sensor. 5. Turn the ignition ON. 6. Note the MAP sensor voltage. 7. Apply 34kPa (10 in. Hg) of vacuum to the Map sensor and note the voltage change. Is the difference in voltage readings more than the value specified?	1.5 V	System OK	Go to *Step 3*
3	Inspect the MAP sensor connector terminals. Is the problem found.	–	Go to *Step 4*	Go to *Step 5*
4	Repair the MAP sensor connector terminals as needed. Is the repair complete?	–	System OK	–
5	Replace the MAP sensor. Is the repair complete?	–	System OK	–



IDLE AIR CONTROL SYSTEM CHECK

Circuit Description

The Engine Control Module (ECM) controls the engine idle speed with the Idle Air Control (IAC) valve. To increase the idle speed, the ECM pulls the IAC pintle away from its seat, allowing more air to pass by the throttle body. To decrease the idle speed, it extends the IAC valve pintle toward its seat, reducing bypass air flow. A scan tool will read the ECM commands to the IAC valve in counts. The higher counts indicate more air bypass (higher idle). The lower counts indicate less air is allowed to bypass (lower idle).

Diagnostic Aids

If the idle is too high, stop the engine. Fully extend the Idle Air Control (IAC) valve with a IAC driver. Start the engine. If the idle speed is above 950 rpm, locate and repair the vacuum leak. Also, check for a binding throttle plate or throttle linkage or an incorrect base idle setting.

Idle Air Control Valve Reset Procedure

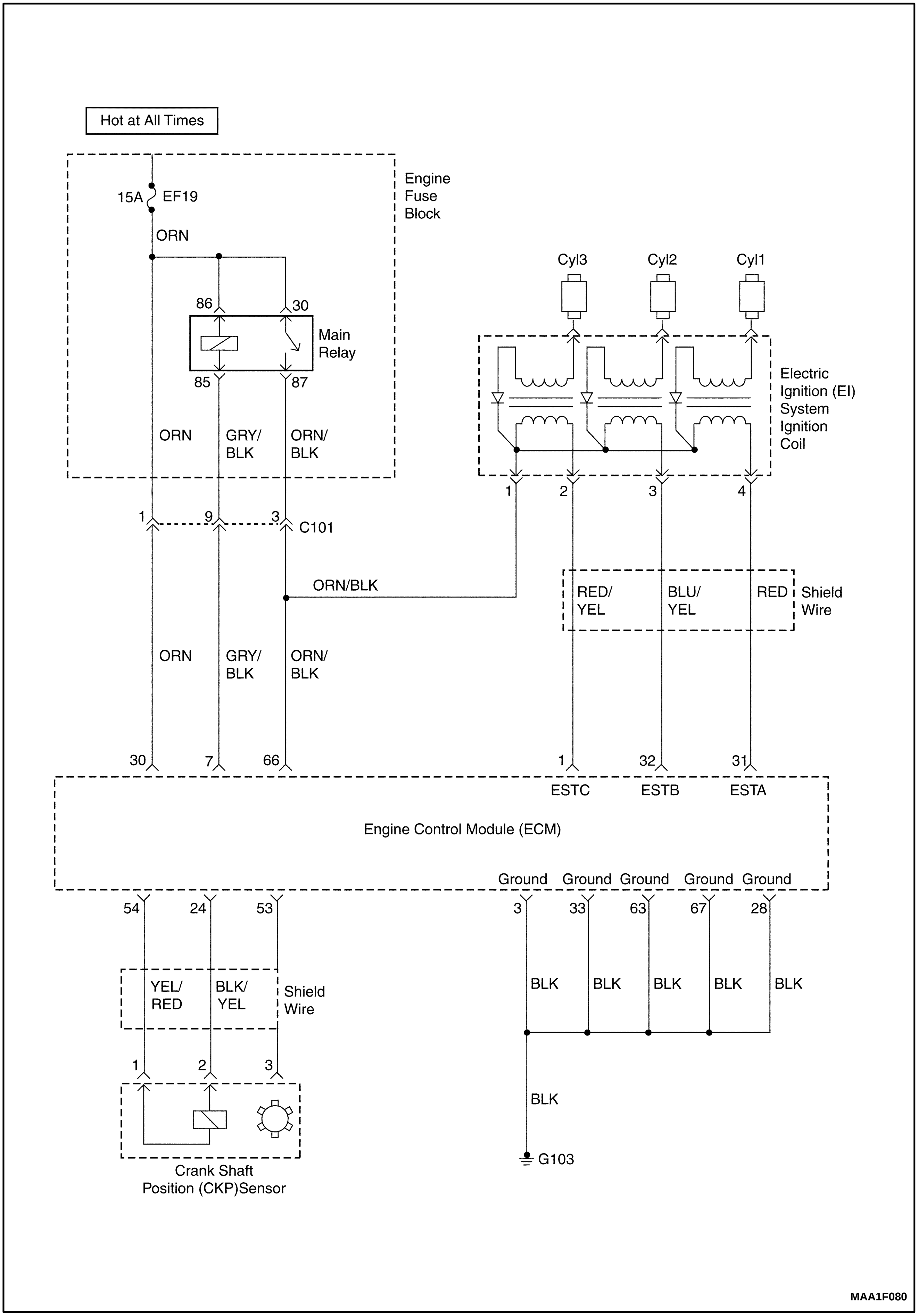
Whenever the battery cable or the Engine Control Module (ECM) connector or the ECM fuse EF6 is disconnected or replaced, the following idle learn procedure must be performed:

1. Turn the ignition ON for 5 seconds.
2. Turn the ignition OFF for 10 seconds.
3. Turn the ignition ON for 5 seconds.
4. Start the engine in park/neutral.
5. Allow the engine to run until the engine coolant is above 85°C (185°F).
6. Turn the A/C ON for 10 seconds, if equipped.
7. Turn the A/C OFF for 10 seconds, if equipped.
8. If the vehicle is equipped with an automatic transaxle, apply the parking brake. While pressing the brake pedal, place the transaxle in D (drive).
9. Turn the A/C ON for 10 seconds, if equipped.
10. Turn the A/C OFF for 10 seconds, if equipped.
11. Turn the ignition OFF. The idle learn procedure is complete.

Idle Air Control System Check

Step	Action	Value(s)	Yes	No
1	Perform an Euro On-Board Diagnostic (EOBD) system check. Was the check performed?	–	Go to *Step 2*	Go to "Euro On-Board Diagnostic System Check"
2	1. Turn the ignition OFF. 2. Remove Idle Air Control (IAC) valve. 3. Inspect the IAC passages for restrictions. Is the problem found?	–	Go to *Step 3*	Go to *Step 4*
3	Clean the IAC passages. Is the repair complete?	–	System OK	–
4	Measure the resistance between following terminals of IAC valve. ● Terminal A and B ● Terminal C and D Does the resistance equal to the value specified?	40–80 Ω	Go to *Step 6*	Go to *Step 5*
5	Replace the IAC valve. Is the repair complete?	–	System OK	–
6	1. Disconnect the Engine control Module (ECM) connector. 2. Check for an open or short in the wires between following terminals. ● Terminal A of IAC valve connector and terminal 70 of ECM connector ● Terminal B of IAC valve connector and terminal 71 of ECM connector ● Terminal C of IAC valve connector and terminal 42 of ECM connector ● Terminal D of IAC valve connector and terminal 72 of ECM connector Is the problem found?	–	Go to *Step 8*	Go to *Step 7*
7	Repair an open or short circuit as needed. Is the repair complete?	–	System OK	–
8	Inspect the IAC connector terminals and the ECM connector terminals. Is the problem found?	–	Go to *Step 9*	Go to *Step 10*
9	Repair or replace the throttle body assembly and/or ECM connector terminals as needed. Is the repair complete?	–	System OK	–
10	Replace the ECM. Is the repair complete?	–	System OK	–

IGNITION SYSTEM CHECK



IGNITION SYSTEM CHECK

Circuit Description

The Electronic Ignition (EI) system uses a waste spark method of spark distribution. In this type of EI system, the Crankshaft Position (CKP) sensor is mounted to the oil pump near a slotted wheel that is a part of the crankshaft pulley. The CKP sensor sends reference pulses to the Engine Control Module (ECM). The ECM then triggers the EI system ignition coil. Each cylinder is individual with coil per cylinder in sequence.

This leaves the remainder of the high voltage to be used to fire the spark plug in the cylinder on its compression stroke. Since the CKP sensor is in a fixed position, timing adjustments are not possible or needed.

Ignition System Check

Caution: Use only electrically insulated pliers when handling ignition wires with the engine running to prevent an electrical shock.

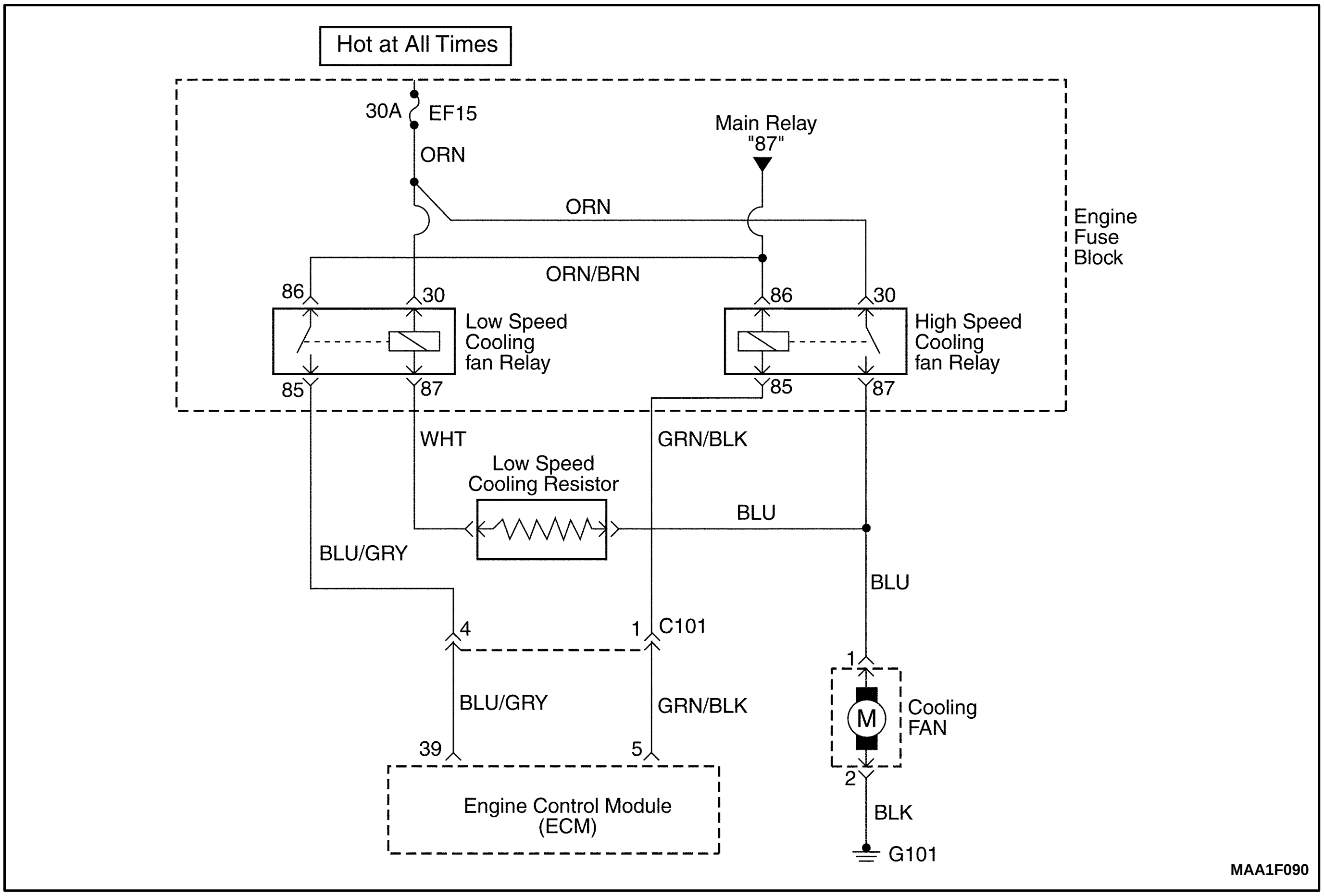
Step	Action	Value(s)	Yes	No
1	1. Remove the spark plugs. 2. Inspect for wet spark plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. 3. Replace the spark plugs as needed. Is the repair complete?	–	System OK	Go to *Step 2*
2	Check for the presence of spark from all of the ignition wires while cranking the engine. Is spark present from all of the ignition wires?	–	System OK	Go to *Step 3*
3	1. Measure the resistance of the ignition wires. 2. Replace any ignition wire(s) with a resistance above the value specified. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	30000 Ω	System OK	Go to *Step 4*
4	Is spark present from at least one of the ignition wires, but not all of the ignition wires?		Go to Step 5	Go to Step 12
5	1. Turn the ignition OFF. 2. Disconnect the Electronic Ignition (EI) system ignition coil connector. 3. While cranking the engine, measure the voltage at the EI system ignition coil connector terminal 1. Does the voltage fluctuate within the values specified?	0.2–2.0 V	Go to *Step 8*	Go to *Step 6*
6	Check for an open in the wire from EI system ignition coil connector terminal 1 to the Engine Control Module (ECM) connector terminal 66. Is the problem found?	–	Go to *Step 7*	Go to *Step 11*
7	1. Repair the wiring as needed. 2. Connect the EI system ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	–	System OK	–
8	While cranking the engine, measure the voltage at the EI system ignition coil connector terminal 2. Does the voltage fluctuate within the values specified?	0.2–2.0 V	Go to *Step 10*	Go to *Step 9*

Ignition System Check (Cont'd)

Step	Action	Value(s)	Yes	No
9	Check for an open in the wire from EI system ignition coil connector terminal 2 to the Engine Control Module (ECM) connector terminal 1. Is the problem found?	–	Go to *Step 7*	Go to *Step 11*
10	1. Replace the EI system ignition coil. 2. Connect the EI system ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	–	System OK	–
11	1. Replace the ECM. 2. Connect the EI system ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	–	System OK	–
12	1. Turn the ignition OFF. 2. Disconnect the crankshaft position (CKP) sensor connector. 3. Measure the resistance between the CKP sensor terminals 1 and 2. Is the resistance within the value specified? 4. Measure the resistance between following terminals. • Terminals 1 and 3 of CKP sensor. • Terminals 2 and 3 of CKP sensor. Is the resistance within the value specified?	400–600 Ω ∞	Go to *Step 14*	Go to *Step 13*
13	Replace the crankshaft position sensor. Is the repair complete?	–	System OK	–
14	1. Turn the ignition ON. 2. Measure the voltage between the CKP sensor connector terminals 1 and 3. Is the voltage within the value specified?	0.95–1.10 V	Go to *Step 20*	Go to *Step 15*
15	Measure the voltage between the CKP sensor connector terminal 1 and ground. Is the voltage within the value specified?	0.95–1.10 V	Go to *Step 18*	Go to *Step 16*
16	Check the wire between the CKP sensor connector terminal 1 and the ECM connector terminal 54 for an open or short. Is the problem found?	–	Go to *Step 17*	Go to *Step 10*
17	Repair the wire between the CKP sensor connector terminal 1 and the ECM connector terminal 54. Is the repair complete?	–	System OK	–
18	Check the wire between the CKP sensor connector terminal 3 and ground for an open or short. Is the problem found?	–	Go to *Step 19*	Go to *Step 11*
19	Repair the wire between the CKP sensor connector terminal 3 and ground. Is the repair complete?	–	System OK	–
20	1. Turn the ignition ON. 2. Measure the voltage between the CKP sensor connector terminals 2 and 3. Is the voltage within the value specified?	0.95–1.10 V	Go to *Step 24*	Go to *Step 21*

Ignition System Check (Cont'd)

Step	Action	Value(s)	Yes	No
21	Measure the voltage between the CKP sensor connector terminal 2 and ground. Is the voltage within the value specified?	0.95–1.10 V	Go to *Step 18*	Go to *Step 22*
22	Check the wire between the CKP sensor connector terminal 2 and the ECM connector terminal 24 for an open or short. Is the problem found?	–	Go to *Step 23*	Go to *Step 11*
23	Repair the wire between the CKP sensor connector terminal 2 and the ECM connector terminal 24. Is the repair complete?	–	System OK	–
24	1. Turn the ignition OFF. 2. Connect a test light between the EI system ignition coil connector terminal 2 and ground. 3. Turn the ignition ON. Is the test light on?	–	Go to *Step 27*	Go to *Step 25*
25	Check for an open in the wiring between the EI system ignition coil connector, terminal 1 and the main relay connector terminal 87. Is the problem found?	–	Go to *Step 26*	Go to "Main Relay Circuit Check"
26	Repair the open in the wiring between the EI system ignition coil connector terminal 1 and the main relay connector terminal 87. Is the repair complete?	–	System OK	–
27	Check for a damage in the terminal of the EI system ignition coil connector and repair as needed. Is the repair complete?	–	System OK	–



ENGINE COOLING FAN CIRCUIT CHECK

Circuit Description

The engine cooling fan circuit operates the cooling fan. The cooling fan is controlled by the engine control module (ECM) based on input from the coolant temperature sensor (CTS) and the A/C ON/OFF. The ECM controls the low speed cooling fan operation by internally grounding the ECM connector terminal 39. This energizes the low speed cooling fan relay and operates the cooling fan at low speed. The low speed cooling fan operation is achieved by the cooling fan resistor causing a drop in the voltage supplied to the cooling fan. The ECM controls the high speed cooling fan operation by internally grounding the ECM connector terminal 5. This energizes the high speed cooling fan relay, bypassing the radiator fan resistor. This results in high speed cooling fan operation.

Diagnostic Aids

- If the owner complained of an overheating problem, it must be determined if the complaint was due to an actual boil over, or the engine coolant temperature gauge indicated overheating. If the engine is overheating and the cooling fans are on, the cooling system should be checked.
- If the engine fuse block fuse EF15 become open (blown) immediately after installation, inspect for a short to ground in the wiring of the appropriate circuit. If the fuse become open (blown) when the cooling fans are to be turned on by the Engine Control Module (ECM), suspect a faulty cooling fan motor.
- The ECM will turn the cooling fan on at low speed when the coolant temperature is 93°C (199°F). The ECM will turn the cooling fans off when the coolant temperature is 90°C (194°F).
- The ECM will turn the cooling fans on at high speed when the coolant temperature is 100°C (212°F). The ECM will change the cooling fans from high speed to low speed when the coolant temperature is 97°C (207°F).

Engine Cooling Fan Circuit Check

Step	Action	Value(s)	Yes	No
1	Perform an Euro On-Board Diagnostic (EOBD) System Check. Was the check performed?	–	Go to *Step 2*	Go to "Euro On-Board Diagnostic System Check.
2	1. Check the fuses EF3 and EF10 in engine fuse block. 2. Replace the fuse(s) as needed. Is the fuse(s) OK?	–	Go to *Step 3*	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Turn the A/C switch OFF. If equipped. 3. Connect a scan tool to the Data Link Connector (DLC). 4. Start the engine. 5. The main cooling fan should run at low speed when the coolant temperature reaches 96°C (205°F). Does the cooling fan run at low speed?	–	Go to *Step 4*	Go to *Step 8*
4	The cooling fans should run at high speed when the coolant temperature reaches 100°C (212°F). Do the cooling fans run at high speed?	–	Go to *Step 5*	Go to *Step 19*
5	1. Turn the ignition OFF. 2. Start the engine. 3. Turn the A/C switch ON. Does the cooling fan runs at low speed?	–	Go to *Step 7*	Go to *Step 6*
6	1. Diagnose the A/C compressor clutch circuit. 2. Repair the A/C compressor clutch circuit as needed. Is the repair complete?	–	System OK	–
7	1. Turn the ignition OFF. 2. Start the engine. 3. Turn the A/C switch ON and raise the rpm. 4. The cooling fan should run at high speed when the high side A/C pressure reaches 2068 kPa (300 psi). Do the cooling fans run at high speed?	–	System OK	–
8	1. Turn the ignition OFF. 2. Disconnect the cooling fan connector. 3. Turn the ignition ON. 4. Connect a test light between terminal 1 of cooling fan connector and ground. Is the test light on?	–	Go to *Step 9*	Go to *Step 12*
9	Connect a test light between terminal 2 of cooling fan connector and battery positive. Is the test light on?	–	Go to *Step 11*	Go to *Step 10*
10	Repair open circuit between terminal 2 of cooling fan connector and ground. Is the repair complete?	–	System OK	–
11	Check for a damaged terminals in main cooling fan connector and repair it or replace the main cooling fan. Is the repair complete?	–	System OK	–

Engine Cooling Fan Circuit Check (Cont'd)

Step	Action	Value(s)	Yes	No
12	1. Turn the ignition ON. 2. Connect a test light between terminals 86 and 30 of low speed cooling fan relay and ground. Does the test light on for both case?	–	Go to *Step 14*	Go to *Step 13*
13	Repair power supply circuit. ● Fuse EF15 and terminal 30 of low speed cooling fan relay. Is the repair complete?	–	System OK	Go to *Step 14*
14	1. Turn the ignition OFF. 2. Disconnect Engine Control Module (ECM) connectors. 3. Turn the ignition ON. 4. Connect a jump wire between terminal 5 and ground. Does the cooling fan run at low speed?	–	Go to *Step 15*	Go to *Step 16*
15	Replace the ECM. Is the repair complete?	–	System OK	–
16	1. Turn the ignition OFF. 2. Measure the resistance between following terminals: ● Terminal 85 of low speed cooling fan relay and terminal 39 of ECM connector. Are the resistance within the value specified?	0 Ω	Go to *Step 18*	Go to *Step 17*
17	Repair open circuit. Is the repair complete?	–	System OK	–
18	Replace the low speed cooling fan relay. Is the repair complete?	–	System OK	–

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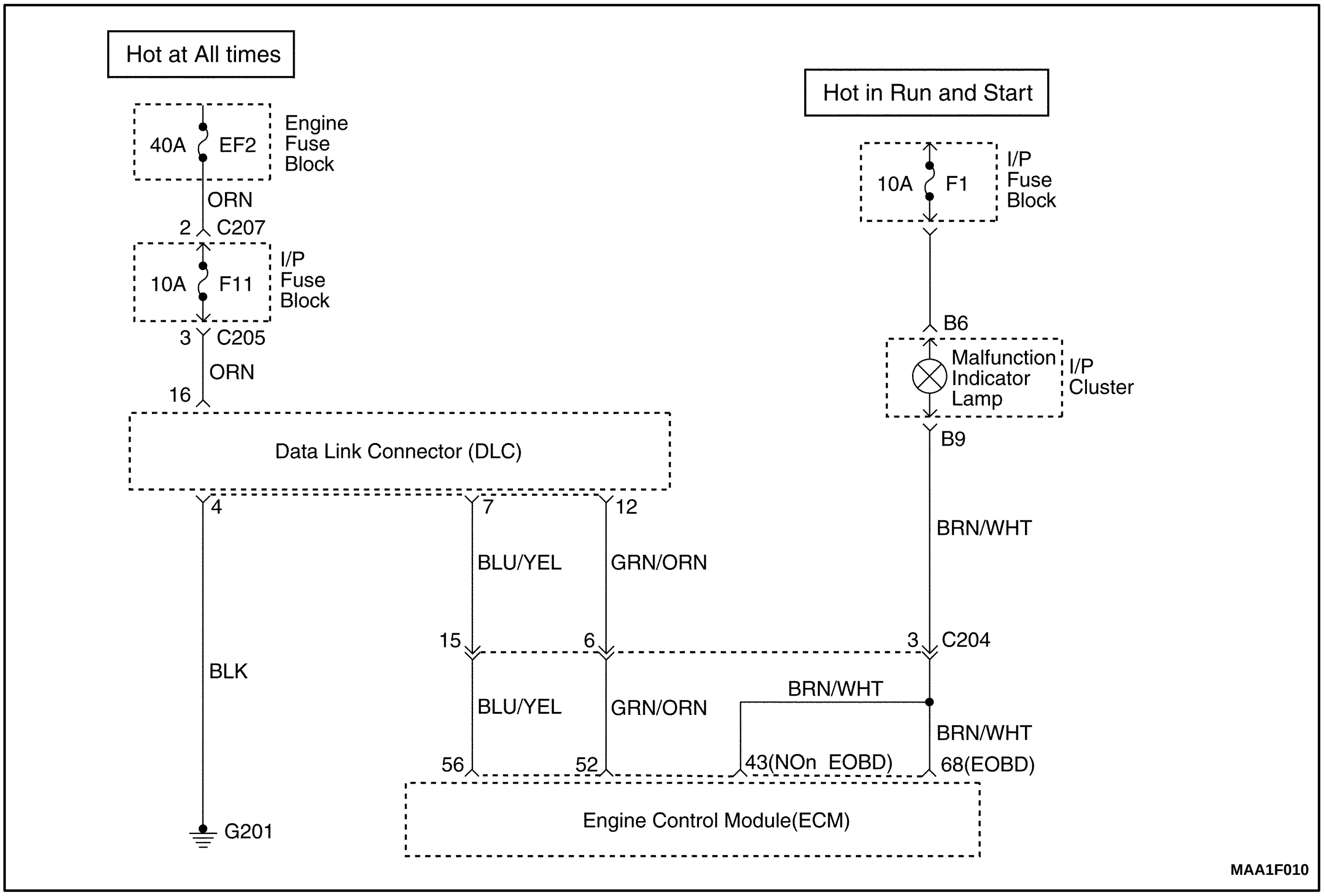

DATA LINK CONNECTOR DIAGNOSIS

Circuit Description

The provision for communicating with the Engine Control Module (ECM) is the Data Link Connector (DLC). It is located under the instrument panel. The DLC is used to connect the scan tool. Battery power and ground is supplied for the scan tool through the DLC. The Keyword 2000 serial data circuit to the DLC allows the ECM to communicate with the scan tool. A Universal Asynchronous Receiver Transmitter (UART) serial data line is used to communicate with the other modules such as the Electronic Brake Control Module (EBCM), the Supplemental Inflatable Restraint (SIR) system. and the Instrument Panel Cluster.

Diagnostic Aids

Ensure that the correct application (model line, car year, etc.) has been selected on the scan tool. If communication still cannot be established, try the scan tool on another vehicle to ensure that the scan tool or cables are not the cause of the condition.

An intermittent may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.

Any circuitry that is suspected of causing an intermittent complaint should be thoroughly checked for the following conditions:

- Backed-out terminals.
- Improper mating of terminals.
- Broken locks.
- Improperly formed or damaged terminals.
- Poor terminal-to-wiring connection.
- Physical damage to the wiring harness.
- Corrosion.

Data Link Connector Diagnosis

Step	Action	Value(s)	Yes	No
1	Perform an Euro On-Board Diagnostic (EOBD) System Check. Was the check performed?	–	Go to *Step 2*	Go to “Euro On-Board Diagnostic System Check.
2	With a test light connected to the ground, probe the Data Link Connector (DLC) battery feed terminal 16. Is the test light on?	–	Go to *Step 4*	Go to *Step 3*
3	Repair an open or short to ground in the DLC battery feed circuit . Is the repair complete?	–	Go to *Step 4*	–
4	With a test light connected to the battery, probe the Data Link Connector (DLC) ground terminal 4 and 5. Is the test light on?	–	Go to *Step 6*	Go to *Step 5*
5	Repair an open circuit . Is the repair complete?	–	Go to *Step 6*	–
6	1. Turn the ignition OFF. 2. Connect a scan tool to the Data Link Connector (DLC). 3. Turn the ignition ON. Does the scan tool power up?	–	Go to *Step 8*	Go to *Step 7*
7	Check for damages in the terminal of DLC and scan tool, and repair as needed. Is the repair complete?	–	Go to *Step 8*	–
8	Using a scan tool, request engine data of Engine Control Module (ECM). Does the scan tool display any data?	–	Go to *Step 12*	Go to *Step 9*
9	Install the scan tool on another vehicle and check for proper operation. Does the scan tool work properly on a different vehicle.	–	Go to *Step 11*	Go to *Step 10*
10	The scan tool is malfunctioning. Refer to the scan tool’s manual for repair. Is the repair complete?	–	Go to *Step 12*	–
11	Repair communication circuit between ECM and DLC. Is the repair complete?	–	Go to *Step 12*	–
12	1. Using a scan tool, clear the Diagnostic Trouble Codes(DTCs). 2. Attempt to start the engine. Does the engine and continue to run?	–	Go to *Step 13*	Go to *Step 1*
13	1. Allow the engine to idle until normal operation temperature reached. 2. Check if any DTCs are set? Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

FUEL INJECTOR BALANCE TEST

A fuel injector tester is used to energize the injector for a precise amount of time, thus spraying a measured amount of fuel into the intake manifold. This causes a drop in the fuel rail pressure that can be recorded and used to compare each of the fuel injectors. All of the fuel injectors should have the same pressure drop.

Fuel Injector Balance Test Example

Cylinder	1	2	3
First Reading	380 kPa (55 psi)	380 kPa (55 psi)	380 kPa (55 psi)
Second Reading	215 kPa (31 psi)	201 kPa (29 psi)	230 kPa (33 psi)
Amount Of Drop	165 kPa (24 psi)	179 kPa (26 psi)	151 kPa (22 psi)
Average Range: 156-176 kPa (22.5-25.5 psi)	Injector OK	Faulty Injector – Too Much Pressure Drop	Faulty Injector – Too Little Pressure Drop

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

Caution: Do not pinch or restrict fuel lines. Damage to the lines could cause a fuel leak, resulting in possible fire or personal injury.

Notice: In order to prevent flooding of the engine, do not perform the Injector Balance Test more than once (including any retest on faulty fuel injectors) without running the engine.

Test

Notice: An engine cool down period of 10 minutes is necessary in order to avoid irregular readings due to hot soak fuel boiling.

1. Connect the fuel pressure gauge carefully to avoid any fuel spillage.
2. The fuel pump should run about 2 seconds after the ignition is turned to the ON position.
3. Insert a clear tube attached to the vent valve of the fuel pressure gauge into a suitable container.
4. Bleed the air from the fuel pressure gauge and hose until all of the air is bled from the fuel pressure gauge.
5. The ignition switch must be in the OFF position at least 10 seconds in order to complete the electronic control module (ECM) shutdown cycle.
6. Turn the ignition ON in order to get the fuel pressure to its maximum level.
7. Allow the fuel pressure to stabilize and then record this initial pressure reading. Wait until there is no movement of the needle on the fuel pressure gauge.
8. Follow the manufacturer's instructions for the use of the adapter harness. Energize the fuel injector tester once and note the fuel pressure drop at its lowest point. Record this second reading. Subtract it from the first reading to determine the amount of the fuel pressure drop.
9. Disconnect the fuel injector tester from the fuel injector.
10. After turning the ignition ON, in order to obtain maximum pressure once again, make a connection at the next fuel injector. Energize the fuel injector tester and record the fuel pressure reading. Repeat this procedure for all the injectors.
11. Retest any of the fuel injectors that the pressure drop exceeds the 10 kPa (1.5 psi) specification.
12. Replace any of the fuel injectors that fail the retest.
13. If the pressure drop of all of the fuel injectors is within 10 kPa (1.5 psi), then the fuel injectors are flowing normally and no replacement should be necessary.
14. Reconnect the fuel injector harness and review the symptom diagnostic tables.