Marine Electronic Fuel Injection (MEFI)

Section 5

Port Fuel Injection (PFI) Diagnosis

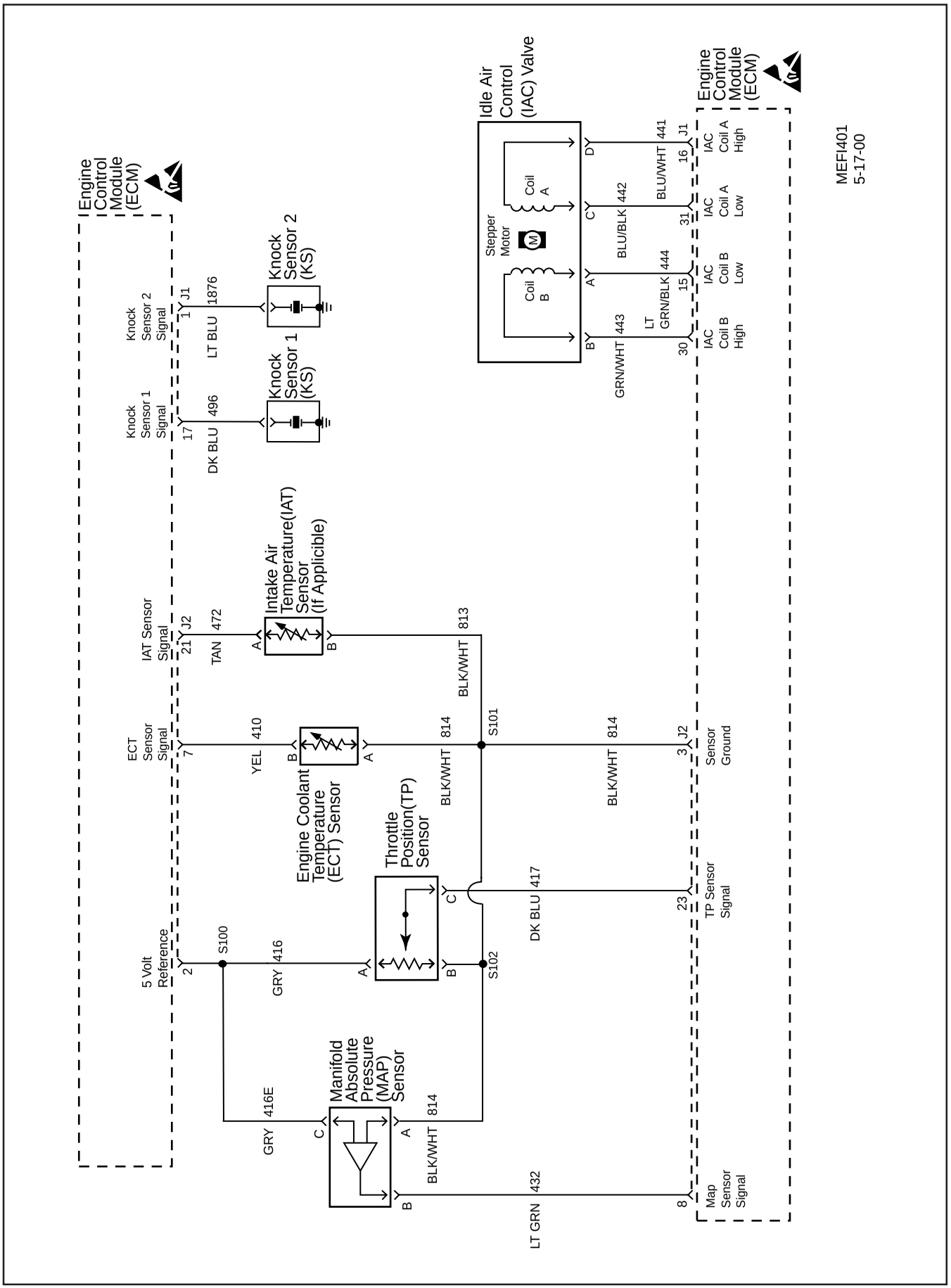
This section will be used to perform diagnostic procedures on the Marine Electronic Fuel Injection equipped engines. The section describes system circuits and diagnostic tables used to diagnose the circuits. It will be used to correct Diagnostic Trouble Codes (DTCs) by following tables for either non-scan or scan tool use. This section contains the On-Board Diagnostic (OBD) System Check that is the first step to perform before any further diagnostics or repairs are made to the MEFI system.

The assumption is made that on all diagnostic tables, the engine is equipped with GM Marine ECM, sensors, wiring harness, fuel components and ignition components. The wiring schematics and circuit identifications are for the GM MEFI originally equipped wiring harness.

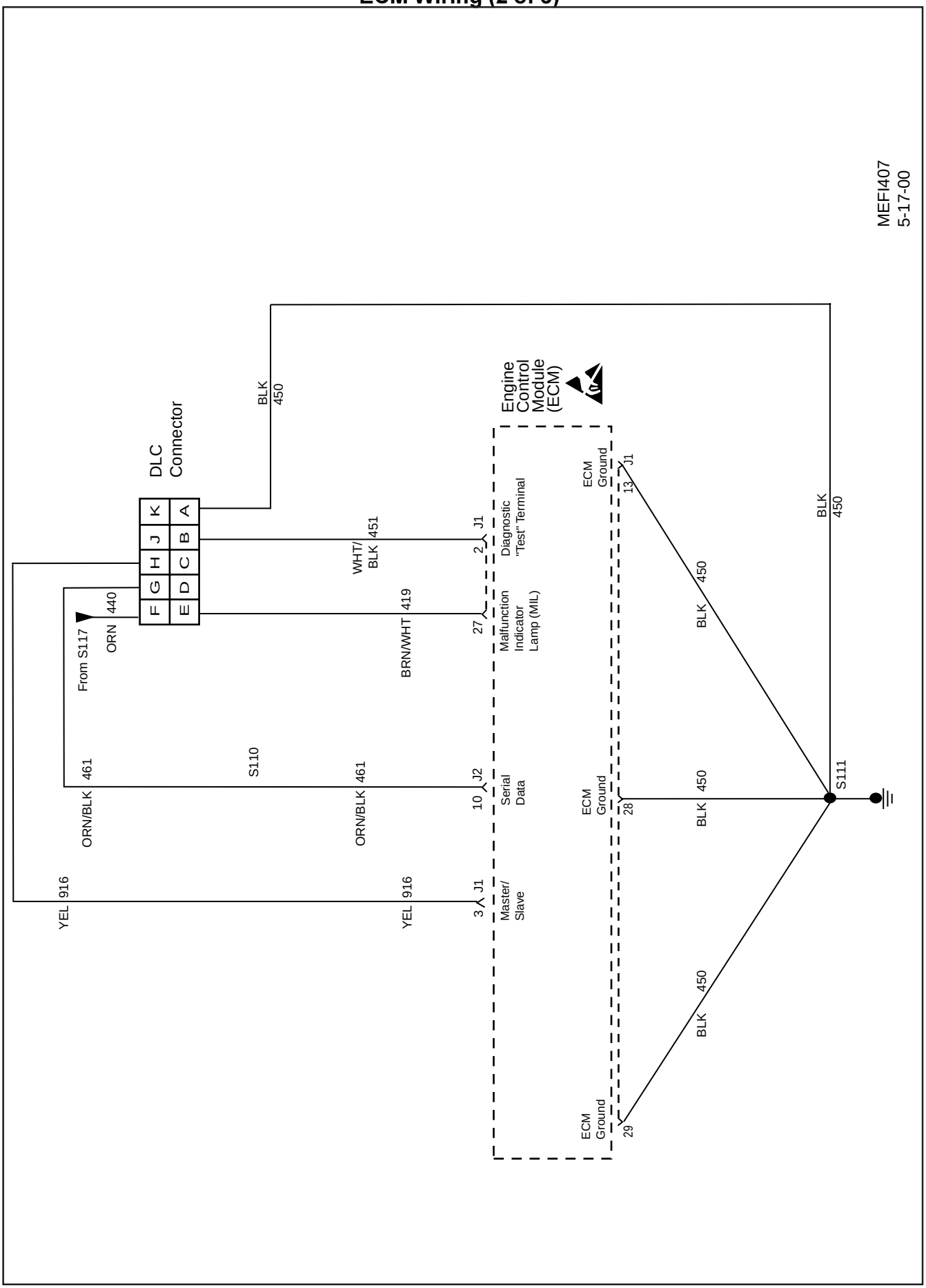
The diagnostic tables and voltages shown are prepared with the requirement that the system functioned correctly at the time of assembly and that there are no multiple failures.

Contents

ECM Wiring (1 of 5)



ECM Wiring (2 of 5)



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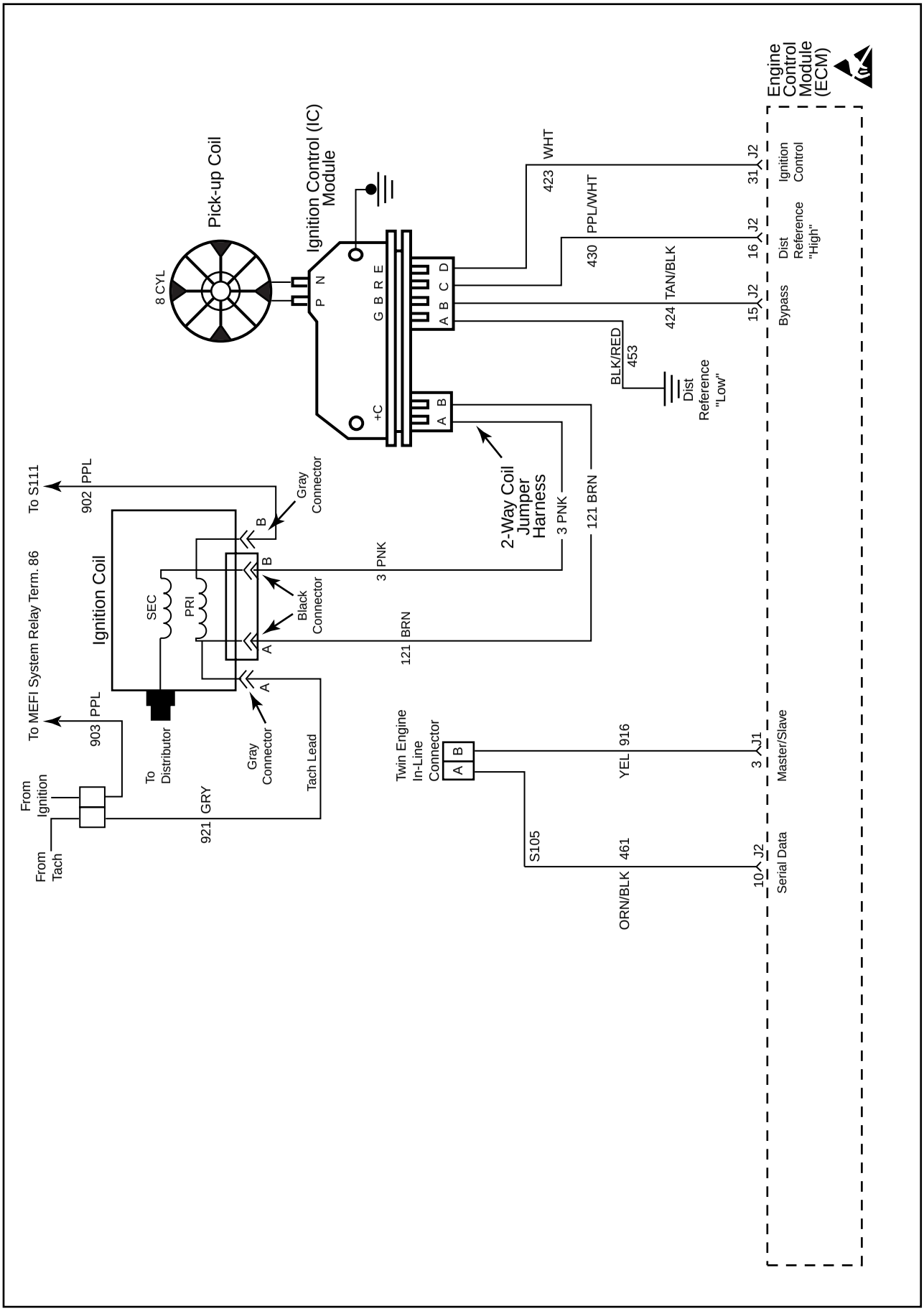

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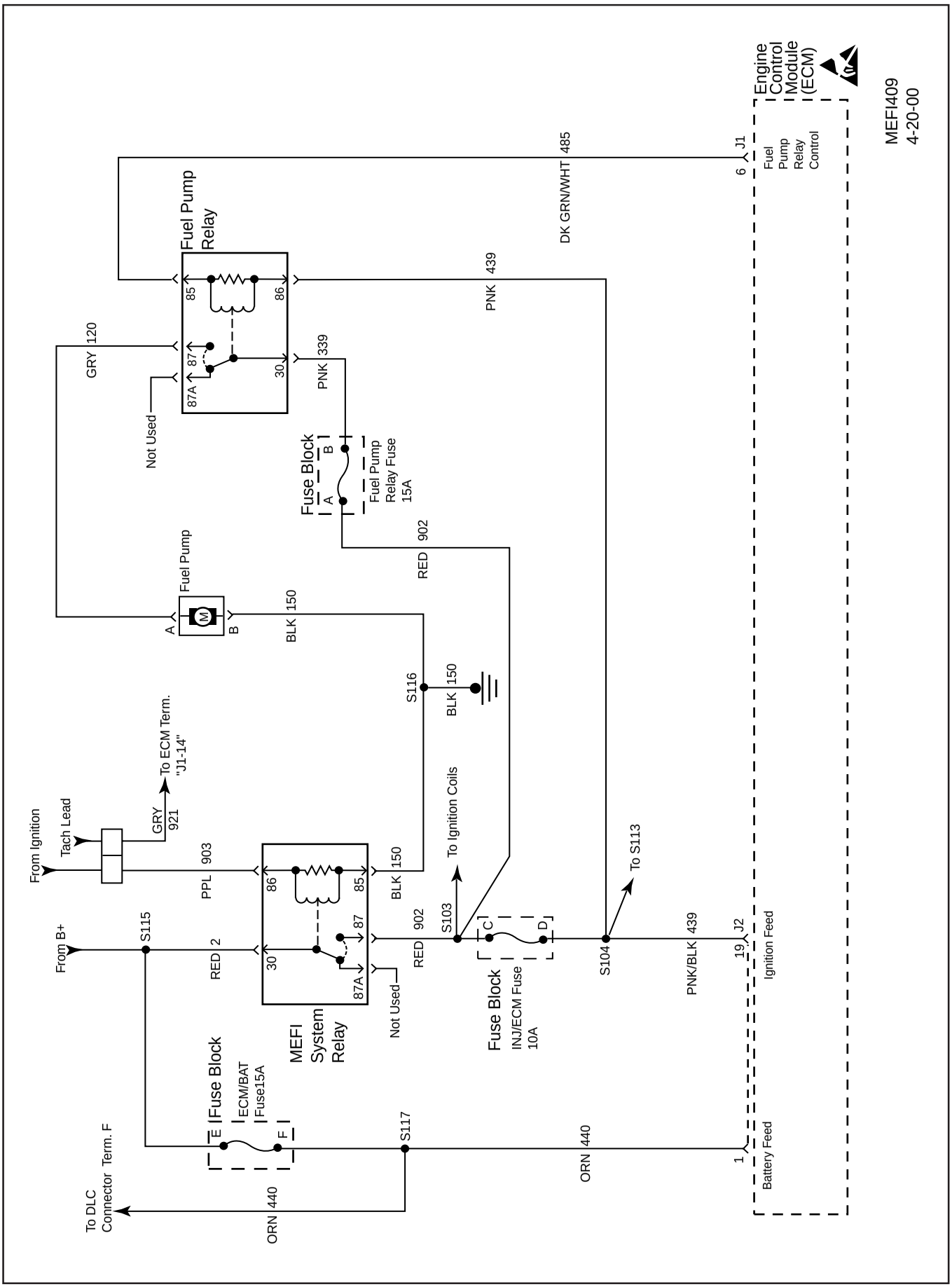
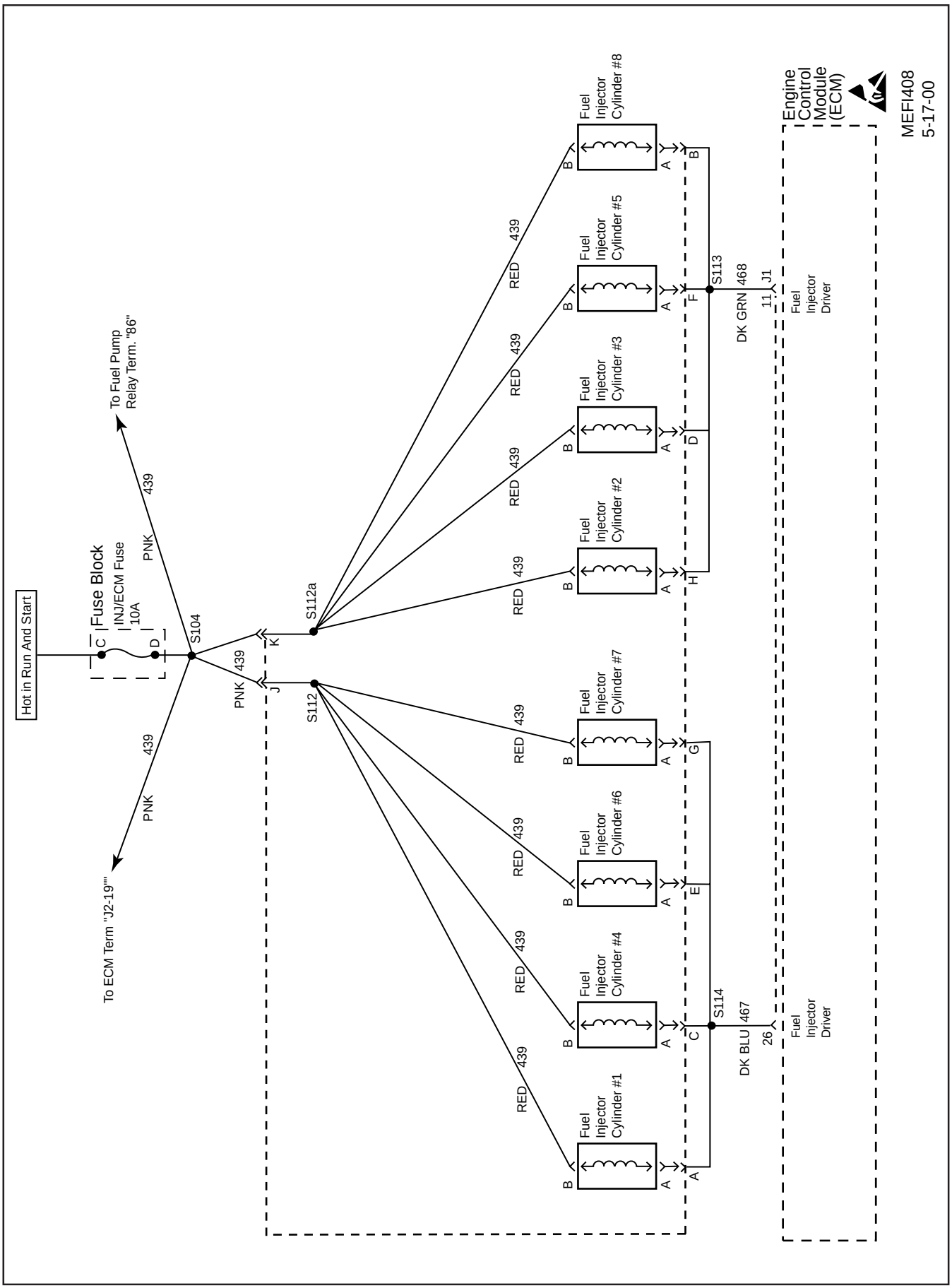


ECM Wiring (5 of 5)



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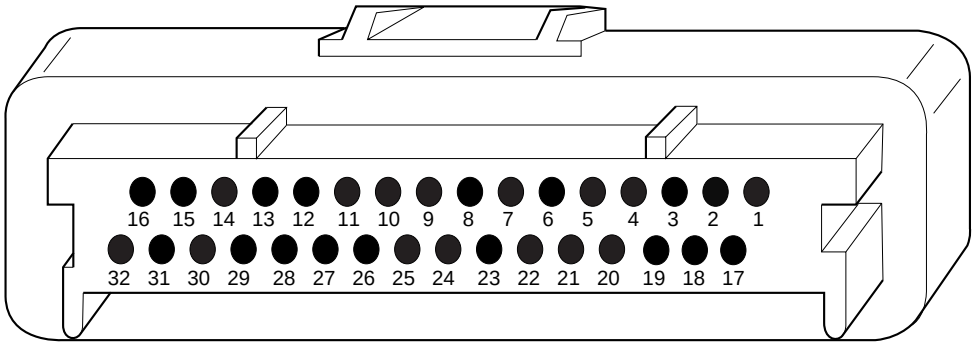
ECM Connector Identification (1 of 2)

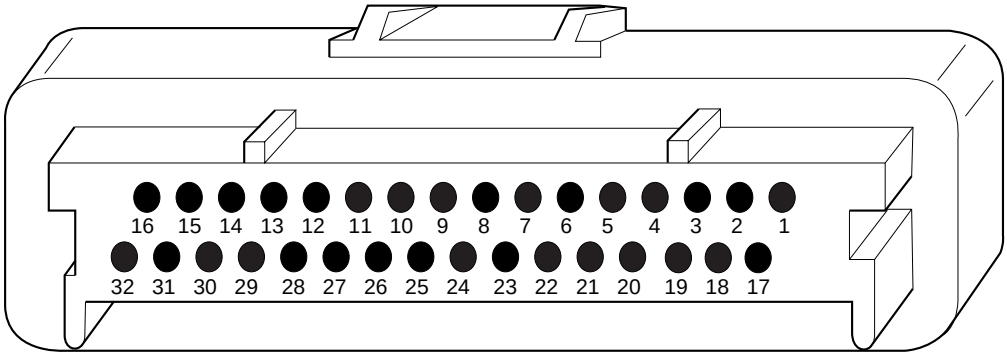


J-1

ECM 32 WAY OUTPUT CONNECTOR

ECM PIN NUMBER	CKT(WIRE) NUMBER	CKT (WIRE) COLOR	CIRCUIT DESCRIPTION
J1-1	468	LT BLU	KNOCK SENSOR 2 SIGNAL (OPTIONAL)
J1-2	451	WHT/BLK	DIAGNOSTIC "TEST" TERMINAL
J1-3	916	YEL	MASTER/SLAVE
J1-4		TAN/BLK	GENERAL WARNING 2 / GOVERNOR MODE
J1-5			EMERGENCY STOP
J1-6	485	DK GRN/WHT	FUEL PUMP RELAY CONTROL
J1-7			RPM CHANGE STATE
J1-8		BRN/WHT	BUZZER
J1-9			CHECK GAUGES / GOVERNOR OVERSPEED LAMP
J1-10			
J1-11	468	DK GRN	FUEL INJECTOR B DRIVER
J1-12			EXHAUST GAS RECIRCULATION (EGR) VALVE
J1-13	450	BLK	ECM GROUND
J1-14		GRAY	TACHOMETER OUTPUT
J1-15	444	LT GRN/BLK	IDLE AIR CONTROL (IAC) COIL "B" LOW
J1-16	441	BLU/WHT	IDLE AIR CONTROL (IAC) COIL "A" HIGH
J1-17	467	DK BLU	KNOCK SENSOR 1 SIGNAL
J1-18			OIL LEVEL
J1-19		TAN/BLK	GENERAL WARNING 1 / FCAL
J1-20		YEL/BLK	LOAD 1 / LOCK LO / SHIFT INTERRUPT
J1-21			LOAD 2 / TWIN ENGINE SYNC / TROLL MODE
J1-22			GENERAL WARNING 1 LAMP / TRANS LAMP / CANISTER PURGE
J1-23			GENERAL WARNING 2 LAMP / TROLL LAMP / GOVERNOR
J1-24			OIL LEVEL LAMP
J1-25			
J1-26	467	DK BLU	FUEL INJECTOR A DRIVER
J1-27		BRN/WHT	CHECK ENGINE
J1-28	450	BLK	ECM GROUND
J1-29	450	BLK	ECM GROUND
J1-30	443	LT GRN/WHT	IDLE AIR CONTROL (IAC) COIL "B" HIGH
J1-31	442	BLU/BLK	IDLE AIR CONTROL (IAC) COIL "A" LOW
J1-32			FUEL PRESSURE RELAY SENSE

ECM Connector Identification (2 of 2)



J-2
ECM 32 WAY OUTPUT CONNECTOR

ECM PIN NUMBER	CKT(WIRE) NUMBER	CKT (WIRE) COLOR	CIRCUIT DESCRIPTION
J2-1	440	ORN	BATTERY FEED
J2-2	416	GRY	5 VOLT REFERENCE
J2-3	814	BLK/WHT	SENSOR GROUND
J2-4			FUEL PRESSURE SENSOR SIGNAL
J2-5			EXHAUST GAS RECIRCULATION (EGR) VALVE FEEDBACK
J2-6			HEATED OXYGEN (HO2) SENSOR “1” SIGNAL
J2-7	410	YEL	ECT SENSOR SIGNAL
J2-8	432	LT GRN	MAP SENSOR SIGNAL
J2-9			
J2-10	461	ORN/BLK	SERIAL DATA
J2-11	410		TAC SERIAL DATA 2
J2-12	2123	LT BLU	IGNITION CONTROL H
J2-13	2125	DK GRN	IGNITION CONTROL F
J2-14	2122	PPL/WHT	IGNITION CONTROL D
J2-15	424	TAN/BLK	IGNITION BYPASS
J2-16	430	PPL/WHT	DISTRIBUTOR REFERENCE “HIGH”
J2-17	631	RED/BLK	DEPSPOWER
J2-18	632	YEL/BLK	DEPSLO
J2-19	439	PNK/BLK	IGNITION FEED
J2-20			OIL PRESSURE INPUT
J2-21	472	TAN	IAT SENSOR SIGNAL
J2-22			HEATED OXYGEN (HO2) SENSOR “2” SIGNAL
J2-23	417	DK BLU	TP SENSOR SIGNAL
J2-24			
J2-25			SPEED SENSOR SIGNAL (VF)
J2-26			SPEED SENSOR SIGNAL (AN) / FUEL TEMPERATURE
J2-27	1061		TAC SERIAL DATA 1
J2-28			
J2-29			
J2-30			
J2-31	423	WHT	IGNITION CONTROL
J2-32	633	BRN/WHT	CAM SENSOR SIGNAL

Typical Scan Tool Data Values

Use the TYPICAL SCAN TOOL DATA VALUES table only after the On-Board Diagnostic (OBD) System Check has been completed, no DTC(s) were noted and you have determined the on-board diagnostics are functioning properly. Scan tool values from a properly running engine may be used for comparison with the engine you are diagnosing. The TYPICAL SCAN TOOL DATA VALUES represent values that would be seen on a normally running engine.

NOTICE: A scan tool that displays faulty data should not be used, and the problem should be reported to the scan tool manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Only the parameters listed below are referred to in this service manual for use in diagnosis. If all values are within the typical range described below, refer to *Symptoms* section for diagnosis.

TEST CONDITIONS

Idle / Warm Engine / Closed Throttle / Neutral

Scan Tool Data Values

Scan Tool Parameter	Units Displayed	Typical Data Value
Calibration ID	Numeric	0-255. Identification number assigned to a specific calibration.
Calibration Checksum	Numeric	0-65535
Engine Speed	RPM	±100 RPM from Desired Idle.
Desired Idle	RPM	ECM commanded idle speed (varies with temperature).
ECT	°C, °F	65°C - 75°C / 149°F - 167°F (varies with temperature).
IAT	°C, °F	Varies with ambient air temperature. (Big Block Only).
MAP	kPa / Volts	29 - 48 kPa / 1 - 2 Volts (Depends on engine vacuum and barometric pressure).
Baro	kPa / Volts	65 - 110 kPa (Depends on altitude and barometric pressure).
TP Sensor	Volts	0.70 - 0.80 Volts
TP Angle	Percent	0 - 2%
Fuel Consumption	GPH	GPH (Varies with application).
Injector Pulse Width	mSEC	mSEC (Varies with application).
Spark Advance	Degrees	6 - 26°(Varies Continuously)
Knock Retard	Degrees of Retard	0°
KS Enabled	Yes / No	Yes
Knock Signal	Yes / No	No
Knock 1	OK / Fault	OK
Knock 2	OK / Fault	OK
Idle Air Control	Counts	20 - 40 Counts
IAC Throttle Follower	Counts	20 - 60 Counts
Closed Throttle	Yes / No	Yes
Vessel Speed	MPH	0 MPH
Battery / Ignition Voltage	Volts	12.0 - 14.5 Volts
System Voltage Warning	OK / Low Voltage	OK
J2-9 Input	On / Off	Dependent on usage.
J2-20 Input	On / Off	Dependent on usage.
Emergency Stop Mode	Yes / No	No
Troll RPM Limit	On / Off	Off
Malfunction Indicator Lamp (MIL)	On / Off	Off

Scan Tool Data Values cont.

Scan Tool Parameter	Units Displayed	Typical Data Value
Fuel Pump Relay	On / Off	On
Cause Power Reduction	Yes / No	No
Power Reduction	Yes / No	No
Overheat Detected	Yes / No	No
Oil Pressure Warning	OK / Low Pressure	OK
Check Gauges Lamp	On / Off	Off
Oil Level Warning	OK / Low	OK
Low Oil Level Lamp	On / Off	Off
Buzzer	On / Off	Off
General Warning 1	OK / Fault Detected	OK
J1-22 Output	On / Off	Dependent on usage.
General Warning 2	OK / Fault Detected	OK
J1-23 Output	On / Off	Dependent on usage.
ECM Master / Slave	Master / Slave	Master (usable for twin engine diagnosis).
J1-7 RPM Output	On / Off	Dependent on usage.
Time From Start	Hrs:Min	Dependent on Time of Ignition Cycle.
Engine Hour Meter	Hours	Dependent on Engine Run Time.

System Configuration Options

This is an options menu that can be used in order to determine how this system is configured. Each item in the "Option" column will be displayed with either a "Yes" or "No" following it.

Option	Configured
4mH Ignition Coil	Yes / No
Knock Sensor(s)	Yes / No
Knock Sensor Module	Yes / No
Intake Air Temperature (IAT) Sensor	Yes / No
Linear EGR Valve	Yes / No
Engine Sync Pulse	Yes / No
Internal Coil Driver	Yes / No
2 Atmosphere MAP Sensor	Yes / No
Vessel Speed Sensor	Yes / No
Governor	Yes / No
Load Anticipate 1	Yes / No
Load Anticipate 2	Yes / No
RPM Change State	Yes / No
Troll Mode	Yes / No
Shift Interrupt	Yes / No
Transmission Upshift	Yes / No
Twin Engine Shift Sync	Yes / No
Emergency Stop Switch	Yes / No
Twin Engine System	Yes / No

Scan Tool Data Definitions

The scan tool information will assist in diagnosing emission or drivability problems. The displays can be viewed while the vessel is being driven. Always perform the "On-Board Diagnostic (OBD) System Check" first. The "OBD System Check" will confirm proper system operation.

ECM Data Descriptions

CALIBRATION ID - Scan Tool Range 0-255 - This is an identification number given to each calibration by the OEM.

CALIBRATION CHECKSUM - Scan Tool Range 0-65535 - This number is automatically calculated by the ECM. This number may also be used as a calibration identifier.

ENGINE SPEED - Scan Tool Range 0-9999 RPM - Engine speed is computed by the ECM from the Ignition Control reference input. It should remain close to the desired idle under various engine loads with engine idling.

DESIRED IDLE - Scan Tool Range 0-3187 RPM - The idle speed that is commanded by the ECM. The ECM will compensate for various engine loads based on engine coolant temperature to keep the engine at the desired speed.

ECT - Scan Tool Range -40°C to 151°C, -40°F to 304°F - The Engine Coolant Temperature (ECT) sensor is mounted in the coolant stream and sends engine temperature information to the ECM. The ECM supplies 5 volts to the ECT sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes. When the sensor is cold (internal resistance high), the ECM monitors a high signal voltage and interprets it as a cold engine. As the sensor warms (internal resistance decreases), the voltage signal will decrease and the ECM will interpret the lower voltage as a warm engine.

IAT - Scan Tool Range -40°C to 151°C, -40°F to 304°F - The ECM converts the resistance of the intake air temperature sensor to degrees. Intake Air Temperature (IAT) is used by the ECM to adjust fuel delivery and spark timing according to incoming air density. (Big Block Multiport Fuel Injection Application Only).

MAP - Scan Tool Range 10-210 kPa/0.00-5.00 Volts - The Manifold Absolute Pressure (MAP) sensor measures the change in the intake manifold pressure from engine load and speed changes. As intake manifold pressure increases, intake vacuum decreases resulting in a higher MAP sensor voltage and kPa reading.

BARO - Scan Tool Range 10-105 kPa/0.00-5.00 Volts - The Barometric Pressure reading displayed is measured from the MAP sensor signal monitored at ignition "ON," engine "OFF" and WOT conditions. The Barometric Pressure is used to compensate for altitude differences.

TP SENSOR - Scan Tool Range 0.00-5.00 Volts - This is the voltage being monitored by the ECM on the TP sensor signal circuit.

TP ANGLE - Scan Tool Range 0% - 100% - TP Angle is computed by the ECM from the TP Sensor voltage. TP Angle should display 0% at idle and 100% at wide open throttle.

FUEL CONSUMPTION - Scan Tool Range 0-100 gph - This is the gallons per hour of fuel that the engine is consuming.

INJ. PULSE WIDTH - Scan Tool Range 0-1000 msec. - Indicates the amount of time the ECM is commanding the injectors "ON" during each engine cycle. A larger injector pulse width will cause more fuel to be delivered. Inj. Pulse Width should increase with increased engine load.

SPARK ADVANCE - Scan Tool Range -90° to 90°- This is a display of the spark advance (IC) calculations which the ECM calculates and then provides all spark advance to the ignition system. The ECM computes the desired spark advance using data such as engine temperature, RPM, engine load, vessel speed, and operating mode. There is no adjustment for spark advance. The ECM also uses spark advance to help maintain idle speed. Under normal operating condition, with the engine warmed up and 0% throttle angle, it is normal to see timing vary continuously.

KNOCK RETARD - Scan Tool Range 0.0°-45.5° - Indicates the amount of spark the ECM is removing from IC spark advance in response to the signal from the knock sensor (KS).

KS ENABLED - Scan Tool Displays "YES" or "NO" - This is informing you whether or not the Knock System is enabled.

KNOCK SIGNAL - Scan Tool Displays "YES" or "NO" - Indicates whether or not a knock signal is being detected by the ECM. Should display "NO" at idle.

KNOCK SENSOR 1 - Scan Tool Displays "OK" or "Fault" - Indicates whether or not a fault is being detected on the knock sensor 1 circuit.

KNOCK SENSOR 2 - Scan Tool Displays "OK" or "Fault" - Indicates whether or not a fault is being detected on the knock sensor 2 circuit.

IAC POSITION - Scan Tool Range 0-255 - Displays the commanded position of the idle air control pintle in counts. A larger number of counts means that more air is being commanded through the idle air passage. Idle air control should respond fairly quickly to changes in engine load to maintain desired idle RPM.

IAC THROTTLE FOLLOWER - **Scan Tool Range 0-255** - When the throttle is moved from the closed throttle position, some idle air control counts are added to prevent stalling when returned to the closed throttle position.

CLOSED THROTTLE - Scan Tool Displays "YES" or "NO" - Indicates whether the throttle is in the closed position.

VESSEL SPEED - Scan Tool Range 0-255 MPH - Indicates the speed of the vessel in MPH.

BATTERY / IGNITION VOLTAGE - **Scan Tool Range 0.0** - **25.5 volts** - This represents the system voltage

SYSTEM VOLTAGE WARNING - Scan Tool Displays "OK" or "LOW VOLTAGE" - Indicates if there may be a fault in the charging system.

J1-20 INPUT - Scan Tool Displays "ON" or "OFF" - This is a discrete input to the ECM that is determined and calibratible per OEM.

J1-21 INPUT - Scan Tool Displays "ON" or "OFF" - This is a discrete input to the ECM that is determined and calibratible per OEM.

EMERGENCY STOP MODE - Scan Tool Displays "YES" or "NO" - Indicates whether you are in emergency stop mode or not.

TROLL RPM LIMIT - Scan Tool Displays "ON" or "OFF" - This is a discrete input to the ECM which limits the RPM for such things as trolling. This RPM limit is calibratible by the OEM.

MIL - Scan Tool Displays "ON" or "OFF" - Indicates the ECM commanded state of the Malfunction Indicator Lamp.

FUEL PUMP RELAY - Scan Tool Displays "ON" or "OFF" - Indicates the ECM commanded state of the fuel pump relay driver circuit.

CAUSE POWER REDUCTION - Scan Tool Displays "YES" or "NO" - Indicates whether or not the ECM has recognized a fault which would put the engine into Power Reduction when the appropriate RPM is achieved.

POWER REDUCTION - Scan Tool Displays "YES" or "NO" - Indicates whether or not the ECM is functioning in Power Reduction mode. During this mode, the ECM only triggers one injector driver resulting in fuel to only half of the cylinders.

OVERHEAT DETECTED - Scan Tool Displays "YES" or "NO" - Indicates if the ECM has recognized an overheat condition with the engine.

OIL PRESSURE WARNING - Scan Tool Displays "OK" or "LOW PRESSURE" - Indicates if the ECM has recognized a fault in the oil pressure circuit.

CHECK GAUGES LAMP - **Scan Tool Displays "ON" or "OFF"** - Indicates the ECM commanded state of the Check Gauges lamp.

OIL LEVEL WARNING - **Scan Tool Displays "OK" or "LOW"** - Indicates if the ECM has recognized a fault in the oil level circuit.

BUZZER - Scan Tool Displays "ON" or "OFF" - Indicates the ECM commanded state of the Buzzer.

GENERAL WARNING 1 - Scan Tool Displays "OK" or "Fault Detected" - This is a discrete input to the ECM that is determined and calibratible per OEM.

J1-22 OUTPUT - Scan Tool Displays "ON" or "OFF" - ECM driven output that is determined and calibratible per OEM.

GENERAL WARNING 2 - Scan Tool Displays "OK" or "Fault Detected" - This is a discrete input to the ECM that is determined and calibratible per OEM.

J1-23 OUTPUT - Scan Tool Displays "ON" or "OFF" - ECM driven output that is determined and calibratible per OEM.

ECM MASTER / SLAVE - Scan Tool Displays "MASTER" or "SLAVE" - Indicates whether you are receiving data from a master or a slave engine.

J1-7 RPM OUTPUT - Scan Tool Displays "ON" or "OFF" - ECM driven output that is determined and calibratible per OEM.

TIME FROM START - Scan Tool Range 00:00:00-99:99:99 Hrs:Min:Sec - Indicates the amount of time the ignition key was in the "ON" or "RUN" position. Once the key has been cycled to the "OFF" position, this counter will reset to 00:00.

ENGINE HOUR METER - Scan Tool Range 00:00:00-99:99:99 Hrs:Min:Sec - Indicates the engine run time.

ECM Diagnostic Trouble Codes

The Malfunction Indicator Lamp (MIL) will be "ON" if the malfunction exists under the conditions listed below. If the malfunction clears, the lamp will go out and the Diagnostic Trouble Code (DTC) will be stored in the ECM. Any DTC's stored will be erased if no problem reoccurs within 50 engine starts. The amount of time after the malfunction occurs before the MIL illuminates is calibratible. (Instantly or up to one minute).

Many of the DTC tables include a functional check of the system that may pinpoint a problem. However, it is important to remember that the DTC tables are specifically designed for use only when a DTC is set. Therefore, a thorough understanding of the normal operation of the system being diagnosed is necessary, and use of the tables for this purpose is at the discretion of the technician.

NOTICE: Some DTC's are referred as "Latching Codes." A latching code will cause the MIL lamp to stay "ON" during an ignition cycle whether the malfunction is corrected or not. This also means you can not clear the DTC during the same ignition cycle.

Diagnostic Trouble Code (DTC) Table

DTC	Description
DTC 13	Oxygen (O2) Sensor 1 Circuit Inactive
DTC 13	Oxygen (O2) Sensor 2 Circuit Inactive
DTC 14	Engine Coolant Temperature (ECT) Sensor Circuit. Low Temperature Indicated.
DTC 15	Engine Coolant Temperature (ECT) Sensor Circuit. High Temperature Indicated.
DTC 21	Throttle Position (TP) Sensor Circuit. High Signal Voltage Indicated.
DTC 22	Throttle Position (TP) Sensor Circuit. Low Signal Voltage Indicated.
DTC 23	Intake Air Temperature (IAT) Sensor Circuit. Low Temperature Indicated.
DTC 24	Vehicle Speed Sensor (VSS) Circuit Inactive.
DTC 25	Intake Air Temperature (IAT) Sensor Circuit. High Temperature Indicated.
DTC 31	Governor System Inactive
DTC 32	Exhaust Gas Recirculation (EGR) Valve Circuit Inactive.
DTC 33	Manifold Absolute Pressure (MAP) Sensor Circuit. High Signal Voltage Indicated.
DTC 34	Manifold Absolute Pressure (MAP) Sensor Circuit. Low Signal Voltage Indicated.
DTC 41	Ignition Control (IC) Circuit Open.
DTC 42	Ignition Control (IC) Circuit Fault, IC Grounded or Open, Grounded Bypass.
DTC 44	Knock Sensor (KS) 1 Circuit Inactive.
DTC 44	Knock Sensor (KS) 2 Circuit Inactive.
DTC 51	Calibration Checksum Failure.
DTC 54	Oxygen (O2) Sensor 1 Low Voltage. Lean Exhaust Indicated.

Diagnostic Trouble Code (DTC) Table (cont'd)

DTC	Description
DTC 54	Oxygen (O2) Sensor 2 Low Voltage. Lean Exhaust Indicated.
DTC 55	Oxygen (O2) Sensor 1 Low Voltage. Rich Exhaust Indicated.
DTC 55	Oxygen (O2) Sensor 2 Low Voltage. Rich Exhaust Indicated.
DTC 61	High Fuel Pressure Indicated.
DTC 62	Low Fuel Pressure Indicated.
DTC 63	High Fuel Temperature Indicated.
DTC 64	Low Fuel Temperature Indicated.
DTC 81	Throttle Actuator Control (TAC) Malfunction - ETC Applications.
DTC 81	Fuel Pump High, Low or Open.
DTC 81	Injector Driver A Circuit High, Low or Open.
DTC 81	Injector Driver B Circuit High, Low or Open.
DTC 81	Recirc J1-32 Fault.
DTC 81	5 Volt Reference Circuit Out of Range.
DTC 81	CAN Bus Fault
DTC 81	Oil/Catalyst Temperature High.
DTC 81	Throttle Position (TP) Sensor 2 Out of Range - ETC Applications.
DTC 81	Throttle Position (TP) Sensor 1 Out of Range - ETC Applications.
DTC 81	Pedal Position Sensor (PPS) 3 Out of Range - ETC Applications.
DTC 81	Pedal Position Sensor (PPS) 2 Out of Range - ETC Applications.
DTC 81	Pedal Position Sensor (PPS) 1 Out of Range - ETC Applications.
DTC 81	Bad Checksum - ETC Applications.
DTC 81	No TAC Module Reply - ETC Applications.
DTC 81	CAN Bus Contention.
DTC 81	Serial Communication Fault - ETC Applications.
DTC 81	Throttle Position (TP) Sensor 1 / 2 Correction - ETC Applications
DTC 81	Pedal Position Sensor (PPS) 2 / 3 Correction - ETC Applications.
DTC 81	Pedal Position Sensor (PPS) 1 / 3 Correction - ETC Applications.
DTC 81	Pedal Position Sensor (PPS) 1 / 2 Correction - ETC Applications.
DTC 81	Limited Authority - ETC Applications.
DTC 81	Actuation Fault - ETC Applications.
DTC 81	Process Fault - ETC Applications.
DTC 81	Not Tracking - ETC Applications.
DTC 81	Throttle Return Fault - ETC Applications.

Logged Warnings

These warnings will be displayed following the Diagnostic Trouble Codes. They can be cleared the same as the trouble codes. Unlike trouble codes, these warnings can not be flashed out through the MIL using the DTC tool.

Description
Overheat
Low Oil Pressure / Catalyst Temperature
Low System Voltage
Low Oil Level
General Warning 1 (J1-19)
General Warning 2 (J1-4)
Low Fuel Pressure
Stop Engine Warning

Clearing Diagnostic Trouble Codes - Non Scan

1. Install Diagnostic Trouble Code (DTC) tool.
2. Ignition "ON," engine "OFF."
3. Switch DTC tool to "service mode" or "ON."
4. Move the throttle from 0% (idle) to 100% (WOT) and back to 0%.
5. Switch DTC tool to "normal mode" or "OFF." (If this step is not performed, the engine may not start and run).
6. Turn ignition "OFF" for at least 20 seconds.
7. Ignition "ON," engine "OFF."
8. Switch DTC tool to "service mode" or "ON" and verify DTC 12 only. Remove MDTC tool.
9. If original DTC's are still present, check "Notice" below and repeat the DTC clearing procedure.
10. If new DTC's are displayed, perform the "On-Board Diagnostic" (OBD) system check.

Clearing Diagnostic Trouble Codes - Scan

1. Install scan tool.
2. Start engine.
3. Select "Clear DTC's" function.
4. Clear DTC's.
5. Turn ignition "OFF" for at least 20 seconds.
6. Turn ignition "ON" and read DTC's. If DTC's are still present, check "Notice" below and repeat procedure following from step 2.

NOTICE: When clearing DTC's with or without the use of a scan tool, the ignition must be cycled to the "OFF" position or the DTC's will not clear.

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Diagnostic Information and Procedures

A Diagnostic Starting Point - Engine Controls

Begin the system diagnosis with *A Diagnostic System Check-Engine Controls.* The Diagnostic System Check will provide the following information:

- The ability of the control module to communicate through the serial data circuit.
- The identification of any stored Diagnostic Trouble Codes (DTCs) and Logged Warnings.

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system.

A Diagnostic System Check - Engine Controls

Description

The Diagnostic System Check is an organized approach to identifying a condition that is created by a malfunction in the electronic engine control system. The Diagnostic System Check must be the starting point for any driveability concern. The Diagnostic System Check directs the service technician to the next logical step in order to diagnose the concern. Understanding, and correctly using the diagnostic table reduces diagnostic time, and prevents the replacement of good parts.

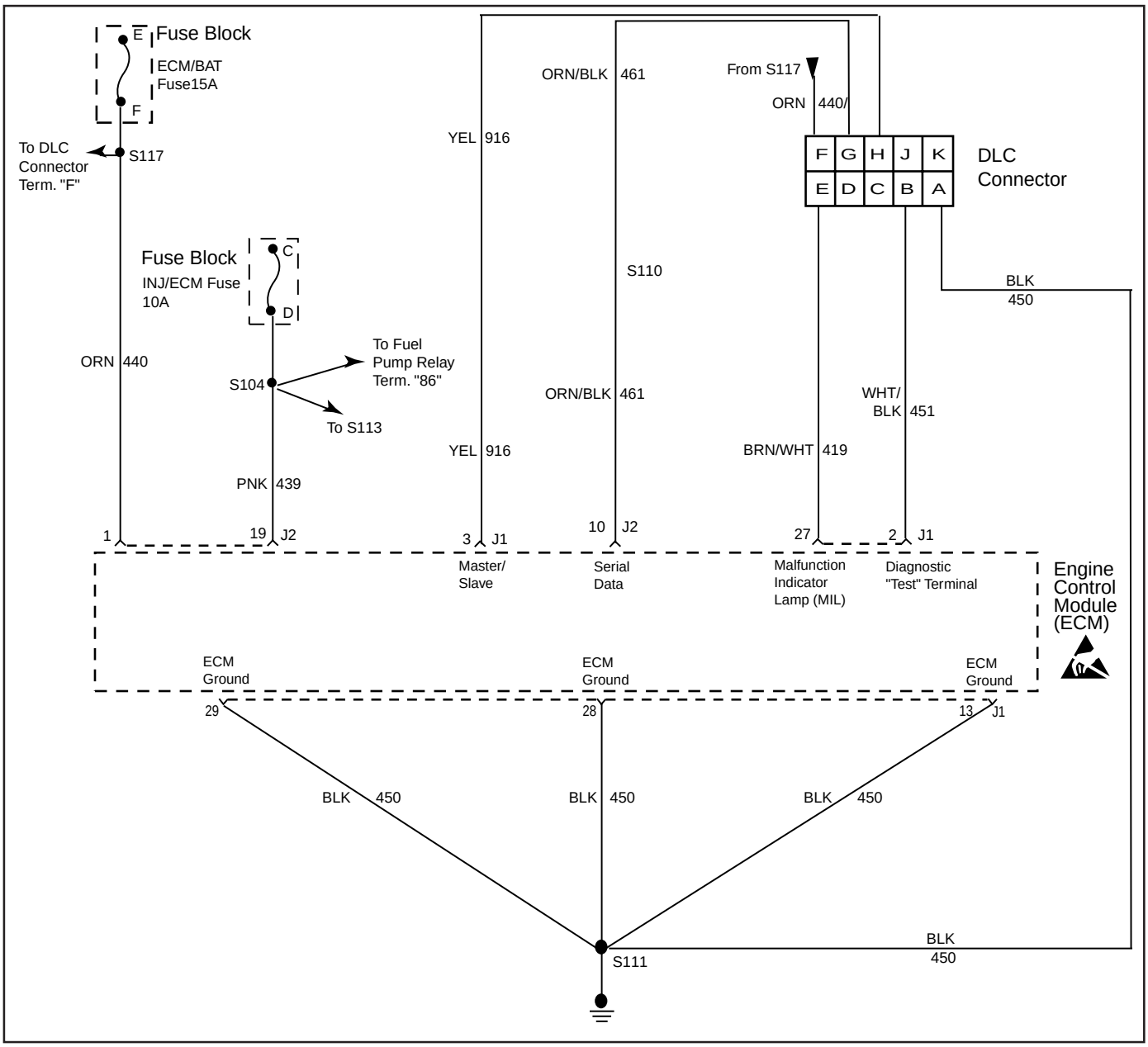
Test Description

Number(s) below refer to the Step number(s) on the Diagnostic Table:

1. The MIL should be “ON” steady with the ignition “ON,” engine “OFF.” If not, Table A-1 should be used to isolate the malfunction.
3. Checks the serial data circuit and ensures that the ECM is able to transmit serial data.
5. If the engine will not start, Table A-3 should be used to diagnose the condition.
8. A scan tool parameter which is not within the typical range may help to isolate the area which is causing the problem.

On-Board Diagnostic (OBD) System Check - Scan

Step	Action	Value	Yes	No
1	**Important:** • Do not perform this diagnostic if there is not a driveability concern, unless another procedure directs you to this diagnostic. • Before you proceed with diagnosis, search for applicable service bulletins. • Unless a diagnostic procedure instructs you, DO NOT clear the DTC's. • If there is a condition with the starting system, repair that first. • Ensure the battery has a full charge. • Ensure the battery cables are clean and tight. • Ensure the ECM grounds are clean, tight and in the correct location. Install a scan tool. Does the scan tool turn ON?	—	*Go to* Step 2	*Go to* Data Link Connector Diagnosis
2	Attempt to start the engine. Does the engine start and idle?	—	*Go to* Step 3	*Go to* Engine Cranks but Does Not Run
3	Select the DTC display function on the scan tool. Does the scan tool display DTCs?	—	*Go to* Applicable DTC Table	*Go to* Step 4
4	1. Review the following symptoms. 2. Refer to the applicable symptom diagnostic table. • *Hard Start* • *Surges/Chuggles* • *Lack of Power, Sluggishness or Sponginess* • *Detonation/Spark Knock* • *Hesitation, Sag or Stumble* • *Cuts Out, Misses* • *Poor Fuel Economy* • *Rough, Unstable or Incorrect Idle and Stalling* • *Dieseling, Run-On* • *Backfire* Did you find and correct the condition?	—	System OK	*Go to* Intermittent Conditions



Data Link Connector Diagnosis

MEFI4302
4-20-00

Circuit Description

Use a properly functioning scan tool with the diagnostic tables in this section. DO NOT clear the DTC's unless directed by a diagnostic procedure. Clearing the DTC's may also clear valuable diagnostic information.

Test Description

Number(s) below refer to the step number(s) on the diagnostic table:

3. An engine that just cranks and does not attempt to start indicates that the ECM is not powered-up.
5. This step is checking for a B+ supply to the Data Link Connector (DLC).
6. A ground must be available for the scan tool to function properly.
9. A no start condition occurs when the fuse(s) for the battery or ignition feed circuits is open. The MIL is inoperative when the battery and ignition feed circuit fuses open. Inspect the circuits for being grounded when either of these fuses open.
12. The scan tool does not communicate when the serial data circuit from the ECM to the DLC is open.
14. If the test lamp does not illuminate for a circuit, inspect the fuse for being open. If the fuse is open, inspect the circuit for a short to ground.
15. Inspect for an open ground circuit.
16. Inspect for an open fuse that supplies the DLC. If the fuse is open, repair the grounded circuit.

Data Link Connector Diagnosis

Step	Action	Value	Yes	No
1	Did you perfom the On-Board Diagnostic (OBD) System Check?	—	*Go to* Step 2	*Go to* OBD System Check
2	**Important:** This table assumes that the scan tool you are using is functional. 1. Turn ON the ignition leaving the engine OFF. 2. Connect the scan tool to the Data Link Connector (DLC). Does the scan tool power-up?	—	*Go to* Step 3	*Go to* Step 5
3	Does the engine start and continue to operate?	—	*Go to* Step 6	*Go to* Step 4
4	Does the engine start and stall?	—	*Go to* Step 12	*Go to* Step 9
5	1. Disconnect the scan tool from the DLC. 2. Turn ON the ignition leaving the engine OFF. 3. Probe the DLC terminal F using a test lamp J 34142-B connected to the battery ground. Is the test lamp illuminated?	—	*Go to* Step 6	*Go to* Step 16
6	Probe the DLC terminal A using a test lamp J 34142-B connected to B+. Is the test lamp illuminated?	—	*Go to* Step 7	*Go to* Step 8
7	Inspect the scan tool connections at the DLC. Also inspect the terminals for proper terminal tension at the DLC. Did you find and repair the condition?	—	*Go to* OBD System Check	*Go to* Step 12
8	Repair the open ground circuit to the DLC terminal A. Is the action complete?	—	*Go to* OBD System Check	—
9	1. Turn OFF the ignition. 2. Disconnect the ECM connector J2. 3. Turn ON the ignition leaving the engine OFF. 4. Probe the ECM battery and the ECM ignition feed circuits (J2-1 and J2-19) in the ECM harness connector using a test lamp J 34142-B connected to a battery ground. Does the test lamp illuminate for each circuit?	—	*Go to* Step 10	*Go to* Step 14
10	1. Turn OFF the ignition. 2. Disconnect the ECM connector J1. 3. Measure the resistance between the battery ground and the ECM ground circuits (J1-13, J1-28 and J1-29) in the ECM harness connectors using a DMM J 39200. Does the DMM display between the specified range on each circuit?	0-2 ohms	*Go to* Step 11	*Go to* Step 15
11	Inspect the ECM for proper connections. Did you find and correct the condition?	—	*Go to* OBD System Check	*Go to* Step 13
12	Inspect the serial data circuit for being open, shorted or a poor connection at the ECM. Did you find and repair the condition?	—	*Go to* OBD System Check	*Go to* Step 13

Data Link Connector Diagnosis (cont'd)

Step	Action	Value	Yes	No
13	Replace the ECM. Is action complete?	—	*Go to* OBD System Check	—
14	Repair the circuit that did not illuminate the test lamp. Is action complete?	—	*Go to* OBD System Check	—
15	Repair the faulty ECM ground circuit(s). Is action complete?	—	*Go to* OBD System Check	—
16	Repair the faulty B+ supply circuit. Is action complete?	—	*Go to* OBD System Check	—

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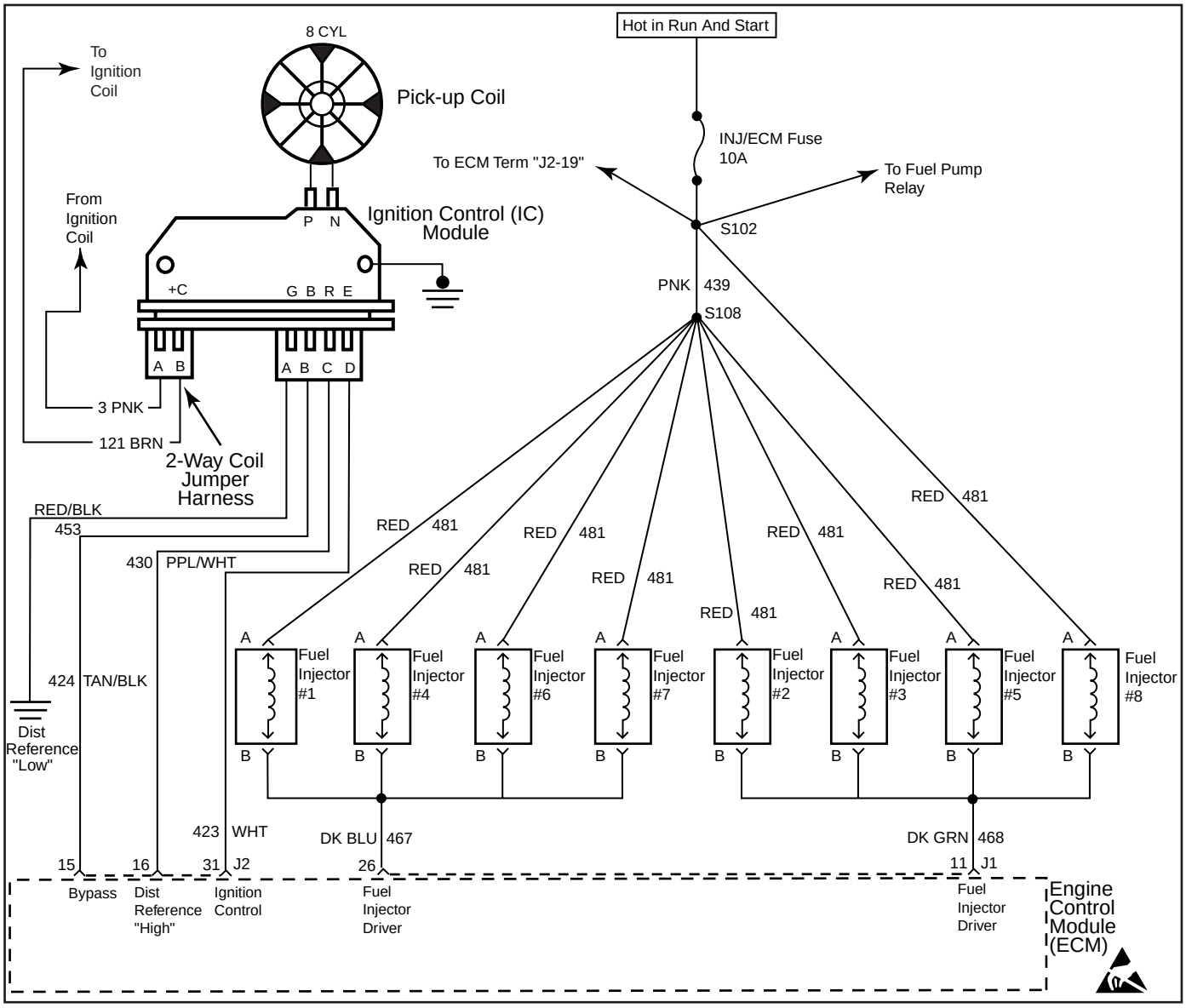


Engine Cranks But Will Not Run

Circuit Description

In the Distributor Ignition (DI) system and the fuel injector circuit, the supply voltage comes from the MEFI system relay. From the MEFI system relay, CKT 902 delivers supply voltage to the INJ/ECM fuse, Fuel Pump Relay fuse and to the ignition coil gray connector terminal “B.”

After supply voltage passes through the INJ/ECM fuse, it branches out into separate CKT’s 439. One is the supply voltage for injector harness CKT 481 and another one goes to ECM terminal “J2-19.” The ECM will control the opening and closing of the injectors through injector driver CKT 468 and CKT 467 by connecting them to ground.

The Ignition Control (IC) module receives supply voltage through CKT 3 from the gray connector at the coil where it is connected with CKT 902. The IC module will control spark to the coil through CKT 121. The IC module interfaces with the ECM through CKT 430. The ECM will control the timing of the spark through CKT 423. For further explanation of distributor ignition system, see “Distributor Ignition System Check,” Table A-7.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation. Check for the following items:

- Poor connection or damaged harness. Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.
- This table assumes that battery voltage and engine cranking speed are OK, and there is adequate fuel in the tank.
- Water or foreign material in fuel system can cause a no start.
- A defective MAP sensor may cause a no start or a start and stall condition.

If above are all OK, refer to “Hard Start” in *Symptoms* section.

Test Description

Number(s) below refer to the Step number(s) on the Diagnostic Table:

5. No spark may be caused by one of several components related to the distributor ignition system. The distributor ignition system check will address all problems related to the causes of a no spark condition.
6. The test light should blink indicating the ECM is controlling the injectors "ON." All lights should blink at the same brightness. All injectors should be within 1 ohm of each other and should not be less than 10 ohms at 21°C (70°F). If an injector is suspected for a no start condition, unplug the suspected injector and try to start the engine.
7. Use fuel pressure gauge J 34730-1A or equivalent. Wrap shop towel around the fuel pressure tap to absorb any small amount of fuel leakage that may occur when installing the gauge.
8. No spark may be caused by one of several components related to the distributor ignition system. The distributor ignition system check will address all problems related to the causes of a no spark condition.
12. Checks for 12 volt supply to injectors. Due to the injectors wired in parallel, there should be a light on both terminals.
13. Checks continuity of CKT 467 and CKT 468.

Engine Cranks But Will Not Run

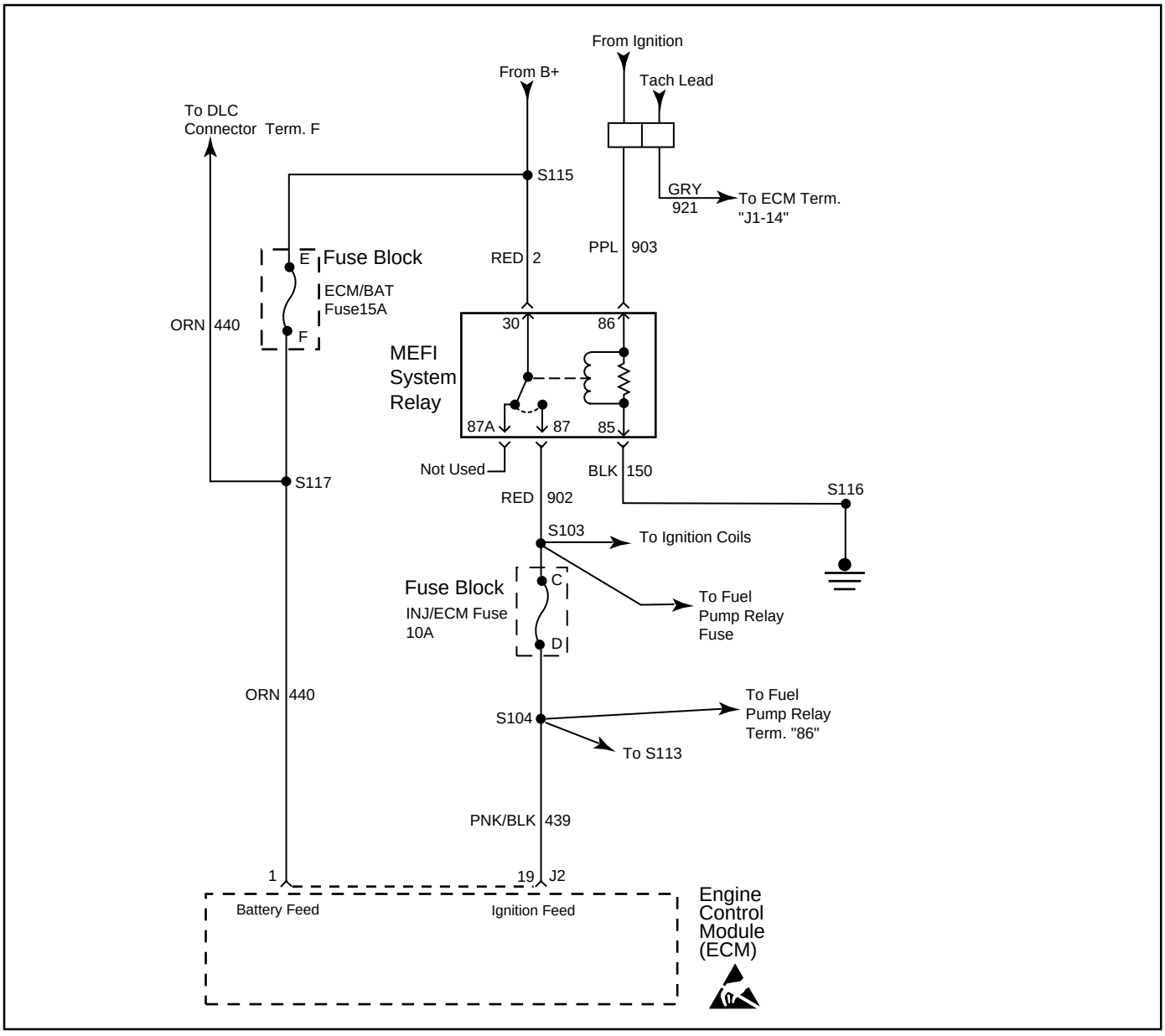
Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic"(OBD) System Check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	Disconnect Throttle Position(TP) sensor. Does the engine start?	—	*Go to* Step 14	*Go to* Step 3
3	1. Key "OFF" for minimum of 10 seconds. 2. Key "ON." 3. Listen for fuel pump to run. Does fuel pump run for 2 seconds?	—	*Go to* Step 4	*Go to* Table A-4
4	Crank engine for 1 second and listen for fuel pump to run. Does fuel pump run?	—	*Go to* Step 5	*Go to* Step 8
5	Check for secondary ignition spark per manufactures recommendation. Is adequate spark present at all cylinders?	—	*Go to* Step 6	*Go to* Table A-7
6	1. Disconnect one injector electrical connector. 2. Connect test light J 34730-2C to injector harness connector. 3. While cranking engine, check for blinking light. 4. Remove test light and reconnect injector harness connector. Repeat this test for all injectors. 5. If any lights are blinking dimly, check for shorted injector by comparing injector resistance values. Were all lights blinking brightly?	—	*Go to* Step 7	*Go to* Step 10
7	1. Install fuel pressure gauge J 34730-1A or equivalent. 2. Ignition "OFF" for 10 seconds. 3. Ignition "ON." Fuel pump will run for about 2 seconds 4. Note fuel pressure with pump running. The pressure may drop after the pump stops running, but the pressure should not drop immediately to 0 psi. System should hold pressure for at least 15 to 20 seconds. Is fuel pressure within specified value?	234-325 kPa (34-47 psi) 379-427 kPa (55-62 psi)	*Refer to* Diagnostic Aids on Facing Page	*Go to* Table A-4

Engine Cranks But Will Not Run

Step	Action	Value	Yes	No
8	Check for secondary ignition spark per manufactures recommendation. Is adequate spark present at all cylinders?	—	*Go to* Step 9	*Refer to* DI System Check
9	1. Ignition "OFF." 2. Disconnect ECM "J2" connector. 3. Using a DVOM connected to ground, probe "J2-16" of the ECM harness connector while cranking the engine. Is the voltage within the specified value?	1-2 volts	*Go to* Step 20	*Go to* Step 15
10	Was the test light a steady light?	—	*Go to* Step 11	*Go to* Step 12
11	Check the injector driver circuit with the steady light for a short to ground. If circuit is not shorted, check resistance across each injector in the circuit. Is resistance greater than the specified value?	10 ohms	*Go to* Step 20	*Go to* Step 16
12	1. Disconnect injector that did not blink. 2. Ignition "ON." 3. Using a test light connected to ground, probe injector harness connector terminals. Does test light illuminate brightly on both terminals?	—	*Go to* Step 13	*Go to* Step 17
13	1. Reconnect injector(s). 2. Ignition "OFF." 3. Disconnect ECM. 4. Ignition "ON." 5. Using a test light connected to ground, probe ECM harness terminals "J1-11" and "J1-26." Does test light illuminate brightly?	—	*Go to* Step 19	*Go to* Step 18
14	Replace faulty TP sensor. Is action complete?	—	*Go to* OBD System Check	—
15	1. Locate and repair open or short to ground in CKT 430. 2. If OK, replace faulty ignition control module. Is action complete?	—	*Go to* OBD System Check	—
16	Locate and repair short to ground or replace any injector that measures under 10 ohms. Is action complete?	—	*Go to* OBD System Check	—
17	1. If the light was "OFF" on both terminals, locate and repair open in injector feed circuit. 2. Due to the injectors wired in parallel, there should be a light on both terminals. If not, locate and repair open in the harness to the tested injector. Is action complete?	—	*Go to* OBD System Check	—
18	Locate and repair open in CKT 467 or CKT 468. Is action complete?	—	*Go to* OBD System Check	—

Engine Cranks But Will Not Run

Step	Action	Value	Yes	No
19	1. All checks made to this point would indicate that the ECM is at fault. However, there is a possibility of CKT 467 and CKT 468 being shorted to voltage source either in the engine harness or in the injector harness. 2. Disconnect all injectors. 3. Ignition "ON." 4. Using a test light connected to ground, probe CKT 467 and CKT 468 on the ECM side of the injector harness. (Test one injector harness on each side of the engine.) If light is "ON," locate and repair short to voltage. 5. Check injector harness connector. Be sure terminals are not backed out of connector and contacting each other. 6. If all OK, replace faulty ECM. Is action complete?	—	*Go to* OBD System Check	—
20	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	*Go to* OBD System Check	—



MEFI4303
4-20-00

System(MEFI) Relay Diagnosis

Circuit Description

The system relay powers the following components:

- Injectors
- Ignition Coils

Diagnostic Aids

The following may cause an intermittent:

- Poor connections. Check for adequate terminal tension.
- Corrosion
- Mis-routed harness
- Rubbed through wire insulation
- Broken wire inside the insulation

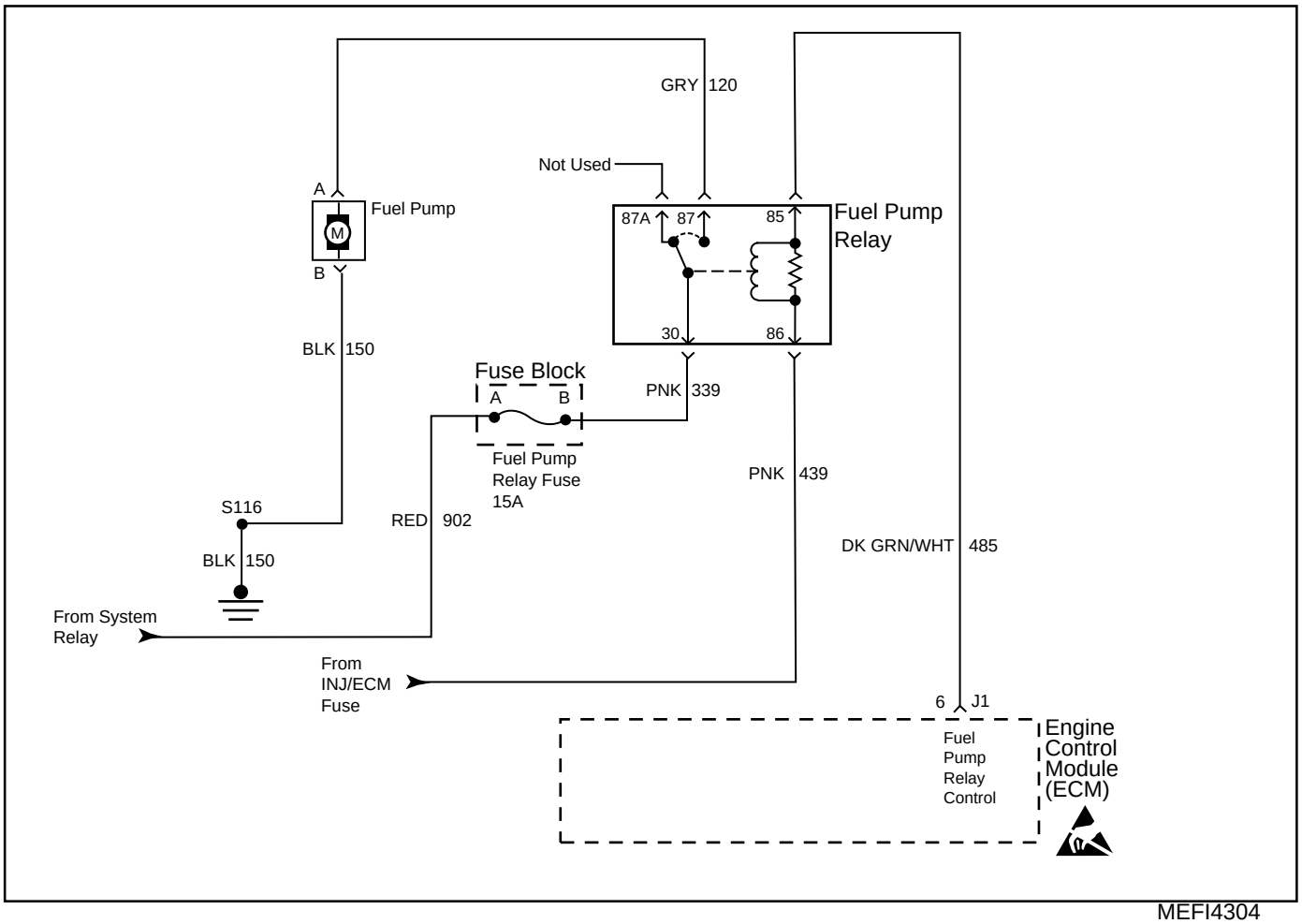
Test Description

Number(s) below refer to the step number(s) on the diagnostic table:

2. Refer to Thumbnail Schematic for proper relay terminal identification.
4. This step is testing the relay ground circuit.
5. This step isolates the circuit from the system relay. All of the circuits are good if the test lamp illuminates.
9. The open circuit will be between the splice and the system relay.

System(MEFI) Relay Diagnosis

Step	Action	Value	Yes	No
1	Did you perfom the On-Board Diagnostic (OBD) System Check?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Turn OFF the ignition. 2. Disconnect the system relay electrical connector. 3. Probe the system relay B+ feed circuit (switch side of the relay) using a test lamp J 34142-B connected to a ground. Does the test lamp illuminate?	—	*Go to* Step 3	*Go to* Step 8
3	1. Turn ON the ignition leaving the engine OFF. 2. Probe the system relay ignition feed circuit using a test lamp J 34142-B connected to a ground. Does the test lamp illuminate?	—	*Go to* Step 4	*Go to* Step 9
4	1. Turn OFF the ignition. 2. Meausure the resistance of the system relay ground circuit using a DMM J 39200 connected to the battery ground. Is the resistance less than the specified value?	0-5 ohms	*Go to* Step 5	*Go to* Step 10
5	1. Turn OFF the ignition. 2. Jumper the system relay B+ feed circuit and the system relay load circuit together using a fused jumper wire. 3. Probe the fuses for the following components with a test lamp J 34142-B connected to a ground. • Injectors • Ignition coils Does the test lamp illuminate?	—	*Go to* Step 6	*Go to* Step 11
6	Inspect for poor terminal contact at the system relay connector. Did you find and correct the condition?	—	System OK	*Go to* Step 7
7	Replace the system relay. Is the action complete?	—	System OK	—
8	Repair the open B+ supply to the system relay. Is the action complete?	—	System OK	—
9	Repair the ignition feed circuit to the system relay. Is the action complete?	—	System OK	—
10	Repair the system relay ground circuit. Is the action complete?	—	System OK	—
11	Repair the system relay load circuit. Is the action complete?	—	System OK	—



MEFI4304
4-20-00

Fuel Pump Relay Circuit Diagnosis

Circuit Description

When the ignition switch is ON, the ECM activates the electric fuel pump. The fuel pump remains ON as long as the ECM receives reference pulses from the ignition system. If there are no reference pulses, the ECM turns the fuel pump OFF after about 2 seconds. The pump delivers fuel to the fuel rail and injectors, then to the pressure regulator, where the system pressure remains at 379-427 kPa (55-62 psi) while the fuel pump is running. Excess fuel returns to the fuel tank. When the engine is stopped, a scan tool in the output controls function can turn ON the fuel pump.

Improper fuel system pressure results in one or many of the following symptoms:

- Cranks but will not run
- Cuts out, may feel like an ignition problem
- Poor fuel economy
- Loss of power
- Hesitation
- DTCs

Diagnostic Aids

The following conditions may have caused the fuel pump fuse to open:

- The fuse is faulty
- There is an intermittent short in the fuel pump power feed circuit.
- The fuel pump has an intermittent internal problem.

For an intermittent condition, refer to *Symptoms.*

Test Description

Number(s) below refer to the step number(s) on the diagnostic table:

3. Refer to Thumbnail Schematic for proper terminal identification.
5. The test lamp only illuminates for two seconds even through the scan tool commanded position is ON. You will have to command the fuel pump OFF then ON to re-enable the ECM fuel pump control.
12. Inspect the fuel pump fuse for an open. If the fuse is open, inspect the circuit for a short to ground.
20. Inspect the fuel pump fuse for an open. If the fuse is open, inspect the circuit for a short to ground.

Fuel Pump Relay Circuit Diagnosis

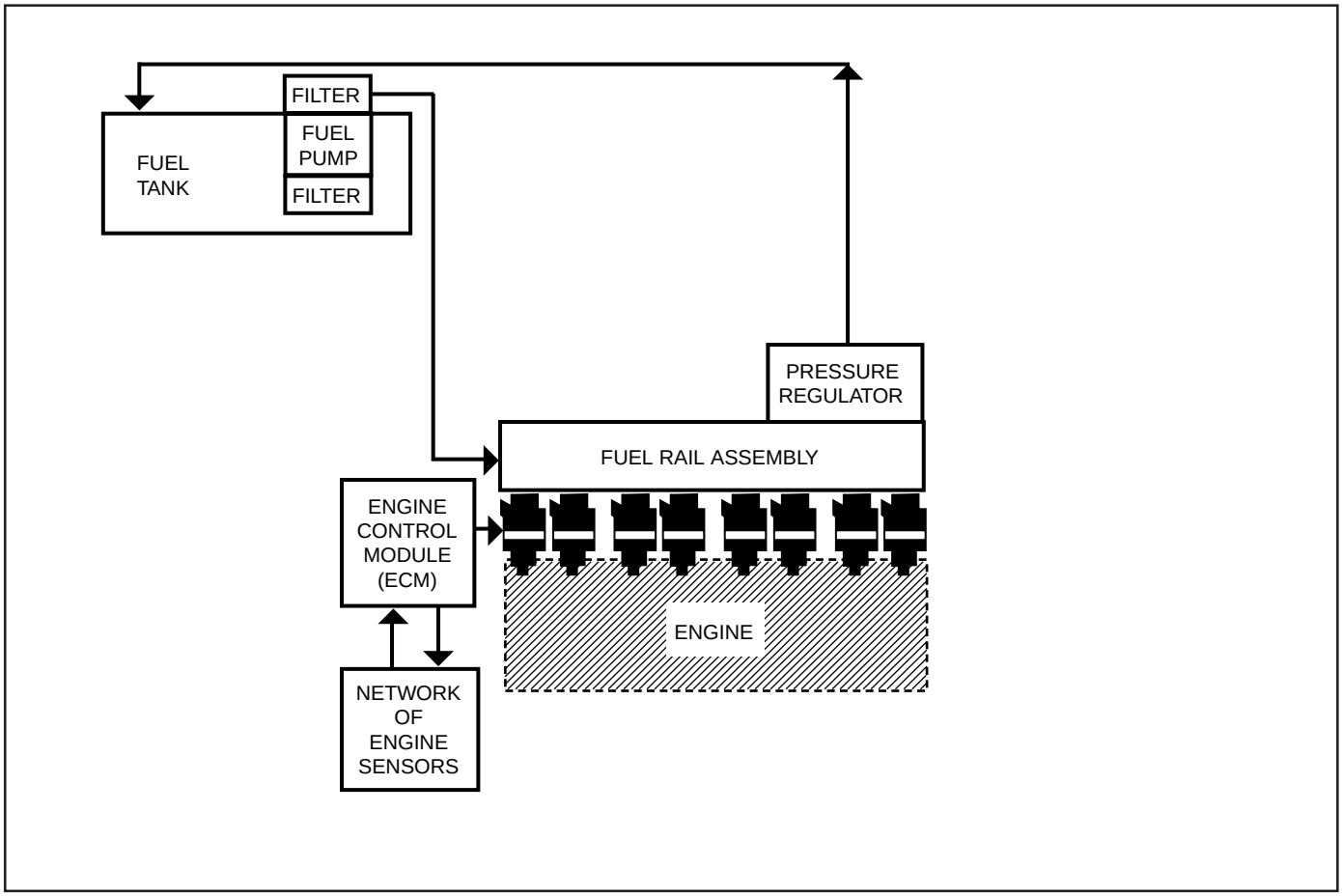
Step	Action	Value	Yes	No
1	Did you perfom the On-Board Diagnostic (OBD) System Check?	—	*Go to* Step 2	*Go to* OBD System Check
2	Check the fuel pump fuse. Is the fuse open?	—	*Go to* Step 9	*Go to* Step 3
3	1. Install a scan tool. 2. Disconnect the fuel pump relay harness connector. 3. Turn ON the ignition leaving the engine OFF. 4. Probe the fuel pump relay battery feed circuit at the harness connector with a test lamp J 34142-B connected to ground. Does the test lamp illuminate?	—	*Go to* Step 4	*Go to* Step 12
4	Probe the fuel pump relay ground circuit at the harness connector with a test lamp J 34142-B connected to B+. Refer to the thumbnail wiring schematic for the proper terminal identification. Does the test lamp illuminate?	—	*Go to* Step 5	*Go to* Step 13
5	1. Probe the fuel pump control circuit at the harness connector with a test lamp J 34142-B connected to ground. Refer to the thumbnail wiring schematic for the proper terminal identification. 2. Enable the fuel pump using the scan tool. Does the test lamp illuminate?	—	*Go to* Step 6	*Go to* Step 11
6	**Important:** Ignition must be ON before performing this step. Jumper the fuel pump relay battery feed circuit to the fuel pump load circuit at the harness connector using a fused jumper wire. Does the fuel pump operate?	—	*Go to* Step 18	*Go to* Step 7
7	1. Leave the fused jumper wire connected. 2. Disconnect the fuel pump harness connector at the fuel pump. 3. Probe the power feed circuit in the fuel pump harness connector with a test lamp J 34142-B connected to ground. Does the test lamp illuminate?	—	*Go to* Step 8	*Go to* Step 14
8	1. Leave the fused jumper wire connected. 2. Connect the test lamp J 34142-B between the battery feed circuit and the ground circuit in the fuel pump harness connector. Does the test lamp illuminate?	—	*Go to* Step 25	*Go to* Step 15
9	1. Turn OFF the ignition. 2. Remove the fuel pump fuse. 3. Disconnect the fuel pump harness connector at the fuel pump.			

Fuel Pump Relay Circuit Diagnosis (cont'd)

Step	Action	Value	Yes	No
9	4. Probe the load circuit for the fuel pump relay at the harness connector with a test lamp J 34142-B connected to B+. Does the test lamp illuminate?	—	*Go to* Step 16	*Go to* Step 10
10	Probe the battery feed circuit for the fuel pump relay at the harness connector with a test lamp J 34142-B connected to B+. Does the test lamp illuminate?	—	*Go to* Step 20	*Go to* Step 21
11	1. Turn OFF the ignition. 2. Disconnect the ECM connector J1. 3. Measure the continuity of the fuel pump relay control circuit from the fuel pump relay harness connector to the ECM connector using the DMM J 39200. Does the DMM display the specified value or lower?	5 ohms	*Go to* Step 22	*Go to* Step 17
12	Repair the open or grounded battery feed circuit to the relay. Replace the fuel pump fuse if the fuse is open. Is the action complete?	—	*Go to* Step 26	—
13	Repair the open fuel pump relay ground circuit. Is the action complete?	—	*Go to* Step 26	—
14	Repair the open circuit between the fuel pump relay and the fuel pump. Is the action complete?	—	*Go to* Step 26	—
15	Repair the open fuel pump ground circuit. Is the action complete?	—	*Go to* Step 26	—
16	Repair the short to ground in the fuel pump relay load circuit between the relay and the fuel pump. Is the action complete?	—	*Go to* Step 26	—
17	Repair the fuel pump relay control circuit. Is the action complete?	—	*Go to* Step 26	—
18	Inspect for poor connections at the relay harness connector. Did you find and correct the condition?	—	*Go to* Step 26	*Go to* Step 19
19	Replace the relay. Refer to *Fuel Pump Relay Replacement* Is the action complete?	—	*Go to* Step 26	—
20	Repair the short to ground in the battery feed circuit to the fuel pump relay. Is the action complete?	—	*Go to* Step 26	—
21	1. Turn OFF the ignition. 2. Re-install the fuel pump relay. 3. Install a new fuse. 4. Connect the fuel pump harness to the fuel pump. 5. Turn ON the ignition leaving the engine OFF. 6. Command the fuel pump relay ON using a scan tool. Is the fuel pump fuse open?	—	*Go to* Step 24	*Go to* Diagnostic Aids

Fuel Pump Relay Circuit Diagnosis (cont'd)

Step	Action	Value	Yes	No
22	Inspect for a poor connection at the ECM. Did you find and correct the condition?	—	*Go to* Step 26	*Go to* Step 23
23	Replace the ECM. Is the action complete?	—	*Go to* Step 26	—
24	1. Inspect the fuel pump harness for a short to ground. 2. If you find a short, repair the circuit as necessary. Did you find and correct the condition?	—	*Go to* Step 26	*Go to* Step 25
25	**Important:** Inspect for poor electrical connections at the fuel pump harness before replacing the fuel pump. Replace the fuel pump. Is the action complete?	—	*Go to* Step 26	—
26	1. Select the Diagnostic Trouble Code (DTC) option and the Clear DTC Information option using the scan tool. 2. Attempt to start the engine. Does the engine start and continue to operate?	—	*Go to* Step 27	*Go to* Step 2
27	1. Idle the engine until the normal operating temperature is reached. 2. Select the Diagnostic Trouble Code (DTC) option. Are any DTCs displayed?	—	*Go to* the applicable DTC table	System OK



Fuel System Diagnosis (Pump-in-Tank)

Circuit Description

When the ignition switch is ON, the ECM activates the electric fuel pump. The fuel pump remains ON as long as the ECM receives reference pulses from the ignition system. If there are no reference pulses, the ECM turns the fuel pump OFF after about 2 seconds.

The electric pump delivers fuel through an outlet fuel filter to the fuel supply line to the fuel rail assembly. The fuel pump provides fuel at a pressure above the pressure needed by the fuel injectors. A fuel pressure regulator, attached to the fuel rail, keeps the fuel available to the fuel injectors at a regulated pressure. Unused fuel returns to the fuel tank by a seperate fuel return line.

Test Description

Number(s) below refer to the step number(s) on the diagnostic table:

2. When the ignition switch is ON and the fuel pump is running, the fuel pressure indicated by the fuel pressure gauge should read 241-325 kPa (35-47 psi), or 379-427 kPa (55-62 psi). The spring pressure inside the fuel pressure regulator controls the fuel pressure.
3. A fuel system that drops more than 14 kPa (2 psi) in 10 minutes has a leak in one or more of the following areas:
   - The fuel pump check valve.
   - The fuel pump flex pipe.
   - The valve or valve seat within the fuel pressure regulator.
   - The fuel injector(s).
4. A fuel system that drops more than 14 kPa (2 psi) in 10 minutes after being relieved to 69 kPa (10 psi) indicates a leaking fuel pump check valve.
5. Fuel pressure that drops off during acceleration, cruise or hard cornering may cause a lean condition. A lean condition can cause a loss of power, surging or misfire.
8. When the engine is at idle, the manifold pressure is low (high vacuum). This low pressure (high vacuum) is applied to the fuel pressure regulator diaphragm. The low pressure (high vacuum) will offset the pressure being applied to the fuel pressure regulator diaphragm by the spring inside the fuel pressure regulator. When this happens, the result is lower fuel pressure. The fuel pressure at idle will vary slightly as the barometric pressure changes, but the fuel pressure at idle should always be less than the fuel pressure noted in step 2 with the engine OFF.

12. A rich condition may result from the fuel pressure being above 325 kPa (47 psi), or 427 kPa (62 psi). Driveability conditions associated with rich conditions can include hard starting followed by black smoke and a strong sulfur smell in the exhaust.
13. This test determines if the high fuel pressure is due to a restricted fuel return pipe or if the high fuel pressure is due to a faulty fuel pressure regulator.
15. A lean condition may result from the fuel pressure being below 241 kPa (35 psi), or 379 kPa (55 psi). Driveability conditions associated with lean conditions can include hard starting (when the engine is cold), hesitation, poor driveability, lack of power, surging and misfiring.

Notice: Do not allow the fuel pressure to exceed 517 kPa (75 psi). Excessive pressure may damage the fuel pressure regulator.

16. Restricting the fuel return pipe with the J 37287 fuel pipe shut-off adapter causes the fuel pressure to rise above the regulated pressure. Using a scan tool to pressurize the fuel system, the fuel pressure should rise above 325 kPa (47 psi), or 427 kPa (62 psi) as the valve on the fuel pipe shut-off adapter connected to the fuel return pipe becomes partially closed.
22. Check the spark plug associated with a particular fuel injector for fouling or saturation in order to determine if that particular fuel injector is leaking. If checking the spark plug associated with a particular fuel injector for fouling or saturation does not determine that a particular fuel injector is leaking, use the following procedure.
    1. Remove the fuel rail. Refer to *Fuel Rail Assembly Replacement*.
    2. Reinstall the crossover pipe to the right fuel rail. Refer to *Fuel Rail Assembly Replacement.*
    3. Connect the fuel feed pipe and the fuel return pipe to the fuel rail. Refer to *Fuel Rail Assembly Replacement.*
    4. Lift the fuel rail just enough to leave the fuel injector nozzles in the fuel injector ports.

Caution: In order to reduce the risk of fire and personal injury that may result from fuel spraying on the engine, verify that the fuel rail is positioned over the fuel injector ports. Also verify that the fuel injector retaining clips ar intact.

    5. Pressurize the fuel system by using the scan tool fuel pump enable.
    6. Visually and physically inspect the fuel injector nozzles for leaks.

Fuel System Diagnosis (Pump-in-Tank)

Step	Action	Value	Yes	No
1	Did you perfom the On-Board Diagnostic (OBD) System Check?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Turn OFF the ignition. ***Caution: Wrap a shop towel around the fuel pressure connection in order to reduce the risk of fire and personal injury. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete.*** 2. Install the J 34730-1A fuel pressure gauge. 3. Place the bleed hose of the fuel pressure gauge into an approved gasoline container. 4. Turn the ignition ON leaving the engine OFF. 5. Bleed the air out of the fuel pressure gauge. 6. Turn the ignition OFF for 10 seconds. 7. Turn the ignition ON leaving the engine OFF. **Important:** The fuel pump will run for approximately 2 seconds. Cycle the ignition as necessary in order to achieve the highest possible fuel pressure. 8. Observe the fuel pressure with the fuel pump running. Is the fuel pressure within the specified limits?	241-325 kPa (35-47 psi) 379-427 kPa (55-62 psi)	*Go to* Step 3	*Go to* Step 12

Fuel System Diagnosis (Pump-in-Tank) (cont'd)

Step	Action	Value	Yes	No
3	**Important:** The fuel pressure may vary slightly when the fuel pump stops running. After the fuel pump stops running, the fuel pressure should stabilize and remain constant. Does the fuel pressure drop more than the specified value in 10 minutes?	—	*Go to* Step 10	*Go to* Step 4
4	Relieve the fuel pressure to the first specified value. Does the fuel pressure drop more than the second specified value in 10 minutes?	69 kPa (10 psi) 14 kPa (2 psi)	*Go to* Step 19	*Go to* Step 5
5	Do you suspect the fuel pressure of dropping-off during acceleration, cruise or hard cornering?	—	*Go to* Step 6	*Go to* Step 8
6	Visually and physically inspect the following items for a restriction: • The fuel filter • The fuel feed pipe Did you find a restriction?	—	*Go to* Step 24	*Go to* Step 7
7	1. Remove the fuel sender assembly. 2. Visually and physically inspect the following items: • The fuel strainer/check valve for a restriction. • The fuel pump pipe for leaks. • Verify the fuel pump is the correct fuel pump for this vehicle. Did you find a problem in any of these areas?	—	*Go to* Step 24	*Go to* Step 19
8	1. Start the engine. 2. Allow the engine to idle at normal operating temperature. Does the fuel pressure drop by the amount specified?	21-69 kPa (3-10 psi)	*Go to* Symptoms	*Go to* Step 9
9	1. Disconnect the vacuum hose from the fuel pressure regulator. 2. With the engine idling, apply 12-14 inches of vacuum to the fuel pressure regulator. Does the fuel pressure drop by the amount specified?	21-69 kPa (3-10 psi)	*Go to* Step 20	*Go to* Step 21
10	1. Relieve the fuel pressure. Refer to *Fuel Pressure Relief Procedure.* 2. Disconnect the fuel feed pipe and the fuel return pipe from the fuel rail. 3. Install the J 37287 fuel pipe shut-off adapters between the fuel feed pipe and the fuel return pipe and the fuel rail. 4. Open the valves on the fuel pipe shut-off adapters. 5. Turn the ignition ON. 6. Pressurize the fuel system using a scan tool. 7. Place the bleed hose of the fuel pressure gauge into			

Fuel System Diagnosis (Pump-in-Tank) (cont'd)

Step	Action	Value	Yes	No
10	an approved gasoline container. 8. Bleed the air out of the fuel pressure gauge. 9. Wait for the fuel pressure to build. 10. Close the valve in the fuel pipe shut-off adapter that is connected to the fuel return pipe. Does the fuel pressure remain constant?	—	*Go to* Step 19	*Go to* Step 11
11	1. Open the valve in the fuel pipe shut-off adapter that is connected to the fuel feed pipe. 2. Pressurize the fuel system using a scan tool. 3. Wait for the fuel pressure to build. 4. Close the valve in the fuel pipe shut-off adapter that is connected to the fuel return pipe. Does the fuel pressure remain constant?	—	*Go to* Step 21	*Go to* Step 22
12	Is the fuel pressure above the specified limit?	325 kPa, 47 psi 427 kPa, 62 psi	*Go to* Step 13	*Go to* Step 15
13	1. Relieve the fuel pressure. Refer to the *Fuel Pressure Relief Procedure.* 2. Disconnect the fuel return pipe from the fuel rail. 3. Attach a length of flexible fuel hose to the fuel rail outlet passage. 4. Place the open end of the flexible fuel hose into an approved gasoline container. 5. Turn the ignition OFF for 10 seconds. 6. Turn the ignition ON. 7. Observe the fuel pressure with the fuel pump running. Is the fuel pressure within the specified limits?	241-325 kPa (35-47 psi) 379-427 kPa (55-62 psi)	*Go to* Step 23	*Go to* Step 14
14	Visually and physically inspect the fuel rail outlet passages for a restriction. Was a restriction found?	—	*Go to* Step 24	*Go to* Step 21
15	Is the fuel pressure above the specified value?	0 kPa (0 psi)	*Go to* Step 16	*Go to* Step 17
16	1. Relieve the fuel pressure. Refer to *Fuel Pressure Relief Procedure.* 2. Disconnect the fuel return pipe from the fuel rail. 3. Install the J 37287 fuel pipe shut-off adapter between the fuel return pipe and the fuel rail. 4. Open the valve on the fuel pipe shut-off adapter. 5. Turn the ignition ON. 6. Pressurize the fuel system using a scan tool. 7. Place the bleed hose of the fuel pressure gauge into an approved gasoline container. 8. Bleed the air out of the fuel pressure gauge. ***Notice:*** Do not allow the fuel pressure to exceed 517 kPa (75 psi). Excessive pressure may damage the fuel			

Fuel System Diagnosis (Pump-in-Tank) (cont'd)

Step	Action	Value	Yes	No
16	pressure regulator. 9. Slowly close the valve in the fuel pipe shut-off adapter that is connected to the fuel return pipe. Does the fuel pressure rise above the specified value?	325 kPa (47 psi) 427 kPa (62 psi)	*Go to* Step 21	*Go to* Step 7
17	Turn ON the fuel pump using a scan tool. Does the fuel pump run?	—	*Go to* Step 18	*Go to* Fuel Pump Relay Circuit Diagnosis
18	Visually and physically inspect the following items: • The fuel filter for obstructions. • The fuel feed pipe for a restriction. • The fuel strainer for obstructions. • The fuel pump pipe for leaks. Did you find a problem in any of these areas?	—	*Go to* Step 24	*Go to* Step 19
19	Replace the fuel pump. Is the action complete?	—	System OK	—
20	Locate and repair the loss of vacuum to the fuel pressure regulator. Is the action complete?	—	System OK	—
21	Replace the fuel pressure regulator. Is the action complete?	—	System OK	—
22	Locate and replace any leaking fuel injector(s). Is the action complete?	—	System OK	—
23	Locate and repair the restriction in the fuel return pipe. Is the action complete?	—	System OK	—
24	Repair the problem as necessary. Is the action complete?	—	System OK	—

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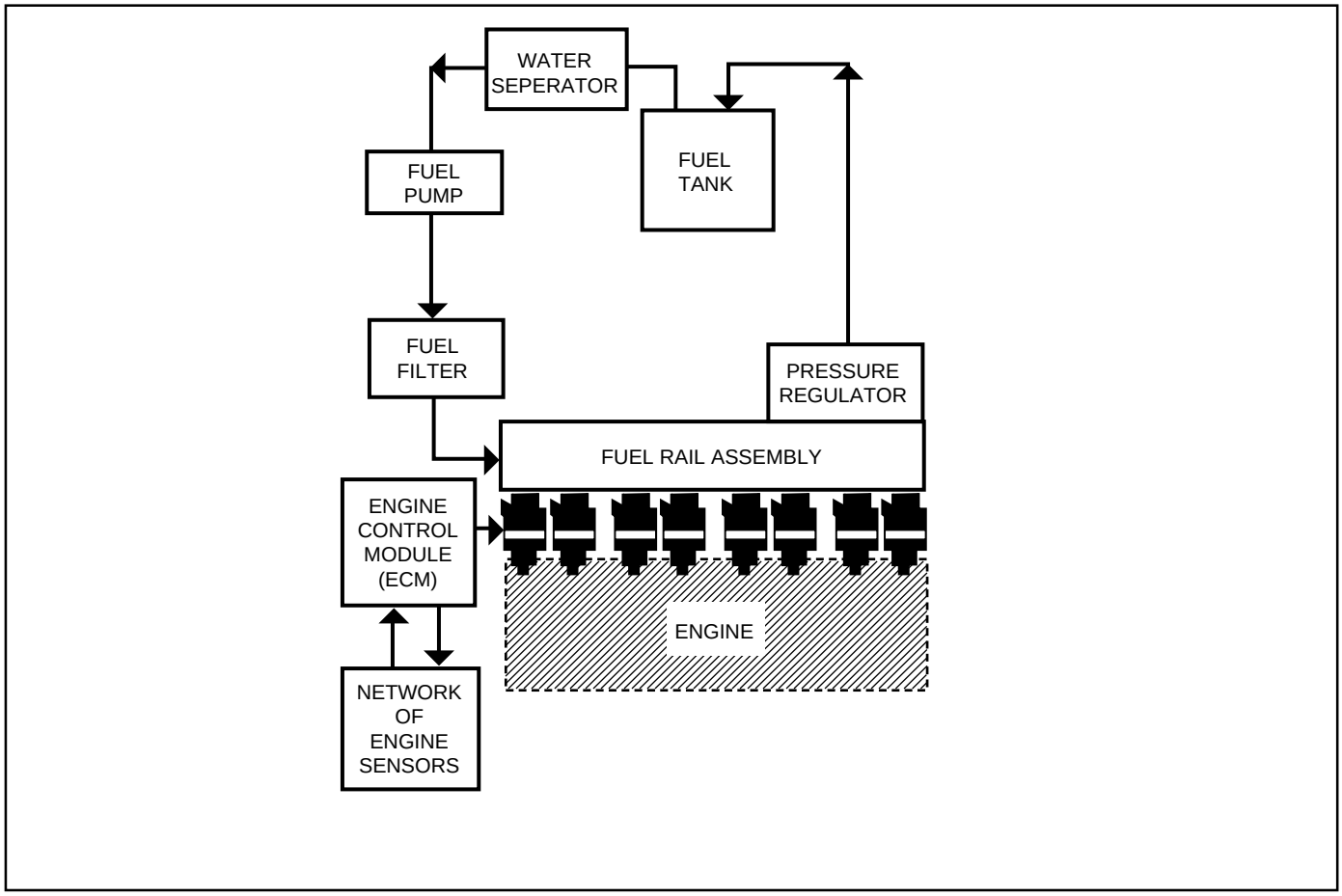

MEFI 4305
4-20-00

Fuel System Diagnosis (Typical)

Circuit Description

When the ignition switch is ON, the ECM activates the electric fuel pump. The fuel pump remains ON as long as the ECM receives reference pulses from the ignition system. If there are no reference pulses, the ECM turns the fuel pump OFF after about 2 seconds.

The electric pump delivers fuel through an in-pipe fuel filter to the fuel rail assembly. The fuel pump provides fuel at a pressure above the pressure needed by the fuel injectors. A fuel pressure regulator, attached to the fuel rail, keeps the fuel available to the fuel injectors at a regulated pressure. Unused fuel returns to the fuel tank by a seperate fuel return pipe.

Test Description

Number(s) below refer to the step number(s) on the diagnostic table:

2. When the ignition switch is ON and the fuel pump is running, the fuel pressure indicated by the fuel pressure gauge should read 241-325 kPa (35-47 psi), or 379-427 kPa (55-62 psi). The spring pressure inside the fuel pressure regulator controls the fuel pressure.
3. A fuel system that drops more than 14 kPa (2 psi) in 10 minutes has a leak in one or more of the following areas:
   - The fuel pump check valve.
   - The fuel pump flex pipe.
   - The valve or valve seat within the fuel pressure regulator.
   - The fuel injector(s).
4. A fuel system that drops more than 14 kPa (2 psi) in 10 minutes after being relieved to 69 kPa (10 psi) indicates a leaking fuel pump check valve.
5. Fuel pressure that drops off during acceleration, cruise or hard cornering may cause a lean condition. A lean condition can cause a loss of power, surging or misfire.
8. When the engine is at idle, the manifold pressure is low (high vacuum). This low pressure (high vacuum) is applied to the fuel pressure regulator diaphragm. The low pressure (high vacuum) will offset the pressure being applied to the fuel pressure regulator diaphragm by the spring inside the fuel pressure regulator. When this happens, the result is lower fuel pressure. The fuel pressure at idle will vary slightly as the barometric pressure changes, but the fuel pressure at idle should always be less than the fuel pressure noted in step 2 with the engine OFF.

12. A rich condition may result from the fuel pressure being above 325 kPa (47 psi), or 427 kPa (62 psi). Driveability conditions associated with rich conditions can include hard starting followed by black smoke and a strong sulfur smell in the exhaust.
13. This test determines if the high fuel pressure is due to a restricted fuel return pipe or if the high fuel pressure is due to a faulty fuel pressure regulator.
15. A lean condition may result from the fuel pressure being below 241 kPa (35 psi), or 379 kPa (55 psi). Driveability conditions associated with lean conditions can include hard starting (when the engine is cold), hesitation, poor driveability, lack of power, surging and misfiring.

Notice: Do not allow the fuel pressure to exceed 517 kPa (75 psi). Excessive pressure may damage the fuel pressure regulator.

16. Restricting the fuel return pipe with the J 37287 fuel pipe shut-off adapter causes the fuel pressure to rise above the regulated pressure. Using a scan tool to pressurize the fuel system, the fuel pressure should rise above 325 kPa (47 psi), or 427 kPa (62 psi) as the valve on the fuel pipe shut-off adapter connected to the fuel return pipe becomes partially closed.
22. Check the spark plug associated with a particular fuel injector for fouling or saturation in order to determine if that particular fuel injector is leaking. If checking the spark plug associated with a particular fuel injector for fouling or saturation does not determine that a particular fuel injector is leaking, use the following procedure.
    1. Remove the fuel rail. Refer to *Fuel Rail Assembly Replacement.*
    2. Reinstall the crossover pipe to the right fuel rail. Refer to *Fuel Rail Assembly Replacement.*
    3. Connect the fuel feed pipe and the fuel return pipe to the fuel rail. Refer to *Fuel Rail Assembly Replacement.*
    4. Lift the fuel rail just enough to leave the fuel injector nozzles in the fuel injector ports.

Caution: In order to reduce the risk of fire and personal injury that may result from fuel spraying on the engine, verify that the fuel rail is positioned over the fuel injector ports. Also verify that the fuel injector retaining clips ar intact.

    5. Pressurize the fuel system by using the scan tool fuel pump enable.
    6. Visually and physically inspect the fuel injector nozzles for leaks.

Fuel System Diagnosis (Typical)

Step	Action	Value	Yes	No
1	Did you perfom the On-Board Diagnostic (OBD) System Check?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Turn OFF the ignition. ***Caution: Wrap a shop towel around the fuel pressure connection in order to reduce the risk of fire and personal injury. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete.*** 2. Install the J 34730-1A fuel pressure gauge. 3. Place the bleed hose of the fuel pressure gauge into an approved gasoline container. 4. Turn the ignition ON leaving the engine OFF. 5. Bleed the air out of the fuel pressure gauge. 6. Turn the ignition OFF for 10 seconds. 7. Turn the ignition ON leaving the engine OFF. **Important:** The fuel pump will run for approximately 2 seconds. Cycle the ignition as necessary in order to achieve the highest possible fuel pressure. 8. Observe the fuel pressure with the fuel pump running. Is the fuel pressure within the specified limits?	241-325 kPa (35-47 psi) 379-427 kPa (55-62 psi)	*Go to* Step 3	*Go to* Step 12

Fuel System Diagnosis (Typical) (cont'd)

Step	Action	Value	Yes	No
3	**Important:** The fuel pressure may vary slightly when the fuel pump stops running. After the fuel pump stops running, the fuel pressure should stabilize and remain constant. Does the fuel pressure drop more than the specified value in 10 minutes?	—	*Go to* Step 10	*Go to* Step 4
4	Relieve the fuel pressure to the first specified value. Does the fuel pressure drop more than the second specified value in 10 minutes?	69 kPa (10 psi) 14 kPa (2 psi)	*Go to* Step 19	*Go to* Step 5
5	Do you suspect the fuel pressure of dropping-off during acceleration, cruise or hard cornering?	—	*Go to* Step 6	*Go to* Step 8
6	Visually and physically inspect the following items for a restriction: • The fuel filter • The fuel feed pipe Did you find a restriction?	—	*Go to* Step 24	*Go to* Step 7
7	1. Remove the fuel sender assembly. 2. Visually and physically inspect the following items: • The fuel strainer/check valve for a restriction. • The fuel pump pipe for leaks. • Verify the fuel pump is the correct fuel pump for this vehicle. Did you find a problem in any of these areas?	—	*Go to* Step 24	*Go to* Step 19
8	1. Start the engine. 2. Allow the engine to idle at normal operating temperature. Does the fuel pressure drop by the amount specified?	21-69 kPa (3-10 psi)	*Go to* Symptoms	*Go to* Step 9
9	1. Disconnect the vacuum hose from the fuel pressure regulator. 2. With the engine idling, apply 12-14 inches of vacuum to the fuel pressure regulator. Does the fuel pressure drop by the amount specified?	21-69 kPa (3-10 psi)	*Go to* Step 20	*Go to* Step 21
10	1. Relieve the fuel pressure. Refer to *Fuel Pressure Relief Procedure.* 2. Disconnect the fuel feed pipe and the fuel return pipe from the fuel rail. 3. Install the J 37287 fuel pipe shut-off adapters between the fuel feed pipe and the fuel return pipe and the fuel rail. 4. Open the valves on the fuel pipe shut-off adapters. 5. Turn the ignition ON. 6. Pressurize the fuel system using a scan tool. 7. Place the bleed hose of the fuel pressure gauge into			

Fuel System Diagnosis (Typical) (cont'd)

Step	Action	Value	Yes	No
10	an approved gasoline container. 8. Bleed the air out of the fuel pressure gauge. 9. Wait for the fuel pressure to build. 10. Close the valve in the fuel pipe shut-off adapter that is connected to the fuel return pipe. Does the fuel pressure remain constant?	—	*Go to* Step 19	*Go to* Step 11
11	1. Open the valve in the fuel pipe shut-off adapter that is connected to the fuel feed pipe. 2. Pressurize the fuel system using a scan tool. 3. Wait for the fuel pressure to build. 4. Close the valve in the fuel pipe shut-off adapter that is connected to the fuel return pipe. Does the fuel pressure remain constant?	—	*Go to* Step 21	*Go to* Step 22
12	Is the fuel pressure above the specified limit?	325 kPa, 47 psi 427 kPa, 62 psi	*Go to* Step 13	*Go to* Step 15
13	1. Relieve the fuel pressure. Refer to the *Fuel Pressure Relief Procedure.* 2. Disconnect the fuel return pipe from the fuel rail. 3. Attach a length of flexible fuel hose to the fuel rail outlet passage. 4. Place the open end of the flexible fuel hose into an approved gasoline container. 5. Turn the ignition OFF for 10 seconds. 6. Turn the ignition ON. 7. Observe the fuel pressure with the fuel pump running. Is the fuel pressure within the specified limits?	241-325 kPa (35-47 psi) 379-427 kPa (55-62 psi)	*Go to* Step 23	*Go to* Step 14
14	Visually and physically inspect the fuel rail outlet passages for a restriction. Was a restriction found?	—	*Go to* Step 24	*Go to* Step 21
15	Is the fuel pressure above the specified value?	0 kPa (0 psi)	*Go to* Step 16	*Go to* Step 17
16	1. Relieve the fuel pressure. Refer to *Fuel Pressure Relief Procedure.* 2. Disconnect the fuel return pipe from the fuel rail. 3. Install the J 37287 fuel pipe shut-off adapter between the fuel return pipe and the fuel rail. 4. Open the valve on the fuel pipe shut-off adapter. 5. Turn the ignition ON. 6. Pressurize the fuel system using a scan tool. 7. Place the bleed hose of the fuel pressure gauge into an approved gasoline container. 8. Bleed the air out of the fuel pressure gauge. ***Notice:*** Do not allow the fuel pressure to exceed 517 kPa (75 psi). Excessive pressure may damage the fuel			

Fuel System Diagnosis (Typical) (cont'd)

Step	Action	Value	Yes	No
16	pressure regulator. 9. Slowly close the valve in the fuel pipe shut-off adapter that is connected to the fuel return pipe. Does the fuel pressure rise above the specified value?	325 kPa (47 psi) 427 kPa (62 psi)	*Go to* Step 21	*Go to* Step 7
17	Turn ON the fuel pump using a scan tool. Does the fuel pump run?	—	*Go to* Step 18	*Go to* Fuel Pump Relay Circuit Diagnosis
18	Visually and physically inspect the following items: • The fuel filter for obstructions. • The fuel feed pipe for a restriction. • The fuel strainer for obstructions. • The fuel pump pipe for leaks. Did you find a problem in any of these areas?	—	*Go to* Step 24	*Go to* Step 19
19	Replace the fuel pump. Is the action complete?	—	System OK	—
20	Locate and repair the loss of vacuum to the fuel pressure regulator. Is the action complete?	—	System OK	—
21	Replace the fuel pressure regulator. Is the action complete?	—	System OK	—
22	Locate and replace any leaking fuel injector(s). Is the action complete?	—	System OK	—
23	Locate and repair the restriction in the fuel return pipe. Is the action complete?	—	System OK	—
24	Repair the problem as necessary. Is the action complete?	—	System OK	—

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Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Between 10-35 Degrees C (50-95 Degrees F)

Test Description

2. The engine coolant temperature affects the ability of the fuel injector tester to detect a faulty fuel injector. If the engine coolant temperature is NOT between 10-35 degrees C (50-95 degrees F), use *Fuel Injector Test - Engine Coolant Temperature (ECT) Outside 10-35 Degrees C (50-95 Degrees F)* table.
3. The first second of the voltage displayed by the DMM may be inaccurate due to the initial current surge. Therefore, record the lowest voltage displayed by the DMM after the first second of the test. The voltage displayed by the DMM should be within the specified range. Refer to the Example. The voltage displayed by the DMM may increase throughout the test as the fuel injector windings warm and the resistance of the fuel injector windings changes. An erratic voltage reading with large fluctuations in voltage that do not stabilize, indicates an intermittent connection with the fuel injector.

Resistance Ohms	Voltage Specification at 10-35 Degrees C (50-95 Degrees F)	
11.8-12.6	5.7-6.6 V	
Fuel Injector Number	Voltage Reading	Pass/Fail
1	6.3	P
2	5.9	P
3	6.2	P
4	6.1	P
5	4.8	F
6	6.0	P
7	5.0	P
8	5.3	P

Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Between 10-35 Degrees C (50-95 Degrees F)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Connect the scan tool. 2. Check the engine coolant temperature. Is the engine coolant temperature within the specified limits?	10°C-35°C (50°F-95°F)	*Go to* Step 3	*Go to* Fuel Injector Coil Test-ECT Outside 10-35°C (50-95°F)
3	1. Turn the ignition OFF. ***Notice:*** Be careful not to flood a single cylinder. 2. Relieve the fuel pressure per manufacturers recommendation. 3. Access the fuel injector electrical connectors as required. 4. Connect the J 39021 fuel injector tester to B+ and ground. 5. Set the amperage supply selector switch on the fuel injector tester to the Coil Test 0.5 amp position. 6. Connect the leads from the DMM to the fuel injector tester. 7. Set the DMM to the tenths scale (0.0). 8. Connect the fuel injector tester to a fuel injector using the J 39021-380 injector test adapter. **Important:** Check the engine coolant temperature again in order to ensure that the correct chart is being used.			

Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Between 10-35 Degrees C (50-95 Degrees F) (cont'd)

Step	Action	Value	Yes	No
3	9. Press the Push to Start Test button on the fuel injector tester. **Important:** The voltage reading may rise during the test. 10. Observe the voltage reading on the DMM. 11. Record the lowest voltage observed after the first second of the test. 12. Repeat steps 8 through 11 for each fuel injector. Did any fuel injector have an erratic voltage reading with large fluctuations in voltage that do not stabilize, or a voltage reading outside the specified limits?	5.7-6.6 V	*Go to* Step 4	*Go to* Fuel Injector Balance Test with Special Tool
4	Replace the faulty fuel injectors. Refer to *Fuel Injector Replacement.* Is the action complete?	—	*Go to* Fuel Injector Balance Test with Special Tool	—

Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Outside 10-35 Degrees C (50-95 Degrees F)

Test Description

2. The engine coolant temperature affects the ability of the fuel injector tester to detect a faulty fuel injector. If the engine coolant temperature is between 10-35 degrees C (50-95 degrees F), use *Fuel Injector Test - Engine Coolant Temperature (ECT) Between 10-35 Degrees C (50-95 Degrees F)* table.
3. The first second of the voltage displayed by the DMM may be inaccurate due to the initial current surge. Therefore, record the lowest voltage displayed by the DMM after the first second of the test. The voltage displayed by the DMM may increase throughout the test as the fuel injector windings warm and the resistance of the fuel injector windings changes. An erratic voltage reading with large fluctuations in voltage that do not stabilize, indicates an intermittent connection with the fuel injector. From the voltages recorded, identify the highest voltage, excluding any voltages above 9.5 volts. Subtract each voltage that is not above 9.5 volts from the highest voltage. Record each subtracted value. Refer to the Example. The subtracted value that is more than 0.6 volt is faulty. Replace the fuel injector. A fuel injector with a recorded voltage above 9.5 volts is also faulty. Replace the fuel injector.

Highest Voltage Reading		Acceptable Subtracted Value Above/Below 10-35°C (50-95°F)	
7.1 V		0.6 V	
Injector Number	Voltage	Subtracted Value	Pass/Fail
1	9.8	—	F
2	6.6	0.5	P
3	6.9	0.2	P
4	5.8	1.3	F
5	7.0	0.1	P
6	7.1	0.0	P
7	9.6	—	F
8	6.0	1.1	F

Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Outside 10-35 Degrees C (50-95 Degrees F)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Connect the scan tool. 2. Check the engine coolant temperature. Is the engine coolant temperature within the specified limits?	10°C-35°C (50°F-95°F)	*Go to* Step 3	*Go to* Fuel Injector Coil Test-ECT Between10-35°C (50-95°F)
3	1. Turn the ignition OFF. ***Notice:*** Be careful not to flood a single cylinder. 2. Relieve the fuel pressure per manufacturers recommendation. 3. Access the fuel injector electrical connectors as required. 4. Connect the J 39021 fuel injector tester to B+ and ground. 5. Set the amperage supply selector switch on the fuel injector tester to the Coil Test 0.5 amp position. 6. Connect the leads from the DMM to the fuel injector tester. 7. Set the DMM to the tenths scale (0.0). 8. Connect the fuel injector tester to a fuel injector using the J 39021-380 injector test adapter. **Important:** Check the engine coolant temperature again in order to ensure that the correct chart is being used. 9. Press the Push to Start Test button on the fuel injector tester. **Important:** The voltage reading may rise during the test. 10. Observe the voltage reading on the DMM. 11. Record the lowest voltage observed after the first second of the test. 12. Repeat steps 8 through 11 for each fuel injector. 13. Identify the highest voltage reading recorded other than those above 9.5 volts. 14. Subtract any other voltage readings recorded from the highest voltage reading recorded. 15. Repeat step 14 for all the remaining fuel injectors. Is any value that resulted from subtraction more than the specified value?	0.6 V	*Go to* Step 4	*Go to* Fuel Injector Balance Test with Special Tool
4	Replace any fuel injector that had any of the following: • A subtracted value exceeding 0.6 volts • An initial reading above 9.5 volts • An erratic reading Refer to *Fuel Injector Replacement.* Is the action complete?	—	*Go to* Fuel Injector Balance Test with Special Tool	—

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Fuel Injector Balance Test with Special Tool

Test Description

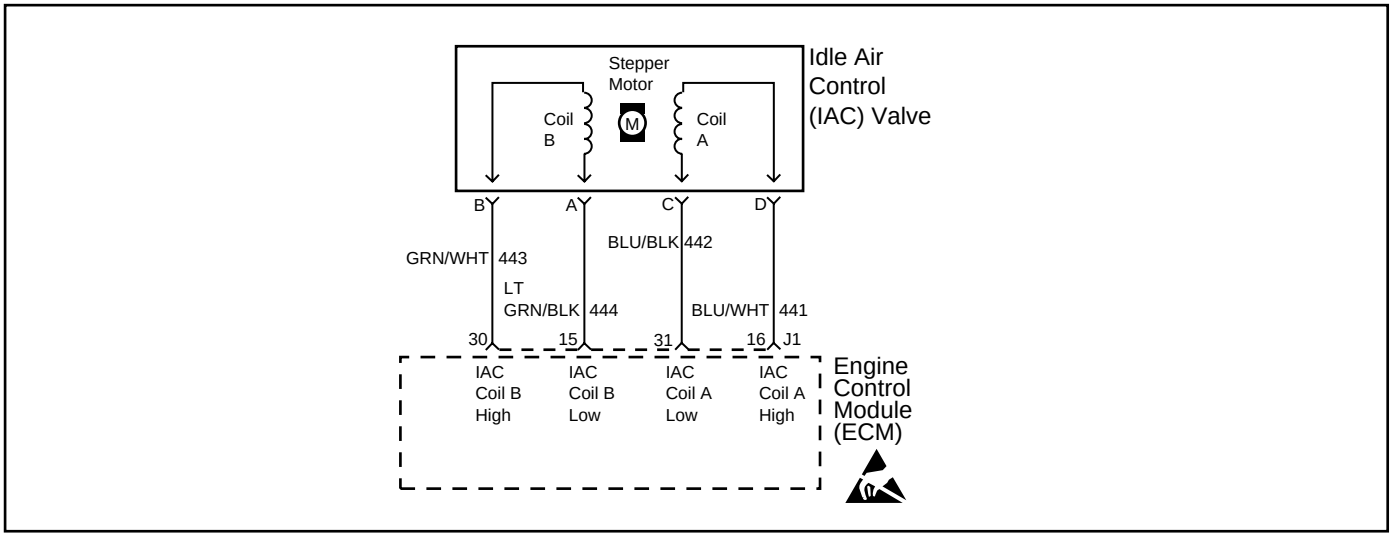
4. The engine coolant temperature must be below the operating temperature in order to avoid irregular fuel pressure readings due to Hot Soak fuel boiling.
5. The fuel pressure should be within the specified range.
6. The fuel pressure should reach a steady value.
7. If the fuel pressure drop value for each injector is within 10 Kpa (1.5 psi) of the average pressure drop value, the fuel injectors are flowing properly. Calculate the pressure drop value for each fuel injector by subtracting the second pressure reading from the first pressure reading.

Fuel Injector Balance Test with Special Tool

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	Did you perform the Fuel Injector Coil Test Procedure?	—	*Go to* Step 3	*Go to* Fuel Injector Coil Test-ECT Between 10-35°C (50-95°F)
3	Is the engine coolant temperature above the specified value?	94°C(201°F)	*Go to* Step 4	*Go to* Step 5
4	Allow the engine to cool below the specified value. Is the engine coolant temperature below the specified value?	94°C(201°F)	*Go to* Step 5	—
5	1. Turn the ignition OFF. 2. Connect the J 34730-1A fuel pressure gauge to the fuel pressure test port. 3. Turn ON the ignition leaving the engine OFF. 4. Install the scan tool. 5. Energize the fuel pump using the scan tool. 6. Place the bleed hose of the fuel pressure gauge into an approved gasoline container. 7. Bleed the air out of the fuel pressure gauge. 8. Again energize the fuel pump using the scan tool. **Important:** The fuel pump will run for approximately 2 seconds. Repeat step 8 as necessary in order to achieve the highest possible fuel pressure. 9. Wait for the fuel pressure to build. 10. Observe the reading on the fuel pressure gauge while the fuel pump is running. Is the fuel pressure within the specified limits?	379-427 kPa (55-62 psi)	*Go to* Step 6	*Go to* Fuel System Diagnosis
6	After the fuel pump stops, the fuel pressure may vary slightly, then should hold steady. Does the fuel pressure remain constant within the specified value?	379-427 kPa (55-62 psi)	*Go to* Step 7	*Go to* Fuel System Diagnosis

Fuel Injector Balance Test with Special Tool (cont'd)

Step	Action	Value	Yes	No
7	1. Connect the J 39021 fuel injector tester to a fuel injector using the J 39021-380 injector test adapter. 2. Set the amperage supply selector switch on the fuel injector tester to the balance test 0.5-2.5 amp position. 3. Energize the fuel pump using the scan tool in order to pressurize the fuel system. 4. Record the fuel pressure indicated by the fuel pressure gauge after the fuel pressure stabilizes. This is the 1st pressure reading. 5. Energize the fuel injector by depressing the Push to Start Test button on the fuel injector tester. 6. Record the fuel pressure indicated by the fuel pressure gauge after the fuel pressure gauge needle has stopped moving. This is the 2nd pressure reading. 7. Repeat steps 1 through 6 for each fuel injector. 8. Subtract the 2nd pressure reading from the 1st pressure reading for one fuel injector. The result is the pressure drop value. 9. Obtain a pressure drop value for each fuel injector. 10. Add all of the individual pressure drop values. This is the total pressure drop. 11. Divide the total pressure drop by the number of fuel injectors. This is the average pressure drop. Does any fuel injector have a pressure drop value that is either higher than the average pressure drop or lower than the average pressure drop by the specified value?	10 kPa (1.5 psi)	*Go to* Step 8	*Go to* Symptoms
8	***Notice:*** Do Not repeat any portion of this test before running the engine in order to prevent the engine from flooding. Retest any fuel injector that does not meet the specification. Refer to the procedure in step 7. Does any fuel injector still have a pressure drop value that is either higher than the average pressure drop or lower than the average pressure drop by the specified value?	10 kPa (1.5 psi)	*Go to* Step 9	*Go to* Symptoms
9	Replace the faulty fuel injectors. Refer to *Fuel Injector Replacement.* Is the action complete?	—	System OK	—



Idle Air Control Functional Test

MEFI 4306
4-20-00

Circuit Description

The ECM controls idle speed to a calibrated “desired” RPM based on sensor inputs and actual engine RPM. The ECM uses four (4) circuits to move the Idle Air Control (IAC) valve. The movement of the IAC valve varies the amount of air flow bypassing the throttle plates. The ECM controls idle speed by determining the position of the IAC valve.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation. Check for the following items:

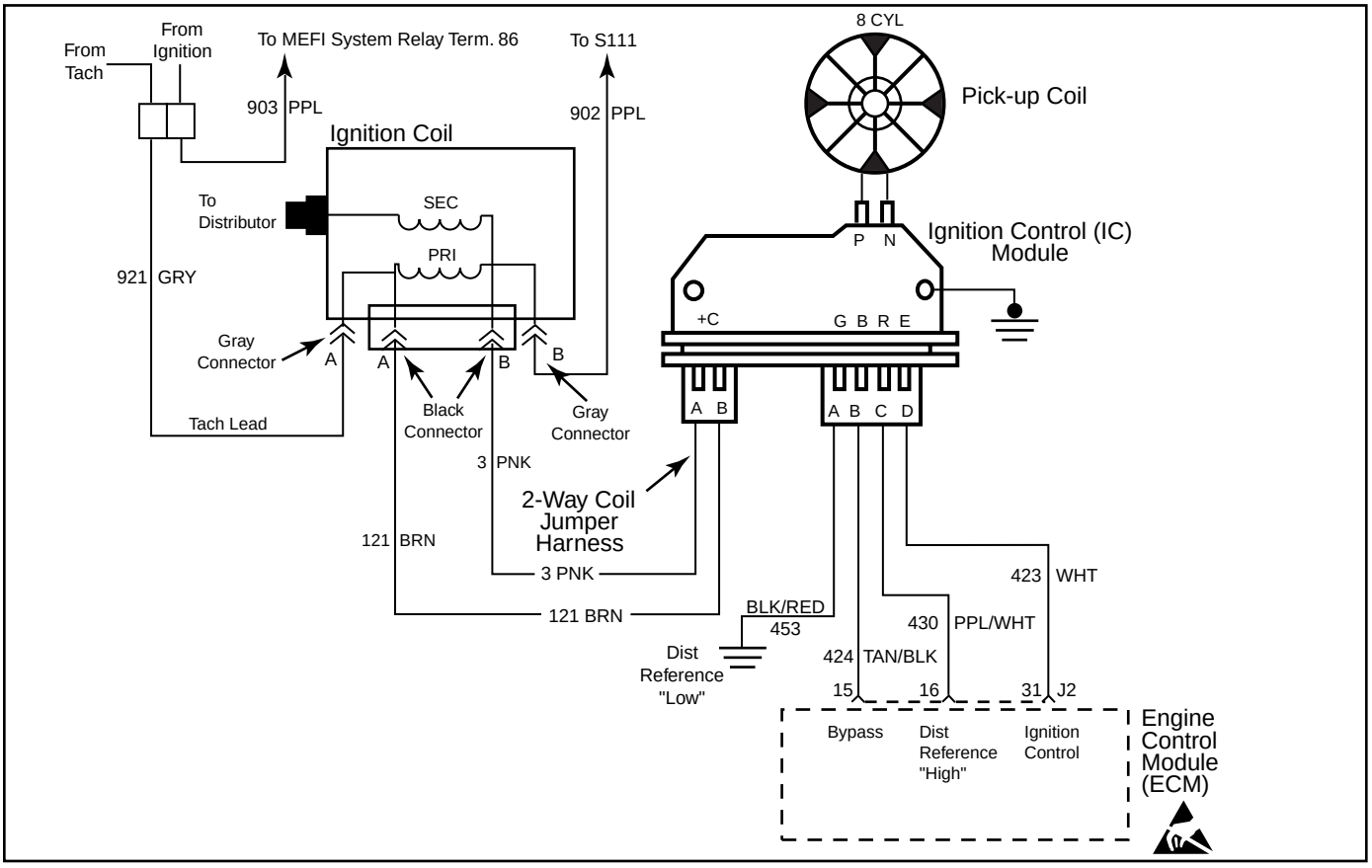
- Poor connection or damaged harness. Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.
- Check for vacuum leaks, disconnected or brittle vacuum hoses, cuts, etc. Examine manifold and throttle body gaskets for proper seal. Check for cracked intake manifold.
- Check for poor connections, opens or short to grounds in CKT’s 441, 442, 443 and 444. This may result in improper idle control.
- An IAC valve which is “frozen” and will not respond to the ECM, a throttle stop screw which has been tampered with, or a damaged throttle body or linkage may cause improper idle.

Test Description

2. This step determines if the IAC valve is functioning properly.
4. This step determines if the circuitry or the IAC valve is faulty.

Idle Air Control Functional Test

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Engine should be at normal operating temperature. 2. Start engine and allow idle to stabilize. 3. Record RPM. 4. Ignition "OFF" for 10 seconds. 5. Disconnect IAC harness connector. 6. Restart engine and record RPM. Is RPM higher than the first recorded RPM by more than the specified value?	200 RPM	*Go to* Step 3	*Go to* Step 4
3	1. Reinstall IAC harness connector. 2. Idle speed should gradually return within 75 RPM of the original recorded RPM within 30 seconds. Does RPM return to original recorded RPM?	—	*Go to* Step 5	*Go to* Step 4
4	1. Ignition "OFF" for 10 seconds. 2. Disconnect IAC harness connector. 3. Restart engine. 4. Using a test lamp J 34142-B connected to ground, probe each one of the four IAC harness terminals. Does the test lamp blink on all four terminals?	—	*Go to* Step 7	*Go to* Step 6
5	IAC circuit is functioning properly.	—	—	—
6	Locate and repair poor connection, open, or short to ground in the IAC circuit that did not blink. If a problem was found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 8
7	Check for poor IAC connections or replace the faulty IAC valve. Is action complete?	—	*Go to* OBD System Check	—
8	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	*Go to* OBD System Check	—



Distributor Ignition (DI) System Check

Circuit Description

The Distributor Ignition (DI) system receives supply voltage from the MEFI system relay through CKT 902 to the ignition coil gray connector “B.” Inside the ignition coil, the gray connector terminal “B” is connected to the black connector terminal “B.” Supply voltage is delivered from the ignition coil black connector terminal “B” to the distributor Ignition Control (IC) module “+” terminal through CKT 3.

Inside the distributor, the pick-up coil and pole piece will produce a voltage signal for cylinder spark. The voltage signals are processed in the IC module and sent to the ECM. The ECM will decide if the engine is in the cranking or running mode and adjust timing accordingly. The voltages or signals are sent between the ECM and the IC module through CKT’s 423, 430 and 424. CKT 453 is the ground circuit.

The IC module will send the voltage signal to the ignition coil black connector terminal “A” through CKT 121. The signal will trigger the coil creating secondary spark to be produced. This secondary spark is sent to the distributor by a high tension lead.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation. Check for the following items:

- Poor connection or damaged harness. Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.
- The “tach” needs to be disconnected while testing the ignition system. You will also need a place to check coil trigger voltage. By disconnecting the “2-wire boat harness” (gray and purple wires), this will give you a test terminal to check coil trigger voltage as needed in several steps. After “tach” is disconnected, try starting the engine. If the engine starts, check for a short to ground in the boat “tach” circuit.

Test Description

Number(s) below refer to the Step number(s) on the Diagnostic Table:

2. Two wires are checked to ensure that an open is not present in a spark plug wire.
4. A spark indicates the problem must be in the distributor cap, rotor or coil output wire.
6. Normally, there should be battery voltage at the "C" and "+" terminals. Low voltage would indicate an open or a high resistance circuit from the distributor to the coil or ignition switch. If "C" terminal voltage was low, but "+" terminal voltage is 10 volts or more, circuit from "C" terminal to ignition coil is open or primary winding of the ignition coil is open.
8. Checks for a shorted module or grounded circuit from the ignition coil to the module. The distributor module should be turned "OFF," so normal voltage should be about 12 volts. If the module is turned "ON," the voltage would be low, but above 1 volt. This could cause the ignition coil to fail from excessive heat. With an open ignition coil primary winding, a small amount of voltage will leak through the module from the "batt" to the "tach" terminal.
11. Applying a voltage (1.35-1.50 volts) to the module terminal "P" should turn the module "ON" and the tach voltage should drop to about 7-9 volts. This test will determine whether the module or coil is faulty or if the pick-up coil is not generating the proper signal to turn the module "ON." This test can be performed by using a DC test battery with a rating of 1.5 volts (Such as AA, C, or D cell). The battery must be a known good battery with a voltage of over 1.35 volts.
12. This should turn the module "OFF" and cause a spark. If no spark occurs, the fault is most likely in the ignition coil because most module problems would have been found before this point in the procedure.

Distributor Ignition (DI) System Check

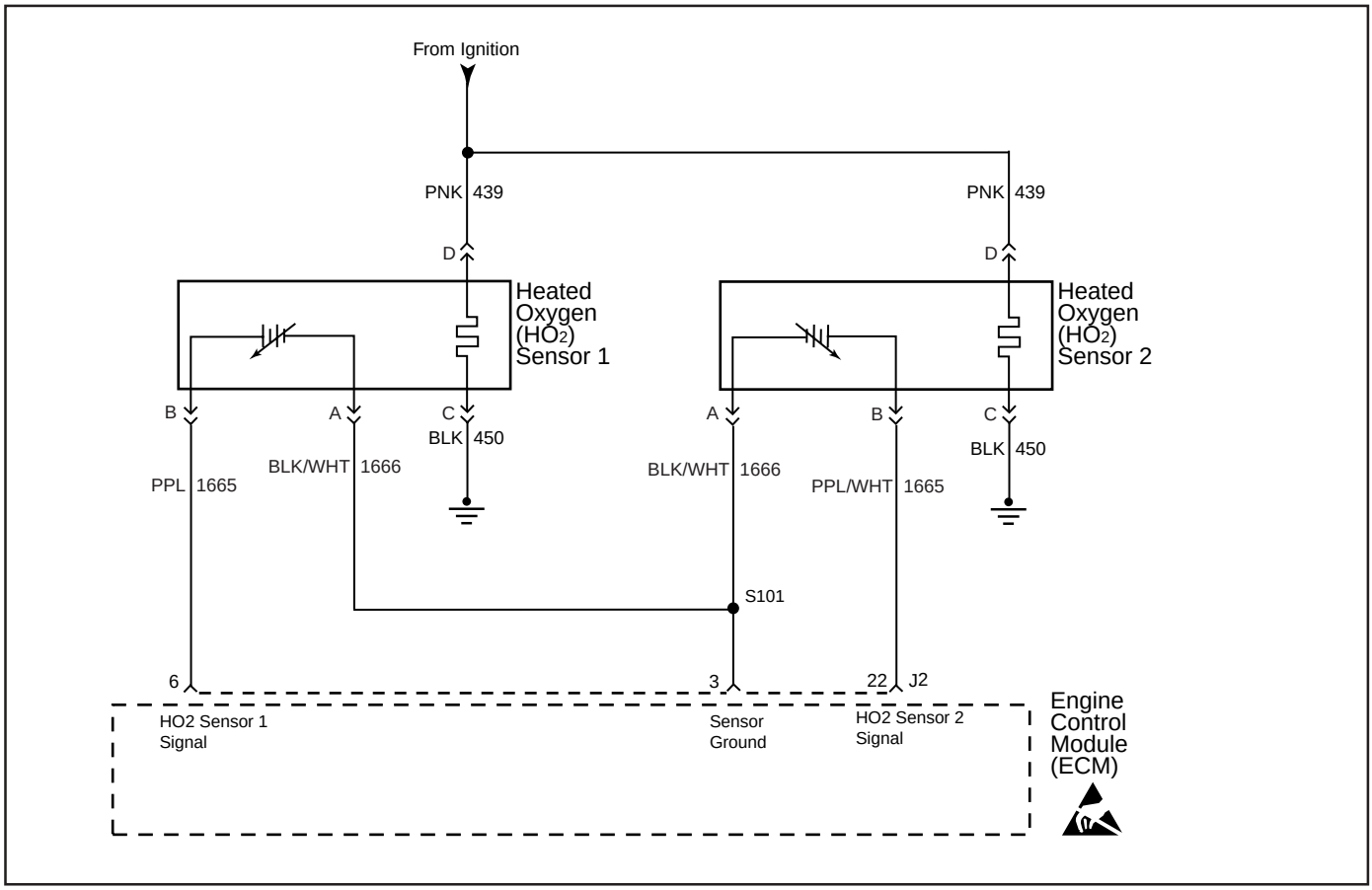
Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostics" (OBD) System Check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Check spark plug wires for open circuits, cracks in insulation, or improper seating of terminals at spark plugs, distributor cap, and coil tower before proceeding with this table. 2. Disconnect 2-wire boat harness (gray and purple wires). 3. Install a temporary jumper wire between the 2 purple wires at the connector of the boat harness. This is CKT 903 for the ignition circuit. 4. Check for secondary spark per manufactures recommendation. If there is "no spark" at one wire, check a few more wires. A few sparks and then nothing is considered "no spark." Is adequate spark present at all cylinders?	—	*Refer to* Symptoms Section	*Go to* Step 3
3	Remove distributor cap and verify rotation of distributor rotor. Is the distributor rotor turning?	—	*Go to* Step 4	*Go to* Step 25
4	1. Disconnect distributor 4-wire connector. 2. Check for secondary spark per manufactures recommendation. Is adequate spark present?	—	*Go to* Step 18	*Go to* Step 5

Distributor Ignition (DI) System Check

Step	Action	Value	Yes	No
5	1. Reconnect distributor 4-wire connector. 2. Check for secondary spark per manufactures recommendation from the coil tower using a known good coil wire. Is adequate spark present?	—	*Go to* Step 19	*Go to* Step 6
6	1. Disconnect distributor 2-wire "C/+" connector harness. 2. Ignition "ON," engine "OFF." 3. Using DVOM J 39978 or equivalent, check voltage at "+" and "C" terminals of the 2-wire distributor harness connector. Is voltage reading greater than the specified value at both terminals?	0 volts	*Go to* Step 8	*Go to* Step 7
7	Is voltage reading less than the specified value at both terminals?	10 volts	*Go to* Step 20	*Go to* Step 21
8	1. Reconnect distributor 2-wire connector. 2. Ignition "ON," engine "OFF." 3. Using DVOM J 39978 or equivalent, check voltage from tach terminal to ground. 4. The tach terminal can be accessed at the 2-wire boat connector. The tach circuit is the gray wire CKT 921. Is voltage reading within the specified value?	1-10 volts	*Go to* Step 15	*Go to* Step 9
9	Is voltage reading greater than the specified value?	10 volts	*Go to* Step 10	*Go to* Step 22
10	1. Using a test light connected to ground, probe tach terminal at the 2-wire boat harness. 2. Observe the test light while cranking engine. Is test light blinking?	—	*Go to* Step 13	*Go to* Step 11
11	1. Disconnect distributor 4-wire connector. 2. Remove distributor cap. 3. Disconnect pick-up coil connector from the distributor ignition control module. 4. Connect DVOM to tach terminal at the 2-wire boat harness and ground. 5. Ignition "ON," engine "OFF." 6. Connect positive (+) end of a known good 1.5 volt test battery to the "P" terminal on the distributor ignition control module. Observe the voltage at the tach terminal as the negative (-) end of the test battery is momentarily grounded to a known good ground. Does the voltage drop?	—	*Go to* Step 12	*Go to* Step 23
12	Check for spark from the coil wire as the test battery lead is removed? Is adequate spark present?	—	*Go to* Step 17	*Go to* Step 13

Distributor Ignition (DI) System Check

Step	Action	Value	Yes	No
13	Replace ignition coil and recheck for spark as set up in steps 11 and 12. Is adequate spark present?	—	*Go to* OBD System Check	*Go to* Step 14
14	Ignition coil removed is OK. Reinstall coil and check coil wire from distributor cap. If OK, replace ignition module. Is action complete?	—	*Go to* OBD System Check	—
15	Replace ignition module and recheck for spark as set up in steps 11 and 12. Is adequate spark present?	—	*Go to* OBD System Check	*Go to* Step 16
16	Replace ignition coil, it too is faulty. Is action complete?	—	*Go to* OBD System Check	—
17	Is the rotating pole piece still magnetized?	—	*Go to* Step 18	*Go to* Step 24
18	Replace faulty pick-up coil. Is action complete?	—	*Go to* OBD System Check	—
19	Inspect distributor cap for water, cracks, etc. If OK, replace faulty distributor rotor. Is action complete?	—	*Go to* OBD System Check	—
20	Check for open or short to ground in CKT 3, the pink wire from the ignition module "+" terminal to the ignition coil. Also check for open CKT 902, the red wire from the MEFI relay to the ignition coil. Is action complete?	—	*Go to* OBD System Check	—
21	Check for open or short to ground in CKT 121, the brown wire from the ignition module "C" terminal to the ignition coil. If OK, replace faulty ignition coil. Is action complete?	—	*Go to* OBD System Check	—
22	Repair faulty connections or open tach lead. Repeat step 8.	—	—	—
23	Check ignition module ground. If OK, replace faulty ignition module. Is action complete?	—	*Go to* OBD System Check	—
24	Replace distributor pole piece and shaft assembly. Is action complete?	—	*Go to* OBD System Check	—
25	A mechanical repair will be necessary before continuing with this test.	—	—	—



DTC 13 - Heated Oxygen (HO_2) Sensor 1 Circuit Inactive (Non-Scan Diagnostics)

Circuit Description

The Heated Oxygen (HO_2) Sensor(s) varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

The heater provides for a faster sensor warm-up. This allows the sensor(s) to become active in a shorter period of time and remain active during a long extended idle.

DTC 13 determines if the heated oxygen sensor circuit(s) has developed an open. With an active DTC 13 set, the system operates in an Open Loop mode and the Malfunction Indicator Lamp (MIL) is turned on.

Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.

Never solder the HO_2 wires. For proper wire and connection repairs, refer to "Wiring Repair."

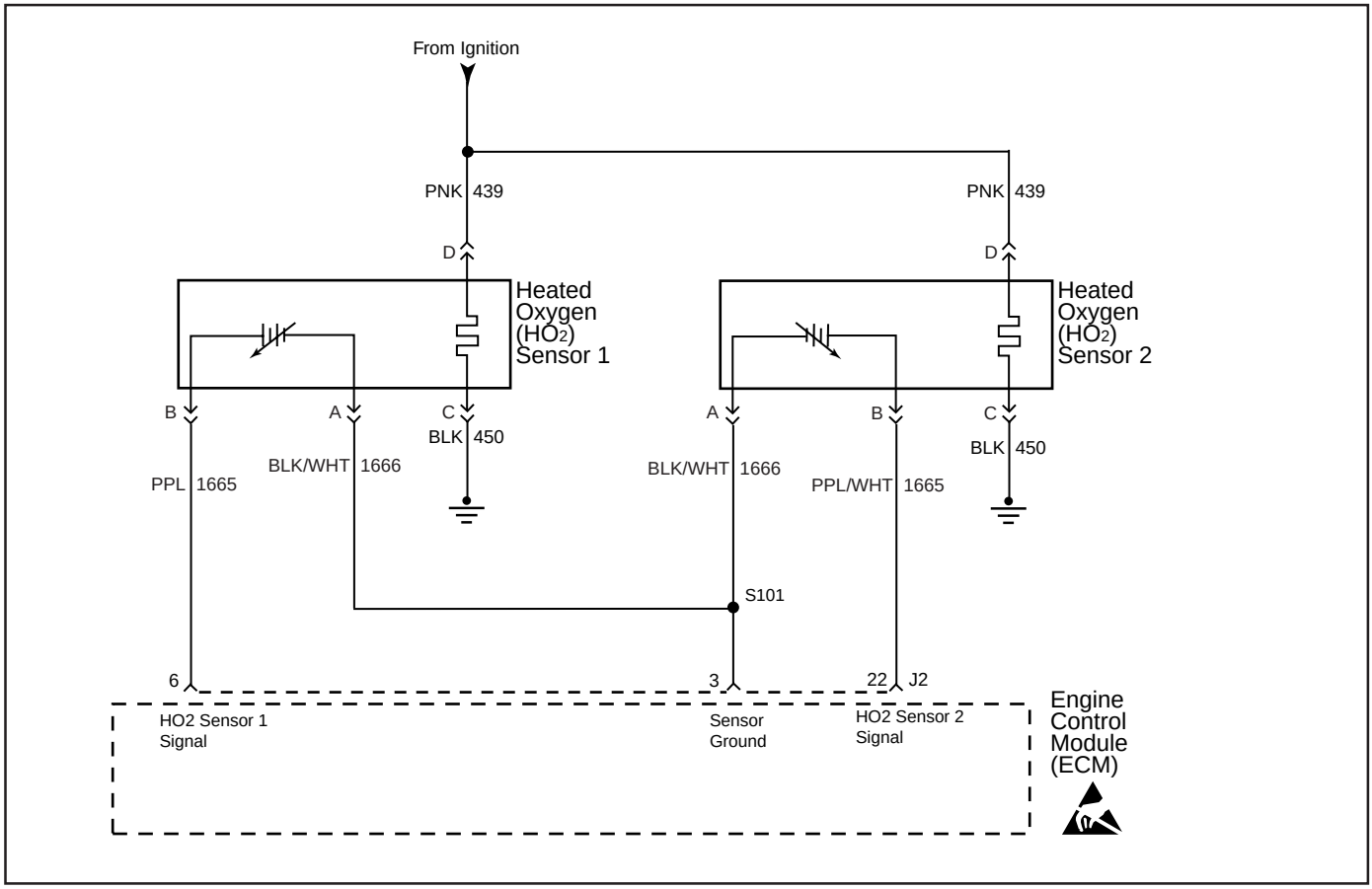
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

2. Probing terminal "D" of the HO_2 sensor harness connector verifies if the voltage is available to the HO_2 sensor heater.
3. Verifies a good ground circuit for the HO_2 sensor heater circuit.
4. Checks for ignition "ON" bias voltage on the HO_2 sensor signal circuit. This should be between 0.423 and 0.487 volts with the ignition "ON".
5. Checks for a good ground for the HO_2 sensor circuit.

DTC 13 - Heated Oxygen (HO_2) Sensor 1 Circuit Inactive (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Disconnect the HO2 sensor 1 electrical connector. 2. Ignition turned ON. 3. With a test light connected to a known good ground, probe terminal "D" of the ECM harness connector. Does the test light illuminate brightly?	—	*Go to* Step 3	*Go to* Step 6
3	Connect test light between terminals "C" and "D" of the ECM harness connector. Does the test light illuminate brightly?	—	*Go to* Step 4	*Go to* Step 7
4	1. Ignition turned ON. 2. Using DVOM J 39200 connected to a known good ground, probe terminal "B" of the ECM harness connector. Is the voltage within the specified value?	0.423 - 0.487 volt	*Go to* Step 5	*Go to* Step 8
5	1. Ignition turned ON. 2. Using DVOM J 39200, check voltage between terminals "A" and "B" of the ECM harness connector. Is the voltage within the specified value?	0.423 - 0.487 volt	*Go to* Step 10	*Go to* Step 9
6	Locate and repair open or short to ground in the ignition feed circuit for the HO2 heater. Is action complete?	—	Verify Repair	—
7	Locate and repair open in the ground circuit for the HO2 heater. Is action complete?	—	Verify Repair	—
8	Locate and repair open in the HO2 sensor 1 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 11
9	Locate and repair open in the HO2 sensor 1 ground circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 11
10	Check for faulty HO2 sensor 1 connections. If OK, replace HO2 sensor 1. Is action complete?	—	Verify Repair	—
11	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 13 - Heated Oxygen (HO_2) Sensor 2 Circuit Inactive (Non-Scan Diagnostics)

Circuit Description

The Heated Oxygen (HO_2) Sensor(s) varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

The heater provides for a faster sensor warm-up. This allows the sensor(s) to become active in a shorter period of time and remain active during a long extended idle.

DTC 13 determines if the heated oxygen sensor circuit(s) has developed an open. With an active DTC 13 set, the system operates in an Open Loop mode and the Malfunction Indicator Lamp (MIL) is turned on.

Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.

Never solder the HO_2 wires. For proper wire and connection repairs, refer to "Wiring Repair."

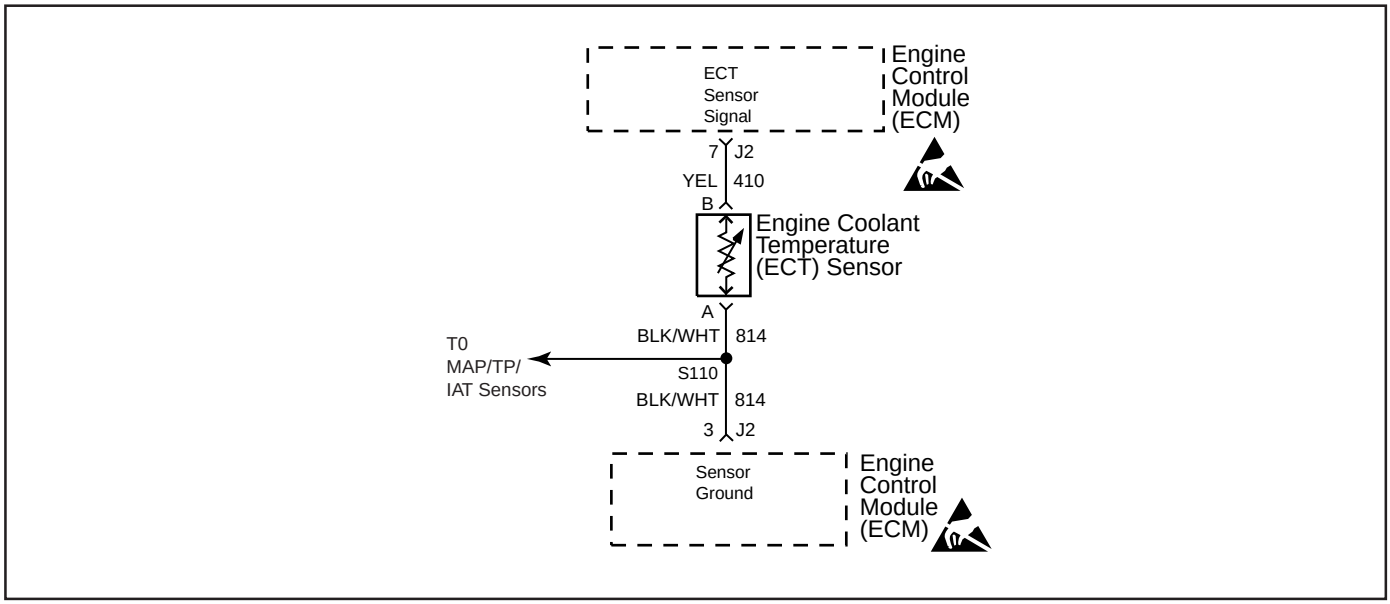
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

2. Probing terminal "D" of the HO_2 sensor harness connector verifies if the voltage is available to the HO_2 sensor heater.
3. Verifies a good ground circuit for the HO_2 sensor heater circuit.
4. Checks for ignition "ON" bias voltage on the HO_2 sensor signal circuit. This should be between 0.423 and 0.487 volts with the ignition "ON".
5. Checks for a good ground for the HO_2 sensor circuit.

DTC 13 - Heated Oxygen (HO_2) Sensor 2 Circuit Inactive (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Disconnect the HO2 sensor 2 electrical connector. 2. Ignition turned ON. 3. With a test light connected to a known good ground, probe terminal "D" of the ECM harness connector. Does the test light illuminate brightly?	—	*Go to* Step 3	*Go to* Step 6
3	Connect test light between terminals "C" and "D" of the ECM harness connector. Does the test light illuminate brightly?	—	*Go to* Step 4	*Go to* Step 7
4	1. Ignition turned ON. 2. Using DVOM J 39200 connected to a known good ground, probe terminal "B" of the ECM harness connector. Is the voltage within the specified value?	0.423 - 0.487 volt	*Go to* Step 5	*Go to* Step 8
5	1. Ignition turned ON. 2. Using DVOM J 39200, check voltage between terminals "A" and "B" of the ECM harness connector. Is the voltage within the specified value?	0.423 - 0.487 volt	*Go to* Step 10	*Go to* Step 9
6	Locate and repair open or short to ground in the ignition feed circuit for the HO2 heater. Is action complete?	—	Verify Repair	—
7	Locate and repair open in the ground circuit for the HO2 heater. Is action complete?	—	Verify Repair	—
8	Locate and repair open in the HO2 sensor 2 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 11
9	Locate and repair open in the HO2 sensor 2 ground circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 11
10	Check for faulty HO2 sensor 2 connections. If OK, replace HO2 sensor 2. Is action complete?	—	Verify Repair	—
11	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 14 - Engine Coolant Temperature (ECT) Sensor Circuit - Low Temp Indicated (Non-Scan Diagnostics)

Circuit Description

The Engine Coolant Temperature (ECT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 410 to the sensor. When the engine coolant is cold, the sensor (thermistor) resistance is high. As the engine coolant warms up, the sensor resistance becomes less. See engine coolant temperature sensor table under "Diagnostic Aids." At normal operating temperature (85°C - 95°C or 185°F - 203°F), the voltage will measure about 1.5-2.0 volts.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the ECT display on the scan tool while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.
- If DTC 33 is also set, check for open ground CKT 814.

After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

Test Description

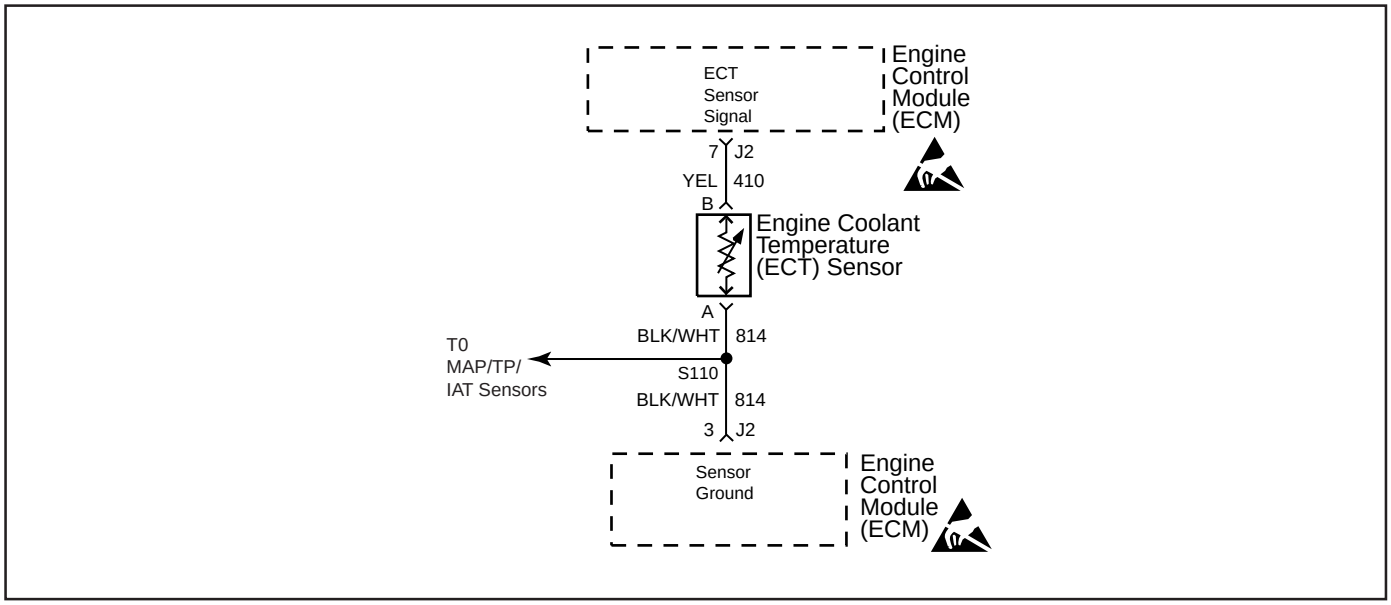
2. This step checks if there is a problem with the ECM and wiring or if the problem is the ECT sensor.
3. This step will isolate the problem to CKT 410 (5 volt reference) or to CKT 814 (sensor ground).
4. Check the harness terminals thoroughly for loose connections. If the resistance of the ECT sensor is monitored, the resistance should steadily decrease as the engine coolant warms up. The resistance reading should stabilize when the thermostat opens.

Engine Coolant Temperature Sensor Table

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
-5	23	12300
-15	5	21450
-30	-22	52700
-40	-40	100700

DTC 14 - Engine Coolant Temperature (ECT) Sensor Circuit - Low Temp Indicated (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the “On-Board Diagnostic” (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Ignition “OFF.” 2. Disconnect ECT sensor harness connector. 3. Ignition “ON,” engine “OFF.” 4. Connect DVOM across the coolant sensor harness terminals. Is voltage above the specified value?	4 volts	Go to Step 4	Go to Step 3
3	1. Connect positive DVOM lead to harness terminal “B” CKT 410 (5 volt reference). 2. Connect negative DVOM lead to a known good ground. Is voltage above the specified value?	4 volts	Go to Step 6	Go to Step 5
4	Locate and repair intermittent faulty connections. If OK, replace faulty ECT sensor. Is action complete?	—	Verify Repair	—
5	Locate and repair open CKT 410. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
6	Locate and repair open ground CKT 814. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
7	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 15 - Engine Coolant Temperature (ECT) Sensor Circuit - High Temp Indicated (Non-Scan Diagnostics)

Circuit Description

The Engine Coolant Temperature (ECT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 410 to the sensor. When the engine coolant is cold, the sensor (thermistor) resistance is high. As the engine coolant warms up, the sensor resistance becomes less. See engine coolant temperature sensor table under "Diagnostic Aids." At normal operating temperature (85°C - 95°C or 185°F - 203°F), the voltage will measure about 1.5-2.0 volts.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the ECT display on the scan tool while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.
- Check harness routing for a potential short to ground in CKT 410.

After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

Test Description

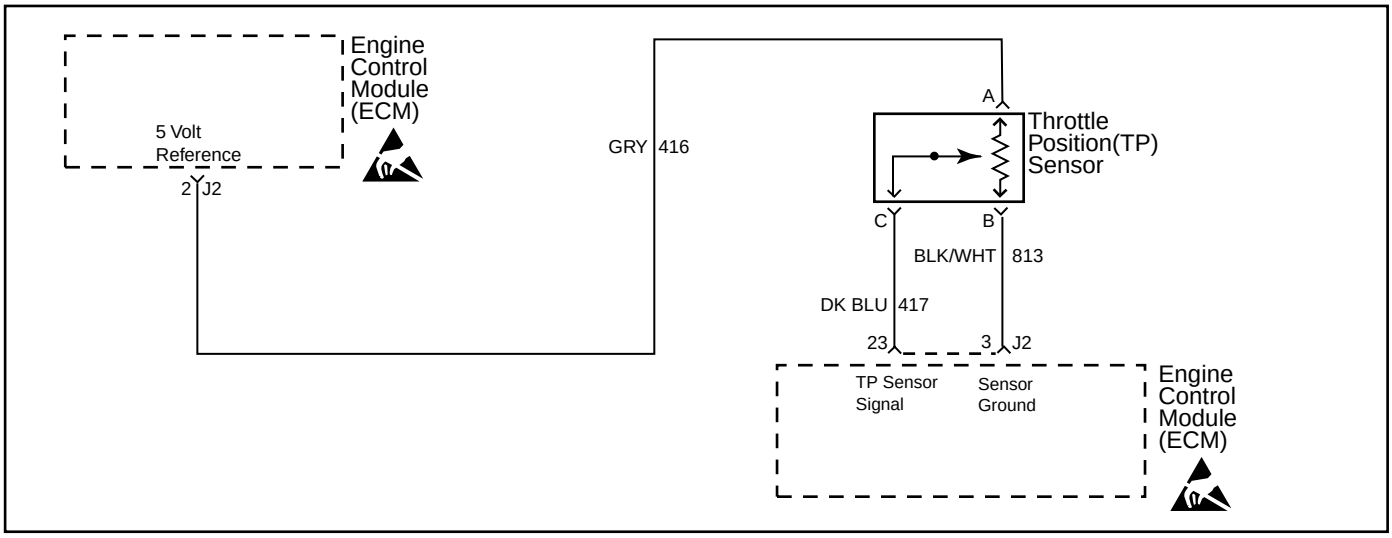
2. This step checks if there is a problem with the ECM and wiring or if the problem is the ECT sensor.
3. Check the harness terminals thoroughly for loose connections. If the resistance of the ECT sensor is monitored, the resistance should steadily decrease as the engine coolant warms up. The resistance reading should stabilize when the thermostat opens.

Engine Coolant Temperature Sensor Table

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
-5	23	12300
-15	5	21450
-30	-22	52700
-40	-40	100700

DTC 15 - Engine Coolant Temperature (ECT) Sensor Circuit - High Temp Indicated (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Ignition "OFF." 2. Disconnect ECT sensor harness connector. 3. Ignition "ON," engine "OFF." 4. Connect DVOM across the coolant sensor harness terminals. Is voltage above the specified value?	4 volts	*Go to* Step 3	*Go to* Step 4
3	Locate and repair intermittent faulty connections. If OK, replace faulty ECT sensor. Is action complete?	—	Verify Repair	—
4	Locate and repair short to ground in CKT 410. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 5
5	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 21 - Throttle Position (TP) Sensor Circuit - Signal Voltage High (Non-Scan Diagnostics)

Circuit Description

The Throttle Position (TP) sensor is a potentiometer that provides a voltage signal that changes relative to the throttle blade. Signal voltage should vary from about .7 volt at idle to about 4.8 volts at Wide Open Throttle (WOT).

The TP sensor signal is one of the most important inputs used by the ECM for fuel control and for IAC control.

The ECM supplies a 5 volt signal to the sensor through CKT 416. CKT 813 is the TP sensor ground circuit. The TP sensor will send a voltage signal back to the ECM, through CKT 417, according to where the throttle blades are positioned.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the TP sensor display on the scan tool while moving connectors and wiring harnesses related to the TP sensor. A change in the TP sensor display will indicate the location of the fault.
- If a TP sensor circuit failure is present, the MAP sensor default value will be used along with the TP sensor default value.

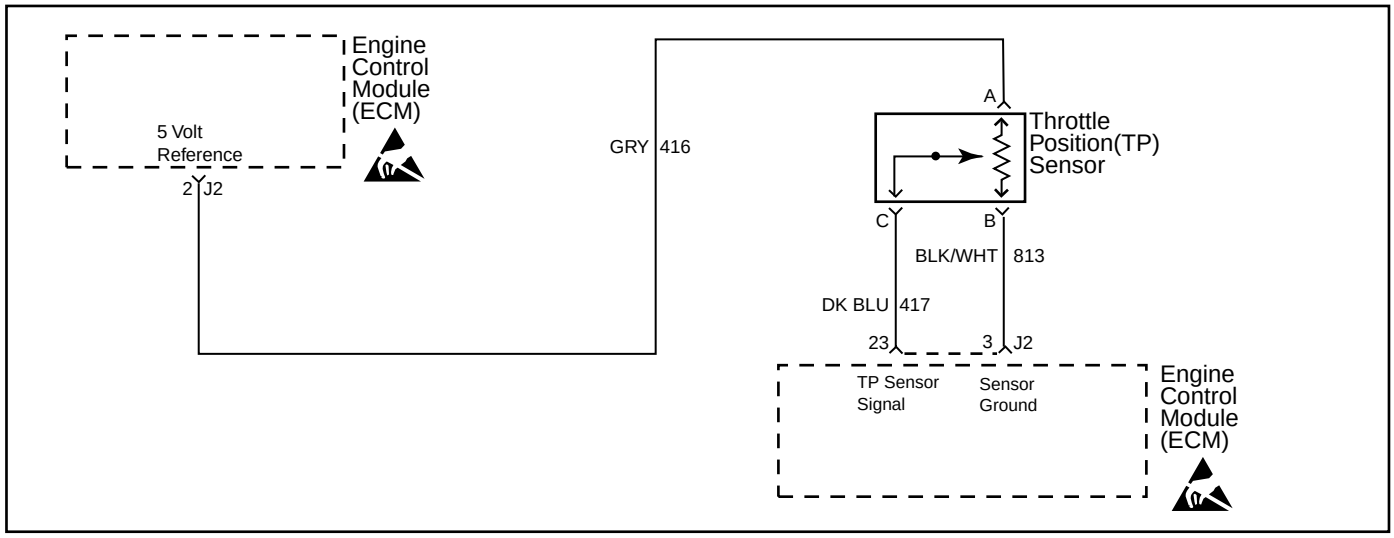
  After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

Test Description

2. This step simulates a DTC 22. If the ECM recognizes the low signal voltage and sets DTC 22, the ECM and wiring are OK.
3. This step checks to see if CKT 813 is open.

DTC 21 - Throttle Position (TP) Sensor Circuit - Signal Voltage High (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Diagnostic Trouble Code (DTC) tool switched to "normal mode," or "OFF." 2. Ignition "OFF." 3. Disconnect TP sensor harness connector. 4. Start engine and idle for 2 minutes or until DTC tool indicates a stored DTC. 5. Ignition "ON," engine "OFF." 6. Switch DTC tool to "service mode," or "ON" and note DTC. Is DTC 22 present?	—	*Go to* Step 4	*Go to* Step 3
3	1. TP sensor harness connector disconnected. 2. Ignition "ON," engine "OFF." 3. Connect DVOM from harness terminal "B" (CKT 813) to harness terminal "A" (CKT 416). Is voltage reading above the specified value?	4 volts	*Go to* Step 6	*Go to* Step 5
4	Locate and repair intermittent faulty connections. If OK, replace faulty TP sensor. Is action complete?	—	Verify Repair	—
5	Locate and repair open in CKT 813. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 7
6	Locate and repair short to voltage in CKT 417. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 7
7	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 22 - Throttle Position (TP) Sensor Circuit - Signal Voltage Low (Non-Scan Diagnostics)

Circuit Description

The Throttle Position (TP) sensor is a potentiometer that provides a voltage signal that changes relative to the throttle blade. Signal voltage should vary from about .7 volt at idle to about 4.8 volts at Wide Open Throttle (WOT).

The TP sensor signal is one of the most important inputs used by the ECM for fuel control and for IAC control.

The ECM supplies a 5 volt signal to the sensor through CKT 416. CKT 813 is the TP sensor ground circuit. The TP sensor will send a voltage signal back to the ECM, through CKT 417, according to where the throttle blades are positioned.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the TP sensor display on the scan tool while moving connectors and wiring harnesses related to the TP sensor. A change in the TP sensor display will indicate the location of the fault.
- If DTC 34 is also set, check for a short to ground in CKT 416 or CKT 416E.
- If a TP sensor circuit failure is present, the MAP sensor default value will be used along with the TP sensor default value.

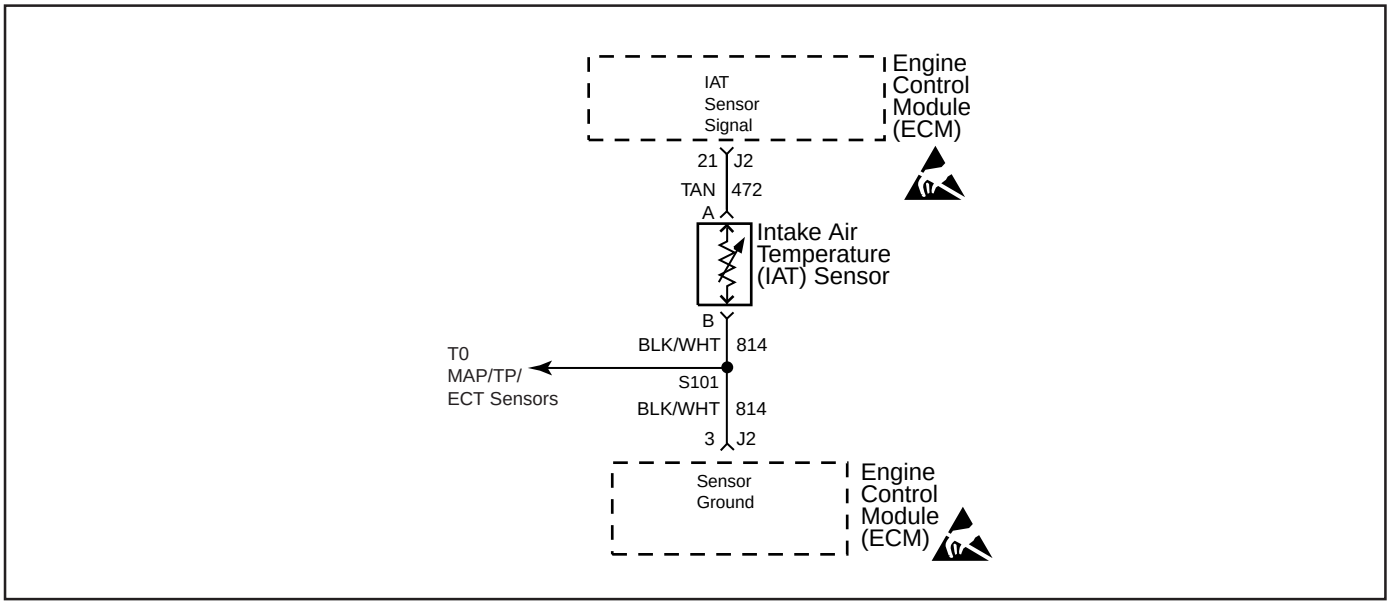
After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

Test Description

2. This step simulates a DTC 21. If the ECM recognizes the high signal voltage and sets a DTC 21, the ECM and wiring are OK.
3. This step checks CKT 416 for the 5 volt reference.

DTC 22 - Throttle Position (TP) Sensor Circuit - Signal Voltage Low (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the “On-Board Diagnostic” (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Diagnostic Trouble Code (DTC) tool switched to “normal mode,” or “OFF.” 2. Ignition “OFF.” 3. Disconnect TP sensor harness connector. 4. Connect a jumper wire from harness terminal “A” (CKT 416) to harness terminal “C” (CKT 417). 5. Start engine and idle for 2 minutes or until DTC tool indicates a stored DTC. 6. Ignition “ON,” engine “OFF.” 7. Switch DTC tool to “service mode,” or “ON” and note DTC. Is DTC 21 present?	—	*Go to* Step 4	*Go to* Step 3
3	1. Remove jumper wire from CKT 416 and 417. 2. Connect DVOM from harness terminal “A” (CKT 416) to harness terminal “B” (CKT 813). Is voltage reading above the specified value?	4 volts	*Go to* Step 5	*Go to* Step 6
4	Locate and repair intermittent faulty connections. If OK, replace faulty TP sensor. Is action complete?	—	Verify repair	—
5	Locate and repair open or short to ground in CKT 417. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	*Go to* Step 7
6	Locate and repair open or short to ground in CKT 416. Also check CKT 416E to the MAP sensor for a short to ground. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	*Go to* Step 7
7	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 23 - Intake Air Temperature (IAT) Sensor Circuit - Low Temp Indicated (Non-Scan Diagnostics)

Circuit Description

The Intake Air Temperature (IAT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 472 to the sensor. When the intake air temperature is cold, the sensor (thermistor) resistance is high. As the intake air temperature warms up, the sensor resistance becomes less. See intake air temperature sensor table under "Diagnostic Aids."

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the IAT display on the scan tool while moving connectors and wiring harnesses related to the IAT sensor. A change in the IAT display will indicate the location of the fault.
- If DTC 33 is also set, check for open ground CKT 814.

After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

Test Description

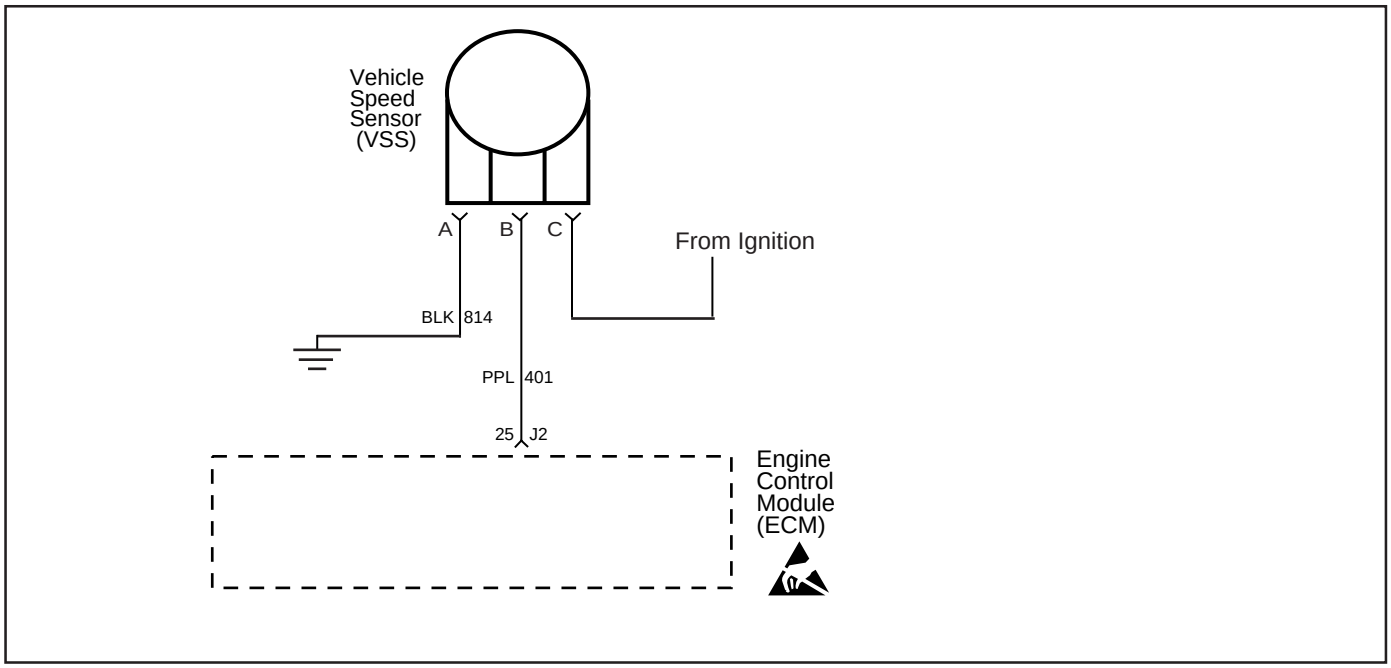
2. This step checks if there is a problem with the ECM and wiring or if the problem is the IAT sensor.
3. This step will isolate the problem to CKT 472 (5 volt reference) or to CKT 814 (sensor ground).
4. Check the harness terminals thoroughly for loose connections. If the resistance of the IAT sensor is monitored, the resistance should steadily decrease as the intake air temperature warms up.

Intake Air Temperature Sensor Table

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
-5	23	12300
-15	5	21450
-30	-22	52700
-40	-40	100700

DTC 23 - Intake Air Temperature (IAT) Sensor Circuit - Low Temp Indicated (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Ignition "OFF." 2. Disconnect IAT sensor harness connector. 3. Ignition "ON," engine "OFF." 4. Connect DVOM across the intake air temperature sensor harness terminals. Is voltage above the specified value?	4 volts	Go to Step 4	Go to Step 3
3	1. Connect positive DVOM lead to harness terminal "A" CKT 472 (5 volt reference). 2. Connect negative DVOM lead to a known good ground. Is voltage above the specified value?	4 volts	Go to Step 6	Go to Step 5
4	Locate and repair intermittent faulty connections. If OK, replace faulty IAT sensor. Is action complete?	—	Verify Repair	—
5	Locate and repair open CKT 472. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
6	Locate and repair open ground CKT 814. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
7	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



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DTC 24 - Vehicle Speed Sensor (VSS) Circuit (Non-Scan Diagnostics)

Circuit Description

The vehicle speed is provided to the ECM by means of the Vehicle Speed Sensor (VSS). The sensor may be mounted in the transmission, but the actual location depends on the application. The sensor produces a 12 volt digital signal whenever the vehicle is moving. The number of pulses increases with vehicle speed. The ECM converts this signal into MPH, which can be monitored with a scan tool. This information may be used by the ECM for several reasons such as governing the vehicle speed to a maximum road speed.

The sensor is a three-wire sensor. Terminal "A" of the sensor is provided a ground on CKT 814 through the ECM. Terminal "C" of the sensor is provided ignition voltage. Terminal "B" of the sensor is the signal to the ECM through CKT 400.

Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.

Check VSS circuits for proper connections and the harness is routed properly.

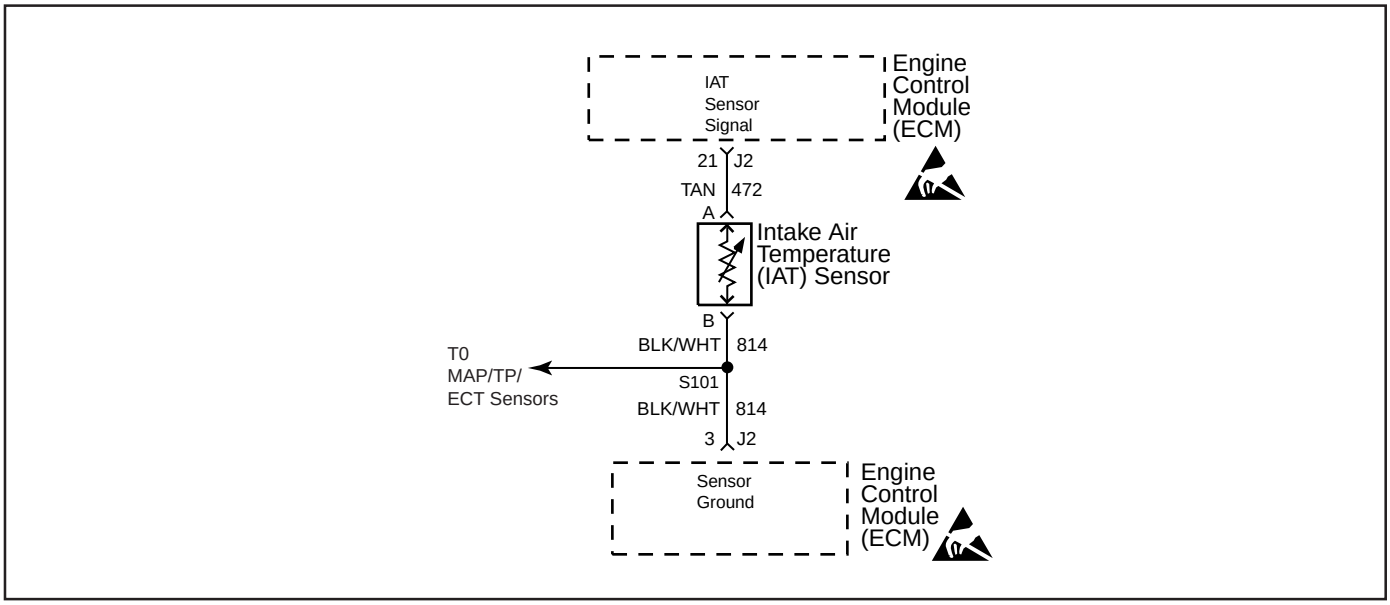
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

2. This step determines if the VSS is receiving ignition voltage.
3. This step checks for a good ground circuit.

DTC 24 - Vehicle Speed Sensor (VSS) Circuit (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Disconnect the vehicle speed sensor electrical connector. 2. Ignition turned ON. 3. Using a test light connected to a known good ground, probe ECM harness terminal "C". Does the test light illuminate brightly?	—	*Go to* Step 3	*Go to* Step 7
3	1. Ignition turned ON. 2. Using a test light connected to B+, probe ECM harness terminal "A". Does the test light illuminate brightly?	—	*Go to* Step 4	*Go to* Step 8
4	1. Ignition OFF. 2. Reconnect VSS electrical connector. 3. Ignition turned ON. 4. Raise and support the vehicle drive wheel(s) per manufacturer's recommendations. 5. Using DVOM J 39200 connected to a known good ground, back probe ECM harness connector terminal "J2-25". 6. While observing the DVOM, slowly rotate the drive wheel(s). Does the DVOM indicate a voltage changing as the wheels are rotated?	—	*Go to* Step 9	*Go to* Step 5
5	Locate and repair open or short to ground on CKT 400. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	*Go to* Step 6
6	Replace faulty VSS. Is action complete?	—	Verify repair	—
7	Locate and repair open or short to ground in the ignition circuit to the VSS. Is action complete?	—	Verify Repair	—
8	Locate and repair open in the ground circuit to the VSS. Is action complete?	—	Verify Repair	—
9	DTC 24 may be intermittent. Clear DTC and drive the vehicle. If DTC 24 returns, repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 25 - Intake Air Temperature (IAT) Sensor Circuit - High Temp Indicated (Non-Scan Diagnostics)

Circuit Description

The Intake Air Temperature (IAT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 472 to the sensor. When the intake air temperature is cold, the sensor (thermistor) resistance is high. As the intake air temperature warms up, the sensor resistance becomes less. See intake air temperature sensor table under "Diagnostic Aids."

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the IAT display on the scan tool while moving connectors and wiring harnesses related to the IAT sensor. A change in the IAT display will indicate the location of the fault.
- Check harness routing for a potential short to ground in CKT 814.

After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

Test Description

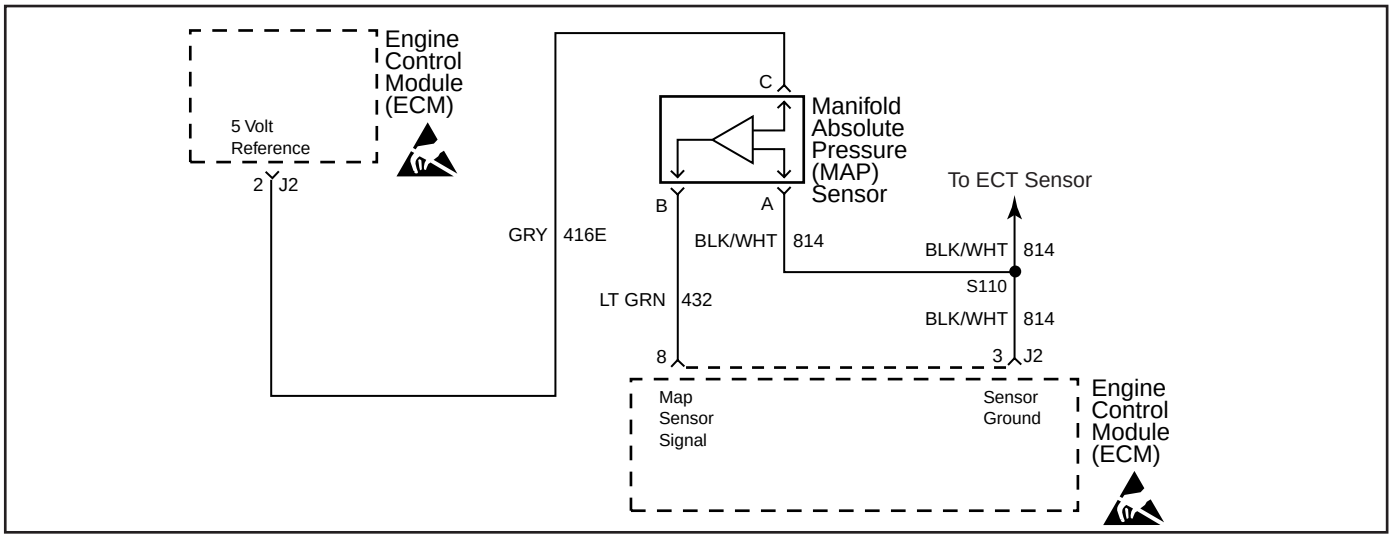
2. This step checks if there is a problem with the ECM and wiring or if the problem is the IAT sensor.
3. Check the harness terminals thoroughly for loose connections. If the resistance of the IAT sensor is monitored, the resistance should steadily decrease as the intake air temperature warms up.

Intake Air Temperature Sensor Table

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
-5	23	12300
-15	5	21450
-30	-22	52700
-40	-40	100700

DTC 25 - Intake Air Temperature (IAT) Sensor Circuit - High Temp Indicated (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Ignition "OFF." 2. Disconnect IAT sensor harness connector. 3. Ignition "ON," engine "OFF." 4. Connect DVOM across the IAT sensor harness terminals. Is voltage above the specified value?	4 volts	*Go to* Step 3	*Go to* Step 4
3	Locate and repair intermittent faulty connections. If OK, replace faulty IAT sensor. Is action complete?	—	Verify Repair	—
4	Locate and repair short to ground in CKT 472. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 5
5	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 33 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage High (Non-Scan Diagnostics)

Circuit Description

The Manifold Absolute Pressure (MAP) sensor responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1.0-1.5 volts at idle to about 4.0-4.5 volts at Wide Open Throttle (WOT).

If the MAP sensor fails, the ECM will substitute a default MAP value that will vary with RPM.

The MAP sensor voltage of 5 volts is delivered to the MAP sensor through CKT 416E. CKT 814 is the ground circuit for the MAP sensor. The MAP signal CKT 432 will send a voltage signal back to the ECM according to what the manifold pressure is.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAP sensor display on the scan tool while moving connectors and wiring harnesses related to the MAP sensor. A change in the MAP sensor display will indicate the location of the fault.
- If the idle is rough or unstable, refer to *Symptoms* section for items which may cause an unstable idle.
- With the ignition "ON," engine "OFF," the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of altitude and is referred to as BARO.
- If DTC 14 is also set, check for open in ground CKT 814.
- If a MAP sensor circuit failure is present, the TP sensor default value will be used along with the MAP sensor default value.

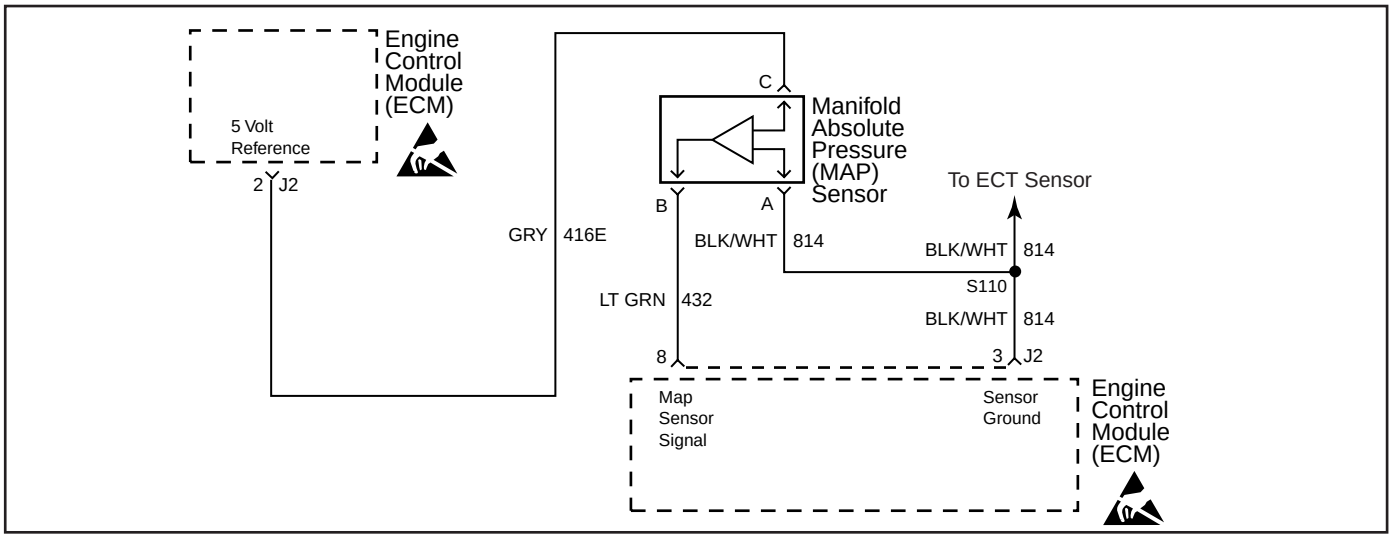
After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

Test Description

2. This step will determine if there is an adequate vacuum supply to the MAP sensor. If the vacuum gauge reading is erratic, refer to the "Rough or Unstable Idle" symptom.
3. This step simulates a DTC 34. If the ECM recognizes the low signal voltage and sets a DTC 34, the ECM and wiring are OK.
4. This step checks to see if CKT 814 is open.
5. Low manifold vacuum may result from a restriction in the MAP sensor hose or from vacuum leaks in the engine induction system.

DTC 33 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage High (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Ignition "OFF." 2. Install a vacuum gauge to a manifold vacuum source. 3. Start engine and raise to about 1000 RPM in neutral. 4. The vacuum reading should be steady. Is the vacuum gauge reading steady and above the specified value?	14" Hg (45.5 kPa)	*Go to* Step 3	*Go to* Step 5
3	1. Diagnostic Trouble Code (DTC) tool switched to "normal mode," or "OFF." 2. Ignition "OFF." 3. Disconnect MAP sensor harness connector. 4. Start engine and idle for 2 minutes or until DTC tool indicates a stored DTC. 5. Ignition "ON," engine "OFF." 6. Switch DTC tool to "service mode," or "ON" and note DTC. Is DTC 34 present?	—	*Go to* Step 6	*Go to* Step 4
4	1. MAP sensor harness connector disconnected. 2. Ignition "ON," engine "OFF." 3. Connect DVOM from harness terminal "A" (CKT 814) to harness terminal "C" (CKT 416E). Is voltage reading above the specified value?	4 volts	*Go to* Step 7	*Go to* Step 8
5	Repair low or unsteady vacuum problem. Is action complete?	—	Verify Repair	—
6	Check for plugged or leaking sensor vacuum fitting. Also locate and repair intermittent faulty connections. If OK, replace faulty MAP sensor. Is action complete?	—	Verify Repair	—
7	Locate and repair short to voltage in CKT 432. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 9
8	Locate and repair open in CKT 814. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 9
9	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 34 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage Low (Non-Scan Diagnostics)

Circuit Description

The Manifold Absolute Pressure (MAP) sensor responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1.0-1.5 volts at idle to about 4.0-4.5 volts at Wide Open Throttle (WOT).

If the MAP sensor fails, the ECM will substitute a default MAP value that will vary with RPM.

The MAP sensor voltage of 5 volts is delivered to the MAP sensor through CKT 416E. CKT 814 is the ground circuit for the MAP sensor. The MAP signal CKT 432 will send a voltage signal back to the ECM according to what the manifold pressure is.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAP sensor display on the scan tool while moving connectors and wiring harnesses related to the MAP sensor. A change in the MAP sensor display will indicate the location of the fault.
- If the idle is rough or unstable, refer to *Symptoms* section for items which may cause an unstable idle.
- With the ignition "ON," engine "OFF," the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of altitude and is referred to as BARO.
- If a MAP sensor circuit failure is present, the TP sensor default value will be used along with the MAP sensor default value.

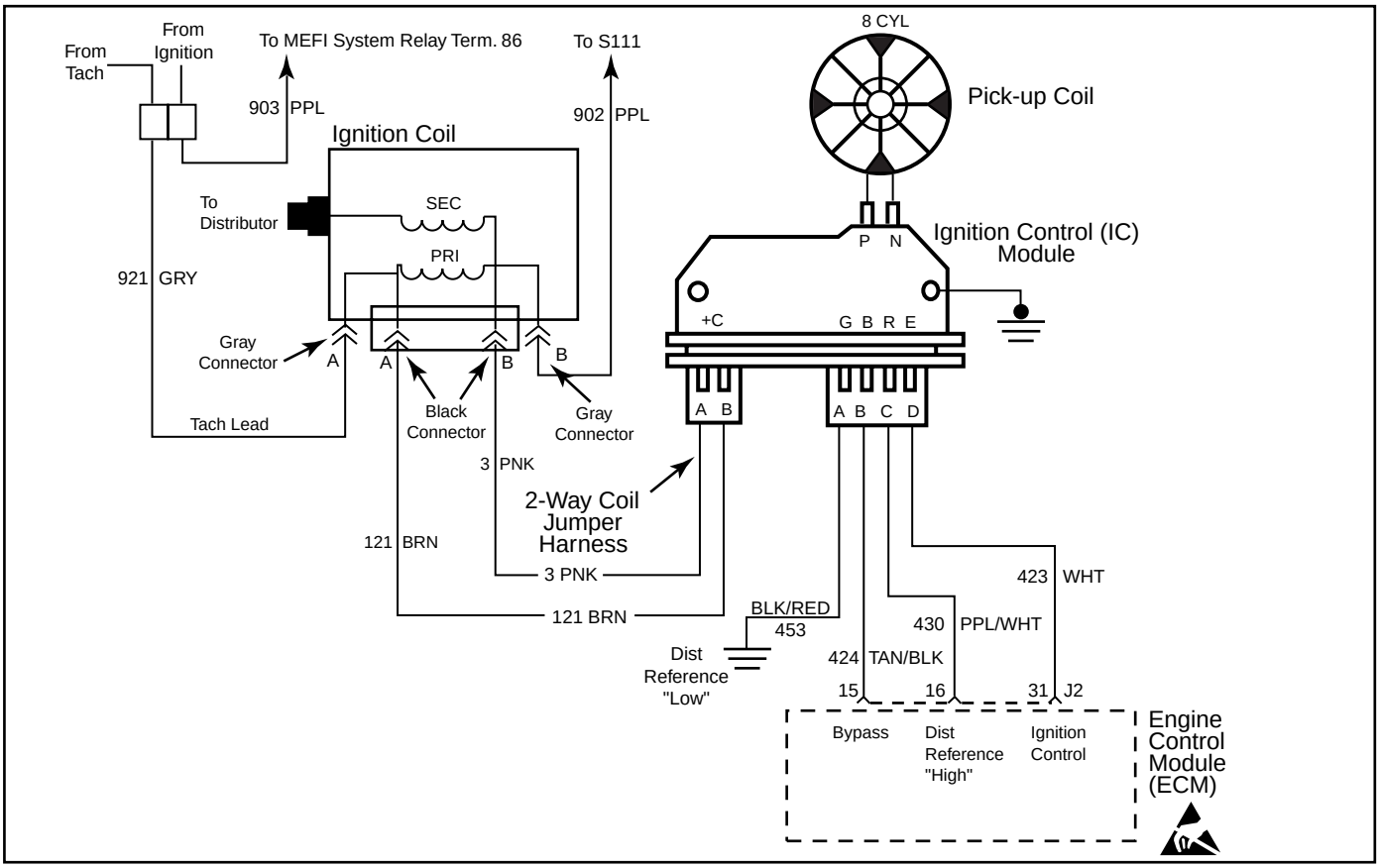
After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

Test Description

2. This step simulates a DTC 33. If the ECM recognizes the high signal voltage and sets a DTC 33, the ECM and wiring are OK.
3. This step checks CKT 416E for the 5 volt reference.

DTC 34 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage Low (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Marine Diagnostic Trouble Code (MDTC) tool switched to "normal mode," or "OFF." 2. Ignition "OFF." 3. Disconnect MAP sensor harness connector. 4. Connect a jumper wire from harness terminal "B" (CKT 432) to harness terminal "C" (CKT 416E). 5. Start engine and idle for 2 minutes or until MDTC tool indicates a stored DTC. 6. Ignition "ON," engine "OFF." 7. Switch MDTC tool to "service mode," or "ON" and note DTC. Is DTC 33 present?	—	*Go to* Step 4	*Go to* Step 3
3	1. Remove jumper wire from CKT 416E and 432. 2. Connect DVOM from harness terminal "A" (CKT 814) to harness terminal "C" (CKT 416E). Is voltage reading above the specified value?	4 volts	*Go to* Step 5	*Go to* Step 6
4	Locate and repair intermittent faulty connections. If OK, replace faulty MAP sensor. Is action complete?	—	Verify repair	—
5	Locate and repair open or short to ground in CKT 432. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	*Go to* Step 7
6	Locate and repair open or short to ground in CKT 416E. Also check CKT 416 to the TP sensor for a short to ground. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	*Go to* Step 7
7	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 41 - Ignition Control (IC) Circuit - Open IC Circuit (Non-Scan Diagnostics)

Circuit Description

When the system is running in the ignition module, or crank mode, there is no voltage on the bypass line, and the Ignition Control (IC) module grounds the IC signal. The ECM expects to see the IC line grounded during this mode. If not, it sets a DTC 41 and will not go into the IC mode.

When the RPM for IC is reached (about 300 RPM), and bypass voltage is applied on CKT 424 by the ECM, the IC line, CKT 423, should no longer be grounded in the IC module. CKT 423 should have varying voltage on it at this point.

If the bypass line is open or shorted to ground, the IC module will not switch to IC mode. The IC line, CKT 423, voltage will be low and DTC 42 will be set.

If CKT 423 is grounded, the IC module will switch to IC mode but, because the line is grounded, there will be no IC signal and a DTC 42 will set.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage.
- If the engine starts and stalls, it may set a false DTC 41. Clear DTC's and repair stalling condition.

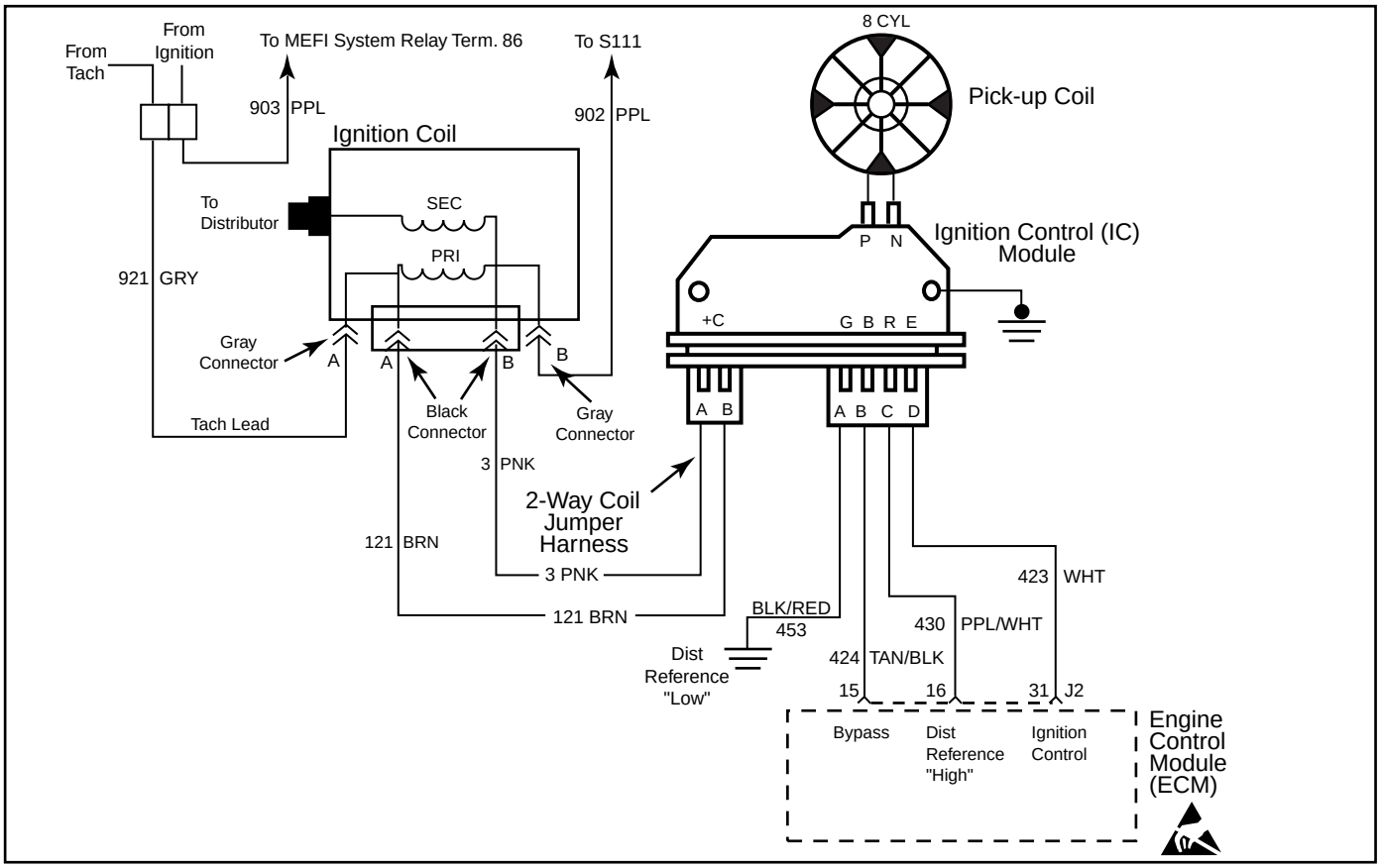
After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

Test Description

2. DTC 41 means the ECM has seen an open in the IC circuit. This test confirms DTC 41 and that the fault causing the DTC is present.
3. Checks for a normal IC ground path through the Ignition Control (IC) module.
4. Confirms that DTC 41 is a faulty ECM and not an intermittent open in CKT 423.

DTC 41 - Ignition Control (IC) Circuit - Open IC Circuit (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Install Marine Diagnostic Trouble Code (MDTC) tool. 2. Clear DTC 41. • *Refer to* "Clear DTC Procedure." 3. Start engine and idle for 2 minutes or until MDTC tool indicates a stored trouble code. 4. Ignition "ON," engine "OFF." 5. Switch MDTC tool to "service mode," or "ON" and note DTC. Is DTC 41 present?	—	*Go to* Step 3	*Go to* Step 8
3	1. Ignition "OFF." 2. Disconnect ECM harness connectors. 3. Using a DVOM selected for ohms, probe ECM harness terminal "J2-31" to ground. Is resistance within the specified value?	3000-6000 ohms	*Go to* Step 4	*Go to* Step 5
4	1. Reconnect ECM. 2. Start engine and idle for 2 minutes or until MDTC tool indicates a stored trouble code. 3. Ignition "ON," engine "OFF." 4. Switch MDTC tool to "service mode" or "ON" and note DTC. Is DTC 41 present?	—	*Go to* Step 7	*Go to* Step 8
5	Locate and repair open in CKT 423. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 6
6	Replace faulty distributor ignition control module. Is action complete?	—	Verify Repair	—
7	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—
8	DTC 41 is intermittent. Refer to "Diagnostic Aids" on facing page. Check harness and connectors for an intermittent open in CKT 423.	—	—	—



DTC 42 - Ignition Control (IC) Circuit - Grounded IC Circuit, Open or Grounded Bypass (Non-Scan Diagnostics)

Circuit Description

When the system is running in the ignition module, or crank mode, there is no voltage on the bypass line, and the Ignition Control (IC) module grounds the IC signal. The ECM expects to see the IC line grounded during this mode. If not, it sets a DTC 41 and will not go into the IC mode.

When the RPM for IC is reached (about 300 RPM), and bypass voltage is applied on CKT 424 by the ECM, the IC line, CKT 423, should no longer be grounded in the IC module. CKT 423 should have varying voltage on it at this point.

If the bypass line is open or shorted to ground, the IC module will not switch to IC mode. The IC line, CKT 423, voltage will be low and DTC 42 will be set.

If CKT 423 is grounded, the IC module will switch to IC mode but, because the line is grounded, there will be no IC signal and a DTC 42 will set.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage.
- If the engine starts and stalls, it may set a false DTC 42. Clear DTC's and repair stalling condition.

After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

Test Description

2. DTC 42 means the ECM has seen an open or short to ground in the bypass circuit, or a short to ground in the IC circuit. This test confirms a DTC 42 and that the fault causing the DTC is present.
3. Checks for a normal IC ground path through the Ignition Control (IC) module. An IC CKT 423 shorted to ground will also read less than 3000 ohms, however, this will be checked later.
4. As the test light voltage touches CKT 424, the module should switch, causing the DVOM reading to go from over 3000 ohms to under 1000 ohms. The important thing is that the module switched.
5. The module did not switch and this step checks for:
   - Bypass CKT 424 open.
   - Bypass CKT 424 shorted to ground.
   - Faulty ignition module.
7. Confirms that DTC 42 is a faulty ECM and not an intermittent in CKT 423 or CKT 424.

DTC 42 - Ignition Control (IC) Circuit - Grounded IC Circuit, Open or Grounded Bypass (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Install Marine Diagnostic Trouble Code (MDTC) tool. 2. Clear DTC 42. • *Refer to* "Clear DTC Procedure." 3. Start engine and idle for 2 minutes or until MDTC tool indicates a stored trouble code. 4. Ignition "ON," engine "OFF." 5. Switch MDTC tool to "service mode," or "ON" and note DTC. Is DTC 42 present?	—	*Go to* Step 3	*Go to* Step 13
3	1. Ignition "OFF." 2. Disconnect ECM harness connectors. 3. Using a DVOM selected for ohms, probe ECM harness terminal "J2-31" to ground. Is resistance within the specified value?	3000-6000 ohms	*Go to* Step 4	*Go to* Step 8
4	1. Leave DVOM connected from ECM harness terminal "J2-31" to ground. 2. Using a test light connected to B+, probe ECM harness terminal "J2-15." 3. As the test light contacts "J2-15," the resistance should switch from over 3000 ohms to under 1000 ohms. Does the resistance switch to under the specified value?	1000 ohms	*Go to* Step 7	*Go to* Step 5
5	Using a test light connected to B+, probe ECM harness terminal "J2-15" (CKT 424). Does test light illuminate brightly?	—	*Go to* Step 6	*Go to* Step 9
6	Disconnect ignition control module 4-wire connector. Does test light illuminate brightly?	—	*Go to* Step 10	*Go to* Step 11

DTC 42 - Ignition Control (IC) Circuit - Grounded IC Circuit, Open or Grounded Bypass (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
7	1. Reconnect ECM. 2. Start engine and idle for 2 minutes or until MDTC tool indicates a stored trouble code. Is DTC 42 present?	—	*Go to* Step 12	*Go to* Step 13
8	Locate and repair short to ground in CKT 423. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 11
9	Locate and repair open in CKT 424. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 11
10	Locate and repair short to ground in CKT 424. Is action complete?	—	Verify Repair	—
11	Replace faulty ignition control module. Is action complete?	—	Verify Repair	—
12	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—
13	DTC 42 is intermittent. Refer to “Diagnostic Aids” on facing page. Check harness and connectors for an intermittent open or short to ground in CKT 424, or an intermittent short to ground in CKT 423.	—	—	—

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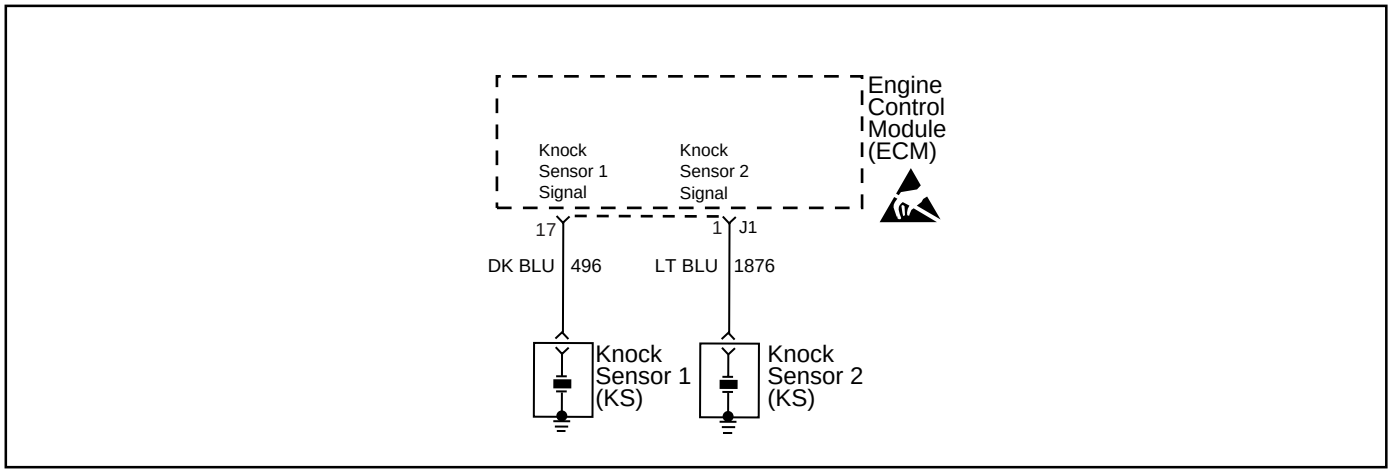


MEFI4310
6-28-00

DTC 44 - Knock Sensor (KS) 1 System Inactive (Non-Scan Diagnostics)

Circuit Description

The ECM uses the Knock Sensors in order to detect engine detonation. This detection allows the ECM to retard spark timing based on the KS signal coming into the ECM. DTC 44 will set only if the ECM does not see any activity on the KS signal circuits.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage.
- Loose Knock Sensors in engine block.
- Poor connection at the Knock Sensors.

After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

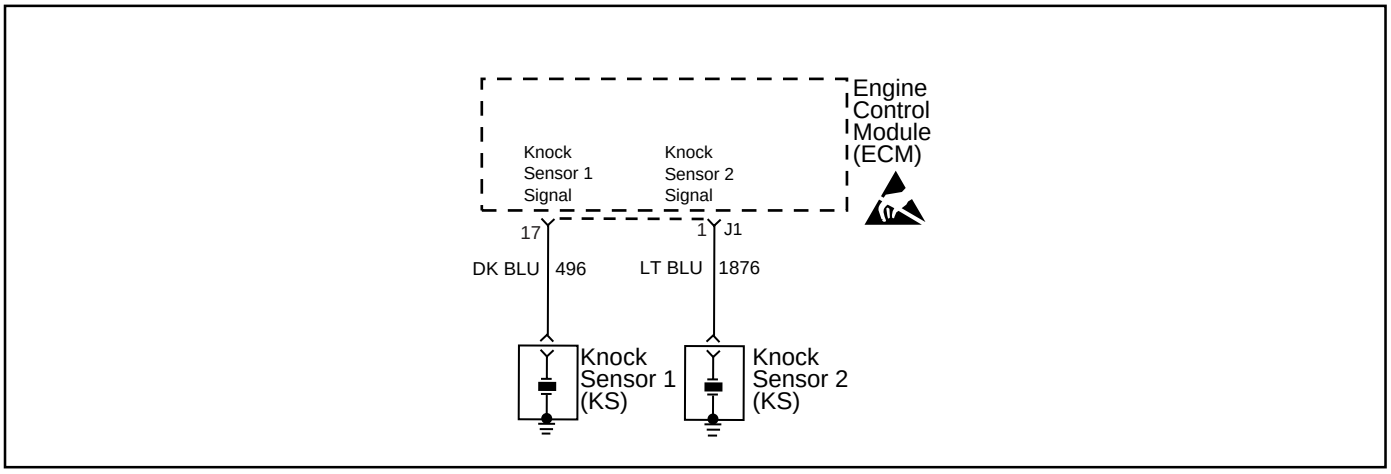
If CKT 496 or CKT497 are routed too close to secondary ignition wires, the ECM may see the interference as a knock signal, resulting in false timing retard.

Test Description

4. This step ensures the knock sensors are secured properly in the engine block.
5. Checks to see that each knock sensor circuit is within specifications. Some engines use two knock sensors, so both circuits need to be checked individually.

DTC 44 - Knock Sensor (KS) 1 System Inactive (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	**Important:** If you can hear the engine knock, repair the engine mechanical problem before proceeding with this diagnostic table. Check the KS signal circuits for incorrect routing near the secondary wires. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 3
3	Check the KS signal circuits for any terminals not being fully seated or for incorrect installation. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 4
4	Checks knock sensors for being loose in the engine block. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 5
5	1. Ignition "OFF." 2. Disconnect "J1" harness connector. 3. Connect DVOM from "J1-17" (CKT 496 - Knock Signal 1) to a known good ground near knock sensor. Is resistance between the specified value for each circuit?	85,000-100,000 ohms	*Go to* Step 8	*Go to* Step 6
6	Locate and repair open or short to ground in the circuit(s) that were out of range. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 7
7	Inspect knock sensor terminal contacts. If OK, replace faulty knock sensor(s). Is action complete?	—	Verify Repair	—
8	Replace faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



MEFI4310
6-28-00

DTC 44 - Knock Sensor (KS) 2 System Inactive (Non-Scan Diagnostics)

Circuit Description

The ECM uses the Knock Sensors in order to detect engine detonation. This detection allows the ECM to retard spark timing based on the KS signal coming into the ECM. DTC 44 will set only if the ECM does not see any activity on the KS signal circuits.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage.
- Loose Knock Sensors in engine block.
- Poor connection at the Knock Sensors.

After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

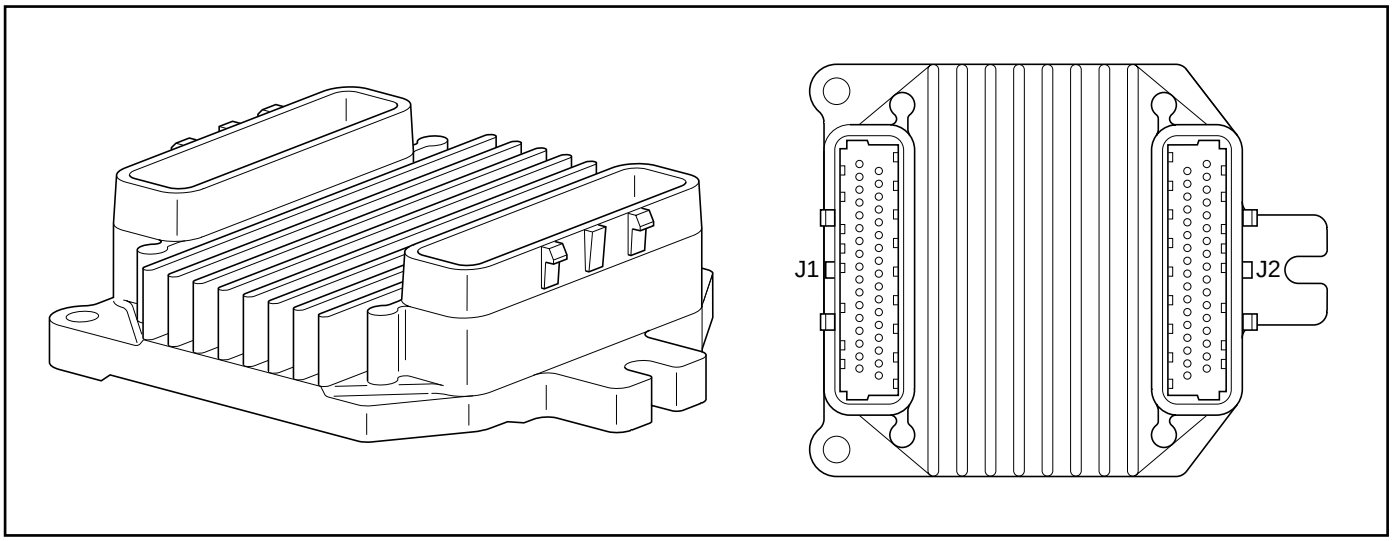
If CKT 496 or CKT497 are routed too close to secondary ignition wires, the ECM may see the interference as a knock signal, resulting in false timing retard.

Test Description

4. This step ensures the knock sensors are secured properly in the engine block.
5. Checks to see that each knock sensor circuit is within specifications. Some engines use two knock sensors, so both circuits need to be checked individually.

DTC 44 - Knock Sensor (KS) 2 System Inactive (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	**Important:** If you can hear the engine knock, repair the engine mechanical problem before proceeding with this diagnostic table. Check the KS signal circuits for incorrect routing near the secondary wires. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 3
3	Check the KS signal circuits for any terminals not being fully seated or for incorrect installation. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 4
4	Checks knock sensors for being loose in the engine block. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 5
5	1. Ignition "OFF." 2. Disconnect "J1" harness connector. 3. Connect DVOM from "J1-1" (CKT 497 - Knock Signal 2) to a known good ground near knock sensor. Is resistance between the specified value for each circuit?	85,000-100,000 ohms	*Go to* Step 8	*Go to* Step 6
6	Locate and repair open or short to ground in the circuit(s) that were out of range. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 7
7	Inspect knock sensor terminal contacts. If OK, replace faulty knock sensor(s). Is action complete?	—	Verify Repair	—
8	Replace faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



MEFI3004

DTC 51 - Calibration Checksum Failure (Non-Scan Diagnostics)

Circuit Description

This test allows the ECM to check for a calibration failure by comparing the calibration value to a known value stored in the EEPROM.

This test is also used as a security measure to prevent improper use of calibration or changes to these calibrations that may alter the designed function of MEFI.

Diagnostic Aids

If DTC 51 failed more than once, but is intermittent, replace the ECM.

Test Description

2. This step checks to see if the fault is present during diagnosis. If present, the ECM is not functioning properly and must be replaced or reprogrammed.

DTC 51 - Calibration Checksum Failure (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Install Diagnostic Trouble Code (DTC) tool. 2. Using "Clear DTC Procedure," clear DTC 51. 3. Ignition "ON." 4. Switch DTC tool to "service mode," or "ON." Does DTC 51 reset?	—	*Go to* Step 3	*Refer to* Diagnostic Aids
3	Replace or reprogram faulty ECM and verify DTC does not reset. Is action complete?	—	Verify Repair	—

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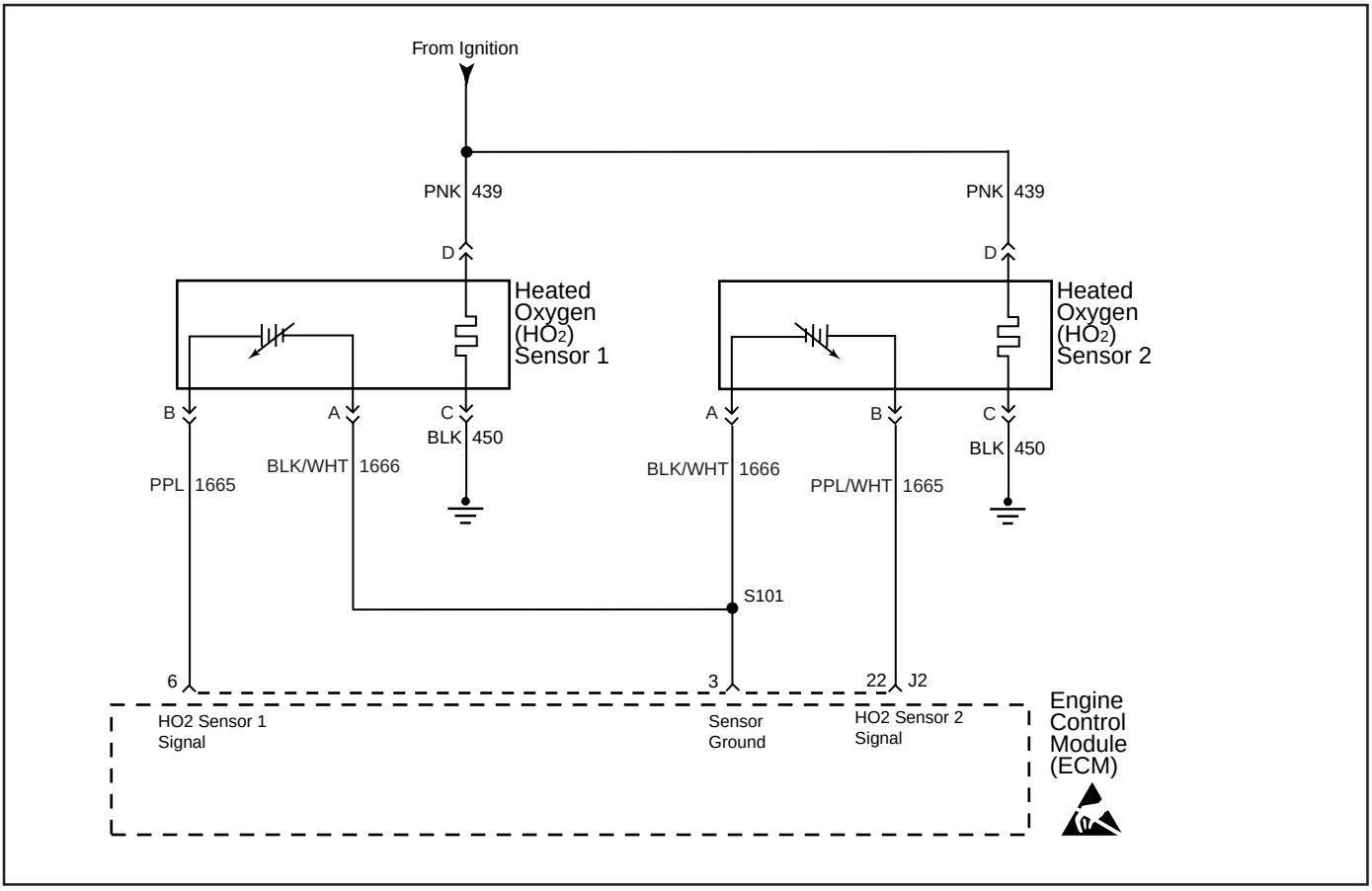


DTC 54 - Heated Oxygen (HO_2) Sensor 1 Circuit Low Voltage - Lean Exhaust Indicated (Non-Scan Diagnostics)

Circuit Description

The Heated Oxygen (HO_2) Sensor(s) varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- An intermittent short to ground in the HO_2 sensor signal circuit.
- Fuel contamination: Water, even in small amounts delivered to the injectors can cause a lean condition.
- Fuel Pressure: If the fuel pressure is too low, the system will be lean. In order to confirm, monitor a fuel pressure gauge while driving the vehicle at various speeds and loads.
- Exhaust Leaks: If there is an exhaust leak, the engine may pull the outside air into the exhaust and past the sensor.
- Vacuum leaks can cause a lean condition or high idle.

Never solder the HO_2 wires. For proper wire and connection repairs, refer to "Wiring Repair."

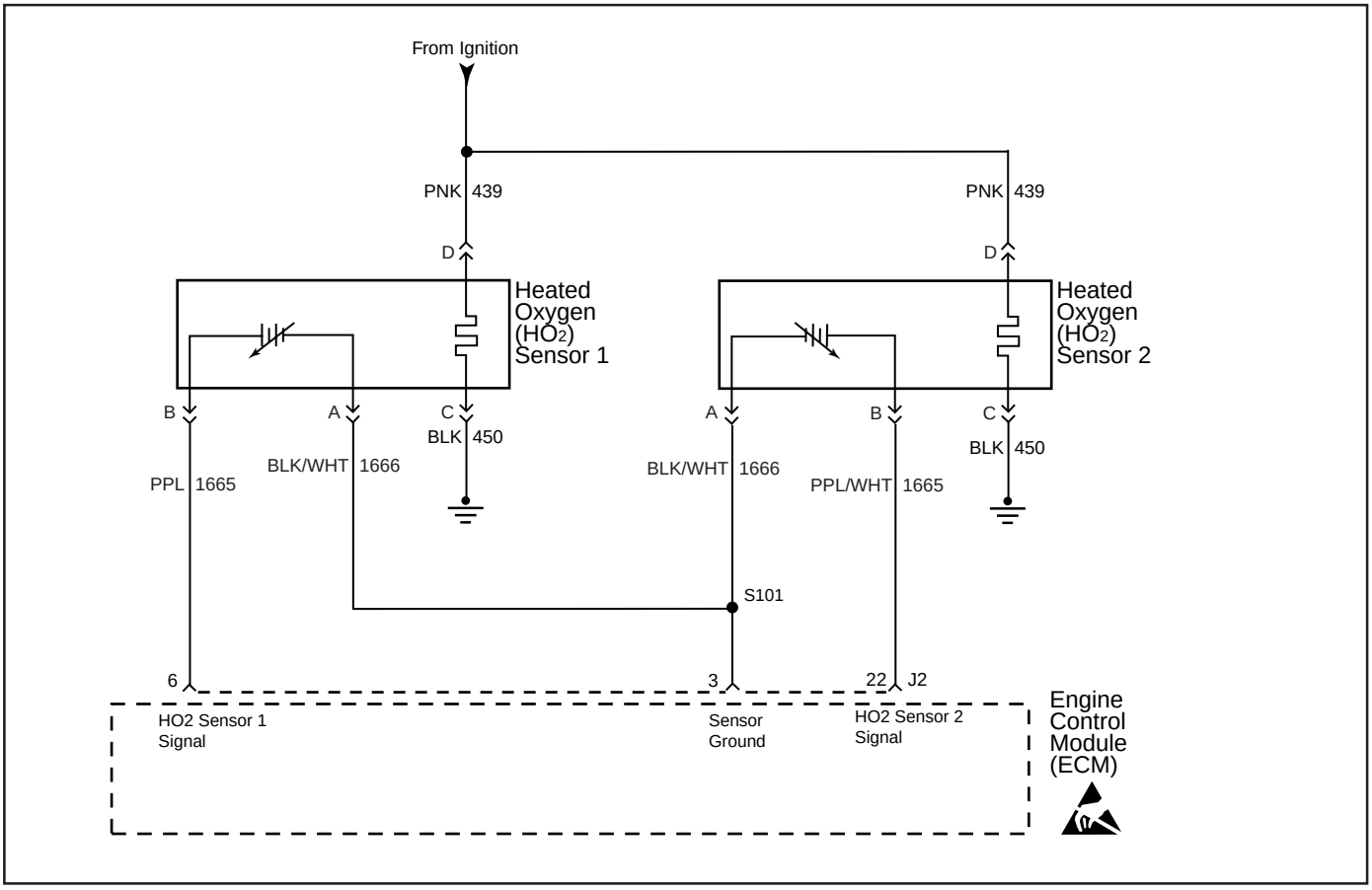
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

2. Running the engine at 1200 RPM keeps the HO_2 sensor hot in order to ensure the oxygen sensor remains active and can indicate the exhaust oxygen content accurately.
3. Opening the heated oxygen sensor circuit should result in a displayed voltage between 0.423 volt and 0.487 volt. If the display is fixed below 0.100 volt, the fault is a short to ground in HO_2 sensor signal circuit or a faulty ECM.

DTC 54 - Heated Oxygen (HO_2) Sensor 1 Circuit Low Voltage - Lean Exhaust Indicated (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Disconnect HO_2 sensor 1 electrical connector. 2. Install jumper wires between the two harness connectors. 3. Run the engine at the normal operaing temperature. 4. Place the vehicle in park or neutral. 5. Increase the engine speed to the specified value. 6. Using DVOM J 39200, check the voltage between CKT 1665 and CKT 1666. Is the voltage displayed fixed less than the specified value?	1200 RPM 0.100 volt	*Go to* Step 3	*Go to* Step 4
3	1. Disconnect the HO2 sensor electrical connector. 2. Using a jumper wire, connect the HO2 sensor 1 Low circuit to a known good ground. 3. Ignition turned ON. Is the voltage displayed within the specified value?	0.423-0.487 volt	Refer to Diagnostic Aids	*Go to* Step 5
4	DTC 54 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
5	Locate and repair short to ground in the HO2 sensor 1 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 6
6	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 54 - Heated Oxygen (HO_2) Sensor 2 Circuit Low Voltage - Lean Exhaust Indicated (Non-Scan Diagnostics)

Circuit Description

The Heated Oxygen (HO_2) Sensor(s) varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- An intermittent short to ground in the HO_2 sensor signal circuit.
- Fuel contamination: Water, even in small amounts delivered to the injectors can cause a lean condition.
- Fuel Pressure: If the fuel pressure is too low, the system will be lean. In order to confirm, monitor a fuel pressure gauge while driving the vehicle at various speeds and loads.
- Exhaust Leaks: If there is an exhaust leak, the engine may pull the outside air into the exhaust and past the sensor.
- Vacuum leaks can cause a lean condition or high idle.

Never solder the HO_2 wires. For proper wire and connection repairs, refer to "Wiring Repair."

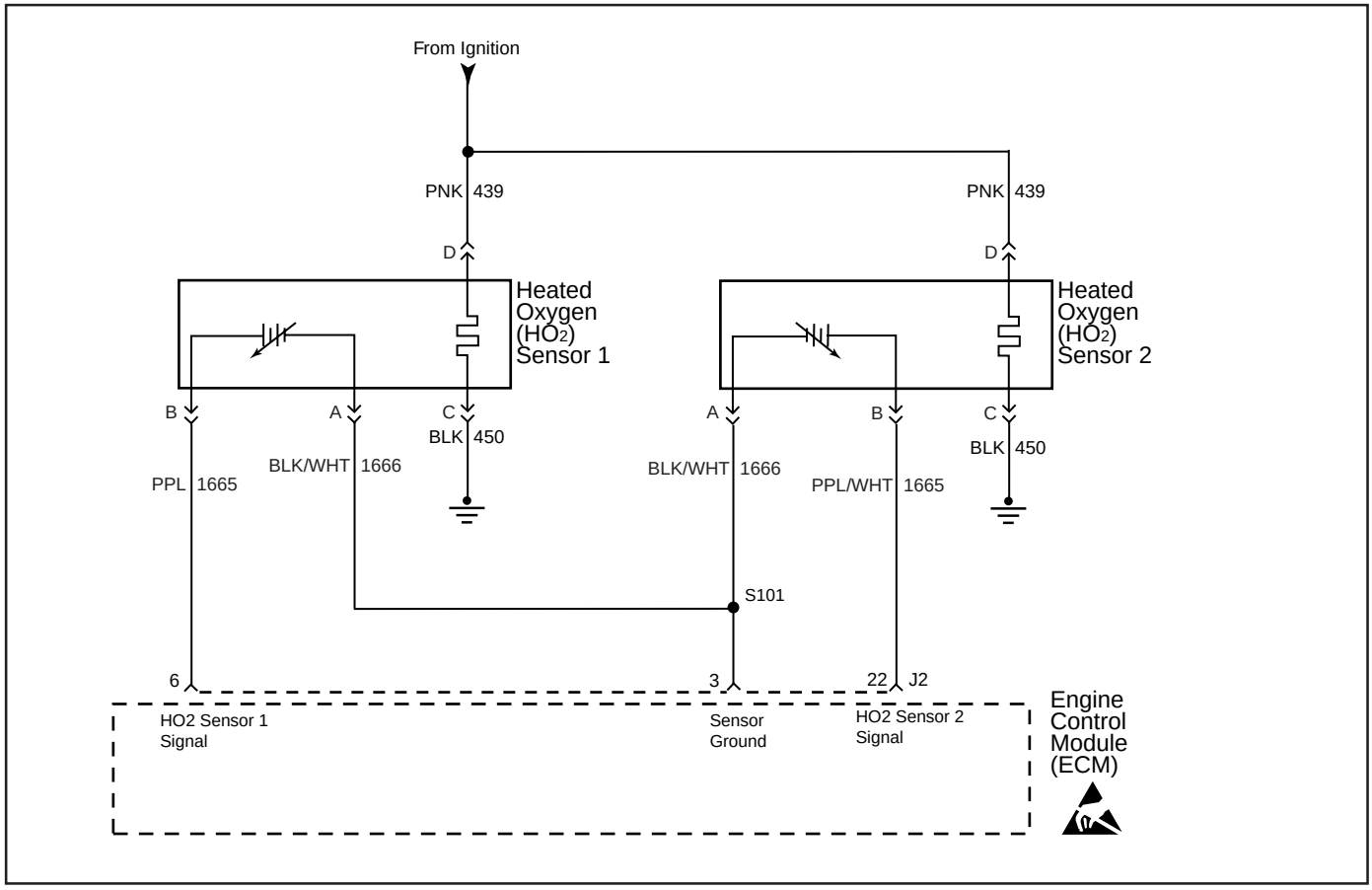
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

2. Running the engine at 1200 RPM keeps the HO_2 sensor hot in order to ensure the oxygen sensor remains active and can indicate the exhaust oxygen content accurately.
3. Opening the heated oxygen sensor circuit should result in a displayed voltage between 0.423 volt and 0.487 volt. If the display is fixed below 0.100 volt, the fault is a short to ground in HO_2 sensor signal circuit or a faulty ECM.

DTC 54 - Heated Oxygen (HO_2) Sensor 2 Circuit Low Voltage - Lean Exhaust Indicated (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Disconnect HO_2 sensor 2 electrical connector. 2. Install jumper wires between the two harness connectors. 3. Run the engine at the normal operaing temperature. 4. Place the vehicle in park or neutral. 5. Increase the engine speed to the specified value. 6. Using DVOM J 39200, check the voltage between CKT 1665 and CKT 1666. Is the voltage displayed fixed less than the specified value?	1200 RPM 0.100 volt	*Go to* Step 3	*Go to* Step 4
3	1. Disconnect the HO2 sensor electrical connector. 2. Using a jumper wire, connect the HO2 sensor 2 Low circuit to a known good ground. 3. Ignition turned ON. Is the voltage displayed within the specified value?	0.423-0.487 volt	Refer to Diagnostic Aids	*Go to* Step 5
4	DTC 54 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
5	Locate and repair short to ground in the HO2 sensor 2 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 6
6	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 55 - Heated Oxygen (HO_2) Sensor 1 Circuit High Voltage - Rich Exhaust Indicated (Non-Scan Diagnostics)

Circuit Description

The Heated Oxygen (HO_2) Sensor varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- A leaking injector.
- Fuel contaminated oil.
- Fuel Pressure: If the fuel pressure is too high, the system will be rich. In order to confirm, monitor a fuel pressure gauge while driving the vehicle at various speeds and loads.
- Leaking fuel pressure regulator. Check for fuel in the vacuum line to regulator.
- The TP sensor: An intermittent TP sensor output can cause the system to run rich due to a false indication of the throttle moving.
- False rich indication due to silicon contamination of the HO_2 sensor. A DTC 55 accompanied by lean drivability conditions and a powdery white deposit on the sensor indicates a false rich condition.
- Faulty HO_2 sensor: The HO_2 sensor is internally shorted, the HO_2 sensor voltage displayed will be over 1.0 volt.

Never solder the HO_2 wires. For proper wire and connection repairs, refer to "Wiring Repair."

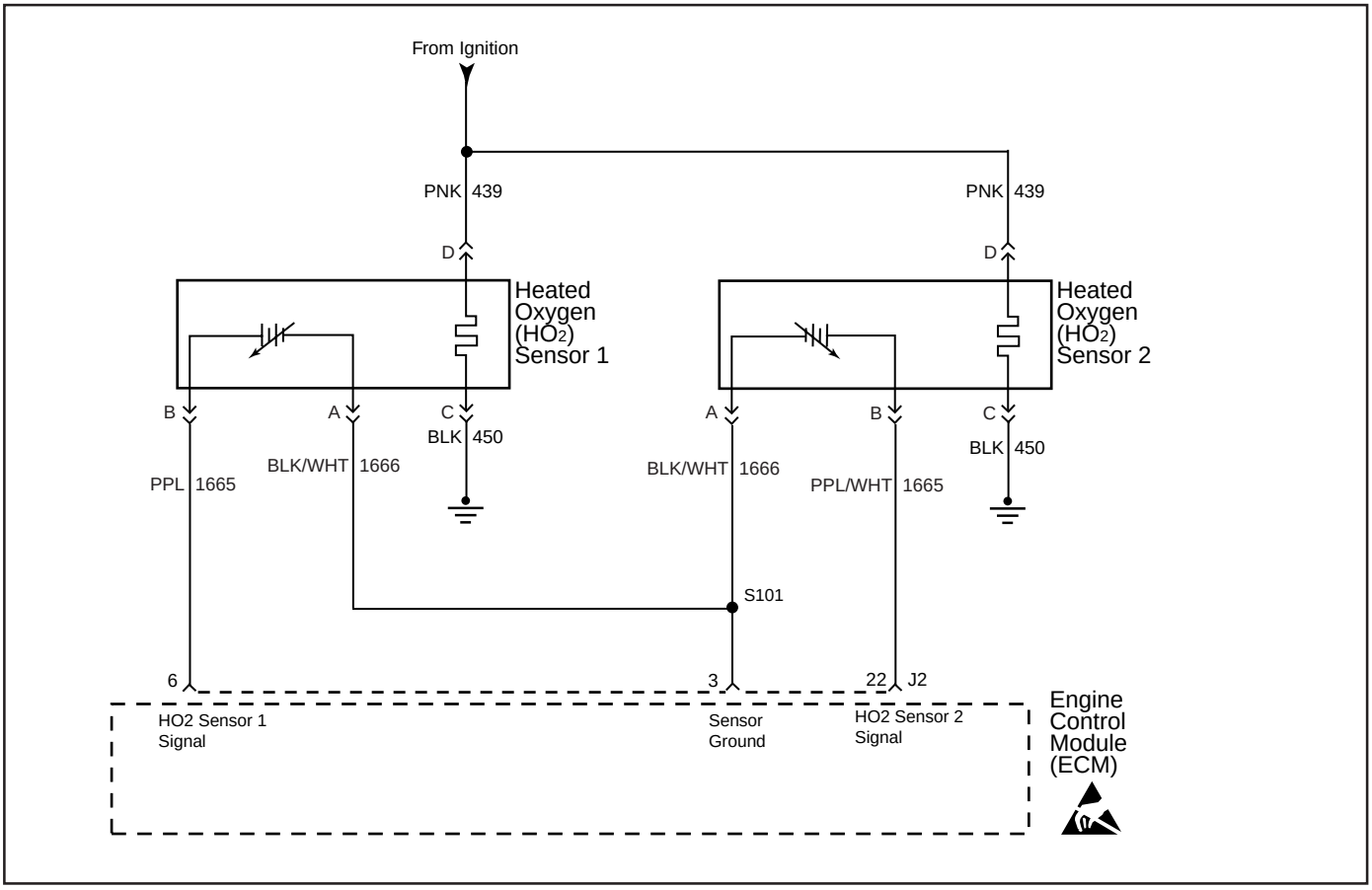
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

2. This test determines if the conditions exist in order to set DTC 55.

DTC 55 - Heated Oxygen (HO_2) Sensor 1 Circuit High Voltage - Rich Exhaust Indicated (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Disconnect HO_2 sensor 1 electrical connector. 2. Install jumper wires between the two harness connectors. 3. Run the engine at the normal operaing temperature. 4. Place the vehicle in park or neutral. 5. Increase the engine speed to the specified value. 6. Using a DVOM, check the voltage between CKT 1665 and CKT 1666. Is the voltage displayed fixed above the specified value?	1200 RPM 0.900 volt	*Go to* Step 3	*Go to* Step 5
3	Ignition turned ON. Is the voltage displayed fixed above the specified value?	0.900 volt	*Go to* Step 4	Refer to Diagnostic Aids
4	1. Disconnect the HO2 sensor 1 electrical connector. 2. Ignition turned ON. Is the voltage displayed fixed above the specified value?	0.900 volt	*Go to* Step 7	*Go to* Step 6
5	DTC 55 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
6	Replace HO2 sensor 1. Is action complete?	—	Verify Repair	—
7	Locate and repair short to voltage in the HO2 sensor 1 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 8
8	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 55 - Heated Oxygen (HO_2) Sensor 2 Circuit High Voltage - Rich Exhaust Indicated (Non-Scan Diagnostics)

Circuit Description

The Heated Oxygen (HO_2) Sensor varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- A leaking injector.
- Fuel contaminated oil.
- Fuel Pressure: If the fuel pressure is too high, the system will be rich. In order to confirm, monitor a fuel pressure gauge while driving the vehicle at various speeds and loads.
- Leaking fuel pressure regulator. Check for fuel in the vacuum line to regulator.
- The TP sensor: An intermittent TP sensor output can cause the system to run rich due to a false indication of the throttle moving.
- False rich indication due to silicon contamination of the HO_2 sensor. A DTC 55 accompanied by lean drivability conditions and a powdery white deposit on the sensor indicates a false rich condition.
- Faulty HO_2 sensor: The HO_2 sensor is internally shorted, the HO_2 sensor voltage displayed will be over 1.0 volt.

Never solder the HO_2 wires. For proper wire and connection repairs, refer to “Wiring Repair.”

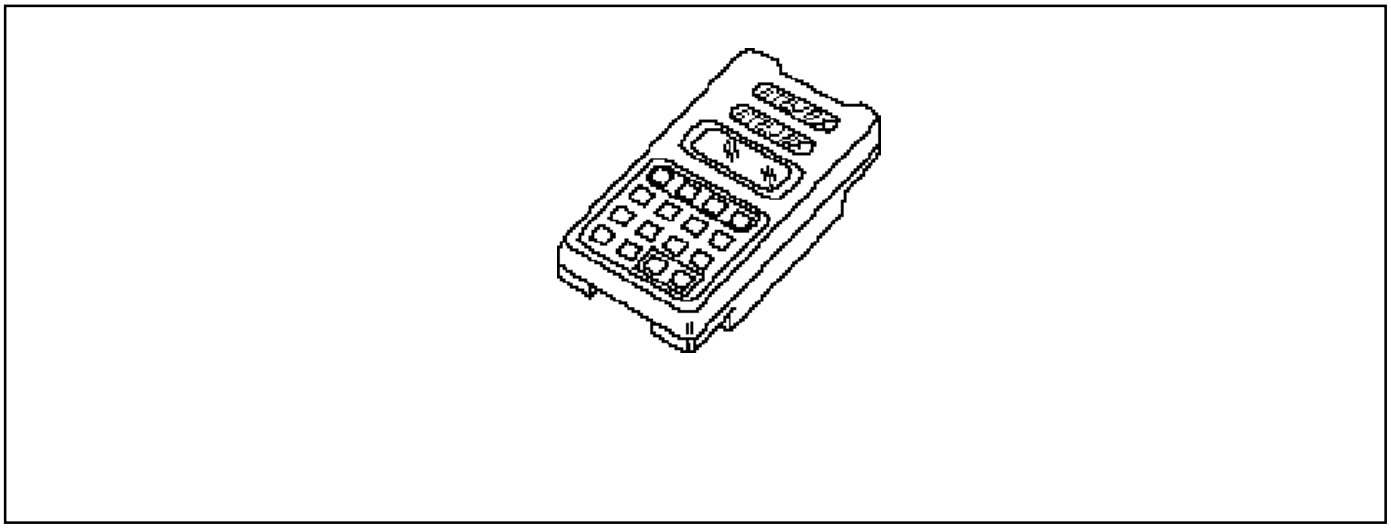
After repairs, clear DTC’s following “Clear DTC’s Procedure.” Failure to do so may result in DTC’s not properly being cleared.

Test Description

2. This test determines if the conditions exist in order to set DTC 55.

DTC 55 - Heated Oxygen (HO_2) Sensor 2 Circuit High Voltage - Rich Exhaust Indicated (Non-Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Disconnect HO_2 sensor 2 electrical connector. 2. Install jumper wires between the two harness connectors. 3. Run the engine at the normal operaing temperature. 4. Place the vehicle in park or neutral. 5. Increase the engine speed to the specified value. 6. Using a DVOM, check the voltage between CKT 1665 and CKT 1666. Is the voltage displayed fixed above the specified value?	1200 RPM 0.900 volt	*Go to* Step 3	*Go to* Step 5
3	Ignition turned ON. Is the voltage displayed fixed above the specified value?	0.900 volt	*Go to* Step 4	Refer to Diagnostic Aids
4	1. Disconnect the HO2 sensor 2 electrical connector. 2. Ignition turned ON. Is the voltage displayed fixed above the specified value?	0.900 volt	*Go to* Step 7	*Go to* Step 6
5	DTC 55 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
6	Replace HO2 sensor 2. Is action complete?	—	Verify Repair	—
7	Locate and repair short to voltage in the HO2 sensor 2 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 8
8	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



MEFI4323
6-12-00

DTC 81 -Non-Scan Diagnostics

Diagnostic Aids

When a DTC 81 is flashed out using a Diagnostic Trouble Code (DTC) tool, a scan tool MUST be used for further diagnostics. DTC 81 has multiple failures, and are only distinguished using a scan tool.

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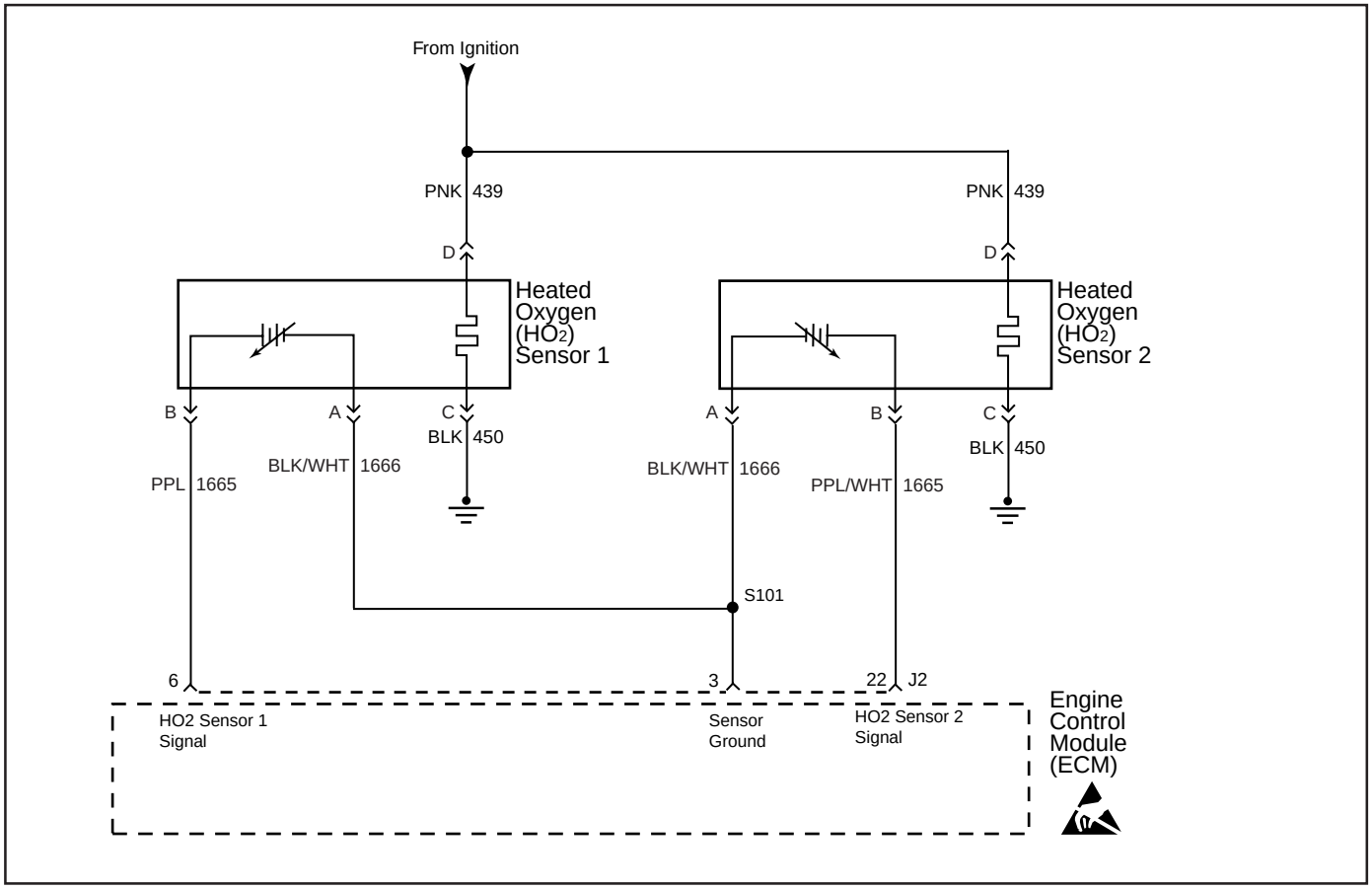

DTC 13 - Heated Oxygen (HO_2) Sensor 1 Circuit Inactive (Scan Diagnostics)

Circuit Description

The Heated Oxygen (HO_2) Sensor varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

The heater provides for a faster sensor warm-up. This allows the sensor to become active in a shorter period of time and remain active during a long extended idle.

DTC 13 determines if the heated oxygen sensor circuit has developed an open. With an active DTC 13 set, the system operates in an Open Loop mode and the Malfunction Indicator Lamp (MIL) is turned on.

Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- A faulty HO_2 heater or heater circuit. With ignition "ON," engine "OFF," the HO_2 voltage displayed on the scan tool should gradually drop to below 0.150 volt, indicating that the heater works properly. If not, disconnect the HO_2 sensor connector and connect a test light between harness terminals "C" and "D." If the test light does not illuminate brightly, repair the open in the ignition feed or ground for the HO_2 heater circuit. If the test light illuminates brightly, replace the HO_2 sensor.

Never solder the HO_2 wires. For proper wire and connection repairs, refer to "Wiring Repair."

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

2. With ignition "ON", engine "OFF", the HO_2 Sensor Voltage displayed on the scan tool should gradually decrease down to approximately 0.150 volt, indicating that the heater is working properly. The HO_2 voltage may rise as high as 0.975 volt before it toggles back down. The main thing to look for is a change.
3. Probing terminal "D" of the HO_2 sensor harness connector verifies if the voltage is available to the HO_2 sensor heater.
5. If conditions for setting DTC 13 exist, the system will not go into Closed Loop Fuel.
7. This test checks the continuity of the HO_2 signal circuit.

DTC 13 - Heated Oxygen (HO_2) Sensor 1 Circuit Inactive (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostics"(OBD) System Check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Connect scan tool. 2. Ignition turned ON. 3. Monitor the HO_2 Sensor 1 Voltage. Does the voltage displayed gradually decrease down to approximately the specified value?	0.150 volt	*Go to* Step 5	*Go to* Step 3
3	1. Disconnect the HO_2 sensor 1 electrical connector. 2. Using a test light connected to a known good ground, probe terminal "D" of the ECM harness connector. Does the test light illuminate brightly?	—	*Go to* Step 4	*Go to* Step 9
4	Connect test light between terminals "C" and "D" of the HO_2 sensor 1 harness connector. Does the test light illuminate brightly?	—	*Go to* Step 5	*Go to* Step 10
5	1. Reconnect HO_2 sensor 1 electrical connector. 2. Connect scan tool. 3. Run the engine at the normal operating temperature. 4. Run the engine above the specified value for 2 minutes. Does the scan tool indicate Closed Loop Fuel control?	1200 RPM	*Go to* Step 8	*Go to* Step 6
6	1. Disconnect the Heated Oxygen (HO2) sensor 1 electrical connector. 2. Install a jumper between the HO2 sensor 1 signal and ground circuit on the ECM harness side. 3. Ignition turned ON. Does the scan tool HO2 Sensor 1 Voltage display indicate a voltage less than the specified value?	0.100 volt	*Go to* Step 13	*Go to* Step 7
7	1. Turn ignition OFF. 2. Remove the jumpers. 3. Using a test light connected to B+, probe the HO2 sensor 1 ground circuit on the ECM harness side. Does the test light illuminate brightly?	—	*Go to* Step 11	*Go to* Step 12
8	DTC 13 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
9	Locate and repair open or short to ground in the ignition feed circuit for the HO_2 heater. Is action complete?	—	Verify Repair	—
10	Locate and repair open in the ground circuit for the HO_2 heater. Is action complete?	—	Verify Repair	—

DTC 13 - Heated Oxygen (HO_2) Sensor 1 Circuit Inactive (Scan Diagnostics)

Step	Action	Value	Yes	No
11	Locate and repair open in the HO_2 sensor 1 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 14
12	Locate and repair open in the HO_2 sensor 1 ground circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 14
13	Check for faulty HO_2 sensor 1 connections. If OK, replace HO2 sensor. Is action complete?	—	Verify Repair	—
14	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—

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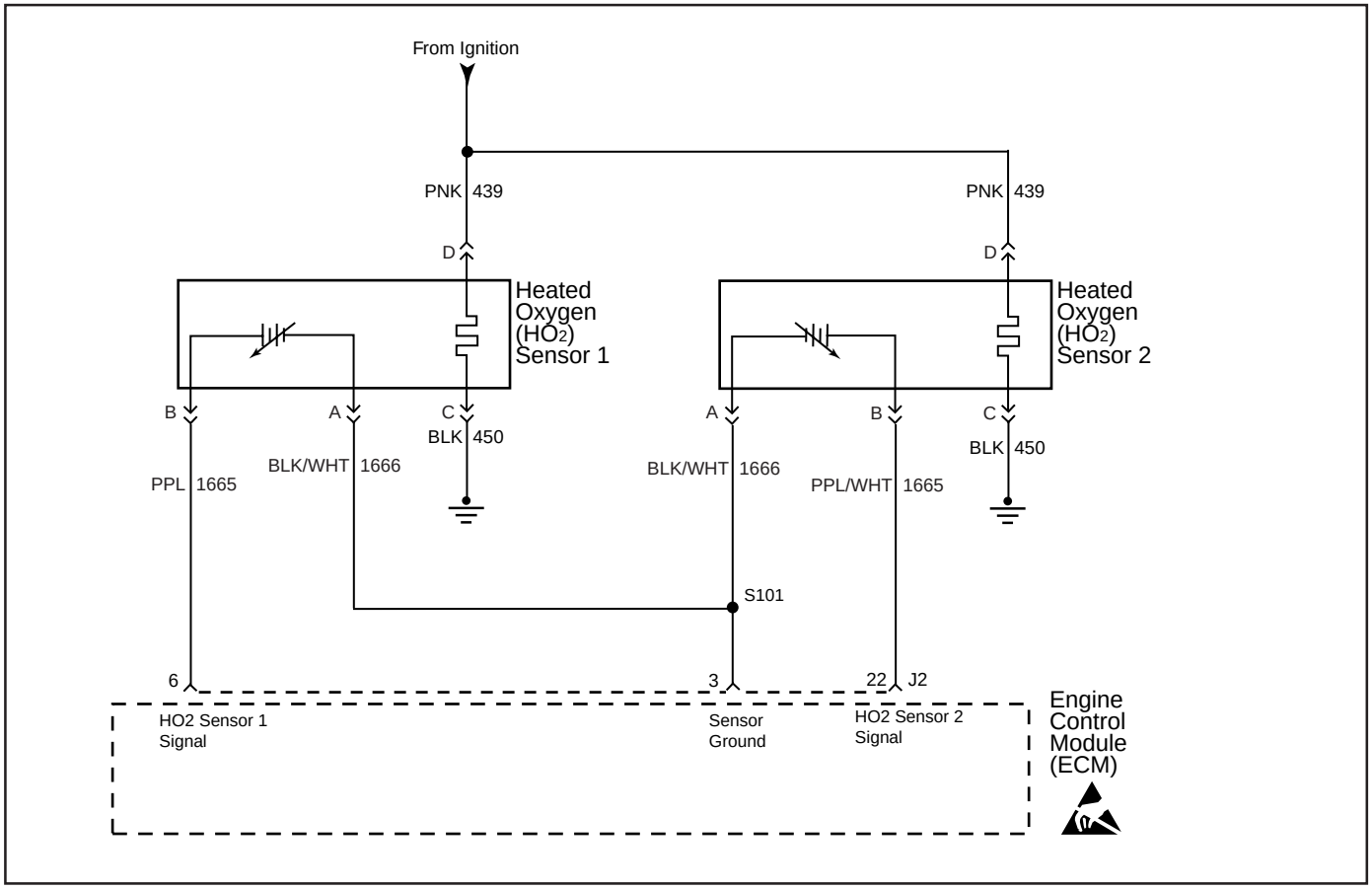

DTC 13 - Heated Oxygen (HO_2) Sensor 2 Circuit Inactive (Scan Diagnostics)

Circuit Description

The Heated Oxygen (HO_2) Sensor varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

The heater provides for a faster sensor warm-up. This allows the sensor to become active in a shorter period of time and remain active during a long extended idle.

DTC 13 determines if the heated oxygen sensor circuit has developed an open. With an active DTC 13 set, the system operates in an Open Loop mode and the Malfunction Indicator Lamp (MIL) is turned on.

Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- A faulty HO_2 heater or heater circuit. With ignition "ON," engine "OFF," the HO_2 voltage displayed on the scan tool should gradually drop to below 0.150 volt, indicating that the heater works properly. If not, disconnect the HO_2 sensor connector and connect a test light between harness terminals "C" and "D." If the test light does not illuminate brightly, repair the open in the ignition feed or ground for the HO_2 heater circuit. If the test light illuminates brightly, replace the HO_2 sensor.

Never solder the HO_2 wires. For proper wire and connection repairs, refer to "Wiring Repair."

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

2. With ignition "ON", engine "OFF", the HO_2 Sensor Voltage displayed on the scan tool should gradually decrease down to approximately 0.150 volt, indicating that the heater is working properly. The HO_2 voltage may rise as high as 0.975 volt before it toggles back down. The main thing to look for is a change.
3. Probing terminal "D" of the HO_2 sensor harness connector verifies if the voltage is available to the HO_2 sensor heater.
5. If conditions for setting DTC 13 exist, the system will not go into Closed Loop Fuel.
7. This test checks the continuity of the HO_2 signal circuit.

DTC 13 - Heated Oxygen (HO_2) Sensor 2 Circuit Inactive (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostics"(OBD) System Check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Connect scan tool. 2. Ignition turned ON. 3. Monitor the HO_2 Sensor 2 Voltage. Does the voltage displayed gradually decrease down to approximately the specified value?	0.150 volt	*Go to* Step 5	*Go to* Step 3
3	1. Disconnect the HO_2 sensor 2 electrical connector. 2. Using a test light connected to a known good ground, probe terminal "D" of the ECM harness connector. Does the test light illuminate brightly?	—	*Go to* Step 4	*Go to* Step 9
4	Connect test light between terminals "C" and "D" of the HO_2 sensor 1 harness connector. Does the test light illuminate brightly?	—	*Go to* Step 5	*Go to* Step 10
5	1. Reconnect HO_2 sensor 2 electrical connector. 2. Connect scan tool. 3. Run the engine at the normal operating temperature. 4. Run the engine above the specified value for 2 minutes. Does the scan tool indicate Closed Loop Fuel control?	1200 RPM	*Go to* Step 8	*Go to* Step 6
6	1. Disconnect the Heated Oxygen (HO2) sensor 2 electrical connector. 2. Install a jumper between the HO2 sensor 2 signal and ground circuit on the ECM harness side. 3. Ignition turned ON. Does the scan tool HO2 Sensor 2 Voltage display indicate a voltage less than the specified value?	0.100 volt	*Go to* Step 13	*Go to* Step 7
7	1. Turn ignition OFF. 2. Remove the jumpers. 3. Using a test light connected to B+, probe the HO2 sensor 2 ground circuit on the ECM harness side. Does the test light illuminate brightly?	—	*Go to* Step 11	*Go to* Step 12
8	DTC 13 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
9	Locate and repair open or short to ground in the ignition feed circuit for the HO_2 heater. Is action complete?	—	Verify Repair	—
10	Locate and repair open in the ground circuit for the HO_2 heater. Is action complete?	—	Verify Repair	—

DTC 13 - Heated Oxygen (HO_2) Sensor 2 Circuit Inactive (Scan Diagnostics)

Step	Action	Value	Yes	No
11	Locate and repair open in the HO_2 sensor 2 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 14
12	Locate and repair open in the HO_2 sensor 2 ground circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 14
13	Check for faulty HO_2 sensor 2 connections. If OK, replace HO2 sensor. Is action complete?	—	Verify Repair	—
14	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—

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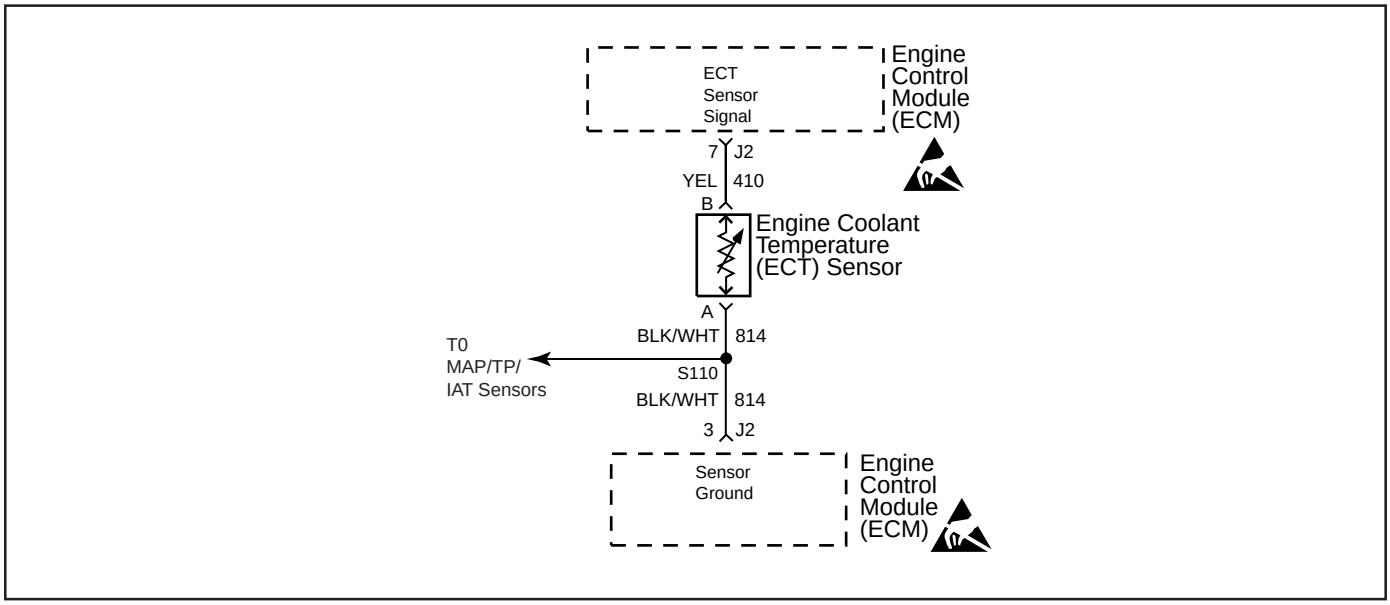


DTC 14 - Engine Coolant Temperature (ECT) Sensor Circuit - Low Temp Indicated (Scan Diagnostics)

Circuit Description

The Engine Coolant Temperature (ECT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 410 to the sensor. When the engine coolant is cold, the sensor (thermistor) resistance is high. As the engine coolant warms up, the sensor resistance becomes less. See engine coolant temperature sensor table under "Diagnostic Aids." At normal operating temperature (85°C - 95°C or 185°F - 203°F), the voltage will measure about 1.5-2.0 volts.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the ECT display on the scan tool while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.
- The scan tool displays engine coolant temperature in degrees celsius and fahrenheit. If the engine is cold (not running within 8 hours), the scan tool should display a ECT sensor value within a few degrees of outside air temperature. This may help aid in diagnosing a "shifted" coolant sensor. After engine is started, the temperature should rise steadily and then stabilize at operating temperature when the thermostat opens.
- If DTC 33 is also set, check for open ground CKT 814.

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

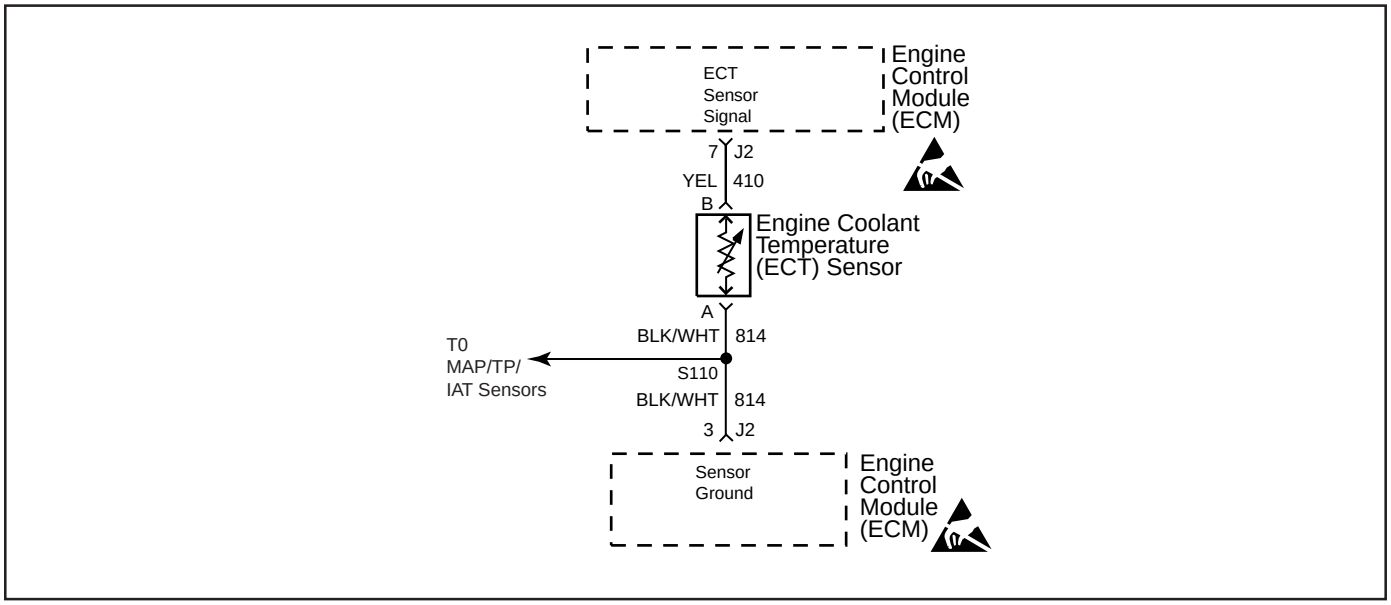
2. DTC 14 will set if signal voltage indicates a coolant temperature below -30°C (-22°F).
3. This test simulates a DTC 15. If the ECM recognizes the low voltage signal and displays a high temperature, the ECM and wiring are OK.

Engine Coolant Temperature Sensor Table

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
-5	23	12300
-15	5	21450
-30	-22	52700
-40	-40	100700

DTC 14 - Engine Coolant Temperature (ECT) Sensor Circuit - Low Temp Indicated (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	Turn ignition ON, leaving engine OFF. Does scan tool display a coolant temperature less than the specified value?	-30°C (-22°F)	*Go to* Step 3	*Go to* Step 4
3	1. Turn ignition OFF. 2. Disconnect the ECT sensor harness connector. 3. Connect a jumper wire from harness terminal "A" (CKT 814) to harness terminal "B" (CKT 410). 4. Turn ignition ON, leaving engine OFF. Does scan tool display a coolant temperature above the specified value?	130°C (266°F)	*Go to* Step 6	*Go to* Step 5
4	DTC 14 is intermittent. Locate and repair intermittent faulty connections. • *Refer to* "Diagnostic Aids."	—	Verify Repair	—
5	Locate and repair open in CKT 410 or CKT 814. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 7
6	Repair faulty ECT sensor. Is action complete?	—	Verify Repair	—
7	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 15 - Engine Coolant Temperature (ECT) Sensor Circuit - High Temp Indicated (Scan Diagnostics)

Circuit Description

The Engine Coolant Temperature (ECT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 410 to the sensor. When the engine coolant is cold, the sensor (thermistor) resistance is high. As the engine coolant warms up, the sensor resistance becomes less. See engine coolant temperature sensor table under "Diagnostic Aids." At normal operating temperature (85°C - 95°C or 185°F - 203°F), the voltage will measure about 1.5-2.0 volts.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the ECT display on the scan tool while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.
- The scan tool displays engine coolant temperature in degrees celsius and fahrenheit. If the engine is cold (not running within 8 hours), the scan tool should display a ECT sensor value within a few degrees of outside air temperature. This may help aid in diagnosing a "shifted" coolant sensor. After engine is started, the temperature should rise steadily and then stabilize at operating temperature when the thermostat opens.
- Check harness routing for a potential short to ground in CKT 410.

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

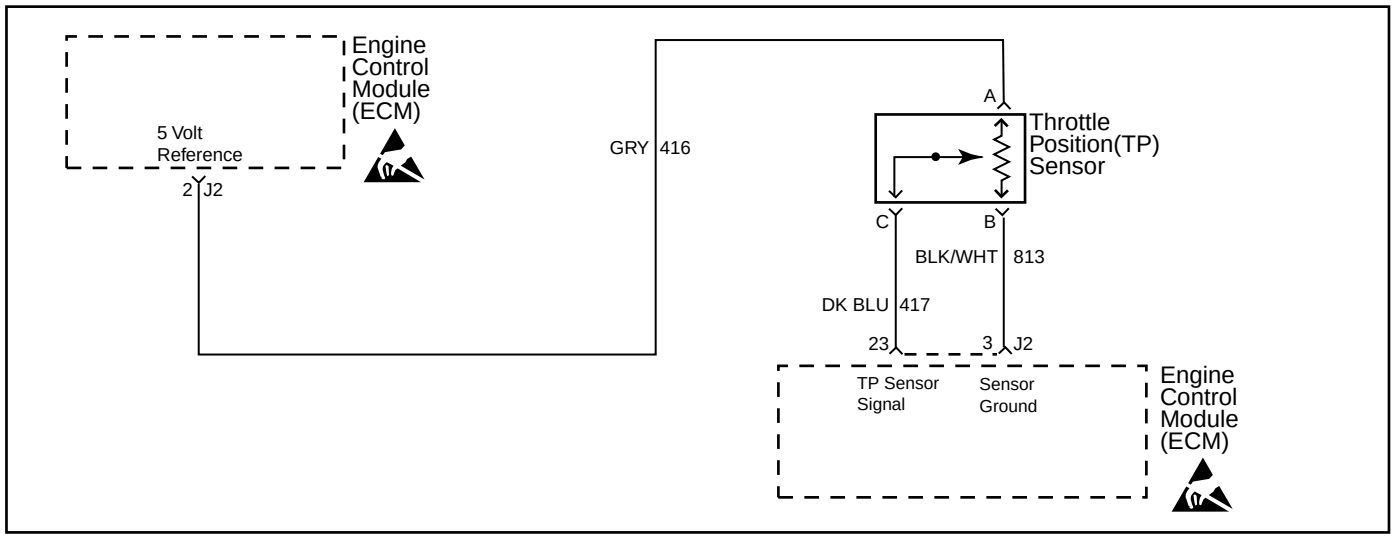
2. DTC 15 will set if signal voltage indicates a coolant temperature above 130°C or 266°F.
3. This test simulates a DTC 14. If the ECM recognizes the high voltage signal and displays a low temperature, the ECM and wiring are OK.

Engine Coolant Temperature Sensor Table

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
-5	23	12300
-15	5	21450
-30	-22	52700
-40	-40	100700

DTC 15 - Engine Coolant Temperature (ECT) Sensor Circuit - High Temp Indicated (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	Turn ignition ON, leaving engine OFF. Does scan tool display a coolant temperature greater than the specified value?	130°C (266°F)	*Go to* Step 3	*Go to* Step 4
3	1. Turn ignition OFF. 2. Disconnect ECT sensor harness connector. 3. Turn ignition ON, leaving engine OFF. Does scan tool display a coolant temperature below the specified value?	-30°C (-22°F)	*Go to* Step 6	*Go to* Step 5
4	DTC 15 is intermittent. Locate and repair intermittent faulty connections. • *Refer to* "Diagnostic Aids."	—	Verify Repair	—
5	Locate and repair short to ground in CKT 410. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 7
6	Repair faulty ECT sensor. Is action complete?	—	Verify Repair	—
7	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 21 - Throttle Position (TP) Sensor Circuit - Signal Voltage High (Scan Diagnostics)

Circuit Description

The Throttle Position (TP) sensor is a potentiometer that provides a voltage signal that changes relative to the throttle blade. Signal voltage should vary from about .7 volt at idle to about 4.8 volts at Wide Open Throttle (WOT).

The TP sensor signal is one of the most important inputs used by the ECM for fuel control and for IAC control.

The ECM supplies a 5 volt signal to the sensor through CKT 416. CKT 813 is the TP sensor ground circuit. The TP sensor will send a voltage signal back to the ECM, through CKT 417, according to where the throttle blades are positioned.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the TP sensor display on the scan tool while moving connectors and wiring harnesses related to the TP sensor. A change in the TP sensor display will indicate the location of the fault.
- The scan tool reads throttle position in voltage and percentage relative to the throttle blade opening. With ignition "ON," engine "OFF," throttle blades closed (idle), the voltage should be 0.3-0.9 volts. The voltage should steadily increase as the throttle is moved toward Wide Open Throttle (WOT).
- If a TP sensor circuit failure is present, the MAP sensor default value will be used along with the TP sensor default value.

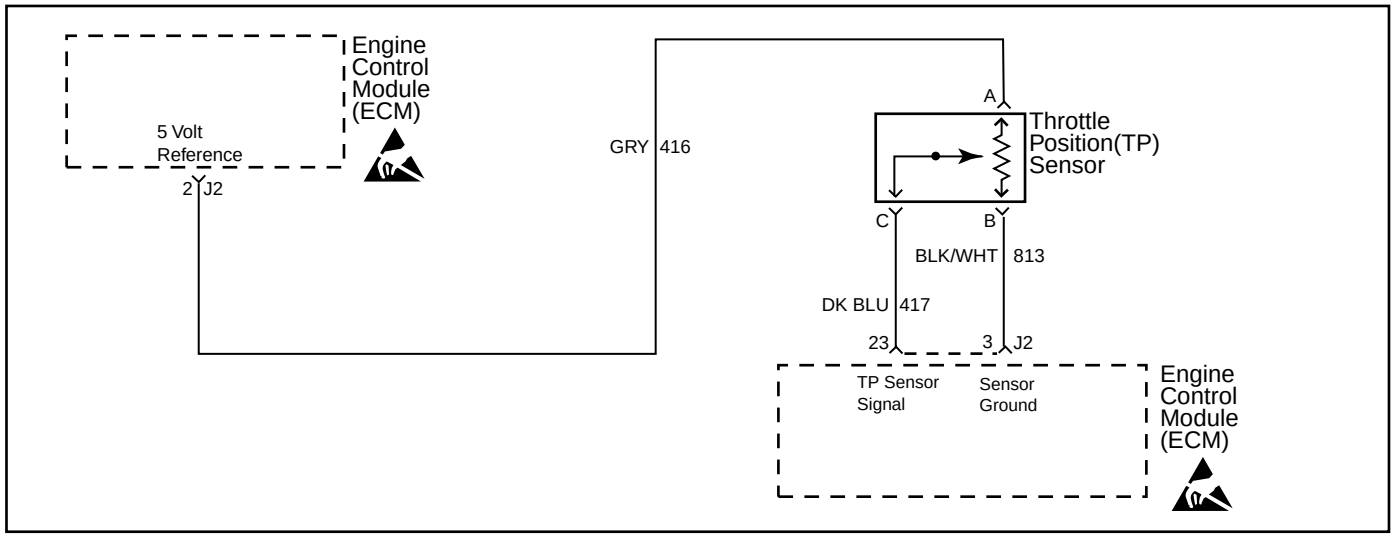
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

2. With the throttle closed, the TP sensor voltage should read 0.3-0.9 volt. If it does not, check the throttle cable adjustment or for bent or binding linkage.
3. This test simulates a DTC 22. If the ECM recognizes the low voltage signal, the ECM and wiring are OK.
4. Using DVOM from harness terminal "A" (CKT 416) harness terminal "B" (CKT 813) checks the sensor ground circuit. A faulty sensor ground CKT 813 will cause a DTC 21.

DTC 21 - Throttle Position (TP) Sensor Circuit - Signal Voltage High (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Throttle closed. 2. Turn ignition ON, leaving engine OFF. Does scan tool indicate TP sensor voltage greater than the specified value?	4 volts	*Go to* Step 3	*Go to* Step 5
3	1. Turn ignition OFF. 2. Disconnect TP sensor harness connector. 3. Turn ignition ON, leaving engine OFF. Does DVOM indicate a voltage less than the specified value?	.36 volt	*Go to* Step 4	*Go to* Step 6
4	Connect DVOM from harness terminal "A" (CKT 416) to harness terminal "B" (CKT 813). Does DVOM indicate a voltage greater than the specified value?	4 volts	*Go to* Step 8	*Go to* Step 7
5	DTC 21 is intermittent. Locate and repair intermittent faulty connections. • *Refer to* "Diagnostic Aids."	—	—	—
6	Locate and repair short to voltage in CKT 417. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 9
7	Locate and repair open in ground CKT 813. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 9
8	Replace faulty TP sensor. Is action complete?	—	Verify Repair	—
9	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 22 - Throttle Position (TP) Sensor Circuit - Signal Voltage Low (Scan Diagnostics)

Circuit Description

The Throttle Position (TP) sensor is a potentiometer that provides a voltage signal that changes relative to the throttle blade. Signal voltage should vary from about .7 volt at idle to about 4.8 volts at Wide Open Throttle (WOT).

The TP sensor signal is one of the most important inputs used by the ECM for fuel control and for IAC control.

The ECM supplies a 5 volt signal to the sensor through CKT 416. CKT 813 is the TP sensor ground circuit. The TP sensor will send a voltage signal back to the ECM, through CKT 417, according to where the throttle blades are positioned.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the TP sensor display on the scan tool while moving connectors and wiring harnesses related to the TP sensor. A change in the TP sensor display will indicate the location of the fault.
- The scan tool reads throttle position in voltage and percentage relative to the throttle blade opening. With ignition "ON," engine "OFF," throttle blades closed (idle), the voltage should be 0.3-0.9 volts. The voltage should steadily increase as the throttle is moved toward Wide Open Throttle (WOT).
- If DTC 34 is also set, check for a short to ground in CKT 416 or CKT 416E.
- If a TP sensor circuit failure is present, the MAP sensor default value will be used along with the TP sensor default value.

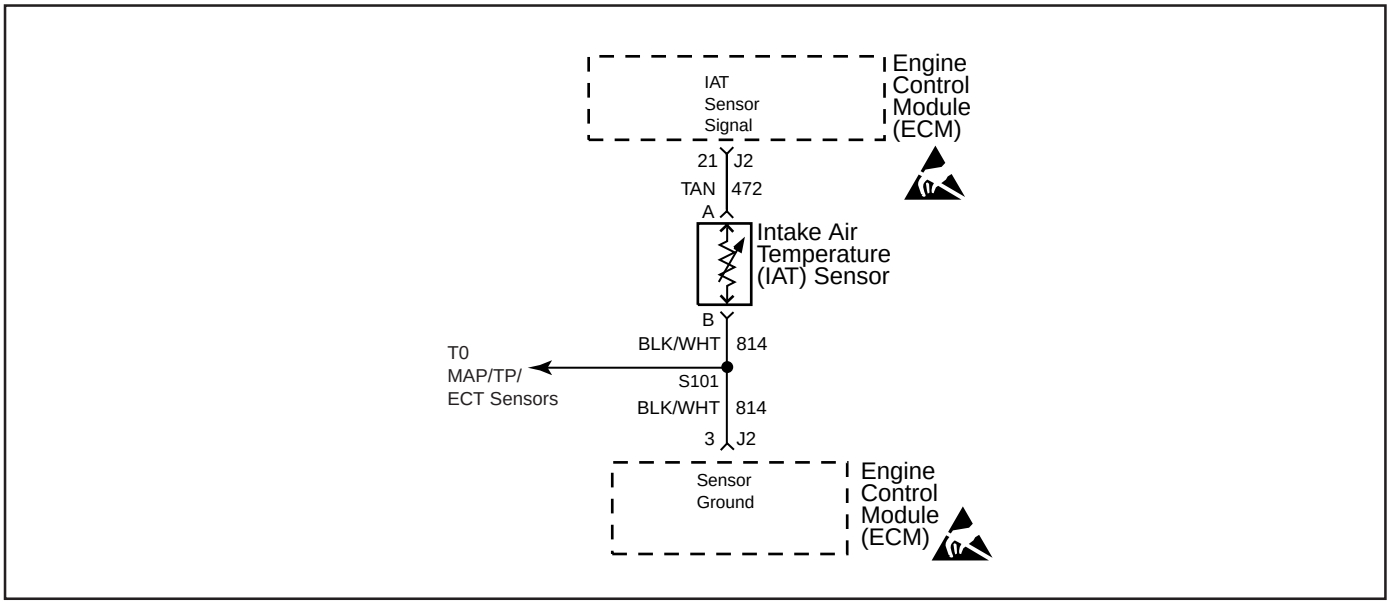
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

2. With the throttle closed, the TP sensor voltage should read 0.3-0.9 volt. If it does not, check the throttle cable adjustment or for bent or binding linkage.
3. This test simulates a DTC 21. If the ECM recognizes the high signal voltage, the ECM and wiring are OK.
4. This test checks for the 5 volt reference on CKT 416.

DTC 22 - Throttle Position (TP) Sensor Circuit - Signal Voltage Low (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Throttle closed. 2. Turn ignition ON, leaving engine OFF. Does scan tool indicate TP sensor voltage less than the specified value?	.36 volt	*Go to* Step 3	*Go to* Step 5
3	1. Turn ignition OFF. 2. Disconnect TP sensor harness connector. 3. Connect a jumper wire from harness terminal "A" (CKT 416) to harness terminal "C" (CKT 417). 4. Turn ignition ON, leaving engine OFF. Does scan tool indicate TP sensor voltage greater than the specified value?	4 volts	*Go to* Step 8	*Go to* Step 4
4	1. Turn ignition OFF. 2. Connect DVOM from harness terminal "A" (CKT 416) to a known good ground. 3. Turn ignition ON, leaving engine OFF. Does DVOM indicate a voltage greater than the specified value?	4 volts	*Go to* Step 7	*Go to* Step 6
5	DTC 22 is intermittent. Locate and repair intermittent faulty connections. • *Refer to* "Diagnostic Aids."	—	—	—
6	Locate and repair open or short to ground in CKT 416. Also check CKT 416E to the MAP sensor for a short to ground. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	*Go to* Step 9
7	Locate and repair open or short to ground in CKT 417. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	*Go to* Step 9
8	Replace faulty TP sensor. Is action complete?	—	Verify repair	—
9	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify repair	—



DTC 23 - Intake Air Temperature (IAT) Sensor Circuit - Low Temp Indicated (Scan Diagnostics)

Circuit Description

The Intake Air Temperature (IAT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 472 to the sensor. When the intake air temperature is cold, the sensor (thermistor) resistance is high. As the intake air temperature warms up, the sensor resistance becomes less. See intake air temperature sensor table under "Diagnostic Aids."

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the IAT display on the scan tool while moving connectors and wiring harnesses related to the IAT sensor. A change in the IAT display will indicate the location of the fault.
- The scan tool displays intake air temperature in degrees celsius and fahrenheit. If the engine is cold (not running within 8 hours), the scan tool should display a IAT sensor value within a few degrees of outside air temperature. This may help aid in diagnosing a "shifted" IAT sensor.
- If DTC 33 is also set, check for open ground CKT 814.

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

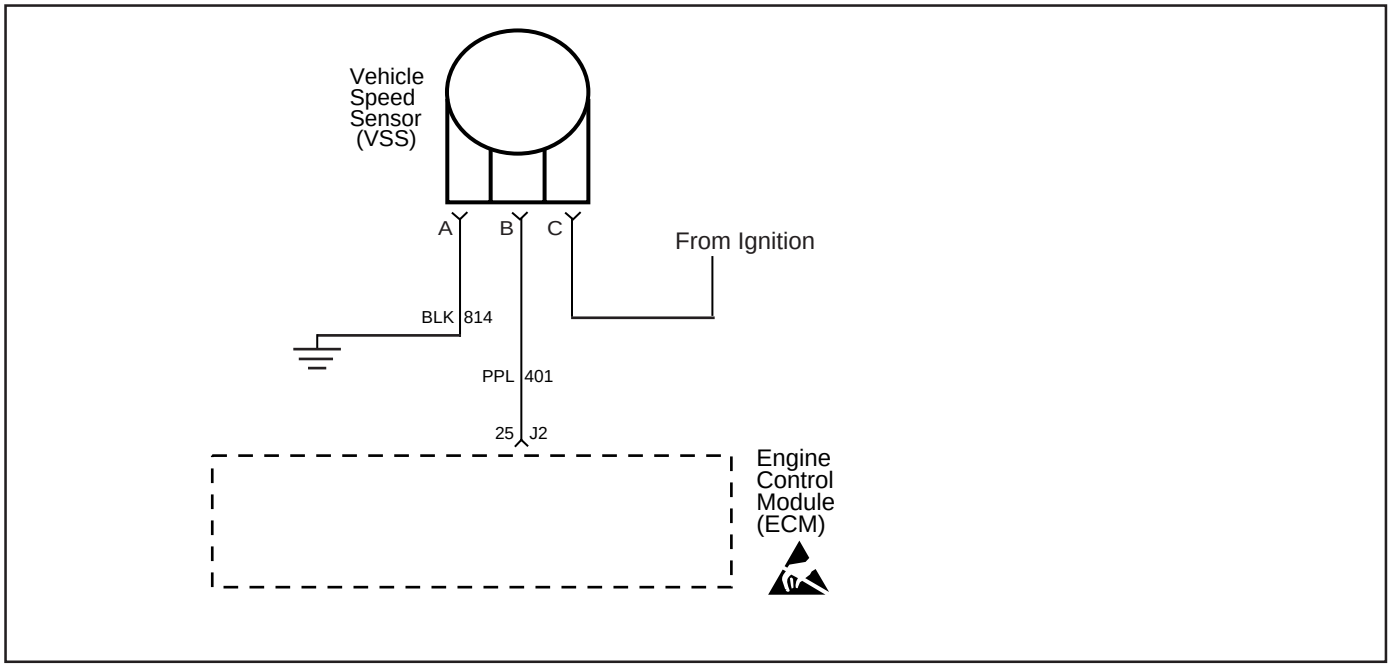
2. DTC 23 will set if signal voltage indicates a intake air temperature below -30°C (-22°F).
3. This test simulates a DTC 25. If the ECM recognizes the low voltage signal and displays a high temperature, the ECM and wiring are OK.

Intake Air Temperature Sensor Table

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
-5	23	12300
-15	5	21450
-30	-22	52700
-40	-40	100700

DTC 23 - Intake Air Temperature (IAT) Sensor Circuit - Low Temp Indicated (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	Turn ignition ON, leaving engine OFF. Does scan tool display an intake air temperature less than the specified value?	-30°C (-22°F)	*Go to* Step 3	*Go to* Step 4
3	1. Turn ignition OFF. 2. Disconnect IAT sensor harness connector. 3. Connect a jumper wire from harness terminal "A" (CKT 472) to harness terminal "B" (CKT 814). 4. Turn ignition ON, leaving engine OFF. Does scan tool display a coolant temperature above the specified value?	130°C (266°F)	*Go to* Step 6	*Go to* Step 5
4	DTC 23 is intermittent. Locate and repair intermittent faulty connections. • *Refer to* "Diagnostic Aids."	—	Verify Repair	—
5	Locate and repair open in CKT 472 or CKT 814. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 7
6	Repair faulty IAT sensor. Is action complete?	—	Verify Repair	—
7	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



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DTC 24 - Vehicle Speed Sensor (VSS) Circuit (Scan Diagnostics)

Circuit Description

The vehicle speed is provided to the ECM by means of the Vehicle Speed Sensor (VSS). The sensor may be mounted in the transmission, but the actual location depends on the application. The sensor produces a 12 volt digital signal whenever the vehicle is moving. The number of pulses increases with vehicle speed. The ECM converts this signal into MPH, which can be monitored with a scan tool. This information may be used by the ECM for several reasons such as governing the vehicle speed to a maximum road speed.

The sensor is a three-wire sensor. Terminal "A" of the sensor is provided a ground on CKT 814 through the ECM. Terminal "C" of the sensor is provided ignition voltage. Terminal "B" of the sensor is the signal to the ECM through CKT 401.

Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.

Check VSS circuits for proper connections and the harness is routed properly.

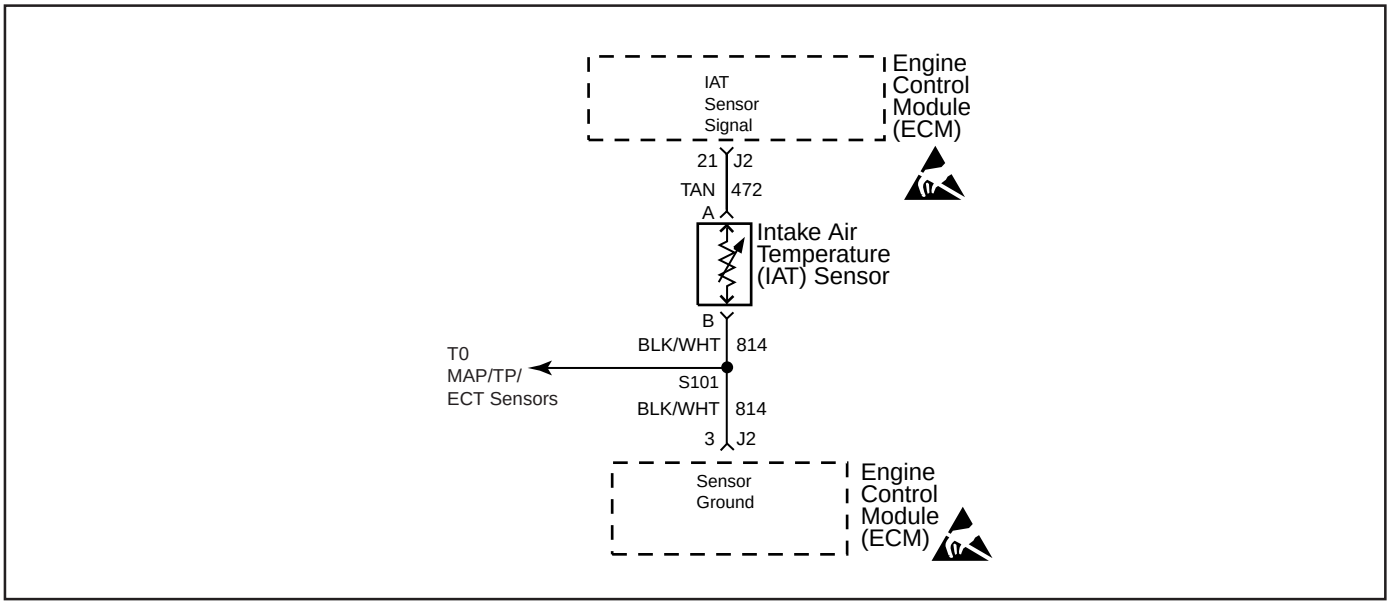
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

2. This step determines if the VSS is receiving ignition voltage.
3. This step checks for a good ground circuit.

DTC 24 - Vehicle Speed Sensor (VSS) Circuit (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Disconnect the vehicle speed sensor harness connector. 2. Turn ignition ON, leaving engine OFF. 3. Using a test light connected to a known good ground, probe ECM harness terminal "C". Does the test light illuminate brightly?	—	*Go to* Step 3	*Go to* Step 7
3	1. Turn ignition ON, leaving engine OFF. 2. Using a test light connected to B+, probe ECM harness terminal "A". Does the test light illuminate brightly?	—	*Go to* Step 4	*Go to* Step 8
4	1. Turn ignition OFF. 2. Reconnect VSS harness connector. 3. Turn ignition ON, leaving engine OFF. 4. Raise and support the vehicle drive wheel(s) per manufacturer's recommendations. 5. Using a DMM connected to a known good ground, back probe ECM harness connector terminal "J2-25". 6. While observing the DMM, slowly rotate the drive wheel(s). Does the DMM indicate a voltage changing as the wheels are rotated?	—	*Go to* Step 9	*Go to* Step 5
5	Locate and repair open or short to ground on CKT 401. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	*Go to* Step 6
6	Replace faulty VSS. Is action complete?	—	Verify repair	—
7	Locate and repair open or short to ground in the ignition circuit to the VSS. Is action complete?	—	Verify Repair	—
8	Locate and repair open in the ground circuit to the VSS. Is action complete?	—	Verify Repair	—
9	DTC 24 may be intermittent. Clear DTC and drive the vehicle. If DTC 24 returns, repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 25 - Intake Air Temperature (IAT) Sensor Circuit - High Temp Indicated (Scan Diagnostics)

Circuit Description

The Intake Air Temperature (IAT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 472 to the sensor. When the intake air temperature is cold, the sensor (thermistor) resistance is high. As the intake air temperature warms up, the sensor resistance becomes less. See intake air temperature sensor table under "Diagnostic Aids."

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the IAT display on the scan tool while moving connectors and wiring harnesses related to the IAT sensor. A change in the IAT display will indicate the location of the fault.
- The scan tool displays intake air temperature in degrees celsius and fahrenheit. If the engine is cold (not running within 8 hours), the scan tool should display an IAT sensor value within a few degrees of outside air temperature. This may help aid in diagnosing a "shifted" IAT sensor.
- Check harness routing for a potential short to ground in CKT 472.

After repairs, clear DTC's following "Clear DTC's Procedure. Failure to do so may result in DTC's not properly being cleared.

Test Description

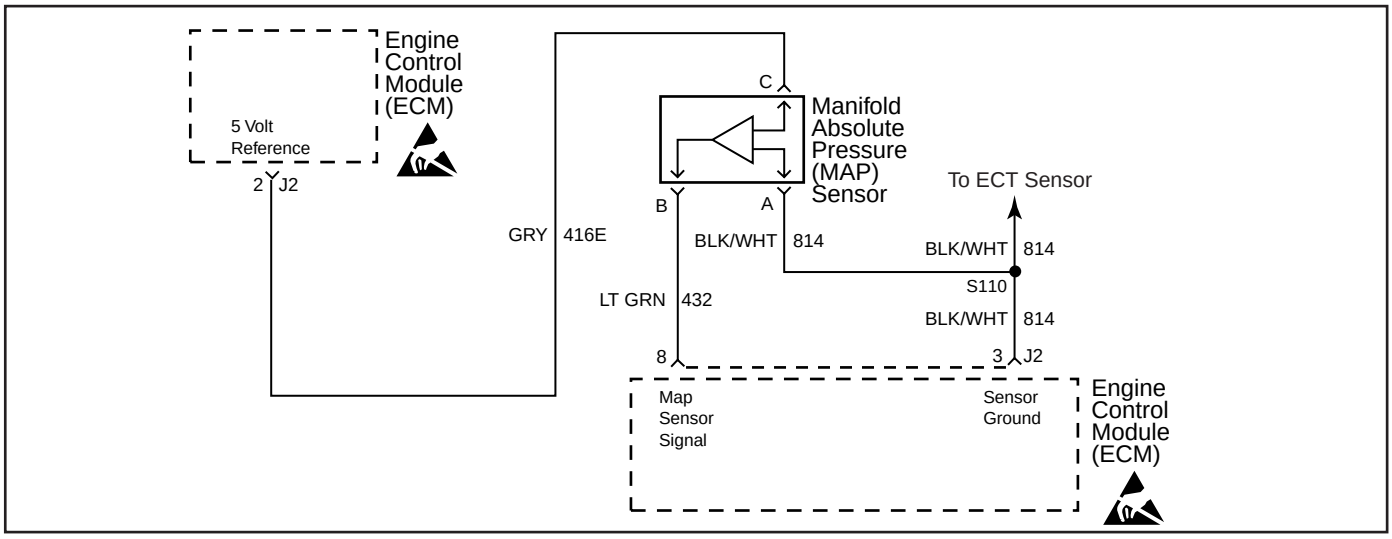
2. DTC 25 will set if signal voltage indicates an intake air temperature above 130°C or 266°F.
3. This test simulates a DTC 23. If the ECM recognizes the high voltage signal and displays a low temperature, the ECM and wiring are OK.

Intake Air Temperature Sensor Table

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
-5	23	12300
-15	5	21450
-30	-22	52700
-40	-40	100700

DTC 25 - Intake Air Temperature (IAT) Sensor Circuit - High Temp Indicated (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	Turn ignition ON, leaving engine OFF. Does scan tool display an intake air temperature greater than the specified value?	130°C (266°F)	*Go to* Step 3	*Go to* Step 4
3	1. Turn ignition OFF. 2. Disconnect IAT sensor harness connector. 3. Turn ignition ON, leaving engine OFF. Does scan tool display an intake air temperature below the specified value?	-30°C (-22°F)	*Go to* Step 6	*Go to* Step 5
4	DTC 25 is intermittent. Locate and repair intermittent faulty connections. • *Refer to* "Diagnostic Aids."	—	Verify Repair	—
5	Locate and repair short to ground in CKT 472. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 7
6	Repair faulty IAT sensor. Is action complete?	—	Verify Repair	—
7	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 33 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage High (Scan Diagnostics)

Circuit Description

The Manifold Absolute Pressure (MAP) sensor responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1.0-1.5 volts at idle to about 4.0-4.5 volts at Wide Open Throttle (WOT).

If the MAP sensor fails, the ECM will substitute a default MAP value that will vary with RPM.

The MAP sensor voltage of 5 volts is delivered to the MAP sensor through CKT 416E. CKT 814 is the ground circuit for the MAP sensor. The MAP signal CKT 432 will send a voltage signal back to the ECM according to what the manifold pressure is.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAP sensor display on the scan tool while moving connectors and wiring harnesses related to the MAP sensor. A change in the MAP sensor display will indicate the location of the fault.
- If the idle is rough or unstable, refer to *Symptoms* for items which may cause an unstable idle.
- With the ignition "ON," engine "OFF," the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of altitude and is referred to as BARO. Comparison of this BARO reading, with a known good MAP sensor, is a good way to check the accuracy of a "suspect" sensor. Reading should be the same, plus or minus 0.4 volt.
- If DTC 14 is also set, check for open in ground CKT 814.
- If a MAP sensor circuit failure is present, the TP sensor default value will be used along with the MAP sensor default value.

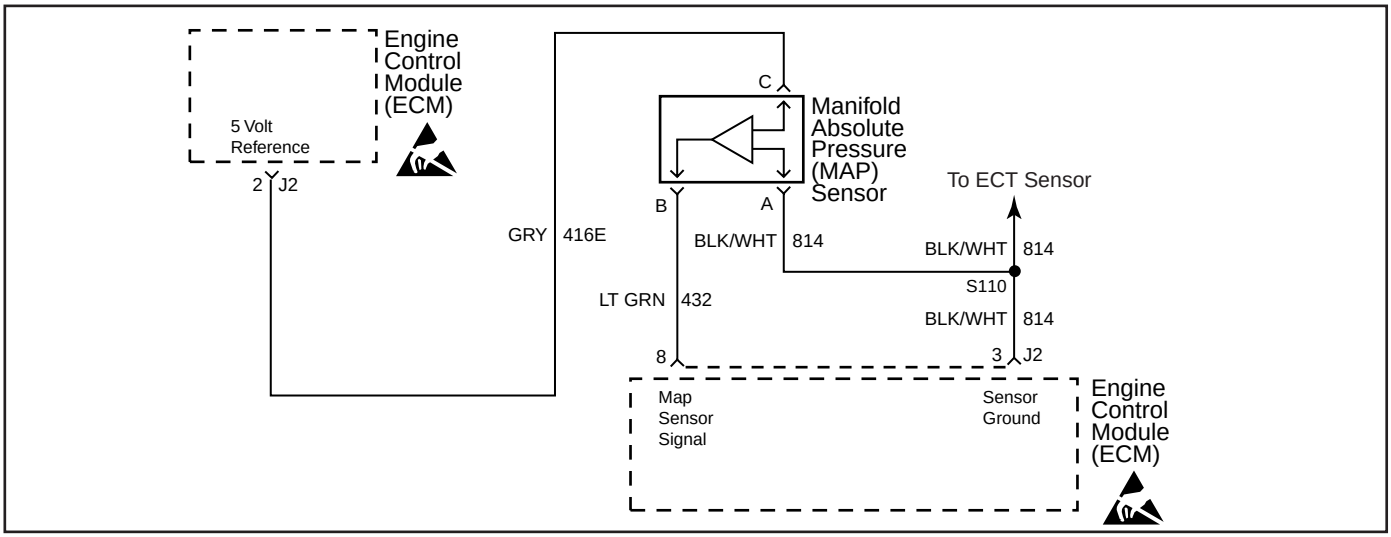
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

2. This step will determine if there is an adequate vacuum supply to the MAP sensor. If the vacuum gauge reading is erratic, refer to the "Rough or Unstable Idle" symptom.
4. This step simulates a DTC 34. If the ECM recognizes the low signal voltage and sets a DTC 34, the ECM and wiring are OK.
5. This step checks for an open in ground CKT 814.

DTC 33 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage High (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Install a vacuum gauge to a manifold vacuum source. 2. Start engine and raise to about 1000 RPM in neutral. 3. The vacuum reading should be steady. Is the vacuum gauge reading steady and above the specified value?	14" Hg (45.5 kPa)	*Go to* Step 3	*Go to* Step 6
3	1. Install a scan tool. 2. Start the engine and allow engine to idle. Does scan tool indicate MAP sensor voltage greater than the specified value?	4 volts	*Go to* Step 4	*Go to* Step 7
4	1. Turn the ignition OFF. 2. Disconnect MAP sensor harness connector. 3. Turn the ignition ON, leaving the engine OFF. Does scan tool indicate MAP sensor voltage less than the specified value?	1 volt	*Go to* Step 5	*Go to* Step 8
5	1. Turn the ignition OFF. 2. Connect DMM from harness terminal "A" (CKT 814) to harness terminal "C" (CKT 416E). 3. Turn the ignition ON, leaving the engine OFF. Does DMM indicate a voltage greater than the specified value?	4 volts	*Go to* Step 10	*Go to* Step 9
6	Repair low or unsteady vacuum problem. Is action complete?	—	Verify Repair	—
7	DTC 33 is intermittent. Locate and repair intermittent faulty connections. • *Refer to* "Diagnostic Aids."	—	—	—
8	Locate and repair short to voltage in CKT 432. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 11
9	Locate and repair open in CKT 814. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 11
10	Check for plugged or leaking sensor vacuum fitting. If OK, replace faulty MAP sensor. Is action complete?	—	Verify Repair	—
11	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 34 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage Low (Scan Diagnostics)

Circuit Description

The Manifold Absolute Pressure (MAP) sensor responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1.0-1.5 volts at idle to about 4.0-4.5 volts at Wide Open Throttle (WOT).

If the MAP sensor fails, the ECM will substitute a default MAP value that will vary with RPM.

The MAP sensor voltage of 5 volts is delivered to the MAP sensor through CKT 416E. CKT 814 is the ground circuit for the MAP sensor. The MAP signal CKT 432 will send a voltage signal back to the ECM according to what the manifold pressure is.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAP sensor display on the scan tool while moving connectors and wiring harnesses related to the MAP sensor. A change in the MAP sensor display will indicate the location of the fault.
- If the idle is rough or unstable, refer to *Symptoms* for items which may cause an unstable idle.
- With the ignition "ON," engine "OFF," the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of altitude and is referred to as BARO. Comparison of this BARO reading, with a known good MAP sensor, is a good way to check the accuracy of a "suspect" sensor. Reading should be the same, plus or minus 0.4 volt.
- If a MAP sensor circuit failure is present, the TP sensor default value will be used along with the MAP sensor default value.

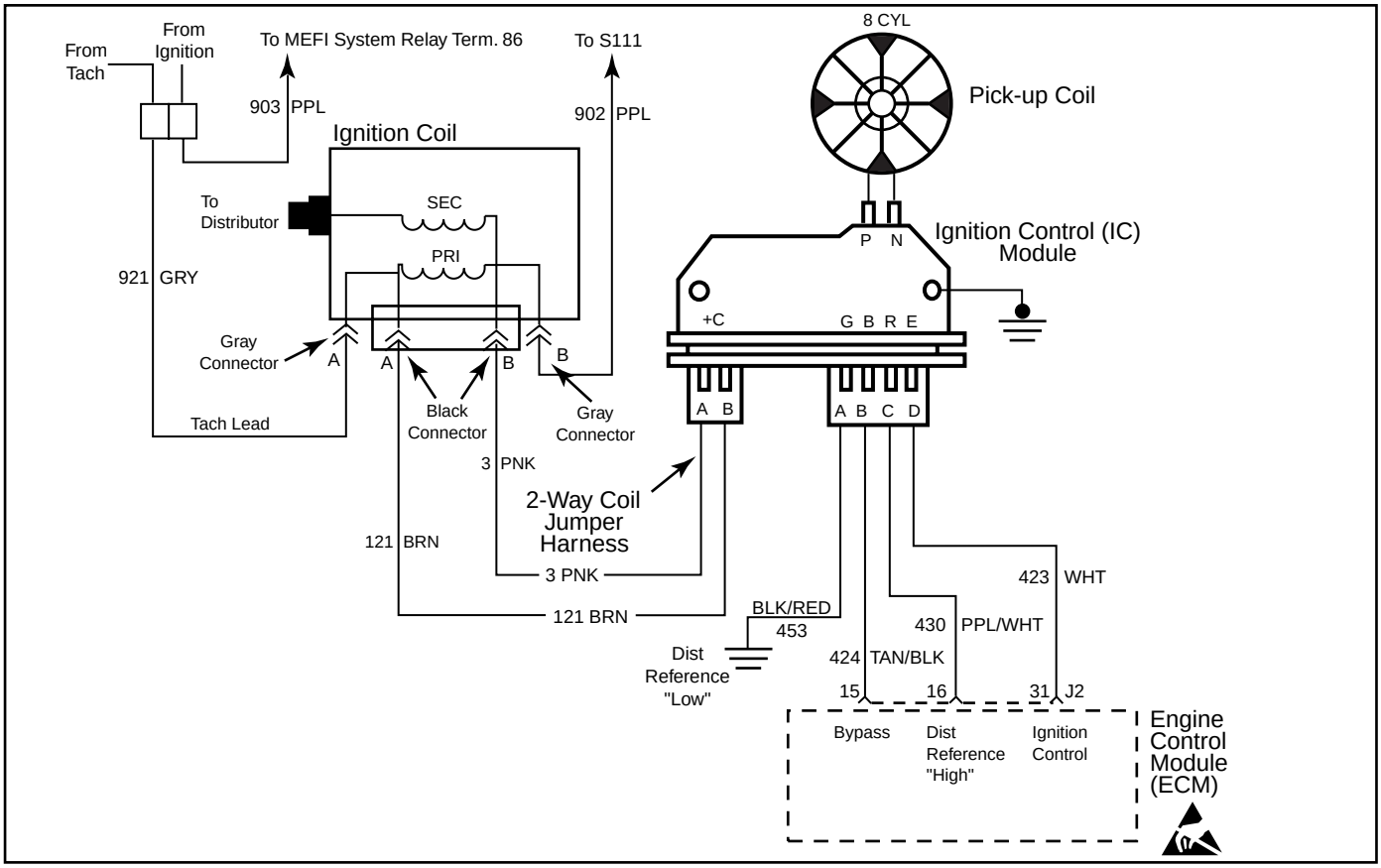
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

2. This step will determine if there is an adequate vacuum supply to the MAP sensor. If the vacuum gauge reading is erratic, refer to the "Rough or Unstable Idle" symptom.
3. This step determines if DTC 34 is the result of a hard failure or an intermittent condition. A DTC will set when MAP signal voltage is too low with engine running.
4. This step simulates a DTC 33. If the ECM recognizes the high signal voltage, the ECM and wiring are OK.
5. This step checks for the 5 volt reference on CKT 416E.

DTC 34 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage Low (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Turn the ignition OFF. 2. Install a vacuum gauge to a manifold vacuum source. 3. Start engine and raise to about 1000 RPM in neutral. 4. The vacuum reading should be steady. Is the vacuum gauge reading steady and above the specified value?	14" Hg (45.5 kPa)	*Go to* Step 3	*Go to* Step 6
3	1. Install a scan tool. 2. Start the engine and allow the engine to idle. Does scan tool indicate MAP sensor voltage less than the specified value?	1 volt	*Go to* Step 4	*Go to* Step 7
4	1. Turn the ignition OFF. 2. Disconnect MAP sensor harness connector. 3. Connect a jumper wire from harness terminal "B" (CKT 432) to harness terminal "C" (CKT 416E). 4. Turn the ignition ON, leaving the engine OFF. Does scan tool indicate MAP sensor voltage greater than the specified value?	4 volts	*Go to* Step 10	*Go to* Step 5
5	1. Turn OFF the ignition. 2. Connect DMM from harness terminal "C" (CKT 416E) to a known good ground. 3. Turn ON the ignition, leaving the engine OFF. Does DMM indicate a voltage greater than the specified value?	4 volts	*Go to* Step 9	*Go to* Step 8
6	Repair low or unsteady vacuum problem. Is action complete?	—	Verify Repair	—
7	DTC 34 is intermittent. Locate and repair intermittent faulty connections. • *Refer to* "Diagnostic Aids."	—	—	—
8	Locate and repair open or short to ground in CKT 416E. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 11
9	Locate and repair open or short to ground in CKT 432. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 11
10	Check for plugged or leaking sensor vacuum fitting. If OK, replace faulty MAP sensor. Is action complete?	—	Verify Repair	—
11	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 41 - Ignition Control (IC) Circuit - Open IC Circuit (Scan Diagnostics)

Circuit Description

When the system is running in the ignition module, or crank mode, there is no voltage on the bypass line, and the Ignition Control (IC) module grounds the IC signal. The ECM expects to see the IC line grounded during this mode. If not, it sets a DTC 41 and will not go into the IC mode.

When the RPM for IC is reached (about 300 RPM), and bypass voltage is applied on CKT 424 by the ECM, the IC line, CKT 423, should no longer be grounded in the IC module. CKT 423 should have varying voltage on it at this point.

If the bypass line is open or shorted to ground, the IC module will not switch to IC mode. The IC line, CKT 423, voltage will be low and DTC 42 will be set.

If CKT 423 is grounded, the IC module will switch to IC mode but, because the line is grounded, there will be no IC signal and a DTC 42 will set.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage.
- If the engine starts and stalls, it may set a false DTC 41 or 42. Clear DTC's and repair stalling condition.

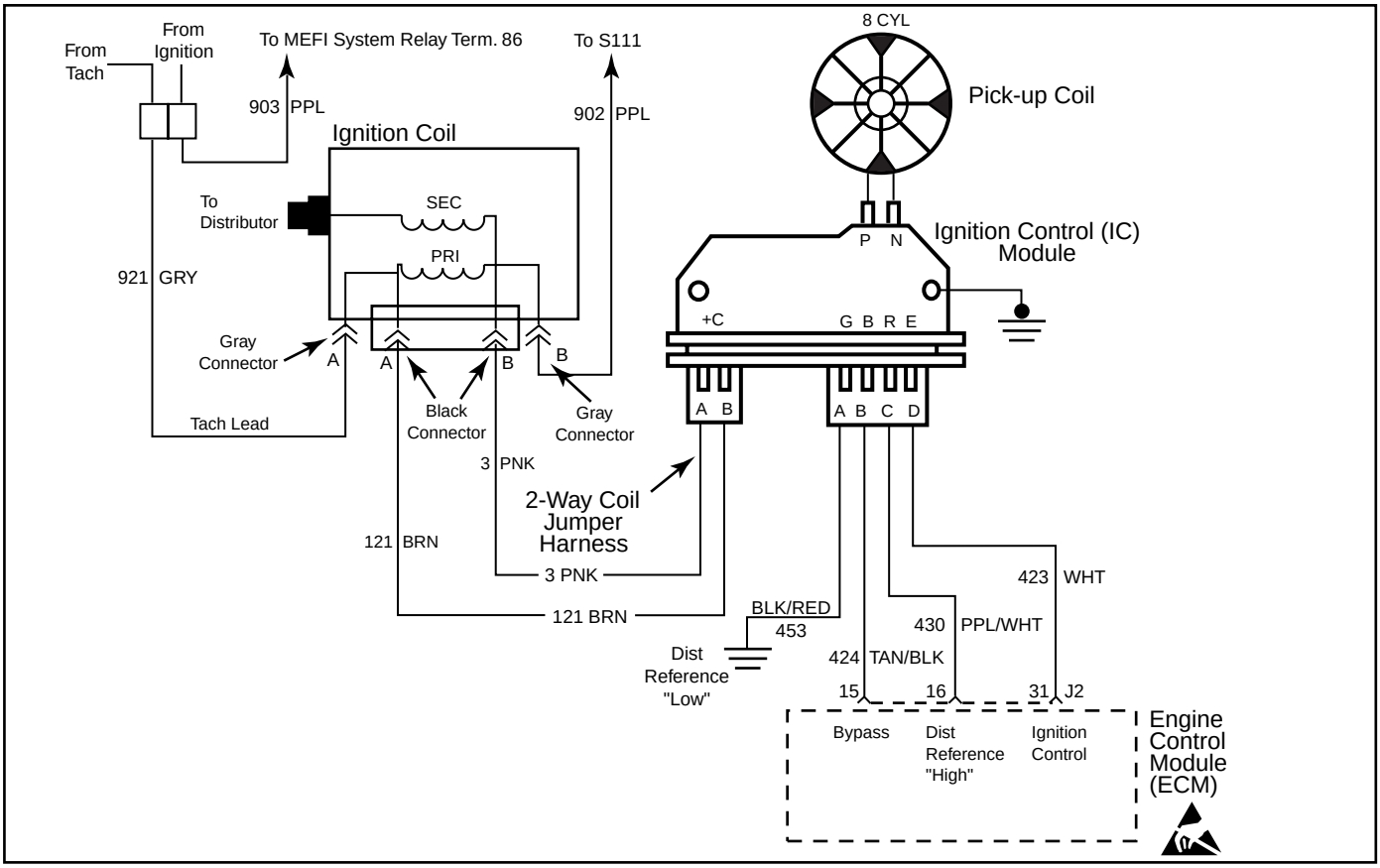
After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

Test Description

2. DTC 41 means the ECM has seen an open in the IC circuit. This test confirms DTC 41 and that the fault causing the DTC is present.
3. Checks for a normal IC ground path through the Ignition Control (IC) module.
4. Confirms that DTC 41 is a faulty ECM and not an intermittent open in CKT 423.

DTC 41 - Ignition Control (IC) Circuit - Open IC Circuit (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Clear DTC 41. • *Refer to* "Clear DTC Procedure." 2. Start engine and idle for 2 minutes or until DTC 41 sets. Is DTC 41 present?	—	*Go to* Step 3	*Go to* Step 8
3	1. Ignition "OFF." 2. Disconnect ECM harness connectors. 3. Using a DVOM selected for ohms, probe ECM harness terminal "J2-31" to ground. Is resistance within the specified value?	3000-6000 ohms	*Go to* Step 4	*Go to* Step 5
4	1. Reconnect ECM. 2. Start engine and idle for 2 minutes or until DTC 41 sets. Is DTC 41 present?	—	*Go to* Step 7	*Go to* Step 8
5	Locate and repair open in CKT 423. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 6
6	Replace faulty distributor ignition control module. Is action complete?	—	Verify Repair	—
7	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—
8	DTC 41 is intermittent. Refer to "Diagnostic Aids" on facing page. Check harness and connectors for an intermittent open in CKT 423.	—	—	—



DTC 42 - Ignition Control (IC) Circuit - Grounded IC Circuit, Open or Grounded Bypass (Scan Diagnostics)

Circuit Description

When the system is running in the ignition module, or crank mode, there is no voltage on the bypass line, and the Ignition Control (IC) module grounds the IC signal. The ECM expects to see the IC line grounded during this mode. If not, it sets a DTC 41 and will not go into the IC mode.

When the RPM for IC is reached (about 300 RPM), and bypass voltage is applied on CKT 424 by the ECM, the IC line, CKT 423, should no longer be grounded in the IC module. CKT 423 should have varying voltage on it at this point.

If the bypass line is open or shorted to ground, the IC module will not switch to IC mode. The IC line, CKT 423, voltage will be low and DTC 42 will be set.

If CKT 423 is grounded, the IC module will switch to IC mode but, because the line is grounded, there will be no IC signal and a DTC 42 will set.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage.
- If the engine starts and stalls, it may set a false DTC 41 or 42. Clear DTC's and repair stalling condition.

After repairs, clear DTC's following "Clear DTC's Procedure" in the *General Information* section. Failure to do so may result in DTC's not properly being cleared.

Test Description

2. DTC 42 means the ECM has seen an open or short to ground in the bypass circuit, or a short to ground in the IC circuit. This test confirms a DTC 42 and that the fault causing the DTC is present.
3. Checks for a normal IC ground path through the Ignition Control (IC) module. An IC CKT 423 shorted to ground will also read less than 3000 ohms, however, this will be checked later.
4. As the test light voltage touches CKT 424, the module should switch , causing the DVOM reading to go from over 3000 ohms to under 1000 ohms. The important thing is that the module switched.
5. The module did not switch and this step checks for:
   - Bypass CKT 424 open.
   - Bypass CKT 424 shorted to ground.
   - Faulty ignition control module.
7. Confirms that DTC 42 is a faulty ECM and not an intermittent in CKT 423 or CKT 424.

DTC 42 - Ignition Control (IC) Circuit - Grounded IC Circuit, Open or Grounded Bypass (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Clear DTC 42. Refer to "Clear DTC Procedure." 2. Start engine and idle for 2 minutes or until DTC 42 sets. Is DTC 42 present?	—	*Go to* Step 3	*Go to* Step 13
3	1. Ignition "OFF." 2. Disconnect ECM harness connectors. 3. Using a DVOM selected for ohms, probe ECM harness terminal "J2-31" to ground. Is resistance within the specified value?	3000-6000 ohms	*Go to* Step 4	*Go to* Step 8
4	1. Leave DVOM connected from ECM harness terminal "J2-31" to ground. 2. Using a test light connected to B+, probe ECM harness terminal "J2-15." 3. As the test light contacts "J2-15," the resistance should switch from over 3000 ohms to under 1000 ohms. Does the resistance switch to under the specified value?	1000 ohms	*Go to* Step 7	*Go to* Step 5
5	Using a test light connected to B+, probe ECM harness terminal "J2-15" (CKT 424). Does test light illuminate brightly?	—	*Go to* Step 6	*Go to* Step 9
6	Disconnect ignition control module 4-wire connector. Does test light illuminate brightly?	—	*Go to* Step 10	*Go to* Step 11
7	1. Reconnect ECM. 2. Start engine and idle for 2 minutes or until DTC 42 sets. Is DTC 42 present?	—	*Go to* Step 12	*Go to* Step 13
8	Locate and repair short to ground in CKT 423. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 11

DTC 42 - Ignition Control (IC) Circuit - Grounded IC Circuit, Open or Grounded Bypass (Scan Diagnostics)

Step	Action	Value	Yes	No
9	Locate and repair open in CKT 424. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 11
10	Locate and repair short to ground in CKT 424. Is action complete?	—	Verify Repair	—
11	Replace faulty ignition control module. Is action complete?	—	Verify Repair	—
12	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—
13	DTC 42 is intermittent. Refer to “Diagnostic Aids” on facing page. Check harness and connectors for an intermittent open or short to ground in CKT 424, or an intermittent short to ground in CKT 423.	—	—	—

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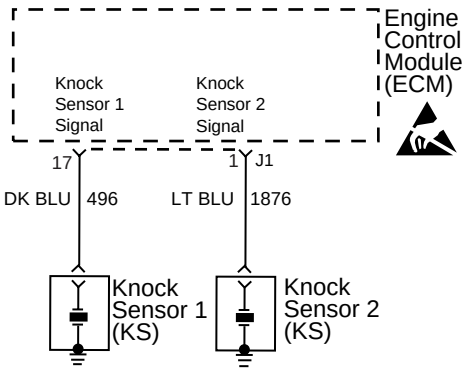


MEFI4310
6-28-00

DTC 44 - Knock Sensor (KS) 1 Circuit (Scan Diagnostics)

Circuit Description

The ECM uses the Knock Sensor(s) in order to detect engine detonation. This detection allows the ECM to retard spark timing based on the KS signal coming into the ECM. DTC 44 will set only if the ECM does not see any activity on the KS signal circuit(s).

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage.
- Loose Knock Sensor(s) in engine block.
- Poor connection at the Knock Sensor(s).

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

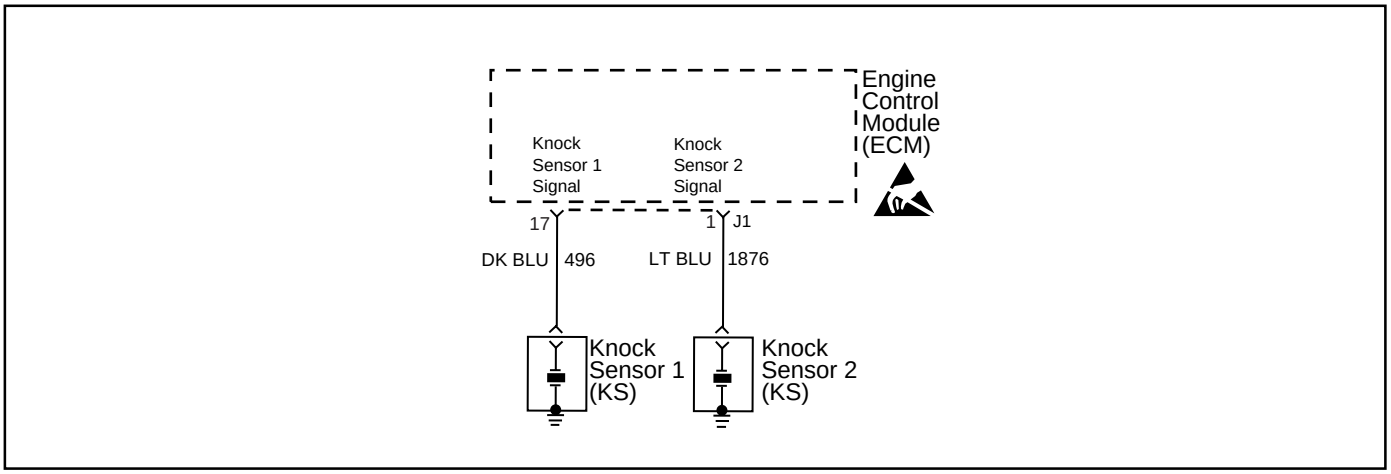
If CKT 496 or CKT 1876 are routed too close to secondary ignition wires, the ECM may see the interference as a knock signal, resulting in false timing retard.

Test Description

4. This step ensures the knock sensor is secured properly in the engine block.
5. Checks to see that the knock sensor circuit is within specifications.

DTC 44 - Knock Sensor (KS) 1 Circuit (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	**Important:** If you can hear the engine knock, repair the engine mechanical problem before proceeding with this diagnostic table. Check the KS signal circuit for incorrect routing near the secondary wires. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 3
3	Check the KS signal circuit for any terminals not being fully seated or for incorrect installation. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 4
4	Check knock sensor for being loose in the engine block. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 5
5	1. Install scan tool. 2. Select the option to view the data list. 3. Select to view the knock signal 1 parameter. 4. Disconnect "J1" harness connector. 5. Connect a DMM from "J1-17" (CKT 496 - Knock Signal 1) to a known good ground near the knock sensor. Is resistance between the specified value?	93-107K ohms	*Go to* Step 8	*Go to* Step 6
6	Locate and repair open or short to ground in the circuit that were out of range. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 7
7	Inspect knock sensor terminal contacts. If OK, replace faulty knock sensor. Is action complete?	—	Verify Repair	—
8	Replace faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



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DTC 44 - Knock Sensor (KS) 2 Circuit (Scan Diagnostics)

Circuit Description

The ECM uses the Knock Sensor(s) in order to detect engine detonation. This detection allows the ECM to retard spark timing based on the KS signal coming into the ECM. DTC 44 will set only if the ECM does not see any activity on the KS signal circuit(s).

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage.
- Loose Knock Sensor(s) in engine block.
- Poor connection at the Knock Sensor(s).

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

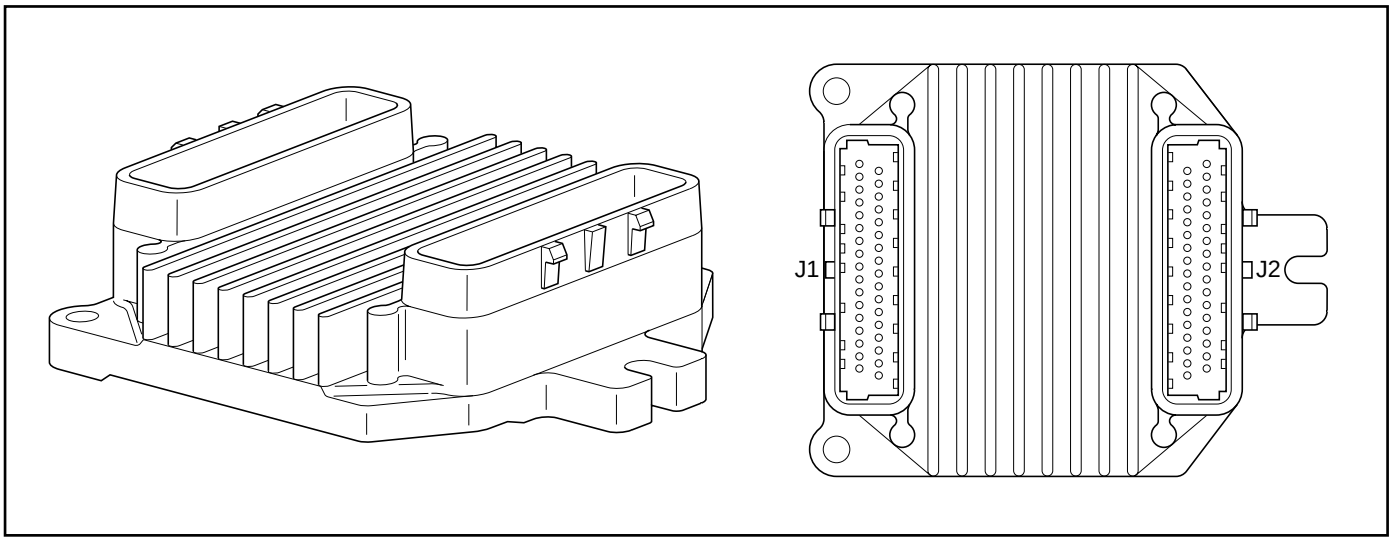
If CKT 496 or CKT 1876 are routed too close to secondary ignition wires, the ECM may see the interference as a knock signal, resulting in false timing retard.

Test Description

4. This step ensures the knock sensor is secured properly in the engine block.
5. Checks to see that the knock sensor circuit is within specifications.

DTC 44 - Knock Sensor (KS) 2 Circuit (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	**Important:** If you can hear the engine knock, repair the engine mechanical problem before proceeding with this diagnostic table. Check the KS signal circuit for incorrect routing near the secondary wires. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 3
3	Check the KS signal circuit for any terminals not being fully seated or for incorrect installation. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 4
4	Check knock sensor for being loose in the engine block. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 5
5	1. Install scan tool. 2. Select the option to view the data list. 3. Select to view the knock signal 2 parameter. 4. Disconnect "J1" harness connector. 5. Connect a DMM from "J1-1" (CKT 1876 - Knock Signal 2) to a known good ground near knock sensor. Is resistance between the specified value?	93-107K ohms	*Go to* Step 8	*Go to* Step 6
6	Locate and repair open or short to ground in the circuit that were out of range. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 7
7	Inspect knock sensor terminal contacts. If OK, replace faulty knock sensor. Is action complete?	—	Verify Repair	—
8	Replace faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



MEFI3004

DTC 51 - Calibration Checksum Failure (Scan Diagnostics)

Circuit Description

This test allows the ECM to check for a calibration failure by comparing the calibration value to a known value stored in the EEPROM.

This test is also used as a security measure to prevent improper use of calibration or changes to these calibrations that may alter the designed function of MEFI.

Diagnostic Aids

If DTC 51 failed more than once, but is intermittent, replace the ECM.

Test Description

2. This step checks to see if the fault is present during diagnosis. If present, the ECM is not functioning properly and must be replaced or reprogrammed.

DTC 51 - Calibration Checksum Failure (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Install Diagnostic Trouble Code (DTC) tool. 2. Using "Clear DTC Procedure," clear DTC 51. 3. Turn the ignition ON, leaving the engine OFF. 4. Switch DTC tool to "service mode," or "ON." Does DTC 51 reset?	—	*Go to* Step 3	*Refer to* Diagnostic Aids
3	Replace or reprogram faulty ECM and verify DTC does not reset. Is action complete?	—	Verify Repair	—

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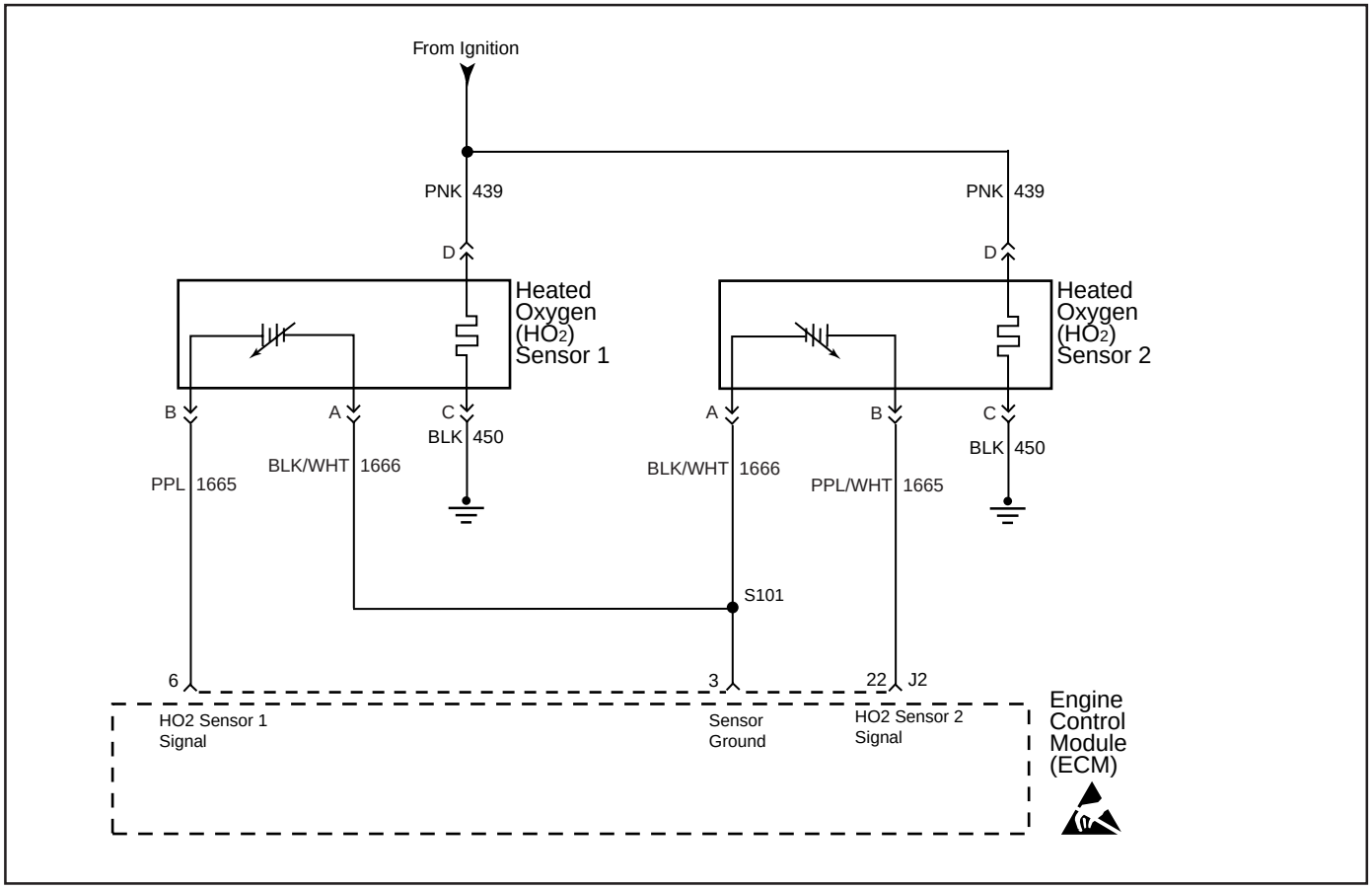


DTC 54 - Heated Oxygen (HO_2) Sensor 1 Circuit Low Voltage - Lean Exhaust Indicated (Scan Diagnostics)

Circuit Description

The Heated Oxygen (HO_2) Sensor varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- An intermittent short to ground in the HO_2 sensor signal circuit.
- Fuel contamination: Water, even in small amounts delivered to the injectors can cause a lean condition.
- Fuel Pressure: If the fuel pressure is too low, the system will be lean. In order to confirm, monitor a fuel pressure gauge while driving the vehicle at various speeds and loads.
- Exhaust Leaks: If there is an exhaust leak, the engine may pull the outside air into the exhaust and past the sensor.
- Vacuum leaks can cause a lean condition or high idle.

Never solder the HO_2 wires. For proper wire and connection repairs, refer to "Wiring Repair."

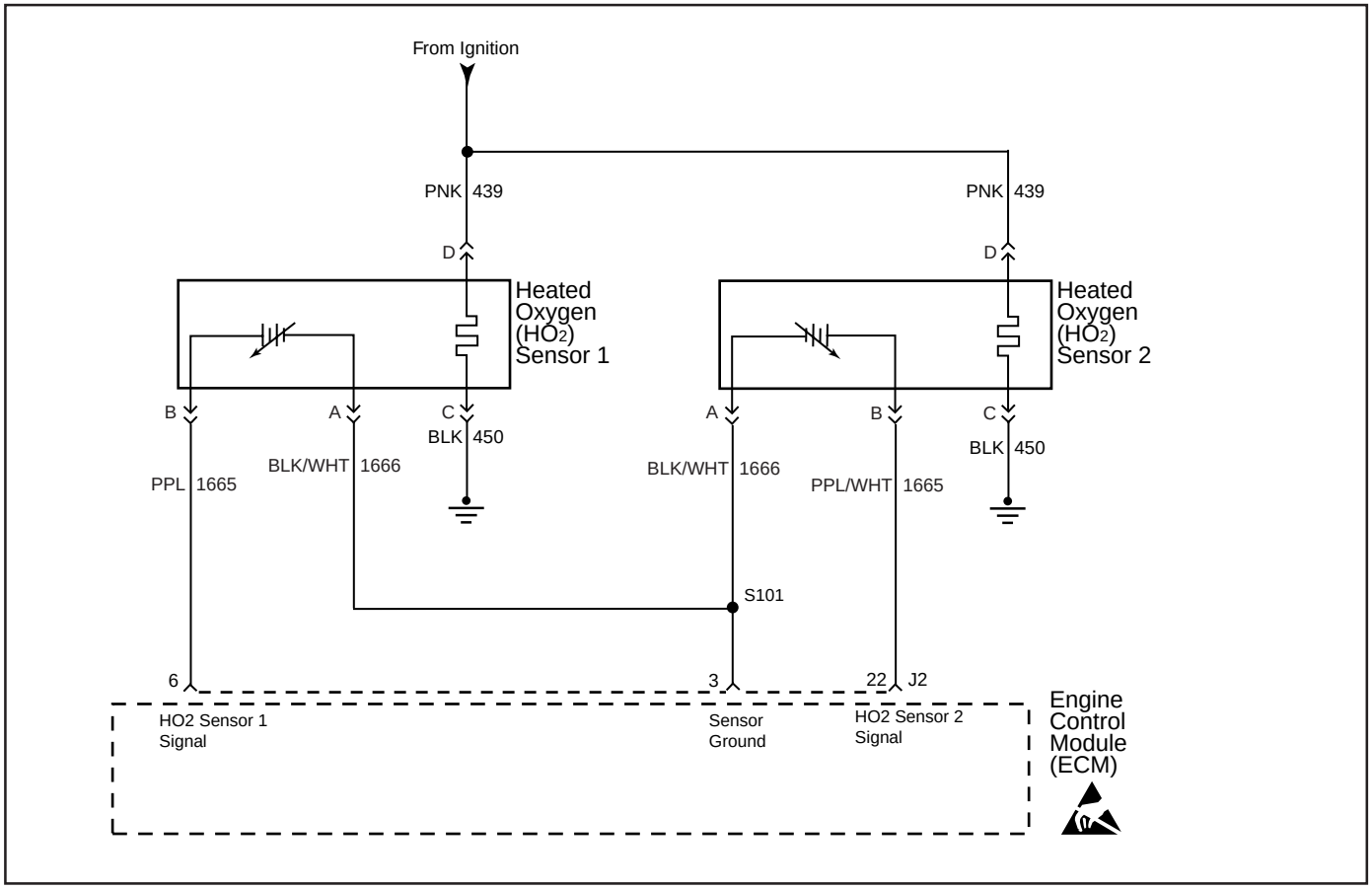
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

2. Running the engine at 1200 RPM keeps the HO_2 sensor hot in order to ensure the oxygen sensor remains active and can indicate the exhaust oxygen content accurately.
3. Opening the heated oxygen sensor circuit should result in a displayed voltage between 0.423 volt and 0.487 volt. If the display is fixed below 0.100 volt, the fault is a short to ground in HO_2 sensor signal circuit or a faulty ECM.

DTC 54 - Heated Oxygen (HO_2) Sensor 1 Circuit Low Voltage - Lean Exhaust Indicated (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Connect a scan tool. 2. Run the engine at the normal operating temperature. 3. Place the vehicle in park or neutral. 4. Increase the engine speed to the specified value. Is the HO2 sensor 1 voltage displayed fixed less than the specified value?	1200 RPM 0.100 volt	*Go to* Step 3	*Go to* Step 4
3	1. Disconnect the HO2 sensor 1 electrical connector. 2. Using a jumper wire, connect the HO2 sensor 1 Low circuit to a known good ground. 3. Turn the ignition ON, leaving the engine OFF. Does the scan tool HO2 Sensor 1 Voltage display indicate a voltage within the specified value?	0.423 - 0.487 volt	Refer to Diagnostic Aids	*Go to* Step 5
4	DTC 54 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
5	Locate and repair short to ground in the HO2 sensor 1 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 6
6	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 54 - Heated Oxygen (HO_2) Sensor 2 Circuit Low Voltage - Lean Exhaust Indicated (Scan Diagnostics)

Circuit Description

The Heated Oxygen (HO_2) Sensor varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- An intermittent short to ground in the HO_2 sensor signal circuit.
- Fuel contamination: Water, even in small amounts delivered to the injectors can cause a lean condition.
- Fuel Pressure: If the fuel pressure is too low, the system will be lean. In order to confirm, monitor a fuel pressure gauge while driving the vehicle at various speeds and loads.
- Exhaust Leaks: If there is an exhaust leak, the engine may pull the outside air into the exhaust and past the sensor.
- Vacuum leaks can cause a lean condition or high idle.

Never solder the HO_2 wires. For proper wire and connection repairs, refer to "Wiring Repair."

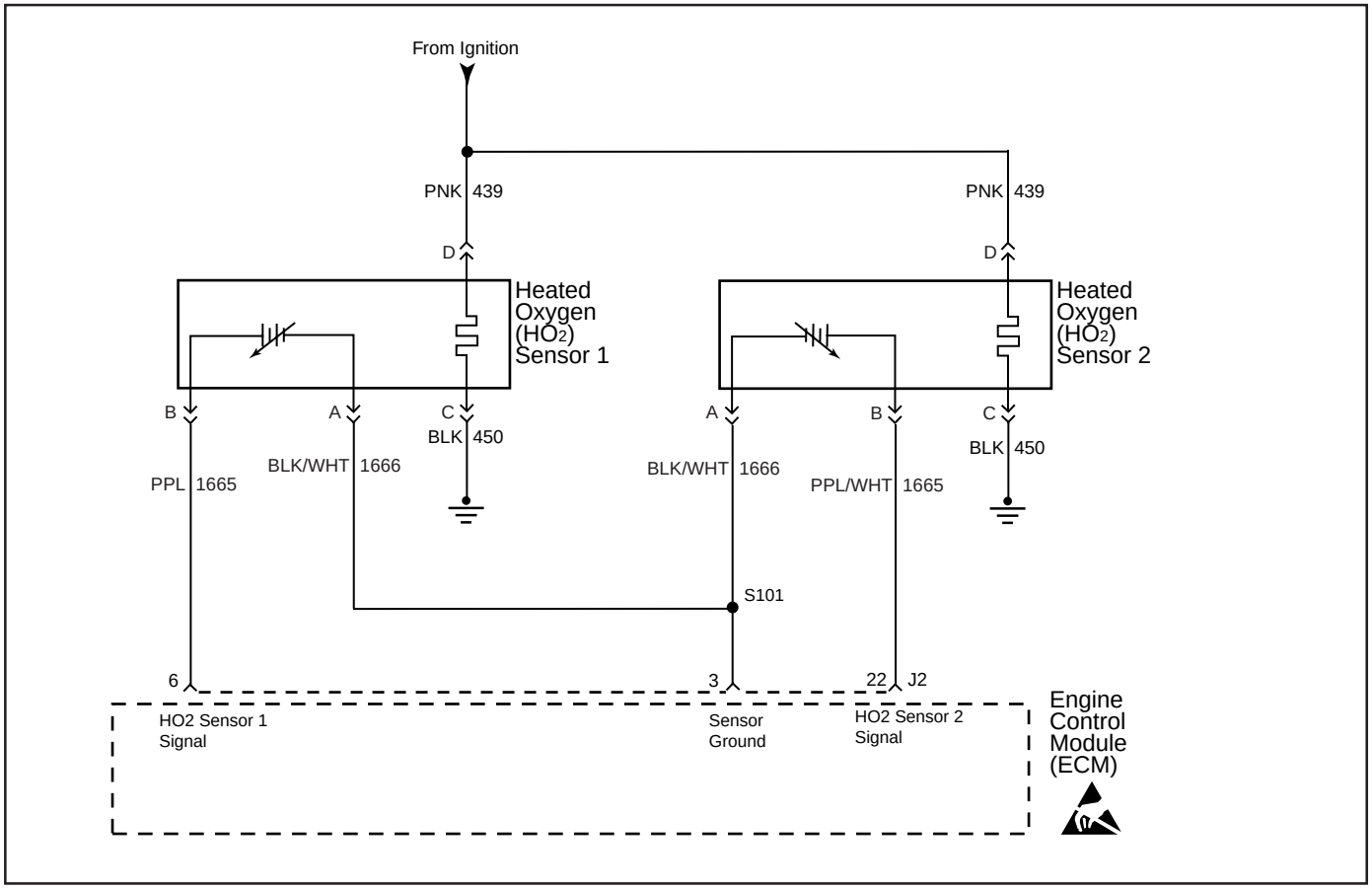
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

2. Running the engine at 1200 RPM keeps the HO_2 sensor hot in order to ensure the oxygen sensor remains active and can indicate the exhaust oxygen content accurately.
3. Opening the heated oxygen sensor circuit should result in a displayed voltage between 0.423 volt and 0.487 volt. If the display is fixed below 0.100 volt, the fault is a short to ground in HO_2 sensor signal circuit or a faulty ECM.

DTC 54 - Heated Oxygen (HO_2) Sensor 2 Circuit Low Voltage - Lean Exhaust Indicated (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Connect scan tool. 2. Run the engine at the normal operating temperature. 3. Place the vehicle in park or neutral. 4. Increase the engine speed to the specified value. Is the HO2 sensor 2 voltage displayed fixed less than the specified value?	1200 RPM 0.100 volt	*Go to* Step 3	*Go to* Step 4
3	1. Disconnect the HO2 sensor 2 electrical connector. 2. Using a jumper wire, connect the HO2 sensor 2 Low circuit to a known good ground. 3. Turn the ignition ON, leaving the engine OFF. Does the scan tool HO2 Sensor 2 Voltage display indicate a voltage within the specified value?	0.423 - 0.487 volt	Refer to Diagnostic Aids	*Go to* Step 5
4	DTC 54 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
5	Locate and repair short to ground in the HO2 sensor 2 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 6
6	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 55 - Heated Oxygen (HO_2) Sensor 1 Circuit High Voltage - Rich Exhaust Indicated (Scan Diagnostics)

Circuit Description

The Heated Oxygen (HO_2) Sensor varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- A leaking injector.
- Fuel contaminated oil.
- Fuel Pressure: If the fuel pressure is too high, the system will be rich. In order to confirm, monitor a fuel pressure gauge while driving the vehicle at various speeds and loads.
- Leaking fuel pressure regulator. Check for fuel in the vacuum line to regulator.
- The TP sensor: An intermittent TP sensor output can cause the system to run rich due to a false indication of the throttle moving.
- False rich indication due to silicon contamination of the HO_2 sensor. A DTC 55 accompanied by lean drivability conditions and a powdery white deposit on the sensor indicates a false rich condition.
- Faulty HO_2 sensor: The HO_2 sensor is internally shorted, the HO_2 Sensor Voltage displayed on the scan tool will be over 1.0 volt. Try disconnecting the HO_2 electrical connector, if the displayed voltage goes from over 1.0 volt down to about 0.5 volt, replace the HO_2 sensor.

Never solder the HO_2 wires. For proper wire and connection repairs, refer to "Wiring Repair."

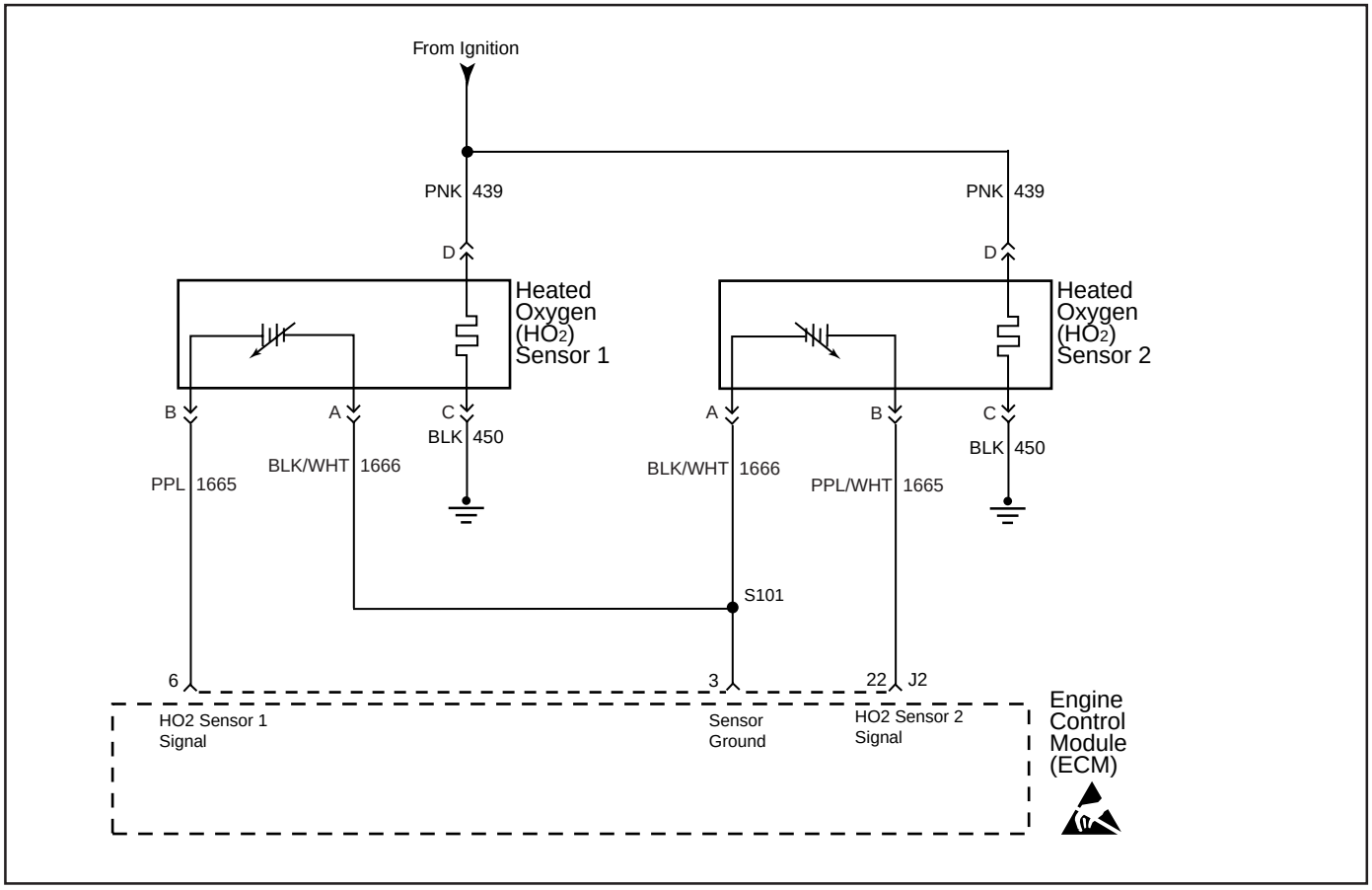
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

2. This test determines if the conditions exist in order to set DTC 55.

DTC 55 - Heated Oxygen (HO_2) Sensor 1 Circuit High Voltage - Rich Exhaust Indicated (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Connect scan tool. 2. Run the engine at the normal operating temperature. 3. Place the vehicle in park or neutral. 4. Increase the engine speed to the specified value. Is the HO2 sensor 1 voltage displayed fixed above than the specified value?	1200 RPM 0.900 volt	*Go to* Step 3	*Go to* Step 5
3	Turn the ignition ON, leaving the engine OFF. Does the scan tool HO2 Sensor 1 Voltage display indicate a voltage fixed above the specified value?	0.900 volt	*Go to* Step 4	Refer to Diagnostic Aids
4	1. Disconnect the HO2 sensor 1 electrical connector. 2. Turn the ignition ON, leaving the engine OFF. Does the scan tool HO2 Sensor 1 Voltage display indicate a voltage fixed above the specified value?	0.900 volt	*Go to* Step 7	*Go to* Step 6
5	DTC 55 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
6	Replace HO2 sensor 1. Is action complete?	—	Verify Repair	—
7	Locate and repair short to voltage on the HO_2 sensor 1 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 8
8	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 55 - Heated Oxygen (HO_2) Sensor 2 Circuit High Voltage - Rich Exhaust Indicated (Scan Diagnostics)

Circuit Description

The Heated Oxygen (HO_2) Sensor varies voltage within a range from about 1.0 volt if the exhaust is rich, down to about 0.1 volt if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600° F). An open oxygen sensor circuit or cold oxygen sensor causes an Open Loop operation.

Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- A leaking injector.
- Fuel contaminated oil.
- Fuel Pressure: If the fuel pressure is too high, the system will be rich. In order to confirm, monitor a fuel pressure gauge while driving the vehicle at various speeds and loads.
- Leaking fuel pressure regulator. Check for fuel in the vacuum line to regulator.
- The TP sensor: An intermittent TP sensor output can cause the system to run rich due to a false indication of the throttle moving.
- False rich indication due to silicon contamination of the HO_2 sensor. A DTC 55 accompanied by lean drivability conditions and a powdery white deposit on the sensor indicates a false rich condition.
- Faulty HO_2 sensor: The HO_2 sensor is internally shorted, the HO_2 Sensor Voltage displayed on the scan tool will be over 1.0 volt. Try disconnecting the HO_2 electrical connector, if the displayed voltage goes from over 1.0 volt down to about 0.5 volt, replace the HO_2 sensor.

Never solder the HO_2 wires. For proper wire and connection repairs, refer to “Wiring Repair.”

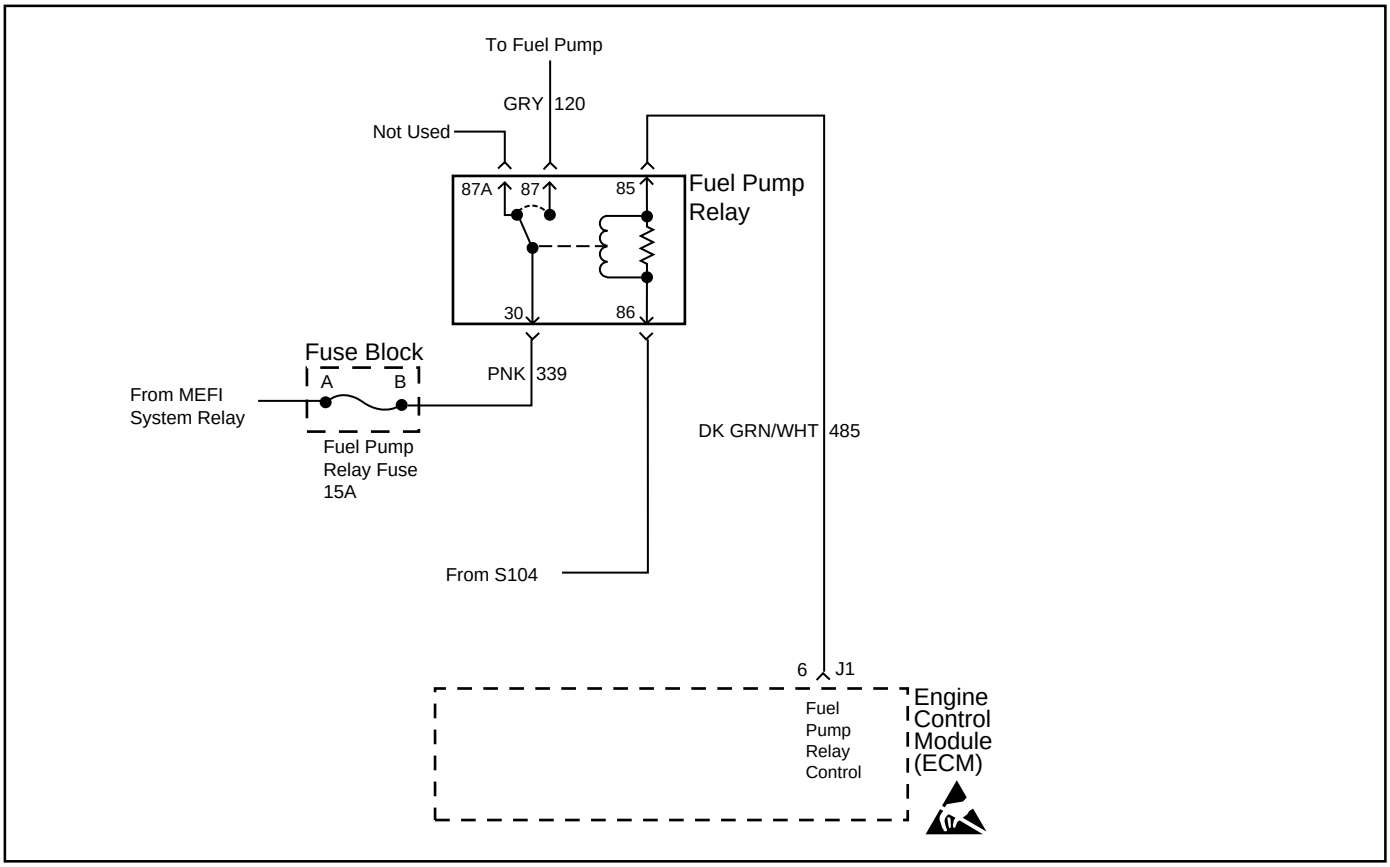
After repairs, clear DTC’s following “Clear DTC’s Procedure.” Failure to do so may result in DTC’s not properly being cleared.

Test Description

2. This test determines if the conditions exist in order to set DTC 55.

DTC 55 - Heated Oxygen (HO_2) Sensor 2 Circuit High Voltage - Rich Exhaust Indicated (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Connect scan tool. 2. Run the engine at the normal operating temperature. 3. Place the vehicle in park or neutral. 4. Increase the engine speed to the specified value. Is the HO2 sensor 2 voltage displayed fixed above than the specified value?	1200 RPM 0.900 volt	*Go to* Step 3	*Go to* Step 5
3	Turn the ignition ON, leaving the engine OFF. Does the scan tool HO2 Sensor 2 Voltage display indicate a voltage fixed above the specified value?	0.900 volt	*Go to* Step 4	Refer to Diagnostic Aids
4	1. Disconnect the HO2 sensor 2 electrical connector. 2. Turn the ignition ON, leaving the engine OFF. Does the scan tool HO2 Sensor 2 Voltage display indicate a voltage fixed above the specified value?	0.900 volt	*Go to* Step 7	*Go to* Step 6
5	DTC 55 is intermittent. If no additional DTC's are stored, refer to the Diagnostic Aids. If any additional DTC's are stored, refer to those table(s) first.	—	Go to Applicable DTC Table	—
6	Replace HO2 sensor 2. Is action complete?	—	Verify Repair	—
7	Locate and repair short to voltage on the HO_2 sensor 2 signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	*Go to* Step 8
8	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



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DTC 81 - Fuel Pump Relay Driver Circuit High, Low or Open (Scan Diagnostics)

Circuit Description

The Engine Control Module (ECM) controls the relay by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the controlled component. This driver has a fault line which the ECM monitors. When the ECM commands the relay ON, the voltage of the control circuit should be low, near 0 volts. When the ECM commands the relay OFF, the voltage should be high, near battery voltage. If the fault detection circuit senses a voltage other than what the ECM expects, the fault line stauts changes causing the DTC to set.

The relay controls the high current flow to the fuel pump. This allows the ECM driver to only have to control the relatively low current used by the relay.

Diagnostic Aids

If the condition is suspected to be intermittent, refer to *Intermittent Conditions.*

Test Description

2. Listen for an audible click when the relay operates. Command both the ON and OFF states. Repeat the commands if necessary.
3. This test can detect a partially shorted coil which would cause an excessive current flow. Leaving the circuit energized for 2 minutes allows the coil to warm up. When warm, the coil may open, and the current drops to 0, or the coil may short, and the current goes above 0.75 amp.
5. Identify and test the relay coil terminals in order to avoid improper diagnosis.
12. If no trouble is found in the control circuit or the connection at the ECM, the ECM may be faulty. However, this is an extremely unlikely failure.

DTC 81 - Fuel Pump Relay Driver Circuit High, Low or Open (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Turn ON the ignition, with the engine OFF. 2. Command the relay ON and OFF using a scan tool. Does the relay turn ON and OFF when commanded?	—	*Go to* Step 3	*Go to* Step 5
3	1. Turn OFF the ignition. 2. Disconnect the ECM connector J1. 3. Install a 5 amp fused jumper wire from a known good ground to the control circuit at the ECM harness connector (J1-6). 4. Turn ON the ignition, with the engine OFF. **Important:** Replace the relay if the DMM goes to 0 during the current draw test. 5. Using a DMM on 40 amp scale, measure the current from the relay control circuit in the ECM harness connector to ground for 2 minutes. Does the current draw measure less than the specified value?	0.75 A	*Go to* Diagnostic Aids	*Go to* Step 4
4	1. Turn OFF the ignition. 2. Disconnect the fuel pump relay connector. 3. Using a DMM, measure the resistance from the relay control circuit in the ECM harness connector to ground Does the DMM display infinite resistance or OL?	—	*Go to* Step 12	*Go to* Step 10
5	1. Turn OFF the engine. 2. Disconnect the fuel pump relay connector. 3. Connect a test lamp between the fuel pump relay control circuit and the fuel pump relay ignition feed circuit, on the coil side of the relay, at the fuel pump relay harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Using a scan tool, command the relay ON and OFF. Does the test lamp turn ON and OFF when commanded?	—	*Go to* Step 8	*Go to* Step 6
6	Using a test lamp connected to ground, probe the ignition feed circuit, on the coil side of the fuel pump relay harness connector. Is the test lamp illuminated?	—	*Go to* Step 7	*Go to* Step 11

DTC 81 - Fuel Pump Relay Driver Circuit High, Low or Open (cont'd) (Scan Diagnostics)

Step	Action	Value	Yes	No
7	1. Turn OFF the ignition. 2. Reconnect the relay. 3. Disconnect the ECM connector J2. 4. Turn ON the ignition, with the engine OFF. 5. Using a fused jumper wire connected to ground, momentarily probe the relay control circuit in the ECM harness connector. Does the relay turn ON when the circuit is grounded and OFF when the circuit is opened?	—	*Go to* Step 9	*Go to* Step 10
8	Locate and repair faulty connections at the relay. Was a problem found?	—	Verify Repair	*Go to* Step 12
9	Locate and repair faulty connections at the ECM. Was a problem found?	—	Verify Repair	*Go to* Step 13
10	Repair the faulty relay control circuit. Is action complete?	—	Verify Repair	—
11	Repair the faulty relay ignition feed circuit. Is action complete?	—	Verify Repair	—
12	Replace the faulty relay. Is action complete?	—	Verify Repair	—
13	Replace the ECM Is action complete?	—	Verify Repair	—

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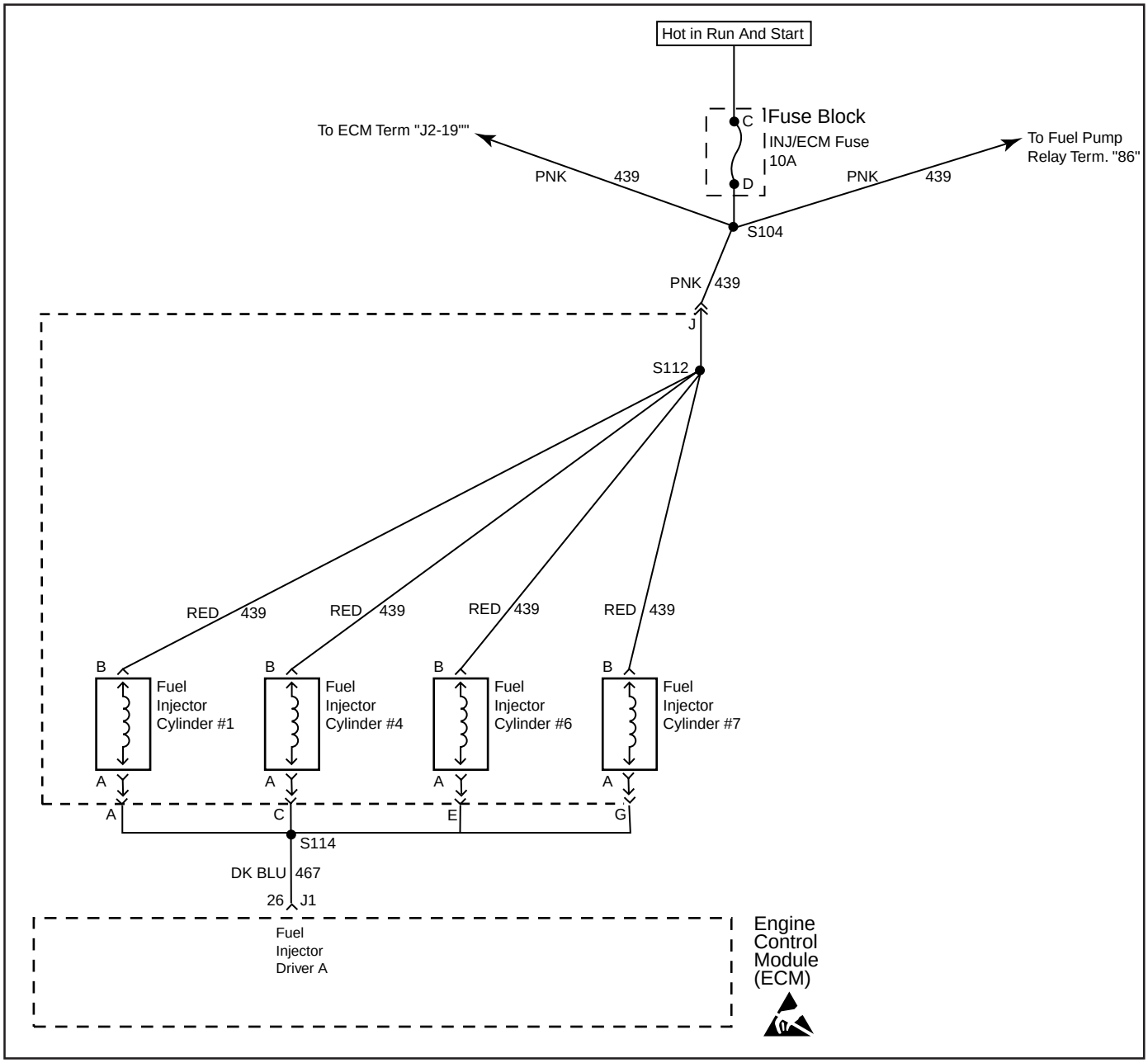

DTC 81 - Fuel Injector Driver A Circuit High, Low or Open (Scan Diagnostics)

Circuit Description

The Engine Control Module (ECM) enables the fuel injector drivers. An ignition voltage is supplied to the fuel injectors. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a driver. The ECM monitors the status of each driver. If the ECM detects an incorrect voltage for the commanded state of the driver, a fuel injector control DTC sets.

Diagnostic Aids

Performing the Fuel Injector Coil test may help isolate an intermittent condition. Refer to *Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Between 10-35 Degrees C (50-95 Degrees F)* or *Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Outside 10-35 Degrees C (50-95 Degrees F).*

If the condition is suspected to be intermittent, refer to *Intermittent Conditions.*

Test Description

4. This step tests for voltage at the fuel injector harness connector. The ECM/INJ fuse supplies power to the coil side of the fuel injector harness connector. If the fuse is open, a short to ground on the fuel injector B+ supply

circuit is indicated. The ECM/INJ fuse also supplies voltage to the ignition coils. If the fuse is open, inspect the circuits to the ignition coils for a short to ground.

5. This test verifies that the ECM is able to control the fuel injector. If the test lamp blinks, then the ECM and wiring are OK.
6. This step tests if a ground is constantly being applied to the fuel injector.

DTC 81 - Fuel Injector Driver A Circuit High, Low or Open (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Disconnect the appropriate harness connectors of the four fuel injectors. 2. Turn ON the ignition, with the engine OFF. 3. Using a test lamp connected to a know good ground, probe the ignition voltage circuits of each fuel injector on the harness connector. Does the test lamp illuminate on all four circuits?	—	*Go to* Step 3	*Go to* Step 8
3	1. Connect the fuel injector test lamp J 34730-2C between the control circuit and the ignition voltage circuit of the fuel injector harness connector. Repeat for all four fuel injectors. 2. Start the engine. Does the test lamp blink on all four fuel injector harness connectors?	—	*Go to* Step 7	*Go to* Step 4
4	Does the test lamp remain illuminated at all times on any of the four fuel injector harness connectors?	—	*Go to* Step 6	*Go to* Step 5
5	Locate and repair an open or short to voltage in the fuel injector control circuit. Was a problem found?	—	Verify Repair	*Go to* Step 8
6	Locate and repair a short to ground in the fuel injector control circuit. Was a problem found?	—	Verify Repair	*Go to* Step 11
7	Locate and repair poor connections at the harness connector of the fuel injector. Was a problem found?	—	Verify Repair	*Go to* Step 10
8	Locate and repair poor connections at the harness connector of the ECM. Was a problem found?	—	Verify Repair	*Go to* Step 11
9	**Important:** The ECM/INJ fuse also supplies voltage to the ignition coils. If the fuse is open, inspect all related circuits for a short to ground. Repair an open or short to ground in the fuel injector ignition voltage circuit. Was a problem found?	—	Verify Repair	—

DTC 81 - Fuel Injector Driver A Circuit High, Low or Open (cont'd) (Scan Diagnostics)

Step	Action	Value	Yes	No
10	Replace the fuel injector. Is action complete?	—	Verify Repair	—
11	Replace the ECM. Is action complete?	—	Verify Repair	—

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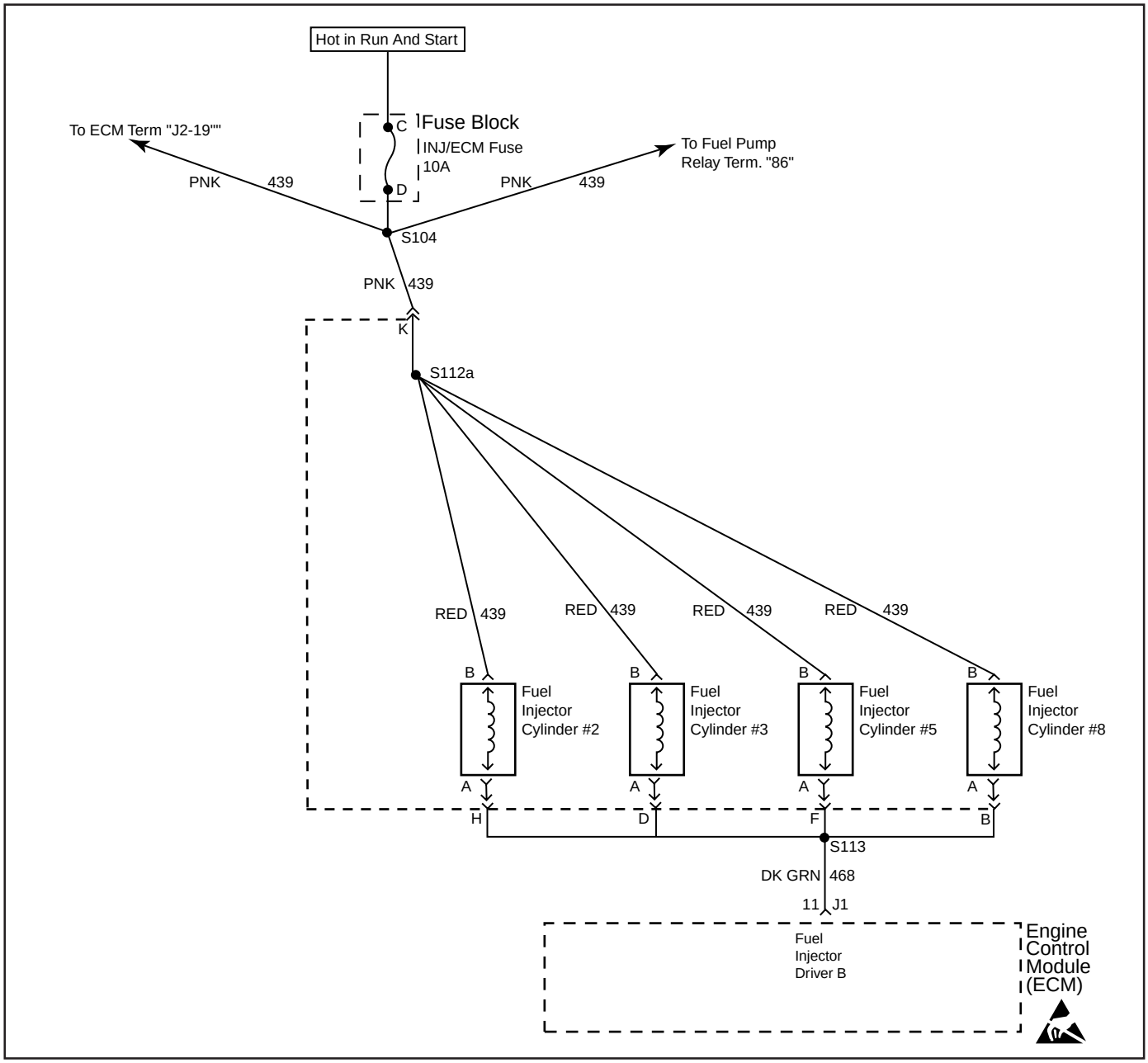

DTC 81 - Fuel Injector Driver B Circuit High, Low or Open (Scan Diagnostics)

Circuit Description

The Engine Control Module (ECM) enables the fuel injector drivers. An ignition voltage is supplied to the fuel injectors. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a driver. The ECM monitors the status of each driver. If the ECM detects an incorrect voltage for the commanded state of the driver, a fuel injector control DTC sets.

Diagnostic Aids

Performing the Fuel Injector Coil test may help isolate an intermittent condition. Refer to *Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Between 10-35 Degrees C (50-95 Degrees F)* or *Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Outside 10-35 Degrees C (50-95 Degrees F).*

If the condition is suspected to be intermittent, refer to *Intermittent Conditions.*

Test Description

4. This step tests for voltage at the fuel injector harness connector. The ECM/INJ fuse supplies power to the coil side of the fuel injector harness connector. If the fuse is open, a short to ground on the fuel injector B+ supply

circuit is indicated. The ECM/INJ fuse also supplies voltage to the ignition coils. If the fuse is open, inspect the circuits to the ignition coils for a short to ground.

5. This test verifies that the ECM is able to control the fuel injector. If the test lamp blinks, then the ECM and wiring are OK.
6. This step tests if a ground is constantly being applied to the fuel injector.

DTC 81 - Fuel Injector Driver B Circuit High, Low or Open (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Disconnect the appropriate harness connectors of the four fuel injectors. 2. Turn ON the ignition, with the engine OFF. 3. Using a test lamp connected to a know good ground, probe the ignition voltage circuits of each fuel injector on the harness connector. Does the test lamp illuminate on all four circuits?	—	*Go to* Step 3	*Go to* Step 8
3	1. Connect the fuel injector test lamp J 34730-2C between the control circuit and the ignition voltage circuit of the fuel injector harness connector. Repeat for all four fuel injectors. 2. Start the engine. Does the test lamp blink on all four fuel injector harness connectors?	—	*Go to* Step 7	*Go to* Step 4
4	Does the test lamp remain illuminated at all times on any of the four fuel injector harness connectors?	—	*Go to* Step 6	*Go to* Step 5
5	Locate and repair an open or short to voltage in the fuel injector control circuit. Was a problem found?	—	Verify Repair	*Go to* Step 8
6	Locate and repair a short to ground in the fuel injector control circuit. Was a problem found?	—	Verify Repair	*Go to* Step 11
7	Locate and repair poor connections at the harness connector of the fuel injector. Was a problem found?	—	Verify Repair	*Go to* Step 10
8	Locate and repair poor connections at the harness connector of the ECM. Was a problem found?	—	Verify Repair	*Go to* Step 11
9	**Important:** The ECM/INJ fuse also supplies voltage to the ignition coils. If the fuse is open, inspect all related circuits for a short to ground. Repair an open or short to ground in the fuel injector ignition voltage circuit. Was a problem found?	—	Verify Repair	—

DTC 81 - Fuel Injector Driver B Circuit High, Low or Open (cont'd) (Scan Diagnostics)

Step	Action	Value	Yes	No
10	Replace the fuel injector. Is action complete?	—	Verify Repair	—
11	Replace the ECM. Is action complete?	—	Verify Repair	—

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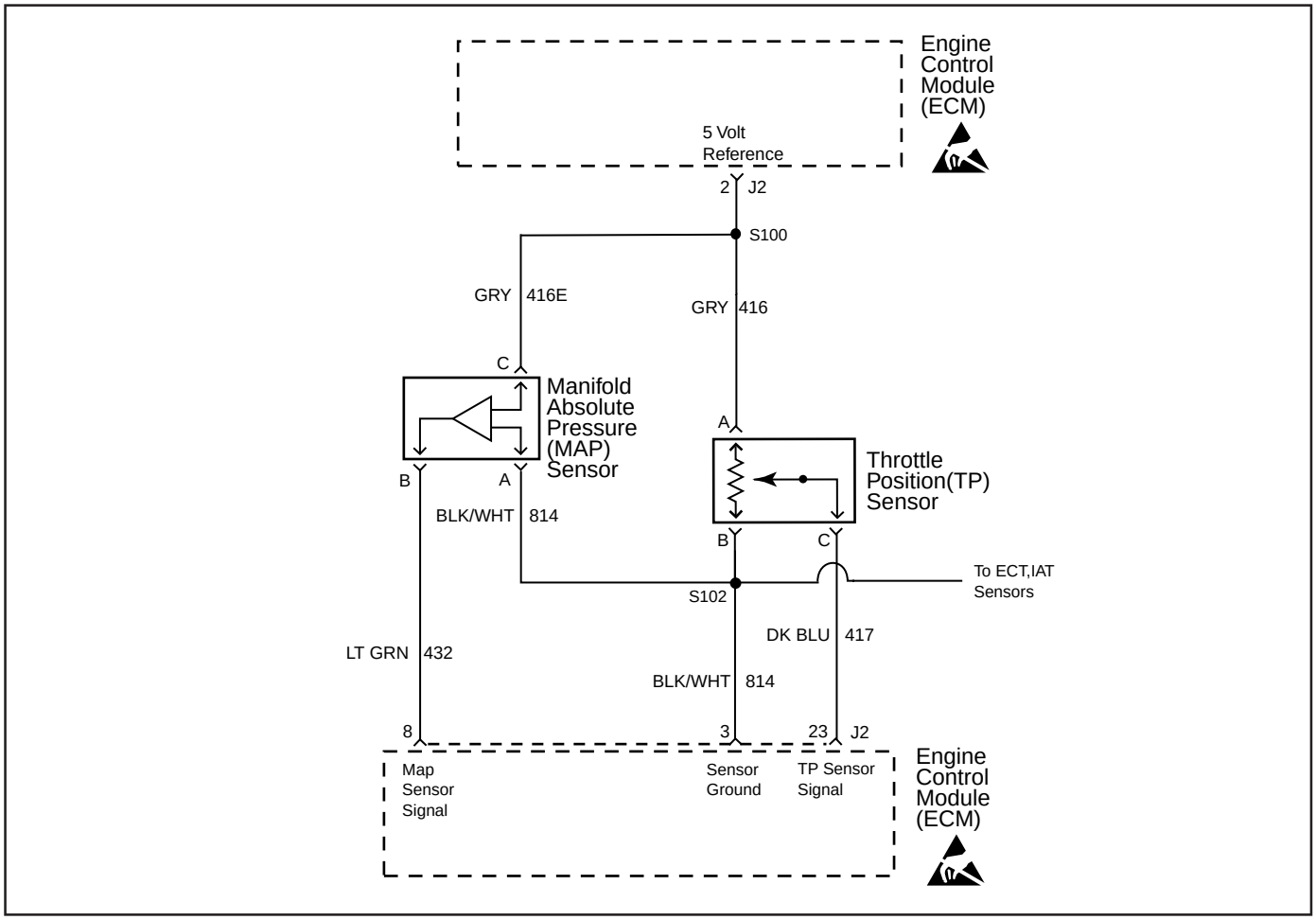

DTC 81 - 5 Volt Reference Circuit Out of Range (Scan Diagnostics)

Circuit Description

The Engine Control Module (ECM) uses a common 5 volt reference circuit as a sensor feed. This circuit supplies 5 volts to the Manifold Absolute Pressure (MAP) sensor and the Throttle Position (TP) sensor. The ECM monitors the voltage on the 5 volt reference circuit. This DTC sets if the voltage is out of range.

Diagnostic Aids

If the condition is suspected to be intermittent, refer to *Intermittent Conditions.*

Test Description

3. The 5 volt reference circuit may be shorted to another ECM circuit. The shorted circuit may not be apparent when the ECM harness connector is disconnected.

DTC 81 - 5 Volt Reference Circuit Out of Range (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	1. Disconnect the ECM harness connector J2. 2. Turn ON the ignition, with the engine OFF. 3. Using a DMM connected to a known good ground, probe the other lead of the DMM to the 5 volt reference circuit (J2-2) at the ECM harness connector. Does the circuit measure more than the specified value?	5.1 V	*Go to* Step 6	*Go to* Step 3
3	Before proceeding, remove the following fuses: • ECM/BAT • INJ/ECM • MEFI System Relay 1. Disconnect the MAP sensor and the TP sensor harness connectors. 2. Using a DMM, test the continuity from the 5 volt reference circuit to all other ECM circuits at the ECM J2 harness connector. Do any of the circuits indicate a resistance within the specified range?	0-2 ohms	*Go to* Step 7	*Go to* Step 9
4	1. Turn OFF the ignition. 2. Disconnect the ECM connector J2. 3. Using a test lamp connected to B+, probe 5 volt reference circuit (J2-2) at the ECM harness connector. Does the test lamp illuminate?	—	*Go to* Step 8	*Go to* Step 5
5	Using a DMM, test the continuity from the 5 volt reference circuit to all other ECM circuits at the ECM J2 harness connector. Do any of the circuits indicate a resistance within the specified range?	0-2 ohms	*Go to* Step 7	*Go to* Step 9
6	Locate and repair a short to voltage on the 5 volt reference circuit. Is action complete?	—	Verify Repair	—
7	Locate and repair short between the 5 volt reference circuit and the ECM circuit that had continuity. Is action complete?	—	Verify Repair	—
8	Locate and repair short to ground on the 5 volt reference circuit. Is action complete?	—	Verify Repair	—
9	Replace the ECM. Is action complete?	—	Verify Repair	—