

2002 ENGINE PERFORMANCE

Self-Diagnostics - Sedona

INTRODUCTION

Most engine control problems result from mechanical failures, poor electrical connections or damaged vacuum hoses. Before condemning the computer system, perform checks and inspections covered in **BASIC DIAGNOSTIC PROCEDURES** article. Failure to do so may result in lost diagnostic time.

If no faults were found while performing BASIC DIAGNOSTIC PROCEDURES, proceed with self-diagnostics. If no fault codes are present after entering self-diagnostics, proceed to **TROUBLE SHOOTING - NO CODES** article for diagnosis by symptom (i.e., ROUGH IDLE, NO START, etc.).

SELF-DIAGNOSTIC SYSTEM

ON BOARD DIAGNOSTICS-II

The purpose of Engine Control Module (ECM) OBD-II software is to ensure proper emission system operation for the life of vehicle. OBD-II monitors emissions related components and systems for deterioration and failure. For emission system related failures, ECM will store a Diagnostic Trouble Code (DTC) and command Malfunction Indicator Light (MIL) to illuminate. See **MALFUNCTION INDICATOR LIGHT** . DTCs can be accessed with Hi-Scan Pro/Kia Data Pro Scan Tool (0K2A1 189 AA0/K96 DP KIT) or equivalent, connected to OBD-II Data Link Connector (OBD-II DLC).

OBD-II software includes advanced diagnostic test modes and allows detection of faults that do NOT illuminate the MIL. Test mode 7 allows verification of repair after one drive cycle. Test mode 7 does not require duplicating particular vehicle operating conditions that existed during original failure. Test mode 22 accesses PIDs (displays component input and output values). Advanced diagnostic test modes can be accessed with Hi-Scan Pro/Kia Data Pro Scan Tool.

MALFUNCTION INDICATOR LIGHT

NOTE: **Loose fuel cap will cause MIL to illuminate.**

The Electronic Control Module (ECM) is equipped with a self-diagnostic system, which detects system failures or abnormalities. When a malfunction that may affect vehicle emissions is detected during 2 sequential drive cycles, the ECM will illuminate the Malfunction Indicator Light (MIL) on the instrument panel. See **Fig. 1** . A corresponding Diagnostic Trouble Code (DTC) will be stored in ECM. If a misfire is detected, MIL will illuminate and DTC will be stored in ECM immediately after fault is detected. If misfire is severe enough to cause catalytic converter damaged, MIL will blink. MIL will continuously blink until danger to catalytic converter has passed. To retrieve stored DTC(s). See **RETRIEVING DIAGNOSTIC TROUBLE CODES** .

DTC will be erased from ECM memory. If battery is disconnected, all DTCs and freeze frame data will be erased from ECM. As a bulb check, Malfunction Indicator Light (MIL) will also illuminate for about 5 seconds when ignition is turned on.

DTCs will be recorded at various operating times and conditions. Some DTCs require operation of sensor or switch for 5 seconds, while other components require operation for 5 minutes or longer at normal operating temperature, vehicle speed, and load. Therefore, when verifying repair, some DTCs may not set in a service bay and may require road testing to duplicate the conditions under which the code will set.

SERVICE PRECAUTIONS

Before proceeding with diagnosis, following precautions must be observed:

- Ensure vehicle has a fully charged battery and functional charging system.
- Visually inspect connectors and circuit wiring being worked on.
- DO NOT disconnect battery or Engine Control Module (ECM) unless instructed to do so. Doing so will erase any fault codes and freeze frame data stored in ECM. Turn ignition off before disconnecting battery or damage to ECM may result.
- DO NOT cause short circuits when performing electrical tests. DO NOT disconnect sensors with ignition on. Either procedure will set additional fault codes, making diagnosis of original problem more difficult.
- DO NOT use a test light in place of a voltmeter.
- When checking for spark, DO NOT hold coil wire more than 1/4" from ground. Damage to vehicle electronics and/or ECM may result.
- DO NOT prolong testing of fuel injectors. Engine may hydrostatically (liquid) lock.
- The control harness between ECM and Heated Oxygen Sensor (HO2S) has a shield grounded to chassis to prevent electromagnetic interference. If shield is damaged, the control harness must be replaced.

DIAGNOSTIC PROCEDURES

NOTE: Before performing testing procedures, check for any related Technical Service Bulletins (TSBs).

Diagnosis of computerized engine control system should be performed in the following order:

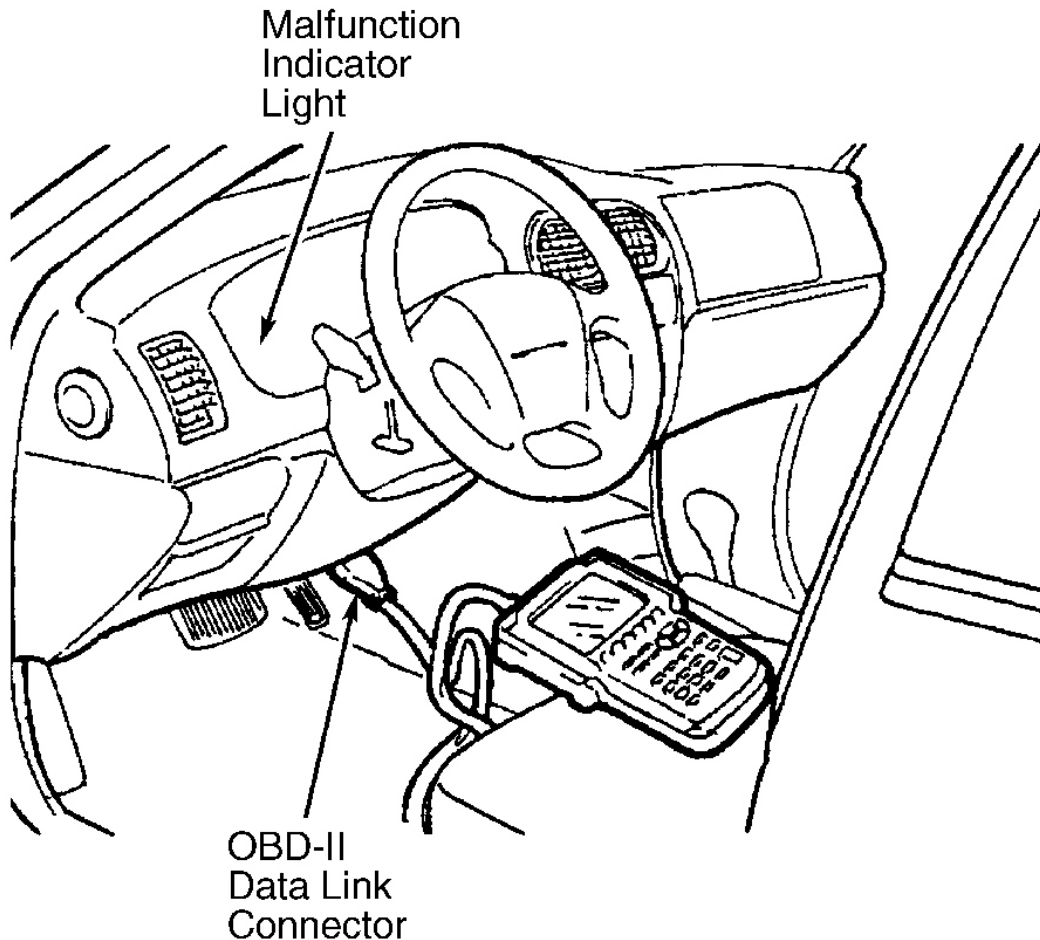
1. Perform visual inspection. Most driveability problems in the engine control system result from faulty wiring, poor electrical connections or leaking air and vacuum hose connections. To avoid unnecessary component testing, perform a visual inspection before beginning self-diagnostic tests.
2. Ensure all mechanical engine systems other than computerized systems (i.e., compression, ignition, etc.) are operating properly. DO NOT proceed with testing unless all other problems have been repaired. If Malfunction Indicator Light (MIL) is on. See **RETRIEVING DIAGNOSTIC TROUBLE CODES** . For diagnosing DTCs, see appropriate DTC test under **DIAGNOSTIC TESTS** .
3. After repairs have been completed, clear DTC(s). See **CLEARING DIAGNOSTIC TROUBLE CODES** . Recheck system and verify repair is complete.

RETRIEVING DIAGNOSTIC TROUBLE CODES

NOTE: To enter self-diagnostics, turn ignition off, connect Hi-Scan Pro./Kia Data Pro. Scan Tool (0K2A1 189 AA0/K96 DP KIT), or equivalent, to OBD-II Data Link

Connector (OBD-II DLC). For specific scan tool operating procedures, see the scan tool manufacturer's instruction manual.

1. Before entering on-board diagnostics. See **SERVICE PRECAUTIONS** . Turn ignition off. Locate and Identify Data Link Connector (OBD-II DLC) under left side of instrument panel. See **Fig. 1** and **Fig. 2** . Connect scan tool to OBD-II DLC connector.
2. Start engine and retrieve Diagnostic Trouble Codes (DTCs). Read and record scan tool self-diagnostic output (stored codes). See **DIAGNOSTIC TROUBLE CODE IDENTIFICATION** table. To perform testing for retrieved codes, see appropriate DTC test under **DIAGNOSTIC TESTS** .



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Fig. 1: Locating MIL & OBD II Data Link Connector (OBD-II DLC)
Courtesy of KIA MOTORS AMERICA, INC.

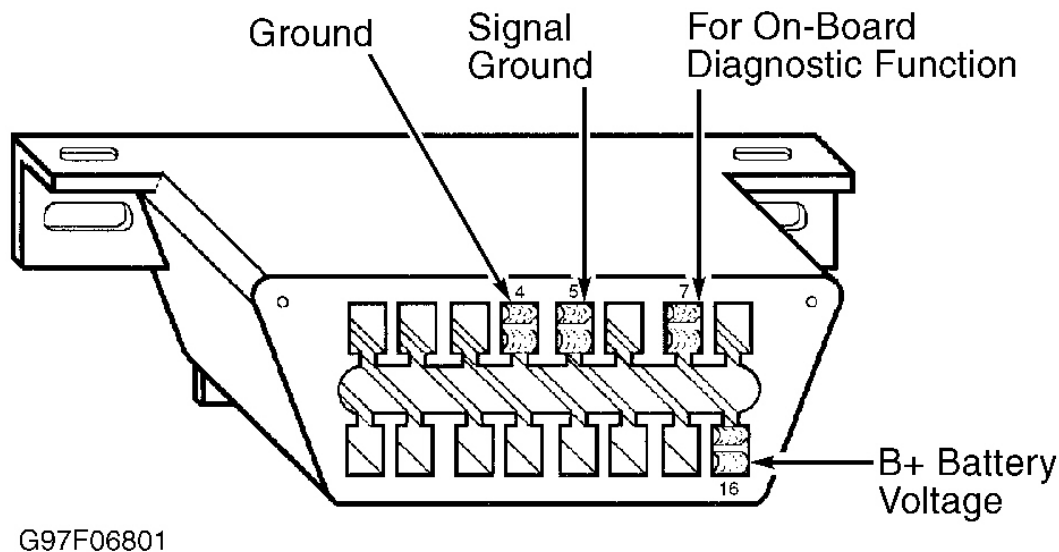


Fig. 2: Identifying OBD II Data Link Connector (OBD-II DLC)
 Courtesy of KIA MOTORS AMERICA, INC.

FREEZE FRAME DATA

Engine operating conditions are required to be captured and stored in Engine Control Module (ECM) memory whenever a malfunction is detected. Data captured in this manner is called FREEZE FRAME data. Freeze frame data is similar to a single record of operating conditions. Whenever a malfunction is detected, corresponding record of operating conditions is recorded in the freeze frame buffer.

Freeze frame data can only be overwritten with data associated with a misfire or fuel trim malfunction. Misfire data takes priority over all other data because of its possible part-damaging (oxygen sensors, catalytic converters, etc.) effects. Freeze frame data will not be erased unless associated DTC is cleared from ECM memory.

CLEARING DIAGNOSTIC TROUBLE CODES

CAUTION: Record diagnostic trouble codes and freeze frame data before erasing DTCs, or freeze frame data will be lost.

DTCs may be cleared by using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent or disconnecting negative battery cable. Clearing DTCs will also clear freeze frame data. Turn ignition off, disconnecting negative battery cable for at least 20 seconds. Reconnect negative battery cable. Verify DTCs have been erased.

When battery is disconnected, vehicle computer memory system may lose memory data. Driveability problems may exist. After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability.

Inform your customer that they may experience driveability different from what they are accustomed to until ECM completes relearn function.

DIAGNOSTIC TROUBLE CODE IDENTIFICATION

DIAGNOSTIC TROUBLE CODE IDENTIFICATION

DTC	Description
P0101	Mass Or Volume Airflow Circuit Range/Performance Malfunction
P0102	Mass Or Volume Airflow Circuit Low Input
P0103	Mass Or Volume Airflow Circuit High Input
P0106	Manifold Absolute Pressure Sensor Circuit Malfunction
P0107	Manifold Absolute Pressure Sensor Low Input
P0108	Manifold Absolute Pressure Sensor High Input
P0112	Intake Air Temperature Circuit Low Input
P0113	Intake Air Temperature Circuit High Input
P0115	Engine Coolant Temperature Circuit Malfunction
P0116	Engine Coolant Temperature Circuit Range/Performance Malfunction
P0121	Throttle Position Sensor Circuit Range/Performance Malfunction
P0122	Throttle Position Sensor Circuit Low Input
P0123	Throttle Position Sensor Circuit High Input
P0125	Insufficient Coolant Temperature For Closed Loop Fuel Control
P0128	Engine Coolant Thermostat Stuck Open
P0132	Right Front Heated Oxygen Sensor Circuit Open
P0133	Right Front Heated Oxygen Sensor Circuit Slow Response
P0134	Right Front Heated Oxygen Sensor Circuit No Activity Detected
P0135	Right Front Heated Oxygen Sensor Heater Circuit Malfunction
P0136	Right Rear Heated Oxygen Sensor Circuit Open
P0139	Right Rear Heated Oxygen Sensor Circuit Slow Response
P0140	Right Rear Heated Oxygen Sensor Circuit Short
P0141	Right Rear Heated Oxygen Sensor Heater Circuit Malfunction
P0150	Left Front Heated Oxygen Sensor Circuit Slow Response
P0152	Left Front Heated Oxygen Sensor Circuit Open
P0154	Left Front Heated Oxygen Sensor Circuit No Activity Detected
P0155	Left Front Heated Oxygen Sensor Heater Circuit Malfunction
P0156	Left Rear Heated Oxygen Sensor Circuit Open
P0159	Left Rear Heated Oxygen Sensor Circuit Slow Response
P0160	Left Rear Heated Oxygen Sensor Circuit Short
P0161	Left Rear Heated Oxygen Sensor Heater Circuit Malfunction
P0171	Fuel System Too Lean (Bank 1)
P0172	Fuel System Too Rich (Bank 1)
P0174	Fuel System Too Lean (Bank 2)

<u>P0175</u>	Fuel System Too Rich (Bank 2)
<u>P0180</u>	Fuel Temperature Sensor Circuit Malfunction
<u>P0201</u>	Fuel Injector No. 1 Circuit Malfunction
<u>P0202</u>	Fuel Injector No. 2 Circuit Malfunction
<u>P0203</u>	Fuel Injector No. 3 Circuit Malfunction
<u>P0204</u>	Fuel Injector No. 4 Circuit Malfunction
<u>P0205</u>	Fuel Injector No. 5 Circuit Malfunction
<u>P0206</u>	Fuel Injector No. 6 Circuit Malfunction
<u>P0300</u>	Random Misfire Detected
<u>P0301</u>	Cylinder No. 1 Misfire Detected
<u>P0302</u>	Cylinder No. 2 Misfire Detected
<u>P0303</u>	Cylinder No. 3 Misfire Detected
<u>P0304</u>	Cylinder No. 4 Misfire Detected
<u>P0305</u>	Cylinder No. 5 Misfire Detected
<u>P0306</u>	Cylinder No. 6 Misfire Detected
<u>P0320</u>	Ignition Failure System Circuit Malfunction
<u>P0325</u>	Knock Sensor Circuit Malfunction
<u>P0335</u>	Crankshaft Position Sensor Circuit Malfunction
<u>P0340</u>	Camshaft Position Sensor Circuit Malfunction
<u>P0350</u>	Ignition Coil Primary/Secondary Circuit Malfunction
<u>P0421</u>	Main Catalyst Efficiency Deterioration (Bank 1)
<u>P0431</u>	Main Catalyst Efficiency Deterioration (Bank 2)
<u>P0441</u>	EVAP Emission Control System Purge Control Solenoid Valve Stuck Open
<u>P0442</u>	EVAP Emission Control System Small Leak Detected (1 mm)
<u>P0443</u>	EVAP Emission Control System Purge Control Solenoid Valve Circuit Malfunction
<u>P0446</u>	EVAP Emission Control System Vent Control Malfunction
<u>P0451</u>	EVAP Emission Control System Pressure Sensor Range/Malfunction
<u>P0452</u>	EVAP Emission Control System Pressure Sensor Low Input
<u>P0453</u>	EVAP Emission Control System Pressure Sensor High Input
<u>P0455</u>	EVAP Emission Control System Large Leak Detected
<u>P0456</u>	EVAP Emission Control System Small Leak Detected (0.5 mm)
<u>P0460</u>	Fuel Level Sensor Circuit Range/Performance Malfunction
<u>P0462</u>	Fuel Level Sensor Circuit Low Input
<u>P0463</u>	Fuel Level Sensor Circuit High Input
<u>P0506</u>	Idle Control System RPM Lower Than Expected
<u>P0507</u>	Idle Control System RPM Higher Than Expected
<u>P0510</u>	Idle Switch Circuit Malfunction
<u>P0560</u>	Battery Backup Line Open
<u>P1330</u>	Spark Timing Adjustment
<u>P1521</u>	Power Steering Switch Malfunction

AFTER-REPAIR PROCEDURE

After repair, clear DTC(s). See **CLEARING DIAGNOSTIC TROUBLE CODES** . Verify repairs by driving vehicle with scan tool connected to OBD-II DLC and monitoring for pending codes.

READINESS DRIVE CYCLE

Connect Hi-Scan Pro/Kia Data Pro scan tool to OBD-II connector. Perform Readiness Drive Cycle when directed to from diagnostic tests. Readiness drive cycle provides conditions for EVAP monitor to run, so that repairs for EVAP DTC(s) may be verified.

ECM LOCATION & ECM CONNECTORS IDENTIFICATION

NOTE: Engine Control Module (ECM), can also be referred to as Powertrain Control Module (PCM).

Engine Control Module (ECM) is located forward of center console, under dash. See **Fig. 3** and **Fig. 4** .

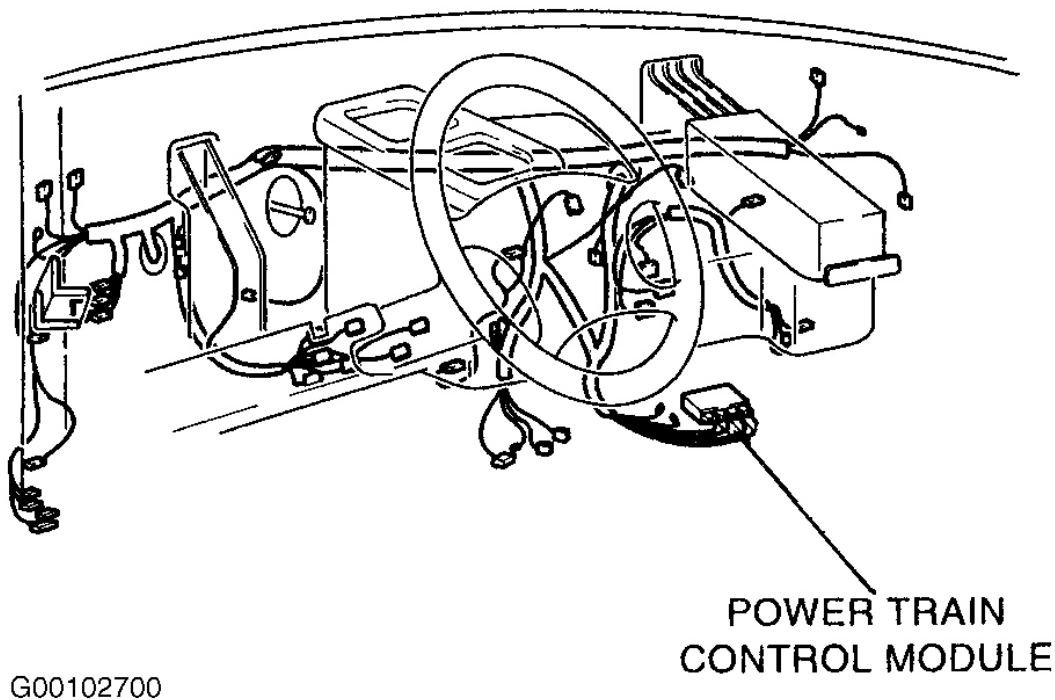
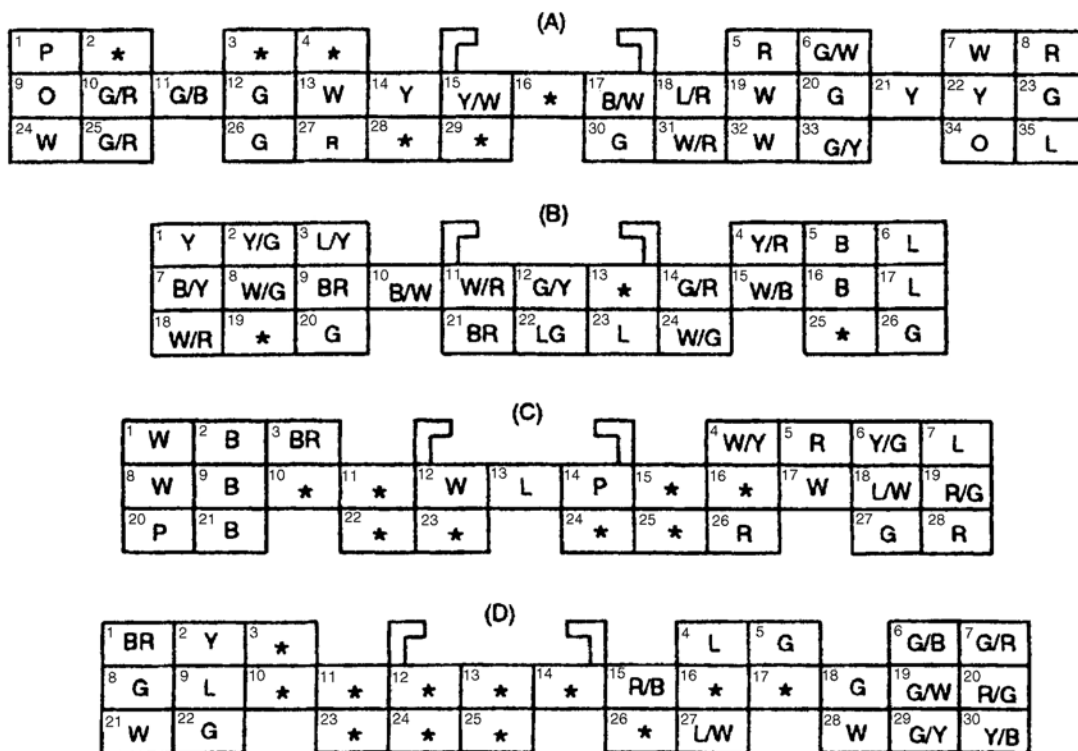


Fig. 3: Locating Engine Control Module
Courtesy of KIA MOTORS AMERICA, INC.



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Fig. 4: Identifying Engine Control Module Connector & Terminals

Courtesy of KIA MOTORS AMERICA, INC.

DIAGNOSTIC TESTS

WARNING: While ignition is on, DO NOT not connect or disconnect battery, or any other electrical connector. Component damage may result.

CAUTION: When battery is disconnected, vehicle computer memory system may lose memory data. Driveability problems may exist. After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that they may experience driveability different from what they are accustomed to until ECM completes relearn function.

CAUTION: DO NOT spray carburetor cleaner on or near coils or plug wires. Allow enough time between checking areas for leaks for carburetor spray to dissipate.

NOTE: Before performing any diagnostic test, refer to SELF-DIAGNOSTIC SYSTEM for system functions and system diagnostic procedures.

- NOTE:** If more than one DTC is stored at ECM memory, always perform diagnosis from first DTC stored at ECM memory, unless stated otherwise in test procedure.
- NOTE:** If component testing procedure is not covered in this article, see appropriate test in SYSTEM & COMPONENT TESTING article.
- NOTE:** For identification of circuits, terminals and wire colors referenced in the testing procedure, see WIRING DIAGRAMS article.
- NOTE:** After any repair has been made. See AFTER-REPAIR PROCEDURE under SELF-DIAGNOSTIC SYSTEM.
For component removal and installation. See REMOVAL, OVERHAUL & INSTALLATION article.
- NOTE:** In some instances, a short to ground or a short to power may cause damage to control modules. Do not replace control modules until testing proves these conditions do not exist. Also verify that ground circuits have good continuity to ground.

DTC P0101: MASS OR VOLUME AIR FLOW CIRCUIT RANGE/PERFORMANCE MALFUNCTION, DTC P0102: MASS OR VOLUME AIR FLOW CIRCUIT LOW INPUT & DTC P0103: MASS OR VOLUME AIR FLOW CIRCUIT HIGH INPUT

- NOTE:** Intake Air Temperature (IAT) sensor is built into Mass Air Flow (MAF) sensor and they share same harness connector.
- NOTE:** Before performing any diagnostic test, refer to WARNINGS, CAUTIONS and NOTES under DIAGNOSTIC TESTS .
- NOTE:** Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Engine Control Module (ECM) continuously monitors MAF sensor output. ECM will set code sensor output voltage has continued to be 4.5 volts or higher for 4 seconds. Check for following possible problems:

- Open between MAF sensor and Main relay.
- Open or short between MAF sensor and ECM.
- Dirty air cleaner.
- Air leak in intake system.

- Contaminated, deteriorated or damaged MAF sensor.
- Poor connection at ECM, MAF sensor or TP sensor.
- Faulty MAF sensor or TP sensor.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If DTCs P0121, P0122 or P0123 are set, do all repairs associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.
2. Start engine. Allow engine to idle until reaches normal operating temperature. Using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent, monitor MAF sensor voltage signals. Voltage should be 1.4-1.6 volts at idle. If voltage is as specified. Problem is intermittent, check MAF sensor and ECM for proper harness connections and go to step 11 . If voltage is not as specified, go to next step.
3. Turn ignition off. Thoroughly check MAF sensor. Also check for loose, bent or corroded MAF sensor or ECM connector terminals. If sensor and connectors terminals are okay, go to next step. If sensor and connector terminals are faulty, repair or replace as necessary and go to step 11 .
4. Start engine. Allow engine to idle until reaches normal operating temperature. Using Hi-Scan Pro/Kia Data Pro Scan tool, monitor TP sensor voltage signal. See **THROTTLE POSITION SENSOR OUTPUT VOLTAGE SPECIFICATION** table. If voltages are as specified, go to next step. If any voltage is not as specified, do all DTCs test procedures associated with TP sensor. See **DTC P0121: THROTTLE POSITION SENSOR CIRCUIT RANGE/PERFORMANCE MALFUNCTION, DTC P0122: THROTTLE POSITION SENSOR CIRCUIT LOW INPUT & DTC P0123: THROTTLE POSITION SENSOR CIRCUIT HIGH INPUT** . After repair, go to step 11 .

THROTTLE POSITION SENSOR OUTPUT VOLTAGE SPECIFICATION

Engine Speed - RPM	TP Sensor Output - Voltage
Idle	0.3-0.9
Throttle Fully Open	4.0-4.6

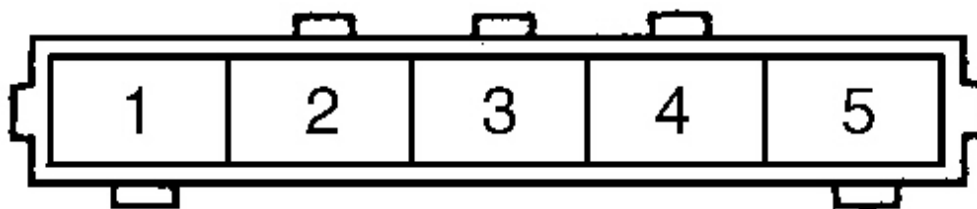
5. Stop engine and turn ignition on. Using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Monitor TP sensor voltage signal. Voltage signal should increase evenly while opening throttle. If voltage is as specified, go to next step. If voltage is not as specified, temporarily install a known-good TP sensor and check for proper operation. If problem is corrected, replace TP sensor and go to step 11 .
6. Turn ignition off. Disconnect MAF sensor 5-pin harness connector. See **Fig. 5** . Turn ignition on. Measure voltage between ground and IAT sensor connector terminal No. 4 (Yellow wire). Voltage should be approximately 5.0 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair open or short circuit as necessary and go to step 11 .
7. Turn ignition off. Disconnect ECM harness connector "B". See **Fig. 4** . Measure resistance between MAF sensor connector terminal No. 3 (Black/Yellow wire) and ECM connector terminal B7. Also measure resistance between MAF sensor connector terminal No. 5 (Brown wire) and ECM connector terminal B1. Both resistances should be below one ohm. If resistances are as specified, go to next step. If any resistance is not as specified, repair open circuit as necessary and go to step 11 .
8. With MAF sensor and ECM harness connectors disconnected. Turn ignition on. Measure voltage between

ground and MAF sensor connector terminal No. 5 (Brown wire). Voltage should be below 0.5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair short circuit as necessary and go to step 11 .

9. Turn ignition off. With MAF sensor and ECM harness connectors disconnected. Measure resistance between ground and MAF sensor connector terminal No. 5 (Brown wire). Resistance should be infinite. If resistance is as specified, go to next step. If resistance is not as specified, repair short circuit as necessary and go to step 11 .
10. Check entire air intake system for blockage, leaks or damage such as:
 - Air cleaner.
 - Throttle body.
 - Positive Crankcase Ventilation (PCV) valve.
 - Intake manifold.
 - Gasket between intake manifold and surge tank.
 - Seals between intake manifold and fuel injectors.
 - Seals between surge tank and PCV valve.

If blockage, leaks or damage are found, repair or replace as necessary and go to next step. If air intake system is okay, temporarily install a known-good MAF sensor and check for proper operation. If problem is corrected, replace MAF sensor and go to next step.

11. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



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Fig. 5: Identifying Mass Air Flow Sensor Connector Terminals
Courtesy of KIA MOTORS AMERICA, INC.

MANIFOLD ABSOLUTE PRESSURE SENSOR LOW INPUT & DTC P0108: MANIFOLD ABSOLUTE PRESSURE SENSOR HIGH INPUT

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Malfunction code will set when Manifold Absolute Pressure (MAP) sensor output voltage has been 4.6 volts or less (corresponding to an absolute pressure of 17 psi [118 kPa] or less) for 4 seconds. Check for following possible problems:

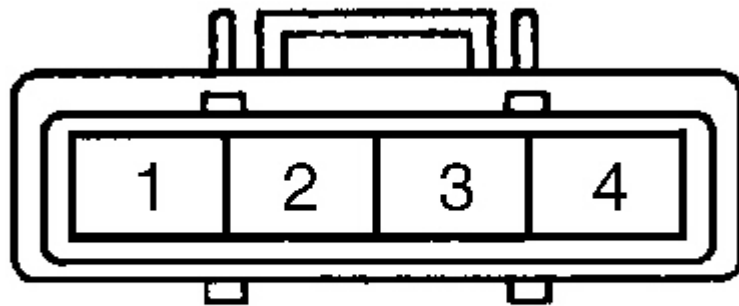
- Open or short between Manifold Absolute Pressure (MAP) sensor and Engine Control Module (ECM).
- Open between MAP sensor and ground.
- Poor connection between MAP sensor and ECM.
- Misplaced, loose or corroded connector terminals.
- Faulty MAP sensor.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for MAP sensor output voltage. Voltage should be 0.8-2.4 volts. If voltage is not as specified, go to next step. If voltage is as specified, problem is intermittent, check for proper connection at MAP sensor and ECM connectors, and go to step 7 .
2. Turn ignition off. Disconnect MAP sensor 4-pin harness connector. See **Fig. 6** . Turn ignition on. Measure voltage between ground and MAP sensor connector terminal No. 3 (Yellow wire). Voltage should be approximately 5.0 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair open or short circuit as necessary and go to step 7 .
3. Turn ignition off. Thoroughly check MAP sensor for damage. Also check for loose, bent or corroded MAP sensor or ECM connector terminals. If sensor and connector terminals are okay, go to next step. If sensor and connector terminals are faulty, repair or replace as necessary and go to step 7 .
4. Turn ignition off. Disconnect ECM harness connectors "B" and "C". See **Fig. 4** . Thoroughly check for loose, bent or corroded terminals. Measure resistance between MAP sensor connector terminal No.1 (Black/Yellow wire) and ECM connector terminal B7. Also measure resistance between MAP sensor connector terminal No. 4 (Green wire) and ECM connector terminal C27. Resistances should be below one ohm. If resistances are as specified, go to next step. If any resistance is not as specified, repair open circuit as necessary and go to step 7 .
5. With ECM and MAP sensor harness connector disconnected. Turn ignition on. Measure voltage between ground and MAP sensor harness connector terminal No. 4 (Green wire). Voltage should be below 0.5

volts. If voltage is as specified, go to next step. If voltage is not as specified, repair short circuit as necessary and go to step 7 .

6. Turn ignition off. With ECM and MAP sensor harness connectors disconnected. Measure resistance between ground and MAP sensor harness connector terminal No. 4 (Green wire). Resistance should be infinity. If resistances are as specified, temporarily install a known-good MAP sensor and check for proper operation. If problem is corrected, replace MAP sensor and go to next step. If any resistance is not as specified, repair short circuit as necessary and go to next step.
7. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



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Fig. 6: Identifying Manifold Absolute Pressure Sensor Connector Terminals

Courtesy of KIA MOTORS AMERICA, INC.

DTC P0112: INTAKE AIR TEMPERATURE SENSOR CIRCUIT LOW INPUT & P0113: INTAKE AIR TEMPERATURE SENSOR CIRCUIT HIGH INPUT

NOTE: Intake Air Temperature (IAT) sensor is built into Mass Air Flow (MAF) sensor and they share same harness connector.

NOTE: Before performing any diagnostic test, refer to WARNINGS, CAUTIONS and NOTES under DIAGNOSTIC TESTS .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Malfunction code will set if at least 60 seconds have passed since engine started, engine is idling and IAT sensor temperature input to Engine Control Module (ECM) is less than -49°F (-45°C) or more than 257°F (125° C). Conditions are continuously monitored. Check for following possible problems:

- Open or short between IAT sensor and ECM.
- Short between IAT sensor wires.
- Faulty IAT sensor.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If DTCs P0102 or P0103 are set, do all repairs associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.
2. Start engine. Allow engine to idle until reaches normal operating temperature. Using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent, monitor IAT sensor voltage signals. See **INTAKE AIR TEMPERATURE SENSOR OUTPUT VOLTAGE SPECIFICATION** table. If voltages are as specified. Problem is intermittent, check IAT sensor and ECM for proper harness connections and go to step 8 . If any voltage is not as specified, go to next step.

INTAKE AIR TEMPERATURE SENSOR OUTPUT VOLTAGE SPECIFICATION

IAT Sensor Voltage Signal	IAT Sensor Temperature
3.2-3.8 volts	32°F (0°C)
2.3-2.9 volts	68°F (20°C)
1.5-2.1 volts	104°F (40°C)
0.5-0.9 volts	176°F (80°C)

3. Turn ignition off. Disconnect IAT sensor 5-pin harness connector. See **Fig. 5** . Measure voltage between ground and IAT sensor connector terminal No. 2 (Brown wire). Voltage should be battery voltage. If voltage is as specified, go to step 5 . If voltage is not as specified, go to next step.
4. Turn ignition off. Locate fuses and Main relay in engine compartment fuse/relay box. Check Main relay operation and fuses condition. For Main relay operation test, see **FUEL PUMP & MAIN RELAYS (SEDONA)** under RELAYS & SOLENOIDS in SYSTEM & COMPONENT TESTING article. Also if necessary check Main relay circuits. See **WIRING DIAGRAMS** article. If fuses, relay and circuits are okay, go to next step. If fuses, relay or circuits are faulty, repair or replace as necessary, and go to step 8 .
5. Turn ignition off. Disconnect ECM harness connector "B" . See **Fig. 4** . Measure resistance between IAT sensor connector terminal No. 1 (Green wire) and ECM connector terminal B20. Resistance should be below one ohm. If resistance is as specified, go to next step. If resistance is not as specified, repair open circuit as necessary and go to step 8 .
6. With IAT sensor and ECM harness connectors disconnected. Turn ignition on. Measure voltage between ground and IAT sensor connector terminal No. 1 (Green wire). Voltage should be below 0.5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair short circuit as necessary and go to step 8 .

7. Turn ignition off. With IAT sensor and ECM harness connectors disconnected. Measure resistance between ground and IAT sensor connector terminal No. 1 (Green wire). Also measure resistance between IAT sensor connector terminal No. 1 (Green wire) and No. 2 (Brown wire). Both resistances should be infinite. If resistances are as specified, go to next step. If any resistance not as specified, repair short circuit as necessary and go to next step.
8. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

DTC P0115: ENGINE COOLANT TEMPERATURE CIRCUIT MALFUNCTION, DTC P0116: ENGINE COOLANT TEMPERATURE CIRCUIT RANGE/PERFORMANCE MALFUNCTION, DTC P0125: INSUFFICIENT COOLANT TEMPERATURE FOR CLOSED LOOP FUEL CONTROL & DTC P0128: ENGINE COOLANT THERMOSTAT STUCK OPEN

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS and NOTES under DIAGNOSTIC TESTS**.

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Engine Control Module (ECM) will set Malfunction Indicator Light (MIL) when engine coolant temperature at engine start takes longer than a predetermined amount of time. Also after engine start-up, elapsed time before feedback operation is initiated is too long (engine coolant temperature sensor input is insufficient for close loop operation). Check for following possible problems:

- Open or short between Engine Coolant Temperature (ECT) sensor and ECM.
- Short between ECT sensor wires.
- Misplaced, loose or corroded ECT sensor and ECM connectors terminals.
- Poor connections between ECT sensor and ECM.
- Faulty ECT sensor.
- Faulty thermostat.

Test Procedure

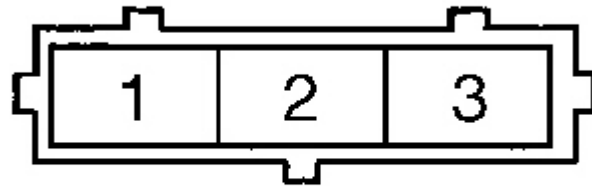
1. Remove thermostat and check if thermostat is stuck. If thermostat is stuck, replace thermostat and go to step 8. If thermostat is okay, return vehicle to original condition and go to next step.
2. Start engine. Allow engine to idle until reaches normal operating temperature. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1**. Monitor ECT sensor voltage signal. See **ENGINE COOLANT TEMPERATURE SENSOR OUTPUT VOLTAGE SPECIFICATION** table. If voltage is as specified. Problem is intermittent, check ECT sensor and ECM

for proper harness connections and go to step 8 . If voltage is not as specified, go to next step.

ENGINE COOLANT TEMPERATURE SENSOR OUTPUT VOLTAGE SPECIFICATION

ECT Sensor Voltage Signal	ECT Sensor Temperature
3.2-3.8 volts	32°F (0°C)
2.3-2.8 volts	68°F (20°C)
1.5-2.1 volts	104°F (40°C)
0.4-0.8 volts	176°F (80°C)

3. Turn ignition off. Thoroughly check ECT sensor for damage. Also check for loose, bent or corroded ECT sensor or ECM connector terminals. If sensor and connector terminals are okay, go to next step. If sensor and connector terminals are faulty, repair or replace as necessary and go to step 8 .
4. Disconnect ECT sensor 3-pin harness connector. See **Fig. 7** . Turn ignition on. Measure voltage between ground and ECT sensor connector terminal No. 1 (Blue/Yellow wire). Voltage should be approximately 5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair open or short circuit as necessary and go to step 8 .
5. Turn ignition off. Disconnect ECM harness connector "B". See **Fig. 4** . Measure resistance between ECT sensor connector terminal No. 1 (Blue/Yellow wire) and ECM connector terminal B3. Also measure resistance between ECT sensor connector terminal No. 3 (Black/Yellow wire) and ECM connector terminal B7. Both resistances should be below one ohm. If resistances are as specified, go to next step. If any resistance is not as specified, repair open or short circuit as necessary and go to step 8 .
6. With ECT sensor and ECM harness connectors disconnected. Turn ignition on. Measure voltage between ground and ECT connector terminal No. 1 (Blue/Yellow wire). Voltage hold be below 0.5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair short circuit as necessary and go to step 8 .
7. Turn ignition off. With ECT sensor and ECM harness connectors disconnected. Measure resistance between ground and ECT sensor connector terminal No. 1 (Blue/Yellow wire). Also Measure resistance between ECT sensor connector terminal No. 1 (Blue/Yellow wire) and No. 3 (Black/Yellow wire). Both resistances should be infinite. If resistances are as specified, temporarily install a known-good ECT sensor and check for proper operation. If problem is corrected, replace ECT sensor and go to next step. If any resistance is not as specified, repair short circuit as necessary and go to next step.
8. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



G00102702

Fig. 7: Identifying Engine Coolant Temperature Sensor Connector Terminals.
Courtesy of KIA MOTORS AMERICA, INC.

**DTC P0121: THROTTLE POSITION SENSOR CIRCUIT RANGE/PERFORMANCE
MALFUNCTION, DTC P0122: THROTTLE POSITION SENSOR CIRCUIT LOW INPUT & DTC
P0123: THROTTLE POSITION SENSOR CIRCUIT HIGH INPUT**

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS**.

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Malfunction code will set if closed throttle switch is set to on and input voltage is more than 2 volts for 4 seconds, or voltage is less than 0.2 volts for 4 seconds. Also malfunction code will set if input voltage is higher than 4.6 volts for 4 seconds. Check for following possible problems:

- Open or short between Throttle Position (TP) sensor and Engine Control Module (ECM).
- Short between TP sensor wires.
- Misplaced, loose or corroded TP sensor terminals.
- Faulty TP sensor.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1**. Turn ignition on. Monitor for other DTCs. If other DTCs are set, do all repairs

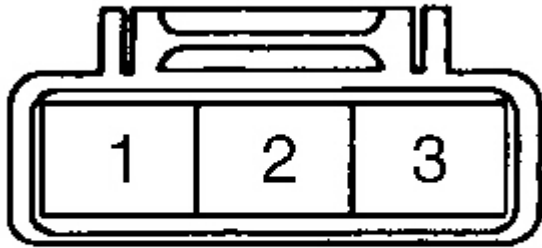
associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.

2. Start engine. Allow engine to idle until reaches normal operating temperature. Using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Monitor TP sensor voltage signal. See **THROTTLE POSITION SENSOR OUTPUT VOLTAGE SPECIFICATIONS** table. If voltages are as specified. Problem is intermittent, check TP sensor and ECM for proper harness connections and go to step 9 . If any voltage is not as specified, go to next step.

THROTTLE POSITION SENSOR OUTPUT VOLTAGE SPECIFICATIONS

Engine Speed - RPM	TPS Output - Voltage
Idle	0.3-0.9
Fully Open	4.0-4.6

3. Stop engine and turn ignition on. Using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Monitor TP sensor voltage signal. Voltage signal should increase evenly while opening throttle. If voltage is as specified, go to next step. If voltage is not as specified, temporarily install a known-good TP sensor and check for proper operation. If problem is corrected, replace TP sensor and go to step 9 .
4. Turn ignition off. Disconnect TP sensor 4-pin harness connector. See **Fig. 8** . Turn ignition on. Measure voltage between ground and TP sensor connector terminal No. 1 (Yellow wire). Voltage should be approximately 5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair open or short circuit as necessary and go to step 9 .
5. Turn ignition off. Disconnect ECM harness connector "B" and "C". See **Fig. 4** . Measure resistance between TP sensor connector terminal No. 2 (Red/Green wire) and ECM connector terminal C19. Also measure resistance between TP sensor connector terminal No. 4 (Black/Yellow wire) and ECM harness connector terminal B7. Both resistances should be below one ohm. If resistances are as specified, go to next step. If any resistance is not as specified, repair open or short circuit as necessary and go to step 9 .
6. With TP sensor and ECM harness connectors disconnected. Turn ignition on. Measure voltage between ground and TP sensor connector terminal No. 2 (Red/Green wire). Voltage should be below 0.5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair short circuit as necessary and go to step 9 .
7. Turn ignition off. With TP sensor and ECM harness connectors disconnected. Measure resistance between ground and TP sensor connector terminal No. 2 (Red/Green wire). Also Measure resistance between TP sensor connector terminal No. 2 (Red/Green wire) and No. 4 (Black/Yellow wire). Both resistances should be infinite. If resistances are as specified, go to next step. If any resistance is not as specified, repair short circuit as necessary and go to step 9 .
8. Thoroughly check TP sensor for damage. Also check for loose, bent or corroded TP sensor or ECM connectors terminals. If sensor and connectors terminals are okay, temporarily install a known-good TP sensor and check for proper operation. If problem is corrected, replace TP sensor and go to next step. If sensor and connectors terminals are faulty, repair or replace as necessary and go to next step.
9. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



G00102703

Fig. 8: Identifying Throttle Position Sensor Connector Terminals
Courtesy of KIA MOTORS AMERICA, INC.

DTC P0132: RIGHT FRONT HEATED OXYGEN SENSOR CIRCUIT OPEN & DTC P0134: RIGHT FRONT HEATED OXYGEN SENSOR CIRCUIT NO ACTIVITY DETECTED

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS**.

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Engine Control Module (ECM). monitors right front HO2S once per trip and will set a code when air-fuel ratio is forcibly changed (lean to rich to lean), right front HO2S signal does not provide response within 1.28 seconds. Check for following possible problems:

- Open or short between right front HO2S and ECM.
- Short between right front HO2S and ECM.
- Short between right front HO2S wires.
- Faulty right front HO2S.
- Poor connection between right front HO2S and ECM.
- Misplaced, bent, loose or corroded right front HO2S or ECM connector terminals.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If DTCs related to any misfire, Purge Control Solenoid Valve (PCSV) or HO2S heater code are set, do all repairs associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.
2. Start engine. Allow engine to idle until reaches normal operating temperature for more than 10 minutes. Using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent, monitor right front HO2S voltage signal waveform. See **Fig. 9** . If HO2S voltage signal switches from lean to rich or rich to lean over 6 times for 10 seconds. Problem is intermittent, check HO2S and ECM for proper harness connections and go to step 8 . If voltage signal waveform is not as specified, go to next step.
3. Turn ignition off. Disconnect right front HO2S 4-pin harness connector. See **Fig. 10** and ECM harness connector "B" and "C". See **Fig. 4** . Measure resistance between HO2S connector terminal No. 1 (Blue/Yellow wire) and ECM connector terminal B7. Also measure resistance between HO2S connector terminal No. 2 (Yellow/Green wire) and ECM connector terminal C6. Both resistances should be below one ohm. If resistances are as specified, go to next step. If any resistance is not as specified, repair open circuit as necessary and go to step 8 .
4. With right front HO2S and ECM harness connectors disconnected. Turn ignition on. Measure voltage between ground and HO2S connector terminal No. 2 (Yellow/Green wire). Voltage should be below 0.5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair short circuit as necessary and go to step 8 .
5. Turn ignition off. With right front HO2S harness connector and ECM harness connectors disconnected. Measure resistance between ground and HO2S connector terminal No. 2 (Yellow/Green wire). Also measure resistance between HO2S connector terminals No. 1 (Blue/Yellow wire) and No. 2 (Yellow/Green wire). Both resistances should be infinite. If resistances are as specified, go to next step. If any resistance is not as specified, repair short circuit as necessary and go to step 8 .
6. Remove right front HO2S from vehicle, check HO2S for contamination, deterioration or damage. If HO2S is contaminated, deteriorated or damaged, temporarily install a known-good HO2S and check for proper operation. If problem is corrected, replace HO2S sensor and go to step 8 . If HO2S seems okay, go to next step.
7. Return vehicle to original condition. Start engine. Thoroughly check exhaust system for leaks (specially between Warm-up Catalytic Converter and front exhaust pipe). If exhaust leak is found, repair as necessary and go to next step. If exhaust leak is not found, temporarily install a known-good HO2S and check for proper operation. If problem is corrected, replace HO2S sensor and go to next step.
8. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

DTC P0133: RIGHT FRONT HEATED OXYGEN SENSOR CIRCUIT SLOW RESPONSE

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS and NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use

ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Engine Control Module (ECM). monitors right front Heated Oxygen Sensor (HO2S) once per trip and will set a code when air-fuel ratio is forcibly changed (lean to rich to lean), right front HO2S signal does not provide response within 1.28 seconds. Check for following possible problems:

- Abnormal combustion.
- Improper fuel pressure.
- Right front and right rear HO2S connections reversed.
- Fault in fuel delivery system.
- Leak in intake system.
- Leak in exhaust system.
- Faulty right front HO2S.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If DTCs related to any misfire, Purge Control Solenoid Valve (PCSV), Mass Air Flow (MAF) sensor or HO2S heater code are set, do all repairs associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.
2. Start engine. Allow engine to idle. Thoroughly check exhaust system for leaks (specially between Warm-up Catalytic Converter and front exhaust pipe). Also check intake system for vacuum leaks. If no exhaust or vacuum leak is found, go to next step. If exhaust or vacuum leak is found, repair as necessary and go to step 6 .
3. Turn ignition off. Release fuel pressure from fuel system. Install fuel pressure gauge at fuel rail. For proper fuel pressure test, see **FUEL PRESSURE (SEDONA)** under FUEL SYSTEM - DELIVERY in SYSTEM & COMPONENT TESTING article. Fuel pressure should be 46-49 psi (320-340 kPa) at idle. If fuel pressure is as specified, temporarily install a known-good HO2S and check for proper operation. If problem is corrected, replace HO2S and go to step 6 . If fuel pressure is too high: go to next step. If fuel pressure is too low: go to step 5 .
4. Turn ignition off. Release fuel pressure from fuel system. Disconnect fuel return line hose from fuel rail and blow through line towards fuel tank. If fuel return line is restricted, repair or replace as necessary and go to step 6 . If return fuel line is okay, replace fuel pressure regulator and go to step 6 .
5. With engine running, clamp fuel delivery line before fuel rail and check for fuel pressure to rises. If fuel pressure rises, replace fuel pump and go to next step. If fuel pressure does not rises, check on-line fuel filter and fuel pump pick-up screen for restriction. If filters are okay replace fuel pump and go to next step. If fuel filters are faulty, repair or replace as necessary, and go to next step.
6. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

DTC P0135: RIGHT FRONT HEATED OXYGEN SENSOR HEATER CIRCUIT MALFUNCTION

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

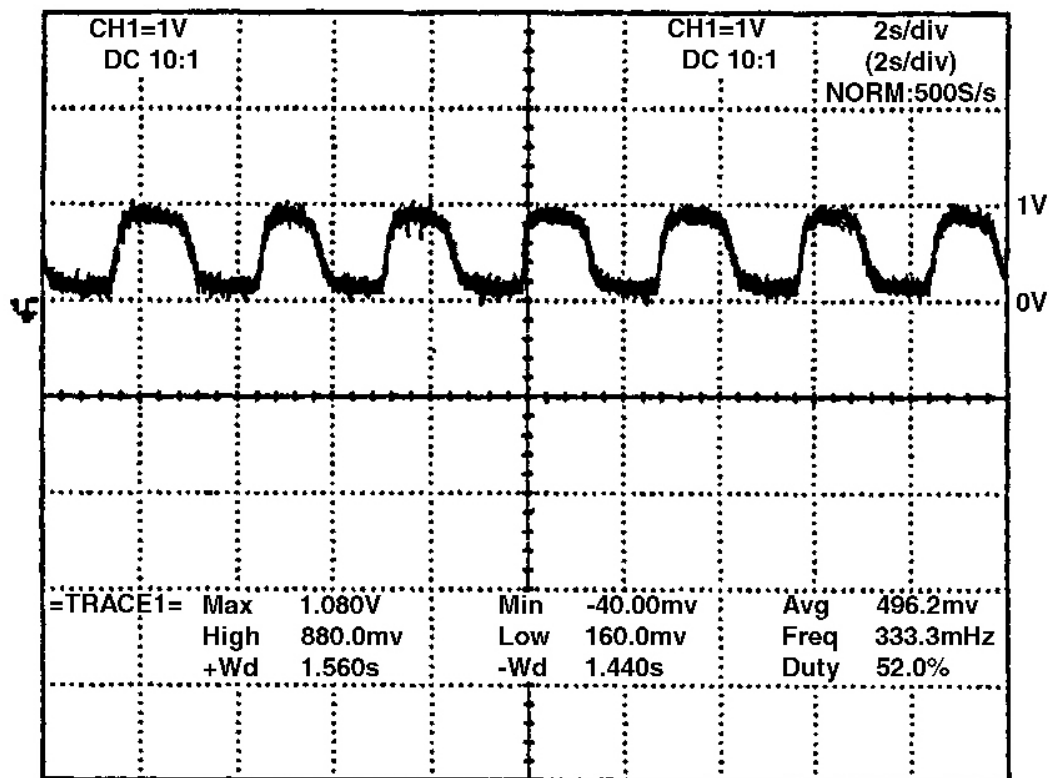
Diagnostic Aids

Heater current of Heated Oxygen Sensor (HO2S) has continued to be 0.2-amps or less, or 3.5-amps or more for 6 second. Monitor runs once per trip. Check for following possible problems:

- Open or short between right front HO2S and Engine Control Module (ECM).
- Incorrect right front HO2S heater resistance.
- Faulty right front HO2S.

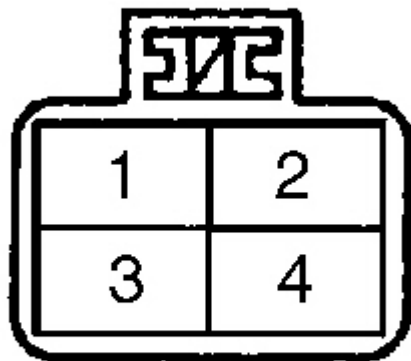
Test Procedure

1. Turn ignition off. Visually Inspect right front HO2S circuit for exposed wiring, contamination, corrosion and proper installation. If no problem is found, go to next step. If problem is found, repair or replace as necessary and go to step 6 .
2. Disconnect right front HO2S 4-pin harness connector. See **Fig. 10** . Start engine. Allow engine to idle. Measure voltage between ground and right front HO2S connector terminal No. 4 (Red/Yellow wire). Voltage should be battery voltage. If voltage is as specified, go to step 4 . If voltage is not as specified, go to next step.
3. Turn ignition off. Locate fuses and Main relay in engine compartment fuse/relay box. Check Main relay operation and fuses condition. For Main relay operation test, see **FUEL PUMP & MAIN RELAYS (SEDONA)** under RELAYS & SOLENOIDS in SYSTEM & COMPONENT TESTING article. Also if necessary check Main relay circuits. See **WIRING DIAGRAMS** article. If fuses, relay and circuits are okay, go to next step. If fuses, relay or circuits are faulty, repair or replace as necessary, and go to step 6 .
4. Disconnect ECM harness connector "A". See **Fig. 4** . Measure resistance between right front HO2S connector terminal No. 3 (Red wire) and ECM connector terminal A5. Resistance should be below one ohm. If resistance is as specified, go to next step. If resistance is not as specified, repair open circuit as necessary and go to step 6 .
5. With right front HO2S harness connector disconnected. Measure resistance between HO2S connector terminal No. 3 and 4 (component side). Resistance should be 3.0-6.2 ohms at 68°F (20°C). If resistance is as specified, go to next step. If resistance is not as specified, temporarily install a known-good HO2S and check for proper operation. If problem is corrected, replace HO2S and go to next step.
6. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



G00102655

Fig. 9: Identifying Normal Heater Oxygen Sensor Waveform
Courtesy of KIA MOTORS AMERICA, INC.



G00102704

Fig. 10: Identifying Heated Oxygen Sensor Connector Terminals
Courtesy of KIA MOTORS AMERICA, INC.

DTC P0136: RIGHT REAR HEATED OXYGEN SENSOR CIRCUIT OPEN & DTC P0140: RIGHT REAR HEATED OXYGEN SENSOR CIRCUIT SHORT

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Engine Control Module (ECM). monitors right rear Heated Oxygen Sensor (HO2S) once per trip and will set a code when air-fuel ratio is forcibly changed (lean to rich to lean), HO2S signal does not provide response within 1.28 seconds. Check for following possible problems:

- Open or short between right rear HO2S and ECM.
- Short between right rear HO2S wires.
- Poor connection between right rear HO2S and ECM.
- Misplaced, bent, loose or corroded right rear HO2S or ECM connector terminals.
- Faulty right rear HO2S.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If other DTCs are set, do all repairs associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.
2. Start engine. Allow engine to idle until reaches normal operating temperature for more than 10 minutes. Using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent, monitor right rear HO2S voltage signal waveform. See **Fig. 9** . If HO2S voltage signal switches from lean to rich or rich to lean over 6 times for 10 seconds. Problem is intermittent, check HO2S and ECM for proper harness connections and go to step 7 . If voltage signal waveform is not as specified, go to next step.
3. Turn ignition off. Disconnect right rear HO2S 4-pin harness connector. See **Fig. 10** and ECM harness connector "B" and "C". See **Fig. 4** . Measure resistance between HO2S connector terminal No. 1 (Black/Yellow wire) and ECM connector terminal B7. Also measure resistance between HO2S connector terminal No. 2 (White/Yellow wire) and ECM harness connector terminal C4. Both resistances should be below one ohm. If resistances are as specified, go to next step. If any resistance is not as specified, repair open circuit as necessary and go to step 7 .
4. With right rear HO2S and ECM harness connectors disconnected. Turn ignition on. Measure voltage between ground and HO2S connector terminal No. 2 (White/Yellow wire). Voltage should be below 0.5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair short circuit as necessary and go to step 7 .
5. Turn ignition off. With right rear HO2S harness connector and ECM harness connectors disconnected. Measure resistance between ground and HO2S connector terminals No. 2 (White/Yellow wire). Also measure resistance between HO2S connector terminals No. 1 (Black/Yellow wire) and No. 2 (White/Yellow wire). Both resistances should be infinite. If resistances are as specified, go to next step. If any resistance is not as specified, repair short circuit as necessary and go to step 7 .
6. Remove right rear HO2S from vehicle, check HO2S for contamination, deterioration or damage. If HO2S is contaminated, deteriorated or damage, replace HO2S and go to next step. If HO2S seems okay, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S sensor and go to next step.
7. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

DTC P0139: RIGHT REAR HEATED OXYGEN SENSOR CIRCUIT SLOW RESPONSE

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Engine Control Module (ECM). monitors right rear Heated Oxygen Sensor (HO2S) once per trip and will set a code when air-fuel ratio is forcibly changed (lean to rich to lean), right rear HO2S signal does not provide response within 1.28 seconds. Check for following possible problems:

- Abnormal combustion.
- Improper fuel pressure.
- Right front and right rear HO2S connections reversed.
- Fault in fuel delivery system.
- Leak in intake system.
- Leak in exhaust system.
- Faulty right rear HO2S.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If DTCs related to any misfire, Purge Control Solenoid Valve (PCSV), Mass Air Flow (MAF) sensor or HO2S heater code are set, do all repairs associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.
2. Start engine. Allow engine to idle. Thoroughly check exhaust system for leaks (specially between Warm-up Catalytic Converter and front exhaust pipe). Also check intake system for vacuum leaks. If no exhaust or vacuum leak is found, go to next step. If exhaust or vacuum leak is found, repair as necessary and go to step 6 .
3. Turn ignition off. Release fuel pressure from fuel system. Install fuel pressure gauge at fuel rail. For proper fuel pressure test, see **FUEL PRESSURE (SEDONA)** under FUEL SYSTEM - DELIVERY in SYSTEM & COMPONENT TESTING article. Fuel pressure should be 46-49 psi (320-340 kPa) at idle. If fuel pressure is as specified, temporarily install a known-good HO2S and check for proper operation. If problem is corrected, replace HO2S and go to step 6 . If fuel pressure is too high, go to next step. If fuel pressure is too low, go to step 5 .
4. Turn ignition off. Release fuel pressure from fuel system. Disconnect fuel return line hose from fuel rail and blow through line towards fuel tank. If fuel return line is restricted, repair or replace as necessary and go to step 6 . If return fuel line is okay, replace fuel pressure regulator and go to step 6 .
5. With engine running, clamp fuel delivery line before fuel rail and check for fuel pressure to rises. If fuel pressure rises, replace fuel pump and go to next step. If fuel pressure does not rises, check on-line fuel filter and fuel pump pick-up screen for restriction. If filters are okay replace fuel pump and go to next step. If fuel filters are faulty, repair or replace as necessary, and go to next step.
6. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

P0141: RIGHT REAR HEATED OXYGEN SENSOR HEATER CIRCUIT MALFUNCTION

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Heater current of right rear Heated Oxygen Sensor (HO2S) has continued to be 0.2-amps or less, or 3.5-amps or more for 6 second. Monitor runs once per trip. Check for following possible problems:

- Open or short between right rear HO2S and Engine Control Module (ECM).
- Incorrect right rear HO2S heater resistance.
- Faulty right rear HO2S.

Test Procedure

1. Turn ignition off. Visually Inspect right rear HO2S circuit for exposed wiring, contamination, corrosion and proper installation. If no problem is found, go to next step. If problem is found, repair or replace as necessary and go to step 6 .
2. Turn ignition off. Disconnect right rear HO2S 4-pin harness connector. See **Fig. 10** . Start engine. Allow engine to idle. Measure voltage between ground and right rear HO2S connector terminal No. 4 (Blue/Yellow wire). Voltage should be battery voltage. If voltage is as specified, go to step 4 . If voltage is not as specified, go to next step.
3. Turn ignition off. Check HO2S fuse (15 amp), located in engine compartment fuse/relay box. Check Main relay operation. See **FUEL PUMP & MAIN RELAYS (SEDONA)** under RELAYS & SOLENOIDS in SYSTEMS & COMPONENT TESTING article. Also if necessary check Main relay circuits. See **WIRING DIAGRAMS** article. If HO2S fuse, Main relay and Main relay circuits are okay, go to next step. If HO2S fuse, Main relay or Main relay circuits are faulty, repair or replace as necessary, and go to step 6 .
4. Disconnect ECM harness connector "A". See **Fig. 4** . Measure resistance between right rear HO2S connector terminal No. 3 (White wire) and ECM connector terminal A32. Resistance should be below one ohm. If resistance is as specified, go to next step. If resistance is not as specified, repair open circuit as necessary and go to step 6 .
5. With right rear HO2S harness connector disconnected. Measure resistance between HO2S connector terminal No. 3 and 4 (component side). Resistance should be 3.0-6.2 ohms at 68°F (20°C). If resistance is as specified, go to next step. If resistance is not as specified, temporarily install a known-good HO2S and check for proper operation. If problem is corrected, replace HO2S and go to next step.
6. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

DTC P0150: LEFT FRONT HEATED OXYGEN SENSOR CIRCUIT SLOW RESPONSE

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Engine Control Module (ECM). monitors left front Heated Oxygen Sensor (HO2S) once per trip and will set a code when air-fuel ratio is forcibly changed (lean to rich to lean), left front HO2S signal does not provide response within 1.28 seconds. Check for following possible problems:

- Abnormal combustion.
- Improper fuel pressure.
- Right front and left front HO2S connections reversed.
- Fault in fuel delivery system.
- Leak in intake system.
- Leak in exhaust system.
- Faulty left front HO2S.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If other DTCs are set, do all repairs associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.
2. Start engine. Allow engine to idle. Thoroughly check exhaust system for leaks (specially between Warm-up Catalytic Converter and front exhaust pipe). Also check intake system for vacuum leaks. If no exhaust or vacuum leak is found, go to next step. If exhaust or vacuum leak is found, repair as necessary and go to step 6 .
3. Turn ignition off. Release fuel pressure from fuel system. Install fuel pressure gauge at fuel rail. For proper fuel pressure test, see **FUEL PRESSURE (SEDONA)** under FUEL SYSTEM - DELIVERY in SYSTEM & COMPONENT TESTING article. Fuel pressure should be 46-49 psi (320-340 kPa) at idle. If fuel pressure is as specified, temporarily install a known-good left front HO2S and check for proper operation. If problem is corrected, replace HO2S and go to step 6 . If fuel pressure is too high: go to next step. If fuel pressure is too low: go to step 5 .
4. Turn ignition off. Release fuel pressure from fuel system. Disconnect fuel return line hose from fuel rail and blow through line towards fuel tank. If fuel return line is restricted, repair or replace as necessary and go to step 6 . If return fuel line is okay, replace fuel pressure regulator and go to step 6 .
5. With engine running, clamp fuel delivery line before fuel rail and check for fuel pressure to rises. If fuel pressure rises, replace fuel pump and go to next step. If fuel pressure does not rises, check on-line fuel filter and fuel pump pick-up screen for restriction. If filters are okay replace fuel pump and go to next step. If fuel filters are faulty, repair or replace as necessary, and go to next step.
6. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test

drive, follow appropriate DTC test procedure.

DTC P0152: LEFT FRONT HEATED OXYGEN SENSOR CIRCUIT OPEN & DTC P0154: LEFT FRONT HEATED OXYGEN SENSOR CIRCUIT NO ACTIVITY DETECTED

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Engine Control Module (ECM) monitors left front Heated Oxygen Sensor (HO2S) once per trip and will set a code when air-fuel ratio is forcibly changed (lean to rich to lean), HO2S signal does not provide response within 1.28 seconds. Check for following possible problems:

- Open or short between left front HO2S signal terminal and ECM.
- Contaminated, deteriorated or aged left front HO2S.
- Misplaced, bent, loose or corroded left front HO2S or ECM connector terminals.
- Faulty left front HO2S.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If DTCs related to any misfire, Purge Control Solenoid Valve (PCSV) or HO2S heater code are set, do all repairs associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.
2. Start engine. Allow engine to idle until reaches normal operating temperature for more than 10 minutes. Using Hi-Scan Pro/Kia Data Pro Scan tool, monitor left front HO2S voltage signal waveform. See **Fig. 11** . If HO2S voltage signal switches from lean to rich or rich to lean over 6 times for 10 seconds. Problem is intermittent, check for proper connection at HO2S and ECM connectors and go to step 8 . If voltage signal waveform is not as specified, go to next step.
3. Turn ignition off. Disconnect left front HO2S 4-pin harness connector and ECM harness connector "B" and "C". See **Fig. 12** and **Fig. 4** . Measure resistance between HO2S harness connector terminal No. 1 (Black/Yellow wire) and ECM connector terminal B7. Also Measure resistance between HO2S harness connector terminal No. 2 (Blue wire) and ECM connector terminal C7. Both resistances should be below one ohm. If resistances are as specified, go to next step. If any resistance is not as specified, repair open circuit as necessary and go to step 8 .
4. With left front HO2S harness connector and ECM harness connectors disconnected. Turn ignition on. measure voltage between ground and HO2S harness connector terminal No. 2 (Blue wire). Voltage should be below 0.5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair short circuit as necessary and go to step 8 .

5. Turn ignition off. With left front HO2S harness connector and ECM harness connectors disconnected. Measure resistance between ground and HO2S harness connector terminals No. 2 (Blue wire). Measure resistance between HO2S harness connector terminals No. 1 (Black/Yellow wire) and No. 2 (Blue wire). Both resistances should be infinite. If resistances are as specified, go to next step. If any resistance is not as specified, repair short circuit as necessary and go to step [8](#) .
6. Remove left front HO2S from vehicle, check HO2S for contamination, deterioration or damage. If HO2S is contaminated, deteriorated or damage, temporarily install a known-good HO2S and check for proper operation. If problem is corrected, replace HO2S and go to step 8 . If HO2S seems okay, go to next step.
7. Return vehicle to original condition. Start engine. Thoroughly check exhaust system for leaks (specially between Warm-up Catalytic Converter and front exhaust pipe). If exhaust leak is found, repair as necessary and go to step 8 . If exhaust system is okay, temporarily install a known-good HO2S and check for proper operation. If problem is corrected, replace HO2S and go to next step.
8. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

P0155: LEFT FRONT HEATED OXYGEN SENSOR HEATER CIRCUIT MALFUNCTION

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

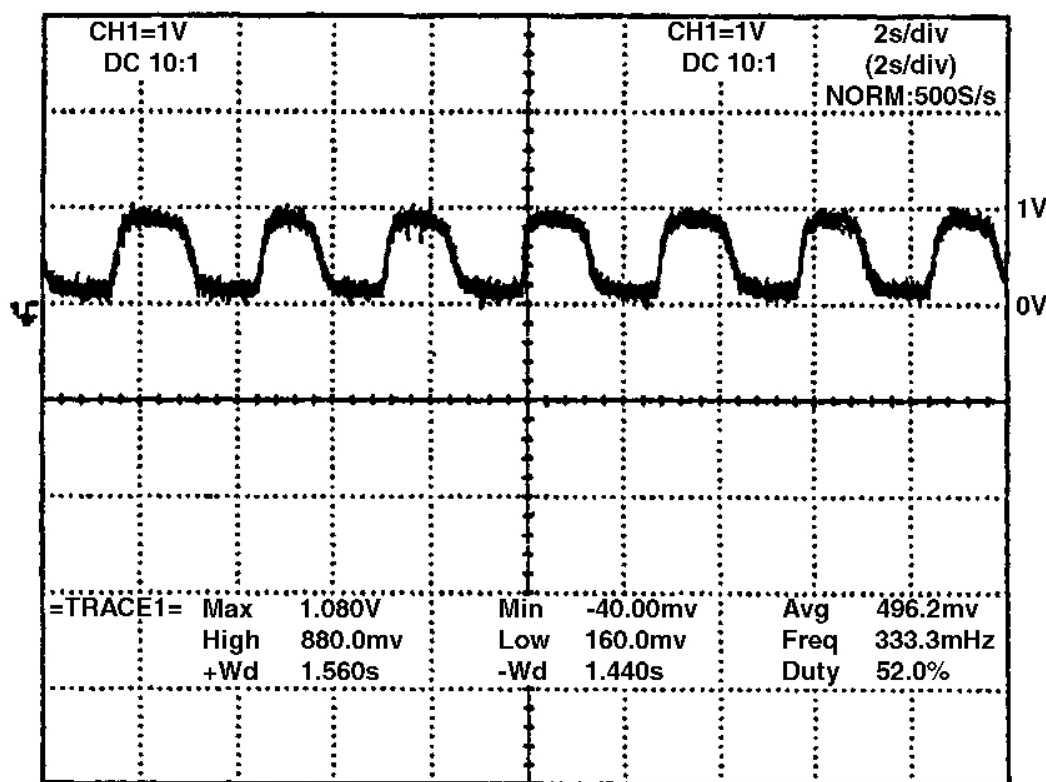
Heater current of left front Heated Oxygen Sensor (HO2S) has continued to be 0.2-amps or less, or 3.5-amps or more for 6 second. Monitor runs once per trip. Check for following possible problems:

- Open or short between left front HO2S and Engine Control Module (ECM).
- Incorrect left front HO2S heater resistance.
- Faulty left front HO2S.

Test Procedure

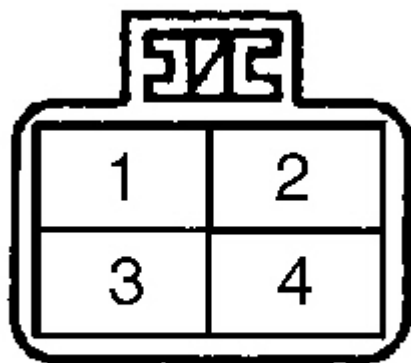
1. Turn ignition off. Visually Inspect left front HO2S circuit for exposed wiring, contamination, corrosion and proper installation. If no problem is found, go to next step. If problem is found, repair or replace as necessary and go to step 6 .
2. Turn ignition off. Disconnect left front HO2S 4-pin harness connector. See **Fig. 12** . Start engine. Allow engine to idle. Measure voltage between ground and left front HO2S connector terminal No. 4 (Blue/Yellow wire). Voltage should be battery voltage. If voltage is as specified, go to step 4 . If voltage is not as specified, go to next step.

3. Turn ignition off. Locate fuses and Main relay in engine compartment fuse/relay box. Check Main relay operation and fuses condition. For Main relay operation test, see **FUEL PUMP & MAIN RELAYS (SEDONA)** under RELAYS & SOLENOIDS in SYSTEM & COMPONENT TESTING article. Also if necessary check Main relay circuits. See **WIRING DIAGRAMS** article. If fuses, relay and circuits are okay, go to next step. If fuses, relay or circuits are faulty, repair or replace as necessary, and go to step 6 .
4. Disconnect ECM harness connector "A". See **Fig. 4** . Measure resistance between left front HO2S connector terminal No. 3 (Green/White wire) and ECM connector terminal A6. Resistance should be below one ohm. If resistance is as specified, go to next step. If resistance is not as specified, repair open circuit as necessary and go to step 6 .
5. With left front HO2S harness connector disconnected. Measure resistance between HO2S connector terminal No. 3 and 4 (component side). Resistance should be 3.0-6.2 ohms at 68°F (20°C). If resistance is as specified, go to next step. If resistance is not as specified, temporarily install a known-good HO2S and check for proper operation. If problem is corrected, replace HO2S and go to next step.
6. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



G00102655

Fig. 11: Identifying Normal Heater Oxygen Sensor Waveform



G00102704

Fig. 12: Identifying Heated Oxygen Sensor Connector Terminals

Courtesy of KIA MOTORS AMERICA, INC.

DTC P0156: LEFT REAR HEATED OXYGEN SENSOR CIRCUIT OPEN & DTC P0160: LEFT REAR HEATED OXYGEN SENSOR CIRCUIT SHORT

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Engine Control Module (ECM). monitors left rear HO2S once per trip and will set a code when air-fuel ratio is forcibly changed (lean to rich to lean), HO2S signal does not provide response within 1.28 seconds. Check for following possible problems:

- Open or short between left rear HO2S and ECM.
- Short between left rear HO2S wires.
- Faulty left rear HO2S.

- Poor connection between left rear HO2S and ECM.
- Misplaced, bent, loose or corroded left rear HO2S or ECM connector terminals.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If other DTCs are set, do all repairs associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.
2. Start engine. Allow engine to idle until reaches normal operating temperature for more than 10 minutes. Using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent, monitor left rear HO2S voltage signal waveform. See **Fig. 11** . If HO2S voltage signal switches from lean to rich or rich to lean over 6 times for 10 seconds. Problem is intermittent, check HO2S and ECM for proper harness connections and go to step 7 . If voltage signal waveform is not as specified, go to next step.
3. Turn ignition off. Disconnect left rear HO2S 4-pin harness connector. See **Fig. 12** and ECM harness connector "B" and "C". See **Fig. 4** . Measure resistance between HO2S connector terminal No. 1 (Black/Yellow wire) and ECM connector terminal B7. Also measure resistance between HO2S connector terminal No. 2 (Red wire) and ECM connector terminal C5. Both resistances should be below one ohm. If resistances are as specified, go to next step. If any resistance is not as specified, repair open circuit as necessary and go to step 7 .
4. With left rear HO2S and ECM harness connectors disconnected. Turn ignition on. Measure voltage between ground and HO2S connector terminal No. 2 (Red wire). Voltage should be below 0.5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair short circuit as necessary and go to step 7 .
5. Turn ignition off. With left rear HO2S harness connector and ECM harness connectors disconnected. Measure resistance between ground and HO2S connector terminals No. 2 (Red wire). Also measure resistance between HO2S connector terminals No. 1 (Black/Yellow wire) and No. 2 (Red wire). Both resistances should be infinite. If resistances are as specified, go to next step. If any resistance is not as specified, repair short circuit as necessary and go to step 7 .
6. Remove left rear HO2S from vehicle, check HO2S for contamination, deterioration or damage. If HO2S is contaminated, deteriorated or damage, replace HO2S and go to next page. If HO2S seems okay, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S sensor and go to next step.
7. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

DTC P0159: LEFT REAR HEATED OXYGEN SENSOR CIRCUIT SLOW RESPONSE

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-

megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Engine Control Module (ECM). monitors left rear Heated Oxygen Sensor (HO2S) once per trip and will set a code when air-fuel ratio is forcibly changed (lean to rich to lean), left rear HO2S signal does not provide response within 1.28 seconds. Check for following possible problems:

- Abnormal combustion.
- Improper fuel pressure.
- Right front and left rear HO2S connections reversed.
- Fault in fuel delivery system.
- Leak in intake system.
- Leak in exhaust system.
- Faulty left rear HO2S.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If DTCs related to any misfire, Purge Control Solenoid Valve (PCSV), Mass Air Flow (MAF) sensor or HO2S heater are set, do all repairs associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.
2. Start engine. Allow engine to idle. Thoroughly check exhaust system for leaks (specially between Warm-up Catalytic Converter and front exhaust pipe). Also check intake system for vacuum leaks. If no exhaust or vacuum leak is found, go to next step. If exhaust or vacuum leak is found, repair as necessary and go to step 6 .
3. Turn ignition off. Release fuel pressure from fuel system. Install fuel pressure gauge at fuel rail. For proper fuel pressure test, see **FUEL PRESSURE (SEDONA)** under FUEL SYSTEM - DELIVERY in SYSTEM & COMPONENT TESTING article. Fuel pressure should be 46-49 psi (320-340 kPa) at idle. If fuel pressure is as specified, temporarily install a known-good left front HO2S and check for proper operation. If problem is corrected, replace HO2S and go to step 6 . If fuel pressure is too high, go to next step. If fuel pressure is too low, go to step 5 .
4. Turn ignition off. Release fuel pressure from fuel system. Disconnect fuel return line hose from fuel rail and blow through line towards fuel tank. If fuel return line is restricted, repair or replace as necessary and go to step 6 . If return fuel line is okay, replace fuel pressure regulator and go to step 6 .
5. With engine running, clamp fuel delivery line before fuel rail and check for fuel pressure to rises. If fuel pressure rises, replace fuel pump and go to next step. If fuel pressure does not rises, check on-line fuel filter and fuel pump pick-up screen for restriction. If filters are okay replace fuel pump and go to next step. If fuel filters are faulty, repair or replace as necessary, and go to next step.
6. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

P0161: LEFT REAR HEATED OXYGEN SENSOR HEATER CIRCUIT MALFUNCTION

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under DIAGNOSTIC TESTS .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Heater current of left rear Heated Oxygen Sensor (HO2S) has continued to be 0.2-amps or less, or 3.5-amps or more for 6 second. Monitor runs once per trip. Check for following possible problems:

- Open or short between left rear HO2S and Engine Control Module (ECM).
- Incorrect left rear HO2S heater resistance.
- Faulty left rear HO2S.

Test Procedure

1. Turn ignition off. Visually Inspect left rear HO2S circuit for exposed wiring, contamination, corrosion and proper installation. If no problem is found, go to next step. If problem is found, repair or replace as necessary and go to step 6 .
2. Turn ignition off. Disconnect left rear HO2S 4-pin harness connector. See **Fig. 12** . Start engine. Allow engine to idle. Measure voltage between ground and left rear HO2S connector terminal No. 4 (Red/Yellow wire). Voltage should be battery voltage. If voltage is as specified, go to step 4 . If voltage is not as specified, go to next step.
3. Turn ignition off. Locate fuses and Main relay in engine compartment fuse/relay box. Check Main relay operation and fuses condition. For Main relay operation test, see **FUEL PUMP & MAIN RELAYS (SEDONA)** under RELAYS & SOLENOIDS in SYSTEM & COMPONENT TESTING article. Also if necessary check Main relay circuits. See **WIRING DIAGRAMS** article. If fuses, relay and circuits are okay, go to next step. If fuses, relay or circuits are faulty, repair or replace as necessary, and go to step 6 .
4. Disconnect ECM harness connector "A". See **Fig. 4** . Measure resistance between left rear HO2S connector terminal No. 3 (Green/Yellow wire) and ECM connector terminal A33. Resistance should be below one ohm. If resistance is as specified, go to next step. If resistance is not as specified, repair open circuit as necessary and go to step 6 .
5. With left rear HO2S harness connector disconnected. Measure resistance between HO2S connector terminal No. 3 and 4 (component side). Resistance should be 3.0-6.2 ohms at 68°F (20°C). If resistance is as specified, go to next step. If resistance is not as specified, temporarily install a known-good HO2S and check for proper operation. If problem is corrected, replace HO2S and go to next step.
6. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

DTC P0171: FUEL SYSTEM TOO LEAN (BANK 1), P0172: FUEL SYSTEM TOO RICH (BANK 1), DTC P0174: FUEL SYSTEM TOO LEAN (BANK 2) AND P0175: FUEL SYSTEM TOO RICH (BANK 2)

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Lambda controller block on minimum or maximum limit. Check for following possible problems:

- Intake or exhaust system leak.
- Faulty EVAP Purge Control Solenoid Valve (PCSV).
- Faulty fuel delivery system.
- Faulty ignition system.
- Faulty Heated Oxygen Sensor (HO2S), Mass Airflow (MAF) sensor or Throttle Position (TP) sensor.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If other DTCs related to Heated Oxygen Sensor (HO2S), Engine Coolant Temperature (ECT) sensor or Mass Air Flow (MAF) sensor are set, do all repairs associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.
2. Start engine. Allow engine to idle. Using Hi-Scan Pro/Kia Data Pro Scan tool, or equivalent, monitor long-term on fuel trim data. Long-term should be: -12.5% -12.5%. If long-term on fuel trim is as specified, Problem is intermittent, go to step 13 . If long-term on fuel trim is not as specified, go to next step.
3. Turn ignition off. Visually and physically inspect the following items:
 - Throttle body gasket.
 - Gasket between intake manifold and surge tank.
 - Seals between intake manifold and fuel injectors.
 - Seals between surge tank and Positive Crankcase ventilation (PCV) valve.
 - PCV valve or PCV system for leaks.
 - Contaminated fuel.

If the above items are okay, go to next step. If above items are found faulty, repair or replace as necessary and go to step 13 .

4. Visually and physically inspect the following items:
 - Restriction at air cleaner element.
 - Mass Air Flow (MAF) sensor for contamination and proper installation.
 - Exhaust system leaks.

If the above items are okay, go to next step. If above items are faulty, repair or replace as necessary and go to step 13 .

5. Check vacuum hoses for splits and proper connections to engine dynamic chamber (specially Positive Crankcase ventilation (PCV) and Idle Air Control (IAC), throttle body, intake manifold and brake booster vacuum hoses). If vacuum hoses and hoses connection are okay, go to next step. If vacuum hose(s) is (are) found split (damage) or disconnected, repair or replace as necessary and go to step 13 .
6. Start engine. Allow engine to idle and disconnect vacuum hose between EVAP Purge Control Solenoid Valve (PCSV) and EVAP canister. Check for vacuum at PCSV. If vacuum is found at PCSV (possible failure at PCSV or circuit), perform diagnose and repairs according to **DTC P0441: EVAP EMISSION CONTROL SYSTEM PURGE CONTROL SOLENOID VALVE STUCK OPEN** and **DTC P0443: EVAP EMISSION CONTROL SYSTEM PURGE CONTROL SOLENOID VALVE CIRCUIT MALFUNCTION** . After repair, go to step 13 . If no vacuum is found at PCSV hose, go to next step.
7. Turn ignition off. Release fuel pressure from fuel system. Install fuel pressure gauge at fuel rail and check fuel pressure. For proper fuel pressure test. See **FUEL PRESSURE (SEDONA)** under FUEL SYSTEM - DELIVERY in SYSTEM & COMPONENT TESTING article. Fuel pressure should be 46-49 psi (320-340 kPa). If fuel pressure is as specified, go to step 10 . If fuel pressure is too high, go to next step. If fuel pressure is too low, go to step 9 .
8. Turn ignition off. Release fuel pressure from fuel system. Disconnect fuel return line hose from fuel rail and blow through line towards fuel tank. If fuel return line is restricted, repair or replace return fuel line as necessary and go to step 13 . If return fuel line is okay, replace fuel pressure regulator and go to step 13 .
9. Start engine. Allow engine to idle and clamp fuel delivery line before fuel rail and check for fuel pressure to rises. If fuel pressure rises, replace fuel pump and go to step [13](#) . If fuel pressure does not rises, check on-line fuel filter and fuel pump pick-up screen for restriction. If filters are okay replace fuel pump and go to step 13 . If fuel filters are faulty, repair or replace as necessary, and go to step 13 .
10. With engine running, check for engine RPM decrease when disconnecting each fuel injector harness connector in sequence. Measure decreasing RPM at all 6 cylinders. If no engine RPM is change or only a small engine RPM change is notice, check for possible cause, repair as necessary and go to step 13 . If engine RPM changes even at all 6 cylinders, go to next step.
11. Remove spark plugs and inspect spark plugs tips. Check for abnormal spark plug tips color, contamination and damage. Compare spark plugs to each other. If a spark plug is faulty, find possible cause, repair as necessary and go to step 13 . If spark plugs are okay, go to next step.
12. Check for ECM input signal from: HO2S, TP sensor, MAF sensor and others input signals. If input signal are as specified, go to next step. If input signals are not as specified, repair as necessary and go to next step.
13. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

DTC P0180: FUEL TEMPERATURE SENSOR CIRCUIT MALFUNCTION

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

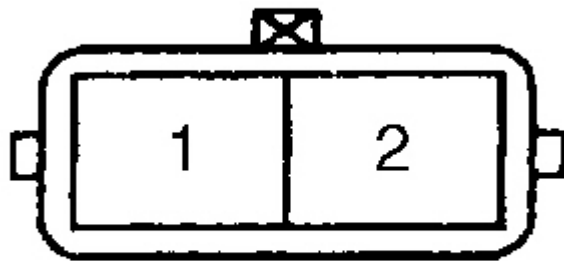
Diagnostic Aids

Malfunction code enable criteria not available from manufacturer. Check for following possible problems:

- Open or short between Fuel Temperature (FT) sensor and Main relay.
- Open or short between FT sensor and Engine Control Module (ECM).
- Short between FT sensor wires.
- Faulty FT sensor.

Test Procedure

1. Turn ignition off. Disconnect FT sensor harness connector. See **Fig. 13** . Turn ignition on. Measure voltage between ground and FT sensor connector terminal No. 2 (Brown wire). Voltage should be approximately 5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair open or short circuit as necessary and go to step 3 .
2. Turn ignition off. Thoroughly check FT sensor for damage. Also check for loose, bent or corroded FT sensor or ECM connectors terminals. If sensor and connectors terminals are okay, temporarily install a known-good FT sensor and check for proper operation. If problem is corrected, replace FT sensor and go to next step. If sensor and connector terminals are faulty, repair or replace as necessary and go to next step.
3. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



G00102705

Fig. 13: Identifying Fuel Temperature Sensor Connector Terminals
Courtesy of KIA MOTORS AMERICA, INC.

DTC P0201: FUEL INJECTORS NO. 1 CIRCUIT MALFUNCTION, DTC P0202: FUEL INJECTORS NO. 2 CIRCUIT MALFUNCTION, DTC P0203: FUEL INJECTORS NO. 3 CIRCUIT MALFUNCTION, DTC P0204: FUEL INJECTORS NO. 4 CIRCUIT MALFUNCTION, DTC P0205: FUEL INJECTORS NO. 5 CIRCUIT MALFUNCTION & DTC P0206: FUEL INJECTORS NO. 6 CIRCUIT MALFUNCTION

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Fuel injector coil surge voltage (system voltage, plus 2 volts) has not been detected for 4 seconds.

Check for following possible problems:

- Open or short between main relay and fuel injectors.
- Open or short between fuel injector and Engine Control Module (ECM).
- Faulty fuel injector.

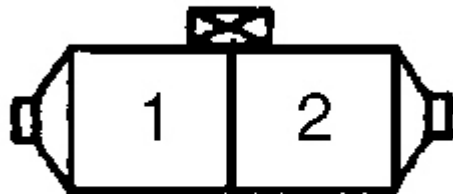
Test Procedure

1. Turn ignition off. Disconnect suspected fuel injector 2-pin harness connector. Measure resistance between fuel injector connector terminals No. 1 and 2 (component side). Resistance should be 13-16 ohms at 68°F (20°C). If resistance is as specified, go to next step. If resistance is not as specified, temporarily install a known-good fuel injector and check for proper operation. If problem is corrected, replace fuel injector and go to step 6 .
2. Turn ignition on. Measure voltage between ground and suspected fuel injector harness connector terminal No. 1 (Red/Black wire) or (Brown wire). See **Fig. 14** . Voltage should be battery voltage. If voltage is as specified, go to step 4 . If voltage is not as specified, go to next step.
3. Turn ignition off. Locate fuses and Main relay in engine compartment fuse/relay box. Check Main relay operation and fuses condition. For Main relay operation test, see **FUEL PUMP & MAIN RELAYS (SEDONA)** under RELAYS & SOLENOIDS in SYSTEM & COMPONENT TESTING article. Also if necessary check Main relay circuits. See **WIRING DIAGRAMS** article. If fuses, relay and circuits are okay, go to next step. If fuses, relay or circuits are faulty, repair or replace as necessary, and go to step 6 .
4. Disconnect ECM harness connector "A". See **Fig. 4** . Measure resistance between suspected fuel injector connector terminal No. 2 and corresponding ECM connector terminal. See **IDENTIFYING FUEL INJECTOR-TO-ECM CIRCUIT** table. Resistance should be below one ohm. If resistance is as specified, go to next step. If resistance is not as specified, repair open circuit between fuel injector and ECM. After repair, go to step 6 .

IDENTIFYING FUEL INJECTOR-TO-ECM CIRCUIT

Application/Injector No.	Color of Wire Between Injector & ECM	ECM Connector Terminal No.
1	Red	A8
2	Green	A23
3	Yellow/White	A35
4	White	A7
5	Yellow	A22
6	Orange	A34

5. With ECM and suspected fuel injector harness connector disconnected. Measure resistance between ground and fuel injector connector terminals No. 2 (signal circuit). Resistance should be infinite. If resistance is not as specified, repair short as necessary and go to next step. If resistance is as specified, temporarily install a known-good fuel injector and check for proper operation. If problem is corrected, replace fuel injector and go to next step.
6. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



G00102706

Fig. 14: Identifying Fuel Injector Connector Terminals
Courtesy of KIA MOTORS AMERICA, INC.

DTC P0300: RANDOM MISFIRE DETECTED & P0301-P0306 CYLINDER NO. 1-6 MISFIRE DETECTED

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** on DIAGNOSTIC TESTS .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Malfunction code will set if misfire has occurred more frequently than allowed during last 200 revolutions, when catalyst temperature is higher than 1742°F (950°C). Also when misfire has occurred more frequently than allowed number of times (2%) during 1000 engine revolutions. Check for following possible problems:

- Vacuum leak in air intake system.
- Faulty Crankshaft Position (CKP) sensor or circuit.
- Faulty ignition circuit.
- Faulty ignition coil or plug wire.
- Faulty spark plug.
- Low engine compression.
- Low or high fuel pressure.
- Faulty fuel injector or circuit.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If DTCs related to Heated Oxygen Sensor (HO2S), Engine Coolant Temperature (ECT) sensor or Mass Air Flow (MAF) sensor are set, do all repairs associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.
2. Turn ignition off. Check Positive Crankcase Ventilation (PCV) valve operation. Also check vacuum hoses for splits and proper connections to engine dynamic chamber (specially PCV, Idle Air Control (IAC), throttle body, intake manifold and brake booster). If PCV valve operation, vacuum hoses and hoses connection are okay, go to next step. If PCV valve and vacuum hoses are found split, damage or misconnected, repair or replace as necessary and go to step 10 .
3. Disconnect suspected ignition coil 3-pin harness connector. See **Fig. 19** . Turn ignition on. Measure voltage between ground and suspected ignition coil connector terminal No. 3 (Red wire). Voltage should be battery voltage. If voltage is as specified, go to next step. If voltage is not as specified, repair open circuit between ignition switch and suspected ignition coil connector terminal No. 3 (Red wire). See **DTC P0320: IGNITION FAILURE SYSTEM CIRCUIT MALFUNCTION** . After repair, go to step 10 .
4. Check ignition coils and spark plug wires for cracks or carbon tracing. Check suspected ignition coil primary resistance, resistance should be approximately 0.80 ohms at 68°F (20°C). Check suspected ignition coil secondary resistance, resistance should be approximately 13,000 ohms at 68°F (20°C). Also check for spark plug wires resistance, resistance should be 16,000 ohms per 3.3 feet. If ignition coil and spark plug wires are as specified, go to next step. If ignition coil and/or spark plug wires are not as specified, repair or replace as necessary and go to step 10 .
5. Return vehicle to original condition. Release fuel pressure from fuel system. Install fuel pressure gauge at fuel rail. For proper fuel pressure test, see **FUEL PRESSURE (SEDONA)** under FUEL SYSTEM - DELIVERY in SYSTEM & COMPONENT TESTING article. Fuel pressure should be 46-49 psi (320-340 kPa) at idle. If fuel pressure is as specified, go to step 8 . If fuel pressure is too high, go to next step. If fuel pressure is too low, go to step 7 .
6. Turn ignition off. Release fuel pressure from fuel system. Disconnect fuel return line hose from fuel rail and blow through line towards fuel tank. If fuel return line is restricted, repair or replace as necessary and go to step 10 . If fuel return line is okay, replace fuel pressure regulator and go to step 10 .
7. Start engine. Allow engine to idle and clamp fuel delivery line before fuel rail and check for fuel pressure to rises. If fuel pressure rises, replace fuel pump and go to step [10](#) . If fuel pressure does not rises, check on-line fuel filter and fuel pump pick-up screen for restriction. If filters are okay replace fuel pump and go to step 10 . If fuel filters are faulty, repair or replace as necessary, and go to step 10 .
8. Turn ignition off. Remove spark plugs. Check condition and gap of spark plugs. Spark plug gap should be .039-.043" (1.0-1.1 mm). If spark plugs are as specified, go to next step. If spark plugs are not as specified, adjust or replace spark plugs as necessary and go to step 10 .
9. Perform engine compression test. For proper engine compression test, see **COMPRESSION** under PRELIMINARY INSPECTION & ADJUSTMENTS in BASIC DIAGNOSTIC PROCEDURES article. Compression should be about 170 psi (1200 kPa) at cranking speed with no more than 10 percent variation between highest and lowest cylinders. If engine compression is as specified, go to next step. If engine compression is not as specified, perform leak down test to determine source of low compression. Repair as necessary and go to next step.
10. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or

equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

DTC P0320: IGNITION FAILURE SYSTEM CIRCUIT MALFUNCTION

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS and NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

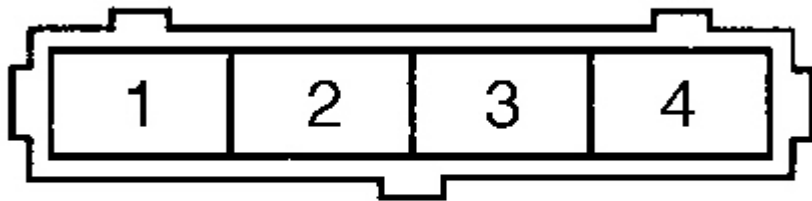
Diagnostic Aids

Malfunction code enable criteria not available from manufacturer. Check for following possible problems:

- Open or short between Ignition Failure Sensor (IFS) and Engine Control Module (ECM).
- Open or short between IFS and ignition coil.
- Open between IFS and ground.
- Faulty IFS.

Test Procedure

1. Turn ignition off. Disconnect IFS 4-pin harness connector. See **Fig. 15** . Turn ignition on. Measure voltage between ground and IFS connector terminal No. 1 (Pink wire). Voltage should be battery voltage. If voltage is as specified, go to next step. If voltage is not as specified, repair open or short circuit as necessary and go to step 5 .
2. With ignition on. Measure voltage between ground and IFS connector terminal No. 3 (Yellow/Red wire). Voltage should be approximately 5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair open or short circuit as necessary and go to step 5 .
3. Turn ignition off. Measure resistance between ground and IFS connector terminal No. 4 (Black wire). Resistance should be below one ohm. If resistance is as specified, go to next step. If resistance is not as specified, repair open circuit as necessary and go to step 5 .
4. Thoroughly check IFS for loose, bent or corroded connector terminals, repair if necessary. Reconnect IFS and turn ignition on. Backprobe and measure voltage between ground and IFS connector terminal No. 2 (Black/White wire). Voltage should be battery voltage. If voltage is as specified, temporarily install a known-good IFS and check for proper operation. If problem is corrected, replace IFS and go to next step. If voltage is not as specified, repair open or short circuit as necessary and go to next step.
5. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



G00140002

Fig. 15: Identifying Ignition Failure Sensor Connector Terminals
Courtesy of KIA MOTORS AMERICA, INC.

DTC P0325: KNOCK SENSOR CIRCUIT MALFUNCTION

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS**.

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Malfunction code enable criteria not available from manufacturer. Check for following possible problems:

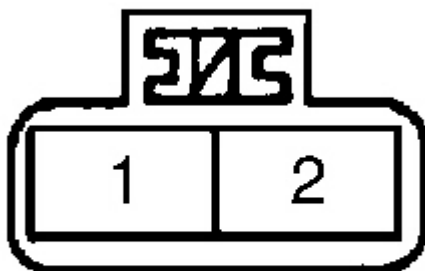
- Open or short between knock sensor and Engine Control Module (ECM).
- Source of high resistance between Knock sensor and ECM.
- Faulty Knock sensor.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool, or equivalent to OBD-II Data Link Connector. See **Fig. 1**. Turn ignition on. Monitor Knock sensor voltage signal, voltage should be 2.3-2.7 volts. If voltage is as specified. Problem is intermittent, check Knock sensor and ECM for proper harness connections and go to step 7. If voltage is not as specified, go to next step.
2. Start engine. Using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent, monitor Knock sensor voltage signal from idle speed to 3000 RPM. Voltage should increase. If voltage is as specified, check if other

DTC is set, do all repairs associated with that DTC before continuing this procedure and go to next step. If voltage is not as specified and no other DTC is set, go to next step.

3. Turn ignition off. Thoroughly check Knock sensor and ECM for loose, bent, corroded, contaminated, deteriorated or damage connectors terminals. If connector terminals are okay, go to next step. If connectors terminals are faulty, repair or replace as necessary and go to step 7 .
4. Disconnect Knock sensor 2-pin harness connector. See **Fig. 16** . Also disconnect ECM harness connector "C". See **Fig. 4** . Measure resistance between Knock sensor connector terminal No. 2 (Red wire) and ECM connector terminal C28. Also measure resistance between ground and Knock sensor connector terminal No. 1 (Black wire). Resistance should be below one ohm. If resistances are as specified, go to next step. If any resistance is not as specified, repair open circuits as necessary and go to step 7 .
5. With Knock sensor and ECM harness connectors disconnected. Turn ignition on. Measure voltage between ground and Knock sensor connector terminal No. 2 (Red wire). Voltage should be below 0.5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair open or short circuit as necessary and go to step 7 .
6. Turn ignition off. With Knock sensor and ECM harness connector disconnected. Measure resistance between ground and Knock sensor connector terminal No. 2 (Red wire). Also measure resistance between Knock connector terminals No. 2 (Red wire) and No. 1 (Black wire). Both resistances should be infinite. If resistances are as specified, temporarily install a Known-good Knock sensor and check for proper operation. If problem is corrected, replace Knock sensor and go to next step. If any resistance is not as specified, repair short circuit as necessary and go to next step.
7. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



G00140003

Fig. 16: Identifying Knock Sensor Connector Terminals
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Malfunction code will set if no voltage output signal from Crankshaft Position (CKP) sensor has not changed (no pulse signal is input) for 4 seconds. Check for following possible problems:

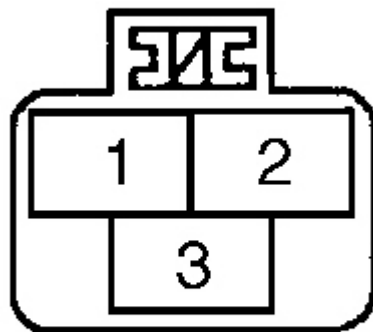
- Open or short between CKP sensor and Engine Control Module (ECM).
- Short between CKP sensor wires.
- Out of allowable air gap.
- Faulty target wheel tolerance
- Faulty CKP sensor.

Test Procedure

1. Turn ignition off. Thoroughly check CKP sensor for damage. Also check for loose, bent, corroded, contaminated, deteriorated or damage CKP sensor and ECM harness connectors terminals. If sensor and harness connectors terminals are okay, go to next step. If sensor and harness connectors are faulty, repair or replace as necessary and go to step 7 .
2. Disconnect CKP sensor 3-pin harness connector. See **Fig. 17** . Turn ignition on. Measure voltage between ground and CKP sensor connector terminal No. 3 (Brown wire). Voltage should be battery voltage. If voltage is as specified, go to step 4 . If voltage is not as specified, go to next step.
3. Turn ignition off. Locate fuses and Main relay in engine compartment fuse/relay box. Check Main relay operation and fuses condition. For Main relay operation test, see **FUEL PUMP & MAIN RELAYS (SEDONA)** under RELAYS & SOLENOIDS in SYSTEM & COMPONENT TESTING article. Also if necessary check Main relay circuits. See **WIRING DIAGRAMS** article. If fuses, relay and circuits are okay, go to next step. If fuses, relay or circuits are faulty, repair or replace as necessary, and go to step 7 .
4. Disconnect ECM harness connector "B". See **Fig. 4** . Measure resistance between CKP sensor connector terminal No. 1 (Yellow/Green wire) and ECM connector terminal B2. Also measure resistance between ground CKP sensor connector terminal No. 2 (Black wire). Both resistances should be below one ohm. If resistances are as specified, go to next step. If any resistance is not as specified, repair open circuit as necessary and go to step 7 .
5. With CKP sensor and ECM harness connectors disconnected. Turn ignition on. Measure voltage between ground and CKP connector terminal No. 1 (Yellow/Green wire). Voltage should be below 0.5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair short circuit as necessary go to step 7 .
6. Turn ignition off. With CKP sensor and ECM harness connectors disconnected. Measure resistance between ground and CKP sensor connector terminal No. 1 (Yellow/Green wire). Also measure resistance

between CKP connector terminals No. 1 (Yellow/Green wire) and No. 2 (Black wire). Both resistances should be infinite. If resistances are as specified, temporarily install a Known-good CKP sensor and check for proper operation. If problem is corrected, replace CKP sensor and go to next step. If any resistance is not as specified, repair short circuit as necessary and go to next step.

7. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



G00102708

Fig. 17: Identifying Crankshaft Position Sensor Connector Terminals

Courtesy of KIA MOTORS AMERICA, INC.

DTC P0340: CAMSHAFT POSITION SENSOR CIRCUIT MALFUNCTION

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

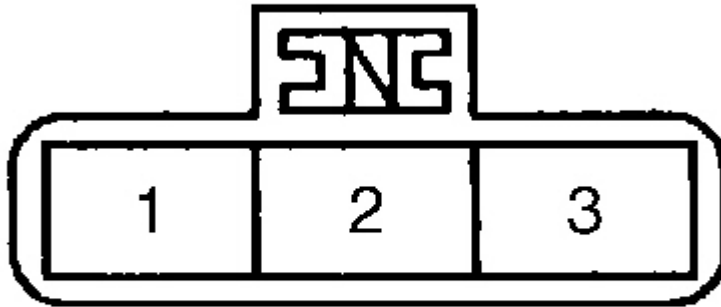
Malfunction code will set if no voltage output signal from Camshaft Position (CMP) sensor has not changed (no pulse signal is input) for 4 seconds. Check for following possible problems:

- Open or short between CMP sensor and Engine Control Module (ECM).

- Short between CMP sensor wires.
- Improper CMP timing.
- Faulty CMP sensor.

Test Procedure

1. Turn ignition off. Thoroughly check CMP sensor. Also check for loose, bent, corroded, contaminated, deteriorated or damage CMP sensor and ECM connectors terminals. If sensor and connectors terminals are okay, go to next step. If sensor and connectors terminals are faulty, repair or replace as necessary and go to step 8 .
2. Disconnect CMP sensor 3-pin harness connector. See **Fig. 18** . Turn ignition on. Measure voltage between ground and CMP sensor connector terminal No. 1 (Brown wire). Voltage should be battery voltage. If voltage is as specified, go to step 4 . If voltage is not as specified, go to next step.
3. Turn ignition off. Locate fuses and Main relay in engine compartment fuse/relay box. Check Main relay operation and fuses condition. For Main relay operation test, see **FUEL PUMP & MAIN RELAYS (SEDONA)** under RELAYS & SOLENOIDS in SYSTEM & COMPONENT TESTING article. Also if necessary check Main relay circuits. See **WIRING DIAGRAMS** article. If fuses, relay and circuits are okay, go to next step. If fuses, relay or circuits are faulty, repair or replace as necessary, and go to step 8 .
4. Disconnect ECM harness connector "B". See **Fig. 4** . Measure resistance between CMP sensor connector terminal No. 2 (White/Green wire) and ECM connector terminal B8. Also measure resistance between ground CMP sensor connector terminal No. 3 (Black wire). Both resistances should be below one ohm. If resistances are as specified, go to next step. If any resistance is not as specified, repair open circuit as necessary and go to step 8 .
5. With CMP sensor and ECM harness connectors disconnected. Turn ignition on. Measure voltage between ground and CMP connector terminal No. 2 (White/Green wire). Voltage should be below 0.5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair short circuit as necessary go to step 8 .
6. Turn ignition off. With CMP sensor and ECM harness connectors disconnected. Measure resistance between ground and CMP sensor connector terminal No. 2 (White/Green wire). Also measure resistance between CMP connector terminals No. 2 (White/Green wire) and No. 3 (Black wire). Both resistances should be infinite. If resistances are as specified, go to next step. If any resistance is not as specified, repair short circuit as necessary and go to step 8 .
7. Check for CMP sensor installation. If CMP sensor is installed properly, temporarily install a Known-good CMP sensor and check for proper operation. If problem is corrected, replace CMP sensor and go to next step. If CMP sensor is not installed properly, remove CMP sensor and reinstall CMP sensor properly, check CMP sensor for proper operation. If CMP sensor still not operating properly, temporarily install a Known-good CMP sensor and check for proper operation. If problem is corrected, replace CMP sensor and go to next step.
8. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



G00140004

Fig. 18: Identifying Camshaft Position Sensor Connector Terminals
Courtesy of KIA MOTORS AMERICA, INC.

DTC P0350: IGNITION COIL PRIMARY / SECONDARY CIRCUIT MALFUNCTION

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under DIAGNOSTIC TESTS .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Malfunction code enable criteria not available from manufacturer. Check for following possible problems:

- Open or short between ignition coil and Engine Control Module (ECM).
- Open or short between ignition coil and spark plug.
- Short between ignition coil wires.
- Faulty Ignition coil.
- Poor connection at ignition coil.
- Faulty ignition system.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If DTCs P0300, P0301, P0302, P0303, P0304, P0305, P0306 and P0320 are set, do all repairs associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.
2. Start engine. Using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent, monitor spark plugs signal pattern. If spark plugs pattern is not normal, go to next step. If spark plug pattern is normal, Problem is intermittent, check ignition coils and ECM for proper harness connections and go to step 8 .
3. Turn ignition off. Thoroughly check ignition coils and spark plug wires for damage. Also check for loose, bent, corroded, contaminated, deteriorated or damage ignition coils connector terminals. If ignition coils, spark plug wires and connector terminals are okay, go to next step. If ignition coils, spark plug wires and connector terminals are faulty, repair or replace as necessary and go to step 8 .
4. Disconnect suspected ignition coil 3-pin harness connector. See **Fig. 19** . Turn ignition on. Measure voltage between ground and suspected ignition coil connector terminal No. 3 (Red wire). Voltage should be battery voltage. If voltage is as specified, go to next step. If voltage is not as specified, repair open circuit between ignition switch and suspected ignition coil connector terminal No. 3 (Red wire). See **DTC P0320: IGNITION FAILURE SYSTEM CIRCUIT MALFUNCTION** . After repair, go to step 10 .
5. Disconnect ECM harness connector "A". See **Fig. 4** . Measure resistance between suspected ignition coil connector terminal No. 2 (Black/White wire) and corresponding ECM connector terminal. See **IDENTIFYING IGNITION COIL-TO-ECM CIRCUIT** table. Resistance should be below one ohm. If resistances are as specified, go to next step. If any resistance is not as specified, repair open circuit between ignition coil and ECM. After repair, go to step 8 .

IDENTIFYING IGNITION COIL-TO-ECM CIRCUIT

Ignition Coil No.	Ignition Coil Terminal No.	Wire Color	ECM Connector Terminal No.
1	2	Black/White	A20
2	2	Black/White	A21
3	2	Black/White	A19

6. With ignition coil and ECM harness connector disconnected. Turn ignition on. Measure voltage between ground and suspected ignition coil connector terminal No. 2 (Black/Yellow wire). Voltage should be below 0.5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair short circuit as necessary and go to step 8 .
7. Turn ignition off. With suspected ignition coil and ECM harness connectors disconnected. Measure resistance between ground and ignition coil connector terminal No. 2 (Black/Yellow wire). Resistance should be infinite. If resistance is as specified, temporarily install a Known-good ignition coil and check for proper operation. If problem is corrected, replace ignition coil and go to next step. If resistance is not as specified, repair short circuit as necessary and go to next step.
8. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

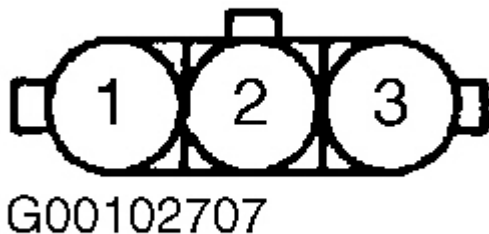


Fig. 19: Identifying Ignition Coil Connector Terminals
Courtesy of KIA MOTORS AMERICA, INC.

DTC P0421: MAIN CATALYST EFFICIENCY DETERIORATION (BANK 1) & DTC P0431: MAIN CATALYST EFFICIENCY DETERIORATION (BANK 2)

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS**.

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Engine Control Module (ECM) evaluates catalytic converter storage capability by monitoring upstream Heated Oxygen Sensor (HO2S) and downstream HO2S performance, calculating a ratio based on the amplitude of the 2 signals and evaluating this information based on load and speed conditions. Code will set when ECM determines catalytic converter storage capability has degraded. Check for catalytic converter deterioration.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool, or equivalent to OBD-II Data Link Connector. See **Fig. 1**. Turn ignition on. Monitor for other DTCs. If DTCs related to Heated Oxygen Sensor (HO2S), Mass Air Flow (MAF) sensor, Fuel Injectors and P0171 or P0172 are set, do all repairs associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.
2. Start engine. Allow engine to idle until reaches normal operating temperature for more than 10 minutes. Using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent, monitor front and rear HO2S voltage signal for (bank 1) and (bank 2). If front and rear HO2S voltage signal for (bank 1) and (bank 2) switches from lean

to rich or rich to lean, replace catalytic converter and go to step 10 . If voltage signal is not as specified, go to next step.

3. Turn ignition off. Release fuel pressure from fuel system. Install fuel pressure gauge at fuel rail. For proper fuel pressure test, see **FUEL PRESSURE (SEDONA)** under FUEL SYSTEM - DELIVERY in SYSTEM & COMPONENT TESTING article. Fuel pressure should be 46-49 psi (320-340 kPa) at idle. If fuel pressure is as specified, go to step 6 . If fuel pressure is too high: go to next step. If fuel pressure is too low: go to step 5 .
4. Turn ignition off. Release fuel pressure from fuel system. Disconnect fuel return line hose from fuel rail and blow through line towards fuel tank. If fuel return line is restricted, repair or replace return fuel line as necessary and go to step 10 . If return fuel line is okay, replace fuel pressure regulator and go to step 10 .
5. With engine running, clamp fuel delivery line before fuel rail and check for fuel pressure to rises. If fuel pressure rises, replace fuel pump and go to step 10 . If fuel pressure does not rises, check on-line fuel filter and fuel pump pick-up screen for restriction. If filters are okay replace fuel pump and go to step 10 . If fuel filters are faulty, repair or replace as necessary, and go to step 10 .
6. With engine running. Check exhaust system for leaks, cracks or loose connection (specially at exhaust manifold, catalytic converter around rear HO2S etc.). If exhaust system is okay, go to next step. If exhaust leak is found, repair exhaust leak as necessary and go to step 10 .
7. Check Positive Crankcase Ventilation (PCV) valve operation. Also check vacuum hoses for splits and proper connections to engine dynamic chamber (specially PCV and Idle Air Control (IAC), throttle body, intake manifold and brake booster vacuum hoses). If PCV valve operation, vacuum hoses and hoses connection are okay, go to next step. If PCV valve and vacuum hoses are found split, damage or misconducted, repair or replace as necessary and go to step 10 .
8. Check fuel injectors for proper operation and volume test, see FUEL INJECTOR TEST under **FUEL SYSTEM - CONTROL** in SYSTEM & COMPONENT TESTING article. If fuel injectors are okay, go to next step. If fuel injectors are faulty, repair or replace as necessary and go to step 10 .
9. Visually and physically inspect the following items:
 - Throttle body gasket.
 - Gasket between intake manifold and surge tank.
 - Seals between intake manifold and fuel injectors.
 - Seals between surge tank PCV valve.

If the above items are okay, replace catalytic converter and go to next step. If above items are faulty, repair or replace as necessary and go to next step.

10. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

DTC P0441: EVAP EMISSION CONTROL SYSTEM PURGE CONTROL SOLENOID VALVE STUCK OPEN

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aid

Malfunction code is set when solenoid coil surge voltage (system voltage +2) is not detected when EVAP emission vent solenoid is turned on/off. Check for Purge Control Solenoid Valve (PCSV) stuck open.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool, or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If DTC P0443 is set, do all repairs associated with that DTC before continuing with this procedure. If no other DTCs are set, go to next step.
2. Turn ignition off. Disconnect vacuum supply hose from PCSV. Start engine. Plug vacuum hose and check for vacuum. If vacuum is found, go to next step. If vacuum is not found, repair or replace vacuum hose or intake vacuum port as necessary and go to step 5 .
3. Turn ignition off. Connect vacuum pump to PCSV nipple, apply vacuum and ensure PCSV holds vacuum. Disconnect PCSV 2-pin harness connector. Connect a fused jumper wire between battery voltage and PCSV connector terminal No. 2 (component side). With another fused jumper wire connected to PCSV connector terminal No. 1 (component side), apply ground by touching jumper wire on/off to ground. A clicking sound should be heard and vacuum should bleed off at this time. Repeat this procedure 4 or 5 times to ensure PCSV reliability. If valve is okay, go to next step. If valve is faulty, temporarily install a known-good PCSV and check for proper operation. If problem is corrected, replace valve and go to step 5
4. Thoroughly check PCSV harness connector terminals for loose, bent, corroded, contaminated, deteriorated or damaged connector terminals. If connector terminals are okay, go to next step. If connector terminals are faulty, repair or replace as necessary and go to step 5 .
5. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

DTC P0442: EVAP EMISSION CONTROL SYSTEM SMALL LEAK DETECTED (1 MM), P0455: EVAP EMISSION CONTROL SYSTEM LARGE LEAK DETECTED AND DTC P0456: EVAP SYSTEM SMALL LEAK DETECTED (0.5 MM)

NOTE: DTC P0455 may be set and Malfunction Indicator Light (MIL) illuminates, when refuelling vehicle with engine running or fuel filler cap is open/loose when engine is running.

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all

voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Malfunction code is set when internal pressure of fuel tank changes more than 100mm/Ag in 20 seconds, after tank and vapor line are close. Check for following possible problems:

- Fuel filler cap loose or missing.
- Fuel filler cap "O" ring missing or damaged.
- Faulty or damaged fuel filler pipe.
- Leaking, disconnected or plugged fuel vapor lines.
- Fuel in lines due to faulty rollover valve or On-board Refueling Vapor Recovery (ORVR) valve.
- Canister Close Valve (CCV) clogged, stuck open or closed.
- Improperly installed EVAP Canister Purge Solenoid Valve (PCSV).
- Purge Control Solenoid Valve (PCSV) stuck open or closed.
- Faulty Fuel Tank Pressure (FTP) sensor.
- Leaking EVAP canister or catch tank.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool, or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If DTCs P0441, P0443, P0446, P0451, P0452 or P0453 are set, do all repairs associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.
2. Using Hi-Scan Pro/Kia Data Pro Scan tool, or equivalent. Perform EVAP system leak test. If EVAP system is okay, Problem is intermittent, perform EVAP system visual inspection and go to step 10 . If EVAP system fail leak test, go to next step.
3. Turn ignition off. Check fuel filler cap for correct tight installation and for good correctly installed "O" ring seal. Test fuel filler cap. It should vent at about 2 psi of pressure or about 1.5 In. Hg of vacuum. If fuel filler cap is okay, go to next step. If fuel filler cap is faulty, replace fuel filler cap and go to step 10 .
4. Check fuel filler pipe for cracks, damage and "O" ring seat deformation. If fuel filler pipe is okay, go to next step. If fuel filler pipe is faulty, replace fuel filler pipe and go to step 10 .
5. Thoroughly check all fuel vapor hoses and hose clamps between:
 - EVAP canister and fuel cut valve (rollover/ORVR valves).
 - EVAP canister and CCV.
 - EVAP canister and PCSV.
 - PCSV and intake manifold.

Ensure arrow on PCSV is pointing towards intake manifold. If vapor hose and hoses clamps are okay, go to next step. If vapor hose and hoses clamps are faulty, repair or replace as necessary and go to step 10 .

6. Turn ignition on. Using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent, monitor FTP sensor output voltage. Voltage should be 2-3 volts. If voltage is as specified, go to next step. If voltage is not as specified, temporarily install a known-good FTP sensor and check for proper operation. If problem is corrected, replace FTP sensor and go to step 10 .
7. Turn ignition off. Connect vacuum pump to PCSV nipple, apply vacuum and ensure PCSV holds vacuum. Disconnect PCSV 2-pin harness connector. Connect a fused jumper wire between battery voltage and PCSV connector terminal No. 2 (component side). With another fused jumper wire connected to PCSV connector terminal No. 1 (component side), apply ground by touching jumper wire on/off to ground. A clicking sound should be heard and vacuum should bleed off at this time. Repeat this procedure 4 or 5 times to ensure PCSV reliability. If valve is okay, go to next step. If valve is faulty, temporarily install a known-good PCSV and check for proper operation. If problem is corrected, replace valve and go to step 10 .
8. Turn ignition off. Disconnect Canister Close Valve (CCV) hose from EVAP canister. Blow air into hose and verify air escapes. Disconnect CCV 2-pin harness connector. Connect a fused jumper wire between battery voltage and CCV connector terminal No. 2 (component side). With another fused jumper wire connected to CCV connector terminal No. 1 (component side), apply ground. Blow air into hose removed from EVAP canister and verify air does not escapes from port. Repeat this procedure 4 or 5 times to ensure CCV reliability. If valve is okay, go to next step. If valve is faulty, temporarily install a known-good CCV and check for proper operation. If problem is corrected, replace valve and go to step 10 .
9. Thoroughly check for fuel leaks, cracks and damage at following items:
 - Fuel filler cap.
 - Fuel vent valve (ORVR).
 - Fuel cut valve (rollover valve).
 - FTP sensor.
 - EVAP hoses.
 - EVAP canister.

If above items are okay, go to next step. If above items are faulty, repair or replace as necessary and go to next step.

10. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

DTC P0443: EVAP EMISSION CONTROL SYSTEM PURGE CONTROL SOLENOID VALVE CIRCUIT MALFUNCTION

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

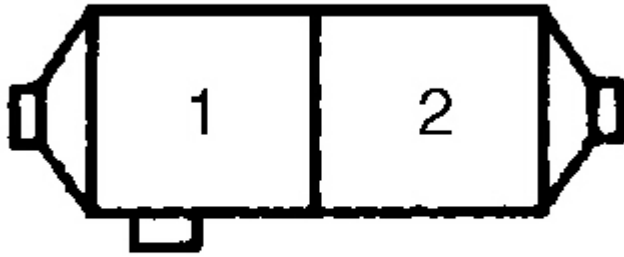
Diagnostic Aid

Malfunction code is set when solenoid coil surge voltage (system voltage +2) is not detected when EVAP emission vent solenoid is turned on/off. Check for following possible problems:

- Open or short between Main relay and Purge Control Solenoid Valve (PCSV).
- Open or short between PCSV and Engine Control Module (ECM).
- Faulty PCSV.

Test Procedure

1. Turn ignition off. Thoroughly check PCSV harness connector terminals for loose, bent, corroded, contaminated, deteriorated or damaged connector terminals. If connector terminals are okay, go to next step. If connector terminals are faulty, repair or replace as necessary and go to step 7 .
2. With PCSV 2-pin harness connector disconnected. See **Fig. 20** . Turn ignition on. Measure voltage between ground and PCSV harness connector terminal No. 1 (Brown wire). Voltage should be battery voltage. If voltage is as specified, go to step 4 . If voltage is not as specified, go to next step.
3. Turn ignition off. Locate fuses and Main relay in engine compartment fuse/relay box. Check Main relay operation and fuses condition. For Main relay operation test, see **FUEL PUMP & MAIN RELAYS (SEDONA)** under RELAYS & SOLENOIDS in SYSTEM & COMPONENT TESTING article. Also if necessary, check Main relay circuits. See **WIRING DIAGRAMS** article. If fuses, relay and circuits are okay, go to next step. If fuses, relay or circuits are faulty, repair or replace as necessary, and go to step 7 .
4. Measure resistance between PCSV connector terminal No. 1 and 2 (component side). Resistance should be 30-34 ohms at 68°F (20°C). If resistance is as specified, go to next step. If resistance is not as specified, temporarily install a known-good PCSV and check for proper operation. If problem is corrected, replace valve and go to step 7 .
5. Disconnect ECM harness connector "A". See **Fig. 4** . Measure resistance between PCSV connector terminal No. 2 (Green/Red wire) and ECM connector terminals A25. Resistance should be below one ohm. If resistance is as specified, go to next step. If resistance is not as specified, repair open circuit as necessary and go to step 7 .
6. With PCSV and ECM harness connectors disconnected. Measure resistance between ground and PCSV harness connector terminals No. 2 (Green/Red wire). Resistance should be infinite. If resistance is as specified, temporarily install a Known-good PCSV and check for proper operation. If problem is corrected, replace PCSV and go to next step. If resistance is not as specified, repair short circuit as necessary and go to next step.
7. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



G00140005

Fig. 20: Identifying Purge Control Solenoid Valve Connector Terminals
Courtesy of KIA MOTORS AMERICA, INC.

DTC P0446: EVAP EMISSION CONTROL SYSTEM VENT CONTROL MALFUNCTION

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

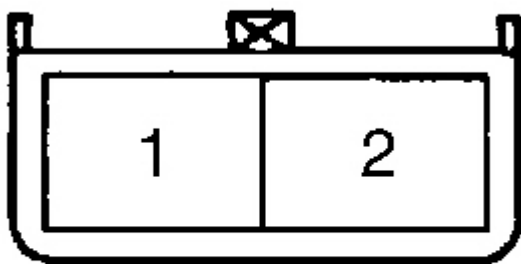
Malfunction code is set when solenoid coil surge voltage (system voltage +2) is not detected when EVAP emission vent solenoid is turned on/off. Check for following possible problems:

- Open or short between Main relay and Canister Control Valve (CCV).
- Open or short between CCV and Engine Control Module (ECM).
- Faulty CCV.

Test Procedure

1. Turn ignition off. Thoroughly check CCV harness connector terminal for loose, bent, corroded, contaminated, deteriorated or damaged connector terminals. If connector terminals are okay, go to next step. If connector and terminals are faulty, repair or replace as necessary and go to step 7 .

2. Disconnect CCV 2-pin harness connector. Measure resistance between CCV connector terminal No. 1 and 2 (component side). Resistance should be 23-26 ohms at 68°F (20°C). If resistance is as specified, go to next step. If resistance is not as specified, temporarily install a known-good PCSV and check for proper operation. If problem is corrected, replace valve and go to step 7 .
3. With CCV 2-pin harness connector disconnected. See **Fig. 21** . Turn ignition on. Measure voltage between ground and CCV harness connector terminal No. 1 (Brown wire). Voltage should be battery voltage. If voltage is as specified, go to step 7 . If voltage is not as specified, go to next step.
4. Turn ignition off. Locate fuses and Main relay in engine compartment fuse/relay box. Check Main relay operation and fuses condition. For Main relay operation test, see **FUEL PUMP & MAIN RELAYS (SEDONA)** under RELAYS & SOLENOIDS in SYSTEM & COMPONENT TESTING article. Also if necessary check Main relay circuits. See **WIRING DIAGRAMS** article. If fuses, relay and circuits are okay, go to next step. If fuses, relay or circuits are faulty, repair or replace as necessary, and go to step 7 .
5. Disconnect ECM harness connector "A". See **Fig. 4** . Measure resistance between CCV connector terminal No. 2 (White wire) ECM connector terminals A24. Resistance should be below one ohm. If resistance is as specified, go to next step. If resistance is not as specified, repair open circuit as necessary and go to step 7 .
6. With CCV and ECM harness connectors disconnected. Measure resistance between ground and CCV harness connector terminals No. 2 (White wire). Resistance should be infinite. If resistance is as specified, temporarily install a Known-good CCV and check for proper operation. If problem is corrected, replace CCV and go to next step. If resistance is not as specified, repair short circuit as necessary and go to next step.
7. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



G00140006

Fig. 21: Identifying Canister Control Valve Connector Terminals
Courtesy of KIA MOTORS AMERICA, INC.

DTC P0451: EVAP EMISSION CONTROL SYSTEM PRESSURE SENSOR RANGE/MALFUNCTION, DTC P0452: EVAP EMISSION CONTROL SYSTEM PRESSURE SENSOR LOW INPUT & DTC P0453: EVAP EMISSION CONTROL SYSTEM PRESSURE SENSOR HIGH INPUT

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Malfunction code will set if Engine Control Module (ECM) determines fuel tank pressure exceeds predetermined limit. Check for following possible problems:

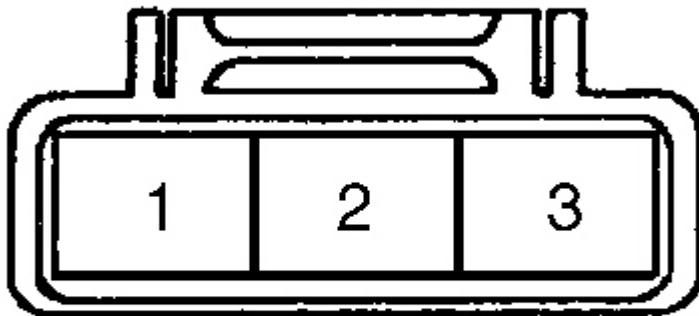
- Open or short between Fuel Tank Pressure (FTP) sensor and ECM.
- Poor connection between FTP sensor and ECM.
- Faulty FTP sensor.
- Stuck close CCV.
-

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If DTC P0446 is set, do all repairs associated with that DTC before continuing with this procedure. If no other DTCs are set, go to next step.
2. Using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent, monitor FTP sensor output voltage. Voltage should be 2.2-2.8 volts. If voltage is not as specified, go to next step. If voltage is as specified, problem is intermittent, check FTP sensor and ECM for proper harness connections and go to step 9 .
3. Turn ignition off. Thoroughly check FTP sensor harness connector terminals for loose, bent, corroded, contaminated, deteriorated or damaged connector terminals. If connector terminals are okay, go to next step. If connector and terminals are faulty, repair or replace as necessary and go to step 9 .
4. Disconnect FTP sensor 3-pin harness connector. See **Fig. 22** . Turn ignition on. Measure voltage between ground and FTP sensor connector terminal No. 2 (Yellow wire). Voltage should be approximately 5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair open circuit or short circuit as necessary and go to step 9 .
5. Turn ignition off. Disconnect ECM harness connector "B" and "C". See **Fig. 4** . Turn ignition on. Measure voltage between ground and FTP sensor connector terminal No. 3 (Red wire). Voltage should be below 0.5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair short circuit as necessary and go to step 9 .
6. Turn ignition off. With FTP sensor and ECM harness connectors disconnected, measure resistance between FTP sensor connector terminal No. 3 (Red wire) and ECM connector terminal C26. Also

measure resistance between FTP sensor connector terminal No. 2 (Yellow wire) and ECM connector terminal B1. Both resistances should be below one ohm. If resistances are as specified, go to next step. If any resistance is not as specified, repair open or short circuit as necessary and go to step 9 .

7. With FTP sensor and E/TCM harness connectors disconnected. Measure resistance between ground and FTP sensor connector terminals No. 3 (Red wire). Resistance should be infinite. If resistances is as specified, temporarily install a Known-good FTP sensor and check for proper operation. If problem is corrected, replace FTP sensor and go to step 9 . If resistance is not as specified, repair short circuit as necessary and go to next step.
8. Disconnect Canister Close Valve (CCV) hose from EVAP canister. Blow air into hose and verify air escapes. With CCV 2-pin harness connector disconnected. Connect a fused jumper wire between battery voltage and CCV connector terminal No. 2 (component side). With another fused jumper wire connected to CCV connector terminal No. 1 (component side), apply ground. Blow air into hose removed from EVAP canister and verify air does not escapes from port. Repeat this procedure 4 or 5 times to ensure CCV reliability. If valve is okay, thoroughly check harness connectors terminals for loose, bent or corroded connector terminals between FTP sensor, CCV and ECM. Repair if necessary and go to next step. If valve is faulty, temporarily install a known-good CCV and check for proper operation. If problem is corrected, replace valve and go to next step.
9. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



G00140007

Fig. 22: Identifying Fuel Tank Pressure Sensor Connector Terminals
Courtesy of KIA MOTORS AMERICA, INC.

DTC: P0460: FUEL LEVER SENSOR CIRCUIT RANGE/PERFORMANCE MALFUNCTION, DTC: P0462: FUEL LEVER SENSOR CIRCUIT LOW INPUT & DTC: P0463: FUEL LEVER SENSOR CIRCUIT HIGH INPUT

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

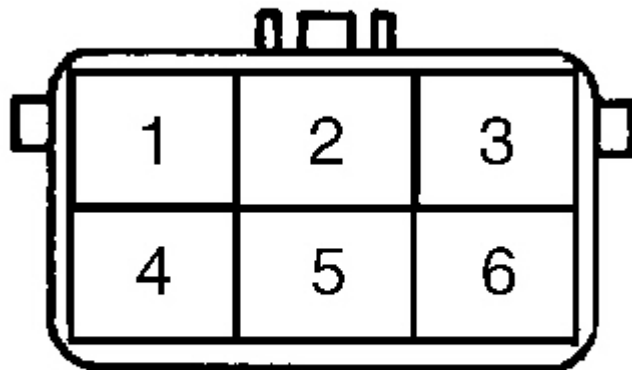
Diagnostic Aids

Malfunction code enable criteria not available from manufacturer. Check for following possible problems:

- Open or short between Fuel Lever Sensor (FLS) and Engine Control Module (ECM).
- Poor connection between FLS and ECM.
- Misplaced, loose, bent corroded harness connector terminals.
- Faulty FLS.

Test Procedure

1. Turn ignition off. Disconnect fuel tank unit 6-pin harness connector. See **Fig. 23** . Turn ignition on. Measure voltage between ground and FLS connector terminal No. 1 (White/Green wire). Voltage should be approximately 5 volts. If voltage is as specified, go to next step. If voltage is not as specified, repair open or short circuit as necessary and go to step.3 .
2. Turn ignition off. Thoroughly check FLS and ECM connectors terminals for loose, bent, corroded, contaminated, deteriorated or damaged connectors terminals. If connectors terminals are okay, temporarily install a Known-good FLS and check for proper operation. If problem is corrected, replace FLS and go to next step. If connector and terminals are faulty, repair or replace as necessary and go to next step.
3. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



G00140008

Fig. 23: Identifying Fuel Level Sensor Connector Terminals
Courtesy of KIA MOTORS AMERICA, INC.

DTC P0506: IDLE CONTROL SYSTEM RPM LOWER THAN EXPECTED

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS**.

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Malfunction code will set when engine actual idle speed is 120 RPM or more, lower than target idle speed for 10 seconds. Check for following possible problems:

- Open or short between Main relay and Idle Air Control-Stepper Motor (IAC-STM).
- Open or short between Engine Control Module (ECM) and IAC-STM.
- Faulty IAC-STM.
- Carbon fouled throttle plate.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If DTCs related to Throttle Position (TP) sensor, Mass Air Flow (MAF) sensor, fuel injector or DTC P0510 are set, do all repairs associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.
2. Turn ignition off. Thoroughly check IAC-STM for damage. Also check for loose, bent, corroded, contaminated, deteriorated or damage IAC-STM and ECM connectors terminals. If valve and connectors terminals are okay, go to next step. If valve and connectors terminals are faulty, repair or replace as necessary and go to step 9 .
3. Turn ignition off. Disconnect IAC-STM 6-pin harness connector. See **Fig. 24** . Turn ignition on. Measure voltage between ground and IAC-STM connector terminal No. 2 and 5 (Brown wire). Voltage should be battery voltage. If voltage is as specified, go to step 5 . If voltage is not as specified, go to next step.
4. Turn ignition off. Locate fuses and Main relay in engine compartment fuse/relay box. Check Main relay operation and fuses condition. For Main relay operation test, see **FUEL PUMP & MAIN RELAYS (SEDONA)** under RELAYS & SOLENOIDS in SYSTEM & COMPONENT TESTING article. Also if necessary check Main relay circuits. See **WIRING DIAGRAMS** article. If fuses, relay and circuits are okay, go to next step. If fuses, relay or circuits are faulty, repair or replace as necessary, and go to step 9 .
5. Measure resistance at IAC-STM (component side) as indicated follow. See **IDLE AIR CONTROL - STOPPER MOTOR COIL RESISTANCE TEST** table. If resistance is as specified, go to next step. If resistance is not as specified, temporarily install a known-good IAC-STM and check for proper operation. If problem is corrected, replace valve and go to step 9 .

IDLE AIR CONTROL-STOPPER MOTOR COIL RESISTANCE TEST

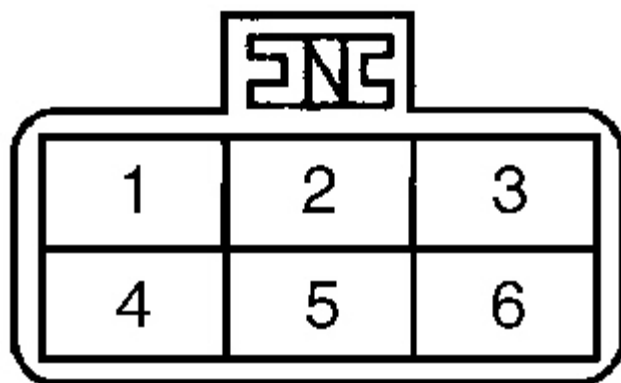
Measure Resistance Between IAC-STM Connector Terminals (Component Side)	Resistance Specifications
No. 5 & No. 1	29-38 Ohms @ 68°F (20° C)
No. 5 & No. 3	29-38 Ohms @ 68°F (20° C)
No. 2 & No. 4	29-38 Ohms @ 68°F (20° C)
No. 2 & No. 6	29-38 Ohms @ 68°F (20° C)

6. Check entire intake air system for debris, blockage, excessive dirt or other damage (specially, air tubes and air cleaner element). Also check entire intake air system for leaks (specially, PCV connectors and hose, vacuum supply connectors and hoses, intake air tube, air cleaner housing, throttle body, gaskets seals, etc.). If no problem is found, go to next step. If problem is found, repair or replace as necessary and go to step 9 .
7. Turn ignition off. Disconnect ECM harness connector "A". See **Fig. 4** . Measure resistance between IAC-STM harness connector terminals and ECM harness connector terminals, as indicated bellow. See **IDENTIFYING IAC-STM-TO-ECM CIRCUITS** table. All resistances should be below one ohm. If resistances are as specified, go to next step. If any resistance is not as specified, repair open or short circuit as necessary and go to step 9 .

IDENTIFYING IAC-STM-TO-ECM CIRCUITS

IAC Valve STM Connector Terminal	Wire Color	ECM Connector Terminal
No. 1	White/Red	A31
No. 3	Blue/Red	A18
No. 4	Green	A30
No. 6	Black/White	A17

8. With IAC-STM and ECM harness connectors disconnected. Turn ignition on. Measure voltage between ground and IAC-STM harness connector terminals No. 1 (White/Red wire), No. 3 (Blue/Red wire), No. 4 (Green wire) and No. 6 (Black/White wire). All voltages should be below 0.5 volts. If voltages are as specified go to next step. If any voltage is not as specified, repair short circuit as necessary and go to next step.
9. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



G00140009

Fig. 24: Identifying Idle Air Control-Stopper Motor Connector Terminals
 Courtesy of KIA MOTORS AMERICA, INC.

DTC P0507: IDLE CONTROL SYSTEM RPM HIGHER THAN EXPECTED

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS**.

NOTE: Testing individual components does not isolate shorts or opens. Perform all

voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Malfunction code will set when engine actual idle speed is 120 RPM or more, higher than target idle speed for 10 seconds. Check for following possible problems:

- Short between Idle Air Control-Stopper Motor (IAC-STM) and Engine Control Module (ECM).
- Air leak in intake system.
- Improperly adjusted accelerator cable.
- Faulty IAC-STM valve.
- Faulty Throttle Position (TP) sensor.
- Faulty Positive Crankcase ventilation (PCV) valve.
- Faulty Purge Control Solenoid Valve (PCSV).

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If DTCs related to Throttle Position (TP) sensor, Mass Air Flow (MAF) sensor, fuel injector or DTC P0510 are set, do all repairs associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.
2. Start engine. Allow engine to idle until reaches normal operating temperature. Using Hi-Scan Pro/Kia Data Pro Scan tool, monitor TP sensor voltage signal. Voltage should be 0.3-0.9 volts at idle, with throttle body fully closed. If voltage is as specified, go to next step. If voltage is not as specified, do all repairs associated with TP sensor. See **DTC P0121: THROTTLE POSITION SENSOR CIRCUIT RANGE/PERFORMANCE MALFUNCTION, DTC P0122: THROTTLE POSITION SENSOR CIRCUIT LOW INPUT & DTC P0123: THROTTLE POSITION SENSOR CIRCUIT HIGH INPUT** . After repair, go to step 12 .
3. Turn ignition off. Check accelerator cable free play. Free play should be, 0.040-0.120 in (1.0-3.0 mm). If accelerator cable is as specified, go to next step. If accelerator cable is not as specified, adjust or replace cable as necessary and go to step 12 .
4. Thoroughly check IAC-STM for damage. Also check for loose, bent, corroded, contaminated, deteriorated or damage IAC-STM and ECM connectors terminals. If IAC-STM and connectors terminals are okay, go to next step. If IAC-STM and connectors terminals are faulty, repair or replace as necessary and go to step 12 .
5. Disconnect IAC-STM 6-pin harness connector. See **Fig. 24** . Turn ignition on. Measure voltage between ground and IAC-STM connector terminal No. 2 and No. 5 (Brown wire). Voltage should be battery voltage. If voltage is as specified, go to step 7 . If voltage is not as specified, go to next step.
6. Turn ignition off. Locate fuses and Main relay in engine compartment fuse/relay box. Check Main relay operation and fuses condition. For Main relay operation test, see **FUEL PUMP & MAIN RELAYS (SEDONA)** under RELAYS & SOLENOIDS in SYSTEM & COMPONENT TESTING article. Also if necessary check Main relay circuits. See **WIRING DIAGRAMS** article. If fuses, relay and circuits are

okay, go to next step. If fuses, relay or circuits are faulty, repair or replace as necessary, and go to step 12 .

7. Measure resistance at IAC-STM (component side) as indicated follow. See **IDLE AIR CONTROL-STOPPER MOTOR COIL RESISTANCE TEST** table. If resistance is as specified, go to next step. If resistance is not as specified, temporarily install a known-good IAC-STM and check for proper operation. If problem is corrected, replace IAC-STM and go to step 12 .

IDLE AIR CONTROL-STOPPER MOTOR COIL RESISTANCE TEST

Measure Resistance Between IAC Valve STM Connector Terminals (Component Side)	Resistance Specifications
No. 5 & No. 1	29-38 Ohms @ 68°F (20° C)
No. 5 & No. 3	29-38 Ohms @ 68°F (20° C)
No. 2 & No. 4	29-38 Ohms @ 68°F (20° C)
No. 2 & No. 6	29-38 Ohms @ 68°F (20° C)

8. Check entire intake air system for debris, blockage, excessive dirt or other damage (specially, air tubes and air cleaner element). Also check entire intake air system for leaks (specially, PCV connectors and hose, vacuum supply connectors and hoses, intake air tube, air cleaner housing, throttle body, gaskets seals, etc.). If no problem is found, go to next step. If problem is found, repair or replace as necessary and go to step 12 .
9. With IAC-STM disconnected. Disconnect ECM harness connector "A". See **Fig. 4** . Measure resistance between ground and IAC-STM harness connector terminals No. 1 (White/Red wire), No. 3 (Blue/Red wire), No. 4 (Green wire) and No. 6 (Black/White wire). All resistances should be infinity. If resistances are as specified go to next step. If any resistance is not as specified, repair short circuit as necessary and go to next step.
10. Measure resistance between IAC-STM harness connector terminals and ECM harness connector terminals, as indicated bellow. See **IDENTIFYING IAC-STM TO ECM CIRCUITS** table. All resistances should be below one ohm. If resistances are as specified, go to next step. If any resistance is not as specified, repair open or short circuit as necessary and go to step 12 .

IDENTIFYING IAC-STM TO ECM CIRCUITS

IAC Valve STM Connector Terminal	Wire Color	ECM Connector Terminal
No. 1	White/Red	A31
No. 3	Blue/Red	A18
No. 4	Green	A30
No. 6	Black/White	A17

11. With IAC-STM and ECM harness connectors disconnected. Turn ignition on. Measure voltage between ground and IAC-STM harness connector terminals No. 1 (White/Red wire), No. 3 (Blue/Red wire), No. 4 (Green wire) and No. 6 (Black/White wire). All voltages should be below 0.5 volts. If voltages are as specified go to next step. If any voltage is not as specified, repair short circuit as necessary and go to next

step.

12. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

DTC P0510: IDLE SWITCH CIRCUIT MALFUNCTION

NOTE: Idle Switch is built into Throttle Position (TP) sensor and they share same harness connector.

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

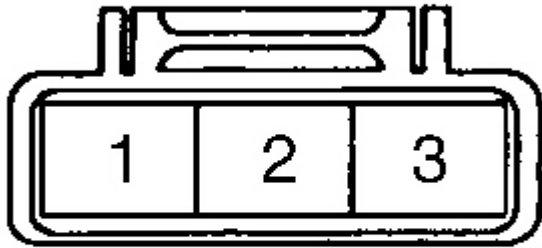
Diagnostic Aids

Malfunction code enable criteria not available from manufacturer. Check for following possible problems:

- Open or short between Idle Switch in TP sensor and Engine Control Module (ECM).
- Faulty Idle Switch in TP sensor.

Test Procedure

1. Turn ignition off. Connect Hi-Scan Pro/Kia Data Pro Scan tool or equivalent to OBD-II Data Link Connector. See **Fig. 1** . Turn ignition on. Monitor for other DTCs. If DTC P0120, P0122 or P0123 are set, do all repairs associated with those DTCs before continuing with this procedure. If no other DTCs are set, go to next step.
2. Turn ignition off. Thoroughly check TP sensor for damage. Also check for loose, bent, corroded, contaminated, deteriorated or damage TP sensor connectors terminals. If sensor and connectors terminals are okay, go to next step. If sensor and connectors terminals are faulty, repair or replace as necessary and go to step 4 .
3. Disconnect Idle Switch-TP sensor 5-pin harness connector. See **Fig. 25** . Turn ignition on. Measure voltage between Idle Switch-TP sensor connector terminal No. 3 (Blue/White wire). Voltage should be approximately 5 volts. If voltage is as specified, temporarily install a known-good TP sensor and check for proper operation. If problem is corrected, replace TP sensor and go to next step. If voltage is not as specified, repair open or short circuit as necessary and go to next step.
4. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



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Fig. 25: Identifying Throttle Position Sensor Connector Terminals
Courtesy of KIA MOTORS AMERICA, INC.

DTC P0560: BATTERY BACKUP LINE OPEN

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Malfunction code enable criteria not available from manufacturer. Check for following possible problems:

- Open or short between Engine Control Module (ECM) and battery.
- Faulty ECM.

Test Procedure

1. Turn ignition off. Disconnect ECM harness connector "B". Turn ignition on. Measure voltage between ground and ECM harness connector terminal B18 (White/Red wire). See **Fig. 4** . Voltage should be battery voltage. If voltage is as specified, check for poor, loose, damaged and corroded terminals at ECM. Repair if necessary and go to step 3 . If voltage is not as specified, go to next step.
2. Turn ignition off. Check P/TRAIN fuse (15 amp) in engine compartment fuse/relay box. If P/TRAIN fuse condition is okay, check circuit between ECM connector terminal B18 (White/Red wire) and battery

voltage supply (Black wire). See **WIRING DIAGRAMS** article. if circuit is faulty, repair as necessary and go to step 4 . If circuit is okay, go to next step. If P/TRAIN fuse is blown, repair short circuit between battery voltage supply(Black wire) and ECM connector terminal B18 (White/Red wire). Repair as necessary, replace P/TRAIN fuse (15 amp) and go to step 4 .

3. Temporarily install a known-good ECM and check for proper operation. If problem is corrected, replace ECM and go to next step.
4. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

DTC P1330: SPARK TIMING ADJUSTMENT

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

Diagnostic Aids

Malfunction code enable criteria not available from manufacturer. Check for short between ROM Change Tool (RCT) and Engine Control Module (ECM).

Test Procedure

1. Turn ignition off. Disconnect ECM harness connector "A". Measure resistance between ground and ECM connector terminal A9. Resistance should be infinity. If resistance is as specified, problem is intermittent, check ECM for proper harness connection and go to next step. If resistance is not as specified. repair short circuit as necessary and go to next step.
2. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.

DTC P1521: POWER STEERING SWITCH MALFUNCTION

NOTE: Before performing any diagnostic test, refer to **WARNINGS, CAUTIONS** and **NOTES** under **DIAGNOSTIC TESTS** .

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter Meter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

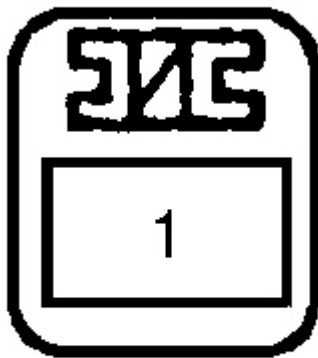
Diagnostic Aids

Malfunction code will set when power steering switch remains on. Check for following possible problems:

- Open between power steering switch and Engine Control Module (ECM).
- Short between power steering switch and ECM.
- Faulty Power steering switch.

Test Procedure

1. Turn ignition off. Disconnect power steering switch one pin harness connector. See **Fig. 26** . Turn ignition on. Measure voltage between ground and power steering switch harness connector (Green/Yellow wire). Voltage should be approximately 10-15 volts. If voltage is specified, go to next step. If voltage is not as specified, repair open or short circuit as necessary and go to step 3 .
2. With power steering switch disconnected, check for poor contact due to bent, damage or misplaced connector terminal. If connector terminal is okay, temporarily install a Known-good power steering switch and check for proper operation. If problem is corrected, replace power steering switch and go to next step.
3. After repair, return vehicle to original condition. Clear codes using Hi-Scan Pro/Kia Data Pro Scan tool or equivalent. Verify repairs by driving vehicle and monitoring for pending codes. If DTC is set during test drive, follow appropriate DTC test procedure.



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Fig. 26: Identifying Power Steering Switch Connector Terminal
Courtesy of KIA MOTORS AMERICA, INC.