ELECTRONIC ENGINE CONTROLS
03

CONTENTS

03

1.6L & 1.8L ENGINE CONTROLS

GENERAL INFORMATION

Description

The Engine Control Module (ECM) utilizes integrated circuitry and information carried on the Controller Area Network (CAN) data bus along with many hard wired inputs to monitor many sensor and switch inputs throughout the vehicle. In response to those inputs, the internal circuitry and programming of the ECM allow it to control and integrate many electronic functions and features of the vehicle through both hard wired outputs and the transmission of electronic message outputs to other electronic modules in the vehicle over the CAN data bus.

The following are the input and output components monitored by the ECM. The components monitored belong to the engine, ignition, transaxle, air conditioning, or any other ECM supported subsystems.

ECM Inputs

- Brake Switch Sensor
- Refrigerant Pressure Sensor
- Camshaft Position (CMP) Sensor
- Crankshaft Position (CKP) Sensor
- Engine Coolant Temperature (ECT) Sensor
- Manifold Absolute Pressure (MAP) Sensor (1.6L)
- Air Flow Sensor (1.8L)
- Throttle Position Sensor (integral with Electric Throttle Control Actuator)
- Power Steering Switch
- Accelerator Pedal Position (APP) Sensor
- Knock Sensor
- Oxygen Sensor (1&2)
- Vehicle Speed Sensor
- Clutch Pedal Switch (manual transmission only)

ECM Outputs

- Canister Control Valve
- Fuel Injectors
- Fuel Pump Relay
- Electric Throttle Control Actuator
- Ignition Coil
- A/C Compressor
- Cooling Fan
- Oxygen Sensor Heater (1&2)

Operation

The ECM monitors components and circuits, and tests them in various ways depending on the hardware, function, and type of signal. For example, analog inputs, such as throttle position or engine coolant temperature are typically checked for opens, shorts and out-of-range values. This type of monitoring is carried out continuously. Some digital inputs like vehicle speed or crankshaft position rely on rationality checks - checking to see if the input value makes sense at the current engine operating conditions. These types of tests may require monitoring several components and can only be carried out under appropriate test conditions.

The ECM is a pre-programmed, microprocessor-based digital computer. It regulates ignition timing, air-fuel ratio, emission control devices, charging system, certain transmission features, speed control, air conditioning compressor clutch engagement and idle speed. The ECM can adapt its programming to meet changing operating conditions.

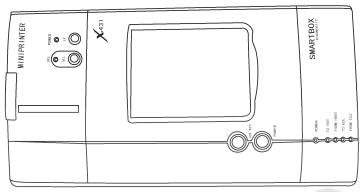
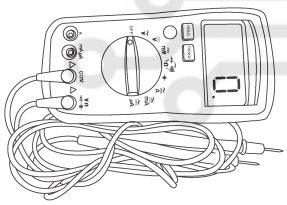
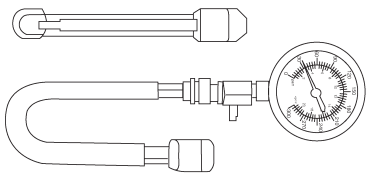
Specifications

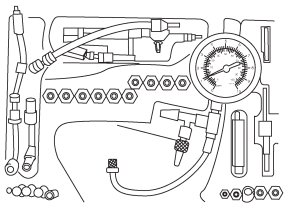
Torque Specifications

DESCRIPTION	TORQUE (N·m)
Engine Coolant Temperature Sensor	20
Knock Sensor	20
Oxygen Sensors	45
Crankshaft Position Sensor	10

DESCRIPTION	TORQUE (N·m)
Camshaft Position Sensor	7
Air Flow Sensor Bolts	5
Engine Control Module Bolts	6
Accelerator Pedal Position Sensor	11
Electronic Throttle Control Actuator	10
Vehicle Speed Sensor	10
Manifold Absolute Pressure Sensor	6

Special Tools

Diagnostic Scan Tool X-431	 besm030001
Digital Multimeter Fluke 15B & 17B	 besm030002
Compression Gauge	 besm030009

Fuel Pressure Gauge	 besm030008

X-431 Diagnostic Scan Tool

The X-431 is a newly developed automobile diagnostic computer. The X-431 is used to diagnose vehicle systems. The X-431 communicates with the vehicle through the data link connector.

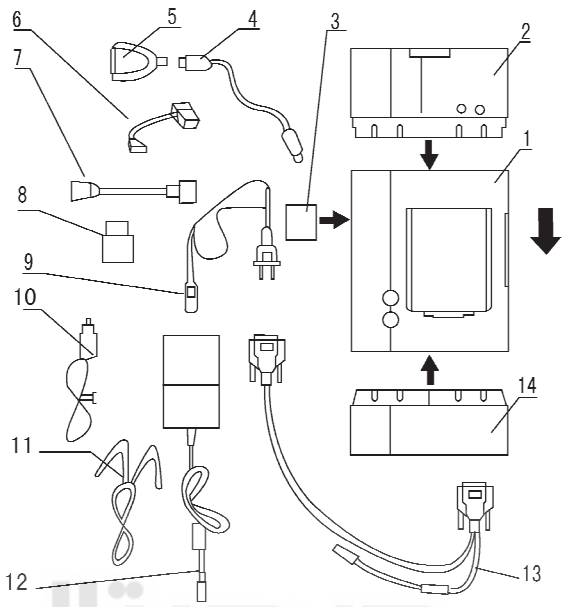
X-431 Diagnose Vehicle System List

CHAPTER	SYSTEM
03	Electronic Engine Controls
08	Transaxle
12	Brakes
14	Restraints
15	Body & Accessories

Hardware Requirements

The hardware configuration of X-431 is as follows:

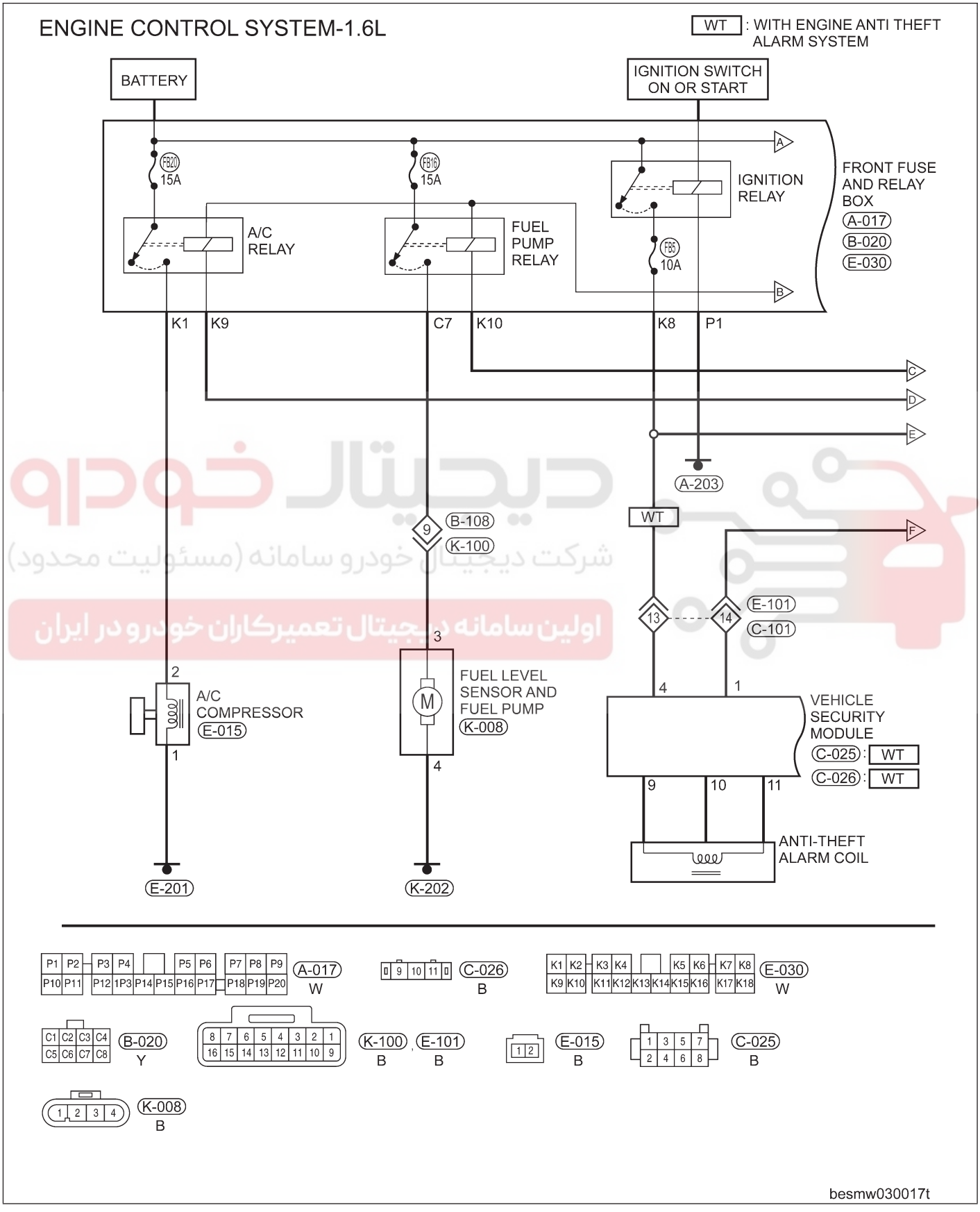
Diagnostic Scan Tool Configuration



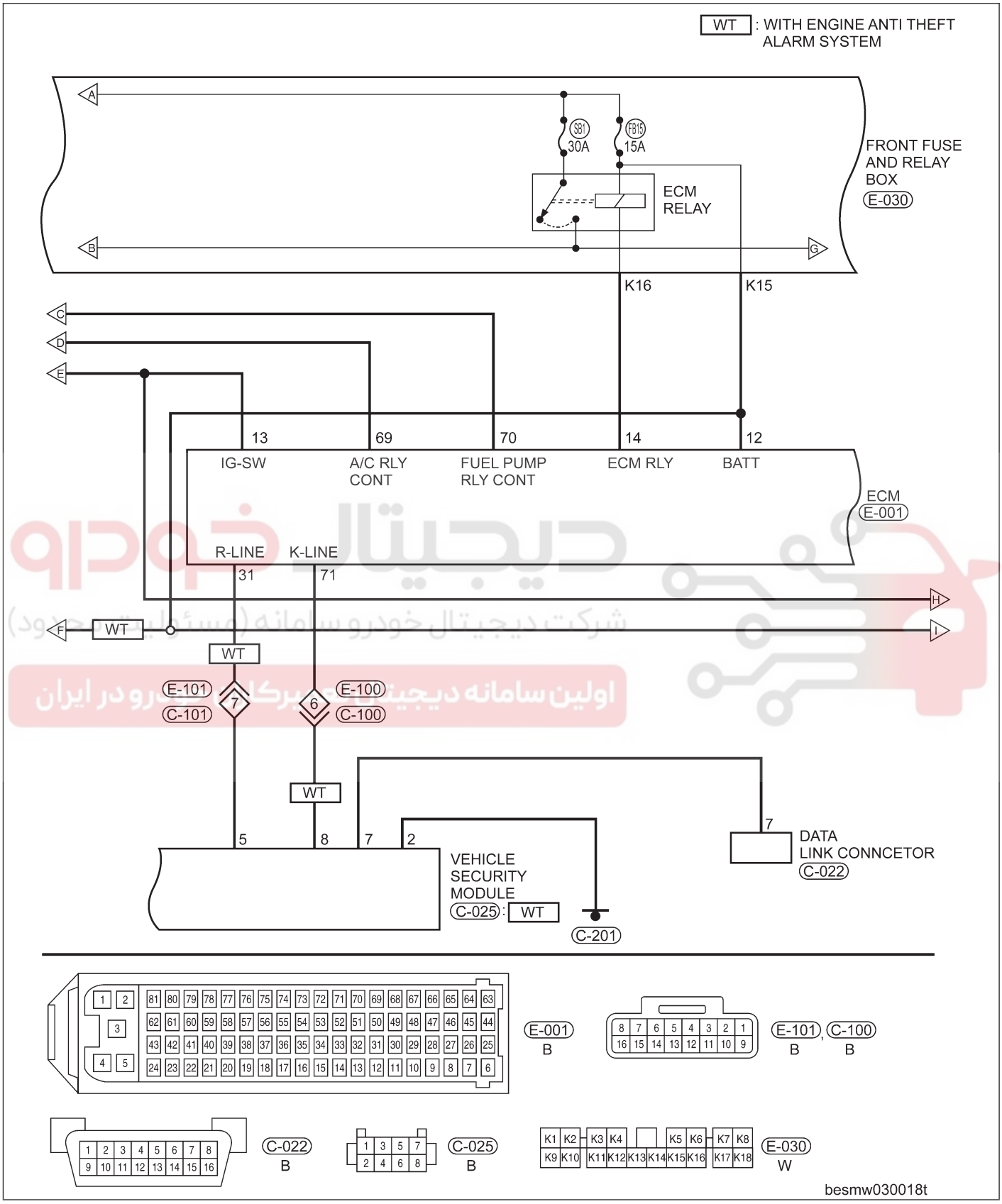
ITEM	NAME	DESCRIPTION
1	X-431 Main Unit	To Display Operational Buttons, Test Results, Help Information, etc.
2	Mini-Printer	To Print Test Results. (Optional)
3	CF Cartridge	To Store Diagnostic Software and Data
4	USB Cable	To Connect CF Card Reader/ Writer and Computer
5	CF Card Reader/Writer	To Read or Write Data On The CF Card
6	Mitsubishi-12+16 Pin Connector	To Diagnose Mitsubishi Electronic Control Systems On Chery B11 Series
7	Fiat-3 Pin Connector	To Diagnose Vehicles With Fiat-3 Pin Diagnostic Connector
8	Smart OBDII-16 Pin Connector	To Diagnose Other Systems Of Vehicle With OBDII-16 Pin Diagnostic Connector
9	Power Cord	To Connect AC 100-240V Outlet and Power Adapter
10	Cigarette Lighter Cable	To Get Power From Vehicle Cigarette Lighter
11	Battery Cable W/Two Clips	To Get Power From Vehicle Battery
12	Power Adapter	To Convert 100-240V AC Power Into 12V DC Power
13	Main Cable	To Connect The Diagnostic Connector and Smartbox
14	Smartbox	To Perform Vehicle Diagnosis

Electrical Schematics

Electronic Engine Controls (Page 1 of 16)



Electronic Engine Controls (Page 2 of 16)



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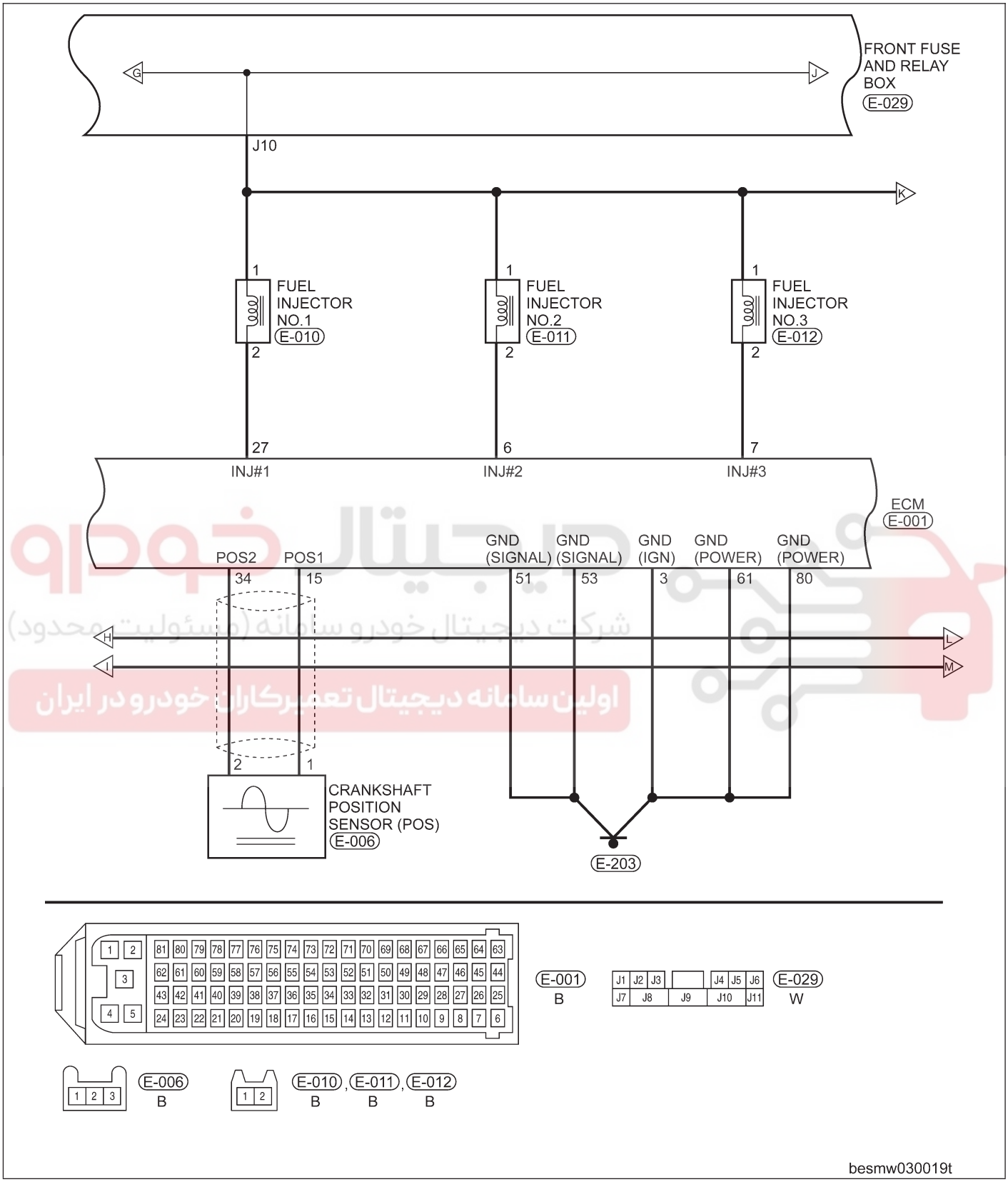

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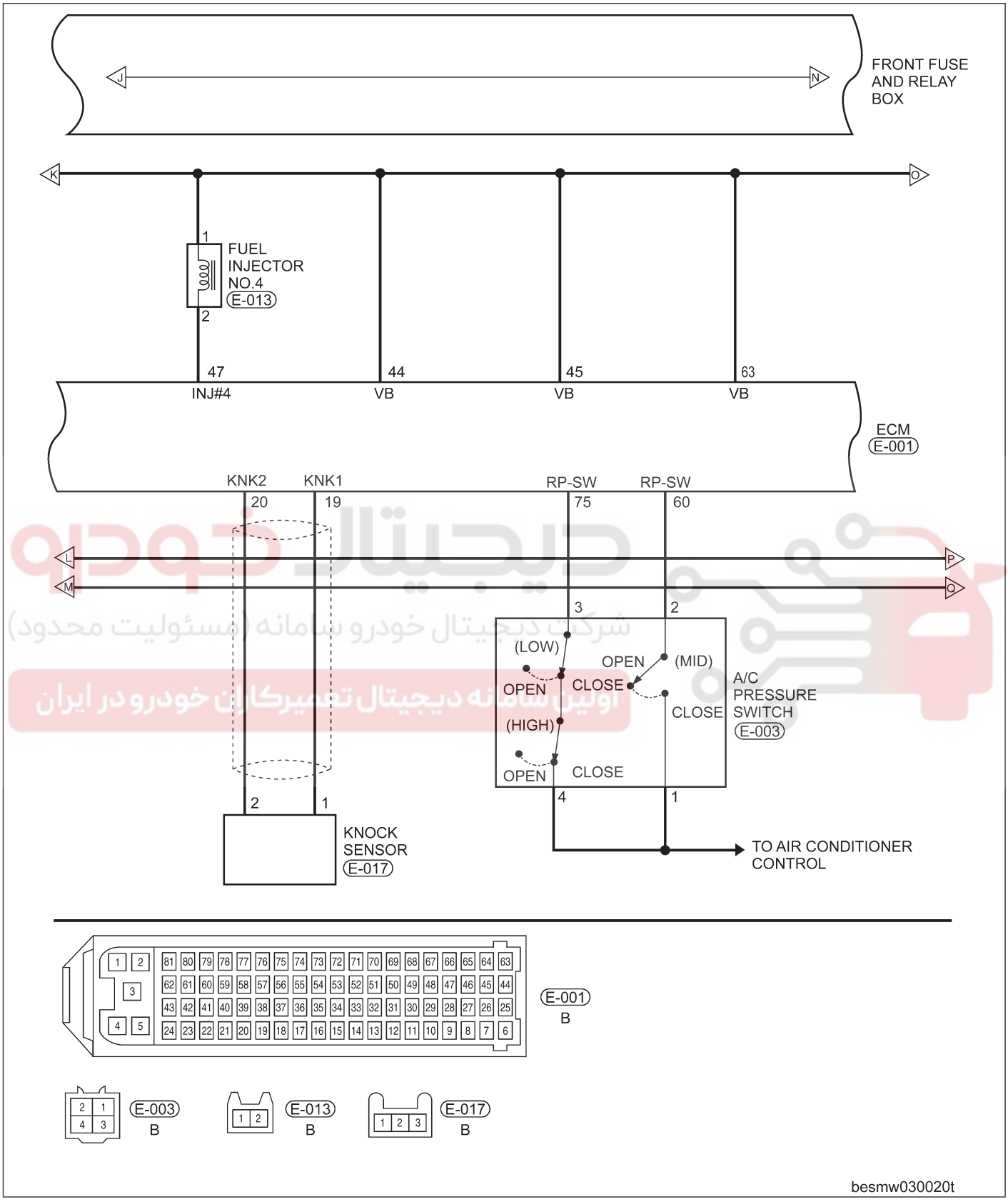

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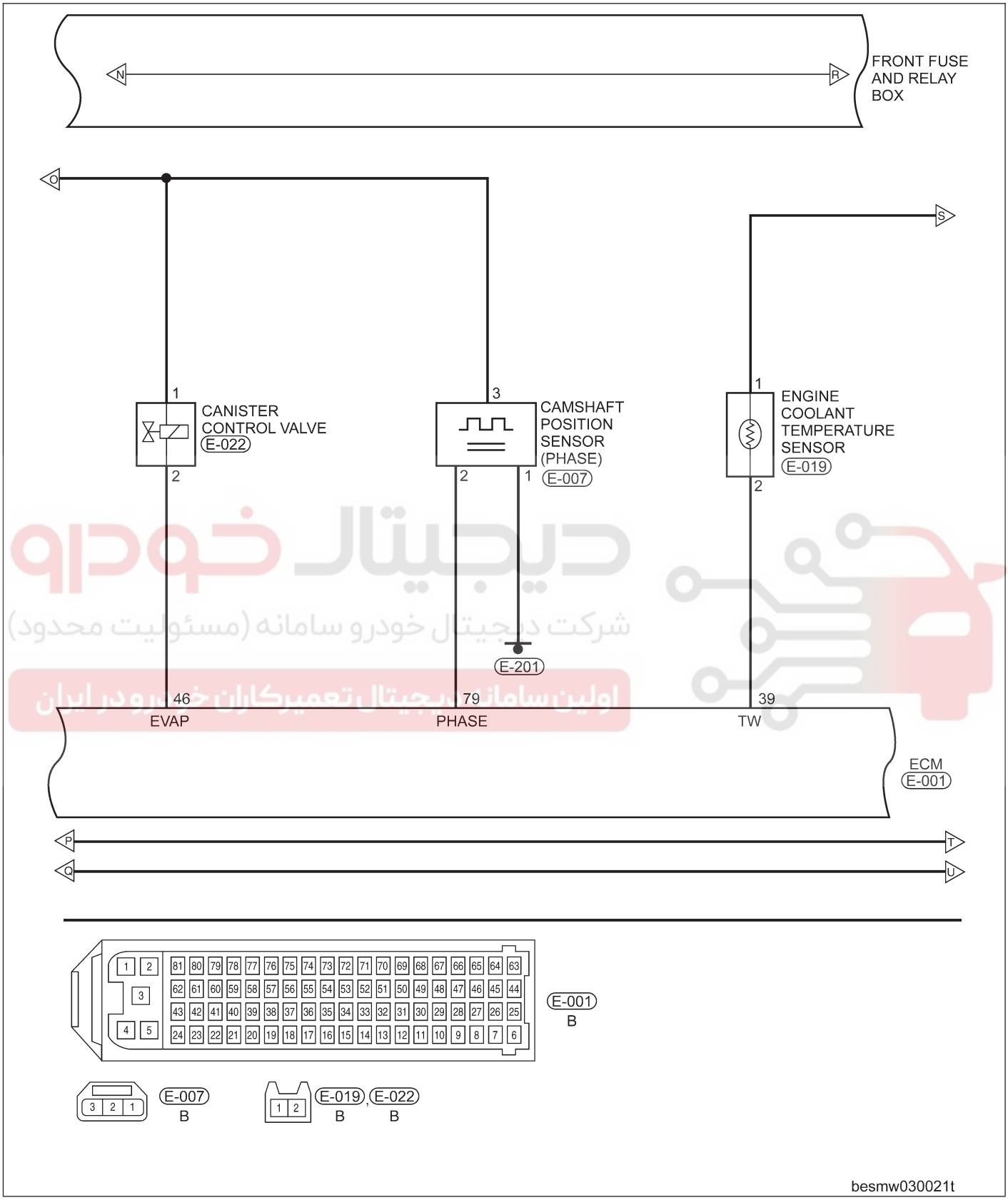

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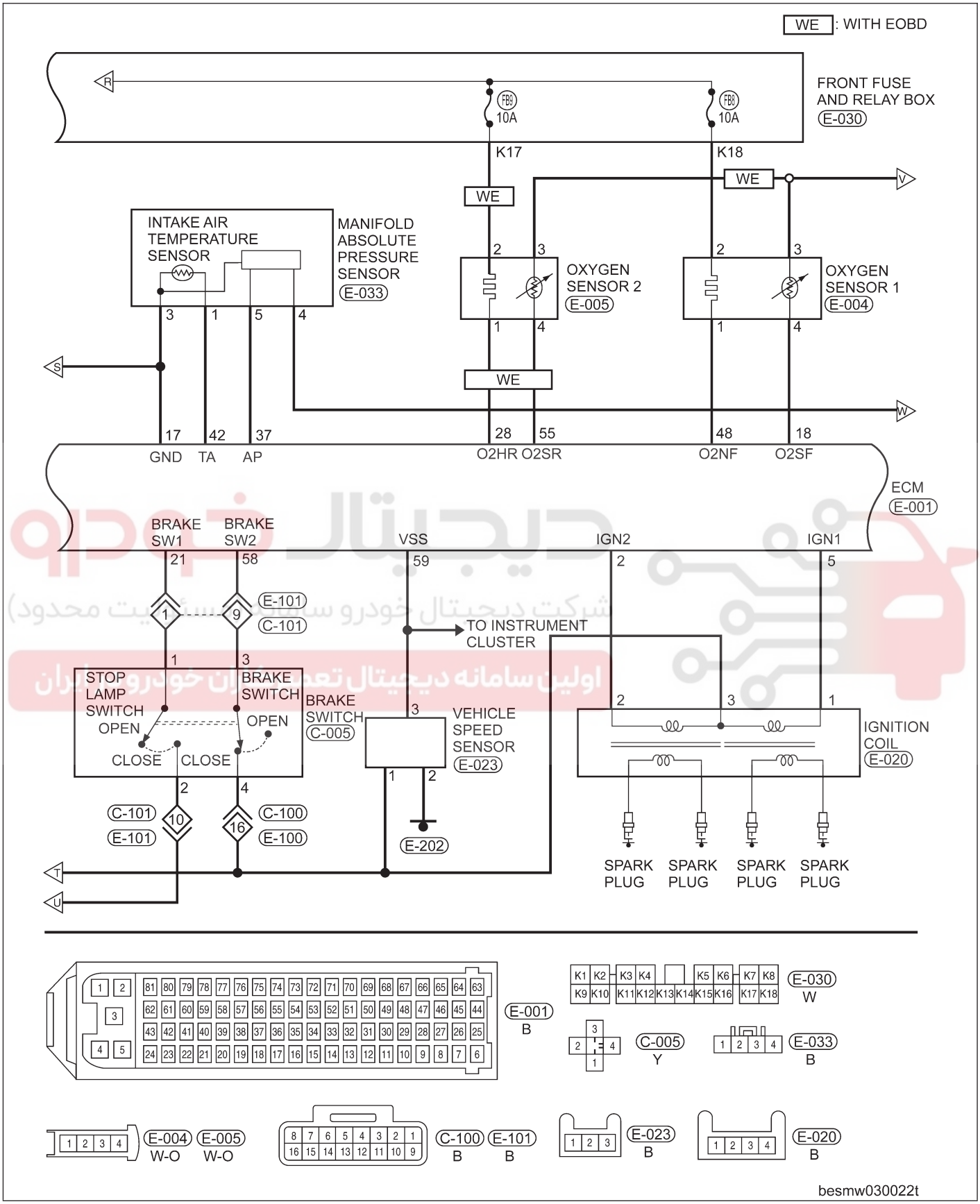

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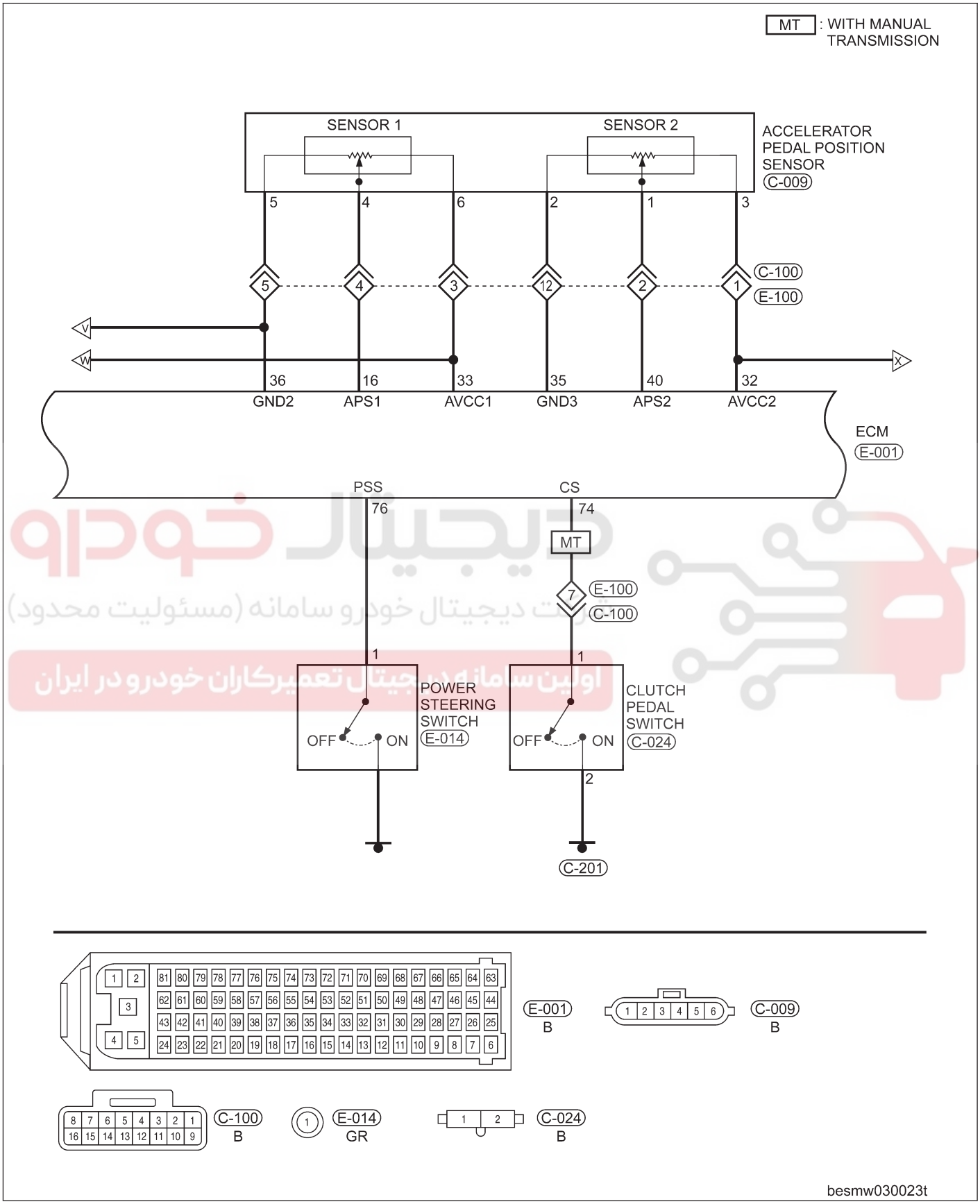

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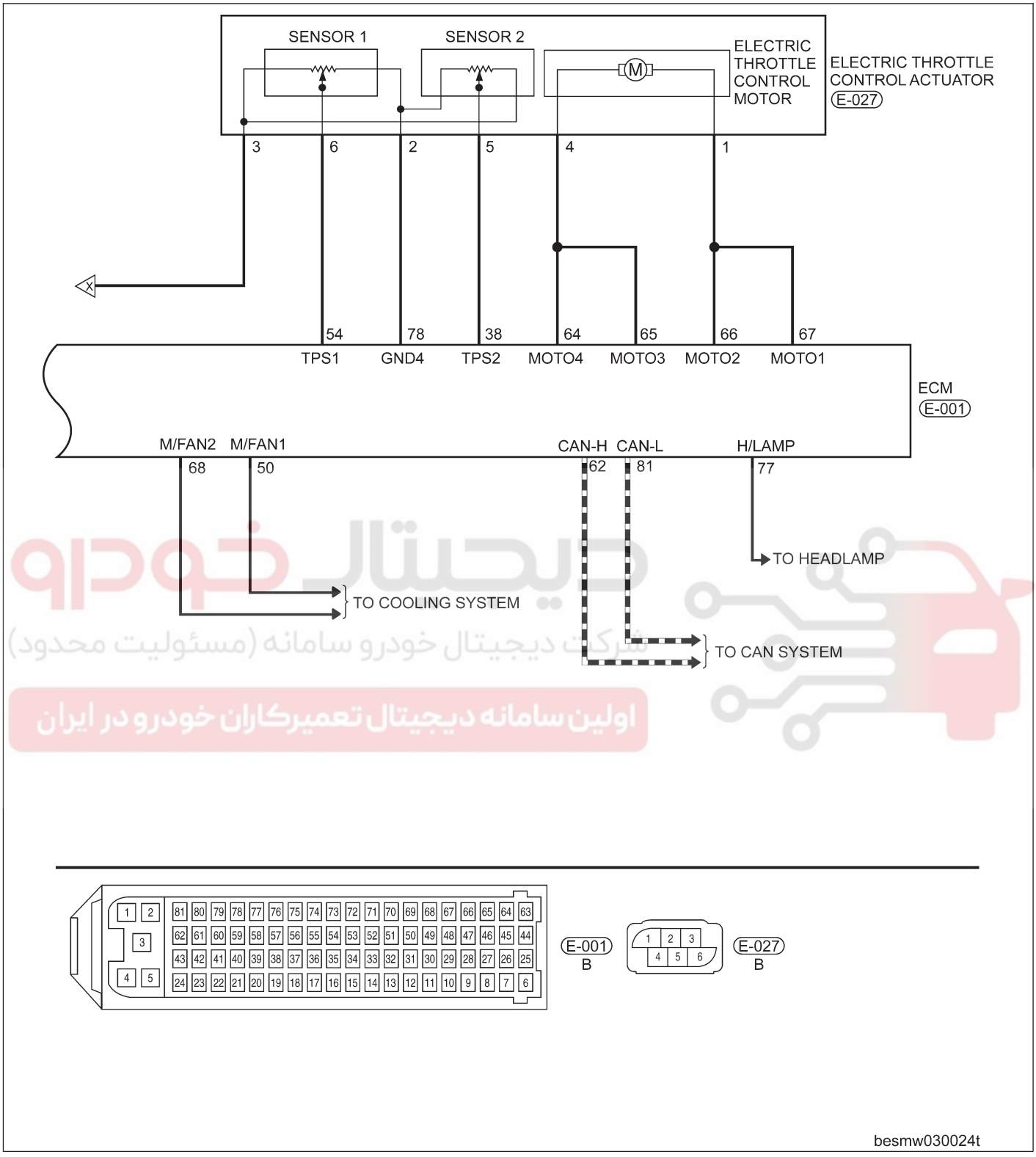
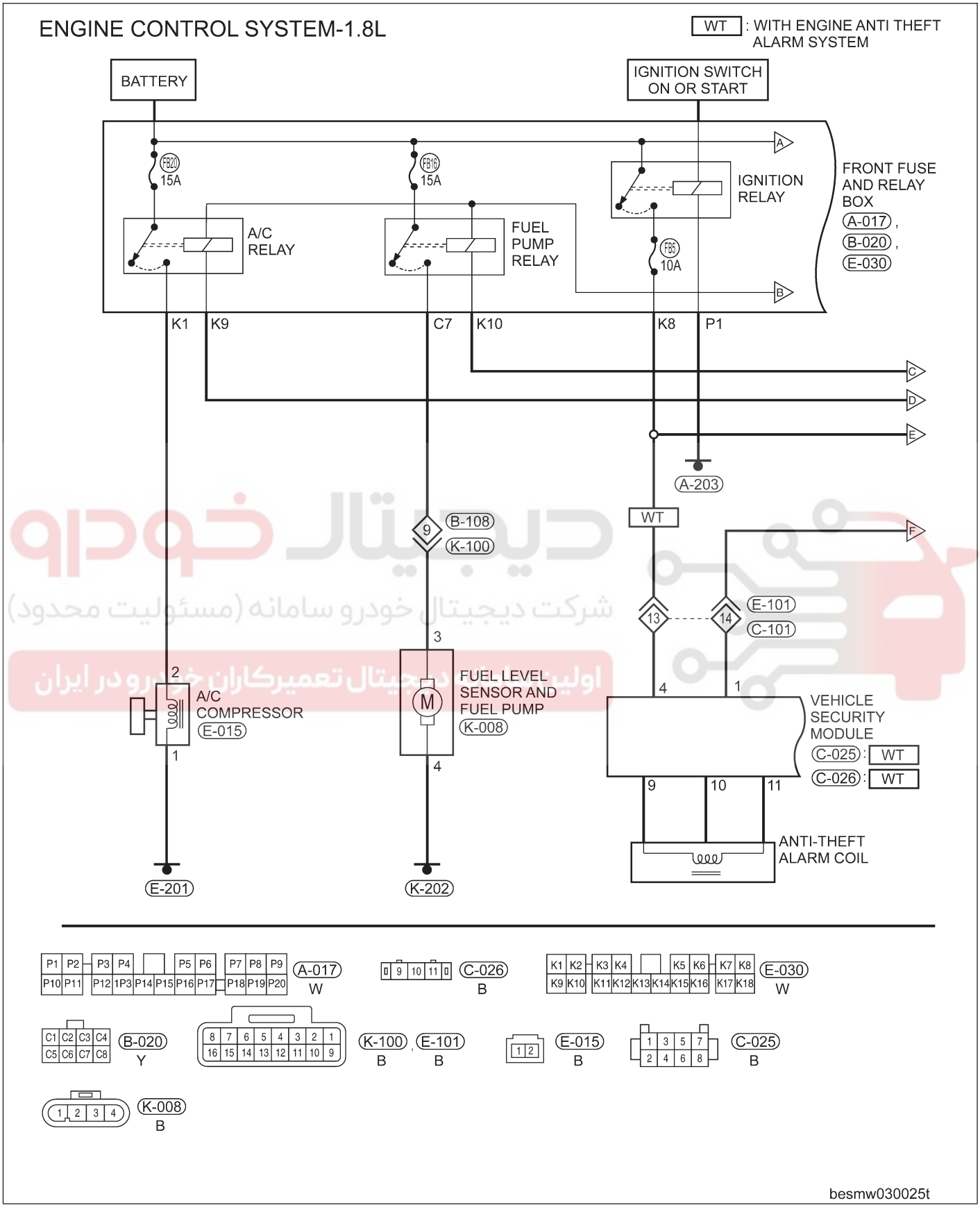
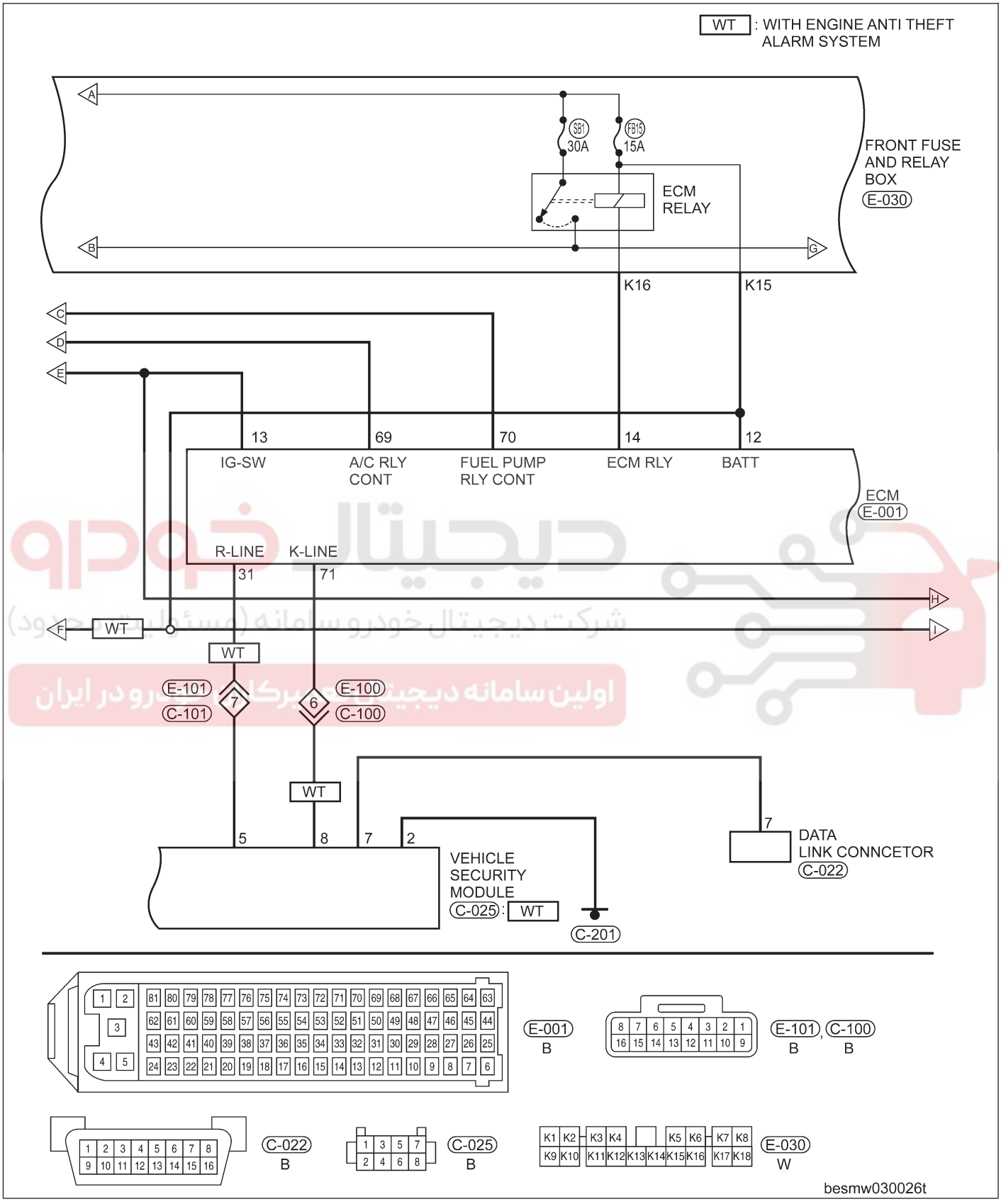


Electronic Engine Controls (Page 9 of 16)



Electronic Engine Controls (Page 10 of 16)



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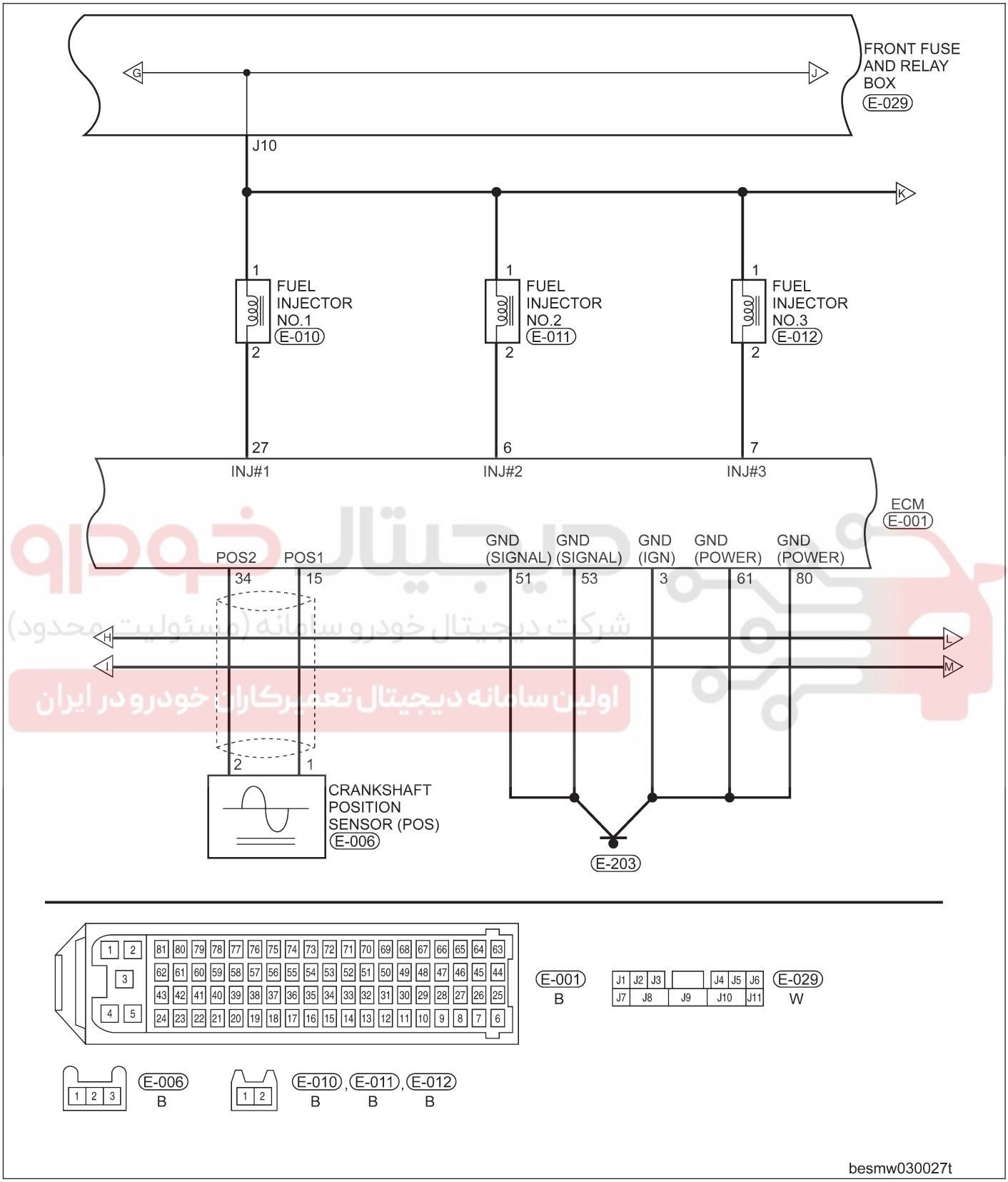

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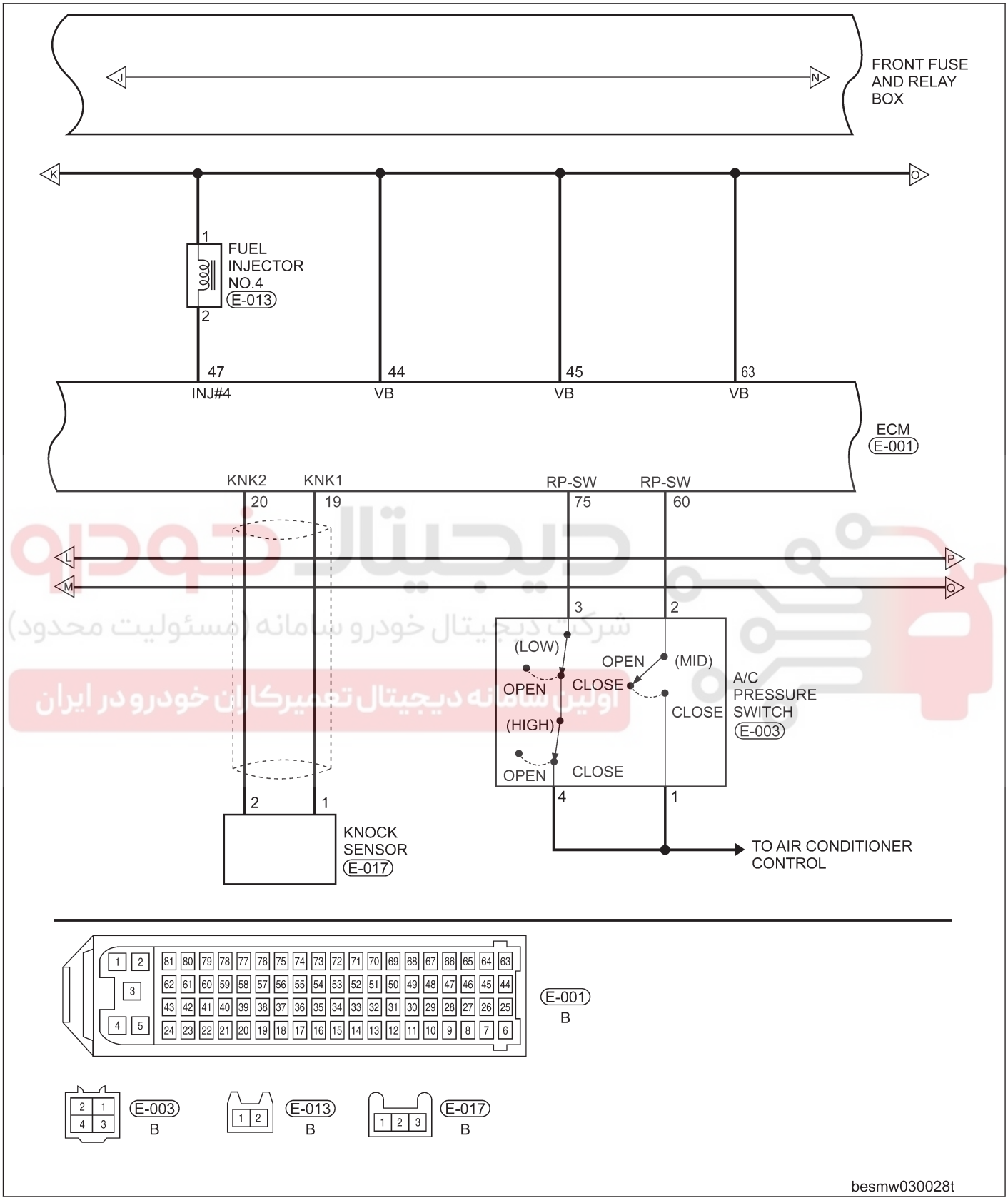

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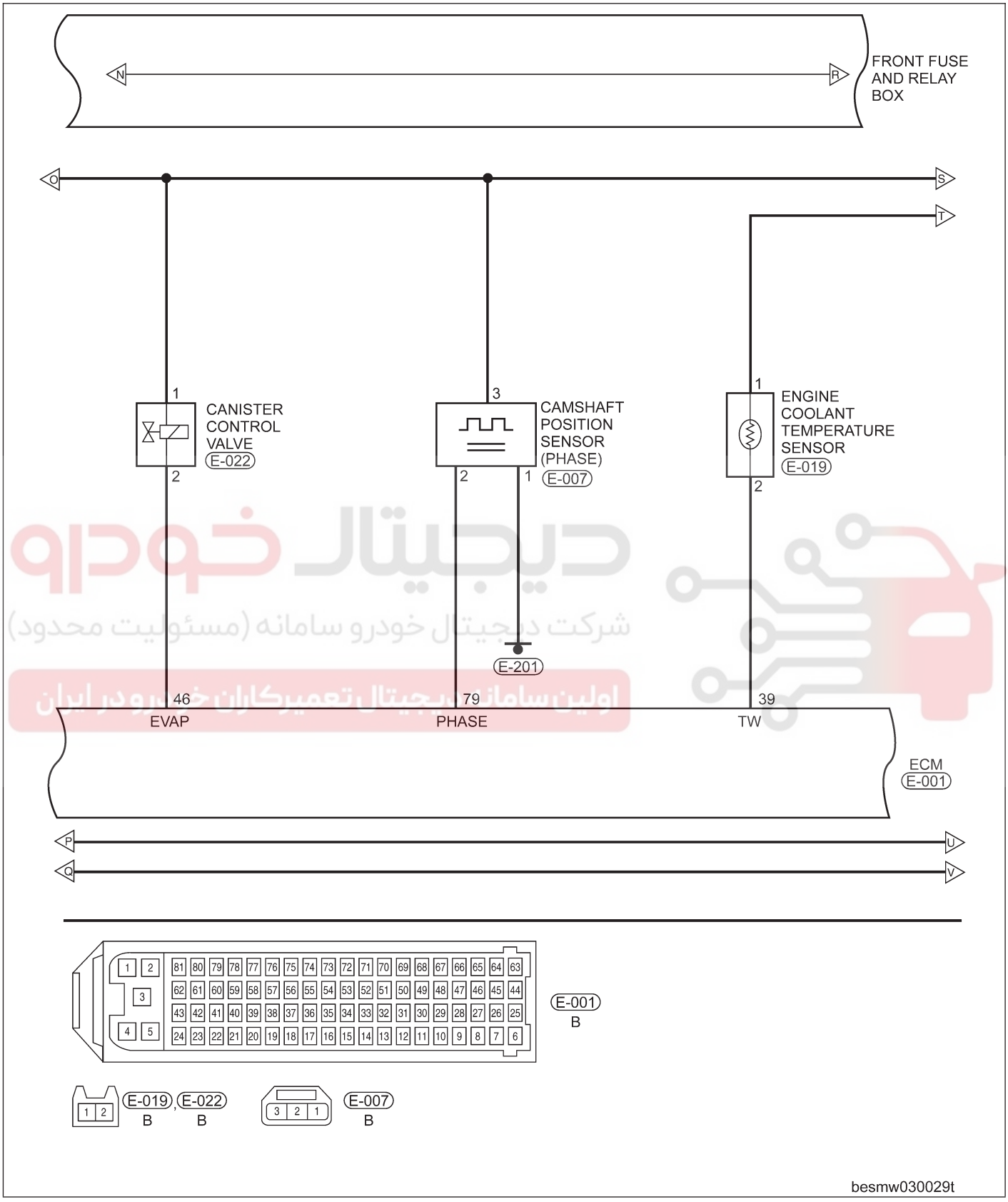

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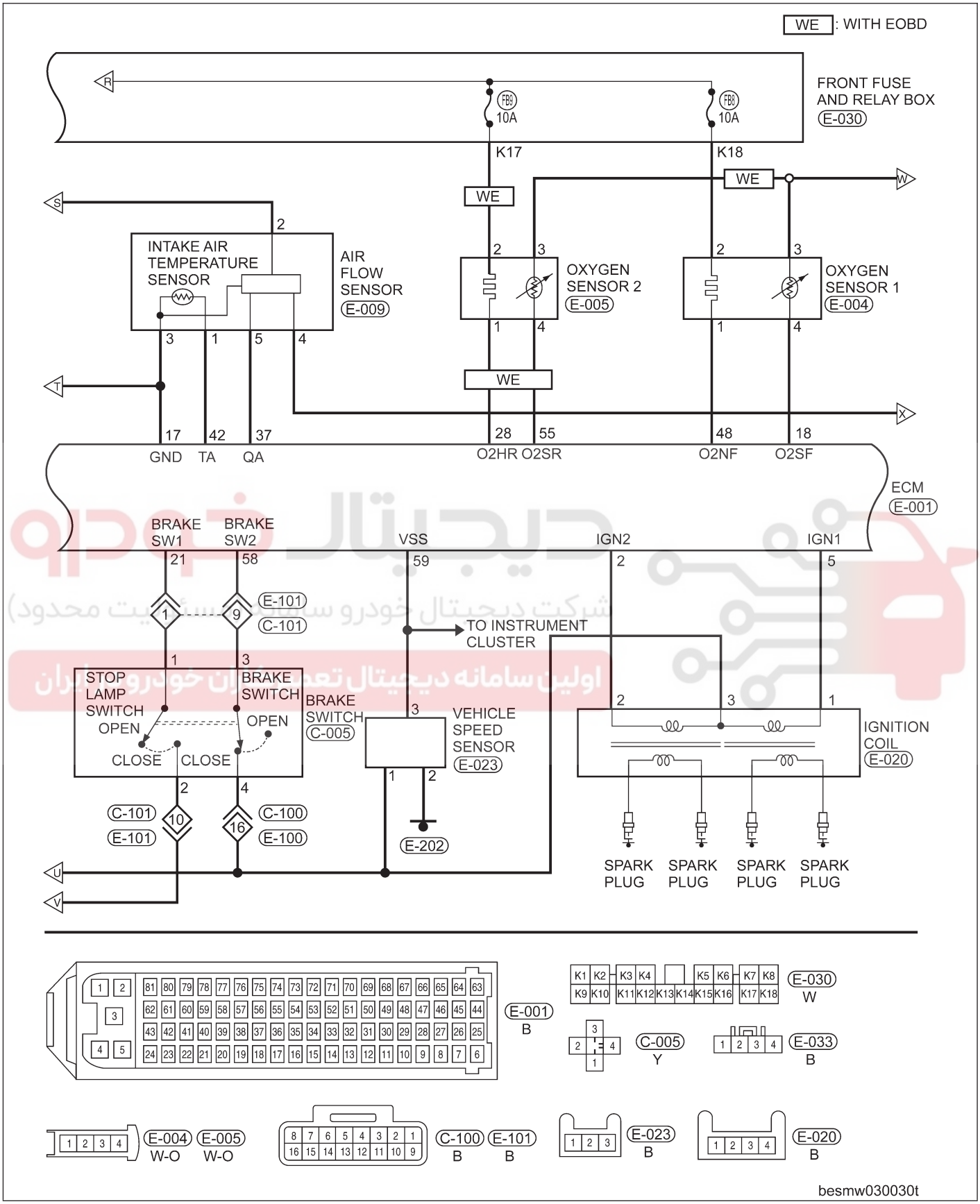

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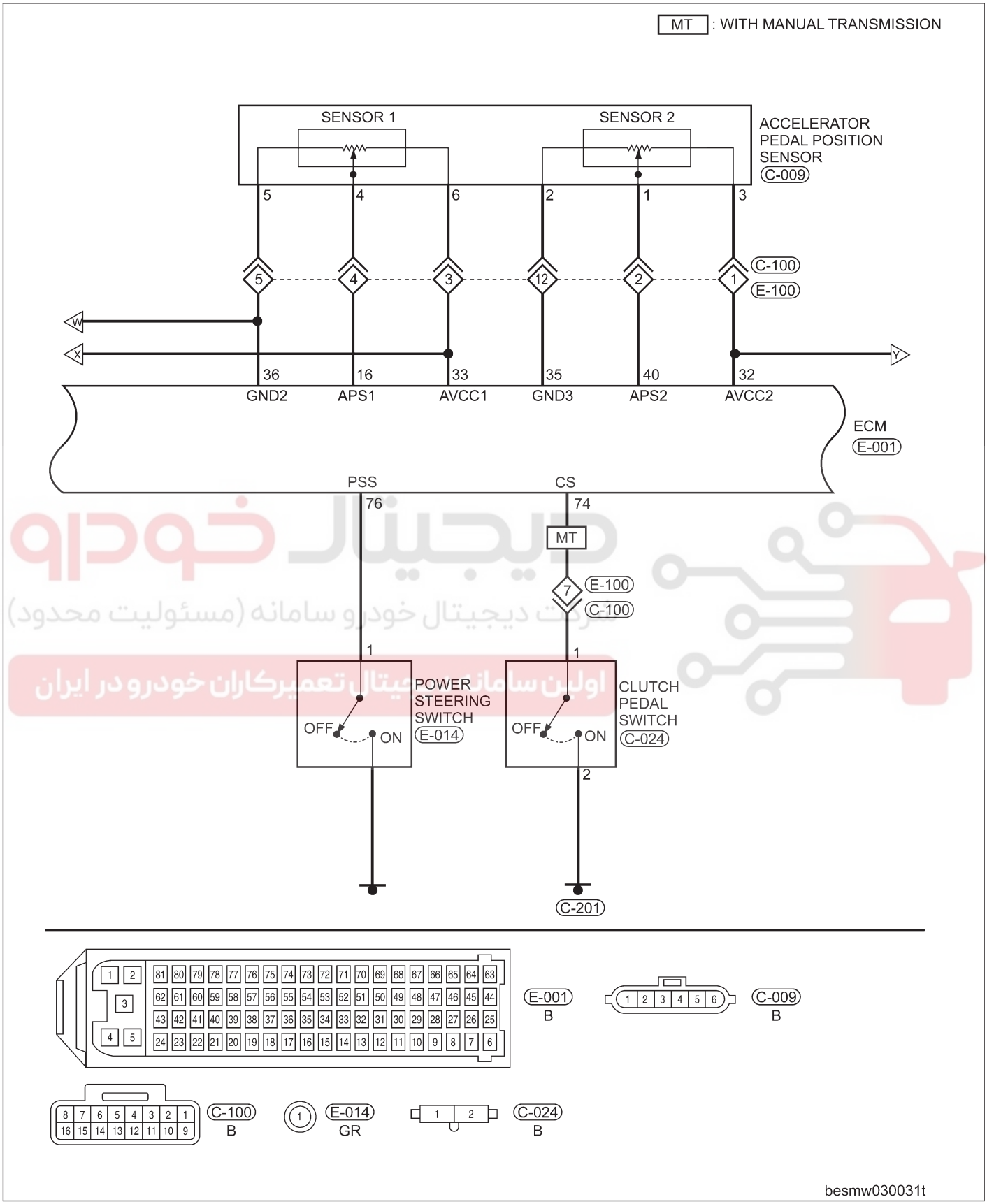
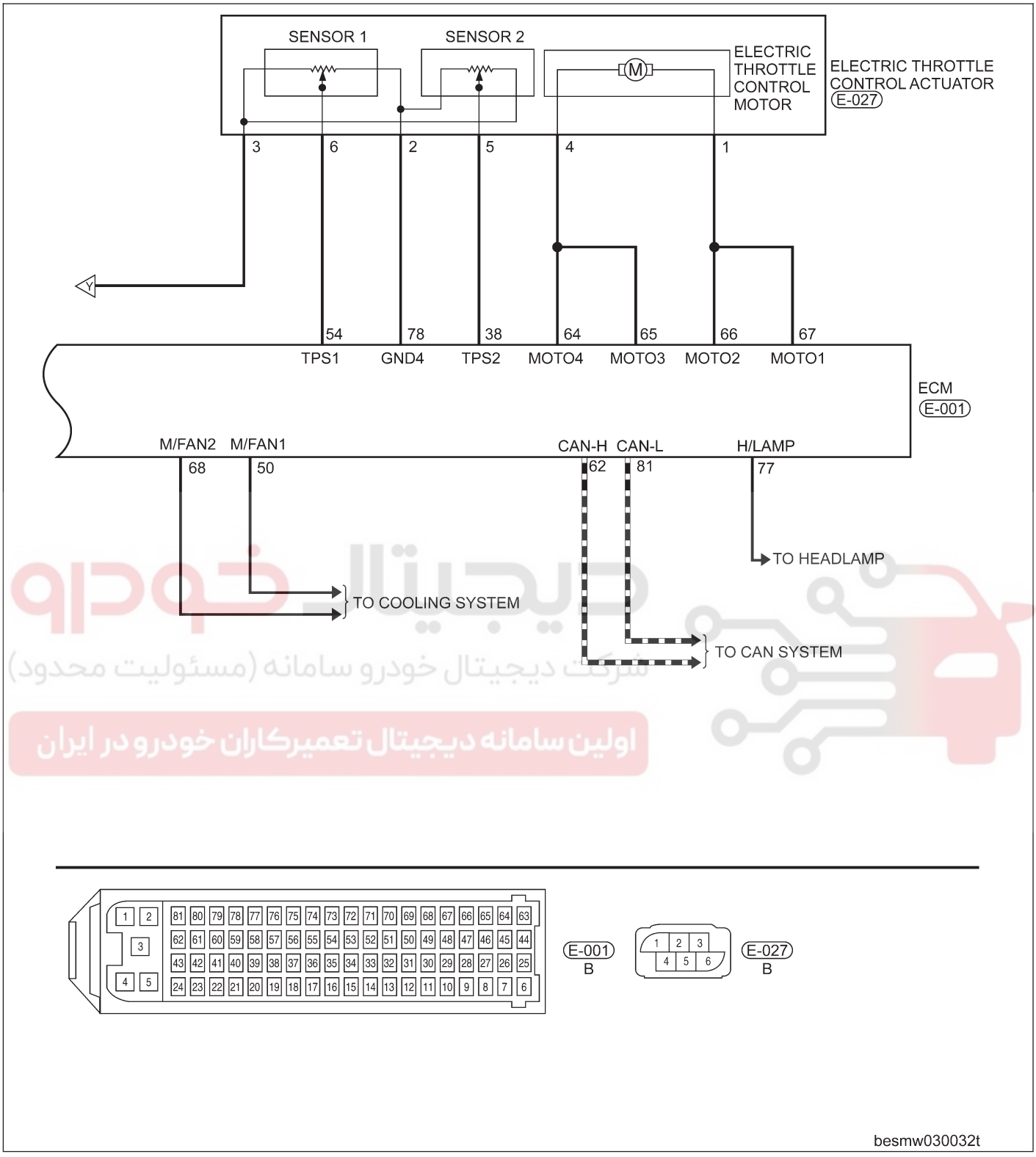


Electronic Engine Controls (Page 16 of 16)



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DIAGNOSIS & TESTING

Diagnostic Help

1. Confirm that the malfunction is current and carry-out the diagnostic tests and repair procedures.
2. If the Diagnostic Trouble Code (DTC) cannot be deleted, it is a current fault.
3. Use only a digital multimeter to perform voltage readings on the Electronic Fuel Injection (EFI) system.
4. Program the vehicle security feature whenever the Engine Control Module (ECM) is replaced.
5. If the following DTCs are set, they may not cause the Engine Light to illuminate.

- P0560
- P0562
- P0563
- P0645
- P0646
- P0647

6. The following shows the circuit explanation of many DTCs:

- Circuit Low - Circuit shorted to ground
- Circuit High - Circuit shorted to voltage
- Circuit Failure - Circuit open or multi-circuit malfunction

7. The scan tool connects to the Data Link Connector (DLC) and communicates with the ECM with the class two serial data circuit.
8. If the failure is intermittent perform the following:

- Check for loose connectors.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Monitor the scan tool data relative to this circuit and wiggle test the wiring and connectors.
- Look for the data to change or for the DTC to reset during the wiggle test.
- Look for broken, bent, pushed out or corroded terminals.
- Inspect the sensor and mounting area for any condition that would result in an incorrect signal, such as damage or foreign material.

9. Remove the ECM from the troubled vehicle and install in a new vehicle and test. If the DTC can not be deleted, the ECM is malfunctioning. If the DTC can be deleted, return the ECM to the original vehicle and inspect the system again.

ECM Connector Pin-Out Table

ECM PIN-OUT TABLE

PIN	CIRCUIT IDENTIFICATION	PIN	CIRCUIT IDENTIFICATION
1	—	42	Intake Air Temperature Sensor
2	Ignition Coil 2	43	—
3	Ignition Ground	44	Non Persistent Power
4	—	45	Non Persistent Power
5	Ignition Coil 1	46	Canister Control Valve
6	Fuel Injector 2	47	Fuel Injector 4
7	Fuel Injector 3	48	Front Oxygen Sensor Heater
8	—	49	—
9	—	50	Fan Control 1
10	—	51	Signal Ground 2
11	—	52	—
12	Power Supply	53	Signal Ground 1

PIN	CIRCUIT IDENTIFICATION	PIN	CIRCUIT IDENTIFICATION
13	Ignition Switch	54	Electric Throttle Control Actuator
14	ECM Relay	55	Rear Oxygen Sensor
15	Crankshaft Sensor 1	56	—
16	Accelerator Position Sensor	57	—
17	Manifold Absolute Pressure Sensor Ground	58	Brake Switch
18	Front Oxygen Sensor	59	Vehicle Speed Sensor
19	Knock Sensor 1	60	Refrigerant Pressure Switch
20	Knock Sensor 2	61	Ground
21	Stop Lamp Switch	62	CAN-H
22	—	63	Non Persistent Power
23	—	64	Electric Throttle Control Actuator
24	—	65	Electric Throttle Control Actuator
25	—	66	Electric Throttle Control Actuator
26	—	67	Electric Throttle Control Actuator
27	Fuel Injector 1	68	Fan Control 2
28	Rear Oxygen Sensor Heater	69	Air Conditioner Relay
29	—	70	Fuel Pump Relay
30	—	71	Diagnostic K Cable
31	Engine Anti-Theft Alarm Control Module	72	—
32	5V Power Supply 2	73	—
33	5V Power Supply 1	74	Clutch Switch
34	Crankshaft Sensor 2	75	Refrigerant Pressure Switch
35	Sensor Ground 3	76	Power Steering Switch
36	Sensor Ground 2	77	Headlamp Switch
37	Manifold Absolute Pressure Sensor	78	Electric Throttle Control Actuator Ground
38	Electronic Throttle Control Actuator 5	79	Camshaft Position Sensor
39	Engine Coolant Temperature Sensor	80	Ground
40	Accelerator Position Sensor	81	CAN-L
41	—		

Diagnostic Trouble Code (DTC) List

DTC	DTC DEFINITION
P000A	"A" Camshaft Position Slow Response
P000B	"B" Camshaft Position Slow Response
P0010	"A" Camshaft Position Actuator Circuit/Open
P0011	"A" Camshaft Position - Timing Over - Advanced or System Performance
P0012	"A" Camshaft Position - Timing Over - Retarded
P0013	"B" Camshaft Position - Actual Circuit/Open
P0014	"B" Camshaft Position - Timing Over - Advanced or System Performance
P0015	"B" Camshaft Position - Timing Over - Retarded
P0016	Crankshaft - Camshaft Position Correlation
P0030	O2 Sensor Heater Control Circuit (Bank 1 Sensor 1)
P0031	O2 Sensor Heater Control Circuit (Bank 1 Sensor 1) Low
P0032	O2 Sensor Heater Control Circuit (Bank 1 Sensor 1) High
P0036	O2 Sensor Heater Control Circuit (Bank 1 Sensor 2)
P0037	O2 Sensor Heater Control Circuit (Bank 1 Sensor 2) Low
P0038	O2 Sensor Heater Control Circuit (Bank 1 Sensor 2) High
P0053	O2 Sensor Heater Resistance (Bank 1 Sensor 1)
P0054	O2 Sensor Heater Resistance (Bank 1 Sensor 2)
P0101	Mass or Volume Air Flow Circuit Range/Performance (1.8 L)
P0102	Mass or Volume Air Flow Circuit Low Input (1.8 L)
P0103	Mass or Volume Air Flow Circuit High Input (1.8 L)
P0105	Manifold Absolute Pressure or Barometric Pressure Circuit (1.6 L)
P0106	Manifold Absolute Pressure or Barometric Pressure Range/Performance (1.6 L)
P0107	Manifold Absolute Pressure or Barometric Pressure Low Input (1.6 L)
P0108	Manifold Absolute Pressure or Barometric Pressure High Input (1.6 L)
P0112	Intake Air Temperature Circuit Low Input
P0113	Intake Air Temperature Circuit High Input
P0116	Engine Coolant Temperature Circuit Range/Performance
P0117	Engine Coolant Temperature Circuit Low Input
P0118	Engine Coolant Temperature Circuit High Input
P0121	Throttle/Pedal Position Sensor A Circuit Range/ Performance
P0122	Throttle/Pedal Position Sensor A Circuit Low Input
P0123	Throttle/Pedal Position Sensor A Circuit High Input
P0130	O2 Sensor Circuit Bank 1 - Sensor 1 Malfunction

DTC	DTC DEFINITION
P0131	O2 Sensor Circuit Bank 1 - Sensor 1 Low Voltage
P0132	O2 Sensor Circuit Bank 1 - Sensor 1 High Voltage
P0133	O2 Sensor Circuit Bank 1 - Sensor 1 Slow Response
P0134	O2 Sensor Circuit Bank 1 - Sensor 1 No Activity Detected
P0136	O2 Sensor Circuit Bank 1 - Sensor 2 Malfunction
P0137	O2 Sensor Circuit Bank 1 - Sensor 2 Low Voltage
P0138	O2 Sensor Circuit Bank 1 - Sensor 2 High Voltage
P0140	O2 Sensor Circuit Bank 1 - Sensor 2 No Activity Detected
P0170	Fuel Trim, Bank 1 Malfunction
P0171	Fuel Trim, Bank 1 System Too Lean
P0172	Fuel Trim, Bank 1 Too Rich
P0201	Cylinder 1 - Injector Circuit
P0202	Cylinder 2 - Injector Circuit
P0203	Cylinder 3 - Injector Circuit
P0204	Cylinder 4 - Injector Circuit
P0219	Engine Overspeed Condition
P0221	Throttle/Pedal Position Sensor/Switch B Range/ Performance
P0222	Throttle/Pedal Position Sensor/Switch B Low Input
P0223	Throttle/Pedal Position Sensor/Switch B High Input
P0261	Cylinder 1 - Injector Circuit Low
P0262	Cylinder 1 - Injector Circuit High
P0264	Cylinder 2 - Injector Circuit Low
P0265	Cylinder 2 - Injector Circuit High
P0267	Cylinder 3 - Injector Circuit Low
P0268	Cylinder 3 - Injector Circuit High
P0270	Cylinder 4 - Injector Circuit Low
P0271	Cylinder 4 - Injector Circuit High
P0300	Random/Multiple Cylinder Misfire Detected
P0301	Cylinder 1 Misfire Detected
P0302	Cylinder 2 Misfire Detected
P0303	Cylinder 3 Misfire Detected
P0304	Cylinder 4 Misfire Detected
P0318	Rough Road Sensor "A" Signal Circuit
P0321	Ignition/Distributor Engine Speed Input Circuit Range/Performance
P0322	Ignition/Distributor Engine Speed Input Circuit No Signal
P0324	Knock Control System Error
P0327	Knock Sensor 1 Circuit Low Input
P0328	Knock Sensor 1 Circuit High Input
P0340	Camshaft Position Sensor Circuit
P0341	Camshaft Position Sensor Circuit Range/Performance
P0342	Camshaft Position Sensor Circuit Low Input

DTC	DTC DEFINITION
P0343	Camshaft Position Sensor Circuit High Input
P0444	Evaporative Emission System Purge Control Valve Circuit Open
P0458	Evaporative Emission System Purge Control Valve Circuit Low
P0459	Evaporative Emission System Purge Control Valve Circuit High
P0480	Cooling Fan 1 Control Circuit
P0481	Cooling Fan 2 Control Circuit
P0501	Vehicle Speed Sensor Range/Performance
P0506	Idle Control System RPM Lower than Expected
P0507	Idle Control System RPM High than Expected
P0508	Idle Air Control System Circuit Low
P0509	Idle Air Control System Circuit High
P0511	Idle Air Control Circuit
P0532	A/C Refrigerant Pressure Sensor Circuit Low Input
P0533	A/C Refrigerant Pressure Sensor Circuit High Input
P0537	A/C Evaporator Temperature Sensor Circuit Low
P0538	A/C Evaporator Temperature Sensor Circuit High
P0560	System Voltage Malfunction
P0562	System Voltage Low Voltage
P0563	System Voltage High Voltage
P0571	Brake Switch "A" Circuit
P0601	Internal Control Module EEPROM Error
P0602	Control Module Programming Error
P0604	Internal Control Module Random Access Memory (RAM) Error
P0605	Internal Control Module ROM Test Error
P0606	ECM Processor
P0627	Fuel Pump "A" Control Circuit/Open
P0628	Fuel Pump "A" Control Circuit Low
P0629	Fuel Pump "A" Control Circuit High
P0645	A/C Clutch Relay Circuit
P0646	A/C Clutch Relay Control Circuit Low
P0647	A/C Clutch Relay Control Circuit High
P0650	Malfunction Indicator Lamp Control Circuit
P0688	EMC/ECM Power Relay Sense Circuit Open
P0691	Cooling Fan 1 Control Circuit Low
P0692	Cooling Fan 1 Control Circuit High
P0693	Cooling Fan 2 Control Circuit Low
P0694	Cooling Fan 2 Control Circuit High
P0700	Transmission Control System Malfunction
P0704	Clutch Switch Input Circuit
P1297	Manufacturer Controlled Computer And Auxiliary Outputs

DTC	DTC DEFINITION
P1336	Engine Torque Control Adaptation at Limit
P1545	Throttle Position Control Malfunction
P1558	Throttle Actuator Electrical Malfunction
P1559	Idle Speed Control Throttle Position Adaptation Malfunction
P1564	Idle Speed Control Throttle Position Low Voltage during Adaptation
P1565	Idle Speed Control Throttle Position Lower Limit not Attained
P1568	Idle Speed Control Throttle Position Mechanical Malfunction
P1579	Idle Speed Control Throttle Position Adaptation not Started
P1604	Internal Control Module Driver Error
P1610	Manufacture Controlled Computer and Auxiliary Outputs
P1611	Manufacture Controlled Computer and Auxiliary Outputs
P1612	Manufacture Controlled Computer and Auxiliary Outputs
P1613	Manufacture Controlled Computer and Auxiliary Outputs
P1614	Manufacture Controlled Computer and Auxiliary Outputs
P1651	Manufacture Controlled Computer and Auxiliary Outputs
P2106	Throttle Actuator Control System Forced Limited Power
P2122	Throttle/Pedal Position Sensor/Switch D Circuit Low Input
P2123	Throttle/Pedal Position Sensor/Switch D Circuit High Input
P2127	Throttle/Pedal Position Sensor/Switch E Circuit Low Input
P2128	Throttle/Pedal Position Sensor/Switch E Circuit High Input
P2138	Accelerator Pedal Position Sensor Signal Correlation Error
P2177	System Too Lean off Idle
P2178	System Too Rich off Idle
P2187	System Too Lean at Idle
P2188	System Too Rich at Idle
P2195	O2 Sensor Signal Stuck Lean; Bank 1 Sensor 1
P2196	O2 Sensor Signal Stuck Rich; Bank 1 Sensor 1
P2270	O2 Sensor Signal Stuck Lean; Bank 1 Sensor 2
P2271	O2 Sensor Signal Stuck Rich; Bank 1 Sensor 2
U0001	High Speed CAN Defective
U0101	Lost Communication with ECM
U104	Lost Communication with Cruise Control Module
U0121	Lost Communication with Anti-Lock Brake System (ABS) Control Module
U0155	Lost Communication with Instrument Panel Cluster Control Module
U0415	Invalid Data Received from ABS Control Module

Diagnostic Trouble Code (DTC) Tests

P0016: Crankshaft Position - Camshaft Position Correlation Error

- **When Monitored:** With the engine running and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.

Turn the engine off and turn the ignition switch on.

With the X-431 scan tool, check for DTCs.

Is DTC P0016 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Using the electrical schematic as a guide, inspect the following:

- Inspect the wiring and connectors between the Crankshaft Position (CKP) sensor and the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Inspect the CKP sensor for conditions such as loose mounting screws, damage, or cracks.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 3.

Using the electrical schematic as a guide, inspect the following:

- Inspect the wiring and connectors between the Camshaft Position (CMP) sensor and the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Inspect the CMP sensor for conditions such as loose mounting screws, damage, or cracks.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Turn the ignition switch on.
Wiggle the related wiring harness and lightly tap on the CKP sensor while monitoring the X-431.
Start the engine.
Monitor the CKP sensor signal on the X-431 screen.

Were any CKP sensor signals irregular or missing?

Yes >> • Go to step 6.

No >> • Go to the next step.

Step 5.

With the engine running, wiggle the related wiring harness and lightly tap on the CMP sensor while monitoring the X-431 screen.
Monitor the CMP sensor signal on the X-431 screen.

Were any CMP sensor signals irregular or missing?

Yes >> • Go to step 7.

No >> • Go to step 10.

Step 6.

Turn the ignition switch off.
Remove the CKP sensor.
Inspect the CKP sensor and mounting area for any condition that would result in an incorrect signal, such as damage, foreign material, or excessive movement.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the CKP sensor.
• Monitor the CKP sensor signal on the X-431 screen.
– If the CKP sensor signals were normal, the system is OK.
– If the CKP sensor signals were still irregular or missing, Go to step 8.

Step 7.

Turn the ignition switch off.
Remove the CMP sensor.
Inspect the CMP sensor and mounting area for any condition that would result in an incorrect signal, such as damage, foreign material, or excessive movement.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the CMP sensor.
• Monitor the CMP sensor signal on the X-431 screen.
– If the CMP sensor signals were normal, the system is OK.
– If the CMP sensor signals were still irregular or missing, Go to step 9.

Step 8.

Remove the cylinder head cover and timing belt cover (See Engine Timing Belt Removal & Installation in Section 02 Engine).

Check the Camshaft and tone wheel for any condition that would result in an incorrect signal, such as damage, movement or foreign material when rotating the Camshaft.

Were any problems found?

Yes >> • Repair or replace as necessary.

No >> • Go to step 10.

Step 9.

Remove the cylinder head cover and timing belt cover (See Engine Timing Belt Removal & Installation in Section 02 Engine).

Check the Crankshaft and tone wheel for any condition that would result in an incorrect signal, such as damage, movement or foreign material when rotating the Crankshaft.

Were any problems found?

Yes >> • Repair or replace as necessary.

No >> • Go to the next step.

Step 10.

Check the engine timing for misalignment.

Is the timing misaligned?

Yes >> • Align the engine timing belt (See Engine Timing Belt Removal & Installation in Section 02 Engine).

No >> • Go to the next step.

Step 11.

Start the engine, with the X-431 scan tool, select view the DTCs.

Does DTC P0016 reset?

Yes >> • Replace and program the ECM.

No >> • The system is normal.
• Erase all codes and test drive the vehicle to verify the repair is complete.

P0031: O2 Sensor 1 Heater Control Circuit Low

- **When Monitored:** With the engine running and battery voltage greater than 12 volts.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear all DTCs.
Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the scan tool, read the DTCs.

Is DTC P0031 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the oxygen sensor connector.
Turn the ignition switch on.
Using a 12-volt test light connected to ground, check the supply circuit in the oxygen sensor electrical connector.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Repair the supply circuit for an open circuit or short to ground.

Step 3.

Turn the ignition switch off.
Disconnect the ECM connector.
Measure the resistance between ground and the heater control circuit in the oxygen sensor electrical connector and measure the resistance between the sensor connector pin 1 and the ECM connector pin 36.

Is the resistance between ground and the heater control circuit in the oxygen sensor electrical connector below 10,000 ohms and the resistance between the sensor connector and the ECM connector above 5 ohms?

Yes >> • Repair the control circuit for a short to ground or open.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.

Using the electrical schematic as a guide, inspect the following:

- Inspect the wiring and connectors between the oxygen sensor and the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 5.

Replace the oxygen sensor.

With the X-431 scan tool, drive the vehicle at a speed over 40 km/h, allow the engine to reach normal operating temperature.

Watch the oxygen signal data stream and view the ECM DTC.

Did DTC P0031 reset?

Yes >> • Go to the next step.

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

Step 6.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Turn the ignition switch off.

Disconnect the ECM connector.

Using the electrical schematic as a guide, inspect the wiring and connectors between the oxygen sensor and the ECM (See Diagnostic Help in Section 03 Electronic Engine Controls).

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0032: O2 Sensor 1 Heater Control Circuit High

- **When Monitored:** With the engine running and battery voltage greater than 12 volts.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear all DTCs.
Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the scan tool, read the DTCs.

Is DTC P0032 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the oxygen sensor connector.
Disconnect the ECM connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.
Turn the ignition switch on.
Using a digital multimeter, inspect the oxygen sensor heater control circuit and perform the following:

- Measure the oxygen sensor heater control circuit for a short to ground between the oxygen sensor connector and ground.
- Measure the oxygen sensor control circuit for a short together with other supply circuits.
- Measure the oxygen sensor control circuit for an open.

Are the test results normal?

Yes >> • Go to the next step.

No >> • Repair the heater control circuit for a short to voltage circuit, ground or open.

Step 3.

Turn the ignition switch off.
Inspect the wiring and connectors between the oxygen sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Replace the oxygen sensor.

With the X-431 scan tool, drive the vehicle at speeds over 40 km/h, allow the engine to reach normal operating temperature.

Watch the oxygen signal data stream and view the ECM DTC.

Did DTC P0032 reset?

Yes >> • Go to the next step.

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

Step 5.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors to look for the data to change or for the DTC to reset during the wiggle test.

Turn the ignition switch off.

Disconnect the ECM connector.

Using the electrical schematic as a guide, inspect the wiring and connectors between the oxygen sensor and the ECM (See Diagnostic Help in Section 03 Electronic Engine Controls).

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0102: Mass Or Volume Air Flow Circuit Low Input

- **When Monitored:** With the ignition switch on and engine running.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear all DTCs.
Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the X-431 scan tool, read the DTCs.

Does the scan tool read: P0102?

Yes >> • Go to the next step.

No >> • See Diagnostic Help in Section 03 Electronic Engine Controls.

Step 2.

Turn the ignition switch off.
Disconnect the Mass Air Flow (MAF) sensor connector.
Turn the ignition switch on.
Measure the voltage of the MAF sensor voltage supply circuit between the MAF sensor connector pin 2 and ground.

Is battery voltage present?

Yes >> • Go to the next step.

No >> • Repair the MAF supply circuit for an open or short to ground in the harness or connectors.

Step 3.

Turn the ignition switch off.
Disconnect the ECM harness connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.
Check harness continuity between the MAF sensor terminal 5 and ECM terminal 42.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next help.

No >> • Repair the Sensor Ground circuit for an open circuit.

Step 4.

Check the resistance between the signal circuit in the MAF connector and ground.

Is the resistance below 10,000 ohms between the signal circuit pin 5 in MAF sensor connector and ground?

Yes >> • Repair the open circuit or short to ground in harness or connectors.

No >> • Go to the next step.

Step 5.

Check the resistance of the reference voltage circuit in the MAF sensor connector between the MAF connector pin 4 and ECM connector pin 33.

Is the resistance below 5 ohms between the MAF sensor connector and ECM connector?

Yes >> • Go to the next step.

No >> • Repair the circuit for an open.

Step 6.

Turn the ignition switch on.

Check the resistance of the reference voltage circuit in the MAF connector between the MAF connector pin 4 and ground.

Is the resistance below 10,000 ohms between the MAF sensor connector and ground?

Yes >> • Repair the circuit for a short to ground.

No >> • Go to the next step.

Step 7.

Turn the ignition switch off.

Reconnect all harness connectors.

Turn the ignition switch on.

With the scan tool, read data stream.

Does the scan tool read MAF voltage above 1.025 volts?

Yes >> • Replace the MAF sensor.

No >> • Go to the next step.

Step 8.

Start engine.

With X-431 scan tool, select “data stream” and check the indication under the conditions.

- 1: Idle speed MAF value: 22-48 HZ.
- 2: 2,500 rpm MAF value: 80-120 HZ.

Does the scan tool read MAF values as above?

Yes >> • See Diagnostic Help in Section 03 Electronic Engine Controls.

No >> • Go to the next step.

Step 9.

Check the following for possible causes of abnormal air flow through the mass air flow sensor:

- Crushed air ducts.
- Improper seal of the air cleaner element.
- Improper intake air system components.

Were there any problems found?

Yes >> • Repair or replace the malfunctioning component.

No >> • Clean or replace the MAF sensor.

P0103: Mass Or Volume Air Flow Circuit High Input

- **When Monitored:** With the ignition switch on and engine running.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear all DTCs.
Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the X-431 scan tool, read the DTCs.

Does the scan tool read: P0103 ?

Yes >> • Go to the next step.

No >> • See Diagnostic Help in Section 03 Electronic Engine Controls.

Step 2.

Turn the ignition switch off.
Disconnect the MAF sensor connector.
Disconnect the ECM connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.
Turn the ignition switch on.
Measure the voltage of the MAF sensor reference voltage circuit between the MAF sensor connector pin 4 and ground.

Is there any voltage present?

Yes >> • Repair the MAF supply circuit for a short to voltage.

No >> • Go to the next step.

Step 3.

Check the voltage of the MAF sensor signal circuit between the MAF sensor terminal 5 and ground.

Is there any voltage present?

Yes >> • Repair the sensor signal circuit for a short to voltage.

No >> • Go to the next step.

Step 4.

Check the resistance of the MAF sensor ground circuit between the MAF ground circuit pin 3 and ECM connector pin 17.

Is the resistance below 5 ohms between the MAF sensor connector pin 3 and ECM connector pin 17?

Yes >> • Go to the next step.

No >> • Repair the open circuit.

Step 5.

Turn ignition switch off.
Reconnect all harness connectors.
Turn ignition switch on.
With the scan tool, read data stream.

Does the scan tool read MAF voltage above 1.025 volts?

Yes >> • Replace the MAF sensor.
No >> • Go to the next step.

Step 6.

Start engine.
With X-431 scan tool, select “data stream” and check the indication under the conditions.
- 1: Idle speed MAF value: 22-48 HZ.
- 2: 2,500 rpm MAF value: 80-120 HZ.

Does the scan tool read MAF values as above?

Yes >> • See Diagnostic Help in Section 03 Electronic Engine Controls.
No >> • Go to the next step.

Step 7.

Check the following for possible causes of abnormal air flow through the mass air flow sensor:
- Crushed air ducts.
- Improper seal of the air cleaner element.
- Improper intake air system components.

Were there any problems found?

Yes >> • Repair or replace the malfunctioning component.
No >> • Clean or replace the MAF sensor.

P0105: Manifold Absolute Pressure/Barometric Pressure Circuit

- **When Monitored:** With the engine running and battery voltage greater than 12 volts.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear all DTCs.
Start the engine and allow it to reach normal operating temperature.
Turn the ignition switch from OFF to ON.
With the X-431 scan tool, select view DTCs.

Does the scan tool read: P0105?

Yes >> • Go to the next step.

No >> • See Diagnostic Help in Section 03 Electronic Engine Controls for more information.

Step 2.

Turn the ignition switch off.
Disconnect the Manifold Absolute Pressure (MAP) sensor connector E-033 and the ECM connector.
Using the electrical schematic as a guide, inspect the connectors for broken, bent, push out or corroded terminals.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 3.

Connect the ECM connector.
Turn the ignition switch on.
Measure the voltage of the 5 volt supply circuit in the MAP sensor harness connector.

Is the test result normal?

Yes >> • Go to step 5.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.
Disconnect the ECM connector.
Check the 5 volt supply circuit for a short to voltage.
Check the 5 volt supply circuit for a short to ground.
Check the 5 volt supply circuit for a short to sensor ground.
Check the 5 volt supply circuit for an open or high resistance.

Are the test results normal?

Yes >> • Go to the next step.

No >> • Repair as necessary.

Step 5.

Check the MAP signal circuit for a short to voltage.
Check the MAP signal circuit for a short to ground.
Check the MAP signal circuit for an open or high resistance.

Are the test results normal?

Yes >> • Go to the next step.
No >> • Repair as necessary.

Step 6.

Check the MAP ground circuit for an open or high resistance.

Is the test result normal?

Yes >> • Go to the next step.
No >> • Repair as necessary.

Step 7.

Turn the ignition switch off.
Connect the ECM connector.
Connect a jumper wire between the sensor ground circuit and the MAP signal circuit in the MAP sensor harness connector.
Turn the ignition switch on.
With the X-431 scan tool, select view DTCs.

Does the scan tool read: P0105 ?

Yes >> • Go to the next step.
No >> • Go to step 9.

Step 8.

Replace the MAP sensor.
Start the engine and with the scan tool read MAP sensor data and select view DTCs in ECM.

Does the DTC P0105 reset?

Yes >> • Go to the next step.
No >> • The system is normal.
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 9.

Using the electrical schematic as a guide, inspect the ECM connector. Look for broken, bent, pushed out or corroded terminals.

Were any problems found?

Yes >> • Repair as necessary.
No >> • Replace and program the ECM.

P0106: Manifold Absolute Pressure or Barometric Pressure - Range/Performance

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the X-431 scan tool, read the DTCs.

Is DTC P0106 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the Manifold Absolute Pressure (MAP) sensor connector.
Turn the ignition switch on.
Measure the voltage of the 5 volt supply circuit in the MAP sensor electrical connector.

Is the voltage between 4.5 and 5.5 volts?

Yes >> • Go to the next step.

No >> • Go to step 7.

Step 3.

Measure the voltage of the MAP signal circuit in the MAP sensor electrical connector.

Is the voltage between 4.5 and 5.5 volts?

Yes >> • Go to the next step.

No >> • Go to step 11.

Step 4.

Turn the ignition switch off.
Using a 12 volt test light connected to 12 volts, check the sensor ground in the MAP sensor electrical connector.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Go to step 15.

Step 5.

Turn the ignition switch off.
Disconnect the ECM connector.
Measure the resistance between the 5 volt supply circuit and the MAP Signal circuit in the MAP sensor electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.
No >> • Repair the 5 volt supply circuit for a short to the MAP signal circuit.

Step 6.

Using the electrical schematic as a guide, inspect the wiring and connectors between the MAP sensor and the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Inspect the MAP sensor for any condition that would result in an incorrect signal, such as damage or contamination.

Were any problems found?

Yes >> • Repair as necessary.
No >> • Replace the MAP sensor.

Step 7.

.
Disconnect the ECM connector.
Measure the 5 volt supply circuit for a short to other supply circuits in the MAP sensor electrical connector.

Is the test result normal?

Yes >> • Go to the next step.
No >> • Repair the 5 volt supply circuit for a short to voltage condition.

Step 8.

Turn the ignition switch off.
Measure the resistance between ground and the 5 volt supply circuit in the MAP sensor electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.
No >> • Repair the 5 volt supply circuit for a short to ground.

Step 9.

Measure the resistance between the 5 volt supply circuit and the sensor ground circuit in the MAP sensor electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.
No >> • Repair the 5 volt supply circuit for a short to the sensor ground circuit.

Step 10.

Measure the resistance of the 5 volt supply circuit between the MAP sensor electrical connector and the ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to step 16.

No >> • Repair the 5 volt supply circuit for an open circuit or high resistance.

Step 11.

Turn the ignition switch off.
Disconnect the ECM connector.
Measure the MAP signal circuit for a short to voltage circuit in the MAP sensor electrical connector.

Is the test result normal?

Yes >> • Go to the next step.

No >> • Repair the MAP signal circuit for a short to voltage.

Step 12.

Measure the resistance between ground and the MAP signal circuit in the MAP sensor electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the MAP signal circuit for a short to ground.

Step 13.

Measure the resistance between the MAP Signal circuit and the sensor ground circuit in the MAP sensor electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the MAP signal circuit for a short to the sensor ground circuit.

Step 14.

Measure the resistance of the MAP signal circuit between the MAP sensor electrical connector and the ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to step 16.

No >> • Repair the MAP signal circuit for an open circuit or high resistance.

Step 15.

Turn the ignition switch off.

Disconnect the ECM connector.

Measure the resistance of the sensor ground circuit between the MAP sensor electrical connector and the ECM.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the circuit for an open circuit or high resistance.

Step 16.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Turn the ignition switch off.

Disconnect the ECM connector.

Using the electrical schematic as a guide, inspect the wiring and connectors between the oxygen sensor and the ECM (See Diagnostic Help in Section 03 Electronic Engine Controls).

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0107: Manifold Absolute Pressure or Barometric Pressure Circuit Low

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.

Turn the engine off and turn the ignition switch on.

With the X-431 scan tool, read the DTCs.

Is DTC P0107 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the Manifold Absolute Pressure (MAP) sensor connector.

Turn the ignition switch on.

Measure the voltage between the 5 volt supply circuit in the MAP sensor C-3 electrical connector and ground.

Is the voltage above 4.5 volts?

Yes >> • Go to step 6.

No >> • Go to the next step.

Step 3.

Turn the ignition switch off.

Disconnect the ECM electrical connector.

Measure the resistance between the 5 volt supply circuit in the MAP sensor electrical connector and ground.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the 5 volt supply circuit for a short to ground.

Step 4.

Measure the resistance between the 5 volt supply circuit and the sensor ground circuit in the MAP sensor electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the 5 volt supply circuit for a short to the sensor ground circuit.

Step 5.

Measure the resistance of the 5 volt supply circuit between the MAP sensor electrical connector and the ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to step 10.

No >> • Repair the 5 volt supply circuit for an open circuit or high resistance.

Step 6.

Turn the ignition switch off.

Disconnect the ECM electrical connector.

Measure the resistance between the MAP signal circuit in the MAP sensor electrical connector and ground.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the MAP signal circuit for a short to ground.

Step 7.

Measure the resistance between the MAP signal circuit and the sensor ground circuit in the MAP sensor electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the MAP signal circuit for a short to the sensor ground circuit.

Step 8.

Turn the ignition switch off.

Connect the ECM connector.

Connect a jumper wire between the 5 volt supply circuit and the MAP Signal circuit in the MAP sensor electrical connector.

Turn the ignition switch on.

With the X-431 scan tool, read the MAP sensor signal voltage.

Is the voltage above 4.5 volts with the jumper wire in place?

Yes >> • Go to the next step.

No >> • Go to step 10.

Step 9.

Using the electrical schematic as a guide, inspect the wiring and connectors between the MAP sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Inspect the MAP sensor for any condition that would result in an incorrect signal, such as damage or contamination.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the MAP sensor.

Step 10.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0108: Manifold Absolute Pressure or Barometric Pressure Circuit High

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the X-431 scan tool, read the DTCs.

Is DTC P0108 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the Manifold Absolute Pressure (MAP) sensor connector.
Turn the ignition switch on.
Measure the voltage of the 5 volt supply circuit in the MAP sensor electrical connector.

Is the test result normal?

Yes >> • Go to the next step.

No >> • Repair the 5 volt supply circuit for a short to voltage.

Step 3.

Measure the voltage of the MAP signal circuit in the MAP sensor electrical connector.

Is the MAP signal circuit normal?

Yes >> • Go to the next step.

No >> • Repair the MAP signal circuit for a short to voltage.

Step 4.

Measure the resistance between the MAP Signal circuit and the 5 volt supply in the MAP sensor electrical connector.

Is the resistance below 10,000 ohms?

Yes >> • Repair the MAP signal circuit for a short to the 5 volt supply circuit.

No >> • Go to the next step.

Step 5.

Turn the ignition switch off.
Measure the resistance of the MAP signal between the MAP sensor electrical connector and the ECM electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.
No >> • Repair the MAP signal circuit for an open.

Step 6.

Measure the resistance of the sensor ground circuit between the MAP sensor electrical connector and the MAP electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.
No >> • Repair the MAP sensor ground circuit for an open.

Step 7.

Turn the ignition switch off.
Connect a jumper wire between the sensor ground circuit and the MAP signal circuit in the MAP sensor electrical connector.
Turn the ignition switch on.
With the X-431 scan tool, read the MAP sensor signal voltage.

Is the voltage below 1.0 volt with the jumper wire in place?

Yes >> • Go to the next step.
No >> • Go to step 9.

Step 8.

Turn the ignition switch off.
Using the electrical schematic as a guide, inspect the wiring and connectors between the MAP sensor and the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Inspect the MAP sensor for any condition that would result in an incorrect signal, such as damage or contamination.

Were any problems found?

Yes >> • Repair as necessary.
No >> • Replace the MAP sensor.

Step 9.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0112: Intake Air Temperature Circuit Low

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the X-431 scan tool, read the DTCs.

Is DTC P0112 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the IAT sensor connector.
Disconnect the ECM connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.
Turn the ignition switch on.
Measure the resistance of the IAT sensor signal circuit between the IAT sensor electrical connector and ground.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the IAT signal circuit for a short to ground.

Step 3.

Turn the ignition switch off.
Measure the resistance between IAT sensor signal circuit and IAT sensor ground circuit.

Is the resistance below 10,000 ohms?

Yes >> • Repair the IAT sensor signal circuit for a short to IAT sensor ground circuit.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.
Connect the ECM connector.
Connect a jumper wire between the IAT signal circuit and the sensor ground in the IAT sensor electrical connector.
Turn the ignition switch on.
With the X-431 scan tool, read the IAT sensor signal voltage.

Is the voltage below 1.0 volt with the jumper wire in place?

Yes >> • Go to the next step.

No >> • Go to step 6.

Step 5.

Turn the ignition switch off.
Using the electrical schematic as a guide, inspect the wiring and connectors between the IAT sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the IAT sensor.

Step 6.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0113: Intake Air Temperature Circuit High

- **When Monitored:** With the ignition switch on and engine running.

Step 1.

Start the engine and allow it to reach normal operating temperature.

Turn the engine off and turn the ignition switch on.

With the X-431 scan tool, read the DTCs.

Is DTC P0118 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the Intake Air Temperature (IAT) sensor connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.

Turn the ignition switch on.

Measure the voltage of the IAT sensor signal circuit between the IAT sensor electrical connector and ground.

Is the IAT sensor signal voltage normal?

Yes >> • Go to the next step.

No >> • Repair the IAT signal circuit for a short to voltage.

Step 3.

Turn the ignition switch on.

Disconnect the ECM connector.

Measure the resistance of the IAT ground circuit between IAT sensor electrical connector and ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the IAT ground circuit for an open or high resistance.

Step 4.

Measure the resistance of the IAT signal circuit between the IAT sensor electrical connector and ECM connector.

Is the resistance below 5 ohms?

Yes >> • Go to the next step.

No >> • Repair the IAT signal circuit for an open circuit or high resistance.

Step 5.

Turn ignition switch off.
Connect the ECM electrical connector.
Turn ignition switch on.
With the X-431 scan tool, read the data of IAT sensor signal voltage.

Is the voltage above 4.5 volts with the IAT sensor disconnected?

Yes >> • Go to the next step.

No >> • Go to step 7.

Step 6.

Turn the ignition switch off.
Using the electrical schematic as a guide, inspect the wiring and connectors between the IAT sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the IAT sensor.

Step 7.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0117: Engine Coolant Temperature Circuit Low

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the X-431 scan tool, read the DTCs.

Is DTC P0117 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the Engine Coolant Temperature (ECT) sensor electrical connector.
Disconnect the ECM electrical connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.
Measure the resistance between ground and the ECT signal circuit in the ECT sensor electrical connector pin 1.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the ECT signal circuit for a short to ground.

Step 3.

Measure the resistance between the ECT signal circuit and the sensor ground circuit in the ECT sensor electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the ECT signal circuit for a short to the sensor ground circuit.

Step 4.

Turn ignition switch off.
Connect the ECM electrical connector.
Connect a jumper wire between the ECT signal circuit and the sensor ground in the ECT sensor electrical connector.
Turn ignition switch on.
With the X-431 scan tool, read the data for the ECT sensor signal voltage.

Is the voltage below 1.0 volt with the jumper wire in place?

Yes >> • Go to the next step.

No >> • Go to step 6.

Step 5.

Turn the ignition switch off.

Using the electrical schematic as a guide, inspect the wiring and connectors between the ECT sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the ECT sensor.

Step 6.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0118: Engine Coolant Temperature Circuit High

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.

Turn the engine off and turn the ignition switch on.

With the X-431 scan tool, read the DTCs.

Is DTC P0118 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the ECT sensor electrical connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.

Turn the ignition switch on.

Measure the voltage of the ECT sensor signal circuit between the ECT sensor electrical connector and ground.

Is the ECT sensor signal voltage normal?

Yes >> • Go to the next step.

No >> • Repair the ECT signal circuit for a short to voltage.

Step 3.

Turn the ignition switch off.

Disconnect the ECM connector.

Turn the ignition switch off.

Measure the resistance of the ECT signal circuit between ECT sensor electrical connector and ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the ECT signal circuit for an open or high resistance.

Step 4.

Measure the resistance of the ECT ground circuit between the ECT sensor electrical connector and ECM electrical connector.

Is the resistance below 5 ohms?

Yes >> • Go to the next step.

No >> • Repair the ECT ground circuit for an open circuit or high resistance.

Step 5.

Connect the ECM connector.
Turn the ignition switch on.
With the X-431 scan tool, read the ECT sensor signal voltage.

Is the voltage above 4.5 volts with the ECT sensor disconnected?

Yes >> • Go to the next step.
No >> • Go to step 7.

Step 6.

Turn the ignition switch off.
Using the electrical schematic as a guide, inspect the wiring and connectors between the ECT sensor and the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.
No >> • Replace the ECT sensor.

Step 7.

Using the electrical schematic as a guide, inspect the wiring and connectors between the ECT sensor and the ECM. See Diagnostic Help in Section 03 Electronic Engine Controls.

Were there any problems found?

Yes >> • Repair as necessary.
No >> • Replace and program the ECM.

P0122: Throttle/Pedal Position Sensor A Circuit Low Input

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.

Stop engine, turn ignition switch on.

With the X-431 scan tool, read the DTCs.

With the scan tool, select data stream.

Read the Accelerator Pedal Position (APP) value under the following two conditions:

- With accelerator pedal at rest: TP sensor-1 value is 0.74 volts, and TP sensor-2 value is 4.24 volts.
- With accelerator pedal pressed: TP sensor-1 value is 4.62 volts, and TP sensor-2 value is 0.72 volts.

Is DTC P0122 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the Throttle Position (TP) sensor electrical connector.

Turn the ignition switch on.

Measure the voltage of the 5 volt supply circuit at the TP sensor-1 electrical connector.

Is the voltage above 4.5 volts?

Yes >> • Go to step 6.

No >> • Go to the next step.

Step 3.

Turn the ignition switch off.

Disconnect the ECM connector.

Measure the resistance between ground and the 5 volt supply circuit at the TP sensor-1 electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the 5 volt supply circuit for a short to ground.

Step 4.

Measure the resistance between the 5 volt supply circuit and the TP sensor-1 ground circuit in the TP electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the 5 volt supply circuit for a short to the TP sensor-1 ground circuit.

Step 5.

Measure the resistance of the 5 volt supply circuit between the TP electrical connector and the ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the 5 volt supply circuit for an open circuit or high resistance.

Step 6.

Measure the resistance between ground and the TP sensor-1 signal circuit in the TP electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the TP sensor-1 signal circuit for a short to ground.

Step 7.

Measure the resistance between the TP sensor-1 signal circuit and the TP sensor ground circuit in the TP electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to step 8.

No >> • Repair the TP sensor-1 signal circuit for a short to the TP sensor ground circuit.

Step 8.

Measure the resistance of the TP sensor-1 signal circuit between the TP electrical connector and the ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the TP sensor-1 signal circuit for an open circuit or high resistance.

Step 9.

Connect the ECM electrical connector.

Connect a jumper wire between the 5 volt supply circuit and the TP sensor-1 signal circuit in the TP electrical connector.

Turn the ignition switch on.

With the X-431 scan tool, read the TP sensor-1 signal circuit voltage.

Is the voltage above 4.5 volts with the jumper wire in place?

Yes >> • Go to the next step.

No >> • Go to step 11.

Step 10.

Turn the ignition switch off.

Using the electrical schematic as a guide, inspect the wiring and connectors between the TP sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the TP sensor.

Step 11.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0123: Throttle/Pedal Position Sensor A Circuit High Input

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.
Stop engine, turn ignition switch on.
With the X-431 scan tool, read the DTCs.
With the scan tool, select data stream.
Read the Accelerator Pedal Position (APP) value under the following two conditions:

- With accelerator pedal at rest: TP sensor-1 value is 0.74 volts, and TP sensor-2 value is 4.24 volts.
- With accelerator pedal pressed: TP sensor-1 value is 4.62 volts, and TP sensor-2 value is 0.72 volts.

Is DTC P0122 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the Throttle Position (TP) sensor connector.
Turn the ignition switch on.
Measure the voltage of the 5 volt supply circuit in the TP electrical connector for a short to voltage.

Is the 5 volt supply voltage normal?

Yes >> • Go to the next step.

No >> • Repair the 5 volt supply circuit for a short to voltage.

Step 3.

Measure the voltage of the TP sensor-1 signal circuit in the TP electrical connector.

Is the TP sensor-1 signal voltage normal?

Yes >> • Go to the next step.

No >> • Repair the TP sensor-1 signal circuit for a short to voltage.

Step 4.

Turn the ignition switch off.
Disconnect the ECM connector.
Measure the resistance between the TP sensor-1 signal circuit and the supply circuit in the TP electrical connector.

Is the resistance below 10,000 ohms?

Yes >> • Repair the APP sensor-1 signal circuit for a short to the supply circuit.

No >> • Go to the next step.

Step 5.

Measure the resistance between the TP sensor-1 signal circuit and the Electronic Throttle Control (ETC) Motor circuit in the TP electrical connector.

Is the resistance below 10,000 ohms?

Yes >> • Repair the ETC Motor circuit for a short to the supply circuit.

No >> • Go to the next step.

Step 6.

Measure the resistance of the TP sensor ground circuit between the TP electrical connector and the ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the TP sensor ground circuit for an open circuit or high resistance.

Step 7.

Turn the ignition switch off.

Connect the ECM connector.

Connect a jumper wire between the APP sensor ground circuit and the TP sensor-1 signal circuit in the TP electrical connector.

Turn the ignition switch on.

With the scan tool, read the TP sensor-1 signal circuit voltage.

Is the voltage below 1.0 volt with the jumper wire in place?

Yes >> • Go to the next step.

No >> • Go to step 9.

Step 8.

Turn the ignition switch off.

Using the electrical schematic as a guide, inspect the wiring and connectors between the TP sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the TP sensor.

Step 9.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0132: O2 Sensor 1 Circuit High

- **When Monitored:** The battery voltage greater than 12 volts, the engine at normal operating temperature.

Step 1.

Start the engine and allow it to reach normal operating temperature.

Turn the engine off and turn the ignition switch on.

With the X-431 scan tool, read the DTCs.

Is DTC P0132 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

With the X-431 scan tool, select oxygen sensor 1 voltage data stream.

Check the voltage of the oxygen data stream.

Is the voltage above normal value?

Yes >> • Go to the next step.

No >> • See Diagnostic Help in Section 03 Electronic Engine Controls for further information.

Step 3.

With the X-431 scan tool, drive the vehicle at speeds over 40 km/h, then release the accelerator pedal.

Watch the oxygen sensor 1 signal data stream when the throttle is less than 3% open, and the engine is decelerating.

Is the voltage signal approximately 110 millivolts?

Yes >> • See Diagnostic Help in Section 03 Electronic Engine Controls for further information.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.

Disconnect the oxygen sensor 1 electrical connector.

Turn the ignition switch on.

With the X-431 scan tool, view the oxygen sensor 1 signal voltage.

If without scan tool

- Connect the oxygen sensor 1 low signal circuit connector pin 3 to ground.
- Check the oxygen sensor 1 high signal voltage with a multimeter between the sensor connector pin 4 and ground.

Is the oxygen sensor reference voltage above 480 millivolts?

Yes >> • Go to the next step.

No >> • Replace the oxygen sensor 1.
• Clear the DTC.

Step 5.

Turn the ignition switch off.

Disconnect the ECM connector.

Check the oxygen sensor 1 signal circuit for a short to voltage circuit between the ECM connector pin 4 and voltage circuit.

Is the resistance below 10,000 ohms?

Yes >> • Repair the signal circuit for a short to voltage circuit.

No >> • Go to step 6.

Step 6.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0171: Fuel Trim Bank 1 Too Lean

- **When Monitored:** With the engine running in closed loop.

Step 1.

Diagnose and repair any other active component or circuit DTCs before continuing with this procedure.
Turn the ignition switch on.
Start the engine and allow it to reach normal operating temperature.

WARNING!

When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in personal injury or death.

NOTE :
Attempt to operate the vehicle under conditions similar to which the DTC was set.

NOTE :
It may be necessary to test drive the vehicle within the DTC monitoring conditions in order for this DTC to set. With the X-431 scan tool, read the DTCs.

Is DTC P0171 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Perform the following inspection procedure:

- Check the oxygen sensor for proper installation.
- Check the oxygen sensor circuits for proper routing.
- Check the oxygen sensor signal circuit for an open, short to ground or short to voltage.
- Check the PCV system for correct operation.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 3.

Perform the following diagnostic procedure:

- Connect the fuel pressure gauge to the fuel system.
- Turn the ignition switch on (fuel pump run time is 2-3 seconds).

Is the fuel pressure 4 bar when the pump runs and stabilizes?

Yes >> • Go to the next step.

No >> • Repair fuel system as necessary.

Step 4.

Perform the diagnostic procedure for the ECT sensor.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 5.

Perform the diagnostic procedure for the MAP sensor.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 6.

Perform the diagnostic procedure for the oxygen sensor.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 7.

Perform the following diagnostic inspection:

- Check the vacuum hose routing.
- Check for fuel contamination.
- Check the intake manifold, throttle body, and seals of the fuel injectors for leaks.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 8.

Using the electrical schematic as a guide, inspect the wiring and connectors between the engine sensors and the ECM. See Diagnostic Help in Section 03 Electronic Engine Controls.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0172: Fuel Trim Bank 1 Too Rich

- **When Monitored:** With the engine running in closed loop.

Step 1.

Diagnose and repair any other active component or circuit DTCs before continuing with this procedure.
Turn the ignition switch on.
Start the engine and allow it to reach normal operating temperature.

WARNING!

When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in personal injury or death.

NOTE :
Attempt to operate the vehicle under conditions similar to which the DTC was set.

NOTE :
It may be necessary to test drive the vehicle within the DTC monitoring conditions in order for this DTC to set. With the X-431 scan tool, read the DTCs.

Is DTC P0172 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Inspect the air cleaner filter for clogged elements, and inspect the intake system for dents or blockage.

Were any problems found?

Yes >> • Replace or clear the air cleaner and repair as necessary.

No >> • Go to the next step.

Step 3.

Perform the diagnostic procedure for fuel delivery system.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Perform the diagnostic procedure for EVAP control system.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 5.

Remove the oxygen sensor and inspect the oxygen sensor for silicon contamination.
- Check the oxygen sensor for proper installation.
- Check the oxygen sensor circuits for proper routing.
- Check the oxygen sensor signal circuit for an open, short to ground or short to voltage.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 6.

Perform the diagnostic procedure for MAP sensor.
If the MAP sensor value is abnormal, see DTC P0106.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 7.

Perform the following diagnostic checks:
- Check if the fuel pressure is above 4 bar.
- Check if the throttle body is blocked.
- Check if the fuel injectors are leaking.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 8.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:
- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0201, P0202, P0203, P0204: Cylinder 1,2,3,4 Injector Circuit Fault

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.

Turn the engine off and turn the ignition switch on.

With the X-431 scan tool, read the DTCs.

Is DTC P0201 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the fuel injector electrical connector.

Turn the ignition switch on.

Using a 12 volt test light connected to ground, check the fuel injector supply circuit in the fuel injector electrical connector.

NOTE :

The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Repair the injector supply circuit for an open or shorted to ground.

Step 3.

Turn the ignition switch off.

Disconnect the ECM electrical connector.

NOTE :

When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.

Measure the resistance of the fuel injector control circuit between the fuel injector electrical connector and the ECM electrical connector.

Is the resistance of the fuel injector control circuit between the fuel injector electrical connector and the ECM electrical connector below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the fuel injector control circuit for an open.

Step 4.

Measure the resistance of the fuel injector control circuit between the fuel injector electrical connector and ground.

Is the resistance of the fuel injector control circuit between the fuel injector electrical connector and ground above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the fuel injector control circuit for a short to ground.

Step 5.

Using a multimeter, measure the resistance between the terminals of the fuel injector.

NOTE :
The resistance of the circuit will vary according to the temperature of the injector coil. Use the table below to determine the resistance range of the injector.

FUEL INJECTOR COIL RESISTANCE BASED ON ENGINE TEMPERATURE	
TEMPERATURE	**RESISTANCE**
20°C	11-13 ohms

Is the resistance of the injector within the specified range?

Yes >> • Go to the next step.

No >> • Replace the fuel injector.

Step 6.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:
- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0221: Throttle/Pedal Position Sensor/Switch B Range/Performance

- **When Monitored:** With the ignition switch on, battery voltage greater than 12 volts, and no other Throttle Position (TP) sensor DTCs present.

Step 1.

Diagnose and repair any other active component or circuit DTCs before continuing with this procedure.

Turn the ignition switch on.

Start the engine and allow it to reach normal operating temperature.

With the X-431 scan tool, read the DTCs.

Is DTC P0221 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the ECM electrical connector.

Disconnect the TP electrical connector.

Measure the resistance of TP sensor-1 and TP sensor-2 5 volt reference voltage circuit and signal circuit between the TP electrical connector and the ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the high resistance circuits.

Step 3.

Check the resistance between the TP sensor-1 and TP sensor-2 signal circuit in TP sensor connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the TP sensor-1 circuit short to TP sensor-2 circuit.

Step 4.

Connect the TP electrical connector.

Connect the ECM electrical connector.

Turn the ignition switch on.

Set up an oscilloscope or X-431 scan tool to view two graphs simultaneously as follows:

- Using one channel on the oscilloscope, backprobe the TP sensor-1 circuit at the TP electrical connector.
- Using the another channel on the oscilloscope, backprobe the TP sensor-2 circuit at the TP electrical connector.
- Slowly press and release the accelerator pedal while monitoring the oscilloscope screen or X-431 scan tool screen.

Does the scope pattern show any missing or erratic signals?

Yes >> • Go to the next step.

No >> • Go to step 6.

Step 5.

Turn the ignition switch off.

Using the electrical schematic as a guide, inspect the wiring and connectors between the TP sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the TP sensor.

Step 6.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0261, P0264, P0267, P0270: Cylinder 1, Cylinder 2, Cylinder 3, Cylinder 4 Injector Circuit Low

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the X-431 scan tool, read the DTCs.

Is DTC P0261 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the effected fuel injector electrical connector.
Turn the ignition switch on.
Using a 12 volt test light connected to ground, check the fuel injector supply circuit from the fused main relay output circuit to the fuel injector electrical connector.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Repair the injector supply circuit as necessary.

Step 3.

Turn the ignition switch off.
Disconnect the ECM electrical connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.
Measure the resistance between ground and fuel injector control circuit in the fuel injector electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the fuel injector control circuit for a short to ground.

Step 4.

Measure the resistance of the injector control circuit between the fuel injector electrical connector and the ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the injector control circuit for an open or high resistance.

Step 5.

Using a multimeter, measure the resistance between the terminals of the fuel injector.

NOTE :
The resistance of the circuit will vary according to the temperature of the injector coil. Use the table below to determine the resistance range of the injector.

FUEL INJECTOR COIL RESISTANCE BASED ON ENGINE TEMPERATURE	
TEMPERATURE	**RESISTANCE**
20°C	11-13 ohms

Is the resistance of the injector within the specified range?

Yes >> • Go to the next step.

No >> • Replace the fuel injector.

Step 6.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:
- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0262, P0265, P0268, P0271: Cylinder 1, Cylinder 2, Cylinder 3, Cylinder 4 Injector Circuit High

- **When Monitored:** With-the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the X-431 scan tool, read the DTCs.

Is DTC P0262 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the effected fuel injector electrical connector.
Turn the ignition switch on.
Measure the voltage of the fuel injector control circuit in the fuel injector electrical connector.

Is the fuel injector control circuit normal?

Yes >> • Go to step 4.

No >> • Go to the next step.

Step 3.

Disconnect the ECM connector.
Measure the resistance between the fuel injector control circuit and voltage circuit in the fuel injector electrical connector for a short to voltage.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the fuel injector control circuit for a short to voltage.

Step 4.

Using a multimeter, measure the resistance between the terminals of the fuel injector.

NOTE :
The resistance of the circuit will vary according to the temperature of the injector coil. Use the table below to determine the resistance range of the injector.

FUEL INJECTOR COIL RESISTANCE BASED ON ENGINE TEMPERATURE	
TEMPERATURE	**RESISTANCE**
20°C	11-13 ohms

Is the resistance of the injector within the specified range?

Yes >> • Go to the next step.

No >> • Replace the fuel injector.

Step 5.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0321: Ignition/Distributor Engine Speed Input Circuit - Range/Performance

- **When Monitored:** With the engine cranking or running.

Step 1.

Start the engine and allow it to reach normal operating temperature.

NOTE :
If the engine will not start, crank the engine for several seconds.
Stop engine, turn ignition switch on.
With the X-431 scan tool, read the DTCs.

Is DTC P0321 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the Crankshaft Position (CKP) sensor connector.
Measure the resistance of the CKP sensor (component side).

Is the resistance between 731 and 989 ohms?

Yes >> • Go to the next step.

No >> • Replace the CKP sensor.

Step 3.

Disconnect the ECM electrical connector.
Check the CKP sensor ground circuit for an open or short to voltage.

Is the CKP sensor ground circuit open or shorted to voltage?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Check the CKP sensor reference circuit for an open between the CKP sensor connector and ECM connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the CKP reference circuit for an open.

Step 5.

Turn the ignition switch on.

Check the CKP sensor reference circuit for a short to ground or short to voltage circuit.

Is the resistance below 10,000 ohms between the CKP sensor reference circuit and ground; or any voltage present between the CKP sensor reference circuit and ground?

Yes >> • Repair the CKP sensor reference circuit for short to ground or voltage.

No >> • Go to the next step.

Step 6.

Inspect the CKP sensor for the following:

- Look for broken, bent, pushed out or corroded terminals of the CKP sensor.
- Inspect the CKP sensor for conditions such as loose mounting screws, damage, or cracks.
- Inspect the CKP sensor and mounting area for any condition that would result in an incorrect signal, such as damage, foreign material, or excessive movement.

Is there any problems found?

Yes >> • Repair the CKP sensor connector as necessary.

No >> • Go to the next step.

Step 7.

Replace the CKP sensor.

Operate the engine under the condition which set the DTC.

Is there any problems found?

Yes >> • Go to the next step.

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

Step 8.

Turn the ignition switch off.

Remove the CKP sensor.

Inspect the pulse ring and mounting area for any condition that would result in an incorrect signal, such as damage, foreign material, or excessive movement.

Is there any problems found?

Yes >> • Replace the pulse ring.

No >> • Go to the next step.

Step 9.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0324: Knock Control System Error

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.

NOTE :
It may be necessary to test drive the vehicle within the DTC monitoring conditions in order for this DTC to reset. Raise the engine speed for a few seconds and listen for any unusual sounds.

Were any engine sounds heard?

Yes >> • Repair the engine mechanical malfunction.
No >> • Go to the next step.

Step 2.

Turn the ignition switch off.
Disconnect the knock sensor electrical connector.
Turn the ignition switch on.
Measure the voltage of the knock sensor signal circuit in the knock sensor electrical connector.

Is there any voltage present?

Yes >> • Go to the next step.
No >> • Go to step 4.

Step 3.

Turn the ignition switch off.
Disconnect the ECM electrical connector.
Turn the ignition switch on.
Measure the voltage of the knock sensor signal circuit in the knock sensor electrical connector.

Is there any voltage present?

Yes >> • Repair the knock sensor signal circuit for a short to voltage.
No >> • Repair the knock sensor signal circuit for a short to ECM output voltage circuit.

Step 4.

Turn the ignition switch off.
Measure the resistance between ground and the knock sensor signal circuit in the knock sensor electrical connector.

Is the resistance above 10,000 ohms between ground and the knock sensor signal circuit?

Yes >> • Go to the next step.
No >> • Repair the knock sensor signal circuit for a short to shielded conductor.

Step 5.

Measure the resistance between the knock sensor signal circuit and the knock sensor return circuit in the knock sensor electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the knock sensor signal circuit for a short to the knock sensor return circuit.

Step 6.

Measure the resistance between the knock sensor pin 1 and pin 2.

Is the resistance above 1 M ohm between pin 1 and pin 2?

Yes >> • Go to the next step.

No >> • Replace the knock sensor.

Step 7.

Measure the resistance of the knock sensor signal circuit between the knock sensor electrical connector and the ECM electrical connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the knock sensor signal circuit for an open circuit or high resistance.

Step 8.

Measure the resistance of the knock sensor return circuit between the knock sensor electrical connector and the ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the knock sensor return for an open circuit or high resistance.

Step 9.

Using the electrical schematic as a guide, inspect the wiring and connectors between the knock sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 10.

Connect the ECM electrical connector.
Replace the knock sensor.
Start the engine and allow it to reach normal operating temperature.
With the X-431 scan tool, read the DTCs.

Is DTC P0324 present?

Yes >> • Go to the next step.

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

Step 11.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0341: Camshaft Position Sensor Circuit - Range/Performance

- **When Monitored:** With the engine cranking or running.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.

NOTE :
If the engine will not start, crank the engine for several seconds.
With the scan tool, read the DTCs.

Is DTC P0341 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the Camshaft Position (CMP) sensor electrical connector.
Turn the ignition switch on.
Measure the voltage of the supply voltage circuit in the CMP sensor connector.

Is 12 volts present?

Yes >> • Go to the next step.

No >> • Repair the supply circuit for a short to ground or open.

Step 3.

Measure the voltage of the CMP signal circuit in the CMP sensor electrical connector.

Is 12 volts present?

Yes >> • Go to the next step.

No >> • Go to step 6.

Step 4.

Turn the ignition switch off.
Using a 12 volt test light connected to 12 volts, check the sensor ground in the CMP sensor electrical connector.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Repair the CMP ground circuit for an open or poor connection.

Step 5.

Using the electrical schematic as a guide, inspect the following:

- Inspect the wiring and connectors between the CMP sensor and the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Inspect the CMP sensor for conditions such as loose mounting screws, damage, or cracks.
- If no other problems are found, remove the CMP sensor. Inspect the CMP sensor and mounting area for any condition that would result in an incorrect signal, such as damage, foreign material, or excessive movement.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the CMP sensor.

Step 6.

Turn the ignition switch off.

Disconnect the ECM electrical connector.

Measure the resistance of the sensor circuit in the sensor connector pin 2 and ECM connector pin 79.

Measure the resistance between the ground or sensor ground and sensor signal circuit.

Is the sensor circuit open or shorted to ground or sensor ground?

Yes >> • Repair the sensor circuit open or shorted to ground.

No >> • Go to the next step.

Step 7.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0444: Evaporative Emission System Purge Control Valve Circuit Fault

- **When Monitored:** With the engine running and battery voltage greater than 12 volts.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.
With the scan tool, read the DTCs.

Is DTC P0444 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the EVAP sensor electrical connector.
Turn the ignition switch on.
Using a 12 volt test light connected to ground, check the EVAP purge supply circuit in the EVAP purge solenoid electrical connector.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Repair the EVAP supply circuit for a short to ground or an open.

Step 3.

With the X-431 scan tool, actuate the EVAP purge solenoid.
Using a 12 volt test light connected to the battery, check the EVAP purge control circuit in the EVAP purge solenoid electrical connector.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Does the test light flash on and off with the actuation?

Yes >> • Replace the EVAP purge solenoid.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.
Disconnect the EVAP purge solenoid connector.
Disconnect the ECM electrical connector.
Check the EVAP purge control circuit for an open, short to ground, short to EVAP purge supply circuit, or short to voltage.

Were any problems found?

Yes >> • Repair the EVAP purge control circuit.
No >> • Go to the next step.

Step 5.

Using the electrical schematic as a guide, inspect the wiring and connectors between the EVAP purge solenoid and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.
No >> • Replace and program the ECM.

P0506: Idle Air Control System RPM Lower Than Expected

- **When Monitored:** With the engine idling in drive, the brake applied, engine run time below a calibrated minimum value, and no VSS, MAF/MAP, ECT, TPS, ETC, Crankshaft Position sensor, fuel system, or injector DTCs present.

Step 1.

NOTE :
If any other Throttle Body DTCs are present, they must be diagnosed and repaired before continuing this test.
Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.
With the scan tool, read the DTCs.

Is DTC P0506 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Inspect the air induction system for the following air restriction problems:
- Dirty air cleaner
- Foreign material trapped in the air intake tube

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 3.

Inspect the PCV system for the following problems:
- Sticking valve
- Collapsed hoses or tubes
- Obstructed passages or ports

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Inspect the throttle body for carbon build up or other restrictions.

Using a straight edge, verify that the throttle plate is not bent. If the throttle plate is bent, the throttle body must be replaced.

Start the engine.

WARNING!

When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in personal injury or death.

While the vehicle is running, lightly tap on the Electronic Throttle Control (ETC) actuator where applicable, with your hand, and listen for the idle to raise.

Were any problems found or did the idle fluctuate while tapping on the ETC actuator?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 5.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0560: System Voltage Malfunction

- **When Monitored:** With the engine running for more than specification seconds.

Step 1.

NOTE :
Diagnose and repair any charging system or generator DTCs before continuing with this test.

NOTE :
Inspect and test the battery in accordance with the Service Information before continuing with this test.

NOTE :
Inspect the vehicle for aftermarket accessories that may exceed the Generator System output.

NOTE :
Inspect the fuses. If an open fuse is found, use the wiring schematics as a guide and inspect the wiring and connectors for damage.
Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.
With the scan tool, select View DTCs.
With the scan tool, read the DTCs.

Is DTC P0560 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Start the engine, raise the engine speed over 1000 rpm.
Measure the charge voltage with the voltmeter.

Is the voltage between 9-16 volts?

Yes >> • Go to the next step.

No >> • Repair the charge system fault.

Step 3.

Turn the engine off.
Disconnect the ECM electrical connector.
Turn the ignition switch on.
Using a 12 volt test light connected to ground, check the ECM supply circuits pin 44, pin 45 and pin 63 in the ECM electrical connector, harness side.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.
Is the test light illuminated and bright?

Yes >> • Replace and program the ECM.

No >> • Repair the ECM supply circuit for an open, high resistance or short to ground as necessary.

P0601: Internal Control Module Memory Check Sum Error

P0602: ECM Programming Error

P0604: Internal Controller Module Random Access Memory (RAM) Error

P0605: Internal Controller Module ROM Test Error

P0606: ECM Processor

- **When Monitored:** With the ignition switch on.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs in ECM.
Monitor the scan tool for at least two minutes.
Cycle the ignition key off and on several times, leaving the ignition switch on for at least 10 seconds at a time.
Start the engine and allow it to reach normal operating temperature.
With the scan tool, read the DTCs.

Is DTC P0601, P0602, P0604, P0605 or P0606 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Check the ECM supply voltage circuit and the ECM ground circuit for an open, high resistance or shorted circuits.

Were any problems found?

Yes >> • Repair the circuits fault as necessary.

No >> • Go to the next step.

Step 3.

With X-431 scan tool, review DTCs.

Is DTC P0602 set?

Yes >> • Go to the next step.

No >> • Replace and program the ECM.

Step 4.

With X-431 scan tool, program ECM before replacing it, and view the DTC with X-431.

Is DTC P0602 setting again?

Yes >> • Replace and program ECM.

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

P0627: Fuel Pump "A" Control Circuit Open

- **When Monitored:** With the engine running and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.

NOTE :
If the engine will not start, crank the engine for several seconds.

NOTE :
When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in personal injury or death.

Turn the ignition switch on.

With the X-431 scan tool, clear the DTCs.

Start the engine and allow it to reach normal operating temperature.

With the scan tool, read the DTCs.

Is DTC P0627 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the fuel pump relay.

Turn the ignition switch on.

Using a 12 volt test light connected to ground, check the relay supply voltage.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Repair the supply circuit for an open, high resistance or short to ground.

Step 3.

Connect a test light between the fuel pump control circuit and relay supply circuit on the fuel pump relay.

Turn the ignition switch on.

With the X-431 scan tool, actuate the fuel pump relay.

Does the test light flash on and off with the actuation?

Yes >> • Replace the relay.

No >> • Go to the next step.

Step 4.

Disconnect the ECM electrical connector.

Check the fuel pump relay control circuit for an open, high resistance, short to ground or short to voltage.

Were any problems found?

Yes >> • Repair the fuel pump relay control circuit.

No >> • Go to the next step.

Step 5.

Using the electrical schematic as a guide, inspect the wiring and connectors between the fuel pump control relay and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0645: A/C Clutch Relay Control Circuit Fault

- **When Monitored:** With the engine running and battery voltage greater than 12 volts.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.
Turn the Air Conditioning on.
With the scan tool, read the DTCs.

Is DTC P0645 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the A/C control relay.
Turn the ignition switch on.
Using a 12 volt test light connected to ground, check the relay supply voltage.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Repair the supply circuit for an open, high resistance or short to ground.

Step 3.

Turn the ignition switch off.
Connect a test light between the control circuit and supply circuit of the relay.
Turn the ignition switch on.
With the X-431 scan tool, actuate the A/C relay.

Does the test light flash on and off with the actuation?

Yes >> • Replace the relay.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.
Disconnect the ECM electrical connector.
Check the A/C relay control circuit for an open, high resistance, short to ground or short to voltage.

Were any problems found?

Yes >> • Repair the A/C relay control circuit.
No >> • Go to the next step.

Step 5.

Connect the ECM electrical connector.
Turn the ignition switch on.
Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.
No >> • Go to the next step.

Step 6.

Using the electrical schematic as a guide, inspect the wiring and connectors between the fuel pump control relay and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.
No >> • Replace and program the ECM.

P0691: Cooling Fan 1 Control Circuit Low

- **When Monitored:** With the engine running and battery voltage greater than 12 volts.

Step 1.

WARNING!

When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in personal injury or death.

Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.
With the scan tool, read the DTCs.

Is DTC P0691 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the cooling fan control module electrical connector.
Turn the ignition switch on.
Using a 12 volt test light connected to ground, check the low relay supply voltage.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Repair the supply circuit for an open, high resistance or short to ground.

Step 3.

Turn the ignition switch off.
Connect a test light between the control circuit and supply circuit of the low speed relay.
Turn the ignition switch on.
With the X-431 scan tool, actuate the radiator cooling fan low speed relay.

Does the test light flash on and off with the actuation?

Yes >> • Replace the radiator cooling fan low speed relay.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.
Disconnect the ECM electrical connector.
Check the radiator cooling fan low speed relay control circuit for a short to ground.

Were any problems found?

Yes >> • Repair the radiator cooling fan low speed relay control circuit.
No >> • Go to the next step.

Step 5.

Connect the ECM electrical connector.
Turn the ignition switch on.
Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.
No >> • Go to the next step.

Step 6.

Using the electrical schematic as a guide, inspect the wiring and connectors between the radiator cooling fan low relay and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.
No >> • Replace and program the ECM.

P0694: Cooling Fan 2 Control Circuit High

- **When Monitored:** With the engine running and battery voltage greater than 12 volts.

Step 1.

WARNING!

When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in personal injury or death.

Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.
With the scan tool, read the DTCs.

Is DTC P0694 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the cooling fan control module electrical connector.
Turn the ignition switch on.
Using a 12 volt test light connected to ground, check the high speed relay supply voltage.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Repair the high speed relay supply circuit for an open, high resistance or short to ground.

Step 3.

Turn the ignition switch off.
Connect a test light between the control circuit and supply circuit of the high speed relay.
Turn the ignition switch on.
With the X-431 scan tool, actuate the radiator cooling fan high speed relay.

Does the test light flash on and off with the actuation?

Yes >> • Replace the radiator cooling fan high relay.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.

Disconnect the ECM electrical connector.

Check the cooling fan high speed relay control circuit for an open, high resistance, short to ground or short to voltage.

Were any problems found?

Yes >> • Repair the cooling fan high speed relay control circuit.

No >> • Go to the next step.

Step 5.

Connect the ECM electrical connector.

Turn the ignition switch on.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 6.

Using the electrical schematic as a guide, inspect the wiring and connectors between the radiator cooling fan high relay and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P1545: Throttle Position Control Malfunction

- **When Monitored:** With the engine running, Electronic Throttle Control (ETC) actuator not in limp home mode, and TPS adaptation complete.

Step 1.

NOTE :
If this DTC sets intermittently, it is possible that the controller is overheating in extremely hot temperatures. This is considered a normal protection operation. No repair is necessary.

NOTE :
Low system voltage can cause excessive current draw in very hot and cold ambient temperatures. Make sure the battery can pass a load test before continuing. Review Freeze Frame information to determine the ambient temperature when the DTC set.

WARNING!

When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in personal injury or death.

Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.
With the scan tool, read the DTCs.

Is DTC P1545 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Remove the air cleaner assembly.
Check for any signs of a foreign material (ice or dirt) on the throttle plate or in the throttle bore that can cause the throttle plate to stick.

Were any problems found?

Yes >> • Remove the debris if possible or replace the Throttle Body Assembly. Disconnect the battery when replacing the Throttle Body Assembly. After installation is complete, use a scan tool and perform the ETC Relearn function.

No >> • Go to the next step.

Step 3.

Install the air cleaner assembly.

Turn the ignition switch on.

Start the engine and allow it to reach normal operating temperature.

With X-431 scan tool, perform the following:

- Monitor and compare the actual throttle position percent to the desired throttle position percent.
- Monitor and compare the TP sensor-1 voltage and TP sensor-2 voltage.

Does the actual TP position match the desired TP position and TP sensor-1 voltage match TP sensor-2 voltage?

Yes >> • Go to the next step.

No >> • Replace the Throttle Body Assembly. Disconnect the battery when replacing the Throttle Body Assembly. After installation is complete, use X-431 scan tool and perform the ETC Relearn function.

Step 4.

Start the engine and depress the accelerator pedal from the idle position to the high speed position, observe the movement of the throttle blade.

NOTE :
It may be necessary to use a mirror to see the throttle blade.

NOTE :
Make sure the motion of the throttle blade is smooth and that it opens and closes.

Did the ETC motor operate smoothly and properly?

Yes >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

No >> • Replace the Throttle Body Assembly. Disconnect the battery when replacing the Throttle Body Assembly. After installation is complete, use X-431 scan tool and perform the ETC Relearn function.

P1610: Secret Key And Secret Code Not Programed In ECM

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.
Turn the ignition switch on, with the scan tool, view and erase stored DTCs in VSM.
Try to start the engine.
Turn the ignition switch off, and wait a few seconds, then turn the ignition switch on.
With the scan tool, view active DTCs in the VSM.

Does the MIL flash?

Yes >> • Go to step 3.

No >> • Go to the next step.

Step 2.

With the X-431 scan tool, clear the DTCs.
With the scan tool, read the DTCs.

Is DTC P1610 present?

Yes >> • Repair the MIL system.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 3.

Using the X-431 scan tool.
- Choose “A 520 series”.
- Choose “VSM”.
- Choose “input code”.

Input the correct primary safety code.

Can the program be performed?

Yes >> • Go to the next step.

No >> • Go to step 5.

Step 4.

With the X-431 scan tool, enter the secret system.

Program the transceiver key.

With the X-431 scan tool, enter the engine management system.

Perform the relative program between VSM and ECM.

- If the ECM has been replaced with a new ECM:
  - First choose VSM, then input safety code.
  - Select VSM.VSM matching.
  - Read VSM to ECM".
- If the VSM has been replaced with a new VSM:
  - First choose VSM, then input safety code.
  - Select VSM.VSM matching.
  - Read ECM to VSM".
  - Choose "key learning", match every primary key.

  Turn the ignition switch off.

Turn the ignition switch on.

Does the MIL flash?

Yes >> • Go to the next step.

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

Step 5.

Turn the ignition switch off.

Disconnect the negative battery cable.

Replace the VSM.

Connect the negative battery cable.

Turn the ignition switch on.

With the X-431 scan tool, enter into VSM, perform the system program.

Using the X-431 scan tool.

- Choose "A 520 series".
- Choose "immobilize".
- Choose "input code".

Input the correct primary safety code.

Program the transceiver key.

With the X-431 scan tool, enter the ECM, perform the relative program between VSM and ECM.

Turn the ignition switch off, and then try to start the engine.

Does the MIL flash?

Yes >> • Install the original VSM. Perform the relative program between VSM and ECM.

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

P2138: Accelerator Pedal Position Sensor Signal Correlation Error

- **When Monitored:** With the ignition switch on, battery voltage greater than 12 volts, and no Accelerator Pedal Position (APP) sensor 1 and APP sensor-2 DTCs present.

Step 1.

WARNING!

When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in personal injury or death.

Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.
With the scan tool, read the DTCs.

Is DTC P2138 present?

Yes >> • Repair the MIL system.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the APP sensor electrical connector.
Disconnect the ECM electrical connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.
Measure the resistance of the APP sensor-1 and APP sensor-2 5 volt reference and signal circuit between the APP sensor electrical connector and the ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the high resistance circuits.

Step 3.

Check the resistance of the APP sensor-1 and APP sensor-2 circuit between the ECM connector and APP sensor connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the APP sensor-1 signal circuit for a short to APP sensor-2 signal circuit.

Step 4.

Connect the APP electrical connector.

Connect the ECM electrical connector.

Turn the ignition switch on.

Set up an oscilloscope or X-431 scan tool to view two graphs simultaneously as follows:

- Using one channel on the oscilloscope, backprobe the APP sensor-1 circuit at the APP electrical connector.
- Using the another channel on the oscilloscope, backprobe the APP sensor-2 circuit at the APP electrical connector.
- Slowly press and release the accelerator pedal while monitoring the oscilloscope screen or X-431 scan tool screen.

Does the scope pattern show any missing or erratic signals?

Yes >> • Go to the next step.

No >> • Go to step 6.

Step 5.

Turn the ignition switch off.

Using the electrical schematic as a guide, inspect the wiring and connectors between the Accelerator Pedal Position sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the Accelerator Pedal Position sensor.

Step 6.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

U0001: High Speed Can Defective

- **When Monitored:** With the ignition switch on.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, delete all the ECM DTCs.
Cycle the ignition switch from ON to OFF 3 times.
With the scan tool, read the DTCs.

Is DTC U0001 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 08 Transaxle).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

With the X-431 scan tool, attempt to enter all the other CAN communication modules ABS module, ECM, IC module and Front BCM.
Read the CAN DTCs.

Were other module DTCs found?

Yes >> • If all of the other modules have the same DTC ″CAN Communication″, Go to the next step.
• If all of the other modules have the DTC ″Lost communication with ECM″, and do not have the ″CAN Communication″, Replace and program the ECM module.

No >> • Go to step 8.

Step 3.

Check for a short to voltage between the diagnostic electrical connector DLC pin 14 (-), pin 6 (+) and ground.

Is there any voltage present?

Yes >> • Go to the next step.

No >> • Go to step 5.

Step 4.

Turn the ignition switch off.
Disconnect the ABS module, ECM, IC module, Front BCM and ECM electrical connectors.
Turn the ignition switch on.
Check for a short to voltage between the diagnostic electrical connector DLC pin 14 (-), pin 6 (+) and ground.

Is there any voltage present when the modules are disconnected?

Yes >> • Go to the next step.

No >> • Replace the corresponding module.

Step 5.

Connect all the disconnected modules.
Check for a short to ground between the diagnostic electrical connector DLC pin 14 (-), pin 6 (+) and ground.

Is the resistance below 10,000 ohms

Yes >> • Go to the next step.
No >> • Go to step 7.

Step 6.

Turn the ignition switch off.
Disconnect the ABS module, ECM, IC module, Front BCM and ECM harness connectors.
Check for a short to ground between the diagnostic electrical connector DLC pin 14 (-), pin 6 (+) and ground.

Is the resistance below 10,000 ohms with all modules disconnected?

Yes >> • Check and repair the CAN communication circuits high (+) and low (-) for a short to ground as necessary.
No >> • Replace the corresponding module.

Step 7.

Turn the ignition switch off.
Disconnect the ABS module, ECM, IC module, Front BCM and ECM harness electrical connectors.
Check the resistance between the CAN HIGH (+) and CAN LOW (-) for a short together.

Is the resistance below 10,000 ohms?

Yes >> • Repair the CAN circuits for a short together as necessary.
No >> • Go to the next step.

Step 8.

Inspect the ECM electrical connector pins for proper fit or any chafed, pierced, pinched, or partially broken wires.

Is there any problems present?

Yes >> • Repair as necessary.
No >> • Replace and program the ECM.

ON-VEHICLE SERVICE

Engine Coolant Temperature Sensor

Description

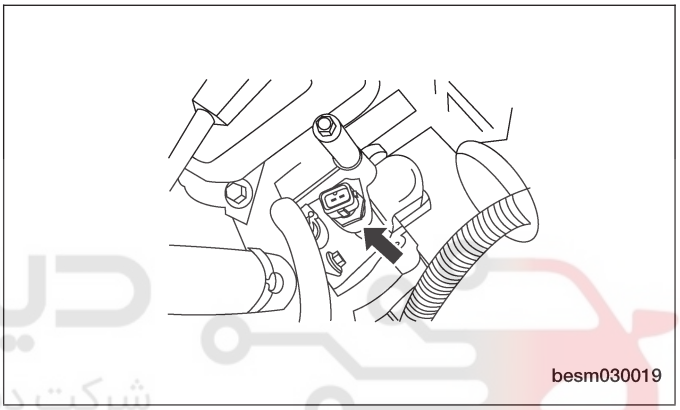
The Engine Coolant Temperature (ECT) sensor threads into the coolant outlet connector. The ECT is a negative thermal coefficient sensor.

Operation

The ECT provides an input to the Engine Control Module (ECM). As temperature increases, resistance of the sensor decreases. As coolant temperature varies, the ECT sensor resistance changes resulting in a different voltage value at the ECT sensor signal circuit. The ECM uses the input to control air-fuel mixture, timing, and radiator fan on/off times.

Removal & Installation

1. Disconnect and isolate the negative battery cable.
2. Release the coolant system pressure.



WARNING!

Never remove the pressure relief cap under any conditions while the engine is operating or hot. Failure to follow these instructions could result in personal injury or damage to the cooling system or engine. To avoid having scalding hot coolant or steam blow out of the cooling system, use extreme care when removing the pressure relief cap. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is released from the cooling system. When you are certain all the pressure has been released, (with a cloth) turn and remove the pressure relief cap. Failure to follow these instructions may result in series personal injury.

3. Disconnect the coolant temperature sensor electrical connector.

CAUTION:

Remove the coolant temperature sensor when the engine is cold.

4. Remove the engine coolant temperature sensor.
   (Tighten: Engine coolant temperature sensor to 20 N·m)
5. Discard the O-ring.
6. Installation is in the reverse order of removal.

Installation Notes:

- After installing the engine coolant temperature sensor, verify the engine coolant is at the proper level.

Knock Sensor

Description

The knock sensor is attached to the cylinder block. The knock sensor is designed to detect engine vibration that is caused by detonation.

Operation

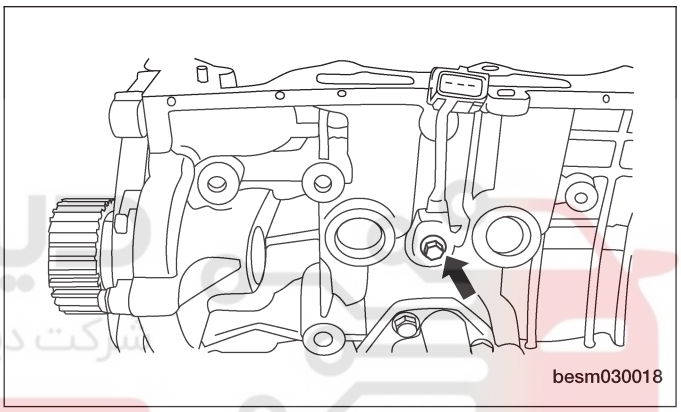
When the knock sensor detects a knock in one of the cylinders, it sends an input signal to the Engine Control Module (ECM). In response, the ECM retards ignition timing for all cylinders by a specified amount.

Knock sensor contains a piezoelectric material which constantly vibrates and sends an input voltage (signal) to the ECM while the engine operates. As the intensity of the crystal's vibration increases, the knock sensor output voltage also increases.

The ECM ignores knock sensor input during engine idle conditions. Once the engine speed exceeds a specified value, knock retard is allowed.

Removal & Installation

1. Disconnect and isolate the negative battery cable.
2. Disconnect the knock sensor electrical connector.
3. Remove the knock sensor retaining bolt and remove the knock sensor.
   (Tighten: Knock sensor retaining bolt to 20 N·m)
4. Installation is in the reverse order of removal.



Oxygen Sensor

Description

This vehicle is equipped with two oxygen sensors (sensor 1 & sensor 2). The oxygen sensors are located before and after the three way catalyst. The oxygen sensors continually monitor the oxygen level in the exhaust gas. Even if switching characteristics of the air flow sensor are shifted, the air flow is controlled to stoichiometric, by the signal from the oxygen sensor. This sensor is made of ceramic zirconia. The zirconia generates voltage from approximately 1 volt in richer conditions to 0 volt in leaner conditions.

Operation

The oxygen sensor has a much longer switching time between rich and lean than the air flow sensor. The oxygen storage capacity of the three way catalyst (manifold) causes the longer switching time. The oxygen senses the oxygen content in the exhaust flow and outputs a voltage between 0 and 1.0 volt. Lean of stoichiometric, air/fuel ratio of approximately 14.7:1, the oxygen sensor generates a voltage between 0 and 0.45 volt. Rich of stoichiometric, the oxygen sensor generates a voltage between 0.45 and 1.0 volt.

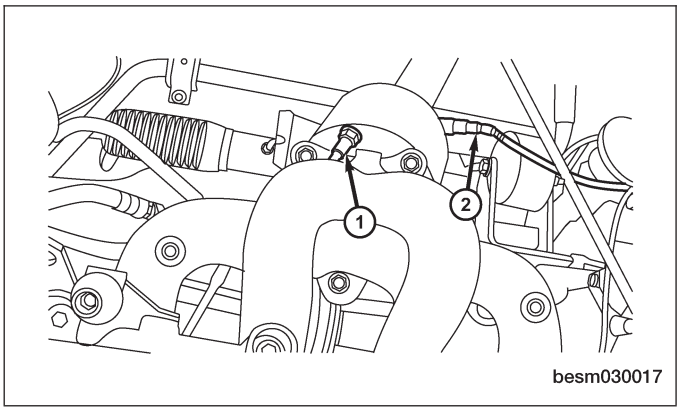
The oxygen sensor senses the oxygen content in the exhaust flow and outputs a voltage between 0 and 1.0 volt. Lean of stoichiometric, air/fuel ratio of approximately 14.7:1, the oxygen sensor generates a voltage between 0 and 0.45 volt. Rich of stoichiometric, the oxygen sensor generates a voltage between 0.45 and 1.0 volt.

Removal & Installation

1. Disconnect and isolate the negative battery cable.
2. Disconnect the oxygen sensor electrical connector.

CAUTION:
Remove the oxygen sensor when the exhaust pipe is cold.

3. Remove the oxygen sensor (1).
   (Tighten: Oxygen sensor to 45 N·m)
4. Installation is in the reverse order of removal.



Crankshaft Position Sensor

Description

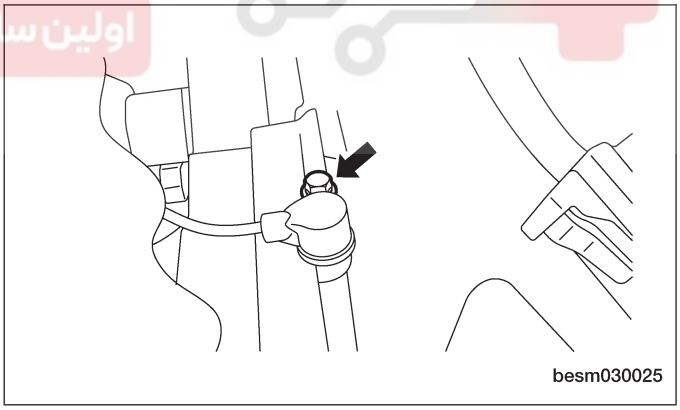
The Crankshaft Position (CKP) sensor is located on the flywheel shell facing the gear teeth of the signal plate. It detects the fluctuation of the engine revolution. The sensor consists of a permanent magnet and Induction coil.

Operation

When the engine is running, the high and low parts of the teeth cause the gap with the sensor to change. The changing gap causes the magnetic field near the sensor to change. Due to the changing magnetic field, the voltage from the sensor changes. The Engine Control Module (ECM) receives the voltage signal and detects the fluctuation of the engine revolution.

Removal & Installation

1. Disconnect and isolate the negative battery cable.
2. Disconnect the CKP sensor electrical connector.
3. Remove the CKP sensor retaining bolt and remove the CKP sensor.
   (Tighten: Crankshaft position sensor retaining bolt to 10 N·m)
4. Installation is in the reverse order of removal.



Camshaft Position Sensor

Description

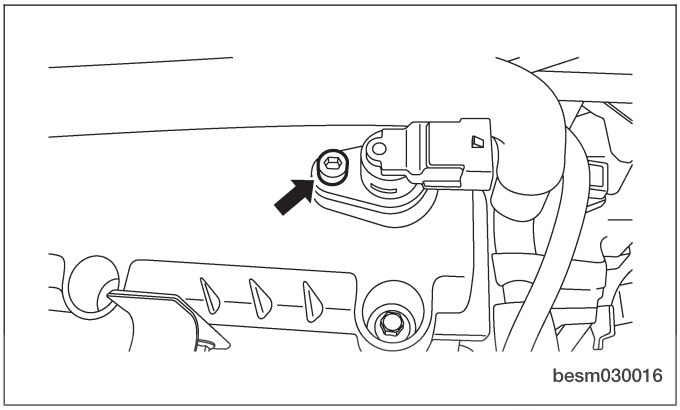
The Camshaft Position (CMP) sensor senses the protrusion of the intake valve cam sprocket to identify a particular cylinder. The CMP sensor senses the piston position. When the Crankshaft Position (CKP) sensor becomes inoperative, the CMP sensor provides various controls of engine parts instead, utilizing timing of cylinder identification signals. The sensor consists of a permanent magnet and Hall IC.

Operation

When engine is running, the high and low parts of the teeth cause the gap with the sensor to change. The changing gap causes the magnetic field near the sensor to change. Due to the changing magnetic field, the voltage from the sensor changes. The Engine Control Module (ECM) detects the voltage signal and identify piston position and cylinder timing.

Removal & Installation

1. Disconnect the negative battery cable.
2. Disconnect the CMP sensor electrical connector.
3. Remove the CMP sensor retaining bolt.
   (Tighten: Camshaft position sensor retaining bolt to 7 N·m)
4. Pull the CMP sensor up and remove from the cylinder head cover.
5. Installation is in the reverse order of removal.



Vehicle Speed Sensor

Description

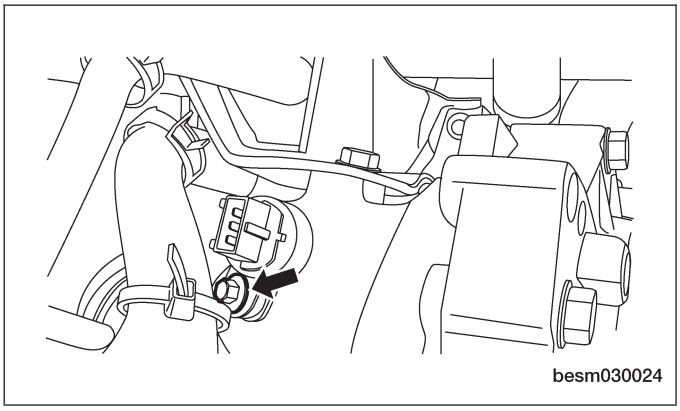
The vehicle speed sensor is mounted to the transaxle housing.

Operation

The vehicle speed sensor generates a signal the Engine Control Module (ECM) and the Transaxle Control Module (ECM) utilize to perform engine and transaxle functions.

Removal & Installation

1. Disconnect the negative battery cable.
2. Disconnect the vehicle speed sensor connector.
3. Remove the vehicle speed sensor mounting bolt.
   (Tighten: Vehicle speed sensor mounting bolt to 10 N·m)
4. Remove the vehicle speed sensor carefully.
5. Installation is in the reverse order of removal.



Manifold Absolute Pressure Sensor (1.6L)

Description

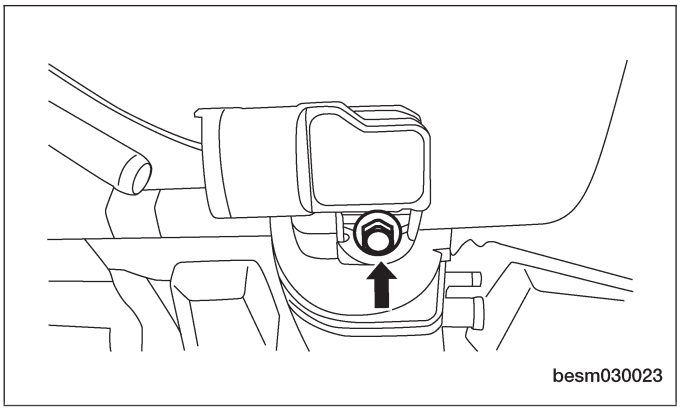
The Manifold Absolute Pressure (MAP) sensor, is mounted to the front of the engine.

Operation

The MAP sensor monitors the pressure in the intake manifold. The pressure in the manifold moves a diaphragm connected to resistors which alter their resistance values. The output voltage of the MAP sensor signals the ECM about the pressure in the intake manifold.

Removal & Installation

1. Disconnect the negative battery cable.
2. Disconnect the MAP sensor electrical connector.
3. Remove the MAP sensor mounting bolt.
   (Tighten: MAP sensor mounting bolt to 6 N·m)
4. Remove the MAP sensor.
5. Installation is in the reverse order of removal.



Air Flow Sensor (1.8L)

Description

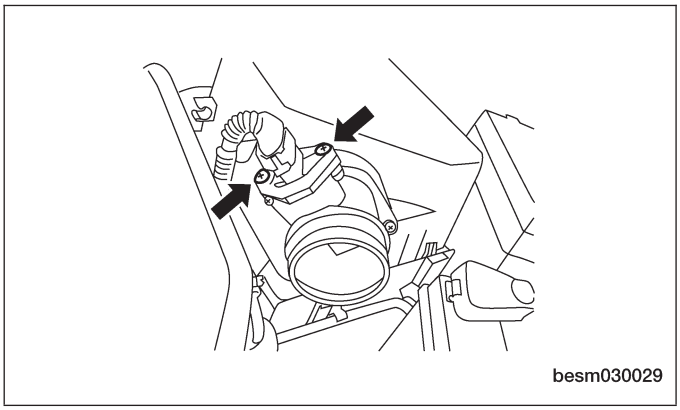
The air flow sensor is placed in the stream of intake air. The air flow sensor measures the intake flow rate by measuring a part of the entire intake flow. The air flow sensor converts the amount of air drawn into the engine into a voltage signal. The Engine Control Module (ECM) needs to know intake air volume to calculate engine load. This is necessary to determine how much fuel to inject.

Operation

The air flow sensor controls the temperature of the hot wire to a certain amount. The heat generated by the hot wire is reduced as the intake air flows around it. The more air,the greater the heat loss. Therefore, the electric current supplied to the hot wire is changed to maintain the temperature of the hot wire as air flow increases. The ECM detects the air flow by means of this current change.

Removal & Installation

1. Disconnect the negative battery cable.
2. Remove the engine cover.
3. Disconnect the air flow sensor electrical connector.
4. Remove the air flow sensor retaining bolts.
   (Tighten: Air flow sensor retaining bolts to 5 N·m)



5. Pull sensor up and take out of the air cleaner case.

6. Installation is in the reverse order of removal.

Accelerator Pedal Position Sensor

Description

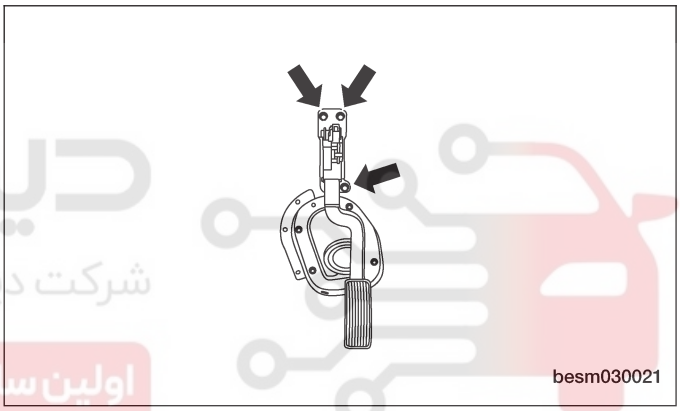
The Accelerator Pedal Position (APP) sensor is located inside the accelerator pedal. The accelerator pedal position sensor can not be serviced by itself. The accelerator pedal must be replaced as a unit.

Operation

The accelerator pedal position (APP) sensor on the accelerator pedal works according to the Hall principal. the sensor is integrated into the pedal lever axis. It consists of a shaft with a ring magnet. This rotates in a printed circuit board with a stator in the fixed Hall elements. This produces a change in the voltage. The accelerator pedal position sensor is supplied with 5 volts from the Engine Control Module (ECM). The information regarding accelerator position is supplied to the ECM by means of two voltages.

Removal & Installation

1. Disconnect the negative battery cable.
2. Remove the instrument panel lower trim panel.
3. Disconnect the APP sensor electrical connector.
4. Remove the three APP sensor mounting bolts.
   (Tighten: APP sensor mounting bolts to 11 N·m)
5. Remove the APP sensor with the pedal.
6. Installation is in the reverse order of removal.



Electronic Throttle Control Actuator

Description

The throttle body is located on the intake manifold. The throttle body meters air into the intake manifold. Fuel does not enter the intake manifold through the throttle body. Fuel is sprayed into the manifold by the fuel injectors.

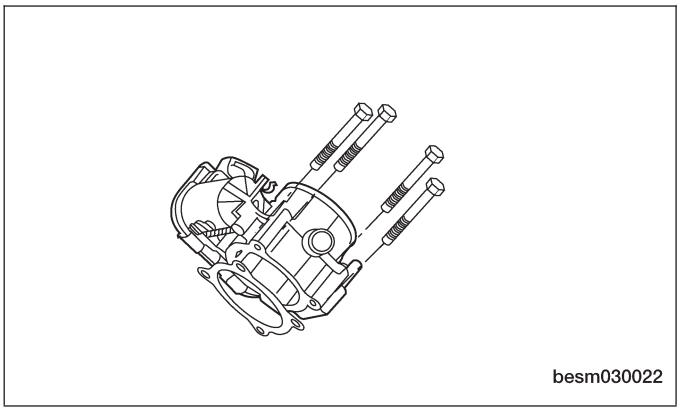
Operation

Filtered air from the air cleaner enters the intake manifold through the throttle body. A throttle valve (plate) is used to supply air for idle and driving conditions. The throttle position sensor is part the throttle body. The throttle position sensor signal is used by the ECM to determine throttle position. The ECM controls the electronic throttle control to meter air into the engine. This regulates engine power. The vehicle is in sense a “Drive by Wire” system.

Removal & Installation

1. Remove the engine cover.
2. Disconnect the negative battery cable.

3. Disconnect the electronic throttle control actuator connector.
4. Remove two pipes on electronic throttle control actuator.
5. Remove four electronic throttle control actuator mounting bolts.
   (Tighten: Electronic throttle control actuator bolts to 10 N·m)
6. Remove the throttle control actuator carefully.
7. Installation is in the reverse order of removal.


besm030022

Engine Control Module (ECM)

Description

The Engine Control Module (ECM) for this model is serviced only as a complete unit.

Operation

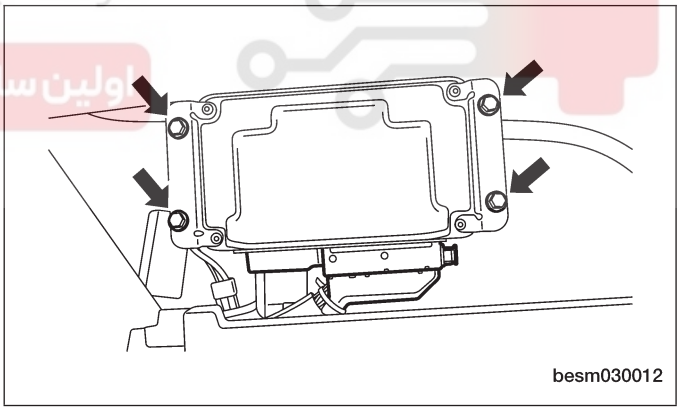
The ECM is a pre-programmed, microprocessor-based digital computer. It regulates ignition timing, air-fuel ratio, emission control devices, charging system, certain transmission features, speed control, air conditioning compressor clutch engagement and idle speed. The ECM can adapt its programming to meet changing operating conditions.

Removal & Installation

1. Disconnect the negative battery cable.
2. Remove the glove box (See Glove Box Removal & Installation in Section 15 Body).
3. Disconnect the ECM electrical connector.
4. Remove the ECM retaining bolts.
   (Tighten: ECM retaining bolts to 6 N·m)
5. Remove the ECM.
6. Installation is in the reverse order of removal.

Installation Notes:

- Program the vehicle security feature whenever the ECM is replaced.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2.0L ENGINE CONTROLS

GENERAL INFORMATION

Description

The Engine Control Module (ECM) utilizes integrated circuitry and information carried on the Controller Area Network (CAN) data bus along with many hard wired inputs to monitor many sensor and switch inputs throughout the vehicle. In response to those inputs, the internal circuitry and programming of the ECM allow it to control and integrate many electronic functions and features of the vehicle through both hard wired outputs and the transmission of electronic message outputs to other electronic modules in the vehicle over the CAN data bus.

The following are the input and output components monitored by the ECM. The components monitored belong to the engine, ignition, transmissions, air conditioning, or any other ECM supported subsystems.

ECM Inputs

- Brake Switch Sensor
- Refrigerant Pressure Sensor
- Camshaft Position (CMP) Sensor
- Crankshaft Position (CKP) Sensor
- Engine Coolant Temperature (ECT) Sensor
- Air Flow Sensor
- Throttle Position Sensor (integral with Electric Throttle Control Actuator)
- Power Steering Switch
- Accelerator Pedal Position (APP) Sensor
- Knock Sensor
- Oxygen Sensor (1&2)
- Vehicle Speed Sensor
- Clutch Pedal Switch (manual transmission only)

ECM Outputs

- Canister Control Valve
- Fuel Injectors
- Fuel Pump Relay
- Electric Throttle Control Actuator
- Ignition Coil
- A/C Compressor
- Cooling Fan
- Oxygen Sensor Heater (1&2)

Operation

The ECM monitors components and circuits and tests them in various ways depending on the hardware, function, and type of signal. For example, analog inputs such as throttle position or engine coolant temperature are typically checked for opens, shorts and out-of-range values. This type of monitoring is carried out continuously. Some digital inputs like vehicle speed or crankshaft position rely on rationality checks - checking to see if the input value makes sense at the current engine operating conditions. These types of tests may require monitoring several components and can only be carried out under appropriate test conditions.

The ECM is a pre-programmed, microprocessor-based digital computer. It regulates ignition timing, air-fuel ratio, emission control devices, charging system, certain transmission features, speed control, air conditioning compressor clutch engagement and idle speed. The ECM can adapt its programming to meet changing operating conditions.

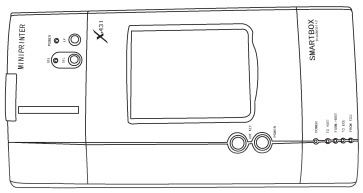
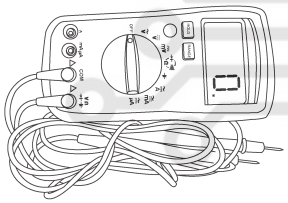
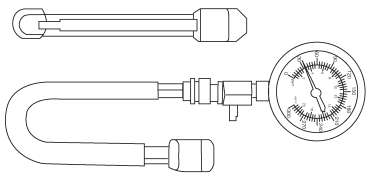
Specifications

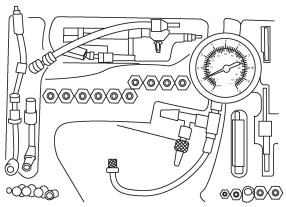
Torque Specifications

DESCRIPTION	TORQUE (N·m)
Engine Coolant Temperature Sensor	20
Knock Sensor	20
Oxygen Sensors	45
Crankshaft Position Sensor	10

DESCRIPTION	TORQUE (N·m)
Camshaft Position Sensor	7
Air Flow Sensor Bolts	5
Engine Control Module Bolts	6
Accelerator Pedal Position Sensor	11
Electronic Throttle Control Actuator	10
Vehicle Speed Sensor	10

Special Tools

Diagnostic Scan ToolX-431	 besm030001
Digital MultimeterFluke 15B & 17B	 besm030002
Compression Gauge	 besm030009

Fuel Pressure Gauge	 besm030008

X-431 Diagnostic Scan Tool

The X-431 is a newly developed automobile diagnostic computer. The X-431 is used to diagnose vehicle systems. The X-431 communicates with the vehicle through the data link connector.

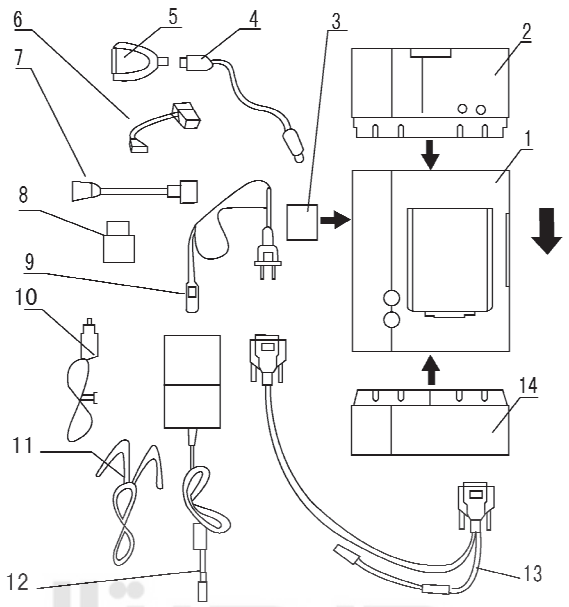
X-431 Diagnose Vehicle System List

CHAPTER	SYSTEM
03	Electronic Engine Controls
08	Transmission
12	Brakes
14	Restraints
15	Body & Accessories

Hardware Requirements

The hardware configuration of X-431 is as follows:

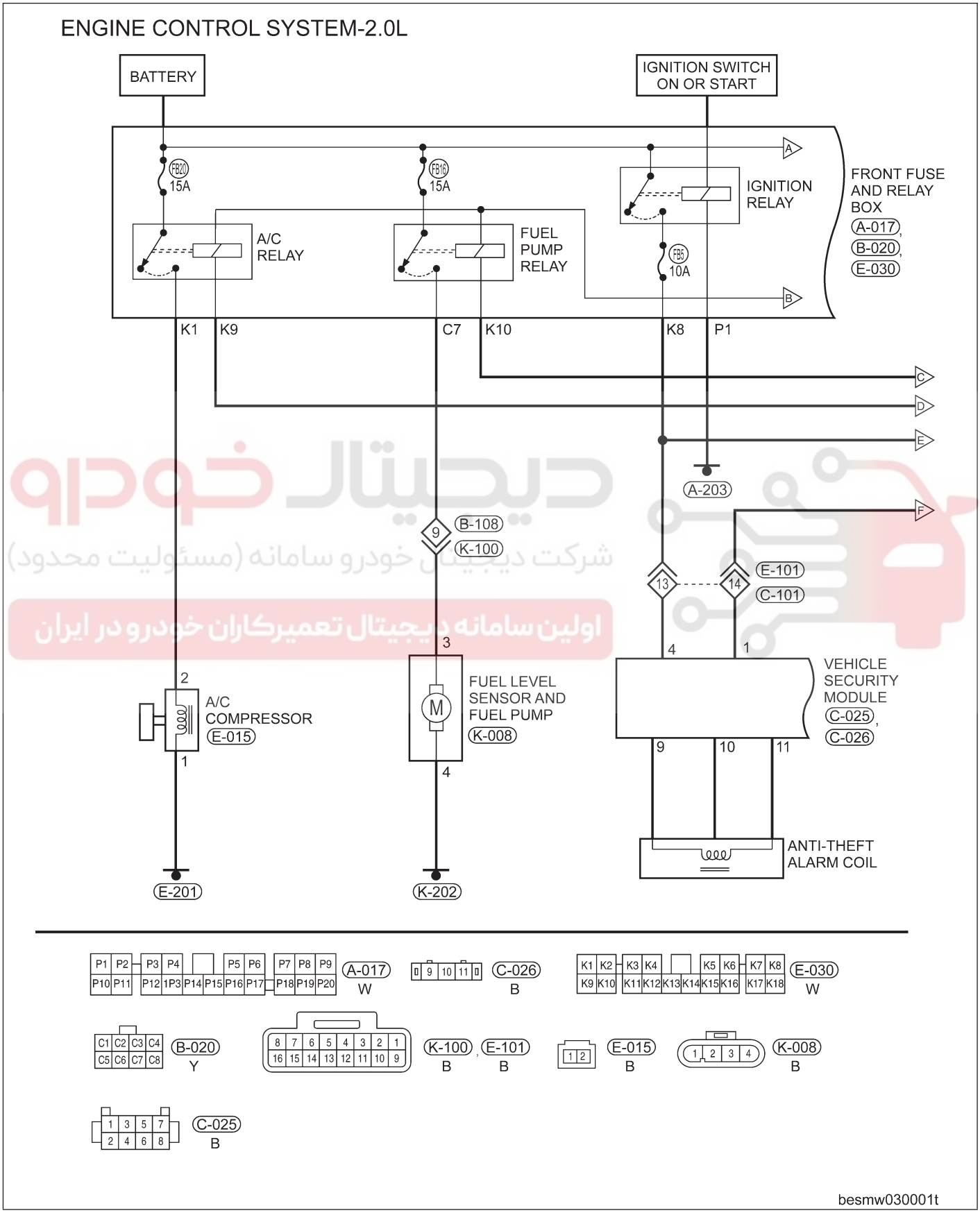
Diagnostic Scan Tool Configuration



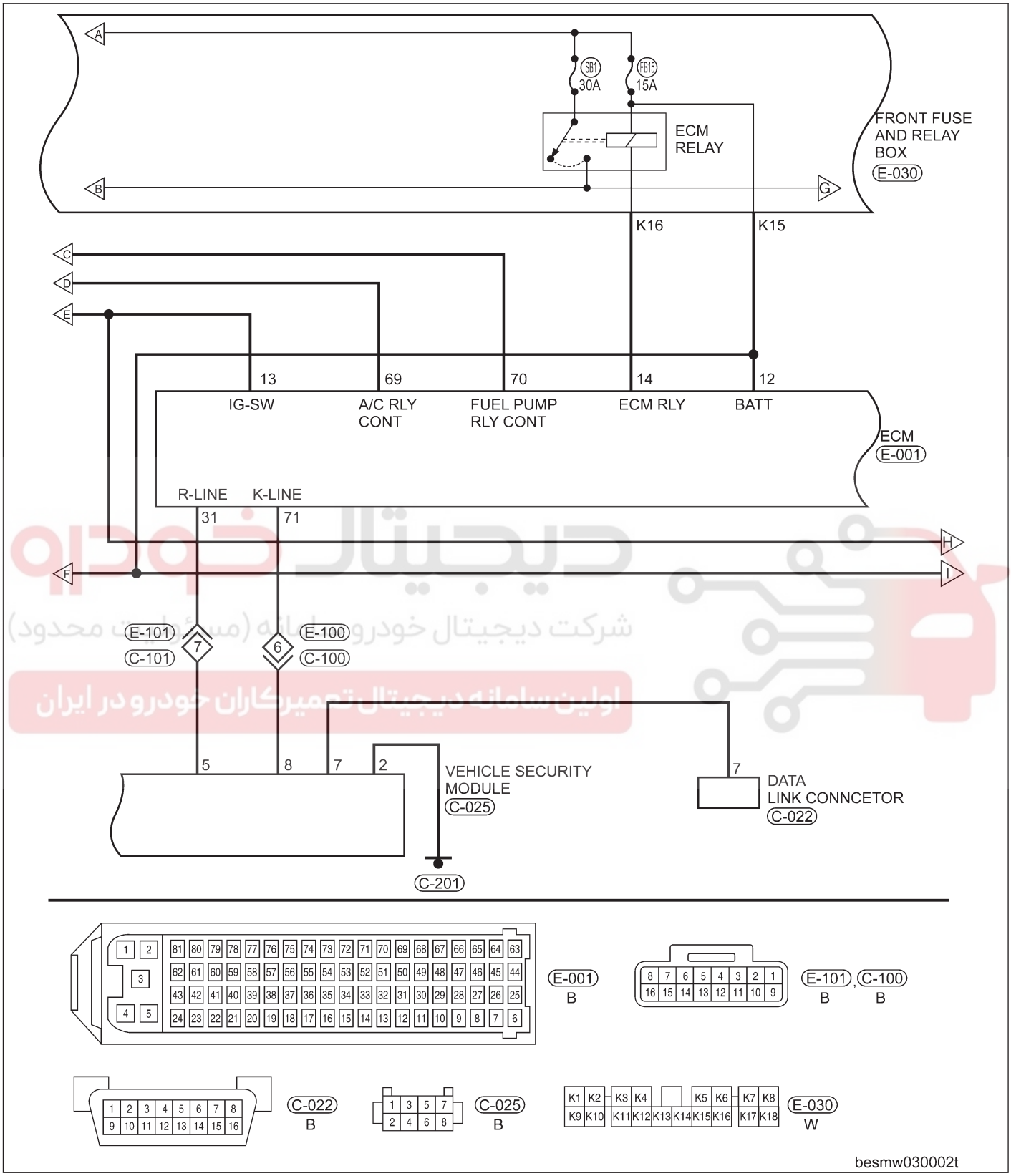
ITEM	NAME	DESCRIPTION
1	X-431 Main Unit	To Display Operational Buttons, Test Results, Help Information, etc.
2	Mini-Printer	To Print Test Results. (Optional)
3	CF Cartridge	To Store Diagnostic Software and Data
4	USB Cable	To Connect CF Card Reader/ Writer and Computer
5	CF Card Reader/Writer	To Read or Write Data On The CF Card
6	Mitsubishi-12+16 Pin Connector	To Diagnose Mitsubishi Electronic Control Systems On Chery B11 Series
7	Fiat-3 Pin Connector	To Diagnose Vehicles With Fiat-3 Pin Diagnostic Connector
8	Smart OBDII-16 Pin Connector	To Diagnose Other Systems Of Vehicle With OBDII-16 Pin Diagnostic Connector
9	Power Cord	To Connect AC 100-240V Outlet and Power Adapter
10	Cigarette Lighter Cable	To Get Power From Vehicle Cigarette Lighter
11	Battery Cable W/Two Clips	To Get Power From Vehicle Battery
12	Power Adapter	To Convert 100-240V AC Power Into 12V DC Power
13	Main Cable	To Connect The Diagnostic Connector and Smartbox
14	Smartbox	To Perform Vehicle Diagnosis

Electrical Schematics

Electronic Engine Controls (Page 1 of 8)



Electronic Engine Controls (Page 2 of 8)



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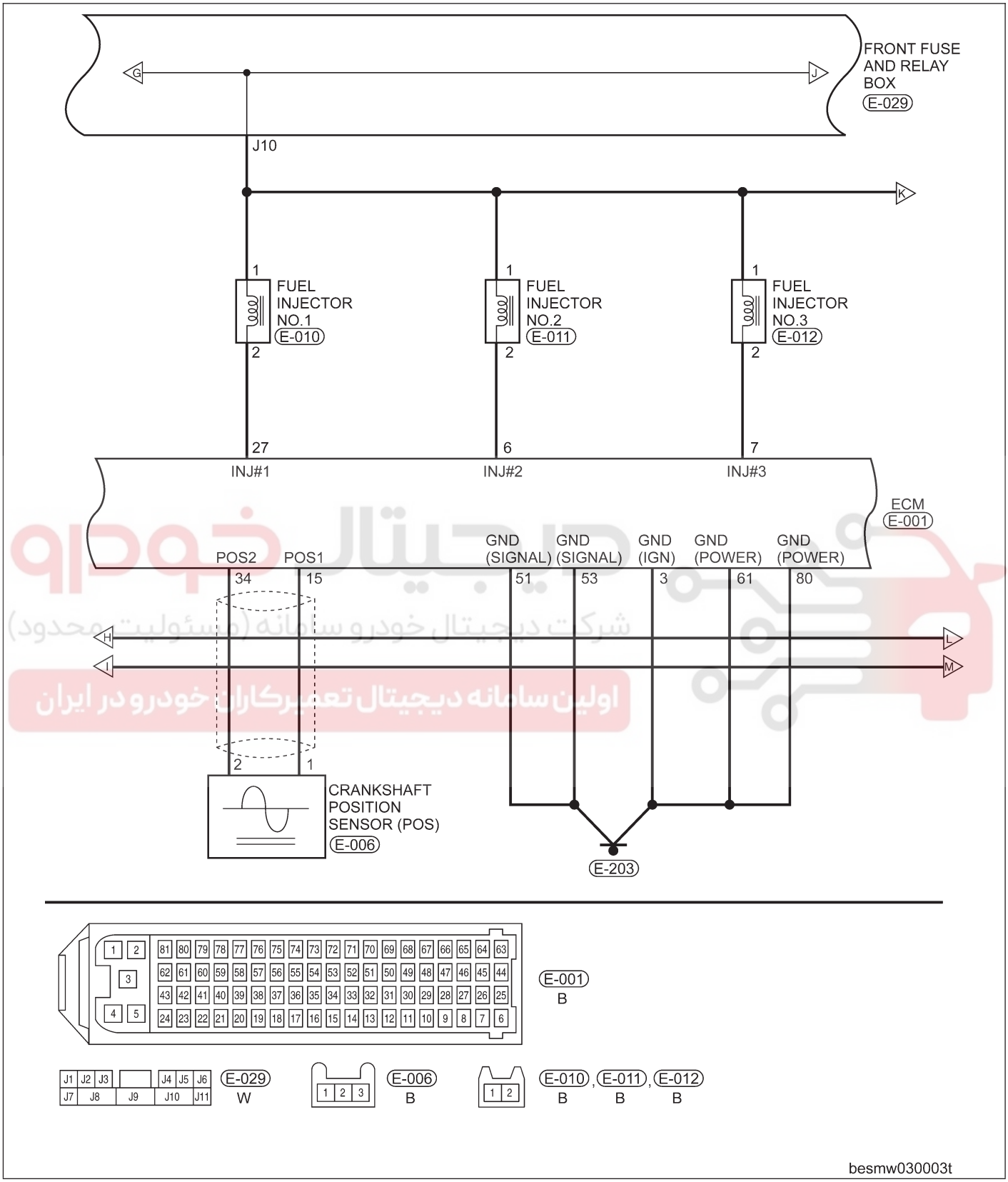
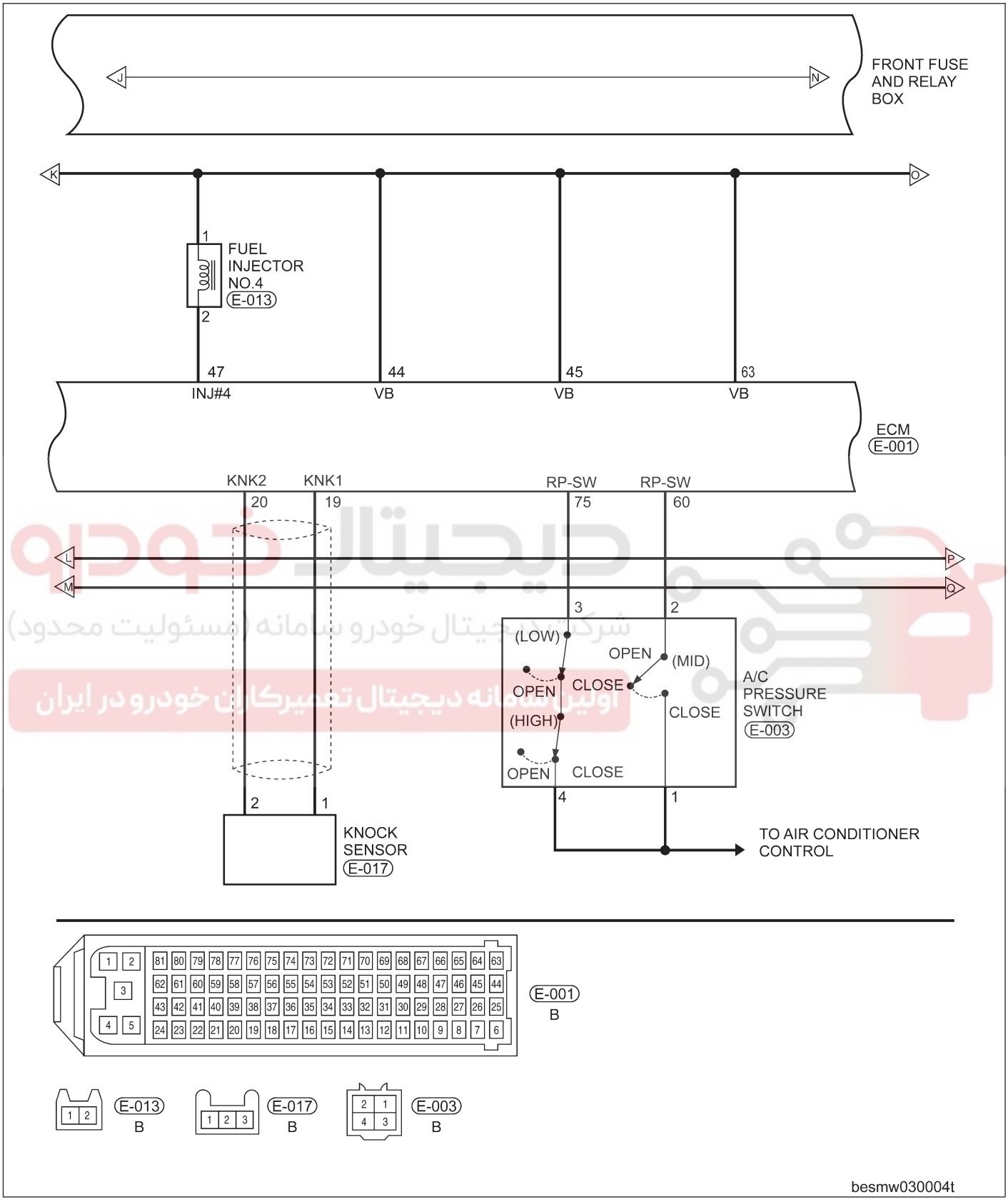
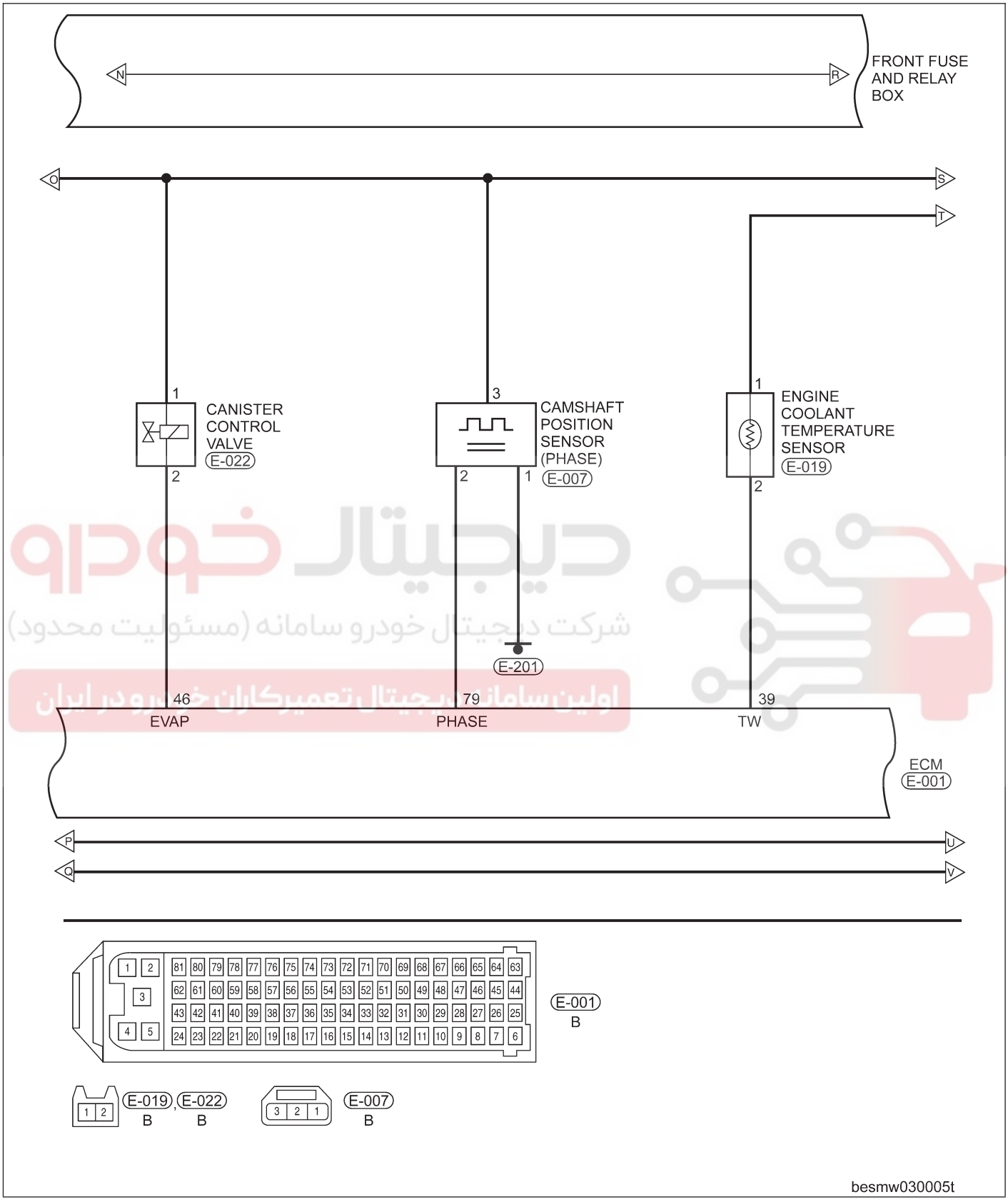
Electronic Engine Controls (Page 3 of 8)



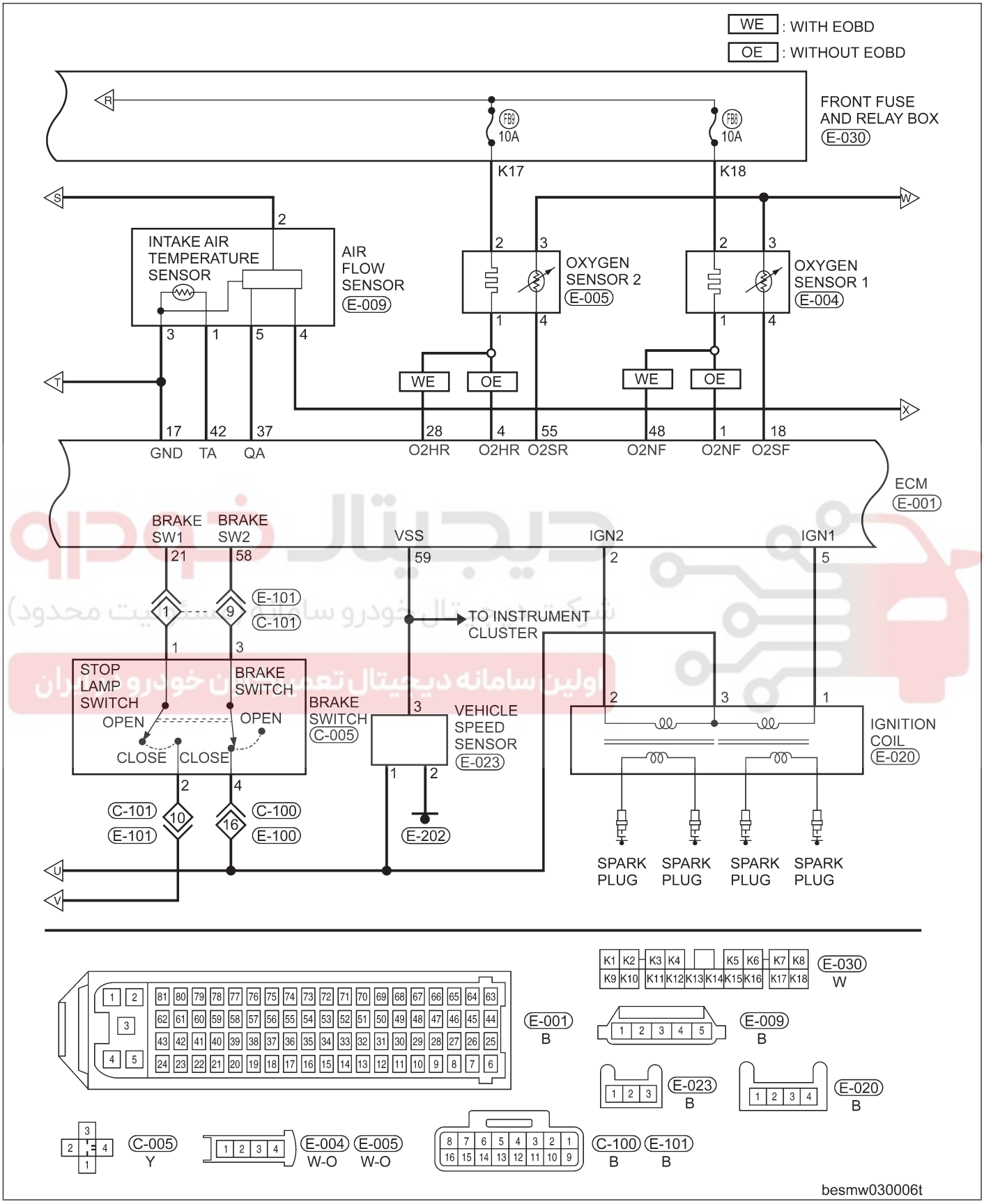
Electronic Engine Controls (Page 4 of 8)



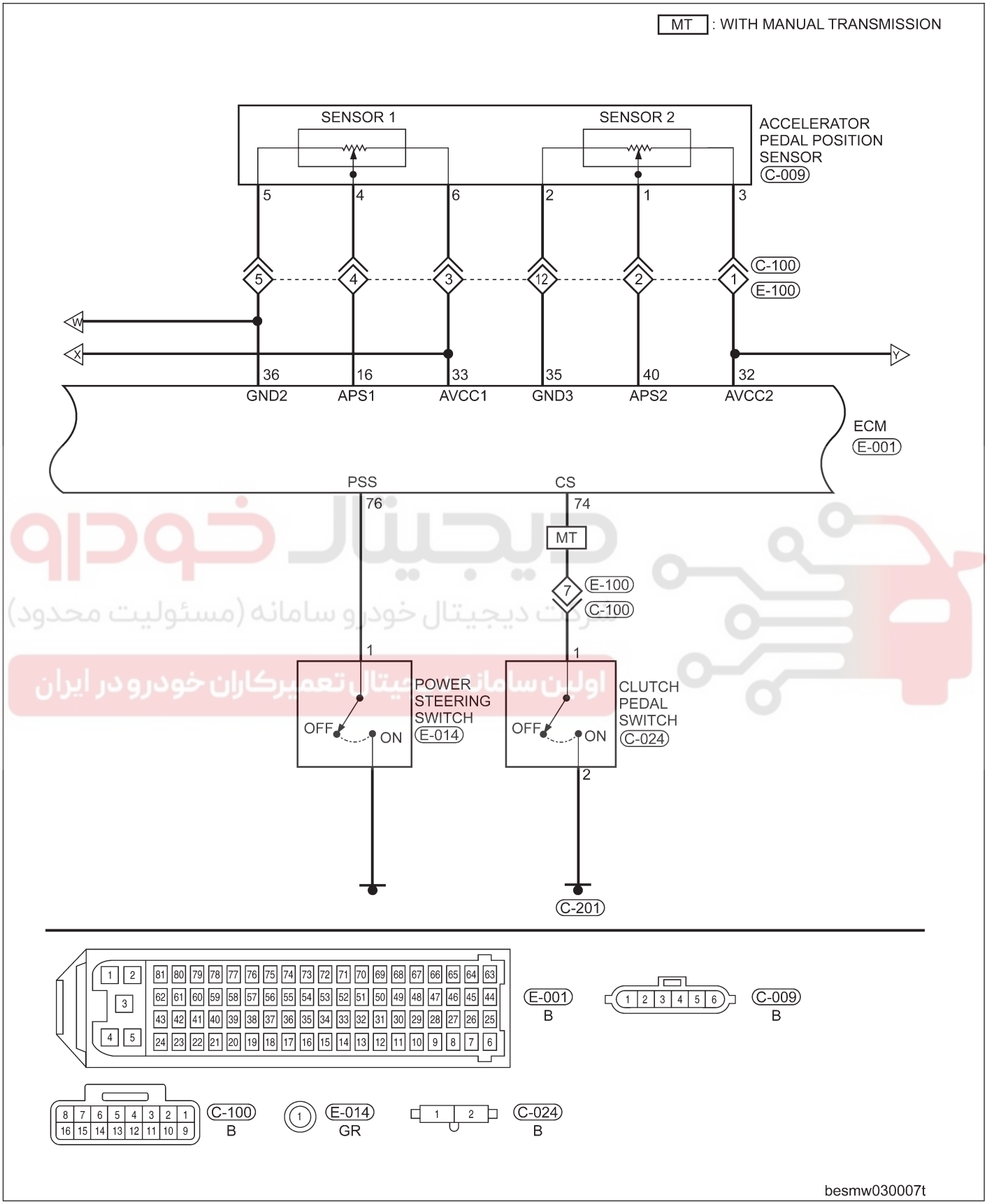
Electronic Engine Controls (Page 5 of 8)



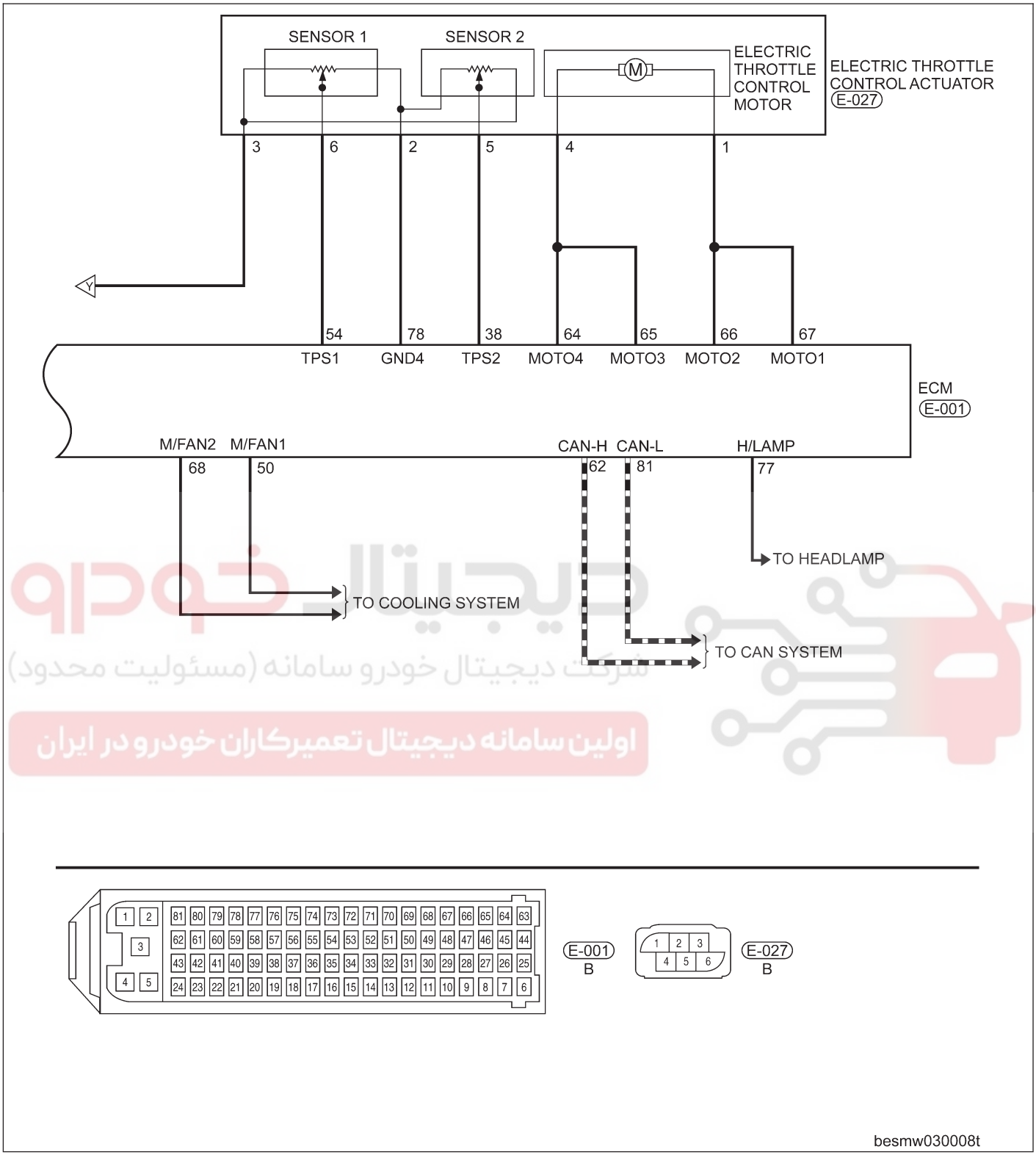
Electronic Engine Controls (Page 6 of 8)



Electronic Engine Controls (Page 7 of 8)



Electronic Engine Controls (Page 8 of 8)



besmw030008t

DIAGNOSIS & TESTING

Diagnostic Help

1. Confirm that the malfunction is current and carry-out the diagnostic tests and repair procedures.
2. If the Diagnostic Trouble Code (DTC) cannot be deleted, it is a current fault.
3. Use only a digital multimeter to perform voltage readings on the Electronic Fuel Injection (EFI) system.
4. Program the vehicle security feature whenever the Engine Control Module (ECM) is replaced.
5. If the following DTCs are set, they may not cause the Engine Light to illuminate.

- P0560
- P0562
- P0563
- P0645
- P0646
- P0647

6. The following shows the circuit explanation of many DTCs:

- Circuit Low - Circuit shorted to ground
- Circuit High - Circuit shorted to voltage
- Circuit Failure - Circuit open or multi-circuit malfunction

7. The scan tool connects to the Data Link Connector (DLC) and communicates with the ECM with the class two serial data circuit.
8. If the failure is intermittent perform the following:

- Check for loose connectors.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Monitor the scan tool data relative to this circuit and wiggle test the wiring and connectors.
- Look for the data to change or for the DTC to reset during the wiggle test.
- Look for broken, bent, pushed out or corroded terminals.
- Inspect the sensor and mounting area for any condition that would result in an incorrect signal, such as damage, foreign material.

9. Remove the Engine Control Module (ECM) from the troubled vehicle and install in a new vehicle and test. If the DTC can not be deleted, the ECM is malfunctioning. If the DTC can be deleted, return the ECM to the original vehicle and inspect the system again.

ECM Connector Pin-Out Table

ECM PIN-OUT TABLE

Pin	Circuit Identification	Pin	Circuit Identification
1	Front Oxygen Sensor Heating	42	Intake Air Temperature Sensor
2	Ignition Coil 2	43	—
3	Ignition Ground	44	Non Persistent Power
4	Rear Oxygen Sensor Heating	45	Non Persistent Power
5	Ignition Coil 1	46	Canister Control Valve
6	Fuel Injector 2	47	Fuel Injector 4
7	Fuel Injector 3	48	—
8	—	49	—
9	—	50	Fan Control 1
10	—	51	Signal Ground 2
11	—	52	—
12	Power Supply	53	Signal Ground 1
13	Ignition Switch	54	Electric Throttle Control Actuator

Pin	Circuit Identification	Pin	Circuit Identification
14	ECM Relay	55	Rear Oxygen Sensor
15	Crankshaft Sensor 1	56	—
16	Accelerator Position Sensor	57	—
17	Air Flow Sensor Ground	58	Brake Switch
18	Front Oxygen Sensor	59	Vehicle Speed Sensor
19	Knock Sensor 1	60	Refrigerant Pressure Switch
20	Knock Sensor 2	61	Ground
21	Stop Lamp Switch	62	CAN-H
22	—	63	Non Persistent Power
23	—	64	Electric Throttle Control Actuator
24	—	65	Electric Throttle Control Actuator
25	—	66	Electric Throttle Control Actuator
26	—	67	Electric Throttle Control Actuator
27	Fuel Injector 1	68	Fan Control 2
28	—	69	Air Conditioner Relay
29	—	70	Fuel Pump Relay
30	—	71	Diagnostic K Cable
31	Engine Anti-Theft Alarm Control Module	72	—
32	5V Power Supply 2	73	—
33	5V Power Supply 1	74	Clutch Switch
34	Crankshaft Sensor 2	75	Refrigerant Pressure Switch
35	Sensor Ground 3	76	Power Steering Switch
36	Sensor Ground 2	77	Headlamp Switch
37	Air Flow Sensor	78	Electric Throttle Control Actuator
38	Electronic Throttle Control Actuator 5	79	Camshaft Position Sensor Ground
39	Engine Coolant Temperature Sensor	80	Ground
40	Accelerator Position Sensor	81	CAN-L
41	—		

Diagnostic Trouble Code (DTC) List

DTC	DTC DEFINITION
P000A	"A" Camshaft Position Slow Response
P000B	"B" Camshaft Position Slow Response
P0010	"A" Camshaft Position Actuator Circuit/Open
P0011	"A" Camshaft Position - Timing Over - Advanced or System Performance
P0012	"A" Camshaft Position - Timing Over - Retarded
P0013	"B" Camshaft Position - Actual Circuit/Open
P0014	"B" Camshaft Position - Timing Over - Advanced or System Performance
P0015	"B" Camshaft Position - Timing Over - Retarded
P0016	Crankshaft - Camshaft Position Correlation
P0030	O2 Sensor Heater Control Circuit (Bank 1 Sensor 1)
P0031	O2 Sensor Heater Control Circuit (Bank 1 Sensor 1) Low
P0032	O2 Sensor Heater Control Circuit (Bank 1 Sensor 1) High
P0036	O2 Sensor Heater Control Circuit (Bank 1 Sensor 2)
P0037	O2 Sensor Heater Control Circuit (Bank 1 Sensor 2) Low
P0038	O2 Sensor Heater Control Circuit (Bank 1 Sensor 2) High
P0053	O2 Sensor Heater Resistance (Bank 1 Sensor 1)
P0054	O2 Sensor Heater Resistance (Bank 1 Sensor 2)
P0101	Mass or Volume Air Flow Circuit Range/Performance
P0102	Mass or Volume Air Flow Circuit Low Input
P0103	Mass or Volume Air Flow Circuit High Input
P0112	Intake Air Temperature Circuit Low Input
P0113	Intake Air Temperature Circuit High Input
P0116	Engine Coolant Temperature Circuit Range/Performance
P0117	Engine Coolant Temperature Circuit Low Input
P0118	Engine Coolant Temperature Circuit High Input
P0121	Throttle/Pedal Position Sensor A Circuit Range/ Performance
P0122	Throttle/Pedal Position. Sensor A Circuit Low Input
P0123	Throttle/Pedal Position Sensor A Circuit High Input
P0130	O2 Sensor Circuit Bank 1 - Sensor 1 Malfunction
P0131	O2 Sensor Circuit Bank 1 - Sensor 1 Low Voltage
P0132	O2 Sensor Circuit Bank 1 - Sensor 1 High Voltage
P0133	O2 Sensor Circuit Bank 1 - Sensor 1 Slow Response
P0134	O2 Sensor Circuit Bank 1 - Sensor 1 No Activity Detected
P0136	O2 Sensor Circuit Bank 1 - Sensor 2 Malfunction
P0137	O2 Sensor Circuit Bank 1 - Sensor 2 Low Voltage
P0138	O2 Sensor Circuit Bank 1 - Sensor 2 High Voltage

DTC	DTC DEFINITION
P0140	O2 Sensor Circuit Bank 1 - Sensor 2 No Activity Detected
P0170	Fuel Trim, Bank 1 Malfunction
P0171	Fuel Trim, Bank 1 System Too Lean
P0172	Fuel Trim, Bank 1 Too Rich
P0201	Cylinder 1 - Injector Circuit
P0202	Cylinder 2 - Injector Circuit
P0203	Cylinder 3 - Injector Circuit
P0204	Cylinder 4 - Injector Circuit
P0219	Engine Overspeed Condition
P0221	Throttle/Pedal Position Sensor/Switch B Range/ Performance
P0222	Throttle/Pedal Position Sensor/Switch B Low Input
P0223	Throttle/Pedal Position Sensor/Switch B High Input
P0261	Cylinder 1 - Injector Circuit Low
P0262	Cylinder 1 - Injector Circuit High
P0264	Cylinder 2 - Injector Circuit Low
P0265	Cylinder 2 - Injector Circuit High
P0267	Cylinder 3 - Injector Circuit Low
P0268	Cylinder 3 - Injector Circuit High
P0270	Cylinder 4 - Injector Circuit Low
P0271	Cylinder 4 - Injector Circuit High
P0300	Random/Multiple Cylinder Misfire Detected
P0301	Cylinder 1 Misfire Detected
P0302	Cylinder 2 Misfire Detected
P0303	Cylinder 3 Misfire Detected
P0304	Cylinder 4 Misfire Detected
P0318	Rough Road Sensor "A" Signal Circuit
P0321	Ignition/Distributor Engine Speed Input Circuit Range/Performance
P0322	Ignition/Distributor Engine Speed Input Circuit No Signal
P0324	Knock Control System Error
P0327	Knock Sensor 1 Circuit Low Input
P0328	Knock Sensor 1 Circuit High Input
P0340	Camshaft Position Sensor Circuit
P0341	Camshaft Position Sensor Circuit Range/Performance
P0342	Camshaft Position Sensor Circuit Low Input
P0343	Camshaft Position Sensor Circuit High Input
P0420	Catalyst System, Bank 1 Efficiency Below Threshold
P0444	Evaporative Emission System Purge Control Valve Circuit Open
P0458	Evaporative Emission System Purge Control Valve Circuit Low
P0459	Evaporative Emission System Purge Control Valve Circuit High

DTC	DTC DEFINITION
P0480	Cooling Fan 1 Control Circuit
P0481	Cooling Fan 2 Control Circuit
P0501	Vehicle Speed Sensor Range/Performance
P0506	Idle Control System RPM Lower than Expected
P0507	Idle Control System RPM High than Expected
P0508	Idle Air Control System Circuit Low
P0509	Idle Air Control System Circuit High
P0511	Idle Air Control Circuit
P0532	A/C Refrigerant Pressure Sensor Circuit Low Input
P0533	A/C Refrigerant Pressure Sensor Circuit High Input
P0537	A/C Evaporator Temperature Sensor Circuit Low
P0538	A/C Evaporator Temperature Sensor Circuit High
P0560	System Voltage Malfunction
P0562	System Voltage Low Voltage
P0563	System Voltage High Voltage
P0571	Brake Switch "A" Circuit
P0601	Internal Control Module EEPROM Error
P0602	Control Module Programming Error
P0604	Internal Control Module Random Access Memory (RAM) Error
P0605	Internal Control Module ROM Test Error
P0606	ECM Processor
P0627	Fuel Pump "A" Control Circuit/Open
P0628	Fuel Pump "A" Control Circuit Low
P0629	Fuel Pump "A" Control Circuit High
P0645	A/C Clutch Relay Circuit
P0646	A/C Clutch Relay Control Circuit Low
P0647	A/C Clutch Relay Control Circuit High
P0650	Malfunction Indicator Lamp Control Circuit
P0688	EMC/ECM Power Relay Sense Circuit Open
P0691	Cooling Fan 1 Control Circuit Low
P0692	Cooling Fan 1 Control Circuit High
P0693	Cooling Fan 2 Control Circuit Low
P0694	Cooling Fan 2 Control Circuit High
P0700	Transmission Control System Malfunction
P0704	Clutch Switch Input Circuit
P1297	Manufacturer Controlled Computer And Auxiliary Outputs
P1336	Engine Torque Control Adaptation at Limit
P1545	Throttle Position Control Malfunction
P1558	Throttle Actuator Electrical Malfunction
P1559	Idle Speed Control Throttle Position Adaptation Malfunction
P1564	Idle Speed Control Throttle Position Low Voltage during Adaptation

DTC	DTC DEFINITION
P1565	Idle Speed Control Throttle Position Lower Limit not Attained
P1568	Idle Speed Control Throttle Position Mechanical Malfunction
P1579	Idle Speed Control Throttle Position Adaptation not Started
P1604	Internal Control Module Driver Error
P1610	Manufacture Controlled Computer and Auxiliary Outputs
P1611	Manufacture Controlled Computer and Auxiliary Outputs
P1612	Manufacture Controlled Computer and Auxiliary Outputs
P1613	Manufacture Controlled Computer and Auxiliary Outputs
P1614	Manufacture Controlled Computer and Auxiliary Outputs
P1651	Manufacture Controlled Computer and Auxiliary Outputs
P2106	Throttle Actuator Control System Forced Limited Power
P2122	Throttle/Pedal Position Sensor/Switch D Circuit Low Input
P2123	Throttle/Pedal Position Sensor/Switch D Circuit High Input
P2127	Throttle/Pedal Position Sensor/Switch E Circuit Low Input
P2128	Throttle/Pedal Position Sensor/Switch E Circuit High Input
P2138	Accelerator Pedal Position Sensor Signal Correlation Error
P2177	System Too Lean off Idle
P2178	System Too Rich off Idle
P2187	System Too Lean at Idle
P2188	System Too Rich at Idle
P2195	O2 Sensor Signal Stuck Lean; Bank 1 Sensor 1
P2196	O2 Sensor Signal Stuck Rich; Bank 1 Sensor 1
P2270	O2 Sensor Signal Stuck Lean; Bank 1 Sensor 2
P2271	O2 Sensor Signal Stuck Rich; Bank 1 Sensor 2
U0001	High Speed CAN Defective
U0101	Lost Communication with ECM
U104	Lost Communication with Cruise Control Module
U0121	Lost Communication with Anti-Lock Brake System (ABS) Control Module
U0155	Lost Communication with Instrument Panel Cluster Control Module
U0415	Invalid Data Received from ABS Control Module

Diagnostic Trouble Code (DTC) Tests

P0016: Crankshaft Position - Camshaft Position Correlation Error

- **When Monitored:** With the engine running and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.

Turn the engine off and turn the ignition switch on.

With the X-431 scan tool, check for DTCs.

Is DTC P0016 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Using the electrical schematic as a guide, inspect the following:

- Inspect the wiring and connectors between the Crankshaft Position (CKP) sensor and the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Inspect the CKP sensor for conditions such as loose mounting screws, damage, or cracks.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 3.

Using the electrical schematic as a guide, inspect the following:

- Inspect the wiring and connectors between the Camshaft Position (CMP) sensor and the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Inspect the CMP sensor for conditions such as loose mounting screws, damage, or cracks.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Turn the ignition switch on.
Wiggle the related wiring harness and lightly tap on the CKP sensor while monitoring the X-431.
Start the engine.
Monitor the CKP sensor signal on the X-431 screen.

Were any CKP sensor signals irregular or missing?

Yes >> • Go to step 6.

No >> • Go to the next step.

Step 5.

With the engine running, wiggle the related wiring harness and lightly tap on the CMP sensor while monitoring the X-431 screen.
Monitor the CMP sensor signal on the X-431 screen.

Were any CMP sensor signals irregular or missing?

Yes >> • Go to step 7.

No >> • Go to step 10.

Step 6.

Turn the ignition switch off.
Remove the CKP sensor.
Inspect the CKP sensor and mounting area for any condition that would result in an incorrect signal, such as damage, foreign material, or excessive movement.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the CKP sensor.
• Monitor the CKP sensor signal on the X-431 screen.
– If the CKP sensor signals were normal, the system is OK.
– If the CKP sensor signals were still irregular or missing, Go to step 8.

Step 7.

Turn the ignition switch off.
Remove the CMP sensor.
Inspect the CMP sensor and mounting area for any condition that would result in an incorrect signal, such as damage, foreign material, or excessive movement.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the CMP sensor.
• Monitor the CMP sensor signal on the X-431 screen.
– If the CMP sensor signals were normal, the system is OK.
– If the CMP sensor signals were still irregular or missing, Go to step 9.

Step 8.

Remove the cylinder head cover and timing belt cover (See Engine Timing Belt Removal & Installation in Section 02 Engine).

Check the Camshaft and tone wheel for any condition that would result in an incorrect signal, such as damage, movement or foreign material when rotating the Camshaft.

Were any problems found?

Yes >> • Repair or replace as necessary.

No >> • Go to step 10.

Step 9.

Remove the cylinder head cover and timing belt cover (See Engine Timing Belt Removal & Installation in Section 02 Engine).

Check the Crankshaft and tone wheel for any condition that would result in an incorrect signal, such as damage, movement or foreign material when rotating the Crankshaft.

Were any problems found?

Yes >> • Repair or replace as necessary.

No >> • Go to the next step.

Step 10.

Check the engine timing for misalignment.

Is the timing misaligned?

Yes >> • Align the engine timing belt (See Engine Timing Belt Removal & Installation in Section 02 Engine).

No >> • Go to the next step.

Step 11.

Start the engine, with the X-431 scan tool, select view the DTCs.

Does DTC P0016 reset?

Yes >> • Replace and program the ECM.

No >> • The system is normal.
• Erase all codes and test drive the vehicle to verify the repair is complete.

P0031: O2 Sensor 1 Heater Control Circuit Low

- **When Monitored:** With the engine running and battery voltage greater than 12 volts.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear all DTCs.
Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the scan tool, read the DTCs.

Is DTC P0031 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the oxygen sensor connector.
Turn the ignition switch on.
Using a 12-volt test light connected to ground, check the supply circuit in the oxygen sensor electrical connector.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Repair the supply circuit for an open circuit or short to ground.

Step 3.

Turn the ignition switch off.
Disconnect the ECM connector.
Measure the resistance between ground and the heater control circuit in the oxygen sensor electrical connector and measure the resistance between the sensor connector pin 1 and the ECM connector pin 36.

Is the resistance between ground and the heater control circuit in the oxygen sensor electrical connector below 10,000 ohms and the resistance between the sensor connector and the ECM connector above 5 ohms?

Yes >> • Repair the control circuit for a short to ground or open.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.

Using the electrical schematic as a guide, inspect the following:

- Inspect the wiring and connectors between the oxygen sensor and the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 5.

Replace the oxygen sensor.

With the X-431 scan tool, drive the vehicle at a speed over 40 km/h, allow the engine to reach normal operating temperature.

Watch the oxygen signal data stream and view the ECM DTC.

Did DTC P0031 reset?

Yes >> • Go to the next step.

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

Step 6.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Turn the ignition switch off.

Disconnect the ECM connector.

Using the electrical schematic as a guide, inspect the wiring and connectors between the oxygen sensor and the ECM (See Diagnostic Help in Section 03 Electronic Engine Controls).

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0032: O2 Sensor 1 Heater Control Circuit High

- **When Monitored:** With the engine running and battery voltage greater than 12 volts.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear all DTCs.
Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the scan tool, read the DTCs.

Is DTC P0032 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the oxygen sensor connector.
Disconnect the ECM connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.
Turn the ignition switch on.
Using a digital multimeter, inspect the oxygen sensor heater control circuit and perform the following:

- Measure the oxygen sensor heater control circuit for a short to ground between the oxygen sensor connector and ground.
- Measure the oxygen sensor control circuit for a short together with other supply circuits.
- Measure the oxygen sensor control circuit for an open.

Are the test results normal?

Yes >> • Go to the next step.

No >> • Repair the heater control circuit for a short to voltage circuit, ground or open.

Step 3.

Turn the ignition switch off.
Inspect the wiring and connectors between the oxygen sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Replace the oxygen sensor.

With the X-431 scan tool, drive the vehicle at speeds over 40 km/h, allow the engine to reach normal operating temperature.

Watch the oxygen signal data stream and view the ECM DTC.

Did DTC P0032 reset?

Yes >> • Go to the next step.

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

Step 5.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors to look for the data to change or for the DTC to reset during the wiggle test.

Turn the ignition switch off.

Disconnect the ECM connector.

Using the electrical schematic as a guide, inspect the wiring and connectors between the oxygen sensor and the ECM (See Diagnostic Help in Section 03 Electronic Engine Controls).

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0102: Mass Or Volume Air Flow Circuit Low Input

- **When Monitored:** With the ignition switch on and engine running.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear all DTCs.
Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the X-431 scan tool, read the DTCs.

Does the scan tool read: P0102?

Yes >> • Go to the next step.

No >> • See Diagnostic Help in Section 03 Electronic Engine Controls.

Step 2.

Turn the ignition switch off.
Disconnect the Mass Air Flow (MAF) sensor connector.
Turn the ignition switch on.
Measure the voltage of the MAF sensor voltage supply circuit between the MAF sensor connector pin 2 and ground.

Is battery voltage present?

Yes >> • Go to the next step.

No >> • Repair the MAF supply circuit for an open or short to ground in the harness or connectors.

Step 3.

Turn the ignition switch off.
Disconnect the ECM harness connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.
Check harness continuity between the MAF sensor terminal 5 and ECM terminal 42.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next help.

No >> • Repair the Sensor Ground circuit for an open circuit.

Step 4.

Check the resistance between the signal circuit in the MAF connector and ground.

Is the resistance below 10,000 ohms between the signal circuit pin 5 in MAF sensor connector and ground?

Yes >> • Repair the open circuit or short to ground in harness or connectors.

No >> • Go to the next step.

Step 5.

Check the resistance of the reference voltage circuit in the MAF sensor connector between the MAF connector pin 4 and ECM connector pin 33.

Is the resistance below 5 ohms between the MAF sensor connector and ECM connector?

Yes >> • Go to the next step.

No >> • Repair the circuit for an open.

Step 6.

Turn the ignition switch on.

Check the resistance of the reference voltage circuit in the MAF connector between the MAF connector pin 4 and ground.

Is the resistance below 10,000 ohms between the MAF sensor connector and ground?

Yes >> • Repair the circuit for a short to ground.

No >> • Go to the next step.

Step 7.

Turn the ignition switch off.

Reconnect all harness connectors.

Turn the ignition switch on.

With the scan tool, read data stream.

Does the scan tool read MAF voltage above 1.025 volts?

Yes >> • Replace the MAF sensor.

No >> • Go to the next step.

Step 8.

Start engine.

With X-431 scan tool, select “data stream” and check the indication under the conditions.

- 1: Idle speed MAF value: 22-48 HZ.
- 2: 2,500 rpm MAF value: 80-120 HZ.

Does the scan tool read MAF values as above?

Yes >> • See Diagnostic Help in Section 03 Electronic Engine Controls.

No >> • Go to the next step.

Step 9.

Check the following for possible causes of abnormal air flow through the mass air flow sensor:

- Crushed air ducts.
- Improper seal of the air cleaner element.
- Improper intake air system components.

Were there any problems found?

Yes >> • Repair or replace the malfunctioning component.

No >> • Clean or replace the MAF sensor.

P0103: Mass Or Volume Air Flow Circuit High Input

- **When Monitored:** With the ignition switch on and engine running.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear all DTCs.
Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the X-431 scan tool, read the DTCs.

Does the scan tool read: P0103 ?

Yes >> • Go to the next step.

No >> • See Diagnostic Help in Section 03 Electronic Engine Controls.

Step 2.

Turn the ignition switch off.
Disconnect the MAF sensor connector.
Disconnect the ECM connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.
Turn the ignition switch on.
Measure the voltage of the MAF sensor reference voltage circuit between the MAF sensor connector pin 4 and ground.

Is there any voltage present?

Yes >> • Repair the MAF supply circuit for a short to voltage.

No >> • Go to the next step.

Step 3.

Check the voltage of the MAF sensor signal circuit between the MAF sensor terminal 5 and ground.

Is there any voltage present?

Yes >> • Repair the sensor signal circuit for a short to voltage.

No >> • Go to the next step.

Step 4.

Check the resistance of the MAF sensor ground circuit between the MAF ground circuit pin 3 and ECM connector pin 17.

Is the resistance below 5 ohms between the MAF sensor connector pin 3 and ECM connector pin 17?

Yes >> • Go to the next step.

No >> • Repair the open circuit.

Step 5.

Turn ignition switch off.
Reconnect all harness connectors.
Turn ignition switch on.
With the scan tool, read data stream.

Does the scan tool read MAF voltage above 1.025 volts?

Yes >> • Replace the MAF sensor.

No >> • Go to the next step.

Step 6.

Start engine.
With X-431 scan tool, select “data stream” and check the indication under the conditions.

- 1: Idle speed MAF value: 22-48 HZ.
- 2: 2,500 rpm MAF value: 80-120 HZ.

Does the scan tool read MAF values as above?

Yes >> • See Diagnostic Help in Section 03 Electronic Engine Controls.

No >> • Go to the next step.

Step 7.

Check the following for possible causes of abnormal air flow through the mass air flow sensor:

- Crushed air ducts.
- Improper seal of the air cleaner element.
- Improper intake air system components.

Were there any problems found?

Yes >> • Repair or replace the malfunctioning component.

No >> • Clean or replace the MAF sensor.

P0112: Intake Air Temperature Circuit Low

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the X-431 scan tool, read the DTCs.

Is DTC P0112 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the IAT sensor connector.
Disconnect the ECM connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.
Turn the ignition switch on.
Measure the resistance of the IAT sensor signal circuit between the IAT sensor electrical connector and ground.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the IAT signal circuit for a short to ground.

Step 3.

Turn the ignition switch off.
Measure the resistance between IAT sensor signal circuit and IAT sensor ground circuit.

Is the resistance below 10,000 ohms?

Yes >> • Repair the IAT sensor signal circuit for a short to IAT sensor ground circuit.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.
Connect the ECM connector.
Connect a jumper wire between the IAT signal circuit and the sensor ground in the IAT sensor electrical connector.
Turn the ignition switch on.
With the X-431 scan tool, read the IAT sensor signal voltage.

Is the voltage below 1.0 volt with the jumper wire in place?

Yes >> • Go to the next step.

No >> • Go to step 6.

Step 5.

Turn the ignition switch off.
Using the electrical schematic as a guide, inspect the wiring and connectors between the IAT sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the IAT sensor.

Step 6.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0113: Intake Air Temperature Circuit High

- **When Monitored:** With the ignition switch on and engine running.

Step 1.

Start the engine and allow it to reach normal operating temperature.

Turn the engine off and turn the ignition switch on.

With the X-431 scan tool, read the DTCs.

Is DTC P0118 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the Intake Air Temperature (IAT) sensor connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.

Turn the ignition switch on.

Measure the voltage of the IAT sensor signal circuit between the IAT sensor electrical connector and ground.

Is the IAT sensor signal voltage normal?

Yes >> • Go to the next step.

No >> • Repair the IAT signal circuit for a short to voltage.

Step 3.

Turn the ignition switch on.

Disconnect the ECM connector.

Measure the resistance of the IAT ground circuit between IAT sensor electrical connector and ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the IAT ground circuit for an open or high resistance.

Step 4.

Measure the resistance of the IAT signal circuit between the IAT sensor electrical connector and ECM connector.

Is the resistance below 5 ohms?

Yes >> • Go to the next step.

No >> • Repair the IAT signal circuit for an open circuit or high resistance.

Step 5.

Turn ignition switch off.
Connect the ECM electrical connector.
Turn ignition switch on.
With the X-431 scan tool, read the data of IAT sensor signal voltage.

Is the voltage above 4.5 volts with the IAT sensor disconnected?

Yes >> • Go to the next step.

No >> • Go to step 7.

Step 6.

Turn the ignition switch off.
Using the electrical schematic as a guide, inspect the wiring and connectors between the IAT sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the IAT sensor.

Step 7.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0117: Engine Coolant Temperature Circuit Low

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the X-431 scan tool, read the DTCs.

Is DTC P0117 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the Engine Coolant Temperature (ECT) sensor electrical connector.
Disconnect the ECM electrical connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.
Measure the resistance between ground and the ECT signal circuit in the ECT sensor electrical connector pin 1.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the ECT signal circuit for a short to ground.

Step 3.

Measure the resistance between the ECT signal circuit and the sensor ground circuit in the ECT sensor electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the ECT signal circuit for a short to the sensor ground circuit.

Step 4.

Turn ignition switch off.
Connect the ECM electrical connector.
Connect a jumper wire between the ECT signal circuit and the sensor ground in the ECT sensor electrical connector.
Turn ignition switch on.
With the X-431 scan tool, read the data for the ECT sensor signal voltage.

Is the voltage below 1.0 volt with the jumper wire in place?

Yes >> • Go to the next step.

No >> • Go to step 6.

Step 5.

Turn the ignition switch off.

Using the electrical schematic as a guide, inspect the wiring and connectors between the ECT sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the ECT sensor.

Step 6.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0118: Engine Coolant Temperature Circuit High

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.

Turn the engine off and turn the ignition switch on.

With the X-431 scan tool, read the DTCs.

Is DTC P0118 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the ECT sensor electrical connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.

Turn the ignition switch on.

Measure the voltage of the ECT sensor signal circuit between the ECT sensor electrical connector and ground.

Is the ECT sensor signal voltage normal?

Yes >> • Go to the next step.

No >> • Repair the ECT signal circuit for a short to voltage.

Step 3.

Turn the ignition switch off.

Disconnect the ECM connector.

Turn the ignition switch off.

Measure the resistance of the ECT signal circuit between ECT sensor electrical connector and ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the ECT signal circuit for an open or high resistance.

Step 4.

Measure the resistance of the ECT ground circuit between the ECT sensor electrical connector and ECM electrical connector.

Is the resistance below 5 ohms?

Yes >> • Go to the next step.

No >> • Repair the ECT ground circuit for an open circuit or high resistance.

Step 5.

Connect the ECM connector.
Turn the ignition switch on.
With the X-431 scan tool, read the ECT sensor signal voltage.
Is the voltage above 4.5 volts with the ECT sensor disconnected?

Yes >> • Go to the next step.
No >> • Go to step 7.

Step 6.

Turn the ignition switch off.
Using the electrical schematic as a guide, inspect the wiring and connectors between the ECT sensor and the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.
No >> • Replace the ECT sensor.

Step 7.

Using the electrical schematic as a guide, inspect the wiring and connectors between the ECT sensor and the ECM. See Diagnostic Help in Section 03 Electronic Engine Controls.
Were there any problems found?

Yes >> • Repair as necessary.
No >> • Replace and program the ECM.

P0122: Throttle/Pedal Position Sensor A Circuit Low Input

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.

Stop engine, turn ignition switch on.

With the X-431 scan tool, read the DTCs.

With the scan tool, select data stream.

Read the Accelerator Pedal Position (APP) value under the following two conditions:

- With accelerator pedal at rest: TP sensor-1 value is 0.74 volts, and TP sensor-2 value is 4.24 volts.
- With accelerator pedal pressed: TP sensor-1 value is 4.62 volts, and TP sensor-2 value is 0.72 volts.

Is DTC P0122 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the Throttle Position (TP) sensor electrical connector.

Turn the ignition switch on.

Measure the voltage of the 5 volt supply circuit at the TP sensor-1 electrical connector.

Is the voltage above 4.5 volts?

Yes >> • Go to step 6.

No >> • Go to the next step.

Step 3.

Turn the ignition switch off.

Disconnect the ECM connector.

Measure the resistance between ground and the 5 volt supply circuit at the TP sensor-1 electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the 5 volt supply circuit for a short to ground.

Step 4.

Measure the resistance between the 5 volt supply circuit and the TP sensor-1 ground circuit in the TP electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the 5 volt supply circuit for a short to the TP sensor-1 ground circuit.

Step 5.

Measure the resistance of the 5 volt supply circuit between the TP electrical connector and the ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the 5 volt supply circuit for an open circuit or high resistance.

Step 6.

Measure the resistance between ground and the TP sensor-1 signal circuit in the TP electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the TP sensor-1 signal circuit for a short to ground.

Step 7.

Measure the resistance between the TP sensor-1 signal circuit and the TP sensor ground circuit in the TP electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to step 8.

No >> • Repair the TP sensor-1 signal circuit for a short to the TP sensor ground circuit.

Step 8.

Measure the resistance of the TP sensor-1 signal circuit between the TP electrical connector and the ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the TP sensor-1 signal circuit for an open circuit or high resistance.

Step 9.

Connect the ECM electrical connector.

Connect a jumper wire between the 5 volt supply circuit and the TP sensor-1 signal circuit in the TP electrical connector.

Turn the ignition switch on.

With the X-431 scan tool, read the TP sensor-1 signal circuit voltage.

Is the voltage above 4.5 volts with the jumper wire in place?

Yes >> • Go to the next step.

No >> • Go to step 11.

Step 10.

Turn the ignition switch off.

Using the electrical schematic as a guide, inspect the wiring and connectors between the TP sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the TP sensor.

Step 11.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0123: Throttle/Pedal Position Sensor A Circuit High Input

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.

Stop engine, turn ignition switch on.

With the X-431 scan tool, read the DTCs.

With the scan tool, select data stream.

Read the Accelerator Pedal Position (APP) value under the following two conditions:

- With accelerator pedal at rest: TP sensor-1 value is 0.74 volts, and TP sensor-2 value is 4.24 volts.
- With accelerator pedal pressed: TP sensor-1 value is 4.62 volts, and TP sensor-2 value is 0.72 volts.

Is DTC P0122 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the Throttle Position (TP) sensor connector.

Turn the ignition switch on.

Measure the voltage of the 5 volt supply circuit in the TP electrical connector for a short to voltage.

Is the 5 volt supply voltage normal?

Yes >> • Go to the next step.

No >> • Repair the 5 volt supply circuit for a short to voltage.

Step 3.

Measure the voltage of the TP sensor-1 signal circuit in the TP electrical connector.

Is the TP sensor-1 signal voltage normal?

Yes >> • Go to the next step.

No >> • Repair the TP sensor-1 signal circuit for a short to voltage.

Step 4.

Turn the ignition switch off.

Disconnect the ECM connector.

Measure the resistance between the TP sensor-1 signal circuit and the supply circuit in the TP electrical connector.

Is the resistance below 10,000 ohms?

Yes >> • Repair the APP sensor-1 signal circuit for a short to the supply circuit.

No >> • Go to the next step.

Step 5.

Measure the resistance between the TP sensor-1 signal circuit and the Electronic Throttle Control (ETC) Motor circuit in the TP electrical connector.

Is the resistance below 10,000 ohms?

Yes >> • Repair the ETC Motor circuit for a short to the supply circuit.

No >> • Go to the next step.

Step 6.

Measure the resistance of the TP sensor ground circuit between the TP electrical connector and the ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the TP sensor ground circuit for an open circuit or high resistance.

Step 7.

Turn the ignition switch off.

Connect the ECM connector.

Connect a jumper wire between the APP sensor ground circuit and the TP sensor-1 signal circuit in the TP electrical connector.

Turn the ignition switch on.

With the scan tool, read the TP sensor-1 signal circuit voltage.

Is the voltage below 1.0 volt with the jumper wire in place?

Yes >> • Go to the next step.

No >> • Go to step 9.

Step 8.

Turn the ignition switch off.

Using the electrical schematic as a guide, inspect the wiring and connectors between the TP sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the TP sensor.

Step 9.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0132: O2 Sensor 1 Circuit High

- **When Monitored:** The battery voltage greater than 12 volts, the engine at normal operating temperature.

Step 1.

Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the X-431 scan tool, read the DTCs.

Is DTC P0132 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

With the X-431 scan tool, select oxygen sensor 1 voltage data stream.
Check the voltage of the oxygen data stream.

Is the voltage above normal value?

Yes >> • Go to the next step.

No >> • See Diagnostic Help in Section 03 Electronic Engine Controls for further information.

Step 3.

With the X-431 scan tool, drive the vehicle at speeds over 40 km/h, then release the accelerator pedal.
Watch the oxygen sensor 1 signal data stream when the throttle is less than 3% open, and the engine is decelerating.

Is the voltage signal approximately 110 millivolts?

Yes >> • See Diagnostic Help in Section 03 Electronic Engine Controls for further information.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.
Disconnect the oxygen sensor 1 electrical connector.
Turn the ignition switch on.
With the X-431 scan tool, view the oxygen sensor 1 signal voltage.
If without scan tool

- Connect the oxygen sensor 1 low signal circuit connector pin 3 to ground.
- Check the oxygen sensor 1 high signal voltage with a multimeter between the sensor connector pin 4 and ground.

Is the oxygen sensor reference voltage above 480 millivolts?

Yes >> • Go to the next step.

No >> • Replace the oxygen sensor 1.
• Clear the DTC.

Step 5.

Turn the ignition switch off.

Disconnect the ECM connector.

Check the oxygen sensor 1 signal circuit for a short to voltage circuit between the ECM connector pin 4 and voltage circuit.

Is the resistance below 10,000 ohms?

Yes >> • Repair the signal circuit for a short to voltage circuit.

No >> • Go to step 6.

Step 6.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0171: Fuel Trim Bank 1 Too Lean

- **When Monitored:** With the engine running in closed loop.

Step 1.

Diagnose and repair any other active component or circuit DTCs before continuing with this procedure.
Turn the ignition switch on.
Start the engine and allow it to reach normal operating temperature.

WARNING!

When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in personal injury or death.

NOTE :
Attempt to operate the vehicle under conditions similar to which the DTC was set.

NOTE :
It may be necessary to test drive the vehicle within the DTC monitoring conditions in order for this DTC to set. With the X-431 scan tool, read the DTCs.

Is DTC P0171 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Perform the following inspection procedure:

- Check the oxygen sensor for proper installation.
- Check the oxygen sensor circuits for proper routing.
- Check the oxygen sensor signal circuit for an open, short to ground or short to voltage.
- Check the PCV system for correct operation.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 3.

Perform the following diagnostic procedure:

- Connect the fuel pressure gauge to the fuel system.
- Turn the ignition switch on (fuel pump run time is 2-3 seconds).

Is the fuel pressure 4 bar when the pump runs and stabilizes?

Yes >> • Go to the next step.

No >> • Repair fuel system as necessary.

Step 4.

Perform the diagnostic procedure for the ECT sensor.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 5.

Perform the diagnostic procedure for the MAP sensor.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 6.

Perform the diagnostic procedure for the oxygen sensor.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 7.

Perform the following diagnostic inspection:

- Check the vacuum hose routing.
- Check for fuel contamination.
- Check the intake manifold, throttle body, and seals of the fuel injectors for leaks.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 8.

Using the electrical schematic as a guide, inspect the wiring and connectors between the engine sensors and the ECM. See Diagnostic Help in Section 03 Electronic Engine Controls.

Were there any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0172: Fuel Trim Bank 1 Too Rich

- **When Monitored:** With the engine running in closed loop.

Step 1.

Diagnose and repair any other active component or circuit DTCs before continuing with this procedure.
Turn the ignition switch on.
Start the engine and allow it to reach normal operating temperature.

WARNING!

When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in personal injury or death.

NOTE :
Attempt to operate the vehicle under conditions similar to which the DTC was set.

NOTE :
It may be necessary to test drive the vehicle within the DTC monitoring conditions in order for this DTC to set. With the X-431 scan tool, read the DTCs.

Is DTC P0172 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Inspect the air cleaner filter for clogged elements, and inspect the intake system for dents or blockage.

Were any problems found?

Yes >> • Replace or clear the air cleaner and repair as necessary.

No >> • Go to the next step.

Step 3.

Perform the diagnostic procedure for fuel delivery system.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Perform the diagnostic procedure for EVAP control system.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 5.

Remove the oxygen sensor and inspect the oxygen sensor for silicon contamination.

- Check the oxygen sensor for proper installation.
- Check the oxygen sensor circuits for proper routing.
- Check the oxygen sensor signal circuit for an open, short to ground or short to voltage.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 6.

Perform the diagnostic procedure for MAP sensor.

If the MAP sensor value is abnormal, see DTC P0106.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 7.

Perform the following diagnostic checks:

- Check if the fuel pressure is above 4 bar.
- Check if the throttle body is blocked.
- Check if the fuel injectors are leaking.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 8.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0201, P0202, P0203, P0204: Cylinder 1,2,3,4 Injector Circuit Fault

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.

Turn the engine off and turn the ignition switch on.

With the X-431 scan tool, read the DTCs.

Is DTC P0201 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).

• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the fuel injector electrical connector.

Turn the ignition switch on.

Using a 12 volt test light connected to ground, check the fuel injector supply circuit in the fuel injector electrical connector.

NOTE :

The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Repair the injector supply circuit for an open or shorted to ground.

Step 3.

Turn the ignition switch off.

Disconnect the ECM electrical connector.

NOTE :

When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.

Measure the resistance of the fuel injector control circuit between the fuel injector electrical connector and the ECM electrical connector.

Is the resistance of the fuel injector control circuit between the fuel injector electrical connector and the ECM electrical connector below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the fuel injector control circuit for an open.

Step 4.

Measure the resistance of the fuel injector control circuit between the fuel injector electrical connector and ground.

Is the resistance of the fuel injector control circuit between the fuel injector electrical connector and ground above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the fuel injector control circuit for a short to ground.

Step 5.

Using a multimeter, measure the resistance between the terminals of the fuel injector.

NOTE :
The resistance of the circuit will vary according to the temperature of the injector coil. Use the table below to determine the resistance range of the injector.

FUEL INJECTOR COIL RESISTANCE BASED ON ENGINE TEMPERATURE	
TEMPERATURE	**RESISTANCE**
20°C	11-13 ohms

Is the resistance of the injector within the specified range?

Yes >> • Go to the next step.

No >> • Replace the fuel injector.

Step 6.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:
- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0221: Throttle/Pedal Position Sensor/Switch B Range/Performance

- **When Monitored:** With the ignition switch on, battery voltage greater than 12 volts, and no other Throttle Position (TP) sensor DTCs present.

Step 1.

Diagnose and repair any other active component or circuit DTCs before continuing with this procedure.

Turn the ignition switch on.

Start the engine and allow it to reach normal operating temperature.

With the X-431 scan tool, read the DTCs.

Is DTC P0221 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the ECM electrical connector.

Disconnect the TP electrical connector.

Measure the resistance of TP sensor-1 and TP sensor-2 5 volt reference voltage circuit and signal circuit between the TP electrical connector and the ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the high resistance circuits.

Step 3.

Check the resistance between the TP sensor-1 and TP sensor-2 signal circuit in TP sensor connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the TP sensor-1 circuit short to TP sensor-2 circuit.

Step 4.

Connect the TP electrical connector.

Connect the ECM electrical connector.

Turn the ignition switch on.

Set up an oscilloscope or X-431 scan tool to view two graphs simultaneously as follows:

- Using one channel on the oscilloscope, backprobe the TP sensor-1 circuit at the TP electrical connector.
- Using the another channel on the oscilloscope, backprobe the TP sensor-2 circuit at the TP electrical connector.
- Slowly press and release the accelerator pedal while monitoring the oscilloscope screen or X-431 scan tool screen.

Does the scope pattern show any missing or erratic signals?

Yes >> • Go to the next step.

No >> • Go to step 6.

Step 5.

Turn the ignition switch off.

Using the electrical schematic as a guide, inspect the wiring and connectors between the TP sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the TP sensor.

Step 6.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0261, P0264, P0267, P0270: Cylinder 1, Cylinder 2, Cylinder 3, Cylinder 4 Injector Circuit Low

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the X-431 scan tool, read the DTCs.

Is DTC P0261 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the effected fuel injector electrical connector.
Turn the ignition switch on.
Using a 12 volt test light connected to ground, check the fuel injector supply circuit from the fused main relay output circuit to the fuel injector electrical connector.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Repair the injector supply circuit as necessary.

Step 3.

Turn the ignition switch off.
Disconnect the ECM electrical connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.
Measure the resistance between ground and fuel injector control circuit in the fuel injector electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the fuel injector control circuit for a short to ground.

Step 4.

Measure the resistance of the injector control circuit between the fuel injector electrical connector and the ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the injector control circuit for an open or high resistance.

Step 5.

Using a multimeter, measure the resistance between the terminals of the fuel injector.

NOTE :
The resistance of the circuit will vary according to the temperature of the injector coil. Use the table below to determine the resistance range of the injector.

FUEL INJECTOR COIL RESISTANCE BASED ON ENGINE TEMPERATURE	
TEMPERATURE	**RESISTANCE**
20°C	11-13 ohms

Is the resistance of the injector within the specified range?

Yes >> • Go to the next step.

No >> • Replace the fuel injector.

Step 6.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:
- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0262, P0265, P0268, P0271: Cylinder 1, Cylinder 2, Cylinder 3, Cylinder 4 Injector Circuit High

- **When Monitored:** With-the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.
Turn the engine off and turn the ignition switch on.
With the X-431 scan tool, read the DTCs.

Is DTC P0262 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the effected fuel injector electrical connector.
Turn the ignition switch on.
Measure the voltage of the fuel injector control circuit in the fuel injector electrical connector.

Is the fuel injector control circuit normal?

Yes >> • Go to step 4.

No >> • Go to the next step.

Step 3.

Disconnect the ECM connector.
Measure the resistance between the fuel injector control circuit and voltage circuit in the fuel injector electrical connector for a short to voltage.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the fuel injector control circuit for a short to voltage.

Step 4.

Using a multimeter, measure the resistance between the terminals of the fuel injector.

NOTE :
The resistance of the circuit will vary according to the temperature of the injector coil. Use the table below to determine the resistance range of the injector.

FUEL INJECTOR COIL RESISTANCE BASED ON ENGINE TEMPERATURE	
TEMPERATURE	**RESISTANCE**
20°C	11-13 ohms

Is the resistance of the injector within the specified range?

Yes >> • Go to the next step.

No >> • Replace the fuel injector.

Step 5.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0321: Ignition/Distributor Engine Speed Input Circuit - Range/Performance

- **When Monitored:** With the engine cranking or running.

Step 1.

Start the engine and allow it to reach normal operating temperature.

NOTE :
If the engine will not start, crank the engine for several seconds.
Stop engine, turn ignition switch on.
With the X-431 scan tool, read the DTCs.

Is DTC P0321 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the Crankshaft Position (CKP) sensor connector.
Measure the resistance of the CKP sensor (component side).

Is the resistance between 731 and 989 ohms?

Yes >> • Go to the next step.

No >> • Replace the CKP sensor.

Step 3.

Disconnect the ECM electrical connector.
Check the CKP sensor ground circuit for an open or short to voltage.

Is the CKP sensor ground circuit open or shorted to voltage?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Check the CKP sensor reference circuit for an open between the CKP sensor connector and ECM connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the CKP reference circuit for an open.

Step 5.

Turn the ignition switch on.

Check the CKP sensor reference circuit for a short to ground or short to voltage circuit.

Is the resistance below 10,000 ohms between the CKP sensor reference circuit and ground; or any voltage present between the CKP sensor reference circuit and ground?

Yes >> • Repair the CKP sensor reference circuit for short to ground or voltage.

No >> • Go to the next step.

Step 6.

Inspect the CKP sensor for the following:

- Look for broken, bent, pushed out or corroded terminals of the CKP sensor.
- Inspect the CKP sensor for conditions such as loose mounting screws, damage, or cracks.
- Inspect the CKP sensor and mounting area for any condition that would result in an incorrect signal, such as damage, foreign material, or excessive movement.

Is there any problems found?

Yes >> • Repair the CKP sensor connector as necessary.

No >> • Go to the next step.

Step 7.

Replace the CKP sensor.

Operate the engine under the condition which set the DTC.

Is there any problems found?

Yes >> • Go to the next step.

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

Step 8.

Turn the ignition switch off.

Remove the CKP sensor.

Inspect the pulse ring and mounting area for any condition that would result in an incorrect signal, such as damage, foreign material, or excessive movement.

Is there any problems found?

Yes >> • Replace the pulse ring.

No >> • Go to the next step.

Step 9.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0324: Knock Control System Error

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.

NOTE :
It may be necessary to test drive the vehicle within the DTC monitoring conditions in order for this DTC to reset. Raise the engine speed for a few seconds and listen for any unusual sounds.

Were any engine sounds heard?

Yes >> • Repair the engine mechanical malfunction.
No >> • Go to the next step.

Step 2.

Turn the ignition switch off.
Disconnect the knock sensor electrical connector.
Turn the ignition switch on.
Measure the voltage of the knock sensor signal circuit in the knock sensor electrical connector.

Is there any voltage present?

Yes >> • Go to the next step.
No >> • Go to step 4.

Step 3.

Turn the ignition switch off.
Disconnect the ECM electrical connector.
Turn the ignition switch on.
Measure the voltage of the knock sensor signal circuit in the knock sensor electrical connector.

Is there any voltage present?

Yes >> • Repair the knock sensor signal circuit for a short to voltage.
No >> • Repair the knock sensor signal circuit for a short to ECM output voltage circuit.

Step 4.

Turn the ignition switch off.
Measure the resistance between ground and the knock sensor signal circuit in the knock sensor electrical connector.

Is the resistance above 10,000 ohms between ground and the knock sensor signal circuit?

Yes >> • Go to the next step.
No >> • Repair the knock sensor signal circuit for a short to shielded conductor.

Step 5.

Measure the resistance between the knock sensor signal circuit and the knock sensor return circuit in the knock sensor electrical connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the knock sensor signal circuit for a short to the knock sensor return circuit.

Step 6.

Measure the resistance between the knock sensor pin 1 and pin 2.

Is the resistance above 1 M ohm between pin 1 and pin 2?

Yes >> • Go to the next step.

No >> • Replace the knock sensor.

Step 7.

Measure the resistance of the knock sensor signal circuit between the knock sensor electrical connector and the ECM electrical connector.

NOTE :
When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the knock sensor signal circuit for an open circuit or high resistance.

Step 8.

Measure the resistance of the knock sensor return circuit between the knock sensor electrical connector and the ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the knock sensor return for an open circuit or high resistance.

Step 9.

Using the electrical schematic as a guide, inspect the wiring and connectors between the knock sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 10.

Connect the ECM electrical connector.
Replace the knock sensor.
Start the engine and allow it to reach normal operating temperature.
With the X-431 scan tool, read the DTCs.

Is DTC P0324 present?

Yes >> • Go to the next step.

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

Step 11.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0341: Camshaft Position Sensor Circuit - Range/Performance

- **When Monitored:** With the engine cranking or running.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.

NOTE :
If the engine will not start, crank the engine for several seconds.
With the scan tool, read the DTCs.

Is DTC P0341 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the Camshaft Position (CMP) sensor electrical connector.
Turn the ignition switch on.
Measure the voltage of the supply voltage circuit in the CMP sensor connector.

Is 12 volts present?

Yes >> • Go to the next step.

No >> • Repair the supply circuit for a short to ground or open.

Step 3.

Measure the voltage of the CMP signal circuit in the CMP sensor electrical connector.

Is 12 volts present?

Yes >> • Go to the next step.

No >> • Go to step 6.

Step 4.

Turn the ignition switch off.
Using a 12 volt test light connected to 12 volts, check the sensor ground in the CMP sensor electrical connector.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Repair the CMP ground circuit for an open or poor connection.

Step 5.

Using the electrical schematic as a guide, inspect the following:

- Inspect the wiring and connectors between the CMP sensor and the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Inspect the CMP sensor for conditions such as loose mounting screws, damage, or cracks.
- If no other problems are found, remove the CMP sensor. Inspect the CMP sensor and mounting area for any condition that would result in an incorrect signal, such as damage, foreign material, or excessive movement.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the CMP sensor.

Step 6.

Turn the ignition switch off.

Disconnect the ECM electrical connector.

Measure the resistance of the sensor circuit in the sensor connector pin 2 and ECM connector pin 79.

Measure the resistance between the ground or sensor ground and sensor signal circuit.

Is the sensor circuit open or shorted to ground or sensor ground?

Yes >> • Repair the sensor circuit open or shorted to ground.

No >> • Go to the next step.

Step 7.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0444: Evaporative Emission System Purge Control Valve Circuit Fault

- **When Monitored:** With the engine running and battery voltage greater than 12 volts.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.
With the scan tool, read the DTCs.

Is DTC P0444 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the EVAP sensor electrical connector.
Turn the ignition switch on.
Using a 12 volt test light connected to ground, check the EVAP purge supply circuit in the EVAP purge solenoid electrical connector.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Repair the EVAP supply circuit for a short to ground or an open.

Step 3.

With the X-431 scan tool, actuate the EVAP purge solenoid.
Using a 12 volt test light connected to the battery, check the EVAP purge control circuit in the EVAP purge solenoid electrical connector.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Does the test light flash on and off with the actuation?

Yes >> • Replace the EVAP purge solenoid.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.

Disconnect the EVAP purge solenoid connector.

Disconnect the ECM electrical connector.

Check the EVAP purge control circuit for an open, short to ground, short to EVAP purge supply circuit, or short to voltage.

Were any problems found?

Yes >> • Repair the EVAP purge control circuit.

No >> • Go to the next step.

Step 5.

Using the electrical schematic as a guide, inspect the wiring and connectors between the EVAP purge solenoid and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0506: Idle Air Control System RPM Lower Than Expected

- **When Monitored:** With the engine idling in drive, the brake applied, engine run time below a calibrated minimum value, and no VSS, MAF/MAP, ECT, TPS, ETC, Crankshaft Position sensor, fuel system, or injector DTCs present.

Step 1.

NOTE :
If any other Throttle Body DTCs are present, they must be diagnosed and repaired before continuing this test.
Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.
With the scan tool, read the DTCs.

Is DTC P0506 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Inspect the air induction system for the following air restriction problems:
- Dirty air cleaner
- Foreign material trapped in the air intake tube

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 3.

Inspect the PCV system for the following problems:
- Sticking valve
- Collapsed hoses or tubes
- Obstructed passages or ports

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Inspect the throttle body for carbon build up or other restrictions.

Using a straight edge, verify that the throttle plate is not bent. If the throttle plate is bent, the throttle body must be replaced.

Start the engine.

WARNING!

When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in personal injury or death.

While the vehicle is running, lightly tap on the Electronic Throttle Control (ETC) actuator where applicable, with your hand, and listen for the idle to raise.

Were any problems found or did the idle fluctuate while tapping on the ETC actuator?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 5.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0560: System Voltage Malfunction

- **When Monitored:** With the engine running for more than specification seconds.

Step 1.

NOTE :
Diagnose and repair any charging system or generator DTCs before continuing with this test.

NOTE :
Inspect and test the battery in accordance with the Service Information before continuing with this test.

NOTE :
Inspect the vehicle for aftermarket accessories that may exceed the Generator System output.

NOTE :
Inspect the fuses. If an open fuse is found, use the wiring schematics as a guide and inspect the wiring and connectors for damage.
Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.
With the scan tool, select View DTCs.
With the scan tool, read the DTCs.

Is DTC P0560 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Start the engine, raise the engine speed over 1000 rpm.
Measure the charge voltage with the voltmeter.

Is the voltage between 9-16 volts?

Yes >> • Go to the next step.

No >> • Repair the charge system fault.

Step 3.

Turn the engine off.
Disconnect the ECM electrical connector.
Turn the ignition switch on.
Using a 12 volt test light connected to ground, check the ECM supply circuits pin 44, pin 45 and pin 63 in the ECM electrical connector, harness side.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.
Is the test light illuminated and bright?

Yes >> • Replace and program the ECM.

No >> • Repair the ECM supply circuit for an open, high resistance or short to ground as necessary.

P0601: Internal Control Module Memory Check Sum Error

P0602: ECM Programming Error

P0604: Internal Controller Module Random Access Memory (RAM) Error

P0605: Internal Controller Module ROM Test Error

P0606: ECM Processor

- **When Monitored:** With the ignition switch on.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs in ECM.
Monitor the scan tool for at least two minutes.
Cycle the ignition key off and on several times, leaving the ignition switch on for at least 10 seconds at a time.
Start the engine and allow it to reach normal operating temperature.
With the scan tool, read the DTCs.

Is DTC P0601, P0602, P0604, P0605 or P0606 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Check the ECM supply voltage circuit and the ECM ground circuit for an open, high resistance or shorted circuits.

Were any problems found?

Yes >> • Repair the circuits fault as necessary.

No >> • Go to the next step.

Step 3.

With X-431 scan tool, review DTCs.

Is DTC P0602 set?

Yes >> • Go to the next step.

No >> • Replace and program the ECM.

Step 4.

With X-431 scan tool, program ECM before replacing it, and view the DTC with X-431.

Is DTC P0602 setting again?

Yes >> • Replace and program ECM.

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

P0627: Fuel Pump "A" Control Circuit Open

- **When Monitored:** With the engine running and battery voltage greater than 12 volts.

Step 1.

Start the engine and allow it to reach normal operating temperature.

NOTE :
If the engine will not start, crank the engine for several seconds.

NOTE :
When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in personal injury or death.
Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.
With the scan tool, read the DTCs.

Is DTC P0627 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the fuel pump relay.
Turn the ignition switch on.
Using a 12 volt test light connected to ground, check the relay supply voltage.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Repair the supply circuit for an open, high resistance or short to ground.

Step 3.

Connect a test light between the fuel pump control circuit and relay supply circuit on the fuel pump relay.
Turn the ignition switch on.
With the X-431 scan tool, actuate the fuel pump relay.

Does the test light flash on and off with the actuation?

Yes >> • Replace the relay.

No >> • Go to the next step.

Step 4.

Disconnect the ECM electrical connector.

Check the fuel pump relay control circuit for an open, high resistance, short to ground or short to voltage.

Were any problems found?

Yes >> • Repair the fuel pump relay control circuit.

No >> • Go to the next step.

Step 5.

Using the electrical schematic as a guide, inspect the wiring and connectors between the fuel pump control relay and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P0645: A/C Clutch Relay Control Circuit Fault

- **When Monitored:** With the engine running and battery voltage greater than 12 volts.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.
Turn the Air Conditioning on.
With the scan tool, read the DTCs.

Is DTC P0645 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the A/C control relay.
Turn the ignition switch on.
Using a 12 volt test light connected to ground, check the relay supply voltage.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Repair the supply circuit for an open, high resistance or short to ground.

Step 3.

Turn the ignition switch off.
Connect a test light between the control circuit and supply circuit of the relay.
Turn the ignition switch on.
With the X-431 scan tool, actuate the A/C relay.

Does the test light flash on and off with the actuation?

Yes >> • Replace the relay.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.
Disconnect the ECM electrical connector.
Check the A/C relay control circuit for an open, high resistance, short to ground or short to voltage.

Were any problems found?

Yes >> • Repair the A/C relay control circuit.
No >> • Go to the next step.

Step 5.

Connect the ECM electrical connector.
Turn the ignition switch on.
Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.
No >> • Go to the next step.

Step 6.

Using the electrical schematic as a guide, inspect the wiring and connectors between the fuel pump control relay and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.
No >> • Replace and program the ECM.

P0691: Cooling Fan 1 Control Circuit Low

- **When Monitored:** With the engine running and battery voltage greater than 12 volts.

Step 1.

WARNING!

When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in personal injury or death.

Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.
With the scan tool, read the DTCs.

Is DTC P0691 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the cooling fan control module electrical connector.
Turn the ignition switch on.
Using a 12 volt test light connected to ground, check the low relay supply voltage.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Repair the supply circuit for an open, high resistance or short to ground.

Step 3.

Turn the ignition switch off.
Connect a test light between the control circuit and supply circuit of the low speed relay.
Turn the ignition switch on.
With the X-431 scan tool, actuate the radiator cooling fan low speed relay.

Does the test light flash on and off with the actuation?

Yes >> • Replace the radiator cooling fan low speed relay.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.
Disconnect the ECM electrical connector.
Check the radiator cooling fan low speed relay control circuit for a short to ground.

Were any problems found?

Yes >> • Repair the radiator cooling fan low speed relay control circuit.
No >> • Go to the next step.

Step 5.

Connect the ECM electrical connector.
Turn the ignition switch on.
Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.
No >> • Go to the next step.

Step 6.

Using the electrical schematic as a guide, inspect the wiring and connectors between the radiator cooling fan low relay and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.
No >> • Replace and program the ECM.

P0694: Cooling Fan 2 Control Circuit High

- **When Monitored:** With the engine running and battery voltage greater than 12 volts.

Step 1.

WARNING!

When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in personal injury or death.

Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.
With the scan tool, read the DTCs.

Is DTC P0694 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Disconnect the cooling fan control module electrical connector.
Turn the ignition switch on.
Using a 12 volt test light connected to ground, check the high speed relay supply voltage.

NOTE :
The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.

Is the test light illuminated and bright?

Yes >> • Go to the next step.

No >> • Repair the high speed relay supply circuit for an open, high resistance or short to ground.

Step 3.

Turn the ignition switch off.
Connect a test light between the control circuit and supply circuit of the high speed relay.
Turn the ignition switch on.
With the X-431 scan tool, actuate the radiator cooling fan high speed relay.

Does the test light flash on and off with the actuation?

Yes >> • Replace the radiator cooling fan high relay.

No >> • Go to the next step.

Step 4.

Turn the ignition switch off.

Disconnect the ECM electrical connector.

Check the cooling fan high speed relay control circuit for an open, high resistance, short to ground or short to voltage.

Were any problems found?

Yes >> • Repair the cooling fan high speed relay control circuit.

No >> • Go to the next step.

Step 5.

Connect the ECM electrical connector.

Turn the ignition switch on.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 6.

Using the electrical schematic as a guide, inspect the wiring and connectors between the radiator cooling fan high relay and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

P1545: Throttle Position Control Malfunction

- **When Monitored:** With the engine running, Electronic Throttle Control (ETC) actuator not in limp home mode, and TPS adaptation complete.

Step 1.

NOTE :
If this DTC sets intermittently, it is possible that the controller is overheating in extremely hot temperatures. This is considered a normal protection operation. No repair is necessary.

NOTE :
Low system voltage can cause excessive current draw in very hot and cold ambient temperatures. Make sure the battery can pass a load test before continuing. Review Freeze Frame information to determine the ambient temperature when the DTC set.

WARNING!

When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in personal injury or death.

Turn the ignition switch on.
With the X-431 scan tool, clear the DTCs.
Start the engine and allow it to reach normal operating temperature.
With the scan tool, read the DTCs.

Is DTC P1545 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.
Remove the air cleaner assembly.
Check for any signs of a foreign material (ice or dirt) on the throttle plate or in the throttle bore that can cause the throttle plate to stick.

Were any problems found?

Yes >> • Remove the debris if possible or replace the Throttle Body Assembly. Disconnect the battery when replacing the Throttle Body Assembly. After installation is complete, use a scan tool and perform the ETC Relearn function.

No >> • Go to the next step.

Step 3.

Install the air cleaner assembly.

Turn the ignition switch on.

Start the engine and allow it to reach normal operating temperature.

With X-431 scan tool, perform the following:

- Monitor and compare the actual throttle position percent to the desired throttle position percent.
- Monitor and compare the TP sensor-1 voltage and TP sensor-2 voltage.

Does the actual TP position match the desired TP position and TP sensor-1 voltage match TP sensor-2 voltage?

Yes >> • Go to the next step.

No >> • Replace the Throttle Body Assembly. Disconnect the battery when replacing the Throttle Body Assembly. After installation is complete, use X-431 scan tool and perform the ETC Relearn function.

Step 4.

Start the engine and depress the accelerator pedal from the idle position to the high speed position, observe the movement of the throttle blade.

NOTE :
It may be necessary to use a mirror to see the throttle blade.

NOTE :
Make sure the motion of the throttle blade is smooth and that it opens and closes.

Did the ETC motor operate smoothly and properly?

Yes >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

No >> • Replace the Throttle Body Assembly. Disconnect the battery when replacing the Throttle Body Assembly. After installation is complete, use X-431 scan tool and perform the ETC Relearn function.

P1610: Secret Key And Secret Code Not Programed In ECM

- **When Monitored:** With the ignition switch on and battery voltage greater than 12 volts.

Step 1.

Connect the X-431 scan tool to the Data Link Connector (DLC) - use the most current software available.
Turn the ignition switch on, with the scan tool, view and erase stored DTCs in VSM.
Try to start the engine.
Turn the ignition switch off, and wait a few seconds, then turn the ignition switch on.
With the scan tool, view active DTCs in the VSM.

Does the MIL flash?

Yes >> • Go to step 3.

No >> • Go to the next step.

Step 2.

With the X-431 scan tool, clear the DTCs.
With the scan tool, read the DTCs.

Is DTC P1610 present?

Yes >> • Repair the MIL system.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 3.

Using the X-431 scan tool.
- Choose “A 520 series”.
- Choose “VSM”.
- Choose “input code”.

Input the correct primary safety code.

Can the program be performed?

Yes >> • Go to the next step.

No >> • Go to step 5.

Step 4.

With the X-431 scan tool, enter the secret system.

Program the transceiver key.

With the X-431 scan tool, enter the engine management system.

Perform the relative program between VSM and ECM.

- If the ECM has been replaced with a new ECM:
  - First choose VSM, then input safety code.
  - Select VSM.VSM matching.
  - Read VSM to ECM".
- If the VSM has been replaced with a new VSM:
  - First choose VSM, then input safety code.
  - Select VSM.VSM matching.
  - Read ECM to VSM".
  - Choose "key learning", match every primary key.

  Turn the ignition switch off.

Turn the ignition switch on.

Does the MIL flash?

Yes >> • Go to the next step.

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

Step 5.

Turn the ignition switch off.

Disconnect the negative battery cable.

Replace the VSM.

Connect the negative battery cable.

Turn the ignition switch on.

With the X-431 scan tool, enter into VSM, perform the system program.

Using the X-431 scan tool.

- Choose "A 520 series".
- Choose "immobilize".
- Choose "input code".

Input the correct primary safety code.

Program the transceiver key.

With the X-431 scan tool, enter the ECM, perform the relative program between VSM and ECM.

Turn the ignition switch off, and then try to start the engine.

Does the MIL flash?

Yes >> • Install the original VSM. Perform the relative program between VSM and ECM.

No >> • The system is now operating properly.
• Reassemble the vehicle and road test to verify the customers complaint is repaired.

P2138: Accelerator Pedal Position Sensor Signal Correlation Error

- **When Monitored:** With the ignition switch on, battery voltage greater than 12 volts, and no Accelerator Pedal Position (APP) sensor 1 and APP sensor-2 DTCs present.

Step 1.

WARNING!

When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in personal injury or death.

Turn the ignition switch on.

With the X-431 scan tool, clear the DTCs.

Start the engine and allow it to reach normal operating temperature.

With the scan tool, read the DTCs.

Is DTC P2138 present?

Yes >> • Repair the MIL system.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 03 Electronic Engine Controls).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

Turn the ignition switch off.

Disconnect the APP sensor electrical connector.

Disconnect the ECM electrical connector.

NOTE :

When checking circuits at the ECM, be careful not to damage or distort the connector terminals. Improper measurement technique could result in poor pin to terminal contact.

Measure the resistance of the APP sensor-1 and APP sensor-2 5 volt reference and signal circuit between the APP sensor electrical connector and the ECM electrical connector.

Is the resistance below 5.0 ohms?

Yes >> • Go to the next step.

No >> • Repair the high resistance circuits.

Step 3.

Check the resistance of the APP sensor-1 and APP sensor-2 circuit between the ECM connector and APP sensor connector.

Is the resistance above 10,000 ohms?

Yes >> • Go to the next step.

No >> • Repair the APP sensor-1 signal circuit for a short to APP sensor-2 signal circuit.

Step 4.

Connect the APP electrical connector.

Connect the ECM electrical connector.

Turn the ignition switch on.

Set up an oscilloscope or X-431 scan tool to view two graphs simultaneously as follows:

- Using one channel on the oscilloscope, backprobe the APP sensor-1 circuit at the APP electrical connector.
- Using the another channel on the oscilloscope, backprobe the APP sensor-2 circuit at the APP electrical connector.
- Slowly press and release the accelerator pedal while monitoring the oscilloscope screen or X-431 scan tool screen.

Does the scope pattern show any missing or erratic signals?

Yes >> • Go to the next step.

No >> • Go to step 6.

Step 5.

Turn the ignition switch off.

Using the electrical schematic as a guide, inspect the wiring and connectors between the Accelerator Pedal Position sensor and the ECM.

- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace the Accelerator Pedal Position sensor.

Step 6.

Monitor the X-431 scan tool data relative to this circuit and wiggle test the wiring and connectors:

- Look for the data to change or for the DTC to reset during the wiggle test.
- Using the wiring schematic as a guide, inspect the wiring and connectors of the ECM.
- Look for any chafed, pierced, pinched, or partially broken wires.
- Look for broken, bent, pushed out or corroded terminals.
- Verify that there is good pin to terminal contact in the related connectors.

Were any problems found?

Yes >> • Repair as necessary.

No >> • Replace and program the ECM.

U0001: High Speed Can Defective

- **When Monitored:** With the ignition switch on.

Step 1.

Turn the ignition switch on.
With the X-431 scan tool, delete all the ECM DTCs.
Cycle the ignition switch from ON to OFF 3 times.
With the scan tool, read the DTCs.

Is DTC U0001 present?

Yes >> • Go to the next step.

No >> • The conditions that caused this code to set are not present at this time. Using the electrical schematics as a guide, check and ensure that the wiring harness is routed properly, and there are no parts interfering with the ECM wiring harness (See Diagnostic Help in Section 08 Transaxle).
• Erase all codes and test drive the vehicle to verify the repair is complete.

Step 2.

With the X-431 scan tool, attempt to enter all the other CAN communication modules ABS module, ECM, IC module and Front BCM.
Read the CAN DTCs.

Were other module DTCs found?

Yes >> • If all of the other modules have the same DTC ″CAN Communication″, Go to the next step.
• If all of the other modules have the DTC ″Lost communication with ECM″, and do not have the ″CAN Communication″, Replace and program the ECM module.

No >> • Go to step 8.

Step 3.

Check for a short to voltage between the diagnostic electrical connector DLC pin 14 (-), pin 6 (+) and ground.

Is there any voltage present?

Yes >> • Go to the next step.

No >> • Go to step 5.

Step 4.

Turn the ignition switch off.
Disconnect the ABS module, ECM, IC module, Front BCM and ECM electrical connectors.
Turn the ignition switch on.
Check for a short to voltage between the diagnostic electrical connector DLC pin 14 (-), pin 6 (+) and ground.

Is there any voltage present when the modules are disconnected?

Yes >> • Go to the next step.

No >> • Replace the corresponding module.

Step 5.

Connect all the disconnected modules.
Check for a short to ground between the diagnostic electrical connector DLC pin 14 (-), pin 6 (+) and ground.

Is the resistance below 10,000 ohms

Yes >> • Go to the next step.
No >> • Go to step 7.

Step 6.

Turn the ignition switch off.
Disconnect the ABS module, ECM, IC module, Front BCM and ECM harness connectors.
Check for a short to ground between the diagnostic electrical connector DLC pin 14 (-), pin 6 (+) and ground.

Is the resistance below 10,000 ohms with all modules disconnected?

Yes >> • Check and repair the CAN communication circuits high (+) and low (-) for a short to ground as necessary.
No >> • Replace the corresponding module.

Step 7.

Turn the ignition switch off.
Disconnect the ABS module, ECM, IC module, Front BCM and ECM harness electrical connectors.
Check the resistance between the CAN HIGH (+) and CAN LOW (-) for a short together.

Is the resistance below 10,000 ohms?

Yes >> • Repair the CAN circuits for a short together as necessary.
No >> • Go to the next step.

Step 8.

Inspect the ECM electrical connector pins for proper fit or any chafed, pierced, pinched, or partially broken wires.

Is there any problems present?

Yes >> • Repair as necessary.
No >> • Replace and program the ECM.

ON-VEHICLE SERVICE

Engine Coolant Temperature Sensor

Description

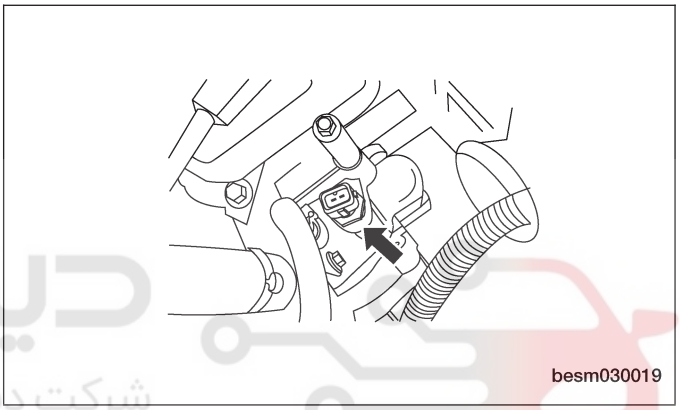
The Engine Coolant Temperature (ECT) sensor threads into the coolant outlet connector. The ECT is a negative thermal coefficient sensor.

Operation

The ECT provides an input to the Engine Control Module (ECM). As temperature increases, resistance of the sensor decreases. As coolant temperature varies, the ECT sensor resistance changes resulting in a different voltage value at the ECT sensor signal circuit. The ECM uses the input to control air-fuel mixture, timing, and radiator fan on/off times.

Removal & Installation

1. Disconnect and isolate the negative battery cable.
2. Release the coolant system pressure.



WARNING!

Never remove the pressure relief cap under any conditions while the engine is operating or hot. Failure to follow these instructions could result in personal injury or damage to the cooling system or engine. To avoid having scalding hot coolant or steam blow out of the cooling system, use extreme care when removing the pressure relief cap. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is released from the cooling system. When you are certain all the pressure has been released, (with a cloth) turn and remove the pressure relief cap. Failure to follow these instructions may result in series personal injury.

3. Disconnect the coolant temperature sensor electrical connector.

CAUTION:

Remove the coolant temperature sensor when the engine is cold.

4. Remove the engine coolant temperature sensor.
   (Tighten: Engine coolant temperature sensor to 20 N·m)
5. Discard the O-ring.
6. Installation is in the reverse order of removal.

Installation Notes:

- After installing the engine coolant temperature sensor, verify the engine coolant is at the proper level.

Knock Sensor

Description

The knock sensor is attached to the cylinder block. The knock sensor is designed to detect engine vibration that is caused by detonation.

Operation

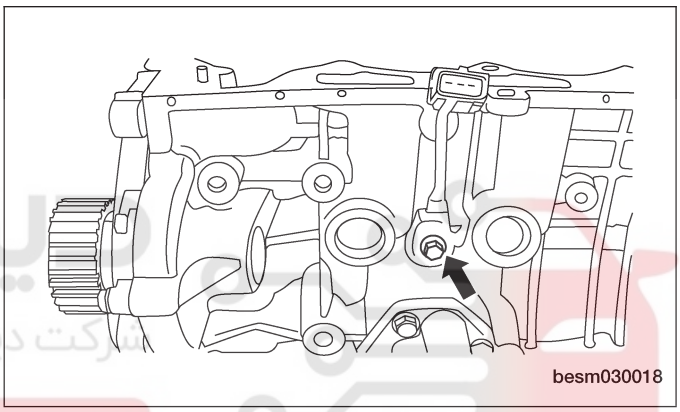
When the knock sensor detects a knock in one of the cylinders, it sends an input signal to the Engine Control Module (ECM). In response, the ECM retards ignition timing for all cylinders by a specified amount.

Knock sensor contains a piezoelectric material which constantly vibrates and sends an input voltage (signal) to the ECM while the engine operates. As the intensity of the crystal's vibration increases, the knock sensor output voltage also increases.

The ECM ignores knock sensor input during engine idle conditions. Once the engine speed exceeds a specified value, knock retard is allowed.

Removal & Installation

1. Disconnect and isolate the negative battery cable.
2. Disconnect the knock sensor electrical connector.
3. Remove the knock sensor retaining bolt and remove the knock sensor.
   (Tighten: Knock sensor retaining bolt to 20 N·m)
4. Installation is in the reverse order of removal.



Oxygen Sensor

Description

This vehicle is equipped with two oxygen sensors (sensor 1 & sensor 2). The oxygen sensors are located before and after the three way catalyst. The oxygen sensors continually monitor the oxygen level in the exhaust gas. Even if switching characteristics of the air flow sensor are shifted, the air flow is controlled to stoichiometric, by the signal from the oxygen sensor. This sensor is made of ceramic zirconia. The zirconia generates voltage from approximately 1 volt in richer conditions to 0 volt in leaner conditions.

Operation

The oxygen sensor has a much longer switching time between rich and lean than the air flow sensor. The oxygen storage capacity of the three way catalyst (manifold) causes the longer switching time. The oxygen senses the oxygen content in the exhaust flow and outputs a voltage between 0 and 1.0 volt. Lean of stoichiometric, air/fuel ratio of approximately 14.7:1, the oxygen sensor generates a voltage between 0 and 0.45 volt. Rich of stoichiometric, the oxygen sensor generates a voltage between 0.45 and 1.0 volt.

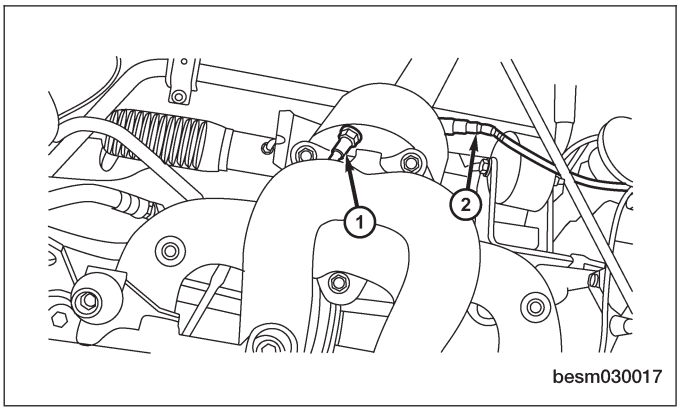
The oxygen sensor senses the oxygen content in the exhaust flow and outputs a voltage between 0 and 1.0 volt. Lean of stoichiometric, air/fuel ratio of approximately 14.7:1, the oxygen sensor generates a voltage between 0 and 0.45 volt. Rich of stoichiometric, the oxygen sensor generates a voltage between 0.45 and 1.0 volt.

Removal & Installation

1. Disconnect and isolate the negative battery cable.
2. Disconnect the oxygen sensor electrical connector.

CAUTION:
Remove the oxygen sensor when the exhaust pipe is cold.

3. Remove the oxygen sensor (1).
   (Tighten: Oxygen sensor to 45 N·m)
4. Installation is in the reverse order of removal.



Crankshaft Position Sensor

Description

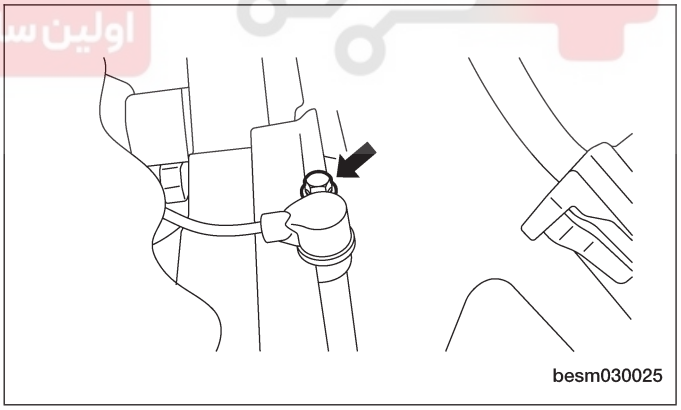
The Crankshaft Position (CKP) sensor is located on the flywheel shell facing the gear teeth of the signal plate. It detects the fluctuation of the engine revolution. The sensor consists of a permanent magnet and Induction coil.

Operation

When the engine is running, the high and low parts of the teeth cause the gap with the sensor to change. The changing gap causes the magnetic field near the sensor to change. Due to the changing magnetic field, the voltage from the sensor changes. The Engine Control Module (ECM) receives the voltage signal and detects the fluctuation of the engine revolution.

Removal & Installation

1. Disconnect and isolate the negative battery cable.
2. Disconnect the CKP sensor electrical connector.
3. Remove the CKP sensor retaining bolt and remove the CKP sensor.
   (Tighten: Crankshaft position sensor retaining bolt to 10 N·m)
4. Installation is in the reverse order of removal.



Camshaft Position Sensor

Description

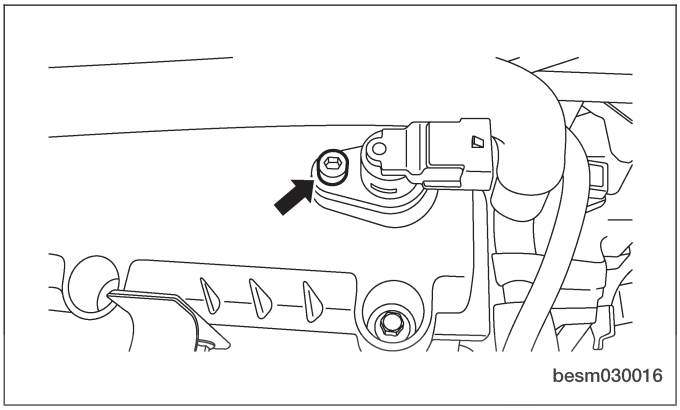
The Camshaft Position (CMP) sensor senses the protrusion of the intake valve cam sprocket to identify a particular cylinder. The CMP sensor senses the piston position. When the Crankshaft Position (CKP) sensor becomes inoperative, the CMP sensor provides various controls of engine parts instead, utilizing timing of cylinder identification signals. The sensor consists of a permanent magnet and Hall IC.

Operation

When engine is running, the high and low parts of the teeth cause the gap with the sensor to change. The changing gap causes the magnetic field near the sensor to change. Due to the changing magnetic field, the voltage from the sensor changes. The Engine Control Module (ECM) detects the voltage signal and identify piston position and cylinder timing.

Removal & Installation

1. Disconnect the negative battery cable.
2. Disconnect the CMP sensor electrical connector.
3. Remove the CMP sensor retaining bolt.
   (Tighten: Camshaft position sensor retaining bolt to 7 N·m)
4. Remove CMP sensor.
5. Pull the sensor up and out of the cylinder head cover.
6. Installation is in the reverse order of removal.



Air Flow Sensor

Description

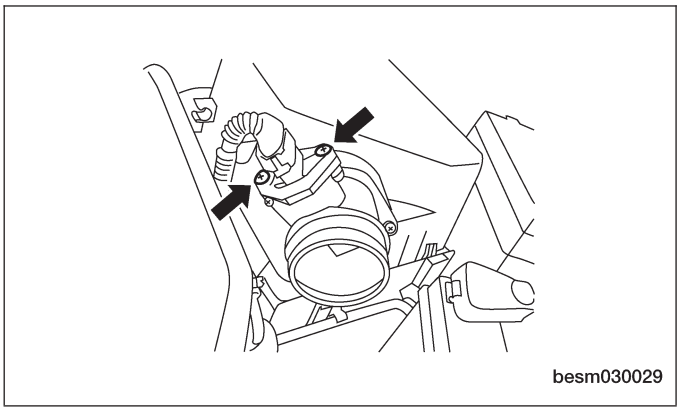
The air flow sensor is placed in the stream of intake air. The air flow sensor measures the intake flow rate by measuring a part of the entire intake flow. The air flow sensor converts the amount of air drawn into the engine into a voltage signal. The Engine Control Module (ECM) needs to know intake air volume to calculate engine load. This is necessary to determine how much fuel to inject.

Operation

The air flow sensor controls the temperature of the hot wire to a certain amount. The heat generated by the hot wire is reduced as the intake air flows around it. The more air,the greater the heat loss. Therefore, the electric current supplied to the hot wire is changed to maintain the temperature of the hot wire as air flow increases. The ECM detects the air flow by means of this current change.

Removal & Installation

1. Disconnect the negative battery cable.
2. Remove the engine cover.
3. Disconnect the air flow sensor electrical connector.
4. For 2.0L engine, remove the air flow sensor retaining bolts.
   (Tighten: Air flow sensor retaining bolts to 5 N·m)



5. Pull sensor up and remove from the air cleaner case.
6. Installation is in the reverse order of removal.

Vehicle Speed Sensor

Description

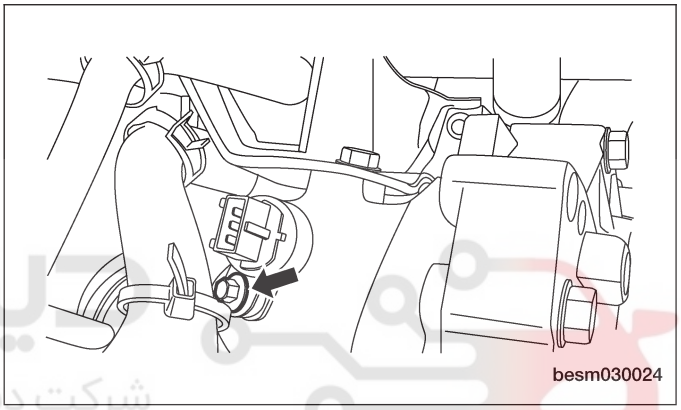
The vehicle speed sensor is mounted to the transaxle housing.

Operation

The vehicle speed sensor generates a signal the Engine Control Module (ECM) and the Transaxle Control Module (ECM) utilize to perform engine and transaxle functions.

Removal & Installation

1. Disconnect the negative battery cable.
2. Disconnect the vehicle speed sensor connector.
3. Remove the vehicle speed sensor mounting bolt. (Tighten: Vehicle speed sensor mounting bolt to 10 N·m)
4. Remove the vehicle speed sensor carefully.
5. Installation is in the reverse order of removal.



Accelerator Pedal Position Sensor

Description

The Accelerator Pedal Position (APP) sensor is located inside the accelerator pedal. The accelerator pedal position sensor can not be serviced by itself. The accelerator pedal must be replaced as a unit.

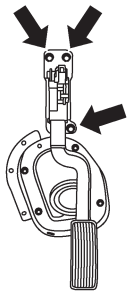
Operation

The accelerator pedal position (APP) sensor on the accelerator pedal works according to the Hall principal. the sensor is integrated into the pedal lever axis. It consists of a shaft with a ring magnet. This rotates in a printed circuit board with a stator in the fixed Hall elements. This produces a change in the voltage. The accelerator pedal position sensor is supplied with 5 volts from the Engine Control Module (ECM). The information regarding accelerator position is supplied to the ECM by means of two voltages.

Removal & Installation

1. Disconnect the negative battery cable.
2. Remove the instrument panel lower trim panel.

3. Disconnect the APP sensor electrical connector.
4. Remove the three APP sensor mounting bolts.
   (Tighten: APP sensor mounting bolts to 11 N·m)
5. Remove the APP sensor with the pedal.
6. Installation is in the reverse order of removal.



besm030021

Electronic Throttle Control Actuator

Description

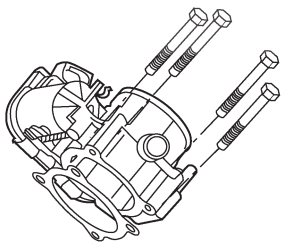
The throttle body is located on the intake manifold. The throttle body meters air into the intake manifold. Fuel does not enter the intake manifold through the throttle body. Fuel is sprayed into the manifold by the fuel injectors.

Operation

Filtered air from the air cleaner enters the intake manifold through the throttle body. A throttle valve (plate) is used to supply air for idle and driving conditions. The throttle position sensor is part the throttle body. The throttle position sensor signal is used by the ECM to determine throttle position. The ECM controls the electronic throttle control to meter air into the engine. This regulates engine power. The vehicle is in sense a “Drive by Wire” system.

Removal & Installation

1. Remove the engine cover.
2. Disconnect the negative battery cable.
3. Disconnect the electronic throttle control actuator connector.
4. Remove two pipes on electronic throttle control actuator.
5. Remove four electronic throttle control actuator mounting bolts.
   (Tighten: Electronic throttle control actuator bolts to 10 N·m)
6. Remove the throttle control actuator carefully.
7. Installation is in the reverse order of removal.



besm030022

Engine Control Module (ECM)

Description

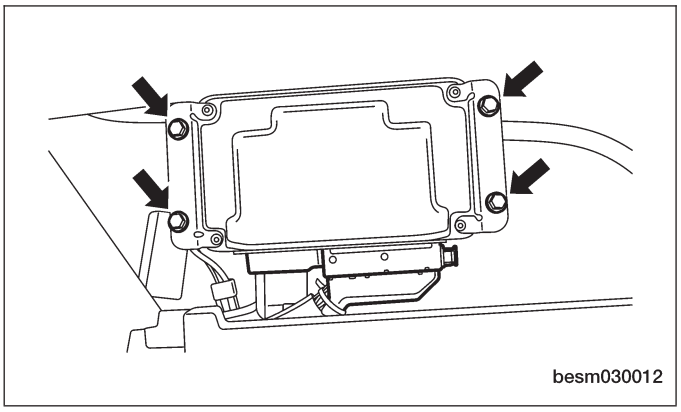
The Engine Control Module (ECM) for this model is serviced only as a complete unit.

Operation

The ECM is a pre-programmed, microprocessor-based digital computer. It regulates ignition timing, air-fuel ratio, emission control devices, charging system, certain transmission features, speed control, air conditioning compressor clutch engagement and idle speed. The ECM can adapt its programming to meet changing operating conditions.

Removal & Installation

1. Disconnect the negative battery cable.
2. Remove the glove box (See Glove Box Removal & Installation in Section 15 Body).
3. Disconnect the ECM electrical connector.
4. Remove the ECM retaining bolts.
   (Tighten: ECM retaining bolts to 6 N·m)
5. Remove the ECM.
6. Installation is in the reverse order of removal.



Installation Notes:

- Program the vehicle security feature whenever the ECM is replaced.

ENGINE SYMPTOM DIAGNOSIS

Symptom Diagnostic Tests

General Troubleshooting Checks

- Confirm the engine trouble light is working properly.
- Confirm that there is no failure information record checked by diagnostic meter.
- Confirm that the failure phenomenon exists according to the customers' complaints, and confirm the conditions causing the failure.

Visual Inspection

- Check if there is any fuel pipe is leaking.
- Check if the vacuum pipe is broken, kinked up or linked correctly.
- Check if the air intake pipe is jammed, leaking, staved or damaged.
- Check the high voltage line of ignition system if it is broken or aging and if the ignition order is correct.
- Check the cable grounding place if it is clean and fastness.
- Check the sensor and actuator joint if it is loosening or bad contact.

WARNING!

If the above phenomenon is appeared, you should repair the above the failure at first otherwise it will influence the later service.

Diagnostic Help

- Confirm there is no engine failure record.
- Confirm that the failure exists before the customer complaints.
- Inspect the engine according to the above steps and find nothing wrong.
- During the service please do not ignore the influence from vehicle maintenance, cylinder pressure, mechanical ignition timing and fuel conditions.
- Replace ECM and carry out test. If the failure is deleted, the failure is in ECM; if the failure can not be deleted, replace back to the original ECM and repeat the flow and check and repair it again.

Symptom Diagnostic Test List

SYMPTOM DEFINITION
Engine Cranks Normal But Will Not Start
Engine Will Not Crank
Hard Start / Long Crank Time
Fast Idle
Lack / Loss Of Power
Back Fires
Engine Poor Driveability
Low Idle / Stalls During Deceleration
Unique Idle Concern

Engine Cranks Normal But Will Not Start

The following conditions apply to this symptom:

- The engine cranks at normal speed.
- The engine will not start.
- The battery is fully charged.

Step 1.

Extended cranking because of a No Start can load the exhaust system with raw fuel, damaging the catalytic converter after the engine starts.

Carry out the following preliminary vehicle inspection:

- Fuel quality
- Electrical connections
- Intake air tube integrity
- Fuses and relays

Do the inspections checks OK?

Yes >> • Go to next step.

No >> • Repair as necessary. Verify symptom no longer exists.

Step 2.

Turn the ignition switch on.

With the X-431 scan tool, read the DTCs.

• ***Are any DTCs displayed on the scan tool?***

Yes >> • Check for cause (See Diagnostic Trouble Code (DTC) Index).

No >> • Go to the next step.

Step 3.

Attempt to start engine.

• ***Does the engine start now with the throttle closed?***

Yes >> • Verify symptom no longer exists.

No >> • Go to the next step.

Step 4.

Inspect the vehicles exhaust system for restriction.

• ***Is there a restriction in the exhaust system?***

Yes >> • Repair as required.

No >> • Go to the next step.

Step 5.

Perform a compression test on the vehicle engine.

• ***Is engine compression correct?***

Yes >> • Verify test results. If OK, see Diagnostic Index to repair any additional symptoms.

No >> • Check for cause.

Engine Will Not Crank

The following conditions apply to this symptom:

- The engine will not crank.

Step 1.

Carry out the following preliminary vehicle inspection:

- Battery connections
- Starter relay connections
- Automatic transmission in PARK or NEUTRAL
- Manual Transmission clutch fully depressed
- Engine anti-theft alarm activated
- Fuses/Fuse links

Do the inspections checks OK?

Yes >> • Go to the next step.

No >> • Repair as necessary. Verify symptom no longer exists.

Step 2.

Check for base engine concerns (such as seized/hydro-locked engine, damaged flywheel).

- ***Is a clicking sound heard from the starter relay when the ignition key is turned to START?***

Yes >> • Go to the next step.

No >> • Go to step 5.

Step 3.

Check the starter, starter ground, starter relay cable to starter and battery.

Is a fault indicated?

Yes >> • Repair as required.

No >> • Go to the next step.

Step 4.

Check the vehicle electrical system.

Do any other electrical accessories work?

Yes >> • Go to the next step.

No >> • Check the charging system.

Step 5.

Turn the ignition switch on.
With the X-431 scan tool, read the DTCs.

- ***Are any DTCs displayed on the scan tool?***

Yes >> • Check for cause.

No >> • Go to the next step.

Step 6.

Check the starting system primary circuits as follows:

- Check starter relay, brake interlock switch, ignition switch or other checks as directed.
- Check transmission linkage adjustment, TR sensor adjustment or other checks as directed.

Are components/systems OK?

Yes >> • Ensure customer's concern has been resolved.

No >> • Repair as required.

Hard Start / Long Crank Time

The following conditions apply to this symptom:

- The engine cranks for an extended period of time.
- The engine starts hard during a long cranking time.

Step 1.

Confirm that the correct starting procedure was used by the customer before proceeding with diagnosis.

Carry out the following preliminary checks:

- Vacuum leaks
- Fuel quality (concerns such as correct octane, contamination)
- Intake air system (tubes)
- Air cleaner (restrictions)
- Battery condition and starting voltage.

- ***Are all checks OK?***

Yes >> • Go to the next step.

No >> • Repair as necessary. Verify symptom no longer exists.

Step 2.

- Disconnect the injector fuse.
- Remove any of the 4 spark plugs.
- Connect the spark plug to high-tension lead.
- Fix the cathode shell of spark plug on the cylinder block.

Check the secondary ignition system while remove the spark plugs in turn as these steps.

- ***Is a strong blue spark visible at each spark plug while cranking engine?***

Yes >> • Go to the next step.

No >> • Check Camshaft Position (CMP) sensor signal at ECM.
- If CMP sensor is OK, check the following:
  - Crankshaft Position (CKP) sensor malfunction.
  - High tension leads.
  - Spark plugs.

Step 3.

Check fuel delivery system.

- Carry out fuel pressure check
  - 400 kPa (4 Bar)

- ***Is fuel pressure correct?***

Yes >> • Go to the next step.

No >> • If the fuel pressure is greater than 400 kPa (4 Bar):
- Install a new fuel pressure regulator.
  - If the fuel pressure is less than 400 kPa (4 Bar):
- Check fuel supply line for restriction or leak.
- If no problems are found, repair or replace fuel filter, pressure regulator or fuel pump assembly.

Step 4.

Check the exhaust system for restrictions.

- *Is there a restriction in the exhaust system?*

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 5.

- Check for possible engine overheating (hot start concern only).
- *For hot start concerns, does engine appear to be overheating?*

Yes >> • Repair the engine cooling system.

No >> • Go to the next step.

Step 6.

Check the Positive Crankcase Ventilation (PCV) system.
Remove PCV valve and shake it.

- *Does PCV valve rattle?*

Yes >> • Go to the next step.

No >> • Install a new PCV valve.

Step 7.

Check the evaporative emissions (EVAP) system.
Disconnect the evaporative hose.
Place a stiff piece of paper over the hose end, start engine.

- *Does vacuum hold the paper?*

Yes >> • Check for a vacuum leak in EVAP system (refer to EVAP system) and refer to EVAP control circuit relative DTCs.

No >> • Go to the next step.

Step 8.

Check the intake air system.
Check for MAP/IAT sensor.

- *Is there any contamination?*

Yes >> • Install a new MAP/IAT sensor.

No >> • See Diagnostic Help for additional information.

Fast Idle

The following conditions apply to this symptom:

- The engine idles at a higher than recommended speed.

Step 1.

Check the engine operating temperature.

- ***Does engine appear to be either overheating or not reaching normal operating temperature?***

Yes >> • Repair the engine cooling system.

No >> • Go to the next step.

Step 2.

Check the engine air intake system.

Carry out the following preliminary checks:

- Vacuum leaks
- Throttle plate and linkage
- Intake air tube (leaks)
- Correct sealing of intake manifold and components attached to intake air tube
- ***Are all checks OK?***

Yes >> • Go to the next step.

No >> • Repair as necessary. Verify symptom no longer exists.

Step 3.

Turn the ignition switch on.

With the X-431 scan tool, read the DTCs.

- ***Are any DTCs displayed on the scan tool?***

Yes >> • Check for cause.

No >> • See Diagnostic Help for additional information.

Lack/Loss Of Power

The following conditions apply to this symptom:

- The engine has poor performance.
- The engine has poor acceleration.

Step 1.

Verify symptom is reported under normal driving conditions without excessive engine/vehicle load conditions.

Be aware of the over rpm/speed limiting functions of the ECM.

Carry out the following preliminary checks:

- Vacuum lines (check for damage and correct routing).
- Intake air system (check for damaged tubes and dirty air filter).
- Vehicle wiring (disconnected, corroded/damaged).
- Throttle linkage.
- Radiator (obstructed).
- Transaxle.

Are all checks OK?

Yes >> • Go to the next step.

No >> • Repair as necessary. Verify symptom no longer exists.

Step 2.

Turn the ignition switch on.

With the X-431 scan tool, read the DTCs.

- ***Are any DTCs displayed on the scan tool?***

Yes >> • Check for cause.

No >> • Go to the next step.

Step 3.

Check fuel delivery system.

- Carry out fuel pressure check
  - 400 kPa (4 Bar)
- ***Is fuel pressure correct?***

Yes >> • Go to the next step.

No >> • If the fuel pressure is greater than 400 kPa (4 Bar):
- Install a new fuel pressure regulator.
  - If the fuel pressure is less than 400 kPa (4 Bar):
- Check fuel supply line for restriction or leak.
- If no problems are found, repair or replace fuel filter, pressure regulator or fuel pump assembly.

Step 4.

- Disconnect the injector fuse.
- Remove any of the 4 spark plugs.
- Connect the spark plug to high-tension lead.
- Fix the cathode shell of spark plug on the cylinder block.

Check the secondary ignition system while remove the spark plugs in turn as these steps.

- ***Is a strong blue spark visible at each spark plug while cranking engine?***

Yes >> • Go to the next step.

No >> • Check Camshaft Position (CMP) sensor signal at ECM.
• If CMP sensor is OK, check the following:
– Crankshaft Position (CKP) sensor malfunction.
– High tension leads.
– Spark plugs.

Step 5.

Check the intake air system.

Check for MAP/IAT sensor.

- ***Is there any contamination?***

Yes >> • Install a new MAP/IAT sensor.

No >> • Go to the next step.

Step 6.

Check the exhaust system for restrictions.

- ***Is there a restriction in the exhaust system?***

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 7.

Check for base engine concerns (such as improper cylinder compression, worn camshaft/valve train, gasket leaks).

- ***Is a fault indicated?***

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 8.

Check the automatic transaxle operation.

- ***Is automatic transmission OK?***

Yes >> • Go to the next step.

No >> • Repair as necessary.

Step 9.

Check the brake system operation.

- *Is a fault indicated?*

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 10.

Additional checks:

- Customer driving habits (such as excessive loads or over rpm/speed limiting functions enabled).
- Ignition base timing (if not previously checked).
- Clutch (M/T).
- Charging system.
- Additional checks:
- *Are all checks OK?*

Yes >> • See Diagnostic Help for additional information.

No >> • Repair as necessary. Verify symptom no longer exists.

Back Fires

The following conditions apply to this symptom:

- The engine will back fire when operated.
- The engine back fire occurs at all operating parameters.

Step 1.

Carry out the following preliminary checks:

- Vacuum lines (check for damage and correct routing).
- Spark plug wire routing (correct firing order).
-

- *Are all checks OK?*

Yes >> • Go to the next step.

No >> • Repair as necessary. Verify symptom no longer exists.

Step 2.

Turn the ignition switch on.

With the X-431 scan tool, read the DTCs.

- *Are any DTCs displayed on the scan tool?*

Yes >> • Check for cause.

No >> • Go to the next step.

Step 3.

- Disconnect the injector fuse.
- Remove any of the 4 spark plugs.
- Connect the spark plug to high-tension lead.
- Fix the cathode shell of spark plug on the cylinder block.

Check the secondary ignition system while remove the spark plugs in turn as these steps.

- *Is a strong blue spark visible at each spark plug while cranking engine?*

Yes >> • Go to the next step.

No >> • Check Camshaft Position (CMP) sensor signal at ECM.
• If CMP sensor is OK, check the following:
– Crankshaft Position (CKP) sensor malfunction.
– High tension leads.
– Spark plugs.

Step 4.

Check fuel quality (concerns such as correct octane, contamination).

Is the fuel quality OK?

Yes >> • Go to the next step.

No >> • Replace as necessary. Verify symptom no longer exists.

Step 5.

Check knock sensor.

Is the check result normal?

Yes >> • Go to the next step.

No >> • Replace as necessary. Verify symptom no longer exists.

Step 6.

Check if the timing misalignment.

Yes >> • Go to the next step.

No >> • Align the engine timing belt (refer to 02 - engine timing belt ″removal and installation″ steps).

Step 7.

Check fuel delivery system.

- Carry out fuel pressure check
  - 400 kPa (4 Bar)
- ***Is fuel pressure correct?***

Yes >> • Go to the next step.

No >> • If the fuel pressure is greater than 400 kPa (4 Bar):
- Install a new fuel pressure regulator.
  - If the fuel pressure is less than 400 kPa (4 Bar):
- Check fuel supply line for restriction or leak.
- If no problems are found, repair or replace fuel filter, pressure regulator or fuel pump assembly.

Step 8.

Check for base engine concerns (such as improper cylinder compression, worn camshaft/valve train, gasket leaks).

- ***Is a fault indicated?***

Yes >> • Repair as necessary.

No >> • See Diagnostic Help for additional information.

Engine Poor Driveability

The following conditions apply to this symptom:

- Engine stalls/quits engine runs rough misses buck/jerk hesitation/stumble acceleration surges rolling idle.
- Engine stops unexpectedly at beginning of acceleration or during acceleration.
- Engine stops unexpectedly while cruising.
- Engine speed fluctuates during acceleration.
- Engine misses during acceleration.
- Vehicle bucks/jerks during acceleration, cruising or deceleration.
- Momentary pause at beginning of acceleration or during acceleration.
- Momentary minor irregularity in engine output.

Step 1.

Be aware of the over rpm/speed limiting functions of the ECM.

Carry out the following preliminary checks:

- Vacuum lines (check for damage and correct routing).
- Intake air system (check for damaged tubes and dirty air filter).
- Vehicle wiring (disconnected, corroded/damaged).
- Throttle linkage.
- Radiator (obstructed).
- Transmission.

Are all checks OK?

Yes >> • Go to the next step.

No >> • Repair as necessary. Verify symptom no longer exists.

Step 2.

Check for engine stall at idle (Park / Neutral).

- ***Does the engine now stall at idle in Park / Neutral?***

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 3.

Check for engine rough idle (Park / Neutral).

- ***Does the engine idle rough in Park / Neutral?***

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 4.

Turn the ignition switch on.

With the X-431 scan tool, read the DTCs.

- ***Are any DTCs displayed on the scan tool?***

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 5.

Check the Electronic Throttle Control (ETC).

- Start engine and let idle.
- While checking for rpm drop or engine stall, disconnect ETC connector.
- After testing turn key off and reconnect ETC connector.

Did rpm drop or engine stall when the ETC connector was disconnected?

Yes >> • Go to the next step.

No >> • Repair as necessary.

Step 6.

- Disconnect the injector fuse.
- Remove any of the 4 spark plugs.
- Connect the spark plug to high-tension lead.
- Fix the cathode shell of spark plug on the cylinder block.

Check the secondary ignition system while remove the spark plugs in turn as these steps.

- ***Is a strong blue spark visible at each spark plug while cranking engine?***

Yes >> • Go to the next step.

No >> • Check Camshaft Position (CMP) sensor signal at ECM.
- If CMP sensor is OK, check the following:
  - Crankshaft Position (CKP) sensor malfunction.
  - High tension leads.
  - Spark plugs.

Step 7.

Check fuel delivery system.

- Carry out fuel pressure check
  - 400 kPa (4 Bar)

- ***Is fuel pressure correct?***

Yes >> • Go to the next step.

No >> • If the fuel pressure is greater than 400 kPa (4 Bar):
- Install a new fuel pressure regulator.
  - If the fuel pressure is less than 400 kPa (4 Bar):
- Check fuel supply line for restriction or leak.
- If no problems are found, repair or replace fuel filter, pressure regulator or fuel pump assembly.

Step 8.

Check the exhaust system for restrictions.

- ***Is there a restriction in the exhaust system?***

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 9.

Check the Positive Crankcase Ventilation (PCV) system.
Remove PCV valve and shake it.

- *Is PCV valve normal?*

Yes >> • Go to the next step.
No >> • Install a new PCV valve.

Step 10.

Check the evaporative emissions system (EVAP).
Start the engine and bring to normal operating temperature.
Disconnect the crankcase ventilation hose.
Place a stiff piece of paper over the hose end.

- *Does vacuum hold the paper?*

Yes >> • Go to the next step.
No >> • Check for a vacuum leak in positive crankcase ventilation (PCV) system, oil fill, PCV valve, rocker cover for bolt/torque/ gasket leak.

Step 11.

- Check engine compression.
- *Is engine compression correct?*

Yes >> • Go to the next step.
No >> • Repair as necessary.

Step 12.

Check the engine air intake system.
Carry out the following preliminary checks:

- Vacuum leaks
- Throttle plate and linkage
- Intake air tube (leaks)
- Correct sealing of intake manifold and components attached to intake air

- *Are all checks OK?*

Yes >> • Go to the next step.
No >> • Repair as necessary. Verify symptom no longer exists.

Step 13.

- Additional checks:
  - Driveline.
  - Transmission/clutch (M/T).
  - Charging system.
  - A/C system (for surge with A/C on).
  - A/C compressor diode (for rolling idle and/or stumble when A/C cycles on).
- ***Are the checks OK?***

Yes >> • See Diagnostic Help for additional information.

No >> • Repair as necessary.

Low Idle / Stalls During Deceleration

The following conditions apply to this symptom:

- Engine stops unexpectedly at beginning of deceleration or recovery from deceleration.

Step 1.

Carry out the following preliminary checks:

- Vacuum lines (routing, leaks).
- Intake air tubes.
- Wiring connections.

Are all checks OK?

Yes >> • Go to the next step.

No >> • Repair as necessary. Verify symptom no longer exists.

Step 2.

•

• ***Does the engine idle rough?***

Yes >> • See Engine Poor Driveability.

No >> • Go to the next step.

Step 3.

Check the Electronic Throttle Control (ETC).

- Start engine and let idle.
- While checking for rpm drop or engine stall, disconnect ETC connector.
- After testing turn key off and reconnect ETC connector.

Did rpm drop or engine stall when the ETC connector was disconnected?

Yes >> • Go to the next step.

No >> • Repair as necessary.

Step 4.

Check the clutch operation.

Check for clutch always applied.

Is the transmission OK?

Yes >> • Go to the next step.

No >> • Repair as necessary.

Step 5.

Start engine.

Cycle A/C switch from on to off (verify A/C clutch engages condition).

Check the A/C system operation.

Does the A/C system operate normally?

Yes >> • Go to the next step.

No >> • Repair as necessary.

Step 6.

Turn the ignition switch off.

Check fuel delivery system.

- Carry out fuel pressure check
  - 400 kPa (4 Bar)
- *Is fuel pressure correct?*

Yes >> • Go to the next step.

No >> • If the fuel pressure is greater than 400 kPa (4 Bar):
- Install a new fuel pressure regulator.
  - If the fuel pressure is less than 400 kPa (4 Bar):
- Check fuel supply line for restriction or leak.
- If no problems are found, repair or replace fuel filter, pressure regulator or fuel pump assembly.

Step 7.

Check for base engine concerns (such as improper compression, worn camshaft/valve train, gasket leaks).

- *Is a fault indicated?*

Yes >> • Repair as necessary.

No >> • See Diagnostic Help for additional information.

Idle Speed is not Steady

The following conditions apply to this symptom:

- Slow return to idle.

Step 1.

Carry out the following preliminary checks:

- Vacuum leaks
- Throttle linkage
- Intake air system
- Throttle body

Are all the checks OK?

Yes >> • Go to the next step.

No >> • Repair as necessary. Verify symptom no longer exists.

Step 2.

Turn the ignition switch on.

With the X-431 scan tool, read the DTCs.

• ***Are any DTCs displayed on the scan tool?***

Yes >> • Repair as necessary.

No >> • Go to the next step.

Step 3.

Check the Positive Crankcase Ventilation (PCV) system.

Remove PCV valve and shake it.

• ***Is PCV valve normal?***

Yes >> • Go to the next step.

No >> • Install a new PCV valve.

Step 4.

Start the engine and bring to normal operating temperature.

Disconnect the crankcase ventilation hose.

Place a stiff piece of paper over the hose end.

• ***Does vacuum hold the paper?***

Yes >> • Go to the next step.

No >> • Check for a vacuum leak in positive crankcase ventilation (PCV) system, oil fill, PCV valve, rocker cover for bolt/torque/ gasket leak.

IGNITION CONTROL

GENERAL INFORMATION

Description

The electronic ignition system consists of the following components:

- Engine Control Module (ECM)
- Ignition Coil
- Spark Plugs
- Spark Plug Wires
- Camshaft Position (CMP) Sensor
- Crankshaft Position (CKP) Sensor

Operation

The ignition coil is split and each side supplies voltage to two cylinders. When the ignition coil discharges, two spark plugs fire at the same time. The ignition coil will discharge properly, based on the Crankshaft Position Sensor and the Camshaft Position Sensor.

The ignition coil consists of a primary and secondary coil winding. The primary side of the coil is connected to the Engine Control Module (ECM) connection. The secondary coil connects to the spark plugs, providing a high-voltage output.

Specifications

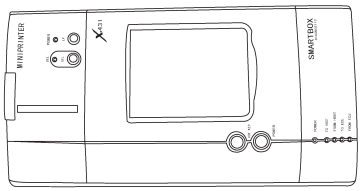
Torque Specifications

DESCRIPTION	TORQUE (N·m)
Spark Plugs	30
Ignition Coil Bolts	6

Spark Plug Specifications

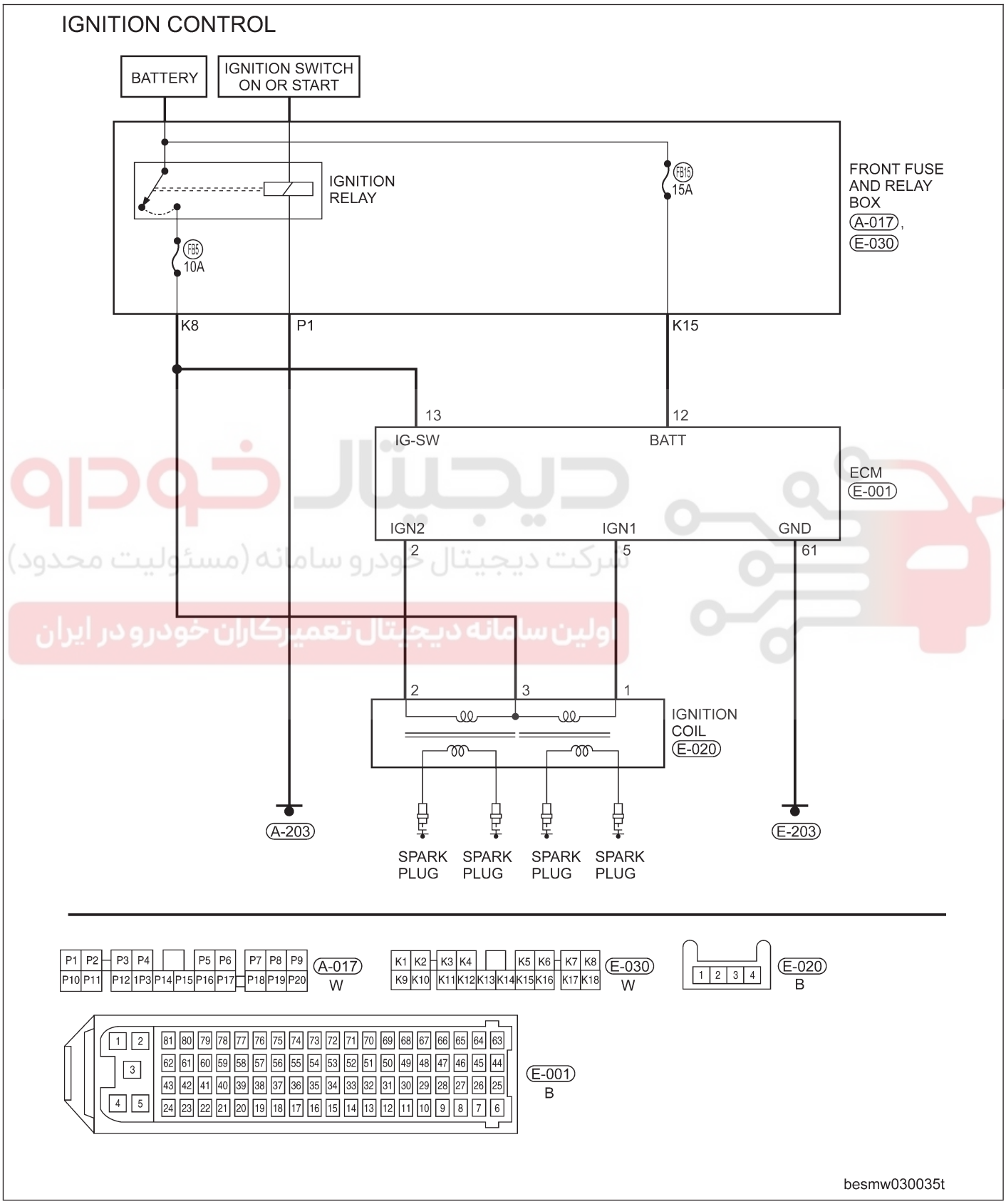
DESCRIPTION	GAP (mm)
FR7DTC	0.7 - 1.1

Special Tools

Diagnostic Scan ToolX-431	 besm030001

Electrical Schematic

Ignition Control System (Page 1 of 1)



ON-VEHICLE SERVICE

Ignition Coil

Description

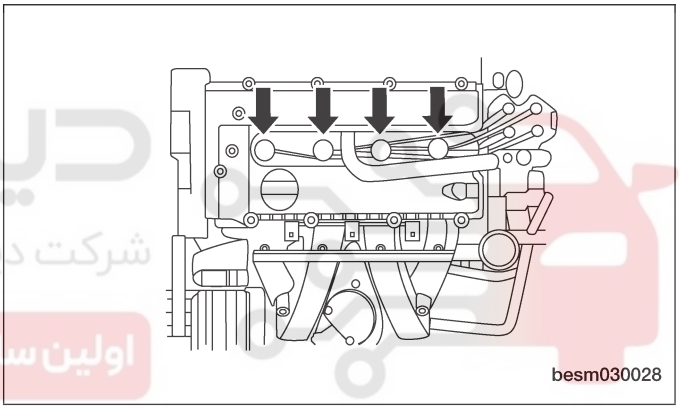
The ignition coil consists of primary and secondary coil windings. The primary side of the coil is connected to the Engine Control Module (ECM) connection. The secondary coil, providing high-voltage output, connects to the spark plugs.

Operation

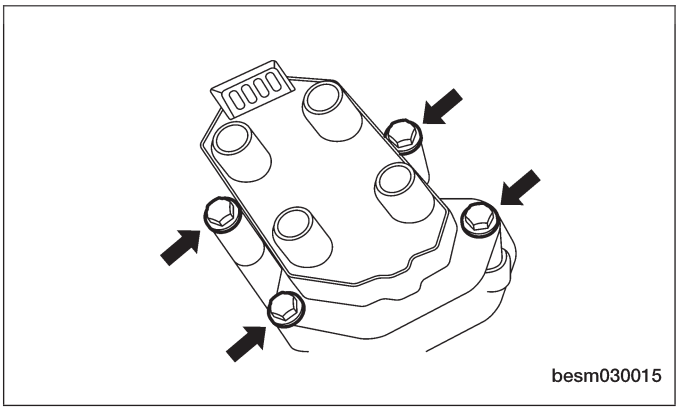
When the primary coil is connected to power, a strong magnetic field is produced. This magnetic field also surrounds the coils secondary windings. When the current to the primary coil is interrupted, the magnetic field collapses rapidly and discharges into the secondary windings. The secondary coil then provides a high-voltage output to the spark plugs.

Removal & Installation

1. Remove the engine cover.
2. Disconnect the negative battery cable.
3. Disconnect the ignition coil electrical connector.
4. Twist the spark plug wires from the ignition coil and remove the four spark plug wires.



5. Remove the 4 ignition coil retaining bolts.
   (Tighten: Ignition coil retaining bolts to 6 N·m)

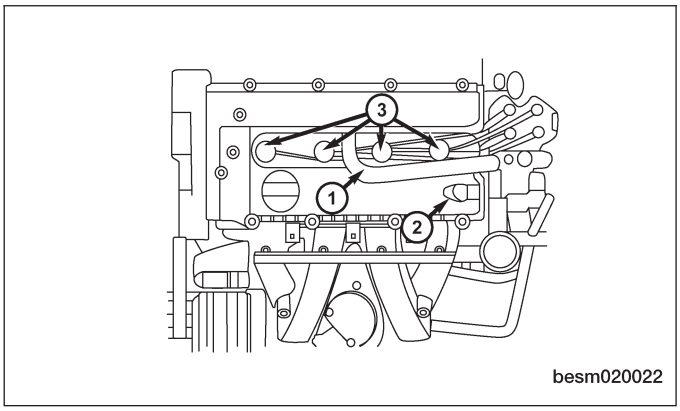


6. Remove the ignition coil.
7. Installation is in the reverse order of removal.

Spark Plug Wire

Removal & Installation

1. Remove the engine cover.
2. Disconnect the negative battery cable.
3. Remove the hose (1), if necessary.
4. Disconnect the ignition coil electrical connector, if necessary.
5. Twist the spark plug wire (3) from the ignition coil and remove the spark plug wire.
6. Twist the spark plug wire (3) from spark plug then pull the spark plug wire straight up.



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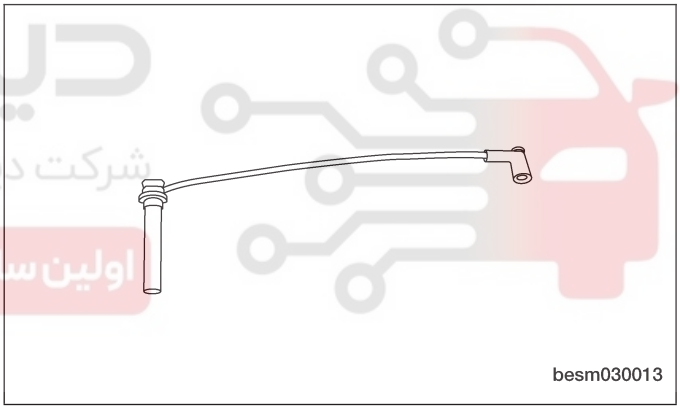
7. Remove the spark plug wire.
8. Installation is in the reverse order of removal.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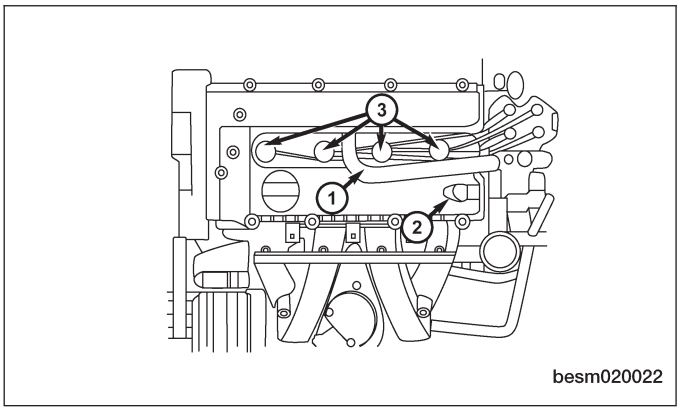
Spark Plug Wire Identification Chart

Cylinder Number	1	2	3	4
Part Number	A11-3707130HA	A11-3707140HA	A11-3707150HA	A11-3707160HA
Length (mm)	405	275	165	125
Resistance (KΩ)	6.99-12.08	5.32-9.59	3.92-7.48	3.4-6.71

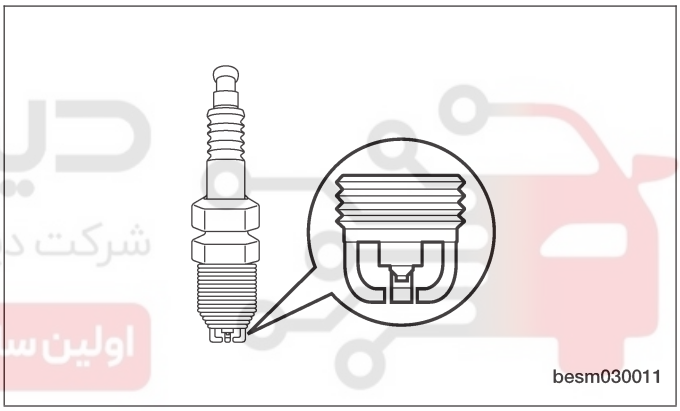
Spark Plug

Removal & Installation

1. Remove the engine cover.
2. Disconnect the negative battery cable.
3. Remove the hose (1), if necessary.
4. Twist the spark plug wire (3) from the spark plug then pull the spark plug wire straight up.



5. Remove the spark plug.
   (Tighten: Spark plugs to 30 N·m)
6. Inspect the spark plug condition.
7. Installation is in the reverse order of removal.



Installation Notes:

- Verify the proper spark plug gap before installing spark plugs.

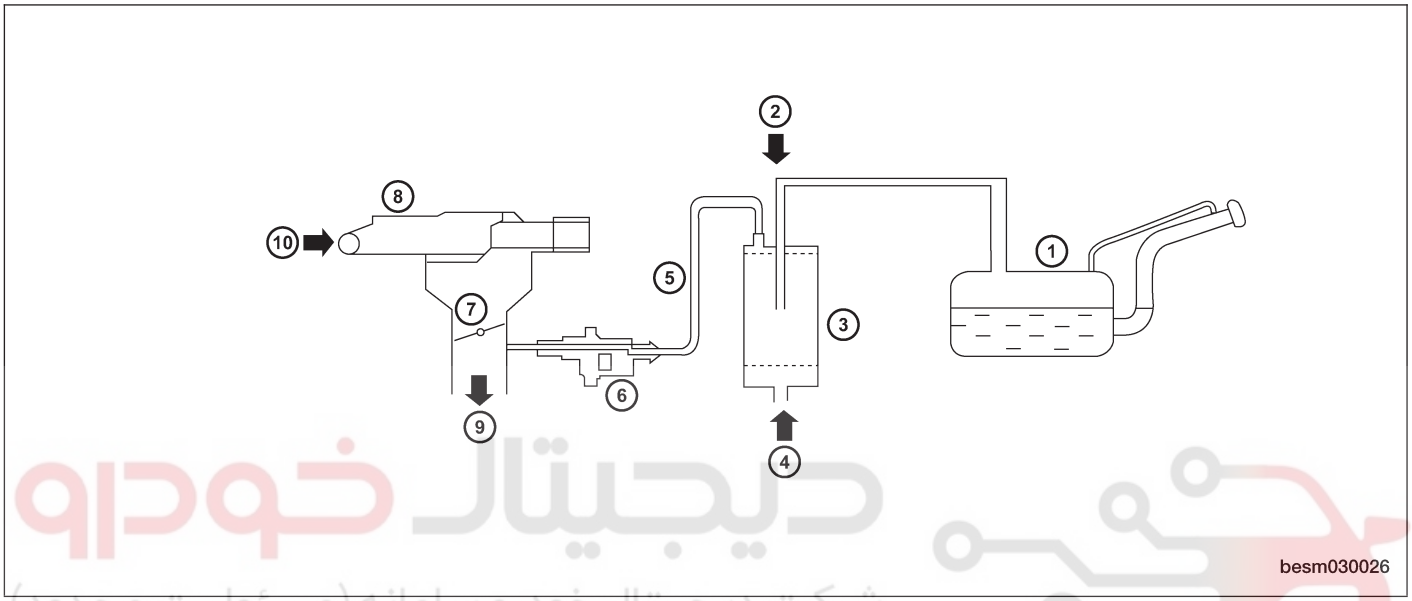
EVAPORATIVE EMISSIONS

GENERAL INFORMATION

Description

The evaporation control system prevents the emission of fuel tank vapors into the atmosphere. When fuel evaporates in the fuel tank, the vapors pass through vent hoses or tubes to an activated carbon filled evaporative canister. The canister temporarily holds the vapors. The Engine Control Module (ECM) allows the intake manifold vacuum to draw vapors into the combustion chambers during certain operating conditions.

Operation



1-Fuel Tank	2-Fuel Vapor	7-Throttle Valve	8-Air Filter Assembly
3-Canister	4-Air Intake	9-To Engine	10-Air Intake
5-Hose	6-Canister Control Valve		

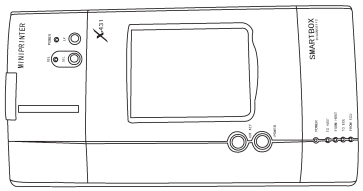
The ECM will only energize the solenoid when the engine is at operating temperature, but will de-energize it during periods of deceleration. When de-energized, no vapors are purged. The pulse-width modulated canister control valve modulates the fuel vapor purge rate from the vapor canister and fuel tank to the engine intake manifold.

Specifications

Torque Specifications

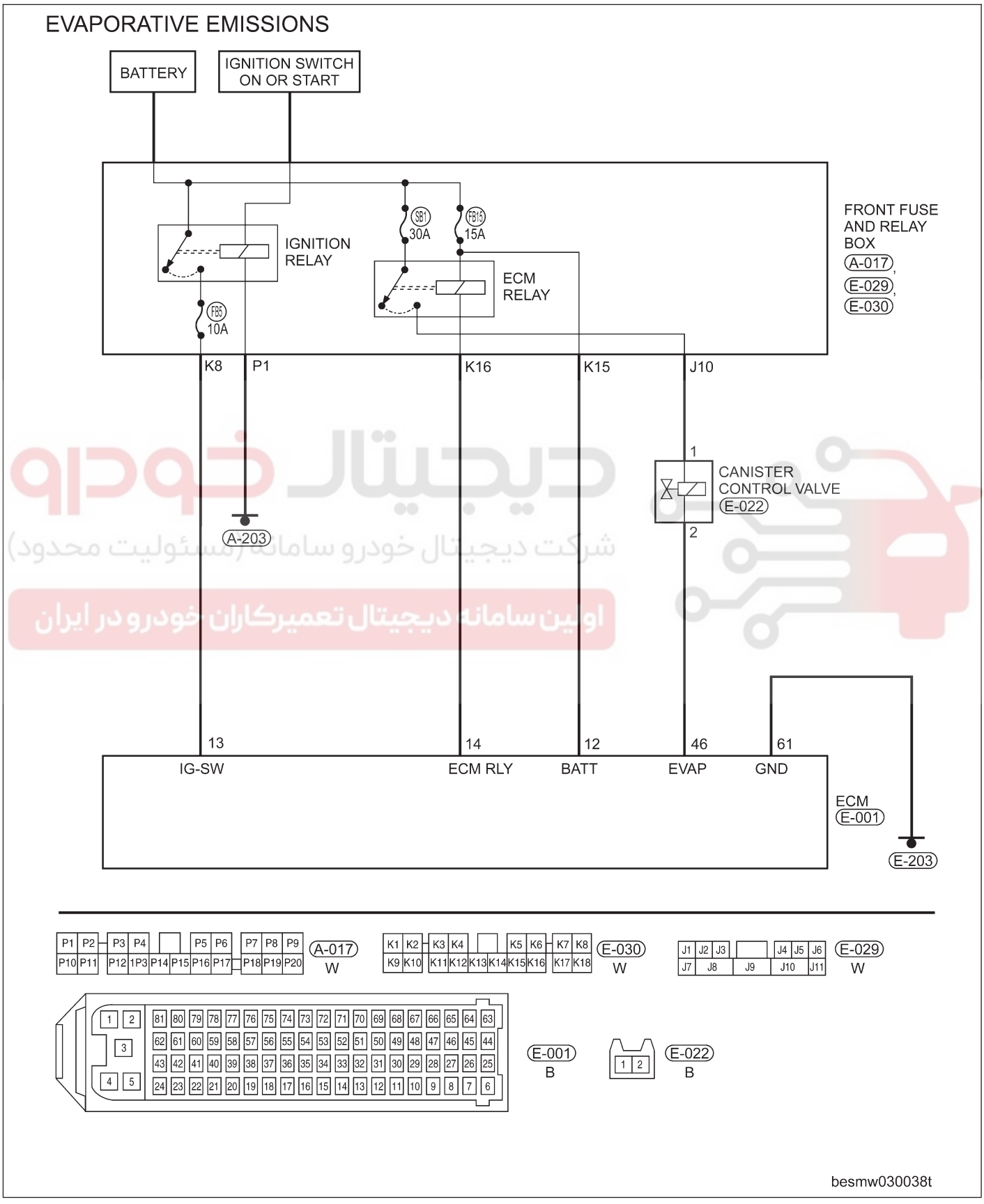
DESCRIPTION	TORQUE (N·m)
Vapor Canister Bolts	10

Special Tools

Diagnostic Scan ToolX-431	 besm030001

Electrical Schematic

Evaporative Emissions System (Page 1 of 1)



ON-VEHICLE SERVICE

Canister Control Valve

Description

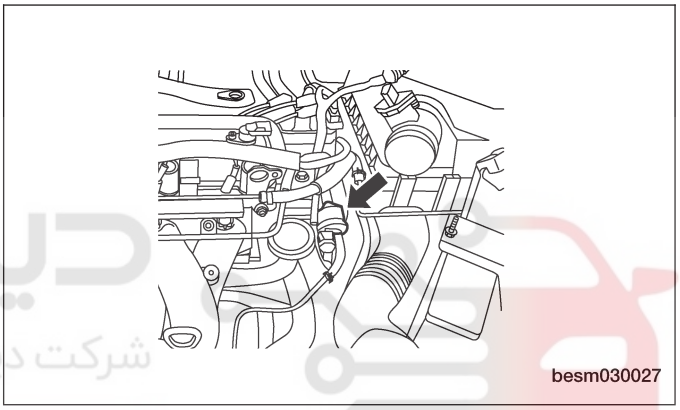
This vehicle uses a pulse-width modulated canister control valve. The canister control valve regulates the rate of vapor flow from the vapor canister to the throttle body. The Engine Control Module (ECM) controls the frequency at which the canister control valve operates in order to accommodate the vapor volume for each cylinder.

Operation

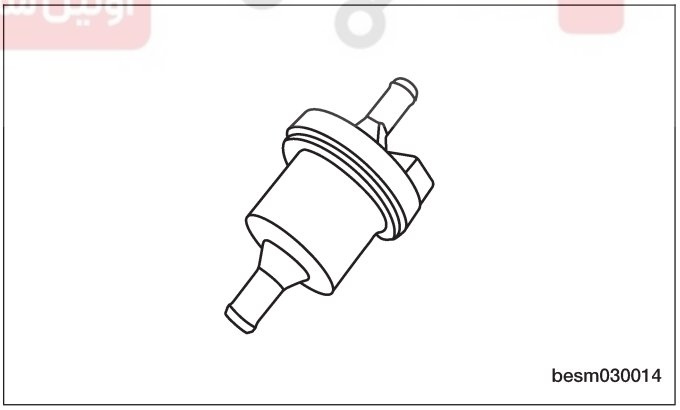
The canister control valve is installed near the engine air filter. The Engine Control Module (ECM) controls the opening and closing of the canister control valve. When the ECM relay is energized, the canister control valve switches from closed to open.

Removal & Installation

1. Disconnect the negative battery cable.
2. Disconnect the canister control valve electrical connector .
3. Disconnect the lines from canister control valve.


besm030027

4. Remove canister control valve from the bracket.
5. Installation is in the reverse order of removal.


besm030014

Vapor Canister

Description

The vapor canister is located on the LH-side of core support and is filled with activated carbon granules.

Operation

This vehicle uses a vapor canister filled with activated carbon granules. Fuel tank vapors are vented into the canister where they are absorbed by the activated carbon granules. The canister temporarily holds the fuel vapors until the intake manifold vacuum draws them back into the engine. The Engine Control Module (ECM) purges the canister

through the pulse-width modulated canister control valve. The ECM purges the canister at predetermined intervals and engine conditions.

Diagnosis & Testing

1. Disconnect the air intake hose and plug the air intake hole.
2. Apply air pressure into the fuel stream intake hose. Verify the air can flow freely through the hose.
3. Make sure the vapor canister is not be plugged or leaking.

Removal & Installation

1. Raise and support the vehicle.
2. Remove the two hoses at the vapor canister (2).
3. Remove the vapor canister retaining bolts (1).
   (Tighten: Vapor canister retaining bolts to 10 N·m)
4. Pull canister rearward to remove.
5. Installation is in the reverse order of removal.