

ENGINE

Engine Control System (4JH1)

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6E-2 Engine Control System (4JH1)

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Specifications

Temperature vs Resistance

Engine Coolant Temperature vs. Resistance

°C	°F	Ω
Temperature vs. Resistance Value (Approximately)		
120	248	120
110	230	160
100	212	200
90	194	260
80	176	350
70	158	470
60	140	640
50	122	880
40	104	1250
30	86	1800
20	68	2650
10	50	4000
0	32	6180
-10	14	9810
-20	-4	16000
-30	-22	27000

Intake Air Temperature vs. Resistance

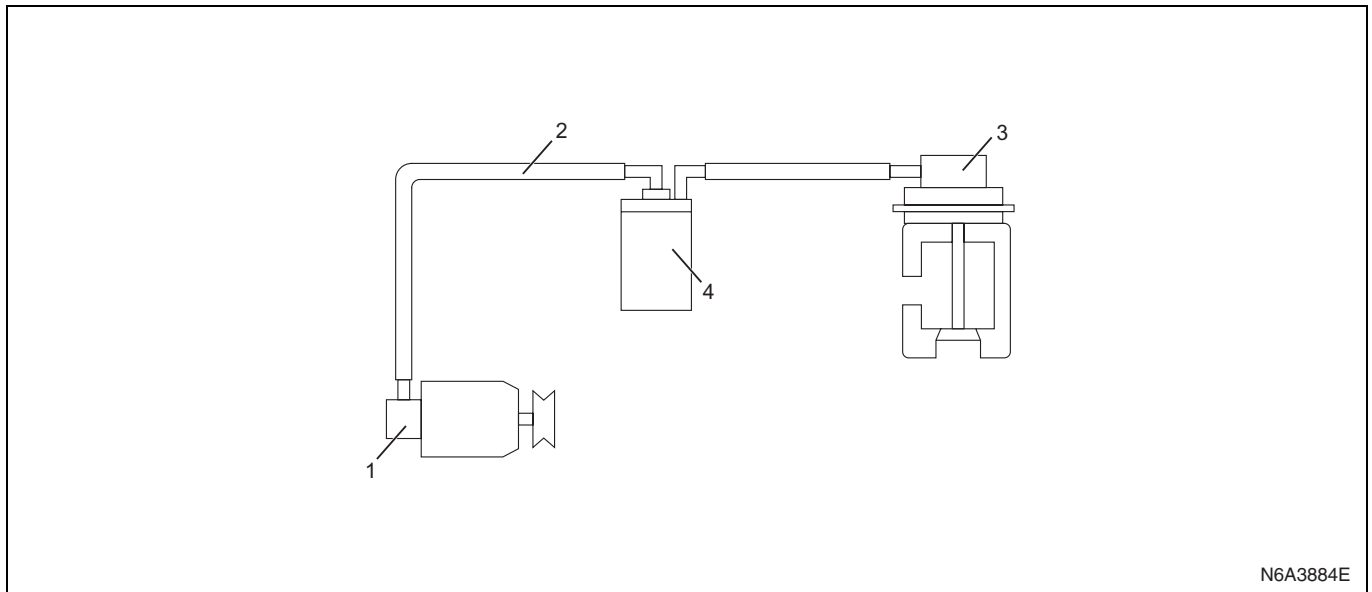
°C	°F	Ω
Temperature vs. Resistance Value (Approximately)		
100	212	190
90	194	240
80	176	320
70	158	430
60	140	590
50	122	810
40	104	1150
30	86	1650
25	77	2000
20	68	2430
10	50	3660
0	32	5650
-10	14	8970
-20	-4	14700

Altitude vs Barometric Pressure

Altitude Measured in Meters (m)	Altitude Measured in Feet (ft)	Barometric Pressure Measured in Kilopascals (kPa)
Determine your altitude by contacting a local weather station or by using another reference source.		
4267	14000	56-64
3962	13000	58-66
3658	12000	61-69
3353	11000	64-72
3048	10000	66-74
2743	9000	69-77
2438	8000	71-79
2134	7000	74-82
1829	6000	77-85
1524	5000	80-88
1219	4000	83-91
914	3000	87-98
610	2000	90-98
305	1000	94-102
0	0 Sea Level	96-104
-305	-1000	101-105

Schematic and Routing Diagrams

Vacuum Hose Routing Diagram

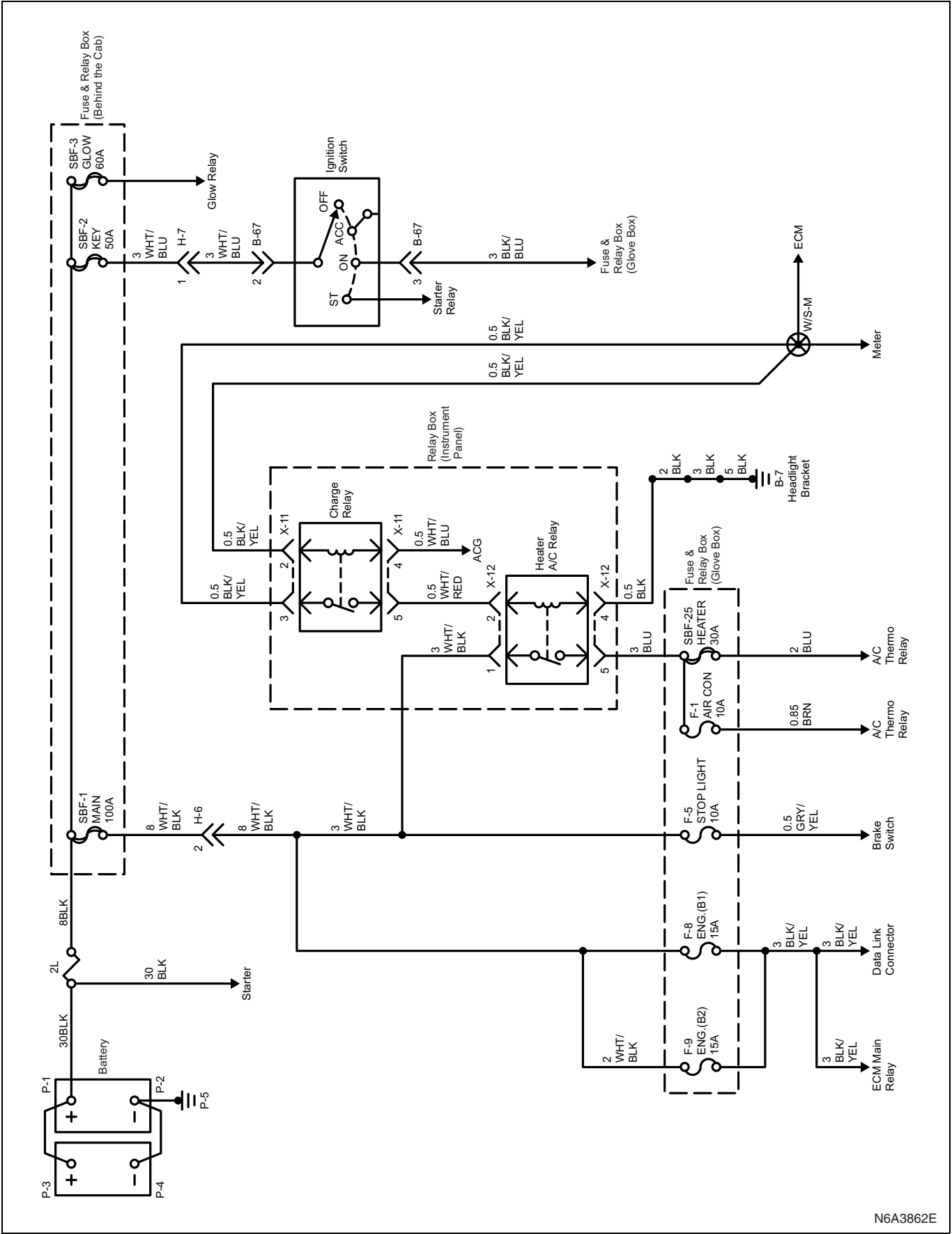


Legend

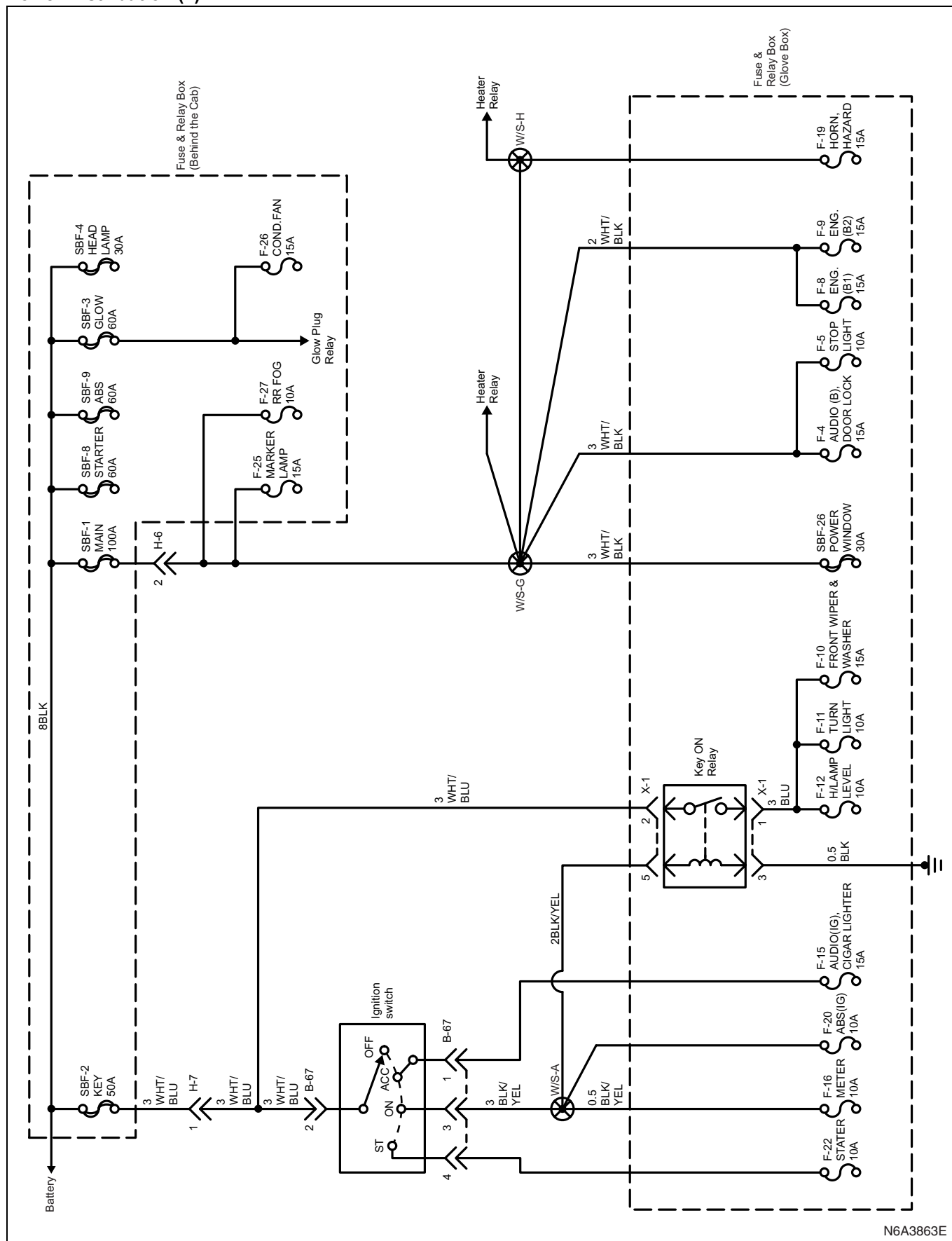
- | | |
|------------------------------|-----------------------|
| 1. Vacuum Pump (part of ACG) | 3. EGR Valve |
| 2. Vacuum Hose | 4. EGR Solenoid Valve |
-

Engine Controls Schematics

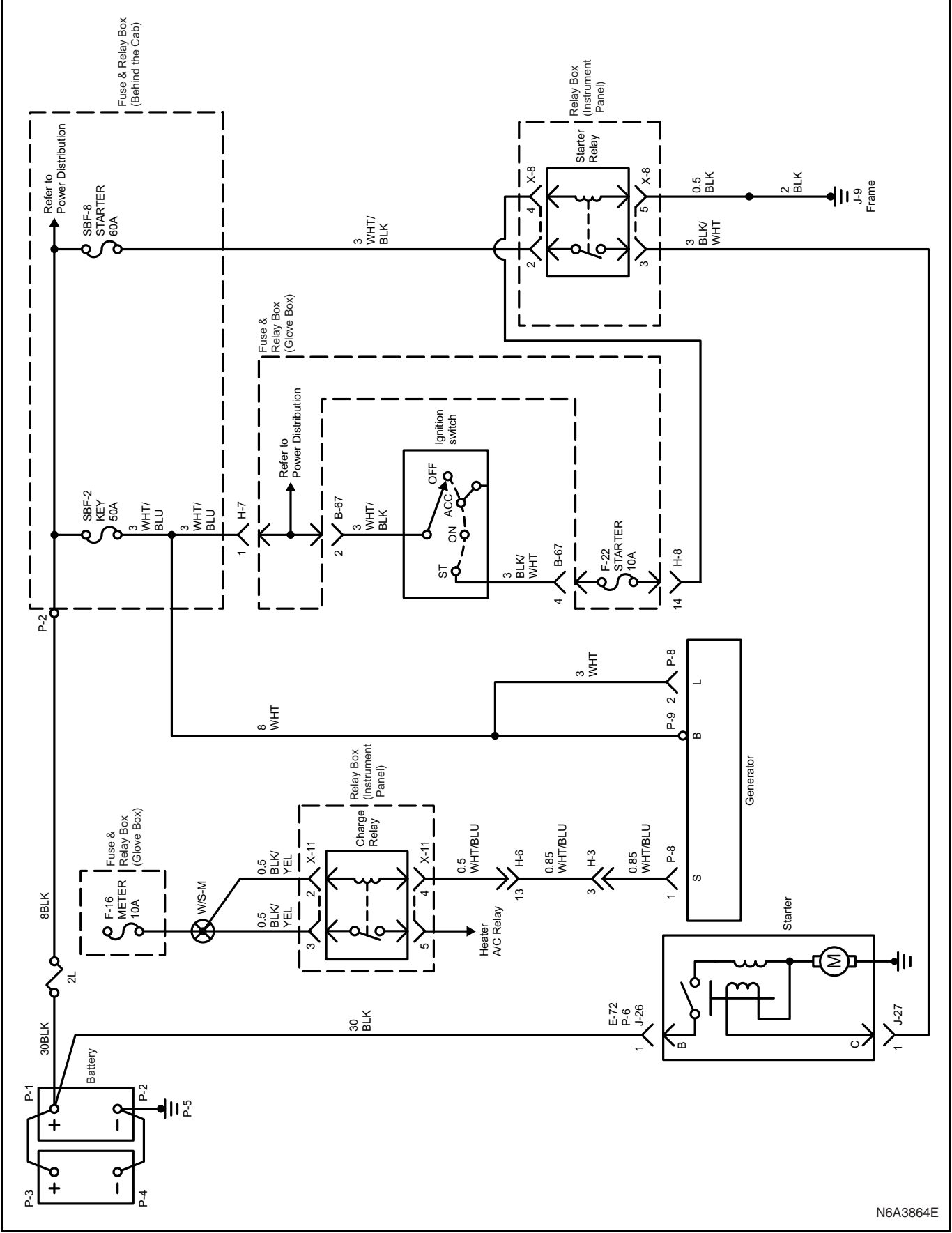
Power Distribution (1)

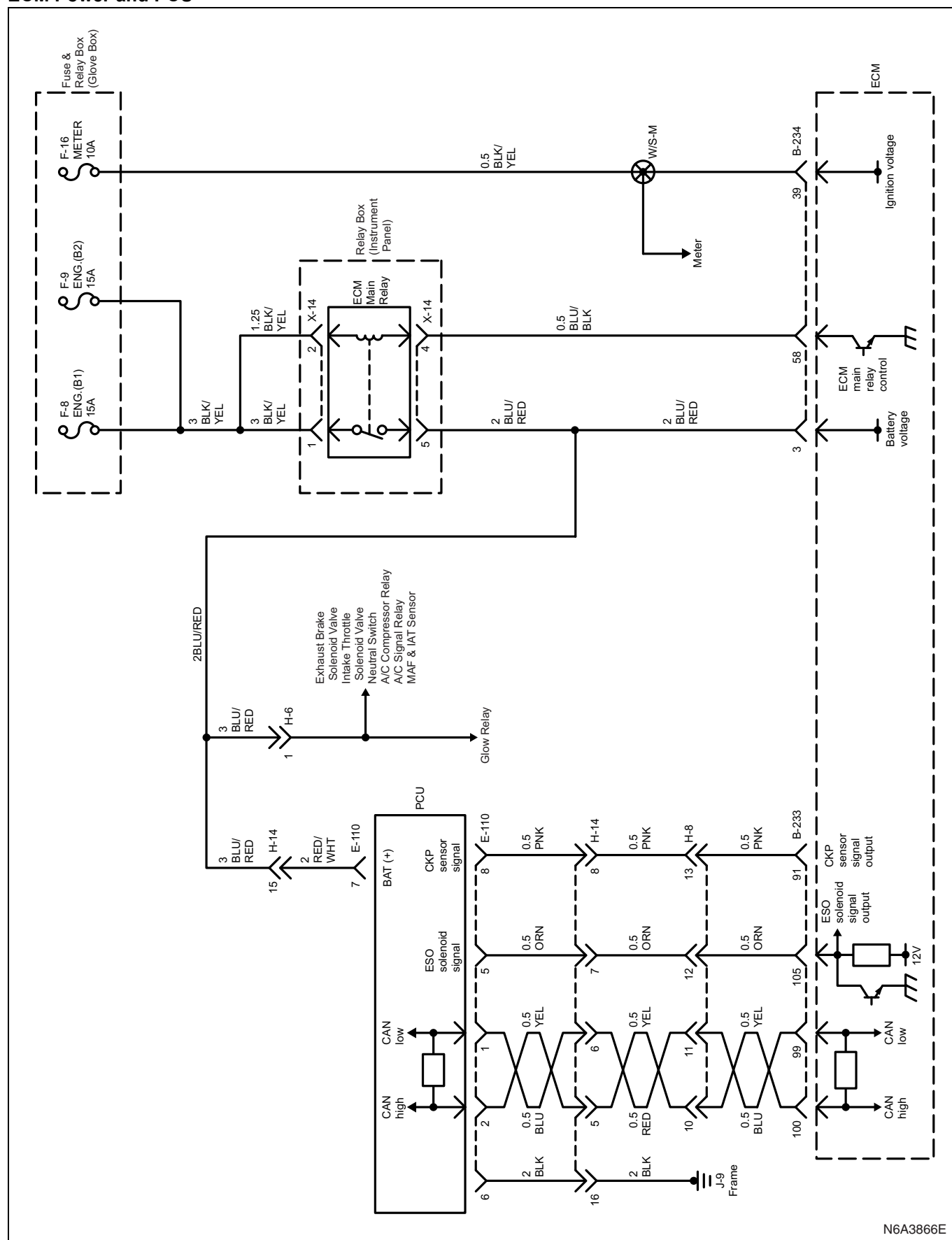


Power Distribution (2)

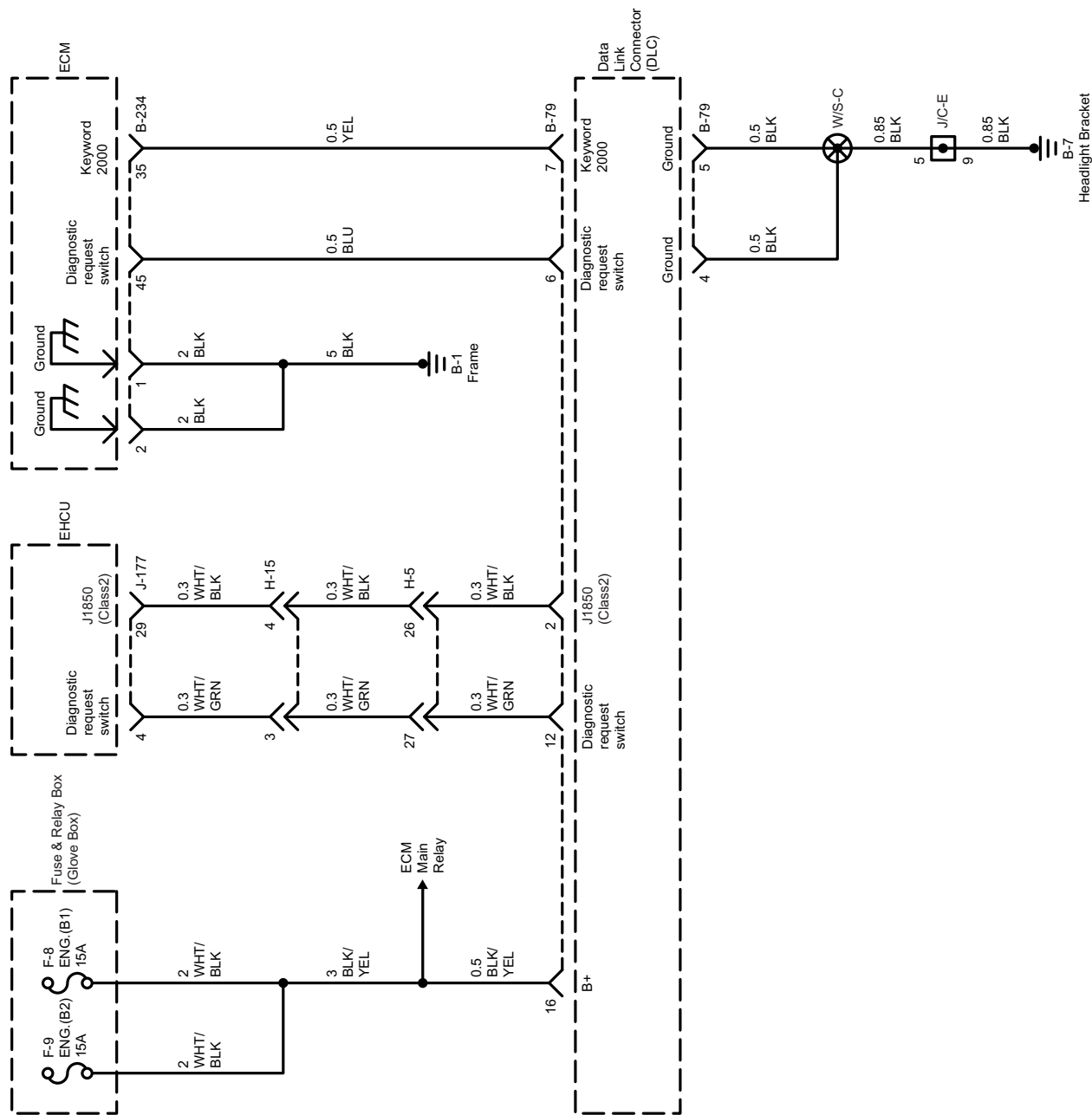


Starting and Charging System

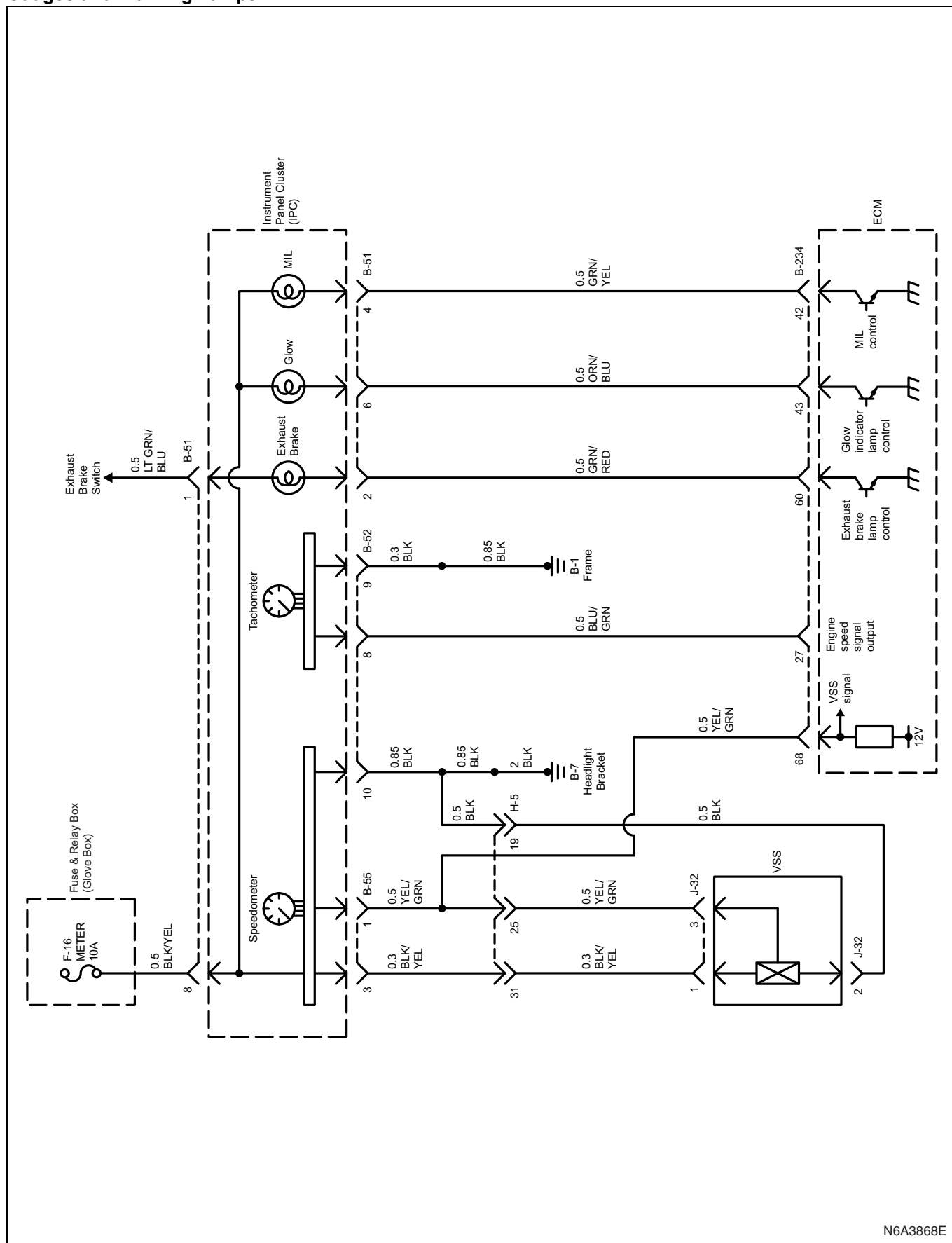




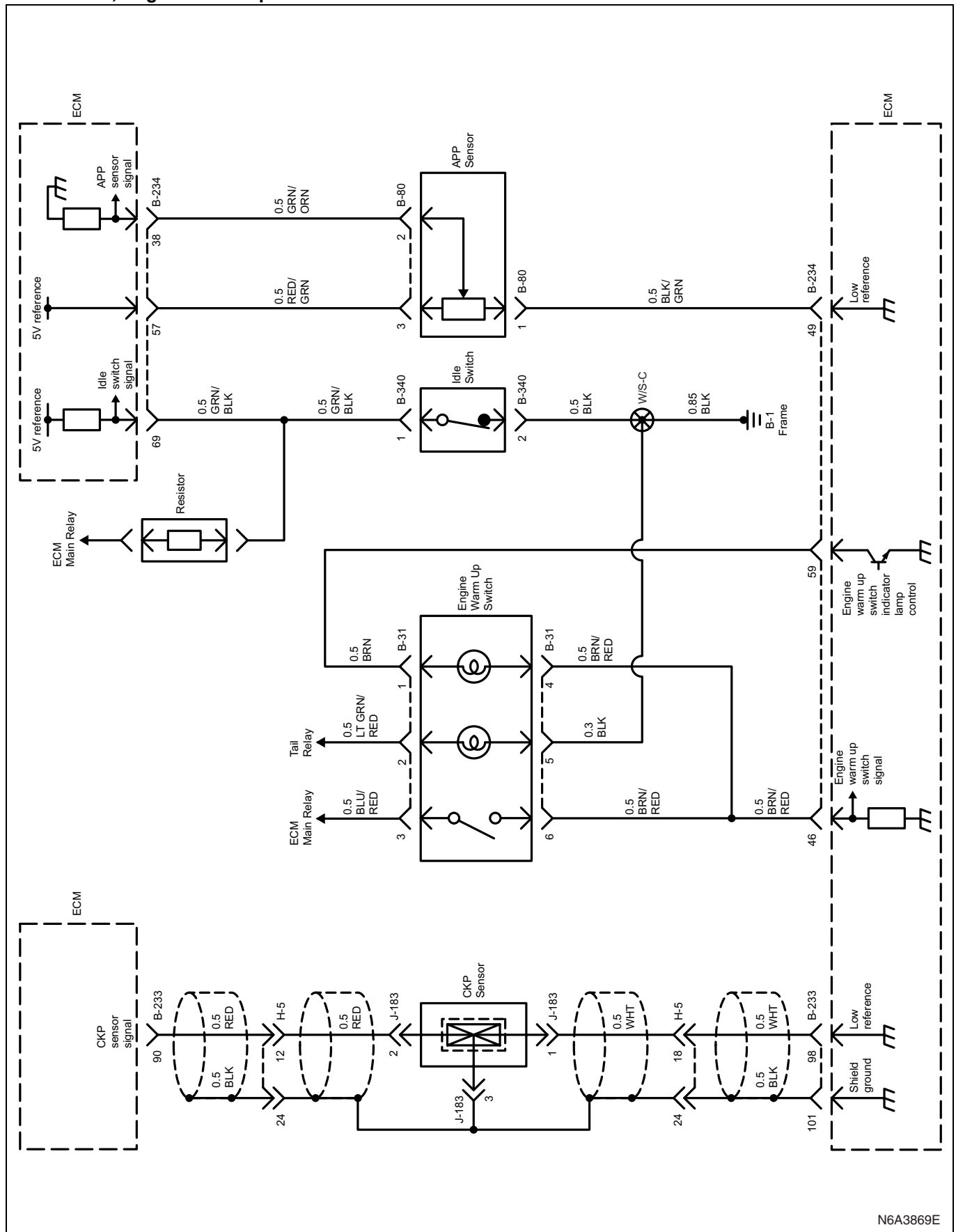
ECM Grounding, EHCU and DLC



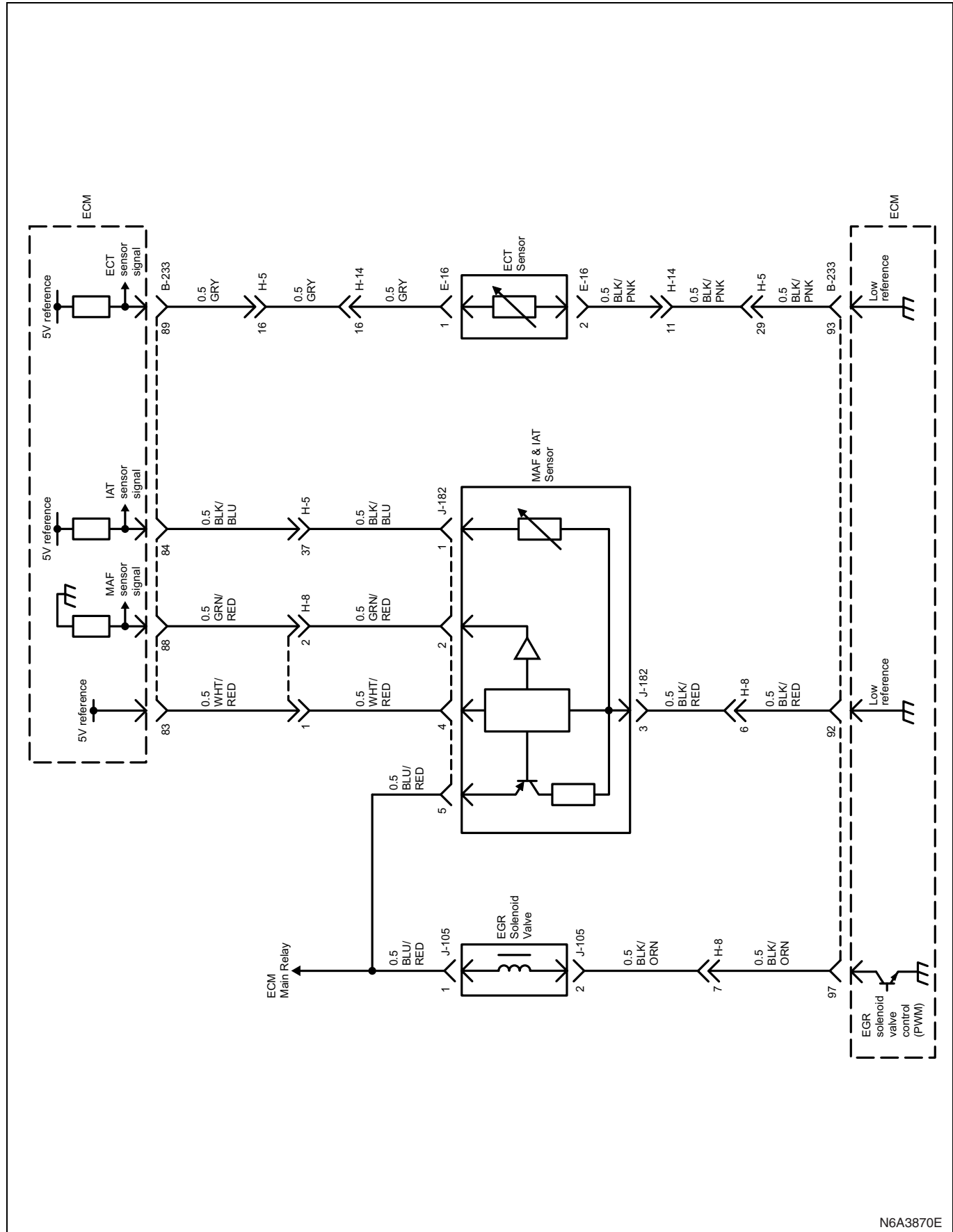
Gauges and Warning Lamps



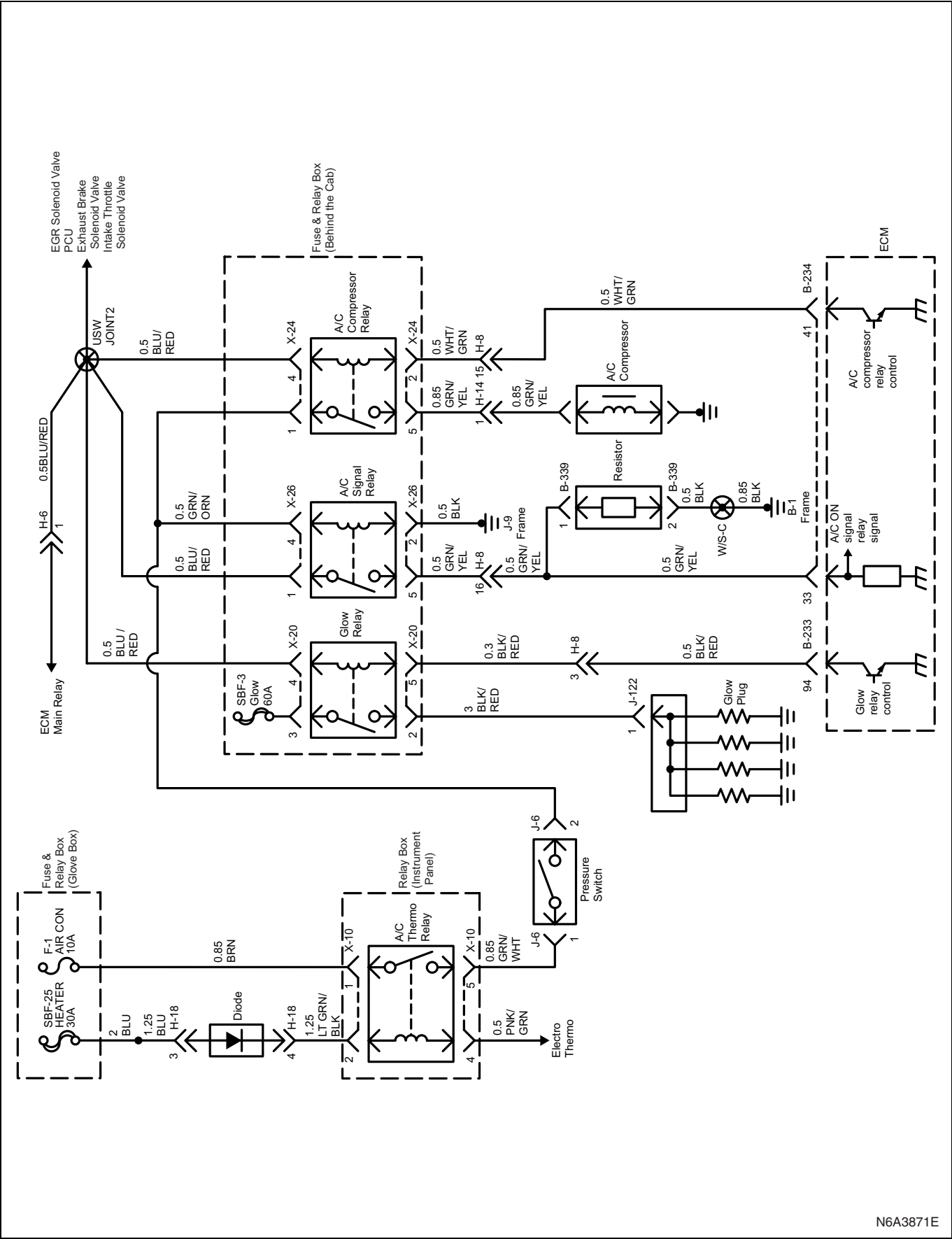
CKP Sensor, Engine Warm Up Switch and APP Sensor



MAF, IAT and ECT Sensors

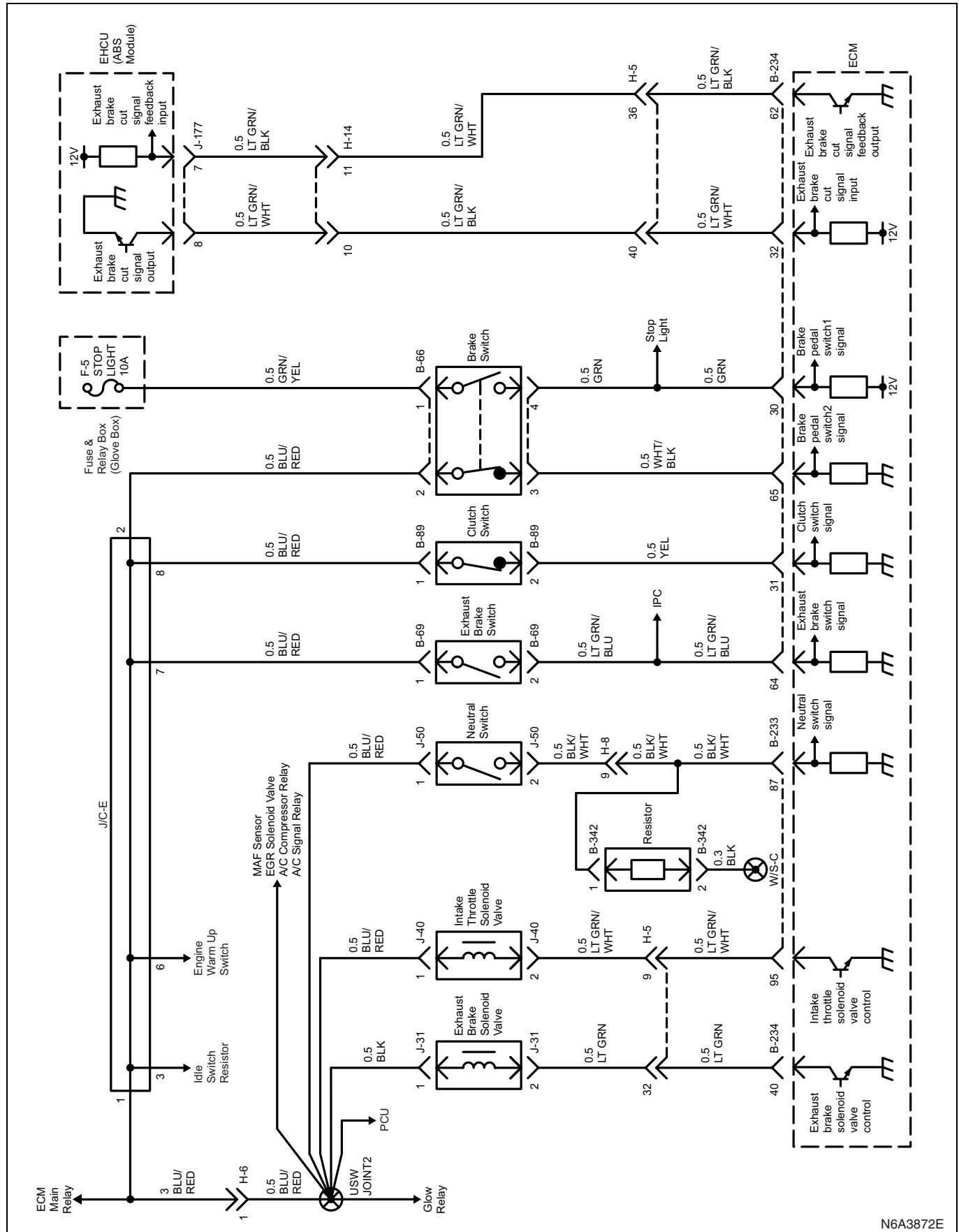


A/C and Glow Relay

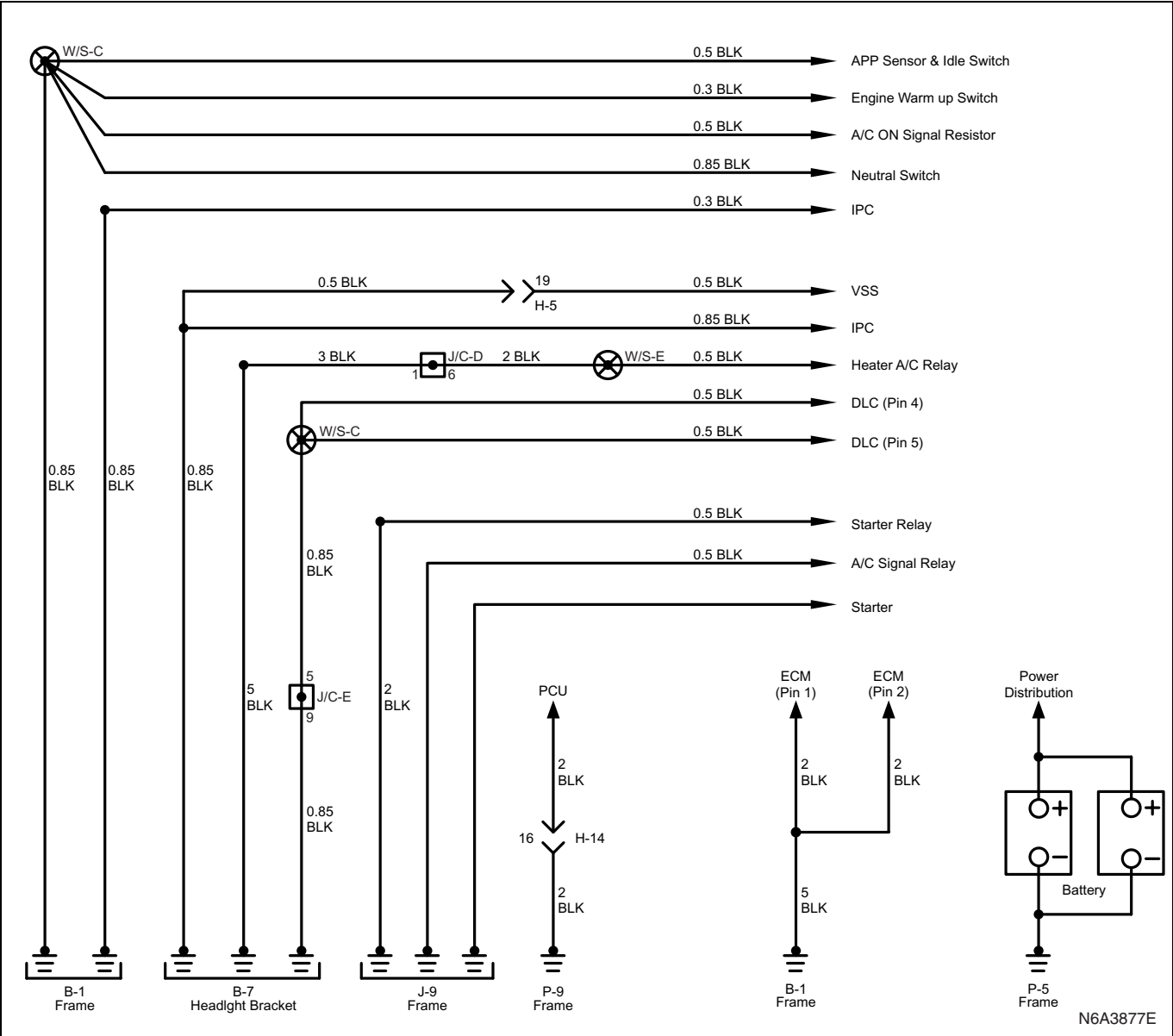


6E-14 Engine Control System (4JH1)

EGR Solenoid Valve, Exhaust Brake Solenoid Valve, Intake Throttle Solenoid Valve, Exhaust Brake Switch, Clutch Switch and Brake Switch



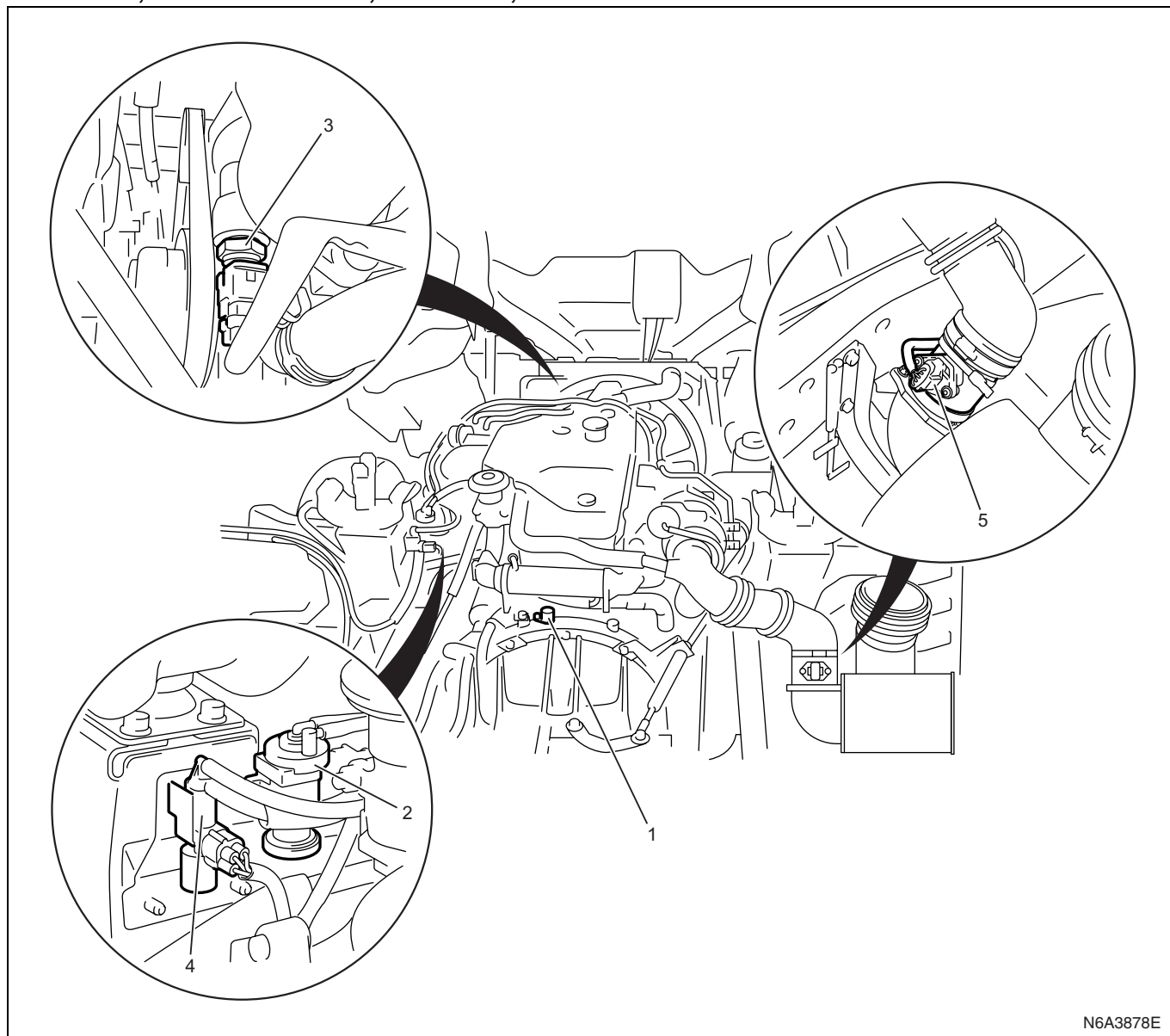
Ground Distributions



Component Locator

Engine Controls Component Views

CKP Sensor, EGR Solenoid Valve, ECT Sensor, Intake Throttle Solenoid Valve and MAF / IAT Sensor

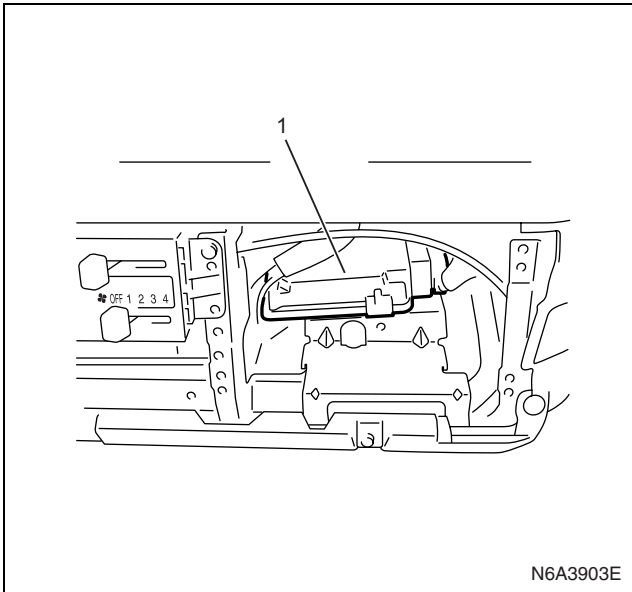


N6A3878E

Legend

- | | |
|--|--|
| 1. Crankshaft Position (CKP) Sensor | 4. Intake Throttle Solenoid Valve |
| 2. EGR Solenoid Valve | 5. Mass Air Flow (MAF) / Intake Air Temperature (IAT) Sensor |
| 3. Engine Coolant Temperature (ECT) Sensor | |

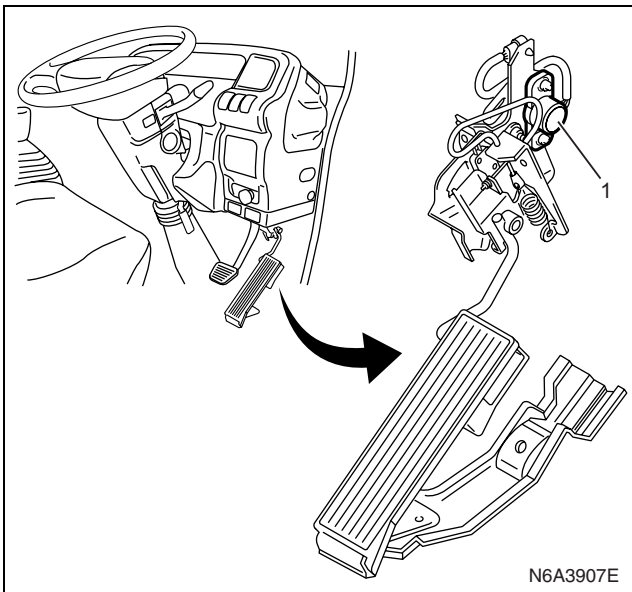
ECM



Legend

1. Engine Control Module (ECM)

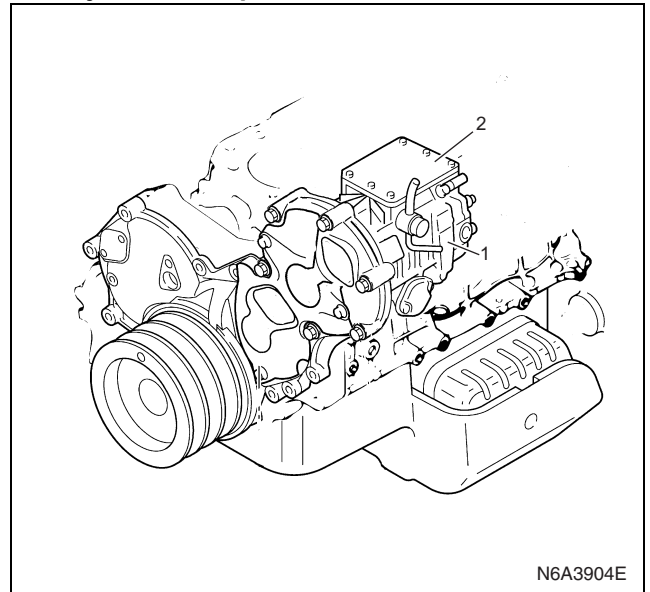
APP Sensor



Legend

1. Accelerator Pedal Position (APP) Sensor

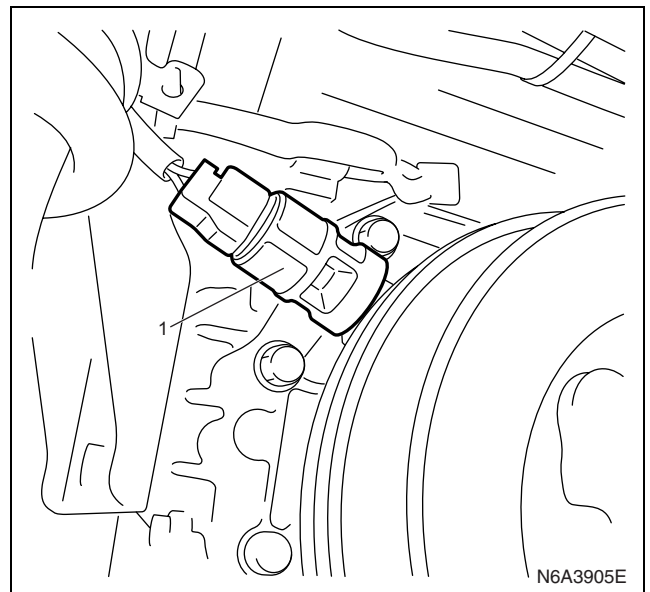
Fuel Injection Pump and PCU



Legend

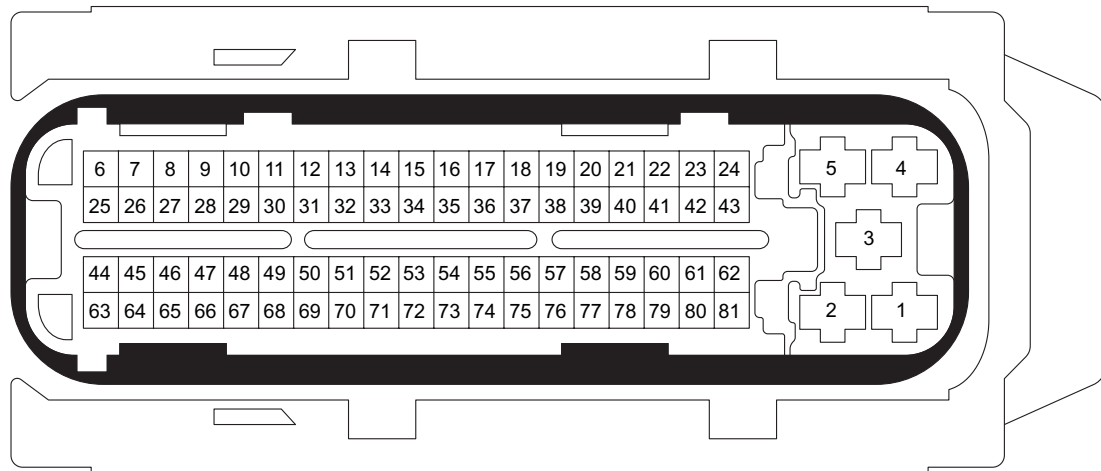
1. Fuel Injection Pump
2. Pump Control Unit (PCU)

VSS



Legend

1. Vehicle Speed Sensor (VSS)

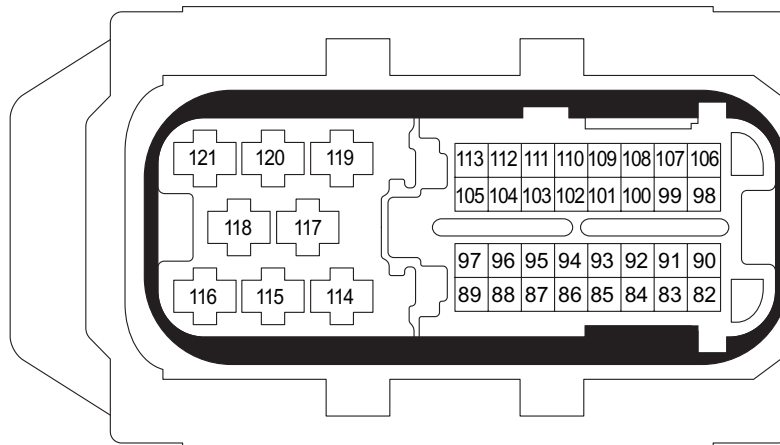
Engine Control Module (ECM) Connector End Views

N6A3797E

Connector No.		B-234
Connector Color		Black
Test Adapter No.		J-35616-4A (Pin 1 – 5) J-35616-64A (Pin 6 – 81)
Pin	Wire Color	Pin Function
1	BLK	ECM Ground
2	BLK	ECM Ground
3	BLU/RED	ECM Battery Voltage
4	—	Not Used
5	—	Not Used
6-24	—	Not Used
25	—	Not Used
26	—	Not Used
27	BLU/GRN	Engine Speed Signal Output to Tachometer
28	—	Not Used
29	—	Not Used
30	GRN	Brake Pedal 1 Switch (Stoplamp Pedal Switch) Signal
31	YEL	Clutch Pedal Switch
32	LT GRN/ WHT	Exhaust Brake Cut Signal Input from EHCUC (ABS Module)
33	GRN/YEL	A/C ON Signal Relay Input
34	—	Not Used
35	YEL	Keyword 2000
36	—	Not Used
37	—	Not Used
38	GRN/ORN	APP Sensor Signal
39	WHT	Ignition Voltage Feed

Connector No.		B-234
Connector Color		Black
Test Adapter No.		J-35616-4A (Pin 1 – 5) J-35616-64A (Pin 6 – 81)
Pin	Wire Color	Pin Function
40	LT GRN	Exhaust Brake Solenoid Valve
41	WHT/GRN	A/C Compressor Relay Control
42	GRN/YEL	MIL Control
43	ORN/BLU	Glow Indicator Lamp Control
44	—	Not Used
45	BLU	Diag Switch
46	BRN/RED	Engine Warm Up Switch Input
47	—	Not Used
48	—	Not Used
49	BLK/GRN	APP Sensor Low Reference
50	—	Not Used
51	—	Not Used
52	—	Not Used
53	—	Not Used
54	—	Not Used
55	—	Not Used
56	—	Not Used
57	RED/GRN	APP Sensor 5 Volts reference
58	BLU/BLK	ECM Main Relay Control
59	BRN	Engine Warm Up Indicator Lamp Control
60	GRN/RED	Exhaust Brake Lamp Control
61	—	Not Used

Connector No.		B-234
Connector Color		Black
Test Adapter No.		J-35616-4A (Pin 1 – 5) J-35616-64A (Pin 6 – 81)
Pin	Wire Color	Pin Function
62	LT GRN/ BLK	Exhaust Brake Cut Signal Output to EHCU (ABS Module)
63	—	Not Used
64	LT GRN/ BLU	Exhaust Brake Switch Signal
65	WHT/BLK	Brake Pedal 2 Switch Signal
66	—	Not Used
67	—	Not Used
68	YEL/GRN	VSS Signal
69	GRN/BLK	Idle Switch Signal
70	—	Not Used
71	—	Not Used
72	—	Not Used
73	—	Not Used
77	—	Not Used
78	—	Not Used
79	—	Not Used
80	—	Not Used
81	—	Not Used



N6A3798E

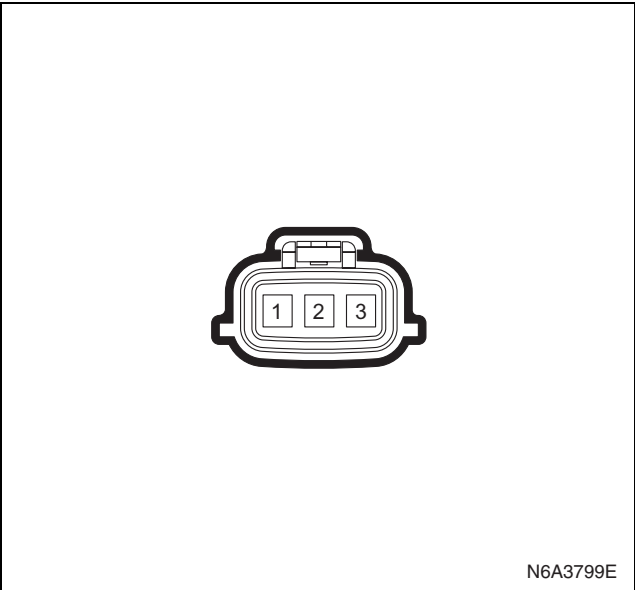
Connector No.		B-233
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin	Wire Color	Pin Function
82	—	Not Used
83	WHT/RED	MAF Sensor 5 Volts Reference

Connector No.		B-233
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin	Wire Color	Pin Function
84	BLK/BLU	IAT Sensor Signal
85	—	Not Used

6E-20 Engine Control System (4JH1)

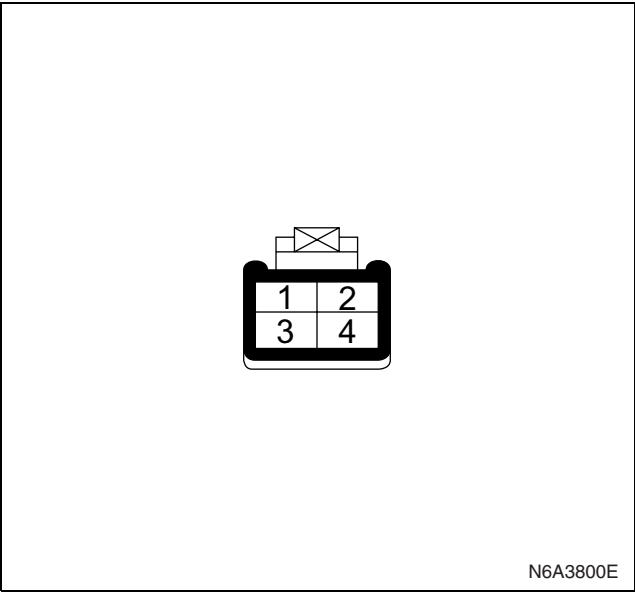
Connector No.		B-233
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin	Wire Color	Pin Function
86	—	Not Used
87	BLK/WHT	Neutral Switch Input
88	GRN/RED	MAF Sensor Signal
89	GRY	ECT Sensor Signal
90	RED	CKP Sensor Signal
91	PNK	CKP Sensor Signal Output
92	BLK/RED	MAF Sensor & IAT Sensor Low Reference
93	BLK/PNK	ECT Sensor Low Reference
94	BLK/RED	Glow Relay Control
95	LT GRN/ WHT	Intake Throttle Solenoid Control
96	—	Not Used
97	BLK/ORN	EGR Solenoid Valve Control
98	WHT	CKP Sensor Low Reference
99	BLU	CAN Low Signal
100	YEL	CAN High Signal
101	BLK	CKP Sensor Shield Ground
102	—	Not Used
102	—	Not Used
103	—	Not Used
105	ORN	Engine Shutoff (ESO) Solenoid Valve Control Signal Output
106-121	—	Not Used

Engine Controls Connector End Views
Accelerator Pedal Position (APP) Sensor

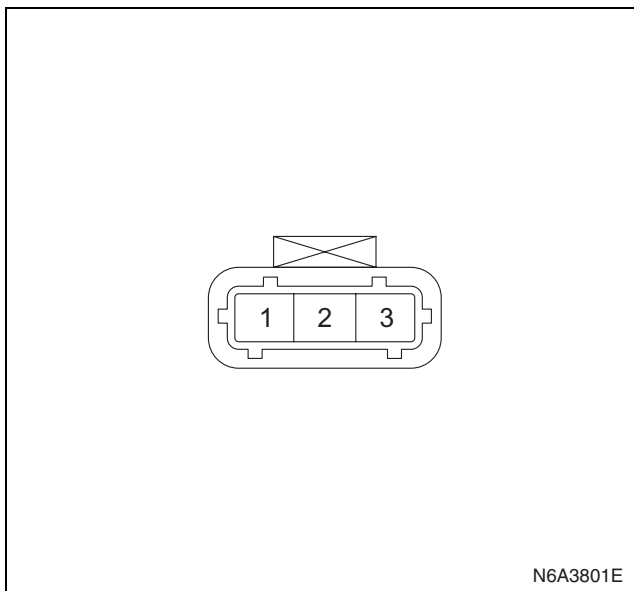


Connector No.		B-80
Connector Color		Gray
Test Adapter No.		J-35616-33
Pin	Wire Color	Pin Function
1	BLK/GRN	APP Sensor Low Reference
2	GRN/ORN	APP Sensor Signal
3	RED/GRN	APP Sensor 5 Volts Reference

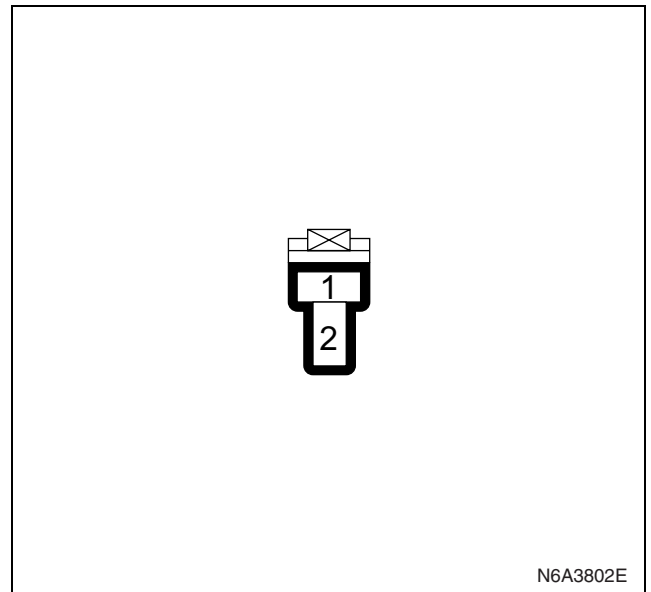
Brake Switch



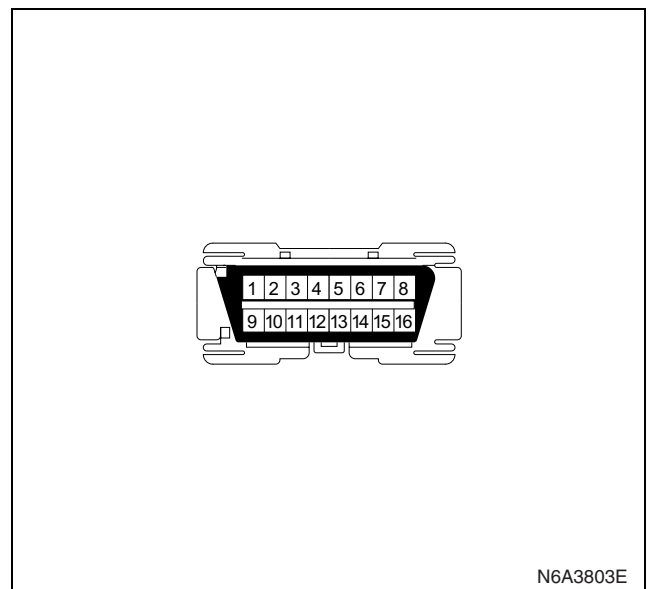
Connector No.		B-66
Connector Color		Brown
Test Adapter No.		J-35616-42
Pin	Wire Color	Pin Function
1	GRN/YEL	Brake Pedal 1 Switch (Stoplamp Pedal Switch) 12 Volts Feed
2	BLU/RED	Brake Pedal 2 Switch Ignition Voltage
3	WHT/BLK	Brake Pedal 2 Switch Signal
4	GRN	Brake Pedal 1 Switch (Stoplamp Pedal Switch) Signal

Crankshaft Position (CKP) Sensor

Connector No.		J-183
Connector Color		Black
Test Adapter No.		J-35616-4A
Pin	Wire Color	Pin Function
1	WHT	CKP Sensor Low Reference
2	RED	CKP Sensor Signal
3	BLK	CKP Sensor Shield Ground

Clutch Switch

Connector No.		B-89
Connector Color		White
Test Adapter No.		J-35616-42
Pin	Wire Color	Pin Function
1	BLU/RED	Clutch Pedal Switch Ignition Voltage
2	YEL	Clutch Pedal Switch Signal

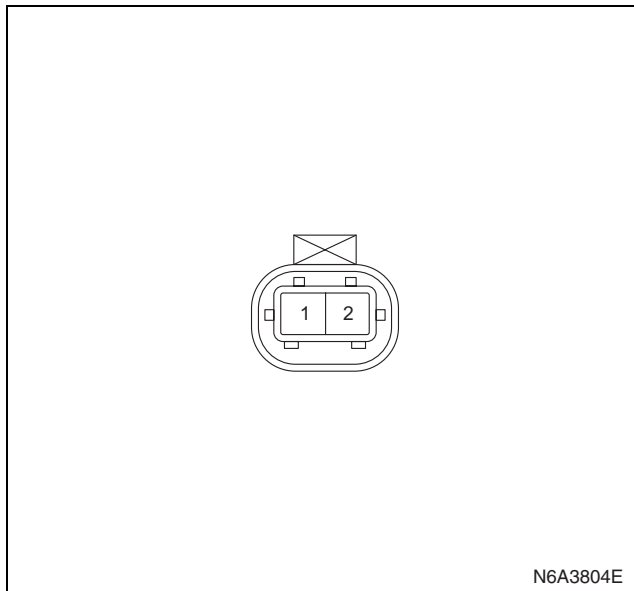
Data Link Connector (DLC)

Connector No.		B-79
Connector Color		Black
Test Adapter No.		J-35616-2A
Pin	Wire Color	Pin Function
1	—	Not Used
2	WHT/BLK	J1850 (Class 2)

6E-22 Engine Control System (4JH1)

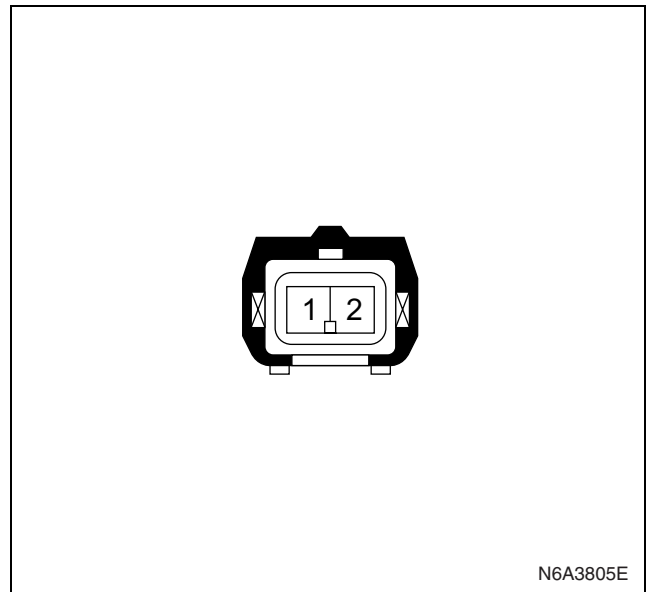
Connector No.		B-79
Connector Color		Black
Test Adapter No.		J-35616-2A
Pin	Wire Color	Pin Function
3	—	Not Used
4	BLK	Ground
5	BLK	Ground
6	BLU	Diagnostic Request Switch (ECM)
7	YEL/BLU	Keyword 2000
8	—	Not Used
9	—	Not Used
10	—	Not Used
11	—	Not Used
12	WHT/GRN	Diagnostic Request Switch (EHCU [ABS Module])
13	—	Not Used
14	—	Not Used
15	—	Not Used
16	BLK/YEL	Power Supply

EGR Solenoid Valve



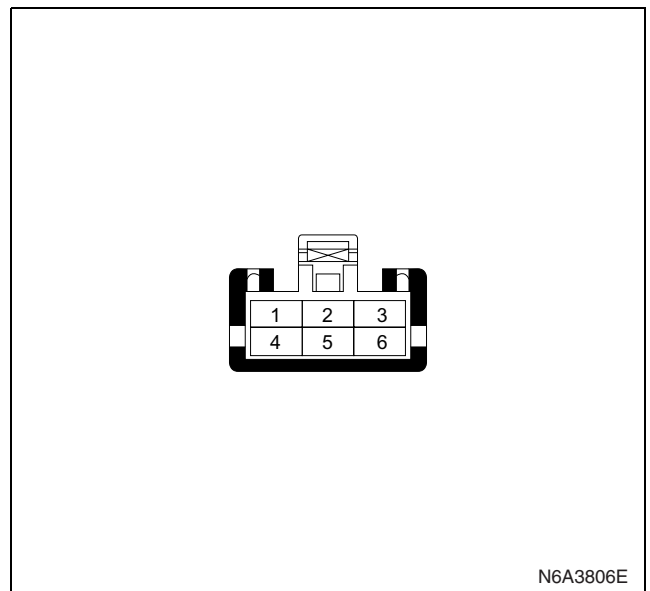
Connector No.		J-105
Connector Color		Black
Test Adapter No.		J-35616-4A
Pin	Wire Color	Pin Function
1	BLU/RED	Solenoid Valve 12 Volts Feed
2	BLK/ORN	Solenoid Valve Control

Engine Coolant Temperature (ECT) Sensor



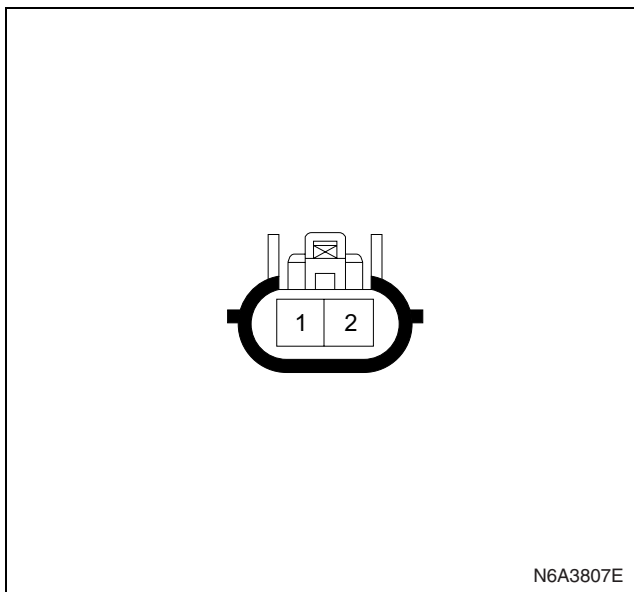
Connector No.		E-16
Connector Color		Gray
Test Adapter No.		J-35616-4A
Pin	Wire Color	Pin Function
1	GRY	ECT Sensor Signal
2	BLK/PNK	ECT Sensor Low Reference

Engine Warm Up Switch

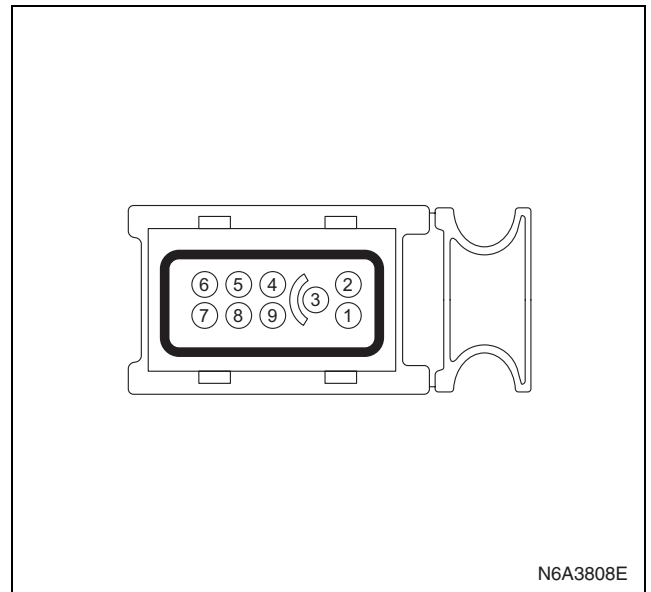


Connector No.		B-31
Connector Color		Gray
Test Adapter No.		J-35616-42
Pin	Wire Color	Pin Function
1	BRN	Indicator Lamp Control
2	GRN/RED	Illumination Lamp 12V Feed

Connector No.		B-31
Connector Color		Gray
Test Adapter No.		J-35616-42
Pin	Wire Color	Pin Function
3	BLU/RED	Engine Warm Up Switch 12V Feed
4	BRN/RED	Indicator Lamp Voltage Feed From Switch Signal
5	BLK	Illumination Lamp Ground
6	BRN/RED	Engine Warm Up Switch Signal

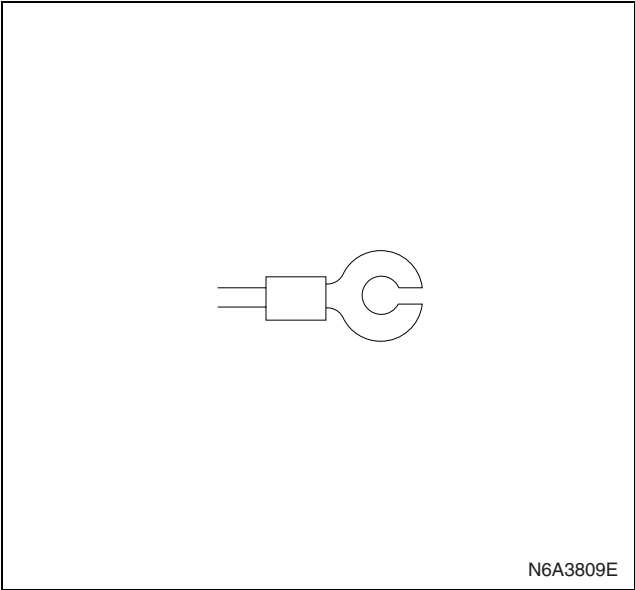
Exhaust Brake Solenoid Valve

Connector No.		J-31
Connector Color		Black
Test Adapter No.		J-35616-33
Pin	Wire Color	Pin Function
1	BLK	Ignition Voltage
2	LT GRN	Exhaust Brake Solenoid Control

Fuel Injection Pump Control Unit (PCU)

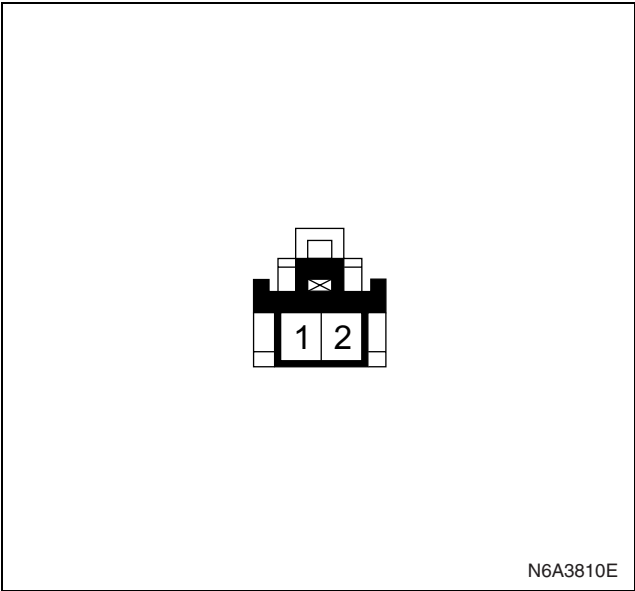
Connector No.		E-110
Connector Color		Black
Test Adapter No.		J-35616-8
Pin	Wire Color	Pin Function
1	BLU	CAN Low Signal
2	YEL	CAN High Signal
3	—	Not Used
4	—	Not Used
5	ORN	Engine Shutoff (ESO) Solenoid Valve Control Signal Input
6	BLK	Ground
7	RED/WHT	Battery voltage
8	PNK	CKP Sensor Signal Input
9	—	Not Used

Glow Plug



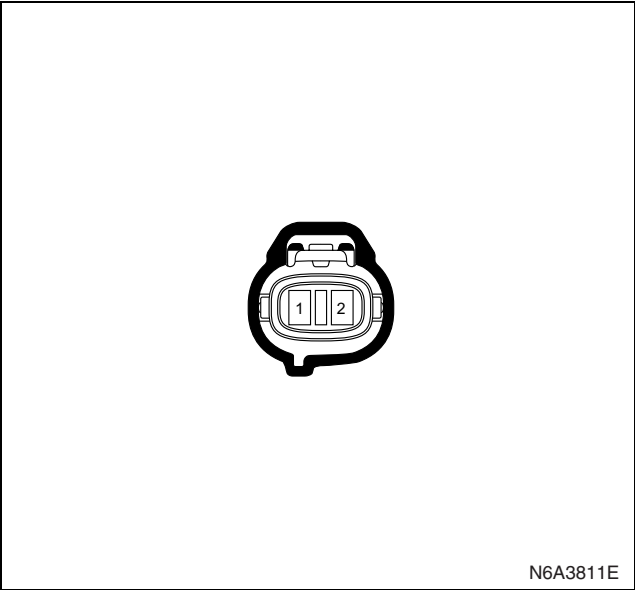
Connector No.		J-122
Connector Color		Silver
Pin	Wire Color	Pin Function
1	BLK/YEL	Power Supply

Idle Switch



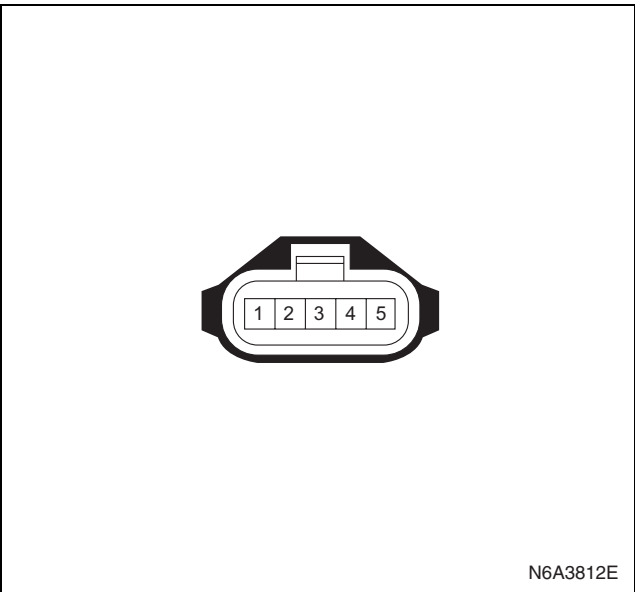
Connector No.		B-340
Connector Color		Black
Test Adapter No.		J-35616
Pin	Wire Color	Pin Function
1	GRN/BLK	Idle Switch Signal
2	BLK	Idle Switch Ground

Intake Throttle Solenoid Valve



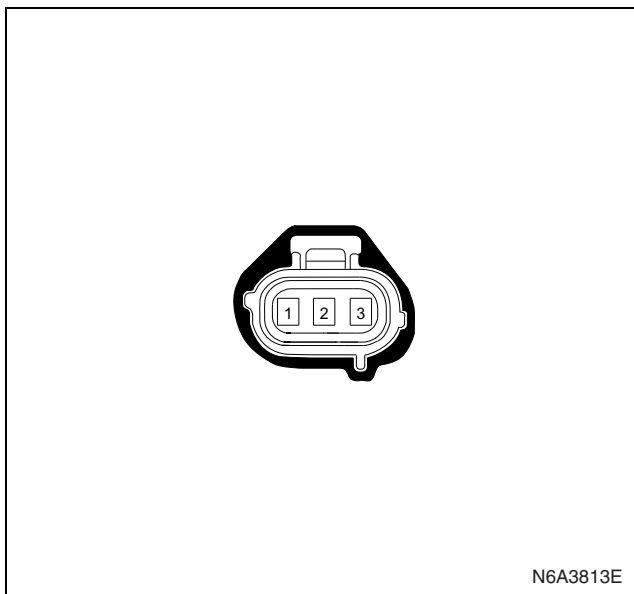
Connector No.		J-40
Connector Color		Brown
Test Adapter No.		J-35616-4A
Pin	Wire Color	Pin Function
1	BLU/RED	Ignition Voltage
2	LT GRN/ WHT	Intake Throttle Solenoid Control

Mass Air Flow (MAF) / Intake Air Temperature Sensor



Connector No.		J-182
Connector Color		Black
Test Adapter No.		J-35616-4A
Pin	Wire Color	Pin Function
1	BLK/BLU	IAT Sensor Signal

Connector No.		J-182
Connector Color		Black
Test Adapter No.		J-35616-4A
Pin	Wire Color	Pin Function
2	BLU/RED	MAF Sensor Ignition Voltage Feed
3	BLK/RED	MAF Sensor & IAT Sensor Low Reference
4	WHT/RED	MAF Sensor 5 Volts Reference
5	GRN/RED	MAF Sensor Signal

Vehicle Speed Sensor (VSS)

Connector No.		J-32
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin	Wire Color	Pin Function
1	BLK/YEL	VSS 12 Volts Feed
2	BLK	VSS Low Reference
3	YEL/GRN	VSS Signal

Diagnostic Information and Procedures

General Service Information

Non-OEM Parts

All of the on-board diagnostic (OBD) has been calibrated to run with original equipment manufacturer (OEM) parts. Accordingly, if commercially sold sensor or switch is installed, it makes a wrong diagnosis and turn on the malfunction indicator lamp (MIL). Aftermarket electronics, such as cellular phones, stereos, and anti-theft devices, may indicate electromagnetic interference (EMI) into the control system if they are improperly installed. This may cause a false sensor reading and turn on the MIL.

Poor Vehicle Maintenance

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

Visual/Physical Engine Compartment Inspection

Perform a careful visual and physical engine compartment inspection when performing any diagnostic procedure or diagnosing the cause of an emission test failure. This can often lead to repairing a problem without further steps. Use the following guidelines when performing a visual/physical inspection:

- Inspect all vacuum hoses for punches, cuts, disconnects, and correct routing.
- Inspect hoses that are difficult to see behind other components.
- Inspect all wires in the engine compartment for proper connections, burned or chafed spots, pinched wires, contact with sharp edges or contact with hot exhaust manifolds or pipes.

Basic Knowledge of Tools Required

Lack of basic knowledge of this powertrain when performing diagnostic procedures could result in an incorrect diagnosis or damage to powertrain components. Do not attempt to diagnose a powertrain problem without this basic knowledge. A basic understanding of hand tools is necessary to effectively use this section of the service manual.

Malfunction Indicator Lamp (MIL)

Basically, the MIL is turned on when the ECM detects a DTC that will impact the vehicle emissions. When the MIL remains “ON” while the engine is running, or when a malfunction is suspected due to a driveability or emissions problem, a Diagnostic System Check must be performed. The procedures for these checks are given in Diagnostic System Check – Engine Controls.

DTC Types

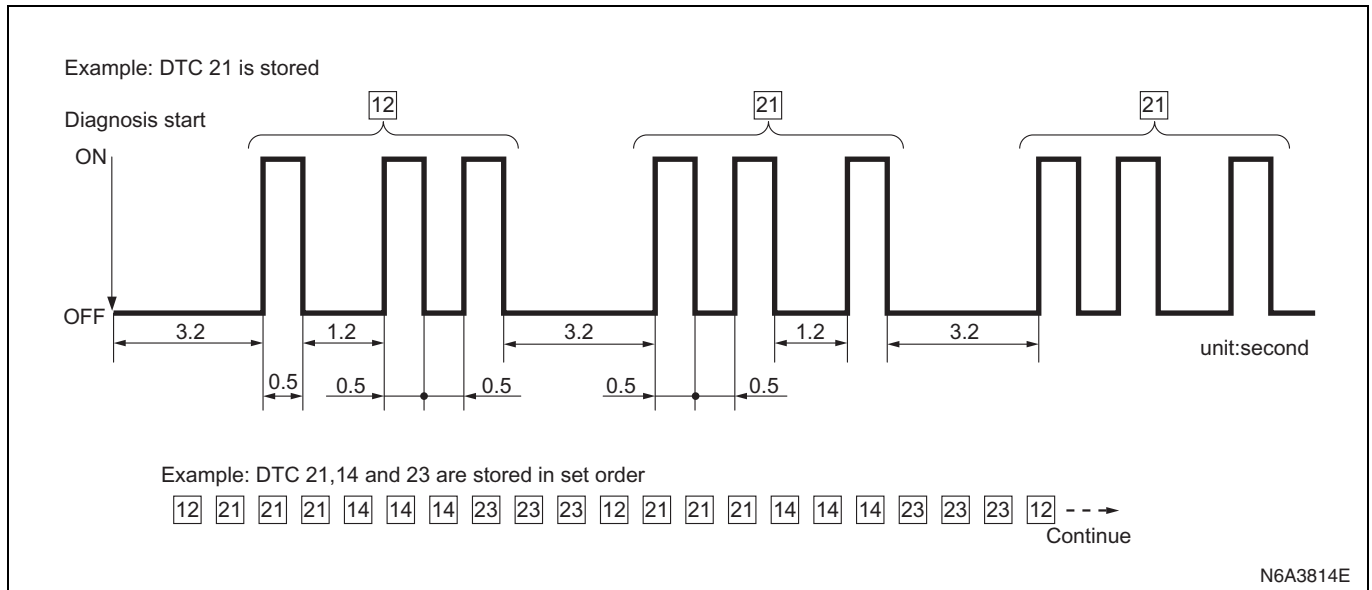
Characteristic of Code

- Non-Emissions related
- Does not request illumination of any lamp
- Stores a DTC on the first trip with a fail

Reading Flash Diagnostic Trouble Codes

The provision for communicating with the ECM is the Data Link Connector (DLC). The DTCs stored in the ECM memory can be read either through a hand-held diagnostic scanner such as Tech 2 plugged into the DLC or by counting the number of flashes of the MIL when the diagnostic test terminal of the DLC is grounded. The DLC terminal “6” (diagnostic request switch) is pulled “Low” (grounded) by jumped to DLC terminal “4”, which is a ground wire.

Once terminals “4” and “6” have been connected, the ignition switch must be moved to the “ON” position, with the engine not running. The MIL will initially flash 12. Then, the MIL will flash the first stored DTC three times, second stored DTC three times and so on. All the stored DTCs are flashed, then return 12 and continue to flash the DTC. If no DTC exists, the MIL flashes 12 continuously. The flash DTC display will continue as long as the DLC is shorted.



Reading Diagnostic Trouble Codes (DTCs) with The Tech 2

The procedure for reading DTC(s) is used a diagnostic Tech 2. To read DTCs, use the Tech 2 "Read DTC Info As Stored By ECU".

Clearing Diagnostic Trouble Codes (DTCs) with The Tech 2 or without Tech 2

Do not clear DTCs unless directed to do so by the service information provided for each diagnostic procedure. To clear DTCs, use the Tech 2 "Clear DTC Information". If there is no Tech 2, history DTCs can also be cleared after 40 consecutive driving cycles without a fault.

Tech 2 Scan Tool

Isuzu recommend using Tech 2. Refer to the Tech 2 Users Guide for proper start up procedures.

Operating Procedure

1. Press Enter at start screen.
2. Select Diagnostic > appropriate vehicle identification > Powertrain > 4JH1-TC.
3. The following table shows, which functions are used the available equipment versions.

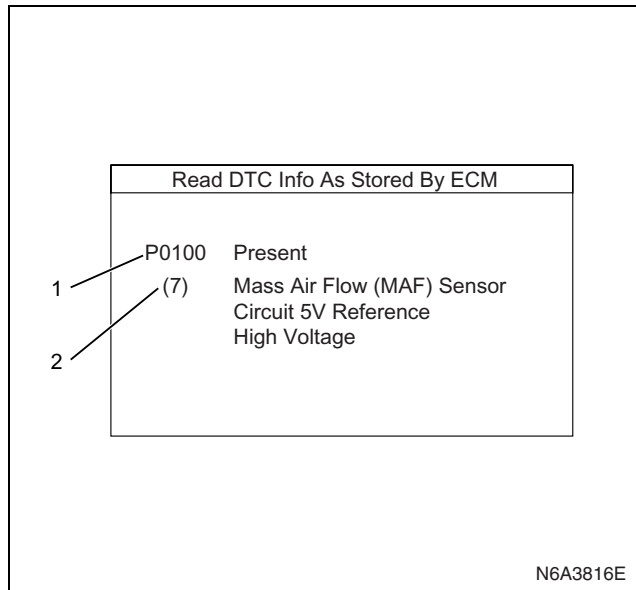
- F0: Diagnostic Trouble Code
 - F0: Read DTC Info As Stored By ECU
 - F1: Clear DTC Information
- F1: Data Display
- F2: Snapshot
- F3: Miscellaneous Tests
 - F0: Lamps
 - F0: Malfunction Indicator Lamp
 - F1: Glow Indicator
 - F1: Relays
 - F0: Glow Relay
 - F2: Solenoids
 - F0: EGR Solenoid Valve
 - F3: Engine Speed (RPM) Control
- F4: Programming
 - F0: Program VIN
 - F1: Lock ECU

F0: Diagnostic Trouble Code

The purpose of this mode is to display stored trouble code in the ECM. When “Clear DTC Information” is selected, “Clear DTC Information”, warning screen appears. This screen informs you that by cleaning DTCs “all stored DTC information in the ECM will be erased”.

Symptom Code

Symptom Code is located under the DTC column. A parenthetic alphabet or number means identification of the malfunction. Each DTC includes individual symptoms, such as DTC P0100 has four symptom codes (7), (9), (B) and (C). DTC chart is separated depending on this symptom code.

**Legend**

1. Diagnostic Trouble Code (DTC)
2. Symptom Code

F1: Data Display

The purpose of this mode is to continuously monitor data parameters. The current actual values of all important sensors and signals in the system are display through this mode. Refer to the Tech 2 Data List in this section.

F2: Snapshot

“Snapshot” allow you to focus on making the condition occur, rather than trying to view all of the data in anticipation of the fault. The snapshot will collect parameter information around a trigger point that you select. Refer to the Tech 2 user instructions for more information.

F3: Miscellaneous Test

The purpose of this mode is to check for correct operation of electronic system actuators. Using miscellaneous test menus can test the state of each actuator and related sensors. Especially when DTC cannot be detected, a faulty circuit can be diagnosed by testing. Even DTC has been detected, the circuit tests using these menus could help discriminate between a mechanical trouble and an electrical trouble. Refer to the Tech 2 Output Controls in this section.

F4: Programming

The purpose of this mode is to program the vehicle identification number (VIN) into the ECM and lock the programmed VIN. Refer to Engine Control Module (ECM) Replacement in this section.

Tech 2 Data List

The Tech 2 Data List contains all engine related parameters that are available on the Tech 2. Use the Tech 2 Data List only after the following is determined:

- The Diagnostic System Check – Engine Controls is completed.
- No diagnostic trouble codes (DTCs) are present.
- On-board diagnostics are functioning properly.

Tech 2 values from a properly running engine may be used for comparison with the engine you are diagnosing. The Tech 2 Data List represents values that would be seen on a normal running engine.

Important:

A Tech 2 that displays faulty data should not be used. The Tech 2 problem should be reported to the manufacturer. Use of a faulty Tech 2 can result in misdiagnosis and unnecessary parts replacement. Only the parameters listed below are referenced in this service manual for use in diagnosis.

Tech 2 Parameter	Units Displayed	Typical Data Value at Engine Idle	Typical Data Value at 2000 RPM
Operating Conditions: Engine Idling or 2000 RPM / Engine Coolant Temperature is between 75-85°C (167-185°F) / Accelerator Pedal is Constant / Park or Neutral / Accessories OFF / Vehicle Located at Sea Level			
Ignition Switch	On/Off	On	On
System Voltage	V	11.0 – 15.0	11.0 – 15.0
ECM Main Relay	On/Off	On	On
Engine Speed	RPM	650 – 750	1950 – 2050
Desired Idle Speed	RPM	700	700
Injection Pump Speed	RPM	325 – 375	975 – 1025
Accelerator Pedal Position	%	0.0	19.0 – 23.0
Idle Switch	On/Off	On	Off
Intake Air Temperature	°C/°F	20 – 40°C / 68 – 104°F	20 – 40°C / 68 – 104°F
Engine Coolant Temperature	°C/°F	75 – 85°C / 167 – 185°F	75 – 85°C / 167 – 185°F

Tech 2 Parameter	Units Displayed	Typical Data Value at Engine Idle	Typical Data Value at 2000 RPM
Fuel Temperature	°C/°F	20 – 60°C / 68 – 140°F	20 – 60°C / 68 – 140°F
Barometric Pressure	hPa	Nearly 1010 hPa at sea level	Nearly 1010 hPa at sea level
EGR Solenoid Command	%	Nearly 70%	Nearly 30%
Mass Air Flow Sensor	mg/strk	More than 480 mg/strk at sea level	More than 1200 mg/strk at sea level
Desired Mass Air Flow	mg/strk	More than 480 mg/strk at sea level	More than 1200 mg/strk at sea level
Actual Injection Quantity	mg/strk	7.0 – 10.0	8.0 – 12.0
Desired Injection Quantity	mg/strk	7.0 – 10.0	8.0 – 12.0
Actual Injection Timing	°CA	3.0 – 5.0	5.0 – 7.0
Desired Injection Timing	°CA	3.0 – 5.0	5.0 – 7.0
Neutral Switch	On/Off	On	On
Brake Pedal 1 Switch	Applied/Released	Released	Released
Brake Pedal 2 Switch	Applied/Released	Released	Released
Clutch Pedal Switch	Applied/Released	Released	Released
Engine Warm Up Switch	On/Off	Off	Off
Exhaust Brake Switch	On/Off	Off	Off
Intake Throttle Solenoid Command	On/Off	Off	Off
Exhaust Brake Solenoid Command	On/Off	Off	Off
ABS Input Signal	On/Off	Off	Off
ABS Output Signal	On/Off	Off	Off
Vehicle Speed	km/h / MPH	0	0
Glow Relay Command	On/Off	Off	Off
Glow Indicator Lamp Command	On/Off	Off	Off
Malfunction Indicator Lamp (MIL) Command	On/Off	Off	Off
A/C Request Signal	On/Off	Off	Off
A/C Relay Command	On/Off	Off	Off

Tech 2 Data Definitions

A list of each message displayed on the Tech 2 will be explained in Engine Controls. This information will assist in emission or driveability problems. The displays can be viewed while the vehicle is being driven. Always perform the Diagnosis System Check – Engine Controls first. The Diagnostic System Check will confirm proper system operation.

Ignition Switch

This parameter displays the input status of the ignition switch to the ECM terminal (pin 39). The Tech 2 will display On or Off. On indicates the ignition switch is turned ON position.

System Voltage

This parameter displays the system voltage measured by the ECM terminal (pin 3) at the voltage feed from the ECM main relay.

ECM Main Relay

This parameter displays the commanded state of the ECM main relay control circuit (pin 58). The Tech 2 will display On or Off. On indicates the ECM main relay control circuit is being grounded by the ECM, allowing the main relay to supply voltage to the other circuits of the ECM. Off indicates the main relay is not being commanded On by the ECM.

Engine Speed

This parameter displays the speed of the crankshaft as calculated by the ECM based on input from the crankshaft position (CKP) sensor or camshaft position (CMP) sensor. The Tech 2 will display the engine speed in revolution per minute (RPM).

Desired Idle Speed

This parameter displays the idle speed requested by the ECM. The ECM will compensate for various engine loads based on engine coolant temperature (ECT) and A/C system status. If the A/C system is activated, the ECM sets 50 RPM higher than normal idle speed.

Injection Pump Speed

This parameter displays the speed of the injection pump as calculated by the fuel injection pump control unit (PCU) based on the input from the fuel injection pump camshaft position (CMP) sensor. The Tech 2 will display the injection pump speed in revolution per minute (RPM).

Accelerator Pedal Position

This parameter displays the angle of the accelerator pedal as calculated by the ECM using the signal from the accelerator pedal position (APP) sensor. The accelerator pedal position indicated angle is a range of values indicating a low percentage when the accelerator pedal is not depressed to a high percentage when the accelerator pedal is fully depressed.

Idle Switch

This parameter displays the input status of the idle switch to the ECM terminal (pin 69). The Tech will display On or Off. On indicates the accelerator pedal is not being pushed down. Off indicates the accelerator pedal is being depressed.

Intake Air Temperature

This parameter displays the temperature of the intake air based on a voltage input from the intake air temperature (IAT) sensor to the ECM. The Tech 2 will display a low temperature when signal voltage is high, and high temperature when the signal voltage is low. Note that the IAT sensor is internal to the mass air flow (MAF) sensor and the MAF sensor is heated.

Engine Coolant Temperature

This parameter displays the temperature of the engine coolant based on a voltage input from the engine coolant temperature (ECT) sensor to the ECM. The Tech 2 will display a low temperature when the signal voltage is high, and a high temperature when the signal voltage is low.

Fuel Temperature

This parameter displays the temperature of the fuel as calculated by the fuel injection pump control unit (PCU) using the signal from the fuel temperature sensor inside of the PCU.

Barometric Pressure

This parameter displays the barometric pressure as calculated by the ECM using the signal from the barometric pressure (BARO) sensor inside of the ECM.

EGR Solenoid Command

This parameter displays the EGR solenoid valve control duty ratio commanded by the ECM terminal (pin 97) using the signal from engine speed, and injection volume and various sensor inputs. When a small duty ratio, the EGR valve is controlled to close. When a large duty ratio, the EGR valve is controlled to open.

Mass Air Flow Sensor

This parameter displays the air flow into the engine as calculated by the ECM based on the mass air flow (MAF) sensor input. The Tech 2 will display a high value at higher engine speeds, and a low value at idle. This can be compared to the Desired Mass Air Flow to determine MAF sensor accuracy, EGR problem or intake problem. Note that the MAF on the Tech 2 will only update with the engine running.

Desired Mass Air Flow

This parameter displays a mass air flow desired by the ECM based on current driving condition.

Actual Injection Quantity

This parameter displays the injection quantity calculated by the PCU based on the fuel injection solenoid valve On time which compensated from the timing device position and fuel temperature inputs. This can be compared to the Desired Injection Quantity to determine fuel system problem.

Desired Injection Quantity

This parameter displays an injection quantity desired by the ECM based on current driving condition using target injection maps.

Actual Injection Timing

This parameter displays the injection timing calculated by the PCU based on the timing device position which determined from the crankshaft position sensor and camshaft position sensor inputs. This can be compared to the Desired Injection Timing to determine timing device problem or fuel system problem.

Desired Injection Timing

This parameter displays injection timing desired by the ECM based on current driving condition using target injection timing maps. This timing is compensated by engine coolant temperature, altitude and intake air temperature, etc.

Neutral Switch

This parameter displays the state of the neutral switch as determined by the ECM terminal (pin 87) based on an input from the neutral switch.

Brake Pedal 1 Switch

This parameter displays the state of the brake pedal as determined by the ECM terminal (pin 30) based on an input from the brake pedal 1 switch. This switch turns On the stop lamps when the brake pedal is depressed. The Tech 2 will display Applied when the brake pedal is depressed.

Brake Pedal 2 Switch

This parameter displays the state of the brake pedal 2 switch as determined by the ECM terminal (pin 65). The Tech 2 will display Released or Applied. Released indicates the brake pedal is not being pushed down. Applied indicates the brake switch is being depressed.

Clutch Pedal Switch

This parameter displays the state of the clutch pedal as determined by the ECM terminal (pin 31) based on an input from the clutch pedal switch. The Tech 2 will display Release or Applied. Release indicates the clutch pedal is not being pushed down. Applied indicates the clutch switch is being depressed.

Engine Warm Up Switch

This parameter displays the input status of the engine warm up switch to the ECM terminal (pin 46). The Tech 2 will display On or Off. On indicates the engine warm up switch is closing the engine quick warm up system request circuit to the ECM. Off indicates the engine warm up switch is open.

Exhaust Brake Switch

This parameter displays the input status of the exhaust brake switch to the ECM terminal (pin 64). The Tech 2 will display On or Off. On indicates the exhaust brake switch is closing the exhaust brake request circuit to the ECM and allowing to energize the intake throttle solenoid and exhaust brake solenoid depending on driving condition. Off indicates the exhaust brake switch is open and exhaust brake will not engage.

Intake Throttle Solenoid Command

This parameter displays the commanded state of the intake throttle solenoid valve control circuit (pin 95). The Tech 2 will display On or Off. On indicates the intake throttle solenoid valve circuit is being energized by the ECM. Off indicates the intake throttle solenoid valve is not being commanded On by the ECM.

Exhaust Brake Solenoid Command

This parameter displays the commanded state of the exhaust brake solenoid valve control circuit (pin 40). The Tech 2 will display On or Off. On indicates the exhaust brake solenoid valve circuit is being energized by the ECM. Off indicates the exhaust brake solenoid valve is not being commanded On by the ECM.

ABS Input Signal

This parameter displays the input status of the exhaust brake cut request from the EHCU (ABS unit) to the ECM terminal (pin 32). The Tech 2 will display On or Off. On indicates the EHCU is commanding to the ECM to release the exhaust brake. Off indicates the EHCU is not being commanded.

ABS Output Signal

This parameter displays a feedback (output) signal of exhaust brake cut request from the ECM terminal (pin 62) to the EHCU (ABS unit). On indicates the ECM is commanding to the EHCU to return a feedback signal. Off indicates the ECM is not being commanded.

Vehicle Speed

This parameter displays the vehicle speed calculated by the ECM based on an input from the vehicle speed sensor (VSS). The Tech 2 will display a high value at higher vehicle speeds, and low value at lower vehicle speeds.

Glow Relay Command

This parameter displays the commanded state of the glow plug relay control circuit (pin 94). The Tech 2 will display On or Off. On indicates the glow plug relay control circuit is being grounded by the ECM, allowing voltage to the glow plugs. Off indicates the glow plug relay is not being commanded On by the ECM.

Glow Indicator Lamp Command

This parameter displays the commanded state of the glow indicator lamp control circuit (pin 43). The glow indicator lamp should be On when the Tech 2 indicates On. The glow indicator should be Off when the Tech 2 indicates Off.

Malfunction Indicator Lamp (MIL) Command

This parameter displays the commanded state of the malfunction indicator lamp (MIL) control circuit (pin 42). The MIL should be On when the Tech 2 indicates On. The MIL should be Off when the Tech 2 indicates Off. The ECM will command the MIL On for a certain length of time when the ignition is On with the engine Off in order to perform a bulb check.

A/C Request Signal

This parameter displays the state of the air conditioning (A/C) request input to the ECM terminal (pin 33) from the heating, ventilation, and air conditioning (HVAC) controls. The Tech 2 will display On or Off. On indicates the ECM is receiving a request from the HVAC system to ground the A/C compressor relay control circuit, engaging the A/C compressor clutch. Off indicates the ECM is not receiving a request from the HVAC system.

A/C Relay Command

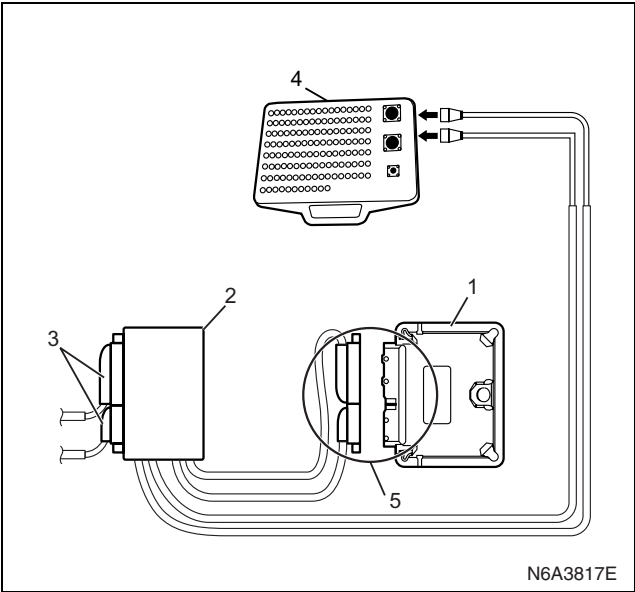
This parameter displays the commanded state of the A/C compressor relay control circuit (pin 41). The Tech 2 will display On or Off. On indicates the A/C compressor relay control circuit is being grounded by the ECM, allowing voltage to the A/C compressor clutch. Off indicates the A/C compressor relay is not being commanded On by the ECM.

Tech 2 Output Controls

Tech 2 Output Control	Additional Menu Selection(s)	Descriptions
EGR Solenoid Valve	Solenoids	The purpose of this test is for checking whether the EGR valve is correctly moved with command. Restricted valve movement by foreign materials, excessive deposits, a faulty vacuum hose routing, a faulty EGR valve or a faulty EGR solenoid could be considered if the mass air flow (MAF) sensor is not changed when commanded ON or OFF.
Engine Speed (RPM) Control	—	The purpose of this test is for checking whether the actual engine idle speed can change to match the commanded RPM.
Glow Indicator	Lamps	The purpose of this test is for checking whether the glow indicator lamp is operating when commanded ON. Faulty circuit(s) or an open bulb could be considered if not operating when commanded ON.
Glow Relay	Relays	The purpose of this test is for checking whether the glow relay is operating when commanded ON. Faulty circuit(s) or a faulty glow relay could be considered if not energizing when commanded ON.
Malfunction Indicator Lamp	Lamps	The purpose of this test is for checking whether the malfunction indicator lamp (MIL) is operating when commanded ON. Faulty circuit(s) or an open bulb could be considered if not operating when commanded ON.

Breaker Box

Breaker Box Connection Type A

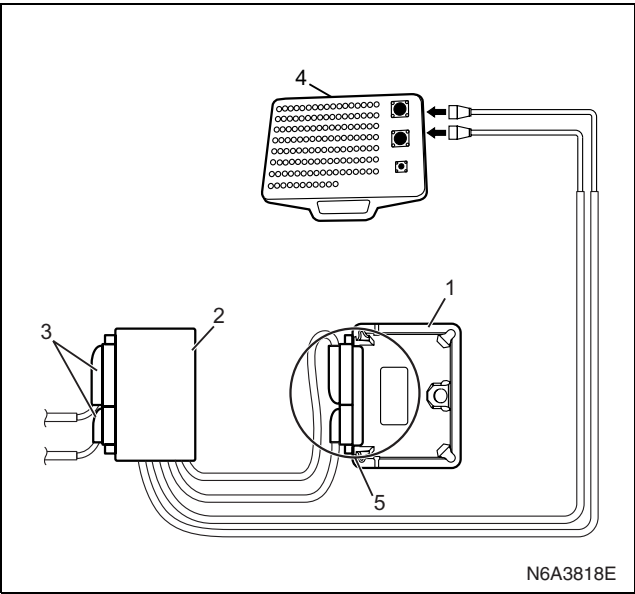


Legend

- 1. Engine Control Module (ECM)
- 2. Harness Adapter
- 3. ECM – Harness Connector
- 4. Breaker Box
- 5. ECM disconnected

Although probe to the engine control module (ECM) harness connector is possible by Test Adapter, Breaker Box Connection Type A is suitable usage to prevent misprobe and damage of female terminals when test open circuit or short to ground between the ECM and electrical components, since the terminals where the harness connector of the ECM is thin have gathered.

Breaker Box Connection Type B



Legend

- 1. Engine Control Module (ECM)
- 2. Harness Adapter
- 3. ECM – Harness Connector
- 4. Breaker Box
- 5. ECM disconnected

The ECM and other connectors have water proof terminal that is not allowed to back probe. Breaker Box Connection Type B is suitable usage to test short to voltage circuit or signal check between the ECM and electrical components.

Engine Control System Check Sheet

ENGINE CONTROL SYSTEM CHECK SHEET		Inspectors Name	
Customer's Name		Model & Model Year	
Driver's Name		Chassis No.	
Date Vehicle Brought In		Engine No.	
License No.		Odometer Reading	Km/miles
Problem Symptoms	☐ Engine Does Not Run	☐ Engine does not crank	☐ No initial combustion ☐ No complete combustion
	☐ Hard Start	☐ Engine cranks slowly	☐ Other ()
	☐ Incorrect Idle	☐ Abnormal idling speed ☐ Rough idling ☐ Other ()	☐ High idling speed (RPM) ☐ Low idling speed (RPM)
	☐ Poor Driveability	☐ Hesitation, sag, stumble ☐ Surge, chuggles ☐ Cut out, misses	☐ Lack of power, sluggishness, sponginess ☐ Other ()
	☐ Engine Stall	☐ Soon after starting ☐ During A/C operation ☐ Other ()	☐ After accelerator pedal depressed ☐ After accelerator pedal released ☐ Shifting from N to D
	☐ Others	☐ Black smoke ☐ White smoke ☐ Poor fuel economy	☐ Fuel knock, combustion noise ☐ Other ()
Dates problem occurred			
Problem frequency	☐ Constant ☐ Intermittently (times per day/month) ☐ Once only	☐ Other ()	
Condition When Problem Occurs	Weather	☐ Fine ☐ Cloudy ☐ Rainy ☐ Snow	☐ Various/Other ()
	Outside Temperature	☐ Hot (approx.) ☐ Warm ☐ Cool ☐ Cold (approx.)	☐ Any temperature
	Place	☐ Highway ☐ Suburbs ☐ City area ☐ Uphill	☐ Downhill ☐ Rough road ☐ Other ()
	Load Condition	☐ Over (approx. tons) ☐ No load	☐ Other (approx. tons)
	Engine Temperature	☐ Cold ☐ Warming up ☐ After warming up ☐ Any temperature	☐ Other ()
	Engine Operation	☐ Starting ☐ Just after starting (Min.) ☐ Idling	☐ Racing ☐ Driving ☐ Constant speed ☐ Acceleration
		☐ Deceleration ☐ A/C switch On/Off	☐ Other ()
	Fuel Amount	☐ Full ☐ Above 1/2 ☐ Below 1/2 ☐ Near empty	
Fuel Bland			
Condition of MIL		☐ Remains On ☐ Intermittently turns On ☐ Does not turn On	
Diagnostic Trouble Code (DTC) or Flash Code	Present Code	☐ Nothing ☐ P Code & Symptom Code No. ()	
	History Code	☐ Nothing ☐ P Code & Symptom Code No. ()	
Other Additional Condition			

Diagnostic Starting Point – Engine Controls

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

- The identification of the control modules which command the system.
- The ability of the control modules to communicate through the serial data circuit.
- The identification of any stored diagnostic trouble codes (DTCs) and their statuses.

The use of the Diagnostic System Check – Engine Controls will identify the correct procedure for diagnosing the system and where the procedure is located.

Important:

Engine Control System Check Sheet must be used to verify the customer complaint, you need to know the correct (normal) operating behavior of the system and verify that the customer complaint is a valid failure of the system.

Diagnostic System Check – Engine Controls

Description

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

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2. Lack of communication may be because of a partial or a total malfunction of the Keyword 2000 serial data circuit. The specified procedure determines the particular condition.

11. If there are other modules with DTCs set, refer to the DTC list. The DTC list directs you to the appropriate diagnostic procedure. If the control module stores multiple DTCs, diagnose the DTCs in the following order.

- Component level DTCs, such as sensor DTCs, solenoid DTCs, actuator DTCs, and relay DTCs. Diagnose the multiple DTCs within this category in numerical order. Begin with the lowest numbered DTC, unless the diagnostic table directs you otherwise.

Diagnostic System Check – Engine Controls

Important:

- DO NOT perform this diagnostic if there is not a driveability concern, unless another procedure directs you to this diagnostic.
- Before you proceed with diagnosis, search for applicable service bulletins.
- Unless a diagnostic procedure instructs you, DO NOT clear the DTCs.
- If there is a condition with the starting system, refer to the starting system section in the engine mechanical.
- Ensure the battery has a full charge.
- Ensure the battery cables (+) (-) are clean and tight.
- Ensure the ECM grounds are clean, tight, and in the correct location.
- Ensure the ECM harness connectors are clean and correctly connected.
- Ensure the ECM terminals are clean and correctly mating.
- Ensure the fuel injection pump control unit (PCU) ground is clean, tight, and in the correct location.
- Ensure the PCU harness connectors are clean and correctly connected.
- Ensure the PCU terminals are clean and correctly mating.
- Ensure the vehicle maintenance has been done enough.

Step	Action	Value(s)	Yes	No
1	Install the Tech 2. Does the Tech 2 turn ON?	—	Go to Step 2	Go to Tech 2 Does Not Power Up
2	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with the engine control module (ECM). Does the Tech 2 communicate with the ECM?	—	Go to Step 3	Go to Lost Communication with The Engine Control Module (ECM)

Step	Action	Value(s)	Yes	No
3	Attempt to start the engine. Does the engine start and idle?	—	Go to Step 4	Go to Engine Cranks but Does Not Run
4	Select the DTC display function of the ECM. Does the Tech 2 display any DTCs?	—	Go to Step 5	Go to Step 12
5	1. Turn OFF the ignition for 30 seconds. 2. Start the engine. 3. Monitor the DTC Information with the Tech 2. Did you complete the action?	—	Go to Step 6	—
6	Does the Tech 2 display ECM DTC P0602?	—	Go to Applicable DTC	Go to Step 7
7	Does the Tech 2 display ECM DTC P0251 (Symptom Code 9 or A), P0606 (Symptom Code A or B) or P1605 (Symptom Code C, D or E)?	—	Go to Applicable DTC	Go to Step 8
8	Does the Tech 2 display ECM DTC P0560 (Symptom Code 1, 2 or A)?	—	Go to Applicable DTC	Go to Step 9
9	Does the Tech 2 display ECM DTC P0561 (Symptom Code A or B) or P1625 (Symptom Code A or B)?	—	Go to Applicable DTC	Go to Step 10
10	Does the Tech 2 display ECM DTC P1650 (Symptom Code A or B) or P1651 (Symptom Code A or B)?	—	Go to Applicable DTC	Go to Step 11
11	Is there any other code in any controller that has not been diagnosed?	—	Go to Applicable DTC	Go to Step 12
12	1. Review the following symptoms. 2. Refer to the applicable symptom diagnostic table: • Hard Start • Rough, Unstable, or Incorrect Idle and Stalling • Cuts Out, Misses • Surge/Chuggles • Lack of Power, Sluggishness, or Sponginess • Hesitation, Sag, Stumble • Fuel Knock/Combustion Noise • Poor Fuel Economy • Excessive Smoke (Black Smoke) • Excessive Smoke (White Smoke) Did you find and correct the condition?	—	System OK	Go to Intermittent Conditions

Tech 2 Does Not Power Up

Circuit Description

The data link connector (DLC) is a standardized 16-cavity connector. Connector design and location is dictated by an industry wide standard, and is required to provide the following:

- Tech 2 power battery positive voltage at terminal 16.
- Tech 2 power ground at terminal 4.

- Common signal ground at terminal 5.

The Tech 2 will power up with the ignition OFF. Some modules however, will not communicate unless the ignition is ON.

Tech 2 Does Not Power Up

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views

Step	Action	Value(s)	Yes	No
1	Important: Make sure the Tech 2 works properly on another vehicle before using this chart. 1. Turn OFF the ignition. 2. Inspect the ENG(B1)(B2) (15A) fuse (F-8 & F-9) in the glove box fuse block. Is the ENG(B1)(B2) (15A) fuse (F-8 & F-9) open?	—	Go to Step 2	Go to Step 3
2	Replace the ENG(B1)(B2) (15A) fuse (F-8 & F-9). If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the ENG(B1)(B2) (15A) fuse (F-8 & F-9) or replace the shorted attached component fed by the ENG(B1)(B2) (15A) fuse (F-8 & F-9). Did you complete the repair?	—	Go to Step 7	—
3	1. Check each circuit at the data link connector (DLC) (B-79 connector) for a backed out, spread or missing terminal. 2. Repair the terminal as necessary. Did you find and complete the repair?	—	Go to Step 7	Go to Step 4
4	Connect a test lamp between the B+ circuit (pin 16 of B-79 connector) at the DLC and a known ground. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 5
5	Repair the open in the battery voltage circuit to the DLC. Did you complete the repair?	—	Go to Step 7	—
6	1. Test each ground circuit at the DLC (pins 4 and 5 of B-79 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Intermittent Conditions
7	1. Connect the Tech 2 to the DLC. 2. Attempt to turn ON the Tech 2. Does the Tech 2 ON?	—	System OK	Go to Step 1

Lost Communication with The Engine Control Module (ECM)

Circuit Description

The engine control module (ECM) communicates with the Tech 2 over the Keyword 2000 serial data link. However, the ECM and fuel injection pump control unit (PCU) communicates with each other over the controller area network (CAN) link. The CAN link is not used for communication with the Tech 2 and is shared only between the ECM and PCU.

Diagnostic Aids

The following conditions will cause a loss of Keyword 2000 serial data communication between the Tech 2 and any control module:

- A Keyword 2000 serial data circuit open.
- A Keyword 2000 serial data circuit shorted to ground.

- A Keyword 2000 serial data circuit shorted to voltage.
- An internal condition within a module or connector on the Keyword 2000 serial data circuit, that causes a short to voltage or ground to the Keyword 2000 serial data circuit.
- Open ground circuit (pin 5) at the DLC.

Lost Communication with The Engine Control Module (ECM)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	Attempt to establish engine control module (ECM) communications with the Tech 2. Does the ECM communicate with the Tech 2?	—	Go to Step 3	Go to Step 4
3	Test the Keyword 2000 serial data circuit for an intermittently short to ground or intermittently short to voltage. Did you find and correct the condition?	—	Go to Step 17	System OK
4	Check the ECM B-234 and B-233 connectors for poor connections. Did you find and correct the condition?	—	Go to Step 17	Go to Step 5
5	1. Turn ON the ignition, with the engine OFF. 2. Check the Main (100A) (SBF-1), Key (50A) (SBF-2) and ENG(B1)(B2) (15A) fuse (F-8 & F-9). Replace and retest if open. If any fuse continues to open, check for a short to ground on each circuit fed by that fuse. 3. Turn OFF the ignition. 4. Disconnect the ECM B-234 harness connector. 5. Turn ON the ignition, with the engine OFF. 6. Connect a test lamp to ground and check for voltage at the ignition voltage supply circuit at the ECM (pin 39 of B-234 connector). Does the test lamp illuminate?	—	Go to Step 6	Go to Step 14
6	Test the data link connector (DLC) ground circuit at terminal 5 for an open circuit or poor connection. Did you find and correct the condition?	—	Go to Step 17	Go to Step 7
7	Test the Keyword 2000 serial data circuit between the ECM (pin 35 of B-234 connector) and the DLC (pin 7 of B-79 connector) for a short to ground or voltage. Did you find and correct the condition?	—	Go to Step 17	Go to Step 8

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Step	Action	Value(s)	Yes	No
8	Important: An open in a ground circuit at the ECM will not cause a loss of communication. 1. Check ECM ground for corrosion and tightness. 2. Clean or tighten grounds as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 9
9	1. Turn OFF the ignition. 2. Reconnect the ECM harness connector if previously disconnected. 3. Turn ON the ignition, with the engine OFF. 4. Replace the ECM main relay with the horn relay or replace with a known good relay. 5. Attempt to establish Tech 2 communications with the ECM. Does the ECM communicate with the Tech 2?	—	Go to Step 15	Go to Step 10
10	1. Turn OFF the ignition. 2. Remove the ECM main relay. 3. Turn ON the ignition, with the engine OFF. 4. Using a test lamp, check for battery voltage at both of the battery voltage supply circuits to the ECM main relay (pins 1 and 2 of X-14 connector). 5. Repair the open in the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 11
11	1. Reinstall the ECM main relay. 2. Turn the ignition ON and OFF while listening or feeling for the ECM main relay click. Wait 2 seconds between transitions. Does the ECM main relay click when the ignition is turned ON or OFF?	—	Go to Step 13	Go to Step 12
12	Repair the ECM main relay control circuit between the ECM main relay (pin 4 of X-14 connector) and the ECM (pin 58 of B-234 connector) for the following conditions: • An open circuit • A short to battery or ignition voltage • High resistance or a poor connection at both the ECM and ECM main relay Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
13	1. Check ECM main relay voltage supply circuit to the ECM between the ECM main relay (pin 5 of X-14 connector) and the ECM (pin 3 of B-234 connector) for the following conditions: • An open circuit • High resistance or a poor connection at the ECM and ECM main relay 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
14	Repair the open in the ignition voltage circuit to the ECM. Did you complete the repair?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
15	Replace the ECM main relay. Did you complete the replacement?	—	Go to Step 17	—
16	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 17	—
17	1. Turn OFF the ignition. 2. Reconnect all disconnected connectors. 3. Turn ON the ignition, with the engine OFF. 4. Attempt to establish Tech 2 communications with the ECM. Does the Tech 2 communicate with the ECM?	—	System OK	Go to Step 3

Engine Cranks but Does Not Run

Description

The Engine Cranks but Does Not Run diagnostic table is an organized approach to identifying a condition that causes an engine to not start. The diagnostic table directs the service technician to the appropriate system diagnosis. The diagnostic table assumes the following conditions are met:

- The battery is completely charged and terminals are cleaned and tight.
- The engine cranking speed is normal.

- There is adequate fuel in the fuel tank.
- There is no fuel leak in the fuel line.
- There is no air in the fuel line.
- Filters (Air, Fuel) are clean.
- Fuse and slow blow fuse are normal.

Diagnostic Aids

If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Engine Cranks but Does Not Run

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Crank the engine for specified amount of time. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the Tech 2 display any DTCs that failed this ignition?	15 seconds	Go to Diagnostic Trouble Code (DTC) List	Go to Step 3
3	1. Check for normal readings at key up for the following inputs and output: Refer to the Tech 2 Data List or a known good vehicle to determine normal values. • System Voltage • Engine Coolant Temperature (ECT) • Intake Air Temperature (IAT) • Mass Air Flow (MAF) Sensor • Barometric Pressure 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 4

Step	Action	Value(s)	Yes	No
4	- Inspect the high pressure side between the fuel injection pump and the fuel injection nozzles for fuel leakage. The following components may contain an external leak. - Fuel injection pump - Fuel injection pump control unit (PCU) - Fuel injection solenoid valve - Timing control valve (TCV) - Constant pressure valve (CPV) - Fuel pipe between the fuel injection pump and fuel injection nozzles - Each fuel pipe sleeve nuts - Each fuel pipe connectors - Each gaskets Notice: Fuel may leak into the engine from the fuel injection pump. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil. - Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 5
5	- Turn OFF the ignition. - Check the fuel system line connections between the fuel tank and the fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. - Pump the priming pump on the fuel filter until it becomes firm. If there is a leak on the suction side of the fuel system between the priming pump and the fuel injection pump, the priming pump will not build up sufficient firmness and fuel leakage may occur. - Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 6
6	- Remove the fuel hose that connects to the fuel injection pump suction side. - Remove the fuel pipe connector that connects to the fuel injection pump suction side. - Inspect the eye bolt for any type of restriction or collapsed gauze filter. Notice: If any type of restriction found, check for a condition that causes contaminated fuel, such as the customer is using an aftermarket fuel filter or extended maintenance interval. Also inspect fuel waxing or icing that is caused by an incorrect fuel type used in winter season or water intrusion in the fuel system. - Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 7

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Step	Action	Value(s)	Yes	No
7	1. Disconnect the fuel hose that connects to the fuel injection pump suction side. In order to measure the discharged fuel amount, put the hose into a bottle or a container. 2. Pump the priming pump on the fuel filter. Notice: If there is a leak on the suction side of the fuel system, the fuel from the disconnected hose will not flow out sufficiently and fuel leakage may occur. Also if there is a restriction on the suction side of the fuel system, the fuel from the disconnected hose will not flow out sufficiently that is most likely caused by clogged fuel filter or kinked fuel hose or pipe. 3. Draw fuel from the fuel tank at the fuel line (as close to the fuel tank as possible) going to the fuel pickup tube to verify a clean stream of fuel comes out (use the hand-held vacuum pump 5-8840-0279-0/J-23738-A with a clear hose or equivalent). This will ensure the fuel pickup tube is not cracked drawing air into the fuel line. 4. Repair any fuel system leaks and restrictions as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
8	1. Other possible causes for the no-start condition: • Fuel injection pump mechanical timing incorrect • Flywheel installed incorrectly causing the crankshaft position (CKP) sensor to be incorrectly timed to the engine. Disconnect sensor and attempt to start engine to verify. • Heavily restricted intake, exhaust or catalytic converter plugged solid • Poor engine compression • Water or gasoline contamination in fuel 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 9
9	Important: The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 10	—
10	1. Reconnect all previously disconnected harness connector(s). 2. Turn OFF the ignition for 30 seconds. 3. Attempt to start the engine. Does the engine start and continue to run?	—	Go to Step 11	Go to Step 2
11	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

Diagnostic Trouble Code (DTC) List

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on Tech 2	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0100 (7)	65	ON	Mass Air Flow (MAF) Sensor Circuit 5V Reference High Voltage	The ignition switch is ON.	The ECM detects that the MAF sensor 5 volts reference circuit voltage is more than 5.2 volts for 0.5 seconds.	- Sensor 5V reference circuit is short to battery or ignition voltage. - Sensor 5V reference circuit is short to the sensor ignition voltage circuit. - Faulty MAF sensor. - Faulty ECM.
P0100 (9)	65	ON	Mass Air Flow (MAF) Sensor Voltage 5V Reference Circuit Low Voltage	The ignition switch is ON.	The ECM detects that the MAF sensor 5 volts reference circuit voltage is less than 4.6 volts for 0.5 seconds.	- Sensor 5V reference circuit is short to ground. - Sensor 5V reference circuit is short to the low reference circuit. - Faulty MAF sensor. - Faulty ECM.
P0100 (B)	65	ON	Mass Air Flow (MAF) Sensor Circuit Low Voltage	- The ignition switch is ON. - The engine is running.	The ECM calculated MAF is lower than -18.6 kg/h for 5 seconds.	- Sensor ignition voltage feed circuit is open circuit or high resistance. - Sensor 5V reference circuit is open circuit, high resistance, short to ground or short to the low reference circuit. - Sensor signal circuit is open circuit, high resistance, short to ground or short to the low reference circuit. - Poor harness connector connection. - Faulty MAF sensor installation. - Faulty MAF sensor. - Faulty ECM.
P0100 (C)	65	ON	Mass Air Flow (MAF) Sensor Circuit High Voltage	- The ignition switch is ON. - The engine is running.	The ECM calculated MAF is higher than 806 kg/h for 10 seconds.	- Sensor signal circuit is short to any 5V reference circuit, short to battery or ignition voltage circuit. - Sensor low reference circuit is open circuit or high resistance. - Poor harness connector connection. - Faulty MAF sensor. - Faulty ECM.

6E-44 Engine Control System (4JH1)

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on Tech 2	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0110 (1)	23	ON	Intake Air Temperature (IAT) Sensor Circuit High Voltage	The ignition switch is ON.	The ECM detects that the IAT sensor signal voltage is more than 4.7 volts for 3 seconds.	- Sensor signal circuit is open circuit, high resistance, short to any 5V reference circuit, short to battery or ignition voltage. - Sensor low reference circuit is open circuit or high resistance. - Poor harness connector connection. - Faulty IAT sensor. - Faulty ECM.
P0110 (2)	23	ON	Intake Air Temperature (IAT) Sensor Circuit Low Voltage	The ignition switch is ON.	The ECM detects that the IAT sensor signal voltage is less than 0.3 volts for 3 seconds.	- Sensor signal circuit is short to ground or short to the low reference circuit. - Faulty IAT sensor. - Faulty ECM.
P0115 (1)	14	ON	Engine Coolant Temperature (ECT) Sensor Circuit High Voltage	The ignition switch is ON.	The ECM detects that the ECT sensor signal voltage is more than 4.7 volts for 3 seconds.	- Sensor signal circuit is open circuit, high resistance, short to any 5V reference circuit, short to battery or ignition voltage. - Sensor low reference circuit is open circuit or high resistance. - Poor harness connector connection. - Faulty ECT sensor. - Faulty ECM.
P0115 (2)	14	ON	Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage	The ignition switch is ON.	The ECM detects that the ECT sensor signal voltage is less than 0.3 volts for 3 seconds.	- Sensor signal circuit is short to ground or short to the low reference circuit. - Faulty ECT sensor. - Faulty ECM.
P0180 (B)	15	ON	Fuel Temperature Sensor Circuit	The ignition switch is ON.	The PCU internal FT sensor output is lower than -40°C (-40°F) for 3 seconds or higher than 150°C (302°F) for 3 seconds.	Faulty PCU.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on Tech 2	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0215 (A)	52	ON at next igni- tion cycle	Engine Shutoff (ESO) Solenoid Control Circuit	- The ignition switch is OFF. - The engine speed is lower than 1500 RPM. - The vehicle speed is lower than 1.5 km/h (1 MPH).	After the condition for running the DTC for 2 seconds, the engine speed is higher than 200 RPM when the ESO solenoid valve is commanded shutoff from the PCU.	Faulty fuel injection pump.
P0215 (B)	52	ON	Engine Shutoff (ESO) Solenoid Control Circuit	The ignition switch is ON.	The PCU detects high voltage condition on the ESO solenoid valve control circuit for longer than 1 second when the ECM does not command shutoff.	- ESO solenoid valve control circuit is short to battery or ignition voltage. - Faulty PCU. - Faulty ECM.
P0215 (C)	52	ON	Engine Shutoff (ESO) Solenoid Control Circuit	- The ignition switch is OFF. - The engine speed is lower than 1500 RPM. - The vehicle speed is lower than 1.5 km/h (1 MPH).	The engine speed is higher than 200 RPM within 2 seconds after the condition for running the DTC are met.	- ESO solenoid valve control circuit is open circuit, high resistance or short to ground. - Faulty PCU. - Faulty ECM.
P0215 (D)	52	ON	Engine Shutoff (ESO) Solenoid Control Circuit	The ignition switch is OFF.	The ECM detects internal CAN controller does not Bus OFF mode.	Faulty ECM.
P0216 (A)	54	ON	Injection Timing Control Circuit	- The engine speed is higher than 700 RPM. - The fuel injection quantity is higher than 4 mg/strk.	The PCU monitored actual fuel injection timing is advanced more than desired by 3°CA for longer than 12 seconds or retarded more than desired by 6°CA for longer than 12 seconds.	- Excessive air in the fuel system. - Loss fuel. - Fuel suction side looseness, kinks or blocked. - Faulty or clogged fuel filter. - Contaminated fuel. - Faulty timing device. - Faulty fuel injection pump CMP sensor.

6E-46 Engine Control System (4JH1)

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on Tech 2	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0216 (B)	54	ON	Injection Timing Control Circuit	The engine speed is higher than 2014 RPM.	The PCU monitored actual fuel injection timing is oscillated higher than desired by 5.2°CA.	- Excessive air in the fuel system. - Loss fuel. - Fuel suction side looseness, kinks or blocked. - Faulty or clogged fuel filter. - Contaminated fuel. - Faulty timing device. - Faulty fuel injection pump CMP sensor.
P0251 (6)	53	ON	Injection Pump Fuel Metering Control	- The fuel injection pump CMP sensor signal is generated. - The CAN communication between the ECM and PCU is normal.	The PCU detects that the fuel injection solenoid valve is operated when the desired fuel injection quantity is commanded 0 mg/strk.	- Faulty fuel injection pump. - Faulty PCU.
P0251 (7)	53	ON	Injection Pump Fuel Metering Control	- The fuel injection pump CMP sensor signal is generated. - The CKP sensor signal is generated. - The engine speed is higher than 500 RPM.	The PCU detects that the doubled fuel injection pump speed is lower than engine speed by 800 RPM for longer than 0.2 seconds.	- Faulty CKP sensor signal. - Faulty fuel injection pump CMP sensor signal. - Electrical interference. - Magnetic interference. - Faulty PCU.
P0251 (9)	53	ON	Injection Pump Fuel Metering Control	The ignition switch is ON.	The PCU detects internal fuel injection pump control maps are not programmed during self-test.	Faulty PCU.
P0251 (A)	53	ON	Injection Pump Fuel Metering Control	The ignition switch is ON.	The PCU detects internal EEPROM or A/D converter is failed during self-test.	Faulty PCU.
P0251 (B)	53	ON	Injection Pump Fuel Metering Control	The ignition switch is ON.	The PCU detects that the fuel injection solenoid valve drive circuit is failed during self-test.	- Faulty fuel injection pump. - Faulty PCU.
P0251 (D)	53	ON	Injection Pump Fuel Metering Control	The ignition switch is ON.	The PCU detects that the fuel injection solenoid valve drive circuit voltage level is abnormal during self-test.	- Faulty fuel injection pump. - Faulty PCU.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on Tech 2	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0251 (E)	53	ON	Injection Pump Fuel Metering Control	The ignition switch is ON.	The ECM detects communication message from the PCU is not received for longer than 1 second.	- CAN high circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. - CAN low circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. - Electrical interference. - Magnetic interference. - Faulty PCU. - Faulty ECM.
P0335 (B)	43	ON	Crankshaft Position (CKP) Sensor Circuit	- The ignition switch is ON. - The engine speed is higher than 665 RPM.	The ECM detects extra or missing CKP sensor signals while engine is running.	- Sensor signal circuit is open circuit, high resistance, short to ground, short to battery or short to ignition voltage. - Sensor low reference circuit is open circuit, high resistance, short to ground, short to battery or short to ignition voltage. - Sensor shield ground is open circuit, high resistance, short to ground, short to battery or short to ignition voltage. - Faulty CKP sensor. - Faulty ECM. - Electrical interference. - Magnetic interference. - Faulty sensor installation. - Faulty flywheel circumference.

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DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on Tech 2	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0335 (D)	43	ON	Crankshaft Position (CKP) Sensor Circuit	- DTC P0335 (Symptom Code B) is not set. - The ignition switch is ON. - The fuel injection pump CMP sensor signal is generated. - The CAN communication between the ECM and PCU is normal.	The ECM detects that the CKP sensor signals are not generated when doubled fuel injection pump rotation speed is higher than 50 RPM.	- Sensor signal circuit is open circuit, high resistance, short to ground, short to battery or short to ignition voltage. - Sensor low reference circuit is open circuit, high resistance, short to ground, short to battery or short to ignition voltage. - Sensor shield ground is open circuit, high resistance, short to ground, short to battery or short to ignition voltage. - Faulty CKP sensor. - Faulty ECM. - Electrical interference. - Magnetic interference. - Faulty sensor installation. - Faulty flywheel circumference.
P0335 (E)	43	ON	Crankshaft Position (CKP) Sensor Circuit	The ignition switch is ON.	The ECM detects that the engine speed is higher than 5700 RPM for 0.2 seconds.	- Engine overrun. - Faulty CKP sensor. - Faulty ECM. - Electrical interference. - Magnetic interference. - Faulty flywheel circumference.
P0380 (4)	66	ON	Glow Plug Relay Control Circuit Low Voltage	The ignition switch is ON.	The ECM detects that the low voltage condition on the glow relay control circuit for longer than 3 seconds when the relay is commanded OFF.	- Glow relay ignition voltage feed circuit on coil side is open circuit or high resistance. - Glow relay control circuit is open circuit, high resistance or short to ground. - Glow relay is poor installation. - Faulty glow relay. - Faulty ECM.
P0380 (8)	66	ON	Glow Plug Relay Control Circuit High Voltage	The ignition switch is ON.	The ECM detect that the high voltage condition on the glow relay control circuit for longer than 1 second when the relay is commanded ON.	- Glow relay control circuit is short to battery or ignition voltage circuit. - Faulty glow relay. - Faulty ECM.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on Tech 2	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0381 (4)	67	ON	Glow Plug Indicator Circuit Low Voltage	The ignition switch is ON.	The ECM detects that the low voltage condition on the glow indicator lamp control circuit for longer than 3 seconds when the indicator lamp is commanded OFF.	- Meter (10A) fuse (F-16) open. - Glow indicator lamp ignition voltage feed circuit is open circuit or high resistance. - Glow indicator lamp control circuit is open circuit, high resistance or short to ground. - Poor harness connector connection. - Glow indicator lamp bulb burned out. - Faulty instrument panel cluster (meter assembly). - Faulty ECM.
P0381 (8)	67	ON	Glow Plug Indicator Circuit High Voltage	The ignition switch is ON.	The ECM detects that the high voltage condition on the glow indicator lamp control circuit for longer than 1 second when the indicator lamp is commanded ON.	- Glow indicator lamp control circuit is short to battery or ignition voltage circuit. - Faulty instrument panel cluster (meter assembly). - Faulty ECM.
P0400 (3)	32	ON	Exhaust Gas Recirculation (EGR) System Performance	- The ignition switch is ON. - The engine is running. - The BARO is between 880 hPa and 1100 hPa. - The IAT is between 16°C (61°F) and 34°C (93°F). - The ECT is between 70°C (158°F) and 100°C (212°F).	The ECM detects that the MAF amount is 150 mg/stk lower than the desired MAF for 60 seconds.	- MAF sensor circuits are high resistance. - MAF sensor signal circuit is short to IAT sensor signal circuit. - Intake air leakage. - Intake duct disconnected. - Intake system is obstructed. - Faulty turbocharger. - Faulty exhaust system. - Faulty EGR valve vacuum control system. - Faulty EGR valve. - Faulty EGR solenoid valve. - Faulty EGR solenoid valve vacuum hose routing. - Faulty MAF sensor.

6E-50 Engine Control System (4JH1)

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on Tech 2	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0400 (4)	32	ON	Exhaust Gas Recirculation (EGR) Solenoid Circuit Low Voltage	The ignition switch is ON.	The ECM detects that the low voltage condition on the EGR solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded OFF.	- EGR solenoid valve ignition voltage feed circuit is open circuit or high resistance. - EGR solenoid valve control circuit is open circuit, high resistance or short to ground. - Poor harness connector connection. - Faulty EGR solenoid valve. - Faulty ECM.
P0400 (5)	32	ON	Exhaust Gas Recirculation (EGR) System Performance	- The ignition switch is ON. - The engine is running. - The BARO is between 880 hPa and 1100 hPa. - The IAT is between 16°C (61°F) and 34°C (93°F). - The ECT is between 70°C (158°F) and 100°C (212°F).	The ECM detects that the MAF amount is 150 mg/stk higher than the desired MAF for 60 seconds.	- MAF sensor low reference circuit is high resistance. - Faulty EGR valve vacuum control system. - Faulty EGR valve. - Faulty vacuum pump. - Faulty EGR solenoid valve. - Faulty EGR solenoid valve vacuum hose routing. - Faulty MAF sensor. - Faulty ECM.
P0400 (8)	32	ON	Exhaust Gas Recirculation (EGR) Solenoid Circuit High Voltage	The ignition switch is ON.	The ECM detects that the high voltage condition on the EGR solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded ON.	- EGR solenoid valve control circuit is short to battery or ignition voltage circuit. - Faulty EGR solenoid valve. - Faulty ECM.
P0500 (1)	24	OFF	Vehicle Speed Sensor (VSS) Circuit	The ignition switch is ON.	The ECM detects that the vehicle speed is higher than 190 km/h (119 MPH) for 5 seconds.	- Vehicle speed too high. - Electrical interference. - Magnetic interference. - Faulty VSS. - Faulty ECM.
P0500 (A)	24	OFF	Vehicle Speed Sensor (VSS) Circuit	The ignition switch is ON.	The ECM detects that the vehicle speed sensor signal frequency is too high for 0.6 seconds.	- Electrical interference. - Magnetic interference. - Faulty VSS. - Faulty ECM.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on Tech 2	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0500 (B)	24	OFF	Vehicle Speed Sensor (VSS) Circuit	- The ignition switch is ON. - The engine speed is higher than 3600 RPM. - The fuel injection quantity is more than 41 mg/strk.	The ECM detects that the vehicle speed is lower than 1.5 km/h (1 MPH) for 60 seconds.	- Meter (10A) fuse (F-16) open. - Sensor ignition voltage circuit is open circuit or high resistance. - Sensor signal circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. - Sensor low reference circuit is open circuit or high resistance. - Poor harness connector connection. - Faulty instrument panel cluster (meter assembly). - Faulty VSS. - Faulty ECM.
P0560 (1)	35	OFF	System Voltage	—	The ECM detects that the battery voltage feed circuit voltage is more than 20 volts.	- Incorrect "Jump Starting". - Faulty charging system. - Faulty ECM.
P0560 (2)	35	OFF	System Voltage	—	The ECM detects that the battery voltage feed circuit voltage is less than 7 volts.	- Faulty charging system. - Battery voltage feed circuit is high resistance. - Faulty ECM.
P0560 (A)	35	OFF	System Voltage	—	The PCU battery voltage feed circuit voltage is less than 4.5 volts or more than 27 volts.	- Incorrect "Jump Starting". - Faulty charging system. - Battery voltage feed or ground circuit is high resistance. - Faulty PCU.
P0561 (A)	18	OFF	Ignition Switch Circuit	—	The ECM detects that the ignition voltage circuit is changed ON to OFF during initialization.	- ECM main relay control circuit is short to ground. - Ignition voltage feed circuit is intermittently open circuit or high resistance. - Faulty ignition switch.
P0561 (B)	18	OFF	Ignition Switch Circuit	—	The ECM detects internal ignition voltage feed circuit is failed after initialization.	Faulty ECM.
P0602 (25)	—	ON	Control Module Not Programmed	—	VIN in the ECM is not programmed.	VIN is not programmed.

6E-52 Engine Control System (4JH1)

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on Tech 2	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0606 (A)	28	ON	Control Module Internal Performance	—	The ECM detects that the internal CPU does not react.	Faulty ECM.
P0606 (B)	28	ON	Control Module Internal Performance	- The accelerator pedal position is less than 1%. - The desired fuel injection quantity is 0 mg/strk.	The ECM detects that the engine speed is higher than 2000 RPM.	Faulty ECM.
P0645 (4)	46	ON	Air Conditioning (A/C) Clutch Relay Control Circuit Low Voltage	- The ignition switch is ON. - The A/C compressor relay is once commanded ON.	The ECM detects that the low voltage condition on the A/C compressor relay control circuit for longer than 3 seconds when the relay is commanded OFF.	- A/C compressor relay ignition voltage feed circuit on coil side is open circuit or high resistance. - A/C compressor relay control circuit is open circuit, high resistance or short to ground. - A/C compressor relay is poor installation. - Faulty A/C compressor relay. - Faulty ECM.
P0645 (8)	46	ON	Air Conditioning (A/C) Clutch Relay Control Circuit High Voltage	- The ignition switch is ON. - The A/C compressor relay is once commanded ON.	The ECM detects that the high voltage condition on the A/C compressor relay control circuit for longer than 3 seconds when the relay is commanded ON.	- A/C compressor relay control circuit is short to battery or ignition voltage circuit. - Faulty A/C compressor relay. - Faulty ECM.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on Tech 2	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0703 (A)	25	ON	Brake Switch Circuit	- The ignition switch is ON. - The engine speed is higher than 1500 RPM. - The accelerator pedal position is more than 10%. - The vehicle speed is higher than 15 km/h (9 MPH).	The ECM detects that the brake pedal 1 switch is ON (Applied) when the brake pedal 2 switch is OFF (Released) for longer than 30 seconds within the enabling conditions ever since ignition switch is ON.	- Stop (15A) fuse (F-5) open. - Brake pedal 1 switch battery voltage feed circuit is open circuit or high resistance. - Brake pedal 1 switch signal circuit is open circuit, high resistance, short to battery or ignition voltage. - Brake pedal 2 switch ignition voltage feed circuit is open circuit or high resistance. - Brake pedal 2 switch signal circuit is open circuit, high resistance, short to battery or ignition voltage. - Misadjusted brake pedal switch. - Brake pedal switch is poor connection. - Faulty brake pedal switch. - Faulty ECM.
P0703 (B)	25	ON	Brake Switch Circuit	- The ignition switch is ON. - The engine speed is higher than 1500 RPM. - The accelerator pedal position is more than 10%. - The vehicle speed is higher than 15 km/h (9MPH).	The ECM detects that the brake pedal 1 switch is OFF (Released) when the brake pedal 2 switch is ON (Applied) for longer than 30 seconds.	- Stop (15A) fuse (F-5) open. - Brake pedal 1 switch battery voltage feed circuit is open circuit or high resistance. - Brake pedal 1 switch signal circuit is open circuit, high resistance, short to battery or ignition voltage. - Brake pedal 2 switch ignition voltage feed circuit is open circuit or high resistance. - Brake pedal 2 switch signal circuit is open circuit, high resistance, short to battery or ignition voltage. - Misadjusted brake pedal switch. - Brake pedal switch is poor connection. - Faulty brake pedal switch. - Faulty ECM.

6E-54 Engine Control System (4JH1)

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on Tech 2	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0704 (6)	57	ON	Clutch Switch Input Circuit	The ignition switch is ON.	The ECM detects that the clutch pedal switch signal does not change during the vehicle speed changes between 5 km/h (3MPH) and 80 km/h (50MPH).	- Clutch pedal switch ignition voltage feed circuit is open circuit or high resistance. - Clutch pedal switch signal circuit is open circuit, high resistance, short to battery or ignition voltage. - Misadjusted clutch pedal switch. - Clutch pedal switch is poor connection. - Faulty clutch pedal switch. - Faulty ECM.
P1105 (2)	86	ON	Barometric Pressure (BARO) Sensor Circuit High Voltage	The ignition switch is ON.	The ECM detects that the BARO sensor signal voltage is more than 4.4 volts for 1 second.	Faulty ECM.
P1105 (2)	86	ON	Barometric Pressure (BARO) Sensor Circuit Low Voltage	The ignition switch is ON.	The ECM detects that the BARO sensor signal voltage is less than 1.5 volts for 1 second.	Faulty ECM.
P1110 (4)	72	ON	Intake Throttle Solenoid Circuit Low Voltage	The ignition switch is ON.	The ECM detects that the low voltage condition on the intake throttle solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded OFF.	- Intake throttle solenoid valve ignition voltage feed circuit is open circuit or high resistance. - Intake throttle solenoid valve control circuit is open circuit, high resistance or short to ground. - Poor harness connector connection. - Faulty intake throttle solenoid valve. - Faulty ECM.
P1110 (8)	72	ON	Intake Throttle Solenoid Circuit High Voltage	The ignition switch is ON.	The ECM detects that the high voltage condition on the intake throttle solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded ON.	- Intake throttle solenoid valve control circuit is short to battery or ignition voltage circuit. - Faulty intake throttle solenoid valve. - Faulty ECM.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on Tech 2	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1120 (1)	21	ON	Accelerator Pedal Position (APP) Sensor Circuit High Voltage	The ignition switch is ON.	The ECM detects that the APP sensor signal voltage is more than 4.9 volts for 0.5 seconds.	- Sensor 5V reference circuit is short to battery or ignition voltage. - Sensor 5V reference circuit is short to ground or short to the low reference circuit. - Sensor signal circuit is short to any 5V reference circuit, short to battery or ignition voltage circuit. - Sensor low reference circuit is open circuit or high resistance. - Poor harness connector connection. - Faulty APP sensor. - Faulty ECM.
P1120 (2)	21	ON	Accelerator Pedal Position (APP) Sensor Circuit Low Voltage	The ignition switch is ON.	The ECM detects that the APP sensor signal voltage is less than 0.3 volts for 0.5 seconds.	- Sensor 5V reference circuit is open circuit, high resistance, short to ground or short to the low reference circuit. - Sensor signal circuit is open circuit, high resistance, short to ground or short to the low reference circuit. - Poor harness connector connection. - Faulty APP sensor. - Faulty ECM.
P1120 (7)	21	ON	Accelerator Pedal Position (APP) Sensor Circuit 5V Reference High Voltage	The ignition switch is ON.	The ECM detects that the APP sensor voltage supply circuit is more than 5.2 volts for 0.5 seconds.	- Sensor 5V reference circuit is short to battery or ignition voltage circuit. - Faulty ECM.
P1120 (9)	21	ON	Accelerator Pedal Position (APP) Sensor Circuit 5V Reference Low Voltage	The ignition switch is ON.	The ECM detects that the APP sensor voltage supply circuit is less than 4.6 volts for 0.5 seconds.	- Sensor 5V reference circuit is short to ground or short to the low reference circuit. - Faulty APP sensor. - Faulty ECM.

6E-56 Engine Control System (4JH1)

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on Tech 2	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1120 (D)	21	ON	Accelerator Pedal Position (APP) Sensor Circuit Correlation	- The ignition switch is ON. - The engine speed is higher than 1700 RPM. - The vehicle speed is higher than 1.5 km/h (1MPH).	The ECM detects APP sensor angle is stationary more than 18%, then brake pedal is depressed for longer than 2 seconds.	- Brake pedal 1 switch signal circuit is open circuit, high resistance, short to battery or ignition voltage. - Accelerator pedal stuck. - Intake throttle valve stuck. - Intake throttle valve control cable damaged, stuck or no free play. - Misadjusted APP sensor. - Faulty APP sensor. - Misadjusted brake pedal switch. - Faulty brake pedal switch. - Faulty ECM.
P1120 (E)	21	ON	Accelerator Pedal Position (APP) Sensor Circuit Correlation	The ignition switch is ON.	The ECM detects APP sensor angle is more than 18%, then idle switch is ON for longer than 0.6 seconds.	- APP sensor low reference circuit is high resistance. - Idle switch signal circuit is short to ground. - Poor harness connector connection. - Faulty APP sensor. - Faulty idle switch. - Faulty ECM.
P1173 (3)	22	OFF	Limitation of Injection Quantity	The ignition switch is ON.	The ECM detects an excessive high coolant temperature for longer than 30 seconds.	- Engine overheat. - Faulty engine cooling system. - Faulty ECT sensor.
P1173 (7)	22	OFF	Limitation of Injection Quantity	The ignition switch is ON.	The ECM detects an excessive high FT for longer than 30 seconds.	Faulty PCU.
P1173 (A)	22	OFF	Limitation of Injection Quantity	The ignition switch is ON.	The ECM detects an excessive low FT for longer than 30 seconds.	Faulty PCU.
P1335 (A)	43	ON	Crankshaft Position (CKP) Sensor Circuit	The ignition switch is ON.	The PCU detects CKP sensor signal from the ECM is faulty.	- CKP sensor signal output circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. - Poor harness connector connection. - Faulty PCU. - Faulty ECM.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on Tech 2	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1345 (A)	41	ON	Crankshaft Position (CKP) – Camshaft Position (CMP) Correlation	—	The PCU received faulty fuel injection pump CMP sensor signal for 1 second.	- Faulty fuel injection pump. - Faulty PCU.
P1520 (A)	47	ON	Park/Neutral Position Switch Circuit	- The ignition switch is ON. - The engine speed is higher than 1500 RPM. - The vehicle speed is higher than 64 km/h (40MPH). - The clutch pedal is released.	The ECM detects that the neutral switch signal is continuously ON (neutral) during three consecutive driving cycles.	- Neutral switch signal circuit is short to battery or ignition voltage. - Faulty neutral switch. - Faulty ECM.
P1520 (B)	47	ON	Park/Neutral Position Switch Circuit	- The ignition switch is ON. - The engine speed is higher than 665 RPM. - The vehicle speed is lower than 2 km/h (3MPH). - The clutch pedal is released after once depressed.	The ECM detects that the neutral switch signal is continuously OFF (other than neutral) during three consecutive driving cycles.	- Neutral switch ignition voltage feed circuit is open circuit or high resistance. - Neutral switch signal circuit is open circuit or high resistance. - Poor harness connector connection. - Faulty neutral switch. - Faulty ECM.
P1576 (4)	71	ON	Exhaust Brake Solenoid Circuit Low Voltage	The ignition switch is ON.	The ECM detects that the low voltage condition on the exhaust brake solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded OFF.	- Exhaust brake solenoid valve ignition voltage feed circuit is open circuit or high resistance. - Exhaust brake solenoid valve control circuit is open circuit, high resistance or short to ground. - Poor harness connector connection. - Faulty exhaust brake solenoid valve. - Faulty ECM.
P1576 (8)	71	ON	Exhaust Brake Solenoid Circuit High Voltage	The ignition switch is ON.	The ECM detects that the high voltage condition on the exhaust brake solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded ON.	- Exhaust brake solenoid valve control circuit is short to battery or ignition voltage circuit. - Faulty exhaust brake solenoid valve. - Faulty ECM.
P1605 (C)	55	ON	Control Module Internal Performance	—	The ECM detects internal seed or key file in EEPROM data is destroyed.	Faulty ECM.

6E-58 Engine Control System (4JH1)

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on Tech 2	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1605 (D)	55	ON	Control Module Internal Performance	—	The ECM detects reading or writing from the EEPROM data is failed during initialization.	Faulty ECM.
P1605 (E)	55	ON	Control Module Internal Performance	—	The ECM detects total sum of EEPROM data is not equal to registered value during initialization.	Faulty ECM.
P1625 (A)	76	OFF	ECM Main Relay Circuit	—	The ECM detects that the ECM main relay is turned OFF before commanded turned OFF.	- ECM main relay control circuit is intermittently open circuit or high resistance. - ECM battery voltage feed circuit is intermittently open or high resistance. - Faulty ECM main relay.
P1625 (B)	76	OFF	ECM Main Relay Circuit	The ignition switch is OFF.	The ECM detects that the ECM main relay is turned ON for longer than 2 seconds.	- ECM main relay control circuit is short to ground. - ECM battery voltage circuit is short to battery. - Faulty ECM main relay. - Faulty ECM.
P1630 (A)	51	ON	Injection Pump Fuel Metering Control	—	The ECM detects that the PCU monitored fuel injection solenoid valve control current is too high.	- Faulty fuel injection pump. - Faulty PCU.
P1630 (B)	51	ON	Injection Pump Fuel Metering Control	—	The ECM detects that the PCU continuously flow the control current to the fuel injection solenoid valve.	- Faulty fuel injection pump. - Faulty PCU.
P1650 (A)	44	ON	CAN Device Offline	—	The ECM detects that the PCU receives from the CAN controller reset or Bus Offline.	- CAN high circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. - CAN low circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. - Electrical interference. - Magnetic interference. - Faulty PCU. - Faulty ECM.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on Tech 2	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1650 (B)	44	ON	CAN Device Hang-up	—	The ECM detects internal CAN controller does not react.	Faulty ECM.
P1651 (A)	45	ON	CAN Malfunction	—	The ECM detects that the PCU does not receive the CAN messages from the ECM.	- CAN high circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. - CAN low circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. - Electrical interference. - Magnetic interference. - Faulty PCU. - Faulty ECM.
P1651 (B)	45	ON	CAN Malfunction	—	The ECM does not receive the CAN messages from the PCU.	- CAN high circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. - CAN low circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. - Electrical interference. - Magnetic interference. - Faulty PCU. - Faulty ECM.
P1690 (4)	77	OFF	Malfunction Indicator Lamp (MIL) Control Circuit Low Voltage	The ignition switch is ON.	The ECM detects a low voltage condition on the MIL control circuit for longer than 3 seconds when the MIL is commanded OFF.	- Meter (10A) fuse (F-16) open. - MIL ignition voltage feed circuit is open circuit or high resistance. - MIL control circuit is open circuit, high resistance or short to ground. - Poor harness connector connection. - MIL bulb burned out. - Faulty instrument panel cluster (meter assembly). - Faulty ECM.

6E-60 Engine Control System (4JH1)

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on Tech 2	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1690 (8)	77	OFF	Malfunction Indicator Lamp (MIL) Circuit High Voltage	The ignition switch is ON.	The ECM detects a high voltage condition on the MIL control circuit for longer than 1 second when the MIL is commanded ON.	- MIL control circuit is short to battery or ignition voltage circuit. - Faulty instrument panel cluster (meter assembly). - Faulty ECM.

P0100 (Symptom Code 7) (Flash Code 65)**Circuit Description**

The mass air flow (MAF) sensor is an air flow meter that measures the amount of air that enters the engine. It is fitted between the air cleaner and turbocharger. A small quantity of air that enters the engine indicates deceleration or idle speed. A large quantity of air that enters the engine indicates acceleration or a high load condition. The MAF sensor has the following circuits.

- Ignition voltage circuit
- 5 volts reference circuit
- Low reference circuit
- MAF sensor signal circuit

The engine control module (ECM) provides 5 volts reference voltage through the reference circuit to the MAF sensor. The ECM monitors the voltage on the 5 volts reference circuit. If the ECM detects an excessively high MAF sensor 5 volts reference voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the MAF sensor 5 volts reference circuit voltage is more than 5.2 volts for 0.5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

- The ECM uses a MAF substitution of 1600 mg/stk for engine control.
- The ECM uses an EGR solenoid valve control substitution of 10%.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- The MAF Sensor parameter on the Tech 2 will only update with engine running.

Test Description

The number below refers to the step number on the diagnostic table.

3. If the MAF sensor 5 volts reference circuit between the ECM and the sensor is normal, the sensor signal voltage low DTC P0100 (Symptom Code B) will set.

DTC P0100 (Symptom Code 7) (Flash Code 65)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the mass air flow (MAF) sensor harness connector. 3. Start the engine and let idle for 30 seconds. 4. Monitor the DTC Information with the Tech 2. Does DTC P0100 (Symptom Code B) set, but not DTC P0100 (Symptom Code 7)?	—	Go to Step 5	Go to Step 4

6E-62 Engine Control System (4JH1)

Step	Action	Value(s)	Yes	No
4	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 83 of B-233 connector) and the MAF sensor (pin 4 of J-182 connector) for the following conditions: • A short to battery or ignition voltage • A short to the sensor ignition voltage 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Replace the MAF sensor. Refer to Mass Air Flow Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
6	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0100 (Symptom Code 9) (Flash Code 65)**Circuit Description**

The mass air flow (MAF) sensor is an air flow meter that measures the amount of air that enters the engine. It is fitted between the air cleaner and turbocharger. A small quantity of air that enters the engine indicates deceleration or idle speed. A large quantity of air that enters the engine indicates acceleration or a high load condition. The MAF sensor has the following circuits.

- Ignition voltage circuit
- 5 volts reference circuit
- Low reference circuit
- MAF sensor signal circuit

The engine control module (ECM) provides 5 volts reference voltage through the reference circuit to the MAF sensor. The ECM monitors the voltage on the 5 volts reference circuit. If the ECM detects an excessively low MAF sensor 5 volts reference voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the MAF sensor 5 volts reference circuit voltage is less than 4.6 volts for 0.5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

- The ECM uses a MAF substitution of 1600 mg/stk for engine control.
- The ECM uses an EGR solenoid valve control substitution of 10%.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- The MAF Sensor parameter on the Tech 2 will only update with engine running.

Test Description

The number below refers to the step number on the diagnostic table.

3. If the MAF sensor 5 volts reference circuit between the ECM and the sensor is normal, the sensor signal voltage low DTC P0100 (Symptom Code B) will set.

DTC P0100 (Symptom Code 9) (Flash Code 65)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the mass air flow (MAF) sensor harness connector. 3. Start the engine and let idle for 30 seconds. 4. Monitor the DTC Information with the Tech 2. Does DTC P0100 (Symptom Code B) set, but not DTC P0100 (Symptom Code 9)?	—	Go to Step 5	Go to Step 4

6E-64 Engine Control System (4JH1)

Step	Action	Value(s)	Yes	No
4	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 83 of B-233 connector) and the MAF sensor (pin 4 of J-182 connector) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Replace the MAF sensor. Refer to Mass Air Flow Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
6	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0100 (Symptom Code B) (Flash Code 65)**Circuit Description**

The mass air flow (MAF) sensor is an air flow meter that measures the amount of air that enters the engine. It is fitted between the air cleaner and turbocharger. A small quantity of air that enters the engine indicates deceleration or idle speed. A large quantity of air that enters the engine indicates acceleration or a high load condition. The MAF sensor has the following circuits.

- Ignition voltage circuit
- 5 volts reference circuit
- Low reference circuit
- MAF sensor signal circuit

The engine control module (ECM) monitors the MAF sensor signal for voltage outside the normal range of the MAF sensor. If the ECM detects an excessively low MAF sensor signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM calculated MAF is lower than -18.6 kg/h for 5 seconds. This indicates the ECM detects that the MAF sensor signal voltage is smaller than a predetermined range during engine run.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a MAF substitution of 1600 mg/strk for engine control.
- The ECM uses an EGR solenoid valve control substitution of 10%.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL that the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Wrong direction of MAF sensor installation will cause this DTC to set.
- Contaminated or restricted MAF sensor will cause this DTC to set.
- The MAF Sensor parameter on the Tech 2 will only update with engine running.

Test Description

The number below refers to the step number on the diagnostic table.

5. If the MAF sensor signal circuit between the ECM and the sensor is short to ground or any low reference circuits, the sensor 5 volts reference voltage low DTC P0100 (Symptom Code 9) will set.

6. If the MAF sensor signal circuit between the ECM and the sensor is normal, the sensor signal voltage high DTC P0100 (Symptom Code C) will set.

DTC P0100 (Symptom Code B) (Flash Code 65)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids

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Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Disconnect the mass air flow (MAF) sensor harness connector. 3. Connect a test lamp between the ignition voltage feed circuit of the MAF sensor harness (pin 2 of J-182 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 7
4	1. Keep the ignition ON, with the engine OFF. 2. Connect a DMM between the 5 volts reference circuit of the MAF sensor harness (pin 4 of J-182 connector) and a known good ground. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 5	Go to Step 8
5	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit of the MAF sensor harness (pins 4 and 5 of J-182 connector). 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. 4. Monitor the DTC Information with the Tech 2. Does DTC P0100 (Symptom Code 9) set, but not DTC P0100 (Symptom Code B)?	—	Go to Step 9	Go to Step 6
6	1. Keep the 3-amp fused jumper wire with connected. 2. Start the engine and let idle for 30 seconds. Does DTC P0100 (Symptom Code C) set, but not DTC P0100 (Symptom Code B)?	—	Go to Step 11	Go to Step 10
7	Repair the open circuit or high resistance on the ignition voltage feed circuit between the ECM main relay (pin 5 of X-14 connector) and the MAF sensor (pin 2 of J-182 connector). Did you complete the repair?	—	Go to Step 15	—
8	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 83 of B-233 connector) and the MAF sensor (pin 4 of J-182 connector) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
9	1. Test the signal circuit between the ECM (pin 88 of B-233 connector) and the MAF sensor (pin 5 of J-182 connector) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14

Step	Action	Value(s)	Yes	No
10	1. Test the signal circuit between the ECM (pin 88 of B-233 connector) and the MAF sensor (pin 5 of J-182 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
11	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the MAF sensor (pins 2, 4 and 5 of J-182 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the MAF sensor circuits at the harness connector of the ECM (pins 83 and 88 of B-233 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	Replace the MAF sensor. Refer to Mass Air Flow Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—
14	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0100 (Symptom Code C) (Flash Code 65)**Circuit Description**

The mass air flow (MAF) sensor is an air flow meter that measures the amount of air that enters the engine. It is fitted between the air cleaner and turbocharger. A small quantity of air that enters the engine indicates deceleration or idle speed. A large quantity of air that enters the engine indicates acceleration or a high load condition. The MAF sensor has the following circuits.

- Ignition voltage circuit
- 5 volts reference circuit
- Low reference circuit
- MAF sensor signal circuit

The engine control module (ECM) monitors the MAF sensor signal for voltage outside the normal range of the MAF sensor. If the ECM detects an excessively high MAF sensor signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM calculated MAF is higher than 806 kg/h for 10 seconds. This indicates the ECM detects that the MAF sensor signal voltage is higher than a predetermined range during engine run.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

- The ECM uses a MAF substitution of 1600 mg/strk for engine control.
- The ECM uses an EGR solenoid valve control substitution of 10%.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- The MAF Sensor parameter on the Tech 2 will only update with engine running.

Test Description

The number below refers to the step number on the diagnostic table.

3. If the MAF sensor signal circuit between the ECM and the sensor is normal, the sensor signal voltage low DTC P0100 (Symptom Code B) will set.

DTC P0100 (Symptom Code C) (Flash Code 65)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the mass air flow (MAF) sensor harness connector. 3. Start the engine and let idle for 30 seconds. 4. Monitor the DTC Information with the Tech 2. Does DTC P0100 (Symptom Code B) set, but not DTC P0100 (Symptom Code C)?	—	Go to Step 4	Go to Step 5

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Connect a test lamp between the low reference circuit of the MAF sensor harness (pin 3 of J-182 connector) and a battery voltage. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 6
5	Important: The MAF sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the engine control module (ECM) (pin 88 of B-233 connector) and the MAF sensor (pin 5 of J-182 connector) for the following conditions: • A short to battery or ignition voltage • A short to 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
6	1. Test the low reference circuit between the ECM (pin 92 of B-233 connector) and the MAF sensor (pin 3 of J-182 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the MAF sensor (pin 3 of J-182 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the MAF sensor circuit at the harness connector of the ECM (pin 92 of B-233 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Replace the MAF sensor. Refer to Mass Air Flow Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 11	—
10	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 11	—

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Step	Action	Value(s)	Yes	No
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 12
12	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0110 (Symptom Code 1) (Flash Code 23)**Circuit Description**

The intake air temperature (IAT) sensor is fitted between the air cleaner and turbocharger internal to the mass air flow (MAF) sensor. The IAT sensor is a variable resistor. The IAT sensor has a signal circuit and a low reference circuit. The IAT sensor measures the temperature of the air entering the engine. The engine control module (ECM) supplies 5 volts to the IAT signal circuit and a ground for the IAT low reference circuit. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the IAT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the IAT signal circuit. If the ECM detects an excessively high IAT signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the IAT sensor signal voltage is more than 4.7 volts for 3 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

- The ECM uses an IAT substitution of 0°C (32°F) for engine control.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Temperature vs. Resistance table to test the IAT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns.

Notice:

- The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake temperature if the ignition switch is being ON.

DTC P0110 (Symptom Code 1) (Flash Code 23)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Intake Air Temperature (IAT) parameter with the Tech 2. Is the IAT parameter less than the specified value?	-38°C (-36°F)	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the mass air flow/intake air temperature (MAF/IAT) sensor harness connector. 3. Connect a DMM between the signal circuit of the IAT sensor harness (pin 1 of J-182 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.3 volts	Go to Step 4	Go to Step 5

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Step	Action	Value(s)	Yes	No
4	Important: The IAT sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the engine control module (ECM) (pin 84 of B-233 connector) and the IAT sensor (pin 1 of J-182 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
5	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit of the IAT sensor harness (pins 1 and 3 of J-182 connector). 3. Turn ON the ignition, with the engine OFF. 4. Observe the IAT parameter with the Tech 2. Is the IAT parameter more than the specified value?	110°C (230°F)	Go to Step 9	Go to Step 6
6	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the signal circuit of the IAT sensor harness (pin 1 of J-182 connector) and a known good ground. 3. Turn ON the ignition, with the engine OFF. 4. Observe the IAT parameter with the Tech 2. Is the IAT parameter more than the specified value?	110°C (230°F)	Go to Step 8	Go to Step 7
7	1. Test the signal circuit between the ECM (pin 84 of B-233 connector) and the IAT sensor (pin 1 of J-182 connector) for an open circuit high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
8	1. Test the low reference circuit between the ECM (pin 92 of B-233 connector) and the IAT sensor (pin 3 of J-182 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
9	1. Test the signal circuit between the ECM (pin 84 of B-233 connector) and the IAT sensor (pin 1 of J-182 connector) for a short to any 5 volts reference circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
10	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the IAT sensor (pins 1 and 3 of J-182 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12

Step	Action	Value(s)	Yes	No
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the IAT sensor circuits at the harness connector of the ECM (pins 84 and 92 of B-233 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
12	Replace the IAT sensor. Refer to Mass Air Flow Sensor Replacement in this section. (IAT sensor is internal to MAF sensor) Did you complete the replacement?	—	Go to Step 14	—
13	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 14	—
14	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 15
15	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0110 (Symptom Code 2) (Flash Code 23)**Circuit Description**

The intake air temperature (IAT) sensor is fitted between the air cleaner and turbocharger internal to the mass air flow (MAF) sensor. The IAT sensor is a variable resistor. The IAT sensor has a signal circuit and a low reference circuit. The IAT sensor measures the temperature of the air entering the engine. The engine control module (ECM) supplies 5 volts to the IAT signal circuit and a ground for the IAT low reference circuit. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the IAT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the IAT signal circuit. If the ECM detects an excessively low IAT signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the IAT sensor signal voltage is less than 0.3 volts for 3 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

- The ECM uses an IAT substitution of 0°C (32°F) for engine control.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Temperature vs. Resistance table to test the IAT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns.

Notice:

- The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake temperature if the ignition switch is being ON.

DTC P0110 (Symptom Code 2) (Flash Code 23)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Intake Air Temperature (IAT) parameter with the Tech 2. Is the IAT parameter more than the specified value?	110°C (230°F)	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the mass air flow/intake air temperature (MAF/IAT) sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the IAT parameter with the Tech 2. Is the IAT parameter less than the specified value?	-38°C (-36°F)	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Test the signal circuit between the engine control module (ECM) (pin 84 of B-233 connector) and the IAT sensor (pin 1 of J-182 connector) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6
5	Replace the IAT sensor. Refer to Mass Air Flow Sensor Replacement in this section. (IAT sensor is internal to MAF sensor) Did you complete the replacement?	—	Go to Step 8	—
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect connections on the IAT sensor circuits at the harness connector of the ECM (pins 84 and 92 of B-233 connector) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 9
9	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0115 (Symptom Code 1) (Flash Code 14)**Circuit Description**

The engine coolant temperature (ECT) sensor is installed to the thermostat housing. The ECT sensor is a variable resistor. The ECT sensor has a signal circuit and a low reference circuit. The ECT sensor measures the temperature of the engine coolant. The engine control module (ECM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT sensor is cold, the sensor resistance is high. When the engine coolant temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the ECT signal circuit. If the ECM detects an excessively high ECT signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the ECT sensor signal voltage is more than 4.7 volts for 3 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an ECT substitution of fuel temperature for engine control.

- The ECM uses an ECT substitution of 60°C (120°F) for injection timing control.
- The ECM uses an ECT substitution of -25°C (-13°F) for glow control.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- After starting the engine, the ECT should rise steadily to about 80°C – 85°C (176°F – 185°F) then stabilize when the thermostat opens.
- Use the Temperature vs. Resistance table to test the ECT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns.

DTC P0115 (Symptom Code 1) (Flash Code 14)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Engine Coolant Temperature (ECT) parameter with the Tech 2. Is the ECT parameter less than the specified value?	-35°C (-31°F)	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the ECT sensor harness connector. 3. Connect a DMM between the signal circuit of the ECT sensor harness (pin 1 of E-16 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.3 volts	Go to Step 4	Go to Step 5

Step	Action	Value(s)	Yes	No
4	Important: The ECT sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the engine control module (ECM) (pin 89 of B-233 connector) and the ECT sensor (pin 1 of E-16 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
5	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit of the ECT sensor harness (pins 1 and 2 of E-16 connector). 3. Turn ON the ignition, with the engine OFF. 4. Observe the ECT parameter with the Tech 2. Is the ECT parameter more than the specified value?	135°C (275°F)	Go to Step 9	Go to Step 6
6	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the signal circuit of the ECT sensor harness (pin 1 of E-16 connector) and a known good ground. 3. Turn ON the ignition, with the engine OFF. 4. Observe the ECT parameter with the Tech 2. Is the ECT parameter more than the specified value?	135°C (275°F)	Go to Step 8	Go to Step 7
7	1. Test the signal circuit between the ECM (pin 89 of B-233 connector) and the ECT sensor (pin 1 of E-16 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
8	1. Test the low reference circuit between the ECM (pin 93 of B-233 connector) and the ECT sensor (pin 2 of E-16 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
9	1. Test the signal circuit between the ECM (pin 89 of B-233 connector) and the ECT sensor (pin 1 of E-16 connector) for a short to any 5 volts reference circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
10	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the ECT sensor (pins 1 and 2 of E-16 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12

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Step	Action	Value(s)	Yes	No
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the ECT sensor circuits at the harness connector of the ECM (pins 89 and 93 of B-233 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
12	Replace the ECT sensor. Refer to Engine Coolant Temperature Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 14	—
13	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 14	—
14	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 15
15	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0115 (Symptom Code 2) (Flash Code 14)**Circuit Description**

The engine coolant temperature (ECT) sensor is installed to the thermostat housing. The ECT sensor is a variable resistor. The ECT sensor has a signal circuit and a low reference circuit. The ECT sensor measures the temperature of the engine coolant. The engine control module (ECM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT sensor is cold, the sensor resistance is high. When the engine coolant temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the ECT signal circuit. If the ECM detects an excessively low ECT signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the ECT sensor signal voltage is less than 0.3 volts for 3 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an ECT substitution of fuel temperature for engine control.

- The ECM uses an ECT substitution of 60°C (120°F) for injection timing control.
- The ECM uses an ECT substitution of -25°C (-13°F) for glow control.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- After starting the engine, the ECT should rise steadily to about 80°C – 85°C (176°F – 185°F) then stabilize when the thermostat opens.
- Use the Temperature vs. Resistance table to test the ECT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns.

DTC P0115 (Symptom Code 2) (Flash Code 14)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Engine Coolant Temperature (ECT) parameter with the Tech 2. Is the ECT parameter more than the specified value?	135°C (275°F)	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the ECT sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Coolant Temperature parameter with the Tech 2. Is the ECT parameter less than the specified value?	-35°C (-31°F)	Go to Step 5	Go to Step 4

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Step	Action	Value(s)	Yes	No
4	1. Test the signal circuit between the engine control module (ECM) (pin 89 of B-233 connector) and the ECT sensor (pin 1 of E-16 connector) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6
5	Replace the ECT sensor. Refer to Engine Coolant Temperature Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 8	—
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect connections on the ECT sensor circuits at the harness connector of the ECM (pins 89 and 93 of B-233 connector) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 9
9	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0180 (Symptom Code B) (Flash Code 15)**Circuit Description**

The fuel temperature (FT) sensor is internal to the fuel injection pump control unit (PCU). It detects fuel temperature in the fuel injection pump. The engine control module (ECM) and PCU communicates with each other over the controller area network (CAN) link. If the PCU internal FT sensor output is an excessively high or low, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The PCU internal FT sensor output is lower than -40°C (-40°F) for 3 seconds or higher than 150°C (302°F).

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a default FT substitution for engine control.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- FT sensor is internal to the PCU and it is part of the fuel injection pump assembly.

DTC P0180 (Symptom Code B) (Flash Code 15)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	Important: The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. (Fuel temperature (FT) sensor is internal to the fuel injection pump control unit (PCU) and it is part of the fuel injection pump assembly.) Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0215 (Symptom Code A) (Flash Code 52)**Circuit Description**

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU. The fuel injection solenoid valve is installed to the fuel injection pump rear side. The fuel injection event is determined by this solenoid ON/OFF command. The fuel injection solenoid valve cuts the fuel when the engine shutoff (ESO) solenoid valve is commanded shutoff from the PCU. (The fuel injection solenoid valve and engine shutoff (ESO) solenoid valve is same part. It calls ESO solenoid valve when fuel is shutoff.) When the ignition switch is turned OFF or commanded from fail-safe action, the ESO solenoid valve is commanded shutoff to stop the engine running. If the ECM detects that the engine is continuously run after the ignition switch is OFF, this DTC will set.

Condition for Running the DTC

- The ignition switch is OFF.

- The engine speed is lower than 1500 RPM.
- The vehicle speed is lower than 1.5 km/h (1MPH).

Condition for Setting the DTC

- After the condition for running this DTC for 2 seconds, the engine speed is higher than 200 RPM when the ESO solenoid valve is commanded shutoff from the PCU. This indicates the PCU reacts to the command from the ECM but ESO solenoid valve does not react to the command from the PCU and fuel cannot shutoff.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) at next ignition cycle.
- The ECM cuts fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Fuel injection solenoid valve is internal to the fuel injection pump assembly.
- PCU is part of the fuel injection pump assembly.

DTC P0215 (Symptom Code A) (Flash Code 52)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. 5. Turn OFF the engine. Does the DTC fail this ignition before the engine control module (ECM) turned OFF?	—	Go to Step 3	Go to Step 4
3	Important: The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 4	—

Step	Action	Value(s)	Yes	No
4	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the Tech 2. 5. Turn OFF the engine. Does the DTC fail this ignition before the ECM turns OFF?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0215 (Symptom Code B) (Flash Code 52)**Circuit Description**

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.

The fuel injection solenoid valve is installed to the fuel injection pump rear side. The fuel injection event is determined by this solenoid ON/OFF command. The fuel injection solenoid valve cuts the fuel when the engine shutoff (ESO) solenoid valve is commanded shutoff from the PCU. (The fuel injection solenoid valve and engine shutoff (ESO) solenoid valve is same part. It calls ESO solenoid valve when fuel is shutoff.) When the ignition switch is turned OFF or commanded from fail-safe action, the ESO solenoid valve is commanded shutoff to stop the engine running. If the PCU detects that the ESO solenoid valve control circuit voltage level from the ECM to PCU is high, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The PCU detects high voltage condition on the ESO solenoid valve control circuit for longer than 1 second when the ECM does not command shutoff.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Fuel injection solenoid valve is internal to the fuel injection pump assembly.
- PCU is part of the fuel injection pump assembly.
- If this DTC is present, engine will not start.

DTC P0215 (Symptom Code B) (Flash Code 52)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. If the engine does not start, crank over the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the fuel injection pump control unit (PCU) harness connector. 3. Connect a test lamp between the engine shutoff (ESO) solenoid valve control signal circuit (pin 5 of E-110 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Reconnect the PCU harness connector. 3. Disconnect the engine control module (ECM) B-233 harness connector. Keep the B-234 harness connector with connected. 4. Connect a test lamp between the ESO solenoid valve control signal circuit (pin 105 of B-233 connector) and a known good ground. 5. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 6	Go to Diagnostic Aids
5	1. Test the ESO solenoid valve control signal circuit between the ECM (pin 105 of B-233 connector) and the PCU (pin 5 of E-110 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
6	Important: The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 8	—
7	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 9
9	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0215 (Symptom Code C) (Flash Code 52)**Circuit Description**

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU. The fuel injection solenoid valve is installed to the fuel injection pump rear side. The fuel injection event is determined by this solenoid ON/OFF command. The fuel injection solenoid valve cuts the fuel when the engine shutoff (ESO) solenoid valve is commanded shutoff from the PCU. (The fuel injection solenoid valve and engine shutoff (ESO) solenoid valve is same part. It calls ESO solenoid valve when fuel is shutoff.) When the ignition switch is turned OFF or commanded from fail-safe action, the ESO solenoid valve is commanded shutoff to stop the engine running. If the ECM detects that the engine is continuously run after the ignition switch is OFF, this DTC will set.

Condition for Running the DTC

- The ignition switch is OFF.
- The engine speed is lower than 1500 RPM.
- The vehicle speed is lower than 1.5 km/h (1MPH).

Condition for Setting the DTC

- The engine speed is higher than 200 RPM within 2 seconds after the condition for running the DTC are met. This indicates the PCU does not react to the command from the ECM and fuel cannot shutoff.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Fuel injection solenoid valve is internal to the fuel injection pump assembly.
- PCU is part of the fuel injection pump assembly.

DTC P0215 (Symptom Code C) (Flash Code 52)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. 5. Turn OFF the engine. Does the DTC fail this ignition before the engine control module (ECM) turns OFF?	—	Go to Step 3	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Disconnect the fuel injection pump control unit (PCU) harness connector. 3. Connect a test lamp between the engine shutoff (ESO) solenoid valve control signal circuit (pin 5 of E-110 connector) and battery voltage. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 4
4	1. Turn OFF the ignition. 2. Connect a DMM between the ESO solenoid valve control signal circuit (pin 5 of E-110 connector) and a known good ground. 3. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	10 volts	Go to Step 7	Go to Step 6
5	1. Test the ESO solenoid valve control signal circuit between the ECM (pin 105 of B-233 connector) and the PCU (pin 5 of E-110 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
6	1. Test the ESO solenoid valve control signal circuit between the ECM (pin 105 of B-233 connector) and the PCU (pin 5 of E-110 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Turn OFF the ignition. 2. Inspect for an intermittent, for a poor connection and corrosion on the ESO solenoid valve control signal circuit at the harness connector of the PCU (pin 5 of E-110 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the ESO solenoid valve control signal circuit at the harness connector of the ECM (pin 105 of B-233 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Important: The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 11	—

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Step	Action	Value(s)	Yes	No
10	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 11	—
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the Tech 2. 6. Turn OFF the engine. Does the DTC fail this ignition before the ECM turns OFF?	—	Go to Step 3	Go to Step 12
12	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0215 (Symptom Code D) (Flash Code 52)**Circuit Description**

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU. The ECM monitors CAN operational status by expecting a constant flow of messages from the PCU. If the ECM detects that the internal CAN controller does not Bus OFF when the ignition switch is OFF, this DTC will set.

Condition for Running the DTC

- The ignition switch is OFF.

DTC P0215 (Symptom Code D) (Flash Code 52)**Condition for Setting the DTC**

- The ECM detects internal CAN controller does not Bus OFF mode.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- CAN controller is internal to the ECM.

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. 5. Turn OFF the engine. Does the DTC fail this ignition before the engine control module (ECM) turns OFF?	—	Go to Step 3	Go to Step 4
3	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the DTC Information with the Tech 2. 5. Turn OFF the engine. Does the DTC fail this ignition before the ECM turns OFF?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0216 (Symptom Code A,B) (Flash Code 54)**Description**

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.

The timing device changes the optimum injection timing against various engine conditions. The pressure of the fuel fed from the feed pump is adjusted and it acts to the timing plunger by TCV controlled fuel pressure. (The TCV is installed to the fuel injection pump rear side and it is controlled by duty ratio cycle from the PCU.) The timing plunger is connected to the cam ring by a ball pin. Axial movement of the timing plunger is transferred to the cam ring in the form of rotational movement. Movement to the right of the timing plunger advances injection timing. If the PCU detects an excessive difference between actual and desired fuel injection timing, this DTC will set.

Condition for Running the DTC**Symptom Code A**

- The engine speed is higher than 700 RPM.
- The fuel injection quantity is higher than 4 mg/strk.

Symptom Code B

- The engine speed is higher than 2014 RPM.

Condition for Setting the DTC**Symptom Code A**

- The PCU monitored actual fuel injection timing is advanced more than desired by 3°C/A for longer than 12 seconds or retarded more than desired by 6°C/A for longer than 12 seconds.

Symptom Code B

- The PCU monitored actual fuel injection timing is oscillated higher than desired by 5.2°C/A.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- The fuel injection pump installation with incorrect mechanical timing may set this DTC.
- This DTC most likely indicate loss fuel pressure by restricted fuel line. Inspect the fuel line restriction between the fuel injection pump and fuel tank.
- The fuel system from the fuel tank(s) to the fuel injection pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight or if there is a crack in one of the fuel hoses. Air in the fuel system will cause fuel injection pump internal pressure fluctuations especially at high engine speed and load, which may set this DTC.
- Improper fuel will cause this DTC to set. Inspect fuel waxing or icing that is caused by an incorrect fuel type used in winter season or water intrusion in the fuel system.
- Contaminated fuel will cause this DTC to set. Inspect the pipe connector fixing bolt (eye bolt) on the fuel injection pump suction side.

Important:

If the fuel tank is empty or near empty, air might be allowed to go into the fuel system. With air in the fuel system, smooth flow of fuel into the fuel injection pump is interrupted and this DTC may set. Refer to air bleeding procedure in Fuel System Section.

DTC P0216 (Symptom Code A,B) (Flash Code 54)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls

Step	Action	Value(s)	Yes	No
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P0335 (Symptom Code B or D), P1335 (Symptom Code A) or P1345 (Symptom Code A) set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn OFF the engine. 2. Place the transmission in neutral and set the park brake. 3. Start the engine and let engine idle for 30 seconds while observing the Actual Injection Timing parameter with the Tech 2. 4. Accelerate the engine and keep the constant engine speed around 2000 RPM while observing the Actual Injection Timing parameter with the Tech 2. 5. Accelerate the engine and keep the constant engine speed around 3000 RPM while observing the Actual Injection Timing parameter with the Tech 2. Does the Actual Injection Timing parameter follow the Desired Injection Timing within 2°C/A on each engine speed?	—	Go to Diagnostic Aids	Go to Step 4
4	1. Turn OFF the ignition. 2. Check the fuel system line connections between the fuel tank and the fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. Notice: The fuel system from the fuel tank(s) to the fuel injection pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel injection pump internal pressure fluctuations especially at high engine speed and load, which may set this DTC. 3. Pump the priming pump on the fuel filter until it becomes firm. If there is a leak on the suction side of the fuel system between the priming pump and the fuel injection pump, the priming pump will not build up sufficient firmness and fuel leakage may occur. 4. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 5

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Step	Action	Value(s)	Yes	No
5	1. Remove the fuel hose that connects to the fuel injection pump suction side. 2. Remove the fuel pipe connector that connects to the fuel injection pump suction side. 3. Inspect the eye bolt for any type of restriction or collapsed gauze filter. Notice: If any type of restriction found, check for a condition that causes contaminated fuel, such as the customer is using an aftermarket fuel filter or extended maintenance interval. Also inspect fuel waxing or icing that is caused by an incorrect fuel type used in winter season or water intrusion in the fuel system. 4. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 6
6	1. Disconnect the fuel hose that connects to the fuel injection pump suction side. In order to measure the discharged fuel amount, put the hose into a bottle or a container. 2. Pump the priming pump on the fuel filter. Notice: If there is a leak on the suction side of the fuel system, the fuel from the disconnected hose will not flow out sufficiently and fuel leakage may occur. Also if there is a restriction on the suction side of the fuel system, the fuel from the disconnected hose will not flow out sufficiently that is most likely caused by clogged fuel filter or kinked fuel hose or pipe. 3. Draw fuel from the fuel tank at the fuel line (as close to the fuel tank as possible) going to the fuel pickup tube to verify a clean stream of fuel comes out (use the hand-held vacuum pump 5-8840-0279-0/J-23738-A with a clear hose or equivalent). This will ensure the fuel pickup tube is not cracked drawing air into the fuel line. 4. Repair any fuel system leaks and restrictions as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 7

Step	Action	Value(s)	Yes	No
7	1. Reconnect the fuel pipe connector that connects to the fuel injection pump suction side. 2. Remove the fuel hose that connects to the fuel injection pump suction side. 3. Substitute a clear hose. Notice: A hose must be cleaned. 4. Connect the clear hose to the fuel injection pump. 5. Bleed the fuel system. Refer to the Diagnostic Aids. 6. Let the engine run at idle for at least 2 minutes. 7. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the clear hose. Notice: If many air bubbles appear in the fuel, check the fuel system line connections between the fuel tank and the fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. 8. Repair as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 8
8	Important: The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 9	—
9	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Place the transmission in neutral and set the park brake. 4. Start the engine and let engine idle for 30 seconds while observing the Actual Injection Timing parameter with the Tech 2. 5. Accelerate the engine and keep the constant engine speed around 2000 RPM while observing the Actual Injection Timing parameter with the Tech 2. 6. Accelerate the engine and keep the constant engine speed around 3000 RPM while observing the Actual Injection Timing parameter with the Tech 2. Does the Actual Injection Timing parameter follow the Desired Injection Timing within 2°CA on each engine speed?	—	Go to Step 10	Go to Step 2
10	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0251 (Symptom Code 6) (Flash Code 53)**Circuit Description**

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU. The fuel injection solenoid valve is installed to the fuel injection pump rear side. The fuel injection event is determined by this solenoid ON/OFF command. The fuel injection solenoid valve cuts the fuel when the engine shutoff (ESO) solenoid valve is commanded shutoff from the PCU. (The fuel injection solenoid valve and engine shutoff (ESO) solenoid valve is same part. It calls ESO solenoid valve when fuel is shutoff.) When the ignition switch is turned OFF or commanded from fail-safe action, the ESO solenoid valve is commanded shutoff to stop the engine running. If the PCU detects that the fuel injection solenoid valve is operated when the desired injection quantity from the ECM is 0 mg/strk, this DTC will set.

Condition for Running the DTC

- The fuel injection pump CMP sensor signal is generated.
- The CAN communication between the ECM and PCU is normal.

Condition for Setting the DTC

- The PCU detects that the fuel injection solenoid valve is operated when the desired fuel injection quantity is commanded 0 mg/strk.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Fuel injection solenoid valve is internal to the fuel injection pump assembly.
- PCU is part of the fuel injection pump assembly.

DTC P0251 (Symptom Code 6) (Flash Code 53)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	Important: The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 4	—

Step	Action	Value(s)	Yes	No
4	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0251 (Symptom Code 7) (Flash Code 53)**Circuit Description**

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU. The PCU also compares the engine speed signal sent from the ECM and the fuel injection pump speed. If the PCU detects that the doubled fuel injection pump speed is excessively lower than engine speed, this DTC will set.

Condition for Running the DTC

- The fuel injection pump CMP sensor signal is generated.
- The crankshaft position (CKP) sensor signal is generated.
- The engine speed is higher than 500 RPM.

Condition for Setting the DTC

- The PCU detects that the doubled fuel injection pump speed is lower than engine speed by 800 RPM for longer than 0.2 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- Electrical or magnetic interference may affect intermittent condition.
- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Fuel injection pump CMP sensor is internal to the fuel injection pump assembly.
- PCU is part of the fuel injection pump assembly.

DTC P0251 (Symptom Code 7) (Flash Code 53)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. If the engine does not start, crank over the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P0335 (Symptom Code B, D or E), P1335 (Symptom Code A) or P1345 (Symptom Code A) set?	—	Go to Applicable DTC	Go to Step 3
3	1. Start the engine. 2. Monitor the DTC Information with the Tech 2. 3. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Observe the Engine Speed parameter with the Tech 2. 2. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the Tech 2. Does the Engine Speed parameter indicate correct engine speed?	—	Go to Step 9	Go to Step 5
5	1. Inspect the crankshaft position (CKP) sensor for tightness. 2. Remove the CKP sensor and check for damage, metal particles on magnet and for flywheel circumference damage. Did you find and correct the condition?	—	Go to Step 10	Go to Step 6
6	1. Turn OFF the ignition. 2. Disconnect the CKP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion on the CKP sensor terminal (pins 1, 2 and 3 of J-183 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 7
7	1. Turn OFF the ignition. 2. Disconnect the fuel injection pump control unit (PCU) harness connector. 3. Inspect for an intermittent, for a poor connection and corrosion on the CKP sensor signal input at the harness connector of the PCU (pin 8 of E-110 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
8	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) harness connector. 3. Inspect for an intermittent, for poor connections and corrosion on at the harness connector of the ECM (pins 90, 91, 98 and 101 of B-233 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 9
9	Important: The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 10	—

6E-98 Engine Control System (4JH1)

Step	Action	Value(s)	Yes	No
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the DTC Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 2	Go to Step 11
11	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0251 (Symptom Code 9, A, B, D) (Flash Code 53)**Circuit Description**

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.

The fuel injection solenoid valve is installed to the fuel injection pump rear side. The fuel injection event is determined by this solenoid ON/OFF command. The fuel injection solenoid valve cuts the fuel when the engine shutoff (ESO) solenoid valve is commanded shutoff from the PCU. (The fuel injection solenoid valve and engine shutoff (ESO) solenoid valve is same part. It calls ESO solenoid valve when fuel is shutoff.) When the ignition switch is turned OFF or commanded from fail-safe action, the ESO solenoid valve is commanded shutoff to stop the engine running.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The PCU detects internal fuel injection pump control maps are not programmed during self-test. (Symptom Code 9)

- The PCU detects internal EEPROM or A/D converter is failed during self-test. (Symptom Code A)
- The PCU detects that the fuel injection solenoid valve drive circuit is failed during self-test. (Symptom Code B)
- The PCU detects that the fuel injection solenoid valve drive circuit voltage level is abnormal during self-test. (Symptom Code D)

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts fuel injection. (Symptom Code 9)
- The ECM limits fuel injection quantity. (Symptom Code A)

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Fuel injection solenoid valve is internal to the fuel injection pump assembly.
- PCU is part of the fuel injection pump assembly.

DTC P0251 (Symptom Code 9, A, B, D) (Flash Code 53)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the igniton, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	Important: The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 4	—

6E-100 Engine Control System (4JH1)

Step	Action	Value(s)	Yes	No
4	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0251 (Symptom Code E) (Flash Code 53)**Circuit Description**

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU. The ECM monitors CAN operational status by expecting a constant flow of messages from the PCU. If the ECM detects that the communication message from the PCU is not received, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

DTC P0251 (Symptom Code E) (Flash Code 53)**Condition for Setting the DTC**

- The ECM detects communication message from the PCU is not received for longer than 1 second.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- PCU is part of the fuel injection pump assembly.

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. If the engine does not start, crank over the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P1650 (Symptom Code A or B) or P1651 (Symptom Code A or B) set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn ON the ignition, with the engine OFF. 2. Monitor the DTC Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 4	Go to Step 5
4	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 5	—
5	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 2	Go to Step 6

6E-102 Engine Control System (4JH1)

Step	Action	Value(s)	Yes	No
6	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0335 (Symptom Code B, D) (Flash Code 43)**Circuit Description**

The crankshaft position (CKP) sensor is located on top of the flywheel housing. There are 4 slits spaced 90° on the flywheel circumference. The CKP sensor is a magnetic coil type sensor, which generates an AC signal voltage based on the crankshaft rotational speed. The engine control module (ECM) monitors both the CKP sensor and injection pump camshaft position (CMP) sensor signals to ensure they correlate with each other.

If the ECM receives extra or missing CKP sensor signal pulses, this DTC will set. (Symptom Code B)

If the ECM receives a certain amount of injection pump CMP sensor signal pulses without a CKP sensor signal, this DTC will set. (Symptom Code D)

Condition for Running the DTC**Symptom Code B**

- The ignition switch is ON.
- The engine speed is higher than 665 RPM.

Symptom Code D

- DTC P0335 (Symptom Code B) is not set.
- The ignition switch is ON.
- The fuel injection pump CMP sensor signal is generated.
- The controller area network (CAN) communication between the ECM and PCU is normal.

Condition for Setting the DTC**Symptom Code B**

- The ECM detects extra or missing CKP sensor signals while engine is running.

Symptom Code D

- The ECM detects that the CKP sensor signals are not generated when doubled fuel injection pump rotation speed is higher than 50 RPM.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails. The ECM uses an engine speed substitution of doubled fuel injection pump speed for engine control.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Ensure the sensor is tight and the flywheel circumference is not damaged.

DTC P0335 (Symptom Code B, D) (Flash Code 43)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine (Note a slight start delay may be noticed). 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the crankshaft position (CKP) sensor harness connector. 3. Connect a DMM across the CKP sensor terminals (pins 1 and 2 of J-183 connector). 4. Measure the resistance across the CKP sensor. Is the CKP sensor resistance within the specified value?	870 – 930 Ω	Go to Step 4	Go to Step 20

6E-104 Engine Control System (4JH1)

Step	Action	Value(s)	Yes	No
4	1. Connect a DMM across the CKP sensor terminals (measure the sensor output voltage). 2. Place the DMM on the AC volt scale. 3. Start the engine. 4. Monitor the DMM while accelerating the engine between idle and W.O.T. (accelerator pedal full travel). Does the DMM indicate an AC voltage increase in accordance with an engine speed increase (the range of approximately 1.4 volts is indicated from approximately 0.7 volts)?	—	Go to Step 5	Go to Step 19
5	1. Turn ON the ignition, with the engine OFF. 2. Connect a test lamp between the low reference circuit of the CKP sensor harness (pin 1 of J-183 connector) and a known good ground. Does the test lamp illuminate?	—	Go to Step 11	Go to Step 6
6	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a test lamp between the low reference circuit of the CKP sensor harness (pin 1 of J-183 connector) and battery voltage. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 12
7	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a test lamp between the shield ground circuit of the CKP sensor harness (pin 3 of J-183 connector) and a known good ground. Does the test lamp illuminate?	—	Go to Step 13	Go to Step 8
8	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a test lamp between the shield ground circuit of the CKP sensor harness (pin 1 of J-183 connector) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 14
9	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a test lamp between the signal circuit of the CKP sensor harness (pin 2 of J-183 connector) and battery voltage. Does the test lamp illuminate?	—	Go to Step 15	Go to Step 10
10	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a DMM between the signal circuit of the CKP sensor harness (pin 2 of J-183 connector) and a known good ground. Is the DMM voltage more than the specified value?	1 volt	Go to Step 16	Go to Step 17

Step	Action	Value(s)	Yes	No
11	Important: The ECM may be damaged if the sensor low reference circuit is shorted to a voltage source. 1. Test the low reference circuit of the CKP sensor between the engine control module (ECM) (pin 98 of B-233 connector) and the CKP sensor (pin 1 of J-183 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 21
12	1. Test the low reference circuit of the CKP sensor between the ECM (pin 98 of B-233 connector) and the CKP sensor (pin 1 of J-183 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 18
13	Important: The ECM may be damaged if the sensor shield ground circuit is shorted to a voltage source. 1. Test the shield ground circuit of the CKP sensor between the ECM (pin 101 of B-233 connector) and the CKP sensor (pin 3 of J-183 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 21
14	1. Test the shield ground circuit of the CKP sensor between the ECM (pin 101 of B-233 connector) and the CKP sensor (pin 3 of J-183 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 18
15	1. Test the signal circuit of the CKP sensor between the ECM (pin 90 of B-233 connector) and the CKP sensor (pin 2 of J-183 connector) for the following conditions: • A short to ground • A short to the low reference circuit • A short to the shield ground 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 21

6E-106 Engine Control System (4JH1)

Step	Action	Value(s)	Yes	No
16	Important: The CKP sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit of the CKP sensor between the ECM (pin 90 of B-233 connector) and the CKP sensor (pin 2 of J-183 connector) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 21
17	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the CKP sensor (pins 1, 2 and 3 of J-183 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 20
18	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the CKP sensor circuits at the harness connector of the ECM (pins 90, 98 and 101 of B-233 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 21
19	1. Inspect the CKP sensor for tightness. Retest if the sensor was loose. 2. Remove the CKP sensor and check for damage, metal particles on magnet and for flywheel circumference damage. Did you find and correct the condition?	—	Go to Step 22	Go to Step 20
20	Replace the CKP sensor. Refer to Crankshaft Position Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 22	—
21	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 22	—
22	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 23
23	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0335 (Symptom Code E) (Flash Code 43)**Circuit Description**

The crankshaft position (CKP) sensor is located on top of the flywheel housing. The engine control module (ECM) calculates the engine speed and exact position of the crankshaft based on the signal from the CKP sensor. If the ECM detects an engine overrun condition, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the engine speed is higher than 5700 RPM for 0.2 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

- The ECM cuts fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- Ensure the sensor is tight and the flywheel circumference is not damaged.

Notice:

- This DTC is caused by an engine overspeed condition, which was most likely caused by driver error (i.e. downshifting a manual transmission on a steep grade). Ensure there are no signs of engine damage. Excessive engine overspeed may damage internal engine components.

DTC P0335 (Symptom Code E) (Flash Code 43)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Start the engine. 3. Observe the Engine Speed parameter with the Tech 2. 4. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the Tech 2. Does the Engine Speed parameter ever exceed the specified value?	5000 RPM	Go to Step 4	Go to Step 3
3	Ask the driver if overrun is caused by gear slip-out, shift error, down-slope diving, etc. If engine overrun has experienced, the engine must be inspected and repaired as necessary. Did you complete the action?	—	Go to Step 7	—
4	1. Remove the crankshaft position (CKP) sensor. Refer to CKP Sensor replacement in this section. 2. Visually inspect the CKP sensor for the following conditions: • For physical damage • For being loose • For improper installation Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	Visually inspect the flywheel circumference for damage. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6

6E-108 Engine Control System (4JH1)

Step	Action	Value(s)	Yes	No
6	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Observe the Engine Speed parameter with the Tech 2. 6. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the Tech 2. Does the Engine Speed parameter ever exceed the specified value?	5000 RPM	Go to Step 4	Go to Step 8
8	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0380 (Symptom Code 4) (Flash Code 66)**Circuit Description**

The engine control module (ECM) controls the glow relay which supplies power to the glow plugs based on engine coolant temperature. In the after glow phase, the glow indicator light is not illuminated but glow plugs remain active for a certain period. If the ECM detects an open circuit or short to ground on the glow relay control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the low voltage condition on the glow relay control circuit for longer than 3 seconds when the relay is commanded OFF.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Notice:

- The glow relay is commanded OFF with ignition ON and engine OFF when the engine coolant temperature is reached at 30°C (86°F).
- The glow relay is commanded OFF with engine run when the engine coolant temperature is reached at 30°C (86°F).

DTC P0380 (Symptom Code 4) (Flash Code 66)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Perform the Glow Relay test with the Tech 2. 4. Command the Glow Relay ON with the Tech 2. Does the glow relay click when commanded ON with the Tech 2?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Replace the glow relay with the starter relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. 4. Command the Glow Relay ON with the Tech 2. Does the glow relay click when commanded ON with the Tech 2?	—	Go to Step 10	Go to Step 4
4	1. Turn OFF the ignition. 2. Remove the glow relay. 3. Connect a test lamp between the voltage feed circuit of the glow relay coil side (pin 4 of X-20 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 7

6E-110 Engine Control System (4JH1)

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Connect a test lamp between the control circuit of the glow relay (pin 5 of X-20 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp continuously illuminate (the test lamp blinks then goes out normally if the engine coolant temperature lower than 30°C [86°F])?	—	Go to Step 8	Go to Step 6
6	1. Keep the test lamp with connected. 2. Command the Glow Relay ON with the Tech 2. Does the test lamp illuminate when commanded ON with the Tech 2?	—	Go to Step 10	Go to Step 9
7	Repair the voltage feed circuit between the ECM main relay (pin 5 of X-14 connector) and the glow relay (pin 4 of X-20 connector) for an open circuit or high resistance. Did you complete the repair?	—	Go to Step 14	—
8	1. Test the control circuit of the glow relay between the engine control module (ECM) (pin 94 of B-233 connector) and the glow relay (pin 5 of X-20 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
9	1. Test the control circuit of the glow relay between the ECM (pin 94 of B-233 connector) and the glow relay (pin 5 of X-20 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
10	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections on the glow relay terminals (pins 4 and 5 of X-20 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the glow relay control circuit at the harness connector of the ECM (pin 94 of B-233 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
12	Replace the glow relay. Did you complete the replacement?	—	Go to Step 14	—
13	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 14	—

Step	Action	Value(s)	Yes	No
14	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and warm up (allow engine coolant temperature to reach at least 35°C [95°F]). 5. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 15
15	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0380 (Symptom Code 8) (Flash Code 66)**Circuit Description**

The engine control module (ECM) controls the glow relay which supplies power to the glow plugs based on engine coolant temperature. In the after glow phase, the glow indicator light is not illuminated but glow plugs remain active for a certain period. If the ECM detects a short to battery or ignition voltage on the glow relay control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the high voltage condition on the glow relay control circuit for longer than 1 second when the relay is commanded ON.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Notice:

- The glow relay is commanded OFF with ignition ON and engine OFF when the engine coolant temperature is reached at 30°C (86°F).
- The glow relay is commanded OFF with engine run when the engine coolant temperature is reached at 30°C (86°F).

DTC P0380 (Symptom Code 8) (Flash Code 66)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Perform the Glow Relay test with the Tech 2. 4. Command the Glow Relay ON with the Tech 2. Does the glow relay click when commanded ON with the Tech 2?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Replace the glow relay with the starter relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. 4. Command the Glow Relay ON with the Tech 2. Does the glow relay click when commanded ON with the Tech 2?	—	Go to Step 5	Go to Step 4
4	1. Test the control circuit of the glow relay between the engine control module (ECM) (pin 94 of B-233 connector) and the glow relay (pin 5 of X-20 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Replace the glow relay. Did you complete the replacement?	—	Go to Step 7	—

Step	Action	Value(s)	Yes	No
6	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Cool down the engine as necessary (allow engine coolant temperature to cool down at least 25°C [77°F]). 5. Start the engine. 6. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8
8	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0381 (Symptom Code 4) (Flash Code 67)**Circuit Description**

The glow indicator lamp is located on the instrument panel cluster (IPC). The glow control system is operated when the engine coolant temperature is low, which allows easier engine starting. If the ignition switch is turned ON when the engine coolant temperature is low, the engine control module (ECM) illuminates the glow indicator lamp and turns ON the glow plugs. After a fixed time passes, the ECM turns OFF the glow indicator lamp and the glow plugs. The ECM monitors the glow indicator lamp control circuit for conditions that are incorrect for the commanded state of the glow indicator lamp. If the ECM detects an open circuit or short to ground on the glow indicator control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the low voltage condition on the glow indicator lamp control circuit for longer than 3 seconds when the lamp is commanded OFF.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- The glow indicator lamp is commanded OFF with the ignition ON and engine OFF when the engine coolant temperature is reached at 30°C (86°F).

DTC P0381 (Symptom Code 4) (Flash Code 67)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Perform the Glow Indicator test with the Tech 2. 4. Command the Glow Indicator ON with the Tech 2. Does the glow indicator lamp turn ON when commanded ON with the Tech 2?	—	Go to Step 3	Go to Step 4
3	Command the Glow Indicator OFF with the Tech 2. Does the glow indicator lamp OFF?	—	Go to Step 17	Go to Step 10
4	1. Turn OFF the ignition. 2. Inspect the Meter (10A) fuse (F-16) in the glove box fuse block. Is the Meter (10A) fuse (F-16) open?	—	Go to Step 5	Go to Step 6
5	Replace the Meter (10A) fuse (F-16). If the fuse continues to open, repair the short to ground on one of the circuits that fed by the Meter (10A) fuse (F-16) or replace the shorted attached component fed by the Meter (10A) fuse (F-16). Did you complete the repair?	—	Go to Step 19	—

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the glow indicator lamp control circuit of the ECM harness connector (pin 43 of B-234 connector) and a known good ground. Does the glow indicator lamp illuminate?	—	Go to Step 11	Go to Step 7
7	1. Turn OFF the ignition. 2. Remove the instrument panel cluster (IPC). 3. Remove the glow indicator bulb from the IPC (meter assembly). Is the glow indicator bulb burned out?	—	Go to Step 15	Go to Step 8
8	1. Disconnect the IPC harness B-51 connector. 2. Connect a test lamp between the voltage feed circuit of the glow indicator lamp (pin 8 of B-51 connector) and a known good ground. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 12
9	1. Turn OFF the ignition. 2. Reconnect the ECM harness connector. 3. Connect a test lamp between the voltage feed circuit and control circuit of the glow indicator lamp (pins 6 and 8 of B-51 connector). 4. Turn ON the ignition, with the engine OFF. 5. Perform the Glow Indicator test with the Tech 2. 6. Command the Glow Indicator ON with the Tech 2. Does the test lamp turn ON when commanded ON with the Tech 2?	—	Go to Step 14	Go to Step 13
10	1. Test the control circuit of the glow indicator lamp between the ECM (pin 43 of B-234 connector) and the IPC (pin 6 of B-51 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the glow indicator lamp control circuit at the harness connector of the ECM (pin 43 of B-234 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
12	Repair the open circuit or high resistance on the voltage feed circuit of the glow indicator lamp between the IPC (pin 8 of B-51 connector) and Meter (10A) fuse (F-16). Did you complete the repair?	—	Go to Step 19	—

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Step	Action	Value(s)	Yes	No
13	1. Repair the open circuit or high resistance on the control circuit of the glow indicator lamp between the ECM (pin 43 of B-234 connector) and the IPC (pin 6 of B-51 connector). 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	—
14	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections on the glow indicator lamp circuits at the IPC (pins 6 and 8 of B-51 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
15	Replace the glow indicator bulb. Did you complete the replacement?	—	Go to Step 19	—
16	Repair or replace the IPC (meter assembly). Did you complete the repair or replacement?	—	Go to Step 19	—
17	1. Turn OFF the ignition for 30 seconds. 2. Turn ON the ignition for 30 seconds, with the engine OFF. 3. Monitor the DTC Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 18	Go to Diagnostic Aids
18	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 19	—
19	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 20
20	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0381 (Symptom Code 8) (Flash Code 67)**Circuit Description**

The glow indicator lamp is located on the instrument panel cluster (IPC). The glow control system is operated when the engine coolant temperature is low, which allows easier engine starting. If the ignition switch is turned ON when the engine coolant temperature is low, the engine control module (ECM) illuminates the glow indicator lamp and turns ON the glow plugs. After a fixed time passes, the ECM turns OFF the glow indicator lamp and the glow plugs. The ECM monitors the glow indicator lamp control circuit for conditions that are incorrect for the commanded state of the glow indicator lamp. If the ECM detects a short to battery or ignition voltage on the glow indicator control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the high voltage condition on the glow indicator lamp control circuit for longer than 1 second when the lamp is commanded ON.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- The glow indicator lamp is commanded OFF with the ignition ON and engine OFF when the engine coolant temperature is reached at 30°C (86°F).

Test Description

The number below refers to the step number on the diagnostic table.

3. If the control circuit of the glow indicator lamp between the ECM and the IPC is normal, the control circuit voltage low DTC P0381 (Symptom Code 4) will set.

DTC P0381 (Symptom Code 8) (Flash Code 67)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Perform the Glow Indicator test with the Tech 2. 4. Command the Glow Indicator ON with the Tech 2. Does the glow indicator lamp turn ON when commanded ON with the Tech 2?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Remove the instrument panel cluster (IPC) in order to disconnect the IPC harness B-51 connector. 3. Disconnect the IPC harness B-51 connector. 4. Turn ON the ignition for 30 seconds, with the engine OFF. 5. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does DTC P0381 (Symptom Code 4) set, but not DTC P0381 (Symptom Code 8)?	—	Go to Step 5	Go to Step 4

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Step	Action	Value(s)	Yes	No
4	1. Test the control circuit of the glow indicator lamp between the engine control module (ECM) (pin 43 of B-234 connector) and the IPC (pin 6 of B-51 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Repair or replace the IPC (meter assembly). Did you complete the repair or replacement?	—	Go to Step 7	—
6	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Cool down the engine as necessary (allow engine coolant temperature to cool down at least 25°C [77°F]). 5. Turn ON the ignition, with the engine OFF. 6. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8
8	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0400 (Symptom Code 3) (Flash Code 32)**Circuit Description**

The engine control module (ECM) controls the exhaust gas recirculation (EGR) flow amount based on the engine speed, engine coolant temperature, intake air temperature, barometric pressure and fuel injection quantity. The ECM controls the EGR valve by controlling the EGR solenoid valve. The mass air flow (MAF) sensor monitors EGR gas flow amount. An expected MAF amount should be detected while the engine running. If the ECM detects the actual MAF amount is lower than desired MAF amount, this DTC will set. This indicates excessive amount of EGR gas flow.

Condition for Running the DTC

- The ignition switch is ON.
- The engine is running.
- The barometric pressure (BARO) is between 880 hPa and 1100 hPa.
- The intake air temperature (IAT) is between 16°C (61°F) and 34°C (93°F).
- The ECT is between 70°C (158°F) and 100°C (211°F).

Condition for Setting the DTC

- The ECM detects that the MAF amount is 150 mg/strk lower than the desired MAF for 60 seconds. This indicates excessive amount of EGR flow.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A sticking or intermittently sticking the EGR valve will cause this DTC to set.
- Misrouted vacuum hoses will cause this DTC to set.

DTC P0400 (Symptom Code 3) (Flash Code 32)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P0100 (Symptom Code 7, 9, B or C) or P0400 (Symptom Code 4 or 8) set?	—	Go to Applicable DTC	Go to Step 3
3	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and warm up (allow engine coolant temperature to reach at least 75°C [167°F]). 4. Perform the EGR Solenoid Valve test with the Tech 2. 5. Command the EGR Solenoid Valve ON and OFF with the Tech 2 while observing the Mass Air Flow (MAF) Sensor parameter. Does the MAF Sensor parameter decrease by at least 200 mg/strk within 2 seconds when the EGR Solenoid Valve is commanded ON?	—	Go to Diagnostic Aids	Go to Step 4

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Step	Action	Value(s)	Yes	No
4	- Turn OFF the ignition. - Inspect for the following conditions: - An EGR valve control vacuum hose is damaged or kinked. - An EGR solenoid valve vacuum hose and ventilation hose that is damaged or kinked. - An EGR valve is stuck open. - Any type of restriction in the exhaust system. - Air leakage around the MAF sensor or debris in the sensor housing. - Air leaking around any of the air induction tubing between the MAF sensor and intake manifold. - Turbine shaft binding causing lower turbocharger shaft spinning speeds. Refer to the Turbocharger in Engine Mechanical section for diagnosis. - Restricted air cleaner element, restricted or collapsed air tubing between the air cleaner and the turbocharger. - Oil in the air tubing causing an incorrect MAF sensor signal. When there is adhesion of oil, inside of the tubing, intercooler and turbocharger needs to be wiped off. - Contaminated, skewed or slow MAF sensor. - Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 5
5	- Turn OFF the ignition. - Disconnect the EGR valve control vacuum hose from the EGR valve. - Connect a hand-held vacuum pump (5-8840-0279-0/J-23738-A) to the disconnected vacuum hose. - Start the engine and let engine idle. - Perform the EGR Solenoid Valve test with the Tech 2. - Command the EGR Solenoid Valve ON and OFF with the Tech 2. Does the hand-held vacuum pump indicate more than 50 cmHg (20 inHg) when commanding the ON and less than 10 cmHg (4 inHg) when commanding OFF?	—	Go to Step 6	Go to Step 9

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the hand-held vacuum pump from the vacuum hose. 3. Connect the hand-held vacuum pump to the vacuum port of EGR valve. 4. Start the engine and let engine idle. 5. Apply vacuum pressure to the EGR valve while observing the MAF Sensor parameter. Does the MAF Sensor parameter decrease by at least 200 mg/strk when the vacuum pressure is applied?	—	Go to Diagnostic Aids	Go to Step 7
7	1. Turn OFF the ignition. 2. Disconnect the MAF sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the MAF sensor (pins 2, 4 and 5 of J-182 connector). 4. Disconnect the engine control module (ECM) harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each MAF sensor circuit at the harness connector of the ECM (pins 83 and 88 of B-233 connector). 6. Test for high resistance on each MAF sensor circuit. 7. Test the MAF sensor signal circuit short to intake air temperature (IAT) sensor signal. 8. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
8	Replace the EGR valve. Refer to EGR Valve Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 10	—
9	Replace the EGR solenoid valve. Refer to EGR Solenoid Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 10	—
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and warm up (allow engine coolant temperature to reach at least 75°C [167°F]) while observing the MAF Sensor parameter with the Tech 2. Does the MAF Sensor parameter follow the Desired MAF parameter within 50 mg/strk?	—	Go to Step 11	Go to Step 2
11	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0400 (Symptom Code 4) (Flash Code 32)**Circuit Description**

The engine control module (ECM) controls the exhaust gas recirculation (EGR) flow amount based on the engine speed, engine coolant temperature, intake air temperature, barometric pressure and fuel injection quantity. The ECM controls the EGR valve by controlling the EGR solenoid valve. The mass air flow (MAF) sensor monitors EGR gas flow amount. An expected MAF amount should be detected while the engine running. If the ECM detects that an open circuit or short to ground on the EGR solenoid valve control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the low voltage condition on the EGR solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded OFF.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0400 (Symptom Code 4) (Flash Code 32)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the EGR control solenoid valve harness connector. 3. Connect a test lamp between the voltage feed circuit of the EGR control solenoid valve harness (pin 1 of J-105 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 6
4	1. Connect a test lamp between the control circuit of the EGR solenoid valve harness (pin 2 of J-105 connector) and battery voltage. 2. Perform the EGR Solenoid Valve test with the Tech 2. 3. Command the EGR Solenoid Valve ON with the Tech 2. Does the test lamp illuminate when commanded ON with the Tech 2?	—	Go to Step 5	Go to Step 7

Step	Action	Value(s)	Yes	No
5	Command the EGR Solenoid Valve OFF with the Tech 2. Does the test lamp continuously illuminate same as Step 4 when commanded OFF with the Tech 2 (the test lamp slightly illuminates if the circuit is normal when commanded OFF)?	—	Go to Step 8	Go to Step 9
6	Repair the open circuit or high resistance on the voltage feed circuit between the ECM main relay (pin 5 of X-14 connector) and the EGR solenoid valve (pin 1 of J-105 connector). Did you complete the repair?	—	Go to Step 13	—
7	1. Test the control circuit between the engine control module (ECM) (pin 97 of B-233 connector) and the EGR solenoid valve (pin 2 of J-105 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
8	1. Test the control circuit between the ECM (pin 97 of B-233 connector) and the EGR solenoid valve (pin 2 of J-105 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
9	1. Turn OFF the ignition. 2. Disconnect the EGR solenoid valve harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the EGR solenoid valve (pins 1 and 2 of J-105 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the EGR solenoid valve control circuit at the harness connector of the ECM (pin 97 of B-233 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the EGR solenoid valve. Refer to EGR Solenoid Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 13	—
12	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 13	—

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Step	Action	Value(s)	Yes	No
13	1. Reconnect all previously disconnected or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 14
14	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0400 (Symptom Code 5) (Flash Code 32)**Circuit Description**

The engine control module (ECM) controls the exhaust gas recirculation (EGR) flow amount based on the engine speed, engine coolant temperature, intake air temperature, barometric pressure and fuel injection quantity. The ECM controls the EGR valve by controlling the EGR solenoid valve. The mass air flow (MAF) sensor monitors EGR gas flow amount. An expected MAF amount should be detected while the engine running. If the ECM detects the actual MAF amount is higher than desired MAF amount, this DTC will set. This indicates insufficient amount of EGR gas flow.

Condition for Running the DTC

- The ignition switch is ON.
- The engine is running.
- The barometric pressure (BARO) is between 880 hPa and 1100 hPa.
- The intake air temperature (IAT) is between 16°C (61°F) and 34°C (93°F).
- The ECT is between 70°C (158°F) and 100°C (211°F).

Condition for Setting the DTC

- The ECM detects that the MAF amount is 150 mg/strk higher than the desired MAF for 60 seconds. This indicates insufficient amount of EGR flow.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A sticking or intermittently sticking the EGR valve will cause this DTC to set.
- Misrouted vacuum hoses will cause this DTC to set.
- A vacuum pump problem will cause this DTC to set.

DTC P0400 (Symptom Code 5) (Flash Code 32)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P0100 (Symptom Code 7, 9, B or C) or P0400 (Symptom Code 4 or 8) set?	—	Go to Applicable DTC	Go to Step 3
3	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and warm up (allow engine coolant temperature to reach at least 75°C [167°F]). 4. Perform the EGR Solenoid Valve test with the Tech 2. 5. Command the EGR Solenoid Valve ON and OFF with the Tech 2 while observing the Mass Air Flow (MAF) Sensor parameter. Does the MAF Sensor parameter decrease by at least 200 mg/strk within 2 seconds when the EGR Solenoid Valve is commanded ON?	—	Go to Diagnostic Aids	Go to Step 4

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Step	Action	Value(s)	Yes	No
4	- Turn OFF the ignition. - Inspect for the following conditions: - An EGR valve control vacuum hose is damaged or kinked. - An EGR solenoid valve control vacuum hose and ventilation hose that is damaged or kinked. - An EGR valve is stuck close. - Restricted or collapsed EGR passage between the exhaust manifold and EGR valve. - A vacuum hose from the vacuum pump is damaged or kinked. - A vacuum pump is damaged. - Oil in the air tubing causing an incorrect MAF sensor signal. When there is adhesion of oil, inside of the tubing, intercooler and turbocharger needs to be wiped off. - Contaminated or skewed MAF sensor. - Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 5
5	- Turn OFF the ignition. - Disconnect the EGR valve control vacuum hose from the EGR valve. - Connect a hand-held vacuum pump (5-8840-0279-0/J-23738-A) to the disconnected vacuum hose. - Start the engine and let engine idle. - Perform the EGR Solenoid Valve test with the Tech 2. - Command the EGR Solenoid Valve ON and OFF with the Tech 2. Does the hand-held vacuum pump indicate more than 50 cmHg (20 inHg) when commanding the ON and less than 10 cmHg (4 inHg) when commanding OFF?	—	Go to Step 6	Go to Step 9
6	- Turn OFF the ignition. - Disconnect the hand-held vacuum pump from the vacuum hose. - Connect the hand-held vacuum pump to the vacuum port of EGR valve. - Start the engine and let engine idle. - Apply vacuum pressure to the EGR valve while observing the MAF Sensor parameter. Does the MAF Sensor parameter decrease by at least 200 mg/strk when the vacuum pressure is applied?	—	Go to Diagnostic Aids	Go to Step 7

Step	Action	Value(s)	Yes	No
7	1. Turn OFF the ignition. 2. Disconnect the MAF sensor harness connector. 3. Inspect for an intermittent, for a poor connection and corrosion at the harness connector of the MAF sensor (pin 3 of J-182 connector). 4. Disconnect the engine control module (ECM) harness connector. 5. Inspect for an intermittent, for a poor connection and corrosion on each MAF sensor circuit at the harness connector of the ECM (pin 92 of B-233 connector). 6. Test for high resistance on each MAF sensor circuit. 7. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
8	Replace the EGR valve. Refer to EGR Valve Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 10	—
9	Replace the EGR solenoid valve. Refer to EGR Solenoid Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 10	—
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and warm up (allow engine coolant temperature to reach at least 75°C [167°F]) while observing the MAF Sensor parameter with the Tech 2. Does the MAF Sensor parameter follow the Desired MAF parameter within 50 mg/strk?	—	Go to Step 11	Go to Step 2
11	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0400 (Symptom Code 8) (Flash Code 32)**Circuit Description**

The engine control module (ECM) controls the exhaust gas recirculation (EGR) flow amount based on the engine speed, engine coolant temperature, intake air temperature, barometric pressure and fuel injection quantity. The ECM controls the EGR valve by controlling the EGR solenoid valve. The mass air flow (MAF) sensor monitors EGR gas flow amount. An expected MAF amount should be detected while the engine running. If the ECM detects a short to battery or ignition voltage on the EGR solenoid valve control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the high voltage condition on the EGR solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded ON.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

- The ECM limits fuel injection quantity.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The number below refers to the step number on the diagnostic table.

3. If the control circuit of the EGR solenoid valve between the ECM and the solenoid valve is normal, the control circuit voltage low DTC P0400 (Symptom Code 4) will set.

DTC P0400 (Symptom Code 8) (Flash Code 32)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and warm up (allow engine coolant temperature to reach at least 75°C [167°F]). 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the EGR control solenoid valve harness connector. 3. Start the engine. 4. Monitor the DTC Information with the Tech 2. Does the DTC P0400 (Symptom Code 4) set, but not DTC P0400 (Symptom Code 8)?	—	Go to Step 5	Go to Step 4
4	1. Test the control circuit between the engine control module (ECM) (pin 97 of B-233 connector) and the EGR solenoid valve (pin 2 of J-105 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Replace the EGR solenoid valve. Refer to EGR Solenoid Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
6	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and warm up (allow engine coolant temperature to reach at least 75°C [167°F]). 5. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0500 (Symptom Code 1, A) (Flash Code 24)**Circuit Description**

The vehicle speed sensor (VSS) is used by the engine control module (ECM) and speedometer, which generates a speed signal from the transmission output shaft. The VSS has the following circuits.

- Ignition voltage feed circuit
- VSS signal circuit
- VSS low reference circuit

The VSS uses a hall effect element. It interacts with the magnetic field created by the rotating magnet and outputs square wave pulse signal. The ECM calculates the vehicle speed by the VSS. If the ECM detects VSS signals are generated with high frequencies, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the vehicle speed is higher than 190 km/h (119 MPH) for 5 seconds. (Symptom Code 1)
- The ECM detects that the vehicle speed sensor signal frequency is too high for 0.6 seconds. (Symptom Code A)

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a vehicle speed substitution of 5 km/h (3 MPH) for engine control.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- Electrical or magnetic interference may affect intermittent condition.
- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0500 (Symptom Code 1, A) (Flash Code 24)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Inspect all of the circuits going to the vehicle speed sensor (VSS) for the following: • Routed too closely to fuel injection solenoid wiring or components • Routed too closely to after-market add-on electrical equipment • Routed too closely to solenoids, relays, and motors 2. If you find incorrect routing, correct the harness routing. Did you find and correct the condition?	—	Go to Step 7	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the VSS harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the VSS (pins 1, 2 and 3 of J-32 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) harness connector. 3. Inspect for an intermittent and for a poor connection on VSS circuit at the harness connector of the ECM (pin 68 of B-234 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	1. Remove the VSS. Refer to Vehicle Speed Sensor (VSS) Replacement in this section. 2. Visually inspect the VSS for the following conditions: - Physical damage - Being loose - Improper installation 3. The following conditions may cause this DTC to set: - Electromagnetic interference in the VSS circuits 4. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	Replace the VSS. Refer to Vehicle Speed Sensor (VSS) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Drive the vehicle. 5. Observe the Vehicle Speed parameter with the Tech 2. Does the Vehicle Speed parameter indicate correct vehicle speed?	—	Go to Step 8	Go to Step 2
8	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0500 (Symptom Code B) (Flash Code 24)**Circuit Description**

The vehicle speed sensor (VSS) is used by the engine control module (ECM) and speedometer, which generates a speed signal from the transmission output shaft. The VSS has the following circuits.

- Ignition voltage feed circuit
- VSS signal circuit
- VSS low reference circuit

The VSS uses a hall effect element. It interacts with the magnetic field created by the rotating magnet and outputs square wave pulse signal. The ECM calculates the vehicle speed by the VSS. If the ECM detects VSS signals are not generated, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine speed is higher than 3600 RPM.
- The fuel injection quantity is more than 41 mg/strk.

Condition for Setting the DTC

- The ECM detects that the vehicle speed is lower than 1.5 km/h (1 MPH) for 60 seconds.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- Electrical or magnetic interference may affect intermittent condition.
- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0500 (Symptom Code B) (Flash Code 24)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Drive the vehicle. 3. Observe the Vehicle Speed parameter with the Tech 2. Does the Vehicle Speed parameter indicate correct vehicle speed?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Inspect the Meter (10A) fuse (F-16) in the glove box fuse block. Is the Meter (10A) fuse (F-16) open?	—	Go to Step 4	Go to Step 5
4	Replace the Meter (10A) fuse (F-16). If the fuse continues to open, repair the short to ground on one of the circuits that fed by the Meter (10A) fuse (F-16) or replace the shorted attached component fed by the Meter (10A) fuse (F-16). Did you complete the repair?	—	Go to Step 18	—

Step	Action	Value(s)	Yes	No
5	1. Remove the vehicle speed sensor (VSS). Refer to Vehicle Speed Sensor (VSS) Replacement in this section. 2. Visually inspect the VSS for the following conditions: • Physical damage • Being loose • Improper installation • For transmission output shaft teeth damage 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 6
6	1. Turn OFF the ignition. 2. Disconnect the VSS harness connector. 3. Connect a test lamp between the ignition voltage feed circuit of the VSS harness (pin 1 of J-32 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 9
7	1. Keep the ignition switch ON. 2. Connect a test lamp between the ignition voltage feed circuit and low reference circuit of the VSS harness (pins 1 and 2 of J-32 connector). Does the test lamp illuminate?	—	Go to Step 8	Go to Step 10
8	1. Turn ON the ignition, with the engine OFF. 2. Intermittently jump the signal circuit of the VSS (pin 3 of J-32 connector) with a test lamp that is connected to a known good ground while monitoring the Vehicle Speed parameter with the Tech 2. Does the Tech 2 indicate any vehicle speed when the circuit is intermittently pulled to ground?	—	Go to Step 12	Go to Step 11
9	1. Test the VSS ignition voltage feed circuit between the VSS (pin 1 of J-32 connector) and the instrument panel cluster (IPC) (pin 3 of B-55 connector) for an open circuit or high resistance, then between the IPC (pin 8 of B-51 connector) and the Meter (10A) fuse (F-16) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 13
10	Repair the open or high resistance in the VSS low reference circuit between the VSS (pin 2 of J-32 connector) and ground terminal (B-7 terminal). Did you complete the repair?	—	Go to Step 18	—

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Step	Action	Value(s)	Yes	No
11	- Test the VSS signal circuit between the engine control module (ECM) (pin 68 of B-234 connector) and the VSS (pin 3 of J-32 connector). - An open circuit - A short to ground - A short to battery or ignition voltage - High resistance - Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 14
12	- Turn OFF the ignition. - Disconnect the VSS harness connector. - Inspect for an intermittent and for poor connections at the harness connector of the VSS (pins 1, 2 and 3 of J-32 connector). - Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 15
13	- Turn OFF the ignition. - Disconnect the IPC B-51 and B-55 harness connector. - Inspect for an intermittent and for poor connections at the harness connector of the IPC (pin 8 of B-51 and pin 3 of B-55 connector). - Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 16
14	- Turn OFF the ignition. - Disconnect the ECM harness connector. - Inspect for an intermittent and for a poor connection on the VSS signal circuit at the harness connector of the ECM (pin 68 of B-234 connector). - Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 17
15	Replace the VSS. Refer to Vehicle Speed Sensor (VSS) Replacement in this section. Did you complete the replacement?	—	Go to Step 18	—
16	Replace the IPC (meter assembly). Refer to Meter Replacement in electrical section. Did you complete the replacement?	—	Go to Step 18	—
17	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 18	—

Step	Action	Value(s)	Yes	No
18	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Drive the vehicle. 5. Observe the Vehicle Speed parameter with the Tech 2. Does the Vehicle Speed parameter indicate correct vehicle speed?	—	Go to Step 19	Go to Step 3
19	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0560 (Symptom Code 1) (Flash Code 35)**Circuit Description**

The engine control module (ECM) monitors the system voltage on the ECM main relay load supply voltage terminal to make sure that the voltage stays within the proper range. If the ECM detects an excessively high system voltage, this DTC will set.

Condition for Setting the DTC

- The ECM detects that the battery voltage feed circuit voltage is more than 20 volts.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- A charging system problem may set this DTC.
- Jump starting the vehicle or a battery charger may have set this DTC.

DTC P0560 (Symptom Code 1) (Flash Code 35)

Schematic Reference: Engine Controls Schematics & Starting and Charging Schematics

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Was the vehicle recently jump started from 24 volts system?	—	Go to Step 8	Go to Step 4
4	1. Start the engine and let idle for 30 seconds. 2. Observe the System Voltage parameter with the Tech 2. Is the System Voltage parameter less than the specified value?	16 volts	Go to Diagnostic Aids	Go to Step 5
5	Test the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you find a charging system problem?	—	Go to Step 6	Go to Step 7
6	Repair the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you complete the repair?	—	Go to Step 8	—
7	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 8	—

Step	Action	Value(s)	Yes	No
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Observe the System Voltage parameter with the Tech 2. Is the System Voltage parameter less than the specified value?	16 volts	Go to Step 9	Go to Step 5
9	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0560 (Symptom Code 2) (Flash Code 35)**Circuit Description**

The engine control module (ECM) monitors the system voltage on the ECM main relay load supply voltage terminal to make sure that the voltage stays within the proper range. If the ECM detects an excessively low system voltage, this DTC will set.

Condition for Setting the DTC

- The ECM detects that the battery voltage feed circuit voltage is less than 7 volts.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A charging system problem may set this DTC.

DTC P0560 (Symptom Code 2) (Flash Code 35)

Schematic Reference: Engine Controls Schematics & Starting and Charging Schematics

Connector End View Reference: Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Start the engine and let idle for 30 seconds. 2. Load the electrical system by turning ON the headlights, A/C, etc. 3. Observe the System Voltage parameter with the Tech 2. Is the System Voltage parameter more than the specified value?	10 volts	Go to Diagnostic Aids	Go to Step 4
4	Test the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you find a charging system problem?	—	Go to Step 5	Go to Step 6
5	Repair the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you complete the repair?	—	Go to Step 8	—
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for a poor connection and corrosion on the battery voltage feed at the harness connector of the ECM (pin 3 of B-234 connector). 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7

Step	Action	Value(s)	Yes	No
7	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Load the electrical system by turning ON the headlights, A/C, etc. 6. Observe the System Voltage parameter with the Tech 2. Is the System Voltage parameter more than the specified value?	10 volts	Go to Step 9	Go to Step 4
9	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0560 (Symptom Code A) (Flash Code 35)**Circuit Description**

The fuel injection pump control unit (PCU) monitors the system voltage on the engine control module (ECM) main relay load supply voltage terminal to make sure that the voltage stays within the proper range. If the ECM detects an excessively high or low system voltage, this DTC will set.

Condition for Setting the DTC

- The PCU detects that the battery voltage feed circuit voltage is less than 4.5 volts or more than 27 volts.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A charging system problem may set this DTC.
- Jump starting the vehicle or a battery charger may have set this DTC.

Notice:

- PCU is part of the fuel injection pump assembly.

DTC P0560 (Symptom Code A) (Flash Code 35)

Schematic Reference: Engine Controls Schematics & Starting and Charging Schematics

Connector End View Reference: Engine Controls Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P0560 (Symptom Code 1 or 2) set?	—	Go to Applicable DTC	Go to Step 3
3	1. Start the engine and let idle for 30 seconds. 2. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the fuel injection pump control unit (PCU) harness connector. 3. Inspect for an intermittent, for poor connections and corrosion on the voltage feed or ground at the harness connector of the PCU (pins 6 and 7 of E-110 connector). 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	Important: The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 6	—

Step	Action	Value(s)	Yes	No
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and let idle for 30 seconds. 5. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 7
7	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0561 (Symptom Code A) (Flash Code 18)**Circuit Description**

The engine control module (ECM) main relay is energized when the ECM receives an ignition voltage switch ON signal. When the ignition switch is OFF, the ECM main relay is de-energized after a certain length of time passed. If the ECM detects the ignition voltage switch signal is changed to OFF during the ECM is energized, this DTC will set.

Condition for Setting the DTC

- The ECM detects that the ignition voltage circuit is changed ON to OFF during initialization.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM turns OFF the ECM if the ignition voltage circuit is OFF even 1 second passes from the judgement.
- The ECM limits fuel injection quantity if the ignition voltage circuit is returned ON within 1 second from the judgement.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Faulty or sticking ECM main relay may set this DTC.

Notice:

- Quick repetition ON and OFF of ignition switch may set this DTC.

Test Description

The numbers below refer to the step number on the diagnostic table.

2. If DTC P1625 (Symptom Code B) is present, Tech 2 can communicate with the ECM when the ignition switch is OFF.

DTC P0561 (Symptom Code A) (Flash Code 18)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P1625 (Symptom Code B) set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the ignition switch harness connector (B-67) to the ignition switch (behind the steering column). 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ignition switch (pins 2 and 3 of B-67 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) harness connector. 3. Inspect for an intermittent, for a poor connection and corrosion on ignition voltage feed circuit at the harness connector of the ECM (pin 39 of B-234 connector). 4. Test for high resistance on ignition voltage feed circuit. 5. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	Replace the ignition switch. Did you complete the replacement?	—	Go to Step 6	—
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Observe the DTC Information with the Tech 2. 6. Turn OFF the ignition. Does the DTC fail this ignition before the ECM turns OFF?	—	Go to Step 2	Go to Step 7
7	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0561 (Symptom Code B) (Flash Code 18)**Circuit Description**

The engine control module (ECM) main relay is energized when the ECM receives an ignition voltage switch ON signal. When the ignition switch is OFF, the ECM main relay is de-energized after a certain length of time passed. If the ECM detects the ignition voltage switch signal is changed to OFF during the ECM is energized, this DTC will set.

Condition for Setting the DTC

- The ECM detects internal ignition voltage feed circuit is failed after initialization.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM turns OFF the ECM.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0561 (Symptom Code B) (Flash Code 18)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0602**Description**

The engine control module (ECM) has the ability to set a diagnostic trouble code (DTC) if it detects that there is no vehicle identification (VIN) programmed.

Diagnostic Aids**Notice:**

- Production and service ECM does not require software programming when it is replaced except calibration software update. This DTC indicates that a production or service ECM does not program VIN.

DTC P0602

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 6
3	Important: Blank engine control module (ECM) must be programmed. Program the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the programming?	—	Go to Step 4	—
4	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 5	Go to Step 7
5	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 6	—
6	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 7
7	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0606 (Symptom Code A, B) (Flash Code 28)**Description**

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM).

Condition for Running the DTC

Symptom Code B

- The accelerator pedal position is less than 1%.
- The desired fuel injection quantity is 0 mg/stk.

Condition for Setting the DTC

Symptom Code A

- The ECM detects that the internal CPU does not react.

Symptom Code B

- The ECM detects that the engine speed is higher than 2000 RPM.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

DTC P0606 (Symptom Code A, B) (Flash Code 28)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0645 (Symptom Code 4) (Flash Code 46)**Circuit Description**

The engine control module (ECM) controls the air conditioning (A/C) compressor relay, which supplies power to the A/C compressor clutch based on A/C request input to the ECM from the heating, ventilation and air conditioning (HVAC) controls. The ECM commands the A/C compressor relay ON at engine run. If the ECM detects an open circuit or short to ground on the A/C compressor relay control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The A/C compressor relay is once commanded ON.

Condition for Setting the DTC

- The ECM detects a low voltage condition on the A/C compressor relay control circuit for longer than 3 seconds when the relay is commanded OFF.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- The A/C compressor relay is commanded OFF when the engine coolant temperature is reached around 115°C (239°F) and it commanded ON again below 110°C (230°F).

DTC P0645 (Symptom Code 4) (Flash Code 46)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle. 4. Turn ON the blower motor switch and the A/C compressor switch. 5. Turn OFF the A/C compressor switch. 6. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Replace the A/C compressor relay with the marker light relay or replace with a known good relay. 3. Start the engine and let idle. 4. Turn ON the blower motor switch and the A/C compressor switch. 5. Turn OFF the A/C compressor switch. 6. Monitor the DTC Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 4	Go to Step 12

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Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Remove the A/C compressor relay. 3. Connect a test lamp between the voltage feed circuit of the A/C compressor relay coil side (pin 4 of X-24 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 7
5	1. Turn OFF the ignition. 2. Connect a test lamp between the A/C compressor relay control circuit (pin 2 of X-24 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 6
6	1. Keep the test lamp with connected. 2. Start the engine. 3. Turn ON the blower motor switch and the A/C compressor switch. Does the test lamp illuminate when the A/C Compressor Relay parameter is ON?	—	Go to Step 10	Go to Step 9
7	Repair the open circuit or high resistance on the voltage feed circuit between the ECM main relay (pin 5 of X-14 connector) and the A/C compressor relay (pin 4 of X-24 connector). Did you complete the repair?	—	Go to Step 14	—
8	1. Test the control circuit of the A/C compressor relay between the ECM (pin 41 of B-234 connector) and the A/C compressor relay (pin 2 of X-24 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
9	1. Test the control circuit of the A/C compressor relay between the engine control module (ECM) (pin 41 of B-234 connector) and the A/C compressor relay (pin 2 of X-24 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
10	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections on the A/C compressor relay terminal (pins 2 and 4 of X-24 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the A/C compressor relay control circuit at the harness connector of the ECM (pin 41 of B-234 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13

Step	Action	Value(s)	Yes	No
12	Replace the A/C compressor relay. Did you complete the replacement?	—	Go to Step 14	—
13	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 14	—
14	1. Reconnect all previously disconnected fuse, relay or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and let idle. 5. Turn ON the blower motor switch and the A/C compressor switch. 6. Turn OFF the A/C compressor switch. 7. Monitor the DTC Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 15
15	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0645 (Symptom Code 8) (Flash Code 46)**Circuit Description**

The engine control module (ECM) controls the air conditioning (A/C) compressor relay, which supplies power to the A/C compressor clutch based on A/C request input to the ECM from the heating, ventilation and air conditioning (HVAC) controls. The ECM commands the A/C compressor relay ON at engine run. If the ECM detects a short to battery or ignition voltage on the A/C compressor relay control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The A/C compressor relay is once commanded ON.

Condition for Setting the DTC

- The ECM detects a high voltage condition on the A/C compressor relay control circuit for longer than 3 seconds when the relay is commanded ON.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- The A/C compressor relay is commanded OFF when the engine coolant temperature is reached around 115°C (239°F) and it commanded ON again below 110°C (230°F).

DTC P0645 (Symptom Code 8) (Flash Code 46)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Turn ON the blower motor switch and the A/C compressor switch. 5. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2 when the A/C Relay Command parameter is ON. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Replace the A/C compressor relay with the marker light relay or replace with a known good relay. 3. Start the engine. 4. Turn ON the blower motor switch and the A/C compressor switch. 5. Monitor the DTC Information with the Tech 2 when the A/C Relay Command parameter is ON. Does the DTC fail this ignition?	—	Go to Step 4	Go to Step 5

Step	Action	Value(s)	Yes	No
4	1. Test the control circuit of the A/C compressor relay between the ECM (pin 41 of B-234 connector) and the A/C compressor relay (pin 2 of X-24 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Replace the A/C compressor relay. Did you complete the replacement?	—	Go to Step 7	—
6	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Turn ON the blower motor switch and the A/C compressor switch. 6. Monitor the DTC Information with the Tech 2 when the A/C Relay Command parameter is ON. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0703 (Symptom Code A, B) (Flash Code 25)**Circuit Description**

The brake pedal switch is installed on the brake pedal bracket. The brake pedal 1 switch is a normally open type switch and the brake pedal 2 switch is a normally closed type switch. When the brake pedal is pressed, the brake pedal 1 switch signal is provided to the engine control module (ECM) and the stoplights are turned ON. Then, the brake pedal 2 switch signal to the ECM is stopped (low voltage). If the ECM detects the brake switch signals out of correlation, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine speed is higher than 1500 RPM.
- The accelerator pedal position is more than 10%.
- The vehicle speed is higher than 15 km/h (9 MPH).

Condition for Setting the DTC

- The ECM detects that the brake pedal 1 switch (normally open type switch) signal and brake pedal 2 switch (normally closed type switch) signal correlation error for longer than 30 seconds within the enabling conditions ever since ignition switch is ON. (Symptom Code A)

- The ECM detects that the brake pedal 1 switch (normally open type switch) signal and brake pedal 2 switch (normally closed type switch) signal correlation error for longer than 30 seconds. (Symptom Code B)

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Misadjusted brake pedal switch will cause this DTC to set.

DTC P0703 (Symptom Code A, B) (Flash Code 25)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Brake Pedal 1 Switch parameter with the Tech 2 while fully depressing and releasing the brake pedal. Does the Tech 2 indicate Applied when the brake pedal is applied and Released when the brake pedal is released?	—	Go to Step 10	Go to Step 3
3	1. Check to ensure the brake pedal switch is adjusted correctly. The plunger should be all the way in when the pedal is released, yet should not impede with the brake pedal full upward travel. 2. Adjust the brake pedal switch as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 4
4	1. Turn OFF the ignition. 2. Inspect the Stop Light (10A) fuse (F-5) in the glove box fuse block. Is the Stop Light (10A) fuse (F-5) open?	—	Go to Step 5	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Replace the Stop Light (10A) fuse (F-5). If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the Stop Light (10A) fuse (F-5) or replace the shorted attached component fed by the Stop Light (10A) fuse (F-5). Did you complete the repair?	—	Go to Step 20	—
6	1. Turn OFF the ignition. 2. Disconnect the brake pedal switch harness connector. 3. Connect a test lamp between the voltage feed circuit of the brake pedal 1 switch harness (pin 1 of B-66 connector) and a known good ground. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 8
7	1. Turn ON the ignition, with the engine OFF. 2. Observe the Brake Pedal 1 Switch parameter with the Tech 2 while momentarily jumping 3-amp fused jumper wire across the brake pedal 1 switch harness connector between pins 1 and 4 of the B-66 connector. Does the Tech 2 indicate Applied when the circuit is jumpered and Released when the circuit is not jumpered?	—	Go to Step 16	Go to Step 9
8	Repair the open circuit or high resistance on the voltage feed circuit between the Stop Light (10A) fuse (F-5) and the brake pedal 1 switch (pin 1 of B-66 connector). Did you complete the repair?	—	Go to Step 20	—
9	1. Test the brake pedal 1 switch signal circuit between the ECM (pin 30 of B-234 connector) and the brake pedal 1 switch (pin 4 of B-66 connector) for the following conditions: • An open circuit • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
10	Observe the Brake Pedal 2 Switch parameter with the Tech 2 while fully depressing and releasing the brake pedal. Does the Tech 2 indicate Applied when the brake pedal is applied and Released when the brake pedal is released?	—	Go to Diagnostic Aids	Go to Step 11
11	1. Check to ensure the brake pedal switch is adjusted correctly. The plunger should be all the way in when the pedal is released, yet should not impede with the brake pedal full upward travel. 2. Adjust the brake pedal switch as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 12

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Step	Action	Value(s)	Yes	No
12	1. Turn OFF the ignition. 2. Disconnect the brake pedal switch harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the voltage feed circuit of the brake pedal 2 switch harness (pin 2 of B-66 connector) and a known good ground. Does the test lamp illuminate?	—	Go to Step 13	Go to Step 14
13	1. Turn ON the ignition, with the engine OFF. 2. Observe the Brake Pedal 2 Switch parameter with the Tech 2 while momentarily jumping 3-amp fused jumper wire across the brake pedal 2 switch harness connector between pins 2 and 3 of the B-66 connector. Does the Tech 2 indicate Released when the circuit is jumpered and Applied when the circuit is not jumpered?	—	Go to Step 16	Go to Step 15
14	Repair the open circuit or high resistance on the voltage feed circuit between the ECM main relay (pin 5 of X-14 connector) and the brake pedal 2 switch (pin 2 of B-66 connector). Did you complete the repair?	—	Go to Step 20	—
15	1. Test the brake pedal 2 switch signal circuit between the ECM (pin 65 of B-234 connector) and the brake pedal 2 switch (pin 3 of B-66 connector) for the following conditions: • An open circuit • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
16	1. Turn OFF the ignition. 2. Disconnect the brake pedal switch harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the brake pedal switch (pins 1, 2, 3 and 4 of B-66 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 18
17	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the brake switch circuits at the harness connector of the ECM (pins 30 and 65 of B-234 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
18	Replace brake pedal switch. Refer to Brake Switch Replacement in this section. Did you complete the replacement?	—	Go to Step 20	—

Step	Action	Value(s)	Yes	No
19	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 20	—
20	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Brake Pedal 1 Switch and the Brake Pedal 2 Switch with the Tech 2 while fully depressing and releasing the brake pedal. Does the Tech 2 indicate Applied when the brake pedal is applied and Released when the brake pedal is released?	—	Go to Step 21	Go to Step 2
21	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0704 (Symptom Code 6) (Flash Code 57)**Circuit Description**

The clutch pedal switch is installed on the clutch pedal bracket. The clutch pedal switch is a normally closed type switch. When the clutch pedal is pressed, the clutch pedal switch signal to the engine control module (ECM) is stopped (low voltage). If the ECM detects the clutch pedal switch signal does not change during a predetermined vehicle speed range, this DTC will set. This DTC will only run once per ignition cycle within the enabling condition.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the clutch pedal switch signal does not change during the vehicle speed changes between 5 km/h (3 MPH) and 80 km/h (50 MPH). This DTC will only run once per ignition cycle within the enabling condition.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Misadjusted clutch pedal switch will cause this DTC to set.

DTC P0704 (Symptom Code 6) (Flash Code 57)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Clutch Pedal Switch parameter with the Tech 2 while fully depressing and releasing the clutch pedal. Does the Tech 2 indicate Applied when the clutch pedal is applied and Released when the clutch pedal is released?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Check to ensure the clutch pedal switch is adjusted correctly. The plunger should be all the way in when the pedal is released, yet should not impede with the clutch pedal full upward travel. 2. Adjust the clutch pedal switch as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the clutch pedal switch harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Clutch Pedal Switch parameter with the Tech 2 while momentarily jumping across the clutch pedal switch harness connector between pins 1 and 2 of B-89 connector. Does the Tech 2 indicate Applied when the circuit is jumped and Released when the circuit is not jumped?	—	Go to Step 10	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Connect a test lamp between the ignition voltage feed circuit of the clutch pedal switch harness (pin 1 of B-89 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 7
6	1. Connect a test lamp between the signal circuit of the clutch pedal switch harness (pin 2 of B-89 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 9
7	Repair the open circuit or high resistance on the ignition voltage feed circuit between the ECM main relay (pin 5 of X-14 connector) and the clutch pedal switch (pin 1 of B-89 connector). Did you complete the repair?	—	Go to Step 14	—
8	1. Test the clutch pedal switch signal circuit between the engine control module (ECM) (pin 31 of B-234 connector) and the clutch pedal switch (pin 2 of B-89 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
9	1. Test the clutch pedal switch signal circuit between the ECM (pin 31 of B-234 connector) and the clutch pedal switch (pin 2 of B-89 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
10	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the clutch pedal switch (pins 1 and 2 of B-89 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the clutch pedal switch circuit at the harness connector of the ECM (pin 31 of B-234 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
12	Replace the clutch pedal switch. Refer to Clutch Pedal Switch Replacement in this section. Did you complete the replacement?	—	Go to Step 14	—

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Step	Action	Value(s)	Yes	No
13	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 14	—
14	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Clutch Pedal Switch parameter with the Tech 2 while fully depressing and releasing the clutch pedal. Does the Tech 2 indicate Applied when the clutch pedal is applied and Released when the clutch pedal is released?	—	Go to Step 15	Go to Step 3
15	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1105 (Symptom Code 1) (Flash Code 86)**Circuit Description**

The barometric pressure (BARO) sensor is installed inside of the engine control module (ECM) and converts the BARO into a voltage signal. The ECM uses this voltage signal to calibrate the fuel injection quantity and injection timing for altitude compensation. If the ECM detects an excessively high BARO sensor signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the BARO sensor signal voltage is more than 4.4 volts for 1 second.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a BARO substitution of 1013 hPa.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

DTC P1105 (Symptom Code 1) (Flash Code 86)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1105 (Symptom Code 2) (Flash Code 86)**Circuit Description**

The barometric pressure (BARO) sensor is installed inside of the engine control module (ECM) and converts the BARO into a voltage signal. The ECM uses this voltage signal to calibrate the fuel injection quantity and injection timing for altitude compensation. If the ECM detects an excessively low BARO sensor signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the BARO sensor signal voltage is less than 1.5 volts for 1 second.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a BARO substitution of 1013 hPa.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

DTC P1105 (Symptom Code 2) (Flash Code 86)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1110 (Symptom Code 4) (Flash Code 72)**Circuit Description**

The engine control module (ECM) controls the exhaust brake which energizes the intake throttle solenoid valve and exhaust brake solenoid valve based on vehicle running condition. The ECM commands each solenoid valve to close each throttle valve by applying vacuum. If the ECM detects that an open circuit or short to ground on the intake throttle solenoid valve control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects a low voltage condition on the intake throttle solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded OFF.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The number below refers to the step number on the diagnostic table.

5. If the intake throttle solenoid valve control circuit between the ECM and the solenoid valve is normal, voltage level high DTC P1110 (Symptom Code 8) will set.

DTC P1110 (Symptom Code 4) (Flash Code 72)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the intake throttle solenoid valve harness connector. 3. Connect a test lamp between the voltage feed circuit of the intake throttle solenoid valve harness (pin 1 of J-40 connector) and a known good ground. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 6
4	1. Turn OFF the ignition. 2. Connect a test lamp between the control circuit of the intake throttle solenoid valve harness (pin 2 of J-40 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 5

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Step	Action	Value(s)	Yes	No
5	1. Connect a 3-amp fused jumper wire across the intake throttle solenoid valve harness connector between pins 1 and 2 of the J-40 connector. 2. Lift the driving wheels or drive the vehicle. 3. Let the vehicle run so that the exhaust brake may operate while observing the Intake Throttle Solenoid Command parameter with the Tech 2. Does DTC P1110 (Symptom Code 8) set when the exhaust brake is operating, but not DTC P1110 (Symptom Code 4)?	—	Go to Step 9	Go to Step 7
6	Repair the open circuit or high resistance on the voltage feed circuit between the ECM main relay (pin 5 of X-14 connector) and the intake throttle solenoid valve (pin 1 of J-40 connector). Did you complete the repair?	—	Go to Step 13	—
7	1. Test the control circuit between the engine control module (ECM) (pin 95 of B-233 connector) and the intake throttle solenoid valve (pin 2 of J-40 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
8	1. Test the control circuit between the ECM (pin 95 of B-233 connector) and the intake throttle solenoid valve (pin 2 of J-40 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
9	1. Turn OFF the ignition. 2. Disconnect the intake throttle solenoid valve harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the intake throttle solenoid valve (pins 1 and 2 of J-40 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the intake throttle solenoid valve control circuit at the harness connector of the ECM (pin 95 of B-233 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the intake throttle solenoid valve. Refer to Intake Throttle Solenoid Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 13	—

Step	Action	Value(s)	Yes	No
12	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 14
14	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1110 (Symptom Code 8) (Flash Code 72)**Circuit Description**

The engine control module (ECM) controls the exhaust brake which energizes the intake throttle solenoid valve and exhaust brake solenoid valve based on vehicle running condition. The ECM commands each solenoid valve to close each throttle valve by applying vacuum. If the ECM detects that a short to battery or ignition voltage on the intake throttle solenoid valve control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects a high voltage condition on the intake throttle solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded ON.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The number below refers to the step number on the diagnostic table.

3. If the intake throttle solenoid valve control circuit between the ECM and the solenoid valve is normal, voltage level low DTC P1110 (Symptom Code 4) will set.

DTC P1110 (Symptom Code 8) (Flash Code 72)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Lift the driving wheels or drive the vehicle. 4. Let the vehicle run so that the exhaust brake may operate while observing the Intake Throttle Solenoid Command with the Tech 2. Does the Diagnostic Trouble Code (DTC) fail this ignition when the exhaust brake is operating?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the intake throttle solenoid valve harness connector. 3. Start the engine. 4. Monitor the DTC Information with the Tech 2. Does DTC P1110 (Symptom Code 4) set, but not DTC P1110 (Symptom Code 8)?	—	Go to Step 5	Go to Step 4
4	1. Test the control circuit between the engine control module (ECM) (pin 95 of B-233 connector) and the intake throttle solenoid valve (pin 2 of J-40 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Replace the intake throttle solenoid valve. Refer to Intake Throttle Solenoid Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—

Step	Action	Value(s)	Yes	No
6	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Lift the driving wheels or drive the vehicle. 5. Let the vehicle run so that the exhaust brake may operate while observing the Intake Throttle Solenoid Command with the Tech 2. Does the DTC fail this ignition when the exhaust brake is operating?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1120 (Symptom Code 1) (Flash Code 21)**Circuit Description**

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal bracket. The engine control module (ECM) uses the APP sensors to determine the amount of acceleration or deceleration desired by the person driving the vehicle via the fuel injection control. The APP sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor signal circuit

The ECM supplies 5 volts to the APP sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The APP sensor provides a signal to the ECM on the APP sensor signal circuit, which is relative to the position changes of the accelerator pedal angle. The ECM monitors the APP sensor signal for voltages outside the normal range of the APP sensor. If the ECM detects an excessively high APP sensor signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the APP sensor signal voltage is more than 4.9 volts for 0.5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an engine speed substitution of 1400 RPM.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1120 (Symptom Code 1) (Flash Code 21)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Accelerator Pedal Position (APP) parameter with the Tech 2. Does the APP parameter less than the specified value?	1%	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Connect a test lamp between the low reference circuit of the APP sensor harness (pin 1 of B-80 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 11	Go to Step 8

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Connect a DMM between the 5 volts reference circuit of the APP sensor harness (pin 3 of B-80 connector) and a known good ground. 3. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 6	Go to Step 9
6	Is the DMM voltage less than the specified value at step 5?	5.3 volts	Go to Step 7	Go to Step 10
7	Important: The APP sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the engine control module (ECM) (pin 38 of E-234 connector) and the APP sensor (pin 2 of B-80 connector) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
8	1. Test the low reference circuit between the ECM (pin 49 of B-234 connector) and the APP sensor (pin 1 of B-80 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
9	1. Test the 5 volts reference circuit between the ECM (pin 57 of B-234 connector) and the APP sensor (pin 3 of B-80 connector) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
10	1. Test the 5 volts reference circuit between the ECM (pin 57 of B-234 connector) and the APP sensor (pin 3 of B-80 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
11	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the APP sensor (pin 1 of B-80 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13

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Step	Action	Value(s)	Yes	No
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the APP sensor circuit at the harness connector of the ECM (pin 49 of B-234 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	Replace APP sensor. Refer to Accelerator Pedal Position (APP) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—
14	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Fully depress and release the accelerator pedal many times. 6. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1120 (Symptom Code 2) (Flash Code 21)**Circuit Description**

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal bracket. The engine control module (ECM) uses the APP sensors to determine the amount of acceleration or deceleration desired by the person driving the vehicle via the fuel injection control. The APP sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor signal circuit

The ECM supplies 5 volts to the APP sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The APP sensor provides a signal to the ECM on the APP sensor signal circuit, which is relative to the position changes of the accelerator pedal angle. The ECM monitors the APP sensor signal for voltages outside the normal range of the APP sensor. If the ECM detects an excessively low APP sensor signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the APP sensor signal voltage is less than 0.3 volts for 0.5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an engine speed substitution of 1400 RPM.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The number below refers to the step number on the diagnostic table.

4. If the APP sensor signal circuit between the ECM and the sensor is normal, the sensor signal voltage high DTC P1120 (Symptom Code 1) will set.

DTC P1120 (Symptom Code 2) (Flash Code 21)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit of the APP sensor harness (pin 3 of B-80 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 4	Go to Step 5

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Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire across the APP sensor connector between pins 2 and 3 of the B-80 connector. 3. Turn ON the ignition, with the engine OFF. Does DTC P1120 (Symptom Code 1) set, but not P1120 (Symptom Code 2)?	—	Go to Step 7	Go to Step 6
5	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 57 of B-234 connector) and the APP sensor (pin 3 of B-80 connector) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
6	1. Test the signal circuit between the ECM (pin 38 of E-234 connector) and the APP sensor (pin 2 of B-80 connector) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the APP sensor (pins 2 and 3 of B-80 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connection on the APP sensor circuit at the harness connector of the ECM (pins 38 and 57 of B-234 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Replace APP sensor. Refer to Accelerator Pedal Position (APP) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 11	—
10	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 11	—

Step	Action	Value(s)	Yes	No
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Fully depress and release the accelerator pedal many times. 6. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 12
12	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1120 (Symptom Code 7) (Flash Code 21)**Circuit Description**

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal bracket. The engine control module (ECM) uses the APP sensors to determine the amount of acceleration or deceleration desired by the person driving the vehicle via the fuel injection control. The APP sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor signal circuit

The ECM provides 5 volts reference voltage through the reference circuit to the APP sensor. The ECM monitors the voltage on the 5 volts reference circuit. If the ECM detects an excessively high APP sensor 5 volts reference voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

The ECM detects that the APP sensor voltage supply circuit is more than 5.2 volts for 0.5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an engine speed substitution of 1400 RPM.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1120 (Symptom Code 7) (Flash Code 21)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 57 of B-234 connector) and the accelerator pedal position (APP) sensor (pin 3 of B-80 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 5	—

Step	Action	Value(s)	Yes	No
5	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Fully depress and release the accelerator pedal many times. 6. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 6
6	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1120 (Symptom Code 9) (Flash Code 21)**Circuit Description**

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal bracket. The engine control module (ECM) uses the APP sensors to determine the amount of acceleration or deceleration desired by the person driving the vehicle via the fuel injection control. The APP sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor signal circuit

The ECM provides 5 volts reference voltage through the reference circuit to the APP sensor. The ECM monitors the voltage on the 5 volts reference circuit. If the ECM detects an excessively high APP sensor 5 volts reference voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the APP sensor voltage supply circuit is less than 4.6 volts for 0.5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

- The ECM uses an engine speed substitution of 1400 RPM.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The number below refers to the step number on the diagnostic table.

3. If the APP sensor 5 volts reference circuit between the ECM and the sensor is normal, the sensor signal low DTC P1120 (Symptom Code 2) will set.

DTC P1120 (Symptom Code 9) (Flash Code 21)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Depress and release the accelerator pedal. 5. Monitor the DTC Information with the Tech 2. Does DTC P1120 (Symptom Code 2) set, but not DTC P1120 (Symptom Code 9)?	—	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 57 of B-234 connector) and the APP sensor (pin 3 of B-80 connector) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Replace the accelerator pedal position sensor. Refer to Accelerator Pedal Position Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
6	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Fully depress and release the accelerator pedal many times. 6. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1120 (Symptom Code D) (Flash Code 21)**Circuit Description**

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal bracket. The engine control module (ECM) uses the APP sensors to determine the amount of acceleration or deceleration desired by the person driving the vehicle via the fuel injection control. The APP sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor signal circuit

The ECM supplies 5 volts to the APP sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The APP sensor provides a signal to the ECM on the APP sensor signal circuit, which is relative to the position changes of the accelerator pedal angle.

The brake pedal switch is installed on the brake pedal bracket. The brake pedal 1 switch is a normally open type switch and the brake pedal 2 switch is a normally closed type switch. When the brake pedal is pressed, the brake pedal 1 switch signal is provided to the ECM and the stoplights are turned ON. Then, the brake pedal 2 switch signal to the ECM is stopped (low voltage).

If the ECM detects accelerator pedal or APP sensor signal is stuck while brake pedal is depressed, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine speed is higher than 1700 RPM.
- The vehicle speed is higher than 1.5 km/h (1 MPH).

Condition for Setting the DTC

- The ECM detects APP sensor angle is stationary more than 18%, then brake pedal is depressed for longer than 2 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an engine speed substitution of 1400 RPM.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Misadjusted brake pedal switch may set this DTC.
- Misadjusted APP sensor may set this DTC.
- A sticking or intermittently sticking the pedal may set this DTC.

DTC P1120 (Symptom Code D) (Flash Code 21)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Was DTC P0703 (Symptom Code A or B) or P1120 (Symptom Code 1, 7, 9 or E) set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the Brake Pedal 1 Switch parameter with the Tech 2 while fully depressing and releasing the brake pedal. Does the Tech 2 indicate Applied when the brake pedal is applied and Released when the brake pedal is released?	—	Go to Step 9	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Check to ensure the brake pedal switch is adjusted correctly. The plunger should be all the way in when the pedal is released, yet should not impede with the brake pedal full upward travel. 2. Adjust the brake pedal switch as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 5
5	1. Turn OFF the ignition. 2. Disconnect the brake pedal switch harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Brake Pedal 1 Switch parameter with the Tech 2 while momentarily jumping 3-amp fused jumper wire across the brake pedal 1 switch harness connector between pins 1 and 4 of the B-66 connector. Does the Tech 2 indicate Applied when the circuit is jumpered and Released when the circuit is not jumpered?	—	Go to Step 8	Go to Step 6
6	1. Test the brake pedal 1 switch signal circuit between the ECM (pin 30 of B-234 connector) and the brake pedal 1 switch (pin 4 of B-66 connector) for the following conditions: • An open circuit • A short to battery or ignition voltage • High resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 7
7	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the brake switch circuit at the harness connector of the ECM (pin 30 of B-234 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	Replace the brake pedal switch. Refer to Brake Pedal Switch Replacement in this section. Did you complete the replacement?	—	Go to Step 13	—
9	1. Turn ON the ignition, with the engine OFF. 2. Fully depress and release the accelerator pedal many times while observing the Accelerator Pedal Position (APP) parameter with the Tech 2. Is the APP parameter smoothly changed within 0 to 100% when the accelerator pedal is depressed and released?	—	Go to Diagnostic Aids	Go to Step 10

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Step	Action	Value(s)	Yes	No
10	1. Turn OFF the ignition. 2. Inspect for the following conditions: • APP sensor is misadjusted. • An accelerator pedal that is stuck depressed. 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
11	Replace the accelerator pedal position sensor. Refer to Accelerator Pedal Position Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 13	—
12	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Observe the APP parameter while fully depressing and releasing the accelerator pedal many times. 6. Also observe the Brake Pedal 1 Switch parameter with the Tech 2 while depressing and releasing the brake pedal. Does the Tech 2 indicate the APP parameter smoothly changed within 0 to 100% when the accelerator pedal is depressed and released, then Tech 2 indicate the Brake Pedal 1 Switch parameter Applied when the brake pedal is depressed and Released when the brake pedal is released?	—	Go to Step 14	Go to Step 2
14	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1120 (Symptom Code E) (Flash Code 21)**Circuit Description**

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal bracket. The engine control module (ECM) uses the APP sensors to determine the amount of acceleration or deceleration desired by the person driving the vehicle via the fuel injection control. The APP sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor signal circuit

The ECM supplies 5 volts to the APP sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The APP sensor provides a signal to the ECM on the APP sensor signal circuit, which is relative to the position changes of the accelerator pedal angle.

The idle switch is also mounted on the accelerator pedal bracket. The idle switch is a normally closed type switch. When the accelerator pedal is released, the idle switch signal to the ECM is low voltage.

If the ECM detects the APP sensor signal and the idle switch out of correlation, this DTC will set.

Condition for Running the DTC

The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects APP sensor angle is more than 18%, then the idle switch is ON for longer than 0.6 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an engine speed substitution of 1400 RPM.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1120 (Symptom Code E) (Flash Code 21)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the Idle Switch parameter with the Tech 2 while depressing and releasing the accelerator pedal. Does the Tech 2 indicate OFF when the accelerator pedal is depressed and ON when the accelerator pedal is released?	—	Go to Step 5	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the idle switch harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Idle Switch parameter with the Tech 2 while momentarily jumping 3-amp fused jumper wire across the idle switch harness connector between pins 1 and 2 of the B-340 connector. Does the Tech 2 indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 7	Go to Step 4

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Step	Action	Value(s)	Yes	No
4	1. Test the switch signal circuit between the engine control module (ECM) (pin 69 of B-234 connector) and the idle switch (pin 1 of B-340 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 9
5	1. Turn ON the ignition, with the engine OFF. 2. Fully depress and release the accelerator pedal many times while observing the Accelerator Pedal Position (APP) parameter with the Tech 2. Is the APP parameter smoothly changed within 0 to 100% when the accelerator pedal is depressed and released?	—	Go to Diagnostic Aids	Go to Step 6
6	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Inspect for an intermittent, for poor connection and corrosion at the harness connector of the APP sensor (pin 1 of B-80 connector). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for a poor connection and corrosion on the APP sensor circuit at the harness connector of the ECM (pin 49 of B-234 connector). 6. Test for high resistance on the APP sensor low reference circuit. 7. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
7	Replace the idle switch. Refer to Idle Switch Replacement in this section. Did you complete the replacement?	—	Go to Step 10	—
8	Replace the accelerator pedal position sensor. Refer to Accelerator Pedal Position Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 10	—
9	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 10	—

Step	Action	Value(s)	Yes	No
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Observe the Idle Switch and APP parameter while fully depressing and releasing the accelerator pedal many times. Does the Tech 2 indicate the APP parameter smoothly changed within 0 to 100% when the accelerator pedal is depressed and released, then Tech 2 indicate the Idle Switch parameter OFF when the accelerator pedal is depressed and ON when the accelerator pedal is released?	—	Go to Step 11	Go to Step 2
11	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1173 (Symptom Code 3) (Flash Code 22)**Circuit Description**

The engine coolant temperature (ECT) sensor is installed to the thermostat housing. The ECT sensor is a variable resistor. The ECT sensor has a signal circuit and a low reference circuit. The ECT sensor measures the temperature of the engine coolant. The engine control module (ECM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT sensor is cold, the sensor resistance is high. When the engine coolant temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the ECT signal circuit. If the ECM detects an excessive high coolant temperature, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects an excessive high coolant temperature for longer than 30 seconds.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- After starting the engine, the ECT should rise steadily to about 80°C – 85°C (176°F – 185°F) then stabilize when the thermostat opens.
- Use the Temperature vs. Resistance table to test the ECT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns.

Notice:

- This DTC is caused by an engine overheat condition (i.e. low engine coolant level). Since this DTC does not illuminate any lamps, clear the DTC and ensure there are no signs of engine damage. Excessive engine overheat may damage internal engine components.

DTC P1173 (Symptom Code 3) (Flash Code 22)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and wait until engine is fully warmed up. 4. Observe the Engine Coolant Temperature (ECT) parameter with the Tech 2. Is the ECT parameter more than the specified value?	100°C (212°F)	Go to Step 4	Go to Step 3
3	Ask the driver if overheat is caused by low engine coolant level, etc. If engine overheat has experienced, the engine must be inspected and repaired as necessary. Did you complete the action?	—	Go to Step 6	—
4	1. Test the ECT sensor at various temperature levels to evaluate the possibility if a skewed sensor. 2. Replace the ECT sensor as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Test the engine cooling system for the following condition. Refer to diagnosis of the engine cooling system section for testing. • Engine coolant level • Engine coolant leakage • Cooling fan belt slippage • Cooling fan clutch working • Thermostat working • Water pump working • Radiator clogging 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Diagnostic Aids
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and wait until engine is fully warmed up. 5. Observe the ECT parameter with the Tech 2. Is the ECT parameter more than the specified value?	100°C (212°F)	Go to Step 4	Go to Step 7
7	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1173 (Symptom Code 7, A) (Flash Code 22)**Circuit Description**

The fuel temperature (FT) sensor is internal to the fuel injection pump control unit (PCU). It detects fuel temperature in the fuel injection pump. If the PCU detects an excessively high or low fuel temperature, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects an excessive high FT for longer than 30 seconds. (Symptom Code 7)
- The ECM detects an excessive low FT for longer than 30 seconds. (Symptom Code A)

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCU limits fuel injection quantity. (Symptom Code 7)

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- FT sensor is internal to the PCU and it is part of the fuel injection pump assembly.

DTC P1173 (Symptom Code 7, A) (Flash Code 22)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	Important: The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. (Fuel temperature [FT] sensor is internal to the fuel injection pump control unit [PCU] and it is part of the fuel injection pump assembly.) Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1335 (Symptom Code A) (Flash Code 43)**Circuit Description**

The crankshaft position (CKP) sensor is located on top of the flywheel housing. There are 4 slits spaced 90° on the flywheel circumference. The CKP sensor is a magnetic coil type sensor, which generates an AC signal voltage based on the crankshaft rotational speed. The engine control module (ECM) monitors both the CKP sensor and injection pump camshaft position (CMP) sensor signals to ensure they correlate with each other. If the fuel injection pump control unit (PCU) receives faulty CKP sensor signal pulses, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The PCU detects CKP sensor signal from the ECM is faulty.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

- The ECM limits fuel injection quantity.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- PCU is part of the fuel injection pump assembly.

DTC P1335 (Symptom Code A) (Flash Code 43)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine (Note a slight start delay may be noticed). 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P0335 (Symptom Code B or D) set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) B-233 harness connector. Keep the B-234 harness connector with connected. 3. Connect a DMM between the crankshaft position (CKP) sensor signal output circuit (pin 91 of B-233 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage more than the specified value?	10 volts	Go to Step 5	Go to Step 4

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Step	Action	Value(s)	Yes	No
4	- Test the CKP sensor signal output circuit between the ECM (pin 91 of B-233 connector) and the fuel injection pump (pin 8 of E-110 connector) for the following conditions: - An open circuit - A short to ground - High resistance - Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 6
5	- Test the CKP sensor signal output circuit between the ECM (pin 91 of B-233 connector) and the fuel injection pump control unit (PCU) (pin 8 of E-110 connector) for a short to battery or ignition voltage. Notice: Perform this by connecting a test lamp between the ECM harness connector (pin 91 of B-233 connector) and a known good ground. If the test lamp illuminates, circuit is short to battery or ignition voltage. - Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 7
6	- Turn OFF the ignition. - Disconnect the PCU harness connector. - Inspect for an intermittent and for a poor connection on the CKP sensor signal circuit at the harness connector of the PCU (pin 8 of E-110 connector). - Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
7	- Turn OFF the ignition. - Disconnect the ECM harness connector. - Inspect for an intermittent and for a poor connection on the CKP sensor signal output circuit at the harness connector of the ECM (pin 92 of B-233 connector). - Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 9
8	Important: The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 10	—
9	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 10	—

Step	Action	Value(s)	Yes	No
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 11
11	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1345 (Symptom Code A) (Flash Code 41)**Circuit Description**

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU. The PCU also compares the engine speed signal sent from the ECM and the fuel injection pump speed. If the PCU received faulty fuel injection pump CMP sensor signal, this DTC will set.

Condition for Setting the DTC

- The PCU received faulty fuel injection pump CMP sensor signal for 1 second.

DTC P1345 (Symptom Code A) (Flash Code 41)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	Important: The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Fuel injection pump CMP sensor is internal to the fuel injection pump assembly.
- PCU is part of the fuel injection pump assembly.

P1520 (Symptom Code A) (Flash Code 47)**Circuit Description**

The neutral switch is installed on the transmission gear control box. When the gear position is neutral, the switch is closed and the switch signal is provided to the engine control module (ECM). If the ECM detects the neutral switch signal is not changed from neutral during the predetermined engine speed and vehicle speed range, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine speed is higher than 1500 RPM.
- The vehicle speed is higher than 64 km/h (40 MPH).
- The clutch pedal is released.

Condition for Setting the DTC

- The ECM detects that the neutral switch signal is continuously ON (neutral) during three consecutive driving cycles.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC**Important:**

- Following conditions must be met two consecutive driving cycles. (One driving cycle: Ignition switch ON > Engine run > Vehicle run > Ignition switch OFF for 10 seconds)
 - The engine speed is higher than 1500 RPM
 - The vehicle speed is higher than 64 km/h (40 MPH)
 - The clutch pedal is released
 - Other than neutral
- After the above procedure is done, a history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1520 (Symptom Code A) (Flash Code 47)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Neutral Switch parameter with the Tech 2 while shift to neutral and other positions. Does the Tech 2 indicate ON when the position is neutral and OFF when other than the neutral?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the neutral switch harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Neutral Switch parameter with the Tech 2. Does the Tech 2 indicate ON?	—	Go to Step 4	Go to Step 5
4	1. Test the neutral switch input signal circuit between the engine control module (ECM) (pin 87 of B-233 connector) and the neutral switch (pin 2 of J-50 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Replace the neutral switch. Refer to Neutral Switch Replacement in Transmission Section. Did you complete the replacement?	—	Go to Step 7	—

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Step	Action	Value(s)	Yes	No
6	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. Important: Following conditions must be met two consecutive driving cycles before clear with the Tech 2. (One driving cycle: Ignition switch ON > Engine run > Vehicle run > Ignition switch OFF for 10 seconds) - The engine speed is higher than 1500 RPM - The vehicle speed is higher than 64 km/h (40 MPH) - The clutch pedal is released - Other than neutral 3. Turn ON the ignition, with the engine OFF. 4. Observe the Neutral Switch parameter with the Tech 2 while shift to neutral and other positions. Does the Tech 2 indicate ON when the position is neutral and OFF when other than the neutral?	—	Go to Step 8	Go to Step 3
8	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1520 (Symptom Code B) (Flash Code 47)**Circuit Description**

The neutral switch is installed on the transmission gear control box. When the gear position is neutral, the switch is closed and the switch signal is provided to the engine control module (ECM). If the ECM detects the neutral switch signal is not changed from other than neutral during the predetermined engine speed and vehicle speed range, this DTC will set. This DTC runs only manual transmission.

Condition for Running the DTC

- The ignition switch is ON.
- The engine speed is higher than 665 RPM.
- The vehicle speed is lower than 2 km/h (3 MPH).
- The clutch pedal is released after once depressed.

Condition for Setting the DTC

- The ECM detects that the neutral switch signal is continuously OFF (other than neutral) during three consecutive driving cycles.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC**Important:**

- Following conditions must be met two consecutive driving cycles. (One driving cycle: Ignition switch ON > Engine run > Ignition switch OFF for 10 seconds)
 - The engine speed is higher than 665 RPM
 - The vehicle speed is lower than 2 km/h (3 MPH)
 - The clutch pedal is released after once depressed
 - Neutral position
- After the above procedure is done, a history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1520 (Symptom Code B) (Flash Code 47)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Neutral Switch parameter with the Tech 2 while shift to neutral and other positions. Does the Tech 2 indicate ON when the position is neutral and OFF when other than the neutral?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the neutral switch harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Neutral Switch parameter with the Tech 2 while momentarily jumping across the neutral switch harness connectors between pins 1 and 2 of J-50 connector. Does the Tech 2 indicate ON when the circuit is jumped and OFF when the circuit is not jumped?	—	Go to Step 7	Go to Step 4
4	1. Connect a test lamp between the ignition voltage feed circuit of the neutral switch harness (pin 1 of J-50 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 5

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Step	Action	Value(s)	Yes	No
5	Repair the open circuit or high resistance on the ignition voltage feed circuit between the ECM main relay (pin 5 of X-14 connector) and the neutral switch (pin 1 of J-50 connector). Did you complete the repair?	—	Go to Step 11	—
6	1. Test the neutral switch signal circuit between the engine control module (ECM) (pin 87 of B-233 connector) and the neutral switch (pin 2 of J-50 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connectors of the neutral switch (pins 1 and 2 of J-50 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the neutral switch circuit at the harness connector of the ECM (pin 87 of B-233 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Replace the neutral switch. Refer to Neutral Switch Replacement in Transmission Section. Did you complete the replacement?	—	Go to Step 11	—
10	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 11	—

Step	Action	Value(s)	Yes	No
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. Important: Following conditions must be met two consecutive driving cycles before clear with the Tech 2. (One driving cycle: Ignition switch ON > Engine run > Ignition switch OFF for 10 seconds) • The engine speed is higher than 665 RPM • The vehicle speed is lower than 2 km/h (3 MPH) • The clutch pedal is released after once depressed • Neutral position 3. Turn ON the ignition, with the engine OFF. 4. Observe the Neutral Switch parameter with the Tech 2 while shift to neutral and other positions. Does the Tech 2 indicate ON when the position is neutral and OFF when other than the neutral?	—	Go to Step 12	Go to Step 3
12	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1576 (Symptom Code 4) (Flash Code 71)**Circuit Description**

The engine control module (ECM) controls the exhaust brake which energizes the intake throttle solenoid valve and exhaust brake solenoid valve based on vehicle running condition. The ECM commands each solenoid valve to close each throttle valve by applying vacuum. If the ECM detects that an open circuit or short to ground on the exhaust brake solenoid valve control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects a low voltage condition on the exhaust brake solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded OFF.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The number below refers to the step number on the diagnostic table.

5. If the exhaust brake solenoid valve control circuit between the ECM and the solenoid valve is normal, voltage level high DTC P1576 (Symptom Code 8) will set.

DTC P1576 (Symptom Code 4) (Flash Code 71)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the exhaust brake solenoid valve harness connector. 3. Connect a test lamp between the voltage feed circuit of the exhaust brake solenoid valve harness (pin 1 of J-31 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 6
4	1. Turn OFF the ignition. 2. Connect a test lamp between the control circuit of the exhaust brake solenoid valve harness (pin 2 of J-31 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Connect a 3-amp fused jumper wire across the exhaust brake solenoid valve harness connector between pins 1 and 2 of the J-31 connector. 2. Lift the driving wheels or drive the vehicle. 3. Let the vehicle run so that the exhaust brake may operate while observing the Exhaust Brake Solenoid Command parameter with the Tech 2. Does DTC P1576 (Symptom Code 8) set when the exhaust brake is operating, but not DTC P1576 (Symptom Code 4)?	—	Go to Step 9	Go to Step 7
6	Repair the open circuit or high resistance on the voltage feed circuit between the ECM main relay (pin 5 of X-14 connector) and the exhaust brake solenoid valve (pin 1 of J-31 connector). Did you complete the repair?	—	Go to Step 13	—
7	1. Test the control circuit between the engine control module (ECM) (pin 40 of B-234 connector) and the exhaust brake solenoid valve (pin 2 of J-31 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
8	1. Test the control circuit between the ECM (pin 40 of B-234 connector) and the exhaust brake solenoid valve (pin 2 of J-31 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
9	1. Turn OFF the ignition. 2. Disconnect the exhaust brake solenoid valve harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the exhaust brake solenoid valve (pins 1 and 2 of J-31 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the exhaust brake solenoid valve control circuit at the harness connector of the ECM (pin 40 of B-234 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the exhaust brake solenoid valve. Refer to Exhaust Brake Solenoid Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 13	—

6E-196 Engine Control System (4JH1)

Step	Action	Value(s)	Yes	No
12	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 14
14	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1576 (Symptom Code 8) (Flash Code 71)**Circuit Description**

The engine control module (ECM) controls the exhaust brake which energizes the intake throttle solenoid valve and exhaust brake solenoid valve based on vehicle running condition. The ECM commands each solenoid valve to close each throttle valve by applying vacuum. If the ECM detects that a short to battery or ignition voltage on the exhaust brake solenoid valve control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects a high voltage condition on the exhaust brake solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded ON.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The number below refers to the step number on the diagnostic table.

3. If the exhaust brake solenoid valve control circuit between the ECM and the solenoid valve is normal, voltage level low DTC P1576 (Symptom Code 4) will set.

DTC P1576 (Symptom Code 8) (Flash Code 71)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Lift the driving wheels or drive the vehicle. 4. Let the vehicle run so that the exhaust brake may operate while observing the Exhaust Brake Solenoid Command with the Tech 2. Does the Diagnostic Trouble Code (DTC) fail this ignition when the exhaust brake is operating?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the exhaust brake solenoid valve harness connector. 3. Start the engine. 4. Monitor the DTC Information with the Tech 2. Does DTC P1576 (Symptom Code 4) set, but not DTC P1576 (Symptom Code 8)?	—	Go to Step 5	Go to Step 4
4	1. Test the control circuit between the engine control module (ECM) (pin 40 of B-234 connector) and the exhaust brake solenoid valve (pin 2 of J-31 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Replace the exhaust brake solenoid valve. Refer to Exhaust Brake Solenoid Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—

6E-198 Engine Control System (4JH1)

Step	Action	Value(s)	Yes	No
6	Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Lift the driving wheels or drive the vehicle. 5. Let the vehicle run so that the exhaust brake may operate while observing the Exhaust Brake Solenoid Command with the Tech 2. Does the DTC fail this ignition when the exhaust brake is operating?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1605 (Symptom Code C, D, E) (Flash Code 55)**Circuit Description**

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM). The electronically erasable programmable read only memory (EEPROM) memorize some data for engine control and communication with other control module. If the ECM detects memory area malfunction inside of the ECM, this DTC will set.

Condition for Setting the DTC

- The ECM detects internal seed or key file in EEPROM data is destroyed (Symptom Code C).
- The ECM detects reading or writing from the EEPROM data is failed during initialization (Symptom Code D).

- The ECM detects total sum of EEPROM data is not equal to registered value during initialization (Symptom Code E).

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses default EEPROM data substitution of faulty EEPROM. (Symptom Code D & E).

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

DTC P1605 (Symptom Code C, D, E) (Flash Code 55)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1625 (Symptom Code A) (Flash Code 76)**Circuit Description**

The engine control module (ECM) main relay is energized when the ECM receives an ignition voltage switch ON signal. When the ignition switch is OFF, the ECM main relay is de-energized after a certain length of time passed. If the ECM detects the ECM main relay is turned OFF before ECM commanded OFF, this DTC will set.

Condition for Setting the DTC

- The ECM detects that the ECM main relay is turned OFF before commanded turned OFF.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Faulty ECM main relay may set this DTC.

DTC P1625 (Symptom Code A) (Flash Code 76)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. 5. Turn OFF the ignition. 6. Turn ON the ignition, with the engine OFF. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the ECM main relay. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM main relay (pins 1, 2, 4 and 5 of X-14 connector). 4. Disconnect the engine control module (ECM) harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on ECM main relay control and battery voltage feed circuit at the harness connector of the ECM (pins 3 and 58 of B-234 connector). 6. Test for high resistance on each ECM main relay circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	Replace the ECM main relay. Did you complete the replacement?	—	Go to Step 5	—

Step	Action	Value(s)	Yes	No
5	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Observe the DTC Information with the Tech 2. 6. Turn OFF the ignition. 7. Turn ON the ignition, with the engine OFF. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 6
6	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1625 (Symptom Code B) (Flash Code 76)**Circuit Description**

The engine control module (ECM) main relay is energized when the ECM receives an ignition voltage switch ON signal. When the ignition switch is OFF, the ECM main relay is de-energized after a certain length of time passed. If the ECM detects the ECM main relay has been ON since the ignition switch was turned OFF, this DTC will set.

Condition for Running the DTC

- The ignition switch is OFF.

Condition for Setting the DTC

- The ECM detects that the ECM main relay is turned ON for longer than 2 seconds.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Faulty or sticking ECM main relay may set this DTC.

Test Description

The numbers below refer to the step number on the diagnostic table.

2. If this DTC is present, Tech 2 can communicate with the ECM when the ignition switch is OFF.

DTC P1625 (Symptom Code B) (Flash Code 76)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail with the ignition switch OFF?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Disconnect the ECM main relay. 2. Monitor the DTC Information with the Tech 2. Does the DTC fail with the ignition switch OFF?	—	Go to Step 6	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the ECM main relay. 3. Connect a test lamp between the control circuit of the ECM main relay harness (pin 4 of X-14 connector) and battery voltage. 4. Keep the ignition switch OFF. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 7
5	1. Test the control circuit of the ECM main relay between the engine control module (ECM) (pin 58 of B-234 connector) and the ECM main relay (pin 4 of X-14 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 8
6	Repair the short to battery on the voltage feed supply circuit to the ECM between the ECM (pin 3 of B-234 connector) and the ECM main relay (pin 5 of X-14 connector). Did you complete the repair?	—	Go to Step 9	—

Step	Action	Value(s)	Yes	No
7	Replace the ECM main relay. Did you complete the replacement?	—	Go to Step 9	—
8	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 9	—
9	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Monitor the DTC Information with the Tech 2. Does the DTC with the ignition switch OFF?	—	Go to Step 3	Go to Step 10
10	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1630 (Symptom Code A, B) (Flash Code 51)**Circuit Description**

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.

The fuel injection solenoid valve is installed to the fuel injection pump rear side. The fuel injection event is determined by this solenoid ON/OFF command. The fuel injection solenoid valve cuts the fuel when the engine shutoff (ESO) solenoid valve is commanded shutoff from the PCU. (The fuel injection solenoid valve and engine shutoff (ESO) solenoid valve is same part. It calls ESO solenoid valve when fuel is shutoff.) When the ignition switch is turned OFF or commanded from fail-safe action, the ESO solenoid valve is commanded shutoff to stop the engine running. If the ECM detects that the fuel injection solenoid valve control current problem, this DTC will set.

Condition for Setting the DTC

- The ECM detects that the PCU monitored fuel injection solenoid valve control current is too high. (Symptom Code A)
- The ECM detects that the PCU continuously flow the control current to the fuel injection solenoid valve. (Symptom Code B)

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity. (Symptom Code A)
- The ECM cuts fuel injection. (Symptom Code B)

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Fuel injection solenoid valve is internal to the fuel injection pump assembly.
- PCU is part of the fuel injection pump assembly.

DTC P1630 (Symptom Code A, B) (Flash Code 51)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	Important: The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 4	—

Step	Action	Value(s)	Yes	No
4	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1650 (Symptom Code A) (Flash Code 44)**Circuit Description**

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU. The ECM monitors CAN operational status by expecting a constant flow of messages from the PCU. If the ECM detects that the PCU receives from the CAN controller rest or Bus Offline, this DTC will set.

Condition for Setting the DTC

- The ECM detects that the PCU receives from the CAN controller reset or Bus Offline.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts the fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1650 (Symptom Code A) (Flash Code 44)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P1651 (Symptom Code A or B) set?	—	Go to Applicable DTC	Go to Step 3
3	Monitor the DTC Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the fuel injection pump control unit (PCU) harness connector. 3. Connect a DMM across the controller area network (CAN) harness (pins 1 and 2 of E-110 connector). 4. Measure the resistance across the CAN terminals. Is the resistance within the specified value?	110 – 130 Ω	Go to Step 5	Go to Step 10
5	1. Connect a DMM between the CAN Low signal circuit (pin 1 of E-110 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Is the DMM voltage within the specified value?	1.5 – 2.5 volts	Go to Step 6	Go to Step 11

Step	Action	Value(s)	Yes	No
6	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a DMM between the CAN High signal circuit (pin 2 of E-110 connector) and a known good ground. Is the DMM voltage within the specified value?	3.0 – 4.0 volts	Go to Step 7	Go to Step 12
7	1. Turn OFF the ignition. 2. Reconnect the PCU harness connector. 3. Disconnect the engine control module (ECM) B-233 harness connector. Keep the ECM B-234 harness connector with connected. 4. Connect a DMM across the CAN harness (pins 99 and 100 of B-233 connector). 5. Measure the resistance across the CAN terminals. Is the resistance within the specified value?	110 – 130 Ω	Go to Step 8	Go to Step 14
8	1. Connect a DMM between the CAN Low signal circuit of the ECM harness (pin 99 of B-233 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Is the DMM voltage within the specified value?	1.5 – 2.5 volts	Go to Step 9	Go to Step 16
9	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a DMM between the CAN High signal circuit of the ECM harness (pin 100 of B-233 connector) and a known good ground. Is the DMM voltage within the specified value?	3.0 – 4.0 volts	Go to Step 13	Go to Step 16
10	1. Test the CAN Low and High circuit between the ECM (pins 99 and 100 of B-233 connector) and the PCU (pins 1 and 2 of E-110 connector) for the following conditions: • An open circuit • A short each other • High resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 15
11	1. Test the CAN Low circuit between the ECM (pin 99 of B-233 connector) and the PCU (pin 1 of E-110 connector) for the following conditions: • A short to ground • A short to battery or ignition voltage 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 17
12	1. Test the CAN Low circuit between the ECM (pin 100 of B-233 connector) and the PCU (pin 2 of E-110 connector) for the following conditions: • A short to ground • A short to battery or ignition voltage 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 17

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Step	Action	Value(s)	Yes	No
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Monitor the DTC Information with the Tech 2. Is DTC P0251 (Symptom Code E) set?	—	Go to Step 16	Go to Diagnostic Aids
14	1. Turn OFF the ignition. 2. Disconnect the PCU harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the PCU (pins 1 and 2 of E-110 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 16
15	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the CAN Low or High circuits at the harness connector of the ECM (pins 99 and 100 of B-233 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 17
16	Important: The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. (PCU is part of the fuel injection pump assembly) Did you complete the replacement?	—	Go to Step 18	—
17	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 18	—
18	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Start the engine. 4. Monitor the DTC Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 2	Go to Step 19
19	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1650 (Symptom Code B) (Flash Code 44)**Circuit Description**

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU. The ECM monitors CAN operational status by expecting a constant flow of messages from the PCU. If the ECM detects internal CAN controller does not react, this DTC will set.

Condition for Setting the DTC

- The ECM detects internal CAN controller does not react.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts the fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Notice:

- CAN controller is internal to the ECM.

DTC P1650 (Symptom Code B) (Flash Code 44)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1651 (Symptom Code A, B) (Flash Code 45)**Circuit Description**

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU. The ECM monitors CAN operational status by expecting a constant flow of messages from the PCU. If the ECM fails to receive an expected message from the PCU, this will set depending on what communication is lost.

Condition for Setting the DTC

- The ECM detects that the PCU does not receive the CAN messages from the ECM. (Symptom Code A)

- The ECM does not receive the CAN messages from the PCU. (Symptom Code B)

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts the fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1651 (Symptom Code A, B) (Flash Code 45)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	1. Turn OFF the ignition. 2. Disconnect the fuel injection pump control unit (PCU) harness connector. 3. Connect a DMM across the controller area network (CAN) harness (pins 1 and 2 of E-110 connector). 4. Measure the resistance across the CAN terminals. Is the resistance within the specified value?	110 – 130 Ω	Go to Step 4	Go to Step 9
4	1. Connect a DMM between the CAN Low signal circuit (pin 1 of E-110 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Is the DMM voltage within the specified value?	1.5 – 2.5 volts	Go to Step 5	Go to Step 10

Step	Action	Value(s)	Yes	No
5	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a DMM between the CAN High signal circuit (pin 2 of E-110 connector) and a known good ground. Is the DMM voltage within the specified value?	3.0 – 4.0 volts	Go to Step 6	Go to Step 11
6	1. Turn OFF the ignition. 2. Reconnect the PCU harness connector. 3. Disconnect the engine control module (ECM) B-233 harness connector. Keep the ECM B-234 harness connector with connected. 4. Connect a DMM across the CAN harness (pins 99 and 100 of B-233 connector). 5. Measure the resistance across the CAN terminals Is the resistance within the specified value?	110 – 130 Ω	Go to Step 7	Go to Step 13
7	1. Connect a DMM between the CAN Low signal circuit of the ECM harness (pin 99 of B-233 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Is the DMM voltage within the specified value?	1.5 – 2.5 volts	Go to Step 8	Go to Step 15
8	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a DMM between the CAN High signal circuit of the ECM harness (pin 100 of B-233 connector) and a known good ground. Is the DMM voltage within the specified value?	3.0 – 4.0 volts	Go to Step 12	Go to Step 15
9	1. Test the CAN Low and High circuit between the ECM (pins 99 and 100 of B-233 connector) and the PCU (pins 1 and 2 of E-110 connector) for the following conditions: • An open circuit • A short each other • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
10	1. Test the CAN Low circuit between the ECM (pin 99 of B-233 connector) and the PCU (pin 1 of E-110 connector) for the following conditions: • A short to ground • A short to battery or ignition voltage 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
11	1. Test the CAN Low circuit between the ECM (pin 100 of B-233 connector) and the PCU (pin 2 of E-110 connector) for the following conditions: • A short to ground • A short to battery or ignition voltage 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16

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Step	Action	Value(s)	Yes	No
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Monitor the DTC Information with the Tech 2. Is DTC P0251 (Symptom Code E) set?	—	Go to Step 15	Go to Diagnostic Aids
13	1. Turn OFF the ignition. 2. Disconnect the PCU harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the PCU (pins 1 and 2 of E-110 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
14	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the CAN Low or High circuits at the harness connector of the ECM (pins 99 and 100 of B-233 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
15	Important: The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. (PCU is part of the fuel injection pump assembly) Did you complete the replacement?	—	Go to Step 17	—
16	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 18
18	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1690 (Symptom Code 4) (Flash Code 77)**Circuit Description**

The malfunction indicator lamp (MIL) is located on the instrument panel cluster (IPC). The battery voltage is supplied to the MIL. The engine control module (ECM) turns the MIL ON by grounding the MIL control circuit. After a fixed time passes, the ECM turns OFF the MIL with the ignition ON and the engine OFF. The MIL has the following functions:

- The MIL informs the driver that a malfunction has occurred and the vehicle should be taken in for service as soon as possible.
- The MIL illuminates during a bulb test and a system test.
- A DTC will be stored if a MIL is requested by the ECM.

If the ECM detects an open circuit or short circuit on the MIL control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects a low voltage condition on the MIL control circuit for longer than 3 seconds when the MIL is commanded OFF.

Action Taken When the DTC Sets

- The ECM does not illuminate the MIL when the diagnostic runs and fails.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1690 (Symptom Code 4) (Flash Code 77)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Perform the Malfunction Indicator Lamp (MIL) test with the Tech 2. 4. Command the MIL ON with the Tech 2. Does the MIL turn ON when commanded ON with the Tech 2?	—	Go to Step 3	Go to Step 4
3	Command the MIL OFF with the Tech 2. Does the MIL OFF?	—	Go to Step 17	Go to Step 10
4	1. Turn OFF the ignition. 2. Inspect the Meter (10A) fuse (F-16) in the glove box fuse block. Is the Meter (10A) fuse (F-16) open?	—	Go to Step 5	Go to Step 6
5	Replace the Meter (10A) fuse (F-16). If the fuse continues to open, repair the short to ground on one of the circuits that fed by the Meter (10A) fuse (F-16) or replace the shorted attached component fed by the Meter (10A) fuse (F-16). Did you complete the repair?	—	Go to Step 19	—

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Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the MIL control circuit of the ECM harness connector (pin 42 of B-234 connector) and a known good ground. Does the MIL illuminate?	—	Go to Step 11	Go to Step 7
7	1. Turn OFF the ignition. 2. Remove the instrument panel cluster (IPC). 3. Remove the MIL bulb from the IPC (meter assembly). Is the MIL bulb burned out?	—	Go to Step 15	Go to Step 8
8	1. Disconnect the IPC harness B-51 connector. 2. Connect a test lamp between the voltage feed circuit of the MIL (pin 8 of B-51 connector) and a known good ground. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 12
9	1. Turn OFF the ignition. 2. Reconnect the ECM harness connector. 3. Connect a test lamp between the voltage feed circuit and control circuit of the MIL (pins 4 and 8 of B-51 connector). 4. Turn ON the ignition, with the engine OFF. 5. Perform the MIL test with the Tech 2. 6. Command the MIL ON with the Tech 2. Does the test lamp turn ON when commanded ON with the Tech 2?	—	Go to Step 14	Go to Step 13
10	1. Test the control circuit of the MIL between the ECM (pin 42 of B-234 connector) and the IPC (pin 4 of B-51 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the MIL control circuit at the harness connector of the ECM (pin 42 of B-234 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
12	Repair the open circuit or high resistance on the voltage feed circuit of the MIL between the IPC (pin 8 of B-51 connector) and Meter (10A) fuse (F-16). Did you complete the repair?	—	Go to Step 19	—

Step	Action	Value(s)	Yes	No
13	Repair the open circuit or high resistance on the control circuit of the MIL between the ECM (pin 42 of B-234 connector) and the IPC (pin 4 of B-51 connector). Did you complete the repair?	—	Go to Step 19	—
14	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections on the MIL circuits at the IPC (pins 4 and 8 of B-51 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
15	Replace the MIL bulb. Did you complete the replacement?	—	Go to Step 19	—
16	Repair or replace the IPC (meter assembly). Did you complete the repair or replacement?	—	Go to Step 19	—
17	1. Turn OFF the ignition for 30 seconds. 2. Turn ON the ignition for 10 seconds, with the engine OFF. 3. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 18	Go to Diagnostic Aids
18	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 19	—
19	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 20
20	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1690 (Symptom Code 8) (Flash Code 77)**Circuit Description**

The malfunction indicator lamp (MIL) is located on the instrument panel cluster (IPC). The battery voltage is supplied to the MIL. The engine control module (ECM) turns the MIL ON by grounding the MIL control circuit. After a fixed time passes, the ECM turns OFF the MIL with the ignition ON and the engine OFF. The MIL has the following functions:

- The MIL informs the driver that a malfunction has occurred and the vehicle should be taken in for service as soon as possible.
- The MIL illuminates during a bulb test and a system test.
- A DTC will be stored if a MIL is requested by the ECM.

If the ECM detects a short to battery or ignition voltage on the MIL control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects a high voltage condition on the MIL control circuit for longer than 1 second when the MIL is commanded ON.

Action Taken When the DTC Sets

- The ECM does not illuminate the MIL when the diagnostic runs and fails.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the Tech 2.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The number below refers to the step number on the diagnostic table.

3. If the control circuit of the MIL between the ECM and the IPC is normal, the control circuit voltage low DTC P1690 (Symptom Code 4) will set.

DTC P1690 (Symptom Code 8) (Flash Code 77)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Perform the Malfunction Indicator Lamp (MIL) test with the Tech 2. 4. Command the MIL ON with the Tech 2. Does the MIL turn ON when commanded ON with the Tech 2?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Remove the instrument panel cluster (IPC) in order to disconnect the IPC harness B-51 connector. 3. Disconnect the IPC harness B-51 connector. 4. Turn ON the ignition, with the engine OFF. 5. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does DTC P1690 (Symptom Code 4) set, but not DTC P1690 (Symptom Code 8)?	—	Go to Step 5	Go to Step 4
4	1. Test the control circuit of the MIL between the engine control module (ECM) (pin 42 of B-234 connector) and the IPC (pin 4 of B-51 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Repair or replace the IPC (meter assembly). Did you complete the repair or replacement?	—	Go to Step 7	—
6	Important: Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8
8	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

Glow Control System Check

Description

The glow control system consists of the engine control module (ECM), the glow relay and glow plugs. The glow control system is operated when the engine coolant temperature is low, which allows easier engine starting. The ECM commands the glow relay ON for a certain length of time at ignition switch is ON with engine OFF. In after glow phase, the glow plugs remain energized for a certain period with engine run.

Glow Control Operation

- The pre glow control system operates when the engine coolant temperature is less than 30°C (86°F).
- The after glow control system operates when the engine coolant temperature is less than 30°C (86°F).

Glow Control System Check

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information of the engine control system with the Tech 2 and check whether following DTC(s) is set: • P0115 (Symptom Code 1 & 2) • P0380 (Symptom Code 4 & 8) • P0381 (Symptom Code 4 & 8) Are any of the above DTC(s) set?	—	Refer to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition. 2. Make sure the metal bus bar that connects switched battery voltage supply terminal (J-122) and all glow plugs is secured tightly. 3. Turn ON the ignition, with the engine OFF 4. Connect a test lamp between the metal bus bar (glow plug power supply J-122 terminal) and a known good ground. 5. Perform the Glow Relay test with the Tech 2. 6. Command the Glow Relay ON with the Tech 2 while observing the test lamp. Does the test lamp turn ON only when commanded ON with the Tech 2?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Remove the metal bus bar from the glow plugs. 3. Measure resistance of each glow plug between the glow plug terminals and a known good ground. Make sure to record all measurements and take them quickly as to not allow engine temperature changes between measurements. Are the resistances within the specified value each other?	1 Ω	System OK	Go to Step 15

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Replace the glow relay with the starter relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the metal bus bar (glow plug power supply J-122 connector) and a known good ground. 5. Perform the Glow Relay test with the Tech 2. 6. Command the Glow Relay ON with the Tech 2 while observing the test lamp. Does the test lamp turn ON only when commanded ON with the Tech 2?	—	Go to Step 9	Go to Step 6
6	Inspect the Glow (60A) slow blow fuse (SBF-3) in the fuse & relay box. Is the Glow (60A) slow blow fuse (SBF-3) open?	—	Go to Step 10	Go to Step 7
7	1. Turn OFF the ignition. 2. Remove the glow relay in the fuse & relay box. 3. Connect a test lamp between the voltage feed circuit of the glow relay terminal (pin 3 of X-20 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 11
8	1. Turn ON the ignition, with the engine OFF. 2. Connect a test lamp between the power supply circuit of glow plugs (pin 2 of X-20 connector) and a known good ground. Does the test lamp illuminate?	—	Go to Step 13	Go to Step 12
9	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the glow relay terminals (pins 2 and 3 of X-20 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 14
10	1. Replace the Glow (60A) slow blow fuse (SBF-3). If the slow blow fuse continues to open, repair the short to ground on a circuit fed by the slow blow fuse or check for a shorted attached component. 2. Repair the short to ground or replace the component as necessary. Did you complete the repair?	—	Go to Step 16	—
11	Repair the open circuit in the battery voltage supply circuit between the Glow (60A) slow blow fuse (SBF-3) and the glow relay (pin 3 of X-20 connector). Did you complete the repair?	—	Go to Step 16	—
12	Repair the open circuit in the switched battery voltage supply circuit between the glow relay (pin 2 of X-20 connector) and the glow plugs (J-122 terminal). Did you complete the repair?	—	Go to Step 16	—

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Step	Action	Value(s)	Yes	No
13	Important: The glow plugs may be burnt out if the battery voltage supply circuit is shorted to a voltage source. Repair the short to battery or ignition voltage on the switched battery voltage supply circuit between the glow relay (pin 2 of X-20 connector) and the glow plugs (J-122 terminal). Did you complete the repair?	—	Go to Step 16	—
14	Replace the glow relay. Did you complete the replacement?	—	Go to Step 16	—
15	Replace the appropriate glow plug. Did you complete the replacement?	—	Go to Step 16	—
16	1. Reconnect all previously disconnected components, relay, fuse or harness connector(s). 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the metal bus bar (glow plug power supply J-122 connector) and a known good ground. 5. Perform the Glow Relay test with the Tech 2. 6. Command the Glow Relay ON with the Tech 2 while observing the test lamp. Does the test lamp turn ON only when commanded ON with the Tech 2?	—	Go to Step 4	Go to Step 2

Symptoms – Engine Controls

Symptoms – Engine Controls

Important Preliminary Inspections Before Starting

Perform Diagnostic System Check – Engine Controls before using the symptom tables, and verify that all of the following are true:

- The engine control module (ECM) and malfunction indicator lamp (MIL) are operating correctly.
- There are no diagnostic trouble codes (DTCs) stored, or a DTC exists but without the MIL.
- The Tech 2 data is within the normal operating range. Refer to the Tech 2 Data List in this section.
- Verify the customer concern and locate the correct symptom in the table of contents. Inspect the items indicated under that symptom.

Visual and Physical Inspection

Several of the symptom procedures ask for careful visual and physical inspection. This step is extremely important. The visual and physical inspection can lead to correcting a problem without further inspections, and can save valuable time. Ensure that:

- The ECM grounds are clean, tight, and in their proper location.
- The vacuum hoses are not split or kinked, and properly connected. Inspect thoroughly for any type of leak or restriction.
- The mass air flow (MAF) sensor is properly installed. The arrows on the plastic portion of the sensor must point toward the engine.
- The air intake ducts are not collapsed or damaged.
- There are no leaks at the MAF sensor, any connections or intake manifold sealing surfaces.
- The engine harness wiring and terminals are properly connected and are not pinched or cut.

Intermittent

Important:

Inspect for improper installation of electrical components if an intermittent condition exists. Inspect for aftermarket add-on electrical equipment devices, lights, and cellular phones. Verify that no aftermarket equipment is connected to the keyword 2000 serial data circuit. If you cannot locate an intermittent condition, a cellular phone communication signal may cause the condition.

Important:

The problem may or may not turn ON the MIL or store a DTC.

Faulty electrical connections or wiring cause most intermittent problems. Perform a careful visual and physical inspection of the suspect connectors for the following conditions:

- Improperly mated connector halves
 - Terminals that are not seated
 - Terminals that are damaged or improperly formed
- Reform or replace connector terminals in the problem circuit in order to ensure proper contact tension. Remove the terminal from the connector body in order to inspect for poor terminal wire connection. Road test the vehicle with the DMM connected to the suspected circuit. An abnormal reading that occurs when the malfunction occurs is a good indication that there is a malfunction in the circuit being monitored. Use the Tech 2 in order to help detect intermittent conditions. Useful features of the Tech 2 include the following:
- Trigger the Snapshot feature in order to capture and store engine parameters when the malfunction occurs. Review this stored information in order to see the specific running conditions that caused the malfunction.
 - Use the Plot Function on the Tech 2 in order to plot selected data parameters. Review this stored information to aid in locating an intermittent problem. Refer to the Tech 2 Users Guide for more information.

Important:

If the intermittent condition exists as a start and then stall, test for DTCs relating to the vehicle theft deterrent system. Test for improper installation of electrical options such as lights, cellular phones, etc.

Any of the following may cause an intermittent MIL with no stored DTC:

- The ECM grounds are loose or dirty. Refer to Engine Controls Schematics.
- The MIL circuit intermittently shorted to ground.
- Electrical system interference caused by a malfunctioning relay, ECM driven solenoid, or switch. The electrical component can cause a sharp electrical surge. Normally, the problem will occur when the malfunctioning component is operating.
- There is an open diode across the A/C compressor clutch or any other open diodes.

Important:

The following symptom tables contain groups of possible causes for each symptom. The order of these procedures is not important. If the Tech 2 readings do not indicate the problems, then proceed in a logical order, easiest to check or most likely to cause first. In order to determine if a specific vehicle is using a particular system or component, refer to Engine Controls Schematics for an application.

Use the following tables when diagnosing a symptom complaint:

6E-222 Engine Control System (4JH1)

- Intermittent Conditions
- Hard Start
- Rough, Unstable, or Incorrect Idle and Stalling
- Cuts Out, Misses
- Surge/Chuggles
- Lack of Power, Sluggishness, or Sponginess
- Hesitation, Sag, Stumble
- Fuel Knock/Combustion Noise
- Poor Fuel Economy
- Excessive Smoke (Black Smoke)
- Excessive Smoke (White Smoke)

Intermittent Conditions

Checks	Action
DEFINITION: The problem is not currently present but is indicated in DTC History. OR There is a customer complaint, but the symptom cannot currently be duplicated, if the problem is not DTC related.	
Preliminary Checks	• Refer to Symptoms – Engine Controls before starting.
Harness/Connector	Many intermittent open or shorted circuits are affected by harness/connector movement that is caused by vibration, engine torque, bumps/rough pavement, etc. Test for this type of condition by performing the applicable procedure from the following list: • Move related connectors and wiring while monitoring the appropriate Tech 2 data. • Move related connectors and wiring with the component commanded ON, and OFF, with the Tech 2. Observe the component operation. • With the engine running, move related connectors and wiring while monitoring engine operation. If harness or connector movement affects the data displayed, component/system operation, or engine operation, inspect and repair the harness/connections as necessary. Refer to Electrical Connections or Wiring.
Electrical Connections or Wiring	Poor electrical connections, terminal tension or wiring problems cause most intermittent. To perform the following inspections: • Inspect for poor mating of the connector halves, or terminals improperly seated in the connector body. • Inspect for improperly formed or damaged terminals. Test for poor terminal tension. • Inspect for poor terminal to wire connections including terminals crimped over insulation. This requires removing the terminal from the connector body. • Inspect for corrosion/water intrusion. Pierced or damaged insulation can allow moisture to enter the wiring. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits. • Inspect for wires that are broken inside the insulation. • Inspect the harness for pinched, cut or rubbed through wiring. • Ensure that the wiring does not come in contact with hot exhaust components.
Control Module Power and Grounds Component Power and Grounds	Poor power or ground connections can cause widely varying symptoms. • Test all control module power supply circuits. Many vehicles have multiple circuits supplying power to the control module. Other components in the system may have separate power supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the power source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Ensure that the circuit can carry the current necessary to operate the component. • Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point. Inspect the connections at the component and in splice packs, where applicable. Ensure that the circuit can carry the current necessary to operate the component.

Checks	Action
Temperature Sensitivity	• An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot. • If the intermittent is related to heat, review the data for a relationship with the following: - High ambient temperatures - Underhood/engine generated heat - Circuit generated heat due to a poor connection, or high electrical load - Higher than normal load conditions, towing, etc. • If the intermittent is related to cold, review the data for the following: - Low ambient temperatures – In extremely low temperatures, ice may form in a connection or component. Test for water intrusion. - The condition only occurs on a cold start. - The condition goes away when the vehicle warms up. • Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
Electromagnetic Interference (EMI) and Electrical Noise	Some electrical components/circuits are sensitive to EMI or other types of electrical noise. Inspect for the following conditions: • A misrouted harness that is too close to high voltage/high current devices such as injection components, motors, generator etc. These components may induce electrical noise on a circuit that could interfere with normal circuit operation. • Electrical system interference caused by a malfunctioning relay, or the engine control module (ECM) driven solenoid or switch. These conditions can cause a sharp electrical surge. Normally, the problem will occur when the malfunctioning component is operating. • Improper installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. These accessories may lead to an emission related failure while in use, but do not fail when the accessories are not in use. • Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode. • Test the generator for a bad rectifier bridge that may be allowing AC noise into the electrical system.
Incorrect ECM Programming	• There are only a few situations where reprogramming a ECM is appropriate: Important: DO NOT reprogram the ECM with the SAME software/calibration files that are already present in the ECM. This is not an effective repair for any type of driveability problem. - A ECM from another vehicle is installed. - Revised software/calibration files have been released for this vehicle. • Verify that the ECM contains the correct software/calibration. If incorrect programming is found, reprogram the ECM with the most current software/calibration.
Duplicating Failure Conditions	• If none of the previous tests are successful, attempt to duplicate and/or capture the failure conditions. • An alternate method is to drive the vehicle with the DMM connected to a suspected circuit. An abnormal reading on the DMM when the problem occurs, may help you locate the problem.
Tech 2 Snapshot	The Tech 2 can be set up to take a Snapshot of the parameters available via serial data. The Snapshot function records live data over a period of time. The recorded data can be played back and analyzed. The Tech 2 can also graph parameters singly or in combinations of parameters for comparison. The Snapshot can be triggered manually at the time the symptom is noticed, or set up in advance to trigger when a DTC sets. An abnormal value captured in the recorded data may point to a system or component that needs to be investigated further. Refer to the Tech 2 user instructions for more information on the Snapshot function.

Hard Start

Checks	Action
DEFINITION: The engine cranks OK, but does not start for a long time. The engine does eventually run, or may start but immediately dies.	
Preliminary Checks	• Diagnostic System Check – Engine Controls. • Ensure the driver is using the correct starting procedure. • Inspect the engine control module (ECM) and fuel injection pump control unit (PCU) grounds for being clean, tight, and in their proper locations. • Inspect that the harness connectors are correctly connected. • Inspect the fuel type and quality. • Inspect the Tech 2 Data List in this section. • Inspect the Service Bulletins for ECM software updates.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. • Use the Tech 2 to compare the Engine Coolant Temperature (ECT) with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. Notice: The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake air temperature if the ignition switch is being ON. FT sensor is internal to the PCU and it is part of the fuel injection pump assembly. • Inspect the crankshaft position (CKP) sensor is tight and the flywheel circumference is not damaged.

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect for water contamination in the fuel. • Inspect for external fuel leaks or fuel leakage into the engine oil. • Inspect the fuel lines between the fuel tank and fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. Notice: The fuel system from the fuel tank(s) to the fuel injection pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel injection pump internal pressure fluctuations especially at high engine speed and load. • Inspect for air in the fuel system. Notice: If many air bubbles appear in the fuel, check the fuel system line connections between the fuel tank and the fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. - Remove the fuel hose that connects to the fuel injection pump suction side. - Substitute a clear hose. Notice: A hose must be cleaned. - Connect the clear hose to the fuel injection pump. - Bleed the fuel system. - Let the engine run at idle for at least 2 minutes. - Accelerator the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the clear hose. • Inspect the fuel tank vent hose for a plugged or kinked. • Inspect inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. Draw fuel from the fuel tank at the fuel line (as close to the fuel tank as possible) going to the fuel pickup tube to verify a clean stream of fuel comes out (use the hand-held vacuum pump 5-8840-0279-0/J-23738-A with a clear hose or equivalent). This will ensure the fuel pickup tube is not cracked drawing air into the fuel line. • Inspect the fuel injection pump operation. Notice: The fuel injection pump must be timed to the engine. • Inspect the eye bolt for any type of restriction or collapsed gauze filter. Notice: If any type of restriction found, check for a condition that causes contaminated fuel, such as the customer is using an aftermarket fuel filter or extended maintenance interval. Also inspect fuel waxing or icing that is caused by an incorrect fuel type used in winter season or water intrusion in the fuel system. • Inspect the fuel injection nozzle(s) for proper splay condition or operating pressure. Notice: Only first stage of operating pressure can be checked.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction in the turbocharger inlet duct. • Inspect for a restriction or deposit in the intake throttle bore. • Inspect for a restriction or leak in the intake manifold.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect for a restriction in the catalytic converter or exhaust pipes.

6E-226 Engine Control System (4JH1)

Checks	Action
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. - Inspect for poor cylinder compression. Proper compression is more than 2100 kPa (309 psi). - Improper mechanical timing (timing gear) - Improper valve gap - Broken or weak valve springs - Worn camshaft lobes
Electrical System Checks	Inspect the engine electrical for the following conditions. Refer to the Engine Electrical section. - Inspect the glow plug control (preheating) system operation. - Inspect for slow cranking speed. - Inspect for weakened batteries.

Rough, Unstable, or Incorrect Idle And Stalling

Checks	Action
DEFINITION: Engine runs unevenly at idle. If severe, the engine or vehicle may shake. Engine idle speed may vary in RPM. Either condition may be severe enough to stall the engine.	
Preliminary Checks	- Diagnostic System Check – Engine Controls. - Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. - Inspect the Engine Control Module (ECM) and fuel injection pump control unit (PCU) grounds for being clean, tight, and in their proper locations. - Inspect that the harness connectors are correctly connected. - Inspect the fuel type and quality. - Inspect the Tech 2 Data List in this section. - Inspect the Service Bulletins for ECM software updates.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. - Use the Tech 2 to compare the Engine Coolant Temperature (ECT) with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. Notice: The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake air temperature if the ignition switch is being ON. FT sensor is internal to the PCU and it is part of the fuel injection pump assembly. - Use the Tech 2 to compare the MAF Sensor parameter with the Desired MAF parameter. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]). The MAF Sensor parameter must follow the Desired MAF parameter within 100mg/strk. If not, inspect the air intake system, EGR system components and contaminated, skewed or slow MAF sensor. - Inspect the crankshaft position (CKP) sensor is tight and the flywheel circumference is not damaged.

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect for water contamination in the fuel. • Inspect for external fuel leaks or fuel leakage into the engine oil. • Inspect the fuel lines between the fuel tank and fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. Notice: The fuel system from the fuel tank(s) to the fuel injection pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel injection pump internal pressure fluctuations especially at high engine speed and load. • Inspect for air in the fuel system. Notice: If many air bubbles appear in the fuel, check the fuel system line connections between the fuel tank and the fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. - Remove the fuel hose that connects to the fuel injection pump suction side. - Substitute a clear hose. Notice: A hose must be cleaned. - Connect the clear hose to the fuel injection pump. - Bleed the fuel system. - Let the engine run at idle for at least 2 minutes. - Accelerator the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the clear hose. • Inspect the fuel tank vent hose for a plugged or kinked. • Inspect inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. Draw fuel from the fuel tank at the fuel line (as close to the fuel tank as possible) going to the fuel pickup tube to verify a clean stream of fuel comes out (use the hand-held vacuum pump 5-8840-0279-0/J-23738-A with a clear hose or equivalent). This will ensure the fuel pickup tube is not cracked drawing air into the fuel line. • Inspect the fuel injection pump operation. Notice: The fuel injection pump must be timed to the engine. • Inspect the eye bolt for any type of restriction or collapsed gauze filter. Notice: If any type of restriction found, check for a condition that causes contaminated fuel, such as the customer is using an aftermarket fuel filter or extended maintenance interval. Also inspect fuel waxing or icing that is caused by an incorrect fuel type used in winter season or water intrusion in the fuel system. • Inspect the fuel injection nozzle(s) for proper splay condition or operating pressure. Notice: Only first stage of operating pressure can be checked.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction in the turbocharger inlet duct. • Inspect for a restriction or deposit in the intake throttle bore. • Inspect for a restriction or leak in the intake manifold. • Inspect for a restriction or damage at MAF sensor.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect for a restriction in the catalytic converter or exhaust pipes.

6E-228 Engine Control System (4JH1)

Checks	Action
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 2100 kPa (309 psi). • Improper mechanical timing • Improper valve gap • Broken or weak valve springs • Worn camshaft lobes • Inspect for incorrect basic engine parts.
Additional Checks	• Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. The Tech 2 can usually detect EMI by monitoring the engine speed. A sudden increase in speed with little change in actual engine speed change indicates that EMI is present. If a problem exists, check routing of high voltage components, such as fuel injection solenoid valve wiring, near the sensor circuits. • Inspect for faulty engine mounts. • Inspect faulty crank pulley. • Inspect faulty generator & A/C compressor. • Inspect the generator output voltage. Repair if less than 9 volts or more than 16 volts. • Inspect the EGR system operating correctly. • Inspect the A/C operation.

Cut Out, Misses

Checks	Action
DEFINITION: A constant jerking that follows the engine speed, usually more pronounced as the engine load increase. The exhaust has a steady spitting sound at idle, low speed, or hard acceleration for the fuel starvation that can cause the engine to cut-out.	
Preliminary Check	• Diagnostic System Check — Engine Controls. • Inspect that the harness connectors are correctly connected. • Inspect the engine control module (ECM) and fuel injection pump control unit (PCU) grounds for being clean, tight, and in their proper locations. • Inspect the Tech 2 Data List in this section. • Inspect the Service Bulletins for ECM software updates.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. • Use the Tech 2 to observe the Accelerator Pedal Position. Accelerator Pedal Position indicating angle parameter should change linearly from 0% to 100% according to the accelerator pedal operation. • Inspect the crankshaft position (CKP) sensor is tight and the flywheel circumference is not damaged.

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect for water contamination in the fuel. • Inspect for external fuel leaks or fuel leakage into the engine oil. • Inspect the fuel lines between the fuel tank and fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. Notice: The fuel system from the fuel tank(s) to the fuel injection pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel injection pump internal pressure fluctuations especially at high engine speed and load. • Inspect for air in the fuel system. Notice: If many air bubbles appear in the fuel, check the fuel system line connections between the fuel tank and the fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. - Remove the fuel hose that connects to the fuel injection pump suction side. - Substitute a clear hose. Notice: A hose must be cleaned. - Connect the clear hose to the fuel injection pump. - Bleed the fuel system. - Let the engine run at idle for at least 2 minutes. - Accelerator the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the clear hose. • Inspect the fuel tank vent hose for a plugged or kinked. • Inspect inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. Draw fuel from the fuel tank at the fuel line (as close to the fuel tank as possible) going to the fuel pickup tube to verify a clean stream of fuel comes out (use the hand-held vacuum pump 5-8840-0279-0/J-23738-A with a clear hose or equivalent). This will ensure the fuel pickup tube is not cracked drawing air into the fuel line. • Inspect the fuel injection pump operation. Notice: The fuel injection pump must be timed to the engine. • Inspect the eye bolt for any type of restriction or collapsed gauze filter. Notice: If any type of restriction found, check for a condition that causes contaminated fuel, such as the customer is using an aftermarket fuel filter or extended maintenance interval. Also inspect fuel waxing or icing that is caused by an incorrect fuel type used in winter season or water intrusion in the fuel system.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction in the turbocharger inlet duct. • Inspect for a restriction or deposit in the intake throttle bore. • Inspect for a restriction or leak in the intake manifold. • Inspect for a restriction or damage at mass air flow (MAF) sensor.
Additional Checks	• Inspect the generator output voltage. Repair if less than 9 volts or more than 16 volts. • Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. The Tech 2 can usually detect EMI by monitoring the engine speed. A sudden increase in speed with little change in actual engine speed change indicates that EMI is present. If a problem exists, check routing of high voltage components, such as fuel injection solenoid wiring, near the sensor circuits.

Surges/Chuggles

Checks	Action
DIFINITION: The engine has a power variation under a steady throttle or cruise. The vehicle seems to speed up and slow down with no change in the accelerator pedal.	
Preliminary Checks	• Diagnostic System Check — Engine Controls. • Ensure the driver understands the A/C compressor operation. • Use the Tech 2 in order to make sure the Vehicle Speed parameter reading matches the vehicle speedometer. • Inspect the engine control module (ECM) and fuel injection pump control unit (PCU) grounds for being clean, tight, and in their proper locations. • Inspect that the harness connectors are correctly connected. • Inspect the fuel type and quality. • Inspect the Tech 2 Data List in this section. • Inspect the Service Bulletins for ECM software updates.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. • Use the Tech 2 to compare the Mass Air Flow (MAF) Sensor parameter with the Desired MAF parameter. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]). The MAF Sensor parameter must follow the Desired MAF parameter within 100mg/strk. If not, inspect the air intake system, EGR system components and contaminated, skewed or slow MAF sensor. • Use the Tech 2 to observe the Accelerator Pedal Position. Accelerator Pedal Position parameter should change linearly from 0% to 100% according to the accelerator pedal operation. Also inspect the Accelerator Pedal Position indicating angle when the accelerator pedal is steady. If the indicating angle fluctuates, check for an intermittent open, high resistance in the circuits or for a skewed sensor. • Inspect the crankshaft position (CKP) sensor is tight and the flywheel circumference is not damaged.

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect for water contamination in the fuel. • Inspect for external fuel leaks or fuel leakage into the engine oil. • Inspect the fuel lines between the fuel tank and fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. Notice: The fuel system from the fuel tank(s) to the fuel injection pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel injection pump internal pressure fluctuations especially at high engine speed and load. • Inspect for air in the fuel system. Notice: If many air bubbles appear in the fuel, check the fuel system line connections between the fuel tank and the fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. - Remove the fuel hose that connects to the fuel injection pump suction side. - Substitute a clear hose. Notice: A hose must be cleaned. - Connect the clear hose to the fuel injection pump. - Bleed the fuel system. - Let the engine run at idle for at least 2 minutes. - Accelerator the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the clear hose. • Inspect the fuel tank vent hose for a plugged or kinked. • Inspect inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. Draw fuel from the fuel tank at the fuel line (as close to the fuel tank as possible) going to the fuel pickup tube to verify a clean stream of fuel comes out (use the hand-held vacuum pump 5-8840-0279-0/J-23738-A with a clear hose or equivalent). This will ensure the fuel pickup tube is not cracked drawing air into the fuel line. • Inspect the fuel injection pump operation. Notice: The fuel injection pump must be timed to the engine. • Inspect the eye bolt for any type of restriction or collapsed gauze filter. Notice: If any type of restriction found, check for a condition that causes contaminated fuel, such as the customer is using an aftermarket fuel filter or extended maintenance interval. Also inspect fuel waxing or icing that is caused by an incorrect fuel type used in winter season or water intrusion in the fuel system. • Inspect the fuel injection nozzle(s) for proper splay condition or operating pressure. Notice: Only first stage of operating pressure can be checked. • Inspect the timing device operating correctly. Observe the Actual Injection Timing parameter with the Tech 2 while running the engine. The Actual Injection Timing parameter must follow the Desired Injection Timing within 2°CA on each engine speed. Engine idle > around 2000 RPM > around 3000 RPM. If not, inspect the fuel system restriction, air in the fuel or fuel injection pump operation.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction in the turbocharger inlet duct. • Inspect for a restriction or deposit in the intake throttle bore. • Inspect for a restriction or leak in the intake manifold. • Inspect for a restriction or damage at MAF sensor.

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Checks	Action
Additional Checks	• Inspect the generator output voltage. Repair if less than 9 volts or more than 16 volts. • Inspect the EGR system operating correctly. • Inspect the A/C operation.

Lack of Power, Sluggishness, Sponginess

Checks	Action
DEFINITION: The engine delivers less than expected power. There is little or no increase in speed when partially applying the accelerator pedal.	
Preliminary Checks	• Diagnostic System Check — Engine Controls. • Compare the vehicle with a similar unit. Ensure the vehicle has an actual problem. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Are the tire sizes changed? • Are excessively heavy loads being carried? • Inspect for clutch slip. • Inspect brake drag. • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Use the Tech 2 in order to make sure the Vehicle Speed parameter reading matches the vehicle speedometer. • Inspect the engine control module (ECM) and fuel injection pump control unit (PCU) grounds for being clean, tight, and in their proper locations. • Inspect the Tech 2 Data List in this section. • Inspect the Service Bulletins for ECM software updates.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. • Use the Tech 2 to compare the Engine Coolant Temperature (ECT) with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. Notice: The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake air temperature if the ignition switch is being ON. FT sensor is internal to the PCU and it is part of the fuel injection pump assembly. • Use the Tech 2 to compare the MAF Sensor parameter with the Desired MAF parameter. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]). The MAF sensor parameter must follow the Desired MAF parameter within 100 mg/strk. If not, inspect the air intake system, EGR system components and contaminated, skewed or slow MAF sensor. • Use the Tech 2 to observe the Accelerator Pedal Position. Accelerator Pedal Position parameter should change linearly from 0% to 100% according to the accelerator pedal operation.

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect for water contamination in the fuel. • Inspect for external fuel leaks or fuel leakage into the engine oil. • Inspect the fuel lines between the fuel tank and fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. Notice: The fuel system from the fuel tank(s) to the fuel injection pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel injection pump internal pressure fluctuations especially at high engine speed and load. • Inspect for air in the fuel system. Notice: If many air bubbles appear in the fuel, check the fuel system line connections between the fuel tank and the fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. - Remove the fuel hose that connects to the fuel injection pump suction side. - Substitute a clear hose. Notice: A hose must be cleaned. - Connect the clear hose to the fuel injection pump. - Bleed the fuel system. - Let the engine run at idle for at least 2 minutes. - Accelerator the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the clear hose. • Inspect the fuel tank vent hose for a plugged or kinked. • Inspect inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. Draw fuel from the fuel tank at the fuel line (as close to the fuel tank as possible) going to the fuel pickup tube to verify a clean stream of fuel comes out (use the hand-held vacuum pump 5-8840-0279-0/J-23738-A with a clear hose or equivalent). This will ensure the fuel pickup tube is not cracked drawing air into the fuel line. • Inspect the fuel injection pump operation. Notice: The fuel injection pump must be timed to the engine. • Inspect the eye bolt for any type of restriction or collapsed gauze filter. Notice: If any type of restriction found, check for a condition that causes contaminated fuel, such as the customer is using an aftermarket fuel filter or extended maintenance interval. Also inspect fuel waxing or icing that is caused by an incorrect fuel type used in winter season or water intrusion in the fuel system. • Inspect the fuel injection nozzle(s) for proper splay condition or operating pressure. Notice: Only first stage of operating pressure can be checked. • Inspect the timing device operating correctly. Observe the Actual Injection Timing parameter with the Tech 2 while running the engine. The Actual Injection Timing parameter must follow the Desired Injection Timing within 2°CA on each engine speed. Engine idle > around 2000 RPM > around 3000 RPM. If not, inspect the fuel system restriction, air in the fuel or fuel injection pump operation.

6E-234 Engine Control System (4JH1)

Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction or leak in the intercooler. • Inspect for a restriction in the turbocharger inlet duct. • Inspect for a restriction or deposit in the intake throttle bore. • Inspect for a restriction or leak in the intake manifold. • Inspect for a restriction or damage at MAF sensor. • Inspect for a worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section. • Inspect for turbocharger wastegate valve operation. Refer to wastegate valve inspection in the Engine Mechanical section.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect for a restriction in the catalytic converter or exhaust pipes.
Engine Mechanical Check	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 2100 kPa (309 psi). • Improper mechanical timing • Improper valve gap • Broken or weak valve springs • Worn camshaft lobes
Additional Checks	• Inspect the generator output voltage. Repair if less than 9 volts or more than 16 volts. • Inspect the EGR system operating correctly. • Inspect the engine overheat condition. Refer to the Engine Cooling section. • Inspect the A/C operation.

Hesitation, Sag, Stumble

Checks	Action
DEFINITION: The vehicle has a momentary lack of response when pushing down on the accelerator. The condition can occur at any vehicle speed. The condition is usually most severe when trying to make the vehicle move from a stop. If severe enough, the condition may cause the engine to stall.	
Preliminary Checks	• Diagnostic System Check — Engine Controls. • Compare the vehicle with a similar unit. Ensure the vehicle has an actual problem. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Inspect the Tech 2 Data List in this section. • Inspect the engine control module (ECM) and fuel injection pump control unit (PCU) grounds for being clean, tight, and in their proper locations. • Inspect the Service Bulletins for ECM software updates.

Checks	Action
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. - Use the Tech 2 to compare the Engine Coolant Temperature (ECT) with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. Notice: The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake air temperature if the ignition switch is being ON. FT sensor is internal to the PCU and it is part of the fuel injection pump assembly. - Use the Tech 2 to compare the MAF Sensor parameter with the Desired MAF parameter. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]). The MAF Sensor parameter must follow the Desired MAF parameter within 100mg/strk. If not, inspect the air intake system, EGR system components and contaminated, skewed or slow MAF sensor - Use the Tech 2 to observe the Accelerator Pedal Position. Accelerator Pedal Position parameter should change linearly from 0% to 100% according to the accelerator pedal operation.

6E-236 Engine Control System (4JH1)

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect for water contamination in the fuel. • Inspect for external fuel leaks or fuel leakage into the engine oil. • Inspect the fuel lines between the fuel tank and fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. Notice: The fuel system from the fuel tank(s) to the fuel injection pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel injection pump internal pressure fluctuations especially at high engine speed and load. • Inspect for air in the fuel system. Notice: If many air bubbles appear in the fuel, check the fuel system line connections between the fuel tank and the fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. a. Remove the fuel hose that connects to the fuel injection pump suction side. b. Substitute a clear hose. Notice: A hose must be cleaned. c. Connect the clear hose to the fuel injection pump. d. Bleed the fuel system. e. Let the engine run at idle for at least 2 minutes. f. Accelerator the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the clear hose. • Inspect the fuel tank vent hose for a plugged or kinked. • Inspect inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. Draw fuel from the fuel tank at the fuel line (as close to the fuel tank as possible) going to the fuel pickup tube to verify a clean stream of fuel comes out (use the hand-held vacuum pump 5-8840-0279-0/J-23738-A with a clear hose or equivalent). This will ensure the fuel pickup tube is not cracked drawing air into the fuel line. • Inspect the fuel injection pump operation. Notice: The fuel injection pump must be timed to the engine. • Inspect the eye bolt for any type of restriction or collapsed gauze filter. Notice: If any type of restriction found, check for a condition that causes contaminated fuel, such as the customer is using an aftermarket fuel filter or extended maintenance interval. Also inspect fuel waxing or icing that is caused by an incorrect fuel type used in winter season or water intrusion in the fuel system. • Inspect the fuel injection nozzle(s) for proper splay condition or operating pressure. Notice: Only first stage of operating pressure can be checked. • Inspect the timing device operating correctly. Observe the Actual Injection Timing parameter with the Tech 2 while running the engine. The Actual Injection Timing parameter must follow the Desired Injection Timing within 2°CA on each engine speed. Engine idle > around 2000 RPM > around 3000 RPM. If not, inspect the fuel system restriction, air in the fuel or fuel injection pump operation.

Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction or leak in the intercooler. • Inspect for a restriction in the turbocharger inlet duct. • Inspect for a restriction or deposit in the intake throttle bore. • Inspect for a restriction or leak in the intake manifold. • Inspect for a restriction or damage at MAF sensor. • Inspect for a worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section. • Inspect for turbocharger wastegate valve operation. Refer to wastegate valve inspection in the Engine Mechanical section.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect for a restriction in the catalytic converter or exhaust pipes.
Engine Mechanical Check	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 2100 kPa (309 psi). • Improper mechanical timing • Improper valve gap • Broken or weak valve springs • Worn camshaft lobes
Additional Checks	• Inspect the generator output voltage. Repair if less than 9 volts or more than 16 volts. • Inspect the EGR system operating correctly. • Inspect the A/C operation.

Fuel Knock/Combustion Noise

Checks	Action
DEFINITION: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with the throttle opening.	
Preliminary Checks	• Diagnostic System Check — Engine Controls. • Ensure the vehicle has an actual problem. • Inspect for smoke associated with the combustion noise. • Inspect the fuel quality (cetane index). • Inspect the Tech 2 Data List in this section. • Inspect the Service Bulletins for ECM software updates.

6E-238 Engine Control System (4JH1)

Checks	Action
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. - Use the Tech 2 to compare the Engine Coolant Temperature (ECT) with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. Notice: The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake air temperature if the ignition switch is being ON. FT sensor is internal to the PCU and it is part of the fuel injection pump assembly. - Use the Tech 2 to compare the MAF Sensor parameter with the Desired MAF parameter. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]). The MAF Sensor parameter must follow the Desired MAF parameter within 100mg/strk. If not, inspect the air intake system, EGR system components and contaminated, skewed or slow MAF sensor. - Inspect the crankshaft position (CKP) sensor is tight and the flywheel circumference is not damaged.
Fuel System Checks	- If excessive smoke is present, check for an injection nozzle(s). Remove each glow plug from the cylinder head and inspect the tip of the glow plugs for wet by fuel. Use the cylinder compression gauge. Proper compression is more than 2100 kPa (309 psi). If poor compression is observed, inspect the engine mechanical. - Inspect the fuel injection nozzle(s) for proper splay condition or operating pressure. Notice: Only first stage of operating pressure can be checked. - Inspect the timing device operating correctly. Observe the Actual Injection Timing parameter with the Tech 2 while running the engine. The Actual Injection Timing parameter must follow the Desired Injection Timing within 2°CA on each engine speed. Engine idle > around 2000 RPM > around 3000 RPM. If not, inspect the fuel system restriction, air in the fuel or fuel injection pump operation.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. - Inspect for poor cylinder compression. Proper compression is more than 2100 kPa (309 psi). - Inspect for incorrect basic engine parts such as camshaft, cylinder head, pistons, etc. - Inspect for any excessive oil entering combustion chamber.
Additional Checks	- Inspect the EGR system operating correctly. - Inspect other possible causes that can make similar noise such as loose component parts, bracket, mount and weak clutch damper spring.

Poor Fuel Economy

Checks	Action
DEFINITION: Fuel economy, as measured by actual road tests and several tanks of fuel, is noticeably lower than expected. Also, the economy is noticeably lower than it was on this vehicle at one time, as previously shown by actual road tests.	

Checks	Action
Preliminary Checks	• Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Inspect the driving habits of the owner. • Is the A/C ON full time, defroster mode ON? • Are the tires at the correct pressure? • Have the tire sizes changed? • Are excessively heavy loads being carried? • Is the acceleration too much, too often? • Inspect for clutch slip. • Inspect brake drag. • Inspect drive belt tension. • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Suggest to the owner to fill the fuel tank and recheck the fuel economy. • Suggest to the driver to read the Important Facts on Fuel Economy in the Owner Manual. • Inspect the odometer is correctly operated. • Inspect the Service Bulletins for ECM software updates.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. • Use the Tech 2 to compare the Engine Coolant Temperature (ECT) with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. Notice: The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake air temperature if the ignition switch is being ON. FT sensor is internal to the PCU and it is part of the fuel injection pump assembly.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect the fuel type and quality. • Check fuel leak.
Cooling System Checks	Inspect the cooling system for the following conditions. Refer to the Cooling System Section. • Inspect the engine coolant level. • Inspect the engine thermostat for always being open or for the wrong heat range. • Inspect the engine cooling fan for always being ON.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction or leak in the intercooler. • Inspect for a restriction in the turbocharger inlet duct. • Inspect for a restriction or deposit in the intake throttle bore. • Inspect for a restriction or leak in the intake manifold. • Inspect for a restriction or damage at MAF sensor.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect for a restriction in the catalytic converter or exhaust pipes.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 2100 kPa (309 psi).

Excessive Smoke (Black Smoke)

Checks	Action
DEFINITION: Black smoke under load, idle or start up hot or cold.	
Preliminary Check	• Ensure the vehicle has an actual problem. • Inspect the engine control module (ECM) and fuel injection pump control unit (PCU) grounds for being clean, tight, and in their proper locations. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Inspect the Service Bulletins for ECM software updates.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. • Use the Tech 2 to compare the Engine Coolant Temperature (ECT) with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. Notice: The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake air temperature if the ignition switch is being ON. FT sensor is internal to the PCU and it is part of the fuel injection pump assembly. • Use the Tech 2 to compare the MAF Sensor parameter with the Desired MAF parameter. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]). The MAF Sensor parameter must follow the Desired MAF parameter within 100mg/strk. If not, inspect the air intake system, EGR system components and contaminated, skewed or slow MAF sensor • Use the Tech 2 to observe the Accelerator Pedal Position. Accelerator Pedal Position indicating angle parameter should change linearly from 0% to 100% according to the accelerator pedal operation.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect the fuel injection nozzle(s) for proper splay condition or operating pressure. Notice: Only first stage of operating pressure can be checked. • Inspect the timing device operating correctly. Observe the Actual Injection Timing parameter with the Tech 2 while running the engine. The Actual Injection Timing parameter must follow the Desired Injection Timing within 2°CA on each engine speed. Engine idle > around 2000 RPM > around 3000 RPM. If not, inspect the fuel system restriction, air in the fuel or fuel injection pump operation.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction or leak in the intercooler. • Inspect for a restriction in the turbocharger inlet duct. • Inspect for a restriction or deposit in the intake throttle bore. • Inspect for a restriction or leak in the intake manifold. • Inspect for a restriction or damage at MAF sensor. • Inspect for a worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect for a restriction in the catalytic converter or exhaust pipes.

Checks	Action
Engine Mechanical Check	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. - Inspect for poor cylinder compression. Proper compression is more than 2100 kPa (309 psi). - Inspect for incorrect basic engine parts such as camshaft, cylinder head, pistons, etc. - Inspect for any excessive oil entering combustion chamber. - Improper mechanical timing - Improper valve gap - Broken or weak valve springs - Worn camshaft lobes
Additional Checks	- Inspect the EGR system operating correctly. - Inspect the excessive blow-by gasses. - Inspect the Tech 2 Data List in this section.

Excessive Smoke (White Smoke)

Checks	Action
DIFINITION: White smoke under load, idle or start up hot or cold.	
Preliminary Check	- Ensure the vehicle has an actual problem. - Inspect the engine control module (ECM) and fuel injection pump control unit (PCU) grounds for being clean, tight, and in their proper locations. - Inspect the fuel quality (cetane index). - Inspect the Service Bulletins for ECM software updates.
Sensor Check	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. - Use the Tech 2 to compare the Engine Coolant Temperature (ECT) with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. Notice: The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake air temperature if the ignition switch is being ON. FT sensor is internal to the PCU and it is part of the fuel injection pump assembly. - Inspect the crankshaft position (CKP) sensor is tight and the flywheel circumference is not damaged.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. - Inspect the fuel injection nozzle(s) for proper splay condition or operating pressure. Notice: Only first stage of operating pressure can be checked. - Inspect the timing device operating correctly. Observe the Actual Injection Timing parameter with the Tech 2 while running the engine. The Actual Injection Timing parameter must follow the Desired Injection Timing within 2°CA on each engine speed. Engine idle > around 2000 RPM > around 3000 RPM. If not, inspect the fuel system restriction, air in the fuel or fuel injection pump operation.

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Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction or leak in the intercooler. • Inspect for a restriction in the turbocharger inlet duct. • Inspect for a restriction or leak in the intake manifold. • Inspect for a restriction or damage at MAF sensor. • Inspect for a worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 2100 kPa (309 psi). • Inspect for incorrect basic engine parts such as camshaft, cylinder head, pistons, etc. • Improper mechanical timing • Improper valve gap • Broken or weak valve springs • Worn camshaft lobes • Inspect for any excessive fuel entering combustion chamber. • Inspect for coolant entering the combustion chamber.
Electrical System Checks	Inspect the engine electrical for the following conditions. Refer to the Engine Electrical section. • Inspect the glow plug control (preheating) system operation.

Repair Instructions

Engine Control Module (ECM) Replacement

Engine Control Module (ECM) Replacement Procedure

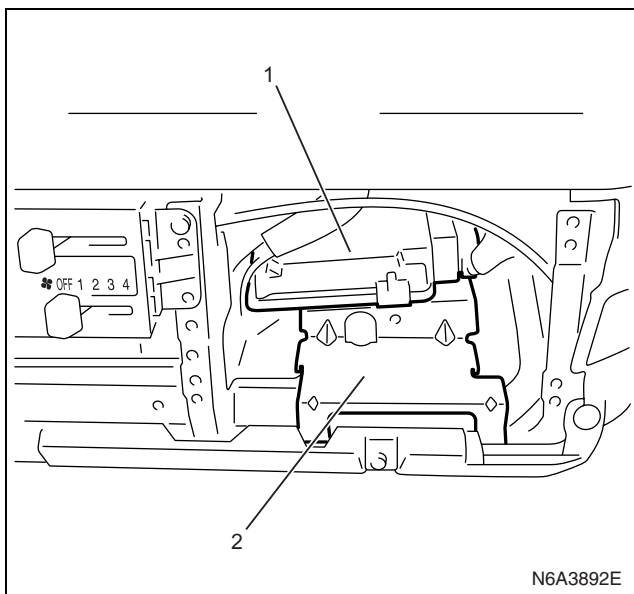
Important:

If the ECM is to be replaced the following programmed contents **MUST** be reprogrammed into the new ECM.

- Vehicle identification number (VIN).
- Latest software/calibrations if released. Refer to Service Programming System (SPS) Description and Service Programming System (SPS) (Remote Procedure) or Service Programming System (SPS) (Pass-Thru Procedure) in this section.

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the instrument cover.
3. Remove a bolt from the ECM bracket.
4. Disconnect the two connectors from the ECM.



Legend

1. ECM
2. Bracket

Installation Procedure

1. Connect the two connectors to the ECM.
2. Put on the ECM to the bracket and tighten by a bolt.
3. Refit the instrument cover by four screws.
4. Connect the negative battery cable.

Vehicle Identification Number (VIN) Programming Procedure

Important:

If the ECM from another vehicle is installed, VIN is not programmed by the Tech 2. Use the SPS to change the original VIN. Refer to Service Programming System (SPS) Description and Service Programming System (SPS) (Remote Procedure) or Service Programming System (SPS) (Pass-Thru Procedure) in this section.

Important:

If an updated software/calibrations is released, **DO NOT** program the VIN now. The VIN is programmed at SPS procedure. Refer to Service Programming System (SPS) Description and Service Programming System (SPS) (Remote Procedure) or Service Programming System (SPS) (Pass-Thru Procedure) in this section.

1. Connect the Tech 2 to the vehicle DLC, with the engine and the Tech 2 OFF.
2. Turn ON the Tech 2.
3. Select Diagnostic > appropriate vehicle identification > Powertrain > 4JH1-TC > Programming > Program VIN.
4. Input correct VIN reading from stamped VIN or affixed VIN plate on the vehicle.
5. Select Lock ECU and lock the programmed VIN.

Service Programming System (SPS) Description

The service programming system (SPS) allows a technician to program a control module through the data link connector (DLC). The information transfer circuit that is used at the DLC is the same serial data circuit used by the Tech 2 for retrieving diagnostic trouble codes (DTCs), displaying data, clearing DTCs etc. This procedure offers the ability to install software/calibrations matched to a particular vehicle.

Most control modules have two types of memory. The software/calibrations reside in the flash memory. The two types of memory are listed below:

- Electrically Erasable Programmable Read Only Memory (EEPROM).
This type of memory allows selected portions of memory to be programmed while other portions remain unchanged.
Certain learned values reside in the EEPROM, such as:
 - The vehicle identification number (VIN)
 - The software/calibrations identification numbers
 - The control module security information

6E-244 Engine Control System (4JH1)

- Flash Read Only Memory-Flash MemoryFlash memory has increased memory storage capacity. During programming, all information within this type of memory is erased, and then replaced with entirely new information.

Service Programming Methods

The two methods of programming an engine control module (ECM) are listed below:

- Remote Programming
- Pass Thru Programming

For information on programming an ECM using one of the methods listed above, refer to Service Programming System (SPS) (Remote Procedure) or Service Programming System (SPS) (Pass-Thru Procedure).

Before Programming a Control Module

Important:

DO NOT program an existing ECM with the identical software/calibration package. This procedure is not a short cut to correct the driveability condition. This is an ineffective repair. An ECM should only be programmed when the following occurs:

- When a service procedure instructs you to replace the ECM. When the ECM from another vehicle is installed, VIN must be changed. And change vehicle information as necessary such as type of transmission.
- An updated software/calibrations is released.

Ensure that the following conditions are met before programming an ECM:

- The Tech 2 PCMCIA card is programmed with the latest software.
- The TIS 2000 is installed with the latest software.
- The hardware key is plugged into the computer port.
- Vehicle system voltage:
 - There are no charging system concerns. All charging system concerns must be repaired before programming the ECM.
 - The battery voltage is greater than 12 volts but less than 16 volts. The battery must be fully charged before programming the ECM.
 - A battery charger is NOT connected to the vehicles battery. Incorrect system voltage or voltage fluctuations from a battery charger may cause programming failure or ECM damage.
 - Turn OFF or disable any system that may put a load on the vehicles battery. Turn OFF or disable systems such as:
 - ◇ Heating, ventilation, and air conditioning (HVAC) systems
 - ◇ Headlights
 - ◇ Room lights
 - ◇ Accessory equipment

- The ignition switch is in the proper position. The Tech 2 prompts you to turn ON the ignition, with the engine OFF. DO NOT change the position of the ignition switch during the programming procedure unless instructed to do so.
- All tool connections are secure:
 - The RS-232 cable
 - The connection at the DLC
 - The voltage supply circuits
- DO NOT disturb the tool harnesses while programming. If an interruption occurs during the programming procedure, programming failure or ECM damage may occur.
- If you are performing the Pass-Thru programming procedure using a notebook computer without the power cord, ensure that the internal battery is fully charged.

Service Programming System (SPS) (Remote Procedure)

The Remote Service Programming System (SPS) method is a three-step process that involves the following procedures:

1. Connecting the Tech 2 to the vehicle and obtaining the information from the engine control module (ECM).
2. Connecting the Tech 2 to the terminal and downloading a new calibration file from the terminal into the Tech 2 memory.
3. Reconnecting the Tech 2 to the vehicle and uploading the new calibration file into the ECM.

Performing the Remote Procedure

1. Connect the Tech 2 to the vehicle and obtain the ECM information using the following procedure:

Important:

Ensure the ECM is installed in the vehicle and the battery is fully charged before programming.

- a. Connect the Tech 2 to the vehicle data link connector (DLC), with the engine and the Tech 2 OFF.
- b. Turn ON the Tech 2.
- c. Press Enter at the title screen.
- d. Turn ON the ignition, with the engine OFF.
- e. Select Service Programming System at the Main Menu.
- f. Select Request Info.

- g. If there is already stored in the Tech 2, the existing data is displayed on the screen. The Tech 2 asks user to keep existing data Keep Data or Continue to request new vehicle information from the ECM. If there is no data in the Tech 2, it will immediately start vehicle identification.
 - h. Enter the vehicle description by following the on-screen instructions based on stamped VIN or affixed VIN plate on the vehicle.
 - i. During obtaining information, the Tech 2 is receiving information from any modules at the same time. But only ECM information is displayed on the screen.
 - j. Turn OFF all accessories and select Continue.
 - k. Verify that the correct VIN is entered on the Tech 2. If the VIN is incorrect, write down the correct VIN.
2. Turn OFF the Tech 2.
 3. Disconnect the Tech 2 from the vehicle.
 4. Turn OFF the ignition.
 5. Transfer the data from the terminal to the Tech 2 using the following procedure:

Important:

The TIS supports service programming with the Tech 2 scan tool only.

- a. Connect the Tech 2 to the terminal.
- b. Launch the TIS application at the terminal.
- c. Select the Service Programming System at the main screen.
- d. Highlight the following information on the Select Diagnostic Tool and Programming Process screen:
 - Select Diagnostic Tool-Select Tech 2.
 - Select Programming Process-Identify whether an existing ECM is being reprogrammed or an ECM is being replaced with a new one.
 - Select ECU Location-Select Vehicle.
- e. Select Next.
- f. Verify the connections on the Preparing for Communication screen and select Next.
- g. Verify the VIN on the Validate Vehicle Identification Number (VIN) screen and select Next.

Important:

If the ECM is replaced to new one, VIN does not displayed. Input correct VIN reading from stamped VIN or affixed VIN plate on the vehicle. If the ECM from another vehicle is installed, input correct VIN by same way.

- h. Highlight Engine on the System Type screen and select Next, if requested.

- i. Complete the following information based on the service ID plate on the Validate Vehicle Data screen until Next is highlighted:
 - Model
 - Model Year
 - Engine
 - Type of Transmission
 - Destination Code
- j. Select Next.
- k. Verify your selection on the Summary screen.

Important:

Refer to Service Bulletins before service programming is performed if the bulletins are listed along with the calibration files.

Important:

Select Cancel if you receive a message stating that the calibration selected is already the current calibration in the ECM and reprogramming with the same download is not allowed.

- l. Select Reprog.
 - m. The Transfer Data screen will appear until the progress bar reaches 100%.
6. Close the application and return to the TIS application selection screen after the download is complete.
 7. Turn OFF the Tech 2.
 8. Disconnect the Tech 2 from the terminal.
 9. Transfer the data from the Tech 2 to the ECM using the following procedure:
 - a. Connect the Tech 2 to the vehicle DLC, with the engine and the Tech 2 OFF.
 - b. Turn ON the Tech 2.
 - c. Press Enter at the Title screen.
 - d. Turn ON the ignition, with the engine OFF.
 - e. Select Service Programming System.
 - f. Select the Program ECU on the Tech 2.
 - g. Follow the on-screen instructions and select Continue.
 - h. Programming in Process will appear until the progress bar reaches 100%.

Important:

The vehicle fitted with automatic transmission, Check Trans lamp may blink while programming the ECM since communication between the ECM and TCM is interrupted. Clear DTC in any module after programming.

- i. Select Continue and exit the program after the Tech 2 displays Programming Was Successful.
10. Turn OFF the ignition.
 11. Turn OFF the Tech 2.
 12. Disconnect the Tech 2 from the vehicle.

Service Programming System (SPS) (Pass-Thru Procedure)

Pass-Thru programming allows the Tech 2 to remain connected to the terminal and to the vehicle throughout the programming process. The vehicle must be in close proximity to the terminal while using Pass-Thru.

Important:

The TIS supports service programming with the Tech 2 scan tool only.

1. Launch the TIS application at the terminal application at the terminal.
2. Select the Service Programming System at the main screen.
3. Highlight the following information on the Select Diagnostic Tool and Programming Process screen:
 - Select Diagnostic Tool-Select Pass-Thru
 - Select Programming Process-Identify whether as existing engine control module (ECM) is being reprogrammed or an ECM is being replaced with a new one.
 - Select ECU Location-Select Vehicle.
4. Select Next.
5. Complete all vehicle data on the Preparing for Communication/Determine Vehicle screen until Next is highlighted.
6. Select Next.
7. Follow the instruction on the Preparing for Communication screen.

Important:

In order to reduce the potential for signal loss, the RS-232 cable should not be more than 25 feet long.

8. Select Next.
9. Verify the VIN on the Validate Vehicle Identification Number (VIN) screen and select Next.

Important:

If the ECM is replaced to new one, VIN does not displayed. Input correct VIN reading from stamped VIN or affixed VIN plate on the vehicle. If the ECM from another vehicle is installed, input correct VIN by same way.

10. Highlight Engine on the System Type screen and select Next, if requested.
11. Complete the following information based on the service ID plate on the Validate Vehicle Data screen until Next is highlighted:
 - Model
 - Model Year
 - Engine
 - Type of Transmission
 - Destination Code

12. Select Next.

13. Verify your selection on the Summary screen.

Important:

Refer to Service Bulletins before service programming is performed if the bulletins are listed along with the calibration files.

Important:

Select Cancel if you receive a message stating that the calibration selected is already the current calibration in the Tech 2 and reprogramming with the same download is not allowed.

14. Select Reprog.

15. The Transfer Data screen will appear until the progress bar reaches 100%.

Important:

The vehicle fitted with automatic transmission, Check Trans lamp may blink while programming the ECM since communication between the ECM and TCM is interrupted. Clear DTC in any module after programming.

16. Select Close on the Programming Complete screen.

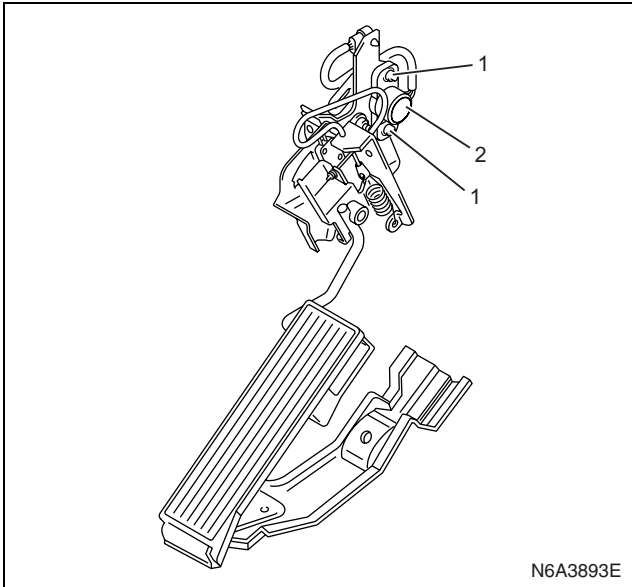
17. Turn OFF the Tech 2.

18. Disconnect the Tech 2 from the vehicle.

Accelerator Pedal Position (APP) Sensor Replacement

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the APP and idle switch connector.
3. Remove the accelerator pedal assembly from the bracket.
4. Loosen two nuts and remove APP from the accelerator pedal bracket.

**Legend**

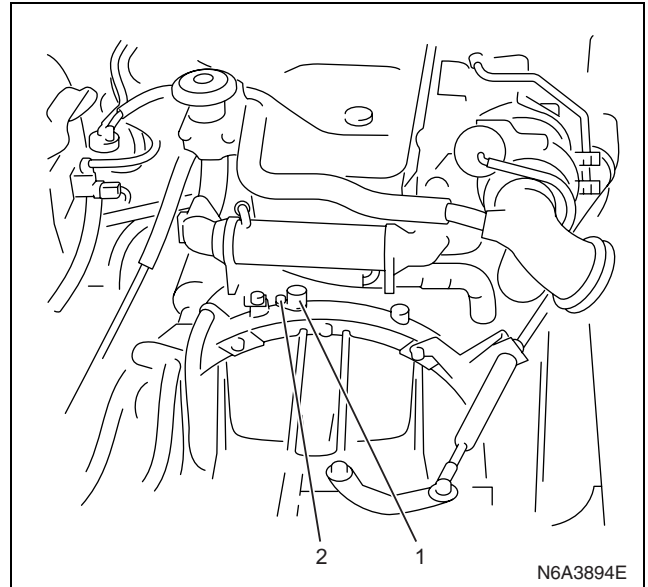
1. Accelerator Pedal Position (APP) Sensor
2. Nut

Installation Procedure

1. Temporarily tighten the APP by two nuts.
2. Refit the accelerator pedal bracket to the body.
3. Connect the idle switch and APP connector.
4. Connect the Tech 2 to the vehicle.
5. Connect the negative battery cable.
6. Select "Data Display" with the Tech 2.
7. Check the accelerator pedal position data and adjust the APP position.
8. Tighten two nuts.

Crankshaft Position (CKP) Sensor Replacement**Removal Procedure**

1. Disconnect the negative battery cable.
2. Disconnect connector from the CKP sensor.
3. Loosen a bolt and remove the CKP sensor from the clutch housing.

**Legend**

1. Crankshaft Position (CKP) Sensor
2. Bolt

Installation Procedure

1. Install the CKP sensor to the clutch housing.
2. Tighten CKP sensor by a bolt with specified tightening torque.

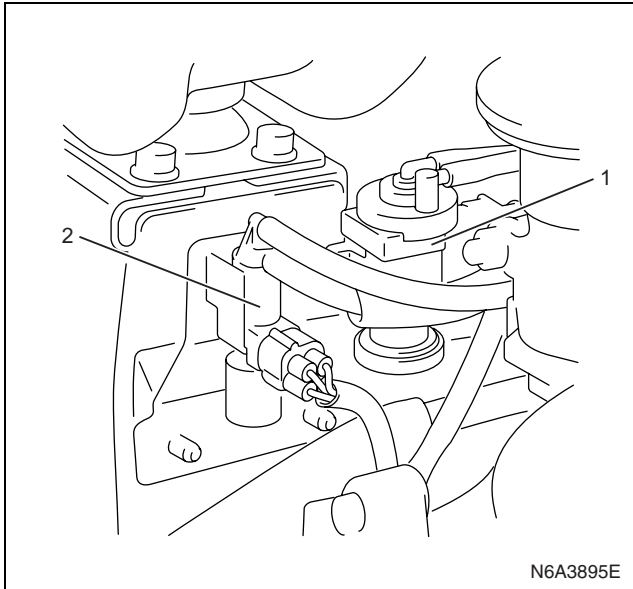
Tighten:

Bolts to 8.0 – 12.0 N·m (0.8 – 1.2 kg·m / 5.9 – 8.9 lb·ft)

3. Connect a CKP sensor connector to the CKP sensor.
4. Connect the negative battery cable.

EGR Solenoid Valve Replacement**Removal Procedure**

1. Disconnect the negative battery cable.
2. Disconnect a EGR solenoid valve connector from the EGR solenoid valve.
3. Disconnect two hoses from the EGR solenoid valve.
4. Loosen two bolts and remove the EGR solenoid valve from the bracket.



Legend

1. EGR Solenoid Valve
2. Intake Throttle Solenoid Valve

Installation Procedure

1. Tighten the purge solenoid by tow bolts.
2. Connect a connector to the EGR solenoid valve.
3. Connect two hoses to the EGR solenoid valve.
4. Connect the negative battery cable.

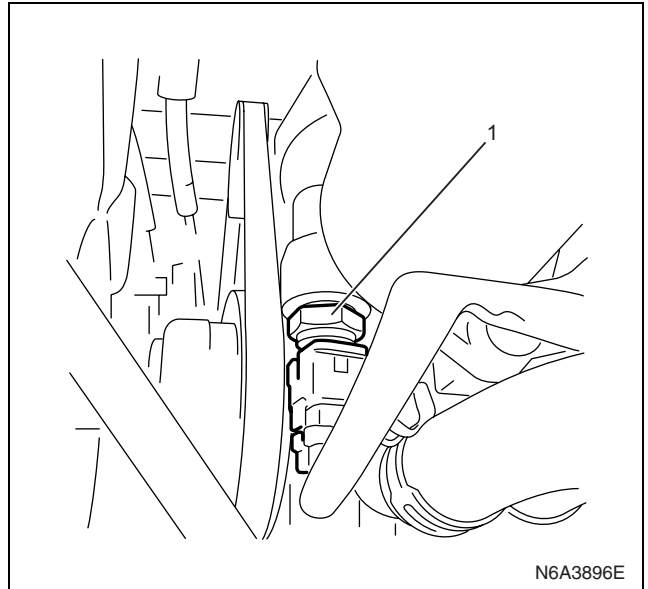
Engine Coolant Temperature (ECT) Sensor Replacement

Removal Procedure

1. Disconnect the negative battery cable.
2. Drain enough engine coolant so that the coolant level will be below the ECT sensor.
3. Disconnect connector from the ECT sensor.
4. Loosen and remove the ECT sensor from the thermostat housing.

Notice:

Cool down the engine before above procedures are carried out.



Legend

1. Engine Coolant Temperature (ECT) Sensor

Installation Procedure

1. Apply sealer to threads of screw at the ECT sensor.
2. Tighten the ECT sensor with specified tightening torque.

Tighten:

Bolt to 13 N·m (1.3 kg·m / 9.6 lb·ft)

3. Connect a ECT sensor connector to the ECT sensor.
4. Fill the engine coolant.
5. Connect the negative battery cable.

Notice:

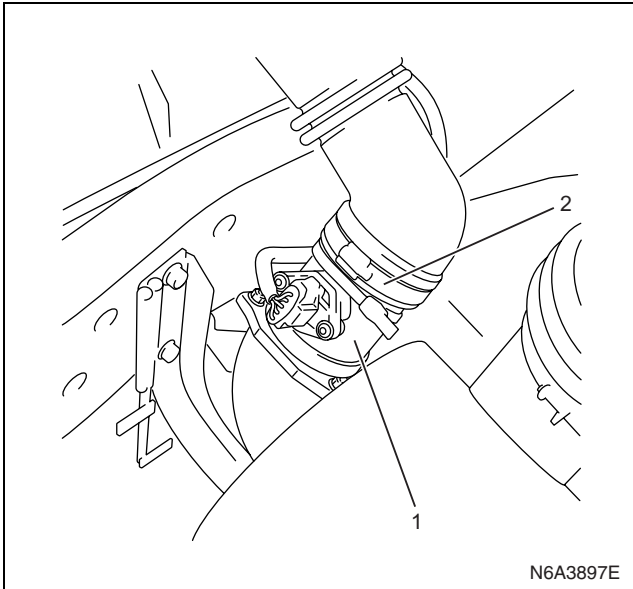
Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

Verify no engine coolant leaking from the sensor threads after replacement.

Mass Air Flow (MAF) / Intake Air Temperature (IAT) Sensor Replacement

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect a MAF & IAT sensor connector from the MAF & IAT sensor assembly.
3. Loosen the clips and remove the MAF & IAT sensor assembly from the intake duct housing.

**Legend**

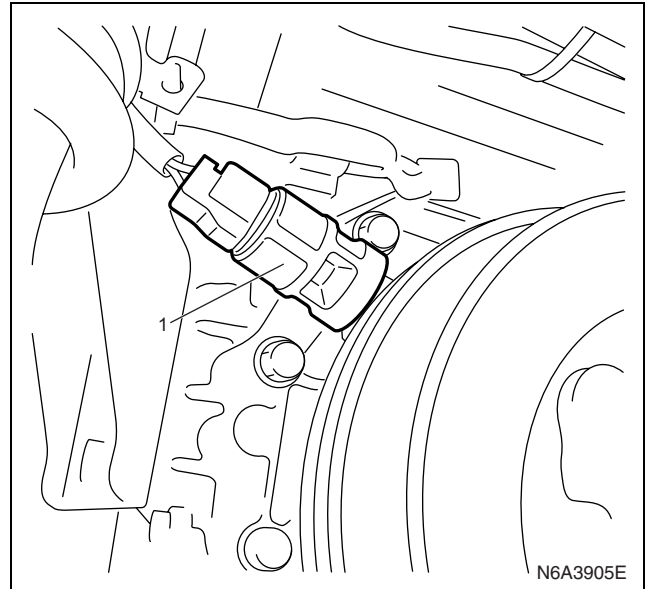
1. Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor
2. Clip

Installation Procedure

1. Install the MAF & IAT sensor assembly into intake air duct.
2. Tighten the clips.
3. Connect a MAF & IAT sensor connector to the MAF & IAT sensor assembly.
4. Connect the negative battery cable.

Vehicle Speed Sensor (VSS) Replacement**Removal Procedure**

1. Disconnect the negative battery cable.
2. Disconnect the vehicle speed sensor connector.
3. Loosen and remove the vehicle speed sensor.

**Legend**

1. Vehicle Speed Sensor (VSS)

Installation Procedure

1. Tighten the vehicle speed sensor to the specified tightening torque.

Tighten:

Hexagonal part of the sensor: 25 N·m (2.5 kg·m / 18 lb·ft)

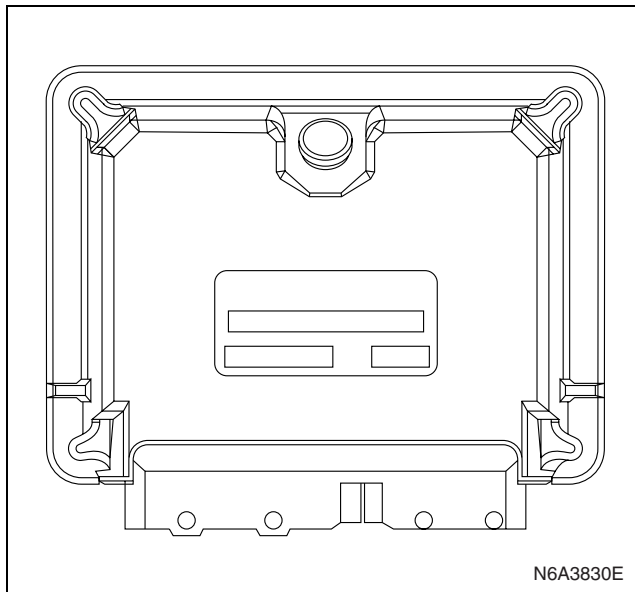
Caution:

Tightening must be made at the hexagonal part of the sensor. To tighten the connector itself would cause damage.

2. Connect the vehicle speed sensor connector to the vehicle speed sensor.
3. Connect the negative battery cable.

Description and Operation

Engine Control Module (ECM) Description



The engine control module (ECM) is designed to withstand normal current draws associated with vehicle operation. Avoid overloading any circuit. When testing for opens and shorts, do not ground or apply voltage to any of the ECM circuits unless instructed to do so. In some cases, these circuits should only be tested using a digital multimeter (DMM). The ECM should remain connected to the ECM harness.

The ECM is located behind the radio via mounting bracket. The ECM mainly controls the following.

- The fuel system control
- The exhaust gas recirculation (EGR) system control
- The preheating (glow) system control
- A/C compressor control
- Exhaust brake control
- On-board diagnostics for engine control

The ECM constantly observes the information from various sensors. The ECM controls the systems that affect vehicle performance. The ECM performs the diagnostic function of the system. The ECM can recognize operational problems, alert the driver through the malfunction indicator lamp (MIL), and store diagnostic trouble codes (DTCs). DTCs identify the system faults to aid the technician in making repairs.

ECM Voltage Description

The ECM supplies a buffered voltage to various switches and sensors. The ECM can do this because resistance in the ECM is so high in value that a test lamp may not illuminate when connected to the circuit. An ordinary shop voltmeter may not give an accurate reading because the voltmeter input impedance is too low. Use a 10-megaohm input impedance DMM, to ensure accurate voltage readings. The input and/or output devices in the ECM include analog-to-digital converters, signal buffers, counters, and special drivers. The ECM controls most components with electronic switches which complete a ground circuit when turned ON.

Aftermarket Electrical and Vacuum Equipment

Aftermarket or add-on electrical and vacuum equipment is defined as any equipment which connects to the vehicle's electrical or vacuum systems that is installed on a vehicle after the vehicle leaves the factory. No allowances have been made in the vehicle design for this type of equipment. No add-on vacuum equipment should be added to this vehicle. Add-on electrical equipment must only be connected to the vehicle's electrical system at the battery power and ground. Add-on electrical equipment, even when installed to these guidelines, may still cause the powertrain system to malfunction. This may also include equipment not connected to the vehicle electrical system such as portable telephones and audios. Therefore, the first step in diagnosing any powertrain fault is to eliminate all aftermarket electrical equipment from the vehicle. After this is done, if the fault still exists, the fault may be diagnosed in the normal manner.

Electrostatic Discharge Damage

Electronic components used in the ECM are often designed to carry very low voltage. Electronic components are susceptible to damage caused by electrostatic discharge. By comparison, as much as 4,000 volts may be needed for a person to feel even the zap of a static discharge. There are several ways for a person to become statically charged. The most common methods of charging are by friction and induction.

- An example of charging by friction is a person sliding across a vehicle seat.

Important:

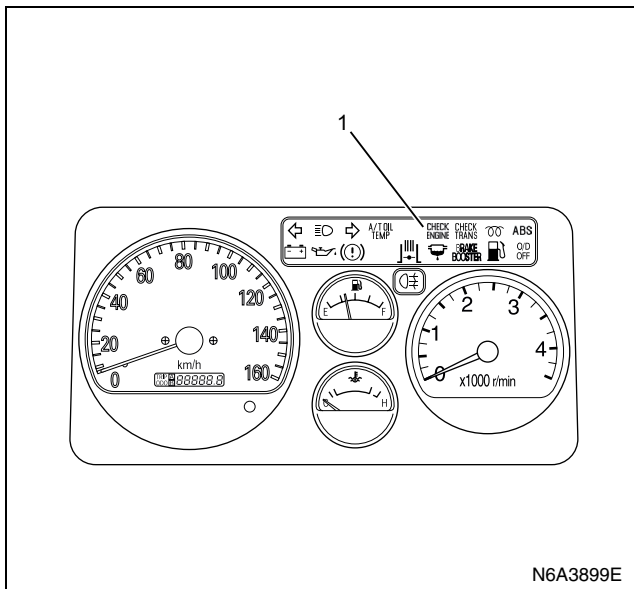
To prevent possible electrostatic discharge damage, follow these guidelines:

- Do not touch the ECM connector pins or soldered components on the ECM circuit board.
- Do not open the replacement part package until the part is ready to be installed.

- Before removing the part from the package, ground the package to a known good ground on the vehicle.
- If the part has been handled while sliding across the seat, while sitting down from a standing position, or while walking a distance, touch a known good ground before installing the part.
- Charge by induction occurs when a person with well insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off leaving the person highly charged with opposite polarity.

Malfunction Indicator Lamp (MIL) Operation

The malfunction indicator lamp (MIL) is located in the instrument panel cluster (IPC). The MIL will display the CHECK ENGINE when commanded ON:



Legend

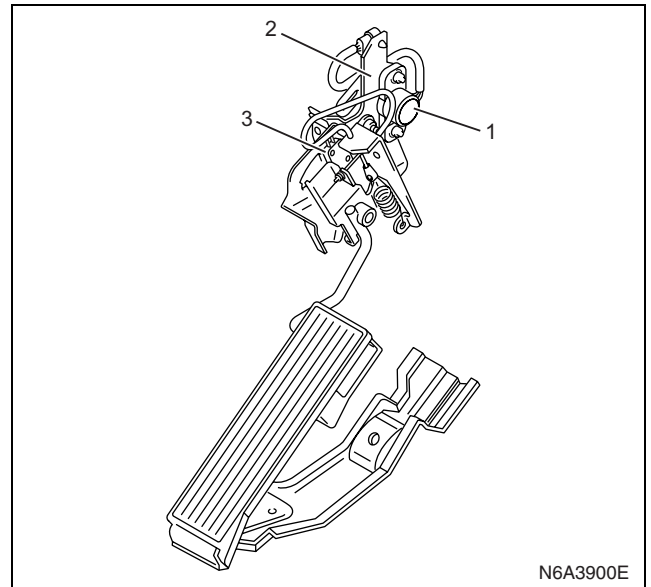
1. Malfunction Indicator Lamp (MIL)

The MIL indicates that an emission or performance related fault has occurred and vehicle service is required. The following is a list of the modes of operation for the MIL:

- The MIL illuminates for approximately 2 seconds when the ignition switch is turned ON, with the engine OFF. This is a bulb test to ensure the MIL is able to illuminate.
- The MIL remains illuminated after the engine is started if the engine control module (ECM) detects a fault. A DTC is stored any time the ECM illuminates the MIL due to an emission or performance related fault.

Engine Control Component Description

Accelerator Pedal Position (APP) Sensor & Idle Switch



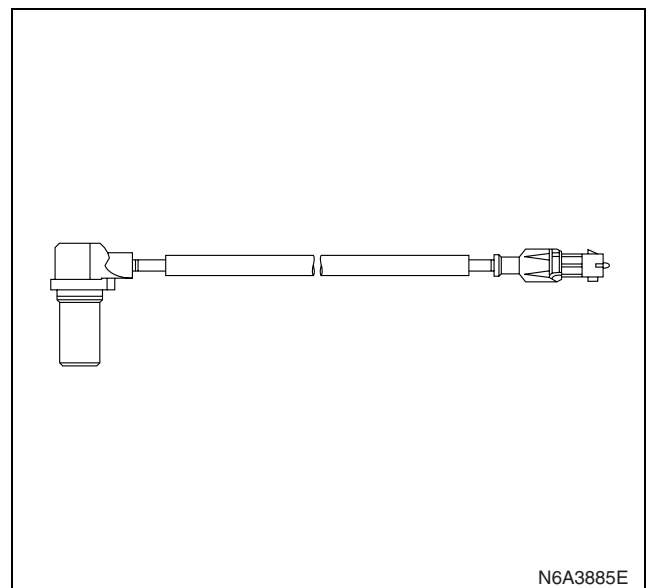
Legend

1. Accelerator Pedal Position (APP) Sensor
2. Accelerator Pedal Bracket
3. Idle Switch

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal bracket. The engine control module (ECM) uses the APP sensors to determine the amount of acceleration or deceleration desired by the person driving the vehicle via the fuel injection control.

The idle switch is also mounted on the accelerator pedal bracket. The idle switch is a normally closed type switch. When the accelerator pedal is released, the idle switch signal to the ECM is low voltage.

Crankshaft Position (CKP) Sensor

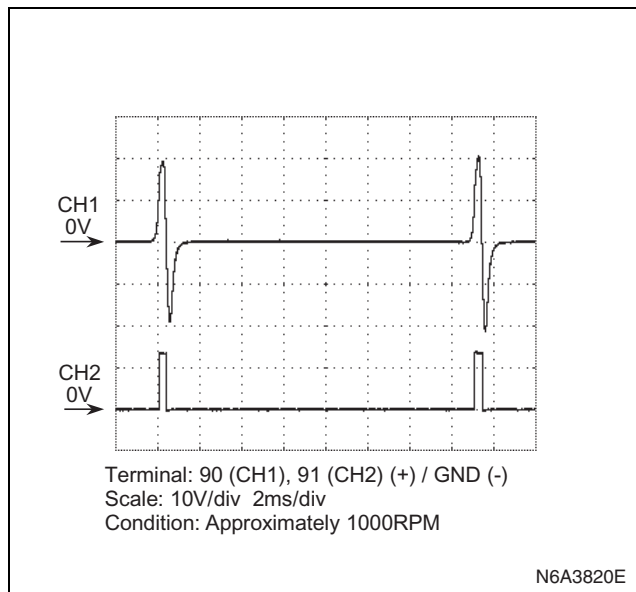


6E-252 Engine Control System (4JH1)

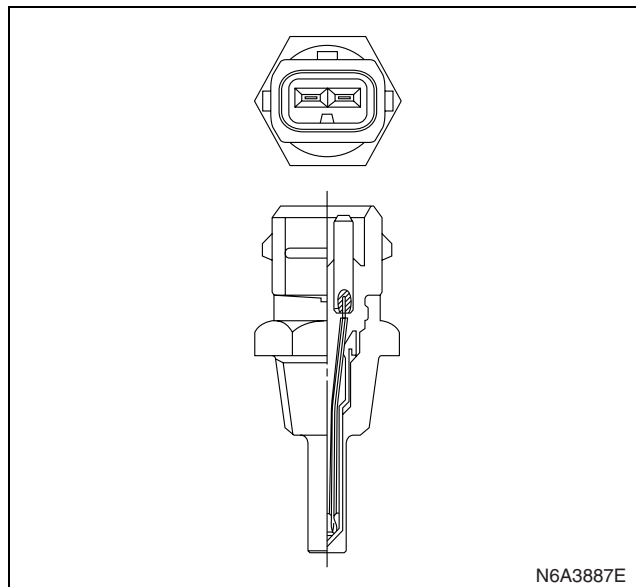
The crankshaft position (CKP) sensor is located on top of the flywheel housing. There are 4 slits spaced 90° on the flywheel circumference. The CKP sensor is a magnetic coil type sensor, which generates an AC signal voltage based on the crankshaft rotational speed. The ECM monitors both the CKP sensor and injection pump camshaft position (CMP) sensor signals to ensure they correlate with each other.

The following waveform aids to diagnose when there is an oscilloscope or equivalent.

- Amplitudes of CKP sensor signal (CH1) increase as engine speed increases.
- Each waveform cycle shorten as the engine speed increases.



Engine Coolant Temperature (ECT) Sensor

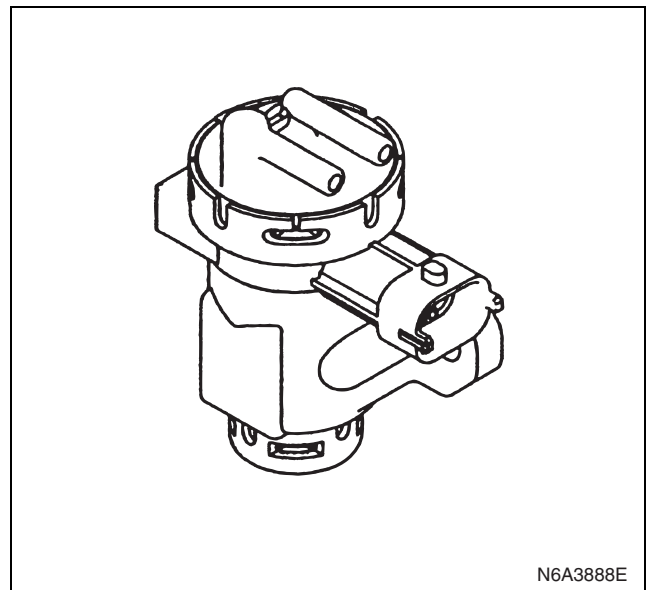


Legend

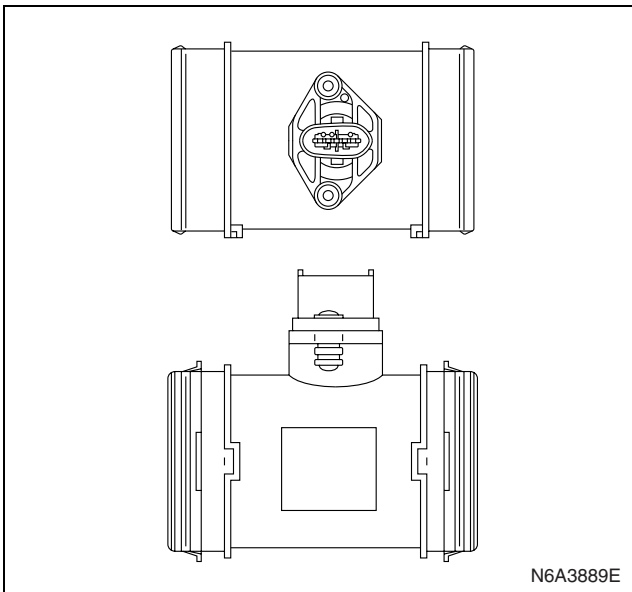
1. Engine Coolant Temperature (ECT) Sensor

The engine coolant temperature (ECT) sensor is installed to the thermostat housing. The ECT sensor is a variable resistor. The ECT sensor measures the temperature of the engine coolant. The engine control module (ECM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT sensor is cold, the sensor resistance is high. When the engine coolant temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the ECT signal circuit.

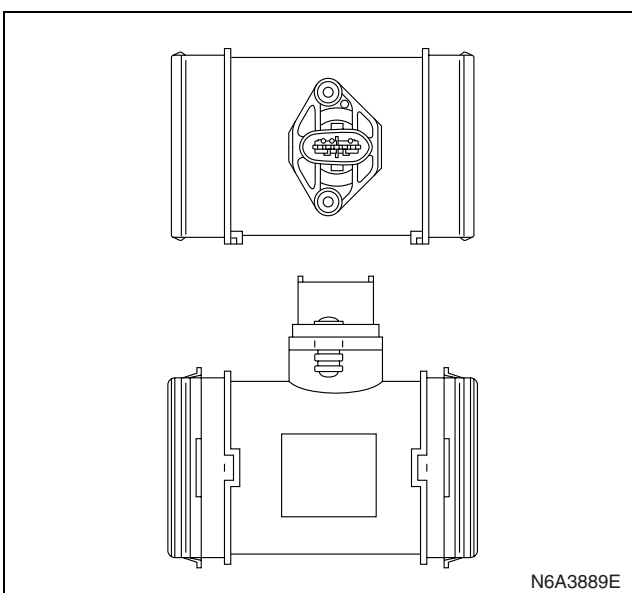
Exhaust Gas Recirculation (EGR) Solenoid Valve



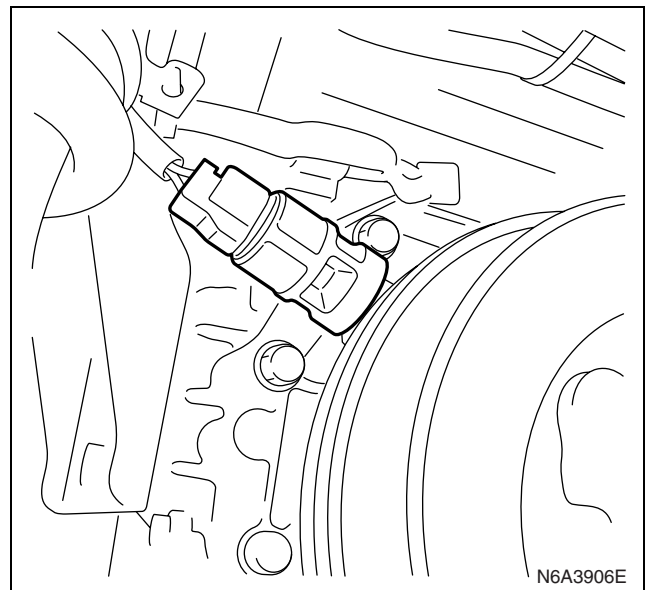
The engine control module (ECM) controls the exhaust gas recirculation (EGR) flow amount based on the engine speed, engine coolant temperature, intake air temperature, barometric pressure and fuel injection quantity. The ECM controls the EGR valve by controlling the EGR solenoid valve. The mass air flow (MAF) sensor monitors EGR gas flow amount. An expected MAF amount should be detected while the engine running.

Intake Air Temperature (IAT) Sensor

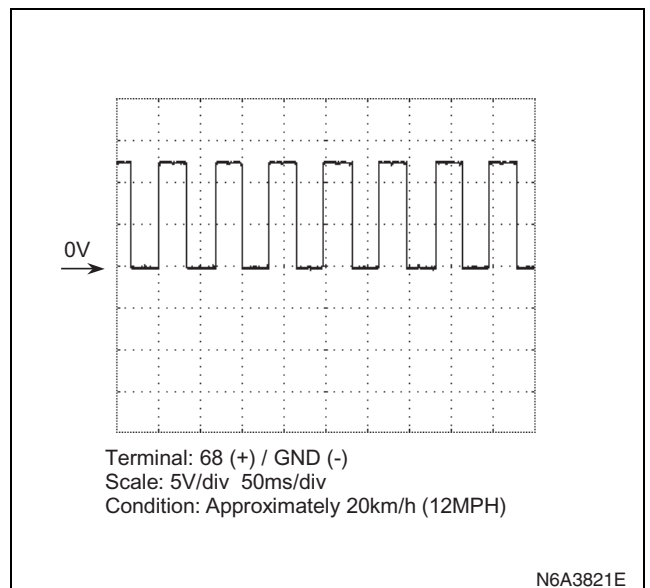
The intake air temperature (IAT) sensor is fitted between the air cleaner and turbocharger internal to the mass air flow (MAF) sensor. The IAT sensor is a variable resistor. The IAT sensor measures the temperature of the air entering the engine. The engine control module (ECM) supplies 5 volts to the IAT signal circuit and a ground for the IAT low reference circuit. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the IAT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the IAT signal circuit.

Mass Air Flow (MAF) Sensor

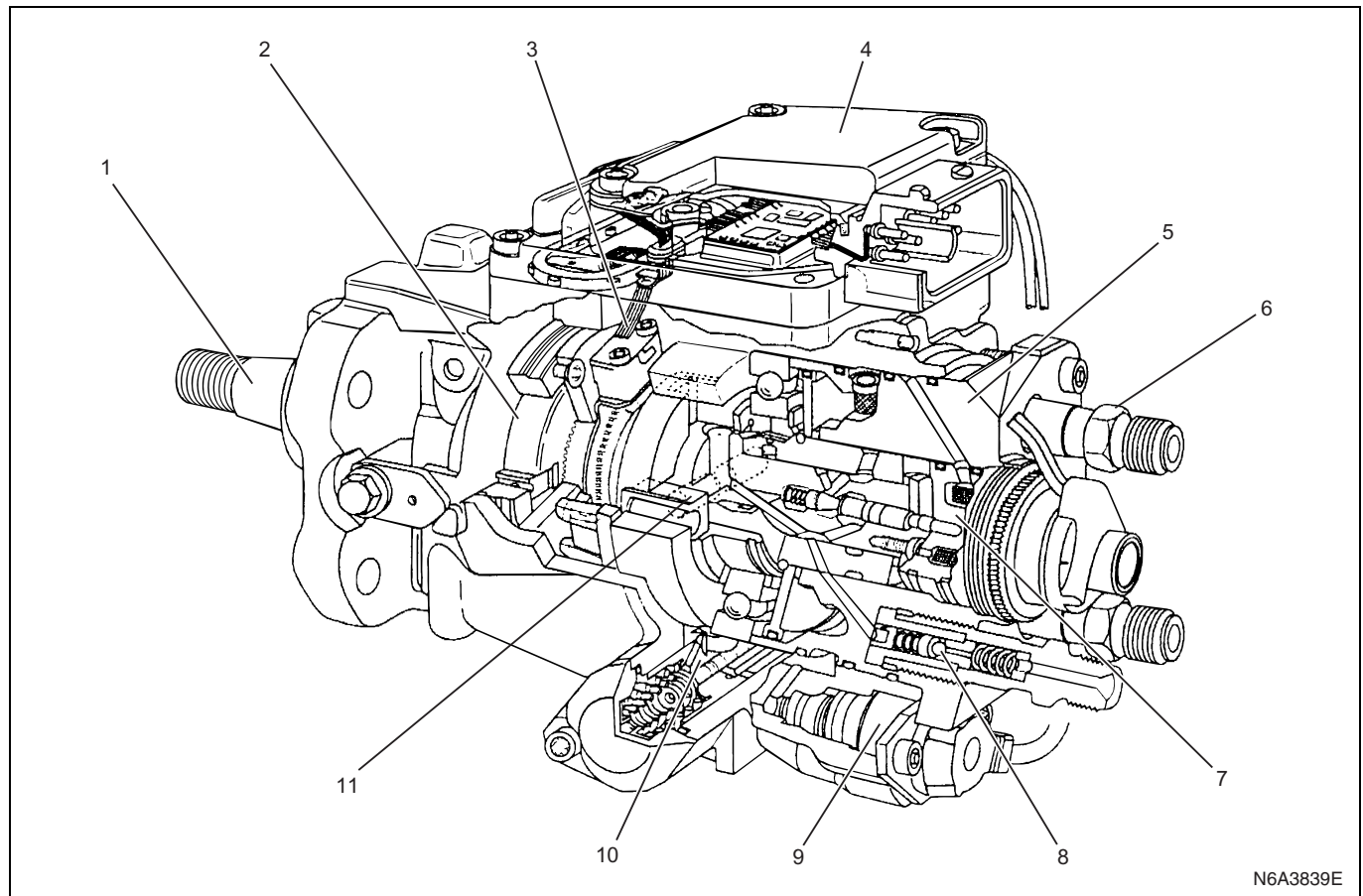
The mass air flow (MAF) sensor is an air flow meter that measures the amount of air that enters the engine. It is fitted between the air cleaner and turbocharger. A small quantity of air that enters the engine indicates deceleration or idle. A large quantity of air that enters the engine indicates acceleration or a high load condition. The MAF sensor assembly consists of a MAF sensor element and an intake air temperature sensor that are both exposed to the air flow to be measured. The MAF sensor element measures the partial air mass through a measurement duct on the sensor housing.

Vehicle Speed Sensor (VSS)

The vehicle speed sensor (VSS) is used by the engine control module (ECM) and speedometer, which generates a speed signal from the transmission output shaft. The VSS uses a hall effect element. It interacts with the magnetic field created by the rotating magnet and outputs square wave pulse signal. The ECM calculates the vehicle speed by the VSS.



Fuel Injection System Description



N6A3839E

Legend

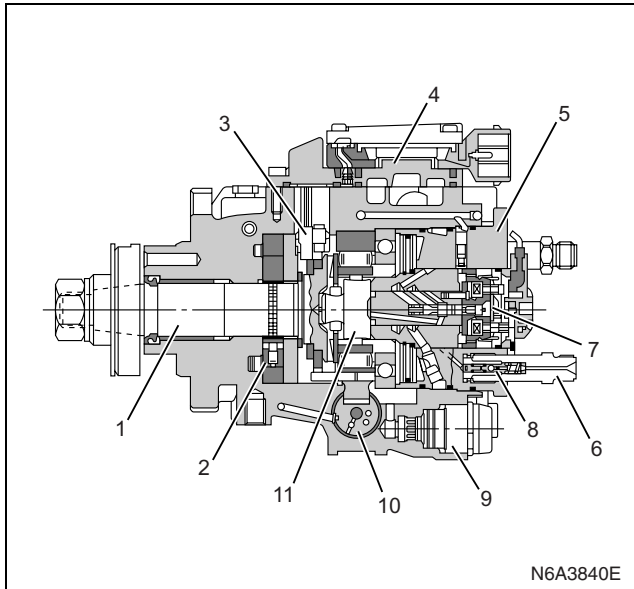
- | | |
|---|----------------------------------|
| 1. Drive Shaft | 7. Fuel Injection Solenoid Valve |
| 2. Fuel Feed Pump | 8. Constant Pressure Valve (CPV) |
| 3. Pump Camshaft Position (CMP) Sensor | 9. Timing Control Valve (TCV) |
| 4. Fuel Injection Pump Control Unit (PCU) | 10. Timer |
| 5. Distributor Head | 11. Radial Plunger |
| 6. Constant Pressure Valve (CPV) Holder | |

Bosch VP44 Fuel Injection Pump

Instead of the previous face cam type, the radial plunger distributor type injection pump utilizes a cam ring to enable fuel injection at high-pressures, making it suitable for small, high-speed direct injection diesel engines. This pump was developed to provide the most suitable fuel injection quantity and injection timing to satisfy the demand for engine reliability, driveability, low smoke, low noise, high output and low exhaust emissions.

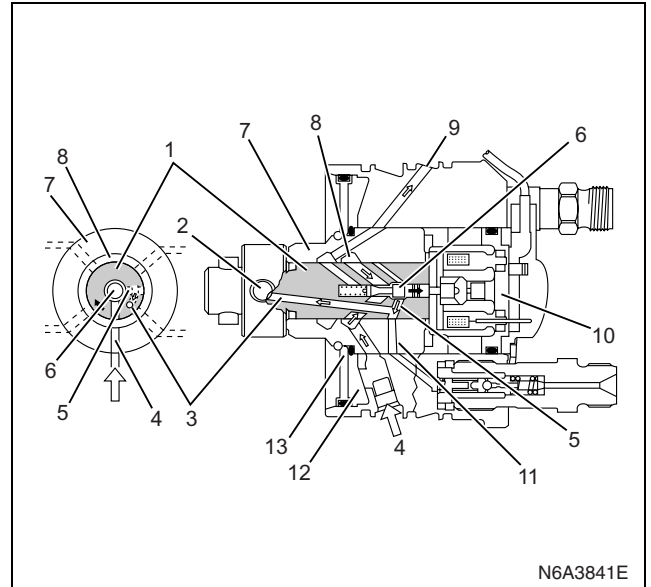
The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.

The timing device changes the optimum injection timing against various engine conditions. The pressure of the fuel fed from the feed pump is adjusted and it acts to the timing plunger by TCV controlled fuel pressure. (The TCV is installed to the fuel injection pump rear side and it is controlled by duty ratio cycle from the PCU.) The timing plunger is connected to the cam ring by a ball pin. Axial movement of the timing plunger is transferred to the cam ring in the form of rotational movement.



Legend

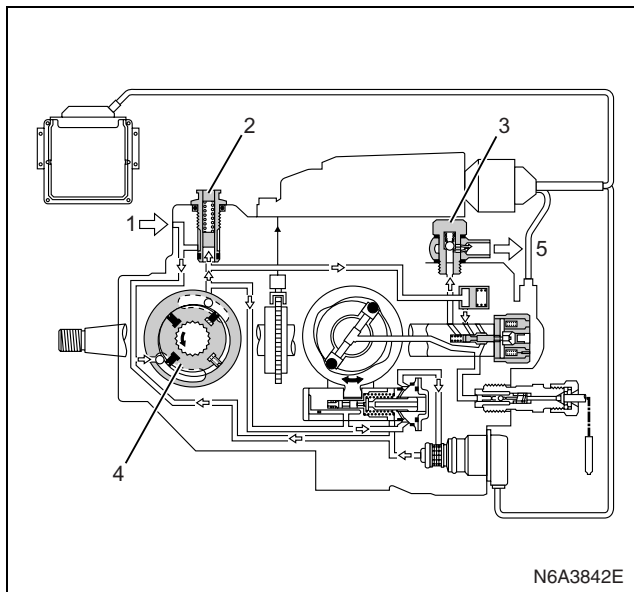
1. Drive Shaft
2. Feed Pump
3. Pump Camshaft Position (CMP) Sensor
4. Fuel Injection Pump Control Unit (PCU)
5. Distributor Head
6. Constant Pressure Valve (CPV) Holder
7. Fuel Injection Solenoid Valve
8. Constant Pressure Valve (CPV)
9. Timing Control Valve (TCV)
10. Timer
11. Radial Plunger



Legend

1. Rotor Shaft
2. Radial Plunger
3. High Pressure Passage
4. Low Pressure Inlet
5. Distribution Slit
6. Valve Needle
7. Barrel
8. Annular Passage
9. Fuel Return
10. Fuel Injection Solenoid Valve
11. High Pressure Outlet
12. Diaphragm Chamber
13. Accumulator Diaphragm

Low Pressure Fuel Circuit Description

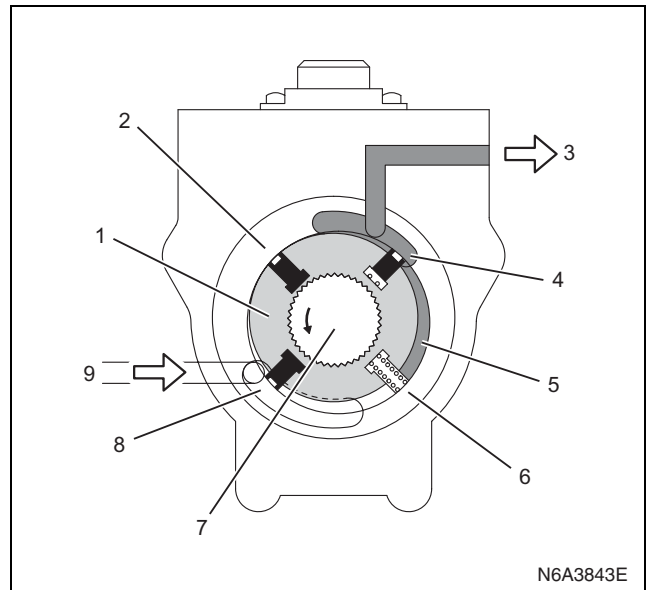


Legend

1. Fuel Suction
2. Regulating Valve
3. Overflow Valve
4. Feed Pump
5. To Fuel Tank

The low pressure fuel circuit must supply sufficient fuel to the high pressure fuel circuit. The main components are the feed pump, the regulating valve and the overflow valve.

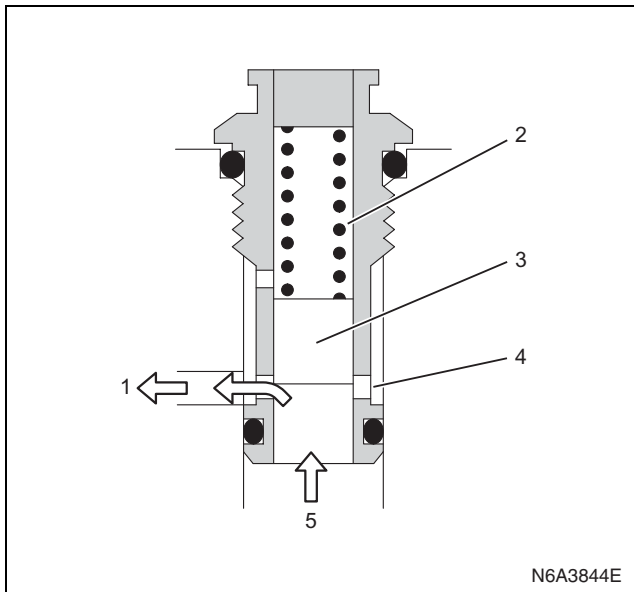
Feed Pump



Legend

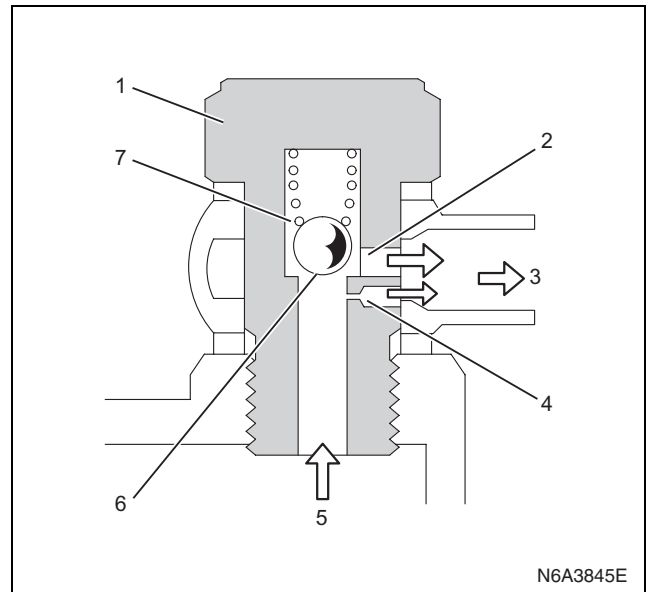
1. Rotor
2. Casing Ring
3. Fuel Supply
4. Outlet
5. Chamber
6. Vane
7. Driveshaft
8. Inlet
9. Fuel Suction

The feed pump is driven by the drive shaft, performs suction and supply of fuel. The vanes assembled in the rotor are pressed against the inside of the casing ring by spring forces and centrifugal force during rotation to form chambers. When the vanes rotate, the volume of these chambers increase when they reach recesses the casing ring connected to the inlet port. Pressure then decreases and fuel is drawn in. When the chambers have passed the inlets and recesses, the volume decreases and the fuel is compressed. Fuel pressure increases until the chamber reaches the outlet, where the fuel passes through the regulating valve to the high pressure fuel circuit.

Regulating Valve**Legend**

1. To Inlet
2. Spring
3. Valve Piston
4. Port
5. From Outlet

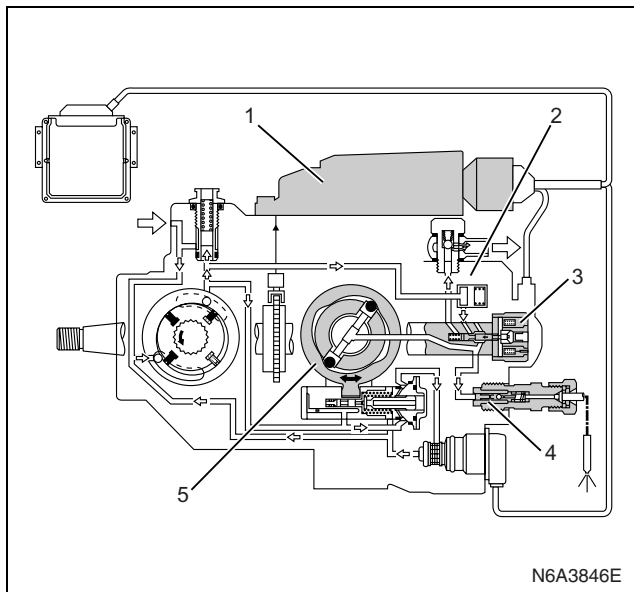
When feed pump speed increases so that the delivery pressure of the fuel delivered from the outlet exceeds the regulating valve spring force, the plunger is pushed upwards. Excess fuel passes through the ports and returns to the inlet side, and the delivery pressure is maintained within a specified range. When feed pump speed decreases so that the delivery pressure decreases, the plunger is pushed downwards by spring force to close the port.

Overflow Valve**Legend**

1. Valve Holder
2. Port
3. To Fuel Tank
4. Orifice Port
5. From Fuel Tank
6. Ball Valve
7. Spring

When the pressure of the fuel, returned from the distributor head, exceeds the spring force, the overflow valve's ball valve is pushed up. Excess fuel presses through the port and returns to the tank, and fuel pressure inside the pump chamber does not exceed a specified pressure. The flow of excess fuel serves cooling and automatic bleeding of the fuel pump during operation. Also the orifice port is installed to assist in automatic air bleeding.

High Pressure Fuel Circuit Description



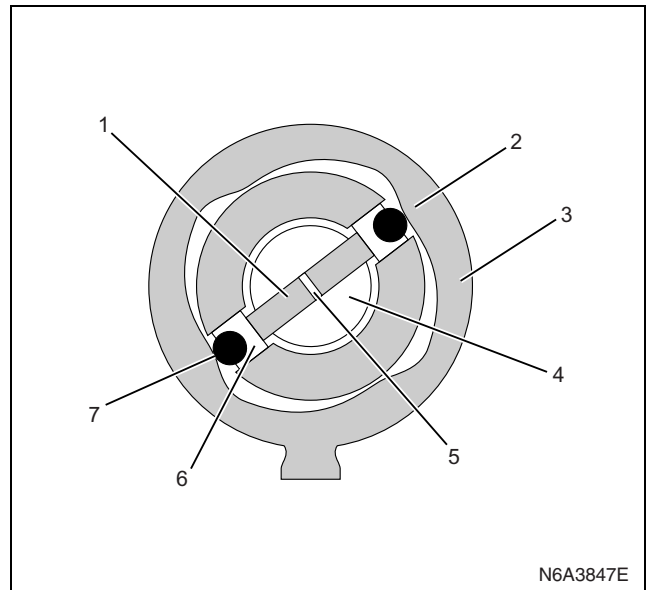
Legend

1. Fuel Injection Pump Control Unit (PCU)
2. Distributor Head
3. Fuel Injection Solenoid Valve
4. Constant Pressure Valve (CPV)
5. Radial Plunger

In addition high pressure generating device, the high pressure circuit also consists of fuel piping, and devices to set the beginning of injection and fuel injection quantity. The main components are as follows:

- High pressure generation: Radial Plunger
- Fuel distribution: Distributor Head
- Beginning of injection timing: Timing Device
- Prevention of secondary injection: Constant Pressure Valve (CPV)

Radial Plunger

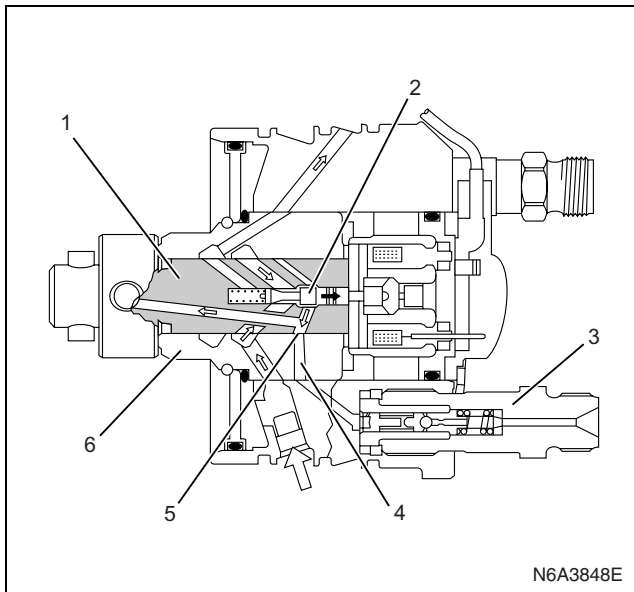


Legend

1. Radial Plunger
2. Internal Cam
3. Cam Ring
4. Rotor Shaft
5. Plunger Chamber
6. Roller Shoe
7. Roller

While the radial plungers assembled to the rotor shaft rotate, they are held against the inside of the cam ring (via the roller shoes and rollers) by fuel delivery pressure from the feed pump and centrifugal force. The radial plungers perform rotational movement as well as internal cam induced reciprocating movement to suck in and compress the fuel in the plunger chamber.

Distributor Head

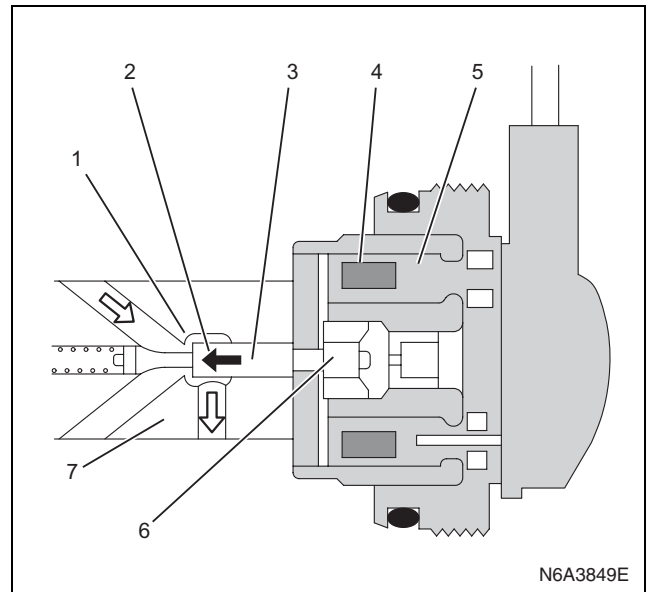


Legend

1. Rotor Shaft
2. Valve Needle
3. Constant Pressure Valve (CPV) Holder
4. High Pressure Outlet
5. Distributor Shaft
6. Barrel

The distributor head distribute the high pressure fuel that has flowed through the rotating rotor shaft's distributor slits and the barrel's high pressure outlets (4 cylinders) to the engine cylinders via the constant pressure valve (CPV) and the nozzle holder assemblies. The fuel injection solenoid valve needle changes the passage to the radial plunger high pressure pump between fuel suction and fuel compression.

Fuel Injection Solenoid Valve

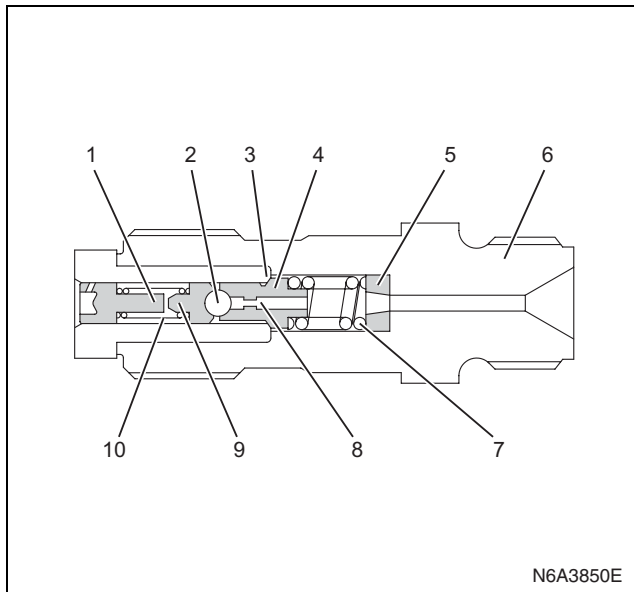


Legend

1. Valve Seat
2. Valve Closing Direction
3. Valve Needle
4. Coil
5. Magnet
6. Magnet Anchor
7. Rotor Shaft

The fuel injection solenoid valve consists of a valve seat, a valve needle, and a magnet anchor (a movable iron core), a coil and a magnet. The valve needle rotates together with the rotor shaft. When current controlled by the fuel injection pump control unit (PCU) flows to the coil, the magnet anchor and the valve needle are pushed towards the valve seat. When the valve seat is completely closed by the valve needle, the fuel in the high pressure passage is isolated from the low pressure passage, is compressed by the radial plunger high pressure pump, and injected into the engine cylinder through the nozzle holder assembly. When the required injection quantity is reached, the current to the coil is cut, the valve seat opens and injection of fuel is completed.

Constant Pressure Valve (CPV)

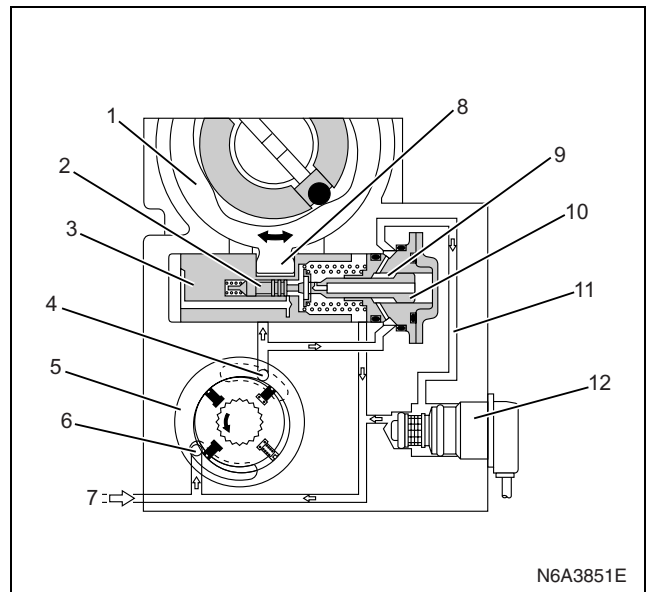


Legend

1. Plug
2. Ball
3. Seat
4. Valve
5. Spacer
6. Holder
7. Valve Spring
8. Orifice
9. Ball Support
10. Spring

The constant pressure valve (CPV) consists of a holder, a spacer, a valve spring, a valve, a seat, a ball, a ball support, a spring and a plug. The valve is equipped with an orifice to suppress the reflected pressure wave (the cause of secondary injection) caused by nozzle closing at the end of the injection and maintains a stable pressure in the injection pipe (residual pressure) to ensure stabilized injection timing for subsequent injection. The valve is opened by pressurized fuel and this high pressure fuel is delivered to the nozzle holder assembly.

Timing Control Device Description

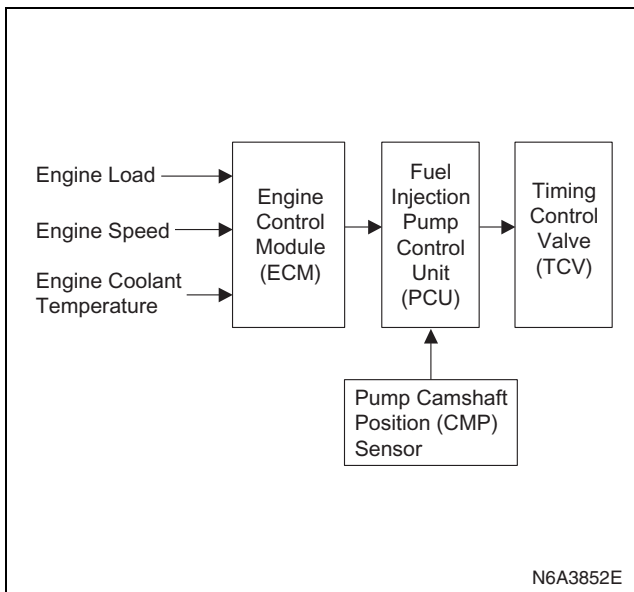


Legend

1. Cam Ring
2. Servo Valve
3. Timer Piston
4. Outlet
5. Feed Pump
6. Inlet
7. Fuel Suction
8. Ball Pin
9. Annular Chamber
10. Hydraulic Stopper
11. Return Passage
12. Timing Control Valve (TCV)

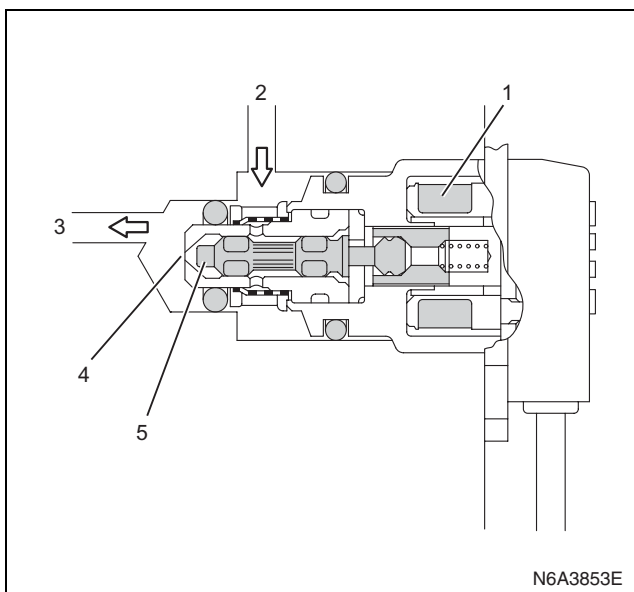
The timing device determines the optimum injection timing against variations in engine speed. The pressure of the fuel fed from the feed pump is adjusted in accordance with speed by the regulating valve. This delivery pressure acts on the hydraulic stopper's annular chamber as control pressure. The chamber pressure of the annular chamber is controlled by the timing control valve (TCV). The timing plunger is connected to the cam ring by a ball pin. Axial movement of the timing plunger is transferred to the cam ring in the form of rotational movement. Movement to the right of the timing plunger (to the spring side) advances injection timing. The main components are timing plunger, the TCV and pump camshaft position (CMP) sensor.

Beginning of Injection Staring



The engine control module (ECM) contains characteristic maps of the beginning of injection, corresponding to engine operating conditions (engine load, engine speed and engine coolant temperature). The fuel injection pump control unit (PCU) is constantly comparing the set beginning of injection timing and the actual beginning of injection timing. If there is a difference, the timing control valve (TCV) is controlled by the duty ratio. (The actual beginning of injection timing is determined from the pump camshaft position (CMP) sensor.)

Timing Control Valve



Legend

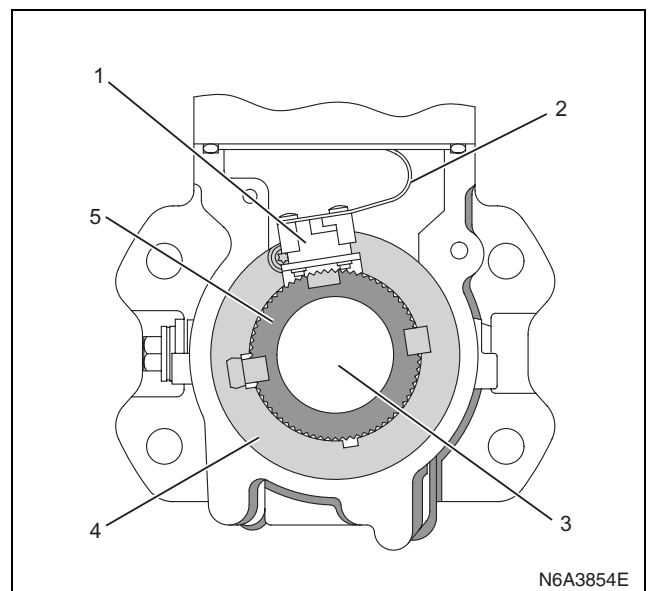
1. Coil
2. From Annular Chamber
3. To Feed Pump
4. Orifice
5. Valve Needle

The timing control valve (TCV) acts as a variable throttle, using the rapid opening and closing (cycling) of the valve needle in the TCV. At normal operation, the TCV controls the pressure acting on the annular chamber so that the hydraulic stopper cam move to any position, from the retard position to the advance position. At this time, the duty ratio is set by the fuel injection pump control unit (PCU).

When control current flows to the TCV coil, the valve needle opens and the fuel annular chamber flows through the orifice to the feed pump inlet. Consequently, the pressure of the annular chamber decreases and the hydraulic stopper is moved to the retard side.

When control current to the TCV coil is cut, the valve needle closes and the return passage is closed. Consequently, the pressure of the annular chamber increases and the hydraulic stopper is moved to the advance side.

Pump Camshaft Position (CMP) Sensor



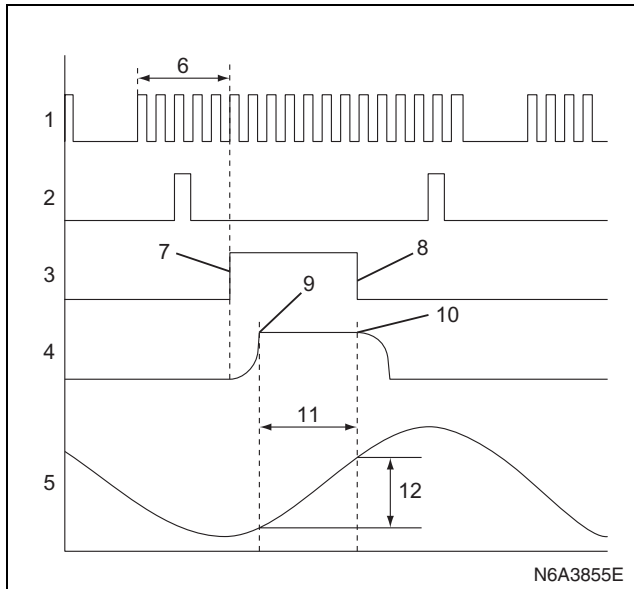
Legend

1. Pump Camshaft Position (CMP) Sensor
2. Flexible Connecting Harness
3. Drive Shaft
4. Pump Camshaft Position (CMP) Sensor Retaining Ring
5. Sensor Wheel

When the drive shaft rotates, the pump camshaft position (CMP) sensor receives signal from the sensor wheel, and an electric pulse is sent through the flexible connecting harness to the fuel injection pump control unit (PCU). From these signals the PCU can determine the average pump speed and the momentary pump speed. The pump CMP sensor is mounted to the cam ring. Thus, the relationship between the cam ring and the pump CMP sensor signal is constant. The pump CMP sensor signal is utilized for the following purposes:

6E-262 Engine Control System (4JH1)

- To determine the momentary angular position of the cam ring.
- To calculate the actual speed of the fuel injection pump.
- To determine the actual timing plunger position.

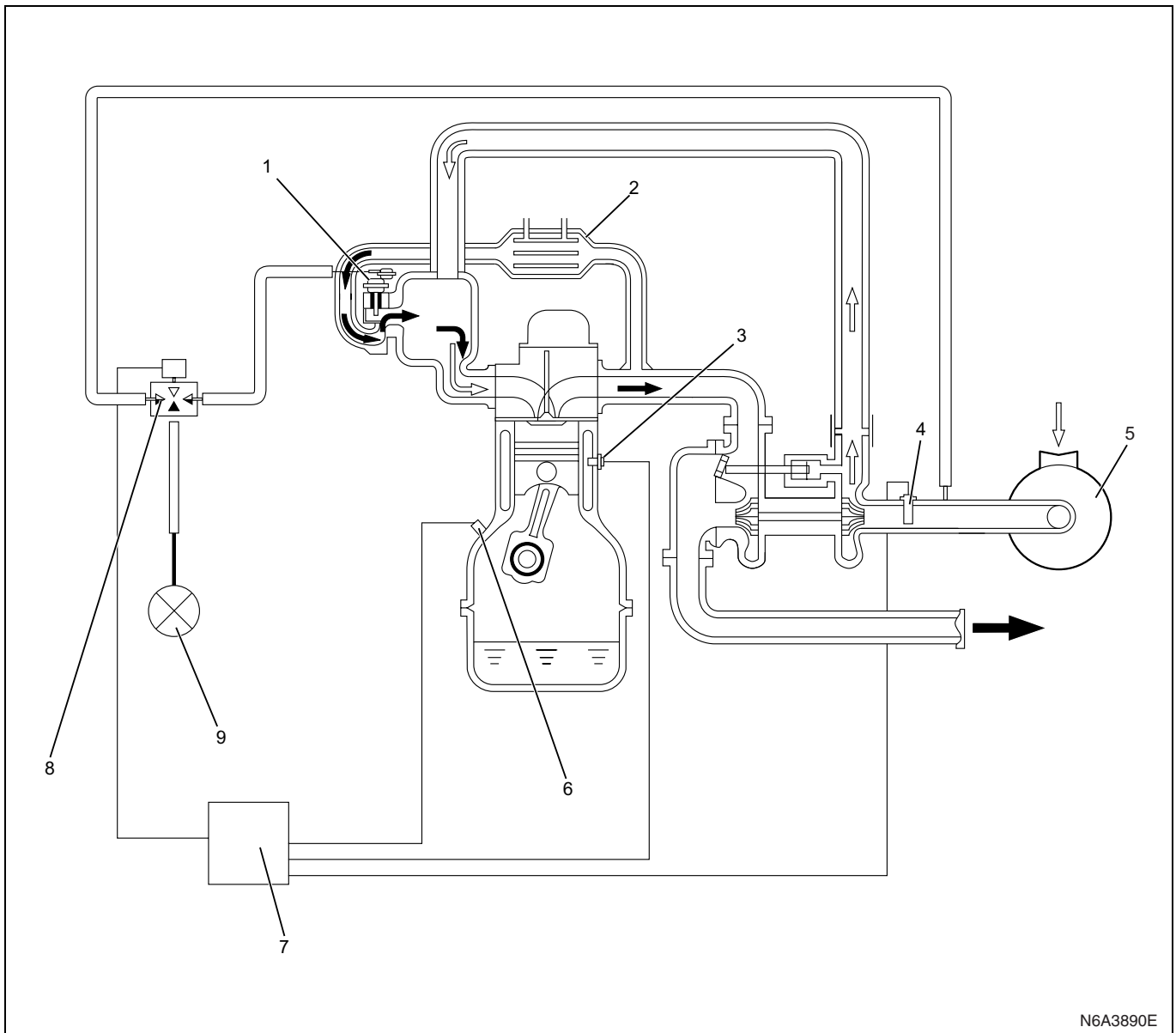


Legend

1. Pump Camshaft Position (CMP) Sensor Signal
2. Crankshaft Position (CKP) Sensor Signal
3. Fuel Injection Solenoid Valve Control Pulse
4. Fuel Injection Solenoid Needle Valve Lift
5. Cam Lift (Cam Profile)
6. Pulse Count
7. Fuel Injection Solenoid Valve Close
8. Fuel Injection Solenoid Valve Open
9. Start of Pressure Delivery
10. End of Pressure Delivery
11. Pressure Delivery Angle
12. Effective Stroke

- **Momentary Cam Ring Angular Position**
The momentary angular position of the cam ring is input into the fuel injection PCU as a fuel injection solenoid valve control signal. From momentary input of angular position for fluctuations in running conditions, the fuel injection solenoid valve open and close intervals corresponding to the cam ring's cam lift can be accurately determined.
- **Actual Injection Pump Speed**
When the crankshaft speed (CKP) sensor is faulty, the engine control module (ECM) uses the pump CMP signal as a replacement signal.
- **Actual Timing Plunger Position**
The actual timing plunger position can be determined by comparing the CKP sensor signal with the pump CMP sensor angle. This position is used for timer control.

Exhaust Gas Recirculation (EGR) System Description



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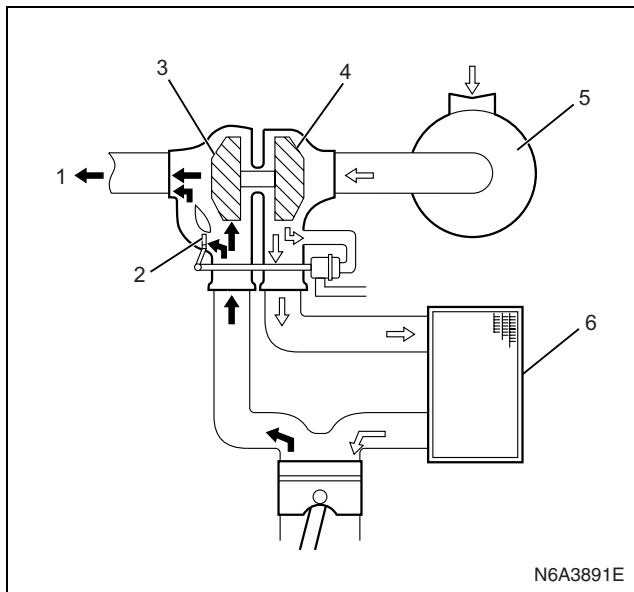
Legend

- | | |
|---------------------|-----------------------|
| 1. EGR Valve | 6. CKP Sensor |
| 2. EGR Cooler | 7. ECM |
| 3. ECT Sensor | 8. EGR Solenoid Valve |
| 4. MAF & IAT Sensor | 9. Vacuum Pump |
| 5. Air Cleaner | |

The EGR system recirculates a part of exhaust gas back into the intake manifold, which results in reducing nitrogen oxide (NOx) emissions. The EGR control system uses an electronic control system solenoid valve and vacuum control EGR valve to ensure both driveability and low emission. The engine control module (ECM) controls the EGR flow amount based on the engine speed, engine coolant temperature, intake air temperature, barometric pressure and fuel injection quantity. The ECM controls the EGR valve opening by controlling the EGR solenoid valve drive duty. The mass air flow (MAF) sensor monitors EGR gas flow

amount. An expected MAF amount should be detected while the engine running.

Turbocharger Description



Legend

1. Exhaust Gas
2. Waste Gate Valve
3. Turbine Wheel
4. Compressor Wheel
5. Air Cleaner
6. Charge Air Cooler (Intercooler)

The turbocharger is used to increase the amount of air that enters the engine cylinders. This allows a proportional increase of fuel to be injected into the cylinders, resulting in increased power output, more complete combustion of fuel, and increased cooling of the cylinder heads, pistons, valves, and exhaust gas. This cooling effect helps extend engine life.

Heat energy and pressures in the engine exhaust gas are utilized to drive the turbine. Exhaust gas is directed to the turbine housing. The turbine housing acts as a nozzle to direct the shaft wheel assembly. Since the compressor wheel is attached directly to the shaft, the compressor wheel rotates at the same speed as the turbine wheel. Clean air from the air cleaner is drawn into the compressor housing and wheel. The air is compressed and delivered through a crossover pipe to the engine air intake manifold, then into the cylinders. The amount of air pressure rise and air volume delivered to the engine from the compressor outlet is regulated by a waste gate valve in the exhaust housing. The position of the waste gate valve is controlled by the amount of pressure built up on the intake side of the turbocharger. The diaphragm on the inside of the waste gate is pressure sensitive, and controls the position of the valve inside the turbocharger. The position of the valve will increase or decrease the amount of boost to the turbocharger.

The charge air cooler also helps the performance of the diesel. Intake air is drawn through the air cleaner and into the turbocharger compressor housing. Pressurized air from the turbocharger then flows forward through the charge air cooler located in the front of the radiator.

From the charge air cooler, the air flows back into the intake manifold.

The charge air cooler is a heat exchanger that uses air flow to dissipate heat from the intake air. As the turbocharger increases air pressure, the air temperature increases. Lowering the intake air temperature increases the engine efficiency and power by packing more air molecules into the same space.

Special Tools and Equipment

Special Tools and Equipment

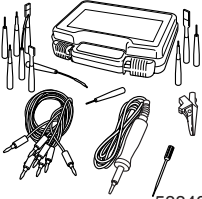
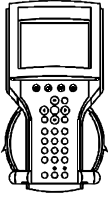
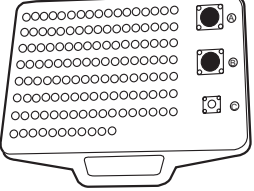
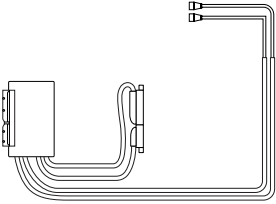
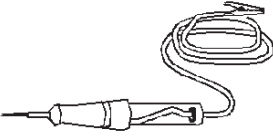
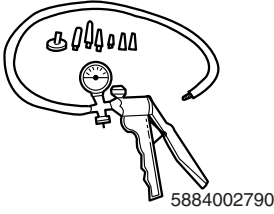
Illustration	Tool Number / Description
 5884028350	5-8840-2835-0 (J-35616-A) Connector Test Adapter Kit (With Test Lamp)
 5884002850	5-8840-0285-0 (J-39200) Digital Multimeter
 7000081	Tech 2 Kit
	Breaker Box
	Adapter Harness
 5884006070	5-8840-0607-0 (J-34142-B) Test Lamp

Illustration	Tool Number / Description
 5884002790	5-8840-0279-0 (J-23738-A) Vacuum Pump