ISUZU

2008MY N SERIES

WORKSHOP MANUAL

ENGINE CONTROL SYSTEM

(4HK1 model)

This Workshop Manual deals only with the screen toned section(s) in the table below.

Section		Sub Section	
0	GENERAL INFORMATION	0A	General Information
1	ENGINE	1A	Engine Control System
		1B	Engine Mechanical
		1C	Engine Cooling
		1D	Engine Fuel
		1E	Engine Electrical
		1F	Emission Control
		1G	Engine Exhaust
		1H	Engine Lubrication
		1I	Engine Speed Control System
		1J	Induction
		1K	Pre-Heating System
2	SUSPENSION	2B	Front Suspension
		2C	Rear Suspension
		2D	Wheel and Tire System
3	DRIVELINE/AXLE	3A1	Front Differential
		3A2	Rear Differential
		3C1	Propeller Shaft
		3C2	Front Axle
		3C3	Rear Axle
		3D1	Transfer Case (Part Time)
4	BRAKES	4B	Brake
		4C1	Anti-Lock Brake (ABS)/Anti-Slip Regulator (ASR)
		4D	Parking Brake
		4E	Hill Start Aid (HSA)
5	TRANSMISSION/TRANSAXLE	5A	Transmission Control System
		5B	Automatic Transmission
		5C	Manual Transmission
		5E	Clutch
		5G1	Side Power Take-Off
6	STEERING	6B	Power Steering
7	HVAC	7A	Heating and Ventilation
		7B	Manual Air Conditioning
		7C	Automatic Air Conditioning
8	RESTRAINTS	8A	Seat Belt
		8B	Supplemental Restraint System (SRS)
		8C	SRS Control System
9	BODY, CAB AND ACCESSORIES	9A	Lighting System
		9B	Wiper/Washer System
		9C	Entertainment
		9D	Wiring System
		9E	Instrumentation/Driver Info.
		9F	Body Structure
		9G	Cab
		9H	Seats
		9I	Security and Lock
		9K	Exterior/Interior Trim
		9L	Cab Mounting
10	CONTROL SYSTEMS	10B	Vehicle Control
11	FRAME	11A	Frame

ENGINE

Engine Control System

(4HK1)

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Specifications

Temperature vs Resistance

Engine Coolant Temperature vs. Resistance

°C	°F	Ohms
Temperature vs. Resistance Value (Approximately)		
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 (Euro 4 Specification)

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

Intake Air Temperature vs. Resistance (Except Euro 4 Specification)

°C	°F	Ohms
Temperature vs. Resistance Value (Approximately)		
90	194	240
80	176	320
70	158	450
60	140	660
50	122	960
40	104	1440
30	86	2300
20	68	3430
10	50	5410
0	32	9770
-10	14	16410
-20	-4	28560

Fuel Temperature vs. Resistance

°C	°F	Ohms
Temperature vs. Resistance Value (Approximately)		
110	230	140
100	212	180
90	194	240
80	176	310
70	158	420
60	140	580
50	122	810
40	104	1150
30	86	1660
20	68	2450
10	50	3700
0	32	5740
-10	14	9160
-20	-4	15000
-30	-22	25400

Exhaust Temperature vs. Resistance

°C	°F	Ohms
Temperature vs. Resistance Value (Approximately)		
1000	1832	115 - 127
950	1742	130 - 143
900	1652	147 - 163
850	1562	167 - 187
800	1472	192 - 219
750	1382	226 - 258
700	1292	267 - 309
650	1202	333 - 360
600	1112	406 - 442
550	1022	504 - 552
500	932	640 - 709
450	842	835 - 937
400	752	1130 - 1280
350	662	1590 - 1850
300	572	2360 - 2830
200	392	6230 - 7830
150	302	11900 - 16300
100	212	27600 - 41200
50	122	82000 - 137000

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	87-95
610	2000	90-98
305	1000	94-102
0	0 Sea Level	96-104
-305	-1000	101-105

Diagnostic Trouble Code (DTC) Type Definitions

Emission Related DTC

Action Taken When the DTC Sets - Type A

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The ECM stores this information in the Freeze Frame/ Failure Records. (Euro 4 specification)

Action Taken When the DTC Sets - Type B

- The ECM illuminates the MIL on the second consecutive driving cycle when the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the ECM stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive driving cycle, the ECM records the operating conditions at the time of failure and stores this information in the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC - Type A or Type B

- The ECM turns OFF the MIL after 3 consecutive driving cycles when the diagnostic runs and does not fail. (Euro 4 specification)
- The ECM turns OFF the MIL after 1 ignition cycle when the diagnostic runs and does not fail. (Except Euro 4 specification)
- A current DTC clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported. (Euro 4 specification)
- A history DTC clears after 20 consecutive driving cycles, if no failures are reported. (Except Euro 4 specification)
- Use a scan tool to clear the MIL and the DTC.

Non-Emissions Related DTCs

Action Taken When the DTC Sets - Type C

- The ECM illuminates the Service Vehicle Soon (SVS) lamp when the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The ECM stores this information in the Failure Records.

Conditions for Clearing the SVS Lamp/DTC - Type C

- The ECM turns OFF the SVS lamp after 1 driving cycle when the diagnostic runs and does not fail.
- A current DTC clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported.
- Use a scan tool to clear the SVS lamp and the DTC.

Action Taken When the DTC Sets - Type D

- The ECM will not illuminate the MIL or SVS lamp.
- The ECM records the operating conditions at the time the diagnostic fails. The ECM stores this information in the Failure Records. (Euro 4 specification)

Conditions for Clearing the DTC - Type D

- A current DTC clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported. (Euro 4 specification)
- A history DTC clears after 20 consecutive driving cycles, if no failures are reported. (Except Euro 4 specification)
- Use a scan tool to clear the DTC.

Diagnostic Trouble Code (DTC) List

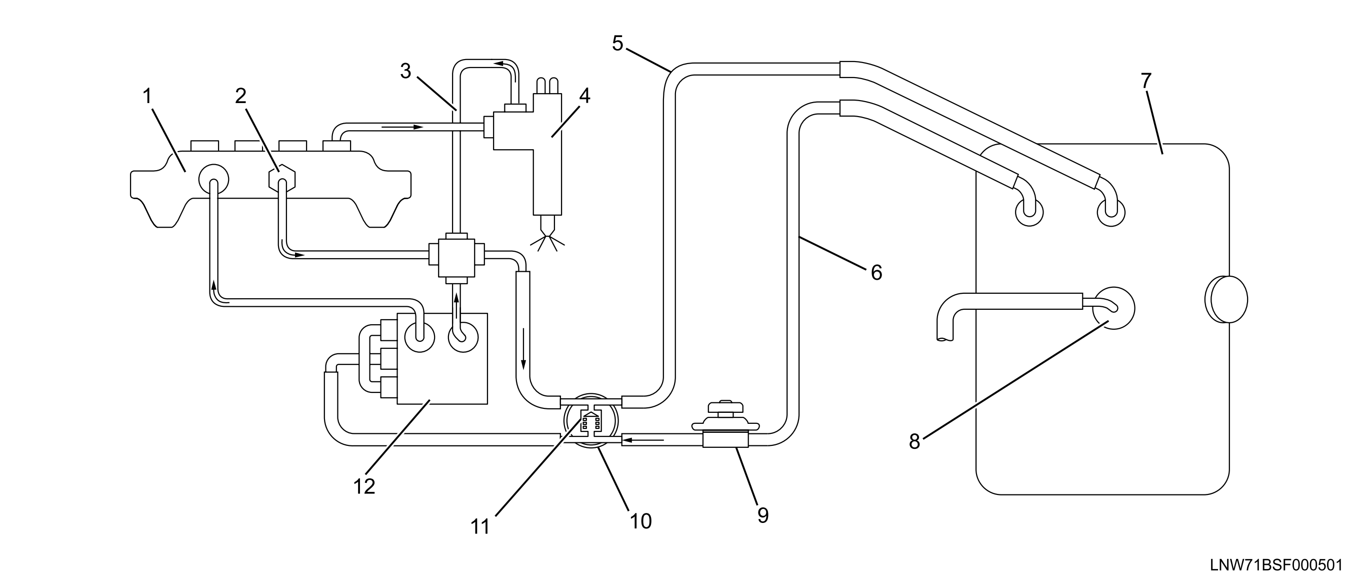
DTC	Flash Code	DTC Type			DTC Descriptor
		Euro 4 Specification	Euro 3 Specification	Euro 2 Specification	
P0016	16	A	A	A	Crankshaft Position - Camshaft Position Correlation
P0045	33	A	–	–	Turbocharger Boost Control Solenoid Circuit
P0079	38	A	–	–	Exhaust Valve Control Solenoid Circuit Low
P0080	38	A	–	–	Exhaust Valve Control Solenoid Circuit High
P0087	225	A	A	A	Fuel Rail/ System Pressure Too Low
P0088	118	D	A	A	Fuel Rail/ System Pressure Too High (First Stage)
P0088	118	A	A	A	Fuel Rail/ System Pressure Too High (Second Stage)
P0089	151	A	A	A	Fuel Pressure Regulator Performance
P0091	247	A	A	A	Fuel Pressure Regulator Control Circuit Low
P0092	247	A	A	A	Fuel Pressure Regulator Control Circuit High
P0093	227	A	A	A	Fuel System Leak Detected
P0101	92	B	–	–	Mass Air Flow Sensor Circuit Range/ Performance
P0102	91	A	–	–	Mass Air Flow Sensor Circuit Low Input
P0103	91	A	–	–	Mass Air Flow Sensor Circuit High Input
P0107	32	A	A	A	Manifold Absolute Pressure Sensor Circuit Low Input
P0108	32	A	A	A	Manifold Absolute Pressure Sensor Circuit High Input
P0112	22	A	A	A	Intake Air Temperature Sensor Circuit Low
P0113	22	A	A	A	Intake Air Temperature Sensor Circuit High
P0116	23	B	–	–	Engine Coolant Temperature Sensor Circuit Range/ Performance
P0117	23	A	A	A	Engine Coolant Temperature Sensor Circuit Low
P0118	23	A	A	A	Engine Coolant Temperature Sensor Circuit High
P0122	43	A	A	A	Throttle Position Sensor Circuit Low
P0123	43	A	A	A	Throttle Position Sensor Circuit High
P0182	211	A	A	A	Fuel Temperature Sensor Circuit Low
P0183	211	A	A	A	Fuel Temperature Sensor Circuit High
P0192	245	A	A	A	Fuel Rail Pressure Sensor Circuit Low
P0193	245	A	A	A	Fuel Rail Pressure Sensor Circuit High
P0201	271	A	A	A	Injector Circuit Open - Cylinder 1
P0202	272	A	A	A	Injector Circuit Open - Cylinder 2
P0203	273	A	A	A	Injector Circuit Open - Cylinder 3
P0204	274	A	A	A	Injector Circuit Open - Cylinder 4
P0217	542	D	A	A	Engine Coolant Over Temperature Condition
P0219	543	D	D	D	Engine Overspeed Condition
P0234	42	A	A	A	Turbocharger Overboost Condition
P0299	65	B	A	A	Turbocharger Underboost

DTC	Flash Code	DTC Type			DTC Descriptor
		Euro 4 Specification	Euro 3 Specification	Euro 2 Specification	
P0335	15	A	A	A	Crankshaft Position Sensor Circuit
P0336	15	A	A	A	Crankshaft Position Sensor Circuit Range/ Performance
P0340	14	A	A	A	Camshaft Position Sensor Circuit
P0341	14	A	A	A	Camshaft Position Sensor Circuit Range/ Performance
P0380	66	C	A	A	Glow Plug Circuit
P0381	67	C	A	A	Glow Plug Indicator Circuit
P0401	93	A	–	–	EGR Flow Insufficient Detected
P0404	45	A	A	–	EGR Control Circuit Range/ Performance
P0409	44	A	A	–	EGR Sensor Circuit
P0426	143	C	–	–	Catalyst Temperature Sensor Circuit Range/ Performance Sensor 1
P0427	48	A	–	–	Catalyst Temperature Sensor Circuit Low Sensor 1
P0428	48	A	–	–	Catalyst Temperature Sensor Circuit High Sensor 1
P042B	145	C	–	–	Catalyst Temperature Sensor Circuit Range/ Performance Sensor 2
P042C	49	C	–	–	Catalyst Temperature Sensor Circuit Low Sensor 2
P042D	49	C	–	–	Catalyst Temperature Sensor Circuit High Sensor 2
P0477	46	–	A	A	Exhaust Pressure Control Valve Low
P0478	46	–	A	A	Exhaust Pressure Control Valve High
P0500	25	B	A	A	Vehicle Speed Sensor
P0502	25	A	A	A	Vehicle Speed Sensor Circuit Low Input
P0503	25	A	A	A	Vehicle Speed Sensor Circuit High Input
P0560	155	A	–	–	System Voltage
P0563	35	C	A	A	System Voltage High
P0601	53	A	A	A	Internal Control Module Memory Check Sum Error
P0602	154	C	A	A	Control Module Programming Error
P0604	153	A	A	A	Internal Control Module RAM Error
P0606	51	A	A	A	ECM Processor
P060B	36	A	A	A	Internal Control Module A/D Processing Performance
P0633	176	C	–	A	Immobilizer Not Programmed
P0638	61	B	A	A	Throttle Actuator Control Range/ Performance
P0641	55	A	A	A	Sensor Reference Voltage 1 Circuit
P0650	77	A	D	D	Malfunction Indicator Lamp (MIL) Control Circuit
P0651	56	A	A	A	Sensor Reference Voltage 2 Circuit
P0685	416	C	A	A	ECM Power Relay Control Circuit Open
P0687	416	C	A	A	ECM Power Relay Control Circuit High
P0697	57	A	A	A	Sensor Reference Voltage 3 Circuit
P1093	227	A	A	A	Fuel Rail Pressure Too Low

DTC	Flash Code	DTC Type			DTC Descriptor
		Euro 4 Specification	Euro 3 Specification	Euro 2 Specification	
P1261	34	A	A	A	Injector Positive Voltage Control Circuit Group 1
P1262	34	A	A	A	Injector Positive Voltage Control Circuit Group 2
P1404	45	A	–	–	EGR Position Fault (Closed Position Error)
P1404	45	A	A	–	EGR Position Fault (Learned Position Error)
P1455	132	A	–	–	PM Over Accumulation
P1471	149	A	–	–	DPD Insufficient Regeneration
P161B	179	C	–	A	Immobilizer Wrong Response
P1621	54	A	A	A	Control Module Long Term Memory Performance
P1664	76	C	–	–	Service Vehicle Soon Lamp Control Circuit
P1669	75	C	–	–	DPD Lamp Control Circuit
P2122	121	B	A	A	Pedal Position Sensor 1 Circuit Low Input
P2123	121	B	A	A	Pedal Position Sensor 1 Circuit High Input
P2127	122	B	A	A	Pedal Position Sensor 2 Circuit Low Input
P2128	122	B	A	A	Pedal Position Sensor 2 Circuit High Input
P2138	124	B	A	A	Pedal Position Sensor 1-2 Voltage Correlation
P2146	158	A	A	A	Fuel Injector Group 1 Supply Voltage Circuit
P2149	159	A	A	A	Fuel Injector Group 2 Supply Voltage Circuit
P2227	71	B	–	–	Barometric Pressure Sensor Circuit Range/ Performance
P2228	71	A	A	A	Barometric Pressure Sensor Circuit Low
P2229	71	A	A	A	Barometric Pressure Sensor Circuit High
P242F	131	A	–	–	DPD Restriction
P2452	142	A	–	–	DPD Differential Pressure Sensor Circuit
P2453	141	A	–	–	DPD Differential Pressure Sensor Circuit Range/ Performance
P2454	47	A	–	–	DPD Differential Pressure Sensor Circuit Low
P2455	47	A	–	–	DPD Differential Pressure Sensor Circuit High
P2456	47	A	–	–	DPD Differential Pressure Sensor Learned Position
P2458	139	A	–	–	DPD Regeneration Duration
P253A	28	C	A	A	PTO Sensor Circuit
P256A	31	C	A	A	Engine Idle Speed Selector Sensor
U0073	84	B	A	A	Control Module Communication Bus Off
U0101	85	C	–	–	Lost Communication with TCM
U0110	87	A	A	A	Lost Communication with VNT System
U0167	177	C	–	A	Lost Communication With Vehicle Immobilizer Control

Schematic and Rounting Diagrams

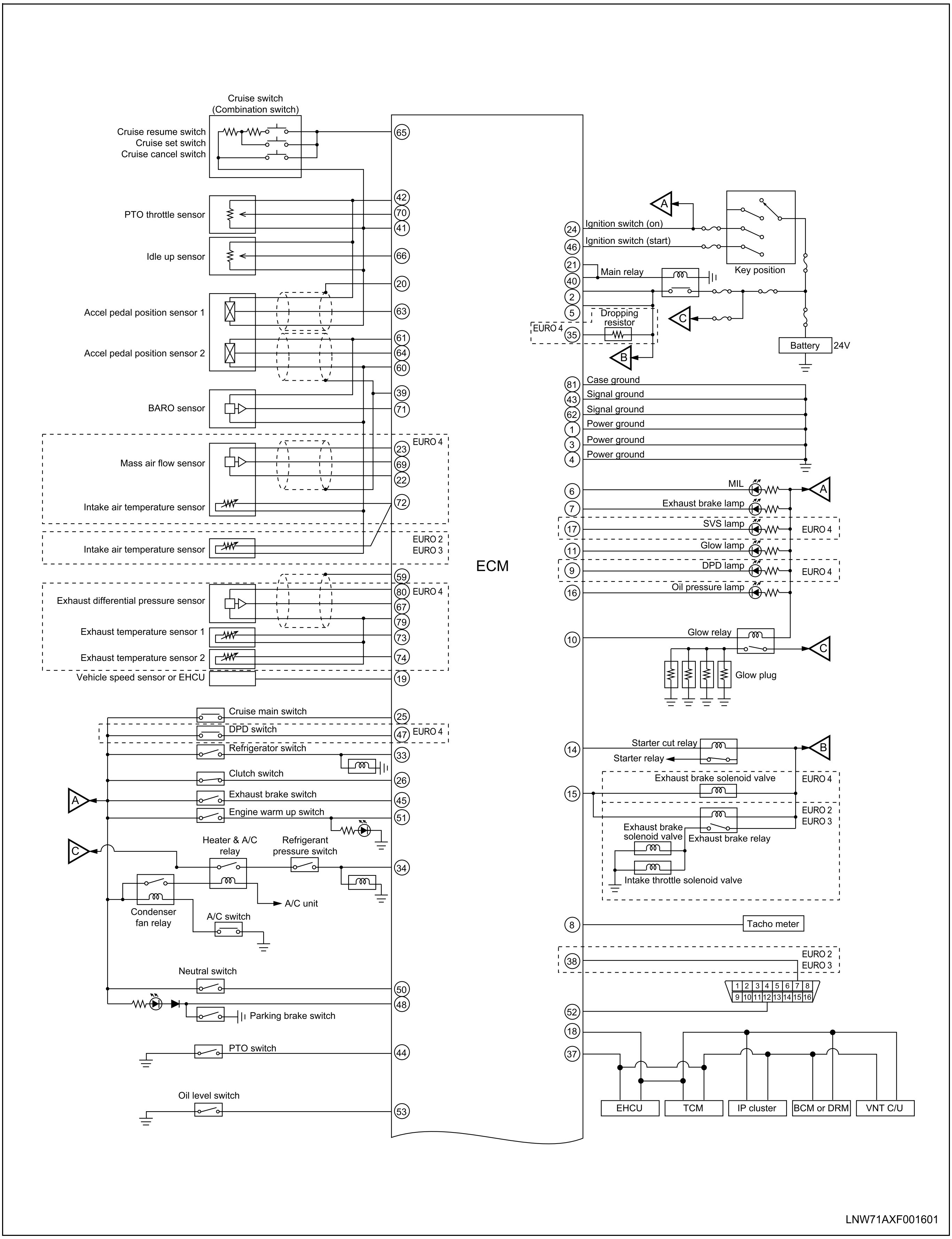
Fuel System Routing Diagram

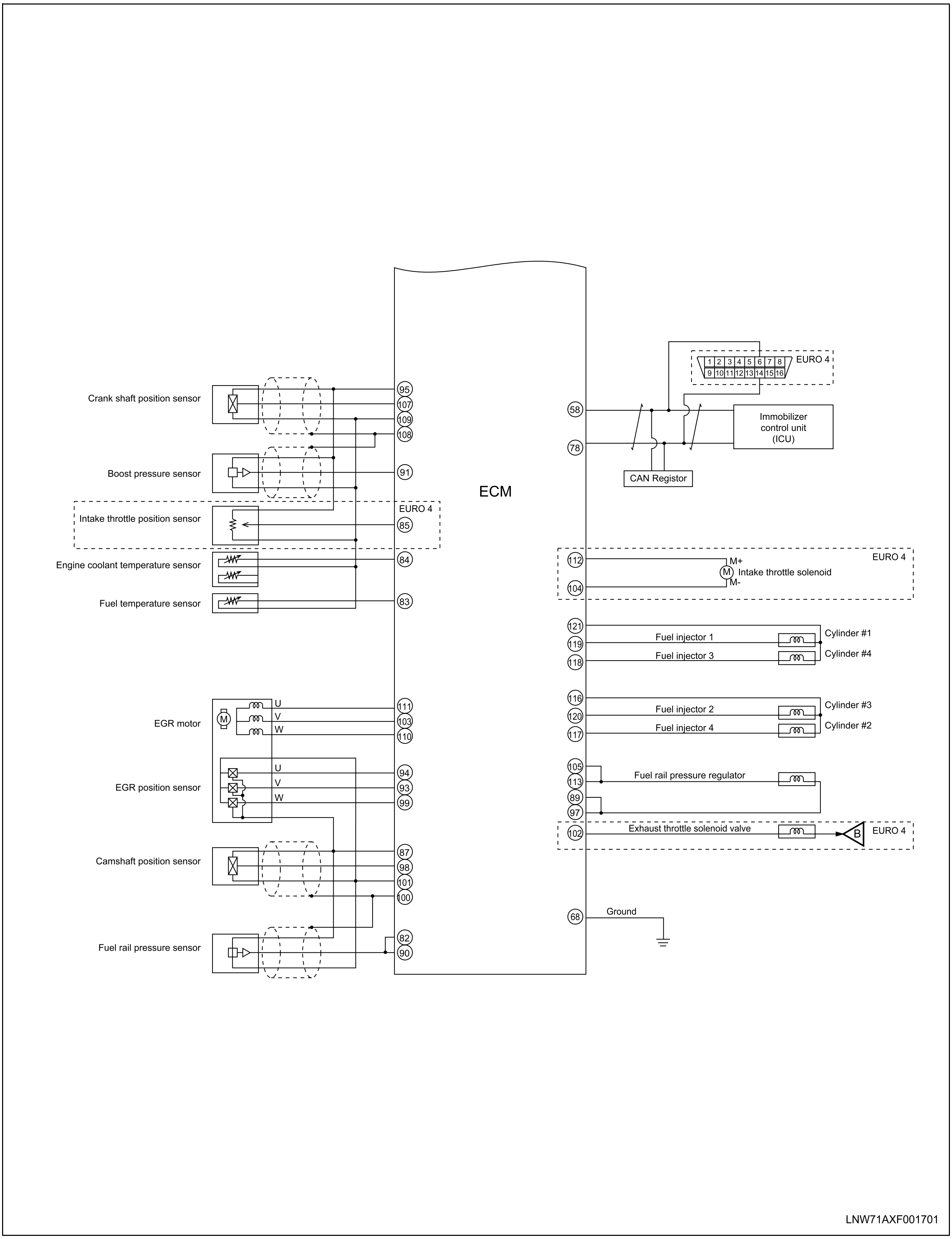


Legend

1. Fuel rail
2. Pressure limiter valve
3. Leak off pipe
4. Fuel injector
5. Fuel return pipe
6. Fuel feed pipe
7. Fuel tank
8. Vent valve
9. Priming pump
10. Fuel filter with water separator
11. Return fuel flow back valve
12. Fuel supply pump

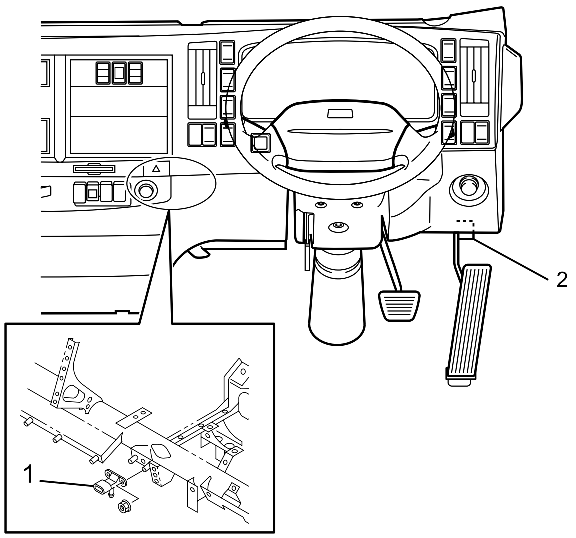
Engine Controls Schematics




ECM
Crank shaft position sensor
Boost pressure sensor
Intake throttle position sensor
EURO 4
Engine coolant temperature sensor
Fuel temperature sensor
EGR motor
U
V
W
EGR position sensor
U
V
W
Camshaft position sensor
Fuel rail pressure sensor
95
107
109
108
91
85
84
83
111
103
110
94
93
99
87
98
101
100
82
90
58
78
CAN Registor
Immobilizer control unit (ICU)
EURO 4
112
104
M+
M-
Intake throttle solenoid
EURO 4
121
119
118
Fuel injector 1
Fuel injector 3
Cylinder #1
Cylinder #4
116
120
117
Fuel injector 2
Fuel injector 4
Cylinder #3
Cylinder #2
105
113
89
97
Fuel rail pressure regulator
102
Exhaust throttle solenoid valve
B
EURO 4
68
Ground
LNW71AXF001701

Component Locator

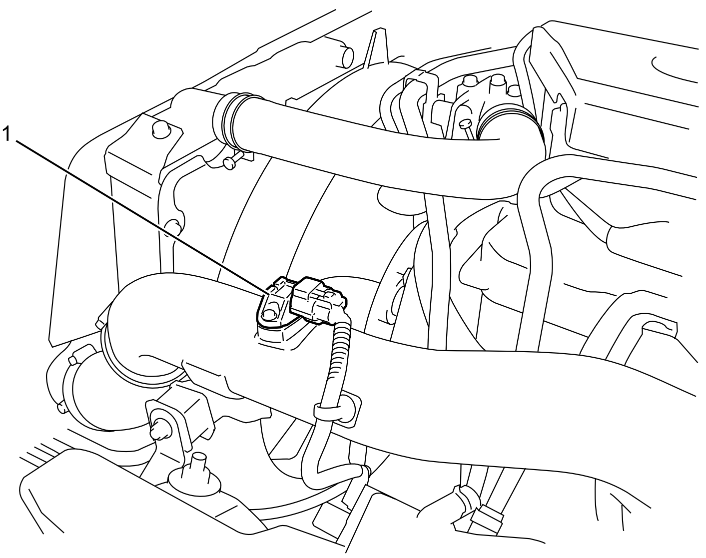
Engine Controls Component Views



LNW81ASF000901

Legend

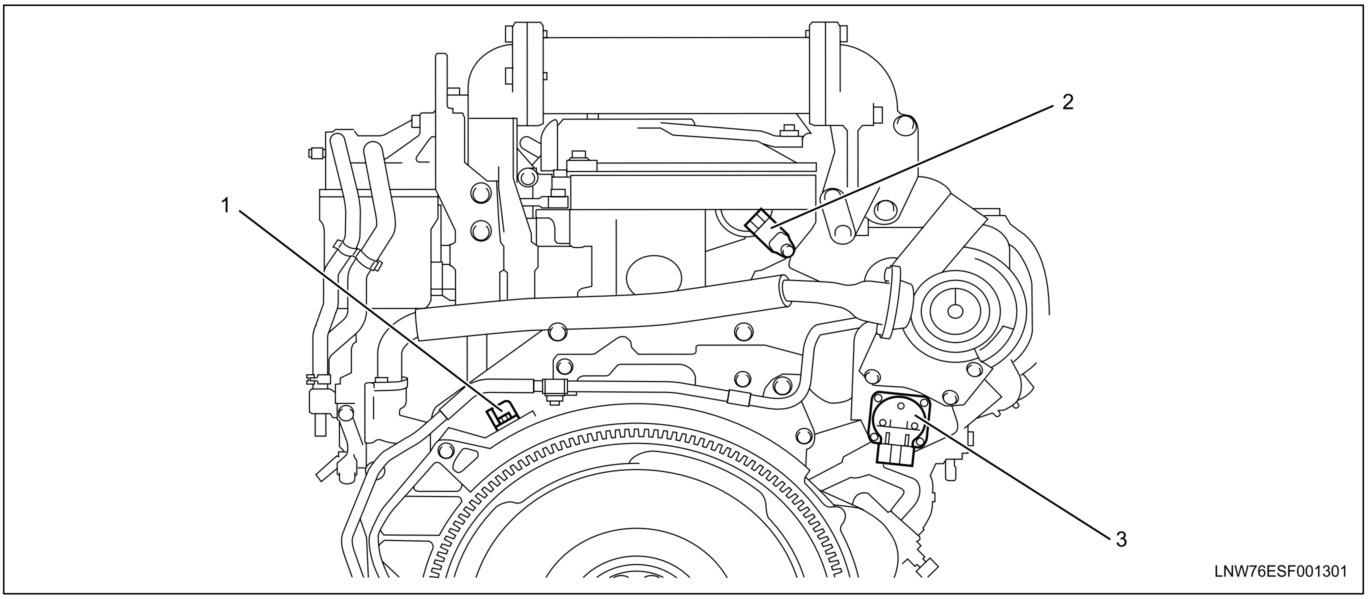
1. Barometric pressure (BARO) sensor
2. Accelerator pedal position (APP) sensor



LNW76ESF001201

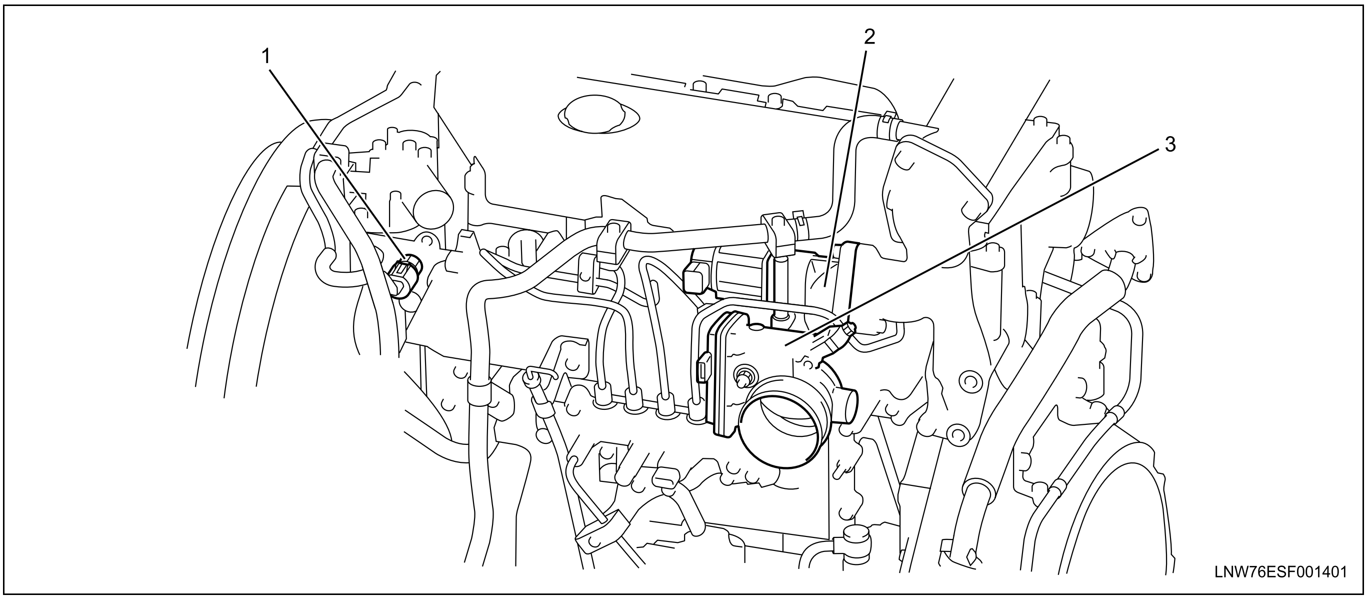
Legend

1. Boost pressure sensor



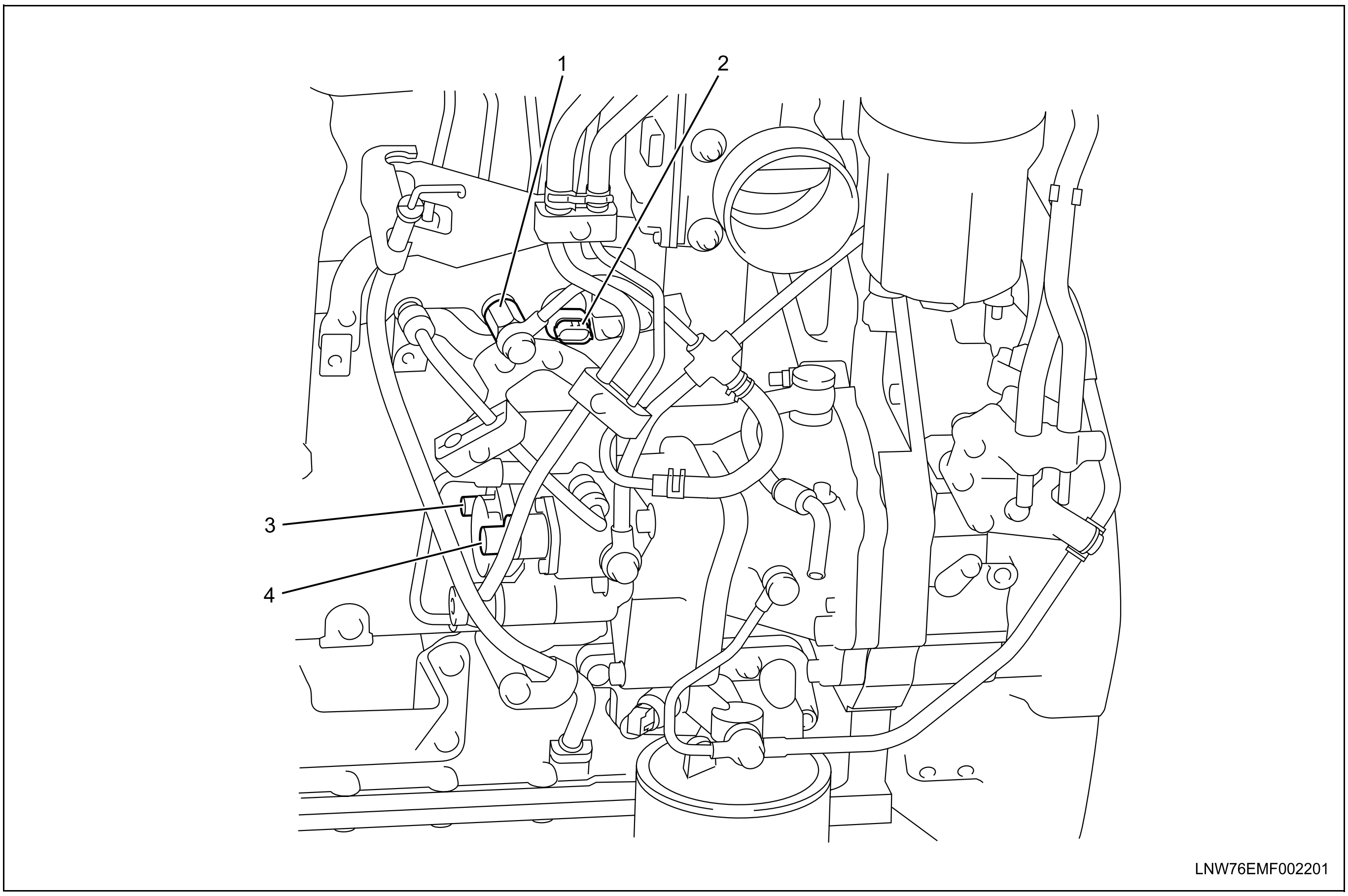
Legend

1. Crankshaft position (CKP) sensor
2. Camshaft position (CMP) sensor
3. Variable nozzle turbocharger (VNT) actuator & sensor



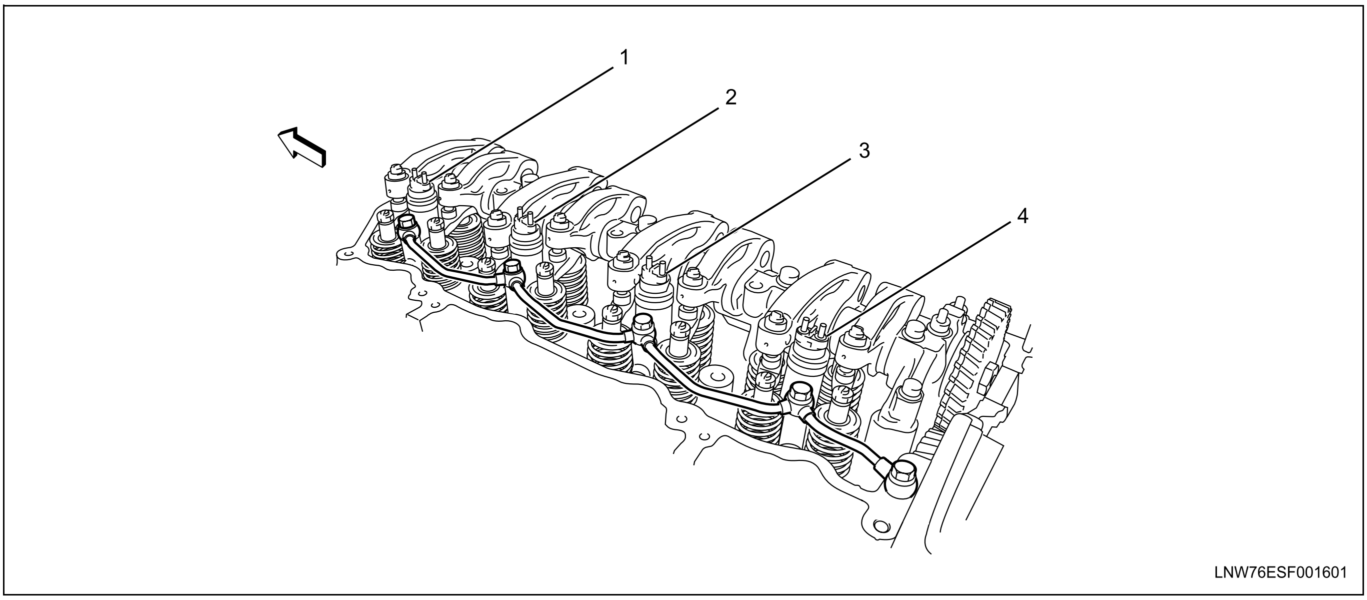
Legend

1. Engine coolant temperature (ECT) sensor
2. Exhaust gas recirculation (EGR) valve
3. Intake throttle valve



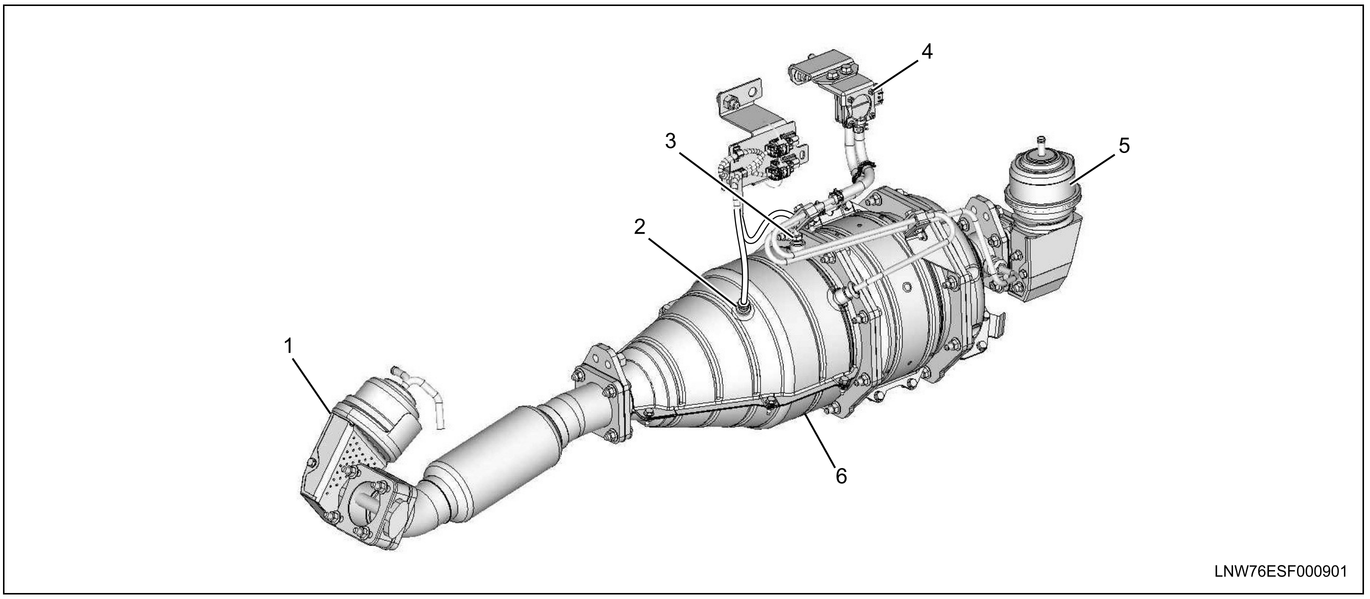
Legend

1. Pressure limiter valve
2. Fuel rail pressure (FRP) sensor
3. Fuel temperature (FT) sensor
4. Fuel rail pressure (FRP) regulator



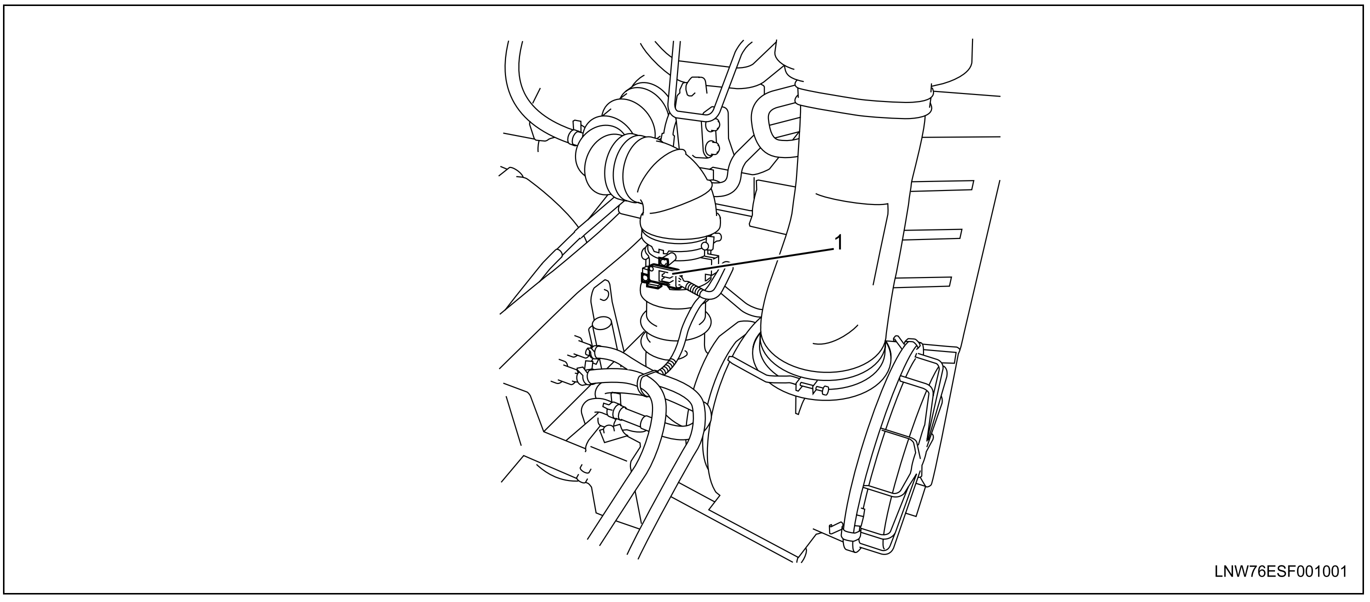
Legend

1. Fuel injector No.1 cylinder
2. Fuel injector No.2 cylinder
3. Fuel injector No.3 cylinder
4. Fuel injector No.4 cylinder



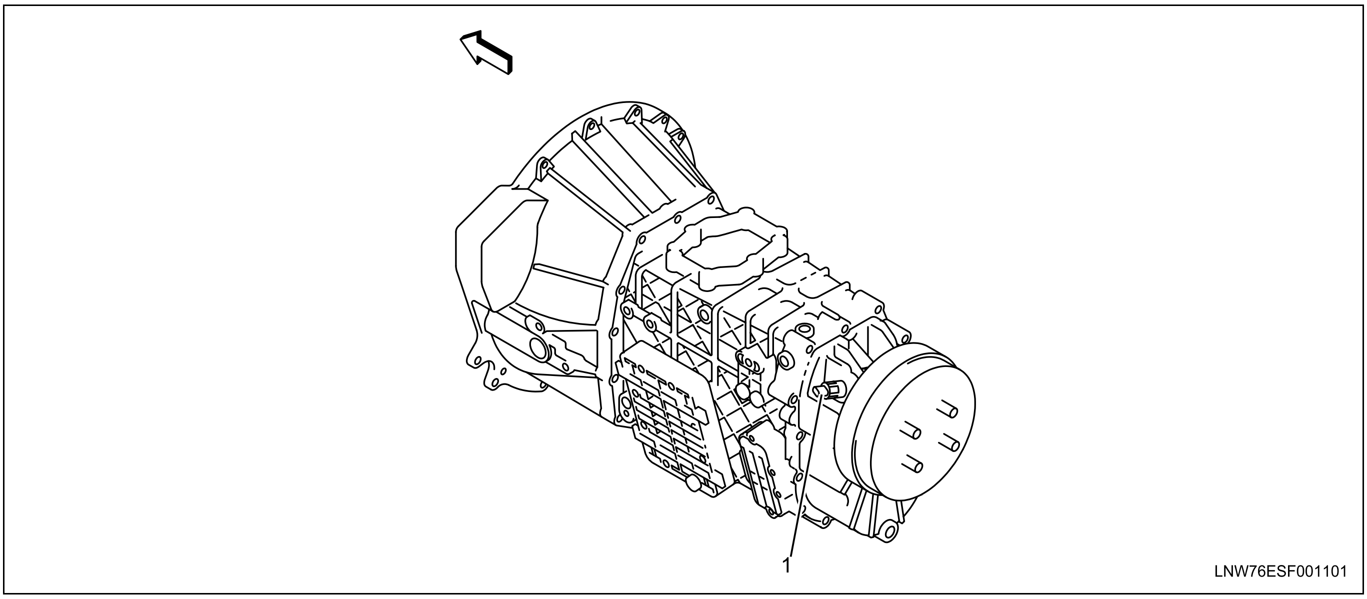
Legend

1. Exhaust brake valve
2. Exhaust temperature sensor 2 (in front of oxygen catalyst)
3. Exhaust temperature sensor 1 (in front of filter)
4. Exhaust differential pressure sensor
5. Exhaust throttle valve
6. DPD assembly

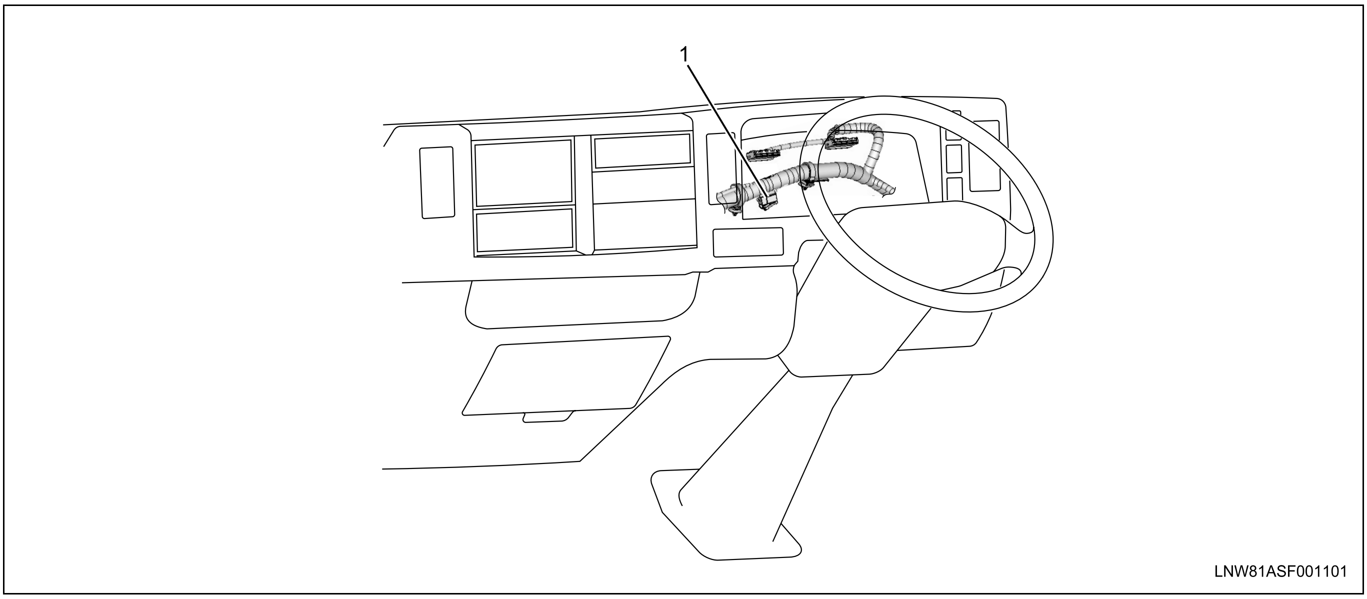


Legend

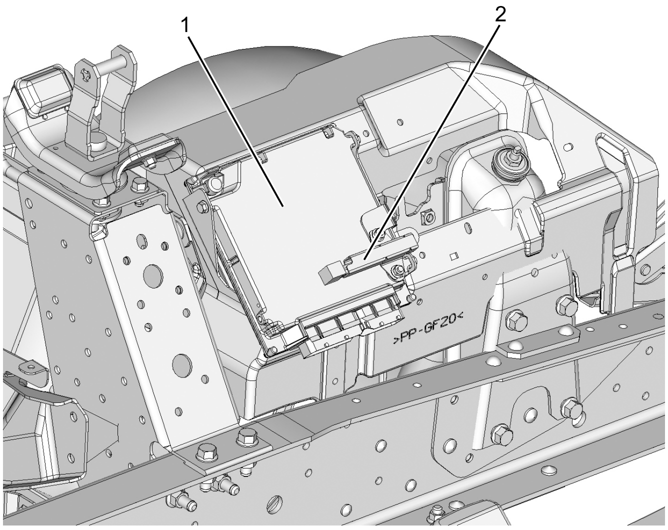
1. Mass air flow (MAF) sensor/ intake air temperature (IAT) sensor



Legend
1. Vehicle speed sensor (VSS) (without ABS)

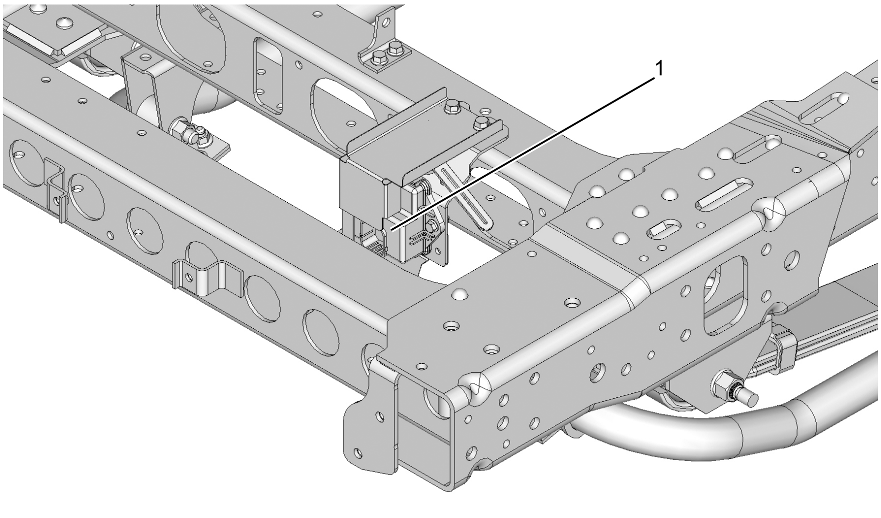


Legend
1. CAN resistor (RHD)



Legend

1. ECM
2. Dropping resistor

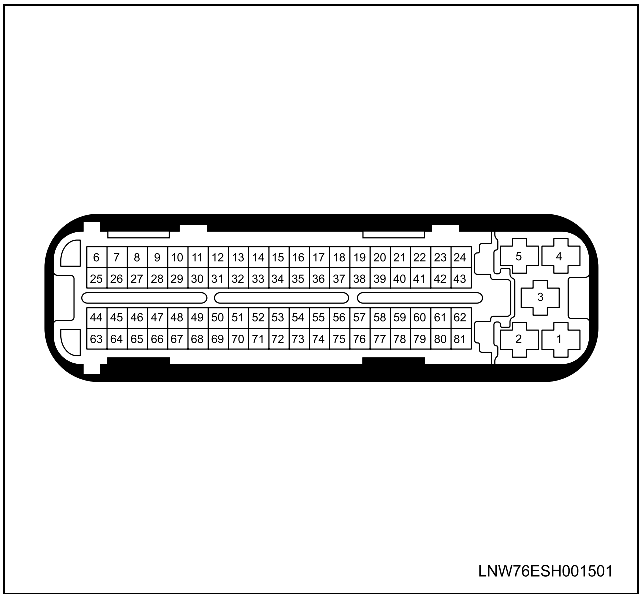


Legend

1. VNT control module

Engine Control Module (ECM) Connector End Views

Engine Control Module (ECM)

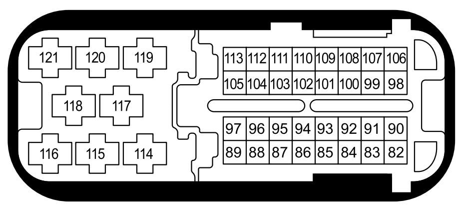


Connector No.		J-14
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	BLK	ECM power ground
2	RED	Battery voltage
3	BLK	ECM power ground
4	BLK	ECM power ground
5	RED	Battery voltage
6	BLU/RED	MIL control
7	BLU/PNK	Exhaust brake lamp control
8	LT GRN	Engine speed signal output to tachometer
9	LT GRN / BLK	DPD lamp control (Euro 4 specification)
10	BLK/RED	Glow plug relay control
11	ORN/BLU	Glow lamp control
12	-	Not used
13	-	Not used
14	WHT/BLU	Starter cut relay control
15	LT GRN / WHT	Exhaust brake solenoid valve control
16	BLU/YEL	Check engine oil level warning control

Connector No.		J-14
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
17	BLU/BLK	SVS lamp control (Euro 4 specification)
18	BLU/WHT	CAN high signal
19	YEL/GRN	VSS signal or EHCU
20	BLK	APP sensor 1 shield ground
21	BLU/BLK	ECM main relay control
22	GRN	MAF sensor low reference (Euro 4 specification)
23	YEL	MAF sensor 12 volts reference (Euro 4 specification)
24	YEL/BLK	Ignition voltage
25	RED/ WHT	Cruise main switch signal
26	BRN/YEL	Clutch pedal switch signal
27	-	Not used
28	-	Not used
29	-	Not used
30	-	Not used
31	-	Not used
32	-	Not used
33	PNK	Refrigerator switch signal
34	GRN/ORN	A/C switch signal
35	GRN/WHT	Dropping register
36	-	Not used
37	BLU	CAN low signal
38	LT BLU	Keyword 2000 serial data (Except Euro 4 specification)
39	BLK	APP sensor 2 & MAF sensor (Euro 4 specification) shield ground
40	BLU/BLK	ECM main relay control
41	PNK/BLK	APP sensor 1, idle up sensor, & PTO throttle sensor low reference
42	RED	APP sensor 1, idle up sensor, & PTO throttle sensor 5 volts reference
43	BLK	ECM signal ground
44	BLU/ORN	PTO mode switch signal

Connector No.		J-14
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
45	LT GRN/ RED	Exhaust brake switch signal
46	RED/WHT	Ignition switch signal
47	WHT/RED	DPD switch signal (Euro 4 specification)
48	WHT/BLK	Parking brake switch signal
49	-	Not used
50	BLK/BLU	Neutral switch signal
51	LT GRN/ BLU	Engine warm up switch signal
52	YEL	Diagnostic request switch
53	VIO/YEL	Engine oil level switch signal
54	-	Not used
55	-	Not used
56	-	Not used
57	-	Not used
58	BLU/WHT	CAN high signal (Euro 4 specification)
59	BLK	Exhaust differential pressure sensor shield ground
60	BLK	APP sensor 2, BARO sensor & IAT sensor low reference
61	RED	APP sensor 2 & BARO sensor 5 volts reference
62	BLK	ECM signal ground
63	BLU/WHT	APP sensor 1 signal
64	WHT	APP sensor 2 signal
65	RED/BLU	Cruise control switch signal
66	BLU/YEL	Idle up sensor signal
67	LT GRN	Exhaust differential pressure sensor signal (Euro 4 specification)
68	BLK	Option (ground)
69	BLU	MAF sensor signal (Euro 4 specification)
70	BRN	PTO throttle sensor signal
71	BRN/GRN	BARO sensor signal
72	RED/GRN	IAT sensor signal

Connector No.		J-14
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
73	YEL/RED	Exhaust temperature sensor 1 signal (Euro 4 specification)
74	RED	Exhaust temperature sensor 2 signal (Euro 4 specification)
75	-	Not used
76	-	Not used
77	-	Not used
78	BLU	CAN low signal (Euro 4 emission regulation or with Immobilizer)
79	BLK	Exhaust differential pressure sensor, exhaust temperature sensor 1 & exhaust temperature sensor 2 low reference (Euro 4 specification)
80	BLU/WHT	Exhaust differential pressure sensor 5 volts reference (Euro 4 specification)
81	BLK	ECM case ground



LNW76ESH001601

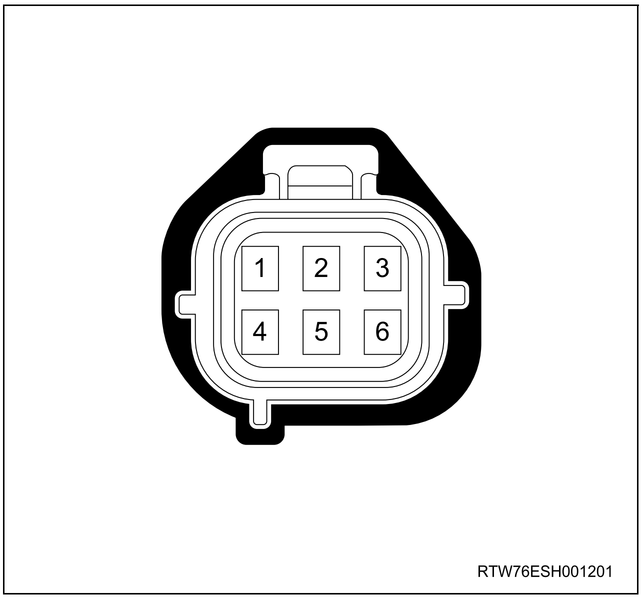
Connector No.		E-12
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
82	WHT	FRP sensor signal

Connector No.		E-12
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
83	LT GRN / WHT	FT sensor signal
84	GRN/YEL	ECT sensor signal
85	VIO/WHT	Intake throttle position sensor signal (Euro4 specification)
86	-	Not used
87	LT GRN	CMP sensor, FRP sensor & EGR position sensor 5 volts reference
88	-	Not used
89	GRN/RED	FRP regulator control low side
90	BLU/WHT	FRP sensor signal
91	RED	Boost pressure sensor signal
92	-	Not used
93	LT BLU	EGR position sensor signal 2
94	WHT/ORN	EGR position sensor signal 1
95	YEL	CKP sensor, intake throttle position sensor & boost pressure sensor 5 volts reference
96	-	Not used
97	GRN/RED	FRP regulator control low side
98	BLU/WHT	CMP sensor signal
99	LT GRN / BLK	EGR position sensor signal 3
100	BLK	CAM sensor & FRP sensor shield ground
101	YEL/BLK	CMP sensor, FRP sensor & EGR position sensor low reference
102	GRN/ORN	Exhaust throttle solenoid control (Euro 4 specification)
103	ORN	EGR motor control 2
104	GRN	Intake throttle solenoid low side
105	WHT/RED	FRP regulator control high side
106	-	Not used
107	RED/BLU	CKP sensor signal
108	BLK	CKP sensor & boost pressure sensor shield ground

Connector No.		E-12
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
109	BLK	CKP Sensor, intake throttle position sensor, FT sensor, ECT sensor & boost pressure sensor low reference
110	WHT	EGR motor control 3
111	BLK/ORN	EGR motor control 1
112	BLK/GRN	Intake throttle solenoid high side
113	WHT/RED	FRP regulator control high side
114	-	Not used
115	-	Not used
116	RED	Common 2 (Cylinder #2 & #3) fuel injector charge voltage
117	WHT/YEL	Cylinder #2 fuel injector control
118	BLK	Cylinder #4 fuel injector control
119	GRN/WHT	Cylinder #1 fuel injector control
120	BLK/BLU	Cylinder #3 fuel injector control
121	WHT	Common 1 (Cylinder #1 & #4) fuel injector charge voltage

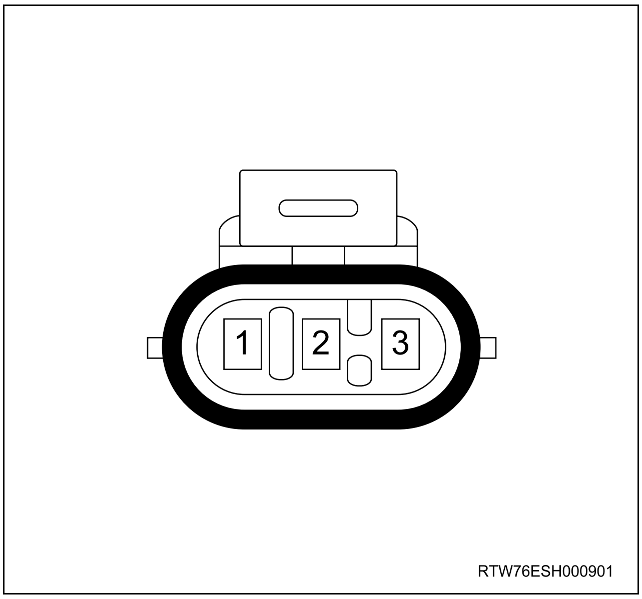
Engine Control Connector End Views

Accelerator Pedal Position (APP) Sensor



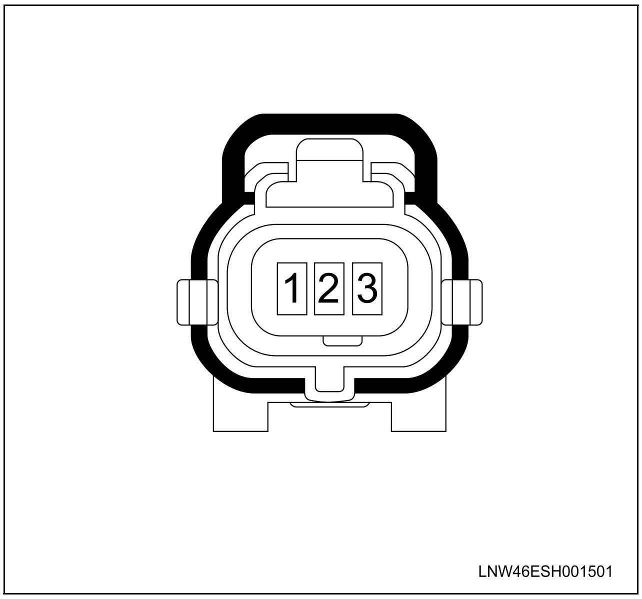
Connector No.		B-5
Connector Color		Gray
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	RED	APP sensor 2 5 volts reference
2	WHT	APP sensor 2 signal
3	BLK	APP sensor 2 low reference
4	BLU	APP sensor 1 5 volts reference
5	BLU/WHT	APP sensor 1 signal
6	BLU/RED	APP sensor 1 low reference

Barometric Pressure (BARO) Sensor



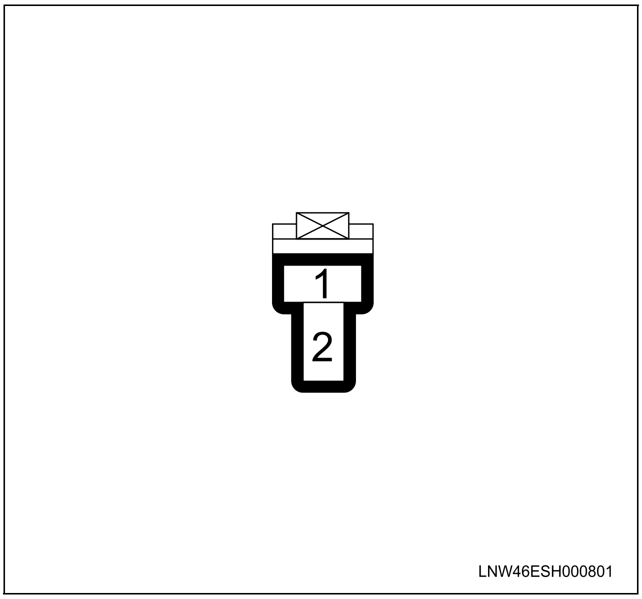
Connector No.		B-121
Connector Color		Gray
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	ORN	Sensor low reference
2	PNK/GRN	Sensor signal
3	BLU/GRN	Sensor 5 volts reference

Boost Pressure Sensor



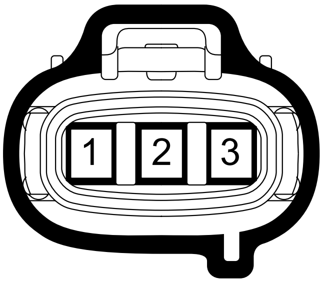
Connector No.		E-24
Connector Color		Black
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	YEL	Sensor signal
2	BLU	Sensor low reference
3	GRN	Sensor 5 volts reference

Clutch Switch



Connector No.		B-161
Connector Color		White
Test Adapter No.		J-35616-42
Pin No.	Wire Color	Pin Function
1	WHT/GRN	Ignition voltage feed
2	YEL	Switch signal

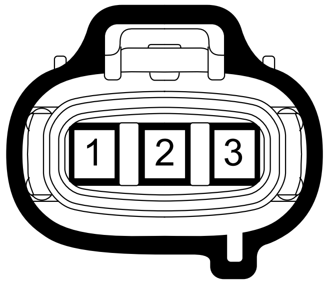
Camshaft Position (CMP) Sensor



RTW76ESH000701

Connector No.		E-18
Connector Color		Black
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	WHT	Sensor signal
2	BLK	Sensor low reference
3	RED	Sensor 5 volts reference

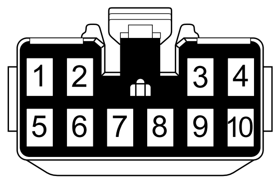
Crankshaft Position (CKP) Sensor



RTW76ESH000701

Connector No.		E-20
Connector Color		Black
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	YEL	Sensor signal
2	BLU	Sensor low reference
3	GRN	Sensor 5 volts reference

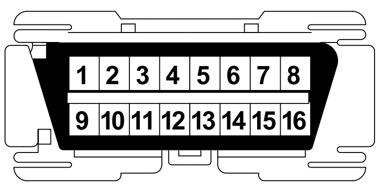
Cruise Main Switch



LNW76ESH004201

Connector No.		B-224
Connector Color		Brown
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	-	Not used
2	-	Not used
3	BLK/ORN	Cruise main switch ignition voltage feed
4	RED/WHT	Cruise main switch ground
5	-	Not used
6	-	Not used
7	BLK	Illumination lamp ground
8	LT GRN/ RED	Illumination lamp voltage feed
9	-	Not used
10	-	Not used

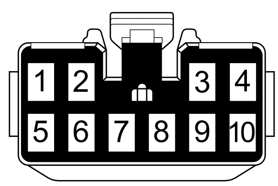
Data Link Connector (DLC)



LNW36ESH015801

Connector No.		B-31
Connector Color		Light blue
Test Adapter No.		J-35616-2A
Pin No.	Wire Color	Pin Function
1	-	Not used
2	WHT/BLK	Class 2 serial data (EHCU [ABS module])
3	-	Not used
4	BLK	Ground
5	BLK	Ground
6	BLU/WHT	CAN high (Euro 4 specification)
7	LT BLU	Keyword serial data (ECM [Except Euro 4 specification], SRS control unit, TCM or HSA control unit)
8	-	Not used
9	-	Not used
10	-	Not used
11	-	Not used
12	YEL	Diagnostic request switch (SRS control unit, TCM or HSA control unit)
13	WHT/GRN	Diagnostic request switch (EHCU [ABS mosule])
14	BLU	CAN low (Euro 4 specification)
15	-	Not used
16	RED/YEL	Battery voltage

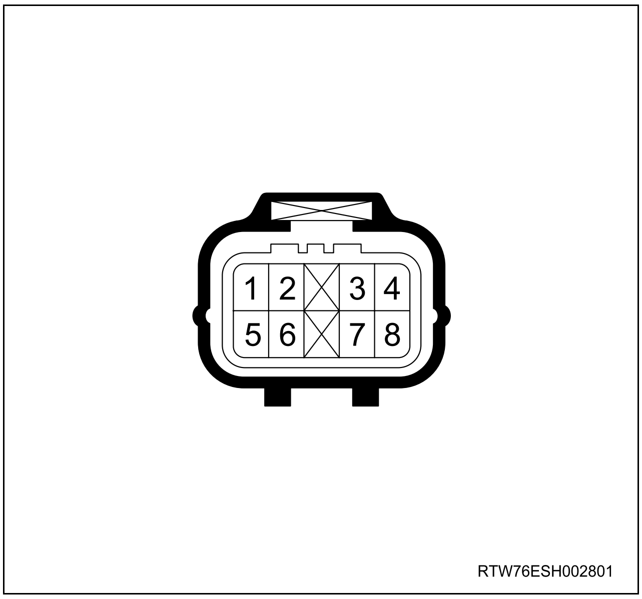
DPD Switch



LNW76ESH004201

Connector No.		B-165
Connector Color		Blue
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	BLK/ORN	DPD switch voltage feed
2	BLU/ WHT	DPD switch signal
3	-	Not used
4	-	Not used
5	-	Not used
6	-	Not used
7	BLK	Illumination lamp ground
8	LT GRN/ RED	Illumination lamp voltage feed
9	-	Not used
10	-	Not used

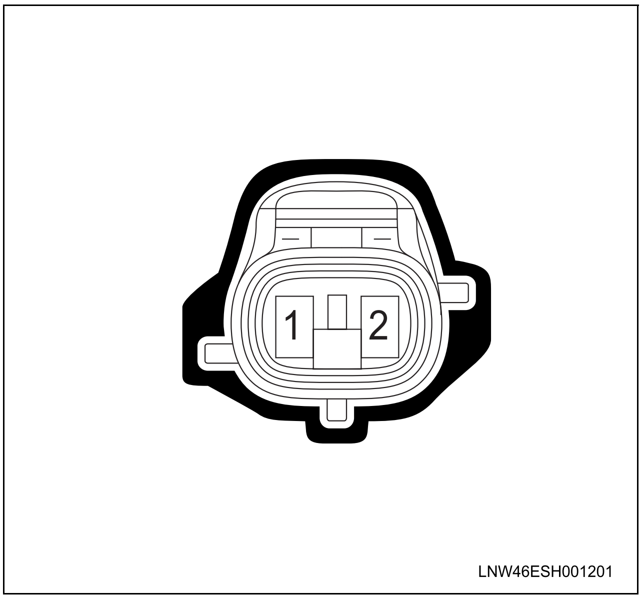
EGR Valve



Connector No.		E-15
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	LT GRN	Position sensor 5 volts reference
2	LT GRN/ BLK	Position sensor signal 3
3	LT BLU	Position sensor signal 2
4	WHT/ORN	Position sensor signal 1

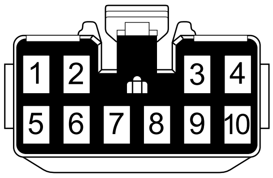
Connector No.		E-15
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
5	YEL/BLK	Position sensor low reference
6	WHT	Motor control 3
7	ORN	Motor control 2
8	BLK/ORN	Motor control 1

Engine Coolant Temperature (ECT) Sensor



Connector No.		E-25
Connector Color		Gray
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	GRN/YEL	Sensor signal
2	BLK	Sensor low reference

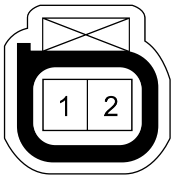
Engine Warm Up Switch



LNW76ESH004201

Connector No.		B-168
Connector Color		Gray
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	BLK/ORN	Engine warm up switch voltage feed
2	BRN/ RED	Engine warm up switch signal
3	-	Not used
4	-	Not used
5	-	Not used
6	-	Not used
7	BLK	Illumination lamp ground
8	LT GRN/ RED	Illumination lamp voltage feed
9	-	Not used
10	-	Not used

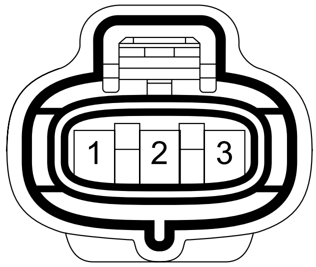
Exhaust Brake Solenoid Valve



LNW66ESH001101

Connector No.		J-26
Connector Color		Black
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	GRN/YEL	Battery voltage feed
2	BLK	Solenoid valve control

Exhaust Differential Pressure Sensor

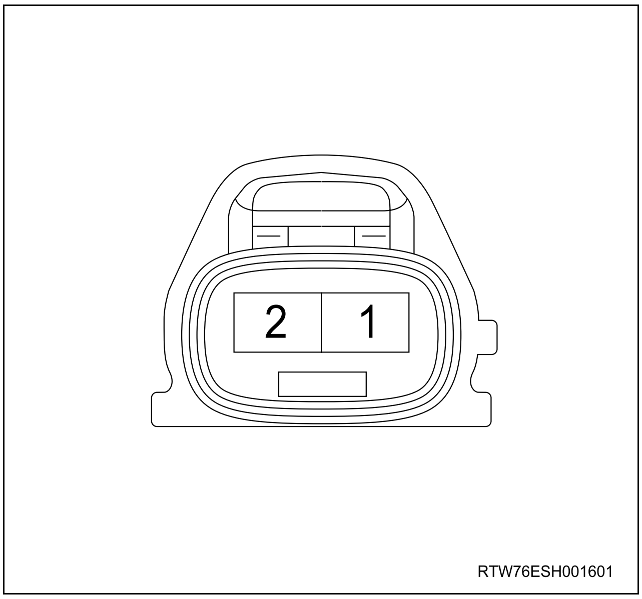


RTW76ESH001301

Connector No.		J-33
Connector Color		Black
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	YEL/BLK	Sensor low reference

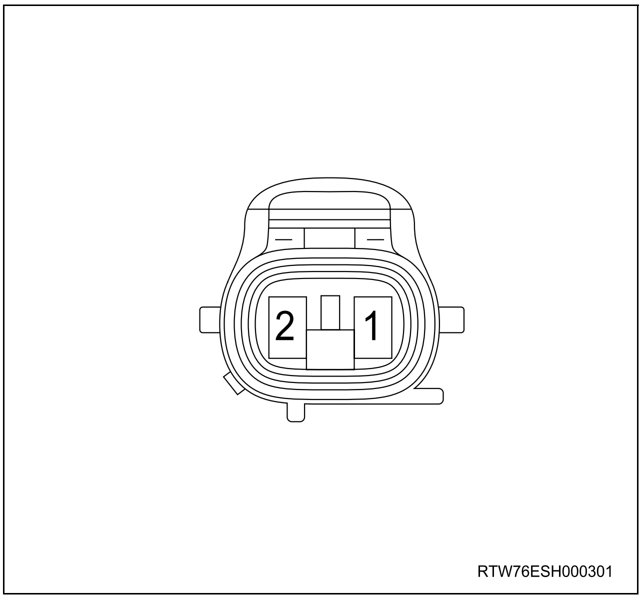
Connector No.		J-33
Connector Color		Black
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
2	LT GRN	Sensor signal
3	BLU/WHT	Sensor 5 volts reference

Exhaust Temperature Sensor 1



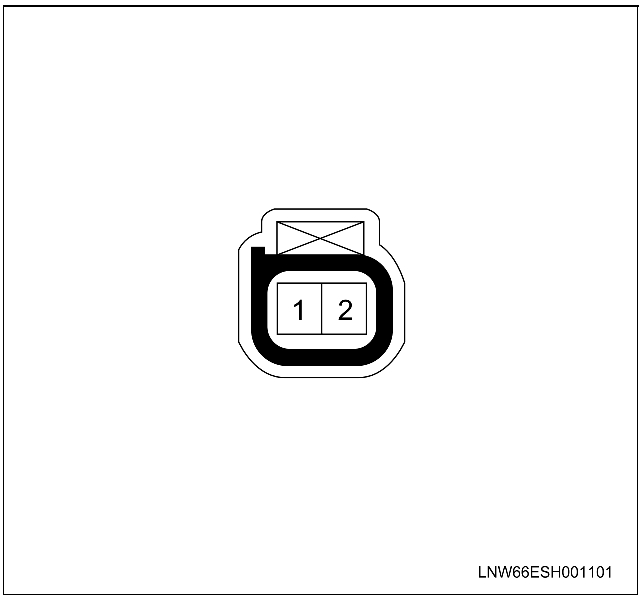
Connector No.		J-34
Connector Color		Light gray
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	BLK	Sensor low reference
2	YEL/RED	Sensor signal

Exhaust Temperature Sensor 2



Connector No.		J-35
Connector Color		Dark gray
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	BLK	Sensor low reference
2	RED	Sensor signal

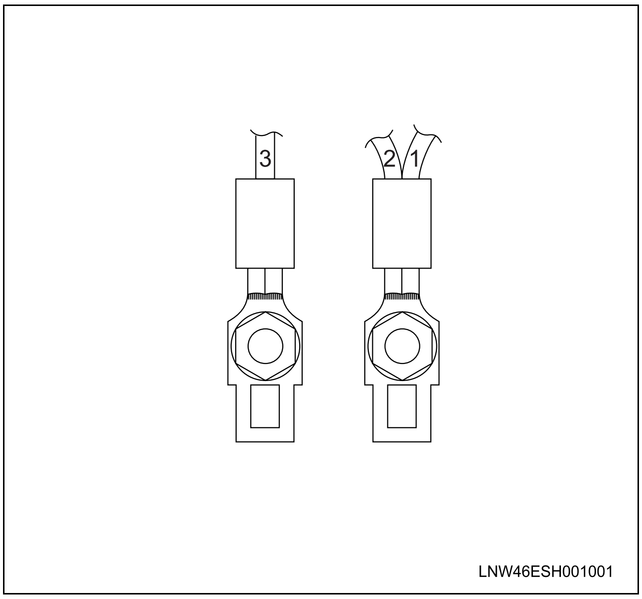
Exhaust Throttle Solenoid Valve



Connector No.		J-59
Connector Color		Black
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	GRN/YEL	Battery voltage feed

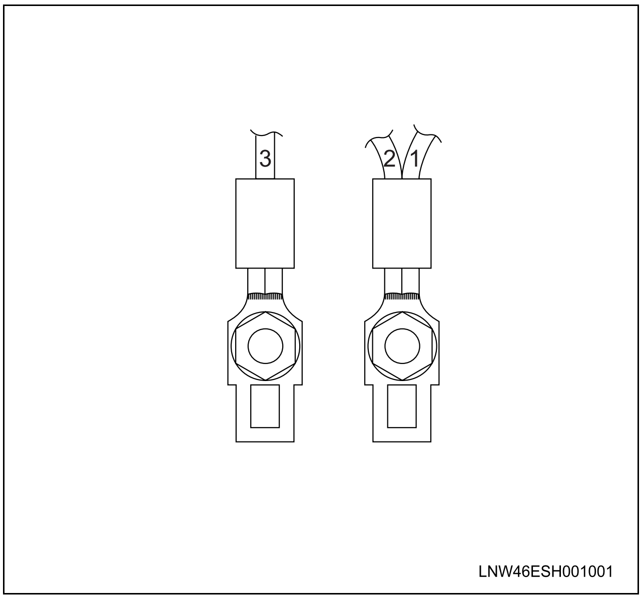
Connector No.		J-59
Connector Color		Black
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
2	BLK	Solenoid valve ground

Fuel Injector No.1 Cylinder



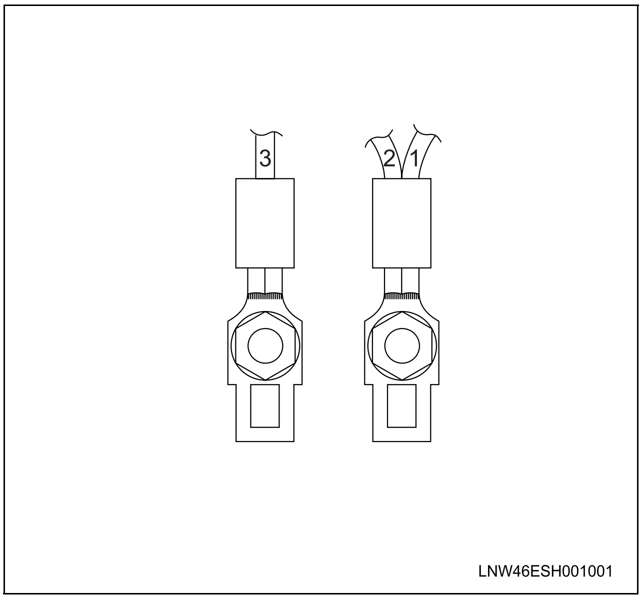
Connector No.		E-35
Pin No.	Wire Color	Pin Function
1	WHT	Charge voltage (Common 1)
2	WHT	Charge voltage (Common 1)
3	GRN	Solenoid control

Fuel Injector No.2 Cylinder



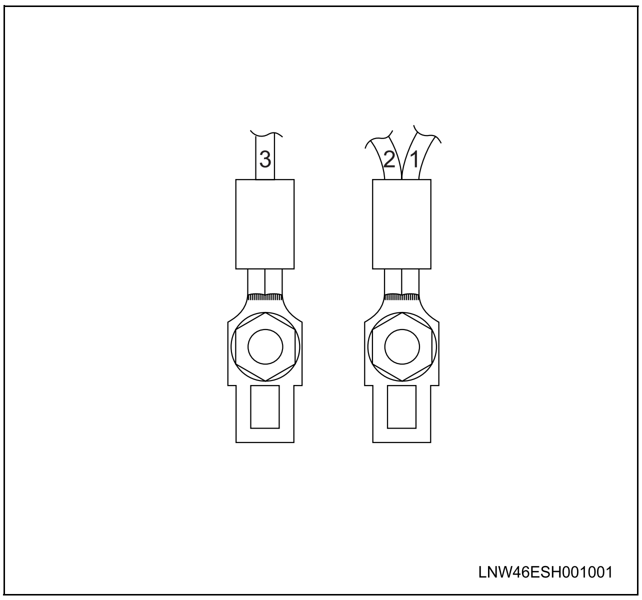
Connector No.		E-37
Pin No.	Wire Color	Pin Function
1	RED	Charge voltage (Common 2)
2	RED	Charge voltage (Common 2)
3	BLU	Solenoid control

Fuel Injector No.3 Cylinder



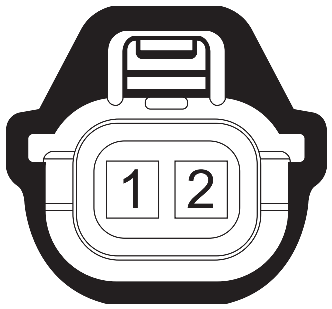
Connector No.		E-39
Pin No.	Wire Color	Pin Function
1	RED	Charge voltage (Common 2)
2	RED	Charge voltage (Common 2)
3	YEL	Solenoid control

Fuel Injector No.4 Cylinder



Connector No.		E-41
Pin No.	Wire Color	Pin Function
1	WHT	Charge voltage (Common 1)
2	WHT	Charge voltage (Common 1)
3	BLK	Solenoid control

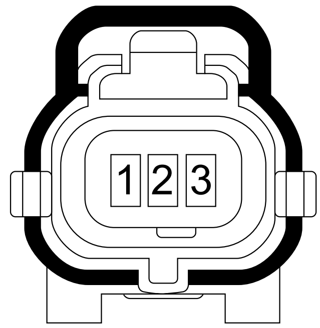
Fuel Rail Pressure (FRP) Regulator



LNW46ESH001101

Connector No.		E-17
Connector Color		Gray
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	WHT/RED	Control high side (PWM)
2	GRN/RED	Low side

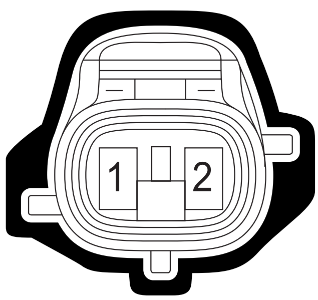
Fuel Rail Pressure (FRP) Sensor



LNW46ESH001501

Connector No.		E-19
Connector Color		Black
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	YEL/BLK	Sensor low reference
2	BLU/WHT	Sensor signal
3	LT GRN	Sensor 5 volts reference

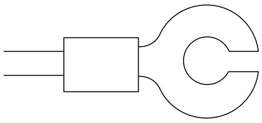
Fuel Temperature (FT) Sensor



LNW46ESH001201

Connector No.		E-22
Connector Color		Gray
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	BLK	Sensor low reference
2	LT GRN/ WHT	Sensor signal

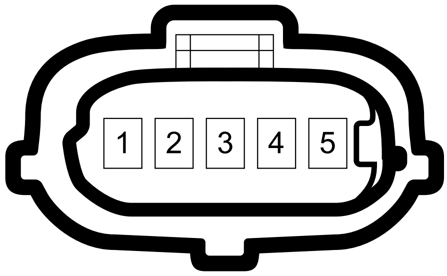
Glow Plug



LNW46ESH000701

Connector No.		E-14
Connector Color		Silver
Pin No.	Wire Color	Pin Function
1	BLK/RED	Power Supply

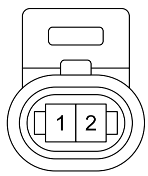
Mass Air Flow (MAF)/ Intake Air Temperature (IAT) Sensor (Euro4 specification)



LNW46ESH001801

Connector No.		J-38
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	YEL	MAF sensor 12 volts reference
2	GRN	MAF sensor low reference
3	BLU	MAF sensor signal
4	RED/GRN	IAT sensor signal
5	BLK	IAT sensor low reference

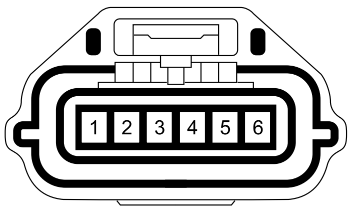
Intake Air Temperature (IAT) Sensor (Except Euro4 specification)



LNW76ESH006101

Connector No.		J-217
Connector Color		Gray
Test Adapter No.		J-35616-16
Pin No.	Wire Color	Pin Function
1	RED/GRN	Sensor signal
2	BLK	Sensor low reference

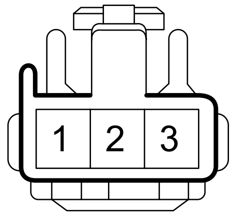
Intake Throttle Valve



RTW76ESH000401

Connector No.		E-16
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	GRN	Solenoid control low side (PWM)
2	BLK/GRN	Solenoid drive voltage
3	-	Not used
4	BLK	Position sensor low reference
5	VIO/WHT	Position sensor signal
6	YEL	Position sensor 5 volts reference

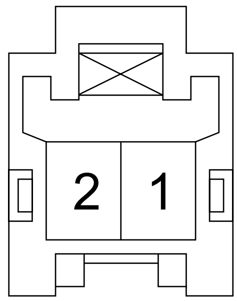
Idle Up Sensor



LNW46ESH002601

Connector No.		B-87
Connector Color		White
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	BLU	Sensor low reference
2	BLU/YEL	Sensor signal
3	BLU	Sensor 5 volts reference

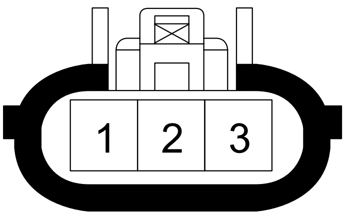
PTO Switch



RTW76ESH001701

Connector No.		B-166
Connector Color		White
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	BLU/ORN	PTO switch signal
2	BLK	PTO switch ground

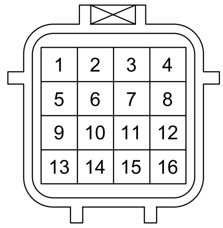
PTO Throttle Sensor



RTW76ESH001801

Connector No.		J-39
Connector Color		Gray
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	RED	Sensor 5 volts reference
2	BRN	Sensor signal
3	PNK/BLK	Sensor low reference

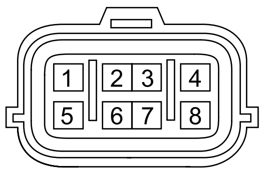
Variable Nozzle Turbocharger (VNT) Control Module



LNW76ESH004101

Connector No.		E-4
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	BLU/WHT	Position sensor signal 1
2	BRN	Position sensor signal 2
3	BLU	Position sensor signal 3
4	BLK	Position sensor low reference
5	BLK	Position sensor shield ground
6	-	Not used
7	-	Not used
8	RED	Position sensor reference voltage
9	-	Not used
10	GRN/RED	VNT motor control 1
11	YEL/RED	VNT motor control 2
12	BLU/RED	VNT motor control 3
13	LT GRN	Ignition voltage feed
14	BLK	Ground
15	BLU/WHT	CAN high signal
16	BLU	CAN low signal

Variable Nozzle Turbocharger (VNT) Actuator & Sensor



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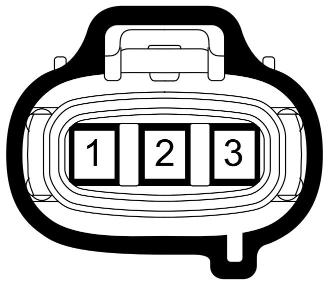
Connector No.		E-2
Connector Color		Brown
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	RED	Position sensor reference voltage
2	BLU	Position sensor signal 3
3	BRN	Position sensor signal 2
4	BLU/WHT	Position sensor signal 1
5	BLK	Position sensor low reference
6	BLU/RED	Motor control 2
7	YEL/RED	Motor control 3
8	GRN/RED	Motor control 1

Vehicle Speed Sensor (VSS)



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Connector No.		J-48
Connector Color		Gray
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	BLK/YEL	Ignition voltage feed
2	BLK	Sensor low reference
3	YEL/GRN	Sensor signal

Diagnostic Information and Procedures

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 ☐ Lack of power, sluggishness, sponginess ☐ Other ( )	☐ Surge	☐ Cut out	
	☐ 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 ☐ Abnormal combustion noise ☐ DPD regeneration long time ☐ Other ( )	☐ White smoke ☐ DPD manual regeneration frequently	☐ Poor fuel economy	
Dates problem occurred					
Problem frequency		☐ Constant ☐ Other ( )	☐ Intermittently (times per day/month)		☐ Once only
Condition When Problem Occurs	Weather	☐ Fine ☐ Various/Other ( )	☐ Cloudy	☐ Rainy	☐ Snow
	Outside Temperature	☐ Hot (approx.) ☐ Any temperature	☐ Warm	☐ Cool	☐ Cold (approx.)
	Place	☐ Highway ☐ Downhill	☐ Suburbs ☐ Rough road	☐ City area ☐ Other ( )	☐ Uphill
	Load Condition	☐ Over (approx. tons) ☐ Other (approx. tons)		☐ No load	
	Engine Temperature	☐ Cold ☐ Other ( )	☐ Warming up	☐ After warming up	☐ Any temperature
	Engine Operation	☐ Starting ☐ Racing ☐ Deceleration ☐ Other ( )	☐ Just after starting (Min.) ☐ Driving ☐ A/C switch On/Off	☐ Constant speed	☐ Idling ☐ Acceleration
	Fuel Amount	☐ Full	☐ Above 1/2	☐ Below 1/2	☐ Near empty
	Fuel Bland				

Condition of MIL or SVS lamp		☐ Remains On	☐ Intermittently turns On	☐ Does not turn On		
Diagnostic Trouble Code (DTC) or Flash Code	Present Code	☐ Nothing	☐ P or U Code No. ( )			
	History Code	☐ Nothing	☐ P or U Code No. ( )			
DPD System	DPD lamp or MID indicator	☐ Blinked		☐ Did not blink		
	DPD switch	☐ Pushed		☐ Did not push		
	DPD accumulation status	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
	DPD distance status	☐ 1	☐ 2	☐ 3	☐ 4	
	DPD incomplete regeneration status	☐ 0	☐ 1	☐ 2		
	DPD insufficient regeneration status	☐ 0	☐ 1	☐ 2		
	Exhaust differential pressure at instructed conditions	kPa				
	Averaged MAF when exhaust differential pressure is measured	g/s				

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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:

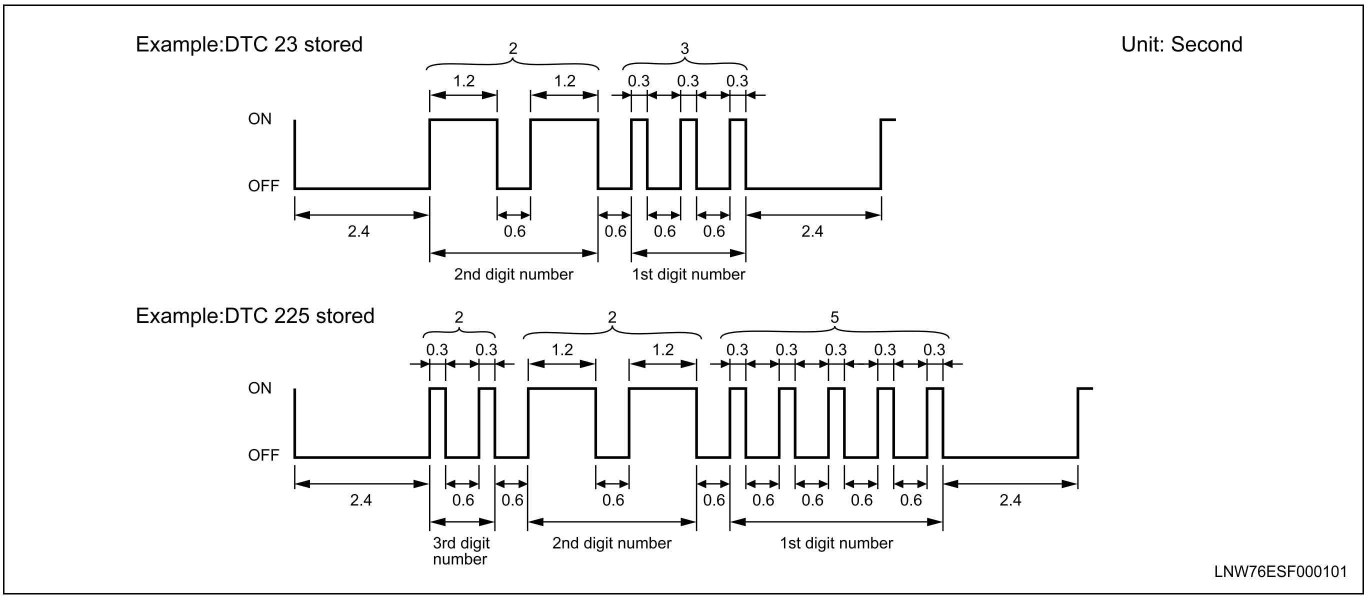
- The identification of the control modules which command the system.
- The ability of the control modules to communicate through the serial data circuit.
- The identification of any stored diagnostic trouble codes (DTCs) and the their statuses.

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.

Reading Flash Diagnostic Trouble Codes (DTC)

The provision for communicating with the ECM is the Data Link Connector (DLC). The DTC(s) 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 malfunction indicator lamp (MIL) or the service vehicle soon (SVS) lamp when the diagnostic test terminal of the DLC is grounded. The DLC terminal "12" (diagnostic request) is pulled "Low" (grounded) by jumped to DLC terminal "4", which is a ground wire. Once terminals "12" and "4" have been connected, turn the ignition switch ON, with the engine OFF. The MIL (Except Euro 4 specification) or the SVS lamp (Euro 4 specification) will indicate a DTC three times is a DTC is present and history. If more than one DTC has been stored in the ECM's memory, the DTCs will be output numerical order with each DTC being displayed three times. The flash DTC display will continue as long as the DLC is shorted.



Diagnostic Trouble Codes (DTC) Clear Method by Accelerator Pedal Operation (Except Euro 4 Specification)

If there is no scan tool, history DTCs can be cleared using accelerator pedal operation.

1. Turn ON the ignition, with the engine OFF.
2. Use a jumper wire and the DLC terminal "12" (diagnostic request) is pulled "Low" (grounded) by jumped to DLC terminal "4".
3. Depress accelerator pedal within 1 to 3 seconds.
4. Release accelerator pedal within 1 to 3 seconds.
5. Depress accelerator pedal within 1 to 3 seconds.
6. Release accelerator pedal within 1 to 3 seconds.
7. Depress accelerator pedal within 1 to 3 seconds.
8. Release accelerator pedal within 1 to 3 seconds.

Notice: DO NOT touch the accelerator pedal when it is released. Clearing DTCs may fail.

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 serial data circuit.
5. The presence of DTCs which begin with U, indicate that some other module is not communicating.
8. 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 in Section 1E Engine Electrical.
- 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. DO NOT attempt to crank the engine with ECM harness connectors disconnect.
- Ensure the ECM terminals are clean and correctly mating.
- Ensure the fuel injector ID code data is correctly programmed in to the ECM.
- If there are fuel system DTC’s (P0087, P0088, P0089, P0093 or P1093), diagnose sensor DTCs, solenoid DTCs, actuator DTCs and relay DTCs first.
- If there are DPD system DTC's (P1455, P1471, P242F, P2452, P2453 or P2458), diagnose sensor DTCs solenoid DTCs, actuator DTCs and relay DTCs first.

Diagnostic System Check - Engine Controls (Euro 4 Specification)

Step	Action	Value(s)	Yes	No
1	Install a scan tool. Does the scan tool turn ON?	—	Go to Step 2	Go to Scan Tool Does Not Power Up
2	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with the ECM. Does the scan tool communicate with the ECM?	—	Go to Step 3	Go to Scan Tool Does Not Communicate with CAN Device
3	**Notice:** If an immobilizer system is active the ECM will disable the fuel injection causing the engine to stall immediately after starting and energize the starter cut relay to disable cranking. Attempt to crank the engine. Does the engine crank?	—	Go to Step 4	Go to Step 5
4	Attempt to start the engine. Does the engine start and idle?	—	Go to Step 6	Go to Engine Cranks but Does Not Run

Step	Action	Value(s)	Yes	No
5	Does the scan tool display ECM DTCs P0633, P161B or U0167?	—	Go to Applicable DTC	Problem is relating to starting system. Refer to Starting System in Section 1E Engine Electrical
6	Select the DTC display function for the following control modules: • ECM • Transmission control module (TCM) (Smoother only) • Electronic hydraulic control unit (EHCU) (If so equipped) Does the scan tool display any DTCs?	—	Go to Step 7	Go to Step 11
7	Does the scan tool display DTCs which begin with U or other control module communication fault DTCs?	—	Go to Applicable DTC	Go to Step 8
8	Does the scan tool display ECM DTCs P0601, P0602, P0604, P0606, P060B or P1621?	—	Go to Applicable DTC	Go to Step 9
9	Does the scan tool display ECM DTC P0563?	—	Go to Applicable DTC	Go to Step 10
10	Is there any other code in any controller that has not been diagnosed?	—	Go to Applicable DTC	Go to Step 11
11	Is the customer's concern with the transmission?	—	Go to Diagnostic System Check - Transmission Controls in Setion 5A Transmission Control System	Go to Step 12
12	Is the customer's concern with the anti-lock brake system?	—	Go to Diagnostic System Check - ABS Controls in Section 4C1 ABS/ ASR	Go to Step 13
13	1. Review the following symptoms. 2. Refer to the applicable symptom diagnostic table: • Hard Start • Rough, Unstable, or Incorrect Idle and Stalling • High Idle Speed • Cuts Out • Surges • Lack of Power, Sluggishness, or Sponginess • Hesitation, Sag, Stumble • Abnormal Combustion Noise • Poor Fuel Economy • Excessive Smoke (Black Smoke) • Excessive Smoke (White Smoke) • DPD System Manual Regeneration Frequently • DPD System Regeneration Long Time Did you find and correct the condition?	—	System OK	Go to Intermittent Conditions

Diagnostic System Check - Engine Controls (Except Euro 4 Specification)

Step	Action	Value(s)	Yes	No
1	Install a scan tool. Does the scan tool turn ON?	—	Go to Step 2	Go to Scan Tool Does Not Power Up
2	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with the listed control modules. • ECM • Transmission control module (TCM) (Smoother only) • Hill start aid (HSA) control unit (If so equipped) • Supplemental restraint system (SRS) control unit (If so equipped) Does the scan tool communicate with all the listed control modules?	—	Go to Step 3	Go to Scan Tool Does Not Communicate with Keyword Device
3	**Notice:** If an immobilizer system is active the ECM will disable the fuel injection causing the engine to stall immediately after starting and energize the starter cut relay to disable cranking. Attempt to crank the engine. Does the engine crank?	—	Go to Step 4	Go to Step 5
4	Attempt to start the engine. Does the engine start and idle?	—	Go to Step 6	Go to Engine Cranks but Does Not Run
5	Does the scan tool display ECM DTCs P0633, P161B or U0167?	—	Go to Applicable DTC	Problem is relating to starting system. Refer to Starting System in Section 1E Engine Electrical
6	Select the DTC display function for the following control modules: • ECM • TCM (Smoother only) • EHCU (If so equipped) • HSA control unit (If so equipped) • SRS control unit (If so equipped) Does the scan tool display any DTCs?	—	Go to Step 7	Go to Step 11
7	Does the scan tool display DTCs which begin with U or other control module communication fault DTCs?	—	Go to Applicable DTC	Go to Step 8
8	Does the scan tool display ECM DTCs P0601, P0602, P0604, P0606, P060B or P1621?	—	Go to Applicable DTC	Go to Step 9
9	Does the scan tool display ECM DTC P0563?	—	Go to Applicable DTC	Go to Step 10
10	Is there any other code in any controller that has not been diagnosed?	—	Go to Applicable DTC	Go to Step 11
11	Is the customer's concern with the transmission?	—	Go to Diagnostic System Check - Transmission Controls in Setion 5A Transmission Control System	Go to Step 12

Step	Action	Value(s)	Yes	No
12	Is the customer's concern with the anti-lock brake system?	—	Go to Diagnostic System Check - ABS Controls in Section 4C1 ABS/ ASR	Go to Step 13
13	Is the customer's concern with the HSA system?	—	Go to Diagnostic System Check - HSA Controls in Section 4E HSA	Go to Step 14
14	Is the customer's concern with the SRS airbag system?	—	Go to Diagnostic System Check - SRS Controls in Section 8C SRS Control System	Go to Step 15
15	1. Review the following symptoms. 2. Refer to the applicable symptom diagnostic table: • Hard Start • Rough, Unstable, or Incorrect Idle and Stalling • High Idle Speed • Cuts Out • Surges • Lack of Power, Sluggishness, or Sponginess • Hesitation, Sag, Stumble • Abnormal 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

Scan Tool Data List

The Engine Scan Tool Data List contains all engine related parameters that are available on the scan tool. A given parameter may appear in any one of the data lists, and in some cases may appear more than once, or in more than one data list in order to group certain related parameters together. Use the Engine Scan Tool Data List only after the following is determined:

- The Engine Controls - Diagnostic System Check is completed.
- On-board diagnostics are functioning properly.

Scan tool values from a properly running engine may be used for comparison with the engine you are diagnosing. The Engine Scan Tool Data List represents values that would be seen on a normal running engine. Only the parameters listed below are referenced in this service manual for use in diagnosis.

Scan Tool Parameter	Units Displayed	Typical Data Value at Engine Idle	Typical Data Value at 1700 RPM
Operating Conditions: Engine idling or 1700RPM/ Engine coolant temperature is between 75 to 85°C (167 to 185°F)/ Accelerator pedal is constant/ Neutral or Park/ Accessories OFF/ Vehicle located at sea level/ DPD is not under regeneration			
Engine Speed	RPM	Nearly 575 RPM	Nearly 1700 RPM
Desired Idle Speed	RPM	575 RPM	575 RPM
Calculated Engine Load	%	Less than 25%	Less than 20%
Coolant Temperature	°C/ °F	75 to 85 °C/ 167 to 185°F	75 to 85 °C/ 167 to 185 °F
Engine Coolant Temperature Sensor	Volts	0.4 to 0.6 volts	0.4 to 0.6 volts
Intake Air Temperature	°C/ °F	20 to 40 °C/ 68 to 104 °F	20 to 40 °C/ 68 to 104 °F
Intake Air Temperature Sensor	Volts	1.4 to 2.3 volts	1.4 to 2.3 volts
Fuel Temperature	°C/ °F	20 to 60 °C / 50 to 140 °F	20 to 60 °C / 50 to 140 °F
Fuel Temperature Sensor	Volts	0.8 to 2.3 volts	0.8 to 2.3 volts
MAF (Mass Air Flow)	g/cyl	More than 0.8 g/cyl at sea level	More than 0.8 g/cyl at sea level
Averaged MAF (Mass Air Flow)	g/s	—	—
MAF Sensor (Mass Air Flow)	Volts	More than 1.5 volts at sea level	More than 2.5 volts at sea level
Barometric Pressure	kPa/ psi	Nearly 100 kPa/ 14.5 psi at sea level	Nearly 100 kPa/ 14.5 psi at sea level
Barometric Pressure Sensor	Volts	Nearly 2.3 volts at sea level	Nearly 2.3 volts at sea level
Desired Turbocharger Position	%	10 to 20%	25 to 35%
Desired Boost Pressure	kPa/ psi	Nearly 100 kPa/ 14.5 psi at sea level	Less than 115 kPa/ 16.7 psi at sea level
Boost Pressure	kPa/ psi	Nearly 100 kPa/ 14.5 psi at sea level	Less than 115 kPa/ 16.7 psi at sea level
Boost Pressure Sensor	Volts	Nearly 1.0 volt at sea level	Less than 1.3 volts at sea level
Desired Fuel Rail Pressure	MPa/ psi	Nearly 32 MPa/ 4,600 psi	More than 90 MPa/ 13,000 psi
Fuel Rail Pressure	MPa/ psi	28 to 35 MPa/ 4,000 to 5,000 psi	More than 90 MPa/ 13,000 psi
Fuel Rail Pressure Sensor	Volts	1.4 to 1.6 volts	More than 2.4 volts

Scan Tool Parameter	Units Displayed	Typical Data Value at Engine Idle	Typical Data Value at 1700 RPM
FRP Regulator Command (Fuel Rail Pressure)	%	30 to 45%	25 to 35%
FRP Regulator Commanded Fuel Flow	mm^3/sec	More than 2000 mm^3/sec	More than 3500 mm^3/sec
FRP Regulator Feedback Current (Fuel Rail Pressure)	mA	900 to 1100 mA	800 to 900 mA
Accelerator Pedal Position	%	0%	23 to 30%
APP Sensor 1 (Accelerator Pedal Position)	Volts	0.3 to 0.7 volts	1.2 to 1.6 volts
APP Sensor 2 (Accelerator Pedal Position)	Volts	4.1 to 4.5 volts	3.4 to 3.8 volts
Desired EGR Position	%	0%	Less than 35%
EGR Position 1	%	0%	Less than 35%
EGR Position 1	Low/ High	Low or High	Low or High
EGR Position 2	Low/ High	Low or High	Low or High
EGR Position 3	Low/ High	Low or High	Low or High
Intake Throttle Solenoid Command	%	0%	0%
Desired Intake Throttle Position	%	More than 90%	More than 90%
Intake Throttle Position	%	More than 100%	More than 100%
Intake Throttle Position Sensor	Volts	More than 3.9 volts	More than 3.9 volts
Idle-Up Sensor	Volts	0.3 to 0.6 volts	0.3 to 0.6 volts
Fuel Compensation Cyl. 1	mm^3	-5.0 to 5.0 mm^3(varies)	0.0 mm^3
Fuel Compensation Cyl. 2	mm^3	-5.0 to 5.0 mm^3(varies)	0.0 mm^3
Fuel Compensation Cyl. 3	mm^3	-5.0 to 5.0 mm^3(varies)	0.0 mm^3
Fuel Compensation Cyl. 4	mm^3	-5.0 to 5.0 mm^3(varies)	0.0 mm^3
Fuel Supply Pump Status	Not Learnd/ Learned	Learned	Learned
Rail Pressure Feedback Mode	Shutoff Mode/ Start Mode/ Wait Mode/ Wait to Restart/ Feedback Mode	Feedback Mode	Feedback Mode
Engine Running Status	Off/ Ignition On/ Cranking/ Running	Running	Running
Engine Runtime	Time (hour: minute: second)	Varies	Varies
Vehicle Speed	km/h/ MPH	0 km/h/ 0 MPH	0 km/h/ 0 MPH
Starter Switch	On/ Off	Off	Off
Ignition Switch	On/ Off	On	On

Scan Tool Parameter	Units Displayed	Typical Data Value at Engine Idle	Typical Data Value at 1700 RPM
Ignition Voltage	Volts	22.0 to 30.0 volts	22.0 to 30.0 volts
Battery Voltage	Volts	22.0 to 30.0 volts	22.0 to 30.0 volts
Clutch Pedal Switch	Applied/ Released	Released	Released
Neutral Switch	Neutral/ In Gear	Neutral	Neutral
Park Brake Switch	Applied/ Released	Released	Released
Exhaust Brake Switch	On/ Off	Off	Off
Exhaust Brake Valve Command	On/ Off	Off	Off
Exhaust Brake Cut Request from ABS Module	Inactive/ Active	Inactive	Inactive
Exhaust Brake Cut Request from TCM	Inactive/ Active	Inactive	Inactive
ASR Commanded APP (Accelerator Pedal Position)	%	100%	100%
PTO Switch	On/ Off	Off	Off
PTO Remote Throttle	%	0%	0%
PTO Remote Throttle Sensor	Volts	Less than 0.4 volts	Less than 0.4 volts
Engine Warm Up Switch	On/ Off	Off	Off
A/C Signal	On/ Off	Off	Off
Refrigerator Switch	On/ Off	Off	Off
Oil Level	Normal/ Low	Normal	Normal
Glow plug Relay Command	On/ Off	Off	Off
Malfunction Indicator Lamp (MIL)	On/ Off	Off	Off
Distance While MIL is Activated	km/ Miles	0 km/ 0 Miles	0 km/ 0 Miles
Engine Run Time with MIL Active	minutes	0	0
Vane Control Solenoid Error	No/ Stuck/ Short Circuit	No	No
Vane Position Sensor Error	No/ All Low/ All High	No	No
Turbocharger Control Module Error	No/ High Voltage	No	No
Total Engine Overspeed Event	Counter	Varies	Varies
Total Engine Coolant Overtemperature Event	Counter	Varies	Varies
Total Fuel Temperature Overtemperature Event	Counter	Varies	Varies

Scan Tool Parameter	Units Displayed	Typical Data Value at Engine Idle	Typical Data Value at 1700 RPM
Total Intake Air Temperature Overtemperature Event	Counter	Varies	Varies
DPD Mode	Varies	30	30
DPD Accumulation Status	0/ 1/ 2/ 3/ 4/ 5	0, 1, 2, 3 or 4	0, 1, 2, 3 or 4
DPD Distance Status	0/ 1/ 2/ 3/ 4	0, 1, 2 or 3	0, 1, 2 or 3
DPD Incomplete Regeneration Status	0/ 1/ 2	0 or 1	0 or 1
DPD Insufficient Regeneration Status	0/ 1/ 2	0 or 1	0 or 1
DPD Regeneration Switch	On/ Off	Off	Off
Exhaust Differential Pressure	kPa/ psi	Varies	Varies
Exhaust Differential Pressure Sensor	Volts	Varies	Varies
Exhaust Temperature 1	°C/ °F	Varies	Varies
Exhaust Temperature Sensor 1	Volts	Varies	Varies
Exhaust Temperature 2	°C/ °F	Varies	Varies
Exhaust Temperature Sensor 2	Volts	Varies	Varies
Exhaust Throttle Status	On/ Off	Off	Off
Immobilizer Function Programmed	Yes/ No	Yes	Yes
Wrong Immobilizer Signal	Yes/ No	No	No
Immobilizer Signal	Yes/ No	Yes	Yes
Security Wait Time	Inactive/ Time (hour: minute: second)	Inactive	Inactive

Scan Tool Data Definitions

This information will assist in emission or driveability problems. The displays can be viewed while the vehicle is being driven. Always perform the Diagnostic System Check - Engine Controls first. The Diagnostic System Check will confirm proper system operation.

Engine Speed
This parameter displays the rotational speed of the crankshaft as calculated by the ECM based on inputs from the crankshaft position (CKP) sensor or camshaft position (CMP) sensor.

Desired Idle Speed
This parameter displays the idle speed requested by the ECM. The ECM will change desired idle speed based on engine coolant temperature and other inputs.

Calculate Engine Load
This parameter displays the engine load in percent based on inputs to the ECM from various engine sensors. The scan tool will display a lower percentage when the engine is at idle with little or no load. The scan tool will display a higher percentage when the engine is running at high engine speed under a heavy load.

Coolant Temperature
This parameter displays the temperature of the engine coolant as calculated by the ECM using the signal from the engine coolant temperature (ECT) sensor. The scan tool will display a low temperature when the ECT sensor signal voltage is high, and a high temperature when the ECT sensor signal voltage is low.

Engine Coolant Temperature Sensor
This parameter displays the voltage signal sent to the ECM from the engine coolant temperature (ECT) sensor. ECT sensor is a range of value indicating a low voltage when the temperature is high, and a high voltage when the temperature is low.

Intake Air Temperature
This parameter displays the temperature of the intake air as calculated by the ECM using the signal from the intake air temperature (IAT) sensor. The scan tool will display a low temperature when the IAT sensor signal voltage is high, and a high temperature when the IAT sensor signal voltage is low.

Intake Air Temperature Sensor
This parameter displays the voltage signal sent to the ECM from the intake air temperature (IAT) sensor. IAT sensor is a range of value indicating a low voltage when the temperature is high, and a high voltage when the temperature is low.

Fuel Temperature
This parameter displays the temperature of the fuel as calculated by the ECM using the signal from the fuel temperature (FT) sensor. The scan tool will display a low temperature when the FT sensor signal voltage is high, and a high temperature when the FT sensor signal voltage is low.

Fuel Temperature Sensor
This parameter displays the voltage signal sent to the ECM from the fuel temperature (FT) sensor. FT sensor is a range of value indicating a low voltage when the temperature is high, and a high voltage when the temperature is low.

MAF (Mass Air Flow)
This parameter displays the air flow into the engine as calculated by the ECM based on the mass air flow (MAF) sensor input. The scan tool will display a high value at higher engine speeds, and a low value at lower engine speed.

MAF Sensor (Mass Air Flow)
This parameter displays the voltage signal sent to the ECM from the mass air flow (MAF) sensor. MAF sensor is a range of value indicating a low voltage at lower engine speed, and a high voltage at a higher engine speeds.

Barometric Pressure
This parameter displays the barometric pressure (BARO) as calculated by the ECM using the signal from the BARO sensor. The scan tool will display a low barometric pressure in high altitude area.

Barometric Pressure Sensor
This parameter displays the voltage signal sent to the ECM from the barometric pressure (BARO) sensor. BARO sensor is a range of value indicating a low voltage in high altitude area, and a middle voltage in sea level.

Desired Turbocharger Position
This parameter displays turbocharger nozzle position desired by the ECM based on current boost pressure.

Desired Boost Pressure
This parameter displays boost pressure desired by the ECM based on current driving conditions. This can be compared to the actual boost pressure to determine sensor accuracy or turbocharger control problems.

Boost Pressure
This parameter displays the boost pressure in the intake duct as calculated by the ECM using the signal from the boost pressure sensor. The scan tool will display a low boost pressure when the low engine load, and a high boost pressure when the high engine load. Note that the true boost pressure is determined by subtracting barometric pressure from the actual reading.

Boost Pressure Sensor
This parameter displays the voltage signal sent to the ECM from the boost pressure sensor. Boost pressure sensor is a range of value indicating a low voltage when the boost pressure is low (idle or lower engine load) and a high voltage when the boost pressure is high (higher engine load).

Fuel Rail Pressure
This parameter displays the fuel rail pressure as calculated by the ECM using the signal from the fuel rail pressure (FRP) sensor. The scan tool will display a low pressure when the low engine load, and a high pressure when the high engine load.

Fuel Rail Pressure Sensor
This parameter displays the voltage signal sent to the ECM from the fuel rail pressure (FRP) sensor. FRP sensor is a range of value indicating a low voltage when the fuel rail pressure is low, and a high voltage when the fuel rail pressure is high.

FRP Commanded Fuel Flow (Fuel Rail Pressure)
This parameter displays the commanded fuel flow quantity of the fuel rail pressure (FRP) regulator to the fuel rail.

FRP Regulator Command (Fuel Rail Pressure)
This parameter displays the fuel rail pressure (FRP) regulator control duty ratio based on inputs to the ECM from various engine sensors. The scan tool will display a lower percentage when the FRP regulator is controlled to open (fuel supply quantity to the fuel rail is increased). The scan tool will display higher percentage when the FRP regulator is controlled to close (fuel supply quantity to the fuel rail is reduced).

FRP Regulator Feedback (Fuel Rail Pressure)
This parameter displays the fuel rail pressure (FRP) regulator control feedback current as measured by the ECM. The scan tool will display a low current when the FRP regulator is controlled to open (fuel supply quantity to the fuel rail is increased). The scan tool will display a high current when the FRP regulator is controlled to close (fuel supply quantity to the fuel rail is reduced).

Accelerator Pedal Position
This parameter displays the angle of the accelerator pedal as calculated by the ECM using the signals from the accelerator pedal position (APP) sensors. The scan tool will display linearly from 0 to 100% according to the pedal operation.

APP Sensor 1 (Accelerator Pedal Position)
This parameter displays the voltage signal sent to the ECM from the accelerator pedal position (APP) sensor 1 of the APP sensor assembly. APP sensor 1 is a range of value indicating a low voltage when the accelerator pedal is not depressed, and a high voltage when the accelerator pedal is fully depressed.

APP Sensor 2 (Accelerator Pedal Position)
This parameter displays the voltage signal sent to the ECM from the accelerator pedal position (APP) sensor 2 of the APP sensor assembly. APP sensor 2 is a range of value indicating a high voltage when the accelerator pedal is not depressed, and a low voltage when the accelerator pedal is fully depressed.

Desired EGR Position
This parameter displays EGR position desired by the ECM based on current driving conditions. This can be compared to the actual EGR position to determine sensor accuracy or solenoid control problems.

EGR Position 1
This parameter displays the EGR valve position calculated by the ECM using the signal from the individual three EGR position sensors. The scan tool will display a low percentage when the EGR valve is closed, and a high percentage when the ERG valve is opened.

EGR Position 1
This parameter displays the input state of the EGR position sensor 1 to the ECM. When the position sensor is opened, the scan tool displays Low. When the position sensor is closed, the scan tool displays High.

EGR Position 2
This parameter displays the input state of the EGR position sensor 2 to the ECM. When the position sensor is opened, the scan tool displays Low. When the position sensor is closed, the scan tool displays High.

EGR Position 3
This parameter displays the input state of the EGR position sensor 3 to the ECM. When the position sensor is opened, the scan tool displays Low. When the position sensor is closed, the scan tool displays High.

Intake Throttle Solenoid Command
This parameter displays the intake throttle solenoid valve control duty ratio based on inputs to the ECM from various engine sensors. The scan tool will display a lower percentage when the intake throttle solenoid valve is controlled to open. The scan tool will display a higher percentage when the intake throttle solenoid valve is controlled to close.

Desired Intake Throttle Position
This parameter displays intake throttle position desired by the ECM based on current driving conditions. This can be compared to the actual intake throttle position to determine sensor accuracy or solenoid control problems.

Intake Throttle Position
This parameter displays the intake throttle valve position calculated by the ECM using the signal from intake throttle position sensor. The scan tool will display a low percentage when the intake throttle valve is closed, and a high percentage when the intake throttle valve is opened. Note that the intake throttle position indicates over 100% if the solenoid is commanded OFF.

Intake Throttle Position Sensor
This parameter displays the voltage signal sent to the ECM from the intake throttle position sensor. Intake throttle position sensor is a range of value indicating a low voltage when the intake throttle valve is closed to a high voltage when the intake throttle valve is opened.

Idle Up Sensor
This parameter displays the voltage signal sent to the ECM from the idle up sensor. Idle up sensor is a range of value indicating a low voltage when the idle up sensor rotates in a counterclockwise direction to a high voltage when the idle up sensor rotates in a clockwise direction.

Fuel Compensation Cyl. 1 to 4
This parameter displays the adjustment of fuel volume for each cylinder at low engine speed area as calculated by the ECM. The scan tool will display a negative value if the fuel volume is lowered. The scan tool will display a positive value if the fuel volume is increased. If there is a cylinder that is excessively high or low value, it may indicate faulty fuel injector, weak or slightly seized cylinder or an incorrectly programmed fuel injector ID code.

Fuel Supply Pump Status
This parameter displays the learning state of the fuel supply pump. Not Learned indicates initialized state that is replaced to a new ECM or adjustment value is reset. After engine is warm upped, leaning will start at idle speed. Learned indicates learning process is completed state.

Rail Pressure Feedback Mode
This parameter displays the state of the fuel rail pressure feedback to the ECM. Wait Mode indicates the ignition switch is turned ON position. Feedback Mode indicates the engine is run. Shutoff Mode indicates the ignition switch is turned OFF position.

Engine Mode
This parameter displays the state of engine. Ignition On indicates the ignition switch is turned ON position. Cranking indicates the engine is during crank. Running indicates the engine is run. Off indicates the ignition switch is tuned OFF position.

Engine Runtime
This parameter displays the time elapsed since the engine start. The scan tool will display the time in hours, minutes and seconds.

Vehicle Speed
This parameter indicates the vehicle speed calculated by the ECM using the signal from the vehicle speed sensor (VSS). The scan tool will display a low value at lower vehicle speeds, and a high value at higher vehicle speeds.

Starter Switch
This parameter displays the input status of the starter switch to the ECM. When the ignition switch is turned at START position, the scan tool displays On.

Ignition Switch
This parameter displays the input status of the ignition switch to the ECM. When the ignition switch is turned ON position, the scan tool displays On.

Ignition Voltage
This parameter displays the ignition voltage measured at the ignition feed circuit of the ECM. Voltage is applied to the ECM when the ignition switch is ON position.

Battery Voltage
This parameter displays the battery voltage measured at the ECM main relay switched voltage feed circuit of the ECM. Voltage is applied to the ECM when the ECM main relay is energized.

Clutch Pedal Switch
This parameter displays the input state of the clutch pedal switch to the ECM. When the clutch pedal is depressed, scan tool displays Applied. If the Smoother is installed, gearshift clutch input state from the TCM is displayed.

Neutral Switch
This parameter displays the input state of the neutral switch to the ECM. When the transmission gear is Park or Neutral, the scan tool displays Neutral.

Park Brake Switch
This parameter displays the input state of the park brake switch to the ECM. When the park brake lever is pulled, scan tool displays Applied.

Exhaust Brake Switch
This parameter displays the input state of the exhaust brake switch to the ECM. On indicates the exhaust brake switch is closed and allows energizing the exhaust brake solenoid valve and intake throttle depending upon driving condition. Off indicates the exhaust brake switch is open and exhaust brake will not engage.

Exhaust Brake Valve Command
This parameter displays the commanded state of the exhaust brake solenoid valve control circuit. On indicates the exhaust brake solenoid valve is being grounded by the ECM, allowing vacuum pressure to the exhaust brake valve.

Exhaust Brake Cut Request from ABS Module
This parameter displays the state of the exhaust brake cut request to the ECM from the electric hydraulic control unit (EHCU). Active indicates the EHCU is commanding to release the exhaust brake.

Exhaust Brake Cut Request from TCM
This parameter displays the state of the exhaust brake cut request to the ECM from the transmission control module (TCM). Active indicates the TCM is commanding to release the exhaust brake.

ASR Commanded APP (Accelerator Pedal Position)
This parameter displays the controlled angle of the accelerator pedal calculated by the electric hydraulic control unit (EHCU) when anti slip regulator (ASR) system operated. The scan tool will display 100% when the ECM is not controlled to reduce fuel injection quantity. The scan tool will display a lower percentage when the ECM is controlled to reduce fuel injection quantity to reduce drive wheels spinning.

PTO Switch
This parameter displays the state of the PTO switch to the ECM. When the PTO switch is operated by control lever or button, scan tool displays On.

PTO Remote Throttle
This parameter displays the angle of the PTO remote throttle sensor as calculated by the ECM using the signal from the PTO remote throttle sensor. The PTO remote throttle angle is a range of values indicating a low percentage when the throttle sensor is not operated to a high percentage when the throttle sensor is operated.

PTO Remote Throttle Sensor
This parameter displays the voltage signal sent to the ECM from the PTO remote throttle sensor. PTO remote throttle sensor is a range of values indicating a low voltage when the throttle sensor is not operated to a high voltage when the throttle sensor is operated.

Engine Warm Up Switch
This parameter displays the input state of the engine warm up switch to the ECM. On indicates the engine warm up switch is closed and allows energizing the exhaust brake solenoid valve and intake throttle valve depending upon engine condition.

A/C Signal
This parameter displays the state of the air conditioning (A/C) compressor engagement. On indicates the ECM receiving an A/C compressor On signal. Off indicates the ECM is not receiving an A/C compressor On signal.

Refrigerator Switch
This parameter displays the state of the refrigerator compressor engagement. On indicates the ECM receiving a refrigerator compressor On signal. Off indicates the ECM is not receiving a refrigerator compressor On signal.

Oil Level
This parameter displays the state of the engine oil level switch to the ECM. Normal indicaters the engine oil level is not too low for safe operation of the engine. Low indicators the engine oil level is abnormally low and has opened the engine oil level switch.

Glow Relay Command
This parameter displays the commanded state of the glow relay control circuit. On indicates the glow relay control circuit is being grounded by the ECM, allowing voltage to the glow plugs.

Malfunction Indicator Lamp (MIL)
This parameter displays the commanded state of the malfunction indicator lamp (MIL) control circuit. The MIL should be On when the scan tool indicates command On. The MIL should be Off when the scan tool indicates command Off.

Distance While MIL is Activated
This parameter displays the mileage since the malfunction indicator lamp (MIL) is turned ON.

Engine Runtime With MIL Active
This parameter displays the accumulated ignition switch ON time elapsed since the malfunction indicator lamp (MIL) is turned ON. The scan tool will display the time in minutes.

Vane Counter Solenoid Error
This parameter displays an error state of the turbocharger nozzle control actuator from the variable nozzle turbocharger (VNT) control module. Stuck indicates the VNT control module detects an open circuit on the solenoid circuit or a sticking the nozzle control actuator. Short Circuit indicates the VNT control module detects a short circuit on the solenoid circuit.

Vane Position Sensor Error
This parameter displays an error status of the turbocharger nozzle position sensor from the variable nozzle turbocharger (VNT) control module. All High or All Low indicates the VNT control module detects all nozzle position sensor signal are stuck low or high.

Turbocharger Control Module Error
This parameter displays an error status of the variable nozzle turbocharger (VNT) control module system voltage. High voltage indicates the VNT control module detects system voltage is too high.

Total Engine Overspeed Event
This parameter indicates counter of engine overspeed event. Counter will be zero if any DTC is cleared.

Total Engine Coolant Overtemperature Event
This parameter indicates counter of engine overheat event. The counter is active if engine coolant is over 110°C (230°F). Counter will be zero if any DTC is cleared.

Total Fuel Temperature Overtemperature Event
This parameter indicates counter of fuel temperature excessively high condition. The counter is active if fuel temperature is over 90°C (194°F). Counter will be zero if any DTC is cleared.

Total Intake Air Temperature Overtemperature Event
This parameter indicates counter of intake air temperature excessively high condition. The counter is active if intake air temperature is over 60°C (140°F). Counter will be zero if any DTC is cleared.

DPD Mode
This parameter displays the state of the DPD. It mainly indicates an action request or status to the user during regeneration event. 1 or 50 indicates DTC is set, which is not allowing the DPD regeneration. 30 indicates under normal engine operation.

DPD Accumulate Status
This parameter displays the state of the PM accumulations. It indicates that the PM accumulative amount to the filter increases while parameter is increasing from 0 to 5. This parameter uses together with DPD Distance Status parameter to determine regeneration type manually.

DPD Distance Status
This parameter displays the state of the distance since last regeneration. It indicates that the accumulative distance without regeneration event increases while parameter is increasing from 0 to 4. This parameter uses together with DPD Accumulation Status parameter to determine regeneration type manually.

DPD Incomplete Regeneration Status
This parameter indicates an error status of the DPD regeneration. 1 or 2 indicates the frequency of the regeneration event that did not finish within a predetermined time.

DPD Insufficient Regeneration Status
This parameter indicates an error status of the DPD regeneration. 1 or 2 indicates the frequency of incomplete filter purification after the regeneration event.

DPD Regeneration Switch
This parameter displays the input state of the DPD regeneration switch to the ECM. On indicates the DPD regeneration switch is closed and allows entering the regeneration process depending upon PM accumulation condition.

Exhaust Differential Pressure
This parameter displays the exhaust differential pressure as calculated by the ECM using the signal from the exhaust differential pressure sensor. The scan tool will display a low exhaust differential pressure at small PM accumulation, and a high exhaust differential pressure at large PM accumulation.

Exhaust Differential Pressure Sensor
This parameter displays the voltage signal set to the ECM from the exhaust differential pressure sensor. Exhaust differential pressure sensor is a range of value indicating a low voltage at a low differential pressure, such as small PM accumulation, and a high voltage at a high differential pressure, such as large PM accumulation.

Exhaust Temperature 1
This parameter displays the temperature of the exhaust gas in front of filter as calculated by the ECM using the signal from the exhaust gas temperature sensor 1. The scan tool will display a low temperature when the exhaust gas temperature sensor 1 signal voltage is high, and a high temperature when the exhaust gas temperature sensor 1 signal voltage is low.

Exhaust Temperature Sensor 1
This parameter displays the voltage signal sent to the ECM from the exhaust gas temperature sensor 1. Exhaust gas temperature sensor 1 is a range of value indicating a low voltage when the temperature is high, and a high voltage when the temperature is low.

Exhaust Temperature 2
This parameter displays the temperature of the exhaust gas in front of oxygen catalyst as calculated by the ECM using the signal from the exhaust gas temperature sensor 2. The scan tool will display a low temperature when the exhaust gas temperature sensor 2 signal voltage is high, and a high temperature when the exhaust gas temperature sensor 2 signal voltage is low.

Exhaust Temperature Sensor 2
This parameter displays the voltage signal sent to the ECM from the exhaust gas temperature sensor 2. Exhaust gas temperature sensor 2 is a range of value indicating a low voltage when the temperature is high, and a high voltage when the temperature is low.

Exhaust Throttle Status
This parameter displays the commanded state of the exhaust throttle solenoid valve control circuit. On indicates the exhaust throttle solenoid valve is being grounded by the ECM, allowing vacuum pressure to the exhaust throttle valve.

Immobilizer Function Programmed
This parameter displays the state of the immobilizer function programming in the ECM. The scan too; will display Yes or No. Yes indicates the immobilizer security information is correctly programmed in the ECM. No indicates the ECM is not programmed or ECM is reset.

Wrong Immobilizer Signal
This parameter displays the input state of the received response signal to the ECM. When the ECM received wrong responce signal from the immobilizer control unit (ICU), the scan tool displays Yes.

Immobilizer Signal
This parameter displays the input state of the response signal to the ECM. When the ECM received any response signal from the immobilizer control unit (ICU), the scan tool displays Yes.

Security Wait Time

This parameter displays the security wait time length in the ECM. Inactive indicates not in security wait time. Time indicates under security wait time. This wait time stage will prevent any further attempts to enter the security code until the wait time has elapsed. Note that this parameter is not count downed. It keeps displaying the same time until that wait time has elapsed. The ignition switch must be kept at ON position during the wait time period.

Scan Tool Output Controls

Scan Tool Output Control	Descriptions
Fuel Pressure Control	The purpose of this test is for checking whether the fuel rail pressure is changing when commanded within 30 to 80MPa (4,350 to 11,600psi) when commanded. Faulty fuel supply pump, fuel rail pressure (FRP) regulator, pressure limiter valve or other fuel lines could be considered if the differential fuel rail pressure is large.
Pilot Injection Control	The purpose of this test is for checking whether the pilot fuel injection is operated when it is commanded to ON/ OFF. Faulty injector(s) could be considered if engine noise does not change when commanded OFF.
Injection Timing Control	The purpose of this test is for checking whether the main injection timing is changing when commanded Retard/ Advance within -5 to 5°CA.
Injector Forced Drive	The purpose of this test is for checking whether the fuel injector is correctly operating when commanded ON. Faulty injector(s) could be considered if it does not create a clicking noise (solenoid operating noise), contains an interrupted noise or has abnormal noise when commanded ON.
Cylinder Balance Test	The purpose of this test is for checking whether the fuel injector is operating when commanded ON/ OFF. Faulty injector(s) could be considered if engine does not change speed when commanded OFF.
Intake Throttle Solenoid Control	The purpose of this test is for checking whether the intake throttle valve is correctly moved with command. Restricted valve movement by foreign materials, excessive deposits or a faulty valve could be considered if the position difference is large.
EGR Solenoid Control	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 or a faulty valve could be considered if the position difference is large.
Turbocharger Solenoid Control	The purpose of this test is for checking whether the turbocharger nozzle control actuator is correctly moved with command. Restricted actuator movement by foreign materials, excessive deposits, damaged linkage, a faulty actuator or a faulty position sensor could be considered if the solenoid is not moved correctly.
Glow Relay Control	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.
Exhaust Brake Control	The purpose of this test is for checking whether the exhaust brake control solenoid is operating when commanded ON. Faulty circuit(s) or a faulty solenoid could be considered if not energizing when commanded ON.
Exhaust Throttle Control	The purpose of this test is for checking whether the exhaust throttle solenoid valve is operating when commanded ON. Faulty circuit(s) or a faulty exhaust throttle solenoid valve could be considered if not energizing when commanded ON.
DPD Normal Regeneration Control	**Important:** Do not perform this test if the exhaust differential pressure is more than a threshold. The purpose of this test is for DPD filter force regeneration.
DPD Slow Regeneration Control	**Important:** Do not perform this test if the exhaust differential pressure is more than a threshold. And, engine oil must be replaced after DPD slow regeneration is completed. The purpose of this test is for DPD filter force regeneration in case of excessively accumulated PM. This very slow regeneration compared with another one.

Scan Tool 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:

- Scan tool power battery positive voltage at terminal 16.
- Scan tool power ground at terminal 4.
- Common signal ground at terminal 5.

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing Scan Tool Does Not Power Up

Step	Action	Value(s)	Yes	No
1	**Important**: Make sure the scan tool and 24 volts adapter works properly on another vehicle before using this chart. 1. Turn OFF the ignition. 2. Inspect the ROOM LAMP, AUDIO (15A) fuse in the cab. Is the ROOM LAMP, AUDIO (15A) fuse open?	—	Go to Step 2	Go to Step 3
2	Replace the ROOM LAMP, AUDIO (15A) fuse. If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the ROOM LAMP, AUDIO (15A) fuse or replace the shorted attached component. Did you complete the repair?	—	Go to Step 7	—
3	1. Check each circuit at the data link connector (DLC) (B-31) 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-31) at the DLC and a known good 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-31) for an open circuit or high resistance. 2. Repair the circuit(s), clean or tighten ground as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Intermittent Conditions
7	1. Connect the scan tool to the DLC. 2. Attempt to turn ON the scan tool. Does the scan tool ON?	—	System OK	Go to Step 1

Scan Tool Does Not Communicate with CAN Device (Euro 4 Specification)

Circuit Description

The ECM communicates with the scan tool over the controller area network (CAN) link. The ECM, transmission control module (TCM), electric hydraulic control unit (EHCU) and the data recording module (DRM) communicate with each other over the separated CAN link that does not affect to the scan tool communication.

Diagnostic Aids

The following conditions will cause a loss of CAN serial data communication between the scan tool and the ECM.

- A CAN serial data circuit open
- A CAN serial data circuit shorted to ground
- A CAN serial data circuit shorted to voltage
- An internal condition within a module or connector on the CAN serial data circuit, that causes a short to voltage or ground to the CAN serial data circuit

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing Scan Tool Does Not Communicate with CAN Device (Euro 4 Specification)

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	**Important:** Make sure the CANdi module is not malfunctioning. When functioning properly, the CANdi module LED will be flashing. In the event of a problem, the LED will be continually illuminated or not illuminated. 1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Attempt to establish communication with the ECM. Does the scan tool communicate with the ECM?	—	Go to Intermittent Conditions	Go to Step 3
3	1. Inspect for an intermittent, for poor connections and for corrosion at the data link connector (DLC) (pins 6 and 14 of B-31). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 4
4	1. Inspect for an intermittent, for poor connections and for corrosion at the ECM E-12 and J-14 connectors. 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 5
5	1. Check the ECM (30A) slow blow fuse, ECM MAIN (15A) fuse and ECM (10A) fuse. Replace and retest if open. If any fuse continues to open, repair the short to ground on each circuit fed by that fuse. 2. Turn OFF the ignition. 3. Disconnect the ECM J-14 harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Connect a test lamp to ground and check for voltage at ignition voltage supply circuit at the ECM (pin 24 of J-14). Does the test lamp illuminate?	—	Go to Step 7	Go to Step 6

Step	Action	Value(s)	Yes	No
6	Repair the open in the ignition voltage circuit to the ECM. Did you complete the repair?	—	Go to Step 18	—
7	1. Turn OFF the ignition. 2. Disconnect the scan tool from the DLC if connected. 3. Measure the resistance across the CAN Low and High circuits by probing the DLC (pins 6 and 14 of B-31). Is the resistance within the specified value (parallel resistance of the 120 Ω resistor in the ECM and the 120 Ω CAN resistor should be 60 Ω)?	50 to 70 Ω	Go to Step 9	Go to Step 8
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 58 and 78 of J-14). 4. Test the CAN Low and High serial data circuits between the ECM (pins 58 and 78 of J-14) and the DLC (pins 6 and 14 of B-31) for the following conditions: • An open circuit • A short circuit each other • High resistance 5. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 17
9	1. Test the CAN Low and High serial data circuits between the DLC (pins 6 and 14 of B-31) and the ECM (pins 58 and 78 of J-14) or resistor (pins 1 and 2 of B-302) for the following conditions: • A short to ground • A short to voltage 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 10
10	**Notice:** 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 18	Go to Step 11

Step	Action	Value(s)	Yes	No
11	1. Turn OFF the ignition. 2. Reconnect the ECM harness connector if disconnected. 3. Replace the ECM main relay with the glow relay or replace with a known good relay. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to establish communication with the ECM. Does the scan tool communicate with the ECM?	—	Go to Step 16	Go to Step 12
12	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 both voltage supply circuit to the ECM main relay (pins 1 and 2 of X-18). 5. Repair the open circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 13
13	1. Reinstall the ECM main relay. 2. Turn the ignition ON and OFF while listening of feeling for the ECM main relay click. Wait 7 seconds between transitions. Does the ECM main relay click when the ignition switch is turned ON or OFF?	—	Go to Step 15	Go to Step 14
14	Repair the ECM main relay ground circuit between the ECM main relay (pin 5 of X-18) and chassis ground terminal (J-13) for the following conditions: • An open circuit • High resistance or a poor connection at the ECM main relay or ground terminal Did you complete the repair?	—	Go to Step 18	—
15	1. Test the battery voltage circuit between the ECM (pins 2 and 5 of J-14) and the ECM main relay for the following conditions: • An open circuit • High resistance or a poor connection at the ECM or ECM main relay 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 17
16	Replace the ECM main relay. Did you complete the replacement?	—	Go to Step 18	—
17	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 18	—

Step	Action	Value(s)	Yes	No
18	1. Turn OFF the ignition. 2. Reconnect all previously disconnected fuse, relay or harness connector(s). 3. Turn ON the ignition, with the engine OFF. 4. Attempt to establish communication with the ECM. Does the scan tool communicate with the ECM?	—	System OK	Go to Step 3

Scan Tool Does Not Communicate with Keyword Device (Except Euro 4 Specification)

Circuit Description

The ECM, transmission control module (TCM) and supplemental restraint system (SRS) control unit communicates with the scan tool over the Keyword 2000 serial data link. The hill start aid (HSA) control unit communicates with the Keyword 82 serial data link. However, the ECM, TCM, electric hydraulic control unit (EHCU) and the data recording module (DRM) communicate with each other over the controller area network (CAN) link. The CAN link is not used for communication with the scan tool and is shared only among each module.

Diagnostic Aids

The following conditions will cause a loss of Keyword serial data communication between the TCM, SRS control unit and HSA control unit or between the scan tool any control module:

- A Keyword serial data circuit open
- A Keyword serial data circuit shorted to ground
- A Keyword serial data circuit shorted to voltage
- An internal condition within a module or connector on the Keyword serial data circuit, that causes a short to voltage or ground to the Keyword serial data circuit.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing Scan Tool Does Not Communicate with Keyword Device (Except Euro 4 Specification)

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 a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Attempt to communicate with the listed control modules. • ECM • Transmission control module (TCM) (Smoother only) • Hill start aid (HSA) control unit (If so equipped) • Supplemental restraint system (SRS) control unit (If so equipped) • Immobilizer Control Unit (ICU) (If so equipped) Does the scan tool communicate with any of the listed control modules?	—	Go to Step 3	Go to Step 9
3	Does the scan tool communicate with the ECM?	—	Go to Step 4	Go to Lost Communication with The Engine Control Module (ECM)
4	**Notice:** If no Smoother transmission is installed, skip to Step 5. Does the scan tool communicate with the TCM?	—	Go to Step 5	Go to Diagnostic System Check - Transmission Controls in Section 5A Transmission Control System
5	**Notice:** If no HSA system is installed, skip to Step 6. Does the scan tool communicate with the HSA control unit?	—	Go to Step 6	Go to Diagnostic System Check - HSA Controls in Section 4E HSA

Step	Action	Value(s)	Yes	No
6	**Notice:** If no airbag system installed, skip to Step 7. Does the scan tool communicate SRS control unit?	—	Go to Step 7	Go to Diagnostic System Check - SRS Controls in Section 8C SRS Control System
7	**Notice:** If no immobilizer system installed, skip to Step 8. Does the scan tool communicate SRS control unit?	—	Go to Step 8	Go to Diagnostic System Check - Immobilizer Controls in Section 9I Security and Lock
8	Test the Keyword serial data circuit for an intermittently short to ground or intermittently short to voltage. Then, test the Keyword serial data circuit for an intermittently open (based on which control module did not communicate) at the connection in the circuit. Did you find and correct the condition?	—	Go to Step 21	System OK
9	1. Inspect for an intermittent, for a poor connection and for corrosion at the data link connector (DLC) (pin 7 of B-31). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 21	Go to Step 10
10	1. Turn OFF the ignition. 2. Disconnect the ECM E-12 and J-14 harness connectors. 3. Turn ON the ignition, with the engine OFF. 4. Attempt to communicate with the TCM, HSA control unit and SRS control unit. Does the scan tool communicate with the TCM, ICU, HSA control unit and SRS control unit?	—	Go to Step 16	Go to Step 11
11	**Notice:** If no Smoother transmission is installed, skip to Step 12. 1. Turn OFF the ignition, 2. Reconnect the ECM E-12 and J-14 harness connectors. 3. Disconnect the TCM B-109, B-110, B-111 and B-112 harness connectors. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to communicate with the ECM, HSA control unit and SRS control unit. Does the scan tool communicate with the ECM, ICU, HSA control unit and SRS control unit?	—	Go to Step 17	Go to Step 12

Step	Action	Value(s)	Yes	No
12	**Notice:** If no HSA system is installed, skip to Step 13. 1. Turn OFF the ignition. 2. Reconnect the ECM E-12 and J-14 harness connectors if disconnected. 3. Disconnect the HSA control unit B-14 harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to communicate with the ECM and SRS control unit. Does the scan tool communicate with the ECM, ICU and SRS control unit?	—	Go to Step 18	Go to Step 13
13	**Notice:** If no airbag system installed, skip to Step 14. 1. Turn OFF the ignition. 2. Reconnect the HSA control unit B-14 harness connector if disconnected. 3. Reconnect the ECM E-12 and J-14 harness connectors if disconnected. 4. Reconnect the TCM B-109, B-110, B-111 and B-112 harness connectors if disconnected. 5. Disconnect the SRS control unit B-129 harness connector. 6. Turn ON the ignition, with the engine OFF. 7. Attempt to communicate with the ECM, TCM and HSA control unit. Does the scan tool communicate with the ECM, TCM, ICU and HSA control unit?	—	Go to Step 19	Go to Step 14
14	**Notice:** If no immobilizer system installed, skip to Step 15. 1. Turn OFF the ignition. 2. Reconnect the HSA control unit B-14 harness connector if disconnected. 3. Reconnect the ECM E-12 and J-14 harness connectors if disconnected. 4. Reconnect the TCM B-109, B-110, B-111 and B-112 harness connectors if disconnected. 5. Reconnect the SRS control unit B-129 harness connector if disconnected. 6. Disconnect the immobilizer control unit (ICU) harness connector. 7. Turn ON the ignition, with the engine OFF. 8. Attempt to communicate with the ECM, TCM, HSA control unit and SRS control unit. Does the scan tool communicate with the ECM, TCM, HSA control unit and SRS control unit?	—	Go to Step 20	Go to Step 15
15	Repair the open circuit, short to ground or short to voltage on the Keyword serial data circuit between the DLC and ECM, TCM, ICU, HSA control unit or SRS control unit. Did you complete the repair?	—	Go to Step 21	—

Step	Action	Value(s)	Yes	No
16	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 21	—
17	**Important:** Replacement TCM must be programmed and learned. Replace the TCM. Refer to TCM in Section 5A Transmission Control System. Did you complete the replacement?	—	Go to Step 21	—
18	**Important:** Replacement HSA control unit must be learned. Replace the HSA control unit. Refer to HSA Control Unit in Section 4E Hill Start Aid (HSA). Did you complete the replacement?	—	Go to Step 21	—
19	Replace the SRS control unit. Refer to SRS Control Unit in Section 8B Supplemental Restraint System (SRS). Did you complete the replacement?	—	Go to Step 21	—
20	Replace the ICU. Refer to Immobilizer Control Unit & Programming in Section 9I Security and Lock. Did you complete the replacement?	—	Go to Step 21	—
21	Attempt to establish communication with the ECM, TCM, ICU, HSA control unit and SRS control unit. Does the scan tool communicate with the ECM, TCM, ICU, HSA control unit and SRS control unit?	—	System OK	Go to Step 2

Lost Communication with The Engine Control Module (ECM) (Except Euro 4 Specification)

Circuit Description

The ECM, transmission control module (TCM) and supplemental restraint system (SRS) control unit communicates with the scan tool over the Keyword 2000 serial data link. The hill start aid (HSA) control unit communicates with the Keyword 82 serial data link. However, the ECM, TCM, electric hydraulic control unit (EHCU) and the data recording module (DRM) communicate with each other over the controller area network (CAN) link. The CAN link is not used for communication with the scan tool and is shared only among each module.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing Lost Communication with The Engine Control Module (ECM) (Except Euro 4 Specification)

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 communication with the ECM. Does the scan tool communicate with the ECM?	—	Go to Intermittent Conditions	Go to Step 3
3	1. Inspect for an intermittent, for poor connections and for corrosion at the ECM E-12 and J-14 connectors. 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 4
4	1. Check the ECM (30A) slow blow fuse, ECM MAIN (15A) fuse and ECM (10A) fuse. Replace and retest if open. If any fuse continues to open, repair the short to ground on each circuit fed by that fuse. 2. Turn OFF the ignition. 3. Disconnect the ECM J-14 harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Connect a test lamp to ground and check for voltage at ignition voltage supply circuit at the ECM (pin 24 of J-14). Does the test lamp illuminate?	—	Go to Step 6	Go to Step 5
5	Repair the open in the ignition voltage circuit to the ECM. Did you complete the repair?	—	Go to Step 15	—

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for a poor connection and corrosion at the harness connector of the ECM (pin 38 of J-14). 4. Test the Keyword serial data circuits between the ECM (pin 38 of J-14) and the DLC (pin 7 of B-31) for an open circuit or high resistance. 5. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 7
7	**Notice:** 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 15	Go to Step 8
8	1. Turn OFF the ignition. 2. Reconnect the ECM harness connector if disconnected. 3. Replace the ECM main relay with the glow relay or replace with a known good relay. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to establish communication with the ECM. Does the scan tool communicate with the ECM?	—	Go to Step 13	Go to Step 9
9	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 both voltage supply circuit to the ECM main relay (pins 1 and 2 of X-18). 5. Repair the open circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
10	1. Reinstall the ECM main relay. 2. Turn the ignition ON and OFF while listening of feeling for the ECM main relay click. Wait 7 seconds between transitions. Does the ECM main relay click when the ignition switch is turned ON or OFF?	—	Go to Step 12	Go to Step 11
11	Repair the ECM main relay ground circuit between the ECM main relay (pin 5 of X-18) and chassis ground terminal (J-13) for the following conditions: • An open circuit • High resistance or a poor connection at the ECM main relay or ground terminal Did you complete the repair?	—	Go to Step 15	—

Step	Action	Value(s)	Yes	No
12	1. Test the battery voltage circuit between the ECM (pins 2 and 5 of J-14) and the ECM main relay for the following conditions: • An open circuit • High resistance or a poor connection at the ECM or ECM main relay 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	Replace the ECM main relay. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	1. Turn OFF the ignition. 2. Reconnect all previously disconnected fuse, relay or harness connector(s). 3. Turn ON the ignition, with the engine OFF. 4. Attempt to establish communication with the ECM. Does the scan tool 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.

Test Description

The number below refers to the step number on the Circuit/ System Testing.

5. If the fuel rail pressure (FRP) regulator low side circuits between the ECM and the FRP regulator are shorted to ground, FRP Regulator Feedback will be approximately 300mA or more low as compared with normal.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing 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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Crank the engine for the specified amount of time. 4. Monitor the DTC Information with a scan tool. Does the scan tool display any DTCs that failed this ignition?	15 seconds	Go to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition. 2. Wait 1 minute for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Fuel Rail Pressure parameter with a scan tool. Does the scan tool indicate the specified value?	0 MPa (0 psi)	Go to Step 4	Go to Step 6
4	Notice: If the vehicle has run out of fuel, air may be trapped in the fuel system. 1. Make sure the fuel tank have adequate fuel and the fuel quality is good (take a sample). 2. Observe the Fuel Rail Pressure parameter on the scan tool while cranking over the engine for 5 seconds. Does the scan tool indicate more than the specified value during crank?	25 MPa (3,600 psi)	Go to Step 9	Go to Step 5
5	Observe the FRP Regulator Feedback parameter on the scan tool while cranking over the engine for 5 seconds. Does the scan tool indicate more than the specified value during crank?	800 mA	Go to Fuel System in Section 1D Engine Fuel	Go to Step 8

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-19). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 82, 87, 90 and 101 of E-12). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 7
7	Replace the FRP sensor. Refer to Fuel Pressure Sensor in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 11	—
8	Repair the short to ground between the ECM (pins 89 and 97 of E-12) and the FRP regulator (pin 2 of E-17). Did you compete the repair?	—	Go to Step 11	—
9	1. Check for normal readings at key up for the following sensor inputs: Use the Scan Tool Data List or a known good vehicle to determine nominal values. • Engine Coolant Temperature Sensor • Barometric Pressure (BARO) Sensor • Boost Pressure Sensor • Intake Throttle Position Sensor 2. Repair the circuit(s) or replace the sensor as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
10	1. Other possible causes for the no-start condition: • Engine mechanical timing • 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 or exhaust plugged solid. • Poor engine compression. • Water or gasoline contamination in fuel. 2. Repair as necessary. Did you find and correct the condition?	—	Go to Step 11	—

Step	Action	Value(s)	Yes	No
11	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 12	Go to Step 2
12	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0016 (Flash Code 16)

Circuit Description

The crankshaft position (CKP) sensor is located on the flywheel housing. The sensor rotor is fixed on the flywheel. There are 56 notches spaced 6° apart and a 30° section that is open span. This open span portion allows for the detection of top dead center (TDC).
The camshaft position (CMP) sensor is installed on the cylinder head at the rear of the camshaft gear. The CMP sensor detects total of five holes per one engine cycle (four holes arranged equally every 90° and one reference hole on the camshaft gear surface).
Detecting the open span portion from the CKP sensor and one reference hole from the CMP sensor, the ECM determines cylinder #1 compression TDC to ensure they correlate with each other. If the ECM detects both signals are out of synchronization, this DTC will set.

Condition for Running the DTC

- DTCs P0335, P0336, P0340 and P0341 are not set.
- The ignition switch is ON.
- The CKP sensor signal pulse is detected.
- The CMP sensor signal pulse is detected.

Condition for Setting the DTC

- The ECM detects that the CKP sensor signals and CMP sensor signals are out of synchronization during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- This DTC is cause by an incorrect mechanical timing condition, which is most likely caused by wrong installation of timing gear, flywheel or camshaft.

Circuit/ System Testing DTC P0016

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. If the engine does not start, crank over the engine for 10 seconds. 4. Monitor the DTC Information with a scan tool. Is DTC P0335, P0336, P0340 or P0341 also set?	—	Go to Applicable DTC	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Inspect the crankshaft position (CKP) sensor and the camshaft position (CMP) sensor for the following conditions: • Physical damage of sensor • Loose or improper installation of sensor • Excessive air gap • Foreign material passing between sensor and sensor rotor or camshaft gear • Physical damage of sensor rotor or camshaft gear • Loose or improper installation of sensor rotor or camshaft gear 2. Inspect the engine mechanical timing for an incorrectly installed timing gear or camshaft. **Notice:** If the flywheel dowel pin is missing or pushed in and the flywheel is incorrectly installed, this DTC may set. 3. Repair or replace as necessary. Did you complete the repair?	—	Go to Step 4	—
4	1. Reconnect all previously disconnected harness connector(s) if disconnected. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. If the engine does not start, crank over the engine for 10 seconds. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 5
5	Observe the DTC Information with the a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0045 (Flash Code 33)

Circuit Description

The position of the turbocharger nozzle is controlled by the variable nozzle turbocharger (VNT) control module based on the command from the ECM. The VNT control module controls a drive signal to the turbocharger nozzle control solenoid that installed to the turbocharger assembly by utilizing position sensor inputs to control the turbocharger nozzles. When the engine is not under load, the turbocharger nozzles are in an open position, or no boost condition. When the engine is under load, the VNT control module commands the control solenoid to close the turbocharger nozzles, thus increasing the boost. The ECM will vary the boost dependant upon the load requirements of the engine. The VNT control module has the ability to perform internal diagnostics for voltage and signal input and output status. If the VNT control module senses an error in the nozzle position signals, solenoid control signal, or VNT control module voltage error, the VNT control module will send a message to the ECM via the controller area network (CAN) communication bus and sets this DTC.

Condition for Running the DTC

- The battery voltage is between 20 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The VNT control module detects system voltage is too high.
- The VNT control module detects all nozzle position sensor signal are stuck low or high.
- The VNT control module detects an open circuit, short to ground or short to voltage circuit on the solenoid circuit.
- The VNT control module detects solenoid or nozzle control is stuck condition.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A sticking or intermittently sticking the turbocharger nozzle control actuator may set this DTC.

Notice: If the VNT control module detects an open circuit on the solenoid circuit, the Vane Control Solenoid Error parameter on the scan tool indicates Stuck.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0045

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Observe the Turbocharger Control Module Error parameter with a scan tool. Does the scan tool indicate High Voltage?	—	Refer to DTC P0563	Go to Step 3
3	Observe the Vane Control Solenoid Error parameter with a scan tool. Does the scan tool indicate Stuck or Short Circuit?	—	Go to Step 5	Go to Step 4
4	Observe the Vane Position Sensor Error parameter with a scan tool. Does the scan tool indicate All High or All Low?	—	Go to Step 9	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
5	1. Inspect the turbocharger assembly for the following conditions: • Physical damage of turbocharger • Turbocharger nozzle control linkage damaged • Physical damage of VNT actuator & sensor • Loose or improper installation of VNT actuator & sensor 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 6
6	1. Turn OFF the ignition. 2. Disconnect the VNT actuator & sensor harness connector. 3. Connect a test lamp between the each solenoid circuit (pins 6, 7 and 8 of E-2) and a known good ground. 4. Turn ON the ignition, with the engine OFF. **Notice:** Ignition switch must be cycled when the test lamp is probed to other positions. Is there circuit which did not illuminate, or continuously illuminate the test lamp (note that the test lamp illuminate then go out normally)?	—	Go to Step 8	Go to Step 7
7	1. Test the solenoid circuit between the VNT control module (pins 10, 11 and 12 of E-4) and the actuator & sensor (pins 6, 7 and 8 of E-2) for a short circuit each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 16
8	1. Test the solenoid circuits (which ever circuit did not illuminate, or continuously illuminate at Step 6) between the VNT control module (pins 10, 11 and 12 of E-4) and the actuator & sensor (pins 6, 7 and 8 of E-2) for the following conditions: • An open circuit • A short to ground • A short to battery or ignition voltage • A short to the position sensor circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
9	1. Turn OFF the ignition. 2. Connect a DMM between the position sensor reference voltage circuit (pin 1 of E-2) and a known good ground. 3. Turn ON the ignition, with the engine OFF. Is the DMM voltage within the specified value?	8.0 to 10.0 volts	Go to Step 10	Go to Step 13

Step	Action	Value(s)	Yes	No
10	Connect a DMM between the each position sensor signal circuit (pins 2, 3 and 4 of E-2) and a known good ground. Is there circuit which did not voltage reading within the specified value?	4.0 to 6.0 volts	Go to Step 14	Go to Step 11
11	1. Test the position sensor signal circuits between the VNT control module (pins 1, 2 and 3 of E-4) and the actuator & sensor (pins 2, 3 and 4 of E-2) for a short circuit each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 12
12	Connect a DMM across the position sensor reference voltage circuit and the low reference circuit (pins 1 and 5 of E-2). Is the DMM voltage more than the specified value?	8.0 to 10.0 volts	Go to Step 16	Go to Step 15
13	1. Test the position sensor reference voltage circuit between the VNT control module (pin 8 of E-4) and the actuator & sensor (pin 1 of E-2) for the following conditions: • An open circuit • A short to ground • A short to the low reference 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
14	1. Test the position sensor signal circuits (which ever voltage reading did not read within the specified value at Step 10) between the VNT control module (pins 1, 2 and 3 of E-4) and the actuator & sensor (pins 2, 3 and 4 of E-2) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • A short to the reference voltage 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
15	1. Test the position sensor low reference circuit between the VNT control module (pin 4 of E-4) and the actuator & sensor (pin 5 of E-2) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 17

Step	Action	Value(s)	Yes	No
16	1. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the actuator & sensor (pins 1, 2, 3, 4, 5, 6, 7 and 8 E-2). 2. 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 VNT control module harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the VNT control module (pins 1, 2, 3, 4, 8, 10, 11 and 12 of E-4). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
18	Replace the turbocharger. Refer to Turbocharger Assembly in Section 1J Induction. Did you complete the replacement?	—	Go to Step 20	—
19	Replace the VNT control module. Refer to VNT Control Module Replacement in Section 1J Induction. Did you complete the replacement?	—	Go to Step 20	—
20	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 21
21	Observe the DTC information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0079 or P0080 (Flash Code 38)

Circuit Description

The ECM controls the exhaust throttle solenoid valve based on the diesel particulate defuser (DPD) system regeneration status. The exhaust throttle solenoid energizes to apply vacuum pressure to the diaphragm chamber to operate exhaust throttle valve that is installed rear of the DPD housing. If the ECM detects an improper voltage level on the exhaust throttle solenoid valve control circuit, DTC P0079 or P0080 will set.

Condition for Running the DTC

- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects a low voltage condition on the exhaust throttle solenoid control circuit for longer than 3 seconds when the solenoid is commanded OFF. (DTC P0079)
- The ECM detects a high voltage condition on the exhaust throttle solenoid control circuit for longer than 3 seconds when the solenoid is commanded ON. (DTC P0080)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

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 Circuit/ System Testing.
DTC P0080
3. If the exhaust throttle solenoid valve control circuit between the ECM and the relay is normal, voltage level low DTC P0079 will set.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0079

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the exhaust throttle solenoid valve harness connector. 3. Connect the test lamp between the ignition voltage feed circuit of the exhaust throttle solenoid valve (pin 2 of J-59) 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 (pin 1 of J-59) and battery voltage. 2. Perform the Exhaust Throttle Control with a scan tool. 3. Command the solenoid valve ON and OFF. Does the test lamp turn ON and OFF with each command?	—	Go to Step 9	Go to Step 5

Step	Action	Value(s)	Yes	No
5	Does the test lamp remain illuminated with each command?	—	Go to Step 8	Go to Step 7
6	Repair the open circuit or high resistance between the ECM MAIN (15A) fuse and the exhaust throttle solenoid valve (pin 1 of J-59). Check the ECM MAIN (15A) fuse first. Did you complete the repair?	—	Go to Step 13	—
7	1. Test the control circuit between the ECM (pin 102 of E-12) and the solenoid valve (pin 1 of J-59) 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 102 of E-12) and the solenoid valve (pin 1 of J-59) 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. Inspect for an intermittent and for poor connection at the harness connector of the solenoid valve (pin 1 and 2 of J-59). 2. 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 poor connection at the harness connector of the ECM (pin 102 of E-12). 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 throttle solenoid valve. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Monitor the DTC information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0080

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 a scan tool. 2. Perform the Exhaust Throttle Control with a scan tool. 3. Command the solenoid valve ON and OFF. Does the solenoid valve click with each command?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Remove the exhaust throttle solenoid valve. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC P0079 set, but not DTC P0080?	—	Go to Step 5	Go to Step 4
4	1. Test the control circuit between the ECM (pin 102 of E-12) and the solenoid valve (pin 1 of J-59) 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 throttle solenoid valve. Did you complete the replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Perform the Exhaust Throttle Control with a scan tool. 5. Command the solenoid valve ON and OFF. Does the exhaust throttle solenoid valve click with each command?	—	Go to Step 8	Go to Step 3
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0087 (Flash Code 225)

Description

The common rail fuel system is comprised of two fuel pressure sections: a suction side between the fuel tank and the fuel supply pump and a high-pressure side between the fuel supply pump and the fuel injectors. Fuel is drawn from the fuel tank via a feed pump and then pumped into the fuel rail by two plungers, all of which are internal to the fuel supply pump. This high pressure is regulated by the ECM using the fuel rail pressure (FRP) regulator dependant upon values from the FRP sensor attached to the fuel rail. In case of fuel rail overpressure, a pressure limiter valve threaded into the fuel rail will open to release overpressure and return fuel back to the fuel tank. If the ECM detects that the fuel rail pressure went excessively high, then sharply decreased, this DTC will set indicating high fuel pressure, which activated the pressure limiter valve.

Condition for Running the DTC

- DTCs P0192, P0193, P060B and P0651 are not set.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the pressure limiter valve is activated with overpressure (more than 170 MPa [24,600 psi]) in the fuel rail.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- An intermittently sticking FRP regulator may have allowed the fuel pressure to become high enough to open the pressure limiter valve.
- A skewed FRP sensor value can set this DTC. The FRP Sensor on the scan tool should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute.

Notice: 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 supply pump is interrupted and this DTC may set. Perform bleeding of fuel system after refilling.

Test Description

The numbers below refers to the step number on the Circuit/ System Testing.
7. This step checks for a fuel restriction by determining if a high vacuum is being pulled on the fuel system during normal operation.
8. This step checks for an air leak on the suction side of the fuel system by determining if a vacuum can be pulled when a fuel line is plugged.

Schematic Reference: Fuel System Routing Diagram and Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0087

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0088, P0089, P0091, P0092, P0192, P0193, P0201 - P0204, P2146 or P2149 set?	—	Go to Applicable DTC	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Place the transmission in Neutral and set the parking brake. 3. Start the engine. 4. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 4	An intermittent problem by foreign material in the fuel system is suspected. Go to Step 13
4	1. Turn OFF the ignition. 2. Wait 1 minute for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Fuel Rail Pressure (FRP) Sensor parameter with the scan tool. Does the scan tool indicate within the specified value?	0.9 to 1.0 volt	Go to Step 5	Go to Step 12
5	1. Start the engine. 2. Perform the Cylinder Balance Test with a scan tool. 3. Command each injector OFF and verify an engine speed change for each injector. Is there an injector that does not change engine speed when commanded OFF?	—	Go to Step 15	Go to Step 6
6	1. Inspect the fuel system line connections between the fuel tank and the fuel supply 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 supply 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 rail pressure fluctuations especially at high engine speed and load, which may set this DTC. 2. Pump the priming pump until it becomes firm. If there is a leak on the suction side of the fuel system between the priming pump and the fuel supply pump, the priming pump will not build up sufficient firmness and fuel leakage may occur. 3. Start the engine and check for high side fuel system leaks at the fuel supply pump and fuel rail. **Notice:** Fuel may leak under the cylinder head cover from the inlet high pressure line. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil. 4. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 7

Step	Action	Value(s)	Yes	No
7	1. Turn OFF the ignition. 2. Remove the rubber fuel hose from the fuel filter housing (fuel supply pump side). Use a pan to catch the fuel from the removed fuel line. **Important:** The fuel pressure/ vacuum gauge connector and the adapter hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the tools line may damage the fuel supply pump. 3. Connect the gauge adapter (5-8840-2844-0/ EN-47667) with fuel pressure/ vacuum gauge assembly (5-8840-2844-0/ J-44638) in series with the filter housing and the disconnected fuel hose. Ensure the service tool and fuel line connections are tight. 4. Bleed the fuel system by priming the priming pump until it becomes firm, then crank over the engine for a maximum of 5 seconds. Repeat as necessary until the engine starts. 5. Let the engine run at idle for at least 1 minute. 6. Monitor the fuel pressure/ vacuum gauge while holding the engine speed higher than 2500 RPM for a minimum of 1 minute. Does the fuel pressure/ vacuum gauge ever indicate a larger vacuum than the specified amount during the test?	5 inHg	Go to Step 9	Go to Step 8
8	1. Fully clamp off a fuel hose as close to the fuel tank as possible (this will draw vacuum on the fuel system). You can also disconnect a fuel line and plug it. 2. Start the engine and turn the idle up control knob to the highest position. (Full clockwise direction. The idle speed is increased up to 1600 RPM.) 3. Monitor the fuel pressure/ vacuum gauge. **Notice:** Release the clamp or open the plug when the gauge is likely to be more than 8 inHg during the test. Can a vacuum of at least the specified amount be pulled on the fuel system?	8 inHg	Go to Step 11	Go to Step 10
9	1. Inspect the fuel lines between the fuel supply pump and fuel tank for being crushed or kinked. 2. Inspect for a plugged fuel tank vent hose. 3. Inspect inside the fuel tank (if possible) for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. 4. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 13

Step	Action	Value(s)	Yes	No
10	1. Inspect the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 11
11	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP regulator (pins 1 and 2 of E-17). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 89, 97, 105 and 113 of E-12). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
12	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-19). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 82, 87, 90 and 101 of E-12). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
13	Replace the fuel filter element. Refer to Fuel Filter Element in Section 1D Engine Fuel . Did you complete the replacement?	—	Go to Step 17	—
14	Replace the FRP sensor. Refer to Fuel Pressure Sensor in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 17	—
15	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Injector in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
16	**Important**: The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. **Notice:** Always replace the fuel filter element when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter element. Refer to Fuel Supply Pump and Fuel Filter Element in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 18
18	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0088 (Flash Code 118)

Description

The common rail fuel system is comprised of two fuel pressure sections: a suction side between the fuel tank and the fuel supply pump and a high-pressure side between the fuel supply pump and the fuel injectors. Fuel is drawn from the fuel tank via a feed pump and then pumped into the fuel rail by two plungers, all of which are internal to the fuel supply pump. This high pressure is regulated by the ECM using the fuel rail pressure (FRP) regulator dependant upon values from the FRP sensor attached to the fuel rail.
If the ECM detects that the fuel pressure went excessively high for a certain length of time, this DTC will set (First Stage). If the ECM detects that during the same ignition cycle the fuel pressure rose even higher than the amount to set DTC P0088 for a certain length of time, the MIL will be illuminated (Second Stage). If the MIL is illuminated, the fuel pressure was too high and the pressure limiter valve did not active or did not active quick enough.

Condition for Running the DTC

- DTCs P0192, P0193, P060B and P0651 are not set.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

First Stage

- The ECM detects that the fuel rail pressure is more than 185 MPa (26,800 psi) for longer than 5 seconds.

Second Stage

- The ECM detects that the fuel rail pressure is more than 190 MPa (27,500 psi) for longer than 5 seconds.

Action Taken When the DTC Sets

First Stage

- The ECM will not illuminate the MIL or SVS lamp. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type D. (Euro 4 specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 specification)
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.

Second Stage

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

First Stage

- Refer to DTC Type Definitions for Condition for Clearing the DTC - Type D. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 specification)

Second Stage

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- An intermittently sticking FRP regulator may have allowed the fuel pressure to become high enough to set this DTC.
- Normal Fuel Rail Pressure readings on the scan tool with the engine running in neutral at idle is around 27 to 33 MPa (3,900 to 4,800 psi) after warm up.
- A skewed FRP sensor value can set this DTC. The FRP Sensor on the scan tool should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute.

Test Description

The numbers below refers to the step number on the Circuit/ System Testing.
7. This step checks for a fuel restriction by determining if a high vacuum is being pulled on the fuel system during normal operation.
8. This step checks for an air leak on the suction side of the fuel system by determining if a vacuum can be pulled when a fuel line is plugged.

Schematic Reference: Fuel System Routing Diagram and Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0088

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0089, P0091, P0092, P0192, P0193, P0201 - P0204, P2146 or P2149 set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition. 2. Place the transmission in Neutral and set the parking brake. 3. Start the engine. 4. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the Fuel Rail Pressure parameter with a scan tool. Does the Fuel Rail Pressure parameter ever exceed the specified value?	180 MPa (26,000 psi)	Go to Step 4	An intermittent problem by foreign material in the fuel system is suspected. Go to Step 13
4	1. Turn OFF the ignition. 2. Wait 1 minute for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Fuel Rail Pressure (FRP) Sensor parameter with the scan tool. Does the scan tool indicate within the specified value?	0.9 to 1.0 volt	Go to Step 5	Go to Step 12
5	1. Start the engine. 2. Perform the Cylinder Balance Test with a scan tool. 3. Command each injector OFF and verify an engine speed change for each injector. Is there an injector that does not change engine speed when commanded OFF?	—	Go to Step 15	Go to Step 6

Step	Action	Value(s)	Yes	No
6	1. Inspect the fuel system line connections between the fuel tank and the fuel supply 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 supply 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 rail pressure fluctuations especially at high engine speed and load, which may set this DTC. 2. Pump the priming pump until it becomes firm. If there is a leak on the suction side of the fuel system between the priming pump and the fuel supply pump, the priming pump will not build up sufficient firmness and fuel leakage may occur. 3. Start the engine and check for high side fuel system leaks at the fuel supply pump and fuel rail. **Notice:** Fuel may leak under the cylinder head cover from the inlet high pressure line. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil. 4. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 7
7	1. Turn OFF the ignition. 2. Remove the rubber fuel hose from the fuel filter housing (fuel supply pump side). Use a pan to catch the fuel from the removed fuel line. **Important:** The fuel pressure/ vacuum gauge connector and the adapter hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the tools line may damage the fuel supply pump. 3. Connect the gauge adapter (5-8840-2844-0/ EN-47667) with fuel pressure/ vacuum gauge assembly (5-8840-2844-0/ J-44638) in series with the filter housing and the disconnected fuel hose. Ensure the service tool and fuel line connections are tight. 4. Bleed the fuel system by priming the priming pump until it becomes firm, then crank over the engine for a maximum of 5 seconds. Repeat as necessary until the engine starts. 5. Let the engine run at idle for at least 1 minute. 6. Monitor the fuel pressure/ vacuum gauge while holding the engine speed higher than 2500 RPM for a minimum of 1 minute. Does the fuel pressure/ vacuum gauge ever indicate a larger vacuum than the specified amount during the test?	5 inHg	Go to Step 9	Go to Step 8

Step	Action	Value(s)	Yes	No
8	1. Fully clamp off a fuel hose as close to the fuel tank as possible (this will draw vacuum on the fuel system). You can also disconnect a fuel line and plug it. 2. Start the engine and turn the idle up control knob to the highest position. (Full clockwise direction. The idle speed is increased up to 1600 RPM.) 3. Monitor the fuel pressure/ vacuum gauge. **Notice:** Release the clamp or open the plug when the gauge is likely to be more than 8 inHg during the test. Can a vacuum of at least the specified amount be pulled on the fuel system?	8 inHg	Go to Step 11	Go to Step 10
9	1. Inspect the fuel lines between the fuel supply pump and fuel tank for being crushed or kinked. 2. Inspect for a plugged fuel tank vent hose. 3. Inspect inside the fuel tank (if possible) for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. 4. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 13
10	1. Inspect the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 11
11	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP regulator (pins 1 and 2 of E-17). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 89, 97, 105 and 113 of E-12). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16

Step	Action	Value(s)	Yes	No
12	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-19). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 82, 87, 90 and 101 of E-12). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
13	Replace the fuel filter element. Refer to Fuel Filter Element in Section 1D Engine Fuel . Did you complete the replacement?	—	Go to Step 17	—
14	Replace the FRP sensor. Refer to Fuel Pressure Sensor in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 17	—
15	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Injector in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 17	—
16	**Important**: The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. **Notice:** Always replace the fuel filter element when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter element. Refer to Fuel Supply Pump and Fuel Filter Element in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 18
18	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0089 (Flash Code 151)

Description

The common rail fuel system is comprised of two fuel pressure sections: a suction side between the fuel tank and the fuel supply pump and a high-pressure side between the fuel supply pump and the fuel injectors. Fuel is drawn from the fuel tank via a feed pump and then pumped into the fuel rail by two plungers, all of which are internal to the fuel supply pump. This high pressure is regulated by the ECM using the fuel rail pressure (FRP) regulator dependant upon values from the FRP sensor attached to the fuel rail. If the ECM detects that fuel pressure is a certain pressure higher than the desired pressure, this DTC will set.

Condition for Running the DTC

- DTCs P0091, P0092, P0192, P0193, P060B, P0651, P0201 - P0204, P1261, P1262, P2146 and P2149 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the actual fuel rail pressure is more than 40 MPa (5,800 psi) over the desired pressure for longer than 5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- An intermittently sticking FRP regulator may have allowed the fuel pressure to become high enough to set this DTC.
- Normal Fuel Rail Pressure readings on the scan tool with the engine running in neutral at idle is around 27 to 33 MPa (3,900 to 4,800 psi) after warm up.
- A skewed FRP sensor value can set this DTC. The FRP Sensor on the scan tool should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute.

Schematic Reference: Fuel System Routing Diagram and Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0089

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0091, P0092, P0192, P0193, P0201 - P0204, P2146 or P2149 set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition. 2. Wait 1 minute for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Fuel Rail Pressure (FRP) Sensor parameter with the scan tool. Does the scan tool indicate within the specified value?	0.9 to 1.0 volt	Go to Step 4	Go to Step 5

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP regulator (pins 1 and 2 of E-17). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 89, 97, 105 and 113 of E-12). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 6
5	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-19). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 82, 87, 90 and 101 of E-12). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
6	1. Turn OFF the ignition. 2. Place the transmission in Neutral and set the parking brake. 3. Start the engine. 4. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter with a scan tool. Does the Fuel Rail Pressure parameter follow within the specified value quick enough (compare with a similar unit if available)?	± 5 MPa (± 725 psi)	Go to Step 7	Go to Step 9
7	**Notice:** An intermittent problem by foreign material in the fuel is suspected. Replace the fuel filter element. Refer to Fuel Filter Element in Section 1D Engine Fuel . Did you complete the replacement?	—	Go to Step 10	—
8	Replace the FRP sensor. Refer to Fuel Pressure Sensor in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 10	—

Step	Action	Value(s)	Yes	No
9	**Important**: The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. **Notice:** Always replace the fuel filter element when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter element. Refer to Fuel Supply Pump and Fuel Filter Element in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 10	—
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 11
11	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0091 or P0092 (Flash Code 247)

Circuit Description

The fuel rail pressure (FRP) regulator is installed to the fuel supply pump and controls the suction fuel quantity into the fuel rail. The FRP regulator is fully opened in the normal state and larger drive current results in smaller opening. The ECM calculates desired fuel rail pressure and fuel flow rate and it compares the calculated desired fuel rail pressure to the actual value to determine the FRP regulator position. When the actual fuel rail pressure is higher than the desired value, the FRP regulator is closed to decease the flow rate. If the ECM detects an excessively low or high FRP regulator solenoid feedback current, DTC P0091 or P0092 will set.

Condition for Running the DTC

- DTCs P060B is not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the FRP regulator feedback current is less than 50mA, or more than 1000mA below the desired current. (DTC P0091)
- The ECM detects that the FRP regulator feedback current is more than 2400mA, or more than 1000mA over the desired current. (DTC P0092)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR control.

Condition for Clearing the MIL/ DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

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 Circuit/ System Testing.
7. If the FRP regulator high side circuit is shorted to voltage, engine stalls and will not start.
8. If the FRP regulator low side circuit is shorted to ground, this DTC may not set. This will cause engine stall or no engine start.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0091 or P0092

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Observe the Fuel Rail Pressure (FRP) Regulator Feedback parameter with a scan tool. Does the scan tool indicate more than the specified value?	300 mA	Go to Step 4	Go to Step 5
4	Does the scan tool indicate more than the specified value at Step 3?	900 mA	Go to Step 7	Go to Step 8

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Connect a test lamp between the high side circuit (pin 1 of E-17) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 9
6	1. Turn OFF the ignition. 2. Connect a test lamp between the low side circuit (pin 2 of E-17) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 11	Go to Step 10
7	1. Test the high side circuits between the ECM (pins 105 and 113 of E-12) and the FRP regulator (pin 1 of E-17) 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
8	1. Test the low side circuits between the ECM (pins 89 and 97 of E-12) and the FRP regulator (pin 2 of E-17) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
9	1. Test the high side circuits between the ECM (pins 105 and 113 of E-12) and the FRP regulator (pin 1 of E-17) for the following conditions: • An open circuit • A short to ground • A short to the low side 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
10	**Important:** The ECM may be damaged if the FRP regulator low side circuit is shorted to a voltage source. 1. Test the low side circuits between the ECM (pins 89 and 97 of E-12) and the FRP regulator (pin 2 of E-17) 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 15	Go to Step 12
11	1. Inspect for an intermittent and for poor connections at the harness connector of the FRP regulator (pins 1 and 2 of E-17). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13

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 poor connections at the harness connector of the ECM (pins 89, 97, 105 and 113 of E-12). 4. Repair the connection(s) as necessary. Does the test lamp illuminate then go out?	—	Go to Step 15	Go to Step 14
13	Replace the FRP regulator. Refer to Fuel Supply Pump in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0093 (Flash Code 227)

Description

The common rail fuel system is comprised of two fuel pressure sections: a suction side between the fuel tank and the fuel supply pump and a high-pressure side between the fuel supply pump and the fuel injectors. Fuel is drawn from the fuel tank via a feed pump and then pumped into the fuel rail by two plungers, all of which are internal to the fuel supply pump. This high pressure is regulated by the ECM using the fuel rail pressure (FRP) regulator dependant upon values from the FRP sensor attached to the fuel rail. If the ECM detects that the fuel rail pressure is certain pressure low as compared with the engine speed, this DTC will set.

Condition for Running the DTC

- DTCs P0087, P0091, P0092, P0192, P0193, P0201 - P0204, P060B, P0651, P1261, P1262, P2146 and P2149 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the actual fuel rail pressure is lower than 15 MPa (2,180 psi) for longer than 3 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- An intermittently sticking FRP regulator may have allowed the fuel pressure to become low enough to set this DTC.
- Normal Fuel Rail Pressure readings on the scan tool with the engine running in neutral at idle is around 27 to 33 MPa (3,900 to 4,800 psi) after warm up.
- A skewed FRP sensor value can set this DTC. The FRP Sensor on the scan tool should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute.

Notice: This DTC most likely indicates a loss of fuel pressure by a fuel leak from the high pressure side. Inspect the high pressure side fuel leakage between the fuel supply pump and fuel injector first.

Notice: 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 supply pump is interrupted and this DTC may set. Perform bleeding of fuel system after refilling.

Test Description

The numbers below refers to the step number on the Circuit/ System Testing.

8. This step checks for a fuel restriction by determining if a high vacuum is being pulled on the fuel system during normal operation.
9. This step checks for an air leak on the suction side of the fuel system by determining if a vacuum can be pulled when a fuel line is plugged.

Schematic Reference: Fuel System Routing Diagram and Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0093

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. Inspect the high pressure side between the fuel supply pump and the fuel injectors for fuel leakage. The following components may contain an external leak. • Fuel supply pump • Fuel rail • Pressure limiter valve • Fuel rail pressure (FRP) sensor • Fuel pipe between the fuel supply pump and fuel rail • Fuel pipe between the fuel rail and fuel injectors • Each fuel pipe sleeve nuts **Notice:** Fuel may leak under the cylinder head cover from the inlet high pressure line. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil. **Notice:** Remove and inspect the inlet high pressure joint to the fuel injectors for fuel leaking from the sleeve nut(s). Replace the fuel injector and injection pipe when foreign material was in contact. 2. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 3
3	1. Remove each glow plug from the cylinder head. 2. Inspect for fuel leakage into the combustion chamber. Is there a cylinder that fuel leakage into the combustion chamber?	—	Go to Step 16	Go to Step 4
4	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0087, P0091, P0092, P0192, P0193, P0201 - P0204, P2146 or P2149 set?	—	Go to Applicable DTC	Go to Step 5
5	1. Turn OFF the ignition. 2. Wait 1 minute for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition, with the engine OFF. 4. Observe the FRP Sensor parameter with the scan tool. Does the scan tool indicate within the specified value?	0.9 to 1.0 volt	Go to Step 6	Go to Step 13

Step	Action	Value(s)	Yes	No
6	1. Place the transmission in Neutral and set the parking brake. 2. Start the engine. 3. Perform the Cylinder Balance Test with a scan tool. 4. Command each injector OFF and verify an engine speed change for each injector. Is there an injector that does not change engine speed when commanded OFF?	—	Go to Step 17	Go to Step 7
7	1. Inspect the fuel system line connections between the fuel tank and the fuel supply 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 supply 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 rail pressure fluctuations especially at high engine speed and load, which may set this DTC. 2. Pump the priming pump until it becomes firm. If there is a leak on the suction side of the fuel system between the priming pump and the fuel supply pump, the priming pump will not build up sufficient firmness and fuel leakage may occur. 3. Start the engine and check for high side fuel system leaks at the fuel supply pump and fuel rail. 4. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 8

Step	Action	Value(s)	Yes	No
8	1. Turn OFF the ignition. 2. Remove the rubber fuel hose from the fuel filter housing (fuel supply pump side). Use a pan to catch the fuel from the removed fuel line. **Important:** The fuel pressure/ vacuum gauge connector and the adapter hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the tools line may damage the fuel supply pump. 3. Connect the gauge adapter (5-8840-2844-0/ EN-47667) with fuel pressure/ vacuum gauge assembly (5-8840-2844-0/ J-44638) in series with the filter housing and the disconnected fuel hose. Ensure the service tool and fuel line connections are tight. 4. Bleed the fuel system by priming the priming pump until it becomes firm, then crank over the engine for a maximum of 5 seconds. Repeat as necessary until the engine starts. 5. Let the engine run at idle for at least 1 minute. 6. Monitor the fuel pressure/ vacuum gauge while holding the engine speed higher than 2500 RPM for a minimum of 1 minute. Does the fuel pressure/ vacuum gauge ever indicate a larger vacuum than the specified amount during the test?	5 inHg	Go to Step 10	Go to Step 9
9	1. Fully clamp off a fuel hose as close to the fuel tank as possible (this will draw vacuum on the fuel system). You can also disconnect a fuel line and plug it. 2. Start the engine and turn the idle up control knob to the highest position. (Full clockwise direction. The idle speed is increased up to 1600 RPM.) 3. Monitor the fuel pressure/ vacuum gauge. **Notice:** Release the clamp or open the plug when the gauge is likely to be more than 8 inHg during the test. Can a vacuum of at least the specified amount be pulled on the fuel system?	8 inHg	Go to Step 12	Go to Step 11
10	1. Inspect the fuel lines between the fuel supply pump and fuel tank for being crushed or kinked. 2. Inspect for a plugged fuel tank vent hose. 3. Inspect inside the fuel tank (if possible) for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. 4. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 14

Step	Action	Value(s)	Yes	No
11	1. Inspect the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 12
12	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP regulator (pins 1 and 2 of E-17). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 89, 97, 105 and 113 of E-12). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
13	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-19). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 82, 87, 90 and 101 of E-12). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 15
14	Replace the fuel filter element. Refer to Fuel Filter Element in Section 1D Engine Fuel . Did you complete the replacement?	—	Go to Step 19	—
15	Replace the FRP sensor. Refer to Fuel Pressure Sensor in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 19	—
16	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that was leaking fuel found at Step 3 and inspect the engine mechanical for any damage or poor engine compression. Refer to Injector in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 19	—

Step	Action	Value(s)	Yes	No
17	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Injector in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 19	—
18	**Important**: The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. **Notice:** Always replace the fuel filter element when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter element. Refer to Fuel Supply Pump and Fuel Filter Element in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 19	—
19	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 20
20	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0101 (Flash Code 92)

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 ECM will calculate a predicted MAF value and compares the actual MAF sensor voltage signal to the predicted MAF value. This comparison will determine if the signal is stuck, or is too low or too high for a given operating condition. If the ECM detects that the actual MAF sensor signal voltage is not within a predetermined range of the calculated MAF value, this DTC will set.

Condition for Running the DTC

- DTCs P0045, P0079, P0080, P0102, P0103, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0122, P0123, P0234, P0404, P0409, P0560, P060B, P0638, P0651, P0697, P1404, P2227, P2228, P2229, U0073 and U0110 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

AND following conditions are met longer than 3 seconds

- The engine speed is less than 1500 RPM or between 2500 to 2800 RPM.
- The EGR control is commanded OFF.
- The intake throttle control is commanded OFF.
- The DPD filter regeneration is inactive.
- The engine run time is longer than 5 seconds.

Condition for Setting the DTC

- The ECM detects that the MAF sensor signal voltage is not within a predetermined range of the calculated MAF value for longer than 10 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL on the second consecutive driving cycle when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type B.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type B.

Diagnostic Aids

- Any unmetered air that enters the engine downstream of the MAF sensor will cause this DTC to set.
- High resistance in the MAF sensor circuit may set this DTC.
- A short between the signal circuit of the MAF sensor and the signal circuit of the intake air temperature (IAT) sensor will skew the MAF sensor lower than normal at higher air flows.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0101

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. Inspect the following conditions: • Restricted air cleaner element, restricted or collapsed air tubing between the air cleaner and the intake manifold • Any air induction leak • Any contamination or objects that block the MAF sensor inlet • Skewed or slow MAF sensor • Any water intrusion in the induction system • Any type of restriction in the exhaust system • A sticking intake throttle valve • A sticking EGR valve • A sticking turbocharger nozzle control actuator • Exhaust throttle valve or exhaust brake valve for stuck condition. Refer to Exhaust System in Section 1G Engine Exhaust 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 3
3	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 1, 2 and 3 of J-38). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 22, 23 and 69 of J-14). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 4
4	1. Test each sensor circuit between the ECM (pins 22, 23 and 69 of J-14) and the MAF sensor (pins 1, 2 and 3 of J-38) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	Replace the MAF sensor. Refer to MAF/IAT Sensor in Section 1J Induction. 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 a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 7
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0102 or P0103 (Flash Code 91)

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 sensor has the following circuits.

- 12 volts reference circuit
- Low reference circuit
- MAF sensor signal circuit

The ECM monitors the MAF sensor signal voltage. This output voltage will display on the scan tool as a voltage parameter and as a grams per cylinder (g/cyl) parameter. If the ECM detects an excessively low or high signal voltage, DTC P0102 or P0103 will set.

Condition for Running the DTC

- DTCs P0560 and P060B are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The engine is running.
- The engine speed is less than 1500RPM. (DTC P0102)

Condition for Setting the DTC

- The ECM detects that the MAF sensor signal voltage is less than 0.1 volts for 3 seconds. (DTC P0102)
- The ECM detects that the MAF sensor signal voltage is more than 4.9 volts for 3 seconds. (DTC P0103)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM uses a MAF substitution of default value.
- The ECM limits fuel injection quantity.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0102

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0560 also set?	—	Go to DTC P0560	Go to Step 3
3	Observe the Mass Air Flow (MAF) Sensor parameter with a scan tool. Is the MAF Sensor parameter less than the specified value?	0.1 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the MAF sensor harness connector. 3. Connect a test lamp between the 12 volts reference circuit (pin 1 of J-38) 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 6

Step	Action	Value(s)	Yes	No
5	Connect a 3-amp fused jumper wire between the 12 volts reference circuit and the signal circuit (pins 1 and 3 of J-38). Is the MAF Sensor parameter more than the specified value?	4.9 volts	Go to Step 8	Go to Step 7
6	1. Test the 12 volts reference circuit between the ECM (pin 23 of J-14) and the MAF sensor (pin 1 of J-38) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	1. Test the signal circuit between the ECM (pin 69 of J-14) and the MAF sensor (pin 3 of J-38) 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 12	Go to Step 9
8	1. Inspect for an intermittent and for poor connections at the harness connector of the MAF sensor (pins 1 and 3 of J-38). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 23 and 69 of J-14). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the MAF sensor. Refer to MAF/IAT Sensor in Section 1J Induction. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13

Step	Action	Value(s)	Yes	No
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0103

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Observe the Mass Air Flow (MAF) Sensor parameter with a scan tool. Is the MAF Sensor parameter more than the specified value?	4.9 volts	Go to Step 3	Go to Diagnostic Aids
3	Monitor the DTC Information with a scan tool. Is DTC P0560 also set?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the MAF sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the MAF Sensor parameter less than the specified value?	0.1 volts	Go to DTC P0560	Go to Step 7
5	1. Turn OFF the ignition. 2. Disconnect the MAF sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the MAF Sensor parameter less than the specified value?	0.1 volts	Go to Step 6	Go to Step 7
6	Connect a test lamp between the low reference circuit (pin 2 of J-38) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
7	**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 ECM (pin 69 of J-14) and the MAF sensor (pin 3 of J-38) for the following conditions: • A short to battery or ignition voltage • A short to the 12 volts reference • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12

Step	Action	Value(s)	Yes	No
8	1. Test the low reference circuit between the ECM (pin 22 of J-14) and the MAF sensor (pin 2 of J-38) 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
9	1. Inspect for an intermittent and for a poor connection at the harness connector of the MAF sensor (pin 2 of J-38). 2. 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 at the harness connector of the ECM (pin 22 of J-14). 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 MAF sensor. Refer to MAF/IAT Sensor in Section 1J Induction. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0107 or P0108 (Flash Code 32)

Circuit Description

The boost pressure sensor is located in the air induction tubing. The boost pressure sensor is a transducer that varies voltage according to changes in the air pressure inside the air tubing. The sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- Boost pressure sensor signal circuit

The boost pressure sensor provides a signal to the ECM on the signal circuit, which is relative to the pressure changes in the air tubing. The ECM should detect a low signal voltage at a low boost pressure, such as low engine load. The ECM should detect high signal voltage at a high boost pressure, such as high engine load. If the ECM detects an excessively low or high signal voltage, DTC P0107 or P0108 will set.

Condition for Running the DTC

- DTCs P060B and P0697 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the boost pressure sensor signal voltage is less than 0.1 volts for 3 seconds. (DTC P0107)
- The ECM detects that the boost pressure sensor signal voltage is more than 4.9 volts for 3 seconds. (DTC P0108)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM uses a boost pressure substitution of default value.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0107

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0697 also set?	—	Go to DTC P0697	Go to Step 3
3	Observe the Boost Pressure Sensor parameter with a scan tool. Is the Boost Pressure Sensor parameter less than the specified value?	0.1 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 3 of E-24) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 5	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit (pins 1 and 3 of E-24). Is the Boost Pressure Sensor parameter more than the specified value?	4.5 volts	Go to Step 8	Go to Step 7
6	**Notice:** The boost pressure sensor shares the 5 volts reference circuit with other sensors. A fault condition in the 5 volts reference circuit may set DTCs on sensors that share this circuit. 1. Test the 5 volts reference circuit between the ECM (pin 95 of E-12) and the boost pressure sensor (pin 3 of E-24) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	1. Test the signal circuit between the ECM (pin 91 of E-12) and the boost pressure sensor (pin 1 of E-24) 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 12	Go to Step 9
8	1. Inspect for an intermittent and for poor connections at the harness connector of the boost pressure sensor (pins 1 and 3 of E-24). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 91 and 95 of E-12). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the boost pressure sensor. Refer to Boost Pressure Sensor in Section 1J Induction. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—

Step	Action	Value(s)	Yes	No
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0108

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Observe the Boost Pressure Sensor parameter with a scan tool. Is the Boost Pressure Sensor parameter more than the specified value?	4.9 volts	Go to Step 3	Go to Diagnostic Aids
3	Monitor the DTC Information with a scan tool. Is DTC P0697 also set?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the Boost Pressure Sensor parameter less than the specified value?	0.1 volts	Go to DTC P0697	Go to Step 7
5	1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the Boost Pressure Sensor parameter less than the specified value?	0.1 volts	Go to Step 6	Go to Step 7
6	Connect a test lamp between the low reference circuit (pin 2 of E-24) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8

Step	Action	Value(s)	Yes	No
7	**Important:** The boost pressure sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 91 of E-12) and the boost pressure sensor (pin 1 of E-24) 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 13	Go to Step 12
8	**Notice:** The boost pressure sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may set DTCs on sensors that share this circuit. 1. Test the low reference circuit between the ECM (pin 109 of E-12) and the boost pressure sensor (pin 2 of E-24) 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
9	1. Inspect for an intermittent and for a poor connection at the harness connector of the boost pressure sensor (pin 2 of E-24). 2. 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 at the harness connector of the ECM (pin 109 of E-12). 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 boost pressure sensor. Refer to Boost Pressure Sensor in Section 1J Induction. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 14

Step	Action	Value(s)	Yes	No
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0112 or P0113 (Flash Code 22)

Circuit Description

The intake air temperature (IAT) sensor is fitted between the air cleaner and turbocharger. It is internal to the mass air flow (MAF) sensor (Euro 4 specification). The IAT sensor is a variable resistor and it measures the temperature of the air entering the engine. The sensor has a signal circuit and a low reference circuit. The ECM supplies 5 volts to the signal circuit and a ground for the 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 signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the signal circuit. If the ECM detects an excessively low or high signal voltage, DTC P0112 or P0113 will set.

Condition for Running the DTC

- DTCs P060B and P0651 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The engine run time is longer than 3 minutes. (DTC P0113)

Condition for Setting the DTC

- The ECM detects that the IAT sensor signal voltage is less than 0.1 volts for 3 seconds. (DTC P0112)
- The ECM detects that the IAT sensor signal voltage is more than 4.85 volts for 3 seconds. (DTC P0113)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM uses an IAT substitution of default value.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

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.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0112

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0651 also set?	—	Go to DTC P0651	Go to Step 3
3	Observe the Intake Air Temperature (IAT) Sensor parameter with a scan tool. Is the IAT Sensor parameter less than the specified value?	0.1 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the mass air flow/ intake air temperature (MAF/ IAT) sensor harness connector (Euro 4 specification) or the IAT sensor harness connector (Expect Euro 4 specification). 3. Turn ON the ignition, with the engine OFF. Is the IAT Sensor parameter more than the specified value?	4.5 volts	Go to Step 6	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Test the signal circuit between the ECM (pin 72 of J-14) and the IAT sensor (pin 4 of J-38 [Euro 4 specification] or pin 1 of J-217 [Expect Euro 4 specification]) 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 9	Go to Step 7
6	Replace the MAF sensor or the IAT sensor. Refer to MAF/IAT Sensor in Section 1J Induction. Did you complete the replacement?	—	Go to Step 9	—
7	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect connections at the harness connector of the ECM (pins 60 and 72 of J-14) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 8
8	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 9	—
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 10
10	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0113

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0651 also set?	—	Go to DTC P0651	Go to Step 3

Step	Action	Value(s)	Yes	No
3	Observe the Intake Air Temperature (IAT) Sensor parameter with a scan tool. Is the IAT Sensor parameter more than the specified value?	4.8 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the mass air flow/ intake air temperature (MAF/ IAT) sensor harness connector (Euro 4 specification) or the IAT sensor harness connector (Expect Euro 4 specification). 3. Connect a DMM between the signal circuit (pin 4 of J-38 [Euro 4 specification] or pin 1 of J-217 [Expect Euro 4 specification]) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.5 volts	Go to Step 5	Go to Step 6
5	**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 ECM (pin 72 of J-14) and the IAT sensor (pin 4 of J-38 [Euro 4 specification] or pin 1 of J-217 [Expect Euro 4 specification]) for the following conditions: • A short to battery or ignition voltage • A short to the 12 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
6	Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit (pins 4 and 5 of J-38 [Euro 4 specification] or pins 1 and 2 of J-217 [Expect Euro 4 specification]). Is the IAT Sensor parameter less than the specified value?	0.1 volts	Go to Step 10	Go to Step 7
7	Connect a 3-amp fused jumper wire between the signal circuit (pin 4 of J-38 [Euro 4 specification] or pin 1 of J-217 [Expect Euro 4 specification]) and a known good ground. Is the IAT Sensor parameter less than the specified value?	0.1 volts	Go to Step 9	Go to Step 8
8	1. Test the signal circuit between the ECM (pin 72 of J-14) and the IAT sensor (pin 4 of J-38 [Euro 4 specification] or pin 1 of J-217 [Expect Euro 4 specification]) 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

Step	Action	Value(s)	Yes	No
9	**Notice:** The IAT sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may set DTCs on sensors that share this circuit. 1. Test the low reference circuit between the ECM (pin 60 of J-14) and the IAT sensor (pin 5 of J-38 [Euro 4 specification] or pin 2 of J-217 [Expect Euro 4 specification]) 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
10	1. Test the signal circuit between the ECM (pin 72 of J-14) and the IAT sensor (pin 4 of J-38 [Euro 4 specification] or pin 1 of J-217 [Expect Euro 4 specification]) 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 15	Go to Step 11
11	1. Inspect for an intermittent and for poor connections at the harness connector of the IAT sensor (pins 4 and 5 of J-38 [Euro 4 specification] or pins 1 and 2 of J-217 [Expect Euro 4 specification]). 2. 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 at the harness connector of the ECM (pins 60 and 72 of J-14). 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 or the IAT sensor. Refer to MAF/IAT Sensor in Section 1J Induction. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16

Step	Action	Value(s)	Yes	No
16	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0116 (Flash Code 23)

Circuit Description

The engine coolant temperature (ECT) sensor is installed to the thermostat housing. The ECT sensor is a variable resistor and it measures the temperature of the engine coolant. If the ECM detects that the difference of engine coolant temperature is smaller than the calculated range during the predetermined conditions, this DTC will set. This DTC will only run once per ignition cycle within the enabling condition.

Condition for Running the DTC

- DTCs P0117, P0118, P0201 - P0204, P0500, P0502, P0503, P060B, P0697, P1261, P1262, P2146 and P2149 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The vehicle runtime is longer than 5 minutes with the vehicle speed is more than 5km/h (3MPH).
- The engine runtime is longer than 5 minutes with the engine speed is more than 1400RPM.
- The accumulation fuel injection quantity since engine start is more than a threshold.

Condition for Setting the DTC

- The ECM detects that the difference of maximum and minimum engine coolant temperature is less than 1 to 15 °C (1.8 to 27°F).

Action Taken When the DTC Sets

- The ECM illuminates the MIL on the second consecutive driving cycle when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type B.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type B.

Diagnostic Aids

- After starting the engine, the ECT should rise steadily to about 80 to 85°C (176 to 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.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0116

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. Test the engine cooling system for the following conditions. Refer to Cooling System in Section 1C Engine Cooling. • Engine coolant level • Engine coolant leakage 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Disconnect the engine coolant temperature sensor (ECT) sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECT sensor (pins 1 and 2 of E-25). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 84 and 109 of E-12). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 4
4	1. Test each sensor circuit between the ECM (pins 84 and 109 of E-12) and the ECT sensor (pins 1 and 2 of E-25) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	Replace the ECT sensor. Refer to ECT Sensor in Section 1C Engine Cooling. Did you complete the replacement?	—	Go to Step 6	—
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Cool down the engine as necessary (allow engine coolant temperature to cool down at least 50°C [122°F]). 5. Start the engine and wait until engine is warm upped while comparing the Coolant Temperature parameter on the scan tool to the water temperature gauge on the instrument panel (IP) cluster. Does the Coolant Temperature rise from 50 to 80°C (122 to 176°F) in proportion to the water temperature gauge indicates from lowest scale to slightly below middle?	—	Go to Step 7	Go to Step 2
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0117 or P0118 (Flash Code 23)

Circuit Description

The engine coolant temperature (ECT) sensor is installed to the thermostat housing. The ECT sensor is a variable resistor and it measures the temperature of the engine coolant. The sensor has a signal circuit and a low reference circuit. The ECM supplies 5 volts to the signal circuit and a ground for the 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 signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the signal circuit. If the ECM detects an excessively low or high signal voltage, DTC P0117 or P0118 will set.

Condition for Running the DTC

- DTCs P060B and P0697 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The engine run time is longer than 5 seconds. (DTC P0118)

Condition for Setting the DTC

- The ECM detects that the ECT sensor signal voltage is less than 0.1 volts for 3 seconds. (DTC P0117)
- The ECM detects that the ECT sensor signal voltage is more than 4.85 volts for 3 seconds. (DTC P0118)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM uses an ECT substitution of default value.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0117

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0697 also set?	—	Go to DTC P0697	Go to Step 3
3	Observe the Engine Coolant Temperature (ECT) Sensor parameter with a scan tool. Is the ECT Sensor parameter less than the specified value?	0.1 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the ECT sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the ECT Sensor parameter more than the specified value?	4.5 volts	Go to Step 6	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Test the signal circuit between the ECM (pin 84 of E-12) and the ECT sensor (pin 1 of E-25) 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 9	Go to Step 7
6	Replace the ECT sensor. Refer to ECT Sensor in Section 1C Engine Cooling. Did you complete the replacement?	—	Go to Step 9	—
7	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect connections at the harness connector of the ECM (pins 84 and 109 of E-12) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 8
8	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 9	—
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 10
10	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0118

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0697 also set?	—	Go to DTC P0697	Go to Step 3

Step	Action	Value(s)	Yes	No
3	Observe the Engine Coolant Temperature (ECT) Sensor parameter with a scan tool. Is the ECT Sensor parameter more than the specified value?	4.8 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the ECT sensor harness connector. 3. Connect a DMM between the signal circuit (pin 1 of E-25) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.5 volts	Go to Step 5	Go to Step 6
5	**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 ECM (pin 84 of E-12) and the ECT sensor (pin 1 of E-25) 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
6	Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit (pins 1 and 2 of E-25). Is the ECT Sensor parameter less than the specified value?	0.1 volts	Go to Step 10	Go to Step 7
7	Connect a 3-amp fused jumper wire between the signal circuit (pin 1 of E-25) and a known good ground. Is the ECT Sensor parameter less than the specified value?	0.1 volts	Go to Step 9	Go to Step 8
8	1. Test the signal circuit between the ECM (pin 84 of E-12) and the ECT sensor (pin 1 of E-25) 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	**Notice:** The ECT sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may set DTCs on sensors that share this circuit. 1. Test the low reference circuit between the ECM (pin 109 of E-12) and the ECT sensor (pin 2 of E-25) 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
10	1. Test the signal circuit between the ECM (pin 84 of E-12) and the ECT sensor (pin 1 of E-25) 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 15	Go to Step 11

Step	Action	Value(s)	Yes	No
11	1. Inspect for an intermittent and for poor connections at the harness connector of the ECT sensor (pins 1 and 2 of E-25). 2. 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 at the harness connector of the ECM (pins 84 and 109 of E-12). 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 ECT sensor. Refer to ECT Sensor in Section 1C Engine Cooling. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0122 or P0123 (Flash Code 43)

Circuit Description

The intake throttle position sensor is installed on the intake throttle valve body together with the control solenoid. The intake throttle position sensor changes output voltage according to intake throttle valve position. The sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- Intake throttle position sensor signal circuit

The intake throttle position sensor provides a signal to the ECM on the signal circuit, which is relative to the position changes of the intake throttle valve. If the ECM detects an excessively low or high signal voltage, DTC P0122 or P0123 will set.

Condition for Running the DTC

- DTCs P060B and P0697 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the intake throttle position sensor signal voltage is less than 0.1 volts for 3 seconds. (DTC P0122)
- The ECM detects that the intake throttle position sensor signal voltage is more than 4.9 volts for 3 seconds. (DTC P0123)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

PCircuit/ System Testing DTC P0122

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0697 also set?	—	Go to DTC P0697	Go to Step 3
3	Observe the Intake Throttle Position Sensor parameter with a scan tool. Is the Intake Throttle Position Sensor parameter less than the specified value?	0.1 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the intake throttle valve harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 6 of E-16) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 5	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit (pins 5 and 6 of E-16). Is the Intake Throttle Position Sensor parameter more than the specified value?	4.5 volts	Go to Step 8	Go to Step 7
6	**Notice:** The intake throttle position sensor shares the 5 volts reference circuit with other sensors. A fault condition in the 5 volts reference circuit may set DTCs on sensors that share this circuit. 1. Test the 5 volts reference circuit between the ECM (pin 95 of E-12) and the intake throttle valve (pin 5 of E-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 12	Go to Step 9
7	1. Test the signal circuit between the ECM (pin 85 of E-12) and intake throttle valve (pin 6 of E-16) 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 12	Go to Step 9
8	1. Inspect for an intermittent and for poor connections at the harness connector of the intake throttle valve (pins 5 and 6 of E-16). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pins 85 and 95 of E-12). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the intake throttle valve. Refer to Intake Throttle Valve in Section 1B Engine Mechanical. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—

Step	Action	Value(s)	Yes	No
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0123

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Observe the Intake Throttle Position Sensor parameter with a scan tool. Is the Intake Throttle Position Sensor parameter more than the specified value?	4.9 volts	Go to Step 3	Go to Diagnostic Aids
3	Monitor the DTC Information with a scan tool. Is DTC P0697 also set?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the intake throttle valve harness connector. 3. Turn ON the ignition, with the engine OFF. Is the Intake Throttle Position Sensor parameter less than the specified value?	0.1 volts	Go to DTC P0697	Go to Step 7
5	1. Turn OFF the ignition. 2. Disconnect the intake throttle valve harness connector. 3. Turn ON the ignition, with the engine OFF. Is the Intake Throttle Position Sensor parameter less than the specified value?	0.1 volts	Go to Step 6	Go to Step 7
6	Connect a test lamp between the low reference circuit (pin 4 of E-16) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8

Step	Action	Value(s)	Yes	No
7	**Important:** The intake throttle position sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 85 of E-12) and the intake throttle valve (pin 5 of E-16) 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 13	Go to Step 12
8	**Notice:** The intake throttle position sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may set DTCs on sensors that share this circuit. 1. Test the low reference circuit between the ECM (pin 109 of E-12) and the intake throttle valve (pin 4 of E-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 13	Go to Step 10
9	1. Inspect for an intermittent and for poor connections at the harness connector of the intake throttle valve (pin 4 of E-16). 2. 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 at the harness connector of the ECM (pin 109 of E-12). 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 valve. Refer to Intake Throttle Valve in Section 1B Engine Mechanical. Did you complete the replacement?	—	Go to Step 13	
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 14

Step	Action	Value(s)	Yes	No
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0182 or P0183 (Flash Code 211)

Circuit Description

The fuel temperature (FT) sensor is installed to the fuel supply pump. The FT sensor is a variable resistor and it measures the temperature of the fuel entering the fuel supply pump. The sensor has a signal circuit and a low reference circuit. The ECM supplies 5 volts to the signal circuit and a ground for the low reference circuit. When the FT sensor is cold, the sensor resistance is high. When the fuel temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the signal circuit. If the ECM detects an excessively low or high signal voltage, DTC P0182 or P0183 will set.

Condition for Running the DTC

- DTCs P060B and P0697 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The engine run time is longer than 3 minutes. (DTC P0183)

Condition for Setting the DTC

- The ECM detects that the FT sensor signal voltage is less than 0.1 volts for 3 seconds. (DTC P0182)
- The ECM detects that the FT sensor signal voltage is more than 4.85 volts for 3 seconds. (DTC P0183)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM uses a FT substitution of default value.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- Before starting a cold engine, FT sensor and engine coolant temperature (ECT) sensor temperature should be relatively close to each other.
- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Temperature vs. Resistance table to test the FT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0182

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0697 also set?	—	Go to DTC P0697	Go to Step 3
3	Observe the Fuel Temperature (FT) Sensor parameter with a scan tool. Is the FT Sensor parameter less than the specified value?	0.1 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the FT sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the FT Sensor parameter more than the specified value?	4.5 volts	Go to Step 6	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Test the signal circuit between the ECM (pin 83 of E-12) and the FT sensor (pin 2 of E-22) 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 9	Go to Step 7
6	Replace the FT sensor. Refer to FT Sensor in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 9	—
7	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect connections at the harness connector of the ECM (pins 83 and 109 of E-12) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 8
8	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 9	—
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 10
10	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0183

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0697 also set?	—	Go to DTC P0697	Go to Step 3

Step	Action	Value(s)	Yes	No
3	Observe the Fuel Temperature (FT) Sensor parameter with a scan tool. Is the FT Sensor parameter more than the specified value?	4.8 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the FT sensor harness connector. 3. Connect a DMM between the signal circuit (pin 2 of E-22) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.5 volts	Go to Step 5	Go to Step 6
5	**Important:** The FT sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 83 of E-12) and the FT sensor (pin 2 of E-22) 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
6	Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit (pins 1 and 2 of E-22). Is the FT Sensor parameter less than the specified value?	0.1 volts	Go to Step 10	Go to Step 7
7	Connect a 3-amp fused jumper wire between the signal circuit of the sensor harness (pin 2 of E-22) and a known good ground. Is the FT Sensor parameter less than the specified value?	0.1 volts	Go to Step 9	Go to Step 8
8	1. Test the signal circuit between the ECM (pin 83 of E-12) and the FT sensor (pin 2 of E-22) 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	**Notice:** The FT sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may set DTCs on sensors that share this circuit. 1. Test the low reference circuit between the ECM (pin 109 of E-12) and the FT sensor (pin 1 of E-22) 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
10	1. Test the signal circuit between the ECM (pin 83 of E-12) and the FT sensor (pin 2 of E-22) 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 15	Go to Step 11

Step	Action	Value(s)	Yes	No
11	1. Inspect for an intermittent and for poor connections at the harness connector of the FT sensor (pins 1 and 2 of E-22). 2. 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 at the harness connector of the ECM (pins 83 and 109 of E-12). 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 FT sensor. Refer to FT Sensor in Section 1D Engine Fuel . Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0192 or P0193 (Flash Code 245)

Circuit Description

The fuel rail pressure (FRP) sensor is installed to the fuel rail and it detects the fuel pressure in the fuel rail, converts the pressure into a voltage signal, and sends the signal to the ECM. The sensor has the following circuits.

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

The ECM monitors the FRP sensor signal voltage. Higher fuel rail pressure provides higher signal voltage while lower pressure provides lower signal voltage. The ECM calculates actual fuel rail pressure (fuel pressure) from the voltage signal and uses the result in fuel injection control and other control tasks. If the ECM detects an excessively low or high signal voltage, DTC P0192 or P0193 will set.

Condition for Running the DTC

- DTCs P060B and P0651 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the FRP sensor signal voltage is less than 0.7 volts. (DTC P0192)
- The ECM detects that the FRP sensor signal voltage is more than 4.5 volts. (DTC P0193)

Action Taken When the DTC Sets

- The ECM illuminates MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM uses a FRP substitution of default value.
- The ECM limits fuel injection quantity
- The ECM inhibits pilot injection.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0192

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	—
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0651 also set?	—	Go to DTC P0651	Go to Step 3
3	Observe the Fuel Rail Pressure (FRP) Sensor parameter with a scan tool. Is the FRP Sensor parameter less than the specified value?	0.7 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the FRP Sensor parameter more than the specified value?	4.5 volts	Go to Step 5	Go to Step 6
5	Connect a DMM between the 5 volts reference circuit (pin 3 of E-19) and a known good ground. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 8	Go to Step 7

Step	Action	Value(s)	Yes	No
6	1. Test the signal circuits between the ECM (pins 82 and 90 of E-12) and the FRP sensor (pin 2 of E-19) 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 12	Go to Step 11
7	**Notice:** The FRP sensor shares the 5 volts reference circuit with other sensors. A fault condition in the 5 volts reference circuit may set DTCs on sensors that share this circuit. 1. Test the 5 volts reference circuit between the ECM (pin 87 of E-12) and the FRP sensor (pin 3 of E-19) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	1. Inspect for an intermittent and for a poor connection at the harness connector of the FRP sensor (pin 3 of E-19). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 87 of E-12). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the FRP sensor. Refer to Fuel Pressure Sensor in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0193

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0651 also set?	—	Go to DTC P0651	Go to Step 3
3	Observe the Fuel Rail Pressure (FRP) Sensor parameter with a scan tool. Is the FRP Sensor parameter more than the specified value?	4.5 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Connect a DMM between the signal circuit (pin 2 of E-19) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.5 volts	Go to Step 10	Go to Step 5
5	1. Connect a test lamp between the signal circuit (pin 2 of E-19) and a known good ground. 2. Connect a DMM between the probe of the test lamp and a known good ground. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 9	Go to Step 6
6	Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit of the sensor harness (pins 1 and 2 of E-19). Is the FRP Sensor parameter less than the specified value?	0.1 volts	Go to Step 11	Go to Step 7
7	**Notice:** The FRP sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may set DTCs on sensors that share this circuit. 1. Test the low reference circuit between the ECM (pin 101 of E-12) and the FRP sensor (pin 1 of E-19) 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 8
8	1. Test the signal circuit between the ECM (pins 82 and 90 of E-12) and the FRP sensor (pin 2 of E-19) 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

Step	Action	Value(s)	Yes	No
9	1. Test the signal circuits between the ECM (pins 82 and 90 of E-12) and the FRP sensor (pin 2 of E-19) 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 15	Go to Step 14
10	**Important:** The FRP sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuits between the ECM (pins 82 and 90 of E-12) and the FRP sensor (pin 2 of E-19) 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. Inspect for an intermittent and for poor connections at the harness connector of the FRP sensor (pins 1 and 2 of E-19). 2. 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 at the harness connector of the ECM (pins 82, 90 and 87 of E-12). 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 FRP sensor. Refer to Fuel Pressure Sensor in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0201, P0202, P0203 or P0204 (Flash Code 271, 272, 273 or 274)

Circuit Description

The ECM calculates the optimum fuel injection ON time using data sent from various engine sensors. The common 1 and 2 fuel injector charge voltage circuits are high-voltage supply, which drives fuel injectors for each cylinder in conjunction with the ECM grounding the fuel injector solenoid control circuit. The common 1 covers fuel injectors in cylinders #1 and #4, and the common 2 covers fuel injectors in cylinders #2 and #3. If the fuel injector charge voltage circuit or solenoid control circuit is open circuit, DTC P0201 - P0204 will set depending upon which cylinder injector circuit failed. If the fuel injector solenoid control circuit is shorted to voltage circuit or common charge voltage circuit, this DTC will also set.

Condition for Running the DTC

- DTCs P1261 and P2146 are not set. (DTC P0201 or P0204)
- DTCs P1262 and P2149 are not set. (DTC P0202 or P0203)
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects an open circuit on the fuel injector solenoid circuits.
- The ECM detects that the fuel injector solenoid control circuit is shorted to voltage circuit or charge voltage circuit.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

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

Notice: Each DTC agrees with engine cylinder order.

- P0201: Cylinder #1
- P0202: Cylinder #2
- P0203: Cylinder #3
- P0204: Cylinder #4

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0201

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector from the cylinder head cover case. 3. Measure the resistance of the charge voltage circuit across the female side connector. 4. Measure the resistance of the charge voltage circuit across the male side connector. Are both resistance readings less than the specified value (either of reading is out of specified value will not set this DTC)?	1.0Ω	Go to Step 4	Go to Step 9

Step	Action	Value(s)	Yes	No
4	1. Connect a DMM between the cylinder #1 charge voltage circuit and a known good ground. 2. Turn ON the ignition, with the engine OFF. Is the DMM voltage less then the specified value?	1.0 volt	Go to Step 5	Go to Step 10
5	Connect a DMM between the cylinder #1 solenoid control circuit and a known good ground. Is the DMM voltage less than the specified value?	16.0 volts	Go to Step 6	Go to Step 11
6	Is the DMM voltage more than the specified value at Step 5?	12.0 volts	Go to Step 7	Go to Step 12
7	1. Inspect for an intermittent and for poor connections at the in-line harness connector. 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 8
8	1. Remove the cylinder head cover. Refer to Cylinder Head Cover in Section 1B Engine Mechanical. 2. Inspect the fuel injector harness for loose injector terminal nuts, objects touching injector terminals. 3. Inspect for an intermittent and for poor connections at the in-line harness connector. 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 13
9	Repair the open circuit or high resistance on the charge voltage circuits between the ECM and the in-line harness connector, then between the in-line harness connector and the fuel injector terminal. Did you complete the repair?	—	Go to Step 17	—
10	1. Test the control circuit between the ECM and the in-line harness connector for a short to the common 1 charge voltage circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
11	1. Test the control circuit between the ECM and the in-line harness 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 17	Go to Step 15
12	1. Test the control circuit between the ECM and the in-line harness connector for an open circuit or high resistance. 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

Step	Action	Value(s)	Yes	No
13	1. Test the cylinder #1 fuel injector circuit between the fuel injector terminals and the in-line harness connector for the following conditions: • An open circuit • A short circuit each other • High resistance 2. Repair the circuit(s) or replace the fuel injector harness 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 a poor connection at the harness connector of the ECM. 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
15	**Important:** Replacement fuel injector must be programmed. Replace the cylinder #1 fuel injector. Refer to Injector in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 17	—
16	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 18
18	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0202

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector from the cylinder head cover case. 3. Measure the resistance of the charge voltage circuit across the female side connector. 4. Measure the resistance of the charge voltage circuit across the male side connector. Are both resistance readings less than the specified value (either of reading is out of specified value will not set this DTC)?	1.0Ω	Go to Step 4	Go to Step 9
4	1. Connect a DMM between the cylinder #2 charge voltage circuit and a known good ground. 2. Turn ON the ignition, with the engine OFF. Is the DMM voltage less then the specified value?	1.0 volt	Go to Step 5	Go to Step 10
5	Connect a DMM between the cylinder #2 solenoid control circuit and a known good ground. Is the DMM voltage less than the specified value?	16.0 volts	Go to Step 6	Go to Step 11
6	Is the DMM voltage more than the specified value at Step 5?	12.0 volts	Go to Step 7	Go to Step 12
7	1. Inspect for an intermittent and for poor connections at the in-line harness connector. 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 8
8	1. Remove the cylinder head cover. Refer to Cylinder Head Cover in Section 1B Engine Mechanical. 2. Inspect the fuel injector harness for loose injector terminal nuts, objects touching injector terminals. 3. Inspect for an intermittent and for poor connections at the in-line harness connector. 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 13
9	Repair the open circuit or high resistance on the charge voltage circuits between the ECM and the in-line harness connector, then between the in-line harness connector and the fuel injector terminal. Did you complete the repair?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
10	1. Test the control circuit between the ECM and the in-line harness connector for a short to the common 2 charge voltage circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
11	1. Test the control circuit between the ECM and the in-line harness 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 17	Go to Step 15
12	1. Test the control circuit between the ECM and the in-line harness connector for an open circuit or high resistance. 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
13	1. Test the cylinder #2 fuel injector circuits between the fuel injector terminals and the in-line harness connector for the following conditions: • An open circuit • A short circuit each other • High resistance 2. Repair the circuit(s) or replace the fuel injector harness 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 a poor connection at the harness connector of the ECM. 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
15	**Important:** Replacement fuel injector must be programmed. Replace the cylinder #2 fuel injector. Refer to Injector in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 17	—
16	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
17	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 18
18	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0203

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector from the cylinder head cover case. 3. Measure the resistance of the charge voltage circuit across the female side connector. 4. Measure the resistance of the charge voltage circuit across the male side connector. Are both resistance readings less than the specified value (either of reading is out of specified value will not set this DTC)?	1.0Ω	Go to Step 4	Go to Step 9
4	1. Connect a DMM between the cylinder #3 charge voltage circuit and a known good ground. 2. Turn ON the ignition, with the engine OFF. Is the DMM voltage less then the specified value?	1.0 volt	Go to Step 5	Go to Step 10
5	Connect a DMM between the cylinder #3 solenoid control circuit and a known good ground. Is the DMM voltage less than the specified value?	16.0 volts	Go to Step 6	Go to Step 11
6	Is the DMM voltage more than the specified value at Step 5?	12.0 volts	Go to Step 7	Go to Step 12

Step	Action	Value(s)	Yes	No
7	1. Inspect for an intermittent and for poor connections at the in-line harness connector. 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 8
8	1. Remove the cylinder head cover. Refer to Cylinder Head Cover in Section 1B Engine Mechanical. 2. Inspect the fuel injector harness for loose injector terminal nuts, objects touching injector terminals. 3. Inspect for an intermittent and for poor connections at the in-line harness connector. 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 13
9	Repair the open circuit or high resistance on the charge voltage circuits between the ECM and the in-line harness connector, then between the in-line harness connector and the fuel injector terminal. Did you complete the repair?	—	Go to Step 17	—
10	1. Test the control circuit between the ECM and the in-line harness connector for a short to the common 2 charge voltage circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
11	1. Test the control circuit between the ECM and the in-line harness 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 17	Go to Step 15
12	1. Test the control circuit between the ECM and the in-line harness connector for an open circuit or high resistance. 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
13	1. Test the cylinder #3 fuel injector circuits between the fuel injector terminals and the in-line harness connector for the following conditions: • An open circuit • A short circuit each other • High resistance 2. Repair the circuit(s) or replace the fuel injector harness 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 a poor connection at the harness connector of the ECM. 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16

Step	Action	Value(s)	Yes	No
15	**Important:** Replacement fuel injector must be programmed. Replace the cylinder #3 fuel injector. Refer to Injector in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 17	—
16	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 18
18	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0204

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector from the cylinder head cover case. 3. Measure the resistance of the charge voltage circuit across the female side connector. 4. Measure the resistance of the charge voltage circuit across the male side connector. Are both resistance readings less than the specified value (either of reading is out of specified value will not set this DTC)?	1.0Ω	Go to Step 4	Go to Step 9

Step	Action	Value(s)	Yes	No
4	1. Connect a DMM between the cylinder #4 charge voltage circuit and a known good ground. 2. Turn ON the ignition, with the engine OFF. Is the DMM voltage less then the specified value?	1.0 volt	Go to Step 5	Go to Step 10
5	Connect a DMM between the cylinder #4 solenoid control circuit and a known good ground. Is the DMM voltage less than the specified value?	16.0 volts	Go to Step 6	Go to Step 11
6	Is the DMM voltage more than the specified value at Step 5?	12.0 volts	Go to Step 7	Go to Step 12
7	1. Inspect for an intermittent and for poor connections at the in-line harness connector. 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 8
8	1. Remove the cylinder head cover. Refer to Cylinder Head Cover in Section 1B Engine Mechanical. 2. Inspect the fuel injector harness for loose injector terminal nuts, objects touching injector terminals. 3. Inspect for an intermittent and for poor connections at the in-line harness connector. 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 13
9	Repair the open circuit or high resistance on the charge voltage circuits between the ECM and the in-line harness connector, then between the in-line harness connector and the fuel injector terminal. Did you complete the repair?	—	Go to Step 17	—
10	1. Test the control circuit between the ECM and the in-line harness connector for a short to the common 1 charge voltage circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
11	1. Test the control circuit between the ECM and the in-line harness 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 17	Go to Step 15
12	1. Test the control circuit between the ECM and the in-line harness connector for an open circuit or high resistance. 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

Step	Action	Value(s)	Yes	No
13	1. Test the cylinder #4 fuel injector circuit between the fuel injector terminals and the in-line harness connector for the following conditions: • An open circuit • A short circuit each other • High resistance 2. Repair the circuit(s) or replace the fuel injector harness 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 a poor connection at the harness connector of the ECM. 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
15	**Important:** Replacement fuel injector must be programmed. Replace the cylinder #4 fuel injector. Refer to Injector in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 17	—
16	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 18
18	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0217 (Flash Code 542)

Circuit Description

The engine coolant temperature (ECT) sensor is installed to the thermostat housing. The ECT sensor is a variable resistor and it measures the temperature of the engine coolant. If the ECM detects an excessive high coolant temperature, this DTC will set.

Condition for Running the DTC

- DTCs P0116, P0117, P0118, P060B and P0697 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the engine coolant temperature is more than 110°C (230°F) for 5 seconds.
- The ECM detects that the engine coolant temperature is more than 120°C (248°F) for 5 seconds during the DPD filter regeneration.

Action Taken When the DTC Sets

- The ECM will not illuminate the MIL or SVS lamp. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type D.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the DTC - Type D.

Diagnostic Aids

- After starting the engine, the ECT should rise steadily to about 80 to 85°C (176 to 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.
- The Total Engine Coolant Overtemperature Events parameter on the scan tool indicates number of overheat events.

Notice: This DTC is caused by an engine overheat condition (e.g. 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.

Circuit/ System Testing DTC P0217

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0117 also set?	—	Go to DTC P0117	Go to Step 3
3	1. Test the engine cooling system for the following condition. Refer to Cooling System in Section 1C Engine Cooling. • 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 7	Go to Step 4

Step	Action	Value(s)	Yes	No
4	Start the engine and wait until engine is fully warm upped while observing the Coolant Temperature parameter with a scan tool. Does the scan tool indicate more than the specified value?	110°C (230°F)	Go to Step 6	Go to Step 5
5	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 7	—
6	1. Test the engine coolant temperature (ECT) sensor at various temperature levels to evaluate the possibility of a skewed sensor. 2. Replace the ECT sensor as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Diagnostic Aids
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and wait until engine is fully warm upped while observing the Coolant Temperature parameter with a scan tool. Does the scan tool indicate more than the specified value?	110°C (230°F)	Go to Step 2	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0219 (Flash Code 543)

Circuit Description

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

Condition for Setting the DTC

- The ECM detects that the engine speed is more than 3700RPM.

Action Taken When the DTC Sets

- The ECM will not illuminate the MIL or SVS lamp. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type D. (Euro 4 specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 specification)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the DTC - Type D. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 specification)

Diagnostic Aids

- Make sure the CKP sensor is tight and the sensor rotor teeth are not damaged.
- Electromagnetic interference in the CKP sensor circuits may set this DTC.
- The Total Engine Overspeed Events parameter on the scan tool indicates number of overrun events.

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). Since the DTC does not illuminate any lamps, clear the DTC and ensure there are no sign of engine damage. Excessive engine overspeed may damage internal engine components.

Circuit/ System Testing DTC P0219

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	**Important:** If DTC P0335 or P0336 is set, diagnose that DTC first. 1. Install a scan tool. 2. Start the engine. 3. Observe the Engine Speed parameter with a scan tool. 4. Accelerate the engine as necessary. Does the Engine Speed parameter ever exceed the specified value?	3700 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 driving, etc. If engine overrun has experienced, the engine must be inspected and repaired as necessary. Did you complete the action?	—	Go to Step 6	—

Step	Action	Value(s)	Yes	No
4	1. Inspect the CKP sensor and sensor rotor for the following conditions: • Physical damage of sensor • Loose or improper installation of sensor • Excessive air gap • Foreign material passing between sensor and sensor rotor • Physical damage of sensor rotor • Loose or improper installation of sensor rotor 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	Replace the CKP sensor. Refer to CKP Sensor in Section 1B Engine Mechanical. Did you complete the replacement?	—	Go to Step 5	—
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 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 Engine Speed parameter with a scan tool. Does the Engine Speed parameter ever exceed the specified value?	3700 RPM	Go to Step 4	Go to Step 7
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0234 (Flash Code 42)

Circuit Description

The boost pressure sensor is located in the air induction tubing. The sensor is a transducer that varies voltage according to changes in the air pressure inside the air tubing. The ECM monitors the boost pressure sensor signal for abnormal values. If the ECM detects that the sensor signal is excessively high, this DTC will set. This indicates excessive high boost pressure.

Condition for Running the DTC

- DTCs P0045, P0107, P0108, P060B, P0697, U0073 and U0110 are not set.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the boost pressure is higher than 130 to 240 kPa (19 to 35 psi) for longer than 5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- An open circuit or high resistance in the boost pressure low reference circuit may set this DTC.
- Check the turbocharger nozzle control solenoid valve for a sticking.
- Use a scan tool to verify the integrity of the boost pressure sensor signal. Compare the sensor values under all load conditions for an excessively high value.
- The fuel with which gasoline was mixed may set this DTC.

Test Description

The numbers below refer to the step number on the Circuit/ System Testing.
3. A skewed boost pressure sensor value (shifted to a higher pressure) can set this DTC. The Boost Pressure on the scan tool should read near Barometric Pressure (BARO) with the ignition switch ON and engine OFF.
4. A skewed BARO sensor value (shifted to a lower pressure) may indicate a wrong boost pressure. The BARO on the scan tool should read near surrounding barometric pressure.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0234

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0045, P0107, P0108, P0638, P2227, P2228 or P2229 also set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the Boost Pressure and Barometric Pressure (BARO) with a scan tool. Does the scan tool indicate that the difference between the Boost Pressure and BARO is more than the specified value?	10 kPa (1.5 psi)	Go to Step 4	Go to Step 5
4	Compare the BARO value to the range specified in the altitude vs. barometric pressure table. Refer to Altitude vs Barometric Pressure. Is the BARO parameter within the range specified?	—	Go to Step 6	Go to Step 7

Step	Action	Value(s)	Yes	No
5	1. Inspect the following for possible causes of high boost pressure. • Turbocharger nozzle control solenoid valve for a stuck condition. Perform the Turbocharger Control with a scan tool. • Intake throttle valve sticking. Perform the Intake Throttle Solenoid Control with a scan tool. • Oil in the air induction tubing causing an incorrect boost pressure sensor signal. When there is adhesion of oil inside of the tubing, intercooler or turbocharger it needs to be wiped off. 2. Repair or replace as necessary. Did you find and correction the condition?	—	Go to Step 10	Go to Diagnostic Aids
6	1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the boost pressure sensor (pin 2 of E-24). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for a poor connection and corrosion at the harness connector of the ECM (pin 109 of E-12). 6. Test for high resistance of the low reference circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
7	1. Turn OFF the ignition. 2. Disconnect the BARO sensor harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the BARO sensor (pins 2 and 3 of B-121). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 61 and 71 of E-12). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 9
8	Replace the boost pressure sensor. Refer to Boost Pressure Sensor in Section 1J Induction. Did you complete the replacement?	—	Go to Step 10	—
9	Replace the BARO sensor. Refer to BARO Sensor Replacement. 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 a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 11
11	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0299 (Flash Code 65)

Circuit Description

The boost pressure sensor is located in the air induction tubing. The sensor is a transducer that varies voltage according to changes in the air pressure inside the air tubing. The ECM monitors the boost pressure sensor signal for abnormal values. If the ECM detects that the sensor signal is excessively low, this DTC will set. This indicates excessive low boost pressure.

Condition for Running the DTC

- DTCs P0045, P0079, P0080, P0087, P0089, P0091, P0092, P0093, P0102, P0103, P0107, P0108, P0116, P0117, P0118, P0122, P0123, P0192, P0193, P0201 - P0204, P0401, P0404, P0409, P0560, P060B, P0638, P0651, P0697, P1093, P1261, P1262, P1404, P2146, P2149, P2227, P2228, P2229, P2453, U0073 and U0110 are not set.
- The ignition switch is ON.
- The engine speed is between 1200 to 2700 RPM.
- The fuel injection quantity is higher than a predetermined range.

Condition for Setting the DTC

- The ECM detects that the boost pressure is lower than 25 to 40 kPa (4 to 6 psi) for longer than 5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL on the second consecutive driving cycle when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type B. (Euro 4 specification)
- The ECM illuminates MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 specification)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type B. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 specification)

Diagnostic Aids

- Induction air leakage can cause a low boost pressure condition. A whistling noise may be heard if a component is allowing air to enter the induction system.
- Check for cracked air tubing that may only open during certain engine movement conditions.
- Check the turbocharger nozzle control solenoid valve for a sticking.
- Use a scan tool to verify the integrity of the boost pressure sensor signal. Compare the sensor values under all load conditions for an excessively low value.
- Fuel system problem (low fuel pressure condition) may set this DTC.

Test Description

The numbers below refer to the step number on the Circuit/ System Testing.

4. A skewed boost pressure sensor value (shifted to a lower pressure) can set this DTC. The Boost Pressure on the scan tool should read near Barometric Pressure (BARO) with the ignition switch ON and engine OFF.

5. A skewed BARO sensor value (shifted to a higher pressure) may indicate a wrong boost pressure. The BARO on the scan tool should read near surrounding barometric pressure.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0299

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0045, P0107, P0108, P2227, P2228 or P2229 also set?	—	Go to Applicable DTC	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Inspect the following for possible causes of low boost pressure. • Air leakage around the boost pressure sensor or objects that block the sensor hole. • Air leaking around any of the air induction tubing between the turbocharger and intake manifold. Check for damaged components and for loose clamps. • Turbine shaft binding causing lower turbocharger shaft spinning speeds. Refer to Turbocharger Assembly in Section 1J Induction. • Turbocharger nozzle control solenoid valve for a stuck condition. Perform the Turbocharger Control with a scan tool. • Intake throttle valve sticking. Perform the Intake Throttle Solenoid Control with a scan tool. • Restricted air cleaner element, restricted or collapsed air tubing between the air cleaner and the boost pressure sensor. • Oil in the air induction tubing causing an incorrect boost pressure sensor signal. When there is adhesion of oil inside of the tubing, intercooler or turbocharger it needs to be wiped off. 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 4
4	1. Turn ON the ignition, with the engine OFF. 2. Observe the Boost Pressure and Barometric Pressure (BARO) with a scan tool. Does the scan tool indicate that the difference between the Boost Pressure and BARO is more than the specified value?	10 kPa (1.5 psi)	Go to Step 5	Go to Diagnostic Aids
5	Compare the BARO value to the range specified in the altitude vs. barometric pressure table. Refer to Altitude vs Barometric Pressure. Is the BARO parameter within the range specified?	—	Go to Step 6	Go to Step 7
6	1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the boost pressure sensor (pins 1 and 3 of E-24). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 91 and 95 of E-12). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8

Step	Action	Value(s)	Yes	No
7	1. Turn OFF the ignition. 2. Disconnect the BARO sensor harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the BARO sensor (pin 1 of B-121). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for a poor connection and corrosion at the harness connector of the ECM (pin 60 of J-14). 6. Test for high resistance of the low reference circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 9
8	Replace the boost pressure sensor. Refer to Boost Pressure Sensor in Section 1J Induction. Did you complete the replacement?	—	Go to Step 10	—
9	Replace the BARO sensor. Refer to BARO Sensor Replacement. Did you complete the replacement?	—	Go to Step 10	—
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 11
11	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0335 (Flash Code 15)

Circuit Description

The crankshaft position (CKP) sensor is located on the flywheel housing. The sensor rotor is fixed on the flywheel. There are 56 notches spaced 6° apart and a 30° section that is open span. This open span portion allows for the detection of top dead center (TDC). The CKP sensor is a magnetic resistance element (MRE) type sensor, which generates a square wave signal pulse. The sensor has the following circuits.

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

The ECM monitors both CKP sensor and camshaft position (CMP) sensor signal pulses to ensure they correlate with each other. If the ECM receives a certain amount of CMP sensor signal pulses without a CKP sensor signal pulse, this DTC will set.

Condition for Running the DTC

- DTCs P0016, P0336, P0340 and P0341 are not set.
- The ignition switch is ON.
- The CMP sensor signal pulse is detected.

Condition for Setting the DTC

- The ECM detects that the CKP sensor signal pulses are not generated during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference in the CKP sensor circuits may set this DTC.
- An intermittent CKP sensor signal pulse may set this DTC.
- Ensure the sensor is tight and the sensor rotor teeth are not damaged.

Notice: If the CKP sensor signal pulse is lost while running, the engine will stop.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0335

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine (Note a slight start delay may be noticed). 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Is DTC P0340, P0341 or P0697 also set?	—	Go to Applicable DTC	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the crankshaft position (CKP) sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 3 of E-20) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 5	Go to Step 9

Step	Action	Value(s)	Yes	No
5	Connect a DMM between the signal circuit (pin 1 of E-20) and a known good ground. Is the DMM voltage more than the specified value?	5.5 volts	Go to Step 12	Go to Step 6
6	Is the DMM voltage more than the specified value at Step 5?	4.5 volts	Go to Step 7	Go to Step 11
7	1. Connect a test lamp between the signal circuit (pin 1 of E-20) and a known good ground. 2. Connect a DMM between the probe of the test lamp and a known good ground. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 13	Go to Step 8
8	Connect a DMM between the 5 volts reference circuit and low reference (pins 2 and 3 of E-20). Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 14	Go to Step 10
9	**Notice:** The CKP sensor shares the 5 volts reference circuit with other sensors. A fault condition in the 5 volts reference circuit may set DTCs on sensors that share this circuit. 1. Test the 5 volts reference circuit between the ECM (pin 95 of E-12) and the CKP sensor (pin 3 of E-20) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 15
10	**Notice:** The CKP sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may set DTCs on sensors that share this circuit. 1. Test the low reference circuit between the ECM (pin 109 of E-12) and the CKP sensor (pin 2 of E-20) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 15
11	1. Test the signal circuit between the ECM (pin 107 of E-12) and the CKP sensor (pin 1 of E-20) 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 19	Go to Step 15

Step	Action	Value(s)	Yes	No
12	**Important:** The CKP sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 107 of E-12) and the CKP sensor (pin 1 of E-20) 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 19	Go to Step 18
13	1. Test the signal circuit between the ECM (pin 107 of E-12) and the CKP sensor (pin 1 of E-20) for a short to any 5 volts reference. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
14	1. Inspect for an intermittent and for poor connections at the harness connector of the CKP sensor (pins 1, 2 and 3 of E-20). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	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 at the harness connector of the ECM (pins 95, 107, 108 and 109 of E-12). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
16	1. Inspect the CKP sensor and sensor rotor for the following conditions: • Physical damage of sensor • Loose or improper installation of sensor • Excessive air gap • Foreign material passing between sensor and sensor rotor • Physical damage of sensor rotor • Loose or improper installation of sensor rotor 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 17
17	Replace the CKP sensor. Refer to CKP Sensor in Section 1B Engine Mechanical. Did you complete the replacement?	—	Go to Step 19	—
18	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 19	—

Step	Action	Value(s)	Yes	No
19	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 20
20	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0336 (Flash Code 15)

Circuit Description

The crankshaft position (CKP) sensor is located on the flywheel housing. The sensor rotor is fixed on the flywheel. There are 56 notches spaced 6° apart and a 30° section that is open span. This open span portion allows for the detection of top dead center (TDC). The ECM monitors both CKP sensor and camshaft position (CMP) sensor signal pulses to ensure they correlate with each other. If the ECM receives extra or missing CKP sensor signal pulse, this DTC will set.

Condition for Running the DTC

- DTCs P0016, P0335, P0340 and P0341 are not set.
- The ignition switch is ON.
- The CKP sensor signal pulse is detected.

Condition for Setting the DTC

- The ECM detects extra or missing CKP sensor signal pulses during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference in the CKP sensor circuits may set this DTC.
- An intermittent CKP sensor signal pulse may set this DTC.
- Ensure the sensor is tight and the sensor rotor teeth are not damaged.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0336

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine (Note a slight start delay may be noticed). 4. Monitor the DTC Information with a scan tool. Is DTC P0335, P0340, P0341 or P0697 also set?	—	Go to Applicable DTC	Go to Step 3
3	1. Inspect all of the circuits going to the crankshaft position (CKP) sensor for the following conditions: • Routed too closely to fuel injection wiring or components • Routed too closely to after-market add-on electrical equipment • Routed too closely to solenoids and relays 2. If you find incorrect routing, correct the harness routing. 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 ECM harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 95, 107, 108 and 109 of E-12). 4. Disconnect the CKP sensor harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the CKP sensor (pins 1, 2 and 3 of E-20). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	1. Inspect the CKP sensor and sensor rotor for the following conditions: • Physical damage of sensor • Loose or improper installation of sensor • Excessive air gap • Foreign material passing between sensor and sensor rotor • Physical damage of sensor rotor • Loose or improper installation of sensor rotor 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	Replace the CKP sensor. Refer to CKP Sensor in Section 1B Engine Mechanical. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0340 (Flash Code 14)

Circuit Description

The camshaft position (CMP) sensor is installed on the cylinder head at the rear of the camshaft gear. The CMP sensor detects total of five holes per one engine cycle (four holes arranged equally every 90° and one reference hole on the camshaft gear surface). The CMP sensor is a magnetic resistance element (MRE) type sensor, which generates a square wave signal pulse. The sensor has the following circuits.

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

The ECM monitors both crankshaft position (CKP) sensor and CMP sensor signal pulses to ensure they correlate with each other. If the ECM receives a certain amount of CKP sensor signal pulses without a CMP sensor signal pulse, this DTC will set.

Condition for Running the DTC

- DTCs P0016, P0335, P0336 and P0341 are not set.
- The ignition switch is ON.
- The CKP sensor signal pulse is detected.

Condition for Setting the DTC

- The ECM detects that the CMP sensor signal pulses are not generated during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference in the CMP sensor circuits may set this DTC.
- An intermittent CMP sensor signal pulse may set this DTC.
- Ensure the sensor is tight and the sensor rotor teeth are not damaged.

Notice: If the CMP sensor signal pulse is lost while running, the engine will operate normally. If the CMP sensor signal pulse is not present on start-up, the engine will not start.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0340

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. If the engine does not start, crank over the engine for 10 seconds. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Is DTC P0651 also set?	—	Go to DTC P0651	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the camshaft position (CMP) sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 3 of E-18) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 5	Go to Step 9

Step	Action	Value(s)	Yes	No
5	Connect a DMM between the signal circuit (pin 1 of E-18) and a known good ground. Is the DMM voltage more than the specified value?	5.5 volts	Go to Step 12	Go to Step 6
6	Is the DMM voltage more than the specified value at Step 5?	4.5 volts	Go to Step 7	Go to Step 11
7	1. Connect a test lamp between the signal circuit (pin 1 of E-18) and a known good ground. 2. Connect a DMM between the probe of the test lamp and a known good ground. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 13	Go to Step 8
8	Connect a DMM between the 5 volts reference circuit and low reference circuit (pins 2 and 3 of E-18). Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 14	Go to Step 10
9	**Notice:** The CMP sensor shares the 5 volts reference circuit with other sensors. A fault condition in the 5 volts reference circuit may set DTCs on sensors that share this circuit. 1. Test the 5 volts reference circuit between the ECM (pin 87 of E-12) and the CMP sensor (pin 3 of E-18) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 15
10	**Notice:** The CMP sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may set DTCs on sensors that share this circuit. 1. Test the low reference circuit between the ECM (pin 101 of E-12) and the CMP sensor (pin 2 of E-18) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 15
11	1. Test the signal circuit between the ECM (pin 98 of E-12) and the CKP sensor (pin 1 of E-18) 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 19	Go to Step 15

Step	Action	Value(s)	Yes	No
12	**Important:** The CMP sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 98 of E-12) and the CMP sensor (pin 1 of E-18) 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 19	Go to Step 18
13	1. Test the signal circuit between the ECM (pin 98 of E-12) and the CMP sensor (pin 1 of E-18) for a short to any 5 volts reference. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
14	1. Inspect for an intermittent and for poor connections at the harness connector of the CMP sensor (pins 1, 2 and 3 of E-18). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	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 at the harness connector of the ECM (pins 87, 98, 100 and 101 of E-12). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
16	1. Inspect the CMP sensor and camshaft gear for the following conditions: • Physical damage of sensor • Loose or improper installation of sensor • Excessive air gap • Foreign material passing between sensor and camshaft gear • Physical damage of camshaft gear • Loose or improper installation of camshaft gear 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 17
17	Replace the CMP sensor. Refer to CMP Sensor in Section 1B Engine Mechanical. Did you complete the replacement?	—	Go to Step 19	—
18	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 19	—

Step	Action	Value(s)	Yes	No
19	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 20
20	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0341 (Flash Code 14)

Circuit Description

The camshaft position (CMP) sensor is installed on the cylinder head at the rear of the camshaft gear. The CMP sensor detects total of five holes per one engine cycle (four holes arranged equally every 90° and one reference hole on the camshaft gear surface). The ECM monitors both crankshaft position (CKP) sensor and CMP sensor signal pulses to ensure they correlate with each other. If the ECM receives extra or missing CMP sensor signal pulse, this DTC will set.

Condition for Running the DTC

- DTCs P0016, P0335, P0336 and P0340 are not set.
- The ignition switch is ON.
- The CMP sensor signal pulse is detected.

Condition for Setting the DTC

- The ECM detects extra or missing CMP sensor signal pulses during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference in the CMP sensor circuits may set this DTC.
- An intermittent CMP sensor signal pulse may set this DTC.
- Ensure the sensor is tight and the camshaft gear are not damaged.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0341

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. If the engine does not start, crank over the engine for 10 seconds. 4. Monitor the DTC Information with a scan tool. Is DTC P0340 or P0651 also set?	—	Go to Applicable DTC	Go to Step 3
3	1. Inspect all of the circuits going to the camshaft position (CMP) sensor for the following conditions: • Routed too closely to fuel injection wiring or components • Routed too closely to after-market add-on electrical equipment • Routed too closely to solenoids and relays 2. If you find incorrect routing, correct the harness routing. 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 CMP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the CMP sensor (pins 1, 2 and 3 of E-18). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 87, 98, 100 and 101 of E-12). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	1. Inspect the CMP sensor and camshaft gear for the following conditions: • Physical damage of sensor • Loose or improper installation of sensor • Excessive air gap • Foreign material passing between sensor and camshaft gear • Physical damage of camshaft gear • Loose or improper installation of camshaft gear 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	Replace the CMP sensor. Refer to CMP Sensor in Section 1B Engine Mechanical. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0380 (Flash Code 66)

Circuit Description

The 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 circuit on the relay control circuit, this DTC will set.

Condition for Running the DTC

- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects a low voltage condition on the glow relay control circuit for longer than 3 second when the relay is commanded OFF.
- The ECM detects a high voltage condition on the glow relay control circuit for longer than 3 second when the relay is commanded ON.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 specification)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 specification)

Diagnostic Aids

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

Test Description

The numbers below refers to the step number on the Circuit/ System Testing.
2. Listen for an audible click when the glow relay operates. Command both the ON and OFF states.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0380

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 a scan tool. 2. Perform the Glow Relay Control with a scan tool. 3. Command the relay ON and OFF. Does the glow relay click with each command?	—	Go to Step 3	Go to Step 4
3	1. Turn OFF the ignition for 30 seconds. 2. Disconnect the engine coolant temperature (ECT) sensor harness connector in order to gain glow ON time long enough. 3. Turn ON the ignition for 30 seconds while observing the DTC information with a scan tool. Does the DTC P0380 fail this ignition?	—	Go to Step 11	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Replace the glow relay with the starter relay or replace with a known good relay. 3. Perform the Glow Relay Control with a scan tool. 4. Command the relay ON and OFF. Does the glow relay click with each command?	—	Go to Step 8	Go to Step 5
5	1. Turn OFF the ignition. 2. Remove the glow relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition voltage feed circuit of the relay coil side (pin 3 of X-19) with a test lamp that is connected to a known good ground. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 7
6	1. Test the control circuit between the ECM (pin 10 of J-14) and the relay (pin 5 of X-19) for the following conditions: • An open circuit • A short to ground • 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 12	Go to Step 9
7	Repair the open circuit or high resistance between the ECM (10A) fuse and the glow relay coil side (pin 3 of X-19). Check the ECM (10A) fuse first. Did you complete the repair?	—	Go to Step 12	—
8	1. Remove the glow relay. 2. Inspect for an intermittent and for a poor connection on each relay terminal. 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 10 of J-14). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the glow relay. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—

Step	Action	Value(s)	Yes	No
12	1. Reconnect all previously disconnected fuse, relay or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Disconnect the ECT sensor harness connector in order to gain glow ON time long enough. 5. Turn ON the ignition for 30 seconds while observing the DTC information with a scan tool. Did the DTC P0380 fail this ignition?	—	Go to Step 2	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0381 (Flash Code 67)

Circuit Description

The glow indicator lamp is located on the instrument panel (IP) cluster. 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 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. For example, a failure condition exists if the ECM detects low voltage when the glow indicator lamp is commanded OFF, or high voltage when the glow indicator lamp is commanded ON. If the ECM detects an improper voltage level on the control circuit, this DTC will set.

Condition for Running the DTC

- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

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

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 specification)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 specification)

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0381

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. Verify whether the instrument panel (IP) cluster is operational. 2. Install a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition for 10 seconds. 5. Start the engine. 6. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Inspect the Meter (10A) fuse in the cab. Is the Meter (10A) fuse open?	—	Go to Step 4	Go to Step 5
4	Replace the Meter (10A) fuse. If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the Meter (10A) fuse or replace the shorted attached component. Did you complete the repair?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the ECM J-14 harness connector. 3. Turn ON the ignition, with the engine OFF. Is the MIL OFF?	—	Go to Step 6	Go to Step 12
6	1. Remove the Meter (10A) fuse that supplies voltage to the MIL. 2. Turn ON the ignition, with the engine OFF. 3. Measure the voltage from the glow indicator lamp control circuit in the ECM harness connector (pin 11 of J-14) to a known good ground. Is the voltage less than the specified value?	1 volt	Go to Step 7	Go to Step 13
7	1. Turn OFF the ignition. 2. Reinstall the Meter (10A) fuse. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the ECM harness connector (pin 11 of J-14) and a known good ground. Is the MIL illuminated?	—	Go to Step 11	Go to Step 8
8	1. Connect a test lamp between the ignition voltage feed circuit of the IP cluster harness connector (pin 2 of B-105) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 14
9	1. Test the control circuit between the ECM (pin 11 of J-14) and the IP cluster (pin 5 of B-106) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 10
10	1. Inspect for an intermittent and for poor connections at the harness connector of the IP cluster (pins 2 and 5 of B-105). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
11	1. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 11 of J-14). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
12	Repair the short to ground between the ECM (pin 11 of J-14) and the IP cluster (pin 5 of B-106). Did you complete the repair?	—	Go to Step 17	—
13	Repair the short to battery or ignition voltage between the ECM (pin 11 of J-14) and the IP cluster (pin 5 of B-106). Did you complete the repair?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
14	Repair the open circuit or high resistance on ignition the voltage feed circuit between the Meter (10A) fuse and the IP cluster (pin 2 of B-105). Did you complete the repair?	—	Go to Step 17	—
15	Repair or replace the IP cluster. Refer to Instrument Panel (IP) Cluster in Section 9E Instrumentation / Driver Info. Did you complete the repair or replacement?	—	Go to Step 17	—
16	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition for 10 seconds. 5. Start the engine. 6. Monitor the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 18
18	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0401 (Flash Code 93)

The ECM controls the EGR valve opening based on the engine running condition and by controlling the EGR solenoid. The EGR valve position is detected by the position sensor, and relayed to the ECM. When the proper enabling conditions are met, the ECM will open the EGR valve while monitoring the mass air flow (MAF) signal. An expected MAF difference should be detected between the closed and open positions. If the ECM detects the MAF difference less than expected, this DTC will set. This DTC will only run once per ignition cycle within the enabling conditions.

Condition for Running the DTC

- DTCs P0079, P0080, P0102, P0103, P0112, P0113, P0116, P0117, P0118, P0122, P0123, P0404, P0409, P0500, P0502, P0503, P0560, P060B, P0638, P0651, P0697, P1404, P2227, P2228 and P2229 are not set.
- The battery voltage is between 16 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the MAF amount is not within the calculated range during the EGR flow test. This indicates insufficient amount of EGR flow.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Notice: A history DTC remains 9,600 hours (accumulated engine runtime) and will not clear with a scan tool.

Diagnostic Aids

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

Circuit/ System Testing DTC P0401

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0101, P0102, P0103 or P0560 also set?	—	Go to Applicable DTC	Go to Step 3
3	Warm up the engine (allow engine coolant temperature to reach at least 75°C [167°F]) and let idle for at least 3 minutes while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Inspect the following conditions: • An EGR valve gasket that is missing or damaged • A sticking EGR valve • EGR gas leakage from any of the EGR passages between the exhaust manifold and intake manifold • Restricted or collapsed EGR passage between the exhaust manifold and the EGR valve • Any type of restriction in the exhaust system • Restricted air cleaner element, restricted or collapsed air tubing between the air cleaner and the intake manifold • Any air induction leak • Any water intrusion in the induction system • Any contamination or objects that block the MAF sensor inlet • Skew or slow MAF sensor • Exhaust throttle valve or exhaust brake valve for stuck condition. Refer to Exhaust System in Section 1G Engine Exhaust. • A ventilation duct that is connected to the exhaust tail pipe. Retest without the duct if connected. 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	1. Perform the EGR Solenoid Control with a scan tool several times. 2. Command the Desired EGR Position Increase and Decrease while observing the EGR Position 1. Does the EGR Position 1 parameter follow within the specified value quick enough (compare with a similar unit if available)?	± 5%	Go to Diagnostic Aids	Go to Step 6
6	Replace the EGR valve. Refer to EGR Valve and EGR Cooler in Section 1F Emission Control. Did you complete the replacement?	—	Go to Step 7	
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. **Notice:** A history DTC will not clear. 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. Let idle for at least 3 minutes while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8

Step	Action	Value(s)	Yes	No
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0404 (Flash Code 45)

Circuit Description

The ECM controls the EGR valve opening based on the engine running condition and by controlling the EGR solenoid. The EGR valve position is detected by the position sensor, and relayed to the ECM. If the ECM detects a variance between the actual EGR valve position and desired EGR valve position for a calibrated amount of time while the EGR valve is commanded ON, this DTC will set.

Condition for Running the DTC

- DTCs P0112, P0113, P0116, P0117, P0118, P0409, P060B, P0651, P0651, P0697, P2227, P2228 and P2229 are not set.
- The battery voltage is between 16 to 32 volts.
- The ignition switch is ON.
- The EGR control is commanded ON.

Condition for Setting the DTC

- The ECM detects that the actual EGR valve position is more than 10% below the desired valve position for longer than 5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Notice: A history DTC remains 9,600 hours (accumulated engine runtime) and will not clear with a scan tool. (Euro 4 specification)

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0404

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0409 also set?	—	Go to DTC P0409	Go to Step 3
3	1. Perform the EGR Solenoid Control with a scan tool several times. 2. Command the Desired EGR Position Increase and Decrease while observing the EGR Position 1. Does the EGR Position 1 parameter follow within the specified value quick enough (compare with a similar unit if available)?	$\pm$ 5%	Go to Diagnostic Aids	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Remove the EGR valve assembly from the engine. 2. Inspect the EGR valve for the following conditions: • Restricted EGR valve by foreign materials • Excessive deposits at valve • Bent valve shaft or valve 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 5
5	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the EGR valve (pins 1, 2, 3, 4, 5, 6, 7 and 8 of E-15). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 87, 93, 94, 99, 101, 103 110 and 111 of E-12). 6. Test for an open circuit or high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6
6	1. Test the solenoid circuits between the ECM (pins 103, 110 and 111 of E-12) and the EGR valve (pins 6, 7 and 8 of E-15) for the following conditions: • A short to ground • A short to battery or ignition voltage • A short circut each other • A short to the EGR position sensor circuit(s) 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	Replace the EGR valve. Refer to EGR Valve and EGR Cooler in Section 1F Emission Control. 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 a scan tool. **Notice:** A history DTC will not clear. (Euro 4 specification) 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 9	Go to Step 11
9	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 10	
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. **Notice:** A history DTC will not clear. (Euro 4 specification) 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 11
11	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0409 (Flash Code 44)

Circuit Description

The exhaust gas recirculation (EGR) position sensor is installed on the EGR valve body together with the control solenoid. The sensor is made up three individual sensors within one housing. The EGR position sensor 1, EGR position sensor 2 and EGR position sensor 3 are hall element type sensors, each with the following circuits.

- 5 volts reference circuit
- Low reference circuit
- Signal circuit

The EGR position sensor provides a low or high signal state to the ECM on the signal circuits, which is relative to the position changes of the EGR valve. If the ECM detects that each EGR position sensor signal state is out of correlation such as all low signal state or high signal state, this DTC will set.

Condition for Running the DTC

- DTCs P060B and P0651 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that all EGR valve position sensor signals are stuck low or high for longer than 3 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Notice: A history DTC remains 9,600 hours (accumulated engine runtime) and will not clear with a scan tool. (Euro 4 specification)

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0409

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0651 also set?	—	Go to DTC P0651	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the EGR Position 1, 2 and 3 parameters with a scan tool. Is there parameter which indicate High?	—	Go to Step 7	Go to Step 4
4	Connect a DMM between the 5 volts reference circuit (pin 1 of E-15) and a known good ground. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 5	Go to Step 8

Step	Action	Value(s)	Yes	No
5	Connect a DMM between the 5 volts reference circuit and low reference circuit (pin 1 and 5 of E-15). Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 6	Go to Step 9
6	Observe the EGR Position 1, 2 and 3 parameter with a scan tool while momentarily jumping a 3-amp fused jumper wire across the EGR valve harness connector between each signal circuit and the 5 volts reference circuit. • EGR position 1: pins 1 and 4 of E-15 • EGR position 2: pins 1 and 3 of E-15 • EGR position 3: pins 1 and 2 of E-15 Is there parameter which did not indicate High when the circuit is jumpered?	—	Go to Step 10	Go to Step 11
7	**Important**: The EGR position sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuits (which ever parameter indicates High at Step 3) between the ECM (pins 93, 94 and 99 of E-12) and the EGR valve (pins 2, 3 and 4 of E-15) 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 16	Go to Step 15
8	**Notice:** The EGR position sensor shares the 5 volts reference circuit with other sensors. A fault condition in the 5 volts reference circuit may set DTCs on sensors that share this circuit. 1. Test the 5 volts reference circuit between the ECM (pin 87 of E-12) and the EGR valve (pin 1 of E-15) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 13
9	**Notice:** The EGR position sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may set DTCs on sensors that share this circuit. 1. Test the low reference circuit between the ECM (pin 101 of E-12) and the EGR valve (pin 5 of E-15) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 13

Step	Action	Value(s)	Yes	No
10	1. Test the position sensor circuits (which ever parameter did not indicate High at Step 6) between the ECM (pins 93, 94 and 99 of E-12) and the EGR valve (pins 2, 3 and 4 of E-15) 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 16	Go to Step 13
11	1. Inspect for an intermittent and for poor connections at the harness connector of the EGR valve (pins 1, 2, 3, 4 and 5 of E-15) 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 12
12	1. Test the solenoid circuits between the ECM (pins 103, 110 and 111 of E-12) and the EGR valve (pins 6, 7 and 8 of E-15) for a short to the EGR position sensor circuit(s). 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 14
13	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 87, 93, 94, 99 and 101 of E-12). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
14	Replace the EGR valve. Refer to EGR Valve and EGR Cooler in Section 1F Emission Control. Did you complete the replacement?	—	Go to Step 16	
15	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 16	
16	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. **Notice:** A history DTC will not clear. (Euro 4 specification) 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 17

Step	Action	Value(s)	Yes	No
17	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0426 (Flash Code 143)

Circuit Description

The exhaust temperature sensor 1 is installed to the diesel particulate defuser (DPD) housing. The exhaust temperature sensor 1 is a variable resistor and it measures the temperature of the exhaust gas in front of DPD filter. If the ECM detects an excessively high exhaust temperature, this DTC will set.

Condition for Running the DTC

- DTCs P0427, P0428, P060B and P0697 are not set.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that exhaust temperature 1 (in front of filter) is higher than 880 °C (1616 °F) for 5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C.
- The ECM limits fuel injection quantity

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C.

Diagnostic Aids

- Use the Temperature vs Resistance table to test the exhaust temperature sensor at various temperature levels to evaluate the possibility of a skewed sensor.
- Fuel system problem (e.g. fuel injector damage) may set this DTC.

Notice: This DTC is caused by an excessively high exhaust temperature condition, which was most likely caused by uncontrolled burning while regeneration process of DPD filter. Excessive high exhaust gas temperature may damage DPD filter or oxygen catalyst.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0426

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0093, P0427 or P1093 also set?	—	Go to Applicable DTC	Go to Step 3
3	1. Test the exhaust temperature sensor 1 at various temperature levels to evaluate the possibility of a skewed sensor. 2. Replace the exhaust temperature sensor as necessary. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	1. Remove the diesel particulate defuser (DPD) assembly. Refer to Exhaust Pipe in Section 1G Engine Exhaust. 2. Inspect the DPD filter and the oxygen catalyst for damage, cracks or melt. **Important:** DPD status in the ECM must be reset when the DPD filter is replaced. 3. Replace the DPD filter or the oxygen catalyst as necessary. Refer to Exhaust Pipe in Section 1G Engine Exhaust. Did you find and correct the condition?	—	Go to Step 5	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
5	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 6
6	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0427 or P0428 (Flash Code 48)

Circuit Description

The exhaust temperature sensor 1 is installed to the diesel particulate defuser (DPD) housing. The exhaust temperature sensor 1 is a variable resistor and it measures the temperature of the exhaust gas in front of DPD filter. The sensor has a signal circuit and a low reference circuit. The ECM supplies 5 volts to the signal circuit and a ground for the low reference circuit. When the exhaust temperature sensor 1 is cold, the sensor resistance is high. When the exhaust temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the signal circuit. If the ECM detects an excessively low or high signal voltage, DTC P0427 or P0428 will set.

Condition for Running the DTC

- DTCs P060B and P0697 are not set. (DTC P0427)
- DTCs P0112, P0113, P0116, P0117, P0118, P060B, P0651, P0697, P2227, P2228 and P2229 are not set. (DTC P0428)
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The engine coolant temperature is more than (80°C) (176 °F). (DTC P0428)
- The engine speed is more than 1400RPM. (DTC P0428)
- The fuel injection quantity is more than a predetermined value. (DTC P0428)
- The vehicle is running or the PTO control is inactive.
- The engine run time is longer than 5 to 10 minutes. (DTC P0428)

Condition for Setting the DTC

- The ECM detects that the exhaust temperature sensor 1 signal voltage is less than 0.2 volts for 3 seconds. (DTC P0427)
- The ECM detects that the exhaust temperature sensor 1 signal voltage is more than 4.85 volts for 5 seconds. (DTC P0428)

Action Taken When the DTC Sets

- The ECM illuminates MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Temperature vs. Resistance table to test the exhaust temperature sensor 1 at various temperature levels to evaluate the possibility of a skewed sensor.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0427

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0697 also set?	—	Go to DTC P0697	Go to Step 3
3	Observe the Exhaust Temperature Sensor 1 parameter with a scan tool. Is the Exhaust Temperature Sensor 1 parameter less than the specified value?	0.2 volts	Go to Step 4	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the exhaust temperature sensor 1 harness connector. 3. Turn ON the ignition, with the engine OFF. Is the Exhaust Temperature Sensor 1 parameter more than the specified value?	4.5 volts	Go to Step 6	Go to Step 5
5	1. Test the signal circuit between the ECM (pin 73 of J-14) and the exhaust temperature sensor 1 (pin 2 of J-34) 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 9	Go to Step 7
6	Replace the exhaust temperature sensor 1. Refer to Exhaust Temperature Sensor in Section 1G Engine Exhaust. Did you complete the replacement?	—	Go to Step 9	—
7	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect connections at the harness connector of the ECM (pins 73 and 79 of J-14) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 8
8	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 9	—
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 10
10	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0428

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0697 also set?	—	Go to DTC P0697	Go to Step 3
3	1. Start the engine and fully warm up (allow engine coolant temperature to reach at least 80°C [176°F]). 2. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the Exhaust Temperature Sensor 1 parameter with a scan tool. Is the Exhaust Temperature Sensor 1 parameter more than the specified value?	4.8 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the exhaust temperature sensor 1 harness connector. 3. Connect a DMM between the signal circuit (pin 1 of J-34) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.5 volts	Go to Step 5	Go to Step 6
5	**Important:** The exhaust temperature sensor 1 may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 73 of J-14) and the exhaust temperature sensor 2 (pin 2 of J-34) 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
6	Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit (pins 1 and 2 of J-34). Is the Exhaust Temperature Sensor 1 parameter less than the specified value?	0.1 volts	Go to Step 10	Go to Step 7
7	Connect a 3-amp fused jumper wire between the signal circuit (pin 2 of J-34) and a known good ground. Is the Exhaust Temperature Sensor 1 parameter less than the specified value?	0.1 volts	Go to Step 9	Go to Step 8

Step	Action	Value(s)	Yes	No
8	1. Test the signal circuit between the ECM (pin 73 of J-14) and the exhaust temperature sensor 1 (pin 2 of J-34) 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	**Notice:** The exhaust temperature sensor 1 shares the low reference circuit with other sensors. A fault condition in the low reference circuit may set DTCs on sensors that share this circuit. 1. Test the low reference circuit between the ECM (pin 79 of J-14) and the exhaust temperature sensor 1 (pin 1 of J-34) 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
10	1. Test the signal circuit between the ECM (pin 73 of J-14) and the exhaust temperature sensor 1 (pin 2 of J-34) 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 15	Go to Step 11
11	1. Inspect for an intermittent and for poor connections at the harness connector of the exhaust temperature sensor 1 (pins 1 and 2 of J-34). 2. 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 at the harness connector of the ECM (pins 73 and 79 of J-14). 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 exhaust temperature sensor 1. Refer to Exhaust Temperature Sensor in Section 1G Engine Exhaust. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 15	—

Step	Action	Value(s)	Yes	No
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and fully warm up (allow engine coolant temperature to reach at least 80° C [176° F]). 5. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the Exhaust Temperature Sensor 1 parameter with a scan tool. Is the Exhaust Temperature Sensor 1 parameter more than the specified value?	4.8 volts	Go to Step 4	Go to Step 16
16	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P042B (Flash Code 145)

Circuit Description

The exhaust temperature sensor 2 is installed to the diesel particulate defuser (DPD) housing. The exhaust temperature sensor 2 is a variable resistor and it measures the temperature of the exhaust gas in front of oxygen catalyst. If the ECM detects an excessively high exhaust temperature, this DTC will set.

Condition for Running the DTC

- DTCs P042C, P042D, P060B and P0697 are not set.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that exhaust temperature 2 (in front of oxygen catalyst) is higher than 870°C (1600 °F) for 5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C.
- The ECM limits fuel injection quantity

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C.

Diagnostic Aids

- Use the Temperature vs. Resistance table to test the exhaust temperature sensor at various temperature levels to evaluate the possibility of a skewed sensor.
- Fuel system problem (e.g. fuel injector damage) may set this DTC.

Notice: This DTC is caused by an excessively high exhaust temperature condition, which was most likely caused by uncontrolled burning while regeneration process of DPD filter. Excessive high exhaust gas temperature may damage DPD filter.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P042B

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0093, P042C or P1093 also set?	—	Go to Applicable DTC	Go to Step 3
3	1. Test the exhaust temperature sensor 2 at various temperature levels to evaluate the possibility of a skewed sensor. 2. Replace the exhaust temperature sensor as necessary. Refer to Exhaust Temperature Sensor in Section 1G Engine Exhaust. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	1. Remove the diesel particulate defuser (DPD) assembly. Refer to Exhaust Pipe in Section 1G Engine Exhaust. 2. Inspect the DPD filter and the oxygen catalyst for damage, cracks or melt. **Important:** DPD status in the ECM must be reset when the DPD filter is replaced. 3. Replace the DPD filter or the oxygen catalyst as necessary. Refer to Exhaust Pipe in Section 1G Engine Exhaust. Did you find and correct the condition?	—	Go to Step 5	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
5	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 6
6	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P042C or P042D (Flash Code 49)

Circuit Description

The exhaust temperature sensor 2 is installed to the diesel particulate defuser (DPD) housing. The exhaust temperature sensor 2 is a variable resistor and it measures the temperature of the exhaust gas in front of oxygen catalyst. The sensor has a signal circuit and a low reference circuit. The ECM supplies 5 volts to the signal circuit and a ground for the low reference circuit. When the exhaust temperature sensor 2 is cold, the sensor resistance is high. When the exhaust temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the signal circuit. If the ECM detects an excessively low or high signal voltage, DTC P042C or P042D will set.

Condition for Running the DTC

- DTCs P060B and P0697 are not set. (DTC P042C)
- DTCs P0112, P0113, P0116, P0117, P0118, P060B, P0651, P0697, P2227, P2228 and P2229 are not set. (DTC P042D)
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The engine speed is more than 1400RPM. (DTC P042D)
- The engine coolant temperature is more than 80°C (176°F). (DTC P042D)
- The fuel injection quantity is more than a predetermined value. (DTC P042D)
- The vehicle is running or the PTO control is inactive.
- The engine run time is longer than 5 to 10 minutes. (DTC P042D)

Condition for Setting the DTC

- The ECM detects that the exhaust temperature sensor 2 signal voltage is less than 0.2 volts for 3 seconds. (DTC P042C)
- The ECM detects that the exhaust temperature sensor 2 signal voltage is more than 4.85 volts for 5 seconds. (DTC P042D)

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Temperature vs. Resistance table to test the exhaust temperature sensor 2 at various temperature levels to evaluate the possibility of a skewed sensor.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P042C

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0697 also set?	—	Go to DTC P0697	Go to Step 3
3	Observe the Exhaust Temperature Sensor 2 parameter with a scan tool. Is the Exhaust Temperature Sensor 2 parameter less than the specified value?	0.2 volts	Go to Step 4	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the exhaust temperature sensor 2 harness connector. 3. Turn ON the ignition, with the engine OFF. Is the Exhaust Temperature Sensor 2 parameter more than the specified value?	4.5 volts	Go to Step 6	Go to Step 5
5	1. Test the signal circuit between the ECM (pin 74 of J-14) and the exhaust temperature sensor 2 (pin 2 of J-35) 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 9	Go to Step 7
6	Replace the exhaust temperature sensor 2. Refer to Exhaust Temperature Sensor in Section 1G Engine Exhaust. Did you complete the replacement?	—	Go to Step 9	—
7	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect connections at the harness connector of the ECM (pins 74 and 79 of J-14) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 8
8	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 9	—
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 10
10	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P042D

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0697 also set?	—	Go to DTC P0697	Go to Step 3
3	1. Start the engine and fully warm up (allow engine coolant temperature to reach at least 80°C [176°F]). 2. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the Exhaust Temperature Sensor 2 parameter with a scan tool. Is the Exhaust Temperature Sensor 2 parameter more than the specified value?	4.8 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the exhaust temperature sensor 2 harness connector. 3. Connect a DMM between the signal circuit (pin 1 of J-35) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.5 volts	Go to Step 5	Go to Step 6
5	**Important:** The exhaust temperature sensor 2 may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 74 of J-14) and the exhaust temperature sensor 2 (pin 2 of J-35) 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
6	Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit (pins 1 and 2 of J-35). Is the Exhaust Temperature Sensor 2 parameter less than the specified value?	0.1 volts	Go to Step 10	Go to Step 7
7	Connect a 3-amp fused jumper wire between the signal circuit (pin 2 of J-35) and a known good ground. Is the Exhaust Temperature Sensor 2 parameter less than the specified value?	0.1 volts	Go to Step 9	Go to Step 8
8	1. Test the signal circuit between the ECM (pin 74 of J-14) and the exhaust temperature sensor 2 (pin 2 of J-35) 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

Step	Action	Value(s)	Yes	No
9	**Notice:** The exhaust temperature sensor 2 shares the low reference circuit with other sensors. A fault condition in the low reference circuit may set DTCs on sensors that share this circuit. 1. Test the low reference circuit between the ECM (pin 79 of J-14) and the exhaust temperature sensor 2 (pin 1 of J-35) 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
10	1. Test the signal circuit between the ECM (pin 74 of J-14) and the exhaust temperature sensor 2 (pin 2 of J-35) 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 15	Go to Step 11
11	1. Inspect for an intermittent and for poor connections at the harness connector of the exhaust temperature sensor 2 (pins 1 and 2 of J-35). 2. 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 at the harness connector of the ECM (pins 74 and 79 of J-14). 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 exhaust temperature sensor 2. Refer to Exhaust Temperature Sensor in Section 1G Engine Exhaust. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and fully warm up (allow engine coolant temperature to reach at least 80°C [176°F]). 5. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the Exhaust Temperature Sensor 2 parameter with a scan tool. Is the Exhaust Temperature Sensor 2 parameter more than the specified value?	4.8 volts	Go to Step 4	Go to Step 16

Step	Action	Value(s)	Yes	No
16	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0477 or P0478 (Flash Code 46)

Circuit Description

The ECM control the exhaust brake, which energizes the exhaust brake solenoid valve based on the vehicle running condition. The ECM commands the exhaust brake solenoid valve to apply vacuum pressure to the diaphragm chamber to operate the exhaust brake valve. If the ECM detects an improper voltage level on the exhaust brake solenoid control circuit, DTC P0477 or P0478 will set.

Condition for Running the DTC

- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM detects a low voltage condition on the exhaust brake solenoid control circuit for longer than 3 seconds when the solenoid is commanded OFF. (DTC P0477)
- The ECM detects a high voltage condition on the exhaust brake solenoid control circuit for longer than 3 seconds when the solenoid is commanded ON. (DTC P0478)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM inhibits exhaust brake control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for
- Clearing the MIL/ DTC - Type A.

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 Circuit/ System Testing.
DTC P0478
3. If the exhaust brake solenoid control circuit between the ECM and the solenoid valve is normal, voltage level low DTC P0477 will set.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0477

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. 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 control solenoid valve harness connector. 3. Connect a test lamp between the ignition voltage feed circuit (pin 1 of J-26) 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

Step	Action	Value(s)	Yes	No
4	1. Connect a test lamp between the control circuit (pin 2 of J-26) and battery voltage. 2. Perform the Exhaust Brake Control with a scan tool. 3. Command the solenoid valve ON and OFF. Does the test lamp turn ON and OFF with each command?	—	Go to Step 9	Go to Step 5
5	Does the test lamp remain illuminated with each command?	—	Go to Step 8	Go to Step 7
6	Repair the open circuit or high resistance between the ECM (10A) fuse and the solenoid valve (pin 1 of J-26). Check the ECM (10A) fuse first. Did you complete the repair?	—	Go to Step 13	—
7	1. Test the control circuit between the ECM (pin 15 of J-14) and the solenoid valve (pin 1 of J-26) 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 15 of J-14) and the solenoid valve (pin 1 of J-26) 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. Inspect for an intermittent and for poor connections at the harness connector of the solenoid valve (pins 1 and 2 of J-26). 2. 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 at harness connector of the ECM (pin 15 of J-14). 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 control solenoid valve. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Monitor the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 14

Step	Action	Value(s)	Yes	No
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0478

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 a scan tool. 2. Perform the Exhaust Brake Control with a scan tool. 3. Command the solenoid valve ON and OFF. Does the solenoid valve click with each command?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the exhaust brake control solenoid valve harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC P0477 set, but not P0478?	—	Go to Step 5	Go to Step 4
4	1. Test the control circuit between the ECM (pin 15 of J-14) and the solenoid valve (pin 2 of J-26) 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 control solenoid valve. Did you complete the replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Perform the Exhaust Brake Control with a scan tool. 5. Command the solenoid valve ON and OFF. Does the solenoid valve click with each command?	—	Go to Step 8	Go to Step 3
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0500 (Flash Code 25)

Circuit Description

Model without ABS

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

- Ignition voltage feed circuit
- Low reference circuit
- VSS signal 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.

Model with ABS

The EHCU calculates the vehicle speed based on the signal from the wheel speed sensors. The ECM receives the pulse signal from the EHCU. If the ECM detects that vehicle speed signal from the EHCU are not generated, this DTC will set.

Condition for Running the DTC

- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The commanded fuel injection quantity is OFF (accelerator pedal is not depressed).
- The engine speed is more than 2000RPM.

Condition for Setting the DTC

- The ECM detects that the VSS pulses are not generated for longer than 7 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL on the second consecutive driving cycle when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type B. (Euro 4 specification)
- The ECM illuminates MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 specification)
- The ECM limits fuel injection quantity.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type B. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference in the VSS circuit may set this DTC.
- An aftermarket signal pulse pickup device may affect intermittent condition.

Notice: If this DTC set, the Vehicle Speed parameter on the scan tool will display 10 km/h (6 MPH).

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0500 (Model without ABS)

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0219, P0502 or P0503 also set?	—	Go to Applicable DTC	Go to Step 3
3	Drive the vehicle while observing the Vehicle Speed parameter with a scan tool. Does the scan tool indicate correct vehicle speed?	—	Go to Diagnostic Aids	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Inspect the VSS, drive gear, driven gear or output shaft for the following conditions: • Physical damage of sensor, drive gear or driven gear • Loose or improper installation of sensor, drive gear or driven gear • Transmission output shaft teeth damage • Excessive transmission output shaft play 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	1. Turn OFF the ignition. 2. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the VSS (pins 1, 2 and 3 of J-48). 3. Disconnect the ECM harness connector. 4. Inspect for an intermittent, for a poor connection and corrosion at the harness connector of the ECM (pin 19 of J-14). 5. Repair the connection(s) 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 in Section 9E Instrumentation/Driver Info. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Drive the vehicle while observing the Vehicle Speed parameter with a scan tool. Does the scan tool indicate correct vehicle speed?	—	Go to Step 8	Go to Step 2
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0500 (Model with ABS)

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0502 or P0503 also set?	—	Go to Applicable DTC	Go to Step 3
3	Observe the ABS DTCs information with a scan tool. Is DTC C0251, C0252, C0253, C0254, C0261, C0262, C0263 or C0264 set?	—	Go to Applicable DTC	Go to Step 4

Step	Action	Value(s)	Yes	No
4	Drive the vehicle while observing the Vehicle Speed parameter with a scan tool. Does the scan tool indicate correct vehicle speed?	—	Go to Diagnostic Aids	Go to Step 5
5	1. Turn OFF the ignition. 2. Disconnect the EHCU harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the EHCU (pins 14 of J-22). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for a poor connection and corrosion at the harness connector of the ECM (pin 19 of J-14). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	**Important:** Replacement EHCU must be programmed. Replace the EHCU. Refer to EHCU in Section 4C1 ABS/ASR. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Drive the vehicle while observing the Vehicle Speed parameter with a scan tool. Does the scan tool indicate correct vehicle speed?	—	Go to Step 8	Go to Step 2
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0502 or P0503 (Flash Code 25)

Circuit Description

Model without ABS

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

- Ignition voltage feed circuit
- Low reference circuit
- VSS signal 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, DTC P0502 or P0503 will set.

Model with ABS

The EHCU calculates the vehicle speed based on the signal from the wheel speed sensors. The ECM receives the pulse signal from the EHCU. If the ECM detects that vehicle speed signal from the EHCU are not generated, this DTC will set.

Condition for Running the DTC

- DTC P060B is not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the VSS signal voltage is less than 0.5 volts. (DTC P0502)
- The ECM detects that the VSS signal voltage is more than 20 volts. (DTC P0503)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- An aftermarket signal pulse pickup device may affect intermittent condition.

Notice: If this DTC set, the Vehicle Speed parameter on the scan tool will display 10 km/h (6 MPH).

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0502 (Model without ABS)

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the VSS harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the ignition voltage feed circuit (pin 1 of J-48) and a known good ground. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 6
4	Connect a test lamp between the signal circuit (pin 3 of J-48) and battery voltage. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Leave the test lamp connected between the VSS harness connector and battery voltage. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC P0503 also set?	—	Go to Step 9	Go to Step 8
6	Repair the open circuit or high resistance on the ignition voltage feed circuit between the Meter (10A) fuse and the VSS (pin 1 of J-48). Check the Meter (10A) fuse first. Did you complete the repair?	—	Go to Step 13	—
7	1. Test the signal circuit between the ECM (pin 19 of J-14) and the VSS (pin 3 of J-48) for a short to ground or short to the low reference. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	1. Test the signal circuit between the ECM (pin 19 of J-14) and the VSS (pin 3 of J-48) 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
9	1. Inspect for an intermittent and for poor connections at the harness connector of the VSS (pins 1 and 3 of J-48). 2. 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 at the harness connector of the ECM (pin 19 of J-14). 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 VSS. Refer to Vehicle Speed Sensor in Section 9E Instrumentation/Driver Info. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	—

Step	Action	Value(s)	Yes	No
13	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0502 (Model with ABS)

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Observe the ABS DTCs information with a scan tool. Is DTC C0251, C0252, C0253, C0254, C0261, C0262, C0263 or C0264 set?	—	Go to Applicable DTC	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the EHCU harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the vehicle speed signal circuit (pin 14 of J-22) and a battery voltage. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 5
5	1. Leave the test lamp connected between the EHCU harness connector and battery voltage. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC P0503 also set?	—	Go to Step 8	Go to Step 7
6	1. Test the vehicle speed signal circuit between the ECM (pin 19 of J-14) and the EHCU (pin 14 of J-22) for a short to ground or short to the low reference. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11

Step	Action	Value(s)	Yes	No
7	1. Test the vehicle speed signal circuit between the ECM (pin 19 of J-14) and the EHCU (pin 14 of J-22) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	1. Inspect for an intermittent and for poor connections at the harness connector of the EHCU (pins 14 of J-22). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 19 of J-14). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	**Important:** Replacement EHCU must be programmed. Replace the EHCU. Refer to EHCU in Section 4C1 ABS/ASR. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0503 (Model without ABS)

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition for 30 seconds. 2. Disconnect the VSS harness connector. 3. Turn ON the ignition, with the engine OFF. Is DTC P0502 also set?	—	Go to Step 4	Go to Step 5
4	Connect a test lamp between the low reference circuit (pin 2 of J-48) and battery voltage. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 6
5	1. Test the signal circuit between the ECM (pin 19 of J-14) and the VSS (pin 3 of J-48) 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 10	Go to Step 9
6	Repair the open circuit or high resistance on the low reference circuit between the VSS (pin 2 of J-48) and ground terminal. Clean or tighten ground as necessary. Did you complete the repair?	—	Go to Step 10	—
7	1. Inspect for an intermittent and for a poor connection at the harness connector of the VSS (pin 2 of J-48). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
8	Replace the VSS. Refer to Vehicle Speed Sensor in Section 9E Instrumentation/Driver Info. Did you complete the replacement?	—	Go to Step 10	—
9	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 10	—
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 11
11	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0503 (Model with ABS)

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Observe the ABS DTCs information with a scan tool. Is DTC C0251, C0252, C0253, C0254, C0261, C0262, C0263 or C0264 set?	—	Go to Applicable DTC	Go to Step 4
4	1. Turn OFF the ignition for 30 seconds. 2. Disconnect the EHCU harness connector. 3. Turn ON the ignition, with the engine OFF. Is DTC P0502 also set?	—	Go to Step 6	Go to Step 5
5	1. Test the signal circuit between the ECM (pin 19 of J-14) and the EHCU (pin 14 of J-22) 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 9	Go to Step 8
6	1. Inspect for an intermittent and for a poor connection at the harness connector of the EHCU (pin 14 of J-22). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 7
7	**Important:** Replacement EHCU must be programmed. Replace the EHCU. Refer to EHCU in Section 4C1 ABS/ASR. Did you complete the replacement?	—	Go to Step 9	—
8	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 9	—
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 10

Step	Action	Value(s)	Yes	No
10	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0560 (Flash Code 155)

Circuit Description

The ECM provides 12 volts reference voltage to the mass air flow (MAF) sensor. Battery voltage is supplied in ECM through the dropping register, and it is converted into 12 volts. The ECM monitors the voltage on the 12 volts reference circuit. If the ECM detects the voltage is excessively low or high, this DTC will set.

Condition for Running the DTC

- DTC P060B is not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the 12 volts reference circuit voltage is less than 7 volts.
- The ECM detects that the 12 volts reference circuit voltage more than 19 volts.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0560

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition for 30 seconds. 2. Disconnect the MAF sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Does the DTC fail?	—	Go to Step 4	Go to Step 13
4	1. Turn OFF the ignition for 30 seconds. 2. Leave the MAF sensor harness connector disconnected. 3. Disconnect the dropping resistor harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DTC fail?	—	Go to Step 10	Go to Step 5
5	Measure the resistance across the dropping resistor. Is the resistance within the specified value?	45 to 55 Ω	Go to Step 6	Go to Step 15

Step	Action	Value(s)	Yes	No
6	1. Connect a DMM between the ignition voltage feed circuit (pin 1 of J-30) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	18.0 volts	Go to Step 7	Go to Step 8
7	Connect a DMM between the voltage supply circuit (pin 2 of J-30) and a known good ground. Is the DMM voltage more than the specified value?	13.0 volts	Go to Step 12	Go to Step 9
8	Repair the open circuit or high resistance on the ignition voltage feed circuit between the ECM MAIN (15A) fuse and the dropping resistor (pin 1 of J-30). Check the ECM MAIN (15A) fuse first. Did you complete the repair?	—	Go to Step 18	—
9	1. Test the voltage supply circuit between the ECM (pin 35 of J-14) and the dropping resistor (pin 2 of J-30) 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 14
10	1. Test the voltage supply circuit between the ECM (pin 35 of J-14) and the dropping resistor (pin 2 of J-30) 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 11
11	1. Test the 12 volts reference circuit between the ECM (pin 23 of J-14) and the MAF sensor (pin 1 of J-38) for the following conditions: • A short to ground • A short to battery or ignition voltage • A short to the low reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 17
12	1. Inspect for an intermittent and for poor connections at the harness connector of the dropping resistor (pins 1 and 2 of J-30). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Diagnostic Aids
13	1. Inspect for corrosion at the harness connector of the MAF sensor (pin 1 of J-38). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 16

Step	Action	Value(s)	Yes	No
14	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 35 of J-14). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 17
15	Replace the dropping resistor. Did you complete the replacement?	—	Go to Step 18	—
16	Replace the MAF sensor. Refer to MAF/IAT Sensor in Section 1J Induction. Did you complete the replacement?	—	Go to Step 18	—
17	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 18	—
18	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 19
19	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0563 (Flash Code 35)

Circuit Description

The ECM monitors the ignition voltage on the ignition feed terminal to make sure that the voltage stays within the proper range. If the ECM detects an excessively high ignition voltage, this DTC will set.

Condition for Running the DTC

- DTC P060B is not set.
- The battery voltage is between 18 to 32 volts.

Condition for Setting the DTC

- The ECM detects that the ignition voltage feed circuit is more than 32 volts for 30 minutes.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 specification)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 specification)

Diagnostic Aids

- A charging system problem may set this DTC.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0563

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	Was the vehicle recently a battery charger placed on the battery?	—	Go to Step 7	Go to Step 3
3	1. Install a scan tool. 2. Start the engine and let idle. 3. Observe the Ignition Voltage parameter with the scan tool. Does the scan tool indicate less than the specified value?	32.0 volts	Go to Diagnostic Aids	Go to Step 4
4	Test the charging system. Refer to Charging System in Section 1E Engine Electrical. Did you find a charging system problem?	—	Go to Step 5	Go to Diagnostic Aids
5	Repair the charging system. Refer to Charging System in Section 1E Engine Electrical. Did you complete the repair?	—	Go to Step 6	—
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and let idle. 5. Observe the ignition Voltage parameter with a scan tool. Does the scan tool parameter less than the specified value?	32.0 volts	Go to Step 7	Go to Step 4

Step	Action	Value(s)	Yes	No
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0601 (Flash Code 53)

Circuit Description

This diagnostic applies to internal microprocessor integrity conditions within the ECM.

Condition for Setting the DTC

- The ECM detects that the calculated checksum does not agree with the read only memory (ROM) internal registered checksum.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM stops engine running. The engine will run after the key is cycled when the ignition has been turned OFF for longer than 10 seconds.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Circuit/ System Testing DTC P0601

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0602 (Flash Code 154)

Circuit Description

The electrically erasable & programmable read only memory (EEPROM) memorizes fuel injector ID code information. If the ECM detects fuel injector ID codes are not programmed into the ECM or an error in the programmed fuel injector ID codes, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the fuel injector ID code is not programmed.
- The ECM detects an error in the programmed fuel injector ID code.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 specification)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 specification)

Notice: Clear the DTC with a scan tool after programming the fuel injector ID code.

Circuit/ System Testing 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. Ensure that all tool connections are secure. 2. Ensure that programming equipment is operating correctly. 3. Install a scan tool. 4. Turn OFF the ignition for 30 seconds. 5. Turn ON the ignition, with the engine OFF. 6. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
3	1. Verify the correct fuel injector ID codes are entered into the ECM with a scan tool. Refer to ECM Replacement. If the fuel injector ID codes are correctly entered, clear the DTC with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. Does the DTC fail this ignition?	—	Go to Step 4	Go to Step 5
4	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 5	—

Step	Action	Value(s)	Yes	No
5	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 6
6	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0604, P0606 or P060B (Flash Code 153, 51 or 36)

Circuit Description

This diagnostic applies to internal microprocessor integrity conditions within the ECM.

Condition for Running the DTC

- The battery voltage is more than 16 volts. (DTC P0604 and P0606)
- The ignition switch is ON. (DTC P0604 and P0606)

Condition for Setting the DTC

- The ECM detects a malfunction in its internal random access memory (RAM). (DTC P0604)
- The ECM detects a malfunction in its internal main central processing unit (CPU) or sub integrated circuit (IC). (DTC P0606)
- The ECM detects a malfunction in its internal A/D converter. (DTC P060B)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM stops engine running. The engine will run after the key is cycled when the ignition has been turned OFF for longer than 10 seconds. (DTC P0604)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Circuit/ System Testing DTC P0604, P0606 or P060B

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0633 (Flash Code 176)

Circuit Description

If the ECM detects immobilizer security information are not programmed into the ECM, this DTC will set.

Condition for Setting the DTC

- The ECM detects that the immobilizer security information is not programmed.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Euro 2 specification)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Euro 2 specification)

Diagnostic Aids

- Non-programmed ECM sets this DTC.

Circuit/ System Testing DTC P0633

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Program immobilizer security information into the ECM. Refer to Immobilizer Control Unit & Programming in Section 9I Security and Lock. Did you complete the programming?	—	Go to Step 4	—
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0638 (Flash Code 61)

Circuit Description

The ECM controls the intake throttle valve opening based on the engine running condition and by controlling the intake throttle solenoid. The intake throttle valve position is detected by the position sensor, and relayed to the ECM. If the ECM detects a variance between the actual intake throttle valve position and desired intake throttle valve position while the intake throttle solenoid is commanded ON, this DTC will set.

Condition for Running the DTC

- DTCs P0122, P0123, P060B and P0697 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The desired intake throttle valve position is stable.
- The intake throttle solenoid is commanded ON.

Condition for Setting the DTC

- The ECM detects that the difference between the actual and the desired intake throttle position is more than 40% for longer than 5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL on the second consecutive driving cycle when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type B. (Euro 4 specification)
- The ECM illuminates MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 specification)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type B. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A sticking or intermittently sticking intake throttle valve may set this DTC.
- A sticking intake throttle valve at full closed position will cause engine starting problem.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0638

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0122 or P0133 also set?	—	Go to Applicable DTC	Go to Step 3
3	1. Perform the Intake Throttle Solenoid Control with a scan tool several times. 2. Command the Desired Intake Throttle Position Increase and Decrease while observing the Intake Throttle Position. Does the Intake Throttle Position parameter follow within the specified value quick enough (compare with a similar unit if available)?	$\pm$ 5%	Go to Diagnostic Aids	Go to Step 4

<table>
<tr><th>Step</th><th>Action</th><th>Value(s)</th><th>Yes</th><th>No</th></tr>
<tr><td>4</td><td>1. Remove the intake duct that is connected to the intake throttle valve.
2. Inspect the intake throttle valve for the following conditions:
• Restricted intake throttle valve by foreign materials
• Excessive deposits at throttle bore
• Bent butterfly valve

Notice: Replace the intake throttle valve if there is any sticking.
3. Repair or replace as necessary.

Did you find and correct the condition?</td><td>—</td><td>Go to Step 8</td><td>Go to Step 5</td></tr>
<tr><td>5</td><td>1. Turn OFF the ignition.
2. Disconnect the intake throttle valve harness connector.
3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the intake throttle valve (pins 1, 2, 4, 5 and 6 of E-16).
4. Disconnect the ECM harness connector.
5. Inspect for an intermittent, for poor connections and corrosion on each intake throttle valve circuit at the harness connector of the ECM (pins 85, 95, 104, 109 and 112 of E-12).
6. Test for an open circuit or high resistance on each circuit.
7. Repair the connection(s) or circuit(s) as necessary.

Did you find and correct the condition?</td><td>—</td><td>Go to Step 8</td><td>Go to Step 6</td></tr>
<tr><td>6</td><td>1. Test the solenoid circuits between the ECM (pins 104 and 112 of E-12) and the intake throttle valve (pins 1 and 2 of E-16) for the following conditions:
• A short to ground
• A short to battery or ignition voltage
• A short circuit each other
• A short to the intake throttle position sensor circuit(s)
2. Repair the circuit(s) as necessary.

Did you find and correct the condition?</td><td>—</td><td>Go to Step 8</td><td>Go to Step 7</td></tr>
<tr><td>7</td><td>Replace the intake throttle valve. Refer to Intake Throttle Valve in Section 1B Engine Mechanical.

Did you complete the replacement?</td><td>—</td><td>Go to Step 8</td><td>—</td></tr>
</table>

Step	Action	Value(s)	Yes	No
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 9	Go to Step 11
9	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 10	—
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 11
11	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0641 (Flash Code 55)

Circuit Description

The ECM provides 5 volts reference voltage through the reference circuit 1 to the following sensors:

- Accelerator pedal position (APP) sensor 1
- PTO throttle sensor
- Idle up sensor

The 5 volts reference circuits are bussed together outside the ECM. Therefore, a short circuit condition on one sensor 5 volts reference circuit may affect the entire 5 volts reference circuit 1.The ECM monitors the voltage on the 5 volts reference circuit 1. If the ECM detects the voltage is excessively low or high, this DTC will set.

Condition for Running the DTC

- DTC P060B is not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the 5 volts reference circuit 1 voltage is less than 4.5 volts.
- The ECM detects that the 5 volts reference circuit 1 voltage is more than 5.5 volts.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.
- The ECM inhibits exhaust brake control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0641

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the idle up sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 3 of B-87) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage less than the specified value?	5.5 volts	Go to Step 4	Go to Step 8
4	Is the DMM voltage more than the specified value at Step 3?	4.5 volts	Go to Step 9	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Leave the DMM connected to the idle up sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the accelerator pedal position (APP) sensor harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value?	4.5volts	Go to Step 10	Go to Step 6
6	**Notice:** If no PTO throttle sensor is installed, skip to Step 7. 1. Leave the DMM connected to the idle up sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the PTO throttle sensor harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value?	4.5 volts	Go to Step 11	Go to Step 7
7	1. Test the 5 volts reference circuit between the ECM (pin 42 of J-14) and the following components for a short to ground or short to the low reference circuit: • APP sensor 1 (pin 4 of B-5) • PTO throttle sensor (pin 1 of J-39) • Idle up sensor (pin 3 of B-87) 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	1. Test the 5 volts reference circuit between the ECM (pin 42 of J-14) and the following components for a short to battery or ignition voltage. • APP sensor 1 (pin 4 of B-5) • PTO throttle sensor (pin 1 of J-39) • Idle up sensor (pin 3 of B-87) 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
9	Replace the idle up sensor. Refer to Idle Up Sensor in Section 1I Engine Speed Control System. Did you complete the replacement?	—	Go to Step 13	—
10	Replace the APP sensor. Refer to Accelerator Pedal Sensor in Section 1I Engine Speed Control System. Did you complete the replacement?	—	Go to Step 13	—
11	Replace the PTO throttle sensor. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	—

Step	Action	Value(s)	Yes	No
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0650 (Flash Code 77)

Circuit Description

The malfunction indicator lamp (MIL) is located on the instrument panel (IP) cluster. The MIL informs the driver that an emission system fault has occurred and that the engine control system requires service.
The ECM monitors the MIL control circuit for conditions that are incorrect for the commanded state of the MIL. For example, a failure condition exists if the ECM detects low voltage when the MIL is commanded OFF, or high voltage when the MIL is commanded ON. If the ECM detects an improper voltage level on the control circuit, this DTC will set.

Condition for Running the DTC

- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects a low voltage condition on the MIL control circuit when the lamp is commanded OFF.
- The ECM detects a high voltage condition on the MIL control circuit when the lamp is commanded ON.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Euro 4 specification)
- The ECM will not illuminate the MIL or SVS lamp. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type D. (Except Euro 4 specification)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the DTC - Type D. (Except Euro 4 specification)

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0650

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. Verify whether the instrument panel (IP) cluster is operational. 2. Install a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition for 10 seconds. 5. Start the engine. 6. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Inspect the Meter (10A) fuse in the cab. Is the Meter (10A) fuse open?	—	Go to Step 4	Go to Step 5
4	Replace the Meter (10A) fuse. If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the Meter (10A) fuse or replace the shorted attached component. Did you complete the repair?	—	Go to Step 17	—
5	1. Turn OFF the ignition. 2. Disconnect the ECM J-14 harness connector. 3. Turn ON the ignition, with the engine OFF. Is the MIL OFF?	—	Go to Sep 6	Go to Step 12

Step	Action	Value(s)	Yes	No
6	1. Remove the Meter (10A) fuse that supplies voltage to the MIL. 2. Turn ON the ignition, with the engine OFF. 3. Measure the voltage from the MIL control circuit in the ECM harness connector (pin 6 of J-14) to a known good ground. Is the voltage less than the specified value?	1 volt	Go to Step 7	Go to Step 13
7	1. Turn OFF the ignition. 2. Reinstall the Meter (10A) fuse. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the ECM harness connector (pin 6 of J-14) and a known good ground. Is the MIL illuminated?	—	Go to Step 11	Go to Step 8
8	1. Connect a test lamp between the ignition voltage feed circuit of the IP cluster harness connector (pin 2 of B-105) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 14
9	1. Test the control circuit between the ECM (pin 6 of J-14) and the IP cluster (pin 31 of B-105) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 10
10	1. Inspect for an intermittent and for poor connections at the harness connector of the IP cluster (pins 2 and 31 of B-105). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
11	1. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 6 of J-14). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
12	Repair the short to ground between the ECM (pin 6 of J-14) and the IP cluster (pin 31 of B-105). Did you complete the repair?	—	Go to Step 17	—
13	Repair the short to battery or ignition voltage between the ECM (pin 6 of J-14) and the IP cluster (pin 31 of B-105). Did you complete the repair?	—	Go to Step 17	—
14	Repair the open circuit or high resistance on ignition the voltage feed circuit between the Meter (10A) fuse and the IP cluster (pin 1 of B-105). Did you complete the repair?	—	Go to Step 17	—
15	Repair or replace the IP cluster. Refer to Instrument Panel (IP) Cluster in Section 9E Instrumentation / Driver Info. Did you complete the repair or replacement?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
16	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition for 10 seconds. 5. Start the engine. 6. Monitor the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 18
18	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0651 (Flash Code 56)

Circuit Description

The ECM provides 5 volts reference voltage through the reference circuit 2 to the following sensors:

- Accelerator pedal position (APP) sensor 2
- Barometric pressure (BARO) sensor
- Intake air temperature (IAT) sensor

The ECM also provides 5 volts reference voltage through the reference circuit 5 to the following sensors:

- Fuel rail pressure (FRP) sensor
- Camshaft position (CMP) sensor
- EGR position sensor

The 5 volts reference circuits 2 and 5 are independent of each other outside of the ECM, but are bussed together inside the ECM. Therefore, a short circuit condition on one sensor 5 volts reference circuit may affect the entire 5 volts reference circuit 2 and 5. The ECM monitors the voltage on the 5 volts reference circuit 2 and 5. If the ECM detects the voltage is excessively low or high, this DTC will set.

Condition for Running the DTC

- DTC P060B is not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the 5 volts reference circuit 2 or 5 voltage is less than 4.5 volts.
- The ECM detects that the 5 volts reference circuit 2 or 5 voltage is more than 5.5 volts.

Action Taken When the DTC Sets

- The ECM illuminates MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR control.
- The ECM inhibits exhaust brake control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

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

Notice: If this DTC is set, the engine cranks but does not start.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0651

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 1 of E-15) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage less than the specified value?	5.5 volts	Go to Step 4	Go to Step 10
4	Is the DMM voltage more than the specified value at Step 3?	4.5 volts	Go to Step 11	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Leave the DMM connected to the EGR valve harness connector. 2. Turn OFF the ignition. 3. Disconnect the fuel rail pressure (FRP) sensor harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value?	4.5volts	Go to Step 12	Go to Step 6
6	1. Leave the DMM connected to the EGR valve harness connector. 2. Turn OFF the ignition. 3. Disconnect the camshaft position (CMP) sensor harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value?	4.5volts	Go to Step 13	Go to Step 7
7	1. Leave the DMM connected to the EGR valve harness connector. 2. Turn OFF the ignition. 3. Disconnect the barometric pressure (BARO) sensor harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value?	4.5 volts	Go to Step 14	Go to Step 8
8	1. Leave the DMM connected to the EGR valve harness connector. 2. Turn OFF the ignition. 3. Disconnect the accelerator pedal position (APP) sensor harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value?	4.5 volts	Go to Step 15	Go to Step 9
9	1. Test the 5 volts reference circuit 2 between the ECM (pin 61 of J-14) and the following components for a short to ground or short to the low reference circuit: • APP sensor 2 (pin 1 of B-5) • BARO sensor (pin 3 of B-121) 2. Test the 5 volts reference circuit 5 between the ECM (pin 87 of E-12) and the following components for a short to ground or short to the low reference circuit: • FRP sensor (pin 3 of E-19) • CMP sensor (pin 3 of E-18) • EGR valve position sensor (pin 1 of E-15) 3. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16

Step	Action	Value(s)	Yes	No
10	1. Test the 5 volts reference circuit 2 between the ECM (pin 61 of J-14) and the following components for a short to battery or ignition voltage. • APP sensor 2 (pin 1 of B-5) • BARO sensor (pin 3 of B-121) 2. Test the 5 volts reference circuit 5 between the ECM (pin 87 of E-12) and the following components for a short to battery or ignition voltage. • FRP sensor (pin 3 of E-19) • CMP sensor (pin 3 of E-18) • EGR valve position sensor (pin 1 of E-15) 3. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
11	Replace the EGR valve. Refer to EGR Valve and EGR Cooler in Section 1F Emission Control. Did you complete the replacement?	—	Go to Step 17	—
12	Replace the FRP sensor. Refer to Fuel Pressure Sensor in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 17	—
13	Replace the CMP sensor. Refer to CMP Sensor in Section 1B Engine Mechanical. Did you complete the replacement?	—	Go to Step 17	—
14	Replace the BARO sensor. Refer to BARO Sensor Replacement. Did you complete the replacement?	—	Go to Step 17	—
15	Replace the APP sensor. Refer to Accelerator Pedal Sensor in Section 1I Engine Speed Control System. Did you complete the replacement?	—	Go to Step 17	—
16	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 18
18	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0685 or P0687 (Flash Code 416)

Circuit Description

The ECM main relay is energized to feed the battery voltage to the ECM through the relay switch side 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 a low voltage condition on the ECM main relay voltage feed circuit when the relay is commanded ON, DTC P0685 will set.
If the ECM detects the ECM has been ON when the relay is commanded OFF, DTC P0687 will set.

Condition for Running the DTC

- The battery voltage is between 18 to 32 volts. (DTC P0685)
- The ignition switch is ON. (DTC P0685)
- The ignition switch is OFF. (DTC P0687)

Condition for Setting the DTC

- The ECM detects a low voltage condition on the ECM main relay voltage feed circuit for 3 seconds when the relay is commanded ON. (DTC P0685)
- The ECM detects that the ECM has been ON when the ECM main relay is commanded OFF. (DTC P0687)

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 specification)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 specification)

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0685

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition for 30 seconds. 2. Replace the ECM main relay with the glow relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. Does the DTC fail?	—	Go to Step 4	Go to Step 6

Step	Action	Value(s)	Yes	No
4	1. Inspect for an intermittent, for poor tightening and corrosion at the chassis ground terminal (J-13). 2. Repair the tightening or clean the corrosion as necessary. 3. Inspect the ECM (30A) slow blow fuse for an open. 4. Replace the ECM (30A) slow blow fuse if open. If it continues to open, repair the short to ground on one of the circuits that is fed by the ECM (30A) slow blow fuse. Did you find and correct the condition?	—	Go to Step 8	Go to Step 5
5	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pin 2, 5, 21 and 40 of J-14). 4. Test for an open circuit or high resistance on each relay circuit. • Between pins 2 and 5 of J-14 and pin 2 of X-18 • Between pins 21 and 40 of J-14 and pin 3 of X-18 • Between ECM (40A) slow blow fuse and pin 1 of X-18 • Between pin 5 of X-18 and chassis ground (J-13) 5. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
6	Replace the ECM main relay. Did you complete the replacement?	—	Go to Step 8	—
7	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 9
9	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0687

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition for 30 seconds. 2. Remove the ECM main relay. 3. Turn ON the ignition, with the engine OFF. Is DTC P0685 set?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition for 30 seconds. 2. Replace the ECM main relay with the glow relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. Does the DTC fail?	—	Go to Step 6	Go to Step 7
5	Repair the short to battery on the battery voltage feed circuits between the ECM (pins 2 and 5 of J-14) and the ECM main relay (pin 2 of X-18) Did you complete the repair?	—	Go to Step 8	—
6	Repair the short to battery on the battery voltage supply circuits between the ECM (pins 21 and 40 of J-14) and the ECM main relay (pin 3 of X-18) Did you complete the repair?	—	Go to Step 8	—
7	Replace the ECM main relay. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 9
9	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0697 (Flash Code 57)

Circuit Description

The ECM provides 5 volts reference voltage through the reference circuit 3 to the following sensors:

- Exhaust differential pressure sensor
- Exhaust temperature sensor 1
- Exhaust temperature sensor 2

The ECM also provides 5 volts reference voltage through the reference circuit 4 to the following sensors:

- Crankshaft position (CKP) sensor
- Boost pressure sensor
- Intake throttle position sensor
- Engine coolant temperature (ECT) sensor
- Fuel temperature (FT) sensor

The 5 volts reference circuits 3 and 4 are independent of each other outside of the ECM, but are bussed together inside the ECM. Therefore, a short circuit condition on one sensor 5 volts reference circuit may affect the entire 5 volts reference circuit 3 and 4. The ECM monitors the voltage on the 5 volts reference circuit 3 and 4. If the ECM detects the voltage is excessively low or high, this DTC will set.

Condition for Running the DTC

- DTC P060B is not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the 5 volts reference circuit 3 or 4 voltage is less than 4.5 volts.
- The ECM detects that the 5 volts reference circuit 3 or 4 voltage is more than 5.5 volts.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0697

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 3 of E-24) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage less than the specified value?	5.5 volts	Go to Step 4	Go to Step 9
4	Is the DMM voltage more than the specified value at Step 3?	4.5 volts	Go to Step 10	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Leave the DMM connected to the boost pressure sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the intake throttle valve harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value?	4.5 volts	Go to Step 11	Go to Step 6
6	1. Leave the DMM connected to the boost pressure sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the crankshaft position (CKP) sensor harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value?	4.5volts	Go to Step 12	Go to Step 7
7	1. Leave the DMM connected to the boost pressure sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the exhaust differential pressure sensor harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value?	4.5volts	Go to Step 13	Go to Step 8
8	1. Test the 5 volts reference circuit 3 between the ECM (pin 80 of J-14) and the exhaust differential pressure sensor (pin 3 of J-33) for a short to ground or short to the low reference circuit. 2. Test the 5 volts reference circuit 4 between the ECM (pin 95 of E-12) and the following components for a short to ground or short to the low reference circuit: • CKP sensor (pin 3 of E-20) • Boost pressure sensor (pin 3 of E-24) • Intake throttle position sensor (pin 5 of E-16) 3. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
9	1. Test the 5 volts reference circuit 3 between the ECM (pin 80 of J-14) and the exhaust differential pressure sensor (pin 3 of J-33) for a short to battery or ignition voltage. 2. Test the 5 volts reference circuit 4 between the ECM (pin 95 of E-12) and the following components for a short to battery or ignition voltage. • CKP sensor (pin 3 of E-20) • Boost pressure sensor (pin 3 of E-24) • Intake throttle position sensor (pin 5 of E-16) 3. 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	Replace the boost pressure sensor. Refer to Boost Pressure Sensor in Section 1J Induction. Did you complete the replacement?	—	Go to Step 15	—
11	Replace the intake throttle valve. Refer to Intake Throttle Valve in Section 1B Engine Mechanical. Did you complete the replacement?	—	Go to Step 15	—
12	Replace the CKP sensor. Refer to CKP Sensor in Section 1B Engine Mechanical. Did you complete the replacement?	—	Go to Step 15	—
13	**Important:** Replacement exhaust differential pressure sensor must be learned. Replace the exhaust differential pressure sensor. Refer to Exhaust Differential Pressure Sensor in Section 1G Engine Exhaust. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1093 (Flash Code 227)

Description

The common rail fuel system is comprised of two fuel pressure sections: a suction side between the fuel tank and the fuel supply pump and a high-pressure side between the fuel supply pump and the fuel injectors. Fuel is drawn from the fuel tank via a feed pump and then pumped into the fuel rail by two plungers, all of which are internal to the fuel supply pump. This high pressure is regulated by the ECM using the fuel rail pressure (FRP) regulator dependant upon values from the FRP sensor attached to the fuel rail. If the ECM detects that the fuel rail pressure is certain pressure lower than the desired pressure, this DTC will set.

Condition for Running the DTC

- DTC P0087, P0091, P0092, P0192, P0193, P0201 - P0204, P060B, P0651, P1261, P1262, P2146 and P2149 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The engine is running.
- The FRP regulator commanded fuel flow is more than a threshold.

Condition for Setting the DTC

- The ECM detects that the actual fuel rail pressure is more than 50 MPa (7,200 psi) below the desired pressure for longer than 5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- An intermittently sticking FRP regulator may have allowed the fuel pressure to become low enough to set this DTC.
- Normal Fuel Rail Pressure readings on the scan tool with the engine running in neutral at idle is around 27 to 33 MPa (3,900 to 4,800 psi) after warm up.
- A skewed FRP sensor value can set this DTC. The FRP Sensor on the scan tool should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute.

Notice: This DTC most likely indicates a loss of fuel pressure by a fuel leak from the high pressure side. Inspect the high pressure side fuel leakage between the fuel supply pump and fuel injector first.

Notice: 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 supply pump is interrupted and this DTC may set. Perform bleeding of fuel system after refilling.

Test Description

The numbers below refers to the step number on the Circuit/ System Testing.

5. This step checks for a fuel restriction by determining if a high vacuum is being pulled on the fuel system during normal operation.

6. This step checks for an air leak on the suction side of the fuel system by determining if a vacuum can be pulled when a fuel line is plugged.

Schematic Reference: Fuel System Routing Diagram and Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P1093

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0087, P0091, P0092, P0192, P0193, P0201 - P0204, P2146 or P2149 set?	—	Go to Applicable DTC	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Wait 1 minute for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Fuel Rail Pressure (FRP) Sensor parameter with the scan tool. Does the scan tool indicate within the specified value?	0.9 to 1.0 volt	Go to Step 4	Go to Step 11
4	1. Inspect the fuel system line connections between the fuel tank and the fuel supply 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 supply 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 rail pressure fluctuations especially at high engine speed and load, which may set this DTC. 2. Pump the priming pump until it becomes firm. If there is a leak on the suction side of the fuel system between the priming pump and the fuel supply pump, the priming pump will not build up sufficient firmness and fuel leakage may occur. 3. Start the engine and check for high side fuel system leaks at the fuel supply pump and fuel rail. **Notice:** Fuel may leak under the cylinder head cover from the inlet high pressure line. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil. 4. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Remove the rubber fuel hose from the fuel filter housing (fuel supply pump side). Use a pan to catch the fuel from the removed fuel line. **Important:** The fuel pressure/ vacuum gauge connector and the adapter hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the tools line may damage the fuel supply pump. 3. Connect the gauge adapter (5-8840-2844-0/ EN-47667) with fuel pressure/ vacuum gauge assembly (5-8840-2844-0/ J-44638) in series with the filter housing and the disconnected fuel hose. Ensure the service tool and fuel line connections are tight. 4. Bleed the fuel system by priming the priming pump until it becomes firm, then crank over the engine for a maximum of 5 seconds. Repeat as necessary until the engine starts. 5. Let the engine run at idle for at least 1 minute. 6. Monitor the fuel pressure/ vacuum gauge while holding the engine speed higher than 2500 RPM for a minimum of 1 minute. Does the fuel pressure/ vacuum gauge ever indicate a larger vacuum than the specified amount during the test?	5 inHg	Go to Step 7	Go to Step 6
6	1. Fully clamp off a fuel hose as close to the fuel tank as possible (this will draw vacuum on the fuel system). You can also disconnect a fuel line and plug it. 2. Start the engine and turn the idle up control knob to the highest position. (Full clockwise direction. The idle speed is increased up to 1600 RPM.) 3. Monitor the fuel pressure/ vacuum gauge. **Notice:** Release the clamp or open the plug when the gauge is likely to be more than 8 inHg during the test. Can a vacuum of at least the specified amount be pulled on the fuel system?	8 inHg	Go to Step 9	Go to Step 8
7	1. Inspect the fuel lines between the fuel supply pump and fuel tank for being crushed or kinked. 2. Inspect for a plugged fuel tank vent hose. 3. Inspect inside the fuel tank (if possible) for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. 4. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 12

Step	Action	Value(s)	Yes	No
8	1. Inspect the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 10
9	1. Turn OFF the ignition. 2. Unclamp or unplug the fuel line from the previous step and reconnect the fuel line (if disconnected). 3. Start the engine and allow it to run for at least 1 minute. 4. Perform the Cylinder Balance Test with a scan tool. 5. Command each injector OFF and verify an engine speed change for each injector. Is there an injector that does not change engine speed when commanded OFF?	—	Go to Step 14	Go to Step 16
10	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP regulator (pins 1 and 2 of E-17). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 89, 97, 105 and 113 of E-12). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
11	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-19). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 82, 87, 90 and 101 of E-12). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 13
12	Replace the fuel filter element. Refer to Fuel Filter Element in Section 1D Engine Fuel . Did you complete the replacement?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
13	Replace the FRP sensor. Refer to Fuel Pressure Sensor in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 17	—
14	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Injector in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 17	—
15	**Important**: The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. **Notice:** Always replace the fuel filter element when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter element. Refer to Fuel Supply Pump and Fuel Filter Element in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 17	—
16	**Notice:** There is a possibility that the pressure limiter valve stuck open or operating pressure has fallen. Replace the pressure limiter valve. Refer to Pressure Limiter in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 18
18	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1261 or P1262 (Flash Code 34)

Circuit Description

The charge up circuit in the ECM steps up the voltage for fuel injectors and is divided into two banks, common 1 and 2. The common 1 covers fuel injectors in cylinders #1 and #4, and the common 2 covers fuel injectors in cylinders #2 and #3. If the common 1 or common 2 fuel injector charge up circuit in the ECM is an open circuit, DTC P1261 or P1262 will set.

Condition for Running the DTC

- The battery voltage is between 16 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects its internal common 1 fuel injector charge up circuit is open circuit. (DTC P1261)
- The ECM detects its internal common 2 fuel injector charge up circuit is open circuit. (DTC P1262)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

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

Circuit/ System Testing DTC P1261 or P1262

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1404 (Flash Code 45)

Circuit Description

The ECM controls the EGR valve opening based on the engine running condition and by controlling the EGR solenoid. The EGR valve position is detected by the position sensor, and relayed to the ECM.
If the ECM detects that the actual EGR position is higher than certain amount, this DTC will set. (Closed Position Error DTC)
If the ECM detects a variance between the learned closed position and actual closed position, this DTC will also set. (Learned Position Error DTC)

Condition for Running the DTC

Closed Position Error DTC

- DTCs P0112, P0113, P0116, P0117, P0118, P0409, P060B, P0651, P0651, P0697 and P2227 are not set.
- The battery voltage is between 16 to 32 volts.
- The desired EGR valve position is stable.

Learned Position Error DTC

- DTCs P0404, P0409, P0500, P0502, P0503, P060B and P0651 are not set.

Condition for Setting the DTC

Closed Position Error DTC

- The ECM detects that the difference between the actual and the desired EGR valve position is more than 15% for longer than 5 seconds.

Learned Position Error DTC

- The ECM detects that the EGR learned minimum position is not within a predetermined range when the ignition switch is OFF.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits EGR control.

Condition for Clearing the MIL/DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Notice: A history DTC remains 9,600 hours (accumulated engine runtime) and will not clear with a scan tool. (Euro 4 specification)

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P1404

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0404 or P0409 also set?	—	Go to Applicable DTC	Go to Step 3
3	1. Remove the EGR valve assembly from the engine. 2. Inspect the EGR valve for the following conditions: • Restricted EGR valve by foreign materials • Excessive deposits at valve • Bent valve shaft or valve 3. Repair or replace 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 EGR valve harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the EGR valve (pins 1, 2, 3, 4, 5, 6, 7 and 8 of E-15). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 87, 93, 94, 99, 101, 103 110 and 111 of E-12). 6. Test for an open circuit or high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	1. Test the solenoid circuits between the ECM (pins 103, 110 and 111 of E-12) and the EGR valve (pins 6, 7 and 8 of E-15) for the following conditions: • A short to ground • A short to battery or ignition voltage • A short circuit each other • A short to the EGR position sensor circuit(s) 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	Replace the EGR valve. Refer to EGR Valve and EGR Cooler in Section 1F Emission Control. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). **Notice:** Ignition switch must be cycled before clear the DTC. 2. Turn ON the ignition, with the engine OFF. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition and clear the DTCs with a scan tool. **Notice:** A history DTC will not clear. (Euro 4 specification) 5. Turn OFF the ignition for 30 seconds. 6. Start the engine. 7. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1455 (Flash Code 132)

Description

The ECM detects the condition of PM accumulations from the exhaust differential pressure sensor attached to the chassis frame near the diesel particulate defuser (DPD) assembly. When it is reached to a certain amount of PM accumulations or a certain length of mileage, the automatic regeneration starts. If the automatic regeneration cannot be completed by some reason, the manual regeneration is requested to the driver by blinking the DPD lamp or "PUSH DPD SWITCH" indicator on the instrument panel cluster. If the DPD filter regeneration interval is more than a predetermined mileage, this DTC will set.

Condition for Running the DTC

- DTCs P0500, P0502 and P0503 are not set.
- The ignition switch is ON.

Condition for Setting the DTC

- The DPD filter regeneration interval is more than 520 km (325 miles).

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If manual regeneration is frequently requested, refer to DPD System Manual Regeneration Frequently in this section.

Notice: This DTC is caused by incomplete automatic regeneration has occurred and manual regeneration urged by the DPD lamp or "PUSH DPD SWITCH" indicator blinking was disregarded or forgot, which was most likely caused by driver error. Primarily ask the driver about DPD lamp or "PUSH DPD SWITCH" indicator blinking in the past.

Circuit/ System Testing DTC P1455

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	Ask the driver about DPD lamp or "PUSH DPD SWITCH" indicator blinking in the past. Explain DPD filter regeneration and the DPD lamp or "PUSH DPD SWITCH" indicator blinking to the driver as necessary. **Notice:** If manual regeneration is frequently requested, refer to DPD System Manual Regeneration Frequently in this section. Did you complete the action?	—	Go to Step 3	—

Step	Action	Value(s)	Yes	No
3	1. Turn ON the ignition for 30 seconds. DO NOT start the engine. Make sure the DPD lamp or "AUTO REGEN.", "MANUAL REGEN." indicators on the instrument panel cluster is turned OFF. (This is to relearn exhaust differential pressure sensor.) 2. Clear the DTC and reset the DPD Status with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Observe the Exhaust Temperature 1 parameter with a scan tool. Make sure the temperature is less than 150 °C (302 °F). If more than 150 °C (302 °F), let increase 1500 RPM without load. (Turn the idle up control knob clockwise.) 6. Accelerate the engine to W.O.T. (accelerator pedal full travel) and read the Exhaust Differential Pressure parameter when the Exhaust Temperature 1 parameter is reached to 200 °C (392 °F). Is the Exhaust Differential Pressure parameter less than the specified value?	15.4 kPa (low output) 5.7 kPa (high output)	Go to Step 4	Go to Step 5
4	1. Turn ON the ignition, with the engine OFF. 2. Clear the DTC with a scan tool if set. 3. Turn OFF the ignition for 30 seconds. **Important:** Engine oil must be replaced after DPD slow regeneration is completed. 4. Perform the DPD Slow Regeneration with a scan tool. Did you complete the action?	—	Go to Step 6	—
5	1. Clear the DTC with a scan tool if set. 2. Replace the DPD filter. Refer to Exhaust System in Section 1G Engine Exhaust. Did you complete the replacement?	—	Go to Step 7	—
6	1. Observe the Exhaust Temperature 1 parameter with a scan tool. Make sure the temperature is less than 150 °C (302 °F). If more than 150 °C (302 °F), let increase 1500 RPM without load. (Turn the idle up control knob clockwise.) 2. Accelerate the engine to W.O.T. (accelerator pedal full travel) and read the Exhaust Differential Pressure parameter when the Exhaust Temperature 1 parameter is reached to 200 °C (392 °F). Is the Exhaust Differential Pressure parameter less than the specified value?	5.9 kPa (low output) 2.5 kPa (high output)	Go to Step 7	Ash cleaning must be performed. Refer to appropriate procedure in Section 1G Engine Exhaust
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1471 (Flash Code 149)

Description

The ECM detects the condition of PM accumulations from the exhaust differential pressure sensor attached to the chassis frame near the diesel particulate defuser (DPD) assembly. When it is reached to a certain amount of PM accumulations or a certain length of mileage, the automatic regeneration starts. If the automatic regeneration cannot be completed by some reason, the manual regeneration is requested to the driver by blinking the DPD lamp or "PUSH DPD SWITCH" indicator on the instrument panel cluster. After the regeneration is finished, an exhaust differential pressure monitors a purification of the filter. If the filter regeneration has been incomplete purification status continuously, this DTC will set.

Condition for Running the DTC

- DTCs P0079, P0080, P0116, P0117, P0118, P0122, P0123, P0201 - P0204, P0335, P0336, P0404, P0409, P0426, P042B, P042C, P042D, P0427, P0428, P0500, P0502, P0503, P060B, P0638, P0641, P0651, P1261, P1262, P1404, P2146, P2149, P2227, P2228, P2229, P2452 - P2456 are not set.
- The ignition switch is ON.
- The exhaust gas temperature 1(in front of filter) is more than 100°C (212°F).
- The engine speed is more than 1000RPM.
- The EGR position is less than 95%.
- The intake throttle position is more than 22%.
- The DPD filter regeneration is finished.

Condition for Setting the DTC

- The DPD filter regeneration has been incomplete purification status continuously.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If manual regeneration is frequently requested, refer to DPD System Manual Regeneration Frequently in this section.
- An excessive ash accumulation in the DPD filter will cause this DTC to set.
- The mass air flow (MAF) sensor problem will cause this DTC to set. Refer to DTC P0101 for MAF sensor diagnosis and Use the Scan Tool Data List or a known good vehicle to determine nominal values.

Circuit/ System Testing DTC P1471

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. Inspect the following conditions: • Misrouted or disconnected exhaust differential pressure hoses or pipes **Important:** There is installation directionality in the exhaust differential pressure hoses. Refer to Exhaust System in Section 1G Engine Exhaust . • Plugged, crushed or kinked exhaust differential pressure hoses or pipes • Physical damage of the exhaust differential pressure sensor • Any contamination or objects that block the exhaust differential pressure sensor port • Skewed or slow exhaust differential pressure sensor • An exhaust system gasket that is missing or damaged • Exhaust gas leakage from the exhaust pipe, gasket, DPD assembly, exhaust temperature sensor(s) or exhaust differential pressure hoses or pipes • Modified exhaust system • Skewed or slow exhaust temperature sensors • Restricted air cleaner element, restricted or collapsed air tubing between the air cleaner and the intake manifold • Modified air induction system • Any air induction leak • Any contamination or objects that block the mass air flow (MAF) sensor inlet • Skewed or slow MAF sensor 2. Repair or replace as necessary. 3. Reconnect all previously disconnected harness connector(s) or components. Did you find and correct the condition?	—	Go to Step 5	Go to Step 3
3	1. Turn ON the ignition for 30 seconds. DO NOT start the engine. Make sure the DPD lamp or “AUTO REGEN.”, “MANUAL REGEN.” indicators on the instrument panel cluster is turned OFF. (This is to relearn exhaust differential pressure sensor.) 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Observe the DPD Accumulation Status and DPD Distance Status with a scan tool and plot both readings on the DPD status table. Refer to DPD Status Table in DPD Control System Check. Is the intersected range located in C or D?	—	Go to Step 4	Go to Step 5

Step	Action	Value(s)	Yes	No
4	1. Turn ON the ignition, with the engine OFF. 2. Clear the DTC and the DPD Status with a scan tool. 3. Turn OFF the ignition for 30 seconds. **Important:** Engine oil must be replaced after DPD slow regeneration is completed. 4. Perform the DPD Slow Regeneration with a scan tool. Did you complete the action?	—	Go to Step 6	—
5	1. Turn ON the ignition, with the engine OFF. 2. Clear the DTC and the DPD Status with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Perform the DPD Regeneration with a scan tool. Did you complete the action?	—	Go to Step 6	—
6	1. Observe the Exhaust Temperature 1 parameter with a scan tool. Make sure the temperature is less than 150 °C (302 °F). If more than 150 °C (302 °F), let increase 1500 RPM without load. (Turn the idle up control knob clockwise.) 2. Accelerate the engine to W.O.T. (accelerator pedal full travel) and read the Exhaust Differential Pressure parameter when the Exhaust Temperature 1 parameter is reached to 200 °C (392 °F). Is the Exhaust Differential Pressure parameter less than the specified value?	5.9 kPa (low output) 2.5 kPa (high output)	Go to Step 7	Ash cleaning must be performed. Refer to appropriate procedure in Section 1G Engine Exhaust
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P161B (Flash Code 179)

Circuit Description

The ECM communicates with the immobilizer control unit (ICU) to execute immobilizer function. If the ECM receives a wrong response signal from the ICU, this DTC will set.

Condition for Setting the DTC

The ECM receives a wrong immobilizer response signal from the ICU.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Euro 2 specification)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Euro 2 specification)

Diagnostic Aids

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

Circuit/ System Testing DTC P161B

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC P0633, U0073 or U0167 also set?	—	Go to Applicable DTC	Go to Step 3
3	Monitor the immobilizer DTC Information with a scan tool. Does the immobilizer DTCs fail this ignition?	—	Go to Applicable DTC for immobilizer in Section 9I Security and Lock	Go to Step 4
4	Program immobilizer security information into the ECM. Refer to Immobilizer Control Unit & Programming in Section 9I Security and Lock in this section. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. 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 a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 7
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1621 (Flash Code 54)

Circuit Description

This diagnostic applies to internal microprocessor integrity conditions within the ECM.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the calculated checksum does not agree with the electrically erasable & programmable read only memory (EEPROM) internal registered checksum.

Action Taken When the DTC Sets

- The ECM illuminates MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Circuit/ System Testing DTC P1621

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. Ensure that all tool connections are secure. 2. Ensure that programming equipment is operating correctly. 3. Install a scan tool. 4. Turn OFF the ignition for 30 seconds. 5. Turn ON the ignition, with the engine OFF. 6. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1664 (Flash Code 76)

Circuit Description

The service vehicle soon (SVS) lamp is located on the instrument panel (IP) cluster. The SVS lamp informs the driver that a non-emission related fault has occurred and vehicle service required.
The ECM monitors the SVS lamp control circuit for conditions that are incorrect for the commanded state of the SVS lamp. For example, a failure condition exists if the ECM detects low voltage when the SVS lamp is commanded OFF, or high voltage when the SVS lamp is commanded ON. If the ECM detects an improper voltage level on the control circuit, this DTC will set.

Condition for Running the DTC

- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects a low voltage condition on the SVS lamp control circuit when the lamp is commanded OFF.
- The ECM detects a high voltage condition on the SVS lamp control circuit when the lamp is commanded ON.

Action Taken When the DTC Sets

- The ECM will illuminate the SVS lamp. Refer to DTC Type Definitions for Action Taken when the DTC Sets - Type C.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C.

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P1664

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. Verify whether the instrument panel (IP) cluster is operational. 2. Install a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition for 10 seconds. 5. Start the engine. 6. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Inspect the Meter (10A) fuse in the cab. Is the Meter (10A) fuse open?	—	Go to Step 4	Go to Step 5
4	Replace the Meter (10A) fuse. If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the Meter (10A) fuse or replace the shorted attached component. Did you complete the repair?	—	Go to Step 17	—
5	1. Turn OFF the ignition. 2. Disconnect the ECM J-14 harness connector. 3. Turn ON the ignition, with the engine OFF. Is the SVS lamp OFF?	—	Go toStep 6	Go to Step 12

Step	Action	Value(s)	Yes	No
6	1. Remove the Meter (10A) fuse that supplies voltage to the SVS lamp. 2. Turn ON the ignition, with the engine OFF. 3. Measure the voltage from the SVS lamp control circuit in the ECM harness connector (pin 17 of J-14) to a known good ground. Is the voltage less than the specified value?	1 volt	Go to Step 7	Go to Step 13
7	1. Turn OFF the ignition. 2. Reinstall the Meter (10A) fuse. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the ECM harness connector (pin 17 of J-14) and a known good ground. Is the SVS lamp illuminated?	—	Go to Step 11	Go to Step 8
8	1. Connect a test lamp between the ignition voltage feed circuit of the IP cluster harness connector (pin 2 of B-105) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 14
9	1. Test the control circuit between the ECM (pin 17 of J-14) and the IP cluster (pin 4 of B-106) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 10
10	1. Inspect for an intermittent and for poor connections at the harness connector of the IP cluster (pins 2 of B-105 and pin 4 of B-106). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
11	1. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 17 of J-14). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
12	Repair the short to ground between the ECM (pin 17 of J-14) and the IP cluster (pin 4 of B-106). Did you complete the repair?	—	Go to Step 17	—
13	Repair the short to battery or ignition voltage between the ECM (pin 17 of J-14) and the IP cluster (pin 4 of B-106). Did you complete the repair?	—	Go to Step 17	—
14	Repair the open circuit or high resistance on the ignition voltage feed circuit between the Meter (10A) fuse and the IP cluster (pin 2 of B-105). Did you complete the repair?	—	Go to Step 17	—
15	Repair or replace the IP cluster. Refer to Instrument Panel (IP) Cluster in Section 9E Instrumentation / Driver Info. Did you complete the repair or replacement?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
16	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition for 10 seconds. 5. Start the engine. 6. Monitor the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 18
18	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1669 (Flash Code 75)

Circuit Description

The diesel particulate defuser (DPD) lamp is located on the instrument panel (IP) cluster. The DPD lamp informs the driver that an incomplete automatic regeneration has occurred and manual regeneration is required.
The ECM monitors the DPD lamp control circuit for conditions that are incorrect for the commanded state of the DPD lamp. For example, a failure condition exists if the ECM detects low voltage when the DPD lamp is commanded OFF, or high voltage when the DPD lamp is commanded ON. If the ECM detects an improper voltage level on the control circuit, this DTC will set.

Condition for Running the DTC

- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects a low voltage condition on the DPD lamp control circuit when the lamp is commanded OFF.
- The ECM detects a high voltage condition on the DPD lamp control circuit when the lamp is commanded ON.

Action Taken When the DTC Sets

- The ECM will illuminate the SVS lamp. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C.

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P1669

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. Verify whether the instrument panel (IP) cluster is operational. 2. Install a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition for 40 seconds while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Inspect the Meter (10A) fuse in the cab. Is the Meter (10A) fuse open?	—	Go to Step 4	Go to Step 5
4	Replace the Meter (10A) fuse. If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the Meter (10A) fuse or replace the shorted attached component. Did you complete the repair?	—	Go to Step 17	—
5	1. Turn OFF the ignition. 2. Disconnect the ECM J-14 harness connector. 3. Turn ON the ignition, with the engine OFF. Is the DPD lamp OFF?	—	Go to Sep 6	Go to Step 12

Step	Action	Value(s)	Yes	No
6	1. Remove the Meter (10A) fuse that supplies voltage to the DPD lamp. 2. Turn ON the ignition, with the engine OFF. 3. Measure the voltage from the DPD lamp control circuit in the ECM harness connector (pin 9 of J-14) to a known good ground. Is the voltage less than the specified value?	1 volt	Go to Step 7	Go to Step 13
7	1. Turn OFF the ignition. 2. Reinstall the Meter (10A) fuse. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the ECM harness connector (pin 9 of J-14) and a known good ground. Is the DPD lamp illuminated?	—	Go to Step 11	Go to Step 8
8	1. Turn OFF the ignition. 2. Remove the IP cluster. 3. Connect a test lamp between the ignition voltage feed circuit of the IP cluster harness connector (pin 1 of B-105) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 14
9	1. Test the control circuit between the ECM (pin 9 of J-14) and the IP cluster (pin 35 of B-105) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 10
10	1. Inspect for an intermittent and for poor connections at the harness connector of the IP cluster (pin 35 of B-105). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
11	1. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 9 of J-14). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
12	Repair the short to ground between the ECM (pin 9 of J-14) and the IP cluster (pin 35 of B-105). Did you complete the repair?	—	Go to Step 17	—
13	Repair the short to battery or ignition voltage between the ECM (pin 9 of J-14) and the IP cluster (pin 35 of B-105). Did you complete the repair?	—	Go to Step 17	—
14	Repair the open circuit or high resistance on the ignition voltage feed circuit between the Meter (10A) fuse and the IP cluster (pin 1 of B-105). Did you complete the repair?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
15	Repair or replace the IP cluster. Refer to Instrument Panel (IP) Cluster in Section 9E Instrumentation / Driver Info. Did you complete the repair or replacement?	—	Go to Step 17	—
16	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition for 40 seconds while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 18
18	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2122 or P2123 (Flash Code 121)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal control assembly. The sensor is made up of two individual sensors within one housing. The ECM uses the APP sensors to determine the amount of acceleration or deceleration that is desired. The APP sensor 1 has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor 1 signal circuit

The APP sensor 1 provides a signal to the ECM on the signal circuit, which is relative to the position changes of the accelerator pedal angle. If the ECM detects an excessively low or high signal voltage, DTC P2122 or P2123 will set.

Condition for Running the DTC

- DTCs P060B and P0641 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the APP sensor 1 signal voltage is less than 0.2 volts. (DTC P2122)
- The ECM detects that the APP sensor 1 signal voltage is more than 4.9 volts. (DTC P2123)

Action Taken When the DTC Sets

- The ECM illuminates the MIL on the second consecutive driving cycle when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type B. (Euro 4 specification)
- The ECM illuminates MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 specification)
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.
- The ECM inhibits exhaust brake control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type B. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 specification)

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2122

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0641 also set?	—	Go to DTC P0641	Go to Step 3
3	Fully depress and release the accelerator pedal while observing the Accelerator Pedal Position (APP) Sensor 1 parameter with a scan tool. Does the scan tool indicate less than the specified value during depressing or releasing the pedal?	0.2 volts	Go to Step 4	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 4 of B-5) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 5	Go to Step 6
5	Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit (pins 4 and 5 of B-5). Is the APP Sensor 1 parameter more than the specified value?	4.5 volts	Go to Step 8	Go to Step 7
6	**Notice:** The APP sensor 1 shares the 5 volts reference circuit with other sensors. A fault condition in the 5 volts reference circuit may set DTCs on sensors that share this circuit. 1. Test the 5 volts reference circuit between the ECM (pin 42 of J-14) and the APP sensor (pin 4 of B-5) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	1. Test the signal circuit between the ECM (pin 63 of J-14) and the APP sensor (pin 5 of B-5) 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 12	Go to Step 9
8	1. Inspect for an intermittent and for poor connections at the harness connector of the APP sensor (pins 4 and 5 of B-5). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 42 and 63 of J-14). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the APP sensor. Refer to Accelerator Pedal Sensor in Section 1I Engine Speed Control System. Did you complete the replacement?	—	Go to Step 12	—

Step	Action	Value(s)	Yes	No
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the APP Sensor 1 parameter with the scan tool. Does the scan tool indicate less than the specified value during depressing or releasing the pedal?	0.2 volts	Go to Step 3	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P2123

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Fully depress and release the accelerator pedal while observing the Accelerator Pedal Position (APP) Sensor 1 parameter with a scan tool. Does the scan tool indicate more than the specified value during depressing or releasing the pedal?	4.9 volts	Go to Step 3	Go to Diagnostic Aids
3	Monitor the DTC Information with a scan tool. Is DTC P0641 also set?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the APP Sensor 1 parameter less than the specified value?	0.1 volts	Go to DTC P0641	Go to Step 7
5	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the APP Sensor 1 parameter less than the specified value?	0.1 volts	Go to Step 6	Go to Step 7

Step	Action	Value(s)	Yes	No
6	Connect a test lamp between the low reference circuit (pin 6 of B-5) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
7	**Important:** The APP sensor 1 may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 63 of J-14) and the APP sensor (pin 5 of B-5) 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 13	Go to Step 12
8	**Notice:** The APP sensor 1 shares the low reference circuit with other sensors. A fault condition in the low reference circuit may set DTCs on sensors that share this circuit. 1. Test the low reference circuit between the ECM (pin 41 of J-14) and the APP sensor (pin 6 of B-5) 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
9	1. Inspect for an intermittent and for a poor connection at the harness connector of the APP sensor (pin 6 of B-5). 2. 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 at the harness connector of the ECM (pin 41 of J-14). 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 APP sensor. Refer to Accelerator Pedal Sensor in Section 1I Engine Speed Control System. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	—

Step	Action	Value(s)	Yes	No
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the APP Sensor 1 parameter with the scan tool. Does the scan tool indicate more than the specified value during depressing or releasing the pedal?	4.9 volts	Go to Step 3	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2127 or P2128 (Flash Code 122)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal control assembly. The sensor is made up of two individual sensors within one housing. The ECM uses the APP sensors to determine the amount of acceleration or deceleration that is desired. The APP sensor 2 has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor 2 signal circuit

The APP sensor 2 provides a signal to the ECM on the signal circuit, which is relative to the position changes of the accelerator pedal angle. If the ECM detects an excessively low or high signal voltage, DTC P2127 or P2128 will set.

Condition for Running the DTC

- DTCs P060B and P0651 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the APP sensor 2 signal voltage is less than 0.2 volts. (DTC P2127)
- The ECM detects that the APP sensor 2 signal voltage is more than 4.9 volts. (DTC P2128)

Action Taken When the DTC Sets

- The ECM illuminates the MIL on the second consecutive driving cycle when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type B. (Euro 4 specification)
- The ECM illuminates MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 specification)
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.
- The ECM inhibits exhaust brake control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type B. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 specification)

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2127

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0651 also set?	—	Go to DTC P0651	Go to Step 3
3	Fully depress and release the accelerator pedal while observing the Accelerator Pedal Position (APP) Sensor 2 parameter with a scan tool. Does the scan tool indicate less than the specified value during depressing or releasing the pedal?	0.2 volts	Go to Step 4	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 1 of B-5) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 5	Go to Step 6
5	Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit (pins 1 and 2 of B-5). Is the APP Sensor 2 parameter more than the specified value?	4.5 volts	Go to Step 8	Go to Step 7
6	**Notice:** The APP sensor 2 shares the 5 volts reference circuit with other sensors. A fault condition in the 5 volts reference circuit may set DTCs on sensors that share this circuit. 1. Test the 5 volts reference circuit between the ECM (pin 61 of J-14) and the APP sensor (pin 1 of B-5) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	1. Test the signal circuit between the ECM (pin 64 of J-14) and the APP sensor (pin 2 of B-5) 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 12	Go to Step 9
8	1. Inspect for an intermittent and for poor connections at the harness connector of the APP sensor (pins 1 and 2 of B-5). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 61 and 64 of J-14). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the APP sensor. Refer to Accelerator Pedal Sensor in Section 1I Engine Speed Control System. Did you complete the replacement?	—	Go to Step 12	—

Step	Action	Value(s)	Yes	No
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the APP Sensor 1 parameter with the scan tool. Does the scan tool indicate less than the specified value during depressing or releasing the pedal?	0.2 volts	Go to Step 3	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P2128

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Fully depress and release the accelerator pedal while observing the Accelerator Pedal Position (APP) Sensor 2 parameter with a scan tool. Does the scan tool indicate more than the specified value during depressing or releasing the pedal?	4.9 volts	Go to Step 3	Go to Diagnostic Aids
3	Monitor the DTC Information with a scan tool. Is DTC P0651 also set?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the APP Sensor 2 parameter less than the specified value?	0.1 volts	Go to DTC P0651	Go to Step 7
5	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the APP Sensor 2 parameter less than the specified value?	0.1 volts	Go to Step 6	Go to Step 7

Step	Action	Value(s)	Yes	No
6	Connect a test lamp between the low reference circuit (pin 3 of B-5) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
7	**Important:** The APP sensor 2 may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 64 of J-14) and the APP sensor (pin 2 of B-5) 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 13	Go to Step 12
8	**Notice:** The APP sensor 2 shares the low reference circuit with other sensors. A fault condition in the low reference circuit may set DTCs on sensors that share this circuit. 1. Test the low reference circuit between the ECM (pin 60 of J-14) and the APP sensor (pin 3 of B-5) 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
9	1. Inspect for an intermittent and for a poor connection at the harness connector of the APP sensor (pin 3 of B-5). 2. 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 at the harness connector of the ECM (pin 60 of J-14). 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 APP sensor. Refer to Accelerator Pedal Sensor in Section 1I Engine Speed Control System. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	—

Step	Action	Value(s)	Yes	No
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the APP Sensor 1 parameter with the scan tool. Does the scan tool indicate more than the specified value during depressing or releasing the pedal?	4.9 volts	Go to Step 3	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2138 (Flash Code 124)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal control assembly. The sensor is made up of two individual sensors within one housing. The APP sensor 1 and APP sensor 2 are hall element type sensors, each with the following circuits.

- 5 volts reference circuit
- Low reference circuit
- 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 signal circuits, which is relative to the position changes of the accelerator pedal angle. The APP sensor 1 signal voltage is low at rest and increases as the pedal is depressed. The APP sensor 2 signal voltage is high at rest and decreases as the pedal is depressed. If the ECM detects that the APP sensor 1 signal voltage and the APP sensor 2 signal voltage are out of the correlation, this DTC will set.

Condition for Running the DTC

- DTCs P060B, P0641, P0651, P2122, P2123, P2127 and P2128 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The APP sensor 1 signal voltage is between 0.2 to 4.9 volts.
- The APP sensor 2 signal voltage is between 0.2 to 4.9 volts.

Condition for Setting the DTC

- The ECM detects that the APP sensor 1 and 2 are more than 45% out of range of each other.

Action Taken When the DTC Sets

- The ECM illuminates the MIL on the second consecutive driving cycle when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type B. (Euro 4 specification)
- The ECM illuminates MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 specification)
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM inhibits exhaust brake control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type B. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 specification)

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2138

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0641, P0651, P2122, P2123, P2127 or P2128 also set?	—	Go to Applicable DTC	Go to Step 3
3	Fully depress and release the accelerator pedal while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the APP sensor (pins 1, 2, 3, 4, 5, and 6 of B-5). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 41, 42, 60, 61, 63 and 64 of J-14). 6. Test for high resistance on each sensor circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 5
5	1. Test the signal circuits between the ECM (pins 63 and 64 of J-14) and the APP sensor (pins 2 and 5 of B-5) for a short circuit each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 6
6	Replace the APP sensor. Refer to Accelerator Pedal Sensor in Section 1I Engine Speed Control System. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 8	Go to Step 10
8	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 9	—
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 10
10	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2146 or P2149 (Flash Code 158 or 159)

Circuit Description

The ECM calculates the optimum fuel injection ON time using data sent from various engine sensors. The common 1 and 2 fuel injector charge voltage circuits are high-voltage supply, which drives fuel injectors for each cylinder in conjunction with the ECM grounding the fuel injector solenoid control circuit. The common 1 covers fuel injectors in cylinders #1 and #4, and the common 2 covers fuel injectors in cylinders #2 and #3. If the common 1 or 2 fuel injector charge voltage circuit is open circuit, shorted to ground or shorted to voltage circuit, DTC P2146 or P2149 will set depending upon which bank injector common circuit failed. If the fuel injector solenoid control circuit is shorted to ground, this DTC will also set.

Condition for Running the DTC

- DTCs P0201 and P0204 are not set. (DTC P2146)
- DTCs P0202 and P0203 are not set. (DTC P2149)
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the common 1 fuel injector charge voltage circuit is open circuit, shorted to ground or shorted to voltage circuit, or cylinder #1 or #4 fuel injector solenoid coil control circuit is shorted to ground. (DTC P2146)
- The ECM detects that the common 2 fuel injector charge voltage circuit is open circuit, shorted to ground or shorted to voltage circuit, or cylinder #2 or #3 fuel injector solenoid coil control circuit is shorted to ground. (DTC P2149)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2146

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector from the cylinder head cover case. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the cylinder #1 or #4 solenoid control circuit female side) and a known good ground. Is the DMM voltage more than the specified value?	12.0 volts	Go to Step 4	Go to Step 6
4	Connect a test lamp between the charge voltage circuit and a known good ground. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 5

Step	Action	Value(s)	Yes	No
5	Connect a test lamp between the charge voltage circuit and battery voltage. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 9
6	1. Test the control circuits between the ECM and the in-line harness connector for a short to ground. • Cylinder #1: Between pin 119 of E-12 and 5 of H-70 • Cylinder #4: Between pin 117 of E-12 and 8 of H-70 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
7	1. Test the charge voltage circuits between the ECM and the in-line harness connector for a short to battery or ignition voltage. • Cylinder #1: Between pin 119 of E-12 and 5 of H-70 • Cylinder #4: Between pin 117 of E-12 and 8 of H-70 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 charge voltage circuits between the ECM and the in-line harness connector for a short to ground. • Cylinder #1: Between pin 121 of E-12 and 1 of H-70 • Cylinder #4: Between pin 121 of E-12 and 4 of H-70 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
9	1. Inspect for an intermittent and for poor connections at the in-line harness connector. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM. 4. Inspect for an open circuit or high resistance on the charge voltage circuit between the ECM and the in-line harness connector. 5. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 10
10	1. Remove the cylinder head cover. Refer to Cylinder Head Cover in Section 1B Engine Mechanical. 2. Inspect the fuel injector harness for loose injector terminal nuts, objects touching injector terminals. 3. Inspect for an intermittent and for poor connections at the in-line harness connector. 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11

Step	Action	Value(s)	Yes	No
11	Measure insulation resistance of the cylinder #1 and #4 fuel injector between each fuel injector terminal and a known good ground. Is the resistance more than the specified value?	1MΩ	Go to Step 12	Go to Step 13
12	Repair or replace the fuel injector harness. Did you complete the repair or replace?	—	Go to Step 15	—
13	**Important:** Replacement injector must be programmed. Replace the appropriate fuel injector that was less insulation resistance found at Step 11. Refer to Injector in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P2149

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector from the cylinder head cover case. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the cylinder #2 or #3 solenoid control circuit and a known good ground. Is the DMM voltage more than the specified value?	12.0 volts	Go to Step 4	Go to Step 6
4	Connect a test lamp between the charge voltage circuit and a known good ground. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 5
5	Connect a test lamp between the charge voltage circuit and battery voltage. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 9
6	1. Test the control circuits between the ECM and the in-line harness connector for a short to ground. • Cylinder #2: Between pin 118 of E-12 and 6 of H-70 • Cylinder #3: Between pin 120 of E-12 and 7 of H-70 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
7	1. Test the charge voltage circuits between the ECM and the in-line harness connector for a short to battery or ignition voltage. • Cylinder #2: Between pin 118 of E-12 and 6 of H-70 • Cylinder #3: Between pin 120 of E-12 and 7 of H-70 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 charge voltage circuits between the ECM and the in-line harness connector for a short to ground. • Cylinder #2: Between pin 116 of E-12 and 2 of H-70 • Cylinder #3: Between pin 116 of E-12 and 3 of H-70 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
9	1. Inspect for an intermittent and for poor connections at the in-line harness connector. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM. 4. Inspect for an open circuit or high resistance on the charge voltage circuit between the ECM and the in-line harness connector. 5. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 10
10	1. Remove the cylinder head cover. Refer to Cylinder Head Cover in Section 1B Engine Mechanical. 2. Inspect the fuel injector harness for loose injector terminal nuts, objects touching injector terminals. 3. Inspect for an intermittent and for poor connections at the in-line harness connector. 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11
11	Measure insulation resistance of the cylinder #2 and #3 fuel injector between each fuel injector terminal and a known good ground. Is the resistance more than the specified value?	1MΩ	Go to Step 12	Go to Step 13
12	Repair or replace the fuel injector harness. Did you complete the repair or replace?	—	Go to Step 15	—
13	**Important:** Replacement injector must be programmed. Replace the appropriate fuel injector that was less insulation resistance found at Step 11. Refer to Injector in Section 1D Engine Fuel. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16

Step	Action	Value(s)	Yes	No
16	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2227 (Flash Code 71)

Circuit Description

The barometric pressure (BARO) sensor is located under the instrument panel (IP) cluster near the pedal bracket. The BARO sensor is a transducer that varies voltage according to changes the barometric pressure. Within the ECM, the diagnostic compares the BARO sensor input to the boost pressure sensor input. If the ECM detects that the inputs are not within a specified amount of each other, this DTC will set.

Condition for Running the DTC

- DTCs P0102, P0103, P0107, P0108, P0116, P0117, P0118, P0122, P0123, P0500, P0502, P0503, P0560, P060B, P0638, P0651, P0697, P2228 and P2229 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The engine speed is less than 625 RPM.
- The fuel injection quantity is less than a predetermined value.
- The accelerator pedal is not depressed.
- The vehicle is not running.

Condition for Setting the DTC

- The ECM detects that the differential pressure between the BARO and the boost pressure is more than 10 kPa (1.5 psi) for longer than 7 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type B.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type B.

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2227

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0107, P0108, P2228 or P2229 also set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn ON the ignition, with the engine OFF. 2. Compare the Boost Pressure parameter to the Barometric Pressure (BARO) parameter with a scan tool. Are both parameter within the range specified of each other?	10 kPa (1.5 psi)	Go to Diagnostic Aids	Go to Step 4
4	Determine the outside barometric pressure from your location specified in the altitude vs barometric pressure table. Refer to Altitude vs Barometric Pressure. Is the BARO parameter on the scan tool close to the outside barometric pressure?	—	Go to Step 5	Go to Step 7

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the boost pressure sensor (pins 1, 2 and 3 of E-24). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 91,95 and 109 of E-12). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 6
6	1. Test each sensor circuit between the ECM (pins 91, 95 and 109 of E-12) and the boost pressure sensor (pins 1, 2 and 3 of E-24) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
7	1. Turn OFF the ignition. 2. Disconnect the BARO sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the BARO sensor (pins 1, 2 and 3 of B-121). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 60, 61 and 71 of J-14). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
8	1. Test each sensor circuits between the ECM (pins 60, 61 and 71 of J-14) and the BARO sensor (pins 1, 2 and 3 of B-121) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Replace the boost pressure sensor. Refer to Boost Pressure Sensor in Section 1J Induction. Did you complete the replacement?	—	Go to Step 11	—
10	Replace the BARO sensor. Refer to BARO Sensor Replacement. 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 a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 12
12	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2228 or P2229 (Flash Code 71)

Circuit Description

The barometric pressure (BARO) sensor is located under the instrument panel (IP) cluster near the pedal bracket. The BARO sensor is a transducer that varies voltage according to changes the barometric pressure. The sensor has the following circuits:

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

The BARO sensor provides a signal to the ECM on the signal circuit, which is relative to the pressure changes of the barometric pressure. The ECM should detect a low signal voltage at a low barometric pressure, such as high altitude place. The ECM should detect high signal voltage at a high barometric pressure. 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 or high signal voltage, DTC P2228 or P2229 will set.

Condition for Running the DTC

- DTCs P060B and P0651 are not set.
- The battery voltage is between 18 to 32 volts
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the BARO sensor signal voltage is less than 0.5 volts for 5 seconds. (DTC P2228)
- The ECM detects that the BARO sensor signal voltage is more than 4.0 volts for 5 seconds. (DTC P2229)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM uses a BARO substitution of default value.
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2228

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0651 also set?	—	Go to DTC P0651	Go to Step 3
3	Observe the Barometric Pressure (BARO) Sensor parameter with a scan tool. Is the BARO Sensor parameter less than the specified value?	0.5 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the BARO sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 3 of B-121) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 5	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit (pins 2 and 3 of B-121). Is the BARO Sensor parameter more than the specified value?	4.5 volts	Go to Step 8	Go to Step 7
6	**Notice:** The BARO sensor shares the 5 volts reference circuit with other sensors. A fault condition in the 5 volts reference circuit may set DTCs on sensors that share this circuit. 1. Test the 5 volts reference circuit between the ECM (pin 61 of J-14) and the BARO sensor (pin 3 of B-121) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	1. Test the signal circuit between the ECM (pin 71 of J-14) and the BARO sensor (pin 2 of B-121) 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 12	Go to Step 9
8	1. Inspect for an intermittent and for poor connections at the harness connector of the BARO sensor (pins 2 and 3 of B-121). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 61 and 71 of J-14). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the BARO sensor. Refer to BARO Sensor Replacement. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—

Step	Action	Value(s)	Yes	No
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P2229

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Observe the Barometric Pressure (BARO) Sensor parameter with a scan tool. Is the BARO Sensor parameter more than the specified value?	4.0 volts	Go to Step 3	Go to Diagnostic Aids
3	Monitor the DTC Information with a scan tool. Is DTC P0651 also set?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the BARO sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the BARO Sensor parameter less than the specified value?	0.1 volts	Go to DTC P0651	Go to Step 7
5	1. Turn OFF the ignition. 2. Disconnect the BARO sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the BARO Sensor parameter less than the specified value?	0.1 volts	Go to Step 6	Go to Step 7
6	Connect a test lamp between the low reference circuit (pin 1 of B-121) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8

Step	Action	Value(s)	Yes	No
7	**Important:** The BARO sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 71 of J-14) and the BARO sensor (pin 1 of B-121) 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 13	Go to Step 12
8	**Notice:** The BARO sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may set DTCs on sensors that share this circuit. 1. Test the low reference circuit between the ECM (pin 60 of J-14 and the BARO sensor (pin 1 of B-121) 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
9	1. Inspect for an intermittent and for a poor connection at the harness connector of the BARO sensor (pin 1 of B-121). 2. 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 at the harness connector of the ECM (pin 60 of J-14). 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 BARO sensor. Refer to BARO Sensor Replacement. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 14

Step	Action	Value(s)	Yes	No
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P242F (Flash Code 131)

Description

The ECM detects the condition of PM accumulations from the exhaust differential pressure sensor attached to the chassis frame near the diesel particulate defuser (DPD) assembly. When it is reached to a certain amount of PM accumulations or a certain length of mileage, the automatic regeneration starts. If the automatic regeneration cannot be completed by some reason, the manual regeneration is requested to the driver by blinking the DPD lamp or "PUSH DPD SWITCH" indicator on the instrument panel cluster. If the ECM detects that the exhaust differential pressure is more than a predetermined range of the calculated value, this DTC will set.

Condition for Running the DTC

- DTCs P0500, P0502 and P0503 are not set.
- The ignition switch is ON.
- The exhaust gas temperature 1 (in front of filter) is more than 100°C (212°F).
- The engine speed is more than 1000RPM.
- The EGR position is less than 95%.
- The intake throttle position is more than 14%.
- The DPD filter regeneration is inactive.

Condition for Setting the DTC

- The exhaust differential pressure is more than a predetermined range of the calculated differential pressure value for longer than 30 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- Misrouted, disconnected or plugged exhaust differential pressure hoses or pipes may set this DTC.
- If manual regeneration is frequently requested, refer to DPD System Manual Regeneration Frequently in this section.

Notice: This DTC is caused by incomplete automatic regeneration has occurred and manual regeneration urged by the DPD lamp or "PUSH DPD SWITCH" indicator blinking was disregarded or forgot, which was most likely caused by driver error. Primarily ask the driver about DPD lamp or "PUSH DPD SWITCH" indicator blinking in the past.

Circuit/ System Testing DTC P242F

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	Ask the driver about DPD lamp or "PUSH DPD SWITCH" indicator blinking in the past. Explain DPD filter regeneration and the DPD lamp or "PUSH DPD SWITCH" indicator blinking to the driver as necessary. **Notice:** If manual regeneration is frequently requested, refer to DPD System Manual Regeneration Frequently in this section. Did you complete the action?	—	Go to Step 3	—

Step	Action	Value(s)	Yes	No
3	1. Turn ON the ignition for 30 seconds. DO NOT start the engine. Make sure the DPD lamp or "AUTO REGEN.", "MANUAL REGEN." indicators on the instrument panel cluster is turned OFF. (This is to relearn exhaust differential pressure sensor.) 2. Clear the DTC and reset the DPD Status with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Observe the Exhaust Temperature 1 parameter with a scan tool. Make sure the temperature is less than 150 °C (302 °F). If more than 150 °C (302 °F), let increase 1500 RPM without load. (Turn the idle up control knob clockwise.) 6. Accelerate the engine to W.O.T. (accelerator pedal full travel) and read the Exhaust Differential Pressure parameter when the Exhaust Temperature 1 parameter is reached to 200 °C (392 °F). Is the Exhaust Differential Pressure parameter less than the specified value?	15.4 kPa (low output) 5.7 kPa (high output)	Go to Step 4	Go to Step 5
4	1. Turn ON the ignition, with the engine OFF. 2. Clear the DTC with a scan tool if set. 3. Turn OFF the ignition for 30 seconds. **Important:** Engine oil must be replaced after DPD slow regeneration is completed. 4. Perform the DPD Slow Regeneration with a scan tool. Did you complete the action?	—	Go to Step 6	—
5	1. Clear the DTC with a scan tool if set. 2. Replace the DPD filter. Refer to Exhaust System in Section 1G Engine Exhaust. Did you complete the replacement?	—	Go to Step 7	—
6	1. Observe the Exhaust Temperature 1 parameter with a scan tool. Make sure the temperature is less than 150 °C (302 °F). If more than 150 °C (302 °F), let increase 1500 RPM without load. (Turn the idle up control knob clockwise.) 2. Accelerate the engine to W.O.T. (accelerator pedal full travel) and read the Exhaust Differential Pressure parameter when the Exhaust Temperature 1 parameter is reached to 200 °C (392 °F). Is the Exhaust Differential Pressure parameter less than the specified value?	5.9 kPa (low output) 2.5 kPa (high output)	Go to Step 7	Ash cleaning must be performed. Refer to appropriate procedure in Section 1G Engine Exhaust
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2452 (Flash Code 142)

Description

The exhaust differential pressure sensor is attached to the chassis frame near the diesel particulate defuser (DPD) assembly. The exhaust differential pressure sensor is a transducer that varies voltage according to changes of the exhaust gas differential pressure between in front and in rear of DPD filter. If the ECM detects that the exhaust differential pressure is certain pressure low under certain conditions, this DTC will set.

Condition for Running the DTC

- DTCs P060B, P0697, P2454, P2455 and P2456 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The engine coolant temperature is more than 80°C (176°F).
- The engine speed is more than 2200RPM.
- The fuel injection quantity is more than a predetermined value.

Condition for Setting the DTC

- The ECM detects that the exhaust differential pressure is less than 2.0 to 9.0 kPa (low output) or 1.0 to 3.5 kPa (high output) for longer than 30 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Misrouted, disconnected or plugged exhaust differential pressure hoses or pipes will set this DTC.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2452

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition for 30 seconds. DO NOT start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P2456 set?	—	Go to DTC P2456	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Inspect the following for possible causes of low exhaust differential pressure. • Misrouted or disconnected exhaust differential pressure hoses or pipes **Important:** There is installation directionality in the exhaust differential pressure hoses. Refer to Exhaust System in Section 1G Engine Exhaust . • Plugged, crushed or kinked exhaust differential pressure hoses or pipes • Dislocated or inclined exhaust differential pressure sensor. Refer to Exhaust System in Section 1G Engine Exhaust . • Physical damage of the exhaust differential pressure sensor • Any contamination or objects that block the exhaust differential pressure sensor port • Skewed or slow exhaust differential pressure sensor • An exhaust system gasket that is missing or damaged • Exhaust gas leakage from the exhaust pipe, gasket, DPD assembly, exhaust temperature sensor(s) or exhaust differential pressure hoses or pipes • Modified exhaust system • Exhaust throttle valve or exhaust brake valve for stuck condition. Refer to Exhaust System in Section 1G Engine Exhaust. 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 4
4	1. Remove the DPD filter from the DPD assembly. Refer to Exhaust Pipe in Section 1G Engine Exhaust. 2. Inspect the DPD filter for damage, cracks or melt. 3. Inspect the oxygen catalyst for damage or excessive deposits. **Important:** DPD status in the ECM must be reset when the DPD filter is replaced. 4. Replace the DPD filter or the oxygen catalyst as necessary. Refer to Exhaust Pipe in Section 1G Engine Exhaust. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the exhaust differential pressure sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the exhaust differential pressure sensor (pins 1, 2 and 3 of J-33). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 67, 79 and 80 of J-14). 6. Test each sensor circuit between the ECM and the exhaust differential pressure sensor for high resistance. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	Replace the exhaust differential pressure sensor. Refer to Exhaust Differential Pressure Sensor in Section 1G Engine Exhaust. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s) or components. 2. Turn ON the ignition for 30 seconds. DO NOT start the engine. (This is to relearn exhaust differential pressure sensor.) 3. Clear the DTC and reset the DPD Status with a scan tool. 4. Turn OFF the ignition for 30 seconds. 5. Perform the DPD Regeneration with a scan tool. If the DPD filter was replaced at Step 4, skip to Step 9. Did you complete the action?	—	Go to Step 8	—
8	1. Observe the Exhaust Temperature 1 parameter with a scan tool. Make sure the temperature is less than 150 °C (302 °F). If more than 150 °C (302 °F), let increase 1500 RPM without load. (Turn the idle up control knob clockwise.) 2. Accelerate the engine to W.O.T. (accelerator pedal full travel) and read the Exhaust Differential Pressure parameter when the Exhaust Temperature 1 parameter is reached to 200 °C (392 °F). Is the Exhaust Differential Pressure parameter more than the specified value?	1.0 kPa	Go to Step 9	Go to Step 2
9	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2453 (Flash Code 141)

Description

The exhaust differential pressure sensor is attached to the chassis frame near the diesel particulate defuser (DPD) assembly. The exhaust differential pressure sensor is a transducer that varies voltage according to changes of the exhaust gas differential pressure between in front and in rear of DPD filter. If the ECM detects that the exhaust differential pressure went excessively high, this DTC will set.

Condition for Running the DTC

- DTCs P060B, P0697, P2454, P2455 and P2456 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The exhaust differential pressure is more than 60 kPa.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Misrouted, disconnected or plugged exhaust differential pressure hoses or pipes will set this DTC.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2453

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition for 30 seconds. DO NOT start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P2456 set?	—	Go to DTC P2456	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Inspect the following for possible causes of high exhaust differential pressure. • Misrouted or disconnected exhaust differential pressure hoses or pipes **Important:** There is installation directionality in the exhaust differential pressure hoses. Refer to Exhaust System in Section 1G Engine Exhaust . • Plugged, crushed or kinked exhaust differential pressure hoses or pipes • Physical damage of the exhaust differential pressure sensor • Any contamination or objects that block the exhaust differential pressure sensor port • Skewed or slow exhaust differential pressure sensor • Exhaust gas leakage from the exhaust differential pressure hoses or pipes • Restricted or collapsed exhaust system • Modified exhaust system 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the exhaust differential pressure sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the exhaust differential pressure sensor (pins 1, 2 and 3 of J-33). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 67, 79 and 80 of J-14). 6. Test each sensor circuit between the ECM and the exhaust differential pressure sensor for high resistance. 7. 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	**Important:** Clear the DTC and the DPD Status in the ECM must be reset when the DPD filter is replaced. Replace the DPD filter. Refer to Exhaust System in Section 1G Engine Exhaust. Did you complete the replacement?	—	Go to Step 8	—

Step	Action	Value(s)	Yes	No
6	1. Reconnect all previously disconnected harness connector(s) or components. 2. Turn ON the ignition for 30 seconds. DO NOT start the engine. (This is to relearn exhaust differential pressure sensor.) 3. Clear the DTC and reset the DPD Status with a scan tool. 4. Turn OFF the ignition for 30 seconds. 5. Perform the DPD Regeneration with a scan tool. Did you complete the action?	—	Go to Step 7	—
7	1. Observe the Exhaust Temperature 1 parameter with a scan tool. Make sure the temperature is less than 150 °C (302 °F). If more than 150 °C (302 °F), let increase 1500 RPM without load. (Turn the idle up control knob clockwise.) 2. Accelerate the engine to W.O.T. (accelerator pedal full travel) and read the Exhaust Differential Pressure parameter when the Exhaust Temperature 1 parameter is reached to 200 °C (392 °F). Is the Exhaust Differential Pressure parameter less than the specified value?	5.9 kPa (low output) 2.5 kPa (high output)	Go to Step 8	Ash cleaning must be performed. Refer to appropriate procedure in Section 1G Engine Exhaust
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2454 or P2455 (Flash Code 47)

Circuit Description

The exhaust differential pressure sensor is attached to the chassis frame near the diesel particulate defuser (DPD) assembly. The exhaust differential pressure sensor is a transducer that varies voltage according to changes of the exhaust gas differential pressure between in front and in rear of DPD filter. The sensor has the following circuits:

- 5 volts reference circuit
- Low reference circuit
- Exhaust differential pressure sensor signal circuit

The exhaust differential pressure sensor provides a signal to the ECM on the signal circuit, which is relative to the differential pressure changes in front and in rear of DPD filter. The ECM should detect a low signal voltage at a low differential pressure, such as small PM accumulation. The ECM should detect high signal voltage at high differential pressure, such as large PM accumulation. If the ECM detects an excessively low or high signal voltage, DTC P2454 or P2455 will set.

Condition for Running the DTC

- DTCs P060B and P0697 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the exhaust differential pressure sensor signal voltage is less than 0.2 volts. (DTC P2454)
- The ECM detects that the exhaust differential pressure sensor signal voltage is more than 4.9 volts. (DTC P2455)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2454

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0697 also set?	—	Go to DTC P0697	Go to Step 3
3	Observe the Exhaust Differential Pressure Sensor parameter with a scan tool. Is the Exhaust Differential Pressure Sensor parameter less than the specified value?	0.2 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the exhaust differential pressure sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 3 of J-33) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 5	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit (pins 2 and 3 of J-33). Is the Exhaust Differential Pressure Sensor parameter more than the specified value?	4.5 volts	Go to Step 8	Go to Step 7
6	1. Test the 5 volts reference circuit between the ECM (pin 80 of J-14) and the exhaust differential pressure sensor (pin 3 of J-33) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	1. Test the signal circuit between the ECM (pin 67 of J-14) and the exhaust differential pressure sensor (pin 2 of J-33) 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 12	Go to Step 9
8	1. Inspect for an intermittent and for poor connections at the harness connector of the exhaust differential pressure sensor (pins 2 and 3 of J-33). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 67 and 80 of J-14). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	**Important:** Replacement exhaust differential pressure sensor must be learned. Replace the exhaust differential pressure sensor. Refer to Exhaust Differential Pressure Sensor in Section 1G Engine Exhaust. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—

Step	Action	Value(s)	Yes	No
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P2455

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Observe the Exhaust Differential Pressure Sensor parameter with a scan tool. Is the Exhaust Differential Pressure Sensor parameter more than the specified value?	4.9 volts	Go to Step 3	Go to Diagnostic Aids
3	Monitor the DTC Information with a scan tool. Is DTC P0697 also set?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the exhaust differential pressure sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the Exhaust Differential Pressure Sensor parameter less than the specified value?	0.1 volts	Go to DTC P0697	Go to Step 7
5	1. Turn OFF the ignition. 2. Disconnect the exhaust differential pressure sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the Exhaust Differential Pressure Sensor parameter less than the specified value?	0.1 volts	Go to Step 6	Go to Step 7
6	Connect a test lamp between the low reference circuit (pin 1 of J-33) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8

Step	Action	Value(s)	Yes	No
7	**Important:** The exhaust differential pressure sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 67 of J-14) and the exhaust differential pressure sensor (pin 2 of J-33) 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 13	Go to Step 12
8	**Notice:** The exhaust differential pressure sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may set DTCs on sensors that share this circuit. 1. Test the low reference circuit between the ECM (pin 79 of J-14) and the exhaust differential pressure sensor (pin 1 of J-33) 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
9	1. Inspect for an intermittent and for a poor connection at the harness connector of the exhaust differential pressure sensor (pin 1 of J-33). 2. 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 at the harness connector of the ECM (pin 79 of J-14). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	**Important:** Replacement exhaust differential pressure sensor must be learned. Replace the exhaust differential pressure sensor. Refer to Exhaust Differential Pressure Sensor in Section 1G Engine Exhaust. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	—

Step	Action	Value(s)	Yes	No
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2456 (Flash Code 47)

Circuit Description

The exhaust differential pressure sensor is attached to the chassis frame near the diesel particulate defuser (DPD) assembly. The exhaust differential pressure sensor is a transducer that varies voltage according to changes of the exhaust gas differential pressure between in front and in rear of DPD filter.
The ECM learns a variance of the exhaust differential pressure sensor signal at every ignition cycle after the ignition switch has been ON with the engine OFF for 30 seconds. (The DPD lamp or “AUTO REGEN.”, “MANUAL REGEN.” indicators on the instrument panel cluster indicates this transition by commanded to OFF.) If the ECM detects that learned exhaust differential pressure is not within a predetermined range, this DTC will set.

Condition for Running the DTC

- DTCs P060B, P0697, P2454 and P2455 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.
- The engine is stopped.

Condition for Setting the DTC

- The ECM detects that the learned exhaust differential pressure is not within -4.5 to 4.5 kPa.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A skewed exhaust differential pressure sensor value can set this DTC. The Exhaust Differential Pressure Sensor on the scan tool should read 0.9 to 1.0 volts with the ignition switch ON and engine OFF.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2456

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P2454 or P2455 set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition for 30 seconds. 2. Disconnect a ventilation duct from the exhaust tail pipe if connected. 3. Turn ON the ignition for 30 seconds while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the exhaust differential pressure sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the exhaust differential pressure sensor (pins 1, 2 and 3 of J-33). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 67, 79 and 80 of J-14). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	1. Test each sensor circuit between the ECM (pins 67, 79 and 80 of J-14) and the exhaust differential pressure sensor (pins 1, 2 and 3 of J-33) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	**Important:** Replacement exhaust differential pressure sensor must be learned. Replace the exhaust differential pressure sensor. Refer to Exhaust Differential Pressure Sensor in Section 1G Engine Exhaust. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition for 30 seconds while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2458 (Flash Code 139)

Description

The ECM detects the condition of PM accumulations from the exhaust differential pressure sensor attached to the chassis frame near the diesel particulate defuser (DPD) assembly. When it is reached to a certain amount of PM accumulations or a certain length of mileage, the automatic regeneration starts. If the automatic regeneration cannot be completed by some reason, the manual regeneration is requested to the driver by blinking the DPD lamp or “PUSH DPD SWITCH” indicator on the instrument panel cluster. Once the regeneration starts, it must be finished within a certain time. If the regeneration process is continuously over a predetermined time, this DTC will set.

Condition for Running the DTC

- DTCs P0079, P0080, P0116, P0117, P0118, P0122, P0123, P0201 - P0204, P0335, P0336, P0404, P0409, P0426, P042B, P042C, P042D, P0427, P0428, P0500, P0502, P0503, P060B, P0638, P0641, P0651, P1261, P1262, P1404, P2146, P2149, P2227, P2228, P2229, P2452 - P2456 are not set.
- The ignition switch is ON.
- The vehicle is running or the PTO control is inactive.
- The DPD filter regeneration is finished.

Condition for Setting the DTC

- The DPD filter regeneration process is continuously over a predetermined time.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- Use the Temperature vs. Resistance table to test the exhaust temperature sensor at various temperature levels to evaluate the possibility or a skewed sensor.
- Fuel system problem (e.g. fuel injector damage) may set this DTC.
- Deteriorated or damaged oxygen catalyst will set this DTC.
- If regeneration time is longer than normal, refer to DPD System Regeneration Long Time chart in symptom diagnostic table.

Notice: Under a driving condition that the exhaust temperature will not be stable during the DPD filter regeneration process (e.g. frequent stop and start), this DTC will set.

Circuit/ System Testing DTC P2458

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0079, P0080, P0426, P0427, P0428, P042B, P042C or P042D set?	—	Go to Applicable DTC	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Inspect the following conditions: • Plugged, crushed or kinked exhaust differential pressure hoses or pipes • Physical damage of the exhaust differential pressure sensor • Any contamination or objects that block the exhaust differential pressure sensor port • Skewed or slow exhaust differential pressure sensor • An exhaust system gasket that is missing or damaged • Exhaust gas leakage from the exhaust pipe, gasket, DPD assembly, exhaust temperature sensor(s) or exhaust differential pressure hoses or pipes • Modified exhaust system • Exhaust throttle valve or exhaust brake valve for stuck condition. Refer to Exhaust System in Section 1G Engine Exhaust. • Skewed or slow exhaust temperature sensors 2. Test the engine cooling system for an overheating condition. Refer to Cooling System in Section 1C Engine Cooling. 3. Repair or replace as necessary. 4. Reconnect all previously disconnected harness connector(s) or components. Did you find and correct the condition?	—	Go to Step 6	Go to Step 4
4	1. Turn ON the ignition for 30 seconds. DO NOT start the engine. Make sure the DPD lamp or “AUTO REGEN.”, “MANUAL REGEN.” indicators on the instrument panel cluster is turned OFF. (This is to relearn exhaust differential pressure sensor.) 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Observe the DPD Accumulation Status and DPD Distance Status with a scan tool and plot both readings on the DPD status table. Refer to DPD Status Table in DPD Control System Check. Is the intersected of a range located in C or D?	—	Go to Step 5	Go to Step 6
5	1. Turn ON the ignition, with the engine OFF. 2. Clear the DTC and the DPD Status with a scan tool. 3. Turn OFF the ignition for 30 seconds. **Important:** Engine oil must be replaced after DPD slow regeneration is completed. 4. Perform the DPD Slow Regeneration with a scan tool. Did you complete the action?	—	Go to Step 7	—

Step	Action	Value(s)	Yes	No
6	1. Turn ON the ignition, with the engine OFF. 2. Clear the DTC and the DPD Status with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Perform the DPD Regeneration with a scan tool. Did you complete the action?	—	Go to Step 7	—
7	1. Observe the Exhaust Temperature 1 parameter with a scan tool. Make sure the temperature is less than 150 °C (302 °F). If more than 150 °C (302 °F), let increase 1500 RPM without load. (Turn the idle up control knob clockwise.) 2. Accelerate the engine to W.O.T. (accelerator pedal full travel) and read the Exhaust Differential Pressure parameter when the Exhaust Temperature 1 parameter is reached to 200 °C (392 °F). Is the Exhaust Differential Pressure parameter less than the specified value?	5.9 kPa (low output) 2.5 kPa (high output)	Go to Step 8	Ash cleaning must be performed. Refer to appropriate procedure in Section 1G Engine Exhaust
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P253A (Flash Code 28)

Circuit Description

The power take off (PTO) throttle sensor (body builder installed) detects the PTO control throttle angle. The ECM receives the PTO control throttle angle from the throttle sensor and controls the fuel injection quantity (engine speed) during PTO. The PTO throttle sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- PTO throttle sensor signal circuit

The PTO throttle sensor provides a signal to the ECM on the signal circuit, which is relative to the position changes of the PTO throttle angle. If the ECM detects an excessively high signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P060B and P0641 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the PTO throttle sensor signal voltage is more than 4.8 volts.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 specification)
- The ECM disables PTO throttle sensor control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- PTO throttle sensor may have an intermittent open somewhere in the operating range.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P253A

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. **Notice:** If no PTO throttle sensor is installed, skip to Step 3. 4. Observe the PTO Remote Throttle Sensor parameter with a scan tool while operating the PTO throttle sensor. Does the scan tool indicate more than the specified value during operating the throttle?	4.8 volts	Go to Step 3	Go to Diagnostic Aids
3	Monitor the DTC Information with a scan tool. Is DTC P0641 also set?	—	Go to Step 4	Go to Step 5

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the PTO throttle sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the PTO Remote Throttle Sensor parameter less than the specified value?	0.1 volts	Go to DTC P0641	Go to Step 7
5	1. Turn OFF the ignition. 2. Disconnect the PTO throttle sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the PTO Remote Throttle Sensor parameter less than the specified value?	0.1 volts	Go to Step 6	Go to Step 7
6	Connect a test lamp between the low reference circuit (pin 3 of J-39) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
7	**Important:** The PTO throttle sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 70 of J-14) and the PTO throttle sensor (pin 2 of J-39) 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 13	Go to Step 12
8	**Notice:** The PTO throttle sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may set DTCs on sensors that share this circuit. 1. Test the low reference circuit between the ECM (pin 41 of J-14) and the PTO throttle sensor (pin 3 of J-39) 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
9	1. Inspect for an intermittent and for a poor connection at the harness connector of the PTO throttle sensor (pin 3 of J-39). 2. 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 at the harness connector of the ECM (pin 70 of J-14). 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 PTO throttle sensor. Did you complete the replacement?	—	Go to Step 13	—

Step	Action	Value(s)	Yes	No
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Observe the PTO Remote Throttle Sensor parameter with a scan tool while operating the PTO throttle sensor. Does the scan tool indicate more than the specified value during operating the throttle?	4.8 volts	Go to Step 3	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P256A (Flash Code 31)

Circuit Description

The idle up sensor controls the idle speed during warm up and it is installed in the driver's side instrument panel. This sensor is active only when the gear position is in the neutral position. When the shift lever is moved to another position, the signal is ignored. The ECM receives the idle up signal from the idle up sensor and controls the fuel injection quantity. The idle up sensor has following circuits

- 5 volts reference circuit
- Low reference circuit
- Idle up sensor signal circuit

The idle up sensor provides a signal to the ECM on the signal circuit, which is relative to the position changes of the idle up sensor angle. If the ECM detects an excessively low or high signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P060B and P0641 are not set.
- The battery voltage is between 18 to 32 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the idle up sensor signal voltage is less than 0.1 volts for longer than 3 seconds.
- The ECM detects that the idle up sensor signal voltage is more than 4.9 volts for longer than 3 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 specification)
- The ECM disables idle up sensor control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Idle up sensor may have an intermittent open somewhere in the operating range.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P256A

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Fully turn the idle up sensor between lowest position (full counterclockwise direction) and highest position (full clockwise direction) while observing the Idle Up Sensor parameter with a scan tool. Does the scan tool indicate within the specified value during turning the sensor?	0.2 to 4.8 volts	Go to Diagnostic Aids	Go to Step 3
3	Monitor the DTC Information with a scan tool. Is DTC P0641 also set?	—	Go to Step 4	Go to Step 5
4	Is the Idle Up Sensor parameter less than the specified value at Step 2?	0.1 volts	Go to DTC P0641	Go to Step 8

Step	Action	Value(s)	Yes	No
5	Turn the idle up sensor to lowest position (full counterclockwise direction). Is the Idle Up Sensor parameter less than the specified value?	0.1 volts	Go to Step 6	Go to Step 9
6	1. Turn OFF the ignition. 2. Disconnect the idle up sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 3 of B-87) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 7	Go to Step 11
7	Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit (pins 2 and 3 of B-87). Is the Idle Up Sensor parameter more than the specified value?	4.5 volts	Go to Step 15	Go to Step 12
8	1. Turn OFF the ignition. 2. Disconnect the idle up sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the Idle Up Sensor parameter less than the specified value?	0.1 volts	Go to DTC P0641	Go to Step 13
9	1. Turn OFF the ignition. 2. Disconnect the idle up sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the Idle Up Sensor parameter less than the specified value?	0.1 volts	Go to Step 10	Go to Step 13
10	Connect a test lamp between the low reference circuit (pin 1 of B-87) and battery voltage. Does the test lamp illuminate?	—	Go to Step 15	Go to Step 14
11	**Notice:** The idle up sensor shares the 5 volts reference circuit with other sensors. A fault condition in the 5 volts reference circuit may set DTCs on sensors that share this circuit. 1. Test the 5 volts reference circuit between the ECM (pin 42 of J-14) and the idle up sensor (pin 3 of B-87) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16

Step	Action	Value(s)	Yes	No
12	1. Test the signal circuit between the ECM (pin 66 of J-14) and the idle up sensor (pin 2 of B-87) 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 19	Go to Step 16
13	**Important:** The idle up sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 66 of J-14) and the APP sensor (pin 2 of B-87) 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 19	Go to Step 18
14	**Notice:** The idle up sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may set DTCs on sensors that share this circuit. 1. Test the low reference circuit between the ECM (pin 41 of J-14) and the idle up sensor (pin 1 of B-87) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
15	1. Inspect for an intermittent and for poor connections at the harness connector of the Idle up sensor (pins 1, 2 and 3 of B-87). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 17
16	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 41, 42 and 66 of J-14). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
17	Replace the Idle up sensor. Refer to Idle Up Sensor in Section 1I Engine Speed Control System. Did you complete the replacement?	—	Go to Step 19	—
18	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 19	—

Step	Action	Value(s)	Yes	No
19	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully turn the idle up sensor between lowest position (full counterclockwise direction) and highest position (full clockwise direction) while observing the Idle Up Sensor parameter with a scan tool. Does the scan tool indicate within the specified value during turning the sensor?	0.2 to 4.8 volts	Go to Step 20	Go to Step 3
20	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC U0073 (Flash Code 84)

Circuit Description

The ECM, the variable nozzle turbocharger (VNT) control module, the transmission control module (TCM), the electric hydraulic control unit (EHCU) body control module (BCM) and the data recording module (DRM) communicate control and diagnostic information via a controller area network (CAN) communication bus. The ECM monitors CAN operational status by expecting a constant flow of messages from each module. If the ECM sets CAN Bus OFF status, this DTC will set.

Condition for Running the DTC

- The battery voltage is more than 20 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM sets the CAN Bus OFF status.

Action Taken When the DTC Sets

- The ECM illuminates the MIL on the second consecutive driving cycle when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type B. (Euro 4 specification)
- The ECM illuminates MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 specification)
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.
- The ECM inhibits exhaust brake control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type B. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 specification)

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC U0073

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the variable nozzle turbocharger (VNT) control module harness connector. 3. Measure the resistance between the CAN Low and High circuits (pins 15 and 16 of E-4). Is the resistance within the specified value (parallel resistance of the 120 Ω resistor in the ECM and the IP cluster should be 60 Ω)?	50 to 70 Ω	Go to Step 11	Go to Step 4
4	1. Disconnect the IP clucter harness connector. 2. Measure the resistance of the IP clucter(pins 13 and 14 of B-105). Is the resistance within the specified value?	110 to 130 Ω	Go to Step 5	Go to Step 17

Step	Action	Value(s)	Yes	No
5	**Notice:** If no Smoother transmission is installed, skip to Step 6. 1. Reconnect the IP cluster. 2. Measure the resistance between the CAN Low and High circuitsby probing the IP cluster (pins 13 and 14 of B-105). 3. Disconnect the transmission control module (TCM) harness connectors. Is the resistance within the specified value?	50 to 70 Ω	Go to Step 22	Go to Step 6
6	1. Reconnect the IP cluster if disconnected. 2. Measure the resistance between the CAN Low and High circuitsby probing the IP cluster (pins 13 and 14 of B-105). 3. Disconnect the data recording module (DRM) harness connector or the body control module (BCM). Is the resistance within the specified value?	50 to 70 Ω	Go to Step 21	Go to Step 7
7	**Notice:** If no ABS is installed, skip to Step 8. 1. Leave the DMM connected to the IP cluster. 2. Disconnect the electric hydraulic control unit (EHCU) harness connector. Is the resistance within the specified value?	50 to 70 Ω	Go to Step 20	Go to Step 8
8	1. Leave the DMM connected to the IP cluster. 2. Disconnect the VNT control module harness connectors. Is the resistance within the specified value?	50 to 70 Ω	Go to Step 19	Go to Step 9
9	1. Leave the DMM connected to the IP cluster. 2. Disconnect the ECM harness connectors. Is the resistance within the specified value?	110 to 130 Ω	Go to Step 18	Go to Step 10
10	Repair the short circuit each other acrocc the CAN Low and High circuits among each component. Did you find and correct the condition?	—	Go to Step 23	—
11	1. Turn OFF the ignition. 2. Disconnect the IP cluster, TCM, DRM, BCM, EHCU, VNT control module and ECM harness connectors. 3. Test the CAN Low and High circuits among each component for a short to ground and short to voltage. 4. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 23	Go to Step 12

Step	Action	Value(s)	Yes	No
12	**Notice:** If no ABS is installed, skip to Step 13. 1. Turn OFF the ignition. 2. Reconnect the EHCU harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the CAN Low circuit (pin 14 of B-105) and a known good ground. 5. Connect a DMM between the CAN High circuit (pin 13 of B-105) and a known good ground. Are both voltage readings within the specified value?	1.5 to 3.5 volts	Go to Step 13	Go to Step 20
13	**Notice:** If no Smoother is installed, skip to Step 14. 1. Turn OFF the ignition. 2. Reconnect the TCM harness connectors. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the CAN Low circuit (pin 14 of B-105) and a known good ground. 5. Connect a DMM between the CAN High circuit (pin 13 of B-105) and a known good ground. Are both voltage readings within the specified value?	1.5 to 3.5 volts	Go to Step 14	Go to Step 22
14	1. Turn OFF the ignition. 2. Reconnect the DRM or BCM harness connectors. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the CAN Low circuit (pin 14 of B-105) and a known good ground. 5. Connect a DMM between the CAN High circuit (pin 13 of B-105) and a known good ground. Are both voltage readings within the specified value?	1.5 to 3.5 volts	Go to Step 15	Go to Step 21
15	1. Turn OFF the ignition. 2. Reconnect the VNT control module harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the CAN Low circuit (pin 14 of B-105) and a known good ground. 5. Connect a DMM between the CAN High circuit (pin 13 of B-105) and a known good ground. Are both voltage readings within the specified value?	1.5 to 3.5 volts	Go to Step 16	Go to Step 19
16	1. Turn OFF the ignition. 2. Reconnect the ECM harness connectors. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the CAN Low circuit (pin 14 of B-105) and a known good ground. 5. Connect a DMM between the CAN High circuit (pin 13 of B-105) and a known good ground. Are both voltage readings within the specified value?	1.5 to 3.5 volts	Go to Diagnostic Aids	Go to Step 18

Step	Action	Value(s)	Yes	No
17	Replace the IP cluster. Refer to Instrument Panel (IP) Cluster in Section 9E Instrumentation/Driver Info. Did you complete the replacement?	—	Go to Step 23	—
18	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 23	—
19	Replace the VNT control module. Did you complete the replacement?	—	Go to Step 23	—
20	Replace the EHCU. Refer to EHCU in Section 4C1 ABS/ASR . Did you complete the replacement?	—	Go to Step 23	—
21	**Important:** Replacement BCM must be programmed. Replace the DRM or BCM. If the BCM is installed, refer to BCM in Section 10B Vehicle Control. Did you complete the replacement?	—	Go to Step 23	—
22	**Important:** Replacement TCM must be programmed and learned. Replace the TCM. Refer to TCM in Section 5A Transmission Control System. Did you complete the replacement?	—	Go to Step 23	—
23	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 24
24	Observe the DTC information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC U0101 (Flash Code 85)

Circuit Description

The ECM and the transmission control module (TCM) communicate control and diagnostic information via a controller area network (CAN) communication bus. The ECM monitors CAN operational status by expecting a constant flow of messages from each module. If the ECM fails to receive an expected message from the TCM, this DTC will set.

Condition for Running the DTC

- DTC U0073 is not set.
- The battery voltage is more than 20 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the CAN Bus messages from the TCM are not being received.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 specification)
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.
- The ECM inhibits exhaust brake control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 specification)

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC U0101

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC U0073 or U0110 also set?	—	Go to Applicable DTC	Go to Step 3
3	Attempt to communicate with the transmission control module (TCM) via the transmission data table. Does the scan tool communicate with the TCM?	—	Go to Step 4	Go to Diagnostic System Check - Transmission Controls in Section 5A Transmission Control System
4	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Measure the resistance across the CAN Low and High circuits (pins 12 and 13 of B-112). Is the resistance within the specified value (parallel resistance of the 120 Ω resistor in the ECM and the IP cluster should be 60 Ω)?	50 to 70 Ω	Go to Step 9	Go to Step 5
5	1. Leave the DMM connected to the TCM harness connector. 2. Disconnect the IP cluster harness connector. Is the resistance within the specified value?	110 to 130 Ω	Go to Step 6	Go to Step 7

Step	Action	Value(s)	Yes	No
6	Measure the resistance of the IP cluster (pin s 13 and 14 of B-105). Is the resistance within the specified value?	110 to 130 Ω	Go to Step 8	Go to Step 11
7	1. Turn OFF the ignition. 2. Disconnect the VNT control module, EHCU, body control module (BCM), data recording module (DRM) harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the CAN Low circuit (pin 13 of B-112) and a known good ground. 5. Connect a DMM between the CAN High circuit (pin 12 of B-112) and a known good ground. 6. Test the CAN Low and High circuits (which ever voltage reading did not read within the specified value) among each component for an open circuit or high resistance. 7. Repair the circuit(s) or connection(s) as necessary. Did you find and correct the condition?	1.5 to 3.5 volts	Go to Step 14	Go to Step 10
8	1. Test the CAN Low and High circuits between the IP cluster (pins 13 and 14 of B-105) and the joint connection for an open circuit or high resistance. 2. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the IP cluster (pins 13 and 14 of B-105). 3. Repair the circuit(s) or connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	—
9	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the TCM (pins 12 and 13 of B-112). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 18 and 37 of J-14). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
11	Replace the IP cluster. Refer to Instrument Panel (IP) Cluster in Section 9E Instrumentation/Driver Info. Did you complete the replacement?	—	Go to Step 14	—

Step	Action	Value(s)	Yes	No
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 14	—
13	**Important:** Replacement TCM must be programmed and learned. Replace the TCM. Refer to TCM in Section 5A Transmission Control System in Section 5A Transmission Control System. Did you complete the replacement?	—	Go to Step 14	—
14	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 15
15	Observe the DTC information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC U0110 (Flash Code 87)

Circuit Description

The ECM and the variable nozzle turbocharger (VNT) control module communicate control and diagnostic information via a controller area network (CAN) communication bus. The ECM monitors CAN operational status by expecting a constant flow of messages from each module. If the ECM fails to send or receive an expected message from the VNT control module, this DTC will set.

Condition for Running the DTC

Error Message DTC

- The battery voltage is between 20 to 32 volts.
- The ignition switch is ON.

Lost Communication DTC

- DTC U0073 is not set
- The battery voltage is more than 20 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Error Message DTC

- The VNT control module received an error CAN Bus messages from the ECM.

Lost Communication DTC

- The ECM detects that the CAN Bus messages from the VNT control module are not being received.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC U0110

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC U0073 or P0045 also set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the variable nozzle turbocharger (VNT) control module harness connector. 3. Measure the resistance across the CAN Low and High circuits (pins 15 and 16 of E-4). Is the resistance within the specified value (parallel resistance of the 120 Ω resistor in the ECM and the IP cluster should be 60 Ω)?	50 to 70 Ω	Go to Step 8	Go to Step 4
4	1. Leave the DMM connected to the VNT control module harness connector. 2. Disconnect the IP cluster harness connector. Is the resistance within the specified value?	110 to 130 Ω	Go to Step 5	Go to Step 6
5	Measure the resistance of the IP cluster (pins 13 and 14 of B-105). Is the resistance within the specified value?	110 to 130 Ω	Go to Step 7	Go to Step 14

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the electric hydraulic control unit (EHCU) harness connector if installed. 3. Disconnect the transmission control module (TCM) harness connectors if installed. 4. Disconnect the data recording module (DRM) or body control modul (BCM) harness connector . 5. Turn ON the ignition, with the engine OFF. 6. Connect a DMM between the CAN Low circuit (pin 16 of E-4) and a known good ground. 7. Connect a DMM between the CAN High circuit (pin 15 of E-4) and a known good ground. 8. Test the CAN Low and High circuits (which ever voltage reading did not read within the specified value) between the ECM (pins 18 and 37 of J-14) and the VNT control module (pins 15 and 16 of E-4) for an open circuit or high resistance. 9. Repair the circuit(s) or connection(s) as necessary. Did you find and correct the condition?	1.5 to 3.5 volts	Go to Step 17	Go to Step 13
7	1. Test the CAN Low and High circuits between the IP cluster (pins 13 and 14 of B-105) and the joint connection for an open circuit or high resistance. 2. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the IP cluster (pins 13 and 14 of B-105). 3. Repair the circuit(s) or connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 12
8	1. Connect a DMM between the ignition voltage feed circuit to the VNT control module (pin 13 of E-4) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	20.0 volts	Go to Step 9	Go to Step 10
9	Connect a DMM across the ignition voltage feed circuit and ground circuit (pins 13 and 14 of E-4). Is the DMM voltage more than the specified value?	20.0 volts	Go to Step 12	Go to Step 11
10	Repair the open circuit or high resistance between the ECM (15A) fuse and the VNT control module (pin 13 of E-4). Check the ECM (15A) fuse first. Did you complete the repair?	—	Go to Step 17	—
11	Repair the open circuit or high resistance between the VNT control module (pin 14 of E-4) and the ground terminal (E-9). Clean or tighten ground as necessary. Did you complete the repair?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
12	1. Turn OFF the ignition. 2. Disconnect the VNT control module harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the VNT control module (pins 13, 14, 15 and 16 of E-4). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
13	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 18 and 37 of J-14). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
14	Replace the IP cluster. Refer to Instrument Panel (IP) Cluster in Section 9E Instrumentation/Driver Info. Did you complete the replacement?	—	Go to Step 17	—
15	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 17	—
16	Replace the VNT control module. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 18
18	Observe the DTC information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC U0167 (Flash Code 177)

Circuit Description

The ECM communicates with the immobilizer control unit (ICU) to execute immobilizer function. If the ECM does not detect a response signal from the ICU, this DTC will set.

Condition for Setting the DTC

- The ECM does not receive an immobilizer response signal from the ICU.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Euro 2 specification)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Euro 2 specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference may affect intermittent condition.
- Any communication fault with the ICU may set this DTC.

Circuit/ System Testing DTC U0167

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC U0073 also set?	—	Go to DTC U0073	Go to Step 3
3	Attempt to communicate with the immobilizer control unit (ICU) via the Immobilizer Data table. Does the scan tool communicate with the ICU?	—	Go to Step 4	Go to Diagnostic System Check - Immobilizer Controls in Section 9I Security and Lock
4	Monitor the immobilizer DTC Information with a scan tool. Does the immobilizer DTCs fail this ignition?	—	Go to Applicable DTC for Immobilizer in Section 9I Security and Lock	Go to Step 5
5	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 6	—
6	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 7
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

EGR Control System Check

Description

The EGR system recirculates a part of exhaust gas back into the intake manifold, which results in reducing NOx emissions. The EGR control system uses an electronic control system to ensure both driveability and low emission. A control current from the ECM operates a solenoid to control the lift amount of EGR valve. Also, an EGR position sensor is provided at the rear of the solenoid to feed actual valve lift amount back to the ECM for more precision control.

The EGR control starts when the conditions for engine speed, engine coolant temperature, intake air temperature and barometric pressure are satisfied. Then, the valve opening is calculated according to the engine speed, and target fuel injection quantity. Based on this valve opening, the drive duty of the solenoid is determined and the valve is driven accordingly. The intake throttle valve is provided to adequate intake manifold depression to ensure EGR gas flow.

EGR Control Operation

- The engine coolant temperature (ECT) is between 70°C (158°F) and 100°C (212°F).
- The intake air temperature (IAT) is more than -30°C (-22°F).
- The barometric pressure (BARO) is more than 90kPa (13psi).

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing EGR Control System Check

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Are any DTCs set in which the "Action Taken When the DTC Sets" under that particular code states, "The ECM inhibits EGR control"?	—	Go to Applicable DTC	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Inspect the following conditions: • An EGR valve gasket that is missing or damaged • A sticking EGR valve • EGR gas leakage any of the EGR passage between the exhaust manifold and intake manifold • Restricted or collapsed EGR passage between the exhaust manifold and the EGR valve • Any type of restriction in the exhaust system • Restricted air cleaner element, restricted or collapsed air tubing between the air cleaner and the intake manifold • Any air induction leak • Any water intrusion in the induction system • Any contamination or objects that block the MAF sensor inlet • Skewed or slow MAF sensor • Skewed engine coolant temperature (ECT) sensor. Refer to Temperature vs Resistance table to test the ECT sensor at various temperature levels to evaluate the possibility of a skewed sensor. • Skewed barometric pressure (BARO) sensor. Determine the outside barometric pressure from you location specified in the altitude vs barometric pressure table. Refer to Altitude vs Barometric Pressure. • A sticking intake throttle valve 2. Repair the condition as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 4
4	1. Place the transmission in Neutral and set the parking brake. 2. Start the engine and warm up (arrow engine coolant temperature to reach at least 75°C [167°F]). 3. Accelerate the engine between idle and W.O.T (accelerator pedal full travel) many times while observing the Desired EGR Position and EGR Position parameter with a scan tool. Does the EGR Position parameter follow within the specified value?	± 5%	Go to Step 5	Go to Step 7
5	1. Perform the EGR Solenoid Control with a scan tool several times. 2. Command the Desired EGR Position Increase and Decrease while observing the EGR Position. Does the EGR Position parameter follow within the specified value quick enough?	± 5%	Go to Step 6	Go to Step 7

Step	Action	Value(s)	Yes	No
6	1. Perform the Intake Throttle Solenoid Control with a scan tool several times. 2. Command the Desired Intake Throttle Position Increase and Decrease while observing the Intake Throttle Position. Does the Intake Throttle Position parameter follow within the specified value quick enough?	± 5%	System OK	Go to Step 9
7	1. Remove the EGR valve assembly from the engine. 2. Inspect the EGR valve for the following conditions: • Restricted EGR valve by foreign materials • Excessive deposits at valve • Bent valve shaft 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 8
8	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the EGR valve (pins 1, 2, 3, 4, 5, 6, 7 and 8 of E-15). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 87, 93, 94, 99, 101 103, 110 and 111 of E-12). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
9	1. Remove the intake duct that is connected to the intake throttle valve. 2. Inspect the intake throttle valve for the following conditions: • Restricted intake throttle valve by foreign materials • Excessive deposits at throttle bore • Bent butterfly valve **Notice:** Replace the intake throttle valve is there is any sticking 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10

Step	Action	Value(s)	Yes	No
10	1. Turn OFF the ignition. 2. Disconnect the intake throttle valve harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the intake throttle valve (pins 1, 2, 4, 5 and 6 of E-16). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 85, 95, 104, 109 and 112 of E-12). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the EGR valve. Refer to EGR Valve and EGR Cooler in Section 1F Emission Control. Did you complete the replacement?	—	Go to Step 13	—
12	Replace the intake throttle valve. Refer to Intake Throttle Valve in Section 1B Engine Mechanical. Did you complete the replacement?	—	Go to Step 13	—
13	Reconnect all previously disconnected components or harness connector(s). Did you complete the action?	—	Go to Step 4	—

Glow Control System Check

Description

The glow control system consists of the ECM, the glow relay, the glow indicator lamp 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 glow indicator lamp illuminates between 0.5 seconds to approximately 10 seconds depending upon the engine coolant temperature. It illuminates 0.5 seconds at 10°C (50°F) or more.
- In pre glow phase, the glow relay energizes between 1 second to approximately 20 seconds depending upon the engine coolant temperature. It energizes 1 second at 10°C (50°F) or more.
- In after glow phase, the glow relay energizes between 1 second to approximately 20 seconds depending upon the engine coolant temperature. It energizes 1 second at 10°C (50°F) or more.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing Glow Control System Check

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 a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC P0117, P0118, P0380 or P0381 set?	—	Go 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 (E-14) 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 E-14 terminal) and a known good ground. 5. Perform the Glow Relay Control with a scan tool. 6. Command the relay ON while observing the test lamp. Does the test lamp turn ON only when commanded ON?	—	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?	1Ω	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 E-14 connector) and a known good ground. 5. Perform the Glow Relay Control with a scan tool. 6. Command the relay ON while observing the test lamp. Does the test lamp turn ON only when commanded ON?	—	Go to Step 13	Go to Step 6
6	Inspect the Glow (60A) slow blow fuse in the chassis side fuse & relay box. Is the Glow (60A) slow blow fuse open?	—	Go to Step 7	Go to Step 8
7	Replace the Glow (60A) slow blow fuse. 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. Did you complete the repair?	—	Go to Step 16	—
8	1. Turn OFF the ignition. 2. Remove the glow relay. 3. Probe the battery voltage feed circuit of the relay (pin 1 of X-19) with a test lamp that is connected to a known good ground. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 10
9	1. Probe the voltage supply circuit of glow plugs (pin 2 of X-19) with a test lamp that is connected to a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 12	Go to Step 11
10	Repair the open circuit or high resistance between the Glow (60A) slow blow fuse and the glow relay (pin 1 of X-19). Did you complete the repair?	—	Go to Step 16	—
11	Repair the open circuit or high resistance between the glow relay (pin 2 of X-19) and the glow plugs (E-14 terminal). Did you complete the repair?	—	Go to Step 16	—
12	**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 between the glow relay (pin 2 of X-19) and the glow plugs (E-14 terminal). Did you complete the repair?	—	Go to Step 16	—

Step	Action	Value(s)	Yes	No
13	1. Remove the glow relay. 2. Inspect for an intermittent and for poor connection on each glow relay terminal. 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 14
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 E-14 connector) and a known good ground. 5. Perform the Glow Relay Control with a scan tool. 6. Command the relay ON while observing the test lamp. Does the test lamp turn ON only when commanded ON?	—	Go to Step 4	Go to Step 2

Engine Warm Up Control System Check

Description

The engine warm up system consists of the ECM, the intake throttle valve, the exhaust brake valve, the exhaust brake solenoid valve and the engine warm up switch. The engine warm up system is operated when the engine coolant temperature is low, which promotes engine warm up. The ECM commands the intake throttle solenoid valve and the exhaust brake solenoid valve to close each valve based on engine coolant temperature and warm up request switch input signal.

Engine Warm Up Control Operation

- The engine warm up switch is ON.
- The engine is running.
- The accelerator pedal is not depressed.
- The engine coolant temperature is less than 77°C (170°F)
- The vehicle is not running.

Test Description

The number below refers to the step number on the Circuit/ System Table.
6. Use the scan tool to observe the Accelerator Pedal Position. The Accelerator Pedal Position parameter should change linearly from 0 to 100% according to the accelerator pedal operation.
7. Use the scan tool to observe the Vehicle Speed. The Vehicle Speed parameter should indicate correct vehicle speed.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing Engine Warm Up Control System Check

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	Does the exhaust brake operate correctly?	—	Go to Step 3	Go to Exhaust Brake Control System Check
3	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC P0117, P0118, P0122, P0123, P0638, P0641, P0651 or P0697 set?	—	Refer to Applicable DTC	Go to Step 4
4	1. Park the vehicle. 2. Make sure the idle up control knob to the lowest position. (Full counterclockwise direction) 3. Cool down the engine as necessary (allow engine coolant temperature to cool down at least 70°C [158°F]). 4. Start the engine. 5. Turn ON the engine warm up switch. Are the intake throttle valve and the exhaust brake valve closed when switched ON?	—	Go to Step 5	Go to Step 8
5	Turn OFF the engine warm up switch. Does the engine warm up control cancel?	—	Go to Step 6	Go to Step 16
6	1. Turn ON the engine warm up switch. 2. Press the accelerator pedal. Does the engine warm up control cancel?	—	Go to Step 7	Observe the Accelerator Pedal Position parameter for accelerator pedal position sensor diagnosis

Step	Action	Value(s)	Yes	No
7	Drive the vehicle. (Lift the driving wheels as necessary) Does the engine warm up control cancel?	—	System OK	Observe the Vehicle Speed parameter. Refer to DTC P0500
8	Observe the Engine Warm Up Switch parameter with a scan tool. Does the scan tool indicate ON?	—	Go to Step 9	Go to Step 10
9	Observe the Exhaust Brake Valve Command parameter with a scan tool. Does the scan tool indicate ON?	—	Problem is relating either solenoid valves, exhaust brake valve or vacuum pressure lines. Go to Exhaust Brake Control System Check	The ECM is not allowing engine warm up control. Refer to Engine Warm Up Control Operation
10	1. Turn OFF the ignition. 2. Remove the bezel surrounding the instrument panel (IP) cluster enough to disconnect the engine warm switch. 3. Disconnect the engine warm up switch harness connector. 4. Connect a test lamp between the voltage feed circuit of the switch harness (pin 1 of B-168) and a known good ground. 5. Start the engine. Does the test lamp illuminate?	—	Go to Step 11	Go to Step 12
11	Observe the Engine Warm Up Switch parameter with a scan tool while momentarily jumping 3-amp fused jumper wire across the switch harness connector between pins 1 and 2 of B-168. Does the scan tool indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 14	Go to Step 13
12	Repair the open circuit or high resistance between the ECM (10A) fuse and the switch (pin 3 of B-168). Did you complete the repair?	—	Go to Step 20	—
13	1. Test the signal circuit between the ECM (pin 51 of J-14) and the switch (pin 2 of B-168) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
14	1. Inspect for an intermittent and for poor connections at the harness connector of the switch (pins 1 and 2 of B-168). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 18
15	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 51 of J-14). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19

Step	Action	Value(s)	Yes	No
16	1. Turn OFF the ignition. 2. Remove the bezel surrounding the IP cluster enough to disconnect the engine warm switch. 3. Disconnect the engine warm up switch harness connector. 4. Start the engine. Does the engine warm up control cancel?	—	Go to Step 18	Go to Step 17
17	1. Test the signal circuit between the ECM (pin 51 of J-14) and the switch (pin 2 of B-168) 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 20	Go to Step 19
18	Repair or replace the engine warm up switch. Did you complete the repair or replacement?	—	Go to Step 20	—
19	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 20	—
20	Reconnect all previously disconnected components, fuse or harness connector(s). Did you complete the action?	—	Go to Step 4	—

Exhaust Brake Control System Check

Description

The exhaust brake control system consists of the ECM, the intake throttle valve, the exhaust brake valve, the exhaust brake solenoid valve and the exhaust brake switch. The ECM commands the intake throttle solenoid valve and the exhaust brake solenoid valve to close each valve based on vehicle running conditions and exhaust brake switch input signal.

Exhaust Brake Control Operation

- The exhaust brake switch is ON.
- The engine is running.
- The accelerator pedal is not depressed.
- The gearshift clutch is not disengaged (Smoother).
- The clutch pedal is not depressed (M/T).
- The vehicle speed is higher than predetermined range.

Test Description

The number below refers to the step number on the Circuit/ System Table.
4. Use the scan tool to observe the Accelerator Pedal Position. The Accelerator Pedal Position parameter should change linearly from 0 to 100% according to the accelerator pedal operation.
8. If the Exhaust Brake Solenoid Command parameter indicates OFF, use the scan tool to observe the Vehicle Speed, Accelerator Pedal Position and Clutch Switch parameters which allows the exhaust brake control. Refer to Engine Controls Schematic and Scan Tool Data List for diagnosis.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing Exhaust Brake Control System Check (1 of 2)

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. Verify whether the instrument panel (IP) cluster is operational. 2. Start the engine. 3. Apply the exhaust brake switch ON and OFF. Does the exhaust brake indicator lamp turn ON and OFF with each switch transition?	—	Go to Step 3	Go to 2 of 2 Step 1
3	1. Drive the vehicle in order to gain exhaust brake ON time long enough. 2. Apply the exhaust brake switch ON. 3. Release the accelerator pedal. Does exhaust brake apply enough (if the vehicle speed is reduced by applying the exhaust brake but engine valve noise is heard, intake throttle valve may not be closed enough)?	—	Go to Step 4	Go to Step 7
4	1. Reenter the exhaust brake control. 2. Apply the accelerator pedal while in exhaust brake control. Does the exhaust brake control cancel?	—	Go to Step 5	Observe the Accelerator Pedal Position parameter for accelerator pedal position sensor diagnosis
5	**Notice:** If no Smoother is installed, skip to Step 6. 1. Reenter the exhaust brake control. 2. Operate the selector lever while in exhaust brake control. Does the exhaust brake control cancel?	—	System OK	Go to Diagnostic System Check - Transmission Controls in Section 5A Transmission Control System

Step	Action	Value(s)	Yes	No
6	1. Reenter the exhaust brake control. 2. Apply the clutch pedal while in exhaust brake control. Does the exhaust brake control cancel?	—	System OK	Go to Step 9
7	1. Park the vehicle. 2. Install a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Monitor the DTC Information with a scan tool. Are any DTCs set in which the “Action Taken When the DTC Sets” under that particular code states, “The ECM inhibits exhaust brake control” ?	—	Go to Applicable DTC	Go to Step 8
8	1. Reenter the exhaust brake control. 2. Trigger the Snapshot function in order to capture and store engine parameters while in exhaust brake control. 3. Review the Exhaust Brake Valve Command parameter. Does the Exhaust Brake Valve Command parameter indicate ON when the exhaust brake may operate enough?	—	Go to Step 18	The ECM is not allowing exhaust brake control. Refer to Exhaust Brake Control Operation
9	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Clutch Pedal Switch parameter with a scan tool while fully depressing and releasing the clutch pedal. Does the scan tool indicate Applied when the clutch pedal is applied and Released when the clutch pedal is released?	—	Go to Step 18	Go to Step 10
10	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 switch as necessary. Did you find and correct the condition?	—	Go to Step 29	Go to Step 11
11	1. Turn OFF the ignition. 2. Disconnect the clutch pedal switch harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the ignition voltage feed circuit of the harness (pin 1 of B-161) and a known good ground. Does the test lamp illuminate?	—	Go to Step 12	Go to Step 13

Step	Action	Value(s)	Yes	No
12	Observe the Clutch Pedal Switch parameter with a scan tool while momentarily jumping 3-amp fused jumper wire across the switch harness connector between pins 1 and 2 of the B-161. Does the scan tool indicate Released when the circuit is jumpered and Applied when the circuit is not jumpered?	—	Go to Step 15	Go to Step 14
13	Repair the open circuit or high resistance between the ECM (10A) fuse and the switch (pin 1 of B-161). Did you complete the repair?	—	Go to Step 29	—
14	1. Test the signal circuit between the ECM (pin 26 of J-14) and the switch (pin 2 of B-161) 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 29	Go to Step 16
15	1. Inspect for an intermittent and for poor connections at the harness connector of the switch (pins 1 and 2 of B-161). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 29	Go to Step 17
16	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 26 of J-14). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 29	Go to Step 28
17	Replace clutch switch. Refer to Clutch Control in Section 5E Clutch. Did you complete the replacement?	—	Go to Step 29	—
18	1. Perform the Exhaust Brake Control with a scan tool. 2. Command the solenoid ON and OFF. Does the solenoid valve click with each command?	—	Problem is relating to solenoid valve, exhaust brake valve or vacuum pressure lines. Refer to applicable diagnostic chart in Section 1G Engine Exhaust.	Go to Step 19
19	1. Turn OFF the ignition. 2. Disconnect the exhaust brake solenoid valve harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the ignition voltage feed circuit (pin 1 of J-26) and a known good ground. Does the test lamp illuminate?	—	Go to Step 20	Go to Step 22

Step	Action	Value(s)	Yes	No
20	1. Connect a test lamp across the exhaust brake solenoid valve harness connector (pins 1 and 2 of J-26). 2. Perform the Exhaust Brake Control with a scan tool. 3. Command the solenoid ON and OFF. Does the test lamp turn ON and OFF with each command?	—	Go to Step 25	Go to Step 21
21	Does the test lamp remain illuminate with each command?	—	Go to Step 24	Go to Step 23
22	Repair the open circuit or high resistance between the ECM MAIN (15A) fuse and the solenoid valve (pin 1 of J-26). Did you complete the repair?	—	Go to Step 29	—
23	1. Test the control circuit between the ECM (pin 15 of J-14) and the solenoid valve (pin 2 of J-26) 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 29	Go to Step 26
24	1. Test the control circuit between the ECM (pin 15 of J-14) and the solenoid valve (pin 2 of J-26) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 29	—
25	1. Inspect for an intermittent and for poor connections at the harness connector of the solenoid valve (pins 1 and 2 of J-26). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 29	Go to Step 27
26	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 15 of J-14). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 29	Go to Step 28
27	Replace the exhaust brake solenoid valve. Did you complete the replacement?	—	Go to Step 29	—
28	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 29	—
29	Reconnect all previously disconnected components, fuse or harness connector(s). Did you complete the action?	—	Go to Step 3	—

Circuit/ System Testing Exhaust Brake Control System Check (2 of 2)

Step	Action	Value(s)	Yes	No
1	1. Install a scan tool. 2. Start the engine. 3. Apply the exhaust brake switch ON and OFF while observing the Exhaust Brake Switch parameter with a scan tool. Does the scan tool indicate ON and OFF with each switch transition?	—	Go to Step 2	Go to Step 3
2	Does the exhaust brake indicator lamp always ON with each switch transition?	—	Go to Step 10	Go to Step 11
3	1. Turn OFF the ignition. 2. Disconnect the combination switch harness connector (B-188). 3. Connect a test lamp between the voltage feed circuit of combination switch harness (pin 13 of B-188) and a known good ground. 4. Start the engine. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 5
4	Observe the Exhaust Brake Switch parameter with a scan tool while momentarily jumping 3-amp fused jumper wire across the switch harness connector between pins 13 and 15 of B-188. Does the scan tool indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 7	Go to Step 6
5	Repair the open circuit or high resistance between the ECM (10A) fuse and the switch (pin 13 of B-188). Check the ECM (10A) fuse first. Did you complete the repair?	—	Go to Step 20	—
6	1. Test the signal circuit between the ECM (pin 45 of J-14) and the switch (pin 5of B-188) 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 8
7	1. Inspect for an intermittent and for poor connections at the harness connector of the switch (pins 13 and 15 of B-188). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 9
8	1. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 45 of J-14). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
9	Repair or replace the combination switch. Did you complete the repair or replacement?	—	Go to Step 20	—

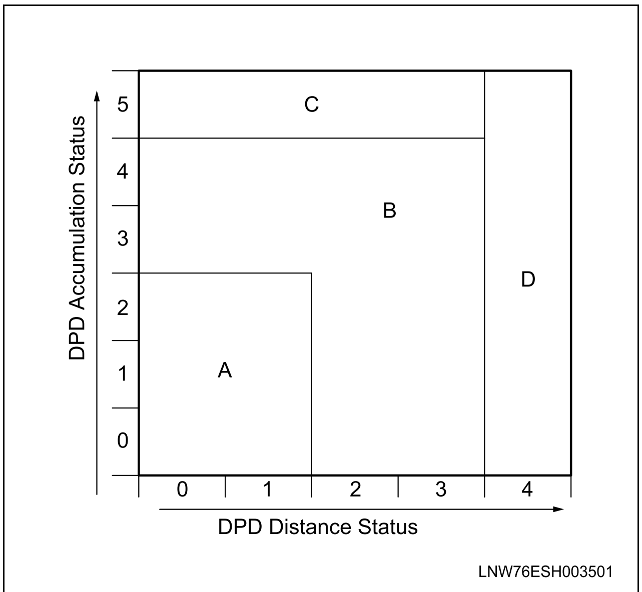
Step	Action	Value(s)	Yes	No
10	1. Turn OFF the ignition. 2. Disconnect the ECM J-14 harness connector. 3. Turn ON the ignition, with the engine OFF. Is the exhaust brake indicator lamp OFF?	—	Go to Step 19	Go to Step 16
11	1. Turn OFF the ignition. 2. Disconnect the ECM J-14 harness connector. 3. Remove the Meter (10A) fuse that supplies voltage to the exhaust brake indicator lamp. 4. Turn ON the ignition, with the engine OFF. 5. Measure the voltage from the exhaust brake indicator lamp control circuit in the ECM harness connector (pin 7 of J-14) to a known good ground. Is the voltage less than the specified value?	1 volt	Go to Step 12	Go to Step 17
12	1. Turn OFF the ignition. 2. Reinstall the Meter (10A) fuse. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the ECM harness connector (pin 7 of J-14) and a known good ground. Is the exhaust brake indicator lamp illuminated?	—	Go to Step 15	Go to Step 13
13	1. Test the control circuit between the ECM (pin 7 of J-14) and the IP cluster (pin 13 of B-106) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 14
14	1. Inspect for an intermittent and for a poor connection at the harness connector of the IP cluster (pin 13 of B-106). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 18
15	1. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 7 of J-14). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
16	Repair the short to ground between the ECM (pin 7 of J-14) and the IP cluster (pin 13 of B-106). Did you complete the repair?	—	Go to Step 20	—
17	Repair the short to battery or ignition voltage between the ECM (pin 7 of J-14) and the IP cluster (pin 13 of B-106). Did you complete the repair?	—	Go to Step 20	—
18	Repair or replace the IP cluster. Refer to Instrument Panel (IP) Cluster in Section 9E Instrumentation / Driver Info. Did you complete the repair or replacement?	—	Go to Step 20	—

Step	Action	Value(s)	Yes	No
19	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 20	—
20	Reconnect all previously disconnected components, fuse or harness connector(s). Did you complete the action?	—	Go to 1 of 2 Step 2	—

Diesel Particulate Defuser (DPD) Control System Check

Description

The ECM detects the condition of PM accumulations from the exhaust differential pressure sensor attached to the chassis frame near the diesel particulate defuser (DPD) assembly or from mileage. The exhaust differential pressure sensor is a transducer that varies voltage according to changes of the exhaust gas differential pressure between in front and in rear of filter. When it is reached to a certain amount of PM accumulations or a certain length of mileage, the automatic regeneration starts. If the automatic regeneration cannot be completed by some reason, the manual regeneration is requested to the driver by blinking the DPD lamp or “PUSH DPD SWITCH” indicator on the instrument panel cluster. Once the regeneration starts, it must be finished within a certain time. After regeneration is finished, a purification of the filter is judged by monitoring an exhaust differential pressure. If an excessive PM accumulation has been detected, the regeneration will not start since uncontrolled burning might be happened during regeneration process.
The DPD Status Table is used to determine type of the DPD filter regeneration procedure by comparing the DPD Accumulation Status parameter and the DPD Distance Status parameter. To use this table, observe both parameters with a scan tool, and plot both readings on the DPD status table. The intersected range indicates A, B, C or D. (e.g. DPD Accumulation Status is 3 and DPD Distance Status is 1. The range is located in B)



Range A: Normal range
Range B: DPD lamp or “PUSH DPD SWITCH” indicator blinks but manual regeneration is possible.
Range C: Exhaust differential pressure is excessive high range and manual regeneration is inhibited.
Range D: Distance status is abnormal range and manual regeneration is inhibited.

Test Description

The number below refers to the step number on the Circuit/ System Table.
6. 8. 9. If the regeneration is not started, any DTCs may be set which inhibits regeneration control. If no DTC is set, use the scan tool to observe the Vehicle Speed, Accelerator Pedal Position, Neutral Switch, Idle Up Sensor and PTO Switch parameters which allows the DPD regeneration control. Refer to Engine Controls Schematic and Scan Tool Data List for diagnosis.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing Diesel Particulate Defuser (DPD) Control System Check

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. Verify whether the instrument panel (IP) cluster is operational. 2. Turn ON the ignition for 30 seconds, with the engine OFF. Does the DPD lamp or “AUTO REGEN.”, “MANUAL REGEN.” indicators turn ON, and then turn OFF?	—	Go to Step 3	Refer to P1669 for DPD lamp circuit diagnosis or Refer to IP cluster diagnosis in Section 9E Instrumentation/ Driver Info.
3	1. Inspect engine oil level. Make sure the oil amount is within a range. 2. Install a scan tool. 3. Start the engine. 4. Observe the DPD Switch parameter with a scan tool. Does the scan tool indicate ON and OFF with each switch transition?	—	Go to Step 4	Go to Step 15

Step	Action	Value(s)	Yes	No
4	1. Inspect the following conditions: • Misrouted or disconnected exhaust differential pressure hoses or pipes **Important:** There is installation directionality in the exhaust differential pressure hoses. Refer to Exhaust System in Section 1G Engine Exhaust . • Plugged, crushed or kinked exhaust differential pressure hoses or pipes • Dislocated or inclined exhaust differential pressure sensor. Refer to Exhaust System in Section 1G Engine Exhaust . • Physical damage of the exhaust differential pressure sensor • Any contamination or objects that block the exhaust differential pressure sensor port • Skewed or slow exhaust differential pressure sensor • An exhaust system gasket that is missing or damaged • Exhaust gas leakage from the exhaust pipe, gasket, DPD assembly, exhaust temperature sensor(s) or exhaust differential pressure hoses or pipes • Modified exhaust system • Exhaust throttle valve or exhaust brake valve for stuck condition. Refer to Exhaust System in Section 1G Engine Exhaust. • Skewed or slow exhaust temperature sensors • Restricted air cleaner element, restricted or collapsed air tubing between the air cleaner and the intake manifold • Modified air induction • Any air induction leak • Any contamination or objects that block the mass air flow (MAF) sensor inlet • Skewed or slow MAF sensor 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 5
5	Start the engine and let idle for 30 seconds. Does the DPD lamp or “PUSH DPD SWITCH” indicator blink?	—	Go to Step 6	Go to Step 7
6	Perform the DPD manual regeneration by pressing the DPD switch. Does the regeneration start?	—	Go to Step 10	ECM is not allowing the DPD regeneration control. Refer to Test Description and DTC List
7	Observe the DPD Accumulation Status and DPD Distance Status with a scan tool, and plot both readings on the DPD status table. Is the intersected range located in A or B?	—	Go to Step 8	Go to Step 9

Step	Action	Value(s)	Yes	No
8	**Important:** Reset the DPD Status before regeneration with a scan tool. Perform the DPD Regeneration with a scan tool. Does the regeneration start?	—	Go to Step 10	ECM is not allowing the DPD regeneration control. Refer to Test Description and DTC List
9	**Important:** Reset the DPD Status before regeneration with a scan tool. **Important:** Engine Oil must be replaced after DPD slow regeneration is completed. Perform the DPD Slow Regeneration with a scan tool. Does the regeneration start?	—	Go to Step 10	ECM is not allowing the DPD regeneration control. Refer to Test Description and DTC List
10	Does the regeneration complete?	—	Go to Step 11	Go to Step 13
11	1. Observe the Exhaust Temperature 1 parameter with a scan tool. Make sure the temperature is less than 150 °C (302 °F). If more than 150 °C (302 °F), let increase 1500 RPM without load. (Turn the idle up control knob clockwise.) 2. Accelerate the engine to W.O.T. (accelerator pedal full travel) and read the Exhaust Differential Pressure parameter when the Exhaust Temperature 1 parameter is reached to 200 °C (392 °F). Is the Exhaust Differential Pressure parameter less than the specified value?	5.9 kPa (low output) 2.5 kPa (higt output)	Go to Step 12	Ash cleaning must be performed. Refer to appropriate procedure in Section 1G Engine Exhaust
12	Is the Exhaust Differential Pressure parameter more than the specified value?	1.0 kPa	System OK	Refer to DTC P2452
13	**Notice:** If the scan tool displays a message "The failure in which compulsive regeneration is impossible was detected", go to applicable DTC. 1. Remove the DPD filter from the DPD assembly. Refer to Exhaust Pipe in Section 1G Engine Exhaust. Inspect the following conditions: • DPD filter for damage, cranks or melt • Oxygen catalyst for damage, cranks melt or excessive deposits • Deteriorated oxygen catalyst 2. Test the engine cooling system for an overheating condition. Refer to Cooling System in Section 1C Engine Cooling. 3. Inspect the fuel system problem. Refer to Fuel System Check chart and appropriate procedure in Section 1D Engine Fuel. 4. Repair or replace as necessary. Did you complete the action?	—	Go to Step 14	—
14	Reconnect all previously disconnected components or harness connector(s). Did you complete the action?	—	Go to Step 5	—

Step	Action	Value(s)	Yes	No
15	1. Turn OFF the ignition. 2. Remove the bezel surrounding the IP cluster enough to disconnect the DPD switch. 3. Disconnect the DPD switch harness connector. 4. Connect a test lamp between the voltage feed circuit of the DPD switch harness (pin 1 of B-165) and a known good ground. 5. Start the engine. Does the test lamp illuminate?	—	Go to Step 16	Go to Step 17
16	Observe the DPD Switch parameter with a scan tool while momentarily jumping 3-amp fused jumper wire across the switch harness connector between pins 1 and 2 of B-165. Does the scan tool indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 19	Go to Step 18
17	Repair the open circuit or high resistance between the ECM (10A) fuse and the switch (pin 1 of B-165). Check the ECM (10A) fuse first. Did you complete the repair?	—	Go to Step 23	—
18	1. Test the signal circuit between the ECM (pin 47 of J-14) and the switch (pin 2 of B-165) 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 23	Go to Step 20
19	1. Inspect for an intermittent and for poor connections at the harness connector of the switch (pins 1 and 2 of B-165). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 23	Go to Step 21
20	1. Inspect for an intermittent, for a poor connection and corrosion at the harness connector of the ECM (pin 47 of J-14). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 23	Go to Step 22
21	Repair or replace the DPD switch. Did you complete the repair or replacement?	—	Go to Step 23	—
22	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 23	—

Step	Action	Value(s)	Yes	No
23	1. Reconnect all previously disconnected components, fuse or harness connector(s). 2. Start the engine. 3. Observe the DPD Switch parameter with a scan tool. Does the scan tool indicate ON and OFF with each switch transition?	—	Go to Step 4	Go to Step 15

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 ECM and malfunction indicator lamp (MIL)/ service vehicle soon (SVS) lamp are operating correctly.
- The scan tool data is within the normal operating range. Refer to Scan Tool 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 air intake ducts are not collapsed or damaged.
- The exhaust pipes are not collapsed or damaged.
- 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 controller area network (CAN) or other serial data circuit.

Important: The problem may or may not turn ON the MIL/ SVS lamp 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 scan tool in order to help detect intermittent conditions. Useful features of the Tech 2 scan tool 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.
- Freeze Frame/ Failure Record can also aid in locating an intermittent condition. Review and capture the information in the Freeze Frame/ Failure Record associated with the intermittent DTC being diagnosed. Drive the vehicle within the conditions that were present when the DTC originally set.
- Use the Plot Function on the scan tool in order to plot selected data parameters. Review this stored information to aid in locating an intermittent problem. Refer to the scan tool Users Guide for more information.

Use the data recording module (DRM) in order to help detect intermittent conditions. The DRM has ability to store engine log data when an event of DTC. Maximum three log data can be stored in the DRM memory. If more than maximum number of storage is set, oldest log data is overwritten. However, if same DTC is set within eight hours that DTC is not stored in the DRM memory.

The manual trigger function is to store the log data by an arbitrary operation of the driver when an event of wrong vehicle performance that is instead of an event of DTC. If the driver presses and releases the manual trigger switch once, that time becomes a trigger and one log data before and behind the trigger is stored in the DRM memory. When there is a space in the DRM memory, log data is stored in that space. However, when more than maximum number of storage is set, oldest log data is overwritten.

Refer to the DRM 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/ SVS lamp with no stored DTC:

- The ECM grounds are loose or dirty. Refer to Engine Controls Schematics.

- The MIL/ SVS lamp 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 are any 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 scan tool 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:

- Intermittent Conditions
- Hard Start
- Rough, Unstable, or Incorrect Idle and Stalling
- High Idle Speed
- Cuts Out
- Surges
- Lack of Power, Sluggishness or Sponginess
- Hesitation, Sag or Stumble
- Abnormal Combustion Noise
- Poor Fuel Economy
- Excessive Smoke (Black Smoke)
- Excessive Smoke (White Smoke)
- DPD System Manual Regeneration Frequently
- DPD System Regeneration Long Time

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 scan tool data. • Move related connectors and wiring with the component commanded ON, and OFF, with the scan tool. 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.
Electrical Connections or Wiring	Poor electrical connections, terminal tension or wiring problems cause most intermittent. To perform the following inspections: • Poor mating of the connector halves, or terminals improperly seated in the connector body. • Improperly formed or damaged terminals. Test for poor terminal tension. • Poor terminal to wire connections including terminals crimped over insulation. This requires removing the terminal from the connector body. • 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. • Wires that are broken inside the insulation. • 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.

<table>
<tr><th>Checks</th><th>Action</th></tr>
<tr><td>Temperature Sensitivity</td><td>
• 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.
• Freeze Frame, Failure Records or Snapshot Data may help with this type of intermittent conditions, where applicable.
• 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.
</td></tr>
<tr><td>Electromagnetic Interference (EMI) and Electrical Noise</td><td>
Some electrical components/ circuits are sensitive to EMI or other types of electrical noise. Inspect 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 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 any 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.
</td></tr>
<tr><td>Incorrect ECM Programming</td><td>
• There are only a few situations where reprogramming a ECM is appropriate:
- An ECM from another vehicle is installed.
- Revised software/ calibration files have been released for this vehicle.

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.
• Verify that the ECM contains the correct software/ calibration. If incorrect programming is found, reprogram the ECM with the most current software/ calibration.
</td></tr>
</table>

Checks	Action
Duplicating Failure Conditions	• If none of the previous tests are successful, attempt to duplicate and/ or capture the failure conditions. • Freeze Frame/ Failure Records data, where applicable, contains the conditions that were present when the DTC set. - Review and record Freeze Frame/ Failure Records data. - Operate the vehicle under the same conditions that were noted in Freeze Frame/ Failure Records data, as closely as possible. The vehicle must also be operating within the Conditions for Running the DTC. Refer to Conditions for Running the DTC in the supporting text of the DTC being diagnosed. • 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.
Scan Tool Snapshot	The scan tool 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 scan tool 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 scan tool Users Guide for more information.
DRM Memory	Use data stored in the DRM memory or use manual trigger function. The DRM has ability to store engine log data when an event of DTC. The manual trigger function is to store the log data by an arbitrary operation of the driver when an event of wrong vehicle performance that is instead of an event of DTC. If the driver presses and releases the manual trigger switch once, that time becomes a trigger and one log data before and behind the trigger is stored in the DRM memory. Refer to the DRM Users Guide for more information.

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 ECM 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 programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters 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 in each circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT may indicate a higher than normal intake air temperature if the ignition switch is being ON. • Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Crankshaft position (CKP) sensor is tight and the sensor rotor is not damaged. • Camshaft position (CMP) sensor is tight and the camshaft gear is not damaged.

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check chart and appropriate procedure in Section 1D Engine Fuel. • Air in the fuel system. • Water contamination in the fuel. • Fuel waxing or icing. • Fuel filter clogging. • External fuel leaks or high engine oil level. • Fuel leak off from the fuel pressure limiter valve and fuel injectors. • Fuel lines between the fuel tank and fuel supply pump for being crushed, kinked, tightness, cracks and plugged. • A plugged fuel tank vent hose. • Inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. • Fuel supply pump operation. **Notice:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Force Drive with a scan tool. • Observe the FRP Regulator Feedback current on the scan tool.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to Exhaust System in Section 1G Engine Exhaust.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Section 1B Engine Mechanical. • Poor cylinder compression. • 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. • Glow plug control system operation. Refer to Glow Control System Check in this section. • Slow cranking speed. • 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 ECM 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 programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters 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 in each circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT may indicate a higher than normal intake air temperature if the ignition switch is being ON. • Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure parameter at idle in Neutral. The Fuel Rail Pressure should always be within 27 to 33 MPa (3,900 to 4,800 psi) after warm up. • Crankshaft position (CKP) sensor is tight and the sensor rotor is not damaged. • Camshaft position (CMP) sensor is tight and the camshaft gear is not damaged.

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check chart and appropriate procedure in Section 1D Engine Fuel. • Air in the fuel system. • Water contamination in the fuel. • Fuel waxing or icing. • Fuel filter clogging. • External fuel leaks or high engine oil level. • Fuel leak off from the fuel pressure limiter valve and fuel injectors. • Fuel lines between the fuel tank and fuel supply pump for being crushed, kinked, tightness, cracks and plugged. • A plugged fuel tank vent hose. • Inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. • Fuel supply pump operation. **Notice:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Force Drive with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool. • Observe the FRP Regulator Feedback current on the scan tool.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to Exhaust System in Section 1G Engine Exhaust.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Section 1B Engine Mechanical. • Poor cylinder compression. • Improper mechanical timing (timing gear). • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes. • Incorrect basic engine parts such as camshaft, cylinder head, pistons, etc.

Checks	Action
Additional Checks	• Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. The scan tool 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 injector solenoid valve wiring, near the sensor circuits. • Faulty engine mounts. • Faulty crank pulley. • Faulty generator & A/C compressor. • Generator output voltage. • EGR system operating correctly. Refer to EGR Control System Check in this section. • A/C operation.

High Idle Speed

Checks	Action
Definition: Engine idle speed is higher than normal in regardless of engine coolant temperature or DPD system regeneration.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Inspect that the harness connectors are correctly connected. • Use the scan tool to compare the engine speed and tachometer on the instrument panel (IP) cluster. • Inspect the A/C operation. • Inspect the fuel type and quality. • Inspect the engine oil level. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters 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 in each circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT may indicate a higher than normal intake air temperature if the ignition switch is being ON. • Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure parameter at idle in Neutral. The Fuel Rail Pressure should always be within 27 to 33 MPa (3,900 to 4,800 psi) after warm up. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation. • Observe the Idle Up Sensor. Idle Up Sensor parameter should read less than 0.6 volts at full counterclockwise. If not, check for high resistance in the low reference circuit or skewed sensor. • Observe the PTO Remote Throttle Sensor. PTO Remote Throttle Sensor parameter should read less than 0.4 volts at lowest position. If not, check for high resistance in the low reference circuit or skewed sensor.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System in Section 1D Engine Fuel. • Fuel injectors. Remove the injectors and visually inspect. (Injector tip(s) may be damaged)

Cuts Out

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 ECM grounds for being clean, tight, and in their proper locations. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Observe the Mass Air Flow (MAF) parameter for a skewed or slow MAF sensor. • Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within $\pm$ 5 MPa ($\pm$ 725 psi) quick enough. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation. • Crankshaft position (CKP) sensor is tight and the sensor rotor is not damaged.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check chart and appropriate procedure in Section 1D Engine Fuel. • Air in the fuel system. • Water contamination in the fuel. • Fuel waxing or icing. • Fuel filter clogging. • Fuel leak off from the fuel pressure limiter valve and fuel injectors. • Fuel lines between the fuel tank and fuel supply pump for being crushed, kinked, tightness, cracks and plugged. • Inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Force Drive with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold.

Checks	Action
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to Exhaust System in Section 1G Engine Exhaust.
Additional Checks	• Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. The scan tool 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 injector solenoid valve wiring, near the sensor circuits.

Surges

<table>
<tr><th>Checks</th><th>Action</th></tr>
<tr><td colspan="2">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.</td></tr>
<tr><td>Preliminary Checks</td><td>• Diagnostic System Check - Engine Controls.
• Ensure the driver understands the A/C compressor operation.
• Use the scan tool in order to make sure the Vehicle Speed parameter reading matches the vehicle speedometer.
• Inspect the ECM 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 programmed fuel injector ID code for each cylinder.
• Inspect the Scan Tool Data List in this section.
• Inspect the Service Bulletin.</td></tr>
<tr><td>Sensor Checks</td><td>Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section.
• Observe the Mass Air Flow (MAF) parameter for a skewed or slow MAF sensor.
• Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor.
• Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 MPa (± 725 psi) quick enough.
• Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation.</td></tr>
<tr><td>Fuel System Checks</td><td>Inspect the fuel system for the following conditions. Refer to Fuel System Check chart and appropriate procedure in Section 1D Engine Fuel.
• Air in the fuel system.
• Water contamination in the fuel.
• Fuel waxing or icing.
• Fuel filter clogging.
• Fuel leak off from the fuel pressure limiter valve and fuel injectors.
• Fuel lines between the fuel tank and fuel supply pump for being crushed, kinked, tightness, cracks and plugged.
• A plugged fuel tank vent hose.
• Inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition.
• Fuel supply pump operation.

Notice: The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM.
• Perform the Cylinder Balance Test with a scan tool.
• Perform the Injector Force Drive with a scan tool.</td></tr>
</table>

Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • Turbocharger nozzle control solenoid for a stuck condition. Refer to Turbocharger Assembly in Section 1J Induction.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to Exhaust System in Section 1G Engine Exhaust.
Additional Checks	• Inspect the EGR system operating correctly. Refer to EGR Control System Check in this section. • Inspect the A/C operation. • Inspect the lock up clutch operation. (Smoother only) • Inspect deformed tire(s) that may cause surges at fixed vehicle speed range.

Lack of Power, Sluggishness or Sponginess

<table>
<tr><th>Checks</th><th>Action</th></tr>
<tr><td colspan="2">Definition:
The engine delivers less than expected power. There is little or no increase in speed when partially applying the accelerator pedal.</td></tr>
<tr><td>Preliminary Checks</td><td>• 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.
• Have the tire sizes changed?
• Are excessively heavy loads being carried?
• Inspect for clutch slip.
• Inspect brake drag.
• Inspect for a proper transmission shift pattern and down shift operation.
• Inspect the fuel quality (cetane index).
• Inspect the engine oil level and quality.
• Use the scan tool in order to make sure the Vehicle Speed parameter reading matches the vehicle speedometer.
• Inspect the ECM grounds for being clean, tight, and in their proper locations.
• Inspect the programmed fuel injector ID code for each cylinder.
• Inspect the Scan Tool Data List in this section.
• Inspect the Service Bulletin.</td></tr>
<tr><td>Sensor Checks</td><td>Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section.
• Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters 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 in each circuit or for a skewed sensor.

Notice: The mass air flow (MAF) sensor is heated and as a result the IAT may indicate a higher than normal intake air temperature if the ignition switch is being ON.
• Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor.
• Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 MPa (± 725 psi) quick enough.
• Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation.
• Observe the Boost Pressure and Barometric Pressure (BARO) with ignition ON and engine OFF. Both parameters should be within the 7.0 kPa (1.0 psi) each other.</td></tr>
</table>

<table>
<tr><th>Checks</th><th>Action</th></tr>
<tr><td>Fuel System Checks</td><td>Inspect the fuel system for the following conditions. Refer to Fuel System Check chart and appropriate procedure in Section 1D Engine Fuel.
• Air in the fuel system.
• Water contamination in the fuel.
• Fuel waxing or icing.
• Fuel filter clogging.
• External fuel leaks or high engine oil level.
• Fuel leak off from the fuel pressure limiter valve and fuel injectors.
• Fuel lines between the fuel tank and fuel supply pump for being crushed, kinked, tightness, cracks and plugged.
• A plugged fuel tank vent hose.
• Inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition.
• Fuel supply pump operation.

Notice: The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM.
• Perform the Cylinder Balance Test with a scan tool.
• Perform the Injector Force Drive with a scan tool.
• Observe the Fuel Compensation for each cylinder at idle on the scan tool.</td></tr>
<tr><td>Air Intake System Checks</td><td>Inspect the air intake system for the following conditions.
• Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks.
• A restriction in the turbocharger inlet duct.
• Intake throttle valve for a stuck condition.
• A restriction or leak in the intake manifold.
• A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to Turbocharger Assembly in Section 1J Induction.
• Turbocharger nozzle control solenoid for a stuck condition. Refer to Turbocharger Assembly in Section 1J Induction.</td></tr>
<tr><td>Exhaust System Checks</td><td>Inspect the exhaust system for a possible restriction. Refer to Exhaust System in Section 1G Engine Exhaust.</td></tr>
<tr><td>Engine Mechanical Checks</td><td>Inspect the engine mechanical for the following conditions. Refer to the Section 1B Engine Mechanical.
• Poor cylinder compression.
• Improper valve gap.
• Broken or weak valve springs.
• Worn camshaft lobes.</td></tr>
<tr><td>Additional Checks</td><td>• Inspect the EGR system operating correctly. Refer to EGR Control System Check in this section.
• Inspect for an engine overheat condition. Refer to Cooling System in Section 1C Engin Cooling.
• Inspect the A/C operation.
• Inspect the lock up clutch operation. (Smoother only).</td></tr>
</table>

Hesitation, Sag or 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 for a proper transmission shift pattern and down shift operation. • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Inspect the ECM grounds for being clean, tight, and in their proper locations. • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters 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 in each circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT may indicate a higher than normal intake air temperature if the ignition switch is being ON. • Observe the MAF parameter for a skewed or slow MAF sensor. • Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 MPa (± 725 psi) quick enough. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation. • Observe the Boost Pressure and Barometric Pressure (BARO) with ignition ON and engine OFF. Both parameters should be within the 7.0 kPa (1.0 psi) each other. • Crankshaft position (CKP) sensor is tight and the sensor rotor is not damaged.

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check chart and appropriate procedure in Section 1D Engine Fuel. • Air in the fuel system. • Water contamination in the fuel. • Fuel waxing or icing. • Fuel filter clogging. • External fuel leaks or high engine oil level. • Fuel leak off from the fuel pressure limiter valve and fuel injectors. • Fuel lines between the fuel tank and fuel supply pump for being crushed, kinked, tightness, cracks and plugged. • A plugged fuel tank vent hose. • Inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. • Fuel supply pump operation. **Notice:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Force Drive with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to Turbocharger Assembly in Section 1J Induction. • Turbocharger nozzle control solenoid for a stuck condition. Refer to Turbocharger Assembly in Section 1J Induction.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to Exhaust System in Section 1G Engine Exhaust.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Section 1B Engine Mechanical. • Poor cylinder compression. • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes.
Additional Checks	• Inspect the EGR system operating correctly. Refer to EGR Control System Check in this section. • Inspect for an engine overheat condition. Refer to Cooling System in Section 1C Engin Cooling. • Inspect the A/C operation. • Inspect the lock up clutch operation. (Smoother only)

Abnormal 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 programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters 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 in each circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT may indicate a higher than normal intake air temperature if the ignition switch is being ON. • Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 MPa (± 725 psi) quick enough. • Crankshaft position (CKP) sensor is tight and the sensor rotor is not damaged.
Fuel System Checks	• If excessive smoke is present, check for a stuck open fuel injector. Inspect for fuel leakage into the combustion chamber. • Inspect the fuel injectors. Remove the injectors and visually inspect. • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Force Drive with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Section 1B Engine Mechanical. • Poor cylinder compression. • Incorrect basic engine parts such as camshaft, cylinder head, pistons, etc. • Inspect for any excessive oil entering combustion chamber.
Additional Checks	• 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.	
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? • Are 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 dive belt tension. • Inspect for a proper transmission shift pattern and down shift operation (Smoother only). • 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. • Inspect the odometer is correctly operated. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters 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 in each circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT may indicate a higher than normal intake air temperature if the ignition switch is being ON.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System in Section 1D Engine Fuel. • Fuel type and quality. • Check fuel leak.
Cooling System Checks	Inspect the cooling system for the following conditions. Refer to Cooling System in Section 1C Engin Cooling. • Engine coolant level. • Engine thermostat for always being open or for the wrong heat range. • Engine cooling fan for always being ON.

Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to Turbocharger Assembly in Section 1J Induction. • Turbocharger nozzle control solenoid for a stuck condition. Refer to Turbocharger Assembly in Section 1J Induction.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to Exhaust System in Section 1G Engine Exhaust.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Section 1B Engine Mechanical. • Poor cylinder compression. • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes.

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 ECM 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 programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters 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 in each circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT may indicate a higher than normal intake air temperature if the ignition switch is being ON. • Observe the MAF parameter for a skewed or slow MAF sensor. • Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ±5 MPa (±725 psi) quick enough. • Observe the Boost Pressure and Barometric Pressure (BARO) with ignition ON and engine OFF. Both parameters should be within the 7.0 kPa (1.0 psi) each other.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System in Section 1D Engine Fuel. • Fuel injectors. Remove the injectors and visually inspect. • Perform the Cylinder Balance Test with a scan tool. • Perform the Pilot Injection Control with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool.

Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • A restriction or damaged at MAF sensor. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to Turbocharger Assembly in Section 1J Induction.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to Exhaust System in Section 1G Engine Exhaust.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Section 1B Engine Mechanical. • Inspect for poor cylinder compression. • Improper mechanical timing (timing gear). • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes. • Any excessive oil entering combustion chamber.
Additional Checks	• EGR system operating correctly. Refer to EGR Control System Check in this section. • Excessive blow-by gasses.

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 ECM grounds for being clean, tight, and in their proper locations. • Inspect the fuel quality (cetane index). • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters 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 in each circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT may indicate a higher than normal intake air temperature if the ignition switch is being ON. • Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the ignition switch ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 MPa (± 725 psi) quick enough. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation. • Observe the Boost Pressure and Barometric Pressure (BARO) with ignition ON and engine OFF. Both parameters should be within the 7.0 kPa (1.0 psi) each other. • Crankshaft position (CKP) sensor is tight and the sensor rotor is not damaged.
Fuel System Checks	• If excessive smoke is present, check for a stuck open fuel injector. Inspect for fuel leakage into the combustion chamber. • Fuel injectors. Remove the injectors and visually inspect. • Perform the Cylinder Balance Test with a scan tool. • Perform the Pilot Injection Control with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool.

Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • A restriction or damaged at MAF sensor. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Oil leak from turbocharger. Refer to Turbocharger Assembly in Section 1J Induction.
Exhaust System Checks	If an excessive white smoke is present while DPD filter regeneration process, a deteriorated or damaged oxygen catalyst is suspected.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Section 1B Engine Mechanical. • Poor cylinder compression. • Improper mechanical timing (timing gear). • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes. • Thermostat working (open stuck). • Any excessive oil entering combustion chamber.
Electrical System Checks	• Glow plug control (preheating) system operation. Refer to Glow Control System Check in this section.

DPD System Manual Regeneration Frequently

Checks	Action
Definition: The manual regeneration is frequently requested to the driver by blinking the DPD lamp. Or, it is frequently requested as compared with before. (The automatic regeneration cannot be completed frequently.)	
Preliminary Checks	• Inspect the fuel quality. • Inspect the engine oil level and quality. • Inspect the odometer is correctly operated. • If an excessive black smoke is present, refer to Excessive Smoke (Black Smoke) chart in symptom diagnostic table. • An excessive ash accumulation in the DPD filter. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin. Inspect the driving habits/conditions of the owner for the following conditions. Suggest to the owner to use an arbitrary regeneration as necessary: In normal operation; • Is the idling time too long? • Is the driving at slow vehicle speed too often? • Is the driving at long downhill? • Is a small cargo delivery truck or a garbage truck? • Is the PTO operating time too long? In regeneration; • Is the idling time too long? • Is the driving at slow vehicle speed too often? • Is the PTO operating too often and/or for a long time? • Is the engine runtime short? • Is the vehicle runtime short? • Is the accelerator pedal ON and OFF too often?
Sensor Checks	Inspect the engine control sensors relating to the DPD system control for the following conditions. Refer to the Scan Tool Data List in this section. • Misrouted or disconnected exhaust differential pressure hoses or pipes. **Notice:** There is installation directionality in the exhaust differential pressure hoses. Refer to Exhaust System in Section 1G Engine Exhaust . • Plugged, crushed or kinked exhaust differential pressure hoses or pipes. • Dislocated or inclined exhaust differential pressure sensor. Refer to Exhaust System in Section 1G Engine Exhaust . • Physical damage of the exhaust differential pressure sensor. • Any contamination or objects that block the exhaust differential pressure sensor port. • Observe the Exhausts Differential Pressure parameter for a skewed or slow exhaust differential pressure sensor. • Skewed or slow exhaust temperature sensors. Use the Temperature vs. Resistance table to test the exhaust temperature sensor at various temperature levels to evaluate the possibility or a skewed sensor. • Observe the MAF parameter for a skewed or slow MAF sensor. • Observe the Boost Pressure and Barometric Pressure (BARO) with ignition ON and engine OFF. Both parameters should be within the 7.0 kPa (1.0 psi) each other.

Checks	Action
Fuel System Checks	Inspect the fuel system problem. Refer to Fuel System Check chart and appropriate procedure in Section 1D Engine Fuel.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • Modified air induction system. • A restriction or damaged or any contamination or objects that block at MAF sensor. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to Turbocharger Assembly in Section 1J Induction.
Exhaust System Checks	Inspect the exhaust system for the following conditions. Refer to Exhaust System in Section 1G Engine Exhaust. • An exhaust system gasket that is missing or damaged. • Exhaust gas leakage from the exhaust pipe, gasket, DPD assembly, exhaust temperature sensor(s) or exhaust differential pressure hoses or pipes. • Modified exhaust system. • Exhaust throttle valve or exhaust brake valve for stuck condition. Refer to Exhaust System in Section 1G Engine Exhaust. • An excessive ash accumulation in the DPD filter. • DPD filter for damage, cracks, melt or excessive deposits. • Oxygen catalyst for damage, cracks, melt or excessive deposits. • If an excessive white smoke is present while regeneration process, a deteriorated or damaged oxygen catalyst is suspected.

DPD System Regeneration Long Time

Checks	Action
Definition: The regeneration time longer than an expected time. Or, it takes longer than before.	
Preliminary Checks	• Inspect the fuel quality. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin. • Is the engine warm up control misunderstood as the DPD regeneration? Inspect the driving habits/conditions of the owner for the following conditions: In regeneration; • Has the manual regeneration started from cold engine? • Is the idling time too long? • Is the driving at slow vehicle speed too often? • Is the PTO operating too often and/or for a long time? • Is the engine runtime short? • Is the vehicle runtime short? • Is the accelerator pedal ON and OFF too often? • Is the ambient temperature excessively high?
Sensor Checks	Inspect the engine control sensors relating to the DPD system control for the following conditions. Refer to the Scan Tool Data List in this section. • Misrouted or disconnected exhaust differential pressure hoses or pipes. **Notice:** There is installation directionality in the exhaust differential pressure hoses. Refer to Exhaust System in Section 1G Engine Exhaust . • Plugged, crushed or kinked exhaust differential pressure hoses or pipes. • Dislocated or inclined exhaust differential pressure sensor. Refer to Exhaust System in Section 1G Engine Exhaust . • Physical damage of the exhaust differential pressure sensor. • Any contamination or objects that block the exhaust differential pressure sensor port. • Observe the Exhausts Differential Pressure parameter for a skewed or slow exhaust differential pressure sensor. • Skewed or slow exhaust temperature sensors. Use the Temperature vs. Resistance table to test the exhaust temperature sensor at various temperature levels to evaluate the possibility or a skewed sensor.
Fuel System Checks	Inspect the fuel system problem. Refer to Fuel System Check chart and appropriate procedure in Section 1D Engine Fuel.
Cooling System Checks	Inspect the cooling system for an overheating conditions. Refer to Cooling System in Section 1C Engin Cooling for testing. • Engine coolant level. • Engine coolant leakage. • Cooling fan belt slippage. • Cooling fan clutch working. • Thermostat working. • Water pump working. • Radiator clogging. • Modified cooling system which is less cooling capacity.

Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • Modified air induction system. • A restriction or damaged or any contamination or objects that block at MAF sensor. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to Turbocharger Assembly in Section 1J Induction.
Exhaust System Checks	Inspect the exhaust system for the following conditions. Refer to Exhaust System in Section 1G Engine Exhaust. • An exhaust system gasket that is missing or damaged. • Exhaust gas leakage from the exhaust pipe, gasket, DPD assembly, exhaust temperature sensor(s) or exhaust differential pressure hoses or pipes. • Modified exhaust system. • Exhaust throttle valve or exhaust brake valve for stuck condition. Refer to Exhaust System in Section 1G Engine Exhaust. • DPD filter for damage, cracks, melt or excessive deposits. • Oxygen catalyst for damage, cracks, melt or excessive deposits. • If an excessive white smoke is present while regeneration process, a deteriorated or damaged oxygen catalyst is suspected.
Additional Checks	• Inspect for an engine overheat condition. Refer to Cooling System in Section 1C Engin Cooling. • Inspect the A/C operation.

Repair Instructions

Engine Control Module (ECM) Replacement

Description

The following A - E steps provide an overview procedure to replace and reprogram an ECM. Each A - E steps is explained further in this section.

- A-1. Upload the fuel injector ID codes from the old ECM (Except Euro 4 specification).
- A-2. Record the fuel injector ID codes manually from the old ECM.
- B. Replace the old ECM with the new ECM.
- C. Program the latest software and calibrations into the new ECM using the Service Programming System (SPS).
- D-1. Program the uploaded fuel injector ID codes and program the vehicle identification number (VIN) into the ECM (Except Euro 4 specification).
- D-2. Program the recorded fuel injector ID codes and the VIN into the ECM using a scan tool programming function.
- E. Perform the fuel supply pump relearn procedure by allowing the engine to idle in Park or Neutral until normal operating temperature is achieved.

A-1. Uploading Fuel Injector ID Code (Except Euro 4 Specification)

The current fuel injector ID code data can be uploaded with a scan tool. If the old ECM cannot be communicated with a scan tool, go to Retrieving the Fuel Injector ID Code Data with a Non-communicating ECM.

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > appropriate vehicle identification > 4HK1 > Programming > Injector ID Code < Upload ID Code.
4. After compete the uploading, turn OFF the scan tool.
5. Turn OFF the ignition.

A-2. Recoding Fuel Injector ID Code

Each fuel injector is designated with 24 hexadecimal characters (0 - 9 or A - F) that MUST be programmed into the ECM for correct engine fueling for each specific cylinder. These characters can be retrieved in one of following places:

Retrieving the Fuel Injector ID Code Data from the ECM

The current fuel injector ID code data can be determined with a scan tool. If the ECM does not communicate with a scan tool, go to the next procedure.

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > appropriate vehicle identification > 4HK1 > Additional Functions > Display Injector Codes.
4. Record 24 digits of each fuel injector ID code.
5. After complete the recording, turn OFF the scan tool.
6. Turn OFF the ignition.

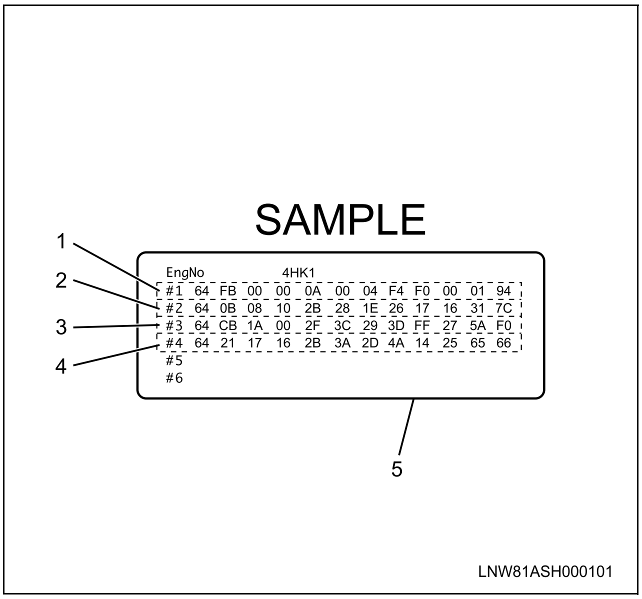
Retrieving the Fuel Injector ID Code Data with a Non-communicating ECM

If a scan tool does not communicate, the fuel injector ID codes must be recorded from the factory affixed label on the cylinder head cover or each fuel injector ID plate.

Recording from the label on cylinder head cover

Notice: Only perform this procedure if the fuel injectors are not being replaced in the past.

1. Record all numbers of each cylinder on the label.

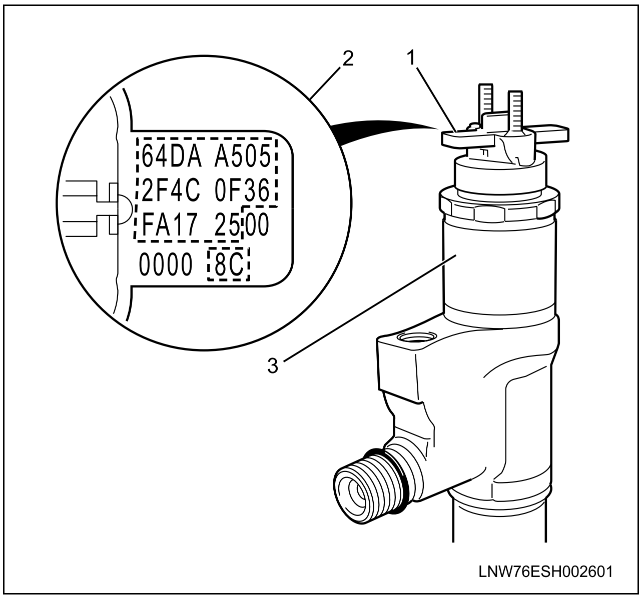


Legend

1. Cylinder #1 fuel injector ID code
2. Cylinder #2 fuel injector ID code
3. Cylinder #3 fuel injector ID code
4. Cylinder #4 fuel injector ID code
5. Injector ID code label

Recording from each fuel injector

1. Remove the cylinder head cover. Refer to Fuel Injector Replacement.
2. Record 24 figures of each fuel injector ID plate. The correct order for the fuel injector ID codes of the following illustration is as follows:
   64 DA A5 05 2F 4C 0F 36 FA 17 25 8C



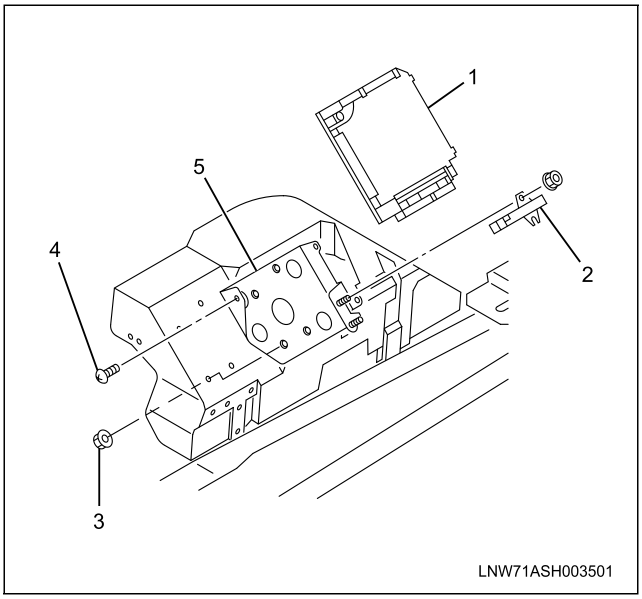
Legend

1. Fuel injector ID plate
2. Fuel injector ID code
3. Fuel injector

B. Removal and Installation

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the dropping resistor harness connector.
3. Disconnect the ECM harness connectors.
4. Remove the dropping resistor (2).
5. Loosen the nuts (3).
6. Remove the ECM with bracket (5) from side cover.
7. Loosen the bolts (4) and remove the ECM (1).



Installation Procedure

1. Install the ECM (1) to the bracket (5) and tighten the ECM fixing bolts(4).
2. Install the ECM with bracket (5) to the engine side cover and tighten the nuts (3).
3. Reconnect the dropping resistor (2).
4. Reconnect the ECM harness connector.
5. Reconnect the dropping resistor harness connector.
6. Reconnect the negative battery cable.

C. Programming Software and Calibrations

Program latest software/ calibrations if released. Refer to Service Programming System (SPS) Description and SPS (Remote Procedure) or SPS (Pass-Thru Procedure) in this section.

D-1. Programming Fuel Injector ID Codes and VIN (Except Euro 4 specification)

If the old ECM cannot be communicated with a scan tool, go to next procedure.

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > appropriate vehicle identification > 4HK1 > Programming > Download ID Code.
4. Select VIN programming. Verify the VIN on the screen if programmed at previously described SPS. If not programmed or incorrect VIN, input correct VIN. In order to get programming approval, the on-screen displays a message to user. Get programming approval from the TIS 2000 using the following procedure:
   a. Connect a scan tool to the terminal that installed TIS 2000 with the latest software and the hardware key is plugged into port.
   b. Turn ON the scan tool and keep at title screen.

c. Launch the TIS application.
d. Select the Security Access at the main screen.
e. Highlight the “Tech 2” on the Diagnostic Tool Selection screen and click “Next”.
f. Click “Close” on the Security Access Enabled screen.
g. Turn OFF the scan tool.
h. Disconnect the scan tool from the terminal.

5. After complete the programming, turn OFF the ignition for 30 seconds.
6. Start the engine and let idle.
7. Inspect for a proper engine running condition and for no DTC's. Refer to the Diagnostic System Check - Engine Controls if needed.

D-2. Programming Fuel Injector ID Codes and VIN

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > appropriate vehicle identification > 4HK1 > Programming > Replace Injector.
4. If except Euro 4 spcecification, skip to step 8. In order to get programming approval, the on-screen displays a message to user. Get programming approval from the TIS 2000 using the following procedure:
   a. Connect a scan tool to the terminal that installed TIS 2000 with the latest software and the hardware key is plugged into port.
   b. Turn ON the scan tool and keep at title screen.
   c. Launch the TIS application.
   d. Select the Security Access at the main screen.
   e. Highlight the “Tech 2” on the Diagnostic Tool Selection screen and click “Next”.
   f. Click “Close” on the Security Access Enabled screen.
   g. Turn OFF the scan tool.
   h. Disconnect the scan tool from the terminal.
5. Install a scan tool to the vehicle.
6. Turn ON the ignition, with the engine OFF.
7. Select Diagnostics > appropriate vehicle identification > 4HK1 > Programming > Replace Injector.
8. Input 24 digits of each fuel injector ID code.
9. Select Program VIN. Verify the VIN on the screen if programmed at previously described SPS. If not programmed or incorrect VIN, input correct VIN.
10. After complete the programming, turn OFF the ignition for 30 seconds.
11. Start the engine and let idle.
12. Inspect for a proper engine running condition and for no DTC's. Refer to the Diagnostic System Check - Engine Controls if needed.

E. Supply Pump Relearn

1. Install a scan tool.
2. Start the engine and let idle until engine coolant temperature reads 65°C (149°F) or higher while observing the Supply Pump Status parameter with a scan tool. The scan tool parameter changes status Not Learned > Learned.

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 scan tool for retrieving 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
- Flash Read Only Memory-Flash Memory
  Flash 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 a 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.
- An updated software/ calibrations is released.

Ensure that the following conditions are met before programming an ECM:

- The scan tool 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 24 volts but less than 30 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 scan tool 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)

Notice: Some module will not accept SPS remote procedure using 10MB PCMCIA card. In such case, use 32MB PCMCIA card or SPS pass-thru procedure.
The Remote SPS method is a three-step process that involves the following procedures:

1. Connecting the scan tool to the vehicle and obtaining the information from the ECM.
2. Connecting the scan tool to the terminal and downloading a new calibration file from the terminal into the scan tool memory.
3. Reconnecting the scan tool to the vehicle and uploading the new calibration file into the ECM.

Performing the Remote Procedure

1. Connect a scan tool to the vehicle and obtain the ECM information using the following procedure:

   Notice: Ensure the ECM is installed in the vehicle and the battery is fully charged before programming.

   a. Install a scan tool.
   b. Turn ON the ignition, with the engine OFF.
   c. Select Service Programming System (SPS) > Request Info.
   d. If there is already stored in the scan tool, the existing data is displayed on the screen. The scan tool 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 scan tool, it will immediately start vehicle identification.
   e. Select the vehicle description by following the on-screen instructions based on stamped VIN or affixed VIN plate on the vehicle.
   f. During obtaining information, the scan tool is receiving information from all modules at the same time. But only ECM information is displayed on the screen.
   g. Turn OFF all accessories and press "Okay".
   h. Verify that the correct VIN is displayed on the scan tool. If the VIN is incorrect or no VIN, record the correct VIN.
2. Turn OFF the ignition.
3. Turn OFF the scan tool and disconnect from the vehicle.
4. Transfer the data from the terminal to the scan tool using the following procedure:

   Notice: The TIS supports service programming with the Tech 2 scan tool only.

   a. Connect the scan tool to the terminal.
   b. Launch the TIS application.
   c. Select the Service Programming System at the main screen.
   d. Highlight the following information on the Select Diagnostic Tool and Programming Process screen, then click "Next":
      - Select Diagnostic Tool - 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 - Vehicle

e. Verify the connections on the Preparing for Communication screen, then click "Next".

f. Verify the VIN on the Validate Vehicle Identification Number (VIN) screen, then click "Next".

Notice: 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.

g. Highlight Engine on the Select System Type screen, then click "Next", if on-screen instruction displayed.

h. Complete the following information based on the service ID plate on the Validate Vehicle Data screen until "Next" is highlighted, then click "Next".

- Model
- Model year
- Engine type
- Model designator
- Destination code
- Transmission type

i. Verify your selection on the Summary screen.

Notice: Refer to Service Bulletin and Description column before service programming is performed if the bulletins are listed along with the calibration files.
Notice: 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.

j. Click "Reprog".

k. The Transfer Data screen will appear until the progress bar reaches 100%.

5. Close the application and return to the TIS application selection screen after the download is complete.
6. Turn OFF the scan tool and disconnect from the terminal.
7. Transfer the data from the scan tool to the ECM using the following procedure:

a. Install a scan tool.

b. Turn ON the ignition, with the engine OFF.

c. Select Service Programming System (SPS) > Program ECU.

d. Turn OFF all accessories and press "Continue".

e. Programming in Process will appear until the progress bar reaches 100%.

Notice: Some warning lamp may turn ON or blink while programming the ECM since communication between the ECM and other modules are interrupted. Clear DTC in any module after programming.

f. Press "Continue" and exit the program after the scan tool displays "Programming Was Successful".

8. Turn OFF the ignition.
9. Turn OFF the scan tool and disconnect from the vehicle.

Service Programming System (SPS) (Pass-Thru Procedure)

Pass-Thru programming allows the scan tool 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.

1. Launch the TIS application.
2. Select the Service Programming System at the main screen.
3. Highlight the following information on the Select Diagnostic Tool and Programming Process screen, then click "Next":
   - Select Diagnostic Tool-Select Pass - Thru
   - Select Programming Process - Identify whether as existing ECM is being reprogrammed or an ECM is being replaced with a new one.
   - Select ECU Location - Vehicle
4. Complete all vehicle data on the Preparing for Communication/ Determine Vehicle screen until "Next" is highlighted, then click "Next".
5. Follow the instruction on the Preparing for Communication screen, then click "Next".

   Notice: In order to reduce the potential for signal loss, the RS-232 cable should not be more than 25 feet long.
6. Verify the VIN on the Validate Vehicle Identification Number (VIN) screen, then click "Next".

   Notice: 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.
7. Highlight Engine on the Select System Type screen, then click "Next", if on-screen instruction displayed.
8. Complete the following information based on the service ID plate on the Validate Vehicle Data screen until "Next" is highlighted, then click "Next".

- Model
- Model year
- Engine type
- Model designator
- Destination code
- Transmission type

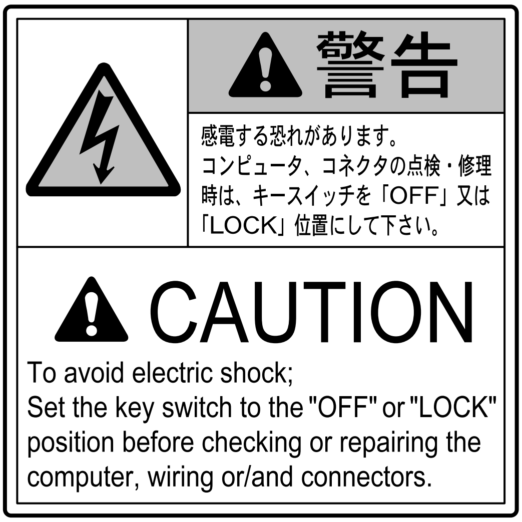
9. Verify your selection on the Summary screen.

   Notice: Refer to Service Bulletin and Description column before service programming is performed if the bulletins are listed along with the calibration files.
   Notice: 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.
10. Click "Reprog".
11. The Transfer Data screen will appear until the progress bar reaches 100%.
    Some warning lamp may turn ON or blink while programming the ECM since communication between the ECM and other modules are interrupted. Clear DTC in any module after programming.
12. Close the application and return to the TIS application selection screen after the download is complete.
13. Turn OFF the ignition.
14. Turn OFF the scan tool and disconnect from the vehicle.

Description and Operation

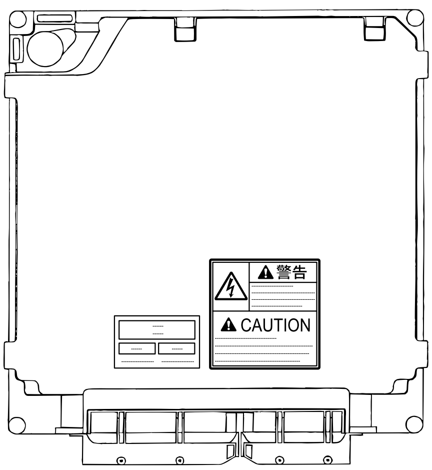
Engine Control Module (ECM) Description

Engine Control Module (ECM) Service Precautions



LNW76ESH000301

Important: The symbol **!**warns you of an electric shock hazard. To avoid shock and possible serious injury, DO NOT touch the terminals. When disconnecting the harness connectors, always turn OFF the ignition switch or disconnect the battery cable.



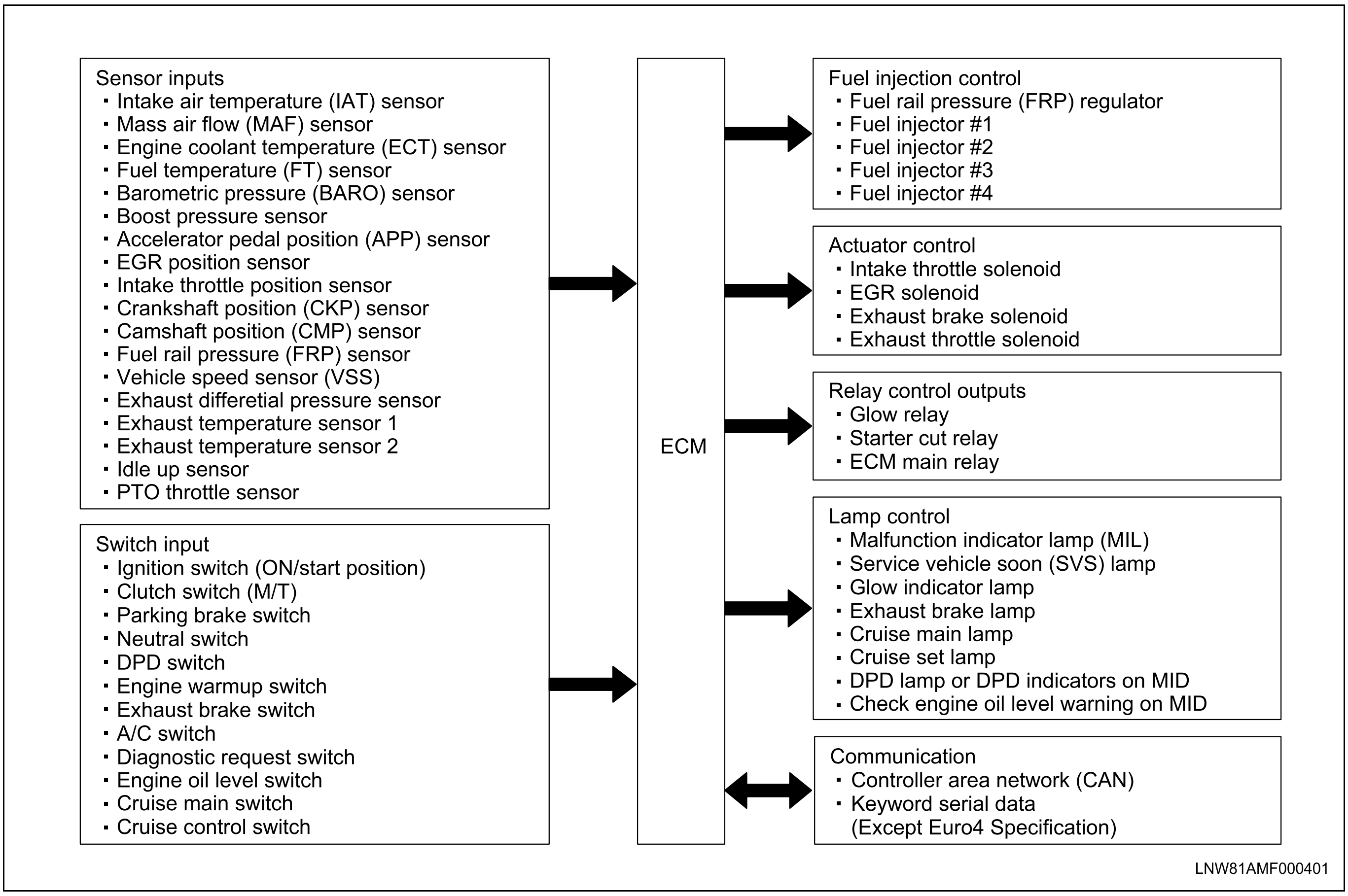
LNW76ESH001001

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 DMM. The ECM should remain connected to the ECM harness.
The ECM is located inside of engine side cover on the left via mounting bracket. The ECM mainly controls the following.

- The fuel system control
- The exhaust gas recirculation (EGR) system control
- The turbocharger system control
- The diesel particulate defuser (DPD) system control
- The preheating (glow) system control
- The exhaust brake system control
- The power take off (PTO) system 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 Input & Output



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.

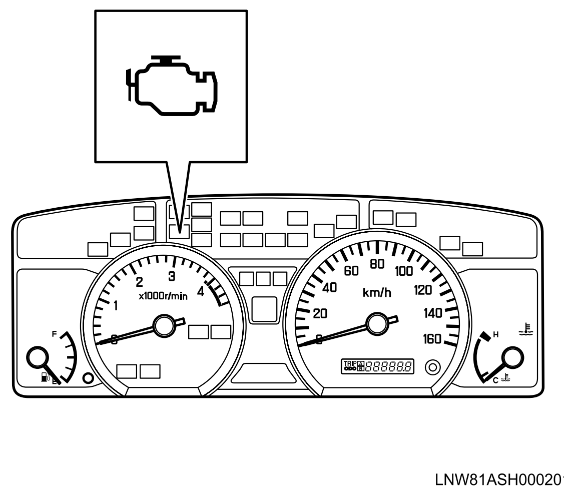
- An example of charging by friction is a person sliding across a vehicle seat.

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

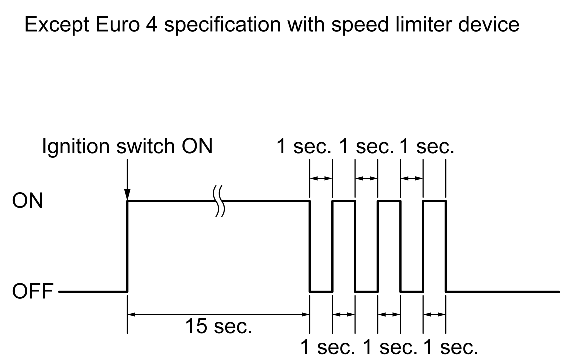
The MIL is located in the instrument panel cluster. The MIL will display the following symbols when commanded ON:



LNW81ASH000201

The MIL indicates that an emission related fault (Type A or B) has occurred (Euro 4 specification) or engine performance related fault has occurred (except Euro 4 specification) and vehicle service is required. The following is a list of the modes of operation for the MIL:

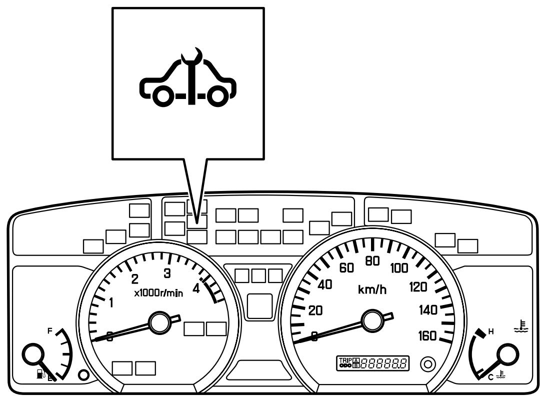
- The MIL illuminates when the ignition switch is turned ON, with the engine OFF. This is a indicator test to ensure the MIL is able to illuminate. (Euro 4 specification)
- The MIL illuminates for approximately 3 seconds when the ignition switch is turned ON, with the engine OFF. This is a indicator test to the MIL is able to illuminate. (except Euro 4 specification without speed limiter device)
- The MIL illuminates for approximately 15 seconds and blinks 3 times when the ignition switch is turned ON, with the engine OFF. This is a indicator test to the MIL is able to illuminate and a speed limiter device installation check. (except Euro 4 specification with speed limiter device)
- The MIL turns OFF after the engine is started if a diagnostic fault is not present.
- The MIL remains illuminated after the engine is started if the ECM detects a fault. A DTC is stored any time the ECM illuminates the MIL due to an emission related fault (Euro 4 specification), and engine performance related fault has occurred (except Euro 4 specification).



LNW76ESH006201

Service Vehicle Soon (SVS) Lamp Operation

The service vehicle soon (SVS) lamp is located in the instrument panel cluster. The SVS lamp will display the following symbol when commanded ON:

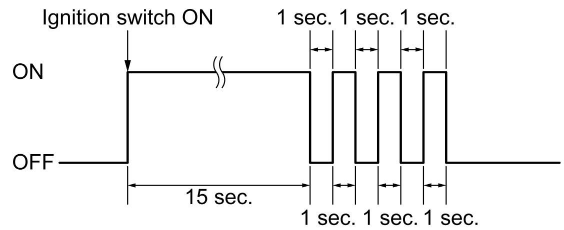


LNW81ASH000301

The SVS lamp indicates that an non-emission related fault (Type C DTC) has occurred and vehicle service required. The following is a list of the modes of operation for the SVS lamp:

- The SVS lamp illuminates when the ignition switch is turned ON, with the engine OFF. This is a indicator test to ensure the SVS lamp is able to illuminate.
- The MIL illuminates for approximately 15 seconds and blinks 3 times when the ignition switch is turned ON, with the engine OFF. This is a indicator test to the MIL is able to illuminate and a speed limiter device installation check. (with speed limiter device)
- The SVS lamp turns OFF after the engine is started if a diagnostic fault is not present.
- The SVS lamp remains illuminated after the engine is started if the ECM detects a fault. A DTC is stored any time the ECM illuminates the SVS lamp due to a non-emission related fault.

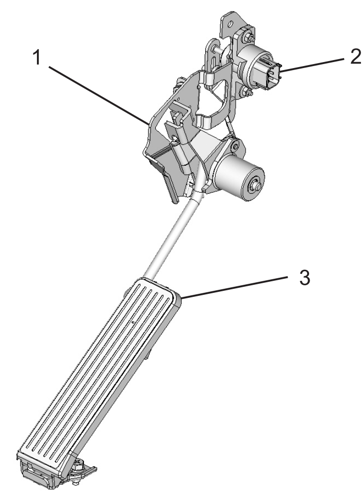
Euro 4 specification with speed limiter device



LNW76ESH006301

Engine Control Component Description

Accelerator Pedal Position (APP) Sensor



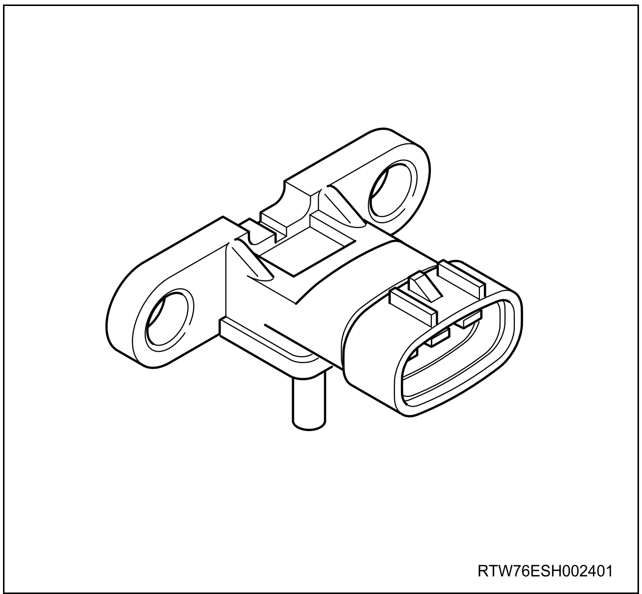
LNW81ASH000801

Legend

1. Accelerator pedal bracket
2. Accelerator pedal position (APP) sensor
3. Accelerator pedal

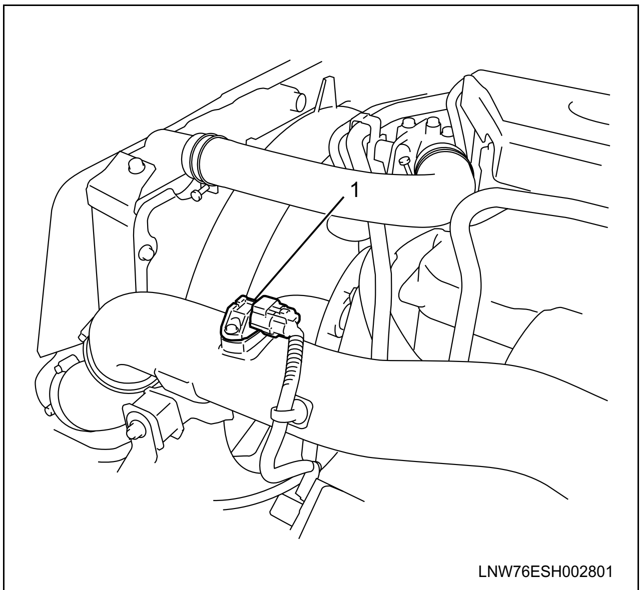
The APP sensor is mounted on the accelerator pedal control assembly. The sensor is made up of two individual sensors within one housing. The ECM uses the APP sensors to determine the amount of acceleration or deceleration that is desired. The APP sensors are hall element type sensors. Each APP sensor provides a different signal to the ECM on the each signal circuit, which relative to the position changes of the accelerator pedal angle. The APP sensor 1 signal voltage is low at rest and increases as the pedal is depressed. The APP sensor 2 signal voltage is high at rest and decreases as the pedal is depressed.

Barometric Pressure (BARO) Sensor



The BARO sensor is located under the instrument panel (IP) cluster near the pedal bracket. The BARO sensor is a transducer that varies voltage according to changes the barometric pressure. The BARO sensor provides a signal to the ECM on the signal circuit, which is relative to the pressure changes of the barometric pressure. The ECM should detect a low signal voltage at a low barometric pressure, such as high altitude place. The ECM should detect high signal voltage at a high barometric pressure. The ECM uses this voltage signal to calibrate the fuel injection quantity and injection timing for altitude compensation.

Boost Pressure Sensor

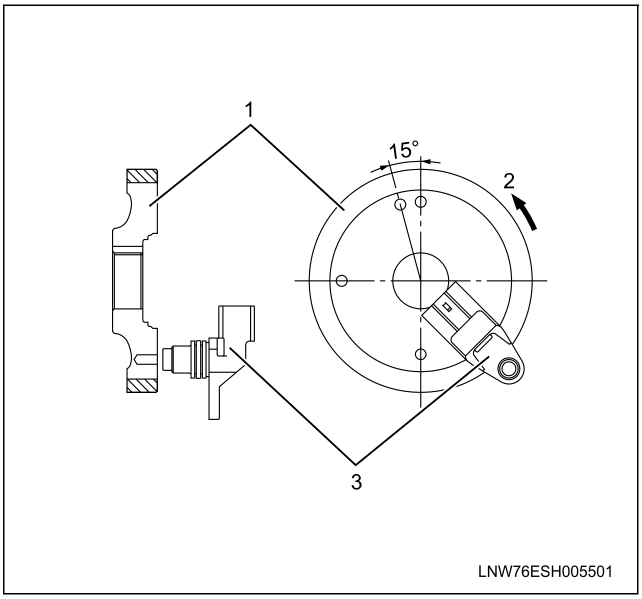


Legend

1. Boost pressure sensor

The boost pressure sensor is located in the air induction tubing. The boost pressure sensor is a transducer that varies voltage according to changes in the air pressure inside the air tubing. The boost pressure sensor provides a signal to the ECM on the signal circuit, which is relative to the pressure changes in the air tubing. The ECM should detect a low signal voltage at a low boost pressure, such as low engine load. The ECM should detect high signal voltage at a high boost pressure, such as high engine load.

Camshaft Position (CMP) Sensor

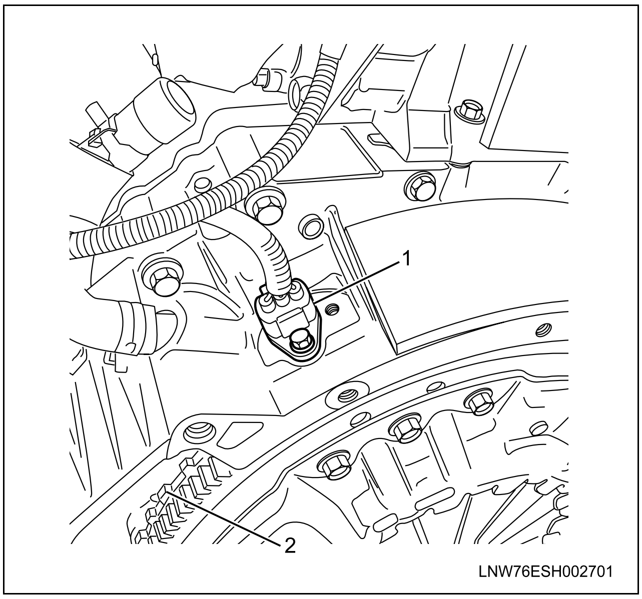


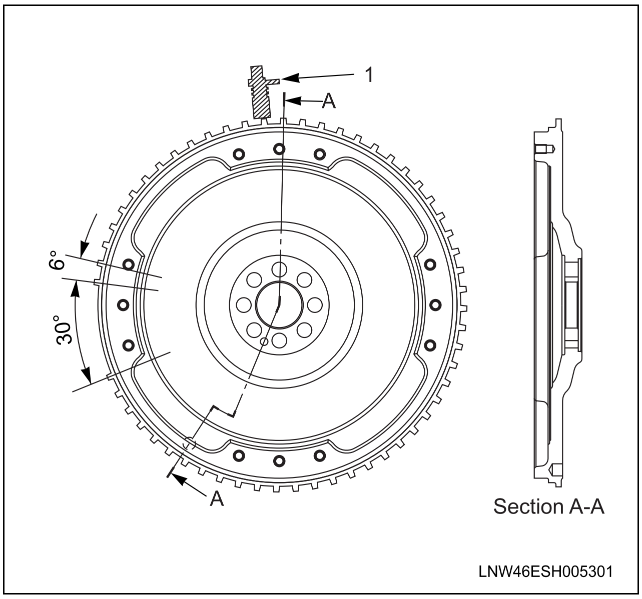
Legend

1. Timing chair sprocket
2. Rotating direction
3. Camshaft position (CMP) sensor

The CMP sensor is installed on the cylinder head at the rear of the camshaft gear. The CMP sensor detects total of five holes per one engine cycle (four holes arranged equally every 90° and one reference hole on the camshaft gear surface). The CMP sensor is a magnetic resistance element (MRE) type sensor, which generates a square wave signal pulse.

Crankshaft Position (CKP) Sensor



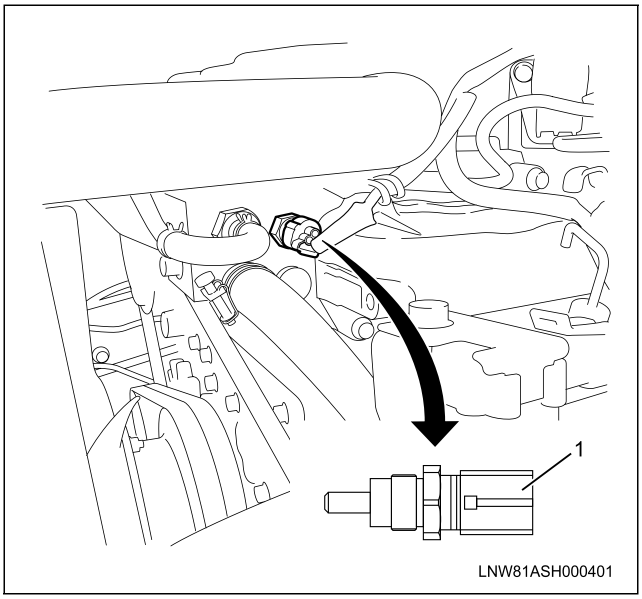


Legend

1. Crankshaft position (CKP) sensor
2. Sensor rotor
3. Rotating direction

The CKP sensor is located on the flywheel housing. The sensor rotor is fixed on the flywheel. There are 56 notches spaced 6° apart and a 30° section that is open span. This open span portion allows for the detection of top dead center (TDC). The CKP sensor is a magnetic resistance element (MRE) type sensor, which generates a square wave signal pulse. Detecting the open span portion from the CKP sensor and one reference hole from the camshaft position (CMP) sensor, the ECM determines cylinder #1 compression TDC to ensure they correlate with each other.

Engine Coolant Temperature (ECT) Sensor

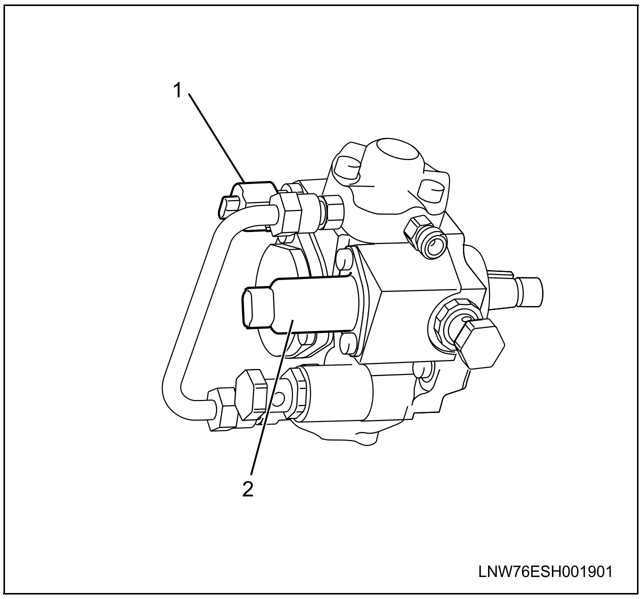


Legend

1. Engine coolant temperature (ECT) sensor

The ECT sensor is installed to the thermostat housing. The ECT sensor is a variable resistor and it measures the temperature of the engine coolant. 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 signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the signal circuit.

Fuel Temperature (FT) Sensor



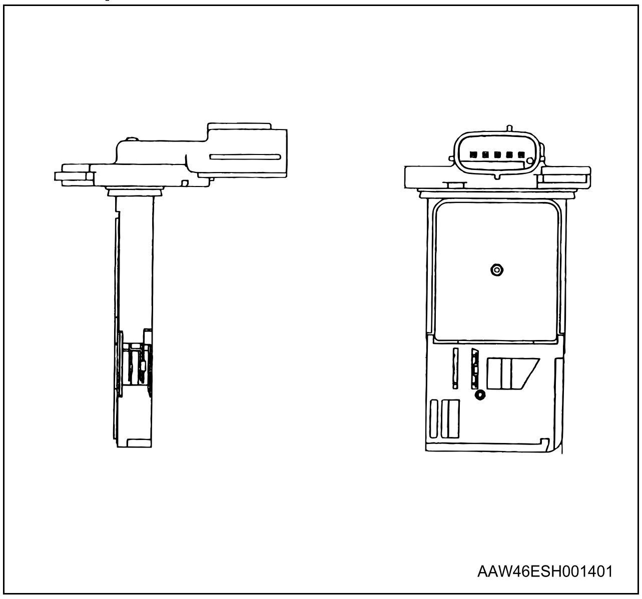
Legend

1. Fuel temperature (FT) sensor
2. Fuel rail pressure (FRP) regulator

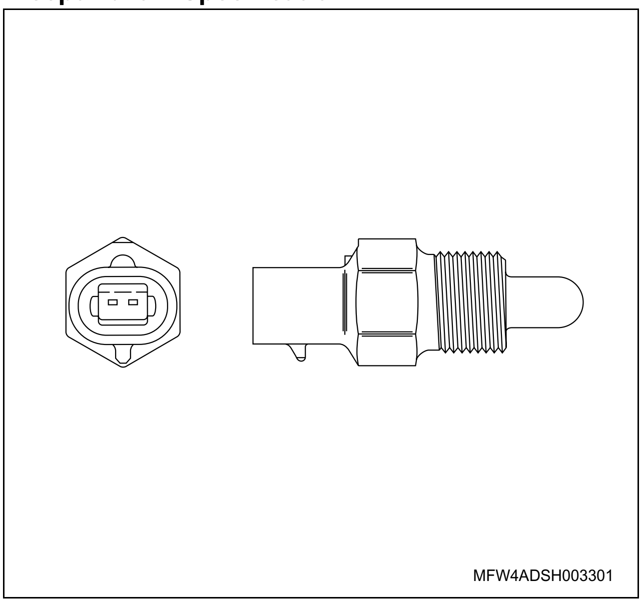
The FT sensor is installed to the fuel supply pump. The FT sensor is a variable resistor and it measures the temperature of the fuel entering the fuel supply pump. When the FT sensor is cold, the sensor resistance is high. When the fuel temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the signal circuit.

Intake Air Temperature (IAT) Sensor

Euro 4 Specification

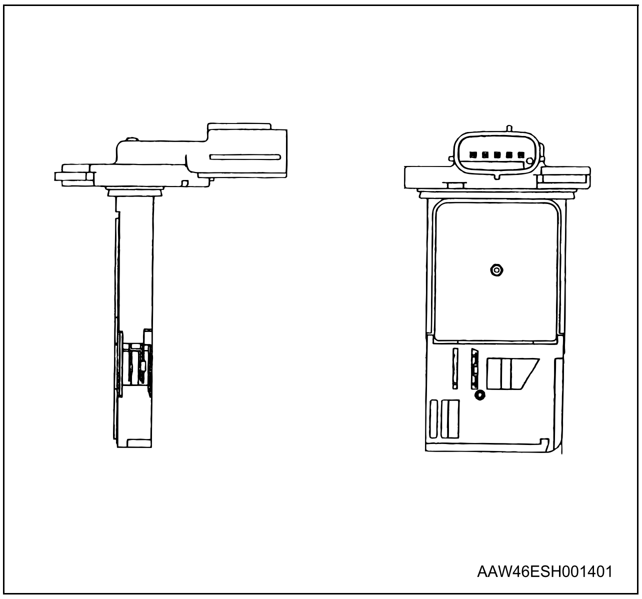


Except Euro 4 Specification



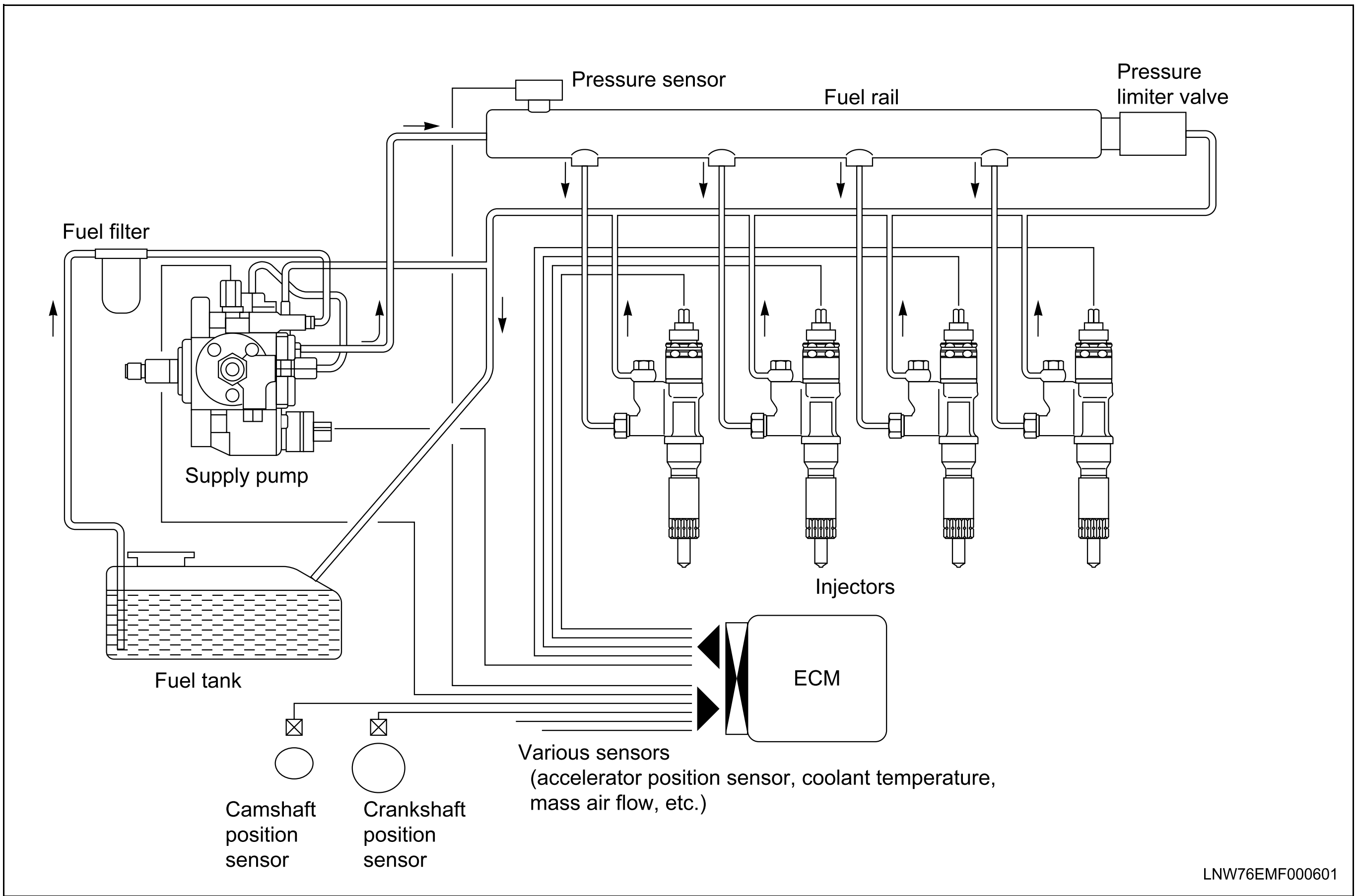
The IAT sensor is fitted between the air cleaner and turbocharger. It is internal to the mass air flow (MAF) sensor (Euro 4 specification). The IAT sensor is a variable resistor and it measures the temperature of the air entering the engine. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the signal circuit.

Mass Air Flow (MAF) Sensor



The 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 assembly consists of a MAF sensor element and an intake air temperature (IAT) 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.

Fuel System Description



The common rail system uses a type of accumulator chamber called the fuel rail to store pressurized fuel, and injectors that contain electronically controlled solenoid valves to spray the pressurized fuel in the combustion chambers. The injection system (injection pressure, injection rate, and injection timing) is controlled by the ECM, and therefore the common rail system can be controlled independently, free from the influence of engine speed and load. This ensures a stable injection pressure at all time, particularly in the low engine speed range, so that black smoke specific to diesel engines generated during vehicle starting or acceleration can be reduced dramatically. As a result, exhaust gas emissions are clear and reduced, and higher output is achieved.

1. High Pressure Control

- Enables high pressure injection from low engine speed range.
- Optimizes control to minimize particulate matter and NOx emissions.

2. Injection Timing Control

- Enables finely tuned optimized control in accordance with running conditions.

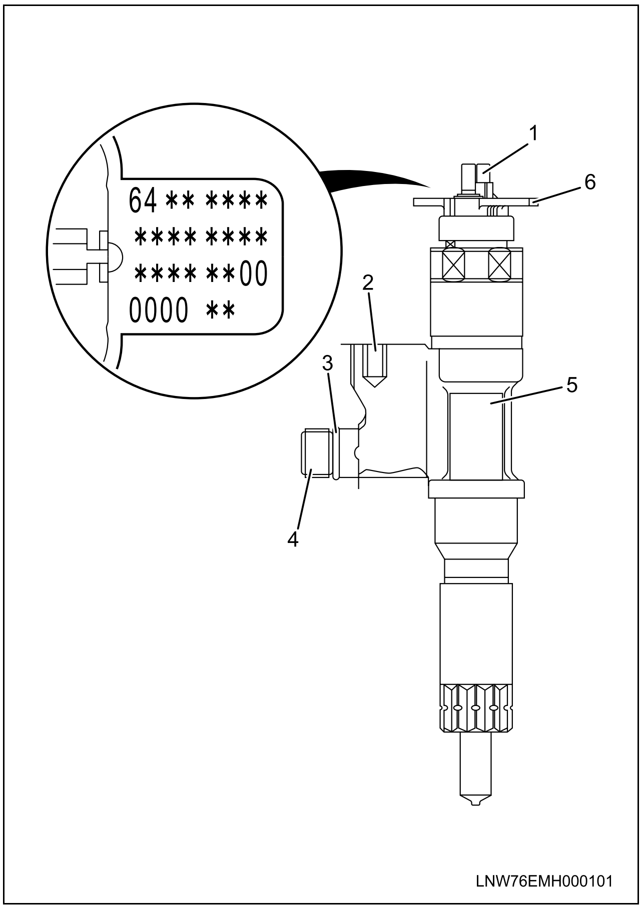
3. Injection Rate Control

- Pilot injection control that performs a small amount of injection before main injection.

The fuel rail system consists primarily of a fuel supply pump, fuel rail, injectors, and ECM.

Fuel System Component Description

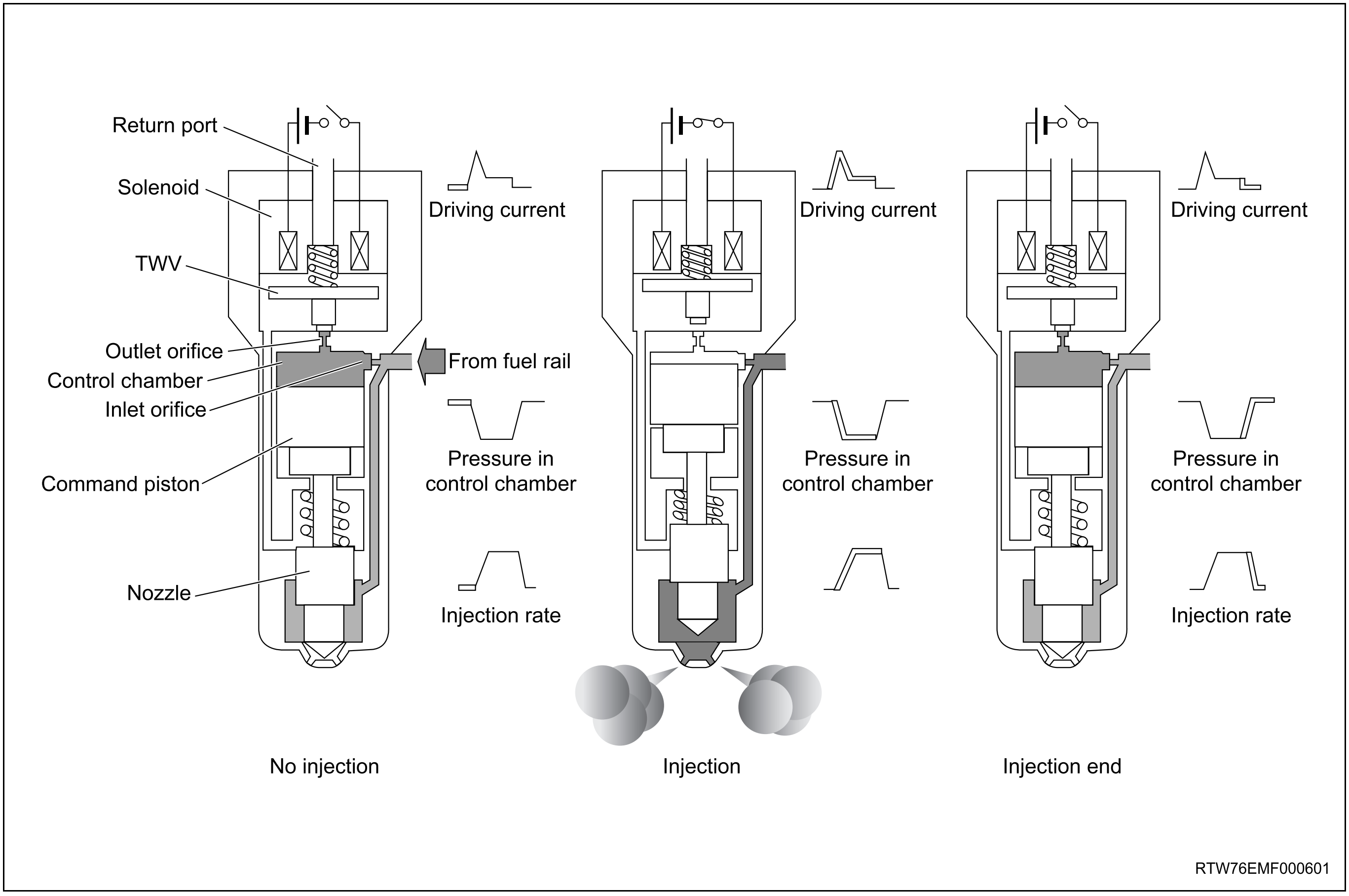
Injector



Legend

1. Terminal stud
2. Fuel leak off port
3. O-ring
4. Fuel inlet port
5. Injector parts number marking
6. QR plate

Electronic control type injectors controlled by the ECM are used. Compared with conventional injection nozzles, a command piston, solenoid valve, etc. are added.
ID codes displaying various injector characteristic are laser marked in the plate, and ID codes showing these in numeric form (30 alphanumeric figures are displayed and only 24 are used). This system uses fuel injector flow rate information (ID codes) to optimize injection quantity control. When an injector is newly installed in a vehicle, it is necessary to input the ID codes in the ECM.
QR (Quick Response) codes or fuel injector flow rate (ID codes) have been adopted to enhance the injection quantity precision of the injectors. The adoption of codes enables injection quantity dispersion control throughout all pressure ranges, contributing to improvement in combustion efficiency and reduction in exhaust gas emissions.



1) Non-injection state

The two way valve (TWV) closes the outlet orifice by means of a spring force, when no current is supplied from the ECM to the solenoid. At this time, the fuel pressure applied to the nozzle leading end is equal to the fuel pressure applied to the control chamber through the inlet orifice. As for the force competition in this state, the pressure on the command piston upper surface + nozzle spring force defeat the pressure on the nozzle leading end, and consequently the nozzle is pushed downward to close the injection holes.

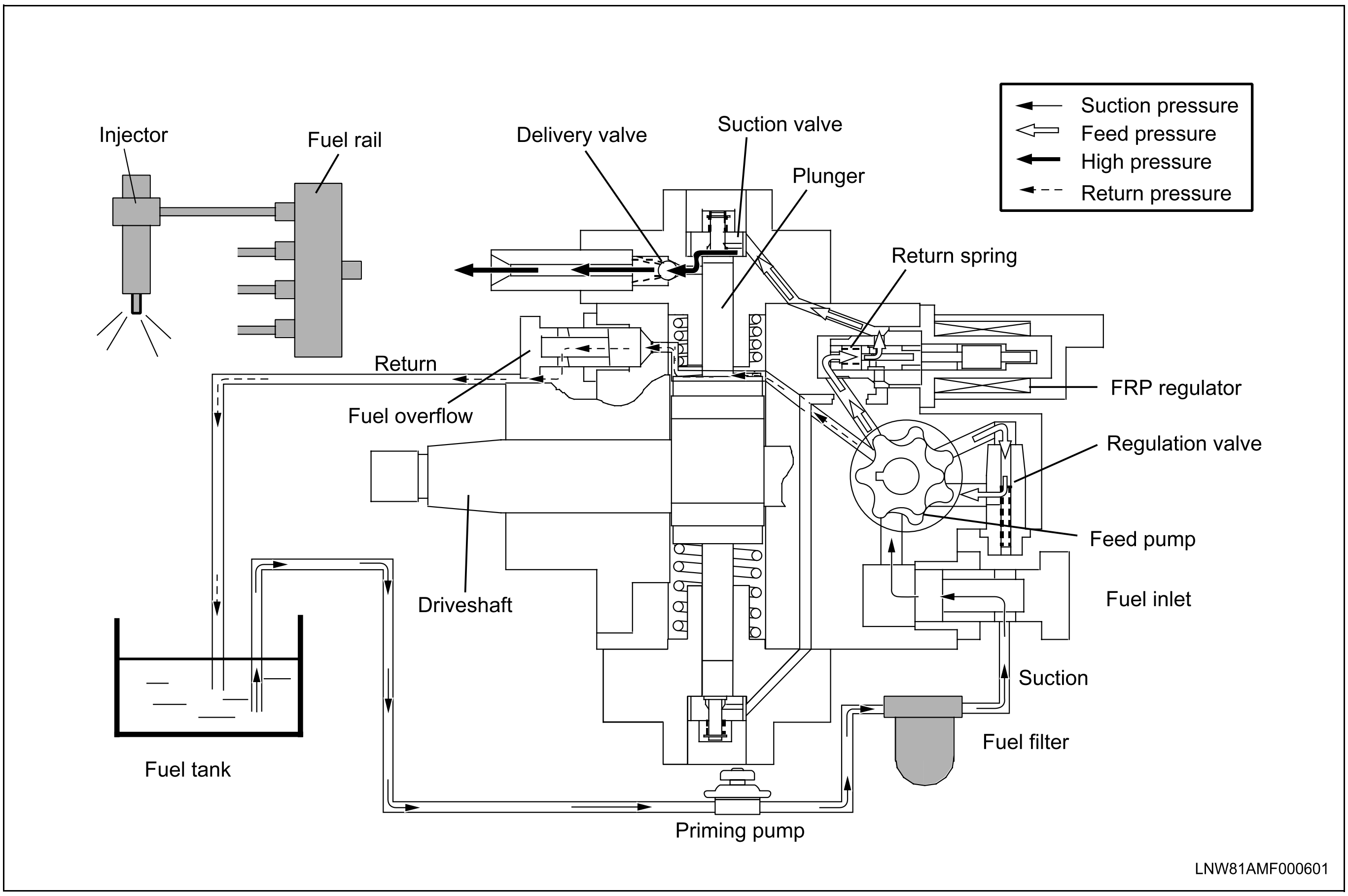
2) Injection start

The TWV is pulled up to open the outlet orifice, and thus the fuel leaks toward the return port, when the current is supplied from the ECM to the solenoid. As a result, the nozzle is pushed up together with the command piston by the fuel pressure applied to the nozzle leading end, and then the nozzle injection holes open to inject the fuel.

3) Injection end

The TWV lowers to close the outlet orifice, when the ECM shuts off a current supply to the solenoid. As a result, the fuel cannot leak from the control chamber, and thus the fuel pressure in the control chamber rises abruptly and then the nozzle is pushed down by the command piston to close the nozzle injection holes, resulting in the end of fuel injection.

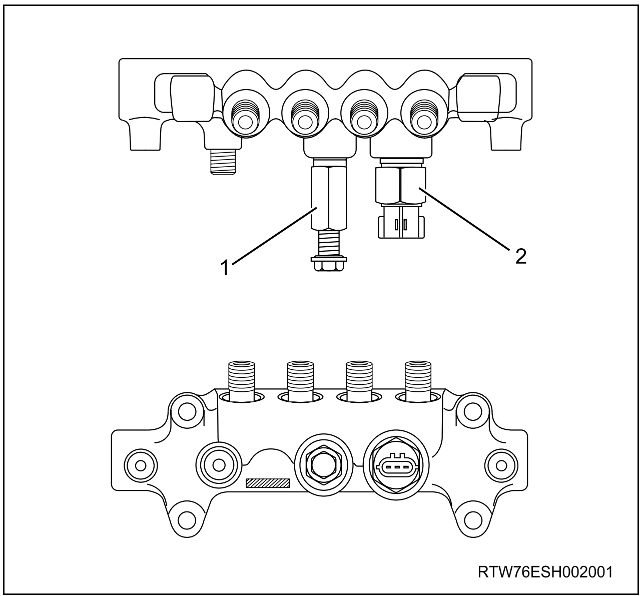
Fuel Supply Pump



The fuel supply pump is the heart of the common rail type electronic fuel injection system. The fuel supply pump is installed at the same location as the conventional injection type pump, which spins at a 1 to 1 ratio of fuel supply pump to crankshaft speed. A fuel rail pressure (FRP) regulator and fuel temperature sensor are part of the fuel supply pump assembly.

Fuel is drawn from the fuel tank via the fuel supply pump by the use of an internal feed pump (trochoid type). This feed pump pumps fuel into a 2-plunger chamber also internal to the fuel supply pump. Fuel into this chamber is regulated by the FRP regulator solely controlled by current supplied from the ECM. No current to the solenoid results in maximum fuel flow whereas full current to the solenoid produces no fuel flow. As the engine spins, these two plungers produce high pressure in the fuel rail. Since the ECM controls the flow of fuel into this 2-plunger chamber, it therefore controls the quantity and pressure of the fuel supply to the fuel rail. This optimizes performance, improves economy and reduces NOx emissions.

Fuel Rail (Common Rail)



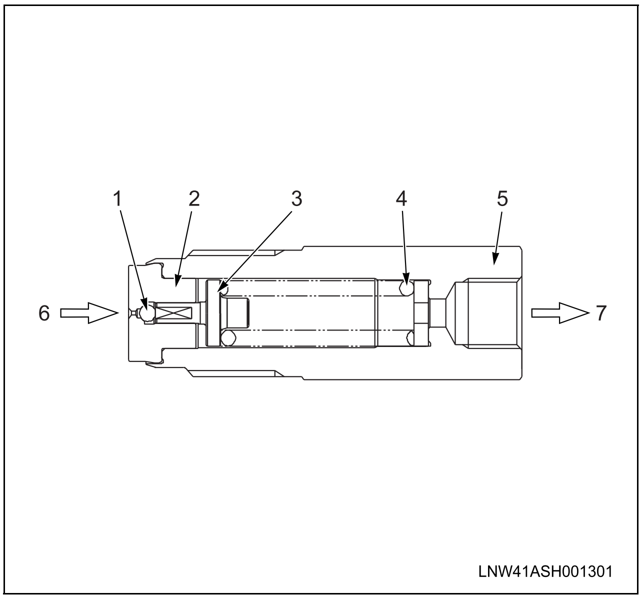
Legend
1. Pressure limiter valve
2. Fuel rail pressure (FRP) sensor

Along with the employment of a common rail type electronic control fuel injection system, the fuel rail is provided to store high pressure fuel between supply pump and injectors. A pressure sensor and a pressure limiter are installed on the fuel rail. The pressure sensor detects the fuel pressure inside the fuel rail and sends its signal to the ECM. Based on this signal, the ECM controls the fuel pressure inside the fuel rail via the fuel rail pressure (FRP) regulator of the supply pump. The pressure limiter opens the valve mechanically to relieve the pressure when the fuel pressure inside the fuel rail is excessive.

Fuel Rail Pressure Sensor

The FRP sensor is installed to the fuel rail and it detects the fuel pressure in the fuel rail, converts the pressure into a voltage signal, and sends the signal to the ECM. The ECM monitors the FRP sensor signal voltage. Higher fuel rail pressure provides higher signal voltage while lower pressure provides lower signal voltage. The ECM calculates actual fuel rail pressure (fuel pressure) from the voltage signal and uses the result in fuel injection control and other control tasks.

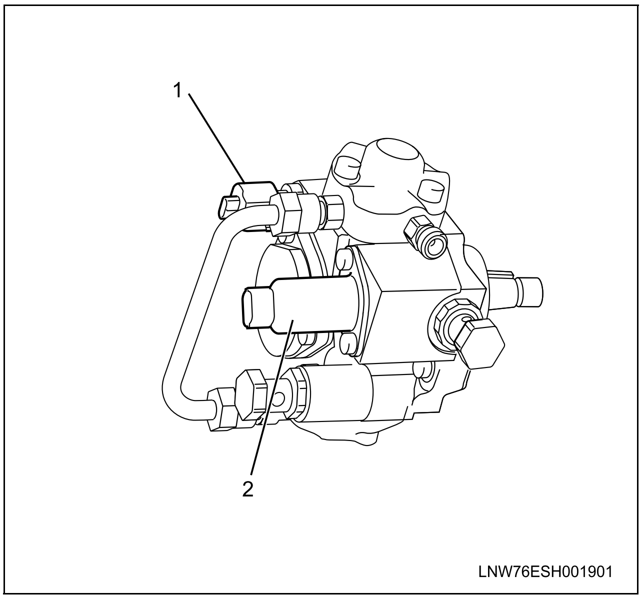
Pressure Limiter Valve



Legend
1. Valve
2. Valve body
3. Valve guide
4. Spring
5. Housing
6. Fuel rail
7. Fuel return pipe

The pressure limiter relieves pressure by opening the valve if abnormally high pressure is generated. The valve opens when pressure in rail reaches approximately 220 MPa (32,000 psi), and closes when pressure falls to approximately 50 MPa (7,250 psi). Fuel leakage through the pressure limiter re-turns to the fuel tank.

Fuel Rail Pressure (FRP) Regulator



The ECM controls the duty ratio of the linear type fuel rail pressure (FRP) regulator (the length of time that the current is applied to the FRP regulator), in order to control the quantity of fuel that is supplied to the high-pressure plungers. Since only the quantity of fuel that is required for achieving the target rail pressure is drawn in, the drive load of the supply pump is decreased. When current flows to the FRP regulator, variable electromotive force is created in accordance with the duty ratio, moving the armature to the left side. The armature moves the cylinder to the left side, changing the opening of the fuel passage and thus regulating the fuel quantity. With the FRP regulator OFF, the return spring contracts, completely opening the fuel passage and supplying fuel to the plungers (Full quantity intake and full quantity discharge). When the FRP regulator is ON, the force of the return spring moves the cylinder to the right, closing the fuel passage (normally opened). By turning the FRP regulator ON/OFF, fuel is supplied in an amount corresponding to the actuation duty ratio, and fuel is discharged by the plungers.

Fuel Injection System Description

Fuel Injection Quantity Control

This control determines the fuel injection quantity by adding coolant temperature, fuel temperature, intake air temperature, barometric pressure and some switch inputs information corrections to the basic injection quantity is calculated by the ECM based on the engine operating conditions (engine speed, accelerator pedal pressing amount and boost pressure sensor). More fuel rate indicates if the engine load is increased as the accelerator pedal is stepped on at constant engine speed.
Combined with high pressure injection of atomized fuel, this control improves exhaust gas and ensures proper fuel consumption. Compared with conventional mechanical governors, an electronic control system provides higher degree of freedom of fuel injection quantity control, thereby presenting high accelerator response (acceleration feeling and pressing feeling).

Starting Injection Quantity Control

At the engine starting (after the key switch is turned to the START position to start the engine, up to return of key switch to the ON position), optimum fuel injection quantity is controlled based on the information on the engine speed and coolant temperature. At low temperature, the fuel injection quantity increases. When the engine started completely, this boosted quantity mode at the starting is cancelled and normal running mode is restored.

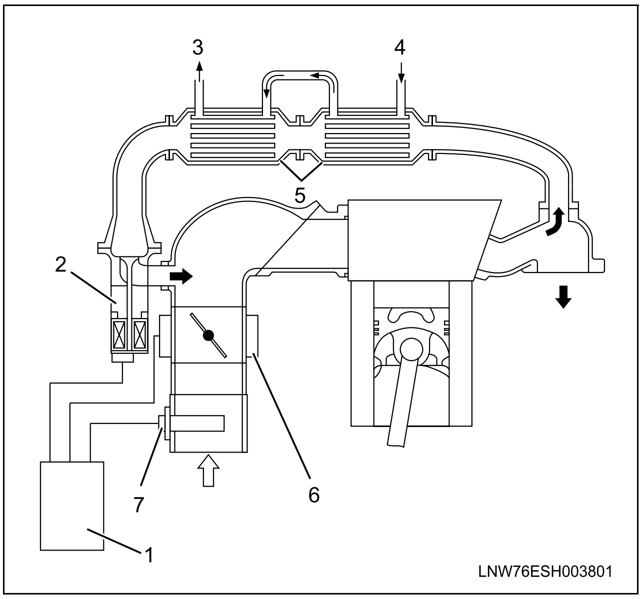
Idle Speed Control

A control is made so as to achieve stable idling speed at all time regardless of engine secular changes or engine condition variations. The ECM sets target idling speed and controls the fuel injection quantity according to the engine conditions (actual engine speed, coolant temperature and engine load) to follow actual engine speed to the target idling speed so as to ensure stable idling speed.

Idle Vibration Control

A control is made so as to reduce the engine vibration caused by torque variations between cylinders due to variations in fuel injection quantity of each cylinder or injector performance. The ECM corrects the injection quantity between cylinders based on the revolution signals from the crankshaft position (CKP) sensor. Normal range of correction quantity between cylinders is within $\pm 5\ mm^3$.

Exhaust Gas Recirculation (EGR) System Description

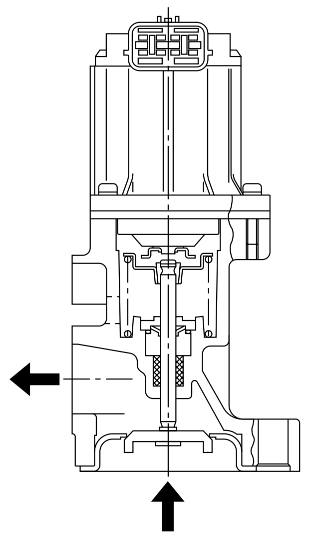


Legend

1. ECM
2. EGR valve
3. Engine coolant outlet
4. Engine coolant inlet
5. EGR cooler
6. Intake throttle valve
7. MAF sensor

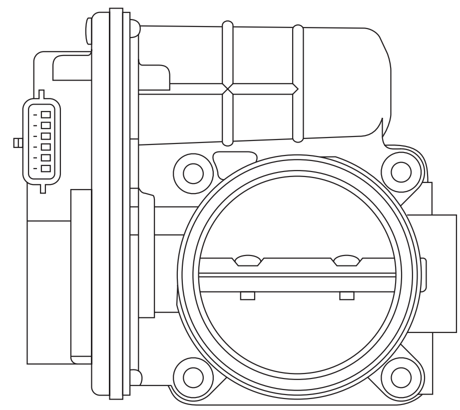
The EGR system recirculates a part of exhaust gas back into the intake manifold, which results in reducing nitrogen oxide (NOx) emissions. The EGR control system uses an electronic control system to ensure both driveability and low emission. A control current from the ECM operates a solenoid to control the lift amount of EGR valve. Also, EGR position sensors are provided at the rear of the motor to feed actual valve lift amount back to the ECM for more precision control of the EGR amount.
The EGR control starts when the conditions for engine speed, engine coolant temperature, intake air temperature and barometric pressure are satisfied. Then, the valve opening is calculated according to the engine speed, and target fuel injection quantity. Based on this valve opening, the drive duty of the solenoid is provided and the valve is driven accordingly. The intake throttle valve is provided to adequate intake manifold depression to ensure EGR gas flow.

EGR Valve


LNW76ESH002901

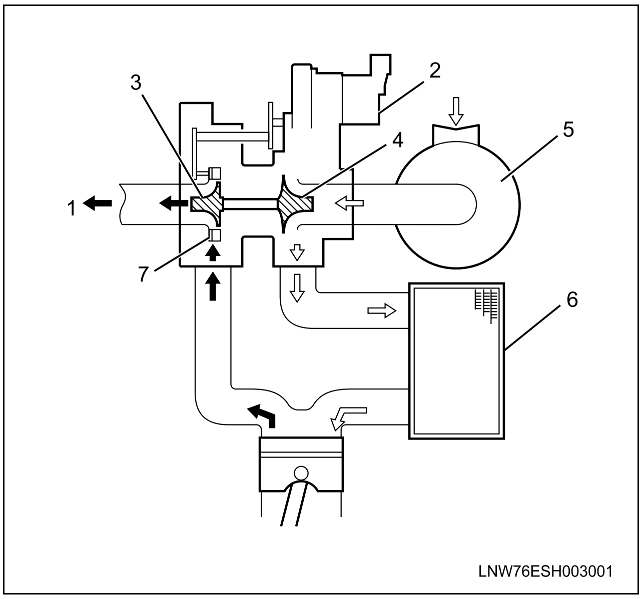
The EGR valve is mounted on the intake manifold. The ECM controls the EGR valve opening based on the engine running condition. The ECM controls the EGR valve by controlling the solenoid. The solenoid is controlled based on pulse width modulation (PWM) signal sent from the ECM. The EGR valve position is detected by the position sensor, and relayed to the ECM. The position sensor is made up three individual sensors within one housing. The EGR position sensor 1, 2 and 3 are hall element type sensors. The position sensor provides a low or high signal state to the ECM on the signal circuits, which is relative to the position changes of the EGR valve.

Intake Throttle Valve


RTW56ESH001101

The intake throttle valve is located on the intake manifold inlet. The ECM controls the intake throttle valve opening based on the engine running condition. The ECM controls the intake throttle valve by controlling the solenoid. The solenoid is controlled based on pulse width modulation (PWM) signal sent from the ECM. A duty ratio change 0% to appropriate percentage is intake throttle valve opening angle control. To open the valve, duty ratio is increased. To close the valve, duty ratio becomes small.
The intake throttle valve position is detected by the position sensor, and relayed to the ECM. The position sensor provides a signal to the ECM on the signal circuit, which is relative to the position changes of the intake throttle valve. The ECM should detect a low signal voltage at a small opening amount or closed position. The ECM should detect high signal voltage at a large opening amount.

Turbocharger Description

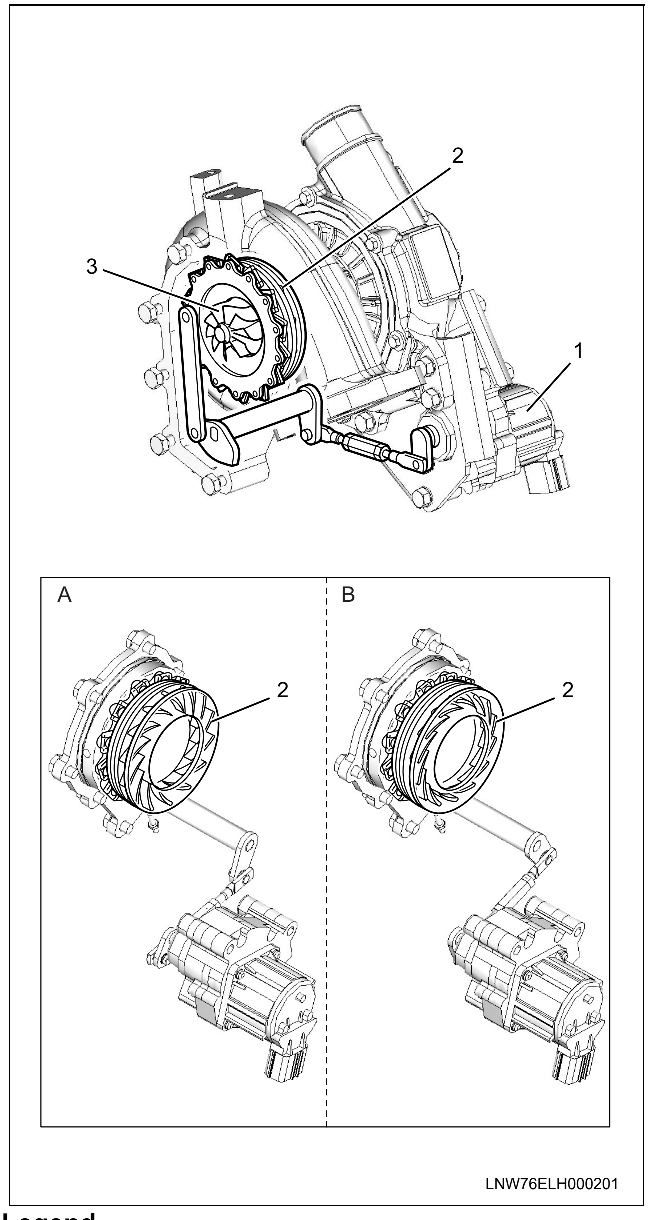


Legend

1. Exhaust gas
2. VNT actuator & sensor
3. Turbine wheel
4. Compressor wheel
5. Air cleaner
6. Charge air cooler
7. Nozzles

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.



Legend

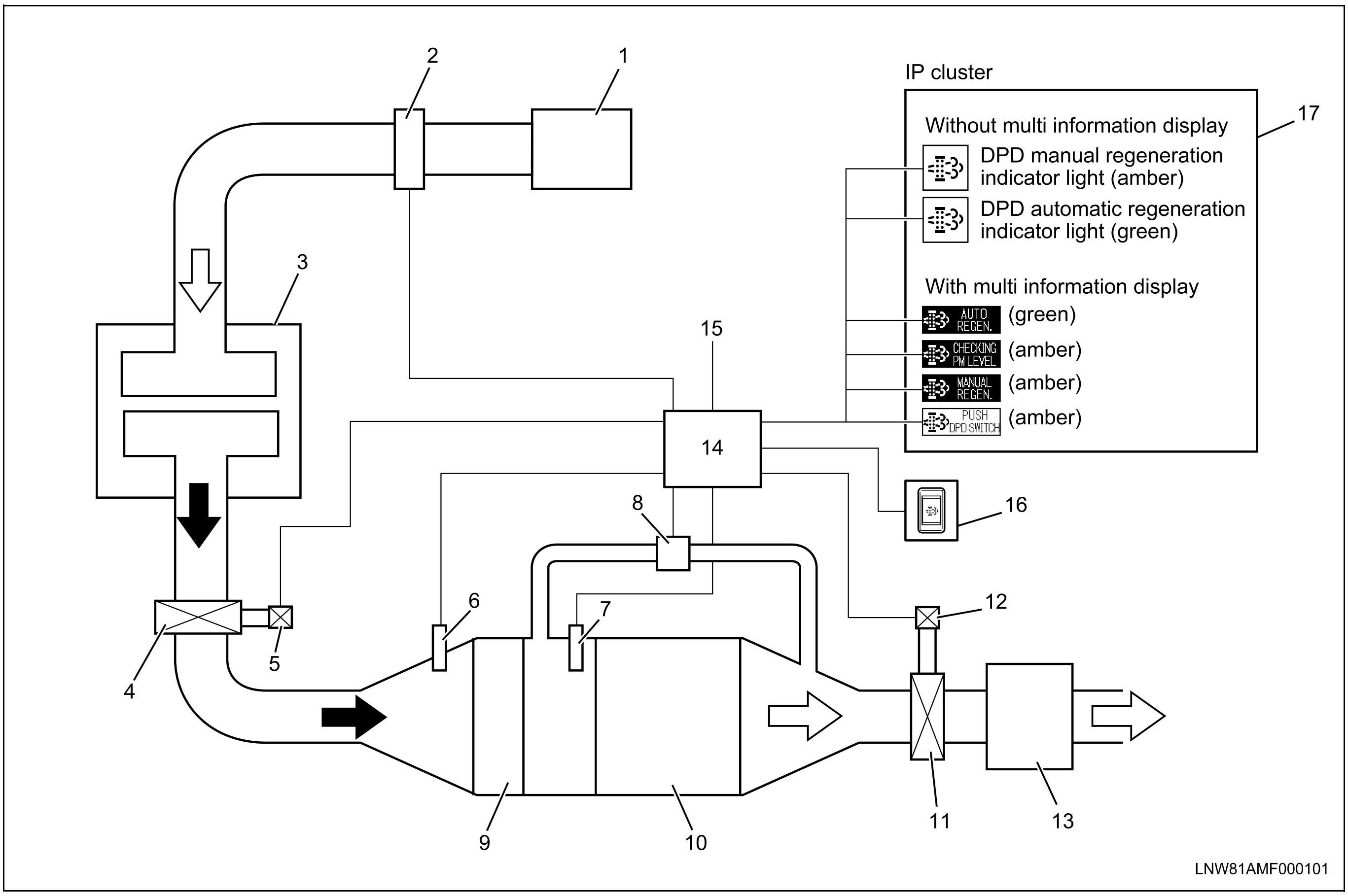
1. VNT actuator & sensor
2. Nozzle
3. Turbine wheel

The position of the turbocharger nozzle is controlled by the variable nozzle turbocharger (VNT) control module based on the command from the ECM. The VNT control module controls a drive signal to the turbocharger nozzle control solenoid that installed to the turbocharger assembly by utilizing position sensor inputs to control the turbocharger nozzles. When the engine is not under load, the turbocharger nozzles are in an open position (A), or no boost condition. When the engine is under load, the VNT control module commands the control solenoid to close the turbocharger nozzles (B), thus increasing the boost. The ECM will vary the boost dependant upon the load requirements of the engine.

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.

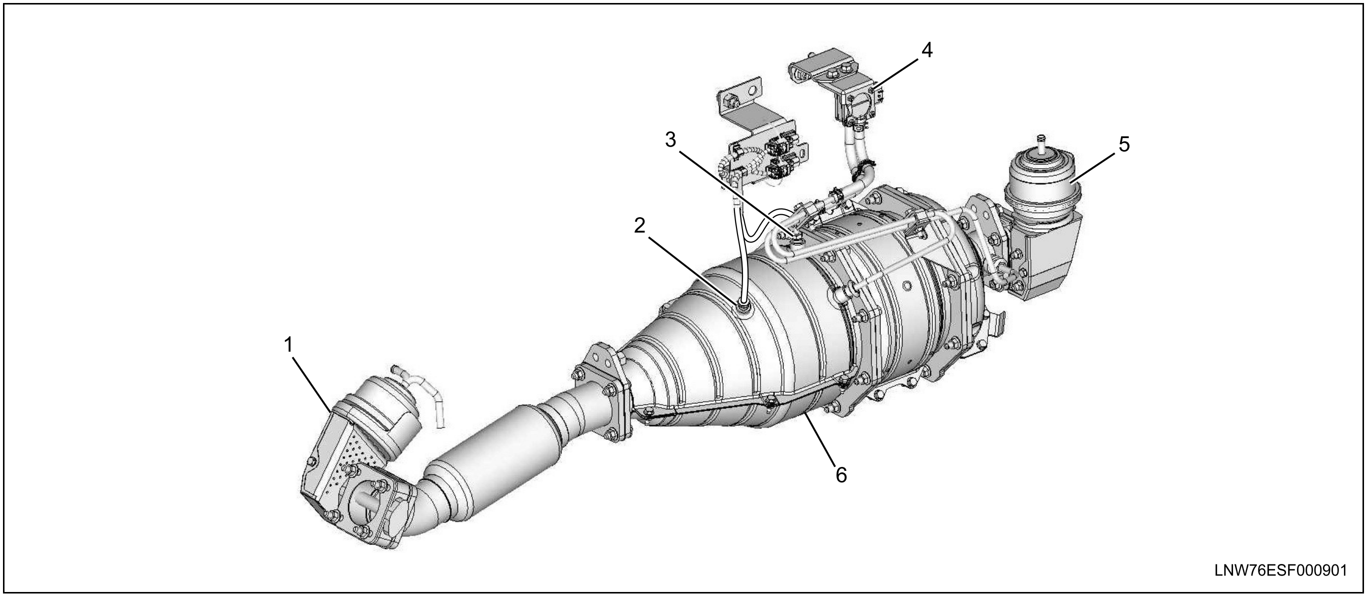
The charge air cooler is a heat exchanger that uses air flow to dissipate hear from the intake air. As the turbocharger increases air pressure, the air temperature increases. Lowering the intake air temperature increases the engine efficiency and power by packing more air molecules into the same space.

Diesel Particulate Defuser (DPD) System Description



Legend

1. Air cleaner
2. Mass air flow (MAF) sensor
3. Engine assembly
4. Exhaust brake valve
5. Exhaust brake solenoid
6. Exhaust temperature sensor 2
7. Exhaust temperature sensor 1
8. Exhaust differential pressure sensor
9. Oxygen catalyst
10. DPD filter
11. Exhaust throttle valve
12. Exhaust throttle solenoid
13. Exhaust silencer
14. ECM
15. Other inputs
16. DPD switch
17. DPD lamp or MID indicators

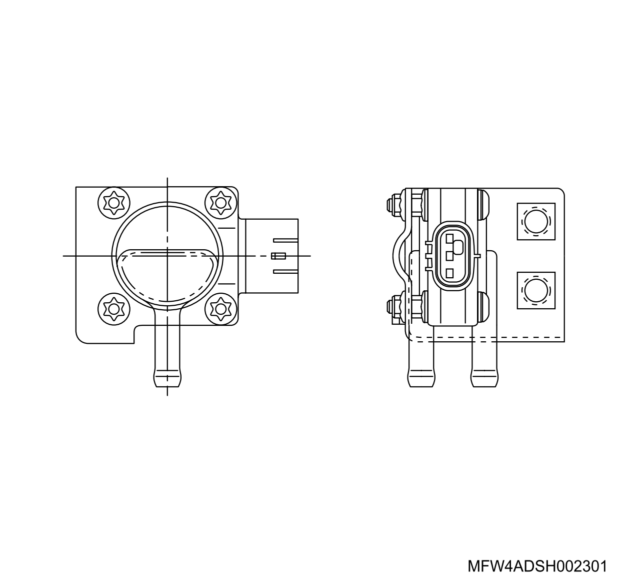


Legend

1. Exhaust brake valve
2. Exhaust temperature sensor 2 (in front of oxygen catalyst)
3. Exhaust temperature sensor 1 (in front of filter)
4. Exhaust differential pressure sensor
5. Exhaust throttle valve
6. DPD assembly

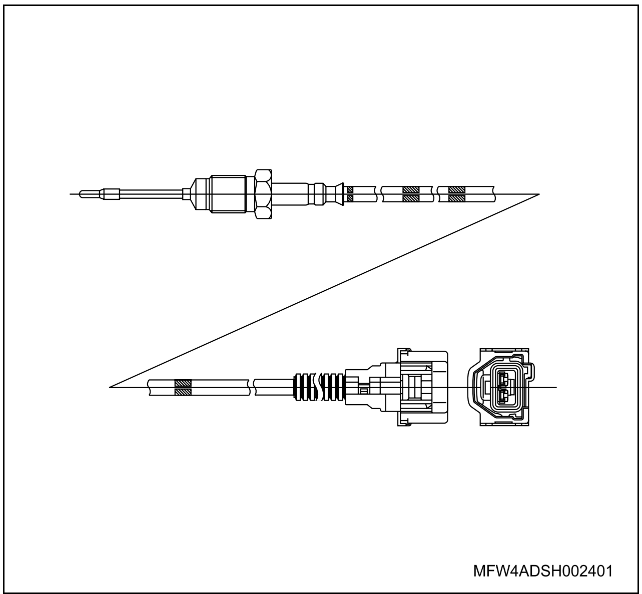
The DPD is a system that uses an oxidation catalyst to clean the NOx and HC, and a filter to collect PM discharged from the engine. When PM accumulated in the filter, regeneration is performed. The ECM detects the condition of PM accumulations from the exhaust differential pressure sensor or from mileage. When it is reached to a certain amount of PM accumulations or a certain length of mileage, the automatic regeneration starts. If the automatic regeneration cannot be completed by some reason, the manual regeneration is requested to the driver by blinking the DPD lamp on the instrument panel cluster. During regeneration, the temperature inside the filter is raised, and the accumulated PM is burned off. In order to adjust to optimized temperature, the ECM detects exhaust temperature using the exhaust temperature sensors, and then raises the temperature by controlling fuel injections, the exhaust brake valve and exhaust throttle valve to burn off the accumulated PM. Once the regeneration starts, it must be finished within a certain time. After regeneration is finished, a purification of the filter is judged by monitoring the exhaust differential pressure. If an excessive PM accumulation has been detected, the regeneration will not start since uncontrolled burning might be happened during regeneration process.

Exhaust Differnetial Pressure Sensor



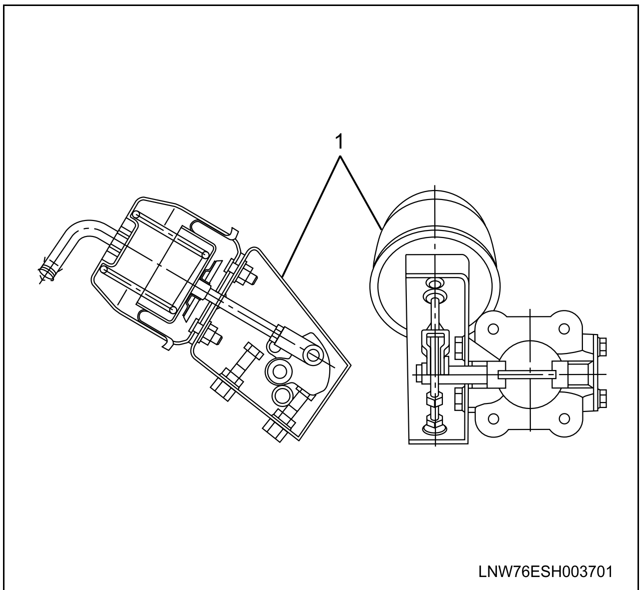
The exhaust differential pressure sensor is attached to the chassis frame near the DPD assembly. The exhaust differential pressure sensor is a transducer that varies voltage according to changes of the exhaust gas differential pressure between in front and in rear of DPD filter. The exhaust differential pressure sensor provides a signal to the ECM on the signal circuit, which is relative to the differential pressure changes in front and in rear of DPD filter. The ECM should detect a low signal voltage at a low differential pressure, such as small PM accumulation. The ECM should detect high signal voltage at high differential pressure, such as large PM accumulation.

Exhaust Temperature Sensor



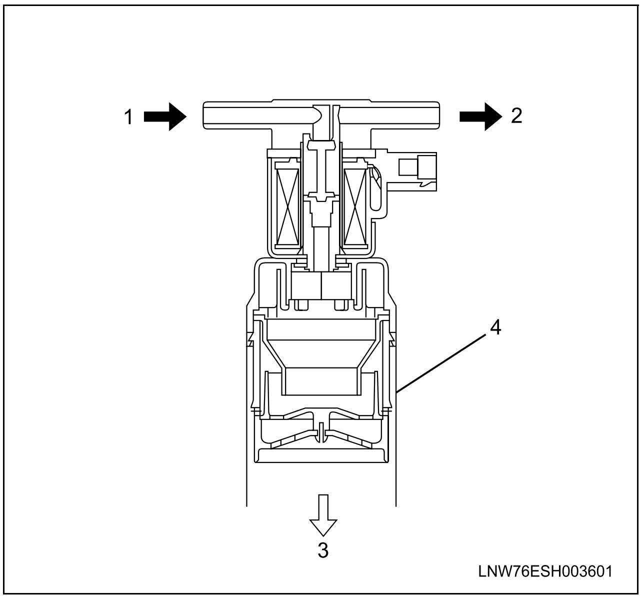
The exhaust temperature sensor 1 and 2 is installed to the DPD housing. Both exhaust temperature sensors are a variable resistor. The sensor 1 measures the temperature of the exhaust gas in front of DPD filter and the sensor 2 measures the temperature of the exhaust gas in front of oxygen catalyst. When the exhaust temperature sensor is cold, the sensor resistance is high. When the exhaust temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the signal circuit.

Exhaust Throttle Valve & Exhaust Brake Valve



Legend

1. Exhaust throttle valve & exhaust brake valve



Legend

1. Vacuum inlet
2. Vacuum outlet
3. Vacuum exhaust
4. Solenoid valve

The exhaust throttle valve is installed in rear of the DPD housing and it composes a part of the exhaust system. The ECM controls the exhaust throttle solenoid valve based on the DPD system regeneration status. The exhaust throttle solenoid energizes to apply vacuum pressure to the diaphragm chamber to operate exhaust throttle valve.

The exhaust brake valve is installed in front of the DPD housing and it also composes a part of the exhaust system. The ECM controls the exhaust brake solenoid valve based on the DPD regeneration status or exhaust brake command signal. The exhaust brake solenoid energizes to apply vacuum pressure to the diaphragm chamber to operate exhaust brake valve.

Special Tools and Equipment

Special Tools and Equipment

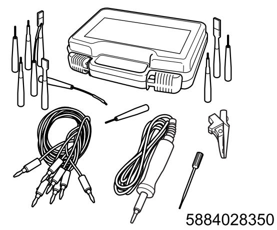
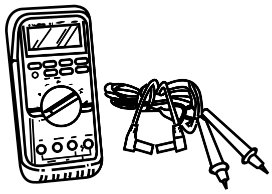
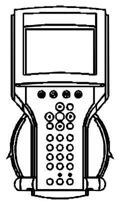
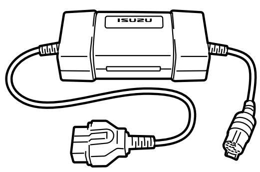
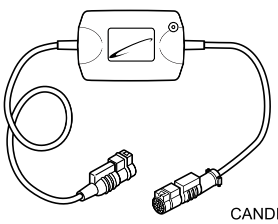
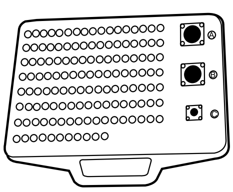
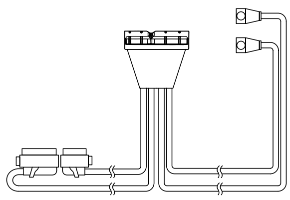
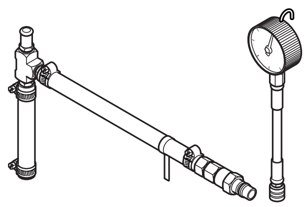
Illustration	Tool Number/ Description
 5884028350	5-8840-2835-0 (J-35616-C) Connector Test Adapter Kit (With Test Lamp)
 5884002850	5-8840-0285-0 (J-39200) Digital Multimeter
 AAW0Z0SH015701	Tech2 Kit
 ADAPTER2	Tech2 DC24 Volt Adapter II
 CANDI	CAN-di Module
 BREAKER	Breaker Box

Illustration	Tool Number/ Description
 ADAPTER-H	Adapter Harness
 5884028440	5-8840-2844-0 (J-44638) Fuel Pressure/ Vacuum Gauge Assembly & (EN-47667) Suction Side Fuel Pressure/ Vacuum Gauge Adapter

MEMO

Published: Dec., 2007
First Edition

ISUZU

N SERIES

WORKSHOP MANUAL
ENGINE CONTROL SYSTEM
(4HK1 model)

Issued by ISUZU MOTORS LIMITED
SERVICE MARKETING DEPARTMENT
Shinagawa-ku, Tokyo, 140-8722 Japan

0-XXXKI