SECTION 6E

ENGINE CONTROL SYSTEM
(4JK1/4JJ1)
TABLE OF CONTENTS

Specifications 6E-3
Temperature vs Resistance 6E-3
Altitude vs Barometric Pressure. 6E-3
Diagnostic Trouble Code (DTC) Type Definitions 6E-4
Diagnostic Trouble Code (DTC) List 6E-4
Schematic and Rounting Diagrams. 6E-9
Fuel System Routing Diagram 6E-9
Vacuum Hose Routing Diagram. 6E-9
Engine Controls Schematics 6E-10
Component Locator. 6E-27
Engine Controls Component Views 6E-27
Engine Control Module (ECM) Connector End Views 6E-30
Engine Control Connector End Views 6E-33
Diagnostic Information and Procedures 6E-42
Engine Control System Check Sheet. 6E-42
Diagnostic Starting Point - Engine Controls . . . 6E-43
Diagnostic System Check - Engine Controls . . 6E-44
Scan Tool Data List 6E-46
Scan Tool Data Definitions 6E-49
Scan Tool Output Controls 6E-54
Scan Tool Does Not Power Up. 6E-55
Scan Tool Does Not Communicate with CAN Device. 6E-56
Lost Communication with The Engine Control Module (ECM) 6E-59
Engine Cranks but Does Not Run 6E-62
DTC P0016 (Flash Code 16) 6E-68
DTC P0045 (Flash Code 33) 6E-70
DTC P0087 (Flash Code 225) 6E-72
DTC P0088 (Flash Code 118) 6E-77
DTC P0089 (Flash Code 151) 6E-82
DTC P0091 or P0092 (Flash Code 247) 6E-85
DTC P0093 (Flash Code 227) 6E-88
DTC P0101 (Flash Code 92) 6E-93
DTC P0102 or P0103 (Flash Code 91) 6E-96
DTC P0107 or P0108 (Flash Code 32) 6E-100
DTC P0112 or P0113 (Flash Code 22) 6E-104
DTC P0116 (Flash Code 23) 6E-108
DTC P0117 or P0118 (Flash Code 23) 6E-110
DTC P0122 or P0123 (Flash Code 43) 6E-114
DTC P0182 or P0183 (Flash Code 211) 6E-118
DTC P0192 or P0193 (Flash Code 245) 6E-122
DTC P0201, P0202, P0203 or P0204 (Flash Code 271, 272, 273 or 274). 6E-126
DTC P0217 (Flash Code 542) 6E-133
DTC P0219 (Flash Code 543) 6E-135
DTC P0231 or P0232 (Flash Code 69) 6E-137
DTC P0234 (Flash Code 42) 6E-140
DTC P0299 (Flash Code 65) 6E-143
DTC P0335 (Flash Code 15) 6E-146
DTC P0336 (Flash Code 15) 6E-149
DTC P0340 (Flash Code 14) 6E-151
DTC P0341 (Flash Code 14) 6E-154
DTC P0380 (Flash Code 66) 6E-156
DTC P0401 (Flash Code 93) 6E-159
DTC P0403 (Flash Code 37) 6E-161
DTC P0404 (Flash Code 45) 6E-164
DTC P0405 or P0406 (Flash Code 44) 6E-166
DTC P0500 (Flash Code 25) 6E-170
DTC P0501 (Flash Code 25) 6E-174
DTC P0512 (Flash Code 417) 6E-176
DTC P0562 or P0563 (Flash Code 35) 6E-178
DTC P0565 (Flash Code 515) 6E-181
DTC P0566 (Flash Code 516) 6E-183
DTC P0567 (Flash Code 517) 6E-185
DTC P0568 (Flash Code 518) 6E-187
DTC P0571 (Flash Code 26) 6E-189
DTC P0601 (Flash Code 53) 6E-192
DTC P0602 (Flash Code 154) 6E-193
DTC P0604 or P0606 (Flash Code 153 or 51). 6E-195
DTC P0615 (Flash Code 19) 6E-196
DTC P0633 (Flash Code 176) 6E-198
DTC P0638 (Flash Code 61) 6E-199
DTC P0642 or P0643 (Flash Code 55) 6E-201
DTC P0650 (Flash Code 77) 6E-204
DTC P0652 or P0653 (Flash Code 56) 6E-207
DTC P0661 or P0662 (Flash Code 58) 6E-211
DTC P0698 or P0699 (Flash Code 57) 6E-215
DTC P0700 (Flash Code 185) 6E-219
DTC P1064 or P1065 (Flash Code 247) 6E-220
DTC P1093 (Flash Code 227) 6E-224
DTC P1094 (Flash Code 226) 6E-229
DTC P1196, P1197 or P1198 (Flash Code 461) 6E-235
DTC P124B (Flash Code 157). 6E-237
DTC P1261 (Flash Code 34) 6E-240
DTC P1262 (Flash Code 34) 6E-242
DTC P1404 (Flash Code 45) 6E-244
DTC P1411, P1412 or P1413 (Flash Code 445) 6E-246
DTC P156A or P156B (Flash Code 135) 6E-248
DTC P161B (Flash Code 179) 6E-251
DTC P1621 (Flash Code 54, 254) 6E-253
DTC P1664 (Flash Code 76) 6E-255
DTC P2100, P2101 or P2103 (Flash Code 446) 6E-258
DTC P2122 or P2123 (Flash Code 121) 6E-261

DTC P2127 or P2128 (Flash Code 122) 6E-265
DTC P2132 or P2133 (Flash Code 123) 6E-269
DTC P2138, P2139 or P2140
(Flash Code 124, 125 or 126) 6E-274
DTC P2146, P2147 or P2148
(Flash Code 158) 6E-280
DTC P2149, P2150 or P2151
(Flash Code 159) 6E-284
DTC P2227 (Flash Code 71) 6E-288
DTC P2228 or P2229 (Flash Code 71) 6E-291
DTC P2621 or P2622 (Flash Code 94) 6E-295
DTC U0001 or U0101
Flash Code 84 or 85) 6E-298
DTC U0167 (Flash Code 177) 6E-299
EGR Control System Check. 6E-300
Glow Control System Check 6E-304
In-Tank Fuel Pump System Check. 6E-309
Cruise Control System Check 6E-312
Turbocharger Control System Check. 6E-318
Symptoms - Engine Controls 6E-321
Symptoms - Engine Controls 6E-321
Intermittent Conditions 6E-323
Hard Start 6E-326
Rough, Unstable, or Incorrect Idle and
Stalling. 6E-328
High Idle Speed 6E-330
Cuts Out 6E-331
Surges 6E-332
Lack of Power, Sluggishness or
Sponginess 6E-334
Hesitation, Sag or Stumble. 6E-336
Abnormal Combustion Noise 6E-338
Poor Fuel Economy 6E-339
Excessive Smoke (Black Smoke) 6E-341
Excessive Smoke (White Smoke) 6E-343
Repair Instructions 6E-345
Engine Control Module (ECM)
Replacement 6E-345
Service Programming System (SPS)
Description 6E-347
Service Programming System (SPS)
(Remote Procedure) 6E-348
Service Programming System (SPS)
(Pass-Thru Procedure) 6E-349
Description and Operation 6E-351
Engine Control Module (ECM) Description . . 6E-351
Engine Control Component Description. 6E-353
Fuel System Description 6E-357
Fuel System Component Description. 6E-358
Fuel Injection System Description 6E-362
Exhaust Gas Recirculation (EGR)
System Description 6E-363
Turbocharger Description. 6E-364
Special Tools and Equipment 6E-366
Special Tools and Equipment 6E-366

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

°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

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

Altitude vs Barometric Pressure

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

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.

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 driving cycle when the diagnostic runs and does not fail. (Except Euro 4 Specification)
- A current DTC clears when the diagnostic runs and passes after 1 driving cycle.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported.
- 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 after 1 driving cycle.
- 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.

Conditions for Clearing the DTC - Type D

- A current DTC clears when the diagnostic runs and passes after 1 driving cycle.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported.
- Use a scan tool to clear the DTC.

Diagnostic Trouble Code (DTC) List

DTC	Flash Code	DTC Type			DTC Descriptor
		Euro 4 Specification	Except Euro 4 Specification (High Output)	Except Euro 4 Specification (Standard Output)	
P0016	16	C	A	A	Crankshaft Position - Camshaft Position Correlation
P0045	33	A	A	-	Turbocharger Boost Control Solenoid Circuit
P0087	225	A	A	A	Fuel Rail/ System Pressure Too-Low
P0088	118	A	A	A	Fuel Rail/ System Pressure Too-High (First Stage)
P0088	118	C	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

DTC	Flash Code	DTC Type			DTC Descriptor
		Euro 4 Specification	Except Euro 4 Specification (High Output)	Except Euro 4 Specification (Standard Output)	
P0093	227	A	A	A	Fuel System Leak Detected
P0101	92	A	-	-	Mass Air Flow Sensor Circuit Range/ Performance
P0102	91	A	A	A	Mass Air Flow Sensor Circuit Low Input
P0103	91	A	A	A	Mass Air Flow Sensor Circuit High Input
P0107	32	A	A	-	Manifold Absolute Pressure Sensor Circuit Low Input
P0108	32	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	A	-	-	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	B	A	A	Throttle Position Sensor Circuit Low
P0123	43	B	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	D	D	Engine Coolant Over Temperature Condition
P0219	543	C	A	A	Engine Overspeed Condition
P0231	69	C	A	A	Fuel Pump Secondary Circuit Low
P0232	69	C	A	A	Fuel Pump Secondary Circuit High
P0234	42	A	A	-	Turbocharger Overboost Condition
P0299	65	A	A	-	Turbocharger Underboost
P0335	15	A	A	A	Crankshaft Position Sensor Circuit
P0336	15	A	A	A	Crankshaft Position Sensor Circuit Range/ Performance
P0340	14	C	A	A	Camshaft Position Sensor Circuit
P0341	14	C	A	A	Camshaft Position Sensor Circuit Range/ Performance
P0380	66	C	A	A	Glow Plug Circuit
P0401	93	A	-	-	EGR Flow Insufficient Detected
P0403	37	B	A	A	EGR Control Circuit
P0404	45	A	A	A	EGR Control Circuit Range/ Performance
P0405	44	B	A	A	EGR Sensor Circuit Low
P0406	44	B	A	A	EGR Sensor Circuit High
P0500	25	A	A	A	Vehicle Speed Sensor

DTC	Flash Code	DTC Type			DTC Descriptor
		Euro 4 Specification	Except Euro 4 Specification (High Output)	Except Euro 4 Specification (Standard Output)	
P0501	25	A	A	A	Vehicle Speed Sensor Circuit Range/ Performance
P0512	417	C	-	-	Starter Request Circuit
P0562	35	C	A	A	System Voltage Low
P0563	35	C	A	A	System Voltage High
P0565	515	D	D	-	Cruise Control On Signal
P0566	516	D	D	-	Cruise Control Off Signal
P0567	517	D	D	-	Cruise Control Resume Signal
P0568	518	D	D	-	Cruise Control Set Signal
P0571	26	D	D	-	Brake Switch Circuit
P0601	53	C	A	A	Internal Control Module Memory Check Sum Error
P0602	154	C	A	A	Control Module Programming Error
P0604	153	C	A	A	Internal Control Module RAM Error
P0606	51	C	A	A	ECM Processor
P0615	19	C	-	-	Starter Relay Circuit
P0633	176	C	A	A	Immobilizer Not Programmed
P0638	61	A	A	A	Throttle Actuator Control Range/ Performance
P0642	55	C	A	A	Sensor Reference Voltage 1 Circuit Low
P0643	55	C	A	A	Sensor Reference Voltage 1 Circuit High
P0650	77	A	A	A	Malfunction Indicator Lamp (MIL) Control Circuit
P0652	56	A	A	A	Sensor Reference Voltage 2 Circuit Low
P0653	56	A	A	A	Sensor Reference Voltage 2 Circuit High
P0661	58	C	A	A	Intake Manifold Turning Valve Control Circuit Low
P0662	58	C	A	A	Intake Manifold Turning Valve Control Circuit High
P0698	57	A	A	A	Sensor Reference Voltage 3 Circuit Low
P0699	57	A	A	A	Sensor Reference Voltage 3 Circuit High
P0700	185	A	A	-	Transmission Control System (MIL Request)
P1064	247	A	A	A	Fuel Pressure Regulator Control Circuit
P1065	247	A	A	A	Fuel Pressure Regulator Control Circuit
P1093	227	A	A	A	Fuel Rail Pressure Too Low
P1094	226	A	A	A	Fuel Rail Pressure Too Low (FRP Regulator Commanded High)
P1094	226	C	A	A	Fuel Rail Pressure Too Low (Fuel Pressure Drop)
P1196	461	A	A	A	Intake Throttle Solenoid Control Driver
P1197	461	A	A	A	Intake Throttle Solenoid Control Driver
P1198	461	A	A	A	Intake Throttle Solenoid Control Driver
P124B	157	C	A	A	Injector Circuit Short Across Group 1 & 2
P1261	34	A	A	A	Injector Positive Voltage Control Circuit Group 1
P1261	34	A	A	A	Injector Positive Voltage Control Circuit (Supply Voltage Low)

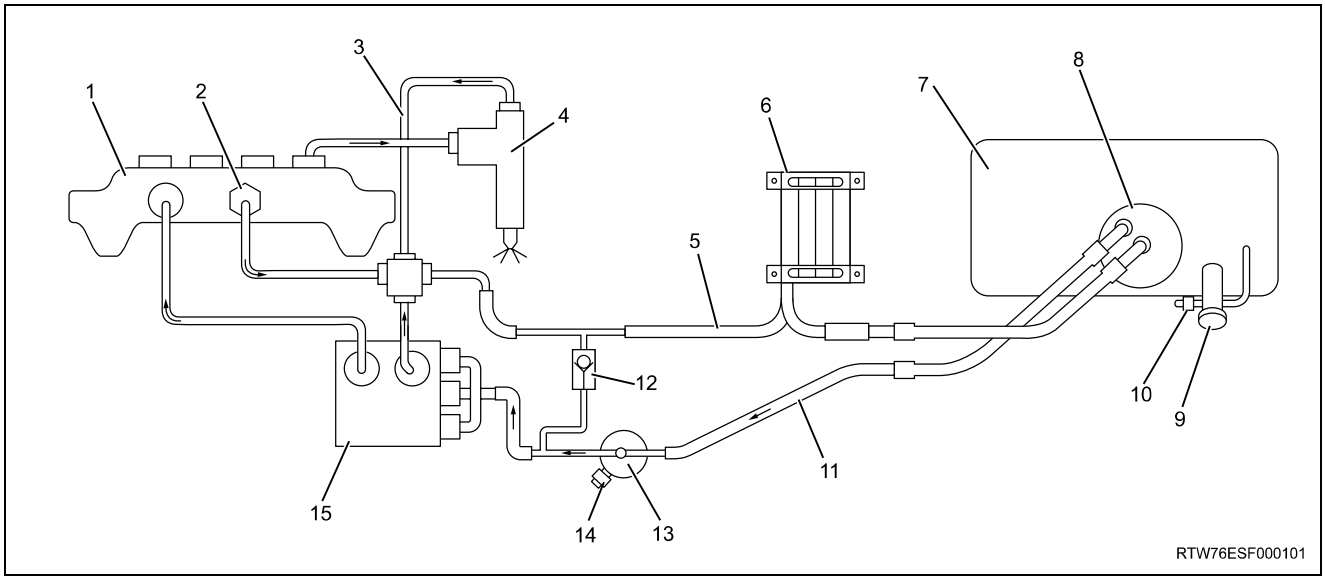



DTC	Flash Code	DTC Type			DTC Descriptor
		Euro 4 Specification	Except Euro 4 Specification (High Output)	Except Euro 4 Specification (Standard Output)	
P1261	34	C	A	A	Injector Positive Voltage Control Circuit (Supply Voltage High)
P1262	34	A	A	A	Injector Positive Voltage Control Circuit Group 2
P1404	45	A	A	A	EGR Position Fault (Closed Position Error)
P1404	45	A	-	-	EGR Position Fault (Learned Position Error)
P1411	445	A	A	A	EGR Solenoid Control Driver
P1412	445	A	A	A	EGR Solenoid Control Driver
P1413	445	A	A	A	EGR Solenoid Control Driver
P156A	135	C	A	A	Battery Voltage Low
P156B	135	C	A	A	Battery Voltage High
P161B	179	C	A	A	Immobilizer Wrong Response
P1621	54	C	A	A	Control Module Long Term Memory Performance (Learned Data)
P1621	254	C	A	A	Control Module Long Term Memory Performance (VIN or Immobilizer Data)
P1664	76	D	-	-	Service Vehicle Soon Lamp Control Circuit (Low Voltage)
P1664	76	C	-	-	Service Vehicle Soon Lamp Control Circuit (High Voltage)
P2100	446	B	A	A	Intake Throttle Solenoid Circuit Open
P2101	446	B	A	A	Intake Throttle Solenoid Circuit Low
P2103	446	B	A	A	Intake Throttle Solenoid Circuit High
P2122	121	C	A	A	Pedal Position Sensor 1 Circuit Low Input
P2123	121	C	A	A	Pedal Position Sensor 1 Circuit High Input
P2127	122	C	A	A	Pedal Position Sensor 2 Circuit Low Input
P2128	122	C	A	A	Pedal Position Sensor 2 Circuit High Input
P2132	123	C	A	A	Pedal Position Sensor 3 Circuit Low Input
P2133	123	A	A	A	Pedal Position Sensor 3 Circuit High Input
P2138	124	C	A	A	Pedal Position Sensor 1 - 2 Voltage Correlation
P2139	125	C	A	A	Pedal Position Sensor 1 - 3 Voltage Correlation
P2140	126	C	A	A	Pedal Position Sensor 2 - 3 Voltage Correlation
P2146	158	A	A	A	Fuel Injector Group 1 Supply Voltage Circuit Short
P2147	158	A	A	A	Fuel Injector Group 1 Supply Voltage Circuit Low
P2148	158	A	A	A	Fuel Injector Group 1 Supply Voltage Circuit High
P2149	159	A	A	A	Fuel Injector Group 2 Supply Voltage Circuit Short
P2150	159	A	A	A	Fuel Injector Group 2 Supply Voltage Circuit Low
P2151	159	A	A	A	Fuel Injector Group 2 Supply Voltage Circuit High
P2227	71	A	A	-	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
P2621	94	-	-	A	Throttle Position Output Circuit Low

DTC	Flash Code	DTC Type			DTC Descriptor
		Euro 4 Specification	Except Euro 4 Specification (High Output)	Except Euro 4 Specification (Standard Output)	
P2622	94	-	-	A	Throttle Position Output Circuit High
U0001	84	A	A	A	High Speed CAN Communication Bus
U0101	85	A	A	-	Lost Communication with TCM
U0167	177	C	A	A	Lost Communication With Vehicle Immobilizer Control Module

Schematic and Rounting Diagrams

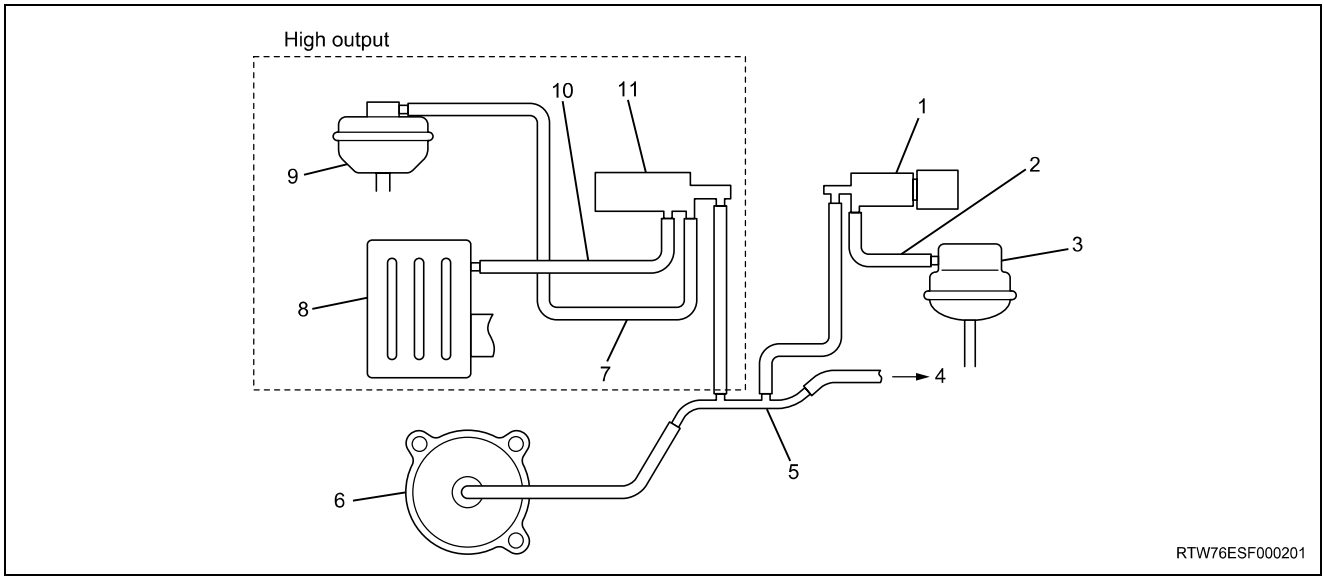
Fuel System Routing Diagram



Legend

1. Fuel rail
2. Fuel pressure limiter
3. Leak off pipe
4. Fuel injector
5. Fuel return pipe
6. Fuel cooler
7. Fuel tank
8. Fuel pump and sender assembly
9. Fuel filler cap
10. Vent valve
11. Fuel feed pipe
12. One-way valve
13. Fuel filter with sedimenter
14. Fuel pressure switch
15. Fuel supply pump

Vacuum Hose Routing Diagram

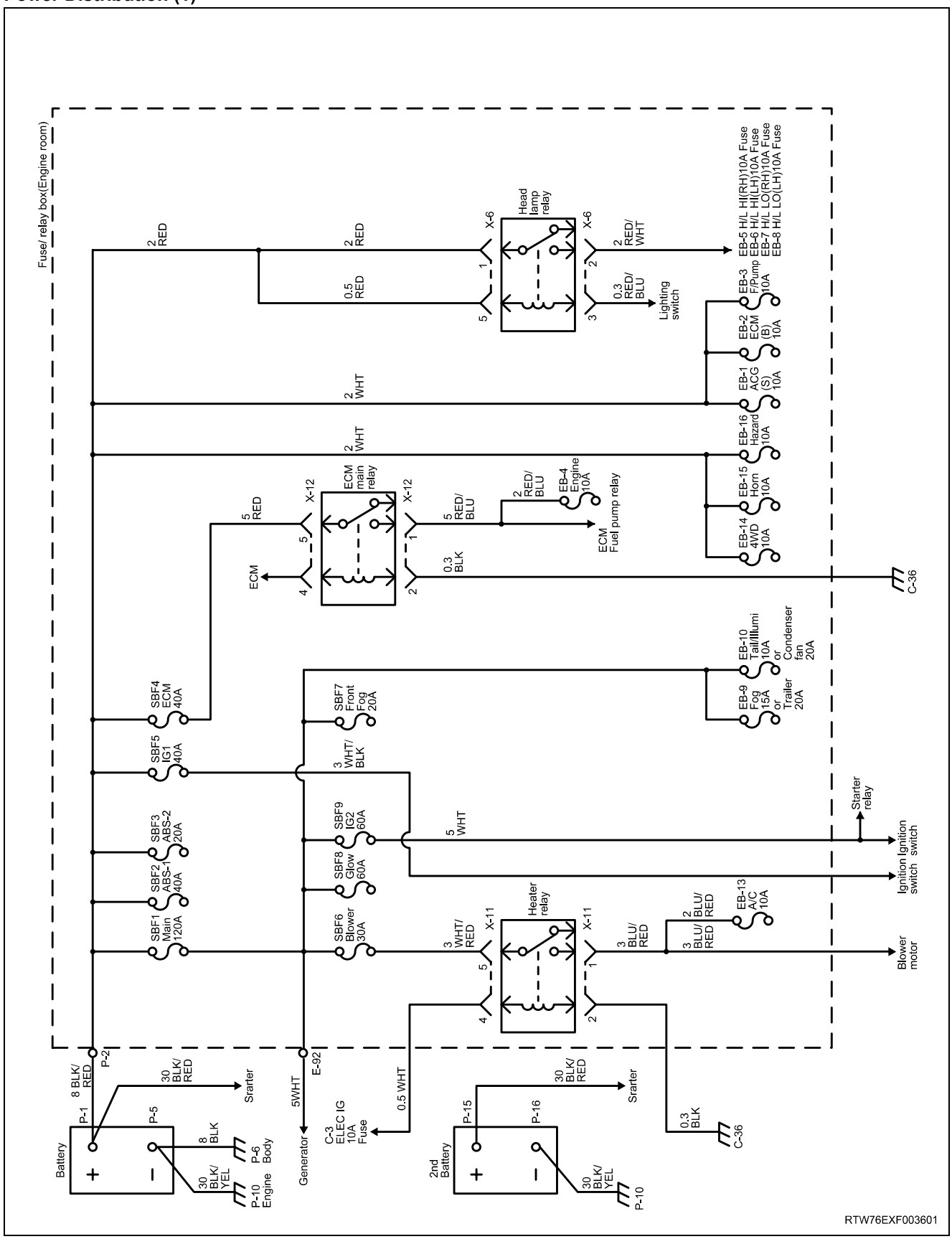


Legend

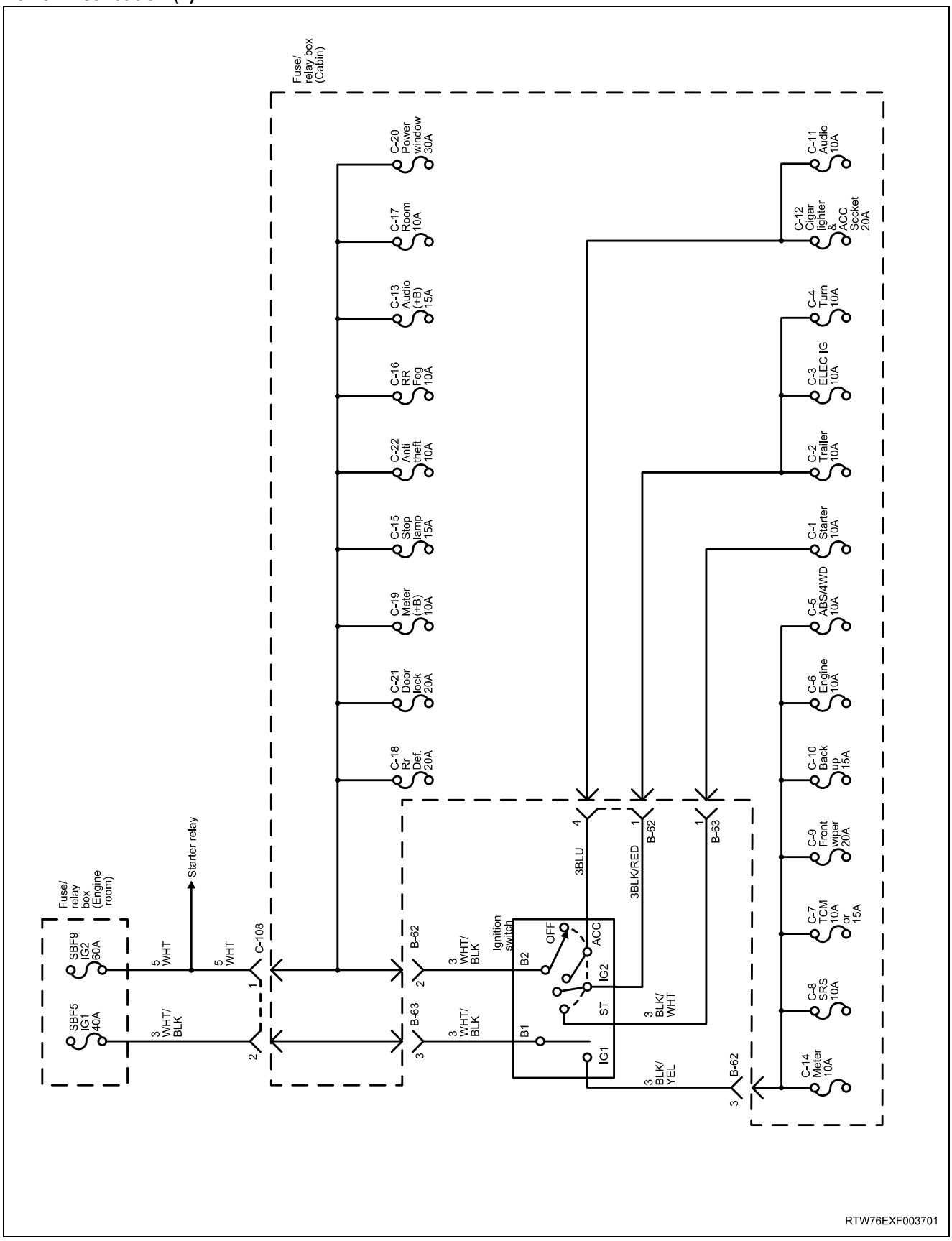
1. Swirl control solenoid valve
2. Actuator control vacuum hose
3. Swirl control actuator
4. Brake booster
5. Vacuum pipe
6. Vacuum pump
7. Actuator control vacuum hose
8. Air cleaner
9. Turbocharger nozzle control actuator
10. Solenoid valve ventilation hose
11. Turbocharger nozzle control solenoid valve

Engine Controls Schematics

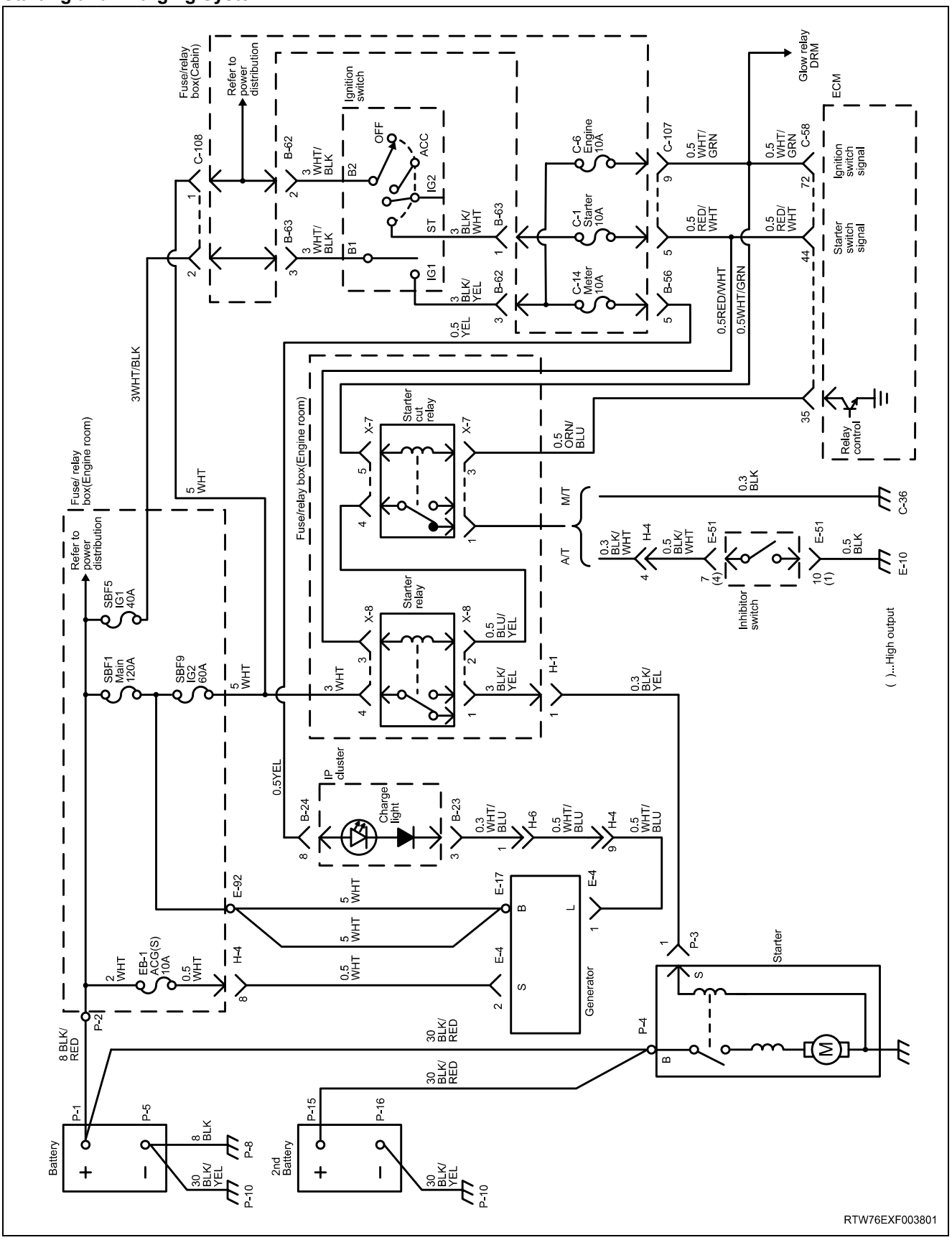
Power Distribution (1)



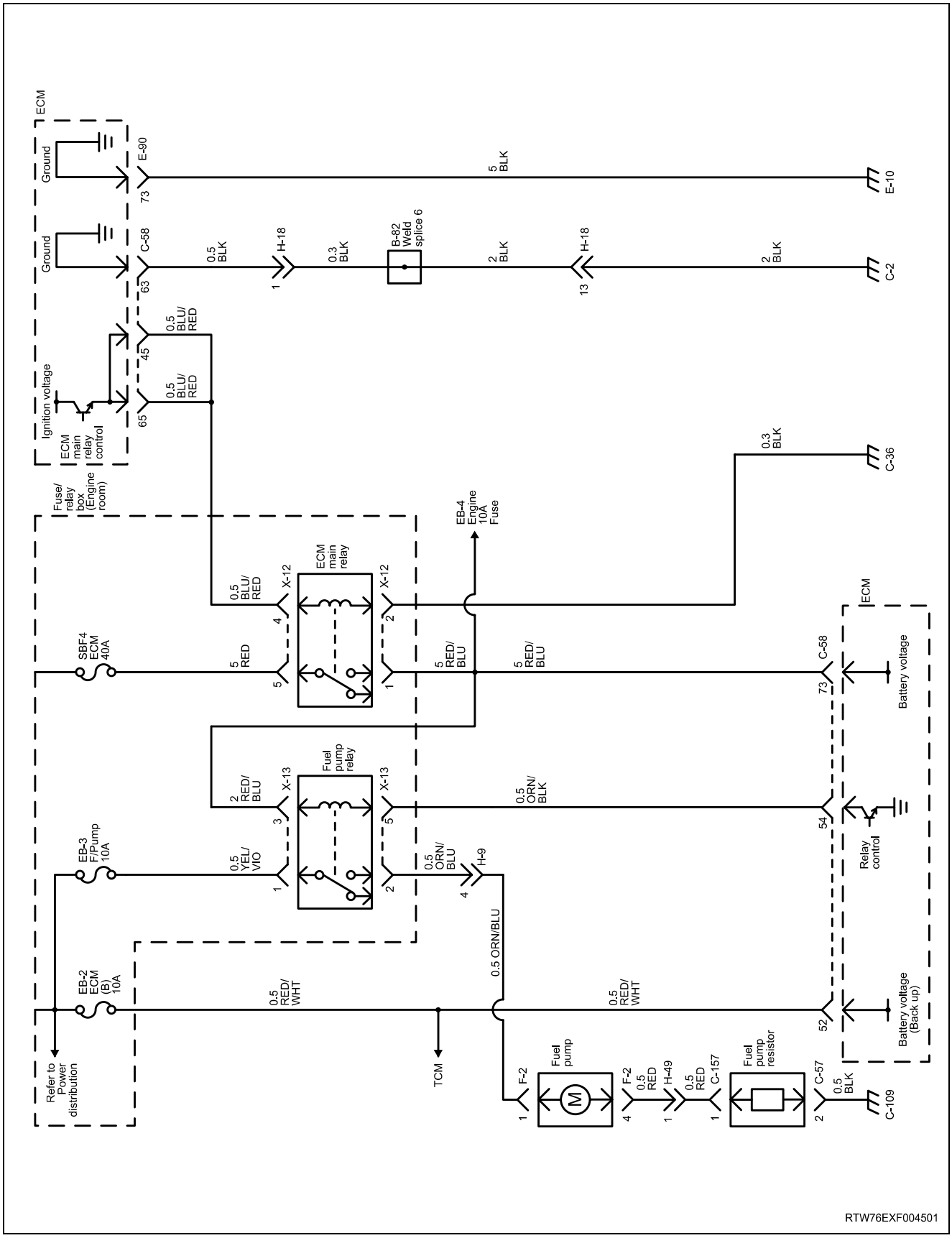
Power Distribution (2)



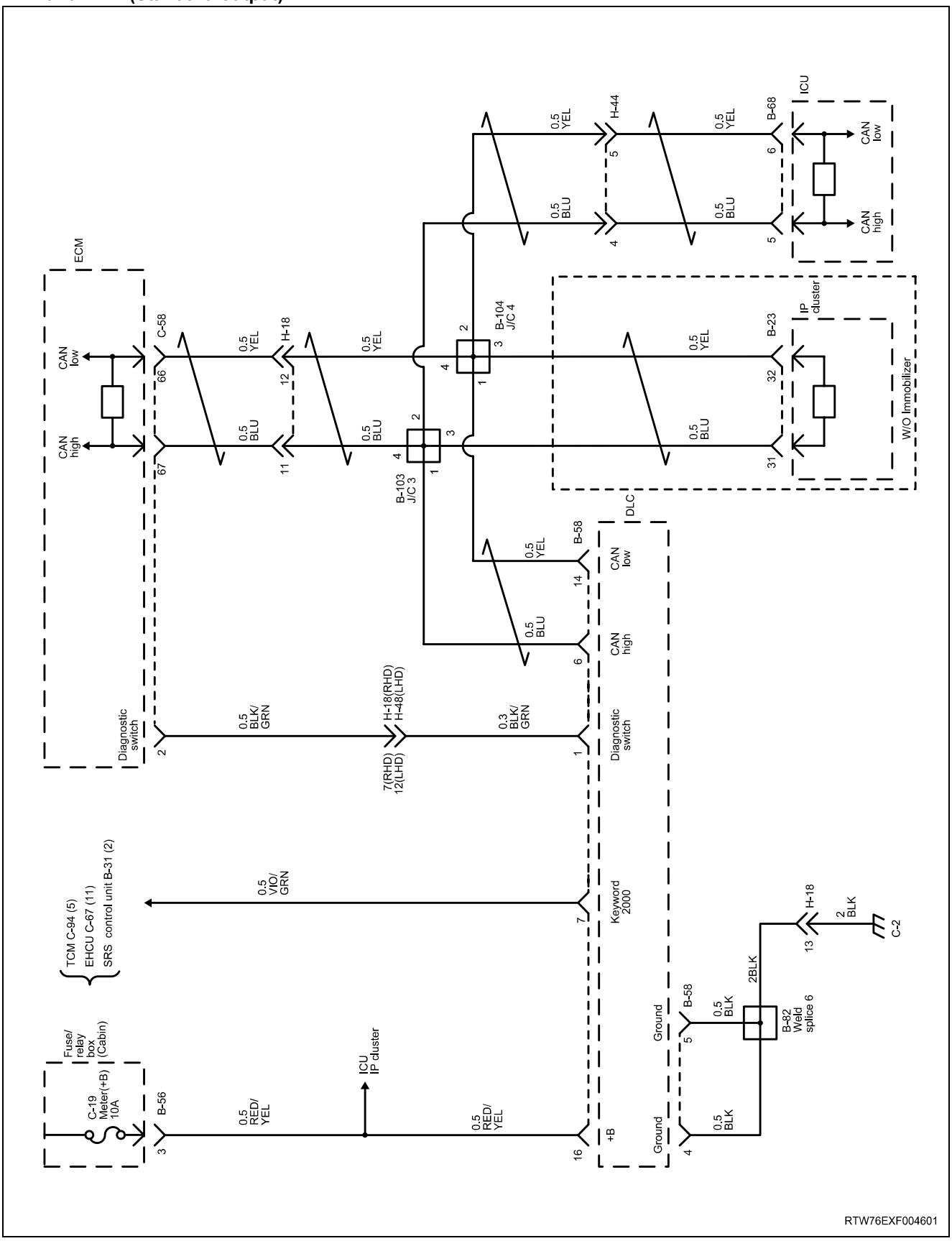
Starting and Charging System



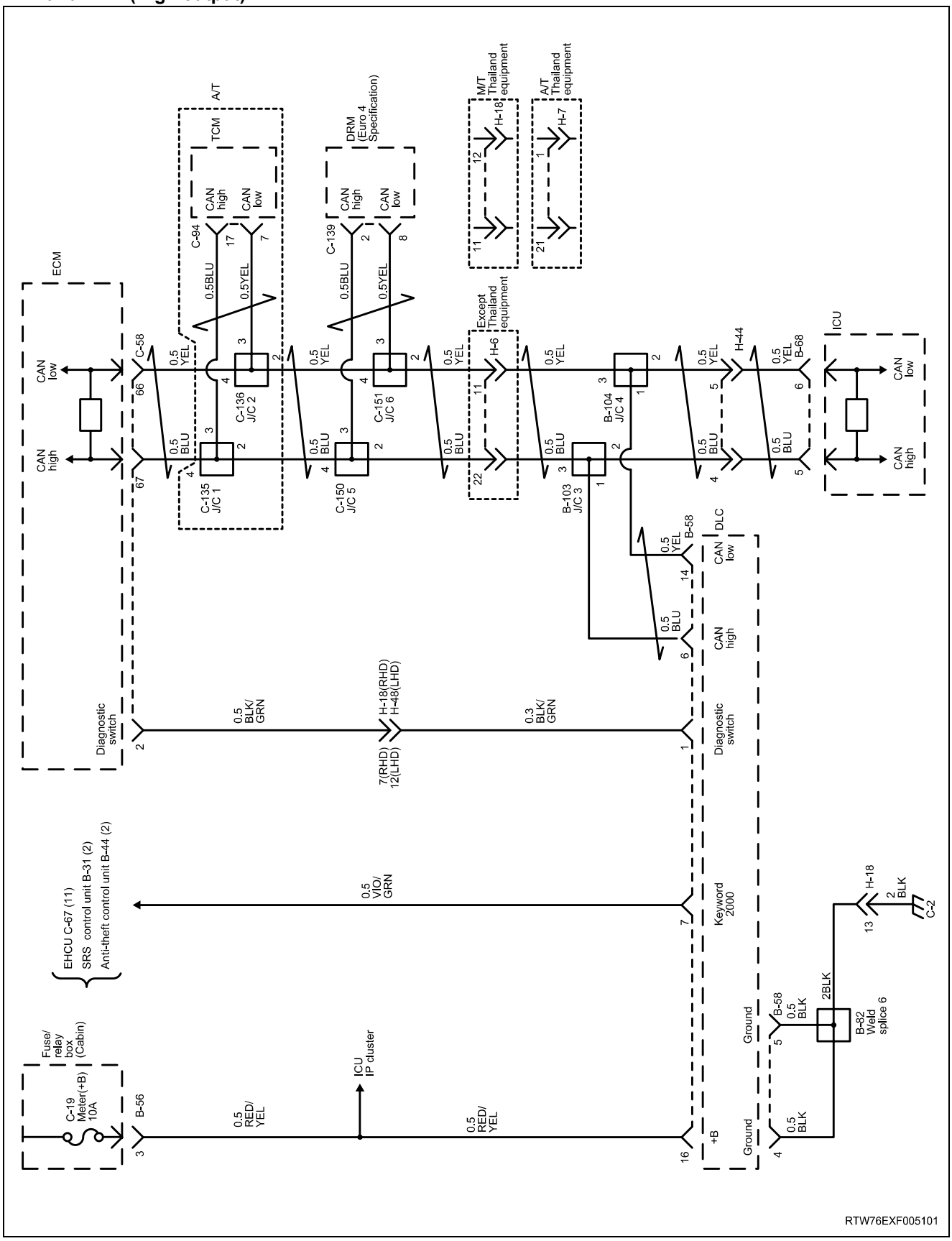
ECM Power and Ground



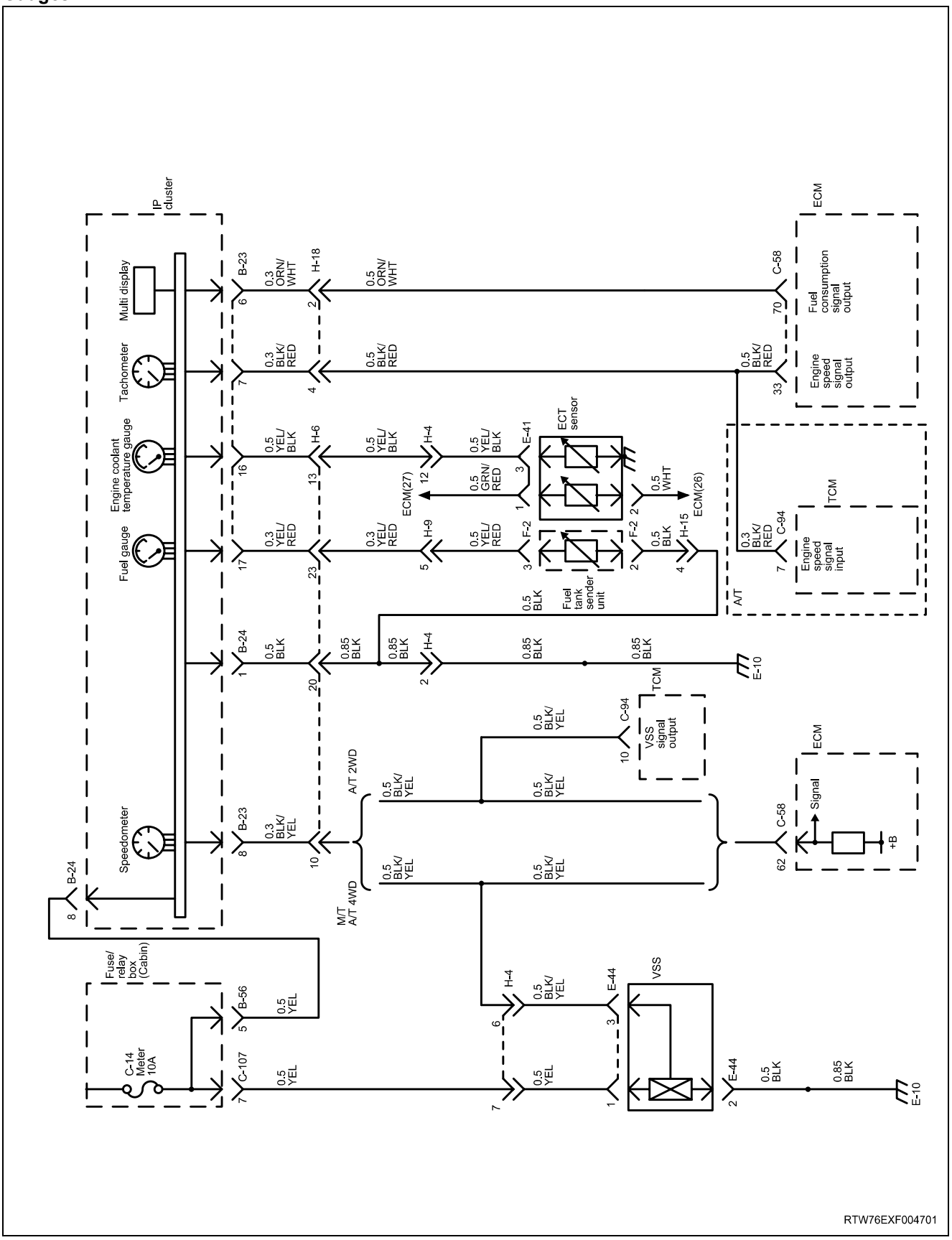
DLC and CAN (Standard output)



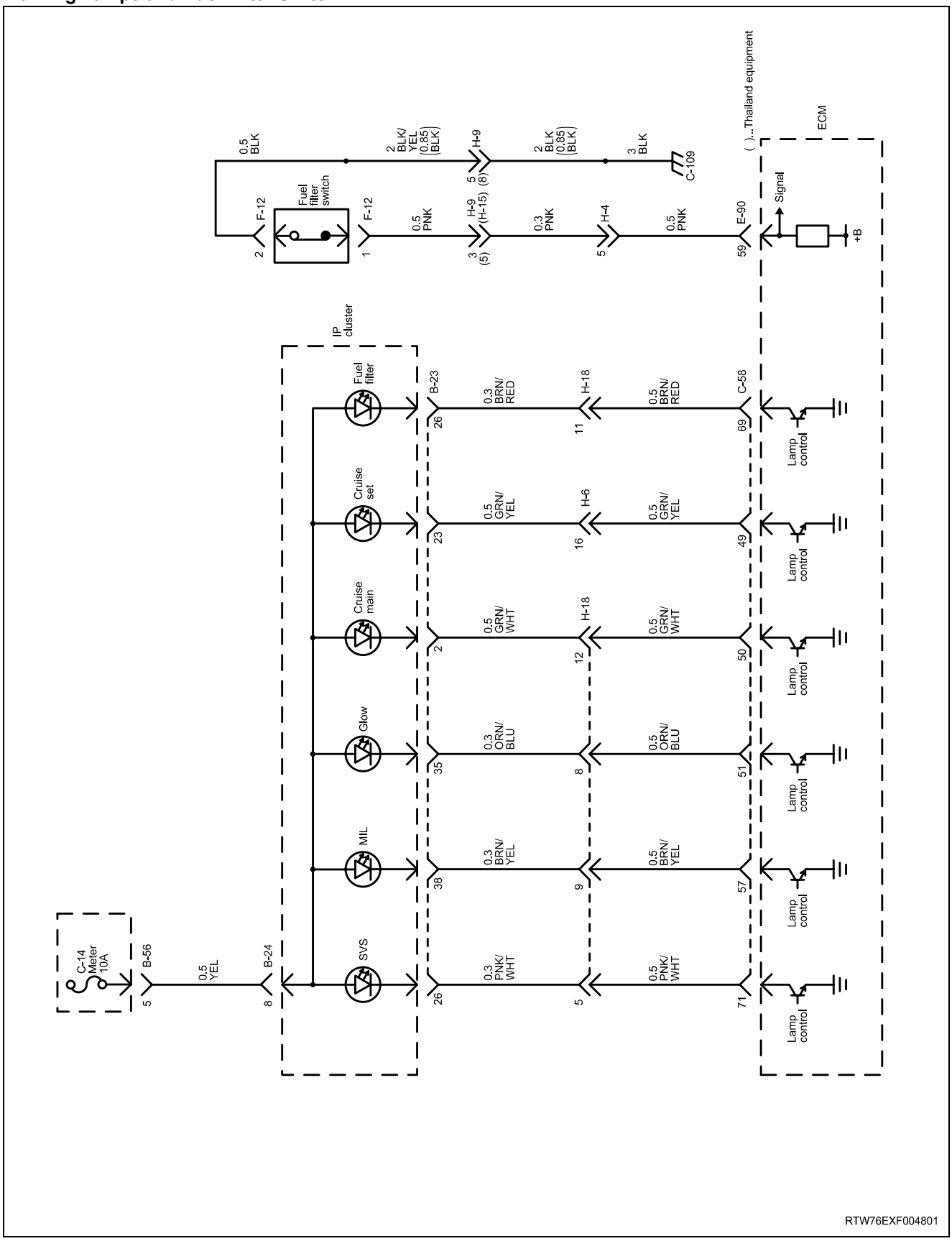
DLC and CAN (High output)



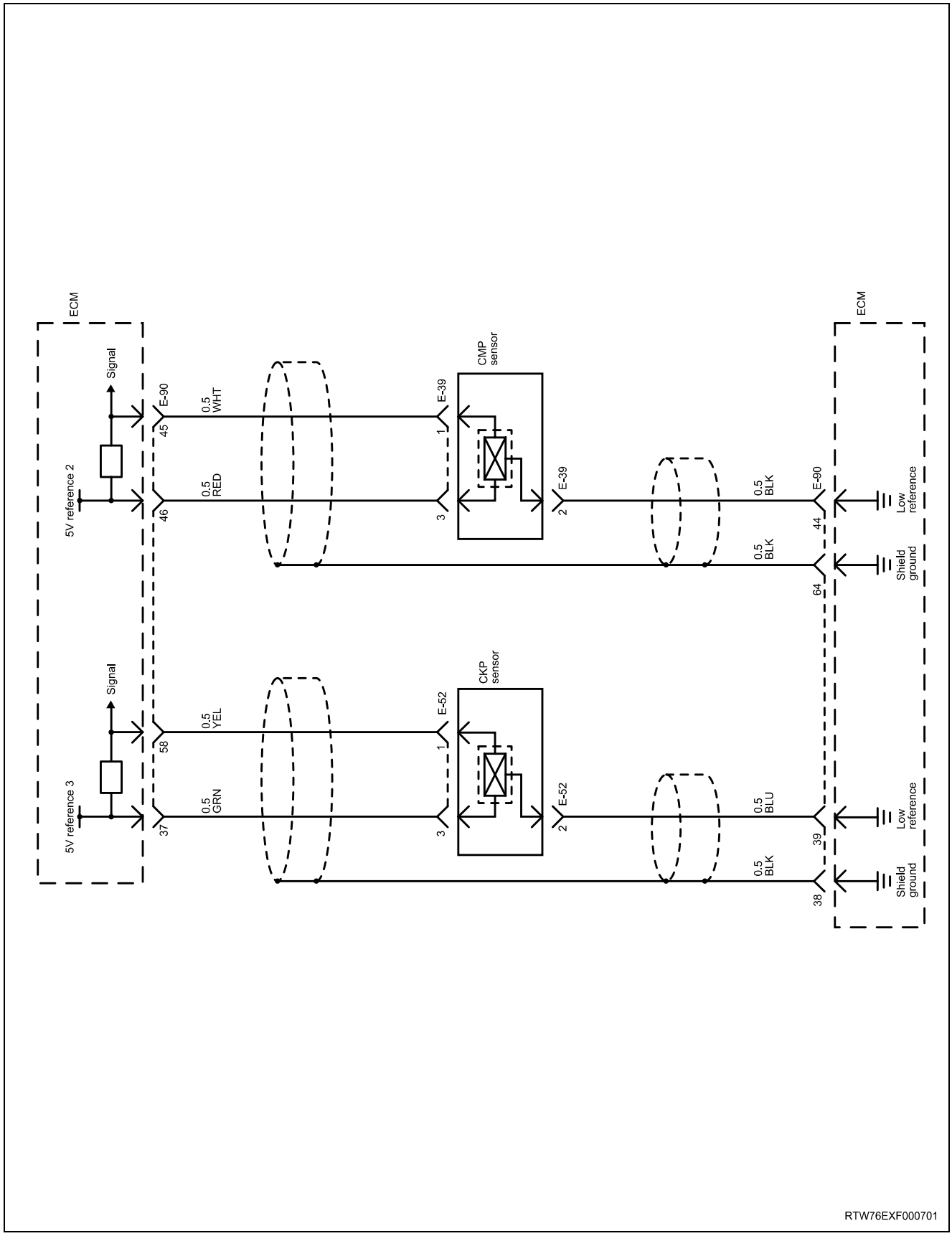
Gauges


IP cluster
Multi display
Tachometer
Engine coolant temperature gauge
Fuel gauge
Speedometer
B-24
B-23
B-56
C-14 Meter 10A
Fuse/ relay box (Cabin)
C-107
H-18
H-6
H-4
H-9
H-15
E-41
F-2
E-10
E-44
C-58
C-94
ECM
TCM
A/T
A/T 2WD
M/T A/T 4WD
ECT sensor
Fuel tank sender unit
VSS
VSS signal output
Fuel consumption signal output
Engine speed signal output
Engine speed signal input
Signal
+B
ECM(27)
ECM(26)
RTW76EXF004701

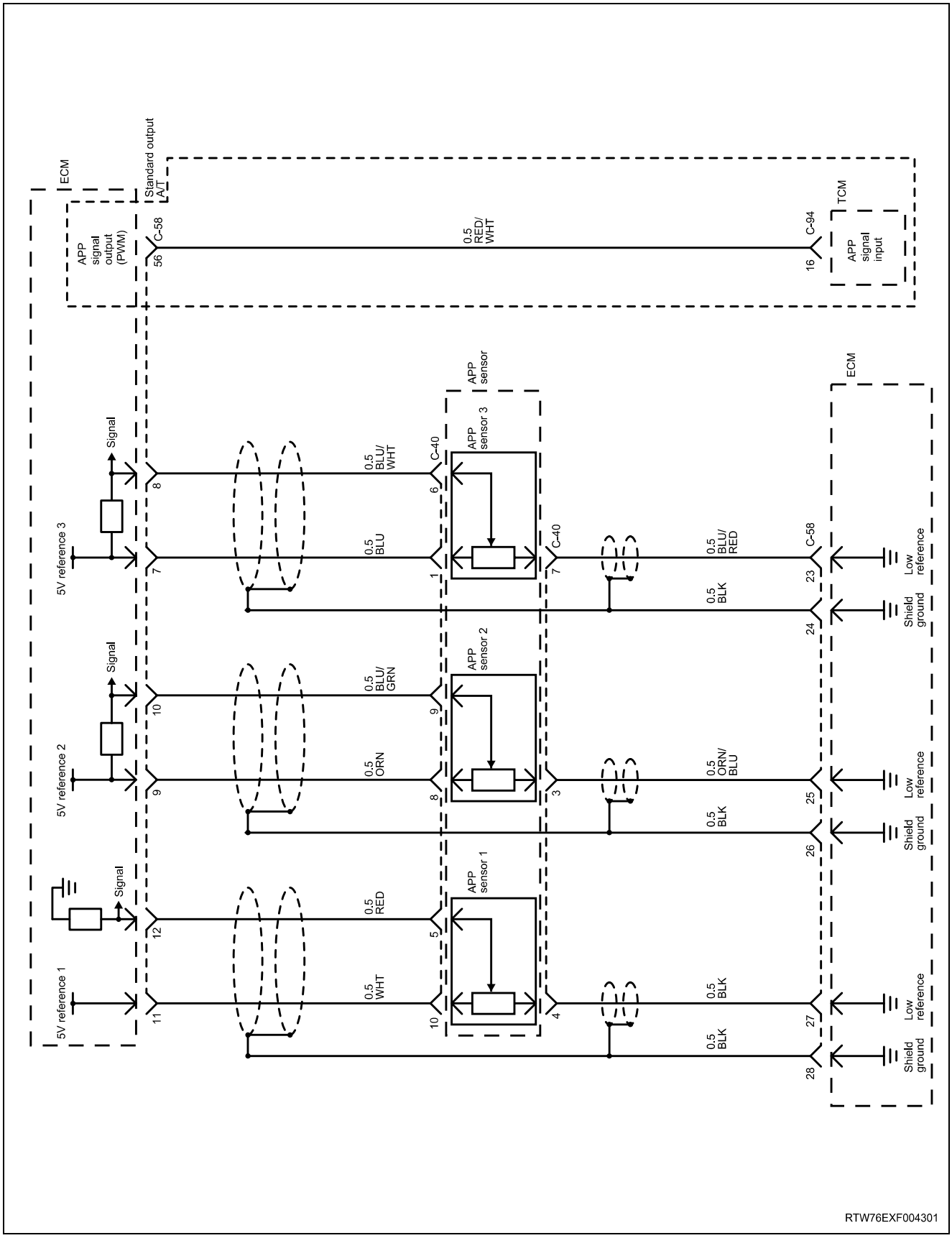
Warning Lamps and Fuel Filter Switch



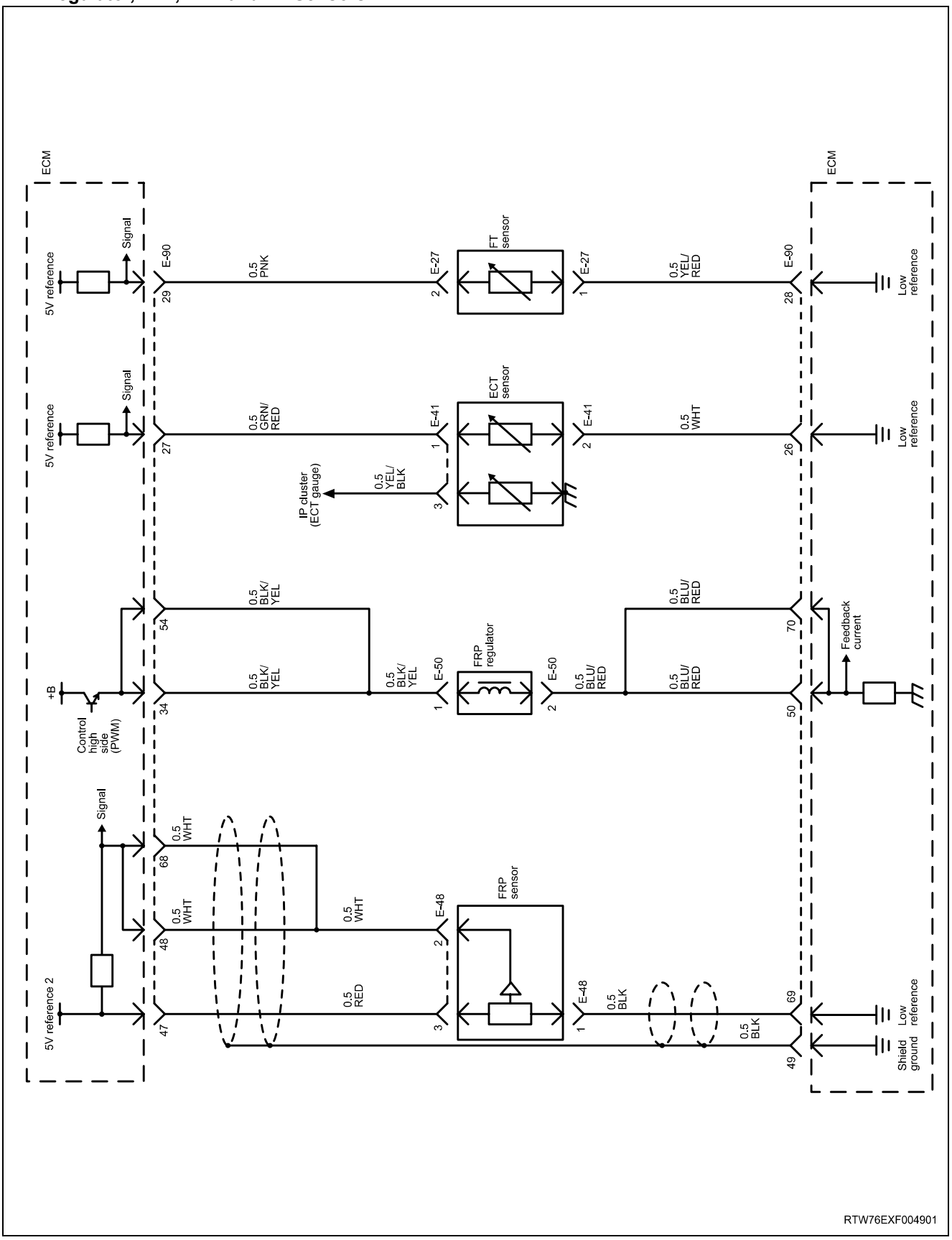
CKP and CMP Sensors



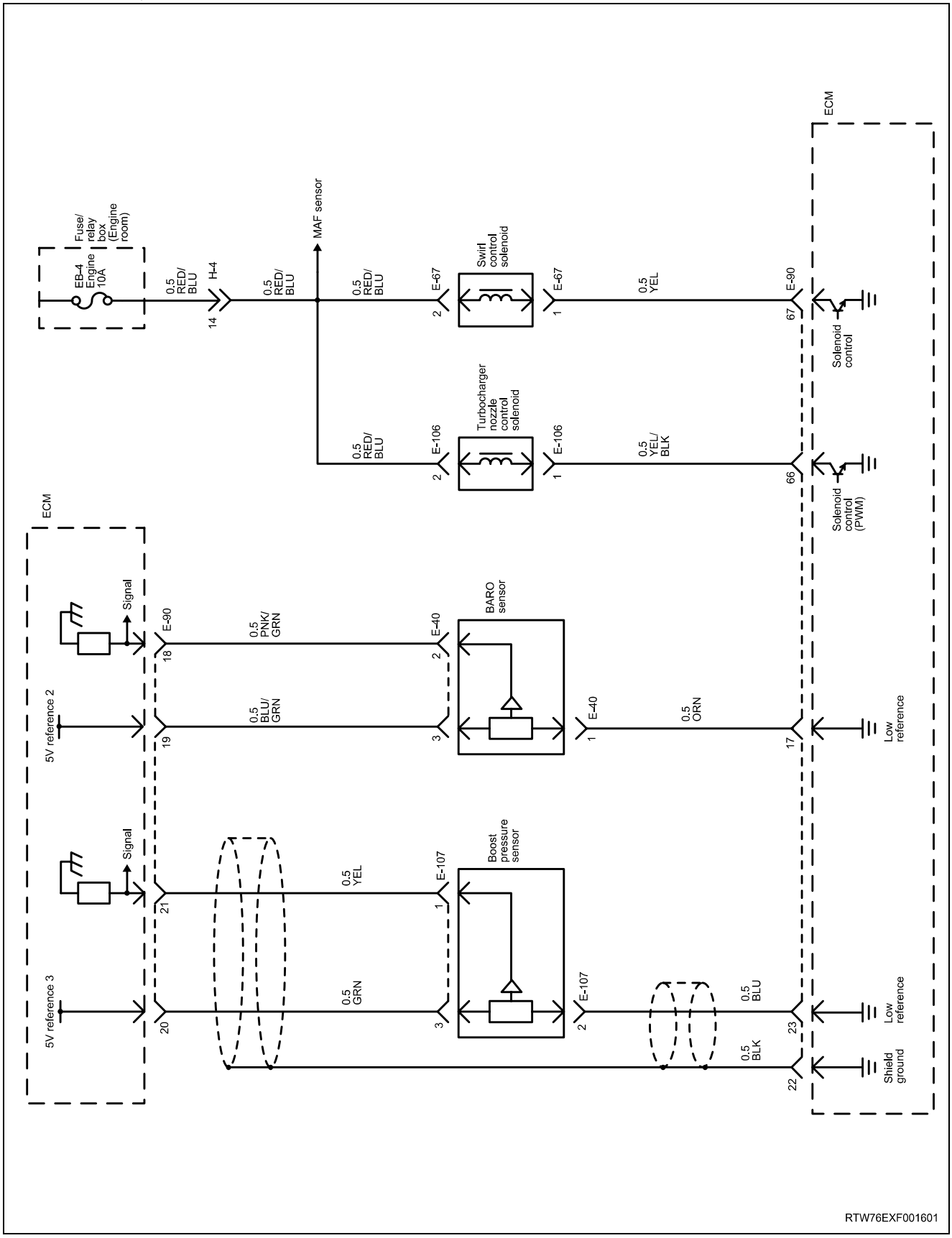
APP Sensors


ECM
Standard output A/T
APP signal output (PWM)
C-58
56
0.5 RED/WHT
C-94
16
TCM
APP signal input
APP sensor
APP sensor 3
APP sensor 2
APP sensor 1
ECM
Signal
5V reference 3
5V reference 2
5V reference 1
8
7
10
9
12
11
0.5 BLU/WHT
0.5 BLU
0.5 BLU/GRN
0.5 ORN
0.5 RED
0.5 WHT
C-40
6
1
9
8
5
10
C-40
7
3
4
0.5 BLU/RED
0.5 ORN/BLU
0.5 BLK
C-58
23
24
25
26
27
28
Low reference
Shield ground
RTW76EXF004301

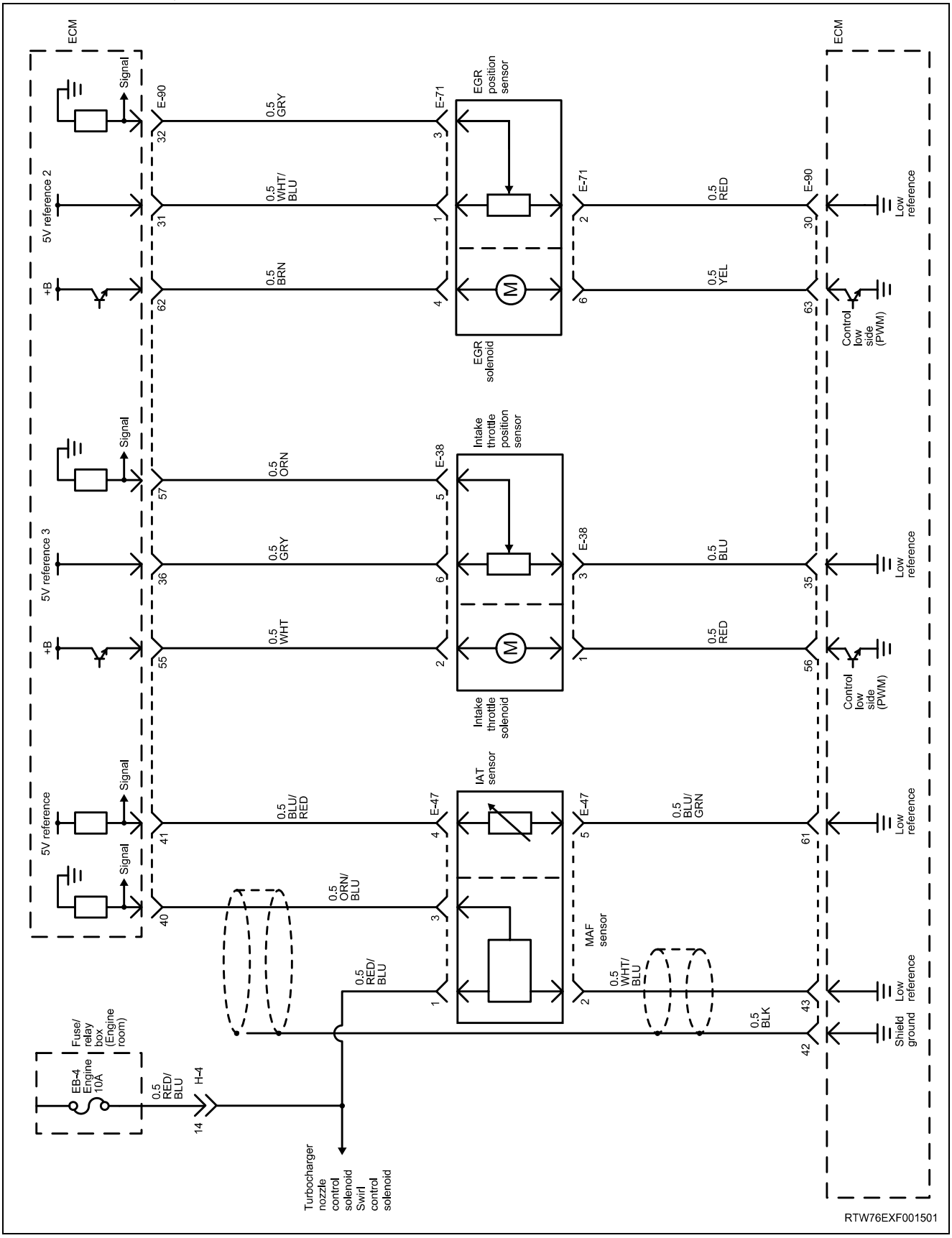
FRP Regulator, FRP, ECT and FT Sensors



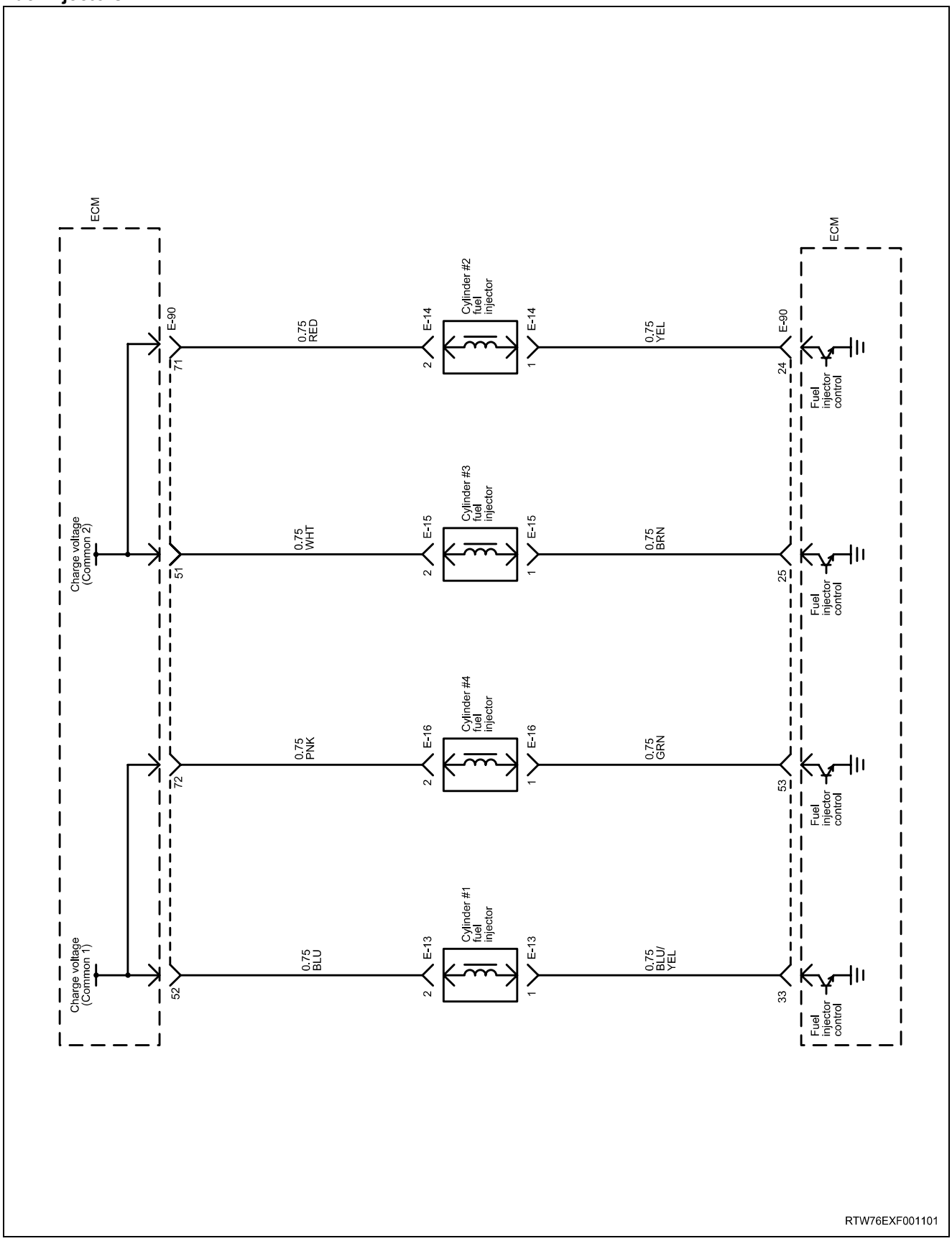
Boost Pressure, BARO Sensors and Solenoids



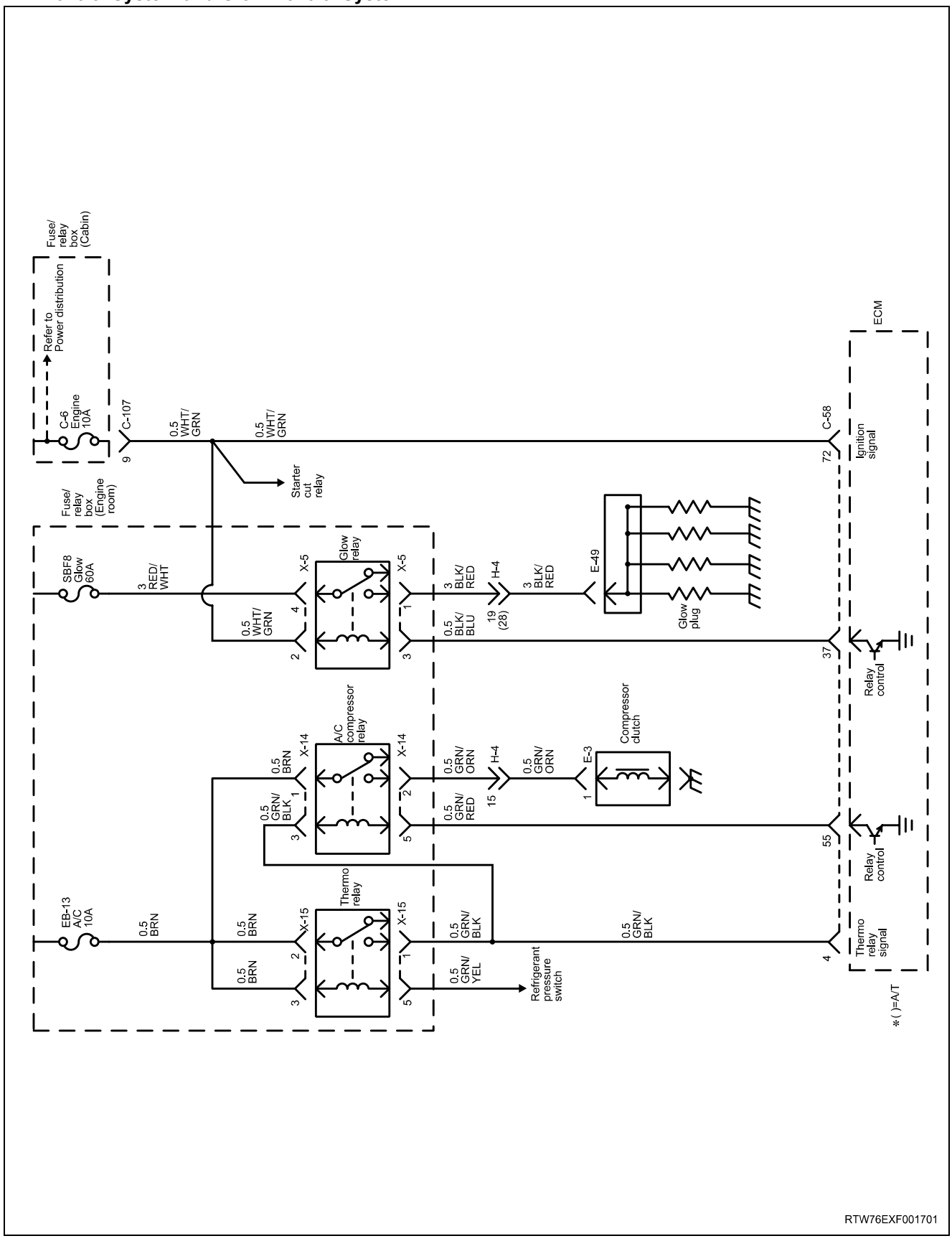
MAF & IAT Sensors, Intake Throttle and EGR Valves



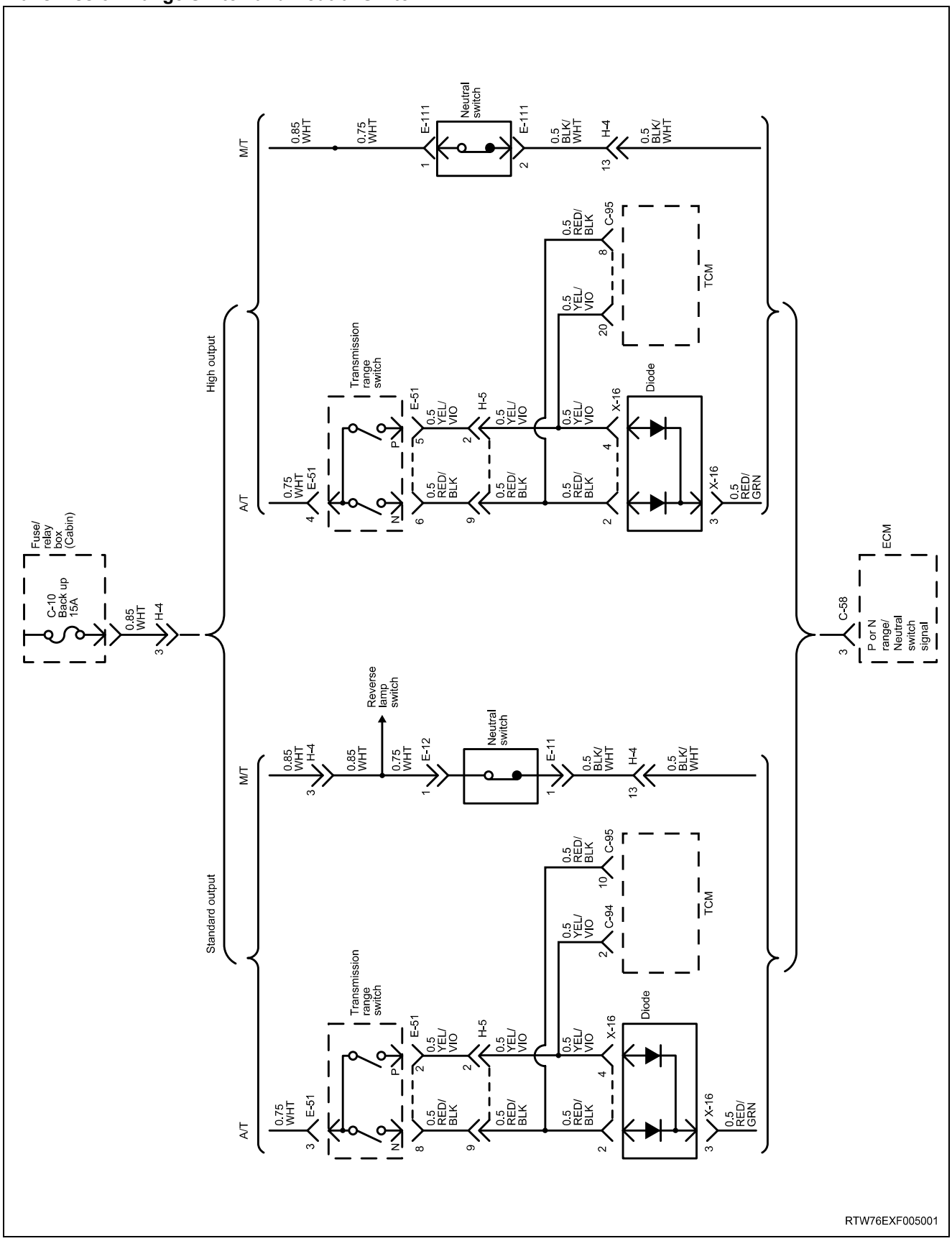
Fuel Injectors



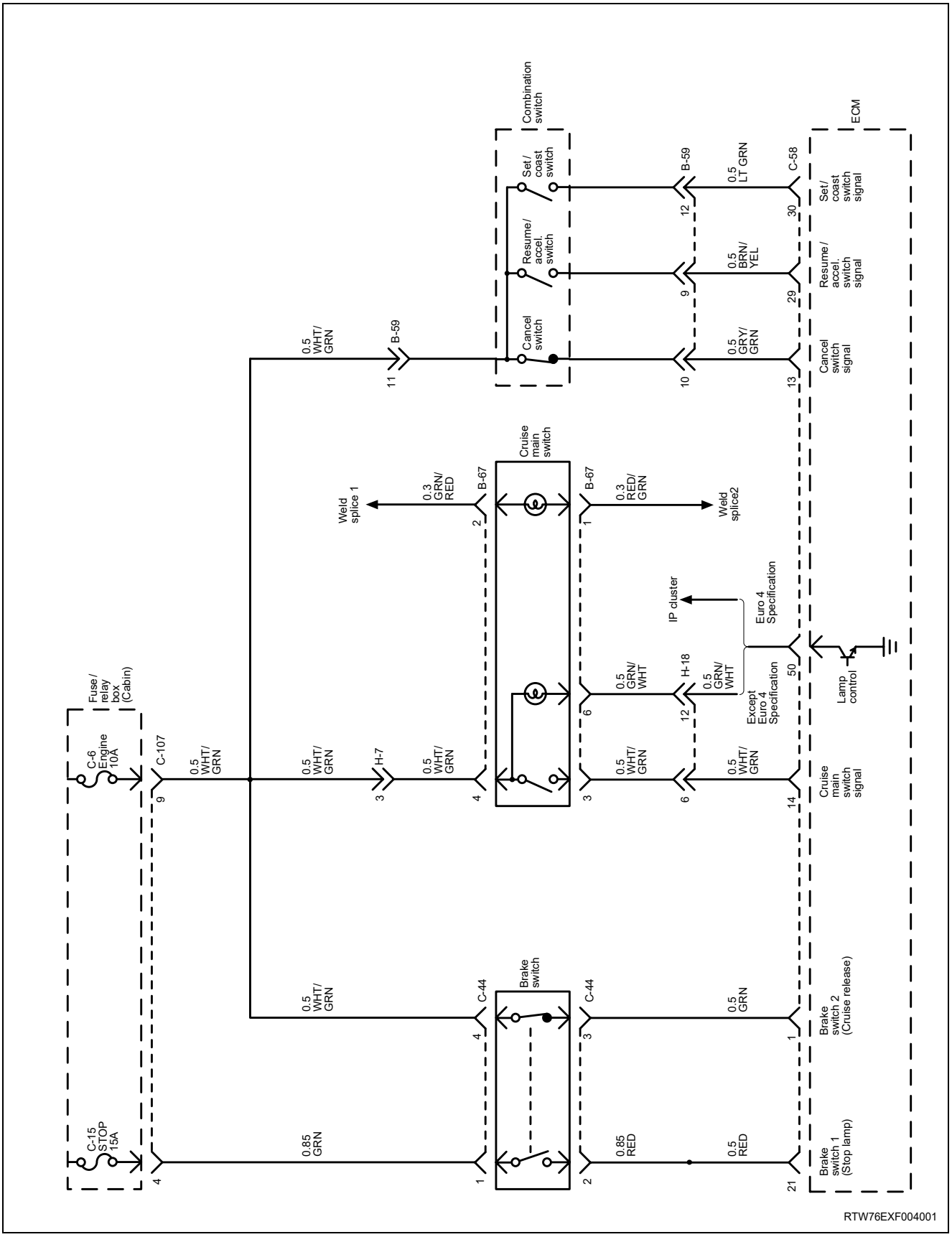
A/C Control System and Glow Control System



Transmission Range Switch and Neutral Switch

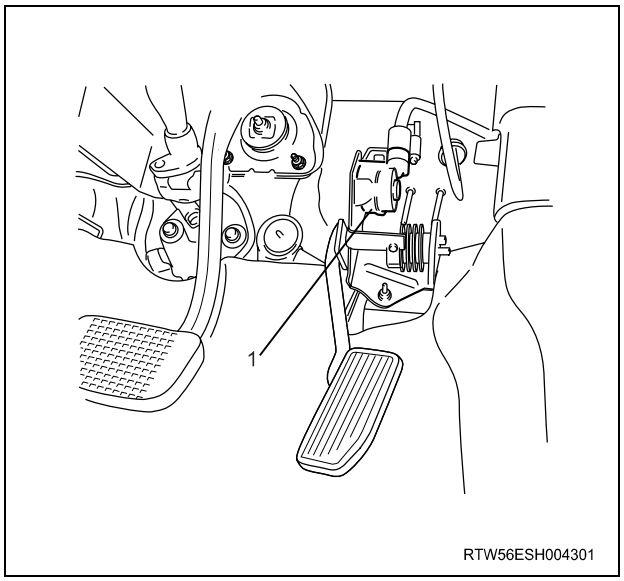


Brake Switch and Cruise Control



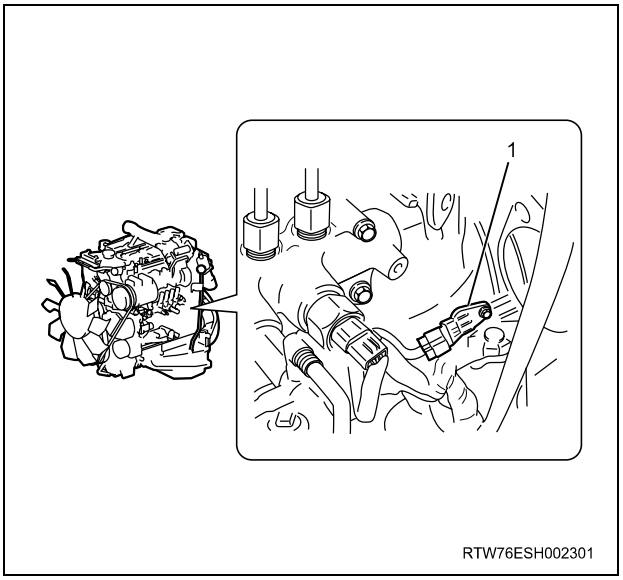
Component Locator

Engine Controls Component Views



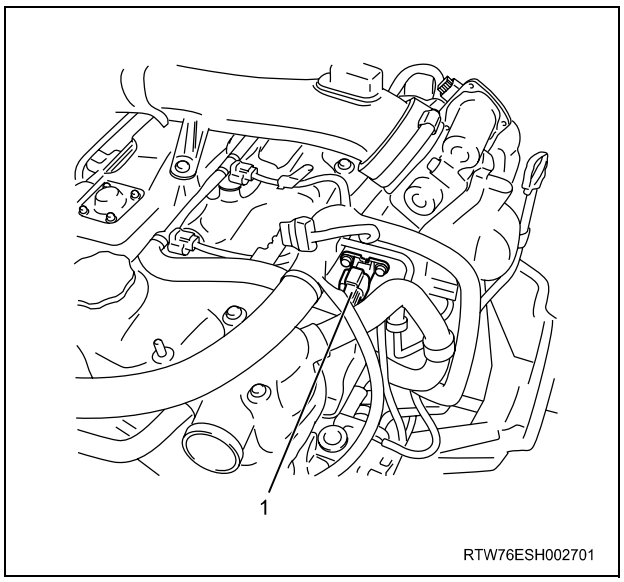
Legend

1. Accelerator pedal position (APP) sensor



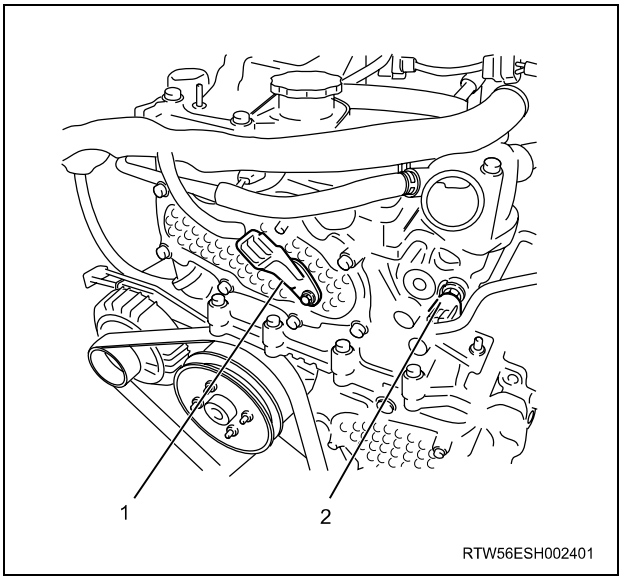
Legend

1. Crankshaft (CKP) sensor



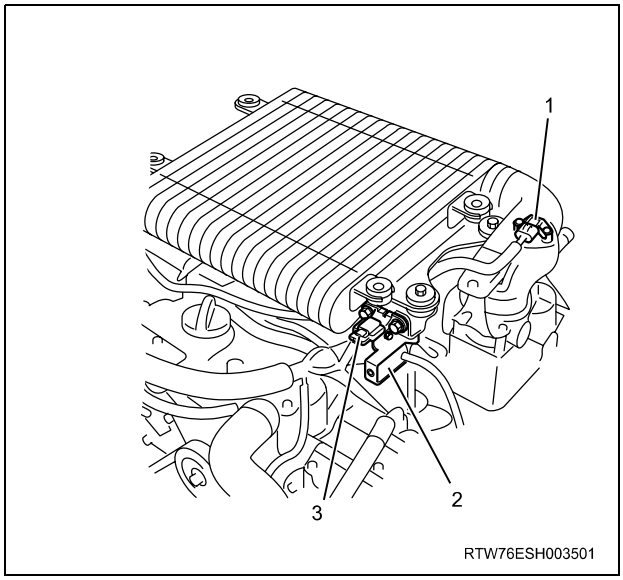
Legend

1. Barometric pressure (BARO) sensor (Standard output)



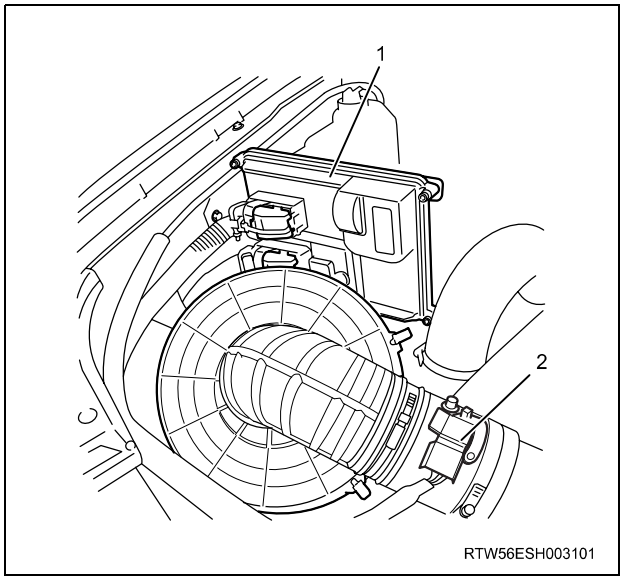
Legend

1. Camshaft position (CMP) sensor
2. Engine coolant temperature (ECT) sensor



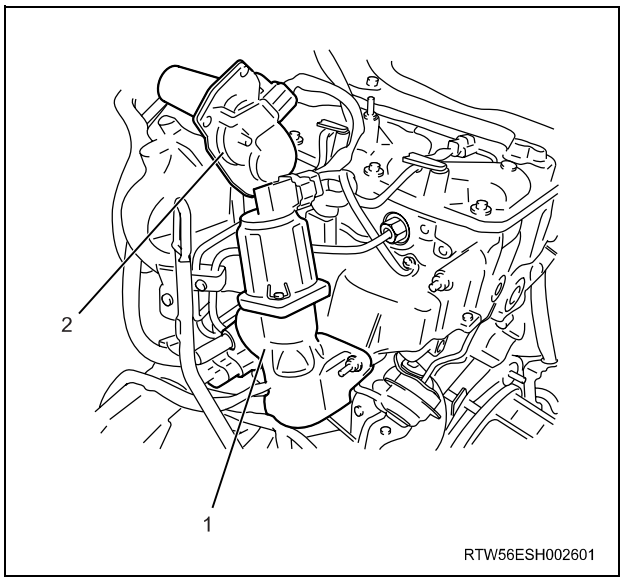
Legend

1. Boost pressure sensor
2. Turbocharger nozzle control solenoid
3. Barometric pressure (BARO) sensor (High output)



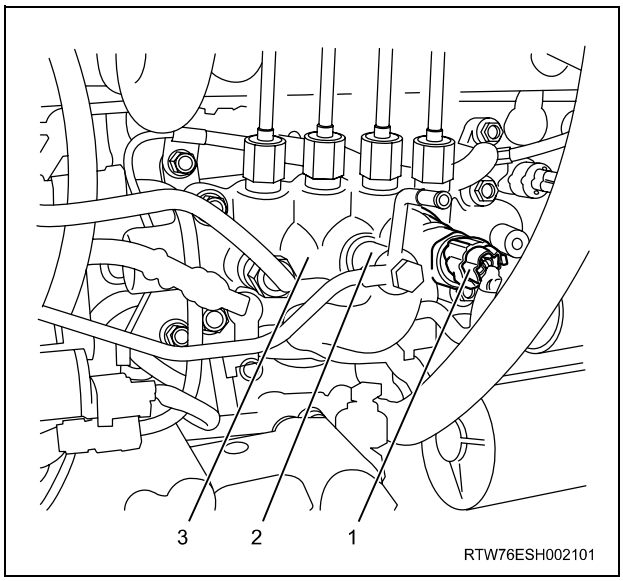
Legend

1. Engine control module (ECM)
2. Mass air flow (MAF) sensor / intake air templature (IAT) sensor



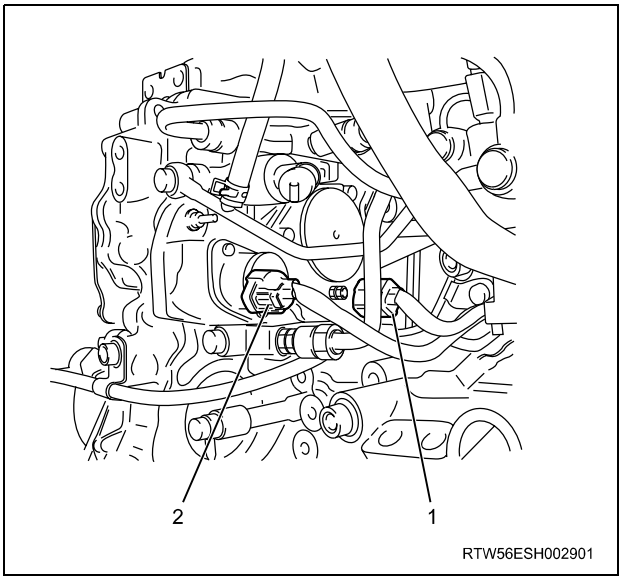
Legend

1. Exhaust gas recirculation (EGR) valve
2. Intake throttle valve



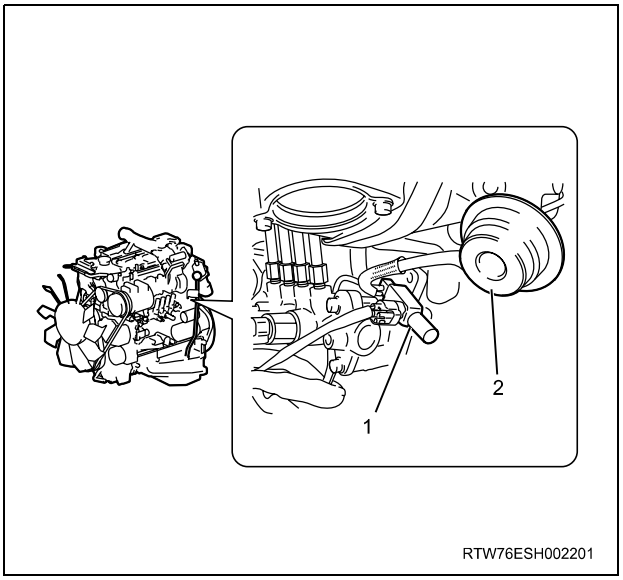
Legend

1. Fuel rail pressure (FRP) sensor
2. Pressure limiter valve
3. Fuel rail



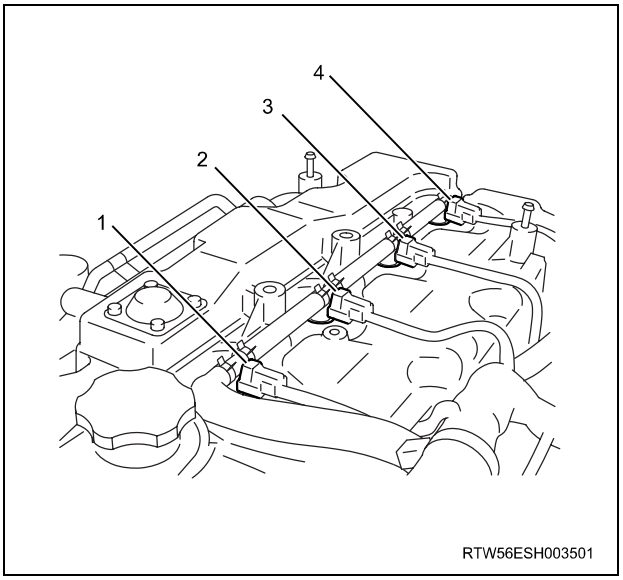
Legend

1. Fuel temperature (FT) sensor
2. Fuel Rail Pressure (FRP) regulator



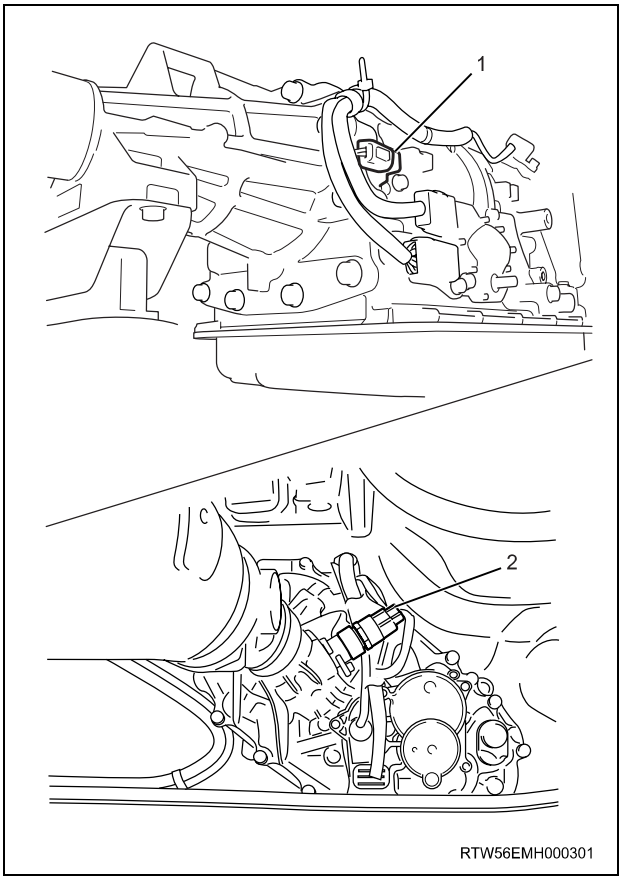
Legend

1. Swirl control solenoid valve
2. Swirl control actuator



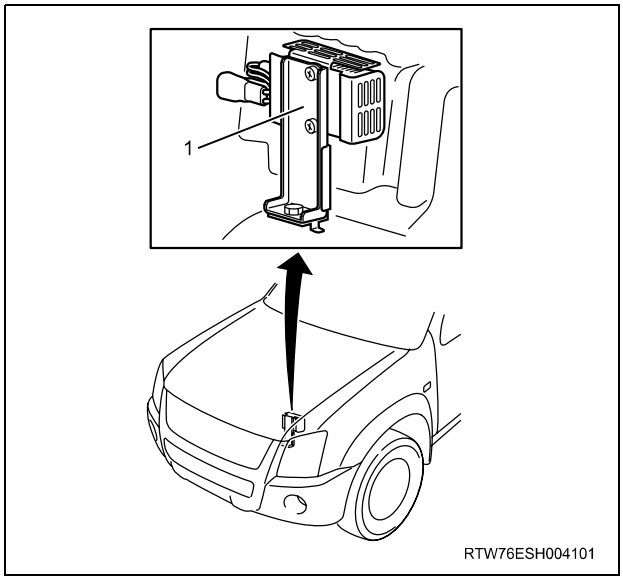
Legend

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



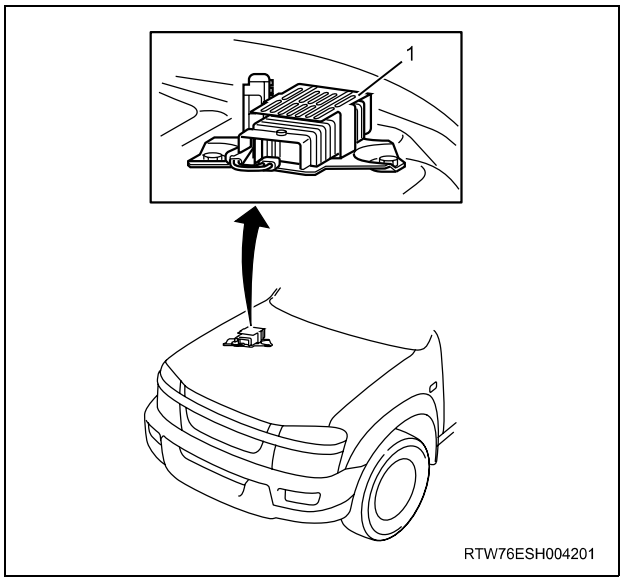
Legend

1. Vehicle speed sensor (VSS) 2WD with A/T
2. Vehicle speed sensor (VSS) except 2WD with A/T



Legend

1. Fuel pump resistor (A type)

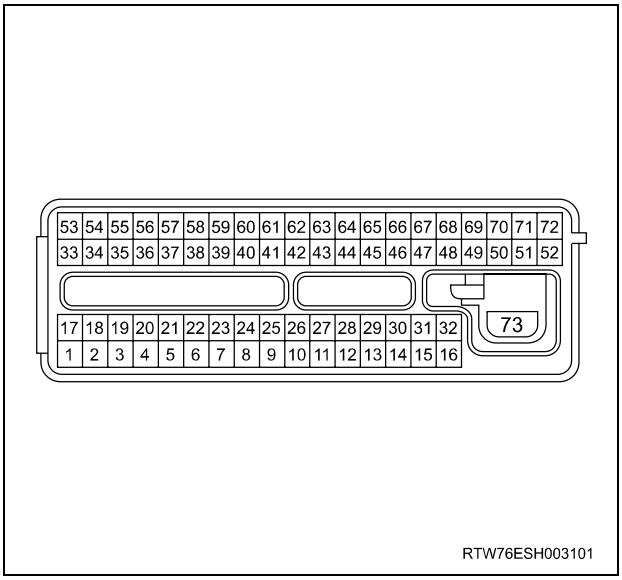


Legend

1. Fuel pump resistor (B type)

Engine Control Module (ECM) Connector End Views

Engine Control Module (ECM)-J1

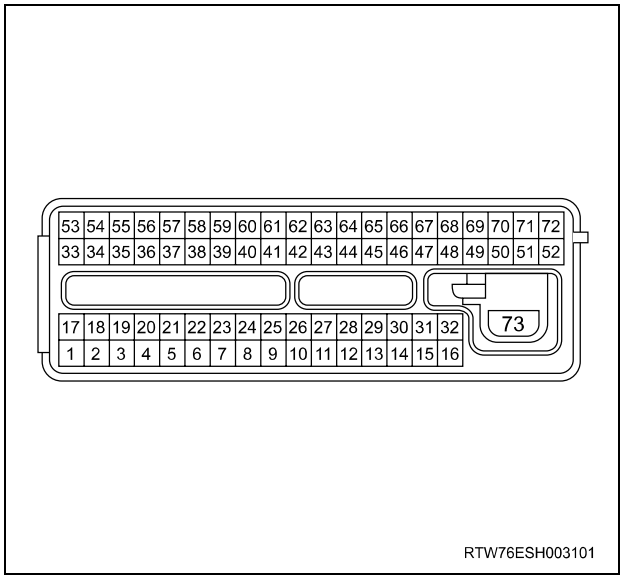


RTW76ESH003101

Connector No.		E-90
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	—	Not used
2	—	Not used
3	—	Not used
4	—	Not used
5	—	Not used
6	—	Not used
7	—	Not used
8	—	Not used
9	—	Not used
10	—	Not used
11	—	Not used
12	—	Not used
13	—	Not used
14	—	Not used
15	—	Not used
16	—	Not used
17	ORN	BARO sensor low reference
18	PNK/ GRN	BARO sensor signal
19	BLU/ GRN	BARO sensor 5V reference
20	GRN	Boost pressure sensor 5V reference
21	YEL	Boost pressure sensor signal
22	BLK	Boost pressure sensor shield ground
23	BLU	Boost pressure sensor low reference
24	YEL	Cylinder #2 fuel injector control
25	BRN	Cylinder #3 fuel injector control
26	WHT	ECT sensor low reference
27	GRN/ RED	ECT sensor signal
28	YEL/ RED	FT sensor low reference
29	PNK	FT sensor signal
30	RED	EGR position sensor low reference
31	WHT/ BLU	EGR position sensor 5V reference
32	GRY	EGR position sensor signal
33	BLU/ YEL	Cylinder #1 fuel injector control
34	BLU/ YEL	FRP regulator control high side
35	BLU	Intake throttle position sensor low reference
36	GRY	Intake throttle position sensor 5V reference
37	GRN	CKP sensor 5V reference
38	BLK	CKP sensor shield ground
39	BLU	CKP sensor low reference
40	ORN/ BLU	MAF sensor signal
41	BLU/ RED	IAT sensor signal
42	BLK	MAF sensor shield ground
43	WHT/ BLU	MAF sensor low reference
44	BLK	CMP sensor low reference
45	WHT	CMP sensor signal
46	RED	CMP sensor 5V reference
47	RED	FRP sensor 5V reference
48	WHT	FRP sensor signal
49	BLK	FRP sensor shield ground
50	BLU/ RED	FRP regulator low side
51	WHT	Cylinder #3 fuel injector charge voltage
52	BLU	Cylinder #1 fuel injector charge voltage
53	GRN	Cylinder #4 fuel injector control
54	BLK/ YEL	FRP regulator control high side
55	WHT	Intake throttle drive voltage
56	RED	Intake throttle control low side
57	ORN	Intake throttle position sensor signal

Pin No.	Wire Color	Pin Function
58	YEL	CKP sensor signal
59	PNK	Fuel filter switch signal
60	—	Not used
61	BLU/ GRN	IAT sensor low reference
62	BRN	EGR drive voltage
63	YEL	EGR control low side
64	BLK	CMP sensor shield ground
65	—	Not used
66	ORN/ BLK	Turbocharger nozzle control solenoid valve control
67	YEL	Swirl control solenoid valve control
68	WHT	FRP sensor signal
69	BLK	FRP sensor low reference
70	BLU/ RED	FRP regulator low side
71	RED	Cylinder #2 fuel injector charge voltage
72	PNK	Cylinder #4 fuel injector charge voltage
73	BLK	Ground

Engine Control Module (ECM)-J2



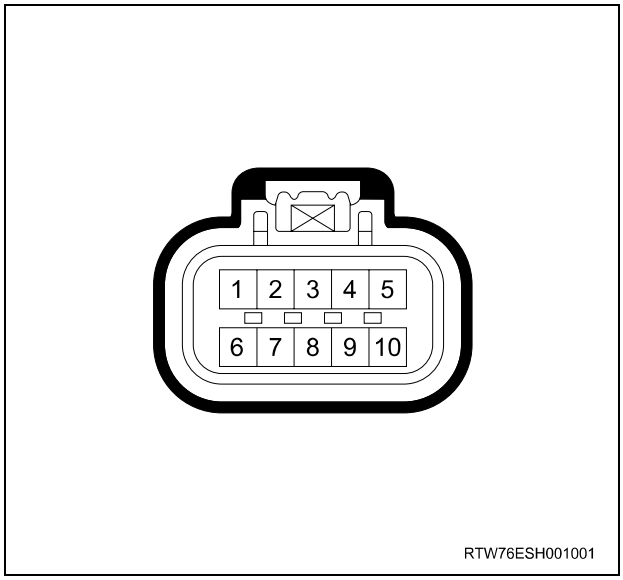
Connector No.		C-58
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	ORN	Brake switch 2 signal
2	BLK/ GRN	Diagnostic request switch

Pin No.	Wire Color	Pin Function
3	RED/ GRN	P or N range switch (A/T)
	BLK/ WHT	Neutral switch (M/T)
4	GRN/ BLK	Thermo relay signal
5	—	Not used
6	—	Not used
7	BLU	APP sensor 3 5V reference
8	BL/ UWHT	APP sensor 3 signal
9	ORN	APP sensor 2 5V reference
10	BLU/ GRN	APP sensor 2 signal
11	WHT	APP sensor 1 5V reference
12	RED	APP sensor 1 signal
13	GRY/ GRN	Cruise cancel switch signal
14	WHT/ GRN	Cruise main switch signal
15	—	Not used
16	—	Not used
17	—	Not used
18	—	Not used
19	YEL	Clutch switch signal
20	—	Not used
21	RED	Brake switch 1 signal
22	—	Not used
23	BLU/ RED	APP sensor 3 low reference
24	BLK	APP sensor 3 shield ground
25	ORN/ BLU	APP sensor 2 low reference
26	BLK	APP sensor 2 shield ground
27	BLK	APP sensor 1 low reference
28	BLK	APP sensor 1 shield ground
29	BRN/ YEL	Cruise resume switch signal
30	LT GRN	Cruise set switch signal
31	—	Not used
32	—	Not used
33	BLK/ RED	Engine speed signal output
34	—	Not used
35	ORN/ BLU	Starter cut relay control
36	—	Not used
37	BLK/ BLU	Glow relay control
38	—	Not used
39	—	Not used
40	—	Not used
41	—	Not used
42	—	Not used

Pin No.	Wire Color	Pin Function
43	—	Not used
44	RED/ WHT	Starter switch signal
45	BLU/ RED	ECM main relay control
46	—	Not used
47	—	Not used
48	—	Not used
49	GRN/ YEL	Cruise set lamp control
50	GRN/ WHT	Cruise main lamp control
51	—	Not used
52	RED/ WHT	Battery voltage (Back-up)
53	—	Not used
54	ORN/ BLK	Fuel pump relay control
55	GRY/ RED	A/C compressor relay control
56	RED/ WHT	Accelerator pedal position signal output
57	BRN/ YEL	MIL control
58	—	Not used
59	—	Not used
60	—	Not used
61	—	Not used
62	BLK/ YEL	VSS signal
63	BLK	Ground
64	—	Not used
65	BLU/ RED	ECM main relay control
66	YEL	CAN High
67	BLU	CAN Low
68	—	Not used
69	BRN/ RED	Fuel filter lamp control
70	ORN/ WHT	Fuel consumption signal output
71	PNK/ WHT	SVS lamp control (Euro 4 specification)
72	WHT/ GRN	Ignition voltage
73	RED/ BLU	Battery voltage

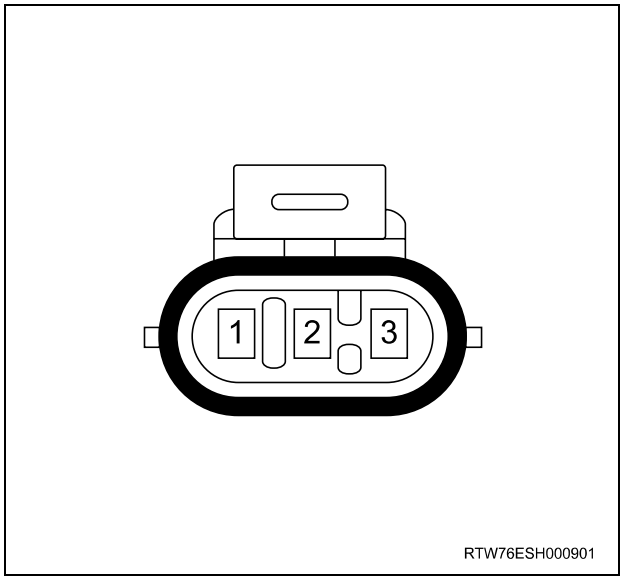
Engine Control Connector End Views

Accelerator Pedal Position (APP) Sensor



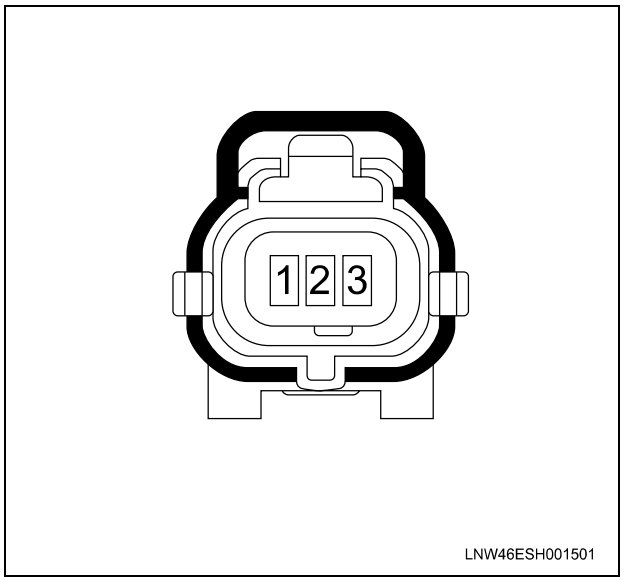
Connector No.		C-40
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	BLU	APP sensor 3 5V reference
2	—	Not used
3	ORN/ BLU	APP sensor 2 low reference
4	BLK	APP sensor 1 low reference
5	RED	APP sensor 1 signal
6	BLU/ WHT	APP sensor 3 signal
7	BLU/ RED	APP sensor 3 low reference
8	ORN	APP sensor 2 5V reference
9	BLU/ GRN	APP sensor 2 signal
10	WHT	APP sensor 1 5V reference

Barometric Pressure (BARO) Sensor



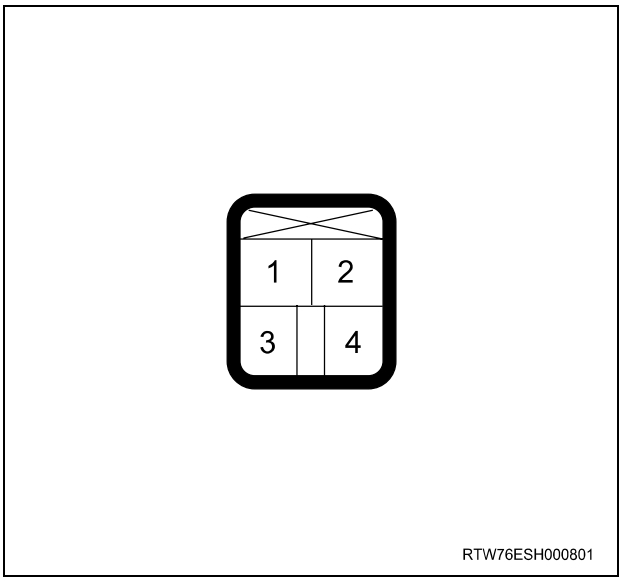
Connector No.		E-40
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	ORN	Sensor low reference
2	PNK/ GRN	Sensor signal
3	BLU/ GRN	Sensor 5V reference

Boost Pressure Sensor



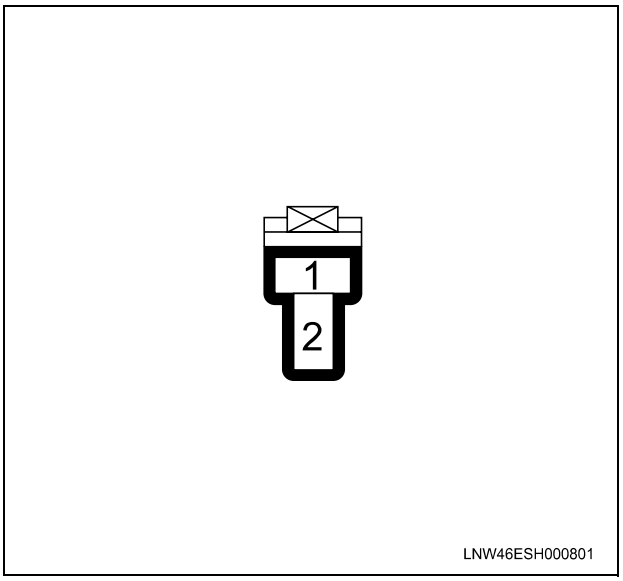
Connector No.		E-107
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	YEL	Sensor signal
2	BLU	Sensor low reference
3	GRN	Sensor 5V reference

Brake Switch



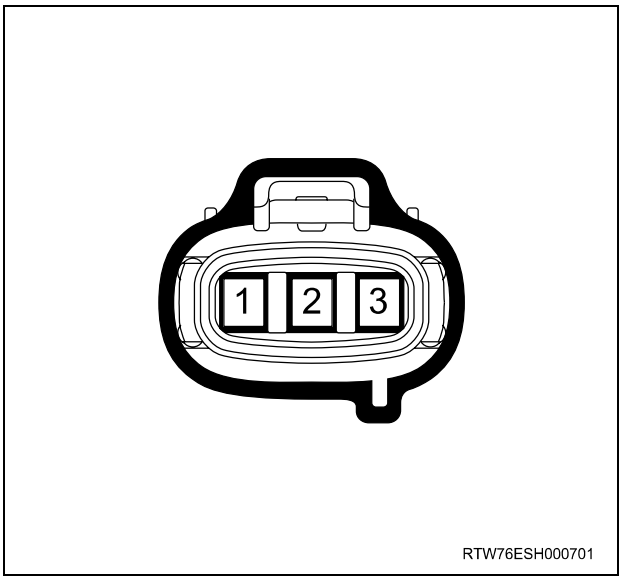
Connector No.		C-44
Connector Color		White
Test Adapter No.		J-35616-40 (Pin1-2) J-35616-2A (Pin3-4)
Pin No.	Wire Color	Pin Function
1	GRN	Switch 1 (stop lamp switch) battery voltage feed
2	RED	Switch 1 (stop lamp switch) signal
3	ORN	Switch 2 signal
4	WHT/ GRN	Brake switch 2 ignition voltage feed

Clutch Switch



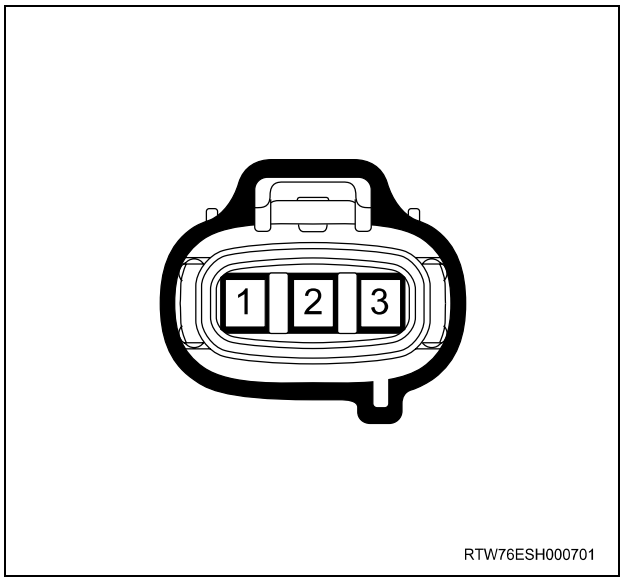
Connector No.		C-77
Connector Color		White
Test Adapter No.		J-35616-42
Pin No.	Wire Color	Pin Function
1	WHT/ GRN	Ignition voltage feed
2	YEL	Switch signal

Camshaft Position (CMP) Sensor



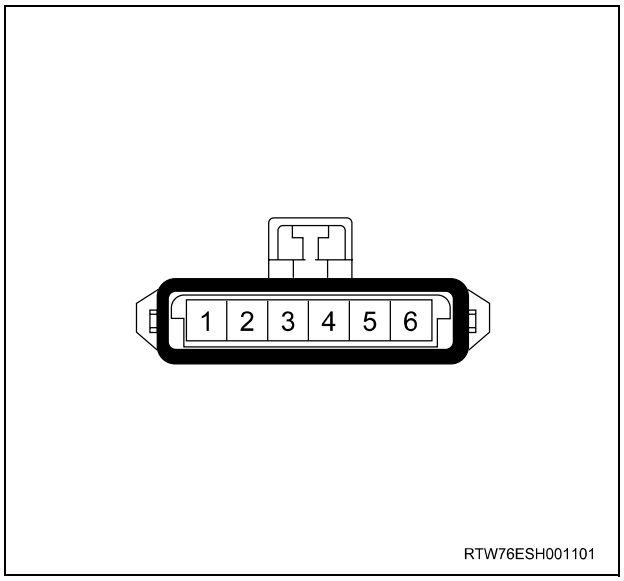
Connector No.		E-39
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	WHT	Sensor signal
2	BLK	Sensor low reference
3	RED	Sensor 5V reference

Crankshaft Position (CKP) Sensor



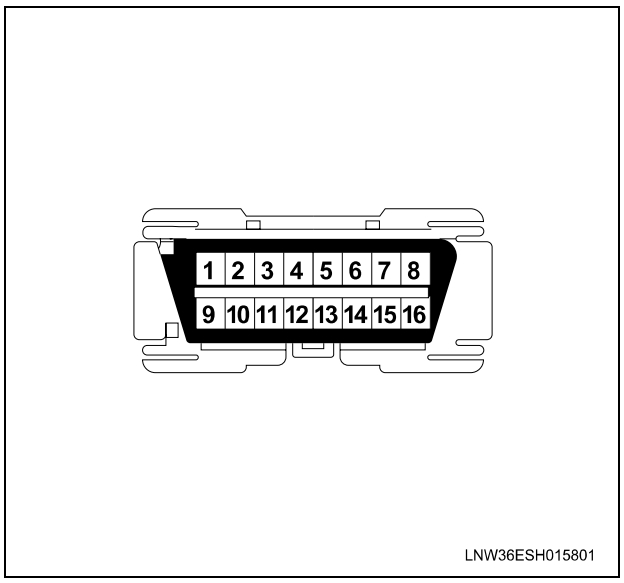
Connector No.		E-52
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	YEL	Sensor signal
2	BLU	Sensor low reference
3	GRN	Sensor 5V reference

Cruise Main Switch



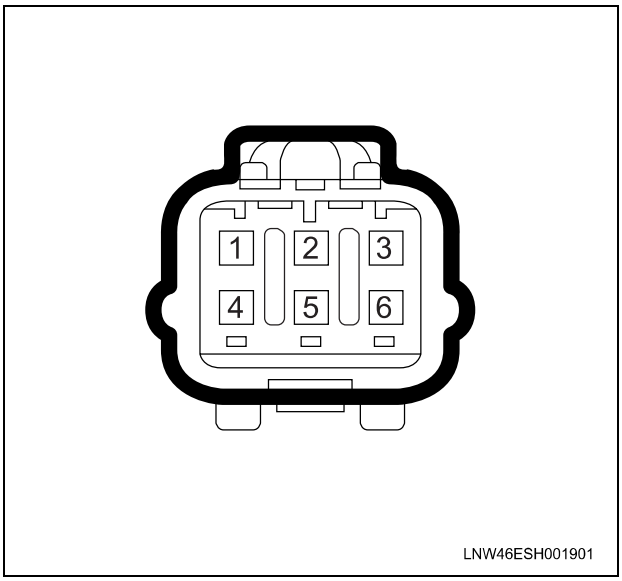
Connector No.		B-67
Connector Color		White
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	RED/ GRN	Illumination lamp ground
2	GRN/ RED	Illumination lamp voltage feed
3	WHT/ GRN	Cruise main switch signal
4	WHT/ GRN	Cruise main switch ignition voltage
5	—	Not used
6	GRN/ WHT	Cruise main switch ignition lamp ground

Data Link Connector (DLC)



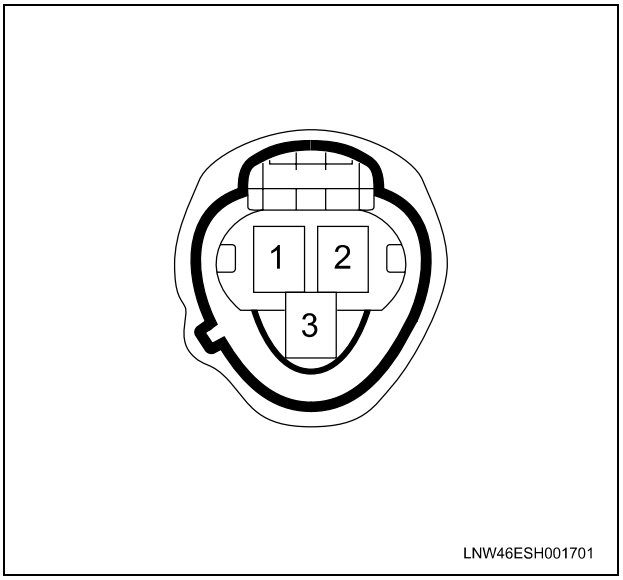
Connector No.		B-58
Connector Color		Black
Test Adapter No.		J-35616-2A
Pin No.	Wire Color	Pin Function
1	BKL/ GRN	Diagnostic request switch (ECM)
2	—	Not used
3	—	Not used
4	BLK	Ground
5	BLK	Ground
6	BLU	CAN high
7	VIO/ GRN	Keyword serial data (TCM [standard output], EHCU [ABS module] and SRS control unit)
8	—	Not used
9	—	Not used
10	—	Not used
11	YEL/ BLK	Diagnostic request switch (TCM)
12	ORN/ WHT	Diagnostic request switch (EHCU [ABS module])
13	RED	Diagnostic request switch (SRS control unit)
14	YEL	CAN low
15	—	Not used
16	RED/ YEL	Battery voltage

EGR Valve



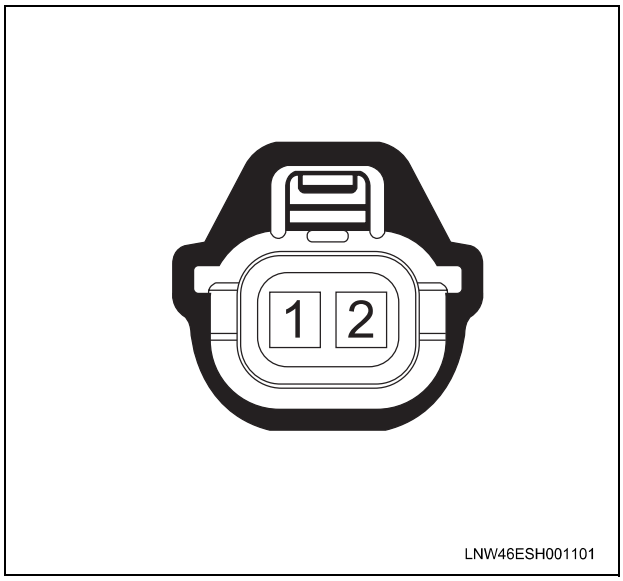
Connector No.		E-71
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	WHT/ BLU	Position sensor 5V reference
2	RED	Position sensor low reference
3	GRY	Position sensor signal
4	BRN	Solenoid drive voltage
5	—	Not used
6	YEL	Solenoid control low side (PWM)

Engine Coolant Temperature (ECT) Sensor



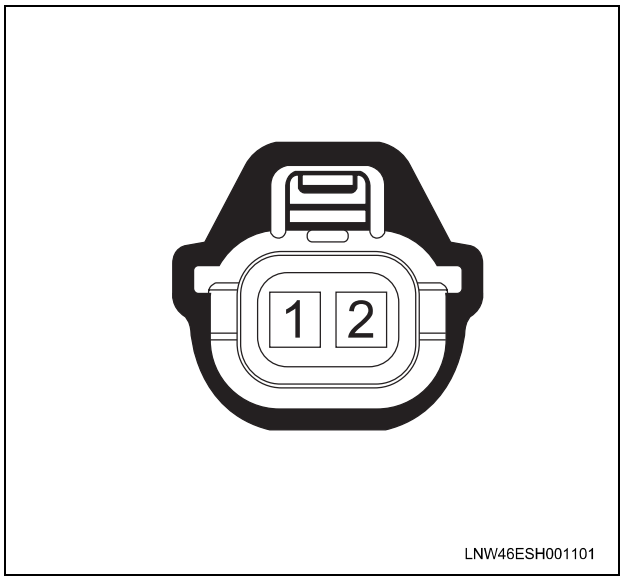
Connector No.		E-41
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	GRN/ RED	Sensor signal
2	WHT	Sensor low reference
3	YEL/ BLK	Gauge signal

Fuel Injector No.1 Cylinder



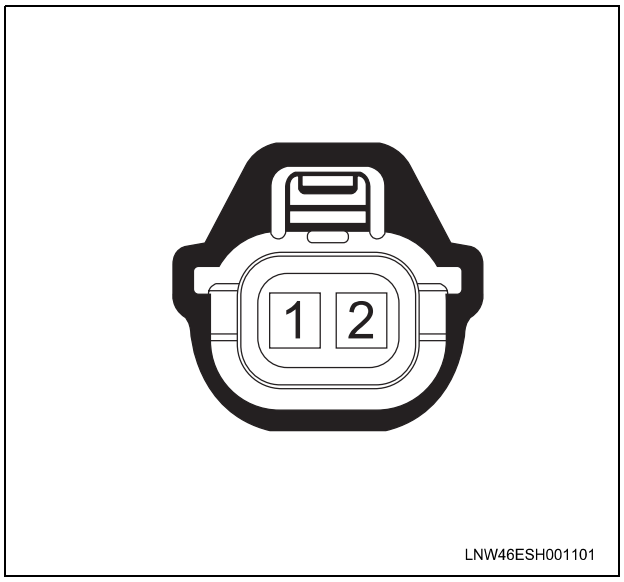
Connector No.		E-13
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	BLU/ YEL	Solenoid control
2	BLU	Charge voltage

Fuel Injector No.2 Cylinder



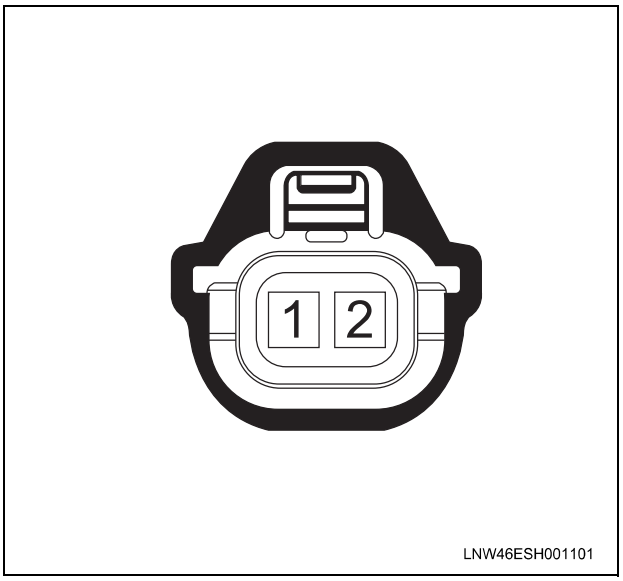
Connector No.		E-14
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	YEL	Solenoid control
2	RED	Charge voltage

Fuel Injector No.3 Cylinder



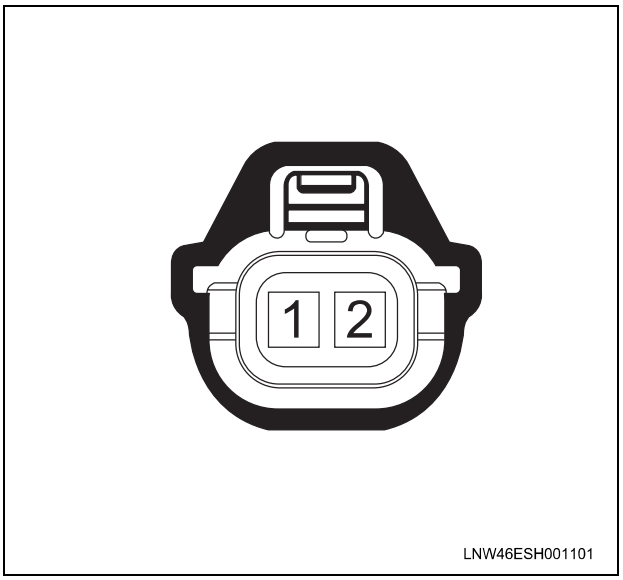
Connector No.		E-15
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	BRN	Solenoid control
2	WHT	Charge voltage

Fuel Injector No.4 Cylinder



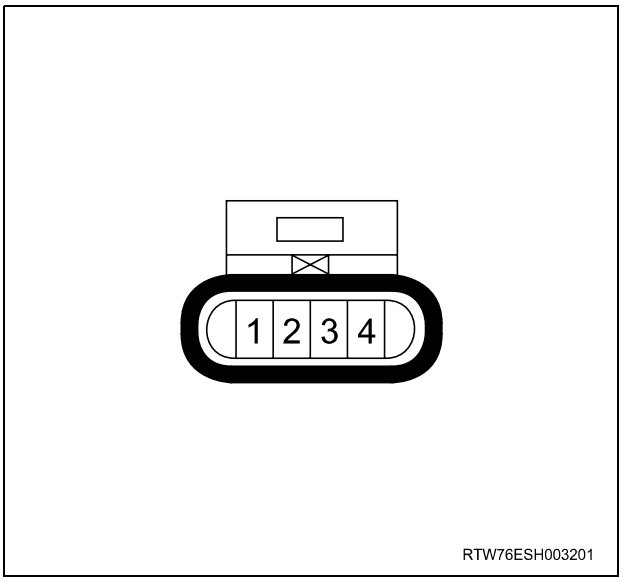
Connector No.		E-16
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	GRN	Solenoid control
2	PNK	Charge voltage

Fuel Rail Pressure (FRP) Regulator



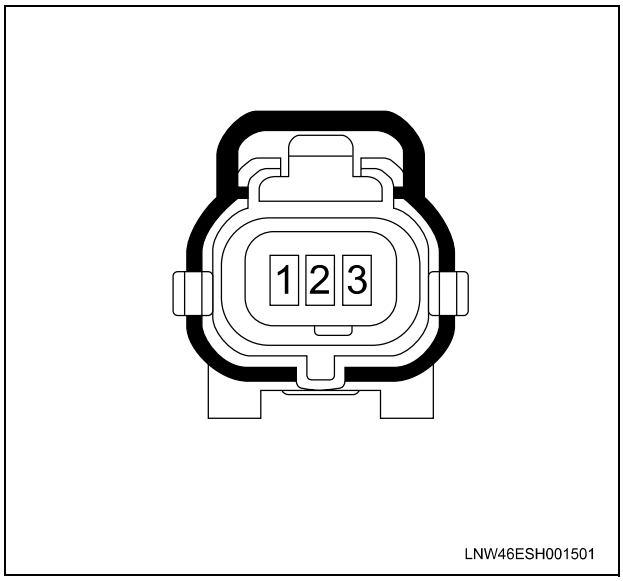
Connector No.		E-50
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	BLK/ YEL	Control high side (PWM)
2	BLU/ RED	Low side

Fuel Pump & Sender Assembly



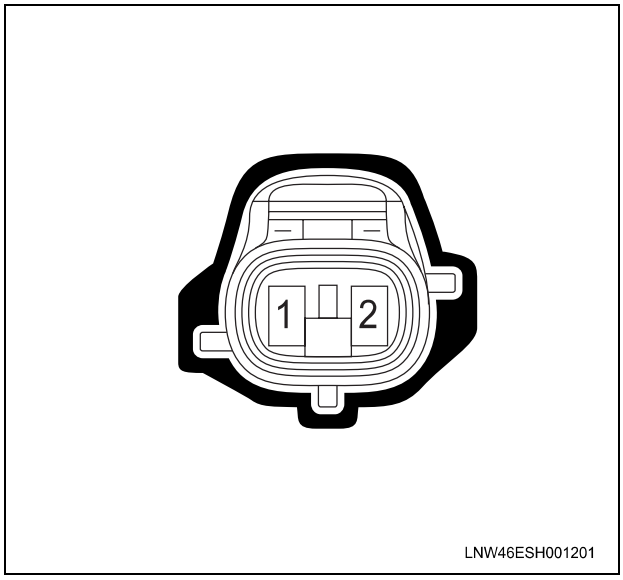
Connector No.		F-2
Connector Color		White
Test Adapter No.		J-35616-4A
Pin No.	Wire Color	Pin Function
1	ORN/ BLU	Fuel pump motor voltage feed
2	BLK	Fuel gauge ground
3	YEL/RED	Fuel gauge signal
4	BLK	Fuel pump motor ground

Fuel Rail Pressure (FRP) Sensor



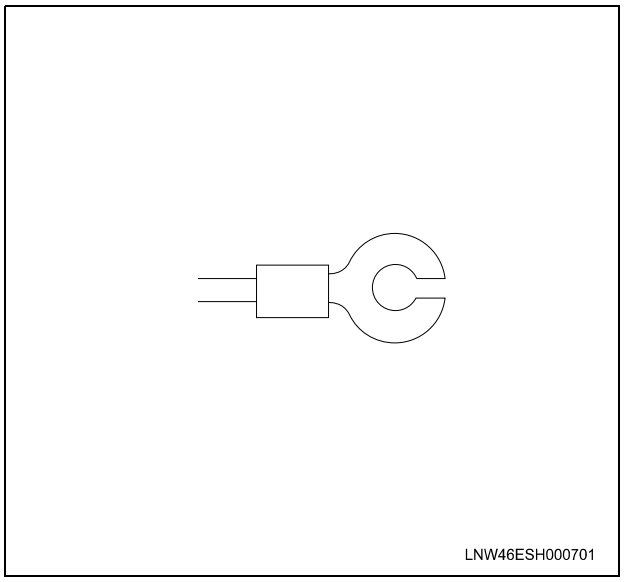
Connector No.		E-48
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	BLK	Sensor low reference
2	WHT	Sensor signal
3	RED	Sensor 5V reference

Fuel Temperature (FT) Sensor



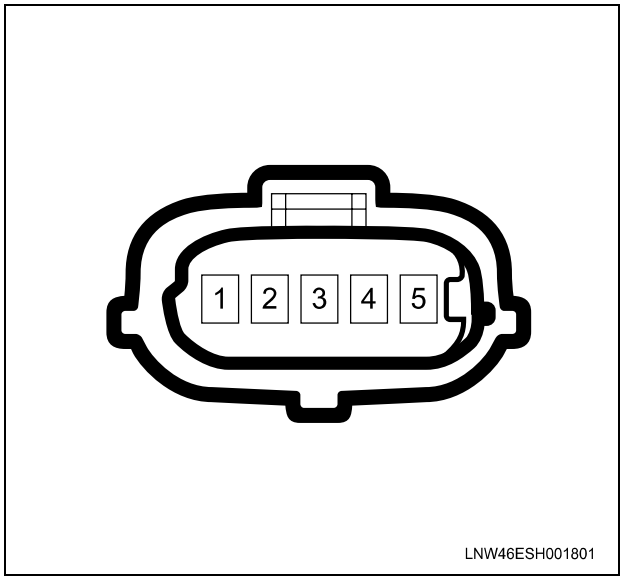
Connector No.		E-27
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	YEL/ RED	Sensor low reference
2	PNK	Sensor signal

Glow Plug



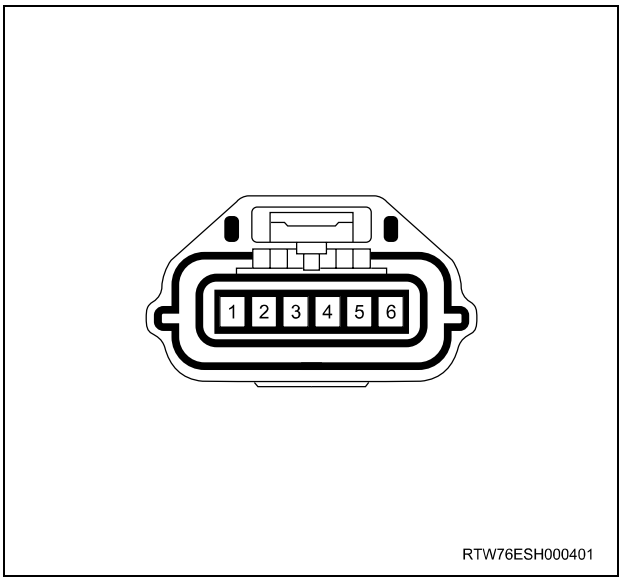
Connector No.		E-49
Connector Color		Silver
Pin No.	Wire Color	Pin Function
1	BLK/ RED	Power supply

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



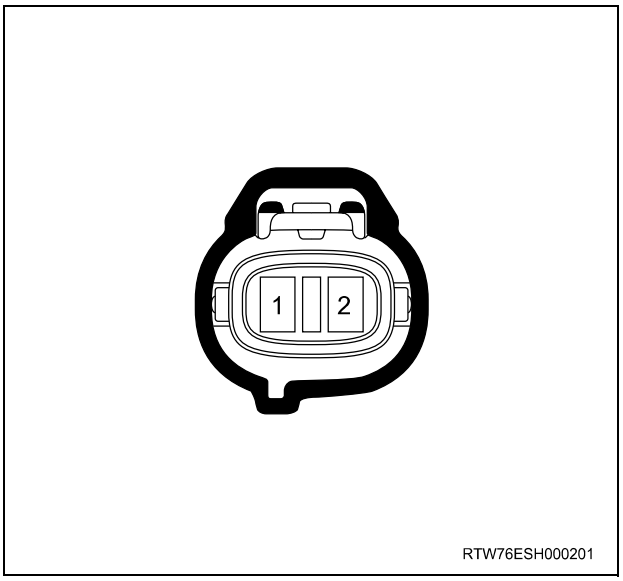
Connector No.		E-47
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	RED/ BLU	MAF sensor ignition voltage feed
2	WHT/ BLU	MAF sensor low reference
3	ORN/ BLU	MAF sensor signal
4	BLU/ RED	IAT sensor signal
5	BLU/ GRN	IAT sensor low reference

Intake Throttle Valve



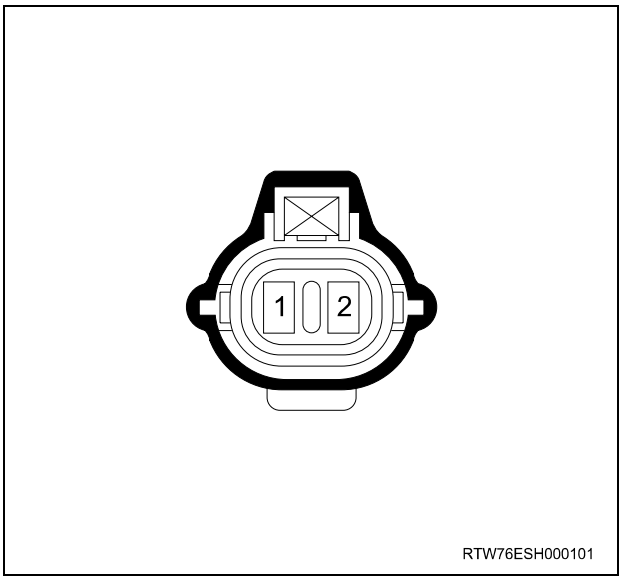
Connector No.		E-38
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	RED	Solenoid control low side (PWM)
2	WHT	Solenoid drive voltage
3	BLU	Position sensor low reference
4	—	Not used
5	ORN	Position sensor signal
6	GRY	Position sensor 5V reference

Swirl Control Solenoid Valve



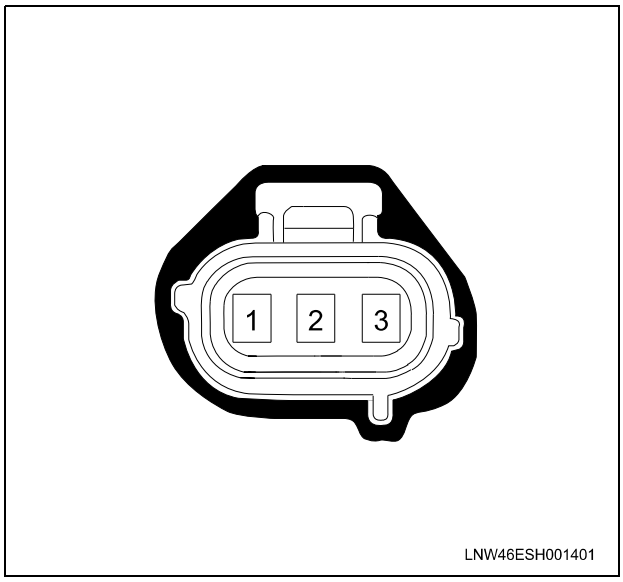
Connector No.		E-67
Connector Color		Brown
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	YEL	Solenoid valve control
2	RED/ BLU	Ignition voltage feed

Turbocharger Nozzle Control Solenoid Valve



Connector No.		E-106
Connector Color		Brown
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	YEL/ BLK	Solenoid valve control (PWM)
2	RED/ BLU	Ignition voltage feed

Vehicle Speed Sensor (VSS)



Connector No.		E-44
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	YEL	Ignition voltage feed
2	GRN/ WHT	Sensor low reference
3	BLK/ YEL	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 ☐ High idling speed (RPM) ☐ Low idling speed (RPM) ☐ Rough idling ☐ Other ( )
	☐ Poor Driveability	☐ Hesitation, sag, stumble ☐ Surge ☐ Cut out ☐ Lack of power, sluggishness, sponginess ☐ Other ( )
	☐ Engine Stall	☐ Soon after starting ☐ After accelerator pedal depressed ☐ During A/C operation ☐ After accelerator pedal released ☐ Shifting from N to D ☐ Other ( )
	☐ Others	☐ Black smoke ☐ White smoke ☐ Poor fuel economy ☐ Fuel knock, combustion noise ☐ Other ( )

Dates problem occurred		
Problem frequency		☐ Constant ☐ Intermittently (times per day/month) ☐ Once only ☐ Other ( )
Condition When Problem Occurs	Weather	☐ Fine ☐ Cloudy ☐ Rainy ☐ Snow ☐ Various/Other ( )
	Outside Temperature	☐ Hot (approx.) ☐ Warm ☐ Cool ☐ Cold (approx.) ☐ Any temperature
	Place	☐ Highway ☐ Suburbs ☐ City area ☐ Uphill ☐ Downhill ☐ Rough road ☐ Other ( )
	Load Condition	☐ Over (approx. tons) ☐ No load ☐ Other (approx. tons)
	Engine Temperature	☐ Cold ☐ Warming up ☐ After warming up ☐ Any temperature ☐ Other ( )
	Engine Operation	☐ Starting ☐ Just after starting (Min.) ☐ Idling ☐ Racing ☐ Driving ☐ Constant speed ☐ Acceleration ☐ Deceleration ☐ A/C switch On/Off ☐ Other ( )
	Fuel Amount	☐ Full ☐ Above 1/2 ☐ Below 1/2 ☐ Near empty
	Fuel Bland	

Condition of MIL or SVS lamp		☐ Remains On ☐ Intermittently turns On ☐ Does not turn On	
DTC or Flash Code	Present Code	☐ Nothing	☐ P or U Code No. ( )
	History Code	☐ Nothing	☐ P or U Code No. ( )
Other Additional Condition			

Diagnostic Starting Point - Engine Controls

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

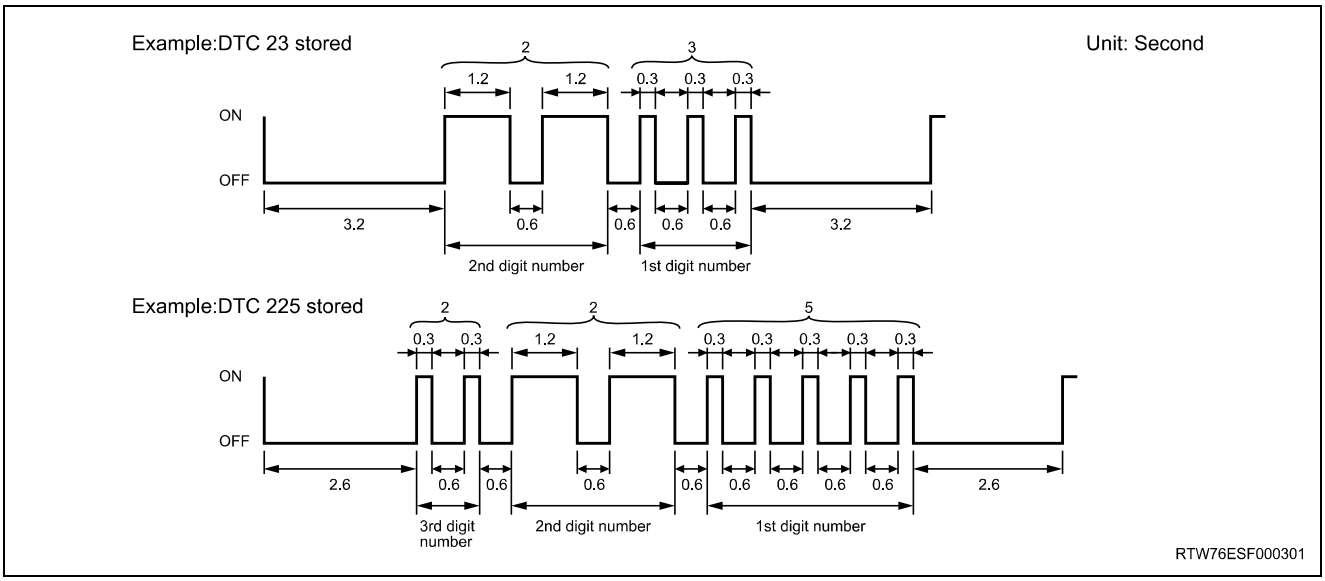
- The identification of the control modules which command the system.
- The ability of the control modules to communicate through the serial data circuit.
- The identification of any stored diagnostic trouble codes (DTCs) and the their statuses.

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 complaint vehicle, 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 "1" (diagnostic request) is pulled "Low" (grounded) by jumped to DLC terminal "4", which is a ground wire. Once terminals "1" 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 set order with each DTC being displayed three times. The flash DTC display will continue as long as the DLC is shorted.



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.
7. The presence of DTCs which begin with U, indicate that some other module is not communicating.
10. If there are other modules with DTCs set, refer to the DTC list. The DTC list directs you to the appropriate diagnostic procedure. If the control module stores multiple DTCs, diagnose the DTCs in the following order:

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

Diagnostic System Check Engine Controls Important:

- DO NOT perform this diagnostic if there is not a driveability concern, unless another procedure directs you to this diagnostic.
- Before you proceed with diagnosis, search for applicable service bulletins.
- Unless a diagnostic procedure instructs you, DO NOT clear the DTCs.
- If there is a condition with the starting system, refer to the starting system section in the engine mechanical.
- Ensure the battery has a full charge.
- Ensure the battery cables (+) (-) are clean and tight.
- Ensure the ECM grounds are clean, tight, and in the correct location.
- Ensure the ECM harness connectors are clean and correctly connected. 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.
- Ensure the immobilizer security information is correctly programmed into the ECM and immobilizer control unit (ICU).
- If there are fuel system DTC's (P0087, P0088, P0089, P0093, P1093 or P1094), diagnose sensor DTCs, solenoid DTCs, actuator DTCs and relay DTCs first.

Diagnostic System Check - Engine Controls

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 • Immobilizer control unit (ICU) (If so equipped) • Transmission control module (TCM) (AISIN A/T only) Does the scan tool communicate with all the listed control modules?	—	Go to Step 3	Go to Scan Tool Does Not Communicate with CAN Device

Step	Action	Value(s)	Yes	No
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 P0615, P0633, P161B or U0167?	—	Go to Applicable DTC	Problem is relating to starting system. Refer to the applicable diagnostic chart in starting system
6	Select the DTC display function for the following control modules: • ECM • ICU (If so equipped) • TCM (AISIN A/T only) 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 or P1621?	—	Go to Applicable DTC	Go to Step 9
9	Does the scan tool display ECM DTCs P0562 or P0563, P156A or P156B?	—	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 automatic transmission?	—	Go to Diagnostic System Check - Transmission Controls	Go to Step 12
12	Is the customer's concern with the immobilizer system?	—	Go to Diagnostic System Check - Immobilizer Controls	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) 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 2000RPM
Operating Conditions: Engine idling or 2000RPM/ 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			
Engine Speed	RPM	Nearly 700 RPM	Nearly 2000 RPM
Desired Engine Idle Speed	RPM	700 RPM	700 RPM
Calculated Engine Load	%	-	-
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/ 68 to 140 °F	20 to 60 °C/ 68 to 140 °F
Fuel Temperature Sensor	Volts	0.8 to 2.3 volts	0.8 to 2.3 volts
MAF (Mass Air Flow)	g/sec	300 to 600 g/sec	200 to 600 g/sec
MAF Sensor (Mass Air Flow)	Volts	1.2 to 1.6 volts	2.0 to 2.7 volts
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
Turbocharger Solenoid Command	%	50 to 60 %	50 to 60 %
Desired Boost Pressure	kPa/ psi	Nearly 100 kPa/ 14.5 psi at sea level	Less than 120 kPa/ 17.4 psi
Boost Pressure	kPa/ psi	Nearly 100 kPa/ 14.5 psi at sea level	Less than 120 kPa/ 17.4 psi
Boost Pressure Sensor	Volts	Nearly 1.0 volt	Less than 1.3 volts
Desired Fuel Rail Pressure	MPa/ psi	30 MPa/ 4,350 psi	More than 70 MPa/ 10,200 psi (4JJ1 Euro 4 specification) More than 50 MPa/ 7,250 psi (4JJ1 except Euro 4 specification) More than 60 MPa/ 8,700 psi (4JK1)
Fuel Rail Pressure	MPa/ psi	27 to 33 MPa/ 3,900 to 4,800 psi	More than 70 MPa/ 10,200 psi (4JJ1 Euro 4 specification) More than 50 MPa/ 7,250 psi (4JJ1 except Euro 4 specification) More than 60 MPa/ 8,700 psi (4JK1)

Scan Tool Parameter	Units Displayed	Typical Data Value at Engine Idle	Typical Data Value at 2000RPM
Fuel Rail Pressure Sensor	Volts	1.4 to 1.5 volts	More than 2.1 volts (4JJ1 Euro 4 specification) More than 1.8 volts (4JJ1 except Euro 4 specification) More than 1.9 volts (4JK1)
FRP Regulator Command (Fuel Rail Pressure)	%	35 to 50 %	35 to 45 %
FRP Regulator Commanded Fuel Flow	mm^3/sec	More than 1,000 mm^3/sec	More than 2,000 mm^3/sec
FRP Regulator Feedback (Fuel Rail Pressure)	mA	1,600 to 2,000 mA	1,500 to 1,800 mA
Accelerator Pedal Position	%	0%	10 to 25 %
APP Sensor 1 (Accelerator Pedal Position)	Volts	0.2 to 1.0 volts	1.0 to 1.7 volts
APP Sensor 2 (Accelerator Pedal Position)	Volts	3.8 to 4.6 volts	3.3 to 3.9 volts
APP Sensor 3 (Accelerator Pedal Position)	Volts	3.8 to 4.6 volts	3.7 to 4.0 volts
EGR Solenoid Command	%	Less than 30 %	Less than 30 %
Desired EGR Position	%	Less than 70 %	Less than 80 %
EGR Position	%	Less than 70 %	Less than 80 %
EGR Position Sensor	Volts	Less than 2.9 volts	Less than 3.1 volts
Intake Throttle Solenoid Command	%	Less than 30 %	Less than 40 %
Desired Intake Throttle Position	%	Less than 30 %	Less than 80 %
Intake Throttle Position	%	Less than 30 %	Less than 80 %
Intake Throttle Position Sensor	Volts	Less than 1.6 volts	Less than 3.3 volts
Desired Injection Quantity	mm^3	7 to 12 mm^3	7 to 12 mm^3
Main Injection Quantity	mm^3	3 to 8 mm^3	5 to 10 mm^3
Main Injection Timing	°CA	2 to 12 °CA	0 to 10 °CA
Main Injection On Time	ms	600 to 800 ms	400 to 550 ms
Pre Injection Quantity	mm^3	1 to 4 mm^3	2 to 4 mm^3
Pre Injection Interval	°CA	3 to 20 °CA	10 to 30 °CA
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
Cylinder Balancing Update	Enabled/ Disabled	Enabled	Disabled
Fuel Supply Pump Status	Not Learn/ Learning/ Learned	Learning or Learned	Learning or Learned
Rail Pressure Feedback Mode	Wait Mode/ Feedback Mode/ Shutoff Mode	Feedback Mode	Feedback Mode
Engine Running Status	Off/ Ignition On/ Cranking/ Running	Running	Running

Scan Tool Parameter	Units Displayed	Typical Data Value at Engine Idle	Typical Data Value at 2000RPM
Cam/ Crank Sensor Signal Synchronization Status	Asynchronous/ No Crank Signal/ Synchronous	Synchronous	Synchronous
Engine Runtime	Time (hour: minute: second)	Varies	Varies
Vehicle Speed	km/h / MPH	0 km/h / 0 MPH	0 km/h / 0 MPH
Transmission Gear	Out of gear/ 1st/ 2nd/ 3rd/ 4th/ 5th	Out of gear	Out of gear
Starter Switch	On/Off	On	On
Ignition Switch	On/Off	On	On
Ignition Voltage	Volts	11.0 to 15.0 volts	11.0 to 15.0 volts
Battery Voltage	Volts	11.0 to 15.0 volts	11.0 to 15.0 volts
Fuel Pump Relay Command	On/ Off	On	On
Swirl Control Solenoid Command	On/ Off	On	On
Fuel Filter Switch	On/ Off	On	On
A/C Request Signal	On/ Off	Off	Off
A/C Relay Command	On/ Off	Off	Off
Park/ Neutral Switch	Neutral/ In Gear	Neutral	Neutral
Glow Relay Command	On/ Off	Off	Off
Glow Plug Lamp Command	On/ Off	Off	Off
Brake Switch 1	Applied/ Released	Released	Released
Brake Switch 2	Applied/ Released	Released	Released
Clutch Pedal Switch	Applied/ Released	Released	Released
Cruise Main Lamp Command	On/ Off	Off	Off
Cruise Main Switch	On/ Off	Off	Off
Cruise Cancel Switch	On/ Off	On	On
Cruise Resume Switch	On/ Off	Off	Off
Cruise Set Switch	On/ Off	Off	Off
MIL Command (Malfunction Indicator Lamp)	On/ Off	Off	Off
SVS Lamp Command (Service Vehicle Soon)	On/ Off	Off	Off
Limp Home Mode	None/ 1/ 2/ 3/ 4	None	None
Distance While MIL is Activated	km/ Mile	0 km/ 0 Mile	0 km/ 0 Mile
Engine Runtime With MIL Active	minutes	0	0
Total Engine Overspeed Event	Counter	Varies	Varies
Total Engine Coolant Overtemperature Event	Counter	Varies	Varies
Total Fuel Temperature Overtemperatrure Event	Counter	Varies	Varies
Total Intake Air Temperature Overtemperaure Event	Counter	Varies	Varies
Immobilizer Function Programmed	Yes/ No	Yes	Yes
Wrong Immobilizer Signal	Yes/ No	No	No

Scan Tool Parameter	Units Displayed	Typical Data Value at Engine Idle	Typical Data Value at 2000RPM
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.

Turbocharger Solenoid Command
This parameter displays the turbocharger nozzle control 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 nozzle is controlled to open (vacuum pressure supply to the actuator is reduced). The scan tool will display a higher percentage when the nozzle is controlled to close (vacuum pressure supply to the actuator is increased).

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).

Desired Fuel Rail Pressure
This parameter displays fuel rail pressure desired by the ECM based on current driving conditions. This can be compared to the actual fuel rail pressure to determine sensor accuracy or fuel pressure control problems.

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.

APP Sensor 3 (Accelerator Pedal Position)
This parameter displays the voltage signal sent to the ECM from the accelerator pedal position (APP) sensor 3 of the APP sensor assembly. APP sensor 3 is a range of value indicating a high voltage when the accelerator pedal is not depressed, and a middle voltage when the accelerator pedal is fully depressed.

EGR Solenoid Command
This parameter displays the EGR 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 EGR solenoid valve is controlled to close (EGR gas supply to the intake is reduced). The scan tool will display a higher percentage when the EGR solenoid valve is controlled to open (EGR gas supply to the intake is increased).

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 EGR control problems.

EGR Position
This parameter displays the EGR valve position calculated by the ECM using the signal from EGR position sensor. 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 Sensor
This parameter displays the voltage signal sent to the ECM from the EGR position sensor. EGR position sensor is a range of value indicating a low voltage when the EGR valve is closed, and a high voltage when the EGR valve is opened.

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 intake throttle 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.

Desired Injection Quantity
This parameter displays a total injection quantity (main injection quantity + pre injection quantity) desired by the ECM based on current driving conditions.

Main Injection Quantity
This parameter displays a main injection quantity desired by the ECM based on current driving conditions.

Main Injection Timing
This parameter displays a main injection timing desired by the ECM based on current driving conditions.

Main Injection On Time
This parameter displays the time the ECM turns ON the fuel injectors. The scan tool will display a higher value with a longer pulse width, or a lower value with a shorter pulse width.

Pre Injection Quantity
This parameter displays a pilot injection quantity desired by the ECM based on current driving conditions.

Pre Injection Interval
This parameter displays a injection interval between end of pilot injection and start of main injection desired by the ECM based on current driving condition.

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.

Cylinder Balancing Update
This parameter displays the state of the fuel compensation for each cylinder. Enabled indicates the adjustment of fuel volume for each cylinder is being executed by the ECM when the engine is idle speed, the engine coolant temperature sensor, the intake air temperature sensor, barometric pressure sensor and the vehicle speed sensor inputs are normal state.

Fuel Supply Pump Status
This parameter displays the learning state of the fuel supply pump. Not Learn 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. Learning indicates learning state. 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 during crank or 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.

Cam/ Crank Sensor Signal/ Synchronization Status
This parameter displays the synchronization state of the crankshaft position (CKP) sensor signal and camshaft position (CMP) sensor signal. Asynchronous indicates the CMP sensor signal is not detected or only CKP sensor signal is detected. No Crank Signal indicates CMP sensor signal is detected but CKP sensor signal is not detected. Synchronous indicates both sensor signals are detected correctly.

Engine Runtime
This parameter displays the time elapsed since the engine start. The scan tool will display the time in hours, minutes and seconds. The engine run time will reset to zero as soon as the ignition switch is OFF.

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.

Transmission Gear
This parameter displays the estimated transmission gear position as calculated by the ECM based on inputs from the vehicle speed and the engine speed.

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.

Fuel Pump Relay Command
This parameter displays the commanded state of the fuel pump relay control circuit. On indicates the fuel pump relay control circuit is being grounded by the ECM, allowing fuel pumping from the tank.

Swirl Control Solenoid Command
This parameter displays the commanded state of the swirl control solenoid control circuit. On indicates the swirl control solenoid control circuit is being grounded by the ECM, allowing vacuum pressure to the swirl control actuator.

Fuel Filter Switch
This parameter displays the input state of the fuel pressure switch to the ECM. When the large vacuum pressure is generated in the fuel suction line such as clogged fuel filter, the scan tool displays Off.

A/C Request Signal
This parameter displays the input state of the air conditioning (A/C) request to the ECM from the heating, ventilation, and air conditioning (HVAC) controls. When the HVAC system is requesting to ground the A/C compressor clutch, the scan tool displays On.

A/C Relay Command
This parameter displays the commanded state of the A/C compressor relay control circuit. On indicates the A/C compressor relay control circuit is being grounded by the ECM, allowing voltage to the A/C compressor.

Park/ 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.

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.

Glow Plug Lamp Command
This parameter displays the commanded state of the glow indicator lamp control circuit. The glow indicator lamp should be On when the scan tool indicates command On. The glow indicator lamp should be Off when the scan tool indicates command Off.

Brake Switch 1
This parameter displays the input state of the brake pedal switch 1 to the ECM. When the brake pedal is depressed, scan tool displays Applied.

Brake Switch 2
This parameter displays the input state of the brake pedal switch 2 to the ECM. When the brake pedal is depressed, scan tool displays Applied.

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.

Cruise Main Lamp Command
This parameter displays the commanded state of the cruise main lamp control circuit. The cruise main lamp should be On when the scan tool indicates command On. The cruise main lamp should be Off when the scan tool indicates command Off.

Cruise Main Switch
This parameter displays the input state of the cruise main switch to the ECM. When the Cruise Main switch is pushed, the scan tool displays On.

Cruise Cancel Switch
This parameter displays the input state of the cruise cancel switch to the ECM. When the Cruise Cancel switch is applied, the scan tool displays Off.

Cruise Resume Switch
This parameter displays the input state of the cruise resume/accel. switch to the ECM. When the Cruise Resume/Accel. switch is applied, the scan tool displays On.

Cruise Set Switch
This parameter displays the input state of the cruise set/coast switch to the ECM. When the Cruise Set/ Coast switch is pushed, the scan tool displays On.

MIL Command (Malfunction Indicator Lamp)
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.

SVS Lamp Command (Service Vehicle Soon)
This parameter displays the commanded state of the service vehicle soon (SVS) lamp control circuit. The SVS lamp should be On when the scan tool indicates command On. The SVS lamp should be Off when the scan tool indicates command Off.

Limp Home Mode
This parameter indicates the state of the limp-home mode. None indicates limp-home mode is not applied. 1, 2, 3 and 4 indicates fuel injection quantity reduction is applied. 2 or higher number inhibits pilot injection. If 4 is indicated, engine running will be stopped when the vehicle speed is less than 5 km/h (3 MPH) for 5 seconds.

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 engine run time elapsed since the malfunction indicator lamp (MIL) is turned ON. The scan tool will display the time in minutes.

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 95°C (203°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 55°C (131°F). Counter will be zero if any DTC is cleared.

Immobilizer Function Programmed
This parameter displays the state of the immobilizer function programming in the ECM. The scan tool 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 response 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. The wait time will increase each time an incorrect security code is entered. 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 Supply Pump Learn Resetting	The purpose of this test to reset the fuel supply pump adjustment value. **Important:** The fuel supply pump relearn procedure must be done when the fuel supply pump or engine is replaced, or an ECM from another vehicle is installed. Refer to Fuel Supply Pump Replacement.
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 Force 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.
Swirl Control Solenoid Control	The purpose of this test is for checking whether the swirl control solenoid is operating when commanded ON. Faulty circuit(s) or a faulty solenoid could be considered if not energizing when commanded ON.
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, misrouted vacuum hoses, a faulty solenoid or a faulty actuator could be considered if the actuator 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.
Glow Plug Lamp Control	The purpose of this test is for checking whether the glow indicator lamp is operating when commanded ON. Faulty circuit(s) or an open circuit could be considered when not operating when commanded ON.
Malfunction Indicator Lamp (MIL) Control	The purpose of this test is for checking whether the MIL is operating when commanded ON. Faulty circuit(s) or an open circuit could be considered when not operating when commanded ON.
Service Vehicle Soon (SVS) Lamp Control	The purpose of this test is for checking whether the SVS lamp is operating when commanded ON. Faulty circuit(s) or an open circuit could be considered when not operating when commanded ON.
Cruise Main Lamp Control	The purpose of this test is for checking whether the cruise main lamp is operating when commanded ON. Faulty circuit(s) or an open circuit could be considered when not operating when commanded ON.
Cruise Set Lamp Control	The purpose of this test is for checking whether the cruise set lamp is operating when commanded ON. Faulty circuit(s) or an open circuit could be considered when not operating when commanded ON.

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 works properly on another vehicle before using this chart. 1. Turn OFF the ignition. 2. Inspect the Meter (+B) (10A) fuse in the cabin fuse block. Is the Meter (+B) (10A) fuse open?	—	Go to Step 2	Go to Step 3
2	Replace the Meter (+B) (10A) fuse. If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the Meter (+B) (10A) 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-58) 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-58) 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-58) 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

Circuit Description

The ECM, transmission control module (TCM) (AISIN A/T only) and immobilizer control unit (ICU) all communicate with the scan tool over the controller area network (CAN) link. The ECM, TCM, ICU and the data recording module (DRM) communicate with each other over the same CAN link. If no immobilizer system is installed, the instrument panel (IP) cluster has a CAN terminating resistor instead of the ICU.

Diagnostic Aids

The following conditions will cause a loss of CAN serial data communication between the TCM and ICU or between the scan tool and any control module:

- 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

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 listed control modules. • ECM • Immobilizer Control Unit (ICU) (If so equipped) • Transmission control module (TCM) (AISIN A/T only) Does the scan tool communicate with any of the listed control modules?	—	Go to Step 3	Go to Step 7
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 AISIN automatic 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
5	**Notice:** If no immobilizer system is installed, skip to Step 6. Does the scan tool communicate with the ICU?	—	Go to Step 6	Go to Diagnostic System Check - Immobilizer Controls
6	Test the CAN Low and High serial data circuit for an intermittently short to ground or intermittently short to voltage. Then, test the CAN Low and High 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 19	System OK

Step	Action	Value(s)	Yes	No
7	1. Inspect for an intermittent, for poor connections and for corrosion at the data link connector (DLC) (pins 6 and 14 of B-58). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 8
8	**Notice:** If no data recording module (DRM) is installed, skip to Step 9. 1. Turn OFF the ignition. 2. Disconnect the DRM C-139 harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Attempt to communicate with the ECM, TCM and ICU. Does the scan tool communicate with the ECM, TCM and ICU?	—	Go to Step 14	Go to Step 9
9	1. Turn OFF the ignition. 2. Reconnect the DRM harness connector if disconnected. 3. Disconnect the ECM J1 (E-90) and J2 (C-58) harness connectors. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to communicate with the TCM and ICU. Does the scan tool communicate with the TCM and ICU?	—	Go to Step 15	Go to Step 10
10	**Notice:** If no AISIN automatic transmission is installed, skip to Step 11. 1. Turn OFF the ignition. 2. Reconnect the ECM J1 (E-90) and J2 (C-58) harness connectors. 3. Disconnect the TCM C-94 and C-95 harness connectors. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to communicate with the ECM and ICU. Does the scan tool communicate with the ECM and ICU?	—	Go to Step 16	Go to Step 11
11	**Notice:** If no immobilizer system is installed, skip to Step 12. 1. Turn OFF the ignition. 2. Reconnect the ECM J1 (E-90) and J2 (C-58) harness connectors if disconnected. 3. Reconnect the TCM C-94 and C-95 harness connectors if disconnected. 4. Disconnect the ICU B-68 harness connector. 5. Turn ON the ignition, with the engine OFF. 6. Attempt to communicate with the ECM and TCM. Does the scan tool communicate with the ECM and TCM?	—	Go to Step 17	Go to Step 13

Step	Action	Value(s)	Yes	No
12	1. Turn OFF the ignition. 2. Reconnect the ECM J1 (E-90) and J2 (C-58) harness connectors if disconnected. 3. Reconnect the TCM C-94 and C-95 harness connectors if disconnected. 4. Disconnect the instrument panel (IP) cluster B-23 and B-24 harness connector. 5. Turn ON the ignition, with the engine OFF. 6. Attempt to communicate with the ECM and TCM. Does the scan tool communicate with the ECM and TCM?	—	Go to Step 18	Go to Step 13
13	Repair the open circuit, short to ground or short to voltage on the CAN Low or High serial data circuit between the DLC and ECM, TCM, ICU, DRM or IP cluster. Did you complete the repair?	—	Go to Step 19	—
14	Replace the DRM. Refer to DRM Replacement. Did you complete the replacement?	—	Go to Step 19	—
15	**Important**: Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 19	—
16	**Important**: Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 19	—
17	**Important**: Replacement ICU must be programmed. Replace the ICU. Refer to ICU Replacement. Did you complete the replacement?	—	Go to Step 19	—
18	Replace the IP cluster. Refer to IP Cluster Replacement. Did you complete the replacement?	—	Go to Step 19	—
19	Attempt to establish communication with the ECM, TCM and ICU. Does the scan tool communicate with the ECM, TCM and ICU?	—	System OK	Go to Step 2

Lost Communication with The Engine Control Module (ECM)

Circuit Description

The ECM, transmission control module (TCM) (AISIN A/T only) and immobilizer control unit (ICU) all communicate with the scan tool over the controller area network (CAN) link. The ECM, TCM, ICU and the data recording module (DRM) communicate with each other over the same CAN link. If no immobilizer system is installed, the instrument panel (IP) cluster has a CAN terminating resistor instead of the ICU.

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)

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	Check the ECM C-58 and E-90 connectors for poor connections. Did you find and correct the condition?	—	Go to Step 16	Go to Step 4
4	1. Check the ECM (40A) slow blow fuse, ECM (B) (10A) fuse and Engine (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 C-58 harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Connect a test lamp to ground and check for voltage at the ignition voltage supply circuit at the ECM (pin 72 of C-58). Does the test lamp illuminate?	—	Go to Step 5	Go to Step 13
5	1. Turn OFF the ignition. 2. Disconnect the scan tool from the data link connector (DLC) if connected. 3. Measure the resistance across the CAN Low and High circuits by probing the DLC (pins 6 and 14 of B-58). Is the resistance within the specified value (parallel resistance of the 120 Ω resistor in the ECM and the 120 Ω resistor in the ICU or IP cluster should be 60Ω)?	50 to 70 Ω	Go to Step 7	Go to Step 6
6	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 66 and 67 of C-58). 4. Test for high resistance on each circuit. 5. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15

Step	Action	Value(s)	Yes	No
7	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 16	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 heater 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 14	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 circuits to the ECM main relay (pins 4 and 5 of X-12). 5. Repair the open circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 10
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 2 of X-12) and engine room ground terminal (C-36) 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 16	—
12	1. Test the battery voltage circuit between the ECM (pin 73 of C-58) and the ECM main relay (pin 1 of X-12) for the following conditions: • An open circuit • High resistance or a poor connection at ECM or ECM main relay 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
13	Repair the open in the ignition voltage circuit to the ECM. Did you complete the repair?	—	Go to Step 16	—
14	Replace the ECM main relay. Did you complete the replacement?	—	Go to Step 16	—

Step	Action	Value(s)	Yes	No
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. 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 400mA lower 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 (1of 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. 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. DO NOT start the engine. 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?	20 MPa (2,900 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?	1500 mA	Go to 2 of 2 Step 1	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-48). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 47, 48, 68 and 69 of E-90). 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 FRP Sensor Replacement. Did you complete the replacement?	—	Go to Step 11	—
8	Repair the short to ground between the ECM (pins 50 and 70 of E-90) and the FRP regulator (pin 2 of E-50). 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 • 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	—
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

Circuit/ System Testing Engine Cranks but Does Not Run (2 of 2)

Step	Action	Value(s)	Yes	No
1	1. Remove the engine cover. 2. Perform the Injector Force Drive with a scan tool. 3. Command each injector ON and verify clicking noise (solenoid operating noise). Is there an injector that does not create a clicking noise (solenoid operating noise), contains an interrupted noise or abnormal noise when commanded ON?	—	Go to Step 8	Go to Step 2
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. 2. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 3
3	1. Check 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 12	Go to Step 4

Step	Action	Value(s)	Yes	No
4	**Notice:** Make sure the in-tank fuel pump operation before performing the following procedures. Refer to In-tank Fuel Pump System Check in this section. 1. Turn OFF the ignition. 2. Disconnect the fuel hose from the fuel supply pump suction side. In order to measure the discharged fuel amount, put the hose into a bottle or a container with a scale. (The inlet of a bottle or a container must be larger than the diameter of hose.) 3. Turn ON the ignition for 20 seconds, with the engine OFF. 4. Turn OFF the ignition for 10 seconds. 5. Perform 3 and 4 three times. The accumulated fuel of three ignition cycles must be more than 300 cc. (Normal amount is more than 100 cc per one ignition cycle.) **Notice:** If there is a leak or a restriction on the suction side, the fuel from the hose will not flow out sufficiently that is most likely caused by fuel leakage, clogged fuel filter, kinked or crushed fuel hose or pipe. Also inside the fuel tank for any foreign materials may be getting drawn into the fuel line pickup. 6. Repair fuel system leaking or restrictions as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 5
5	1. Turn OFF the ignition. 2. Remove the Fuel Pump (10A) fuse from the engine room fuse block in order to disable in-tank fuel pump. 3. Disconnect each fuel injector harness connector from all fuel injectors in order to disable injection. 4. Remove the rubber fuel hose from the leak-off pipe. Then, remove the leak-off pipe assembly from the engine that is jointed to the fuel supply pump and the pressure limiter valve. Use a pan to catch the fuel from the removed fuel line. 5. Crank over the engine while observing the fuel leak from the pressure limiter valve. **Important:** Safety glasses must be worm. Fuel may splash if the pressure limiter valve is faulty. Is there fuel leak from the pressure limiter valve?	—	Go to Step 11	Go to Step 6

Step	Action	Value(s)	Yes	No
6	1. Remove the rubber hoses from the leak-off pipes that are connected to each fuel injector. 2. Crank over the engine while observing the fuel leak from the leak-off pipe of each fuel injector (very small leak is normal). **Important:** Safety glasses must be worm. Fuel may splash if the fuel injector is faulty. **Important:** Replacement fuel injector must be programmed. 3. Replace the fuel injector(s) that return fuel is excessive. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. 4. Retest after replacement of the fuel injector(s). Did you find and correct the condition?	—	Go to Step 12	Go to Step 7
7	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 9	Go to Step 10
8	**Important**: Replacement fuel injector must be programmed. Replace the appropriate fuel injector that does not create a clicking noise (solenoid operating noise), contains an interrupted noise or abnormal noise at Step 1. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 12	—
9	**Important**: Replacement fuel injector must be programmed. Replace the appropriate fuel injector that was leaking fuel found at Step 7 and inspect the engine mechanical for any damage or poor engine compression. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming and engine mechanical section. Did you complete the replacement?	—	Go to Step 12	—
10	**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 cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement and Fuel Filter Cartridge Replacement. Did you complete the replacement?	—	Go to Step 12	—
11	Replace the pressure limiter valve. Refer to Fuel Rail 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. Turn OFF the ignition for 30 seconds. 3. Attempt to start the engine. Does the engine start and continue to run?	—	Go to Step 13	Go to Step 1
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 P0016 (Flash Code 16)

Circuit Description

The crankshaft position (CKP) sensor is located on the left-hand of the cylinder block rear and it is behind the starter motor. The sensor rotor is fixed on the crankshaft. 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 timing chain sprocket cover at the front of the camshaft idle gear. The CMP sensor detects total of five projections per one engine cycle (four projections arranged equally every 90° and one reference projection on the timing chain sprocket surface).
Detecting the open span portion from the CKP sensor and one reference projection 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 battery voltage is more than 9 volts.
- 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 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

- This DTC is caused by an incorrect mechanical timing condition, which is most likely caused by wrong installation of timing gear or chain.
- The engine reverse rotation may set this DTC.

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 chain sprocket • Physical damage of sensor rotor or chain sprocket • Loose or improper installation of sensor rotor or chain sprocket 2. Inspect the engine mechanical timing for the following conditions: • Incorrectly installed timing gear or chain • Faulty timing chain tensioner • Excessive play in the timing chain • Timing chain that jumped teeth 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 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 ECM. The ECM utilizes a turbocharger nozzle control solenoid valve and a boost pressure sensor 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 ECM commands the control solenoid valve to close the turbocharger nozzles, thus increasing the boost. The ECM will vary the boost dependant upon the load requirements of the engine. The ECM uses a pulse width modulation (PWM) on the control circuit to open and control the solenoid valve. If the ECM detects an open circuit or short circuit on the solenoid valve circuit, 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 a low voltage condition on the turbocharger nozzle control solenoid circuit when the solenoid is commanded OFF.
- The ECM detects a high voltage condition on the turbocharger nozzle control solenoid circuit when the solenoid 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.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise 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.
4. If the solenoid control circuit between the ECM and the solenoid is normal, the test lamp changes from Bright to Dim when commanded from Increase to Decrease.

Schematic Reference: Vacuum Hose Routing Diagram and 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. 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 turbocharger nozzle control solenoid valve harness connector. 3. Connect a test lamp between the ignition voltage feed circuit (pin 2 of E-106) 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 5

Step	Action	Value(s)	Yes	No
4	1. Connect a test lamp between the control circuit (pin 1 of E-106) and battery voltage. 2. Perform the Turbocharger Solenoid Control with a scan tool. 3. Command the solenoid valve Increase and Decrease while observing the test lamp. Does the test lamp change brightness when commanded Increase and Decrease?	—	Go to Step 7	Go to Step 6
5	Repair the open circuit or high resistance between the Engine (10A) fuse and the solenoid valve (pin 2 of E-106). Check the Engine (10A) fuse first. Did you complete the repair?	—	Go to Step 11	—
6	1. Test the control circuit between the ECM (pin 66 of E-90) and the solenoid valve (pin 1 of E-106) 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 11	Go to Step 8
7	1. Inspect for an intermittent and for poor connections at the harness connector of the solenoid valve (pins 1 and 2 of E-106). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 66 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Replace the turbocharger nozzle control solenoid valve. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—
11	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 12

Step	Action	Value(s)	Yes	No
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 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 and P0193 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the pressure limiter valve is activated with overpressure (more than 190 MPa [27,600 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 pilot injection.
- The ECM inhibits cruise 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 key 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.

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, P1064, P1065, P124B or P2146 - P2151 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	Go to Diagnostic Aids
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. DO NOT start the engine. 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 10
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 12	Go to Step 6
6	1. Check 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:** Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC. 2. 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. 3. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 7

Step	Action	Value(s)	Yes	No
7	**Notice:** Make sure the in-tank fuel pump operation before performing the following procedures. Refer to In-tank Fuel Pump System Check in this section. 1. Turn OFF the ignition. 2. Disconnect the fuel hose from the fuel supply pump suction side. In order to measure the discharged fuel amount, put the hose into a bottle or a container with a scale. (The inlet of a bottle or a container must be larger than the diameter of hose.) 3. Turn ON the ignition for 20 seconds, with the engine OFF. 4. Turn OFF the ignition for 10 seconds. 5. Perform 3 and 4 three times. The accumulated fuel of three ignition cycles must be more than 300 cc. (Normal amount is more than 100 cc per one ignition cycle.) **Notice:** If there is a leak or a restriction on the suction side, the fuel from the hose will not flow out sufficiently that is most likely caused by fuel leakage, clogged fuel filter, kinked or crushed fuel hose or pipe. Also inside the fuel tank for any foreign materials may be getting drawn into the fuel line pickup. 6. Repair fuel system leaking or restrictions as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 8
8	1. Remove the fuel hose that connects to the fuel supply pump suction side and substitute a clear hose. **Notice:** The hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the hose may damage the fuel supply pump. 2. Bleed the fuel system. Repeat as necessary until the engine starts. 3. Let the engine run at idle for at least 1 minute. 4. Observe the clear hose while holding the engine speed higher than 3000 RPM for a minimum of 1 minute. **Notice:** If many air bubbles appear in the fuel, check the fuel line connections between the fuel supply pump and the fuel tank for tightness and all fuel hoses for cuts, cranks and for the uses of proper clamps. 5. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 9

Step	Action	Value(s)	Yes	No
9	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-50). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 34, 50, 54 and 70 of E-90). 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 14	Go to Step 13
10	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-48). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 47, 48, 68 and 69 of E-90). 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 14	Go to Step 11
11	Replace the FRP sensor. Refer to FRP sensor Replacement. Did you complete the replacement?	—	Go to Step 14	—
12	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 14	—
13	**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 cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement and Fuel Filter Cartridge Replacement. Did you complete the replacement?	—	Go to Step 14	—

Step	Action	Value(s)	Yes	No
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 2	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 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 engine is stopped (Second Stage). If the engine is stopped, 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 and P0193 are not set.
- The battery voltage is more than 9 volts.
- 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 197 MPa (28,600 psi) for longer than 5 seconds.

Second Stage

- The ECM detects that the fuel rail pressure is more than 200 MPa (29,000 psi) for longer than 5 seconds.

Action Taken When the DTC Sets

First 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 cruise control.

Second Stage

- 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 limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.
- The ECM stops engine running when the vehicle speed is lower than 5 km/h (3 MPH) for 5 seconds. The engine will run after the key is cycled when the ignition has been tuned OFF for longer than 10 seconds.

Condition for Clearing the DTC

First Stage

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

Second Stage

- 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

- An intermittently sticking Fuel Rail Pressure 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 48,00 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 key 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 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, P0219, P1064, P1065, P124B or P2146 - P2151 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?	190 MPa (27,600 psi)	Go to Step 4	Go to Step 11
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. DO NOT start the engine. 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 10
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 13	Go to Step 6
6	1. Check 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:** Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC. 2. 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. 3. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 7

Step	Action	Value(s)	Yes	No
7	**Notice:** Make sure the in-tank fuel pump operation before performing the following procedures. Refer to In-tank Fuel Pump System Check in this section. 1. Turn OFF the ignition. 2. Disconnect the fuel hose from the fuel supply pump suction side. In order to measure the discharged fuel amount, put the hose into a bottle or a container with a scale. (The inlet of a bottle or a container must be larger than the diameter of hose.) 3. Turn ON the ignition for 20 seconds, with the engine OFF. 4. Turn OFF the ignition for 10 seconds. 5. Perform 3 and 4 three times. The accumulated fuel of three ignition cycles must be more than 300 cc. (Normal amount is more than 100 cc per one ignition cycle.) **Notice:** If there is a leak or a restriction on the suction side, the fuel from the hose will not flow out sufficiently that is most likely caused by fuel leakage, clogged fuel filter, kinked or crushed fuel hose or pipe. Also inside the fuel tank for any foreign materials may be getting drawn into the fuel line pickup. 6. Repair fuel system leaking or restrictions as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 8
8	1. Remove the fuel hose that connects to the fuel supply pump suction side and substitute a clear hose. **Notice:** The hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the hose may damage the fuel supply pump. 2. Bleed the fuel system. Repeat as necessary until the engine starts. 3. Let the engine run at idle for at least 1 minute. 4. Observe the clear hose while holding the engine speed higher than 3000 RPM for a minimum of 1 minute. **Notice:** If many air bubbles appear in the fuel, check the fuel line connections between the fuel supply pump and the fuel tank for tightness and all fuel hoses for cuts, cranks and for the uses of proper clamps. 5. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 9

Step	Action	Value(s)	Yes	No
9	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-50). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 34, 50, 54 and 70 of E-90). 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 15	Go to Step 14
10	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-48). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 47, 48, 68 and 69 of E-90). 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 15	Go to Step 12
11	**Notice:** An intermittent problem by foreign material in the fuel is suspected. Replace the fuel filter cartridge. Refer to Fuel Filter Cartridge Replacement. Did you complete the replacement?	—	Go to Step 15	—
12	Replace the FRP sensor. Refer to FRP sensor Replacement. Did you complete the replacement?	—	Go to Step 15	—
13	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 15	—

Step	Action	Value(s)	Yes	No
14	**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 cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement and Fuel Filter Cartridge Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	**Notice:** There is a possibility that the pressure limiter valve did not active. Replace the pressure limiter valve. Refer to Fuel Rail 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. 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 17
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 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, P0652, P0653, P0201 - P0204, P1064, P1065, P124B and P2146 - P2151 are not set.
- The battery voltage is more than 9 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 20 to 40 MPa (2,900 to 5,800 psi) over the desired pressure for longer than 20 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 cruise 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 key 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, P0219, P1064, P1065, P124B or P2146 - P2151 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. DO NOT start the engine. 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-50). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 34, 50, 54 and 70 of E-90). 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-48). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 47, 48, 68 and 69 of E-90). 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 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 cartridge. Refer to Fuel Filter Cartridge Replacement. Did you complete the replacement?	—	Go to Step 10	—
8	Replace the FRP sensor. Refer to FRP Sensor Replacement. 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 cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement and Fuel Filter Cartridge 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 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 feedback current, DTC P0091 or P0092 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the FRP regulator feedback current is less than 100mA, or more than 1000mA below the desired current. (DTC P0091)
- The ECM detects that the FRP regulator feedback current is more than 2450mA, 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 cruise 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.
8. If the FRP regulator high side circuit is shorted to voltage, engine stalls and will not start.
9. 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	Is DTC P1064 also set?	—	Go to DTC P1064	Go to Step 4
4	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 5	Go to Step 6
5	Does the scan tool indicate more than the specified value at Step 4?	1300 mA	Go to Step 8	Go to Step 9

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition for 30 seconds. 2. Disconnect the FRP regulator harness connector. 3. Connect a test lamp between the high side circuit (pin 1 of E-50) and a known good ground. 4. Turn ON the ignition, with the engine OFF. DO NOT start the engine. Does the test lamp illuminate then go out?	—	Go to Step 7	Go to Step 10
7	1. Turn OFF the ignition for 30 seconds. 2. Connect a test lamp between the low side circuit (pin 2 of E-50) and battery voltage. 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. Does the test lamp illuminate then go out?	—	Go to Step 12	Go to Step 11
8	1. Test the high side circuits between the ECM (pins 34 and 54 of E-90) and the FRP regulator (pin 1 of E-50) 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 16	Go to Step 15
9	1. Test the low side circuits between the ECM (pins 50 and 70 of E-90) and the FRP regulator (pin 2 of E-50) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
10	1. Test the high side circuits between the ECM (pins 34 and 54 of E-90) and the FRP regulator (pin 1 of E-50) 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 16	Go to Step 13
11	**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 50 and 70 of E-90) and the FRP regulator (pin 2 of E-50) 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 16	Go to Step 13

Step	Action	Value(s)	Yes	No
12	1. Inspect for an intermittent and for poor connections at the harness connector of the FRP regulator (pins 1 and 2 of E-50). 2. Repair the connection(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 34, 50, 54 and 70 of E-90). 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 FRP regulator. Refer to Fuel Pump Replacement. 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. 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
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 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

- DTC P0087, P0091, P0092, P0192, P0193, P0652, P0653, P0201 - P0204, P1064, P1065, P124B and P2146 - P2151 are not set.
- The battery voltage is more than 9 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 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 cruise 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 key 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.
- 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.

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 16	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 13	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, P1064, P1065, P124B or P2146 - P2151 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. DO NOT start the engine. 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 11

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Place the transmission in Neutral and set the parking brake. 3. Start the engine. 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 7
7	1. Check 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:** Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC. 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 8
8	**Notice:** Make sure the in-tank fuel pump operation before performing the following procedures. Refer to In-tank Fuel Pump System Check in this section. 1. Turn OFF the ignition. 2. Disconnect the fuel hose from the fuel supply pump suction side. In order to measure the discharged fuel amount, put the hose into a bottle or a container with a scale. (The inlet of a bottle or a container must be larger than the diameter of hose.) 3. Turn ON the ignition for 20 seconds, with the engine OFF. 4. Turn OFF the ignition for 10 seconds. 5. Perform 3 and 4 three times. The accumulated fuel of three ignition cycles must be more than 300 cc. (Normal amount is more than 100 cc per one ignition cycle.) **Notice:** If there is a leak or a restriction on the suction side, the fuel from the hose will not flow out sufficiently that is most likely caused by fuel leakage, clogged fuel filter, kinked or crushed fuel hose or pipe. Also inside the fuel tank for any foreign materials may be getting drawn into the fuel line pickup. 6. Repair fuel system leaking or restrictions as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 9

Step	Action	Value(s)	Yes	No
9	1. Remove the fuel hose that connects to the fuel supply pump suction side and substitute a clear hose. **Notice:** The hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the hose may damage the fuel supply pump. 2. Bleed the fuel system. Repeat as necessary until the engine starts. 3. Let the engine run at idle for at least 1 minute. 4. Observe the clear hose while holding the engine speed higher than 3000 RPM for a minimum of 1 minute. **Notice:** If many air bubbles appear in the fuel, check the fuel line connections between the fuel supply pump and the fuel tank for tightness and all fuel hoses for cuts, cranks and for the uses of proper clamps. 5. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 10
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-50). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 34, 50, 54 and 70 of E-90). 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 16	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-48). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 47, 48, 68 and 69 of E-90). 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 16	Go to Step 12

Step	Action	Value(s)	Yes	No
12	Replace the FRP sensor. Refer to FRP Sensor Replacement. Did you complete the replacement?	—	Go to Step 16	—
13	**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 Fuel Injector Replacement/ Fuel Injector ID Code Data Programming and engine mechanical section. Did you complete the replacement?	—	Go to Step 16	—
14	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 16	—
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 cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement and Fuel Filter Cartridge 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. 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 17
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 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, P0102, P0103, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0122, P0123, P0234, P0403, P0404, P0405, P0406, P0638, P0652, P0653, P0698, P0699, P1404, P2100, P2101, P2103, P2227, P2228 and P2229 are not set.

AND following conditions are met longer than 10 seconds.

- The battery voltage is between 10.0 to 16.0 volts.
- The ignition switch is ON.
- The intake air temperature is less than 110°C (230°F).
- The engine coolant temperature is between 0 to 110°C (32 to 230°F).
- The engine speed is between 850 to 3700 RPM.
- The EGR control is commanded OFF.
- The intake throttle control is commanded OFF.
- The commanded fuel injection quantity is OFF (accelerator pedal is not depressed).
- 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 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.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

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

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 will 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.

Notice:

- The MAF Sensor parameter on scan tool will only update with engine running or one time after the key is cycled when the ignition has been turned OFF for longer than 10 seconds.

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 or solenoid valve 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 E-47). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 40, 42 and 43 of E-90). 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 40 and 43 of E-90) and the MAF sensor (pins 2 and 3 of E-47) 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 Sensor Replacement. 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. 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

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 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.

- Ignition voltage 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 second (g/s) parameter. If the ECM detects an excessively low or high signal voltage, DTC P0102 or P0103 will set.

Condition for Running the DTC

- The battery voltage is between 11.5 to 16.0 volts.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the MAF sensor signal voltage is less than 0.1 volts. (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 pilot injection.
- The ECM inhibits EGR control.
- The ECM inhibits cruise 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:

- The MAF Sensor parameter on scan tool will only update with engine running or one time after the key is cycled when the ignition has been turned OFF for longer than 10 seconds.

Test description

The number below refers to the step number on the Circuit/ System Testing.
DTC P0102
4. This step tests for proper operation of the circuit in the signal circuit. If the fuse in the jumper opens when you perform this test, the signal circuit is shorted to ground or low reference circuits.

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. 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 3	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Disconnect the MAF sensor harness connector. 3. Connect a test lamp between the ignition voltage feed circuit (pin 1 of E-47) 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 5
4	1. Turn OFF the ignition for 30 seconds. 2. Connect a 3-amp fused jumper wire between the ignition voltage feed circuit and the signal circuit (pins 1 and 3 of E-47). 3. Turn ON the ignition, with the engine OFF. Is the MAF Sensor parameter more than the specified value?	4.9 volts	Go to Step 7	Go to Step 6
5	Repair the open circuit or high resistance between the ECM Main Relay (pin 1 of X-12) and the MAF sensor (pin 1 of E-47) for and open circuit or high resistance. Check the Engine (10A) fuse first. Did you complete the repair?	—	Go to Step 11	—
6	1. Test the signal circuit between the ECM (pin 40 of E-90) and the MAF sensor (pin 3 of E-47) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Inspect for an intermittent and for poor connections at the harness connector of the MAF sensor (pins 1 and 3 of E-47). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 40 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Replace the MAF sensor. Refer to MAF Sensor Replacement. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—

Step	Action	Value(s)	Yes	No
11	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. 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 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

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	1. Turn OFF the ignition for 30 seconds. 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 4	Go to Step 5
4	Connect a test lamp between the low reference circuit (pin 2 of E-47) 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 40 of E-90) and the MAF sensor (pin 3 of E-47) 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 11	Go to Step 10
6	1. Test the low reference circuit between the ECM (pin 43 of E-90) and the MAF sensor (pin 2 of E-47) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8

Step	Action	Value(s)	Yes	No
7	1. Inspect for an intermittent and for a poor connection at the harness connector of the MAF sensor (pin 2 of E-47). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 43 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Replace the MAF sensor. Refer to MAF Sensor Replacement. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—
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 2	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 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 P0698 and P0699 are not set.
- The battery voltage is more than 9 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. (DTC P0107)
- The ECM detects that the boost pressure sensor signal voltage is more than 4.75 volts. (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 limits fuel injection quantity.
- The ECM inhibits EGR control.
- The ECM inhibits cruise 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 P0698 also set?	—	Go to DTC P0698	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-107) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 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 3 and 1 of E-107). Is the Boost Pressure Sensor parameter more than the specified value?	4.7 volts	Go to Step 8	Go to Step 7
6	1. Test the 5 volts reference circuit between the ECM (pin 20 of E-90) and the boost pressure sensor (pin 3 of E-107) 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 21 of E-90) and the boost pressure sensor (pin 1 of E-107) 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-107). 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 20 and 21 of E-90). 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 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	—
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 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?	4.7 volts	Go to Step 3	Go to Diagnostic Aids
3	Monitor the DTC Information with a scan tool. Is DTC P0699 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 P0699	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-107) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
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 21 of E-90) and the boost pressure sensor (pin 1 of E-107) 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	1. Test the low reference circuit between the ECM (pin 23 of E-90) and the boost pressure sensor (pin 2 of E-107) 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

Step	Action	Value(s)	Yes	No
9	1. Inspect for an intermittent and for a poor connection at the harness connector of the boost pressure sensor (pin 2 of E-107). 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 23 of E-90). 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 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
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. 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

- The battery voltage is more than 9 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 4.75 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 limits fuel injection quantity.
- The ECM inhibits EGR control.
- The ECM inhibits cruise 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. Turn ON the ignition, with the engine OFF. 4. 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 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the mass air flow/ intake air temperature (MAF/ IAT) sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the IAT Sensor parameter more than the specified value?	4.7 volts	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Test the signal circuit between the ECM (pin 41 of E-90) and the IAT sensor (pin 4 of E-47) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6
5	Replace the MAF sensor. Refer to MAF Sensor Replacement. (IAT sensor is internal to MAF sensor) Did you complete the replacement?	—	Go to Step 8	—
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect connections at the harness connector of the ECM (pins 41 and 61 of E-90) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 8	—
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 2	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 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. Turn ON the ignition, with the engine OFF. 4. Observe the Intake Air Temperature (IAT) Sensor parameter with a scan tool. Is the IAT Sensor parameter more than the specified value?	4.7 volts	Go to Step 3	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Disconnect the mass air flow/ intake air temperature (MAF/ IAT) sensor harness connector. 3. Connect a DMM between the signal circuit (pin 4 of E-47) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.3 volts	Go to Step 4	Go to Step 5
4	**Important:** The IAT sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 41 of E-90) and the IAT sensor (pin 4 of E-47) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
5	Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit (pins 4 and 5 of E-47). Is the IAT Sensor parameter less than the specified value?	0.1 volts	Go to Step 9	Go to Step 6
6	Connect a 3-amp fused jumper wire between the signal circuit (pin 4 of E-47) and a known good ground. Is the IAT Sensor parameter less than the specified value?	0.1 volts	Go to Step 8	Go to Step 7
7	1. Test the signal circuit between the ECM (pin 41 of E-90) and the IAT sensor (pin 4 of E-47) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
8	1. Test the low reference circuit between the ECM (pin 61 of E-90) and the IAT sensor (pin 5 of E-47) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
9	1. Test the signal circuit between the ECM (pin 41 of E-90) and the IAT sensor (pin 4 of E-47) for a short to any 5 volts reference circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
10	1. Inspect for an intermittent and for poor connections at the harness connector of the IAT sensor (pins 4 and 5 of E-47). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12

Step	Action	Value(s)	Yes	No
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 41 and 61 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
12	Replace the MAF sensor. Refer to MAF Sensor Replacement. (IAT sensor is internal to MAF sensor) Did you complete the replacement?	—	Go to Step 14	—
13	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. 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 2	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 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, P0501 P124B, P1261, P1262 and P2146 - P2151 are not set.
- The ignition switch is ON.
- The engine coolant temperature is between -10 to 110°C (14 to 230°F).
- The vehicle run time is longer than 18 minutes.
- The engine run time is longer than 5 minutes with engine speed is more than 1200 RPM.
- 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 5°C (9°F).

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.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

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

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 condition. Refer to diagnosis of the engine cooling system section for testing. • 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
3	1. Turn OFF the ignition 2. Disconnect the engine coolant temperature (ECT) sensor harness connector. 3. Inspect for an intermittent, for poor connectors and corrosion at the harness connector of the ECT sensor (pins 1 and 2 of E-41). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 26 and 27 of E-90). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Test each sensor circuit between the ECM (pins 26 and 27 of E-90) and the ECT sensor (pins 1 and 2 of E-41) 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 Replacement. 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 coolant 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

- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine run time is longer than 3 minutes. (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 4.75 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 limits fuel injection quantity.
- The ECM inhibits EGR control.
- The ECM inhibits cruise 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. Turn ON the ignition, with the engine OFF. 4. 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 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the ECT sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the ECT Sensor parameter more than the specified value?	4.7 volts	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Test the signal circuit between the ECM (pin 27 of E-90) and the ECT sensor (pin 1 of E-41) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6
5	Replace the ECT sensor. Refer to ECT Sensor Replacement. Did you complete the replacement?	—	Go to Step 8	—
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect connections at the harness connector of the ECM (pins 26 and 27 of E-90) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 8	—
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 2	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 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. Turn ON the ignition, with the engine OFF. 4. Observe the Engine Coolant Temperature (ECT) Sensor parameter with a scan tool. Is the ECT Sensor parameter more than the specified value?	4.7 volts	Go to Step 3	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Disconnect the ECT sensor harness connector. 3. Connect a DMM between the signal circuit (pin 1 of E-41) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.3 volts	Go to Step 4	Go to Step 5
4	**Important:** The ECT sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 27 of E-90) and the ECT sensor (pin 1 of E-41) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
5	Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit (pins 1 and 2 of E-41). Is the Engine Coolant Temperature Sensor parameter less than the specified value?	0.1 volts	Go to Step 9	Go to Step 6
6	Connect a 3-amp fused jumper wire between the signal circuit (pin 1 of E-41) and a known good ground. Is the Engine Coolant Temperature Sensor parameter less than the specified value?	0.1 volts	Go to Step 8	Go to Step 7
7	1. Test the signal circuit between the ECM (pin 27 of E-90) and the ECT sensor (pin 1 of E-41) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
8	1. Test the low reference circuit between the ECM (pin 26 of E-90) and the ECT sensor (pin 2 of E-41) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
9	1. Test the signal circuit between the ECM (pin 27 of E-90) and the ECT sensor (pin 1 of E-41) for a short to any 5 volts reference circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
10	1. Inspect for an intermittent and for poor connections at the harness connector of the ECT sensor (pins 1 and 2 of E-41). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12

Step	Action	Value(s)	Yes	No
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 26 and 27 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
12	Replace the ECT sensor. Refer to ECT Sensor Replacement. Did you complete the replacement?	—	Go to Step 14	—
13	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. 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 2	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 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 P0698 and P0699 are not set.
- The battery voltage is more than 9 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. (DTC P0122)
- The ECM detects that the intake throttle position sensor signal voltage is less than 4.75 volts. (DTC P0123)

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 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 inhibits EGR control.
- The ECM inhibits cruise 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 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 P0698 also set?	—	Go to DTC P0698	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-38) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 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-38). Is the Intake Throttle Position Sensor parameter more than the specified value?	4.7 volts	Go to Step 8	Go to Step 7
6	1. Test the 5 volts reference circuit between the ECM (pin 36 of E-90) and the intake throttle valve (pin 6 of E-38) for an open circuit for 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 57 of E-90) and the intake throttle valve (pin 5 of E-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 intake throttle valve (pins 5 and 6 of E-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 36 and 57 of E-90). 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 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	—
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 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 valve?	4.7 volts	Go to Step 3	Go to Diagnostic Aids
3	Monitor the DTC Information with a scan tool. Is DTC P0699 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 P0699	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 3 of E-38) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
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 57 of E-90) and the intake throttle valve (pin 5 of E-38) 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	1. Test the low reference circuit between the ECM (pin 35 of E-90) and the intake throttle valve (pin 3 of E-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

Step	Action	Value(s)	Yes	No
9	1. Inspect for an intermittent and for a poor connection at the harness connector of the intake throttle valve (pin 3 of E-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 35 of E-90). 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 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
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

- The battery voltage is more than 9 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 4.75 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.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

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. Turn ON the ignition, with the engine OFF. 4. 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 3	Go to Diagnostic Aids
3	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?	4.7 volts	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Test the signal circuit between the ECM (pin 29 of E-90) and the FT sensor (pin 2 of E-27) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6
5	Replace the FT sensor. Refer to FT Sensor Replacement. Did you complete the replacement?	—	Go to Step 8	—
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect connections at the harness connector of the ECM (pins 28 and 29 of E-90) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 8	—
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 2	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 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. Turn ON the ignition, with the engine OFF. 4. Observe the Fuel Temperature (FT) Sensor parameter with a scan tool. Is the FT Sensor parameter more than the specified value?	4.7 volts	Go to Step 3	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Disconnect the FT sensor harness connector. 3. Connect a DMM between the signal circuit (pin 2 of E-27) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.3 volts	Go to Step 4	Go to Step 5
4	**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 29 of E-90) and the FT sensor (pin 2 of E-27) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
5	Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit (pins 1 and 2 of E-27). Is the FT Sensor parameter less than the specified value?	0.1 volts	Go to Step 9	Go to Step 6
6	Connect a 3-amp fused jumper wire between the signal circuit (pin 2 of E-27) and a known good ground. Is the FT Sensor parameter less than the specified value?	0.1 volts	Go to Step 8	Go to Step 7
7	1. Test the signal circuit between the ECM (pin 29 of E-90) and the FT sensor (pin 2 of E-27) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
8	1. Test the low reference circuit between the ECM (pin 28 of E-90) and the FT sensor (pin 1 of E-27) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
9	1. Test the signal circuit between the ECM (pin 29 of E-90) and the FT sensor (pin 2 of E-27) for a short to any 5 volts reference circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
10	1. Inspect for an intermittent and for poor connections at the harness connector of the FT sensor (pins 1 and 2 of E-27). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 28 and 29 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13

Step	Action	Value(s)	Yes	No
12	Replace the FT sensor. Refer to FT Sensor Replacement. Did you complete the replacement?	—	Go to Step 14	—
13	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. 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 2	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 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 P0652 and P0653 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the FRP sensor signal voltage is less than 0.4 volts. (DTC P0192)
- The ECM detects that the FRP sensor signal voltage is more than 4.75 volts. (DTC P0193)

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 FRP substitution of default value.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise 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	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 P0652 also set?	—	Go to DTC P0652	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?	0.4 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?	4.7 volts	Go to Step 5	Go to Step 6
5	Connect a DMM between the 5 volts reference circuit (pin 3 of E-48) and a known good ground. Is the DMM voltage more than the specified value?	4.7 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 48 and 68 of E-90) and the FRP sensor (pin 2 of E-48) 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	1. Test the 5 volts reference circuit between the ECM (pin 47 of E-90) and the FRP sensor (pin 3 of E-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 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-48). 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 47 of E-90). 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 FRP 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	—
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 P0653 also set?	—	Go to DTC P0653	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?	4.7 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-48) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.3 volts	Go to Step 10	Go to Step 5
5	1. Connect a test lamp between the signal circuit (pin 2 of E-48) 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?	4.7 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 (pins 1 and 2 of E-48). Is the FRP Sensor parameter less than the specified value?	0.1 volts	Go to Step 11	Go to Step 7
7	1. Test the low reference circuit between the ECM (pin 69 of E-90) and the FRP sensor (pin 1 of E-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 15	Go to Step 8
8	1. Test the signal circuit between the ECM (pins 48 and 68 of E-90) and the FRP sensor (pin 2 of E-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 15	Go to Step 12
9	1. Test the signal circuits between the ECM (pins 48 and 68 of E-90) and the FRP sensor (pin 2 of E-48) 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

Step	Action	Value(s)	Yes	No
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 48 and 68 of E-90) and the FRP sensor (pin 2 of E-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 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-48). 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 48, 68 and 69 of E-90). 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 FRP Sensor Replacement. 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 ECM supplies a high voltage along with grounding the fuel injector control circuit when it needs to energize the fuel injector (turn it ON). If the fuel injector charge voltage circuit or solenoid control circuit is open circuit, this DTC will set. DTC P0201 - P0204 will set depending upon which cylinder injector circuit failed.

Condition for Running the DTC

- DTCs P2146, P2147 and P2148 are not set. (DTC P0201 or P0204)
- DTCs P2149, P2150 and P2151 are not set. (DTC P0203 or P0204)
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine is running.
- The engine speed is lower than 2000RPM.

Condition for Setting the DTC

- The ECM detects an open circuit on the fuel injector solenoid circuits.

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 cruise 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:

- 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 cylinder #1 fuel injector harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector (pins 1 and 2 of E-13). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 4
4	Measure the resistance of cylinder #1 fuel injector solenoid. Is the resistance less the specified value?	2.0 Ω	Go to Step 5	Go to Step 9

Step	Action	Value(s)	Yes	No
5	1. Disconnect the cylinder #4 fuel injector harness connector. 2. Measure the resistance of the charge voltage circuit between the cylinder #1 and #4 fuel injector (pin 2 of E-13 and pin 2 of E-16). Is the resistance less than the specified value?	1.0 Ω	Go to Step 6	Go to Step 7
6	1. Test the control circuit between the ECM (pin 33 of E-90) and the cylinder #1 fuel injector (pin 1 of E-13) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Test the charge voltage circuit between the ECM (pin 52 of E-90) and the cylinder #1 fuel injector (pin 2 of E-13) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
8	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 33 and 52 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	**Important:** Replacement fuel injector must be programmed. Replace the cylinder #1 fuel injector. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—
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

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
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 cylinder #2 fuel injector harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector (pins 1 and 2 of E-14). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 4
4	Measure the resistance of cylinder #2 fuel injector solenoid. Is the resistance less the specified value?	2.0 Ω	Go to Step 5	Go to Step 9
5	1. Disconnect the cylinder #3 fuel injector harness connector. 2. Measure the resistance of the charge voltage circuit between the cylinder #2 and #3 fuel injector (pin 2 of E-14 and pin 2 of E-15). Is the resistance less than the specified value?	1.0 Ω	Go to Step 6	Go to Step 7
6	1. Test the control circuit between the ECM (pin 24 of E-90) and the cylinder #2 fuel injector (pin 1 of E-14) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Test the charge voltage circuit between the ECM (pin 71 of E-90) and the cylinder #2 fuel injector (pin 2 of E-14) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
8	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 24 and 71 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	**Important:** Replacement fuel injector must be programmed. Replace the cylinder #2 fuel injector. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 11	—

Step	Action	Value(s)	Yes	No
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—
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

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 cylinder #3 fuel injector harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector (pins 1 and 2 of E-15). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 4
4	Measure the resistance of cylinder #3 fuel injector solenoid. Is the resistance less the specified value?	2.0 Ω	Go to Step 5	Go to Step 9
5	1. Disconnect the cylinder #2 fuel injector harness connector. 2. Measure the resistance of the charge voltage circuit between the cylinder #2 and #3 fuel injector (pin 2 of E-14 and pin 2 of E-15). Is the resistance less than the specified value?	1.0 Ω	Go to Step 6	Go to Step 7

Step	Action	Value(s)	Yes	No
6	1. Test the control circuit between the ECM (pin 25 of E-90) and the cylinder #3 fuel injector (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 11	Go to Step 8
7	1. Test the charge voltage circuit between the ECM (pin 51 of E-90) and the cylinder #3 fuel injector (pin 2 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 11	Go to Step 8
8	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 25 and 51 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	**Important:** Replacement fuel injector must be programmed. Replace the cylinder #3 fuel injector. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—
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

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

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 cylinder #4 fuel injector harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector (pins 1 and 2 of E-16). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 4
4	Measure the resistance of cylinder #4 fuel injector solenoid. Is the resistance less the specified value?	2.0 Ω	Go to Step 5	Go to Step 9
5	1. Disconnect the cylinder #1 fuel injector harness connector. 2. Measure the resistance of the charge voltage circuit between the cylinder #1 and #4 fuel injector (pin 2 of E-13 and pin 2 of E-16). Is the resistance less than the specified value?	1.0 Ω	Go to Step 6	Go to Step 7
6	1. Test the control circuit between the ECM (pin 53 of E-90) and the cylinder #4 fuel injector (pin 1 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 11	Go to Step 8
7	1. Test the charge voltage circuit between the ECM (pin 72 of E-90) and the cylinder #4 fuel injector (pin 2 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 11	Go to Step 8
8	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 53 and 72 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	**Important:** Replacement fuel injector must be programmed. Replace the cylinder #4 fuel injector. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM 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 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 and P0118 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the engine coolant temperature is more than 110°C (230°F) for 5 seconds.

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 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 diagnosis of the engine cooling system section for testing. • Engine coolant level • Engine coolant leakage • Cooling fan belt slippage • Cooling fan clutch working • Thermostat working • Water pump working • Radiator clogging 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 4
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

Step	Action	Value(s)	Yes	No
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 left-hand of the cylinder block rear and it is behind the starter motor. 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 4900 RPM (4JK1 standard output) or 4700 RPM (4JK1 high output and 4JJ1).

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 limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.
- The ECM stops engine running when the vehicle speed is lower than 5 km/h (3 MPH) for 5 seconds. The engine will run after the key is cycled when the ignition has been tuned OFF for longer than 10 seconds.

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

- Make sure the CKP sensor is tight and the teeth are not damaged.
- Electromagnetic interference in the CKP sensor circuits may set this DTC.
- The Total Engine Overspeed Events parameter on 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). 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?	5000 RPM	Go to Step 4	Go to Step 3
3	Ask the driver if overrun is caused by gear slip-out, shift error, down-slope 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 Replacement. 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?	5000 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 P0231 or P0232 (Flash Code 69)

Circuit Description

The ECM controls the fuel pump relay which supplies power to the fuel pump in the fuel tank. The ECM commands the fuel pump relay ON for a certain length of time at ignition switch is ON with the engine OFF. During the engine running it is continuously commanded ON. If the ECM detects an improper voltage level on the relay control circuit, DTC P0231 or P0232 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects a low voltage condition on the fuel pump relay control circuit for longer than 3 second when the relay is commanded OFF. (DTC P0231)
- The ECM detects a high voltage condition on the fuel pump relay control circuit for longer than 3 second when the relay is commanded ON. (DTC P0232)

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 limits fuel injection quantity.
- The ECM inhibits cruise 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.

Notice:

- The fuel pump relay is commanded ON for 12 seconds at ignition switch is ON with the 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 P0231

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 20 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. Replace the fuel pump relay with the head light relay or replace with a known good relay. 3. Turn ON the ignition for 20 seconds while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Step 7

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Remove the fuel pump relay. 3. Probe the ignition voltage feed circuit of the relay coil side (pin 3 of X-13) with a test lamp that is connected 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
5	1. Test the control circuit between the ECM (pin 54 of C-58) and the relay (pin 5 of X-13) for the following conditions: • An open circuit • A short to ground • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
6	Repair the open circuit or high resistance between the ECM main relay (pin 1 of X-12) and the fuel pump relay (pin 3 of X-13). Did you complete the repair?	—	Go to Step 11	—
7	1. Remove the fuel pump 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 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 54 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Replace the fuel pump relay. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—
11	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. Turn ON the ignition for 20 seconds while observing the DTC Information with a scan tool. 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

Circuit/ System Testing DTC P0232

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. Replace the fuel pump relay with the head light relay or replace with a known good relay. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail?	—	Go to Step 4	Go to Step 5
4	1. Test the control circuit between the ECM (pin 54 of C-58) and the relay (pin 5 of X-13) 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 fuel pump relay. 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 relay 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 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 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 and P0108 are not set.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the actual boost pressure is more than 20 kPa (3 psi) over the desired boost pressure under certain conditions for longer than 10 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.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Diagnostic Aids

- An open circuit or high resistance in the boost pressure low reference circuit may set this DTC.
- Misrouted vacuum hoses may set this DTC.
- Check the turbocharger nozzle control actuator for a sticking. Refer to Turbocharger in the Engine Mechanical section.
- Use a scan tool to verify the integrity of the boost pressure sensor signal. Compare the Boost Pressure to the Desired Boost Pressure 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 key 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: Vacuum Hose Routing Diagram and 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, P1196, P1197, P1198, 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

Step	Action	Value(s)	Yes	No
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
5	1. Inspect the following for possible causes of high boost pressure. • Misrouted turbocharger nozzle control actuator vacuum hoses • Turbocharger nozzle control actuator or solenoid valve for a stuck condition. Refer to Turbocharger Control System Check in this section. • 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-107). 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 23 of E-90). 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 E-40). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 18 and 19 of E-90). 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

Step	Action	Value(s)	Yes	No
8	Replace the boost pressure sensor. Refer to Boost Pressure Sensor Replacement. 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. Drive the vehicle that the Calculated Engine Load parameter reaches at least 50% for longer than 10 seconds (such as acceleration on ramp) while comparing the Boost Pressure to the Desired Boost Pressure. Does the Boost Pressure parameter follow within the specified value?	±20 kPa (±3 psi)	Go to Step 11	Go to Step 2
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, P0087, P0088, P0089, P0091, P0092, P0093, P0101, P0102, P0103, P0107, P0108, P0116, P0117, P0118, P0122, P0123, P0192, P0193, P0401, P0403, P0404, P0405, P0406, P0638, P0652, P0653, P0698, P0699, P1064, P1065, P1093, P1404, P2100, P2101, P2103, P2227, P2228 and P2229 are not set.
- The ignition switch is ON.
- The engine is running.
- The fuel injection quantity is higher than a predetermined value.

Condition for Setting the DTC

- The ECM detects that the actual boost pressure is more than 40 kPa (6 psi) below the desired boost pressure under certain conditions for longer than 10 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 cruise control.

Condition for Clearing the DTC

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

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.
- Misrouted vacuum hoses may set this DTC.
- Check the turbocharger nozzle control actuator for a sticking. Refer to Turbocharger in the Engine Mechanical section.
- Use a scan tool to verify the integrity of the boost pressure sensor signal. Compare the Boost Pressure to the Desired Boost Pressure under all load conditions for an excessively low value.
- Loss of vacuum pressure or vacuum pump problem sets this DTC.

Test Description

The numbers below refer to the step number on the diagnostic table.
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 key 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: Vacuum Hose Routing Diagram and 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. • Misrouted, disconnected or kinked turbocharger nozzle control actuator vacuum hose. • Turbine shaft binding causing lower turbocharger shaft spinning speeds. Refer to the Turbocharger in Engine Mechanical section for diagnosis. • Turbocharger nozzle control actuator or solenoid valve for a stuck condition. Refer to Turbocharger Control System Check in this section. • 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

Step	Action	Value(s)	Yes	No
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-107). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 20 and 21 of E-90). 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
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 E-40). 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 17 of E-90). 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 Replacement. 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. Drive the vehicle that the engine speed is more than 2000 RPM and the Calculated Engine Load parameter reaches at least 50% for longer than 10 seconds (such as acceleration on ramp) while comparing the Boost Pressure to the Desired Boost Pressure. Does the Boost Pressure parameter follow within the specified value?	±20 kPa (±3 psi)	Go to Step 11	Go to Step 2
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 left-hand of the cylinder block rear and it is behind the starter motor. The sensor rotor is fixed on the crankshaft. 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

- The battery voltage is more than 9 volts.
- 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.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise 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 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. Is DTC P0340, P0341, P0698 or P0699 also set?	—	Go to Applicable DTC	Go to Step 3
3	Observe the Cam/ Crank Sensor Signal Synchronization Status parameter with a scan tool. Does the scan tool indicate Synchronous?	—	Go to Diagnostic Aids	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-52) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 5	Go to Step 9

Step	Action	Value(s)	Yes	No
5	Connect a DMM between the signal circuit (pin 1 of E-52) and a known good ground. Is the DMM voltage more than the specified value?	5.3 volts	Go to Step 12	Go to Step 6
6	Is the DMM voltage more than the specified value at Step 5?	4.7 volts	Go to Step 7	Go to Step 11
7	1. Connect a test lamp between the signal circuit (pin 1 of E-52) 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?	4.7 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-52). Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 14	Go to Step 10
9	1. Test the 5 volts reference circuit between the ECM (pin 37 of E-90) and the CKP sensor (pin 3 of E-52) 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	1. Test the low reference circuit between the ECM (pin 39 of E-90) and the CKP sensor (pin 2 of E-52) 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 58 of E-90) and the CKP sensor (pin 1 of E-52) 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
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 58 of E-90) and the CKP sensor (pin 1 of E-52) 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 58 of E-90) and the CKP sensor (pin 1 of E-52) 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

Step	Action	Value(s)	Yes	No
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-52). 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 37, 38, 39 and 58 of E-90). 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 Replacement. 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	—
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 P0336 (Flash Code 15)

Circuit Description

The crankshaft position (CKP) sensor is located on the left-hand of the cylinder block rear and it is behind the starter motor. The sensor rotor is fixed on the crankshaft. 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

- DTC P0335 is not set.
- The battery voltage is more than 9 volts.
- 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.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise 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 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, P0698 or P0699 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 37, 38, 39 and 58 of E-90). 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-52). 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 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. 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 timing chain sprocket cover at the front of the camshaft idle gear. The CMP sensor detects total of five projections per one engine cycle (four projections arranged equally every 90° and one reference projection on the timing chain sprocket 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 and P0341are not set.
- The battery voltage is more than 9 volts.
- 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 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 inhibits cruise 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.
- 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 timing chain sprocket is 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. Is DTC P0652 or P0653 also set?	—	Go to Applicable DTC	Go to Step 3
3	Start the engine. If the engine does not start, crank over the engine for 10 seconds while observing the Cam/ Crank Sensor Signal Synchronization Status parameter with a scan tool. Does the scan tool indicate Synchronous?	—	Go to Diagnostic Aids	Go to Step 4

Step	Action	Value(s)	Yes	No
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-39) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 5	Go to Step 9
5	Connect a DMM between the signal circuit (pin 1 of E-39) and a known good ground. Is the DMM voltage more than the specified value?	5.3 volts	Go to Step 12	Go to Step 6
6	Is the DMM voltage more than the specified value at Step 5?	4.7 volts	Go to Step 7	Go to Step 11
7	1. Connect a test lamp between the signal circuit (pin 1 of E-39) 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?	4.7 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-39). Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 14	Go to Step 10
9	1. Test the 5 volts reference circuit between the ECM (pin 46 of E-90) and the CMP sensor (pin 3 of E-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 19	Go to Step 15
10	1. Test the low reference circuit between the ECM (pin 44 of E-90) and the CMP sensor (pin 2 of E-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 19	Go to Step 15
11	1. Test the signal circuit between the ECM (pin 45 of E-90) and the CKP sensor (pin 1 of E-39) 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
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 45 of E-90) and the CMP sensor (pin 1 of E-39) 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

Step	Action	Value(s)	Yes	No
13	1. Test the signal circuit between the ECM (pin 45 of E-90) and the CMP sensor (pin 1 of E-39) 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-39). 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 44, 45, 46 and 64 of E-90). 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 chain sprocket for the following conditions: • Physical damage of sensor • Loose or improper installation of sensor • Excessive air gap • Foreign material passing between sensor and chain sprocket • Physical damage of chain sprocket • Loose or improper installation of chain sprocket 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 Replacement. 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	—
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 P0341 (Flash Code 14)

Circuit Description

The camshaft position (CMP) sensor is installed on the timing chain sprocket cover at the front of the camshaft idle gear. The CMP sensor detects total of five projections per one engine cycle (four projections arranged equally every 90° and one reference projection on the timing chain sprocket 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 and P0340 are not set.
- The battery voltage is more than 9 volts.
- 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 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 inhibits cruise 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.
- 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 timing chain sprocket is 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, P0652 or P0653 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-39). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 44, 45, 46 and 64 of E-90). 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 chain sprocket for the following conditions: • Physical damage of sensor • Loose or improper installation of sensor • Excessive air gap • Foreign material passing between sensor and chain sprocket • Physical damage of chain sprocket • Loose or improper installation of chain sprocket 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 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. 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 more than 9 volts.
- The ignition voltage is more than 9 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 2 of X-5) 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 37 of C-58) and the relay (pin 3 of X-5) for the following conditions: • An open circuit • 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 12	Go to Step 9
7	Repair the open circuit or high resistance between the Engine (10A) fuse and the glow relay coil side (pin 2 of X-5). Check the Engine (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 37 of C-58). 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 P0401 (Flash Code 93)

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. 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 P0101, P0102, P0103, P0112, P0113, P0116, P0117, P0118, P0122, P0123, P0403, P0404, P0405, P0406, P0500, P0501, P0652, P0653, P0698, P0699, P2100, P2101, P2102, P2103, P2227, P2228 and P2229 are not set.
- The battery voltage is between 10 to 16 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.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise 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 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 and warm up as necessary (allow engine coolant temperature to reach at least 60°C [140°F]). 4. Perform the EGR Solenoid Control with a scan tool. 5. Command the Desired EGR Position Increase or Decrease while observing the Mass Air Flow (MAF) Sensor parameter with a scan tool. Does the MAF Sensor parameter decrease by at least 0.5 volts when the Desired EGR Position is commanded from 0 to 90%?	—	Go to Diagnostic Aids	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 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 • Skewed or slow MAF sensor • 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 5	Go to Step 4
4	Replace the EGR valve. Refer to EGR Valve Replacement. Did you complete the replacement?	—	Go to Step 5	—
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 and warm up as necessary (allow engine coolant temperature to reach at least 60°C [140°F]). 5. Perform the EGR Solenoid Control with a scan tool. 6. Command the Desired EGR Position Increase or Decrease while observing the MAF Sensor parameter with a scan tool. Does the MAF parameter decrease by at least 0.5 volts when the Desired EGR Position is commanded from 0 to 90%?	—	Go to Step 6	Go to Step 3
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 P0403 (Flash Code 37)

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 an open circuit or short circuit on the solenoid circuits, this DTC will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects an open circuit on the EGR solenoid circuits.
- The ECM detects a short to ground on the EGR solenoid circuits.
- The ECM detects a short to voltage circuit on the EGR solenoid circuits.

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 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 inhibits EGR 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 P0403

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 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. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the drive voltage circuit (pin 4 of E-71) and a known good ground. 5. Connect a DMM between the low side circuit (pin 6 of E-71) and a known good ground. Are both voltage readings within the specified value?	1.4 - 1.8 volts	Go to Step 5	Go to Step 4
4	Is the DMM voltage more than the specified value at Step 3?	—	Go to Step 7	Go to Step 6

Step	Action	Value(s)	Yes	No
5	1. Test the circuits between the ECM (pins 62 and 63 of E-90) and the EGR valve (pins 4 and 6 of E-71) for a short circuit each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 8
6	1. Test the circuits (which ever voltage reading did not read within the specified value at Step 3) between the ECM (pins 62 and 63 of E-90) and the EGR valve (pins 4 and 6 of E-71) for the following conditions: • An open circuit • A short to ground • A short to the position sensor 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
7	1. Test the circuits (which ever voltage reading did not read within the specified value at Step 3) between the ECM (pins 62 and 63 of E-90) and the EGR valve (pins 4 and 6 of E-71) 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 12	Go to Step 11
8	1. Inspect for an intermittent and for poor connections at the harness connector of the EGR valve (pins 4 and 6 of E-71). 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 62 and 63 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
10	Replace the EGR valve. Refer to EGR Valve Replacement. Did you complete the replacement?	—	Go to Step 10	—
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

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, P0405, P0406, P0652, P0653, P2227, P2228 and P2229 are not set.
- The battery voltage is between 10 to 16 volts.
- The ignition switch is ON.
- The engine coolant temperature is between 20 to 110 °C (68 to 230 °F).
- The intake air temperature is between 0 to 110 °C (32 to 230°F).
- The barometric pressure is between 60 to 120 kPa (8.7 to 17.4 psi).
- The EGR control is commanded ON.

Condition for Setting the DTC

- The ECM detects that the actual EGR position is more than 10% below the desired position for 4 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.
- The ECM inhibits cruise 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 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 P0403, P0405 or P0406 also set?	—	Go to Applicable DTC	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. Does the EGR Position parameter follow within the specified value quick enough (compare with a similar unit if available)?	± 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 3. 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. 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 and 6 of E-71). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 30, 31, 32, 62 and 63 of E-90). 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 7	Go to Step 6
6	Replace the EGR valve. Refer to EGR Valve 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. 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 P0405 or P0406 (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 EGR position sensor changes output voltage according to EGR valve position. The sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- EGR position sensor signal circuit

The EGR position sensor provides a signal to the ECM on the signal circuit, which is relative to the position changes of the EGR valve. If the ECM detects an excessively low or high signal voltage, DTC P0405 or P0406 will set.

Condition for Running the DTC

- DTCs P0652 and P0653 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the EGR position sensor signal voltage is less than 0.2 volts for 3 seconds. (DTC P0405)
- The ECM detects that the EGR position sensor signal voltage is more than 4.6 volts for 3 seconds. (DTC P0406)

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 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 inhibits EGR control.
- The ECM inhibits cruise 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 P0405

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 P0652 also set?	—	Go to DTC P0652	Go to Step 3
3	Observe the EGR Position Sensor parameter with a scan tool. Is EGR Position 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 EGR valve harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 1 of E-71) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 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-71). Is the EGR Position Sensor parameter more than the specified value?	4.7 volts	Go to Step 8	Go to Step 7
6	1. Test the 5 volts reference circuit between the ECM (pin 31 of E-90) and the EGR valve (pin 1 of E-71) 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 32 of E-90) and the EGR valve (pin 3 for E-71) 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 EGR valve (pins 1 and 3 of E-71). 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 31 and 32 of E-90). 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 EGR valve. Refer to EGR Valve 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	—
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 P0406

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 EGR Position Sensor parameter with a scan tool. Is the EGR Position Sensor parameter more than the specified valve?	4.6 volts	Go to Step 3	Go to Diagnostic Aids
3	Monitor the DTC Information with a scan tool. Is DTC P0653 also set?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Turn ON the ignition, with the engine OFF. Is the EGR Position Sensor parameter less than the specified value?	0.1 volts	Go to DTC P0653	Go to Step 7
5	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Turn ON the ignition, with the engine OFF. Is the EGR 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 2 of E-71) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
7	**Important:** The EGR 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 32 of E-90) and the EGR valve (pin 3 of E-71) 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	1. Test the low reference circuit between the ECM (pin 30 of E-90) and the EGR valve (pin 2 of E-71) 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

Step	Action	Value(s)	Yes	No
9	1. Inspect for an intermittent and for a poor connection at the harness connector of the EGR valve (pin 2 of E-71). 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 30 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the EGR valve. Refer to EGR Valve 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
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 P0500 (Flash Code 25)

Circuit Description

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

- Ignition voltage 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 2WD fitted with Jatco automatic transmission, VSS signals are sent from the TCM. If the ECM detects VSS signals are not generated, this DTC will set.

Condition for Running the DTC

- The ignition voltage is more than 9 volts.
- The ignition switch is ON.
- The engine speed is more than 1000 RPM.
- The commanded fuel injection quantity is OFF (accelerator pedal is not depressed).

Condition for Setting the DTC

- The ECM detects that the VSS signals are not generated for 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 inhibits cruise 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 in the VSS circuits may set this DTC.

Notice:

- If this DTC set, the Vehicle Speed parameter on the scan tool will display 3 km/h (2 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 (2WD fitted with Jatco A/T)

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 P0219 also set?	—	Go to DTC P0219	Go to Step 3
3	Monitor the transmission DTC Information with a scan tool. Is DTC P0722 set?	—	Go to P0722 in Automatic Transmission Section	Go to Step 4
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

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Intermittently jump the signal circuit (pin 10 of C-94) with a test lamp that is connected to a known good ground while observing the Vehicle Speed parameter with a scan tool. Does the scan tool indicate any vehicle speed when the circuit is intermittently pulled to ground?	—	Go to Step 7	Go to Step 6
6	1. Test the signal circuit between the ECM (62 of C-58) and the TCM (10 of C-94) 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 11	Go to Step 8
7	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the TCM (pin 10 of C-94). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 62 of C-58). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—
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. Drive the vehicle while observing the Vehicle Speed parameter with a scan tool. Does the scan tool indicate correct vehicle speed?	—	Go to Step 12	Go to Step 3
12	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 (except 2WD fitted with Jatco A/T)

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 P0219 also set?	—	Go to DTC P0219	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
4	1. Turn OFF the ignition. 2. Disconnect the vehicle speed sensor (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 E-44) and a known good ground. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 7
5	Intermittently jump the signal circuit (pin 3 of E-44) with a test lamp that is connected to a known good ground while observing the Vehicle Speed parameter with a scan tool. Does the scan tool indicate any vehicle speed when the circuit is intermittently pulled to ground?	—	Go to Step 6	Go to Step 9
6	Connect a test lamp between the voltage feed circuit and the low reference circuit (pins 1 and 2 of E-44). Does the test lamp illuminate?	—	Go to Step 10	Go to Step 8
7	Repair the open circuit or high resistance between the Meter (10A) fuse and the VSS (pin 1 of E-44). Check the Meter (10A) fuse first. Did you complete the repair?	—	Go to Step 15	—
8	Repair the open circuit or high resistance on the low reference circuit between the VSS (pin 2 of E-44) and ground terminal (E-10). Clean or tighten ground as necessary. Did you complete the repair?	—	Go to Step 15	—
9	1. Test the signal circuit between the ECM (pin 62 of C-58) and the VSS (pin 3 of E-44), then between the instrument panel (IP) cluster (pin 8 of B-23) and the VSS (pin 3 of E-44) 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 15	Go to Step 11

Step	Action	Value(s)	Yes	No
10	1. Inspect for an intermittent and for poor connections at the harness connector of the VSS (pin 1, 2 and 3 of E-44). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 62 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
12	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 • Transfer output shaft teeth damage • Excessive transfer output shaft play 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
13	Replace the VSS. Refer to VSS Replacement. 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 fuse or 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 16	Go to Step 4
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 P0501 (Flash Code 25)

Circuit Description

The vehicle speed sensor (VSS) is used by the ECM and speedometer, which generates a speed signal from the transmission output shaft rotational speed or transfer 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 2WD fitted with Jatco automatic transmission, VSS signals are sent from the TCM. If the ECM detects VSS signals are sharply changed, this DTC will set.

Condition for Running the DTC

- The ignition voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the VSS signal are changed larger than a predetermined vehicle speed within a very short calibrated 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 inhibits cruise 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 in the VSS circuits may set this DTC.

Notice:

- If this DTC set, the Vehicle Speed parameter on the scan tool will display 3 km/h (2 MPH).

Schematic Reference: Engine Controls Schematics

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

Circuit/ System Testing DTC P0501

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Inspect all of the circuits going to the vehicle speed sensor (VSS) for the following 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, relays, and motors 2. If you find incorrect routing, correct the harness routing. Did you find and correct the condition?	—	Go to Step 8	Go to Step 3
3	1. Inspect for an intermittent, for poor connections and corrosion at the Meter (10A) fuse. 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 4
4	1. Inspect for an intermittent, a poor connection and corrosion at the ground terminal (E-10). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the VSS harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the VSS (pins 1, 2 and 3 of E-44). 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 62 of C-58). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6
6	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 • Transfer output shaft teeth damage • Excessive transfer output shaft play 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	Replace the VSS. Refer to VSS Replacement. Did you complete the replacement?	—	Go to Step 8	—
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. Drive the vehicle while observing the Vehicle Speed with a scan tool. Does the scan tool parameter indicate correct vehicle speed?	—	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 P0512 (Flash Code 417)

Circuit Description

The starter switch signal is inputted to the ECM during the ignition switch START position. If the ECM detects the starter switch signal continuously ON during the engine running, this DTC will set.

Condition for Running the DTC

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

Condition for Setting the DTC

- The ECM detects that the starter switch signal is stuck at the ON position (high voltage) for longer than 20 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.

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.

Notice:

- This DTC will set if the ignition switch continues being START position for longer than 20 seconds.

Schematic Reference: Engine Controls Schematics

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

Circuit/ System Testing DTC P0512

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Turn OFF the ignition. 2. Remove the starter cut relay in order to inhibit starter motor engagement at ignition switch ON. 3. Install a scan tool. 4. Turn ON the ignition, with the engine OFF. 5. Observe the Starter Switch parameter with a scan tool. Does the Starter Switch parameter indicate OFF?	—	Go to Diagnostic Aids	Go to Step 3
3	Remove the Starter (10A) fuse in the cabin fuse block. Does the Starter Switch parameter indicate OFF?	—	Go to Step 4	Go to Step 5
4	1. Test the signal circuit between the starter switch (pin 1 of B-63) and each terminal of the ignition switch (pins 1, 2, 3 and 4 of B-62 and pin 3 of B-63) for short circuit each other at the ignition switch ON. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
5	1. Test the signal circuit between the ECM (pin 44 of C-58) and the Starter (10A) fuse or starter relay (pin 3 of X-8) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect the connection on the starter switch signal circuit at the harness connector of the ECM (pin 44 of C-58) for corrosion. 4. Repair the connection(s) as necessary. Did you complete the action?	—	Go to Step 8	—
7	Repair or replace the ignition switch. Did you complete the repair or 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. 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 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 P0562 or 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 low or high ignition voltage, DTC P0562 or P0563 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.

Condition for Setting the DTC

- The ECM detects that the ignition voltage feed circuit is less than 8 volts for 5 seconds. (DTC P0562)
- The ECM detects that the ignition voltage feed circuit is more than 16 volts for 5 seconds. (DTC P0563)

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 limits fuel injection quantity. (DTC P0563)
- The ECM inhibits pilot injection. (DTC P0563)
- The ECM inhibits cruise control. (DTC P0563)

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.
- The weakened battery may set DTC P0562.
- Jump starting the vehicle or a battery charger may have set this DTC P0563.

Schematic Reference: Engine Controls Schematics

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

Circuit/ System Testing DTC P0562

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 and let idle. 4. Load the electrical system by turning ON the headlights, A/C, etc. while observing the Ignition Voltage parameter with a scan tool. Does the scan tool indicate more than the specified value?	10.0 volts	Go to Diagnostic Aids	Go to Step 3
3	Test the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you find a charging system problem?	—	Go to Step 4	Go to Step 5
4	Repair the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you complete the repair?	—	Go to Step 6	—

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for a poor connection and for corrosion at the harness connector of the ECM (pin 72 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Diagnostic Aids
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and let idle. 5. Load the electrical system by turning ON the headlights, A/C, etc. while observing the Ignition Voltage parameter with a scan tool. Does the scan tool indicate more than the specified value?	10.0 volts	Go to Step 7	Go to Step 3
7	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 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 jump started or 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?	16.0 volts	Go to Diagnostic Aids	Go to Step 4
4	Test the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you find a charging system problem?	—	Go to Step 5	Go to Diagnostic Aids
5	Repair the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you complete the repair?	—	Go to Step 6	—

Step	Action	Value(s)	Yes	No
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 indicate less than the specified value?	16.0 volts	Go to Step 7	Go to Step 4
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 P0565 (Flash Code 515)

Circuit Description

The cruise control keeps the vehicle speed at a driver's set speed. When the cruise main switch is turned ON, signal is provided to the ECM and the cruise main indicator lamp on the switch or the instrument panel cluster will light up. If the ECM detects the cruise main switch signal repeats ON/ OFF or continuously ON, this DTC will set.

Condition for Running the DTC

- 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 cruise main switch signal is repeated ON/ OFF continuously within a very short calibrated time.
- The ECM detects that the cruise main switch signal is stuck at the ON position (high voltage) for longer than 15 seconds.

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.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

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

Diagnostic Aids

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

Notice:

- This DTC will set if the cruise main switch continues being pushed for longer than 15 seconds.

Schematic Reference: Engine Controls Schematics

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

Circuit/ System Testing DTC P0565

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. Observe the Cruise Main Switch parameter with a scan tool. Does the scan tool indicate ON when the switch is pushed and OFF when the switch is released?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the cruise main switch harness connector. (Remove the switch from the IP bezel as necessary) 3. Turn ON the ignition, with the engine OFF. Does the Cruise Main Switch indicate OFF?	—	Go to Step 5	Go to Step 4
4	1. Test the signal circuit between the ECM (pin 14 of C-58) and the cruise main switch (pin 3 of B-67) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Repair or replace the cruise main switch. Did you complete the repair or 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	—

Step	Action	Value(s)	Yes	No
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Cruise Main Switch parameter with a scan tool. Dose the scan tool indicate ON when the switch is pushed and OFF when the switch is released?	—	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 P0566 (Flash Code 516)

Circuit Description

The cruise control keeps the vehicle speed at a driver's set speed. When the cruise main switch is turned ON, signal is provided to the ECM and the cruise main indicator lamp on the switch or the instrument panel cluster will light up. The cruise cancel switch is a normally closed type switch. When the cruise cancel switch is applied, the switch signal to the ECM is stopped (low voltage) and the cruise control system is inactive. If the ECM detects the cruise cancel switch signal repeats ON/ OFF or continuously OFF this DTC will set.

Condition for Running the DTC

- 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 cruise cancel switch signal is repeated ON/ OFF continuously within a very short calibrated time.
- The ECM detects that the cruise cancel switch signal is stuck at the OFF position (low voltage) for longer than 40 seconds.

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.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

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

Diagnostic Aids

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

Notice:

- This DTC will set if the cruise cancel switch continues being applied for longer than 40 seconds.

Schematic Reference: Engine Controls Schematics

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

Circuit/ System Testing DTC P0566

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. Observe the Cruise Cancel Switch parameter with a scan tool. Does the scan tool indicate OFF when the switch is applied and ON when the switch is released?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the combination switch harness connector (B-59). (Remove the IP cluster lower cover as necessary) 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the ignition voltage feed circuit of the combination switch harness (pin 11 of B-59 male side) and a known good ground. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 5

Step	Action	Value(s)	Yes	No
4	Observe the Cruise Cancel Switch parameter with a scan tool while momentarily jumping 3-amp fused jumper wire across the combination switch harness connector (male side) between pins 10 and 11 of B-59. 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 Engine (10A) fuse and the combination switch (pin 11 of B-59). Check Engine (10A) fuse first. Did you complete the repair?	—	Go to Step 11	—
6	1. Test the signal circuit between the ECM (pin 13 of C-58) and the combination switch (pin 11 of B-59) for and open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did your find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Inspect fro an intermittent and for a poor connection at the harness connector of the combination switch (pin 11 of B-59). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pin 13 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Repair or replace the combination switch. Did you complete the repair or replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Cruise Cancel Switch parameter with a scan tool. Dose the scan tool indicate OFF when the switch is applied and ON when the switch is released?	—	Go to Step 12	Go to Step 3
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 P0567 (Flash Code 517)

Circuit Description

The cruise control keeps the vehicle speed at a driver's set speed. When the cruise main switch is turned ON, signal is provided to the ECM and the cruise main indicator lamp on the switch or the instrument panel cluster will light up. When the cruise resume/ accel. switch is applied, the switch signal is provided to the ECM and the vehicle speed is reset to the previous set speed or vehicle speed is increased. If the ECM detects the cruise resume/ accel. switch signal repeats ON/ OFF or continuously ON, this DTC will set.

Condition for Running the DTC

- 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 cruise resume/ accel. switch signal is repeated ON/ OFF continuously within a very short calibrated time.
- The ECM detects that the cruise resume/ accel. switch signal is stuck at the ON position (high voltage) for longer than 120 seconds.

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.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

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

Diagnostic Aids

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

Notice:

- This DTC will set if the cruise resume/ accel. switch continues being applied for longer than 120 seconds.

Schematic Reference: Engine Controls Schematics

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

Circuit/ System Testing DTC P0567

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. Observe the Cruise Resume Switch parameter with a scan tool. Does the scan tool indicate ON when the switch is applied and OFF when the switch is released?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the combination switch harness connector (B-59). (Remove the IP cluster lower cover as necessary) 3. Turn ON the ignition, with the engine OFF. Does the Cruise Resume Switch parameter indicate OFF?	—	Go to Step 5	Go to Step 4
4	1. Test the signal circuit between the ECM (pin 29 of C-58) and the combination switch (pin 9 of B-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	Repair or replace the combination switch. Did you complete the repair or replacement?	—	Go to Step 7	—

Step	Action	Value(s)	Yes	No
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 ON the ignition, with the engine OFF. 4. Observe the Cruise Resume Switch parameter with a scan tool. Dose the scan tool indicate ON when the switch is applied and OFF when the switch is released?	—	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 P0568 (Flash Code 518)

Circuit Description

The cruise control keeps the vehicle speed at a driver's set speed. When the cruise main switch is turned ON, signal is provided to the ECM and the cruise main indicator lamp on the switch or the instrument panel cluster will light up. When the cruise set/ coast switch is turned ON, the switch signal is provided to the ECM and the vehicle speed is set or vehicle speed is decreased. If the ECM detects the cruise set/ coast switch signal repeats ON/ OFF or continuously ON, this DTC will set.

Condition for Running the DTC

- 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 cruise set/ coast switch signal is repeated ON/ OFF continuously within a very short calibrated time.
- The ECM detects that the cruise set/ coast switch signal is stuck at the ON position (high voltage) for longer than 120 seconds.

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.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

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

Diagnostic Aids

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

Notice:

- This DTC will set if the cruise set/ coast switch continues being pushed for longer than 120 seconds.

Schematic Reference: Engine Controls Schematics

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

Circuit/ System Testing DTC P0568

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. Observe the Cruise Set Switch parameter with a scan tool. Does the scan tool indicate ON when the switch is pushed and OFF when the switch is released?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the combination switch harness connector (B-59). (Remove the switch from the IP bezel as necessary) 3. Turn ON the ignition, with the engine OFF. Does the Cruise Set Switch parameter indicate OFF?	—	Go to Step 5	Go to Step 4
4	1. Test the signal circuit between the ECM (pin 30 of C-58) and the combination switch (pin 12 of B-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	Repair or replace the combination switch. Did you complete the repair or replacement?	—	Go to Step 7	—

Step	Action	Value(s)	Yes	No
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 ON the ignition, with the engine OFF. 4. Observe the Cruise Set Switch parameter with a scan tool. Dose the scan tool indicate ON when the switch is pushed and OFF when the switch is released?	—	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 P0571 (Flash Code 26)

Circuit Description

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

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects a brake switch 1 (normally open type switch) signal and brake switch 2 (normally closed type switch) signal correlation error for longer than 10 seconds over 33 times since ignition switch is ON.

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.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

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

Diagnostic Aids

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

Schematic Reference: Engine Controls Schematics

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

Circuit/ System Testing DTC P0571

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. Observe the Brake Switch 1 parameter with a scan tool while fully depressing and releasing the brake pedal. Does the scan tool indicate Applied when the brake pedal is applied and Released when the brake pedal is released?	—	Go to Step 8	Go to Step 3
3	1. Check to ensure the brake switch is adjusted correctly. The plunger should be all the way in when the pedal is released, yet should not impede with the brake pedal full upward travel. 2. Adjust the brake switch as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the brake switch harness connector. 3. Connect a test lamp between the battery voltage feed circuit of the brake switch 1 harness (pin 1 of C-44) and a known good ground. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 6

Step	Action	Value(s)	Yes	No
5	1. Turn ON the ignition, with the engine OFF. 2. Observe the Brake Switch 1 parameter with a scan tool while momentarily jumping 3-amp fused jumper wire across the brake switch harness connector between pins 1 and 2 of the C-44. Does the scan tool indicate Applied when the circuit is jumpered and Released when the circuit is not jumpered?	—	Go to Step 14	Go to Step 7
6	Repair the open circuit or high resistance between the Stop Light (15A) fuse and the brake switch (pin 1 of C-44). Check the Stop Light (15A) fuse first. Did you complete the repair?	—	Go to Step 18	—
7	1. Test the signal circuit between the ECM (pin 21 of C-58) and the brake switch (pin 2 of C-44) 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 18	Go to Step 15
8	Observe the Brake Switch 2 parameter with a scan tool while fully depressing and releasing the brake pedal. Does the scan tool indicate Applied when the brake pedal is applied and Released when the brake pedal is released?	—	Go to Diagnostic Aids	Go to Step 9
9	1. Check to ensure the brake switch is adjusted correctly. The plunger should be all the way in when the pedal is released, yet should not impede with the brake pedal full upward travel. 2. Adjust the brake switch as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 10
10	1. Turn OFF the ignition. 2. Disconnect the brake 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 brake switch 2 harness (pin 4 of C-44) and a known good ground. Does the test lamp illuminate?	—	Go to Step 11	Go to Step 12
11	Observe the Brake Switch 2 parameter with a scan tool while momentarily jumping 3-amp fused jumper wire across the brake switch harness connector between pins 3 and 4 of the C-44. Does the scan tool indicate Released when the circuit is jumpered and Applied when the circuit is not jumpered?	—	Go to Step 14	Go to Step 13
12	Repair the open circuit or high resistance between the Engine (10A) fuse and the brake switch (pin 4 of C-44). Check the Engine (10A) fuse first. Did you complete the repair?	—	Go to Step 18	—

Step	Action	Value(s)	Yes	No
13	1. Test the signal circuit between the ECM (pin 1 of C-58) and the brake switch (pin 3 of C-44) 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 18	Go to Step 15
14	1. Inspect for an intermittent and for poor connections at the harness connector of the brake switch (pins 1, 2, 3 and 4 of C-44). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 16
15	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 1 and 21 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 17
16	Replace brake switch. Refer to Brake Switch Replacement. 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. Observe the Brake Switch 1 and Brake Switch 2 parameter with a scan tool while fully depressing and releasing the brake pedal. Does the scan tool indicate Applied when the brake pedal is applied and Released when the brake pedal is released on each parameter?	—	Go to Step 19	Go to Step 2
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 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 ECM internal registered checksum.

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 limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.
- The ECM stops engine running when the vehicle speed is lower than 5 km/h (3 MPH) for 5 seconds. The engine will run after the key is cycled when the ignition has been tuned OFF for longer than 10 seconds.

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)

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)
- The ECM limits fuel injection quantity.
- The ECM inhibits cruise 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)

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 or P0606 (Flash Code 153 or 51)

Circuit Description

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

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)

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 limits fuel injection quantity. (DTC P0604)
- The ECM inhibits pilot injection. (DTC P0604)
- The ECM inhibits cruise control. (DTC P0604)
- The ECM stops engine running when the vehicle speed is lower than 5 km/h (3 MPH) for 5 seconds. The engine will run after the key is cycled when the ignition has been tuned OFF for longer than 10 seconds. (DTC P0604)

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)

Circuit/ System Testing DTC P0604 or P0606

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 P0615 (Flash Code 19)

Circuit Description

The ECM controls the starter cut relay, which de-energizes the starter relay based on engine speed inputs or immobilizer command signal. The starter cut relay uses normally close type relay. During engine stopping, the starter cut relay is closed to allow grounding the starter relay. Once engine run, the ECM energizes the starter cut relay to open the starter relay circuit and starter motor is disengaged even the ignition is positioned at START. If the ECM detects an improper voltage on the starter cut relay control circuit, 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 a short to ground circuit condition on the starter cut relay control circuit for longer than 3 seconds when the relay is commanded OFF.
- The ECM detects a short to voltage circuit condition on the starter cut relay control circuit for longer than 3 seconds 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.

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.

Notice:

- If the starter cut relay control circuit is short to ground, engine does not crank.

Schematic Reference: Engine Controls Schematics

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

Circuit/ System Testing DTC P0615

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. DO NOT start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Step 3
3	1. Start the engine. 2. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 6	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Replace the starter cut relay with the head light dimmer relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 5	Go to Step 7

Step	Action	Value(s)	Yes	No
5	1. Test the control circuit between the ECM (pin 35 of C-58) and the relay (pin 3 of X-7) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 8
6	1. Test the control circuit between the ECM (pin 35 of C-58) and the relay (pin 3 of X-7) 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
7	Replace the starter cut relay. 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 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 for 10 seconds. 5. Start the engine. 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 P0633 (Flash Code 176)

Circuit Description

The electronically erasable & programmable read only memory (EEPROM) memorizes immobilizer security information for communication with the immobilizer control unit (ICU) and enabling the engine to start. 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. (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

- 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 Resetting and Programming Guidelines in immobilizer section. 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 position and desired intake throttle position while the intake throttle solenoid is commanded ON, this DTC will set.

Condition for Running the DTC

- DTCs P0122, P0123, P0698 and P0699 are not set.
- The battery voltage is between 11 to 16 volts.
- The ignition switch is ON.
- The intake throttle solenoid commanded ON.
- The desired intake throttle position is stable.

Condition for Setting the DTC

- The ECM detects that the difference between the actual and the desired intake throttle position is more than 10% for 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.
- The ECM inhibits cruise 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 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, P0123, P2100, P2101 or P2103 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)?	± 5%	Go to Diagnostic Aids	Go to Step 4

Step	Action	Value(s)	Yes	No
4	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?	—	Go to Step 7	Go to Step 5
5	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, 3, 5 and 6 of E-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 35, 36, 55, 56 and 57 of E-90). 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 7	Go to Step 6
6	Replace the intake throttle valve. Refer to Intake Throttle Valve 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. 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 P0642 or P0643 (Flash Code 55)

Circuit Description

The ECM provides 5 volts reference voltage through the reference circuit 1 to the accelerator pedal position (APP) sensor 1. The ECM monitors the voltage on the 5 volts reference circuit 1. If the ECM detects the voltage is excessively low or high, DTC P0642 or P0643 will set.

Condition for Running the DTC

- The battery voltage is more than 6 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the 5 volts reference circuit 1 voltage is less than 4.7 volts. (DTC P0642)
- The ECM detects that the 5 volts reference circuit 1 voltage is more than 5.3 volts. (DTC P0643)

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 limits fuel injection quantity
- The ECM inhibits cruise 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 P0642

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 accelerator pedal position (APP) sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 10 of C-40) and a known good ground. 4. Turn ON the ignition, with engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 5	Go to Step 4
4	1. Test the 5 volts reference circuit between the ECM (pin 11 of C-58) and the APP sensor (pin 10 of C-40) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Replace the APP sensor. Refer to APP Sensor Replacement. 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. 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 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

Circuit/ System Testing DTC P0643

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. Test the 5 volts reference circuit between the ECM (pin 11 of C-58) and the APP sensor 1 (pin 10 of C-40) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	**Important:** Replacement ECM must be programmed 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. 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 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 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 ignition voltage is more than 9 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.

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 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. Perform the Malfunction Indicator Lamp (MIL) Control with a scan tool. 4. Command the lamp ON and OFF. Does the MIL turn ON and OFF with each command?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Inspect the Meter (10A) fuse in the cabin fuse block. 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-2 (C-58) 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 57 of C-58) 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 57 of C-58) and a known good ground. Is the MIL 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 8 of B-24) 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 57 of C-58) and the IP cluster (pin 38 of B-23) 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 8 of B-24 and pin 38 of B-23). 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 57 of C-58). 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 57 of C-58) and the IP cluster (pin 38 of B-23). Did you complete the repair?	—	Go to Step 17	—
13	Repair the short to battery or ignition voltage between the ECM (pin 57 of C-58) and the IP cluster (pin 38 of B-23). 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 8 of B-24). Did you complete the repair?	—	Go to Step 17	—
15	Repair or replace the IP cluster. 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. Perform the MIL Control with a scan tool. 5. Command the lamp ON and OFF. Does the MIL turn ON and OFF with each command?	—	Go to Step 18	Go to Step 3
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 P0652 or P0653 (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
- Fuel rail pressure (FRP) sensor
- Barometric pressure (BARO) sensor
- Camshaft position (CMP) sensor
- EGR position sensor

The 5 volts reference circuits are independent of each other outside the ECM, but are bussed together inside the ECM. Therefore, a short circuit condition on one 5 volts reference circuit affects the entire 5 volts reference circuit 2. The ECM monitors the voltage on the 5 volts reference circuit 2. If the ECM detects the voltage is excessively low or high, DTC P0652 or P0653 will set.

Condition for Running the DTC

- The battery voltage is more than 6 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the 5 volts reference circuit 2 voltage is less than 4.7 volts. (DTC P0652)
- The ECM detects that the 5 volts reference circuit 2 voltage is more than 5.3 volts. (DTC P0653)

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.
- The ECM inhibits cruise 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 present, 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 P0652

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 barometric pressure (BARO) sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 3 of E-40) and a known good ground. 4. Turn ON the ignition, with engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 9	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Leave the DMM connected to the BARO sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the EGR valve harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value?	4.7 volts	Go to Step 10	Go to Step 5
5	1. Leave the DMM connected to the BARO sensor 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?	4.7 volts	Go to Step 11	Go to Step 6
6	1. Leave the DMM connected to the BARO sensor 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?	4.7 volts	Go to Step 12	Go to Step 7
7	1. Leave the DMM connected to the BARO 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?	4.7 volts	Go to Step 13	Go to Step 8
8	1. Test the 5 volts reference circuit between the ECM and the following components for a short to ground or short to the low reference circuit: • ECM (pin 19 of E-90) and BARO sensor (pin 3 of E-40) • ECM (pin 31 of E-90) and EGR position sensor (pin 1 of E-71) • ECM (pin 47 of E-90) and FRP sensor (pin 3 of E-48) • ECM (pin 46 of E-90) and CMP sensor (pin 3 of E-39) • ECM (pin 9 of C-58) and APP sensor 2 (pin 8 of C-40) 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
9	Replace the BARO sensor. Refer to BARO Sensor Replacement. Did you complete the replacement?	—	Go to Step 15	—
10	Replace the EGR valve. Refer to EGR Valve Replacement. Did you complete the replacement?	—	Go to Step 15	—

Step	Action	Value(s)	Yes	No
11	Replace the FRP sensor. Refer to FRP Sensor Replacement. Did you complete the replacement?	—	Go to Step 15	—
12	Replace the CMP sensor. Refer to CMP Sensor Replacement. Did you complete the replacement?	—	Go to Step 15	—
13	Replace the APP sensor. Refer to APP Sensor Replacement. 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

Circuit/ System Testing DTC P0653

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. Test the 5 volts reference circuit between the ECM and the following components for a short to battery or ignition voltage: • ECM (pin 19 of E-90) and BARO sensor (pin 3 of E-40) • ECM (pin 31 of E-90) and EGR position sensor (pin 1 of E-71) • ECM (pin 47 of E-90) and FRP sensor (pin 3 of E-48) • ECM (pin 46 of E-90) and CMP sensor (pin 3 of E-39) • ECM (pin 9 of C-58) and APP sensor 2 (pin 8 of C-40) 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 5	—
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 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 P0661 or P0662 (Flash Code 58)

Circuit Description

The ECM controls the swirl levels, which energize the swirl control solenoid valve based on the engine running condition. The ECM commands the swirl control solenoid valve to apply vacuum pressure to the diaphragm actuator to operate swirl control butterflies that is provided each intake port. If the ECM detects an open circuit or short circuit on the solenoid valve circuit, DTC P0661 or P0662 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects a low voltage condition on the swirl control solenoid valve circuit when the solenoid is commanded OFF. (DTC P0661)
- The ECM detects a high voltage condition on the swirl control solenoid valve circuit when the solenoid is commanded ON. (DTC P0662)

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 limits fuel injection quantity. (DTC P0661)
- The ECM inhibits cruise control. (DTC P0661)

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: Vacuum Hose Routing Diagram and Engine Controls Schematics

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

Circuit/ System Testing DTC P0661

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 swirl control solenoid valve harness connector. 3. Connect a test lamp between the ignition voltage feed circuit (pin 2 of E-67) 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 1 of E-67) and battery voltage. 2. Perform the Swirl Control Solenoid Test with a scan tool. 3. Command the solenoid valve ON and OFF. Does the test lamp turn ON and OFF with each command (if test is aborted, go to Step 5)?	—	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 Engine (10A) fuse and the solenoid valve (pin 2 of E-67). Check the Engine (10A) fuse first. Did you complete the repair?	—	Go to Step 13	—
7	1. Test the control circuit between the ECM (pin 67 of E-90) and the solenoid valve (pin 1 of E-67) 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 67 of E-90) and the solenoid valve (pin 1 of E-67) 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 E-67). 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 67 of E-90). 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 swirl 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	—

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. 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 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 P0662

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 swirl 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 P0661 set, but not P0662?	—	Go to Step 5	Go to Step 4
4	1. Test the control circuit between the ECM (pin 67 of E-90) and the solenoid valve (pin 1 of E-67) 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 swirl 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	—

Step	Action	Value(s)	Yes	No
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 3	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 P0698 or P0699 (Flash Code 57)

Circuit Description

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

- Accelerator pedal position (APP) sensor 3
- Boost pressure sensor
- Crankshaft position (CKP) sensor
- Intake throttle position sensor

The 5 volts reference circuits are independent of each other outside the ECM, but are bussed together inside the ECM. Therefore, a short circuit condition on one 5 volts reference circuit affects the entire 5 volts reference circuit 3. The ECM monitors the voltage on the 5 volts reference circuit 3. If the ECM detects the voltage is excessively low or high, DTC P0698 or P0699 will set.

Condition for Running the DTC

- The battery voltage is more than 6 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the 5 volts reference circuit 3 voltage is less than 4.7 volts. (DTC P0698)
- The ECM detects that the 5 volts reference circuit 3 voltage is less than 5.3 volts. (DTC P0699)

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.
- The ECM inhibits cruise 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.

Engine Controls Schematics

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

Circuit/ System Testing DTC P0698

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 accelerator pedal position (APP) sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 1 of C-40) and a known good ground. 4. Turn ON the ignition, with engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 8	Go to Step 4
4	**Notice:** If no boost pressure sensor is installed, skip to Step 5. 1. Leave the DMM connected to the APP sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the boost pressure harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value?	4.7 volts	Go to Step 9	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Leave the DMM connected to the APP 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?	4.7 volts	Go to Step 10	Go to Step 6
6	1. Leave the DMM connected to the APP sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the camshaft 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?	4.7 volts	Go to Step 11	Go to Step 7
7	1. Test the 5 volts reference circuit between the ECM and the following components for a short to ground or short to the low reference circuit: • ECM (pin 7 of C-58) and APP sensor 3 (pin 1 of C-40) • ECM (pin 20 of E-90) and boost pressure sensor (pin 3 of E-107) • ECM (pin 36 of E-90) and intake throttle position sensor (pin 6 of E-38) • ECM (pin 37 of E-90) and CKP sensor (pin 3 of E-52) 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	Replace the APP sensor. Refer to APP Sensor Replacement. Did you complete the replacement?	—	Go to Step 13	—
9	Replace the boost pressure sensor. Refer to Boost Pressure Sensor Replacement. Did you complete the replacement?	—	Go to Step 13	—
10	Replace the intake throttle valve. Refer to Intake Throttle Valve Replacement. Did you complete the replacement?	—	Go to Step 13	—
11	Replace the CKP sensor. Refer to CKP 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	—

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

Circuit/ System Testing DTC P0699

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. Test the 5 volts reference circuit between the ECM and the following components for a short to battery or ignition voltage: • ECM (pin 7 of C-58) and APP sensor 3 (pin 1 of C-40) • ECM (pin 20 of E-90) and boost pressure sensor (pin 3 of E-107) • ECM (pin 36 of E-90) and intake throttle position sensor (pin 6 of E-38) • ECM (pin 37 of E-90) and CKP sensor (pin 3 of E-52) 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	**Important:** Replacement ECM must be programmed 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. 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 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 P0700 (Flash Code 185)

Circuit Description

The transmission control module (TCM) requests to illuminate the malfunction indicator lamp (MIL) via a controller area network (CAN) communication bus to the ECM when the TCM sets a MIL request DTC(s). If the ECM detects the MIL illumination request signal, this DTC will set.

Condition for Running the DTC

- DTCs U0001 and U0101 are not set.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the MIL illumination is requested by the TCM.

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 inhibits cruise control.

Condition for Clearing the DTC

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

Diagnostic Aids

- Under normal conditions if the TCM sets a DTC that requests the MIL to be illuminated, P0700 will set.

Test Description

The number below refers to the step number on the Circuit/ System Testing.
2. If the TCM has DTCs set that are requesting MIL illumination, diagnose that DTC first.
3. If the TCM has DTCs set, clear the DTCs in the TCM first.

Circuit/ System Testing DTC P0700

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 transmission DTC Information with a scan tool. Are there any transmission DTCs set?	—	Go to Applicable DTC in Automatic Transmission Section	Go to Step 3
3	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 4
4	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1064 or P1065 (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 over current condition on the FRP regulator feedback circuit, DTC P1064 will set.
If the ECM detects an improper voltage level on the FRP regulator control high side circuit, DTC P1065 will set.

Condition for Running the DTC

- DTC P1064 is not set. (DTC P1065)
- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects an over current condition on the FRP regulator feedback circuit. (DTC P1064)
- The ECM detects a low or high voltage condition on the FRP regulator high side circuit. (DTC P1065)

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 cruise 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 P1064

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	**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 50 and 70 of E-90) and the FRP regulator (pin 2 of E-50) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	**Important:** Replacement ECM must be programmed 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. 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 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

Circuit/ System Testing DTC P1065

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	Is DTC P0091 or P0092 also set?	—	Go to Applicable DTC	Go to Step 4
4	Observe the Fuel Rail Pressure (FRP) Regulator Feedback parameter with a scan tool. Is the scan tool parameter more than the specified value?	300 mA	Go to Step 7	Go to Step 5
5	1. Turn OFF the ignition for 30 seconds. 2. Disconnect the FRP regulator harness connector. 3. Connect a test lamp between the high side circuit (pin 1 of E-50) and a known good ground. 4. Turn ON the ignition, with the engine OFF. DO NOT start the engine. Does the test lamp illuminate then go out?	—	Go to Step 6	Go to Step 8
6	1. Turn OFF the ignition for 30 seconds. 2. Connect a test lamp between the low side circuit (pin 2 of E-50) and battery voltage. 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. Does the test lamp illuminate then go out?	—	Go to Step 10	Go to Step 9

Step	Action	Value(s)	Yes	No
7	1. Test the high side circuits between the ECM (pins 34 and 54 of E-90) and the FRP regulator (pin 1 of E-50) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
8	1. Test the high side circuits between the ECM (pins 34 and 54 of E-90) and the FRP regulator (pin 1 of E-50) 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 14	Go to Step 11
9	1. Test the low side circuits between the ECM (pins 50 and 70 of E-90) and the FRP regulator (pin 2 of E-50) for the following conditions: • An open circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
10	1. Inspect for an intermittent and for poor connections at the harness connector of the FRP regulator (pins 1 and 2 of E-50). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 34, 50, 54 and 70 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
12	Replace the FRP regulator. Refer to Fuel Pump Replacement. Did you complete the replacement?	—	Go to Step 14	—
13	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 14	—

Step	Action	Value(s)	Yes	No
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 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, P0652, P0653, P0201 - P0204, P1064, P1065, P124B and P2146 - P2151 are not set.
- The battery voltage is more than 9 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 10 to 20 MPa (1,450 to 2,900 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 cruise 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 key 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 restricted suction side fuel line. Inspect the suction side fuel restriction between the fuel supply pump and the fuel tank.
- 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.

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, P1064, P1065, P1094, P124B or P2146 - P2151 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. DO NOT start the engine. 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 10
4	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. 5. Let idle for at least 3 minutes while observing the DTC Information with a scan tool. Is DTC P1094 set?	—	Go to Step 14	Go to Step 5
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 12	Go to Step 6
6	1. Check 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:** Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC. 2. 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. 3. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 7

Step	Action	Value(s)	Yes	No
7	**Notice:** Make sure the in-tank fuel pump operation before performing the following procedures. Refer to In-tank Fuel Pump System Check in this section. 1. Turn OFF the ignition. 2. Disconnect the fuel hose from the fuel supply pump suction side. In order to measure the discharged fuel amount, put the hose into a bottle or a container with a scale. (The inlet of a bottle or a container must be larger than the diameter of hose.) 3. Turn ON the ignition for 20 seconds, with the engine OFF. 4. Turn OFF the ignition for 10 seconds. 5. Perform 3 and 4 three times. The accumulated fuel of three ignition cycles must be more than 300 cc. (Normal amount is more than 100 cc per one ignition cycle.) **Notice:** If there is a leak or a restriction on the suction side, the fuel from the hose will not flow out sufficiently that is most likely caused by fuel leakage, clogged fuel filter, kinked or crushed fuel hose or pipe. Also inside the fuel tank for any foreign materials may be getting drawn into the fuel line pickup. 6. Repair fuel system leaking or restrictions as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 8
8	1. Remove the fuel hose that connects to the fuel supply pump suction side and substitute a clear hose. **Notice:** The hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the hose may damage the fuel supply pump. 2. Bleed the fuel system. Repeat as necessary until the engine starts. 3. Let the engine run at idle for at least 1 minute. 4. Observe the clear hose while holding the engine speed higher than 3000 RPM for a minimum of 1 minute. **Notice:** If many air bubbles appear in the fuel, check the fuel line connections between the fuel supply pump and the fuel tank for tightness and all fuel hoses for cuts, cranks and for the uses of proper clamps. 5. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 9

Step	Action	Value(s)	Yes	No
9	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-50). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 34, 50, 54 and 70 of E-90). 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 15	Go to Step 13
10	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-48). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on at the harness connector of the ECM (pins 47, 48, 68 and 69 of E-90). 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 15	Go to Step 11
11	Replace the FRP sensor. Refer to FRP sensor Replacement. Did you complete the replacement?	—	Go to Step 15	—
12	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 15	—
13	**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 cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement and Fuel Filter Cartridge Replacement. Did you complete the replacement?	—	Go to Step 15	—

Step	Action	Value(s)	Yes	No
14	**Notice:** There is a possibility that the pressure limiter valve stuck open or opening pressure has fallen. Replace the pressure limiter valve. Refer to Fuel Rail 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 2	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 P1094 (Flash Code 226)

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 difference between the actual and the desired fuel pressure is small at low engine speed but the FRP regulator commanded fuel flow is certain amount high, this DTC will set. (FRP Regulator Commanded High DTC)
If the ECM detects that the fuel rail pressure is sharply decreased when fuel cut, this DTC will also set. (Fuel Pressure Drop DTC)

Condition for Running the DTC

FRP Regulator Commanded High DTC

- DTCs P0087, P0091, P0092, P0117, P0118, P0182, P0183, P0192, P0193, P0500, P0501, P0652, P0653, P0201 - P0204, P1064, P1065, P124B and P2146 - P2151 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The accelerator pedal is not depressed.
- The engine coolant temperature is more than 50°C (122°F).
- The vehicle speed is less than 3km/h (2MPH).

Fuel Pressure Drop DTC

- DTCs P0087, P0091, P0092, P0182, P0183, P0192, P0193, P0652, P0653, P0201 - P0204, P1064, P1065, P124B and P2146 - P2151 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The accelerator pedal is not depressed.
- The engine speed is more than 1500RPM.
- The vehicle speed is more than 3km/h (2MPH).

Condition for Setting the DTC

FRP Regulator Commanded High DTC

- The ECM detects that the FRP regulator commanded fuel flow is more than a predetermined range for longer than 10 seconds when the engine speed is near idle speed.

Fuel Pressure Drop DTC

- The ECM detects that the fuel rail pressure is dropped more than a threshold when the commanded fuel is cut.

Action Taken When the DTC Sets

FRP Regulator Commanded High DTC

- 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 cruise control.

Fuel Pressure Drop DTC

- 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 limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.
- The ECM stops engine running when the vehicle speed is lower than 5 km/h (3 MPH) for 5 seconds. The engine will run after the key is cycled when the ignition has been tuned OFF for longer than 10 seconds.

Condition for Clearing the DTC

FRP Regulator Commanded High DTC

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

Fuel Pressure Drop 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

- 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 key 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.
- 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.

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 P1094

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Inspect 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 15	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, P1064, P1065, P124B or P2146 - P2151 set?	—	Go to Applicable DTC	Go to Step 5

Step	Action	Value(s)	Yes	No
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. DO NOT start the engine. 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 6	Go to Step 13
6	1. Turn OFF the ignition. 2. Place the transmission in Neutral and set the parking brake. 3. Start the engine 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 8	Go to Step 7
7	1. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times. 2. 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 18	Go to Step 8
8	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 16	Go to Step 9
9	1. Check 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:** Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC. 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 10

Step	Action	Value(s)	Yes	No
10	**Notice:** Make sure the in-tank fuel pump operation before performing the following procedures. Refer to In-tank Fuel Pump System Check in this section. 1. Turn OFF the ignition. 2. Disconnect the fuel hose from the fuel supply pump suction side. In order to measure the discharged fuel amount, put the hose into a bottle or a container with a scale. (The inlet of a bottle or a container must be larger than the diameter of hose.) 3. Turn ON the ignition for 20 seconds, with the engine OFF. 4. Turn OFF the ignition for 10 seconds. 5. Perform 3 and 4 three times. The accumulated fuel of three ignition cycles must be more than 300 cc. (Normal amount is more than 100 cc per one ignition cycle.) **Notice:** If there is a leak or a restriction on the suction side, the fuel from the hose will not flow out sufficiently that is most likely caused by fuel leakage, clogged fuel filter, kinked or crushed fuel hose or pipe. Also inside the fuel tank for any foreign materials may be getting drawn into the fuel line pickup. 6. Repair fuel system leaking or restrictions as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 11
11	1. Remove the fuel hose that connects to the fuel supply pump suction side and substitute a clear hose. **Notice:** The hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the hose may damage the fuel supply pump. 2. Bleed the fuel system. Repeat as necessary until the engine starts. 3. Let the engine run at idle for at least 1 minute. 4. Observe the clear hose while holding the engine speed higher than 3000 RPM for a minimum of 1 minute. **Notice:** If many air bubbles appear in the fuel, check the fuel line connections between the fuel supply pump and the fuel tank for tightness and all fuel hoses for cuts, cranks and for the uses of proper clamps. 5. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 12

Step	Action	Value(s)	Yes	No
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-50). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 34, 50, 54 and 70 of E-90). 6. Test for high resistance on each FRP regulator 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 17
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-48). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 47, 48, 68 and 69 of E-90). 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 14
14	Replace the FRP sensor. Refer to FRP sensor Replacement. Did you complete the replacement?	—	Go to Step 19	—
15	**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 Fuel Injector Replacement/ Fuel Injector ID Code Data Programming and engine mechanical section. Did you complete the replacement?	—	Go to Step 19	—
16	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 19	—

Step	Action	Value(s)	Yes	No
17	**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 cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement and Fuel Filter Cartridge Replacement. Did you complete the replacement?	—	Go to Step 19	—
18	**Notice:** There is a possibility that the pressure limiter valve stuck open or opening pressure has fallen. Replace the pressure limiter valve. Refer to Fuel Rail Replacement. 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 P1196, P1197 or P1198 (Flash Code 461)

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 an excessively high temperature condition in its internal intake throttle solenoid drive circuit for certain length of time, DTC P1196, P1197 or P1198 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects an excessively high temperature in its internal intake throttle solenoid drive circuit for longer than 30 seconds. (DTC P1196)
- The ECM detects an excessively high temperature in its internal intake throttle solenoid drive circuit for longer than 60 seconds in accumulation time during same ignition cycle. (DTC P1197)
- The ECM detects an excessively high temperature in its internal intake throttle solenoid drive circuit for longer than 120 seconds in accumulation time exceeding ignition cycle. (DTC P1198)

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 cruise 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 intake throttle valve may set this DTC.

Circuit/ System Testing DTC P1196, P1197 or P1198

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 P0638 also set?	—	Go to DTC P0638	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)?	± 5%	Go to Diagnostic Aids	Go to Step 4

Step	Action	Value(s)	Yes	No
4	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?	—	Go to Step 6	Go to Step 5
5	Replace the intake throttle valve. Refer to Intake Throttle Valve Replacement. 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. 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 7	Go to Step 9
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 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 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 P124B (Flash Code 157)

Circuit Description

The ECM calculates the optimum fuel injection ON time using data sent from various engine sensors. The common 1 and common 2 fuel injector charge voltage circuit is a high-voltage supply which drives fuel injectors for each cylinder in conjunction with the ECM grounding the fuel injector solenoid control circuit. If the fuel injector charge voltage circuit or solenoid control circuit is shorted across the bank, this DTC will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine speed is lower than 2000RPM.

Condition for Setting the DTC

- The ECM detects that the fuel injector charge voltage circuit or solenoid control circuit is shorted across the bank.

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 P124B

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 all fuel injector harness connectors. 3. Disconnect the ECM harness connector. 4. Measure continuity through the fuel injector harness connectors. • #1 and #2 solenoid control circuits (pin 1 of E-13 and pin 1 of E-14) • #1 and #2 charge voltage circuits (pin 2 of E-13 and pin 2 of E-14) • #1 solenoid control circuit (pin 1 of E-13) and #2 charge voltage circuit (pin 2 of E-14) • #2 solenoid control circuit (pin 1 of E-14) and #1 charge voltage circuit (pin 2 of E-13) • #1 and #3 solenoid control circuits (pin 1 of E-13 and pin 1 of E-15) • #1 and #3 charge voltage circuits (pin 2 of E-13 and pin 2 of E-15) • #1 solenoid control circuit (pin 1 of E-13) and #3 charge voltage circuit (pin 2 of E-15) • #3 solenoid control circuit (pin 1 of E-15) and #1 charge voltage circuit (pin 2 of E-13) • #2 and #4 solenoid control circuits (pin 1 of E-14 and pin 1 of E-16) • #2 and #4 charge voltage circuits (2 of E-14 and pin 2 of E-16) • #2 solenoid control circuit (pin 1 of E-14) and #4 charge voltage circuit (pin 2 of E-16) • #4 solenoid control circuit (pin 1 of E-16) and #2 charge voltage circuit (pin 2 of E-14) • #3 and #4 solenoid control circuits (pin 1 of E-15 and pin 1 of E-16) • #3 and #4 charge voltage circuits (pin 2 and of E-15 and pin 2 of E-16) • #3 solenoid control circuit (pin 1 of E-15) and #4 charge voltage circuit (pin 2 of E-16) • #4 solenoid control circuit (pin 1 of E-16) and #3 charge voltage circuit (pin 2 of E-15) 5. Repair the short circuit if continuity exists for any measurement. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
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. 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 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 P1261 (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 common 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 fuel injector charge up circuit in the ECM is an insufficient charge or an overcharge, this DTC will set. (Charge Up Voltage DTC)
If the supply voltage to the common 1 and common 2 fuel injector charge up circuits is an excessively low or high voltage, this DTC will also set. (Supply Voltage Low or High DTC)

Condition for Running the DTC

Charge Up Voltage DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine is not running.

Supply Voltage Low or High DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Charge Up Voltage DTC

- The ECM detects that the common 1 fuel injector charge up circuit is an insufficient charge or an overcharge.

Supply Voltage Low or High DTC

- The ECM detects that the supply voltage to the common 1 and common 2 fuel injector charge up circuits is an excessively low or high voltage.

Action Taken When the DTC Sets

Charge Up Voltage DTC & Supply Voltage Low DTC

- 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 cruise control.

Supply Voltage High DTC

- 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 limits fuel injection quantity.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

Charge Up Voltage DTC & Supply Voltage Low DTC

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

Supply Voltage High 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 P1261

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 8

Step	Action	Value(s)	Yes	No
3	1. Inspect for an intermittent, for poor tightening and corrosion at the engine ground terminal (E-10). 2. Repair the tightening or clean the corrosion as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 4
4	1. Test ground circuit between the ECM (pin 73 of E-90) and the engine ground terminal (E-10) for an intermittently open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 5
5	1. Test the battery voltage feed circuit between the ECM (pin 73 of E-90) and the ECM main relay (pin 1 of X-12) for an intermittently open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6
6	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 73 of C-58 and pin 73 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed 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. 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 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 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 common 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 2 fuel injector charge up circuit in the ECM is an insufficient charge or an overcharge, this DTC will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine is not running.

Condition for Setting the DTC

- The ECM detects that the common 2 fuel injector charge up circuit is an insufficient charge or an overcharge.

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 cruise 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 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 8
3	1. Inspect for an intermittent, for poor tightening and corrosion at the engine ground terminal (E-10). 2. Repair the tightening or clean the corrosion as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 4
4	1. Test ground circuit between the ECM (pin 73 of E-90) and the engine ground terminal (E-10) for an intermittently open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 5
5	1. Test the battery voltage feed circuit between the ECM (pin 73 of E-90) and the ECM main relay (pin 1 of X-12) for an intermittently open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6

Step	Action	Value(s)	Yes	No
6	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 73 of E-90 and pin 73 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed 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. 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 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 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, P0404 P0405, P0406, P0652, P0653, P2227, P2228 and P2229 are not set.
- The battery voltage is between 10 to 16 volts.
- The ignition switch is ON.
- The engine coolant temperature is between 20 to 110 °C (68 to 230 °F).
- The intake air temperature is between 0 to 110 °C (32 to 230 °F).
- The barometric pressure is between 60 to 120 kPa (8.7 to 17.4 psi)

Learned Position Error DTC

- DTCs P0404, P0405 and P0406 are not set.

Condition for Setting the DTC

Closed Position Error DTC

- The ECM detects that the actual EGR position is more than 20% for 5 seconds when the EGR control is commanded OFF.

Learned Position Error DTC

- The ECM detects that the EGR learned minimum position is more than 10% or less than -10% 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 pilot injection.
- The ECM inhibits EGR control. (Closed Position Error DTC)
- The ECM inhibits cruise 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 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 P0403, P0405 or P0406 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 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the 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 and 6 of E-71). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 30, 31, 32, 62 and 63 of E-90). 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 6	Go to Step 5
5	Replace the EGR valve. Refer to EGR Valve Replacement. Did you complete the replacement?	—	Go to Step 6	—
6	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. 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 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 P1411, P1412 or P1413 (Flash Code 445)

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 an excessively high temperature condition in its internal EGR solenoid drive circuit for certain length of time, DTC P1411, P1412 or P1413 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects an excessively high temperature in its internal EGR solenoid drive circuit for longer than 30 seconds. (DTC P1411)
- The ECM detects an excessively high temperature in its internal EGR solenoid drive circuit for longer than 60 seconds in accumulation time during same ignition cycle. (DTC P1412)
- The ECM detects an excessively high temperature in its internal EGR solenoid drive circuit for longer than 120 seconds in accumulation time exceeding ignition cycle. (DTC P1413)

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 cruise 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 EGR valve may set this DTC.

Circuit/ System Testing DTC P1411, P1412 or P1413

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 P1404 also set?	—	Go to Applicable DTC	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. Does the EGR Position parameter follow within the specified value quick enough (compare with a similar unit if available)?	±5%	Go to Diagnostic Aids	Go to Step 4
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 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5

Step	Action	Value(s)	Yes	No
5	Replace the EGR valve. Refer to EGR Valve Replacement. 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. 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 7	Go to Step 9
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 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 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 P156A or P156B (Flash Code 135)

Circuit Description

The ECM monitors the battery voltage on the ECM main relay voltage feed terminal to make sure that the voltage stays within the proper range. If the ECM detects an excessively low or high battery voltage, DTC P156A or P156B will set.

Condition for Running the DTC

- The ignition voltage is more than 9 volts. (DTC P156B)

Condition for Setting the DTC

- The ECM detects that the battery voltage feed circuit is less than 8 volts for 20 seconds. (DTC P156A)
- The ECM detects that the battery voltage feed circuit is more than 16 volts for 5 seconds. (DTC P156B)

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 limits fuel injection quantity. (DTC P156B)
- The ECM inhibits pilot injection. (DTC P156B)
- The ECM inhibits cruise control. (DTC P156B)

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.
- The weakened battery may set DTC P156A.
- Jump starting the vehicle or a battery charger may have set DTC P156B.

Schematic Reference: Engine Controls Schematics

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

Circuit/ System Testing DTC P156A

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 and let idle. 4. Load the electrical system by turning ON the headlights, A/C, etc. while observing the Battery Voltage parameter with a scan tool. Does the scan tool indicate more than the specified value?	10.0 volts	Go to Diagnostic Aids	Go to Step 3
3	Test the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you find a charging system problem?	—	Go to Step 4	Go to Step 5
4	Repair the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you complete the repair?	—	Go to Step 6	—

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for a poor connection and for corrosion at the harness connector of the ECM (pin 73 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Diagnostic Aids
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and let idle. 5. Load the electrical system by turning ON the headlights, A/C, etc. while observing the Battery Voltage parameter with a scan tool. Does the scan tool indicate more than the specified value?	10.0 volts	Go to Step 7	Go to Step 3
7	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 P156B

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 jump started or 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 Battery Voltage parameter with the scan tool. Does the scan tool indicate less than the specified value?	16.0 volts	Go to Diagnostic Aids	Go to Step 4
4	Test the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you find a charging system problem?	—	Go to Step 5	Go to Diagnostic Aids
5	Repair the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you complete the repair?	—	Go to Step 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 and let idle. 5. Observe the Battery Voltage parameter with a scan tool. Does the scan tool indicate less than the specified value?	16.0 volts	Go to Step 7	Go to Step 4
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. The ECM transmits a specific request signal to the ICU and the ICU sends back a response signal to the ECM. Both communication signals are carried out via a controller area network (CAN) communication bus. 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. (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.
- 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, U0001 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 which begin with B or U?	—	Go to Applicable DTC in Immobilizer Section	Go to Step 4
4	Program immobilizer security information into the ECM. Refer to Resetting and Programming Guidelines in immobilizer 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, 254)

Circuit Description

The electrically erasable & programmable read only memory (EEPROM) memorizes learning data, VIN data and immobilzer security information. If the ECM detects an error in either of their data, 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 a faulty learning data in its internal EEPROM. (Flash Code 54)
- The ECM detects a faulty VIN data or immobilizer security information in its internal EEPROM. (Flash Code 254)

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 limits fuel injection quantity. (Flash Code 54)
- The ECM inhibits cruise control. (Flash Code 54)

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)

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 5
3	1. Verify the correct VIN and immobilizer code are entered into the ECM with a scan tool. Refer to ECM Replacement. 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 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 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 ignition voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Low Voltage DTC

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

High Voltage DTC

- 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

Low Voltage DTC

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

High Voltage DTC

- 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

Low Voltage DTC

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

High Voltage 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. Perform the Service Vehicle Soon (SVS) Lamp Control with a scan tool. 4. Command the lamp ON and OFF. Does the SVS lamp turn ON and OFF with each command?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Inspect the Meter (10A) fuse in the cabin fuse block. 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-2 (C-58) harness connector. 3. Turn ON the ignition, with the engine OFF. Is the SVS lamp OFF?	—	Go to Sep 6	Go to Step 12
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 71 of C-58) 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 71 of C-58) and a known good ground. Is the SVS 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 8 of B-24) 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 71 of C-58) and the IP cluster (pin 26 of B-23) 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 8 of B-24 and pin 26 of B-23). 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 71 of C-58). 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 71 of C-58) and the IP cluster (pin 26 of B-23). Did you complete the repair?	—	Go to Step 17	—
13	Repair the short to battery or ignition voltage between the ECM (pin 71 of C-58) and the IP cluster (pin 26 of B-23). Did you complete the repair?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
14	Repair the open circuit or high resistance on the ignition voltage feed circuit between the Meter (10A) fuse and the IP cluster (pin 8 of B-24). Did you complete the repair?	—	Go to Step 17	—
15	Repair or replace the IP cluster. 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. Perform the SVS Lamp Control with a scan tool. 5. Command the lamp ON and OFF. Does the SVS lamp turn ON and OFF with each command?	—	Go to Step 18	Go to Step 3
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 P2100, P2101 or P2103 (Flash Code 446)

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 an open circuit or short circuit on the solenoid circuits, DTC P2100, P2101 or P2103 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects an open circuit on the intake throttle solenoid circuits. (DTC P2100)
- The ECM detects a short to ground on the intake throttle solenoid circuits. (DTC P2101)
- The ECM detects a short to voltage circuit on the intake throttle solenoid circuits. (DTC P2103)

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 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 inhibits EGR 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 P2100, P2101 or P2103

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 intake throttle valve harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the drive voltage circuit (pin 2 of E-38) and a known good ground. 5. Connect a DMM between the low side circuit (pin 1 of E-38) and a known good ground. Are both voltage readings within the specified value?	1.4 to 1.8 volts	Go to Step 5	Go to Step 4
4	Is the DMM voltage more than the specified value at Step 3?	—	Go to Step 7	Go to Step 6

Step	Action	Value(s)	Yes	No
5	1. Test the circuits between the ECM (pins 55 and 56 of E-90) and the intake throttle valve (pins 1 and 2 of E-38) for a short circuit each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 8
6	1. Test the circuits (which ever voltage reading did not read within the specified value at Step 3) between the ECM (pins 55 and 56 of E-90) and the intake throttle valve (pins 1 and 2 of E-38) for the following conditions: • An open circuit • A short to ground • A short to the position sensor 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
7	1. Test the circuits (which ever voltage reading did not read within the specified value at Step 3) between the ECM (pins 55 and 56 of E-90) and the intake throttle valve (pins 1 and 2 of E-38) 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 12	Go to Step 11
8	1. Inspect for an intermittent and for poor connections at the harness connector of the intake throttle valve (pins 1 and 2 of E-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 55 and 56 of E-90). 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 Replacement. Did you complete the replacement?	—	Go to Step 10	—
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

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 three 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 P0642 and P0643 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the APP sensor 1 signal voltage is less than 0.15 volts. (DTC P2122)
- The ECM detects that the APP sensor 1 signal voltage is more than 4.85 volts. (DTC P2123)

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 limits fuel injection quantity
- The ECM inhibits cruise 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.
- APP sensor 1 may have an intermittent open somewhere in the pedal range.

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 P0642 also set?	—	Go to DTC P0642	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 10 of C-40) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 5	Go to Step 6
5	Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit (pins 5 and 10 of C-40). Is the APP Sensor 1 parameter more than the specified value?	4.7 volts	Go to Step 8	Go to Step 7
6	1. Test the 5 volts reference circuit between the ECM (pin 11 of C-58) and the APP sensor (pin 10 of C-40) 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 12 of C-58) and the APP sensor (pin 5 of C-40) 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 5 and 10 of C-40). 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 11 and 12 of C-58). 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 APP 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. 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?	4.8 volts	Go to Step 3	Go to Diagnostic Aids
3	Monitor the DTC Information with a scan tool. Is DTC P0643 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 P0643	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
6	Connect a test lamp between the low reference circuit (pin 4 of C-40) 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 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 12 of C-58) and the APP sensor (pin 5 of C-40) 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	1. Test the low reference circuit between the ECM (pin 27 of C-58) and the APP sensor (pin 4 of C-40) 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 4 of C-40). 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 27 of C-58). 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 APP 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. 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?	4.8 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 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 three 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 P0652 and P0653 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the APP sensor 2 signal voltage is less than 0.15 volts. (DTC P2127)
- The ECM detects that the APP sensor 2 signal voltage is more than 4.85 volts. (DTC P2128)

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 limits fuel injection quantity.
- The ECM inhibits cruise 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.
- APP sensor 2 may have an intermittent open somewhere in the pedal range.

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 P0652 also set?	—	Go to DTC P0652	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
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 more than the specified value?	4.7 volts	Go to Step 5	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Connect a DMM between the 5 volts reference circuit (pin 8 of C-40) and a known good ground. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 8	Go to Step 7
6	1. Test the signal circuit between the ECM (pin 10 of C-58) and the APP sensor (pin 9 of C-40) 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	1. Test the 5 volts reference circuit between the ECM (pin 9 of C-58) and the APP sensor (pin 8 of C-40) 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 APP sensor (pin 8 of C-40). 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 9 of C-58). 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 APP 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	—
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 2 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. Monitor the DTC Information with a scan tool. Is DTC P0653 also set?	—	Go to DTC P0653	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 more than the specified value during depressing or releasing the pedal?	4.8 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Connect a DMM between the signal circuit (pin 9 of C-40) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.3 volts	Go to Step 10	Go to Step 5
5	1. Connect a test lamp between the signal circuit of the sensor 2 harness (pin 9 of C-40) 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?	4.7 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 2 harness (pins 3 and 9 of C-40). Is the APP Sensor 2 parameter less than the specified value?	0.2 volts	Go to Step 11	Go to Step 7
7	1. Test the low reference circuit between the ECM (pin 25 of C-58) and the APP sensor (pin 3 of C-40) 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 (pin 10 of C-58) and the APP sensor (pin 9 of C-40) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
9	1. Test the signal circuit between the ECM (pin 10 of C-58) and the APP sensor (pin 9 of C-40) for 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

Step	Action	Value(s)	Yes	No
10	**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 10 of C-58) and the APP sensor (pin 9 of C-40) 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 APP sensor (pins 3 and 9 of C-40). 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 10 and 25 of C-58). 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 APP sensor. Refer to APP Sensor Replacement. 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. Fully depress and release the accelerator pedal while observing the APP Sensor 2 parameter with the scan tool. Does the scan tool indicate more than the specified value during depressing or releasing the pedal?	4.8 volts	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 P2132 or P2133 (Flash Code 123)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal control assembly. The sensor is made up of three 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 3 has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor 3 signal circuit

The APP sensor 3 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 P2132 or P2133 will set.

Condition for Running the DTC

- DTCs P0698 and P0699 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the APP sensor 3 signal voltage is less than 1.2 volts. (DTC P2132)
- The ECM detects that the APP sensor 3 signal voltage is more than 4.85 volts. (DTC P2133)

Action Taken When the DTC Sets

DTC P2132

- 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 limits fuel injection quantity.
- The ECM inhibits cruise control.

DTC P2133

- 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 cruise control.

Condition for Clearing the DTC

DTC P2132

- 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)

DTC P2133

- 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.
- APP sensor 3 may have an intermittent open somewhere in the pedal range.

Schematic Reference: Engine Controls Schematics

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

Circuit/ System Testing DTC P2132

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 P0698 also set?	—	Go to DTC P0698	Go to Step 3
3	Fully depress and release the accelerator pedal while observing the Accelerator Pedal Position (APP) Sensor 3 parameter with a scan tool. Does the scan tool indicate less than the specified value during depressing or releasing the pedal?	1.2 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. Turn ON the ignition, with the engine OFF. Is the APP Sensor 3 parameter more than the specified value?	4.7 volts	Go to Step 5	Go to Step 6
5	Connect a DMM between the 5 volts reference circuit (pin 1 of C-40) and a known good ground. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 8	Go to Step 7
6	1. Test the signal circuit between the ECM (pin 8 of C-58) and the APP sensor (pin 6 of C-40) 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	1. Test the 5 volts reference circuit between the ECM (pin 7 of C-58) and the APP sensor (pin 1 of C-40) 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 APP sensor (pin 1 of C-40). 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 7 of C-58). 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 APP 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. Fully depress and release the accelerator pedal while observing the APP Sensor 3 parameter with the scan tool. Does the scan tool indicate less than the specified value during depressing or releasing the pedal?	1.2 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 P2133

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 P0699 also set?	—	Go to DTC P0653	Go to Step 3
3	Fully depress and release the accelerator pedal while observing the Accelerator Pedal Position (APP) Sensor 3 parameter with a scan tool. Does the scan tool indicate more than the specified value during depressing or releasing the pedal?	4.8 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Connect a DMM between the signal circuit (pin 6 of C-40) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.3 volts	Go to Step 10	Go to Step 5
5	1. Connect a test lamp between the signal circuit (pin 6 of C-40) 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?	4.7 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 3 harness (pins 6 and 7 of C-40). Is the APP Sensor 3 parameter less than the specified value?	0.2 volts	Go to Step 11	Go to Step 7

Step	Action	Value(s)	Yes	No
7	1. Test the low reference circuit between the ECM (pin 23 of C-58) and the APP sensor (pin 7 of C-40) 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 (pin 8 of C-58) and the APP sensor (pin 6 of C-40) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
9	1. Test the signal circuit between the ECM (pin 8 of C-58) and the APP sensor (pin 6 of C-40) for 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 APP sensor 3 may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 8 of C-58) and the APP sensor (pin 6 of C-40) 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 APP sensor (pins 6 and 7 of C-40). 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 8 and 23 of C-58). 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 APP sensor. Refer to APP Sensor Replacement. 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. 5. Fully depress and release the accelerator pedal while observing the APP Sensor 3 parameter with the scan tool. Does the scan tool indicate more than the specified value during depressing or releasing the pedal?	4.8 volts	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 P2138, P2139 or P2140 (Flash Code 124, 125 or 126)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal control assembly. The sensor is made up of three individual sensors within one housing. The APP sensor 1, APP sensor 2 and APP sensor 3 are potentiometer type sensors, each with the following circuits.

- 5 volts reference circuit
- Low reference circuit
- Signal 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 and APP sensor 3 signal voltage is high at rest and decreases as the pedal is depressed. If the ECM detects that each APP sensor signal voltage is out of the correlation, DTC P2138, P2139 or P2140 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The APP sensor 1 signal voltage is between 0.15 to 4.85 volt. (DTC P2138 or P2139)
- The APP sensor 2 signal voltage is between 0.15 to 4.85 volt. (DTC P2138 or P2140)
- The APP sensor 3 signal voltage is between 1.20 to 4.85 volt. (DTC P2139 or P2140)

Condition for Setting the DTC

- The ECM detects that the APP sensor 1 and 2 are more than 40% out of range of each other. (DTC P2138)
- The ECM detects that the APP sensor 1 and 3 are more than 40% out of range of each other. (DTC P2139)
- The ECM detects that the APP sensor 2 and 3 are more than 40% out of range of each other. (DTC P2140)

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 limits fuel injection quantity.
- The ECM inhibits cruise 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 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 P0642, P0643, P0652, P0653, P0698, P0699, P2132 or P2133 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
4	Is DTC P2140 also set?	—	Go to Step 6	Go to Step 5
5	Is DTC P2139 also set?	—	Go to Step 7	Go to Step 8

Step	Action	Value(s)	Yes	No
6	1. Test each accelerator pedal position (APP) sensor 2 circuits between the ECM (pins 9, 10 and 25 of C-58) and the APP sensor (pins 3, 8 and 9 of C-40) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 7
7	1. Test each APP sensor 1 circuits between the ECM (pins 11, 12 and 27 of C-58) and the APP sensor (pins 4, 5 and 10 of C-40) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 8
8	1. Test each APP sensor 3 circuits between the ECM (pins 7, 8 and 23 of C-58) and the APP sensor (pins 1, 6 and 7 of C-40) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 9
9	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the APP sensor (pins 1, 3, 4, 5, 6, 7, 8, 9 and 10 of C-40). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 7, 8, 9, 10, 11, 12, 23, 25 and 27 of C-58). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
10	1. Test the APP sensor 1 and sensor 3 signal circuit between the ECM (pins 8 and 12 of C-58) and the APP sensor (pins 5 and 6 of C-40) for a short circuit each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
11	Replace the APP sensor. Refer to APP Sensor 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 DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 13	Go to Step 15

Step	Action	Value(s)	Yes	No
13	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. 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. 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 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

Circuit/ System Testing DTC P2139

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 P0642, P0643, P0652, P0653, P0698, P0699, 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
4	Is DTC P2138 also set?	—	Go to DTC P2138	Go to Step 5
5	Is DTC P2140 also set?	—	Go to DTC P2140	Go to Step 6
6	1. Test each accelerator pedal position (APP) sensor 2 circuits between the ECM (pins 9, 10 and 25 of C-58) and the APP sensor (pins 3, 8 and 9 of C-40) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 7

Step	Action	Value(s)	Yes	No
7	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the APP sensor (pins 3, 8 and 9 of C-40). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 9, 10 and 25 of C-58). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 8
8	1. Test the APP sensor 1 and sensor 2 signal circuit between the ECM (pins 10 and 12 of C-58) and the APP sensor (pins 5 and 9 of C-40) for a short circuit each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
9	Replace the APP sensor. Refer to APP 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. 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 11	Go to Step 13
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 DTC Information with a scan tool. Did the DTC 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

Circuit/ System Testing DTC P2140

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 P0642, P0643, P0652, P0653, P0698, P0699, P2122 or P2123 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
4	Is DTC P2138 also set?	—	Go to DTC P2138	Go to Step 5
5	Is DTC P2139 also set?	—	Go to Step 6	Go to Step 7
6	1. Test each accelerator pedal position (APP) sensor 3 circuits between the ECM (pins 7, 8 and 23 of C-58) and the APP sensor (pins 1, 6 and 7 of C-40) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 7
7	1. Test each APP sensor 1 circuits between the ECM (pins 11, 12 and 27 of C-58) and the APP sensor (pins 4, 5 and 10 of C-40) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 8
8	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the APP sensor (pins 1, 4, 5, 6, 7 and 10 of C-40). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 7, 8, 11, 12, 23 and 27 of C-40). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 9
9	1. Test the APP sensor 1 and sensor 2 signal circuit between the ECM (pins 10 and 12 of C-58) and the APP sensor (pins 5 and 9 of C-40) for a short circuit each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10

Step	Action	Value(s)	Yes	No
10	1. Test the APP sensor 1 and sensor 3 signal circuit between the ECM (pins 8 and 12 of C-58) and the APP sensor (pins 5 and 6 of C-40) for a short circuit each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
11	Replace the APP sensor. Refer to APP Sensor 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 DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 13	Go to Step 15
13	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. 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. 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 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 P2146, P2147 or P2148 (Flash Code 158)

Circuit Description

The ECM calculates the optimum fuel injection ON time using data sent from various engine sensors. The common 1 fuel injector charge voltage circuit is a high-voltage supply which drives fuel injectors for cylinder #1 and #4 in conjunction with the ECM grounding the fuel injector solenoid control circuit. If the common 1 fuel injector charge voltage circuit is shorted to cylinder #1 or #4 fuel injector solenoid control circuit, shorted to ground or shorted voltage circuit DTC P2146, P2147 or P2148 will set. If the cylinder #1 and #4 fuel injector solenoid control circuit is shorted each other, shorted to ground or shorted voltage circuit DTC P2146, P2147 or P2148 will also set.

Condition for Running the DTC

- DTCs P0201, P0204, P2147 and P2148 are not set. (DTC P2146)
- The battery voltage is more than 9 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 shored to cylinder #1 or #4 fuel injector solenoid control circuit, or cylinder #1 and #4 fuel injector solenoid control circuit is shorted each other. (DTC P2146)
- The ECM detects that the common 1 fuel injector charge voltage circuit, cylinder #1 or #4 fuel injector solenoid control circuit is shorted to ground. (DTC P2147)
- The ECM detects that the common 1 fuel injector charge voltage circuit, cylinder #1 or #4 fuel injector solenoid control circuit is shorted to voltage circuit. (DTC P2148)

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 cruise 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. Accelerate the engine and keep the accelerator pedal at any position. 5. 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 cylinder #1 and #4 fuel injector harness connector. 3. Disconnect the ECM harness connector. 4. Measure continuity through the fuel injector harness connector(s). • Each #1 fuel injector circuit (pins 1 and 2 of E-13) • Each #4 fuel injector circuit (pins 1and 2 of E-16) • #1 and #4 solenoid control circuits (pin 1 of E-13 and pin 1 of E-16) • #1 solenoid control circuit (pins 1 of E-13) and #4 charge voltage circuit (pin 2 of E-16) • #1 charge voltage circuit (pins 2 of E-13) and #4 solenoid control circuit (pin 1 of E-16) 5. Repair the short circuit if continuity exists for any measurement. Did you find and correct the condition?	—	Go to Step 7	Go to Step 4
4	Measure the resistance of cylinder #1 and #4 fuel injector solenoid. Is the resistance more than the specified value?	0.5Ω	Go to Step 6	Go to Step 5
5	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that was less solenoid resistance found at Step 4. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. 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. 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 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

Circuit/ System Testing DTC P2147

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 cylinder #1 and #4 fuel injector harness connector. 3. Disconnect the ECM harness connector. 4. Measure continuity between each fuel injector circuit and a known good ground. • #1 (pins 1 and 2 of E-13) and a known good ground • #4 (pins 1 and 2 of E-16) and a known good ground 5. Repair the short to ground if continuity exists for any measurement. Did you find and correct the condition?	—	Go to Step 7	Go to Step 4
4	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 6	Go to Step 5
5	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that was less insulation resistance found at step 4. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. 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. Turn ON the ignition, with the engineOFF. 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 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

Circuit/ System Testing DTC P2148

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 cylinder #1 and #4 fuel injector harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between each fuel injector circuit and a known good ground. • #1 (pins 1 and 2 of E-13) and a known good ground • #4 (pins 1 and 2 of E-16) and a known good ground 5. Repair the short to battery or ignition voltage if the test lamp illuminates. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
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	—
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. Turn ON the ignition, with the engineOFF. 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 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 P2149, P2150 or P2151 (Flash Code 159)

Circuit Description

The ECM calculates the optimum fuel injection ON time using data sent from various engine sensors. The common 2 fuel injector charge voltage circuit is a high-voltage supply which drives fuel injectors for cylinder #2 and #3 in conjunction with the ECM grounding the fuel injector solenoid control circuit. If the common 2 fuel injector charge voltage circuit is shorted to cylinder #2 or #3 fuel injector solenoid control circuit, shorted to ground or shorted voltage circuit DTC P2149, P2150 or P2151 will set. If the cylinder #2 and #3 fuel injector solenoid control circuit is shorted each other, shorted to ground or shorted voltage circuit DTC P2149, P2150 or P2151 will also set.

Condition for Running the DTC

- DTCs P0202, P0203, P2150 and P2151 are not set. (DTC P2149)
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the common 2 fuel injector charge voltage circuit is shored to cylinder #2 or #3 fuel injector solenoid control circuit, or cylinder #2 and #3 fuel injector solenoid control circuit is shorted each other. (DTC P2149).
- The ECM detects that the common 2 fuel injector charge voltage circuit, or cylinder #2 or #3 fuel injector solenoid control circuit is shorted to ground. (DTC P2150)
- The ECM detects that the common 2 fuel injector charge voltage circuit, or cylinder #2 or #3 fuel injector solenoid control circuit is shorted to voltage circuit. (DTC P2151)

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 cruise 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 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. Accelerate the engine and keep the accelerator pedal at any position. 5. 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 cylinder #2 and #3 fuel injector harness connector. 3. Disconnect the ECM harness connector. 4. Measure continuity through the fuel injector harness connector(s). • Each #2 fuel injector circuit (pins 1 and 2 of E-14) • Each #3 fuel injector circuit (pins 1and 2 of E-15) • #2 and #3 solenoid control circuits (pin 1 of E-14 and pin 1 of E-15) • #2 solenoid control circuit (pin 1 of E-14) and #3 charge voltage circuit (pin 2 of E-15) • #2 charge voltage circuit (pin 2 of E-14) and #3 solenoid control circuit (pin 1 of E-15) 5. Repair the short circuit if continuity exists for any measurement. Did you find and correct the condition?	—	Go to Step 7	Go to Step 4
4	Measure the resistance of cylinder #2 and #3 fuel injector solenoid. Is the resistance less than the specified value?	0.5Ω	Go to Step 6	Go to Step 5
5	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that was less solenoid resistance found at Step 4. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. 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. 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 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

Circuit/ System Testing DTC P2150

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 cylinder #2 and #3 fuel injector harness connector. 3. Disconnect the ECM harness connector. 4. Measure continuity between each fuel injector circuit and a known good ground. • #2 (pins 1 and 2 of E-14) and a known good ground • #3 (pins 1 and 2 of E-15) and a known good ground 5. Repair the short to ground if continuity exists for any measurement. Did you find and correct the condition?	—	Go to Step 7	Go to Step 4
4	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 6	Go to Step 5
5	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that was less insulation resistance found at Step 4. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. 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. Turn ON the ignition, with the engineOFF. 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 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

Circuit/ System Testing DTC P2151

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 cylinder #2 and #3 fuel injector harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between each fuel injector circuit and a known good ground. • #2 (pins 1 and 2 of E-14) and a known good ground • #3 (pins 1 and 2 of E-15) and a known good ground 5. Repair the short to battery or ignition voltage if the test lamp illuminates. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
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	—
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. Turn ON the ignition, with the engineOFF. 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 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 P2227 (Flash Code 71)

Circuit Description

The barometric pressure (BARO) sensor is located on the intake manifold. 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 P0101, P0102, P0103, P0107, P0108, P0116, P0117, P0118, P0122, P0123, P0500, P0501, P0638, P0652, P0653, P0698, P0699, P2100, P2101, P2103, P2228 and P2229 are not set.

AND following conditions are met for longer than 3 seconds.

- The ignition switch is ON.
- The engine coolant temperature is more than 5°C (41°F).
- The engine speed is less than 800 RPM.
- The fuel injection quantity is less than a predetermined value.
- The accelerator pedal is not depressed.
- The vehicle is not running.
- The engine run time is longer than 5 seconds.

Condition for Setting the DTC

- The ECM detects that the differential pressure between the barometric pressure and the boost pressure is more than 10 kPa (1.5 psi) for 10 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.
- The ECM inhibits cruise 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 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. 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-107). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 20, 21, 22 and 23 of E-90). 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 20, 21 and 23 of E-90) and the boost pressure sensor (pins 1, 2 and 3 of E-107) 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 E-40). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 17, 18 and 19 of E-90). 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 circuit between the ECM (pins 17, 18 and 19 of E-90) and the BARO sensor (pins 1, 2 and 3 of E-40) 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 Replacemenet in this section. 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 on the intake manifold. 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 P0652 and P0653 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the BARO sensor signal voltage is less than 0.1 volts for 3 seconds. (DTC P2228)
- The ECM detects that the BARO sensor signal voltage is less than 4.3 volts for 3 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 limits fuel injection quantity.
- The ECM inhibits EGR control.
- The ECM inhibits cruise 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 P0652 also set?	—	Go to DTC P0652	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?	0.1 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 E-40) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 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 E-40). Is the BARO Sensor parameter more than the specified value?	4.7 volts	Go to Step 8	Go to Step 7
6	1. Test the 5 volts reference circuit between the ECM (pin 19 of E-90) and the BARO sensor (pin 3 of E-40) 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 18 of E-90) and the BARO sensor (pin 2 of E-40) 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 E-40). 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 18 and 19 of E-90). 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	—
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 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?	4.3 volts	Go to Step 3	Go to Diagnostic Aids
3	Monitor the DTC Information with a scan tool. Is DTC P0653 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 P0653	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 E-40) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
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 18 of E-90) and the BARO sensor (pin 2 of E-40) 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	1. Test the low reference circuit between the ECM (pin 17 of E-90) and the BARO sensor (pin 1 of E-40) 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

Step	Action	Value(s)	Yes	No
9	1. Inspect for an intermittent and for a poor connection at the harness connector of the BARO sensor (pin 1 of E-40). 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 17 of E-90). 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
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 P2621 or P2622 (Flash Code 94)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal control assembly. The analogue APP signals are converted by the ECM into a pulse width modulation (PWM) signal. This converted signal is sent from the ECM to the TCM to determine appropriate shift points depending on the accelerator pedal pressing amount. If the ECM detects an improper voltage level on the APP PWM signal circuit, DTC P2621 or P2622 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects a low voltage condition on the APP PWM signal circuit for longer than 3 seconds. (DTC P2621)
- The ECM detects a high voltage condition on the APP PWM signal circuit for longer than 3 seconds. (DTC P2622)

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 P2621

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. Back probe a DMM between the accelerator pedal position (APP) signal circuit of the TCM harness connector (pin 16 of C-94) and a known good ground. 3. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	10.0 volts	Go to Step 6	Go to Step 4
4	Is the DMM voltage more than the specified value at Step 3?	2.0 volts	Go to Step 7	Go to Step 5
5	Repair the short to ground between the ECM (pin 56 of C-58) and the TCM (pin 16 of C-94). Did you complete the repair?	—	Go to Step 11	—
6	1. Test the signal circuit between the ECM (pin 56 of C-58) and the TCM (pin 16 of C-94) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8

Step	Action	Value(s)	Yes	No
7	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the TCM (pin 16 of C-94). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 56 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—
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

Circuit/ System Testing DTC P2622

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 TCM harness connector. 3. Connect a test lamp between the accelerator pedal position (APP) signal circuit of the TCM harness connector (pin 16 of C-94) 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 5
4	1. Test the signal circuit between the ECM (pin 56 of C-58) and the TCM (pin 16 of C-94) 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	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. 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. 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 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 U0001 or U0101 (Flash Code 84 or 85)

Circuit Description

The ECM, the transmission control module (TCM), the immobilizer control unit (ICU), the data recording module (DRM), instrument panel (IP) cluster and scan tool 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 the TCM, ICU, DRM and IP cluster. If the ECM fails to send or receive an expected message from the TCM, ICU, DRM and IP cluster, DTC U0001 or U0101 will set depending on what communication is lost.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the CAN Bus OFF status. (DTC U0001)
- The ECM detects that the CAN Bus messages from the TCM are not being received. (DTC U0101)

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 cruise 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 the TCM has DTCs set, clear the DTCs in the TCM first.

Schematic Reference: Engine Controls Schematics

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

Circuit/ System Testing DTC U0001 or 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	Refer to Scan Tool Does Not Communicate with The CAN Device in this section. Did you complete the action?	—	Go to Step 3	—
3	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 4
4	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. The ECM sends request signal to the ICU. The ECM receives response signal from the ICU. Both communication signals are carried out via a controller area network (CAN) communication bus. 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. (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.
- 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 U0001 also set?	—	Go to DTC U0001	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
4	Monitor the immobilizer DTC Information with a scan tool. Does the immobilizer DTCs fail this ignition which begin with B or U?	—	Go to Applicable DTC in Immobilizer Section	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 5°C (41°F) and 100°C (212°F).
- The intake air temperature (IAT) is more than 5°C (41°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”?	—	Refer 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 14	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 60°C [140°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 8
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 8

Step	Action	Value(s)	Yes	No
6	**Notice:** If the intake throttle solenoid is commanded OFF, Intake Throttle Position parameter indicates over 100%. Observe the Desired Intake Throttle Position and Intake Throttle Position parameter with a scan tool. Does the Intake Throttle Position parameter follow within the specified value?	±5%	Go to Step 7	Go to Step 10
7	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 10
8	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 14	Go to Step 9
9	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 and 6 of E-71). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 30, 31, 32, 62 and 63 of E-90). 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 14	Go to Step 12
10	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 14	Go to Step 11

Step	Action	Value(s)	Yes	No
11	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, 3, 5 and 6 of E-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 35, 36, 55, 56 and 57 of E-90). 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 14	Go to Step 13
12	Replace the EGR valve. Refer to EGR valve Replacement. Did you complete the replacement?	—	Go to Step 14	—
13	Replace the intake throttle valve. Refer to Intake Throttle Valve Replacement. Did you complete the replacement?	—	Go to Step 14	—
14	Reconnect all previously disconnected components or harness connector(s). Did you complete the action?	—	Go to Step 2	—

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 7 seconds depending upon the engine coolant temperature.
- The pre glow control system operates when the engine coolant temperature is less than 30°C (86°F).
- The after glow control system operates when the engine coolant temperature is less than 60°C (140°F).

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 (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. 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 or P0380 set?	—	Refer to Applicable DTC	Go to Step 3
3	**Notice:** If no glow indicator lamp is equipped, skip to Step 3. 1. Verify whether the instrument panel (IP) cluster is operational. 2. Perform the Glow Plug Lamp Control with a scan tool. 3. Command the lamp ON and OFF. Does the glow indicator lamp turn ON and OFF with each command?	—	Go to Step 4	Go to 2 of 2 Step 1
4	1. Turn OFF the ignition. 2. Make sure the metal bus bar that connects switched battery voltage supply terminal (E-49) 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-49 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 5	Go to Step 6

Step	Action	Value(s)	Yes	No
5	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 16
6	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-49 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 14	Go to Step 7
7	Inspect the Glow (60A) slow blow fuse in the engine room fuse block. Is the Glow (60A) slow blow fuse open?	—	Go to Step 8	Go to Step 9
8	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 17	—
9	1. Turn OFF the ignition. 2. Remove the glow relay. 3. Probe the battery voltage feed circuit of the relay (pin 4 of X-5) with a test lamp that is connected to a known good ground. Does the test lamp illuminate?	—	Go to Step 10	Go to Step 11
10	1. Probe the voltage supply circuit of glow plugs (pin 1 of X-5) 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 13	Go to Step 12
11	Repair the open circuit or high resistance between the Glow (60A) slow blow fuse and the glow relay (pin 4 of X-5). Did you complete the repair?	—	Go to Step 17	—
12	Repair the open circuit or high resistance between the glow relay (pin 1 of X-5) and the glow plugs (E-49 terminal). Did you complete the repair?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
13	**Important**: The glow plugs may be burnt out if the battery voltage supply circuit is shorted to a voltage source. Repair the short to battery or ignition voltage between the glow relay (pin 1 of X-5) and the glow plugs (E-49 terminal). Did you complete the repair?	—	Go to Step 17	—
14	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 17	Go to Step 15
15	Replace the glow relay. Did you complete the replacement?	—	Go to Step 17	—
16	Replace the appropriate glow plug. Did you complete the replacement?	—	Go to Step 17	—
17	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-49 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 5	Go to Step 2

Circuit/ System Testing Glow Control System Check (2 of 2)

Step	Action	Value(s)	Yes	No
1	1. Turn OFF the ignition. 2. Inspect the Meter (10A) fuse in cabin fuse block. Is the Meter (10A) fuse open?	—	Go to Step 2	Go to Step 3
2	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 14	—
3	1. Turn OFF the ignition. 2. Disconnect the ECM J-2 (C-58) harness connector. 3. Turn ON the ignition, with the engine OFF. Is the glow indicator lamp OFF?	—	Go to Step 4	Go to Step 10

Step	Action	Value(s)	Yes	No
4	1. Remove the Meter (10A) fuse that supplies voltage to the glow indicator lamp. 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 51 of C-58) to a known good ground. Is the voltage less than the specified value?	1 volt	Go to Step 5	Go to Step 11
5	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 51 of C-58) and a known good ground. Is the glow indicator lamp illuminated?	—	Go to Step 9	Go to Step 6
6	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 8 of B-24) and a known good ground. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 12
7	1. Test the control circuit between the ECM (pin 51 of C-58) and the IP cluster (pin 35 of B-23) 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. Inspect for an intermittent and for poor connections at the harness connector of the IP cluster (pin 35 of B-23 and pin 8 of B-24). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
9	1. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 51 of C-58). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
10	Repair the short to ground between the ECM (pin 51 of C-58) and the IP cluster (pin 35 or of B-23). Did you complete the repair?	—	Go to Step 15	—
11	Repair the short to battery or ignition voltage between the ECM (pin 51 of C-58) and the IP cluster (pin 35 of B-23). Did you complete the repair?	—	Go to Step 15	—
12	Repair the open circuit or high resistance on ignition the voltage feed circuit the Meter (10A) fuse and the IP cluster (pin 8 of B-24). Did you complete the repair?	—	Go to Step 15	—

Step	Action	Value(s)	Yes	No
13	Repair or replace the IP cluster. Did you complete the repair or 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 fuse or harness connector(s). 2. Perform the Glow Plug Lamp Control with a scan tool. 3. Command the lamp ON and OFF. Does the glow indicator lamp turn ON and OFF with each command?	—	Go to 1 of 2 Step 4	Go to Step 1

In-Tank Fuel Pump System Check

Description

The ECM controls the fuel pump relay, which supplies power to the fuel pump in the fuel tank. The ECM commands the fuel pump relay ON for a certain length of time at ignition switch is ON with the engine OFF. During the engine is running it is continuity commanded ON.

In-tank Fuel Pump Control Operation

- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The fuel pump is commanded ON for 12 seconds at ignition switch is ON with the engine OFF.
- The fuel pump is continuously ON while engine is running.

Schematic Reference: Engine Controls Schematics

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

Circuit/ System Testing In-Tank Fuel Pump 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 for 20 seconds, then start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0231 or P0232 set?	—	Refer to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition for 30 seconds. 2. Remove the fuel filler cap. 3. Turn ON the ignition, with the engine OFF. Is the fuel pump operating sound heard from the fuel filler?	—	Go to Step 4	Go to Step 7
4	Does the fuel pump operating sound stop after approximately 12 seconds passed?	—	Go to Step 21	Go to Step 5
5	1. Turn OFF the ignition for 30 seconds. 2. Replace the fuel pump relay with the head light relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. Does the fuel pump operating sound stop after approximately 12 seconds passed?	—	Go to Step 20	Go to Step 6
6	Repair the short to battery or ignition voltage between the fuel pump relay (pin 2 of X-13) and the fuel pump (pin 1 of F-2). Did you complete the repair?	—	Go to Step 25	—
7	1. Turn OFF the ignition for 30 seconds. 2. Replace the fuel pump relay with the head light relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. Is the fuel pump operating sound heard from the fuel filler?	—	Go to Step 17	Go to Step 8
8	Inspect the Fuel Pump (10A) fuse in the engine room fuse block. Is the Fuel Pump (10A) fuse open?	—	Go to Step 9	Go to Step 10

Step	Action	Value(s)	Yes	No
9	Replace the Fuel Pump (10A) fuse. If the fuse continues to open, repair the short to ground on a circuit fed by the fuse or check for a shorted attached component. Did you complete the repair?	—	Go to Step 25	—
10	1. Turn OFF the ignition. 2. Remove the fuel pump relay. 3. Probe the battery voltage feed circuit of the relay (pin 1 of X-13) with a test lamp that is connected to a known good ground. Does the test lamp illuminate?	—	Go to Step 12	Go to Step 11
11	Repair the open circuit or high resistance between the Fuel Pump (10A) fuse and the fuel pump relay (pin 1 of X-13). Did you complete the repair?	—	Go to Step 25	—
12	1. Reconnect the fuel pump relay. 2. Disconnect the fuel pump resistor harness connector. 3. Measure the resistance across the fuel pump resistor. Is the resistance within the specified value?	2.2 to 2.7 Ω	Go to Step 13	Go to Step 23
13	1. Connect a test lamp between the fuel pump side voltage feed circuit on the resistor harness (pin 1 of C-157) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate for approximately 12 seconds then go out?	—	Go to Step 14	Go to Step 15
14	Connect a test lamp between the ground circuit on the resistor harness (pin 2 of C-157) and battery voltage. Does the test lamp illuminate?	—	Go to Step 18	Go to Step 16
15	1. Test the fuel pump circuit between the fuel pump (pins 1 and 4 of F-2) and the fuel pump relay (pin 2 of X-13) or the fuel pump resistor (pin 1 of C-157) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 25	Go to Step 19
16	Repair the open circuit or high resistance between the fuel pump resistor (pin 2 of C-57) and the body ground terminal (C-109). Clean or tighten ground as necessary. Did you complete the repair?	—	Go to Step 25	—
17	1. Remove the fuel pump relay. 2. Inspect for an intermittent and for poor connection on each relay terminal. 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 25	Go to Step 20

Step	Action	Value(s)	Yes	No
18	1. Inspect for an intermittent, poor connections and corrosion at the harness connector of the fuel pump resistor (pins 1 and 2 of C-57). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 25	—
19	1. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the fuel pump (pins 1 and 4 of F-2). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 25	Go to Step 24
20	Replace the fuel pump relay. Did you complete the replacement?	—	Go to Step 25	—
21	1. Make sure the fuel amount in the fuel tank. Refill adequate fuel as necessary. 2. Check the fuel system connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, kinks, cracks and for the use of proper clamps. Repair or replace as necessary. 3. Turn OFF the ignition. 4. Disconnect the fuel hose that connects to the fuel filter inlet side. In order to measure the discharged fuel amount, put the hose into a bottle or a container with a scale. (The inlet of a bottle or a container must be larger than the diameter of hose.) 5. Turn ON the ignition for 20 seconds, with the engine OFF. 6. Turn OFF the ignition for 10 seconds. 7. Perform 5 and 6 three times. The accumulated fuel of three ignition cycles must be more than 300cc. (Normal amount is more than 100cc per one ignition cycle.) Is enough amount of fuel discharged?	—	System OK	Go to Step 22
22	1. Remove the fuel pump from the fuel tank. Refer to Fuel Gauge Unit in the Fuel System section. 2. Inspect the fuel pump for any type of restriction or damage on the fuel pipes. 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 25	Go to Step 24
23	Replace the fuel pump resistor. Did you complete the replacement?	—	Go to Step 25	—
24	Replace the fuel pump. Refer to Fuel Gauge Unit in the Fuel System section. Did you complete the replacement?	—	Go to Step 25	—
25	Reconnect all previously disconnected components, fuse, relay or harness connector(s). Did you complete the action?	—	Go to Step 3	—

Cruise Control System Check

Description

The cruise control system consists of the ECM, the cruise main switch, set/ coast switch, resume/ accel. switch and cancel switch. The cruise control keeps the vehicle speed at a driver's set speed. When the cruise main switch is turned ON, signal is provided to the ECM and the cruise main indicator lamp on the switch will light up. When the cruise set/ coast switch is turned ON, the switch signal is provided to the ECM and the vehicle speed is set. The vehicle speed is increased or decreased if the set/ coast switch or the resume/ accel. switch is turned ON. When the cruise cancel switch is applied, the switch signal is provided to the ECM and the cruise control system is inactive.

Condition for Running the Cruise Control

- The vehicle speed is between approximately 40 km/h (24 MPH) to 175 km/h (105 MPH).
- The engine speed is less than 4500 PRM.
- The cruise main switch is ON.

1. Function of "SET"
If the set/ coast switch is pressed and released while condition for running the cruise control are satisfied, the ECM memorize and maintain the vehicle speed at that time.
2. Function of "COAST"
If the set/ coast switch is pressed while the cruise control system is operating, the vehicle speed is decreased. Then, when the set/ coast switch is released, the vehicle will maintain the vehicle speed at that time.
3. Function of "RESUME"
If the resume/ accel. switch is applied while the cruise control system is operating and the ECM memorizes the vehicle speed, the vehicle speed is returned to the vehicle speed memorized by the ECM.
4. Function of "ACCEL"
If the resume/ accel. switch is applied while the cruise control system is operating, the vehicle speed is increased. Then, when the resume/ accel. switch is released, the vehicle will maintain the vehicle speed at that time.
5. Function of "TAP UP"
If the resume/ accel. switch is tapped (momentarily applied) while the cruise control system is operating, the vehicle speed is increased 1 km/h (0.6 MPH) at a time.
6. Function of "TAP DOWN"
If the set/ coast switch is tapped while the cruise control system is operating, the vehicle speed is decreased 1 km/h (0.6 MPH).
7. Function of Temporary Acceleration
If the accelerator pedal is pressed while the cruise control system is operating, the vehicle speed is increased.
8. Function of Temporary Cancellation
The cruise control is canceled temporarily if any of the following condition is met:

- The cruise cancel switch is applied.
- The brake pedal is depressed.
- The clutch pedal is depressed (M/T).
- The selector lever position is not D, 3, 2 or L (A/T).
- The cruise set/ coast switch and resume/ accel. switch are ON at the same time.
- The actual vehicle speed becomes less than approximately 35 km/h (22 MPH).
- The actual vehicle speed is more than 40 km/h (24 MPH) over the set speed, or more than 10 km/h (6 MPH) over the set speed for longer than 3 minutes.
- The actual vehicle speed is more than 70 km/h (42 MPH) below the set speed, or more than 10 km/h (6 MPH) below the set speed for 3 minutes.

By applying the resume/ accel. switch, the vehicle speed is returned to the vehicle speed memorized by the ECM (resume function) if within the condition for running the cruise control are satisfied.
9. Function of Complete Cancellation
The cruise control is canceled completely if any of the following condition is met:

- The cruise main switch is OFF.
- The ignition switch is OFF.
- The vehicle is once stopped.
- The DTCs relating to the cruise control system inhibits are set.

Schematic Reference: Engine Controls Schematics

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

Circuit/ System Testing Cruise 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

Step	Action	Value(s)	Yes	No
2	1. Drive the vehicle at 50 km/h (30 MPH) on a flat level road. 2. Press and release the cruise main switch. 3. Press and release the cruise set/ coast switch. 4. Verify the 50 km/h (30 MPH) vehicle speed is maintained. 5. Tap the cruise set/ coast. Did the vehicle maintain the set speed of 50 km/h (30 MPH), and then decrease by 1 km/h (0.6 MPH) each time the switch was tapped?	—	Go to Step 3	Go to Step 7
3	Tap (momentarily apply) the cruise resume/ accel. switch 10 times. Does the vehicle speed increase by 1 km/h (0.6 MPH) each time the switch was tapped (momentarily applied)?	—	Go to Step 4	Go to Step 10
4	Are the cruise main and cruise set lamps illuminated while in cruise control?	—	Go to Step 5	Go to 2 of 2 Step 1
5	Apply the cruise cancel switch Does the cruise control cancel?	—	Go to Step 6	Go to Step 11
6	1. Reenter the cruise control. 2. Depress and release the brake pedal. Does the cruise control cancel?	—	System OK	Refer to DTC P0571 for brake switch diagnosis
7	1. Park the vehicle. 2. Install a scan tool. 3. 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 cruise control”?	—	Refer to Applicable DTC	Go to Step 8
8	Observe the Cruise Main Switch parameter with a scan tool. Does the scan tool indicate ON when the switch is pushed and OFF when the switch is released?	—	Go to Step 9	Go to Step 12
9	Observe the Cruise Set/ Coast Switch parameter with a scan tool. Does the scan tool indicate ON when the switch is pushed and OFF when the switch is released?	—	Retest the cruise control. Refer to Condition for Running the Cruise Control	Go to Step 17
10	Observe the Cruise Resume/ Accel. Switch parameter with a scan tool. Does the scan tool indicate ON when the switch is applied and OFF when the switch is released?	—	Go to Intermittent Conditions	Go to Step 19
11	Observe the Cruise Cancel Switch parameter with a scan tool. Does the scan tool indicate OFF when the switch is applied and ON when the switch is released?	—	Go to Intermittent Conditions	Go to Step 23

Step	Action	Value(s)	Yes	No
12	1. Turn OFF the ignition. 2. Disconnect the cruise main switch harness connector. (Remove the switch from the IP bezel as necessary) 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the ignition voltage feed circuit of the cruise main switch harness (pin 4 of B-56) and a known good ground. Does the test lamp illuminate?	—	Go to Step 13	Go to Step 14
13	Observe the Cruise Main Switch parameter with a scan tool while momentarily jumping 3-amp fused jumper wire across the cruise main switch harness connector between pins 3 and 4 of the B-67. Does the scan tool indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 16	Go to Step 15
14	Repair the open circuit or high resistance between the Engine (10A) fuse and the cruise main switch (pin 4 of B-67). Did you complete the repair?	—	Go to Step 28	—
15	1. Test the signal circuit between the ECM (pin 14 of C-58) and the cruise main switch (pin 3 of B-67) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 28	Go to Step 22
16	1. Inspect for an intermittent and for poor connections at the harness connector of the cruise main switch (pins 3 and 4 of B-67). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 28	Go to Step 25
17	1. Turn OFF the ignition. 2. Disconnect the combination switch harness connector (B-59). (Remove the IP cluster lower cover as necessary) 3. Turn ON the ignition, with the engine OFF. 4. Observe the Cruise Set Switch parameter with a scan tool while momentarily jumping 3-amp fused jumper wire across the combination switch harness connector (male side) between pins 11 and 12 of B-59. Does the scan tool indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 21	Go to Step 18
18	1. Test the signal circuit between the ECM (pin 30 of C-58) and the combination switch (pin 12 of B-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 28	Go to Step 22

Step	Action	Value(s)	Yes	No
19	1. Turn OFF the ignition. 2. Disconnect the combination switch harness connector (B-59). (Remove the IP cluster lower cover as necessary) 3. Turn ON the ignition, with the engine OFF. 4. Observe the Cruise Resume Switch parameter with a scan tool while momentarily jumping 3-amp fused jumper wire across the combination switch harness connector (male side) between pins 9 and 11 of B-59. Does the scan tool indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 21	Go to Step 20
20	1. Test the signal circuit between the ECM (pin 29 of C-58) and the combination switch (pin 9 of B-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 28	Go to Step 22
21	1. Inspect for an intermittent and for poor connections at the harness connector of the combination switch (pins 9 or 12 of B-59). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 28	Go to Step 26
22	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 14, 29 or 30 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 28	Go to Step 27
23	1. Turn OFF the ignition. 2. Disconnect the combination switch harness connector (B-59). 3. Turn ON the ignition, with the engine OFF. Does the Cruise Cancel Switch indicate OFF?	—	Go to Step 26	Go to Step 24
24	1. Test the signal circuit between the ECM (pin 13 of C-58) and the combination switch (pin 10 of B-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 28	Go to Step 27
25	Repair or replace the cruise main switch. Did you complete the repair or replacement?	—	Go to Step 28	—
26	Repair or replace the combination switch. Did you complete the repair or replacement?	—	Go to Step 28	—
27	**Important**: Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 28	—

Step	Action	Value(s)	Yes	No
28	Reconnect all previously disconnected components, fuse or harness connector(s). Did you complete the action?	—	Go to Step 2	—

Circuit/ System Testing Cruise Control System Check (2 of 2)

Step	Action	Value(s)	Yes	No
1	1. Verify whether the instrument panel (IP) cluster is operational. 2. Install a scan tool. 3. Perform the Lamp Control with a scan tool. 4. Command the lamp ON and OFF with a scan tool. 5. Perform the Cruise Set Lamp Control with a scan tool. 6. Command the lamp ON and OFF with a scan tool. Are both lamps ON and OFF when commanded with a scan tool?	—	Go to Intermittent Conditions	Go to Step 2
2	Is the cruise main lamp inoperative?	—	Go to Step 3	Go to Step 7
3	1. Remove the Meter (10A) fuse that supplies voltage to the IP cluster (Euro 4 specification) or the Engine (10A) fuse that supplies voltage to the cruise main switch (Except Euro 4 specification). 2. Turn ON the ignition, with the engine OFF. 3. Measure the voltage from the cruise main lamp control circuit in the ECM harness connector (pin 50 of C-58) to a good ground. Is the voltage less than the specified value?	1 volt	Go to Step 4	Go to Step 6
4	1. Turn OFF the ignition. 2. Reinstall the Meter (10A) or Engine (10A) fuse. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the cruise main lamp control circuit of the ECM harness connector (pin 50 of C-58) and a known good ground. Is the cruise main lamp illuminated?	—	Go to Step 12	Go to Step 5
5	1. Test the control circuit between the ECM (pin 50 of C-58) and the IP cluster (pin 2 of B-23) or the cruise main switch (pin 6 of B-67) 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 11
6	Repair the short to battery or ignition voltage on the control circuit between the ECM (pin 50 of C-58) and the IP cluster (pin 2 of B-23) or the cruise main switch (pin 6 of B-67). Did you complete the repair?	—	Go to Step 15	—

Step	Action	Value(s)	Yes	No
7	1. Remove the Meter (10A) fuse that supplies voltage to the IP cluster. 2. Turn ON the ignition, with the engine OFF. 3. Measure the voltage from the cruise set lamp control circuit in the ECM harness connector (pin 49 of C-58) to a good ground. Is the voltage less than the specified value?	1 volt	Go to Step 8	Go to Step 10
8	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 cruise set lamp control circuit of the ECM harness connector (pin 49 of C-58) and a known good ground. Is the cruise main lamp illuminated?	—	Go to Step 12	Go to Step 9
9	1. Test the control circuit between the ECM (pin 49 of C-58) and the IP cluster (pin 23 of B-23) 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 11
10	Repair the short to battery or ignition voltage on the control circuit between the ECM (pin 49 of C-58) and the IP cluster (pin 23 of B-23). Did you complete the action?	—	Go to Step 15	—
11	1. Inspect for an intermittent and for a poor connection at the harness connector of the IP cluster (pins 23 of B-23). 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 on the cruise main or set lamp control circuit at the harness connector of the ECM (pin 49 or 50 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	Repair or replace the IP cluster. Did you complete the repair or 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	Reconnect all previously disconnected components, fuse or harness connector(s). Is the action complete?	—	Go to 1 of 2 Step 2	—

Turbocharger Control System Check

Description

The position of the turbocharger nozzle is controlled by the ECM. The ECM utilizes a turbocharger nozzle control solenoid valve and a boost pressure sensor 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 ECM commands the control solenoid valve to close the turbocharger nozzles, thus increasing the boost. The ECM will vary the boost dependant upon the load requirements of the engine. The ECM uses a pulse width modulation (PWM) on the control circuit to open and control the solenoid valve.

Notice:

- This Circuit/ System Testing is only applicable to high output engine.

Schematic Reference: Engine Controls Schematics

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

Circuit/ System Testing Turbocharger 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 P0045, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0234, P0299, P0638, P0698, P0699, P1196, P1197, P1198, 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 conditions: • Air leakage around the boost pressure sensor 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. • Misrouted, disconnected or kinked turbocharger nozzle control actuator vacuum hoses. Refer to Vacuum Hose Routing Diagram in this section for correct routing. • Turbine shaft binding causing lower turbocharger spinning speeds. Refer to the Turbocharger in engine mechanical section for diagnosis. • Turbocharger nozzle control actuator for a stuck condition or slow movement. Refer to Turbocharger in engine mechanical section for testing. • 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 tubing, intercooler or turbocharger it needs to be wiped off. 2. Repair the condition as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 4
4	1. Place the transmission in Neutral and set the parking brake. 2. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the Desired Boost Pressure and Boost Pressure parameter with a scan tool. 3. Drive the vehicle that the engine speed is more than 2000 RPM and the Calculated Engine Load parameter reaches at least 50% for longer than 10 seconds (such as acceleration on ramp) while comparing the Boost Pressure to the Desired Boost Pressure. Does the Boost Pressure parameter follow within the specified value?	±20 kPa (±3 psi)	System OK	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the vacuum hose from the turbocharger nozzle control actuator diaphragm. 3. Connect a hand-held vacuum pump (5-8840-0279-0/ J-23738-A) to the disconnected vacuum hose. 4. Start the engine and let idle. 5. Perform the Turbocharger Solenoid Control with a scan tool. 6. Command the solenoid valve Increase and Decrease while observing the vacuum pump. Does the hand-held vacuum pump reading more than 50 cmHg (20 inHg) when commanded maximum Increase and ZERO range when commanded minimum Decrease?	—	Go to Step 8	Go to Step 6
6	1. Inspect the following conditions: • Misrouted, disconnected, kinked or plugged turbocharger nozzle actuator control vacuum hose. • Misrouted, disconnected, kinked or plugged solenoid valve ventilation hose. • Misrouted, disconnected, kinked or plugged vacuum source hose or pipe. 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	Replace the turbocharger nozzle control solenoid valve. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected components or harness connector(s). 2. Clear the DTCs with a scan tool if set. 3. Turn OFF the ignition for 30 seconds. Did you complete the action?	—	Go to Step 2	—

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)

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.

Checks	Action
Temperature Sensitivity	• An intermittent condition may occur when a component/ connection reaches normal operating temperature. The condition may occur only when the component/ connection is cold, or only when the component/ connection is hot. • 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.
Electromagnetic Interference (EMI) and Electrical Noise	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.
Incorrect ECM Programming	• 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.
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.

Checks	Action
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 key 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 timing chain sprocket is not damaged.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check chart and appropriate procedure in the Fuel System section. • Air in the fuel system. • Water contamination in the fuel. • Fuel waxing or icing. • Fuel filter indicator lamp is continuously or frequently turned ON with engine run. • External fuel leaks or high engine oil level. • In-tank fuel pump operation. Refer to In-tank Fuel Pump System Check in this section. • 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 valve and 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.

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.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Poor cylinder compression. • Improper mechanical timing (timing gear and timing chain). • 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 key 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 timing chain sprocket is not damaged.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check Chart and appropriate procedure in the Fuel System section. • Air in the fuel system. • Water contamination in the fuel. • Fuel waxing or icing. • Fuel filter indicator lamp is continuously or frequently turned ON with engine run. • External fuel leaks or high engine oil level. • In-tank fuel pump operation. Refer to In-tank Fuel Pump System Check in this section. • 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 valve and 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.

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.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Poor cylinder compression. • Improper mechanical timing (timing gear and timing chain). • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes. • Incorrect basic engine parts such as camshaft, cylinder head, pistons, etc..
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.	
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 battery voltage. If the battery voltage is less than 11 volts, the ECM set the idle speed 50RPM higher than normal. • 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 key 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.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • 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 key 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. • 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 the Fuel System section. • Air in the fuel system. • Water contamination in the fuel. • Fuel waxing or icing. • Fuel filter indicator lamp is continuously or frequently turned ON with engine run. • In-tank fuel pump operation. Refer to In-tank Fuel Pump System Check in this section. • 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. • A restriction or damaged at MAF sensor.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section.
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

Checks	Action
Difinition: The engine has a power variation under a steady throttle or cruise. The vehicle seems to speed up and slow down with no change in the accelerator pedal.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Ensure the driver understands the A/C compressor operation. • Use the 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.
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 key 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.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check chart and appropriate procedure in the Fuel System section. • Air in the fuel system. • Water contamination in the fuel. • Fuel waxing or icing. • Fuel filter indicator lamp is continuously or frequently turned ON with engine run. • In-tank fuel pump operation. Refer to In-tank Fuel Pump System Check in this section. • 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 valve and 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.

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. • Perform the Swirl Control Solenoid Test with a scan tool. Inspect the diaphragm valve operation when it commanded ON/ OFF. • Turbocharger wastegate valve operation. Refer to wastegate valve inspection in the Engine Mechanical section. (Standard output) • Turbocharger nozzle control actuator operation. Refer to Turbocharger Control System Check in this section. (High output)
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section.
Additional Checks	• Inspect the EGR system operating correctly. Refer to EGR Control System Check in this section. • Inspect the A/C operation. • Inspect the torque converter clutch (TCC) operation. (A/T only) • Inspect deformed tire(s) that may cause surges at fixed vehicle speed range.

Lack of Power, Sluggishness or Sponginess

Checks	Action
Definition: The engine delivers less than expected power. There is little or no increase in speed when partially applying the accelerator pedal.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Compare the vehicle with a similar unit. Ensure the vehicle has an actual problem. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • 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.
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 key 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 Barometric Pressure (BARO) parameter. The BARO parameter should indicate near surrounding barometric pressure. Refer to Altitude vs. Barometric Pressure. (Standard output) • Observe the Boost Pressure and BARO with ignition ON and engine OFF. Both parameters should be within the 7.0 kPa (1.0 psi) each other. (High output)

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check chart and appropriate procedure in the Fuel System section. • Air in the fuel system. • Water contamination in the fuel. • Fuel waxing or icing. • Fuel filter indicator lamp is continuously or frequently turned ON with engine run. • External fuel leaks or high engine oil level. • In-tank fuel pump operation. Refer to In-tank Fuel Pump System Check in this section. • 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 valve and 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 restriction or damaged at MAF sensor. • Perform the Swirl Control Solenoid Test with a scan tool. Inspect the diaphragm valve operation when it commanded ON/ OFF. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section. • Turbocharger wastegate valve operation. Refer to wastegate valve inspection in the Engine Mechanical section. (Standard output) • Turbocharger nozzle control actuator operation. Refer to Turbocharger Control System Check in this section. (High output)
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • 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. • Observe the Park/ Neutral Switch parameter with a scan tool. • Inspect for an engine overheat condition. Refer to Engine Cooling section. • Inspect the A/C operation. • Inspect the torque converter clutch (TCC) operation. (A/T only).

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 key 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 Barometric Pressure (BARO) parameter. The BARO parameter should indicate near surrounding barometric pressure. Refer to Altitude vs. Barometric Pressure. (Standard output) • Observe the Boost Pressure and BARO with ignition ON and engine OFF. Both parameters should be within the 7.0 kPa (1.0 psi) each other. (High output) • 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 the Fuel System section. • Air in the fuel system. • Water contamination in the fuel. • Fuel waxing or icing. • Fuel filter indicator lamp is continuously or frequently turned ON with engine run. • External fuel leaks or high engine oil level. • In-tank fuel pump operation. Refer to In-tank Fuel Pump System Check in this section. • 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 valve and 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 restriction or damaged at MAF sensor. • Perform the Swirl Control Solenoid Test with a scan tool. Inspect the diaphragm valve operation when it commanded ON/ OFF. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section. • Turbocharger wastegate valve operation. Refer to wastegate valve inspection in the Engine Mechanical section. (Standard output) • Turbocharger nozzle control actuator operation. Refer to Turbocharger Control System Check in this section. (High output)
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • 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 Engine Cooling section. • Inspect the A/C operation. • Inspect the torque converter clutch (TCC) operation. (A/T 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 key 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 Engine Mechanical section. • 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. • 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 the Fuel System section. • Fuel type and quality. • Check fuel leak.
Cooling System Checks	Inspect the cooling system for the following conditions. Refer to the Cooling System Section. • 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 restriction or damaged at MAF sensor. • Perform the Swirl Control Solenoid Test with a scan tool. Inspect the diaphragm valve operation when it commanded ON/ OFF. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section. • Turbocharger wastegate valve operation. Refer to wastegate valve inspection in the Engine Mechanical section. (Standard output) • Turbocharger nozzle control actuator operation. Refer to Turbocharger Control System Check in this section. (High output)
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • 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 key 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 Barometric Pressure (BARO) parameter. The BARO parameter should indicate near surrounding barometric pressure. Refer to Altitude vs. Barometric Pressure. (Standard output) • Observe the Boost Pressure and BARO with ignition ON and engine OFF. Both parameters should be within the 7.0 kPa (1.0 psi) each other. (High output)
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • 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.
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 inspection in the Engine Mechanical section.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section.

Checks	Action
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. • Improper mechanical timing (timing gear and timing chain). • 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 key 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.
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. • Perform the Swirl Control Solenoid Test with a scan tool. Inspect the diaphragm valve operation when it commanded ON/ OFF. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Oil leak from turbocharger. Refer to turbocharger inspection in the Engine Mechanical section.

Checks	Action
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Poor cylinder compression. • Improper mechanical timing (timing gear and timing chain). • 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.

Repair Instructions

Engine Control Module (ECM) Replacement

Description

The following A - G steps provide an overview procedure to replace and reprogram an ECM. Each A - G steps is explained further in this section.

A. Record the fuel injector ID codes manually from the old ECM.
B. Reset the immobilizer security information in the old ECM. (If so equipped)
C. Replace the old ECM with the new ECM.
D. Program the immoblizer security information into the new ECM. (If so equipped)
E. Program the latest software and calibrations into the new ECM using the Service Programming System (SPS).
F. Program the recorded fuel injector ID codes and the vehicle identification number (VIN) into the ECM using a scan tool programming function.
G. Perform the fuel supply pump relearn procedure by allowing the engine to idle in Park or Neutral until normal operating temperature is achieved.

A. 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 retrieved with a scan tool. If the old ECM cannot be communicated 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 > 4JK1 or 4JJ1 > Programming > Injector ID Code.
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.

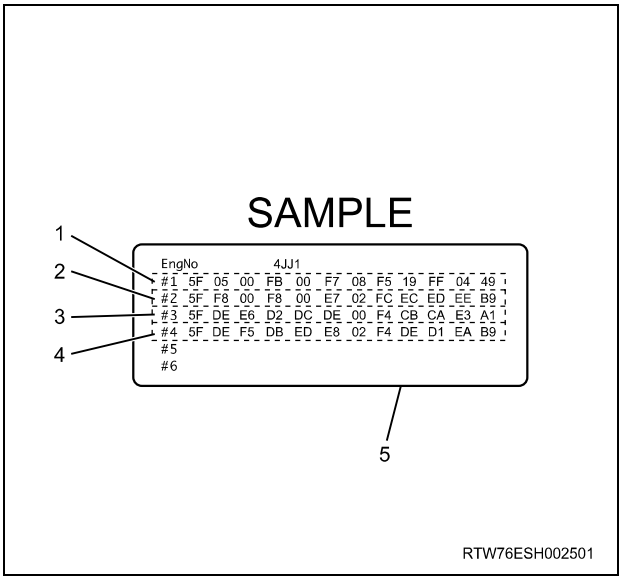
Retrieving the Fuel Injector ID Code Data with a Non-communicating ECM

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 harness connector housing.

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.



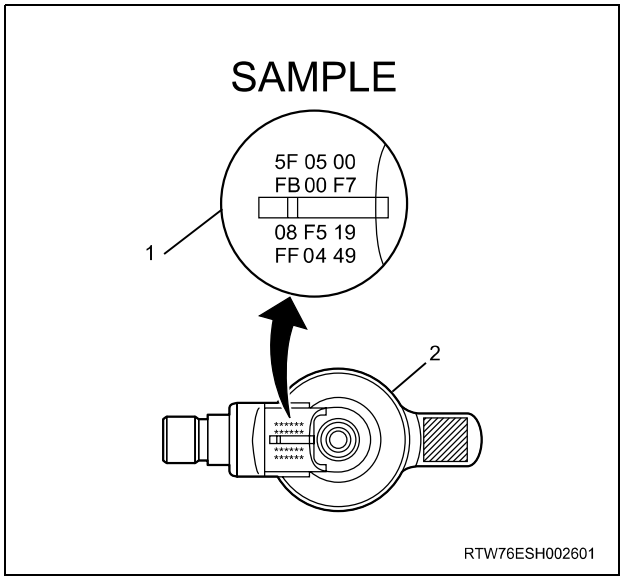
Legend

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. Disconnect each fuel injector harness connector.

2. Record all numbers of each cylinder on the harness connector housing. The correct order for the fuel injector ID codes of the following illustration is as follows:
   5F 05 00 FB 00 F7 08 F5 19 FF 04 49



Legend
1. Fuel injector ID code
2. Fuel injector

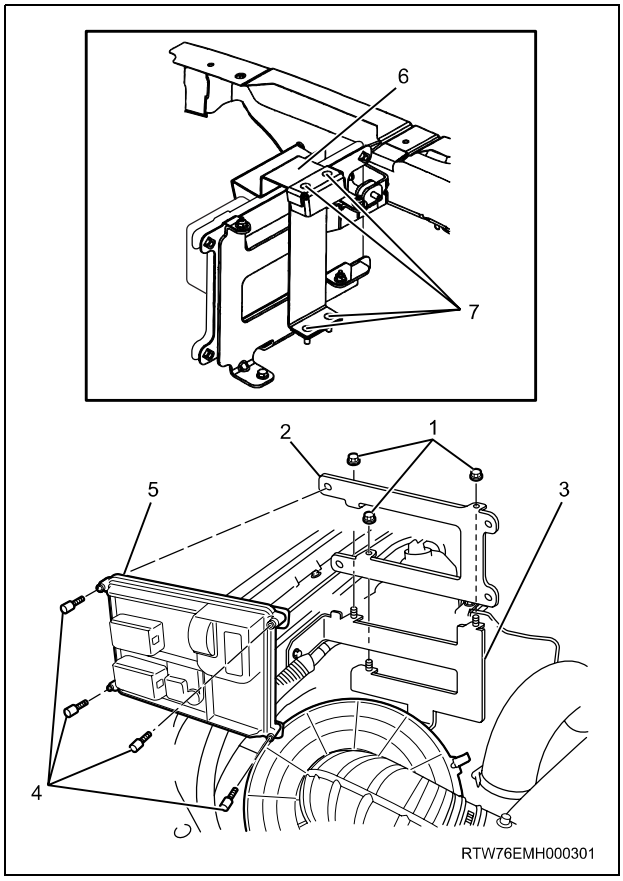
B. Resetting Immobilizer Security Information (If so equipped)

Reset immobilizer security information in the old ECM. Refer to Resetting and Programming Guidelines in immobilizer section. If the old ECM cannot be communicated with a scan tool, go to the next produce.

C. Removal and Installation

Removal Procedure

1. Disconnect the negative battery cable.
2. Loosen bolts (7) and remove the ECM cover (6). (If so equipped)
3. Disconnect the ECM harness connectors.
4. Loosen nuts (1) and remove the ECM with bracket (2) from the base bracket (3).
5. Loosen bolts (4) and remove the ECM (5).



Installation Procedure

1. Install the ECM (5) to the bracket (2) and tighten bolts (4).
2. Install the ECM with bracket (2) to the base bracket (3) and tighten nuts (1).
3. Connect the ECM harness connectors.
4. Install the ECM cover (6) and tighten bolts (7).
5. Connect the negative battery cable.

D. Programming Immobilizer Security Information (If so equipped)

Programming immobilizer security information into the ECM. Refer to Resetting and Programming Guidelines in immobilizer section.

E. 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.

F. 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 > 4JK1 or 4JJ1 > Programming > Program ECU.

4. 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 > 4JK1 or 4JJ1 > Programming > Program ECU.
8. Verify the VIN on the screen if programmed at previously described SPS. If not programmed or incorrect VIN, input correct VIN.
9. Input 24 digits of each fuel injector ID code.
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.

G. 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 Learn > Learning > Learned.
3. If the ECM has correctly learned the fuel supply pump current adjustment, the Supply Pump Status parameter on the scan tool will repeatedly indicate Learning and 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 an 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 12 volts but less than 16 volts. The battery must be fully charged before programming the ECM.
  - A battery charger is NOT connected to the vehicles battery. Incorrect system voltage or voltage fluctuations from a battery charger may cause programming failure or ECM damage.
  - Turn OFF or disable any system that may put a load on the vehicles battery. Turn OFF or disable systems such as:
    - ◊ Heating, ventilation, and air conditioning (HVAC) systems
    - ◊ Headlights
    - ◊ Room lights
    - ◊ Accessory equipment
- The ignition switch is in the proper position. The 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 completed.
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%.

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.

12. Close the application and return to the TIS application selection screen after the download is completed.
13. Turn OFF the ignition.
14. Turn OFF the scan tool and disconnect from the vehicle.

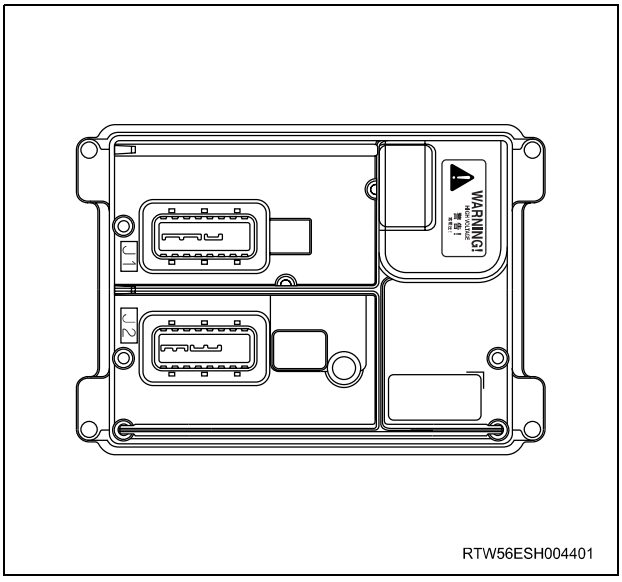
Description and Operation

Engine Control Module (ECM) Description

Engine Control Module (ECM) Service Precautions



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.



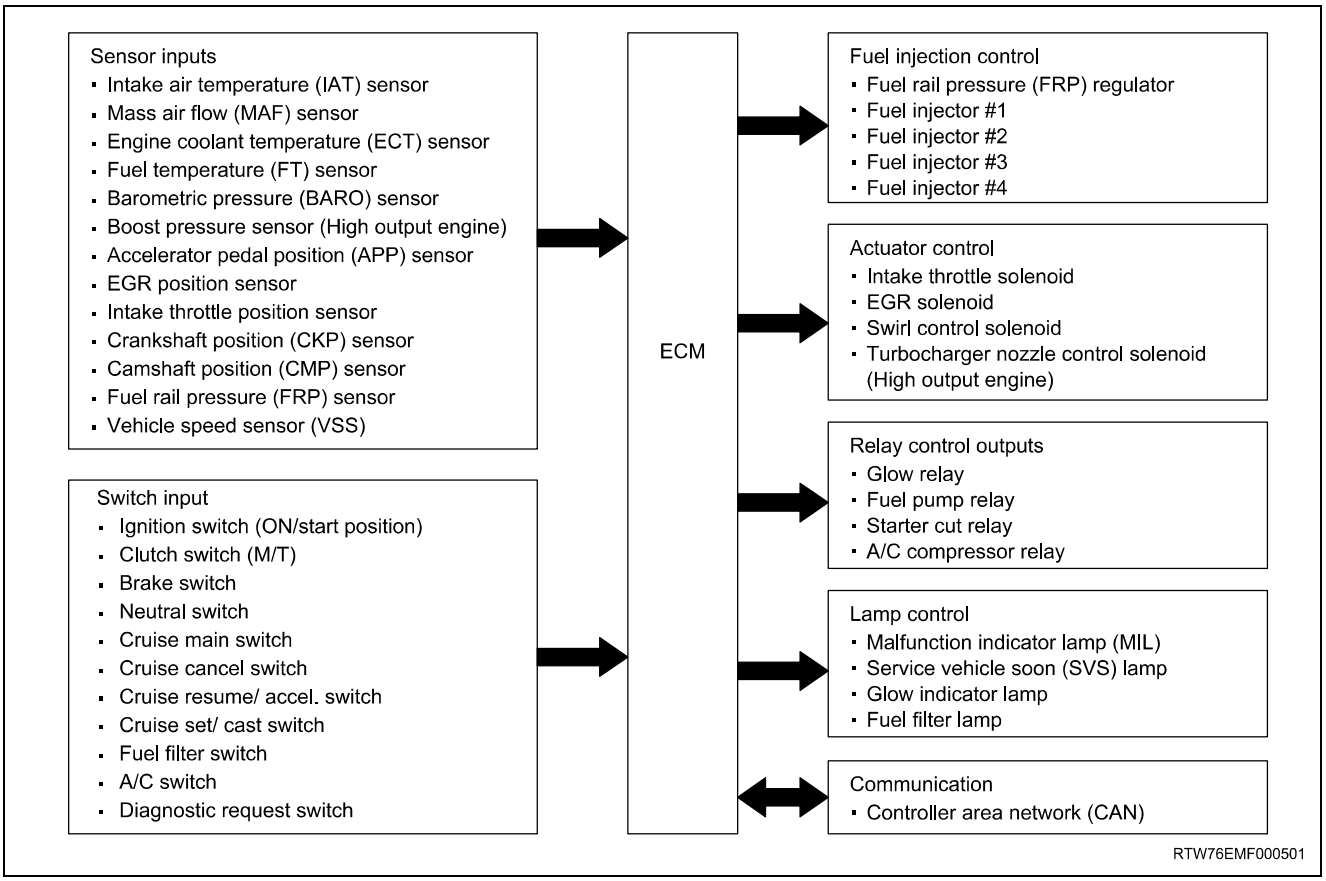
The engine control module (ECM) is designed to withstand normal current draws associated with vehicle operation. Avoid overloading any circuit. When testing for opens and shorts, do not ground or apply voltage to any of the ECM circuits unless instructed to do so. In some cases, these circuits should only be tested using a DMM. The ECM should remain connected to the ECM harness.

The ECM is located inside of engine compartment via mounting bracket and is behind air cleaner case. The ECM mainly controls the following.

- The fuel system control
- The exhaust gas recirculation (EGR) system control
- The preheating (glow) system control
- The A/C compressor control
- The immobilizer 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.

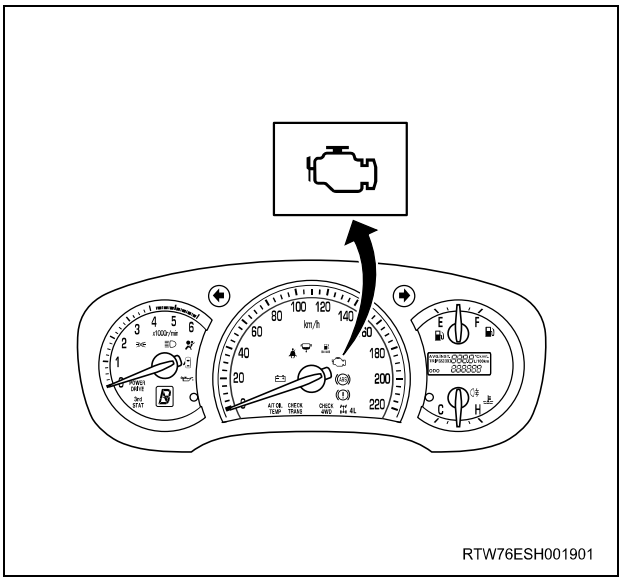
- An example of charging by friction is a person sliding across a vehicle seat.

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:

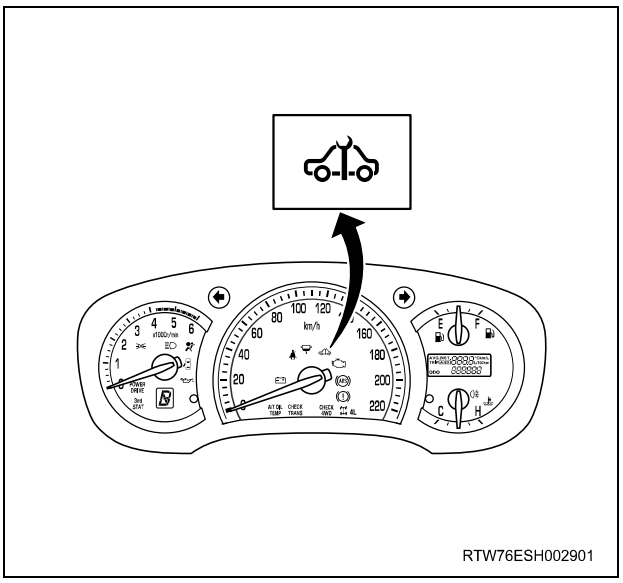


The MIL indicates that an emission related fault (Type A or B) has occurred (Euro 4 specification) or engine performance related fault has occurred (except Euro 4 specification) and vehicle service is required. The following is a list of the modes of operation for the MIL:

- The MIL illuminates when the ignition switch is turned ON, with the engine OFF. This is a bulb test to ensure the MIL is able to illuminate.
- 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).

Service Vehicle Soon (SVS) Lamp Operation (Euro 4 Specification)

The service vehicle soon (SVS) lamp is located in the instrument panel cluster. The SVS lamp will display the following symbol when commanded ON:

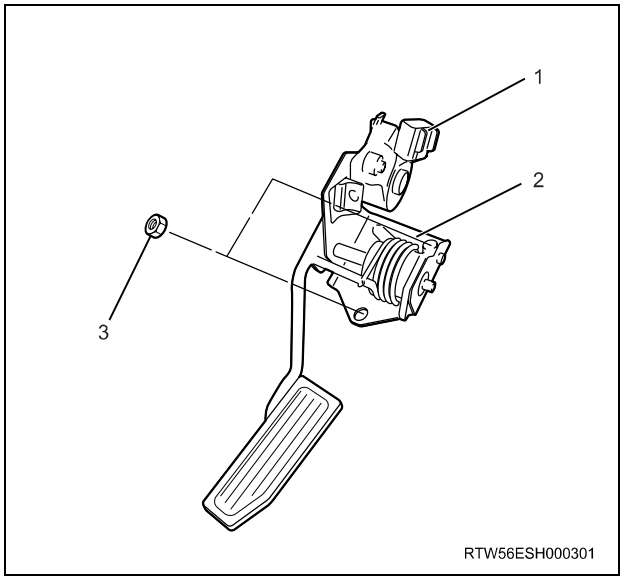


The SVS lamp indicates that a non-emission related fault (Type C) has occurred and vehicle service required. The following is a list of the modes of operation for the SVS lamp:

- The SVS lamp illuminates when the ignition switch is turned ON, with the engine OFF. This is a bulb test to ensure the SVS lamp is able to illuminate.
- 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.

Engine Control Component Description

Accelerator Pedal Position (APP) Sensor

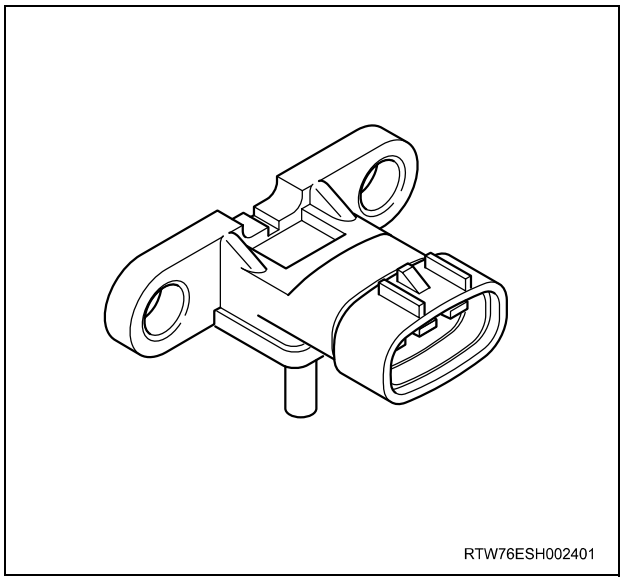


Legend

1. Accelerator pedal position (APP) sensor
2. Accelerator pedal bracket
3. Nut

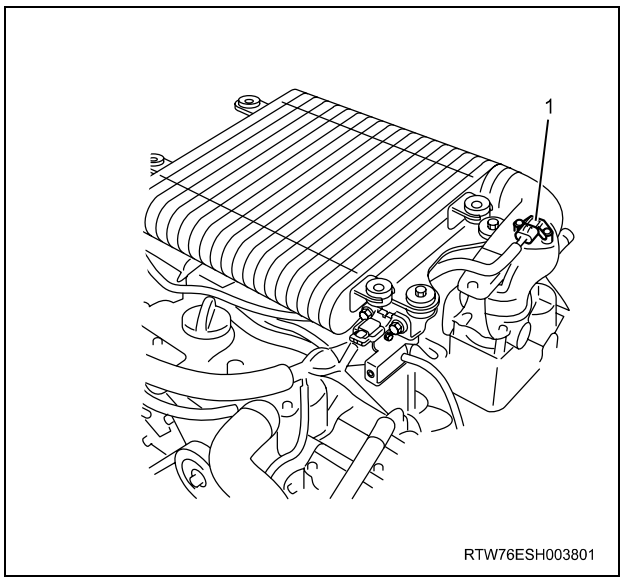
The APP sensor is mounted on the accelerator pedal control assembly. The sensor is made up of three individual sensors within one housing. The ECM uses the APP sensors to determine the amount of acceleration or deceleration that is desired. The APP sensors are potentiometer type sensors. Each APP sensor 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 and APP sensor 3 signal voltage is high at rest and decreases as the pedal is depressed.

Barometric Pressure (BARO) Sensor



The BARO sensor is located on the intake manifold. 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

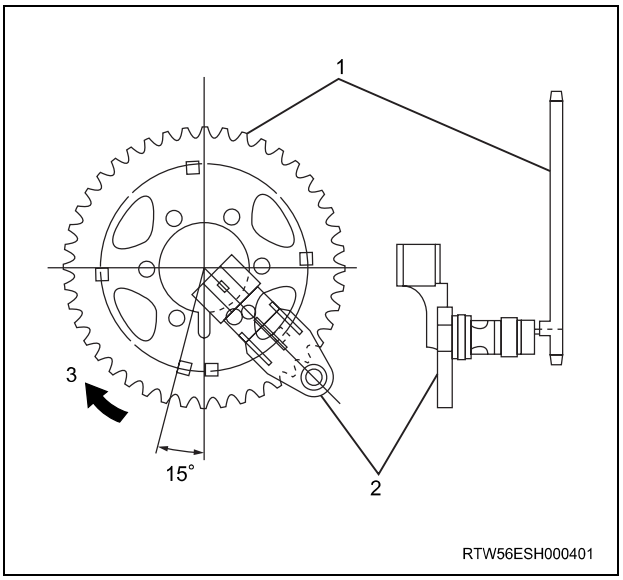


Legend

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

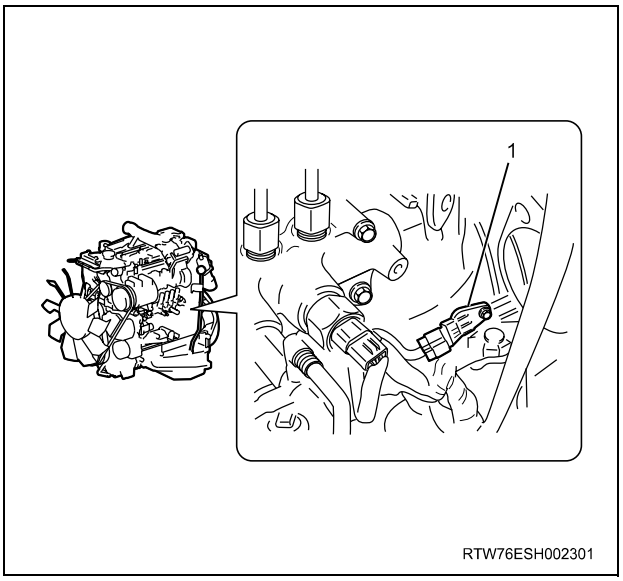


Legend

1. Timing chair sprocket
2. Camshaft position (CMP) sensor
3. Rotating direction

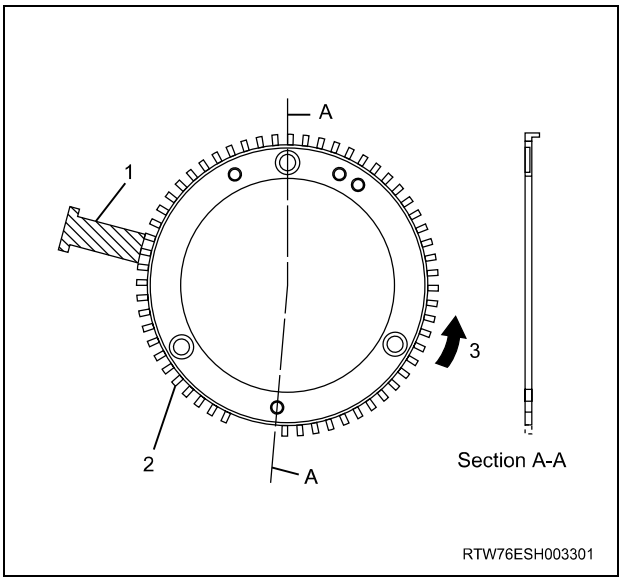
The CMP sensor is installed on the timing chain sprocket cover at the front of the camshaft idle gear. The CMP sensor detects total of five projections per one engine cycle (four projections arranged equally every 90° and one reference projection on the timing chain sprocket surface). The CMP sensor 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

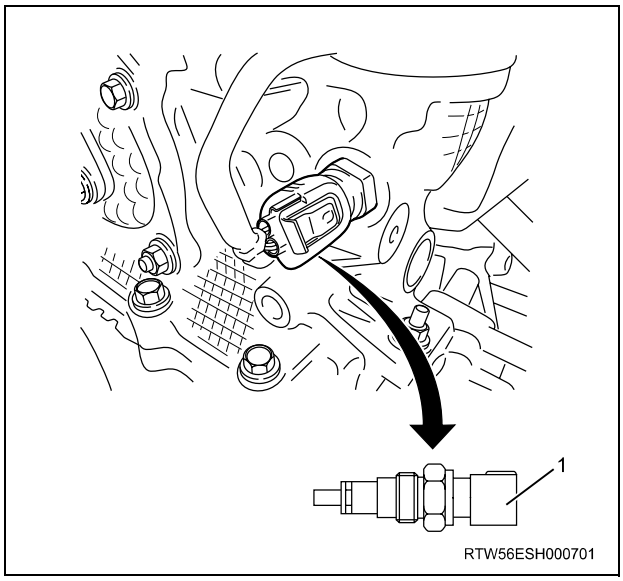


Legend

1. Crankshaft position (CKP) sensor
2. Sensor rotor
3. Rotating direction

The CKP sensor is located on the left-hand of the cylinder block rear and it is behind the starter motor. The sensor rotor is fixed on the crankshaft. 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 projection 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

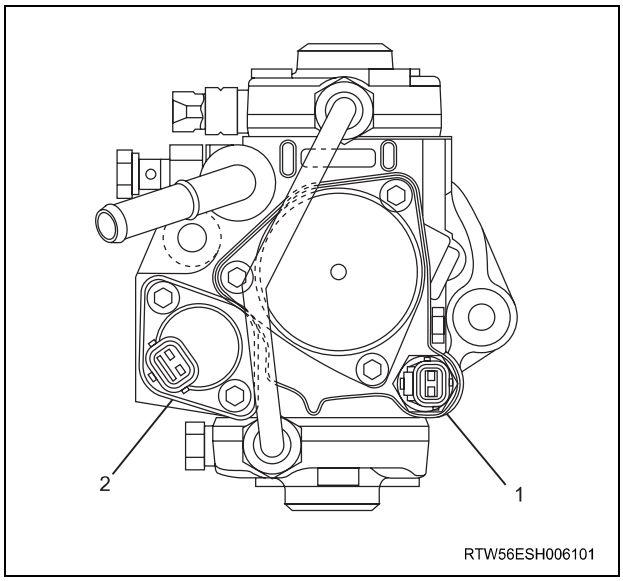


Legend

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

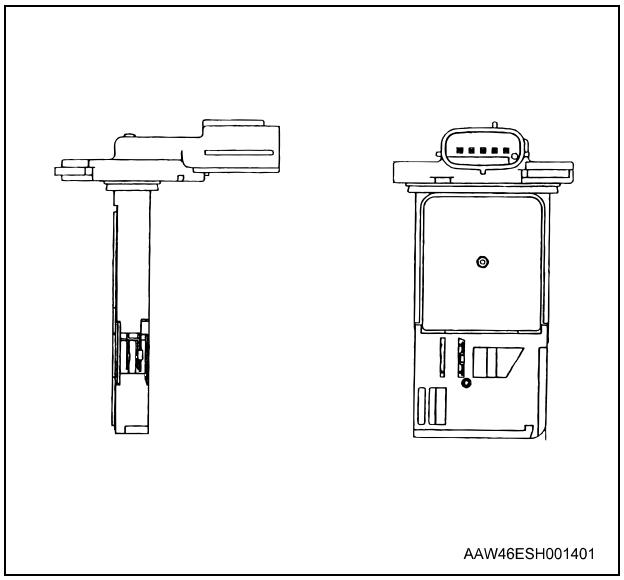


Legend

1. Fuel temperature (FT) sensor
2. Fuel rail pressure (FRP) regulator

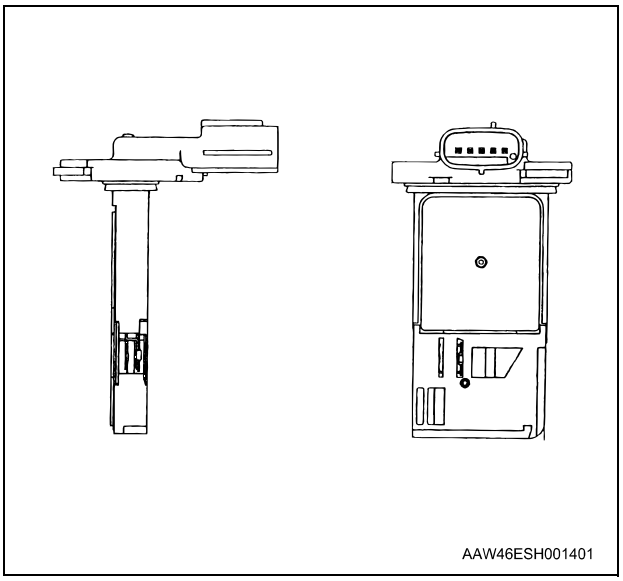
The FT sensor is installed to the fuel supply pump. The FT sensor is a variable resistor and it measures the temperature of the fuel entering the fuel supply pump. When the FT sensor is cold, the sensor resistance is high. When the fuel temperature increases, the sensor resistance decreases. With high 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



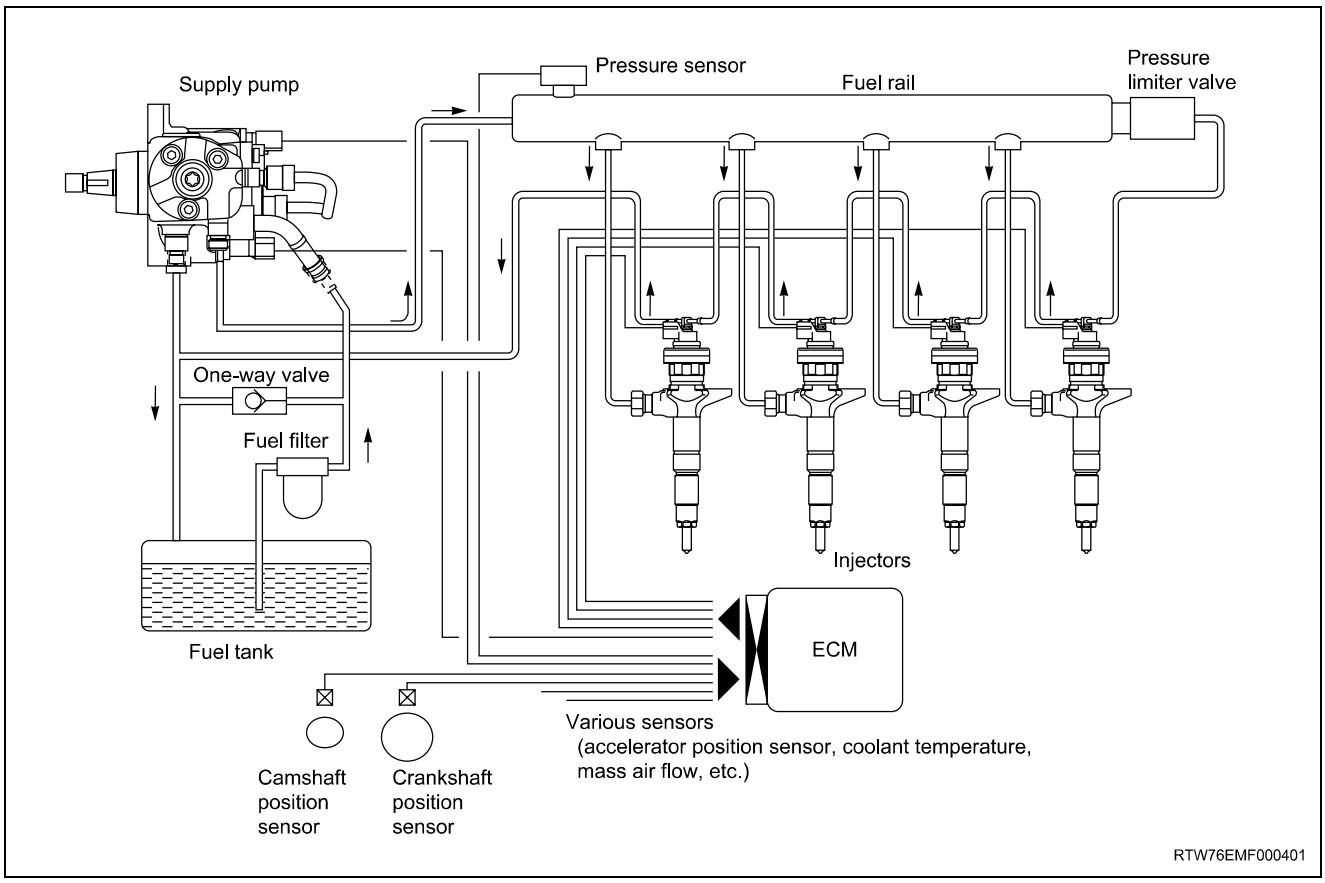
The IAT sensor is fitted between the air cleaner and turbocharger. It is internal to the mass air flow (MAF) sensor. The IAT sensor is a variable resistor and it measures the temperature of the air entering the engine. When the IAT sensor is cold, the sensor resistance is high. When the air temperature 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.

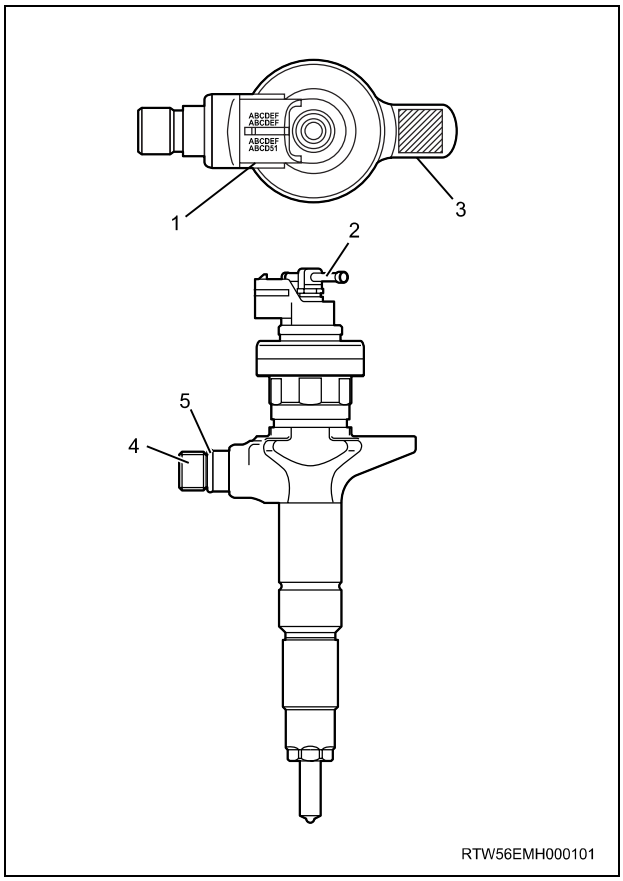
3. Injection Rate Control

- 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



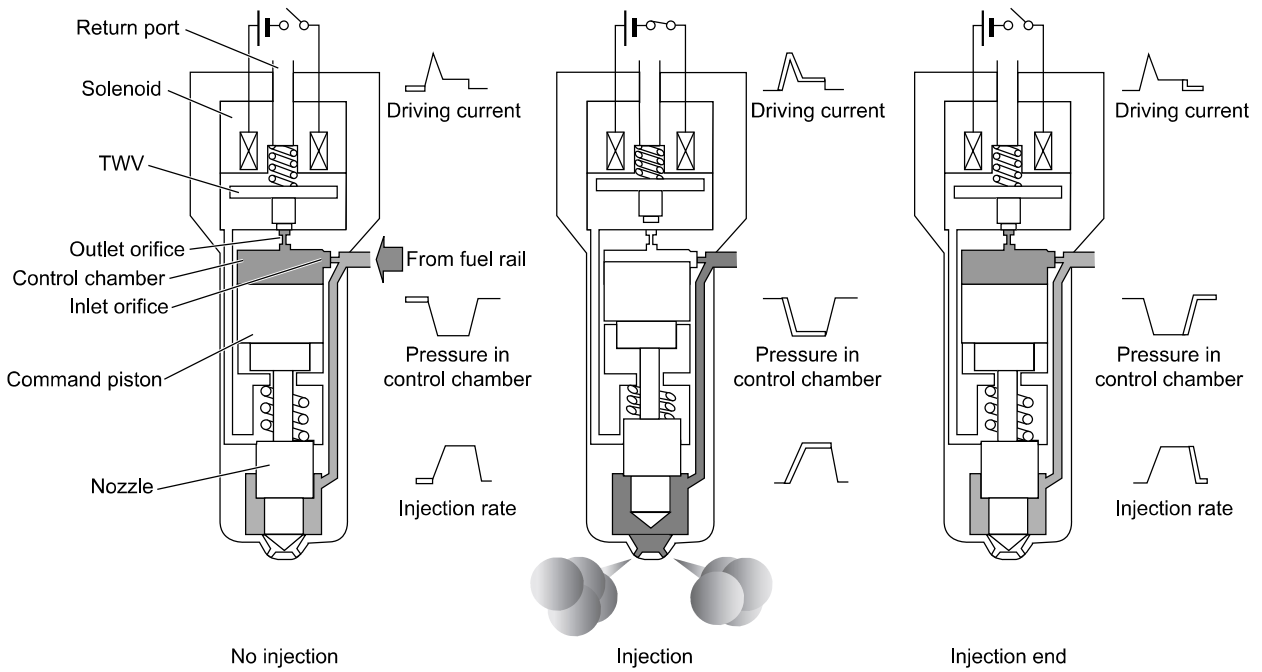
Legend

1. Fuel injector ID code
2. Leak off pipe
3. Two dimensional barcode
4. Port for mounting the injection pipe
5. O-ring

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 on the connector housing, and ID codes showing these in numeric form (24 alphanumeric figures). 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.

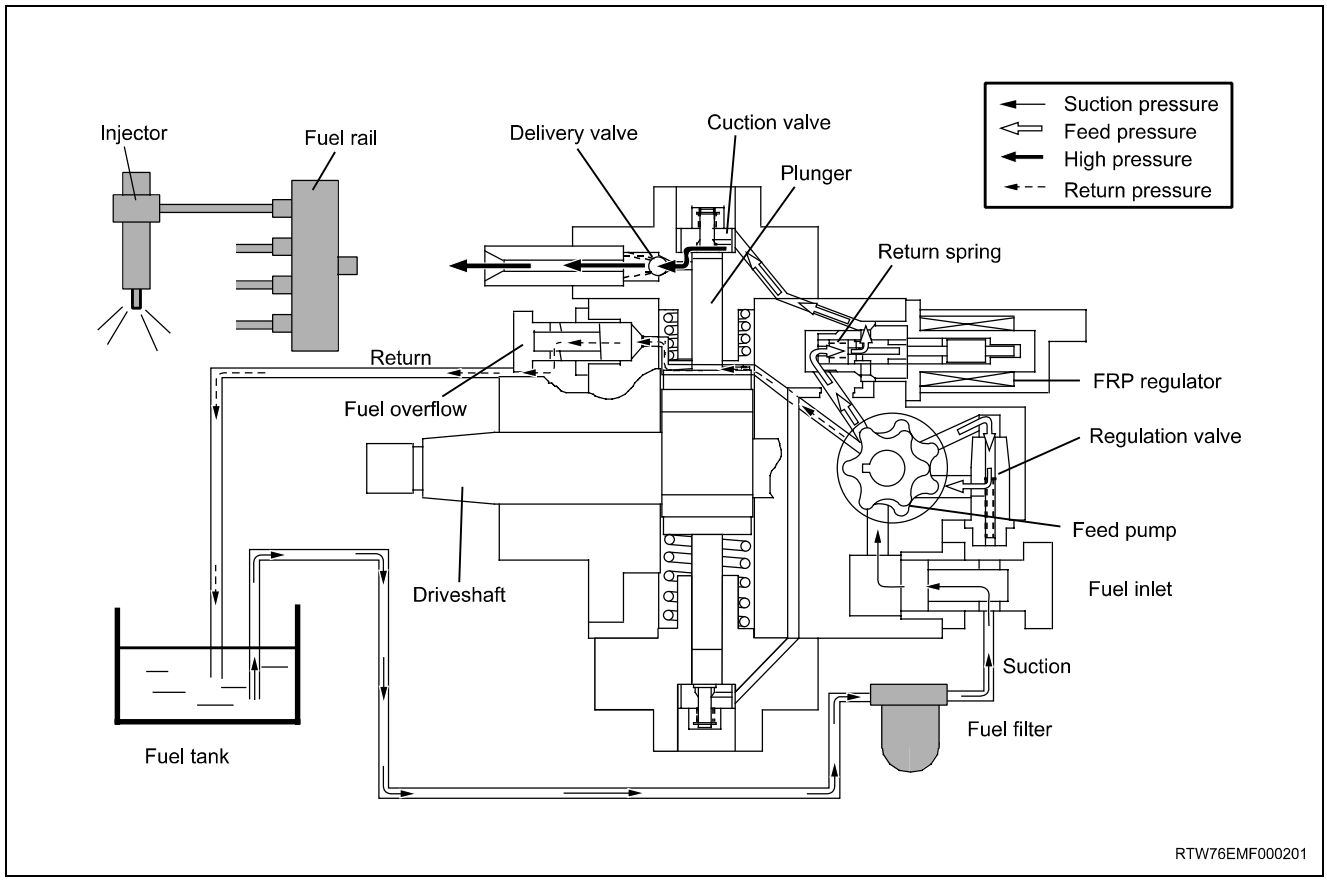
2) Injection start

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.

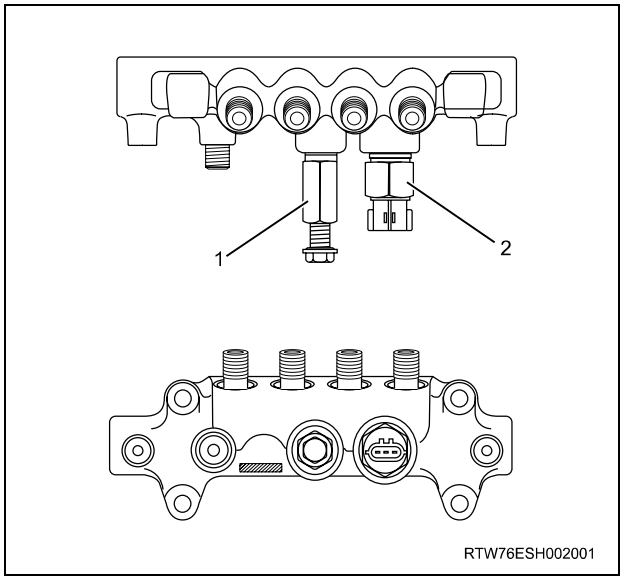
Fuel Supply Pump



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

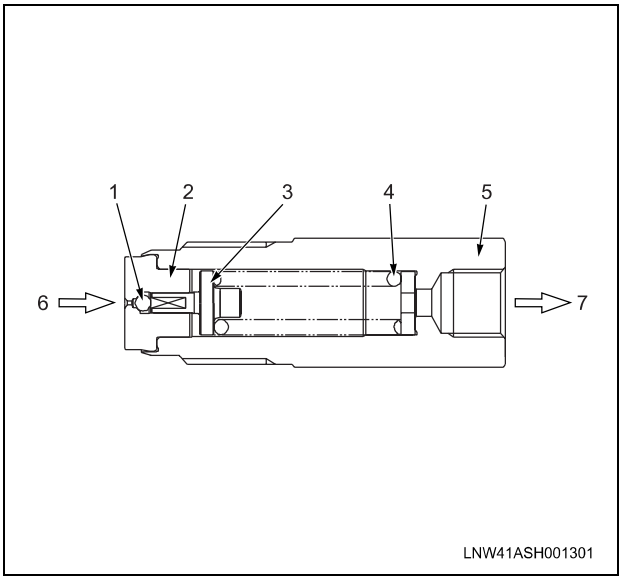
1. Pressure limiter valve
2. Fuel rail pressure (FRP) sensor

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

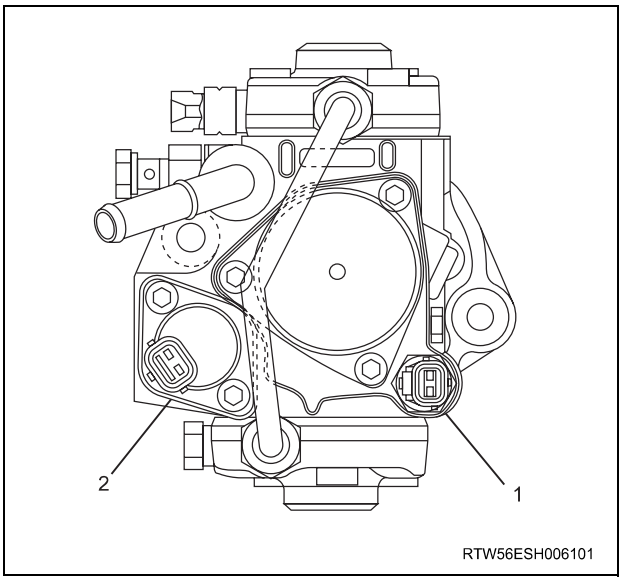


Legend

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, mass air flow 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.

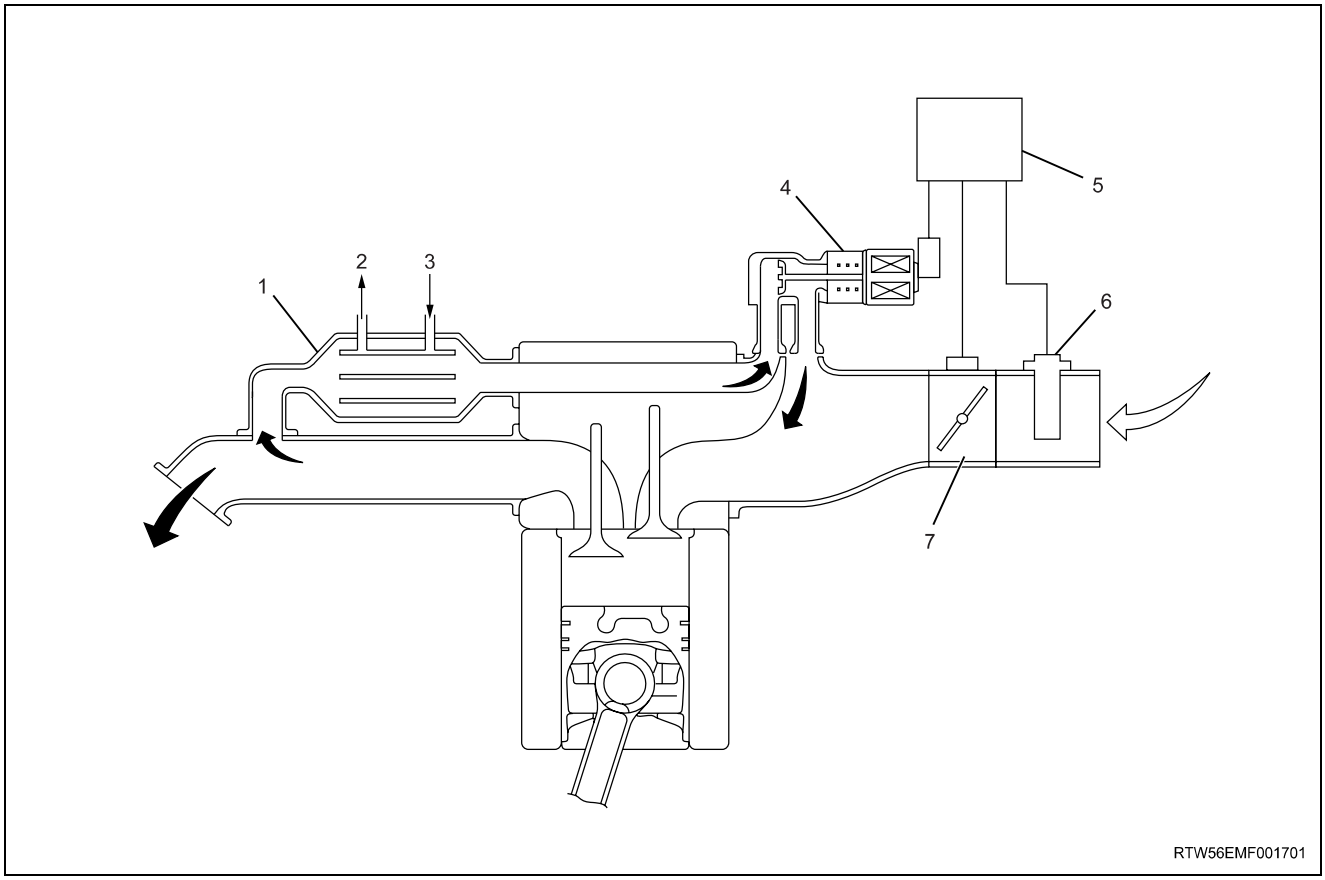
Idle Speed Control

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 ± 5 mm^3.

Exhaust Gas Recirculation (EGR) System Description



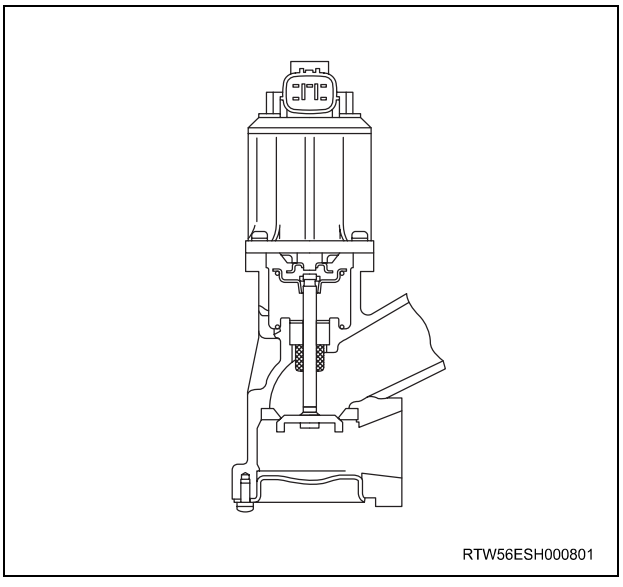
Legend

1. EGR cooler
2. Engine coolant outlet
3. Engine coolant inlet
4. EGR valve
5. ECM
6. MAF sensor
7. Intake throttle valve

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, an EGR position sensor is 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.

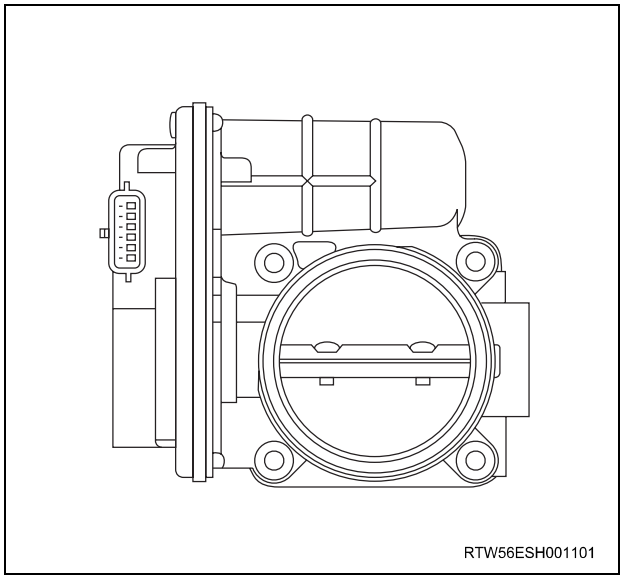
The EGR control starts when the conditions for engine speed, engine coolant temperature, intake air temperature and barometric pressure are satisfied. Then, the valve opening is calculated according to the engine speed, and target fuel injection quantity. Based on this valve opening, the drive duty of the solenoid is determined and the valve is driven accordingly. The intake throttle valve is provided to adequate intake manifold depression to ensure EGR gas flow.

EGR Valve



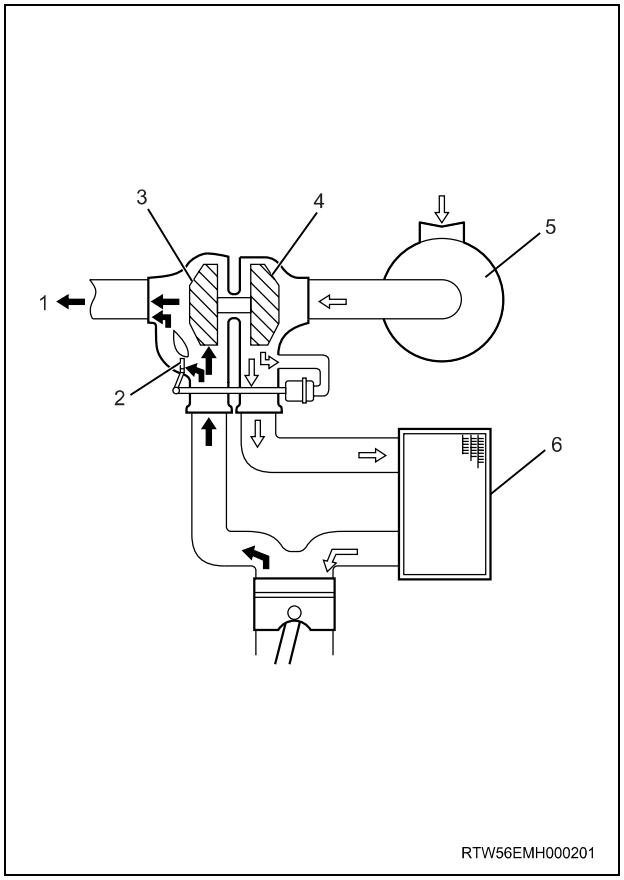
The EGR valve is mounted on the intake manifold. The ECM controls the EGR valve opening based on the engine running condition. The ECM controls the EGR valve by controlling the solenoid. The solenoid is controlled based on pulse width modulation (PWM) signal sent from the ECM. A duty ratio change 0% to appropriate percentage is EGR valve lift control. To open the valve, duty ratio is increased. To close the valve, duty ratio becomes small.
The EGR 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 EGR valve. The ECM should detect a low signal voltage at a small lift amount or closed position. The ECM should detect high signal voltage at a large lift amount.

Intake Throttle Valve



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

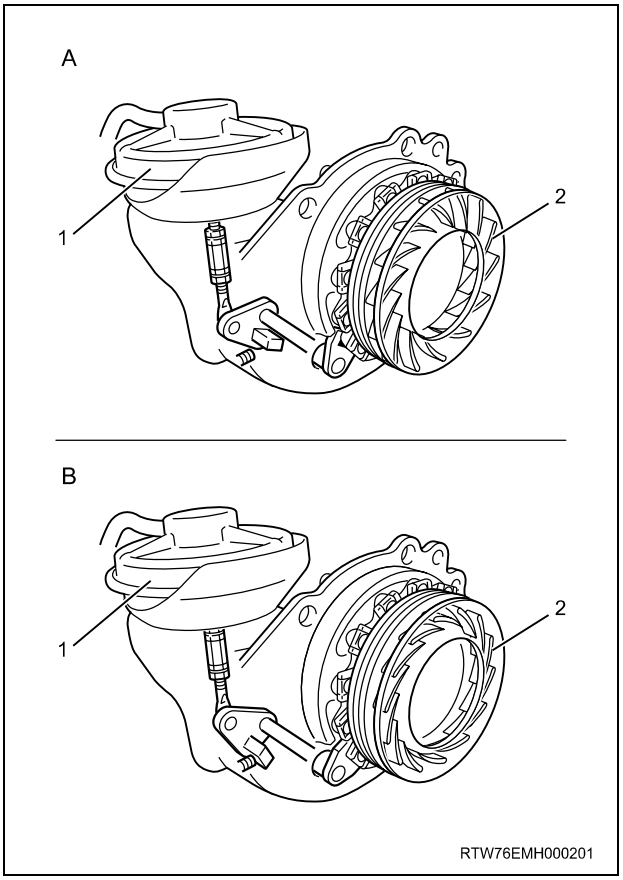


Legend

1. Exhaust gas
2. Waste gate valve
3. Turbine wheel
4. Compressor wheel
5. Air cleaner
6. Charge air cooler (Intercooler)

The turbocharger is used to increase the amount of air that enters the engine cylinders. This allows a proportional increase of fuel to be injected into the cylinders, resulting in increased power output, more complete combustion of fuel, and increased cooling of the cylinder heads, pistons, valves, and exhaust gas. This cooling effect helps extend engine life.
Heat energy and pressures in the engine exhaust gas are utilized to drive the turbine. Exhaust gas is directed to the turbine housing. The turbine housing acts as a nozzle to direct the shaft wheel assembly. Since the compressor wheel is attached directly to the shaft, the compressor wheel rotates at the same speed as the turbine wheel. Clean air from the air cleaner is drawn into the compressor housing and wheel. The air is compressed and delivered through a crossover pipe to the engine air intake manifold, then into the cylinders.

The amount of air pressure rise and air volume delivered to the engine from the compressor outlet is regulated by a waste gate valve in the exhaust housing. The position of the waste gate valve is controlled by the amount of pressure built up on the intake side of the turbocharger. The diaphragm on the inside of the waste gate is pressure sensitive, and controls the position of the valve inside the turbocharger. The position of the valve will increase or decrease the amount of boost to the turbocharger. (Standard output engine)



Legend

1. Turbocharger nozzle control actuator
2. Nozzle

The amount of air pressure rise and air volume delivered to the engine from compressor outlet is regulated by a turbocharger nozzle control actuator indirectly. The position of the turbocharger nozzle is controlled by the ECM. The ECM utilizes a turbocharger nozzle control solenoid valve and a boost pressure sensor 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 (vacuum pressure supply to the actuator is reduced). When the engine is under load, the ECM commands the control solenoid valve to close the turbocharger nozzles (B), thus increasing the boost (vacuum pressure supply to the actuator is increased). The ECM will vary the boost dependant upon the load requirements of the engine. The ECM uses a pulse width modulation (PWM) on the control circuit to open and control the solenoid valve. (High output 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.

Special Tools and Equipment

Special Tools and Equipment

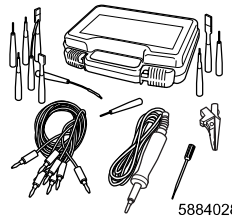
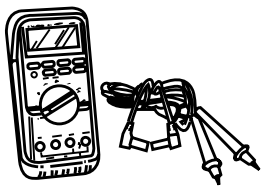
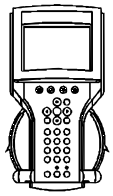
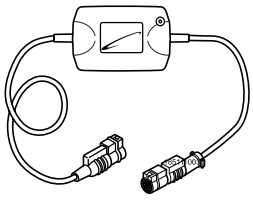
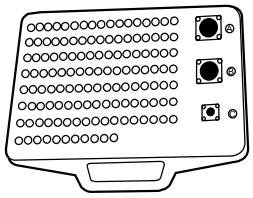
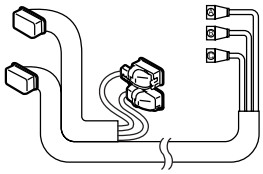
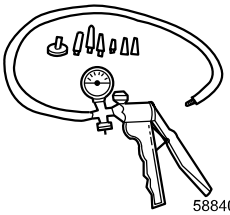
Illustration	Tool Number/ Description
 5884028350	5-8840-2835-0 (J-35616-C) Connector Test Adapter Kit (With Test Lamp)
 5884002850	5-8840-0285-0 (J-39200) Digital Multimeter
 AAW0Z0SH015701	Tech2 Kit
	CAN-di Module
	Breaker Box
	Adapter Harness

Illustration	Tool Number/ Description
 5884002790	5-8840-0279-0 (J-23738-A) Vacuum Pump

SECTION 6F

EXHAUST SYSTEM

CONTENTS

Exhaust Silencer and Exhaust Pipe 6F-2
Main Data and Specifications 6F-2
Components 6F-3
Removal 6F-4
Installation 6F-4
Inspection and Repair 6F-5
Torque Specifications 6F-6
EGR Cooler 6F-7
Components (Standard Output) 6F-7
Components (High Output) 6F-8
Removal 6F-9
Installation (Standard Output) 6F-9
Installation (High Output) 6F-10
Torque Specifications (Standard Output) 6F-11
Torque Specifications (High Output) 6F-12

Exhaust Silencer and Exhaust Pipe

Main Data and Specifications

Front pipe		
Pipe outside diameter × thickness	mm (in)	50.8 × 1.5 (2.0 × 0.059) and 60.5 × 1.5 (2.38 × 0.059)
Middle pipe		
Pipe outside diameter × thickness	mm (in)	60.5 × 1.5 (2.38 × 0.059)
Silencer & tail pipe		
Type		Circular section-shell construction of double skin and end plates, internal construction of baffles and perforated tubes.
Tail pipe outside diameter × thickness	mm (in)	Standard output: 60.5 × 1.6 (2.38 × 0.063) High output: 63.5 × 1.6 (2.5 × 0.063)
Length	mm (in)	Approximately 1335 (52.6)
Mounting		
Number of suspension points		4
Type		Rubber