

SERVICE INFORMATION

Volvo Bus Corporation



Engine Control Module (ECM), Aftertreatment
Control Module (ACM), Electrical System
Multiplexed Version 2
OBD2014 Green House Gas (GHG) Diagnostic
Trouble Codes (DTC)
From Build Date 1.5.2014



Foreword

The descriptions and service procedures contained in this manual are based on designs and technical studies carried out through February 2014.

The products are under continuous development. Vehicles and components produced after the above date may therefore have different specifications and repair methods. When this is deemed to have a significant bearing on this manual, an updated version of this manual will be issued to cover the changes.

Each section of this manual contains specific safety information and warnings which must be reviewed before performing any procedure. If a printed copy of a procedure is made, be sure to also make a printed copy of the safety information and warnings that relate to that procedure. The following levels of observations, cautions and warnings are used in this Service Documentation:

Note: Indicates a procedure, practice, or condition that must be followed in order to have the vehicle or component function in the manner intended.

Caution: Indicates an unsafe practice where damage to the product could occur.

Warning: Indicates an unsafe practice where personal injury or severe damage to the product could occur.

Danger: Indicates an unsafe practice where serious personal injury or death could occur.

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Contents

Troubleshooting	1
Engine Control Module (ECM) Diagnostic Trouble Codes (DTCs).....	1

Troubleshooting

Engine Control Module (ECM) Diagnostic Trouble Codes (DTCs)

The manufacturer scan tool is the preferred tool for performing diagnostic work. Contact your local dealer for more information or visit "www.premiumtechtool.com".

Note: The use of a scan tool is necessary to perform diagnostic work as well as clearing of any diagnostic trouble codes (DTCs). DTC(s) can no longer be cleared using the vehicles instrument cluster digital display and stalk switch control.

System Overview

Multiple electronic control units (ECUs) are used; the engine control module (ECM), instrument control module (ICM), Vehicle Electronic Control Unit (VECU), transmission control module (TCM), the gear selector control module (GSCM) and the aftertreatment control module (ACM). Together, these modules operate and communicate data link to control a variety of engine and vehicle cab functions. The ECM controls a variety of functions related to operation of the engine. The ECM works in conjunction with the ACM to control the EATS system and reduce emissions.. The VECU controls cruise control functions, accessory relay controls and idle shutdown functions.

In addition to their control functions, the modules have on board diagnostic (OBD) capabilities. The OBD is designed to detect faults or abnormal conditions that are not within normal operating parameters. When the system detects a fault or abnormal condition, the fault will be logged, the vehicle operator will be advised that a fault has occurred by illumination a malfunction indicator lamp (MIL). The module may initiate the engine shutdown procedure if the system determines that the fault could damage the engine.

In some situations when a fault is detected, the system will enter a "derate" mode. The derate mode allows continued vehicle operation but the system may substitute a sensor or signal value that may result in reduced performance. In some instances, the system will continue to function but engine power may be limited to protect the engine and vehicle. Diagnostic trouble codes (DTCs) logged in the system memory can later be read, to aid in diagnosing the problem using a Premium Tech Tool.

The VECU and ECM are dependent on each other to perform their specific control functions. In addition to switch and sensor data, the broadcast of data between modules also includes various calculations and conclusions that each module has developed, based on the input information it has received.

System Electronic Control Unit (ECU) Overview

The ECM monitors engine parameters to monitor the engine system's performance in real time. This is performed to aid the ECM with its self diagnostic capabilities. Many sensors are used for input to the emission control system.

The system contains the following "emission critical" ECUs that are monitored;

- Engine Control Module (ECM)
- Vehicle Electronic Control Unit (VECU)
- Aftertreatment Control Module (ACM)
- Aftertreatment Nitrogen Oxides (NOx) Sensors
- Engine Variable Geometry Turbocharger (VGT) Smart Remote Actuator (SRA)

These ECUs all communicate with the ECM via data links. The VECU communicates across the SAE J1939 (CAN1) data link while the others use the SAE J1939-7 (CAN2) data link. The OBD systems use SAE J2284 (ISO) data link for communication with scan tools. Scan tools compliant with ISO 15031-5 (SAE J1979) or ISO 14229 will be able to access all emission critical data from the ECM and ACM. The ECM gateways all of the DTCs and descriptions from the VECU, NOx Sensors and the VGT-SRA. The use of a scan tool is necessary to perform diagnostic work as well as clearing of any diagnostic trouble codes (DTCs). DTC(s) can no longer be cleared using the vehicles instrument cluster digital display and stalk switch control.

Malfunction Indicator Lamp (MIL), Description and Location

A MIL located in the instrument cluster. This amber colored lamp is used to inform the driver that an "emission critical" malfunction signal has occurred.



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Code Definition

The Diagnostic Trouble Code follows a standardized format. All DTC's have a letter followed by a 4-digit code. Here is a breakdown of what an OBD code means.

First Character

- P=Powertrain
 - B=Body
 - C=Chassis (not used in NA yet)
 - U=Network (Data Link), power supply
-
- P00XX Fuel and air metering and Auxiliary Emissions controls
 - P01XX Fuel and air metering
 - P02XX Fuel and air metering
 - P03XX Ignition system or misfire
 - P04XX Auxiliary Emissions Controls
 - P05XX Vehicle Speed, Idle control, auxiliary inputs
 - P06XX Computer and Auxiliary inputs
 - P07XX Transmission
 - P08XX Transmission
 - P09XX Transmission
 - P1XX manufacturer controlled
 - P2XX SAE controlled DTCs
 - P3XX Manufacturer controlled and SAE reserved

Fifth and Sixth Digit-(if applicable)

- Failure Type Byte (FTB)

The DTC Failure Type Byte defines the DTC Failure Category and Sub Type of a base DTC. It represents the type of fault in the circuit or system (e.g. sensor open circuit, sensor shorted to ground, algorithm based failure, etc).

- 00 = No Subtype information
 - 01 = General Electrical Failure
 - 02 = General Signal Failure
 - 03 = FM (Frequency Modulated) PWM (Pulse With Modulated) failures
 - 04 = System internal Failures
 - 05 = System Programming Failures
-

- 06 = Algorithm Based Failures
 - 07 = Mechanical Failures
 - 08 = Bus Signal/Message Failures
 - 09 = Component Failures
 - 10 = ISO/SAE reserved
 - 11 = Circuit short to ground
 - 12 = Circuit short to battery
 - 13 = Circuit open
 - 14 = Circuit short to ground or open
 - 15 = Circuit short to battery or open
 - 16 = Circuit voltage below threshold
 - 17 = Circuit voltage above threshold
 - 18 = Circuit current below threshold
 - 19 = Circuit current above threshold
 - 1A = Circuit resistance below threshold
 - 1B = Circuit resistance above threshold
 - 1C = Circuit voltage out of range
 - 1D = Circuit current out of range
 - 1E = Circuit resistance out of range
 - 1F = Circuit intermittent
 - 20 = ISO/SAE reserved
 - 21 = Signal amplitude < minimum
 - 22 = Signal amplitude > minimum
 - 23 = Signal stuck low
 - 24 = Signal stuck high
 - 25 = Signal shape/wave form failure
 - 26 = Signal rate of change below threshold
 - 27 = Signal rate of change above threshold
 - 28 = Signal bias level out of range/zero adjustment failure
 - 29 = Signal invalid
 - 2A = ISO/SAE reserved
-

- 2B = ISO/SAE reserved
 - 2C = ISO/SAE reserved
 - 2D = ISO/SAE reserved
 - 2E = ISO/SAE reserved
 - 2F = Signal erratic
 - 30 = ISO/SAE reserved
 - 31 = No signal
 - 32 = Signal low time < minimum
 - 33 = Signal low time > maximum
 - 34 = Signal high time < minimum
 - 35 = Signal high time > maximum
 - 36 = Signal frequency too low
 - 37 = Signal frequency too high
 - 38 = Signal frequency incorrect
 - 39 = Signal has too few pulses
 - 3A = Signal has too many pulses
 - 3B = ISO/SAE reserved
 - 3C = ISO/SAE reserved
 - 3D = ISO/SAE reserved
 - 3F = ISO/SAE reserved
 - 40 = ISO/SAE reserved
 - 41 = General checksum failure
 - 42 = General memory failure
 - 43 = Special memory failure
 - 44 = Data memory failure
 - 45 = Program memory failure
 - 46 = Calibration/parameter memory failure
 - 47 = Watchdog/safety μ C failure
 - 48 = Supervision software failure
 - 49 = Internal electronic failure
 - 4A = Incorrect component installed
-

- 4B = Over temperature
 - 4C = ISO/SAE reserved
 - 4D = ISO/SAE reserved
 - 4F = ISO/SAE reserved
 - 50 = ISO/SAE reserved
 - 51 = Not programmed
 - 52 = Not activated
 - 53 = Deactivated
 - 54 = Missing calibration
 - 55 = Not configured
 - 56 = ISO/SAE reserved
 - 5A = ISO/SAE reserved
 - 5B = ISO/SAE reserved
 - 5C = ISO/SAE reserved
 - 5D = ISO/SAE reserved
 - 5F = ISO/SAE reserved
 - 60 = ISO/SAE reserved
 - 61 = Signal calculation failure
 - 62 = Signal compare failure
 - 63 = Circuit/component protection time-out
 - 64 = Signal plausibility failure
 - 65 = Signal has too few transitions/events
 - 66 = Signal has too many transitions/events
 - 67 = Signal incorrect after event
 - 68 = Event information
 - 69 = ISO/SAE reserved
 - 6A = ISO/SAE reserved
 - 6B = ISO/SAE reserved
 - 6C = ISO/SAE reserved
 - 6D = ISO/SAE reserved
 - 6F = ISO/SAE reserved
 - 70 = ISO/SAE reserved
-

- 71 = Actuator stuck
 - 72 = Actuator stuck open
 - 73 = Actuator stuck closed
 - 74 = Actuator slipping
 - 75 = Emergency position not reachable
 - 76 = Wrong mounting position
 - 77 = Commanded position not reachable
 - 78 = Alignment or adjustment incorrect
 - 79 = Mechanical linkage failure
 - 7A = Fluid leak or seal failure
 - 7B = Low fluid level
 - 7C = ISO/SAE reserved
 - 7D = ISO/SAE reserved
 - 7C = ISO/SAE reserved
 - 7D = ISO/SAE reserved
 - 7F = ISO/SAE reserved
 - 80 = ISO/SAE reserved
 - 81 = Invalid serial data received
 - 82 = Alive/sequence counter incorrect/not updated
 - 83 = Value of signal protection calculation incorrect
 - 84 = Signal below allowable range
 - 85 = Signal above allowable range
 - 86 = Signal invalid
 - 87 = Missing message
 - 88 = Bus off
 - 89 = ISO/SAE reserved
 - 8A = ISO/SAE reserved
 - 8B = ISO/SAE reserved
 - 8C = ISO/SAE reserved
 - 8D = ISO/SAE reserved
 - 8F = ISO/SAE reserved
-

- 90 = ISO/SAE reserved
 - 91 = Parametric
 - 92 = Performance or incorrect operation
 - 93 = No operation
-

Diagnostic Trouble Codes (DTC)

- “P0016 Camshaft Position Sensor: Rationality Low”, page 113
 - “P0046 VGT Position Actuator: VGT Mechanical Fault”, page 148
 - “P006E VGT Position Actuator: Low Supply Voltage”, page 151
 - “P0070 Ambient Air Temperature Sensor (AAT): Open Circuit”, page 160
 - “P0071 Ambient Air Temperature Sensor (AAT): Circuit "A" Range / Performance”, page 159
 - “P0072 Ambient Air Temperature Sensor (AAT): Short Circuit Low”, page 160
 - “P0095 Intake Manifold Temperature Sensor (IMT): Open Circuit Check”, page 88
 - “P0096 Intake Manifold Temperature Sensor (IMT): Sensor 2 Circuit Range / Performance Bank 1”, page 91
 - “P0097 Intake Manifold Temperature Sensor (IMT): Short Circuit Low”, page 88
 - “P009A Intake Manifold Temperature Sensor (IMT): Rationality Monitor”, page 89
 - “P00AF VGT Position Actuator: Bad Device”, page 150
 - “P0105 Intake Manifold Pressure Sensor (IMP): Open Circuit Check”, page 81
 - “P0069 Intake Manifold Pressure Sensor Monitor”, page 80
 - “P0108 Intake Manifold Pressure Sensor (IMP): Short Circuit High”, page 81
 - “P0110 Intake Manifold Temperature Sensor (IMT): Open Circuit Check”, page 92
 - “P0111 Intake Manifold Temperature Sensor (IMT): Sensor 1 Circuit Range / Performance Bank 1”, page 90
 - “P0112 Intake Manifold Temperature Sensor (IMT): Short Circuit Low”, page 92
 - “P0115 Engine Coolant Temperature Sensor (ECT): Open Circuit Check”, page 75
 - “P0116 Engine Coolant Temperature Sensor (ECT): Sensor Stuck Low Monitor”, page 74
 - “P0117 Engine Coolant Temperature Sensor (ECT): Short Circuit Low”, page 75
 - “P0128 Engine Cooling System: Stuck Open or Leaking Thermostat Monitor”, page 73
 - “P0195 Engine Oil Temperature Sensor (OTS): Open Circuit Check”, page 106
 - “P0196 Engine Oil Temperature Sensor (OTS): Rationality Monitor”, page 105
 - “P0197 Engine Oil Temperature Sensor (OTS): Short Circuit Low”, page 106
 - “P0201 Engine Fuel Injectors: Short Circuit Low (Injector 1)”, page 156
 - “P0202 Engine Fuel Injectors: Short Circuit Low (Injector 2)”, page 156
 - “P0203 Engine Fuel Injectors: Short Circuit Low (Injector 3)”, page 157
 - “P0204 Engine Fuel Injectors: Short Circuit Low (Injector 4)”, page 157
 - “P0205 Engine Fuel Injectors: Short Circuit Low (Injector 5)”, page 158
 - “P0206 Engine Fuel Injectors: Short Circuit Low (Injector 6)”, page 158
 - “P0234 Boost Pressure: Overboost”, page 47
 - “P0262 Engine Fuel Injectors: Short Circuit High (Injector 1)”, page 153
 - “P0265 Engine Fuel Injectors: Short Circuit High (Injector 2)”, page 153
 - “P026A Charge Air Cooler: Efficiency Below Threshold”, page 49
 - “P0268 Engine Fuel Injectors: Short Circuit High (Injector 3)”, page 154
 - “P026C Fuel Injector (low mass flow)”, page 18
-

“P026D Fuel Injector (high mass flow)”, page 19

“P0271 Engine Fuel Injectors: Short Circuit High (Injector 4)”, page 154

“P0274 Engine Fuel Injectors: Short Circuit High (Injector 5)”, page 155

“P0277 Engine Fuel Injectors: Short Circuit High (Injector 6)”, page 155

“P0299 Boost Pressure: Underboost”, page 46

“P02CC Single Cylinder Fuel Injector Offset – Low (Cylinder 1)”, page 26

“P02CD Single Cylinder Fuel Injector Offset – High (Cylinder 1)”, page 20

“P02CE Single Cylinder Fuel Injector Offset – Low (Cylinder 2)”, page 27

“P02CF Single Cylinder Fuel Injector Offset – High (Cylinder 2)”, page 21

“P02D0 Single Cylinder Fuel Injector Offset – Low (Cylinder 3)”, page 28

“P02D1 Single Cylinder Fuel Injector Offset – High (Cylinder 3)”, page 22

“P02D2 Single Cylinder Fuel Injector Offset – Low (Cylinder 4)”, page 29

“P02D3 Single Cylinder Fuel Injector Offset – High (Cylinder 4)”, page 23

“P02D4 Single Cylinder Fuel Injector Offset – Low (Cylinder 5)”, page 30

“P02D5 Single Cylinder Fuel Injector Offset – High (Cylinder 5)”, page 24

“P02D6 Single Cylinder Fuel Injector Offset – Low (Cylinder 6)”, page 31

“P02D7 Single Cylinder Fuel Injector Offset – High (Cylinder 6)”, page 25

“P0300 Misfire Multiple Cylinders”, page 32

“P0301 Misfire Single Cylinder (Cylinder 1)”, page 33

“P0302 Misfire Single Cylinder (Cylinder 2)”, page 34

“P0303 Misfire Single Cylinder (Cylinder 3)”, page 35

“P0304 Misfire Single Cylinder (Cylinder 4)”, page 36

“P0305 Misfire Single Cylinder (Cylinder 5)”, page 37

“P0306 Misfire Single Cylinder (Cylinder 6)”, page 38

“P0335 Crankshaft Position Sensor: Open Circuit”, page 111

“P0336 Crankshaft Position Sensor: Rationality High”, page 112

“P0339 Crankshaft Position Sensor: Rationality Low”, page 111

“P0340 Camshaft Position Sensor: Open Circuit”, page 112

“P0341 Camshaft Position Sensor: Rationality High”, page 113

“P0401 EGR System (Low Flow)”, page 39

“P0402 EGR System (High Flow)”, page 40

“P0403 EGR Valve Actuator: Open Circuit”, page 152

“P0406 EGR Differential Pressure Sensor: Short Circuit High”, page 85

“P0409 EGR Differential Pressure Sensor: Open Circuit Check”, page 85

“P040A EGR Temperature Sensor: Open Circuit Check”, page 95

“P040B EGR Temperature Sensor: Rationality Monitor (At Start Up After An 8 Hour Soak Time)”, page 93

“P040B EGR Temperature Sensor: Rationality Monitor (During Engine Running Conditions)”, page 94

“P040C EGR Temperature Sensor: Short Circuit Low”, page 95

“P0420 NMHC Catalyst: Conversion Efficiency”, page 50

“P0420 NMHC Catalyst: Missing Substrate”, page 51

“P0420 NMHC Catalyst: Conversion Efficiency”, page 50

“P0420 NMHC Catalyst: Missing Substrate”, page 51

“P046C EGR Differential Pressure Sensor: DP Sensor Rationality”, page 84

“P0489 EGR Valve Actuator: Short Circuit Low”, page 152

“P04DB Crankcase Ventilation: Disconnected Pipe/Separator Monitor”, page 76

“P04D8 Excessive Time To Enter Closed Loop EGR Control”, page 42

“P04D9 EGR System: Feedback Control (Saturated Low)”, page 43

“P04DA EGR System: Feedback Control (Saturated High)”, page 44

“P0500 Wheel Based Vehicle Speed: Vehicle Speed Sensor (VSS): Open Circuit”, page 162

“P0502 Wheel Based Vehicle Speed: Vehicle Speed Sensor (VSS): Short Circuit Low”, page 162

“P0506 Idle Engine Speed Rationality: Idle Speed Low”, page 173

“P0507 Idle Engine Speed Rationality: Idle Speed High”, page 174

“P051A Crankcase Pressure Sensor (CPS): Open Circuit Check”, page 87

“P051B Crankcase Pressure Sensor (CPS): Rationality Monitor”, page 86

“P051D Crankcase Pressure Sensor (CPS): Short Circuit High”, page 87

“P0520 Engine Oil Pressure Sensor (OPS): Open Circuit Check”, page 108

“P0521 Engine Oil Pressure Sensor: Rationality Monitor”, page 107

“P0523 Engine Oil Pressure Sensor (OPS): Short Circuit High”, page 108

“P0544 Pre-DOC Temperature Sensor: Open Circuit Check”, page 102

“P0545 Pre-DOC Temperature Sensor: Short Circuit Low”, page 102

“P054E Idle Engine Fuel Rationality: Fuel Rationality Low”, page 175

“P054F Idle Engine Fuel Rationality: Fuel Rationality High”, page 176

“P05E4 Parking Brake Switch: Short Circuit Low”, page 165

“P0562 ACM Supply: ACM Battery Potential Below Range”, page 181

“P0563 ACM Supply: ACM Battery Potential Above Range”, page 181

“P0658 Actuator Supply #1 ACM: Short Circuit Low”, page 179

“P0659 Actuator Supply #1 ACM: Short Circuit High”, page 180

“P06B1 ACM Sensor Supply #1: Below Range”, page 177

“P06B1 ECM Supply #1: Below Range”, page 166

“P06B2 ACM Sensor Supply #1: Above Range”, page 177

“P06B2 ECM Sensor Supply #1: Above Range”, page 177

“P06B4 ECM Supply #2: Below Range”, page 167

“P06B4 ACM Sensor Supply #2: Below Range”, page 178

“P06B5 ACM Sensor Supply #2: Above Range”, page 178

“P06B5 ECM Supply #2: Above Range”, page 167

“P06E7 ECM Supply #3: Below Range”, page 168

"P06E8 ECM Supply #3: Above Range", page 168

"P10AD Aftertreatment DEF Pump: Reductant Pump "A" Control Low Side", page 132

"P10AE Aftertreatment DEF Pump: Reductant Pump "A" Control Low Side Circuit Low", page 133

"P10AF Aftertreatment DEF Pump: Reductant Pump "A" Control Low Side Circuit High", page 133

"P10CE Aftertreatment DEF Pump: Reductant Return No Flow Detected", page 130

"P1131 Aftertreatment Hydrocarbon Air Purge Valve: Short Circuit Low", page 122

"P1134 Aftertreatment Hydrocarbon Air Purge Valve: Open Circuit", page 122

"P20B1 Aftertreatment DEF Tank Heater: Reductant Heater Coolant Control Valve Control", page 140

"P20B2 Aftertreatment DEF Tank Heater: Reductant Heater Coolant Control Valve Performance/Stuck Open", page 139

"P20B3 Aftertreatment DEF Tank Heater: Reductant Heater Coolant Control Valve Circuit Low", page 140

"P20B4 Aftertreatment DEF Tank Heater: Reductant Heater Coolant Control Valve Circuit High", page 141

"P20B9 Aftertreatment DEF Line Heater 1: Reductant Heater "A" Control Circuit Open", page 142

"P20BB Aftertreatment DEF Line Heater 1: Aftertreatment Reagent Hose Heater 1 Short Circuit Low", page 142

"P20BC Aftertreatment DEF Line Heater 1: Aftertreatment Reagent Hose Heater 1 Short Circuit High", page 143

"P20C1 Aftertreatment DEF Line Heater 2: Reductant Heater "C" Control", page 143

"P20C3 Aftertreatment DEF Line Heater 2: Aftertreatment Reagent Hose Heater 3 Short Circuit Low", page 144

"P20C4 Aftertreatment DEF Line Heater 2: Aftertreatment Reagent Hose Heater 3 Short Circuit High", page 144

"P20EE NOx Catalyst: Conversion Efficiency", page 52

"P20EE NOx Catalyst: Reductant Delivery", page 53

"P20EE NOx Catalyst: Missing SCR", page 54

"P20E8 Aftertreatment DEF Pump: Pump Pressure Build Up", page 128

"P2002 PM Filter Efficiency Monitor", page 55

"P202D Aftertreatment DEF Pump: Aftertreatment Reagent Pressure Leakage", page 129

"P2031 Post-DOC Temperature Sensor: Open Circuit Check", page 103

"P2032 Post-DOC Temperature Sensor: Short Circuit Low", page 103

"P203C Aftertreatment DEF Pump Pressure Sensor: Aftertreatment Reagent Level Short Circuit Low", page 139

"P203F Aftertreatment DEF Level Sensor: Reductant Level Low", page 138

"P2043 Aftertreatment DEF Level Sensor: Aftertreatment Reagent Tank Temperature Sensor Stuck", page 138

"P2047 Aftertreatment SCR Dosing Valve: Open Circuit", page 146

"P2048 Aftertreatment SCR Dosing Valve: Short Circuit Low", page 147

"P2049 Aftertreatment SCR Dosing Valve: Short Circuit High", page 146

"P204A Aftertreatment DEF Pump Pressure Sensor: Open Circuit", page 137

"P204B Aftertreatment DEF Pump Pressure Sensor: Rationality", page 136

"P204C Aftertreatment DEF Pump Pressure Sensor: Short Circuit Low", page 137

"P205A Aftertreatment DEF Tank Temperature Sensor: Open Circuit", page 127

"P205B Aftertreatment DEF Tank Temperature Sensor: Rationality Low", page 126

"P205C Aftertreatment DEF Tank Temperature Sensor: Short Circuit Low", page 127

"P2080 Exhaust Gas Temperature Sensors: Pre-DOC Rationality Check (Plausibility Check Of The Sensor Value)", page 96

"P2080 Exhaust Gas Temperature Sensors: Pre-DOC Rationality Check (At Start Up After A 6 Hour Soak Time)", page 97

"P2084 Exhaust Gas Temperature Sensor: Post-DOC Rationality Check (Signal Plausibility Failure)", page 98

"P2084 Exhaust Gas Temperature Sensor: Post-DOC Rationality Check (At Start Up After A 6 Hour Soak Time)", page 99

"P208A Aftertreatment DEF Pump: Open Circuit", page 131

"P208B Aftertreatment DEF Pump: Reductant Pump "A" Control Performance/Stuck Off", page 128

"P208C Aftertreatment DEF Pump: Short Circuit Low", page 132

"P208D Aftertreatment DEF Pump: Short Circuit High", page 131

"P208E Aftertreatment SCR Dosing Valve: Aftertreatment Reagent Dosing Valve Clogged", page 145

"P20A0 Aftertreatment DEF Pump Direction Valve: Open Circuit", page 135

"P20A1 Aftertreatment DEF Pump Direction Valve: Functional Check", page 134

"P20A2 Aftertreatment DEF Pump Direction Valve: Short Circuit Low", page 136

"P20A3 Aftertreatment DEF Pump Direction Valve: Short Circuit High", page 135

"P20D7 Aftertreatment Hydrocarbon Doser Solenoid: Open Circuit", page 119

"P20D9 Aftertreatment Hydrocarbon Doser Solenoid: Short Circuit Low", page 119

"P20DD Aftertreatment Hydrocarbon Doser Fuel Pressure Sensor: Open Circuit", page 115

"P20DE Aftertreatment Hydrocarbon Doser Fuel Pressure Sensor: Range/Performance", page 116

"P20E0 Aftertreatment Hydrocarbon Doser Fuel Pressure Sensor: Short Circuit High", page 115

"P20E8 Aftertreatment DEF Pump: Pump Pressure Build Up", page 128

"P2109 Accelerator Pedal Position Sensor: Rationality Low", page 163

"P215A Wheel Based Vehicle Speed: Vehicle Speed Sensor (VSS): Rationality", page 161

"P2163 Accelerator Pedal Position Sensor: Rationality High", page 163

"P2200 NOx Sensor #1: Open Circuit", page 63

"P2201 NOx Sensor #1: Rationality Monitor", page 58

"P2203 NOx Sensor #1: Short Circuit Low", page 63

"P220A NOx Sensor #1: Supply Voltage Out of Range", page 64

"P220B NOx Sensor #2: Supply Voltage Out of Range", page 72

"P220E NOx Sensor #1: Sensor Start Up Monitor", page 60

"P220F NOx Sensor #2: Sensor Start Up Monitor", page 67

"P221A NOx Sensors: NOx Sensor Measurement Rationality Monitor", page 69

"P2226 Barometric Pressure Sensor (BPS): Open Circuit Check", page 79

"P2227 Barometric Pressure Sensor (BPS): Rationality Monitor (Out Of Range)", page 77

"P2227 Barometric Pressure Sensor (BPS): Rationality Monitor (Barometric Pressure Sensor Evaluation)", page 78

"P2229 Barometric Pressure Sensor (BPS): Short Circuit High", page 79

"P225C Inlet and Outlet NOx Sensor Biased High", page 59

"P225D NOx Sensor #1 Removed", page 61

"P225E NOx Sensor #2: Rationality High Monitor", page 66

"P225F NOx Sensor #2 Removed", page 70

"P226C Boost Pressure Slow Response", page 48

"P229E NOx Sensor #2: Open Circuit", page 71

"P229F NOx Sensor #2: Rationality Low Monitor", page 65

"P22A1 NOx Sensor #2: Short Circuit Low", page 71

"P22FB NOx Sensor #1: Bad Device Monitor", page 62

"P22FE NOx Sensor #2: Bad Device Monitor", page 68

"P240F EGR System Slow Response", page 41

"P242A Post-DPF Temperature Sensor: Open Circuit Check", page 104

"P242B Exhaust Gas Temperature Sensors: Post-DPF Rationality Check (Signal Plausibility Failure)", page 100

"P242B Exhaust Gas Temperature Sensors: Post-DPF Rationality Check (At Start Up After A 6 Hour Soak Time)", page 101

"P242C Post-DPF Temperature Sensor: Short Circuit Low", page 104

"P244A PM Filter: Missing Substrate", page 56

"P244B PM Filter: Differential Pressure Too High", page 57

"P2452 Aftertreatment Differential Pressure Sensor (DPS): Open Circuit Check", page 83

"P2453 Aftertreatment Differential Pressure Sensor (DPS): DPS Differential Pressure Sensor", page 82

"P2454 Aftertreatment Differential Pressure Sensor (DPS): Short Circuit Low", page 83

"P2457 EGR System: EGR Cooler Monitoring", page 45

"P2563 VGT Position: Cannot Reach the Demanded Position", page 149

"P2578 Turbocharger Speed Sensor (TSS): Missing Signal Monitor", page 109

"P26E8 Actuator Supply #2 ACM: Short Circuit Low", page 180

"P2579 Turbocharger Speed Sensor (TSS): Overspeed", page 110

"P2697 Aftertreatment Hydrocarbon Dosing Valve: Open Circuit", page 125

"P2698 Aftertreatment Hydrocarbon Dosing Valve: Functional", page 124

"P2699 Aftertreatment Hydrocarbon Dosing Valve: Short Circuit Low", page 125

"U0001 CAN Link: Missing Signal on Backbone 2", page 172

"U0010 CAN Link: SAE J1939-1 Missing Signal", page 169

"U0080 CAN Link: Powertrain CAN Missing Signal", page 170

"U010C VGT Position Actuator: Missing Signal", page 150

"U010E CAN Link: Lost Communication With Aftertreatment Control Module", page 172

"U0141 CAN Link: Missing Signal from the VECU", page 171

"U0155 CAN Link: Lost Communication With Instrument Panel Cluster (IPC) Control Module", page 170

"U029D NOx Sensor #1: Missing Signal", page 64

"U029E NOx Sensor #2: Missing Signal", page 72

"U116F CAN Link: Missing ACM at Engine Subnet", page 171

"U3017 Real Time Clock: Abnormal Rate of Change", page 182

Definitions and Terminology

Confirmed Fault Code:

The diagnostic trouble code (DTC) stored when an OBD system has confirmed that a malfunction exists.

Continuous Monitors:

Monitors that are always running after enabling criteria has been met.

Deactivate:

Means to turn-off, shutdown, desensitize, or otherwise make inoperable through software programming or other means during the actual life of the engine.

Diagnostic or Emission Critical:

Refers to the engine and any other on-board electronic control unit containing software that has primary control over any of the required monitors, excluding anti-lock brake system (ABS) control units or stability/traction control units, and has primary control over the diagnostics for more than two of the components required to be monitored.

Diagnostic Trouble Code (DTC)

In the heavy truck industry, codes that are developed by SAE standards to help diagnose and track problems in a vehicle detected by its on-board diagnostics (OBD).

Drive Cycle:

The combination of driving conditions that enable a monitor and allow it to be completed.

It is defined as a trip that meets any of the four conditions below:

- Begins with engine start and ends with engine shutoff
- Begins with engine start and ends after four hours of continuous engine-on operation
- Begins at the end of the previous four hours of continuous engine-on operation and ends after four hours of continuous engine-on operation
- Begins at the end of the previous four hours of continuous engine-on operation and ends with engine shutoff

Enable Conditions:

A combination of conditions occurring to trigger a specific monitor to run.

Engine Misfire:

Means lack of combustion in the cylinder due to absence of spark, poor fuel metering, poor compression, or any other cause. This does not include lack of combustion events in non-active cylinders due to default fuel shut-off or cylinder deactivation strategies.

Engine Start:

Is defined as the point when the engine reaches a speed 150 rpm below the normal, warmed-up idle speed (as determined in the drive position for vehicles equipped with an automatic transmission).

Fault Memory:

Information pertaining to malfunctions stored in the onboard computer, including fault codes, stored engine conditions, and MIL status.

Functional Check:

For an output component or system means verification of proper response of the component and system to a computer command.

Ignition Cycle:

A drive cycle that begins with engine start, meets the engine start definition for at least two seconds plus or minus one second, and ends with engine shutoff.

Key On, Engine Off (KOEO):

Refers to a vehicle with the ignition key in the engine run position (not engine crank or accessory position) but with the engine not running.

Key On, Engine Running (KOER):

Refers to a vehicle with the ignition key in the engine run position with the engine running.

Malfunction:

Means any deterioration or failure of a component that causes the performance to be outside of the applicable limits.

Malfunction Indicator Lamp (MIL):

An amber colored lamp located in the instrument cluster used to inform the driver that an "emission critical" malfunction signal has occurred.

MIL-On Fault Code:

For engines using ISO15765 or SAE J1979 data link, refers to the DTC stored when an OBD system has confirmed that a malfunction exists (typically on the second drive cycle that the malfunction is detected).

Monitor

Testing routines, performed by the ECM and ACM, which are designed to indicate that all of the components within a portion of the Engine Management System (EMS) are working properly to minimize emissions.

Noncontinuous Monitors:

Monitors that are only run only when their individual enabling criteria is met.

On-Board Diagnostics (OBD):

A term referring to a vehicle's self-diagnostic, monitoring and fault code reporting capability.

Pending Fault Code:

A DTC stored upon the initial detection of a malfunction (typically on a single drive cycle) prior to illumination of the MIL.

Permanent Fault Code:

A confirmed or MIL-on fault code that is currently commanding the MIL on and is stored in NVRAM.

Rationality Fault Diagnostic:

For an input component means verification of the accuracy of the input signal while in the range of normal operation and when compared to all other available information.

Warm-Up Cycle:

Means sufficient vehicle operation such that the coolant temperature has risen by at least 40 degrees Fahrenheit from engine start and reaches a minimum temperature of at least 160 degrees Fahrenheit (140 degrees Fahrenheit for applications with diesel engines).

Fuel Pressure, Timing and Quantity

All cylinders may have pressure, timing and quantity deviations which result in significant change in engine performance and exhaust gas composition. These deviations may in part be used to diagnose and evaluate a faulty fuel system.

Using the NOx sensors on the vehicle.

P026C Fuel Injector (low mass flow)

DTC	P026C
Component / System	Fuel System Monitoring Injection Quantity – Low
Monitor Strategy Description	Actual air fuel ratio based fueling compared to expected
Fault Limit	Ratio = (lambda based estimated fuel flow) / (modeled fuel flow) < 85% (average ratio during the evaluation time) Test value: MID 81 - Fuel System Monitor Bank 1, TID 8C - Fuel injection amount
Enable Conditions	<ul style="list-style-type: none"> • Engine Coolant Temperature 20 - 110 °C • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • EGR content in the intake manifold (burned fraction) 0 - 20% [100 = only EGR, no fresh air] • Intake Manifold Air Temperature -7 - 120 °C • Engine Torque > 1000 Nm • Engine Speed 1000 - 2200 RPM • Engine Speed rate of change < 50 RPM/s • Engine torque rate of change < 500 Nm/s • Burned fraction rate of change < 10%/s • Demanded fuel delivery rate of change < 50 mg/stroke • Intake manifold pressure deviation -1000 - 1000 kPa • Pre DOC temperature 100 - 400 °C • Post DOC temperature 200 - 400 °C • Post DPF temperature 200 - 400 °C • Modeled exhaust flow > 0 kg/s • AHI duty cycle 0%
Disable Conditions Note: The diagnosis can be performed only once per driving cycle.	No Active DTC's: <ul style="list-style-type: none"> • P0117, P0115, P2229, P0108, P0105, P0340, P0335, P2226, P0095, P0097, P0336, P2578, P0489, P0403, P006E, P00AF, P0046, P1148, P040C, P040A, P0072, P0070, P0406, P0409, P2200, P2203
Time Required For DTC To Be Set	45 seconds (accumulated time)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P026D Fuel Injector (high mass flow)

DTC	P026D
Component / System	Fuel System Monitoring Injection Quantity – High
Monitor Strategy Description	Actual air fuel ratio based fueling compared to expected
Fault Limit	Ratio = (lambda based estimated fuel flow) / (modeled fuel flow) > 132% (average ratio during the evaluation time) Test value: MID 81 - Fuel System Monitor Bank 1, TID 8C - Fuel injection amount
Enable Conditions	<ul style="list-style-type: none"> • Engine Coolant Temperature 20 - 110 °C • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • EGR content in the intake manifold (burned fraction) 0 - 20% [100 = only EGR, no fresh air] • Intake Manifold Air Temperature -7 - 120 °C • Engine Torque > 1000 Nm • Engine Speed 1000 - 2200 RPM • Engine Speed rate of change < 50 RPM/s • Engine torque rate of change < 500 Nm/s • Burned fraction rate of change < 10%/s • Demanded fuel delivery rate of change < 50 mg/stroke • Intake manifold pressure deviation -1000 - 1000 kPa • Pre DOC temperature 100 - 400 °C • Post DOC temperature 200 - 400 °C • Post DPF temperature 200 - 400 °C • Modeled exhaust flow > 0 kg/s • AHI duty cycle 0%
Disable Conditions Note: The diagnosis can be performed only once per driving cycle.	<p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P0108, P0105, P0340, P0335, P2226, P0095, P0097, P0336, P2578, P0489, P0403, P006E, P00AF, P0046, P1148, P040C, P040A, P0072, P0070, P0406, P0409, P2200, P2203
Time Required For DTC To Be Set	45 seconds (accumulated time)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Fuel Pressure, Timing and Quantity Threshold – Single Cylinder High Mass Flow

This OBD monitor works by observing engine acceleration as measured by the crank angle sensor. This acceleration measurement is taken during a crank angle window where the current firing cylinder should be generating its torque. Acceleration is then filtered with a low pass filter and after all cylinders have fired, an average acceleration of all cylinders is generated. The error of each cylinder is calculated as the

deviation of its individual acceleration reading from the average acceleration value.

An average quantity offset value for all cylinders (either positive or negative) is calculated and if a single cylinder's fuel value deviates from a calibrated limit a DTC is set.

P02CD Single Cylinder Fuel Injector Offset – High (Cylinder 1)

DTC	P02CD
Component / System	Single Cylinder Fueling Offset – High (Cylinder 1)
Monitor Strategy Description	Single Cylinder Fueling Offset
Fault Limit	Cylinder fueling offset < 0.7 edeg (= +100% below (fueling offset ratios in percentage of the fault code limit))
Enable Conditions	<ul style="list-style-type: none"> • Engine Torque 75 - 600 Nm • Barometric Pressure > 75 kPa • Ambient Air Temperature -8 - 55 °C • Vehicle Speed < 0.1 km/h • Engine Speed 450 - 750 RPM • Accelerator Pedal Position 0% • Engine Coolant Temperature > 65 °C • VGT Position 0 - 40% • Engine Speed rate of change 50 RPM/s • Engine Torque rate of change 50 Nm/s
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0335, P0336, P0340, P0341, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206
Time Required For DTC To Be Set	420 seconds (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P02CF Single Cylinder Fuel Injector Offset – High (Cylinder 2)

DTC	P02CF
Component / System	Single Cylinder Fueling Offset – High (Cylinder 2)
Monitor Strategy Description	Single Cylinder Fueling Offset
Fault Limit	Cylinder fueling offset < 0.7 edeg (= +100% below (fueling offset ratios in percentage of the fault code limit))
Enable Conditions	<ul style="list-style-type: none"> • Engine Torque 75 - 600 Nm • Barometric Pressure > 75 kPa • Ambient Air Temperature -8 - 55 °C • Vehicle Speed < 0.1 km/h • Engine Speed 450 - 750 RPM • Accelerator Pedal Position 0% • Engine Coolant Temperature > 65 °C • VGT Position 0 - 40% • Engine Speed rate of change 50 RPM/s • Engine Torque rate of change 50 Nm/s
Disable Conditions	<p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0335, P0336, P0340, P0341, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206
Time Required For DTC To Be Set	420 seconds (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P02D1 Single Cylinder Fuel Injector Offset – High (Cylinder 3)

DTC	P02D1
Component / System	Single Cylinder Fueling Offset – High (Cylinder 3)
Monitor Strategy Description	Single Cylinder Fueling Offset
Fault Limit	Cylinder fueling offset < 0.7 edeg (= +100% below (fueling offset ratios in percentage of the fault code limit)
Enable Conditions	<ul style="list-style-type: none">• Engine Torque 75 - 600 Nm• Barometric Pressure > 75 kPa• Ambient Air Temperature -8 - 55 °C• Vehicle Speed < 0.1 km/h• Engine Speed 450 - 750 RPM• Accelerator Pedal Position 0%• Engine Coolant Temperature > 65 °C• VGT Position 0 - 40%• Engine Speed rate of change 50 RPM/s• Engine Torque rate of change 50 Nm/s
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0117, P0115, P2229, P2226, P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0335, P0336, P0340, P0341, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206
Time Required For DTC To Be Set	420 seconds (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P02D3 Single Cylinder Fuel Injector Offset – High (Cylinder 4)

DTC	P02D3
Component / System	Single Cylinder Fueling Offset – High (Cylinder 4)
Monitor Strategy Description	Single Cylinder Fueling Offset
Fault Limit	Cylinder fueling offset < 0.7 edeg (= +100% below (fueling offset ratios in percentage of the fault code limit))
Enable Conditions	<ul style="list-style-type: none">• Engine Torque 75 - 600 Nm• Barometric Pressure > 75 kPa• Ambient Air Temperature -8 - 55 °C• Vehicle Speed < 0.1 km/h• Engine Speed 450 - 750 RPM• Accelerator Pedal Position 0%• Engine Coolant Temperature > 65 °C• VGT Position 0 - 40%• Engine Speed rate of change 50 RPM/s• Engine Torque rate of change 50 Nm/s
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0117, P0115, P2229, P2226, P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0335, P0336, P0340, P0341, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206
Time Required For DTC To Be Set	420 seconds (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P02D5 Single Cylinder Fuel Injector Offset – High (Cylinder 5)

DTC	P02D5
Component / System	Single Cylinder Fueling Offset – High (Cylinder 5)
Monitor Strategy Description	Single Cylinder Fueling Offset
Fault Limit	Cylinder fueling offset < 0.7 edeg (= +100% below (fueling offset ratios in percentage of the fault code limit)
Enable Conditions	<ul style="list-style-type: none"> • Engine Torque 75 - 600 Nm • Barometric Pressure > 75 kPa • Ambient Air Temperature -8 - 55 °C • Vehicle Speed < 0.1 km/h • Engine Speed 450 - 750 RPM • Accelerator Pedal Position 0% • Engine Coolant Temperature > 65 °C • VGT Position 0 - 40% • Engine Speed rate of change 50 RPM/s • Engine Torque rate of change 50 Nm/s
Disable Conditions	<p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0335, P0336, P0340, P0341, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206
Time Required For DTC To Be Set	420 seconds (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P02D7 Single Cylinder Fuel Injector Offset – High (Cylinder 6)

DTC	P02D7
Component / System	Single Cylinder Fueling Offset – High (Cylinder 6)
Monitor Strategy Description	Single Cylinder Fueling Offset
Fault Limit	Cylinder fueling offset < 0.7 edeg (= +100% below (fueling offset ratios in percentage of the fault code limit))
Enable Conditions	<ul style="list-style-type: none">• Engine Torque 75 - 600 Nm• Barometric Pressure > 75 kPa• Ambient Air Temperature -8 - 55 °C• Vehicle Speed < 0.1 km/h• Engine Speed 450 - 750 RPM• Accelerator Pedal Position 0%• Engine Coolant Temperature > 65 °C• VGT Position 0 - 40%• Engine Speed rate of change 50 RPM/s• Engine Torque rate of change 50 Nm/s
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0117, P0115, P2229, P2226, P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0335, P0336, P0340, P0341, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206
Time Required For DTC To Be Set	420 seconds (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Fuel Pressure, Timing and Quantity Threshold – Single Cylinder Low Mass Flow

P02CC Single Cylinder Fuel Injector Offset – Low (Cylinder 1)

DTC	P02CC
Component / System	Single Cylinder Fueling Offset – Low (Cylinder 1)
Monitor Strategy Description	Single Cylinder Fueling Offset
Fault Limit	Cylinder fueling offset < -0.7 edeg (= -100% below (fueling offset ratios in percentage of the fault code limit))
Enable Conditions	<ul style="list-style-type: none">• Engine Torque 75 - 600 Nm• Barometric Pressure > 75 kPa• Ambient Air Temperature -8 - 55 °C• Vehicle Speed < 0.1 km/h• Engine Speed 450 - 750 RPM• Accelerator Pedal Position 0%• Engine Coolant Temperature > 65 °C• VGT Position 0 - 40%• Engine Speed rate of change 50 RPM/s• Engine Torque rate of change 50 Nm/s
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0117, P0115, P2229, P2226, P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0335, P0336, P0340, P0341, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206
Time Required For DTC To Be Set	420 Seconds (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P02CE Single Cylinder Fuel Injector Offset – Low (Cylinder 2)

DTC	P02CE
Component / System	Single Cylinder Fueling Offset – Low (Cylinder 2)
Monitor Strategy Description	Single Cylinder Fueling Offset
Fault Limit	Cylinder fueling offset < -0.7 edeg (= -100% below (fueling offset ratios in percentage of the fault code limit))
Enable Conditions	<ul style="list-style-type: none"> • Engine Torque 75 - 600 Nm • Barometric Pressure > 75 kPa • Ambient Air Temperature -8 - 55 °C • Vehicle Speed < 0.1 km/h • Engine Speed 450 - 750 RPM • Accelerator Pedal Position 0% • Engine Coolant Temperature > 65 °C • VGT Position 0 - 40% • Engine Speed rate of change 50 RPM/s • Engine Torque rate of change 50 Nm/s
Disable Conditions	<p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0335, P0336, P0340, P0341, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206
Time Required For DTC To Be Set	420 Seconds (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P02D0 Single Cylinder Fuel Injector Offset – Low (Cylinder 3)

DTC	P02D0
Component / System	Single Cylinder Fueling Offset – Low (Cylinder 3)
Monitor Strategy Description	Single Cylinder Fueling Offset
Fault Limit	Cylinder fueling offset < -0.7 edeg (= -100% below (fueling offset ratios in percentage of the fault code limit))
Enable Conditions	<ul style="list-style-type: none"> • Engine Torque 75 - 600 Nm • Barometric Pressure > 75 kPa • Ambient Air Temperature -8 - 55 °C • Vehicle Speed < 0.1 km/h • Engine Speed 450 - 750 RPM • Accelerator Pedal Position 0% • Engine Coolant Temperature > 65 °C • VGT Position 0 - 40% • Engine Speed rate of change 50 RPM/s • Engine Torque rate of change 50 Nm/s
Disable Conditions	<p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0335, P0336, P0340, P0341, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206
Time Required For DTC To Be Set	420 Seconds (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P02D2 Single Cylinder Fuel Injector Offset – Low (Cylinder 4)

DTC	P02D2
Component / System	Single Cylinder Fueling Offset – Low (Cylinder 4)
Monitor Strategy Description	Single Cylinder Fueling Offset
Fault Limit	Cylinder fueling offset < -0.7 edeg (= -100% below (fueling offset ratios in percentage of the fault code limit))
Enable Conditions	<ul style="list-style-type: none"> • Engine Torque 75 - 600 Nm • Barometric Pressure > 75 kPa • Ambient Air Temperature -8 - 55 °C • Vehicle Speed < 0.1 km/h • Engine Speed 450 - 750 RPM • Accelerator Pedal Position 0% • Engine Coolant Temperature > 65 °C • VGT Position 0 - 40% • Engine Speed rate of change 50 RPM/s • Engine Torque rate of change 50 Nm/s
Disable Conditions	<p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0335, P0336, P0340, P0341, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206
Time Required For DTC To Be Set	420 Seconds (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P02D4 Single Cylinder Fuel Injector Offset – Low (Cylinder 5)

DTC	P02D4
Component / System	Single Cylinder Fueling Offset – Low (Cylinder 5)
Monitor Strategy Description	Single Cylinder Fueling Offset
Fault Limit	Cylinder fueling offset < -0.7 edeg (= -100% below (fueling offset ratios in percentage of the fault code limit))
Enable Conditions	<ul style="list-style-type: none">• Engine Torque 75 - 600 Nm• Barometric Pressure > 75 kPa• Ambient Air Temperature -8 - 55 °C• Vehicle Speed < 0.1 km/h• Engine Speed 450 - 750 RPM• Accelerator Pedal Position 0%• Engine Coolant Temperature > 65 °C• VGT Position 0 - 40%• Engine Speed rate of change 50 RPM/s• Engine Torque rate of change 50 Nm/s
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0117, P0115, P2229, P2226, P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0335, P0336, P0340, P0341, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206
Time Required For DTC To Be Set	420 Seconds (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P02D6 Single Cylinder Fuel Injector Offset – Low (Cylinder 6)

DTC	P02D6
Component / System	Single Cylinder Fueling Offset – Low (Cylinder 6)
Monitor Strategy Description	Single Cylinder Fueling Offset
Fault Limit	Cylinder fueling offset < -0.7 edeg (= -100% below (fueling offset ratios in percentage of the fault code limit))
Enable Conditions	<ul style="list-style-type: none"> • Engine Torque 75 - 600 Nm • Barometric Pressure > 75 kPa • Ambient Air Temperature -8 - 55 °C • Vehicle Speed < 0.1 km/h • Engine Speed 450 - 750 RPM • Accelerator Pedal Position 0% • Engine Coolant Temperature > 65 °C • VGT Position 0 - 40% • Engine Speed rate of change 50 RPM/s • Engine Torque rate of change 50 Nm/s
Disable Conditions	<p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0335, P0336, P0340, P0341, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206
Time Required For DTC To Be Set	420 Seconds (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Misfire Monitoring at Idle Conditions

This OBD monitor works by observing engine acceleration as measured by the crank angle sensor. This acceleration measurement is taken during a crank angle window where the current firing cylinder should be generating its torque.

Acceleration is then filtered with a low pass filter and after all

cylinders have fired, an average acceleration of all cylinders is generated. The error of each cylinder is calculated as the deviation of its individual acceleration reading from the average acceleration value.

P0300 Misfire Multiple Cylinders

DTC	P0300
Component / System	Misfire Monitoring Misfire Multiple Cylinders
Monitor Strategy Description	Engine flywheel acceleration evaluation
Fault Limit	Acceleration > 0.7 edeg/s ²
Enable Conditions	<ul style="list-style-type: none">• Engine Coolant Temperature > 65 °C• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Engine Speed 450 - 750 RPM• Engine Torque > 0 Nm• Vehicle Speed < 0.1 km/h• PTO Not Active• Engine Speed rate of change < 100 RPM/s (absolute value)• Engine Torque rate of change < 100 Nm/s (absolute value)• Enable Delay 10 seconds• Engine run time after engine start > 60 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0117, P0115, P2229, P0070, P0072, P2226, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206, P0339, P0335, P0336, P0016, P0340, P0341
Time Required For DTC To Be Set	15 seconds at continuous idle OR 100 seconds (1000 cumulative engine revolutions)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P0301 Misfire Single Cylinder (Cylinder 1)

DTC	P0301
Component / System	Misfire Monitoring Misfire Single Cylinder (Cylinder 1)
Monitor Strategy Description	Single cylinder engine flywheel acceleration evaluation
Fault Limit	Acceleration > 0.7 edeg/s ²
Enable Conditions	<ul style="list-style-type: none">• Engine Coolant Temperature > 65 °C• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Engine Speed 450 - 750 RPM• Engine Torque > 0 Nm• Vehicle Speed < 0.1 km/h• PTO Not Active• Engine Speed rate of change < 100 RPM/s (absolute value)• Engine Torque rate of change < 100 Nm/s (absolute value)• Enable Delay 10 seconds• Engine run time after engine start > 60 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0117, P0115, P2229, P0070, P0072, P2226, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206, P0339, P0335, P0336, P0016, P0340, P0341
Time Required For DTC To Be Set	15 seconds at continuous idle OR 100 seconds (1000 cumulative engine revolutions)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P0302 Misfire Single Cylinder (Cylinder 2)

DTC	P0302
Component / System	Misfire Monitoring Misfire Single Cylinder (Cylinder 2)
Monitor Strategy Description	Single cylinder engine flywheel acceleration evaluation
Fault Limit	Acceleration > 0.7 edeg/s ²
Enable Conditions	<ul style="list-style-type: none">• Engine Coolant Temperature > 65 °C• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Engine Speed 450 - 750 RPM• Engine Torque > 0 Nm• Vehicle Speed < 0.1 km/h• PTO Not Active• Engine Speed rate of change < 100 RPM/s (absolute value)• Engine Torque rate of change < 100 Nm/s (absolute value)• Enable Delay 10 seconds• Engine run time after engine start > 60 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0117, P0115, P2229, P0070, P0072, P2226, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206, P0339, P0335, P0336, P0016, P0340, P0341
Time Required For DTC To Be Set	15 seconds at continuous idle OR 100 seconds (1000 cumulative engine revolutions)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P0303 Misfire Single Cylinder (Cylinder 3)

DTC	P0303
Component / System	Misfire Monitoring Misfire Single Cylinder (Cylinder 3)
Monitor Strategy Description	Single cylinder engine flywheel acceleration evaluation
Fault Limit	Acceleration > 0.7 edeg/s ²
Enable Conditions	<ul style="list-style-type: none"> • Engine Coolant Temperature > 65 °C • Barometric Pressure 75 - 105 kPa • Ambient Air Temperature -8 - 55 °C • Engine Speed 450 - 750 RPM • Engine Torque > 0 Nm • Vehicle Speed < 0.1 km/h • PTO Not Active • Engine Speed rate of change < 100 RPM/s (absolue value) • Engine Torque rate of change < 100 Nm/s (absolute value) • Enable Delay 10 seconds • Engine run time after engine start > 60 seconds
Disable Conditions	<p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P0070, P0072, P2226, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206, P0339, P0335, P0336, P0016, P0340, P0341
Time Required For DTC To Be Set	15 seconds at continuous idle OR 100 seconds (1000 cumulative engine revolutions)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P0304 Misfire Single Cylinder (Cylinder 4)

DTC	P0304
Component / System	Misfire Monitoring Misfire Single Cylinder (Cylinder 4)
Monitor Strategy Description	Single cylinder engine flywheel acceleration evaluation
Fault Limit	Acceleration > 0.7 edeg/s ²
Enable Conditions	<ul style="list-style-type: none">• Engine Coolant Temperature > 65 °C• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Engine Speed 450 - 750 RPM• Engine Torque > 0 Nm• Vehicle Speed < 0.1 km/h• PTO Not Active• Engine Speed rate of change < 100 RPM/s (absolute value)• Engine Torque rate of change < 100 Nm/s (absolute value)• Enable Delay 10 seconds• Engine run time after engine start > 60 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0117, P0115, P2229, P0070, P0072, P2226, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206, P0339, P0335, P0336, P0016, P0340, P0341
Time Required For DTC To Be Set	15 seconds at continuous idle OR 100 seconds (1000 cumulative engine revolutions)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P0305 Misfire Single Cylinder (Cylinder 5)

DTC	P0305
Component / System	Misfire Monitoring Misfire Single Cylinder (Cylinder 5)
Monitor Strategy Description	Single cylinder engine flywheel acceleration evaluation
Fault Limit	Acceleration > 0.7 edeg/s ²
Enable Conditions	<ul style="list-style-type: none"> • Engine Coolant Temperature > 65 °C • Barometric Pressure 75 - 105 kPa • Ambient Air Temperature -8 - 55 °C • Engine Speed 450 - 750 RPM • Engine Torque > 0 Nm • Vehicle Speed < 0.1 km/h • PTO Not Active • Engine Speed rate of change < 100 RPM/s (absolue value) • Engine Torque rate of change < 100 Nm/s (absolute value) • Enable Delay 10 seconds • Engine run time after engine start > 60 seconds
Disable Conditions	<p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P0070, P0072, P2226, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206, P0339, P0335, P0336, P0016, P0340, P0341
Time Required For DTC To Be Set	15 seconds at continuous idle OR 100 seconds (1000 cumulative engine revolutions)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P0306 Misfire Single Cylinder (Cylinder 6)

DTC	P0306
Component / System	Misfire Monitoring Misfire Single Cylinder (Cylinder 6)
Monitor Strategy Description	Single cylinder engine flywheel acceleration evaluation
Fault Limit	Acceleration > 0.7 edeg/s ²
Enable Conditions	<ul style="list-style-type: none">• Engine Coolant Temperature > 65 °C• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Engine Speed 450 - 750 RPM• Engine Torque > 0 Nm• Vehicle Speed < 0.1 km/h• PTO Not Active• Engine Speed rate of change < 100 RPM/s (absolute value)• Engine Torque rate of change < 100 Nm/s (absolute value)• Enable Delay 10 seconds• Engine run time after engine start > 60 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0117, P0115, P2229, P0070, P0072, P2226, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206, P0339, P0335, P0336, P0016, P0340, P0341
Time Required For DTC To Be Set	15 seconds at continuous idle OR 100 seconds (1000 cumulative engine revolutions)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Exhaust Gas Recirculation (EGR) System Monitoring

This OBD monitor is designed to detect conditions where the EGR mass flow is lower or higher than demanded by the current system operation.

Demanded EGR mass flow is modeled from the burned air fraction (see the Technical Description for detailed information) request for the current engine operating conditions.

Actual EGR mass flow is computed directly from the output of the EGR Venturi differential pressure and temperature sensors. A fault occurs if the ratio of measured EGR mass flow to the modeled (demanded) EGR mass flow meets the threshold.

$$\text{Ratio} = \frac{\text{Measured EGR mass flow}}{\text{Modeled EGR mass flow}}$$

P0401 EGR System (Low Flow)

DTC	P0401
Component / System	EGR System - Low Flow
Monitor Strategy Description	Compare demanded EGR flow to actual
Fault Limit	Ratio = (Measured EGR Mass Flow) / (Demanded Egr Mass Flow) < 75%
Enable Conditions	<ul style="list-style-type: none"> • Engine Speed 1300 - 2300 RPM • Engine Torque 1300 - 2500 Nm • EGR Mass Flow Demand Ratio 0.2 - 0.6 ratio • EGR Mass Flow Demand 0.05 - 0.4 kg/s • EGR Mass Flow Demand Rate of Change - 0.012 - 0.02 kg/s • Engine Torque Rate of Change -50 - 20 Nm • Engine Speed Rate of Change -5 - 20 RPM • EGR Valve Position 40 - 100 %
Disable Conditions	<p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0335, P0336, P2578, P0489, P0403, P006E, P00AF, P0046, P1148, P040C, P040A, P0072, P0070, P0097, P0095, P0117, P0115, P0406, P0409, P2229, P2226, P0108, P0105
Time Required For DTC To Be Set	4 Seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P0402 EGR System (High Flow)

DTC	P0402
Component / System	EGR System - High Flow
Monitor Strategy Description	Compare demanded EGR flow to actual
Fault Limit	Ratio = (Measured EGR Mass Flow) / (Demanded Egr Mass Flow) > 450%
Enable Conditions	<ul style="list-style-type: none"> • Engine Speed 600 - 1500 RPM • Engine Torque 400 - 2450 Nm • EGR Mass Flow Demand Ratio 0 - 0.34 ratio • EGR Mass Flow Demand 0 - 0.1 kg/s • EGR Mass Flow Demand Rate of Change - 0.06 - 0.01 kg/s • Engine Torque Rate of Change 0 - 280 Nm • Engine Speed Rate of Change -70 - 85 RPM • EGR Valve Position 0 - 100 %
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0335, P0336, P2578, P0489, P0403, P006E, P00AF, P0046, P1148, P040C, P040A, P0072, P0070, P0097, P0095, P0117, P0115, P0406, P0409, P2229, P2226, P0108, P0105
Time Required For DTC To Be Set	4 Seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

EGR: Slow Response Emission Threshold

This OBD monitor evaluates a slowly responding EGR system by comparing two evaluation windows. Within a window, demanded EGR flow rate is evaluated. If a transition occurs within an allowable time, the demanded EGR flow is compared to the actual flow at the target time to determine if the proper flow was achieved. If the flow is not achieved then a DTC is raised.

P240F EGR System Slow Response

DTC	P240F		
Component / System	EGR System - Slow Response		
Monitor Strategy Description	EGR mass flow fails to achieve a flow change Note: This is an intrusive monitor requesting the EGR valve to close for 2 seconds and then open at 80% for 2 seconds.		
Fault Limit	Decreasing Delta = (Average Demanded EGR Flow) - (Average Actual EGR Flow) < 0.085 kg/s	Increasing Delta = (Average Demanded EGR Flow) - (Average Actual EGR Flow) < 0.055 kg/s	
Enable Conditions	Decreasing Low Flow Window <ul style="list-style-type: none"> • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Engine Coolant Temperature > 60 °C • SCR Average Temperature > 200 °C • Engine Speed 1300 - 2200 RPM • Engine Torque 400 - 1100 Nm • Engine Speed Rate of Change -20 - 20 RPM • Engine Torque Rate of Change -60 - 60 Nm • EGR Demand Ratio 0.1 - 0.6 kg/s • EGR Demand 0 - 0.05 kg/s • EGR Valve Position 60 - 100 % High Flow Window <ul style="list-style-type: none"> • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Engine Coolant Temperature > 60 °C • SCR Average Temperature > 200 °C • Engine Speed 1300 - 2200 RPM • Engine Torque 400 - 1100 Nm • Engine Speed Rate of Change -20 - 20 RPM • Engine Torque Rate of Change -60 - 60 Nm • EGR Demand Ratio 0.1 - 0.6 kg/s • EGR Demand 0.04 - 0.2 kg/s • EGR Valve Position 60 - 100 % 	Increasing Low Flow Window <ul style="list-style-type: none"> • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Engine Coolant Temperature > 60 °C • SCR Average Temperature > 200 °C • Engine Speed 1300 - 2200 RPM • Engine Torque 400 - 1100 Nm • Engine Speed Rate of Change -20 - 20 RPM • Engine Torque Rate of Change -60 - 60 Nm • EGR Demand Ratio 0.1 - 0.6 kg/s • EGR Demand 0.04 - 0.2 kg/s • EGR Valve Position 75 - 85% High Flow Window <ul style="list-style-type: none"> • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Engine Coolant Temperature > 60 °C • SCR Average Temperature > 200 °C • Engine Speed 1300 - 2200 RPM • Engine Torque 400 - 1100 Nm • Engine Speed Rate of Change -20 - 20 RPM • Engine Torque Rate of Change -60 - 60 Nm • EGR Demand Ratio 0.1 - 0.6 kg/s • EGR Demand 0 - 0.05 kg/s • EGR Valve Position 0 - 1% 	
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0406, P0409, P0489, P0403, P0105, P0108, P006E, P00AF, P0046, P1148, P0095, P0097, P040A, P040C 		
Time Required For DTC To Be Set	Total 4 seconds (2 seconds + 2 seconds)	Decreasing 2 seconds	Increasing 2 seconds
MIL Illumination	2 Drive Cycles		
Probable Causes	See Tech Tool		

Time To Closed Loop OBD Monitoring

The diagnostic idea for the Time To Closed Loop monitor is to monitor if the engine coolant temperature is insufficient to enter closed loop for a too long period of time. This is done by comparing the sensed engine coolant temperature against a modeled engine coolant temperature during engine running operational conditions. When the modeled engine coolant temperature reaches the highest closed loop enable

temperature in the control system, an evaluation timer is started. When the timer elapse it's threshold (calibratable) the sensed engine coolant temperature must be above the highest closed loop enable temperature to rate the system as OK. The monitor is designed to run once per driving cycle. This OBD monitor is introduced for 2014MY.

P04D8 Excessive Time To Enter Closed Loop EGR Control

DTC	P04D8
Component / System	EGR Control - Excessive Time To Enter Closed Loop
Monitor Strategy Description	Time To Enter Closed Loop EGR Control
Fault Limit	<ul style="list-style-type: none"> Coolant Temperature After Evaluation Time < 20 °C, > 150 Seconds <p>Note: Evaluation timer starts when a modeled coolant temperature reaches 20 °C.</p>
Enable Conditions	<ul style="list-style-type: none"> Engine Speed 750 - 2100 RPM Engine Torque 0 - 3000 Nm Barometric Pressure 75 - 105 kPa Ambient Air Temperature -40 - 55°C Enable Delay 5 Seconds
Disable Conditions	<p>No Active DTC's:</p> <ul style="list-style-type: none"> P0335, P0336, P0072, P0070, P0097, P0095, P0117, P0115, P2229, P2226, P0108, P0105
Time Required For DTC To Be Set	150 Seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

EGR: Feedback Saturation

This OBD monitor indicates if the burned air fraction error is saturated against a high or low limit. The logic for the monitor evaluates the time spent at saturation and compares the ratio

between the time spent in a saturation mode and the total time with engine running. A fault is reported whenever the ratio exceeds the fault limit.

P04D9 EGR System: Feedback Control (Saturated Low)

DTC	P04D9
Component / System	EGR System - Feedback Control
Monitor Strategy Description	Saturated low: Difference between demanded and calculated burned air fraction
Fault Limit	Ratio = Time spent saturated low / total time > 90%
Enable Conditions	<ul style="list-style-type: none">• Engine Coolant Temperature > 60 °C• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Engine Speed 1400 - 2000 RPM• Engine Torque 1100 - 1700 Nm• Estimated Exhaust Mass Flow 0.2 - 0.06 kg/s• Engine Speed Rate of Change -25 - 25 RPM• Engine Torque Rate of Change -70 - 120 Nm• Estimated Exhaust Mass Flow Rate of Change -0.04 - 0.1 kg/s• EGR Valve Position 40 - 100%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0335, P0336, P2578, P0489, P0403, P006E, P00AF, P0046, P1148, P040C, P040A, P0072, P0070, P0097, P0095, P0117, P0115, P0406, P0409, P2229, P2226, P0108, P0105
Time Required For DTC To Be Set	15 Seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P04DA EGR System: Feedback Control (Saturated High)

DTC	P04DA
Component / System	EGR System - Feedback Control
Monitor Strategy Description	Saturated high: Difference between demanded and calculated burned air fraction
Fault Limit	Ratio = Time spent saturated low / total time > 90%
Enable Conditions	<ul style="list-style-type: none">• Engine Coolant Temperature > 60 °C• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Engine Speed 1400 - 2000 RPM• Engine Torque 1100 - 1700 Nm• Estimated Exhaust Mass Flow 0.2 - 0.06 kg/s• Engine Speed Rate of Change -25 - 25 RPM• Engine Torque Rate of Change -70 - 120 Nm• Estimated Exhaust Mass Flow Rate of Change -0.04 - 0.1 kg/s• EGR Valve Position 40 - 100%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0335, P0336, P2578, P0489, P0403, P006E, P00AF, P0046, P1148, P040C, P040A, P0072, P0070, P0097, P0095, P0117, P0115, P0406, P0409, P2229, P2226, P0108, P0105
Time Required For DTC To Be Set	15 Seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P2457 EGR System: EGR Cooler Monitoring

DTC	P2457
Component / System	EGR System - Cooler Efficiency Below Threshold
Monitor Strategy Description	EGR Cooler Efficiency calculation from modeled exhaust temperature, measured EGR temperature after the EGR cooler and the measured engine coolant temperature
Fault Limit	Average EGR Cooler efficiency < 75% (calculated during the 10 second evaluation time)
Enable Conditions	<ul style="list-style-type: none"> • Barometric Pressure 75 - 110 kPa • Ambient Air Temperature -8 - 55 °C • Engine Speed 1400 - 1900 RPM • Engine Torque 1200 - 2400 Nm • EGR Valve Position 50 - 100% • EGR Mass Flow 0.08 - 0.2 kg/s • Engine Coolant Temperature > 65 °C • Estimated Exhaust Manifold Temperature 300 - 650 °C • Estimated Exhaust Manifold Temperature (rate of change) -10 - 10 °C/s • EGR Mass Flow (rate of change) -0.015 - 0.015 kg/s • Enable Delay 2 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0070, P0072, P0095, P0097, P0105, P0108, P0115, P0117, P0335, P0336, P0403, P040A, P040C, P0489, P2226, P2229
Time Required For DTC To Be Set	10 Seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Boost Pressure: Under or Over Boost Emission Threshold

This OBD monitor is designed to detect under or over boost conditions.

A modeled version of boost pressure is calculated continuously from a map based on engine speed and torque. The modeled boost pressure is compared to the actual value read from the boost pressure sensor. A DTC is raised if the threshold is reached.

Under Boost: Threshold < (Actual boost pressure - Modeled boost pressure)

Over Boost: Threshold > (Actual boost pressure - Modeled boost pressure)

P0299 Boost Pressure: Underboost

DTC	P0299
Component / System	Boost Pressure - Underboost
Monitor Strategy Description	Comparison of actual boost pressure to a modeled boost pressure
Fault Limit	Delta = Actual boost pressure - Modeled boost pressure < -60 kPa
Enable Conditions	<ul style="list-style-type: none"> • Engine Speed 1350 - 1700 RPM • Engine Torque 1700 - 2420 Nm • EGR Position 0 - 96% • VGT Position 5 - 90% • Inlet Manifold Temperature -25 - 130 °C • Absolute Engine Speed rate of change < 10 RPM • Engine Torque rate of change < 50 Nm • Estimated Intake Manifold Pressure rate of change < 10kPa • Enable Delay 5 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0335, P0336, P0489, P0403, P006E, P00AF, P0046, P1148, P0097, P0095, P0108, P0105
Time Required For DTC To Be Set	5 Seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P0234 Boost Pressure: Overboost

DTC	P0234
Component / System	Boost Pressure - Overboost
Monitor Strategy Description	Comparison of actual boost pressure to a modeled boost pressure
Fault Limit	Delta = Actual boost pressure - Modeled boost pressure > 30 kPa
Enable Conditions	<ul style="list-style-type: none">• Engine Speed 1350 - 1700 RPM• Engine Torque 1700 - 2420 Nm• EGR Position 0 - 96%• VGT Position 5 - 90%• Inlet Manifold Temperature -25 - 130 °C• Absolute Engine Speed rate of change < 10 RPM• Engine Torque rate of change < 50 Nm• Estimated Intake Manifold Pressure rate of change < 10kPa• Enable Delay 5 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0335, P0336, P0489, P0403, P006E, P00AF, P0046, P1148, P0097, P0095, P0108, P0105
Time Required For DTC To Be Set	5 Seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Boost Pressure: Slow Response

This OBD monitor is designed to detect conditions where the boost system is slow to respond, indicating degradation in the boost system. The monitor defines a low boost and a high boost window based on appropriate engine operating conditions. When the engine is being operated in the low window, boost pressure is sampled continuously. When operating conditions move out of the low window, the last boost pressure

value is retained. At the instant the engine enters the high-speed evaluation window, an evaluation timer is started. When the timer expires, the current boost pressure is compared to the retained value from the low boost window. If the difference does not meet or exceed the calibration target, the boost pressure slow response malfunction is detected.

P226C Boost Pressure Slow Response

DTC	P226C	
Component / System	Boost Pressure - Slow Response	
Monitor Strategy Description	Comparison of boost pressures in low/high windows to verify pressures are met.	
Fault Limit	Delta = (Sensed Boost Pressure evaluated in high window) - (Sensed Boost Pressure evaluated in low evaluation window) < 160 kPa	
Enable Conditions	Low Pressure Window <ul style="list-style-type: none"> • Engine Speed 400 - 1600 RPM • Engine Torque 1000 - 1800 Nm • VGT Position 5 - 90% • EGR Valve Position 0 - 96% • Inlet Manifold Temperature -25 - 130 °C • Absolute Engine Speed rate of change < 10 RPM • Engine Torque rate of change < 50 Nm • Estimated Intake Manifold Pressure rate of change < 10kPa • Enable Delay 5 seconds 	High Pressure Window <ul style="list-style-type: none"> • Engine Speed 0 - 900 RPM • Engine Torque 1600 - 3000 Nm • VGT Position 5 - 90% • EGR Valve Position 0 - 96% • Inlet Manifold Temperature -25 - 130 °C • Absolute Engine Speed rate of change < 10 RPM • Engine Torque rate of change < 50 Nm • Estimated Intake Manifold Pressure rate of change < 10kPa • Enable Delay 5 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0335, P0336, P0489, P0403, P006E, P00AF, P0046, P1148, P0097, P0095, P0108, P0105 	
Time Required For DTC To Be Set	5 seconds	
MIL Illumination	2 Drive Cycles	
Probable Causes	<i>See Tech Tool</i>	

Charge Air Cooler: Efficiency Threshold

P026A Charge Air Cooler: Efficiency Below Threshold

DTC	P026A
Component / System	Charge Air Cooler - Efficiency Below Threshold
Monitor Strategy Description	Charge Air Cooler relative temperature ratio
Fault Limit	Ratio = $1 - ((\text{Estimated CAC Temp} - \text{Nominal CAC Temp}) / (\text{Deteriorated CAC Temp} - \text{Nominal CAC Temp})) < 0.2$
Enable Conditions	<ul style="list-style-type: none">• Barometric Pressure 75 - 105 kPa• Vehicle Speed > 30 km/h• Engine Coolant Temperature > 65 °C• Engine Speed 1400 - 1900 RPM• Engine load at current engine speed 75 - 102%• Air Mass Flow 0.28 - 0.60 kg/s• CAC Temp Diff between deteriorated-(Threshold)CAC temperature & Nominal-(Fresh)CAC temperature > 17 °C• Enable Delay Time 20 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0335, P0336, P0072, P0070, P0117, P0115, P0097, P0095, P0112, P0110, P2229, P2226, P0108, P0105
Time Required For DTC To Be Set	10 Seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Non–Methane Hydrocarbon (NMHC) Converting Calalyst: Conversion Efficiency Emission Threshold

The Diesel Oxidation Catalyst (DOC) is constructed from a porous ceramic substrate coated in precious metals. It is used to oxidize fuel in the exhaust stream after the engine, and to generate an exotherm to assist in other EATS systems functionality, such as raising the temperature of the SCR during cold start conditions. The OBD monitor for the DOC

consists of two separate system evaluations- one for the effectiveness of the DOC at oxidizing fuel actively dosed by the Aftertreatment Hydrocarbon Doser System during cold start up conditions, and another portion that runs when fuel dosing is not active, where an evaluation on the physical presence of the substrate is made.

P0420 NMHC Catalyst: Conversion Efficiency

DTC	P0420
Component / System	NMHC Catalyst - Conversion Efficiency
Monitor Strategy Description	Compare calculated total HC slip rate to modeled total HC slip rate
Fault Limit	Ratio = Calculated total HC slip rate / Modeled total HC slip rate > 2.25
Enable Conditions	<ul style="list-style-type: none"> • Barometric Pressure 75 - 105 kPa • Ambient Air Temperature -8 - 55 °C • Engine Speed > 550 RPM • Exhaust Aftertreatment Fuel Injection Active • Post DPF Temperature > 100 °C • SCR warming OR Moving Crystal Sublimation Active • Cumulative Dosed AHI Fuel > 53g
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P2229, P2080, P2084, P242B, P2226, P0072, P0070, P0105, P0108, P0409, P0406, P040A, P040C, P20D0, P1133, P20DC, P20CF, P20DD, P20E0, P0545, P0544, P2032, P2031, P242C, P242A, P0335, P0336, P0339, P2698
Time Required For DTC To Be Set	400 seconds (with no more than 45s AHI dosing break)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P0420 NMHC Catalyst: Missing Substrate

DTC	P0420
Component / System	NMHC Catalyst - Missing Substrate
Monitor Strategy Description	Compare engine exhaust temperature rate of change to DOC temperature rate of change
Fault Limit	Ratio = Engine exhaust temperature rate of change / DOC temperature rate of change < 2.1
Enable Conditions	<ul style="list-style-type: none">• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Engine Speed > 550 RPM• Exhaust Aftertreatment Fuel Injection Not Active• Pre DOC Temperature > 20 °C• Post DOC Temperature > 20 °C• Pre DOC Temperature Derivative > 3.75 °C OR < -3.75 °C• Modeled Post-DOC Temperature < 2.5 °C OR > -2.5 °C
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P2229, P2080, P2084, P242B, P2226, P0072, P0070, P0105, P0108, P0409, P0406, P040A, P040C, P0545, P0544, P2032, P2031, P242C, P242A, P0335, P0336, P0339
Time Required For DTC To Be Set	10 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Oxides of Nitrogen (NOX) Converting Catalyst: Conversion Efficiency Emission Threshold

This OBD monitor is designed to determine the DEF efficiency as calculated by using the inputs of the commanded DEF and the two NOx sensors located upstream and downstream of the NOx Catalyst.

The DEF efficiency evaluation is calculated as an average value over an accumulated exhaust NOx value. A fault condition is logged if the DEF average efficiency is less than the threshold fault limit.

P20EE NOx Catalyst: Conversion Efficiency

DTC	P20EE
Component / System	NOx Catalyst - Conversion Efficiency
Monitor Strategy Description	Low SCR NOx conversion efficiency
Fault Limit	EWMA Filtered NOx Catalyst conversion < 66%
Enable Conditions	<ul style="list-style-type: none"> • Barometric Pressure 75 - 105 kPa • Ambient Air Temperature -8 - 55 °C • Modeled SCR Average Temperature 260 - 450 °C • Modeled SCR Outlet Temperature 260 - 450 °C • Modeled SCR Inlet Temperature 230 - 450 °C • Exhaust Mass Flow 0.10 - 0.40 • Engine Speed 1100 - 2050 RPM • Engine Torque rate of change -100 - 75 Nm • NOx Flow > 0.05 g/s • Engine Speed rate of change -20 - 20 RPM/s • Exhaust Mass Flow rate of change -0.008 - 0.008 kg/s • Gradient Max and Min SCR Temperature < 70C
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P2201, P225C, P225D, P221A, P225F, P229F, P225E, P242A, P242B, P0420, P0401, P0402, P0105, P0108
Time Required For DTC To Be Set	60 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P20EE NOx Catalyst: Reductant Delivery

A faulty DEF delivery system operation will impact the NOx emissions and subsequently a low DEF efficiency will be

detected. The fault separation from conversion efficiency is achieved by using an aftermarket/service routine.

DTC	P20EE
Component / System	NOx Catalyst - Reductant Delivery
Monitor Strategy Description	Reductant delivery monitoring For malfunction detection at (or below) the OBD threshold
Fault Limit	EWMA Filtered NOx Catalyst conversion < 66%
Enable Conditions	<ul style="list-style-type: none"> • Barometric Pressure 75 - 105 kPa • Ambient Air Temperature -8 - 55 °C • Modeled SCR Average Temperature 260 - 450 °C • Modeled SCR Outlet Temperature 260 - 450 °C • Modeled SCR Inlet Temperature 230 - 450 °C • Exhaust Mass Flow 0.10 - 0.40 • Engine Speed 1100 - 2050 RPM • Engine Torque rate of change -100 - 75 Nm • NOx Flow > 0.05 g/s • Engine Speed rate of change -20 - 20 RPM/s • Exhaust Mass Flow rate of change -0.008 - 0.008 kg/s • Gradient Max and Min SCR Temperature < 70C
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P2201, P225C, P225D, P221A, P225F, P229F, P225E, P242A, P242B, P0420, P0401, P0402, P0105, P0108
Time Required For DTC To Be Set	60 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P20EE NOx Catalyst: Missing SCR

DTC	P20EE
Component / System	NOx Catalyst - Missing SCR
Monitor Strategy Description	Missing Substrate
Fault Limit	EWMA Filtered NOx Catalyst conversion < 66%
Enable Conditions	<ul style="list-style-type: none">• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Modeled SCR Average Temperature 260 - 450 °C• Modeled SCR Outlet Temperature 260 - 450 °C• Modeled SCR Inlet Temperature 230 - 450 °C• Exhaust Mass Flow 0.10 - 0.40• Engine Speed 1100 - 2050 RPM• Engine Torque rate of change -100 - 75 Nm• NOx Flow > 0.05 g/s• Engine Speed rate of change -20 - 20 RPM/s• Exhaust Mass Flow rate of change -0.008 - 0.008 kg/s• Gradient Max and Min SCR Temperature < 70C
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P2201, P225C, P225D, P221A, P225F, P229F, P225E, P242A, P242B, P0420, P0401, P0402, P0105, P0108
Time Required For DTC To Be Set	60 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Particulate Matter (PM) Filter Monitoring: Filter Emission Threshold

Failures that result in a reduction to the DPF's filtration efficiency, such as cracked or melted filter, are monitored by comparing the soot accumulation calculated by a physical DPF delta Pressure (DPF dP) sensor based soot model (Pressure Model) to the soot accumulation predicted by a chemical reaction based soot model (Chemical Model). If the filter has failed in a way that results in a high level of PM in

the exhaust gas, the calculated soot load in the filter after an amount of time will be lower than the level calculated by the Chemical Model. A failure of the DPF that results in an increased DPF dP level, such as a melted substrate, can also be identified, as the higher DPF dP will result in a pressure model that reports a much higher level of soot than the chemical model.

P2002 PM Filter Efficiency Monitor

DTC	P2002		
Component / System	PM Filter - Filtering Performance		
Monitor Strategy Description	Modeled vs Measured filtration efficiency.		
Fault Limit	Pressure related failure: Delta = Delta pressure based soot load \square reference soot load > 3g/L	Pressure neutral failure: Ratio = Chemical based soot model / delta pressure based soot model < 10% for 75% of the evaluation time	Ratio = Measured Pressure Model based Soot Reduction / Chemical based Soot Reduction < 3.0 for 75% of evaluation time
Enable Conditions	<ul style="list-style-type: none"> • Barometric Pressure 75 - 105 kPa • Ambient Air Temperature -8 - 55 °C • Engine Speed > 500 RPM • AHI Injection Not Active • Exhaust Mass Flow (LP filtered) > 0.10kg/s • Modeled Average DPF Temperature > 120 °C • Engine Torque > -50 Nm • DPF Differential Pressure > 1.0 kPa 		
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0335, P0336, P0339, P2084, P2453, P0072, P0070, P2229, P2226, P244B, P244A, P0545, P0544, P2080, P2032, P2031, P242A, P242B, P242C, P0108, P0105, P0095, P0097, P040C, P040A, P0406, P0409 		
Time Required For DTC To Be Set	Pressure related failure: 150 seconds	Pressure neutral failure: 350 seconds	N/A
MIL Illumination	2 Drive Cycles		
Probable Causes	<i>See Tech Tool</i>		

PM Filter: Missing Substrate Functional

The Diesel Particulate Filter is constructed from a porous ceramic substrate coated in precious metals. The porous nature of the DPF results in a certain level of differential pressure (DPF dP) between the inlet and outlet of the DPF, dependant on the exhaust mass flow, the temperature at the inlet of the DPF, and the temperature at the outlet of the DPF. If the DPF substrate has been completely removed, the DPF dP will be

close to zero. By comparing the measured DPF dP to a modeled DPF dP at operating conditions where the difference should be large, an evaluation on the presence of the filter can be made. If the DPF dP is below a certain threshold during the evaluation conditions, the filter substrate can be assumed to be missing.

P244A PM Filter: Missing Substrate

DTC	P244A
Component / System	PM Filter - Missing Substrate
Monitor Strategy Description	Measured vs modeled Differential Pressure
Fault Limit	Ratio = (Measured differential pressure) / (Modeled differential pressure) < 35 %
Enable Conditions	<ul style="list-style-type: none"> • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Engine Speed 1150 - 2000 RPM • Engine Load at current Engine Speed > 57% • Post DOC Temperature 250 - 475 °C • Post DPF Temperature 250 - 475 °C • Modeled Exhaust Mass Flow > 0.25kg/s • Delay Time Post Active AHI Injection 60 seconds • Enable Time Delay 1 second
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P2229, P2226, P2452, P2454, P0335, P0336, P0339, P2032, P2031, P2084, P242A, P242B, P242C, P0105, P0108, P0095, P0097, P0409, P0406, P040A, P040C
Time Required For DTC To Be Set	2 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P244B PM Filter: Differential Pressure Too High

DTC	P244B
Component / System	PM Filter - Differential Pressure Too High
Monitor Strategy Description	Measured vs modeled Differential Pressure
Fault Limit	Ratio = (Measured differential pressure) / (Modeled differential pressure) > 750 %
Enable Conditions	<ul style="list-style-type: none"> • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Engine Speed 1150 - 2000 RPM • Engine Load at current Engine Speed > 57% • Post DOC Temperature 250 - 475 °C • Post DPF Temperature 250 - 475 °C • Modeled Exhaust Mass Flow > 0.25kg/s • Delay Time Post Active AHI Injection 60 seconds • Enable Time Delay 1 second
Disable Conditions	<p>No Active DTC's:</p> <ul style="list-style-type: none"> • P2229, P2226, P2452, P2454, P0335, P0336, P0339, P2032, P2031, P2084, P242A, P242B, P242C, P0105, P0108, P0095, P0097, P0409, P0406, P040A, P040C
Time Required For DTC To Be Set	2 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

NOx Sensor #1: Emission Threshold

In addition to the circuitry monitors, the two NOx sensors are subjected to plausibility checks as part of the NOx sensor diagnostics. The two NOx sensors are monitored to ensure that they are capable of accurately evaluating the NOx exhaust emissions and that they can be used by the engine emissions control strategies.

Inlet NOx Sensor

The NOx sensor located upstream of the NOx converting catalyst is rationalized against a calculated NOx value. The NOx sensor is considered faulty whenever the difference between the NOx sensor value and the calculated NOx value is greater than the threshold.

P2201 NOx Sensor #1: Rationality Monitor

DTC	P2201
Component / System	NOx Sensor #1 - Plausibility
Monitor Strategy Description	Sensor Rationality Check
Fault Limit	Delta = (Measured NOx flow) – (Modeled NOx flow) < -0.38OR> 2.59 Number of sub evaluations 4
Enable Conditions	<ul style="list-style-type: none"> • Barometric Pressure 75 - 105 kPa • Ambient Air Temperature -8 - 55 °C • Modeled NOx Flow > 0.14 g/s • Absolute Burned Air Fraction Diff (actual - demanded) < 2.5 % • EGR Valve Position 53 - 101% • Engine speed rate of change -30 - 30 RPM/s • Engine torque rate of change -15 - 15 Nm/s • Coolant Temperature 70 - 100 °C • AHI Injection Not Active • Heat Mode Not Active • Engine Torque 1450 - 2000 Nm • Engine Speed 1450 - 1850 RPM • Enable Time Delay 2.1 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P225D, P225F, P242B, P0420, P0402, P0401, P0072, P0070, P2229, P2226, P0105, P0108, P0095, P0097, P0409, P0406, P040A, P040C, P0111, P0112, P0110, P22FB, P220A, P2200, P2203, P220E, P22FE, P220B, P229E, P22A1, P220F, U029D, U029E
Time Required For DTC To Be Set	10.4 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P225C Inlet and Outlet NOx Sensor Biased High

The monitor is performed during no fueling (motoring) conditions where the expected amount of exhaust NOx concentration is nearly zero. A fault condition is logged whenever the

NOx sensor read value is above a limit value during no fueling.

DTC	P225C
Component / System	NOx Sensor #1 - Rationality High
Monitor Strategy Description	Rationality High
Fault Limit	EWMA filtered NOx value: > 50 ppm
Enable Conditions	<ul style="list-style-type: none"> • Barometric Pressure 75 - 105 kPa • Ambient Air Temperature -8 - 55 °C • Demanded Fuel Value < 0.1 mg/str • Engine Speed 725 - 2500 RPM • Pre-DOC Temperature > 175 °C • Average SCR Temperature 175 - 500 °C • Average SCR Temperature rate of change < 0.5 C/s • AHI Injection Not Active • Heat Mode Not Active
Disable Conditions	<p>No Active DTC's:</p> <ul style="list-style-type: none"> • P225D, P225F, P242B, P0420, P0402, P0401, P0072, P0070, P2229, P2226, P0105, P0108, P0095, P0097, P0409, P0406, P040A, P040C, P0111, P0112, P0110, P22FB, P220A, P2200, P2203, P220E, P22FE, P220B, P229E, P22A1, P220F, U029D, U029E
Time Required For DTC To Be Set	8.5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

NOx Sensor #1: Heater Performance

This OBD monitor is designed to detect faulty startup behavior. The function monitors the time from enable command

sent to the time when the sensor reports full readiness. If the time is greater than the fault limit a DTC is set.

P220E NOx Sensor #1: Sensor Start Up Monitor

DTC	P220E
Component / System	NOx Sensor #1 - Sensor Start
Monitor Strategy Description	Time to for sensor to report good quality
Fault Limit	Time for start up 180 seconds
Enable Conditions	<ul style="list-style-type: none">• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Upstream NOx sensor Dew Point comand sent by ECM• Downstream NOx sensor Dew Point comand sent by ECM
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P2200, P225E, P2203, P22A1, P220B, U029D, U029E, P220A
Time Required For DTC To Be Set	180 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

NOx Sensor #1: Removed

P225D NOx Sensor #1 Removed

DTC	P225D
Component / System	NOx Sensor #1
Monitor Strategy Description	NOx Sensor Removed
Fault Limit	Upstream Sensor Lambda value > 12 Number of sub evaluations to report the monitor 4 Fault Ratio 100% (all 4 evaluations above the threshold)
Enable Conditions	<ul style="list-style-type: none">• Engine Speed > 1000 rpm• Engine Torque > 1100 Nm
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P2200, P225E, P2203, P220B, U029D, U029E, P221A, P220A
Time Required For DTC To Be Set	25 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

NOx Sensor #1: Bad Device

This OBD Monitor is designed to detect bad sensor quality. The function monitors the time when the sensor reports bad quality. If the time is greater than the fault limit a DTC is set.

P22FB NOx Sensor #1: Bad Device Monitor

DTC	P22FB
Component / System	NOx Sensor #1 - Sensor Voltage High
Monitor Strategy Description	Bad Device
Fault Limit	Signal not valid during the 250 second eval time
Enable Conditions	<ul style="list-style-type: none">• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Upstream NOx sensor Active (Start-up finalized)• Upstream NOx sensor heater Sensor heated• Engine torque rate of change < 33 Nm
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P2200, P2203, U029D, P220A, P221A
Time Required For DTC To Be Set	250 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

NOx Sensor #1: Circuit Monitors

P2203 NOx Sensor #1: Short Circuit Low

DTC	P2203
Component / System	NOx #1 Sensor - Short Circuit
Monitor Strategy Description	NOx Sensor Short Circuit
Fault Limit	Time with short circuit bad quality > 5 seconds
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• U029D
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P2200 NOx Sensor #1: Open Circuit

DTC	P2200
Component / System	NOx Sensor #1 - Open Circuit
Monitor Strategy Description	NOx Sensor Open Circuit
Fault Limit	Time with open circuit bad quality > 5 seconds
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• U029D
Time Required For DTC To Be Set	5 Seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P220A NOx Sensor #1: Supply Voltage Out of Range

DTC	P220A
Component / System	NOx Sensor #1 - Sensor Voltage
Monitor Strategy Description	Sensor evaluation of supply voltage
Fault Limit	Time with voltage out of range signal > 5 seconds
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• U029D
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

U029D NOx Sensor #1: Missing Signal

DTC	U029D
Component / System	NOx Sensor - Missing Signal
Monitor Strategy Description	Signal not recieved to ACM after key on
Fault Limit	Missing Signal No message for > 5 s
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• U0080
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

NOx Sensor #2: Emission Threshold

The rationality check for this sensor consists of sensor stuck low and stuck high check. It is performed whenever the engine operates on highly transient conditions. A fault condition

is reached whenever the NOx sensor values are below or above a fault limit.

P229F NOx Sensor #2: Rationality Low Monitor

DTC	P229F
Component / System	NOx Sensor #2 - Plausibility
Monitor Strategy Description	Sensor Rationality Check
Fault Limit	NOx sensor reading < 2ppm Accumulated time > 240 seconds
Enable Conditions	<ul style="list-style-type: none"> • Barometric Pressure 75 - 105 kPa • Ambient Air Temperature -8 - 55 °C • Engine Torque 1200 - 1900 Nm • Engine Speed > 1200 RPM • Engine Torque rate of change -15 - 15 Nm/s • Average SCR Catalyst Temperature 150 - 300 °C • Enable hold time 30 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P225D, P225F, P242B, P0420, P0402, P0401, P0072, P0070, P2229, P2226, P0105, P0108, P0095, P0097, P0409, P0406, P040A, P040C, P0111, P0112, P0110, P22FB, P220A, P2200, P2203, P220E, P22FE, P220B, P229E, P22A1, P220F, U029D, U029E
Time Required For DTC To Be Set	240 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P225E NOx Sensor #2: Rationality High Monitor

DTC	P225E
Component / System	NOx Sensor #2 - Rationality high
Monitor Strategy Description	Sensor Rationality Check
Fault Limit	EWMA filtered NOx value: > 50 ppm
Enable Conditions	<ul style="list-style-type: none">• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Demanded Fuel Value < 0.1 mg/str• Demanded DEF Mass Flow < 0.01 g/s• Engine Speed 725 - 2500 RPM• Pre-DOC Temperature > 175 °C• Average SCR Temperature 175 - 500 °C• Average SCR Temperature rate of change < 0.5 C/s• AHI Injection Not Active• Heat Mode Not Active
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P225D, P0400, P0402, P225F, P242A, P0421, P2201, P225C, P221A
Time Required For DTC To Be Set	8.5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See <i>Tech Tool</i>

NOx Sensor #2: Heater Performance

This OBD monitor is designed to detect faulty startup behavior. The function monitors the time from enable command sent (ok for sensor to heat itself since all water is considered to be evaporated from the exhaust stream) to the time when

the sensor reports full readiness. If the time is too long the sensor does not fulfill the requirements. (Activating the NOx sensors in an environment with water present, there is a risk the sensor elements will crack.)

P220F NOx Sensor #2: Sensor Start Up Monitor

DTC	P220F
Component / System	NOx #2 Sensor - Sensor Start
Monitor Strategy Description	Time to for sensor to report good quality
Fault Limit	Time for start up 180 seconds
Enable Conditions	<ul style="list-style-type: none">• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Upstream NOx sensor Dew Point comand sent by ECM• Downstream NOx sensor Dew Point comand sent by ECM
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P2200, P225E, P2203, P22A1, P220B, U029D, U029E, P220A
Time Required For DTC To Be Set	180 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

NOx Sensor #2: Bad Device

This OBD Monitor is designed to detect bad sensor quality.

The quality flag from the NOx sensor is monitored. Too long duration of not reliable sensor signal quality is considered as an error. When the NOx sensor is unable to maintain a

reliable output, its signal quality will be set to not reliable. This can e.g. be the case during fast transients and fast variations in NOx Sensor measurement value. This monitor will not run until the start-up monitor is successfully completed.

P22FE NOx Sensor #2: Bad Device Monitor

DTC	P22FE
Component / System	NOx Sensor #2 - Sensor Voltage High
Monitor Strategy Description	Bad Device
Fault Limit	Signal not valid during the 250 second eval time
Enable Conditions	<ul style="list-style-type: none">• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Upstream NOx sensor Active (Start-up finalized)• Upstream NOx sensor heater Sensor heated• Engine torque rate of change < 33 Nm
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P2200, P2203, U029D, P220A, P22A1, P225E, P220B, U029E, P221A
Time Required For DTC To Be Set	250 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

NOx Sensor #2: NOx Sensor Measurement Monitor

This OBD monitor consists of a NOx Sensor Measurement value comparison between the two NOx sensors. The fault condition is reached whenever the absolute difference

between the NOx Sensor Measurement values exceeds the threshold.

P221A NOx Sensors: NOx Sensor Measurement Rationality Monitor

DTC	P221A
Component / System	NOx Sensors - NOx Sensor Measurement
Monitor Strategy Description	Lambda mismatch
Fault Limit	Delta = (Upstream NOx sensor lambda) - (Downstream NOx sensor lambda) > 1.0 (absolute value) Number of sub evaluations 15 evaluations Fault Ratio 100%
Enable Conditions	<ul style="list-style-type: none"> • Barometric Pressure 75 - 105 kPa • Ambient Air Temperature -8 - 55 °C • Engine speed rate of change -30 - 30 RPM/s • Engine torque rate of change -15 - 15 Nm/s • Engine Torque > 1000Nm • Engine Speed 1300 - 1900 RPM • Enable Time Delay 2 seconds • AHI Injection Not Active
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P225D, P225F, P242B, P0420, P0402, P0401, P0072, P0070, P2229, P2226, P0105, P0108, P0095, P0097, P0409, P0406, P040A, P040C, P0111, P0112, P0110, P22FB, P220A, P2200, P2203, P220E, P22FE, P220B, P229E, P22A1, P220F, U029D, U029E
Time Required For DTC To Be Set	20 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

NOx Sensor #2: Removed

P225F NOx Sensor #2 Removed

DTC	P225F
Component / System	NOx Sensor #2
Monitor Strategy Description	NOx Sensor Removed
Fault Limit	Upstream Sensor Lambda value > 12 Number of sub evaluations to report the monitor 4 Fault Ratio 100% (all 4 evaluations above the threshold)
Enable Conditions	<ul style="list-style-type: none">• Engine Speed > 1000 rpm• Engine Torque > 1100 Nm
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P2200, P225E, P2203, P220B, U029D, U029E, P221A, P220A
Time Required For DTC To Be Set	25 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

NOx Sensor #2: Circuit Monitors

P22A1 NOx Sensor #2: Short Circuit Low

DTC	P22A1
Component / System	NOx #2 Sensor - Short Circuit
Monitor Strategy Description	NOx Sensor Short Circuit
Fault Limit	Time with bad signal quality > 5 seconds
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• U029D, U029E
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P229E NOx Sensor #2: Open Circuit

DTC	P229E
Component / System	NOx Sensor #2 - Open Circuit
Monitor Strategy Description	NOx Sensor Open Circuit
Fault Limit	Time with bad signal quality > 5 seconds
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• U029D, U029E
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P220B NOx Sensor #2: Supply Voltage Out of Range

DTC	P220B
Component / System	NOx Sensor #2 - Sensor Voltage
Monitor Strategy Description	Sensor evaluation of supply voltage
Fault Limit	Time with voltage out of range signal > 5 seconds
Enable Conditions	<ul style="list-style-type: none">• Key On > Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• U029D, U029E
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

U029E NOx Sensor #2: Missing Signal

DTC	U029E
Component / System	NOx Sensor #2 - Missing Signal
Monitor Strategy Description	Signal not recieved to ACM after key on
Fault Limit	Missing Signal No message for > 5 s
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• U0080
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Engine Cooling System: Time To Reach Threshold Temperature

This OBD monitor evaluates the coolant thermostat. If the coolant temperature sensor value doesn't reach the threshold

or if the temperature decreases below the threshold during operation the thermostat is judged as faulty and a DTC is set.

P0128 Engine Cooling System: Stuck Open or Leaking Thermostat Monitor

DTC	P0128
Component / System	Engine Cooling System - Thermostat failure
Monitor Strategy Description	Stuck open or leaking thermostat
Fault Limit	Coolant temperature threshold < 72 °C (Coolant thermostat opening temperature - 11 °C)
Enable Conditions	<ul style="list-style-type: none">• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Engine Speed 600 - 1200 RPM• Engine Torque 250 - 650 Nm• Vehicle Speed > 38 km/h• Enable Delay 14 seconds• Coolant Temperature at Start < 53 °C• Warm-up Complete flag True
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0335, P0336, P0072, P0070, P0117, P0115, P0116, P0097, P0095, P2229, P2226, P0500, P0502, P215A
Time Required For DTC To Be Set	14 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Engine Coolant Temperature Sensor (ECT): Rationality Monitor

P0116 Engine Coolant Temperature Sensor (ECT): Sensor Stuck Low Monitor

DTC	P0116	
Component / System	Engine Coolant Temperature Sensor - Circuit Range/Performance	
Monitor Strategy Description	ECT ensor rationality check at start up after a 8 hour soak time. Note: If auxiliary heaters is used the coolant temperature sensor is evaluated in engine running conditions (60 second delay time after engine start)	
Fault Limit	Engine Pre-Crank: Delta = (Average Engine Coolant Temperature) - (mean(average EGR Temp, average Comp Temp, average Intake Manifold temp)) > 40 °C (absolute)	Engine Running Delta = (Average Engine Coolant Temperature) - (mean(average EGR Temp, average Comp Temp, average Intake Manifold temp)) < 3 °C (absolute)
Enable Conditions	Engine Pre Crank: <ul style="list-style-type: none"> • Key On • Engine Speed < 100 RPM • Soak Time ≥ 8 Hours • Enable Delay ≥ 2 Seconds • Reset Pre-crank delay ≥ 3.5 Seconds 	Engine Running: <ul style="list-style-type: none"> • Engine Speed ≥ 500 RPM • Enable Delay Time ≥ 60 Seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0335, P0336, P0072, P0070, P0117, P0115, P0097, P0095, P2229, P2226, P040A, P040C, P0545, P0544, P0110, P0112, P205A, P205C 	
Time Required For DTC To Be Set	3 Seconds	
MIL Illumination	2 Drive Cycles	
Probable Causes	See Tech Tool	

Engine Coolant Temperature Sensor (ECT): Circuit Monitors

The engine coolant temperature sensor is checked for open circuit, short circuit, or out-of-range value by monitoring the analog-to-digital (A/D) input voltage.

P0115 Engine Coolant Temperature Sensor (ECT): Open Circuit Check

DTC	P0115
Component / System	ECT - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage > 4.9V (-40 °C) OR 0.15 - 0.23V (130-140 °C)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0117 Engine Coolant Temperature Sensor (ECT): Short Circuit Low

DTC	P0117
Component / System	ECT - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Voltage < 0.15V (140 °C)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Crankcase Ventilation System: Disconnection

This OBD monitor diagnoses the crankcase ventilation system by looking at the crankcase pressure sensor value. By comparing the crankcase - to ambient pressure at two different states, one where the speed of the CCV separator is "HIGH" and the second where the speed of the CCV separator is "LOW". The upper and lower limits for the crankcase pressure are established.

The separator malfunction is detected when CCV separator impeller (shaft) sticks (does not spin) resulting in a pressure above the upper limit.

The disconnected pipe malfunction is detected when the ventilator tube from the valve cover to the separator device is disconnected resulting in a pressure below the lower limit.

Both of these malfunctions will result in a DTC being set.

P04DB Crankcase Ventilation: Disconnected Pipe/Separator Monitor

DTC	P04DB	
Component / System	Crankcase Ventilation - Disconnect	
Monitor Strategy Description	Disconnected ventilation hose or faulty separator unit.	
Fault Limit	Delta = High Separator Speed Pressure - Low Separator Speed Pressure < 0.05 kPa	
Enable Conditions	High Speed Conditions <ul style="list-style-type: none"> • Oil Temperature > 60 °C • Engine Run Time > 2 seconds • Oil Pressure 300 - 800 kPa • Engine Torque 0 - 250 Nm • Ambient Air Temperature -8 - 40 °C • Barometric Pressure rate of change < 0.025 kPa • Coolant Temperature > 65 °C • Engine Speed 1150 - 3000 RPM • Minimum Evaluation Time 5 seconds 	Low Speed Conditions <ul style="list-style-type: none"> • Oil Temperature > 60 °C • Engine Run Time > 2 seconds • Oil Pressure 300 - 400 kPa • Engine Torque 0 - 300 Nm • Ambient Air Temperature -8 - 40 °C • Barometric Pressure rate of change < 0.025 kPa • Coolant Temperature > 65 °C • Engine Speed 570 - 715 RPM • Minimum Evaluation Time 1 second
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0523, P0520, P0197, P0195, P051D, P051A, P2226, P2229 	
Time Required For DTC To Be Set	6 seconds	
MIL Illumination	2 Drive Cycles	
Probable Causes	See Tech Tool	

Barometric Pressure Sensor (BPS): Rationality Monitor

This OBD rationality monitor for the Barometric Pressure sensor evaluates the plausibility of the sensor comparing the Barometric, Intake Air and Crankcase pressure sensor values.

A comparison of pressures from all sensors is made. The smallest difference between the three is determined and a reference pressure is calculated. The Barometric pressure sensor value is compared to the reference value and if the difference is above the threshold a DTC is reported.

P2227 Barometric Pressure Sensor (BPS): Rationality Monitor (Out Of Range)

DTC	P2227
Component / System	BPS Rationality
Monitor Strategy Description	Out Of Range
Fault Limit	Barometric Pressure < 44 kPa or > 114 kPa
Enable Conditions	<ul style="list-style-type: none">• Engine Speed < 180 RPM• Ambient Air Temperature -8 - 55 °C• Key On Active• Enable Delay 0.5 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0105, P0108, P051D, P051A, P0489, P0403, P006E, P00AF, P0046, P1148
Time Required For DTC To Be Set	2 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P2227 Barometric Pressure Sensor (BPS): Rationality Monitor (Barometric Pressure Sensor Evaluation)

DTC	P2227
Component / System	BPS Rationality
Monitor Strategy Description	Barometric pressure sensor evaluation
Fault Limit	$\Delta = (\text{Barometric pressure}) - (\text{Reference pressure}) < -15 \text{ kPa} \text{ or } > 15 \text{ kPa}$
Enable Conditions	<ul style="list-style-type: none">• Engine Speed < 180 RPM• Ambient Air Temperature -8 - 55 °C• Key On Active• Enable Delay 0.5 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0105, P0108, P051D, P051A, P0489, P0403, P006E, P00AF, P0046, P1148
Time Required For DTC To Be Set	1 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Barometric Pressure Sensor (BPS): Circuit Monitors

The Barometric Pressure Sensor is checked for electrical failures by monitoring the analog-to-digital (A/D) input voltage.

P2226 Barometric Pressure Sensor (BPS): Open Circuit Check

DTC	P2226
Component / System	BPS Open
Monitor Strategy Description	Open Circuit
Fault Limit	4.78 - 4.85 V (115-118 kPa) or < 0.12V (15 kPa)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P2229 Barometric Pressure Sensor (BPS): Short Circuit High

DTC	P2229
Component / System	BPS High
Monitor Strategy Description	Short Circuit High
Fault Limit	Sensor Voltage > 4.85V (118 kPa)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Intake Manifold Pressure Sensor (IMP): Rationality Monitor

This OBD rationality monitor for the Intake Manifold Pressure sensor evaluates the plausibility of the sensor comparing the Barometric, Intake Air and Crankcase pressure sensor values.

A comparison of pressures from all sensors is made. The smallest difference between the three is determined and a reference pressure is calculated. The Intake Manifold pressure sensor value is compared to the reference value and if the difference is above the threshold a DTC is reported.

P0069 Intake Manifold Pressure Sensor Monitor

DTC	P0069
Component / System	IMP Rationality
Monitor Strategy Description	Intake manifold pressure sensor evaluation
Fault Limit	Delta = Intake manifold pressure - reference pressure < -15 kPa or >15 kPa
Enable Conditions	<ul style="list-style-type: none">• Engine Speed < 180 RPM• Ambient Air Temperature -8 - 55 °C• Key On Active• Enable Delay 0.5 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0105, P0108, P051D, P051A, P0489, P0403, P006E, P00AF, P0046, P1148
Time Required For DTC To Be Set	1 second
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Intake Manifold Pressure Sensor (IMP): Circuit Monitors

The Intake Manifold Pressure Sensor is located in the inlet manifold and the sensor is checked for electrical failures by monitoring the analog-to-digital (A/D) input voltage.

P0105 Intake Manifold Pressure Sensor (IMP): Open Circuit Check

DTC	P0105
Component / System	IMP Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage 4.70 - 4.85V (500-550 kPa) or < 0.30V (50 kPa)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0108 Intake Manifold Pressure Sensor (IMP): Short Circuit High

DTC	P0108
Component / System	IMP High
Monitor Strategy Description	Short Circuit High
Fault Limit	Sensor Voltage > 4.85V (550 kPa)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Aftertreatment Differential Pressure Sensor (DPS): Rationality Monitor

This OBD monitor diagnoses the DPF differential pressure sensor, by monitoring the deviation between estimated DPF differential pressure and the measured DPF differential pressure value.

There are two independent tests that evaluate the differential pressure sensor plausibility:

Low Flow Condition:

When the engine is in idle or in low engine speed and torque condition, the differential pressure over the DPF is expected

to be close to zero. If the differential pressure exceeds a threshold then the differential pressure sensor plausibility DTC is set.

High Flow Condition:

When the engine is in higher engine speed and torque condition, the differential pressure over the DPF is expected to rise according to engine speed and torque. If the differential pressure exceeds a threshold then the differential pressure sensor plausibility DTC is set.

P2453 Aftertreatment Differential Pressure Sensor (DPS): DPS Differential Pressure Sensor

DTC	P2453	
Component / System	DPS - Plausibility	
Monitor Strategy Description	Rationality high and low	
Fault Limit	Low Pressure Monitor Measured DPF Delta Pressure in Low Pressure Conditions > 1.5 kPa	High Load Window Measured DPF Delta Pressure in High pressure Conditions < 2.0 kPa
Enable Conditions	Low Pressure Monitor <ul style="list-style-type: none"> • Key On Active • Engine Speed < 50 RPM • Post DOC Temperature -8 - 400 °C • Post DPF Temperature -8 - 400 °C • Modeled DPF delta Pressure < 1.5 kPa • Delay Time Post Active AHI Injection 60 seconds • Enable Time Delay 1 second 	High Load Window <ul style="list-style-type: none"> • Engine Speed 1400 - 1900 RPM • Engine Load at current Engine Speed > 70% • Post DOC Temperature 300 - 400 °C • Post DPF Temperature 275 - 400 °C • Delay Time Post Active AHI Injection 60 seconds • Modeled Exhaust Mass Flow > 0.2 kg/s • Modeled DPF delta Pressure > 3.5 kPa • Enable Time Delay 1 second
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P2229, P2226, P2452, P2454, P0335, P0336, P0339, P2032, P2031, P2084, P242A, P242B, P242C, P0105, P0108, P0095, P0097, P0409, P0406, P040A, P040C 	
Time Required For DTC To Be Set	Low Pressure Monitor 1 second	High Load Window 1 second
MIL Illumination	2 Drive Cycles	
Probable Causes	<i>See Tech Tool</i>	

Aftertreatment Differential Pressure Sensor (DPS): Circuit Monitors

The Aftertreatment Differential Pressure Sensor is checked for electrical failures by monitoring the analog-to-digital (A/D) input voltage.

P2452 Aftertreatment Differential Pressure Sensor (DPS): Open Circuit Check

DTC	P2452
Component / System	DPF - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage > 4.90V (35 kPa)
Enable Conditions	<ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P2454 Aftertreatment Differential Pressure Sensor (DPS): Short Circuit Low

DTC	P2454
Component / System	DPS - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Voltage < 0.15V (0 kPa)
Enable Conditions	<ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

EGR Differential Pressure Sensor: Rationality Monitor

This OBD monitor diagnoses the EGR differential pressure sensor.

There are two methods for monitoring the EGR differential pressure sensor:

Normal Flow Condition:

This monitors the deviation between estimated EGR differential pressure and the measured EGR differential pressure value.

Zero Flow Condition:

This monitors when the EGR differential pressure is supposed to be zero when the EGR valve closed.

P046C EGR Differential Pressure Sensor: DP Sensor Rationality

DTC	P046C	
Component / System	DP Sensor Rationality	
Monitor Strategy Description	Compare actual vs estimated EGR delta pressure	
Fault Limit	<p>Plausibility Check Delta = (Measured EGR Diff Pressure) - (Estimated EGR Diff Pressure) < -3.5 kPa Delta = (Measured EGR Diff Pressure) - (Estimated EGR Diff Pressure) > 18 kPa</p>	<p>Zero Check Delta = (Measured EGR Diff Pressure) - (Estimated EGR Diff Pressure) < -2.18 kPa Delta = (Measured EGR Diff Pressure) - (Estimated EGR Diff Pressure) > -2.18 kPa</p>
Enable Conditions	<p>Plausibility Check</p> <ul style="list-style-type: none"> • Engine Speed 1500 - 1900 RPM • Engine Torque 1350 - 2300 Nm • Cold Sensor Flag False • EGR Valve Position > 5% • VGT Position 40 - 100% • Warm up time at ambient air temp = -50 °C at start 900 seconds • Warm up time at ambient air temp = -30 °C at start 700 seconds • Warm up time at ambient air temp = -7 °C at start 0 seconds • Warm up time at ambient air temp = 10 °C at start 0 seconds • Warm up time at ambient air temp = 50 °C at start 0 seconds • Engine Torque (rate of change) -90 - 90 Nm • Engine Speed (rate of change) -30 - 30 RPM <p>Note: Cold Sensor Flag set to false after warm up time is completed</p>	<p>Zero Check</p> <ul style="list-style-type: none"> • Engine Speed 0 - 315 RPM • Cold Sensor Flag False • Key On Active • EGR Valve Position < 0.1%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0406, P0409, P0489, P0403, P0105, P0108, P006E, P00AF, P0046, P1148, P2229, P2226, P0095, P0097, P040A, P040C, P22FB, P220A, P2200, P2203, P220E, U029D 	
Time Required For DTC To Be Set	<p>Plausibility Check 10 seconds</p>	<p>Zero Check 1 second</p>
MIL Illumination	2 Drive Cycles	
Probable Causes	<i>See Tech Tool</i>	

EGR Differential Pressure Sensor: Circuit Monitors

The EGR Differential Pressure Sensor is checked for electrical failures by monitoring the analog-to-digital (A/D) input voltage.

P0409 EGR Differential Pressure Sensor: Open Circuit Check

DTC	P0409
Component / System	DP Sensor - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage < 0.21V (0 kPa)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0406 EGR Differential Pressure Sensor: Short Circuit High

DTC	P0406
Component / System	DP Sensor - High
Monitor Strategy Description	Short Circuit High
Fault Limit	Sensor Voltage > 4.83V (35 kPa)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Crankcase Pressure Sensor (CPS): Rationality Monitor

This OBD rationality monitor for the Crankcase Pressure sensor evaluates the plausibility of the sensor comparing the Barometric, Intake Air and Crankcase pressure sensor values.

A comparison of pressures from all sensors is made. The smallest difference between the three is determined and a reference pressure is calculated. The Crankcase pressure sensor value is compared to the reference value and if the difference is above the threshold a DTC is reported.

P051B Crankcase Pressure Sensor (CPS): Rationality Monitor

DTC	P051B
Component / System	CPS - Rationality
Monitor Strategy Description	Crankcase Pressure Sensor evaluation
Fault Limit	Delta = Crankcase pressure - reference pressure < -15 kPa or >15 kPa
Enable Conditions	<ul style="list-style-type: none">• Engine Speed < 180 RPM• Ambient Air Temperature -8 - 55 °C• Key On Active• Enable Delay 0.5 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0105, P0108, P051D, P051A, P0489, P0403, P006E, P00AF, P0046, P11480
Time Required For DTC To Be Set	1 second
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Crankcase Pressure Sensor (CPS): Circuit Monitors

The Crankcase Pressure Sensor is checked for electrical failures by monitoring the analog-to-digital (A/D) input voltage.

P051A Crankcase Pressure Sensor (CPS): Open Circuit Check

DTC	P051A
Component / System	CPS - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage 4.75 - 4.85V (140-150 kPa) or < 0.31V (40 kPa)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P051D Crankcase Pressure Sensor (CPS): Short Circuit High

DTC	P051D
Component / System	CPS - High
Monitor Strategy Description	Short Circuit High
Fault Limit	Sensor Voltage > 4.85V (150 kPa)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Intake Manifold Temperature Sensor (IMT): Circuit Monitor

The Intake Manifold Temperature Sensor is checked for electrical failures by monitoring the analog-to-digital (A/D) input voltage.

P0095 Intake Manifold Temperature Sensor (IMT): Open Circuit Check

DTC	P0095
Component / System	IMT - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage > 4.91V (-40 °C) or 0.15 - 0.29V (130-140 °C)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	15 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0097 Intake Manifold Temperature Sensor (IMT): Short Circuit Low

DTC	P0097
Component / System	IMT - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Voltage < 0.15V (140 °C)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	15 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Intake Manifold Temperature Sensor (IMT): Rationality Monitor

The Intake Manifold Temperature Sensor is monitored by comparing it with a calculated Intake Manifold temperature based on intake manifold pressure and ambient air temperature.

When the evaluation time has elapsed the average difference is compared to an upper and a lower limit resulting in a low temperature and high temperature fault.

P009A Intake Manifold Temperature Sensor (IMT): Rationality Monitor

DTC	P009A
Component / System	IMT - Ambient Air Temperature - Correlation
Monitor Strategy Description	Engine Air Intake Temperature - Correlation
Fault Limit	Delta = (Sensed Intake Manifold Temperature) - (Modeled Intake Manifold Temperature) < -45°C OR > 45°C)
Enable Conditions	<ul style="list-style-type: none"> • Barometric Pressure 75 - 105kPa • Vehicle Speed > 30km/h • Engine Coolant Temperature > 65°C • Engine Speed 1250 - 1850 rpm • Engine load at current engine speed 0 - 60% • Air Mass Flow 0.07 - 0.36 kg/s • Deteriorated CAC - Threshold CAC > 17 °C • Deteriorated CAC - Nominal CAC > 17 °C • Enable Delay Time 5 Seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0335, P0336, P0072, P0070, P0117, P0115, P0097, P0095, P0112, P0110, P2229, P2226, P0108, P0105
Time Required For DTC To Be Set	10 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P0111 Intake Manifold Temperature Sensor (IMT): Sensor 1 Circuit Range / Performance Bank 1

DTC	P0111
Component / System	IMT Sensor - Range/Performance
Monitor Strategy Description	Temperature sensor rationality check at start up after a 8 hour soak time.
Fault Limit	$\Delta = (\text{Average Compressor Discharge Temperature}) - (\text{mean}(\text{average EGR Temp, average Intake Manifold Temp, average Engine Coolant temp})) > 40 \text{ }^\circ\text{C (absolute)}$
Enable Conditions	Pre-crank: <ul style="list-style-type: none">• Key On• Engine Speed < 100 RPM• Soak Time ≥ 8 h• Enable Delay ≥ 2 s• Reset Pre-crank delay ≥ 3.5 s
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0335, P0336, P0072, P0070, P0117, P0115, P0097, P0095, P2229, P2226, P040A, P040C, P0545, P0544, P0110, P0112, P205A, P205C
Time Required For DTC To Be Set	3 Seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P0096 Intake Manifold Temperature Sensor (IMT): Sensor 2 Circuit Range / Performance Bank 1

DTC	P0096
Component / System	IMT Sensor- Range/Performance
Monitor Strategy Description	Temperature sensor rationality check at start up after a 8 hour soak time
Fault Limit	$\Delta = (\text{Average Intake Manifold Temperature}) - (\text{mean}(\text{average EGR Temp, average Comp Temp, average Engine Coolant temp})) > 40 \text{ } ^\circ\text{C}$
Enable Conditions	Pre-crank: <ul style="list-style-type: none"> • Key On • Engine Speed < 100 RPM • Soak Time \geq 8 h • Enable Delay \geq 2 s • Reset Pre-crank delay \geq 3.5 s
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0335, P0336, P0072, P0070, P0117, P0115, P0097, P0095, P2229, P2226, P040A, P040C, P0545, P0544, P0110, P0112, P205A, P205C
Time Required For DTC To Be Set	3 Seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Intake Manifold Temperature Sensor (IMT): Circuit Monitors

The Intake Manifold Temperature sensor is checked for electrical failures by monitoring the analog-to-digital (A/D) input voltage.

P0110 Intake Manifold Temperature Sensor (IMT): Open Circuit Check

DTC	P0110
Component / System	IMT - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage > > 4.82V (850 °C) or 0.02 - 0.18V (-100 - (-40) °C)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0112 Intake Manifold Temperature Sensor (IMT): Short Circuit Low

DTC	P0112
Component / System	IMT - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Voltage < 0.02V (-100 °C)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

EGR Temperature Sensor: Rationality Monitor

This OBD monitor evaluates the rationality of the EGR temperature sensor at two different windows, during engine running conditions and also during the key on/engine off conditions after an 8 hour soak time.

The monitor compares the EGR temperature with the coolant temperature during conditions where they should read the same temperature.

P040B EGR Temperature Sensor: Rationality Monitor (At Start Up After An 8 Hour Soak Time)

DTC	P040B
Component / System	EGR Temperature Sensor - Rationality
Monitor Strategy Description	Temperature sensor rationality check at start up after a 8 hour soak time
Fault Limit	$\Delta = (\text{Average EGR Temperature}) - (\text{mean}(\text{average Intake Manifold Temp, average Compressor Discharge Temp, average Engine Coolant temp})) > 40 \text{ } ^\circ\text{C}$
Enable Conditions	Pre-crank: <ul style="list-style-type: none">• Key On Active• Engine Speed < 100 RPM• Soak Time \geq 8 hours• Enable Delay \geq 2 seconds• Reset Pre-crank delay \geq 3.5 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0335, P0336, P0072, P0070, P0117, P0115, P0097, P0095, P2229, P2226, P040A, P040C, P0545, P0544, P0110, P0112, P205A, P205C
Time Required For DTC To Be Set	3 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P040B EGR Temperature Sensor: Rationality Monitor (During Engine Running Conditions)

DTC	P040B	
Component / System	EGR Temperature Sensor - Rationality	
Monitor Strategy Description	EGR Temperature Sensor Evaluation during Engine Running conditions	
Fault Limit	Plausibility Check Delta = Average (EGR Temperature - Coolant Temperature) > 45 °C or < -45 °C Note: Average calculation during the 12 second evaluation time.	Stuck Check Delta = Stuck High EGR Temperature - Stuck Low EGR Temperature < -1000 °C
Enable Conditions	Engine Running Plausibility Check <ul style="list-style-type: none"> • Engine Speed 550 - 800 RPM • Engine Torque 0 - 500 Nm • EGR Valve Position 15 - 100 % • EGR Mass Flow 0 - 0.08 kg/s • Coolant Temperature Warm-up flag True • Enable Delay ≥ 60 s 	Engine Running Stuck Check <ul style="list-style-type: none"> • Engine Speed 0 - 3000 RPM • Engine Torque 0 - 3000 Nm • EGR Valve Position 0 - 2 % • Estimated EGR Inlet Temperature > 0 °C
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0335, P0336, P0072, P0070, P0117, P0115, P0116, P0128, P0097, P0095, P2229, P2226, P040A, P040C, P0403, P0489 	
Time Required For DTC To Be Set	Plausibility Check 12 seconds	Stuck Check 1 second
MIL Illumination	2 Drive Cycles	
Probable Causes	<i>See Tech Tool</i>	

EGR Temperature Sensor: Circuit Monitors

The EGR Temperature Sensor is checked for electrical failures by monitoring the analog-to-digital (A/D) input voltage.

P040A EGR Temperature Sensor: Open Circuit Check

DTC	P040A
Component / System	EGR Temperature Sensor - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage >> 4.82V (850 °C) or 0.02 - 0.18V (-100 - (-40) °C))
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P040C EGR Temperature Sensor: Short Circuit Low

DTC	P040C
Component / System	EGR Temperature Sensor - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Voltage < 0.02V (-100 °C)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Exhaust Gas Temperature Sensors: Rationality Monitors

The exhaust gas system has three temperature sensors. The pre-DOC sensor measures the engine exhaust gas temperature, the post-DOC sensor measures the temperature downstream of the DOC, and the post-DPF sensor measures the temperature downstream of the DPF.

The rationality monitor for the exhaust temperature sensors evaluates the plausibility of the sensor comparing the pre-DOC, DOC outlet and DPF outlet temperature sensor values.

During normal driving conditions, the temperature of the DOC outlet and the DPF outlet is very close to the engine exhaust gas temperature (pre-DOC). This difference is integrated over a period of time.

The average of the three sensors is determined and a reference temperature is calculated. The temperature sensor values are compared to the reference value and if the difference is above the threshold a DTC is reported.

P2080 Exhaust Gas Temperature Sensors: Pre-DOC Rationality Check (Plausibility Check Of The Sensor Value)

DTC	P2080
Component / System	Pre-DOC Temperature Sensor - Rationality
Monitor Strategy Description	Plausibility check of the sensor value
Fault Limit	Delta = (Pre DOC Temperature) - (Post DOC Temperature) > 70 °C AND Delta = (Pre DOC Temperature) - (Post DPF Temperature) > 70 °C OR Pre-DOC Temperature < 100 °C
Enable Conditions	<ul style="list-style-type: none"> • Barometric Pressure 75 - 105 kPa • Ambient Air Temperature -8 - 55 °C • Coolant Temperature > 65 °C • Filtered Engine Torque 500 - 2000 Nm • Modeled Exhaust Gas Temperature 200 - 400 °C • (Modeled Pre-DOC Temperature) - (Modeled Post DPF Temperature) < 20 °C • (Modeled Pre-DOC Temperature) - (Modeled Post-DOC Temperature) < 20 °C • (Modeled Post-DOC Temperature) - (Modeled Post-DPF Temperature) < 20 °C • Delay Post AHI Injection 600 seconds • Enable Time Delay 3 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0072, P0070, P2229, P2226, P0117, P0115, P0544, P0545, P2031, P2032, P242C, P242A, P040A, P040C, P0406, P0409, P0105, P0108, P0095, P0097
Time Required For DTC To Be Set	45 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P2080 Exhaust Gas Temperature Sensors: Pre-DOC Rationality Check (At Start Up After A 6 Hour Soak Time)

DTC	P2080
Component / System	Pre-DOC Temperature Sensor - Rationality
Monitor Strategy Description	Temperature sensor rationality check at start up after a 6 hour soak time
Fault Limit	Delta = (Pre DOC Temperature) - (Post DOC Temperature) > 70 °C AND Delta = (Pre DOC Temperature) - (Post DPF Temperature) > 70 °C OR Pre-DOC Temperature > 70 °C
Enable Conditions	<ul style="list-style-type: none"> • Key On Active • Soak Time > 6 hours • Enable Crank Time < 3 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0072, P0070, P2229, P2226, P0117, P0115, P0544, P0545, P2031, P2032, P242C, P242A, P040A, P040C, P0406, P0409, P0105, P0108, P0095, P0097
Time Required For DTC To Be Set	1 second
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P2084 Exhaust Gas Temperature Sensor: Post-DOC Rationality Check (Signal Plausibility Failure)

DTC	P2084
Component / System	Post-DOC Temperature Sensor - Rationality
Monitor Strategy Description	Signal Plausibility Failure
Fault Limit	Delta = (Pre DOC Temperature) - (Post DOC Temperature) > 70 °C AND Delta = (Post DOC Temperature) - (Post DPF Temperature) > 70 °C OR Post-DOC Temperature < 100 °C
Enable Conditions	<ul style="list-style-type: none"> • Barometric Pressure 75 - 105 kPa • Ambient Air Temperature -8 - 55 °C • Coolant Temperature > 65 °C • Filtered Engine Torque 500 - 2000 Nm • Modeled Exhaust Gas Temperature 200 - 400 °C • (Modeled Pre-DOC Temperature) - (Modeled Post DPF Temperature) < 20 °C • (Modeled Pre-DOC Temperature) - (Modeled Post-DOC Temperature) < 20 °C • (Modeled Post-DOC Temperature) - (Modeled Post-DPF Temperature) < 20 °C • Delay Post AHI Injection 600 seconds • Enable Time Delay 3 seconds
Disable Conditions	<p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0072, P0070, P2229, P2226, P0117, P0115, P0544, P0545, P2031, P2032, P242C, P242A, P040A, P040C, P0406, P0409, P0105, P0108, P0095, P0097
Time Required For DTC To Be Set	45 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P2084 Exhaust Gas Temperature Sensor: Post-DOC Rationality Check (At Start Up After A 6 Hour Soak Time)

DTC	P2084
Component / System	Post-DOC Temperature Sensor - Rationality
Monitor Strategy Description	Temperature sensor rationality check at start up after a 6 hour soak time
Fault Limit	Delta = (Pre DOC Temperature) - (Post DOC Temperature) > 70 °C AND Delta = (Post DOC Temperature) - (Post DPF Temperature) > 70 °C OR Post-DOC Temperature > 70 °C
Enable Conditions	<ul style="list-style-type: none"> • Key On Active • Soak Time > 6 hours • Enable Crank Time < 3 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0072, P0070, P2229, P2226, P0117, P0115, P0544, P0545, P2031, P2032, P242C, P242A, P040A, P040C, P0406, P0409, P0105, P0108, P0095, P0097
Time Required For DTC To Be Set	1 second
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P242B Exhaust Gas Temperature Sensors: Post-DPF Rationality Check (Signal Plausibility Failure)

DTC	P242B
Component / System	Post-DPF Temperature Sensor - Rationality
Monitor Strategy Description	Signal Plausibility Failure
Fault Limit	Delta = (Pre DOC Temperature) - (Post DPF Temperature) > 70 °C AND Delta = (Post DOC Temperature) - (Post DPF Temperature) > 70 °C OR Post-DPF Temperature < 100 °C
Enable Conditions	<ul style="list-style-type: none"> • Barometric Pressure 75 - 105 kPa • Ambient Air Temperature -8 - 55 °C • Coolant Temperature > 65 °C • Filtered Engine Torque 500 - 2000 Nm • Modeled Exhaust Gas Temperature 200 - 400 °C • (Modeled Pre-DOC Temperature) - (Modeled Post DPF Temperature) < 20 °C • (Modeled Pre-DOC Temperature) - (Modeled Post-DOC Temperature) < 20 °C • (Modeled Post-DOC Temperature) - (Modeled Post-DPF Temperature) < 20 °C • Delay Post AHI Injection 600 seconds • Enable Time Delay 3 seconds
Disable Conditions	<p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0072, P0070, P2229, P2226, P0117, P0115, P0544, P0545, P2031, P2032, P242C, P242A, P040A, P040C, P0406, P0409, P0105, P0108, P0095, P0097
Time Required For DTC To Be Set	40 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P242B Exhaust Gas Temperature Sensors: Post-DPF Rationality Check (At Start Up After A 6 Hour Soak Time)

DTC	P242B
Component / System	Post-DPF Temperature Sensor - Rationality
Monitor Strategy Description	Temperature sensor rationality check at start up after a 6 hour soak time
Fault Limit	Delta = (Pre DOC Temperature) - (Post DPF Temperature) > 70 °C AND Delta = (Post DOC Temperature) - (Post DPF Temperature) > 70 °C OR Post-DPF Temperature > 70 °C
Enable Conditions	<ul style="list-style-type: none"> • Key On Active • Soak Time > 6 hours • Enable Crank Time < 3 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0072, P0070, P2229, P2226, P0117, P0115, P0544, P0545, P2031, P2032, P242C, P242A, P040A, P040C, P0406, P0409, P0105, P0108, P0095, P0097
Time Required For DTC To Be Set	1 second
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Exhaust Gas Temperature Sensors: Circuit Monitors

The Exhaust Gas Temperature Sensor circuits are monitored to check for electrical failures by monitoring the analog-to-digital (A/D) input voltages.

P0544 Pre-DOC Temperature Sensor: Open Circuit Check

DTC	P0544
Component / System	Pre-DOC Temperature Sensor - Open
Monitor Strategy Description	Circuit Short To Battery or Open
Fault Limit	Sensor Voltage > 2.26V (850 °C) or 0.15 - 0.68V (-100 - (-40) °C)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	15 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0545 Pre-DOC Temperature Sensor: Short Circuit Low

DTC	P0545
Component / System	Pre-DOC Temperature Sensor - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Voltage < 0.15V (-100 °C)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	15 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P2031 Post-DOC Temperature Sensor: Open Circuit Check

DTC	P2031
Component / System	Post-DOC Temperature Sensor - Open
Monitor Strategy Description	Circuit Short To Battery or Open
Fault Limit	Sensor Voltage > 2.26V (850 °C) or 0.15 - 0.68V (-100 - (-40) °C)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	15 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P2032 Post-DOC Temperature Sensor: Short Circuit Low

DTC	P2032
Component / System	Post-DOC Temperature Sensor - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Voltage < 0.15V (-100 °C)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	15 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P242A Post-DPF Temperature Sensor: Open Circuit Check

DTC	P242A
Component / System	Post-DPF Temperature Sensor - Open
Monitor Strategy Description	Circuit Short To Battery or Open
Fault Limit	Sensor Voltage > 2.26V (850 °C) or 0.15 - 0.68V (-100 - (-40) °C)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	15 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P242C Post-DPF Temperature Sensor: Short Circuit Low

DTC	P242C
Component / System	Post-DPF Temperature Sensor - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Voltage < 0.15V (-100 °C)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	15 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Engine Oil Temperature Sensor

The oil temperature sensor monitor is designed to detect a sensor that is reporting an unrealistic oil temperature value.

P0196 Engine Oil Temperature Sensor (OTS): Rationality Monitor

DTC	P0196	
Component / System	OTS - Rationality	
Monitor Strategy Description	Temperature sensor rationality check at start up after a 8 hour soak time	
Fault Limit	Engine Pre Crank: Delta = (Average Oil Temperature) - (Engine Reference Temperature) > 40 °C (absolute)	Engine Running: Delta = (Average Oil Temperature) - (mean(average EGR Temp, average Comp Temp, average Intake Manifold temp, average Coolant Temp)) < 3 °C Reference temperature = mean(average Intake Manifold Temp, average EGR Temp, average Engine Coolant Temp)
Enable Conditions	Engine Pre Crank: <ul style="list-style-type: none"> • Key On • Engine Speed < 100 RPM • Soak Time ≥ 8 Hours • Enable Delay ≥ 2 Seconds • Reset Pre-crank delay ≥ 3.5 Seconds 	Engine Running: <ul style="list-style-type: none"> • Engine Speed ≥ 500 RPM • Enable Delay Time ≥ 60 Seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0335, P0336, P0072, P0070, P0117, P0115, P0097, P0095, P2229, P2226, P040A, P040C, P0545, P0544, P0110, P0112, P205A, P205C 	
Time Required For DTC To Be Set	3 Seconds	
MIL Illumination	2 Drive Cycles	
Probable Causes	<i>See Tech Tool</i>	

Engine Oil Temperature Sensor: Circuit Monitors

The Engine Oil Temperature Sensor circuits are monitored to check for electrical failures by monitoring the analog-to-digital (A/D) input voltages.

P0195 Engine Oil Temperature Sensor (OTS): Open Circuit Check

DTC	P0195
Component / System	OTS - High
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage > 4.78V (-40 °C)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	N/A
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0197 Engine Oil Temperature Sensor (OTS): Short Circuit Low

DTC	P0197
Component / System	OTS - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Voltage < 0.1V (140 °C)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	N/A
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Engine Oil Pressure Sensor (OPS): Rationality Monitor

This OBD monitor is designed to detect a sensor that is reporting an unrealistic value.

Engine oil pressure is checked during two conditions:

Engine Pre-Cranking:

When the engine is in the Pre-Cranking state, the Engine Oil Pressure is expected to be in a respectively low range, close to ambient pressure. If this range is exceeded, a Pre-Crank DTC is set.

Another engine operating area is defined for high engine oil pressure. A plausible oil pressure is expected to be within a calibrated range, based on engine speed and torque. When the engine is being operated within this high area, the expected oil pressure is compared to the measured oil pressure and the difference is averaged during the test execution time. If the averaged difference is greater than a calibrated threshold, this plausibility monitor will assert the sensor plausibility DTC.

High Pressure Condition:

P0521 Engine Oil Pressure Sensor: Rationality Monitor

DTC	P0521	
Component / System	OPS - Rationality	
Monitor Strategy Description	Plausibility check of the sensor by comparing a high oil pressure condition to a low pressure condition.	
Fault Limit	Pre-Crank Oil pressure outside > 100 kPa OR < -50 kPa	High Pressure Check Oil pressure > 575 kPa OR < 280 kPa
Enable Conditions	Pre-Crank <ul style="list-style-type: none"> • Key On Active • Engine Speed < 50 RPM • Enable Time Delay 3 seconds 	High Pressure Check <ul style="list-style-type: none"> • Engine Torque 0 - 300 Nm • Engine Speed 1600 - 1850 RPM • Engine Oil Temperature 80 - 120 °C • Engine speed rate of change < 15 RPM/s • Enable Delay Time 5 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0523, P0520, P0197, P0195, P0196 	
Time Required For DTC To Be Set	Pre-Crank 1 second	High Pressure Check 4 seconds
MIL Illumination	2 Drive Cycles	
Probable Causes	<i>See Tech Tool</i>	

Engine Oil Pressure Sensor: Circuit Monitors

The Engine Oil Pressure Sensor circuits are monitored to check for electrical failures by monitoring the analog-to-digital (A/D) input voltages.

P0520 Engine Oil Pressure Sensor (OPS): Open Circuit Check

DTC	P0520
Component / System	OPS - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage 4.78 - 4.85V (700-750 kPa) or < 0.21V (0 kPa)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0523 Engine Oil Pressure Sensor (OPS): Short Circuit High

DTC	P0523
Component / System	OPS - High
Monitor Strategy Description	Short Circuit High
Fault Limit	Sensor Voltage > 4.85V (750 kPa)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Turbocharger Speed Sensor (TSS): Rationality Monitor

This OBD monitor evaluates the turbo speed sensor for missing signal and for rationality faults. The turbo speed is compared during two working conditions, one when the turbo speed is supposed to be low and another when the turbo speed is supposed to be high.

Low Flow Condition :

When the engine is in idle or in low engine speed and torque condition, the expected Turbo Speed is expected to be low. If

the turbo speed exceeds a calibrated threshold, a low speed error is set.

High Flow Condition :

When the engine is in higher engine speed and torque condition, the expected Turbo Speed is expected to be high. If the turbo speed lies below a calibrated threshold, a high speed error is set.

P2578 Turbocharger Speed Sensor (TSS): Missing Signal Monitor

DTC	P2578
Component / System	TSS - Missing Signal
Monitor Strategy Description	Missing signal
Fault Limit	Average turbo speed < 0.1 RPM Note: Averaged over 5 seconds.
Enable Conditions	<ul style="list-style-type: none"> • Engine Speed 1000 - 2000 RPM • Engine Torque > 1200 Nm • Enable Delay Time 5 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0335, P0336
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P2579 Turbocharger Speed Sensor (TSS): Overspeed

DTC	P2579
Component / System	TSS - Signal has too many pulses
Monitor Strategy Description	Signal Has Too Many Pulses
Fault Limit	(Ratio between Fault Timer (incremented when EGR Afr Cntrl Flag is TRUE) and Evaluation Timer) > 90 %
Enable Conditions	<ul style="list-style-type: none">• Engine Coolant Temperature > 65 °C• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Engine Speed 1300 - 2100 RPM• Engine Speed (rate of change) -50 - 50 RPM• Engine Torque (rate of change) -50 - 50 Nm• Engine Torque map (Engine Speed and Barometric Pressure)<ul style="list-style-type: none">• At 75 kPa — 800 Nm• At 80 kPa — 100 Nm• At 85 kPa — 1100 Nm• At 90 kPa — 1200 Nm• At 95 kPa — 1300 Nm• At 100 kPa — 1500 Nm• At 105 kPa — 1600 Nm
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0335, P0336, P2578, P0489, P0403, P006E, P00AF, P0046, P1148, P040C, P040A, P0072, P0070, P0097, P0095, P0117, P0115, P0406, P0409, P2229, P2226, P0108, P0105
Time Required For DTC To Be Set	30 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Crankshaft Position Sensor: Rationality Monitors

The Crankshaft Position Sensor is monitored by comparing its output signal to the output signal of the camshaft position sensor.

P0335 Crankshaft Position Sensor: Open Circuit

DTC	P0335
Component / System	Crankshaft Position Sensor - Open
Monitor Strategy Description	Input Open Circuit
Fault Limit	No signal from Crankshaft Speed Sensor No signal for number of revolutions greater than 3
Enable Conditions	<ul style="list-style-type: none">• Engine Speed > 50 RPM
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0339 Crankshaft Position Sensor: Rationality Low

DTC	P0339
Component / System	Crankshaft Position Sensor - Rationality Low
Monitor Strategy Description	Input Rationality - Low (Intermittent signal)
Fault Limit	Less crank teeth than expected Less crank teeth for number of revolutions greater than 3
Enable Conditions	<ul style="list-style-type: none">• Engine Speed > 50 RPM
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0336 Crankshaft Position Sensor: Rationality High

DTC	P0336
Component / System	Crankshaft Position Sensor - Rationality High
Monitor Strategy Description	Input Rationality - High (Signal Frequency Incorrect)
Fault Limit	More crank teeth than expected More crank teeth for number of revolutions greater than 3
Enable Conditions	<ul style="list-style-type: none">• Engine Speed > 50 RPM
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Camshaft Position Sensor: Rationality Monitors

The camshaft position sensor is monitored by comparing its output signal to the output signal of the crankshaft position sensor.

P0340 Camshaft Position Sensor: Open Circuit

DTC	P0340
Component / System	Camshaft Position Sensor - Open
Monitor Strategy Description	Input Open Circuit
Fault Limit	No signal from Camshaft Speed Sensor No signal for number of revolutions greater than 3
Enable Conditions	<ul style="list-style-type: none">• Engine Speed > 50 RPM
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P0016 Camshaft Position Sensor: Rationality Low

DTC	P0016
Component / System	Camshaft Position Sensor - Rationality Low
Monitor Strategy Description	Input Rationality - Low
Fault Limit	Difference between teeth on crank and cam wheel 5 crank angles
Enable Conditions	<ul style="list-style-type: none">• Engine Speed > 50 RPM
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0341 Camshaft Position Sensor: Rationality High

DTC	P0341
Component / System	Camshaft Position Sensor - Rationality High
Monitor Strategy Description	Input Rationality - High
Fault Limit	More cam teeth than expected More cam teeth for number of revolutions greater than 3
Enable Conditions	<ul style="list-style-type: none">• Engine Speed > 50 RPM
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Aftertreatment Hydrocarbon Injection System

The exhaust aftertreatment fuel injection system injects diesel fuel into the exhaust stream to increase the exhaust gas temperature during some operating conditions

This OBD monitor identifies malfunctions of the Aftertreatment Hydrocarbon Doser System by analyzing the fuel pressures during an OBD controlled sequence of the fuel cut-off valve (FCV), the air purge valve (APV) and the fuel dosing valve (FDV). A DTC will be reported if the expected pressure at any point of the check sequence is not reached within a specified time.

The following Diagnostic Sequence describes the Aftertreatment Hydrocarbon Doser System functional checks:

Air Pressure Check (AP):

During this test the Air Pressure Valve and the Fuel Dosing Valve are open. During this phase the Fuel Pressure Sensor reading shall be at the air supply pressure.

Low Pressure Check (LP):

During this test the Fuel Dosing Valve is open. During this phase the Fuel Pressure Sensor reading shall be at the pressure in the exhaust pipe.

Fuel Pressure Check (FP):

During this test the Fuel Cut-Off Valve is open. During this phase the Fuel Pressure Sensor reading shall be at the fuel delivery pressure.

Fuel Leakage Check (FL):

During this test all valves are closed. During this phase the Fuel Pressure Sensor reading shall be stable at the fuel delivery pressure.

Fuel Delivery Check (FD):

During this test the Fuel Dosing Valve is opened to release the fuel pressure. During this phase the Fuel Pressure Sensor reading shall drop to the pressure in the exhaust system.

Aftertreatment Hydrocarbon Doser Fuel Pressure Sensor: Circuit Monitors

The fuel doser pressure sensor is monitored to check for electrical failures by monitoring the analog-to-digital (A/D) input voltages.

P20DD Aftertreatment Hydrocarbon Doser Fuel Pressure Sensor: Open Circuit

DTC	P20DD
Component / System	Fuel Pressure Sensor - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage 4.79 - 4.85V (700-750 kPa) OR < 0.21V (0 kPa)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P20E0 Aftertreatment Hydrocarbon Doser Fuel Pressure Sensor: Short Circuit High

DTC	P20E0
Component / System	Fuel Pressure Sensor - High
Monitor Strategy Description	Short Circuit High
Fault Limit	Sensor Voltage > 4.85V (750 kPa)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Aftertreatment Hydrocarbon Doser Fuel Pressure Sensor: Rationality Monitors

P20DE Aftertreatment Hydrocarbon Doser Fuel Pressure Sensor: Range/Performance

DTC	P20DE
Component / System	Fuel Pressure Sensor - Rationality
Monitor Strategy Description	Fuel Pressure Sensor Circuit Range/Performance
Fault Limit	Fuel Pressure Sensor < 0 kPa for a time of 20 seconds OR Fuel Pressure Sensor >700 kPa for a time of 20 seconds
Enable Conditions	<ul style="list-style-type: none">• Battery Voltage 10 - 16V• Engine Speed 475 - 3500 RPM• Monitoring Request Active• Engine Coolant Temperature > 20 °C• Exhaust Mass Flow > 0.01 kg/s• Pre-DOC Temperature 0 - 500 °C• Post-DOC Temperature 120 - 400 °C• AHI Air Supply Check (Completed without any air supply failure reported)
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0115, P0117, P0339, P0336, P0335, P20E0, P20DD, P1134, P1131, P2697, P2699, P20D9, P20D7, P0545, P0544, P2032, P2031
Time Required For DTC To Be Set	100 seconds (up to 4 complete Monitor evaluations)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Aftertreatment Hydrocarbon Doser Solenoid: Rationality Monitors

P20DC Aftertreatment Hydrocarbon Doser Solenoid: Stuck Closed

DTC	P20DC
Component / System	Doser Solenoid - Stuck Closed
Monitor Strategy Description	Exhaust Aftertreatment Fuel Supply Control Stuck Closed
Fault Limit	Aftertreatment Fuel Pressure Sensor < 100 kPa For a time of 0.5 seconds
Enable Conditions	<ul style="list-style-type: none">• Battery Voltage 10 - 16V• Engine Speed 475 - 3500 RPM• Monitoring Request Active• Engine Coolant Temperature > 20 °C• Exhaust Mass Flow > 0.01 kg/s• Pre-DOC Temperature 0 - 500 °C• Post-DOC Temperature 120 - 400 °C• AHI Air Supply Check (Completed without any air supply failure reported)
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0115, P0117, P0339, P0336, P0335, P20E0, P20DD, P1134, P1131, P2697, P2699, P20D9, P20D7, P0545, P0544, P2032, P2031
Time Required For DTC To Be Set	100 seconds (up to 4 complete Monitor evaluations)
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P20D0 Aftertreatment Hydrocarbon Doser Solenoid: Exhaust Aftertreatment Fuel Injector "A" Stuck Closed

DTC	P20D0
Component / System	Exhaust Aftertreatment Fuel Injector "A" Stuck Closed
Monitor Strategy Description	Aftertreatment Fuel Pressure Sensor < 100 kPa For a time of 0.5 seconds
Fault Limit	Open Valve system pressure > 100 kPa
Enable Conditions	<ul style="list-style-type: none"> • Battery Voltage 10 - 16V • Engine Speed 475 - 3500 RPM • Monitoring Request Active • Engine Coolant Temperature > 20 °C • Exhaust Mass Flow > 0.01 kg/s • Pre-DOC Temperature 0 - 500 °C • Post-DOC Temperature 120 - 400 °C • AHI Air Supply Check (Completed without any air supply failure reported)
Disable Conditions	<p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0115, P0117, P0339, P0336, P0335, P20E0, P20DD, P1134, P1131, P2697, P2699, P20D9, P20D7, P0545, P0544, P2032, P2031
Time Required For DTC To Be Set	100 seconds (up to 4 complete Monitor evaluations)
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Aftertreatment Hydrocarbon Doser Solenoid: Circuit Monitors

The fuel doser solenoid is checked for electrical failures.

P20D7 Aftertreatment Hydrocarbon Doser Solenoid: Open Circuit

DTC	P20D7
Component / System	Doser Solenoid - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Current < 0.5 A
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P20D9 Aftertreatment Hydrocarbon Doser Solenoid: Short Circuit Low

DTC	P20D9
Component / System	Doser Solenoid - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Current > 5 A
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Aftertreatment Hydrocarbon Air Purge Valve: Rationality Monitors

P1133 Aftertreatment Hydrocarbon Air Purge Valve: Stuck Open

DTC	P1133
Component / System	Air Purge Valve - Stuck Open
Monitor Strategy Description	Exhaust Aftertreatment Fuel Air Purge Valve Stuck Open
Fault Limit	Closed Valve system pressure > 50 kPa for a time of 0.5 seconds
Enable Conditions	<ul style="list-style-type: none">• Battery Voltage 10 - 16V• Engine Speed 475 - 3500 RPM• Monitoring Request Active• Exhaust Mass Flow < 0.5 kg/s• Time since engine start > 300 seconds OR Vehicle Speed > 5 km/h OR Post-DOC Temperature > 120 °C
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0115, P0117, P0339, P0336, P0335, P20E0, P20DD, P1134, P1131, P2697, P2699, P20D9, P20D7, P0545, P0544, P2032, P2031
Time Required For DTC To Be Set	100 seconds (up to 4 complete Monitor evaluations)
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P1130 Aftertreatment Hydrocarbon Air Purge Valve: Stuck Closed

DTC	P1130
Component / System	Air Purge Valve - Stuck Closed
Monitor Strategy Description	Exhaust Aftertreatment Fuel Air Purge Valve Stuck Closed
Fault Limit	Open Valve system pressure < 70 kPa for a time of 1 second
Enable Conditions	<ul style="list-style-type: none"> • Battery Voltage 10 - 16V • Engine Speed 475 - 3500 RPM • Monitoring Request Active • Exhaust Mass Flow < 0.5 kg/s • Pre-DOC Temperature 0 - 500 °C • Time since engine start > 300 seconds OR Vehicle Speed > 5 km/h OR Post-DOC Temperature > 120 °C
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0115, P0117, P0339, P0336, P0335, P20E0, P20DD, P1134, P1131, P2697, P2699, P20D9, P20D7, P0545, P0544, P2032, P2031
Time Required For DTC To Be Set	100 seconds (up to 4 complete Monitor evaluations)
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Aftertreatment Hydrocarbon Air Purge Valve: Circuit Monitors

The fuel air purge valve is checked for electrical failures.

P1134 Aftertreatment Hydrocarbon Air Purge Valve: Open Circuit

DTC	P1134
Component / System	Air Purge Valve - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Current < 0.6 A
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P1131 Aftertreatment Hydrocarbon Air Purge Valve: Short Circuit Low

DTC	P1131
Component / System	Air Purge Valve - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Current > 10 A
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Aftertreatment Hydrocarbon Dosing Valve: Rationality Monitors

P20CF Aftertreatment Hydrocarbon Dosing Valve: Stuck Open

DTC	P20CF
Component / System	Aftertreatment Hydrocarbon Dosing Valve - Stuck Open
Monitor Strategy Description	System Pressure With Valve Commanded Closed (FL Failed)
Fault Limit	Closed Valve system pressure < 75 kPa for a time of 0.5 seconds
Enable Conditions	<ul style="list-style-type: none">• Battery Voltage 10 - 16V• Engine Speed 475 - 3500 RPM• Monitoring Request Fuel Pressure Check Active (Fuel Cut-Off Valve open)• Engine Coolant Temperature > 20 °C• Exhaust Mass Flow > 0.01 kg/s• Pre-DOC Temperature 0 - 500 °C• Post-DOC Temperature 120 - 400 °C• AHI Air Supply Check (Completed without any air supply failure reported)
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0115, P0117, P0339, P0336, P0335, P20E0, P20DD, P1134, P1131, P2697, P2699, P20D9, P20D7, P0545, P0544, P2032, P2031
Time Required For DTC To Be Set	100 seconds (up to 4 complete Monitor evaluations)
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P2698 Aftertreatment Hydrocarbon Dosing Valve: Functional

DTC	P2698
Component / System	Aftertreatment Hydrocarbon Dosing Valve - Functional
Monitor Strategy Description	Nozzle Plausibility
Fault Limit	AHI Flow Loss Ratio > 0.75
Enable Conditions	<ul style="list-style-type: none">• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Engine Speed > 550 RPM• Post- DPF Temperature > 100 °C• Exhaust Aftertreatment Fuel Injection Active• SCR warming OR Moving Crystal Sublimation Active• Cumulative Dosed AHI Fuel > 53g
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P2226, P2229, P0072, P0070, P0335, P0339, P0336, P0545, P0544, P2080, P2032, P2031, P2084, P242C, P242A, P242B, P040C, P040A, P0406, P0409, P0108, P0105, P0110, P0112, P20DD, P20E0, P20D0, P1133, P20DC, P20CF
Time Required For DTC To Be Set	400 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Aftertreatment Hydrocarbon Dosing Valve: Circuit Monitors

The fuel doser is checked for electrical failures.

P2697 Aftertreatment Hydrocarbon Dosing Valve: Open Circuit

DTC	P2697
Component / System	Aftertreatment Hydrocarbon Dosing Valve - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Current < 0.6 A
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P2699 Aftertreatment Hydrocarbon Dosing Valve: Short Circuit Low

DTC	P2699
Component / System	Aftertreatment Hydrocarbon Dosing Valve - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Current > 10 A
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Aftertreatment DEF Tank Temperature Sensor: Rationality Monitors

The DEF tank temperature sensor is checked for rational values. When heating the DEF tank by activating the coolant

valve, the DEF tank temperature sensor value is expected to increase within the evaluation time.

P205B Aftertreatment DEF Tank Temperature Sensor: Rationality Low

DTC	P205B
Component / System	Temperature Sensor - Rationality Low
Monitor Strategy Description	Signal Plausibility Failure
Fault Limit	$\Delta = (\text{Average DEF Tank Temperature}) - (\text{Engine Reference}) > 40 \text{ }^\circ\text{C (absolute)}$
Enable Conditions	Pre-Crank: <ul style="list-style-type: none">• Key On Active• Engine Speed < 100 RPM• Soak Time RPM \geq 8 hours• Enable Delay \geq 2 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0072, P0070, P2226, P2229, P0335, P0336, P0095, P0097, P040C, P040A, P0545, P0544, P0112, P0110, P2032, P2031, P242C, P242A, P205C, P205A, P0115, P0117, U3017
Time Required For DTC To Be Set	3 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Aftertreatment DEF Tank Temperature Sensor: Circuit Monitors

The DEF tank temperature sensor is checked for electrical failures.

P205A Aftertreatment DEF Tank Temperature Sensor: Open Circuit

DTC	P205A
Component / System	Temperature Sensor - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage > 4.5V
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P205C Aftertreatment DEF Tank Temperature Sensor: Short Circuit Low

DTC	P205C
Component / System	Temperature Sensor - Open
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Voltage < 0.5 V
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Aftertreatment DEF Pump: Rationality Monitors

The Aftertreatment DEF pump has internal diagnostics which evaluate whether the DEF pump is able to meet its demand.

If the pump reports insufficient performance for more than a threshold time then a DTC is set.

P20E8 Aftertreatment DEF Pump: Pump Pressure Build Up

DTC	P20E8
Component / System	DEF Pump - High
Monitor Strategy Description	DEF Pressure Build Up Failure
Fault Limit	<ul style="list-style-type: none"> • DEF Pressure < 650 kPa • Pressure build up attempt time 120 seconds • Number of failed attempts 6
Enable Conditions	<ul style="list-style-type: none"> • DEF System Pressure Build Up State Active • Enable Delay 4 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P10AE, P10AF, P208A, P208C, P208D, P2047, P2048, P2049, P204A, P204C
Time Required For DTC To Be Set	740 Seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P208B Aftertreatment DEF Pump: Reductant Pump "A" Control Performance/ Stuck Off

DTC	P208B
Component / System	Reductant Pump "A" Control Performance/Stuck Off
Monitor Strategy Description	Reductant Pump "A" Control Performance/Stuck Off Pump motor speed too low
Fault Limit	DEF Pressure < 100kPa
Enable Conditions	DEF System States: <ul style="list-style-type: none"> • Running State Active OR After Run State Active OR Pressure Build Up AND Defrosting Active
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P204A, P204C, P10AE, P10AF, P208A, P208C, P208D, P20E8, P2047, P2048, P2049
Time Required For DTC To Be Set	0 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P202D Aftertreatment DEF Pump: Aftertreatment Reagent Pressure Leakage

DTC	P202D
Component / System	Aftertreatment Reagent Pressure Leakage
Monitor Strategy Description	Aftertreatment Reagent Pressure Leakage Pump motor speed too high
Fault Limit	DEF Pump duty cycle > 60% Delay Time 40 seconds
Enable Conditions	<ul style="list-style-type: none">• DEF System Running State Active• DEF Dosing valve duty cycle < 15%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P204A, P204C, P10AE, P10AF, P208A, P208C, P208D, P20E8, P2047, P2048, P2049
Time Required For DTC To Be Set	40 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P10CE Aftertreatment DEF Pump: Reductant Return No Flow Detected

DTC	P10CE
Component / System	Reductant Return No Flow Detected
Monitor Strategy Description	Component or System Operation Obstructed or Blocked
Fault Limit	<ul style="list-style-type: none">• DEF pressure > 1100 kPa• Delay Time 20 seconds
Enable Conditions	<ul style="list-style-type: none">• DEF System Running State Active
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P204A, P204C, P10AE, P10AF, P208B, P208A, P208C, P208D, P2047, P2048, P2049, P20E8
Time Required For DTC To Be Set	20 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Aftertreatment DEF Pump: Circuit Monitors

The Aftertreatment DEF Pump is checked for electrical failures.

P208A Aftertreatment DEF Pump: Open Circuit

DTC	P208A
Component / System	DEF Pump - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Pump Voltage < 3.75 V
Enable Conditions	<ul style="list-style-type: none">• Pump Duty Cycle > 0%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P208D Aftertreatment DEF Pump: Short Circuit High

DTC	P208D
Component / System	DEF Pump - High
Monitor Strategy Description	Short Circuit High
Fault Limit	Pump Current > 9 A
Enable Conditions	<ul style="list-style-type: none">• Pump Duty Cycle > 0%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P208C Aftertreatment DEF Pump: Short Circuit Low

DTC	P208C
Component / System	DEF Pump - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Pump Voltage < 1.5 V
Enable Conditions	<ul style="list-style-type: none">• Pump Duty Cycle > 0%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P10AD Aftertreatment DEF Pump: Reductant Pump "A" Control Low Side

DTC	P10AD
Component / System	Reductant Pump "A" Control - Low
Monitor Strategy Description	Circuit Open
Fault Limit	Voltage < 3.8V
Enable Conditions	<ul style="list-style-type: none">• Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P10AE Aftertreatment DEF Pump: Reductant Pump "A" Control Low Side Circuit Low

DTC	P10AE
Component / System	Reductant Pump "A" Control Low Side Circuit Low
Monitor Strategy Description	Control Low Side Circuit Low
Fault Limit	Voltage 2.5 - 3.5V
Enable Conditions	<ul style="list-style-type: none"> Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P10AF Aftertreatment DEF Pump: Reductant Pump "A" Control Low Side Circuit High

DTC	P10AF
Component / System	Reductant Pump "A" Control Low Side Circuit High
Monitor Strategy Description	Control Low Side Circuit High
Fault Limit	Voltage 2.5 - 3.5V
Enable Conditions	<ul style="list-style-type: none"> Actuator Duty Cycle 100%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Aftertreatment DEF Pump Direction Valve: Rationality Monitor

After the ignition key is turned to the OFF position the aftertreatment control module (ACM) commands the aftertreatment diesel exhaust fluid (DEF) direction valve ON by grounding the control wire (-). When the aftertreatment DEF direction valve is activated, the DEF reverses flow back to the aftertreatment DEF tank, and aftertreatment DEF absolute pressure is expected to drop.

During reverse DEF flow conditions on a pressurized selective catalytic reduction (SCR) system, pressure drop is evaluated. If DEF pressure drop is too low, the aftertreatment DEF direction valve is considered to have a mechanical fault (blocked or stuck).

P20A1 Aftertreatment DEF Pump Direction Valve: Functional Check

DTC	P20A1
Component / System	Direction Valve -Mechanical Failures
Monitor Strategy Description	DEF pressure too high
Fault Limit	<ul style="list-style-type: none">• DEF pressure > 950 kPa• Time above DEF pressure limit 60 s
Enable Conditions	<ul style="list-style-type: none">• DEF System After Run State Active
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P10AE, P10AF, P208B, P208A, P208C, P208D, P20E8, P2047, P2048, P2049, P204A, P204C, P20A0, P20A2, P20A3
Time Required For DTC To Be Set	60 Seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Aftertreatment DEF Pump Direction Valve: Circuit Monitors

The Aftertreatment DEF Pump is checked for electrical failures.

P20A0 Aftertreatment DEF Pump Direction Valve: Open Circuit

DTC	P20A0
Component / System	Direction Valve - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Valve Voltage < 3.75 V
Enable Conditions	<ul style="list-style-type: none">• Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	10 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P20A3 Aftertreatment DEF Pump Direction Valve: Short Circuit High

DTC	P20A3
Component / System	Direction Valve - High
Monitor Strategy Description	Short Circuit High
Fault Limit	Valve Current > 9 A
Enable Conditions	<ul style="list-style-type: none">• Actuator Duty Cycle 100%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P20A2 Aftertreatment DEF Pump Direction Valve: Short Circuit Low

DTC	P20A2
Component / System	Direction Valve - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Valve Voltage < 1.5 V
Enable Conditions	<ul style="list-style-type: none"> Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Aftertreatment DEF Pump Pressure Sensor: Rationality Monitor

DEF pressure is compared with the expected value when the DEF pump is in initial pressure build-up mode or if the DEF

pressure is above expected value when DEF pump is in idle speed mode.

P204B Aftertreatment DEF Pump Pressure Sensor: Rationality

DTC	P204B
Component / System	Pump Sensor - Rationality
Monitor Strategy Description	DEF pressure > 100 kPa Delay Times: <ul style="list-style-type: none"> Wait for Start State 180 seconds OR Defrost State 10799 seconds
Fault Limit	Monitors the actual pressure vs expected pressure < 100 kPa
Enable Conditions	DEF System States: <ul style="list-style-type: none"> Wait for Start State Active OR Defrost State Active
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> P208A, P208C, P208D, P20E8, P20E8P2047, P2048, P2049, P204A, P204
Time Required For DTC To Be Set	Dependent On State
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Aftertreatment DEF Pump Pressure Sensor: Circuit Monitors

P204A Aftertreatment DEF Pump Pressure Sensor: Open Circuit

DTC	P204A
Component / System	Pump Sensor - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage > 4.9 V
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P204C Aftertreatment DEF Pump Pressure Sensor: Short Circuit Low

DTC	P204C
Component / System	Pump Sensor - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Voltage < 0.11V (0 kPa)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Aftertreatment DEF Level Sensor: Rationality Monitor

P203F Aftertreatment DEF Level Sensor: Reductant Level Low

DTC	P203F
Component / System	Aftertreatment DEF Level Sensor - Low
Monitor Strategy Description	Reductant Level Low
Fault Limit	Reductant level < 0.1%
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P208A, P208C, P208D, P20E8, P20E8P2047, P2048, P2049, P204A, P204
Time Required For DTC To Be Set	15 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P2043 Aftertreatment DEF Level Sensor: Aftertreatment Reagent Tank Temperature Sensor Stuck

DTC	P2043
Component / System	Temperature Sensor - Stuck
Monitor Strategy Description	Signal Plausibility Failure
Fault Limit	<ul style="list-style-type: none">• Rise in DEF Pump Temperature ≤ 2 °C• Evaluation Time 1150 seconds
Enable Conditions	<ul style="list-style-type: none">• DEF System Defrost State Active
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P10AF, P10AE, P208C, P208D, P208A, P204A, P204C, P2049, P2048, P2047, P20E8, P208B
Time Required For DTC To Be Set	1150 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Aftertreatment DEF Level Sensor: Circuit Monitor

P203C Aftertreatment DEF Pump Pressure Sensor: Aftertreatment Reagent Level Short Circuit Low

DTC	P203C
Component / System	Aftertreatment Reagent Level Short Circuit Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Failure mode identifier broadcasted by reductant level sensor = 4
Enable Conditions	<ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • N/A
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Aftertreatment DEF Tank Heater: Rationality Monitor

P20B2 Aftertreatment DEF Tank Heater: Reductant Heater Coolant Control Valve Performance/Stuck Open

DTC	P20B2
Component / System	Reductant Heater Coolant Control Valve Performance/Stuck Open
Monitor Strategy Description	Component or System Operation Obstructed or Blocked
Fault Limit	Rise of Reductant Tank Temperature < 2 °C AND Rise of Reductant Pump Temperature < 2 °C
Enable Conditions	<ul style="list-style-type: none"> • DEF System Defrost State Active
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • ActiveP10AE, P10AF, P2047, P2048, P2049, P204A, P204C, P208A, P208C, P208D, P208B, P20E8, P20B1, P20B3, P20B4
Time Required For DTC To Be Set	150 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Aftertreatment DEF Tank Heater: Circuit Monitors

P20B1 Aftertreatment DEF Tank Heater: Reductant Heater Coolant Control Valve Control

DTC	P20B1
Component / System	Reductant Heater Coolant Control Valve Control
Monitor Strategy Description	Circuit Open
Fault Limit	Valve Voltage < 3.75V
Enable Conditions	<ul style="list-style-type: none">• Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	10 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P20B3 Aftertreatment DEF Tank Heater: Reductant Heater Coolant Control Valve Circuit Low

DTC	P20B3
Component / System	Reductant Heater Coolant Control Valve Circuit Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Valve Voltage < 1.5V
Enable Conditions	<ul style="list-style-type: none">• Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P20B4 Aftertreatment DEF Tank Heater: Reductant Heater Coolant Control Valve Circuit High

DTC	P20B4
Component / System	Reductant Heater Coolant Control Valve Circuit High
Monitor Strategy Description	Short Circuit High
Fault Limit	Valve Current > 9A
Enable Conditions	<ul style="list-style-type: none">• Actuator Duty Cycle 100%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Aftertreatment DEF Line Heater 1: Circuit Monitors

P20B9 Aftertreatment DEF Line Heater 1: Reductant Heater "A" Control Circuit Open

DTC	P20B9
Component / System	Reductant Heater "A" Control
Monitor Strategy Description	Circuit Open
Fault Limit	Heater Voltage < 3.75V
Enable Conditions	<ul style="list-style-type: none">• Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P20BB Aftertreatment DEF Line Heater 1: Aftertreatment Reagent Hose Heater 1 Short Circuit Low

DTC	P20BB
Component / System	Aftertreatment Reagent Hose Heater 1 Short Circuit Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Heater Voltage < 1.5V
Enable Conditions	<ul style="list-style-type: none">• Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P20BC Aftertreatment DEF Line Heater 1: Aftertreatment Reagent Hose Heater 1 Short Circuit High

DTC	P20BC
Component / System	Aftertreatment Reagent Hose Heater 1 Short Circuit High
Monitor Strategy Description	Short Circuit High
Fault Limit	Heater Current > 18A
Enable Conditions	<ul style="list-style-type: none"> Actuator Duty Cycle > 0%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Aftertreatment DEF Line Heater 2: Circuit Monitors

P20C1 Aftertreatment DEF Line Heater 2: Reductant Heater "C" Control

DTC	P20C1
Component / System	Reductant Heater "C" Control
Monitor Strategy Description	Circuit Open
Fault Limit	Heater Voltage < 3.75V
Enable Conditions	<ul style="list-style-type: none"> Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P20C3 Aftertreatment DEF Line Heater 2: Aftertreatment Reagent Hose Heater 3 Short Circuit Low

DTC	P20C3
Component / System	Aftertreatment Reagent Hose Heater 3 Short Circuit Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Heater Voltage < 1.5V
Enable Conditions	<ul style="list-style-type: none">• Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P20C4 Aftertreatment DEF Line Heater 2: Aftertreatment Reagent Hose Heater 3 Short Circuit High

DTC	P20C4
Component / System	Aftertreatment Reagent Hose Heater 3 Short Circuit High
Monitor Strategy Description	Short Circuit High
Fault Limit	Heater Current > 18A
Enable Conditions	<ul style="list-style-type: none">• Actuator Duty Cycle > 0%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Aftertreatment SCR Dosing Valve: Rationality Monitor

During reverse DEF flow conditions on a pressurized selective catalytic reduction (SCR) system, pressure drop is evaluated. If DEF pressure drop is too low, the aftertreatment

DEF direction valve is considered to have a mechanical fault (blocked or stuck).

P208E Aftertreatment SCR Dosing Valve: Aftertreatment Reagent Dosing Valve Clogged

DTC	P208E
Component / System	SCR Dosing Valve - Functional
Monitor Strategy Description	Aftertreatment Reagent Dosing Valve Clogged
Fault Limit	Rise in DEF Pump duty cycle when transition from Low to High Dosing Window < 0.8%
Enable Conditions	<ul style="list-style-type: none">• DEF System Running State Active• SCR Dosing Valve duty cycle > 0% for a time of 60 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	160 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Aftertreatment SCR Dosing Valve: Circuit Monitors

The Aftertreatment SCR Dosing Valve is checked for electrical failures.

P2047 Aftertreatment SCR Dosing Valve: Open Circuit

DTC	P2047
Component / System	SCR Dosing Valve - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Dosing Valve Current < 0.2A
Enable Conditions	<ul style="list-style-type: none">• Actuator Duty Cycle > 0%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P2049 Aftertreatment SCR Dosing Valve: Short Circuit High

DTC	P2049
Component / System	SCR Dosing Valve - High
Monitor Strategy Description	Short Circuit High
Fault Limit	Dosing Valve Current > 10 A
Enable Conditions	<ul style="list-style-type: none">• Actuator Duty Cycle > 0%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P2048 Aftertreatment SCR Dosing Valve: Short Circuit Low

DTC	P2048
Component / System	SCR Dosing Valve - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Dosing Valve Current < 0.4 A
Enable Conditions	<ul style="list-style-type: none">• Actuator Duty Cycle > 0%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

VGT Position Actuator: Electrical Check

The VGT actuator is a Smart Remote Actuator and it has both a rationality check and an electrical monitor. The rationality monitor covers detection of mechanical faults of the actuator, a bad device and a missing signal from the actuator. The electrical check monitors the VGT supply voltage.

Internal Error (Bad Device):

No valid actuator command transmitted for longer than a calibrated period of time.

CAN Communication (Missing Signal):

No CAN command received for longer than a calibrated period of time; Corresponding with SAE J1939 Datalink #3 (Engine Subnet) (U010C).

Mechanical Fault:

Detects actuator mechanical faults.

P0046 VGT Position Actuator: VGT Mechanical Fault

DTC	P0046
Component / System	Actuator Rationality
Monitor Strategy Description	VGT Mechanical Fault
Fault Limit	Time with mechanical fault reported from the VGT > 200ms
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V• Enable Delay Time 10 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• U0080
Time Required For DTC To Be Set	10 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P2563 VGT Position: Cannot Reach the Demanded Position

DTC	P2563
Component / System	VGT Position
Monitor Strategy Description	Cannot reach the demanded VGT position.
Fault Limit	Ratio = Fault Timer (incremented when VGT Cntrl Flag is TRUE) / (Evaluation Timer) > 90 %
Enable Conditions	<ul style="list-style-type: none">• Engine Coolant Temperature > 65 °C• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Engine Torque 1200 - 3000 Nm• Engine Speed 1450 - 1800 RPM• VGT Position (rate of change) -10 - 10%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0335, P0336, P2578, P0489, P0403, P006E, P00AF, P0046, P1148, P040C, P040A, P0072, P0070, P0097, P0095, P0117, P0115, P0406, P0409, P2229, P2226, P0108, P0105
Time Required For DTC To Be Set	15 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P00AF VGT Position Actuator: Bad Device

DTC	P00AF
Component / System	Actuator Rationality
Monitor Strategy Description	Bad device
Fault Limit	Time with internatl Error reported from the VGT > 20ms
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V• Enable Delay Time 10 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• U0080
Time Required For DTC To Be Set	10 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

U010C VGT Position Actuator: Missing Signal

DTC	U010C
Component / System	Actuator Missing Signal
Monitor Strategy Description	VGT Actuator Communication
Fault Limit	Time with lost communication with VGT > 250ms
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V• Enable Delay Time 3 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• U0080
Time Required For DTC To Be Set	< 1 second
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

VGT Position Actuator: Circuit Monitors

The electrical check monitors the VGT supply voltage and if the supply voltage is below the threshold value a DTC is set.

P006E VGT Position Actuator: Low Supply Voltage

DTC	P006E
Component / System	Actuator - Low
Monitor Strategy Description	VGT Actuator Electrical Check
Fault Limit	Time with supply voltage error reported from the VGT > 1.8s
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V• Enable Delay Time 10 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• U0080
Time Required For DTC To Be Set	10 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

EGR Valve Actuator: Circuit Monitors

The EGR valve actuator is checked for electrical circuit checks by monitoring the current.

P0403 EGR Valve Actuator: Open Circuit

DTC	P0403
Component / System	Actuator - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Valve Current < 0.15 A
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	1 second
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0489 EGR Valve Actuator: Short Circuit Low

DTC	P0489
Component / System	Actuator - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Valve Current > 2.7 A
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Engine Fuel Injectors: Injectors 1 through 6: Circuit Monitors

The injection diagnostic function monitors that current level reaches specified levels, defined by the supplier, within the correct time span, typically specified with a minimum time

and a maximum time. The evaluation of the current is made for every injection pulse and throughout the complete pulse.

P0262 Engine Fuel Injectors: Short Circuit High (Injector 1)

DTC	P0262
Component / System	Injector 1 - High
Monitor Strategy Description	Short Circuit High
Fault Limit	<ul style="list-style-type: none">• Injector current valid peak event > 9 A• Number of injections with failure detected > 3
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	2 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0265 Engine Fuel Injectors: Short Circuit High (Injector 2)

DTC	P0265
Component / System	Injector 2 - High
Monitor Strategy Description	Short Circuit High
Fault Limit	<ul style="list-style-type: none">• Injector current valid peak event > 9 A• Number of injections with failure detected > 3
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	2 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0268 Engine Fuel Injectors: Short Circuit High (Injector 3)

DTC	P0268
Component / System	Injector 3 - High
Monitor Strategy Description	Short Circuit High
Fault Limit	<ul style="list-style-type: none">• Injector current valid peak event > 9 A• Number of injections with failure detected > 3
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	2 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0271 Engine Fuel Injectors: Short Circuit High (Injector 4)

DTC	P0271
Component / System	Injector 4 - High
Monitor Strategy Description	Short Circuit High
Fault Limit	<ul style="list-style-type: none">• Injector current valid peak event > 9 A• Number of injections with failure detected > 3
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	2 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0274 Engine Fuel Injectors: Short Circuit High (Injector 5)

DTC	P0274
Component / System	Injector 5 - High
Monitor Strategy Description	Short Circuit High
Fault Limit	<ul style="list-style-type: none">• Injector current valid peak event > 9 A• Number of injections with failure detected > 3
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	2 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0277 Engine Fuel Injectors: Short Circuit High (Injector 6)

DTC	P0277
Component / System	Injector 6 - High
Monitor Strategy Description	Short Circuit High
Fault Limit	<ul style="list-style-type: none">• Injector current outside of valid peak event > 9 A• Number of injections with SCH detected > 3
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	2 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0201 Engine Fuel Injectors: Short Circuit Low (Injector 1)

DTC	P0201
Component / System	Injector 1 - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	<ul style="list-style-type: none">• Injector current outside of valid peak event > 9 A• Number of injections with failure detected > 3
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	2 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0202 Engine Fuel Injectors: Short Circuit Low (Injector 2)

DTC	P0202
Component / System	Injector 2 - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	<ul style="list-style-type: none">• Injector current outside of valid peak event > 9 A• Number of injections with failure detected > 3
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	2 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0203 Engine Fuel Injectors: Short Circuit Low (Injector 3)

DTC	P0203
Component / System	Injector 3 - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	<ul style="list-style-type: none">• Injector current outside of valid peak event > 9 A• Number of injections with failure detected > 3
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	2 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0204 Engine Fuel Injectors: Short Circuit Low (Injector 4)

DTC	P0204
Component / System	Injector 4 - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	<ul style="list-style-type: none">• Injector current outside of valid peak event > 9 A• Number of injections with failure detected > 3
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	2 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0205 Engine Fuel Injectors: Short Circuit Low (Injector 5)

DTC	P0205
Component / System	Injector 5 - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	<ul style="list-style-type: none">• Injector current outside of valid peak event > 9 A• Number of injections with failure detected > 3
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	2 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0206 Engine Fuel Injectors: Short Circuit Low (Injector 6)

DTC	P0206
Component / System	Injector 6 - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	<ul style="list-style-type: none">• Injector current outside of valid peak event > 9 A• Number of injections with failure detected > 3
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	2 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Ambient Air Temperature Sensor (AAT): Rationality Monitor

The rationality monitor for the ambient air temperature sensor monitors for missing signal from the sensor. If the sensor signal is missing for a specified time the rationality DTC is set.

P0071 Ambient Air Temperature Sensor (AAT): Circuit "A" Range / Performance

DTC	P0071
Component / System	AAT Sensor - Range/Performance
Monitor Strategy Description	Temperature sensor rationality check at start up after a 8 hour soak time
Fault Limit	$\Delta = (\text{Average Ambient Air Temperature}) - (\text{mean}(\text{average Pre-DOC Temp, average Post DOC Temp, average Post DPF temp})) > 40 \text{ }^\circ\text{C (absolute)}$
Enable Conditions	Pre Crank: <ul style="list-style-type: none">• Key On• Engine Speed < 100 RPM• Soak Time \geq 8 hours• Enable Delay \geq 2 seconds• Reset Pre-crank delay \geq 3.5 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0335, P0336, P0072, P0070, P0117, P0115, P0097, P0095, P2229, P2226, P040A, P040C, P0545, P0544, P0110, P0112, P205A, P205C
Time Required For DTC To Be Set	3 Seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Ambient Air Temperature Sensor (AAT): Circuit Monitors

The rationality monitor for the ambient air temperature sensor monitors for missing signal from the sensor. If the sensor signal is missing for a specified time the rationality DTC is set.

P0070 Ambient Air Temperature Sensor (AAT): Open Circuit

DTC	P0070
Component / System	AAT - Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage > 90 °C (4.5V)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0072 Ambient Air Temperature Sensor (AAT): Short Circuit Low

DTC	P0072
Component / System	AAT - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Voltage < -55 °C (0.5 V)
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Wheel Based Vehicle Speed: Vehicle Speed Sensor (VSS): Rationality Monitor

The VECU performs a rationality check on the computed road speed by comparing it with that reported by the ABS.

Deviations between signals greater than a pre-set value cause a fault to be reported on the network.

P215A Wheel Based Vehicle Speed: Vehicle Speed Sensor (VSS): Rationality

DTC	P215A
Component / System	VSS - Rationality
Monitor Strategy Description	Input Other Rationality
Fault Limit	Difference between vehicle speed and ABS > 12 km/h
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Vehicle Speed > 0 km/h• Road Speed from ABS > 0 km/h
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	17 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Wheel Based Vehicle Speed: Vehicle Speed Sensor (VSS): Circuit Monitors

The VECU performs circuit checks of the sensor when the road speed is zero.

P0500 Wheel Based Vehicle Speed: Vehicle Speed Sensor (VSS): Open Circuit

DTC	P0500
Component / System	VSS - Open
Monitor Strategy Description	Input Open Circuit
Fault Limit	Sensor Voltage: <ul style="list-style-type: none">• For inductive sensor > 3.75 V• For hall effect sensor > 5V
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Vehicle Speed 0 km/h• Road Speed from ABS 0 km/h
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P0502 Wheel Based Vehicle Speed: Vehicle Speed Sensor (VSS): Short Circuit Low

DTC	P0502
Component / System	VSS - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Voltage: <ul style="list-style-type: none">• For inductive sensor < 2.5 V• For hall effect sensor < 0V
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Vehicle Speed 0 km/h• Road Speed from ABS 0 km/h
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	7 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Accelerator Pedal Position #1 Sensor: Rationality Monitors

The VECU performs diagnostics on the analog voltages read from the Accelerator Pedal Position Sensor and the Idle Validation Switch (IVS).

P2109 Accelerator Pedal Position Sensor: Rationality Low

DTC	P2109
Component / System	APP - Rationality Low
Monitor Strategy Description	Pedal position switch rationality - low
Fault Limit	Sensor Voltage < 0.65V
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5.5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P2163 Accelerator Pedal Position Sensor: Rationality High

DTC	P2163
Component / System	APP - Rationality High
Monitor Strategy Description	Pedal position switch rationality - high
Fault Limit	Sensor Voltage > 1.0V
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5.5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Accelerator Pedal Position Sensor: Circuit Monitors

P0122 Accelerator Pedal Position Sensor: Below Range

DTC	P0122
Component / System	APP - Low
Monitor Strategy Description	Below range
Fault Limit	Sensor Voltage < 0.35 V
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5.5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P0123 Accelerator Pedal Position Sensor: Above Range

DTC	P0123
Component / System	APP - High
Monitor Strategy Description	Above range
Fault Limit	Sensor Voltage > 4.25 V
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5.5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Parking Brake Switch: Electrical Check

P05E4 Parking Brake Switch: Short Circuit Low

DTC	P05E4
Component / System	Parking Brake Switch
Monitor Strategy Description	Short Circuit Low
Fault Limit	Time with applied parking brake > 10s
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V• Vehicle Speed > 2 km/h
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0500, P0502, P215A
Time Required For DTC To Be Set	10 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

5 Volt ECM Supply: Supply #1

The 5 Volt sensor supplies are located in the Engine Electronic Control Unit (EECU). Some sensors, especially pressure sensors, require 5 Volt supply to operate. They are fed by three 5 Volt supplies in the EECU (referred as #1, #2 and

#3 below). If the 5 Volt supply fails or the feed is shorted to ground or battery the above/below range monitoring reports this. If it occurs, none of the readings from the sensors connected to the failing supply is reliable.

P06B1 ECM Supply #1: Below Range

DTC	P06B1
Component / System	ECM Supply #1
Monitor Strategy Description	Below range
Fault Limit	Voltage Sensed < 4.5V
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5.5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P06B2 ECM Supply #1: Above Range

DTC	P06B2
Component / System	ECM Supply #1
Monitor Strategy Description	Above range
Fault Limit	Voltage Sensed > 5.5V
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5.5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

5 Volt ECM Supply: Supply #2

P06B4 ECM Supply #2: Below Range

DTC	P06B4
Component / System	ECM Supply #2
Monitor Strategy Description	Below range
Fault Limit	Voltage Sensed < 4.5V
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5.5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P06B5 ECM Supply #2: Above Range

DTC	P06B5
Component / System	ECM Supply #2
Monitor Strategy Description	Above range
Fault Limit	Voltage Sensed > 5.5V
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5.5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

5 Volt ECM Supply: Supply #3

P06E7 ECM Supply #3: Below Range

DTC	P06E7
Component / System	ECM Supply #3
Monitor Strategy Description	Below range
Fault Limit	Voltage Sensed < 4.5V
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5.5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P06E8 ECM Supply #3: Above Range

DTC	P06E8
Component / System	ECM Supply #3
Monitor Strategy Description	Above range
Fault Limit	Voltage Sensed > 5.5V
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5.5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Data Link Communication: CAN Links

The Engine ECU software monitors CAN messages received by the Engine ECU for detection of lost data link communication to other ECU's. In addition, the ECU monitors the electrical behavior of the data buses. It cannot detect electrical failures, but "bus off" conditions, where it is not possible to send data. The bus off conditions are monitored and a fault code set if such a condition occurs on any of the datalinks. "Bus off" conditions are typically related to electrical problems with the CAN harness.

The EECU monitors bus off conditions on the following datalinks:

- Backbone 1, 250kbit medium speed CAN communication bus
- Backbone 2, 500kbit High speed CAN communication bus
- Engine subnet, 250kbit medium speed CAN communication bus
- Powertrain CAN, 500kbit High speed CAN communication bus

U0010 CAN Link: SAE J1939-1 Missing Signal

DTC	U0010
Component / System	SAE J1939 Datalink # 1 (Public)
Monitor Strategy Description	Missing Signal
Fault Limit	Time Missing Signal > 5.5 seconds
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5.5 seconds
MIL Illumination	1 Drive Cycle
Probable Causes	<i>See Tech Tool</i>

U0080 CAN Link: Powertrain CAN Missing Signal

DTC	U0080
Component / System	SAE J1939 Datalink # 2 (Powertrain)
Monitor Strategy Description	Missing Signal
Fault Limit	Time Missing Signal > 5.5 seconds
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5.5 seconds
MIL Illumination	1 Drive Cycle
Probable Causes	<i>See Tech Tool</i>

U0155 CAN Link: Lost Communication With Instrument Panel Cluster (IPC) Control Module

DTC	U0155
Component / System	IPC - Missing
Monitor Strategy Description	Lost Communication With Instrument Panel Cluster (IPC) Control Module
Fault Limit	Time Out > 100 seconds
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• U0010
Time Required For DTC To Be Set	100 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

U116F CAN Link: Missing ACM at Engine Subnet

DTC	U116F
Component / System	ACM
Monitor Strategy Description	Missing Signal
Fault Limit	Time Missing Signal > 5 seconds
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• U0080
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

U0141 CAN Link: Missing Signal from the VECU

DTC	U0141
Component / System	VECU
Monitor Strategy Description	Missing Signal
Fault Limit	Time Missing Signal > 0.1 seconds
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• U0010
Time Required For DTC To Be Set	< 1 second
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

U0001 CAN Link: Missing Signal on Backbone 2

DTC	U0001
Component / System	ISO 15765 Datalink
Monitor Strategy Description	Missing Signal
Fault Limit	Time Missing Signal > 5.5 seconds
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5.5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

U010E CAN Link: Lost Communication With Aftertreatment Control Module

DTC	U010E
Component / System	ACM
Monitor Strategy Description	Missing Signal
Fault Limit	Time Missing Signal > 5 seconds
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• U0010
Time Required For DTC To Be Set	5.5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Idle Engine Speed: Idle Engine Speed Rationality

When engine is in idle governor mode fueling is controlled to get target idle speed. If the idle governor is not able to control the engine speed above 500 rpm an idle speed low fault code

is logged. If idle governor is not able to control the engine speed below 750 rpm an idle speed high fault code is logged.

P0506 is for low speed and P0507 is for high speed.

P0506 Idle Engine Speed Rationality: Idle Speed Low

DTC	P0506
Component / System	Idle speed - Rationality Low
Monitor Strategy Description	Flywheel based idle speed validation
Fault Limit	Average engine speed < 500 RPM Note: Calculated during 5 second evaluation period.
Enable Conditions	<ul style="list-style-type: none"> • Engine Coolant Temperature > 65 °C • Barometric Pressure 75 - 105 kPa • Ambient Air Temperature -8 - 55 °C • Engine Torque > 0 Nm • Vehicle Speed < 0.1 km/h • PTO Not Active • Engine Speed rate of change < 100 RPM/s (absolute value) • Engine Torque rate of change < 100 RPM/s (absolute value) • Enable delay 5 seconds • Engine run time after engine start > 60 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0117, P0115, P2229, P0340, P0335, P0070, P0072, P2226, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206, P0339, P0336, P0016, P0341
Time Required For DTC To Be Set	10 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P0507 Idle Engine Speed Rationality: Idle Speed High

DTC	P0507
Component / System	Idle speed - Rationality High
Monitor Strategy Description	Flywheel based idle speed validation
Fault Limit	Average engine speed > 750 RPM Note: Calculated during 5 second evaluation period.
Enable Conditions	<ul style="list-style-type: none">• Engine Coolant Temperature > 65 °C• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Engine Torque > 0 Nm• Vehicle Speed < 0.1 km/h• PTO Not Active• Engine Speed rate of change < 100 RPM/s (absolute value)• Engine Torque rate of change < 100 RPM/s (absolute value)• Enable delay 5 seconds• Engine run time after engine start > 60 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0117, P0115, P2229, P0340, P0335, P0070, P0072, P2226, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206, P0339, P0336, P0016, P0341
Time Required For DTC To Be Set	10 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

Idle Engine Speed: Idle Engine Fuel Rationality

Fuel Rationality Low:

Nominal idle fuel rate (based on engineering analysis) can be as low as 10mm³/stroke and as high as 100mm³/stroke due to various installation differences and activations of various features (AC, air compressor, alternator etc). Diagnostics is set up to detect 50% lower than the lowest possible idle fuel rates. When engine is in idle governor mode (or fuel limiter mode) if the required fueling is below limit idle fuel low fault code is logged.

Fuel Rationality High:

Nominal idle fuel rate (based on engineering analysis) can be as low as 10mm³/stroke and as high as 100mm³/stroke due to various installation differences and activations of various features (AC, air compressor, alternator etc). Diagnostics is set up to detect 50% higher than the highest possible and 50% lower than lowest possible idle fuel rates. When engine is in idle governor mode (or fuel limiter mode) if the required fueling is above limit idle fuel high fault code is logged.

P054E Idle Engine Fuel Rationality: Fuel Rationality Low

DTC	P054E
Component / System	Idle speed - Fuel Rationality low
Monitor Strategy Description	Low fuel validation at idle
Fault Limit	Average fuel quantity in each injection < 5mg/stroke Note: Calculated for the 185 second evaluation period.
Enable Conditions	<ul style="list-style-type: none"> • Engine Coolant Temperature > 65 °C • Barometric Pressure 75 - 105 kPa • Ambient Air Temperature -8 - 55 °C • Engine Torque > 0 Nm • Vehicle Speed < 0.1 km/h • PTO Not Active • Engine Speed rate of change < 100 RPM/s (absolute value) • Engine Torque rate of change < 100 RPM/s (absolute value) • Enable delay 5 seconds • Engine run time after engine start > 60 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • P0117, P0115, P2229, P0340, P0335, P0070, P0072, P2226, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206, P0339, P0336, P0016, P0341
Time Required For DTC To Be Set	190 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

P054F Idle Engine Fuel Rationality: Fuel Rationality High

DTC	P054F
Component / System	Idle speed - Fuel Rationality high
Monitor Strategy Description	High fuel validation at idle
Fault Limit	Average fuel quantity in each injection > 50 mg/stroke Note: Calculated for the 185 second evaluation period.
Enable Conditions	<ul style="list-style-type: none">• Engine Coolant Temperature > 65 °C• Barometric Pressure 75 - 105 kPa• Ambient Air Temperature -8 - 55 °C• Engine Torque > 0 Nm• Vehicle Speed < 0.1 km/h• PTO Not Active• Engine Speed rate of change < 100 RPM/s (absolute value)• Engine Torque rate of change < 100 RPM/s (absolute value)• Enable delay 5 seconds• Engine run time after engine start > 60 seconds
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0117, P0115, P2229, P0340, P0335, P0070, P0072, P2226, P0262, P0201, P0265, P0202, P0268, P0203, P0271, P0204, P0274, P0205, P0277, P0206, P0339, P0336, P0016, P0341
Time Required For DTC To Be Set	190 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

5 Volt ACM Sensor Supply: Supply #1

The 5 Volt sensor supplies are located in the Aftertreatment Control Module (ACM). Some sensors require a 5 Volt supply to operate. They are fed by two 5 Volt supplies in the ACM

(referred as #1 and #2 below). If the 5 Volt supply fails or is shorted the above/below range monitoring reports.

P06B1 ACM Sensor Supply #1: Below Range

DTC	P06B1
Component / System	ACM Sensor Supply #1
Monitor Strategy Description	Below range
Fault Limit	Voltage Sensed < 4.5V
Enable Conditions	<ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • N/A
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P06B2 ACM Sensor Supply #1: Above Range

DTC	P06B2
Component / System	ACM Sensor Supply #1
Monitor Strategy Description	Above range
Fault Limit	Voltage Sensed > 5.5V
Enable Conditions	<ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none"> • N/A
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

5 Volt ACM Sensor Supply: Supply #2

P06B4 ACM Sensor Supply #2: Below Range

DTC	P06B4
Component / System	ACM Sensor Supply #2
Monitor Strategy Description	Below range
Fault Limit	Voltage Sensed < 4.5V
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P06B5 ACM Sensor Supply #2: Above Range

DTC	P06B5
Component / System	ACM Sensor Supply #2
Monitor Strategy Description	Above range
Fault Limit	Voltage Sensed > 5.5V
Enable Conditions	<ul style="list-style-type: none">• Key On Active• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Actuator Supply #1 ACM: Circuit Monitors

P0658 Actuator Supply #1 ACM: Short Circuit Low

DTC	P0658
Component / System	Actuator Supply #1 ACM - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Voltage Supply < 8V
Enable Conditions	<ul style="list-style-type: none">• Actuator Duty Cycle \geq 100 %
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5.5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0659 Actuator Supply #1 ACM: Short Circuit High

DTC	P0659
Component / System	Actuator Supply #1 ACM - High
Monitor Strategy Description	Short Circuit High
Fault Limit	Current Supply > 18 A
Enable Conditions	<ul style="list-style-type: none">• Actuator Duty Cycle \leq 0%• Battery Voltage > 8V
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	5.5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Actuator Supply #2 ACM: Circuit Monitors

P26E8 Actuator Supply #2 ACM: Short Circuit Low

DTC	P26E8
Component / System	Actuator Supply #2 ACM - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Voltage Supply < 8V
Enable Conditions	<ul style="list-style-type: none">• Actuator Duty Cycle 100%
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

ACM Supply: Circuit Monitors

P0562 ACM Supply: ACM Battery Potential Below Range

DTC	P0562
Component / System	ACM Battery Potential Below Range
Monitor Strategy Description	Battery Potential Below Range
Fault Limit	ACM Supply Voltage < 8V
Enable Conditions	<ul style="list-style-type: none">• Key On Active
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	1 second
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

P0563 ACM Supply: ACM Battery Potential Above Range

DTC	P0563
Component / System	ACM Battery Potential Above Range
Monitor Strategy Description	Battery Potential Above Range
Fault Limit	ACM Supply Voltage > 36V
Enable Conditions	<ul style="list-style-type: none">• Key On Active
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• N/A
Time Required For DTC To Be Set	1 second
MIL Illumination	2 Drive Cycles
Probable Causes	<i>See Tech Tool</i>

Real Time Clock Monitor

The ECM receives real time clock values from the instrument cluster once every second. The purpose of the Real Time Clock Monitor is to evaluate the performance and consistency of the real time clock while the engine is operating. The evaluation is performed by capturing a timestamp and then

comparing the current real time clock value against the timestamp over a timed period. Once the time period has elapsed, the monitor will capture a new timestamp and a new evaluation cycle will begin. The evaluations will occur continuously as long as the engine is running.

U3017 Real Time Clock: Abnormal Rate of Change

DTC	U3017
Component / System	Real Time Clock - Abnormal Rate of Change
Monitor Strategy Description	Abnormal rate of change
Fault Limit	Delta = Time Stamp - Real Time Clock Value > 1560 Seconds
Enable Conditions	<ul style="list-style-type: none">• Key On• Engine Speed > 500 RPM
Disable Conditions	No Active DTC's: <ul style="list-style-type: none">• P0115, P0117, U0155
Time Required For DTC To Be Set	1080 Seconds
MIL Illumination	2 Drive Cycles
Probable Causes	See Tech Tool

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