Service Information

Volvo Trucks

Engine Control Module (ECM),

Aftertreatment Control Module (ACM) Diagnostic Trouble Codes Group 28

Release 02

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 December 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.

The new edition of this manual will update the changes.

In service procedures where the title incorporates an operation number, this is a reference to an V.S.T. (Volvo Standard Times).

Service procedures which do not include an operation number in the title are for general information and no reference is made to an V.S.T.

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.

Volvo Trucks North America, a division of Volvo Group North America, Inc.
Greensboro, NC USA

Order number: PV776-89149152

©2014 Volvo Group North America, Inc., Greensboro, NC USA

Troubleshooting

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.

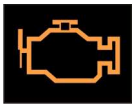
The system contains the following “emission critical” ECUs that are monitored;

- 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.



W2036007

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 break-down 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 µC 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)

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 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) Diagnosis can only be performed once per driving cycle.
Enable Conditions	• Engine Coolant Temperature 65 - 110 °C • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 120 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 - 460 °C • Post DOC temperature 200 - 460 °C • Post DPF temperature 200 - 460 °C • Modeled exhaust flow > 0 kg/s • AHI duty cycle < 0.1% • Cold Start Emission Reduction Strategy Active • Enable Delay 1s
Disable Conditions **Note:** The diagnosis can be performed only once per driving cycle.	No Active DTC's: • 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 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)
Enable Conditions	• Engine Coolant Temperature 65 - 110 °C • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 120 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 - 460 °C • Post DOC temperature 200 - 460 °C • Post DPF temperature 200 - 460 °C • Modeled exhaust flow > 0 kg/s • AHI duty cycle < 0.1% • Cold Start Emission Reduction Strategy Active • Enable Delay 1s
Disable Conditions **Note:** The diagnosis can be performed only once per driving cycle.	No Active DTC's: • 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

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 it's 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 it's 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.

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

DTC	P02CC
Component / System	Cylinder 1 Fuel Injector Offset □Low
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	• 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 > 45 °C • VGT Position 0 - 40% • Engine Speed rate of change < 1000 RPM/s (cal out) • Engine Torque rate of change < 1000 Nm/s (cal out) • Cold Start Emission Reduction Strategy Not Active
Disable Conditions	No Active DTC's: • 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	420s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P02CD
Component / System	Cylinder 1 Fuel Injector Offset — High
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	• 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 > 45 °C • VGT Position 0 - 40% • Engine Speed rate of change < 1000 RPM/s (cal out) • Engine Torque rate of change < 1000 Nm/s (cal out) • Cold Start Emission Reduction Strategy Not Active
Disable Conditions	No Active DTC's: • 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	Cylinder 2 Single Cylinder Fueling Offset – Low
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	• 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 > 45 °C • VGT Position 0 - 40% • Engine Speed rate of change < 1000 RPM/s • Engine Torque rate of change < 1000 Nm/s • Cold Start Emission Reduction Strategy Not Active
Disable Conditions	No Active DTC's: • 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	Cylinder 2 Single Cylinder Fueling Offset – High
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	• 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 > 45 °C • VGT Position 0 - 40% • Engine Speed rate of change < 1000 RPM/s (cal out) • Engine Torque rate of change <1000 Nm/s (cal out) • Cold Start Emission Reduction Strategy Not Active
Disable Conditions	No Active DTC's: • 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	Cylinder 3 Single Cylinder Fueling Offset – Low
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	• 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 > 45 °C • VGT Position 0 - 40% • Engine Speed rate of change < 1000 RPM/s • Engine Torque rate of change < 1000 Nm/s • Cold Start Emission Reduction Strategy Not Active
Disable Conditions	No Active DTC's: • 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	Cylinder 3 Single Cylinder Fueling Offset – High
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	• 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 > 45 °C • VGT Position 0 - 40% • Engine Speed rate of change < 1000 RPM/s (cal out) • Engine Torque rate of change < 1000 Nm/s (cal out) • Cold Start Emission Reduction Strategy Not Active
Disable Conditions	No Active DTC's: • 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	Cylinder 4 Single Cylinder Fueling Offset – Low
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	• 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 > 45 °C • VGT Position 0 - 40% • Engine Speed rate of change < 1000 RPM/s (cal out) • Engine Torque rate of change < 1000 Nm/s (cal out) • Cold Start Emission Reduction Strategy Not Active
Disable Conditions	No Active DTC's: • 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	Cylinder 4 Single Cylinder Fueling Offset – High
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	• 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 > 45 °C • VGT Position 0 - 40% • Engine Speed rate of change < 1000 RPM/s (cal out) • Engine Torque rate of change < 1000 Nm/s (cal out) • Cold Start Emission Reduction Strategy Not Active
Disable Conditions	No Active DTC's: • 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	Cylinder 5 Single Cylinder Fueling Offset – Low
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	• 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 > 45 °C • VGT Position 0 - 40% • Engine Speed rate of change < 1000 RPM/s (cal out) • Engine Torque rate of change < 1000 Nm/s (cal out) • Cold Start Emission Reduction Strategy Not Active
Disable Conditions	No Active DTC's: • 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	Cylinder 5 Single Cylinder Fueling Offset – High
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	• 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 > 45 °C • VGT Position 0 - 40% • Engine Speed rate of change < 1000 RPM/s (cal out) • Engine Torque rate of change < 1000 Nm/s (cal out) • Cold Start Emission Reduction Strategy Not Active
Disable Conditions	No Active DTC's: • 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	Cylinder 6 Single Cylinder Fueling Offset – Low
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	• 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 > 45 °C • VGT Position 0 - 40% • Engine Speed rate of change < 1000 RPM/s (cal out) • Engine Torque rate of change < 1000 Nm/s (cal out) • Cold Start Emission Reduction Strategy Not Active
Disable Conditions	No Active DTC's: • 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	• 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 > 45 °C • VGT Position 0 - 40% • Engine Speed rate of change < 1000 RPM/s (cal out) • Engine Torque rate of change < 1000 Nm/s (cal out) • Cold Start Emission Reduction Strategy Not Active
Disable Conditions	No Active DTC's: • 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 it's 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	• 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 • Accelerator Pedal Position 0% • PTO Not Active • Enable Delay 10 seconds • Engine run time after engine start > 60 seconds
Disable Conditions	No Active DTC's: • 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	15s at continuous idle **or** 100s (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	• Engine Coolant Temperature > 65 °C • Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55 °C • Engine Speed 450 - 750 RPM • Engine Torque > 0 Nm • Vehicle Speed < 0.1 km/h • Accelerator Pedal Position 0% • PTO Not Active • Enable Delay 10s • Engine run time after engine start > 60s
Disable Conditions	No Active DTC's: • 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	15s at continuous idle **or** 100s (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	• Engine Coolant Temperature > 65 °C • Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55 °C • Engine Speed 450 - 750 RPM • Engine Torque > 0 Nm • Vehicle Speed < 0.1 km/h • Accelerator Pedal Position 0% • PTO Not Active • Enable Delay 10s • Engine run time after engine start > 60s
Disable Conditions	No Active DTC's: • 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	15s continuous idle **or** 100s (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	• Engine Coolant Temperature > 65 °C • Barometric Pressure 75 - 120 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 • Enable Delay 10s • Engine run time after engine start > 60s
Disable Conditions	No Active DTC's: • 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	15s at continuous idle **or** 100s (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	• Engine Coolant Temperature > 65 °C • Barometric Pressure 75 - 120 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 • Enable Delay 10s • Engine run time after engine start > 60s
Disable Conditions	No Active DTC's: • 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	15s 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	• Engine Coolant Temperature > 65 °C • Barometric Pressure 75 - 120 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 • Enable Delay 10s • Engine run time after engine start > 60s
Disable Conditions	No Active DTC's: • 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	• Engine Coolant Temperature > 65 °C • Barometric Pressure 75 - 120 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 • Enable Delay 10s • Engine run time after engine start > 60s
Disable Conditions	No Active DTC's: • 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	15s at continuous idle **or** 100s (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.

Ratio = Measured EGR mass flow 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) < 66%
Enable Conditions	• Ambient Air Temperature –8–55°C • Barometric Pressure 75 –120 kPa • Engine Coolant Temperature > 60°C • Engine Speed 1300 - 2200 RPM • Engine Torque 1500 - 2600 Nm • EGR Mass Flow Demand Ratio 0.2 - 0.6 ratio • EGR Mass Flow Demand 0.01 - 0.4 kg/s • EGR Mass Flow Demand Rate of Change - 0.01 - 0.02 kg/s^2 • Engine Torque Rate of Change -20 - 20 Nm/s • Engine Speed Rate of Change -5 - 20 RPM/s • EGR Valve Position 80 - 100 % • Enable Delay 2s
Disable Conditions	No Active DTC's: • 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	4s
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) > 850%
Enable Conditions	• Ambient Air Temperature -8-55°C • Barometric Pressure 75-120 kPa • Engine Coolant Temperature > 60°C • Engine Speed 600 - 2000 RPM • Engine Torque 1000 - 3000 Nm • EGR Mass Flow Demand Ratio 0 - 0.25 ratio • EGR Mass Flow Demand 0 - 0.1 kg/s • EGR Mass Flow Demand Rate of Change - 0.030 - 0.015 kg/s • Engine Torque Rate of Change 100 - 400 Nm/s • Engine Speed Rate of Change 0 – 200 RPM/s • EGR Valve Position 0 - 90% • Enable delay 1s
Disable Conditions	No Active DTC's: • 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	3s
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

<table>
<tr><td>DTC</td><td colspan="3">P240F</td></tr>
<tr><td>Component / System</td><td colspan="3">EGR System - Slow Response</td></tr>
<tr><td>Monitor Strategy Description</td><td colspan="3">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.</td></tr>
<tr><td>Fault Limit</td><td colspan="2">Decreasing
ABS Delta = (Average Demanded EGR Flow) - (Average Actual EGR Flow) < 0.035 kg/s
after an evaluation time of 2s</td><td>Increasing
ABS Delta = (Average Demanded EGR Flow) - (Average Actual EGR Flow) < 0.025 kg/s
after an evaluation time of 2s</td></tr>
<tr><td>Enable Conditions</td><td colspan="2">Common Enable Conditions
Ambient Air Temperature –8–55°C
Barometric Pressure 75–120 kPa
Engine Coolant Temperature > 60°C
SCR Average Temperature > 200°C
Engine Speed 1400–2000 RPM
Engine Torque 500 –1200 Nm
Engine Speed Rate of Change –200 – 200 RPM/s
Engine Torque Rate of Change –500 – 500 Nm/s</td><td>Enable Conditions for Sequence Request
EGR Mass Flow Demand 0.0 – 0.2 kg/s
EGR Valve Position 50 –100%
Engine Speed Rate of Change –20 – 20 RPM/s
Engine Torque Rate of Change –60 – 60 Nm/s
Enable Delay 2s
Enable Restart Time 600s</td></tr>
<tr><td>Disable Conditions</td><td colspan="3">No Active DTC's:
P0406, P0409, P0489, P0403, P0105, P0108, P006E, P00AF, P0046, P1148, P0095, P0097, P040A, P040C</td></tr>
<tr><td>Time Required For DTC To Be Set</td><td>Total
4s (2s + 2s)</td><td>Decreasing
2s</td><td>Increasing
2s</td></tr>
<tr><td>MIL Illumination</td><td colspan="3">2 Drive Cycles</td></tr>
<tr><td>Probable Causes</td><td colspan="3">See Tech Tool</td></tr>
</table>

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 EGR Control
Monitor Strategy Description	Excessive Time To Enter Closed Loop EGR Control
Fault Limit	• Coolant Temperature After Evaluation Time < 20 °C
Enable Conditions	• Engine Speed > 750 RPM • Engine Torque > 500 Nm • Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -40 - 55°C • Modeled Coolant Temperature > 20°C • Enable Delay 5s
Disable Conditions	No Active DTC's: • P0335, P0336, P0072, P0070, P0097, P0095, P0117, P0115, P2229, P2226, P0108, P0105
Time Required For DTC To Be Set	150s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Engine Coolant Temperature > 60 °C • Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55 °C • Engine Speed 1400 - 1800 RPM • Engine Torque 1100 - 1700 Nm • Estimated Exhaust Mass Flow 0.2 - 0.6 kg/s • Engine Speed Rate of Change -25 - 25 RPM • Engine Torque Rate of Change -70 - 120 Nm/s • Estimated Exhaust Mass Flow Rate of Change -0.04 - 0.1 kg/s • EGR Vale Position 40 - 101% • Enable Delay 1s
Disable Conditions	No Active DTC's: • 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	15s
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	• Engine Coolant Temperature > 60 °C • Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55 °C • Engine Speed 1400 - 1800 RPM • Engine Torque 1100 - 1700 Nm • Estimated Exhaust Mass Flow 0.2 - 0.6 kg/s • Engine Speed Rate of Change -25 - 25 RPM/s • Engine Torque Rate of Change -70 - 120 Nm • Estimated Exhaust Mass Flow Rate of Change -0.04 - 0.1 kg/s • EGR Vale Position 40 - 101% • Enable Delay 1s
Disable Conditions	No Active DTC's: • 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	15s
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 < 77% (calculated during the 10s evaluation time)
Enable Conditions	• Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55 °C • Engine Speed 1400 - 1700 RPM • Engine Torque 1800 - 2600 Nm • EGR Vale Position 50 - 101% • 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 2s
Disable Conditions	No Active DTC's: • 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	***See Tech Tool***

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 =(Sensed boost pressure - Estimated boost pressure) < -70 kPa
Enable Conditions	• Ambient Air Temperature –8–55°C • Barometric Pressure 75–120 kPa • Engine Coolant Temperature > 60°C • Engine Speed 1350 - 1600 RPM • Engine Torque (% of max torque at current engine speed) 75–105% • EGR Valve Position 10 - 96% • VGT Position 5 - 90% • Inlet Manifold Temperature -25 - 130 °C • Absolute Engine Speed rate of change < 10 RPM/s • Engine Torque Rate of Change < 50 Nm/s • Absolute Estimated Intake Manifold Pressure rate of change < 10kPa/s • Enable Delay 10s
Disable Conditions	No Active DTC's: • P0335, P0336, P0489, P0403, P006E, P00AF, P0046, P1148, P0097, P0095, P0108, P0105
Time Required For DTC To Be Set	5s
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 = (Sensed boost pressure - Estimated boost pressure) > 60 kPa
Enable Conditions	• Ambient Air Temperature □8□55 °C • Barometric Pressure 75 — 120 kPa • Engine Coolant Temperature > 60°C • Engine Speed 1350 - 1600 RPM • Engine Torque (% of max torque at current engine speed) 75–105% • EGR Valve Position 10 - 96% • VGT Position 5 - 90% • Inlet Manifold Temperature -25 - 130 °C • Absolute Engine Speed rate of change < 10 RPM/s • Absolute Engine Torque rate of change < 50 Nm/s • Absolute Estimated Intake Manifold Pressure rate of change < 10 kPa/s • Enable Delay 10s
Disable Conditions	No Active DTC's: • P0335, P0336, P0489, P0403, P006E, P00AF, P0046, P1148, P0097, P0095, P0108, P0105
Time Required For DTC To Be Set	5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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)) < 90 kPa	
Enable Conditions	**Low Pressure Window** • Ambient Air Temperature -8 - 55°C • Barometric Pressure 75 - 120 kPa • Engine Coolant Temperature > 60°C • Engine Speed 500 - 1400 RPM • Engine Torque (% of max torque) 0–15% • VGT Position 5 - 90% • EGR Valve Position 10 - 96% • Inlet Manifold Temperature -25 - 130 °C • Enable Delay 5s	**High Pressure Window** • Ambient Air Temperature -8 - 55°C • Barometric Pressure 75 - 120 kPa • Engine Coolant Temperature > 60°C • Engine Speed 1050–1800 RPM • Engine Torque (% of max torque) 90–105% • VGT Position 5 - 90% • EGR Valve Position 10 - 96% • Inlet Manifold Temperature -25 - 130 °C • Enable Delay 5s
Disable Conditions	No Active DTC's: • P0335, P0336, P0489, P0403, P006E, P00AF, P0046, P1148, P0097, P0095, P0108, P0105	
Time Required For DTC To Be Set	2s	
MIL Illumination	2 Drive Cycles	
Probable Causes	***See Tech Tool***	

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 - ((Estimated CAC Temp - Nominal CAC Temp)/(Deteriorated CAC Temp - Nominal CAC Temp)) < 0.0
Enable Conditions	• Barometric Pressure 75 - 120 kPa • Vehicle Speed > 65 km/h • Engine Coolant Temperature > 68 °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 20s
Disable Conditions	No Active DTC's: • P0335, P0336, P0072, P0070, P0117, P0115, P0097, P0095, P0112, P0110, P2229, P2226, P0108, P0105
Time Required For DTC To Be Set	20s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	DOC □Conversion Efficiency/Feedgas
Monitor Strategy Description	Compare ((Calculated total HC slip rate) / (Modeled total HC slip rate)) > 2.80 **and** AHI Flow Loss Ratio > 75% **and** SCR Conversion Efficiency < MAP Value dependent on Avg SCR Temp MAP: x [215 230 255 280 315]°C y: [43 50 61.7 77 89]%
Fault Limit	Ratio = Calculated total HC slip rate Modeled total HC slip rate > 2.80
Enable Conditions	• Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55 °C **Heat Release Calc Enable Conditions** • Engine Speed > 590RPM • Engine Torque > 1Nm • Exhaust Aftertreatment Fuel Injection Active • Pre DOC Temperature 170–400°C • Post DPF Temperature 200–600°C • SCR Warming **or** Moving Crystal Sublimation Active • Cumulative Dosed AHI Fuel > 53g • Enable Delay 5s • Enable Hold Time 40s **SCR Conversion Efficiency Enable Conditions** • Engine Torque > 1 Nm • Engine Speed > 500 RPM • Modeled SCR Average Temperature 215 — 300°C • Exhaust Mass Flow 0.35 — 0.50 kg/s • NOx Upstream Value > 100ppm • Exhaust After Treatment Fuel Injection Not Active • NOx Upstream Sensor Active • NOx Downstream Sensor Active • Heat Release Calc Enable Conditions Fulfilled (once within 3600s)

Disable Conditions	No Active DTC's: • 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, P0110, P0112, P20EE, P2201, P2200, P2203, P225C, P220A, P22FB, P220E, P225D, U029D, P229F, P22A1, P229E, P225E, P220B, P22FE, P220F, U029E, P221A, P225F, P24F7, P24F6, P24F8, P24FA, P20CF, P2698, P2699, P2697
Time Required For DTC To Be Set	-
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	Low SCR NOx Catalyst Efficiency
Fault Limit	EWMA Filtered NOx Catalyst conversion < 79.5% Output = (((output — input)*Filter coefficient) + input Fast filter 0.2 Slow filter 0.9 Number of evals to use fast filter step change (negative) 2 Filter initialization on value after code clear —20.5% Init margin when step change detected 100% Fault Limit +1%
Enable Conditions	• Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55 °C • Modeled SCR Average Temperature 270 - 450 °C • Modeled SCR Outlet Temperature 230 - 450 °C • Modeled SCR Inlet Temperature 270 - 450 °C • Exhaust Mass Flow 0.10 - 0.50 kg/s • Engine Speed 1100 - 2050 RPM • Engine Torque rate of change -100 - 75 Nm/s • NOx Reduced in SCR Catalyst > 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 < 70°C
Disable Conditions	No Active DTC's: • P2201, P225C, P225D, P221A, P225F, P229F, P225E, P242B, P0420, P0401, P0402, P0105, P0108, P2080, P2084
Time Required For DTC To Be Set	60s
MIL Illumination	2 Drive Cycles EWMA filtered
Probable Causes	***See Tech Tool***

P20EE NOx Catalyst: Missing Substrate

DTC	P20EE
Component / System	NOx Catalyst - Missing SCR
Monitor Strategy Description	Low SCR NOx Catalyst Efficiency
Fault Limit	EWMA Filtered NOx Catalyst conversion < 79.5% Output = (((output — input)*Filter coefficient) + input Fast filter 0.2 Slow filter 0.9 Number of evals to use fast filter step change (negative) 2 Filter initialization on value after code clear —20.5% Init margin when step change detected 100% Fault Limit +1%
Enable Conditions	• Barometric Pressure 75 - 120 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 - 0.50 kg/s • Engine Speed 1100 - 2050 RPM • Engine Torque rate of change -100 - 75 Nm/s • 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 < 70°C
Disable Conditions	No Active DTC's: • P2201, P225C, P225D, P221A, P225F, P229F, P225E, P242A, P242B, P0420, P0401, P0402, P0105, P0108, P2080, P2084
Time Required For DTC To Be Set	60s
MIL Illumination	1 Drive Cycle EWMA filtered
Probable Causes	***See Tech Tool***

P0420 NMHC Catalyst: Missing Substrate

DTC	P0420
Component / System	DOC — 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)) < 1.75 8 or more large changes in Pre DOC derivative and ratio of large Pre DOC derivative changes to large model Post DOC derivative changes above 4
Enable Conditions	• 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/s **and** Modeled Post DOC Temperature Derivative < 2.75 °C/s **or** Pre Doc Temperature Derivative < –3.75°C/s **and** > –2.5°C • Modeled Post-DOC Temperature < 2.5 °C OR > -2.5 °C
Disable Conditions	No Active DTC's: • 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	-
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

Cold Start Reduction Cylinder Injections

P102A Cold Start Injector — All Cyl Low

DTC	P102A
Component / System	Cold Start Injector - All Cyl low
Monitor Strategy Description	Actual lambda based fueling compared to expected during cold start. The diagnosis can be performed only once per driving cycle.
Fault Limit	Ratio = ((lambda based estimated fuel flow) / (modeled fuel flow)) < 85% (Average ratio during the evaluation time.)
Enable Conditions	• Engine Coolant Temperature 65–110°C • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 120 kPa • EGR Content in the intake manifold (burned fraction) 0–20% [100=only ER, 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 100–460°C • Post DOC Temperature 200–460°C • Post DPF Temperature 200–460°C • Modeled Exhaust Mass Flow > 0 kg/s • AHI Duty Cycle < 0.1% • Cold Start Emission Reduction Strategy Active • Enable Delay 1s
Disable Conditions	No Active DTC's: • 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	45s (accumulated)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P102B Cold Start Injector — All Cyl High

DTC	P102B
Component / System	Cold Start Injector - All Cyl high
Monitor Strategy Description	Actual lambda based fueling compared to expected during cold start. The diagnosis can be performed only once per driving cycle.
Fault Limit	Ratio = ((lambda based estimated fuel flow) / (modeled fuel flow)) > 132% (Average ratio during the evaluation time.)
Enable Conditions	• Engine Coolant Temperature 65–110°C • Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55 °C • EGR Content in the intake manifold (burned fraction) 0–20% [100=only ER, 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 100–460°C • Post-DOC Temperature 200–460°C • Post-DPF Temperature 200–460°C • Modeled Exhaust Mass Flow > 0 kg/s • AHI Duty Cycle < 0.1% • Cold Start Emission Reduction Strategy Active • Enable Delay 1s
Disable Conditions	No Active DTC's: • 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	45s (accumulated)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P1011 Single Cylinder Fueling Offset

DTC	P1011
Component / System	Cold Start Cylinder 1 Fuel Injector Offset - High
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	• 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 > 45°C • VGT Position 0–40% • Engine Speed Rate of Change < 1000 RPM/s • Engine Torque Rate of Change < 1000 Nm/s • Cold Start Emission Reduction Strategy Active
Disable Conditions	No Active DTC's: • 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	420s (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P1012 Single Cylinder Fueling Offset

DTC	P1012
Component / System	Cold Start Cylinder 1 Fuel Injector Offset - Low
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	• 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 > 45°C • VGT Position 0–40% • Engine Speed Rate of Change < 1000 RPM/s • Engine Torque Rate of Change < 1000 Nm/s • Cold Start Emission Reduction Strategy Active
Disable Conditions	No Active DTC's: • 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	420s (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P1013 Single Cylinder Fueling Offset

DTC	P1013
Component / System	Cold Start Cylinder 2 Fuel Injector Offset - High
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	• 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 > 45°C • VGT Position 0–40% • Engine Speed Rate of Change < 1000 RPM/s • Engine Torque Rate of Change < 1000 Nm/s • Cold Start Emission Reduction Strategy Active
Disable Conditions	No Active DTC's: • 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	420s (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P1014 Single Cylinder Fueling Offset

DTC	P1014
Component / System	Cold Start Cylinder 2 Fuel Injector Offset - Low
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	• 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 > 45°C • VGT Position 0–40% • Engine Speed Rate of Change < 1000 RPM/s • Engine Torque Rate of Change < 1000 Nm/s • Cold Start Emission Reduction Strategy Active
Disable Conditions	No Active DTC's: • 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	420s (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P101D Single Cylinder Fueling Offset

DTC	P101D
Component / System	Cold Start Cylinder 3 Fuel Injector Offset - High
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	• 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 > 45°C • VGT Position 0–40% • Engine Speed Rate of Change < 1000 RPM/s • Engine Torque Rate of Change < 1000 Nm/s • Cold Start Emission Reduction Strategy Active
Disable Conditions	No Active DTC's: • 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	420s (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P1023 Single Cylinder Fueling Offset

DTC	P1023
Component / System	Cold Start Cylinder 3 Fuel Injector Offset - Low
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	• 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 > 45°C • VGT Position 0–40% • Engine Speed Rate of Change < 1000 RPM/s • Engine Torque Rate of Change < 1000 Nm/s • Cold Start Emission Reduction Strategy Active
Disable Conditions	No Active DTC's: • 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	420s (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P1024 Single Cylinder Fueling Offset

DTC	P1024
Component / System	Cold Start Cylinder 4 Fuel Injector Offset - High
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	• 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 > 45°C • VGT Position 0–40% • Engine Speed Rate of Change < 1000 RPM/s • Engine Torque Rate of Change < 1000 Nm/s • Cold Start Emission Reduction Strategy Active
Disable Conditions	No Active DTC's: • 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	420s (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P1025 Single Cylinder Fueling Offset

DTC	P1025
Component / System	Cold Start Cylinder 4 Fuel Injector Offset - Low
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	• 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 > 45°C • VGT Position 0–40% • Engine Speed Rate of Change < 1000 RPM/s • Engine Torque Rate of Change < 1000 Nm/s • Cold Start Emission Reduction Strategy Active
Disable Conditions	No Active DTC's: • 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	420s (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P1026 Single Cylinder Fueling Offset

DTC	P1026
Component / System	Cold Start Cylinder 5 Fuel Injector Offset - High
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	• 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 > 45°C • VGT Position 0–40% • Engine Speed Rate of Change < 1000 RPM/s • Engine Torque Rate of Change < 1000 Nm/s • Cold Start Emission Reduction Strategy Active
Disable Conditions	No Active DTC's: • 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	420s (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P1027 Single Cylinder Fueling Offset

DTC	P1027
Component / System	Cold Start Cylinder 5 Fuel Injector Offset - Low
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	• 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 > 45°C • VGT Position 0–40% • Engine Speed Rate of Change < 1000 RPM/s • Engine Torque Rate of Change < 1000 Nm/s • Cold Start Emission Reduction Strategy Active
Disable Conditions	No Active DTC's: • 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	420s (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P1028 Single Cylinder Fueling Offset

DTC	P1028
Component / System	Cold Start Cylinder 6 Fuel Injector Offset - High
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	• 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 > 45°C • VGT Position 0–40% • Engine Speed Rate of Change < 1000 RPM/s • Engine Torque Rate of Change < 1000 Nm/s • Cold Start Emission Reduction Strategy Active
Disable Conditions	No Active DTC's: • 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	420s (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P1029 Single Cylinder Fueling Offset

DTC	P1029
Component / System	Cold Start Cylinder 6 Fuel Injector Offset - Low
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	• 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 > 45°C • VGT Position 0–40% • Engine Speed Rate of Change < 1000 RPM/s • Engine Torque Rate of Change < 1000 Nm/s • Cold Start Emission Reduction Strategy Active
Disable Conditions	No Active DTC's: • 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	420s (accumulated time at idle)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P04DD Cold Start EGR "A" Flow Insufficient Detected

DTC	P04DD
Component / System	Cold Start EGR "A" Flow Insufficient Detected
Monitor Strategy Description	Compare demanded EGR flow to actual
Fault Limit	Ratio = ((Measured EGR Mass Flow) / (Demanded Egr Mass Flow)) < 68%
Enable Conditions	• Engine Coolant Temperature > –40°C • Ambient Air Temperature –8–55°C • Barometric Pressure > 75 kPa • Engine Speed 1300–2200 RPM • Engine Torque > 1500–2600 Nm • EGR Mass Flow Demand Ratio 0.2–0.6 • EGR Mass Flow Demand 0.1–0.4 kg/s • EGR Mass Flow Demand Rate of Change –0.010–0.200 kg/s^2 • Engine Torque Rate of Change –20–20 Nm/s • Engine Speed Rate of Change –5–20 RPM/s • EGR Valve Position 80–100% • Cold Start Emission Reduction Strategy Active
Disable Conditions	No Active DTC's: • 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	4s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P050C Cold Start Engine Coolant Temperature Performance

DTC	P050C
Component / System	Cold Start Engine Coolant Temperature Performance
Monitor Strategy Description	Compare filtered coolant temp to limit
Fault Limit	Filtered Coolant Temperature used for activation of normal engine operation mode less than limit < 68° C
Enable Conditions	• Ambient Air Temperature –40 – 55°C • Barometric Pressure 75–120 kPa • Enable Delay 120s • Engine Speed > 500 RPM • Filtered Modeled Engine Coolant Temperature > 68°C • Enable Delay 120s
Disable Conditions	No Active DTC's: • P0115, P0117, P0335, P0336, P0072, P0070, P2226, P2229
Time Required For DTC To Be Set	-
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P056E Cold Start Turbocharger/Supercharger Boost Control Performance

DTC	P056E
Component / System	Cold Start Turbocharger/Supercharger Boost Control Performance
Monitor Strategy Description	VGT SRA Fault Signal during Cold Start Conditions
Fault Limit	Ratio of time seen with SRA fault > 0.99
Enable Conditions	• Ambient Air Temperature –15 – 50°C • Engine Speed 500–2200 RPM • Engine Torque > 0 Nm • Barometric Pressure 75–110 kPa • Cold Start Emission Reduction Strategy Active • Enable Delay 0s
Disable Conditions	No Active DTC's: • P0335, P0336 , P0072, P0070, P2226, P2229, P0115, P0117
Time Required For DTC To Be Set	0.1s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P050E Cold Start Engine Exhaust Temperature Too Low

DTC	P050E
Component / System	Cold Start Engine Exhaust Temperature Too Low
Monitor Strategy Description	Emission Reduction Strategy ineffective - Exhaust Temp Too Low
Fault Limit	Difference = (Modeled Pre-DOC Temperature - SensedI Pre DOC Temperature) > 500°C
Enable Conditions	• Ambient Air Temperature –40 – 50°C • Barometric Pressure 75–120 kPa • Engine Speed 1400–1900 RPM • Engine Torque 1800–2800 Nm • Cold Start Emission Reduction Strategy Active
Disable Conditions	No Active DTC's: • P0335, P0336, P0339, P0545, P0544,P0046, P006E, P00AF, P1148, P0403, P0489, P0406, P0409, P040C, P040A, P0406, P0409, P0108, P0105, P0110, P0112, P0072, P0070
Time Required For DTC To Be Set	40s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P05EB Cold Start SCR NOx Catalyst Inlet Temperature Too Low

DTC	P05EB
Component / System	Cold Start SCR NOx Catalyst Inlet Temperature Too Low
Monitor Strategy Description	Compare EATS Heating Efficiency
Fault Limit	Ratio= (Calculate Heat Release through Oxidation)/ (Energy dosed by AHI System) < 30%
Enable Conditions	• Engine Speed 500–2500 RPM • Exhaust Aftertreatment Fuel Injection > 0.0 g/s • Pre-DOC Temperature 240–450°C • Enable Delay 3.0s • Enable Hold Time 120s • Cold Start Emission Reduction Strategy Active
Disable Conditions	No Active DTC's: • P0335, P0339, P0336, P040C, P040A, P0406, P0409, P0108, P0105, P0095, P0097, P0545, P0544, P2080, P2032, P2031, P2084, P242C, P242A, P242B, P20E0, P200D, P20DE, P24F8, P24FA, P20D9, P20D7, P2699, P2697
Time Required For DTC To Be Set	< 1200s
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	Diesel Particulate Filter Efficiency	
Monitor Strategy Description	Modeled vs Measured filtration efficiency.	
Fault Limit	**Pressure related failure:** Delta = Pressure based soot load □Delta Pressure based soot load > 3.0g/L	**Pressure neutral failure:** Ratio = (Delta pressure based soot model / delta pressure based soot model) < –200% for 75% of the evaluation time
Enable Conditions	• Barometric Pressure 75 - 120 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 > 10 Nm • DPF Differential Pressure > 1.0 kPa	
Disable Conditions	No Active DTC's: • 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:** 150s	**Pressure neutral failure:** 350s
MIL Illumination	2 Drive Cycles	
Probable Causes	***See Tech Tool***	

P226D Diesel Particulate Filter Missing Substrate

DTC	P226D
Component / System	Diesel Particulate Filter
Monitor Strategy Description	Measured vs Modeled Differential Pressure
Fault Limit	DPF missing substrate counter > 8 counts. If |Actual System Thermal Deviation - Missing Substrate System Deviation| < 0.33*|Nominal System Thermal Deviation - Missing Substrate System Deviation| the DPF missing substrate counter is incremented. Counter will be updated when Accumulated Exhaust Mass > 2 kg **Note:** Cumulative Exhaust Mass will be reset to 0 kg when counter is updated.
Enable Conditions	• Engine Coolant Temperature > 60°C • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75–120 kPa • Engine Speed 1000–2500 RPM • Post DPF Temperature 150–500 °C • Modeled Exhaust Mass Flow > 0.25 kg/s • Delay Time Post Active AHI Injection 100s • |Post-DOC Temp – Modeled Post-DPF Temp| > 15°C **or** |Post-DOC Temp High Pass filtered| > 0.7 °C/s • Enable Delay 4s
Disable Conditions	No Active DTC's: • P2229, P2226, P2452, P2454, P0335, P0336, P0339, P2032, P2031, P2084, P242A, P242B, P242C, P0105, P0108, P0095, P0097, P0409, P0406, P040A, P040C, P0070, P0072, P0111, P0112, P0110
Time Required For DTC To Be Set	-
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P0422 NMHC Conversion Efficiency

DTC	P0422
Component / System	Diesel Particulate Filter — NMHC Conversion Efficiency/Feedgas
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) < 2.80 **and** AHI Flow Loss Ratio > 75% **and** SCR Conversion Efficiency < MAP Value Dependent on SCR Average Temp MAP: x: [215 230 255 280 315]°C and y: [43 50 61.5 77 89]%
Enable Conditions	• Barometric Pressure 75–120 kPa • Ambient Air Temperature -8 - 55 °C • Engine Speed > 590 RPM • Engine Torque > 1 Nm • Exhaust Aftertreatment Fuel Injection Active • Pre DOC Temperature 170–400°C • Post DPF Temperature 200–600°C • SCR warming **or** Moving Crystal Sublimation Active • Cumulative Dosed AHI Fuel > 53 g • Enable Delay 5s • Enable Hold Time 40s **SCR Conversion Efficiency Enable Conditions:** • Engine Torque > 1 Nm • Engine Speed > 500 RPM • Modeled SCR Average Temperature 215–300°C • Exhaust Mass Flow 0.35 — 0.50 kg/s • NOx Upstream Value > 100 ppm • Exhaust Aftertreatment Fuel Injection Not Active • NOx Upstream Sensor Active • NOx Downstream Sensor Active • Heat Release Calc Enable Conditions Fulfilled (once within 3600 s)
Disable Conditions	No Active DTC's: • P2229, P2080, P2084, P242B, P2226, P0072, P0070, P0105, P0108, P0409, P0406, P040A, P040C, P20D0, P20D9, P20D7, P1133, P20DC, P20CF, P20DD, P20E0, P0545, P0544, P2032, P2031, P242C, P242A, P0335, P0336, P0339, P2698, P0110, P0112, P20EE, P2201, P2200, P2203, P225C, P220A, P22FB, P220E, P225D, U029D, P229F, P22A1, P229E, P225E, P220B, P22FE, P220F, U029E, P221A, P225F, P24F7, P24F6, P24F8, P24FA, P20CF, P2698, P2699, P2697
Time Required For DTC To Be Set	Not Applicable

MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P2459 Too Frequent Regeneration

DTC	P2459
Component / System	Diesel Particulate Filter
Monitor Strategy Description	Regeneration Frequency Too High
Fault Limit	Regeneration Frequency Counter > 1 count If Pressure Based Soot Model — Chemical Reaction Based Soot Model > 3.0 g/L the Regeneration Frequency Counter is incremented. Counter will be updated when Start Conditions are TRUE **and** at least one regeneration has been triggered. **Note:** Counter will be reset if Time between regenerations > 16400s
Enable Conditions	• Engine Coolant Temperature > 60°C • Barometric Pressure 75 –120 kPa • Ambient Air Temperature –8–55°C • Engine Speed > 500 RPM • Regeneration Strategy Active • Aftermarket Regeneration Inactive
Disable Conditions	No Active DTC's: • P0545, P0544, P2032, P2031, P242A, P242C, P2452, P2454, P0072, P0070, P2226, P2229
Time Required For DTC To Be Set	-
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P24A2 Incomplete Soot Regeneration

DTC	P24A2
Component / System	Incomplete Regeneration
Monitor Strategy Description	Incomplete Soot Regeneration
Fault Limit	**Moving Regeneration:** • Pressure Based Soot Model Reduction < 0.5 g/L • Chemical Reaction Based Soot Model Reduction 1.5–2.5 g/L **Parked Regeneration:** • Sensed DPF diff pressure relative to diff pressure for nominal empty DPF > 150%
Enable Conditions	• Engine Coolant Temperature > 60°C • Barometric Pressure 75–120 kPa • Ambient Air Temperature –8–55°C • AHI Injection Demand < 0.01 g/s • Delay Time Post Active AHI Injection Demand > 60s **Moving Regeneration:** • Engine Speed 600–2100 RPM • Engine Torque 800–4000 Nm • Exhaust Mass Flow 0.25–0.70 kg/s • Post DPF Temperature (Averaged Modeled Value) 250–475°C • Engine Speed Rate of Change –30 — 30 RPM/s • Engine Torque Rate of Change –100 — 150 Nm/s • Post DPF Temperature Rate of Change –1.5 — 1.5°C • Chemical Reaction Based Soot Model Ratio > 3.5 g/L • Pressure Based Soot Model Ratio > 3.5 g/L • Parked Regeneration Active **Parked Regeneration:** • Engine Speed 600–2100 RPM • Engine Torque 800–4000 Nm • Exhaust Mass Flow 0.25 — 0.7 kg/s • Post DPF Temperature (Average Modeled Value) 250–425°C • Engine Speed Rate of Change –30–30 RPM/s • Engine Torque Rate of Change –100–150 Nm/s • Post DPF Temperature Rate of Change –1.5–1.5 °C/s • Regeneration completed and diagnosis not performed: TRUE
Disable Conditions	No Active DTC's: • P2032, P2031, P2226, P2229, P0070, P0072, P2452, P2454, P0335, P0339, P0336
Time Required For DTC To Be Set	**Moving Regeneration:** 10s Enable Delay **Parked Regeneration:** 10+15s Enable Delay + Eval Time

MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P249F Excessive Time to Enter Closed Loop-Regeneration Control

DTC	P249F
Component / System	Excessive Time to Enter Closed Loop-Regeneration Control
Monitor Strategy Description	Time to enter Regeneration closed loop too long
Fault Limit	Ratio = (Time spent in open loop / total evaluation time) > 50%
Enable Conditions	• AHI Control Startup Time > MAP Value dependant on ambient air temperature (see below) MAP: x:[-20 -5 0 15 25]°C and y:[420 380 365 340 300]s • AHI Injection Status Active • Feedback Control Demand Active • Pre-DOC 225–550°C • Modeled Post-DOC Temperature without AHI Based Heating 225–550°C • |HP Fit Modeled Post-DOC Temp w/o AHI Based Heating| < 3°C/s • Exhaust Mass Flow 0.05 – 0.6 kg/s • Engine Torque > 5.0 Nm
Disable Conditions	No Active DTC's: • P0072, P0070, P2226, P2229, P0545, P0544, P2080, P2032, P2031, P2084
Time Required For DTC To Be Set	120s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P24A0 Regeneration — Feedback Control

DTC	P24A0
Component / System	Regeneration – Feedback Control
Monitor Strategy Description	Controller Saturated—Temperature Too Low
Fault Limit	Ratio = (Time with saturated controller and control error for aftertreatment temperature controller above threshold / total evaluation time) > 90% Control Error Temperature > Fault Threshold MAP Value x:[200 350 500 650]°C y:[50 60 80 100]°C
Enable Conditions	• AHI Control Startup Time > MAP Value dependant on ambient air temperature (see below) MAP: x:[-20 -5 0 15 25]°C and y:[420 380 365 340 300]s • AHI Injection Status Active • Feedback Control Demand Active • Pre DOC Temperature 225–500°C • Modeled Post-DOC Temperature without AHI Based Heating 200–650°C • |HP Flt Modeled Post-DOC Temp w/o AHI Based Heating| < 3°C • Exhaust Mass Flow 0.05–0.6 kg/s • Engine Torque > 5.0 Nm • Closed Loop Active
Disable Conditions	No Active DTC's: • P0072, P0070, P2226, P2229, P0545, P0544, P2080, P2032, P2031, P2084
Time Required For DTC To Be Set	100s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P24A1 Regeneration — Feedback Control

DTC	P24A1
Component / System	Regeneration – Feedback Control
Monitor Strategy Description	Controller Saturated—Temperature Too High
Fault Limit	Ratio = (Time with saturated controller and control error for aftertreatment temperature controller above threshold / total evaluation time) > 90% Control error Temperature < —100°C
Enable Conditions	• AHI Control Startup Time > MAP Value dependant on ambient air temperature (see below) MAP: x:[-20 -5 0 15 25]°C and y:[420 380 365 340 300]s • AHI Injection Status Active • Feedback Control Demand Active • Pre DOC 225–500°C • Modeled Post DOC Temperature without AHI Based Heating 200–650°C • |HP Flt Modeled Post-DOC Temp w/o AHI Based Heating| < 3°C/s • Exhaust Mass Flow 0.05–0.6 kg/s • Engine Torque > 5.0 Nm • Closed Loop Active
Disable Conditions	No Active DTC's: • P0072, P0070, P2226, P2229, P0545, P0544, P2080, P2032, P2031, P2084
Time Required For DTC To Be Set	100s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• 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: • 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	Diesel Particulate Filter □Differential Pressure Too High
Monitor Strategy Description	Measured vs modeled Differential Pressure
Fault Limit	Ratio = ((Measured differential pressure) / (Modeled differential pressure)) > 700 %
Enable Conditions	• Ambient Air Temperature -8 - 55 °C • Engine Coolant Temperature > 60 °C • Barometric Pressure 75 - 120 kPa • Engine Speed 1150 - 2000 RPM • Engine Torque 1200 □3000 Nm • Engine Load at current Engine Speed > 57% • Post DOC Temperature 250 - 475 °C • Post DPF Temperature 250 - 475 °C • Modeled Exhaust Mass Flow 0.28kg/s — 0.70kg/s • Delay Time Post Active AHI Injection 60s • Enable Time Delay 1s
Disable Conditions	No Active DTC's: • 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	2s
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	Range/performance
Monitor Strategy Description	Sensor Rationality Check
Fault Limit	Delta = ((Measured NOx flow) – (Modeled NOx flow)) < -0.39 g/s **or** > 1.00 g/s Number of sub evaluations 4
Enable Conditions	• Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55 °C • Modeled NOx Fllow > 0.12 g/s • Absolute Burned Air Fraction Diff (actual - demanded) < 4.0 % • EGR Valve Position 65 - 101% • Engine speed rate of change -15 - 15 RPM/s • Engine torque rate of change -40 - 40 Nm/s • Engine Coolant Temperature 70 - 110 °C • AHI Injection Not Active • Regeneration Not Active • Engine Torque 1000 - 2500 Nm • Engine Speed 1300 - 1800 RPM • Enable Time Delay 5s
Disable Conditions	No Active DTC's: • 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	35s
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 Performance □Signal Stuck High Bank 1 Sensor 1
Monitor Strategy Description	Rationality High. This is an intrusive monitor requesting the EGR valve to close for a maximum time of 60s when all start conditions are met. Maximum number of attempts is 1 per drive cycle.
Fault Limit	EWMA filtered NOx value: > 50 ppm (for 13L engine) EWMA filtered NOx value: > 75 ppm (for 11L and 16L engines) Fast Filter 0.16 Slow Filter 0.85 Number of Evals to Use Fast Filter 2.0 Step Change (positive) 50 ppm for 13L (70ppm for 11L) Filter initialization value after code clear 0.0ppm Init Margin Fault Limit — 5.0 ppm
Enable Conditions	• Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55 °C • Demanded Fuel Value < 0.1 mg/str • Engine Speed 725 - 2500 RPM • Pre DOC Temperature 150 — 300°C • Average SCR Temperature > 175°C • AHI Injection Not Active • Regeneration Not Active • EGR Valve Position rate of change -10 - 10 %/s
Disable Conditions	No Active DTC's: • 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	5s
MIL Illumination	1 Drive Cycle
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 heater temperature reached
Fault Limit	Time for sensor to report heater temp reached 180 seconds — Temperature of heater not reached
Enable Conditions	• Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55 °C • Upstream NOx Sensor Activation Request sent by ECM • AHI Injection Status Active
Disable Conditions	No Active DTC's: • P2200, P225E, P2203, P22A1, P220B, U029D, U029E, P220A
Time Required For DTC To Be Set	180s
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 blocks (each during 15s eval time) Fault Ratio 100% (all 4 evaluations above the threshold)
Enable Conditions	• Engine Speed > 1000 rpm • Engine Torque > 1100 Nm
Disable Conditions	No Active DTC's: • P2200, P225E, P2203, P220B, U029D, U029E, P221A, P220A
Time Required For DTC To Be Set	60s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

NOx Sensor #1: Bad Device

This OBD Monitoris designed to 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	• Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55 °C • Upstream NOx sensor Activation Request sent by ECM • Upstream NOx sensor heater Sensor heated • Engine torque rate of change < 33 Nm/s
Disable Conditions	No Active DTC's: • P2200, P225E, P2203, U029D, P220A, P221A
Time Required For DTC To Be Set	250s
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	Short circuit
Monitor Strategy Description	NOx Sensor Short Circuit
Fault Limit	Short Circuit Detected Error byte for Internal Circuit signal cumulative debounce timer > 5s
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • U029D
Time Required For DTC To Be Set	5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P2200 NOx Sensor #1: Open Circuit

DTC	P2200
Component / System	Open Circuit
Monitor Strategy Description	NOx Sensor Open Circuit
Fault Limit	Short circuit detected Error byte for Internal Circuit signal cumulative debounce timer > 5s
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • U029D
Time Required For DTC To Be Set	5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P220A NOx Sensor #1: Supply Voltage Out of Range

DTC	P220A
Component / System	Supply Voltage
Monitor Strategy Description	Circuit Voltage Out of Range Sensor evaluation of the supply voltage
Fault Limit	Status byte for Internal Supply Voltage signal — Supply Voltage signal out of range Cummulative debounce timer > 5s
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • U029D
Time Required For DTC To Be Set	5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

U029D NOx Sensor #1: Missing Signal

DTC	U029D
Component / System	Lost Communication With NOx Sensor
Monitor Strategy Description	Missing signal evaluation
Fault Limit	Time without communication from NOx Sensor > 5 s
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • U0080
Time Required For DTC To Be Set	5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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 Gas Outlet Removed. Sensor biased, stuck low.
Monitor Strategy Description	Signal plausibility failure. The sensor shall respond to tip-in events (sudden power increase.)
Fault Limit	Difference of highest and lowest NOx sensor reading < 5ppm during for > 5 events
Enable Conditions	• Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55 °C • Engine Torque 1200 - 1900 Nm • Engine Speed > 1200 RPM • Engine Torque rate of change > 50 Nm/s **or** < -50 Nm/s • Average SCR Catalyst Temperature 150 - 300 °C • Enable hold time 30s
Disable Conditions	No Active DTC's: • 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	5 events
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P225E NOx Sensor #2: Rationality High Monitor

DTC	P225E
Component / System	NOx Sensor Performance — Signal Stuck High Bank 1 Sensor 2
Monitor Strategy Description	NOx Sensor Performance — Signal Biased High This is an intrusive monitor requesting the EGR valve to close for a maximum time of 60s when all start conditions are met. Maximum number of attempts is 1 per drive cycle.
Fault Limit	EWMA filtered NOx value: > 50 ppm (for 13L engine) EWMA filtered NOx value: > 75 ppm (for 11L and 16L engines) Output = ((output — input)*Filter coefficient) + input Fast Filter 0.16 Slow Filter 0.85 Number of evals to use fast filter 2.0 Step Change (positive) 50 ppm for 13L (70ppm for 11L) Filter initialization value after code clear 0.0 Init margin Fault limit — 5.0
Enable Conditions	• Barometric Pressure 75 - 120 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 150 – 300 °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 • EGR Valve Position -10 - 10%/s
Disable Conditions	No Active DTC's: • 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	6.5s
MIL Illumination	1 Drive Cycle EWMA filtered
Probable Causes	***See Tech Tool***

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 Sensor Heater Control Circuit Range/Performance Bank 1 Sensor 2
Monitor Strategy Description	Start□up.Time for NOx sensor to report heater temperature reached
Fault Limit	Internal status byte received from upstream NOx sensor — temperature of heater not reached Time for sensor to report heater temp reached 180s
Enable Conditions	• Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55 °C • Downstream NOx sensor Dew Point command sent by ECM • AHI Injection Status Active
Disable Conditions	No Active DTC's: • 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 #2: Bad Device

This OBD Monitoris designed to 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 Performance □Sensing Element Bank 1 Sensor 2
Monitor Strategy Description	NOx Sensor Performance □Sensing Element Bank 1 Sensor 2 Bad device
Fault Limit	Internal status byte from Upstream — NOx sensor signal not valid NOx Sensor signal not valid during the 250s eval time
Enable Conditions	• Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55 °C • Downstream NOx Sensor Activation Request sent by ECM • Downstream NOx sensor heater Sensor Heated • AHI Injection Status Active • Engine torque rate of change < 33 Nm/s
Disable Conditions	No Active DTC's: • P2200, P2203, U029D, P220A, P22A1, P225E, P220B, U029E, P221A
Time Required For DTC To Be Set	250s
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 Sensor 1/2 Correlation Bank 1
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 (each with evaluation time 0.60s) Fault Ratio 100%
Enable Conditions	• Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55 °C • Engine speed rate of change -15 - 15 RPM/s • Engine torque rate of change -40 - 40 Nm/s • Engine Torque > 1000Nm • Engine Speed 1300 - 1900 RPM • Enable Time Delay 2 s • AHI Injection Not Active
Disable Conditions	No Active DTC's: • 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	9s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

NOx Sensor #2: Removed

P225F NOx Sensor #2 Removed

DTC	P225F
Component / System	NOx Sensor Performance □Signal Stuck Low Bank 1 Sensor 2
Monitor Strategy Description	NOx Sensor Removed
Fault Limit	Downstream Sensor Lambda value > 12 (during a 5s evaluation block) Number of sub evaluations to report the monitor 4 blocks (each during 15s eval time) Fault Ratio 100% (all 4 evaluations above the threshold)
Enable Conditions	• Engine Speed > 1000 rpm • Engine Torque > 1100 Nm
Disable Conditions	No Active DTC's: • P2200, P225E, P2203, P220B, U029D, U029E, P221A, P220A
Time Required For DTC To Be Set	60s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

NOx Sensor #2: Circuit Monitors

P22A1 NOx Sensor #2: Short Circuit Low

DTC	P22A1
Component / System	Circuit High
Monitor Strategy Description	NOx Sensor Circuit High
Fault Limit	Error byte for internal circuit signal – short circuit detected Cumulative debounce timer > 5s
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • U029D, U029E
Time Required For DTC To Be Set	5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P229E NOx Sensor #2: Open Circuit

DTC	P229E
Component / System	Open circuit
Monitor Strategy Description	NOx Sensor Open Circuit
Fault Limit	Error byte for internal open circuit signal – open circuit detected Cumulative debounce timer > 5s
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • U029D, U029E
Time Required For DTC To Be Set	5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P220B NOx Sensor #2: Supply Voltage Out of Range

DTC	P220B
Component / System	NOx Sensor Supply Voltage Circuit Bank 1 Sensor 2
Monitor Strategy Description	Circuit Voltage Out of Range
Fault Limit	Status byte for internal supply voltage signal — supply voltage signal out of range detected Cumulative debounce timer 5s
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • U029D, U029E
Time Required For DTC To Be Set	5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

U029E NOx Sensor #2: Missing Signal

DTC	U029E
Component / System	Lost Communication With NOx
Monitor Strategy Description	Missing signal evaluation
Fault Limit	Time with lost communication with NOX sensor > 5 s
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • U0080
Time Required For DTC To Be Set	5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	Coolant Thermostat (Coolant Temp Below Thermostat Regulating Temperature)
Monitor Strategy Description	Coolant Thermostat (Coolant Temp Below Thermostat Regulating Temperature) Thermostat stuck open or leaking
Fault Limit	Coolant temperature threshold < 71 °C (Coolant thermostat opening temperature - 11 °C
Enable Conditions	• Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55°C • Modeled Coolant Temperature > 80°C **Warm up enable conditions:** • Idle Speed Percentage < 50% • Fuel Cut off Percentage < 50% • Engine Coolant Temperature at Start < 51°C • Engine Speed > 500 RPM • Enable Delay 2s **Continuous Enable Conditions:** • Engine Speed 580 — ESPD MAP Value RPM • Engine Torque 300 — TRQ Map Value Nm • Vehicle Speed > 54 km/h • Enable Delay 14s ESPD Map Value as Function of Ambient Air Temperature: • x:[-30 —10 0 10 20 30 50]°C • y: [1200 1200 1600 1600 1600 1200 1200]RPM TRQ MAP Value as function of Ambient Air Temperature • x:[-30 -10 0 10 20 30 50]°C • y:[900 800 700 600 500 450 400]Nm
Disable Conditions	No Active DTC's: • P0335, P0336, P0072, P0070, P0117, P0115, P0116, P0097, P0095, P2229, P2226, P0500, P0502, P215A
Time Required For DTC To Be Set	10s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

Engine Coolant Temperature Sensor (ECT): Rationality Monitor

P0116 Engine Coolant Temperature Circuit Range/Performance

DTC	P0116
Component / System	Engine Coolant Temperature Circuit Range/Performance
Monitor Strategy Description	Temperature sensor rationality check at start up after a 8 hour soak time. If auxiliary heaters is used the coolant temperature senosor is evaluated in engine running conditions (60s delay time after engine start) if entry conditions to run pre□crankmonitor have been met prior to evaluation
Fault Limit	**Pre-Crank:** |Delta| =| (Average Engine Coolant Temperature) □(mean(average EGR Temp, average Comp Temp, average Intake Manifold temp))| > 40 °C (absolute)
Enable Conditions	**Pre-Crank:** • Key Position Key On • Engine Speed < 100 RPM • Soak Time > 8h • Enable Hold Tme 2s **Engine Running:** • Engine Speed ≥ 500 RPM • Enable Delay Time ≥ 60s
Disable Conditions	No Active DTC's: • P0335, P0336, P0072, P0070, P0117, P0115, P0097, P0095, P2229, P2226, P040A, P040C, P0545, P0544, P0110, P0112, P205A, P205C, U3016
Time Required For DTC To Be Set	1s
MIL Illumination	1 Drive Cycle
Probable Causes	***See Tech Tool***

P0116 Engine Coolant Temperature Circuit Range/Performance

DTC	P0116
Component / System	Engine Coolant Temperature Circuit Range/Performance
Monitor Strategy Description	Stuck check — in range
Fault Limit	|Delta| = |Highest stored Coolant Temperature — Lowest Coolant Temperature| < 3°C
Enable Conditions	**Pre-Crank:** • Key Position Key On • Engine Speed > 500 RPM • Barometric Pressure 75–120 kPa • Engine Coolant Temperature at start < 65°C • Modeled Coolant Temperature ≥ 82°C **Engine Running:** • Engine Speed ≥ 500 RPM • Enable Delay Time ≥ 60s
Disable Conditions	No Active DTC's: • P0335, P0336, P0072, P0070, P0117, P0115, P0097, P0095, P2229, P2226, P040A, P040C, P0545, P0544, P0110, P0112, P205A, P205C, U3017
Time Required For DTC To Be Set	-
MIL Illumination	1 Drive Cycle
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	Engine Coolant Temperature Sensor 1
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage > 4.9V (-40 °C) **or** 0.15 - 0.23V (130-140 °C)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P0117
Component / System	Engine Coolant Temperature Circuit Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Voltage < 0.15V (140 °C)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P0116 Engine Coolant Temperature Circuit Range/Performance

DTC	P0116
Component / System	Engine Coolant Temperature Circuit Range/Performance
Monitor Strategy Description	Stuck Check — In Range
Fault Limit	| Delta | = | Highest stored Coolant Temperature - Lowest stored Coolant Temperature | < 3°C
Enable Conditions	• Key Position Key On • Engine Speed > 500 RPM • Barometric Pressure 75–120 kPa • Engine Coolant Temperature at Start < 65°C • Modeled Coolant Temperature ≥ 82°C
Disable Conditions	No Active DTC's: • P0335, P0336, P0072, P0070, P0117, P0115, P0097, P0095, P2229, P2226, P040A, P040C, P0545, P0544, P0110, P0112, P205A, P205C, U3017
Time Required For DTC To Be Set	-
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P268C Injector Data Incompatible

DTC	P268C
Component / System	Cylinder 1
Monitor Strategy Description	Injector Data Incompatible
Fault Limit	Calculated injector trim checksum compared to hardware checksum ≠
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	N/A
Time Required For DTC To Be Set	0s
MIL Illumination	1 Drive Cycle
Probable Causes	***See Tech Tool***

P268D Injector Data Incompatible

DTC	P268D
Component / System	Cylinder 2
Monitor Strategy Description	Injector Data Incompatible
Fault Limit	Calculated injector trim checksum compared to hardware checksum ≠
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	N/A
Time Required For DTC To Be Set	0s
MIL Illumination	1 Drive Cycle
Probable Causes	***See Tech Tool***

P268E Injector Data Incompatible

DTC	P268E
Component / System	Cylinder 3
Monitor Strategy Description	Injector Data Incompatible
Fault Limit	Calculated injector trim checksum compared to hardware checksum ≠
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	N/A
Time Required For DTC To Be Set	0s
MIL Illumination	1 Drive Cycle
Probable Causes	***See Tech Tool***

P268F Injector Data Incompatible

DTC	P268F
Component / System	Cylinder 4
Monitor Strategy Description	Injector Data Incompatible
Fault Limit	Calculated injector trim checksum compared to hardware checksum ≠
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	N/A
Time Required For DTC To Be Set	0s
MIL Illumination	1 Drive Cycle
Probable Causes	***See Tech Tool***

P2690 Injector Data Incompatible

DTC	P2690
Component / System	Cylinder 5
Monitor Strategy Description	Injector Data Incompatible
Fault Limit	Calculated injector trim checksum compared to hardware checksum ≠
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	N/A
Time Required For DTC To Be Set	0s
MIL Illumination	1 Drive Cycle
Probable Causes	***See Tech Tool***

P2691 Injector Data Incompatible

DTC	P2691
Component / System	Cylinder 6
Monitor Strategy Description	Injector Data Incompatible
Fault Limit	Calculated injector trim checksum compared to hardware checksum ≠
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	N/A
Time Required For DTC To Be Set	0s
MIL Illumination	1 Drive Cycle
Probable Causes	***See Tech Tool***

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 System Disconnected or stuck separator
Monitor Strategy Description	Crankcase Ventilation System Disconnected. Low evaluation is required to be completed before high evaluation. When low evaluation has completed, high window must be evaluated within 600s or else low evaluation result is reset.
Fault Limit	Delta = Highest stored normalized crank case pressure □Lowest stored normalized crank case pressure < 0.15 kPa **Note:** Crank case pressure is normalized against Ambient Air Pressure
Enable Conditions	• Ambient Air Temperature □8□55 °C • Engine Coolant Temperature > 60 °C • Barometric Pressure 75 — 120 kPa • Barometric Pressure Rate of Change < 0.025 kPa/s • Engine Run Time > 2s **High Pressure Conditions** • Engine Oil Pressure 300 - 800 kPa • Engine Speed 1150 — 3000 RPM • Engine Torque 0 - 50 Nm • Enable Delay 2.5s • Minimum Evaluation Time 6s **Low Pressure Conditions** • Engine Oil Pressure 80–230 kPa • Engine Speed 500 — 750 RPM • Engine Torque 0 - 300 Nm • Enable Delay 8s • Minimum Evaluation Time 2s
Disable Conditions	No Active DTC's: • P0523, P0520, P0197, P0195, P051D, P051A, P2226, P2229
Time Required For DTC To Be Set	2 + 6s
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	• Engine Speed < 180 RPM • Ambient Air Temperature -8 - 55 °C • Key Position Key On • Enable Delay 0.5s
Disable Conditions	No Active DTC's: • P2229, P2226
Time Required For DTC To Be Set	2s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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 = ((Barometric pressure) - (Reference pressure)) < -15 kPa **or** >15 kPa
Enable Conditions	• Engine Speed < 180 RPM • Ambient Air Temperature -8 - 55 °C • Key On Active • Enable Delay 0.5 seconds
Disable Conditions	No Active DTC's: • P0105, P0108, P051D, P051A, P0489, P0403, P006E, P00AF, P0046, P1148, P2229, P2226
Time Required For DTC To Be Set	1s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	Sensor Voltage < 0.12V (15 kPa)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Key Pressure Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	Intake Manifold Pressure □Rationality
Monitor Strategy Description	Intake Manifold Pressure sensor evaluation
Fault Limit	Delta = ((Intake Manifold pressure) □(Reference pressure)) < □15kPa**or** >15kPa
Enable Conditions	• Engine Speed < 180 RPM • Ambient Air Temperature -8 - 55 °C • Key Position Key On • Enable Delay 0.5s
Disable Conditions	No Active DTC's: • P0105, P0108, P051D, P051A, P0489, P0403, P006E, P00AF, P0046, P1148, P2229, P2226
Time Required For DTC To Be Set	1s
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	Intake Manifold Pressure Sensor □Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage < 0.30V (50 kPa)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P0108
Component / System	Intake Manifold Pressure Sensor □High
Monitor Strategy Description	Manifold Absolute Pressure/Barometric Pressure Sensor Circuit High
Fault Limit	Sensor Voltage > > 4.85V (550 kPa)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	Diesel Particulate Filter Pressure Sensor "A" Circuit Range/Performance	
Monitor Strategy Description	DPF Differential Pressure Sensor evaluation	
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 < 1.75 kPa
Enable Conditions	Ambient Air Temperature □8□55 °C Barometric Pressure 75 — 120 kPa Delay Time Post Active AHI Injection 60s **Low Pressure Monitor** • Key Position Key On • Engine Speed < 50 RPM • Post DOC Temperature -8 - 400 °C • Post DPF Temperature -8 - 400 °C • Modeled DPF delta Pressure < 1.5 kPa • Enable Time Delay 1s **High Load Window** • Engine Coolant Temperature > 60 °C • Engine Speed 1400 - 1900 RPM • Engine Torque > 1000 Nm • Post DOC Temperature 270 - 500°C • Post DPF Temperature 240 - 400 °C • Modeled Exhaust Mass Flow > 0.28 kg/s • Modeled DPF delta Pressure > 3.0 kPa • Enable Time Delay 1s	
Disable Conditions	No Active DTC's: • 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** 1s	**High Load Window** 4s
MIL Illumination	2 Drive Cycles	
Probable Causes	***See Tech Tool***	

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	Particulate Filter Pressure Sensor "A"
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage > 4.90V (35 kPa)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P2454
Component / System	Aftertreatment 1 Diesel Particulate Filter Differential Pressure
Monitor Strategy Description	Aftertreatment 1 Diesel Particulate Filter Differential Pressure Circuit Low
Fault Limit	Sensor Voltage < 0.15V (0 kPa)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	EGR Differential Pressure Sensor Rationality	
Monitor Strategy Description	Compare actual vs estimated EGR delta pressure	
Fault Limit	**Plausibility Check** Delta = (Measured EGR Diff Pressure) - (Estimated EGR Diff Pressure) < -10 kPa **or**Delta = (Measured EGR Diff Pressure) - (Estimated EGR Diff Pressure) > 18 kPa	**Zero Check** Delta = (Measured EGR Diff Pressure) - (Estimated EGR Diff Pressure) < -2.18 kPa **or**Delta = (Measured EGR Diff Pressure) - (Estimated EGR Diff Pressure) > 2.18 kPa **Note:** Sensor is considered warm after a delay timer has elapsed a MAP value dependent on Ambient Air Temp. This is used to secure that sensor value is not stuck due to a frozen sensor. Delay time after start MAP Value as function of Amb Air Temp: x: [□50□30□710 50] °C y: [900 700 0 0 0] s
Enable Conditions	**Plausibility Check:** • Engine Speed 1100 - 1800 RPM • Engine Torque 1600 - 2800 Nm • VGT Position 40 - 100% • Cold Sensor Flag False • Engine Torque Rate of Change □10 □110 Nm/s • Engine Speed rate of change □40□40 RPM/s • EGR Valve Position > 5% • Enable Delay MAP Value: Enable delay time MAP Value is dependent on Ambient Air Temp Enable Delay MAP Value: x: [□20□100 20 35] °C y: [20 20 15 10 10] s	**Zero Check:** • Engine Coolant Temperature > 60 °C • Ambient Air Temperature - 8 – 55°C • Barometric Pressure 75 — 120 kPa • Engine Speed < 315 RPM • Cold Sensor Flag False • Key Position Key On • EGR Valve Position < 0.1%
Disable Conditions	No Active DTC's: • 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	**Plausibility Check** 10s	**Zero Check** 1s
MIL Illumination	2 Drive Cycles	
Probable Causes	***See Tech Tool***	

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	EGR Differential Pressure Sensor
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage < 0.21V (0 kPa)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P0406 EGR Differential Pressure Sensor: Short Circuit High

DTC	P0406
Component / System	EGR Differential Pressure Sensor Circuit High
Monitor Strategy Description	Short Circuit High
Fault Limit	Sensor Voltage > 4.83V (35 kPa)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	Crankcase Pressure □Rationality
Monitor Strategy Description	Crankcase pressure sensor evaluation
Fault Limit	Delta = (Crankcase pressure) □(Reference pressure) < -15 kPa **or** > 15 kPa
Enable Conditions	• Engine Speed < 180 RPM • Ambient Air Temperature -8 - 55 °C • Key Position Key On • Enable Delay 0.5s
Disable Conditions	No Active DTC's: • P0105, P0108, P051D, P051A, P0489, P0403, P006E, P00AF, P0046, P1148, P2229, P2226
Time Required For DTC To Be Set	1s
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	Crankcase Pressure Sensor
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage < 0.31V (40 kPa)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P051D Crankcase Pressure Sensor (CPS): Short Circuit High

DTC	P051D
Component / System	Engine High Resolution Crankcase Pressure
Monitor Strategy Description	Engine High Resolution Crankcase Pressure
Fault Limit	Sensor Voltage > 4.85V (150 kPa)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	Temperature Sensor — Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage > 4.91V (-40 °C)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	15s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P0097
Component / System	Temperature Sensor □Low
Monitor Strategy Description	Intake Air Temperature Sensor 2 Circuit Low (Bank 1)
Fault Limit	Sensor Voltage < 0.15V (140°C)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	15s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	Intake Manifold / 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	• Barometric Pressure 75 - 120 kPa • Vehicle Speed > 65 km/h • Engine Coolant Temperature > 68°C • Engine Speed 1200 - 1850 rpm • Engine load at current engine speed 0 - 60% • Air Mass Flow 0.07 - 0.36 kg/s • CAC Temp Diff between deteriorated (Threshold) CAC temperature & Nominal (Fresh) CAC temperature < 20°C • Enable Delay Time 5s
Disable Conditions	No Active DTC's: • P0335, P0336, P0072, P0070, P0117, P0115, P0097, P0095, P0112, P0110, P2229, P2226, P0108, P0105
Time Required For DTC To Be Set	10s
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	Temperature Sensor □Range/Performance
Monitor Strategy Description	Temperature sensor rationality check at start up after a 8 hour soak time
Fault Limit	|Delta| = |(Average Compressor Discharge Temperature) □(mean(average EGR Temp, average Intake Manifold Temp, average Engine Coolant temp))| > 40 °C (absolute)
Enable Conditions	**Pre-crank:** • Key Position Key On • Engine Speed < 100 RPM • Soak Time > 8h • Enable Hold Time > 2s
Disable Conditions	No Active DTC's: • P0335, P0336, P0072, P0070, P0117, P0115, P0097, P0095, P2229, P2226, P040A, P040C, P0545, P0544, P0110, P0112, P205A, P205C, U3017
Time Required For DTC To Be Set	1s
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	Temperature Sensor □Range/Performance
Monitor Strategy Description	Temperature sensor rationality check at start up after a 8 hour soak time
Fault Limit	|Delta| =| (Average Intake Manifold Temperature) □(mean(average EGR Temp, average Comp Temp, average Engine Coolant temp))| > 40°C
Enable Conditions	**Pre-crank:** • Key Position Key On • Engine Speed < 100 RPM • Soak Time > 8h • Enable Hold Time > 2 s
Disable Conditions	No Active DTC's: • P0335, P0336, P0072, P0070, P0117, P0115, P0097, P0095, P2229, P2226, P040A, P040C, P0545, P0544, P0110, P0112, P205A, P205C, U3017
Time Required For DTC To Be Set	1s
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	Temperature Sensor □Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage > > 4.82V (850 °C)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P0112
Component / System	Temperature Sensor □Low
Monitor Strategy Description	Intake Air Temperature Sensor 1 Circuit Low Bank 1
Fault Limit	Sensor Voltage < 0.02V (-100 °C)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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| =| (Average EGR Temperature) □(mean(average Intake Manifold Temp, average Compressor Discharge Temp, average Engine Coolant temp))| > 40°C (absolute)
Enable Conditions	**Pre-crank:** • Key Position Key On • Engine Speed < 100 RPM • Soak Time > 8 hours • Enable Hold Time 2s • Reset Pre-crank delay ≥ 3.5 seconds
Disable Conditions	No Active DTC's: • P0335, P0336, P0072, P0070, P0117, P0115, P0097, P0095, P2229, P2226, P040A, P040C, P0545, P0544, P0110, P0112, P205A, P205C, U3017
Time Required For DTC To Be Set	1s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	**Stuck Check** Delta = Highest stored EGR Temperature (captured in high window) □Lowest stored EGR Temperature (captured in low window) < □1000°C
Enable Conditions	• Barometric Pressure 75–120 kPa • Ambient Air Temperature □8□55 °C **Engine Running Plausibility Check:** • Engine Speed 500–800 RPM • Engine Torque 0 — 500 Nm • EGR Valve Position 15–100% • EGR Mass Flow 0–0.08 kg/s • Modeled Coolant Temperature > 82°C • Vehicle Speed < 5km/h • Enable Delay Time 30s **Engine Running Stuck Check High:** • Engine Speed 0 - 3000 RPM • Engine Torque > 0 Nm • EGR Mass Flow > 0 kg/s • Estimated EGR Inlet Temperature > 0 °C **Engine Running Stuck Check Low:** • Engine Speed 0–3000 RPM • Engine Torque < 3000 Nm • EGR Mass Flow < 2kg/s • Estimated EGR Inlet Temperature (bef cooler) < 1000 °C	
Disable Conditions	No Active DTC's: • 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** 12s	**Stuck Check** 1s
MIL Illumination	2 Drive Cycles	
Probable Causes	***See Tech Tool***	

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 Circuit
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage > 4.82V (850°C)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P040C EGR Temperature Sensor: Short Circuit Low

DTC	P040C
Component / System	EGR Temperature Sensor □Short circuit low
Monitor Strategy Description	Exhaust Gas Recirculation Temperature Sensor "A" Circuit Low
Fault Limit	Sensor Voltage < 0.02V (-100 °C)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	Exhaust Gas Temperature Sensor Circuit Range/Performance Bank 1 Sensor 1
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** Avg Pre DOC Temperature < 100 °C
Enable Conditions	• Barometric Pressure 75 - 120 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) < 25 °C • (Modeled Pre-DOC Temperature(-(Modeled Post-DOCTemperature) < 25 °C • (Modeled Post-DOC Temperature) - (Modeled Post-DPF Temperature < 25 °C • Turn off delay Post AHI Injection 600s • Enable Time Delay 3s
Disable Conditions	No Active DTC's: • 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	35s
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	Exhaust Gas Temperature Sensor Circuit Range/Performance Bank 1 Sensor 1
Monitor Strategy Description	Temperature sensor rationality check at start up after a 6 hour soak time
Fault Limit	|Delta| = |(Avg Pre DOC Temperature) □(Avg Post DOC Temperature)| > 40°C**and** |Delta| = |(Avg Pre DOC Temperature) □(Avg Post DPF Temperature)| > 40°C **or** Avg Pre DOC Temperature > 70 °C
Enable Conditions	• Key Position Key On • Soak Time > 6h • Enable Crank Time < 3s
Disable Conditions	No Active DTC's: • 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	0.8s
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	Exhaust Gas Temperature Sensor Circuit Range/Performance (Bank 1 Sensor 2)
Monitor Strategy Description	Signal Plausibility Failure
Fault Limit	|Delta| = |(Avg Pre DOC Temperature) □(Avg Post DOC Temperature)| > 70 °C **and** |Delta| = |(Avg Post DOC Temperature) □(Avg Post DPFTemperature)| > 70 °C **or** Post-DOC Temperature < 100 °C
Enable Conditions	• Barometric Pressure 75 - 120 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) < 25 °C • (Modeled Pre-DOC Temperature(-(Modeled Post-DOCTemperature) < 25 °C • (Modeled Post-DOC Temperature) - (Modeled Post-DPF Temperature < 25 °C • Delay Post AHI Injection 600 seconds • Enable Time Delay 3s
Disable Conditions	No Active DTC's: • 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	35s
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	Exhaust Gas Temperature Sensor Circuit Range/Performance (Bank 1 Sensor 2)
Monitor Strategy Description	Temperature sensor rationality check at start up after a 6 hour soak time
Fault Limit	|Delta| = |(Avg Pre DOC Temperature) □(Avg Post DOC Temperature)| > 40 °C **and** |Delta| = |(Avg Post DOC Temperature) □(Avg Post DPFTemperature)| > 40 °C **or** Post-DOC Temperature > 70 °C
Enable Conditions	• Key Position Key On • Soak Time > 6h • Enable Crank Time < 3s
Disable Conditions	No Active DTC's: • 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	0.8s
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	Exhaust Gas Temperature Sensor Circuit Range/Performance (Bank 1 Sensor 3)
Monitor Strategy Description	Signal Plausibility Failure
Fault Limit	|Delta| = |(Avg Pre DOC Temperature) □(Avg Post DPF Temperature)| > 70 °C **and**|Delta| = |(Avg PostDOC Temperature) □(Avg Post DPFTemperature)|> 70 °C **or** Post-DPF Temperature < 100 °C
Enable Conditions	• Barometric Pressure 75 - 120 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) < 25 °C • (Modeled Pre-DOC Temperature(-(Modeled Post-DOCTemperature) < 25 °C • (Modeled Post-DOC Temperature) - (Modeled Post-DPF Temperature < 25 °C • Delay Post AHI Injection 600s • Enable Time Delay 3s
Disable Conditions	No Active DTC's: • 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	35s
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	Exhaust Gas Temperature Sensor Circuit Range/Performance (Bank 1 Sensor 3)
Monitor Strategy Description	Temperature sensor rationality check at start up after a 6 hour soak time
Fault Limit	|Delta| = |(Avg Pre DOC Temperature) □(Avg Post DPF Temperature)| > 40°C **and** |Delta| = |(Avg Post DOC Temperature) □(Avg Post DPFTemperature)| > 40°C **or** Avg Post-DPF Temperature > 70 °C
Enable Conditions	• Key Position Key On • Soak Time > 6h • Enable Crank Time < 3s
Disable Conditions	No Active DTC's: • 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	0.8s
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	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	15s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P0545 Pre-DOC Temperature Sensor: Short Circuit Low

DTC	P0545
Component / System	Exhaust Gas Temperature Short Circuit Low
Monitor Strategy Description	Exhaust Gas Temperature Short Circuit Low
Fault Limit	Sensor Voltage < 0.15V (-100°C)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	15s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P2031 Post-DOC Temperature Sensor: Open Circuit Check

DTC	P2031
Component / System	Exhaust Gas Temperature Sensor Bank 1 Sensor 2
Monitor Strategy Description	Circuit Short To Battery or Open
Fault Limit	Sensor Voltage > 2.26V (850C°C) **or** 0.15 - 0.68V (-100 - (-40) °C)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	15s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P2032 Post-DOC Temperature Sensor: Short Circuit Low

DTC	P2032
Component / System	Engine Exhaust Gas Temperature Circuit Low (Bank 1 Sensor 2)
Monitor Strategy Description	Engine Exhaust Gas Temperature Circuit Low (Bank 1 Sensor 2)
Fault Limit	Sensor Voltage < 0.15V (-100 °C)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	15s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P242A Post-DPF Temperature Sensor: Open Circuit Check

DTC	P242A
Component / System	Exhaust Gas Temperature Sensor Bank 1 Sensor 3
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	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	15s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P242C Post-DPF Temperature Sensor: Short Circuit Low

DTC	P242C
Component / System	Exhaust Gas Temperature Sensor Circuit Low (Bank 1 Sensor 3)
Monitor Strategy Description	Exhaust Gas Temperature Sensor Circuit Low (Bank 1 Sensor 3)
Fault Limit	Sensor Voltage < 0.15V (-100 °C)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	15s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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 OilTemperature) - (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:** • Key On • Engine Speed < 100 RPM • Soak Time ≥ 8 Hours • Enable Delay ≥ 2 Seconds • Reset Pre-crank delay ≥ 3.5 Seconds	**Engine Running:** • Engine Speed ≥ 500 RPM • Enable Delay Time ≥ 60 Seconds
Disable Conditions	No Active DTC's: • 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 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	• Key On Active • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	N/A
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Key On Active • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	N/A
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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.

High Pressure Condition:
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.

P0521 Engine Oil Pressure Sensor: Rationality Monitor

DTC	P0521	
Component / System	Engine Oil Pressure Sensor/Switch Range/Performance	
Monitor Strategy Description	Signal Plausibility Failure	
Fault Limit	**Pre-Crank** Oil pressure > 100 kPa **or** < -50 kPa	**High Pressure Check** Oil pressure > 600 kPa **or** < 230 kPa
Enable Conditions	**Pre-Crank** • Key Position Key On • Engine Speed < 50 RPM • Soak Time > 100s • Enable Time Delay 2s	**High Pressure Check** • Engine Torque 0 - 300 Nm • Engine Speed 1600 - 1850 RPM • Engine Oil Temperature > 60°C • |Engine speed rate of change| < 100 RPM/s • Enable Delay Time 5s
Disable Conditions	No Active DTC's: • P0523, P0520	
Time Required For DTC To Be Set	**Pre-Crank** 0.8s	**High Pressure Check** 4s
MIL Illumination	2 Drive Cycles	
Probable Causes	***See Tech Tool***	

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	Engine Oil Pressure Sensor/Switch "A"
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage < 0.21V (0 kPa)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P0523
Component / System	Engine Oil Pressure Circuit High
Monitor Strategy Description	Engine Oil Pressure Circuit High
Fault Limit	Sensor Voltage > 4.85V (750 kPa)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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 5s
Enable Conditions	• Engine Speed 1000 - 2000 RPM • Engine Torque > 1200 Nm • Enable Delay Time 5s
Disable Conditions	No Active DTC's: • P0335, P0336
Time Required For DTC To Be Set	5s
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 VGT Overspeed Control Limit Flag is TRUE) and Evaluation Timer) > 90%
Enable Conditions	• Engine Coolant Temperature > 60 °C • Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55 °C • Engine Speed 1300 - 2100 RPM • Engine Speed (rate of change) -50 - 50 RPM/s • Engine Torque (rate of change) -50 - 50 Nm/s • Enable Delay 2s • Engine Torque < MAP Value Dependent on Barometric Pressure x:[75 80 85 90 95 100 105]kPa y: [1300 1500 1600 1700 1800 2000 2100]Nm
Disable Conditions	No Active DTC's: • 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	30s (accumulated)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

Crankshaft Position Sensor: Rationality Monitors

The Crankshaft Position Sensor is monitored by comparing it's 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	Open Circuit
Fault Limit	No signal from crank speed sensor—No signal for number of revolutions > 3
Enable Conditions	• Engine Speed > 50 RPM
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Engine Speed > 50 RPM
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Engine Speed > 50 RPM
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
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	• Engine Speed > 50 RPM
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
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	Rationality Low (Phase Error)
Fault Limit	Incorrect angle between cam and crank wheel Difference 5 crank angles
Enable Conditions	• Engine Speed > 50 RPM
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P0341 Camshaft Position Sensor: Rationality High

DTC	P0341
Component / System	Camshaft Position Sensor - Rationality High
Monitor Strategy Description	Input Rationality - High
Fault Limit	Less teeth than expected **or** the +1 tooth doesn't appear between expected crank teeth for number of revolutions > 3
Enable Conditions	• Engine Speed > 50 RPM
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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 < 0.21V (0 kPa)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	Exhaust Aftertreatment Fuel Pressure Sensor Circuit Range/Performance
Fault Limit	Aftertreatment Fuel Pressure Sensor during high press sequence for time < 45 kPa for a time of 20s (Air Pressure Evaluation)**and** Fuel Pressure Sensor > 300 kPa for a time of 20s (Fuel Pressure Evaluation) **or** Aftertreatment Fuel Pressure Sensor during low press sequence for time > 200 kPa (Air Pressure Drop Evaluation) for 2s **and** > 200 kPa (Fuel Delivery Evaluation) for 0.5s
Enable Conditions	• Battery Voltage 10 - 16V • Engine Speed > 475 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: • P0115, P0117, P0339, P0336, P0335, P20E0, P20DD, P1134, P1131, P2697, P2699, P20D9, P20D7, P0545, P0544, P2032, P2031, U3000
Time Required For DTC To Be Set	100s (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 0.5s
Enable Conditions	• Battery Voltage 10 - 16V • Engine Speed > 475 • Monitoring Request 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: • P0115, P0117, P0339, P0336, P0335, P20E0, P20DD, P1134, P1131, P2697, P2699, P20D9, P20D7, P0545, P0544, P2032, P2031, U3000
Time Required For DTC To Be Set	100s (up to 4 complete Monitor evaluations)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	Exhaust Aftertreatment Fuel Injector "A" Stuck Closed
Fault Limit	AHI Fuel Pressure Sensor > 140 kPa for 0.5s
Enable Conditions	• Battery Voltage 10 - 16V • Engine Speed > 475RPM • 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: • P0115, P0117, P0339, P0336, P0335, P20E0, P20DD, P1134, P1131, P2697, P2699, P20D9, P20D7, P0545, P0544, P2032, P2031, U3000
Time Required For DTC To Be Set	100s (up to 4 complete Monitor evaluations)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	Exhaust Aftertreatment Fuel Supply Control Circuit Open
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Current < 0.5 A
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P20D9 Aftertreatment Hydrocarbon Doser Solenoid: Short Circuit Low

DTC	P20D9
Component / System	Exhaust Aftertreatment Fuel Supply Control Circuit Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Current > 5 A
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• 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: • 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	• 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: • 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***

P24F6 Exhaust Aftertreatment Fuel Air Purge Valve Stuck Open

DTC	P24F6
Component / System	Exhaust Aftertreatment Fuel Air Purge Valve Stuck Open
Monitor Strategy Description	Exhaust Aftertreatment Fuel Air Purge Valve Stuck Open
Fault Limit	Aftertreatment Fuel Pressure Sensor > 50 kPa for time 0.5s
Enable Conditions	• Battery Voltage 10 - 16V • Engine Speed > 475 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: • P0115, P0117, P0339, P0336, P0335, P20E0, P20DD, P1134, P1131, P2697, P2699, P20D9, P20D7, P0545, P0544, P2032, P2031
Time Required For DTC To Be Set	100s (up to 4 complete Monitor evaluations)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P24F7 Exhaust Aftertreatment Fuel Air Purge Valve Stuck Closed

DTC	P24F7
Component / System	Exhaust Aftertreatment Fuel Air Purge Valve Stuck Closed
Monitor Strategy Description	Exhaust Aftertreatment Fuel Air Purge Valve Stuck Closed
Fault Limit	Aftertreatment Fuel Pressure Sensor > 70 kPa for time 1s
Enable Conditions	• 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: • P0115, P0117, P0339, P0336, P0335, P20E0, P20DD, P1134, P1131, P2697, P2699, P20D9, P20D7, P0545, P0544, P2032, P2031
Time Required For DTC To Be Set	100s (up to 4 complete Monitor evaluations)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P24F8 Exhaust Aftertreatment Fuel Air Purge Valve Circuit Low

DTC	P24F8
Component / System	Exhaust Aftertreatment Fuel Air Purge Valve Circuit Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Current > 10A
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's:
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P24FA Exhaust Aftertreatment Fuel Air Purge Valve

DTC	P24FA
Component / System	Exhaust Aftertreatment Fuel Air Purge Valve
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Current < 0.6A
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's:
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Key On Active • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Key On Active • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

Aftertreatment Hydrocarbon Dosing Valve: Rationality Monitors

P20CF Aftertreatment Hydrocarbon Dosing Valve: Stuck Open

DTC	P20CF
Component / System	Exhaust Aftertreatment Fuel Injector "A" Stuck Open
Monitor Strategy Description	Fluid Leak or Seal Failure
Fault Limit	Aftertreatment Fuel Pressure Sensor < 75 kPa for time 0.5s
Enable Conditions	• Battery Voltage 10 - 16V • Engine Speed < 475 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: • P0115, P0117, P0339, P0336, P0335, P20E0, P20DD, P1134, P1131, P2697, P2699, P20D9, P20D7, P0545, P0544, P2032, P2031
Time Required For DTC To Be Set	100s (up to 4 complete Monitor evaluations)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P2698 Exhaust Aftertreatment Fuel Injector "A" Performance

DTC	P2698
Component / System	Aftertreatment Hydrocarbon Dosing Valve - Functional
Monitor Strategy Description	Nozzle Plausibility This monitor is divided in two sets of enable conditions refered to as "Heat Release Calc Enable Conditions" and "SCR Conversion Efficiency Enable Conditions". The "Heat Release Calc Enable Conditions" are utilized to trigger and complete the calculation of total HC slip rate and modeled total HC slip rate. When this is completed the enable condition state is stored in the Non□volatile-memory and is valid for a cumulative time of 3600 s (valid across drive cycles). "SCR Conversion Efficiency Enable Conditions" are utilized to trigger and complete the calculation of the SCR Conversion Efficiency as well as calculation of AHI Flow Loss Completion of DOC □Conversion Efficiency/Feedgas Evaluation requires "SCR Conversion Efficiency Enable Conditions" to be fulfilled and "Heat Release Calc Enable Conditions" to not be fulfilled by the time of decision.
Fault Limit	AHI Flow Loss Ratio > 0.75% **and** SCR Conv Eff > MAP Value dependent on SCR Avg Temp MAP: x:[215 230 255 280 315]°C y:[43 50 61.5 77 89]%
Enable Conditions	• Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55°C **Heat Release Calc Enable Conditions:** • Engine Speed > 590 RPM • Engine Torque 1 > 1Nm • Exhaust Aftertreatment Fuel Injection Active • Pre DOC Temperature 170 — 400°C • Post DPF Temperature 200 – 600°C • SCR Warming **or** Moving Crystal Sublimation Active • Cumulative Dosed AHI Fuel > 53g • Enable Delay 5s • Enable Hold Time 40s **SCR Conversion Efficiency Enable Conditions:** • Engine Torque > 1 Nm • Engine Speed > 500 RPM • Modeled SCR Average Temperature 215 — 300°C • Exhaust Mass Flow 0.35 — 0.50 kg/s • NOx Upstream Value > 100 ppm • Exhaust Aftertreatment Fuel Injection Not Active • NOx Upstream Sensor Active • NOx Downstream Sensor Active • Heat Release Calc Enable Conditions Fulfilled (once within 3600s)

Disable Conditions	No Active DTC's: • P2229, P2080, P2084, P242B, P2226, P0072, P0070, P0105, P0108, P0409, P0406, P040A, P040C, P20D0, P20D9, P20D7, P1133, P20DC, P20CF, P20DD, P20E0, P0545, P0544, P2032, P2031, P242C, P242A, P0335, P0336, P0339, P2698, P0110, P0112, P20EE, P2201, P2200, P2203, P225C, P220A, P22FB, P220E, P225D, U029D, P229F, P22A1, P229E, P225E, P220B, P22FE, P220F, U029E, P221A, P225F, P24F7, P24F6, P24F8, P24FA, P20CF, P2698, P2699, P2697
Time Required For DTC To Be Set	—
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	Exhaust Aftertreatment Fuel Injector "A"
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Current < 0.6 A
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P2699 Aftertreatment Hydrocarbon Dosing Valve: Short Circuit Low

DTC	P2699
Component / System	Exhaust Aftertreatment Fuel Injector "A" Circuit Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Current > 10 A
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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| = |(Average DEF Tank Temperature) □(Engine Reference Temperature)| > 40 °C (absolute) Reference temperature = mean(average Intake Manifold Temp, average EGR Temp, average Engine Coolant Temp)
Enable Conditions	**Pre-Crank:** • Key Position Key On • Engine Speed < 100 RPM • Soak Time RPM > 8 hours • Enable Hold Time > 2 seconds
Disable Conditions	No Active DTC's: • P0335, P0336, P0072, P0070, P0117, P0115, P0097, P0095, P2229, P2226, P040A, P040C, P0545, P0544, P0110, P0112, P205A, P205C, U3017
Time Required For DTC To Be Set	1s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P24FF Aftertreatment DEF Tank Temperature Sensor: Rationality Low

DTC	P24FF
Component / System	Temperature □Rationality high
Monitor Strategy Description	Signal Plausibility High Failure
Fault Limit	|Delta| = |(Average DEF Tank Temperature) □(Engine Reference Temperature)| > 40 °C (absolute) Reference temperature = mean(average Intake Manifold Temp, average EGR Temp, average Engine Coolant Temp)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: •
Time Required For DTC To Be Set	2s
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	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• DEF Pressure < 650 kPa • Pressure build up attempt time 120s • Number of failed attempts 9
Enable Conditions	• DEF System Pressure Build Up State Active • Enable Delay 1s
Disable Conditions	No Active DTC's: • P10AE, P10AF, P208A, P208C, P208D, P2047, P2048, P2049, P204A, P204C
Time Required For DTC To Be Set	1080s (9 attempts*120s each)
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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:** • Running State Active **or** After Run State Active **or** Pressure Build Up **and** Defrosting Active
Disable Conditions	No Active DTC's: • 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	***See Tech Tool***

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	• DEF System Running State Active • DEF Dosing valve duty cycle < 15%
Disable Conditions	No Active DTC's: • P204A, P204C, P10AE, P10AF, P208A, P208C, P208D, P20E8, P2047, P2048, P2049
Time Required For DTC To Be Set	40s
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	• DEF pressure > 1100 kPa
Enable Conditions	• DEF System Running State Active
Disable Conditions	No Active DTC's: • P204A, P204C, P10AE, P10AF, P208B, P208A, P208C, P208D, P2047, P2048, P2049, P20E8
Time Required For DTC To Be Set	20s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P21CA Aftertreatment DEF Pump: Reductant Return No Flow Detected

DTC	P21CA
Component / System	Reductant Return No Flow Detected
Monitor Strategy Description	Reductant Control Module Supply Voltage Circuit
Fault Limit	• Supply Voltage to DEF Pump > 16V **or** <10V
Enable Conditions	• Key Position Key On • Battery Voltage > 8V • Enable Delay 1s
Disable Conditions	No Active DTC's: • P204A, P204C, P10AE, P10AF, P208A, P208C, P208D, P20E8, P2047, P2048, P2049
Time Required For DTC To Be Set	20s
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	Reductant Pump "A" Control
Monitor Strategy Description	Open Circuit
Fault Limit	Pump Voltage < 3.75 V
Enable Conditions	• Pump Duty Cycle > 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P208D Aftertreatment DEF Pump: Short Circuit High

DTC	P208D
Component / System	Aftertreatment Reagent Pump Control Short Circut High
Monitor Strategy Description	Short Circuit High
Fault Limit	Pump Current > 9 A
Enable Conditions	• Pump Duty Cycle > 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Pump Duty Cycle > 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P10AD
Component / System	Reductant Pump "A" Control Low Side
Monitor Strategy Description	Circuit Open
Fault Limit	Voltage < 3.8V
Enable Conditions	• Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	Reductant Pump "A" Control Low Side Circuit High
Fault Limit	Voltage 2.5 - 3.5V
Enable Conditions	• Actuator Duty Cycle 100%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

DEF Dosing

P249C Time to Enter DEF Dosing

DTC	P249C
Component / System	Time to Enter DEF Dosing
Monitor Strategy Description	Check if DPF temp out is less than limit
Fault Limit	Filtered DPF Temp Out is Less than Limit < 215˚C
Enable Conditions	• SCR Enable Power Value > 90 kW • Coolant Temp > 71˚C • Engine State Engine Running • UDS State UDS Running • Enable Delay 50s
Disable Conditions	No Active DTC's: • P0115, P0117, P0335, P0336, P0072, P0070, P0095, P0097, P0105, P0108, P2226, P2229, P242B
Time Required For DTC To Be Set	-
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	Aftertreatment Reagent Direction Valve Mechanical Problem
Monitor Strategy Description	Mechanical Failures
Fault Limit	• DEF pressure > 950 kPa
Enable Conditions	• DEF System After Run State Active • Enable Delay 2s
Disable Conditions	No Active DTC's: • P10AE, P10AF, P208B, P208A, P208C, P208D, P20E8, P2047, P2048, P2049, P204A, P204C, P20A0, P20A2, P20A3
Time Required For DTC To Be Set	60s
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	Reductant Purge Control Valve
Monitor Strategy Description	Open Circuit
Fault Limit	Valve Voltage < 3.75 V
Enable Conditions	• Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	10s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P20A3 Aftertreatment DEF Pump Direction Valve: Short Circuit High

DTC	P20A3
Component / System	Aftertreatment Reagent Direction Valve Short Circuit High
Monitor Strategy Description	Short Circuit High
Fault Limit	Valve Current > 9 A
Enable Conditions	• Actuator Duty Cycle 100%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P20A2 Aftertreatment DEF Pump Direction Valve: Short Circuit Low

DTC	P20A2
Component / System	Aftertreatment Reagent Direction Valve Short Circuit Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Valve Voltage < 1.5 V
Enable Conditions	• Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
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	Aftertreatment reagent pressure
Monitor Strategy Description	Pressure High
Fault Limit	Monitors the actual pressure vs expected pressure < 100 kPa • DEF Pressure Delay Times > 100 kPa • Delay Times 180s **or** Defrost State 10799s
Enable Conditions	DEF System States: Wait for Start State Active **or** Defrost State Active
Disable Conditions	No Active DTC's: • P208A, P208C, P208D, P20E8, P20E8 P2047, 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	Reductant Pressure Sensor
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage > 4.89 V (1300 kPa)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P204C Aftertreatment DEF Pump Pressure Sensor: Short Circuit Low

DTC	P204C
Component / System	Aftertreatment Reagent Pressure Sensor Circuit Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Voltage < 0.11V (0 kPa)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	DEF Mass of total available mass < 0.1%
Enable Conditions	• Key Position Key On • Battery Voltage > 8V • DEF Tank Temperature > –99°C (cal out)
Disable Conditions	No Active DTC's: • P208A, P208C, P208D, P20E8, P20E8P2047, P2048, P2049, P204A, P204
Time Required For DTC To Be Set	15s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Difference = present urea pump temp □urea pump temp at start of first defrost attempt < 1°C
Enable Conditions	• DEF System Defrost State Active
Disable Conditions	No Active DTC's: • P10AF, P10AE, P208C, P208D, P208A, P204A, P204C, P2049, P2048, P2047, P20E8, P208B
Time Required For DTC To Be Set	1150s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

Aftertreatment DEF Level Sensor: Circuit Monitor

P203A Aftertreatment DEF Pump Pressure Sensor: Aftertreatment Reagent Level Short Circuit Low

DTC	P203C
Component / System	Aftertreatment Reagent Level Short Circuit Low
Monitor Strategy Description	Aftertreatment Reagent Level Short Circuit Low
Fault Limit	Failure mode identifier broadcasted by reductant level sensor = 5
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	Aftertreatment Reagent Level Short Circuit Low
Fault Limit	Failure mode identifier broadcasted by reductant level sensor = 4
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	Difference = present reductant tank temp □eductant tank temp at start of first defrost attempt < 3 °C **and** Difference = present urea pump temp □urea pump temp at start of first defrost attempt < 1 °C
Enable Conditions	• DEF System Defrost State Active
Disable Conditions	No Active DTC's: • P10AE, P10AF, P2047, P2048, P2049, P204A, P204C, P208A, P208C, P208D, P208B, P20E8, P20B1, P20B3, P20B4
Time Required For DTC To Be Set	1150s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	10s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Actuator Duty Cycle 100%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Actuator Duty Cycle > 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Actuator Duty Cycle 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Actuator Duty Cycle > 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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 Reagent Dosing Valve Clogged

DTC	P208E
Component / System	Reductant Delivery
Monitor Strategy Description	Aftertreatment Reagent Dosing Valve Clogged
Fault Limit	Delta=(DEF Pump Duty Cycle in high window □DEF Pump Duty Cycle in low window) < 1.0%
Enable Conditions	• Engine Coolant Temperature > 60°C • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75–120 kPa • DEF Pressure Deviation from Nominal Pressure -75–75 kPa • DEF Tank Temperature 15–55°C • DEF System Running State Active **Enable Conditions for Low Dosing Window:** • DEF Mass Flow Demand < 0.05 g/s • Enable Delay 60s **Enable Conditions for High Dosing Window:** • DEF Mass Flow Demand > 0.45 g/s • Average SCR Temperature > 250°C • DEF Mass Flow (Integrated) > 75 g • NH3 Buffer Status OK • DEF Injection Allowed OK • Enable Delay 60s
Disable Conditions	No Active DTC's: • P10AE, P10AF, P208A, P208C, P208D, P20E8, P2047, P2048, P2049, P204A, P204C
Time Required For DTC To Be Set	10s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	Reductant Injection Valve Control Bank 1 Unit 1
Monitor Strategy Description	Open Circuit
Fault Limit	Dosing Valve Current < 0.2A
Enable Conditions	• Actuator Duty Cycle > 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Actuator Duty Cycle > 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P2048 Aftertreatment SCR Dosing Valve: Short Circuit Low

DTC	P2048
Component / System	Aftertreatment Reagent Dosing Valve Short Circuit Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Dosing Valve Current < 0.4 A
Enable Conditions	• Actuator Duty Cycle > 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	Turbocharger/Supercharge r Boost Control "A" Circuit Range/Performance
Monitor Strategy Description	VGT Mechanical Fault
Fault Limit	Time with mechanical fault reported from the VGT > 200ms
Enable Conditions	• Key Position Key On • Battery Voltage > 8V • Enable Delay Time 10s
Disable Conditions	No Active DTC's: • U0080
Time Required For DTC To Be Set	10s
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 position
Fault Limit	Ratio = Fault Timer ((incremented when VGT Cntrl Flag is TRUE) / (Evaluation Timer)) > 90 %
Enable Conditions	• Engine Coolant Temperature > 60 °C • Barometric Pressure 75 - 120 kPa • Ambient Air Temperature -8 - 55 °C • Engine Torque 1200 - 3000 Nm • Engine Speed 1450 - 1800 RPM • VGT Position (rate of change) -10 - 10%/s
Disable Conditions	No Active DTC's: • 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	15s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Key Position Key On • Battery Voltage > 8V • Enable Delay Time 10s
Disable Conditions	No Active DTC's: • U0080
Time Required For DTC To Be Set	10s
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	• Key Position Key On • Battery Voltage > 8V • Enable Delay Time 3s
Disable Conditions	No Active DTC's: • 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	• Key Position Key On • Battery Voltage > 8V • Enable Delay Time 10s
Disable Conditions	No Active DTC's: • U0080
Time Required For DTC To Be Set	95s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	1s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Injector current valid peak event > 9 A • Number of injections with failure detected > 3
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	2s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P0265
Component / System	Injector 2 - High
Monitor Strategy Description	Short Circuit High
Fault Limit	• Injector current valid peak event > 9 A • Number of injections with failure detected > 3
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	2s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P0268
Component / System	Injector 3 - High
Monitor Strategy Description	Short Circuit High
Fault Limit	• Injector current valid peak event > 9 A • Number of injections with failure detected > 3
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	2s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P0271
Component / System	Injector 4 - High
Monitor Strategy Description	Short Circuit High
Fault Limit	• Injector current valid peak event > 9 A • Number of injections with failure detected > 3
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	2s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P0274
Component / System	Injector 5 - High
Monitor Strategy Description	Short Circuit High
Fault Limit	• Injector current valid peak event > 9 A • Number of injections with failure detected > 3
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	2s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P0277
Component / System	Injector 6 - High
Monitor Strategy Description	Short Circuit High
Fault Limit	• Injector current valid peak event > 9 A • Number of injections with failure detected > 3
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	2s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P0201
Component / System	Injector 1 - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	• Injector current outside of valid peak event > 9 A • Number of injections with failure detected > 3
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	2s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P0202
Component / System	Injector 2 - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	• Injector current outside of valid peak event > 9 A • Number of injections with failure detected > 3
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	2s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P0203
Component / System	Injector 3 - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	• Injector current outside of valid peak event > 9 A • Number of injections with failure detected > 3
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	2s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P0204
Component / System	Injector 4 - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	• Injector current outside of valid peak event > 9 A • Number of injections with failure detected > 3
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	2s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P0205
Component / System	Injector 5 - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	• Injector current outside of valid peak event > 9 A • Number of injections with failure detected > 3
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	2s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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

DTC	P0206
Component / System	Injector 6 - Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	• Injector current outside of valid peak event > 9 A • Number of injections with failure detected > 3
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	2s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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| = |(Average Ambient AirTemperature) - (mean(average Pre-DOC Temp, average Post DOC Temp, average Post DPF temp))| > 40 °C (absolute)
Enable Conditions	**Pre-Crank:** • Key Position Key On • Engine Speed < 100 RPM • Soak Time > 8 hours • Enable Hold Time > 2s
Disable Conditions	No Active DTC's: • P0335, P0336, P0072, P0070, P0117, P0115, P0097, P0095, P2229, P2226, P040A, P040C, P0545, P0544, P0110, P0112, P205A, P205C, P2032, P2031, P242C, P242A, U3017
Time Required For DTC To Be Set	1s
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 > 4.5V (90°C)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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 < 0.5 V(-55 °C)
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	Vehicle Speed □Wheel Speed Correlation
Monitor Strategy Description	Sensor Rationality Check
Fault Limit	Delta = Vehicle speed □ABS > 12 km/h
Enable Conditions	• Key Position Key On • Vehicle Speed > 0 km/h • Road Speed from ABS > 0 km/h
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	17s
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	Wheel□Based□Vehicle Speed
Monitor Strategy Description	Open Circuit
Fault Limit	Sensor Voltage: • For inductive sensor > 3.75 V • For hall effect sensor > 5V
Enable Conditions	• Key On Active • Vehicle Speed 0 km/h • Road Speed from ABS 0 km/h
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
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	Vehicle Speed Sensor "A" Circuit Low
Monitor Strategy Description	Short Circuit Low
Fault Limit	Sensor Voltage: • For inductive sensor < 2.5 V • For hall effect sensor < 0V
Enable Conditions	• Key On Active • Vehicle Speed 0 km/h • Road Speed from ABS 0 km/h
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	7s
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	Rationality Low
Fault Limit	Sensor Voltage < 0.65V
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5.5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Key On Active • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5.5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P0643 Pedal Position Sensor Supply □Short Circuit High

DTC	P0643
Component / System	Pedal Position Sensor Supply □Short Circuit High
Monitor Strategy Description	Sensor Supply Short Circuit High
Fault Limit	Sensor Voltage > 5.7V
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5.5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P0642 Pedal Position Sensor Supply □Short Circuit High

DTC	P0642
Component / System	Pedal Position Sensor Supply □Short Circuit Low
Monitor Strategy Description	Sensor Supply Short Circuit Low
Fault Limit	Sensor Voltage < 4.7V
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5.5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

Accelerator Pedal Position Sensor: Circuit Monitors

P0122 Accelerator Pedal Position Sensor: Below Range

DTC	P0122
Component / System	APP - Low
Monitor Strategy Description	Sensor Circuit Below Range
Fault Limit	Sensor Voltage < 0.35 V
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5.5s
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	Sensor Circuit Above Range
Fault Limit	Sensor Voltage > 4.25 V
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5.5s
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	Circuit Low
Fault Limit	Time with applied parking brake > 10s
Enable Conditions	• Key Position Key On • Battery Voltage > 8V • Vehicle Speed > 2 km/h
Disable Conditions	No Active DTC's: • P0500, P0502, P215A
Time Required For DTC To Be Set	10s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

5 Volt ECM Supply: Supply #1

The 5 Volt sensor supplies are is 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	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5.5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P06B2 ECM Supply #1: Above Range

DTC	P06B2
Component / System	ECM Supply #1
Monitor Strategy Description	Above range
Fault Limit	Voltage Sensed > 5.5 V
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5.5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5.5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P06B5 ECM Supply #2: Above Range

DTC	P06B5
Component / System	ECM Supply #2
Monitor Strategy Description	Above range
Fault Limit	Voltage Sensed > 5.5 V
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5.5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5.5s
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 > 5.5 V
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5.5s
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	CAN Communication Backbone 1 Net
Monitor Strategy Description	Bus off
Fault Limit	Time Missing Signal > 5.5 seconds
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5.5s
MIL Illumination	1 Drive Cycle
Probable Causes	***See Tech Tool***

U0080 CAN Link: Powertrain CAN Missing Signal

DTC	U0080
Component / System	Vehicle Communication Engine Subnet
Monitor Strategy Description	Bus off
Fault Limit	Time Missing Signal > 5.5s
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5.5s
MIL Illumination	1 Drive Cycle
Probable Causes	***See Tech Tool***

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 > 100s
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • U0010
Time Required For DTC To Be Set	100s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

U116F CAN Link: Missing ACM at Engine Subnet

DTC	U116F
Component / System	Lost Communication with Reductant Control Module on Engine Subnet
Monitor Strategy Description	Lost Communication with Reductant Control Module on Engine Subnet
Fault Limit	Time Missing Signal > 5s
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • U0080
Time Required For DTC To Be Set	5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

U0141 CAN Link: Missing Signal from the VECU

DTC	U0141
Component / System	VECU
Monitor Strategy Description	Missing Signal
Fault Limit	Time Missing Signal > 0.1s
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • U0010
Time Required For DTC To Be Set	< 1s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

U02A2 CAN Link: Lost Communication with DEF Level ECU

DTC	U02A2
Component / System	Lost Communication with DEF Level ECU
Monitor Strategy Description	Missing message from DEF Level ECU
Fault Limit	Time Missing Signal > 6s
Enable Conditions	• Key Position Key On
Disable Conditions	No Active DTC's: • U0080
Time Required For DTC To Be Set	9s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

U1146 CAN Link: Lost Communication with ECM on Engine Subnet

DTC	U1146
Component / System	Lost Communication with ECM on Engine Subnet
Monitor Strategy Description	Missing message from ECM on Engine Subnet
Fault Limit	Time Missing Signal > 0.12s
Enable Conditions	• Key Position Key On
Disable Conditions	No Active DTC's: • U0080
Time Required For DTC To Be Set	3.12s
MIL Illumination	1 Drive Cycle
Probable Causes	***See Tech Tool***

U0323 CAN Link: Lost Communication with ECM on Engine Subnet

DTC	U0323
Component / System	Software Incompatibility With Instrument Panel Cluster (IPC) Control Module
Monitor Strategy Description	Missing message from IC
Fault Limit	Time Missing Signal > 30s
Enable Conditions	• Key Position Key On
Disable Conditions	No Active DTC's: • U0080
Time Required For DTC To Be Set	33s
MIL Illumination	1 Drive Cycle
Probable Causes	***See Tech Tool***

U0331 Software Incompatibility With VECU

DTC	U03331
Component / System	Software Incompatibility With VECU
Monitor Strategy Description	Missing message from VECU
Fault Limit	Time Missing Signal > 30s
Enable Conditions	• Key Position Key On
Disable Conditions	No Active DTC's: • U0080
Time Required For DTC To Be Set	33s
MIL Illumination	1 Drive Cycle
Probable Causes	***See Tech Tool***

P1154 Lost Communication Between VECU and IC

DTC	P1154
Component / System	Lost Communication Between VECU and IC
Monitor Strategy Description	Lost Communication With IC
Fault Limit	Time Missing Signal > 5s
Enable Conditions	• Key Position Key On
Disable Conditions	No Active DTC's: • U0010
Time Required For DTC To Be Set	5s
MIL Illumination	1 Drive Cycle
Probable Causes	***See Tech Tool***

U0001 CAN Link: Missing Signal on Backbone 2

DTC	U0001
Component / System	CAN Communication Backbone 2 Net
Monitor Strategy Description	Bus off
Fault Limit	Time Missing Signal > 5.5 seconds
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5.5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

U010E CAN Link: Lost Communication With Aftertreatment Control Module

DTC	U010E
Component / System	Lost Communication With Aftertreatment Control Module
Monitor Strategy Description	Lost Communication With Aftertreatment Control Module
Fault Limit	Time Missing Signal > 5s
Enable Conditions	• Key Position Key On • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • U0010
Time Required For DTC To Be Set	15s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Engine Coolant Temperature > 65 °C • Barometric Pressure 75 - 120 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 Nm/s (absolute value) • Enable delay 5s • Engine run time after engine start > 60s
Disable Conditions	No Active DTC's: • 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	5s
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	• Engine Coolant Temperature > 65 °C • Barometric Pressure 75 - 120 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 Nm/s (absolute value) • Enable delay 5s • Engine run time after engine start > 60s
Disable Conditions	No Active DTC's: • 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 185s evaluation period.
Enable Conditions	• Engine Coolant Temperature > 65 °C • Barometric Pressure 75 - 120 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 Nm/s (absolute value) • Enable delay 5s • Engine run time after engine start > 60s
Disable Conditions	No Active DTC's: • 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	185s
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 185s evaluation period.
Enable Conditions	• Engine Coolant Temperature > 65 °C • Barometric Pressure 75 - 120 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 Nm/s (absolute value) • Enable delay 5s • Engine run time after engine start > 60s
Disable Conditions	No Active DTC's: • 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	185s
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	• Key On Active • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P06B2 ACM Sensor Supply #1: Above Range

DTC	P06B2
Component / System	ACM Sensor Supply #1
Monitor Strategy Description	Above range
Fault Limit	Voltage Sensed > 5.5 V
Enable Conditions	• Key On Active • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Key On Active • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

P06B5 ACM Sensor Supply #2: Above Range

DTC	P06B5
Component / System	ACM Sensor Supply #2
Monitor Strategy Description	Above range
Fault Limit	Voltage Sensed > 5.5 V
Enable Conditions	• Key On Active • Battery Voltage > 8V
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5 seconds
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Actuator Duty Cycle ≥ 100 %
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5.5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Actuator Duty Cycle ≤ 0%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	5.5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

Actuator Supply #1 ACM: Circuit Monitors

P26E8 Actuator Supply #1 ACM: Short Circuit Low

DTC	P26E8
Component / System	Actuator Supply Voltage "D" Circuit Low
Monitor Strategy Description	Actuator Supply #1 Short Circuit to ground
Fault Limit	Voltage Supply < 8V
Enable Conditions	• Actuator Duty Cycle 100%
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	6s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Key Position Key On
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	< 1s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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	• Key Position Key On
Disable Conditions	No Active DTC's: • N/A
Time Required For DTC To Be Set	< 1s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

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 > 1560s
Enable Conditions	• Key Position Key On • Engine Speed > 500 RPM
Disable Conditions	No Active DTC's: • P0115, P0117, U0155
Time Required For DTC To Be Set	1080s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

Battery Voltage

U3000 Battery Voltage Open Circuit

DTC	U3000
Component / System	Battery Voltage Open Circuit
Monitor Strategy Description	Below Range
Fault Limit	EECU Internal Voltage < 0.148926V
Enable Conditions	• Key Position Key On
Disable Conditions	No Active DTC's: •
Time Required For DTC To Be Set	5.5s
MIL Illumination	2 Drive Cycles
Probable Causes	***See Tech Tool***

VOLVO

Volvo Trucks North America, a division of Volvo Group North America, Inc.
Greensboro, NC USA

PV776-89149152 English 2014.2014 Printed in USA