

Service Information

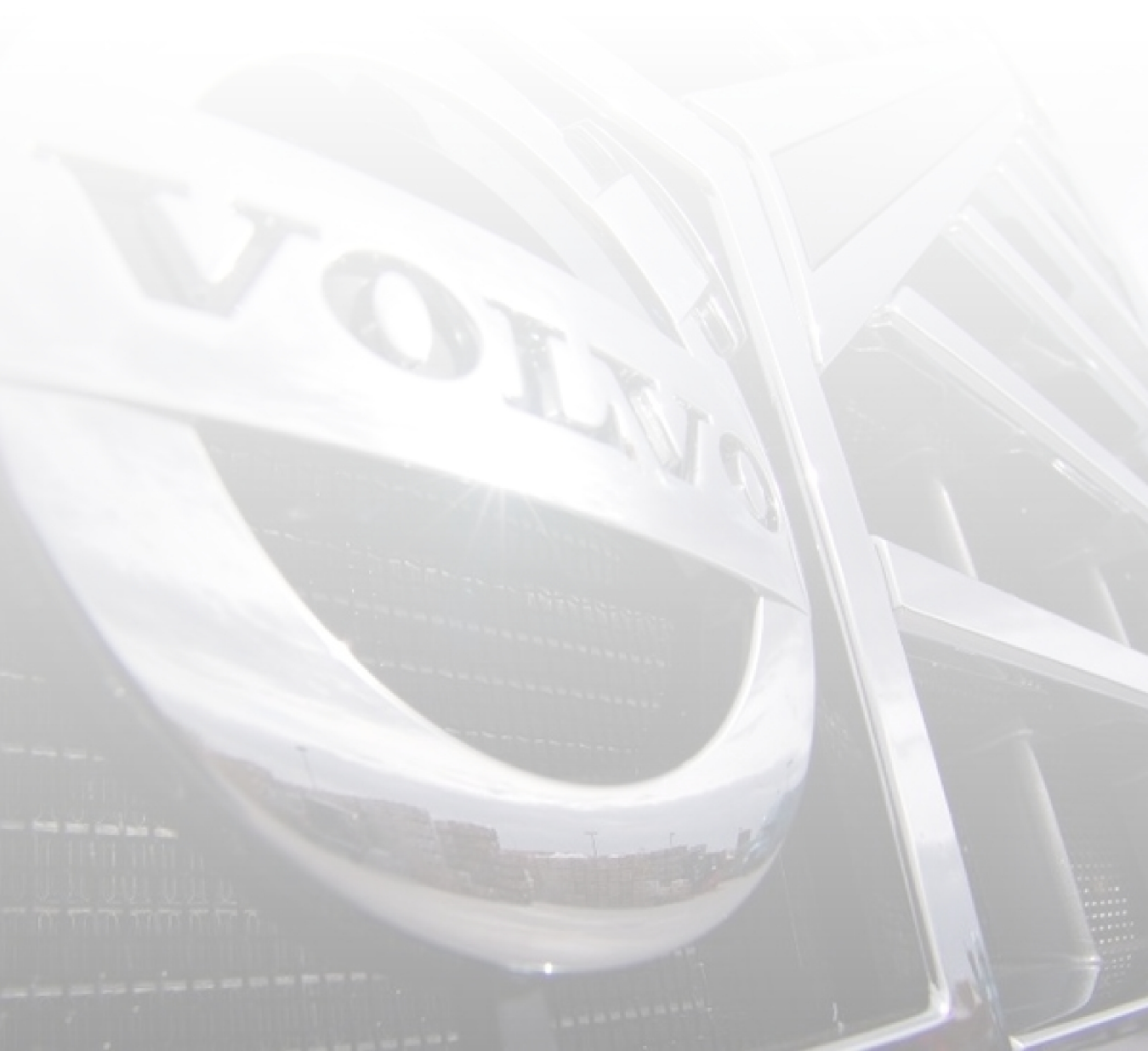


Volvo Trucks

**Engine Control Module (ECM), Aftertreatment Control
Module (ACM), Electrical System Version3
Diagnostic Trouble Code (DTC)**

**Group 28
Release 01**

Volvo Trucks



Foreword

The descriptions and service procedures contained in this manual are based on designs and technical studies carried out through January 2013.

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.

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Troubleshooting

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

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

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

System Overview

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

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

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

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

System Electronic Control Unit (ECU) Overview

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

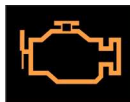
The system contains the following "emission critical" ECUs that are monitored;

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

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

Malfunction Indicator Lamp (MIL), Description and Location

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



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OBD2013 Code Definition

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

First Character

- P=Powertrain
- B=Body
- C=Chassis (not used in NA yet)
- U=Network (Data Link), power supply

- P00XX Fuel and air metering and Auxiliary Emissions controls
- P01XX Fuel and air metering
- P02XX Fuel and air metering
- P03XX Ignition system or misfire
- P04XX Auxiliary Emissions Controls
- P05XX Vehicle Speed, Idle control, auxiliary inputs
- P06XX Computer and Auxiliary inputs
- P07XX Transmission
- P08XX Transmission
- P09XX Transmission
- P1XX manufacturer controlled
- P2XX SAE controlled DTCs
- P3XX Manufacturer controlled and SAE reserved

Fifth and Sixth Digit-(if applicable)

- Failure Type Byte (FTB)

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

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

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

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

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

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

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

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Definitions and Terminology

Confirmed Fault Code:

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

Continuous Monitors:

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

Deactivate:

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

Diagnostic or Emission Critical:

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

Diagnostic Trouble Code (DTC)

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

Drive Cycle:

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

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

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

Enable Conditions:

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

Engine Misfire:

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

Engine Start:

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

Fault Memory:

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

Functional Check:

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

Ignition Cycle:

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

Key On, Engine Off (KOEO):

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

Key On, Engine Running (KOER):

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

Malfunction:

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

Malfunction Indicator Lamp (MIL):

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

MIL-On Fault Code:

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

Monitor

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

Noncontinuous Monitors:

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

On-Board Diagnostics (OBD):

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

Pending Fault Code:

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

Permanent Fault Code:

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

Rationality Fault Diagnostic:

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

Warm-Up Cycle:

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

Fuel Pressure, Timing and Quantity

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

P026C Fuel Injector (low mass flow)

| | |
|--|---|
| DTC | P026C |
| Component / System | Fuel System Monitoring Injection Quantity – Low |
| Monitor Strategy Description | Actual air fuel ratio based fueling compared to expected |
| Fault Limit | Ratio = (Air fuel ratio based estimated fuel flow Modeled Fuel flow) < 0.85 |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Exhaust Gas Temperature 100 - 400 °C • DOC Outlet Temperature 200 - 400 °C • DPF Outlet Temperature 200 - 400 °C • Average Engine Speed 1000 - 2000 RPM • Average Engine Torque > 1000 Nm • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0071, P0108, P0105, P0340, P0335, P2200, P2203, P221A |
| Time Required For DTC To Be Set | 45 seconds (accumulated time) |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

P026D Fuel Injector (high mass flow)

| | |
|--|---|
| DTC | P026D |
| Component / System | Fuel System Monitoring Injection Quantity – High |
| Monitor Strategy Description | Actual air fuel ratio based fueling compared to expected |
| Fault Limit | Ratio = (Air fuel ratio based estimated fuel flow Modeled Fuel flow) > 1.42 |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Exhaust Gas Temperature 100 - 400 °C • DOC Outlet Temperature 200 - 400 °C • DPF Outlet Temperature 200 - 400 °C • Average Engine Speed 1000 - 2000 RPM • Average Engine Torque > 1000 Nm • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0071, P0108, P0105, P0340, P0335, P2200, P2203, P221A |
| Time Required For DTC To Be Set | 45 seconds (accumulated time) |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

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

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

individual acceleration reading from the average acceleration value.

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

P02CD Single Cylinder High Mass Flow Monitor (Cylinder 1)

| | |
|--|---|
| DTC | P02CD |
| Component / System | Fuel System Monitoring Injection Quantity – High (Cylinder 1) |
| Monitor Strategy Description | Single cylinder fueling offset |
| Fault Limit | Fueling offset of any one injector at idle < -1.5 deg CA |
| Enable Conditions | <ul style="list-style-type: none"> • Vehicle Speed < 0.1 km/h • Engine Speed 525 - 725 RPM • PTO Not Active • Engine Torque 0 - 600 Nm • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0301, P0302, P0303, P0304, P0305, P0306, P0300, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 600 seconds (accumulated time at idle) |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

P02CF Single Cylinder High Mass Flow Monitor (Cylinder 2)

| | |
|--|---|
| DTC | P02CF |
| Component / System | Fuel System Monitoring Injection Quantity – High (Cylinder 2) |
| Monitor Strategy Description | Single cylinder fueling offset |
| Fault Limit | Fueling offset of any one injector at idle < -1.5 deg CA |
| Enable Conditions | <ul style="list-style-type: none"> • Vehicle Speed < 0.1 km/h • Engine Speed 525 - 725 RPM • PTO Not Active • Engine Torque 0 - 600 Nm • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0301, P0302, P0303, P0304, P0305, P0306, P0300, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 600 seconds (accumulated time at idle) |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

P02D1 Single Cylinder High Mass Flow Monitor (Cylinder 3)

| | |
|--|---|
| DTC | P02D1 |
| Component / System | Fuel System Monitoring Injection Quantity – High (Cylinder 3) |
| Monitor Strategy Description | Single cylinder fueling offset |
| Fault Limit | Fueling offset of any one injector at idle < -1.5 deg CA |
| Enable Conditions | <ul style="list-style-type: none"> • Vehicle Speed < 0.1 km/h • Engine Speed 525 - 725 RPM • PTO Not Active • Engine Torque 0 - 600 Nm • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0301, P0302, P0303, P0304, P0305, P0306, P0300, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 600 seconds (accumulated time at idle) |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

P02D3 Single Cylinder High Mass Flow Monitor (Cylinder 4)

| | |
|--|---|
| DTC | P02D3 |
| Component / System | Fuel System Monitoring Injection Quantity – High (Cylinder 4) |
| Monitor Strategy Description | Single cylinder fueling offset |
| Fault Limit | Fueling offset of any one injector at idle < -1.5 deg CA |
| Enable Conditions | <ul style="list-style-type: none"> • Vehicle Speed < 0.1 km/h • Engine Speed 525 - 725 RPM • PTO Not Active • Engine Torque 0 - 600 Nm • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0301, P0302, P0303, P0304, P0305, P0306, P0300, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 600 seconds (accumulated time at idle) |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

P02D5 Single Cylinder High Mass Flow Monitor (Cylinder 5)

| | |
|--|---|
| DTC | P02D5 |
| Component / System | Fuel System Monitoring Injection Quantity – High (Cylinder 5) |
| Monitor Strategy Description | Single cylinder fueling offset |
| Fault Limit | Fueling offset of any one injector at idle < -1.5 deg CA |
| Enable Conditions | <ul style="list-style-type: none"> • Vehicle Speed < 0.1 km/h • Engine Speed 525 - 725 RPM • PTO Not Active • Engine Torque 0 - 600 Nm • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0301, P0302, P0303, P0304, P0305, P0306, P0300, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 600 seconds (accumulated time at idle) |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

P02D7 Single Cylinder High Mass Flow Monitor (Cylinder 6)

| | |
|--|---|
| DTC | P02D7 |
| Component / System | Fuel System Monitoring Injection Quantity – High (Cylinder 6) |
| Monitor Strategy Description | Single cylinder fueling offset |
| Fault Limit | Fueling offset of any one injector at idle < -1.5 deg CA |
| Enable Conditions | <ul style="list-style-type: none"> • Vehicle Speed < 0.1 km/h • Engine Speed 525 - 725 RPM • PTO Not Active • Engine Torque 0 - 600 Nm • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0301, P0302, P0303, P0304, P0305, P0306, P0300, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 600 seconds (accumulated time at idle) |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

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

The single cylinder low mass flow malfunction is monitored using the misfire detection monitor. See "Misfire Monitoring at Idle Conditions", page 29 for detailed monitor descriptions.

P0301 Single Cylinder Low Mass Flow Monitor (Cylinder 1)

| | |
|--|---|
| DTC | P0301 |
| Component / System | Fuel System Monitoring Injection Quantity – Low (Cylinder 1) |
| Monitor Strategy Description | Single cylinder engine flywheel acceleration evaluation |
| Fault Limit | Number of misfire events per cylinder 400 out of 500 |
| Enable Conditions | <ul style="list-style-type: none"> • Average Engine Speed 525 - 725 RPM • PTO Not Active • Number of Cylinders Misfiring < 4 Cylinders • Engine Torque 0 - 400 Nm • Vehicle Speed < 0.1 km/h • Revolution Count 125 Revolutions • Delay Time After Engine Start 60 seconds • Delay Time After Enable Condition Met 10 seconds • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 180 Seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

P0302 Single Cylinder Low Mass Flow Monitor (Cylinder 2)

| | |
|--|---|
| DTC | P0302 |
| Component / System | Fuel System Monitoring Injection Quantity – Low (Cylinder 2) |
| Monitor Strategy Description | Single cylinder engine flywheel acceleration evaluation |
| Fault Limit | Number of misfire events per cylinder 400 out of 500 |
| Enable Conditions | <ul style="list-style-type: none"> • Average Engine Speed 525 - 725 RPM • PTO Not Active • Number of Cylinders Misfiring < 4 Cylinders • Engine Torque 0 - 400 Nm • Vehicle Speed < 0.1 km/h • Revolution Count 125 Revolutions • Delay Time After Engine Start 60 seconds • Delay Time After Enable Condition Met 10 seconds • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 180 Seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

P0303 Single Cylinder Low Mass Flow Monitor (Cylinder 3)

| | |
|--|---|
| DTC | P0303 |
| Component / System | Fuel System Monitoring Injection Quantity – Low (Cylinder 3) |
| Monitor Strategy Description | Single cylinder engine flywheel acceleration evaluation |
| Fault Limit | Number of misfire events per cylinder 400 out of 500 |
| Enable Conditions | <ul style="list-style-type: none"> • Average Engine Speed 525 - 725 RPM • PTO Not Active • Number of Cylinders Misfiring < 4 Cylinders • Engine Torque 0 - 400 Nm • Vehicle Speed < 0.1 km/h • Revolution Count 125 Revolutions • Delay Time After Engine Start 60 seconds • Delay Time After Enable Condition Met 10 seconds • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 180 Seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P0304 Single Cylinder Low Mass Flow Monitor (Cylinder 4)

| | |
|--|---|
| DTC | P0304 |
| Component / System | Fuel System Monitoring Injection Quantity – Low (Cylinder 4) |
| Monitor Strategy Description | Single cylinder engine flywheel acceleration evaluation |
| Fault Limit | Number of misfire events per cylinder 400 out of 500 |
| Enable Conditions | <ul style="list-style-type: none"> • Average Engine Speed 525 - 725 RPM • PTO Not Active • Number of Cylinders Misfiring < 4 Cylinders • Engine Torque 0 - 400 Nm • Vehicle Speed < 0.1 km/h • Revolution Count 125 Revolutions • Delay Time After Engine Start 60 seconds • Delay Time After Enable Condition Met 10 seconds • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 180 Seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

P0305 Single Cylinder Low Mass Flow Monitor (Cylinder 5)

| | |
|--|---|
| DTC | P0305 |
| Component / System | Fuel System Monitoring Injection Quantity – Low (Cylinder 5) |
| Monitor Strategy Description | Single cylinder engine flywheel acceleration evaluation |
| Fault Limit | Number of misfire events per cylinder 400 out of 500 |
| Enable Conditions | <ul style="list-style-type: none"> • Average Engine Speed 525 - 725 RPM • PTO Not Active • Number of Cylinders Misfiring < 4 Cylinders • Engine Torque 0 - 400 Nm • Vehicle Speed < 0.1 km/h • Revolution Count 125 Revolutions • Delay Time After Engine Start 60 seconds • Delay Time After Enable Condition Met 10 seconds • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 180 Seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P0306 Single Cylinder Low Mass Flow Monitor (Cylinder 6)

| | |
|--|---|
| DTC | P0306 |
| Component / System | Fuel System Monitoring Injection Quantity – Low (Cylinder 6) |
| Monitor Strategy Description | Single cylinder engine flywheel acceleration evaluation |
| Fault Limit | Number of misfire events per cylinder 400 out of 500 |
| Enable Conditions | <ul style="list-style-type: none"> • Average Engine Speed 525 - 725 RPM • PTO Not Active • Number of Cylinders Misfiring < 4 Cylinders • Engine Torque 0 - 400 Nm • Vehicle Speed < 0.1 km/h • Revolution Count 125 Revolutions • Delay Time After Engine Start 60 seconds • Delay Time After Enable Condition Met 10 seconds • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 180 Seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

Misfire Monitoring at Idle Conditions

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

is then filtered with a low pass filter and after all cylinders have fired, an average acceleration of all cylinders is generated. The error of each cylinder is calculated as the deviation of its individual acceleration reading from the average acceleration value.

P0300 Misfire Multiple Cylinders

| | |
|--|---|
| DTC | P0300 |
| Component / System | Misfire Monitoring Misfire Multiple Cylinders |
| Monitor Strategy Description | Engine flywheel acceleration evaluation |
| Fault Limit | Number of misfire events per cylinder 400 out of 500 |
| Enable Conditions | <ul style="list-style-type: none"> • Average Engine Speed 525 - 725 RPM • PTO Not Active • Number of Cylinders Misfiring < 4 Cylinders • Engine Torque 0 - 400 Nm • Vehicle Speed < 0.1 km/h • Revolution Count 125 Revolutions • Delay Time After Engine Start 60 seconds • Delay Time After Enable Condition Met 10 seconds • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 180 Seconds |
| 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 | Number of misfire events per cylinder 400 out of 500 |
| Enable Conditions | <ul style="list-style-type: none"> • Average Engine Speed 525 - 725 RPM • PTO Not Active • Number of Cylinders Misfiring < 4 Cylinders • Engine Torque 0 - 400 Nm • Vehicle Speed < 0.1 km/h • Revolution Count 125 Revolutions • Delay Time After Engine Start 60 seconds • Delay Time After Enable Condition Met 10 seconds • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 180 Seconds |
| 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 | Number of misfire events per cylinder 400 out of 500 |
| Enable Conditions | <ul style="list-style-type: none"> • Average Engine Speed 525 - 725 RPM • PTO Not Active • Number of Cylinders Misfiring < 4 Cylinders • Engine Torque 0 - 400 Nm • Vehicle Speed < 0.1 km/h • Revolution Count 125 Revolutions • Delay Time After Engine Start 60 seconds • Delay Time After Enable Condition Met 10 seconds • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 180 Seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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 | Number of misfire events per cylinder 400 out of 500 |
| Enable Conditions | <ul style="list-style-type: none"> • Average Engine Speed 525 - 725 RPM • PTO Not Active • Number of Cylinders Misfiring < 4 Cylinders • Engine Torque 0 - 400 Nm • Vehicle Speed < 0.1 km/h • Revolution Count 125 Revolutions • Delay Time After Engine Start 60 seconds • Delay Time After Enable Condition Met 10 seconds • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 180 Seconds |
| 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 | Number of misfire events per cylinder 400 out of 500 |
| Enable Conditions | <ul style="list-style-type: none"> • Average Engine Speed 525 - 725 RPM • PTO Not Active • Number of Cylinders Misfiring < 4 Cylinders • Engine Torque 0 - 400 Nm • Vehicle Speed < 0.1 km/h • Revolution Count 125 Revolutions • Delay Time After Engine Start 60 seconds • Delay Time After Enable Condition Met 10 seconds • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 180 Seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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 | Number of misfire events per cylinder 400 out of 500 |
| Enable Conditions | <ul style="list-style-type: none"> • Average Engine Speed 525 - 725 RPM • PTO Not Active • Number of Cylinders Misfiring < 4 Cylinders • Engine Torque 0 - 400 Nm • Vehicle Speed < 0.1 km/h • Revolution Count 125 Revolutions • Delay Time After Engine Start 60 seconds • Delay Time After Enable Condition Met 10 seconds • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 180 Seconds |
| 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 | Number of misfire events per cylinder 400 out of 500 |
| Enable Conditions | <ul style="list-style-type: none"> • Average Engine Speed 525 - 725 RPM • PTO Not Active • Number of Cylinders Misfiring < 4 Cylinders • Engine Torque 0 - 400 Nm • Vehicle Speed < 0.1 km/h • Revolution Count 125 Revolutions • Delay Time After Engine Start 60 seconds • Delay Time After Enable Condition Met 10 seconds • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, P0206 |
| Time Required For DTC To Be Set | 180 Seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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 / Modeled EGR mass flow) < 0.55 |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 1300 - 1800 RPM • Engine Torque 625 - 2000 Nm • EGR Position 70 - 100 % • EGR Flow Demand 0.1 - 0.4 kg/s • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0069, P046C, P0234, P0299 |
| Time Required For DTC To Be Set | 4 Seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

P0402 EGR System (High Flow)

| | |
|--|---|
| DTC | P0402 |
| Component / System | EGR System - High Flow |
| Monitor Strategy Description | Compare demanded EGR flow to actual |
| Fault Limit | Ratio = (Measured EGR mass flow Modeled EGR mass flow) > 4.0 |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 600 - 1600 RPM • Engine Torque 400 - 2450 Nm • EGR Position 0 - 80 % • EGR Flow Demand 0 □ 0.083 kg/s • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0069, P046C, P0234, P0299 |
| Time Required For DTC To Be Set | 5 Seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

EGR: Slow Response Emission Threshold

This OBD monitor evaluates a slowly responding EGR system by comparing two evaluation windows. Within a window, demanded EGR flowrate is evaluated. If a transition occurs within

an allowable time, the demanded EGR flow is compared to the actual flow at the target time to determine if the proper flow was achieved. If the flow is not achieved then a DTC is raised.

P240F EGR System Slow Response

| | | |
|--|---|---|
| DTC | P240F | |
| Component / System | EGR System - Slow Response | |
| Monitor Strategy Description | EGR mass flow fails to achieve a flow change | |
| Fault Limit | Decreasing Delta = Modeled EGR mass flow - Measured EGR mass flow < -0.025 | Increasing Delta = Measured EGR mass flow - Modeled EGR mass flow < -0.01 |
| Enable Conditions | Decreasing Low Flow Window <ul style="list-style-type: none"> • Engine Speed 580 - 1600 RPM • Engine Torque > 600 Nm • EGR Mass Flow Demand < 0.05 kg/s • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C High Flow Window <ul style="list-style-type: none"> • Engine Speed 550 - 620 RPM • Engine Torque 100 - 170 Nm • EGR Mass Flow Demand 0.03 - 0.05 kg/s • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C | Increasing Low Flow Window <ul style="list-style-type: none"> • Engine Speed 650 - 1100 RPM • Engine Torque 200 - 600 Nm • EGR Mass Flow Demand 0.01 - 0.2 kg/s • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C High Flow Window <ul style="list-style-type: none"> • Engine Speed 1400 - 1600 RPM • Engine Torque > 2200 Nm • EGR Mass Flow Demand 0.06 - 0.13 kg/s • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0069, P046C, P0234, P0299 | |
| Time Required For DTC To Be Set | Decreasing 33 seconds | Increasing 23 seconds |
| 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 > 0.9 |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Torque 300 - 2500 Nm • Exhaust Mass Flow 0.1 - 1.0 kg/s • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0069, P046C, P0234, P0299, P0401, P0402 |
| Time Required For DTC To Be Set | 90 Seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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 high total time > 0.9 |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Torque 300 - 2500 Nm • Exhaust Mass Flow 0.1 - 1.0 kg/s • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0069, P046C, P0234, P0299, P0401, P0402 |
| Time Required For DTC To Be Set | 90 Seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Boost Pressure: Under or Over Boost Emission Threshold

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

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

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.

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

P0299 Boost Pressure: Underboost

| | |
|--|---|
| DTC | P0299 |
| Component / System | Boost Pressure □Underboost |
| Monitor Strategy Description | Comparison of actual boost pressure to a modeled boost pressure |
| Fault Limit | Delta = Actual boost pressure □Modeled boost pressure < □50kPa |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 1350 - 1700 RPM • EGR Position 10 - 96% • VGT Position 5 - 90% • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0069, P0726, P0106, P0490, P045F, P045E, P2563, P0045, U010C, U040D, P2578, P2581, P2580, P0069, U010C, P2229 |
| Time Required For DTC To Be Set | 5 Seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

P0234 Boost Pressure: Overboost

| | |
|--|---|
| DTC | P0234 |
| Component / System | Boost Pressure - Overboost |
| Monitor Strategy Description | Comparison of actual boost pressure to a modeled boost pressure |
| Fault Limit | Delta = Actual boost pressure - Modeled boost pressure > 120 kPa |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 1350 - 1700 RPM • EGR Position 10 - 96% • VGT Position 5 - 90% • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0069, P0726, P0106, P0490, P045F, P045E, P2563, P0045, U010C, U040D, P2578, P2581, P2580, P0069, U010C, P2229 |
| Time Required For DTC To Be Set | 5 Seconds |
| 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 = Low pressure window - high pressure window < 5 kPa | |
| Enable Conditions | Low Pressure Window <ul style="list-style-type: none"> • Engine Speed 400 - 1600 RPM • Engine Torque 0 - 1000 Nm • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C | High Pressure Window <ul style="list-style-type: none"> • Engine Speed 1000 - 1800 RPM • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • None | |
| Time Required For DTC To Be Set | 5 seconds | |
| MIL Illumination | 2 Drive Cycles | |
| Probable Causes | <i>See Tech Tool</i> | |

Non-Methane Hydrocarbon (NMHC) Converting Catalyst: Conversion Efficiency Emission Threshold

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

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

P0420 NMHC Catalyst: Conversion Efficiency

| | |
|--|---|
| DTC | P0420 |
| Component / System | NMHC Catalyst - Conversion Efficiency |
| Monitor Strategy Description | Compare calculated total HC slip rate to modeled total HC slip rate |
| Fault Limit | Ratio = Calculated total HC slip rate / Modeled total HC slip rate > 1.4 |
| Enable Conditions | <ul style="list-style-type: none"> • DPF Outlet Temperature > 100 °C • AHI Fuel Injection State Active • Start Coolant Temperature < 73 °C • Barometric Pressure 75 - 105 kPa • Ambient Air Temperature -8 - 55 °C • Total HC injected > 57g |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P2226, P2229, P0110, P0112, P0115, P0117, P20DD, P20E0, P229E, P2200, P0105, P0108; P2031, P2322, P2084, P242C, P242A, P242B, P0545, P0544, P2080, P1130, P1133, P20DC, P20D0, P20CF |
| Time Required For DTC To Be Set | 300 seconds (with no more than 45s AHI dosing break) |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P0421 NMHC Catalyst: Missing Substrate

| | |
|--|---|
| DTC | P0421 |
| Component / System | NMHC Catalyst - Missing Substrate |
| Monitor Strategy Description | Compare engine exhaust temperature rate of change to DOC temperature rate of change |
| Fault Limit | Ratio = Engine exhaust temperature rate of change / DOC temperature rate of change < 1.5 |
| Enable Conditions | <ul style="list-style-type: none"> • Exhaust Gas Temperature Derivative > 3.75 °C/s or < -3.75 °C/s • Modeled DOC Outlet Temperature Derivative > 3.75 °C/s or < -3.75 °C/s • AHI Fuel Injection State Not Active • Number of sub evaluations 8 |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P2226, P2229, P0110, P0112, P0115, P0117, P20DD, P20E0, P229E, P2200, P0105, P0108; P2031, P2322, P2084, P242C, P242A, P242B, P0545, P0544, P2080, P1130, P1133, P20DC, P20D0, P20CF |
| Time Required For DTC To Be Set | 650 seconds (8 sub evaluations. 5 pass of 8 evaluations => PASS, 6 fail of 8 evaluations => FAIL) |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

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

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

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

P20EE NOx Catalyst: Conversion Efficiency

| | |
|--|--|
| DTC | P20EE |
| Component / System | NOx Catalyst - Conversion Efficiency |
| Monitor Strategy Description | Low NOx conversion efficiency |
| Fault Limit | Calculated NOx conversion efficiency DOC temperature rate of change < 66% |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 1400 - 1800 RPM • Exhaust Mass Flow > 0.33 kg/s • System Out NOx Flow > 0.05 g/s • Inlet SCR Temperature 250 - 500 °C • Average SCR Temperature 250 - 500 °C • Outlet SCR Temperature 250 - 500 °C • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P2201, P229F, P242B, P0421, P0402, P0401, P225C, P225E |
| Time Required For DTC To Be Set | 30 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P0420 NOx Catalyst: Missing SCR

| | |
|--|--|
| DTC | P0420 |
| Component / System | NOx Catalyst - Missing SCR |
| Monitor Strategy Description | Missing Substrate |
| Fault Limit | Calculated NOx conversion efficiency DOC temperature rate of change < 66% |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 1400 - 1800 RPM • Exhaust Mass Flow > 0.33 kg/s • System Out NOx Flow > 0.05 g/s • Inlet SCR Temperature 250 - 500 °C • Average SCR Temperature 250 - 500 °C • Outlet SCR Temperature 250 - 500 °C • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P2201, P229F, P242B, P0421, P0402, P0401, P225C, P225E |
| Time Required For DTC To Be Set | 30 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

NOx Catalyst: Reductant Delivery Emission Threshold

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

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

P0420 NOx Catalyst: Reductant Delivery Performance

| | |
|--|--|
| DTC | P0420 |
| Component / System | NOx Catalyst - Reductant Delivery Performance |
| Monitor Strategy Description | Low NOx conversion efficiency |
| Fault Limit | Calculated NOx conversion efficiency DOC temperature rate of change < 66% |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 1400 - 1800 RPM • Exhaust Mass Flow > 0.33 kg/s • System Out NOx Flow > 0.05 g/s • Inlet SCR Temperature 250 - 500 °C • Average SCR Temperature 250 - 500 °C • Outlet SCR Temperature 250 - 500 °C • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P2201, P229F, P242B, P0421, P0402, P0401, P225C, P225E |
| Time Required For DTC To Be Set | 30 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

NOx Catalyst: Feedback: Slow/Fails to Enter: Default CL

This diagnostic function indicates if the DEF feedback control is saturated against a high or low limit. The logic for this diagnostic evaluates the time spent at saturation and compares the ratio

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

P249D NOx Catalyst: Feedback Control (Saturated Low Monitor)

| | |
|--|---|
| DTC | P249D |
| Component / System | NOx Catalyst - Feedback Control (Saturated Low Monitor) |
| Monitor Strategy Description | Evaluates the time spent in Saturation Low Mode |
| Fault Limit | Time spent saturated low > 240 seconds |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed > 500 RPM • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | N/A |
| Time Required For DTC To Be Set | 300 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P249E NOx Catalyst: Feedback Control (Saturated High Monitor)

| | |
|--|---|
| DTC | P249E |
| Component / System | NOx Catalyst □Feedback Control (Saturated High Monitor) |
| Monitor Strategy Description | Evaluates the time spent in Saturation High Mode |
| Fault Limit | Time spent saturated high > 240 seconds |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed > 500 RPM • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | N/A |
| Time Required For DTC To Be Set | 300 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Particulate Matter (PM) Filter Monitoring: Filter Emission Threshold

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

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

P2002 PM Filter Efficiency Monitor

| | | | |
|---|--|---|---|
| DTC | P2002 | | |
| Component / System | PM Filter - Filtering Performance | | |
| Monitor Strategy Description | Modeled vs Measured filtration efficiency. | | |
| Fault Limit | Low Soot Load Evaluation Delta = Delta pressure based soot load \square reference soot load > 3g/L | High Soot Load Evaluation Ratio = Chemical based soot mode ldelta pressure based soot model < 50% | Temperature Evaluation Post DPF Temperature >725 °C |
| Enable Conditions | Low Soot Load Evaluation <ul style="list-style-type: none"> Chemical Soot Load < 0.35 g/L Ambient Air Temperature -8 - 55 °C Barometric Pressure 75 - 105 kPa Coolant Temperature > 65 °C | High Soot Load Evaluation <ul style="list-style-type: none"> Chemical Soot Load > 0.55 g/L Ambient Air Temperature -8 - 55 °C Barometric Pressure 75 - 105 kPa Coolant Temperature > 65 °C | Temperature Evaluation N/A |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> P2453, P244A, P2080, P2084, P242B | | |
| Time Re-quired For DTC To Be Set | Low Soot Load Evaluation 60 seconds | High Soot Load Evaluation 200 seconds | Temperature Evaluation N/A |
| MIL Illumination | 2 Drive Cycles | | |
| Probable Causes | <i>See Tech Tool</i> | | |

PM Filter: Missing Substrate Functional

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

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

P244A PM Filter: Missing Substrate

| | |
|--|--|
| DTC | P244A |
| Component / System | PM Filter - Missing Substrate |
| Monitor Strategy Description | Compare modeled DPF pressure to actual |
| Fault Limit | Ratio = Measured modeled DPF delta pressure < 63% |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 1225 - 1725 RPM • Engine Torque > 1700 Nm • Exhaust Mass Flow 0.3 - 0.5 kg/s • Modeled DPF Delta Pressure 3 □15 kPa • DOC Out Temperature 300 - 400 °C • DPF Out Temperature 300 - 400 °C • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P2226, P2229, P0110, P0112, P0115, P0117, P20DD, P20E0, P229E, P2200, P0105, P0108, P2031, P2322, P2084, P242C, P242A, P242B, P0545, P0544, P2080, P1130, P1133, P20DC, P20D0, P20CF |
| Time Required For DTC To Be Set | 7 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

NOx Sensor #1: Emission Threshold

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

Inlet NOx Sensor

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

P2201 NOx Sensor #1: Rationality Monitor

| | |
|--|---|
| DTC | P2201 |
| Component / System | NOx Sensor #1 - Plausibility |
| Monitor Strategy Description | Sensor Rationality Check |
| Fault Limit | Delta = Engine modeled NOx flow - NOx sensor based NOx flow < -20% |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 1120 - 1620 RPM • Modeled NOx Flow > 0.15 g/s • Engine Torque 1300 - 2000 Nm • Ambient Air Temperature -7 - 40 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 70 °C • Engine Speed Stability -10 to 10 RPM • Torque Stability -15 to 15 RPM • EGR Control Stability -1.5% to 1.5% |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0401, P0402, P0400, P0402, P225D, P225F, P242A, P0421, P221A |
| Time Required For DTC To Be Set | 3 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P225C Inlet and Outlet NOx Sensor Stuck High

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

| | |
|--|---|
| DTC | P225C |
| Component / System | NOx Sensor #1 - Rationality High |
| Monitor Strategy Description | Rationality High |
| Fault Limit | NOx sensor value > 200 PPM |
| Enable Conditions | <ul style="list-style-type: none"> • Fueling Amount < 0.001 g/sec • Engine Torque < 1000 Nm |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P225D, P0400, P0402, P225F, P242A, P0421, P221A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

NOx Sensor #1: Heater Performance

This OBD monitor is designed to detect faulty startup behavior. The function monitors the time from enable command sent to the time when the sensor reports full readiness. If the time is greater than the fault limit a DTC is set.

P220E NOx Sensor #1: Sensor Start Up Monitor

| | |
|--|---|
| DTC | P220E |
| Component / System | NOx Sensor #1 - Sensor Start |
| Monitor Strategy Description | Sensor start up |
| Fault Limit | Time for start up > 600 seconds |
| Enable Conditions | <ul style="list-style-type: none"> Supply Voltage 11.5 - 16V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> P2200, P2203, P220A, U029D |
| Time Required For DTC To Be Set | 10 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

NOx Sensor #1: Bad Device

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

P22FB NOx Sensor #1: Bad Device Monitor

| | |
|--|---|
| DTC | P22FB |
| Component / System | NOx Sensor #1 - Sensor Voltage High |
| Monitor Strategy Description | Bad Device |
| Fault Limit | Signal not valid for a specified time interval > 5 seconds |
| Enable Conditions | <ul style="list-style-type: none"> Engine Speed >550 RPM |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> P2200, P2203, P220A, U029D |
| Time Required For DTC To Be Set | Continuous |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

NOx Sensor #1: Circuit Monitors

P2203 NOx Sensor #1: Short Circuit Low

| | |
|--|--|
| DTC | P2203 |
| Component / System | NOx #1 Sensor - Short Circuit |
| Monitor Strategy Description | NOx Sensor Short Circuit |
| Fault Limit | Time with short circuit bad quality > 5 seconds |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • U029D |
| Time Required For DTC To Be Set | 10 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

P2200 NOx Sensor #1: Open Circuit

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

P220A NOx Sensor #1: Supply Voltage Out of Range

| | |
|--|---|
| DTC | P220A |
| Component / System | NOx Sensor #1 - Sensor Voltage |
| Monitor Strategy Description | Sensor evaluation of supply voltage |
| Fault Limit | Time with voltage out of range signal > 5 seconds |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed > 500 RPM |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • U029D |
| Time Required For DTC To Be Set | 10 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

U029D NOx Sensor #1: Missing Signal

| | |
|--|--|
| DTC | U029D |
| Component / System | NOx Sensor - Missing Signal |
| Monitor Strategy Description | Signal not recieved to ACM after key on |
| Fault Limit | Missing Signal No message for > 5 s |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 10 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

NOx Sensor #2: Emission Threshold

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

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

P229F NOx Sensor #2: Rationality Low Monitor

| | |
|--|--|
| DTC | P229F |
| Component / System | NOx Sensor #2 - Plausibility |
| Monitor Strategy Description | Sensor Rationality Check |
| Fault Limit | NOX Sensor rate of change < 0.7 ppm/sec |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed > 1200 RPM • Average Catalyst Temperature 200 - 500 °C • Engine Torque > 1800 Nm • Ambient Air Temperature -7 - 40 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C • Filtered Torque Rise > 60 Nm |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P225D, P0400, P0402, P225F, P242A, P0421, P225C, P2201, P221A |
| Time Required For DTC To Be Set | 300 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P225E NOx Sensor #2: Rationality High Monitor

| | |
|--|--|
| DTC | P225E |
| Component / System | NOx Sensor #2 - Rationality high |
| Monitor Strategy Description | Sensor Rationality Check |
| Fault Limit | NOX Sensor Value > 125 ppm |
| Enable Conditions | <ul style="list-style-type: none"> • Fueling Amount < 0.001 g/sec • SCR Temperature 150 - 500 °C • SCR Temperature Stability < 0.2 °C/sec • Engine Torque < 1000 Nm |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P225D, P0400, P0402, P225F, P242A, P0421, P2201, P225C, P221A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| 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 #2 Sensor - Sensor Start |
| Monitor Strategy Description | Time to for sensor to report good quality |
| Fault Limit | Time evaluation > 600 seconds |
| Enable Conditions | <ul style="list-style-type: none"> • Battery Voltage 11- 16V • Engine Speed > 500 RPM • Dew point trig Enabled (ECT start delay and dew point calculation delay) |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P2200, P2203, P220A, U029E |
| Time Required For DTC To Be Set | 10 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

NOx Sensor #2: Bad Device

This OBD Monitor is designed to detect bad sensor quality.

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

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

P22FE NOx Sensor #2: Bad Device Monitor

| | |
|--|---|
| DTC | P22FE |
| Component / System | NOx Sensor #2 - Sensor Voltage High |
| Monitor Strategy Description | Bad Device |
| Fault Limit | Signal not valid for a specified time interval > 5 seconds |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed >550 RPM • Battery Voltage 11 - 16 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P2200, P2203, P220A, U029E |
| Time Required For DTC To Be Set | 10 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

NOx Sensor #2: NOx Sensor Measurement Monitor

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

P221A NOx Sensors: NOx Sensor Measurement Rationality Monitor

| | |
|--|---|
| DTC | P221A |
| Component / System | NOx Sensors - NOx Sensor Measurement |
| Monitor Strategy Description | Plausibility |
| Fault Limit | Absolute difference between Lambda IN and Lambda OUT greater than threshold evaluated 30 times > 1 |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 1300-1900 RPM • Engine Torque > 1000 Nm • Ambient Air Temperature -7 - 40 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C • Engine Speed Stability -10 - 10 RPM • Torque Stability -15 - 15 Nm |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0400, P0402, P225D, P225F, P242A, P0421, P2201, P225C, P221A |
| Time Required For DTC To Be Set | 0.6 seconds (30 sub evaluations. If 30 out of 30 evaluations are good => PASS, If 1 or more out of 30 evaluations is fail => FAIL) |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

NOx Sensor #2: Circuit Monitors

P22A1 NOx Sensor #2: Short Circuit Low

| | |
|--|--|
| DTC | P22A1 |
| Component / System | NOx #2 Sensor - Short Circuit |
| Monitor Strategy Description | NOx Sensor Short Circuit |
| Fault Limit | Time with bad signal quality > 5 seconds |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • U029E |
| Time Required For DTC To Be Set | 10 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P229E NOx Sensor #2: Open Circuit

| | |
|--|--|
| DTC | P229E |
| Component / System | NOx Sensor #2 - Open Circuit |
| Monitor Strategy Description | NOx Sensor Open Circuit |
| Fault Limit | Time with bad signal quality > 5 seconds |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • U029E |
| Time Required For DTC To Be Set | 10 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P220B NOx Sensor #2: Supply Voltage Out of Range

| | |
|--|--|
| DTC | P220B |
| Component / System | NOx Sensor #2 - Sensor Voltage |
| Monitor Strategy Description | Sensor evaluation of supply voltage |
| Fault Limit | Time with voltage out of range signal > 5 seconds |
| Enable Conditions | <ul style="list-style-type: none"> • Key On > Active |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • U029E |
| Time Required For DTC To Be Set | 10 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

U029E NOx Sensor #2: Missing Signal

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

Engine Cooling System: Time To Reach Threshold Temperature

This OBD monitor evaluates the coolant thermostat. If the coolant temperature sensor value doesn't reach the threshold or if the temperature decreases below the threshold during operation the thermostat is judged as faulty and a DTC is set.

P0128 Engine Cooling System: Stuck Open or Leaking Thermostat Monitor

| | |
|--|---|
| DTC | P0128 |
| Component / System | Engine Cooling System - Thermostat failure |
| Monitor Strategy Description | Stuck open or leaking thermostat |
| Fault Limit | Coolant temperature threshold < 72°C |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 1000 - 1600 RPM • Engine Torque 550 - 1200 Nm • Vehicle Speed > 40 km/h • Ambient Air Temperature -15 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature at Start < 72 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0112, P0110, P0117, P0115, P0116, P0339, P0335, P0336, P2226, P2227, P2229 |
| Time Required For DTC To Be Set | Ambient air temperature dependent (ambient air temperature multiplied with a warm up delay time to get total warm up time) |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

Engine Coolant Temperature Sensor (ECT): Rationality Monitor

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

| | |
|--|---|
| DTC | P0116 |
| Component / System | Engine Coolant Temperature Sensor - ECT Stuck Low Monitor |
| Monitor Strategy Description | ECT Stuck Below the Highest Minimum Enable Temperature |
| Fault Limit | Delta = Coolant temperature sensor value - estimated coolant temperature > 3 °C |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 1000 - 1400 RPM • Engine Torque 1000 - 1400 • Vehicle Speed > 40 km/h • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature < 65 °C • Open Thermostat evaluated True |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0112, P0110, P0117, P0115, P0116, P0339, P0335, P0336, P2226, P2227, P2229 |
| Time Required For DTC To Be Set | 6 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Engine Coolant Temperature Sensor (ECT): Circuit Monitors

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

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

| | |
|--|---|
| DTC | P0115 |
| Component / System | ECT - Open |
| Monitor Strategy Description | Open Circuit |
| Fault Limit | Sensor Voltage > 4.87 V (-40 °C) |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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

| | |
|--|---|
| DTC | P0117 |
| Component / System | ECT - Low |
| Monitor Strategy Description | Short Circuit Low |
| Fault Limit | Sensor Voltage < 0.2767 V (140 °C) |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Crankcase Ventilation System: Disconnection

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

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

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

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

P04DB Crankcase Ventilation: Disconnected Pipe/Separator Monitor

| | | |
|--|--|--|
| DTC | P04DB | |
| Component / System | Crankcase Ventilation - Disconnect | |
| Monitor Strategy Description | Disconnected ventilation hose or faulty separator unit. | |
| Fault Limit | Delta = (Delta Pressure High) - (Delta Pressure Low); (Absolute Value) < 0.15 kPa Delta Pressure = (Crankcase Pressure) - (Barometric Pressure) | |
| Enable Conditions | High Speed Conditions <ul style="list-style-type: none"> Oil Temperature > 30 °C Engine Run Time > 700s Oil Pressure 375 - 800 kPa Engine Torque > 95 Nm Ambient Air Temperature -8 - 55 °C Barometric Pressure 75 - 105 kPa Coolant Temperature > 65 °C | Low Speed Conditions <ul style="list-style-type: none"> Oil Temperature > 30 °C Engine Run Time > 700s Oil Pressure 100 - 280 kPa Engine Torque < 380 Nm Ambient Air Temperature -8 - 55 °C Barometric Pressure 75 - 105 kPa Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> P01BB, P01B9, P0112, P2229, P051A, P051C, P051D, P051B, P0523, P0520 | |
| Time Required For DTC To Be Set | 18 seconds | |
| MIL Illumination | 2 Drive Cycles | |
| Probable Causes | <i>See Tech Tool</i> | |

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.

This evaluation is performed in two scenarios:

Pre Cranking:

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.

Engine running:

The engine running sensor evaluation is similar to the Pre Cranking sensor evaluation. The enable conditions are defined when the vehicle is typically at idle when Intake Air and Crankcase pressure are similar to Barometric pressure.

P2227 Barometric Pressure Sensor (BPS): Rationality Monitor

| | | |
|--|---|--|
| DTC | P2227 | |
| Component / System | BPS Rationality | |
| Monitor Strategy Description | Barometric pressure sensor evaluation | |
| Fault Limit | Delta = Barometric pressure - reference pressure > 10kPa | |
| Enable Conditions | Engine Pre-Crank <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V | Engine Running <ul style="list-style-type: none"> • Engine Speed 450 - 750 RPM • Engine Torque 100 - 400 Nm |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P2226, P2227, P2229, P051A, P051B, P051C, P051D, P2578 | |
| Time Required For DTC To Be Set | 8 seconds | |
| 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 < 0.1 V (15 kPa) |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P2229 Barometric Pressure Sensor (BPS): Short Circuit High

| | |
|--|---|
| DTC | P2229 |
| Component / System | BPS High |
| Monitor Strategy Description | Short Circuit High |
| Fault Limit | Sensor Voltage > 4.9 V (115 kPa) |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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.

This evaluation is performed in two scenarios:

Pre Cranking:

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.

Engine Running:

The engine running sensor evaluation is similar to the Pre Cranking sensor evaluation. The enable conditions are defined when the vehicle is typically at idle when Barometric and Crankcase pressure are similar to Intake Manifold pressure.

P0069 Intake Manifold Pressure Sensor Monitor

| | | |
|--|--|--|
| DTC | P0069 | |
| Component / System | IMP Rationality | |
| Monitor Strategy Description | Intake manifold pressure sensor evaluation | |
| Fault Limit | Delta = Intake manifold pressure \square reference pressure > 10kPa | |
| Enable Conditions | Engine Pre \square Crank <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V | Engine Running <ul style="list-style-type: none"> • Engine Speed 450 - 750 RPM • Engine Torque 100 - 400 Nm |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P2226, P2227, P2229, P051A, P051B, P051C, P051D, P2578 | |
| Time Required For DTC To Be Set | 8 seconds | |
| MIL Illumination | 2 Drive Cycles | |
| Probable Causes | <i>See Tech Tool</i> | |

Intake Manifold Pressure Sensor (IMP): Circuit Monitors

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

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

| | |
|--|---|
| DTC | P0105 |
| Component / System | IMP Open |
| Monitor Strategy Description | Open Circuit |
| Fault Limit | Sensor Voltage < 0.3 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | Continuous |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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

| | |
|--|---|
| DTC | P0108 |
| Component / System | IMP High |
| Monitor Strategy Description | Short Circuit High |
| Fault Limit | Sensor Voltage > 4.9 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | Continuous |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Aftertreatment Differential Pressure Sensor (DPS): Rationality Monitor

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

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

Low Flow Condition:

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

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

High Flow Condition:

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

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

| | | |
|--|--|---|
| DTC | P2453 | |
| Component / System | DPS - Plausibility | |
| Monitor Strategy Description | Rationality high and low | |
| Fault Limit | Low Condition Measured DPF Delta Pressure in Low Pressure Conditions > 1.5 kPa | High Condition Measured DPF Delta Pressure in High pressure Conditions < 2.5 kPa |
| Enable Conditions | Low Condition <ul style="list-style-type: none"> • Engine Speed < 750 RPM • Engine Torque < 300 Nm • Modeled DPF delta Pressure < 1.5 kPa • DOC Out Temperature 15 - 275 °C • DPF Out Temperature 15 - 275 °C • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C | High Condition <ul style="list-style-type: none"> • Engine Speed 1400 - 1900 RPM • Engine Torque > 4.5 kPa • Modeled DPF delta Pressure < 1.5 kPa • DOC Out Temperature > 325 °C • DPF Out Temperature > 325 °C • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P2226, P2229, P0110, P0112, P0115, P0117, P20DD, P20E0, P229E, P2200, P0105, P0108, P2031: P2322: P2084, P242C, P242A, P242B P0545, P0544, P2080, P1130, P1133, P20DC, P20D0, P20CF | |
| Time Required For DTC To Be Set | Low Condition 15 seconds | High Condition 8 seconds |
| MIL Illumination | 2 Drive Cycles | |
| Probable Causes | <i>See Tech Tool</i> | |

Aftertreatment Differential Pressure Sensor (DPS): Circuit Monitors

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

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

| | |
|--|---|
| DTC | P2452 |
| Component / System | DPF - Open |
| Monitor Strategy Description | Open Circuit |
| Fault Limit | Sensor Voltage > 4.8 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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

| | |
|--|---|
| DTC | P2454 |
| Component / System | DPS - Low |
| Monitor Strategy Description | Short Circuit Low |
| Fault Limit | Sensor Voltage < 0.2 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

EGR Differential Pressure Sensor: Rationality Monitor

This OBD monitor diagnoses the EGR differential pressure sensor.

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

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

Zero Flow Condition:

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

Normal Flow Condition:

P046C EGR Differential Pressure Sensor: DP Sensor Rationality

| | | |
|--|---|---|
| DTC | P046C | |
| Component / System | DP Sensor Rationality | |
| Monitor Strategy Description | Compare actual vs estimated EGR delta pressure | |
| Fault Limit | Plausibility Actual EGR delta pressure - estimated EGR delta pressure Low High Low < -20 kPa High > 20 kPa | Zero EGR delta Pressure Low < -2 kPa High > 3 kPa |
| Enable Conditions | Plausibility <ul style="list-style-type: none"> • Engine Speed 1100 - 1800 RPM • Engine Torque > 1600 Nm • EGR Position > 5% • VGT Position 40 - 92% | Zero <ul style="list-style-type: none"> • Engine Speed 0 - 1500 RPM • EGR Position < 0.1% |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A | |
| Time Required For DTC To Be Set | Plausibility 30 seconds | Zero 3 seconds |
| MIL Illumination | 2 Drive Cycles | |
| Probable Causes | <i>See Tech Tool</i> | |

EGR Differential Pressure Sensor: Circuit Monitors

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

P0409 EGR Differential Pressure Sensor: Open Circuit Check

| | |
|--|---|
| DTC | P0409 |
| Component / System | DP Sensor - Open |
| Monitor Strategy Description | Open Circuit |
| Fault Limit | Sensor Voltage < 0.2 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P0406 EGR Differential Pressure Sensor: Short Circuit High

| | |
|--|---|
| DTC | P0406 |
| Component / System | DP Sensor - High |
| Monitor Strategy Description | Short Circuit High |
| Fault Limit | Sensor Voltage > 4.8 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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.

This evaluation is performed in two scenarios:

Engine Pre-Cranking:

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.

Engine Running:

The engine running sensor evaluation is similar to the Pre Cranking sensor evaluation. The enable conditions are defined when the vehicle is typically at idle when Barometric and Crankcase pressure are similar to Intake Manifold pressure.

P051B Crankcase Pressure Sensor (CPS): Rationality Monitor

| | | |
|--|---|--|
| DTC | P051B | |
| Component / System | CPS - Rationality | |
| Monitor Strategy Description | Crankcase Pressure Sensor evaluation | |
| Fault Limit | Delta = Crankcase pressure - reference pressure > 10 kPa | |
| Enable Conditions | Engine Pre-Cranking <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V | Engine Running <ul style="list-style-type: none"> • Engine Speed 450 - 750 RPM • Engine Torque 100 - 400 Nm |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P2226, P2227, P2229, P051A, P051C, P051D, P2578, P0105, P010 | |
| Time Required For DTC To Be Set | 4 seconds | |
| MIL Illumination | 2 Drive Cycles | |
| Probable Causes | See Tech Tool | |

Crankcase Pressure Sensor (CPS): Circuit Monitors

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

P051A Crankcase Pressure Sensor (CPS): Open Circuit Check

| | |
|--|---|
| DTC | P051A |
| Component / System | CPS - Open |
| Monitor Strategy Description | Open Circuit |
| Fault Limit | Sensor Voltage < 0.3 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P051D Crankcase Pressure Sensor (CPS): Short Circuit High

| | |
|--|---|
| DTC | P051D |
| Component / System | CPS - High |
| Monitor Strategy Description | Short Circuit High |
| Fault Limit | Sensor Voltage > 4.9 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Intake Manifold Temperature Sensor (IMT): Rationality Monitor

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

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

P009A Intake Manifold Temperature Sensor (IMT): Rationality Monitor

| | |
|--|--|
| DTC | P009A |
| Component / System | IMT - Rationality |
| Monitor Strategy Description | Intake Manifold Temperature Sensor Evaluation |
| Fault Limit | Delta = Intake manifold temperature - reference temperature > 18 C |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 450 - 750 RPM • Engine Torque 100 - 400 Nm |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0110, P0112, P2226, P2229, P040C, P040A, P2578 |
| Time Required For DTC To Be Set | 10 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

Intake Manifold Temperature Sensor (IMT): Circuit Monitors

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

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

| | |
|--|---|
| DTC | P0110 |
| Component / System | IMT - Open |
| Monitor Strategy Description | Open Circuit |
| Fault Limit | Sensor Voltage > 4.9 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | Continuous |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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

| | |
|--|---|
| DTC | P0112 |
| Component / System | IMT - Low |
| Monitor Strategy Description | Short Circuit Low |
| Fault Limit | Sensor Voltage < 0.1 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | Continuous |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

EGR Temperature Sensor: Rationality Monitor

This OBD monitor evaluates the rationality of the EGR temperature sensor.

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

| | | |
|--|---|---|
| DTC | P040B | |
| Component / System | EGR Temperature Sensor - Rationality | |
| Monitor Strategy Description | EGR Temperature Sensor evaluation | |
| Fault Limit | Delta = EGR temperature - Coolant temperature < - 40 °C or > 80 °C | |
| Enable Conditions | Stuck Low <ul style="list-style-type: none"> • Engine Speed 1000 - 1600 RPM • Engine Torque < 1200 Nm • EGR Mass Flow < 0.08 kg/s | Stuck High <ul style="list-style-type: none"> • Engine Speed 1200 - 2000 RPM • EGR Mass Flow > 0.1 kg/s |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P040A, P040C | |
| Time Required For DTC To Be Set | 30 seconds | |
| 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 |
| Monitor Strategy Description | Open Circuit |
| Fault Limit | Sensor Voltage > 4.8 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P040C EGR Temperature Sensor: Short Circuit Low

| | |
|--|---|
| DTC | P040C |
| Component / System | EGR Temperature Sensor - Low |
| Monitor Strategy Description | Short Circuit Low |
| Fault Limit | Sensor Voltage < 0.1 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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

| | |
|--|--|
| DTC | P2080 |
| Component / System | Pre-DOC Temperature Sensor - Rationality |
| Monitor Strategy Description | Rationality check of the sensor |
| Fault Limit | Average Exhaust Gas Temperature deviation > 70 °C |
| Enable Conditions | <ul style="list-style-type: none"> • Modeled Exhaust Temperature < 15 °C • Modeled DOC Temperature - DPF Temperature < 15 °C • Modeled DPF Temperature - Exhaust Temperature < 15 °C • Engine Torque > 800 Nm • Modeled Engine Exhaust Temperature 250 - 475 °C • Ambient Air Temperature -8 - 55 °C • Barometric Pressure < 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P242C, P242A, P2032, P2031, P0544, P0545 |
| Time Required For DTC To Be Set | 45 seconds (accumulated time) |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

P2084 Exhaust Gas Temperature Sensor: Post-DOC Rationality Check

| | |
|--|--|
| DTC | P2084 |
| Component / System | Post-DOC Temperature Sensor - Rationality |
| Monitor Strategy Description | Plausibility check of the sensor value |
| Fault Limit | Average DOC temperature deviation > 65 °C |
| Enable Conditions | <ul style="list-style-type: none"> • Exhaust Temperature < 15 °C • DOC Temperature - DPF Temperature < 15 °C • DPF Temperature - Exhaust Temperature < 15 °C • Engine Torque > 800 Nm • Engine Exhaust Temperature 250 - 475 °C • Ambient Air Temperature -8 - 55 °C • Barometric Pressure < 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P242C, P242A, P2032, P2031, P0544, P0545 |
| Time Required For DTC To Be Set | 45 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P242B Exhaust Gas Temperature Sensors: Post-DPF Rationality Check

| | |
|--|--|
| DTC | P242B |
| Component / System | Post-DPF Temperature Sensor - Rationality |
| Monitor Strategy Description | Plausibility check of the sensor value |
| Fault Limit | Average DPF temperature deviation > 70 °C |
| Enable Conditions | <ul style="list-style-type: none"> • Modeled Exhaust Temperature < 15 °C • Modeled DOC Temperature - DPF Temperature < 15 °C • Modeled DPF Temperature - Exhaust Temperature < 15 °C • Engine Torque > 800 Nm • Modeled Engine Exhaust Temperature 250 - 475 °C • Ambient Air Temperature -8 - 55 °C • Barometric Pressure < 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P242C, P242A, P2032, P2031, P0544, P0545 |
| Time Required For DTC To Be Set | 45 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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 | Open Circuit |
| Fault Limit | Sensor Voltage > 2.3 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P0545 Pre-DOC Temperature Sensor: Short Circuit Low

| | |
|--|---|
| DTC | P0545 |
| Component / System | Pre-DOC Temperature Sensor - Low |
| Monitor Strategy Description | Short Circuit Low |
| Fault Limit | Sensor Voltage < 0.2 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P2031 Post-DOC Temperature Sensor: Open Circuit Check

| | |
|--|---|
| DTC | P2031 |
| Component / System | Post-DOC Temperature Sensor - Open |
| Monitor Strategy Description | Open Circuit |
| Fault Limit | Sensor Voltage > 2.3 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | Continuous |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

P2032 Post-DOC Temperature Sensor: Short Circuit Low

| | |
|--|---|
| DTC | P2032 |
| Component / System | Post-DOC Temperature Sensor - Low |
| Monitor Strategy Description | Short Circuit Low |
| Fault Limit | Sensor Voltage < 0.2 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | Continuous |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

P242A Post-DPF Temperature Sensor: Open Circuit Check

| | |
|--|---|
| DTC | P242A |
| Component / System | Post-DPF Temperature Sensor - Open |
| Monitor Strategy Description | Open Circuit |
| Fault Limit | Sensor Voltage > 2.3 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

P242C Post-DPF Temperature Sensor: Short Circuit Low

| | |
|--|---|
| DTC | P242C |
| Component / System | Post-DPF Temperature Sensor - Low |
| Monitor Strategy Description | Short Circuit Low |
| Fault Limit | Sensor Voltage < 0.2 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | 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 | Plausibility check of the sensor by checking if the temperature rises fast enough. |
| Fault Limit | Oil Temperature \leq 39 °C |
| Enable Conditions | <ul style="list-style-type: none"> Indicated torque \geq 800 Nm |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> N/A |
| Time Required For DTC To Be Set | Ambient air temperature dependent |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Engine Oil Temperature Sensor: Circuit Monitors

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

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

| | |
|--|---|
| DTC | P0195 |
| Component / System | OTS - High |
| Monitor Strategy Description | Open Circuit |
| Fault Limit | Sensor Voltage > 4.9 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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 < 0.1 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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 | OPS - Rationality | |
| Monitor Strategy Description | Plausibility check of the sensor by comparing a high oil pressure condition to a low pressure condition. | |
| Fault Limit | Low Check Oil pressure outside range 0 - 120 kPa | High Check Oil pressure outside range 280 - 600 kPa |
| Enable Conditions | Low Check <ul style="list-style-type: none"> • Engine Speed 1600 - 1850 RPM • Engine Torque 0 - 300 Nm • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C | High Check <ul style="list-style-type: none"> • Engine Speed Delta 30 RPM • Engine Speed 1000 - 1300 RPM • Engine Torque 0 - 300 Nm • Engine Oil Temperature 80 - 120 °C • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0520, P0523, P0195, P0197 | |
| Time Required For DTC To Be Set | 100 seconds | |
| MIL Illumination | 2 Drive Cycles | |
| Probable Causes | <i>See Tech Tool</i> | |

Engine Oil Pressure Sensor: Circuit Monitors

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

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

| | |
|--|---|
| DTC | P0520 |
| Component / System | OPS - Open |
| Monitor Strategy Description | Open Circuit |
| Fault Limit | Sensor Voltage < 0.2 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | Continuous |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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

| | |
|--|---|
| DTC | P0523 |
| Component / System | OPS - High |
| Monitor Strategy Description | Short Circuit High |
| Fault Limit | Sensor Voltage > 4.9 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | Continuous |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Turbocharger Speed Sensor (TSS): Rationality Monitor

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

Low Flow Condition :

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

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

High Flow Condition :

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

P2581 Turbocharger Speed Sensor (TSS): Rationality High

| | |
|--|---|
| DTC | P2581 |
| Component / System | TSS - Rationality High |
| Monitor Strategy Description | Input Rationality High |
| Fault Limit | Average turbo speed \geq 50 000 RPM |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 500 - 1000 RPM • Engine Torque 0 - 200 Nm |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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 \leq 0 RPM |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 500 - 2000 RPM • Engine Torque > 200 Nm |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P2581 |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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 | Input Open Circuit |
| Fault Limit | No signal from Crankshaft Speed Sensor No signal for number of revolutions greater than 3 |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed > 50 RPM |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P0339 Crankshaft Position Sensor: Rationality Low

| | |
|--|--|
| DTC | P0339 |
| Component / System | Crankshaft Position Sensor - Rationality Low |
| Monitor Strategy Description | Input Rationality - Low |
| Fault Limit | Less crank teeth than expected Less crank teeth for number of revolutions greater than 3 |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed > 50 RPM |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P0336 Crankshaft Position Sensor: Rationality High

| | |
|--|---|
| DTC | P0336 |
| Component / System | Crankshaft Position Sensor - Rationality High |
| Monitor Strategy Description | Input Rationality - High |
| Fault Limit | More crank teeth than expected More crank teeth for number of revolutions greater than 3 |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed > 50 RPM |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Camshaft Position Sensor: Rationality Monitors

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

P0340 Camshaft Position Sensor: Open Circuit

| | |
|--|---|
| DTC | P0340 |
| Component / System | Camshaft Position Sensor - Open |
| Monitor Strategy Description | Input Open Circuit |
| Fault Limit | No signal from Camshaft Speed Sensor No signal for number of revolutions greater than 3 |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed > 50 RPM |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P0016 Camshaft Position Sensor: Rationality Low

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

P0341 Camshaft Position Sensor: Rationality High

| | |
|--|--|
| DTC | P0341 |
| Component / System | Camshaft Position Sensor - Rationality High |
| Monitor Strategy Description | Input Rationality - High |
| Fault Limit | More cam teeth than expected More cam teeth for number of revolutions greater than 3 |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed > 50 RPM |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Aftertreatment Hydrocarbon Injection System

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

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

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

Air Pressure Check (AP):

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

Low Pressure Check (LP):

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

Fuel Pressure Check (FP):

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

Fuel Leakage Check (FL):

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

Fuel Delivery Check (FD):

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

Aftertreatment Hydrocarbon Doser Fuel Pressure Sensor: Circuit Monitors

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

P20DD Aftertreatment Hydrocarbon Doser Fuel Pressure Sensor: Open Circuit

| | |
|--|---|
| DTC | P20DD |
| Component / System | Fuel Pressure Sensor - Open |
| Monitor Strategy Description | Open Circuit |
| Fault Limit | Sensor Voltage < 0.2 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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 > 4.9 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Aftertreatment Hydrocarbon Doser Solenoid: Rationality Monitors

P20DC Aftertreatment Hydrocarbon Doser Solenoid: Plausibility Low

| | |
|--|---|
| DTC | P20DC |
| Component / System | Doser Solenoid - Plausibility Low |
| Monitor Strategy Description | System Pressure with Valve Commanded Closed (FP Failed) |
| Fault Limit | Closed Valve system pressure < 100 kPa |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 550 RPM • Coolant Temperature 20 °C • DOC Out Temperature 120 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P2226, P2229, P0110, P0112, P0115, P0117, P20DD, P20E0, P229E, P2200, P0105, P0108, P2031, P2322, P2084, P242C, P242A, P242B, P0545, P0544, P2080, P1130, P1133, P20D0, P20CF |
| Time Required For DTC To Be Set | PASS: 35 seconds FAIL: 140 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P20D0 Aftertreatment Hydrocarbon Doser Solenoid: Rationality High

| | |
|--|---|
| DTC | P20D0 |
| Component / System | Doser Solenoid - Rationality High |
| Monitor Strategy Description | System Pressure with Valve Commanded Open (FD Failed) |
| Fault Limit | Open Valve system pressure > 100 kPa |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 550 RPM • Coolant Temperature 20 °C • DOC Out Temperature 120 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P2226, P2229, P0110, P0112, P0115, P0117, P20DD, P20E0, P229E, P2200, P0105, P0108, P2031, P2322, P2084, P242C, P242A, P242B, P0545, P0544, P2080, P1130, P1133, P20D0, P20CF |
| Time Required For DTC To Be Set | PASS: 35 seconds FAIL: 140 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Aftertreatment Hydrocarbon Doser Solenoid: Circuit Monitors

The fuel doser solenoid is checked for electrical failures.

P20D7 Aftertreatment Hydrocarbon Doser Solenoid: Open Circuit

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

P20D9 Aftertreatment Hydrocarbon Doser Solenoid: Short Circuit Low

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

Aftertreatment Hydrocarbon Air Purge Valve: Rationality Monitors

P1133 Aftertreatment Hydrocarbon Air Purge Valve: Stuck Open

| | |
|--|---|
| DTC | P1133 |
| Component / System | Air Purge Valve - Stuck Open |
| Monitor Strategy Description | System Pressure with Valve Commanded Closed (LP Failed) |
| Fault Limit | Closed Valve system pressure < 50 kPa |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 550 RPM • Coolant Temperature 20 °C • DOC Out Temperature 120 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P2226, P2229, P0110, P0112, P0115, P0117, P20DD, P20E0, P229E, P2200, P0105, P0108, P2031, P2322, P2084, P242C, P242A, P242B, P0545, P0544, P2080, P1130, P1133, P20D0, P20CF |
| Time Required For DTC To Be Set | PASS: 35 seconds FAIL: 140 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P1130 Aftertreatment Hydrocarbon Air Purge Valve: Stuck Closed

| | |
|--|--|
| DTC | P1130 |
| Component / System | Air Purge Valve - Stuck Closed |
| Monitor Strategy Description | System Pressure with Valve Commanded (AP Failed) |
| Fault Limit | Open Valve system pressure > 70 kPa |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 550 RPM • Coolant Temperature 20 °C • DOC Out Temperature 120 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P2226, P2229, P0110, P0112, P0115, P0117, P20DD, P20E0, P229E, P2200, P0105, P0108, P2031, P2322, P2084, P242C, P242A, P242B, P0545, P0544, P2080, P1133, P20D0, P20CF |
| Time Required For DTC To Be Set | PASS: 35 seconds FAIL: 140 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Aftertreatment Hydrocarbon Air Purge Valve: Circuit Monitors

The fuel air purge valve is checked for electrical failures.

P1134 Aftertreatment Hydrocarbon Air Purge Valve: Open Circuit

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

P1131 Aftertreatment Hydrocarbon Air Purge Valve: Short Circuit Low

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

Aftertreatment Hydrocarbon Dosing Valve: Rationality Monitors

P20CF Aftertreatment Hydrocarbon Dosing Valve: Stuck Open

| | |
|--|--|
| DTC | P20CF |
| Component / System | Aftertreatment Hydrocarbon Dosing Valve - Stuck Open |
| Monitor Strategy Description | System Pressure With Valve Commanded Closed (FL Failed) |
| Fault Limit | Closed Valve system pressure < 75 kPa |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 550 RPM • Coolant Temperature 20 °C • DOC Out Temperature 120 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P2226, P2229, P0110, P0112, P0115, P0117, P20DD, P20E0, P229E, P2200, P0105, P0108, P2031, P2322, P2084, P242C, P242A, P242B, P0545, P0544, P2080, P1130, P1133, P20D0 |
| Time Required For DTC To Be Set | PASS: 35 seconds FAIL: 140 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P2698 Aftertreatment Hydrocarbon Dosing Valve: Functional

| | |
|--|---|
| DTC | P2698 |
| Component / System | Aftertreatment Hydrocarbon Dosing Valve - Functional |
| Monitor Strategy Description | Nozzle Function |
| Fault Limit | Ratio = $1 - \frac{\text{Calculated Energy delivered from AHI}}{\text{Energy released by oxidation of Fuel by EATS}} > 0.75$ |
| Enable Conditions | <ul style="list-style-type: none"> • DPF Out Temperature > 100 °C • AHI Fuel Injection State Active |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P2226, P2229, P0110, P0112, P0115, P0117, P20DD, P20E0, P229E, P2200, P0105, P0108, P2031, P2322, P2084, P242C, P242A, P242B, P0545, P0544, P2080, P1130, P1133, P20D0, P20CF |
| Time Required For DTC To Be Set | 600 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Aftertreatment Hydrocarbon Dosing Valve: Circuit Monitors

The fuel doser is checked for electrical failures.

P2697 Aftertreatment Hydrocarbon Dosing Valve: Open Circuit

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

P2699 Aftertreatment Hydrocarbon Dosing Valve: Short Circuit Low

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

Aftertreatment DEF Tank Temperature Sensor: Rationality Monitors

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

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

P209F Aftertreatment DEF Tank Temperature Sensor: Rationality High

| | |
|--|---|
| DTC | P209F |
| Component / System | Temperature Sensor - Rationality High |
| Monitor Strategy Description | Evaluate actual DEF temperature against the maximum allowed DEF temperature |
| Fault Limit | DEF temperature > 68 °C |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 550 RPM |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 2 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P205B Aftertreatment DEF Tank Temperature Sensor: Rationality Low

| | |
|--|---|
| DTC | P205B |
| Component / System | Temperature Sensor - Rationality Low |
| Monitor Strategy Description | Monitors the DEF tank temperature increase during start up. |
| Fault Limit | Delta = DEF temperature after start - Temperature at end of evaluation < 5 °C |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 550 RPM • DEF Defrosting Active |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 900 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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 > 4.5 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P205C Aftertreatment DEF Tank Temperature Sensor: Short Circuit Low

| | |
|--|---|
| DTC | P205C |
| Component / System | Temperature Sensor - Open |
| Monitor Strategy Description | Short Circuit Low |
| Fault Limit | Sensor Voltage < 0.5 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Aftertreatment DEF 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 | Pressure build up monitor |
| Fault Limit | DEF pressure <= 650 kPa |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 550 RPM |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 50 Seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P218F Aftertreatment DEF Pump: Functional Check

| | |
|--|---|
| DTC | P218F |
| Component / System | DEF Pump - Functional |
| Monitor Strategy Description | Urea flow through the orifice functional check |
| Fault Limit | <ul style="list-style-type: none"> • DEF pressure > 1100 kPa • Time above DEF pressure limit > 20 seconds |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed 550 RPM |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P204C, P204D, P204A, P2049, P2048, P2047, P208E |
| Time Required For DTC To Be Set | 20 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Aftertreatment DEF Pump: Circuit Monitors

The Aftertreatment DEF Pump is checked for electrical failures.

P208A Aftertreatment DEF Pump: Open Circuit

| | |
|--|---|
| DTC | P208A |
| Component / System | DEF Pump - Open |
| Monitor Strategy Description | Open Circuit |
| Fault Limit | Pump Voltage < 3.75 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 6 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P208D Aftertreatment DEF Pump: Short Circuit High

| | |
|--|---|
| DTC | P208D |
| Component / System | DEF Pump - High |
| Monitor Strategy Description | Short Circuit High |
| Fault Limit | Pump Current > 9 A |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 6 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P208C Aftertreatment DEF Pump: Short Circuit Low

| | |
|--|---|
| DTC | P208C |
| Component / System | DEF Pump - Low |
| Monitor Strategy Description | Short Circuit Low |
| Fault Limit | Pump Voltage < 1.5 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 6 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Aftertreatment DEF Pump Direction Valve: Rationality Monitor

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

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

P20A1 Aftertreatment DEF Pump Direction Valve: Functional Check

| | |
|--|--|
| DTC | P20A1 |
| Component / System | Direction Valve - Functional |
| Monitor Strategy Description | DEF pressure too high |
| Fault Limit | <ul style="list-style-type: none"> • DEF pressure > 950 kPa • Time above DEF pressure limit > 60 s |
| Enable Conditions | <ul style="list-style-type: none"> • Key Position Off • DEF System Purge Mode |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 60 Seconds (in after run) |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

Aftertreatment DEF Pump Direction Valve: Circuit Monitors

The Aftertreatment DEF Pump is checked for electrical failures.

P20A0 Aftertreatment DEF Pump Direction Valve: Open Circuit

| | |
|--|---|
| DTC | P20A0 |
| Component / System | Direction Valve - Open |
| Monitor Strategy Description | Open Circuit |
| Fault Limit | Valve Voltage < 3.75 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 6 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P20A3 Aftertreatment DEF Pump Direction Valve: Short Circuit High

| | |
|--|---|
| DTC | P20A3 |
| Component / System | Direction Valve - High |
| Monitor Strategy Description | Short Circuit High |
| Fault Limit | Pump Current > 9 A |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 6 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P20A2 Aftertreatment DEF Pump Direction Valve: Short Circuit Low

| | |
|--|---|
| DTC | P20A2 |
| Component / System | Direction Valve - Low |
| Monitor Strategy Description | Short Circuit Low |
| Fault Limit | Pump Voltage < 1.5 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 6 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Aftertreatment DEF Pump Pressure Sensor: Rationality Monitor

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

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

P204B Aftertreatment DEF Pump Pressure Sensor: Rationality

| | |
|--|---|
| DTC | P204B |
| Component / System | Pump Sensor - Rationality |
| Monitor Strategy Description | DEF pressure |
| Fault Limit | Monitors the actual pressure vs expected pressure < 100 kPa |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P204C, P204A |
| Time Required For DTC To Be Set | 180 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Aftertreatment DEF Pump Pressure Sensor: Circuit Monitors

The Aftertreatment DEF Pump Pressure Sensor is checked for electrical failures.

P204A Aftertreatment DEF Pump Pressure Sensor: Open Circuit

| | |
|--|---|
| DTC | P204A |
| Component / System | Pump Sensor - Open |
| Monitor Strategy Description | Open Circuit |
| Fault Limit | Sensor Voltage > 4.9 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P204C Aftertreatment DEF Pump Pressure Sensor: Short Circuit Low

| | |
|--|---|
| DTC | P204C |
| Component / System | Pump Sensor - Low |
| Monitor Strategy Description | Short Circuit Low |
| Fault Limit | Sensor Voltage < 0.1 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Aftertreatment SCR Dosing Valve: Rationality Monitor

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

P208E Aftertreatment SCR Dosing Valve: Functional Check

| | | |
|--|---|---|
| DTC | P208E | |
| Component / System | SCR Dosing Valve - Functional | |
| Monitor Strategy Description | Pump duty cycle comparison between high and low DEF demand | |
| Fault Limit | Delta = High DEF pump duty cycle - Low DEF pump duty cycle < 1.5% | |
| Enable Conditions | High <ul style="list-style-type: none"> • DEF Pressure > 800 kPa • Dosing Valve Duty Cycle > 15% | Low <ul style="list-style-type: none"> • DEF Pressure > 800 kPa • Dosing Valve Duty Cycle < 5% |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P2048, P2049, P204C, P204D, P204A, P208B, P208D, P208C | |
| Time Required For DTC To Be Set | 100 seconds (7 sub evaluations. If 6 out of 7 are bad => FAIL, If 2 out of 7 are good => PASS) | |
| MIL Illumination | 2 Drive Cycles | |
| Probable Causes | <i>See Tech Tool</i> | |

Aftertreatment SCR Dosing Valve: Circuit Monitors

The Aftertreatment SCR Dosing Valve is checked for electrical failures.

P2047 Aftertreatment SCR Dosing Valve: Open Circuit

| | |
|--|---|
| DTC | P2047 |
| Component / System | SCR Dosing Valve - Open |
| Monitor Strategy Description | Open Circuit |
| Fault Limit | Dosing Valve Current < 0.2A |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P2049 Aftertreatment SCR Dosing Valve: Short Circuit High

| | |
|--|---|
| DTC | P2049 |
| Component / System | SCR Dosing Valve - High |
| Monitor Strategy Description | Short Circuit High |
| Fault Limit | Dosing Valve Current > 10 A |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P2048 Aftertreatment SCR Dosing Valve: Short Circuit Low

| | |
|--|---|
| DTC | P2048 |
| Component / System | SCR Dosing Valve - Low |
| Monitor Strategy Description | Short Circuit Low |
| Fault Limit | Dosing Valve Current < 0.4 A |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

VGT Position Actuator: Electrical Check

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

Internal Error (Bad Device):

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

CAN Communication (Missing Signal):

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

Mechanical Fault:

Detects actuator mechanical faults.

P0046 VGT Position Actuator: VGT Mechanical Fault

| | |
|--|---|
| DTC | P0046 |
| Component / System | Actuator Rationality |
| Monitor Strategy Description | VGT Mechanical Fault |
| Fault Limit | Malfunction determined by vendor supplied VGT Smart Remote Actuator |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P00AF VGT Position Actuator: Bad Device

| | |
|--|---|
| DTC | P00AF |
| Component / System | Actuator Rationality |
| Monitor Strategy Description | Bad device |
| Fault Limit | Monitor disabled by internal diagnostics |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

U010C VGT Position Actuator: Missing Signal

| | |
|--|---|
| DTC | U010C |
| Component / System | Actuator Missing Signal |
| Monitor Strategy Description | VGT Actuator Communication |
| Fault Limit | Missing communication from VGT SRA |
| Enable Conditions | <ul style="list-style-type: none"> • Ignition Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • U0080 |
| Time Required For DTC To Be Set | 2 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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 | Supply Voltage < 10V |
| Enable Conditions | <ul style="list-style-type: none"> • Ignition Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 10 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

EGR Valve Actuator: Circuit Monitors

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

P0403 EGR Valve Actuator: Open Circuit

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

P0489 EGR Valve Actuator: Short Circuit Low

| | |
|--|---|
| DTC | P0489 |
| Component / System | Actuator - Low |
| Monitor Strategy Description | Short Circuit Low |
| Fault Limit | Valve Current > 2.7 A |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Engine Fuel Injectors: Injectors 1 through 6: Circuit Monitors

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Ambient Air Temperature Sensor (AAT): Rationality Monitor

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

U0155 Ambient Air Temperature Sensor (AAT): Missing Signal

| | |
|--|---|
| DTC | U0155 |
| Component / System | AAT - Missing |
| Monitor Strategy Description | Missing Signal From Sensor |
| Fault Limit | Time Out > 9 seconds |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | Continuous |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

Ambient Air Temperature Sensor (AAT): Circuit Monitors

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

P0070 Ambient Air Temperature Sensor (AAT): Open Circuit

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

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

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

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

The VECU performs a rationality check on the computed road speed by comparing it with that reported by the ABS. Deviations between signals greater than a pre-set value cause a fault to be reported on the network.

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

| | |
|--|---|
| DTC | P215A |
| Component / System | VSS - Rationality |
| Monitor Strategy Description | Input Other Rationality |
| Fault Limit | Difference between vehicle speed and ABS > 12 km/h |
| Enable Conditions | <ul style="list-style-type: none"> • Engine Speed > 500 RPM |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | Continuous |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

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

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

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

| | |
|--|---|
| DTC | P0500 |
| Component / System | VSS - Open |
| Monitor Strategy Description | Input Open Circuit |
| Fault Limit | Sensor Current < 0.1 mA |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | Continuous |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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

| | |
|--|---|
| DTC | P0502 |
| Component / System | VSS - Low |
| Monitor Strategy Description | Short Circuit Low |
| Fault Limit | Sensor Voltage < 2.5 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | Continuous |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Accelerator Pedal Position #1 Sensor: Rationality Monitors

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

P2109 Accelerator Pedal Position Sensor: Rationality Low

| | |
|--|---|
| DTC | P2109 |
| Component / System | APP - Rationality Low |
| Monitor Strategy Description | Pedal position switch rationality - low |
| Fault Limit | Sensor Voltage 0.38 - 0.65 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | Continuous |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P2163 Accelerator Pedal Position Sensor: Rationality High

| | |
|--|---|
| DTC | P2163 |
| Component / System | APP - Rationality High |
| Monitor Strategy Description | Pedal position switch rationality - high |
| Fault Limit | Sensor Voltage 1.2 V - 4.25 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | Continuous |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Accelerator Pedal Position Sensor: Circuit Monitors

P0122 Accelerator Pedal Position Sensor: Below Range

| | |
|--|---|
| DTC | P0122 |
| Component / System | APP - Low |
| Monitor Strategy Description | Below range |
| Fault Limit | Sensor Voltage < 0.38 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | Continuous |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P0123 Accelerator Pedal Position Sensor: Above Range

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

Parking Brake Switch: Electrical Check

P05E4 Parking Brake Switch: Short Circuit Low

| | |
|--|---|
| DTC | P05E4 |
| Component / System | Parking Brake Switch |
| Monitor Strategy Description | Short Circuit Low |
| Fault Limit | Sensor Voltage < 0.1 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | Continuous |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

5 Volt ECM Supply: Supply #1

The 5 Volt sensor supplies are located in the Engine Electronic Control Unit (EECU). Some sensors, especially pressure sensors, require 5 Volt supply to operate. They are fed by three 5 Volt supplies in the EECU (referred as #1, #2 and #3 below).

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

P06B1 ECM Supply #1: Below Range

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

P06B2 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 | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

5 Volt 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 < 4.5 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | 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 | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | 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 < 4.5 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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 | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Data Link Communication: CAN Links

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

The EECU monitors bus off conditions on the following datalinks:

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

U0010 CAN Link: SAE J1939-1 Missing Signal

| | |
|--|---|
| DTC | U0010 |
| Component / System | SAE J1939 Datalink # 1 (Public) |
| Monitor Strategy Description | Missing Signal |
| Fault Limit | Time Missing Signal > 5 seconds |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 1 Drive Cycle |
| Probable Causes | See Tech Tool |

U0080 CAN Link: Powertrain CAN Missing Signal

| | |
|--|---|
| DTC | U0080 |
| Component / System | SAE J1939 Datalink # 2 (Powertrain) |
| Monitor Strategy Description | Missing Signal |
| Fault Limit | Time Missing Signal > 5 seconds |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 1 Drive Cycle |
| Probable Causes | <i>See Tech Tool</i> |

U116F CAN Link: Missing ACM at Engine Subnet

| | |
|--|---|
| DTC | U116F |
| Component / System | ACM |
| Monitor Strategy Description | Missing Signal |
| Fault Limit | Time Missing Signal > 9 seconds |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

U0141 CAN Link: Missing Signal from the VECU

| | |
|--|---|
| DTC | U0141 |
| Component / System | VECU |
| Monitor Strategy Description | Missing Signal |
| Fault Limit | Time Missing Signal > 9 seconds |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

U0001 CAN Link: Missing Signal on Backbone 2

| | |
|--|---|
| DTC | U0001 |
| Component / System | ISO 15765 Datalink |
| Monitor Strategy Description | Missing Signal |
| Fault Limit | Time Missing Signal > 5 seconds |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 1 Drive Cycle |
| Probable Causes | <i>See Tech Tool</i> |

Idle Engine Speed: Idle Engine Speed Rationality

Idle speed target can be between 550 to 700 rpm. When engine is in idle governor mode fueling is controlled to get target idle

speed. If it is not able to control the engine speed above 525 rpm an idle speed low fault code is logged.

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 | Idle Speed < 525 RPM |
| Enable Conditions | <ul style="list-style-type: none"> • Vehicle Speed < 0.1 km/h • PTO Not Active • Engine Torque < 400 Nm • Acceleration Pedal Position < 0.1% • Delay Time After Engine Start 60 seconds • Delay Time After Enable Condition Met 20 seconds • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, |
| Time Required For DTC To Be Set | 300 seconds (accumulated time at idle) |
| 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 | Idle Speed > 725 RPM |
| Enable Conditions | <ul style="list-style-type: none"> • Vehicle Speed < 0.1 km/h • PTO Not Active • Engine Torque < 400 Nm • Acceleration Pedal Position < 0.1% • Delay Time After Engine Start 60 seconds • Delay Time After Enable Condition Met 20 seconds • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, |
| Time Required For DTC To Be Set | 300 seconds (accumulated time at idle) |
| 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 | Idle Fuel < 5mm ³ stroke |
| Enable Conditions | <ul style="list-style-type: none"> • Vehicle Speed < 0.1 km/h • PTO Not Active • Engine Torque < 400 Nm • Acceleration Pedal Position < 0.1% • Delay Time After Engine Start 60 seconds • Delay Time After Enable Condition Met 20 seconds • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, |
| Time Required For DTC To Be Set | 300 seconds (accumulated time at idle) |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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 | Idle Fuel > 150mm ³ stroke |
| Enable Conditions | <ul style="list-style-type: none"> • Vehicle Speed < 0.1 km/h • PTO Not Active • Engine Torque < 400 Nm • Acceleration Pedal Position < 0.1% • Delay Time After Engine Start 60 seconds • Delay Time After Enable Condition Met 20 seconds • Ambient Air Temperature -8 - 55 °C • Barometric Pressure 75 - 105 kPa • Coolant Temperature > 65 °C |
| Disable Conditions | <p>No Active DTC's:</p> <ul style="list-style-type: none"> • P0117, P0115, P2229, P2226, P0340, P0335, P0262, P0265, P0268, P0271, P0274, P0277, P0201, P0202, P0203, P0204, P0205, |
| Time Required For DTC To Be Set | 300 seconds (accumulated time at idle) |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

Idle Validation Switch (IVS): Rationality Monitor

P2136 Idle Validation Switch (IVS): IVS Does Not Match Accelerator Pedal Position

| | |
|--|---|
| DTC | P2136 |
| Component / System | IVS - Rationaliy |
| Monitor Strategy Description | IVS Does Not Match Accelerator Pedal Position |
| Fault Limit | Voltage > 6 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | Continuous |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | See Tech Tool |

Idle Validation Switch (IVS): Circuit Monitor

P0652 Idle Validation Switch (IVS): Short Circuit Low

| | |
|--|---|
| DTC | P0652 |
| Component / System | IVS - Low |
| Monitor Strategy Description | Short Circuit Low |
| Fault Limit | Voltage < 0.1 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | Continuous |
| 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 < 4.5 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P06B2 ACM Sensor Supply #1: Above Range

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

5 Volt ACM Sensor Supply: Supply #2

P06B4 ACM Sensor Supply #2: Below Range

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

Actuator Supply #1 ACM: Circuit Monitors

P0657 Actuator Supply #1 ACM: Open Circuit

| | |
|--|---|
| DTC | P0657 |
| Component / System | Actuator Supply #1 ACM - Open |
| Monitor Strategy Description | Open Circuit |
| Fault Limit | Voltage Supply < 2V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

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 < 8 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P0659 Actuator Supply #1 ACM: Short Circuit High

| | |
|--|---|
| DTC | P0659 |
| Component / System | Actuator Supply #1 ACM - High |
| Monitor Strategy Description | Short Circuit High |
| Fault Limit | Current Supply > 18 A |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

Actuator Supply #2 ACM: Circuit Monitors**P1080 Actuator Supply #2 ACM: Open Circuit**

| | |
|--|---|
| DTC | P1080 |
| Component / System | Actuator Supply #2 ACM - Open |
| Monitor Strategy Description | Open Circuit |
| Fault Limit | Voltage Supply < 2V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P1095 Actuator Supply #2 ACM: Short Circuit Low

| | |
|--|---|
| DTC | P1095 |
| Component / System | Actuator Supply #2 ACM - Low |
| Monitor Strategy Description | Short Circuit Low |
| Fault Limit | Voltage Supply < 8 V |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

P1096 Actuator Supply #2 ACM: Short Circuit High

| | |
|--|---|
| DTC | P1096 |
| Component / System | Actuator Supply #2 ACM - High |
| Monitor Strategy Description | Short Circuit High |
| Fault Limit | Current Supply > 18 A |
| Enable Conditions | <ul style="list-style-type: none"> • Key On Active • Battery Voltage > 8 V |
| Disable Conditions | No Active DTC's: <ul style="list-style-type: none"> • N/A |
| Time Required For DTC To Be Set | 5 seconds |
| MIL Illumination | 2 Drive Cycles |
| Probable Causes | <i>See Tech Tool</i> |

VOLVO

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