Repair Manual
GTI 2014 ➤

Generic Scan Tool									
Engine ID	CNT A	CNT C	CXC A	CXC B					

Edition 04.2015

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List of Workshop Manual Repair Groups

Repair Group

ST - Generic Scan Tool

Technical information should always be available to the foremen and mechanics, because their careful and constant adherence to the instructions is essential to ensure vehicle road-worthiness and safety. In addition, the normal basic safety precautions for working on motor vehicles must, as a matter of course, be observed.

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ST – Generic Scan Tool

1 General Information

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Included in the contents of this Generic Scan Tool (GST) manual is a summary table of the vehicle specific OBD II Emission Related DTCs. The DTC table contains DTC Malfunction Criteria, Threshold Values, Secondary Parameters, Enabling Conditions, Monitoring Time Length, Frequency of Checks, and MIL Illumination information which can be used to accurately monitor and diagnose emissions related faults and perform functions required to run Modes 01 through 0A (if applicable) with a hand held scan tool.

This manual also contains the step by step procedures to accurately diagnose and repair a component or system once a DTC has been set. References to repair procedures and wiring diagrams can be found within the diagnostic test procedures.

- ⇒ “1.1 Safety Precautions”, page 2
- ⇒ “1.2 Clean Working Conditions”, page 3
- ⇒ “1.3 High Voltage System General Warnings”, page 4

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1.1 Safety Precautions

Check for Technical Bulletins that may supersede any information included in this manual.

WARNING

Failure to follow these instructions may result in personal injury or possible death.

Check the Technical Bulletins for information, cautions and warnings that may supersede or supplement any information included in this manual.

When performing the drive cycle operation, pay strict attention to driving conditions and observe and obey all posted speed limits.

Test equipment must always be secured to the rear seat and operated by a second person. If test and measuring equipment is operated from the passenger seat, the person seated could be injured in the event of an accident involving deployment of the passenger-side airbag.

The fuel system is under pressure! Before opening the fuel system, place rags around the connection area. Then release pressure by carefully loosening the connection.

The engine section of the fuel system, after the high pressure pump, is under extremely high pressure! When working on engine or fuel injection system, fuel pressure must be relieved to residual pressure before opening high pressure components. Refer to the Service Manual for the proper procedure.

If the battery has not been disconnected, the fuel pump fuse must be removed before opening the fuel supply system as the fuel pump may be activated by the driver's door contact switch.

Testing of the EVAP and ORVR systems can result in the escape of explosive fuel vapor. Do not smoke while testing the EVAP system, and make sure the area you are working in is well ventilated.

Observe the following for all procedures, especially in the engine compartment due to lack of room:

- *Route lines of all types (e.g. for fuel, hydraulic, EVAP canister system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.*
- *Watch for sufficient clearance to all moving or hot components.*
- *Do not touch or disconnect the Ignition Coils, ignition wires, connecting parts or adapter cables when the ignition is on or the engine is running or turning at starting RPM.*
- *Only disconnect and reconnect wires for injection and ignition system, including test leads, when the ignition is turned off.*

When removing and installing components from full or partially full fuel tanks, observe the following:

- *The fuel tank must only be partially full. How much fuel can remain in the fuel tank may be read in the respective work description. Empty the fuel tank if necessary.*

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- *Before starting work, switch on the exhaust extraction system and place an extraction hose close to the installation opening of the fuel tank to extract escaping fuel fumes. If no exhaust extraction system is available, a radial fan (as long as motor is not in air flow) with a displacement greater than 15 m^3/h can be used.*
- *Prevent fuel from contacting the skin! Wear fuel-resistant gloves!*

When servicing the engine control module (ECM), it may be necessary to use a heat gun. The heat gun, shear bolts, and parts of the protective housing will become extremely hot. Use extreme caution when working with or handling these parts to avoid personal injury.

Observe operating instructions when working with a heat gun. To prevent damage (burning) to the wiring and harness connections, insulation and the electronic components, perform outlined work steps exactly!

The cooling system is under pressure. To avoid scalding, use caution when opening the cooling system and servicing cooling system components!



Caution

The battery must only be disconnected and connected with the ignition switched off. Otherwise, the engine control module (ECM) can be damaged.

The use of nails, paper clips, or another unauthorized materials to back-probe harness connectors is strictly prohibited and may cause damage to the harness connectors, terminal ends or to a component. Use only the manufacturers test lead kit or an equivalent aftermarket test lead kit for back-probing all harness connectors.

Do not use sealants containing silicone. Particles of silicone drawn into the engine, will not be burned in the engine and will damage the oxygen sensors.

Secure all hose connections with the correct hose clips (the same as original equipment).

If engine is to be cranked without starting (for example; as part of a compression test), remove the fuses for the voltage supply of ignition coils and the fuel injectors.

An electrostatic charge can lead to functional problems of electrical components of the engine, transmission and selector lever mechanism. Touch a grounded object, e.g. a water pipe or a hoist, before working on electrical components.

Do not make direct contact with harness connector terminals.

Use only gold-plated terminals when servicing any component with gold-plated harness connector terminals.

1.2 Clean Working Conditions

Even minor contaminations can lead to malfunctions in the fuel injection system. When working on the fuel supply/injection system, pay careful attention to the following rules of cleanliness:

- Thoroughly clean all connections and the surrounding area before disconnecting.

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- Place removed parts on a clean surface and cover. Use lint-free cloths.
- Carefully cover opened components or seal, if repairs are not performed immediately.
- When the system is open, do not work with compressed air. Do not move vehicle unless absolutely necessary.
- Install clean components: Remove the parts being replaced immediately prior to installation of the new parts. Do not use parts that have been stored unpacked (e.g. in tool boxes etc.).
- Electrical connectors that have been disconnected: Protect from dirt and moisture. Make sure connections are clean and dry when reconnecting.

1.3 High Voltage System General Warnings

Before performing any work on the high voltage system, always check with the importer if there are any questions regarding the terms “technician trained in electrical systems”, “high voltage technician”, “high voltage expert”, “high voltage systems”, or “hybrid systems”. Qualifications necessary for most of these terms are also provided below ⇒ page 9 .

Before beginning work on the high voltage system, a high voltage technician ⇒ page 9 , must de-energize the high voltage system. Refer to appropriate repair manual for high voltage system de-energizing.

For a list of work procedures requiring the high voltage system to be de-energized, refer to the tables listed below in: Working on the High Voltage System, Conventional Work Near High Voltage Components, and General Work ⇒ page 6 .

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WARNING

Read and follow the information below when de-energizing the high voltage system to reduce the risk of fatal injury.

- *Only a qualified technician (high voltage technician) should disable the high voltage system.*
- *The high voltage technician (HVT) makes sure the system is de-energized and cannot be re-energized again.*
- *The high voltage technician assures that the system cannot be re-energized again by safely storing the key, the High Voltage System Maintenance Connector - TW- and the pilot line connector.*
- *The high voltage technician (HVT) puts a sign on the vehicle saying the voltage is disabled.*
- *Only hybrid electrically instructed persons may perform all work (maintenance, tire changing, Convenience System) on vehicles with a high voltage system. If there is any uncertainty, discuss with the responsible high voltage technician.*
- *A high voltage technician must disable the system before any work can be performed on the high voltage electrical system or any other service work to the body.*
- *Only a high voltage expert (HVE) may perform repairs to the vehicle if it is not possible to disable the high voltage electrical system.*
- *Individuals with electrical medical equipment must not work on vehicles with a high voltage electrical system. Examples of electrical medical equipment include pain medication pumps, implanted heart defibrillators, pacemakers, insulin pumps and hearing aids.*

WARNING

Working with high voltage cables:

- *Do not support yourself or lay tools on the high voltage cables or on any of its components.*
- *When working near high voltage components and high voltage cables, do not use tools that generate heat, that have sharp edges or that are used for cutting or shaping, such as welding, soldering, hot air or thermal adhesive equipment.*
- *When working near high voltage components and high voltage cables, do not use tools that generate heat such as welding, soldering, hot air or thermal adhesive equipment.*
- *Do not excessively bend or flex high voltage cables.*
- *Always contact a high voltage technician (HVT) if there are questions or if something is not clearly understood.*

Check the contact surfaces on the potential equalization cables before installation.

The contact surfaces must be clean. There must be no rust or grease on them.

Follow all guidelines for clean working conditions.

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Observe the following precautions when working on the high voltage system:

- Only technicians who are trained in electrical systems should work on high voltage system (hybrid) vehicles.
- When working on a hybrid vehicle, always inspect the hybrid components in the area where the work is being performed.
- Do not excessively bend or flex high voltage cables.
- Always contact a high voltage technician or a high voltage expert specializing in electrical systems if something is not understood or if there are questions.
- All the work described below is referencing removing, installing and replacing the individual components.

Working on the High Voltage System

During the Following Work	Minimum Qualifications, refer to ⇒ page 9
De-energizing the high voltage system	High voltage technician
Re-energizing the high voltage system	High voltage technician

When Working on the Following Components	The High Voltage System Must Be De-energized By A High Voltage Technician Prior To Beginning the Work?		Minimum Qualifications, refer to ⇒ page 9
	Yes	No	
Electro-Drive Drive Motor - V141-	X		Technician trained in electrical systems
Electric Drive Power and Control Electronics - JX1-	X		Technician trained in electrical systems
High Voltage System Maintenance Connector - TW-		X	Technician trained in electrical systems
Electric A/C Compressor High Voltage Cable - P3-	X		Technician trained in electrical systems
Drive Motor High Voltage Wiring Harness - PX2-	X		Technician trained in electrical systems
High Voltage Wiring Harness For High Voltage Battery - PX1-	X		Technician trained in electrical systems
Hybrid Battery Unit - AX1- , Removing and Installing	X		Technician trained in electrical systems
Charging the Hybrid-Battery - A38- with High Voltage Battery Charger - VAS6565-	X		High voltage technician
Battery Regulation Control Module - J840-	X		High voltage technician
Battery Fan 1 - V457-		X	Technician trained in electrical systems
Air guides next to the Hybrid Battery Unit - AX1-		X	Technician trained in electrical systems
Air guides under the Hybrid Battery Unit - AX1-	X		Technician trained in electrical systems
Electrical A/C Compressor - V470-	X		Technician trained in electrical systems
Drive Motor Temperature Sensor - G712-	X		Technician trained in electrical systems
Drive Motor Rotor Position Sensor 1 - G713-	X		Technician trained in electrical systems

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When Working on the Following Components	The High Voltage System Must Be De-energized By A High Voltage Technician Prior To Beginning the Work?		Minimum Qualifications, refer to ⇒ page 9
	Yes	No	
Three-Phrase Current Drive - VX54-	X		Technician trained in electrical systems
Electrical Drive Button - E656-		X	Technician trained in electrical systems
Fuse Electrical A/C Compressor - V470- in Electric Drive Power and Control Electronics - JX1-	X		Technician trained in electrical systems
Potential equalization cable (Ground [GND] wires)	X		Technician trained in electrical systems
Working on the coolant circuit for the high voltage components	X		Technician trained in electrical systems
Measuring insulation resistance	X		High voltage technician
Working when the system is de-energized and the ignition is on	X		Technician trained in electrical systems

Conventional Work Near High Voltage Components

When Working on the Following Components	The High Voltage System Must Be De-energized By A High Voltage Technician Prior To Beginning the Work?		Minimum Qualifications, refer to ⇒ page 9
	Yes	No	
Spark plugs		X	Technician trained in electrical systems
Catalytic converter		X	Technician trained in electrical systems
Exhaust System		X	Technician trained in electrical systems
Coolant reservoir		X	Technician trained in electrical systems
Front brakes		X	Technician trained in electrical systems
Decoupler	X		Technician trained in electrical systems
Internal Combustion Engine, Removing and Installing	X		Technician trained in electrical systems
Transmission without Electro-Drive Drive Motor - V141- , Removing and Installing	X		Technician trained in electrical systems
Fuel Tank		X	Technician trained in electrical systems
Front subframe		X	Technician trained in electrical systems
Rear axle		X	Technician trained in electrical systems
Underbody Trim		X	Technician trained in electrical systems
Welding (Cover high voltage components with non-combustible materials and then perform a visual inspection)	X		Technician trained in electrical systems
Vehicle Body Work (Using an Alignment Bench)	X		Technician trained in electrical systems

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When Working on the Following Components	The High Voltage System Must Be De-energized By A High Voltage Technician Prior To Beginning the Work?		Minimum Qualifications, refer to ⇒ page 9
	Yes	No	
When working near high voltage components and high voltage cables, do not use tools that generate heat, that have sharp edges or that are used for cutting or shaping, such as welding, soldering, hot air or thermal adhesive equipment (Cover high voltage components with non-combustible materials and then perform a visual inspection).	X		Technician trained in electrical systems
Left Front Headlamp - MX1- , Removing and Installing		X	Technician trained in electrical systems
Right Front Headlamp - MX2- , Removing and Installing		X	Technician trained in electrical systems
Headlamp Bulbs, Removing and Installing		X	Technician trained in electrical systems

General Work

When Working On the Following Components	The High Voltage System Must Be De-energized By A High Voltage Technician Prior To Beginning the Work?		Minimum Qualifications, refer to ⇒ page 9
	Yes	No	
12V Battery, removing and installing		X	Technician trained in electrical systems
General controls modules and electric components, 12V, removing and installing		X	Technician trained in electrical systems
Fluids, coolant and fluids, draining and filling		X	Technician trained in electrical systems
Refrigerant extracting, evacuating, filling		X	Technician trained in electrical systems
Refrigerant pipes directly to the A/C compressor	X		Technician trained in electrical systems
A/C System, flushing		X	Technician trained in electrical systems
Peripheral refrigerant line (work that does not involve the A/C compressor directly without opening the refrigerant circuit, for example, loosening and tightening the refrigerant line)		X	Technician trained in electrical systems
Work with the engine raised, engine mount	X		Technician trained in electrical systems
Emissions test		X	Technician trained in electrical systems
Follow the instructions in the paint handbook when performing any paint/drying work		X	Technician trained in electrical systems

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Qualification Explanation

Qualification	Area of Application
Hybrid electrically instructed person	May perform general work and Maintenance services on the vehicle. May be requested by the high voltage technician to perform mechanical work on the tension-free high voltage system.
High voltage technician (HVT)	The high voltage technician has the same authorization as a technician trained in electrical systems due to their qualifications. The high voltage technician can also: ◆ 1. De-energize the system. ◆ 2. Secure the system so that it cannot be energized again. ◆ 3. Ascertain that the system is definitely de-energized (certified measurement). ◆ 4. Assign work on the high voltage system to the hybrid electrically instructed person. ◆ 5 Put the vehicle back in operation.
High voltage expert (HVE)	A high voltage expert (HVE) is actually a high voltage technician (HVT) but with an extra qualification that allows them to de-energize the high voltage system in the case that a high voltage technician is not able to perform measurements with the standard tools and equipment. The high voltage expert must continue the work if the high voltage technician does not have the authority to work on the high voltage system. The high voltage expert is responsible exclusively to de-energize the high voltage system if it cannot be de-energized by the high voltage technician using the usual means or methods.

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2 Description and Operation

- ⇒ “2.1 On Board Diagnostic Systems”, page 10
- ⇒ “2.2 Evaporative Emission System”, page 10
- ⇒ “2.3 Electronic Throttle Control (ETC) System”, page 12
- ⇒ “2.4 Electronic Power Control (EPC) Warning Lamp”, page 12
- ⇒ “2.5 Engine Control Module (ECM)”, page 13
- ⇒ “2.6 Malfunction Indicator Lamp (MIL)”, page 13
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2.1 On Board Diagnostic Systems

On Board Diagnostics, or OBD, is an automotive term referring to a vehicle's self-diagnostic and reporting capability. OBD systems give the vehicle owner or repair technician access to the status of the various vehicle sub-systems. Modern OBD implementations use a standardized digital communications port to provide real-time data in addition to a standardized series of Diagnostic Trouble Codes (DTCs) which allow one to rapidly identify and remedy malfunctions within the vehicle. Legislation mandates a vehicle equipped with OBD-II to light up the fault indicator lamp if its emissions exceed the prevailing limit due to system malfunction.

All cars built since January 1st, 1996 (MY 1996) are equipped OBD-II systems. Manufacturers started incorporating OBD-II in various models as early as 1994; however, some early OBD-II cars (MY 1994 and MY 1995) were not 100% compliant.

2.2 Evaporative Emission System

The evaporative emission system has been designed to minimize the release of hydrocarbons from the fuel system into the atmosphere. The evaporative emission system components all work together with the ECM to prevent fuel vapor from escaping and route it to the intake manifold to be burned during normal combustion.

The leak detection system checks the integrity of the evaporative emission system by pressurizing the system.

- There are 3 different types of evaporative emission systems used. These systems are explained below.

- ⇒ “2.2.1 Leak Detection Pump (LDP) Evap System”, page 11
- ⇒ “2.2.2 Tank Leak Diagnostic Module (DM - TL) Evap System”, page 11
- ⇒ “2.2.3 Natural Vacuum Leak Detection (NVLD) Evap System”, page 11
- ⇒ “2.2.4 EVAP System, Checking for Leaks”, page 11

2.2.1 Leak Detection Pump (LDP) Evap System

The leak detection pump (LDP) is integrated into the EVAP system and can have two functions. The LDP can:

- Pressurize the EVAP system and detect a drop in pressure that would indicate a leak.
- Function as the EVAP Canister Vent on vehicles that do not have a separate EVAP Canister Vent.

The LDP is a vacuum-driven, ECM controlled, diaphragm pump. In order to operate, the engine must be running and vacuum applied to the Vacuum Switch.

2.2.2 Tank Leak Diagnostic Module (DM - TL) Evap System

The canister purge valve can be actively checked using the Tank Leak Diagnostic Module (DM - TL). For this purpose the electric pump is shortly activated while the combustion engine is running, to build up a minor pressure in the fuel tank and monitor the pressure decay after opening the canister purge valve. Optionally as a quick pass method, the monitoring can be carried out by passively monitoring the fuel mixture deviation when the canister purge valve is opened. If a significant fuel mixture deviation is detected, the purge valve monitor passes. The Tank Leak Diagnostic Module (DM - TL) consists of an electrically operated air pump, an orifice with a defined diameter serving as a reference leak, and a change-over valve switching the air flow between the reference leak and the tank. If neither the pump nor the change-over valve is activated, the tank is ventilated through a bypass in the module.

2.2.3 Natural Vacuum Leak Detection (NVLD) Evap System

The system utilizes an engine-off natural vacuum evaporative system integrity check that tests for leaks with a diameter of 0.020 inch while the engine is off and the ignition is off. The natural vacuum leak detection (NVLD) evaporative system integrity check uses a pressure switch to detect evaporative system leaks. The correlation between the pressure and the temperature in a sealed system is used to generate a vacuum in the tank when the temperature drops. If a sufficient temperature drop is detected for a minimum time period, the vacuum level in a sealed system will exceed the threshold to close the NVLD pressure switch. Therefore, if the switch does not close under these conditions, a leak is detected. If the switch closes, the system is considered to be leak-free.

2.2.4 EVAP System, Checking for Leaks

The following procedure is used to diagnose EVAP System leaks.

Special tools and workshop equipment required

- Smoke tester.
- EVAP and Fuel Supply System Vacuum hose and line routing diagram.

Leak checking

– Using a Smoke tester, check the Evaporative Emission (EVAP) canister system for leaks.

– Always follow the manufacturers directions for the proper installation and operation of the smoke tester being used.

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If a leak is detected:

- Check the fuel filler cap seal for damage and for proper installation. Replace if necessary.
- Check all hose connections of the fuel supply system and replace or repair any leaking lines.
- Check all hose connections of the EVAP system and replace or repair any leaking lines.
- Check that the seal under the locking flange is properly tightened on the fuel tank.
- Secure all hose connections using appropriate fittings for the model type.
- Replace seals and gaskets when performing repair work.
- Repair or replace any damaged component.

If no leaks are found in the EVAP system:

1. Erase the DTC memory if a DTC was set. Refer to ⇒ “3.3.4 Diagnostic Mode 04 - Erase DTC Memory”, page 26 .
- Perform a road test to verify repair.

If a DTC was set and does not return:

Diagnosis complete. Generate readiness code. Refer to ⇒ “3.2 Readiness Codes”, page 19 .

If the same DTC does return and no leaks are found in the EVAP system:

- Check for any related TSB's.
- Perform the diagnostic test procedure for the suspected component.

2.3 Electronic Throttle Control (ETC) System

The electronic throttle control (ETC) system consists of the accelerator-pedal module, the engine control module (ECM), and the electronic throttle body. The electronic throttle body mainly consists of the throttle valve, the electric throttle-valve drive element, and the throttle-valve position sensor (TPS). The drive element is a DC servomotor, which acts on the throttle-valve shaft via a gear unit. The throttle-valve position sensor is a redundant sensor system that detects the position of the throttle valve. The sensors have opposite resistance curves so that the ECM can always cross check the signals to ensure the correct position of the throttle valve is always known.

The driver command is detected by a redundant sensor system in the accelerator-pedal module, and the signal is sent to the engine control module. The engine control module then determines the required throttle-valve position by performing calculations from data measured by sensors such as accelerator pedal position sensor, engine speed sensor and vehicle speed sensor. The actual throttle opening can be more or less in proportion to accelerator pedal position given different engine operating points.

2.4 Electronic Power Control (EPC) Warning Lamp

When the ignition is switched on, the engine control module (ECM) checks the electronic throttle control system for static system integrity (e.g. circuit integrity, communications, etc); the electronic power control (EPC) warning light is turned on via the Instrument Cluster during this process. Shortly after engine start,

the EPC warning light is turned off if no malfunction in the electronic throttle control system is detected. In the event of a malfunction while the engine is running, the ECM will activate the EPC warning light via the Instrument Cluster and at the same time, a Diagnostic Trouble Code (DTC) is stored in the ECM memory.

2.5 Engine Control Module (ECM)

The Engine Control Module (ECM) is a generic term for any embedded system that controls one or more of the electrical systems or subsystems in a vehicle. It controls a series of actuators on an internal combustion engine to ensure that driver commands (e.g. to accelerate) are translated into appropriate engine performance. It reads values from a multitude of sensors, interprets the data, and adjusts the engine actuators accordingly. The ECM also interacts with the transmission control module (TCM), ABS/traction/stability control module and other vehicle function related control systems.

ECM controlled systems and functions (performance and emission related) will be introduced in the following chapters. These include the OBD system, controller area network (CAN), throttle control module, fuel supply, ignition, variable valve timing, exhaust-gas recirculation, secondary air injection, exhaust system, and EVAP system.

2.6 Malfunction Indicator Lamp (MIL)

When the ignition is switched on, the Engine Control Module (ECM) performs checks on static system integrity (e.g. circuit integrity, communications, etc). The Malfunction Indicator Lamp (MIL) is switched on during this process via the Instrument Cluster. After engine starts, the ECM examines engine operation for potential malfunction(s) or failure(s) that can lead to increased emission values. If no malfunction is detected, the ECM switches off the MIL via the Instrument Cluster.

In the event of a malfunction during the operation of the engine, the ECM will activate the MIL via the instrument cluster and at the same time, a Diagnostic Trouble Code (DTC) is stored in the ECM memory. In OBD systems, the MIL can have up to three stages: steady, flashing and Stop Vehicle. A steady MIL indicates a minor fault (e.g. a failing oxygen sensor) whereas a flashing MIL indicates a more severe malfunction that could result in damage of engine or exhaust system components (e.g. the catalytic converter) if left uncorrected for an extended period. This would also indicate a severe fault. The three stages are 1. ON, then OFF; 2. ON steady; 3. flashing constantly. The 3rd stage indicates damage may occur and driver must stop.

2.7 Controller Area Network (CAN)

Overview

The Controller Area Network (CAN) bus is a message-based protocol that allows control units and devices to communicate with each other using a shared network. With this system, control units of the various electronic systems are no longer interconnected by multiple separate cables. This does away with a large number of electrical connections and results in a reduced likelihood of failure of the device network.

Broadcast Communication

Each of the devices on the network has a CAN circuit and is therefore is considered “intelligent”. All devices on the network see all transmitted messages. Each device can determine if a message is relevant or if it should be filtered out. This structure allows modifications to CAN networks with minimal impact. Addi-

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tional non-transmitting nodes can be added without modification to the network.

Priority

Every message has an assigned priority. If two nodes try to send messages simultaneously, the one with the higher priority gets transmitted and the one with the lower priority gets postponed. This arbitration does not affect other messages and results in non-interrupted transmission of the highest priority message

2.8 Fuel Supply

Overview

The fuel supply system delivers fuel to an internal combustion engine. With carburetors being replaced by fuel injections systems in the late 1980s and 1990s, the most common types of fuel supply system currently in use are throttle body injection (single-point injection), multiport injection (MPI) and direct injection (DI).

Fuel injectors atomize fuel because high pressure is forcing the fuel through a small nozzle in the injector into the intake air stream or the combustion chamber. This process is often controlled by the ECM and is dependent on data received from other sources (e.g. mass air flow sensor, throttle position sensor, etc.) to determine the precise amount of fuel needed for any given operating condition. The primary advantages of fuel injection over carburetor are improved fuel economy, increased power output and reduced emissions. The following sections will discuss each fuel injection concept in detail.

Throttle Body Injection

Throttle body injection uses a single electrically controlled injector at the throttle body. The fuel is drawn by an electric fuel pump out of the fuel tank and flows through a paper filter into the fuel injector. Since injection happens at the same location as the carburetor, very little engine redesign (intake manifold, fuel line routing, etc.) is necessary. The cost saving of throttle body injection compared to other fuel injection methods encouraged vast adoption in the late 1980s and early 1990s.

Throttle body injection system also inherits many disadvantages of the carburetor. One of them being the inability to precisely control the amount of fuel supplied into each cylinder, and is unable to precisely control combustion and emissions. It also restricts the design of intake manifold as any sharp bends in the intake path will cause atomized fuel to accumulate on the outer wall of the intake path. Supplying moderate engine heat to the intake manifold is also necessary to ensure that the fuel stay vaporized. This results in a relatively high intake air temperature and compromises performance.

Multiport Injection (MPI)

Multiport injection (MPI) consists of an injector for each cylinder just upstream of the intake valve. The fuel pump delivers the fuel into a high-pressure line where it flows to the fuel rail and injectors. When activated by the ECM, each injector sprays fuel at the intake port of its corresponding cylinder – this allows individual cylinders to receive the right amount of fuel in a more precisely timed manner. Sequential fuel injection mode can be applied to activate each injector individually to improve engine response. Lowered fuel consumption and emissions are also achieved.

Sequential multiport injection is still the most common fuel injection system found on most economy cars thanks to its high efficiency, control simplicity and low manufacturing cost (compared to direct injection). However, to further improve driveability (performance) while reducing emissions and fuel consumption, direct injection becomes a superior alternative.

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Direct Injection

Injectors in directly injected (DI) engines are mounted on the cylinder head and fuel is injected directly into the engine's combustion chamber. In order to overcome the pressure in the combustion chamber during compression and power stroke, injectors often operate at a primary pressure as high as 3000 psi. At such extreme pressure level, no single fuel pump can supply the required pressure directly from the fuel tank to the injectors. Instead, a low-pressure and a high-pressure system are employed. The low-pressure system principally utilizes the same fuel systems and components for multiport injected engines. The high-pressure system consists of a high-pressure fuel pump driven directly by the camshaft, a fuel rail (high-pressure accumulator), a high-pressure sensor and, depending on the system, a pressure-control valve or a pressure limiter. The injectors are operated by the ECM to send a precise amount of fuel from the high-pressure rail directly into the combustion chamber.

The distinctive difference between direct injection and other injection methods is that direct injection offers the flexibility regarding when in the combustion cycle the fuel is added and how. MPI systems can only add fuel during induction; A DI system can add fuel whenever it needs to. For example, fuel can be added during induction to create a homogeneous charge then added again after ignition to enhance power delivery under full load conditions.

VW/Audi Fuel Stratified Injection (FSI)

The goal of a stratified-charge operation is to form an ignitable mixture near the spark plug at the instant of ignition. This means that, instead of supplying the corresponding stoichiometric fuel quantity to the amount of air in the combustion chamber, the fuel interacts only with a portion of the air before it is conveyed to the spark plug. The rest of the fresh air surrounds the stratified charge allowing an ultra-lean condition with air-fuel ratio exceeding 50:1 in some instances. As less fuel is used to "burn" more air, stratified injection helps to further reduce fuel consumption when the engine is operating in low-load conditions (e.g. highway cruising). This is created by designing the combustion chamber so that a "swirling" effect of the air-fuel charge is caused.

2.9 Ignition and Timing

Ignition

A spark ignition (SI) engine requires a spark to initiate combustion in the combustion chamber. Voltage is supplied to the spark plug where the electricity will arc across a gap at a voltage as high as 100 kilovolts. The ECM determines the precise moment to fire each spark plug using ignition logic which is pre-programmed into the ECM as a function of engine speed and load. An optimally calibrated ignition system ensures consistent and reliable ignition under all conditions. Knock or misfire as a result of incorrect ignition can lead to destruction of engine components or damage of the catalytic converter.

Timing

Shifts in the moment of ignition (ignition timing) can result in increased emissions, decreased performance and fuel economy. Whereas more spark advance improves power and fuel economy, it also raises HC and NOx emissions. Excessive spark advance can cause engine knock which is potentially destructive to engines. If the ECM detects knock from a signal sent by a knock sensor, it will delay (retard) the timing of the spark. Excessive spark retard lowers power output and produces high exhaust temperatures, which can also harm the engine. Carefully designed ignition logic provides optimum timing that best balances performance, fuel economy and emissions.

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2.10 Variable Valve Timing

Engines equipped with variable valve timing provide the option of adjusting the phase of the camshaft with respect to the crankshaft. This allows the ECM to control the time at which the valves open or close, and therefore better assists engine “breathing” at various engine speeds. When engine speed increases, the duration of intake and exhaust stroke shortens so that less fresh air can be drawn into the combustion chamber and less exhaust gas can escape. In such a scenario, the ECM opens the intake valve before the exhaust gas has completely left the combustion chamber, and their considerable velocity assists in drawing in the fresh charge – this is referred to as “valve overlap”.

In addition to valve timing, some engines also employ variable valve lift that switches to a more aggressive camshaft-lobe profile as engine speed increases. A more aggressive camshaft-lobe profile actuates valves more rapidly and lifts valves to a greater magnitude in comparison to a normal camshaft-lobe profile. This improves intake and exhaust flow rate, allowing engines to raise maximum operating speed and power output.

2.11 Exhaust-Gas Recirculation (EGR) System

Exhaust-Gas Recirculation (EGR) can be utilized to control the cylinder charge and therefore the combustion process. The exhaust gas that is recirculated to the intake manifold increases the proportion of inert gas in the fresh gas filling; this results in a reduction in the peak combustion temperature and, in turn, a drop in temperature-dependent NOx emission.

Exhaust-gas recirculation is made possible by a connection between the exhaust pipe and the intake manifold. Due to the pressure differential, the intake manifold can draw in exhaust gas via this connection. Together with the exhaust-gas recirculation valve, the ECM adjusts the opening cross-section and therefore controls the partial flow tapped from the main exhaust flow. A malfunction in exhaust-gas recirculation system can result in performance loss and increased emissions. In such a scenario, the Malfunction Indicator Lamp (MIL) lights up and a Diagnostic Trouble Code (DTC) is stored in the ECM memory.

2.12 Secondary Air Injection

Additionally injecting air into the exhaust pipe triggers an exothermic (release of heat) reaction. This leads to the combustion of HC and CO components that prevail mainly during the warm up phase. This oxidation process releases additional heat. Consequently, the exhaust gas becomes hotter, causing the catalytic converter to heat up at a faster rate. For spark-ignition engines, secondary-air injection is an effective means of reducing HC and CO emissions after starting the engine and to rapidly heat up the catalytic converter. This ensures that the conversion of NOx emissions commences earlier.

An electronically controlled valve operates the secondary-air valve (a one-way check valve). The ECM actuates the pump and the control valve, ensuring that secondary air can be injected at a defined point in time. The secondary air must also be injected as close to the outlet valve as possible in order to exploit the high temperatures to utilize the exothermic (release of heat) reaction effectively.

2.13 Exhaust Systems

Overview

There are three important functions of the exhaust system: to reduce the pollutants in exhaust gas, muffle engine combustion noise and to discharge exhaust gas at a convenient location on

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the vehicle (often underneath the rear bumper). A passenger-car exhaust system consists of the following; exhaust manifold, exhaust treatment components, sound absorption components and the system of pipes connecting these components.

Exhaust Manifold

The manifold is an important component in the exhaust system. It routes the exhaust gas out of the cylinder outlet ports into the subsequent exhaust system. The geometry of the manifold (i.e. length and cross-section of the individual pipes) has an impact on the performance characteristics, the acoustic behavior of the exhaust system, and the exhaust temperature. In some cases, the manifold is insulated with an air gap to quickly reach high exhaust temperature and to shorten the time taken by the catalytic converter to reach its operating temperature.

Emission Control

The primary emission control component is the catalytic converter, which breaks down the gaseous pollutants in the exhaust gas (CO, HC and NOx). Catalytic converters are installed as close as possible to the engine so that they can quickly reach their operating temperature and therefore be effective in urban driving. It also bears a sound-absorbing function, especially to the higher frequency portion of the engine combustion noise.

Sound Absorption

Mufflers dampen or absorb the noise produced by engine combustion. In principle, they can be installed at any position in the exhaust system. However, they are mostly located in the middle and rear sections of the exhaust system. Depending on the number of cylinders and engine output, generally 1 to 3 mufflers are used in an exhaust system. In V-engines, the left and right cylinder banks are often run separately, each being fitted with its own catalytic converters and mufflers. Although the aim of mufflers is to reduce noise in compliance with legislations, they can also help to create the sound specific to the type of vehicle.

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3 Diagnosis and Testing

- ⇒ “3.1 Preliminary Check ”, page 18
- ⇒ “3.2 Readiness Codes”, page 19
- ⇒ “3.3 Diagnostic Modes 01 - 0A”, page 21
- ⇒ “3.4 Engine DTC Tables”, page 46
- ⇒ “3.5 Transmission DTC Tables”, page 396
- ⇒ “3.6 Diagnostic Procedures”, page 456

3.1 Preliminary Check

Note

- *Before performing any pin point test or component diagnosis, a Preliminary Check must be performed.*
- *Check for Technical Bulletins that may supersede any information included in the repair manual or GST Manual.*

- For Electrical Testing: Refer to ⇒ page 18 .
- For Fuel System Mechanical Testing: Refer to ⇒ page 19 .

Electrical Testing

Step	Procedure	Result / Action to Take
1	• CONNECT: Scan Tool. • IGNITION: ON. • CHECK: For stored or related DTCs. – Were any other DTCs stored?	– YES: ♦ GO TO: Step 2 ⇒ page 18 . – NO: ♦ GO TO: Step 3 ⇒ page 18 .
2	• Repair these DTCs first before performing any of the following steps.	♦ GO TO: Proper Diagnostic procedure per the stored DTC. Refer to ⇒ “3.4 Engine DTC Tables”, page 46 .
3	• Using the Scan Tool, erase the DTC memory. Refer to ⇒ “3.3.4 Diagnostic Mode 04 - Erase DTC Memory”, page 26 . • Perform a road test to attempt to duplicate the customers complaint. – Does DTC return?	– YES: ♦ GO TO: Step 4 ⇒ page 18 . – NO: ♦ GO TO: Step 5 ⇒ page 18 .
4	• Perform the diagnostic procedure for that DTC.	♦ GO TO: Proper Diagnostic procedure per the stored DTC. Refer to ⇒ “3.4 Engine DTC Tables”, page 46 .
5	• FAULT: Intermittent or a sporadic condition. • CHECK: Suspected components. • PERFORM: Visual Inspection of wiring and components. • CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. • REPAIR: Faulty wiring or connector.	♦ Perform a road test to verify the repair. ♦ Generate readiness code. Refer to ⇒ “3.2 Readiness Codes”, page 19 .

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Fuel System Mechanical Testing

Check the following items for possible mechanical delivery deficiency:

- Fuel level in tank is too low.
- Fuel lines pinched.
- Fuel filter plugged.
- Fuel pump delivery unit internal leak.
- Clogged injectors.
- Poor fuel quantity delivery. Refer to appropriate repair manual.

3.2 Readiness Codes

Caution

When performing the Readiness drive cycle operation, pay strict attention to driving conditions and observe and obey all posted speed limits.

Readiness code description

Diagnostics are performed at regular intervals during normal vehicle operation. After repairing an emissions related system, a readiness code is generated by road testing the vehicle.

If a malfunction is recognized during the drive cycle, it will be stored in the DTC memory.

The OBD drive cycle operation will be monitored with a hand held diagnostic tool. Consult the manufacturer's instruction manual for correct tool operation.

The readiness code is erased every time the DTC memory is erased or any time the battery is disconnected. If the DTC memory has been erased or the battery is disconnected, a new readiness code must be generated.

Only erase the DTC memory if a DTC has been stored.

General recommendations

Most monitors will complete easier and quicker using a “steady-foot” and “smooth” acceleration during the drive cycle operation.

Operating conditions

For the EVAP monitor test, the coolant temperature and the ambient air temperature must be between 10° C and 35° C with a difference between them no greater than 4° C. The ambient air temperature must not change more than 4° C during the drive cycle procedure (e.g. when driving out of a heated workshop in the winter).

Note

Do not assume that the scan tool ID and engine code are correct if the scan tool communicates. The scan tool does not use the ID to establish communication—the units are automatically identified.

Test requirements

- NO DTC in memory
- Switch OFF all electrical and electronic accessories

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- Necessary driving speed: 50 – 70 mph
- Drive profile takes approx. 60 – 90 min.

Readiness Drive Cycle Procedure

– CONNECT: Scan Tool

Step	Procedure	Result / Action to Take
1	Activate Monitors: • START: Engine and idle for 2 – 3 min.	♦ Monitoring Active. ♦ Executes Misfire Monitoring.
2	O2 Sensor Monitoring: • DRIVE: Vehicle at 45 – 55 mph for a continuous 7 minute period. Avoid stopping.	♦ Executes O2 Sensor Monitoring. ♦ Executes Fuel Trim Monitoring. ♦ Executes EVAP Monitoring.
3	Fuel Cut-Off Monitoring: • ACCELERATE: Vehicle to an engine speed of 5,000 RPM; lift off the throttle until the engine speed is around 1,200 RPM.	♦ Fuel Cut-Off Monitoring Ready.
4	Catalyst Monitoring: • ACCELERATE: Vehicle smoothly to 60 – 65 mph, cruise at a constant speed for 5 min.	♦ Executes Catalyst Monitoring. ♦ Executes O2 Sensor Monitoring. ♦ Executes Fuel Trim Monitoring. ♦ Executes Misfire Monitoring. ♦ Executes EVAP Monitoring.
5	Secondary Air Injection, EVAP Monitoring: • DRIVE: Vehicle for 30 – 40 min. at a constant speed of 50 – 70 mph in high gear for 2 min with no coasting.	♦ Executes Secondary Air Injection Monitoring. ♦ Executes EVAP Monitoring. • Check the status of the readiness code.

– If any engine monitor fails the drive cycle test. Repeat the drive cycle test until all engine monitors have successfully run through and passed.

Note

♦ *When repeating the drive cycle operation for a failed evaporative or thermostat monitor, allow the engine to cool until the coolant temperature and the ambient air temperature are be between 10° C and 35° C with a difference no greater than 4° C and repeat the drive cycle operation.*

♦ *Depending on the scan tool used. The readiness code status may be displayed as complete, passed or OK. At an exterior temperature < 7° C, the setting of the readiness for the NOx catalytic converter test is delayed. Here the vehicle must be Driven considerably longer.*

Readiness Codes and Monitoring Completed

1 - If any engine monitor fails the drive cycle test. Repeat the drive cycle test until all engine monitors have successfully run through and passed.

2 - If the drive cycle operation fails again.

3 - Check the DTC memory for stored DTCs.

4 - Repair the vehicle if necessary.

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5 - Repeat the drive cycle operation until all engine monitors have successfully run through and passed.

6 - Remove the scan tool and switch the ignition off.

3.3 Diagnostic Modes 01 - 0A

The information provided in Modes 01 through 0A displays the various levels of emission related data that may be monitored, as well as the ability to retrieve and read stored DTCs, erase stored DTCs, generate readiness codes, and select the various PIDs and Test IDs used within the modes to monitor the engine, and emission related component parameters.

- ⇒ “3.3.1 Diagnostic Mode 01 - Read Current System Data”, page 21
- ⇒ “3.3.2 Diagnostic Mode 02 - Read Operating Conditions”, page 23
- ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24
- ⇒ “3.3.4 Diagnostic Mode 04 - Erase DTC Memory”, page 26
- ⇒ “3.3.5 Diagnostic Mode 05 - Read Oxygen Sensor Monitoring Test Results”, page 26
- ⇒ “3.3.6 Diagnostic Mode 06 - Read Test Results for Specific Diagnostic Functions, 2014 - 2015 MY’s”, page 27
- ⇒ “3.3.7 Diagnostic Mode 06 - Read Test Results for Specific Diagnostic Functions, 2016 MY”, page 34
- ⇒ “3.3.8 Diagnostic Mode 07 - Read Faults Detected During the Current or Last Driving Cycle”, page 41
- ⇒ “3.3.9 Diagnostic Mode 08 - Request Control of On-Board System, Test or Component”, page 42
- ⇒ “3.3.10 Diagnostic Mode 09 - Read Vehicle Information”, page 42
- ⇒ “3.3.11 Diagnostic Mode 0A - Check Permanent DTC Memory ”, page 44

3.3.1 Diagnostic Mode 01 - Read Current System Data

Note

Depending on scan tool and protocol used, the information in diagnostic mode 01 may be referred to by different names such as Test-ID (TID), Hex-ID, Component-ID (CID), or On-Board Diagnostic Monitor Identifier (OBDMID).

Diagnostic Mode 01 makes it possible to access current emissions-related measured values and diagnostic data. The original measured values (no replacement values), input and output data and system status information are displayed using Diagnostic Mode 1.

Test requirement

- Coolant temperature at least 80° C.

Procedure

– Connect the scan tool.

– Start the engine and run at idle.

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– Select “Diagnostic Mode 1: Obtain data.”.
– From the following table, select the desired the “PID” that is to be monitored, e.g. “PID $05 Coolant temperature”.

The current values of the component or system that is being monitored will be displayed on the scan tool screen.

PID	Component or System
$00:	Supported PIDs $01 – $20
$01:	Monitoring Status Since Erasing Dtc Memory
$03:	Fuel System Status
$04:	Calculated Load Value
$05:	Coolant Temperature
$06:	O2 Sensor Bank 1
$07:	O2 Sensor Adaptation Value Bank 1
$0B:	Manifold Pressure
$0C:	Engine Speed
$0D:	Vehicle Speed
$0E:	Ignition Angle Cylinder 1
$0F:	Intake Air Temperature
$11:	Absolute Throttle Position
$12:	Secondary Air Status
$13:	Location of Oxygen Sensors
$15:	O2 Sensor Voltage (Jump Probes)
$1C:	OBD Requirements
$1F:	Time Since Engine Start
$20:	Supported PIDs $21 – $40
$21:	Distance Driven With Mil On
$23:	Fuel (Rail) Pressure
$2E:	Fuel Tank Vent Valve Control
$2F:	Fuel Tank Level
$30:	Number Of Warm Up Cycles Since Fault Memory Cleared
$31:	Distance Driven After Erasing Fault Memory
$33:	Ambient Air Pressure
$34:	O2 Sensor Voltage (Linear Probes)
$3C:	Catalyst Temperature Bank 1 Sensor 1
$40:	Supported PIDs $41 – $60
$41:	Diagnostic Status In This Cycle
$42:	Engine Control Module System Voltage
$43:	Absolute Load Value
$44:	Lambda Value
$45:	Relative Throttle Position
$46:	Ambient Air Temperature
$47:	Absolute Throttle Position (Redundant)
$49:	Accelerator Pedal Position 1 Absolute
$4A:	Accelerator Pedal Position 2 Absolute (Redundant)
$4C:	Throttle Position Set Point
$51:	Fuel Type
$56:	Offset Lambda Control Behind Catalyst, Bank 1

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PID	Component or System
$60:	Supported PIDs $61 – $80
$70:	Boost Pressure Control

– Switch the ignition off.

3.3.2 Diagnostic Mode 02 - Read Operating Conditions

When an emissions-related fault (pending DTC, visible in mode 07) is first detected, operating conditions are stored. Mode 02 makes it possible to access this freeze frame data as soon as this fault is shown in mode 03. Each control module only shows freeze frame data for one fault via mode 02. Therefore, there are two priority levels. If there is a malfunction with higher priority, the freeze frame data is overwritten.

– Fault with higher priority: Misfire malfunction or fuel trim malfunction.
– Fault with normal priority: All other emissions-related faults.

Note

Depending on scan tool and protocol used, the information in diagnostic mode 02 may be referred to by different names such as Test-ID, Hex-ID, Component-ID, or On-Board Diagnostic Monitor Identifier (OBDMID).

Procedure

– Connect the scan tool.
– Start the engine and run at idle.

Note

If the engine does not start, crank the engine using starter for at least 5 seconds, do not switch the ignition off afterward.

– Select “Diagnostic Mode 2: Obtain operating conditions.”.
– From the following table, select the desired the “PID”, e.g. “PID $05 Coolant temperature” that is to be monitored.

The current values of the component or system that is being monitored will be displayed on the scan tool screen.

PID	Component or System
$00:	Supported PIDs $01 – $1F
$02:	DTC Which Triggered Freeze Frame Data
$03:	Fuel System Status
$04:	Calculated Load Value
$05:	Coolant Temperature
$06:	O2 Sensor Bank 1
$07:	O2 Sensor Adaptation Value Bank 1
$0B:	Manifold Pressure
$0C:	Engine Speed
$0D:	Vehicle Speed

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PID	Component or System
$0E:	Firing Angle Cylinder 1
$0F:	Intake Air Temperature
$11:	Absolute Throttle Position 1
$12:	Secondary Air Status
$1F:	Time Since Engine Start
$20:	Supported PIDs $21 – $3F
$23:	Fuel Pressure (Rail Pressure)
$2E:	Fuel Tank Vent Valve Control
$2F:	Fuel Tank Level
$33:	Ambient Air Pressure
$40:	Supported PIDs $41 – $5F
$42:	Engine Control Module System Voltage
$43:	Absolute Load Value
$44:	Lambda Value
$45:	Relative Throttle Position
$46:	Ambient Air Temperature
$47:	Absolute Throttle Position 2
$49:	Accelerator Pedal Position 1 Absolute
$4A:	Accelerator Pedal Position 2 Absolute
$4C:	Throttle Position Set Point
$51:	Fuel Type
$56:	Offset Lambda Control Behind Catalyst, Bank 1
$60:	Supported PIDs $61 – $80
$70:	Boost Pressure Control

– Switch Ignition OFF

3.3.3 Diagnostic Mode 03 - Read DTC Memory

Diagnostic Mode 03 makes it possible to read emissions-related faults (confirmed DTCs; faults which have activated the MIL) in the ECM and in the TCM.

When the ECM recognizes an emissions-related fault in two consecutive drive cycles, it sends a request to the instrument cluster over the CAN to turn on the malfunction indicator lamp. If an electronic throttle malfunction is recognized, the ECM will send a request to the instrument cluster over the CAN to turn on the electronic power control warning lamp.

The DTCs are sorted by SAE code with the DTC tables consisting of a 5-digit alphanumeric value.

Note

Depending on the scan tool and protocol used, diagnostic mode 03 and the information provided may be referred to by a different name.

The following tables provide a breakdown and explanation of the DTC code.

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P Codes

Component group					
P	x	x	x	x	DTC for the drivetrain
Norm-Code					
P	0	x	x	x	Trouble codes defined by SAE with specified malfunction texts
P	1	x	x	x	Additional emission relevant DTCs provided by the manufacturer
P	2	x	x	x	DTCs defined by SAE with specified texts, from MY 2000
P	3	x	x	x	Additional emission relevant DTCs provided by the manufacturer from MY 2000

Component group					
Repair group					
P	x	0	x	x	Fuel and air mixture and additional emission regulations
P	x	1	x	x	Fuel and air ratios
P	x	2	x	x	Fuel and air ratios
P	x	3	x	x	Ignition system
P	x	4	x	x	Additional exhaust system
P	x	5	x	x	Speed and idle control
P	x	6	x	x	Control module and output signals
P	x	7	x	x	Transmission
P	x	8	x	x	Transmission
P	x	9	x	x	Control modules, input and output signals

U Codes

Component group					
U	x	x	x	x	DTC for network (CAN bus)
Norm-Code					
U	0	x	x	x	Trouble codes defined by SAE with specified malfunction texts

Procedure

– Connect the scan tool.

– Switch the ignition to the ON position.

– Select Diagnostic Mode 03: Interrogating fault memory.

– The stored DTC or DTCs will be displayed on the scan tool screen.

The following table is an example of the DTC information that may be displayed on the scan tool screen:

Indication example	Explanation
P0444	SAE Diagnostic Trouble Code
Evaporative emission canister purge regulator valve	Malfunctioning wiring path or malfunctioning component
Circuit open	Malfunction type as next

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– Refer to the DTC tables for the diagnostic repair procedures.
– Switch the ignition off.

3.3.4 Diagnostic Mode 04 - Erase DTC Memory

Diagnostic Mode 04 makes it possible to erase the DTC memory and to reset all emission related diagnostic data. In that way, all faults in the DTC memory in the ECM and TCM are erased. The adaptation values may also be reset.

Emission related diagnostic data includes (as applicable):

- - MIL status
- - Number of DTCs
- - Readiness bits
- - Confirmed DTCs
- - Pending DTCs
- - DTC that belongs to freeze frame
- - Freeze frame data
- - Test results of specific diagnostic functions
- - Distance driven with MIL on
- - Number of warm-up cycles after erasing the DTC memory
- - Distance driven after erasing the DTC memory
- - Misfire counter

Note

Depending on the scan tool and protocol used, diagnostic mode 04 and the information provided may be referred to by a different name.

Procedure

– Connect the scan tool.
– Switch the ignition on.
– Select Diagnostic Mode 03: Interrogating fault memory.
– Then select Mode 4: Reset/delete diagnostic data.

The scan tool will display ”Diagnostic data being erased”.

– Switch the ignition off.

3.3.5 Diagnostic Mode 05 - Read Oxygen Sensor Monitoring Test Results

Note

Mode 05 may not be supported on all systems. On systems where Diagnostic Mode 05 is not supported, refer to Diagnostic Mode 6 for oxygen sensor monitoring test results.

Test Requirements

– No Test requirements are available for this powertrain.

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Function Test

– No Function Tests are available for this powertrain.

3.3.6 Diagnostic Mode 06 - Read Test Results for Specific Diagnostic Functions, 2014 - 2015 MY's

Diagnostic Mode 06 makes it possible to retrieve test results for special components and systems which are continuously or not continuously monitored. If the diagnosis of a system is complete, the diagnostic result and the corresponding thresholds are saved and displayed in mode 06. This data remains saved (even with the ignition off) until either new diagnostic results become available or the DTC memory is erased.

The min & max values for each individual test in Mode 06 represent the min & max operating values for a properly operating system. This data is provided to the individual aftermarket scan tool companies for development of their scan tool. Depending on the scan tool being used, the min & max values shown may vary, or be rounded up or down to the nearest decimal point depending on the aftermarket scan tool company's development process.

For example; GST manual documentation will show the value as 0.3499 (units) while the scan tool will display the same value as 0.35 (units).

Depending on the scan tool and protocol used, the information displayed in Diagnostic Mode 06 may be referred to by different names such as Test-ID (TID), Hex-ID, Component-ID (CID), On-Board Diagnostic Monitor Identifier (OBDMID), or contain no name at all and may be referenced by only a number.

Test requirements

- Exhaust system must be properly sealed between the catalytic converter and the cylinder heads.
- No DTCs stored in the DTC memory.
- Coolant temperature at least 80° C.

Work procedure

– Connect the scan tool.

– Start the engine and let run at idle speed.

– Select Mode 6: Check test the results of components that are not continuously monitored.

Select the desired Test-ID.

The current minimum and maximum values will be displayed on the scan tool screen.

The following table is a numerical list of all"Test-IDs" that may be selected.

Monitor-ID	Component or System
$01: ⇒ page 28	Oxygen Sensor Monitor Bank 1 – Sensor 1
$02: ⇒ page 28	Oxygen Sensor Monitor Bank 1 – Sensor 2
$21: ⇒ page 29	Catalytic Converter Monitoring
$35: ⇒ page 29	Camshaft Adjustment Bank 1
$3C: ⇒ page 30	Tank Venting System Leak Test (0.020" / 0.5 mm)
$3D: ⇒ page 30	Tank Vent Valve Function Check
$41: ⇒ page 31	O2 Sensor Heater Bank 1 – Sensor 1
$42: ⇒ page 31	O2 Sensor Heater Bank 1 – Sensor 2

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Monitor-ID	Component or System
$71: ⇒ page 32	Secondary Air System Bank 1
$A2: ⇒ page 32	Misfire Cylinder 1 Data
$A3: ⇒ page 33	Misfire Cylinder 2 Data
$A4: ⇒ page 33	Misfire Cylinder 3 Data
$A5: ⇒ page 33	Misfire Cylinder 4 Data

Monitor-ID $01: Oxygen Sensor Monitor Bank 1 – Sensor 1

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $01”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$83	P0133	Oxygen Sensor Dynamic Test Bank 1, Sensor 1.	0.0 V	1.0996 V	Refer to DTC P0133 in the DTC summary table. ⇒ page 63
$86	P0133	Oxygen Sensor Dynamic Test Bank 1, Sensor 1.	0.0 V	1.0996 V	Refer to DTC P0133 in the DTC summary table. ⇒ page 63
$8A	P2195	Oxygen Sensor Intrusive Check	0.89	32.767	Refer to DTC P2195 in DTC summary table. ⇒ page 164
$8B	P2196	Oxygen Sensor Intrusive Check	1.06	32.767	Refer to DTC P2196 in the DTC summary table. ⇒ page 165

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $02: Oxygen Sensor Monitor Bank 1 – Sensor 2

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $02”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$05	P013A	Oxygen Sensor Transition Time.	900.0 mV/s	65,534.0 mV/s	Refer to DTC P013A in the DTC summary table. ⇒ page 67

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Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$92	P013B	Oxygen Sensor Maximum Gradient Of Sensor Signal During Lean – Rich – Transition.	650.0 mV/s	65,534.0 mV/s	Refer to DTC P013B in the DTC summary table. ⇒ page 70
$93	P013E	Oxygen Sensor Dynamic Test, Delay Rich To Lean.	0.0 s	0.9 s	Refer to DTC P013E in the DTC summary table. ⇒ page 73
$94	P013F	Oxygen Sensor Dynamic Test, Delay Lean To Rich.	0.0 s	NaN	Refer to DTC P013F in the DTC summary table. ⇒ page 76
$95	P2270	Oxygen Sensor Target Voltage In Fat Mode Not Reached.	0.874 V	7.999 V	Refer to DTC P2270 in the DTC summary table. ⇒ page 179
$96	P2271	Oxygen Sensor Target Voltage In Lean-Burn Mode Not Reached.	0.0 V	0.249 V	Refer to DTC P2271 in the DTC summary table. ⇒ page 182

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $21: Catalytic Converter Monitoring

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $21”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$84	P0420	Catalytic Converter Assessment Of Oxygen Storage Capacity (OSC) Compared To Catalytic Converter Map.	0.0 OSC	1.0 OSC	Refer to DTC P0420 in the DTC summary table. ⇒ page 121

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $35: Camshaft Adjustment Bank 1

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $35”.

– Select the desired “Test-ID” or “Hex-ID”.

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– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$80	P0011	VVT Intake Camshaft Diagnosis, Target Position Not Reached, Target Error.	0.0° CRK	10.0° CRK	Refer to DTC P0011 in the DTC summary table. ⇒ page 46
$81	P000A	VVT Intake Camshaft Diagnosis, Specified Position Reached Too Slowly, Slow Response.	10.0° CRK	655.35° CRK	Refer to DTC P000A in the DTC summary table. ⇒ page 46

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $3C: Tank Venting System Leak Test (0.020" / 0.5 mm)

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $3C”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$83	P0456	NVLD Fine Leak Detection.	10.0	65,535.0	Refer to DTC P0456 in the DTC summary table. ⇒ page 127

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $3D: Tank Vent Valve Function Check

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $3D”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$8B	P0441	Tank Vent Valve – Function Check, Test Using Cross-Correlation.	0.1	655.35	Refer to DTC P0441 in the DTC summary table. ⇒ page 124

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– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $41: O2 Sensor Heater Bank 1 – Sensor 1

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $41”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$85	P0135	Oxygen Sensor Ceramic Temperature Monitoring.	630.0° C	6,513.5° C	Refer to DTC P0135 in the DTC summary table. ⇒ page 66

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $42: O2 Sensor Heater Bank 1 – Sensor 2

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $42”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$90	P0141	Oxygen Sensor Nernst Cell Resistance Test.	0.0 Ω	700.0 Ω	Refer to DTC P0141 in the DTC summary table. ⇒ page 79

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

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Monitor-ID $71: Secondary Air System Bank 1

– Connect the scan tool.
– Start the engine and run at idle.
– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $71”.

– Select the desired “Test-ID” or “Hex-ID”.
– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$82	P0491	System Testing, Reduced Secondary Air Mass.	0.0	1.999	Refer to DTC P0491 in the DTC summary table. ⇒ page 129
$85	P0410	System Testing Of Pressure Sensor.	0.0 kPa	5.0 kPa	Refer to DTC P0410 in the DTC summary table. ⇒ page 119
$8C	P2440	Functional Testing Of Secondary Air Valve, Valve Leak Check.	0.0	1.34	Refer to DTC P2440 in the DTC summary table. ⇒ page 190

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .
– Switch the ignition OFF.

Monitor-ID $A2: Misfire Cylinder 1 Data

– Connect the scan tool.
– Start the engine and run at idle.
– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $A2”.

– Select the desired “Test-ID” or “Hex-ID”.
– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$0B	P0301	Misfire Cylinder 1, Average Value Over 10 Driving Cycles.	0.0 counts	65,535.0 counts	Refer to DTC P0301 in the DTC summary table. ⇒ page 98
$0C	P0301	Misfire Cylinder 1, In This Driving Cycle.	0.0 counts	65,535.0 counts	Refer to DTC P0301 in the DTC summary table. ⇒ page 98

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .
– Switch the ignition OFF.

Monitor-ID $A3: Misfire Cylinder 2 Data

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $A3”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$0B	P0302	Misfire Cylinder 2, Average Value Over 10 Driving Cycles.	0.0 counts	65,535.0 counts	Refer to DTC P0302 in the DTC summary table. ⇒ page 99
$0C	P0302	Misfire Cylinder 2, In This Driving Cycle.	0.0 counts	65,535.0 counts	Refer to DTC P0302 in the DTC summary table. ⇒ page 99

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $A4: Misfire Cylinder 3 Data

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $A4”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$0B	P0303	Misfire Cylinder 3, Average Value Over 10 Driving Cycles.	0.0 counts	65,535.0 counts	Refer to DTC P0303 in the DTC summary table. ⇒ page 99
$0C	P0303	Misfire Cylinder 3, In This Driving Cycle.	0.0 counts	65,535.0 counts	Refer to DTC P0303 in the DTC summary table. ⇒ page 99

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $A5: Misfire Cylinder 4 Data

– Connect the scan tool.

– Start the engine and run at idle.

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– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $A5”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$0B	P0304	Misfire Cylinder 4, Average Value Over 10 Driving Cycles.	0.0 counts	65,535.0 counts	Refer to DTC P0304 in the DTC summary table. ⇒ page 100
$0C	P0304	Misfire Cylinder 4, In This Driving Cycle.	0.0 counts	65,535.0 counts	Refer to DTC P0304 in the DTC summary table. ⇒ page 100

– Switch the ignition OFF.

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

3.3.7 Diagnostic Mode 06 - Read Test Results for Specific Diagnostic Functions, 2016 MY

Diagnostic Mode 06 makes it possible to retrieve test results for special components and systems which are continuously or not continuously monitored. If the diagnosis of a system is complete, the diagnostic result and the corresponding thresholds are saved and displayed in mode 06. This data remains saved (even with the ignition off) until either new diagnostic results become available or the DTC memory is erased.

The min & max values for each individual test in Mode 06 represent the min & max operating values for a properly operating system. This data is provided to the individual aftermarket scan tool companies for development of their scan tool. Depending on the scan tool being used, the min & max values shown may vary, or be rounded up or down to the nearest decimal point depending on the aftermarket scan tool company's development process.

For example; GST manual documentation will show the value as 0.3499 (units) while the scan tool will display the same value as 0.35 (units).

Depending on the scan tool and protocol used, the information displayed in Diagnostic Mode 06 may be referred to by different names such as Test-ID (TID), Hex-ID, Component-ID (CID), On-Board Diagnostic Monitor Identifier (OBDMID), or contain no name at all and may be referenced by only a number.

Test requirements

- Exhaust system must be properly sealed between the catalytic converter and the cylinder heads.
- No DTCs stored in the DTC memory.
- Coolant temperature at least 80 °C.

Work procedure

– Connect the scan tool.

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– Start the engine and let run at idle speed.
– Select Mode 6: Check test the results of components that are not continuously monitored.

Select the desired Test-ID.

The current minimum and maximum values will be displayed on the scan tool screen.

The following table is a numerical list of all“Test-IDs” that may be selected.

Monitor-ID	Component or System
$01: ⇒ page 35	Oxygen Sensor Monitor Bank 1 – Sensor 1
$02: ⇒ page 36	Oxygen Sensor Monitor Bank 1 – Sensor 2
$21: ⇒ page 36	Catalytic Converter Monitoring
$35: ⇒ page 37	Camshaft Adjustment Bank 1
$3C: ⇒ page 37	Tank Venting System Leak Test (0.020" / 0.5 mm)
$3D: ⇒ page 38	Tank Vent Valve Function Check
$41: ⇒ page 38	O2 Sensor Heater Bank 1 – Sensor 1
$42: ⇒ page 39	O2 Sensor Heater Bank 1 – Sensor 2
$71: ⇒ page 39	Secondary Air System Bank 1
$A2: ⇒ page 39	Misfire Cylinder 1 Data
$A3: ⇒ page 40	Misfire Cylinder 2 Data
$A4: ⇒ page 40	Misfire Cylinder 3 Data
$A5: ⇒ page 41	Misfire Cylinder 4 Data

Monitor-ID $01: Oxygen Sensor Monitor Bank 1 – Sensor 1

– Connect the scan tool.
– Start the engine and run at idle.
– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $01”.

– Select the desired “Test-ID” or “Hex-ID”.
– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$83	P0133	Oxygen Sensor Dynamic Test Bank 1, Sensor 1.	0.0 V	1.0996 V	Refer to DTC P0133 in the DTC summary table. ⇒ page 224
$86	P0133	Oxygen Sensor Dynamic Test Bank 1, Sensor 1.	0.0 V	1.0996 V	Refer to DTC P0133 in the DTC summary table. ⇒ page 224
$8A	P2195	Oxygen Sensor Intrusive Check	0.89	32.767	Refer to DTC P2195 in DTC summary table. ⇒ page 345
$8B	P2196	Oxygen Sensor Intrusive Check	0.89	32.767	Refer to DTC P2196 in the DTC summary table. ⇒ page 346

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure

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⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $02: Oxygen Sensor Monitor Bank 1 – Sensor 2

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $02”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$05	P013A	Oxygen Sensor Transition Time.	900.0 mV/s	65,534.0 mV/s	Refer to DTC P013A in the DTC summary table. ⇒ page 228
$92	P013B	Oxygen Sensor Maximum Gradient Of Sensor Signal During Lean – Rich – Transition.	650.0 mV/s	65,534.0 mV/s	Refer to DTC P013B in the DTC summary table. ⇒ page 232
$93	P013E	Oxygen Sensor Dynamic Test, Delay Rich To Lean.	0.0 s	0.9 s	Refer to DTC P013E in the DTC summary table. ⇒ page 236
$94	P013F	Oxygen Sensor Dynamic Test, Delay Lean To Rich.	0.0 s	NaN	Refer to DTC P013F in the DTC summary table. ⇒ page 240
$95	P2270	Oxygen Sensor Target Voltage In Fat Mode Not Reached.	0.874 V	7.999 V	Refer to DTC P2270 in the DTC summary table. ⇒ page 361
$96	P2271	Oxygen Sensor Target Voltage In Lean-Burn Mode Not Reached.	0.0 V	0.249 V	Refer to DTC P2271 in the DTC summary table. ⇒ page 365

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $21: Catalytic Converter Monitoring

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $21”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$84	P0420	Catalytic Converter Assessment Of Oxygen Storage Capacity (OSC) Compared To Catalytic Converter Map.	0.0 OSC	1.0 OSC	Refer to DTC P0420 in the DTC summary table. ⇒ page 288

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– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $35: Camshaft Adjustment Bank 1

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $35”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$80	P0011	VVT Intake Camshaft Diagnosis, Target Position Not Reached, Target Error.	0.0° CRK	10.0° CRK	Refer to DTC P0011 in the DTC summary table. ⇒ page 201
$81	P000A	VVT Intake Camshaft Diagnosis, Specified Position Reached Too Slowly, Slow Response.	10.0° CRK	655.35° CRK	Refer to DTC P000A in the DTC summary table. ⇒ page 200
$82	P0014	VVT Exhaust Camshaft Diagnosis, Target Position Not Reached, Target Error.	0.0° CRK	10.0° CRK	Refer to DTC P0014 in the DTC summary table. ⇒ page 201
$83	P000B	VVT Exhaust Camshaft Diagnosis, Specified Position Reached Too Slowly, Slow Response.	3.5° CRK	655.35° CRK	Refer to DTC P000B in the DTC summary table. ⇒ page 200

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $3C: Tank Venting System Leak Test (0.020" / 0.5 mm)

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $3C”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$83	P0456	NVLD Fine Leak Detection.	10.0	65,535.0	Refer to DTC P0456 in the DTC summary table. ⇒ page 295

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– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $3D: Tank Vent Valve Function Check

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $3D”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$8B	P0441	Tank Vent Valve – Function Check, Test Using Cross-Correlation.	0.1	655.35	Refer to DTC P0441 in the DTC summary table. ⇒ page 292
$92	P0441	Tank Vent Valve – Function Check, Quick Check	0.399	1.999	Refer to DTC P0441 in the DTC summary table. ⇒ page 292

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $41: O2 Sensor Heater Bank 1 – Sensor 1

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $41”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$85	P0135	Oxygen Sensor Ceramic Temperature Monitoring.	630.0° C	6,513.5° C	Refer to DTC P0135 in the DTC summary table. ⇒ page 227

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

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– Switch the ignition OFF.

Monitor-ID $42: O2 Sensor Heater Bank 1 – Sensor 2

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $42”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$90	P0141	Oxygen Sensor Nernst Cell Resistance Test.	0.0 Ω	700.0 Ω	Refer to DTC P0141 in the DTC summary table. ⇒ page 243

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $71: Secondary Air System Bank 1

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $71”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$82	P0491	System Testing, Reduced Secondary Air Mass.	0.0	1.999	Refer to DTC P0491 in the DTC summary table. ⇒ page 297
$85	P0410	System Testing Of Pressure Sensor.	0.0 kPa	5.0 kPa	Refer to DTC P0410 in the DTC summary table. ⇒ page 286
$8C	P2440	Functional Testing Of Secondary Air Valve, Valve Leak Check.	0.0	1.34	Refer to DTC P2440 in the DTC summary table. ⇒ page 389

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $A2: Misfire Cylinder 1 Data

– Connect the scan tool.

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– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $A2”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$0B	P0301	Misfire Cylinder 1, Average Value Over 10 Driving Cycles.	0.0 counts	65,535. 0 counts	Refer to DTC P0301 in the DTC summary table. ⇒ page 263
$0C	P0301	Misfire Cylinder 1, In This Driving Cycle.	0.0 counts	65,535. 0 counts	Refer to DTC P0301 in the DTC summary table. ⇒ page 263

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $A3: Misfire Cylinder 2 Data

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $A3”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$0B	P0302	Misfire Cylinder 2, Average Value Over 10 Driving Cycles.	0.0 counts	65,535. 0 counts	Refer to DTC P0302 in the DTC summary table. ⇒ page 265
$0C	P0302	Misfire Cylinder 2, In This Driving Cycle.	0.0 counts	65,535. 0 counts	Refer to DTC P0302 in the DTC summary table. ⇒ page 265

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $A4: Misfire Cylinder 3 Data

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $A4”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$0B	P0303	Misfire Cylinder 3, Average Value Over 10 Driving Cycles.	0.0 counts	65,535. 0 counts	Refer to DTC P0303 in the DTC summary table. ⇒ page 267
$0C	P0303	Misfire Cylinder 3, In This Driving Cycle.	0.0 counts	65,535. 0 counts	Refer to DTC P0303 in the DTC summary table. ⇒ page 267

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

– Switch the ignition OFF.

Monitor-ID $A5: Misfire Cylinder 4 Data

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $A5”.

– Select the desired “Test-ID” or “Hex-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$0B	P0304	Misfire Cylinder 4, Average Value Over 10 Driving Cycles.	0.0 counts	65,535. 0 counts	Refer to DTC P0304 in the DTC summary table. ⇒ page 269
$0C	P0304	Misfire Cylinder 4, In This Driving Cycle.	0.0 counts	65,535. 0 counts	Refer to DTC P0304 in the DTC summary table. ⇒ page 269

– Switch the ignition OFF.

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 24 .

3.3.8 Diagnostic Mode 07 - Read Faults Detected During the Current or Last Driving Cycle

Mode 07 makes it possible to check emission related faults which appeared during the current or last driving cycle (pending DTCs).

A pending DTC is saved the first time a fault is detected (output via Mode 07).

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– If the fault is detected again by the end of the following driving cycle, a confirmed DTC is entered (output via Mode 03) and the MIL is activated.
– If this malfunction is not detected again by the end of the following driving cycle, the corresponding pending code will be deleted at the end of the driving cycle.

Note

Depending on the scan tool and protocol used, some of the information provided may be referred to by a different name.

Procedure

– Connect the scan tool.
– Start the engine and run at idle.

Note

If the engine does not start, crank the engine using starter for at least 5 seconds. Do not switch the ignition off afterward.

– Select Mode 7: Check test results of components that are continuously monitored.

The number of pending DTCs or 0 malfunctions detected will be displayed on the scan tool screen.

– Refer to the DTC tables for the diagnostic repair procedures.
– Switch the ignition off.

3.3.9 Diagnostic Mode 08 - Request Control of On-Board System, Test or Component

Diagnostic Mode 08 is used to control the operation of an on-board system, test or component. A Mode 8 service can be used to turn on-board system ON or OFF, or to cycle an on-board system, test, or component on or off for a specific period of time. The service can also be used to request system status or to report test results.

Test Requirements

– No Test requirements are available for this powertrain.

Function Test

– No Function Tests are available for this powertrain.

3.3.10 Diagnostic Mode 09 - Read Vehicle Information

Diagnostic Mode 09 makes it possible to access vehicle specific information from the control modules (where applicable).

Note

Depending on the scan tool and protocol used, Diagnostic Mode 09 and the information provided may be referred to by a different name.

Test Requirement

- No DTCs stored in the DTC memory.

Procedure

– Connect the scan tool.

– Switch the ignition on.

– Select Mode 09: Vehicle information.

– Select the desired Test ID.

– The information requested will be displayed on the scan tool screen.

The following table is a numerical list of all Test IDs that may be selected.

Test-ID	Diagnostic text	
02:	Vehicle identification number e.g.	
	♦ A different 17 digit number will be displayed for each vehicle	
04:	Calibration identification e.g.	
	♦ Engine Control Module	
	♦ Transmission Control Module	
06:	CVN (check sum) e.g.	
	♦ EC5AE460 the check sum is different for every control module version	
	♦ 000D105	
$08:	In-use Performance Tracking information (CAN)	
	♦ General Denominator	– 0 ... 65,535 cnts
	♦ Ignition Cycle Counter	– 0 ... 65,535 cnts
	♦ Catalytic converter diagnosis counter bank 1	– 0 ... 65,535 cnts
	♦ Catalytic converter diagnosis denominator bank 1	– 0 ... 65,535 cnts
	♦ Catalytic converter diagnosis counter bank 2	– 0 ... 65,535 cnts
	♦ Catalytic converter diagnosis denominator bank 2	– 0 ... 65,535 cnts
	♦ Oxygen sensor diagnosis counter before catalytic converter bank 1	– 0 ... 65,535 cnts
	♦ Oxygen sensor diagnosis denominator before catalytic converter bank 1	– 0 ... 65,535 cnts
	♦ Oxygen sensor diagnosis counter before catalytic converter bank 2	– 0 ... 65,535 cnts
	♦ Oxygen sensor diagnosis denominator before catalytic converter bank 2	– 0 ... 65,535 cnts
	♦ AGR diagnosis / VVT diagnosis counter	– 0 ... 65,535 cnts
	♦ AGR diagnosis / VVT diagnosis denominator	– 0 ... 65,535 cnts

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Test-ID	Diagnostic text	
	♦ Secondary air injection diagnosis counter	– 0 ... 65,535 cnts
	♦ Secondary air injection diagnosis denominator	– 0 ... 65,535 cnts
	♦ Tank ventilation diagnosis counter	– 0 ... 65,535 cnts
	♦ Tank ventilation diagnosis denominator	– 0 ... 65,535 cnts
	♦ Oxygen sensor diagnosis counter after catalytic converter bank 1	– 0 ... 65,535 cnts
	♦ Oxygen sensor diagnosis denominator after catalytic converter bank 1	– 0 ... 65,535 cnts
	♦ Oxygen sensor diagnosis counter after catalytic converter bank 2	– 0 ... 65,535 cnts
	♦ Oxygen sensor diagnosis denominator after catalytic converter bank 2	– 0 ... 65,535 cnts
0A	ECU Name	
	♦ Engine Control Module (ECM)	

– Switch the ignition off.

3.3.11 Diagnostic Mode 0A - Check Permanent DTC Memory

Note

♦ *The following is a generic explanation of the requirements, coverage, and operation of Mode 0A.*

♦ *Mode 0A may only be supported exclusively by OBD control modules in US vehicles. Mode 0A may not be supported in EOBD vehicles, meaning the control module may not send a response here.*

Mode 0A - Check Permanent DTC Memory (Request emissions-related diagnostic trouble codes with permanent status after code clear)

Permanent Fault Codes From MY 2010 with Phase-In conforming to CCR 1968.2 (d)(2.2.5): 50% from MY 2010 / 75% from MY 2011 / 100% from MY 2012 The vehicle only participates in Phase-In if all of the OBD-relevant control modules in the vehicle meet these requirements.

Mode 0A enables the request of all OBD-relevant faults with the status “Permanent Fault Code”

- Permanent Fault Codes are Confirmed Fault Codes that are currently activating the MIL. That means faults that are still displayed in Mode 03 but no longer activate the MIL (History Fault Codes) are not Permanent Fault Codes.

- Permanent Fault Codes are updated in Mode 0A at the same time as NVRAM storage immediately after switching the ignition off. A newly detected Permanent Fault Code is only visible after switching the ignition off/on in Mode 0A.

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- Permanent Fault Codes may only be erased in the control module after they are corrected as long as the last diagnostic result was a PASS and the MIL is no longer activated by this fault. The Permanent Fault Codes should be erased from Mode 0A at the same time the MIL switches off when the ignition is switched off/on.

- Permanent Fault Codes may not be erased by clearing the DTC memory or disconnecting the power supply. Storage in NVRAM is required.

- Permanent Fault Codes may only be erased after clearing the DTC memory under the following conditions: - As long as no FAIL diagnostic result was detected for a Permanent Fault Code - and at least one PASS diagnostic result was detected - and the Minimum Trip Conditions for a General Denominator (without considering high/ambient temperature) were met in this phase in any DCY after erasing the DTC memory.

- The engine control module relays the message “Minimum Trip conditions met” to all other OBD control modules via CAN: CAN message OBD_01, Byte 8, Bit 4: OBD_Minimum_Trip

- Permanent Fault Codes may NOT be erased if the diagnostic result is FAIL after clearing the DTC memory. A Pending Fault Code should be stored and the DTC memory line should be overwritten with new Freeze Frame data. (Exception: If the Pending Fault Code is corrected without a Confirmed Fault Code being detected, the Permanent Fault Code may also be erased under the conditions described below.)

- Permanent Fault Codes should be erased in engine control modules after Update Programming. At this time, all readiness bits (Mode 01 PID $01) must be reset to “not complete” [(g)(4.4.6)(D)]. Permanent Fault Codes should not be erased in OBD control modules with Comprehensive Components (CCM) as a single readiness bit if the identical program/data status is being programmed. If a different program/data status is being programmed, Permanent Fault Codes should be erased after Update Programming.

- The procedure in Mode 01 through Mode 09 and in the service tester is NOT affected by implementation of the Permanent Fault Codes.

Note

After MIL off during the 40 warm-up cycle self-healing process, the fault may not be reported as Permanent Fault Code anymore

Procedure

- Erasing Permanent Fault Codes after code clear Service $0A – Permanent Fault Codes: can only be erased at the end of a driving cycle (during ECM keep alive time) if all the following conditions are fulfilled:
- ERASE: Permanent Fault Codes after code clear, the vehicle needs to be driven!
- NO FAIL: DTC cleared
- MONITORS: PASS
- MINIMUM: Conditions fulfilled 600 s (cumulative) Engine running
- DRIVE: 300 s (cumulative) vehicle speed > 25 mph (40 km/h)

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3.4 Engine DTC Tables

- ⇒ “3.4.1 Engine Control Module , 2014 - 2015 MY’s”, page 46
- ⇒ “3.4.2 Engine Control Module , 2016 MY”, page 200

3.4.1 Engine Control Module , 2014 - 2015 MY’s

DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P000A "A" Camshaft Position Slow Response Bank 1	VVT Actuator Intake Rationality Check	• Adjustment angle difference >= 1.00; < 10.0° CRK	• Modelled oil temperature -40 – 160° C • Engine speed 608 – 6,016 RPM • Set point change > 25.0° CRK • Dynamic diagnosis timer >= 0.95 – 4.0 s	• 0 (FTP75: 350) s • Continuous	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.3 Camshaft Adjustment Valve 1 N205 , Checking”, page 462 .
P0010 "A" Camshaft Position Actuator Control Circuit/ Open Bank 1	VVT Actuator Intake Open Circuit	• Output voltage lower range 1.92 – 2.21 V • Output voltage upper range (hardware values) 2.85 – 3.25 V	• Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.3 Camshaft Adjustment Valve 1 N205 , Checking”, page 462 .
P0011 "A" Camshaft Position - Timing Over-Advanced or System Performance Bank 1	VVT Actuator Intake Rationality Check	• Camshaft position deviation > 10.0° CRK	• Modeled oil temperature -40 – 160° C • Engine speed 608 – 6,016 RPM • Camshaft adjustment n.a. • Catalyst heating n.a.	• 0 (FTP75: 120) s • Multiple	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.3 Camshaft Adjustment Valve 1 N205 , Checking”, page 462 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0016 Crankshaft Position - Camshaft Position Correlation Bank 1 Sensor A	Camshaft Position/ Crankshaft Position Intake - Correlation Adaptation Value Monitoring	• Adapted value for each edge of the target wheel < -14.0° CRK • Or • Adapted value for each edge of the target wheel > 14.0° CRK	• Camshaft adjustment active (exhaust side) engine speed 288 – 4,000 RPM • Modeled oil temperature >= -15° C • Modeled oil temperature <= 160° C • Engine speed < 8,160 RPM • Diff. actual exhaust camshaft position vs. previous camshaft position @ reference signal edge < 2.0° CRK • And • Case 1: • Ignition off • Engine speed > 380 RPM • Engine stalling >= 1.0 s • Or • Case 2: • Engine speed >= 380 RPM • Or • Engine running • And • Engine stalling >= 5.0 s • Or • Case 3: • Backwards rotation not detected • Or • Case 4: • Engine speed >= 300 RPM • Engine stopped	• 720° CRK • Once / DCY	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205 . Refer to ⇒ “3.6.3 Camshaft Adjustment Valve 1 N205 , Checking”, page 462 . – Check the Engine Speed Sensor - G28- . Refer to ⇒ “3.6.11 Engine Speed Sensor G28 , Checking”, page 479 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0017 Crankshaft Position - Camshaft Position Correlation Bank 1 Sensor B	Camshaft Position/ Crankshaft Position Exhaust - Correlation Adaptation Value Monitoring	• Adapted value for each edge of the target wheel < -14.0° CRK • Or • Adapted value for each edge of the target wheel > 14.0° CRK	• Camshaft adjustment active (exhaust side) engine speed 288 – 4,000 RPM • Modeled oil temperature >= -15° C • Modeled oil temperature <= 160° C • Engine speed < 8,160 RPM • Diff. actual exhaust camshaft position vs. previous camshaft position @ reference signal edge < 2.0° CRK • And • Case 1: • Ignition off • Engine speed > 380 RPM • Engine stalling >= 1.0 s • Or • Case 2: • Engine speed >= 380 RPM • Or • Engine running • And • Engine stalling >= 5.0 s • Or • Case 3: • Backwards rotation not detected • Or • Case 4: • Engine speed >= 300 RPM • Engine stopped	• 720° CRK • Once / DCY	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.3 Camshaft Adjustment Valve 1 N205 , Checking”, page 462 . – Check the Engine Speed Sensor - G28- . Refer to ⇒ “3.6.11 Engine Speed Sensor G28 , Checking”, page 479 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0030 HO2S Heater Control Circuit Bank 1 Sensor 1	Oxygen Sensors Heater Front Open Circuit	• O2S upstream heater voltage lower range 1.92 – 2.21 V • O2S upstream heater voltage upper range 2.85 – 3.25 V		• 2.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .
P0031 HO2S Heater Control Circuit Low Bank 1 Sensor 1	Oxygen Sensors Heater Front Short To Ground	• O2S upstream heater voltage lower range 1.92 – 2.21 V		• 2.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .
P0032 HO2S Heater Control Circuit High Bank 1 Sensor 1	Oxygen Sensors Heater Front Short To Battery Voltage	• O2S upstream heater driver temperature > 160.0 – 200.0° C • Or • O2S upstream heater driver output current > 8.0 – 12.0 A	• EGT @ O2S front >= -273° C • Actuator commanded on	• 2.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .
P0036 HO2S Heater Control Circuit Bank 1 Sensor 2	Oxygen Sensors Heater Rear Open Circuit	• O2S downstream heater voltage lower range 1.92 – 2.21 V • O2S downstream heater voltage upper range 2.85 – 3.25 V	• Engine not in start process	• 2.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .
P0037 HO2S Heater Control Circuit Low Bank 1 Sensor 2	Oxygen Sensors Heater Rear Short To Ground	• O2S downstream heater voltage lower range 1.92 – 2.21 V	• Engine not in start process	• 2.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0038 HO2S Heater Control Circuit High Bank 1 Sensor 2	Oxygen Sensors Heater Rear Short To Battery Voltage	• O2S downstream heater driver temperature > 160.0 – 200.0° C • Or • O2S downstream heater driver output current > 8.0 – 12.0 A	• EGT @ O2S rear (binary) >= -273 • Actuator commanded on • Engine not in start process	• 2.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .
P0045 Turbocharger/ Supercharger Boost Control "A" Circuit/ Open	Turbocharger Boost Pressure Control Valve Open Circuit	• Bypass valve driver load resistance > 200 kOhm	• Deviation between actual and filtered boost pressure actuator position <= 5.0 % • Boost pressure actuator controller not active • Time delay > 1.0 s	• 0.4 s • Continuous	• 2 DCY	– Check the Charge Pressure Actuator - V465- / Charge Pressure Actuator Position Sensor - G581- . Refer to ⇒ “3.6.7 Charge Pressure Actuator V465 / Charge Pressure Actuator Position Sensor G581 , Checking”, page 470 .
P0068 MAP/ MAF - Throttle Position Correlation	Leak to Intake Manifold Rationality Check	• Difference between target intake manifold pressure and actual intake manifold pressure < -15.0 – -10.0 kPa	• Time after engine start > 5.0 s • Barometric pressure > 73.0 – 105.0 kPa • Engine speed > 576 – 512 RPM • Engine speed < 3,000 RPM • IAT @ intake manifold > -48° C • ECT @ cylinder head > -48° C • Difference between engine speed and filtered engine speed < 8,160 RPM • Difference between MAF set point and filtered MAF set point < 15.01 mg/rev • Throttle actuator commanded on	• 5.0 s • Continuous	• 2 DCY	– Check the Intake system for vacuum leaks, make sure oil dipstick is pushed properly into place. – Check the Intake Manifold Sensor - GX9- . Refer to ⇒ “3.6.23 Intake Manifold Sensor GX9 , Checking”, page 505 . – Check the Throttle Valve Control Module - GX3- Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Intake Air System Rationality Check	• General conditions: • Filtered lambda controller included correction and adaption -30.00 – 30.00 % • Lambda control active • And • Deviation throttle area controller < -60.00 %	• Modeled pressure quotient 0.10 – 0.60 [-] • Gradient of intake manifold pressure >= -199.90; <= 199.90 kPa/s • Vehicle speed <= 1 mph			
P0070 Ambient Air Temperature Sensor Circuit "A"	CAN: Ambient Air Temperature Sensor Short To Battery Voltage Or Open Circuit	• AAT sensor voltage (hardware values) > 4.50 V		• 2.0 s • Continuous	• 2 DCY	– Check the Outside Air Temperature Sensor - G17- . Refer to ⇒ “3.6.26 Outside Air Temperature Sensor G17 , Checking”, page 511 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0071 Ambient Air Temperature Sensor Circuit "A" Range/ Performance	Ambient Air Temperature Sensor Cross Check	• High side: • Diff. AAT @ cold start vs. IAT @ manifold @ cold start > 25 K • Diff. AAT @ cold start vs. ECT @ radiator outlet @ cold start > 25 K • Or • Low side: • Diff. IAT @ manifold @ cold start vs. AAT @ cold start > 25.0 K • Diff. ECT @ radiator outlet @ cold start vs. AAT @ cold start > 25.0 K	• Engine off time >= 360.0 min • Engine off time plausible • Time after engine start < 1,400.0 s • Depending on temperature slope: • Diff. actual vs previous IAT < 256.0 K • Diff. actual vs previous ECT @ cylinder head < 256.0 K • Diff.. actual vs previous ECT@ radiator outlet < 256.0 K • Diff. actual vs previous AAT < 256.0 K • For time >= 1.0 s	• 0.1 s • Once / DCY	• 2 DCY	– Check the Outside Air Temperature Sensor - G17- . Refer to ⇒ “3.6.26 Outside Air Temperature Sensor G17 , Checking”, page 511 .
P0072 Ambient Air Temperature Sensor Circuit "A" Low	CAN: Ambient Air Temperature Sensor Short To Ground	• AAT sensor voltage < 0.10 V		• 2.0 s • Continuous	• 2 DCY	– Check the Outside Air Temperature Sensor - G17- . Refer to ⇒ “3.6.26 Outside Air Temperature Sensor G17 , Checking”, page 511 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0087 Fuel Rail/ System Pressure - Too Low Bank 1	Fuel System Pressure Sensor, High Pressure Side Out Of Range Low	• Deviation between reference fuel pressure set point and current fuel pressure > 2,000.10 kPa • Case 1: • Fuel mass controller output -50.0 – 50.0 % • High pressure controller output > 30 mg • Fuel pressure < 3,500.31 kPa • Case 2: • Fuel pump at max limit • Mass fuel flow set point < 1389.0 mg/rev • Fuel pressure < 34,777.60 kPa	• Engine speed > 600 RPM • EVAP purge adaptation < 22 • ECT >= 63 °C • IAT < 90 °C • Lambda control closed loop	• 4.5 s • Continuous	• 2 DCY	– Check the fuel pressure, refer to the repair manual for proper procedures. – Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.17 Fuel Pressure Sensor G247 , Checking”, page 491 . – Check the Fuel Pressure Regulator Valve - N276- . Refer to ⇒ “3.6.16 Fuel Pressure Regulator Valve N276 , Checking”, page 489 . – Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Fuel System Pressure Sensor, High Pressure Side Rationality Check Low	• Fuel mass controller output -50.0 – 50.0 % • And • High pressure controller output > 35 mg • And • Deviation between fuel pressure set point and current fuel pressure > 2,000.10 kPa and fuel pressure >= 3,500.31 kPa	• Engine speed 608 – 6,816 RPM • Mass fuel flow set point 15.01 – 1,389.0 mg/rev • For time after request for mass fuel flow set point >= 5.0 s • Engine start not active • Time after engine start > 10.0 s • Engine warm-up n.a. • Catalyst heating not active • Full load n.a. • Catalyst purge n.a. • Lambda control n.a. • Evap purge functionality diagnosis n.a. • And • Choice of: • Canister load <= n.a. [-] • Or • Evap purge valve n.a.			
P0092 Fuel Pressure Regulator 1 Control Circuit High	Fuel Control Valve Short To Battery Plus (Low Side)	• Current low side (hardware values) > 13.5 – 17.0 A	• Ignition on • Or • Ignition off (during ECM keep alive-time) • And • Actuator commanded on	• 0.8 s • Continuous	• 2 DCY	– Check the Fuel Pressure Regulator Valve - N276- . Refer to ⇒ “3.6.16 Fuel Pressure Regulator Valve N276 , Checking”, page 489 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Fuel Control Valve Short To Battery Plus (High Side)	• Voltage high side (hardware values) < 1.92 – 2.21 V	• Ignition on • Or • Ignition off (during ECM keep alive-time) • And • Actuator commanded off			
P00B7 Engine Coolant Flow Low/ Performance	Rotary Coolant Valve Functional Check	• Diff. previous and actual position of RVC < 4.0°	• ECT @ cylinder head > 11° C • RCV position 0.00 – 270.0° • Diff. previous actual and target position of RCV > 5.0° • And • RCV adaptation finished • Or • RCV adaptation not active	• 3.0 s • Continuous	• 2 DCY	– Check coolant system for leaks or damage. – Check the Coolant Thermostat and the Engine Temperature Control Actuator - N493- . Refer to ⇒ “3.6.12 Engine Temperature Control Actuator N493 , Checking”, page 481 . .
P0106 Manifold Absolute Pressure/ Barometric Pressure Sensor Circuit Range/ Performance	Manifold Pressure Sensor By Engine Standing: Rationality Check During Engine Off	• Diff. barometric pressure vs. intake manifold pressure >= 8.50 kPa • Or • Diff. upstream throttle pressure vs. intake manifold pressure >= 8.50 kPa	• Case 1: Engine stop during DCY • Engine stopped • Vehicle speed < 1 mph • Engine stop >= 5.0 s • For time >= 10.0 s • Case 2: Engine stop at start of DCY • Engine stop stopped • Vehicle speed < 1 mph • Engine stop >= 5.0 s	• 3.0 s • Continuous	• 2 DCY	– Check the Intake Manifold Sensor - GX9- . Refer to ⇒ “3.6.23 Intake Manifold Sensor GX9 , Checking”, page 505 .

DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Manifold Pressure Sensor By Engine Standing: Rationality Check During ECM Keep Alive-Time:	• Diff. upstream throttle pressure @ engine off vs. intake manifold pressure @ engine off > 8.50 kPa • And • Diff. intake manifold pressure @ engine stop vs. intake manifold pressure @ idle speed < n.a. kPa • Or • Diff. barometric pressure vs. intake manifold pressure >= 8.50 kPa • And • Diff. intake manifold pressure @ engine stop vs. intake manifold pressure @ idle speed < n.a. kPa • Or • Intake manifold pressure (raw value) < 0.00; > 543.40 kPa	• Engine stop • vehicle speed < 1 mph • Delay time in ECM keep alive-time > 10.0 s • Engine stop >= 5.0 s • Barometric pressure sensor voltage 0.20 – 4.80 V • Intake manifold pressure sensor voltage 0.20 – 4.80 V • Turbocharger boost pressure sensor voltage 0.20 –4.80 V			
	Intake Air System Rationality Check	• General conditions: • Filtered lambda controller included correction and adaption < -30.0 % • And • Deviation throttle area controller > 45.0 %	• Throttle position > 0.0° TPS • Throttle position < 100.003° TPS • Engine speed > 576; < 3008 RPM • Modeled pressure quotient > 0.27; < 0.60 [-] • Engine running • Throttle actuator commanded on • Time after engine start > 5.0 s • Throttle position sensor failure not detected	• 5.0 s • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• General conditions: • Filtered lambda controller included correction and adaption > 30.0 % • And • Deviation throttle area controller < -45.0 %	• Fuel cut off not active • Fast throttle adaptation finished • Gradient intake manifold pressure -199.90 – 199.90 kPa/s • Engine speed limitation not active • Barometric pressure plausibility diagnosis finished • Intake manifold modeled adaption active • And • Choice of: • MAF sensor active • Or • Manifold pressure sensor active • And • Choice of: • Barometric pressure > 73.00; < 107.50 kPa • Or • Barometric pressure sensor not active			
P0107 Manifold Absolute Pressure/ Barometric Pressure Sensor Circuit Low	Manifold Pressure Sensor Short To Ground	• Intake manifold pressure sensor voltage < 0.20 V		• 0.5 s • Continuous	• 2 DCY	– Check the Intake Manifold Sensor - GX9- . Refer to ⇒ “3.6.23 Intake Manifold Sensor GX9 , Checking”, page 505 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0108 Manifold Absolute Pressure/ Barometric Pressure Sensor Circuit High	Manifold Pressure Sensor Short To Battery Voltage	• Intake manifold pressure sensor voltage > 4.80 V		• 0.5 s • Continuous	• 2 DCY	– Check the Intake Manifold Sensor - GX9- . Refer to ⇒ “3.6.23 Intake Manifold Sensor GX9 , Checking”, page 505 .
P0111 Intake Air Temperature Sensor 1 Circuit Range/ Performance Bank 1	Intake Air Temperature Sensor @ Manifold Cross Check	• High side: • Diff. IAT @ manifold @ cold start vs. AAT @ cold start > 25.0 K • Diff. IAT @ manifold @ cold start vs. ECT @ radiator outlet @ cold start > 25.0 K • Or • Low side: • Diff. AAT @ cold start vs. IAT @ manifold @ cold start > 25.0 K • Diff. ECT @ radiator outlet @ cold start vs. IAT @ manifold @ cold start > 25.0 K	• Engine off time >= 360.0 min • Engine off time plausible time after engine start <= 1,400.0 s • Depending on temperature slope: • Diff. actual vs previous IAT < 256.0 K • Diff. actual vs previous ECT @ cylinder head < 256.0 K • Diff. actual vs previous ECT @ radiator outlet < 256.0 K • Diff. actual vs previous AAT < 256.0 K • For time >= 1.0 s	• 0.1 s • Once / DCY	• 2 DCY	– Check the Intake Manifold Sensor - GX9- . Refer to ⇒ “3.6.23 Intake Manifold Sensor GX9 , Checking”, page 505 .
P0112 Intake Air Temperature Sensor 1 Circuit Low Bank 1	Intake Air Temperature Sensor @ Manifold Short To Ground	• IAT sensor voltage < 0.10 V		• 2.0 s • Continuous		
P0113 Intake Air Temperature Sensor 1 Circuit High Bank 1	Intake Air Temperature Sensor @ Manifold Short To Battery Voltage	• IAT sensor voltage > 4.50 V				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0116 Engine Coolant Temperature Sensor 1 Circuit Range/ Performance	Engine Coolant Temperature Sensor @ Cylinder Head Rationality Check Inappropriately Low	• Diff. min temperature of cross check sensors vs. ECT @ cylinder head @ engine start >= 25° C	• Rationality check inappropriately low: • Cross checks finished	• 1.0 s • Once / DCY	• 2 DCY	– Check the Engine Coolant Temperature Sensor - G62- . Refer to ⇒ “3.6.9 Engine Coolant Temperature Sensor G62 , Checking”, page 475 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Engine Coolant Temperature Sensor @ Cylinder Head Rationality Check Inappropriately High	• ECT @ cylinder head @ engine start > 40 – 80° C • Or • Difference between maximum and minimum temperature of ECT @ cylinder head < 1° C	• Rationality check high: • Cross checks finished • Engine running • Engine off time >= 360.0 min • Valid AAT signal for time >= 2.0 s • Valid engine stop signal for time >= 2.0 s • Or • ECT @ cylinder head > -256° C • Modeled IAT @ throttle -48 –143° C • Depending on thermostat control: • ECT @ cylinder head <= n.a.° C • Or • ECT @ cylinder head >= n.a.° C • Engine n.a. • And • Engine part load • Or • Engine full load • Engine speed > 1,300 RPM • Vehicle speed > 12 mph • Engine load > 2.0 % • For time >= 20.0 – 43.0 s • Engine idle vehicle speed < 3 mph • Or • Fuel cut off active • Or			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Engine stop for time >= 20.0 – 43.0 s			
	Engine Coolant Temperature Sensor @ Cylinder Head Rationality Check Low	• Difference between modelled and measured cylinder head temperature > 5° C	• ECT @ cylinder head -128 – 127° C • Time after engine start > 60.0 s	• 30.0 s • Once / DCY		
P0117 Engine Coolant Temperature Sensor 1 Circuit Low	Engine Coolant Temperature Sensor @ Cylinder Head Short To Ground	• ECT sensor voltage @ cylinder head < 0.30 V		• 0.5 s • Continuous	• 2 DCY	– Check the Engine Coolant Temperature Sensor - G62- . Refer to ⇒ “3.6.9 Engine Coolant Temperature Sensor G62 , Checking”, page 475 .
P0118 Engine Coolant Temperature Sensor 1 Circuit High	Engine Coolant Temperature Sensor @ Cylinder Head Short To Battery / Open Circuit	• ECT sensor voltage @ cylinder head > 4.90 V	• Modeled IAT @ throttle >= -33° C	• 0.5 s • Continuous	• 2 DCY	– Check the Engine Coolant Temperature Sensor - G62- . Refer to ⇒ “3.6.9 Engine Coolant Temperature Sensor G62 , Checking”, page 475 .
P0121 Throttle/ Pedal Position Sensor/ Switch "A" Circuit Range/ Performance	Throttle Position Sensor 1 Rationality Check	• Normalized difference between measured and modeled value of mass air flow from TPS 1 >= 1.00 [-] • Or • Relative mass air flow integral from TPS 1 > 60.0 [-]	• Throttle adaption not active	• 0.01 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .
		• Difference between TPS 1 and TPS 2 > 6.499° TPS		• 0.3 s • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0122 Throttle/ Pedal Position Sensor/ Switch "A" Circuit Low	Throttle Position Sensor 1 Short To Ground	• Throttle position sensor 1 voltage < 0.15 V		• 0.2 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .
P0123 Throttle/ Pedal Position Sensor/ Switch "A" Circuit High	Throttle Position Sensor 1 Short To Battery Voltage	• Throttle position sensor 1 voltage > 4.85 V		• 0.2 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .
P0131 O2 Sensor Circuit Low Voltage Bank 1 Sensor 1	Oxygen Sensors Front Short To Ground	• O2S sensor voltage < 0.15 V	• O2S heater front active • Pump current controller active • Measurement of WRAF sensor label resistor not active • Active phase of open circuit diagnosis for linear lambda sensor not active	• 0.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .
P0132 O2 Sensor Circuit High Voltage Bank 1 Sensor 1	Oxygen Sensors Front Short To Battery Voltage	• O2S sensor voltage > 5.20 – 5.35 V	• O2S heater front active • pump current controller active • measurement of WRAF sensor label resistor not active • active phase of open circuit diagnosis for linear lambda sensor not active	• 0.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0133 O2 Sensor Circuit Slow Response Bank 1 Sensor 1	Oxygen Sensors Front Response Check	• Dynamic Path: • Lambda value vs. modeled lambda value >= 1.25 [-] • Or • Ratio of failed diagnostic cycle > n.a. [-] • Or • Delay Path: • Llambda delay value vs. modeled lambda value > 1.25 [-]	• General conditions: • ECT @ cylinder head >= -48° C • Vehicle speed > 0 mph • Integrated MAF after gear change > 0.0 g • MAF >= 0.0 mg/rev • MAF <= 1,389.0 mg/rev • Vehicle speed >= 0 mph • Time after engine start >= 0.0 s • Integrated mass for fuel in oil < 255.0 [-] • Engine speed 1,216 – 3,008 RPM • MAF (intake air rate) 25.0 – 150.0 kg/h • Vehicle speed >= 0 mph • ECT @ cylinder head >= -48° C • Integrated MAF after gear change > 0.0 g • Depending on transmission type: For A/T • Integrated MAF per cylinder >= 0.50 – 2.0 kg • For DCT: • Integrated MAF per cylinder > 0.50 – 2.0 kg • For MT: • Integrated MAF per cylinder >= 0.50 – 2.0 kg • Depending on dynamic conditions:	• 2.4 s • Once / DCY	• 1 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Dynamic engine speed < 288 RPM • Dynamic torque < 80.0 Nm • Dynamic MAF < 70.0 kg/h • For time >= 0.6 s • And depending on canister and catalyst purge: • Evap purge n.a. • Or • Canister load calculation n.a • Or • Canister load <= n.a. [-]			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Delay path: • Lambda delay value vs. modeled lambda value > 1.25 [-]	• General conditions: • MAF >= 0.0 mg/rev • MAF <= 1,389.0 mg/rev • Vehicle speed >= 0 mph • Time after engine start >= 0.0 s • Integrated mass for fuel in oil < 255.0 [-] • Engine speed 1,216 – 3,008 RPM • MAF (intake air rate) 25.0 – 150.0 kg/h • Vehicle speed >= 0 mph • ECT @ cylinder head >= -48° C • Integrated MAF after gear change > 0.0 g • Depending on transmission type: For A/T • Integrated MAF per cylinder >= 0.50 – 2.0 kg • For DCT: • Integrated MAF per cylinder > 0.50 – 2.0 kg • For MT: • Integrated MAF per cylinder >= 0.50 – 2.0 kg • Depending on dynamic conditions: • Dynamic engine speed < 288 RPM • Dynamic torque < 80.0 Nm • Dynamic MAF < 70.0 kg/h • For time >= 0.6 s	• 13.2 s		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• And depending on canister and catalyst purge: • Evap purge n.a. • Or • Canister load calculation n.a • Or • Canister load <= n.a. [-]	• Once / DCY		
P0135 O2 Sensor Heater Circuit Bank 1 Sensor 1	Oxygen Sensors Heater Front Functional Check	• O2S ceramic temperature, < 630° C	• Stir up O2S heater front (linear) finished • For time >= 10.0 s	• 20.0 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .
P0137 O2 Sensor Circuit Low Voltage Bank 1 Sensor 2	Oxygen Sensors Rear Short To Ground	• O2S sensor voltage < 0.15 V	• O2S heater active	• 0.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .
P0138 O2 Sensor Circuit High Voltage Bank 1 Sensor 2	Oxygen Sensors Rear Short To Battery	• O2S sensor voltage > 5.2 – 5.35 V	• O2S heater active	• 0.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P013A O2 Sensor Slow Response - Rich to Lean Bank 1 Sensor 2	Oxygen Sensors Rear Response Check	• Gradient sensor voltage < 600.00 mV/s	• General conditions: • Forced close the gap stimulation not active • Close the gap stimulation request active • Vehicle speed >= 6 mph • Catalyst overheating protection not active • Turbine overheating protection not active • O2S rear ready • O2S front ready • ECT @ cylinder head > 60° C • Modeled catalyst temperature 470 –780° C • Difference between dynamic and stationary catalyst temperature -306 – 304° C • Modeled catalyst temperature once after engine start > 550° C • Integrated MAF, catalyst temp. conditions fulfilled >= 0.0 g • Modeled EGT @ O2S rear <= 900° C • MAF per cylinder 30.0 – 200.0 kg/h • MAF per cylinder per stroke, lower range >= 89.99 mg/rev • MAF per cylinder per stroke, upper range <= 750.0 mg/rev • And	• 60.0 – 70.0 s • Once / DCY	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Low dynamic conditions deviation actual • And • Target engine speed < 150 RPM • Dynamic MAF < 15.01 mg/rev • Dynamic lambda controller output <= 20.0 % • And • Integrated MAF after dynamic conditions are fulfilled > 20.0 g • Time after a catalyst purge phase >= 1.0 s • O2S rear voltage @ diagnosis start >= 0.55 V • Integrated MAF to start diagnosis >= 5.0 g • Integrated heat energy >= 800.0 – 2,000.0 kJ • Engine speed 1,248 – 3,008 RPM • Coasting function n.a O2S • Heater rear active • Lambda adaptation not active • Valve lift n.a. • And depending on lambda control • Intervention of trim control behavior activation of catalyst diagnosis < 0.10 [-] • Or			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Intervention of trim control during active catalyst diagnosis < 0.20 [-] • Depending on canister purge: • Canister load <= n.a. [-] • Evap purge flow n.a. • Or • Canister load calculation n.a. • Evap purge flow n.a. • Or • Evap purge valve n.a • Depending on canister purge closing: • Canister purge (conditions) n.a. • Canister purge valve (closing time) n.a. • And choice of: • Evap purge valve n.a. or evap purge valve n.a. and modeled MAF-integral > 0.0 g • Depending on transmission type: For MT • Integrated MAF per cylinder >= 0.0 kg • For AT • Integrated MAF per cylinder >= 0.0 kg • For DCT • Integrated MAF per cylinder >= 0.0 kg			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P013B O2 Sensor Slow Response - Lean to Rich Bank 1 Sensor 2	Oxygen Sensors Rear Response Check	• Gradient sensor voltage < 600.00 mV/s	• General conditions: • Forced close the gap stimulation not active • Close the gap stimulation request active • Vehicle speed >= 6 mph • Catalyst overheating protection not active • Turbine overheating protection not active • O2S rear ready • O2S front ready • ECT @ cylinder head > 60° C • Modeled catalyst temperature 470 –780° C • Difference between dynamic and stationary catalyst temperature -306 – 304° C • Modeled catalyst temperature once after engine start > 550° C • Integrated MAF, catalyst temp. conditions fulfilled >= 0.0 g • Modeled EGT @ O2S rear <= 900° C • MAF per cylinder 30.0 – 200.0 kg/h • MAF per cylinder per stroke, lower range >= 89.99 mg/rev • MAF per cylinder per stroke, upper range <= 750.0 mg/rev • And	• 60.0 – 70.0 s • Once / DCY	• 1 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Low dynamic conditions deviation actual • And • Target engine speed < 150 RPM • Dynamic MAF < 15.01 mg/rev • Dynamic lambda controller output <= 20.0 % • And • Integrated MAF after dynamic conditions are fulfilled > 20.0 g • Time after a catalyst purge phase >= 1.0 s • O2S rear voltage @ diagnosis start >= 0.55 V • Integrated MAF to start diagnosis >= 5.0 g • Integrated heat energy >= 800.0 – 2,000.0 kJ • Engine speed 1,248 – 3,008 RPM • Coasting function n.a O2S • Heater rear active • Lambda adaptation not active • Valve lift n.a. • And depending on lambda control • Intervention of trim control behavior activation of catalyst diagnosis < 0.10 [-] • Or			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Intervention of trim control during active catalyst diagnosis ≤ 0.20 [-] • Depending on canister purge: • Canister load <= n.a. [-] • Evap purge flow n.a. • Or • Canister load calculation n.a. • Evap purge flow n.a. • Or • Evap purge valve n.a • Depending on canister purge closing: • Canister purge (conditions) n.a. • Canister purge valve (closing time) n.a. • And choice of: • Evap purge valve n.a. or evap purge valve n.a. and modeled MAF-integral > 0.0 g • Depending on transmission type: For MT • Integrated MAF per cylinder >= 0.0 kg • For AT • Integrated MAF per cylinder >= 0.0 kg • For DCT • Integrated MAF per cylinder >= 0.0 kg			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P013E O2 Sensor Delayed Response - Rich to Lean Bank 1 Sensor 2	Oxygen Sensors Rear Delayed Response Monitoring, Delay Measurement	• Sensor signal delay time > 1.0 s	• General conditions: • Forced close the gap stimulation not active • Close the gap stimulation request active • Vehicle speed >= 6 mph • Catalyst overheating protection not active • Turbine overheating protection not active • O2S rear ready • O2S front ready • ECT @ cylinder head > 60° C • Modeled catalyst temperature 470 –780° C • Difference between dynamic and stationary catalyst temperature -306 – 304° C • Modeled catalyst temperature once after engine start > 550° C • Integrated MAF, catalyst temp. conditions fulfilled >= 0.0 g • Modeled EGT @ O2S rear <= 900° C • MAF per cylinder 30.0 – 200.0 kg/h • MAF per cylinder per stroke, lower range >= 89.99 mg/rev • MAF per cylinder per stroke, upper range <= 750.0 mg/rev • And	• 60.0 – 70.0 s • Once / DCY	• 1 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Low dynamic conditions deviation actual • And • Target engine speed < 150 RPM • Dynamic MAF < 15.01 mg/rev • Dynamic lambda controller output <= 20.0 % • And • Integrated MAF after dynamic conditions are fulfilled > 20.0 g • Time after a catalyst purge phase >= 1.0 s • O2S rear voltage @ diagnosis start >= 0.55 V • Integrated MAF to start diagnosis >= 5.0 g • Integrated heat energy >= 800.0 – 2,000.0 kJ • Engine speed 1,248 – 3,008 RPM • Coasting function n.a O2S • Heater rear active • Lambda adaptation not active • Valve lift n.a. • And depending on lambda control • Intervention of trim control behavior activation of catalyst diagnosis < 0.10 [-] • Or			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Intervention of trim control during active catalyst diagnosis < 0.20 [-] • Depending on canister purge: • Canister load <= n.a. [-] • Evap purge flow n.a. • Or • Canister load calculation n.a. • Evap purge flow n.a. • Or • Evap purge valve n.a • Depending on canister purge closing: • Canister purge (conditions) n.a. • Canister purge valve (closing time) n.a. • And choice of: • Evap purge valve n.a. or evap purge valve n.a. and modeled MAF-integral > 0.0 g • Depending on transmission type: For MT • Integrated MAF per cylinder >= 0.0 kg • For AT • Integrated MAF per cylinder >= 0.0 kg • For DCT • Integrated MAF per cylinder >= 0.0 kg			

DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P013F O2 Sensor Delayed Response - Lean to Rich Bank 1 Sensor 2	Oxygen Sensors Rear Delayed Response Monitoring, Delay Measurement	• Sensor signal delay time > 1.5 s	• General conditions: • Forced close the gap stimulation not active • Close the gap stimulation request active • Vehicle speed >= 6 mph • Catalyst overheating protection not active • Turbine overheating protection not active • O2S rear ready • O2S front ready • ECT @ cylinder head > 60° C • Modeled catalyst temperature 470 –780° C • Difference between dynamic and stationary catalyst temperature -306 – 304° C • Modeled catalyst temperature once after engine start > 550° C • Integrated MAF, catalyst temp. conditions fulfilled >= 0.0 g • Modeled EGT @ O2S rear <= 900° C • MAF per cylinder 30.0 – 200.0 kg/h • MAF per cylinder per stroke, lower range >= 89.99 mg/rev • MAF per cylinder per stroke, upper range <= 750.0 mg/rev • And	• 60.0 – 70.0 s • Once / DCY	• 1 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Low dynamic conditions deviation actual • And • Target engine speed < 150 RPM • Dynamic MAF < 15.01 mg/rev • Dynamic lambda controller output <= 20.0 % • And • Integrated MAF after dynamic conditions are fulfilled > 20.0 g • Time after a catalyst purge phase >= 1.0 s • O2S rear voltage @ diagnosis start >= 0.55 V • Integrated MAF to start diagnosis >= 5.0 g • Integrated heat energy >= 800.0 – 2,000.0 kJ • Engine speed 1,248 – 3,008 RPM • Coasting function n.a O2S • Heater rear active • Lambda adaptation not active • Valve lift n.a. • And depending on lambda control • Intervention of trim control behavior activation of catalyst diagnosis < 0.10 [-] • Or			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Intervention of trim control during active catalyst diagnosis < 0.20 [-] • Depending on canister purge: • Canister load <= n.a. [-] • Evap purge flow n.a. • Or • Canister load calculation n.a. • Evap purge flow n.a. • Or • Evap purge valve n.a • Depending on canister purge closing: • Canister purge (conditions) n.a. • Canister purge valve (closing time) n.a. • And choice of: • Evap purge valve n.a. or evap purge valve n.a. and modeled MAF-integral > 0.0 g • Depending on transmission type: For MT • Integrated MAF per cylinder >= 0.0 kg • For AT • Integrated MAF per cylinder >= 0.0 kg • For DCT • Integrated MAF per cylinder >= 0.0 kg			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0140 O2 Sensor Circuit No Activity Detected Bank 1 Sensor 2	Oxygen Sensors Rear Open Circuit	• Internal resistance of O2S (binary) > 25,000.0 Ohm		• 2.5 s • Continuous	• 1 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .
P0141 O2 Sensor Heater Circuit Bank 1 Sensor 2	Oxygen Sensors Heater Rear Out Of Range High	• Internal resistance of O2S (binary) 700.0 – 25,000.0 Ohm	• Stir up O2S heater front (linear) finished	• 20.0 s • Once / DCY	• 1 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .
P0149 Fuel Timing Error	Injection Valves Supply Voltage Out Of Range Low	• Boost voltage < 30.0 V • Boost voltage <= 50.0 V	• Engine running >= 0.3 s	• 3.6 s • Continuous	• 2 DCY	– Check the Engine Control Module - J623- . Refer to appropriate repair manual.
	Injection Valves Supply Voltage Out Of Range High	• Boost voltage > 75.0 V				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0171 System Too Lean Bank 1	Fuel System, System Too Lean	• Lambda controller output > 35.0 %	• Lambda control closed loop • Barometric pressure > 73.0 kPa • Mass air flow > 60.0 mg/rev • Engine speed > 576 RPM • ECT @ cylinder head > 20° C • IAT at intake manifold > -48° C • AAT > -48° C	• 60.0 s • Continuous	• 2 DCY	– Check the intake and vacuum hoses for leaks, Check the Positive Crankcase Ventilation, also make sure the oil dipstick is properly secured. – Listen to and visually inspect the Exhaust system to insure there are no leaks. – Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 . – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0172 System Too Rich Bank 1	Fuel System, System Too Rich	• Lambda controller output < -35.0 %	• Lambda control closed loop • Barometric pressure > 73.0 kPa • Mass air flow > 60.0 mg/rev • Engine speed > 576 RPM • ECT @ cylinder head > 20° C • IAT at intake manifold > -48° C • AAT > -48° C • Oil dilution not detected	• 60.0 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 . – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 . – Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 . – Check the Evaporative Emission System for contamination. Refer to appropriate repair manual.
P0190 Fuel Pressure Regulator 1 Control Circuit/ Open	Fuel System Pressure Sensor High Pressure Side Short To Battery / Open Circuit	• High fuel pressure sensor voltage > 4.80 V		• 2.0 s • Continuous	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.17 Fuel Pressure Sensor G247 , Checking”, page 491 . – Check the fuel pressure. Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0191 Fuel Rail Pressure Sensor Circuit Range/ Performance Bank 1	Fuel Rail High Pressure Side Out Of Range	• Fuel pressure > 29,300.0 kPa	• Engine running • Engine speed < 6,816 RPM • Time after engine start > 10.0 s	• 5.0 s • Continuous	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.17 Fuel Pressure Sensor G247 , Checking”, page 491 . – Check the fuel pressure. Refer to appropriate repair manual.
P0192 Fuel Rail Pressure Sensor Circuit Low Bank 1	Fuel System Pressure Sensor High Pressure Side Short To Ground	• High fuel pressure sensor voltage < 0.20 V		• 2.0 s • Continuous	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.17 Fuel Pressure Sensor G247 , Checking”, page 491 . – Check the fuel pressure. Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0201 Cylinder 1 Injector "A" Circuit	Injection Valves Electrical Error	• Indeterminate fault pattern via power stage diagnosis detected and injector low side voltage < 2.0 V • Injector low side switch current > 25.0 A • Or • Injector low side voltage < 2.0 V • Injector high side switch current > 25.0 A • Or • Injector low side voltage < 2.0 V • Injector low side switch current (hardware values) > 9.0 – 14.0 A • Or • Injector voltage < 2.0 V • Injector low side switch current > 25.0 A • Or • Injector voltage < 2.0 V • Injector low side switch current (hardware values) > 9.0 – 14.0 A • Or • Injector load resistance to ground and battery > 20.0 Ohm • Injector low side switch current > 25.0 A • Or	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Injector load resistance to ground and battery > 20.0 Ohm • Injector high side switch current > 25.0 A • Or • Power stage temperature > 150° C • Or • Fault pattern for short circuit via power stage diagnosis detected • Injector current rise time during peak phase < 0.064 ms				
	Injection Valves Electrical Error Open Circuit	• Fault pattern for open circuit via power stage diagnosis detected • Injector low side voltage < 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s			
	Injection Valves Electrical Error Short Circuit	• Fault pattern for short circuit via power stage diagnosis detected • Injector current rise time during peak phase < 0.064 ms				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0202 Cylinder 2 Injector "A" Circuit	Injection Valves Electrical Error	• Indeterminate fault pattern via power stage diagnosis detected and injector low side voltage < 2.0 V • Injector low side switch current > 25.0 A • Or • Injector low side voltage < 2.0 V • Injector high side switch current > 25.0 A • Or • Injector low side voltage < 2.0 V • Injector low side switch current (hardware values) > 9.0 – 14.0 A • Or • Injector voltage < 2.0 V • Injector low side switch current > 25.0 A • Or • Injector voltage < 2.0 V • Injector low side switch current (hardware values) > 9.0 – 14.0 A • Or • Injector load resistance to ground and battery > 20.0 Ohm • Injector low side switch current > 25.0 A • Or	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Injector load resistance to ground and battery > 20.0 Ohm • Injector high side switch current > 25.0 A • Or • Power stage temperature > 150° C • Or • Fault pattern for short circuit via power stage diagnosis detected • Injector current rise time during peak phase < 0.064 ms				
	Injection Valves Electrical Error Open Circuit	• Fault pattern for open circuit via power stage diagnosis detected • Injector low side voltage < 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s			
	Injection Valves Electrical Error Short Circuit	• Fault pattern for short circuit via power stage diagnosis detected • Injector current rise time during peak phase < 0.064 ms				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0203 Cylinder 3 Injector "A" Circuit	Injection Valves Electrical Error	• Indeterminate fault pattern via power stage diagnosis detected and injector low side voltage < 2.0 V • Injector low side switch current > 25.0 A • Or • Injector low side voltage < 2.0 V • Injector high side switch current > 25.0 A • Or • Injector low side voltage < 2.0 V • Injector low side switch current (hardware values) > 9.0 – 14.0 A • Or • Injector voltage < 2.0 V • Injector low side switch current > 25.0 A • Or • Injector voltage < 2.0 V • Injector low side switch current (hardware values) > 9.0 – 14.0 A • Or • Injector load resistance to ground and battery > 20.0 Ohm • Injector low side switch current > 25.0 A • Or	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Injector load resistance to ground and battery > 20.0 Ohm • Injector high side switch current > 25.0 A • Or • Power stage temperature > 150° C • Or • Fault pattern for short circuit via power stage diagnosis detected • Injector current rise time during peak phase < 0.064 ms				
	Injection Valves Electrical Error Open Circuit	• Fault pattern for open circuit via power stage diagnosis detected • Injector low side voltage < 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s			
	Injection Valves Electrical Error Short Circuit	• Fault pattern for short circuit via power stage diagnosis detected • Injector current rise time during peak phase < 0.064 ms				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0204 Cylinder 4 Injector "A" Circuit	Injection Valves Electrical Error	• Indeterminate fault pattern via power stage diagnosis detected and injector low side voltage < 2.0 V • Injector low side switch current > 25.0 A • Or • Injector low side voltage < 2.0 V • Injector high side switch current > 25.0 A • Or • Injector low side voltage < 2.0 V • Injector low side switch current (hardware values) > 9.0 – 14.0 A • Or • Injector voltage < 2.0 V • Injector low side switch current > 25.0 A • Or • Injector voltage < 2.0 V • Injector low side switch current (hardware values) > 9.0 – 14.0 A • Or • Injector load resistance to ground and battery > 20.0 Ohm • Injector low side switch current > 25.0 A • Or	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Injector load resistance to ground and battery > 20.0 Ohm • Injector high side switch current > 25.0 A • Or • Power stage temperature > 150° C • Or • Fault pattern for short circuit via power stage diagnosis detected • Injector current rise time during peak phase < 0.064 ms				
	Injection Valves Electrical Error Open Circuit	• Fault pattern for open circuit via power stage diagnosis detected • Injector low side voltage < 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s			
	Injection Valves Electrical Error Short Circuit	• Fault pattern for short circuit via power stage diagnosis detected • Injector current rise time during peak phase < 0.064 ms				
P0221 Throttle/ Pedal Position Sensor/ Switch "B" Circuit Range/ Performance	Throttle Position Sensor 2 Rationality Check	• Normalized difference between measured and modeled value of mass air flow from TPS 2 >= 1.0 [-]	• Throttle adaption not active	• 0.01 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0222 Throttle/ Pedal Position Sensor/ Switch "B" Circuit Low	Throttle Position Sensor 2 Short To Ground	• Throttle position sensor 2 voltage < 0.15 V		• 0.2 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .
P0223 Throttle/ Pedal Position Sensor/ Switch "B" Circuit High	Throttle Position Sensor 2 Short To Battery Voltage	• Throttle position sensor 2 voltage > 4.85 V		• 0.2 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .
P0236 Turbocharger/ Supercharger Boost Sensor "A" Circuit Range/ Performance	Turbocharger Boost Pressure Sensor Rationality Check During Engine Off	• By engine standing three sensors: • Diff. barometric pressure vs. upstream throttle pressure >= 8.50 kPa • Or • Diff. upstream throttle pressure vs. intake manifold pressure >= 8.50 kPa	• Case 1: • Engine stop active vehicle speed < 1 mph • Delay after engine stop >= 5.0 s • For time >= 10.0 s • Case 2: • Engine stop active • Vehicle speed < 1 [mph] • Delay after engine stop >= 5.0 s	• 3.0 s • Continuous	• 2 DCY	– Check the Charge Air Pressure Sensor - G31- . Refer to ⇒ “3.6.6 Charge Air Pressure Sensor G31 , Checking”, page 468 .
	Turbocharger Boost Pressure Sensor Rationality Check	• By full load: diff. • Upstream throttle pressure vs. intake manifold pressure > 10.0 kPa	• Engine speed > 2,000 RPM • Engine running • Throttle position > 20.999 – 78.003° TPS • For time >= 2.0 s			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• During ECM keep alive-time: • Diff. upstream throttle pressure vs. intake manifold pressure >= 8.50 kPa • Diff. intake manifold pressure vs. intake manifold pressure @ idle or low part load >= n.a. kPa • Or • Diff. barometric pressure vs. upstream throttle pressure >= 8.50 kPa • Diff. upstream throttle pressure @ full or high part load vs. upstream throttle pressure < n.a. kPa	• Engine stop active • Ignition off • Vehicle speed < 1 mph • Delay time in ECM keep alive-time > 10.0 s • Delay after engine stop >= 5.0 s • Barometric pressure sensor voltage 0.20 – 4.80 V • Intake manifold pressure sensor voltage 0.20 – 4.80 V • Turbocharger boost pressure sensor voltage 0.20 – 4.80 V			
P0237 Turbocharger/ Supercharger Boost Sensor "A" Circuit Low	Turbocharger Boost pressure Sensor Short To Ground	• Turbocharger boost pressure sensor voltage < 0.20 V		• 0.5 s • Continuous	• 2 DCY	– Check the Charge Air Pressure Sensor - G31- . Refer to ⇒ “3.6.6 Charge Air Pressure Sensor G31 , Checking”, page 468 .
P0238 Turbocharger/ Supercharger Boost Sensor "A" Circuit High	Turbocharger Boost pressure Sensor Short To Battery Voltage	• Turbocharger boost pressure sensor voltage > 4.80 V		• 0.5 s • Continuous	• 2 DCY	– Check the Charge Air Pressure Sensor - G31- . Refer to ⇒ “3.6.6 Charge Air Pressure Sensor G31 , Checking”, page 468 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P025A Fuel Pump Module "A" Control Circuit/ Open	Fuel Pump Open Circuit	• Signal voltage, lower range > 1.92 – 2.21 V • And • Signal voltage, upper range (hardware values) < 2.84 – 3.25 V	• Commanded PWM 9.80 – 90.20 % • Fuel pump commanded off	• 0.5 s • Continuous	• 2 DCY	– Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 .
P025C Fuel Pump Module "A" Control Circuit Low	Fuel Pump Short To Ground	• Signal voltage (hardware values) < 1.92 – 2.21 V	• Commanded PWM 9.80 – 90.20 % • Fuel pump commanded off	• 3.0 s • Continuous	• 2 DCY	– Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 .
P025D Fuel Pump Module "A" Control Circuit High	Fuel Pump Short To Battery Voltage	• Power stage temperature > 160.0 – 200.0° C • Or • Signal current (hardware values) > 0.1 – 0.18 A	• Commanded PWM 9.80 – 90.20 % • Fuel pump commanded on	• 0.5 s • Continuous	• 2 DCY	– Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 .
P0261 Cylinder 1 Injector "A" Circuit Low	Injection Valves Short To Ground	• Fault pattern for short to ground via powerstage diagnosis detected • Injector voltage < 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .
	Injection Valves Short To Ground (High Side)	• Injector driver voltage < 2 V • And • Injector driver high side switch current (hardware values) > 25 A	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 720° CRK • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Injection Valves Short To Ground (Low Side)	• Injector driver voltage < 2 V • And • Injector driver high side switch current < 25 A • And • Injector driver low side switch current (hardware values) < 25 A				
P0262 Cylinder 1 Injector "A" Circuit High	Injection Valves Short To Battery Plus	• Fault pattern for short to Battery plus via powerstage diagnosis detected • Injector voltage > 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .
	Injection Valves Short To Battery Plus (High Side)	• injector driver voltage > 2.0 V • And • Injector driver high side switch current (hardware values) > 25 A	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 720° CRK • Continuous		
	Injection Valves Short To Battery Plus (Low Side)	• injector driver voltage > 2.0 V • And • Injector driver low side switch current (hardware values) > 25 A				
P0264 Cylinder 2 Injector "A" Circuit Low	Injection Valves Short To Ground	• Fault pattern for short to ground via powerstage diagnosis detected • Injector voltage < 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Injection Valves Short To Ground (High Side)	• Injector driver voltage < 2 V • And • Injector driver high side switch current (hardware values) > 25 A	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 720° CRK • Continuous		
	Injection Valves Short To Ground (Low Side)	• Injector driver voltage < 2 V • And • Injector driver high side switch current < 25 A • And • Injector driver low side switch current (hardware values) < 25 A				
P0265 Cylinder 2 Injector "A" Circuit High	Injection Valves Short To Battery Plus	• Fault pattern for short to Battery plus via powerstage diagnosis detected • Injector voltage > 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ "3.6.15 Fuel Injectors , Checking", page 487.
	Injection Valves Short To Battery Plus (High Side)	• injector driver voltage > 2.0 V • And • Injector driver high side switch current (hardware values) > 25 A	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 720° CRK • Continuous		
	Injection Valves Short To Battery Plus (Low Side)	• injector driver voltage > 2.0 V • And • Injector driver low side switch current (hardware values) > 25 A				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0267 Cylinder 3 Injector "A" Circuit Low	Injection Valves Short To Ground	• Fault pattern for short to ground via powerstage diagnosis detected • Injector voltage < 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ "3.6.15 Fuel Injectors , Checking", page 487 .
	Injection Valves Short To Ground (High Side)	• Injector driver voltage < 2 V • And • Injector driver high side switch current (hardware values) > 25 A	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 720° CRK • Continuous		
	Injection Valves Short To Ground (Low Side)	• Injector driver voltage < 2 V • And • Injector driver high side switch current < 25 A • And • Injector driver low side switch current (hardware values) < 25 A				
P0268 Cylinder 3 Injector "A" Circuit High	Injection Valves Short To Battery Plus	• Fault pattern for short to Battery plus via powerstage diagnosis detected • Injector voltage > 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ "3.6.15 Fuel Injectors , Checking", page 487 .
	Injection Valves Short To Battery Plus (High Side)	• injector driver voltage > 2.0 V • And • Injector driver high side switch current (hardware values) > 25 A	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 720° CRK • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Injection Valves Short To Battery Plus (Low Side)	• injector driver voltage > 2.0 V • And • Injector driver low side switch current (hardware values) > 25 A				
P0270 Cylinder 4 Injector "A" Circuit Low	Injection Valves Short To Ground	• Fault pattern for short to ground via powerstage diagnosis detected • Injector voltage < 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .
	Injection Valves Short To Ground (High Side)	• Injector driver voltage < 2 V • And • Injector driver high side switch current (hardware values) > 25 A	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 720° CRK • Continuous		
	Injection Valves Short To Ground (Low Side)	• Injector driver voltage < 2 V • And • Injector driver high side switch current < 25 A • And • Injector driver low side switch current (hardware values) < 25 A				
P0271 Cylinder 4 Injector "A" Circuit High	Injection Valves Short To Battery Plus	• Fault pattern for short to Battery plus via powerstage diagnosis detected • Injector voltage > 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Injection Valves Short To Battery Plus (High Side)	• injector driver voltage > 2.0 V • And • Injector driver high side switch current (hardware values) > 25 A	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 720° CRK • Continuous		
	Injection Valves Short To Battery Plus (Low Side)	• injector driver voltage > 2.0 V • And • Injector driver low side switch current (hardware values) > 25 A				
P0300 Random/ Multiple Cylinder Misfire Detected	Misfire Crankshaft Speed Fluctuation (Multiple)	• Number of cylinders with emission threshold misfire within 4000 revolutions ≥ 2.00 [-] • Or • Number of cylinders with emission threshold misfire within 1000 revolutions ≥ 2.00 [-]	• Emission threshold misfire detected	• 0 s • Continuous	• 2 DCY	– Check the spark plugs visually. – Check the intake system visually for leaks. – Check the fuel pressure. Refer to appropriate repair manual. – Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 . – Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.20 Ignition Coils with Power Output Stage , Checking”, page 499 .
		• Number of cylinders with catalyst damaging misfire ≥ 2.00 [-]	• Catalyst damaging misfire detected		• Immediate	
P0301 Cylinder 1 Misfire Detected	Misfire Crankshaft Speed Fluctuation (Single Or Multiple)	• Catalyst damage misfire For AT: • Catalyst damaging misfire rate > 1.8 – 20.3 % • For DCT: • Catalyst damaging misfire rate > 1.8 – 20.3 %	• Initial engine speed > 550 RPM • Engine speed > 550 RPM • Engine speed < 6,848 for DCT: • Barometric pressure >= 60.01 kPa • Time after engine start > 0.0 s	• 0.1 s • Once / DCY	• 2 DCY	– Check the spark plugs visually. – Check the intake system visually for leaks. – Check the fuel pressure. Refer to appropriate repair manual. – Check the Fuel Injectors . Refer to

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0302 Cylinder 2 Misfire Detected P0303 inder 3 Misfire Detected	Misfire Crankshaft Speed Fluctuation (Single Or Multiple)	• For MT: • Catalyst damaging misfire rate > 1.8 – 20.3 % • Emission threshold misfire within 1000 rev For AT: • Emission threshold misfire rate (MR) > 2.3 % • For DCT: • Emission threshold misfire rate (MR) > 2.3 % • For MT: • Emission threshold misfire rate (MR) > 2.3 % • Emission threshold misfire within 4000 rev For AT: • Emission threshold misfire rate (MR) > 2.3 % • For DCT: • Emission threshold misfire rate (MR) > 2.3 % • For MT: • Emission threshold misfire rate (MR) > 2.3 %	• And depending on transmission mode for MT: • Engine load > 5.05 – 47.0 % • For AT: • Engine load > 4.68 – 41.67 % • For DCT: • Engine load > 4.18 – 36.0 % • And • Depending on ECT @ cylinder head @ start • ECT @ cylinder head @ start <= -48° C • And • ECT @ cylinder head >= 20° C • Or • ECT @ cylinder head @ engine start > -48° C • And • Fuel cut off not active • Or • Single fuel cut off not active • Or • Number of fade out cylinders < 2.00 [-] • And • Dynamic manifold air pressure <= n.a. kPa • And • Dynamic throttle position <= n.a.° TPS/s • And • Engine n.a. • Engine speed < n.a. RPM			⇒ “3.6.15 Fuel Injectors , Checking”, page 487 . – Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.20 Ignition Coils with Power Output Stage , Checking”, page 499 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0304 Cylinder 4 Misfire Detected	Misfire Crankshaft Speed Fluctuation (Single Or Multiple)		• Dynamic of ignition angle <= n.a. ° CRK • Or • Dynamic of ignition angle <= n.a. ° CRK • And • Rough road not detected			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0326 Knock/ Combustion Vibration Sensor 1 Circuit Range/ Performance Bank 1 or Single Sensor	Knock Sensor Rationality Check Low	• Difference between knock sensor signal and average knock sensor signal < 0.00 – 0.12 V	• ECT @ cylinder head > 60° C • MAF > 229.00 mg/rev	• 4.3 s • Continuous	• 2 DCY	– Check the Knock Sensor 1 - G61- . Refer to ⇒ “3.6.24 Knock Sensor 1 G61 , Checking”, page 507 .
P0327 Knock/ Combustion Vibration Sensor 1 Circuit Low Bank 1 or Single Sensor	Knock Sensor Out Of Range	• Sensor signal < 0.12 – 0.31 V	• ECT @ cylinder head > 60° C • MAF > 229.00 mg/rev • Engine speed > 2,016 RPM	• 4.0 s • Continuous	• 2 DCY	– Check the Knock Sensor 1 - G61- . Refer to ⇒ “3.6.24 Knock Sensor 1 G61 , Checking”, page 507 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0335 Crankshaft Position Sensor "A" Circuit	Crankshaft Position Sensor Activity Check	• Case 1: • Counted exhaust camshaft signals without synchronization >= 1.00 [-] • Or • Counted intake camshaft signals without synchronization >= n.a. [-] • Case 2: • Counted exhaust camshaft signals without synchronization >= 1.00 [-] • Or • Counted intake camshaft signals without synchronization >= 17.00 [-]	• Signal edges @ selected camshaft signal detected • Choice of: • Ignition off • Engine speed > 380 RPM • Engine stalling >= 1.0 s • Or • Synchronization test incorrect • Or • Engine speed >= 380 RPM • Or • Engine running engine stalling >= 5.0 s • Or • Backwards rotation not detected • Or • Engine speed >= 300 RPM • Engine stop active	• 0.01 s • Continuous	• 2 DCY	– Check the Camshaft Position Sensor - G40- . Refer to ⇒ “3.6.5 Camshaft Position Sensor G40 , Checking”, page 466 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0336 Crankshaft Position Sensor "A" Circuit Range/ Performance	RPM Sensor Out Of Range	• Segment adaptation >= 0.70 %	• Fuel cut off all cylinders • Segment adaptation active • Difference between one segment time < 100 µs • Cylinder shut off not active • For MT: • Engine speed 2,016 – 5,024 RPM • For AT: • Engine speed 2,016 – 5,024 RPM • For DCT: • Engine speed 2,016 – 5,024 RPM	• 900.0° CRK • Continuous	• 2 DCY	– Check the Engine Speed Sensor - G28- . Refer to ⇒“3.6.11 Engine Speed Sensor G28 , Checking”, page 479 .
		• Counted teeth vs reference >= 1; <= 2 [-]	• Cylinder shut off not active • Engine running	• 3,600.0° CRK • Continuous		
	Crankshaft Position Sensor Rationality Check	• Case 1: • Engine speed > 1,200 RPM • Time between falling signal edges < 50 – 832 µs • Case 2: • Engine speed <= 1,200 RPM • Time between signal edges < 30 µs	• Engine speed >= 380 RPM	• 4,5720.0° CRK • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Crankshaft Position Sensor Rationality Check	• Crankshaft reference gap not detected	• General conditions: • Start/Stop reference gap detected • And • Case 1: • Ignition off • Engine speed > 380 RPM • Engine stalling >= 1.0 s • Or • Case 2: • Engine speed >= 380 RPM • Or • Engine running • And • Engine stalling >= 5.0 s • Or • Case 3: • Backwards rotation not detected • Or • Case 4: • Engine speed >= 300 RPM • Engine stopped	• 2,160° CRK • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Crankshaft Position Sensor Rationality Check	• Counted teeth vs. reference >= 1; <= 2 [-]	• General conditions: • Engine speed > 320 RPM • And • Case 1: • Ignition off • Engine speed > 380 RPM • Engine stalling >= 1.0 s • Or • Case 2: • Engine speed >= 380 RPM • Or • Engine running • And • Engine stalling >= 5.0 s • Or • Case 3: • Backwards rotation not detected • Or • Case 4: • Engine speed >= 300 RPM • Engine stopped	• 1,800° CRK • Continuous		
P0340 Camshaft Position Sensor "A" Circuit Bank 1 or Single Sensor	Camshaft Position Sensor Intake Signal Activity Check	• No change on signal >= 3 [-]	• Engine speed >= 380 RPM	• 4,680.0° CRK • Continuous	• 2 DCY	– Check the Camshaft Position Sensor - G40- . Refer to ⇒ “3.6.5 Camshaft Position Sensor G40 , Checking”, page 466 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0341 Camshaft Position Sensor "A" Circuit Range/ Performance Bank 1 or Single Sensor	Camshaft Position Sensor Intake Rationality Check	• Ratio between measured segment time ratio and specified camshaft angle ratio > 2.75 [-] • Or • Ratio between measured segment time ratio and specified camshaft angle ratio < 0.36 [-] • Or • Offset between camshaft and crankshaft < -79.0° CRK • Or • Offset between camshaft and crankshaft > 15.0° CRK	• Engine speed 380 – 8,160 RPM	• 990.0° CRK • Continuous	• 2 DCY	– Check the Camshaft Position Sensor - G40- . Refer to ⇒ “3.6.5 Camshaft Position Sensor G40 , Checking”, page 466 .
	Camshaft Position Sensor Intake Signal Activity Check	• segment time value < 50 [µs]		• 1,440.0° CRK • Continuous		
	Camshaft Position Sensor Intake Angular Offset Check	• Offset between camshaft and crankshaft < -79.00; > 15.0° CRK	• Engine speed > 32 RPM	• 450.0° CRK • Once / DCY		
P0351 Ignition Coil "A" Primary Control Circuit/ Open	Ignition Coils Open Circuit	• Output voltage in OFF state, lower range >= 1.92 – 2.21 V • Output voltage in OFF state, upper range (hardware values) <= 2.85 – 3.25 V	• Engine speed > 512 RPM • ECT @ cylinder head > -30° C • Engine stop not active	• 1.0 s • Continuous	• 2 DCY	– Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.20 Ignition Coils with Power Output Stage , Checking”, page 499 .
	Ignition Coils Short To Ground	• Output current in ON state (hardware values) > 50 – 100 mA				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Ignition Coils Short To Battery Plus	• Diagnosis by inactive low side: switch in ATIC: • output voltage in OFF state (hardware values) > 4.95 – 5.285 V	• Engine speed > 512 RPM • Engine stop not active • Actuator commanded off			
		• Diagnosis by inactive low side: switch in ATIC: • Output temperature from ATIC in ON state > 160.0 – 200.0° C • Or • Output current in ON state (hardware values) > 100.0 – 180.0 mA	• Engine speed > 512 RPM • Engine stop not active • Actuator commanded on			
P0352 Ignition Coil "B" Primary Control Circuit/ Open	Ignition Coils Open Circuit	• Output voltage in OFF state, lower range >= 1.92 – 2.21 V • Output voltage in OFF state, upper range (hardware values) <= 2.85 – 3.25 V	• Engine speed > 512 RPM • ECT @ cylinder head > -30° C • Engine stop not active	• 1.0 s • Continuous	• 2 DCY	– Check the Ignition Coils with Power Output Stage . Refer to ⇒ "3.6.20 Ignition Coils with Power Output Stage , Checking", page 499 .
	Ignition Coils Short To Ground	• Output current in ON state (hardware values) > 50 – 100 mA				
	Ignition Coils Short To Battery Plus	• Diagnosis by inactive low side: switch in ATIC: • output voltage in OFF state (hardware values) > 4.95 – 5.285 V	• Engine speed > 512 RPM • Engine stop not active • Actuator commanded off			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Diagnosis by inactive low side: switch in ATIC: • Output temperature from ATIC in ON state > 160.0 – 200.0° C • Or • Output current in ON state (hardware values) > 100.0 – 180.0 mA	• Engine speed > 512 RPM • Engine stop not active • Actuator commanded on			
P0353 Ignition Coil "C" Primary Control Circuit/ Open	Ignition Coils Open Circuit	• Output voltage in OFF state, lower range >= 1.92 – 2.21 V • Output voltage in OFF state, upper range (hardware values) <= 2.85 – 3.25 V	• Engine speed > 512 RPM • ECT @ cylinder head > -30° C • Engine stop not active	• 1.0 s • Continuous	• 2 DCY	– Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.20 Ignition Coils with Power Output Stage , Checking”, page 499 .
	Ignition Coils Short To Ground	• Output current in ON state (hardware values) > 50 – 100 mA				
	Ignition Coils Short To Battery Plus	• Diagnosis by inactive low side: switch in ATIC: • output voltage in OFF state (hardware values) > 4.95 – 5.285 V	• Engine speed > 512 RPM • Engine stop not active • Actuator commanded off			
		• Diagnosis by inactive low side: switch in ATIC: • Output temperature from ATIC in ON state > 160.0 – 200.0° C • Or • Output current in ON state (hardware values) > 100.0 – 180.0 mA	• Engine speed > 512 RPM • Engine stop not active • Actuator commanded on			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0354 Ignition Coil "D" Primary Control Circuit/ Open	Ignition Coils Open Circuit	• Output voltage in OFF state, lower range >= 1.92 – 2.21 V • Output voltage in OFF state, upper range (hardware values) <= 2.85 – 3.25 V	• Engine speed > 512 RPM • ECT @ cylinder head > -30° C • Engine stop not active	• 1.0 s • Continuous	• 2 DCY	– Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.20 Ignition Coils with Power Output Stage , Checking”, page 499
	Ignition Coils Short To Ground	• Output current in ON state (hardware values) > 50 – 100 mA				
	Ignition Coils Short To Battery Plus	• Diagnosis by inactive low side: switch in ATIC: • output voltage in OFF state (hardware values) > 4.95 – 5.285 V	• Engine speed > 512 RPM • Engine stop not active • Actuator commanded off			
		• Diagnosis by inactive low side: switch in ATIC: • Output temperature from ATIC in ON state > 160.0 – 200.0° C • Or • Output current in ON state (hardware values) > 100.0 – 180.0 mA	• Engine speed > 512 RPM • Engine stop not active • Actuator commanded on			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0366 Camshaft Position Sensor "B" Circuit Range/ Performance Bank 1	Camshaft Position Sensor Exhaust Rationality Check	• Ratio between measured segment time ratio and specified camshaft angle ratio > 2.75 [-] • Or • Ratio between measured segment time ratio and specified camshaft angle ratio < 0.36 [-] • Or • Offset between camshaft and crankshaft < -24.0° CRK • Or • Offset between camshaft and crankshaft > 49.0° CRK	• Engine speed 380 – 8,160 RPM	• 990.0° CRK • Continuous	• 2 DCY	– Check the Camshaft Position Sensor 3 - G300- . Refer to ⇒ “3.6.4 Camshaft Position Sensor 3 G300 , Checking”, page 464 .
	Camshaft Position Sensor Exhaust Signal Activity Check	• Segment time value < 50 µs		• 1,440.0° CRK • Continuous		
	Camshaft Position Sensor Exhaust Out Of Range	• Offset between camshaft and crankshaft < -24.0° CRK • Or • Offset between camshaft and crankshaft > 49.0° CRK	• Engine synchronization not validated	• 450.0° CRK • Once / DCY		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P039B Cylinder 1 Pressure Too High	Knock Control Function Check	• Slow detection: • Ratio between knock sensor and knock threshold in main knock window > 2.00 – 3.00 [-] • For time >= 4,500.0 – 7,200.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 3.50 – 5.00 [-] • For time >= 2,160.0 – 3,240.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 3.50 – 5.00 [-] • Ratio between knock sensor and knock threshold in main knock window > 2.00 – 3.00 [-] • For time >= 5,760.0 – 9,540.0° CRK • Or • Torque limitation factor < 0.90 [-]	• Engine running ECT @ cylinder head > 60° C • Engine speed 1,216 – 6,400 RPM • Engine load n.a. % • Mass air flow > 403.00 – 447.00 mg/rev • Dynamic engine speed not active	• 900.0° CRK • Continuous	• 2 DCY	– Check the Knock Sensor 1 - G61- . Refer to ⇒ “3.6.24 Knock Sensor 1 G61 , Checking”, page 507 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Fast detection: • Ratio between knock sensor and knock threshold in main knock window > 1.50 – 2.50 [-] • For time >= 540.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 2.75 – 4.50 [-] • For time >= 360.0° CRK • Case 1: • ratio between filtered engine roughness and misfire detection threshold <= 0.41 – 0.59 [-] • Or • Case 2: • Ratio between normalized engine roughness and misfire detection threshold <= n.a. [-] • Or • Case 3: • Ratio between filtered engine roughness and misfire detection threshold <= n.a. [-] • Or • Ratio between normalized engine roughness and misfire detection threshold <= n.a. [-]				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P03A5 Cylinder 2 Pressure Too High	Knock Control Function Check	• Slow detection: • Ratio between knock sensor and knock threshold in main knock window > 2.00 – 3.00 [-] • For time >= 4,500.0 – 7,200.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 3.50 – 5.00 [-] • For time >= 2,160.0 – 3,240.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 3.50 – 5.00 [-] • Ratio between knock sensor and knock threshold in main knock window > 2.00 – 3.00 [-] • For time >= 5,760.0 – 9,540.0° CRK • Or • Torque limitation factor < 0.90 [-]	• Engine running ECT @ cylinder head > 60° C • Engine speed 1,216 – 6,400 RPM • Engine load n.a. % • Mass air flow > 403.00 – 447.00 mg/rev • Dynamic engine speed not active	• 900.0° CRK • Continuous	• 2 DCY	– Check the Knock Sensor 1 - G61- . Refer to ⇒ “3.6.24 Knock Sensor 1 G61 , Checking”, page 507 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Fast detection: • Ratio between knock sensor and knock threshold in main knock window > 1.50 – 2.50 [-] • For time >= 540.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 2.75 – 4.50 [-] • For time >= 360.0° CRK • Case 1: • ratio between filtered engine roughness and misfire detection threshold <= 0.41 – 0.59 [-] • Or • Case 2: • Ratio between normalized engine roughness and misfire detection threshold <= n.a. [-] • Or • Case 3: • Ratio between filtered engine roughness and misfire detection threshold <= n.a. [-] • Or • Ratio between normalized engine roughness and misfire detection threshold <= n.a. [-]				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P03AF Cylinder 3 Pressure Too High	Knock Control Function Check	• Slow detection: • Ratio between knock sensor and knock threshold in main knock window > 2.00 – 3.00 [-] • For time >= 4,500.0 – 7,200.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 3.50 – 5.00 [-] • For time >= 2,160.0 – 3,240.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 3.50 – 5.00 [-] • Ratio between knock sensor and knock threshold in main knock window > 2.00 – 3.00 [-] • For time >= 5,760.0 – 9,540.0° CRK • Or • Torque limitation factor < 0.90 [-]	• Engine running ECT @ cylinder head > 60° C • Engine speed 1,216 – 6,400 RPM • Engine load n.a. % • Mass air flow > 403.00 – 447.00 mg/rev • Dynamic engine speed not active	• 900.0° CRK • Continuous	• 2 DCY	– Check the Knock Sensor 1 - G61- . Refer to ⇒ “3.6.24 Knock Sensor 1 G61 , Checking”, page 507 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Fast detection: • Ratio between knock sensor and knock threshold in main knock window > 1.50 – 2.50 [-] • For time >= 540.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 2.75 – 4.50 [-] • For time >= 360.0° CRK • Case 1: • ratio between filtered engine roughness and misfire detection threshold <= 0.41 – 0.59 [-] • Or • Case 2: • Ratio between normalized engine roughness and misfire detection threshold <= n.a. [-] • Or • Case 3: • Ratio between filtered engine roughness and misfire detection threshold <= n.a. [-] • Or • Ratio between normalized engine roughness and misfire detection threshold <= n.a. [-]				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P03B9 Cylinder 4 Pressure Too High	Knock Control Function Check	• Slow detection: • Ratio between knock sensor and knock threshold in main knock window > 2.00 – 3.00 [-] • For time >= 4,500.0 – 7,200.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 3.50 – 5.00 [-] • For time >= 2,160.0 – 3,240.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 3.50 – 5.00 [-] • Ratio between knock sensor and knock threshold in main knock window > 2.00 – 3.00 [-] • For time >= 5,760.0 – 9,540.0° CRK • Or • Torque limitation factor < 0.90 [-]	• Engine running ECT @ cylinder head > 60° C • Engine speed 1,216 – 6,400 RPM • Engine load n.a. % • Mass air flow > 403.00 – 447.00 mg/rev • Dynamic engine speed not active	• 900.0° CRK • Continuous	• 2 DCY	– Check the Knock Sensor 1 - G61- . Refer to ⇒ “3.6.24 Knock Sensor 1 G61 , Checking”, page 507 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Fast detection: • Ratio between knock sensor and knock threshold in main knock window > 1.50 – 2.50 [-] • For time >= 540.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 2.75 – 4.50 [-] • For time >= 360.0° CRK • Case 1: • ratio between filtered engine roughness and misfire detection threshold <= 0.41 – 0.59 [-] • Or • Case 2: • Ratio between normalized engine roughness and misfire detection threshold <= n.a. [-] • Or • Case 3: • Ratio between filtered engine roughness and misfire detection threshold <= n.a. [-] • Or • Ratio between normalized engine roughness and misfire detection threshold <= n.a. [-]				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0410 AIR System "A"	Secondary Air System Functional Check	• Diff. pressure value after secondary air injection vs. pressure value before secondary air activation > 5.0 kPa	• General: • Secondary air pump ready • Catalyst heating active • Secondary air injection finished • MAF <= 140.0 kg/h • ECT @ cylinder head >= -10; < 115° C • IAT @ manifold >= -10; < 100° C • Modeled catalyst temperature < 700° C • Relative barometric pressure > 0.73 [-] • Diff. barometric pressure vs. manifold pressure > n.a. kPa	• 0.1 s • Once / DCY	• 2 DCY	– Check the Secondary Air System - GX24- . Refer to ⇒ “3.6.30 Secondary Air Injection Sensor 1 G609 / Secondary Air Injection Solenoid Valve N112 , Checking”, page 521 . – Check the Secondary Air Injection Pump Motor - V101- / Secondary Air Injection Pump Relay - J299- . Refer to ⇒ “3.6.29 Secondary Air Injection Pump Motor V101 / Secondary Air Injection Pump Relay J299 , Checking”, page 519 .
P0413 AIR System Switching Valve "A" Circuit Open	Secondary Air Valve Open Circuit	• Output voltage, lower range >= 1.92 – 2.21 V • Output voltage, upper range (hardware values) <= 2.85 – 3.25 V	• Engine running • Actuator commanded off	• 1.0 s • Continuous	• 2 DCY	– Check the Secondary Air System - GX24- . Refer to ⇒ “3.6.30 Secondary Air Injection Sensor 1 G609 / Secondary Air Injection Solenoid Valve N112 , Checking”, page 521 .
P0414 AIR System Switching Valve "A" Circuit Shorted	Secondary Air Valve Short To Ground	• Output voltage (hardware values) < 1.92 – 2.21 V	• Engine running • Actuator commanded off	• 1.0 s • Continuous	• 2 DCY	– Check the Secondary Air System - GX24- . Refer to ⇒ “3.6.30 Secondary Air Injection Sensor 1 G609 / Secondary Air Injection Solenoid Valve N112 , Checking”, page 521 .
	Secondary Air Valve Short To Battery Plus	• Actuator temperature > 160 – 200° C • Or • Output current (hardware values) > 1.0 – 2.0 A	• Engine running • Actuator commanded on			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0418 AIR System Control "A" Circuit	Secondary Air Injection Pump Relay Open Circuit	• Output voltage, lower range 1.92 – 2.21 V • Output voltage, upper range (hardware values) <= 2.85 – 3.25 V	• Engine running • Actuator commanded off	• 1.0 s • Continuous	• 2 DCY	– Check the Secondary Air Injection Pump Motor - V101- / Secondary Air Injection Pump Relay - J299- . Refer to ⇒ “3.6.29 Secondary Air Injection Pump Motor V101 / Secondary Air Injection Pump Relay J299 , Checking”, page 519 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0420 Catalyst System Efficiency Below Threshold Bank 1	NMOG / NMHC Conversion Capability	• Catalyst efficiency > 1.00 [-]	• General conditions: • Vehicle speed >= 6 mph • Catalyst overheating protection not active • Turbine overheating protection not active • O2S rear ready • O2S front ready • ECT @ cylinder head > 60° C • Modeled catalyst temperature 470 – 780° C • Difference between dynamic and stationary catalyst temperature -306 – 304° C • Modeled catalyst temperature once after engine start > 550° C • Integrated MAF, catalyst temp. conditions fulfilled >= 0.0 g • Modeled EGT @ O2S rear <= 900° C • MAF per cylinder 30.00 – 200.00 kg/h • MAF per cylinder per stroke, lower range >= 89.99 mg/rev • MAF per cylinder per stroke, upper range <= 750.00 mg/rev • And • Low dynamic conditions deviation actual and target engine speed < 150 RPM • Dynamic MAF < 15.01 mg/rev	• 60.0 – 70.0 s • Once / DCY	• 1 DCY	– Check the Three Way Catalytic Converter. Refer to appropriate repair manual. – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Lambda controller output <= 20.00 % • Dynamic and integrated MAF after dynamic conditions are fulfilled > 20.0 g • Tme after a catalyst purge phase >= 1.0 s • O2S rear voltage @ diagnosis start >= 0.55 V • Integrated MAF to start diagnosis >= 5.0 g • Integrated heat energy >= 800.00 – 2,000.00 kJ • Engine speed 1,248 – 3,008 RPM • Coasting function n.a • O2S heater rear active • Lambda adaptation not active • Valve lift n.a. • Depending on Lambda control: • Intervention of trim control behavior activation of catalyst diagnosis < 0.10 [-] • Or • Intervention of trim control during active catalyst diagnosis < 0.20 [-] • Choice of: canister load <= n.a. [-] • Evap purge n.a • Or • Canister load calculation n.a. • Or • Evap purge n.a.			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Evap purge valve n.a. • Or • Evap purge n.a. • Or • Canister purge (conditions) n.a. • Canister purge valve (closing time) n.a. • And • Choice of: • Evap purge valve n.a. • Or • Evap purge n.a. • And • Modeled MAF-integral > 0.0 g • Depending on transmission type: • For MT integrated MAF per cylinder >= 0.00 kg • For AT integrated MAF per cylinder >= 0.00 kg • For DCT integrated MAF per cylinder >= 0.00 kg			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0441 EVAP System Incorrect Purge Flow	EVAP Purge Valve Functional Check: Stuck Close	• Ratio actual intake manifold pressure and modeled set point intake manifold pressure < 0.10 [-]	• ECT @ cylinder head > 58° C • Barometric pressure > 73.0 kPa • AAT > 4.50° C • AAT @ start < 4.5° C • Diff. barometric pressure vs. filtered intake manifold pressure n.a. • Diff. barometric pressure vs. filtered intake manifold pressure > 25.00 kPa • Ratio MAF @ intake manifold and MAF max. > 0.07 – 0.09 [-] • Engine speed 1,180 – 2,700 RPM • Vehicle speed >= 11 mph • Diff. engine speed vs. filtered engine speed < 90 RPM • Diff. ratio MAF @ intake manifold and MAF max vs. ratio filtered MAF @ intake manifold and MAF max < 0.15 [-] • Diff. modeled intake manifold pressure vs. filtered modeled intake manifold pressure < 1.50 kPa • And • Integrated MAF since engine start >= 0.0 – 5,000.0 g • Lambda control active • Lambda control value -30.00 — 30.00 %	• 8.5 s • Once / DCY	• 2 DCY	– Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.13 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 484 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• O2S front 0.95 – 1.05 [-] • Case 1: • Integrated MAF @ canister purge per driving cycle >= n.a. g • Case 2: • Integrated MAF @ canister purge valve >= 2.1 g • Ratio MAF @ canister purge and MAF per cylinder >= 0.00 [-] • And • Depending on AAT: • AAT >= 50° C • Canister load <= 0.25 [-] • Or • AAT >= 30; < 50° C • Canister load <= 0.25 [-] • Or • AAT < 30° C • Canister load <= 0.25 [-]			
P0444 EVAP System Purge Control Valve "A" Circuit Open	EVAP Purge Valve Open Circuit	• Output voltage, lower range >= 1.92 – 2.21 V • Output voltage, upper range (hardware values) <= 2.85 – 3.25 V	• Engine start not active • Engine running • Evap purge valve opening signal (PWM) 3.13 – 98.83 % • Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.13 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 484 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0445 EVAP System Purge Control Valve "A" Circuit Shorted	EVAP Purge Valve Short To Ground	• Output voltage (hardware values) 1.92 – 2.21 V	• Engine start not active • Engine running • Evap purge valve opening signal (PWM) <= 98.83 % • Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.13 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 484 .
	EVAP Purge Valve Short To Battery Plus	• Actuator temperature 160 – 200° C • Or • output current (hardware values) > 4.0...7.0 A	• Engine start not active • Engine running • Evap purge valve opening signal (PWM) <= 3.13 % • Actuator commanded on			
P0450 EVAP System Pressure Sensor/ Switch Circuit	NVLD Switch Open Circuit	• Signal voltage 0.39 – 0.55 V	• Case 1: • Engine running • Case 2: • Ignition off • NVLD (EVAP-System) diagnostic mode active	• 0.5 s • Continuous	• 2 DCY	– Check the Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- . Refer to ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496 .
P0451 EVAP System Pressure Sensor/ Switch Circuit Range/ Performance	NVLD Switch Functional Check Stuck Close	• Natural vacuum leak detection (NVLD) switch position closed	• Ignition off • Fuel level < 85.10 % • Fuel temperature increase >= 5 K • For time >= 1.0 h • AAT >= 4° C • Barometric pressure >= 73.0 kPa • Time since ignition off > 20; < 1,440 min	• 0.1 s • Once / DCY	• 2 DCY	– Check the Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- . Refer to ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0452 EVAP System Pressure Sensor/ Switch Circuit Low	NVLD Switch Short To Battery Plus	• Signal voltage > 3.0 V	• Case 1: • Engine running • Case 2: • Ignition off • NVLD (EVAP-System) diagnostic mode active	• 0.5 s • Continuous	• 2 DCY	– Check the Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- . Refer to ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496 .
P0453 EVAP System Pressure Sensor/ Switch Circuit High	NVLD Switch Short To Ground	• Signal voltage < 0.24 V	• Case 1: • Engine running • Case 2: • Ignition off • NVLD (EVAP-System) diagnostic mode active	• 0.5 s • Continuous	• 2 DCY	– Check the Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- . Refer to ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496 .
P0456 EVAP System Leak Detected (Very Small Leak)	EVAP System Small Leak Functional Check	• Natural vacuum leak detection (NVLD) switch position = open	• Ignition off • Fuel level < 85.10 % • Fuel temperature drop >= 6 K • For time > 1 h • AAT >= 4° C • Barometric pressure > 73.00 kPa • Diff. barometric pressure @ stop and barometric pressure @ start < 0.65 kPa • Time since ignition off > 90 [min] ; < 600 min	• 0.1 s • Once / DCY	• 2 DCY	– Check the EVAP System visually for any leaking hoses or damage to components. – Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.13 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 484 . – Check the Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- . Refer to ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0461 Fuel Level Sensor "A" Circuit Range/ Performance	Fuel Level Plausibility Check	• Diff. fuel consumption • And • Fuel level changes < -12.0; > 12.0 l	• General: • Vehicle speed > 19 mph • And • Case 1: • For tank full fuel level > 96.09 % • Fuel consumption since last refueling or last plausibility check > 30.0 l • Case 2: • For tank not full fuel level <= 96.09 % • Fuel consumption since last refueling or last plausibility check > 15.0 l	• 1.0 s • Multiple	• 2 DCY	• Check the Fuel Level Sensor - G- . Refer to appropriate repair manual.
P0462 Fuel Level Sensor "A" Circuit Low	CAN: Fuel Level Sensor 1 CAN Communication With Instrument Cluster Module	• Instrument cluster module signal: short to ground failure • Instrument cluster module signal: signal range check failure		• 0.5 s • Continuous	• 2 DCY	• Check the Fuel Level Sensor - G- . Refer to appropriate repair manual.
P0463 Fuel Level Sensor "A" Circuit High	CAN: Fuel Level Sensor 1 CAN Communication With Instrument Cluster Module	• Instrument cluster module signal: short to battery / open circuit failure		• 0.5 s • Continuous	• 2 DCY	• Check the Fuel Level Sensor - G- . Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0491 AIR System Insufficient Flow Bank 1	Secondary Air System Functional Check	• Case 1: • Blockage: ratio relative measured secondary air pressure and modelled secondary air pressure [tube blocked] < 0.70 [-] • Or • Leakage: ratio relative measured secondary air pressure and modelled secondary air pressure [leak diagnosis] < 0.60 [-] • Case 2: • Diff. expected integrated secondary air pressure pulsations and actual integrated secondary air pressure pulsations n.a. kPa • Case 3: • Blockage: ratio relative measured secondary air pressure and modelled secondary air pressure [tube blocked] < 0.15 [-] • Or • Leakage: ratio relative measured secondary air pressure and modelled secondary air pressure [leak diagnosis] < 0.15 [-]	• General: • Secondary air pump active • Catalyst heating active • Secondary air injection active • MAF <= 140.0 kg/h • ECT @ cylinder head >= -10; < 115° C • IAT @ manifold >= -10; < 100° C • Modelled catalyst temperature < 700° C • Relative barometric pressure > 0.73 [-] • Diff. barometric pressure vs. manifold pressure > n.a. kPa	• 0.1 s • Once / DCY	• 2 DCY	– Check the Secondary Air Combination Valve visually. – Check visually for Blockage in system tubing.
P0501 Vehicle Speed Sensor "A" Circ-	CAN: Vehicle Speed Sensor CAN	• Speed sensor fault value: Out of range high failure		• 1.3 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC's

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
cuit Range/ Performance	Communication With Vehicle Speed Sensor	• Speed sensor fault value: Out of range low failure • Speed sensor fault value: Rationality check high failure • Speed sensor fault value: Rationality check low failure				present check them first. – Refer to the proper wiring schematic for terminal and component location.
P0502 Vehicle Speed Sensor "A" Circuit Low	Vehicle Speed Sensor Electrical Check	• Vehicle speed sensor signal: electrical error failure		• 1.3 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC's present check them first. – Refer to the proper wiring schematic for terminal and component location.
P0506 Idle Control System RPM - Lower Than Expected	Idle Controller Function Monitoring: Out Of Range Low	• Negative engine speed deviation from set point > 100 RPM • Integrated I-part of idle speed controller n.a.	• Gear switch not active • Vehicle speed = 0 mph • For time >= 0.0 s • Driver request not active • Throttle actuator commanded on • Evap purge flow < 4.0 kg/h • Torque safety limitation not active • Clutch switch n.a. • Barometric pressure > 69.99 kPa • Catalyst heating not active • ECT @ cylinder head > -48° C • Time after engine start > 0.0 s • Set point change n.a. • For time n.a.	• 12.0 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ "3.6.31 Throttle Valve Control Module GX3 , Checking", page 524 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0507 Idle Control System RPM - Higher Than Expected	Idle Controller Function Monitoring: Out Of Range High	• Positive engine speed deviation from set point > 90 RPM • Integrated I-part of idle speed controller n.a.	• Gear switch not active • Vehicle speed = 0 mph • For time >= 0.0 s • Driver request not active • Throttle actuator commanded on • Evap purge flow < 4.0 kg/h • Torque safety limitation not active • Clutch switch n.a. • Barometric pressure > 69.99 kPa • Catalyst heating not active • ECT @ cylinder head > -48° C • Time after engine start > 0.0 s • Set point change n.a. • For time n.a.	• 12 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P050A Cold Start Idle Control System Performance	Cold Idle Controller Function Monitoring: Out Of Range High	• Positive engine speed deviation from set point > 90 RPM • Integrated I-part of idle speed controller n.a.	• Gear switch not active • Vehicle speed = 0 mph • For time >= 0.0 s • Driver request not active • Throttle actuator commanded on • Evap purge flow < 4.0 kg/h • Torque safety limitation not active • Clutch switch n.a. • Barometric pressure > 69.99 kPa • Catalyst heating not active • ECT @ cylinder head > -48° C • Time after engine start > 0.0 s • Set point change n.a. • For time n.a.	• 12 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Cold Idle Controller Function Monitoring: Out Of Range Low	• Negative engine speed deviation from set point > 100 RPM • Integrated I-part of idle speed controller n.a.	• Gear switch not active • Vehicle speed = 0 mph • For time >= 0.0 s • Driver request not active • Throttle actuator commanded on • Evap purge flow < 4.0 kg/h • Torque safety limitation not active • Clutch switch n.a. • Barometric pressure > 69.99 kPa • Catalyst heating not active • ECT @ cylinder head > -48° C • Time after engine start > 0.0 s • Or • Set point change n.a. • For time n.a.			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P050B Cold Start Ignition Timing Performance	Ignition Control Ignition Timing Monitor	• Ratio between ignition angle efficiency integral and time at idle speed > 0.20 [-]	• Engine idle speed time @ idle speed > 5.0 s • Ignition angle setpoint <= 0.85 [-] • Modeled pressure quotient <= 1.0 [-] • Vehicle speed = 0.00 miles • And • Diff. air mass set point vs. filtered air mass set point for load dynamic detection < 99,999.00 mg/rev • For time >= 0.0 s • And • Diff. engine speed vs. filtered engine speed for engine speed dynamic detection < 8,160 RPM • For time >= 0.0 s	• 0.1 s • Once / DCY	• 2 DCY	– Check for any Engine Speed sensor or Ignition Coil faults and diagnose them first. – Check the Engine Speed Sensor - G28- . Refer to ⇒ “3.6.11 Engine Speed Sensor G28 , Checking”, page 479 . – Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.20 Ignition Coils with Power Output Stage , Checking”, page 499 . – If NO other codes are set, check the ECM. Refer to appropriate repair manual. – Check the Engine Control Module - J623- . Refer to appropriate repair manual.
P053F Cold Start Fuel Pressure Performance Bank 2	Fuel System Out Of Range High	• Deviation between reference and actual fuel pressure < -2,000.10 kPa • For time >= 3.0 s	• Engine speed > 608 RPM • Catalyst heating active • ECT @ cylinder head > -48° C • Time after engine start > 7.0 s • Mass fuel flow set point >= 5.0 mg/rev • For time >= 3.0 s • And • Mass fuel flow > 1.99 mg/rev • For time >= 5.0 s • And	• 5.0 s • Once / DCY	• 2 DCY	– Check the fuel pressure. Refer to appropriate repair manual. – Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 . – Check the Fuel Pressure Regulator Valve - N276- . Refer to ⇒ “3.6.16 Fuel Pressure Regulator Valve

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Fuel System Out Of Range Low	• Deviation between reference and actual fuel pressure > 2,000.10 kPa • For time >= 3.0 s	• Fuel pump delivery range < 72 – 145 mg/rev • Gradient mass fuel flow per stroke -1389.0 – 1,389.0 mg/rev • For time >= 5.0 s			N276 , Checking", page 489 . – Check the Fuel Pressure Sensor - G247- . Refer to ⇒ "3.6.17 Fuel Pressure Sensor G247 , Checking", page 491 .
P0601 Internal Control Module Memory Checksum Error	ECM: Checksum Verification	• Calibration checksum incorrect • Software checksum incorrect		• 1 s • Continuous	• 2 DCY	– Check the Engine Control Module - J623- . Refer to appropriate repair manual.
P0603 Internal Control Module Keep Alive Memory (KAM) Error	Injection Valves Supply Voltage Internal Hardware Check	• Hardware vs. software version check during initialization failure • Calibration during initialization failure • Hardware during initialization failure • Time reference from micro controller during initialization failure • Time reference from micro controller during initialization missing		• 4.9 s • Once / DCY • 2,880.0° CRK	• 2 DCY	– Check the Engine Control Module - J623- . Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Communication between micro controller and SDI-Driver power stage failed		• 4,320.0° CRK		
		• Communication between micro controller and SDI-Driver power stage failure		• 4.9 s • Once / DCY		
				• 2,880.0° CRK		
	ECM: Communication Check	• Device 1: • SPI communication with AT-IC failure		• 2.0 s • Continuous		
		• Device 2: • SPI communication with AT-IC failure				
		• SPI communication with AT-IC failure				
P0606 Control Module Processor	Barometric Pressure Sensor Rationality Check By Engine Off	• Diff. barometric pressure vs. upstream throttle pressure >= 8.50 kPa • Or • Diff. barometric pressure vs. intake manifold pressure >= 8.50 kPa	• Case 1: • Engine stop during DCY • Engine stop active • Vehicle speed < 1 mph • Delay after engine stop > 5.0 s • For time >= 10.0 s • Case 2: • Engine stop at start of DCY • Engine stopped • Vehicle speed < 1 mph • Delay after engine stop >= 5.0 s	• 3.0 s • Continuous	• 2 DCY	– Using scan tool, monitor the Barometric Pressure Sensor, located within the Engine Control Module - J623- . – Check the Engine Control Module - J623- . Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Barometric Pressure Sensor Rationality Check During ECM Keep Alive-Time:	• Diff. barometric pressure vs. intake manifold pressure > 8.50 kPa • Diff. intake manifold pressure vs. intake manifold pressure @ idle or low part load >= n.a. kPa • Or • Diff. barometric pressure vs. upstream throttle pressure >= 8.50 kPa • Diff. upstream throttle pressure @ full or high part load vs. upstream throttle pressure >= n.a. kPa	• Engine stop active • Vehicle speed < 1 mph • Ignition off • Delay time in ECM keep alive-time > 10.0 s • Delay after engine stop >= 5.0 s • Barometric pressure sensor voltage 0.20 – 4.80 V • intake manifold pressure sensor voltage 0.20 – 4.80 V • Turbocharger boost pressure sensor voltage 0.20 – 4.80 V			
	Barometric Pressure Sensor Out Of Range High	• Measured barometric pressure > 115.0 kPa		• 5.0 s • Continuous		
	Barometric Pressure Sensor Out Of Range Low	• Measured barometric pressure < 45.0 kPa				
	Knock Control Functional Check	• Knock control failure	• Engine running	• 6.4 s • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	ECM: EEPROM Check	• EEPROM information failure • Decryption of NVMCrypt failed • Finished NVMCrypt integrity error • Communication between sample software and production hardware error • RAM error detected • Monitoring module check failed		• 1.0 s • Once / DCY		
	ECM: Communication Check	• SPI communication with ATIC failure	• Time after ignition on >= 1.0 s	• 10.0 s • Continuous		
	ECM: Random Access Memory (RAM) Internal Hardware Check	• Finished NVMCrypt integrity error		• 1.0 s • Once / DCY		
	ECM: Random Access Memory (RAM) Functional Check	• Communication between sample software and production hardware error				
	ECM: A/D Converter Function Monitoring: A/D Converter	• Diff. A/D-channel 1 vs. A/D-channel 2 > 0.30 V		• 0.5 s • Continuous		
	ECM: Electronic Throttle Control Module Function Monitoring: Torque	• Monitoring of difference between actual and set point torque value engine torque overflow > 45.00 – 350.00 Nm	• Throttle actuator commanded on	• 0.5 s • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Monitoring of torque difference integration integrated engine torque > 655.35 Nms		• 0.01 s • Continuous		
	ECM: Electronic Throttle Control Module Function Monitoring: Engine Speed Limitation	• Engine speed > 1,760 RPM	• Engine speed limitation active • Injection active	• 0.5 s • Continuous		
	ECM: Electronic Throttle Control Module Function Monitoring: A/D Converter	• Internal check failed		• 0.5 s • Continuous		
P0607 Control Module Performance	Barometric Pressure Sensor Short To Ground	• Barometric pressure sensor voltage < 0.20 V		• 0.5 s • Continuous	• 2 DCY	– Using scan tool, monitor the Barometric Pressure Sensor, located within the Engine Control Module - J623- . – Check the Engine Control Module - J623- . Refer to appropriate repair manual.
	Barometric Pressure Sensor Short To Battery Plus	• Barometric pressure sensor voltage > 4.80 V				
P0638 Throttle Actuator Control Range/ Performance Bank 1	Throttle Actuator Basic Settings Adaptation Value Monitoring	• Battery voltage <= 9.04 V	• TPS adaptation commanded on	• 0.01 s • Once per lifetime	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Accelerator pedal value > 99.90 % • Or • Engine speed > 64 RPM • Or • Vehicle speed > 1 mph • Or • Modeled IAT @ throttle < 5° C • Or • ECT @ cylinder head < 5° C • Or • ECT @ cylinder head > 110° C				
		• Actual TPS 1 or 2 voltage - voltage ref. point > 0.07 V	• Throttle adaptation demanded • Accelerator pedal value < 99.90 % • Engine speed < 64 RPM • Vehicle speed < 1 mph • Modeled IAT @ throttle > 5° C • ECT @ cylinder head 5 – 110° C			
		• Actual TPS - ref. point > 0.503° TPS				
	Throttle Actuator Basic Settings Monitoring Of Position	• Actual TPS - ref. point > 0.503° TPS				
		• Throttle position sensor 1 voltage < 0.40 V • Or • Throttle position sensor 2 voltage > 4.60 V • Or • Throttle position sensor 1 voltage > 0.80 V • Or • Throttle position sensor 2 voltage < 4.20 V				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Actual TPS 1 or 2 voltage - voltage ref. point > 0.07 V • Actual TPS 1 or 2 voltage - voltage ref. point > 0.25 V • Actual TPS - ref. point > 0.503° TPS • Actual TPS 1 or 2 voltage - voltage ref. point > 0.07 V				
P0642 Sensor Reference Voltage "A" Circuit Low	ECM: 5V Supply Voltage Out Of Range Low	• Analog output 1 supply voltage < 4.62 V		• 0.2 s • Continuous	• 2 DCY	– If a related sensor voltage code is also set, refer to that sensor for diagnosis first. If no other related codes set, replace the Engine Control Module - J623- . Refer to appropriate repair manual.
P0643 Sensor Reference Voltage "A" Circuit High	ECM: 5V Supply Voltage Out Of Range High	• Analog output 1 supply voltage > 5.43 V		• 0.2 s • Continuous	• 2 DCY	– If a related sensor voltage code is also set, refer to that sensor for diagnosis first. If no other related codes set, replace the Engine Control Module - J623- . Refer to appropriate repair manual.
P0652 Sensor Reference Voltage "B" Circuit Low	ECM: 5V Supply Voltage Out Of Range Low	• Analog output 2 supply voltage < 4.62 V		• 0.2 s • Continuous	• 2 DCY	– If a related sensor voltage code is also set, refer to that sensor for diagnosis first. If no other related codes set, replace the Engine Control Module - J623- . Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0653 Sensor Reference Voltage "B" Circuit High	ECM: 5V Supply Voltage Out Of Range High	• Analog output 2 supply voltage > 5.43 V		• 0.2 s • Continuous	• 2 DCY	– If a related sensor voltage code is also set, refer to that sensor for diagnosis first. If no other related codes set, replace the Engine Control Module - J623- . Refer to appropriate repair manual.
P0657 Actuator Supply Voltage "A" Circuit/ Open	Supply Voltage Relay Engine Components Open Circuit	• Output voltage, lower range >= 1.90 – 2.30 V • Output voltage, upper range (hardware values) <= 2.80 – 3.20 V	• Relay commanded off	• 1.0 s • Continuous	• 2 DCY	– Check the Engine Component Power Supply Relay - J757- . Refer to ⇒ “3.6.8 Engine Component Power Supply Relay J757 , Checking”, page 473 .
P0658 Actuator Supply Voltage "A" Circuit Low	Supply Voltage Relay Engine Components Short To Ground	• Output voltage (hardware values) < 1.90 – 2.28 V	• Relay commanded off			
P0659 Actuator Supply Voltage "A" Circuit High	Supply Voltage Relay Engine Components Short To Battery Voltage	• Output current > 1.0 – 2.3 A • Or • Actuator temperature (hardware values) > 175 – 195° C	• Relay commanded on			
P0686 ECM/ PCM Power Relay Control Circuit Low	Main Relay Rationality Check During Engine Off	• Sensed circuit voltage > 6.00 V	• main relay commanded on • for time >= 0.3 [s]	• 0.1 s • Continuous	• 2 DCY	– Check the Motronic Engine Control Module Power Supply Relay - J271- . Refer to ⇒ “3.6.25 Motronic Engine Control Module Power Supply Relay J271 , Checking”, page 509 .
P0687 ECM/ PCM Power Relay Control Circuit High	Main Relay Rationality Check During Engine On	• Sensed circuit voltage < 5.00 V	• Main relay commanded on • For time >= 0.1 s	• 0.1 s • Continuous	• 2 DCY	– Check the Motronic Engine Control Module Power Supply Relay - J271- . Refer to ⇒ “3.6.25 Motronic Engine Control Module Power Supply Relay J271 ,

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Main Relay Short To Battery Plus	• Main relay driver temperature > 175 – 195° C • Or • Main relay output current (hardware values) > 1.0 – 2.3 A	• Main relay commanded on • For time >= 0.4 s	• 0.2 s • Continuous		Checking", page 509 .
P0698 Sensor Reference Voltage "C" Circuit Low	ECM: 5V Supply Voltage Out Of Range Low	• Analog output 3 supply voltage < 4.62 V		• 0.2 s • Continuous	• 2 DCY	– If a related sensor voltage code is also set, refer to that sensor for diagnosis first. If no other related codes set, replace the Engine Control Module - J623- . Refer to appropriate repair manual.
P0699 Sensor Reference Voltage "C" Circuit High	ECM: 5V Supply Voltage Out Of Range High	• Analog output 3 supply voltage > 5.43 V		• 0.2 s • Continuous	• 2 DCY	– If a related sensor voltage code is also set, refer to that sensor for diagnosis first. If no other related codes set, replace the Engine Control Module - J623- . Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P12A1 Fuel Rail Pressure Sensor Inappropriately Low	Fuel System Pressure Sensor, High Pressure Side Rationality Check Low	• Fuel mass controller output < -35.0 % • And • High pressure controller output > 15 mg	• Engine speed 608 – 6,816 RPM • Mass fuel flow set point 4.01 – 30.01 mg/rev • For time after request for mass fuel flow set point >= 5.0 s • Time after change to DFI >= 0.0 s • Time after engine start > 10.0 s • Engine warm-up n.a. • Catalyst heating n.a. • Full load n.a. • Catalyst purge not active • Lambda control closed loop • Evap purge functionality diagnosis n.a. • And • Choice of: • Canister load <= n.a. [-] • Or • Evap purge valve n.a.	• 5.0 s • Continuous	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.17 Fuel Pressure Sensor G247 , Checking”, page 491 . – Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493. – Check the fuel pressure. Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P12A2 Fuel Rail Pressure Sensor Inappropriately High	Fuel System Pressure Sensor, High Pressure Side Rationality Check High	• Fuel mass controller output > 30.0 % • And • High pressure controller output < -15 mg	• Engine speed 608 – 6,816 RPM • Mass fuel flow set point 4.01 – 30.01 mg/rev • For time after request for mass fuel flow set point >= 5.0 s • Time after change to DFI >= 0.0 s • Time after engine start > 10.0 s • Engine warm-up n.a. • Catalyst heating n.a. • Full load n.a. • Catalyst purge not active • Lambda control closed loop • Evap purge functionality diagnosis n.a. • And • Choice of: • Canister load <= n.a. [-] • Or • Evap purge valve n.a.	• 5.0 s • Continuous	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.17 Fuel Pressure Sensor G247 , Checking”, page 491 . – Check the Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 . – Check the fuel pressure. Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P12A4 Fuel Rail Pump Control Valve Stuck Closed	Fuel System Pressure Sensor, High Pressure Side Out Of Range High	• Deviation between fuel pressure set point and current fuel pressure < -2,000.10 kPa • Fuel mass controller output -50.0 – 50.0 % • Case 1: • High pressure controller output < -30 mg • Case 2: • Flow control valve open mass fuel flow set point > 15.01 mg/rev	• Engine speed 608 – 6,816 RPM • Mass fuel flow set point 4.01 – 30.01 mg/rev • For time after request for mass fuel flow set point >= 5.0 s • Time after change to DFI >= 0.0 s • Time after engine start > 10.0 s • Engine warm-up n.a. • Catalyst heating n.a. • Full load n.a. • Catalyst purge not active • Lambda control closed loop • Evap purge functionality diagnosis n.a. • And • Choice of: • Canister load <= n.a. [-] • Or • Evap purge valve n.a.	• 4.5 s • Continuous	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.17 Fuel Pressure Sensor G247 , Checking”, page 491 . – Check the Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 . – Check the fuel pressure. Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P13EA Cold Start Ignition Timing Performance Off Idle	Ignition Control Ignition Timing Monitor	• Ratio between ignition angle efficiency integral and time at part load > 0.25 [-]	• Time @ part load > 5.0 s • Ignition angle set point <= 0.94 [-] • Engine part load • Vehicle speed > 2 mph • And • Diff. air mass set point vs. filtered air mass set point for load dynamic detection < 99.999.0 mg/rev • For time >= 0.0 s • And • Diff. engine speed vs. filtered engine speed for engine speed dynamic detection < 8,160 RPM • For time >= 0.0 s	• 0.1 s • Once / DCY	• 2 DCY	– Check the Engine Speed Sensor - G28- . Refer to ⇒ “3.6.11 Engine Speed Sensor G28 , Checking”, page 479 . – Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.20 Ignition Coils with Power Output Stage , Checking”, page 499 . – Check for any Engine Speed sensor or Ignition Coil faults and diagnose them first. – If NO other codes are set, check the ECM. Refer to appropriate repair manual.
P1545 Throttle Actuator "A" Control Motor Circuit Range/ Performance	Throttle Actuator Out Of Range	• Control duty cycle > 98.0 %	• Throttle position not at min. value • Throttle adaptation not active • Throttle actuator commanded on	• 5.0 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .
	Throttle Actuator Rationality Check	• Difference between throttle position set point and throttle flap opening angle for electronic throttle control > 2.998 – 24.982° TPS	• Throttle adaptation not active • Throttle actuator commanded on • Difference between throttle position set point and throttle flap opening angle <= 1.999; > -1.999° TPS			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P169A Loading Mode Active	ECM: Transport Mode Function Monitoring: Mode Change	• Transport mode active	• Vehicle speed < 3 mph • Max trip mileage since initial vehicle start-up < 62.15 miles • During ECM keep alive-time after ignition off engine speed 0 RPM • Production mode not active • For hybrid: • Drive motor off	• 0.01 s • Continuous	• 1 DCY	– Perform readiness check. Refer to ⇒ "3.2 Readiness Codes", page 19 .
P2004 Intake Manifold Runner Control Stuck Open Bank 1	Intake Manifold Runner Flap Actuator Stuck Open	• Signal voltage > 0.70 V • For time >= 1.5 s	• Flap commanded off • Time after engine start > 5.0 s	• 0.2 s • Continuous	• 2 DCY	– Check the Intake Manifold Runner Control Valve - N316- . Refer to ⇒ "3.6.21 Intake Manifold Runner Control Valve N316 , Checking", page 501 .
P2006 Intake Manifold Runner Control Stuck Closed Bank 1	Intake Manifold Runner Flap Actuator Stuck Close	• Signal voltage < 0.70 V • For time >= 1.5 s	• Flap commanded on • Time after engine start > 5.0 s	• 0.2 s • Continuous	• 2 DCY	– Check the Intake Manifold Runner Control Valve - N316- . Refer to ⇒ "3.6.21 Intake Manifold Runner Control Valve N316, Checking", page 501 .
P2008 Intake Manifold Runner Control Circuit/ Open Bank 1	Intake Manifold Runner Flap Actuator Open Circuit	• Output voltage lower range 1.92 – 2.21 V • Output voltage upper range (hardware values) 2.85 – 3.25 V	• Engine running • Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check the Intake Manifold Runner Control Valve - N316- . Refer to ⇒ "3.6.21 Intake Manifold Runner Control Valve N316 , Checking", page 501 .
P2009 Intake Manifold Runner Control Circuit Low Bank 1	Intake Manifold Runner Flap Actuator Short To Ground	• Output voltage (hardware values) < 1.92 – 2.21 V	• Engine running • Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check the Intake Manifold Runner Control Valve - N316- . Refer to ⇒ "3.6.21 Intake Manifold Runner Control Valve N316 , Checking", page 501 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2010 Intake Manifold Runner Control Circuit High Bank 1	Intake Manifold Runner Flap Actuator Short To Battery Plus	• Power stage temperature > 160 – 200° C • Or • Output current (hardware values) > 4.0 – 7.0 A	• Engine running • Actuator commanded on	• 2.0 s • Continuous	• 2 DCY	– Check the Intake Manifold Runner Control Valve - N316- . Refer to ⇒ “3.6.21 Intake Manifold Runner Control Valve N316 , Checking”, page 501 .
P2014 Intake Manifold Runner Position Sensor/ Switch Circuit Bank 1	Intake Manifold Runner Flap Position Sensor Short To Ground / Open Circuit	• Intake manifold runner flap position sensor voltage < 0.20 V	• Engine start not active	• 0.04 s • Continuous	• 2 DCY	– Check the Intake Manifold Runner Position Sensor - G336- . Refer to ⇒ “3.6.22 Intake Manifold Runner Position Sensor G336 , Checking”, page 503 .
P2015 Intake Manifold Runner Position Sensor/ Switch Circuit Range/ Performance Bank 1	Intake Manifold Runner Flap Actuator Adaptation Value Monitoring	• Diff. actual value vs. substitution value @ lower mechanical thresh hold > 0.70 V • Or • Diff. actual value vs. substitution value @ upper mechanical thresh hold > 0.70 V • Failed adaptations >= 1.00 [-]	• Modeled air temperature < 0.75 [-] • Engine running • Engine speed > 640; < 1,504 RPM • ECT @ cylinder head > -30° C • Intake manifold runner flap adaptation not finished	• 0.04 s • Once per lifetime	• 2 DCY	– Check the Intake Manifold Runner Position Sensor - G336- . Refer to ⇒ “3.6.22 Intake Manifold Runner Position Sensor G336 , Checking”, page 503 .
P2017 Intake Manifold Runner Position Sensor/ Switch Circuit High Bank 1	Intake Manifold Runner Flap Position Sensor Short To Battery Voltage	• Intake manifold runner flap position sensor voltage > 4.80 V	• Engine start not active	• 0.04 s • Continuous	• 2 DCY	– Check the Intake Manifold Runner Position Sensor - G336- . Refer to ⇒ “3.6.22 Intake Manifold Runner Position Sensor G336 , Checking”, page 503 .
P2024 EVAP Fuel Vapor Temperature Sensor Circuit	Smart Temperature Sensor Open Circuit	• NVLD output voltage lower range >= 1.92 – 2.21 V • NVLD output voltage upper range <= 2.85 – 3.25 V	• Case 1: • Ignition on • Case 2: • Ignition off (during ECM keep alive-time)	• 0.5 s • Continuous	• 2 DCY	– Check the Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- . Refer to ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2025 EVAP Fuel Vapor Temperature Sensor Performance	Smart Temperature Sensor Functional Check	• Diff. time between ECU and smart module > 3.0 s	• Ignition off • ECM keep alive time active	• 3.0 s • Once / DCY	• 2 DCY	– Check the Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- . Refer to ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496 .
		• Reset counter > 3.00 [-]	• Engine running • Last ECM keep alive mode finished	• 0.1 s • Once / DCY	• 3 DCY	
	Smart Temperature Sensor Out Of Range High	• Smart module temperature > 119° C	• Ignition off • NVLD (EVAP-System) diagnostic mode = active	• 300.0 s • Continuous	• 2 DCY	
			• Engine Running	• 30.0 s • Continuous		
	Smart Temperature Sensor Out Of Range Low	• Smart module temperature < -39° C	• Cold start detected • ECT @ cylinder head > 26° C • IAT cross check finished • ECT cross check finished	• 1.0 s • Once / DCY		
	Smart Temperature Sensor Cross Check	• Difference between smart temperature and ECT @ cylinder head >= 25.5 K • And • Difference between smart temperature and IAT @ manifold >= 25.5 K	• Cold start detected • IAT cross check finished • ECT cross check finished			
	Smart Temperature Sensor Signal Dynamic Check	• Gradient smart temperature > 20 K/10min	• Ignition off • Fuel level < 85.10 % • NVLD (EVAP-System) diagnostic mode active	• 300.0 s • Once / DCY		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Smart Temperature Sensor Communication with Smart Temperature Sensor	• Response time > 1.0 s • And • Number of checks > 3.00 [-] • Or • Security bit incorrect • And • Number of checks > 3.00 [-]	• Case 1: • Ignition on • Engine running • Case 2: • Ignition off (during ECM keep alive-time)	• 5.0 s • Continuous		
P2026 EVAP Fuel Vapor Temperature Sensor Circuit Low Voltage	Smart Temperature Sensor Short To Ground	• NVLD output voltage < 1.92 – 2.21 V	• Case 1: • Ignition on engine running • Case 2: • Ignition off (during ECM keep alive-time)	• 0.5 s • Continuous	• 2 DCY	– Check the Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- . Refer to ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496 .
P2027 EVAP Fuel Vapor Temperature Sensor Circuit High Voltage	Smart Temperature Sensor Short To Battery Voltage	• NVLD output temperature > 160.0 – 200.0° C • Or • NVLD output current 4.0 – 7.0 A	• Case 1: • Ignition on engine running • Case 2: • Ignition off (during ECM keep alive-time)	• 0.5 s • Continuous	• 2 DCY	– Check the Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- . Refer to ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496 .
P2088 "A" Camshaft Position Actuator Control Circuit Low Bank 1	VVT Actuator Intake Short To Ground	• Output voltage (hardware values) < 1.92 – 2.21 V	• Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.3 Camshaft Adjustment Valve 1 N205 , Checking”, page 462 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2089 "A" Camshaft Position Actuator Control Circuit High Bank 1	VVT Actuator Intake Short To Battery Plus	• Power stage temperature > 160 – 200° C • Or • Output current (hardware values) > 8.0 – 12.0 A	• Actuator commanded on	• 2.0 s • Continuous	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.3 Camshaft Adjustment Valve 1 N205 , Checking”, page 462 .
P2090 "B" Camshaft Position Actuator Control Circuit Low Bank 1	VVT Actuator Outlet Short To Ground	• Output voltage (hardware values) < 1.92 – 2.21 V	• Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check thee Exhaust Camshaft Adjustment Valve 1 - N318- . Refer to ⇒ “3.6.14 Exhaust Camshaft Adjustment Valve 1 N318 , Checking”, page 485 .
P2091 "B" Camshaft Position Actuator Control Circuit High Bank 1	VVT Actuator Outlet Short To Battery Plus	• Power stage temperature > 160 – 200° C • Or • Output current (hardware values) > 8.0 – 12.0 A	• Actuator commanded on	• 2.0 s • Continuous	• 2 DCY	– Check thee Exhaust Camshaft Adjustment Valve 1 - N318- . Refer to ⇒ “3.6.14 Exhaust Camshaft Adjustment Valve 1 N318 , Checking”, page 485 .
P2096 Post Catalyst Fuel Trim System Too Lean Bank 1	Fuel System Out Of Range Low	• Adaption value > 0.05 [-]	• 2nd lambda control n.a. • Catalyst purge not active • Engine speed >= 704 RPM • Integrated mass for fuel in oil < 255.00 [-] • Choice of: • O2S rear (binary) check not active • Or • O2S rear (binary) check finished	• 5.0 s • Continuous	• 2 DCY	– Check exhaust system visually for leaks first and correct as necessary. – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2097 Post Catalyst Fuel Trim System Too Rich Bank 1	Fuel System Out Of Range High	• Adaption value < -0.05 [-]	• 2nd lambda control n.a. • Catalyst purge not active • Engine speed >= 704 RPM • Integrated mass for fuel in oil < 255.00 [-] • Choice of: • O2S rear (binary) check not active • Or • O2S rear (binary) check finished	• 5.0 s • Continuous	• 2 DCY	– Check exhaust system visually for leaks first and correct as necessary. – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513
P2100 Throttle Actuator "A" Control Motor Circuit/ Open	Throttle Actuator Open Circuit	• Electronic throttle valve driver load resistance > 200.0 kOhm	• Difference between measured and filtered throttle position <= 0.073° TPS • Actuator commanded off	• 0.1 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .
P2101 Throttle Actuator "A" Control Motor Circuit Range/ Performance	Throttle Actuator Over Temperature	• Electronic throttle valve driver temperature (hardware values) > 170.0 – 190.0° C	• Actuator commanded on	• 0.1 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .
P2103 Throttle Actuator "A" Control Motor Circuit High	Throttle Actuator Short Circuit	• Electronic throttle valve driver current (hardware values) > 9.3 – 15.0 A	• Actuator commanded on	• 0.1 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .
P2122 Throttle/ Pedal Position Sensor/ Switch "D" Circuit Low	Accelerator Pedal Position Sensor 1 Out Of Range Low	• Signal voltage sensor 1 < 0.40 V		• 0.3 s • Continuous	• 2 DCY	– Check the Accelerator Pedal Module - GX2- . Refer to ⇒ “3.6.1 Accelerator Pedal Module GX2 , Checking”, page 457 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2123 Throttle/ Pedal Position Sensor/ Switch "D" Circuit High	Accelerator Pedal Position Sensor 1 Out Of Range High	• Signal voltage sensor 1 > 4.82 V		• 0.3 s • Continuous	• 2 DCY	– Check the Accelerator Pedal Module - GX2- . Refer to ⇒ “3.6.1 Accelerator Pedal Module GX2 , Checking”, page 457 .
P2127 Throttle/ Pedal Position Sensor/ Switch "E" Circuit Low	Accelerator Pedal Position Sensor 2 Out Of Range Low	• Signal voltage sensor 2 < 0.20 V		• 0.3 s • Continuous	• 2 DCY	– Check the Accelerator Pedal Module - GX2- . Refer to ⇒ “3.6.1 Accelerator Pedal Module GX2 , Checking”, page 457 .
P2128 Throttle/ Pedal Position Sensor/ Switch "E" Circuit High	Accelerator Pedal Position Sensor 2 Out Of Range High	• Signal voltage sensor 2 > 2.80 V		• 0.3 s • Continuous	• 2 DCY	– Check the Accelerator Pedal Module - GX2- . Refer to ⇒ “3.6.1 Accelerator Pedal Module GX2 , Checking”, page 457 .
P2138 Throttle/ Pedal Position Sensor/ Switch "D"/"E" Voltage Correlation	Accelerator Pedal Position Sensor 1 And 2 Rationality Check	• Difference between signal voltage sensor 1 and sensor 2 > 0.10 – 0.12 V		• 0.4 s • Continuous	• 2 DCY	– Check the Accelerator Pedal Module - GX2- . Refer to ⇒ “3.6.1 Accelerator Pedal Module GX2 , Checking”, page 457 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2177 System Too Lean Off Idle Bank 1	Fuel System Direct Fuel Injection System Too Lean	• Adaptive value >= 30.0 %	• Barometric pressure > 73.0 kPa • MAF > 60.0 mg/rev • Engine speed > 576 RPM • ECT @ cylinder head > 20° C • IAT @ manifold > -48° C • AAT > -48° C • Lambda set point 0.95 – 1.05 [-] • Lambda control closed loop • Integrated MAF >= 5.0 – 200.0 g • Lambda adaptation active • Vehicle speed < 4 mph • Driver request low dynamics • And • Mass fuel flow lower range > 0.00 mg/rev • Mass fuel flow upper range < 0.00 – 17.74 mg/rev • Or • Evap purge valve closed • Or • Canister load <= 1.20 [-] • Evap purge flow at max. value • Or • Dependence on canister purge min: • Lower limit of lambda controller output n.a. • Or	• 5.0 s • Continuous	• 2 DCY	– Check the intake and vacuum hoses visually for leaks. Check the Positive Crankcase Ventilation visually. Also make sure the oil dipstick is properly secured. – Listen to and visually inspect the exhaust system to insure there are no leaks. – Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 . – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 . – Check the Intake Manifold Sensor - GX9- . Refer to ⇒ “3.6.23 Intake Manifold Sensor GX9 , Checking”, page 505 . – Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.13 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 484 . – Check the Fuel Injectors . Refer to

DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Upper limit of lambda controller output n.a. • And • Evap purge flow at min. value			⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2178 System Too Rich Off Idle Bank 1	Fuel System Direct Fuel Injection System Too Rich	• Adaptive value <= -30.0 %	• Barometric pressure > 73.0 kPa • MAF > 60.0 mg/rev • Engine speed > 576 RPM • ECT @ cylinder head > 20° C • IAT @ manifold > -48° C • AAT > -48° C • Lambda set point 0.95 – 1.05 [-] • Lambda control closed loop • Integrated MAF >= 5.0 – 200.0 g • Lambda adaptation active • Vehicle speed < 4 mph • Driver request low dynamics • And • Mass fuel flow lower range > 0.00 mg/rev • Mass fuel flow upper range < 0.00 – 17.74 mg/rev • Or • Evap purge valve closed • Or • Canister load <= 1.20 [-] • Evap purge flow at max. value • Or • Dependence on canister purge min: • Lower limit of lambda controller output n.a. • Or	• 5.0 s • Continuous	• 2 DCY	– Check the Evaporative Emission (EVAP) System visually for contamination. – Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 . – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 . – Check the Intake Manifold Sensor - GX9- . Refer to ⇒ “3.6.23 Intake Manifold Sensor GX9 , Checking”, page 505 . – Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Upper limit of lambda controller output n.a. • And • Evap purge flow at min. value			
P2181 Cooling System Performance	Engine Cooling System Rationality Check	• Modeled ECT @ cylinder head > 66 – 70° C • Choice of: • ECT @ cylinder head < 65 – 69° C • Or • ECT @ radiator outlet < n.a.° C	• ECT @ cylinder head @ first start >= -10° C • ECT @ cylinder head @ first start <= 50 – 55° C • AAT > -10° C • Ratio fuel cut off <= 10.16 % • Ratio engine load time <= 39.84 % • Ratio maximum vehicle speed <= 14.84 % • Ratio start-stop time <= 16.02 % • Set point of RVC in measurement window < 99.61 % • Case 1: • Engine speed < 8,160 RPM • Case 2: • Engine speed >= 8,160 RPM • Diff. ECT@ cylinder head during measurement < 256° C • For time >= 0.0 s	• 1.0 s • Once / DCY	• 2 DCY	– Check cooling system visually for leaks or damaged components. – Check the coolant thermostat and the Engine Temperature Control Actuator - N493- . Refer to ⇒ “3.6.12 Engine Temperature Control Actuator N493 , Checking”, page 481 . – Check the Engine Coolant Temperature Sensor - G62- . Refer to ⇒ “3.6.9 Engine Coolant Temperature Sensor G62 , Checking”, page 475 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Electrical Thermostat Rationality Check	• ECT @ cylinder head < 60° C • For time >= 0.0 s	• Engine running • Or • Engine stopped • And • ECT @ cylinder head once after start > 65° C • Or • ECT @ radiator outlet n.a. • And • AAT sensor signal valid • AAT > -10° C • Relative actual MAF > 5.00 % • ECT @ cylinder head @ first start lower limit <= 215° C • Vehicle speed >= 0 mph • Modeled ECT @ cylinder head > 60° C • Start-stop cycles <= 255.00 [-] • For time >= 15.0 s			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2183 Engine Coolant Temperature Sensor 2 Circuit Range/ Performance	Engine Coolant Temperature Sensor @ Radiator Outlet Cross Check	• High side: • Diff. ECT @ radiator outlet @ cold start vs. IAT @ manifold @ cold start > 25.0 K • Diff. ECT @ radiator outlet @ cold start vs. AAT @ cold start > 25.0 K • Or • Low side: • Diff. IAT @ manifold @ cold start vs. ECT @ radiator outlet @ cold start > 25.0 K • Diff. AAT @ cold start vs. ECT @ radiator outlet @ cold start > 25.0 K	• Engine off time >= 360.0 min • Engine off time plausible time after engine start <= 1,400.0 s • Depending on temperature slope diff. actual vs previous IAT < 256.0 K • Diff. actual vs previous ECT @ cylinder head < 256.0 K • Diff. actual vs previous ECT @ radiator outlet < 256.0 K • Diff. actual vs previous AAT < 256.0 K • For time >= 1.0 s	• 0.1 s • Once / DCY	• 2 DCY	– Check the Engine Coolant Temperature Sensor On Radiator Outlet - G83- . Refer to ⇒ “3.6.10 Engine Coolant Temperature Sensor On Radiator Outlet G83 , Checking”, page 477.
P2184 Engine Coolant Temperature Sensor 2 Circuit Low	Engine Coolant Temperature Sensor @ Radiator Outlet Short To Ground	• Sensor voltage < 0.30 V		• 0.5 s • Continuous	• 2 DCY	– Check the Engine Coolant Temperature Sensor On Radiator Outlet - G83- . Refer to ⇒ “3.6.10 Engine Coolant Temperature Sensor On Radiator Outlet G83 , Checking”, page 477 .
P2185 Engine Coolant Temperature Sensor 2 Circuit High	Engine Coolant Temperature Sensor @ Radiator Outlet Short To Battery / Open Circuit	• Sensor voltage > 4.90 V	• Modeled IAT @ throttle >= -33° C • Time after engine start > 60.0 s	• 0.5 s • Continuous	• 2 DCY	– Check the Engine Coolant Temperature Sensor On Radiator Outlet - G83- . Refer to ⇒ “3.6.10 Engine Coolant Temperature Sensor On Radiator Outlet G83 , Checking”, page 477 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2187 System Too Lean at Idle Bank 1	Fuel System Direct Fuel Injection System Too Lean	• Case 1: • Adaptive value >= 2.80 mg/rev • Case 2: • Adaptive value n.a.	• Barometric pressure > 73.0 kPa • MAF > 60.0 mg/rev • Engine speed > 576 RPM • ECT @ cylinder head > 20° C • IAT @ manifold > -48° C • AAT > -48° C • Lambda set point 0.95 – 1.05 [-] • Lambda control closed loop • Integrated MAF >= 5.0 – 200.0 g • Lambda adaptation active • Vehicle speed < 4 mph • Driver request low dynamics • And • Mass fuel flow lower range > 0.00 mg/rev • Mass fuel flow upper range < 0.00 – 17.74 mg/rev • Or • Evap purge valve closed • Or • Canister load <= 1.20 [-] • Evap purge flow at max. value • Or • Depending on canister purge min: • Lower limit of lambda controller output n.a. • Or	• 5.0 s • Continuous	• 2 DCY	– Check the intake and vacuum hoses visually for leaks. Check the Positive Crankcase Ventilation visually. Also make sure the oil dipstick is properly secured. – Listen to and visually inspect the exhaust system to insure there are no leaks. – Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 . – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 . – Check the Intake Manifold Sensor - GX9- . Refer to ⇒ “3.6.23 Intake Manifold Sensor GX9 , Checking”, page 505 . – Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.13 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 484 . – Check the Fuel Injectors . Refer to

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Upper limit of lambda controller output n.a. • And • Evap purge flow at min. value			⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2188 System Too Rich at Idle Bank 1	Fuel System Direct Fuel Injection System Too Rich	• Case 1: • Adaptive value <= -3.01 mg/rev • Case 2: • Adaptive value <= n.a. kg/h	• Barometric pressure > 73.0 kPa • MAF > 60.0 mg/rev • Engine speed > 576 RPM • ECT @ cylinder head > 20° C • IAT @ manifold > -48° C • AAT > -48° C • Lambda set point 0.95 – 1.05 [-] • Lambda control closed loop • Integrated MAF >= 5.0 – 200.0 g • Lambda adaptation active • Vehicle speed < 4 mph • Driver request low dynamics • And • Mass fuel flow lower range > 0.00 mg/rev • Mass fuel flow upper range < 0.00 – 17.74 mg/rev • Or • Evap purge valve closed • Or • Canister load <= 1.20 [-] • Evap purge flow at max. value • Or • Depending on canister purge min: • Lower limit of lambda controller output n.a. • Or	• 5.0 s • Continuous	• 2 DCY	– Check the Evaporative Emission (EVAP) System visually for contamination. – Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 . – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 . – Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Upper limit of lambda controller output n.a. • And • Evap purge flow at min. value			
P2195 O2 Sensor Signal Biased/ Stuck Lean Bank 1 Sensor 1	Oxygen Sensors Front Rationality Check	• Plausibility check upstream and downstream oxygen sensor signal: • Lambda value > 1.15 [-] • And • O2S signal rear >= 0.88 [V]	• O2S front ready • O2S rear ready • ECT @ cylinder head >= -48° C • MAF > 15.0; < 300.0 kg/h • Catalyst purge not active • Integrated MAF after end of catalyst purge 0 [-] • Engine speed > 1,152 RPM • EGT @ O2S front > -273; < 800° C • Integrated MAF > 40.0 g • Dynamic lambda controller output < 3.0 % • Dynamic MAF < 0.05 g/rev • Dynamic engine speed < 200 RPM • And • Second control loop active: • MAF 0.06 – 0.75 g/rev • Engine speed 576 – 5,088 RPM	• 117.0 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2196 O2 Sensor Signal Biased/ Stuck Rich Bank 1 Sensor 1	Oxygen Sensors Front Rationality Check	• Plausibility check upstream and downstream oxygen sensor signal: • Lambda value < 0.85 [-] • And • O2S signal rear >= 0.25 V	• Modeled exhaust gas temp 450 - 850° C • Delta engine load < 35% • Exhaust. gas mass flow 14 – 300 kg/h • Lambda control, 2nd lambda control, closed loop • O2S front, rear and heaters ready - no fault • Fuel cutoff, catalyst heating, SAI - not active • 1st lambda control loop not at min or max • 2nd lambda control loop active	• 117.0 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .
P219C Cylinder 1 Air-Fuel Ratio Imbalance	Air Fuel Imbalance Monitoring Out Of Range High	• Cylinder 1: • Weighted adaptive value > 15.0 %	• Modeled catalyst temperature @ start <= 900° C • Lambda set value 0.97 – 1.03 [-] • Catalyst heating not active • Engine roughness signal valid • Cylinder shut off not active • AAT >= -48° C • Barometric pressure >= 73.0 kPa • And • Choice of: • Catalyst diagnosis n.a. • Or • Catalyst diagnosis n.a. • Depending on catalyst diagnosis: • Canister purge (conditions) n.a. • Or	• 90.0 s • Once / DCY	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Air Fuel Imbalance Monitoring Out Of Range Low	• Cylinder 1: • Weighted adaptive value < -15.0 %	• Evap purge valve n.a. • Or • Evap purge n.a. • And • O2S dynamic diagnosis n.a. • O2S delay diagnosis n.a. • Lambda control closed loop • Catalyst purge not active • Canister load <= 2.00 [-] • Engine no full load • Fuel cut off not active • Segment adaptation finished • Catalyst damaging misfire not detected • Emission threshold misfire not detected • No gear switch for segments >= 90.00 [-] • Segments after start > 0.00 [-] • Time after engine start > 0.0 [s] • Rough road n.a. • And depending on gear: • 1st gear not active • 2nd gear not active • 3rd gear not active • 4th gear active • 5th gear active • 6th gear active • 7th gear active			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• 8th gear active • And • Integrated MAF >= 1.0 – 5.0 kg • Diff. engine speed vs. dynamic engine speed < 75 RPM • Diff. MAF vs. dynamic MAF < 29.99 mg/rev • ECT @ cylinder head 60 – 143° C • Adaptation cycles <= 3.00 [-] • And • Depending on transmission type: • For AT • Engine speed 1,408 – 3,008 RPM • For MT • Engine speed 1,408 – 3,008 RPM • For DCT • Engine speed 1,408 – 3,008 RPM • And • Mass fuel flow lower range >= 12.00 mg/rev • Mass fuel flow upper range <= 29.99 mg/rev			
P219D Cylinder 2 Air-Fuel Ratio Imbalance	Air Fuel Imbalance Monitoring Out Of Range High	• Cylinder 2: • Weighted adaptive value > 15.0 %	• Modeled catalyst temperature @ start <= 900° C • Lambda set value 0.97 – 1.03 [-] • Catalyst heating not active • Engine roughness signal valid • Cylinder shut off not active	• 90.0 s • Once / DCY	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Air Fuel Imbalance Monitoring Out Of Range Low	• Cylinder 2: • Weighted adaptive value < -15.0 %	• AAT >= -48° C • Barometric pressure >= 73.0 kPa • And • Choice of: • Catalyst diagnosis n.a. • Or • Catalyst diagnosis n.a. • Depending on catalyst diagnosis: • Canister purge (conditions) n.a. • Or • Evap purge valve n.a. • Or • Evap purge n.a. • And • O2S dynamic diagnosis n.a. • O2S delay diagnosis n.a. • Lambda control closed loop • Catalyst purge not active • Canister load <= 2.00 [-] • Engine no full load • Fuel cut off not active • Segment adaptation finished • Catalyst damaging misfire not detected • Emission threshold misfire not detected • No gear switch for segments >= 90.00 [-]			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Segments after start > 0.00 [-] • Time after engine start > 0.0 [s] • Rough road n.a. • And depending on gear: • 1st gear not active • 2nd gear not active • 3rd gear not active • 4th gear active • 5th gear active • 6th gear active • 7th gear active • 8th gear active • And • Integrated MAF >= 1.0 – 5.0 kg • Diff. engine speed vs. dynamic engine speed ≤ 75 RPM • Diff. MAF vs. dynamic MAF < 29.99 mg/rev • ECT @ cylinder head 60 – 143° C • Adaptation cycles <= 3.00 [-] • And • Depending on transmission type: • For AT • Engine speed 1,408 – 3,008 RPM • For MT • Engine speed 1,408 – 3,008 RPM • For DCT			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Engine speed 1,408 – 3,008 RPM • And • Mass fuel flow lower range >= 12.00 mg/rev • Mass fuel flow upper range <= 29.99 mg/rev			
P219E Cylinder 3 Air-Fuel Ratio Imbalance	Air Fuel Imbalance Monitoring Out Of Range High	• Cylinder 3: • Weighted adaptive value > 15.0 %	• Modeled catalyst temperature @ start <= 900° C • Lambda set value 0.97 – 1.03 [-] • Catalyst heating not active • Engine roughness signal valid • Cylinder shut off not active • AAT >= -48° C • Barometric pressure >= 73.0 kPa • And • Choice of: • Catalyst diagnosis n.a. • Or • Catalyst diagnosis n.a. • Depending on catalyst diagnosis: • Canister purge (conditions) n.a. • Or • Evap purge valve n.a. • Or • Evap purge n.a. • And • O2S dynamic diagnosis n.a. • O2S delay diagnosis n.a.	• 90.0 s • Once / DCY	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Air Fuel Imbalance Monitoring Out Of Range Low	• Cylinder 3: • Weighted adaptive value < -15.0 %	• Lambda control closed loop • Catalyst purge not active • Canister load <= 2.00 [-] • Engine no full load • Fuel cut off not active • Segment adaptation finished • Catalyst damaging misfire not detected • Emission threshold misfire not detected • No gear switch for segments >= 90.00 [-] • Segments after start > 0.00 [-] • Time after engine start > 0.0 [s] • Rough road n.a. • And depending on gear: • 1st gear not active • 2nd gear not active • 3rd gear not active • 4th gear active • 5th gear active • 6th gear active • 7th gear active • 8th gear active • And • Integrated MAF >= 1.0 – 5.0 kg • Diff. engine speed vs. dynamic engine speed < 75 RPM			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Diff. MAF vs. dynamic MAF < 29.99 mg/rev • ECT @ cylinder head 60 – 143° C • Adaptation cycles <= 3.00 [-] • And • Depending on transmission type: • For AT • Engine speed 1,408 – 3,008 RPM • For MT • Engine speed 1,408 – 3,008 RPM • For DCT • Engine speed 1,408 – 3,008 RPM • And • Mass fuel flow lower range >= 12.00 mg/rev • Mass fuel flow upper range <= 29.99 mg/rev			
P219F Cylinder 4 Air-Fuel Ratio Imbalance	Air Fuel Imbalance Monitoring Out Of Range High	• Cylinder 4: • Weighted adaptive value > 15.0 %	• Modeled catalyst temperature @ start <= 900° C • Lambda set value 0.97 – 1.03 [-] • Catalyst heating not active • Engine roughness signal valid • Cylinder shut off not active • AAT >= -48° C • Barometric pressure >= 73.0 kPa • And • Choice of: • Catalyst diagnosis n.a.	• 90.0 s • Once / DCY	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Air Fuel Imbalance Monitoring Out Of Range Low	• Cylinder 4: • Weighted adaptive value < -15.0 %	• Or • Catalyst diagnosis n.a. • Depending on catalyst diagnosis: • Canister purge (conditions) n.a. • Or • Evap purge valve n.a. • Or • Evap purge n.a. • And • O2S dynamic diagnosis n.a. • O2S delay diagnosis n.a. • Lambda control closed loop • Catalyst purge not active • Canister load <= 2.00 [-] • Engine no full load • Fuel cut off not active • Segment adaptation finished • Catalyst damaging misfire not detected • Emission threshold misfire not detected • No gear switch for segments >= 90.00 [-] • Segments after start > 0.00 [-] • Time after engine start > 0.0 [s] • Rough road n.a. • And depending on gear: • 1st gear not active			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• 2nd gear not active • 3rd gear not active • 4th gear active • 5th gear active • 6th gear active • 7th gear active • 8th gear active • And • Integrated MAF >= 1.0 – 5.0 kg • Diff. engine speed vs. dynamic engine speed < 75 RPM • Diff. MAF vs. dynamic MAF < 29.99 mg/rev • ECT @ cylinder head 60 – 143° C • Adaptation cycles <= 3.00 [-] • And • Depending on transmission type: • For AT • Engine speed 1,408 – 3,008 RPM • For MT • Engine speed 1,408 – 3,008 RPM • For DCT • Engine speed 1,408 – 3,008 RPM • And • Mass fuel flow lower range >= 12.00 mg/rev • Mass fuel flow upper range <= 29.99 mg/rev			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2237 O2 Sensor Positive Current Control Circuit/ Open Bank 1 Sensor 1	Oxygen Sensors Front Open Circuit Pump Voltage (VIP)	• Diff. pump voltage (VIP) vs. virtual ground voltage (VG) <= 1.20 V • Diff. nernst voltage (VN) vs. virtual ground voltage (VG) <= 1.20 V • And • Choice of: • Nernst voltage (VN) > 4.40 V • Or • Diff. pump voltage (VIP) vs. virtual ground voltage (VG) > 2.35 V • Diff. pump voltage (VIP) vs. virtual ground voltage (VG) < -2.35 V • Or • Diff. nernst voltage (VN) vs. virtual ground voltage (VG) > 1.60 V • Diff. nernst voltage (VN) vs. virtual ground voltage (VG) < -0.10 V • Or • Pump current > 0.0115 A • Or • Measurement WRAF sensor label resistor > n.a. Ohm	• O2S front (linear) ready • Measurement of WRAF sensor label resistor finished • Pump current controller active	• 2.3 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2243 O2 Sensor Reference Voltage Circuit/ Open Bank 1 Sensor 1	Oxygen Sensors Front Open Circuit Nernst Voltage (VN)	• Diff. pump voltage (VIP) vs. virtual ground voltage (VG) <= 1.20 V • Diff. nernst voltage (VN) vs. virtual ground voltage (VG) <= 1.20 V • And • Choice of: • Nernst voltage (VN) > 4.40 V • Or • Diff. pump voltage (VIP) vs. virtual ground voltage (VG) > 2.35 V • Diff. pump voltage (VIP) vs. virtual ground voltage (VG) < -2.35 V • Or • Diff. nernst voltage (VN) vs. virtual ground voltage (VG) > 1.60 V • Diff. nernst voltage (VN) vs. virtual ground voltage (VG) < -0.10 V • Or • Pump current > 0.0115 A • Or • Measurement WRAF sensor label resistor > n.a. Ohm	• O2S front (linear) ready • Measurement of WRAF sensor label resistor finished • Pump current controller active	• 2.3 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2251 O2 Sensor Negative Current Control Circuit/ Open Bank 1 Sensor 1	Oxygen Sensors Front Open Circuit Virtual Ground (VG)	• Nernst voltage (VN) > 4.40 V • Or • Diff. pump voltage (VIP) vs. virtual ground voltage (VG) > 2.35 V • Ddiff. pump voltage (VIP) vs. virtual ground voltage (VG) < -2.35 V • Or • Diff. nernst voltage (VN) vs. virtual ground voltage (VG) > 1.60 V • Diff. nernst voltage (VN) vs. virtual ground voltage (VG) < -0.10 V • Or • Pump current > 0.0115 A • Or • Measurement WRAF sensor label resistor > n.a. Ohm • And • Choice of: • Diff. pump voltage (VIP) vs. virtual ground voltage (VG) <= 1.20 V • Diff. nernst voltage (VN) vs. virtual ground voltage (VG) <= 1.20 V	• O2S front (linear) ready • Measurement of WRAF sensor label resistor finished • Pump current controller active	• 2.3 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2257 AIR System Control "A" Circuit Low	Secondary Air Injection Pump Relay Short To Ground	• Output voltage (hardware values) 1.92 – 2.21 V	• Engine running • Actuator commanded off	• 1.0 s • Continuous	• 2 DCY	– Check the Secondary Air Injection Pump Motor - V101- / Secondary Air Injection Pump Relay - J299- . Refer to ⇒ “3.6.29 Secondary Air Injection Pump Motor V101 / Secondary Air Injection Pump Relay J299 , Checking”, page 519 .
P2258 AIR System Control "A" Circuit High	Secondary Air Injection Pump Relay Short To Battery Plus	• Actuator temperature > 160 – 200° C • Or • Output current (hardware values) > 1.0 – 2.0 A	• Engine running • Actuator commanded on	• 1.0 s • Continuous	• 2 DCY	– Check the Secondary Air Injection Pump Motor - V101- / Secondary Air Injection Pump Relay - J299- . Refer to ⇒ “3.6.29 Secondary Air Injection Pump Motor V101 / Secondary Air Injection Pump Relay J299 , Checking”, page 519 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2270 O2 Sensor Signal Biased/ Stuck Lean Bank 1 Sensor 2	Oxygen Sensors Rear Signal Range Check	• Max. O2S rear voltage < 0.87 V	• General conditions: • Close the gap stimulation request active • Vehicle speed >= 6 mph • Catalyst overheating protection not active • Turbine overheating protection not active • O2S rear ready • O2S front ready • ECT @ cylinder head > 60° C • Modeled catalyst temperature 470 – 780° C • Difference between dynamic and stationary catalyst temperature -306 – 304° C • Modeled catalyst temperature once after engine start > 550° C • Integrated MAF, catalyst temp. conditions fulfilled >= 0.0 g • Modeled EGT @ O2S rear <= 900° C • MAF per cylinder 30.0 – 200.0 kg/h • MAF per cylinder per stroke, lower range >= 89.99 mg/rev • MAF per cylinder per stroke, upper range <= 750.0 mg/rev • And • Low dynamic conditions deviation actual • And	• 60.0 – 70.0 s • Once / DCY	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Target engine speed < 150 RPM • Dynamic MAF < 15.01 mg/rev • Dynamic lambda controller output <= 20.0 % • And • Integrated MAF after dynamic conditions are fulfilled > 20.0 g • Time after a catalyst purge phase >= 1.0 s • O2S rear voltage @ diagnosis start >= 0.55 V • Integrated MAF to start diagnosis >= 5.0 g • Integrated heat energy >= 800.0 – 2,000.0 kJ • Engine speed 1,248 – 3,008 RPM • Coasting function n.a • O2S heater rear active • Lambda adaptation not active • Valve lift n.a. • And • Depending on lambda control: • Intervention of trim control behavior activation of catalyst diagnosis < 0.10 [-] • Or • Intervention of trim control during active catalyst diagnosis < 0.20 [-] • Depending on canister purge:			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Canister load <= n.a. [-] • Evap purge flow n.a. • Or • Canister load calculation n.a. • Evap purge flow n.a. • Or • Evap purge valve n.a. • Depending on canister purge closing: • Canister purge (conditions) n.a. • Canister purge valve (closing time) n.a. • And • Choice of: • Evap purge valve n.a. or evap purge valve n.a. and modeled MAF-integral > 0.0 g • Depending on transmission type: • For MT • Integrated MAF per cylinder >= 0.00 kg • For AT • Integrated MAF per cylinder >= 0.00 kg • For DCT • Integrated MAF per cylinder >= 0.00 kg			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2271 O2 Sensor Signal Biased/ Stuck Rich Bank 1 Sensor 2	Oxygen Sensors Rear Signal Range Check	• Max. O2S rear voltage > 0.87 V	• General conditions: • Close the gap stimulation request active • Vehicle speed >= 6 mph • Catalyst overheating protection not active • Turbine overheating protection not active • O2S rear ready • O2S front ready • ECT @ cylinder head > 60° C • Modeled catalyst temperature 470 – 780° C • Difference between dynamic and stationary catalyst temperature -306 – 304° C • Modeled catalyst temperature once after engine start > 550° C • Integrated MAF, catalyst temp. conditions fulfilled >= 0.0 g • Modeled EGT @ O2S rear <= 900° C • MAF per cylinder 30.0 – 200.0 kg/h • MAF per cylinder per stroke, lower range >= 89.99 mg/rev • MAF per cylinder per stroke, upper range <= 750.0 mg/rev • And • Low dynamic conditions deviation actual • And	• 60.0 – 70.0 s • Once / DCY	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Target engine speed < 150 RPM • Dynamic MAF < 15.01 mg/rev • Dynamic lambda controller output <= 20.0 % • And • Integrated MAF after dynamic conditions are fulfilled > 20.0 g • Time after a catalyst purge phase >= 1.0 s • O2S rear voltage @ diagnosis start >= 0.55 V • Integrated MAF to start diagnosis >= 5.0 g • Integrated heat energy >= 800.0 – 2,000.0 kJ • Engine speed 1,248 – 3,008 RPM • Coasting function n.a • O2S heater rear active • Lambda adaptation not active • Valve lift n.a. • And • Depending on lambda control: • Intervention of trim control behavior activation of catalyst diagnosis < 0.10 [-] • Or • Intervention of trim control during active catalyst diagnosis < 0.20 [-] • Depending on canister purge:			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Canister load <= n.a. [-] • Evap purge flow n.a. • Or • Canister load calculation n.a. • Evap purge flow n.a. • Or • Evap purge valve n.a. • Depending on canister purge closing: • Canister purge (conditions) n.a. • Canister purge valve (closing time) n.a. • And • Choice of: • Evap purge valve n.a. or evap purge valve n.a. and modeled MAF-integral > 0.0 g • Depending on transmission type: • For MT • Integrated MAF per cylinder >= 0.00 kg • For AT • Integrated MAF per cylinder >= 0.00 kg • For DCT • Integrated MAF per cylinder >= 0.00 kg			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2279 MAP/ MAF - Throttle Position Correlation	Intake Air System Rationality Check	• General conditions: • Filtered lambda controller included correction and adaption -30.0 – 30.0 % • Lambda control active • And • Deviation throttle area controller > 60.0 %	• Throttle position > 0.0° TPS • Throttle position < 100.003° TPS • Engine speed > 576; < 3,008 RPM • Modeled pressure quotient > 0.27; < 0.60 [-] • Engine running • Throttle actuator commanded on • Time after engine start > 5.0 s • Throttle position sensor failure not detected • Fuel cut off not active • Fast throttle adaptation finished • Gradient intake manifold pressure -199.90 – 199.90 kPa/s • Engine speed limitation not active • Barometric pressure plausibility diagnosis finished • Intake manifold modeled adaption active • And • Choice of: • MAF sensor active • Or • Manifold pressure sensor active • And • Choice of: • Pressure upstream throttle < 135.0 kPa	• 5.0 s • Continuous	• 2 DCY	– Check visually for air leaks between intake and throttle body, oil fill cap not tight or oil dipstick not seated in tube. – Also visually inspect any engine gaskets that can cause additional air to enter the crankcase can set this fault as the PCV system is not metered. If a vacuum leak or crankcase gasket sealing is at cause, the idle may be rough or unstable.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Or • Pressure upstream throttle not active • And • Choice of: • Barometric pressure > 73.00; < 107.50 kPa • Or • Barometric pressure sensor not active			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Deviation throttle area controller > 35.0 % • Filtered lambda controller correction -50.0 – 50.0 % • Lambda control active	• Throttle position > 4.50° TPS • Engine speed > 1,216; < 6.000 RPM • Modeled pressure quotient > 0.63; < 0.90 [-] • Engine running • Throttle actuator commanded on • Time after engine start > 5.0 s • Throttle position sensor failure not detected • Fuel cut off not active • Fast throttle adaptation finished • Gradient intake manifold pressure -199.90 – 199.90 kPa/s • Engine speed limitation not active • Barometric pressure plausibility diagnosis finished • And • Choice of: • MAF sensor active • Or • Manifold pressure sensor active • And • Choice of: • Pressure upstream throttle < 135.0 kPa • Or • Pressure upstream throttle not active			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• And • Choice of: • Barometric pressure > 73.00; < 107.50 kPa • Or • Barometric pressure sensor not active			
P2294 Fuel Pressure Regulator 1 Control Circuit/ Open	Fuel Control Valve Open Circuit	• Voltage high side < 1.87 – 2.26 V • Voltage low side > 2.78 – 3.33 V	• Engine speed > 0 RPM • Or • Fuel cut off active • Actuator commanded off	• 0.8 s • Continuous	• 2 DCY	– Check the Fuel Pressure Regulator Valve - N276- . Refer to ⇒ “3.6.16 Fuel Pressure Regulator Valve N276 , Checking”, page 489 .
		• Low and high side off: • Voltage low side > 2.78 – 3.33 V • Voltage high side < 1.87 – 2.26 V • Low and high side on: • Current low side < 12.2 – 15.0 A • Current high side < 13.5 – 16.5 A	• Engine speed > 600 RPM • And • Fuel cut off not active • Actuator commanded on			
P2295 Fuel Pressure Regulator 2 Control Circuit Low	Fuel Control Valve Short To Ground High Side	• Current high side (hardware values) > 13.4 – 17.0 A	• Ignition on • Or • Ignition off (during ECM keep alive-time) • And • Actuator commanded on	• 0.8 s • Continuous	• 2 DCY	– Check the Fuel Pressure Regulator Valve - N276- . Refer to ⇒ “3.6.16 Fuel Pressure Regulator Valve N276 , Checking”, page 489 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Fuel Control Valve Short To Ground Low Side	• Voltage low side (hardware values) < 1.92 – 2.10 V	• Ignition on • Or • Ignition off (during ECM keep alive-time) • And • Actuator commanded off			
P2414 O2 Sensor Exhaust Sample Error Bank 1 Sensor 1	Oxygen Sensors Front Rationality Check	• Pump current correction (nernst-cell) > 0.00 A	• O2S front ready • Fuel cut off not active • Cylinder shut off not active • Depending on engine state: • Engine part load • Or • Engine full load • Or • Engine idle for time >= 5.0 s	• 10.0 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .
P2431 AIR System Air Flow/ Pressure Sensor Circuit Range/ Performance Bank 1	Secondary Air System Pressure Sensor Rationality Check	• Difference between AIR pressure and barometric pressure > 6.0 kPa • And • Difference between AIR pressure and intake manifold pressure > 6.0 kPa	• Engine stop • For time > 0.0 s	• 0.1 s • Once / DCY	• 2 DCY	– Check the Secondary Air System - GX24- . Refer to ⇒ “3.6.30 Secondary Air Injection Sensor 1 G609 / Secondary Air Injection Solenoid Valve N112 , Checking”, page 521 .
P2432 AIR System Air Flow/ Pressure Sensor Circuit Low Bank 1	Secondary Air System Pressure Sensor Out Of Range Low	• Sensor voltage < 0.50 V		• 0.1 s • Continuous	• 2 DCY	– Check the Secondary Air System - GX24- . Refer to ⇒ “3.6.30 Secondary Air Injection Sensor 1 G609 / Secondary Air Injection Solenoid Valve N112 , Checking”, page 521 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2433 AIR System Air Flow/ Pressure Sensor Circuit High Bank 1	Secondary Air System Pressure Sensor Out Of Range High	• Sensor voltage > 4.50 V		• 0.1 s • Continuous	• 2 DCY	– Check the Secondary Air System - GX24- . Refer to ⇒ “3.6.30 Secondary Air Injection Sensor 1 G609 / Secondary Air Injection Solenoid Valve N112 , Checking”, page 521 .
P2440 AIR System Switching Valve Stuck Open Bank 1	Secondary Air Valve Functional Check	• Ratio relative pressure phase 1 and relative pressure phase 2 > 1.34 [-]	• General: • Secondary air pump active • Catalyst heating active • Secondary air injection active • MAF <= 140.0 kg/h • ECT @ cylinder head >= -10; < 115° C • IAT @ manifold >= -10; < 100° C • Modeled catalyst temperature < 700° C • Relative barometric pressure > 0.73 [-] • And • Diff. barometric pressure vs. manifold pressure > n.a. kPa • Or • Engine n.a.	• 0.1 s • Once / DCY	• 2 DCY	– Check the Secondary Air System - GX24- . Refer to ⇒ “3.6.30 Secondary Air Injection Sensor 1 G609 / Secondary Air Injection Solenoid Valve N112 , Checking”, page 521 .
P2556 Engine Coolant Level Sensor/ Switch Circuit	Rotary Coolant Valve Communication Check	• Communication signal failure		• 0.5 s • Continuous	• 2 DCY	– Check the Engine Temperature Control Actuator - N493- . Refer to ⇒ “3.6.12 Engine Temperature Control Actuator N493 , Checking”, page 481 .
	Rotary Coolant Valve Signal Check	• Sensor signal failure				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2557 Engine Coolant Level Sensor/ Switch Circuit Range/ Performance	Rotary Coolant Valve Checksum Verification	• Checksum signal failure		• 0.5 s • Continuous	• 2 DCY	– Check the Engine Temperature Control Actuator - N493- . Refer to ⇒ “3.6.12 Engine Temperature Control Actuator N493 , Checking”, page 481 .
P2564 Turbocharger Boost Control Position Sensor "A" Circuit Low	Turbocharger Boost Control Position Sensor Short To Ground / Open Circuit	• Turbocharger boost control position sensor voltage < 0.20 V		• 0.5 s • Continuous	• 2 DCY	– Check the Charge Pressure Actuator - V465- / Charge Pressure Actuator Position Sensor - G581- . Refer to ⇒ “3.6.7 Charge Pressure Actuator V465 / Charge Pressure Actuator Position Sensor G581 , Checking”, page 470 . .
P2565 Turbocharger Boost Control Position Sensor "A" Circuit High	Turbocharger Boost Control Position Sensor Short To Battery Voltage	• Turbocharger boost control position sensor voltage > 4.80 V		• 0.5 s • Continuous	• 2 DCY	– Check the Charge Pressure Actuator - V465- / Charge Pressure Actuator Position Sensor - G581- . Refer to ⇒ “3.6.7 Charge Pressure Actuator V465 / Charge Pressure Actuator Position Sensor G581 , Checking”, page 470 .
P2610 ECM/ PCM Engine Off Timer Performance	Engine Off Time ECM Internal Timer Check	• Case 1: • ECM internal timer initialization failure • Case 2: • ECM internal timer communication failure	• ECM internal timer reset not active • SPI communication failure after reset not detected	• 1.3 s • Continuous	• 2 DCY	– Check the Engine Control Module - J623- . Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Engine Off Time ECM Rationality Check	• Difference between engine-off-time and ECM keep alive-time >= 12.0 s • Or • Engine off time (hardware values) not valid	• Choice of: • ECM keep alive-time active • ECU internal timer reset not activated • Time delay >= 1.0 s • Or • Delay timer for acquisition of engine-off-time (hardware values) > 1.0 s • Or • Result of low power check initialization > 0.0; < 9.0 [-]	• 0.01 s • Once / DCY		
		• Difference between engine-off-time and ECM keep alive-time >= 12.0 s	• Time after engine stop < 86,400.0 s • Engine off time plausible • Engine off time monitoring not finished • Engine off time signal valid time after reset < 2.0 s • And • Case 1: • Engine off timer n.a. • Or • Engine off time n.a. • Case 2: • ECM internal timer active • SPI communication failure after reset detected			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2681 Engine Coolant Bypass Valve "A" Control Circuit/ Open	Rotary Coolant Valve Open Circuit	• Load resistance > 200.0 kOhm		• 1.5 s • Continuous	• 2 DCY	– Check the Engine Temperature Control Actuator - N493- . Refer to ⇒ “3.6.12 Engine Temperature Control Actuator N493 , Checking”, page 481 . .
P2682 Engine Coolant Bypass Valve "A" Control Circuit Low	Rotary Coolant Valve Short To Ground Output 1	• High side current output 1 > 9.3 – 15.0 A	• Rotary slide valve commanded on • Rotary valve direction forward	• 0.25 s • Continuous	• 2 DCY	– Check the Engine Temperature Control Actuator - N493- . Refer to ⇒ “3.6.12 Engine Temperature Control Actuator N493 , Checking”, page 481 .
	Rotary Coolant Valve Short To Ground Output 2	• High side current output 2 > 9.3 – 15.0 A	• Rotary slide valve commanded on • Rotary valve direction reserved			
P2683 Engine Coolant Bypass Valve "A" Control Circuit High	Rotary Coolant Valve Short To Battery Plus Output 1	• Low side current output 1 > 9.3 – 15.0 A	• Rotary slide valve commanded off • Or • Rotary slide valve commanded on • Rotary valve direction reverse	• 0.25 s • Continuous	• 2 DCY	– Check the Engine Temperature Control Actuator - N493- . Refer to ⇒ “3.6.12 Engine Temperature Control Actuator N493 , Checking”, page 481 .
	Rotary Coolant Valve Short To Battery Plus Output 2	• Low side current output 2 > 9.3 – 15.0 A	• Rotary slide valve commanded off • Or • Rotary slide valve commanded on • Rotary valve direction forward			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P3043 Fuel Pump Mechanical Malfunction	CAN: Fuel Pump CAN Communication With Fuel Pump	• Fuel pump signal: rotary failure feedback >= 2.00 [-]	• Engine on	• 1.8 s • Continuous	• 2 DCY	– Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 . – Check the Engine Control Module - J623- . Refer to appropriate repair manual.
P3044 Fuel Pump "A" Control Circuit Low	CAN: Fuel Pump CAN Communication With Fuel Pump	• Fuel pump sensor: short to ground failure feedback >= 2.00 [-]	• Engine on	• 2.0 s • Continuous	• 2 DCY	– Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 . – Check the Engine Control Module - J623- . Refer to appropriate repair manual.
P3045 Fuel Pump Electronics Faulty	CAN: Fuel Pump CAN Communication With Fuel Pump	• Fuel pump signal: ROM / RAM failure feedback >= 2.00 [-]	• Engine on	• 1.2 s • Continuous	• 2 DCY	– Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 . – Check the Engine Control Module - J623- . Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P3073 Fuel Pump "A" Control Circuit/ Open	CAN: Fuel Pump CAN Communication With Fuel Pump	• Fuel pump sensor: open circuit failure feedback >= 2.00 [-]	• Engine on	• 2.2 s • Continuous	• 2 DCY	– Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 . – Check the Engine Control Module - J623- . Refer to appropriate repair manual.
P308D Fuel Pump Engine Speed Too Low	CAN: Fuel Pump Communication With Fuel Pump	• Fuel pump signal: over-current failure feedback >= 2.00 [-]	• Engine on	• 1.6 s • Continuous	• 2 DCY	– Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 . – Check the Engine Control Module - J623- . Refer to appropriate repair manual.
P308E Fuel Pump Control Module "A"	CAN: Fuel Pump Communication With Fuel Pump	• Fuel pump signal: power amplifier failure feedback >= 2.00 [-]	• Engine on	• 1.4 s • Continuous	• 2 DCY	– Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 . – Check the Engine Control Module - J623- . Refer to appropriate repair manual.
		• Fuel pump sensor: Short to battery failure • Or • RPM deviation feedback >= 2.00 [-]		• 2.4 s • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P334A Charge Pressure Actuator Electrical Error	Turbocharger Boost Pressure Control Valve Short To Ground	• Bypass valve driver current > 9.3 – 15.0 A	• Boost pressure actuator controller active	• 0.4 s • Continuous	• 2 DCY	– Check the Charge Pressure Actuator - V465- / Charge Pressure Actuator Position Sensor - G581- . Refer to ⇒ “3.6.7 Charge Pressure Actuator V465 / Charge Pressure Actuator Position Sensor G581 , Checking”, page 470 .
U0001 High Speed CAN Communication Bus	CAN: Bus-Off CAN Communication	• Bus off counter >= 3.0 [-]	• Time after ignition on >= 0.5 s	• 0.5 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC’s present check them first. – Refer to the proper wiring schematic for terminal and component location.
U0002 High Speed CAN Communication Bus Performance	CAN: Global Time Out CAN Communication	• General CAN timeout >= 0.4 s	• Time after ignition on >= 0.5 s	• 0.5 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC’s present check them first. – Refer to the proper wiring schematic for terminal and component location.
U0101 Lost Communication with TCM	CAN: Transmission Control Module (TCM) CAN Communication With TCM	• Received CAN message no message	• Time after ignition on >= 0.5 s	• 0.5 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC’s present check them first. – Refer to the proper wiring schematic for terminal and component location.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
U0121 Lost Communication With Anti-Lock Brake System (ABS) Control Module	CAN: Brake System Control Module (BSCM) CAN Communication With Brake Unit	• Received CAN message no message	• Time after ignition on >= 0.5 s	• 0.5 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC's present check them first. – Refer to the proper wiring schematic for terminal and component location.
U0140 Lost Communication With Body Control Module	CAN: Body Control Module (BCM) CAN Communication With Body Control Module	• Received CAN message no message	• Time after ignition on >= 0.5 s	• 0.5 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC's present check them first. – Refer to the proper wiring schematic for terminal and component location.
U0146 Lost Communication With Gateway "A"	CAN: Gateway CAN Communication With Gateway	• Received CAN message no message	• Time after ignition on >= 0.5 s	• 0.5 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC's present check them first. – Refer to the proper wiring schematic for terminal and component location.
U0155 Lost Communication With Instrument Panel Cluster (IPC) Control Module	CAN: Instrument Cluster CAN Communication With Instrument Cluster Module	• Received CAN message no message	• Time after ignition on >= 0.5 s	• 0.5 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC's present check them first. – Refer to the proper wiring schematic for terminal and component location.
U0302 Software Incompatibility With Transmission Control Module	ECM: Coding Code Check Of ECM Concerning TCM	• Received AT vehicle data from TCM, TCM signal		• 50.0 s • Continuous	• 2 DCY	– Check for software updates and TSB's. Reprogram as necessary. If none are found, refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
U0322 Software Incompatibility With Body Control Module	CAN: Gateway CAN Communication With Gateway	• Ambient temperature sensor coding monitoring failure	• Time after ignition on > 1.5 s	• 2.0 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC's present check them first. – Refer to the proper wiring schematic for terminal and component location.
U0402 Invalid Data Received From TCM	CAN: Transmission Control Module (TCM) CAN Communication With TCM	• Received data from TCS implausible message	• Time after ignition on >= 0.5 s	• 0.5 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC's present check them first. – Refer to the proper wiring schematic for terminal and component location.
U0415 Invalid Data Received From Anti-Lock Brake System (ABS) Control Module	Vehicle Speed Rationality Check High	• Vehicle speed > 202 mph		• 4.0 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC's present check them first. – Refer to appropriate repair manual for the ABS. – Refer to the proper wiring schematic for terminal and component location.
	CAN: Vehicle Speed Sensor CAN Communication With Vehicle Speed Sensor	• Speed sensor signal: sensor error 407 mph	• Time since engine on > 0.5 s	• 0.5 s • Continuous		
		• Speed sensor signal: initialization error 407 mph	• Time since engine on > 0.5 s • Vehicle speed < 7.46 mph	• 2.0 s • Continuous		
		• Speed sensor signal: low voltage error 407 mph	• Time since engine on > 0.5 s • Vehicle speed > 7.46 mph	• 0.5 s • Continuous		
	CAN: Brake System Control Module (BSCM) CAN Communication With Brake Unit	• Received data from TCS implausible message	• Time after ignition on >= 0.5 s	• 0.5 s • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
U0422 Invalid Data Received From Body Control Module	CAN: Gateway CAN Communication With Gateway	• Ambient temperature value (initialization) failure	• Time after ignition on > 1.5 s • Engine running	• 3.0 s • Continuous	• 2 DCY	– Check the Outside Air Temperature Sensor - G17- . Refer to ⇒ “3.6.26 Outside Air Temperature Sensor G17 , Checking”, page 511 . – Check the CAN-Bus circuits. If there are any other DTC’s present check them first. – Refer to the proper wiring schematic for terminal and component location.
U0423 Invalid Data Received From Instrument Panel Cluster Control Module	CAN: Instrument Cluster CAN Communication With Instrument Cluster Module	• Received data from Instrument Cluster implausible message	• Time after ignition on >= 0.5 s	• 0.5 s • Continuous • 3.0 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC’s present check them first. – Refer to the proper wiring schematic for terminal and component location.
U0447 Invalid Data Received From Gateway "A"	CAN: Gateway CAN Communication With Gateway	• Received data from gateway implausible message	• Time after ignition on >= 0.5 s	• 0.5 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC’s present check them first. – Refer to the proper wiring schematic for terminal and component location.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
U1103 Production Mode Active	ECM: Production Mode Function Monitoring: Mode Change	• production mode active	• vehicle speed < 3 [mph] • max trip mileage since initial vehicle start-up < 62.15 [miles] • during ECM keep alive-time after ignition off engine speed 0 [rpm] • production mode not active for hybrid: • drive motor off	• 0.01 s • Continuous	• 1DCY	– PERFORM: Preliminary Check to verify the concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Perform readiness check. Refer to ⇒ “3.2 Readiness Codes”, page 19 .

3.4.2 Engine Control Module , 2016 MY

DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P000A "A" Camshaft Position Slow Response Bank 1	VVT Actuator Intake Rationality Check	• Adjustment angle difference >= 1.00; < 10.0° CRK	• Modeled oil temperature -40 – 160° C • Engine speed 608 – 6,016 RPM • Set point change > 20.0° CRK • Dynamic diagnosis timer >= 0.95 – 4.0 s	• 0 FTP75; 300 s • Continuous	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.3 Camshaft Adjustment Valve 1 N205 , Checking”, page 462 .
P000B "B" Camshaft Position Slow Response Bank 1	Variable Valve Timing (VVT) Exhaust Actuator rationality check	• Adjustment angle difference >= 1.00; < 3.50° CRK	• Modeled oil temperature -40 – 160° C • Engine speed 608 – 6,016 RPM • Set point change > 6.0° CRK • Dynamic diagnosis timer >= 0.95 – 4.0 s	• 0 FTP75; 700 s • Continuous	• 2 DCY	– Check the Exhaust Camshaft Adjustment Valve 1 - N318- . Refer to ⇒ “3.6.14 Exhaust Camshaft Adjustment Valve 1 N318 , Checking”, page 485
P0010 "A" Camshaft Position Actuator Control Circuit/ Open Bank 1	VVT Actuator Intake Open Circuit	• Output voltage lower range 1.92 – 2.21 V • Output voltage upper range (hardware values) 2.85 – 3.25 V	• Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.3 Camshaft Adjustment Valve 1 N205 , Checking”, page 462 .

DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0011 "A" Camshaft Position - Timing Over-Advanced or System Performance Bank 1	VVT Actuator Intake Rationality Check	• Camshaft position deviation > 10.0° CRK	• Modeled oil temperature -40 – 160° C • Engine speed 608 – 6,016 RPM • Camshaft position n.a. • Camshaft position adjustment active • Catalyst heating not active • Camshaft position deviation integrator (actual vs. setpoint position) >= 9.00 – 12.00° CRK	• 0 FTP75: 250 s • Continuous	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.3 Camshaft Adjustment Valve 1 N205 , Checking”, page 462 .
P0013 "B" Camshaft Position Actuator Control Circuit/ Open Bank 1	Variable Valve Timing (VVT) Exhaust Actuator open circuit	• Output voltage, lower range 1.92 – 2.21 V • Output voltage, upper range 2.85 – 3.25 V (hardware values)	• Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check the Exhaust Camshaft Adjustment Valve 1 - N318- . Refer to ⇒ “3.6.14 Exhaust Camshaft Adjustment Valve 1 N318 , Checking”, page 485
P0014 "B" Camshaft Position - Timing Over-Advanced or System Performance Bank 1	Variable Valve Timing (VVT) Exhaust Actuator Rationality Check	• Difference between target and actual position > 10.00° CRK	• Modeled oil temperature -40 – 160° C • Engine speed 608 – 6,016 RPM • Camshaft position n.a. • Camshaft position adjustment active • Catalyst heating not active • Camshaft position deviation integrator (actual vs. setpoint position) >= 9.00 – 12.00° CRK	• 0 FTP75: 450 s • Continuous	• 2 DCY	– Check the Exhaust Camshaft Adjustment Valve 1 - N318- . Refer to ⇒ “3.6.14 Exhaust Camshaft Adjustment Valve 1 N318 , Checking”, page 485

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0016 Crankshaft Position - Camshaft Position Correlation Bank 1 Sensor A	Camshaft Position/ Crankshaft Position Intake - Correlation Adaptation Value Monitoring	• Adapted value for each edge of the target wheel < -14.0° CRK • Or • Adapted value for each edge of the target wheel > 14.0° CRK	• Camshaft position adaptation active • (Exhaust side) • Engine speed 288 – 4,000 rpm • Modeled oil temperature >= -15° C • Modeled oil temperature <= 160° C • Diff. actual exhaust camshaft position vs. previous camshaft position @ reference signal edge < 2.00° CRK • And • Case 1: • Ignition off • Engine speed > 380 rpm • Engine stalling >= 1.0 s • Or • Case 2: • Engine speed >= 380 rpm • Or • Engine running • Engine stalling >= 5.0 s • Or • Case 3: • Backwards rotation not detected • Or • Case 4: • Engine speed >= 400 rpm • Engine stopped	• 720° CRK • Multiple	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.3 Camshaft Adjustment Valve 1 N205 , Checking”, page 462 . – Check the Engine Speed Sensor - G28- . Refer to ⇒ “3.6.11 Engine Speed Sensor G28 , Checking”, page 479 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Diff. actual camshaft adaptation per cylinder vs. previous reference camshaft adaptation >= 12.00° CRK	General: • Camshaft phasing commanded • Engine speed < 8,160 rpm • Diff. actual intake camshaft position vs. previous camshaft position @ reference signal edge < 2.00° CRK • Case 1: • Ignition off • Engine speed > 380 RPM • Engine stalling >= 1.0 s • Case 2: • synchronization test incorrect • Or • Engine running • And • Engine stalling >= 5.0 s • Case 3: • Backwards rotation not detected • Or • Case 4: • Engine speed >= 400 RPM • Engine stopped	• 0.1 s • Continuous		

DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0017 Crankshaft Position - Camshaft Position Correlation Bank 1 Sensor B	Camshaft Position/ Crankshaft Position Exhaust - Correlation Adaptation Value Monitoring	• Adapted value for each edge of the target wheel < -14.0° CRK • Or • Adapted value for each edge of the target wheel > 14.0° CRK	• Camshaft position adaptation active • (Exhaust side) • Modeled oil temperature >= -15° C • Modeled oil temperature <= 160° C • Engine speed 288 – 4,000 RPM • Diff. actual exhaust camshaft position vs. previous camshaft position @ reference signal edge < 2.0° CRK • And • Case 1: • Ignition off • Engine speed > 380 RPM • Engine stalling >= 1.0 s • Or • Case 2: • Engine speed >= 380 RPM • Or • Engine running • And • Engine stalling >= 5.0 s • Or • Case 3: • Backwards rotation not detected • Or • Case 4: • Engine speed >= 400 RPM • Engine stopped	• 720° CRK • Multiple	• 2 DCY	– Check the Exhaust Camshaft Adjustment Valve 1 - N318- . Refer to ⇒ “3.6.14 Exhaust Camshaft Adjustment Valve 1 N318 , Checking”, page 485 – Check the Engine Speed Sensor - G28- . Refer to ⇒ “3.6.11 Engine Speed Sensor G28 , Checking”, page 479 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0030 HO2S Heater Control Circuit Bank 1 Sensor 1	Oxygen Sensors Heater Front Open Circuit	• O2S upstream heater voltage lower range 1.92 – 2.21 V • O2S downstream heater voltage upper range 2.85 – 3.25 V		• 2.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .
P0031 HO2S Heater Control Circuit Low Bank 1 Sensor 1	Oxygen Sensors Heater Front Short To Ground	• O2S upstream heater voltage lower range 1.92 – 2.21 V		• 2.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .
P0032 HO2S Heater Control Circuit High Bank 1 Sensor 1	Oxygen Sensors Heater Front Short To Battery Voltage	• O2S upstream heater driver temperature > 160.0 – 200.0° C • Or • O2S upstream heater driver output current driver stage internal value	• EGT @ O2S front >= -273° C • Actuator commanded on	• 2.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .
P0033 Turbocharger/ Supercharger Bypass Valve "A" Control Circuit	Turbocharger Bypass (TCBY) open circuit	• Voltage, lower range 1.92 – 2.21 V • voltage, upper range 2.85 – 3.25 V (hardware values)	• Actuator commanded off	• 1.0 s • Continuous	• 2 DCY	– Check the Turbocharger Recirculation Valve - N249- . Refer to ⇒ “3.6.32 Turbocharger Recirculation Valve N249 , Checking”, page 527
	Turbocharger Bypass (TCBY) short to battery plus	• Current driver stage internal value • Or • Temperature > 160 – 200° C (hardware values)	• Actuator commanded on			

DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0034 Turbocharger/ Supercharger Bypass Valve "A" Control Circuit Low	Turbocharger Bypass (TCBY) short to ground	• Voltage < 1.92 – 2.21 V (hardware values)	• Actuator commanded off	• 1.0 s • Continuous	• 2 DCY	– Check the Turbocharger Recirculation Valve - N249- . Refer to ⇒ “3.6.32 Turbocharger Recirculation Valve N249 , Checking”, page 527
P0036 HO2S Heater Control Circuit Bank 1 Sensor 2	Oxygen Sensors Heater Rear Open Circuit	• O2S downstream heater voltage lower range 1.92 – 2.21 V • O2S downstream heater voltage upper range 2.85 – 3.25 V	• Engine not in start process	• 2.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .
P0037 HO2S Heater Control Circuit Low Bank 1 Sensor 2	Oxygen Sensors Heater Rear Short To Ground	• O2S downstream heater voltage 1.92 – 2.21 V	• Engine not in start process	• 2.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .
P0038 HO2S Heater Control Circuit High Bank 1 Sensor 2	Oxygen Sensors Heater Rear Short To Battery Voltage	• O2S downstream heater driver temperature > 160.0 – 200.0° C • Or • O2S downstream heater driver output current driver stage internal value	• EGT @ O2S rear (binary) >= -273 • Actuator commanded on • Engine not in start process	• 2.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .
P0045 Turbocharger/ Supercharger Boost Control "A" Circuit/ Open	Turbocharger Boost Pressure Control Valve Open Circuit	• Bypass valve driver load resistance > 200 kOhm	• Deviation between actual and filtered boost pressure actuator position <= 5.0 % • Boost pressure actuator controller not active • Time delay > 1.0 s	• 0.4 s • Continuous	• 2 DCY	– Check the Charge Pressure Actuator - V465- / Charge Pressure Actuator Position Sensor - G581- . Refer to ⇒ “3.6.7 Charge Pressure Actuator V465 / Charge Pressure Actuator Position Sensor G581 , Checking”, page 470 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0068 MAP/ MAF - Throttle Position Correlation	Leak to Intake Manifold Rationality Check	• Difference between target intake manifold pressure and actual intake manifold pressure < -15.0 – -10.0 kPa	• Time after engine start > 5.0 s • Barometric pressure > 73.0 – 105.0 kPa • Engine speed > 576 – 512 RPM • Engine speed < 3,000 RPM • IAT @ intake manifold > -48° C • ECT @ cylinder head > -48° C • Difference between engine speed and filtered engine speed < 8,160 RPM • Diff. air mass setpoint vs. filtered air mass setpoint for load dynamic detection < 25.01 mg/rev • Throttle actuator commanded on • Modeled pressure quotient 0.10 – 0.60 [-] • Gradient of intake manifold pressure >= -199.90; <= 199.90 kPa/s • Vehicle speed <= 1 mph	• 5.0 s • Continuous	• 2 DCY	– Check the Intake system for vacuum leaks, make sure oil dipstick is pushed properly into place. – Check the Intake Manifold Sensor - GX9- . Refer to ⇒ “3.6.23 Intake Manifold Sensor GX9 , Checking”, page 505 . – Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Intake Air System Rationality Check	• General conditions: • Filtered lambda controller included correction and adaptation -30.00 – 30.00 % • Lambda control active • And • Deviation throttle area controller < -60.00 %	General conditions: • Throttle position > 0.000° TPS • Throttle position < 100.003° TPS • Engine speed > 576; < 3,008 rpm • Modeled pressure quotient > 0.27; < 0.57 [-] • Engine running • Throttle actuator commanded on • Time after engine start > 5.0 s • Throttle position sensor failure not detected • Fuel cut off not active • Fast throttle adaptation finished • MAP gradient -199.90 – 199.90 kPa/s • BARO plausibility diagnosis finished • Intake manifold modeled adaptation active • And • Choice of: • MAF sensor active • Or • MAP sensor active • And • Choice of: • Pressure upstream throttle < 135.00 kPa • Or • Pressure upstream throttle not active			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• And • Choice of: • BARO > 73.00; < 107.50 kPa • Or • Barometric pressure sensor not active			
P0070 Ambient Air Temperature Sensor Circuit "A"	CAN: Ambient Air Temperature Sensor Short To Battery Voltage Or Open Circuit	• AAT sensor voltage (hardware values) > 4.50 V		• 2.0 s • Continuous	• 2 DCY	– Check the Outside Air Temperature Sensor - G17- . Refer to ⇒ “3.6.26 Outside Air Temperature Sensor G17 , Checking”, page 511 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0071 Ambient Air Temperature Sensor Circuit "A" Range/ Performance	Ambient Air Temperature Sensor Cross Check	• High side: • Diff. AAT @ cold start vs. IAT @ manifold @ cold start > 25 K • Diff. AAT @ cold start vs. ECT @ radiator outlet @ cold start > 25 K • min. amount of faulty reference measurements to detect defective sensor 2.00 [-] • Or • Low side: • Diff. IAT @ manifold @ cold start vs. AAT @ cold start > 25.0 K • Diff. ECT @ radiator outlet @ cold start vs. AAT @ cold start > 25.0 K • min. amount of faulty reference measurements to detect defective sensor 2.00 [-]	• Engine off time >= 360.0 min • Engine off time plausible • Time after engine start < 1,400.0 s • Depending on temperature slope: • Diff. actual vs previous IAT < 256.0 K • Diff. actual vs previous ECT @ cylinder head n.a. K • Diff.. actual vs previous ECT@ radiator outlet < 256.0 K • Diff. actual vs previous AAT < 256.0 K • For time >= 1.0 s • Depending on meanvalue condition • Mean value of all temperature sensors @ cold start >= -256 ° C • Number of valid sensors >= 2.00 [-] • Depending on block heater / solar radiation detection • Time after engine start >= 0.5 s • Vehicle speed >= 22 mph • For time >= 20.0 s • Diff. actual IAT @ manifold vs. min. IAT @ manifold < 5.0 K • Diff. actual ECT @ cylinder head vs. min. ECT @ cylinder head n.a. K	• 0.1 s • Once / DCY	• 2 DCY	– Check the Outside Air Temperature Sensor - G17- . Refer to ⇒ “3.6.26 Outside Air Temperature Sensor G17 , Checking”, page 511 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Diff. actual AAT vs. min. AAT < 4.0 K • Diff. actual ECT @ radiator outlet vs. min. ECT @ radiator outlet < 1.1 K			
P0072 Ambient Air Temperature Sensor Circuit "A" Low	CAN: Ambient Air Temperature Sensor Short To Ground	• AAT sensor voltage < 0.10 V		• 2.0 s • Continuous	• 2 DCY	– Check the Outside Air Temperature Sensor - G17- . Refer to ⇒ “3.6.26 Outside Air Temperature Sensor G17 , Checking”, page 511 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0087 Fuel Rail/ System Pressure - Too Low Bank 1	Fuel System Pressure Sensor, High Pressure Side Out Of Range Low	• Deviation lambda of controller included adaption -50.0 – 50.0 % • and • High pressure controller output > 45 mg • And • Deviation between fuel pressure set point and current fuel pressure > 2,999.80 kPa • Fuel pressure > 3,500.31 kPa	General: • Engine speed 608 – 6,816 [rpm] • Fuel mass setpoint 5.00 – 1,389.00 mg/rev • Time after engine start > 10.0 s • Engine warm-up not calibrated • Catalyst heating not calibrated • Full load not calibrated • Catalyst purge not calibrated • Lambda control not calibrated • Evap purge functionality diagnosis not calibrated • Fuel pressure setpoint gradient <= 34,777.60 kPa • And • Depending on low dynamic conditions: • Fuel mass setpoint lower range > 5.00 mg/rev • For time >= 10.0 s • Fuel mass setpoint upper range < 187.17 – 229.23 mg/rev • Fuel mass setpoint gradient -1389.00 – 1389.00 mg/rev • For time >= 5.0 s • And • Depending on canister purge: • Canister load not calibrated [-] • Or • Evap purge valve not calibrated	• 5.0 s • Continuous	• 2 DCY	– Check the fuel pressure, refer to the repair manual for proper procedures. – Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.17 Fuel Pressure Sensor G247 , Checking”, page 491 . – Check the Fuel Pressure Regulator Valve - N276-. Refer to ⇒ “3.6.16 Fuel Pressure Regulator Valve N276 , Checking”, page 489 . – Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0090 Fuel Pressure Regulator 1 Control Circuit/ Open	Fuel Volume Regulator Control open circuit	• Voltage high side < 1.87 – 2.26 V • Voltage low side > 2.78 – 3.33 V	• Engine speed > 600 rpm • And • Fuel cut off not active • Actuator commanded on	• 0.8 s • Continuous	• 2 DCY	– Check the Fuel Pressure Regulator Valve - N276- . Refer to ⇒ “3.6.16 Fuel Pressure Regulator Valve N276 , Checking”, page 489 .
		• Low and high side Off: • Voltage low side > 2.78 – 3.33 V • Voltage high side < 1.87 – 2.26 V • Low and high side On: • Current low side driver stage internal value • Current high side driver stage internal value				
P0091 Fuel Pressure Regulator 1 Control Circuit Low	Fuel Volume Regulator Control short to ground (high side)	• Current high side driver stage internal value (hardware values)	• Ignition on • Or • Ignition off (during ECM keep alive-time) • And • Actuator commanded on	• 0.8 s • Continuous	• 2 DCY	– Check the Fuel Pressure Regulator Valve - N276- . Refer to ⇒ “3.6.16 Fuel Pressure Regulator Valve N276 , Checking”, page 489 .
	Fuel Volume Regulator Control short to ground (low side)	• Voltage low side < 1.87 – 2.26 V (hardware values)	• Ignition on • Or • Ignition off (during ECM keep alive-time) • And • Actuator commanded off			

DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0092 Fuel Pressure Regulator 1 Control Circuit High	Fuel Control Valve Short To Battery Plus (Low Side)	• Current low side (hardware values) driver stage internal value	• Ignition on • Or • Ignition off (during ECM keep alive-time) • And • Actuator commanded on	• 0.8 s • Continuous	• 2 DCY	– Check the Fuel Pressure Regulator Valve - N276- . Refer to ⇒ “3.6.16 Fuel Pressure Regulator Valve N276 , Checking”, page 489 .
	Fuel Control Valve Short To Battery Plus (High Side)	• Voltage high side (hardware values) < 2.78 – 3.33 V	• Ignition on • Or • Ignition off (during ECM keep alive-time) • And • Actuator commanded off			
P00B7 Engine Coolant Flow Low/ Performance	Rotary Coolant Valve Functional Check	• Diff. previous and actual position of RVC < 4.0°	• ECT @ cylinder head > 11° C • RCV position 0.00 – 270.0° • Diff. previous actual and target position of RCV > 5.0° • And • RCV adaptation finished • Or • RCV adaptation not active	• 3.0 s • Continuous	• 2 DCY	– Check coolant system for leaks or damage. – Check the Engine Temperature Control Actuator - N493- . Refer to ⇒ “3.6.12 Engine Temperature Control Actuator N493 , Checking”, page 481 . .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0106 Manifold Absolute Pressure/ Barometric Pressure Sensor Circuit Range/ Performance	Manifold Pressure Sensor By Engine Standing: Rationality Check During ECM Keep Alive-Time:	• Case 1: • Diff. barometric pressure vs. intake manifold pressure >= 8.50 kPa • Diff. upstream throttle pressure vs. intake manifold pressure > 8.50 kPa • Diff. barometric pressure vs. upstream throttle pressure < 8.50 kPa • Case 2: • Intake manifold pressure (raw value) < 25.00; > 125.00 kPa • Case 3; • Diff. barometric pressure vs. intake manifold pressure n.a. kPa • Diff. upstream throttle pressure vs. intake manifold pressure n.a. kPa • Diff. barometric pressure vs. upstream throttle pressure n.a. kPa • Diff. intake manifold pressure vs. intake manifold pressure @ idle or low part load n.a. kPa • Case 4: • Diff. barometric pressure vs. intake manifold pressure n.a. kPa • Diff. upstream throttle pressure vs. intake manifold pressure n.a. kPa	• Engine stopped • Ignition off • Vehicle speed < 1 mph • ECM keep alive time > 10.0 s • Delay time after engine stop >= 5.0 s • Barometric pressure sensor voltage 0.20 - 4.80 V • MAP sensor voltage 0.20 – 4.80 V • Turbocharger boost pressure sensor voltage 0.20 – 4.80 V	• 3.0 s • Once / DCY	• 2 DCY	– Check the Intake Manifold Sensor - GX9- . Refer to ⇒ “3.6.23 Intake Manifold Sensor GX9 , Checking”, page 505 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Diff. barometric pressure vs. upstream throttle pressure n.a. kPa • Diff. intake manifold pressure vs. intake manifold pressure @ idle or low part load n.a. kPa				
	Intake Air System Rationality Check	• General conditions: • Filtered lambda controller included correction and adaptation < -30.0 % • And • Deviation throttle area controller > 45.0 %	• Throttle position > 0.0° TPS • Throttle position < 100.003° TPS • Engine speed > 576; < 3008 RPM • Modeled pressure quotient > 0.27; < 0.57 [-] • Engine running • Throttle actuator commanded on • Time after engine start > 5.0 s • Throttle position sensor failure not detected • Fuel cut off not active • Fast throttle adaptation finished • Gradient intake manifold pressure -199.90 – 199.90 kPa/s • Barometric pressure plausibility diagnosis finished • Intake manifold modeled adaptation active • And • Choice of: • MAF sensor active • Or	• 5.0 s • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• General conditions: • Filtered lambda controller included correction and adaptation > 30.0 % • And • Deviation throttle area controller < -45.0 %	• Manifold pressure sensor active • And • Choice of: • pressure upstream throttle < 135.00 kPa • Or • Pressure upstream throttle not active • And • Choice of: • BARO > 73.00; < 107.50 [kPa] • Or • Barometric pressure sensor not active			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0107 Manifold Absolute Pressure/ Barometric Pressure Sensor Circuit Low	Manifold Pressure Sensor Short To Ground	• Intake manifold pressure sensor voltage < 0.20 V		• 0.5 s • Continuous	• 2 DCY	– Check the Intake Manifold Sensor - GX9- . Refer to ⇒ “3.6.23 Intake Manifold Sensor GX9 , Checking”, page 505 .
P0108 Manifold Absolute Pressure/ Barometric Pressure Sensor Circuit High	Manifold Pressure Sensor Short To Battery Voltage	• Intake manifold pressure sensor voltage > 4.80 V		• 0.5 s • Continuous	• 2 DCY	– Check the Intake Manifold Sensor - GX9- . Refer to ⇒ “3.6.23 Intake Manifold Sensor GX9 , Checking”, page 505 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0111 Intake Air Temperature Sensor 1 Circuit Range/ Performance Bank 1	Intake Air Temperature Sensor @ Manifold Cross Check	• High side: reference measuring • Diff. IAT @ manifold @ cold start vs. AAT @ cold start > 25.0 K • Diff. IAT @ manifold @ cold start vs. ECT @ cylinder head @ cold start n.a. K • Diff. IAT @ manifold @ cold start vs. ECT @ radiator outlet @ cold start > 25.0 K • Min. amount of faulty reference measurements to detect defective sensor 2.00 [-] • Or • Low side: reference measuring • Diff. AAT @ cold start vs. IAT @ manifold @ cold start > 25.0 K • Diff. ECT @ cylinder head @ cold start vs. IAT @ manifold @ cold start > 25.0 K • Diff. ECT @ radiator outlet @ cold start vs. IAT @ manifold @ cold start > 25.0 K • Min. amount of faulty reference measurements to detect defective sensor 2.00 [-]	• Engine off time >= 360.00 min • Engine off time plausible • Time after engine start <= 1400.0 s • Depending on temperature slope • Diff. actual vs previous IAT < 256.0 K • Diff. actual vs previous ECT@ cylinder head n.a. K • Diff. actual vs previous ECT@ radiator outlet < 256.0 K • Diff. actual vs previous AAT < 256.0 K • For time >= 1.0 s • Depending on mean value condition • Mean value of all temperature sensors @ cold start >= -256° C • Number of valid sensors >= 2.00 [-] • Depending on block heater / solar radiation detection • Time after engine start >= 0.5 s • Vehicle speed >= 22 mph • For time >= 20.0 s • Diff. actual IAT @ manifold vs. min. IAT @ manifold < 5.0 K • Diff. actual ECT @ cylinder head vs. min. ECT @ cylinder head n.a. K	• 0.1 s • Once / DCY	• 2 DCY	– Check the Intake Manifold Sensor - GX9- . Refer to ⇒ “3.6.23 Intake Manifold Sensor GX9 , Checking”, page 505 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Diff. actual AAT vs. min. AAT < 4.0 K • Diff. actual ECT @ radiator outlet vs. min. ECT @ radiator outlet < 1.1 K			
P0112 Intake Air Temperature Sensor 1 Circuit Low Bank 1	Intake Air Temperature Sensor Short To Ground	• IAT sensor voltage < 0.10 V		• 0.5 s • Continuous		
P0113 Intake Air Temperature Sensor 1 Circuit High Bank 1	Intake Air Temperature Sensor open circuit	• IAT sensor voltage > 4.50 V				
P0116 Engine Coolant Temperature Sensor 1 Circuit Range/ Performance	Engine Coolant Temperature Sensor @ Cylinder Head Rationality Check Inappropriately Low	• Diff. min temperature of cross check sensors vs. ECT @ cylinder head @ engine start >= 25° C	• Cross checks finished	• 1.0 s • Once / DCY	• 2 DCY	– Check the Engine Coolant Temperature Sensor - G62- . Refer to ⇒ “3.6.9 Engine Coolant Temperature Sensor G62 , Checking”, page 475 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Engine Coolant Temperature Sensor @ Cylinder Head Rationality Check High	• Difference between maximum and minimum temperature of ECT @ cylinder head < 1° C • ECT @ cylinder head @ engine start > 40 – 80° C	• ECT @ cylinder head > -256° C • IAT @ throttle -48...143° C • Depending on thermostat control: • ECT @ cylinder head n.a.° C • Or • ECT @ cylinder head n.a.° C • Engine n.a. • And • Engine part load • Or • Engine full load • Engine speed > 1300 rpm • Vehicle speed >= 12 mph • Engine load > 2.00 % • For time >= 20.0 – 43.0 s • Engine idle • Vehicle speed < 3 mph • Or • Fuel cut off active • Or • Engine stop for time >= 20.0 – 43.0 s • Time after engine start > 100 s			
	Engine Coolant Temperature Sensor @ Cylinder Head Rationality Check Low	• Difference between modelled and measured cylinder head temperature > 5° C	• ECT @ cylinder head -128 – 127° C • Time after engine start > 60.0 s	• 30 s • Once / DCY		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0117 Engine Coolant Temperature Sensor 1 Circuit Low	Engine Coolant Temperature Sensor @ Cylinder Head Short To Ground	• ECT sensor voltage @ cylinder head < 0.30 V		• 0.5 s • Continuous	• 2 DCY	– Check the Engine Coolant Temperature Sensor - G62- . Refer to ⇒ “3.6.9 Engine Coolant Temperature Sensor G62 , Checking”, page 475 .
P0118 Engine Coolant Temperature Sensor 1 Circuit High	Engine Coolant Temperature Sensor @ Cylinder Head Short To Battery / Open Circuit	• ECT sensor voltage @ cylinder head > 4.90 V	• Modeled IAT @ throttle >= -33° C • Time after engine start > 60.0 s	• 0.5 s • Continuous	• 2 DCY	– Check the Engine Coolant Temperature Sensor - G62- . Refer to ⇒ “3.6.9 Engine Coolant Temperature Sensor G62 , Checking”, page 475 .
P0121 Throttle/ Pedal Position Sensor/ Switch "A" Circuit Range/ Performance	Throttle Position Sensor 1 Rationality Check	• Normalized difference between measured and modeled value of mass air flow from TPS 1 >= 1.00 [-] • Or • Relative mass air flow integral from TPS 1 > 60.0 [-]	• Throttle adaptation not active	• 0.01 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .
		• Difference between TPS 1 and TPS 2 > 6.499° TPS		• 0.3 s • Continuous		
P0122 Throttle/ Pedal Position Sensor/ Switch "A" Circuit Low	Throttle Position Sensor 1 Short To Ground / open circuit	• Throttle position sensor 1 voltage < 0.15 V		• 0.2 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .
P0123 Throttle/ Pedal Position Sensor/ Switch "A" Circuit High	Throttle Position Sensor 1 Short To Battery Voltage	• Throttle position sensor 1 voltage > 4.85 V		• 0.2 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0131 O2 Sensor Circuit Low Voltage Bank 1 Sensor 1	Oxygen Sensors Front Short To Ground	• O2S sensor voltage < 0.15 V	• Engine running	• 0.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .
P0132 O2 Sensor Circuit High Voltage Bank 1 Sensor 1	Oxygen Sensors Front Short To Battery Voltage	• O2S sensor voltage > 5.20 – 5.35 V	• Engine running	• 0.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0133 O2 Sensor Circuit Slow Response Bank 1 Sensor 1	Oxygen Sensors Front Response Check	• Dynamic Path: • Lambda value vs. modeled lambda value >= 1.10 [-] • Or • Ratio of failed diagnostic cycle > n.a. [-]	• General conditions: • Injection mode change (DFI/MFI) not active • ECT @ cylinder head >= -48° C • Vehicle speed > 0 mph • Integrated air mass after gear change > 0.0 g • Air mass , lower range >= 0.00 mg/rev • Air mass , upper range <= 1389.00 mg/rev • Counter of integrated mass for fuel in oil < 255.00 [-] • And • Time after engine start >= 0.0 s • Or • Integrated air mass per cylinder >= 0.00 kg • Depending on canister and catalyst purge: • Evap purge n.a. • Or • Evap purge n.a. • Or • Evap purge n.a. • Canister load calculation n.a. • Or • Evap purge n.a. • Canister load n.a. [-] • And • Case 1: • O2S front n.a.	• 2.4 s • Once / DCY	• 1 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Lambda stimulation n.a. • Upper limit of lambda controller output n.a. • Lower limit of lambda controller output n.a. • Engine speed n.a. rpm • Air mass n.a. mg/rev • MAF n.a. kg/h • Catalyst purge n.a. • And • Depending on limited dynamic conditions: • Integrated air mass n.a. g • Dynamic engine speed n.a. g • Dynamic air mass n.a. mg/rev • Dynamic lambda n.a. % • Or • Dynamic engine speed n.a. rpm • Diff. actual engine load vs. filtered engine load in limited dynamic conditions, lower range n.a. kg/h • Diff. actual engine load vs. filterd engine load in limited dynamic conditions, upper range n.a. kg/h • Dynamic torque n.a. [-] • Case 2: lambda set value adjustment for conditioning and measuring active			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Delay path: • Lambda delay value vs. modeled lambda value > 1.10 [-]	• General conditions: • MAF >= 0.0 mg/rev • MAF <= 1,389.0 mg/rev • Vehicle speed >= 0 mph • Time after engine start >= 0.0 s • Integrated mass for fuel in oil < 255.0 [-] • Engine speed 1,216 – 3,008 RPM • MAF (intake air rate) 20.0 – 150.0 kg/h • Vehicle speed >= 3 mph • Integrated MAF per cylinder >= 0.30 – 2.0 kg • Depending on dynamic conditions: • Dynamic engine speed < 288 RPM • Dynamic torque < 80.0 Nm • Dynamic MAF < 70.0 kg/h • For time >= 0.6 s • And depending on canister and catalyst purge: • Evap purge n.a. • Or • Canister load calculation n.a • Or • Canister load <= n.a. [-]	• 13.2 s • Once / DCY		

DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0135 O2 Sensor Heater Circuit Bank 1 Sensor 1	Oxygen Sensors Heater Front Functional Check	• O2S ceramic temperature, < 630° C	• O2S heater commanded on • For time >= 10.0 s	• 20 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .
P0137 O2 Sensor Circuit Low Voltage Bank 1 Sensor 2	Oxygen Sensors Rear Short To Ground	• O2S sensor voltage < 0.15 V	• O2S heater active	• 0.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .
P0138 O2 Sensor Circuit High Voltage Bank 1 Sensor 2	Oxygen Sensors Rear Short To Battery	• O2S sensor voltage > 5.2 – 5.35 V	• O2S heater active	• 0.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P013A O2 Sensor Slow Response - Rich to Lean Bank 1 Sensor 2	Oxygen Sensors Rear Response Check	• Gradient sensor voltage < 900.00 mV/s	• General conditions: • Intrusive lambda ramp request not active • Internal resistance O2S rear <= 700.00 Ohm • Counter of integrated mass for fuel in oil < 255.00 [-] • Catalyst monitor lambda modulation request active • Vehicle speed 19 – 158 mph • Barometric pressure >= 0.00 kPa • Catalyst overheating protection not active • Turbine overheating protection not active • O2S rear ready • O2S front ready • ECT @ cylinder head > 60° C • IAT @ manifold > -48° C • Modeled catalyst temperature @ start of diagnosis > 510° C • Modeled catalyst temperature @ during diagnosis 470 – 830° C • Diff. between dynamic and stationary catalyst temperature -150 – 150° C • Integrated air mass, catalyst temp. conditions fulfilled >= 0.0 g • Modeled EGT @ O2S rear <= 900° C	• 0 FTP75: 50 s • Once / DCY	• 1 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• MAF per cylinder 22.50 – 150.00 kg/h • Air mass , lower range >= 0.00 mg/rev • Air mass , upper range <= 650.00 – 1389.00 mg/rev • And • Engine load n.a. % • Air mass setpoint n.a. g/rev • Accelerator pedal value n.a. % • For time n.a. s • And • Low dynamic conditions • Dynamic engine speed < 50 rpm • Dynamic air mass < 50.00 mg/rev • Dynamic lambda controller output < 20.00 % • And • Integrated air mass after dynamic conditions are fulfilled > 20.0 g • Time after a catalyst purge phase >= 1.0 s • O2S rear voltage @ diagnosis start >= 0.55 V • Integrated air mass >= 0.0 g • Integrated heat energy >= 550 – 700 kJ • Engine speed 1,088 – 3,008 rpm • Deviation of lambda controller output < 50.00 %			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Proportional part of secondary fuel control loop not calibrated • Coasting function not active • O2S heater rear active • Lambda adaptation not active • Valve lift not active • And • Depending on Lambda control: • Sum of integral and proportional part of secondary fuel control loop before diagnosis < 0.10 [-] • Or • Sum of integral and proportional part of secondary fuel control loop during diagnosis < 0.25 [-] • Depending on canister purge: • Canister load n.a. [-] • Evap purge flow n.a. • Or • Canister load calculation n.a. • Evap purge flow n.a. • Or • Evap purge valve n.a. • Or • Evap purge valve n.a. • Or • Evap purge n.a. • Or			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Depending on canister purge closing: • Canister purge (conditions) n.a. • Canister purge valve (closing time) n.a. s • And • Choice of: • Evap purge valve n.a. • Or • Evap purge valve n.a. • And • Modeled air mass integral > 50.0 g • Integrated air mass per cylinder >= 1.40 – 1.80 kg			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P013B O2 Sensor Slow Response - Lean to Rich Bank 1 Sensor 2	Oxygen Sensors Rear Response Check	• Gradient sensor voltage < 900.00 mV/s	• General conditions: • Intrusive lambda ramp request not active • Internal resistance O2S rear <= 700.00 Ohm • Counter of integrated mass for fuel in oil < 255.00 [-] • Catalyst monitor lambda modulation request active • Vehicle speed >= 19 mph • Barometric pressure >= 0.00 kPa • Catalyst overheating protection not active • Turbine overheating protection not active • O2S rear ready • O2S front ready • ECT @ cylinder head > 60° C • IAT @ manifold > -48 ° C • Modeled catalyst temperature @ start of diagnosis 510 – 1,775° C • Modeled catalyst temperature @ during diagnosis 470 – 830° C • Diff. between dynamic and stationary catalyst temperature -150 – 150° C • Integrated air mass, catalyst temp. conditions fulfilled >= 0.0 g • Modeled EGT @ O2S rear 0 – 900° C	• 0 FTP75: 50 s • Once / DCY	• 1 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• MAF per cylinder 22.50 – 150.00 kg/h • Air mass , lower range >= 0.00 mg/rev • Air mass , upper range <= 650.00 – 1,389.00 mg/rev • And • Engine load n.a. % • Air mass setpoint n.a. [g/rev] • Accelerator pedal value n.a. % • For time n.a. s • And • Low dynamic conditions • Dynamic engine speed < 50 rpm • Dynamic air mass < 50,000 mg/rev • Dynamic lambda controller output < 20.00 % • And • Integrated air mass after dynamic conditions are fulfilled > 20.0 g • Time after a catalyst purge phase >= 1.0 s • O2S rear voltage @ diagnosis start >= 0.55 V • Integrated air mass >= 0.0 g • Integrated heat energy >= 550 – 700 kJ • Engine speed 1,088 – 3,008 rpm			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Deviation of lambda controller output < 50.00 % • Proportional part of secondary fuel control loop not calibrated % • Coasting function not active • O2S heater rear active • Lambda adaptation not active • Valve lift not active • And • Depending on Lambda control: • Sum of integral and proportional part of secondary fuel control loop before diagnosis < 0.10 [-] • Or • Sum of integral and proportional part of secondary fuel control loop during diagnosis < 0.25 [-] • Depending on canister purge: • Canister load n.a. [-] • Evap purge flow n.a. • Or • Canister load calculation n.a. • Evap purge flow n.a. • Or • Evap purge valve n.a. • Or • Evap purge valve n.a. • Or			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Evap purge n.a. • Or • Depending on canister purge closing: • Canister purge (conditions) n.a. • Canister purge valve (closing time) n.a. s • And • Choice of: • Evap purge valve n.a. • Or • Evap purge valve n.a. • And • Modeled air mass integral > 50.0 g • Integrated air mass per cylinder >= 1.45 – 1.80 kg			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P013E O2 Sensor Delayed Response - Rich to Lean Bank 1 Sensor 2	Oxygen Sensors Rear Delayed Response Monitoring, Delay Measurement	• Sensor signal delay time > 0.9 s	• General conditions: • Intrusive lambda ramp request not active • Catalyst monitor lambda modulation request active • Vehicle speed >= 19 mph • Barometric pressure >= 0.00 kPa • Catalyst overheating protection not active • Turbine overheating protection not active • O2S rear ready • O2S front ready • ECT @ cylinder head > 60° C • IAT @ manifold > -48° C • Modeled catalyst temperature @ start of diagnosis > 510° C • Modeled catalyst temperature @ during diagnosis 470 – 830° C • Diff. between dynamic and stationary catalyst temperature -150 – 150° C • Integrated air mass, catalyst temp. conditions fulfilled >= 0.0 g • Modeled EGT @ O2S rear <= 900° C • MAF per cylinder 22.50 – 150.00 kg/h • Air mass , lower range >= 0.00 mg/rev	• 0 FTP75: 50 s • Once / DCY	• 1 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Air mass , upper range <= 650.00 – 1,389.00 mg/rev • And • Engine load n.a. % • Air mass setpoint n.a. g/rev • Accelerator pedal value n.a. % • For time n.a. [s] • And • Low dynamic conditions • Dynamic engine speed < 50 rpm • Dynamic air mass < 50.00 mg/rev • Dynamic lambda controller output < 20.00% • And • Integrated air mass after dynamic conditions are fulfilled > 20.0 g • Time after a catalyst purge phase >= 1.0 s • O2S rear voltage @ diagnosis start >= 0.55 V • Integrated air mass >= 0. [g • Integrated heat energy >= 550.00 – 700.00 kJ • Engine speed 1,088 – 3,008 rpm • Deviation of lambda controller output < 50.00% • Proportional part of secondary fuel control loop not calibrated [%]			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Coasting function not active • O2S heater rear active • Lambda adaptation not active • Valve lift not active • And • Depending on Lambda control: • Sum of integral and proportional part of secondary fuel control loop before diagnosis < 0.10 [-] • Or • Sum of integral and proportional part of secondary fuel control loop during diagnosis < 0.25 [-] • Depending on canister purge: • Canister load n.a. [-] • Evap purge flow n.a. • Or • Canister load calculation n.a. • Evap purge flow n.a. • Or • Evap purge valve n.a. • Or • Evap purge valve n.a. • Or • Evap purge n.a. • Or • Depending on canister purge closing: • Canister purge (conditions) n.a.			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Canister purge valve (closing time) n.a. [s] • And • Choice of: • Evap purge valve n.a. • Or • Evap purge valve n.a. • And • Modeled air mass integral > 50.0 g • Integrated air mass per cylinder >= 1.40 – 1.80 kg			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P013F O2 Sensor Delayed Response - Lean to Rich Bank 1 Sensor 2	Oxygen Sensors Rear Delayed Response Monitoring, Delay Measurement	• Sensor signal delay time > 1.5 s	• General conditions: • Intrusive lambda ramp request not active • Catalyst monitor lambda modulation request active • Vehicle speed >= 19 mph • Barometric pressure >= 0.00 kPa • Catalyst overheating protection not active • Turbine overheating protection not active • O2S rear ready • O2S front ready • ECT @ cylinder head > 60° C • IAT @ manifold > -48° C • Modeled catalyst temperature @ start of diagnosis > 510° C • Modeled catalyst temperature @ during diagnosis 470 – 830° C • Diff. between dynamic and stationary catalyst temperature -150 – 150° C • Integrated air mass, catalyst temp. conditions fulfilled >= 0.0 g • Modeled EGT @ O2S rear <= 900° C • MAF per cylinder 22.50 – 150.00 kg/h • Air mass , lower range >= 0.00 mg/rev	• 0 (FTP75: 50) s • Once / DCY	• 1 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Air mass , upper range <= 650.00 – 1,389.00 mg/rev • And • Engine load n.a. % • Air mass setpoint n.a. g/rev • Accelerator pedal value n.a. % • For time n.a. s • And • Low dynamic conditions • Dynamic engine speed < 50 rpm • Dynamic air mass < 50.00 mg/rev • Dynamic lambda controller output < 20.00 % • And • Integrated air mass after dynamic conditions are fulfilled > 20.0 g • Time after a catalyst purge phase >= 1.0 s • O2S rear voltage @ diagnosis start >= 0.55 V • Integrated air mass >= 0.0 g • Integrated heat energy >= 550.00 – 700.00 kJ • Engine speed 1,088 – 3,008 rpm • Deviation of lambda controller output < 50.00 % • Proportional part of secondary fuel control loop not calibrated			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Coasting function not active • O2S heater rear active • Lambda adaptation not active • Valve lift not active • And • Depending on Lambda control: • Sum of integral and proportional part of secondary fuel control loop before diagnosis < 0.10 [-] • Or • Sum of integral and proportional part of secondary fuel control loop during diagnosis < 0.25 [-] • Depending on canister purge: • Canister load n.a. [-] • Evap purge flow n.a. • Or • Canister load calculation n.a. • Evap purge flow n.a. • Or • Evap purge valve n.a. • Or • Evap purge valve n.a. • Or • Evap purge n.a. • Or • Depending on canister purge closing: • Canister purge (conditions) n.a.			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Canister purge valve (closing time) n.a. s • And • Choice of: • Evap purge valve n.a. • Or • Evap purge valve n.a. • And • Modeled air mass integral > 50.0 g • Integrated air mass per cylinder >= 1.40 – 1.80 kg			
P0140 O2 Sensor Circuit No Activity Detected Bank 1 Sensor 2	Oxygen Sensors Rear Open Circuit	• Internal resistance of O2S (binary) > 25,000.0 Ohm		• 2.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .
P0141 O2 Sensor Heater Circuit Bank 1 Sensor 2	Oxygen Sensors Heater Rear Out Of Range High	• Internal resistance of O2S (binary) 700.0 – 25,000.0 Ohm	• O2S heater commanded on • For time >= 10.0 s	• 20 s • Once / DCY	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .
P0149 Fuel Timing Error	Injection Valves Supply Voltage Out Of Range Low	• Boost voltage < 30.0 V • Boost voltage <= 50.0 V	• Engine running >= 0.3 s	• 3.6 s • Continuous	• 2 DCY	– Check the Engine Control Module - J623- . Refer to appropriate repair manual.
	Injection Valves Supply Voltage Out Of Range High	• Boost voltage > 75.0 V				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0171 System Too Lean Bank 1	Fuel System, System Too Lean	• Lambda controller output > 35.0 %	• Lambda control closed loop • Mass air flow > 60.0 mg/rev • Engine speed > 576 RPM • ECT @ cylinder head > 20° C • IAT at intake manifold > -48° C • AAT > -48° C • And • Evap purge valve closed • Or • Canister load <= 1.20 [-] • Evap purge flow at max. value • Or • Depending on canister purge min: • Lower limit of lambda controller output n.a. • Or • Upper limit of lambda controller output n.a. • And • Evap purge flow at min. value	• 60 s • Continuous	• 2 DCY	– Check the intake and vacuum hoses for leaks, Check the Positive Crankcase Ventilation, also make sure the oil dipstick is properly secured. – Listen to and visually inspect the Exhaust system to insure there are no leaks. – Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10- Checking”, page 516 . – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7- Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0172 System Too Rich Bank 1	Fuel System, System Too Rich	• Lambda controller output < -35.0 %	• Lambda control closed loop • Mass air flow > 60.0 mg/rev • Engine speed > 576 RPM • ECT @ cylinder head > 20° C • IAT at intake manifold > -48° C • AAT > -48° C • Oil dilution not detected • And • Evap purge valve closed • Or • Canister load <= 1.20 [-] • Evap purge flow at max. value • Or • Depending on canister purge min: • Lower limit of lambda controller output n.a. • Or • Upper limit of lambda controller output n.a. • And • Evap purge flow at min. value	• 60 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 . – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 . – Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 . – Check the Evaporative Emission System for contamination. Refer to appropriate repair manual.
P0190 Fuel Pressure Regulator 1 Control Circuit/ Open	Fuel System Pressure Sensor High Pressure Side Short To Battery / Open Circuit	• High fuel pressure sensor voltage > 4.80 V		• 2.0 s • Continuous	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.17 Fuel Pressure Sensor G247 , Checking”, page 491 . – Check the fuel pressure. Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0191 Fuel Rail Pressure Sensor Circuit Range/ Performance Bank 1	Fuel Rail High Pressure Side Out Of Range High	• Fuel pressure > 26,500.18 kPa	• Engine running • Engine speed < 6,816 RPM • Time after engine start > 10.0 s	• 5.0 s • Continuous	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.17 Fuel Pressure Sensor G247 , Checking”, page 491 . – Check the fuel pressure. Refer to appropriate repair manual.
P0192 Fuel Rail Pressure Sensor Circuit Low Bank 1	Fuel System Pressure Sensor High Pressure Side Short To Ground	• High fuel pressure sensor voltage < 0.20 V		• 2.0 s • Continuous	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.17 Fuel Pressure Sensor G247 , Checking”, page 491 . – Check the fuel pressure. Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0201 Cylinder 1 Injector "A" Circuit	Injection Valves Electrical Error	• Indeterminate fault pattern via power stage diagnosis detected • And • Injector low side voltage < 2.0 V • Injector low side switch current driver stage internal value • Or • Injector low side voltage < 2.0 V • Injector high side switch current driver stage internal value • Or • Injector low side voltage < 2.0 V • Injector low side switch current (hardware values) driver stage internal value • Or • Injector voltage < 2.0 V • Injector low side switch current driver stage internal value • Or • Injector voltage < 2.0 V • Injector low side switch current (hardware values) driver stage internal value • Or	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0 s CRK • Continuous	2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Injector load resistance to ground and battery > 20.0 Ohm • Injector low side switch current driver stage internal value • Or • Injector load resistance to ground and battery > 20.0 Ohm • Injector high side switch current driver stage internal value • Or • Power stage temperature > 150° C				
	Injection Valves Electrical Error Open Circuit	• Fault pattern for open circuit via power stage diagnosis detected • Injector low side voltage < 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s			
	Injection Valves Electrical Error Short Circuit	• Fault pattern for short circuit via power stage diagnosis detected • Injector current rise time during peak phase < 0.064 ms				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0202 Cylinder 2 Injector "A" Circuit	Injection Valves Electrical Error	• Indeterminate fault pattern via power stage diagnosis detected • And • Injector low side voltage < 2.0 V • Injector low side switch current driver stage internal value • Or • Injector low side voltage < 2.0 V • Injector high side switch current driver stage internal value • Or • Injector low side voltage < 2.0 V • Injector low side switch current (hardware values) driver stage internal value • Or • Injector voltage < 2.0 V • Injector low side switch current driver stage internal value • Or • Injector voltage < 2.0 V • Injector low side switch current (hardware values) driver stage internal value • Or	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0 s CRK • Continuous	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Injector load resistance to ground and battery > 20.0 Ohm • Injector low side switch current driver stage internal value • Or • Injector load resistance to ground and battery > 20.0 Ohm • Injector high side switch current driver stage internal value • Or • Power stage temperature > 150° C				
	Injection Valves Electrical Error Open Circuit	• Fault pattern for open circuit via power stage diagnosis detected • Injector low side voltage < 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s			
	Injection Valves Electrical Error Short Circuit	• Fault pattern for short circuit via power stage diagnosis detected • Injector current rise time during peak phase < 0.064 ms				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0203 Cylinder 3 Injector "A" Circuit	Injection Valves Electrical Error	• Indeterminate fault pattern via power stage diagnosis detected • And • Injector low side voltage < 2.0 V • Injector low side switch current driver stage internal value • Or • Injector low side voltage < 2.0 V • Injector high side switch current driver stage internal value • Or • Injector low side voltage < 2.0 V • Injector low side switch current (hardware values) driver stage internal value • Or • Injector voltage < 2.0 V • Injector low side switch current driver stage internal value • Or • Injector voltage < 2.0 V • Injector low side switch current (hardware values) driver stage internal value • Or	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0 s CRK • Continuous	2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Injector load resistance to ground and battery > 20.0 Ohm • Injector low side switch current driver stage internal value • Or • Injector load resistance to ground and battery > 20.0 Ohm • Injector high side switch current driver stage internal value • Or • Power stage temperature > 150° C				
	Injection Valves Electrical Error Open Circuit	• Fault pattern for open circuit via power stage diagnosis detected • Injector low side voltage < 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s			
	Injection Valves Electrical Error Short Circuit	• Fault pattern for short circuit via power stage diagnosis detected • Injector current rise time during peak phase < 0.064 ms				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0204 Cylinder 4 Injector "A" Circuit	Injection Valves Electrical Error	• Indeterminate fault pattern via power stage diagnosis detected • And • Injector low side voltage < 2.0 V • Injector low side switch current driver stage internal value • Or • Injector low side voltage < 2.0 V • Injector high side switch current driver stage internal value • Or • Injector low side voltage < 2.0 V • Injector low side switch current (hardware values) driver stage internal value • Or • Injector voltage < 2.0 V • Injector low side switch current driver stage internal value • Or • Injector voltage < 2.0 V • Injector low side switch current (hardware values) driver stage internal value • Or	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0 s CRK • Continuous	2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Injector load resistance to ground and battery > 20.0 Ohm • Injector low side switch current driver stage internal value • Or • Injector load resistance to ground and battery > 20.0 Ohm • Injector high side switch current driver stage internal value • Or • Power stage temperature > 150° C				
	Injection Valves Electrical Error Open Circuit	• Fault pattern for open circuit via power stage diagnosis detected • Injector low side voltage < 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s			
	Injection Valves Electrical Error Short Circuit	• Fault pattern for short circuit via power stage diagnosis detected • Injector current rise time during peak phase < 0.064 ms				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0221 Throttle/ Pedal Position Sensor/ Switch "B" Circuit Range/ Performance	Throttle Position Sensor 2 Rationality Check	• Normalized difference between measured and modeled value of mass air flow from TPS 2 >= 1.0 [-] • Or • Relative mass air flow integral from TPS 2 > 60.00 -	• Throttle adaptation (@ initial start or after detection of throttle exchange or checksum error) not active	• 0.01 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .
P0222 Throttle/ Pedal Position Sensor/ Switch "B" Circuit Low	Throttle Position Sensor 2 Short To Ground / Open Circuit	• Throttle position sensor 2 voltage < 0.15 V		• 0.2 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .
P0223 Throttle/ Pedal Position Sensor/ Switch "B" Circuit High	Throttle Position Sensor 2 Short To Battery Voltage	• Throttle position sensor 2 voltage > 4.85 V		• 0.2 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .
P0230 Fuel Pump Circuit	COM: Fuel Pump Control Module (FPCM) communication with FPCM	• FP sensor: short to ground failure feedback >= 2.00 [-]	• Engine on	• 2.0 s • Continuous	• 2 DCY	
		• FP sensor: open circuit failure feedback >= 2.00 [-]		• 2.2 s • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0236 Turbocharger/ Supercharger Boost Sensor "A" Circuit Range/ Performance	Turbocharger Boost Pressure Sensor Rationality Check	• Diff. barometric pressure vs. upstream throttle pressure >= 8.50 kPa • Diff. upstream throttle pressure vs. intake manifold pressure >= 8.50 kPa • Or • Diff. barometric pressure vs. intake manifold pressure < 8.50 kPa	• Case 1: • Engine stop at start of DCY • Engine stopped • Vehicle speed < 1 mph • Delay after engine stop >= 5.0 s • Case 2: • Engine stop during DCY • Engine stopped • Vehicle speed < 1 mph • Delay after engine stop >= 5.0 s • For time >= 10.0 s	• 3.0 s • Once / DCY	• 2 DCY	– Check the Charge Air Pressure Sensor - G31- . Refer to ⇒ "3.6.6 Charge Air Pressure Sensor G31 , Checking", page 468 .
P0237 Turbocharger/ Supercharger Boost Sensor "A" Circuit Low	Turbocharger Boost pressure Sensor Short To Ground	• Turbocharger boost pressure sensor voltage < 0.20 V		• 0.5 s • Continuous	• 2 DCY	– Check the Charge Air Pressure Sensor - G31- . Refer to ⇒ "3.6.6 Charge Air Pressure Sensor G31 , Checking", page 468 .
P0238 Turbocharger/ Supercharger Boost Sensor "A" Circuit High	Turbocharger Boost pressure Sensor Short To Battery Voltage	• Turbocharger boost pressure sensor voltage > 4.80 V		• 0.5 s • Continuous	• 2 DCY	– Check the Charge Air Pressure Sensor - G31- . Refer to ⇒ "3.6.6 Charge Air Pressure Sensor G31 , Checking", page 468 .
P025A Fuel Pump Module "A" Control Circuit/ Open	Fuel Pump Open Circuit	• Signal voltage, lower range > 1.92 – 2.21 V • And • Signal voltage, upper range (hardware values) < 2.84 – 3.25 V	• Commanded PWM 9.80 – 92.20 % • Fuel pump commanded off	• 0.5 s • Continuous	• 2 DCY	– Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ "3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking", page 493 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P025C Fuel Pump Module "A" Control Circuit Low	Fuel Pump Short To Ground	• Signal voltage (hardware values) < 1.92 – 2.21 V	• Commanded PWM 9.80 – 92.20 % • Fuel pump commanded off	• 3.0 s • Continuous	• 2 DCY	– Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 .
P025D Fuel Pump Module "A" Control Circuit High	Fuel Pump Short To Battery Voltage	• Power stage temperature > 160 – 200° C • Or • Signal current (hardware values) driver stage internal value	• Commanded PWM 9.80 – 92.20 % • Fuel pump commanded on	• 0.5 s • Continuous	• 2 DCY	– Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 .
P0261 Cylinder 1 Injector "A" Circuit Low	Injection Valves Short To Ground	• Fault pattern for short to ground via powerstage diagnosis detected • Injector voltage < 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .
	Injection Valves Short To Ground (High Side)	• Injector driver voltage < 2 V • And • Injector driver high side switch current (hardware values) driver stage internal value	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 ms	• 720° CRK • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Injection Valves Short To Ground (Low Side)	• Injector driver voltage < 2 V • And • Injector driver high side switch current driver stage internal value • And • Injector driver low side switch current (hardware values) driver stage internal value				
P0262 Cylinder 1 Injector "A" Circuit High	Injection Valves Short To Battery Plus	• Fault pattern for short to Battery plus via powerstage diagnosis detected • Injector voltage > 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .
	Injection Valves Short To Battery Plus (High Side)	• Injector driver voltage > 2.0 V • And • Injector driver high side switch current (hardware values) driver stage internal value	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 720° CRK • Continuous		
	Injection Valves Short To Battery Plus (Low Side)	• Injector driver voltage > 2.0 V • And • Injector driver low side switch current (hardware values) driver stage internal value				
P0264 Cylinder 2 Injector "A" Circuit Low	Injection Valves Short To Ground	• Fault pattern for short to ground via powerstage diagnosis detected • Injector voltage < 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Injection Valves Short To Ground (High Side)	• Injector driver voltage < 2 V • And • Injector driver high side switch current (hardware values) driver stage internal value	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 720° CRK • Continuous		
	Injection Valves Short To Ground (Low Side)	• Injector driver voltage < 2 V • And • Injector driver high side switch current driver stage internal value • And • Injector driver low side switch current (hardware values) driver stage internal value				
P0265 Cylinder 2 Injector "A" Circuit High	Injection Valves Short To Battery Plus	• Fault pattern for short to Battery plus via powerstage diagnosis detected • Injector voltage > 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .
	Injection Valves Short To Battery Plus (High Side)	• Injector driver voltage > 2.0 V • And • Injector driver high side switch current (hardware values) driver stage internal value	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 720° CRK • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Injection Valves Short To Battery Plus (Low Side)	• Injector driver voltage > 2.0 V • And • Injector driver low side switch current (hardware values) driver stage internal value				
P0267 Cylinder 3 Injector "A" Circuit Low	Injection Valves Short To Ground	• Fault pattern for short to ground via powerstage diagnosis detected • Injector voltage < 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .
	Injection Valves Short To Ground (High Side)	• Injector driver voltage < 2 V • And • Injector driver high side switch current (hardware values) driver stage internal value	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 720° CRK • Continuous		
	Injection Valves Short To Ground (Low Side)	• Injector driver voltage < 2 V • And • Injector driver high side switch current driver stage internal value • And • Injector driver low side switch current (hardware values) driver stage internal value				
P0268 Cylinder 3 Injector "A" Circuit High	Injection Valves Short To Battery Plus	• Fault pattern for short to Battery plus via powerstage diagnosis detected • Injector voltage > 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Injection Valves Short To Battery Plus (High Side)	• Injector driver voltage > 2.0 V • And • Injector driver high side switch current (hardware values) driver stage internal value	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 720° CRK • Continuous		
	Injection Valves Short To Battery Plus (Low Side)	• Injector driver voltage > 2.0 V • And • Injector driver low side switch current (hardware values) driver stage internal value				
P0270 Cylinder 4 Injector "A" Circuit Low	Injection Valves Short To Ground	• Fault pattern for short to ground via powerstage diagnosis detected • Injector voltage < 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .
	Injection Valves Short To Ground (High Side)	• Injector driver voltage < 2 V • And • Injector driver high side switch current (hardware values) driver stage internal value	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 720° CRK • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Injection Valves Short To Ground (Low Side)	• Injector driver voltage < 2 V • And • Injector driver high side switch current driver stage internal value • And • Injector driver low side switch current (hardware values) driver stage internal value				
P0271 Cylinder 4 Injector "A" Circuit High	Injection Valves Short To Battery Plus	• Fault pattern for short to Battery plus via powerstage diagnosis detected • Injector voltage > 2.0 V	• Engine stop not active • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 8,640.0° CRK • Continuous	2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .
	Injection Valves Short To Battery Plus (High Side)	• Injector driver voltage > 2.0 V • And • Injector driver high side switch current (hardware values) driver stage internal value	• Engine running • ECT @ cylinder head >= -30° C • Engine speed < 7,000 RPM • Injection time >= 0.0 s	• 720° CRK • Continuous		
	Injection Valves Short To Battery Plus (Low Side)	• Injector driver voltage > 2.0 V • And • Injector driver low side switch current (hardware values) driver stage internal value				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0300 Random/ Multiple Cylinder Misfire Detected	Misfire Crankshaft Speed Fluctuation (Multiple)	• Number of cylinders with emission threshold misfire within 4,000 revolutions ≥ 2.00 [-] • Or • Number of cylinders with emission threshold misfire within 1,000 revolutions ≥ 2.00 [-]	• Emission threshold misfire detected	• 1000 rev • Continuous	• 2 DCY	– Check the spark plugs visually. – Check the intake system visually for leaks. – Check the fuel pressure. Refer to appropriate repair manual. – Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 . – Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.20 Ignition Coils with Power Output Stage , Checking”, page 499 .
		• Number of cylinders with catalyst damaging misfire ≥ 2.00 [-]	• Catalyst damaging misfire detected	• 200 rev • Continuous	• Immediate	
P0301 Cylinder 1 Misfire Detected	Misfire Crankshaft Speed Fluctuation (Single Or Multiple)	• Catalyst damage misfire: • Catalyst damaging misfire rate > 5.20 - 20.83 %	• Initial engine speed > 550 RPM • Engine speed > 550 RPM • Engine speed < 6,848 for DCT: • Time after engine start not calibrated • Engine load > 1.99 - 37.99 % • Depending on ECT @ cylinder head @ start • ECT @ cylinder head @ start <= -48° C • Then activation if • ECT @ cylinder head >= 20° C • Or • ECT @ cylinder head @ engine start > -48° C • And • Fuel cut off not active	• 200 rev • Continuous	• Immediate	– Check the spark plugs visually. – Check the intake system visually for leaks. – Check the fuel pressure. Refer to appropriate repair manual. – Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 . – Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.20 Ignition Coils with Power Output Stage , Checking”, page 499 .
		• Emission threshold misfire within 1,000 rev: • Emission threshold misfire rate (MR) >= 2.05 %		• 1,000 rev • Continuous	• 2 DCY	

DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Emission threshold misfire within 4,000 rev: • Emission threshold misfire rate (MR) > 2.05 %	• Or • Single fuel cut off not active • Or • Number of fade out cylinders < 2.00 [-] • And • Dynamic manifold air pressure not calibrated [kPa] • Dynamic throttle position not calibrated • And • Dynamic of engine load not calibrated • And • Engine not calibrated • Engine speed not calibrated [rpm] • Dynamic of ignition angle @ idle speed not calibrated [°CRK] • Or • Dynamic of ignition angle not calibrated [°CRK] • And • Rough road not detected	• 4 x 1,000 rev • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0302 Cylinder 2 Misfire Detected	Misfire Crankshaft Speed Fluctuation (Single Or Multiple)	• Catalyst damage misfire: • Catalyst damaging misfire rate > 5.20 - 20.83 %	• Initial engine speed > 550 RPM • Engine speed > 550 RPM • Engine speed < 6,848 for DCT:	• 200 rev • Continuous	• Immediate	– Check the spark plugs visually. – Check the intake system visually for leaks. – Check the fuel pressure. Refer to appropriate repair manual. – Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 . – Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.20 Ignition Coils with Power Output Stage , Checking”, page 499 .
		• Emission threshold misfire within 1,000 rev: • Emission threshold misfire rate (MR) >= 2.05 %	• Time after engine start not calibrated • Engine load > 1.99 - 37.99 % • Depending on ECT @ cylinder head @ start • ECT @ cylinder head @ start <= -48° C • Then activation if • ECT @ cylinder head >= 20° C • Or • ECT @ cylinder head @ engine start > -48° C • And • Fuel cut off not active • Or • Single fuel cut off not active • Or • Number of fade out cylinders < 2.00 [-] • And • Dynamic manifold air pressure not calibrated [kPa] • Dynamic throttle position not calibrated [°TPS/s] • And • Dynamic of engine load not calibrated [%] • And	• 1,000 rev • Continuous	• 2 DCY	

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Emission threshold misfire within 4,000 rev: • Emission threshold misfire rate (MR) > 2.05 %	• Engine not calibrated • Engine speed not calibrated [rpm] • Dynamic of ignition angle @ idle speed not calibrated [°CRK] • Or • Dynamic of ignition angle not calibrated [°CRK] • And • Rough road not detected	• 4 x 1,000 rev • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0303 Cylinder 3 Misfire Detected	Misfire Crankshaft Speed Fluctuation (Single Or Multiple)	• Catalyst damage misfire: • Catalyst damaging misfire rate > 5.20 - 20.83 %	• Initial engine speed > 550 RPM • Engine speed > 550 RPM • Engine speed < 6,848 for DCT: • Time after engine start not calibrated • Engine load > 1.99 - 37.99 % • Depending on ECT @ cylinder head @ start • ECT @ cylinder head @ start <= -48° C • Then activation if • ECT @ cylinder head >= 20° C • Or • ECT @ cylinder head @ engine start > -48° C • And • Fuel cut off not active • Or • Single fuel cut off not active • Or • Number of fade out cylinders < 2.00 [-] • And • Dynamic manifold air pressure not calibrated [kPa] • Dynamic throttle position not calibrated [°TPS/s] • And • Dynamic of engine load not calibrated [%] • And	• 200 rev • Continuous	• Immediate	– Check the spark plugs visually. – Check the intake system visually for leaks. – Check the fuel pressure. Refer to appropriate repair manual. – Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 . – Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.20 Ignition Coils with Power Output Stage , Checking”, page 499 .
		• Emission threshold misfire within 1,000 rev: • Emission threshold misfire rate (MR) >= 2.05 %		• 1,000 rev • Continuous	• 2 DCY	

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Emission threshold misfire within 4,000 rev: • Emission threshold misfire rate (MR) > 2.05 %	• Engine not calibrated • Engine speed not calibrated [rpm] • Dynamic of ignition angle @ idle speed not calibrated [°CRK] • Or • Dynamic of ignition angle not calibrated [°CRK] • And • Rough road not detected	• 4 x 1,000 rev • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0304 Cylinder 4 Misfire Detected	Misfire Crankshaft Speed Fluctuation (Single Or Multiple)	• Catalyst damage misfire: • Catalyst damaging misfire rate > 5.20 - 20.83 %	• Initial engine speed > 550 RPM • Engine speed > 550 RPM • Engine speed < 6,848 for DCT: • Time after engine start not calibrated • Engine load > 1.99 - 37.99 % • Depending on ECT @ cylinder head @ start • ECT @ cylinder head @ start <= -48° C • Then activation if • ECT @ cylinder head >= 20° C • Or • ECT @ cylinder head @ engine start > -48° C • And • Fuel cut off not active • Or • Single fuel cut off not active • Or • Number of fade out cylinders < 2.00 [-] • And • Dynamic manifold air pressure not calibrated [kPa] • Dynamic throttle position not calibrated [°TPS/s] • And • Dynamic of engine load not calibrated [%] • And	• 200 rev • Continuous	• Immediate	– Check the spark plugs visually. – Check the intake system visually for leaks. – Check the fuel pressure. Refer to appropriate repair manual. – Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 . – Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.20 Ignition Coils with Power Output Stage , Checking”, page 499 .
		• Emission threshold misfire within 1,000 rev: • Emission threshold misfire rate (MR) >= 2.05 %		• 1,000 rev • Continuous	• 2 DCY	

DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Emission threshold misfire within 4,000 rev: • Emission threshold misfire rate (MR) > 2.05 %	• Engine not calibrated • Engine speed not calibrated [rpm] • Dynamic of ignition angle @ idle speed not calibrated [°CRK] • Or • Dynamic of ignition angle not calibrated [°CRK] • And • Rough road not detected	• 4 x 1,000 rev • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0326 Knock / Combustion Vibration Sensor 1 Circuit Range/ Performance Bank 1 or Single Sensor	Knock Sensor Rationality Check Low	• Difference between knock sensor signal and average knock sensor signal < 0.00 – 0.12 V	• ECT @ cylinder head > 59° C • MAF > 229.00 mg/rev	• 4.3 s • Continuous	• 2 DCY	– Check the Knock Sensor 1 - G61- . Refer to ⇒ “3.6.24 Knock Sensor 1 G61 , Checking”, page 507 .
P0327 Knock / Combustion Vibration Sensor 1 Circuit Low Bank 1 or Single Sensor	Knock Sensor Out Of Range	• Sensor signal < 0.12 – 0.31 V	• ECT @ cylinder head > 59° C • MAF > 229.00 mg/rev • Engine speed > 2,016 RPM	• 4.0 s • Continuous	• 2 DCY	– Check the Knock Sensor 1 - G61- . Refer to ⇒ “3.6.24 Knock Sensor 1 G61 , Checking”, page 507 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0335 Crankshaft Position Sensor "A" Circuit	Crankshaft Position Sensor Activity Check	• Case 1: • Counted exhaust camshaft signals without synchronization >= 17.00 [-] • Or • Counted intake camshaft signals without synchronization >= 17.00 [-] • Case 2: • Counted exhaust camshaft signals without synchronization n.a. [-] • Or • Counted intake camshaft signals without synchronization n.a. [-]	• Signal edges @ selected camshaft signal detected • Choice of: • Ignition off • Engine speed > 380 RPM • Engine stalling >= 1.0 s • Or • Synchronization test incorrect • Or • Engine speed >= 380 RPM • Or • Engine running • Engine stalling >= 5.0 s • Or • Backwards rotation not detected • Or • Engine speed >= 400 RPM • Engine stop active	• 0.01 s • Continuous	• 2 DCY	– Check the Camshaft Position Sensor - G40- . Refer to ⇒ “3.6.5 Camshaft Position Sensor G40 , Checking”, page 466 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0336 Crankshaft Position Sensor "A" Circuit Range/Performance	RPM Sensor Out Of Range	• Segment adaptation >= 0.70 %	• Delay time >= 5,760.00° CRK • And • Diff. actual air mass vs. previous air mass <= 20.01 – 39.99 mg/rev • Engine load <= 20.00 % • Dynamic throttle position <= 269.50 – 398.40° TPS/s • Rough road not detected • Engine roughness signal not valid • Segments in fuel cut-off mode >= 32.00 [-] • Segment adaptation finished • Engine speed 2,496 – 5,024 rpm • Diff. between adapted value of cylinder 1 and cylinder 3 < 0.70 % • Diff. between adapted value of cylinder 2 and cylinder 4 < 0.70 %	• 180.0° CRK • Continuous	• 2 DCY	– Check the Engine Speed Sensor - G28- . Refer to ⇒ “3.6.5 Camshaft Position Sensor G40 , Checking”, page 466.
		• Counted teeth vs reference >= 1; <= 2 [-]	• Engine running	• 3,600.0° CRK • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Crankshaft Position Sensor Rationality Check	• Case 1: • Engine speed > 3000 RPM • Time between falling signal edges < 50 – 62.5 µs • Case 2: • Engine speed <= 3000 RPM • Time between signal edges < 30 µs	• Engine speed >= 400 RPM	• 4,5720.0° CRK • Continuous		
	Crankshaft Position Sensor Rationality Check	• Crankshaft reference gap not detected	• General conditions: • Reference gap of reluctor wheel detected • And • Case 1: • Ignition off • Engine speed > 380 RPM • Engine stalling >= 1.0 s • Or • Case 2: • Engine speed >= 380 RPM • Or • Engine running • And • Engine stalling >= 5.0 s • Or • Case 3: • Backwards rotation not detected • Or • Case 4: • Engine speed >= 400 RPM • Engine stopped	• 2,160° CRK • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Crankshaft Position Sensor Rationality Check	• Counted teeth vs. reference >= 1; <= 2 [-]	• General conditions: • Engine speed > 320 RPM • And • Case 1: • Ignition off • Engine speed > 380 RPM • Engine stalling >= 1.0 s • Or • Case 2: • Engine speed >= 380 RPM • Or • Engine running • And • Engine stalling >= 5.0 s • Or • Case 3: • Backwards rotation not detected • Or • Case 4: • Engine speed >= 400 RPM • Engine stopped	• 1,800° CRK • Continuous		
P0340 Camshaft Position Sensor "A" Circuit Bank 1 or Single Sensor	Camshaft Position Sensor Intake Signal Activity Check	• No change on signal >= 3 [-]	• Engine speed >= 400 RPM	• 4,680.0° CRK • Continuous	2 DCY	– Check the Camshaft Position Sensor G40- . Refer to ⇒ “3.6.5 Camshaft Position Sensor G40 , Checking”, page 466.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0341 Camshaft Position Sensor "A" Circuit Range/Performance Bank 1 or Single Sensor	Camshaft Position Sensor Intake Rationality Check	• Ratio between measured segment time ratio and specified camshaft angle ratio > 2.75 [-] • Or • Ratio between measured segment time ratio and specified camshaft angle ratio < 0.36 [-] • Or • Offset between camshaft and crankshaft < -79.0° CRK • Or • Offset between camshaft and crankshaft > 15.0° CRK	• Engine speed 400 – 8,160 RPM	• 990.0° CRK • Continuous	• 2 DCY	– Check the Camshaft Position Sensor - G40- . Refer to ⇒ “3.6.5 Camshaft Position Sensor G40 , Checking”, page 466.
	Camshaft Position Sensor Intake Signal Activity Check	• Segment time value < 50 [µs]		• 1,440.0° CRK • Continuous		
	Camshaft Position Sensor Intake Angular Offset Check	• Offset between camshaft and crankshaft < -79.00; OR > 15.0° CRK	• Engine synchronization not validated • Failure by exhaust camshaft sensor detected	• 450.0° CRK • Once / DCY		
P0365 Camshaft Position Sensor "B" Circuit Bank 1	Camshaft Position (CMP) Exhaust Sensor	• No change on signal >= 3 [-]	• Engine speed >= 400 rpm	• 1080.00° CRK • Continuous	• 2 DCY	– Check the Camshaft Position Sensor 3 - G300- . Refer to ⇒ “3.6.4 Camshaft Position Sensor 3 G300 , Checking”, page 464

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0366 Camshaft Position Sensor "B" Circuit Range/ Performance Bank 1	Camshaft Position (CMP) Exhaust Sensor rationality check	• Ratio between measured segment time ratio and specified camshaft angle ratio > 2.75 [-] • Or • Ratio between measured segment time ratio and specified camshaft angle ratio < 0.36 [-] • Or • Offset between camshaft and crankshaft < -24.00° CRK • Or • Offset between camshaft and crankshaft > 49.00° CRK	• Engine speed 400 – 8,160 rpm	• 990.00° CRK • Continuous	• 2 DCY	– Check the Camshaft Position Sensor 3 - G300- . Refer to ⇒ “3.6.4 Camshaft Position Sensor 3 G300 , Checking”, page 464
	Camshaft Position (CMP) Exhaust Sensor signal activity check	• Segment time value < 50 [µs]	• Engine speed 400 – 8,160 rpm	• 1440.00° CRK • Continuous	2 DCY	
	Camshaft Position / Crankshaft Position (CMP/ CKP) Exhaust Sensor out of range	• Offset between camshaft and crankshaft < -24.00° CRK • Or • Offset between camshaft and crankshaft > 49.00° CRK	• Engine synchronization via crankshaft and camshaft not finished • Or • Engine synchronization via crankshaft and camshaft lost	• 450.00° CRK • Once / DCY"	• 2 DCY	

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P039B Cylinder 1 Pressure Too High	Knock Control Function Check	• Slow detection: • Ratio between knock sensor and knock threshold in main knock window > 2.00 – 3.00 [-] • For time >= 9,000.0 – 11,700.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 3.50 – 5.00 [-] • For time >= 5,760.0 – 6,840.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 3.50 – 5.00 [-] • Ratio between knock sensor and knock threshold in main knock window > 2.00 – 3.00 [-] • For time >= 12,960.0 – 16,740.0° CRK • Or • Torque limitation factor < 0.90 [-]	• Engine running • ECT @ cylinder head > 59° C • Engine speed 1,216 – 6,720 RPM • Engine load n.a. % • Mass air flow > 501.00 – 599.00 mg/rev • Dynamic engine speed not active • Delay time 0.0 s	• 900.0° CRK • Continuous	• 2 DCY	– Check the Knock Sensor 1 - G61- . Refer to ⇒ “3.6.24 Knock Sensor 1 G61 , Checking”, page 507 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Fast detection: • Ratio between knock sensor and knock threshold in main knock window > 1.50 – 2.50 [-] • For time >= 540.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 2.75 – 4.50 [-] • For time >= 360.0° CRK • Case 1: • ratio between filtered engine roughness and misfire detection threshold <= 0.41 – 0.59 [-] • Or • Case 2: • Ratio between normalized engine roughness and misfire detection threshold <= n.a. [-] • Or • Case 3: • Ratio between filtered engine roughness and misfire detection threshold <= n.a. [-] • Or • Ratio between normalized engine roughness and misfire detection threshold <= n.a. [-]				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P03A5 Cylinder 2 Pressure Too High	Knock Control Function Check	• Slow detection: • Ratio between knock sensor and knock threshold in main knock window > 2.00 – 3.00 [-] • For time >= 9,000.0 – 11,700.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 3.50 – 5.00 [-] • For time >= 5,760.0 – 6,840.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 3.50 – 5.00 [-] • Ratio between knock sensor and knock threshold in main knock window > 2.00 – 3.00 [-] • For time >= 12,960.0 – 16,740.0° CRK • Or • Torque limitation factor < 0.90 [-]	• Engine running ECT @ cylinder head > 60° C • Engine speed 1,216 – 6,400 RPM • Engine load n.a. % • Mass air flow > 403.00 – 447.00 mg/rev • Dynamic engine speed not active	• 900.0° CRK • Continuous	• 2 DCY	– Check the Knock Sensor 1 - G61- . Refer to ⇒ “3.6.24 Knock Sensor 1 G61 , Checking”, page 507 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Fast detection: • Ratio between knock sensor and knock threshold in main knock window > 1.50 – 2.50 [-] • For time >= 540.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 2.75 – 4.50 [-] • For time >= 360.0° CRK • Case 1: • ratio between filtered engine roughness and misfire detection threshold <= 0.41 – 0.59 [-] • Or • Case 2: • Ratio between normalized engine roughness and misfire detection threshold <= n.a. [-] • Or • Case 3: • Ratio between filtered engine roughness and misfire detection threshold <= n.a. [-] • Or • Ratio between normalized engine roughness and misfire detection threshold <= n.a. [-]				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P03AF Cylinder 3 Pressure Too High	Knock Control Function Check	• Slow detection: • Ratio between knock sensor and knock threshold in main knock window > 2.00 – 3.00 [-] • For time >= 9,000.0 – 11,700.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 3.50 – 5.00 [-] • For time >= 5,760.0 – 6,840.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 3.50 – 5.00 [-] • Ratio between knock sensor and knock threshold in main knock window > 2.00 – 3.00 [-] • For time >= 12,960.0 – 16,740.0° CRK • Or • Torque limitation factor < 0.90 [-]	• Engine running ECT @ cylinder head > 60° C • Engine speed 1,216 – 6,400 RPM • Engine load n.a. % • Mass air flow > 403.00 – 447.00 mg/rev • Dynamic engine speed not active	• 900.0° CRK • Continuous	• 2 DCY	– Check the Knock Sensor 1 - G61- . Refer to ⇒ “3.6.24 Knock Sensor 1 G61 , Checking”, page 507 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Fast detection: • Ratio between knock sensor and knock threshold in main knock window > 1.50 – 2.50 [-] • For time >= 540.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 2.75 – 4.50 [-] • For time >= 360.0° CRK • Case 1: • ratio between filtered engine roughness and misfire detection threshold <= 0.41 – 0.59 [-] • Or • Case 2: • Ratio between normalized engine roughness and misfire detection threshold <= n.a. [-] • Or • Case 3: • Ratio between filtered engine roughness and misfire detection threshold <= n.a. [-] • Or • Ratio between normalized engine roughness and misfire detection threshold <= n.a. [-]				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P03B9 Cylinder 4 Pressure Too High	Knock Control Function Check	• Slow detection: • Ratio between knock sensor and knock threshold in main knock window > 2.00 – 3.00 [-] • For time >= 9,000.0 – 11,700.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 3.50 – 5.00 [-] • For time >= 5,760.0 – 6,840.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 3.50 – 5.00 [-] • Ratio between knock sensor and knock threshold in main knock window > 2.00 – 3.00 [-] • For time >= 12,960.0 – 16,740.0° CRK • Or • Torque limitation factor < 0.90 [-]	• Engine running ECT @ cylinder head > 60° C • Engine speed 1,216 – 6,400 RPM • Engine load n.a. % • Mass air flow > 403.00 – 447.00 mg/rev • Dynamic engine speed not active	• 900.0° CRK • Continuous	• 2 DCY	– Check the Knock Sensor 1 - G61- . Refer to ⇒ “3.6.24 Knock Sensor 1 G61 , Checking”, page 507 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Fast detection: • Ratio between knock sensor and knock threshold in main knock window > 1.50 – 2.50 [-] • For time >= 540.0° CRK • Or • Ratio between knock sensor and noise level in pre knock window > 2.75 – 4.50 [-] • For time >= 360.0° CRK • Case 1: • ratio between filtered engine roughness and misfire detection threshold <= 0.41 – 0.59 [-] • Or • Case 2: • Ratio between normalized engine roughness and misfire detection threshold <= n.a. [-] • Or • Case 3: • Ratio between filtered engine roughness and misfire detection threshold <= n.a. [-] • Or • Ratio between normalized engine roughness and misfire detection threshold <= n.a. [-]				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0410 AIR System "A"	Secondary Air System Functional Check	• Diff. pressure value after secondary air injection vs. pressure value before secondary air activation > 5.0 kPa	• General: • Secondary air pump ready • Catalyst heating active • Secondary air injection finished • MAF <= 140.0 kg/h • ECT @ cylinder head >= -10; < 115° C • IAT @ manifold >= -10; < 100° C • Modeled catalyst temperature < 900° C • Relative barometric pressure > 0.73 [-] • Diff. barometric pressure vs. manifold pressure > n.a. kPa	• 0.1 s • Once / DCY	• 2 DCY	– Check the Secondary Air System - GX24- . Refer to ⇒ “3.6.30 Secondary Air Injection Sensor 1 G609 / Secondary Air Injection Solenoid Valve N112 , Checking”, page 521 . – Check the Secondary Air Injection Pump Motor - V101- / Secondary Air Injection Pump Relay - J299- . Refer to ⇒ “3.6.29 Secondary Air Injection Pump Motor V101 / Secondary Air Injection Pump Relay J299 , Checking”, page 519 .
P0413 AIR System Switching Valve "A" Circuit Open	Secondary Air Valve Open Circuit	• Output voltage, lower range >= 1.92 – 2.21 V • Output voltage, upper range (hardware values) <= 2.85 – 3.25 V	• Engine running • Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check the Secondary Air System - GX24- . Refer to ⇒ “3.6.30 Secondary Air Injection Sensor 1 G609 / Secondary Air Injection Solenoid Valve N112 , Checking”, page 521 .
P0414 AIR System Switching Valve "A" Circuit Shorted	Secondary Air Valve Short To Ground	• Output voltage (hardware values) < 1.92 – 2.21 V	• Engine running • Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check the Secondary Air System - GX24- . Refer to ⇒ “3.6.30 Secondary Air Injection Sensor 1 G609 / Secondary Air Injection Solenoid Valve N112 , Checking”, page 521 .
	Secondary Air Valve Short To Battery Plus	• Actuator temperature > 160 – 200° C • Or • Output current (hardware values) driver stage internal value	• Engine running • Actuator commanded on			

DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0418 AIR System Control "A" Circuit	Secondary Air Injection Pump Relay Open Circuit	• Output voltage, lower range 1.92 – 2.21 V • Output voltage, upper range (hardware values) <= 2.85 – 3.25 V	• Engine running • Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check the Secondary Air Injection Pump Motor - V101- / Secondary Air Injection Pump Relay - J299- . Refer to ⇒ “3.6.29 Secondary Air Injection Pump Motor V101 / Secondary Air Injection Pump Relay J299 , Checking”, page 519 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0420 Catalyst System Efficiency Below Threshold Bank 1	NMOG / NMHC Conversion Capability	• Catalyst efficiency > 1.00 [-]	• Catalyst monitor lambda modulation request active • General conditions: • Vehicle speed >= 19 mph • BARO >= 0.00 kPa • Catalyst overheating protection not active • Turbine overheating protection not active • O2S rear ready • O2S front ready • ECT @ cylinder head > 60° C • IAT@ manifold > -48° C • modeled catalyst temperature @ start of diagnosis > 510° C • Modeled catalyst temperature @ during diagnosis 470 – 830° C • Difference between dynamic and stationary catalyst temperature -150 – 150° C • Integrated MAF, catalyst temp. conditions fulfilled >= 0.0 g • Modeled EGT @ O2S rear <= 900° C • MAF per cylinder 22.50 – 150.00 kg/h • Air mass, lower range >= 0.00 mg/rev • Air mass, upper range <= 650.00 – 1,389.00 mg/rev	• 60.0 – 70.0 s • Once / DCY	• 1 DCY	– Check the Three Way Catalytic Converter. Refer to appropriate repair manual. – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• And • Engine load n.a. [%] • Air mass setpoint n.a. [g/rev] • Accelerator pedal value n.a. [%] • For time n.a. [s] • And • Low dynamic conditions • Dynamic engine speed < 50 rpm • Dynamic air mass < 50.00 mg/rev • Dynamic lambda controller output < 20.00 % • And • Integrated air mass after dynamic conditions are fulfilled > 20.0 g • Time after a catalyst purge phase >= 1.0 s • O2S rear voltage @ diagnosis start >= 0.55 V • Integrated air mass >= 0.0 g • Integrated heat energy >= 550.00 – 700.00 kJ • Engine speed 1,088 – 3,008 rpm • Deviation of lambda controller output < 50.00 % • Proportional part of secondary fuel control loop not calibrated % • Coasting function not active • O2S heater rear active			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Lambda adaptation not active • Valve lift not active • And • Depending on Lambda control: • Sum of integral and proportional part of secondary fuel control loop before diagnosis < 0.10 [-] • Or • Sum of integral and proportional part of secondary fuel control loop during diagnosis < 0.25 [-] • Depending on canister purge: • Canister load n.a. [-] • Evap purge flow n.a. • Or • Canister load calculation n.a. • Evap purge flow n.a. • Or • Evap purge valve n.a. • Or • Evap purge valve n.a. • Or • Evap purge n.a. • Or • Depending on canister purge closing: • Canister purge (conditions) n.a. • Canister purge valve (closing time) n.a. [s] • And			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Choice of: • Evap purge valve n.a. • Or • Evap purge valve n.a. • And • Modeled air mass integral > 50.0 g • Integrated air mass per cylinder >= 1.45 – 1.70 kg • Internal resistance O2S rear <= 700.00 Ohm			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0441 EVAP System Incorrect Purge Flow	EVAP Purge Valve Functional Check: Stuck Close	• Ratio actual intake manifold pressure and modeled set point intake manifold pressure < 0.10 [-]	• ECT @ cylinder head > 60° C • Barometric pressure > 73.0 kPa • AAT > 5° C • AAT @ start < 5° C • Diff. barometric pressure vs. filtered intake manifold pressure n.a. • Diff. barometric pressure vs. filtered intake manifold pressure > 28.00 kPa • Ratio MAF @ intake manifold and MAF max. > 0.07 – 0.10 [-] • Engine speed 1,180 – 2,800 RPM • Vehicle speed >= 11 mph • Diff. engine speed vs. filtered engine speed < 90 RPM • Diff. ratio MAF @ intake manifold and MAF max vs. ratio filtered MAF @ intake manifold and MAF max < 0.15 [-] • Diff. modeled intake manifold pressure vs. filtered modeled intake manifold pressure < 1.50 – 2.50 kPa • And • Integrated MAF since engine start >= 0.0 – 5,000.0 g • Lambda control active • Lambda control value -30.00 — 30.00 %	• 8.5 s • Once / DCY	• 2 DCY	– Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.13 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 484 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• O2S front 0.90 – 1.10 [-] • or • Fuel cut off not calibrated • Case 1: • Integrated MAF @ canister purge per driving cycle >= n.a. g • Case 2: • ratio MAF @ canister purge and MAF per cylinder >= 0.00 [-] • Or • Canister purge sampling rate >= 20.00 % • And • Integrated air mass @ canister purge valve >= 31.9 g • Depending on AAT: • AAT >= 30° C • Canister load <= 0.20 [-] • Or • AAT >= 50; < 30° C • Canister load <= 0.20 [-] • Or • AAT < 50° C • Canister load <= 0.20 [-]			
P0444 EVAP System Purge Control Valve "A" Circuit Open	EVAP Purge Valve Open Circuit	• Output voltage, lower range >= 1.92 – 2.21 V • Output voltage, upper range (hardware values) <= 2.85 – 3.25 V	• Engine start not active • Engine running • Evap purge valve opening signal (PWM) > 3.13; <= 98.83 % • Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.13 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 484 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0445 EVAP System Purge Control Valve "A" Circuit Shorted	EVAP Purge Valve Short To Ground	• Output voltage (hardware values) 1.92 – 2.21 V	• Engine start not active • Engine running • Evap purge valve opening signal (PWM) <= 98.83 % • Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.13 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 484 .
	EVAP Purge Valve Short To Battery Plus	• Actuator temperature 160 – 200° C • Or • Output current (hardware values) driver stage internal value	• Engine start not active • Engine running • Evap purge valve opening signal (PWM) >= 3.13 % • Actuator commanded on			
P0450 EVAP System Pressure Sensor/ Switch Circuit	NVLD Switch Open Circuit	• Signal voltage 0.39 – 0.55 V	• Case 1: • Engine running • Case 2: • Ignition off • NVLD (EVAP-System) diagnostic mode active	• 0.5 s • Continuous	• 2 DCY	– Check the Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- . Refer to ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496 .
P0451 EVAP System Pressure Sensor/ Switch Circuit Range/ Performance	NVLD Switch Functional Check Stuck Close	• Natural vacuum leak detection (NVLD) switch position closed	• Ignition off • Fuel level < 85.10 % • Fuel temperature increase >= 5 K • For time >= 1.0 h • AAT >= 4° C • Barometric pressure >= 73.0 kPa • Time since ignition off > 20; < 1,440 min	• 0.1 s • Once / DCY	• 2 DCY	– Check the Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- . Refer to ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0452 EVAP System Pressure Sensor/ Switch Circuit Low	NVLD Switch Short To Ground	• Signal voltage < 0.24 V	• Case 1: • Engine running • Case 2: • Ignition off • NVLD (EVAP-System) diagnostic mode active	• 0.5 s • Continuous	• 2 DCY	– Check the Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- . Refer to ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496 .
P0453 EVAP System Pressure Sensor/ Switch Circuit High	NVLD Switch Short To Battery Plus	• Signal voltage > 3.0 V	• Case 1: • Engine running • Case 2: • Ignition off • NVLD (EVAP-System) diagnostic mode active	• 0.5 s • Continuous	• 2 DCY	– Check the Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- . Refer to ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496 .
P0456 EVAP System Leak Detected (Very Small Leak)	EVAP System Small Leak Functional Check	• Natural vacuum leak detection (NVLD) switch position = open	• Ignition off • Fuel level < 85.10 % • Fuel temperature drop >= 6 K • For time > 1 h • AAT >= 4° C • Barometric pressure > 73.00 kPa • Diff. barometric pressure @ stop and barometric pressure @ start < 0.65 kPa • Time since ignition off > 90 [min] ; < 600 min	• 0.1 s • Once / DCY	• 2 DCY	– Check the EVAP System visually for any leaking hoses or damage to components. – Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.13 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 484 . – Check the Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- . Refer to ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0461 Fuel Level Sensor "A" Circuit Range/ Performance	Fuel Level Plausibility Check	• Diff. fuel consumption And Fuel level changes < -25.0; > 12.0 [-]	• General: • Refueling or defueling not detected • And • Case 1: • For tank full fuel level > 96.09 % • Fuel consumption since last refueling or last plausibility check > 44.0 [-] • Case 2: • For tank not full fuel level <= 96.09 % • Fuel consumption since last refueling or last plausibility check > 15.0 l	• 1.0 s • Multiple	• 2 DCY	• Check the Fuel Level Sensor - G- . Refer to appropriate repair manual.
P0462 Fuel Level Sensor "A" Circuit Low	CAN: Fuel Level Sensor 1 CAN Communication With Instrument Cluster Module	• Instrument cluster module signal: short to ground failure • Instrument cluster module signal: signal range check failure		• 0.5 s • Continuous	• 2 DCY	• Check the Fuel Level Sensor - G- . Refer to appropriate repair manual.
P0463 Fuel Level Sensor "A" Circuit High	CAN: Fuel Level Sensor 1 CAN Communication With Instrument Cluster Module	• Instrument cluster module signal: short to battery / open circuit failure		• 0.5 s • Continuous	• 2 DCY	• Check the Fuel Level Sensor - G- . Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0491 AIR System Insufficient Flow Bank 1	Secondary Air System Functional Check	• Case 1: • Blockage: ratio relative measured secondary air pressure and modelled secondary air pressure [tube blocked] < 0.70 [-] • Or • Leakage: ratio relative measured secondary air pressure and modelled secondary air pressure [leak diagnosis] < 0.65 [-] • Case 2: • Diff. expected integrated secondary air pressure pulsations and actual integrated secondary air pressure pulsations n.a. kPa • Case 3: • Blockage: ratio relative measured secondary air pressure and modelled secondary air pressure [tube blocked] < 0.40 [-] • Or • Leakage: ratio relative measured secondary air pressure and modelled secondary air pressure [leak diagnosis] < 0.15 [-]	• General: • Secondary air pump active • Catalyst heating active • Secondary air injection active • MAF <= 140.0 kg/h • ECT @ cylinder head >= -10; < 115° C • IAT @ manifold >= -10; < 100° C • Modelled catalyst temperature < 900° C • Relative barometric pressure > 0.73 [-] • Diff. barometric pressure vs. manifold pressure > n.a. kPa	• 0.1 s • Once / DCY	• 2 DCY	– Check the Secondary Air System - GX24- . Refer to ⇒ “3.6.30 Secondary Air Injection Sensor 1 G609 / Secondary Air Injection Solenoid Valve N112 , Checking”, page 521 . – Check the Secondary Air Injection Pump Motor - V101- / Secondary Air Injection Pump Relay - J299- . Refer to ⇒ “3.6.29 Secondary Air Injection Pump Motor V101 / Secondary Air Injection Pump Relay J299 , Checking”, page 519 .
P0501 Vehicle Speed Sensor "A" Cir-	CAN: Vehicle Speed Sensor CAN	• Speed sensor fault value: Out of range high failure		• 0.5 s	• 2 DCY	– Check the Vehicle Speed Signal. Refer to ⇒ “3.6.33 Vehicle Speed Sig-

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
cuit Range/ Performance	Communication With Vehicle Speed Sensor	• Speed sensor fault value: Out of range low failure		• Continuous		nal, Checking", page 529
		• Speed sensor fault value: Rationality check high failure				
		• Speed sensor fault value: Rationality check low failure				
P0502 Vehicle Speed Sensor "A" Circuit Low	Vehicle Speed Sensor (VSS) short to ground	• Diagnostic signal from output driver failure		• 0.5 s • Continuous	• 2 DCY	– Check the Vehicle Speed Signal. Refer to ⇒ "3.6.33 Vehicle Speed Signal, Checking", page 529
	Vehicle Speed Sensor (VSS) open circuit					
	Vehicle Speed Sensor (VSS) short to battery plus					

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0506 Idle Control System RPM - Lower Than Expected	Idle Speed Control (ISC) function monitoring: engine speed deviation	• Diff. actual engine speed vs. engine speed setpoint < -100 RPM • Integrated I-part of idle speed controller n.a.	• General conditions: • Vehicle speed =0 mph • Accelerator pedal released by driver • Throttle actuator commanded on • Evap purge flow < 4.00 kg/h • Engine running • Time after engine start > 0.0 s • Clutch switch n.a. • Barometric pressure > 70.00 kPa • Catalyst heating not active • ECT @ cylinder head > -48° C • And • Setpoint change n.a. rpm • For time n.a. s • And • Additional after dynamic conditions fulfilled: • Gear switch not active • (A/T only) • Accelerator pedal released by driver • Vehicle speed 0 mph • Engine load < 31.25 % • (M/T only) • For time >= 0.0 s	• 12.0 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0507 Idle Control System RPM - Higher Than Expected	Idle Speed Control (ISC) function monitoring: engine speed deviation	• Diff. actual engine speed vs. engine speed setpoint > 90 RPM • Integrated I-part of idle speed controller n.a.	• General conditions: • Vehicle speed =0 mph • Accelerator pedal released by driver • Throttle actuator commanded on • Evap purge flow < 4.00 kg/h • Engine running • Time after engine start > 0.0 s • Clutch switch n.a. • Barometric pressure > 70.00 kPa • Catalyst heating not active • ECT @ cylinder head > -48° C • And • Setpoint change n.a. rpm • For time n.a. s • And • Additional after dynamic conditions fulfilled: • Gear switch not active • (A/T only) • Accelerator pedal released by driver • Vehicle speed 0 mph • (M/T only) • For time >= 0.0 s	• 12 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P050A Cold Start Idle Control System Performance	Cold Idle Controller Function Monitoring: engine speed deviation	• Positive engine speed vs. engine speed set point > 90 RPM • Integrated I-part of idle speed controller n.a.	• General conditions: • Vehicle speed =0 mph • Accelerator pedal released by driver • Throttle actuator commanded on • Evap purge flow < 4.00 kg/h • Engine running • Time after engine start > 0.0 s • Clutch switch n.a. • Barometric pressure > 70.00 kPa • Catalyst heating active • ECT @ cylinder head > -10° C • And • Setpoint change n.a. rpm • For time n.a. s • And • Additional after dynamic conditions fulfilled: • Gear switch not active • (A/T only) • Accelerator pedal released by driver • Vehicle speed 0 mph • For time >= 0.0 s	• 12 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Cold Idle Controller Function Monitoring: engine speed deviation	• Negative engine speed deviation from set point > 100 RPM • Integrated I-part of idle speed controller n.a.	• General conditions: • Vehicle speed =0 mph • Accelerator pedal released by driver • Throttle actuator commanded on • Evap purge flow < 4.00 kg/h • Engine running • Time after engine start > 0.0 s • Clutch switch n.a. • Barometric pressure > 70.00 kPa • Catalyst heating active • ECT @ cylinder head > -10° C • And • Setpoint change n.a. rpm • For time n.a. s • And • Additional after dynamic conditions fulfilled: • Gear switch not active • (A/T only) • Accelerator pedal released by driver • Vehicle speed 0 mph • Engine load < 31.25 % • (M/T only) • For time >= 0.0 s			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P050B Cold Start Ignition Timing Performance	Ignition Control Ignition Timing Monitor	• Ratio between ignition angle efficiency integral and time at idle speed > 0.20 [-]	• Engine idle speed time @ idle speed > 5.0 s • Ignition angle setpoint <= 0.85 [-] • Modeled pressure quotient <= 1.0 [-] • Vehicle speed = 0 mph • And • Diff. air mass set point vs. filtered air mass set point for load dynamic detection < 99,999.00 mg/rev • For time >= 0.0 s • And • Diff. engine speed vs. filtered engine speed for engine speed dynamic detection < 8,160 RPM • For time >= 0.0 s	• 0.1 s • Once / DCY	• 2 DCY	– Check for any Engine Speed sensor or Ignition Coil faults and diagnose them first. – Check the Engine Speed Sensor - G28- . Refer to ⇒ “3.6.11 Engine Speed Sensor G28 , Checking”, page 479 . – Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.20 Ignition Coils with Power Output Stage , Checking”, page 499 . – If NO other codes are set, check the ECM. Refer to appropriate repair manual. – Check the Engine Control Module - J623- . Refer to appropriate repair manual.
P052A Cold Start "A" Camshaft Position Timing Over-Advanced Bank 1	Cold Start Monitoring Variable Valve Timing (VVT) Intake Actuator rationality check	• Camshaft position deviation > 9.00° CRK	• Modeled oil temperature -40 – 160° C • Engine speed 608 – 6,016 rpm • Camshaft position n.a. • Camshaft position adjustment active • Catalyst heating active • Camshaft position deviation integrator (actual vs. setpoint position) >= 8.00° CRK’s	• 0 (FTP75: 45) [s] • once / DCY	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.3 Camshaft Adjustment Valve 1 N205 , Checking”, page 462

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P053F Cold Start Fuel Pressure Performance Bank 2	Fuel System Out Of Range High	• Deviation between reference and actual fuel pressure < -2,999.90 kPa • For time >= 3.0 s	• General: • Engine speed > 512 rpm • Time after engine start > 10.0 s • And • Fuel mass setpoint lower range > 5.00 mg/rev • for time >= 10.0 s • Fuel mass setpoint upper range <= 187.17 – 229.23 mg/rev • Fuel mass setpoint gradient -1389.00 – 1389.00 mg/rev • For time >= 5.0 s • And • Additional for catalyst heating: • Catalyst heating active • ECT @ cylinder head > -48° C • Fuel mass setpoint lower range >= 5.00 mg/rev • For time >= 5.1 s	• 4.5 s • Once / DCY	• 2 DCY	– Check the fuel pressure. Refer to appropriate repair manual. – Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 – Check the Fuel Pressure Regulator Valve - N276- . Refer to ⇒ “3.6.16 Fuel Pressure Regulator Valve N276 , Checking”, page 489 . – Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.17 Fuel Pressure Sensor G247 , Checking”, page 491
	Fuel System Out Of Range Low	• Deviation between reference and actual fuel pressure > 2,999.90 kPa • For time >= 3.0 s				
P054A Cold Start "B" Camshaft Position Timing Over-Advanced Bank 1	Cold Start Monitoring Variable Valve Timing (VVT) Exhaust Actuator rationality check	• Camshaft position deviation > 9.00° CRK	• Modeled oil temperature -40...160° C • Engine speed 608 – 6,016 rpm • Camshaft position n.a. • Camshaft position adjustment active • Catalyst heating active • Camshaft position deviation integrator (actual vs. setpoint position) >= 8.00° CRK’s	• 0 (FTP75: 45) s • Once / DCY	• 2 DCY	– Check the Exhaust Camshaft Adjustment Valve 1 - N318- . Refer to ⇒ “3.6.14 Exhaust Camshaft Adjustment Valve 1 N318 , Checking”, page 485

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P064A Fuel Pump Control Module	COM: Fuel Pump Control Module (FPCM) communication with FPCM	• FP signal: ROM / RAM failure feedback >= 2.00 [-]	• Engine on	• 1.2 s Continuous	• 2 DCY	– Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 .
		• FP signal: power amplifier failure feedback >= 2.00 [-]		• 1.4 s Continuous		
P0601 Internal Control Module Memory Checksum Error	ECM: Checksum Verification	• Calibration checksum incorrect		• 1.0 s • Continuous	• 2 DCY	– Check the Engine Control Module - J623- . Refer to appropriate repair manual.
		• Software checksum incorrect				
P0603 Internal Control Module Keep Alive Memory (KAM) Error	Injection Valves Supply Voltage Internal Hardware Check	• Hardware vs. software version check during initialization failure		• 4.9 s • Once / DCY	• 2 DCY	– Check the Engine Control Module - J623- . Refer to appropriate repair manual.
		• Calibration during initialization failure				
		• Hardware during initialization failure				
		• Time reference from micro controller during initialization failure				
		• Time reference from micro controller during initialization missing		• 2,880.0° CRK • Continuous		
		• Communication between micro controller and SDI-Driver power stage failure		• 2880.0° CRK • Continuous		
		• Communication between micro controller and SDI-Driver power stage failure		• 360.0° CRK • Once / DCY		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	ECM: Communication Check	• Device 1: • SPI communication with ATIC failure • Device 2: • SPI communication with ATIC failure • SPI communication with ATIC failure		• 2.0 s • Continuous		
P0606 Control Module Processor	Barometric Pressure Sensor Rationality Check By Engine Off*	• Diff. barometric pressure vs. upstream throttle pressure >= 8.50 kPa • Or • Diff. barometric pressure vs. intake manifold pressure >= 8.50 kPa	• Case 1: • Engine stop during DCY • Engine stopped • Vehicle speed < 1 mph • Case 2: • Engine stop at start of DCY • Engine stopped • Vehicle speed < 1 mph • Delay after engine stop >= 5.0 s • For time >= 10.0 s	• 3.0 s • Multiple	• 2 DCY	– Using scan tool, monitor the Barometric Pressure Sensor, located within the Engine Control Module - J623- . – Check the Engine Control Module - J623- . Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Barometric Pressure Sensor Rationality Check During ECM Keep Alive-Time:*	• Case 1: • Diff. barometric pressure vs. intake manifold pressure >= 8.50 kPa • And • Diff. barometric pressure vs. upstream throttle pressure >= 8.50 kPa • Case 2: • Diff. intake manifold pressure vs. intake manifold pressure @ idle or low part load n.a. kPa • Diff. barometric pressure vs. intake manifold pressure n.a. kPa • Diff. barometric pressure vs. upstream throttle pressure n.a. kPa • Case 3: • Diff. upstream throttle pressure @ full or high part load vs. upstream throttle pressure n.a. kPa • Diff. barometric pressure vs. intake manifold pressure n.a. kPa • Diff. barometric pressure vs. upstream throttle pressure n.a. kPa • Diff. upstream throttle pressure vs. intake manifold pressure n.a. kPa	• Engine stopped • Vehicle speed < 1 mph • Ignition off • Delay time in ECM keep alive-time > 10.0 s • Delay after engine stop >= 5.0 s • Barometric pressure sensor voltage 0.20 – 4.80 V • intake manifold pressure sensor voltage 0.20 – 4.80 V • Turbocharger boost pressure sensor voltage 0.20 – 4.80 V	• 3.0 s • Once / DCY		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Barometric Pressure Sensor Out Of Range High*	• Measured barometric pressure > 115.0 kPa		• 5.0 s • Continuous		
	Barometric Pressure Sensor Out Of Range Low*	• Measured barometric pressure < 45.0 kPa				
	Knock Control Functional Check*	• Knock control failure	• Engine running	• 6.4 s • Continuous		
	ECM: EEPROM Check*	• EEPROM information failure • Decryption of NVMCrypt failed • Finished NVMCrypt integrity error • Communication between sample software and production hardware error • RAM error detected • Monitoring module check failed		• 1.0 s • Once / DCY		
	ECM: Communication Check*	• SPI communication with AT-IC failure	• Time after ignition on >= 1.0 s	• 1.0 s • Continuous		
	ECM: A/D Converter Function Monitoring: A/D Converter*	• Diff. A/D-channel 1 vs. A/D-channel 2 > 0.30 V		• 0.5 s • Continuous		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	ECM: Electronic Throttle Control Module Function Monitoring: Torque	• Monitoring of difference between actual and set point torque value engine torque overflow > 45.00 – 350.00 Nm	• Throttle actuator commanded on	• 0.5 s • Continuous		
		• Monitoring of torque difference integration integrated engine torque > 655.35 Nms		• 0.01 s • Continuous		
	ECM: Electronic Throttle Control Module Function Monitoring: Engine Speed Limitation	• Engine speed > 1,760 RPM	• Engine speed limitation active • Injection active	• 0.5 s • Continuous		
	ECM: Electronic Throttle Control Module Function Monitoring: A/D Converter	• Internal check failed		• 0.5 s • Continuous		
	CAN: Controller controller RAM check	• RAM error memory checksum error	• Initialization phase active • Ignition on	• 0.2 s • Once / DCY		
P0607 Control Module Performance	Barometric Pressure Sensor Short To Ground	• Barometric pressure sensor voltage < 0.20 V		• 0.5 s • Continuous	• 2 DCY	– Using scan tool, monitor the Barometric Pressure Sensor, located within the Engine Control Module - J623- . – Check the Engine Control Module - J623- . Refer to appropriate repair manual.
	Barometric Pressure Sensor Short To Battery Plus	• Barometric pressure sensor voltage > 4.80 V				

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0638 Throttle Actuator Control Range/ Performance Bank 1	Throttle Actuator Basic Settings Adaptation Value Monitoring	• Battery voltage <= 9.04 V	• Throttle adaptation (@ initial start or after detection of throttle exchange or checksum error) active	• 0.01 s • Once Per Lifetime	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ "3.6.31 Throttle Valve Control Module GX3 , Checking", page 524 .
		• Accelerator pedal value > 99.90 % • Or • Engine speed > 64 RPM • Or • Vehicle speed > 1 mph • Or • Modeled IAT @ throttle < 5° C • Or • ECT @ cylinder head < 5° C • Or • ECT @ cylinder head > 110° C		• 0.01 s • Once Per Lifetime		
		• Actual TPS 1 or 2 voltage - voltage ref. point > 0.07 V	• Throttle adaptation demanded • Accelerator pedal value < 99.90 % • Engine speed < 64 RPM • Vehicle speed < 1 mph • Modeled IAT @ throttle > 5° C • ECT @ cylinder head 5 – 110° C	• 0.01 s • Once / DCY		
		• Actual TPS - ref. point > 0.503° TPS		• 0.01 s • Once / DCY		
	Throttle Actuator Basic Settings Monitoring Of Position	• Actual TPS - ref. point > 0.503° TPS		• 0.01 s • Once Per Lifetime		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Throttle position sensor 1 voltage < 0.40 V • Or • Throttle position sensor 2 voltage > 4.60 V • Or • Throttle position sensor 1 voltage > 0.80 V • Or • Throttle position sensor 2 voltage < 4.20 V				
		• Actual TPS 1 or 2 voltage - voltage ref. point > 0.07 V				
		• Actual TPS 1 or 2 voltage - voltage ref. point > 0.25 V				
		• Actual TPS - ref. point > 0.503° TPS				
		• Actual TPS 1 or 2 voltage - voltage ref. point > 0.07 V				
P0642 Sensor Reference Voltage "A" Circuit Low	ECM: 5V Supply Voltage Out Of Range Low	• Analog output 1 supply voltage < 4.62 V		• 0.2 s • Continuous	• 2 DCY	– If a related sensor voltage code is also set, refer to that sensor for diagnosis first. If no other related codes set, replace the Engine Control Module -J623- . Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0643 Sensor Reference Voltage "A" Circuit High	ECM: 5V Supply Voltage Out Of Range High	• Analog output 1 supply voltage > 5.43 V		• 0.2 s • Continuous	• 2 DCY	– If a related sensor voltage code is also set, refer to that sensor for diagnosis first. If no other related codes set, replace the Engine Control Module - J623- . Refer to appropriate repair manual.
P0652 Sensor Reference Voltage "B" Circuit Low	ECM: 5V Supply Voltage Out Of Range Low	• Analog output 2 supply voltage < 4.62 V		• 0.2 s • Continuous	• 2 DCY	– If a related sensor voltage code is also set, refer to that sensor for diagnosis first. If no other related codes set, replace the Engine Control Module - J623- . Refer to appropriate repair manual.
P0653 Sensor Reference Voltage "B" Circuit High	ECM: 5V Supply Voltage Out Of Range High	• Analog output 2 supply voltage > 5.43 V		• 0.2 s • Continuous	• 2 DCY	– If a related sensor voltage code is also set, refer to that sensor for diagnosis first. If no other related codes set, replace the Engine Control Module - J623- . Refer to appropriate repair manual.
P0657 Actuator Supply Voltage "A" Circuit/ Open	Supply Voltage Relay Engine Components Open Circuit	• Output voltage, lower range >= 1.90 – 2.30 V • Output voltage, upper range (hardware values) <= 2.80 – 3.20 V	• Relay commanded off	• 1.0 s • Continuous	• 2 DCY	– Check the Engine Component Power Supply Relay - J757- . Refer to ⇒ “3.6.8 Engine Component Power Supply Relay J757 , Checking”, page 473 .
P0658 Actuator Supply Voltage "A" Circuit Low	Supply Voltage Relay Engine Components Short To Ground	• Output voltage (hardware values) < 1.90 – 2.30 V	• Relay commanded off			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0659 Actuator Supply Voltage "A" Circuit High	Supply Voltage Relay Engine Components Short To Battery Voltage	• Output current driver stage internal value • Or • Actuator temperature (hardware values) > 175 – 195° C	• Relay commanded on			
P0686 ECM/PCM Power Relay Control Circuit Low	Main Relay Rationality Check During Engine Off	• Sensed circuit voltage > 6.00 V	• Main relay commanded on • For time >= 0.3 s	• 0.1 s • Continuous	• 2 DCY	– Check the Motronic Engine Control Module Power Supply Relay - J271- . Refer to ⇒ “3.6.25 Motronic Engine Control Module Power Supply Relay J271 , Checking”, page 509 .
P0687 ECM/PCM Power Relay Control Circuit High	Main Relay Rationality Check During Engine Running	• Sensed circuit voltage < 5.00 V	• Main relay commanded on • For time >= 0.1 s	• 0.1 s • Continuous	• 2 DCY	– Check the Motronic Engine Control Module Power Supply Relay - J271- . Refer to ⇒ “3.6.25 Motronic Engine Control Module Power Supply Relay J271 , Checking”, page 509 .
	Main Relay Short To Battery Plus	• Main relay driver temperature > 175 – 195° C • Or • Main relay output current (hardware values) driver stage internal value	• Main relay commanded on • For time >= 0.4 s	• 0.2 s • Continuous		
P0698 Sensor Reference Voltage "C" Circuit Low	ECM: 5V Supply Voltage Out Of Range Low	• Analog output 3 supply voltage < 4.62 V		• 0.2 s • Continuous	• 2 DCY	– If a related sensor voltage code is also set, refer to that sensor for diagnosis first. If no other related codes set, replace the Engine Control Module - J623- . Refer to appropriate repair manual.

DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P0699 Sensor Reference Voltage "C" Circuit High	ECM: 5V Supply Voltage Out Of Range High	• Analog output 3 supply voltage > 5.43 V		• 0.2 s • Continuous	• 2 DCY	– If a related sensor voltage code is also set, refer to that sensor for diagnosis first. If no other related codes set, replace the Engine Control Module - J623- . Refer to appropriate repair manual.
P11A1 Cam Shift Actuator "A" Cylinder 1 Circuit/ Open	Variable Valve Lift (VVL) short to ground	• Output voltage < 1.92 – 2.21 V (hardware values)	• Actuator commanded off	• 0.5 s • Continuous	• 2 DCY	– Check the Cylinder 1 Exhaust Camshaft Adjuster A - N580- . Refer to ⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459
	Variable Valve Lift (VVL) open circuit	• Output voltage, lower range < 1.92 – 2.21 V • Output voltage, upper range > 2.85 – 3.25 V			• 2 DCY	
P11A2 Cam Shift Actuator "A" Cylinder 1 Range/ Performance	Variable Valve Lift (VVL) rationality check low	• Actuator feedback signal voltage permanently low [-]	• Modeled oil temperature < 20° C	• 6.0 s • Continuous	• 2 DCY	– Check the Cylinder 1 Exhaust Camshaft Adjuster A - N580- . Refer to ⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459
P11A3 Cam Shift Actuator "B" Cylinder 1 Circuit/ Open	Variable Valve Lift (VVL) short to ground	• Output voltage < 1.92 – 2.21 V (hardware values)	• Actuator commanded off	• 0.5 s • Continuous	• 2 DCY	– Check the Cylinder 1 Exhaust Camshaft B - N581- . Refer to ⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459
	Variable Valve Lift (VVL) open circuit	• Output voltage, lower range < 1.92 – 2.21 V • Output voltage, upper range > 2.85 – 3.25 V			• 2 DCY	
P11A4 Cam Shift Actuator "B" Cylinder 1 Range/ Performance	Variable Valve Lift (VVL) rationality check low	• Actuator feedback signal voltage permanently low [-]	• Modeled oil temperature < 20° C	• 6.0 s • Continuous	• 2 DCY	– Check the Cylinder 1 Exhaust Camshaft B - N581- . Refer to ⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459
P11A5 Cam Shift Actuator "A" Cyl-	Variable Valve Lift (VVL) short to ground	• Output voltage < 1.92 – 2.21 V (hardware values)	• Actuator commanded off	• 0.5 s • Continuous	• 2 DCY	– Check the Cylinder 2 Exhaust Camshaft Adjuster A - N588- . Refer to

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
inder 2 Circuit/ Open	Variable Valve Lift (VVL) open circuit	• Output voltage, lower range < 1.92 – 2.21 V • Output voltage, upper range > 2.85 – 3.25 V			• 2 DCY	⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459
P11A6 Cam Shift Actuator "A" Cylinder 2 Range/ Performance	Variable Valve Lift (VVL) rationality check low	• Actuator feedback signal voltage permanently low [-]	• Modeled oil temperature < 20° C	• 6.0 s • Continuous	• 2 DCY	– Check the Cylinder 2 Exhaust Camshaft Adjuster A - N588- . Refer to ⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459
P11A7 Cam Shift Actuator "B" Cylinder 2 Circuit/ Open	Variable Valve Lift (VVL) short to ground	• Output voltage < 1.92 – 2.21 V (hardware values)	• Actuator commanded off	• 0.5 s • Continuous	• 2 DCY	– Check the Cylinder 2 Exhaust Camshaft B - N589- . Refer to ⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459
	Variable Valve Lift (VVL) open circuit	• Output voltage, lower range < 1.92 – 2.21 V • Output voltage, upper range > 2.85 – 3.25 V			• 2 DCY	
P11A8 Cam Shift Actuator "B" Cylinder 2 Range/ Performance	Variable Valve Lift (VVL) rationality check low	• Actuator feedback signal voltage permanently low [-]	• Modeled oil temperature < 20° C	• 6.0 s • Continuous	• 2 DCY	– Check the Cylinder 2 Exhaust Camshaft B - N589- . Refer to ⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459
P11A9 Cam Shift Actuator "A" Cylinder 3 Circuit/ Open	Variable Valve Lift (VVL) short to ground	• Output voltage < 1.92 – 2.21 V (hardware values)	• Actuator commanded off	• 0.5 s • Continuous	• 2 DCY	– Check the Cylinder 3 Exhaust Camshaft Adjuster A - N596- . Refer to ⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459
	Variable Valve Lift (VVL) open circuit	• Output voltage, lower range < 1.92 – 2.21 V • Output voltage, upper range > 2.85 – 3.25 V			• 2 DCY	

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P11AA Cam Shift Actuator "A" Cylinder 3 Range/ Performance	Variable Valve Lift (VVL) rationality check low	• Actuator feedback signal voltage permanently low [-]	• Modeled oil temperature < 20° C	• 6.0 s • Continuous	• 2 DCY	– Check the Cylinder 3 Exhaust Camshaft Adjuster A - N596- . Refer to ⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459
P11AB Cam Shift Actuator "B" Cylinder 3 Circuit/ Open	Variable Valve Lift (VVL) short to ground	• Output voltage < 1.92 – 2.21 V (hardware values)	• Actuator commanded off	• 0.5 s • Continuous	• 2 DCY	– Check the Cylinder 3 Exhaust Camshaft B - N597- . Refer to ⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459
	Variable Valve Lift (VVL) open circuit	• Output voltage, lower range < 1.92 – 2.21 V • Output voltage, upper range > 2.85 – 3.25 V			• 2 DCY	
P11AC Cam Shift Actuator "B" Cylinder 3 Range/ Performance	Variable Valve Lift (VVL) rationality check low	• Actuator feedback signal voltage permanently low [-]	• Modeled oil temperature < 20° C	• 6.0 s • Continuous	• 2 DCY	– Check the Cylinder 3 Exhaust Camshaft B - N597- . Refer to ⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459
P11AD Cam Shift Actuator "A" Cylinder 4 Circuit/ Open	Variable Valve Lift (VVL) short to ground	• Output voltage < 1.92 – 2.21 V (hardware values)	• Actuator commanded off	• 0.5 s • Continuous	• 2 DCY	– Check the Cylinder 4 Exhaust Camshaft Adjuster A - N604- . Refer to ⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459
	Variable Valve Lift (VVL) open circuit	• Output voltage, lower range < 1.92 – 2.21 V • Output voltage, upper range > 2.85 – 3.25 V			• 2 DCY	
P11AE Cam Shift Actuator "A" Cylinder 4 Range/ Performance	Variable Valve Lift (VVL) rationality check low	• Actuator feedback signal voltage permanently low [-]	• Modeled oil temperature < 20° C	• 6.0 s • Continuous	• 2 DCY	– Check the Cylinder 4 Exhaust Camshaft Adjuster A - N604- . Refer to ⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459
P11AF Cam Shift Actuator "B" Cylinder 4	Variable Valve Lift (VVL) short to ground	• Output voltage < 1.92 – 2.21 V (hardware values)	• Actuator commanded off	• 0.5 s • Continuous	• 2 DCY	– Check the Cylinder 4 Exhaust Camshaft B - N605- . Refer to ⇒ “3.6.2 Cam Adjustment Ac-

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
Circuit/ Open	Variable Valve Lift (VVL) open circuit	• Output voltage, lower range < 1.92 – 2.21 V • Output voltage, upper range > 2.85 – 3.25 V			• 2 DCY	tuators , Checking", page 459
P11B0 Cam Shift Actuator "B" Cylinder 4 Range/ Performance	Variable Valve Lift (VVL) rationality check low	• Actuator feedback signal voltage permanently low [-]	• Modeled oil temperature < 20° C	• 6.0 s • Continuous	• 2 DCY	– Check the Cylinder 4 Exhaust Camshaft B - N605- . Refer to ⇒ "3.6.2 Cam Adjustment Actuators , Checking", page 459
P11BF Cam Shift Actuator Outlet "A" Cylinder 1 Range/ Performance	Variable Valve Lift (VVL) short to battery plus	• Power stage temperature > 160 – 200° C • Or • Output current driver stage internal value (hardware values)	• Actuator commanded on	• 0.1 s • Continuous	• 2 DCY	– Check the Cylinder 1 Exhaust Camshaft Adjuster A - N580- . Refer to ⇒ "3.6.2 Cam Adjustment Actuators , Checking", page 459
P11C0 Cam Shift Actuator Outlet "B" Cylinder 1 Circuit/ Open	Variable Valve Lift (VVL) short to battery plus	• Power stage temperature > 160 – 200° C • Or • Output current driver stage internal value (hardware values)	• Actuator commanded on	• 0.1 s • Continuous	• 2 DCY	– Check the Cylinder 1 Exhaust Camshaft B - N581- . Refer to ⇒ "3.6.2 Cam Adjustment Actuators , Checking", page 459
P11C1 Cam Shift Actuator Outlet "A" Cylinder 2 Range/ Performance	Variable Valve Lift (VVL) short to battery plus	• Power stage temperature > 160 – 200° C • Or • Output current driver stage internal value (hardware values)	• Actuator commanded on	• 0.1 s • Continuous	• 2 DCY	– Check the Cylinder 2 Exhaust Camshaft Adjuster A - N588- . Refer to ⇒ "3.6.2 Cam Adjustment Actuators , Checking", page 459
P11C2 Cam Shift Actuator Outlet "B" Cylinder 2 Circuit/ Open	Variable Valve Lift (VVL) short to battery plus	• Power stage temperature > 160 – 200° C • Or • Output current driver stage internal value (hardware values)	• Actuator commanded on	• 0.1 s • Continuous	• 2 DCY	– Check the Cylinder 2 Exhaust Camshaft B - N589- . Refer to ⇒ "3.6.2 Cam Adjustment Actuators , Checking", page 459

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P11C3 Cam Shift Actuator Outlet "A" Cylinder 3 Range/ Performance	Variable Valve Lift (VVL) short to battery plus	• Power stage temperature > 160 – 200° C • Or • Output current driver stage internal value (hardware values)	• Actuator commanded on	• 0.1 s • Continuous	• 2 DCY	– Check the Cylinder 3 Exhaust Camshaft Adjuster A - N596- . Refer to ⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459
P11C4 Cam Shift Actuator Outlet "B" Cylinder 3 Circuit/ Open	Variable Valve Lift (VVL) short to battery plus	• Power stage temperature > 160 – 200° C • Or • Output current driver stage internal value (hardware values)	• Actuator commanded on	• 0.1 s • Continuous	• 2 DCY	– Check the Cylinder 3 Exhaust Camshaft B N597- . Refer to ⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459
P11C5 Cam Shift Actuator Outlet "A" Cylinder 4 Range/ Performance	Variable Valve Lift (VVL) short to battery plus	• Power stage temperature > 160 – 200° C • Or • Output current driver stage internal value (hardware values)	• Actuator commanded on	• 0.1 s • Continuous	• 2 DCY	– Check the Cylinder 4 Exhaust Camshaft Adjuster A - N604- . Refer to ⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459
P11C6 Cam Shift Actuator Outlet "B" Cylinder 4 Circuit/ Open	Variable Valve Lift (VVL) short to battery plus	• Power stage temperature > 160 – 200° C • Or • Output current driver stage internal value (hardware values)	• Actuator commanded on	• 0.1 s • Continuous	• 2 DCY	– Check the Cylinder 4 Exhaust Camshaft B - N605- . Refer to ⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P12A1 Fuel Rail Pressure Sensor Inappropriately Low	Fuel System Pressure Sensor, High Pressure Side Rationality Check Low	• Deviation lambda of controller included adaptation < -22.50% • and • high pressure controller output > 40 mg	• General: • Engine speed 512 – 6,816 rpm • Fuel mass setpoint 5.00 – 1,389.00 mg/rev • Time after change to DFI not equipped s • Time after engine start > 10.0 s • Engine warm-up not active • Catalyst heating not active • Full load not active • Catalyst purge not active • Lambda control closed loop • Evap purge functionality diagnosis not active • Fuel pressure setpoint gradient <= 34,777.60 [kPa • And • Depending on low dynamic conditions: • Fuel mass setpoint lower range > 5.00 mg/rev • For time >= 10.0 s • Fuel mass setpoint upper range < 187.17 – 229.23 mg/rev • Fuel mass setpoint gradient -1,389.00 – 1,389.00 mg/rev • For time >= 5.0 s • And • Depending on canister purge: • Canister load <= 1.00 [-]	• 5.0 s • Continuous	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.17 Fuel Pressure Sensor G247 , Checking”, page 491 . – Check the Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 . – Check the fuel pressure. Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Or • Evap purge valve not active or closed			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P12A2 Fuel Rail Pressure Sensor Inappropriately High	Fuel System Pressure Sensor, High Pressure Side Rationality Check High	• Deviation lambda of controller included adaptation > 30.00% • And • High pressure controller output < -35 mg	• General: • Engine speed 608 – 6,816 rpm • Fuel mass setpoint 5.00 – 1,389.00 mg/rev • Time after change to DFI not equipped s • Time after engine start > 10.0 s • Engine warm-up not active • Catalyst heating not active • Full load not active • Catalyst purge not active • Lambda control closed loop • Evap purge functionality diagnosis not active • Fuel pressure setpoint gradient <= 34,777.60 kPa • And • Depending on low dynamic conditions: • Fuel mass setpoint lower range > 5.00 mg/rev • For time >= 10.0 s • Fuel mass setpoint upper range < 187.17 – 229.23 mg/rev • Fuel mass setpoint gradient -1,389.00 – 1,389.00 mg/rev • For time >= 5.0 s • And • Depending on canister purge: • Canister load <= 1.00 [-]	• 5.0 s • Continuous	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.17 Fuel Pressure Sensor G247 , Checking”, page 491 . – Check the Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 . – Check the fuel pressure. Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Or • Evap purge valve not active or closed			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P12A4 Fuel Rail Pump Control Valve Stuck Closed	Fuel System Pressure Sensor, High Pressure Side Out Of Range High	• Deviation between fuel pressure setpoint and current fuel pressure < -2999.90 kPa • Deviation lambda of controller included adaption -50.00 – 50.00 % • Case 1: • High pressure controller output < -45 mg • Case 2: • Flow control valve open • Mass fuel flow setpoint > 15.01 mg/rev	• General: • Engine speed 608 – 6,816 rpm • Fuel mass setpoint 5.00 – 1,389.00 mg/rev • Time after engine start > 10.0 s • Engine warm-up not calibrated • Catalyst heating not calibrated • Full load not calibrated • Catalyst purge not calibrated • Lambda control not calibrated • Evap purge functionality diagnosis not calibrated • Fuel pressure setpoint gradient <= 34,777.60 kPa • And • Depending on low dynamic conditions: • Fuel mass setpoint lower range > 5.00 mg/rev • For time >= 10.0 s • Fuel mass setpoint upper range < 187.17 – 229.23 mg/rev • Fuel mass setpoint gradient -1,389.00 – 1,389.00 mg/rev • For time >= 5.0 s • And • Depending on canister purge: • Canister load not calibrated [-] • Or • Evap purge valve not calibrated	• 5.0 s • Continuous	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.17 Fuel Pressure Sensor G247 , Checking”, page 491 . – Check the Fuel Delivery Unit - GX1- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493 . – Check the fuel pressure. Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P13EA Cold Start Ignition Timing Performance Off Idle	Ignition Control Ignition Timing Monitor	• Ratio between ignition angle efficiency integral and time at part load > 0.16 [-]	• Time @ part load > 5.0 s • Ignition angle set point <= 0.94 [-] • Engine part load • Vehicle speed > 2 mph • And • Diff. air mass set point vs. filtered air mass set point for load dynamic detection < 99.999.0 mg/rev • For time >= 0.0 s • And • Diff. engine speed vs. filtered engine speed for engine speed dynamic detection < 8,160 RPM • For time >= 0.0 s	• 0.1 s • Once / DCY	• 2 DCY	– Check the Engine Speed Sensor - G28- . Refer to ⇒ “3.6.11 Engine Speed Sensor G28 , Checking”, page 479 . – Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.20 Ignition Coils with Power Output Stage , Checking”, page 499 . – Check for any Engine Speed sensor or Ignition Coil faults and diagnose them first. – If NO other codes are set, check the ECM. Refer to appropriate repair manual.
P1545 Throttle Actuator "A" Control Motor Circuit Range/ Performance	Throttle Actuator Out Of Range	• Control duty cycle > 98.0 %	• Throttle position not at min. value • Throttle adaptation not active • Throttle actuator commanded on	• 5.0 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .
	Throttle Actuator Rationality Check	• Difference between throttle position set point and throttle flap opening angle for electronic throttle control > 2.998 – 24.982° TPS	• Throttle adaptation (@ initial start or after detection of throttle exchange or checksum error) not active • Throttle actuator commanded on • Difference between throttle position set point and throttle flap opening angle <= 1.999; > -1.999° TPS			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P169A Loading Mode Active	ECM: Transport Mode Function Monitoring: Mode Change	• Transport mode active	• Vehicle speed < 3 mph • Max trip mileage since initial vehicle start-up < 62.15 miles • During ECM keep alive-time after ignition off engine speed 0 RPM • Production mode not active • For hybrid: • Drive motor off	• 0.01 s • Continuous	• 1 DCY	– Perform readiness check. Refer to ⇒ “3.2 Readiness Codes”, page 19 .
P2004 Intake Manifold Runner Control Stuck Open Bank 1	Intake Manifold Runner Flap Actuator Stuck Open	• Signal voltage > 1.89 V • For time >= 1.5 s	• Flap commanded off • Time after engine start > 5.0 s	• 0.2 s • Continuous	• 2 DCY	– Check the Intake Manifold Runner Control Valve - N316- . Refer to ⇒ “3.6.21 Intake Manifold Runner Control Valve N316 , Checking”, page 501 .
P2006 Intake Manifold Runner Control Stuck Closed Bank 1	Intake Manifold Runner Flap Actuator Stuck Close	• Signal voltage < 3.10 V • For time >= 1.5 s	• Flap commanded on • Time after engine start > 5.0 s	• 0.2 s • Continuous	• 2 DCY	– Check the Intake Manifold Runner Control Valve - N316- . Refer to ⇒ “3.6.21 Intake Manifold Runner Control Valve N316 , Checking”, page 501 .
P2008 Intake Manifold Runner Control Circuit/ Open Bank 1	Intake Manifold Runner Flap Actuator Open Circuit	• Output voltage lower range 1.92 – 2.21 V • Output voltage upper range (hardware values) 2.85 – 3.25 V	• Engine running • Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check the Intake Manifold Runner Control Valve - N316- . Refer to ⇒ “3.6.21 Intake Manifold Runner Control Valve N316 , Checking”, page 501 .
P2009 Intake Manifold Runner Control Circuit Low Bank 1	Intake Manifold Runner Flap Actuator Short To Ground	• Output voltage (hardware values) < 1.92 – 2.21 V	• Engine running • Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check the Intake Manifold Runner Control Valve - N316- . Refer to ⇒ “3.6.21 Intake Manifold Runner Control Valve N316 , Checking”, page 501 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2010 Intake Manifold Runner Control Circuit High Bank 1	Intake Manifold Runner Flap Actuator Short To Battery Plus	• Power stage temperature > 160 – 200° C • Or • Output current (hardware values) driver stage internal value	• Engine running • Actuator commanded on	• 2.0 s • Continuous	• 2 DCY	– Check the Intake Manifold Runner Control Valve - N316- . Refer to ⇒ “3.6.21 Intake Manifold Runner Control Valve N316 , Checking”, page 501 .
P2014 Intake Manifold Runner Position Sensor/ Switch Circuit Bank 1	Intake Manifold Runner Flap Position Sensor Short To Ground / Open Circuit	• Intake manifold runner flap position sensor voltage < 0.20 V	• Engine start not active	• 0.04 s • Continuous	• 2 DCY	– Check the Intake Manifold Runner Position Sensor - G336- . Refer to ⇒ “3.6.22 Intake Manifold Runner Position Sensor G336 , Checking”, page 503 .
P2015 Intake Manifold Runner Position Sensor/ Switch Circuit Range/ Performance Bank 1	Intake Manifold Runner Flap Actuator Adaptation Value Monitoring	• Diff. actual value vs. substitution value @ lower mechanical thresh hold > 0.70 V • Or • Diff. actual value vs. substitution value @ upper mechanical thresh hold > 0.70 V • Failed adaptations >= 1.00 [-]	• Modeled air temperature < 0.75 [-] • Engine running • Engine speed > 640; < 1,504 RPM • ECT @ cylinder head > -30° C • Intake manifold runner flap adaptation not finished	• 0.04 s • Once per lifetime	• 2 DCY	– Check the Intake Manifold Runner Position Sensor - G336- . Refer to ⇒ “3.6.22 Intake Manifold Runner Position Sensor G336 , Checking”, page 503 .
P2017 Intake Manifold Runner Position Sensor/ Switch Circuit High Bank 1	Intake Manifold Runner Flap Position Sensor Short To Battery Voltage	• Intake manifold runner flap position sensor voltage > 4.80 V	• Engine start not active	• 0.04 s • Continuous	• 2 DCY	– Check the Intake Manifold Runner Position Sensor - G336- . Refer to ⇒ “3.6.22 Intake Manifold Runner Position Sensor G336 , Checking”, page 503 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2024 EVAP Fuel Vapor Temperature Sensor Circuit	Smart Temperature Sensor Open Circuit	• NVLD output voltage lower range >= 1.92 – 2.21 V • NVLD output voltage upper range <= 2.85 – 3.25 V	• Case 1: • Ignition on • Case 2: • Ignition off (during ECM keep alive-time)	• 0.5 s • Continuous	• 2 DCY	– Check the Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- . Refer to ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496 .
P2025 EVAP Fuel Vapor Temperature Sensor Performance	Smart Temperature Sensor Functional Check	• Diff. time between ECU and smart module > 3.0 s	• Ignition off • ECM keep alive time active	• 3.0 s • Once / DCY	• 2 DCY	– Check the Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- . Refer to ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496 .
		• Reset counter > 3.00 [-]	• Engine running • Last ECM keep alive mode finished	• 0.1 s • Once / DCY	• 3 DCY	
	Smart Temperature Sensor Out Of Range High	• Smart module temperature > 119° C	• Ignition off • NVLD (EVAP-System) diagnostic mode = active • Fuel level < 85.10%	• 300 s • Continuous	• 2 DCY	
			• Engine Running	• 30 s • Continuous		
	Smart Temperature Sensor Out Of Range Low	• Smart module temperature < -39° C	• Engine off time >= 360.00 min • ECT @ cylinder head > -23° C • IAT cross check finished • ECT cross check finished • Fuel level < 85.10%	• 1.0 s • Once / DCY		

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Smart Temperature Sensor Cross Check	• Difference between smart temperature and ECT @ cylinder head >= 25.5 K • And • Difference between smart temperature @ engine start and IAT @ manifold >= 25.5 K	• Engine off time >= 360.00 min • IAT cross check finished • ECT cross check finished • Fuel level < 85.10%			
	Smart Temperature Sensor Signal Dynamic Check	• Gradient smart temperature > 20 K/10min	• Ignition off • Fuel level < 85.10 % • NVLD (EVAP-System) diagnostic mode active	• 300 s • Once / DCY		
	Smart Temperature Sensor Communication with Smart Temperature Sensor	• Response time > 1.0 s • And • Number of checks > 3.00 [-] • Or • Security bit incorrect • And • Number of checks > 3.00 [-]	• Case 1: • Ignition on • Engine running • Case 2: • Ignition off (during ECM keep alive-time)	• 5.0 s • Continuous		
P2026 EVAP Fuel Vapor Temperature Sensor Circuit Low Voltage	Smart Temperature Sensor Short To Ground	• NVLD output voltage < 1.92 – 2.21 V	• Case 1: • Ignition on • Case 2: • Ignition off (during ECM keep alive-time)	• 0.5 s • Continuous	• 2 DCY	– Check the Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- . Refer to ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2027 EVAP Fuel Vapor Temperature Sensor Circuit High Voltage	Smart Temperature Sensor Short To Battery Voltage	• NVLD output temperature > 160.0 – 200.0° C • Or • NVLD output current driver stage internal value	• Case 1: • Ignition on • Case 2: • Ignition off (during ECM keep alive-time)	• 0.5 s • Continuous	• 2 DCY	– Check the Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- . Refer to ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496 .
P2067 Fuel Level Sensor "B" Circuit Low	COM: Fuel Level (FL) Sensor 2 communication with IPC	• Instrument cluster module signal: short to ground failure • Instrument cluster module signal: signal range check failure		• 0.5 s • Continuous	• 2 DCY	– Check the Fuel Level Sensor - G- . Refer to appropriate repair manual.
P2068 Fuel Level Sensor "B" Circuit High	COM: Fuel Level (FL) Sensor 2 communication with IPC	• Instrument cluster module signal: short to battery / open circuit failure		• 0.5 s • Continuous	• 2 DCY	Check the Fuel Level Sensor - G- . Refer to appropriate repair manual.
P2088 "A" Camshaft Position Actuator Control Circuit Low Bank 1	VVT Actuator Intake Short To Ground	• Output voltage (hardware values) < 1.92 – 2.21 V	• Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.3 Camshaft Adjustment Valve 1 N205 , Checking”, page 462 .
P2089 "A" Camshaft Position Actuator Control Circuit High Bank 1	VVT Actuator Intake Short To Battery Plus	• Power stage temperature > 160 – 200° C • Or • Output current (hardware values) driver stage internal value	• Actuator commanded on	• 2.0 s • Continuous	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.3 Camshaft Adjustment Valve 1 N205 , Checking”, page 462 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2090 "B" Camshaft Position Actuator Control Circuit Low Bank 1	Variable Valve Timing (VVT) Exhaust Actuator short to ground	• Output voltage < 1.92 – 2.21 V (hardware values)	• Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check the Exhaust Camshaft Adjustment Valve 1 - N318- . Refer to ⇒ “3.6.14 Exhaust Camshaft Adjustment Valve 1 N318 , Checking”, page 485
P2091 "B" Camshaft Position Actuator Control Circuit High Bank 1	Variable Valve Timing (VVT) Exhaust Actuator short to battery plus	• Power stage temperature > 160 – 200° C • Or • Output current driver stage internal value (hardware values)	• Actuator commanded on	• 2.0 s • Continuous	• 2 DCY	– Check the Exhaust Camshaft Adjustment Valve 1 - N318- . Refer to ⇒ “3.6.14 Exhaust Camshaft Adjustment Valve 1 N318 , Checking”, page 485
P2096 Post Catalyst Fuel Trim System Too Lean Bank 1	Fuel System Out Of Range Low	• Adaptation value < 0.05 [-]	• 2nd lambda control n.a. • Catalyst purge not active • Injection mode change (DFI/MFI) not active • Engine speed >= 896 RPM • Integrated mass for fuel in oil < 255.00 [-] • Choice of: • O2S rear (binary) check not active • Or • O2S rear (binary) check finished	• 0.0 s • Continuous	• 2 DCY	– Check exhaust system visually for leaks first and correct as necessary. – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2097 Post Catalyst Fuel Trim System Too Rich Bank 1	Fuel System Out Of Range High	• Adaptation value > -0.05 [-]	• 2nd lambda control n.a. • Catalyst purge not active • Injection mode change (DFI/MFI) not active • Engine speed >= 896 RPM • Integrated mass for fuel in oil < 255.00 [-] • Choice of: • O2S rear (binary) check not active • Or • O2S rear (binary) check finished	• 0.0 s • Continuous	• 2 DCY	– Check exhaust system visually for leaks first and correct as necessary. – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .
P2100 Throttle Actuator "A" Control Motor Circuit/ Open	Throttle Actuator Open Circuit	• Electronic throttle valve driver load resistance > 200.0 kOhm	• Difference between measured and filtered throttle position <= 0.073° TPS • Actuator commanded off	• 0.1 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .
P2101 Throttle Actuator "A" Control Motor Circuit Range/ Performance	Throttle Actuator Over Temperature	• Electronic throttle valve driver temperature (hardware values) > 170.0 – 190.0° C	• Actuator commanded on	• 0.1 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .
P2103 Throttle Actuator "A" Control Motor Circuit High	Throttle Actuator Short Circuit	• Electronic throttle valve driver current (hardware values) driver stage internal value	• Actuator commanded on	• 0.1 s • Continuous	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524 .
P2122 Throttle/ Pedal Position Sensor/ Switch "D" Circuit Low	Accelerator Pedal Position Sensor 1 Out Of Range Low	• Signal voltage sensor 1 < 0.40 V		• 0.3 s • Continuous	• 2 DCY	– Check the Accelerator Pedal Module - GX2- . Refer to ⇒ “3.6.1 Accelerator Pedal Module GX2 , Checking”, page 457 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2123 Throttle/ Pedal Position Sensor/ Switch "D" Circuit High	Accelerator Pedal Position Sensor 1 Out Of Range High	• Signal voltage sensor 1 > 4.82 V		• 0.3 s • Continuous	• 2 DCY	– Check the Accelerator Pedal Module - GX2- . Refer to ⇒ “3.6.1 Accelerator Pedal Module GX2 , Checking”, page 457 .
P2127 Throttle/ Pedal Position Sensor/ Switch "E" Circuit Low	Accelerator Pedal Position Sensor 2 Out Of Range Low	• Signal voltage sensor 2 < 0.20 V		• 0.3 s • Continuous	• 2 DCY	– Check the Accelerator Pedal Module - GX2- . Refer to ⇒ “3.6.1 Accelerator Pedal Module GX2 , Checking”, page 457 .
P2128 Throttle/ Pedal Position Sensor/ Switch "E" Circuit High	Accelerator Pedal Position Sensor 2 Out Of Range High	• Signal voltage sensor 2 > 2.80 V		• 0.3 s • Continuous	• 2 DCY	– Check the Accelerator Pedal Module - GX2- . Refer to ⇒ “3.6.1 Accelerator Pedal Module GX2 , Checking”, page 457 .
P2138 Throttle/ Pedal Position Sensor/ Switch "D"/"E" Voltage Correlation	Accelerator Pedal Position Sensor 1 And 2 Rationality Check	• Difference between signal voltage sensor 1 and sensor 2 > 0.10 – 0.12 V		• 0.4 s • Continuous	• 2 DCY	– Check the Accelerator Pedal Module - GX2- . Refer to ⇒ “3.6.1 Accelerator Pedal Module GX2 , Checking”, page 457 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2177 System Too Lean Off Idle Bank 1	Fuel System Direct Fuel Injection System Too Lean	• Adaptive value >= 28.0 %	• MAF > 60.0 mg/rev • ECT @ cylinder head > 20° C • IAT @ manifold > -48° C • AAT > -48° C • Lambda set point 0.95 – 1.05 [-] • Lambda control closed loop • Integrated MAF >= 600.0 – 10,000.0 g • Fuel mass 15.01 – 50.00 mg/rev • Engine speed 1,024 – 3,744 rpm • Low dynamic conditions: • Diff. engine speed vs. averaged engine speed for engine speed dynamic detection < 60 – 130 rpm • Diff. air mass vs. averaged air mass for load dynamic detection < 16.00 – 30.01 mg/rev • Diff. between reference and actual fuel pressure, high side <= 2000.10 kPa • Integrated air mass > 5.0 – 25.0 g • And • Evap purge valve closed or canister load <= 1.20 [-] • Evap purge flow at max. value • Or • Dependence on canister purge min:	• 5.0 s • Continuous	• 2 DCY	– Check the intake and vacuum hoses visually for leaks. Check the Positive Crankcase Ventilation visually. Also make sure the oil dipstick is properly secured. – Listen to and visually inspect the exhaust system to insure there are no leaks. – Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 . – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 . – Check the Intake Manifold Sensor - GX9- . Refer to ⇒ “3.6.23 Intake Manifold Sensor GX9 , Checking”, page 505 . – Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.13 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 484 . – Check the Fuel Injectors . Refer to

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Lower limit of lambda controller output n.a. • Or • Upper limit of lambda controller output n.a. • And • Evap purge flow at min. value			⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2178 System Too Rich Off Idle Bank 1	Fuel System Direct Fuel Injection System Too Rich	• Adaptive value <= -30.0 %	• Air mass > 60.00 mg/rev • ECT @ cylinder head > 20° C • IAT @ manifold > -48 ° C • AAT > -48 ° C • Lambda setpoint 0.97 – 1.05 [-] • Lambda control closed loop • Integrated air mass >= 600.0 – 10,000.0 g • Fuel mass 15.01 – 50.00 mg/rev • Engine speed 1,024 – 3,744 rpm • Low dynamic conditions: • Diff. engine speed vs. averaged engine speed for engine speed dynamic detection < 60 – 130 rpm • Diff. air mass vs. averaged air mass for load dynamic detection < 16.00 - 30.01 mg/rev • Diff. between reference and actual fuel pressure, high side <= 2,000.10 kPa • Integrated air mass > 5.0 – 25.0 g • And • Evap purge valve closed • Or • Canister load <= 1.20 [-] • Evap purge flow at max. value • Or	• 5.0 s • Continuous	• 2 DCY	– Check the Evaporative Emission (EVAP) System visually for contamination. – Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 . – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 . – Check the Intake Manifold Sensor - GX9- . Refer to ⇒ “3.6.23 Intake Manifold Sensor GX9 , Checking”, page 505 . – Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Dependence on canister purge min: • Lower limit of lambda controller output n.a. • Or • Upper limit of lambda controller output n.a. • And • Evap purge flow at min. value			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2181 Cooling System Performance	Engine Cooling System Rationality Check	• Modeled ECT @ cylinder head > 66 – 70° C • Choice of: • ECT @ cylinder head < 65 – 69° C • Or • ECT @ radiator outlet < n.a.° C	• ECT @ cylinder head @ first start >= -10° C • ECT @ cylinder head @ first start <= 50 – 55° C • AAT > -10° C • Ratio fuel cut off <= 10.16 % • Ratio accumulated time engine load condition vs. time since engine start <= 39.84 % • Determination engine load condition: • Engine load (lower threshold) <= 2.50 % • engine load (upper threshold) >= 100.00 % • Ratio accumulated time high speed condition <= 14.84 % • Determination high speed condition: • Vehicle speed > 75 mph • Ratio accumulated time start-stop active <= 16.02 % • Setpoint of RVC in measurement window < 99.61 % • Case 1: • Engine speed < 8,160 rpm • Case 2: • Engine speed >= 8,160 rpm • Diff. ECT@ cylinder head during measurement < 256° C • For time >= 0.0 s	• 1.0 s • Once / DCY	• 2 DCY	– Check cooling system visually for leaks or damaged components. – Check the Engine Temperature Control Actuator - N493- . Refer to ⇒ “3.6.12 Engine Temperature Control Actuator N493 , Checking”, page 481 . – Check the Engine Coolant Temperature Sensor - G62- . Refer to ⇒ “3.6.9 Engine Coolant Temperature Sensor G62 , Checking”, page 475 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Electrical Thermostat Rationality Check	• ECT @ cylinder head < 60° C • For time >= 0.0 s	• Engine running • Or • Engine stopped • And • ECT @ cylinder head once after start > 65° C • Or • ECT @ radiator outlet after engine start not calibrated [°C] • And • AAT sensor signal valid • AAT > -10° C • Relative actual MAF > 5.00 % • ECT @ cylinder head @ first start lower limit >= -40° C • ECT @ cylinder head @ first start upper limit <= 215° C • Vehicle speed >= 0 mph • Modeled ECT @ cylinder head > 60° C • Start-stop cycles <= 255.00 [-] • For time >= 15.0 s			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2183 Engine Coolant Temperature Sensor 2 Circuit Range/ Performance	Engine Coolant Temperature Sensor @ Radiator Outlet Cross Check	• High side: reference measuring • Diff. ECT @ radiator outlet @ cold start vs. IAT @ manifold @ cold start > 25.0 K • Diff. ECT @ radiator outlet @ cold start vs. ECT @ cylinder head @cold start n.a. K • Diff. ECT @ radiator outlet @ cold start vs. AAT @ cold start > 25.0 K • Min. amount of faulty reference measurements to detect defective sensor 2.00 [-] • Or • Low side: reference measuring • Diff. IAT @ manifold @ cold start vs. ECT @ radiator outlet @ cold start > 25.0 K • Diff. ECT @ cylinder head @ cold start vs. ECT @ radiator outlet @cold start n.a. K • Diff. AAT @ cold start vs. ECT @ radiator outlet @ cold start > 25.0 K • Min. amount of faulty reference measurements to detect defective sensor 2.00 [-]	• Engine off time >= 360.00 min • Engine off time plausible • Time after engine start <= 1,400.0 s • Depending on temperature slope • Diff. actual vs previous IAT < 256.0 K • Diff. actual vs previous ECT@ cylinder head n.a. K • Diff. actual vs previous ECT@ radiator outlet < 256.0 K • Diff. actual vs previous AAT < 256.0 K • For time >= 1.0 s • Depending on mean value condition • Mean value of all temperature sensors @ cold start >= -256° C • Number of valid sensors >= 2.00 [-] • Depending on block heater / solar radiation detection • Time after engine start >= 0.5 s • Vehicle speed >= 22 mph • For time >= 20.0 s • Diff. actual IAT @ manifold vs. min. IAT @ manifold < 5.0 K • Diff. actual ECT @ cylinder head vs. min. ECT @ cylinder head n.a. K	• 0.1 s • Once / DCY	• 2 DCY	– Check the Engine Coolant Temperature Sensor On Radiator Outlet - G83- . Refer to ⇒ “3.6.10 Engine Coolant Temperature Sensor On Radiator Outlet G83 , Checking”, page 477 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Diff. actual AAT vs. min. AAT < 4.0 K • Diff. actual ECT @ radiator outlet vs. min. ECT @ radiator outlet < 1.1 K			
P2184 Engine Coolant Temperature Sensor 2 Circuit Low	Engine Coolant Temperature Sensor @ Radiator Outlet Short To Ground	• Sensor voltage < 0.30 V		• 0.5 s • Continuous	• 2 DCY	– Check the Engine Coolant Temperature Sensor On Radiator Outlet - G83- . Refer to ⇒ “3.6.10 Engine Coolant Temperature Sensor On Radiator Outlet G83 , Checking”, page 477 .
P2185 Engine Coolant Temperature Sensor 2 Circuit High	Engine Coolant Temperature Sensor @ Radiator Outlet Short To Battery / Open Circuit	• Sensor voltage > 4.90 V	• IAT @ throttle >= -33° C • Time after engine start > 60 s	• 0.5 s • Continuous	• 2 DCY	– Check the Engine Coolant Temperature Sensor On Radiator Outlet - G83- . Refer to ⇒ “3.6.10 Engine Coolant Temperature Sensor On Radiator Outlet G83 , Checking”, page 477 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2187 System Too Lean at Idle Bank 1	Fuel System Direct Fuel Injection System Too Lean	• Case 1: • Adaptive value >= 3.01 mg/rev • Case 2: • Adaptive value n.a.	• Air mass > 60.00 mg/rev • ECT @ cylinder head > 20° C • IAT @ manifold > -48° C • AAT > -48° C • Lambda setpoint 0.97 – 1.05 [-] • Lambda control closed loop • Integrated air mass >= 600.0 – 10,000.0 g • Vehicle speed < 4 mph • Low dynamic conditions: • Diff. engine speed vs. averaged engine speed for engine speed dynamic detection < 60 – 130 rpm • Diff. air mass vs. averaged air mass for load dynamic detection < 16.00 – 30.01mg/rev • Diff. between reference and actual fuel pressure, high side <= 2000.10 kPa • Integrated air mass > 5.0 – 25.0 g • And • Fuel mass lower range > 4.01 mg/rev • Fuel mass upper range < 17.00 – 19.01 mg/rev • Engine speed 704 – 927 [rpm] • Or • Engine n.a. • And	• 5.0 s • Continuous	• 2 DCY	– Check the intake and vacuum hoses visually for leaks. Check the Positive Crankcase Ventilation visually. Also make sure the oil dipstick is properly secured. – Listen to and visually inspect the exhaust system to insure there are no leaks. – Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 . – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 . – Check the Intake Manifold Sensor - GX9- . Refer to ⇒ “3.6.23 Intake Manifold Sensor GX9 , Checking”, page 505 . – Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.13 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 484 . – Check the Fuel Injectors . Refer to

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Evap purge valve closed • Or • Canister load <= 1.20 [-] • Evap purge flow at max. value • Or • Depending on canister purge min: • Lower limit of lambda controller output n.a. • Or • Upper limit of lambda controller output n.a. • And • Evap purge flow at min. value			⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2188 System Too Rich at Idle Bank 1	Fuel System Direct Fuel Injection System Too Rich	• Case 1: • Adaptive value <= -3.01 mg/rev • Case 2: • Adaptive value <= n.a. kg/h	• Air mass > 60.00 mg/rev • ECT @ cylinder head > 20° C • IAT @ manifold > -48 ° C • AAT > -48° C • Lambda setpoint 0.97 – 1.05 [-] • Lambda control closed loop • Oil dilution not detected • Integrated air mass >= 600.0 – 10,000.0 g • Vehicle speed < 4 mph • Low dynamic conditions: • Diff. engine speed vs. averaged engine speed for engine speed dynamic detection < 60 – 130 rpm • Diff. air mass vs. averaged air mass for load dynamic detection < 16.00 – 30.01 mg/rev • Diff. between reference and actual fuel pressure, high side <= 2000.10 kPa • Integrated air mass > 5.0 – 25.0 g • And • Fuel mass lower range > 4.01 mg/rev • Fuel mass upper range < 17.00 – 19.01 mg/rev • Engine speed 704 – 927 rpm • Or	• 5.0 s • Continuous	• 2 DCY	– Check the Evaporative Emission (EVAP) System visually for contamination. – Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 . – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 . – Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Engine n.a. • And • Evap purge valve closed • Or • Canister load <= 1.20 [-] • Evap purge flow at max. value • Or • Depending on canister purge min: • Lower limit of lambda controller output n.a. • Or • Upper limit of lambda controller output n.a. • And • Evap purge flow at min. value			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2195 O2 Sensor Signal Biased/ Stuck Lean Bank 1 Sensor 1	Oxygen Sensors Front Rationality Check	• Plausibility signal check O2S front and O2S rear: • Lambda value > 1.15 [-] • And • O2S signal rear >= 0.91 [V]	• O2S front ready • O2S rear ready • ECT @ cylinder head >= -48° C • MAF > 0.0; < 2,047.0 kg/h • Catalyst purge not active • Integrated MAF after end of catalyst purge 10.0 g • Engine speed > 0 RPM • Modeled EGT @ O2S front > -273; < 850° C • Integrated MAF > 40.0 g • Dynamic lambda controller output < 3.0 % • Dynamic MAF < 0.05 g/rev • Dynamic engine speed < 200 RPM • And • Second control loop active: • MAF 0.06 – 0.75 g/rev • Engine speed 576 – 4,512 RPM	• 67.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2196 O2 Sensor Signal Biased/ Stuck Rich Bank 1 Sensor 1	Oxygen Sensors Front Rationality Check	• Plausibility signal check O2S front and O2S rear: • Lambda value < 0.85 [-] • And • O2S signal rear >= 0.17 V	• O2S front ready • O2S rear ready • ECT @ cylinder head >= -48° C • MAF > 0.00; < 2047.97 kg/h • Catalyst purge not active • Integrated air mass after end of catalyst purge 10.0 g • Engine speed > 0 rpm • Modeled EGT @ O2S front > -273; < 850° C • Injection mode change (DFI/MFI) not active • Integrated air mass > 40.0 g • Dynamic lambda controller output < 3.00 % • Dynamic air mass < 0.05 g/rev • Dynamic engine speed < 200 rpm • And • Second control loop active: • Air mass 0.06 – 0.75 g/rev • Engine speed 576 – 4,512 rpm	• 67.5 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .
P219C Cylinder 1 Air-Fuel Ratio Imbalance	Air Fuel Imbalance Monitoring Out Of Range High	• Cylinder 1: • Weighted adaptive value > 10.0 %	• Fuel pressure setpoint not calibrated kPa • Modeled catalyst temperature @ start <= 850° C • Lambda set value 0.97 – 1.03 [-] • Catalyst heating not active • Engine roughness signal valid	• 90 s • Once / DCY	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Air Fuel Imbalance Monitoring Out Of Range Low	• Cylinder 1: • Weighted adaptive value < -15.0 %	• Cylinder shut off not active • AAT >= -48° C • Barometric pressure >= 73.0 kPa • Min. injection time not reached • And • Choice of: • Catalyst diagnosis n.a. • Or • Catalyst diagnosis n.a. • Depending on catalyst diagnosis: • Canister purge (conditions) n.a. • Or • Evap purge valve n.a. • Or • Evap purge n.a. • And • O2S dynamic diagnosis n.a. • O2S delay diagnosis n.a. • Lambda control closed loop • Catalyst purge not active • Canister load <= 2.00 [-] • Engine no full load • Segment adaptation finished • Catalyst damaging misfire not detected • Emission threshold misfire not detected			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• No gear switch for segments >= 90.00 [-] • Segments after start > 0.00 [-] • Time after engine start > 0.0 s • Rough road not detected • Min. fuel mass >= 0.00 mg/rev • Intake manifold runner flap position change not active • Injection mode change (DFI/MFI) not equipped • Valve lift position change not active • Depending on gear: • 1st gear not active • 2nd gear not active • 3rd gear not active • 4th gear active • 5th gear active • 6th gear active • 7th gear active • 8th gear not active • And • Integrated MAF >= 1.0 – 12.0 kg • Diff. engine speed vs. dynamic engine speed < 200 RPM • Diff. MAF vs. dynamic MAF < 29.99 mg/rev • ECT @ cylinder head 60 – 143° C • Adaptation cycles <= 255 [-]			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Engine speed 1,312 – 3,008 RPM • And • Mass fuel flow lower range >= 11.00 mg/rev • Mass fuel flow upper range <= 32.00 mg/rev			
P219D Cylinder 2 Air-Fuel Ratio Imbalance	Air Fuel Imbalance Monitoring Out Of Range High	• Cylinder 1: • Weighted adaptive value > 10.0 %	• Fuel pressure setpoint not calibrated kPa • Modeled catalyst temperature @ start <= 850° C • Lambda set value 0.97 – 1.03 [-] • Catalyst heating not active • Engine roughness signal valid • Cylinder shut off not active • AAT >= -48° C • Barometric pressure >= 73.0 kPa • Min. injection time not reached • And • Choice of: • Catalyst diagnosis n.a. • Or • Catalyst diagnosis n.a. • Depending on catalyst diagnosis: • Canister purge (conditions) n.a. • Or • Evap purge valve n.a. • Or • Evap purge n.a. • And	• 90 s • Once / DCY	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Air Fuel Imbalance Monitoring Out Of Range Low	• Cylinder 2: • Weighted adaptive value < -15.0 %	• O2S dynamic diagnosis n.a. • O2S delay diagnosis n.a. • Lambda control closed loop • Catalyst purge not active • Canister load <= 2.00 [-] • Engine no full load • Segment adaptation finished • Catalyst damaging misfire not detected • Emission threshold misfire not detected • No gear switch for segments >= 90.00 [-] • Segments after start > 0.00 [-] • Time after engine start > 0.0 s • Rough road not detected • Min. fuel mass >= 0.00 mg/rev • Intake manifold runner flap position change not active • Injection mode change (DFI/MFI) not equipped • Valve lift position change not active • Depending on gear: • 1st gear not active • 2nd gear not active • 3rd gear not active • 4th gear active			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• 5th gear active • 6th gear active • 7th gear active • 8th gear not active • And • Integrated MAF >= 1.0 – 12.0 kg • Diff. engine speed vs. dynamic engine speed < 200 RPM • Diff. MAF vs. dynamic MAF < 29.99 mg/rev • ECT @ cylinder head 60 – 143° C • Adaptation cycles <= 255 [-] • Engine speed 1,312 – 3,008 RPM • And • Mass fuel flow lower range >= 11.00 mg/rev • Mass fuel flow upper range <= 32.00 mg/rev			
P219E Cylinder 3 Air-Fuel Ratio Imbalance	Air Fuel Imbalance Monitoring Out Of Range High	• Cylinder 1: • Weighted adaptive value > 10.0 %	• Fuel pressure setpoint not calibrated [kPa] • Modeled catalyst temperature @ start <= 850° C • Lambda set value 0.97 – 1.03 [-] • Catalyst heating not active • Engine roughness signal valid • Cylinder shut off not active • AAT >= -48° C • Barometric pressure >= 73.0 kPa • Min. injection time not reached	• 90 s • Once / DCY	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Air Fuel Imbalance Monitoring Out Of Range Low	• Cylinder 3: • Weighted adaptive value < -15.0 %	• And • Choice of: • Catalyst diagnosis n.a. • Or • Catalyst diagnosis n.a. • Depending on catalyst diagnosis: • Canister purge (conditions) n.a. • Or • Evap purge valve n.a. • Or • Evap purge n.a. • And • O2S dynamic diagnosis n.a. • O2S delay diagnosis n.a. • Lambda control closed loop • Catalyst purge not active • Canister load <= 2.00 [-] • Engine no full load • Segment adaptation finished • Catalyst damaging misfire not detected • Emission threshold misfire not detected • No gear switch for segments >= 90.00 [-] • Segments after start > 0.00 [-] • Time after engine start > 0.0 [s] • Rough road not detected			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Min. fuel mass >= 0.00 [mg/rev] • Intake manifold runner flap position change not active • Injection mode change (DFI/MFI) not equipped • Valve lift position change not active • Depending on gear: • 1st gear not active • 2nd gear not active • 3rd gear not active • 4th gear active • 5th gear active • 6th gear active • 7th gear active • 8th gear not active • And • Integrated MAF >= 1.0 – 12.0 kg • Diff. engine speed vs. dynamic engine speed < 200 RPM • Diff. MAF vs. dynamic MAF < 29.99 mg/rev • ECT @ cylinder head 60 – 143° C • Adaptation cycles <= 255 [-] • Engine speed 1,312 – 3,008 RPM • And • Mass fuel flow lower range >= 11.00 mg/rev • Mass fuel flow upper range <= 32.00 mg/rev			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P219F Cylinder 4 Air-Fuel Ratio Imbalance	Air Fuel Imbalance Monitoring Out Of Range High	• Cylinder 1: • Weighted adaptive value > 10.0 %	• Fuel pressure setpoint not calibrated [kPa] • Modeled catalyst temperature @ start <= 850° C • Lambda set value 0.97 – 1.03 [-] • Catalyst heating not active • Engine roughness signal valid • Cylinder shut off not active • AAT >= -48° C • Barometric pressure >= 73.0 kPa • Min. injection time not reached • And • Choice of: • Catalyst diagnosis n.a. • Or • Catalyst diagnosis n.a. • Depending on catalyst diagnosis: • Canister purge (conditions) n.a. • Or • Evap purge valve n.a. • Or • Evap purge n.a. • And • O2S dynamic diagnosis n.a. • O2S delay diagnosis n.a. • Lambda control closed loop • Catalyst purge not active • Canister load <= 2.00 [-]	• 90 s • Once / DCY	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Air Fuel Imbalance Monitoring Out Of Range Low	• Cylinder 4: • Weighted adaptive value < -15.0 %	• Engine no full load • Segment adaptation finished • Catalyst damaging misfire not detected • Emission threshold misfire not detected • No gear switch for segments >= 90.00 [-] • Segments after start > 0.00 [-] • Time after engine start > 0.0 [s] • Rough road not detected • Min. fuel mass >= 0.00 [mg/rev] • Intake manifold runner flap position change not active • Injection mode change (DFI/MFI) not equipped • Valve lift position change not active • Depending on gear: • 1st gear not active • 2nd gear not active • 3rd gear not active • 4th gear active • 5th gear active • 6th gear active • 7th gear active • 8th gear not active • And • Integrated MAF >= 1.0 – 12.0 kg			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Diff. engine speed vs. dynamic engine speed < 200 RPM • Diff. MAF vs. dynamic MAF < 29.99 mg/rev • ECT @ cylinder head 60 – 143° C • Adaptation cycles <= 255 [-] • Engine speed 1,312 – 3,008 RPM • And • Mass fuel flow lower range >= 11.00 mg/rev • Mass fuel flow upper range <= 32.00 mg/rev			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2237 O2 Sensor Positive Current Control Circuit/ Open Bank 1 Sensor 1	Oxygen Sensors Front Open Circuit Pump Voltage (VIP)	• Diff. pump voltage (VIP) vs. virtual ground voltage (VG) <= 1.20 V • Diff. nernst voltage (VN) vs. virtual ground voltage (VG) <= 1.20 V • And • Choice of: • Nernst voltage (VN) > 4.40 V • Or • Diff. pump voltage (VIP) vs. virtual ground voltage (VG) > 2.35 V • Diff. pump voltage (VIP) vs. virtual ground voltage (VG) < -2.35 V • Or • Diff. nernst voltage (VN) vs. virtual ground voltage (VG) > 1.60 V • Diff. nernst voltage (VN) vs. virtual ground voltage (VG) < -0.10 V • Or • Pump current driver stage internal value • Or • Measurement WRAF sensor label resistor > n.a. Ohm	• O2S front (linear) ready • O2S ceramic temperature > 785° C • For time >= 10.0 s	• 2.3 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2243 O2 Sensor Reference Voltage Circuit/ Open Bank 1 Sensor 1	Oxygen Sensors Front Open Circuit Nernst Voltage (VN)	• Diff. pump voltage (VIP) vs. virtual ground voltage (VG) <= 1.20 V • Diff. nernst voltage (VN) vs. virtual ground voltage (VG) <= 1.20 V • And • Choice of: • Nernst voltage (VN) > 4.40 V • Or • Diff. pump voltage (VIP) vs. virtual ground voltage (VG) > 2.35 V • Diff. pump voltage (VIP) vs. virtual ground voltage (VG) < -2.35 V • Or • Diff. nernst voltage (VN) vs. virtual ground voltage (VG) > 1.60 V • Diff. nernst voltage (VN) vs. virtual ground voltage (VG) < -0.10 V • Or • Pump current-driver stage internal value • Or • Measurement WRAF sensor label resistor > n.a. Ohm	• O2S front (linear) ready • O2S ceramic temperature > 785° C • For time >= 10.0 s	• 2.3 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2251 O2 Sensor Negative Current Control Circuit/ Open Bank 1 Sensor 1	Oxygen Sensors Front Open Circuit Virtual Ground (VG)	• Nernst voltage (VN) > 4.40 V • Or • Diff. pump voltage (VIP) vs. virtual ground voltage (VG) > 2.35 V • Diff. pump voltage (VIP) vs. virtual ground voltage (VG) < -2.35 V • Or • Diff. nernst voltage (VN) vs. virtual ground voltage (VG) > 1.60 V • Diff. nernst voltage (VN) vs. virtual ground voltage (VG) < -0.10 V • Or • Pump current driver stage internal value • Or • Measurement O2S front label resistor > n.a. Ohm • And • Choice of: • Diff. pump voltage (VIP) vs. virtual ground voltage (VG) <= 1.20 V • Diff. nernst voltage (VN) vs. virtual ground voltage (VG) <= 1.20 V • Or • Diff. pump voltage (VIP) vs. virtual ground voltage (VG) > 1.20 V	• O2S front (linear) ready • O2S ceramic temperature > 785° C • For time >= 10.0 s	• 2.3 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Diff. nernst voltage (VN) vs. virtual ground voltage (VG) > 1.20 V				
P2257 AIR System Control "A" Circuit Low	Secondary Air Injection Pump Relay Short To Ground	• Output voltage (hardware values) 1.92 – 2.21 V	• Engine running • Actuator commanded off	• 2.0 s • Continuous	• 2 DCY	– Check the Secondary Air Injection Pump Motor - V101- / Secondary Air Injection Pump Relay - J299- . Refer to ⇒ “3.6.29 Secondary Air Injection Pump Motor V101 / Secondary Air Injection Pump Relay J299 , Checking”, page 519 .
P2258 AIR System Control "A" Circuit High	Secondary Air Injection Pump Relay Short To Battery Plus	• Actuator temperature > 160 – 200° C • Or • Output current (hardware values) driver stage internal value	• Engine running • Actuator commanded on	• 2.0 s • Continuous	• 2 DCY	– Check the Secondary Air Injection Pump Motor - V101- / Secondary Air Injection Pump Relay - J299- . Refer to ⇒ “3.6.29 Secondary Air Injection Pump Motor V101 / Secondary Air Injection Pump Relay J299 , Checking”, page 519 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2270 O2 Sensor Signal Biased/ Stuck Lean Bank 1 Sensor 2	Oxygen Sensors Rear Signal Range Check	• Max. O2S rear voltage < 0.87 V • Intrusive lambda ramp lean < 0.85 [-]	• General conditions: • Catalyst monitor lambda modulation request active • Vehicle speed >= 19 mph • Barometric pressure >= 0.00 kPa • Catalyst overheating protection not active • Turbine overheating protection not active • O2S rear ready • O2S front ready • ECT @ cylinder head > 60° C • IAT @ manifold > -48° C • Modeled catalyst temperature @ start of diagnosis > 510° C • Modeled catalyst temperature @ during diagnosis 470 – 830° C • Diff. between dynamic and stationary catalyst temperature -150 – 150° C • Integrated air mass, catalyst temp. conditions fulfilled >= 0.0 g • Modeled EGT @ O2S rear <= 900° C • MAF per cylinder 22.50 – 150.00 kg/h • Air mass , lower range >= 0.00 mg/rev • Air mass, upper range <= 650.00 – 1389.00 mg/rev • And	• 0 (FTP75: 50) s • Once / DCY	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Engine load n.a. % • Air mass setpoint n.a. mg/rev • Accelerator pedal value n.a. % • For time n.a. s • And • Low dynamic conditions • Dynamic engine speed < 50 rpm • Dynamic air mass < 50.00 mg/rev • Dynamic lambda controller output < 20.00 % • And • Integrated air mass after dynamic conditions are fulfilled > 20.0 g • Time after a catalyst purge phase >= 1.0 s • O2S rear voltage @ diagnosis start >= 0.55 V • Integrated air mass >= 0.0 g • Integrated heat energy >= 550.00 – 700.00 kJ • Engine speed 1,088 – 3,008 rpm • Deviation of lambda controller output < 50.00 % • Proportional part of secondary fuel control loop not calibrated % • Coasting function not active • O2S heater rear active • Lambda adaptation not active			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Valve lift not active • And • Depending on Lambda control: • Sum of integral and proportional part of secondary fuel control loop before diagnosis < 0.10 [-] • Or • Sum of integral and proportional part of secondary fuel control loop during diagnosis < 0.25 [-] • Depending on canister purge: • Canister load n.a. [-] • Evap purge flow n.a. • Or • Canister load calculation n.a. • Evap purge flow n.a. • Or • Evap purge valve n.a. • Or • Evap purge valve n.a. • Or • Evap purge n.a. • Or • Depending on canister purge closing: • Canister purge (conditions) n.a. • Canister purge valve (closing time) n.a. [s] • And • Choice of: evap purge valve n.a.			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Or • Evap purge valve n.a. • And • Modeled air mass integral > 50.0 g • Integrated air mass per cylinder >= 1.40 – 1.80 kg			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2271 O2 Sensor Signal Biased/ Stuck Rich Bank 1 Sensor 2	Oxygen Sensors Rear Signal Range Check	• O2S rear voltage > 0.25 V • Intrusive lambda ramp lean > 1.12 [-]	• General conditions: • Catalyst monitor lambda modulation request active • Intrusive lambda ramp request active • Vehicle speed >= 19 mph • Barometric pressure >= 0.00 kPa • Catalyst overheating protection not active • Turbine overheating protection not active • O2S rear ready • O2S front ready • ECT @ cylinder head > 60° C • IAT @ manifold > -48° C • Modeled catalyst temperature @ start of diagnosis > 510° C • Modeled catalyst temperature @ during diagnosis 470 – 830° C • Diff. between dynamic and stationary catalyst temperature -150 – 150° C • Integrated air mass, catalyst temp. conditions fulfilled >= 0.0 g • Modeled EGT @ O2S rear <= 900° C • MAF per cylinder 22.50 – 150.00 kg/h • Air mass , lower range >= 0.00 mg/rev	• 0 (FTP75: 50) s • Once / DCY	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Air mass , upper range <= 650.00 – 1,389.00 mg/rev • And • Engine load n.a. % • Air mass setpoint n.a. g/rev • Accelerator pedal value n.a. % • For time n.a. s • And • Low dynamic conditions • Dynamic engine speed < 50 rpm • Dynamic air mass < 50.00 mg/rev • Dynamic lambda controller output < 20.00 % • And • Integrated air mass after dynamic conditions are fulfilled > 20.0 g • Time after a catalyst purge phase >= 1.0 s • O2S rear voltage >= 0.55 V • Integrated air mass >= 0.0 g • Integrated heat energy >= 550.00 – 700.00 kJ • Engine speed 1,088 – 3,008 rpm • Deviation of lambda controller output < 50.00 % • Proportional part of secondary fuel control loop not calibrated % • Coasting function not active			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• O2S heater rear active • Lambda adaptation not active • Valve lift not active • And • Depending on Lambda control: • Sum of integral and proportional part of secondary fuel control loop before diagnosis < | 0.10 | [-] • Or • Sum of integral and proportional part of secondary fuel control loop during diagnosis < | 0.25 | [-] • Depending on canister purge: • Canister load n.a. [-] • Evap purge flow n.a. • Or • Canister load calculation n.a. • Evap purge flow n.a. • Or • Evap purge valve n.a. • Or • Evap purge valve n.a. • Or • Evap purge n.a. • Or • Depending on canister purge closing: • Canister purge (conditions) n.a.			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Canister purge valve (closing time) n.a. [s] • And • Choice of: • Evap purge valve n.a. • Or • Evap purge valve n.a. • And • Modeled air mass integral > 50.0 g • Integrated air mass per cylinder >= 1.40 – 1.80 kg			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2279 MAP/ MAF - Throttle Position Correlation	Intake Air System Rationality Check	• Filtered lambda controller included correction and adaptation -30.0 – 30.0 % • Lambda control active • And • Deviation throttle area controller > 60.0 %	• Throttle position > 0.0° TPS • Throttle position < 100.003° TPS • Engine speed > 576; < 3,008 RPM • Modeled pressure quotient > 0.27; < 0.57 [-] • Engine running • Throttle actuator commanded on • Time after engine start > 5.0 s • Throttle position sensor failure not detected • Fuel cut off not active • Fast throttle adaptation finished • Gradient intake manifold pressure -199.90 – 199.90 kPa/s • Engine speed limitation not active • Barometric pressure plausibility diagnosis finished • Intake manifold modeled adaption active • And • Choice of: • MAF sensor active • Or • Manifold pressure sensor active • And • Choice of: • Pressure upstream throttle < 135.0 kPa	• 5.0 s • Continuous	• 2 DCY	– Check visually for air leaks between intake and throttle body, oil fill cap not tight or oil dipstick not seated in tube. – Also visually inspect any engine gaskets that can cause additional air to enter the crankcase can set this fault as the PCV system is not metered. If a vacuum leak or crankcase gasket sealing is at cause, the idle may be rough or unstable. – Check the Intake Manifold Sensor - GX9- . Refer to ⇒ “3.6.23 Intake Manifold Sensor GX9 , Checking”, page 505

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Or • Pressure upstream throttle not active • And • Choice of: • Barometric pressure > 73.00; < 107.50 kPa • Or • Barometric pressure sensor not active			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Filtered lambda controller correction > 35.0 % • Filtered lambda controller correction -50.0 – 50.0 % • Lambda control active	• Throttle position > 4.50° TPS • Engine speed > 1,216; < 6,000 RPM • Modeled pressure quotient > 0.63; < 0.90 [-] • Engine running • Throttle actuator commanded on • Time after engine start > 5.0 s • Throttle position sensor failure not detected • Fuel cut off not active • Fast throttle adaptation finished • Gradient intake manifold pressure -199.90 – 199.90 kPa/s • Barometric pressure plausibility diagnosis finished • And • Choice of: • MAF sensor active • Or • Manifold pressure sensor active • And • Choice of: • Pressure upstream throttle < 135.0 kPa • Or • Pressure upstream throttle not active • And • Choice of:			

DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Barometric pressure > 73.00; < 107.50 kPa • Or • Barometric pressure sensor not active			
P2300 Ignition Coil "A" Primary Control Circuit Low	Ignition Coils Open Circuit	• Output voltage in OFF state, lower range >= 1.92 – 2.21 V • Output voltage in OFF state, upper range (hardware values) <= 2.85 – 3.25 V	• Engine speed > 512 RPM • ECT @ cylinder head > -30° C • Engine stop not active	• 1.0 s • Continuous	• 2 DCY	– Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.20 Ignition Coils with Power Output Stage , Checking”, page 499 .
	Ignition Coils Short To Ground	• Output current in ON state (hardware values) > 50 – 100 mA				
	Ignition Coils Short To Battery Plus	• Diagnosis by inactive low side: switch in ATIC: • Output voltage in OFF state (hardware values) > 4.95 – 5.285 V	• Engine speed > 512 RPM • Engine stop not active • Actuator commanded off			
		• Diagnosis by inactive low side: switch in ATIC: • Output temperature from ATIC in ON state > 160.0 – 200.0° C • Or • Output current in ON state (hardware values) driver stage internal value	• Engine speed > 512 RPM • Engine stop not active • Actuator commanded on			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2303 Ignition Coil "B" Primary Control Circuit Low	Ignition Coils Open Circuit	• Output voltage in OFF state, lower range >= 1.92 – 2.21 V • Output voltage in OFF state, upper range (hardware values) <= 2.85 – 3.25 V	• Engine speed > 512 RPM • ECT @ cylinder head > -30° C • Engine stop not active	• 1.0 s • Continuous	• 2 DCY	– Check the Ignition Coils with Power Output Stage . Refer to ⇒ "3.6.20 Ignition Coils with Power Output Stage , Checking", page 499 .
	Ignition Coils Short To Ground	• Output current in ON state (hardware values) > 50 – 100 mA				
	Ignition Coils Short To Battery Plus	• Diagnosis by inactive low side: switch in ATIC: • Output voltage in OFF state (hardware values) > 4.95 – 5.285 V	• Engine speed > 512 RPM • Engine stop not active • Actuator commanded off			
		• Diagnosis by inactive low side: switch in ATIC: • Output temperature from ATIC in ON state > 160.0 – 200.0° C • Or • Output current in ON state (hardware values) driver stage internal value	• Engine speed > 512 RPM • Engine stop not active • Actuator commanded on			
P2306 Ignition Coil "C" Primary Control Circuit Low	Ignition Coils Open Circuit	• Output voltage in OFF state, lower range >= 1.92 – 2.21 V • Output voltage in OFF state, upper range (hardware values) <= 2.85 – 3.25 V	• Engine speed > 512 RPM • ECT @ cylinder head > -30° C • Engine stop not active	• 1.0 s • Continuous	• 2 DCY	– Check the Ignition Coils with Power Output Stage . Refer to ⇒ "3.6.20 Ignition Coils with Power Output Stage , Checking", page 499 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Ignition Coils Short To Ground	• Output current in ON state (hardware values) > 50 – 100 mA				
	Ignition Coils Short To Battery Plus	• Diagnosis by inactive low side: switch in ATIC: • Output voltage in OFF state (hardware values) > 4.95 – 5.285 V	• Engine speed > 512 RPM • Engine stop not active • Actuator commanded off			
		• Diagnosis by inactive low side: switch in ATIC: • Output temperature from ATIC in ON state > 160.0 – 200.0° C • Or • Output current in ON state (hardware values) driver stage internal value	• Engine speed > 512 RPM • Engine stop not active • Actuator commanded on			
P2309 Ignition Coil "D" Primary Control Circuit Low	Ignition Coils Open Circuit	• Output voltage in OFF state, lower range >= 1.92 – 2.21 V • Output voltage in OFF state, upper range (hardware values) <= 2.85 – 3.25 V	• Engine speed > 512 RPM • ECT @ cylinder head > -30° C • Engine stop not active	• 1.0 s • Continuous	• 2 DCY	– Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.20 Ignition Coils with Power Output Stage , Checking”, page 499 .
	Ignition Coils Short To Ground	• Output current in ON state (hardware values) > 50 – 100 mA				
	Ignition Coils Short To Battery Plus	• Diagnosis by inactive low side: switch in ATIC: • Output voltage in OFF state (hardware values) > 4.95 – 5.285 V	• Engine speed > 512 RPM • Engine stop not active • Actuator commanded off			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
		• Diagnosis by inactive low side: switch in ATIC: • Output temperature from ATIC in ON state > 160.0 – 200.0° C • Or • Output current in ON state (hardware values) driver stage internal value	• Engine speed > 512 RPM • Engine stop not active • Actuator commanded on			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P230A Cylinder 1 Air-Fuel Ratio Imbalance - Adjustment At Limit During Balance	Fuel System A/F imbalance: rationality check	• Cylinder misfire counter > 2.00 [-]	• Fuel pressure setpoint not calibrated kPa • Modeled catalyst temperature @ start <= 850° C • Lambda set value 0.97 – 1.03 [-] • Catalyst heating not active • Engine roughness signal valid • Fuel cut off not active • AAT >= -48° C • Barometric pressure >= 73.00 kPa • And • Min. injection time not reached • And • Choice of: • Catalyst diagnosis n.a. • Or • Catalyst diagnosis n.a. • Depending on catalyst diagnosis: • Canister purge (conditions) n.a. • Or • Evap purge valve n.a. • Or • Evap purge n.a. • And • O2S dynamic diagnosis n.a. • O2S delay diagnosis n.a. • Lambda control closed loop • Catalyst purge not active	• 90 (does not run in FTP) s • Once / DCY	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Canister load <= 2.00 [-] • Engine no full load • Segment adaptation finished • Catalyst damaging misfire not detected • Emission threshold misfire not detected • No gear switch for segments >= 90.00 [-] • Segments after start > 0.00 [-] • Time after engine start > 0.0 [s] • Rough road not detected • And • Min. fuel mass >= 0.00 [mg/rev] • Intake manifold runner flap position change not active • Injection mode change (DFI/MFI) not equipped • Valve lift position change not active • And • Depending on gear • 1st gear not active • 2nd gear not active • 3rd gear not active • 4th gear active • 5th gear active • 6th gear active • 7th gear active • 8th gear not active			

DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• And • Integrated air mass >= 1.00 – 12.00 kg • Diff. engine speed vs. dynamic engine speed < 200 rpm • Diff. air mass vs. dynamic air mass < 29.99 mg/rev • ECT @ cylinder head 60 – 143° C • Adaptation cycles <= 255.00 [-] • Engine speed 1,312 – 3,008 rpm • And • Fuel mass setpoint lower range >= 11.00 mg/rev • Fuel mass setpoint upper range <= 32.00 mg/rev			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P230B Cylinder 2 Air-Fuel Ratio Imbalance - Adjustment At Limit During Balance	Fuel System A/F imbalance: rationality check	• Cylinder misfire counter > 2.00 [-]	• Fuel pressure setpoint not calibrated kPa • Modeled catalyst temperature @ start <= 850° C • Lambda set value 0.97 – 1.03 [-] • Catalyst heating not active • Engine roughness signal valid • Fuel cut off not active • AAT >= -48° C • Barometric pressure >= 73.00 kPa • And • Min. injection time not reached • And • Choice of: • Catalyst diagnosis n.a. • Or • Catalyst diagnosis n.a. • Depending on catalyst diagnosis: • Canister purge (conditions) n.a. • Or • Evap purge valve n.a. • Or • Evap purge n.a. • And • O2S dynamic diagnosis n.a. • O2S delay diagnosis n.a. • Lambda control closed loop • Catalyst purge not active	• 90 (does not run in FTP) s • Once / DCY	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Canister load <= 2.00 [-] • Engine no full load • Sgment adaptation finished • Catalyst damaging misfire not detected • Emission threshold misfire not detected • No gear switch for segments >= 90.00 [-] • Segments after start > 0.00 [-] • Time after engine start > 0.0 s • Rough road not detected • And • Min. fuel mass >= 0.00 mg/rev • Intake manifold runner flap position change not active • Injection mode change (DFI/MFI) not equipped • Valve lift position change not active • And • Depending on gear • 1st gear not active • 2nd gear not active • 3rd gear not active • 4th gear active • 5th gear active • 6th gear active • 7th gear active • 8th gear not active			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• And • Integrated air mass >= 1.00 – 12.00 kg • Diff. engine speed vs. dynamic engine speed < 200 rpm • Diff. air mass vs. dynamic air mass < 29.99 mg/rev • ECT @ cylinder head 60 – 143° C • Adaptation cycles <= 255.00 [-] • Engine speed 1,312 – 3,008 rpm • And • Fuel mass setpoint lower range >= 11.00 mg/rev • Fuel mass setpoint upper range <= 32.00 mg/rev			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P230C Cylinder 3 Air-Fuel Ratio Imbalance - Adjustment At Limit During Balance	Fuel System A/F imbalance: rationality check	• Cylinder misfire counter > 2.00 [-]	• Fuel pressure set point not calibrated kPa • Modeled catalyst temperature @ start <= 850° C • Lambda set value 0.97 – 1.03 [-] • Catalyst heating not active • Engine roughness signal valid • Fuel cut off not active • AAT >= -48° C • Barometric pressure >= 73.00 kPa • And • Min. injection time not reached • And • Choice of: • Catalyst diagnosis n.a. • Or • Catalyst diagnosis n.a. • Depending on catalyst diagnosis: • Canister purge (conditions) n.a. • Or • Evap purge valve n.a. • Or • Evap purge n.a. • And • O2S dynamic diagnosis n.a. • O2S delay diagnosis n.a. • Lambda control closed loop • Catalyst purge not active	• 90 (does not run in FTP) s • Once / DCY	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Canister load <= 2.00 [-] • Engine no full load • Segment adaptation finished • Catalyst damaging misfire not detected • Emission threshold misfire not detected • No gear switch for segments >= 90.00 [-] • Segments after start > 0.00 [-] • Time after engine start > 0.0 s • Rough road not detected • And • Min. fuel mass >= 0.00 mg/rev • Intake manifold runner flap position change not active • Injection mode change (DFI/MFI) not equipped • Valve lift position change not active • And • Depending on gear • 1st gear not active • 2nd gear not active • 3rd gear not active • 4th gear active • 5th gear active • 6th gear active • 7th gear active • 8th gear not active			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• And • Integrated air mass >= 1.00 – 12.00 kg • Diff. engine speed vs. dynamic engine speed < 200 rpm • Diff. air mass vs. dynamic air mass < 29.99 mg/rev • ECT @ cylinder head 60 – 143° C • Adaptation cycles <= 255.00 [-] • Engine speed 1,312 – 3,008 rpm • And • Fuel mass setpoint lower range >= 11.00 mg/rev • Fuel mass setpoint upper range <= 32.00 mg/rev			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P230D Cylinder 4 Air-Fuel Ratio Imbalance - Adjustment At Limit During Balance	Fuel System A/F imbalance: rationality check	• Cylinder misfire counter > 2.00 [-]	• Fuel pressure setpoint not calibrated kPa • Modeled catalyst temperature @ start <= 850° C • Lambda set value 0.97 – 1.03 [-] • Catalyst heating not active • Engine roughness signal valid • Fuel cut off not active • AAT >= -48° C • Barometric pressure >= 73.00 kPa • And • Min. injection time not reached • And • Choice of: • Catalyst diagnosis n.a. • Or • Catalyst diagnosis n.a. • Depending on catalyst diagnosis: • Canister purge (conditions) n.a. • Or • Evap purge valve n.a. • Or • Evap purge n.a. • And • O2S dynamic diagnosis n.a. • O2S delay diagnosis n.a. • Lambda control closed loop • Catalyst purge not active	• 90 (does not run in FTP) s • Once / DCY	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.15 Fuel Injectors , Checking”, page 487 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• Canister load <= 2.00 [-] • Engine no full load • Segment adaptation finished • Catalyst damaging misfire not detected • Emission threshold misfire not detected • No gear switch for segments >= 90.00 [-] • Segments after start > 0.00 [-] • Time after engine start > 0.0 s • Rough road not detected • And • Min. fuel mass >= 0.00 mg/rev • Intake manifold runner flap position change not active • Injection mode change (DFI/MFI) not equipped • Valve lift position change not active • And • Depending on gear • 1st gear not active • 2nd gear not active • 3rd gear not active • 4th gear active • 5th gear active • 6th gear active • 7th gear active • 8th gear not active			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
			• And • Integrated air mass >= 1.00 – 12.00 kg • Diff. engine speed vs. dynamic engine speed < 200 rpm • Diff. air mass vs. dynamic air mass < 29.99 mg/rev • ECT @ cylinder head 60 – 143° C • Adaptation cycles <= 255.00 [-] • Engine speed 1,312 – 3,008 rpm • And • Fuel mass set-point lower range >= 11.00 mg/rev • Fuel mass set-point upper range <= 32.00 mg/rev			
P2414 O2 Sensor Exhaust Sample Error Bank 1 Sensor 1	Oxygen Sensors Front Rationality Check	• Pump current correction (nernst-cell) > 1.2 mA	• O2S front ready • Fuel cut off not active • Cylinder shut off not active • Depending on engine state: • Engine part load • Or • Engine full load • Or • Engine idle for time >= 3.0 s	• 10.0 s • Continuous	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2431 AIR System Air Flow/ Pressure Sensor Circuit Range/ Performance Bank 1	Secondary Air System Pressure Sensor Rationality Check	• Difference between AIR pressure and barometric pressure > 6.0 kPa • And • Difference between AIR pressure and intake manifold pressure > 6.0 kPa	• Engine stop • For time > 0.0 s	• 0.1 s • Once / DCY	• 2 DCY	– Check the Secondary Air System - GX24- . Refer to ⇒ “3.6.30 Secondary Air Injection Sensor 1 G609 / Secondary Air Injection Solenoid Valve N112 , Checking”, page 521 .
P2432 AIR System Air Flow/ Pressure Sensor Circuit Low Bank 1	Secondary Air System Pressure Sensor Out Of Range Low	• Sensor voltage < 0.50 V		• 0.1 s • Continuous	• 2 DCY	– Check the Secondary Air System - GX24- . Refer to ⇒ “3.6.30 Secondary Air Injection Sensor 1 G609 / Secondary Air Injection Solenoid Valve N112 , Checking”, page 521 .
P2433 AIR System Air Flow/ Pressure Sensor Circuit High Bank 1	Secondary Air System Pressure Sensor Out Of Range High	• Sensor voltage > 4.50 V		• 0.1 s • Continuous	• 2 DCY	– Check the Secondary Air System - GX24- . Refer to ⇒ “3.6.30 Secondary Air Injection Sensor 1 G609 / Secondary Air Injection Solenoid Valve N112 , Checking”, page 521 .

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2440 AIR System Switching Valve Stuck Open Bank 1	Secondary Air Valve Functional Check	• Ratio relative pressure phase 1 and relative pressure phase 2 > 1.34 [-]	• General: • Secondary air pump active • Catalyst heating active • Secondary air injection active • MAF <= 140.0 kg/h • ECT @ cylinder head >= -10; < 115° C • IAT @ manifold >= -10; < 100° C • Modeled catalyst temperature < 900° C • Relative barometric pressure > 0.73 [-] • And • Diff. barometric pressure vs. manifold pressure > n.a. kPa • Or • Engine n.a.	• 0.1 s • Once / DCY	• 2 DCY	– Check the Secondary Air System- GX24- . Refer to ⇒ “3.6.30 Secondary Air Injection Sensor 1 G609 / Secondary Air Injection Solenoid Valve N112 , Checking”, page 521 .
P2556 Engine Coolant Level Sensor/ Switch Circuit	Rotary Coolant Valve Communication Check	• Communication signal failure		• 0.5 s • Continuous	• 2 DCY	– Check the Engine Temperature Control Actuator - N493- . Refer to ⇒ “3.6.12 Engine Temperature Control Actuator N493 , Checking”, page 481 .
	Rotary Coolant Valve Signal Check	• Sensor signal failure				
P2557 Engine Coolant Level Sensor/ Switch Circuit Range/ Performance	Rotary Coolant Valve Checksum Verification	• Checksum signal failure		• 0.5 s • Continuous	• 2 DCY	– Check the Engine Temperature Control Actuator - N493- . Refer to ⇒ “3.6.12 Engine Temperature Control Actuator N493 , Checking”, page 481 .

DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2564 Turbocharger Boost Control Position Sensor "A" Circuit Low	Turbocharger Boost Control Position Sensor Short To Ground / Open Circuit	• Turbocharger boost control position sensor voltage < 0.20 V		• 0.5 s • Continuous	• 2 DCY	– Check the Charge Pressure Actuator - V465- / Charge Pressure Actuator Position Sensor - G581- . Refer to ⇒ “3.6.7 Charge Pressure Actuator V465 / Charge Pressure Actuator Position Sensor G581 , Checking”, page 470 . .
P2565 Turbocharger Boost Control Position Sensor "A" Circuit High	Turbocharger Boost Control Position Sensor Short To Battery Voltage	• Turbocharger boost control position sensor voltage > 4.80 V		• 0.5 s • Continuous	• 2 DCY	– Check the Charge Pressure Actuator - V465- / Charge Pressure Actuator Position Sensor - G581- . Refer to ⇒ “3.6.7 Charge Pressure Actuator V465 / Charge Pressure Actuator Position Sensor G581 , Checking”, page 470 .
P2610 ECM/PCM Engine Off Timer Performance	Engine Off Time ECM Internal Timer Check	• ECM internal timer failure • Or • ECM internal timer signal not calibrated • ECM internal timer not calibrated • Time after last engine stop not calibrated	• SPI initialization finished	• 1.3 s • Continuous	• 2 DCY	– Check the Engine Control Module - J623- . Refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
	Engine Off Time ECM Rationality Check	• Difference between engine-off-time and ECM keep alive-time >= 12.0 s • Or • Difference between ECM keep alive-time and engine-off-time >= 12.0 s	• Monitor Entry Conditions: • ECM keep alive-time active • ECU internal timer reset not activated • Time delay >= 1.0 s • Time after last engine stop < 48 [h] • Case 1: • For time (after entry conditions fulfilled) >= 65 s • Case 2: • For time (after entry conditions fulfilled) < 65 s • Ignition key transition off to on	• 10 ms • Once / DCY		
		• Difference between engine-off-time and ECM keep alive-time >= 12.0 s	• Time after engine stop < 86,400.0 s • Engine off time plausible • Engine off time monitoring not finished • Engine off time signal valid time after reset < 2.0 s • And • Case 1: • Engine off timer n.a. • Or • Engine off time n.a. • Case 2: • ECM internal timer active • SPI communication failure after reset detected			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P2635 Fuel Pump Control Module Performance	COM: Fuel Pump Control Module (FPCM) communication with FPCM	• FP signal: overcurrent failure feedback >= 2.00 [-]	• Engine on	• 1.6 s • Continuous	• 2 DCY	– Check the Fuel Pump Control Module - J538- . Refer to ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493
		• FP signal: rotary failure feedback >= 2.00 [-]		• 1.8 s • Continuous		
		• FP sensor: short to battery failure or rpm deviation feedback >= 2.00 [-]		• 2.4 s • Continuous		
P2681 Engine Coolant Bypass Valve "A" Control Circuit/ Open	Rotary Coolant Valve Open Circuit	• Load resistance > 200.0 kOhm	• Rotary slide valve commanded off	• 1.3 s • Continuous	• 2 DCY	– Check the Engine Temperature Control Actuator - N493- . Refer to ⇒ “3.6.12 Engine Temperature Control Actuator N493 , Checking”, page 481 . .
P2682 Engine Coolant Bypass Valve "A" Control Circuit Low	Rotary Coolant Valve Short To Ground Output 1	• High side current output 1 driver stage internal value	• Rotary slide valve commanded on • Rotary valve direction forward	• 0.30 s • Continuous	• 2 DCY	– Check the Engine Temperature Control Actuator - N493- . Refer to ⇒ “3.6.12 Engine Temperature Control Actuator N493 , Checking”, page 481 .
	Rotary Coolant Valve Short To Ground Output 2	• High side current output 2 driver stage internal value	• Rotary slide valve commanded on • Rotary valve direction reversed			
P2683 Engine Coolant Bypass Valve "A" Control Circuit High	Rotary Coolant Valve Short To Battery Plus Output 1	• Low side current output 1 driver stage internal value	• Rotary slide valve commanded off	• 0.30 s • Continuous	• 2 DCY	– Check the Engine Temperature Control Actuator - N493- . Refer to ⇒ “3.6.12 Engine Temperature Control Actuator N493 , Checking”, page 481 .
	Rotary Coolant Valve Short To Battery Plus Output 2	• Low side current output 2 driver stage internal value	• Rotary slide valve commanded off			

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
P334A Charge Pressure Actuator Electrical Error	Turbocharger Boost Pressure Control Valve Short To Ground	• Bypass valve driver current driver stage internal value	• Boost pressure actuator controller active	• 0.4 s • Continuous	• 2 DCY	– Check the Charge Pressure Actuator - V465- / Charge Pressure Actuator Position Sensor - G581- . Refer to ⇒ “3.6.7 Charge Pressure Actuator V465 / Charge Pressure Actuator Position Sensor G581 , Checking”, page 470 .
U0001 High Speed CAN Communication Bus	CAN: Powertrain BUS reading back sent message Powertrain	• Message no feedback	• Time after ignition on 0.5 s	• 0.5 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC’s present check them first. – Refer to the proper wiring schematic for terminal and component location.
U0002 High Speed CAN Communication Bus Performance	CAN: Powertrain BUS communication check Powertrain	• Global time out receiving no message	• Time after ignition on 0.5 s	• 0.5 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC’s present check them first. – Refer to the proper wiring schematic for terminal and component location.
U0101 Lost Communication with TCM	CAN: Transmission Control Module (TCM) CAN Communication With TCM	• Received message from TCM no message	• Time after ignition on 0.5 s	• 1.0 s	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC’s present check them first. – Refer to the proper wiring schematic for terminal and component location.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
U0121 Lost Communication With Anti-Lock Brake System (ABS) Control Module	CAN: Brake System Control Module (BSCM) communication with BSCM	• Received CAN message no message	• Time after ignition on 0.5 s	• 0.5 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC's present check them first. – Refer to the proper wiring schematic for terminal and component location.
U0140 Lost Communication With Body Control Module	CAN: Body Control Module (BCM) CAN Communication With Body Control Module	• Received CAN message no message	• Time after ignition on 0.5 s	• 2.0 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC's present check them first. – Refer to the proper wiring schematic for terminal and component location.
U0146 Lost Communication With Gateway "A"	CAN: Gateway CAN Communication With Gateway	• Message no message	• Time after ignition on 0.5 s	• 1.0 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC's present check them first. – Refer to the proper wiring schematic for terminal and component location.
U0155 Lost Communication With Instrument Panel Cluster (IPC) Control Module	CAN: Instrument Cluster CAN Communication With Instrument Cluster Module	• Message no message	• Time after ignition on 0.5 s	• 5.0 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC's present check them first. – Refer to the proper wiring schematic for terminal and component location.
U0302 Software Incompatibility With Transmission Control Module	COM: Transmission Control Module (TCM) communication with TCM	• Received AT vehicle data from TCM, TCM signal	• Time after ignition on 0.5 s	• 5.0 s • Continuous	• 2 DCY	– Check for software updates and TSB's. Reprogram as necessary. If none are found, refer to appropriate repair manual.

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
U0322 Software Incompatibility With Body Control Module	CAN: Gateway CAN Communication With Gateway	• Ambient temperature sensor coding monitoring failure	• Time after ignition on > 1.5 s	• 2.0 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC's present check them first. – Refer to the proper wiring schematic for terminal and component location.
U0415 Invalid Data Received From Anti-Lock Brake System (ABS) Control Module	Vehicle Speed Rationality Check High	• Vehicle speed > 202 mph		• 2.0 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC's present check them first. – Refer to appropriate repair manual for the ABS. – Refer to the proper wiring schematic for terminal and component location.
	CAN: Vehicle Speed Sensor CAN communication with BSCM	• Speed sensor signal: sensor error =655,35 km/h (no map, just bottom and top limit)	• Time since engine on > 0.5 s	• 0.5 s • Continuous		
		• Speed sensor signal: initialization error =655,33 – 655,34 km/h (no map, just bottom and top limit)	• Time since engine on > 0.5 s • Vehicle speed < 7 mph	• 2.0 s • Continuous		
		• speed sensor signal: low voltage error =655,33 – 655,34 km/h (no map, just bottom and top limit)	• Time since engine on > 0.5 s • Vehicle speed > 7 mph	• 0.5 s • Continuous		
	CAN: Brake System Control Module (BSCM) CAN Communication With Brake Unit	• Received data from TCS implausible message	• Time after ignition on 0.5 s	• 0.5 s • Continuous		
U0422 Invalid Data Received From Body	CAN: Gateway CAN communication with BCM	• Received data from BCM implausible message	• Time after ignition on 0.5 s	• 1.0 s • Continuous	• 2 DCY	– Check the Outside Air Temperature Sensor - G17- . Refer to ⇒ "3.6.26 Outside Air Temperature Sensor

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DTC / Description	Monitor Strategy Description	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illum.	Component Diagnostic Procedure
Control Module		• Ambient temperature value (initialization) failure	• Time after ignition on > 1.5 s • Engine running	• 3.0 s • Continuous	• 2 DCY	G17 , Checking", page 511 . – Check the CAN-Bus circuits. If there are any other DTC's present check them first. – Refer to the proper wiring schematic for terminal and component location.
U0423 Invalid Data Received From Instrument Panel Cluster Control Module	CAN: Instrument Cluster CAN Communication With Instrument Cluster Module	• Received data from Instrument Cluster implausible message	• Time after ignition on 0.5 s	• 3.0 s • Continuous	• 2 DCY	– Check the CAN-Bus circuits. If there are any other DTC's present check them first. – Refer to the proper wiring schematic for terminal and component location.
U1103 Production Mode Active	ECM: Production Mode Function Monitoring: Mode Change	• Production mode active	• Vehicle speed < 3 mph • Max trip mileage since initial vehicle start-up < 62.15 miles • During ECM keep alive-time after ignition off engine speed 0 rpm For hybrid: • Drive motor off	• 0.01 s • Continuous	• 1DCY	– PERFORM: Preliminary Check to verify the concern. Refer to ⇒ "3.1 Preliminary Check ", page 18 . – Perform readiness check. Refer to ⇒ "3.2 Readiness Codes", page 19 .

3.5 Transmission DTC Tables

- ⇒ "3.5.1 Transmission Mechatronic , DSG 6-spd 02E (2015 MY)", page 397
- ⇒ "3.5.2 Transmission Mechatronic , DSG 6-spd 02E (2016 MY)", page 427

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3.5.1 Transmission Mechatronic , DSG 6-spd 02E (2015 MY)

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0219	Engine Over-speed Condition	• signal range check	• rotational speed of gearbox input shaft exceed a maximum value	• rotational speed> 12000 rpm	• terminal 15 voltage > 4 V for more than 500 ms	• 500 ms	• 2 driving cycles
P0501	Vehicle Speed Sensor "A" Circuit Range / Performance	• plausibility check	• calculate the speed of input shaft with the gear ratio of engaged gear on input shaft and the output shaft speed. compare the calculated speed with measured speed of input shaft	• speed difference magnitude > 330 rpm (output speed = 500rpm)… 100 rpm (output speed>=2000 rpm)	• gear on input shaft engaged • no valid CAN output speed information • output speed > 25 rpm OR speed of input shaft > 1000 rpm • terminal 15 voltage >4 V for more than 500 ms • battery voltage >9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 300 ms	• 2 driving cycles
P0701	Transmission Control System Range/Performance	• signal range check	• travel sensor voltage gearshift fork 1/3 out of plausibility range • travel sensor voltage gearshift fork 2/4 out of plausibility range • travel sensor voltage gearshift fork 5/N out of plausibility range	• voltage < 100 mV OR • voltage > 4900mV		• 300 ms	• 2 driving cycles

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DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
			• travel sensor voltage gearshift fork 6/R out of plausibility range				
P0702	Transmission Control System Electrical	• plausibility check	• In spite of cut off Common High-side Switch 1 a measurable current. In spite of turned on Common High-side Switch 1 no current measurable.	• CHS1 cut off and CHS1-Current> 40 mA CHS1 turned on and CHS1-Current< 200 mA	• one time after reset • terminal 15 voltage < 18 V • no short-circuit current check failure of CHS1 • common high-side switch 1 voltage >9.2V • gearbox subsystem 1 active • common high-side switches not deactivated by module 2	• 300 ms	• 2 driving cycles
			• In spite of cut off Common High-side Switch 2 a measurable current. In spite of turned on Common High-side Switch 2 no current measurable.	• CHS2 cut off and CHS2-Current> 40 mA CHS2 turned on and CHS2-Current< 200 mA	• one time after reset • terminal 15 voltage < 18 V • no short-circuit current check failure of CHS2 • common high-side switch 2 voltage >9.2V • gearbox subsystem 2 active • common high-side switches not deactivated by module 2		

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
			• In spite of cut off Common High-side Switch 3 a measurable current. In spite of turned on Common High-side Switch 3no current measurable.	• CHS3 cut off and CHS3-Current> 40 mA CHS3 turned on and CHS3-Current< 200 mA	• one time after reset • terminal 15 voltage < 18 V • no short-circuit current check failure of CHS3 and main pressure solenoid valve • common high-side switch 1 and 2 voltage >9.2V • common high-side switches not deactivated by module 2		
P0717	Input/Turbine Shaft Speed Sensor "A" Circuit No Signal	• plausibility check	• calculate the speed of input shaft 1 with the gear ratio of engaged gear on input shaft 1 and the output shaft speed. compare the calculated speed with measured speed of input shaft 1	• speed difference magnitude> 330 rpm (output speed = 500rpm)… 100 rpm (output speed>=2000 rpm)	• gear engaged on input shaft 1 • valid CAN output speed information • speed of input shaft 1 < 25 rpm • output speed > 25 rpm • terminal 15 voltage >4 V for more than 500 ms • battery voltage >9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 900 ms	• 2 driving cycles

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DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
			• calculate the speed of input shaft 2 with the gear ratio of engaged gear on input shaft 2 and the output shaft speed. compare the calculated speed with measured speed of input shaft 2		• gear engaged on input shaft 2 • valid CAN output speed information • speed of input shaft 2 < 25 rpm • output speed > 25 rpm • terminal 15 voltage >4 V for more than 500 ms • battery voltage >9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms		
P0729	Gear 6 Incorrect Ratio	• synchronizing detection while the gearshift fork was controlled to engage sixth gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 2	• integral > 125	• no slipping point adaptation of clutch 2 • multiplexer position = 0 • control gearshift fork valve 3 >= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• synchronizing slip, duty factor of safety valve 2	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0731	Gear 1 Incorrect Ratio	• synchronizing detection while the gearshift fork was controlled to engage first gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 1	• integral > 125	• no slipping point adaptation of clutch 1 • multiplexer position = 0 • control gearshift fork valve 1 >= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• synchronizing slip, duty factor of safety valve 1	• 2 driving cycles
P0732	Gear 2 Incorrect Ratio	• synchronizing detection while the gearshift fork was controlled to engage second gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 2	• integral > 125	• no slipping point adaptation of clutch 2 • multiplexer position = 1 • control gearshift fork valve 3>= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• synchronizing slip, duty factor of safety valve 2	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0733	Gear 3 Incorrect Ratio	• synchronizing detection while the gearshift fork was controlled to engage third gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 1	• integral > 125	• no slipping point adaptation of clutch 1 • multiplexer position = 0 • control gearshift fork valve 2 >= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• synchronizing slip, duty factor of safety valve 1	• 2 driving cycles
P0734	Gear 4 Incorrect Ratio	• synchronizing detection while the gearshift fork was controlled to engage fourth gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 2	• integral > 125	• no slipping point adaptation of clutch 2 • multiplexer position = 1 • control gearshift fork valve 4 >= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• synchronizing slip, duty factor of safety valve 2	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0735	Gear 5 Incorrect Ratio	• synchronizing detection while the gearshift fork was controlled to engage fifth gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 1	• integral > 125	• no slipping point adaptation of clutch 1 • multiplexer position = 1 • control gearshift fork valve 1>= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• synchronizing slip, duty factor of safety valve 1	• 2 driving cycles
P0736	Reverse Incorrect Ratio	• unable to disengage the reverse gear	• gearshift fork of reverse gear stays in shifted position in spite of control to disengage	• gearshift fork position < synchronizing point reverse gear - 10% synchronizing point measured by a basic adjustment (reverse gear stays in shifted position) control gearshift fork	• control safety valve 2 (ON) >= 20% • multiplexer position = 0 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 6000 ms	• 2 driving cycles

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DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
		• synchronizing detection while the gearshift fork was controlled to engage reverse gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 2	• integral > 125	• no slipping point adaptation of clutch 1 • multiplexer position = 0 • control gearshift fork valve 4 >= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms		
P0746	Pressure Control Solenoid "A" Performance/Stuck Off	• pressure integral monitoring	• integral of actual pressure minus desired pressure minus drain exceeds a maximum value	• pressure integral>= 0,1 bars	• desired pressure <= adapted clutch slipping point + 1 bar • standing vehicle with accelerator pedal < 0.1% • battery voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
		• open-circuit check	• desired valve current of clutch 1 exceeds a threshold simultaneous the actual valve current is smaller than a second threshold	• desired current> 350 mA actual current< 50 mA	• common high-side switch 1 on, not defect and voltage > 9.2 V • gearbox subsystem 1 active • common high-side switches not deactivated by module 2 • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm		
P0747	Pressure Control Solenoid "A" Stuck On	• pressure buildup monitoring	• the number of successive pressure buildup failure of clutch 1 reaches a maximum value	• counter > 2	• engaged gear on input shaft 1 • desired pressure >adapted clutch slipping point – 0.2 bar • output speed < 200 rpm • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 0 ms	• 2 driving cycles

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DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
		• short-circuit current check	• comparison of actual valve current with desired valve current of clutch 1	• actual current>desired current and (actual current- desired current)> 200 mA for more than 200 ms	• common high-side switch 1 on, not defect and voltage > 9.2 V • gearbox subsystem 1 active • common high-side switches not deactivated by module 2 • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 200 ms	

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0751	Shift Solenoid "A" Performance/Stuck Off	• open-circuit check	• Comparison of residual current of gearbox subsystem 1 (total current at common high-side switch 1 – actual current of clutch 1) at switching point of control gearshift fork valve 1 with residual current at permanent control of control gearshift fork valve 1	• difference of residual current<= 200 mA (supply voltage at common high-side 1=7 V) .. 450 mA (supply voltage at common high-side 1=13 V)	• common high-side switch 1 on, not defect and voltage > 9.2 V • gearbox subsystem 1 active • common high-side switches not deactivated by module 2 • change of supply voltage < 1 V • duty factor change of safety valve 1 (control of safety valve 1 is stable) <= 5% • duty factor change of gearshift fork valve 2 (control of gearshift fork valve 2 is stable) <= 5% • y factor change of safety valve 2 > 70% • control of safety valve 2 is stable >= 50 ms • duty factor change of gearshift > 500 rpm	• 300 ms	• 2 driving cycles

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DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P0756	Shift Solenoid "B" Performance/Stuck Off	• open-circuit check	• Comparison of residual current of gearbox subsystem 1 (total current at common high-side switch 1 – actual current of clutch 1) at switching point of control gearshift fork valve 2 with residual current at permanent control of control gearshift fork valve 2	• difference of residual current<= 200 mA (supply voltage at common high-side 1=7 V) .. 450 mA (supply voltage at common high-side 1=13 V)	• common high-side switch 1 on, not defect and voltage > 9.2 V • gearbox subsystem 1 active • common high-side switches not deactivated by module 2 • change of supply voltage < 1 V • duty factor change of safety valve 1 (control of safety valve 1 is stable) <= 5% • duty factor change of gearshift fork valve 1 (control of gearshift fork valve 1 is stable) <= 5% • duty factor of control gearshift fork valve 2 > 70% and steady state time >= 50ms • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0761	Shift Solenoid "C" Performance/Stuck Off	• open-circuit check	• Comparison of residual current of gearbox subsystem 2 (total current at common high-side switch 2 – actual current of clutch 2) at switching point of control gearshift fork valve 3 with residual current at permanent control of control gearshift fork valve 3	• difference of residual current<= 200 mA (supply voltage at common high-side 2=7 V) .. 450 mA (supply voltage at common high-side 2=13 V)	• common high-side switch 2 on, not defect and voltage > 9.2 V • gearbox subsystem 2 active • common high-side switches not deactivated by module 2 • change of supply voltage < 1 V • duty factor change of safety valve 2 <= 5% (control of safety valve 2 is stable) • duty factor change of gearshift fork valve 4 <= 5% (control of gearshift fork valve 4 is stable) • duty factor of control gearshift fork valve 3 > 70% and steady state time >= 50 ms • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0766	Shift Solenoid "D" Performance/Stuck Off	• open-circuit check	• Comparison of residual current of gearbox subsystem 2 (total current at common high-side switch 2 – actual current of clutch 2) at switching point of control gearshift fork valve 4 with residual current at permanent control of control gearshift fork valve 4	• difference of residual current<= 200 mA (supply voltage at common high-side 2=7 V) .. 450 mA (supply voltage at common high-side 2=13 V)	• common high-side switch 2 on, not defect and voltage > 9.2 V • gearbox subsystem 2 active • common high-side switches not deactivated by module 2 • change of supply voltage < 1 V • duty factor change of safety valve 2 <= 5% (control of safety valve 2 is stable) • duty factor change of gearshift fork valve 3 <= 5% (control of gearshift fork valve 3 is stable) • duty factor of control gearshift fork valve 4 > 70% and steady state time >= 50 ms • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0771	Shift Solenoid "E" Performance/Stuck Off	• open-circuit check	• Comparison of residual current of central control (total current at common high-side switch 3 – actual current of main pressure valve and cooling oil valve) at switching point of multiplexer valve with residual current at permanent control of multiplexer valve	• difference of residual current <= 150 mA (maximum of supply voltage at common high-side 1,2 and terminal 15 =7 V) .. 300 mA (maximum of supply voltage at common high-side 1,2 and terminal 15 =13 V)	• common high-side switch 3 on and not defect • no short-circuit current check failure of main pressure solenoid valve • common high-side switch 1 and 2 voltage > 9.2 V • common high-side switches not deactivated by module 2 • change of supply voltage < 1 V • multiplexer valve is controlled and steady state time >= 50 ms • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm		

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0776	Pressure Control Solenoid "B" Performance/Stuck Off	• pressure integral monitoring	• integral of actual pressure minus desired pressure minus drain exceeds a maximum value	• pressure integral >= 0,1 bars	• desired pressure <= adapted clutch slipping point + 1 bar • standing vehicle with accelerator pedal < 0.1% • battery voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles
		• open-circuit check	• desired valve current of clutch 2 exceeds a threshold simultaneous the actual valve current is smaller than a second threshold	• desired current> 350 mA actual current< 50 mA	• common high-side switch 2 on, not defect and voltage > 9.2 V • gearbox subsystem 2 active • common high-side switches not deactivated by module 2 • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm		

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0777	Pressure Control Solenoid "B" Stuck On	• pressure buildup monitoring	• the number of successive pressure buildup failure of clutch 2 reaches a maximum value	• counter > 2	• engaged gear on input shaft 2 • desired pressure > adapted clutch slipping point – 0.2 bar • output speed < 200 rpm • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 0 ms	• 2 driving cycles
		• short-circuit current check	• comparison of actual valve current with desired valve current of clutch 2	• actual current >desired current and (actual current-desired current) > 200 mA for more than 200 ms	• common high-side switch 2 on, not defect and voltage > 9.2 V • gearbox subsystem 2 active • common high-side switches not deactivated by module 2 • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 200 ms	

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DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P0781	1-2 Shift	• unable to disengage the first gear	• gearshift fork of first gear stays in shifted position in spite of control to disengage	• gearshift fork position > synchronizing point first gear + 10% synchronizing point measured by a basic adjustment (first gear stays in shifted position) control gearshift fork valve 2 >= 5%	• control safety valve 1 (ON) >= 20% • multiplexer position = 0 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 6000 ms	• 2 driving cycles
P0782	2-3 Shift	• unable to disengage the second gear	• gearshift fork of second gear stays in shifted position in spite of control to disengage	• gearshift fork position < synchronizing point second gear - 10% synchronizing point measured by a basic adjustment (second gear stays in shifted position) control gearshift fork valve 4 >= 5%	• control safety valve 1 (ON) >= 20% • multiplexer position = 1 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 6000 ms	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0783	3-4 Shift	• unable to disengage the third gear	• gearshift fork of third gear stays in shifted position in spite of control to disengage	• gearshift fork position < synchronizing point third gear - 10% synchronizing point measured by a basic adjustment (third gear stays in shifted position) control gearshift fork valve 1 >= 5%	• control safety valve 1 (ON) >= 20% • multiplexer position = 0 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 6000 ms	• 2 driving cycles
P0784	4-5 Shift	• unable to disengage the fourth gear	• gearshift fork of fourth gear stays in shifted position in spite of control to disengage	• gearshift fork position > synchronizing point fourth gear + 10% synchronizing point measured by a basic adjustment (fourth gear stays in shifted position) control gearshift fork valve 3 >= 5%	• control safety valve 2 (ON) >= 20% • multiplexer position = 1 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 6000 ms	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0791	Intermediate Shaft Speed Sensor "A" Circuit	• signal range check	• rotational speed of input shaft 1 exceed a maximum value OR • rotational speed of input shaft 2 exceed a maximum value	• rotational speed > 12000 rpm	• terminal 15 voltage > 4 V for more than 500 ms	• 100 ms	• 2 driving cycles
P0797	Pressure Control Solenoid "C" Stuck On	• short-circuit current check	• comparison of actual valve current with desired valve current of main pressure solenoid valve	• actual current>desired current and (actual current- desired current) > 200 mA for more than 300 ms	• common high-side switch 3 on and not defect • common high-side switch 1 and 2 voltage > 9.2 V • common high-side switches not deactivated by module 2 • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0829	5-6 Shift	• unable to disengage the fifth gear	• gearshift fork of fifth gear stays in shifted position in spite of control to disengage	• gearshift fork position > synchronizing point fifth gear + 10% synchronizing point measured by a basic adjustment (fifth gear stays in shifted position) control gearshift fork valve 2 >= 5%	• control safety valve 1 (ON) >= 20% • multiplexer position = 1 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 6000 ms	• 2 driving cycles
		• unable to disengage the sixth gear	• gearshift fork of sixth gear stays in shifted position in spite of control to disengage	• gearshift fork position > synchronizing point sixth gear + 10% synchronizing point measured by a basic adjustment (sixth gear stays in shifted position) control gearshift fork valve 4 >= 5%	• control safety valve 2 (ON) >= 20% • multiplexer position = 0 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms		

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0840	Transmission Fluid Pressure Sensor/ Switch "A" Circuit	• signal range check	• pressure sensor voltage clutch 1 out of plausibility range	• voltage < 100 mV OR • voltage > 4900 mV		• 300 ms	• 2 driving cycles
P0841	Transmission Fluid Pressure Sensor/ Switch "A" Circuit Range/Performance	• overpressure monitoring	• hydraulic pressure of clutch 1 exceeds a maximum value	• pressure>= 15.5 bar	• signal range check is correct • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 1000 ms	• 2 driving cycles
P0845	Transmission Fluid Pressure Sensor/ Switch "B" Circuit	• pressure sensor voltage clutch 2 out of plausibility range	• pressure sensor voltage clutch 1 out of plausibility range	• voltage < 100 mV OR • voltage > 4900 mV		• 300 ms	• 2 driving cycles
P0846	Transmission Fluid Pressure Sensor/ Switch "B" Circuit Range/Performance	• overpressure monitoring	• hydraulic pressure of clutch 2 exceeds a maximum value	• pressure >= 15.5 bar	• signal range check is correct • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 80 ms	• 2 driving cycles
P0864	TCM Communication Circuit Range/Performance	• buss off detection of the microcontroller			• terminal 15 voltage > 9 V for more than 500 ms • > 500 ms after reset	• 1000 ms	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0890	TCM Power Relay Sense Circuit Low	• short-circuit current check	• Detection by hardware circuit	• current > 8.5 A	• terminal 15 voltage > 4 V for more than 500 ms	• 200 ms	• 2 driving cycles
P0914	Gear Shift Position Circuit	• time out detection of the question and answer diagnosis	• if time out of the question and answer diagnosis is detected increment an event counter	• time out threshold > 100 ms	• gear message for selector lever is transmittable and selector lever message is receivable • no failure of selector lever CAN messages • time after Reset > 100 ms • terminal 15 voltage > 4 V for more than 500 ms	• 300 ms	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
		• plausibility check of selector lever	• selector lever position is not equal to negation of the inverse selector lever position OR • selector lever position equals initialization value OR • selector lever position equals error value OR • selector lever position is equal to negation of the inverse selector lever position but no valid position	• selector lever position = Position 1 or Position 2 or Position 3 or Position 4 or Position L	• no bus off error • no error failure of all CAN messages • no failure of selector lever CAN messages • time after Reset > 1100 ms • terminal 15 voltage > 9 V for more than 1100 ms	• 1000 ms	
		• question and answer diagnosis	• failure of question and answer diagnosis			• 1500 ms	
P0919	Gear Shift Position Control Error	• evaluation the error signal of selector lever CAN message	• error flag of not determinable selector lever position is set		• no failure of selector lever CAN messages • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 20 ms	• 2 driving cycles

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DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
		• validity check of selector lever position	• if the selector lever position is equal to negation of the inverse selector lever position but is not valid (position == L, P4, P3, P2, or P1) AND • is not in error state (position != error) AND • initialization value with the initialization flag not set then increment an event counter		• no failure of selector lever CAN messages • terminal 15 voltage > 4 V for more than 500 ms		
		• error detection of the question and answer diagnosis	• if the answer of the diagnosis is wrong an event counter is incremented		• no failure of selector lever CAN messages • terminal 15 voltage > 4 V for more than 500 ms	• 100 ms	

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
		• plausibility check of selector lever position	• if the selector lever position is not equal to negation of the inverse selector lever position OR • selector lever position equals initialization value but the initialization flag is not set OR • selector lever position equals error value then increment an event counter		• no failure of selector lever CAN messages • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 400 ms	
P0929	Gear Shift Lock Solenoid/Actuator Control Circuit "A" Range/Performance	• validity check of shiftlock position signal	• if the shiftlock position signal is not valid (position != error, deactivate, active or init) increment an event counter		• no failure of selector lever CAN messages • terminal 15 voltage > 4 V for more than 500 ms	• 20 ms	• 2 driving cycles
P2711	Unexpected Mechanical Gear Disengagement	• unable to engage a gear on shaft 1	• the number of successive engagements of the same gear on shaft 1 exceeds a maximum value	• counter>=6	• battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 0 ms	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
		• unable to engage a gear on shaft 2	• the number of successive engagements of the same gear on shaft 2 exceeds a maximum value				
		• detect disengagement of gears on shaft 1 without control	• In spite of a constant desired gear disengagement counter exceeds a maximum value	• counter >3	• battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms • output speed >= 12 rpm		
		• detect disengagement of gears on shaft 2 without control	• In spite of a constant desired gear disengagement counter exceeds a maximum value				

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P2723	Pressure Control Solenoid "E" Performance/Stuck Off	• open-circuit check	• residual current of gearbox subsystem 1 (total current at common high-side switch 1 – actual current of clutch 1) is smaller than a minimum value	• residual current <= 150 mA (supply voltage at common high-side 1=7 V) .. 300 mA (supply voltage at common high-side 1=13 V)	• common high-side switch 1 on, not defect and voltage > 9.2 V • gearbox subsystem 1 active • common high-side switches not deactivated by module 2 • change of supply voltage < 1 V • duty factor of control gearshift fork valve 1 and 2 <= 10 % • duty factor of safety valve 1 >= 53% and steady state time >= 50 ms • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles

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DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P2732	Pressure Control Solenoid "F" Performance/Stuck Off	• open-circuit check	• residual current of gearbox subsystem 2 (total current at common high-side switch 2 – actual current of clutch 2) is smaller than a minimum value	• residual current <= 150 mA (supply voltage at common high-side 2=7 V) .. 300 mA (supply voltage at common high-side 2=13 V)	• common high-side switch 2 on, not defect and voltage > 9.2 V • gearbox subsystem 2 active • common high-side switches not deactivated by module 2 • change of supply voltage < 1 V • duty factor of control gearshift fork valve 3 and <= 10 % • duty factor of safety valve 2 >= 53% and steady state time >= 50 ms • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles
U0100	Lost Communication With ECM/PCM "A"	• Timeout Check	• failure of all CAN engine messages	• time-out for more than 490 ms	• no bus off error • no error failure of all CAN messages • terminal 15 voltage > 9 V for more than 500 ms • >500 ms after reset	• 490 ms	• 2 driving cycles

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DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
			• failure of one or more CAN engine messages (but not all CAN engine messages)	• time-out for more than 1010 ms	• no bus off error • no error failure of all CAN messages • no error failure of all CAN engine messages • terminal 15 voltage > 9 V for more than 500 ms • >500 ms after reset	• 1010 ms	
			• failure of all CAN messages but gearbox is still in position to send	• time-out for more than 2080 ms	• terminal 15 voltage > 9 V for more than 500 ms • >500 ms after reset	• 2080 ms	
U0103	Lost Communication With Gear Shift Control Module "A"	• Timeout Check	• failure of selector lever CAN messages	• time-out for more than 490 ms	• kein Bus off Fehler no bus off error • no error failure of all CAN messages • terminal 15 voltage > 9 V for more than 500 ms, >500 ms after reset	• 490 ms	• 2 driving cycles
U0404	Invalid Data Received From Gear Shift Control Module "A"	• evaluation of selector lever CAN message counter	• if the value of message counter is permanent constant or change exceeds a threshold increment an event counter	• maximum change of message counter > 5	• no failure of selector lever CAN messages • terminal 15 voltage > 4 V for more than 500 ms	• 50 ms	• 2 driving cycles

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3.5.2 Transmission Mechatronic , DSG 6-spd 02E (2016 MY)

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0219	Engine Overspeed Condition	• signal range check	• rotational speed of gearbox input shaft exceed a maximum value	• rotational speed> 12000 rpm	• terminal 15 voltage > 4 V for more than 500 ms	• 500 ms	• 2 driving cycles
P0501	Vehicle Speed Sensor "A" Circuit Range/ Performance	• plausibility check	• calculate the speed of input shaft with the gear ratio of engaged gear on input shaft and the output shaft speed. compare the calculated speed with measured speed of input shaft	• speed difference magnitude > 330 rpm (output speed = 500 rpm) – 100 rpm (output speed>=2000 rpm)	• gear on input shaft engaged • no valid CAN output speed information • output speed > 25 rpm OR speed of input shaft > 1000 rpm • terminal 15 voltage >4 V for more than 500 ms • battery voltage >9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 300 ms	• 2 driving cycles
P0701	Transmission Control System Range/ Performance	• signal range check	• travel sensor voltage gearshift fork 1/3 out of plausibility range • travel sensor voltage gearshift fork 2/4 out of plausibility range • travel sensor voltage gearshift fork 5/N out of plausibility range	• voltage < 100 mV OR • voltage > 4900 mV		• 300 ms	• 2 driving cycles

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DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
			• travel sensor voltage gearshift fork 6/R out of plausibility range				
P0702	Transmission Control System Electrical	• plausibility check	• In spite of cut off Common Highside Switch 1 a measurable current. In spite of turned on Common Highside Switch 1 no current measurable.	• CHS1 cut off and CHS1-Current> 40 mA CHS1 turned on and CHS1-Current< 200 mA	• one-time after reset • terminal 15 voltage < 18 V • no short-circuit current check failure of CHS1 • common highside switch 1 voltage >9.2V • gearbox subsystem 1 active • common highside switches not deactivated by module 2	• 300 ms	• 2 driving cycles
			• In spite of cut off Common Highside Switch 2 a measurable current. In spite of turned on Common Highside Switch 2 no current measurable.	• CHS2 cut off and CHS2-Current> 40 mA CHS2 turned on and CHS2-Current< 200 mA	• one-time after reset • terminal 15 voltage < 18 V • no short-circuit current check failure of CHS2 • common highside switch 2 voltage >9.2V • gearbox subsystem 2 active • common highside switches not deactivated by module 2		

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
			• In spite of cut off Common Highside Switch 3 a measurable current. In spite of turned on Common Highside Switch 3 no current measurable.	• CHS3 cut off and CHS3-Current> 40 mA CHS3 turned on and CHS3-Current< 200 mA	• one-time after reset • terminal 15 voltage < 18 V • no short-circuit current check failure of CHS3 and main pressure solenoid valve • common highside switch 1 and 2 voltage >9.2V • common highside switches not deactivated by module 2		
P0717	Input/Turbine Shaft Speed Sensor "A" Circuit No Signal	• plausibility check	• calculate the speed of input shaft 1 with the gear ratio of engaged gear on input shaft 1 and the output shaft speed. compare the calculated speed with measured speed of input shaft 1	• speed difference magnitude> 330 rpm (output speed = 500rpm)… 100 rpm (output speed>=2000 rpm)	• gear engaged on input shaft 1 • valid CAN output speed information • speed of input shaft 1 < 25 rpm • output speed > 25 rpm • terminal 15 voltage >4 V for more than 500 ms • battery voltage >9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 900 ms	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
			• calculate the speed of input shaft 2 with the gear ratio of engaged gear on input shaft 2 and the output shaft speed. compare the calculated speed with measured speed of input shaft 2		• gear engaged on input shaft 2 • valid CAN output speed information • speed of input shaft 2 < 25 rpm • output speed > 25 rpm • terminal 15 voltage >4 V for more than 500 ms • battery voltage >9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms		
P0729	Gear 6 Incorrect Ratio	• synchronizing detection while the gearshift fork was controlled to engage sixth gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 2	• integral > 125	• no slipping point adaptation of clutch 2 • multiplexer position = 0 • control gearshift fork valve 3 >= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• synchronizing slip, duty factor of safety valve 2	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0731	Gear 1 Incorrect Ratio	• synchronizing detection while the gearshift fork was controlled to engage 1st gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 1	• integral > 125	• no slipping point adaptation of clutch 1 • multiplexer position = 0 • control gearshift fork valve 1 >= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• synchronizing slip, duty factor of safety valve 1	• 2 driving cycles
P0732	Gear 2 Incorrect Ratio	• synchronizing detection while the gearshift fork was controlled to engage second gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 2	• integral > 125	• no slipping point adaptation of clutch 2 • multiplexer position = 1 • control gearshift fork valve 3>= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• synchronizing slip, duty factor of safety valve 2	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0733	Gear 3 Incorrect Ratio	• synchronizing detection while the gearshift fork was controlled to engage third gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 1	• integral > 125	• no slipping point adaptation of clutch 1 • multiplexer position = 0 • control gearshift fork valve 2 >= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• synchronizing slip, duty factor of safety valve 1	• 2 driving cycles
P0734	Gear 4 Incorrect Ratio	• synchronizing detection while the gearshift fork was controlled to engage fourth gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 2	• integral > 125	• no slipping point adaptation of clutch 2 • multiplexer position = 1 • control gearshift fork valve 4 >= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• synchronizing slip, duty factor of safety valve 2	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0735	Gear 5 Incorrect Ratio	• synchronizing detection while the gearshift fork was controlled to engage fifth gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 1	• integral > 125	• no slipping point adaptation of clutch 1 • multiplexer position = 1 • control gearshift fork valve 1>= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• synchronizing slip, duty factor of safety valve 1	• 2 driving cycles
P0736	Reverse Incorrect Ratio	• unable to disengage the reverse gear	• gearshift fork of reverse gear stays in shifted position in spite of control to disengage	• gearshift fork position < synchronizing point reverse gear - 10% synchronizing point measured by a basic adjustment (reverse gear stays in shifted position) control gearshift fork	• control safety valve 2 (ON) >= 20% • multiplexer position = 0 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 6000 ms	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
		• synchronizing detection while the gearshift fork was controlled to engage reverse gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 2	• integral > 125	• no slipping point adaptation of clutch 1 • multiplexer position = 0 • control gearshift fork valve 4 >= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms		
P0746	Pressure Control Solenoid "A" Performance/ Stuck Off	• pressure integral monitoring	• integral of actual pressure minus desired pressure minus drain exceeds a maximum value	• pressure integral>= 0,1 bar * s	• desired pressure <= adapted clutch slipping point + 1 bar • standing vehicle with accelerator pedal < 0.1% • battery voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
		• open-circuit check	• desired valve current of clutch 1 exceeds a threshold simultaneous the actual valve current is smaller than a second threshold	• desired current> 350 mA actual current< 50 mA	• common highside switch 1 on, not defect and voltage > 9.2 V • gearbox subsystem 1 active • common highside switches not deactivated by module 2 • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm		
P0747	Pressure Control Solenoid "A" Stuck On	• pressure buildup monitoring	• the number of successive pressure buildup failure of clutch 1 reaches a maximum value	• counter > 2	• engaged gear on input shaft 1 • desired pressure >adapted clutch slipping point – 0.2 bar • output speed < 200 rpm • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 0 ms	• 2 driving cycles

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DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
		• short-circuit current check	• comparison of actual valve current with desired valve current of clutch 1	• actual current>desired current and (actual current- desired current)> 200 mA for more than 200 ms	• common highside switch 1 on, not defect and voltage > 9.2 V • gearbox subsystem 1 active • common highside switches not deactivated by module 2 • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 200 ms	

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0751	Shift Solenoid "A" Performance/ Stuck Off	• open-circuit check	• Comparison of residual current of gearbox subsystem 1 (total current at common highside switch 1 – actual current of clutch 1) at switching point of control gearshift fork valve 1 with residual current at permanent control of control gearshift fork valve 1	• difference of residual current<= 200 mA (supply voltage at common highside 1=7 V) 450 mA (supply voltage at common highside 1=13 V)	• common highside switch 1 on, not defect and voltage > 9.2 V • gearbox subsystem 1 active • common highside switches not deactivated by module 2 • change of supply voltage < 1 V • duty factor change of safety valve 1 (control of safety valve 1 is stable) <= 5% • duty factor change of gearshift fork valve 2 (control of gearshift fork valve 2 is stable) <= 5% • y factor change of safety valve 2 > 70% • control of safety valve 2 is stable >= 50 ms • duty factor change of gearshift > 500 rpm	• 300 ms	• 2 driving cycles

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DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P0756	Shift Solenoid "B" Performance/ Stuck Off	• open-circuit check	• Comparison of residual current of gearbox subsystem 1 (total current at common highside switch 1 – actual current of clutch 1) at switching point of control gearshift fork valve 2 with residual current at permanent control of control gearshift fork valve 2	• difference of residual current<= 200 mA (supply voltage at common highside 1=7 V) , 450 mA (supply voltage at common highside 1=13 V)	• common highside switch 1 on, not defect and voltage > 9.2 V • gearbox subsystem 1 active • common highside switches not deactivated by module 2 • change of supply voltage < 1 V • duty factor change of safety valve 1 (control of safety valve 1 is stable) <= 5% • duty factor change of gearshift fork valve 1 (control of gearshift fork valve 1 is stable) <= 5% • duty factor of control gearshift fork valve 2 > 70% and steady state time >= 50 ms • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0761	Shift Solenoid "C" Performance/ Stuck Off	• open-circuit check	• Comparison of residual current of gearbox subsystem 2 (total current at common highside switch 2 – actual current of clutch 2) at switching point of control gearshift fork valve 3 with residual current at permanent control of control gearshift fork valve 3	• difference of residual current<= 200 mA (supply voltage at common highside 2=7 V) 450 mA (supply voltage at common highside 2=13 V)	• common highside switch 2 on, not defect and voltage > 9.2 V • gearbox subsystem 2 active • common highside switches not deactivated by module 2 • change of supply voltage < 1 V • duty factor change of safety valve 2 <= 5% (control of safety valve 2 is stable) • duty factor change of gearshift fork valve 4 <= 5% (control of gearshift fork valve 4 is stable) • duty factor of control gearshift fork valve 3 > 70% and steady state time >= 50 ms • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles

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DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P0766	Shift Solenoid "D" Performance/ Stuck Off	• open-circuit check	• Comparison of residual current of gearbox subsystem 2 (total current at common highside switch 2 – actual current of clutch 2) at switching point of control gearshift fork valve 4 with residual current at permanent control of control gearshift fork valve 4	• difference of residual current<= 200 mA (supply voltage at common highside 2=7 V) 450 mA (supply voltage at common highside 2=13 V)	• common highside switch 2 on, not defect and voltage > 9.2 V • gearbox subsystem 2 active • common highside switches not deactivated by module 2 • change of supply voltage < 1 V • duty factor change of safety valve 2 <= 5% (control of safety valve 2 is stable) • duty factor change of gearshift fork valve 3 <= 5% (control of gearshift fork valve 3 is stable) • duty factor of control gearshift fork valve 4 > 70% and steady state time >= 50 ms • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0771	Shift Solenoid "E" Performance/ Stuck Off	• open-circuit check	• Comparison of residual current of central control (total current at common highside switch 3 – actual current of main pressure valve and cooling oil valve) at switching point of multiplexer valve with residual current at permanent control of multiplexer valve	• difference of residual current <= 150 mA (maximum of supply voltage at common highside 1,2 and terminal 15 =7 V) 300 mA (maximum of supply voltage at common highside 1,2 and terminal 15 =13 V)	• common highside switch 3 on and not defect • no short-circuit current check failure of main pressure solenoid valve • common highside switch 1 and 2 voltage > 9.2 V • common highside switches not deactivated by module 2 • change of supply voltage < 1 V • multiplexer valve is controlled and steady state time >= 50 ms • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm		
P0776	Pressure Control Solenoid "B" Performance/ Stuck Off	• pressure integral monitoring	• integral of actual pressure minus desired pressure minus drain exceeds a maximum value	• pressure integral >= 0,1 bar * s	• desired pressure <= adapted clutch slipping point + 1 bar • standing vehicle with accelerator pedal < 0.1% • battery voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
		• open-circuit check	• desired valve current of clutch 2 exceeds a threshold simultaneous the actual valve current is smaller than a second threshold	• desired current> 350 mA actual current< 50 mA	• common highside switch 2 on, not defect and voltage > 9.2 V • gearbox subsystem 2 active • common highside switches not deactivated by module 2 • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm		
P0777	Pressure Control Solenoid "B" Stuck On	• pressure buildup monitoring	• the number of successive pressure buildup failure of clutch 2 reaches a maximum value	• counter > 2	• engaged gear on input shaft 2 • desired pressure > adapted clutch slipping point – 0.2 bar • output speed < 200 rpm • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 0 ms	• 2 driving cycles

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DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
		• short-circuit current check	• comparison of actual valve current with desired valve current of clutch 2	• actual current >desired current and (actual current-desired current) > 200 mA for more than 200 ms	• common highside switch 2 on, not defect and voltage > 9.2 V • gearbox subsystem 2 active • common highside switches not deactivated by module 2 • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 200 ms	
P0781	1-2 Shift	• unable to disengage the 1st gear	• gearshift fork of 1st gear stays in shifted position in spite of control to disengage	• gearshift fork position > synchronizing point 1st gear + 10% synchronizing point measured by a basic adjustment (1st gear stays in shifted position) control gearshift fork valve 2 >= 5%	• control safety valve 1 (ON) >= 20% • multiplexer position = 0 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 6000 ms	• 2 driving cycles

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DQ-250 6F 02E							
DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P0782	2-3 Shift	• unable to disengage the second gear	• gearshift fork of second gear stays in shifted position in spite of control to disengage	• gearshift fork position < synchronizing point second gear - 10% synchronizing point measured by a basic adjustment (second gear stays in shifted position) control gearshift fork valve 4 >= 5%	• control safety valve 1 (ON) >= 20% • multiplexer position = 1 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 6000 ms	• 2 driving cycles
P0783	3-4 Shift	• unable to disengage the third gear	• gearshift fork of third gear stays in shifted position in spite of control to disengage	• gearshift fork position < synchronizing point third gear - 10% synchronizing point measured by a basic adjustment (third gear stays in shifted position) control gearshift fork valve 1 >= 5%	• control safety valve 1 (ON) >= 20% • multiplexer position = 0 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 6000 ms	• 2 driving cycles

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DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0784	4-5 Shift	• unable to disengage the fourth gear	• gearshift fork of fourth gear stays in shifted position in spite of control to disengage	• gearshift fork position > synchronizing point fourth gear + 10% synchronizing point measured by a basic adjustment (fourth gear stays in shifted position) control gearshift fork valve 3 >= 5%	• control safety valve 2 (ON) >= 20% • multiplexer position = 1 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 6000 ms	• 2 driving cycles
P0791	Intermediate Shaft Speed Sensor "A" Circuit	• signal range check	• rotational speed of input shaft 1 exceed a maximum value • rotational speed of input shaft 2 exceed a maximum value	• rotational speed > 12000 rpm	• terminal 15 voltage > 4 V for more than 500 ms	• 100 ms	• 2 driving cycles

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DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0797	Pressure Control Solenoid "C" Stuck On	• short-circuit current check	• comparison of actual valve current with desired valve current of main pressure solenoid valve	• actual current>desired current and (actual current- desired current) > 200 mA for more than 300 ms	• common highside switch 3 on and not defect • common highside switch 1 and 2 voltage > 9.2 V • common highside switches not deactivated by module 2 • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles
P0829	5-6 Shift	• unable to disengage the fifth gear	• gearshift fork of fifth gear stays in shifted position in spite of control to disengage	• gearshift fork position > synchronizing point fifth gear + 10% synchronizing point measured by a basic adjustment (fifth gear stays in shifted position) control gearshift fork valve 2 >= 5%	• control safety valve 1 (ON) >= 20% • multiplexer position = 1 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 6000 ms	• 2 driving cycles

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DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
		• unable to disengage the sixth gear	• gearshift fork of sixth gear stays in shifted position in spite of control to disengage	• gearshift fork position > synchronizing point sixth gear + 10% synchronizing point measured by a basic adjustment (sixth gear stays in shifted position) control gearshift fork valve 4 >= 5%	• control safety valve 2 (ON) >= 20% • multiplexer position = 0 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms		
P0840	Transmission Fluid Pressure Sensor/ Switch "A" Circuit	• signal range check	• pressure sensor voltage clutch 1 out of plausibility range	• voltage < 100 mV OR • voltage > 4900 mV		• 300 ms	• 2 driving cycles
P0841	Transmission Fluid Pressure Sensor/ Switch "A" Circuit Range/ Performance	• overpressure monitoring	• hydraulic pressure of clutch 1 exceeds a maximum value	• pressure>= 15.5 bar	• signal range check is correct • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 1000 ms	• 2 driving cycles
P0845	Transmission Fluid Pressure Sensor/ Switch "B" Circuit	• pressure sensor voltage clutch 2 out of plausibility range	• pressure sensor voltage clutch 1 out of plausibility range	• voltage < 100 mV OR • voltage > 4900 mV		• 300 ms	• 2 driving cycles

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DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0846	Transmission Fluid Pressure Sensor/ Switch "B" Circuit Range/ Performance	• overpressure monitoring	• hydraulic pressure of clutch 2 exceeds a maximum value	• pressure >= 15.5 bar	• signal range check is correct • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 80 ms	• 2 driving cycles
P0864	TCM Communication Circuit Range/ Performance	• buss off detection of the microcontroller			• terminal 15 voltage > 9 V for more than 500 ms • > 500 ms after reset	• 1000 ms	• 2 driving cycles
P0890	TCM Power Relay Sense Circuit Low	• short-circuit current check	• Detection by hardware circuit	• current > 8.5 A	• terminal 15 voltage > 4 V for more than 500 ms	• 200 ms	• 2 driving cycles
P0914	Gear Shift Position Circuit	• time out detection of the question and answer diagnosis	• if time out of the question and answer diagnosis is detected increment an event counter	• time out threshold > 100 ms	• gear message for selector lever is transmittable and selector lever message is receivable • no failure of selector lever CAN messages • time after Reset > 100 ms • terminal 15 voltage > 4 V for more than 500 ms	• 300 ms	• 2 driving cycles

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DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
		• plausibility check of selector lever	• selector lever position is not equal to negation of the inverse selector lever position OR • selector lever position equals initialization value OR • selector lever position equals error value OR • selector lever position is equal to negation of the inverse selector lever position but no valid position	• selector lever position = Position 1 or Position 2 or Position 3 or Position 4 or Position L	• no bus off error • no error failure of all CAN messages • no failure of selector lever CAN messages • time after Reset > 1100 ms • terminal 15 voltage > 9 V for more than 1100 ms	• 1000 ms	
		• question and answer diagnosis	• failure of question and answer diagnosis			• 1500 ms	
P0919	Gear Shift Position Control Error	• evaluation the error signal of selector lever CAN message	• error flag of not determinable selector lever position is set		• no failure of selector lever CAN messages • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 20 ms	• 2 driving cycles

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DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
		• validity check of selector lever position	• if the selector lever position is equal to negation of the inverse selector lever position but is not valid (position = L, P4, P3, P2, or P1) AND • is not in error state (position != error) AND • initialization value with the initialization flag not set then increment an event counter		• no failure of selector lever CAN messages • terminal 15 voltage > 4 V for more than 500 ms		
		• error detection of the question and answer diagnosis	• if the answer of the diagnosis is wrong an event counter is incremented		• no failure of selector lever CAN messages • terminal 15 voltage > 4 V for more than 500 ms	• 100 ms	

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
		• plausibility check of selector lever position	• if the selector lever position is not equal to negation of the inverse selector lever position OR • selector lever position equals initialization value but the initialization flag is not set OR • selector lever position equals error value then increment an event counter		• no failure of selector lever CAN messages • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 400 ms	
P0929	Gear Shift Lock Solenoid/ Actuator Control Circuit "A" Range/ Performance	• validity check of shiftlock position signal	• if the shiftlock position signal is not valid (position != error, deactive, active or init) increment an event counter		• no failure of selector lever CAN messages • terminal 15 voltage > 4 V for more than 500 ms	• 20 ms	• 2 driving cycles
P2711	Unexpected Mechanical Gear Disengagement	• unable to engage a gear on shaft 1	• the number of successive engagements of the same gear on shaft 1 exceeds a maximum value	• counter>=6	• battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 0 ms	• 2 driving cycles

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DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
		• unable to engage a gear on shaft 2	• the number of successive engagements of the same gear on shaft 2 exceeds a maximum value				
		• detect disengagement of gears on shaft 1 without control	• In spite of a constant desired gear disengagement counter exceeds a maximum value	• counter >3	• battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms • output speed >= 12 rpm		
		• detect disengagement of gears on shaft 2 without control	• In spite of a constant desired gear disengagement counter exceeds a maximum value				

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DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P2723	Pressure Control Solenoid "E" Performance/ Stuck Off	• open-circuit check	• residual current of gearbox subsystem 1 (total current at common highside switch 1 – actual current of clutch 1) is smaller than a minimum value	• residual current <= 150 mA (supply voltage at common highside 1=7 V) 300 mA (supply voltage at common highside 1=13 V)	• common highside switch 1 on, not defect and voltage > 9.2 V • gearbox subsystem 1 active • common highside switches not deactivated by module 2 • change of supply voltage < 1 V • duty factor of control gearshift fork valve 1 and 2 <= 10% • duty factor of safety valve 1 >= 53% and steady state time >= 50 ms • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles

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DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P2732	Pressure Control Solenoid "F" Performance/ Stuck Off	• open-circuit check	• residual current of gearbox subsystem 2 (total current at common highside switch 2 – actual current of clutch 2) is smaller than a minimum value	• residual current <= 150 mA (supply voltage at common highside 2=7 V) 300 mA (supply voltage at common highside 2=13 V)	• common highside switch 2 on, not defect and voltage > 9.2 V • gearbox subsystem 2 active • common highside switches not deactivated by module 2 • change of supply voltage < 1 V • duty factor of control gearshift fork valve 3 and <= 10% • duty factor of safety valve 2 >= 53% and steady state time >= 50 ms • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles
U0100	Lost Communication With ECM/ PCM "A"	• Timeout Check	• failure of all CAN engine messages	• time-out for more than 490 ms	• no bus off error • no error failure of all CAN messages • terminal 15 voltage > 9 V for more than 500 ms • >500 ms after reset	• 490 ms	• 2 driving cycles

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DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
			• failure of one or more CAN engine messages (but not all CAN engine messages)	• time-out for more than 1010 ms	• no bus off error • no error failure of all CAN messages • no error failure of all CAN engine messages • terminal 15 voltage > 9 V for more than 500 ms • >500 ms after reset	• 1010 ms	
			• failure of all CAN messages but gearbox is still in position to send	• time-out for more than 2080 ms	• terminal 15 voltage > 9 V for more than 500 ms • >500 ms after reset	• 2080 ms	
U0103	Lost Communication With Gear Shift Control Module "A"	• Timeout Check	• failure of selector lever CAN messages	• time-out for more than 490 ms	• kein Bus off Fehler no bus off error • no error failure of all CAN messages • terminal 15 voltage > 9 V for more than 500 ms, >500 ms after reset	• 490 ms	• 2 driving cycles
U0404	Invalid Data Received From Gear Shift Control Module "A"	• evaluation of selector lever CAN message counter	• if the value of message counter is permanent constant or change exceeds a threshold increment an event counter	• maximum change of message counter > 5	• no failure of selector lever CAN messages • terminal 15 voltage > 4 V for more than 500 ms	• 50 ms	• 2 driving cycles

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3.6 Diagnostic Procedures

- ⇒ “3.6.1 Accelerator Pedal Module GX2 , Checking”, page 457
- ⇒ “3.6.2 Cam Adjustment Actuators , Checking”, page 459
- ⇒ “3.6.3 Camshaft Adjustment Valve 1 N205 , Checking”, page 462
- ⇒ “3.6.4 Camshaft Position Sensor 3 G300 , Checking”, page 464
- ⇒ “3.6.5 Camshaft Position Sensor G40 , Checking”, page 466
- ⇒ “3.6.6 Charge Air Pressure Sensor G31 , Checking”, page 468
- ⇒ “3.6.7 Charge Pressure Actuator V465 / Charge Pressure Actuator Position Sensor G581 , Checking”, page 470
- ⇒ “3.6.8 Engine Component Power Supply Relay J757 , Checking”, page 473
- ⇒ “3.6.9 Engine Coolant Temperature Sensor G62 , Checking”, page 475
- ⇒ “3.6.10 Engine Coolant Temperature Sensor On Radiator Outlet G83 , Checking”, page 477
- ⇒ “3.6.11 Engine Speed Sensor G28 , Checking”, page 479
- ⇒ “3.6.12 Engine Temperature Control Actuator N493 , Checking”, page 481
- ⇒ “3.6.13 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 484
- ⇒ “3.6.14 Exhaust Camshaft Adjustment Valve 1 N318 , Checking”, page 485
- ⇒ “3.6.15 Fuel Injectors , Checking”, page 487
- ⇒ “3.6.16 Fuel Pressure Regulator Valve N276 , Checking”, page 489
- ⇒ “3.6.17 Fuel Pressure Sensor G247 , Checking”, page 491
- ⇒ “3.6.18 Fuel Pump Control Module J538 / Fuel Delivery Unit GX1 , Checking”, page 493
- ⇒ “3.6.19 Fuel Tank Leak Detection Control Module J909 / Fuel Tank Pressure Sensor G400 , Checking”, page 496
- ⇒ “3.6.20 Ignition Coils with Power Output Stage , Checking”, page 499
- ⇒ “3.6.21 Intake Manifold Runner Control Valve N316 , Checking”, page 501
- ⇒ “3.6.22 Intake Manifold Runner Position Sensor G336 , Checking”, page 503
- ⇒ “3.6.23 Intake Manifold Sensor GX9 , Checking”, page 505
- ⇒ “3.6.24 Knock Sensor 1 G61 , Checking”, page 507
- ⇒ “3.6.25 Motronic Engine Control Module Power Supply Relay J271 , Checking”, page 509
- ⇒ “3.6.26 Outside Air Temperature Sensor G17 , Checking”, page 511

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- ⇒ “3.6.27 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 513
- ⇒ “3.6.28 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 516
- ⇒ “3.6.29 Secondary Air Injection Pump Motor V101 / Secondary Air Injection Pump Relay J299 , Checking”, page 519
- ⇒ “3.6.30 Secondary Air Injection Sensor 1 G609 / Secondary Air Injection Solenoid Valve N112 , Checking”, page 521
- ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 524
- ⇒ “3.6.32 Turbocharger Recirculation Valve N249 , Checking”, page 527
- ⇒ “3.6.33 Vehicle Speed Signal, Checking”, page 529

3.6.1 Accelerator Pedal Module - GX2- , Checking

General Description

The Accelerator Pedal Position Sensor - G79- and Accelerator Pedal Position Sensor 2 - G185- are combined in one component and integrated into the Accelerator Pedal Module - GX2- . They are used to detect the position of the accelerator pedal throughout the entire adjustment range. The Engine Control Module - J623- detects the driver’s request from these signals and uses them to calculate the injection quantity and EPC Throttle valve operation.

The Accelerator Pedal Module - GX2- contains the following components:

- Accelerator Pedal Position Sensor - G79-
- Accelerator Pedal Position Sensor 2 - G185-

The Accelerator Pedal Module - GX2- components cannot be serviced separately, and must be serviced as a unit.

Special tools and workshop equipment required

- Multimeter.
- Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

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Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 458 . – NO: ◆ GATHER more information from customer about the complaint.
2	• CONNECT: Scan Tool. • IGNITION: ON. • CHECK: Throttle valve position closed. • SPECIFIED VALUE: 3 – 25%. • DEPRESS: Accelerator pedal slowly to WOT while observing the percentage display. The percentage display must increase uniformly. • CHECK: Throttle valve position at WOT. • SPECIFIED VALUE: 84 – 99%. • IGNITION: OFF. – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 458 . – NO: ◆ GO TO: Step 4 ⇒ page 458 .
3	• Condition may be intermittent. • PERFORM: Visual Inspection of wiring and component. • CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. • REPAIR: Faulty wiring or connector.	◆ GO TO: Step 7 ⇒ page 459 .
4	• DISCONNECT: Accelerator Pedal Module - GX2- harness connector. • IGNITION: ON. • CHECK: Accelerator Pedal Module - GX2- harness connector terminals 2 to 3 and 1 to 5 for voltage. • SPECIFIED VALUE: About 5.0 V. • IGNITION: OFF. – Were Values obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 458 . – NO: ◆ GO TO: Step 6 ⇒ page 459 .
5	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Accelerator Pedal Module - GX2- harness connector terminal 4 to the Engine Control Module - J623- harness connector T91 / 52 for resistance. • CHECK: Accelerator Pedal Module - GX2- harness connector terminal 6 to the Engine Control Module - J623- harness connector T91 / 69 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 7 ⇒ page 459 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 459 .

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Step	Procedure	Result / Action to Take
6	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Accelerator Pedal Module - GX2- harness connector terminal 1 to the Engine Control Module - J623- harness connector T91 / 16 for resistance. • CHECK: Accelerator Pedal Module - GX2- harness connector terminal 2 to the Engine Control Module - J623- harness connector T91 / 33 for resistance. • CHECK: Accelerator Pedal Module - GX2- harness connector terminal 3 to the Engine Control Module - J623- harness connector T91 / 34 for resistance. • CHECK: Accelerator Pedal Module - GX2- harness connector terminal 5 to the Engine Control Module - J623- harness connector T91 / 51 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 7 ⇒ page 459 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 459 .
7	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ◆ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ◆ REPAIR: As necessary. ◆ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ◆ Return vehicle to Customer. ◆ If all electrical connections are OK: ◆ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ◆ Return vehicle to Customer. – NO: ◆ Perform the diagnostic procedure for any DTC's. ◆ If no DTC's return the repair is complete. ◆ Return vehicle to customer.

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3.6.2 Cam Adjustment Actuators , Checking

◆ Includes:

◆ Cylinder 1 Exhaust Camshaft Adjuster A - N580-

◆ Cylinder 1 Exhaust Camshaft B - N581-

- Cylinder 2 Exhaust Camshaft Adjuster A - N588-
- Cylinder 2 Exhaust Camshaft B - N589-
- Cylinder 3 Exhaust Camshaft Adjuster A - N596-
- Cylinder 3 Exhaust Camshaft B - N597-
- Cylinder 4 Exhaust Camshaft Adjuster A - N604-
- Cylinder 4 Exhaust Camshaft B - N605-

General Description

The Cam Adjustment Actuators are electromagnetic solenoid-type actuators. Two actuators are used per cylinder. One actuator moves the cam element on the camshaft for large valve lift. The other actuator resets the cam element for small valve lift. Each actuator is attached externally to the cylinder head cover by a bolt. They are sealed with O rings. When the actuator is activated by the Engine Control Module - J623- , a metal pin engages the displacement groove in the cam element, thereby moving the other cam lobe into position.

Special tools and workshop equipment required

- Multimeter.
- Wiring Diagram.
- Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 461 . – NO: ♦ GATHER more information from customer about the complaint.

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Step	Procedure	Result / Action to Take
2	• IGNITION: OFF. • DISCONNECT: Suspected Cam Adjustment Actuator(s) harness connector. • CHECK: Suspected Cam Adjustment Actuator (s) component connector terminals 1 to 2 for resistance. Refer to appropriate wiring diagram. • SPECIFIED VALUE: 7 – 10 Ω (@ approx. 20° C). – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 461 . – NO: ◆ REPLACE: Cam Adjustment Actuator(s) . Refer to appropriate repair manual. ◆ GO TO: Step 5 ⇒ page 462 .
3	• IGNITION: ON. • CHECK: Suspected Cam Adjustment Actuator (s) harness connector terminal 2 to ground for voltage. Refer to appropriate wiring diagram. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 461 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 462 .
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Suspected Cam Adjustment Actuator (s) harness connector terminal 1 to the Engine Control Module - J623- harness connector for resistance. Refer to appropriate wiring diagram. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 462 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 462 .

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Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.3 Camshaft Adjustment Valve 1 - N205- , Checking

General Description

The camshaft's task is to operate the valves at the right time and in the right order to control the charge cycle. Camshaft adjustment using the Camshaft Adjustment Valve 1 - N205- varies the opening times of the valves to suit all operating conditions. This ensures ideal charge cycles within a wide range of engine speeds and loads. Fuel consumption and pollutant emissions are reduced, torque and smoothness increased. In engines with a double overhead camshaft the size and positioning of the valve opening overlap can be influenced, enhancing characteristics in full-load and part-load operation. In continuous camshaft adjustment, the adjustment is infinitely variable within specific parameters.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.

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- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 463 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Camshaft Adjustment Valve 1 - N205- harness connector. • CHECK: Camshaft Adjustment Valve 1 - N205- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 5 to 20 Ω (at approx. 20° C). – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 463 . – NO: ◆ REPLACE: Camshaft Adjustment Valve 1 - N205- . Refer to appropriate repair manual. ◆ GO TO: Step 5 ⇒ page 464 .
3	• IGNITION: ON. • CHECK: Camshaft Adjustment Valve 1 - N205- harness connector terminal 1 to ground for voltage. • SPECIFIED VALUE: Battery voltage. • IGNITION: OFF. – Was Value obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 463 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 464 .
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Camshaft Adjustment Valve 1 - N205- harness connector terminal 2 to the Engine Control Module - J623- harness connector T105 / 105 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 464 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 464 .

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Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

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3.6.4 Camshaft Position Sensor 3 - G300- , Checking

General Description

Camshaft position sensors are located at each camshaft for control and monitoring of the camshaft adjusters. For exact determination of the camshaft adjustment, the basic settings (retard position) of the four camshafts are learned by the control modules (adaptation). During adaptation, the Camshaft solenoid valves are de-energized. The camshafts are moved to retard position (basic setting) both by the setting of the solenoid valves and the direction of pull exerted by the chain. The position of the camshaft position sensor signals relative to the engine speed sensor reference mark (actual values), is stored as basic position and compared to the specified values.

This provides the basic values for camshaft timing control. A distinction is made between basic and fine adaptation. Basic adaptation is always implemented after the ECM is de-energized (no Terminal 30) or erasing of DTCs. After starting the engine, the camshafts briefly remains in the basic position until the exact position of the camshafts with respect to the crankshaft has been established. If the camshafts are already in basic position (valves de-energized) and the coolant temperature is greater than 185° F (85° C), and assuming basic adaptation has been implemented, fine adaptation is always performed briefly several times (for approximately one second) after starting the engine. Adaptation of the inlet camshafts takes place at idle or in the near idle range. Adaptation of the exhaust camshafts takes place in the engine speed range between 1,200 and 2,000 RPM and at low engine

load. The camshaft timing control function is disabled if adaptation is not performed successfully.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Man. Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 465 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Camshaft Position Sensor 3 - G300- harness connector. • IGNITION: ON. • CHECK: Camshaft Position Sensor 3 - G300- harness connector terminals 1 to 3 for voltage. • SPECIFIED VALUE: About 5.0 V. • IGNITION: OFF. – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 465 . – NO: ♦ GO TO: Step 4 ⇒ page 466 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Camshaft Position Sensor 3 - G300- harness connector terminal 2 to the Engine Control Module - J623- harness connector T105 / 28 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ♦ GO TO: Step 5 ⇒ page 466 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 466 .

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Step	Procedure	Result / Action to Take
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Camshaft Position Sensor 3 - G300- harness connector terminal 1 to the Engine Control Module - J623- harness connector T105 / 48 for resistance. • CHECK: Camshaft Position Sensor 3 - G300- harness connector terminal 3 to the Engine Control Module - J623- harness connector T105 / 29 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ GO TO: Step 5 ⇒ page 466 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 466 .
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.5 Camshaft Position Sensor - G40- , Checking

General Description

Using the signal from the Camshaft Position Sensor - G40- , the precise position of the camshaft relative to the crankshaft is determined very quickly when the engine is started. Used in combination with the signal from the Engine Speed Sensor - G28- , the signal from the Camshaft Position Sensor - G40- allows to detect which cylinder is at TDC. The fuel can be injected into the corresponding cylinder and ignited.

Special tools and workshop equipment required

♦ Multimeter.

- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Man. Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒“3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 467 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Camshaft Position Sensor - G40- harness connector. • IGNITION: ON. • CHECK: Camshaft Position Sensor - G40- harness connector terminals 1 to 3 for voltage. • SPECIFIED VALUE: About 5.0 V. • IGNITION: OFF. – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 467 . – NO: ♦ GO TO: Step 4 ⇒ page 468 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Camshaft Position Sensor - G40- harness connector terminal 2 to the Engine Control Module - J623- harness connector terminals T105 / 30 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω) – Was Value obtained?	– YES: ♦ GO TO: Step 5 ⇒ page 468 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 468 .

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Step	Procedure	Result / Action to Take
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Camshaft Position Sensor - G40- harness connector terminal 1 to the Engine Control Module - J623- harness connector T105 / 35 for resistance. • CHECK: Camshaft Position Sensor - G40- harness connector terminal 3 to the Engine Control Module - J623- harness connector T105 / 47 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ GO TO: Step 5 ⇒ page 468 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 468 .
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.6 Charge Air Pressure Sensor - G31- , Checking

General Description

The Charge Air Pressure Sensor - G31- is located in the inlet to the intake manifold. The Engine Control Module - J623- uses the sensor signal to regulate the turbo boost. There is no substitute function in the event of signal failure. Charge air pressure regulation is shut off, leading to a significant reduction in engine output.

Special tools and workshop equipment required

♦ Multimeter.

♦ Wiring Diagram.

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◆ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Man. Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 469 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Charge Air Pressure Sensor - G31- harness connector. • IGNITION: ON. • CHECK: Charge Air Pressure Sensor - G31- harness connector terminals 1 to 3 for voltage. • SPECIFIED VALUE: About 5.0 V. • IGNITION: OFF. – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 469 . – NO: ◆ GO TO: Step 4 ⇒ page 470 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Charge Air Pressure Sensor - G31- harness connector terminal 2 to the Engine Control Module - J623- harness connector T91 / 54 for resistance. • CHECK: Charge Air Pressure Sensor - G31- harness connector terminal 4 to the Engine Control Module - J623- harness connector T91 / 55 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 470 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 470 .

Step	Procedure	Result / Action to Take
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Charge Air Pressure Sensor - G31- harness connector terminal 1 to the Engine Control Module - J623- harness connector T91 / 35 for resistance. • CHECK: Charge Air Pressure Sensor - G31- harness connector terminal 3 to the Engine Control Module - J623- harness connector T91 / 32 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ GO TO: Step 5 ⇒ page 470 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 470 .
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

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3.6.7 Charge Pressure Actuator - V465- / Charge Pressure Actuator Position Sensor - G581- , Checking

General Description

The Engine Control Module - J623- computes the nominal charge pressure from the requested torque. If the actual charge pressure deviates from the nominal charge pressure, the wastegate* is opened further by the Charge Pressure Actuator - V465- (charge pressure decreases) or closed further (charge pressure increases). The rapid response of the Charge Pressure Actuator - V465- ensures that the wastegate opens quickly in overrun mode, thereby reducing the pumping effort of the turbocharger. The wastegate is closed in the start position. The Charge Pressure Actuator - V465- is activated by the PWM signal, and the Charge

Pressure Actuator Position Sensor - G581- provides position feedback.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Man. Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 471 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Charge Pressure Actuator - V465- / Charge Pressure Actuator Position Sensor - G581- harness connector. • CHECK: Charge Pressure Actuator - V465- / Charge Pressure Actuator Position Sensor - G581- component connector terminals 2 to 6 for resistance. • SPECIFIED VALUE: 2.4 – 4.6 Ω (@ approx. 20° C). – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 471 . – NO: ♦ REPLACE: Charge Pressure Actuator - V465- / Charge Pressure Actuator Position Sensor - G581- . Refer to appropriate repair manual. ♦ GO TO: Step 6 ⇒ page 473 .
3	• IGNITION: ON. • CHECK: Charge Pressure Actuator - V465- / Charge Pressure Actuator Position Sensor - G581- harness connector terminals 1 to 3 for voltage. • SPECIFIED VALUE: About 5.0 V. • IGNITION: OFF. – Was Value obtained?	– YES: ♦ GO TO: Step 5 ⇒ page 472 . – NO: ♦ GO TO: Step 4 ⇒ page 472 .

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Step	Procedure	Result / Action to Take
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Charge Pressure Actuator - V465- / Charge Pressure Actuator Position Sensor - G581- harness connector terminal 1 to the Engine Control Module - J623- harness connector T105 / 35 for resistance. • CHECK: Charge Pressure Actuator - V465- / Charge Pressure Actuator Position Sensor - G581- harness connector terminal 3 to the Engine Control Module - J623- harness connector T105 / 33 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ GO TO: Step 6 ⇒ page 473 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 6 ⇒ page 473 .
5	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Charge Pressure Actuator - V465- / Charge Pressure Actuator Position Sensor - G581- harness connector terminal 2 to the Engine Control Module - J623- harness connector T105 / 88 for resistance. • CHECK: Charge Pressure Actuator - V465- / Charge Pressure Actuator Position Sensor - G581- harness connector terminal 5 to the Engine Control Module - J623- harness connector T105 / 41 for resistance. • CHECK: Charge Pressure Actuator - V465- / Charge Pressure Actuator Position Sensor - G581- harness connector terminal 6 to the Engine Control Module - J623- harness connector T105 / 89 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ GO TO: Step 6 ⇒ page 473 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 6 ⇒ page 473 .

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Step	Procedure	Result / Action to Take
6	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

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3.6.8 Engine Component Power Supply Relay - J757- , Checking

General Description

The following procedure is used to diagnose the Engine Component Power Supply Relay - J757- and the power supply voltage that is provided to the Ignition Coils .

Special tools and workshop equipment required

♦ Multimeter.

♦ Wiring Diagram.

♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Man. Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions: ⇒ "1.1 Safety Precautions", page 2 .

- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 474 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Engine Component Power Supply Relay - J757- from the fuse box in the engine compartment. • CHECK: Engine Component Power Supply Relay - J757- harness connector terminal 111 and 113 to ground for voltage. • SPECIFIED VALUE: Battery voltage. • IGNITION: OFF. – Were Values obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 474 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 475 .
3	• CONNECT: Jumper wire, Engine Component Power Supply Relay - J757- socket terminals 113 and 115. • DISCONNECT: Ignition Coil 1, 2, 3, 4 With Power Output Stage - N70, N127, N291, N292- harness connectors. • CHECK: Ignition Coil 1, 2, 3, 4 With Power Output Stage - N70, N127, N291, N292- harness connector terminal 4 to ground for voltage. • SPECIFIED VALUE: Battery voltage. – Were Values obtained?	– YES: ♦ GO TO: Step 4 ⇒ page 474 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 475 .
4	• REMOVE: Jumper wire, Engine Component Power Supply Relay - J757- socket terminals 113 and 115. • REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Engine Component Power Supply Relay - J757- harness connector terminal 112 to the Engine Control Module - J623- harness connector T91 / 8 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ♦ GO TO: Step 5 ⇒ page 475 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 475 .

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Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.9 Engine Coolant Temperature Sensor - G62- , Checking

General Description

The Engine Coolant Temperature Sensor - G62- sends information about the current coolant temperature to the Engine Control Module - J623- . It uses the coolant temperature as a correction value for calculating the injection quantity.

Special tools and workshop equipment required

♦ Multimeter.

♦ Wiring Diagram.

♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Manual Transmission, ensure Gear Shift Lever position is in "N" with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.

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- Observe all safety precautions:
⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 476 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Engine Coolant Temperature Sensor - G62- harness connector. • CHECK: Engine Coolant Temperature Sensor - G62- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 2,250 Ω (+/- 750 Ω @ approx. 20° C). – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 476 . – NO: ♦ REPLACE: Engine Coolant Temperature Sensor - G62- . Refer to appropriate repair manual. ♦ GO TO: Step 4 ⇒ page 477 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Engine Coolant Temperature Sensor - G62- harness connector terminal 1 to the Engine Control Module - J623- harness connector T105 / 47 for resistance. • CHECK: Engine Coolant Temperature Sensor - G62- harness connector terminal 2 to the Engine Control Module - J623- harness connector T105 / 40 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ GO TO: Step 4 ⇒ page 477 . – NO: ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 4 ⇒ page 477 .

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Step	Procedure	Result / Action to Take
4	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.10 Engine Coolant Temperature Sensor On Radiator Outlet - G83- , Checking

General Description

The Engine Coolant Temperature Sensor On Radiator Outlet - G83- sends information about the current coolant temperature to the Engine Control Module - J623- . It uses the coolant temperature as a correction value for calculating the injection quantity.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Man. Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.

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- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 478 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Engine Coolant Temperature Sensor On Radiator Outlet - G83- harness connector. • CHECK: Engine Coolant Temperature Sensor On Radiator Outlet - G83- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 2,250 Ω (+/- 750 Ω @ approx. 20° C). – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 478 . – NO: ♦ REPLACE: Engine Coolant Temperature Sensor On Radiator Outlet - G83- . Refer to appropriate repair manual. ♦ GO TO: Step 4 ⇒ page 479 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Engine Coolant Temperature Sensor On Radiator Outlet - G83- harness connector terminal 1 to the Engine Control Module - J623- harness connector T91 / 49 for resistance. • CHECK: Engine Coolant Temperature Sensor On Radiator Outlet - G83- harness connector terminal 2 to the Engine Control Module - J623- harness connector T91/ 29 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ GO TO: Step 4 ⇒ page 479 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 4 ⇒ page 479 .

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Step	Procedure	Result / Action to Take
4	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.11 Engine Speed Sensor - G28- , Checking

General Description

The Engine Speed Sensor - G28- detects rpm and reference marks from a toothed wheel on the crankshaft. Without an engine speed signal, the engine will not start. If the engine speed signal fails while the engine is running, the engine will stop immediately.

Special tools and workshop equipment required

♦ Multimeter.

♦ Wiring Diagram.

♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Man. Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions: ⇒ "1.1 Safety Precautions", page 2 .

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- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 480 . – NO: ♦ GATHER more information from customer about the complaint.
2	• CONNECT: Scan Tool. • START or CRANK: Engine. • CHECK: Engine rpm. • SPECIFIED VALUE: Cranking or Idle rpm. • IGNITION: OFF. – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 480 . – NO: ♦ GO TO: Step 4 ⇒ page 480 .
3	• CONDITION: May be intermittent. • PERFORM: Visual Inspection of wiring and component. • CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. • REPAIR: Faulty wiring or connector.	♦ GO TO: Step 7 ⇒ page 481 .
4	• DISCONNECT: Engine Speed Sensor - G28- harness connector. • IGNITION: ON. • CHECK: Engine Speed Sensor - G28- wiring connector terminals 1 to 3 for voltage. • SPECIFIED VALUE: About 5.0 V. • IGNITION: OFF. – Was Value obtained?	– YES: ♦ GO TO: Step 5 ⇒ page 480 . – NO: ♦ GO TO: Step 6 ⇒ page 481 .
5	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Engine Speed Sensor - G28- harness connector terminal 2 to the Engine Control Module - J623- harness connector T105 / 70 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ♦ REMOVE: Engine Speed Sensor - G28- . Refer to appropriate repair manual. ♦ CHECK: Engine Speed Sensor - G28- wheel for proper seating, damage and/or run - out. Refer to appropriate repair manual. ♦ Sensor wheel OK ♦ REPLACE: Engine Speed Sensor - G28- . Refer to appropriate repair manual. ♦ GO TO: Step 7 ⇒ page 481 . – NO: ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 7 ⇒ page 481 .

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Step	Procedure	Result / Action to Take
6	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Engine Speed Sensor - G28- harness connector terminal 1 to the Engine Control Module - J623- harness connector T105 / 35 for resistance. • CHECK: Engine Speed Sensor - G28- harness connector terminal 3 to the Engine Control Module - J623- harness connector T105 / 33 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ GO TO: Step 7 ⇒ page 481 . – NO: ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 7 ⇒ page 481 .
7	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.12 Engine Temperature Control Actuator - N493- , Checking

General Description

Coolant flow is regulated by means of two mechanically coupled rotary slide valves. The angular position of the rotary slide valves is regulated according to various engine maps stored in the engine control unit. Various switching positions can be implemented by configuring the rotary slide valves accordingly. This allows rapid heating of the engine, which, in turn, results in lower friction and higher fuel economy.

Special tools and workshop equipment required

♦ Multimeter.

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- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Man. Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 482 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Engine Temperature Control Actuator - N493- harness connector. • CHECK: Engine Temperature Control Actuator - N493- component connector terminals 4 to 5 for resistance. • SPECIFIED VALUE: 2.4 – 4.6 Ω (@ approx. 20° C). – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 482 . – NO: ♦ REPLACE: Engine Temperature Control Actuator - N493- . Refer to appropriate repair manual. ♦ GO TO: Step 6 ⇒ page 483 .
3	• IGNITION: ON. • CHECK: Engine Temperature Control Actuator - N493- harness connector terminals 1 to 3 for voltage. • SPECIFIED VALUE: About 5.0 V. • IGNITION: OFF. – Was Value obtained?	– YES: ♦ GO TO: Step 5 ⇒ page 483 . – NO: ♦ GO TO: Step 4 ⇒ page 483 .

Step	Procedure	Result / Action to Take
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Engine Temperature Control Actuator - N493- harness connector terminal 1 to the Engine Control Module - J623- harness connector T105 / 33 for resistance. • CHECK: Engine Temperature Control Actuator - N493- harness connector terminal 3 to the Engine Control Module - J623- harness connector T105 / 35 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 6 ⇒ page 483 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 6 ⇒ page 483 .
5	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Engine Temperature Control Actuator - N493- harness connector terminal 2 to the Engine Control Module - J623- harness connector T105 / 80 for resistance. • CHECK: Engine Temperature Control Actuator - N493- harness connector terminal 4 to the Engine Control Module - J623- harness connector T105 / 86 for resistance. • CHECK: Engine Temperature Control Actuator - N493- harness connector terminal 5 to the Engine Control Module - J623- harness connector T105 / 87 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 6 ⇒ page 483 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 6 ⇒ page 483 .
6	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ◆ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ◆ REPAIR: As necessary. ◆ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ◆ Return vehicle to Customer. ◆ If all electrical connections are OK: ◆ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ◆ Return vehicle to Customer. – NO: ◆ Perform the diagnostic procedure for any DTC's. ◆ If no DTC's return the repair is complete. ◆ Return vehicle to customer.

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3.6.13 EVAP Canister Purge Regulator Valve 1 - N80- , Checking

General Description

EVAP system is designed so that the admission of fuel vapors takes place only at idle and at light part-throttle. EVAP Canister Purge Regulator Valve 1 - N80- is map-activated by the Engine Control Module (ECM) - J623- to accomplish this task.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 484 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: EVAP Canister Purge Regulator Valve 1 - N80- harness connector. • CHECK: EVAP Canister Purge Regulator Valve 1 - N80- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 10 – 35 Ω (@ approx. 20° C). – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 485 . – NO: ♦ REPLACE: EVAP Canister Purge Regulator Valve 1 - N80- . Refer to appropriate repair manual. ♦ GO TO: Step 5 ⇒ page 485 .

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Step	Procedure	Result / Action to Take
3	• IGNITION: ON. • CHECK: EVAP Canister Purge Regulator Valve 1 - N80- harness connector terminal 1 to ground for voltage. • SPECIFIED VALUE: Battery voltage. • IGNITION: OFF. – Was Value obtained?	– YES: ♦ GO TO: Step 4 ⇒ page 485 . – NO: ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ REPLACE: Any open fuses. ♦ GO TO: Step 5 ⇒ page 485 .
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: EVAP Canister Purge Regulator Valve 1 - N80- harness connector terminal 2 to the Engine Control Module - J623- harness connector T105 / 3 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ♦ GO TO: Step 5 ⇒ page 485 . – NO: ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 485 .
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

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3.6.14 Exhaust Camshaft Adjustment Valve 1 - N318- , Checking

General Description

By adjusting the camshafts, power and torque can be increased, fuel consumption can be improved and emissions reduced, depending on the load characteristics of the engine. To adjust the

camshafts, the Engine Control Module (ECM) - J623- actuates Exhaust Camshaft Adjustment Valve 1 - N318- . Camshaft adjusters are adjusted by actuator solenoids with the assistance of the engine oil pressure. Adjusting both camshafts enables a maximum valve overlap of 42° CRK. The valve overlap allows for internal exhaust gas recirculation.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 486 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Exhaust Camshaft Adjustment Valve 1 - N318- harness connector. • CHECK: Exhaust Camshaft Adjustment Valve 1 - N318- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 5 – 30 Ω (@ approx. 20° C). – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 487 . – NO: ♦ REPLACE: Exhaust Camshaft Adjustment Valve 1 - N318- . Refer to appropriate repair manual. ♦ GO TO: Step 5 ⇒ page 487 .

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Step	Procedure	Result / Action to Take
3	• IGNITION: ON. • CHECK: Exhaust Camshaft Adjustment Valve 1 - N318- harness connector terminal 1 to ground for voltage. • SPECIFIED VALUE: Battery voltage. • IGNITION: OFF. – Was Value obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 487 . – NO: ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ REPLACE: Any open fuses. ◆ GO TO: Step 5 ⇒ page 487 .
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Exhaust Camshaft Adjustment Valve 1 - N318- harness connector terminal 2 to the Engine Control Module - J623- harness connector terminals T105 / 104 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 487 . – NO: ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 487 .
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ◆ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ◆ REPAIR: As necessary. ◆ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ◆ Return vehicle to Customer. ◆ If all electrical connections are OK: ◆ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ◆ Return vehicle to Customer. – NO: ◆ Perform the diagnostic procedure for any DTC's. ◆ If no DTC's return the repair is complete. ◆ Return vehicle to customer.

3.6.15 Fuel Injectors , Checking

General Description

The Cylinder Fuel Injectors are controlled by the Engine Control Module - J623- and mounted normal in the cylinder head. The fuel injectors spray high-pressure atomized fuel directly into the combustion chamber.

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Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Man. Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 488 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Suspect Fuel Injector from harness connector. • CHECK: Suspect Fuel Injector component connector terminals 1 to 2 for resistance (refer to the wiring diagram for proper terminal locations). • SPECIFIED VALUE: 0.5 – 15 Ω (@ approx. 20° C). – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 488 . – NO: ♦ REPLACE: Suspect Fuel Injector (s). Refer to appropriate repair manual. ♦ GO TO: Step 4 ⇒ page 489 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Suspect Fuel Injector harness connector terminal 1 to the Engine Control Module - J623- harness connector T105 / xx for resistance (refer to the wiring diagram for proper terminal locations). • CHECK: Suspect Fuel Injector harness connector terminal 2 to the Engine Control Module - J623- harness connector T105 / xx for resistance (refer to the wiring diagram for proper terminal locations). • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ♦ GO TO: Step 4 ⇒ page 489 . – NO: ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 4 ⇒ page 489 .

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Step	Procedure	Result / Action to Take
4	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.16 Fuel Pressure Regulator Valve - N276- , Checking

General Description

The Engine Control Module - J623- regulates the Fuel Pressure Regulator Valve - N276- directly at the High Pressure Fuel Pump to control the low pressure valve inside the High Pressure Fuel Pump.

Special tools and workshop equipment required

♦ Multimeter.

♦ Wiring Diagram.

♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Man. Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.

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- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 490 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Fuel Pressure Regulator Valve - N276- harness connector. • CHECK: Fuel Pressure Regulator Valve - N276- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 0.5 – 12 Ω (@ approx. 20° C). – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 490 . – NO: ◆ REPLACE: Fuel Pressure Regulator Valve - N276- . Refer to appropriate repair manual. ◆ GO TO: Step 4 ⇒ page 491 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Fuel Pressure Regulator Valve - N276- harness connector terminal 1 to the Engine Control Module - J623- harness connector T105 / 93 for resistance. • CHECK: Fuel Pressure Regulator Valve - N276- harness connector terminal 2 to the Engine Control Module - J623- harness connector T105 / 92 for resistance. • SPECIFIED VALUE: 0.5 to 11 Ω (± 0.5 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 491 . – NO: ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 4 ⇒ page 491 .

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Step	Procedure	Result / Action to Take
4	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.17 Fuel Pressure Sensor - G247- , Checking

General Description

The Fuel Pressure Sensor - G247- measures the fuel pressure in the high-pressure fuel system. The Engine Control Module - J623- analyzes the signal and regulates the fuel high pressure through the Fuel Pressure Regulator Valve - N276- in the high-pressure pump.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Man. Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.

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- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 492 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Fuel Pressure Sensor - G247- harness connector. • IGNITION: ON. • CHECK: Fuel Pressure Sensor - G247- harness connector terminals 1 to 3 for voltage. • SPECIFIED VALUE: About 5.0 V. • IGNITION: OFF. – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 492 . – NO: ◆ GO TO: Step 4 ⇒ page 492 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Fuel Pressure Sensor - G247- harness connector terminal 2 to the Engine Control Module - J623- harness connector T105 / 49 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 493 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 493 .
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Fuel Pressure Sensor - G247- harness connector terminal 1 to the Engine Control Module - J623- harness connector T105 / 33 for resistance. • CHECK: Fuel Pressure Sensor - G247- harness connector terminal 3 to the Engine Control Module - J623- harness connector T105 / 35 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 493 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 493 .

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Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC’s. Refer to ⇒ “3.3.4 Diagnostic Mode 04 - Erase DTC Memory”, page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ “3.2 Readiness Codes”, page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ “3.2 Readiness Codes”, page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC’s. ♦ If no DTC’s return the repair is complete. ♦ Return vehicle to customer.

3.6.18 Fuel Pump Control Module - J538- / Fuel Delivery Unit - GX1- , Checking

General Description

The Engine Control Module - J623- tells the Fuel Pump Control Module - J538- the demand needed for fuel volume and pressure and activates the Fuel Delivery Unit - GX1- . The Fuel Delivery Unit - GX1- transfers fuel to the rest of the fuel system, where it is monitored by the Engine Control Module - J623- through sensors, and controlled through regulators and/or metering valves.

Special tools and workshop equipment required

♦ Multimeter.

♦ Wiring Diagram.

♦ Scan Tool.

Test requirements

• Fuses OK.

• Battery voltage OK.

• Switch OFF all electrical and electronic accessories.

• Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.

• Vehicles with Man. Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.

• Coolant Temperature: ≥ 80° C.

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- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Note

When the door is opened or the Ignition is turned to the ON position the fuel pump is activated for 2 seconds to build up the pressure in the fuel system.

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 494 . ◆ NO: ◆ GATHER more Information from customer about the complaint.
2	• IGNITION: ON. • LISTEN: Fuel Delivery Unit - GX1- Should be heard running for 2 s. • SPECIFIED VALUE: Transfer Fuel Pump ON for 2 s. • IGNITION: OFF. – Was Value obtained?	– YES: ◆ Condition may be intermittent. ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 496 . ◆ NO: ◆ GO TO: Step 3 ⇒ page 494 .
3	• IGNITION: OFF. • DISCONNECT: Fuel Pump Control Module. - J538- • IGNITION: ON. • CHECK: Fuel Pump Control Module - J538- harness connector terminals 3 to 4 for voltage. • CHECK: Fuel Pump Control Module - J538- harness connector terminal 4 to battery voltage for voltage. • CHECK: Fuel Pump Control Module - J538- harness connector terminal 3 to ground for voltage. • SPECIFIED VALUE: Battery voltage. • IGNITION: OFF. – Were Values obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 495 . ◆ NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 496 .

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Step	Procedure	Result / Action to Take
4	• RECONNECT: Fuel Pump Control Module - J538- . • DISCONNECT: Fuel Delivery Unit - GX1- . • CRANK: Engine. • CHECK: Fuel Delivery Unit - GX1- harness connector terminals 1 to 5 for voltage while engine is cranking. • IGNITION: OFF. • SPECIFIED VALUE: 7 – 11 V. – Was Value obtained?	– YES: ◆ REPLACE: Fuel Delivery Unit - GX1- , Refer to appropriate repair manual. ◆ GO TO: Step 7 ⇒ page 496 . ◆ NO: ◆ GO TO: Step 5 ⇒ page 495 .
5	• DISCONNECT: Fuel Pump Control Module - J538- . • CHECK: Fuel Delivery Unit - GX1- harness connector terminal 1 to Fuel Pump Control Module - J538- wiring connector 1 for resistance. • CHECK: Fuel Delivery Unit - GX1- harness connector terminal 5 to Fuel Pump Control Module - J538- wiring connector 2 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were values obtained?	– YES: ◆ GO TO: Step 6 ⇒ page 495 . ◆ NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 496 .
6	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Fuel Pump Control Module - J538- harness connector terminal 5 to Engine Control Module - J623- wiring connector terminal T91 / 9 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were values obtained?	– YES: ◆ REPLACE: Fuel Pump Control Module - J538- . Refer to appropriate repair manual. ◆ GO TO: Step 7 ⇒ page 496 . ◆ NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 496 .

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Step	Procedure	Result / Action to Take
7	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.19 Fuel Tank Leak Detection Control Module - J909- / Fuel Tank Pressure Sensor - G400- , Checking

General Description

The system can test the evaporative system integrity by using natural vacuum after the engine is shut off. The Engine Control Module - J623- monitors the ability of the system to maintain vacuum through signals sent from the Fuel Tank Pressure Sensor - G400- / Fuel Tank Leak Detection Control Module - J909- . If the vacuum remains for a specified period of time, then there are no evaporative leaks, and a PASS is reported by the Engine Control Module - J623- . If there is a leak, the system either will not achieve a vacuum, or a vacuum cannot be maintained. Usually a fault can only be detected after a cold start.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.

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- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Man. Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 497 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • REMOVE: Evaporative Canister. Refer to appropriate repair manual. • Plug or Cap off the Fuel Tank Pressure Sensor - G400- hose going to the vent filter. • CONNECT: Hand vacuum pump to the Fuel Tank Pressure Sensor - G400- and apply 0.700 bar and see if the vacuum holds. – Did the vacuum hold?	– YES: ◆ GO TO: Step 3 ⇒ page 497 . – NO: ◆ REPLACE: Fuel Tank Pressure Sensor - G400- . Refer to appropriate repair manual. ◆ GO TO: Step 5 ⇒ page 498 .
3	• DISCONNECT: Fuel Tank Leak Detection Control Module - J909 - harness connector. • IGNITION: ON. • CHECK: Fuel Tank Leak Detection Control Module - J909 - harness connector terminal 4 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 498 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 498 .

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Step	Procedure	Result / Action to Take
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • DISCONNECT: Fuel Tank Pressure Sensor - G400- . Refer to appropriate repair manual. • CHECK: Fuel Tank Leak Detection Control Module - J909 - harness connector terminal 2 to the Engine Control Module - J623- harness connector T91 / 38 for resistance. • CHECK: Fuel Tank Leak Detection Control Module - J909 - harness connector terminal 3 to the Engine Control Module - J623- harness connector T91 / 78 for resistance. • CHECK: Fuel Tank Leak Detection Control Module - J909 - harness connector terminal 1 to the Fuel Tank Pressure Sensor - G400- harness connector terminal 1 for resistance. • CHECK: Fuel Tank Leak Detection Control Module - J909 - harness connector terminal 5 to the Fuel Tank Pressure Sensor - G400- harness connector terminal 3 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ REPLACE: Fuel Tank Leak Detection Control Module - J909 - . Refer to appropriate repair manual. ♦ GO TO: Step 5 ⇒ page 498 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 498 .
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

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3.6.20 Ignition Coils with Power Output Stage , Checking

General Description

The ignition coil must transform the relatively low 12 V on-board vehicle voltage to the high ignition voltage required and supply the energy stored in that voltage to the spark plug. The functional principle of the ignition coil is relatively simple. It has a primary winding (small number of turns) and a secondary winding (lots of turns). The turn ratio between the number of primary and secondary winding turns determines the level of the voltage generated at the output. Ignition Coils With Power Output Stage are plugged directly into the spark plug. This means that the ignition energy can be transferred directly to the spark plug with virtually zero power loss.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.
- ♦ LED Test Lamp.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Man. Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 500 . – NO: ♦ GATHER more information from customer about the complaint.

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Step	Procedure	Result / Action to Take
2	• IGNITION: OFF. • DISCONNECT: Suspected Ignition Coil With Power Output Stage harness connector. • IGNITION: ON. • CHECK: Ignition Coil With Power Output Stage harness connector terminal 4 to 1 for voltage. • CHECK: Ignition Coil With Power Output Stage harness connector terminal 4 to 3 for voltage. • SPECIFIED VALUE: Battery voltage. • IGNITION: OFF. – Were Values obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 500 . – NO: ◆ CHECK: Wiring for opens, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ REPLACE: Any open fuses. ◆ GO TO: Step 5 ⇒ page 501 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Suspected Ignition Coil With Power Output Stage harness connector terminal 2 to the Engine Control Module - J623- harness connector terminals (refer to the wiring diagram for proper terminal locations). • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 500 . – NO: ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 501 .
4	• DISABLE: Fuel Injectors . Refer to appropriate electrical schematic for in-line connector locations and/or fuses. • DISCONNECT: Cold Start Injector (if applicable). • CONNECT: LED Test Lamp to suspected Ignition Coil With Power Output Stage harness connector terminals 2 to 3. • CRANK: Engine. • SPECIFIED VALUE: LED Test Lamp should flicker ON & OFF. – Was Value obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 501 . – NO: ◆ GO TO: Step 5 ⇒ page 501 .

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Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

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3.6.21 Intake Manifold Runner Control Valve - N316- , Checking

General Description

The intake manifold runner valve(s) are mounted on a common shaft and actuated by a vacuum cell. The partial vacuum required for actuation is supplied by the Intake Manifold Runner Control Valve - N316- . The Engine Control Module (ECM) - J623- activates the Intake Manifold Runner Control Valve - N316- on the basis of a characteristic map.

Special tools and workshop equipment required

♦ Multimeter.

♦ Wiring Diagram.

♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Man. Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.

- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 502 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Intake Manifold Runner Control Valve - N316- harness connector. • CHECK: Intake Manifold Runner Control Valve - N316- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 5 – 35 Ω (@ approx. 20° C). – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 502 . – NO: ◆ REPLACE: Intake Manifold Runner Control Valve - N316- . Refer to appropriate repair manual. ◆ GO TO: Step 5 ⇒ page 503 .
3	• IGNITION: ON. • CHECK: Intake Manifold Runner Control Valve - N316- harness connector terminal 1 to ground for voltage. • SPECIFIED VALUE: Battery voltage. • IGNITION: OFF. – Was Value obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 502 . – NO: ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ REPLACE: Any open fuses. ◆ GO TO: Step 5 ⇒ page 503 .
4	• REMOVE: Engine Control Module - J623- Refer to appropriate repair manual. • CHECK: Intake Manifold Runner Control Valve - N316- harness connector terminal 2 to the Engine Control Module - J623- harness connector T105 / 53 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 503 . NO: ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 503 .

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Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.22 Intake Manifold Runner Position Sensor - G336- , Checking

General Description

The Engine Control Module - J623- uses the Intake Manifold Runner Position Sensor - G336- signal to calculate a correction value for the charge air pressure. Evaluation of the signal gives consideration to the influence of temperature on the density of the charge air. Failure In the event of signal failure, the Engine Control Module - J623- employs a fixed, substitute value for calculation purposes. This may lead to reduced engine output.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Man. Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.

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- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 504 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Intake Manifold Runner Position Sensor - G336- harness connector. • IGNITION: ON. • CHECK: Intake Manifold Runner Position Sensor - G336- harness connector terminals 1 to 3 for voltage. • SPECIFIED VALUE: About 5.0 V. • IGNITION: OFF. – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 504 . – NO: ◆ GO TO: Step 4 ⇒ page 504 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Intake Manifold Runner Position Sensor - G336- harness connector terminal 2 to the Engine Control Module - J623- harness connector T105 / 36 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 505 . – NO: ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 505 .
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Intake Manifold Runner Position Sensor - G336- harness connector terminal 1 to the Engine Control Module - J623- harness connector T105 / 48 for resistance. • CHECK: Intake Manifold Runner Position Sensor - G336- harness connector terminal 3 to the Engine Control Module - J623- harness connector T105 / 47 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 505 . – NO: ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 505 .

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Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.23 Intake Manifold Sensor - GX9- , Checking

General Description

Air mass and charge pressure are two factors used for engine load management. For this purpose, there are several sensors with absolutely identical functions. They measure the intake air temperature and the intake manifold pressure. The first sender unit is located upstream of the Throttle Valve Control Module - J338- in the Intake Manifold Sensor - GX9- . They measure the pressure and temperature of the air in each individual cylinder bank. The values measured here correspond to the actual air mass in the cylinder bank(s).

Note the Intake Air Temperature Sensor - G42- / Manifold Absolute Pressure Sensor - G71- are also known as the Intake Manifold Sensor - GX9- .

The Intake Manifold Sensor - GX9- contains the following components:

♦ Manifold Absolute Pressure Sensor - G71- .

♦ Intake Air Temperature Sensor 2 - G299- .

The Intake Manifold Sensor - GX9- components cannot be serviced separately, it must be serviced as a unit.

Special tools and workshop equipment required

♦ Multimeter.

♦ Wiring Diagram.

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- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Man. Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18. – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 506 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Intake Manifold Sensor - GX9- harness connector. • IGNITION: ON. • CHECK: Intake Manifold Sensor - GX9- harness connector terminals 1 to 3 for voltage. • SPECIFIED VALUE: About 5.0 V. • IGNITION: OFF. – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 506 . – NO: ♦ GO TO: Step 4 ⇒ page 507 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Intake Manifold Sensor - GX9- harness connector terminal 2 to the Engine Control Module - J623- harness connector T105 / 51 for resistance. • CHECK: Intake Manifold Sensor - GX9- harness connector terminal 4 to the Engine Control Module - J623- harness connector T105 / 52 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω), – Were Values obtained?	– YES: ♦ GO TO: Step 5 ⇒ page 507 . – NO: ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 507 .

Step	Procedure	Result / Action to Take
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Intake Manifold Sensor - GX9- harness connector terminal 1 to the Engine Control Module - J623- harness connector T105 / 33 for resistance. • CHECK: Intake Manifold Sensor - GX9- harness connector terminal 3 to the Engine Control Module - J623- harness connector T105 / 35 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ GO TO: Step 5 ⇒ page 507 . – NO: ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 507 .
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.24 Knock Sensor 1 - G61-, Checking

General Description

The Knock Sensor 1 - G61- is a tuned accelerometer on the engine which converts engine vibration to an electrical signal. The Engine Control Module - J623- uses this signal to determine the presence of engine knock and to retard spark timing.

Special tools and workshop equipment required

- Multimeter.
- Wiring Diagram.
- Scan Tool.

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Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Man. Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 508 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Knock Sensor 1 - G61- harness connector. • CHECK: Knock Sensor 1 - G61- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 2,250 Ω (+/- 750 Ω @ approx. 20° C). – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 508 . – NO: ◆ REPLACE: Knock Sensor 1 - G61- . Refer to appropriate repair manual. ◆ GO TO: Step 4 ⇒ page 509 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Knock Sensor 1 - G61- harness connector terminal 1 to the Engine Control Module - J623- harness connector T105 / 98 for resistance. • CHECK: Knock Sensor 1 - G61- harness connector terminal 2 to the Engine Control Module - J623- harness connector T105 / 97 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 509 . – NO: ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 4 ⇒ page 509 .

Step	Procedure	Result / Action to Take
4	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ◆ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ◆ REPAIR: As necessary. ◆ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ◆ Return vehicle to Customer. ◆ If all electrical connections are OK: ◆ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ◆ Return vehicle to Customer. – NO: ◆ Perform the diagnostic procedure for any DTC's. ◆ If no DTC's return the repair is complete. ◆ Return vehicle to customer.

3.6.25 Motronic Engine Control Module Power Supply Relay - J271- , Checking

General Description

The following procedure is used to diagnose the Motronic Engine Control Module Power Supply Relay - J271- and the Engine Control Module - J623- power supply voltage that is provided by the Motronic Engine Control Module Power Supply Relay - J271- .

Special tools and workshop equipment required

◆ Multimeter.

◆ Wiring Diagram.

◆ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Man. Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.

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- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 510 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Motronic Engine Control Module Power Supply Relay - J271- from the fuse box in the engine compartment. • IGNITION: ON. • CHECK: Motronic Engine Control Module Power Supply Relay - J271- socket terminals 30 and 85 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Were Values obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 510 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 6 ⇒ page 511 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CONNECT: Jumper wire Motronic Engine Control Module Power Supply Relay - J271- socket terminals 30 and 71. • CHECK: Engine Control Module - J623- harness connector T91 / 5 and T91 / 6 to ground for voltage. • SPECIFIED VALUE: Battery voltage. – Were Values obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 510 . – NO: ◆ GO TO: Step 5 ⇒ page 511 .
4	• REMOVE: Jumper wire Motronic Engine Control Module Power Supply Relay - J271- socket terminals 30 and 71. • CHECK: Motronic Engine Control Module Power Supply Relay - J271- socket terminal 86 to the Engine Control Module - J623- harness connector T91 / 7 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ REPLACE: Motronic Engine Control Module Power Supply Relay - J271- . Refer to appropriate repair manual. ◆ GO TO: Step 6 ⇒ page 511 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 6 ⇒ page 511 .

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Step	Procedure	Result / Action to Take
5	• REMOVE: Jumper wire Motronic Engine Control Module Power Supply Relay - J271- socket terminals 30 and 71. • REMOVE: Fuse. Refer to appropriate repair manual. • CHECK: Downstream (output) side of Fuse to Engine Control Module - J623- harness connector T91 / 5 and T91 / 6 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ REPLACE: Fuse Panel B - SB- fuse box. Refer to appropriate repair manual. ♦ GO TO: Step 6 ⇒ page 511 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 6 ⇒ page 511 .
6	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.26 Outside Air Temperature Sensor - G17- , Checking

General Description

The ambient or Outside Air Temperature Sensor - G17- is a negative temperature coefficient (NTC) sensor that informs the semiautomatic / automatic temperature control system of outside air temperature. An NTC sensor's resistance decreases as the temperature increases. The computer uses this input along with different in-car temperature sensors to control temperature and blower speed. When there is a problem with this sensor, performance will suffer and the compressor's clutch may not engage.

Special tools and workshop equipment required

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- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Man. Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 512 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Outside Air Temperature Sensor - G17- harness connector. • CHECK: Outside Air Temperature Sensor - G17- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 1,300 Ω (+/- 500 Ω @ approx. 20° C). – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 512 . – NO: ♦ REPLACE: Outside Air Temperature Sensor - G17- . Refer to appropriate repair manual. ♦ GO TO: Step 4 ⇒ page 513 .
3	• REMOVE: Vehicle Electrical System Control Module - J519- . Refer to appropriate repair manual. • CHECK: Outside Air Temperature Sensor - G17- harness connector terminal 1 to the Vehicle Electrical System Control Module - J519- harness connector T46b / 19 for resistance. • CHECK: Outside Air Temperature Sensor - G17- harness connector terminal 2 to the Vehicle Electrical System Control Module - J519- harness connector T46b / 27 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ REPLACE: Vehicle Electrical System Control Module - J519- . Refer to appropriate repair manual. ♦ GO TO: Step 4 ⇒ page 513 . – NO: ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 4 ⇒ page 513 .

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Step	Procedure	Result / Action to Take
4	• Final Procedure • Perform a road test to verify repair. • Do any DTC's return:	– YES: ♦ Check the DTC memory. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Perform the diagnostic procedure for that DTC. – NO: ♦ Repair is complete. Generate readiness code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer.

3.6.27 Oxygen Sensor 1 After Catalytic Converter - GX7- , Checking

General Description

The Oxygen Sensor 1 After Catalytic Converter - GX7- downstream of the primary catalytic converter supplies the Engine Control Module - J623- with a voltage signal (nonlinear) indicating "rich" or "lean. If the primary catalytic converter is supersaturated with oxygen (lean mixture), Oxygen Sensor 1 After Catalytic Converter - GX7- will send the Engine Control Module - J623- a nonlinear signal indicating the lean mixture condition. The mixture is then enriched with fuel until the oxygen has been "displaced" from the catalytic converter. This condition, in turn, is registered by Oxygen Sensor 1 After Catalytic Converter - GX7- as a nonlinear signal indicating the rich mixture condition. The mixture is then leaned out by the Engine Control Module - J623- . If the nonlinear signal is received again, the mixture will again be enriched. The frequency, or period, during which the mixture is enriched or leaned out is variable, being dependent on the gas flow rate (engine load) at that moment.

Note the Oxygen Sensor 1 After Catalytic Converter - GX7- is also referred to as the Oxygen Sensor After Three Way Catalytic Converter - G130- .

The Oxygen Sensor 1 After Catalytic Converter - GX7- contains the following components:

♦ Oxygen Sensor After Three Way Catalytic Converter - G130-

♦ Heater For Oxygen Sensor 1 After Catalytic Converter - Z29-

The Oxygen Sensor 1 After Catalytic Converter - GX7- components cannot be serviced separately, it must be serviced as a unit.

Special tools and workshop equipment required

♦ Multimeter.

♦ Wiring Diagram.

♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Man. Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.

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- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 514 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Oxygen Sensor 1 After Catalytic Converter - GX7- harness connector. • CHECK: Oxygen Sensor 1 After Catalytic Converter - GX7- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 1 – 5 Ω (@ 25° C). – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 514 . – NO: ◆ REPLACE: Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to appropriate repair manual. ◆ GO TO: Step 8 ⇒ page 515 .
3	• IGNITION: ON • CHECK: Oxygen Sensor 1 After Catalytic Converter - GX7- harness connector terminal 1 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 514 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 8 ⇒ page 515 .
4	• RECONNECT: Oxygen Sensor 1 After Catalytic Converter - GX7- harness connector. • CONNECT: Scan Tool. • START: Engine and let Idle. • Perform the function test located in diagnostic mode 06. Refer to ⇒ “3.3 Diagnostic Modes 01 - 0A”, page 21 . • IGNITION: OFF. • SPECIFIED VALUE: Mode 6 Pass. – Were Values obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 514 . – NO: ◆ GO TO: Step 6 ⇒ page 515 .
5	• FAULT: Is intermittent. • PERFORM: Visual Inspection of wiring and component. • CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. • REPAIR: Faulty wiring or connector.	◆ GO TO: Step 8 ⇒ page 515 .

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Step	Procedure	Result / Action to Take
6	• DISCONNECT: Oxygen Sensor 1 After Catalytic Converter - GX7- harness connector. • IGNITION: ON. • CHECK: Oxygen Sensor 1 After Catalytic Converter - GX7- component connector terminals 3 to 4 for voltage. • IGNITION: OFF. • SPECIFIED VALUE: 0.0 V to 1.0 V. – Was Value obtained?	– YES: ◆ GO TO: Step 7 ⇒ page 515 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 8 ⇒ page 515 .
7	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Oxygen Sensor 1 After Catalytic Converter - GX7- harness connector terminal 2 to the Engine Control Module - J623- harness connector T91 / 11 for resistance. • CHECK: Oxygen Sensor 1 After Catalytic Converter - GX7- harness connector terminal 3 to the Engine Control Module - J623- harness connector T91 / 26 for resistance. • CHECK: Oxygen Sensor 1 After Catalytic Converter - GX7- harness connector terminal 4 to the Engine Control Module - J623- harness connector T91 / 25 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 8 ⇒ page 515 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 8 ⇒ page 515 .
8	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ◆ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ◆ REPAIR: As necessary. ◆ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ◆ Return vehicle to Customer. ◆ If all electrical connections are OK: ◆ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ◆ Return vehicle to Customer. – NO: ◆ Perform the diagnostic procedure for any DTC's. ◆ If no DTC's return the repair is complete. ◆ Return vehicle to customer.

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3.6.28 Oxygen Sensor 1 Before Catalytic Converter - GX10- , Checking

General Description

The Oxygen Sensor 1 Before Catalytic Converter - GX10- does not actually measure oxygen concentration, but rather the difference between the amount of oxygen in the exhaust gas and the amount of oxygen in air. Rich mixture causes an oxygen demand. This demand causes a voltage to build up, due to transportation of oxygen ions through the Oxygen Sensor 1 Before Catalytic Converter - GX10- layer. Lean mixture causes low voltage, since there is an oxygen excess. The Oxygen Sensor 1 Before Catalytic Converter - GX10- and catalytic converters are used in order to reduce exhaust emissions. Information on oxygen concentration is sent to Engine Control Module - J623- , which adjusts the amount of fuel injected into the engine to compensate for excess air or excess fuel. The Engine Control Module - J623- attempts to maintain, on average, a certain air–fuel ratio by interpreting the information it gains from the Oxygen Sensor 1 Before Catalytic Converter - GX10- . The primary goal is a compromise between power, fuel economy, and emissions. The heater for Oxygen Sensor 1 Before Catalytic Converter - GX10- is designed to minimize the time-to-readiness for closed-loop operation by heating the Oxygen Sensor 1 Before Catalytic Converter - GX10- as quickly as possible.

Note the Oxygen Sensor 1 Before Catalytic Converter - GX10- is also referred to as the Heated Oxygen Sensor - G39- .

The Oxygen Sensor 1 Before Catalytic Converter - GX10- contains the following components:

- Oxygen Sensor Heater - Z19-
- Heated Oxygen Sensor - G39-

The Oxygen Sensor 1 Before Catalytic Converter - GX10- components cannot be serviced separately, and must be serviced as a unit.

Special tools and workshop equipment required

- Multimeter.
- Wiring Diagram.
- Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Man. Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

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Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 517 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Oxygen Sensor 1 Before Catalytic Converter - GX10- harness connector. • CHECK: Oxygen Sensor 1 Before Catalytic Converter - GX10- component connector terminals 3 to 4 for resistance. • SPECIFIED VALUE: 2 - 4 Ω (@ 25° C). – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 517 . – NO: ◆ REPLACE: Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to appropriate repair manual. ◆ GO TO: Step 7 ⇒ page 518 .
3	• IGNITION: ON. • CHECK: Oxygen Sensor 1 Before Catalytic Converter - GX10- harness connector terminal 4 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 517 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 518 .
4	• RECONNECT: Oxygen Sensor 1 Before Catalytic Converter - GX10- harness connector. • CONNECT: Scan Tool. • START: Engine and let Idle. • Perform the function test located in diagnostic mode 06. Refer to appropriate Diagnostic Mode 06 - Read Test Results for Specific Diagnostic Functions, ⇒ “3.3 Diagnostic Modes 01 - 0A”, page 21 . • SPECIFIED VALUE: Mode 6 Pass. • IGNITION: OFF. – Were Values obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 517 . – NO: ◆ GO TO: Step 6 ⇒ page 518 .
5	• FAULT: Is intermittent. • PERFORM: Visual Inspection of wiring and component. • CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. • REPAIR: Faulty wiring or connector.	◆ GO TO: Step 7 ⇒ page 518 .

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Step	Procedure	Result / Action to Take
6	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Oxygen Sensor 1 Before Catalytic Converter - GX10- harness connector terminal 1 to the Engine Control Module - J623- harness connector T91 / 43 for resistance. • CHECK: Oxygen Sensor 1 Before Catalytic Converter - GX10- harness connector terminal 2 to the Engine Control Module - J623- harness connector T91 / 44 for resistance. • CHECK: Oxygen Sensor 1 Before Catalytic Converter - GX10- harness connector terminal 3 to the Engine Control Module - J623- harness connector T91 / 74 for resistance. • CHECK: Oxygen Sensor 1 Before Catalytic Converter - GX10- harness connector terminal 5 to the Engine Control Module - J623- harness connector T91 / 41 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 7 ⇒ page 518 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 518 .
7	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ◆ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ◆ REPAIR: As necessary. ◆ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ◆ Return vehicle to Customer. ◆ If all electrical connections are OK: ◆ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ◆ Return vehicle to Customer. – NO: ◆ Perform the diagnostic procedure for any DTC's. ◆ If no DTC's return the repair is complete. ◆ Return vehicle to customer.

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3.6.29 Secondary Air Injection Pump Motor - V101- / Secondary Air Injection Pump Relay - J299- , Checking

General Description

Injecting additional air into the exhaust pipe triggers an exothermic reaction. This leads to the combustion of HC and CO components that prevail mainly during the warm up phase. This oxidation process releases additional heat. Consequently, the exhaust gas becomes hotter, causing the catalytic converter to heat up at a faster rate. For spark-ignition engines, secondary-air injection is an effective means of reducing HC and CO emissions after starting the engine and to rapidly heat up the catalytic converter. This ensures that the conversion of NOx emissions commences earlier.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Man. Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≤ 20 °C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Note

The engine MUST be cold (room temperature) in order for the ECM to command the air pump relay ON. The pump runs for approximately 20 – 100 seconds. Once the engine has been started, the ECM may not command the pump to run again for approx 6-8 hrs of engine off time. Due to potential damage to the catalyst, the generic scan tool has no provision for SAI relay control.

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 520 . – NO: ♦ GATHER more information from customer about the complaint.

Step	Procedure	Result / Action to Take
2	• IGNITION: OFF • DISCONNECT: Secondary Air Injection Pump Relay - J299- from the Fuse Panel B - SB- . • CONNECT: Jumper wire, Secondary Air Injection Pump Relay - -J299-- socket terminals 5/87 and 3/30. • SPECIFIED VALUE: The Secondary Air Injection Pump Motor - V101- should be heard running. – Was Value obtained?	– YES: ◆ GO TO: Step 6 ⇒ page 521 . – NO: ◆ GO TO: Step 3 ⇒ page 520 .
3	• DISCONNECT: Jumper wire, Secondary Air Injection Pump Relay - -J299-- socket terminals 5/87 and 3/30. • IGNITION: ON. • CHECK: Secondary Air Injection Pump Relay - J299- socket terminals 5/87 and 1/86 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Were Values obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 520 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ REPLACE: Any open fuses. ◆ GO TO: Step 7 ⇒ page 521 .
4	• REINSTALL: Secondary Air Injection Pump Relay - J299- into the Fuse Panel B - SB- . • DISCONNECT: Secondary Air Injection Pump Motor - V101- harness connector. • IGNITION: ON. • CHECK: Secondary Air Injection Pump Motor - V101- harness connector terminals 1 to 2 for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ◆ REPLACE: Secondary Air Injection Pump Motor - V101- , Refer to appropriate repair manual. ◆ GO TO: Step 7 ⇒ page 521 . – NO: ◆ GO TO: Step 5 ⇒ page 520 .
5	• REMOVE: The Fuse from the Fuse Panel B - SB- . Refer to appropriate wiring diagram for fuse designation. • CHECK: Secondary Air Injection Pump Motor - V101- harness connector terminal 1 to ground for resistance. • CHECK: Secondary Air Injection Pump Motor - V101- harness connector terminal 2 to output cavity of Fuse 11 (On Fuse Panel B) - SB11- for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 6 ⇒ page 521 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ REPLACE: Any open fuses. ◆ GO TO: Step 7 ⇒ page 521 .

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Step	Procedure	Result / Action to Take
6	• DISCONNECT: Jumper wire, Secondary Air Injection Pump Relay - -J299-- socket terminals 5/87 and 3/30. • REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Secondary Air Injection Pump Relay - J299- harness connector terminal 2/85 to Engine Control Module - J623- harness connector T105 / 60 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ REPLACE: Secondary Air Injection Pump Relay - J299- . Refer to appropriate repair manual. ◆ PERFORM: Road Test to verify repair. ◆ FAULT DOES RETURN: No malfunction is detected in the wiring. ◆ GO TO: Step 7 ⇒ page 521 . ◆ – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 521 .
7	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ◆ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ◆ REPAIR: As necessary. ◆ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ◆ Return vehicle to Customer. ◆ If all electrical connections are OK: ◆ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ◆ Return vehicle to Customer. – NO: ◆ Perform the diagnostic procedure for any DTC's. ◆ If no DTC's return the repair is complete. ◆ Return vehicle to customer.

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3.6.30 Secondary Air Injection Sensor 1 - G609- / Secondary Air Injection Solenoid Valve - N112- , Checking

General Description

The secondary air injection system sends air into the exhaust on a cold-start of the engine for about 45 – 100 sec. and serves to quickly heat the catalytic convertor(s) for improved emissions. A

"pressure based secondary air diagnostics" function is used. In this system, the signal from Secondary Air Injection Sensor 1 - G609- is evaluated in the Engine Control Module - J623- . The injected air quantity is determined from the pressure level.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Man. Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions: ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions: ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to: ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 522 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Secondary Air Injection Solenoid Valve - N112- harness connector. • CHECK: Secondary Air Injection Solenoid Valve - N112- component connector terminals 1 to 5 for resistance. • SPECIFIED VALUE: 5 – 35 Ω (at approx. 20° C). – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 522 . – NO: ♦ REPLACE: Secondary Air Injection Sensor 1 - G609- / Secondary Air Injection Solenoid Valve - N112- . Refer to appropriate repair manual. ♦ GO TO: Step 8 ⇒ page 524 .
3	• IGNITION: ON • CHECK: Secondary Air Injection Solenoid Valve - N112- harness connector terminal 1 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ♦ GO TO: Step 4 ⇒ page 523 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 8 ⇒ page 524 .

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Step	Procedure	Result / Action to Take
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Secondary Air Injection Solenoid Valve - N112- harness connector terminal 5 to the Engine Control Module - J623- harness connector T105 / 21 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 523 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 8 ⇒ page 524 .
5	• IGNITION: ON. • CHECK: Secondary Air Injection Sensor 1 - G609- harness connector terminals 1 to 3 for voltage. • SPECIFIED VALUE: About 5.0 V. • IGNITION: OFF. – Was Value obtained?	– YES: ◆ GO TO: Step 7 ⇒ page 523 . – NO: ◆ GO TO: Step 6 ⇒ page 523 .
6	• CHECK: Secondary Air Injection Sensor 1 - G609- harness connector terminal 1 to the Engine Control Module - J623- harness connector T105 / 35 for resistance. • CHECK: Secondary Air Injection Sensor 1 - G609- harness connector terminal 3 to the Engine Control Module - J623- harness connector T105 / 33 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 8 ⇒ page 524 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 8 ⇒ page 524 .
7	• CHECK: Secondary Air Injection Sensor 1 - G609- harness connector terminal 2 to the Engine Control Module - J623- harness connector T105 / 9 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ GO TO: Step 8 ⇒ page 524 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 8 ⇒ page 524 .

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Step	Procedure	Result / Action to Take
8	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.31 Throttle Valve Control Module - GX3- , Checking

General Description

Throttle valve operation occurs by an electric motor identified as EPC Throttle Drive - G186- located within the Throttle Valve Control Module - GX3- . It is controlled by the Engine Control Module - J623- with primary inputs from the Accelerator Pedal Module - GX2- as well as other peripheral inputs from EPC Throttle Drive Angle Sensor 1 - G187- and EPC Throttle Drive Angle Sensor 2 - G188- .

Note the Throttle Valve Control Module - GX3- was referred to as the Throttle Valve Control Module - J338- .

The Throttle Valve Control Module - GX3- contains the following components:

- ♦ EPC Throttle Drive - G186-
- ♦ EPC Throttle Drive Angle Sensor 1 - G187-
- ♦ EPC Throttle Drive Angle Sensor 2 - G188-

The Throttle Valve Control Module - GX3- components cannot be serviced separately, and must be serviced as a unit.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

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Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Man. Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 525 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • CONNECT: Scan Tool. • IGNITION: ON. • CHECK: Throttle valve position closed. • SPECIFIED VALUE: 3 - 25%. • DEPRESS: Accelerator pedal slowly to WOT while observing the percentage display. The percentage display must increase uniformly. • CHECK: Throttle valve position at WOT. • SPECIFIED VALUE: 84 - 97%. • IGNITION: OFF. – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 525 . – NO: ◆ GO TO: Step 4 ⇒ page 526 . .
3	• CONDITION: May be intermittent. • PERFORM: Visual Inspection of wiring and component. • CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. • REPAIR: Faulty wiring or connector.	◆ GO TO: Step 7 ⇒ page 527 .

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Step	Procedure	Result / Action to Take
4	• REMOVE: Throttle Valve Control Module - J338 - far enough so that the harness connector terminals are accessible. • DISCONNECT: Throttle Valve Control Module - J338- harness connector. • IGNITION: ON. • CHECK: Throttle Valve Control Module - GX3- harness connector terminals 2 to 6 for voltage. • CHECK: Throttle Valve Control Module - GX3- harness connector terminal 2 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: About 5.0 V. – Were Values obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 526 . – NO: ◆ GO TO: Step 6 ⇒ page 526 .
5	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Throttle Valve Control Module - GX3- harness connector terminal 1 to the Engine Control Module - J623- harness connector T105 / 55 for resistance. • CHECK: Throttle Valve Control Module - GX3- harness connector terminal 3 to the Engine Control Module - J623- harness connector T105 / 90 for resistance. • CHECK: Throttle Valve Control Module - GX3- harness connector terminal 4 to the Engine Control Module - J623- harness connector T105 / 34 for resistance. • CHECK: Throttle Valve Control Module - GX3- harness connector terminal 5 to the Engine Control Module - J623- harness connector T105 / 91 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 7 ⇒ page 527 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 527 .
6	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Throttle Valve Control Module - GX3- harness connector terminal 2 to the Engine Control Module - J623- harness connector T105 / 54 for resistance. • CHECK: Throttle Valve Control Module - GX3- harness connector terminal 6 to the Engine Control Module - J623- harness connector T105 / 56 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 7 ⇒ page 527 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 527 .

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Step	Procedure	Result / Action to Take
7	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.32 Turbocharger Recirculation Valve - N249- , Checking

General Description

A Turbocharger Recirculation Valve - N249- keeps a portion of air running through the intake side of the turbocharger when the throttle valve is closed and boost pressure is still present. This keeps the turbocharger impeller from slowing down, reducing turbo lag when the throttle is applied again.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Man. Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.

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- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 528 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Turbocharger Recirculation Valve - N249- harness connector. • CHECK: Turbocharger Recirculation Valve - N249- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 3 – 15 Ω (at approx. 20° C). – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 528 . – NO: ♦ REPLACE: Turbocharger Recirculation Valve - N249- . Refer to appropriate repair manual. ♦ GO TO: Step 5 ⇒ page 529 .
3	• IGNITION: ON. • CHECK: Turbocharger Recirculation Valve - N249- harness connector terminal 1 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ♦ GO TO: Step 4 ⇒ page 528 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 529 .
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Turbocharger Recirculation Valve - N249- harness connector terminal 2 to the Engine Control Module - J623- harness connector T105 / 66 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ♦ GO TO: Step 5 ⇒ page 529 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 529 .

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Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 26 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Codes", page 19 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.33 Vehicle Speed Signal, Checking

General Description

The Vehicle Speed Signal or VSS measures Transmission / Transaxle output or Wheel Speed from the ABS System. The signal is broadcasted over the CAN Bus. The Engine Control Module - J623- uses this information to modify engine functions such as ignition timing, AF ratio, transmission shift points, and to initiate diagnostic routines.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Man. Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Coolant Temperature: ≥ 80° C.

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- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .
- For Hybrid vehicles refer to:
  ⇒ “1.3 High Voltage System General Warnings”, page 4 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers concern. Refer to ⇒ “3.1 Preliminary Check ”, page 18 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 530 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • CONNECT: Scan Tool. • ROAD TEST: Vehicle. • CHECK: Scan Tool to Speedometer for accuracy. • SPECIFIED VALUE: Difference ≤ 10%. Was Value obtained?	– YES: ◆ CONDITION: May be intermittent. ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: faulty wiring or connector. ◆ GO TO: Step 4 ⇒ page 530 . – NO: ◆ GO TO: Step 3 ⇒ page 530 .
3	• CHECK: ABS system. • CHECK: ABS DTC’s. – Was the ABS system OK?	– YES: ◆ CHECK: CAN Bus wiring from Instrument Cluster Control Module - J285- to ABS Control Module - J104- . ◆ GO TO: Step 4 ⇒ page 530 . – NO: ◆ REPAIR: Any ABS concerns 1st. ◆ GO TO: Step 4 ⇒ page 530 .
4	• Final Procedure • Perform a road test to verify repair. • Do any DTC’s return:	– YES: ◆ Check the DTC memory. Refer to ⇒ “3.3.4 Diagnostic Mode 04 - Erase DTC Memory”, page 26 . ◆ Perform the diagnostic procedure for that DTC. – NO: ◆ Repair is complete. Generate readiness code. Refer to ⇒ “3.2 Readiness Codes”, page 19 . ◆ Return vehicle to Customer.

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Cautions & Warnings

Please read these WARNINGS and CAUTIONS before proceeding with maintenance and repair work. You must answer that you have read and you understand these WARNINGS and CAUTIONS before you will be allowed to view this information.

- If you lack the skills, tools and equipment, or a suitable workshop for any procedure described in this manual, we suggest you leave such repairs to an authorized Volkswagen retailer or other qualified shop. We especially urge you to consult an authorized Volkswagen retailer before beginning repairs on any vehicle that may still be covered wholly or in part by any of the extensive warranties issued by Volkswagen.

- Disconnect the battery negative terminal (ground strap) whenever you work on the fuel system or the electrical system. Do not smoke or work near heaters or other fire hazards. Keep an approved fire extinguisher handy.

- Volkswagen is constantly improving its vehicles and sometimes these changes, both in parts and specifications, are made applicable to earlier models. Therefore, part numbers listed in this manual are for reference only. Always check with your authorized Volkswagen retailer parts department for the latest information.

- Any time the battery has been disconnected on an automatic transmission vehicle, it will be necessary to reestablish Transmission Control Module (TCM) basic settings using the VAG 1551 Scan Tool (ST).

- Never work under a lifted vehicle unless it is solidly supported on stands designed for the purpose. Do not support a vehicle on cinder blocks, hollow tiles or other props that may crumble under continuous load. Never work under a vehicle that is supported solely by a jack. Never work under the vehicle while the engine is running.

- For vehicles equipped with an anti-theft radio, be sure of the correct radio activation code before disconnecting the battery or removing the radio. If the wrong code is entered when the power is restored, the radio may lock up and become inoperable, even if the correct code is used in a later attempt.

- If you are going to work under a vehicle on the ground, make sure that the ground is level. Block the wheels to keep the vehicle from rolling. Disconnect the battery negative terminal (ground strap) to prevent others from starting the vehicle while you are under it.

- Do not attempt to work on your vehicle if you do not feel well. You increase the danger of injury to yourself and others if you are tired, upset or have taken medicine or any other substances that may impair you or keep you from being fully alert.

- Never run the engine unless the work area is well ventilated. Carbon monoxide (CO) kills.

- Always observe good workshop practices. Wear goggles when you operate machine tools or work with acid. Wear goggles, gloves and other protective clothing whenever the job requires working with harmful substances.

- Tie long hair behind your head. Do not wear a necktie, a scarf, loose clothing, or a necklace when you work near machine tools or running engines. If your hair, clothing, or jewelry were to get caught in the machinery, severe injury could result.

- Do not re-use any fasteners that are worn or deformed in normal use. Some fasteners are designed to be used only once and are unreliable and may fail if used a second time. This includes, but is not limited to, nuts, bolts, washers, circlips and cotter pins. Always follow the recommendations in this manual - replace these fasteners with new parts where indicated, and any other time it is deemed necessary by inspection.

next

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- Illuminate the work area adequately but safely. Use a portable safety light for working inside or under the vehicle. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

- Friction materials such as brake pads and clutch discs may contain asbestos fibers. Do not create dust by grinding, sanding, or by cleaning with compressed air. Avoid breathing asbestos fibers and asbestos dust. Breathing asbestos can cause serious diseases such as asbestosis or cancer, and may result in death.

- Finger rings should be removed so that they cannot cause electrical shorts, get caught in running machinery, or be crushed by heavy parts.

- Before starting a job, make certain that you have all the necessary tools and parts on hand. Read all the instructions thoroughly; do not attempt shortcuts. Use tools that are appropriate to the work and use only replacement parts meeting Volkswagen specifications. Makeshift tools, parts and procedures will not make good repairs.

- Catch draining fuel, oil or brake fluid in suitable containers. Do not use empty food or beverage containers that might mislead someone into drinking from them. Store flammable fluids away from fire hazards. Wipe up spills at once, but do not store the oily rags, which can ignite and burn spontaneously.

- Use pneumatic and electric tools only to loosen threaded parts and fasteners. Never use these tools to tighten fasteners, especially on light alloy parts. Always use a torque wrench to tighten fasteners to the tightening torque listed.

- Keep sparks, lighted matches, and open flame away from the top of the battery. If escaping hydrogen gas is ignited, it will ignite gas trapped in the cells and cause the battery to explode.

- Be mindful of the environment and ecology. Before you drain the crankcase, find out the proper way to dispose of the oil. Do not pour oil onto the ground, down a drain, or into a stream, pond, or lake. Consult local ordinances that govern the disposal of wastes.

- The air-conditioning (A/C) system is filled with a chemical refrigerant that is hazardous. The A/C system should be serviced only by trained automotive service technicians using approved refrigerant recovery/recycling equipment, trained in related safety precautions, and familiar with regulations governing the discharging and disposal of automotive chemical refrigerants.

- Before doing any electrical welding on vehicles equipped with anti-lock brakes (ABS), disconnect the battery negative terminal (ground strap) and the ABS control module connector.

- Do not expose any part of the A/C system to high temperatures such as open flame. Excessive heat will increase system pressure and may cause the system to burst.

- When boost-charging the battery, first remove the fuses for the Engine Control Module (ECM), the Transmission Control Module (TCM), the ABS control module, and the trip computer. In cases where one or more of these components is not separately fused, disconnect the control module connector(s).

- Some of the vehicles covered by this manual are equipped with a supplemental restraint system (SRS), that automatically deploys an airbag in the event of a frontal impact. The airbag is operated by an explosive device. Handled improperly or without adequate safeguards, it can be accidentally activated and cause serious personal injury. To guard against personal injury or airbag system failure, only trained Volkswagen Service technicians should test, disassemble or service the airbag system.

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- Do not quick-charge the battery (for boost starting) for longer than one minute, and do not exceed 16.5 volts at the battery with the boosting cables attached. Wait at least one minute before boosting the battery a second time.

- Never use a test light to conduct electrical tests of the airbag system. The system must only be tested by trained Volkswagen Service technicians using the VAG 1551 Scan Tool (ST) or an approved equivalent. The airbag unit must never be electrically tested while it is not installed in the vehicle.

- Some aerosol tire inflators are highly flammable. Be extremely cautious when repairing a tire that may have been inflated using an aerosol tire inflator. Keep sparks, open flame or other sources of ignition away from the tire repair area. Inflate and deflate the tire at least four times before breaking the bead from the rim. Completely remove the tire from the rim before attempting any repair.

- When driving or riding in an airbag-equipped vehicle, never hold test equipment in your hands or lap while the vehicle is in motion. Objects between you and the airbag can increase the risk of injury in an accident.

I have read and I understand these Cautions and Warnings.

back OK

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