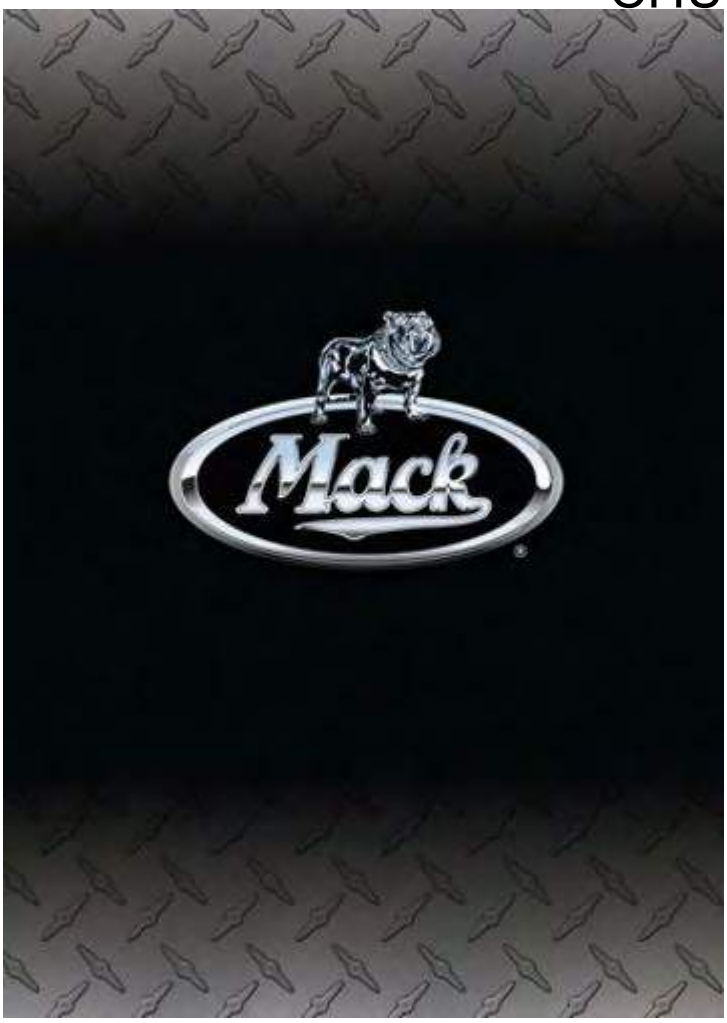
Service Manual
Trucks

Group **28**

Engine Control Module (ECM), Diagnostic Trouble Code (DTC), Guide

2010 Emissions

CHU, CXU, GU, TD



PV776-88961816

Foreword

The descriptions and service procedures contained in this manual are based on designs and methods studies carried out up to March 2010.

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

The new edition of this manual will update the changes.

In service procedures where the title incorporates an operation number, this is a reference to a Labor Code (Standard Time).

Service procedures which do not include an operation number in the title are for general information and no reference is made to a Labor Code (Standard Time).

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

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

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

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

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

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Repl:

Contents

Design and Function

Engine Control Module (ECM)

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

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

System Overview

Six electronic control units (ECUs) are used; the engine control module (ECM), instrument control module (ICM), Vehicle Electronic Control Unit (VECU), transmission control module (TCM), the gear selector control module (GSCM) and the aftertreatment control module (ACM). Together, these modules operate and communicate through the SAE J1939 (CAN 1) data link to control a variety of engine and vehicle cab functions. The ECM controls such things as fuel timing and delivery, fan operation, engine protection functions, engine brake operation, the exhaust gas recirculation (EGR) valve and the turbocharger nozzle. The VECU controls cruise control functions, accessory relay controls and idle shutdown functions. The ICM primarily displays operational parameters and communicates these to the other ECUs. All have the capability to communicate over the SAE J1587 data link primarily for programming, diagnostics and data reporting.

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

In some situations when a fault is detected, the system will enter a "derate" mode. The derate mode allows continued vehicle operation but the system may substitute a sensor or signal value that may result in reduced performance. In some instances, the system will continue to function but engine power may be limited to protect the engine and vehicle. Diagnostic trouble codes (DTCs) logged in the system memory can later be read, to aid in diagnosing the problem using a diagnostic computer or through the instrument cluster display, if equipped. When diagnosing an intermittent DTC or condition, it may be necessary to use a scan tool connected to the Serial Communication Port.

The use of a scan tool is necessary to perform diagnostic work as well as clearing of any diagnostic trouble codes (DTCs). DTC(s) can no longer be cleared using the vehicles instrument cluster digital display and stalk switch control. Additional data and diagnostic tests are available when a scan tool is connected to the Serial Communication Port.

For diagnostic software, contact your local dealer.

The ECM is a microprocessor based controller programmed to perform fuel injection quantity and timing control, diagnostic fault logging, and to broadcast data to other ECUs. The fuel quantity and injection timing to each cylinder is precisely controlled to obtain optimal fuel economy and reduced exhaust emissions in all driving situations.

The ECM controls the operation of the injectors, engine brake solenoid, EGR valve, turbocharger nozzle position, and cooling fan clutch based on inputs from many sensors and information received over the data links from other ECUs.

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

On Board Diagnostic (OBD) Monitors

System Electronic Control Unit (ECU) Overview

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

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

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

These ECUs all communicate with the ECM via data links. The VECU communicates across the SAE J1939 (CAN1) data link while the others use the SAE J1939-7 (CAN2) data link. The OBD systems use SAE J1939 data link protocol for communication with scan tools but, MACK trucks still are capable of communicating via the SAE J1587 data link for diagnostics. The use of a scan tool is necessary to perform diagnostic work as well as clearing of any diagnostic trouble codes (DTCs). DTC(s) can no longer be cleared using the vehicles instrument cluster digital display and stalk switch control.

There are other ECUs such as the Instrument Control Module (ICM), Transmission Control Module (TCM) and Anti-lock Brake System (ABS) Module that provide data to the emission control system or the diagnostic system but are not "emission critical".

Malfunction Indicator Lamp (MIL), Description and Location

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

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Systems Monitoring Information

Section Content

Accelerator Pedal Position (APP) Sensor, Overview

The APP sensor input is an analog voltage signal proportional to the pedal position that is read by the vehicle electronic control unit (VECU). The angular position of the pedal is divided in three different areas used for fault detection and/or recovery. The value that is transmitted under normal conditions (value of 0 - 100%), is directly proportional to the pedal's angular position. The physical accelerator assembly also supports a digital DC voltage (On/Off) generated by an idle validation (IV) switch that is also powered by the same regulated reference voltage source.

Active/intrusive Injection (Aftertreatment Hydrocarbon Doser Clogging)

This diagnostic is based on the checking the aftertreatment diesel particulate filter (DPF) intake temperature during aftertreatment DPF active parked regeneration cycles. If the aftertreatment DPF intake temperature does not reach a minimum regeneration temperature within a specified time then the aftertreatment hydrocarbon doser is considered to be clogged.

Aftertreatment Diesel Exhaust Fluid (DEF) Feedback Control

The aftertreatment DEF control consists of a feedforward control together with a feedback control. The feedforward control value is how much urea that must be injected in order to obtain the demanded nitrogen oxides (NOx) conversion efficiency. The feedback controls the ammonia (NH3) buffer in the aftertreatment selective catalytic reduction (SCR).

Aftertreatment Diesel Exhaust Fluid (DEF) Quality

Aftertreatment DEF quality is evaluated and determined through conversion efficiency. If the aftertreatment SCR system efficiency is below the specified limit, a fault is reported.

Aftertreatment Diesel Particulate Filter (DPF)

The aftertreatment DPF collects particulate and soot in a ceramic wall-flow substrate. The strategy to manage the accumulation of soot is to take advantage of natural aftertreatment DPF passive regeneration whenever possible, and to invoke an operating mode that enhances aftertreatment DPF passive regeneration when necessary. Aftertreatment DPF active regeneration is performed using an aftertreatment hydrocarbon doser.

Aftertreatment Diesel Particulate Filter (DPF) Regeneration Frequency

This function detects if the aftertreatment DPF regeneration frequency increases to a level that it would cause the non-methane hydro carbon (NMHC) emissions to exceed the legal limitation or if the frequency exceeds the design requirements. If the number of aftertreatment DPF regenerations are above the threshold at the end of the time period a fault is reported.

Aftertreatment Diesel Particulate Filter (DPF) Incomplete Regeneration

The aftertreatment DPF regeneration strategy is to reduce the soot level in the DPF using passive regeneration. However, if the driving conditions do not enable enough exhaust heat for passive regeneration to keep up with the soot loading an active parked aftertreatment DPF regeneration will be required. An interrupted parked aftertreatement DPF regeneration is detected by this function. This is not a fault mode but handled by the aftertreatment system. If the ratio between the uncompleted and completed regenerations is above the specified limit, a fault is reported.

Aftertreatment Diesel Particulate Filter (DPF) Regeneration Feedback Control

This function monitors the particulate matter regeneration feedback control and detects:

- If the system fails to begin feedback control
- If a failure or deterioration causes open loop
- If the feedback control has used up all of the allowed adjustment

When the aftertreatment hydrocarbon doser is used, the feedback control is monitored for a saturated controller or a saturated actuator. A saturated controller or actuator means that all allowed adjustment has been used up. The monitors detect a malfunction if the controller is saturated more than a given percentage of the time and the target temperature can not be reached or if the actuator is saturated more than a given percentage of the time.

Aftertreatment Fuel System, Rationality Monitors

The aftertreatment fuel system consists of a aftertreatment fuel shutoff valve, a separate aftertreatment hydrocarbon doser (injector), and an aftertreatment fuel pressure sensor. The aftertreatment fuel shutoff valve diagnostic function look at the aftertreatment fuel pressure when the valve is opened and closed. When conditions are proper for the diagnostic, the function requests an opening of the aftertreatment fuel shutoff valve in order to pressurize the aftertreatment fuel system. This action should increase system pressure. When the aftertreatment fuel shutoff valve is closed the system pressure should decrease since the valve has an internal drain pipe that constantly depressurizes the system. For more information about these components refer to “Aftertreatment Fuel Pressure Sensor, Circuit Monitors”, page 16, “Aftertreatment Fuel Shutoff Valve, Circuit Monitors”, page 16 or “Aftertreatment Hydrocarbon Doser, Circuit Monitors”, page 16.

Aftertreatment Non-Methane Hydro Carbons (NMHC) Catalyst

To detect when the hydrocarbon conversion fails in the aftertreatment diesel oxidation catalyst (DOC), the temperature reaction at the aftertreatment DOC outlet is monitored when fuel is injected in the exhaust. The amount of hydrocarbon supplied by the aftertreatment hydrocarbon doser will determine the expected increase in temperature after the aftertreatment DOC. The aftertreatment hydrocarbon doser injection rate (duty cycle) is monitored and used to calculate whether there should be a corresponding heat reaction. Once it has reached an acceptable accumulated duty cycle the expected temperature difference can be calculated. This difference should then be above a certain limit if the hydrocarbon conversion was achieved.

Aftertreatment Nitrogen Oxides (NOx) Sensor(s) Overview

The NOx sensors consist of:

- Housing holding the sensing element.
- An electronic control unit (ECU), interfacing the sensor and the engine control module (ECM).
- A wire, electrically connecting the sensing element with the ECU.

There are two aftertreatment NOx sensors, one before and one after the aftertreatment selective catalytic reduction (SCR) catalyst. The aftertreatment NOx sensor before and after SCR catalyst have unique CAN identification numbers hence can not be swapped. The sensor before the SCR catalyst monitors the engine out NOx level. The sensor after SCR monitors system out NOx level.

Aftertreatment NOx sensor diagnostics monitor the sensors signal quality and performance. The purpose of this function is to detect the following,

- Bad signal quality
- Removed sensor
- Missing signal

Circuit integrity of the aftertreatment NOx sensor is checked by the sensor itself and the status is transmitted to the engine control module (ECM) over the CAN data link. The following can be transmitted,

- open circuit
- high voltage
- circuit low or high

Aftertreatment Selective Catalytic Reduction (SCR)

The aftertreatment SCR system is a catalyst system that is used to reduce exhaust Nitrogen Oxides (NOx) emissions. This reduction is performed by injecting diesel exhaust fluid (DEF) (a urea solution) into the exhaust fumes prior to the aftertreatment SCR catalyst. A chemical process performed by aftertreatment SCR catalyst and DEF, converts NOx to nitrogen oxide (NO) and water (H2O). The aftertreatment control module (ACM) is used to control the aftertreatment SCR components and relays system information to the Engine Control Module (ECM). The ECM controls the overall system function.

Aftertreatment Selective Catalytic Reduction (SCR) Conversion Efficiency

The aftertreatment SCR catalyst diagnosis calculates the low temperature performance of the aftertreatment SCR system and compares it to the performance when the catalyst is warm enough to reach high nitrogen oxides (NOx) conversion. This is based on the premise that a deteriorated catalyst can be considered as a catalyst with less volume. The volume is critical to reach the low temperature performance of the aftertreatment SCR system.

Ambient Air Temperature (AAT) Sensor, Overview

The AAT sensor is an analog input that is read by the instrument cluster electronic control unit. The instrument cluster processes the raw signal and transmits the AAT value on the SAE J1939 data link. The vehicle electronic control unit (VECU) receives the AAT value and based on certain vehicle conditions the value is adjusted. The VECU then transmits the AAT value back on the SAE J1939 data link where it is received by the engine control module (ECM).

Charge Air Cooler (CAC)

The nominal CAC efficiency is a map based on mass air flow (MAF) and ambient air temperature (AAT). The method to evaluate the CAC efficiency is to compare a nominal CAC efficiency with one calculated based on the exhaust gas recirculation (EGR) and the intake air temperature (IAT) sensor along with their corresponding mass flows.

Combined Monitoring

Cylinder balancing function is used to detect fuel system pressure, quantity and timing fault. By processing the tooth times cylinder balancing detects if the combustion power contribution from one or several cylinders is too week or too strong and need to be compensated to get even combustion power from all cylinders. The compensation is calculated at the lower engine speed (RPM) and torque regions during warm engine where the impact from each combustion becomes most visible. If the compensation becomes too high or too low fault is detected.

Crankcase Ventilation

The crankcase pressure (CCP) depends on the blow-by flow and the under pressure generated by the separator. Blow-by gases come mainly from the combustion when exhaust gas passes the piston rings. A malfunctioning of the valve guides, or the turbocharger can also contribute. The blow-by gases consist of exhaust gases mixed with oil. A high speed rotating separator is used to expel engine oil from these gases.

Crankcase Ventilation Diagnostic Function

When the high speed separator enabling conditions exist, the minimum value of the difference between crankcase and barometric pressure (BARO) during a time period is stored. The system performs high speed and low speed evaluations of the separator to conclude if the system is tight.

Engine Control Module (ECM), Rationality Monitors

If electrical power to the ECM is lost or very low, the ECM will stop to functioning and the engine will stop. Other electronic control units (ECUs) on the SAE J1939 (CAN1) data link will indicate that data from the ECU is missing.

Engine Coolant Temperature (ECT) Sensor Overview

The ECT sensor is monitored for rationality at key **ON** by comparing the ECT with the other engine temperature sensors (engine oil temperature (EOT) and engine turbocharger compressor outlet temperature). Using this comparison the following conclusions may be made when a problem occurs:

- Unable to reach Closed loop/Feedback enable Temperature (covered by thermostat warmed up temperature)
- Time to reach Closed loop/Feedback enable Temperature (covered by thermostat warmed up temperature)
- Stuck in a range below the highest minimum Enable temperature
- Stuck in a Range Above the Lowest maximum Enable temperature - Rationality Check

When the engine is used, the three temperatures are not the same and depending on how fast the engine is restarted normal differences will be found. When these differences and the ambient air temperature (AAT) exceeds a limit, the fault limits are adjusted in order to allow these differences.

Exhaust Gas Recirculation (EGR)

US2010 emission level MACK engines use EGR to enhance engine out Nitrogen Oxides (NOx) control. EGR flow is managed using an EGR valve and a Variable Geometry Turbocharger (VGT) nozzle position. These actuator settings are based on open loop settings established to achieve desired burned fraction rates. These settings can be modified in a closed loop burned fraction mode by feedback from a combustion property model. The EGR system is diagnosed by monitoring the burned fraction whenever the engine enters burned fraction closed loop mode.

Exhaust Gas Recirculation (EGR) Low Flow

This function monitors the reduction of EGR flow in the EGR system, i.e. too low EGR mass flow compared with demand. It is activated when the engine enters the burned fraction mode with minimum demand for BF and the engine speed/torque is in a range where EGR flow measurements and BF calculations have sufficient accuracy.

Exhaust Gas Recirculation (EGR) High Flow

This function diagnoses too much EGR in the system, i.e. too high EGR mass flow compared with the demand. This function handles positive deviations when EGR closed loop control is active. When closed loop EGR control is entered, an initial difference between measured burned fraction and burned fraction demand might exist. Due to the fact that some time is needed for adaptation, not all the difference is taken into account.

Exhaust Gas Recirculation (EGR) Slow Response

As described in “Exhaust Gas Recirculation (EGR) Low Flow”, page 8 and “Exhaust Gas Recirculation (EGR) High Flow”, page 8 , the deviation between the demanded and measured burned fraction are monitored when EGR closed loop control is active. Slow response is detected when the deviation (high/low) above the threshold is detected.

Exhaust Gas Recirculation (EGR) Feedback Control

This function detects:

- If any of the feedback control loops are not achieved.
- If feedback control mode is inhibited.

Exhaust Gas Recirculation (EGR) Cooler Performance

This function uses an equation based off of engine turbocharger turbine intake temperature, EGR temperature and the engine coolant temperature (ECT), to calculate cooler efficiency. The calculated efficiency is deemed too low if it is below a certain constant limit.

Exotherm

Exotherm, exothermic or exothermal all refer to a chemical change that is accompanied by a great release of heat. The aftertreatment heating function uses the aftertreatment hydrocarbon doser, to heat up the exhaust system for parked aftertreatment diesel particulate filter (DPF) regeneration. When the aftertreatment hydrocarbon doser is used the hydrocarbons (HC) create an exotherm in the aftertreatment diesel oxidation catalyst (DOC). The aftertreatment hydrocarbon doser injection rate (duty cycle) is monitored and used to calculate whether there should be a corresponding exotherm. A starting temperature value is set when the aftertreatment hydrocarbon doser starts to inject fuel. As soon as the model says that exotherm should occur, the difference is calculated to identify whether it has occurred.

Filtering Performance

A malfunction of the aftertreatment diesel particulate filter (DPF) can be detected by analysing the pressure drop over the aftertreatment DPF. During the aftertreatment DPF evaluation, the lower and upper limiting values of the measured pressure drop are calculated. If the pressure drop is lower or higher than expected a fault indication occurs.

Fuel System

The D13L engine uses a unit injector system (as opposed to a rail injector system) to inject fuel in the cylinders. The unit injectors are not equipped with any pressure sensors and therefore it is not possible to measure fuel pressure. Diagnostics of the fuel injection system is done using the crankshaft position (CKP) sensor. The flywheel of the engine has slots machined at 6 degree intervals around its circumference. Three gaps where two slots are missing, are equally spaced around its circumference also. The three gaps are used to identify the next cylinder in firing order.

Idle Speed, Rationality Monitors

The target idle engine speed (RPM) and fuel injection quantity are monitored in the idle control system. The diagnosis monitors compare the measured engine speed (RPM) (averaged over each engine cycle) and target idle engine speed (RPM). The accumulated difference is averaged over a number of revolutions. If the averaged difference is above or below the defined fault limits, diagnostic trouble codes (DTCs) will be set for high fault and for low fault, respectively.
The same holds true for the fuel quantity. The accumulated fuel value is averaged over a number of revolutions. If the averaged difference is above, DTCs will be set for high fault.

Intake Manifold Pressure (IMP) Control System

A IMP sensor located in the intake manifold is used to measure IMP. The IMP system is monitored by comparing target/estimated IMP with actual measured pressure during certain engine speed (RPM) or load.
The target/estimated IMP is continuously calculated based on engine speed and fuel angle and adjusted for the influence of variable geometry turbocharger (VGT) nozzle position, exhaust gas recirculation (EGR) position and barometric pressure (BARO).

Misfire

The misfire monitor is disabled during Power Take Off (PTO) operation. It is active during positive brake torque, idle, and high idle. Engine misfire events are monitored by measuring tooth times on the crank wheel that indicates combustion acceleration in each cylinder. It is also possible to compare the previous acceleration contribution on each cylinder in order to examine if there has been a misfire or not.

After monitoring misfire events during idle conditions for the accumulation of less than 15 seconds, the percentage of misfire is evaluated. If the percentage of misfire exceeds the threshold limit, the misfire diagnostic trouble code (DTC) will be set for the fault.

Missing Substrate

The aftertreatment diesel particulate filter (DPF) is backpressure monitored. This monitoring is used to determine whether the aftertreatment DPF is either clogged, missing or significantly cracked.

Over-boost

If the measured intake manifold pressure (IMP) is over the deviation upper limit then the high boost average calculation is positive. If the measured IMP is below the deviation upper limit then the high boost integration is negative. If the integrated value exceeds the maximum limit a fault for high IMP is set.

Parking Brake Switch, Overview

The parking brake switch is a pressure switch that is physically connected to the vehicle's parking brake pneumatic circuit and is used to determine if the parking brake is applied or released. The parking brake switch signal is received by the vehicle electronic control unit (VECU). When the vehicle's parking brake is applied a ground signal is applied to the input and the VECU acknowledges the parking brake as being applied. The parking brake switch signal is provided to the engine control module (ECM) via the SAE J1939 data link.

Power Take-off (PTO) Enable Switch, Overview

The PTO enable switch is an input that is read by the vehicle electronic control unit (VECU). When 12V is applied to the input the VECU acknowledges the PTO function is being commanded on. The PTO Enable switch signal is provided to the engine control module (ECM) from the VECU by via the SAE J1939 data link.

SAE J1939 (CAN1) Data Link, Overview

Communication between the electronic control units (ECUs) is performed via the vehicle's SAE J1939 (CAN1) data link and is accessible for diagnostics through the vehicle's SAE J1939-13 data link connector (DLC). This data link is the main powertrain communication bus.

Diagnostic trouble codes (DTCs) are set for this data link when an ECU is found to not be communicating or recognized on the data link (off bus mode) or when there is an abnormal rate of occurrence of errors on the data link.

Thermostat Monitor

This feature monitors and compares the engine coolant temperature (ECT), engine speed (RPM), engine torque, fan speed and ambient air temperature (AAT) to conclude when the thermostat may be stuck open or closed.

Time/Date Overview

The time and date is calculated from an internal clock within the instrument cluster. The internal clock is backed up by an internal battery therefore the time and date is retained even when vehicle battery supply to the instrument cluster is removed. The time and date signal is provided to the engine control module (ECM) from the instrument cluster via the SAE J1939 data link.

Variable Geometry Turbocharger (VGT) Feedback Control

This function detects:

If any of the feedback control loops are not achieved.

If feedback control mode is inhibited.

If the actuators have used up all the adjustment allowed when in feedback mode.

Vehicle Speed Sensor (VSS), Overview

The vehicle road speed is calculated by the vehicle electronic control unit (VECU). The source for calculating vehicle road speed can be derived from multiple sources depending on vehicle equipment. Some trucks may use a dedicated speed sensor (which may be inductive or hall effect type) and some may use the transmission output shaft speed (OSS) sensor signal which is communicated across the SAE J1939 data link.

Under-boost

If the measured intake manifold pressure (IMP) is less than the deviation lower limit then the low boost average calculation is negative. If the measured IMP is above the deviation lower limit then the low boost integration is positive. If the integrated value becomes less than the minimum limit a fault for low IMP is set.

Variable Geometry Turbocharger (VGT) Slow Response

The VGT actuator reports a fault to the engine control module (ECM) when it has detected that the VGT nozzle is not moving, or if it has not been able to close the set-point error to acceptable limits.

Sensor and Component Information

Section Content

Accelerator Pedal Position (APP) Sensor, Circuit Monitors

Both signals are continuously monitored (sampled) by the vehicle electronic control unit (VECU) at 50 ms intervals to detect any distortion or disruption of these signals. Signals detected as invalid for a period extending over 500 ms trigger active faults that are broadcast by the VECU. The APP sensor circuits are monitored to identify the following:

- Circuit open
- Circuit low
- Circuit high

Accelerator Pedal Position (APP) Sensor, Rationality Monitors

The vehicle electronic control unit (VECU) simultaneously reads the APP sensor and the idle validation (IV) switch values and performing a plausibility to verify sensor performance.

Aftertreatment Control Module (ACM), Rationality Monitors

If electrical power to the ACM is lost or very low the ACM will stop functioning. Aftertreatment diesel exhaust fluid (DEF) dosing will stop. The engine control module (ECM) will log a diagnostic trouble code (DTC) indicating SAE J1939 data link (sub data link CAN2) communications from the ACM is missing.

Aftertreatment Control Module (ACM) 5 Volt Supply 1, Circuit Monitors

The ACM 5 volt supply “1” circuit is monitored to identify the following:

- Circuit low
- Circuit high

When either fault is detected the supply is disabled.

Aftertreatment Control Module (ACM) 5 Volt Supply 2, Circuit Monitors

The ACM 5 volt supply“2” circuit is monitored to identify the following:

- Circuit low
- Circuit high

When circuit high or circuit low faults are detected the supply is disabled.

Aftertreatment Control Module (ACM) Actuator Supply Voltage 1, Circuit Monitors

The ACM actuator supply voltage “1” circuit is monitored to identify the following:

- Circuit open
- Circuit low
- Circuit high

When circuit high or circuit low faults are detected the supply is disabled.

Aftertreatment Control Module (ACM) Actuator Supply Voltage 2, Circuit Monitors

The ACM actuator supply voltage “2” circuit is monitored to identify the following:

- Circuit open
- Circuit low
- Circuit high

When circuit high or circuit low faults are detected the supply is disabled.

Aftertreatment Diesel Exhaust Fluid (DEF) Dosing Valve, Circuit Monitors

The aftertreatment DEF dosing valve circuits are monitored to identify the following:

- Circuit open
- Circuit low
- Circuit high

Aftertreatment Diesel Exhaust Fluid (DEF) Dosing Valve, Rationality Monitors

The aftertreatment DEF pump control value is monitored when the aftertreatment DEF dosing valve duty cycle has been above a predetermined threshold, for a short duration. If the control value is too low a diagnostic trouble code (DTC) is set. This indicates a clogged dosing valve or blocked aftertreatment DEF line.

Aftertreatment Diesel Exhaust Fluid (DEF) Pressure Sensor, Circuit Monitors

The aftertreatment DEF pressure sensor circuits are monitored to identify the following:

- Circuit open/circuit high
- Out of range low
- Out of range high
- Circuit low

Aftertreatment Diesel Exhaust Fluid (DEF) Pressure Sensor, Rationality Monitors

During pressure build up (aftertreatment DEF pump runs with maximum speed with no dosing) if selective catalytic reduction (SCR) system pressure stays low for a preset duration, a diagnostic trouble code (DTC) is set. Pressure is also evaluated during normal operation with aftertreatment DEF pump turned off. If the pressure is too high for a preset duration a DTC is set

Aftertreatment Diesel Exhaust Fluid (DEF) Pump, Circuit Monitors

The aftertreatment DEF pump circuits are monitored to identify the following:

- Circuit open
- Circuit low
- Circuit high
- Battery voltage

Aftertreatment Diesel Exhaust Fluid (DEF) Pump, Rationality Monitors

The aftertreatment DEF pump gets a signal for the required pump speed from the aftertreatment control module (ACM). The pump has internal diagnosis which evaluates the pump speed quality. If the pump speed deviates from commanded speed for some time a diagnostic trouble code (DTC) is set.

The aftertreatment DEF return value is monitored during specific conditions to identify if a leak in the system is present. A DTC is set if a leak condition is identified. The leak can be invisible (internal to the pump or valve) or visible (aftertreatment DEF lines or connections).

Aftertreatment Diesel Exhaust Fluid (DEF) Return Value, Circuit Monitors

The aftertreatment DEF return valve circuits are monitored to identify the following:

- Circuit open
- Circuit low
- Circuit high

Aftertreatment Diesel Exhaust Fluid (DEF) Return Valve, Rationality Monitors

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

Aftertreatment Diesel Exhaust Fluid (DEF) Tank Heater Valve, Circuit Monitors

The aftertreatment DEF tank heater valve circuits are monitored to identify the following:

- Circuit open
- Circuit low
- Circuit high

Aftertreatment Diesel Exhaust Fluid (DEF) Tank Heater Valve, Rationality Monitors

Aftertreatment DEF tank heater valve diagnostics evaluates if tank heater is taking place, when demanded. A comparison of an initial aftertreatment DEF tank temperature without heating and then a tank temperature with aftertreatment DEF tank heater valve open for some duration is performed. If the increase in temperature is smaller than the threshold, a diagnostic trouble code (DTC) is set.

Aftertreatment Diesel Exhaust Fluid (DEF) Tank Temperature Sensor, Circuit Monitors

The aftertreatment DEF tank temperature sensor circuits are monitored to identify the following:

- Circuit open/circuit high
- Out of range low
- Out of range high
- Circuit low

Aftertreatment Diesel Exhaust Fluid (DEF) Tank Temperature Sensor, Rationality Monitors

Aftertreatement DEF tank temperature is checked for high frequency oscillations with high amplitude that is so large that is physically impossible for a temperature to achieve. A fault is set when this behavior is observed. Aftertreatement DEF tank temperature diagnostics is also evaluating if the aftertreatement DEF temperature is too high and will activate reverse flow (to protect aftertreatment selective catalytic reduction (SCR) system components) and a timer is started. If the temperature stays high for a short duration, a fault is set.

Aftertreatment Diesel Particulate Filter (DPF), Differential Pressure Sensor, Circuit Monitoring

The aftertreatment DPF differential pressure sensor circuits are monitored to identify the following:

- Circuit low
- Circuit high
- Circuit open

Aftertreatement Diesel Particulate Filter (DPF) Differential Pressure Sensor, Rationality Monitors

The evaluation of the pressure-drop sensor is carried out as follows. When the pressure model indicates a low pressure the sensor should also show a low pressure otherwise there is a (large) positive offset fault. Combining this with a check that the sensor shows high values when the model is high gives a sensor stuck check. The second step can also find (large) negative offset faults.

Aftertreatment Fuel Pressure Sensor, Circuit Monitors

The aftertreatment fuel pressure sensor circuits are monitored to identify the following:

- Circuit open
- Out of range low
- Out of range high
- Circuit low
- Circuit high

Aftertreatment Fuel Shutoff Valve, Circuit Monitors

The aftertreatment fuel shutoff valve circuits are monitored to identify the following:

- Circuit open
- Circuit low
- Circuit high

Aftertreatment Hydrocarbon Doser, Circuit Monitors

The aftertreatment hydrocarbon doser circuits are monitored to identify the following:

- Circuit open
- Circuit low
- Circuit high

Aftertreatment Nitrogen Oxides (NOx) Sensors, Circuit Monitors

The NOx sensors circuits are monitored to identify the following:

- open circuit
- high voltage
- circuit low or high

Aftertreatment Nitrogen Oxides (NOx) Sensors, Rationality Monitors

There are two different monitors which diagnose aftertreatment NOx sensor rationality. One compares the aftertreatment intake NOx sensor value to a calculated engine NOx output value. This is only perform within a given set of predetermined conditions. If the NOx sensor value is not deemed within range, a faulty is set. The other compares theaftertreatment intake NOx sensor value to the aftertreatment outlet NOx sensor value to determine rationality. This is only perform within a given set of predetermined conditions. If either of the aftertreatment NOx sensor values are deemed not plausible, a diagnostic faulty code (DTC) is set.

Ambient Air Temperature (AAT) Sensor, Circuit Monitors

The AAT sensor circuits are monitored by the instrument cluster module to identify the following:

- Current below normal or open
- Current above normal or grounded

None of the AAT sensor circuits are monitored by the ECM or the VECU.

Ambient Air Temperature (AAT) Sensor, Rationality Monitors

Plausibility of the sensor value is determined by comparing the AAT with the intake air temperature (IAT).

Barometric Pressure (Baro) Sensor Circuit Monitoring

The BARO sensor circuits are monitored to identify the following:

- Circuit low
- Circuit high
- Circuit open

Barometric Pressure (BARO) Sensor Rationality Monitors

The BARO sensor, intake manifold pressure (IMP) sensor, and crankcase pressure (CCP) sensor should show the same pressure when engine speed (RPM) and torque is low. The diagnosis calculates the difference between:

- BARO and IMP
- BARO and CCP
- IMP and CCP

These comparisons are used to identify defects.

Camshaft Position (CMP) Sensor, Circuit Monitors

The CMP sensor circuits are monitored to identify the following:

- Circuit open
- Circuit low
- Circuit high

Camshaft Position (CMP) Sensor, Rationality Monitors

The CMP sensor is monitored by comparing it's output signal to the output signal of the crankshaft position (CMP) sensor. This comparison is used to identify abnormal CKP and CMP sensor frequency as well as camshaft to crankshaft phasing (calculated top dead center (TDC). Abnormal sensor frequency and shaft phasing angle will set faults.

Crankcase Pressure (CCP) Sensor, Circuit Monitors

The CCP circuits are monitored to identify the following:

- Circuit open
- Out of range low
- Out of range high
- Circuit low
- Circuit high

Crankcase Pressure (CCP) Sensor, Rationality Monitors

The BARO sensor, intake manifold pressure (IMP) sensor, and crankcase pressure (CCP) sensor should show the same pressure when engine speed (RPM) and torque is low. The diagnosis calculates the difference between:

- BARO and IMP
- BARO and CCP
- IMP and CCP

Crankshaft Position (CKP) Sensor, Circuit Monitors

The CKP sensor circuits are monitored to identify the following:

- Circuit open
- Circuit low
- Circuit high

Crankshaft Position (CKP) Sensor, Rationality Monitors

The CKP sensor is monitored by comparing it's output signal to the output signal of the camshaft position (CMP) sensor. This comparison is used to identify abnormal CKP and CMP sensor frequency as well as camshaft to crankshaft phasing (calculated top dead center (TDC). Abnormal sensor frequency and shaft phasing angle will set faults.

Engine Control Module (ECM) 5 Volt Supply A, Circuit Monitors

The ECM 5 volt supply "A" circuit is monitored to identify the following:

- Circuit low
- Circuit high

When either fault is detected the supply is disabled.

Engine Control Module (ECM) 5 Volt Supply B, Circuit Monitors

The ECM 5 volt supply "B" circuit is monitored to identify the following:

- Circuit low
- Circuit high

When either fault is detected the supply is disabled.

Engine Coolant Temperature (ECT) Sensor, Circuit Monitors

The ECT sensor circuits are monitored to identify the following:

- Circuit open
- Out of range low
- Circuit low
- Circuit high

Engine Coolant Temperature (ECT) Sensor, Rationality Monitors

The ECT sensor is monitored for rationality at key **ON** by comparing the ECT with engine oil temperature (EOT) and engine turbocharger compressor outlet temperature. For more information refer to "Engine Coolant Temperature (ECT) Sensor Overview", page 8 .

Engine Exhaust Gas Recirculation (EGR), Differential Pressure Sensor, Circuit Monitoring

The engine EGR differential pressure sensor circuits are monitored to identify the following:

- Circuit low
- Circuit high
- Circuit open

Engine Exhaust Gas Recirculation (EGR), Differential Pressure Sensor, Rationality Monitors

Engine EGR differential pressure is estimated based on engine speed (RPM) or torque and corrected for variable geometry turbocharger (VGT) position, EGR valve position, intake manifold pressure (IMP) and barometric pressure (BARO). This estimated engine EGR differential pressure is compared with actual measured pressure. This comparison is used to identify if the engine EGR differential pressure sensor is faulty. During certain conditions the engine EGR differential pressure should be zero. The engine EGR differential pressure sensor is also monitored during these conditions to verify that the engine EGR is closing as necessary as well as to verify proper engine EGR differential pressure sensor operation.

Engine Exhaust Gas Recirculation (EGR) Temperature Sensor, Circuit Monitors

The engine EGR temperature sensor circuits are monitored to identify the following:

- Circuit open
- Out of range low
- Out of range high
- Circuit low
- Circuit high

Engine Exhaust Gas Recirculation (EGR) Temperature Sensor, Rationality Monitors

For information about the engine EGR temperature sensor rationality refer to “Intake Air Temperature (IAT) Sensor, Rationality Monitors”, page 20.

Engine Exhaust Gas Temperature (EGT) Sensors, Circuit Monitors

The exhaust system is equipped with the following three engine EGT sensors:

1 Engine EGT sensor

2 Aftertreatment diesel particulate filter (DPF) intake temperature sensor

3 Aftertreatment DPF outlet temperature sensor

The engine EGT sensor circuits are monitored to identify the following:

- Circuit open
- Out of range low
- Out of range high
- Circuit low
- Circuit high

Engine Exhaust Gas Temperature (EGT) Sensors, Rationality Monitors

There are two independent tests that can evaluate temperature sensor plausibility in the exhaust system. One is performed while stationary and the other is performed at cold start. Each sensors output value is used to compare against the other sensor values. This in turn is used to determine the plausibility of the sensors. If the temperatures received by any of the sensors is deemed to be out of range, a plausibility fault is set.

Engine Turbocharger Compressor Bypass Valve Solenoid, Circuit Monitors

The engine turbocharger compressor bypass valve solenoid circuits are monitored to identify the following:

- Circuit open
- Circuit low
- Circuit high

Engine Turbocharger Compressor Bypass Valve Solenoid, Rationality Monitors

The engine turbocharger compressor bypass valve solenoid fault detection is performed during the phase where the valve is opened, the intake manifold pressure (IMP) is monitored and compared to the maximum allowed.

Engine Turbocharger Compressor Outlet Temperature Sensor, Circuit Monitors

The engine turbocharger compressor outlet temperature sensor circuits are monitored to identify the following:

- Circuit open
- Out of range low
- Out of range high
- Circuit low
- Circuit high

Engine Turbocharger Compressor Outlet Temperature Sensor, Rationality Monitors

The engine turbocharger compressor outlet temperature sensor, is monitored for rationality by comparing the sensor output value against an estimated temperature based on ambient air temperature (AAT), intake manifold pressure (IMP), barometric pressure (BARO) and a calculated efficiency of the turbocharger.

Engine Turbocharger Speed Sensor, Circuit Monitors

The engine turbocharger speed sensor circuits are monitored to identify the following:

- Circuit open
- Out of range low
- Out of range high
- Circuit low
- Circuit high

Engine Turbocharger Speed Sensor, Rationality Monitors

An engine turbocharger speed sensor test is run within a set of conditions to evaluate the speed sensor output value. The engine turbocharger speed sensor value is compared to a calculated speed value that is based on intake manifold pressure (IMP). If the sensor output value is deemed out of range a fault is set.

Engine Variable Geometry Turbocharger (VGT) Actuator Position, Circuit Monitors

The engine VGT actuator position position actuator circuits are monitored to identify the following:

- Circuit open
- Circuit low
- Circuit high

Engine Variable Geometry Turbocharger (VGT) Actuator Position, Rationality Monitors

The engine VGT has a smart actuator position that is checked within Smart Remote Actuator (SRA) unit. Engine VGT position is then communicated to engine control module (ECM) via the SAE J1939 (CAN) data link.

Exhaust Gas Recirculation (EGR) Valve Actuator, Circuit Monitors

The EGR valve actuator circuits are monitored to identify the following:

- Circuit open
- Circuit low
- Circuit high

Exhaust Gas Recirculation (EGR) Valve Actuator, Rationality Monitors

When EGR valve is commanded to be closed, the EGR differential pressure sensor is monitored and expects no pressure difference between upstream and downstream of EGR venture. A fault occurs when differential pressure greater than a fault limit due to a stuck-open EGR valve or a leaking EGR valve is detected for a period of time. A stuck-closed EGR valve can be detected if the difference from the actual burned fraction to the demanded burned fraction is lower than a fault limit for a period of time. There is no EGR Valve position feedback.

Fan, Circuit Monitors

The fan circuits are monitored to identify the following:

- Circuit open
- Circuit low
- Circuit high

Electrical power is supplied to the fan drive from the chassis. Circuit monitoring is performed on the low side drive. The fan circuitry is such, that when the low side drive is opened the fan will be on. Closing the path to ground causes the fan to turn off. Since the low side is monitored the checks are only performed under certain conditions:

- Open circuit monitoring is only performed when the fan is ON (open circuit low). The open circuit fault detects when power is not supplied to the high side of the fan drive
- Circuit low monitoring is only performed when the fan is ON (open circuit low). The circuit low fault detects when the low side control line is shorted to ground
- Circuit high monitoring is only performed when the fan is OFF (closed circuit low). The circuit high fault detects an over-current condition on the low side control line. If this over-current condition is detected the drive is disabled (fan ON) until the key is cycled

Some fans also have a fan speed sensor. If the fan is equipped with a speed sensor circuit high is also supported. This diagnostic is used for any electrical cause of a missing signal. If the fan does not support a speed sensor this circuit monitor is not supported.

Fan, Rationality Monitors

Fan speed is calculated from the commanded percent engagement, the engine speed and the fan drive ratio. If a fan speed sensor is present the sensor speed signal is sent.

Injector, Circuit Monitors

The injector circuits are monitored to identify the following:

- Circuit open
- Circuit low
- Circuit high

Intake Air Temperature (IAT) Sensor, Circuit Monitors

The IAT sensor circuits are monitored to identify the following:

- Circuit open
- Out of range low
- Circuit low
- Circuit high

Intake Air Temperature (IAT) Sensor, Rationality Monitors

The IAT sensor is used to calculate engine charge air cooler (CAC) ambient air temperature (AAT). The CAC AAT can be calculated in the two following ways,

- Using engine exhaust exhaust gas recirculation (EGR) temperature and IAT with their corresponding mass flow rates.
- Using AAT, engine turbocharger compressor outlet temperature and the mass air flow (MAF) rate.

If there is a mismatch in these two estimated temperatures it is concluded that the most probably cause is on of the temperature sensors. The system then rationalizes which sensor is faulty.

Intake Manifold Pressure (IMP) Sensor Circuit Monitoring

The IMP sensor circuits are monitored to identify the following:

- Circuit open
- Out of range low
- Out of range high
- Circuit low
- Circuit high

Intake Manifold Pressure (IMP) Sensor Rationality Monitors

The IMP sensor, BARO sensor, and crankcase pressure (CCP) sensor should show the same pressure when engine speed and torque is low. The diagnosis calculates the difference between:

- BARO and IMP
- BARO and CCP
- IMP and CCP

These comparisons are used to identify defects.

Injector, Rationality Monitors

For injector rationality monitor information refer to “Fuel System”, page 9 .

Parking Brake Switch, Circuit Monitors

The vehicle electronic control unit (VECU) does not support comprehensive circuit monitoring on parking brake switch.

Parking Brake Switch, Rationality Monitors

The vehicle electronic control unit (VECU) does not support rationality monitors on the parking brake switch.

Power Take-off (PTO) Enable Switch, Circuit Monitors

The vehicle electronic control unit (VECU) does not support comprehensive circuit monitoring for the PTO enable switch input. However, based on the type of failure modes to the circuit the PTO operation will be or become non-functional. The failure mode behaviors are defined as:

- **Short to Ground –** A short circuit to ground will result in a non-functional PTO operation.
- **Short to Battery –** A short circuit to battery voltage will not have an immediate affect to the PTO operation, but will result in a non-functional PTO operation after exiting the PTO function or during the next VECU power down/up sequence (I.e. Cycling of the ignition key switch).
- **Open Circuit –** An open will result in a non-functional PTO operation.

Power Take-off (PTO) Enable Switch, Rationality Monitors

The vehicle electronic control unit (VECU) does not support rationality monitors on the PTO enable switch.

SAE J1939 (CAN1) Data Link, Circuit Monitors

Error detection of the SAE J1939 (CAN1) data link is performed by multiple electronic control units (ECUs). An ECU detecting an error condition signals this by transmitting an error flag. There are 5 types of error detections:

- Bit error
- Stuff error
- Cyclic Redundancy Code (CRC) error
- Form error
- Acknowledgement error

SAE J1939 (CAN1) Data Link, Rationality Monitors

Rationality monitors do not exist for the SAE J1939 (CAN1) data link.

SAE J1939 (CAN2) Data Link, Overview

The SAE J1939 (CAN2) data link is a sub-data link that communicates information directly to the engine control module (ECM). There's no direct communication to other electronic control units (ECUs) residing on the on the SAE J1939 (CAN1) data link. Information that is sent across the CAN2 data link can be shared on the CAN1 data link via the ECM. Diagnostic trouble codes (DTCs) are set when an ECU is found to not be communicating or recognized on the data link (off bus mode) or when there is an abnormal rate of occurrence of errors on the data link.

SAE J1939 (CAN2) Data Link, Circuit Monitors

Error detection of the SAE J1939 (CAN2) data link is performed by multiple electronic control units (ECUs). An ECU detecting an error condition signals this by transmitting an error flag. There are 5 types of error detections:

- Bit error
- Stuff error
- Cyclic Redundancy Code (CRC) error
- Form error
- Acknowledgement error

SAE J1939 (CAN2) Data Link, Rationality Monitors

Rationality monitors do not exist for the SAE J1939 (CAN2) data link.

Time/Date, Circuit Monitoring

The instrument cluster does not support comprehensive circuit monitoring for the Time/Date.

Time/Date, Rationality Monitoring

The engine control module (ECM) does support rational monitoring by comparing time and date from instrument cluster. Soak time is based on engine cooling down using temperatures before and after soak.

Vehicle Speed Sensor (VSS), Circuit Monitors

The comprehensive circuit monitors are supported by the vehicle electronic control unit (VECU) and are determined by the vehicle road speed source. When a dedicated speed sensor is used, electrical error detection is supported. When the transmission output shaft speed (OSS) sensor is used via the SAE J1939 data link, the diagnostics are based on a communication timeout and receiving "error indicator" flagged from the transmitting electronic control unit (ECU).

Vehicle Speed Sensor (VSS), Rationality Monitors

Error detection is performed by comparing another source of vehicle speed information to the calculated vehicle road speed. At zero vehicle road speed an error is generated when the comparison vehicle speed source (ABS/EBS) is higher than a specified limit. When the vehicle road speed is greater than zero the difference between the calculated vehicle road speed and the comparison vehicle speed source (ABS/EBS) is not allowed to be greater than a specified value or a fault is registered.

Troubleshooting

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

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

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

SAE J1939 Data Link Communication

The electronic control units (ECUs) that communicate on the SAE J1939 data link, communicate according to the SAE J1587 standard. The diagnostic trouble codes (DTCs) set by the ECUs contain information that is described by the following abbreviations.

SA	Source Address: Identification of a control module.
SPN	Suspect Parameter Number: Identification of a parameter (value).
FMI	Failure Mode Identifier: Identification of fault types.

SAE J1939 FMI Table

FMI	SAE Text
0	Data valid but above normal operational range - Most severe level
1	Data valid but below normal operational range - Most severe level
2	Data erratic, intermittent or incorrect
3	Voltage above normal, or shorted to high source
4	Voltage below normal, or shorted to low source
5	Current below normal or open circuit
6	Current above normal or grounded circuit
7	Mechanical system not responding or out of adjustment
8	Abnormal frequency or pulse width or period
9	Abnormal update rate
10	Abnormal rate of change
11	Root cause not known
12	Bad intelligent device or component
13	Out of calibration
14	Special instructions
15	Data valid but above normal operating range - Least severe level
16	Data valid but above normal operating range - Moderately severe level
17	Data valid but below normal operating range - Least severe level
18	Data valid but below normal operating range - Moderately severe level
19	Received network data in error
20	Reserved for SAE assignment
21	Reserved for SAE assignment
22	Reserved for SAE assignment
23	Reserved for SAE assignment
24	Reserved for SAE assignment
25	Reserved for SAE assignment
26	Reserved for SAE assignment
27	Reserved for SAE assignment
28	Reserved for SAE assignment
29	Reserved for SAE assignment
30	Reserved for SAE assignment
31	Condition exists

SAE J1587 Data Link Communication

The electronic control units (ECUs) also communicate on the SAE J1587 data link. These ECUs communicate according to the SAE J1587 standard. The standard has been extended with MACK's supplement (PPID, PSID). The diagnostic trouble codes (DTCs) set by the ECUs contain information that is described by the following abbreviations.

MID — Message Identification Description: Identification of a control module.

PID — Parameter Identification Description: Identification of a parameter (value).

PPID — Proprietary Parameter Identification Description Mack: Unique identification of a parameter (value).

SID — Subsystem Identification Description: Identification of a component.

PSID — Proprietary Subsystem Identification Description Mack: Unique identification of a component.

FMI — Failure Mode Identifier: Identification of fault types.

SAE J1587 FMI Table

FMI	SAE Text
0	Data valid, but above the normal working range
1	Data valid, but below the normal working range
2	Intermittent or incorrect data
3	Abnormally high voltage or short circuit to higher voltage
4	Abnormally low voltage or short circuit to lower voltage
5	Abnormally low current or open circuit
6	Abnormally high current or short circuit to ground
7	Incorrect response from a mechanical system
8	Abnormal frequency
9	Abnormal update rate
10	Abnormally strong vibrations
11	Non-identifiable fault
12	Faulty module or component
13	Calibration values outside limits
14	Special instructions
15	Reserved for future use

Diagnostic Trouble Code (DTC) Content

SPN 0–500

SPN 500–999

SPN 1000–1999

SPN 2000–2999

SPN 3000–3999

SPN 4000–5500

ECM SPN 84, Wheel-Based Vehicle Speed – MID 128 PID 84

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 9	• Abnormal update rate	• Missing signal from VECU	• Engine derate	• SAE J1587 data link vehicle speed message does not exist, (VECU error) • VECU
FMI 10	• Abnormal rate of change	• Vehicle speed deemed inaccurate by VECU	• MIL illuminated (13L engine only)	• Vehicle speed sensor (VSS) • VECU
FMI 13	• Out of calibration	• No vehicle speed available to VECU	• MIL illuminated (13L engine only)	• Vehicle speed sensor (VSS) • VECU
FMI 19	• Received network data in error	• Vehicle speed deemed inaccurate by VECU	• MIL illuminated (13L engine only)	• Vehicle speed sensor (VSS) • VECU

ECM SPN 91, Accelerator Pedal Position 1 – MID 128 PID 91

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 9	• Abnormal update rate	• Missing signal from VECU	• N/A	• SAE J1587 data link pedal information not available
FMI 13	• Out of calibration	• Pedal not connected to VECU	• MIL illuminated (13L engine only)	• Accelerator pedal sensor fault
FMI 10	• Abnormal rate of change	• Pedal position deemed inaccurate by VECU	• MIL illuminated (13L engine only)	• Accelerator pedal sensor fault
FMI 19	• Received network data in error	• Pedal position deemed inaccurate by VECU	• MIL illuminated (13L engine only)	• Accelerator pedal sensor fault

ECM SPN 94, Engine Fuel Delivery Pressure – MID 128 PID 94

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Low fuel pressure sensor signal line voltage	• N/A	• Damaged contacts in harness • Faulty fuel pressure sensor • Open circuit.
FMI 5	• Current below normal or open circuit	• Low fuel pressure sensor signal line voltage	• N/A	• Damaged contacts in harness • Faulty fuel pressure sensor

FMI 7	• Mechanical system not responding properly	• Drop in fuel pressure	• Engine derate	• Clogged fuel filter • Faulty fuel pressure sensor • Leaking fuel line or fitting • Poor fuel pump response
FMI 13	• Out of Calibration	• Sensor indicates a invalid value	• N/A	• Wiring harness • Faulty fuel pressure sensor • Clogged fuel filter
FMI 15	• Data valid but above normal operating range - Least severe level	• Sensor indicates a invalid value	• N/A	• Wiring harness • Faulty fuel pressure sensor
FMI 17	• Data valid but below normal operating range - Least severe level	• Sensor indicates a invalid value	• N/A	• Wiring harness • Faulty fuel pressure sensor • Clogged fuel filter
FMI 18	• Data valid but below normal operating range - Moderately severe level	• Drop in fuel pressure	• Engine derate	• Clogged fuel filter • Faulty fuel pressure sensor • Leaking fuel line or fitting • Poor fuel pump response

ECM SPN 97, Water in Fuel Indicator – MID 128 PID 97

Type of fault:	**FMI Description:**	**Fault Condition:**	**Possible Symptoms:**	**Possible Cause:**
FMI 0	• Data valid but above normal operational range - Most severe level	• Water in fuel is indicated	• Uneven running • Engine stalling	• Water in fuel
FMI 3	• Voltage above normal, or shorted to high source	• N/A	• Undetected water in fuel supply • Uneven running • Engine stalling	• Open circuit
FMI 4	• Voltage below normal, or shorted to low source	• N/A	• Undetected water in fuel supply • Uneven running	• Short to ground • Open circuit • Faulty sensor

ECM SPN 98, Engine Oil Level – MID 128 PID 98

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 1	• Data valid but above normal operational range	• Critically below range	• Red engine shutdown or yellow electronic malfunction lamps illuminated dependent of severity	• Low oil level leakage • Critically low oil level
FMI 4	• Voltage below normal, or shorted to low source	• Short Circuit - Positive side	• Oil level can not be measured	• Engine Oil Level (EOL) sensor failure • Faulty harness
FMI 5	• Current below normal or open circuit	• Short Circuit +, Positive side • Open Circuit +, Positive side • Open Circuit- Negative side	• Oil level can not be measured	• Engine Oil Level (EOL) sensor failure • Faulty harness
FMI 18	• Data valid but below normal operating range - Moderately severe level	• Moderately below range • Critically below range	• Red engine shutdown or Yellow electronic malfunction lamps illuminated dependent of severity	• Low oil level leakage • Moderately low oil level

ECM SPN 100, Engine Oil Pressure – MID 128 PID 100

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 1	• Data valid but below normal operational range	• Critically below range	• Engine derate • Low pressure • Red engine shutdown lamp illuminated	• Oil leakage • Broken oil pump • Clogged oil system
FMI 3	• Voltage below normal or shorted low	• Short Circuit +, Measuring line • Open Circuit, Ground line	• Oil pressure shows 0 in the cluster, engine is running • Yellow electronic malfunction lamp illuminated	• Engine Oil Pressure (EOP) sensor failure • Faulty harness

FMI 5	• Current below normal or open circuit	• Open Circuit +, 5V Supply line • Short Circuit -, Measuring line • Open Circuit, Measuring line	• Oil pressure shows 0 in the cluster, engine is running • Yellow electronic malfunction lamps illuminated	• Engine Oil Pressure (EOP) sensor failure • Faulty harness
FMI 13	• Out of Calibration	• Sensor indicates a invalid value	• Oil pressure shows 0 in the cluster, engine is running	• Engine Oil Pressure (EOP) sensor failure • Faulty harness
FMI 15	• Data valid but above normal operating range - Least severe level	• Sensor indicates a invalid value	• Oil pressure shows 0 in the cluster, engine is running	• Engine Oil Pressure (EOP) sensor failure • Faulty harness
FMI 17	• Data valid but below normal operating range - Least severe level	• Sensor indicates a invalid value	• Oil pressure shows 0 in the cluster, engine is running	• Engine Oil Pressure (EOP) sensor failure • Faulty harness

ECM SPN 102, Engine Intake Manifold 1 Pressure – MID 128 PID 102

Type of fault:	**FMI Description:**	**Fault Condition:**	**Possible Symptoms:**	**Possible Cause:**
FMI 2	• Data erratic, intermittent or incorrect	• Intake Manifold Pressure Sensor output is too high or too low	• Engine derate • MIL lamp illuminated	• Faulty harness • Intake Manifold Pressure sensor
FMI 3	• Voltage above normal, or shorted to high source	• A short to battery in the metering circuit • An open in the ground circuit of the Intake Manifold Pressure Sensor	• Engine derate • MIL lamp illuminated	• Faulty harness • Harness connectors • Intake Manifold Pressure sensor
FMI 5	• Current below normal or open circuit	• A short to ground in the harness • An open in the 5 volt supply circuit • An open in the metering circuit	• Engine derate • MIL lamp illuminated	• Faulty harness • Harness connectors • Intake Manifold Pressure sensor
FMI 12	• Bad intelligent device or component	• Intake Manifold Pressure sensor output is too high • Sensor indicates a invalid value	• Engine derate • MIL lamp illuminated	• Faulty harness • Intake Manifold Pressure sensor

FMI 13	• Out of Calibration	• Sensor indicates a invalid value	• Engine derate • MIL lamp illuminated	• Faulty harness • Harness connectors • Intake Manifold Pressure sensor
FMI 14	• Special instructions	• Intake Manifold Pressure sensor output is too low • Sensor indicates a invalid value	• Engine derate • MIL lamp illuminated	• Faulty harness • Intake Manifold Pressure sensor • Inlet air leakage
FMI 15	• Data valid but above normal operating range - Least severe level	• Intake Manifold Pressure sensor output is too high	• Engine derate • MIL lamp illuminated	• Faulty harness • Harness connectors • Intake Manifold Pressure sensor
FMI 17	• Data valid but below normal operating range - Least severe level	• Sensor indicates a invalid value	• Engine derate • MIL lamp illuminated	• Faulty harness • Harness connectors • Intake Manifold Pressure sensor

ECM SPN 103, Engine Turbocharger 1 Speed – MID 128 PID 103

Type of fault:	**FMI Description:**	**Fault Condition:**	**Possible Symptoms:**	**Possible Cause:**
FMI 0	• Data valid but above normal operational range	• Turbocharger speed is at least 25% greater than the target wheel speed for the measured boost	• Engine derate • MIL illuminated	• Miss detection • Faulty harness • Faulty harness connector • Turbocharger Speed Sensor
FMI 1	• Data valid but below normal operational range - Most severe level	• Turbocharger speed is at least 25% less than the target wheel speed for the measured boost	• Engine derate • MIL illuminated	• Miss detection • Faulty harness • Faulty harness connector • Turbocharger Speed Sensor
FMI 9	• Abnormal update rate	• A fault is logged if the Turbocharger Speed Sensor signal is lost	• Engine derate • MIL illuminated	• Faulty harness • Faulty harness connector • Turbocharger Speed Sensor
FMI 15	• Data valid but above normal operating range - Least severe level	• Turbocharger speed is at least 25% greater than the target wheel speed for the measured boost	• Engine derate • MIL illuminated	• Miss detection • Faulty harness • Faulty harness connector • Turbocharger Speed Sensor
FMI 17	• Data valid but below normal operating range - Least severe level	• Turbocharger speed is at least 25% less than the target wheel speed for the measured boost	• Engine derate • MIL illuminated	• Miss detection • Faulty harness • Faulty harness connector • Turbocharger Speed Sensor

ECM SPN 105, Engine Intake Manifold 1 Temperature – MID 128 PID 105

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Sensor indicates a invalid value	• Engine derate	• Poor cooling • Extreme running conditions
FMI 2	• Data erratic, intermittent or incorrect	• The Intake Manifold Temperature sensor output is too high or too low	• Engine derate • MIL illuminated	• Poor cooling • Extreme running conditions • Engine Intake Manifold sensor • Faulty harness • Faulty harness connector • Ambient Air Temperature sensor
FMI 4	• Voltage below normal, or shorted to low source	• N/A	• Difficult to start in cold climates • Minor cold engine smoke • Engine derate • MIL illuminated	• Engine Intake Manifold sensor • Faulty harness • Faulty harness connector
FMI 5	• Current below normal or open circuitt	• Possible short to sensor	• Difficult to start in cold climates • Engine derate • MIL illuminated	• Engine Intake Manifold sensor • Faulty harness • Faulty harness connector
FMI 13	• Out of Calibration	• The sensor output is showing a constant value	• Engine derate • Minor cold engine smoke • MIL illuminated	• Engine Intake Manifold sensor • Faulty harness • Faulty harness connector
FMI 17	• Data valid but below normal operating range - Least severe level	• The sensor output is showing a constant value	• Engine derate • Minor cold engine smoke • MIL illuminated	• Engine Intake Manifold sensor • Faulty harness • Faulty harness connector

ECM SPN 108, Barometric Pressure – MID 128 PID 108

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 2	• Data erratic, intermittent or incorrect	• Barometric Pressure sensor output is too high or too low	• Minor engine derate • MIL illuminated	• Faulty Sensor • Faulty Engine Control Module

FMI 3	• Voltage above normal, or shorted to high source	• Short to battery on the metering side	• MIL illuminated	• Internal fault in the Engine Control Module • Faulty Sensor
FMI 4	• Voltage below normal, or shorted to low source	• A short to ground on the metering side	• MIL illuminated	• Internal fault in the Engine Control Module • Faulty Sensor

ECM SPN 110, Engine Coolant Temperature – MID 128 PID 110

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Coolant temperature indicates critical limit	• Engine derate • Red engine shutdown lamp illuminated	• Extreme driving condition • Faulty coolant thermostat • Malfunctioning fan • Blocked radiator
FMI 2	• Data erratic, intermittent or incorrect	• Engine Coolant Temperature sensor output is too high or too low	• May affect driveability in extreme cases • MIL illuminated	• Faulty Sensor • Faulty harness • Faulty coolant thermostat
FMI 4	• Voltage below normal or shorted low	• Engine Coolant Temperature sensor voltage too low	• Difficult to start in cold climates • Idle run regulation is deteriorated • MIL illuminated	• Faulty Sensor • Faulty harness
FMI 5	• Current below normal or open circuit	• N/A	• Difficult to start in cold climates • Idle run regulation is deteriorated • MIL illuminated	• Faulty Sensor • Faulty harness
FMI 10	• Abnormal rate of change	• Engine Coolant Temperature sensor output is showing a constant value	• May affect vehicle driveability • MIL illuminated	• Faulty Sensor • Faulty harness
FMI 13	• Out of Calibration	• Sensor out of range • Sensor indicates a invalid value	• MIL illuminated	• Faulty Sensor

FMI 16	• Data valid but above normal operating range - Moderately severe level	• Coolant temperature indicates moderate upper limit	• Engine derate • Yellow electronic malfunction lamp illuminated	• Extreme driving condition • Faulty coolant thermostat • Malfunctioning fan • Blocked radiator
FMI 17	• Data valid but below normal operating range - Least severe level	• Sensor out of range • Sensor indicates a invalid value	• MIL illuminated	• Faulty Sensor

ECM SPN 111, Engine Coolant Level – MID 128 PID 111

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 1	• Data valid but below normal operational range - Most severe level	• Critically below range • Coolant level can not be detected	• Engine derate • Red engine shutdown lamp illuminated • Coolant level can not be detected	• Coolant level below range • Faulty harness
FMI 3	• Voltage above normal, or shorted to high source	• Short Circuit +, measuring line • Coolant level can not be detected	• Coolant level can not be detected • Yellow electronic malfunction lamp illuminated	• Faulty harness • Faulty harness connector • Faulty level sensor
FMI 4	• Voltage below normal, or shorted to low source	• Short Circuit -, measuring line • Coolant level can not be detected	• Coolant level can not be detected • Yellow electronic malfunction lamp illuminated	• Faulty harness • Faulty harness connector • Faulty level sensor
FMI 5	• Current below normal or open circuit	• Open Circuit • Coolant level can not be detected	• Coolant level can not be detected • Yellow electronic malfunction lamp illuminated	• Faulty harness • Faulty harness connector • Faulty level sensor
FMI 14	• Special instructions	• Sensor out of range • Sensor indicates a invalid value	• Coolant level can not be detected • Yellow electronic malfunction lamp illuminated	• Faulty harness • Faulty harness connector • Faulty level sensor
FMI 18	• Data valid but below normal operating range - Moderately severe level	• Sensor out of range • Sensor indicates a invalid value	• Coolant level can not be detected • Yellow electronic malfunction lamp illuminated	• Faulty harness • Faulty harness connector • Faulty level sensor

ECM SPN 153, Engine High Resolution Crankcase Pressure – MID 128 PID 153/PSID 23

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Out of range, max voltage, illegal • Critically Above Range	• Red engine shutdown lamp illuminated • Forced idle • Engine shut down	• Piston ring blow-by
FMI 2	• Data erratic, intermittent or incorrect	• Crankcase pressure indication to high or to low a value	• MIL illuminated	• Faulty Crank Case Pressure senor • Faulty harness
FMI 3	• Voltage above normal or shorted to high source	• Short Circuit +, Measuring line • Open Circuit, Ground line	• MIL illuminated • Yellow electronic malfunction lamp illuminated	• Faulty Crank Case Pressure senor • Faulty harness
FMI 5	• Current below normal or open circuit	• Open Circuit +, 5V Supply Line • Short Circuit -, measuring line • Open Circuit, measuring line	• MIL illuminated • Yellow electronic malfunction lamp illuminated	• Faulty Crank Case Pressure senor • Faulty harness
FMI 7	• Mechanical system not responding or out of adjustment	• Leakage detected in the crankcase ventilation system	• MIL illuminated	• Faulty separator, hoses or pipes
FMI 13	• Out of Calibration	• Sensor out of range • Sensor indicates a invalid value	• MIL illuminated	• Faulty Sensor
FMI 15	• Data valid but above normal operating range - Least severe level	• Sensor out of range • Sensor indicates a invalid value	• MIL illuminated	• Faulty Sensor
FMI 17	• Data valid but below normal operating range - Least severe level	• Sensor out of range • Sensor indicates a invalid value	• MIL illuminated	• Faulty Sensor

ECM SPN 158, Keyswitch Battery Potential – MID 128 PID 158/PSID 124

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range	• Engine Control Module battery voltage too high	• N/A	• Charging system fault • External charger • Engine control module (ECM)

FMI 1	• Data valid but below normal operational range	• Engine Control Module battery voltage too low	• Starter will not crank	• Charging system fault • Battery • Ground connection
FMI 3	• Voltage above normal, or shorted to high source	• Engine Control Module battery voltage too high	• N/A	• Charging system fault • External charger • Engine control module (ECM)
FMI 4	• Voltage below normal, or shorted to low source	• Engine Control Module battery voltage too low	• Starter will not crank	• Charging system fault • Battery • Ground connection
FMI 16	• Data valid but above normal operating range - Moderately severe level	• Engine Control Module battery voltage too high	• N/A	• Charging system fault • External charger • Engine control module (ECM)
FMI 18	• Data valid but below normal operating range - Moderately severe level	• Engine Control Module battery voltage too low	• Starter will not crank	• Charging system fault • Battery • Ground connection

ECM SPN 171, Ambient Air Temperature – MID 128 PID 171

Type of fault:	**FMI Description:**	**Fault Condition:**	**Possible Symptoms:**	**Possible Cause:**
FMI 2	• Data erratic, intermittent or incorrect	• Key ON, Ambient Air Temperature message missing on SAE J1939 and SAE J1587 data links	• N/A	• Faulty instrument cluster • Faulty harness
FMI 9	• Abnormal Update Rate	• Key ON, Ambient Air Temperature message missing on SAE J1587 data link	• N/A	• Faulty instrument cluster • Faulty harness
FMI 10	• Abnormal rate of change	• Ambient Temperature sensor signal fault	• MIL illuminated (13L engine only)	• Faulty instrument cluster
FMI 12	• Bad intelligent device or component	• Loss of SAE J1939 data link communication between Engine Control Module and Instrument Cluster Control Module	• MIL illuminated (13L engine only)	• Faulty instrument cluster • Faulty harness

FMI 13	• Out of calibration	• Ambient Temperature sensor signal fault • No ambient temperature calculated by Vehicle ECU • No valid ambient temperature received by Engine Control Module	• MIL illuminated (13L engine only)	• Faulty instrument cluster/harness or cluster harness connectors
FMI 14	• Special instructions	• Ambient Temperature sensor signal fault	• MIL illuminated	• Ambient Temperature sensor signal missing from Vehicle ECU
FMI 19	• Received network data in error	• Ambient Temperature sensor signal fault	• MIL illuminated (13L engine only)	• Faulty instrument cluster

ECM SPN 173, Engine Exhaust Gas Temperature (EGT) – MID 128 PID 173

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Exhaust Gas Temperature is critically high	• Engine derate • Poor driveability • Regeneration is not possible	• Faulty harness • Faulty harness connector • Intake air leak
FMI 2	• Data erratic, intermittent or incorrect	• Sensor is not rational	• MIL illuminated • Regeneration is not possible	• Faulty harness • Faulty harness connector • Exhaust leak • Intake air leak • Sensor failure
FMI 4	• Voltage below normal, or shorted to low source	• Short to ground on the metering side of the circuit	• MIL illuminated • Regeneration is not possible	• Sensor failure • Faulty harness • Faulty harness connector • Aftertreatment control module (ACM)
FMI 5	• Current below normal or open circuit	• Short to battery on the metering side of the circuit • Open in the metering side of the circuit • Open in the ground side of the circuit	• MIL illuminated	• Faulty harness • Sensor failure • Faulty harness connector
FMI 15	• Data valid but above normal operating range - Least severe level	• Sensor out of range • Sensor indicates a invalid value	• MIL illuminated	• Sensor failure • Faulty harness
FMI 16	• Data valid but above normal operating range - Moderately severe level	• Exhaust Gas Temperature is moderately too high	• Engine derate • Poor driveability	• Faulty harness • Faulty harness connector • Intake air leak

ECM SPN 175, Engine Oil Temperature 1 – MID 128 PID 175

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Extreme driving conditions • Engine oil temperature critically above range	• Red engine shutdown lamp illuminated • Engine derate	• Extreme driving conditions • Engine cooling fan • Oil thermostat • Coolant system • Clogged oil cooler
FMI 2	• Data erratic, intermittent or incorrect	• Engine oil temperature sensor indicating too high or too low a value (abnormal value)	• MIL illuminated (13L engine only) • In some cases may have an effect on driveability	• Engine Oil Temperature (EOT) sensor failure • Faulty harness
FMI 4	• Voltage below normal, or shorted to low source	• Short circuit -, measuring line	• MIL illuminated (13L engine only) • Yellow electronic malfunction lamp illuminated	• Engine Oil Temperature (EOT) sensor failure • Faulty harness
FMI 5	• Current below normal or open circuit	• Short circuit +, measuring line • Open circuit	• MIL illuminated (13L engine only) • Yellow electronic malfunction lamp illuminated	• Engine Oil Temperature (EOT) sensor failure • Faulty harness
FMI 13	• Out of Calibration	• Sensor out of range • Sensor indicates a invalid value	• MIL illuminated	• Engine Oil Temperature (EOT) sensor failure
FMI 16	• Data valid but above normal operating range - Moderately severe level	• Extreme driving conditions • Engine oil temperature is moderately too high	• Yellow electronic malfunction lamp illuminated • Engine derate	• Extreme driving conditions • Engine cooling fan • Oil thermostat • Coolant system • Clogged oil cooler
FMI 17	• Data valid but below normal operating range - Least severe level	• Sensor out of range • Sensor indicates a invalid value	• MIL illuminated	• Engine Oil Temperature (EOT) sensor failure

ECM SPN 177, Transmission Oil Temperature – MID 128 PID 177

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Oil temperature critically above range	• Red engine shutdown lamp illuminated	• Transmission oil cooler • Coolant system
FMI 16	• Data valid but above normal operating range - Moderately severe level	• Oil temperature is moderately too high	• Yellow electronic malfunction lamp illuminated	• Extreme driving conditions • Engine cooling fan • Oil thermostat • Coolant system • Clogged oil cooler

ECM SPN 188, Engine Speed At Idle, Point 1 (Engine Configurations) – MID 128 PID 188

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Engine idle speed above desired speed	• MIL illuminated • High engine oil consumption • High fuel consumption	• Engine oil entering cylinders • Leaking or faulty fuel injector
FMI 1	• Data valid but below normal operational range - Most severe level	• Engine idle speed below desired speed	• MIL illuminated • High fuel consumption	• Low engine torque production • Faulty fuel injector • Low cylinder compression • Engine friction is too high

ECM SPN 190, Engine Speed – MID 128 PID 190

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Engine is/was overspeeding	• Red engine shutdown lamp illuminated	• Engine oil entering cylinders • Faulty crankcase oil filter • Possible engine brake engaged causing engine overspeeding • Possible transmission downshift causing engine overspeeding

ECM SPN 228, Speed Sensor Calibration – MID 128 PID 228

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 9	• Abnormal update rate	• SAE J1587 data link calibration factor message does not exist. (VECU error).	• Wrong trip data	• Vehicle ECU
FMI 11	• Failure mode not identifiable	• SAE J1587 data link calibration factor message does not exist. (VECU error).	• Wrong trip data	• Vehicle ECU

ECM SPN 237, Vehicle Identification Number – MID 128 PSID 161/162

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 2	• Data erratic, intermittent or incorrect	• No answer from VIN	• Yellow electronic malfunction lamp illuminated • Engine will not start	• Data link error • ECM • Missing VIN in other ECM's (commonly VECU, LCM)
FMI 12	• Bad intelligent device or component	• Bad answer from VIN	• Yellow electronic malfunction lamp illuminated • Engine will not start	• ECM • Mismatched VIN sent from other ECM's (commonly VECU, LCM)

ECM SPN 245, Total Vehicle Distance – MID 128 PID 245

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 9	• Abnormal update rate	• SAE J1587 data link total vehicle distance message does not exist. (VECU error).	• N/A	• Vehicle ECU

ECM SPN 251, Time – MID 128 PID 251

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 2	• Data erratic, intermittent or incorrect	• Time data message missing on SAE J1587 and J1939 data links. (Cluster error). • Time stamp from cluster isn't available.	• N/A	• Instrument Cluster
FMI 9	• Abnormal update rate	• Time data message didn't arrive when expected. (Cluster error). • Time stamp from cluster isn't available.	• N/A	• Instrument Cluster
FMI 10	• Abnormal rate of change	• Soak time too long. • Time data fault, data deemed inaccurate.	• MIL illuminated (13L engine only) • Engine makes warm start but cold start needed.	• Instrument Cluster
FMI 12	• Bad intelligent device or component	• Time and date data missing on J1939 data link.	• MIL illuminated	• Instrument Cluster • Faulty harness • Faulty harness connector
FMI 13	• Out of calibration	• Time/date fault	• MIL illuminated (13L engine only)	• Instrument Cluster • Faulty harness • Faulty harness connector
FMI 19	• Received network data in error	• Soaktime too long. • Time data fault, data deemed inaccurate.	• MIL illuminated (13L engine only)	• Instrument Cluster

ECM SPN 252, Date – MID 128 PID 252

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 9	• Abnormal update rate	• Time stamp from cluster isn't available. • Date data message missing on SAE J1587 data link. (Cluster error).	• N/A	• Instrument Cluster

ECM SPN 411, Engine Exhaust Gas Recirculation Differential Pressure – MID 128 PID 411

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Exhaust Gas Recirculation (EGR) differential pressure sensor output reading too high. (abnormal value)	• MIL illuminated • Engine derate	• Faulty harness • Faulty harness connector • Faulty sensor • EGR leakage • Clogged EGR cooler
FMI 1	• Data valid but below normal operational range - Most severe level	• Exhaust Gas Recirculation (EGR) differential pressure sensor output reading too low. (abnormal value)	• MIL illuminated	• Faulty harness • Faulty harness connector • Faulty sensor • Clogged venturi
FMI 2	• Data erratic, intermittent or incorrect	• Only used to control EGR valve.	• N/A	• N/A
FMI 3	• Voltage above normal or shorted to high source	• Short to battery in metering line • Open in the ground circuit	• MIL illuminated • Engine derate	• Faulty EGR differential pressure sensor connector • Faulty EGR differential pressure sensor harness • Faulty EGR differential pressure sensor

FMI 5	• Current below normal or open circuit	• Open in the 5 volt supply line • Short to ground in metering line • Open in the metering line	• MIL illuminated • Engine derate	• Faulty EGR differential pressure sensor connector • Faulty EGR differential pressure sensor harness • Faulty EGR differential pressure sensor
FMI 7	• Mechanical system not responding or out of adjustment	• EGR differential pressure sensor is read either to high or too low. (Abnormal value).	• MIL illuminated • Engine derate	• Faulty EGR differential pressure sensor connector • Faulty EGR differential pressure sensor harness • Faulty EGR differential pressure sensor • EGR valve • EGR valve leak • Clogged venturi

ECM SPN 412, Engine Exhaust Gas Recirculation Temperature – MID 128 PID 412

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Engine Exhaust Gas Recirculation Temperature is above range	• Engine derate	• Extreme driving conditions • EGR cooler failure
FMI 2	• Data erratic, intermittent or incorrect	• EGR temperate signal, believed to be not valid (plausibility fault)	• MIL illuminated • Engine derate	• Faulty sensor
FMI 4	• Voltage below normal, or shorted to low source	• Short to ground on the metering side of the EGR Sensor circuit	• MIL illuminated • Engine power will be derated according to the error torque map	• Faulty EGR Temperature Sensor connector • Faulty EGR Temperature Sensor harness • Faulty EGR Temperature Sensor
FMI 5	• Current below normal or open circuit	• Short to battery in the metering side of the EGR Sensor circuit • Open in the metering side of the EGR Sensor circuit • Open circuit in the ground line of the EGR Sensor circuit	• MIL illuminated • Engine derate	• Faulty EGR Temperature Sensor connector • Faulty EGR Temperature Sensor harness • Faulty EGR Temperature Sensor

FMI 13	• Out of calibration	• Engine Exhaust Gas Recirculation Temperature sensor is out of range (low) • Sensor indicates a invalid value	• MIL illuminated	• Faulty EGR Temperature Sensor connector • Faulty EGR Temperature Sensor harness • Faulty EGR Temperature Sensor
FMI 13	• Out of calibration	• Engine Exhaust Gas Recirculation Temperature sensor is above range	• Engine derate	• Extreme driving conditions • EGR cooler failure
FMI 15	• Data valid but above normal operating range - Least severe level	• Engine Exhaust Gas Recirculation Temperature sensor is out of range (high) • Sensor indicates a invalid value	• MIL illuminated	• Faulty EGR Temperature Sensor connector • Faulty EGR Temperature Sensor harness • Faulty EGR Temperature Sensor
FMI 16	• Data valid but above normal operating range - Moderately severe level	• Engine Exhaust Gas Recirculation Temperature is above range	• Engine derate	• Extreme driving conditions • EGR cooler failure
FMI 17	• Data valid but below normal operating range - Least severe level	• Engine Exhaust Gas Recirculation Temperature is out of range (low) • Sensor indicates a invalid value	• MIL illuminated	• Faulty EGR Temperature Sensor connector • Faulty EGR Temperature Sensor harness • Faulty EGR Temperature Sensor

ECM SPN 558, Accelerator Pedal 1 Idle Validation Switch – MID 128 SID 230

Type of fault:	**FMI Description:**	**Fault Condition:**	**Possible Symptoms:**	**Possible Cause:**
FMI 3	• Voltage above normal, or shorted to high source	• Idle Validation Switch (IVS) signal shorted to voltage	• Yellow electronic malfunction lamp illuminated	• Faulty harness or connector
FMI 5	• Current below normal or open circuit	• Idle Validation Switch (IVS) signal shorted to ground or open	• Yellow electronic malfunction lamp illuminated	• Faulty harness or connector

ECM SPN 626, Intake Air Heater (IAH) Relay – MID 128 PID 45

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Short Circuit +, Measuring line	• Preheat relay not activated • White smoke for cold start • Start problems in cold climate	• Preheat relay solenoid shorted
FMI 4	• Voltage below normal, or shorted to low source	• Short Circuit -, Measuring line	• Red engine shutdown lamp illuminated (13L engine CXU, CHU and GU only) • Yellow electronic malfunction lamp illuminated • Induction air is hot • Preheat relay is impossible to turn off	• Faulty harness
FMI 5	• Current below normal or open circuit	• Open Circuit	• Preheat relay not activated • White smoke for cold start • Start problems in cold climate	• Faulty Preheat relay • Faulty harness

ECM SPN 628, Program Memory – MID 128 SID 240

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 2	• Data erratic, intermittent or incorrect	• Check sum error	• Red engine shutdown lamp illuminated • Engine will not start	• Engine Control Module (ECM) software
FMI 11	• Root cause not known	• Bad software configuration	• MIL illuminated • Engine will not start	• Engine Control Module (ECM) software

FMI 12	• Bad intelligent device or component	• Error on code-part of flash RAM or erased vendor area	• Red engine shutdown lamp illuminated • Nothing functions	• Engine Control Module (ECM) software • Engine Control Module (ECM)
FMI 14	• Special instructions	• VIN not loaded yet	• Flashing MIL • Engine will not start	• VIN missing

ECM SPN 629, Electronic Control Unit (ECU) 1 – MID 128 SID 254

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 8	• Abnormal frequency or pulse width or period	• Self test failure	• Red engine shutdown lamp illuminated • Not possible to program Engine Control Module (ECM)	• Engine Control Module (ECM)
FMI 12	• Bad intelligent device or component	• Self test failure	• Red engine shutdown lamp illuminated • Engine will not start	• Engine Control Module (ECM)

ECM SPN 630, Calibration Memory – MID 128 SID 253

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 2	• Data erratic, intermittent or incorrect	• Check sum error	• Red engine shutdown lamp illuminated • Engine will not start	• Engine Control Module (ECM) software

FMI 12	• Bad intelligent device or component	• Check sum error	• Red engine shutdown lamp illuminated • Engine will not start	• Engine Control Module (ECM)
FMI 14	• Special instructions	• VIN not loaded yet	• Red engine shutdown lamp illuminated • Loss of log data and some user configurable data	• Engine Control Module (ECM) software

ECM SPN 631, Calibration Module – MID 128 PSID 77/PSID 124

Type of fault:	**FMI Description:**	**Fault Condition:**	**Possible Symptoms:**	**Possible Cause:**
FMI 3	• Voltage above normal, or shorted to high source	• Check sum error	• Engine will not start	• Software error
FMI 8	• Abnormal frequency or pulse width or period	• Reset of ECM does not work	• Engine will not start	• Software error

ECM SPN 633, Engine Fuel Actuator 1 Control Command – MID 128 SID 18

Type of fault:	**FMI Description:**	**Fault Condition:**	**Possible Symptoms:**	**Possible Cause:**
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted +	• Yellow electronic malfunction lamp illuminated • Valve constantly shut	• Faulty solenoid • Faulty harness • Faulty ECM driver
FMI 4	• Voltage below normal, or shorted to low source	• Circuit shorted –	• Yellow electronic malfunction lamp illuminated • High fuel consumption due to fuel leakage	• Faulty solenoid • Faulty harness • Faulty ECM driver
FMI 5	• Current below normal or open circuit	• Open circuit	• Yellow electronic malfunction lamp illuminated • Valve constantly shut	• Faulty solenoid • Faulty harness

ECM SPN 636, Camshaft Position Sensor (CMP) – MID 128 SID 21

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 2	• Data erratic, intermittent or incorrect	• Phase Error - Incorrect correlation between CMP and crankshaft position (CKP) sensor	• MIL illuminated • Increase in fuel consumption	• Engine timing
FMI 3	• Voltage above normal, or shorted to high source	• Missing Signal from CMP sensor • Open in the CMP sensor circuit • Short to battery in the CMP sensor circuit • Short to ground in the CMP sensor circuit	• MIL illuminated • Possible loss of engine power • Increased engine start time	• Faulty harness
FMI 8	• Abnormal frequency or pulse width or period	• Noisy Signal from CMP sensor • Open in the CMP sensor circuit	• MIL illuminated • Possible loss of engine power • Increased engine start time	• Faulty CMP sensor • Faulty harness

ECM SPN 637, Crankshaft Position Sensor (CKP) – MID 128 SID 22

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 2	• Data erratic, intermittent or incorrect	• Intermittent or weak signal	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Increased fuel consumption • Imprecise engine timing • Increased fuel consumption • Uneven cylinder balancing • Power loss • Smoke	• Faulty CKP sensor harness • Faulty CKP sensor
FMI 3	• Voltage above normal, or shorted to high source	• Missing Signal CKP sensor • Open in the CKP sensor circuit • Short to battery in the CKP sensor circuit • Short to ground in the CKP sensor circuit	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Possible loss of engine power • Increased fuel consumption	• Faulty CKP sensor harness • Faulty CKP sensor
FMI 8	• Abnormal frequency or pulse width or period	• Erratic or intermittent signal from CKP sensor • Open in the CKP sensor	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Possible loss of engine power • Increased engine start time • Increased fuel consumption • Uneven cylinder balancing • Power loss • Smoke	• Faulty CKP sensor harness • Faulty CKP sensor mounting

ECM SPN 639, SAE J1939 Data Link 1 – MID 128 SID 231

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 2	• Data erratic, intermittent or incorrect	• SAE J1939 high or low circuit shorted + • SAE J1939 high or low circuit shorted – • SAE J1939 high or low circuit open	• MIL illuminated	• Faulty harness or connector

ECM SPN 641, Engine Variable Geometry Turbocharger (VGT) Actuator 1 – MID 128 SID 27

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Engine Variable Geometry Turbocharger (VGT) actuator temperature out of range	• Possible Red engine shutdown lamp illuminated (dependant on severity) • Yellow electronic malfunction lamp illuminated • Possible engine derate	• N/A
FMI 2	• Data erratic, intermittent or incorrect	• Engine Variable Geometry Turbocharger (VGT) actuator has not seen a valid command on CAN2 data link • Incorrect data	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Low boost • Low power • Nozzle opens • Smoke from engine	• Disturbance on CAN2 data link
FMI 4	• Voltage below normal, or shorted to low source	• Short to ground	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Nozzle will open resulting in low power and low boost • VGT actuator will continue to attempt and maintain target nozzle position	• Faulty VGT actuator connector • Faulty VGT actuator harness • Low battery voltage

FMI 7	• Mechanical system not responding or out of adjustment	• Mechanical problem with the Engine Variable Geometry Turbocharger (VGT) actuator	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Low boost and smoke • Possible engine derate • Power loss in some cases when actuator motor has been disabled	• VGT actuator motor effort is temporarily limited to prevent overheating • Restrictions detected when running learn sequence • VGT actuator is slow to follow commands • VGT actuator position is not tracking command
FMI 9	• Abnormal update rate	• Data from the Engine Variable Geometry Turbocharger (VGT) actuator has been missing for 2-seconds	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Engine derated (major) • EGR valve closed	• Data link harness • No supply to VGT actuator • VGT actuator • VGT actuator connector
FMI 13	• Out of calibration	• Failed self-calibration	• Yellow electronic malfunction lamp illuminated	• VGT actuator

ECM SPN 642, Engine Variable Geometry Turbocharger (VGT) Actuator 2 – MID 128 PPID 89

Type of fault	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause
FMI 0	• Data valid but above normal operational range - Most severe level	• VGT SRA temperature is critically high	• Red engine shutdown lamp illuminated • Engine derate	• Coolant system malfunction • Extreme driving conditions • Overheated VGT actuator
FMI 16	• Data valid but above normal operating range - Moderately severe level	• VGT SRA temperature is moderately too high	• Yellow electronic malfunction lamp illuminated • Engine derate	• Coolant system malfunction • Extreme driving conditions • Overheated VGT actuator

ECM SPN 647, Engine Fan Clutch Output Device Driver – MID 128 SID 33

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Short to positive in the cooling fan control circuit	• Yellow electronic malfunction lamp illuminated • Increased fuel consumption • Fan runs at full speed	• Faulty cooling fan actuator • Faulty cooling fan actuator harness or connector

FMI 4	• Voltage below normal, or shorted to low source	• Short to ground in the cooling fan control circuit • Output voltage is 1/3 the supply voltage	• Yellow electronic malfunction lamp illuminated • Fan always deactivated or always activated if fault is intermittent	• Faulty cooling fan actuator • Faulty cooling fan actuator harness or connector
FMI 5	• Current below normal or open circuit	• Open in the cooling fan control circuit	• Increased fuel consumption • Fan runs at full speed	• Faulty cooling fan actuator • Faulty cooling fan actuator harness or connector

ECM SPN 651, Engine Injector Cylinder 1 – MID 128 SID 1

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Harness shorted + low side circuit	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Engine power loss • Engine running uneven (misfire)	• Faulty harness
FMI 5	• Current below normal or open circuit	• Harness shorted +, – or open high side circuit • Harness shorted – low side circuit	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Engine power loss • Engine running uneven (misfire)	• Faulty harness • Faulty engine fuel injector
FMI 7	• Mechanical system not responding properly	• Cylinder balancing data above limit	• MIL illuminated	• PTO engaged without ECM knowing • Faulty engine fuel injector • Low cylinder compression • Damaged or flywheel
FMI 8	• Abnormal frequency, pulse width, or period	• Misfire detected	• MIL illuminated • Rough engine idle	• Faulty engine fuel injector (possibly clogged)
FMI 13	• Out of calibration	• Cylinder balancing data above limit	• MIL illuminated	• PTO engaged without ECM knowing • Faulty engine fuel injector • Low cylinder compression • Damaged or flywheel
FMI 31	• Condition exists	• Misfire detected	• MIL illuminated • Rough engine idle	• Faulty engine fuel injector (possibly clogged)

ECM SPN 652, Engine Injector Cylinder 2 – MID 128 SID 2

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Harness shorted + low side circuit	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Engine power loss • Engine running uneven (misfire)	• Faulty harness
FMI 5	• Current below normal or open circuit	• Harness shorted +, – or open high side circuit • Harness shorted – low side circuit	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Engine power loss • Engine running uneven (misfire)	• Faulty harness • Faulty engine fuel injector
FMI 7	• Mechanical system not responding properly	• Cylinder balancing data above limit	• MIL illuminated • Yellow electronic malfunction lamp illuminated	• PTO engaged without ECM knowing • Faulty engine fuel injector • Low cylinder compression • Damaged or flywheel
FMI 8	• Abnormal frequency, pulse width, or period	• Misfire detected	• MIL illuminated • Rough engine idle	• Faulty engine fuel injector (possibly clogged)
FMI 13	• Out of calibration	• Cylinder balancing data above limit	• MIL illuminated • Yellow electronic malfunction lamp illuminated	• PTO engaged without ECM knowing • Faulty engine fuel injector • Low cylinder compression • Damaged or flywheel
FMI 31	• Condition exists	• Misfire detected	• MIL illuminated • Rough engine idle	• Faulty engine fuel injector (possibly clogged)

ECM SPN 653, Engine Injector Cylinder 3 – MID 128 SID 3

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Harness shorted + low side circuit	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Engine power loss • Engine running uneven (misfire)	• Faulty harness

FMI 5	• Current below normal or open circuit	• Harness shorted +, – or open high side circuit • Harness shorted – low side circuit	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Engine power loss • Engine running uneven (misfire)	• Faulty harness • Faulty engine fuel injector
FMI 7	• Mechanical system not responding properly	• Cylinder balancing data above limit	• MIL illuminated • Yellow electronic malfunction lamp illuminated	• PTO engaged without ECM knowing • Faulty engine fuel injector • Low cylinder compression • Damaged or flywheel
FMI 8	• Abnormal frequency, pulse width, or period	• Misfire detected	• MIL illuminated • Rough engine idle	• Faulty engine fuel injector (possibly clogged)
FMI 13	• Out of calibration	• Cylinder balancing data above limit	• MIL illuminated • Yellow electronic malfunction lamp illuminated	• PTO engaged without ECM knowing • Faulty engine fuel injector • Low cylinder compression • Damaged or flywheel
FMI 31	• Condition exists	• Misfire detected	• MIL illuminated • Rough engine idle	• Faulty engine fuel injector (possibly clogged)

ECM SPN 654, Engine Injector Cylinder 4 – MID 128 SID 4

Type of fault:	**FMI Description:**	**Fault Condition:**	**Possible Symptoms:**	**Possible Cause:**
FMI 3	• Voltage above normal, or shorted to high source	• Harness shorted + low side circuit	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Engine power loss • Engine running uneven (misfire)	• Faulty harness
FMI 5	• Current below normal or open circuit	• Harness shorted +, – or open high side circuit • Harness shorted – low side circuit	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Engine power loss • Engine running uneven (misfire)	• Faulty harness • Faulty engine fuel injector
FMI 7	• Mechanical system not responding properly	• Cylinder balancing data above limit	• MIL illuminated • Yellow electronic malfunction lamp illuminated	• PTO engaged without ECM knowing • Faulty engine fuel injector • Low cylinder compression • Damaged or flywheel

FMI 8	• Abnormal frequency, pulse width, or period	• Misfire detected	• MIL illuminated • Rough engine idle	• Faulty engine fuel injector (possibly clogged)
FMI 13	• Out of calibration	• Cylinder balancing data above limit	• MIL illuminated • Yellow electronic malfunction lamp illuminated	• PTO engaged without ECM knowing • Faulty engine fuel injector • Low cylinder compression • Damaged or flywheel
FMI 31	• Condition exists	• Misfire detected	• MIL illuminated • Rough engine idle	• Faulty engine fuel injector (possibly clogged)

ECM SPN 655, Engine Injector Cylinder 5 – MID 128 SID 5

Type of fault:	**FMI Description:**	**Fault Condition:**	**Possible Symptoms:**	**Possible Cause:**
FMI 3	• Voltage above normal, or shorted to high source	• Harness shorted + low side circuit	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Engine power loss • Engine running uneven (misfire)	• Faulty harness
FMI 5	• Current below normal or open circuit	• Harness shorted +, – or open high side circuit • Harness shorted – low side circuit	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Engine power loss • Engine running uneven (misfire)	• Faulty harness • Faulty engine fuel injector
FMI 7	• Mechanical system not responding properly	• Cylinder balancing data above limit	• MIL illuminated • Yellow electronic malfunction lamp illuminated	• PTO engaged without ECM knowing • Faulty engine fuel injector • Low cylinder compression • Damaged or flywheel
FMI 8	• Abnormal frequency, pulse width, or period	• Misfire detected	• MIL illuminated • Rough engine idle	• Faulty engine fuel injector (possibly clogged)
FMI 13	• Out of calibration	• Cylinder balancing data above limit	• MIL illuminated • Yellow electronic malfunction lamp illuminated	• PTO engaged without ECM knowing • Faulty engine fuel injector • Low cylinder compression • Damaged or flywheel
FMI 31	• Condition exists	• Misfire detected	• MIL illuminated • Rough engine idle	• Faulty engine fuel injector (possibly clogged)

ECM SPN 656, Engine Injector Cylinder 6 – MID 128 SID 6

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Harness shorted + low side circuit	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Engine power loss • Engine running uneven (misfire)	• Faulty harness
FMI 5	• Current below normal or open circuit	• Harness shorted +, – or open high side circuit • Harness shorted – low side circuit	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Engine power loss • Engine running uneven (misfire)	• Faulty harness • Faulty engine fuel injector
FMI 7	• Mechanical system not responding properly	• Cylinder balancing data above limit	• MIL illuminated • Yellow electronic malfunction lamp illuminated	• PTO engaged without ECM knowing • Faulty engine fuel injector • Low cylinder compression • Damaged or flywheel
FMI 8	• Abnormal frequency, pulse width, or period	• Misfire detected	• MIL illuminated • Rough engine idle	• Faulty engine fuel injector (possibly clogged)
FMI 13	• Out of calibration	• Cylinder balancing data above limit	• MIL illuminated • Yellow electronic malfunction lamp illuminated	• PTO engaged without ECM knowing • Faulty engine fuel injector • Low cylinder compression • Damaged or flywheel
FMI 31	• Condition exists	• Misfire detected	• MIL illuminated • Rough engine idle	• Faulty engine fuel injector (possibly clogged)

ECM SPN 677, Engine Starter Motor Relay – MID 128 SID 39

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted +	• Yellow electronic malfunction lamp illuminated • Engine will not start	• Faulty starter relay • Fault harness

FMI 5	• Current below normal or open circuit	• Open circuit	• Yellow electronic malfunction lamp illuminated • Engine will not start	• Faulty starter relay • Fault harness

ECM SPN 729, Intake Air Heater (IAH) 1 – MID 128 SID 70

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted +, measuring line	• Yellow electronic malfunction lamp illuminated	• Faulty preheat relay • Faulty intake air heater (IAH) 1
FMI 4	• Voltage below normal, or shorted to low source	• Circuit shorted –, measuring line	• Yellow electronic malfunction lamp illuminated	• Faulty preheat relay • Faulty intake air heater (IAH) 1
FMI 5	• Current below normal or open circuit	• Open circuit	• Yellow electronic malfunction lamp illuminated	• Faulty intake air heater (IAH) 1

ECM SPN 730, Intake Air Heater (IAH) 2 – MID 128 SID 71

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted +, measuring line	• Yellow electronic malfunction lamp illuminated	• Faulty preheat relay • Fautly intake air heater (IAH) 2
FMI 4	• Voltage below normal, or shorted to low source	• Circuit shorted –, measuring line	• Yellow electronic malfunction lamp illuminated	• Faulty preheat relay • Fautly intake air heater (IAH) 2

FMI 5	• Current below normal or open circuit	• Open circuit	• Yellow electronic malfunction lamp illuminated	• Fautly intake air heater (IAH) 2

ECM SPN 975, Estimated Percent Fan Speed – (MID 128 PID 26)

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Missing signal from Fan Speed Sensor • Short Circuit +, Measuring line • Short Circuit -, Measuring line • Open Circuit, Measuring line • Open Circuit, Ground line	• Higher fuel consumption • Will work as on/off fan, 100%fan speed if cooling is needed	• Cooling Fan Speed (CFS) sensor failure • Faulty Cooling Fan Speed (CFS) sensor harness

ECM SPN 1072, Engine Compression Brake Output #1 – MID 128 PPID 122

Type of fault	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause
FMI 1	• Data valid but below normal operational range - Most severe level	• Below range	• No Engine Compression Brake	• Low engine oil temperature
FMI 3	• Voltage above normal, or shorted to high source	• Short Circuit +	• Yellow electronic malfunction lamp illuminated • Engine Compression Brake can not be turned on • Engine brake function derated • Gear shift performance derated for some automatic transmissions	• Faulty Engine Compression Brake actuator • Faulty harness
FMI 4	• Voltage below normal, or shorted to low source	• Short Circuit -	• Yellow electronic malfunction lamp illuminated • Compression brake can not be turned off • Engine stops running • Engine impossible to restart	• Faulty Engine Compression Brake actuator • Faulty harness
FMI 5	• Current below normal or open circuit	• Open Circuit	• Yellow electronic malfunction lamp illuminated • Compression rake can not be turned on • Engine brake function derated • Gear shift performance derated for some automatic transmission boxes	• Faulty Engine Compression Brake actuator • Faulty harness

ECM SPN 1127, Engine Turbocharger Intake Manifold Pressure (IMP) – MID 128 PSID 98

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range	• Engine Turbocharger boost pressure is too high	• MIL illuminated (13L engine only) • Turbocharger surge	• EGR system failure • Faulty Turbocharger oulet pressure sensor
FMI 1	• Data valid but below normal operational range	• Engine Turbocharger boost pressure is too low	• MIL illuminated (13L engine only) • Engine derate • Engine slow to respond	• Air leak in turbocharger hoses, pipes, brackets, cooler or components • EGR system fault
FMI 10	• Abnormal rate of change	• Poor Engine Turbocharger boost pressure response	• MIL illuminated • Engine power loss/re-sponse/drivability	• Turbocharger inlet air system leak • Faulty Turbocharger
FMI 11	• Root cause not known	• Variable Geometry Turbocharger control mode fault	• MIL illuminated	• Variable Geometry Turbocharger fault
FMI 13	• Out of calibration	• Variable Geometry Turbocharger control mode adjustment exceeded	• Engine power loss/re-sponse/drivability	• Air leak in turbocharger hoses, pipes, brackets, cooler or components • EGR system fault • Faulty Turbocharger oulet pressure sensor • Exhaust back pressure too high
FMI 14	• Special instructions	• Poor Engine Turbocharger boost pressure response	• MIL illuminated	• Air leak in turbocharger hoses, pipes, brackets, cooler or components • Variable Geometry Turbocharger fault • Oil pressure fault
FMI 16	• Data valid but above normal operating range - Moderately severe level	• Engine Turbocharger boost pressure is too high	• MIL illuminated (13L engine only) • Turbocharger surge	• EGR system failure • Faulty sensor
FMI 18	• Data valid but below normal operating range - Moderately severe level	• Engine Turbocharger boost pressure is too low	• MIL illuminated (13L engine only) • Engine derate • Engine slow to respond	• Air leak in turbocharger hoses, pipes, brackets, cooler or components • EGR system failure

ECM SPN 1136, Engine Control Module (ECM) Temperature – MID 128 PPID 55

Type of fault	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause
FMI 4	• Voltage below normal, or shorted to low source	• Short to ground on the metering circuit	• N/A	• Engine Control Module (ECM)
FMI 5	• Current below normal or open circuit	• Short to battery in the metering circuit • Open in the metering circuit • Open circuit in the ground circuit	• N/A	• Engine Control Module (ECM)

ECM SPN 1198, Anti–theft Random Number – MID 128 PID 224

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 2	• Data erratic, intermittent or incorrect	• Engine Control Module and Instrument Control Module security codes do not match	• Yellow electronic malfunction lamp illuminated • Can start engine	• Security system failure
FMI 12	• Bad intelligent device or component	• Security system not installed	• Yellow electronic malfunction lamp illuminated • Can start engine	• Security system failure

ECM SPN 1231, SAE J1939 Data Link 2 – MID 128 PSID 229/232

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 2	• Data erratic, intermittent or incorrect	• Circuit shorted + • Circuit shorted – • Open circuit	• MIL illuminated • Engine power loss • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing • No variable geometry engine turbocharger control	• Faulty harness
FMI 9	• Abnormal update rate	• Missing signal from Transmission Control Module (TCM)	• MIL illuminated • Yellow electronic malfunction lamp illuminated • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing	• SAE J1939 data link • Faulty harness or connectors • DEF pump • Aftertreatment Diesel Exhaust Fluid (DEF) control module

ECM SPN 1265, Engine Piston Cooling Oil Pressure Actuator – MID 128 SID 85

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted +	• Yellow electronic malfunction lamp illuminated • Possible smoke during start up	• Faulty harness • Faulty actuator
FMI 4	• Voltage below normal, or shorted to low source	• Circuit shorted –	• Red engine shutdown lamp illuminated • Engine damage can occur without piston cooling	• Faulty harness • Faulty actuator
FMI 5	• Current below normal or open circuit	• Open circuit	• Yellow electronic malfunction lamp illuminated • Possible smoke during start up	• Faulty harness • Faulty actuator

ECM SPN 1322, Engine Misfire for Multiple Cylinders – MID 128 PSID 27

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 8	• Abnormal frequency or pulse width or period	• Cylinder misfires detected in multiple cylinders	• MIL illuminated • Rough idle	• Engine fuel injectors
FMI 31	• Condition exists	• Cylinder misfires detected in multiple cylinders	• MIL illuminated • Rough idle	• Engine fuel injectors

ECM SPN 1659, Engine Coolant System Thermostat – MID 128 PSID 109

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 7	• Mechanical system not responding or out of adjustment	• Thermostat stuck closed	• Possible poor drivability	• Coolant thermostat
FMI 12	• Bad intelligent device or component	• Thermostat is leaking or stuck open	• MIL illuminated (13L engine only) • Longer engine warm up time • Poor heat in cab	• Coolant thermostat

ECM SPN 1675, Engine Starter Mode – MID 128 SID 39

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Starter overheating	• Engine will not start	• Starter is deactivated due to overheating
FMI 7	• Mechanical system not responding or out of adjustment	• Transmission not in neutral	• Engine will not start	• Starter is deactivated due to overheating
FMI 10	• Abnormal rate of change	• Starter gear is stuck, engaged with engine	• Engine will not start	• Starter is deactivated due to overheating
FMI 14	• Special instructions	• PTO is engaged or switch on	• Engine will not start	• Starter is deactivated due to overheating

ECM SPN 1677, Aftertreatment DPF Auxiliary Heater Mode – MID 128 PSID 25

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range — most severe level	• Truck has idled too long without completing a periodic heat mode	• Red engine shutdown lamp illuminated • Engine derate • High temperature spikes in DPF when driving is resumed or during stationary regeneration	• Extremely cold ambient temperatures • PTO operated with limited exhaust temperatures • Engine turbocharger • Engine turbocharger compressor bypass valve
FMI 7	• Mechanical system not responding or out of adjustment	• Truck has idled too long without completing a periodic heat mode	• Yellow electronic malfunction lamp illuminated • White exhaust smoke • High temperature spikes in DPF when driving is resumed or during stationary regeneration	• Extremely cold ambient temperatures • PTO operated with limited exhaust temperatures • Engine turbocharger • Engine turbocharger compressor bypass valve
FMI 16	• Data valid but above normal operating range - Moderately severe level	• Truck has idled too long without completing a periodic heat mode	• Yellow electronic malfunction lamp illuminated • White exhaust smoke • High temperature spikes in DPF when driving is resumed or during stationary regeneration	• Extremely cold ambient temperatures • PTO operated with limited exhaust temperatures • Engine turbocharger • Engine turbocharger compressor bypass valve

ECM SPN 1761, Aftertreatment Diesel Exhaust Fluid (DEF) Tank Level – PPID 278

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Short circuit high side	• N/A	• DEF tank pickup assembly/sensor failure
FMI 5	• Current below normal or open circuit	• Short circuit + • Open circuit	• Yellow electronic malfunction lamp illuminated	• DEF tank pickup assembly/sensor failure

FMI 11	• Root cause not known	• DEF tank level low (driver warning)	• Low DEF fluid lamp illuminated	• N/A
FMI 14	• Special Instructions	• DEF tank almost empty (driver warning)	• Low DEF fluid lamp illuminated • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing	• N/A
FMI 18	• Data valid but below normal operating range - Moderately severe level	• DEF tank almost empty (driver warning)	• Low DEF fluid lamp illuminated • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing	• N/A

ECM SPN 2003, Transmission Control Module (TCM) Status – MID 128 PSID 205

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 9	• Abnormal update rate	• Missing signal from Transmission Control Module (TCM)	• N/A	• Data link error

ECM SPN 2017, Cruise Control Status – MID 128 PID 85

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 9	• Abnormal update rate	• Missing (Cruise Control) signal from VECU	• Cruise Control does not work	• No clutch information to Engine Control Module (ECM) from SAE J1939 data link

ECM SPN 2029, Invalid or Missing Data from Vehicle ECU – MID 128 PSID 201

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 8	• Abnormal frequency or pulse width or period	• No contact with VECU	• Yellow electronic malfunction lamp illuminated • PTO, engine compression brake and cruise control do not work	• Faulty harness
FMI 9	• Abnormal update rate	• Missing signal from cluster	• MIL illuminated (13L engine only)	• Faulty harness

ECM SPN 2629, Engine Turbocharger Compressor Outlet Temperature – MID 128 PID 404

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Estimated engine turbocharger discharge temperature error.	• Engine derate	• High ambient temperature • Low barometric pressure • Leak in engine turbocharger inlet tube
FMI 2	• Data erratic, intermittent or incorrect	• Engine turbocharger outlet temperature signal believed to be not valid (high) (plausibility fault)	• Engine derate • MIL illuminated	• Engine turbocharger outlet temperature sensor
FMI 4	• Voltage below normal, or shorted to low source	• Short circuit -, measuring line	• MIL illuminated • Yellow electronic malfunction lamp illuminated	• Faulty sensor • Faulty harness
FMI 5	• Current below normal or open circuit	• Short circuit +, measuring line • Open circuit	• MIL illuminated • Yellow electronic malfunction lamp illuminated	• Faulty sensor • Faulty harness
FMI 13	• Out of calibration	• Sensor out of range	• MIL illuminated	• Faulty sensor
FMI 15	• Data valid but above normal operating range - Least severe level	• Sensor out of range	• MIL illuminated	• Faulty sensor
FMI 17	• Data valid but below normal operating range - Least severe level	• Sensor out of range	• MIL illuminated	• Faulty sensor

ECM SPN 2659, Engine Exhaust Gas Recirculation (EGR) Mass Flow Rate – MID 128 PPID 35

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0)	• Data valid but above normal operational range	• EGR flow is too high	• MIL illuminated • Exhaust smoke	• Faulty EGR system

FMI 1	• Data valid but below normal operational range	• EGR flow is too low	• MIL illuminated	• Faulty EGR system • Clogged EGR cooler
FMI 16	• Data valid but above normal operating range - Moderately severe level	• EGR flow is too high	• MIL illuminated • Exhaust smoke	• Faulty EGR system • Faulty harness or connector
FMI 18	• Data valid but below normal operating range - Moderately severe level	• EGR flow is too low	• MIL illuminated	• Faulty EGR system • Clogged EGR cooler • Faulty harness or connector

ECM SPN 2791, Engine Exhaust Gas Recirculation (EGR) Valve Control – MID 128 SID 146

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Stuck EGR valve • EGR valve circuit shorted + • EGR valve circuit shorted to –	• MIL illuminated • Engine derate	• Faulty harness or connector • Faulty EGR valve
FMI 5	• Current below normal or open circuit	• Open EGR valve circuit	• MIL illuminated • Engine derate	• Faulty harness or connector • Faulty EGR valve

ECM SPN 2836, Battery Potential/Switched Voltage – MID 128 PSID 49

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Battery voltage too high	• N/A	• Faulty cab or chassis harness • Charging system fault • External charger
FMI 4	• Voltage below normal, or shorted to low source	• Battery voltage too low	• Starter will not crank	• Faulty cab or chassis harness • Charging system fault • Battery • Fuse

ECM SPN 3031, Aftertreatment Diesel Exhaust Fluid (DEF) Tank Temperature – MID 128 PPID 274

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Aftertreatment Diesel Exhaust Fluid (DEF) tank temperature too high • Date data message missing on SAE J1587 data link. (Cluster error).	• MIL illuminated • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing	• DEF tank pickup assembly/sensor failure
FMI 4	• Voltage below normal, or shorted to low source	• Short Circuit -	• MIL illuminated	• DEF tank pickup assembly/sensor failure • DEF tank pickup asssembly/sensor wiring or connectors
FMI 5	• Current below normal or open circuit	• Short Circuit + • Open Circuit	• MIL illuminated	• DEF tank pickup assembly/sensor failure • DEF tank pickup assembly/sensor wiring or connectors
FMI 8	• Abnormal frequency or pulse width or period	• Sensor ripple is not too high	• N/A	• DEF tank pickup assembly/sensor failure • DEF tank pickup ‘assembly/sensor wiring or connectors

ECM SPN 3064, Aftertreatment DPF System Monitor – MID 128 PPID 326

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Moderately high soot load	• Yellow electronic malfunction lamp illuminated • Medium to high engine derate	• Diesel Particulate Filter (DPF) clogged • After Treatment Fuel Injector clogged • Regeneration disabled by driver or other component
FMI 10	• Abnormal rate of change	• Soot loading high due to heavy load or use (no problem)	• Yellow electronic malfunction lamp illuminated • Engine derate	• No error, condition occurs during heavy load or use with high soot loading
FMI 11	• Root cause not known	• Critically high soot load	• Red engine shutdown lamp illuminated • High engine derate • Engine derate	• Diesel Particulate Filter (DPF) clogged • Aftertreatment hydrocarbon doser (injector) • Regeneration disabled by driver or other component

ECM SPN 3216, Aftertreatment Intake NOx – MID 128 PPID 348

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 2	• Data erratic, intermittent or incorrect	• Inlet NOx sensor error (plausibility)	• MIL illuminated	• Engine out NOx high • Faulty NOx sensor
FMI 3	• Voltage above normal, or shorted to high source	• Short Circuit, NOx signal	• MIL illuminated	• Faulty wiring between NOx sensor and NOx sensor ECU • Faulty NOx sensor
FMI 5	• Current below normal or open circuit	• Open Circuit, NOx signal	• MIL illuminated	• Faulty wiring between NOx sensor and NOx sensor ECU • Faulty NOx sensor
FMI 9	• Abnormal update rate	• Missing signal from NOx sensor	• MIL illuminated • Yellow electronic malfunction lamp illuminated	• Loss of communication from NOx sensor ECU and Engine Control Module (ECM)
FMI 11	• Root cause not known	• NOx sensor measures near zero for long time with high load	• MIL illuminated	• Faulty NOx sensor
FMI 12	• Bad intelligent device or component	• NOx-sensor signal corrupt (incorrect value)	• MIL illuminated	• Faulty NOx sensor
FMI 13	• Out of calibration	• NOx-sensor activation (incorrect value)	• MIL illuminated	• Faulty NOx sensor
FMI 14	• Special instructions	• Missing signal from sensor due to battery voltage	• MIL illuminated	• Voltage to NOx sensor is too high or too low • Faulty harness to sensor

ECM SPN 3226, Aftertreatment Outlet NOx – MID 128 PPID 270/ PSID 90

MID 233 Fault code sent by MID 128 Engine control unit

Type of fault	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause
FMI 2)	• Data erratic, intermittent or incorrect	• Inlet NOx sensor error (plausibility) • Mismatch between sensors	• MIL illuminated	• Engine out NOx high • Faulty NOx sensor • Aftertreatment Diesel Exhaust Fluid (DEF) quality
FMI 3	• Voltage above normal or shorted to high source	• Short Circuit, NOx signal	• MIL illuminated	• Faulty wiring between NOx sensor and NOx sensor ECU • Faulty NOx sensor
FMI 5	• Current below normal or open circuit	• Open Circuit, NOx signal	• MIL illuminated	• Faulty wiring between NOx sensor and NOx sensor ECU • Faulty NOx sensor

MID 233 Fault code sent by MID 128 Engine control unit (cont'd.)

FMI 9	• Abnormal update rate	• Missing signal from NOx sensor	• MIL illuminated • Yellow electronic malfunction lamp illuminated	• Loss of communication from NOx sensor ECU and Engine Control Module (ECM)
FMI 11	• Root cause not known	• NOx sensor measures near zero for long time with high load	• MIL illuminated	• Faulty NOx sensor
FMI 12	• Bad intelligent device or component	• NOx-sensor signal corrupt (incorrect value)	• MIL illuminated	• Faulty NOx sensor
FMI 13	• Out of calibration	• NOx-sensor activation (incorrect value)	• MIL illuminated	• Faulty NOx sensor
FMI 14	• Special instructions	• Missing signal from sensor due to battery voltage	• MIL illuminated	• Voltage to NOx sensor is too high or too low • Faulty harness to sensor
FMI 31	• Condition exists	• Inlet NOx sensor error • Mismatch between sensors	• MIL illuminated	• Engine out NOx high • Faulty NOx sensor • Aftertreatment Diesel Exhaust Fluid (DEF) quality

ECM SPN 3245, Aftertreatment DPF Outlet Temperature – MID 128 PPID 436

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Temperature critically too high	• Low engine power	• Restricted Catalyst • Intake air leak • Faulty sensor
FMI 2	• Data erratic, intermittent or incorrect	• Sensor is not rational (plausibility)	• MIL illuminated • Regeneration not possible	• Faulty sensor • Exhaust system leak • Faulty harness connectors or connections
FMI 4	• Voltage below normal, or shorted to low source	• Short to ground on the metering side of the circuit	• MIL illuminated • Regeneration not possible	• Faulty harness • Faulty sensor • Aftertreatment control module (ACM)

FMI 5	• Current below normal or open circuit	• Short to battery on the metering side of the circuit • Open in the metering side of the circuit • Open in the ground side of the circuit	• MIL illuminated	• Faulty harness • Faulty sensor • Aftertreatment control module (ACM)
FMI 15	• Data valid but above normal operating range - Least severe level	• Temperature sensor is out of range (high) • Sensor indicates a invalid value	• MIL illuminated	• Faulty harness • Faulty sensor

ECM SPN 3249, Aftertreatment DPF Intake Temperature – MID 128 PPID 387

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 2	• Data erratic, intermittent or incorrect	• Sensor is not rational (plausibility)	• MIL illuminated • Aborted regeneration	• Faulty harness • Faulty harness connectors or connections • Exhaust system leak • Faulty sensor
FMI 4	• Voltage below normal, or shorted to low source	• Short to ground on the metering side of the circuit	• MIL illuminated • Aborted regeneration	• Faulty harness • Faulty sensor • Aftertreatment control module (ACM)
FMI 5	• Current below normal or open circuit	• Short to battery on the metering side of the circuit • Open in the metering side of the circuit • Open in the ground side of the circuit	• MIL illuminated • Regeneration not possible	• Faulty harness • Faulty sensor • Aftertreatment control module (ACM)
FMI 15	• Data valid but above normal operating range - Least severe level	• Temperature sensor is out of range (high) • Sensor indicates a invalid value	• MIL illuminated	• Faulty harness • Faulty sensor

ECM SPN 3251, Aftertreatment DPF Differential Pressure – MID 128 PID 81

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range	• Critically high pressure	• Engine derate • Red engine shutdown lamp illuminated	• Aftertreatment diesel particulate filter (DPF) differential pressure sensor failure
FMI 2	• Data erratic, intermittent or incorrect	• Sensor is not rational	• MIL illuminated	• Aftertreatment diesel particulate filter (DPF) differential pressure sensor failure
FMI 3	• Voltage above normal, or shorted to high source	• Short to battery on the metering side • Open in the ground line	• MIL illuminated	• Aftertreatment diesel particulate filter (DPF) differential pressure sensor failure • Faulty aftertreatment diesel particulate filter (DPF) differential pressure sensor connector • Faulty harness
FMI 5	• Current below normal or open circuit	• Open in 5 volt supply line • Short to ground in metering line • Open in metering line	• MIL illuminated	• Aftertreatment diesel particulate filter (DPF) differential pressure sensor failure • Faulty harness
FMI 16	• Data valid but above normal operating range - Moderately severe level	• Moderately high pressure	• Engine derate	• Aftertreatment diesel particulate filter (DPF) differential pressure sensor failure

ECM SPN 3363, Aftertreatment Diesel Exhaust Fluid (DEF) Tank Heater – MID 128 PSID 75

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 2	• Data erratic, intermittent or incorrect	• Commanded valve position is not plausible	• N/A	• Faulty harness or connectors • Aftertreatment DEF tank temperature sensor • Aftertreatment DEF tank heating valve
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted +	• N/A	• Aftertreatment DEF pump assembly
FMI 4	• Voltage below normal, or shorted to low source	• Circuit shorted – • Open circuit	• N/A	• Aftertreatment DEF pump assembly
FMI 5	• Current below normal or open circuit	• Open circuit	• N/A	• Aftertreatment DEF pump assembly

ECM SPN 3471, Aftertreatment Fuel Pressure Control Actuator – MID 128 PPID 328

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted to battery	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Aborted regeneration	• Faulty harness • Actuator failure
FMI 4	• Voltage below normal, or shorted to low source	• Circuit shorted to ground	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Aborted regeneration	• Faulty harness • Actuator failure
FMI 5	• Current below normal or open circuit	• Open circuit	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Aborted regeneration	• Faulty harness • Actuator failure
FMI 7	• Mechanical system not responding or out of adjustment	• Aftertreatment hydrocarbon doser fuel pressure too low	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Regeneration not possible	• Fuel shut off valve stuck open • Faulty fuel pressure sensor
FMI 14	• Special instructions	• Aftertreatment hydrocarbon doser fuel pressure too high	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Regeneration not possible	• Fuel shut off valve leakage

ECM SPN 3480, Aftertreatment Diesel Particulate Filter (DPF) Fuel Pressure – MID 128 PPID 437/PSID 108

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 2	• Data erratic, intermittent or incorrect	• DPF fuel pressure sensor is not rational (plausibility) • Aftertreatment hydrocarbon hydrocarbon doser fuel pressure too low	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Regeneration not possible	• Faulty aftertreatment fuel shut off valve • Faulty DPF fuel pressure sensor • Air in fuel • Fuel filter • Aftertreatment fuel pump
FMI 3	• Voltage above normal or shorted to high source	• Short to battery on the metering side • Open in the ground line	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Regeneration not possible	• Faulty harness • Faulty DPF fuel pressure sensor
FMI 5	• Current below normal or open circuit	• Open circuit in the 5 volt supply • Short circuit to ground in the metering line • Open circuit in the metering line	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Regeneration not possible	• Faulty harness • Faulty DPF fuel pressure sensor
FMI 7	• Mechanical system not responding or out of adjustment	• Mechanical problem	• MIL illuminated • Engine derate • Possible engine shutdown • Regeneration not possible	• Faulty aftertreatment hydrocarbon doser system • Aftertreatment hydrocarbon doser • Faulty aftertreatment fuel shut off valve • Aftertreatment fuel pump
FMI 10	• Abnormal rate of change	• Aftertreatment hydrocarbon doser fuel pressure sensor stuck • Aftertreatment hydrocarbon doser fuel pressure too high	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Regeneration not possible	• Faulty fuel pressure sensor • Faulty shut off valve • Aftertreatment hydrocarbon doser (injector)
FMI 15	• Data valid but above normal operating range - Least severe level	• Fuel pressure sensor is out of range • Sensor indicates a invalid value	• MIL illuminated	• Faulty fuel pressure sensor

ECM SPN 3483, Aftertreatment Regeneration Status – MID 128 PSID 47

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Unable to achieve needed aftertreatment temperature	• MIL illuminated • Possible incomplete regeneration	• Aftertreatment hydrocarbon doser clogged • Aftertreatment hydrocarbon doser fuel pressure too low
FMI 1	• Data valid but below normal operational range	• Aftertreatment temperature too high	• MIL illuminated • Possible incomplete regeneration	• Aftertreatment hydrocarbon doser clogged • Aftertreatment hydrocarbon doser fuel pressure too high • Injector leakage (engine)
FMI 10	• Abnormal rate of change	• Regeneration period too long	• MIL illuminated • Regeneration frequency too high	• Aftertreatment hydrocarbon doser • Air leakage • Faulty injector(s) (engine)
FMI 12	• Bad intelligent device or component	• Regeneration efficiency too low	• N/A	• Aftertreatment hydrocarbon doser clogged • Diesel Particulate Filter (DPF) catalyst damaged • Diesel Particulate Filter (DPF) catalyst clogged
FMI 13	• Out of Calibration	• Regeneration period too long	• MIL illuminated • Regeneration frequency too high	• Aftertreatment hydrocarbon doser • Air leakage • Fuel line clogged
FMI 15	• Data valid but above normal operating range - Least severe level	• Unable to achieve needed temperature	• MIL illuminated • Possible incomplete regeneration	• Aftertreatment hydrocarbon doser clogged • Aftertreatment hydrocarbon doser fuel pressure too low
FMI 17	• Data valid but below normal operating range - Least severe level	• Aftertreatment temperature too high	• MIL illuminated • Possible incomplete regeneration	• Aftertreatment hydrocarbon doser clogged • Aftertreatment hydrocarbon doser fuel pressure too high • Injector leakage (engine)
FMI 31	• Condition exists	• Regeneration period too long	• MIL illuminated • Regeneration frequency too high	• Aftertreatment hydrocarbon doser • Air leakage • Fuel line clogged

ECM SPN 3509, Sensor Supply Voltage 1 – MID 128 SID 232

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Sensor supply voltage out of range (high)	• MIL illuminated • Incorrect sensor values	• Faulty harness or connector
FMI 4	• Voltage below normal, or shorted to low source	• Sensor supply voltage out of range (low)	• MIL illuminated • Incorrect sensor values	• Faulty harness or connector

ECM SPN 3510, Sensor Supply Voltage 2 – MID 128 SID 211

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted +	• MIL illuminated • Incorrect sensor values	• Faulty harness or connector
FMI 4	• Voltage below normal, or shorted to low source	• Circuit shorted –	• MIL illuminated • Incorrect sensor values	• Faulty harness or connector

ECM SPN 3511, Sensor Supply Voltage 3 – MID 128 PSID 113

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted +	• MIL illuminated	• Faulty harness
FMI 4	• Voltage below normal, or shorted to low source	• Circuit shorted –	• MIL illuminated	• Faulty harness

ECM SPN 3512, Sensor Supply Voltage 4 – MID 128 PSID 126

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Sensor supply circuit shorted +	• MIL illuminated • Incorrect sensor values	• Faulty harness
FMI 4	• Voltage below normal, or shorted to low source	• Sensor supply circuit shorted –	• MIL illuminated • Incorrect sensor values	• Faulty harness

ECM SPN 3522, Aftertreatment Total Fuel Used – MID 128 PSID 91

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range	• Aftertreatment Diesel Exhaust Fluid (DEF) level change too much	• N/A	• DEF system leak • Wrong DEF tank • Aftertreatment DEF Dosing Module failure or wrong module
FMI 1	• Data valid but below normal operational range	• Aftertreatment Diesel Exhaust Fluid (DEF) level change too little	• N/A	• DEF tank level sensor stuck • DEF system clog • Wrong DEF tank • Aftertreatment DEF Dosing Module failure or wrong module
FMI 16	• Data valid but above normal operating range - Moderately severe level	• Aftertreatment Diesel Exhaust Fluid (DEF) level change too much	• N/A	• DEF system leak • Wrong DEF tank • Aftertreatment DEF Dosing Module failure or wrong module
FMI 18	• Data valid but below normal operating range - Moderately severe level	• Aftertreatment Diesel Exhaust Fluid (DEF) level change too little	• N/A	• DEF tank level sensor stuck • DEF system clog • Wrong DEF tank • Aftertreatment DEF Dosing Module failure or wrong module

ECM SPN 3556, Aftertreatment Hydrocarbon Doser – MID 128 PPID 329

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted to battery	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Regeneration not possible	• Faulty harness • Aftertreatment hydrocarbon doser failure
FMI 4	• Voltage below normal, or shorted to low source	• Circuit shorted to ground	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Regeneration not possible	• Faulty harness • Aftertreatment hydrocarbon doser failure
FMI 5	• Current below normal or open circuit	• Open circuit	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Regeneration not possible	• Faulty harness • Aftertreatment hydrocarbon doser failure
FMI 13	• Out of calibration	• Aftertreatment hydrocarbon doser clogged	• MIL illuminated	• Aftertreatment hydrocarbon doser failure • Fuel shut off valve • Fuel supply failure
FMI 14	• Special instructions	• Aftertreatment hydrocarbon doser leaking	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Regeneration not possible	• Aftertreatment hydrocarbon doser failure

ECM SPN 3597, Aftertreatment Diesel Particulate Filter (DPF) Regeneration too Frequent – MID 128 PSID 119

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted +	• MIL illuminated	• Faulty harness • Faulty connector • Aftertreatment DEF line heater 1 or 3 failure • Aftertreatment DEF pump assembly failure • Aftertreatment DEF tank heating valve failure • Aftertreatment Control Module (ACM)
FMI 4	• Voltage below normal, or shorted to low source	• Circuit shorted –	• MIL illuminated	• Faulty harness • Faulty connector • Aftertreatment DEF line heater 1 or 3 failure • Aftertreatment DEF pump assembly failure • Aftertreatment DEF tank heating valve failure • Aftertreatment Control Module (ACM)
FMI 5	• Current below normal or open circuit	• Open circuit	• MIL illuminated	• Faulty harness • Faulty connector • Aftertreatment DEF line heater 1 or 3 failure • Aftertreatment DEF pump assembly failure • Aftertreatment DEF tank heating valve failure • Aftertreatment Control Module (ACM)

ECM SPN 3675, Engine Turbocharger Compressor Bypass Valve Position – MID 128 PPID 330

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted + • On/off valve can't be activated	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Regeneration not possible • High engine braking without request • Driveability affected	• Faulty bypass valve solenoid • Faulty harness • Faulty harness connector
FMI 4	• Voltage below normal, or shorted to low source	• Short circuit - • Valve constantly activated	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Major engine derate • Exhaust manifold overheating • Engine shut down	• Faulty bypass valve solenoid • Faulty harness • Faulty harness connector
FMI 5	• Current below normal or open circuit	• Open circuit • On/off valve can't be activated	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Regeneration not possible • High engine braking without request • Driveability affected	• Faulty bypass valve solenoid • Faulty harness • Faulty harness connector
FMI 7	• Mechanical system not responding or out of adjustment	• Mechanically Stuck • On/off valve can't be activated	• MIL illuminated • Yellow electronic malfunction lamp illuminated • Regeneration not possible • High engine braking without request • Driveability affected • Valve constantly activated	• Leaking pipes • Faulty bypass valve solenoid

			• Major engine derate • Exhaust manifold overheating • Engine shut down	

ECM SPN 3720, Aftertreatment DPF Ash Load Percent – MID 128 PPID 337

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Ash level too high	• Yellow electronic malfunction lamp illuminated	• Need service, ash level is too high

ECM SPN 3936, Aftertreatment DPF System – MID 128 PSID 28

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Aftertreatment DPF differential pressure sensor value too high	• MIL illuminated	• Aftertreatment DPF differential pressure sensor • Aftertreatment particulate filter
FMI 1	• Data valid but below normal operational range - Most severe level	• Aftertreatment DPF differential pressure sensor value too low	• MIL illuminated	• Aftertreatment DPF differential pressure sensor • Aftertreatment particulate filter

ECM SPN 4094, NOx Limits Exceeded Due to Insufficient Diesel Exhaust Fluid (DEF) Quality – MID 128 PSID 90

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 1	• Data valid but below normal operational range - Most severe level	• Aftertreatment Diesel Exhaust Fluid (DEF) dosing too low	• Yellow electronic malfunction lamp illuminated • Engine derate	• DEF quality • Aftertreatment DEF line clogged • Aftertreatment DEF doser • Aftertreatment control module failure
FMI 14	• Special Instructions	• Aftertreatment Diesel Exhaust Fluid (DEF) dosing too low	• Yellow electronic malfunction lamp illuminated • Engine derate	• DEF quality • Aftertreatment DEF line clogged • Aftertreatment DEF doser • Aftertreatment control module failure
FMI 18	• Data valid but below normal operating range - Moderately severe level	• Aftertreatment Diesel Exhaust Fluid (DEF) dosing too low	• Yellow electronic malfunction lamp illuminated • Engine derate	• DEF quality • Aftertreatment DEF line clogged • Aftertreatment DEF doser • Aftertreatment control module failure

ECM SPN 4095, NOx Limits Exceeded Due to Interrupted Diesel Exhaust Fluid (DEF) Dosing – MID 128 PSID 90

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 7	• Mechanical system not responding or out of adjustment	• Dosing failure	• MIL illuminated • Aftertreatment Diesel Exhaust Fluid (DEF) low usage	• DEF level • Faulty DEF pump • Leak in DEF hose

ECM SPN 4334, Afterteatment Diesel Exhaust Fluid (DEF) Dosing Absolute Pressure – MID 128 PPID 273

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 1	• Data valid but below normal operational range - Most severe level	• DEF system leakage detected	• MIL illuminated • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing	• DEF pump • DEF hose • Aftertreatment Diesel Exhaust Fluid (DEF) doser (injector)
FMI 4	• Voltage below normal, or shorted to low source	• Short Circuit -	• MIL illuminated • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing	• DEF pump assembly
FMI 5	• Current below normal or open circuit	• Short Circuit + • Open Circuit	• MIL illuminated • Yellow electronic malfunction lamp illuminated • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing	• DEF pump assembly

ECM SPN 4339, Aftertreatment SCR Feedback Control Status – MID 128 PSID 90

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Adaptation too high	• N/A	• NOx sensor • Aftertreatment Diesel Exhaust Fluid (DEF) dosing system failure

FMI 1	• Data valid but below normal operational range - Most severe level	• Adaptation too low	• N/A	• NOx sensor • Aftertreatment Diesel Exhaust Fluid (DEF) dosing system failure • DEF quality
FMI 10	• Abnormal rate of change	• Adaptation too high	• N/A	• NOx sensor • Aftertreatment Diesel Exhaust Fluid (DEF) dosing system failure
FMI 12	• Bad intelligent device or component	• Adaptation too low	• N/A	• NOx sensor • Aftertreatment Diesel Exhaust Fluid (DEF) dosing system failure • DEF quality

ECM SPN 4354, Aftertreatment Diesel Exhaust Fluid (DEF) Line Heater 1 – MID 128 PSID 103

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted +	• N/A	• Faulty harness • Faulty connector • Aftertreatment DEF line heater 1 failure
FMI 4	• Voltage below normal, or shorted to low source	• Circuit shorted –	• N/A	• Faulty harness • Faulty connector • Aftertreatment DEF line heater 1 failure
FMI 5	• Current below normal or open circuit	• Open circuit	• N/A	• Faulty harness • Faulty connector • Aftertreatment DEF line heater 1 failure

ECM SPN 4356, Aftertreatment Diesel Exhaust Fluid (DEF) Line Heater 3 – MID 128 PSID 102

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted +	• N/A	• Faulty harness • Faulty connector • Aftertreatment DEF line heater 3 failure

FMI 4	• Voltage below normal, or shorted to low source	• Circuit shorted –	• N/A	• Faulty harness • Faulty connector • Aftertreatment DEF line heater 3 failure
FMI 5	• Current below normal or open circuit	• Open circuit	• N/A	• Faulty harness • Faulty connector • Aftertreatment DEF line heater 3 failure

ECM SPN 4374, Aftertreatment Diesel Exhaust Fluid (DEF) Pump Motor Speed – MID 128 PSID 87

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 1	• Data valid but below normal operational range - Most severe level	• Slow pump speed	• MIL illuminated • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing	• Faulty harness • Faulty connector • Aftertreatment DEF pump assembly failure

ECM SPN 4375, Aftertreatment Diesel Exhaust Fluid Pump (DEF) Drive Percentage – MID 128 PSID 121

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Circuit shorted +	• MIL illuminated • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing	• Faulty harness • Faulty connector • Aftertreatment DEF pump assembly failure
FMI 1	• Data valid but below normal operational range - Most severe level	• Circuit shorted – • Open circuit	• MIL illuminated • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing	• Faulty harness • Faulty connector • Aftertreatment DEF pump assembly failure
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted +	• MIL illuminated • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing	• Faulty harness • Faulty connector • Aftertreatment DEF pump assembly failure
FMI 4	• Voltage below normal, or shorted to low source	• Circuit shorted –	• MIL illuminated • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing	• Faulty harness • Faulty connector • Aftertreatment DEF pump assembly failure

FMI 5	• Current below normal or open circuit	• Open circuit	• MIL illuminated • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing	• Faulty harness • Faulty connector • Aftertreatment DEF pump assembly failure
FMI 12	• Bad intelligent device or component	• Open circuit	• MIL illuminated • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing	• Faulty harness • Faulty connector • Aftertreatment DEF pump assembly failure
FMI 14	• Special instructions	• Voltage to pump out of range	• MIL illuminated • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing	• Faulty harness • Faulty connector • Aftertreatment DEF pump assembly failure

ECM SPN 4376, Aftertreatment Diesel Exhaust Fluid (DEF) Return Valve – MID 128 PSID 105

Type of fault:	**FMI Description:**	**Fault Condition:**	**Possible Symptoms:**	**Possible Cause:**
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted +	• MIL illuminated • Not possible to perform afterrun	• Faulty harness • Faulty connector • Aftertreatment DEF pump assembly failure
FMI 4	• Voltage below normal, or shorted to low source	• Circuit shorted – • Open circuit	• MIL illuminated • Not possible to perform afterrun	• Faulty harness • Faulty connector • Aftertreatment DEF pump assembly failure
FMI 5	• Current below normal or open circuit	• Open circuit	• MIL illuminated • Not possible to perform afterrun	• Faulty harness • Faulty connector • Aftertreatment DEF pump assembly failure
FMI 7	• Mechanical system not responding or out of adjustment	• Possible mechanical problem with aftertreatment diesel exhaust fluid (DEF) return valve	• MIL illuminated • Not possible to perform afterrun	• Mechanical fault – DEF return line restricted between DEF pump and DEF tank • Aftertreatment Diesel Exhaust Fluid (DEF) pump assembly

ECM SPN 4752, Engine Exhaust Gas Recirculation (EGR) Cooler Efficiency – MID 128 SID 282

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 7	• Mechanical system not responding or out of adjustment	• Low EGR cooler efficiency	• MIL illuminated	• EGR cooler clogged or damaged

ECM SPN 4811, Engine Piston Cooling Oil Pressure – MID 128 PPID 8

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 1	• Data valid but below normal operational range - Most severe level	• Pressure below range	• Red engine shutdown lamp illuminated	• N/A
FMI 3	• Voltage above normal or shorted to high source	• Short to battery in metering line	• Yellow electronic malfunction lamp illuminated	• Faulty harness
FMI 5	• Current below normal or open circuit	• Open in the metering side sensor circuit • Open circuit in the ground line sensor circuit	• Yellow electronic malfunction lamp illuminated	• Faulty sensor • Faulty harness

ECM SPN 4813, Engine Oil Thermostat Bypass Valve Opening – MID 128 PSID 72

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted +	• Yellow electronic malfunction lamp illuminated • Oil thermostat is always open	• Faulty actuator • Faulty harness

FMI 4	• Voltage below normal, or shorted to low source	• Circuit shorted –	• Yellow electronic malfunction lamp illuminated • Oil thermostat is always closed • Engine may overheat	• Faulty actuator • Faulty harness
FMI 5	• Current below normal or open circuit	• Open circuit	• Yellow electronic malfunction lamp illuminated • Oil thermostat is always open • May have increased fuel consumption	• Faulty actuator • Faulty harness

ECM SPN 4815, Engine Cooling Fan Thermal Switch Position – MID 128 PPID 333

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted to battery	• Yellow electronic malfunction lamp illuminated	• Faulty harness • Faulty harness connector • Faulty sensor
FMI 4	• Voltage below normal, or shorted to low source	• Short circuit -	• Yellow electronic malfunction lamp illuminated	• Faulty harness • Faulty harness connector • Faulty sensor
FMI 5	• Current below normal or open circuit	• Open circuit	• Yellow electronic malfunction lamp illuminated	• Faulty harness • Faulty harness connector • Faulty sensor

ECM SPN 5246, Aftertreatment SCR Operator Inducement Severity – MID 128 PSID 46

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Severe SCR system fault detected – Warning fault	• Severe engine derate	• N/A

FMI 15	• Data valid but above normal operating range - Least severe level	• Moderate SCR system fault detected – Warning fault	• Moderate engine derate	• N/A
FMI 16	• Data valid but above normal operating range - Moderately severe level	• SCR system fault detected – Warning fault	• Engine derate	• N/A

ECM SPN 5285, Charge Air Cooler (CAC) Temperature – MID 128 PID 52

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 7	• Mechanical system not responding properly	• Boost temperature too high	• MIL illuminated (13L engine only)	• Air flow through charge air cooler (CAC) too low • Charge air cooler (CAC)
FMI 18	• Data valid but below normal operating range	• Boost temperature too high	• MIL illuminated (13L engine only)	• Air flow through charge air cooler (CAC) too low • Charge air cooler (CAC)

ECM SPN 5298, Aftertreatment Diesel Oxidation Catalyst (DOC) Conversion Efficiency – MID 128 PSID 99

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 7	• Mechanical system not responding properly	• Hydrocarbon conversion is too low in the Diesel Oxidation Catalyst (DOC)	• MIL illuminated	• Catalyst failure • DOC temperature sensor
FMI 18	• Data valid but below normal operating range - Moderately severe level	• Hydrocarbon conversion is too low in the Diesel Oxidation Catalyst (DOC)	• MIL illuminated	• Catalyst failure • DOC temperature sensor

ECM SPN 5392, Aftertreatment Diesel Exhaust Fluid (DEF) Dosing Valve Loss of Prime – MID 128 PSID 121

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 7	• Mechanical system not responding properly	• Aftertreatment Diesel Exhaust Fluid (DEF) pressure build up failure	• MIL illuminated • Yellow electronic malfunction lamp illuminated • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing	• Empty DEF tank • DEF filter clogged • DEF inlet pipe leak or blockage • DEF pump assembly
FMI 31	• Condition exists	• Aftertreatment Diesel Exhaust Fluid (DEF) pressure build up failure	• MIL illuminated • Yellow electronic malfunction lamp illuminated • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing	• Empty DEF tank • DEF filter clogged • DEF inlet pipe leak or blockage • DEF pump assembly

ECM SPN 5394, Aftertreatment Diesel Exhaust Fluid (DEF) Dosing Valve – MID 128 PSID 89

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 0	• Data valid but above normal operational range - Most severe level	• Low side circuit shorted to +	• MIL illuminated	• Aftertreatment DEF dosing pump assembly
FMI 1	• Data valid but below normal operational range - Most severe level	• Short to ground • Low side circuit open	• MIL illuminated	• Aftertreatment DEF dosing pump assembly
FMI 3	• Voltage above normal, or shorted to high source	• Circuit shorted +	• MIL illuminated	• Aftertreatment DEF dosing pump assembly
FMI 4	• Voltage below normal, or shorted to low source	• Circuit shorted –	• MIL illuminated	• Aftertreatment DEF dosing pump assembly

FMI 5	• Current below normal or open circuit	• Open circuit	• MIL illuminated • Yellow electronic malfunction lamp illuminated	• Aftertreatment DEF doser • Aftertreatment DEF dosing pump assembly
FMI 14	• Special instructions	• Aftertreatment Diesel Exhaust Fluid (DEF) Doser clogged or hose clogged	• MIL illuminated • Yellow electronic malfunction lamp illuminated	• Aftertreatment Diesel Exhaust Fluid (DEF) doser clogged • Hose clogged

ECM SPN 5394, Aftertreatment Diesel Exhaust Fluid (DEF) Dosing Valve – MID 128 PSID 90

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 1	• Data valid but below normal operational range	• Dosing failure • Aftertreatment Diesel Exhaust Fluid (DEF) dosing amount too low or DEF quality	• MIL illuminated • NOx emissions too high	• NOx sensor • SCR catalyst malfunction • EGR mass flow failure • SCR inlet temperature sensor
FMI 17	• Data valid but below normal operating range - Least severe level	• Dosing failure • Aftertreatment Diesel Exhaust Fluid (DEF) dosing amount too low or DEF quality	• MIL illuminated • NOx emissions too high	• NOx sensor • SCR catalyst malfunction • EGR mass flow failure • SCR inlet temperature sensor

ECM SPN 5485, Aftertreatment Diesel Exhaust Fluid (DEF) Pump Orifice – MID 128 PSID 121

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 11	• Root cause not known	• Aftertreatment Diesel Exhaust Fluid (DEF) bleed orifice clogged	• MIL illuminated • Yellow electronic malfunction lamp illuminated • No Aftertreatment Diesel Exhaust Fluid (DEF) dosing	• Bleed orifice • Aftertreatment Diesel Exhaust Fluid (DEF) pressure sensor

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