2000 MY OBD System Operation

Summary for 7.3L Diesel Engine

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Introduction – OBD-I and OBD-II

OBD-II Systems

California OBD-II applies to all gasoline engine vehicles up to 14,000 lbs. Gross Vehicle Weight Rating (GVWR) starting in the 1996 MY and all diesel engine vehicles up to 14,000 lbs. GVWR starting in the 1997 MY.

"Green States" are states in the Northeast that chose to adopt California emission regulations, starting in the 1998 MY. At this time, Massachusetts, New York, Vermont and Maine are Green States. Massachusetts and Maine receive California – certified vehicles for passenger cars and light trucks up to 14,000 lbs. GVWR. New York and Vermont receive California – certified vehicles for passenger cars and light trucks up to 6,000 lbs. GVWR.

The National LEV program (NLEV) requires compliance with California OBD-II, including 0.020" evaporative system monitoring requirements. The NLEV program applies to passenger cars and light trucks up to 6,000 lbs. GVWR nation-wide from 2001 MY through 2003 MY

Federal OBD applies to all gasoline engine vehicles up to 8,500 lbs. GVWR starting in the 1996 MY and all diesel engine vehicles up to 8,500 lbs. GVWR starting in the 1997 MY.

OBD-II system implementation and operation is described in the remainder of this document.

OBD-I Systems

If a vehicle is not required to comply with OBD-II requirements, it utilizes an OBD-I system. OBD-I systems are used on all over 8,500 lbs. GVWR Federal truck calibrations. Federal > 8,500 lbs. OBD-I vehicles use the same PCM, J1850 serial data communication link, J1962 Data Link Connector, and PCM software as the corresponding OBD-II vehicle.

The following list indicates what monitors and functions have been altered for OBD-I calibrations:

Monitor / Feature	Calibration
Misfire Monitor	Calibrated in for service, all DTCs are non-MIL. Catalyst damage misfire criteria calibrated out, emission threshold criteria set to 4%, enabled between 150 °F and 220 °F, 254 sec start-up delay.
Comprehensive Component Monitor	All circuit checks same as OBD-II. Some rationality and functional tests are calibrated out. MIL control for Federal truck applications is unique, not consistent with OBD-II MIL illumination.
Glow Plug Monitor	Glow Plug diagnostics do not set the MIL on Federal truck applications over 8,500lbs.
Communication Protocol and DLC	Same as OBD-II, all generic and enhanced scan tool modes work the same as OBD-II but reflect the OBD-I calibration that contains fewer supported monitors. "OBD Supported" PID indicates OBD-I.
MIL Control	Illuminates the MIL for P0117 and P0118 (ECT), P0197 and P0198 (EOT), P0237 and P0238 (MAP), P2285 and P2286 (ICP), P1148 and P1149 (Boost hose), P0122 and P0123 (Pedal position)

Misfire Monitor

Low Data Rate System

The LDR Misfire Monitor utilizes a low-data-rate Hall Effect camshaft position (CAMP) sensor signal triggered off a 24-tooth camshaft-timing wheel. One narrow window and an opposing wide window provide sync pulses to the CAMP sensor to indicate camshaft position for correct cylinder timing. The PCM calculates camshaft rotational velocity for each cylinder from this position signal. The acceleration for each cylinder is then calculated into a percentage delta change decrease in velocity for use by the misfire algorithm. The resulting deviant cylinder acceleration values are used in evaluating misfire.

Misfire is defined as a loss of compression. The amount of compression loss in a cylinder that misfire monitor will detect is referenced as a 3/16" or larger hole in a cylinder or valve train component.

Misfire Algorithm Processing

The acceleration that a piston undergoes during a normal firing event is directly related to the amount of torque that a cylinder produces. For misfire determination the CAMP signal is processed at the peak instantaneous inverse velocity angle of 90^{o} after top dead center (ATDC) from the previous cylinder-firing event. The calculated inverse velocity of a cylinder under test is compared to the previous cylinder-firing event to establish a percentage delta velocity change decrease. A cylinder with a misfire is identified by a large delta velocity value. When the delta value exceeds the calibrated threshold, the misfire algorithm increments the specific cylinders misfire counter.

The numbers of misfires are counted in a block of 1000 revs. (The misfire counters are not reset if the misfire monitor is temporarily disabled such as an off idle condition, etc.)

To insure accurate misfire calculation and reliable cylinder misfire quantification, misfire data is sampled at engine speeds below 750 RPM. Misfire data becomes unreliable in an operating range outside of the idle region. For this reason other engine operating parameters are monitored to insure misfire operates in a region that yields accurate misfire results. The following table outlines the entry conditions required in order to execute the misfire monitor algorithm.

Misfire Monitor Operation:	
DTCs	P0301 – Fault Cylinder 1 Misfire Detected P0302 – Fault Cylinder 2 Misfire Detected P0303 – Fault Cylinder 3 Misfire Detected P0304 – Fault Cylinder 4 Misfire Detected P0305 – Fault Cylinder 5 Misfire Detected P0306 – Fault Cylinder 6 Misfire Detected P0307 – Fault Cylinder 7 Misfire Detected P0308 – Fault Cylinder 8 Misfire Detected
Monitor execution	Continuous every combustion event.
Monitor Sequence	None
Sensors OK	Camshaft Position (CMP), No Injector faults
Monitoring Duration	40 Consecutive faults when conditions are met.

Typical Misfire Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
Fuel desired	None	25 mg/stroke
Engine Oil Temperature	50 ^{o}C	110 ^{o}C
Engine Speed (Low Idle)	600 rpm	750 rpm
Vehicle Speed	0 MPH	1 MPH
Ambient Air Temperature	-15 ^{o}C	110 ^{o}C
Exhaust Backpressure Gauge	None	100KPaG
Injection Control Pressure Duty Cycle	0	25%
PTO	Off	Off
Fuel tank level	15%	100%

Typical Misfire Monitor Malfunction Thresholds:
When the percentage change (Auto > 9%, Manual > 4%) of instantaneous inverse velocity at 90° after top dead center (ATDC) from the previous cylinder to the cylinder under test exceeds a specified value for a specified amount of time (about 10 sec), the fault is set.

Glow Plug Monitor

Glow Plug Control, Comprehensive Component Monitors, and Wait to Start Indicator—California

The California glow plug system is composed of solid state Glow Plug Control Module (GPCM), glow plugs, glow plug light, and the associated wiring harness. The glow plug on-time is controlled by the Powertrain Control Module (PCM) and is a function of oil temperature, barometric pressure and battery voltage. The PCM enables the GPCM which drives the individual glow plugs. Glow plug on-time normally varies between 1 and 120 seconds. In addition to PCM control, the GPCM internally limits the glow plug operation to 180 seconds regardless of PCM commanded on-time. The power to the glow plugs is provided through the GPCM solid state drivers directly from the vehicle battery. The GPCM monitors and detects individual glow plug functionality, and the control and communication links to the PCM. The failures detected by the GPCM are passed to the PCM using a serial communication signal on the glow plug diagnostic line.

Glow Plug Module Control Circuit Check:	
DTCs	P0670 – Glow Plug Control Module control line failure
Monitor execution	Continuous (Background 25ms – 50ms)
Monitor Sequence	None
Sensors OK	Not Applicable
Typical Monitoring Duration	Less than 1 second.

Typical Glow Plug Module Control Circuit Check Entry Conditions:
No Entry Conditions

Typical Glow Plug Module Control Circuit Check Malfunction Thresholds:
Actuator driver status indicates open/short

Glow Plug Module Diagnostic Communication Circuit Operation:	
DTCs	P0683 – Glow Plug Control Module communication line failure
Monitor execution	Continuous (Background 25ms – 50ms)
Monitor Sequence	None
Sensors OK	Not Applicable
Monitoring Duration	Glow plug on time greater than 8.5 seconds.

Typical Glow Plug Monitor Entry Conditions:
Glow plugs enabled

Typical Glow Plug Monitor Malfunction Thresholds:
The Glow Plug Control Module (GPCM) passes Glow Plug status information across the Glow Plug Diagnostic Line. If no Glow Plug pass/fail message string can be determined the P0683 fault is set.

Glow Plug Monitor Operation:	
DTCs	P0671 – Glow Plug Circuit Failure 1 P0672 – Glow Plug Circuit Failure 2 P0673 – Glow Plug Circuit Failure 3 P0674 – Glow Plug Circuit Failure 4 P0675 – Glow Plug Circuit Failure 5 P0676 – Glow Plug Circuit Failure 6 P0677 – Glow Plug Circuit Failure 7 P0678 – Glow Plug Circuit Failure 8
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	Not Applicable
Monitoring Duration	Glow plug on time greater than 8.5 seconds.

Typical Glow Plug Monitor Entry Conditions:
Battery Voltage (IVPWR) must be between 10 and 14 Volts and the Glow Plug Duty Cycle must = 100%.

Typical Glow Plug Monitor Malfunction Thresholds:
An Open is a current level less than 4 Amps and a current level above 60 Amps is a short.

Glow Plug Wait to Start Light Operation:	
DTCs	P0381 – Glow Plug indicator circuit malfunction
Monitor execution	Continuous (Background 25ms-50ms)
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	Internal to Chip

Glow Plug Light Wait to Start Light Entry Conditions:
Glow Plugs Enabled

Glow Plug Light Wait to Start Light Malfunction Thresholds:
Status internal to chip

Comprehensive Component Monitor - Engine

Engine Inputs (Analog)

Battery Voltage (IVPWR):	
DTCs	P0562 - System Voltage Low
Monitor execution	Continuous (Background 25ms-50ms)
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	Less than 2 second

Typical Battery Voltage Entry Conditions:
No entry conditions.

Typical Battery Voltage Malfunction Thresholds:
Voltage less 6.51 V.

Barometric Pressure (BP) Sensor Circuit Check:	
DTCs	P0107 - Barometric pressure sensor circuit low input P0108 – Barometric pressure sensor circuit high input
Monitor execution	Continuous (Background 25ms – 50ms)
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	Less than 1 second

Typical Barometric Pressure Sensor Circuit Check Entry Conditions:
No entry conditions.

Typical Barometric Pressure Sensor Circuit Check Malfunction Thresholds:
P0107 – Voltage less than 0.04 volts. P0108 – Voltage greater than 4.90 volts.

Manifold Absolute Pressure (MAP) Sensor Circuit Check:	
DTCs	P0237 - Turbo boost sensor A circuit low input P0238 – Turboboost sensor A circuit high input
Monitor execution	Continuous (Background 25ms – 50ms)
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	Less than 1 second

Typical Manifold Absolute Pressure Sensor Circuit Check Entry Conditions:
No Entry Conditions

Typical Manifold Absolute Pressure Sensor Circuit Check Malfunction Thresholds:
P0237 – Voltage less than 0.04 volts. P0238 – Voltage greater than 4.90 volts.

Manifold Air Temperature (MAT) Circuit Check : *F-Series Only*	
DTCs	P1118 – Manifold Air Temperature Circuit Low P1119 – Manifold Air Temperature Circuit High
Monitor execution	Continuous (Background 25ms – 50ms)
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	Less than 1 second

Typical MAT entry conditions:
No entry conditions.

Typical MAT sensor check malfunction thresholds:
P1118 – Voltage less than 0.13 volts. P1119 – Voltage greater than 4.6 volts.

Manifold Absolute Pressure Functional Check Operation:	
DTCs	P0236 – Turbo boost sensor A circuit performance P1247 – Turbo boost pressure low P1248 – Turbo boost pressure not detected
Monitor execution	Continuous (Background 25ms – 50ms)
Monitor Sequence	None
Sensors OK	P0236 – Manifold Absolute Pressure (MAP), Barometric Pressure (BP) P1247 – Manifold Absolute Pressure (MAP), Barometric Pressure (BP) P1248 – Manifold Absolute Pressure (MAP), Barometric Pressure (BP)
Typical Monitoring Duration	P0236 – Greater than 10 seconds P1247 – Greater than 10 seconds P1248 – Greater than 15 seconds

Typical Manifold Absolute Pressure Functional Check Entry Conditions:
P0236 – Mass Fueling Desired (MFDES) < 14 mg/stroke and Engine Speed (N) < 850 rpm
P1247 – No Entry Conditions.
P1248 – No Entry Conditions.

Typical Manifold Absolute Pressure Functional Malfunction Thresholds:
P0236 – Fault sets if Manifold Absolute Pressure (MAP) signal is higher than the specified pressure. (MAP > 70 kPa, Manifold Gauge Pressure (MGP) > 30 kPa)
P1247 – Fault sets if a minimum specified boost doesn't occur. (F-Series: Engine Speed(N)>1750rpm, Volume Fuel Desired (VFDES) >40, Manifold Absolute Pressure (MAP) chg<30 kPa - E-Series: N>2600, VFDES>30, MAP chg<8 kPa)
P1248 – Fault sets if a minimum specified boost doesn't occur. (Engine Speed (N) > 1500rpm, Volume Fuel Desired (VFDES) > 32, Manifold Absolute Pressure (MAP) chg<5 kPa)

Exhaust Back Pressure (EBP) Sensor Circuit Check:	
DTCs	P0472 - Exhaust pressure sensor circuit low input P0473 – Exhaust pressure sensor circuit high input
Monitor execution	Continuous (Background 25ms-50ms)
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	Less than 1 second

Typical Exhaust Back Pressure Sensor Circuit Check Entry Conditions:
No Entry Conditions

Typical Exhaust Back Pressure Sensor Circuit Check Malfunction Thresholds:
P0472 – Voltage less than 0.04 volts. P0473 – Voltage greater than 4.90 volts.

Exhaust Back Pressure Functional Check Operation:	
DTCs	P0471 - Exhaust press sensor circuit performance P0478 – Exhaust press control valve high input
Monitor execution	Continuous (Background 25ms – 50ms)
Monitor Sequence	None.
Sensors OK	Exhaust Back Pressure (EBP)
Typical Monitoring Duration	P0471 – Greater than 3 seconds. P0478 – Greater than 3 seconds.

Typical Exhaust Back Pressure Functional Check Entry Conditions:
P0471 - Engine speed (N) is greater than 2300 RPM. P0478 - Engine speed (N) is greater 650 RPM.

Typical Exhaust Back Pressure Functional Thresholds:
P0471 - Checks for a minimum change in Exhaust Back Pressure (EBP) (20kPaG). P0478 - Checks the Exhaust Back Pressure sensor (EBP) by looking for a pressure above a specified value for the sensor (240kPaG).

Engine Oil Temperature (EOT) Sensor Circuit Check:	
DTCs	P0197 - Engine oil temp sensor circuit low input P0198 – Engine oil temp sensor circuit high input
Monitor execution	Continuous (Background 25ms – 50ms)
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	Less than 1 second

Typical Engine Oil Temperature Sensor Circuit Check Entry Conditions:
No Entry Conditions

Typical Engine Oil Temperature Sensor Circuit Check Malfunction Thresholds:
P0197 – Voltage less than .15. P0198 – Voltage greater than 4.80.

Intake Air Temperature (IAT) Sensor Circuit Check:	
DTCs	P0112 – Intake air temp sensor circuit low input P0113 – Intake air temp sensor circuit high input
Monitor execution	Continuous (Background 25ms – 50ms)
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	Less than 1 second

Typical Intake Air Temperature Entry Conditions:
No Entry Conditions.

Typical Intake Air Temperature Sensor Circuit Check Malfunction Thresholds:
P0112 – Voltage less than 0.13 volts. P0113 – Voltage greater than 4.60 volts.

Injection Control Pressure (ICP) Sensor Circuit Check:	
DTCs	P1280 - ICP circuit out of range low P1281 – ICP circuit out of range high
Monitor execution	Continuous (Background 25ms – 50ms)
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	Less than 1 second

Typical Injection Control Pressure Sensor Circuit Check Entry Conditions:
No Entry Conditions

Typical Injection Control Pressure Sensor Circuit Check Malfunction Thresholds:
P1280 – Voltage less than 0.04 volts. P1281 – Voltage greater than 4.90 volts.

Injection Control Pressure Functional Check Operation:	
DTCs	P1209 – ICP system fault P1210 – ICP above expected level P1211 – ICP pressure above/below desired P1282 – Excessive ICP pressure
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	Injection Control Pressure (ICP)
Typical Monitoring Duration	P1209 – Greater than 5 seconds. P1210 – Greater than 3 seconds. P1211 – Greater than 7 seconds. P1282 – Greater than 1.5 seconds.

Typical Injection Control Pressure Functional Check Entry Conditions:
P1209 – The engine is running (mode = 2)
P1210 – The engine is off (mode =0), the engine speed is 0.
P1211 – The engine is running (mode =2)
P1282 – The engine is running (mode =2)

Typical Injection Control Pressure Functional Malfunction Thresholds:
P1209 – Fault sets when the difference between the commanded and actual Injection Control Pressure (ICP) exceeds a specified value (12 MPa).
P1210 – When the actual pressure is greater than a specified maximum pressure (8 MPa)
P1211 – Fault sets when actual pressure differs from the commanded by a specified value (+2.0 MPa or – 2.8 MPa)
P1282 – When the actual pressure is greater than a specified maximum pressure (25 MPa)

Pedal Position Sensor Circuit Check:	
DTCs	P0122 – Accelerator pedal sensor circuit low input P0123 – Accelerator pedal sensor circuit high input
Monitor execution	Continuous (Background 25ms – 50ms)
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	Less than 1 second

Typical Pedal Sensor Circuit Check Entry Conditions:
Pedal not at idle position. (IVS = 1)

Typical Pedal Sensor Circuit Check Malfunction Thresholds:
P0122 – Less than .37 V. P0123 – Greater than 4.5 V.

Note: Pedal position sensor faults illuminate the MIL to inform the customer of the malfunction. The vehicle cannot be driven because the engine remains at idle. Engine emissions are not affected.

Idle Validation Switch (IVS) Sensor Circuit Check:	
DTCs	P0221 – Throttle switch B circuit malfunction
Monitor execution	Continuous (Background 25ms – 50ms)
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	Less than 1 second

Typical Idle Validation Switch (IVS) Sensor Circuit Check Entry Conditions:
Pedal at idle position. (IVS = 0)

Typical Idle Validation Switch (IVS) Sensor Circuit Check Malfunction Thresholds:
Greater than 1.60 volts or less than .40 volts.

Fuel Level Input Operation:	
DTCs	P0460 – Fuel Level Sensor Circuit Malfunction
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	Greater than 33 seconds.

Fuel Level Input Entry Conditions:
No entry conditions

Fuel Level Input Malfunction Thresholds:
Instrument cluster driver chip checks for open circuit, or short circuit.

Wastegate Control Operation:	
DTCs	P1249 – Waste Gate failure steady state
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	Greater than 6 seconds.

Wastegate Control Malfunction Entry Conditions:
Mass Fuel Desired is greater than 30 mg/stk and Engine Speed is greater than 1750 rpm.

Wastegate Control Malfunction Thresholds:
When actual manifold air pressure (MAP) differs from the desired value by a specified margin (15 kPa) .

Engine Inputs (Digital)

Camshaft Position Sensor (CMP) Check Operation:	
DTCs	P0341 –Camshaft position sensor ckt performance P0344 – Camshaft position sensor ckt intermittent
Monitor execution	Continuous
Monitor Sequence	None.
Sensors OK	Not applicable
Typical Monitoring Duration	P0344 – Greater than .25 seconds.

Typical Camshaft Position Sensor Malfunction Entry Conditions:
P0341 – No Entry Conditions P0344 – Engine Speed (N) is greater than 500 rpm.

Typical Camshaft Position Sensor Malfunction Thresholds:
P0341 – If time since last CAMP signal is too short (<15 clock counts), and this occurs 255 times during one key-on cycle the fault is set. P0344 – Fault sets when the synchronization tooth signal is not detected when expected.

Injector Driver Module (IDM) Check Operation:	
DTCs	P1316 –Injector circuit/IDM codes detected P1670 – Engine Feedback signal not detected
Monitor execution	Continuous
Monitor Sequence	None.
Sensors OK	Not applicable
Typical Monitoring Duration	Less than 1 second

Typical Injector Driver Module (IDM) Malfunction Entry Conditions:
P1316 – No Entry Conditions P1670 – Engine is running (mode=2).

Typical Injector Driver Module (IDM) Malfunction Thresholds:
P1316 – The PCM interrogates the Injector Driver Module (IDM) for a 300 µsec, 400 µsec, or 500 µsec extension on the Engine Feedback line. If any of these extensions exist that indicates that the Injector Driver Module (IDM) has stored codes then the fault is set. P1670 – When a commanded Injector Driver Module (IDM) response is not received this fault is set.

Engine Outputs

Dual Alternator Control Check Operation:	
DTCs	P1107 – Dual alternator lower circuit malf. (control)
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	Internal to Chip

Typical Dual Alternator Control Entry Conditions:
No entry conditions

Typical Dual Alternator Control Malfunction Thresholds:
Actuator driver status indicates open/short

Exhaust Pressure Regulator (EPR) Valve Check Operation:	
DTCs	P0475 – Exhaust press control valve malfunction
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	Internal to Chip

Exhaust Pressure Regulator (EPR) Valve Check Entry Conditions:
No entry conditions

Exhaust Pressure Regulator (EPR) Valve Check Malfunction thresholds:
Actuator driver status indicates open/short

Fuel Pump Monitor Operation:	
DTCs	P0231 – Fuel Pump circuit failure
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	Greater than 1 second.

Fuel Pump Monitor Malfunction Entry Conditions:
Fuel Pump commanded "on", engine not cranking, Battery Voltage (IVPWR) above 11V

Fuel Pump Monitor Malfunction Thresholds:
When the fuel pump monitor sees a voltage other than expected for a specified time after the fuel pump is commanded "on", the fault is set.

Wastegate Control Operation :	*F-Series Only*
DTCs	P1690 – Wastegate failure.
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	Less than 1 second.

Wastegate Control Malfunction Entry Conditions:
No entry conditions.

Wastegate Control Malfunction Thresholds:
Actuator driver status indicates open/short.

Comprehensive Component Monitor - Transmission

General

The MIL is illuminated for all emissions related electrical component malfunctions. For malfunctions attributable to a mechanical component (such as a clutch, gear, band, valve, etc.), some transmissions are capable of not commanding the mechanically failed component and providing the remaining maximum functionality (functionality is reassessed on each power up)- in such case a non-MIL Diagnostic Trouble Code (DTC) will be stored and, if so equipped, a Transmission Control Indicator Light (TCIL) will flash.

Transmission Inputs

Transmission Range Sensor Check Operation:	
DTCs	P0708, P0705 (open/invalid pattern for digital TRS)
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	
Monitoring Duration	30 seconds

Typical TRS check entry conditions:		
Auto Transmission Entry Conditions	Minimum	Maximum
Gear selector position	each position for up to 30 seconds	480 seconds

Typical TRS malfunction thresholds:
For digital sensor: Invalid pattern from 3 or 5 digital inputs and/or 1 analog circuit open for 5 seconds

Most vehicle applications no longer have a standalone vehicle speed sensor input. The PCM sometimes obtains vehicle speed information from another module on the vehicle, i.e. ABS module. In most cases, however, vehicle speed is calculated in the PCM by using the transmission output shaft speed sensor signal and applying a conversion factor for axle ratio and tire programmed into the Vehicle ID block. A Vehicle Speed Output pin on the PCM provides the rest of the vehicle with the standard 8,000 pulses/mile signal.

Note: If the Vehicle ID block has not been programmed or has been programmed with an out-of-range (uncertified) tire/axle ratio, a P1639 DTC will be stored and the MIL will be illuminated immediately.

Vehicle Speed Sensor Functional Check Operation:	
DTCs	P0500
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	
Monitoring Duration	30 seconds

Typical VSS functional check entry conditions:		
Auto Transmission Entry Conditions	Minimum	Maximum
Gear selector position	drive	
Engine rpm (above converter stall speed) OR	3000 rpm	
Turbine shaft rpm (if available) OR	1500 rpm	
Output shaft rpm	650 rpm	
Vehicle speed (if available)	15 mph	
Manual Transmission Entry Conditions		
Engine load	50 %	
Engine rpm	2400 rpm	

Typical VSS functional check malfunction thresholds:
Vehicle is inferred to be moving with positive driving torque and VSS is < 1 - 5 mph for 5 seconds

Output Shaft Speed Sensor Functional Check Operation:	
DTCs	P0720
Monitor execution	continuous
Monitor Sequence	none
Sensors OK	
Monitoring Duration	30 seconds

Typical OSS functional check entry conditions:		
Auto Transmission Entry Conditions	Minimum	Maximum
Gear selector position	drive	
Engine rpm (above converter stall speed) OR	3000 rpm	
Turbine shaft rpm (if available) OR	1500 rpm	
Output shaft rpm	650 rpm	
Vehicle speed (if available)	15 mph	

Typical OSS functional check malfunction thresholds:
Vehicle is inferred to be moving with positive driving torque and OSS < 100 to 200 rpm for 5 seconds

Turbine Shaft Speed Sensor Functional Check Operation:	
DTCs	P0715
Monitor execution	continuous
Monitor Sequence	none
Sensors OK	
Monitoring Duration	30 seconds

Typical TSS functional check entry conditions:		
Auto Transmission Entry Conditions	Minimum	Maximum
Gear selector position	drive	
Engine rpm (above converter stall speed) OR	3000 rpm	
Turbine shaft rpm (if available) OR	1500 rpm	
Output shaft rpm	650 rpm	
Vehicle speed (if available)	15 mph	
Torque converter lock-up (some applications)	3rd gear only	

Typical TSS functional check malfunction thresholds:
vehicle is inferred to be moving with positive driving torque and TSS < 200 rpm for 5 seconds

Transmission Fluid Temperature Sensor Functional Check Operation:	
DTCs (non-MIL)	P0712, P0713 (open/short) P1713,(stuck low), P1718 (stuck high)
Monitor execution	continuous
Monitor Sequence	none
Sensors OK	(ECT substituted if TFT has malfunction)
Monitoring Duration	5 seconds for electrical, 600 seconds for functional check

Typical TFT functional check entry conditions:		
Auto Transmission Entry Conditions	Minimum	Maximum
Engine Coolant Temp (hot or cold, not midrange)	> 100 ^{o}F	< 20 ^{o}F
Time in run mode	500 sec	
Time in gear, vehicle moving, positive torque	150 sec	
Time with engine off (soak time)	420 min	
Vehicle Speed	15 mph	

Typical TFT malfunction thresholds:
Electrical check: TFT voltage <0.05 or > 4.6 volts for 5 seconds TFT functional check (TFT stuck at high temperature or stuck at low temperature): < 6 ^{o}F rise or fall in TFT after startup

Transmission Outputs

Shift Solenoid Check Operation:	
DTCs	SS A - P0750 electrical, P1714 ISIG functional SS B - P0755 electrical, P1715 ISIG functional
Monitor execution	electrical - continuous, functional - during off to on solenoid transitions
Monitor Sequence	None
Sensors OK	
Monitoring Duration	10 solenoid events

Typical Shift Solenoid ISIG functional check entry conditions:		
Entry Conditions	Minimum	Maximum
Transmission Fluid Temp	70 ^{o}F	225 ^{o}F
Throttle position	positive drive torque (actual TP varies)	

Typical Shift Solenoid mechanical functional check entry conditions:		
Entry Conditions (with turbine speed)	Minimum	Maximum
Gear ratio calculated	each gear	
Throttle position	positive drive torque	

Typical Shift Solenoid mechanical functional check entry conditions:		
Entry Conditions (without turbine speed)	Minimum	Maximum
Rpm drop is obtained	each shift	
Throttle position	positive drive torque	

Typical SS malfunction thresholds:
Electrical check: Output driver feedback circuit does not match commanded driver state for 5 seconds
ISIG functional check: ISIG chip hardware circuit does not detect characteristic current dip and rise produced by solenoid movement.
Mechanical functional check: Actual obtained gear or shift pattern indicates which shift solenoid is stuck on or off.

Torque Converter Clutch Check Operation:	
DTCs	P0743 electrical, P1740 ISIG functional, or P1744 mechanical functional
Monitor execution	electrical - continuous, mechanical - during lockup
Monitor Sequence	none
Sensors OK	VSS
Monitoring Duration	5 lock-up events

Typical Torque Converter Clutch ISIG functional check entry conditions:		
Entry Conditions	Minimum	Maximum
Transmission Fluid Temp	70 ^{o}F	225 ^{o}F
Engine Torque	positive drive torque	
Commanded TCC dutycycle for 0 rpm slip	60%	90%

Typical Torque Converter Clutch mechanical functional check entry conditions:		
Entry Conditions	Minimum	Maximum
Throttle Position	steady	
Engine Torque	positive drive torque	
Transmission Fluid Temp	70 ^{o}F	225 ^{o}F
Commanded TCC dutycycle (0 rpm slip)	60%	100%
Not shifting		

Typical TCC malfunction thresholds:
Electrical check:
Output driver feedback circuit does not match commanded driver state for 5 seconds(> 1.0 volt if commanded on, < 2.0 volts if commanded off.)
ISIG functional check:
ISIG chip hardware circuit does not detect characteristic current dip and rise produced by solenoid movement.
Mechanical check:
Slip across torque converter > 100 rpm or (on some applications) speed ratio < 0.93
Mechanical check:
Slip across torque converter < 20 rpm with converter commanded off (some applications)

Electronic Pressure Control Check Operation:	
DTCs	P1747 electrical,
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	
Monitoring Duration	5 seconds,

Typical EPC malfunction thresholds:
Electrical check: Current feedback circuit is less than commanded current for 5 seconds

Inductive Signature Chip Communication Check Operation:	
DTCs	P1636 loss of communication
Monitor execution	off-to-on solenoid transitions
Monitor Sequence	none
Sensors OK	
Monitoring Duration	< 100 solenoid events

Typical Inductive Signature Chip Communication Check entry conditions:		
Entry Conditions	Minimum	Maximum
Transmission Fluid Temp	70 ^{o}F	225 ^{o}F
Solenoid commanded off duration		< 2 seconds

Typical Inductive Signature Communication Chip malfunction thresholds:
Checksum error, chip not responding

(turbine speed sensor in most applications)

Transmission Inputs

The Digital Transmission Range (DTR) sensor provides a single analog and three digital inputs to the PCM. The PCM decodes the inputs to determine the driver-selected gear position (Park, Rev, Neutral, OD, 2, 1). This input device is checked for opens and invalid input patterns. (P0708, P0705)

The Vehicle Speed Sensor (VSS), Turbine Shaft Speed (TSS) sensor and Output Shaft Speed (OSS) sensor, if equipped, are analog inputs that are checked for rationality. If the engine rpm is above the torque converter stall speed and engine load is high, it can be inferred that the vehicle must be moving. If there is insufficient output from the VSS sensor, a malfunction is indicated (P0500). If there is insufficient output from the TSS sensor, a malfunction is indicated (P0715). If there is insufficient output from the OSS sensor, a malfunction is indicated (P0720).

Transmission Outputs

Shift Solenoids

The Shift Solenoid (SSA and SSB) output circuits are checked for opens and shorts by the PCM by monitoring the status of a feedback circuit from the output driver (P0750 SSA, P0755 SSB).

All vehicle applications will utilize an inductive signature circuit to monitor the shift solenoids functionally. The ISIG circuit monitors the current signature of the shift solenoid as the solenoid is commanded on. A solenoid that functions properly will show a characteristic decrease in current as the solenoid starts to move. If the solenoid is malfunctioning, the current will not change (P1714 SS1, P1715 SS2). The ISIG test runs in conjunction with the other transmission functional tests. In all applications, the lack of communication between the ISIG chip and the PCM microprocessor is also monitored (P1636).

Torque Converter Clutch

The Torque Converter Clutch (TCC) output circuit is either an on/off or duty-cycled output that is checked electrically for opens and shorts internally in the PCM by monitoring the status of a feedback circuit from the output driver (P0743).

Vehicle applications with on/off output drivers will utilize an inductive signature circuit to monitor the torque converter clutch functionality. The ISIG circuit monitors the current signature of the TCC solenoid as the solenoid is commanded on. A solenoid the functions properly will show a characteristic decrease in current as the solenoid starts to move. If the solenoid is malfunctioning, the current will not change (P1740). The ISIG test runs in conjunction with the other transmission functional tests. In some applications, the lack of communication between the ISIG chip and the PCM microprocessor is also monitored (P1636).

Vehicle applications that use duty-cycled output drivers utilize a rationality check for TCC operation. Actuation of the TCC on and off will result in a change of the calculated speed ratio under high engine load. If a speed ratio delta does not occur, a malfunction is indicated (P1744).

Electronic Pressure Control

The EPC solenoid is a variable force solenoid that controls line pressure in the transmission. The EPC solenoid has a feedback circuit in the PCM that monitors EPC current. If the current indicates a short to ground (low pressure), engine torque may be reduced to prevent damage to the transmission. (P1747, PCA)