2023-2024 MY OBD System Operation Summary for Diesel Engines

(PCED Pinpoint Test)

NON-METHANE HYDROCARBON (NMHC) CONVERTING CATALYST MONITOR

Diesel Oxidation Catalyst Efficiency Monitor - Functional

DOC Efficiency Monitor Summary:	
DTCs	P0420 – Catalyst System Efficiency Below Threshold
Monitor execution	Once per driving cycle during which an active DPF regeneration occurs
Monitor Sequence	None
Sensors OK	EGT12, EGT13, ECT, MAF, IAT
Monitoring Duration	4 minutes

Typical DOC Efficiency Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
DPF regeneration event		
Engine speed	1000 rpm	3000 rpm
Torque set point	100 Nm	1000 Nm
Engine coolant temperature	70 deg C	
DOC inlet temperature	200 deg C	500 deg C
PTO inactive		

Typical DOC Efficiency Monitor Malfunction Threshold:
Normalized exotherm is less than 45% of the expected exotherm for 60 seconds

Diesel Oxidation Catalyst Efficiency Monitor – Intrusive

DOC Efficiency Monitor Summary:	
DTCs	P0420 – Catalyst System Efficiency Below Threshold
Monitor execution	Triggered when distance since last completion is 400km.
Monitor Sequence	None
Sensors OK	EGT12, EGT13, ECT, MAF, IAT
Monitoring Duration	With valid entry conditions: Monitor session: 75 sec (includes time to post-inject fuel and calculate metric)

Typical DOC Efficiency Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
Distance since last monitor completion	400 km	
Time since entering normal Engine Operating Mode (EOM0)	360 sec	
Pre-DOC Temp	210 deg C	280 deg C
Post-DOC Temp	210 deg C	1000 deg C
Exhaust Mass Flow Rate	70 kg/hr	1000 kg/hr
Post Injection Fuel (from requests other than this monitor)	-10 mg/stroke	10 mg/stroke
Engine coolant temperature	70 deg C	
Ambient Air Temperature	-6.7 deg C	
Barometric Pressure	74.5 kPa	
Engine speed	1000 rpm	
Torque set point	100 Nm	

Typical DOC Efficiency Monitor Malfunction Threshold:
Monitor requires 1 failing result in order to diagnose a failed DOC. Normalized exotherm efficiency must be less than 45% of expected.

OXIDES OF NITROGREN (NOx) CONVERTING CATALYST MONITORING

Selective Catalyst Reduction – Catalyst Efficiency Monitor – 6.7L

Monitor Summary:	
DTC	P20EE – SCR NOx Catalyst Efficiency Below Threshold
Monitor execution	P20EE - Once per driving cycle
Sensors OK	NOx, EGT12, EGT13, ECT, DEF injection system, MAF, BARO, O2, EGR system
Monitoring Duration	P20EE – 1 Minute (with no storage adjustment), 5 minutes with storage adjustment

Typical Entry Conditions:		
Entry condition	Minimum	Maximum
Barometric Pressure	81.2 kPa	120 kPa
Ambient air temperature	-6.7 degC	
Engine coolant temperature	70 degC	120 degC
Engine Speed	1000 rpm	3000 rpm
Indicated Torque	150	800
Torque Transients	-20 N-m/s	20 N-m/s
Feedgas NOx (upstream of SCR)		800 ppm
Exhaust gas flowrate	145 kg/hr	1800 kg/hr
DEF storage quantity	0.75 g	8 g
Ratio of DEF storage (actual vs desired)	40% understored	10% overstored
SCR Inlet temp	200 degC	320 degC
SCR Outlet temp	180 degC	320 degC
Filtered rate of change of SCR inlet temp		10 deg/sec
NH3 dosing (ratio of NH3 vs FG NOx)	0.8 ppm NH3 / ppm NOx	3.0 ppm NH3 / ppm NOx
Engine Operating Mode	Not in Regen, not in SCR warm-up mode	
Dosing not limited by AECD		
No faults on pertinent sensors		

Typical Malfunction Thresholds:
P20EE: If the cumulative efficiency of the SCR Catalyst is less than 55%, a fault is indicated.

Selective Catalyst Reduction Feedback Control Monitors

Monitor Summary:	
DTCs	P249D – SCR Feedback at Minimum Limit P249E – SCR Feedback at Maximum Limit P249C – SCR Time to Closed Loop
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	NOx, EGT12, EGT13, ECT, EGT11 EGT14, MAF, BARO, IAT, DPFP, and EGR system
Monitoring Duration	5 minutes

Typical Entry Conditions:		
Entry condition	Minimum	Maximum
For P249D/E:		
Long Term Adaptation is enabled (SCR catalyst is at acceptable and stable operating temperature and has proper ammonia storage, vehicle is in steady-state operation		
For P249C only:		
Engine speed	800 rpm	3000 rpm
Torque set point	0 Nm	1000 Nm
Barometric pressure	74.5 kPa	
Ambient temperature	-6.7 deg C	
Engine coolant temperature	70 deg C	
Modeled SCR temperature	160 deg C	550 deg C

Typical Malfunction Thresholds:
P249D: If the correction factor is clipped at its minimum value for 30 seconds then a fault is indicated. P249E: If the correction factor is clipped at its maximum value for 30 seconds then a fault is indicated. P249C: The error is set as soon as the fraction of closed loop operation vs expected is less than the threshold. The monitor needs to run for 300 seconds to call it complete.

Missing SCR Catalyst – 6.7L Only

Monitor Summary:	
DTC	P24FE – SCR Catalyst Incorrect
Monitor execution	Continuous
Sensors OK	NOx, EGT12, EGT13, ECT, DEF injection system, MAF, BARO, O2, EGR system
Monitoring Duration	Approximately 60 seconds

Typical Entry Conditions:		
Entry condition	Minimum	Maximum
Barometric Pressure	81.2 kPa	120 kPa
Ambient air temperature	-6.7 degC	80 degC
Engine coolant temperature	70 degC	
Engine Speed	900 rpm	4000 rpm
Time since previous monitor completion to rerun the monitor	5 s	
Torque Transients	-30 N-m/s	30 N-m/s
Feedgas NOx (upstream of SCR)	70 ppm	500 ppm
Exhaust gas space velocity	10002 1/h	149996 1/h
DEF storage fraction in SCR (desired-actual/desired)	-0.4	0.4
Estimated NH3 Storage in SCR	0.75	
SCR Inlet temp	195 degC	340 degC
SCR Outlet temp	185 degC	340 degC
Filtered rate of change of SCR inlet temp		45
NH3 dosing (ratio of NH3 vs FG NOx)	0.4 ppm NH3 / ppm NOx	25 ppm NH3 / ppm NOx
DPF Regeneration Not Active		
No faults on pertinent sensors		

Typical Malfunction Thresholds:
P24FE: If the cumulative efficiency of the SCR Catalyst is less than 0%, a fault is indicated.

MISFIRE MONITOR

Misfire Monitor Operation:	
DTCs	P0300 – Random Misfire Detected P0301 – Cylinder 1 Misfire Detected P0302 – Cylinder 2 Misfire Detected P0303 – Cylinder 3 Misfire Detected P0304 – Cylinder 4 Misfire Detected P0305 – Cylinder 5 Misfire Detected P0306 – Cylinder 6 Misfire Detected P0307 – Cylinder 7 Misfire Detected P0308 – Cylinder 8 Misfire Detected
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	Engine Coolant Temperature (ECT), Vehicle Speed (VSS), Crankshaft Position Sensor (CKP) Injector Faults, Injector Bank Faults
Monitoring Duration	4000 revs

Typical Misfire Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
Engine Speed	500 rpm	3750 rpm
Engine Coolant Temperature (ECT)	-7 deg C	
Torque Gradient	-2000 Nm/s	2000 Nm/s
Transmission Gear Change	Not occurring	
Engine Operating Mode	Not in regeneration	

FUEL SYSTEM MONITOR

Fuel Rail Pressure Sensor Checks

Fuel Rail Pressure (FRP) Sensor Circuit Check:	
DTCs	P0192 - Fuel Rail Pressure Sensor A Circuit Low Input P0193 - Fuel Rail Pressure Sensor A Circuit High Input
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	Sensor Supply 1 OK (P06A6)
Typical Monitoring Duration	0.5 sec

Typical Fuel Rail Pressure Sensor Circuit Check Malfunction Thresholds:
FRP voltage < 0.13 V, or > 3.17 V

Fuel Rail Pressure (FRP) Rationality Check Operation:	
DTCs	P0191 - Fuel Rail Pressure Sensor "A" Circuit Range/Performance
Monitor Execution	Immediately Prior to Crank and After Key-off
Monitor Sequence	None
Sensors OK	Sensor Supply Voltage 1 OK (P06A6), FRP OK (P0192, P0193), CKP OK (P0335, P0336), CMP OK (P0016, P0341, P0342, P0343)
Typical Monitoring Duration	0.5 sec

Typical Fuel Rail Pressure Rationality Check Entry Conditions:		
Entry condition	Minimum	Maximum
Pre-crank: engine coolant temperature	-7 deg C	
Pre-crank: time engine off	600 sec	
After key-off: fuel temperature	-40 deg C	
After key-off: time since key off	12 sec	

Typical Fuel Rail Pressure Rationality Malfunction Thresholds:
FRP voltage < 0.251 V (-40 bar) or > 0.384 V (68 bar).

Fuel Rail Pressure Controller Range Check

Fuel Rail Pressure (FRP) Controller Range Check Operation:	
DTCs	P016D - Excessive Time To Enter Closed Loop Fuel Pressure Control P228E - Fuel Pressure Regulator 1 Exceeded Learning Limits - Too Low P228F - Fuel Pressure Regulator 1 Exceeded Learning Limits - Too High
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK (6.7L only)	Sensor Supply Voltage 1 (P06A6), FRP (P0192, P0193)
Typical Monitoring Duration	P016D – 300 sec, P228E, P228F - 10 sec

Typical Fuel Rail Pressure Controller Range Check Entry Conditions:		
Entry condition	Minimum	Maximum
P016D:		
Requested rail pressure	600 bar	1300 bar
Fuel temperature		40 deg C
P228E, P228F:		
Rail pressure set point	600 bar	1300 bar
Fuel Temperature		40 deg C

Typical Fuel Rail Pressure Range Controller Check Malfunction Thresholds:
P016D: If the system is within the adaptation operating conditions, but fails to learn a new adaptation factor after 300 seconds, this DTC is set. P228E, P228F: If the adaptation factor exceeds positive or negative thresholds which correspond to approximately a 20% deviation in the Rail Pressure Sensor slope, a DTC is set.

Fuel Rail Temperature Sensor Checks

Fuel Temperature Sensor Circuit Check Operation:	
DTCs	P0181 – Fuel Temperature Sensor "A" Circuit Range/Performance P0182 – Fuel Temperature Sensor "A" Circuit Low P0183 – Fuel Temperature Sensor "A" Circuit High
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	None
Typical Monitoring Duration	0.5 sec

Typical Fuel Temperature Sensor Circuit Check Entry Conditions:		
Entry condition	Minimum	Maximum
P0181:		
Engine Off Time	6 hours	

Typical Fuel Temperature Sensor Circuit Check Malfunction Thresholds:
P0181: If after an 6 hour engine off soak, the difference in temperature between the fuel temperature sensor and the charge air cooler outlet temperature sensor exceeds 40 deg C or if the difference in temperature between the fuel temperature sensor and the charge air cooler outlet temperature sensor exceeds 20 deg C and no active block heater is detected, a DTC is set. P0182, P0183: FTS voltage < 0.0946 V (0.122.4 V = 150 deg C) or > 4.918 V (4.762 V = -40 deg C)

Fuel Volume Control Valve Checks

Volume Control Valve (VCV) Monitor Operation:	
DTCs	P0001 - Fuel Volume Regulator Control Circuit / Open P0002 - Fuel Volume Regulator Control Circuit Range/Performance P0003 - Fuel Volume Regulator Control Circuit Low P0004 - Fuel Volume Regulator Control Circuit High
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	None
Typical Monitoring Duration	0.3 sec

Typical Volume Control Valve Monitor Malfunction Thresholds:
P0001 – If the volume control valve is not energized and the voltage from the volume control valve control chip is in the range 2.8 – 4.8 V (normal operation: 5V secondary voltage supply)
P0002 – Temperature of powerstage driver on ECM > 170 deg C
P0003 – If the volume control valve is not energized and the observed voltage from the volume control valve control chip is less than 2.8V (normal operation: 5V secondary voltage supply)
P0004 – If the volume control valve is energized and the current to the volume control valve exceeds 3.7A (normal operation: 2.2A maximum)

Fuel Pressure Control Valve Checks

Fuel Pressure Control Valve (PCV) Monitor Operation:	
DTCs	P0089 - Fuel Pressure Regulator Performance P0090 - Fuel Pressure Regulator Control Circuit P0091 - Fuel Pressure Regulator Control Circuit Low P0092 - Fuel Pressure Regulator Control Circuit High
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	None
Typical Monitoring Duration	0.3 sec

Typical Fuel Pressure Control Valve Monitor Malfunction Thresholds:
P0089 – Temperature of power stage driver on ECM is > 170 deg C
P0090 – The pressure control valve is not energized and the voltage from the pressure control valve control chip is in the range 2.8 – 4.8 V (normal operation: 5V secondary voltage supply)
P0091 – The pressure control valve is not energized and the voltage from the pressure control valve control chip is less than 2.8V (normal operation: 5V secondary voltage supply)
P0092 – The pressure control valve is energized and the observed current to the pressure control valve exceeds 5.1A (normal operation: 3.7A maximum)

Fuel Low Pressure Lift Pump Checks

The 6.7L diesel in the F650-F750 chassis cab uses a fuel pump that is directly controlled from the PCM. The 6.7L diesel in the F250-F550 pickup and chassis cab and all 3.0L products use a fuel pump that is controlled from a fuel pump controller module.

Fuel Low Pressure Lift Pump Monitor Operation:	
DTCs	P025C – Fuel Pump Module “A” Control Circuit Low P025D – Fuel Pump Module “A” Control Circuit High P027C - Fuel Pump Module "B" Control Circuit Low P027D - Fuel Pump Module "B" Control Circuit High P0627 - Fuel Pump "A" Control Circuit / Open P0628 - Fuel Pump "A" Control Circuit Low P0629 - Fuel Pump "A" Control Circuit High P062A – Fuel Pump "A" Control Circuit Range/Performance P064A – Fuel Pump Control Module “A” U0109 – Lost Communication With Fuel Pump Control Module “A”
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	None
Typical Monitoring Duration	P0627, P0628, P0629 - 0.2 sec P025C, P025D, P027C, P027D, P062A, P064A, U0109 – 0.5 sec

Typical Fuel Low Pressure Lift Pump Monitor Malfunction Thresholds:
P025C – The PEM detects a short circuit to ground (3.0L); short circuit to ground detected on the low side of the fuel pump relay (6.7L)
P025D – The PEM detects a short circuit to power (3.0L); short circuit to power detected on the low side of the fuel pump relay (6.7L)
P0627 – Open circuit detected on either the high or low side of the fuel pump relay (6.7L)
P0628 – Short circuit to ground detected on the high side of the fuel pump relay (6.7L)
P0629 – Short circuit to power detected on the high side of the fuel pump relay (6.7L)
P062A – The fuel pump duty cycle feedback from the lift pump is outside the range 78-82%
P064A – The time period of the fuel pump monitoring signal is outside the range 0-1.2 sec OR the fuel pump command duty cycle is implausible
U0109 – Fuel pump command duty cycle <5% or >95%

Fuel Injector Checks

Fuel Injector Driver Circuit Monitor Operation:	
DTCs	P062D - Fuel Injector Driver Circuit Performance Bank 1 P062E - Fuel Injector Driver Circuit Performance Bank 2 P2147 – Fuel Injector Group “A” Supply Voltage Circuit Low P2148 – Fuel Injector Group “A” Supply Voltage Circuit High P2150 – Fuel Injector Group “B” Supply Voltage Circuit Low P2151 – Fuel Injector Group “B” Supply Voltage Circuit High P2153 – Fuel Injector Group “C” Supply Voltage Circuit Low P2154 – Fuel Injector Group “C” Supply Voltage Circuit High
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	None
Typical Monitoring Duration	P062D, P062E– 0.5 seconds P2147, P2150, P2153 – 0.2 seconds

Typical Fuel Injector Driver Circuit Malfunction Thresholds:
P062D, P062E – Failure of high voltage supply detected by IC Internal logic
P2147, P2150, P2153 – Short to ground or battery of group detected by IC internal logic
P2148, P2151, P2154 – Control chip for high voltage injector driver in ECU reports an internal fault within high voltage system

Injection Circuits Monitor Operation:	
DTCs	P0201 - Injector Circuit / Open - Cylinder 1 P0202 - Injector Circuit / Open - Cylinder 2 P0203 - Injector Circuit / Open - Cylinder 3 P0204 - Injector Circuit / Open - Cylinder 4 P0205 - Injector Circuit / Open - Cylinder 5 P0206 - Injector Circuit / Open - Cylinder 6 P0207 - Injector Circuit / Open - Cylinder 7 P0208 - Injector Circuit / Open - Cylinder 8 P0261 – Cylinder 1 Injector “A” Circuit Low P0262 – Cylinder 1 Injector “A” Circuit High P0264 – Cylinder 2 Injector “A” Circuit Low P0265 – Cylinder 2 Injector “A” Circuit High P0267 – Cylinder 3 Injector “A” Circuit Low P0268 – Cylinder 3 Injector “A” Circuit High P0270 – Cylinder 4 Injector “A” Circuit Low P0271 – Cylinder 4 Injector “A” Circuit High P0273 – Cylinder 5 Injector “A” Circuit Low P0274 – Cylinder 5 Injector “A” Circuit High P0276 – Cylinder 6 Injector “A” Circuit Low P0277 – Cylinder 6 Injector “A” Circuit High P0279 – Cylinder 7 Injector “A” Circuit Low P0280 – Cylinder 7 Injector “A” Circuit High P0282 – Cylinder 8 Injector “A” Circuit Low P0283 – Cylinder 8 Injector “A” Circuit High P02EE – Cylinder 1 Injector Circuit Range/Performance P02EF – Cylinder 2 Injector Circuit Range/Performance P02F0 – Cylinder 3 Injector Circuit Range/Performance P02F1 – Cylinder 4 Injector Circuit Range/Performance P02F2 – Cylinder 5 Injector Circuit Range/Performance P02F3 – Cylinder 6 Injector Circuit Range/Performance P02F4 – Cylinder 7 Injector Circuit Range/Performance P02F5 – Cylinder 8 Injector Circuit Range/Performance
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	None
Typical Monitoring Duration	0.3 seconds

Typical Injection Circuits Entry Conditions:		
Entry condition	Minimum	Maximum
Injections requested		

Typical Injection Circuits Malfunction Thresholds:
P0201 – P0208 – Injector open circuit detected by IC internal logic P0261, P0264, P0267, P0270, P0273, P0276, P0279, P0282 – Injector short circuit detected by IC internal logic P0262, P0265, P0268, P0271, P0274, P0277, P0280, P0283 – Injector high side to low side short circuit detected by IC internal logic P02EE – P02F5 – Implausible injector response detected by IC internal logic

Fuel Injector Code Missing/Invalid:

Injector Code Monitor Operation:	
DTCs	P268C – Cylinder 1 Injector Data Incompatible P268D – Cylinder 2 Injector Data Incompatible P268E – Cylinder 3 Injector Data Incompatible P268F – Cylinder 4 Injector Data Incompatible P2690 – Cylinder 5 Injector Data Incompatible P2691 – Cylinder 6 Injector Data Incompatible P2692 – Cylinder 7 Injector Data Incompatible P2693 – Cylinder 8 Injector Data Incompatible
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	None
Typical Monitoring Duration	0.5 seconds

Typical Injector Code Monitor Malfunction Thresholds:
P268C – P2693: Each injector has a code stored in EEPROM that provides information to the ECU about deviations of that injector from a theoretical average injector. If the injector code is missing or invalid (value out of the acceptable range or the injector code checksum incorrect), a DTC is set.

Fuel Rail Pressure Monitors:

Fuel Rail Pressure (FRP) Monitor Operation:	
DTCs	P0087 - Fuel Rail/System Pressure - Too Low P0088 - Fuel Rail/System Pressure – Too High P0093 – Fuel System Leak Detected – Large Leak
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	FRP (P0191, P0192, P0193)
Typical Monitoring Duration	P0087, P0088 – 1.4 sec P0093 – 2 sec

Typical Fuel Rail Pressure Monitor Malfunction Thresholds:
P0087: If the commanded rail pressure exceeds the measured rail pressure by 250 bar for 1.4 sec or if the measured rail pressure drops below 140 bar for 0.3 sec
P0088: If the measured rail pressure exceeds the commanded rail pressure by 250 bar for 1.4 sec or if the measured rail pressure exceeds 150 bar more than maximum expected pressure for 0.3 sec
P0093: If the set point needed for the volume control valve to maintain desired rail pressure exceeds 13,500 mm3/sec at idle or if the set point needed for the volume control valve to maintain desired rail pressure is 40% greater than the volume control valve set point as calculated from the requested injection quantity when not at idle

Low Fuel Rail Pressure Monitor Operation:	
DTCs	P008A - Low Pressure Fuel System Pressure - Too Low
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	none
Typical Monitoring Duration	P008A – 60 sec

Low Fuel Rail Pressure Switch Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
Fuel Temperature	-40 deg C	
Fuel in tank		10 liter
Engine coolant temperature	-40 deg C	
Airbag	Not deployed	
Battery	9 v	

Typical Fuel Rail Pressure Monitor Malfunction Thresholds:
P008A: If indicated pressure in low pressure fuel system is constantly < 51 psig or if low pressure fuel system pressure temporarily drops below 51 psig five times in 15 minutes, code is set

Injection Timing / Injection quantity

Fuel Balancing Control (FBC) Control Limits:			
Injection quantity requested before FBC correction (mg/stroke)			
Maximum allowable FBC correction (mg/stroke):	3.5	7.5	15
	4	7	14

Fuel Balancing Control (FBC) Monitor Operation:	
DTCs	P0263 – Cylinder #1 Contribution/Balance P0266 – Cylinder #2 Contribution/Balance P0269 – Cylinder #3 Contribution/Balance P0272 – Cylinder #4 Contribution/Balance P0275 – Cylinder #5 Contribution/Balance P0278 – Cylinder #6 Contribution/Balance P0281 – Cylinder #7 Contribution/Balance P0284 – Cylinder #8 Contribution/Balance
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	Injector circuit codes, CKP, CMP, BARO, sensor supply voltage
Typical Monitoring Duration	7.5 sec

Typical Fuel Balancing Control (FBC) Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
Engine speed	500 rpm	3000 rpm
Injection quantity	3.5 mg/stroke	90 mg/stroke
Engine coolant temperature	15 deg C	
Not In Regeneration		
FBC wheel learn complete		

Typical Fuel Balancing Control (FBC) Monitor Malfunction Thresholds:
P0266 – P2084: If the current correction for the injector exceeds 90% of the allowable correction for current operation conditions, the code is set.

Fuel Mass Observer (Global Fuel Bias)

Fuel Mass Observer (FMO) Monitor Operation:	
DTCs	P0170 – Fuel Trim (Bank 1) P0171 – System Too Lean Bank 1 P0172 – System Too Rich Bank 1
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	None
Typical Monitoring Duration	P0170 - 45 sec

Typical Fuel Mass Observer (FMO) Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
Engine speed	1000 rpm	3000 rpm
Fuel injection quantity	20 mg/stroke	80 mg/stroke
Rate of change of fueling	-2 mg/stroke/sec	2 mg/stroke/sec
Ambient pressure	700 hPa	
Engine coolant temperature	70C	120C
System voltage	9 V	
Ambient temperature	-7 C	
Tailpipe oxygen sensor status	Ready	
Post injection	Not occurring	

Typical Fuel Mass Observer (FMO) Monitor Malfunction Thresholds:
P0170 : if the absolute value of the filtered ratio of error in fueling exceeds 0.15, this code is set.
P0171: if the filtered ratio of error in fueling is <-0.15, this code is set.
P0172: if the filtered ratio of error in fuel is >0.15, this code is set.

Feedback control:

Zero Fuel Calibration:

Zero Fuel Calibration (ZFC) Monitor Operation:	
DTCs	P2B11 – Cylinder 1 Injection Pulse Offset Exceeded Learning Limit P2B13 – Cylinder 2 Injection Pulse Offset Exceeded Learning Limit P2B15 – Cylinder 3 Injection Pulse Offset Exceeded Learning Limit P2B17 – Cylinder 4 Injection Pulse Offset Exceeded Learning Limit P2B19 – Cylinder 5 Injection Pulse Offset Exceeded Learning Limit P2B1B – Cylinder 6 Injection Pulse Offset Exceeded Learning Limit P2B1D – Cylinder 7 Injection Pulse Offset Exceeded Learning Limit P2B1F – Cylinder 8 Injection Pulse Offset Exceeded Learning Limit
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	AAT, ECT, injectors, PCV
Typical Monitoring Duration	30 sec

Typical Zero Fuel Calibration (ZFC) Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
Intake air temperature	0 deg C	
Fuel temperature	10 deg C	75 deg C
Engine coolant temperature	50 deg C	
System voltage	10 V	
Time in overrun/decel fuel shut-off (3.0L only)		30 sec
Engine speed (3.0L only)	890 rpm	2400 rpm
Boost pressure	750 mbar	
Accelerator pedal		2 %
Transmission gear (no gear change) (3.0L only)	4 th	10 th
Difference between requested and actual FRP		50 bar
Torque converter locked (3.0L only)		
Fuel Balance Control wheel learn complete (3.0L only)		
Note: these are the entry conditions for the base function. The monitor runs whenever the base function runs.		

Typical Zero Fuel Calibration (ZFC) Monitor Malfunction Thresholds:
P2B11, P2B13, P2B15, P2B17, P2B19, P2B1B, P2B1D, P2B1F: If the observed energizing time for the test injection is 156 us or more lower or 254 us or more higher than the target energizing time for the given injector, the code is set.

Nominal Voltage Calibration/Injector Charge Control:

Nominal Voltage Calibration (NVC) Monitor Operation:	
DTCs	P02EE – Cylinder 1 Injector Circuit Range/Performance P02EF – Cylinder 2 Injector Circuit Range/Performance P02F0 – Cylinder 3 Injector Circuit Range/Performance P02F1 – Cylinder 4 Injector Circuit Range/Performance P02F2 – Cylinder 5 Injector Circuit Range/Performance P02F3 – Cylinder 6 Injector Circuit Range/Performance P02F4 – Cylinder 7 Injector Circuit Range/Performance P02F5 – Cylinder 8 Injector Circuit Range/Performance
Monitor Execution	continuous
Monitor Sequence	None
Sensors OK	Injector open circuit (P0201-0208), Injector short circuit (P0261, P0264, P0267, P0270, P0273, P0276, P0279, P0282), Injector high to low short (P0262, P0265, P0268, P0271, P0274, P0277, P0280, P0283), ECT (P0117, P0118), RPS (P0191, P0192, P0193, P228E, P228F); Injector driver (P062D, P062E, P2147, P2150, P2153)
Typical Monitoring Duration	90 sec

Typical Nominal Voltage Calibration (NVC) Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
Rail pressure	1200 bar	1600 bar
Engine coolant temperature	70 deg C	100 deg C
Injection duration	300 us	

Typical Nominal Voltage Calibration (NVC) Monitor Malfunction Thresholds:
P02EE-P02F5: If the voltage governor (3.0L) or charge governor (6.7L) or the discharge governor (both) exceeds a high or low control limit, a fault is set.

EXHAUST GAS SENSOR MONITOR

NOx Controller Module Malfunctions	
DTCs	P2200 NOx Sensor Circuit (Bank 1 Sensor 1) U05A1 NOx Sensor "A" Received Invalid Data From ECM/PCM
Monitor execution	continuous
Sensors OK	not applicable
Monitoring Duration	5 seconds to register a malfunction

Typical NOx Controller Malfunction Thresholds
P2200 RAM failure ROM CRC check error EEPROM CRC check error U05A1 Erroneous Signal (Dew point reached with ignition off, etc.) Timeout (>1 second before message received)

NOx – O2 Sensor Malfunctions	
DTCs	P0133 O2 Sensor Circuit Slow Response (Bank 1, Sensor 1) P2A00 O2 Sensor Circuit Range/Performance (Bank 1, Sensor 1) P2200 NOx Sensor Circuit (Bank 1 Sensor 1) P2201 NOx Sensor Circuit Range/Performance (Bank 1 Sensor 1) P2209 NOx Signal Readiness (Bank 1 Sensor 1) P220A NOx Sensor Supply Voltage Circuit (Bank 1 Sensor 1) P220E NOx Sensor Heater Control Circuit Range/Performance (Bank 1 Sensor 1)
Monitor execution	continuous
Sensors OK	not applicable
Monitoring Duration	1 event per trip

Typical NOx – O2 Sensor Malfunctions Thresholds
P0133 during a transition from load to overrun/decel fuel shutoff, one of the following occurs: The time for the observed O2 percentage to increase from the value under load by 30% of (21%-O2 percentage under load) exceeds 6 seconds OR The time for the observed O2 percentage to increase from the value under load + 30% of the difference to the value under load + 60% of the difference exceeds 5 seconds OR The time for the observed O2 percentage to increase from the value under load to the value under load + 60% of the difference exceeds 11 seconds. (Used to detect completely inert sensors.) (monitor operates when the vehicle is not undergoing particulate filter regeneration) P2A00 A calculated oxygen concentration is derived from fuel, boost, and EGR. Observed oxygen

concentration is evaluated within two speed/load/air mass ranges. Code is set if observed oxygen concentration falls outside the range ((calculated O2 concentration – negative offset, calculated O2 concentration + positive offset). Ranges and allowable O2 concentration deviations are given in the table below.
OR

In an extended overrun/decel fuel shutoff condition, an adaption factor is calculated for the response of the O2 sensor to ensure that the sensor reads 20.95% O2 in air. Code is set if adaption factor is outside the range 0.95 – 1.22.

(monitor operates when the vehicle is not undergoing particulate filter regeneration)

P2200 Vs, COM, Ip1, Ip2 short to battery –Vs, COM, Ip1, Ip2 ≥ 5V
Vs, COM, Ip1 short to ground –Vs, COM, Ip1 ==0V
Ip2 short to ground – Ip2 ≤ 250mV
Vs, COM, Ip1, Ip2 Open – Open Circuit detected by hardware

P2201 NOx Negative Offset – Nox Sensor greater than ~20 ppm offset
NOx Positive Offset – Nox Sensor greater than ~40 ppm offset

P2209 NOx/O2 Signal Readiness – > Ratio of actual on time / expected on time > 90 %

P220A Supplied Voltage failure – Voltage supplied > 16.5V or < 8.5V

P220E Heater Open – Open circuit detected by hardware
Heater short to battery – Heater Voltage > 5V
Heater short to ground – Heater Voltage == 0V
Heater Rationality – Duty cycle of heater different than expected by > 20%

Feedgas NOx Sensor Plausibility Monitors

FG NOx Plausibility Monitor	
DTCs	P2201 - NOx Sensor Circuit Range/Performance (Bank 1 Sensor 1)
Monitor execution	During Key off/Engine Off conditions (can be over multiple key cycles)
Monitor Sequence	Key off / Engine off
Sensors OK	NOx Sensor
Monitoring Duration	0.1 s (each self-diagnostic event)

Typical Nominal FG NOx Plausibility Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
Exhaust temperature at NOx Sensor	69.96 deg C	299.96 deg C
Engine Speed	0 rpm (or equal to)	10 rpm
Time since last DPF regen	300 s	
Time in EOM0	30 s	
Ambient Air Temperature	-7.04 deg C	
Ambient Air Pressure	740 hPa	
Battery Voltage	11 V	
Time since NOx module achieved closed loop heater control		
Vehicle Speed		1 kph
NOx Sensor Valid Status		True
Engine off time	3.0L – 30 sec 6.7L – 1-3 hours	

Typical NOx Controller Malfunction Thresholds
Averaged normalized self-diagnostic result is less than XXXXX AND The number of completed self-diagnostic events is greater than 7

Tailpipe NOx Sensor – 3.0L and 6.7L

NOx Controller Module Malfunctions	
DTCs	P229E NOx Sensor Processor Performance (Bank 1 Sensor 2) U05A2 NOx Sensor "B" Received Invalid Data From ECM/PCM
Monitor execution	continuous
Sensors OK	not applicable
Monitoring Duration	5 seconds to register a malfunction

Typical NOx Controller Malfunction Thresholds
U05A2 Erroneous Signal (Dew point reached with ignition off, etc.) Timeout (>1 second before message received)

Tailpipe NOx and O2 Sensor Malfunction – 3.0L and 6.7L

NOx – O2 Sensor Malfunctions	
DTCs	P0139 O2 Sensor Circuit Slow Response (Bank 1 Sensor 2) P2A01 O2 Sensor Circuit Range/Performance (Bank 1 Sensor 2) P229E NOx Sensor Circuit (Bank 1 Sensor 2) P22A7 NOx Signal Readiness (Bank 1 Sensor 2) P229F NOx Sensor Circuit Range/Performance (Bank 1 Sensor 2) P220F NOx Sensor Heater Sense Circuit Range/Performance (Bank 1 Sensor 2) P220B NOx Sensor Supply Voltage Circuit (Bank 1 Sensor 2)
Monitor execution	continuous
Sensors OK	not applicable
Monitoring Duration	X events per trip

Typical NOx Sensor – O2 Sensor Malfunctions Entry Conditions:		
Entry condition	Minimum	Maximum
Sensor dewpoint reached		
P22A7:		
Exhaust mass flow	110 g/sec	
P229E Ip2 crack detection only:		
Fuel injection quantity	0 mg/stroke	
Time at zero fuel quantity	5 seconds	
P2A01:		
Post injection status	Not occurring	
Fuel tank level	0L	
System voltage	10.7V	
Variation in O2 signal over 2 sec		1.5% O2
Engine speed	1000 rpm	2700 rpm
Injection quantity (zero fuel point)	-0.5 mg/stroke	0.5 mg/stroke
Injection quantity (load point)	15 mg/stroke	40 mg/stroke

Typical NOx – O2 Sensor Malfunctions Thresholds

P0139 As shown in figure below, during a transition from load to overrun/decel fuel shutoff, one of the following occurs:
The time for the observed O2 percentage to increase from the value under load by 30% of (21%-O2 percentage under load) exceeds 6 seconds
OR
The time for the observed O2 percentage to increase from the value under load + 30% of the difference to the value under load + 60% of the difference exceeds 5 seconds
OR
The time for the observed O2 percentage to increase from the value under load to the value under load + 60% of the difference exceeds 11 seconds. (Used to detect completely inert sensors.)

(monitor operates when the vehicle is not undergoing particulate filter regeneration)

P2A01 A calculated oxygen concentration is derived from fuel, boost, and EGR. Observed oxygen concentration is evaluated within two speed/load/air mass ranges. Code is set if observed oxygen concentration falls outside the range ((calculated O2 concentration – negative offset, calculated O2 concentration + positive offset). Ranges and allowable O2 concentration deviations are given in the table below.
OR
In an extended overrun/decel fuel shutoff condition, an adaption factor is calculated for the response of the O2 sensor to ensure that the sensor reads 20.95% O2 in air. Code is set if adaption factor is outside the range 0.95 – 1.22.

(monitor operates when the vehicle is not undergoing particulate filter regeneration)

P229E Vs, COM, Ip1 short to battery –Vs, COM, Ip1 ≥ 6.4V
Ip2 short to battery – Voltage rise between IP2 and REF circuits > 1V
Vs, COM, Ip1 short to ground –Vs, COM, Ip1 < 0.23V
Ip2 short to ground – Voltage drop between IP2 and REF circuits ≤ 230mV
Vs, COM, Ip1, Open – ==0V
IP2 Open – IP2 <1.35V

P229F NOx Negative Offset – Nox Sensor greater than ~30 ppm offset
NOx Positive Offset – Nox Sensor greater than ~50 ppm offset
Tip-in – Nox rise rate on tip-in < .01 ppm/sec

P220F Heater Open – Heater current < 0.4A
Heater short to battery – Δ Heater Voltage > 0.2V
Heater short to ground – Δ Heater Voltage > 0.2V
Heater Rationality – Duty cycle of heater different than expected by > 20%

P22A7 NOx/O2 Signal Readiness – > Ratio of actual on time / expected on time > 90 %

P220B Supplied Voltage failure – Voltage supplied > 16.5V or < 8.5V

PARTICULATE MATTER SENSOR MONITOR

Exhaust Gas Particulate Matter Sensor (PMS)

PMS Control Module Checks:	
DTCs	P24D0 Particulate Matter Sensor Supply Voltage Circuit Low U02A3 Lost Communication With PM Sensor
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	P24D0 – 2 seconds U02A3 – 7 seconds

PMS Control Module Checks Entry Conditions:		
Entry condition	Minimum	Maximum
Battery voltage	11 V	16 V
P24D0 only:		
Sensor heater duty cycle	35%	

PMS Control Module Checks Malfunction Thresholds:
P24D0: If battery voltage is > 15 V, voltage drop > 1.1 V if battery voltage is > 11.7 V, voltage drop > 2.1 V if battery voltage is < 11.7 V, voltage drop > 3 V U02A3: PMS CAN message missing for more than 7 seconds

PMS Temperature Sensor Circuit Checks:	
DTCs	P24C6 Particulate Matter Sensor Temperature Circuit
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	P24C6 – 2 seconds

PMS Temperature Sensor Circuit Checks Entry Conditions:		
Entry condition	Minimum	Maximum
Battery voltage	11 V	16 V
Exhaust temperature	-39 degC	800 degC

PMS Temperature Sensor Circuit Checks Malfunction Thresholds:
Temperature sensor circuit voltage is < 0.3 volts or > 3 volts

PMS Heater Circuit Checks:	
DTCs	P24B3 Particulate Matter Sensor Heater Control Circuit/Open P24B4 Particulate Matter Sensor Heater Control Circuit Range/Performance
Monitor Execution	P24B3: Continuous during PMS regeneration P24B4: Continuous during PMS measuring
Monitor Sequence	None
Sensors OK	PMS Temperature
Typical Monitoring Duration	2 seconds

PMS Heater Circuit Checks Entry Conditions:		
Entry condition	Minimum	Maximum
Battery voltage	11 V	16 V
For P24B3, PMS heating on		
For P24B4, PMS heating off		

PMS Heater Circuit Checks Malfunction Thresholds:
P24B3: PMS heater current < 0.2 amps P24B4: PMS heater voltage > 7 volts

PMS Temperature Plausibility Checks:	
DTCs	P24C7 Particulate Matter Sensor Temperature Circuit Range/performance
Monitor Execution	- Offset test once per cold start - Dynamic check during sensor measurement
Monitor Sequence	None
Sensors OK	EGT14
Typical Monitoring Duration	- Cold start test, 10 sec - Dynamic test, 120 sec

PMS Temperature Plausibility Checks Entry Conditions:		
Entry condition	Minimum	Maximum
For dynamic test:		
Battery voltage	11 V	16 V
EGT for offset check	-40 degC	80 degC
Exhaust gas velocity	12 m/s	655 m/s
Vehicle speed	25 km/hr	250 km/hr
BARO	74.5 kPa	
Modeled PMS temperature for dynamic check	-40 degC	400 degC
Modeled PMS temperature change during dynamic check		30 degC
For cold start test:		
EGT1, EGT2, EGT3 temperature	-40 deg C	80 deg C
Time since PMS power-on	2.5 sec	
Engine off time	6 hours	

PMS Temperature Plausibility Checks Malfunction Thresholds:
- Difference between PM Sensor reported temperature and modeled temperature < -150 degC or > 60 degC
- Difference between PMS temperature and average of reference exhaust sensors > 45 degC
- PM sensor temperature at key-on < -40 degC

PMS Heater Checks:	
DTCs	P24B7 Particulate Matter Sensor Heater Resistance
Monitor Execution	Once per drive at key on
Monitor Sequence	None
Sensors OK	PMS Temperature
Typical Monitoring Duration	10 seconds

PMS Heater Checks Entry Conditions:		
Entry condition	Minimum	Maximum
Battery voltage	11 V	16 V
PMS Temperature	-30 degC	150 degC
Change in PMS Temperature during monitor		150 degC

PMS Heater Checks Malfunction Thresholds:
PMS heater resistance @ -30 degC < 1.06 Ohms or > 2.93 Ohms
PMS heater resistance @ 150 degC < 1.81 Ohms or > 4.12 Ohms

PMS Electrode Checks:	
DTCs	P24AE Particulate Matter Sensor Circuit P24AF Particulate Matter Sensor Circuit Range/Performance P24B0 Particulate Matter Sensor Circuit Low P24B1 Particulate Matter Sensor Circuit High
Monitor Execution	P24AE – After each PMS regeneration P24AF – After each PMS regeneration P24B0 – Continuous during sensor measurement P24B1 – Continuous during sensor measurement
Monitor Sequence	None
Sensors OK	EGT
Typical Monitoring Duration	P24AE – 120 seconds P24AF – 120 seconds P24B0 – 1.6 seconds P24B1 – 3 seconds

PMS Electrode Checks Entry Conditions:		
Entry condition	Minimum	Maximum
Battery voltage	11 V	16 V
Key on		
P24AE:		
PMS state	measure	
PMS temperature:	200 deg C	425 deg C
P24AF:		
PMS state	Sensor regeneration	
PMS temperature	770 deg C	800 deg C

PMS Electrode Checks Malfunction Thresholds:
P24AE: PMS current > 5 microamps after sensor regeneration
P24AF: PMS current during sensor regeneration less than 0.094 microamps
P24B0: PMS Voltage < 41.55 V
P24B1: PMS Current > 41 microamps

Particulate Matter Sensor Sampling Monitor

PMS Sampling Error Check:	
DTCs	P24DA Particulate Matter Sensor Exhaust Sample Error Bank 1
Monitor Execution	Once per drive
Monitor Sequence	None
Sensors OK	EGT14
Typical Monitoring Duration	3 minutes

PMS Sampling Error Check Entry Conditions:		
Entry condition	Minimum	Maximum
PMS in protective heating mode		
Exhaust gas acceleration	0.5 m/sec/sec	5 m/sec/sec
Time after engine start	10 sec	
Exhaust gas temperature	-3000 degC	3000 degC
Battery voltage	11 V	16 V
Engine running		
Final EGT sensor temperature	-40 deg C	180 deg C
PMS temperature at start	-3550 deg C	120 deg C
Exhaust gas velocity	35 m/sec	50 m/sec

PMS Sampling Error Check Malfunction Thresholds:
Cumulative PM sensor voltage during exhaust gas velocity changes < 0.5 volts

Particulate Matter Sensor Regeneration Monitor

PMS Regeneration Check:	
DTCs	P24D1 Particulate Matter Sensor Regeneration Incomplete
Monitor Execution	After each PMS regeneration
Monitor Sequence	None
Sensors OK	EGT14
Typical Monitoring Duration	120 seconds

PMS Regeneration Check Entry Conditions:		
Entry condition	Minimum	Maximum
Battery voltage	11 V	16 V
PMS heater power not exceeded		

PMS Regeneration Check Malfunction Thresholds:
PMS unable to enter “measure” state

Particulate Matter Filter Monitor Using PM Sensor

DPF Efficiency Check:	
DTCs	P2002 Particulate Filter Efficiency Below Threshold (Bank 1)
Monitor Execution	Continuous while PMS can measure
Monitor Sequence	None
Sensors OK	PMS, EGT, ECT, MAF, NOx, IAT
Typical Monitoring Duration	10 minutes

DPF Efficiency Check Entry Conditions:		
Entry condition	Minimum	Maximum
Dewpoint reached at PMS		
Not currently in DPF regeneration or catalyst heating mode		
Time since DPF regeneration	600 sec	
PMS temperature		400 degC
Estimated soot load on DPF	0 g	300 g
Exhaust velocity	0 m/s	50 m/s
Exhaust pressure	74.5 kPa	135 kPa
EGT	65 degC	400 degC
Engine run time	300 sec	
Tailpipe NOx	200 ppm	
Ambient temperature	-10 C	60 C
Barometric pressure	74.5 kPa	
Battery voltage	11V	16V

DPF Efficiency Check Malfunction Thresholds:
Once a modeled amount of soot has been generated by the engine, if the current of the PMS > 12 uA, measurement is failed.

EXHAUST GAS RECIRCULATION (EGR) SYSTEM MONITOR

EGR Rate System Monitor

EGR Flow Check Operation:	
DTCs	P0401 – Insufficient EGR Flow P0402 – Excessive EGR Flow
Monitor Execution	Continuous
Monitor Sequence	None
Monitoring Duration High Flow	4 seconds required to detect a malfunction
Monitoring Duration Low Flow	8 seconds required to detect a malfunction (Variable depending on reference accumulation and engine speed/load)

Typical EGR Flow Check Entry Conditions (High Flow Detection):		
Entry Condition	**Minimum**	**Maximum**
Engine Torque	Monitor is released in a speed/load region as shown in the following figure.	
Engine RPM		
Engine Coolant Temperature	6.7L: 50 deg C 3.0L: 45 deg C	112 deg C
Engine Operating Mode	Normal (no post injection)	
EGR Valve Position	0%	25%
Desired EGR Ratio	-100%	25%
Intake Air Temperature	0 deg C	70 deg C
Ambient Pressure	74.5 kPa	110 kPa
EGR System in Closed Loop Control for >1.5 sec		

Typical EGR High Flow Rate Malfunction Thresholds:
Expected EGR Ratio – Measured EGR Ratio < 6.7L SuperDuty Dyno: -10 6.7L SuperDuty Chassis: -9 6.7L F650-F750: -10 3.0L: -10

Typical EGR Flow Check Entry Conditions (Low Flow Detection):		
Entry Condition	**Minimum**	**Maximum**
Engine Torque	Monitor is released in a speed/load region as shown in the following figure.	
Engine RPM		
Engine Coolant Temperature	6.7L: 70 deg C	120 deg C

	3.0L: 60 deg C	
EGR Valve Position	6.7L: 15% 3.0L: 10%	100%
Desired EGR Ratio	6.7L SuperDuty Chassis : 20% 6.7L SuperDuty Dyno: 15% 6.7L F650-F750: 15% 3.0L: 0%	100%
Intake Air Temperature	0 deg C	70 deg C
Ambient Pressure	74.5 kPa	110 kPa
EGR System in Closed Loop Control for > 1.5 sec		

Typical EGR Low Flow Rate Malfunction Thresholds:
Accumulated insufficient EGR ratio > 6.7L SuperDuty: 10% 6.7L F650-F750: 7.9% 3.0L: 9.8%

Typical EGR Flow Check Entry Conditions (Low Flow Detection):		
Entry Condition	**Minimum**	**Maximum**
Engine RPM	1000	2700
Rate of change of engine RPM	-20 rpm/sec	150 rpm/sec
Engine torque	100 Nm	400 Nm
Rate of change of engine torque	-5 Nm/sec	15 Nm/sec
MAF	0 kg/hr	500 kg/hr
Rate of change of MAF	-10 (kg/hr)/sec	100 (kg/hr)/sec
Engine coolant temperature	65 deg C	
Engine operating mode	Normal (not in particulate filter regeneration)	
Ratio of Exhaust Pressure to Intake Manifold Pressure	1.1	
EGR System in Closed Loop Control for > 0.5 sec		

Typical EGR Low Flow Rate Malfunction Thresholds:
Accumulated insufficient EGR ratio > 6.7L SuperDuty: 10% 6.7L F650-F750: 7.9% 3.0L: 9.8%

EGR Cooler / EGR Cooler Bypass Monitor

EGR Cooler (Undercooling) Monitor:	
DTCs	P2457 – EGR Cooler Performance
Monitor execution	Once per driving cycle , once entry conditions are met
Monitor Sequence	None
Monitoring Duration	12 seconds to detected a malfunction

EGR Cooler/ECB Entry Conditions (Undercooling):		
Entry Condition	**Minimum**	**Maximum**
EGR Cooler Bypass Valve Command	Cooling Position	
EGR System in Closed-Loop Control		
Engine Coolant Temperature	70 deg C	130 deg C
Engine Speed	1100 rpm	3500 rpm
Engine Torque	6.7L: 200 Nm 3.0L: 100 Nm	6.7L: 1400 Nm 3.0L: 350 Nm
Exhaust Temperature	0 deg C	800 deg C
EGR Flow	6 g/s	6.7L SuperDuty Chassis:42 g/s 6.7L SuperDuty Dyno: 56 g/s 6.7L F650-750: 42 g/s 3.0L: 42 g/s
Ratio of exhaust pressure to MAP	0	5
Engine Operating Mode	Normal	

EGR Cooler/ECB Entry Timers (Undercooling):	
Timer	**Minimum Time**
Bypass Position Timer	5 sec
Combined Release Timer	6.7L: 1 sec 3.0L: 0.5 sec
Exhaust Temperature Timer	5 sec
EGR Flow Timer	5 sec
Engine Mode Timer	100 sec

Typical Undercooling Malfunction Thresholds:
Measured EGR temperature downstream of the EGR cooler assembly > Coolant Temperature + 88 (6.7L) or Coolant Temperature + variable offset (3.0L, see map below)

Typical Undercooling Malfunction Thresholds: x: ECT (C) and y: Modeled EGR Upstream Temp (C) (3.0L)										
y/x	**0**	**20**	**40**	**60**	**80**	**100**	**120**	**140**	**160**	**180**
100	130.0	180.0	210.0	230.0	240.0	260.0	280.0	290.0	300.0	310.0
200	130.0	180.0	210.0	230.0	240.0	260.0	280.0	290.0	300.0	310.0
300	130.0	180.0	210.0	230.0	240.0	260.0	280.0	290.0	300.0	310.0
400	130.0	180.0	210.0	230.0	240.0	260.0	280.0	290.0	300.0	310.0
500	130.0	180.0	210.0	230.0	240.0	260.0	280.0	290.0	300.0	310.0
600	130.0	180.0	210.0	230.0	240.0	260.0	280.0	290.0	300.0	310.0
700	130.0	180.0	210.0	230.0	240.0	260.0	280.0	290.0	300.0	310.0
800	130.0	180.0	210.0	230.0	240.0	260.0	280.0	290.0	300.0	310.0
900	130.0	180.0	210.0	230.0	240.0	260.0	280.0	290.0	300.0	310.0
1000	130.0	180.0	210.0	230.0	240.0	260.0	280.0	290.0	300.0	310.0

EGR Cooler (Intrusive) Monitor:	
DTCs	P245B – EGR Cooler Bypass Control Circuit Range/Performance
Monitor execution	Once per driving cycle, once entry conditions are met
Monitor Sequence	None
Monitoring Duration	Immediate

EGR Cooler (Intrusive) Entry Conditions:		
Entry Condition	**Minimum**	**Maximum**
EGR Cooler Bypass Valve Command (only evaluated during monitor pre-release)	Cooling Position	
EGR System in Closed-Loop Control		
Engine Coolant Temperature	70 deg C	150 deg C
Engine Speed	1050 rpm	6.7L: 3000 rpm 3.0L: 1600 rpm
Filtered Absolute Value of the Gradient of Engine Speed		6.7L: 150 rpm/s 3.0L: 75 rpm/s
Engine Torque	6.7L: 200 Nm 3.0L: 80 Nm	6.7L: 1000 Nm 3.0L: 600 Nm
Filtered Absolute Value of the Gradient of Engine Torque		150 Nm/s
Exhaust Temperature	6.7L: 10 deg C 3.0L: 0 deg C	6.7L: 1500 deg C 3.0L: 1000 deg C
Filtered Absolute Value of the Gradient of Exhaust Temperature		
Fuel Injection Quantity	6.7L: -0.005 g/rev 3.0L: 0.005 g/rev	6.7L: 0.164 g/rev 3.0L: 0.05 g/rev
Filtered Absolute Value of the Gradient of Fuel Injection Quantity		6.7L: 0.5 g/rev/s 3.0L: 0.0075 g/rev/s
EGR Flow	5 g/s	112 g/s
Filtered Absolute Value of the Gradient of EGR Flow		28 g/s/s
Modeled Intake Manifold Temperature		140 deg C
Engine Operating Mode	Normal	

Typical Malfunction Thresholds:
P245B: Measured Gradient of EGR Downstream Temperature < 3 deg C / s

EGR Control Limits Monitor

EGR Closed-loop Control Limits Check Operation:	
DTCs	P04DA (Closed Loop EGR Control At Limit - Flow Too High) P04D9 (Closed Loop EGR Control At Limit - Flow Too Low)
Monitor Execution	Continuous
Monitor Sequence	None
Monitoring Duration	20 seconds to detect a malfunction

Typical EGR Closed-loop Control Limits Check Entry Conditions:
No Air System Faults
EGR system in closed loop EGR control

Typical EGR Control Limits Malfunction Thresholds:
Desired EGR Ratio – Measured EGR Ratio < 6.7L: -60 (function of Engine Speed / Torque) or Desired EGR Ratio – Measured EGR Ratio > 6.7L: 50 (function of Engine Speed / Torque)

Mass Airflow Closed-loop Control Limits Monitor

Mass Airflow Closed-loop Control Limits Check Operation:	
DTCs	P02EC - Diesel Intake Air Flow Control System - High Air Flow Detected P02ED - Diesel Intake Air Flow Control System - Low Air Flow Detected
Monitor Execution	Continuous
Monitor Sequence	None
Monitoring Duration	6.7L: 10 seconds required to detect a malfunction 3.0L: 5 seconds required to detect a malfunction

Typical Mass Air Flow Closed-loop Control Limits Check Entry Conditions:
No Air System Faults
EGR System in closed loop air mass control

Typical Air Mass Control Limits Malfunction Thresholds:
Desired Air Mass – Measure Air Mass > maximum air mass deviation (function of Engine Speed / Torque) or Desired Air Mass – Measure Air Mass < minimum air mass deviation (function of Engine Speed / Torque)

Maximum air mass deviation (g/rev) for 6.7L

TRQ\ RPM	500	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3400	3800
0	0.80	1.04	1.46	1.48	1.09	1.00	0.94	0.96	0.85	0.75	0.80	0.87	0.79	0.99	0.60	0.50
50	0.99	1.44	1.15	1.19	1.12	1.43	0.96	1.06	0.90	0.88	0.76	0.74	0.67	0.62	0.50	0.50
100	0.90	1.44	1.47	1.37	1.14	1.47	0.79	1.02	1.09	0.86	0.80	0.75	0.69	0.62	0.50	0.50
150	0.83	1.45	1.25	1.39	1.36	1.39	1.04	1.02	1.10	0.74	0.73	0.74	0.69	0.65	0.50	0.50
200	0.73	1.30	1.37	1.48	1.15	0.91	0.89	0.99	1.09	0.95	0.78	0.90	0.78	0.65	0.50	0.50
250	0.50	1.23	1.22	1.35	1.17	0.90	0.89	0.95	1.00	0.95	0.84	0.69	0.62	0.74	0.50	0.50
300	0.50	1.07	1.15	1.44	1.26	1.30	0.91	1.00	1.01	0.92	0.93	0.60	0.59	0.63	0.58	0.50
400	0.50	0.50	1.14	1.26	1.31	1.35	1.01	1.04	1.17	0.89	0.85	0.85	0.65	0.74	0.55	0.50
500	0.50	0.50	1.23	0.98	1.09	1.00	1.01	1.04	1.06	0.95	0.90	0.97	0.81	0.81	0.50	0.50
600	0.50	0.50	0.50	0.50	1.01	0.94	0.93	0.97	1.10	1.02	0.98	0.93	0.95	0.86	0.50	0.50
700	0.50	0.50	0.50	0.50	0.84	0.85	0.94	0.87	0.99	0.92	0.88	0.63	1.38	0.75	0.50	0.50
800	0.50	0.50	0.50	0.50	0.86	0.86	0.86	0.88	0.93	0.99	0.99	0.85	1.64	0.62	0.96	0.50
900	0.50	0.50	0.50	0.50	0.66	0.90	0.82	0.88	0.86	0.90	1.04	1.09	1.64	1.09	0.50	0.50
1000	0.50	0.50	0.50	0.50	0.68	0.84	0.83	0.77	0.85	0.91	1.41	1.24	1.36	0.76	0.50	0.50
1100	0.50	0.50	0.50	0.50	0.50	0.53	0.82	0.76	0.81	0.80	1.18	0.90	1.22	0.69	0.50	0.50
1200	0.50	0.50	0.50	0.50	0.50	0.50	0.84	0.82	0.80	0.75	0.72	0.58	0.63	0.57	0.50	0.50

Minimum air mass deviation (g/rev) for 6.7L

TRQ\ RPM	500	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3400	3800
0	-0.46	-0.46	-0.52	-0.64	-0.51	-0.44	-0.42	-0.47	-0.38	-0.42	-0.46	-0.47	-0.40	-0.38	-0.38	-0.38
50	-0.38	-0.60	-0.58	-0.55	-0.52	-0.40	-0.43	-0.56	-0.46	-0.46	-0.44	-0.43	-0.40	-0.38	-0.38	-0.38
100	-0.38	-0.65	-0.56	-0.65	-0.53	-0.38	-0.38	-0.48	-0.42	-0.39	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38
150	-0.38	-0.83	-0.59	-0.68	-0.52	-0.38	-0.38	-0.45	-0.39	-0.45	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38
200	-0.38	-0.58	-0.63	-0.73	-0.56	-0.38	-0.38	-0.57	-0.38	-0.38	-0.47	-0.40	-0.38	-0.38	-0.38	-0.38
250	-0.38	-0.47	-0.48	-0.66	-0.60	-0.40	-0.42	-0.48	-0.41	-0.38	-0.42	-0.39	-0.38	-0.38	-0.38	-0.38
300	-0.38	-0.38	-0.42	-0.74	-0.65	-0.44	-0.46	-0.52	-0.42	-0.39	-0.42	-0.40	-0.38	-0.38	-0.38	-0.38
400	-0.38	-0.38	-0.38	-0.58	-0.61	-0.47	-0.45	-0.54	-0.53	-0.39	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38
500	-0.38	-0.38	-0.38	-0.38	-0.49	-0.47	-0.46	-0.46	-0.49	-0.43	-0.46	-0.41	-0.39	-0.38	-0.38	-0.38
600	-0.38	-0.38	-0.38	-0.38	-0.41	-0.44	-0.45	-0.48	-0.44	-0.44	-0.48	-0.52	-0.39	-0.38	-0.38	-0.38
700	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.39	-0.45	-0.50	-0.52	-0.51	-0.58	-0.54	-0.38	-0.38	-0.38
800	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.43	-0.48	-0.56	-0.65	-0.65	-0.64	-0.54	-0.41	-0.57	-0.38
900	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.42	-0.46	-0.61	-0.56	-0.53	-0.58	-0.38	-0.38	-0.38
1000	-0.38	-0.38	-0.38	-0.38	-0.79	-0.38	-0.38	-0.40	-0.41	-0.52	-0.52	-0.59	-0.47	-0.50	-0.38	-0.38

1100	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.44	-0.48	-0.50	-0.59	-0.62	-0.45	-0.38	-0.38	-0.38
1200	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.39	-0.47	-0.54	-0.53	-0.46	-0.38	-0.38	-0.38

Maximum air mass deviation (g/rev) for 3.0L								
TRQ\RPM	**600**	**800**	**1200**	**1600**	**2000**	**2400**	**2800**	**3200**
75	0.21	0.21	0.34	0.53	0.62	0.55	0.37	0.37
175	0.28	0.28	0.35	0.48	0.58	0.52	0.36	0.36
275	0.29	0.29	0.38	0.47	0.57	0.62	0.48	0.48
375	0.35	0.35	0.35	0.45	0.47	0.47	0.62	0.62
475	0.34	0.34	0.44	0.47	0.41	0.41	0.44	0.44
575	0.34	0.34	0.51	0.55	0.33	0.37	0.54	0.54
675	0.34	0.34	0.58	0.59	0.49	0.52	0.48	0.48
775	0.34	0.34	0.58	0.59	0.49	0.52	0.48	0.48

Minimum air mass deviation (g/rev) for 3.0L																
TRQ\ RPM	**500**	**700**	**900**	**1100**	**1300**	**1500**	**1700**	**1900**	**2100**	**2300**	**2500**	**2700**	**2900**	**3100**	**3300**	**3500**
0	-0.20	-0.20	-0.30	-0.33	-0.30	-0.29	-0.63	-0.50	-0.83	-0.43	-0.57	-0.44	-0.44	-0.18	-0.18	-0.18
50	-0.20	-0.20	-0.30	-0.33	-0.41	-0.41	-0.63	-0.50	-0.83	-0.43	-0.57	-0.44	-0.44	-0.18	-0.18	-0.18
100	-0.20	-0.20	-0.33	-0.33	-0.39	-0.42	-0.46	-0.54	-0.56	-0.35	-0.57	-0.57	-0.57	-0.18	-0.18	-0.18
150	-0.20	-0.20	-0.30	-0.30	-0.35	-0.45	-0.50	-0.53	-0.55	-0.39	-0.56	-0.66	-0.66	-0.18	-0.18	-0.18
200	-0.20	-0.20	-0.28	-0.30	-0.36	-0.53	-0.49	-0.51	-0.58	-0.52	-0.55	-0.60	-0.60	-0.18	-0.18	-0.18
250	-0.20	-0.20	-0.20	-0.29	-0.35	-0.45	-0.47	-0.35	-0.55	-0.52	-0.52	-0.59	-0.59	-0.18	-0.18	-0.18
300	-0.20	-0.20	-0.18	-0.26	-0.32	-0.45	-0.50	-0.41	-0.64	-0.80	-0.43	-0.39	-0.39	-0.18	-0.18	-0.18
350	-0.20	-0.20	-0.18	-0.19	-0.30	-0.37	-0.35	-0.40	-0.57	-0.73	-0.22	-0.37	-0.42	-0.18	-0.18	-0.18
400	-0.20	-0.20	-0.18	-0.18	-0.30	-0.25	-0.35	-0.25	-0.55	-0.42	-0.24	-0.18	-0.49	-0.18	-0.18	-0.18
450	-0.20	-0.20	-0.18	-0.25	-0.29	-0.25	-0.32	-0.25	-0.54	-0.40	-0.36	-0.25	-0.44	-0.18	-0.18	-0.18
500	-0.20	-0.20	-0.18	-0.25	-0.58	-0.25	-0.31	-0.29	-0.33	-0.37	-0.30	-0.27	-0.35	-0.18	-0.18	-0.18
550	-0.20	-0.20	-0.18	-0.25	-0.26	-0.25	-0.29	-0.19	-0.34	-0.30	-0.33	-0.37	-0.46	-0.18	-0.18	-0.18
600	-0.20	-0.20	-0.18	-0.25	-0.25	-0.25	-0.43	-0.18	-0.42	-0.30	-0.35	-0.45	-0.34	-0.18	-0.18	-0.18
650	-0.20	-0.20	-0.18	-0.25	-0.25	-0.25	-0.38	-0.36	-0.44	-0.30	-0.25	-0.25	-0.34	-0.18	-0.18	-0.18
700	-0.18	-0.18	-0.18	-0.18	-0.25	-0.25	-0.38	-0.36	-0.44	-0.18	-0.21	-0.26	-0.34	-0.18	-0.18	-0.18
750	-0.18	-0.18	-0.18	-0.18	-0.25	-0.25	-0.38	-0.36	-0.44	-0.18	-0.21	-0.26	-0.34	-0.18	-0.18	-0.18

BOOST PRESSURE CONTROL SYSTEM MONITORING

Intrusive Turbo Position and Response Monitoring

VGT Monitor:	
DTCs	P226C – Turbocharger Boost Control "A" Slow Response (3.0L and 1.5L Only)
Monitor Execution	Once per driving cycle
Sensors OK	ECT, MAP, VS, VGTP
Typical Monitoring Duration	7 seconds for full VGT monitoring cycle if pressure abort threshold hasn't been reached

Typical VGT Monitor Entry Conditions:		
Entry Condition	Minimum	Maximum
Engine speed	6.7L:300 rpm 3.0L: 900 rpm	6.7L: 750 rpm 3.0L: 1550 rpm
Pedal position allowed		6.7L: 1% 3.0L: 0.1%
Engine coolant temperature	6.7L: 70 deg C 3.0L: 50 deg C	6.7L: 120 deg C 3.0L: 124 deg C
Fuel quantity allowed		20 mg/stoke
Vehicle speed		6.7L: 1.9 mph 3.0L: 100 mph
Time at idle	0 sec	
Barometric Pressure	6.7L: 60 kPa 3.0L: 67 kPa	6.7L: 110kPa 3.0L: 102 kPa
Time after engine start	6.7: 60 seconds 3.0L 30 seconds	
Battery voltage	10V	16V
Engine operating mode	Normal (no post injection)	

Typical VGT Monitor Malfunction Thresholds:
Response from closed VGT position to open VGT position in 7 seconds results in a change in manifold pressure of 2 kPa or greater at sea level or 0.75 kPa at 8000 feet for 6.7L. (3.0L is 6.5 kPa or greater at sea level or 3.5kPa at 8000 feet..

Overboost Monitoring

Overboost Monitor:	
DTCs	P259F - Turbocharger/Supercharger "A" Boost Control Position at High Limit
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	ECT, MAP, MAF,
Typical Monitoring Duration	6.7L: 10 seconds 3.0L: 11 seconds

Typical Overboost Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
Engine Torque	6.7L: 50 Nm 3.0L: 135 Nm	
Engine Speed	6.7L: 800 3.0L: 1300	4000

Typical Overboost Monitor Malfunction Thresholds:
If desired boost pressure – actual boost pressure < 6.7L: -120.0 kPa, 3.0L: -80 kPa

Threshold Overboost Monitoring

Threshold Overboost Monitor:	
DTCs	P0234 - Turbocharger "A" Overboost Condition
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	ECT, MAP, MAF
Typical Monitoring Duration	2 sec

Typical Threshold Overboost Entry Conditions:		
Entry condition	Minimum	Maximum
Key-on		
Battery voltage (IVPWR)	9 V	16.25 V

Typical Threshold Overboost Monitor Malfunction Thresholds:
If exhaust pressure > 6.7L: 4.5 bar gauge pressure, 3.0L: 4.0 bar gauge pressure

Underboost Monitoring

Underboost Monitor:	
DTCs	P2263 - Turbocharger ”A” Boost System Performance P259E – Turbocharger "A" Boost Control Position At Low Limit
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	ECT, MAP, MAF, VGTP
Typical Monitoring Duration	P2263: 100 sec P259E: 6.7L: 10 sec 3.0L: 11 sec

Typical Underboost Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
Closed-loop boost control	enabled	
P2263:		
Ambient air temperature	-40 deg C	Ambient air temperature
Engine coolant temperature	-40 deg C	Engine coolant temperature
Engine Speed	1500 rpm	Engine Speed
Barometric pressure	50 kPa	Barometric pressure
P259E:		P259E:
Engine Torque	6.7L: 50 Nm 3.0L: 135 Nm	Engine Torque
Engine Speed	6.7L: 800 rpm 3.0L: 1300 rpm	Engine Speed

Typical Underboost Monitor Malfunction Thresholds:
P2263: If desired boost pressure – actual boost pressure > 35 kPa until deviation counter reaches 10000 counts P259E: If desired boost pressure – actual boost pressure > 120 kPa (6.7L) or 80 kPa (3.0L)

Threshold Underboost Monitoring

Underboost Monitor:	
DTCs	P0299 – Turbocharger/Supercharger “A” Underboost Condition
Monitor Execution	Continuous
Monitor Sequence	None

Sensors OK	ECT, MAP, MAF, VGTP, EGR, Throttle, BARO
Typical Monitoring Duration	6.7L: 15 sec 3.0L: 10 sec

Typical Underboost Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
Closed-loop boost control	enabled	
Engine Torque	onitor is released in a speed/load region as shown in the following figure.	
Engine Speed		
Engine run time	6.7L: 150 sec 3.0L: 0 sec	
Filtered EP gradient	6.7L: -50 kPa/s 3.0L: -53 kPa/s	6.7L: 40 kPa/s 3.0L: 43 kPa/s
Engine Operating Mode	6.7L SuperDuty Chassis: Normal 6.7L SuperDuty Dyno: Normal and Warm up 6.7L F650-750: Normal and Warm up 3.0L: Normal and Warm up	
Transient turbo position correction	-20 %	400 %
Engine coolant temperature	6.7L: 40 deg C 3.0L: 58 deg C	

Typical Underboost Monitor Malfunction Thresholds:
P0299: If desired boost pressure – actual boost pressure > 30 kPa (6.7L) or 40 kPa (3.0L) for more than 15 sec (6.7L) or 10 sec (3.0L)

Charge Air Cooler Monitoring

Charge Air Cooler Monitor:	
DTCs	P026A - Charge Air Cooler Efficiency Below Threshold P007E - Charge Air Cooler Temperature Sensor Intermittent/Erratic (Bank 1)
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	ECT, MAP, MAF
Typical Monitoring Duration	10 seconds for fault detection

Typical Charge Air Cooler Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
Engine coolant temperature	70 deg C	
Ambient air temperature	-7 deg C	
Barometric Pressure	74.5 kPa	110 kPa
Ratio of Manifold Absolute Pressure to Barometric Pressure	1.2	
Intake air temperature	-7 deg C	
Output release factor of Engine Speed vs. Injection Quantity MAP	0.5	

Typical Threshold Charge Air Cooler Monitor Engine Speed vs Injection Quantity Threshold MAP (6.7L)

RPM vs Mg/Hub	0	500	1000	1200	2000	2500	3000	3200	3500	4500	4600	4700
0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	1	1	1	1	1	0	0	0	0
40	0	0	0	1	1	1	1	1	0	0	0	0
50	0	0	0	1	1	1	1	1	0	0	0	0
60	0	0	0	1	1	1	1	1	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0
150	0	0	0	0	0	0	0	0	0	0	0	0

Typical Threshold Charge Air Cooler Monitor Engine Speed vs Injection Quantity Threshold (3.0L)

RPM vs Mg/Hub	0	500	1000	1200	2000	2500	3000	3200	3500	4500	4600	4700
0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	1	1	1	0	0	0	0	0	0
30	0	0	0	1	1	1	0	0	0	0	0	0
40	0	0	0	1	1	1	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0

100	0	0	0	0	0	0	0	0	0	0	0	0
150	0	0	0	0	0	0	0	0	0	0	0	0

Typical Charge Air Cooler Monitor Malfunction Thresholds:

P026A - If the difference of measured temperature and modeled temperature is less than -18 deg C at 0 deg C compressor out temp, or less than -35 deg C at 200 deg C compressor out temp, a fault is set. For 3.0L: difference of measured temperature and modeled temperature is less than -35 deg C at 0 deg C compressor out temp, or less than -65 deg C at 200 deg C compressor out temp

P007E – If the difference of measured temperature and modeled temperature is greater than 35 deg C a fault is set.

PARTICULATE MATTER (PM) FILTER MONITORING

DPF Filter Missing Substrate Monitor

Monitor Summary:	
DTCs	P244A – Diesel Particulate Filter Differential Pressure Too Low
Monitor execution	P244A: Continuous while meeting entry conditions
Monitor Sequence	None
Sensors OK	EGT, DPFP, CKP, ECT (P0117, P0118), EGT13 EGT14, MAF, IAT
Monitoring Duration	90 sec

Typical Entry Conditions:		
Entry condition	Minimum	Maximum
Exhaust Mass Flow		500
Time after regeneration ended	30 sec	
Intake air temperature	-20 deg C	
Engine coolant temperature	-20 deg C	
Torque	50 Nm	
EGT1 temperature	150 deg C	

Typical Malfunction Thresholds:

DPF Differential Pressure Test: (P244A)
Measured DPF inlet pressure is below a threshold (function of engine exhaust volumetric flow) for 90 seconds.
Typical values for threshold:

Flow (m^3/hr)	300	600	900	1200	1500	1800	2100	2500
Pressure (kPa)	7.99	15.02	27.94	47.13	72.80	104.94	143.45	204.61

DPF Frequent Regeneration Monitor

Monitor Summary:	
DTC	P2459 – Diesel Particulate Filter Regeneration Frequency
Monitor execution	During each completed regeneration event
Monitor Sequence	None
Sensors OK	DPFP

Typical Entry Conditions:		
Entry condition	Minimum	Maximum
Regeneration runs to completion (not aborted by customer input or drive cycle)		
Not in “degraded regen” mode due to DPF pressure sensor error		

Typical Malfunction Thresholds:
A fault is stored when the average distance between regeneration events is below a threshold. Typical threshold is 40 km.

DPF Incomplete Regeneration Monitor

Monitor Summary:	
DTC	P24A2 – Diesel Particulate Filter Regeneration Incomplete
Monitor execution	During each DPF regeneration cycle
Monitor Sequence	None
Sensors OK	EGT12, EGT13,EGT14, EGT15, DPFP, INJ
Monitoring Duration	40 minutes (maximum)

Typical Entry Conditions:		
Entry condition	Minimum	Maximum
Monitor is activated during Aftertreatment regeneration events		
Ambient air temperature	-6.7 degC	
Ambient pressure	74.5 kPa	
Engine speed	1000 rpm	3500 rpm
Engine Indicated Torque	150 N-m	1500 N-m
Engine Coolant Temperature	70 degC	
Minimum time with valid entry conditions (function of regen duration)		
Time since last closed-loop soot update at beginning of regeneration		4200 sec
Time since last closed-loop soot update at end of regeneration		120 sec

Typical Malfunction Thresholds:
If the estimated soot at the end of the regeneration event is above a threshold, a fault is indicated.

DPF Feedback Control Monitors

Monitor Summary:	
DTC	P24A0 – DPF Temperature Control P249F – Excessive Time To Enter Closed Loop DPF Regeneration Control
Monitor execution	During an active regeneration event
Monitor Sequence	None
Sensors OK	TIA, ECT, AMP, EGT11, EGT12, EGT13, EGT14
Monitoring Duration	Once per regeneration event

Typical Entry Conditions:		
Entry condition	Minimum	Maximum
Engine Operating Mode	Particulate filter regeneration	
Engine Speed	1000 rpm	3500 rpm
Indicated Torque Setpoint	150 Nm	1500 Nm
Ambient Temperature	-7 deg C	
Coolant Temperature	70 deg C	
Barometric Pressure	74.5 kPa	
Absolute value of transient torque difference		2047 Nm
First EGT sensor temperature		525 deg C
HC desorb mode	Not occurring	

Typical Malfunction Thresholds:
P249F - If the time in closed loop operation is less than a threshold (function of total time in regen), a fault is indicated. P24A0 - If the temperature controller is saturated at its max/min clip and the difference between desired and actual temperature is greater than a threshold for a sufficient period of time, a fault is indicated.

DPF Restriction Monitor

Monitor Summary:	
DTCs	P246C - Diesel Particulate Filter Restriction – Forced Limited Power
Monitor execution	Continuous while meeting entry conditions
Monitor Sequence	None
Sensors OK	DPFP
Monitoring Duration	300 seconds

Typical Entry Conditions:		
Entry condition	Minimum	Maximum
None		

Typical Malfunction Thresholds:
Diesel Particulate Filter Restriction – Forced Limited Power (P246C) (Immediate MIL and Wrench Light) Estimated soot in the DPF is twice the soot load that would trigger a normal regen (200% loaded).

DOWNSTREAM INJECTION SYSTEM MONITORING

DSI- Downstream Injection Leakage Monitoring - Temperature Based Logic

Monitor Summary:	
DTCs	P2698 – DSI Monitor
Monitor execution	Triggered after minimum 6 hours of soak.
Monitor Sequence	None
Sensors OK	EGT13, EGT14, ECT, MAF, IAT
Monitoring Duration	With valid entry conditions: Monitor session: 300 sec

Typical DSI Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
Minimum Engine Soak Time	21600 sec	
Modeled Aftertreatmet HC		0.1 g
Pre-DEC Temp	200 deg C	600 deg C
Post-DEC Temp	200 deg C	
Exhaust Mass Flow Rate		500 kg/hr
Engine Temperature	70 deg C	

Ambient Air Temperature	-7 deg	
Barometric Pressure	74.5 kPa	
Engine speed	1000 rpm	
Torque set point	100 Nm	
Engine Running Time	2 sec	
Time with Entry all Entry Conditions Met	30 sec	

Typical Malfunction Thresholds:
P2698 The difference between Post DEC temperature and it its corresponding modelled temperature. is greater than threshold.

DSI- Downstream Injection Leakage Monitor: Oxygen Concentration Based Logic (P708 CC Only)

Monitor Summary:	
DTCs	P2698 – DSI Monitor
Monitor execution	Continuously during normal engine operation mode.
Monitor Sequence	None
Sensors OK	NOx1, NOx3, MAF, IAT
Monitoring Duration	With valid entry conditions: Monitor session: 300 sec

Typical DSI Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
Ambient Air Temperature	-7 deg C	50 deg C
Barometric Pressure	74.5 kPa	120 kPa
NOx Sensors Signal Valid		
Accumulated/Modelled Aftertreatment HC		0.1 g
Time in Normal operation conditions	100 sec	
Time to require to populate the measured O2 buffer	2 sec	
Exhaust Mass Flow	144 kg/hr	

Typical Malfunction Thresholds:
P2698 Calibrated number of counts with the difference between inlet and outlet integrated O2 mass exceeding a threshold limit.

ENGINE COOLING SYSTEM MONITORING

Thermostat Monitor

Thermostat Monitor:			
DTCs	P0128 –Coolant Temp Below Thermostat Regulating Temperature		
Monitor Execution	Continuous		
Monitor Sequence	None		
Sensors OK	Engine Coolant Temperature (ECT), Intake Air Temperature (IAT), Vehicle Speed (VS)		
Typical Monitoring Duration	Nominal time it takes for engine to warm up to thermostat "Start-To–Open" temperature – see approximate times below. (Note: Unified Drive Cycle is 23.9 minutes long)		
	Ambient Temperature	Drive Cycle	Completion Time
	-7 deg C	Unified Drive Cycle x2	40 min
	21 deg C	Unified Drive Cycle	19 min
	38 deg C	Unified Drive Cycle	14 min

Typical Thermostat Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
Ambient air temperature	-7 deg C	
Engine coolant temperature at start		70 deg C
Engine speed	See table below	
Load based on percent of total fuel injection quantity	10 %	
Percent of time engine speed and load must be above idle threshold ratio	50 %	
Engine Operating Mode	Normal	

Minimum engine speed for monitor operation for 6.7L								
Ambient Temp (deg C)	**-40**	**-7**	**0**	**10**	**25**	**50**	**75**	**100**
RPM	**1500**	**1150**	**1050**	**1050**	**1050**	**1050**	**1050**	**1050**

Minimum engine speed for monitor operation for 3.0L								
Ambient Temp (deg C)	**-40**	**-20**	**-10**	**-7**	**10**	**20**	**40**	**50**
RPM	**850**	**850**	**850**	**850**	**850**	**850**	**850**	**850**

Typical Thermostat Monitor Malfunction Thresholds:
Measured Engine Coolant Temperature < 70.2 deg C when modeled coolant temp > 90 deg C

Primary Coolant Temp Rise Monitoring

ECT Rise Monitor:	
DTCs	P0116 - Engine Coolant Temperature Sensor 1 Circuit Range/Performance
Monitor Execution	Once per trip
Monitor Sequence	None
Sensors OK	ECT
Typical Monitoring Duration	5400 seconds at -35 deg C start temp. idle only 2700 seconds at -7 deg C start temp, idle only

Typical ECT Rise Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
Ambient air temperature	-40 degC	-7 deg C

Typical ECT Rise Monitor Malfunction Thresholds:
Engine coolant rises above the threshold within a given amount of time. The threshold and time requirements are based

Engine coolant temp threshold based on engine coolant temp at start						
ECT at start (deg C)	**-40**	**-30**	**0**	**19.9**	**20**	**40**
ECT threshold (deg C)	**35**	**35**	**35**	**35**	**-40**	**-40**

Time threshold to reach coolant temp								
ECT at start (deg C)	**-40**	**-30**	**-25**	**-15**	**-10**	**-7**	**20**	**40**
Time (s)	**5400**	**5400**	**4800**	**3600**	**3000**	**2700**	**1200**	**900**

COLD START EMISSION REDUCTION STRATEGY MONITORING

Cold Start Emission Reduction Component Monitor

Cold Throttle Actuator Jammed Valve Check Operation:	
DTCs	P02E4 – Diesel Intake Air Flow “A” Control Stuck Open
Monitor execution	Continuous
Monitor Sequence	None
Monitoring Duration	25 seconds to register a malfunction

Typical Cold Throttle Jammed Valve Entry Conditions:
See Throttle Valve Actuator Jammed Detection
Engine Operating mode is cold start mode

Typical Cold Throttle Jammed Valve Check (P02E4) Malfunction Thresholds:
A P02E4 is set in cold start mode.

Cold EGR Valve Actuator Jammed Detection

EGR Valve Jammed Check Operation:	
DTCs	P042E – Exhaust Gas Recirculation "A" Control Stuck Open
Monitor execution	Continuous
Monitor Sequence	None
Monitoring Duration	25 seconds to register a malfunction

Typical Actuator Jammed Valve Entry Conditions:
See EGR Valve Actuator Jammed Detection
Engine Operating mode is cold start mode

Typical EGR Valve Jammed Check (P042E) Malfunction Thresholds:
A P042E is set in cold start mode.

Cold Turbocharger Actuator Jammed Detection

Turbocharger Jammed Check Operation:	
DTCs	P2598 – Turbocharger Boost Control Position Sensor “A” Performance – Stuck Low
Monitor execution	Continuous
Monitor Sequence	None
Monitoring Duration	25 seconds to register a malfunction

Typical Actuator Jammed Valve Entry Conditions:
See Turbocharger Valve Actuator Jammed Detection
Engine Operating mode is cold start mode

Typical Turbocharger Jammed Check (P2598) Malfunction Thresholds:
A P2598 is set in cold start mode.

Cold FBC (Only 6.7L Applications)

CSER Component Monitor: Cold FBC Monitor Operation:	
DTCs	P0263 – Cylinder #1 Contribution/Balance P0266 – Cylinder #2 Contribution/Balance P0269 – Cylinder #3 Contribution/Balance P0272 – Cylinder #4 Contribution/Balance P0275 – Cylinder #5 Contribution/Balance P0278 – Cylinder #6 Contribution/Balance P0281 – Cylinder #7 Contribution/Balance P0284 – Cylinder #8 Contribution/Balance
Monitor Execution	P0263 – During cold start mode after a cold start P0266 – During cold start mode after a cold start P0269 – During cold start mode after a cold start P0272 – During cold start mode after a cold start P0275 – During cold start mode after a cold start P0278 – During cold start mode after a cold start P0281 – During cold start mode after a cold start P0284 – During cold start mode after a cold start
Monitor Sequence	None
Sensors OK	Crankshaft Position Sensor "A" Circuit (P0335) Crankshaft Position Sensor "A" Circuit Range/Performance (P0336)
Typical Monitoring Duration	7.5 sec

Typical CSER Component Monitor: Cold FBC Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
cold start mode Active		
Engine speed	500 rpm	3000 rpm
Injection quantity	3.5 mg/stroke	90 mg/stroke
Engine Temperature		
Barometric Pressure		
FBC wheel learn complete		

Typical CSER Component Monitor: Cold FBC Monitor Malfunction Thresholds:
If the current correction for the injector exceeds 90% of the allowable correction for current operation conditions, the code is set.

Monitoring of High Pressure Fuel System during start

Monitor Summary:	
DTCs	P2291 - Injector Control Pressure Too Low - Engine Cranking
Monitor execution	During engine cranking
Monitor Sequence	None
Sensors OK	
Monitoring Duration	P2291- 20 Sec

Typical Entry Conditions:		
Entry condition	Minimum	Maximum
Fuel temperature	-50 Deg C	150 Deg C
Engine Coolant Downstream temperature	-50 Deg C	150 Deg C
Rail pressure		14000 kPa
Fuel tank level	-1 L	
Inertia Switch	Not set	

Typical Malfunction Thresholds:
If the rail pressure is less than 14000 kPa within the entry condition for 20 sec, fault is set.

Cold Start Emission Reduction System Monitors

Pre-Light Off Monitor

Monitor Summary:	
DTCs	P05EC – Cold Start Injection Timing Performance
Monitor execution	When EOM3 or EOM8 is commanded after an engine start.
Monitor Sequence	None
Sensors OK	
Monitoring Duration	10 s

Typical Malfunction Thresholds:
If the CSER is not commanded when requested, a fault will set.

NOx Emission Reduction Re-Enablement Monitor

Monitor Summary:	
DTCs	P168F – Cold Start Injection Performance
Monitor execution	When EOM3 or EOM8 is commanded
Monitor Sequence	After P05EC
Sensors OK	
Monitoring Duration	10 s

Typical Malfunction Thresholds:
If the CSER is not commanded when requested, a fault will set.

Air Temperature Rationality Test

Ambient Air Temperature (AAT) Sensor Circuit Check:	
DTCs	P0072 – Ambient Air Temperature Circuit Low P0073 – Ambient Air Temperature Sensor Circuit High
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	2 sec.

Typical Ambient Air Temperature Sensor Circuit Check Entry Conditions:		
Entry Condition	Minimum	Maximum
Battery Voltage	9 V	16.25 V
Key On		

Typical Ambient Air Temperature Sensor Circuit Check Malfunction Thresholds:
Voltage < 0.10 V (-40 deg C) or voltage > 4.99 V (108 deg C)

Ambient Air Temperature Rationality Check	
DTCs	P0071 – Ambient Air Temperature Sensor Range/Performance
Monitor Execution	Once per driving cycle. The check is disabled if a block heater is in use.
Monitor Sequence	None
Sensors OK	AAT (P0072, P0073), IAT1 (P0112, P0113), EGT11 (P0548, P0549), EGRCOT (P040C), ECT (P0117, P0118), CACT1 (P007C, P007D)
Typical Monitoring Duration	0.5 sec

Typical Ambient Air Temperature Rationality Check Entry Conditions:		
Entry Condition	Minimum	Maximum
Engine Off Time	6 hrs	N/A
Engine coolant temperature	-35 deg C	121 deg C

Typical Ambient Air Temperature Rationality Check Thresholds:	
AAT Rationality is confirmed against 4 other sensors (absolute temperature difference thresholds):	
CACT1	10 deg C
IAT1	15 deg C
EGRCOT	16 deg C
ECT2	20 deg C

Charge Air Cooler (CACT1) Sensor Circuit Check:	
DTCs	P007C – Charge Air Cooler Temperature Sensor Circuit Low P007D – Charge Air Cooler Temperature Sensor Circuit High
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	4 sec

Typical Charge Air Cooler Temperature Sensor Circuit Check Malfunction Thresholds:
Voltage < 0.092 V (161 deg C) or voltage > 4.90 V (-43 deg C)

Charge Air Cooler Temperature (CACT1) Rationality Check:	
DTCs	P007B - Charge Air Cooler Temperature Sensor Circuit Range/Performance
Monitor Execution	Once per drive cycle.
Monitor Sequence	None
Sensors OK	AAT (P0072, P0073), IAT1 (P0112, P0113), EGT11 (P0548, P0549), EGRCOT (P040C), ECT (P0117, P0118), CACT1 (P007C, P007D)
Typical Monitoring Duration	0.5 sec

Typical Charge Air Cooler Temperature Rationality Check Entry Conditions:		
Entry Condition	Minimum	Maximum
Engine Off Time	6 hrs	

Typical Charge Air Cooler Temperature Functional Thresholds:	
CACT1 Rationality is confirmed against 2 other sensors (absolute temperature difference thresholds), thresholds are listed with no block heater detected followed by block heater detection:	
IAT1	16 deg C / 20 deg C
EGRCOT	25 deg C / 45 deg C

Intake Air Temperature (IAT) Sensor Circuit Check:	
DTCs	P0112 - Intake Air Temperature Sensor Circuit Low P0113 - Intake Air Temperature Sensor Circuit High
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	4 sec.

Typical Intake Air Temperature Sensor Circuit Check Malfunction Thresholds:
Voltage < 0.10 volts (137 deg C) or voltage > 4.91 volts (-25 deg C)

Intake Air Temperature Rationality Check	
DTCs	P0111 – Temperature Sensor Circuit Range/Performance
Monitor Execution	Once per drive cycle. The check is disabled if a block heater is in use.
Monitor Sequence	None
Sensors OK	AAT (P0072, P0073), IAT1 (P0112, P0113), EGT11 (P0548, P0549), EGRCOT (P040C), ECT (P0117, P0118), CACT1 (P007C, P007D)
Typical Monitoring Duration	0.5 sec

Typical Intake Air Temperature Rationality Check Entry Conditions:		
Entry Condition	Minimum	Maximum
Engine Off Time	6 hrs	

Typical Intake Air Temperature Functional Thresholds:	
IAT Rationality is confirmed against 2 other sensors (absolute temperature difference thresholds), thresholds are listed with no block heater detected followed by block heater detection:	
CACT1	16 deg C / 20 deg C
EGTCOT	25 deg C / 30 deg C

EGR Cooler Downstream Temperature (EGR COT) Sensor Circuit Check (6.7L):	
DTCs	P041C – Exhaust Gas Recirculation Temperature Sensor “B” Circuit Low P041D – Exhaust Gas Recirculation Temperature Sensor “B” Circuit High
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	3 sec.

Typical EGR Cooler Downstream Temperature Sensor Circuit Check Malfunction Thresholds:
Voltage < 0.10 volts (961 deg C) or voltage > 4.90 volts (-46 deg C)

EGR Cooler Downstream Temperature Rationality Check	
DTCs	P041B – Exhaust Gas Recirculation Temperature Sensor “B” Circuit Range/Performance
Monitor Execution	Once per drive cycle.
Monitor Sequence	None
Sensors OK	AAT (P0072, P0073), IAT1 (P0112, P0113), EGT11 (P0548, P0549), EGRCOT (P040C), ECT (P0117, P0118), CACT1 (P007C, P007D)
Typical Monitoring Duration	0.5 sec

Typical EGR Cooler Downstream Temperature Rationality Check Entry Conditions:		
Entry Condition	Minimum	Maximum
Engine Off Time	6 hrs	
Ambient Temperature	-40 deg C	
Barometric Pressure	74.5 kPa	

Typical EGR Cooler Downstream Temperature Functional Thresholds:	
EGRCOT Rationality is confirmed against 2 other sensors (absolute temperature difference thresholds), thresholds are listed with no block heater detected followed by block heater detection:	
CACT1	6.7L: 25 deg C / 30 deg C 3.0L: 25 deg C / 45 deg C
IAT1	25 deg C / 30 deg C

EGR Temperature Check:	
DTCs	P040C – EGR Temperature Sensor "A" Circuit LowP040D – "A" Circuit P041C – EGR Temperature Sensor "B" Circuit Low P041D – EGR Temperature Sensor "B" Circuit High
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	None
Typical Monitoring Duration	5 sec

Typical EGR Temperature Sensor Circuit Check Malfunction Thresholds:
P040C – EGR temperature "A" sensor voltage < 0.69V
P041C – EGR temperature "B" sensor voltage < 0.19V
P041D – EGR temperature "B" sensor voltage > 4.95V

EGR Temperature Sensor "A" Plausibility Check:	
DTCs	P040B - EGR Temperature Sensor "A" Circuit Range/Performance
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	P040C
Typical Monitoring Duration	30 sec

Typical EGR Temperature Sensor "A" Plausibility Check Entry Conditions:		
Entry condition	Minimum	Maximum
Time since engine start	60 sec	500C
Engine off timer	300 sec	
Engine torque	6.7L: 900 Nm 3.0L: 450 Nm	
Time since torque condition met	6.7L: 30 sec 3.0L: 15 sec	

Typical EGR Temperature Sensor "A" Plausibility Check Malfunction Thresholds:
P040B – Delta temperature between engine start and when entry conditions are met < 10 deg C.

Barometric Pressure and Manifold Absolute Pressure

Barometric Pressure (BARO) Sensor Circuit Check:	
DTCs	P2227 – Barometric Pressure Sensor "A" Circuit Range/Performance P2228 – Barometric Pressure Circuit Low Input P2229 – Barometric Pressure Circuit High Input
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	P2227 – 1 sec P2228, P2229 –.5 sec.

Typical Barometric Pressure Sensor Circuit Check Entry Conditions:		
Entry condition	Minimum	Maximum
Battery voltage (IVPWR)	9 V	16.25 V

Typical Barometric Pressure Sensor Circuit Check Malfunction Thresholds:
P2227 – Observed pressure less than 50 kPa
P2228 - Voltage less than 0.25 V. (6.3 kPa)
P2229 - Voltage greater than 4.85 V. (115 kPa)

Manifold Absolute Pressure (MAP) Sensor Circuit Check:	
DTCs	P0107 - Manifold Absolute Pressure/BARO Sensor Low Input P0108 - Manifold Absolute Pressure/BARO Sensor High Input
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	P0107, P0108 - 2 sec.

Typical Manifold Absolute Pressure Sensor Circuit Check Entry Conditions:		
Entry condition	Minimum	Maximum
Key-on		
Battery voltage (IVPWR)	9 V	16.25 V

Typical Manifold Absolute Pressure Sensor Circuit Check Malfunction Thresholds:
P0107 – Voltage less than .1 V (50 kPa)
P0108 – Voltage greater than 4.745 V (390 kPa)

Manifold Absolute Pressure (MAP) Sensor Physical Range Check:	
DTCs	P0106 – Manifold Absolute Pressure/BARO Sensor Circuit
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	4 s

Typical Manifold Absolute Pressure Sensor Physical Range Thresholds:
Manifold Absolute Pressure > 365 kPa

Manifold Absolute Pressure (MAP) / Barometric Pressure (BARO) Rationality Check:	
DTCs	P0069 – MAP/BARO Correlation
Monitor Execution	Once per trip
Monitor Sequence	None
Sensors OK	BARO (P2228, P2229), MAP (P0107, P0108)
Typical Monitoring Duration	1.5 sec.

Typical MAP / BARO Rationality Check Entry Conditions:		
Entry condition	Minimum	Maximum
P0069 - MAP / BARO Correlation:		
Key-on		
Battery voltage (IVPWR)	9 V	16.25 V
Engine Speed (N)	0 rpm	437.5 rpm
Engine off time	2 sec	

Typical MAP / BARO Rationality Check Malfunction Thresholds:
P0069 - The difference between MAP and BARO is greater than 4.5 kPa, or less than -8 kPa.

Turbine Upstream Pressure Sensor Plausibility Checks

Turbine Upstream Pressure Sensor Offset Plausibility Check Operation:	
DTCs	P0471– Exhaust Pressure Sensor "A" Circuit Range / Performance
Monitor execution	Continuous in with engine off.
Monitor Sequence	None
Monitoring Duration for stuck midrange	6.7L: 5 sec, 3.0L: 3 sec

Turbine Upstream Pressure Sensor Offset Entry Conditions		
Entry Condition:	**Minimum**	**Maximum**
Turbine Upstream Pressure Sensor is not Frozen		
Ambient Pressure	74.5 kPa	
Ambient Air Temperature	5 deg C	
Coolant Temperature	5 deg C	
Engine Speed		0 rpm
Engine Off Time		10 sec.
No Turbine Upstream Pressure Sensor		

Typical Upstream Turbine Pressure Sensor Plausibility Check Malfunction Thresholds:
| Turbine Pressure Sensor – Ambient Pressure Sensor | > 15 kPa

The second check compares the measured pressure upstream of the turbine to a model of the pressure upstream of the turbine under specific entry conditions. If the difference between the measured and modeled pressure is greater than a threshold, for a predetermined amount of time while the entry conditions are met, a fault is set.

Turbine Upstream Pressure Sensor -Model Plausibility Check Operation:	
DTCs	P0474– Exhaust Pressure Sensor "A" Circuit Intermittent / Erratic
Monitor execution	Continuous when entry conditions are met.
Monitor Sequence	None
Monitoring Duration for stuck midrange	2.0 seconds to register a malfunction once entry conditions are met.

Turbine Upstream Pressure Sensor Offset Entry Conditions		
Entry Condition:	**Minimum**	**Maximum**
Turbine Upstream Pressure Sensor is not Frozen		
Coolant Temperature	50 deg C	
Engine Speed	1300 rpm	2400 rpm
Engine Torque	6.7L: 500 Nm 3.0L: 150 Nm	6.7L: 1400 Nm 3.0L: 700 Nm
Ambient Air Temperature	5 deg C	
Ambient Pressure	74.5 kPa	
Modeled Exhaust Pressure	147.5 kPa	800 kPa
Air Flow Gradient		140 g/s/step

Typical Upstream Turbine Pressure Sensor Plausibility Check Malfunction Thresholds:
(Turbine Pressure Model – Turbine Pressure Sensor) > 500 kPa (Turbine Pressure Model – Turbine Pressure Sensor) < -100 kPa

Upstream Turbine Pressure Sensor Signal Range Check

Reductant Pressure Sensor Open/Short Check Operation:	
DTCs	P0472 - Exhaust Pressure Sensor "A" Circuit Low P0473 - Exhaust Pressure Sensor "A" Circuit High
Monitor execution	Continuous
Monitor Sequence	none
Sensors OK	none
Monitoring Duration	2 seconds to register a malfunction

Typical Reductant Pressure Sensor Check Malfunction Thresholds:
Pressure sensor voltage < 0.100 volts or Pressure sensor voltage > 4.8 volts

EGR Valve Position Sensor

EGR Valve Position Sensor Check Operation:	
DTCs	P0405 (EGR Sensor "A" Circuit Low) P0406 (EGR Sensor "A" Circuit High)
Monitor execution	continuous
Monitor Sequence	none
Sensors OK	not applicable
Monitoring Duration	3 seconds to register a malfunction

Typical EGR Valve position sensor check malfunction thresholds (P0405,P0406):

Voltage < 0.30 volts or Voltage > 4.70 volts

Throttle Position Sensor

Throttle Position Sensor Check Operation:	
DTCs	P02E9 (Diesel Intake Air Flow Position Circuit High), P02E8 (Diesel Intake Air Flow Position Circuit Low).
Monitor execution	continuous
Monitor Sequence	none
Sensors OK	not applicable
Monitoring Duration	3 seconds to register a malfunction

Typical TP sensor check malfunction thresholds (P02E8,P02E9):
Voltage < 0.08 volts or Voltage > 4.92 volts

Engine Coolant & Engine Oil Correlation

Engine Coolant Temperature (ECT) Sensor Circuit Check:	
DTCs	P0117 - Engine Coolant Temperature Sensor Circuit Low P0118 - Engine Coolant Temperature Sensor Circuit High
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	Not Applicable
Typical Monitoring Duration	2 sec.

Typical Engine Coolant Temperature Sensor Circuit Check Entry Conditions:		
Entry condition	Minimum	Maximum
Key On		
Battery Voltage	9 V	16.25 V

Typical Engine Coolant Temperature Sensor Circuit Check Malfunction Thresholds:
Voltage < 0.10 (163 deg C) volts or voltage > 4.91 volts (-44 deg C)

Engine Coolant Temperature In Range Rationality Check	
DTCs	P0196 –Engine Oil Temperature Sensor Range/Performance
Monitor Execution	Once per drive cycle where block heater is not detected.
Monitor Sequence	None

Sensors OK	None
Typical Monitoring Duration	Immediate when conditions exist

Typical Engine Coolant Temperature Rationality Check Entry Conditions:		
Entry Condition	Minimum	Maximum
Engine Off Time	6 hrs	
Engine Coolant Temp	70C	
Block heater detection	complete	
Engine speed	500 rpm	4200 rpm

Typical Engine Coolant Temperature Functional Thresholds:	
ECT Rationality is confirmed against EOT:	
Absolute Temperature Difference	35 deg C

Cam and Crank Sensor

Camshaft and Crankshaft Sensor Monitor Operation:	
DTCs	P0016 – Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A) P0315 – Crankshaft Position System Variation Not Learned P0335 – Crankshaft Position Sensor "A" Circuit P0336 – Crankshaft Position Sensor "A" Circuit Range/Performance P0341 – Camshaft Position Sensor "A" Circuit Range/Performance (Bank 1 or single sensor) P0342 – Camshaft Position Sensor “A” Circuit Low (Bank 1 or single sensor) P0343 – Camshaft Position Sensor “A” Circuit High (Bank 1 or single sensor)
Monitor Execution	P0016 – Continuous P0315 – Continuous P0335 – Continuous P0336 – Continuous P0341 – Continuous P0342 – Continuous P0343 – Continuous
Monitor Sequence	None
Sensors OK	P0016 – Sensor Supply Voltage 1 (P06A6), Sensor Supply Voltage 2 (P06A7) P0315 – Sensor Supply Voltage 1 (P06A6), Crankshaft Sensor (P0335, P0336) P0335 – Sensor Supply Voltage 1 (P06A6) P0336 – Sensor Supply Voltage 1 (P06A6) P0341 – Sensor Supply Voltage 2 (P06A7) P0342 – None P0343 – None
Typical Monitoring Duration	P0016 – 3.6 sec ,P0315 – 5000 sec of overrun/decel fuel shut-off P0335 – 1.8 sec, P0336 – 1.8 sec, P0341 – 1.2 sec, P0342 – 3 sec, P0343 – 3 sec

Typical Camshaft and Crankshaft Sensor Monitor Entry Conditions:

Entry condition	Minimum	Maximum
P0016 – Engine running or cranking		
P0315 – Overrun/decel fuel shut-off		
P0335 – Engine running or cranking		
P0336 – Engine running or cranking		
P0341 – Engine running or cranking		
P0342 – Engine running or cranking		
P0343 – Engine running or cranking		

Typical Camshaft Sensor Monitor Malfunction Thresholds:
P0016 – If the location of the gap on the crankshaft sensor wheel occurs at a location on the camshaft sensor wheel that is more than 6 degrees from the expected location for two detection attempts, the code is set (larger deviation permitted for 3.0L)
P0315 – If after 5000 total seconds of overrun/decel fuel shut-off, the system has been unable to learn crankshaft wheel deviation corrections, the code is set
P0335 – If no signal is detected from the crankshaft sensor, the code is set
P0336 – If the gap in the 60-2 tooth wheel is not detected for three revolutions, the code is set
P0341 – If the segment profile detected does not match the segment profile shown in the figure above, the code is set
P0342 – If the camshaft sensor signal is constantly low (0V) for 10+ revolutions of the crankshaft
P0343 – If the camshaft sensor signal is constantly high (system voltage) for 10+ revolutions of the crankshaft

Mass Air Meter

MAF Sensor Circuit Check:	
DTCs	P0100 – Mass or Volume Air Flow “A” Circuit P0102 – Mass or Volume Air Flow “A” Circuit Low P0103 – Mass or Volume Air Flow “A” Circuit High
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	P0100 – 1.5 sec P0102 – 2 sec P0103 – 2 sec

MAF Sensor Circuit Check Entry Conditions:		
Entry condition	Minimum	Maximum
Battery voltage	9 V	16.25 V
Key on		

MAF Sensor Circuit Check Malfunction Thresholds:
P0100 – hard coded, not visible in software
P0102 – period less than 62 us
P0103 – period greater than 1600 us

MAF Rationality Check

Mass Air Flow Sensor Functional Check Operation:	
DTCs	P2073 – Manifold Absolute Pressure/Mass Air Flow - Throttle Position Correlation at Idle P2074 – Manifold Absolute Pressure/Mass Air Flow - Throttle Position Correlation at Higher Load P00BC – Mass or Volume (MAF/VAF) Air Flow “A” Circuit Range/Performance – Air Flow Too Low P00BD– Mass or Volume (MAF/VAF) Air Flow “A” Circuit Range/Performance – Air Flow Too High P0101 – Mass or Volume (MAF/VAF) Air Flow Sensor “A” Circuit Range Performance
Monitor Execution	Once per drive cycle
Monitor Sequence	None.
Sensors OK	MAF (P0100, P0101, P0102), BARO (P2228, P2229), EGRP (P0405, P0406, P0042E, P042F, P1335),
Typical Monitoring Duration	5 Seconds

Typical Mass Air Flow Sensor Functional Check Entry Conditions:		
Entry condition	Minimum	Maximum
P2073, P2074, P0101:		
AMA learning	Active	
P00BC, P00BD:		
AMA learning or Intrusive VGT monitoring	Active	

Typical Mass Air Flow Sensor Functional Check Malfunction Thresholds:
P2073, P2074 - If the final AMA stored value in either the idle or higher load cell is greater than 20% or less than a threshold, a fault is detected and the appropriate P-code is set. Thresholds: 6.7L SuperDuty Chassis: >27% or -13% (idle), >20% or -20% (load) 6.7L SuperDuty Dyno: >18% or <-22% (idle), >18% or <-22% (load), 6.7L F650-750: >24% or <-16% (idle), >20% or -20% (load) 3.0L: >20% or -20% (load) P00BC - Corrected measured airflow / Modeled airflow < 0.75 (3.0L), 0.70 (6.7L) P00BD – Corrected measured airflow / Modeled airflow > 1.25 P0101 - Corrected measured airflow / Modeled airflow < 0.7 P2074 – If the algorithm cannot learn a stable value for AMA within 20 learning events, this code is set.

Humidity Sensor Temperature Plausibility Check

Humidity Sensor Temperature Plausibility Check Operation:	
DTCs	P00F3– Humidity Sensor Circuit Performance
Monitor execution	Once per drive cycle.
Monitor Sequence	None
Monitoring Duration	10 sec

Humidity Sensor Temperature Plausibility Check Entry Conditions		
Entry Condition:	**Minimum**	**Maximum**
Accumulated air flow through engine	30 kg	

Typical Humidity Sensor Temperature Plausibility Check Malfunction Thresholds:
| IAT – Humidity Sensor Temperature | > 50 deg C

Air Path Leakage Check

Air Path Leakage Check Operation:	
DTCs	P00BC – Mass or Volume (MAF/VAF) Air Flow A Circuit Range/Performance – Air Flow Too Low P0101 – Mass or Volume (MAF/VAF) Air Flow Sensor “A” Circuit Range Performance P00BD - Mass or Volume (MAF/VAF) Air Flow A Circuit Range/Performance – Air Flow Too High
Monitor Execution	Once per drive cycle
Monitor Sequence	None.
Sensors OK	MAF (P0100, P0101, P0102), BARO (P2228, P2229), EGRP (P0405, P0406, P0042E, P042F, P1335),
Typical Monitoring Duration	6.7L: 3 seconds 3.0L: 2.5 seconds (P00BD) or 3.1 seconds (P00BC)

Typical Air Path Leakage Check Entry Conditions:		
Entry condition	Minimum	Maximum
Engine Coolant Temperature	70 deg C	111 deg C
Turbocharger Position	75%	
EGR Valve Position		0%

Typical Air Path Leakage Check Malfunction Thresholds:
If the ratio between modeled airflow and measured uncorrected airflow is greater than 1.25 or less than 0.70 (6.7L) or 0.75 (3.0L) a fault is detected and the appropriate P-code is set.

Mass Air Flow Sensor Plausibility Check Operation:	
DTCs	P00BC – Mass Air Flow Sensor In Range But Lower Than Expected P00BD – Mass Air Flow Sensor In Range But Higher Than Expected
Monitor Execution	Continuous
Monitor Sequence	None.
Sensors OK	MAF (P0100, P0101, P0102), BARO (P2228, P2229), EGRP (P0405, P0406, P0042E, P042F, P1335),
Typical Monitoring Duration	10 seconds

Typical Mass Air Flow Sensor Plausibility Check Entry Conditions:		
Entry condition	Minimum	Maximum
Barometric Pressure	75 kPa	110 kPa
Engine Coolant Temperature	70 deg C	121 deg C

Ambient Air Temperature	-20 deg C	80 deg C
Key On		

Typical Mass Air Flow Sensor Plausibility Check Malfunction Thresholds:
If Mass Air Flow is greater than the maximum AFS threshold map,, or less than the minimum AFS threshold map for 10 seconds, a fault is detected and a P-code is set.

Minimum AFS Threshold Map for 6.7L										
RPM	**300**	**400**	**600**	**1000**	**1500**	**2000**	**2500**	**3000**	**3500**	**4000**
Airflow	**-50**	**20**	**100**	**45**	**60**	**107**	**129**	**154**	**180**	**190**

Maximum AFS Threshold Map for 6.7L								
RPM	**600**	**750**	**1000**	**1500**	**2000**	**2500**	**3000**	**3500**
Airflow	**420**	**560**	**791**	**1260**	**1680**	**1988**	**2170**	**2170**

Minimum AFS Threshold Map for 3.0L										
RPM	**600**	**750**	**1000**	**1500**	**2000**	**2500**	**3000**	**3500**	**4000**	**4500**
Airflow	**0**	**10**	**20**	**30**	**40**	**60**	**80**	**90**	**100**	**120**

Maximum AFS Threshold Map for 3.0L										
RPM	**600**	**750**	**1000**	**1500**	**2000**	**2500**	**3000**	**3500**	**4000**	**4500**
Airflow	**200**	**300**	**400**	**600**	**800**	**1000**	**1000**	**1000**	**1000**	**1000**

Turbocharger Position Sensor Signal Range Check (Turbocharger Position Sensor Equipped Only)

Turbocharger Position Sensor Signal Range Check Operation:	
DTCs	P2564 – Turbocharger Boost Control Position Sensor "A" Circuit Low P2565 – Turbocharger Boost Control Position Sensor "A" Circuit High
Monitor execution	Continuous
Monitor Sequence	None
Monitoring Duration	2 s

Typical Turbocharger Position Sensor Signal Range Check Malfunction Thresholds:
Voltage on turbocharger > 4.85V or < 0.15V

Engine Oil Pressure Sensor/Switch Signal Range Check (EOP Sensor Equipped Only)

Engine Oil Pressure Sensor Signal Range Check Operation:	
DTCs	P0522 – Engine Oil Pressure Sensor/Switch "A" Circuit Low P0523 – Engine Oil Pressure Sensor/Switch "A" Circuit High
Monitor execution	Continuous
Monitor Sequence	None
Monitoring Duration	5 s

Typical Engine Oil Pressure Sensor Signal Range Check Malfunction Thresholds:
Voltage on turbocharger > 4.992V or < 0.018V

Engine Oil Pressure Sensor/Switch Circuit Plausibility Check (EOP Sensor Equipped Only)

Engine Oil Pressure Sensor/Switch Plausibility Check Operation:	
DTCs	P0521 – Engine Oil Pressure Sensor/Switch "A" Circuit Range/Performance
Monitor Execution	At engine start
Monitor Sequence	None
Sensors OK	none
Typical Monitoring Duration	Immediate

Typical Engine Oil Pressure Sensor/Switch Plausibility Check Entry Conditions:		
Entry condition	Minimum	Maximum
Minimum engine on time	10 s	
Number of engine off EOP samples	Function of temperature (maximum of 5 samples)	

Typical Engine Oil Pressure Sensor/Switch Plausibility Check Malfunction Thresholds:
Minimum expected difference between average EOP during engine on and off < approximately 50 kPa (function of temperature)
Maximum expected average EOP during engine off > 70 kPa

Engine Oil Pressure Too Low (EOP Sensor Equipped Only)

Engine Oil Pressure Too Low Check Operation:	
DTCs	P0524 – Engine Oil Pressure Too Low
Monitor Execution	At engine start
Monitor Sequence	None
Sensors OK	none
Typical Monitoring Duration	5 s

Typical Engine Oil Pressure Too Low Check Entry Conditions:		
Entry condition	Minimum	Maximum
Minimum engine on time	10 s	

Typical Engine Oil Pressure Too Low Check Malfunction Thresholds:
EOP for engine protection < Function of engine speed and load (30…90 kPa)
EOP for engine protection < Function of EOT and engine speed (6.9 kPa)

DEF Control and Delivery Systems – 6.7L & 3.0L Diesel

DEF System Pressure Control

DEF Pump Pressure Control (Normal) Functional Check Operation:	
DTCs	P20E8 (Reductant Pressure Too Low OR failure to build pressure) P20E9 (Reductant Pressure Too High)
Monitor execution	continuous
Monitor Sequence	P204C and P204D must complete before setting P20E8 or P20E9
Sensors/Actuators OK	DEF pump pressure sensor, DEF pump motor, DEF injector
Monitoring Duration	> 60 sec

Typical DEF Pump Pressure Control (Normal) Functional Check Entry Conditions:		
Entry Condition	Minimum	Maximum
Reductant system pressurized and ready to inject		

Typical DEF Pump Pressure Control (Normal) Functional Check Malfunction Thresholds:
P20E8: Reductant pressure > 200 kPa below setpoint Failed to build pressure / reach pressure control after 5 attempts P20E9: Reductant pressure > 150 kPa above setpoint

Reductant Pump Motor Circuit Checks

Reductant Pump Motor Open/Short Check Operation:	
DTCs	P208A – Reductant Pump Control Circuit Open P208C – Reductant Pump Control Circuit Low P208D – Reductant Pump Control Circuit High
Monitor execution	Continuous – Open and Low with driver off / High with driver on
Monitor Sequence	none
Sensors OK	none
Monitoring Duration	Circuit Open / Low: 8 seconds to register a malfunction Circuit High: 2 seconds to register a malfunction

Typical Reductant Motor Check Malfunction Thresholds:
No calibration thresholds available, fault information is sent directly from power stage.
P208A – Reductant pump voltage in range 2.6 – 3.4V OR reductant PMC voltage < 6V
P208C – Reductant pump current > 5A or reductant PMC current > 15A
P208D – Reductant pump voltage > 16V or reductant PMC current > 5A

Reductant Pump Motor Functional Check

Reductant Pump Motor Control (Normal) Functional Check Operation:	
DTCs	P204C - Reductant Pressure Sensor Circuit Low P204D - Reductant Pressure Sensor Circuit High P208B – Reductant Pump Control Range/Performance P20FF – Reductant Control Module Performance P214E - Reductant Pump "A" Current Too High P21CB - Reductant Control Module Supply Voltage Low P21CC - Reductant Control Module Supply Voltage High U040F - Invalid Data Received from Reductant Control Module
Monitor execution	continuous
Monitor Sequence	P208A , P208C, P208D must complete
Sensors/Actuators OK	Reductant pump pressure sensor, Reductant injector
Monitoring Duration	5 sec for fault detection

Typical Reductant Pump Motor Control (Normal) Functional Check Malfunction Thresholds:
P204C: Voltage < 0.2V
P204D: Voltage > 4.85V
P208B: Reductant pump speed deviation from setpoint > 300 RPM
Reductant pump speed control authority clipped at min or max for 30 sec.
P20FF: Reductant PMC temperature > 130°C OR internal error reported in PMC

P214E: Reductant PMC current > 15A
P21CB: Reductant PMC voltage < 8.5V
P21CC: Reductant PMC voltage >19V
U040F: Reductant PMC control signal duty cycle <4% or >96%

Reductant Dosing Valve Circuit Checks

Reductant Dosing Valve Circuit Check Operation:	
DTCs	P2047 – Reductant Injection Valve Circuit / Open (Bank 1 Unit 1) P2048 – Reductant Injection Valve Circuit Low (Bank 1 Unit 1) P2049 – Reductant Injection Valve Circuit High (Bank 1 Unit 1) P2054 – Reductant Injection Valve Circuit Low (Bank 1 Unit 2) P2055 - Reductant Injection Valve Circuit High (Bank 1 Unit 2)
Monitor execution	Continuous
Monitor Sequence	none
Sensors OK	none
Monitoring Duration	2 seconds to register a malfunction

Typical Reductant Dosing Valve Circuit Check Malfunction Thresholds:
No calibration thresholds available, fault information is sent directly from power stage
P2047 – Voltage in range 2.6 – 3.4V
P2048 – Current > 1.6A
P2049 – Current < 0.1A
P2054 – Resistance < -2 ohm
P2055 – Resistance > 2 ohm

Plausibility Check for Reductant Delivery Performance (Clogging)

Plausibility Check for Reductant Delivery Performance:	
DTCs	P218F - Reductant System Performance
Monitor execution	Continuous
Monitor Sequence	None
Sensors/Actuators OK	P204C, P204D
Monitoring Duration	5 sec

Typical Plausibility Check for Reductant Delivery Performance Conditions:		
Entry Condition	Minimum	Maximum
SCR operating mode	Dosing	Dosing
Reductant pressure control error	-0.5 bar	0.5 bar
Minimum time entry conditions met	5 seconds	

Typical Plausibility Check for Pump Motor Duty Cycle Malfunction Thresholds:
P218F: Detection occurs when the summation in commanded injection rate and pump duty cycle complete a correlation error > 0.15 and Integrated correlation of changes in DEF pressure with changes in commanded injection rate > threshold at completion

Reductant Injection Functional Check Operation:	
DTCs	P208E - Reductant Injection Valve Stuck Closed (Bank 1 Unit 1)
Monitor execution	Once per injection stroke
Monitor Sequence	P208E is inhibited by active P2047, P2048 or P2049
Sensors/Actuators OK	Reductant pump motor, Reductant pressure sensor
Monitoring Duration	50 injection strokes for fault detection

Typical Reductant Injection Functional Check Malfunction Thresholds:
No calibration thresholds available, fault information is sent directly from power stage

Reductant Heater Plausibility Check Operation:	
DTCs	P205B - Reductant Tank Temperature Sensor "A" Circuit Range/Performance P20BA – Reductant Heater "A" Control Performance P20BE – Reductant Heater "B" Control Performance P20C2 – Reductant Heater "C" Control Performance P263D – Reductant Heater Driver Performance
Monitor execution	Once per drive cycle (at peak heater power)
Monitor Sequence	P20BB, P20BC must complete for P20BA P20BF, P20C0 must complete for P20BE
Sensors/Actuators OK	none
Monitoring Duration	1 event for fault detection

Typical Reductant Heater Plausibility Check Malfunction Thresholds:
P205B: Absolute value of difference between reductant tank temperature and reductant quality sensor temperature at startup > 40C
P20BA: Powerstage on and heater circuit #1 current < 3A and heater circuit #1 output voltage <5V or Powerstage off and heater circuit #1 current > 3A and heater circuit #1 output voltage >5V
P20BE: Powerstage on and heater circuit #2 current < 3A and heater circuit #2 output voltage <5V or Powerstage off and heater circuit #2 current > 3A and heater circuit #2 output voltage >5V
P20C2: Heater supply voltage < 5V
P263D: Driver circuit temperatures > 125C

Reductant Heater Plausibility Check Operation (Heater Circuit #2):	
DTCs	P20BE – Reductant Heater "B" Control Performance P20C0 – Reductant Heater "B" Control Circuit High P221C – Reductant Heater "B" Current Too Low P221D – Reductant Heater "B" Current Too High
Monitor execution	Continuously, if heater “B” is activated
Monitor Sequence	P20BF, P20C0 must complete for P20BE
Sensors/Actuators OK	Pressure line heater
Monitoring Duration	2200 ms for fault detection

Typical Reductant Heater Plausibility Check Malfunction Thresholds (Heater Circuit #2):
P20BE: Conductance of heater circuit #2 < 0.3 Ω^{-1}
P20C0: Powerstage off and heater circuit #2 current < 3A and heater circuit #2 voltage output > 5V
P20BF: Powerstage on and heater circuit #2 current > 15A
P221C: Heater circuit #2 current < 3A and Reductant line heater voltage supply > 5V or Heater circuit #2 power lower than expected
P221C: Reductant heater line power < 1W or heater line power lower than expected
P221D: Reductant heater line power greater than expected

Reductant Heater Performance Check Operation (Heater Circuit #1):	
DTCs	P205C - Reductant Tank Temperature Sensor "A" Circuit Low P205D - Reductant Tank Temperature Sensor "A" Circuit High P20BB - Reductant Heater "A" Control Circuit Low P20BC - Reductant Heater "A" Control Circuit High P214F - Reductant Heater "A" Current Too High P21DD - Reductant Heater "A" Current Too Low
Monitor execution	Once per heat cycle (after cold start)
Monitor Sequence	P20BB
Sensors/Actuators OK	tank temperature sensor, tank heater
Monitoring Duration	2200 ms for fault detection

Typical Reductant Heater Performance Check Malfunction Thresholds (Heater Circuit #1):
P205C: Reductant tank temperature sensor voltage < 0.165V
P205D: Reductant tank temperature sensor voltage > 4.3V
P20BB: Powerstage on and heater circuit #1 current > 15A
P20BC: Powerstage off and heater circuit #1 current < 3A and heater circuit #1 voltage output > 5V
P214F: Reductant tank heater power greater than expected
P21DD: Heater circuit #1 current < 3A and Reductant line heater voltage supply > 5V or Heater circuit #1 power lower than expected

Reductant Heater Control Relay Performance Check:	
DTCs	P21C2 – Reductant Heater Relay Control Circuit/Open P21C3 – Reductant Heater Relay Control Circuit Low P21C4 – Reductant Heater Relay Control Circuit High P21C7 – Reductant Control Module Power Relay/Relays Control Circuit/Open
Monitor execution	Continuously when heaters are activated
Monitor Sequence	N/A
Sensors/Actuators OK	Reductant heater power control relay
Monitoring Duration	Max. 5000 ms for fault detection

Typical Reductant Heater Control Relay Performance Check Malfunction Thresholds:
P21C2: Power stage on, heaters off and reductant heater current < 0.2A
P21C3: Power stage on, heaters off and reductant heater current > 6A
P21C4: Power stage off, heaters off and reductant heater voltage > 5V
P21C7: Power stage on, heaters off and reductant heater voltage 0V OR Power stage off, heaters off and reductant heater voltage > 0V

Reductant Quality and Level Sensor:	
DTCs	P203B - Reductant Level Sensor "A" Circuit Range/Performance P206C – Reductant Quality Sensor Low P206D – Reductant Quality Sensor High P21CD - Reductant Quality Module Supply Voltage Low P206B – Reductant Quality Sensor Range / Performance
Monitor execution	Continuous
Sensors/Actuators OK	U02A2 – Lost Communication with RDQM P2507, P2508
Monitoring Duration	15 sec – 900 sec

Typical Reductant Quality Sensor Range/Performance (P203B) Entry Conditions:		
Entry condition	Minimum	Maximum
P203B:		
Battery Voltage (min. 60 sec)	9 V	20 V
Reductant temperature (min. 60 sec)	0°C	
Environmental temperature (min. 60 sec)	-3°C	
Reductant mass in tank	3 kg	

Typical Reductant Quality Sensor Range/Performance Monitor Malfunction Thresholds:
P203B: Reductant level could not be measured (0xFE) OR Reductant level sensor fault (0xFF) OR Reductant level reading exceeds height of tank.

Typical Reductant Quality Sensor Low/High Entry Conditions:		
Entry condition	Minimum	Maximum
P206C, P206D:		
Reductant quality sensor temperature	-3 Deg C	
Ambient Air Temperature	-20 Deg C	
Acceleration pedal position	5 %	
Time since engine start	60 sec	
Mass Of Reductant in Tank	3 kg	
Reductant Concentration signal	5 sec	
Filter Reductant Concentration stabilize time	600 sec	
Battery voltage	9 V	20 V

Typical Reductant Quality Sensor Malfunction Thresholds:
P206C – Filter Reductant Concentration <= 28% for > 900 sec
P206D – Filter Reductant Concentration >= 60% for > 900 sec
P21CD – Reductant Quality Sensor supply voltage < 10 V OR >20V, for 15 sec
P206B – Internal Sensor Error

Exhaust Gas Temperature (EGT) Sensor Circuit Check:	
DTCs	P0545 – Exhaust Gas Temperature Circuit Low (Sensor 1) P0546 – Exhaust Gas Temperature Sensor Circuit High (Sensor 1) P2032 – Exhaust Gas Temperature Circuit Low (Sensor 2) P2033 – Exhaust Gas Temperature Sensor Circuit High (Sensor 2) P242C – Exhaust Gas Temperature Circuit Low (Sensor 3) P242D – Exhaust Gas Temperature Sensor Circuit High (Sensor 3) P2470 – Exhaust Gas Temperature Circuit Low (Sensor 4) P2471 – Exhaust Gas Temperature Sensor Circuit High (Sensor 4) P24C2 – Exhaust Gas Temperature Measurement System - Multiple Sensor Correlation Bank 1
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	2 sec.

Typical Exhaust Gas Temperature Sensor Circuit Check Entry Conditions:		
Entry Condition	Minimum	Maximum
Battery Voltage	9 V	16.25 V
Key On		

Typical Exhaust Gas Temperature Sensor Circuit Check Malfunction Thresholds:
Voltage < 0.10 volts or voltage > 2.66 volts

Exhaust Gas Temperature Rationality Check	
DTCs	Sensor vs. Model Plausibility P0544 – Exhaust Gas Temperature Sensor Circuit (Sensor 1) P2031 – Exhaust Gas Temperature Sensor Circuit (Sensor 2) P242A – Exhaust Gas Temperature Sensor Circuit (Sensor 3) P246E – Exhaust Gas Temperature Sensor Circuit (Sensor 4) P24C2 – Exhaust Gas Temperature Measurement System – Multiple Sensor Correlation Sensor to Sensor Plausibility P2080 - Exhaust Gas Temperature Sensor Circuit Range/Performance (Bank 1, Sensor 1) P2084 - Exhaust Gas Temperature Sensor Circuit Range/Performance (Bank 1, Sensor 2) P242B - Exhaust Gas Temperature Sensor Circuit Range/Performance (Bank 1, Sensor 3) P246F - Exhaust Gas Temperature Sensor Circuit Range/Performance (Bank 1, Sensor 4)
Monitor Execution	Once per driving cycle.
Monitor Sequence	Correlation Test completes after the Model Comparison Tests once the cold start is detected.
Sensors OK	
Typical Monitoring Duration	Model Comparison Test Monitor Duration is 200 to 400 seconds.

Typical Exhaust Gas Temperature Rationality Check Entry Conditions:		
Entry Condition	Minimum	Maximum
Engine off time	6 hours	
Ambient Temperature	-7 deg C	40
Engine speed	1100 RPM	
Engine torque	80 Nm	
Engine operating mode	Not in DPF regeneration	
Temperature of sensor to be diagnosed:	25 deg C	500 deg C
Change of temperature over 10 second period	20 deg C	

Typical Exhaust Gas Temperature Rationality Check Thresholds:	
Each EGT Rationality is confirmed against 3 other sensors (absolute temperature difference thresholds):	
Key-On Comparison Threshold	50 deg C
Modeled Comparison Threshold	±80 deg C for EGT12, ±80 deg C for EGT13, ±80 deg C for EGT14
Modeled Comparison Duration	Comparison Test will run for 200 to 400 seconds. Fault must persist for 20 seconds for robust detection.

Diesel Particulate Filter Over Temperature Check:	
DTCs	P200C– Diesel Particulate Filter Over Temperature (Bank1) P200E – Catalyst System Over Temperature (Bank 1)
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	3 sec.
Thresholds	P200C – Pre DPF > 830C or Post DPF > 950C or Post DPF Temp Sensor Circuit failure P200E - The conditions for P200C have been met for 3 seconds and vehicle speed is less than 1 km/hr

Diesel Particulate Filter Pressure Sensor

Diesel Particulate Filter Pressure (DPFP) Sensor Circuit Check:	
DTCs	P2454 – Particulate Filter Pressure Sensor "A" Circuit Low P2455 – Particulate Filter Pressure Sensor "A" Circuit High
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	2 sec.

Typical Diesel Particulate Filter Pressure Sensor Circuit Check Entry Conditions:		
Entry Condition	Minimum	Maximum
Battery Voltage	9 V	16.25 V
Key On		

Typical Diesel Particulate Filter Pressure Sensor Circuit Check Malfunction Thresholds:
Voltage < 0.10 volts or voltage > 4.90 volts

DPFP Sensor Transfer Function (6.7L F250-F550)		
DPFP volts = 0.082 * kPaG Delta Pressure) + 0.45		
Volts	A/D Counts in PCM	Delta Pressure, kPa Gauge

0.10	20	-4.3
0.45	92	0
1.27	260	10
2.09	428	20
2.91	595	30
3.73	763	40
4.55	931	50
4.90	1003	54.3

DPS Sensor Transfer Function (6.7L F650-F750)	
DPFP volts = 0.082 * kPaG Delta Pressure) + 0.45	
Volts	Delta Pressure, kPa Gauge
0.5	0.0
1.0	4.4
1.6	9.6
2.0	13.1
2.6	18.4
3.0	21.9
3.6	27.1
4.0	30.6
4.6	35.9
4.8	37.6

Diesel Particulate Filter Pressure Offset Test

Diesel Particulate Filter Pressure Sensor Offset Check	
DTCs	P2452 – Particulate Filter Pressure Sensor "A" Circuit
Monitor Execution	Afterrun
Monitor Sequence	None.
Sensors OK	P2454, P2455
Typical Monitoring Duration	1 second.

Typical Diesel Particulate Filter Pressure Sensor Offset Check Thresholds:
Exhaust Pressure Sensor value > 1 kPa

Diesel Particulate Filter Pressure Rationality Test

Diesel Particulate Filter Pressure Sensor Rationality Check	
DTCs	P2453 – Particulate Filter Pressure Sensor "A" Circuit Range/Performance
Monitor Execution	Continuous.
Monitor Sequence	None.

Sensors OK	
Typical Monitoring Duration	2 seconds.

Typical Diesel Particulate Filter Pressure Sensor Rationality Check Entry Conditions:		
Entry Condition	Minimum	Maximum
Exhaust Volume	500 m3/hour	None.

Typical Diesel Particulate Filter Pressure Sensor Rationality Check Thresholds:
Exhaust Pressure Sensor value < 1 kPa

SENT Sensor Monitors

SENT Sensor Errors	
DTCs	U060F – Lost Communication with Mass or Volumn Air Flow Sensor “A” U0691 – Lost Communication with Exhaust Pressure Sensor “A” P0470 – Exhaust Pressure Sensor “A” Circuit P00F2 – Humidity sensor Circuit/Open U0609 – Lost Communication with Manifold Absolute Pressure Sensor “A” P0105 – Manifold Absolute Pressure / Barometric Pressure Sensor Circuit Range / Performance U068B – Lost Communication with Turbocharger / Supercharger Inlet Pressure Sensor “A” P012A – Turbocharger / Supercharger Inlet Pressure Sensor “A” Circuit U0601 – Lost Communication with Particulate Filter Pressure Sensor “A” P0110 – Intake Air Temperature Sensor 1 Circuit (Bank 1) U0600 – Lost Communication with Engine Oil Pressure Sensor “A” P0520 – Engine Oil Pressure Sensor / Switch “A” Circuit U0667 – Lost Communication with Engine Oil Temperature Sensor “A” P0195 – Engine Oil Temperature Sensor “A” Circuit
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	Not Applicable
Monitoring Duration	5 s

Typical Engine Control Unit (ECU) Monitor Malfunction Thresholds:
U060F – MAF sensor SENT driver detects a communication error
U0691 – SENT low level driver detects a communication error and no data has been received in appropriate time frame OR SENT data line is stuck to low or high voltage or SENT sensor has an internal error
P0470 – SENT sensor status reports an error OR Fast channel raw data from SENT sensor is higher than a threshold, OR SENT is not within low threshold limits
P00F2 – Maximum time or minimum time between SENT sensor humidity sensor messages is too high or too low
U0609 – SENT Low level driver detects a communication error OR the SENT data is stuck to low voltage OR there is an internal SENT sensor error
P0105 – Bit 0 of the status and communication nibble is not set OR MAP sensor is not within high or low threshold limits
U068B – Low level SENT driver detects the sensor is stuck at high or low voltage

P012A – SENT sensor error flag is set or SENT data is above a threshold

U0601 – SENT low level driver detects a communication error or that the line is stuck to high or low voltage ‘

P0110 – SENT data value of the slow channel is reporting 0, SENT signal is above a high threshold, communication status reports an error, or SENT sensor value is above or below a threshold,

U0600 – SENT sensor detects a communication error

P0520 – EOP SENT sensor failed to initialize or its value is above or below a threshold

U0667 – SENT sensor detects a communication error

P0195 – SENT sensor detects a communication error

Charge Air Cooler Coolant Temperature Sensor Circuit Monitors

CAC Coolant Temperature Sensor Errors	
DTCs	P00E0 – Charge Air Cooler Coolant Temperature Sensor “A” Circuit Low P00E1 – Charge Air Cooler Coolant Temperature Sensor “A” Circuit High
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	Not Applicable
Monitoring Duration	5 s

Typical Engine Control Unit (ECU) Monitor Malfunction Thresholds:
P00E0 – If the raw signal of the sensor is lower than 0.162 V, then a fault is set P00E1 – If the raw signal of the sensor is greater than 4.928 V, then a fault is set

Intake Air Pressure Sensor Plausibility Check

Intake Air Pressure Sensor Plausibility Check Operation:	
DTCs	P00C7– Intake Air Pressure Measurement System – Multiple Sensor Correlation
Monitor execution	Continuous
Monitor Sequence	None
Monitoring Duration	5 sec

Intake Air Pressure Sensor Plausibility Check Entry Conditions		
Entry Condition:	**Minimum**	**Maximum**
Engine speed		300 RPM

Typical Intake Air Pressure Sensor Plausibility Check Malfunction Thresholds:
Intake air pressure - BARO > 20 hPa or < -20 hPa

DRIVER INPUT DEVICES

Accelerator Pedal Diagnostics

Accelerator Pedal Diagnostic Circuit and Plausibility Checks:	
DTCs	P2122 – Throttle/Pedal Position Sensor/Switch "D" Circuit Low P2123 – Throttle/Pedal Position Sensor/Switch "D" Circuit High P2127 – Throttle/Pedal Position Sensor/Switch "E" Circuit Low P2128 – Throttle/Pedal Position Sensor/Switch "E" Circuit High P2138 – Throttle/Pedal Position Sensor/Switch "D"/"E" Voltage Correlation
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	
Monitoring Duration	0.3 seconds

Typical Accelerator Pedal Diagnostic Thresholds:
P2122 – Observed voltage on first pedal track <0.25V
P2123 – Observed voltage on first pedal track >4.75V
P2127 – Observed voltage on second pedal track <0.25V
P2128 – Observed voltage on second pedal track > 4.75V
P2138 – The absolute value of the difference between ((voltage on pedal track 1)/2 – voltage on pedal track 2) exceeds a threshold dependent on pedal track 2 voltage (0.25V @ pedal track 2 voltage of 1.2V, 0.5V @ pedal track 2 voltage of 1.96V)

Brake Switch Diagnostics

Brake Switch Plausibility Checks:	
DTCs	P0504 – Brake Switch "A"/"B" Correlation P0572 – Brake Switch "A" Circuit Low P0573 – Brake Switch "A" Circuit High
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	
Monitoring Duration	Varies with driving conditions

Typical Brake Switch Diagnostic Thresholds:
P0504 – Brake switches disagree (pressed/not pressed) for 40 braking events
P0572 – No brake switch activation seen for 40 inferred braking events
P0573 – Brake switch activation seen for 40 inferred acceleration events

Turbocharger Actuator Jammed Detection (Turbocharger Position Sensor Equipped Only)

Turbocharger Actuator Jammed Detection Operation:	
DTCs	P2598 – Turbocharger Boost Control Position Sensor "A" Performance – Stuck Low
Monitor execution	Continuous
Monitor Sequence	None
Monitoring Duration	25 s

Typical Actuator Jammed Valve Entry Conditions:		
Entry Condition	**Minimum**	**Maximum**
Engine speed	500 rpm	
Adaptive Learning Not Active		
Jammed Valve Fault not present on Actuator		
Governor Active (closed-loop position control)		

Typical Turbocharger Valve Jammed Check (P042E) Malfunction Thresholds:
Desired turbocharger position – actual turbocharger position > 15% or Desired turbocharger position – actual turbocharger position < -15%

Turbocharger Actuator Offset Learn Limits

Turbocharger Actuator Offset Learn Limits:	
DTCs	P003A- Turbocharger/Supercharger Boost Control "A" Position Exceeded Learning (6.7L only)
Monitor execution	At completion of offset learn
Monitor Sequence	None
Monitoring Duration	Immediate at completion of offset learn

Typical Actuator Jammed Valve Entry Conditions:		
Entry Condition	**Minimum**	**Maximum**
Turbocharger offset learning has completed		

Typical Turbocharger Actuator Lean (P003A) Malfunction Thresholds:
Actuator Learn position: > 11% (6.7L) or 0.3% (3.0L) < -39% (6.7L) or -100% (3.0L)

EGR Valve Actuator Signal Range Check

EGR Valve Actuator Short Circuit (P0489/P0490) Check Operation:	
DTCs	P0489 – EGR "A Control Circuit Low, P0490 – EGR "A" Control Circuit High
Monitor execution	Continuous; when Power-stage ON
Monitor Sequence	None
Monitoring Duration	0.35 seconds to register a malfunction

EGR Valve Offset Learn Limits

EGR Valve Offset Learn Limits :	
DTCs	P049D – EGR "A" Control Position Exceeded Learning Limit
Monitor execution	At completion of offset learn
Monitor Sequence	None
Monitoring Duration	Immediate at completion of offset learn

EGR Valve Offset Learn Limits Entry Conditions:		
Entry Condition	**Minimum**	**Maximum**
EGR valve offset learning complete		

EGR Valve Offset Learn Limits Malfunction Thresholds:
"Edge" Offset Learn < 7.5 or "Edge" Offset Learn >32.5 or "Min" Offset Learn < 0 or "Min" Offset Learn >25

EGR Valve Actuator Jammed Detection

EGR Valve Jammed Check Operation:	
DTCs	P042E – Exhaust Gas Recirculation "A" Control Stuck Open
Monitor execution	Continuous
Monitor Sequence	None
Monitoring Duration	25 seconds to register a malfunction

Typical Actuator Jammed Valve Entry Conditions:		
Entry Condition	**Minimum**	**Maximum**
Governor Active (closed-loop position control)		
Adaptive Learning Not Active		
Jammed Valve Fault Not Present on Actuator		
RPM	500 rpm	

Typical EGR Valve Jammed Check (P042E) Malfunction Thresholds:
Desired EGR Valve position – actual EGR Valve position > 15% or Desired EGR Valve position – actual EGR Valve position < -15%

Throttle Valve Actuator Signal Range Check

Throttle Valve Actuator Short Circuit (P02E2/P02E3) Check Operation:	
DTCs	P02E2- Diesel Intake Air Flow Control Circuit Low; P02E3- Diesel Intake Air Flow Control Circuit High
Monitor execution	Continuous; when power stage ON
Monitor Sequence	None
Monitoring Duration	0.2 seconds to register a malfunction.

Throttle Valve Offset Learn Limits

Throttle Valve Offset Learn Limits:	
DTCs	P02FA – Diesel Intake Air Flow Position Sensor Minimum/Maximum Stop Performance
Monitor execution	At completion of offset learn
Monitor Sequence	None
Monitoring Duration	Immediate at completion of offset learn

Throttle Valve Offset Learn Limits Entry Conditions:		
Entry Condition	**Minimum**	**Maximum**
Throttle valve offset learning complete		

Throttle Valve Offset Learn Limits Malfunction Thresholds:
"Min" Offset Learn < -10 (6.7L) / -6.7 (3.0L) or "Min" Offset Learn >10 (6.7L) / 6.7 (3.0L)

Throttle Valve Actuator Jammed Detection

DTCs	P02E4 – Diesel Intake Air Flow "A" Control Stuck Open
Monitor execution	Continuous
Monitor Sequence	None
Monitoring Duration	25 seconds to register a malfunction

Typical Actuator Jammed Valve Entry Conditions:		
Entry Condition	**Minimum**	**Maximum**
Governor Active (closed-loop position control)		
Adaptive Learning Not Active		
Jammed Valve Fault Not Present on Actuator		
RPM	500 rpm	

Typical Throttle Jammed Valve Check (P02E4) Malfunction Thresholds:
Desired Throttle Valve position – actual Throttle Valve position > 15% or Desired Throttle Valve position – actual Throttle Valve position < -15%

ECB Valve Actuator Signal Range Check

ECB Actuator Open-Load Check Operation:	
DTCs	P2425 - Exhaust Gas Recirculation Cooling Valve Control Circuit Open Load
Monitor execution	Continuous;
Monitor Sequence	None

Monitoring Duration	2 seconds to register a malfunction

ECB Actuator Short-Circuit (P2426/P2427) Check Operation:	
DTCs	P2426- Exhaust Gas Recirculation Cooling Valve Control Circuit Low, P2427- Exhaust Gas Recirculation Cooling Valve Control Circuit High
Monitor execution	Continuous;
Monitor Sequence	None
Monitoring Duration	2 seconds to register a malfunction.

Engine Coolant Bypass Valve (ATWU) Circuit Checks

Engine Coolant Bypass Valve Check:	
DTCs	P2681 – Engine Coolant Bypass Valve “A” Control Circuit / Open P2682 – Engine Coolant Bypass Valve “A” Contol Circuit Low P2683 – Engine Coolant Bypass Valve “A” Control Circuit High
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	5 s

Engine Coolant Bypass Valve Malfunction Thresholds:
P2681 – If the powerstage reports an open load of the actuator a fault is set
P2682 – If the powerstage reports a short to ground error of the actuator a fault is set
P2683 – If the powerstage reports a short to power error of the actuator a fault is set

Engine Over Speed Monitor

Engine Over Speed Check:	
DTCs	P0219 - Engine Overspeed Condition
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	Not applicable
Typical Monitoring Duration	0.1 Sec to register a malfunction

Engine Over Speed Check Entry Conditions:
Key On

Engine Over Speed Check Malfunction Thresholds:
6.7L - If engine speed > 4200 rpm
3.0L – if engine speed > 4800 rpm

Engine Control Unit (ECU) Monitors

Engine Control Unit (ECU) Monitor Operation:	
DTCs	P0600 - Serial Communication Link P0603 – Internal Control Module Keep Alive Memory (KAM) Error P0606 - Control Module Processor P0607 - Control Module Performance P060A - Internal Control Module Monitoring Processor Performance P060B - Internal Control Module A/D Processing Performance P060C - ECM/PCM Internal Control Module Main Processor Performance P060D - Internal Control Module Accelerator Pedal Position Performance P0611 – Fuel Injector Control Module Performance P061A - Internal Control Module Torque Performance P061B - Internal Control Module Torque Calculation Performance P061C - Internal Control Module Engine RPM Performance P062B - Internal Control Module Fuel Injector Control Performance P062F - Internal Control Module EEPROM Error P06A6 - Sensor Reference Voltage "A" Circuit Range/Performance P06A7 - Sensor Reference Voltage "B" Circuit Range/Performance P06A8 - Sensor Reference Voltage "C" Circuit Range/Performance P2507 - ECM / PCM Power Input Signal Low P2508 - ECM / PCM Power Input Signal High P2610 – ECM / PCM Engine Off Timer Performance

Monitor Execution	P0600, P0603, P0606, P060A, P060B, P060C, P060D, P0611, P061A, P061B, P061C, P062B, P062F, P06A6, P06A7, P06A8, P2507, P2508, P2610 – Continuous P0607 – 20 sec
Monitor Sequence	None
Sensors OK	None
Typical Monitoring Duration	P0600, P0603, P0606, P060A, P060B, P060C, P060D, P061B, P061C, P062B, P062F, P06A6, P06A7, P06A8, P2507, P2508, P0611 – 5 sec P061A – 0.1 sec , P2610 – 8 sec

Typical Engine Control Unit (ECU) Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
P0600, P0603, P0606, P0607, P060A, P060B, P060C, P060D, P061A, P061B, P061C, P062B, P062F, P06A6, P06A7, P06A8, P2507, P2508, P2610: ECU energized (key-on, engine running, or post-drive before ECU shutdown)		
Engine speed (as calculated by monitoring function)	1000 RPM	
P0611: Engine running or cranking		

Typical Engine Control Unit (ECU) Monitor Malfunction Thresholds:

P0600 – – A data transfer between chips in the ECU either is not possible or has invalid check bytes

OR Communication is interrupted between the CPU and the monitoring module

P0603 – Voltage on the separate power supply for the ECU engine off timer chip (power supply used when the main ECU is shut down) is < 0.25V (normal operation: battery voltage ~12V)

P0606 – A communications error exists between the powerstage controller chip and the CPU OR an internal chip error has been detected within the voltage generation/monitoring system for the ECU OR voltage at 5V supply in ECU is <4.7V or > 5.3V

P0607 – Five errors with internal ECU communication with the monitoring module chip are detected

P060A – An irreversible error occurs with an operating system function call OR An irreversible error occurs in the test of the monitoring module

P060B – Failure on power-up calibration done for the A/D conversion module and A/D conversion time performed on ECU start OR >249 mV reading in the cycle following grounding of a specific voltage OR Cyclical conversion of a predetermined voltage results in <4727 mV or >4830 mV reading.

P060C – An error is detected with the microcontroller due to data integrity, memory address violation, global timer, and system condition integrity (e.g., system voltage limits [1.3v to 3.3v] & operating temperature range)

P060D – If either pedal voltage 1 or pedal voltage 2 < 742 mV and (pedal voltage 1) – 2 * (pedal voltage 2) > 547 mV OR If pedal voltage 1 and pedal voltage 2 >= 742 mV and (pedal voltage 1) – 2 * (pedal voltage 2) > 1055 mV

P0611 – If the raw voltage detected by an internal ECU voltage measurement for fuel system Nominal Voltage Calibration falls below 0 mV or above 3300 mV for the monitoring duration

P061A – Commanded inner torque > permissible inner torque at current engine operating condition

P061B – The energizing time for Zero Fuel Calibration is <10 ms or > 850 ms OR The difference between programmed energizing time and actual energizing time exceeds 127.2 us or The requested time for start of energizing of a given fuel injection is outside the crank angle regime permitted for that injection

OR The correction in requested fuel injection quantity due to transient pressure effects within the fuel injector as calculated by the control software and as calculated by the monitor exceeds 5 mg for an injection

P061C – The engine speed calculated by the control software and the engine speed calculated by the monitor deviate by more than 400 RPM

P062B – If an error is detected in a requested post injection OR If requested energizing time exceeds 200 us when the controller is operating in overrun/decel fuel shut-off mode

P062F – An error is detected in an EEPROM read, write, or erase operation

P06A6 – Voltage output of sensor supply 1 is <4.7 V or >5.3 V

P06A7 – Voltage output of sensor supply 2 is <4.7 V or >5.3 V

P06A8 – Voltage output of sensor supply 3 <4.7 V or >5.3 V

P2507 – The 5V internal ECU supply is <4.2 V

P2508 – The 5V internal ECU supply is > 5.5 V P2610 – If, during a key off event, engine coolant temperature decreases by 30 degrees and the engine off timer has not incremented at least 1200 seconds OR If, while running for 1200 seconds as measured by ECU timer, the timer used for engine off time and the time as determined by the secondary timer differ by at least 100 seconds OR In afterrun, if a requested 8 second stop timer measurement is <7.52 seconds or >8.48 seconds

Idle Speed and Fuel Monitor Operation Monitors

Idle Speed and Fuel Monitor Operation:	
DTCs	P0506 - Idle Control System - RPM Lower Than Expected P0507 - Idle Control System - RPM Higher Than Expected P054E - Idle Control System - Fuel Quantity Lower Than Expected P054F - Idle Control System - Fuel Quantity Higher Than Expected
Monitor Execution	P0506, P0507, P054E, P054F – Continuous
Monitor Sequence	None
Sensors OK	ECT, CKP
Typical Monitoring Duration	P0506 – 5 sec P0507 – 5 sec P054E – 5 sec P054F – 5 sec

Typical Idle Speed and Fuel Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
P0506, P0507:		
Engine idle speed governor active		
Engine Coolant Temperature (°C)	0	120
Vehicle Speed (kph)		1
Engine RPM	300 (stall speed)	1500 (300 rpm above max requestable idle speed)
P054E, P054F:		
Engine running		
Vehicle speed		0 mph
Difference between observed and target idle speed		160 RPM
Accelerator pedal input		0%
RPM gradient		100 RPM/sec
Engine operating mode	Normal (no post injection)	
Time in normal operating mode	5 sec	
Power Take off	Not occurring	

Gradient of fuel quantity requested		20 mg/stroke/sec
Total distance traveled over vehicle life	100 km	
Barometric pressure	50 kPa	
Engine coolant temperature	70 deg C	
Typical Idle Speed and Fuel Monitor Malfunction Thresholds:		
P0506 – If observed idle speed is 100 or more RPM below requested idle speed		
P0507 – If observed idle speed is 160 or more RPM above requested idle speed		
P054E – If ((actual fuel use at idle) – (expected fuel use))/(expected fuel use) < -0.5		
P054F – If ((actual fuel use at idle) – (expected fuel use))/(expected fuel use) > 0.5		

Lack of Communication Monitors

ECU CAN Communication Malfunctions	
DTCs	U0073 - Control Module Communication Bus "A" Off U0074 - Control Module Communication Bus "B" Off U0101 - Lost Communication with TCM U0102 - Lost Communication with Transfer Case Control Module U0121 - Lost Communication With Anti-Lock Brake System (ABS) Control Module U0151 - Lost Communication With Restraints Control Module U0212 - Lost Communication With Steering Column Control Module U029D - Lost Communication With NOx Sensor "A" U029E - Lost Communication With NOx Sensor "B" U0307 - Software Incompatibility with Glow Plug Control Module U059E - Invalid Data Received from NOx Sensor "A" U1013 – Invalid Internal Control Module Monitoring Data Received from TCM U0140 – Lost Communication with Body Control Module U02A2 – Lost Communication with Reductant Quality Module U0155 – Lost Communication with Instrument Panel Cluster (IPC) Control
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	Not Applicable
Monitoring Duration	Continuous

Typical Malfunction Thresholds
U0073 – CAN Chip Driver detect CAN line short or open > 10 ms
U0074 – CAN Chip Driver detect CAN line short or open > 10 ms
U0101 – TCM master message not received > 1 sec
U0102 – TCCM master message not received > 5 sec
U0121 – ABS master message not received > 5 sec
U0151 – RCM master message not received > 10 sec
U0212 – SCCM master message not received > 5 sec
U029D – NOx Sensor "A" master message not received > 1 sec
U029E – NOx Sensor "B" master message not received > 1 sec
U0307 – Glow module reporting "safe glow" mode
U059E - Calibration Verification Number not received by ECU
U1013 – invalid data received from TCM > 5 sec
U0140 – BCM master message not received > 5 sec
U02A2 – RDQM master message not received > 5 sec
U0155 – IPC master message not received > 5 sec

VS Communication Plausibility Malfunctions	
DTCs	P0500 Vehicle Speed Sensor "A"
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	Not Applicable
Monitoring Duration	Continuous

Typical Malfunction Thresholds
Vehicle Speed signal is missing from the CAN system for 0.5 Seconds.

Active Grill Shutter Control – 3.0L Only

Active Grill Shutter Endstop Detection:	
DTCs	P05A1 – Active Grille Air Shutter "A" Position Sensor Minimum/Maximum Stop P05B0 – Active Grille Air Shutter "B" Position Sensor Minimum/Maximum Stop
Monitor execution	Continuous
Monitor Sequence	None
Monitoring Duration	10 seconds.

Typical Active Grille Shutter Endstop Entry Conditions:
Entry Condition
Commanded to an endstop (Fully closed or fully open position)
AGS self-learning events > 5

Typical Active Grille Shutter Endstop Malfunction Thresholds:
Commanded vs. Actual final shutter position when calibrating AGS fully closed during self-cal > 40 deg
Commanded vs. Actual final shutter position when calibration AGS fully open during self-cal > 20 deg
Commanded vs. Actual final shutter position during normal operation towards fully closed/open position > 20 deg

Active Grill Shutter Control Circuit Open Detection:	
DTCs	P05A2 – Active Grille Air Shutter "A" Control Circuit/Open P05B1 – Active Grille Air Shutter "B" Control Circuit/Open
Monitor execution	Open coil check is performed once at the beginning and once 500ms after the end of each movement. Short coil check is performed continuously.
Monitor Sequence	None
Monitoring Duration	10 seconds.

Typical Active Grille Shutter Control Circuit Open Entry Conditions:
Entry Condition
Initiation of movement command

Typical Active Grille Shutter Control Circuit Open Malfunction Thresholds:
Shorted or open motor coil detected by the microcontroller inside the actuator = TRUE

Active Grill Shutter Loss of Communication Detection:	
DTCs	U0284 – Loss Communication with Active Grille Air Shutter Module “A” U0285 – Loss Communication with Active Grille Air Shutter Module “B”
Monitor execution	Continuous
Monitor Sequence	None
Monitoring Duration	Immediate

Typical Active Grille Shutter Supply Voltage Entry Conditions:		
Entry Condition	**Minimum**	**Maximum**
Key on		
Time since engine start	5 s	
Battery voltage	10.0V	16.26 V
Afterrun or pre-drive is not active		

Typical Active Grille Shutter Loss of Communication Malfunction Thresholds:
Time signal is missing from AGS module > 10 sec

Active Grill Shutter Module Overtemperature Detection:	
DTCs	P05C0 – Active Grille Air Shutter Module “A” Over Temperature P05C1 – Active Grille Air Shutter Module “B” Over Temperature
Monitor execution	Continuous
Monitor Sequence	None
Monitoring Duration	10 sec

Typical Active Grille Shutter Module Overtemperature Entry Conditions:
Entry Condition
None

Typical Active Grille Shutter Module Overtemperature Malfunction Thresholds:
Actuator junction temperature inside ASIC controller chip > 140 deg C

Active Grill Shutter Performance Detection:	
DTCs	P059F – Active Grille Air Shutter “A” Performance/Stuck Off

	P05AE – Active Grille Air Shutter “B” Performance/Stuck Off
Monitor execution	Continuous
Monitor Sequence	None
Monitoring Duration	300 sec

Typical Active Grille Shutter Performance Entry Conditions:
Entry Condition
AGS self-learning events > 5
AGS freeze mode is active (AGS will enter freeze mode when ambient temperature is below 2 degC and engine coolant temperature is below 110 degC)

Typical Active Grille Shutter Performance Malfunction Thresholds:
Command vs. Actual final shutter position when calibrating AGS fully open during self-learning event > 20 deg
Command vs. Actual final shutter position during normal operation conditions towards fully closed/open position > 6 deg

Active Grill Shutter Supply Voltage Detection:	
DTCs	P05A7 – Active Grille Air Shutter “A” Supply Voltage Circuit Low P05B6 – Active Grille Air Shutter “B” Supply Voltage Circuit Low
Monitor execution	Continuous
Monitor Sequence	None
Monitoring Duration	Instantaneous

Typical Active Grille Shutter Supply Voltage Entry Conditions:		
Entry Condition	**Minimum**	**Maximum**
Key on		
Time since engine start	5 s	
Battery voltage	9.0V	16.26 V

Typical Active Grille Shutter Supply Voltage Malfunction Thresholds:
Internal supply voltage measured by the ASIC controller chip < 6.9 V

Engine Control Unit Wake-Up Monitor

ECU Wake-Up Performance Malfunctions	
DTCs	U3012 - Control Module Improper Wake-Up Performance
Monitor execution	When Wake-Up is commanded
Monitor Sequence	None
Sensors OK	Not Applicable
Monitoring Duration	Continuous

Typical Engine Control Unit (ECU) Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
U3012: Engine Running & ECU Alarm Wake Requested		

Typical Engine Control Unit (ECU) Monitor Malfunction Thresholds:
U3012 – An error is detected when more than two ECU Wake Up events occur 10min prior to ECU Alarm Wake request & when an ECU Alarm Wake has not occurred within 10min post an ECU Alarm Wake request (worst case scenarios)

Cruise Control Performance

Cruise Control Performance	
DTCs	P0570 – Cruise Control ACCEL Signal
Monitor execution	Every 10ms
Monitor Sequence	None
Sensors OK	Not Applicable
Monitoring Duration	0.1s

Typical Engine Control Unit (ECU) Monitor Entry Conditions:		
Entry condition	Minimum	Maximum
P0570: Vehicle must be configured for Adaptive Cruise Control Vehicle **must not** be in Factory/Transport Mode		

Typical Engine Control Unit (ECU) Monitor Malfunction Thresholds:
P0570 – A failure occurs when there is an error with the maximum acceleration request message while operating Adaptive Cruise Control

GLOW PLUGS AND GLOW PLUG CONTROL MODULE (GPCM) FOR 6.7L AND 3.0L

Glow Plug Module Operational Checks:	
DTCs	U0106 – Lost Communication with GPCM P0381 – Glow Plug/Heater Indicator Circuit P064C – Glow Plug Control Module P06DF – Glow Plug Module Memory Checksum Error P0384 – Glow Plug Module System Voltage P052F – Glow Plug Module 1 System Voltage P20C2 – Reductant Heater "C" Control Performance P263C - Glow Plug Driver Performance P06E5 - Glow Plug Control Module 1 Performance P263E - Glow Plug Control Module 1 Over Temperature
Monitor execution	P06DF, P0381 at power up, otherwise continuous
Monitor Sequence	None
Sensors OK	None
Monitoring Duration	~1 second to register a malfunction

Glow Plug Module: Malfunction Thresholds:
Communication lost for > 5 seconds
Cluster detects wait to start lamp in wrong state (off when commanded on)
Any internal driver circuits detect fault (not switching or over temp) > 1 sec (glow plugs, DEF heaters or relay)
RAM checksums do not match expected
GPCM main power feed voltage too low / too high / open circuit (< 6.5 volts or > 16.5 volts)
Low voltage detected on the Reductant Heater Circuit "C" < 5 volts
Glow plug module controller internal temperature > 125°C

Glow Plug Circuit Open Load Check Operation:	
DTCs	P0671 – Cylinder 1 Glow Plug Circuit / Open P0672 – Cylinder 2 Glow Plug Circuit / Open P0673 – Cylinder 3 Glow Plug Circuit / Open P0674 – Cylinder 4 Glow Plug Circuit / Open P0675 – Cylinder 5 Glow Plug Circuit / Open P0676 – Cylinder 6 Glow Plug Circuit / Open P0677 – Cylinder 7 Glow Plug Circuit / Open (V8 Diesel Only) P0678 – Cylinder 8 Glow Plug Circuit / Open (V8 Diesel Only)
Monitor execution	Glow plugs in heating mode. Heaters operational
Monitor Sequence	None
Sensors OK	None
Monitoring Duration	~1 second to register a malfunction

Glow Plug Circuit Open Load: Malfunction Thresholds:
Individual glow plug circuit current < 1 A, Individual reductant heater circuit current < .2 A

Glow Plug Circuit Short to Battery Check Operation:	
DTCs	P066B – Cylinder 1 Glow Plug Circuit High P066D – Cylinder 2 Glow Plug Circuit High P066F – Cylinder 3 Glow Plug Circuit High P067B – Cylinder 4 Glow Plug Circuit High P067D – Cylinder 5 Glow Plug Circuit High P067F – Cylinder 6 Glow Plug Circuit High P068D – Cylinder 7 Glow Plug Circuit High (V8 Diesel Only) P068F – Cylinder 8 Glow Plug Circuit High (V8 Diesel Only) P20BC – Reductant Heater "A" Control Circuit High P20C0 – Reductant Heater "B" Control Circuit High
Monitor execution	Glow plugs in heating mode. Heaters operational
Monitor Sequence	None
Sensors OK	None
Monitoring Duration	~1 second to register a malfunction for glow plugs 250 ms to register a malfunction for the reductant heaters

Glow Plug Circuit Short to Battery: Malfunction Thresholds:
Individual glow plug circuit = 0 Amps current, Individual reductant heater circuit = 0 Amps current

Glow Plug Circuit Short to Ground Check Operation:	
DTCs	P066A – Cylinder 1 Glow Plug Circuit Low P066C – Cylinder 2 Glow Plug Circuit Low P066E – Cylinder 3 Glow Plug Circuit Low P067A – Cylinder 4 Glow Plug Circuit Low P067C – Cylinder 5 Glow Plug Circuit Low P067E – Cylinder 6 Glow Plug Circuit Low P068C – Cylinder 7 Glow Plug Circuit Low (V8 Diesel Only) P068E – Cylinder 8 Glow Plug Circuit Low (V8 Diesel Only) P20BB – Reductant Heater "A" Control Circuit Low P20BF – Reductant Heater "B" Control Circuit Low
Monitor execution	Glow plugs in heating mode. Heaters operational.
Monitor Sequence	None
Sensors OK	None
Monitoring Duration	~3 second to register a malfunction for glow plugs 250 ms to register a malfunction for the reductant heaters

Glow Plug Circuit Short to Battery: Malfunction Thresholds:
Individual glow plug circuit > 22 Amps current > 0.3 second
Individual glow plug circuit > 20 AND < 22 Amps current for > 2 second
Reductant heater relay (circuit "A" & "B") > 15 Amps current > 250 ms

Glow Plug Circuit Resistance Out of Range Check:	
DTCs	P06B9 – Cylinder 1 Glow Plug Circuit Range / Performance P06BA – Cylinder 2 Glow Plug Circuit Range / Performance P06BB – Cylinder 3 Glow Plug Circuit Range / Performance P06BC – Cylinder 4 Glow Plug Circuit Range / Performance P06BD – Cylinder 5 Glow Plug Circuit Range / Performance P06BE – Cylinder 6 Glow Plug Circuit Range / Performance P06BF – Cylinder 7 Glow Plug Circuit Range / Performance (V8 Diesel Only) P06C0 – Cylinder 8 Glow Plug Circuit Range / Performance (V8 Diesel Only)
Monitor execution	Glow plugs in heating mode.
Monitor Sequence	After Open circuit, short to battery and short to ground testing
Sensors OK	None
Monitoring Duration	~3 second to register a malfunction

Glow Plug Circuit Short to Battery: Malfunction Thresholds:
Individual circuit > 2 ohms resistance

MISCELLANEOUS ECU MONITORS

Fan Control Checks

Fan Control Circuit Check Operation:	
DTCs	P0693 – Fan 2 Control Circuit Low P0694 – Fan 2 Control Circuit High
Monitor Execution	Continuous
Monitor Sequence	None
Sensors OK	None
Typical Monitoring Duration	0.5 sec

Typical Fan Control Circuit Check Malfunction Thresholds:
P0693: The secondary electric cooling fan relay detects an open circuit or short to ground
P0694: The secondary electric cooling fan relay detects a short to power

Vehicle Configuration Information

Vehicle Configuration	
DTCs	P0603 - Internal Control Module Keep Alive Memory (KAM) Error P0610 - Control Module Vehicle Options Error P0630 - VIN Not Programmed or Incompatible - ECM/PCM P264F - Engine Serial Number Not Programmed or Incompatible P068B – Internal Control Module Non-Volatile Random Access Memory

ECU Main Relay	
DTCs	P0685 - ECM/PCM Power Relay Control Circuit/Open P068A – ECM/PCM Power Relay De-Energized Too Early
Monitor execution	Continuous
Monitor Sequence	None
Monitoring Duration	0.5 seconds to register a malfunction.

Transmission Park/Neutral Gear Check at Start-Up

Transmission Park/Neutral Switch Plausibility Check:	
DTCs	P0850 – Park / Neutral Switch Input Circuit
Monitor execution	Continuous
Monitor Sequence	None
Monitoring Duration	1 second to register a malfunction.

Motor Slip Control Plausibility Check:	
DTCs	P1637 – CAN Link ECM/ABS Control Module Circuit/Network U1012 – Invalid Internal Control Module Monitoring Data Received from Anti-Lock Brake System (ABS) Control Module
Monitor execution	Continuous
Monitor Sequence	None
Monitoring Duration	1 second to register a malfunction.

COMPREHENSIVE COMPONENT MONITOR - TRANSMISSION

Transmission Inputs

Transmission Range Sensor Check Operation:	
DTCs	P0706 - Out of range signal frequency for PWM TRS P0707, P0708 - Low /High duty cycle for PWM TRS
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	
Monitoring Duration	5 seconds of signal out of range

Typical TRS check entry conditions:		
Auto Transmission Entry Conditions	Minimum	Maximum
battery voltage	7v	18v

Typical TRS malfunction thresholds:
PWM TRS: Frequency > 175 Hz or < 75 Hz, Duty Cycle > 90% or < 10%

Output Shaft Speed Sensor Functional Check Operation:	
DTCs	P0720 – OSS circuit P0722 – OSS no signal
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	TSS, Wheel Speed
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	300 - 650 rpm	
Vehicle speed (if available)	12.5 - 15 mph	

Typical OSS functional check malfunction thresholds:
Circuit/no signal - vehicle is inferred to be moving with positive driving torque and OSS < 100 to 200 rpm for 5 to 30 seconds

Turbine Shaft Speed Sensor Functional Check Operation:	
DTCs	P0715 – TSS circuit P0717 – TSS no signal
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	OSS, Wheel Speed
Monitoring Duration	30 seconds

Typical TSS functional check entry conditions:		
Auto Transmission Entry Conditions	Minimum	Maximum
Gear selector position	Forward range	
Engine rpm (above converter stall speed) OR	3000 rpm	
Output shaft rpm OR	600 - 650 rpm	
Vehicle speed (if available)	12.5 - 15 mph	

Typical TSS functional check malfunction thresholds:
Circuit/no signal - vehicle is inferred to be moving with positive driving torque and TSS < 200 rpm for 5 – 30 seconds

System voltage:	
DTCs	P0882 – voltage out of range low P0883 – voltage out of range high
Monitoring execution	electrical - continuous

Transmission Fluid Temperature Sensor Functional Check Operation:	
DTCs (non-MIL)	P0712, P0713 or P0710 - Opens/shorts P1711 – in range failures P1783 – Transmission over temperature (non-MIL fault, TFT > 275 deg F for 5 seconds)
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 Stuck Low/High 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 – 600 sec	
Time in gear, vehicle moving, positive torque	150 sec	
Vehicle Speed	15 mph	
Time with engine off (cold start) OR	420 min	
Engine Coolant Temp AND Trans Fluid Temp (inferred cold start)		122 ^{o}F

Typical TFT malfunction thresholds:
Opens/shorts: TFT voltage <0.05 or > 4.6 volts for 5 – 12 seconds TFT Stuck low/high, i.e. TFT stuck at high temperature or stuck at low temperature): Stores a fault code if TFT stabilizes (stops increasing if temperature < 70 deg F, stops decreasing if temperature > 225 deg F) before reaching the temperature region where all MIL tests are enabled (70 to 225 deg F). If TFT remains constant (+/- 2 deg F) for approximately 2.5 minutes of vehicle driving outside the 70 to 225 deg F zone a P0711 fault code will be stored. Old logic used to indicate a "pass" for a single delta, and not test until the normal operating region (70-225 deg F) was reached.

CAN:	
DTCs	U0073 – CAN bus off U0100 – Lost communication with ECM
Monitoring execution	Continuous
Monitoring sequence	none

Transmission Outputs

Transmission Solenoid Power Control (TSPC – provides power to all transmission solenoids:	
DTCs	P0657 – TSPC1 fault, impacts SSA, SSC, SSE P2669 – TSPC2 fault, impacts SSB, SSD, TCC and LPC
Monitoring execution	electrical - continuous
Monitor sequence	Disables individual solenoid circuit fault detection if either above DTC sets and power is removed from all solenoids (one relay, removes power from both TSPC1 and TSPC2 wires)

Shift Solenoid Check Operation:	
DTCs	SS A - Electrical: P0750 (Open), P0973 (short to ground), P0974 (short to power) Functional: P0751 (stuck off), P0752 (stuck on) SS B - Electrical: P0755 (Open), P0976 (short to ground), P0977 (short to power) Functional: P0756 (stuck off), P0757 (stuck on) SS C - Electrical: P0760 (Open), P0979 (short to ground), P0980 (short to power) Functional: P0761 (stuck off), P0762 (stuck on) SS D - Electrical: P0765 (Open), P0982 (short to ground), P0983 (short to power) Functional: P0766 (stuck off), P0767 (stuck on) SS E - Electrical: P0770 (Open), P0985 (short to ground), P0986 (short to power) Functional: P0771 (stuck off), P0772 (stuck on)
Monitor execution	electrical - continuous, functional - continuous
Monitor Sequence	None
Sensors OK	TRS, TSS and OSS ok for functional diagnostics
Monitoring Duration	0.5 to 5 seconds for electrical checks, 3 clutch failed to apply (stuck off) or release (stuck on) events for functional check

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 Shift Solenoid malfunction thresholds:
Electrical circuit check: Output driver feedback indicates an open, short to ground or open circuit for 0.5 – 5.0 seconds

Gear Ratio Check Operation:	
DTCs	P0731 - incorrect gear 1 ratio P0732 - incorrect gear 2 ratio P0733 - incorrect gear 3 ratio P0734 - incorrect gear 4 ratio P0735 - incorrect gear 5 ratio P0729 - incorrect gear 6 ratio P0736 - incorrect reverse ratio 6
Monitor execution	Continuous, in each gear
Monitor Sequence	None
Sensors OK	TSS, OSS, wheel speed
Monitoring Duration	12 seconds

Typical Forward Gear Ratio check entry conditions:		
Entry Conditions	Minimum	Maximum
Gear selector position	forward range, > 8 seconds	
Engine Torque	100 NM	
Throttle position	10%	
Not shifting	> 0.5 seconds	
Engine/input Speed	550 rpm	
Output Shaft Speed	250 rpm	1350 rpm

Typical Neutral Gear Ratio check entry conditions:		
Entry Conditions	Minimum	Maximum
Gear selector position	forward range, > 1 second	
Absolute value of Engine rpm – Turbine rpm		150 rpm
Output Shaft Speed		500 rpm

Typical Gear Ratio malfunction thresholds:
Forward gear check: > 20% error in commanded ratio for > 12 seconds

Typical Shift Completion check entry conditions:		
Entry Conditions	Minimum	Maximum
Gear selector position	forward range	
Transmission Fluid Temp	50 °F	
Engine/input Speed	1200 rpm	
Output Shaft Speed	256 rpm	

Typical Shift Completion malfunction thresholds:	
Up-shift rpm check:	rpm does not drop by > 30 rpm
Down-shift rpm check:	rpm does not increase by > 30 rpm
Up-shift rpm check:	rpm increases (flares) by > 300 rpm

Torque Converter Clutch Check Operation:	
DTCs	Electrical: P0740 (open), P0742 (short to ground), P0744 (short to power) Functional: P0741 (stuck off), P2758 (stuck on) Note: P2758 is non-MIL, all other TCC DTC's are MIL
Monitor execution	electrical - continuous, mechanical - TCC fails to apply 3 times (stuck off) or fails to release 3 times (stuck on)
Monitor Sequence	None
Sensors OK	TSS, OSS
Monitoring Duration	Electrical – 5 seconds, Functional - 3 lock-up or release events

Typical TCC mechanical functional check stuck off entry conditions:		
Entry Conditions	Minimum	Maximum
Throttle Position	steady	
Engine Torque	positive drive torque	
Transmission Fluid Temp	70 °F	225 °F
Commanded TCC pressure (0 rpm slip)	55 psi	none
Not shifting		

Typical TCC malfunction thresholds:
Electrical circuit check: Output driver feedback circuit does not match commanded driver state for 0.5 – 5.0 seconds
Mechanical check, stuck off: Slip across torque converter > 100 for 3 seconds after each of 3 lock events
Mechanical check, stuck on: Slip across torque converter < 20 rpm with converter commanded off in at least 3 different gears

Pressure Control Solenoid Check Operation:	
DTCs	P0960, P0962, P0963 - PC A opens/shorts P0961 - PC A current range
Monitor execution	Continuous
Monitor Sequence	none
Sensors OK	
Monitoring Duration	Electrical: 5 seconds,

Typical Pressure Control Solenoid mechanical functional check entry conditions:		
Entry Conditions	Minimum	Maximum
Gear ratio calculated	each gear	
Transmission Fluid Temperature	70 ^{o}F	225 ^{o}F
Throttle Position	positive drive torque	

Typical Pressure Control Solenoid malfunction thresholds:
Electrical circuit check: Output driver feedback circuit does not match commanded driver state for 0.5 – 5.0 seconds
Electrical current check: Feedback current out of range for 0.5 seconds

Transmission Control Module (TCM)

TCM	
DTCs	P0604 – RAM fault present P0605 – ROM fault present P0607 – CPU reset fault P06B8 – NVRAM error
Monitoring execution	Once per driving cycle at start-up except reset monitoring which is continuous
Monitor sequence	non

ADLER (chip that controls the transmission solenoids):	
DTCs	P1636 – lost communication (over internal SPI network) with ADLER chip
Monitoring execution	electrical - continuous
Monitor sequence	Transmission enters mechanical limp home (get P, R, N and 5M with open TCC and max line) if the main micro cannot communicate with the ADLER chip

Transmission ID (TRID) block (contains solenoid characterization data	
DTCs	P163E – programming error (checksum fault) P163F – TRID data not programmed
Monitoring execution	Start-up – TRID is a portion of flash memory, either it is present at start-up or not
Monitor sequence	Transmission solenoid data missing, enters limited operating mode (P, R, N and 3rd gear with open TCC).