SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL type & trips
Intake Camshaft Position Actuator Solenoid Control Circuit Bank 1	**P 0010 Open Circuit** **P 2088 Short to Ground** **P 2089 Short to Battery**	The purpose is to diagnose electrical errors detected by the PWM Driver internal to the ECU on the Oil Control Solenoid actuator circuit	The drive self check the electrical condition to determine the source of electrical failure. If any of the electrical failure is detected an errors flag is set after the failure counter max value is reached Fail time > **16 (1.6 s)** **<u>If this error is set the following actions are taken:</u>** - Cam phasing (VCP function) is set to limp home (function Passive) - Deactivation of "Hardware Based Diagnosis with the CJ120 - Deactivate Generator L & F Terminal Monitor - Disable knock Control - Knock control adaptation (Circuit 1) - Maximum end of Pre-injection angle is used & a calibratable constant for start of injection - Disable fuel quality adaptation at start (start injection time adaptation) - Disable downstream lambda trim control - Disable Plausibility check of WARF Sensors - Disable WARF Sensors diagnosis Heater Coupling - Disable Diagnosis of the WRAF Sensor Dynamic - Disable Monitoring Upstream Sensor Signal - Disable Monitoring Upstream Sensor Signal during pull full cutoff (PUC) - Disable downstream oxygen sensor diagnosis - Disable dynamic fuel trim diagnosis - Disable catalyst efficiency diagnosis	Battery voltage > **11 V** No previous failure on the Oil Control solenoid actuator is present	o	M/2

Intake Camshaft Position System Performance. Bank 1 & 2	**P0011 Bank 1** **P0021 Bank 2**	The purpose of this diagnosis is to detect a difference in the camshaft position relative to the desired position (set point). To ignore temporary differences during the controller adjustment period, there is a calibratible cycle counter that has to expire before the diagnosis is activated. If the controller adjustment and the PWM adaptation cycles have expired and a steady position of the camshaft is the result of the actual engine state, this camshaft difference is integrated. If the integrated difference reaches a max calibrated value the Failure counter is incremented. Also, when the actual position is with in acceptable window another integrator will start and when the value of the reaches the diagnosis initialization value the failure counter is decrement.	Actual Cam position > desired cam position (set point) + allowed tolerance for deviation - **Actual camshaft position > desired position (set point) + 6 ° CKP** Actual Cam position < desired cam position (set point) + allowed tolerance for deviation - **Actual camshaft position < desired position (set point) + 6 ° CKP** The errors flag for intake camshaft is set after the failure counter max value is reached Failure counter > **16 (1.6s)** **<u>If this error is set the following actions are taken:</u>** - Cam phasing (VCP function) is set to limp home (function Passive) - Deactivation of "Hardware Based Diagnosis with the CJ120 - Deactivate Generator L & F Terminal Monitor - Disable knock Control - Knock control adaptation (Circuit 1) - Maximum end of Pre-injection angle is used & a calibratable constant for start of injection - Disable fuel quality adaptation at start (start injection time adaptation) - Disable downstream lambda trim control - Disable Plausibility check of WARF Sensors - Disable WARF Sensors diagnosis Heater Coupling - Disable Diagnosis of the WRAF Sensor Dynamic - Disable Monitoring Upstream Sensor Signal - Disable Monitoring Upstream Sensor Signal during pull full cutoff (PUC) - Disable downstream oxygen sensor diagnosis - Disable dynamic fuel trim diagnosis - Disable catalyst efficiency	- VCP State – enable (the cam phasing function is active – controller is active & set points are calculated) - Min engine speed for steady deviation < engine speed < Max engine speed for steady deviation Table base on oil temp < N RPM < Table based on oil temp - Min oil pressure for steady deviation < actual oil pressure < Max oil pressure for steady deviation 1 Bar < actual oil pressure < 7 bar - PWM adaptation cycle has expired - VCP is not in Limp Home (no failure on VCP electrical or mechanical)	Recurrence Rate: **Every 360° Crank Revolution**	M / 1

			diagnosis Cam phasing (VCP function) is set to limp home (function Passive) until the transition from engine run to engine stop is detected, even if the error is resolved			
Exhaust Camshaft Position Actuator Solenoid Control Circuit Bank 1	**P 2091 Short to Battery** **P 2090 Short to Ground** **P 0013 Open Circuit**	The purpose is to diagnose electrical errors detected by the PWM Driver internal to the ECU on the Oil Control Solenoid actuator circuit	The drive self check the electrical condition to determine the source of electrical failure. If any of the electrical failure is detected an errors flag is set after the failure counter max value is reached Fail time > **16 (1.6s)** **<u>If this error is set the following actions are taken:</u>** - Cam phasing (VCP function) is set to limp home (function Passive) - Deactivation of "Hardware Based Diagnosis with the CJ120 - Deactivate Generator L & F Terminal Monitor - Disable knock Control - Knock control adaptation (Circuit 1) - Maximum end of Pre-injection angle is used & a calibratable constant for start of injection - Disable fuel quality adaptation at start (start injection time adaptation) - Disable downstream lambda trim control - Disable Plausibility check of WARF Sensors - Disable WARF Sensors diagnosis Heater Coupling - Disable Diagnosis of the WRAF Sensor Dynamic - Disable Monitoring Upstream Sensor Signal - Disable Monitoring Upstream Sensor Signal during pull full cutoff (PUC) - Disable downstream oxygen sensor diagnosis - Disable dynamic fuel trim diagnosis - Disable catalyst efficiency diagnosis	Battery voltage > **11 V** No previous failure on the Oil Control solenoid actuator is present	Recurrence Rate: **100 ms**	M/2

Exhaust Camshaft Position System Performance. Bank 1 & 2	**P0014 Bank 1** **P0024 Bank 2**	The goal of this diagnosis is to detect steady deviation of the camshaft position relative to the desired position (set point) by integrating the camshaft deviation at specific conditions. To ignore temporary deviations during the controller adjustment there is a tuneable cycle counter, That has to expire before the diagnosis is activated. If the controller adjustment and the PWM adaptation cycles have expired and a steady position of the camshaft is the result of the actual engine state, this camshaft deviation is integrated. If the integrated deviation reaches a max calibrated value the debounce errors counter is incremented. And If the integrator reach the value of the diagnosis initialization value the errors counter is decrement.	Actual Cam position > desired cam position (set point) + allowed tolerance for deviation - **Actual camshaft position > desired position (set point) + 6 ° CKP** Actual Cam position < desired cam position (set point) + allowed tolerance for deviation - **Actual camshaft position < desired position (set point) +6 ° CKP** The errors flag for intake camshaft is set after the failure counter max value is reached Fail time> **16 1.6s)** **<u>If this error is set the following actions are taken:</u>** - Cam phasing (VCP function) is set to limp home (function Passive) - Deactivation of "Hardware Based Diagnosis with the CJ120 - Deactivate Generator L & F Terminal Monitor - Disable knock Control - Knock control adaptation (Circuit 1) - Maximum end of Pre-injection angle is used & a calibratable constant for start of injection - Disable fuel quality adaptation at start (start injection time adaptation) - Disable downstream lambda trim control - Disable Plausibility check of WARF Sensors - Disable WARF Sensors diagnosis Heater Coupling - Disable Diagnosis of the WRAF Sensor Dynamic - Disable Monitoring Upstream Sensor Signal - Disable Monitoring Upstream Sensor Signal during pull full cutoff (PUC) - Disable downstream oxygen sensor diagnosis - Disable dynamic fuel trim diagnosis - Disable catalyst efficiency diagnosis	- VCP State – enable (the cam phasing function is active – controller is active & set points are calculated) - Min engine speed for steady deviation < engine speed < Max engine speed for steady deviation Table base on oil temp < N RPM < Table based on oil temp - Min oil pressure for steady deviation < actual oil pressure < Max oil pressure for steady deviation 1 Bar < actual oil pressure < 7 bar - PWM adaptation cycle has expired - VCP is not in Limp Home (no failure on VCP electrical or mechanical)	Recurrence Rate: **360° CKP**	M/2

			Cam phasing (VCP function) is set to limp home (function Passive) until the transition from engine run to engine stop is detected, even if the error is resolved.			
Intake Cam /Crank Correlation Bank 1 & 2	**P0016 Bank 1** **P0018 Bank 2**	The goal of this diagnosis is to detect if the actual CAM edge change lies in the permissible expected range. A hysteresis range is set around the expected CKP position in which the errors free CAM edge change is expected. If a Cam edge change does not occur in this CKP range then an errors is detected. This diagnosis is done on two reference edges (180° CKP apart) which are defined in the SW, (the edges are correlated to the max opening of the intake camshaft lift curve/design edge) The design reference Cam position is also defined in the SW.	VCP State Ready (cam phasing function is in a ready state after all activation condition are fulfilled) or Adaptation (in this state the mechanical edges are learned relative to design edges) **Actual camshaft position > deign camshaft position + Mechanical tolerance** Actual camshaft position > 133° CKP + 12° CKP **Actual camshaft position < deign camshaft position - Mechanical tolerance** Actual camshaft position < 133° CKP – 12° CKP VCP State enable (the cam phasing function is active – controller is active & setpoints are calculated) **Actual camshaft position > Deign reference camshaft position – Max adjustable phase range – tolerance for desired camshaft position (set point) around home position** Actual camshaft position > 133° CKP – 40° CKP - 3° CKP **Actual camshaft position < deign camshaft position + tolerance for desired camshaft position (set point) around home position** Actual camshaft position > 133° CKP + 3° CKP The errors flag for Exhaust Cam /Crank Correlation is set after the Fail timeMax Value is reached Fail time> **36 (3.6 sec)** **<u>If this error is set the following actions are taken:</u>** - Cam phasing (VCP function) is set to limp home (function Passive) - Deactivation of “Hardware Based Diagnosis with the CJ120 - Deactivate Generator L & F Terminal	- Battery voltage ≥ **11 V** - VCP is not in Limp Home (no failure on VCP electrical or mechanical) - The EOL/Service Tool request for VCP Mechanical check is Passive At ECM reset & transition from engine run to stop: The errors flag is cleared	Recurrence Rate: **100 ms**	M/2

			Monitor - Disable knock Control - Knock control adaptation (Circuit 1) - Maximum end of Pre-injection angle is used & a calibratable constant for start of injection - Disable fuel quality adaptation at start (start injection time adaptation) - Disable downstream lambda trim control - Disable Plausibility check of WARF Sensors - Disable WARF Sensors diagnosis Heater Coupling - Disable Diagnosis of the WRAF Sensor Dynamic - Disable Monitoring Upstream Sensor Signal - Disable Monitoring Upstream Sensor Signal during pull full cutoff (PUC) - Disable downstream oxygen sensor diagnosis - Disable dynamic fuel trim diagnosis - Disable catalyst efficiency diagnosis Cam phasing (VCP function) is set to limp home (function Passive) until the transition from engine run to engine stop is detected, even if the error is resolved			
Exhaust Cam /Crank Correlation Bank 1 & 2	**P0017 Bank 1** **P0019 Bank 2**	The goal of this diagnosis is to detect if the actual CAM edge change lies in the permissible expected range. A hysteresis range is set around the expected CKP position in which the errors free CAM edge change is expected. If a Cam edge change does not occur in this CKP range then an errors is detected. This diagnosis is done on two reference edges (180° CKP apart) which are defined in the SW, (the edges are correlated to the max opening of the intake camshaft lift curve/design edge) The design reference Cam position is also defined in the SW.	VCP State Ready (cam phasing function is in a ready state after all activation condition are fulfilled) or Adaptation ((in this state the mechanical edges are learned relative to design edges) **Actual camshaft position > deign camshaft position + Mechanical tolerance** Actual camshaft position > -117° CKP + 12° CKP **Actual camshaft position < deign camshaft position - Mechanical tolerance** Actual camshaft position < -117° CKP – 12° CKP VCP State enable (the cam phasing function is active – controller is active & setpoints are calculated) **Actual camshaft position > Deign**	**The following conditions are fulfilled:** - Battery voltage ≥ **11 V** - VCP is not in Limp Home (no failure on VCP electrical or mechanical) - The EOL/Service Tool request for VCP Mechanical check is Passive At ECM reset & transition from engine run to stop: The errors flag is cleared	Recurrence Rate: **100 ms**	M/2

			reference camshaft position + Max adjustable phase range + tolerance for desired camshaft position (set point) around home position Actual camshaft position > -117° CKP + 50° CKP + 3° CKP **Actual camshaft position < deign camshaft position - tolerance for desired camshaft position (set point) around home position** Actual camshaft position > -117° CKP – 3° CKP The errors flag for Exhaust Cam /Crank Correlation is set after the Fail time Max Value is reached **Fail time > 36 (3.6 sec)** **<u>If this error is set the following actions are taken:</u>** - Cam phasing (VCP function) is set to limp home (function Passive) - Deactivation of "Hardware Based Diagnosis with the CJ120 - Deactivate Generator L & F Terminal Monitor - Disable knock Control - Knock control adaptation (Circuit 1) - Maximum end of Pre-injection angle is used & a calibratable constant for start of injection - Disable fuel quality adaptation at start (start injection time adaptation) - Disable downstream lambda trim control - Disable Plausibility check of WARF Sensors - Disable WARF Sensors diagnosis Heater Coupling - Disable Diagnosis of the WRAF Sensor Dynamic - Disable Monitoring Upstream Sensor Signal - Disable Monitoring Upstream Sensor Signal during pull full cutoff (PUC) - Disable downstream oxygen sensor diagnosis - Disable dynamic fuel trim diagnosis - Disable catalyst efficiency diagnosis Cam phasing (VCP function) is set to limp home (function Passive) until the transition from engine run to engine stop			

			is detected, even if the error is resolved			

Intake Camshaft Position Actuator Solenoid Control Circuit Bank 2	**P 2093 Short to Battery** **P 2092 Short to Ground** **P 0020 Open Circuit**	The purpose is to diagnose electrical errors detected by the hardware on the actuator Solenoid circuit	The drive self check the electrical condition to determine the source of electrical failure. If any of the electrical failure is detected an errors flag is set after the Fail time max value is reached Fail time> **16 (1.6s)** **<u>If this error is set the following actions are taken:</u>** - Cam phasing (VCP function) is set to limp home (function Passive) - Deactivation of "Hardware Based Diagnosis with the CJ120 - Deactivate Generator L & F Terminal Monitor - Disable knock Control - Knock control adaptation (Circuit 1) - Maximum end of Pre-injection angle is used & a calibratable constant for start of injection - Disable fuel quality adaptation at start (start injection time adaptation) - Disable downstream lambda trim control - Disable Plausibility check of WARF Sensors - Disable WARF Sensors diagnosis Heater Coupling - Disable Diagnosis of the WRAF Sensor Dynamic - Disable Monitoring Upstream Sensor Signal - Disable Monitoring Upstream Sensor Signal during pull full cutoff (PUC) - Disable downstream oxygen sensor diagnosis - Disable dynamic fuel trim diagnosis - Disable catalyst efficiency diagnosis	Battery voltage > **11 V** No previous failure on the Oil Control solenoid actuator is present	Recurrence Rate: **100 ms**	M/2
Exhaust Camshaft Position Actuator Solenoid Control Circuit Bank 1	**P 2095 Short to Battery** **P 2094 Short to Ground** **P 0023 Open Circuit**	The purpose is to diagnose electrical errors detected by the hardware on the actuator Solenoid circuit	The drive self check the electrical condition to determine the source of electrical failure. If any of the electrical failure is detected an errors flag is set after the Fail time max value is reached Fail time> **16 (1.6s)** **<u>If this error is set the following actions are taken:</u>** - Cam phasing (VCP function) is set to	Battery voltage > **11 V** No previous failure on the Oil Control solenoid actuator is present	Recurrence Rate: **100 ms**	M/2

			limp home (function Passive) - Deactivation of "Hardware Based Diagnosis with the CJ120 - Deactivate Generator L & F Terminal Monitor - Disable knock Control - Knock control adaptation (Circuit 1) - Maximum end of Pre-injection angle is used & a calibratable constant for start of injection - Disable fuel quality adaptation at start (start injection time adaptation) - Disable downstream lambda trim control - Disable Plausibility check of WARF Sensors - Disable WARF Sensors diagnosis Heater Coupling - Disable Diagnosis of the WRAF Sensor Dynamic - Disable Monitoring Upstream Sensor Signal - Disable Monitoring Upstream Sensor Signal during pull full cutoff (PUC) - Disable downstream oxygen sensor diagnosis - Disable dynamic fuel trim diagnosis - Disable catalyst efficiency diagnosis			
Mass Air Flow (MAF) Sensor Performance	**P0101**	When the LOAD/TPS error occurs (P1101). The intake manifold model switch from adapting the model under MAF sensor to the MAP sensor and the plausibility is checked by comparing the excitation of the controller (reduced area & pressure with the corresponding "basic" value (Throttle reduce area if area controlled, ambient pressure if pressure controlled). The MAF sensor is determined implausible by comparing the controller excitation when the model was adapted to MAF sensor and MAP sensor If the delta excitation of reduced area or Ambient controller under MAF & Map is greater than a threshold and the reduced area controller or	**All three condition have to be meet for the MAF sensor to be implausibly:** **A.** Plausibility check throttle reduced area controller excitation - The delta of the reduced area excitation under MAF & MAP is greater than the calibrable threshold: delta of the reduced area excitation **> 14 %** - the reduced area excitation under MAP sensor control does not exceed the max or min calibratable threshold: reduced area excitation under MAP < **25%** reduced area excitation under MAP > **-25%** **B.** Plausibility check ambient Pressure controller excitation - The delta of the ambient pressure controller excitation under MAF &	- Drive cycle has started - The load/TP rationality check was complete - No pervious faulty exists on the MAF, MAP or TPS Plausibility performance - pressure ration (MAP/ambient) - **< 0.99** - The lambda sensors are active - Settling time for the switching from MAF to MAP > **7250 ms**	Recurrence Rate: 25 ms	M/2

		Ambient pressure controller excitation under the Map control do not exceed a calibratbale threshold in combination with the lambda excitation for both bank is lower than a calibratable limit then the MAF sensor is consider implausible	MAP is greater than the calibrable threshold: delta of the ambient pressure controller **> 124 hpa** - the ambient pressure controller under MAP sensor control does not exceed the max or min calibratable threshold: reduced area excitation under **MAP > -250 hpa** reduced area excitation under **MAP < 250 hpa** **C.** The lambda controller excitation under MAP controller does not exceed the calibratable threshold: - bank 1 & 2 Lambda controller excitation under MAP control > **-25%** - bank 1 & 2 Lambda controller excitation under MAP control < **25%** The MAF sensor performance errors flag is set after the errors counter reaches max value Fail time> **16 (400ms)**			
Mass Air Flow (MAF) Sensor Circuit	**P0102 Low Frequency** **P0103 High Frequency**	The purpose of the diagnosis shall be to detect electrical faults in the frequency sensor HFM, The diagnosis will run only when the engine is running (HFM diagnosis).	Low frequency MAF Frequency for Diagnoses < **50 Hz** Frequency is lower than 200 Hz Low frequency flag = 1 after debounce Fail time> **16 (200ms)** High Frequency MAF Frequency for Diagnoses > **12425 Hz** Frequency is higher than 20000 kHz high frequency errors flag = 1 after debounce MAF Frequency for Diagnoses > **520 Kg/h** MAF Frequency for Diagnoses < **1 Kg/h** Sensor has exceed the diagnostic threshold the MAF DTC's are stored if any of the condition are fulfilled Fail time >**16 (200ms)**	Engine running - Ignition Key "ON" Eng "ON" - Rpm > **544 rpm**	Recurrence Rate: 12.5 ms	M / 2

Throttle Body Performance	**P1101**	The load/TP plausibility check proofs the consistency between load and throttle position. The plausibility is checked by comparing the excitation of the controller (reduced area & pressure with the corresponding "basic" value (Throttle reduce area if area controlled, ambient pressure if pressure controlled). In addition, the throttle reduce area adaptation values are checked separately. This is necessary, because at closed throttle small absolute values (e.g. due to leakage air adaptation) may result in large relative values that pretend a bad system. If the current load and throttle position signals are not consistent (implausible) a flag is set, that indicates problems in the plausibility check If the controller excitation (or area adaptation value) is above a calibratable threshold, The unplausibility detected only states, that the actual load and throttle position do not fit together and therefore a large controller excitation is required to bring them into line.	Plausibility check throttle reduced area adaptation values (The additive and multiplicative adaptation values of the reduced area are checked separately. If one of them exceeds the corresponding threshold, a related errors flag is set, if the value is inside the thresholds the respective flag is reset. Because adaptation is done with a slow Recurrence Rate, no filtering of the adaptation values is required and they are directly used) - Throttle reduced area controller additive < -**0.15 cm ^2** - Throttle reduced area controller additive > **0.17 cm ^2** Plausibility check throttle reduced area controller excitation (In the plausibility check only the steady state conditions are of interest. Therefore, the controller excitations of the reduced area controller is smoothed with a low pass filter. This controller output is only calculated as long as the corresponding controller is active. If the plausibility check is deactivated the calculation of the moving mean value from the reduced area controller output is stopped (but not reset). Depending on several input variables the threshold for the controller excitation is selected. If e.g. the ECT-sensor goes bad, the threshold for plausibility errors detection can be chosen higher, so that more controller excitation is allowed. If the filtered reduced area controller excitation reaches a certain thresholds the plausibility check errors is set to active). - Filtered reduced area controller < -**25%** - filtered reduced area controller > **24%** if a coolant or intake air temperature sensor failure occurs the threshold will become: - Filtered reduced area controller < **-27%** - Filtered reduced area controller > **26%**	Drive cycle has started No errors currently exist on the throttle or load. Diagnoses in not disabled **RPM > 544 < 6400** **(MAP/ambient) > 0.2 < 0.99g**	Recurrence Rate: 25 ms	M/2

			Plausibility check pressure controller excitation ((In the plausibility check only the steady state conditions are of interest. Therefore, the controller excitations of the reduced area controller is smoothed with a low pass filter. This controller output is only calculated as long as the corresponding controller is active. If the plausibility check is deactivated the calculation of the moving mean value from the reduced area controller output is stopped (but not reset). Depending on several input variables the threshold for the controller excitation is selected. If e.g. the ECT-sensor goes bad, the threshold for plausibility errors detection can be chosen higher, so that more controller excitation is allowed. If the ratio of the filtered pressure controller excitation and the (adapted) ambient pressure reaches a certain threshold, the plausibility check errors is set to active. - filtered pressure controller excitation < **-24%** - filtered pressure controller excitation > **24%** if a coolant or intake air temperature sensor failure occurs the threshold will become: - Filtered reduced area controller < **-27%** - Filtered reduced area controller > **27%** if any of the above condition are fulfilled then the TP/Load plausibility errors flag is set after Fail time max value is reached Fail time> **100 (2.5s)** **<u>If this diagnostic is present the following are disabled</u>** The intake model adaptive & excitation are rested and the model is calculating the load in pre-control (open loop no close feedback signal is used from the sensors). Only the throttle signal is used.			

Throttle Body Performance	**P0068**	When the LOAD/TPS error occurs (P1101). The intake manifold model switch from adapting the model under MAF sensor to the MAP sensor and the plausibility is checked by comparing the excitation of the controller (reduced area & pressure with the corresponding "basic" value (Throttle reduce area if area controlled, ambient pressure if pressure controlled). The TPS is determined implausible (Restriction or leak in the air path) by comparing the controller excitation when the model was adapted to MAF sensor and MAP sensor If the delta excitation of reduced area or Ambient controller under MAF & Map is less than a threshold and the reduced area controller or Ambient pressure controller excitation under the Map control do exceed a calibratbale threshold in combination with the lambda excitation for both bank is greater than a calibratable limit then the TPS is determined implausible (Restriction or leak in the air path) is consider implausible	**All three condition have to be meet for the MAF sensor to be implausibly:** **A.** Plausibility check throttle reduced area controller excitation - The delta of the reduced area excitation under MAF & MAP is less than the calibrable threshold: delta of the reduced area excitation < **14 %** - the reduced area excitation under MAP sensor control do exceed the max or min calibratable threshold: reduced area excitation under MAP > **25%** reduced area excitation under MAP < **-25%** **B.** Plausibility check ambient Pressure controller excitation - The delta of the ambient pressure controller excitation under MAF & MAP is less than the calibrable threshold: delta of the ambient pressure controller < **124 hpa** - the ambient pressure controller under MAP sensor control do exceed the max or min calibratable threshold: reduced area excitation under MAP < **-250 hpa** reduced area excitation under MAP > **250 hpa** **C.** The lambda controller excitation under MAP controller do exceed the calibratable threshold: - bank 1 & 2 Lambda controller excitation under MAP control < **- 25%** - bank 1 & 2 Lambda controller excitation under MAP control > **25%** The TPS is determined implausible (Restriction or leak in the air path) throttle performance errors flag is set after the errors counter reaches max value Fail time> **16 (400ms)**	- Drive cycle has started - The load/TP rationality check was complete - No pervious faulty exists on the MAF, MAP or TPS Plausibility performance - pressure ration (MAP/ambient) < **.99** - The lambda sensors are active - Settling time for the switching from MAF to MAP > **7250 ms**	Recurrence Rate: 25 ms	M/1

Manifold Absolute Pressure (MAP) Sensor Performance	**P0106**	When the LOAD/TPS error occurs (P1101). The intake manifold model switch from adapting the model under MAF sensor to the MAP sensor and the plausibility is checked by comparing the excitation of the controller (reduced area & pressure with the corresponding "basic" value (Throttle reduce area if area controlled, ambient pressure if pressure controlled). The MAP sensor is determined implausible by comparing the controller excitation when the model was adapted to MAF sensor and MAP sensor If the delta excitation of reduced area or Ambient controller under MAF & Map is greater than a threshold and the reduced area controller or Ambient pressure controller excitation under the Map control do exceed a calibratbale threshold in combination with the lambda excitation for both bank is greater than a calibratable limit then the MAP sensor is consider implausible	**All three condition have to be meet for the MAF sensor to be implausibly:** **A.** Plausibility check throttle reduced area controller excitation - The delta of the reduced area excitation under MAF & MAP is greater than the calibrable threshold: delta of the reduced area excitation > **14 %** - the reduced area excitation under MAP sensor control does not exceed the max or min calibratable threshold: reduced area excitation under MAP < **25%** reduced area excitation under MAP > **-25%** **B.** Plausibility check ambient Pressure controller excitation - The delta of the ambient pressure controller excitation under MAF & MAP is greater than the calibrable threshold: delta of the ambient pressure controller > **124 hpa** - the ambient pressure controller under MAP sensor control does not exceed the max or min calibratable threshold: reduced area excitation under MAP > **-250 hpa** reduced area excitation under MAP < **250 hpa** **C.** The lambda controller excitation under MAP controller do exceed the calibratable threshold: - bank 1 & 2 Lambda controller excitation under MAP control > **-25%** - bank 1 & 2 Lambda controller excitation under MAP control > **25%** The MAP sensor performance errors flag is set after the errors counter reaches max value Fail time> **16 (400ms)**	- Drive cycle has started - The load/TP rationality check was complete - No pervious faulty exists on the MAF, MAP or TPS Plausibility performance - pressure ration (MAP/ambient) < **0.99** - The lambda sensors are active - Settling time for the switching from MAF to MAP > **7250 ms**	Recurrence Rate: 25 ms	M/2

Manifold Absolute Pressure (MAP) Sensor Performance (Stuck Signal)	**P0106**	**The purpose of this function is to detect a stuck (non-fluctuating MAP sensor) as quickly as possible after start.** This is required for Load/TPS Plausibility robustness, since a stuck MAP sensor could cause Load/TPS Plausibility errors due to initialization of the Ambient pressure with the MAP sensor value during cranking. **To detect a stuck MAP sensor:** the MAP reading during engine off is determined and compared to a MAP reading after start. Typically a decrease in pressure should be seen. To protect against false readings if the driver has his foot on the pedal, or is requesting maximum torque, the modeled MAP value is also compared with the measured value – if there is a large difference and the MAP sensor reading did not change significantly during start then the error is set.	The MAP sensor first reading is measured at key on, the engine is not running - engine is not running - First reading at key on = measured MAP value The MAP sensor second reading is measured after engine has being to run and a calibratable timer has expired - engine is running - time after start **> 700 ms** - second reading at key on = measured MAP value **all the following condition must be meet** **A.** Delta between first MAP reading and second MAP reading is less than a calibratable threshold delta between two readings **< 200 hpa** **B.** absolute delta between measure and modeled MAP values is less than a calibratable threshold Abs delta between MAP modeled & MAP measured **> 150 hpa** **C.** the first MAP reading at engine stopped and key on is less than the min allowable ambient value First MAP reading **< 600 hpa** The MAP sensor performance errors flag is set after the errors counter reaches max value Fail time> **16 (400ms)**	This function will only run once per trip No pervious faulty exists on the MAP electrical	125ms	M/2
Manifold Absolute Pressure (MAP) Sensor Performance	**P0106**	**The purpose of this function is to detect a MAP sensor that has a shifted characteristic due to external influences that is not detected by electrical or stuck tests.** This test is performed by comparing the measured MAP value to the modeled MAP value when MAF sensor is used to adapt the delta between modeled and actual	Determining weather the measured MAP value must be consistently either higher or lower than the modeled value - Ratio of measured MAP/ Modeled **MAP > 1.2** Measured MAP is considered higher than modeled - Ratio of measured MAP/ Modeled **MAP < 0.8** Measured MAP is considered lower than modeled Determining the engine speed and load window for detecting an implausible MAP	No pervious faulty exists on the MAP performance MAF sensor is used to adapt the delta between modeled and actual airflow	125ms	M/2

		airflow. To become implausible, the measured MAP value must be consistently either higher or lower than the modeled value in a range of speeds and loads.	sensor (there are four windows for detection) Window one is active if: - pressure ration (MAP/ambient) - < **0.57** - engine speed **< 2000 RPM** Window two is active if: - pressure ration (MAP/ambient) - < **0.57** - engine speed **> 2000 RPM** Window three is active if: - pressure ration (MAP/ambient) - > **0.57** - engine speed **< 2000 RPM** Window four is active if: - pressure ration (MAP/ambient) - > **0.57** - engine speed **> 2000 RPM** Measured MAP must be consistently either higher or lower than the modeled value in each window for a period **> 3.1** sec The MAP sensor performance errors flag is set after the errors counter reaches max value Fail time>**16 (400ms)**			
Manifold Absolute Pressure (MAP) Sensor Circuit	**P0107 Low Voltage** **P0108 High Voltage**	The purpose is to diagnose the mean value of the analog input signal circuit or the MAP sensor to the micro-controller for SCG, SCVB, and OL.	High voltage/Open Line Filtered MAP < .11v MAP Volts > **4.9V** DTC = Active P0108 Low voltage Filtered MAP < .11v MAP Volts < **.08V** DTC = Active P0107 Fail time > **16 (400ms)**	Ignition Key “ON” Eng “OFF” or “ON” This Diagnostic will be inhibited if any of the following are stored: Map DTC’s	Recurrence Rate; Every 90° of Crank	M / 2
Intake Air temperature (IAT) Sensor Circuit	**P0112 Low Voltage** **P0113 High Voltage**	The purpose of this diagnostic is to detect a SCG, SCVB, or OL in the intake air temperature sensor or it’s circuit.	Low Voltage Engine run time > **120s** IAT Voltage < **.04V** DTC = Active P0112 High voltage / Open Line Engine run time > **120s** IAT Voltage > **4.9V** DTC = Active P0113 Fail time > **800ms**	Ign Key “ON” Eng “ON” Engine Metal Overtemp Protection (EMOP) = Not Active	Recurrence Rate: 100 msec	M / 2

Intake Air temperature (IAT) Sensor Circuit Intermittent	**P1111 Intermittent high** **P1112 Intermittent low**	The purpose is to diagnose an intermittent failure detected on IAT sensor, a specific Fail timeis used in this case. Target is to avoid sudden calculation transition in any function based on IAT temperature	High voltage / Open Line IAT Voltage > **4.9V** DTC = Active P1111 Low Voltage IAT Voltage < **.04V** DTC = Active P1112 Fail time > **10s**	**Enable conditions:** • Ignition Key "ON" • Engine running • Engine run time > **120s** • IAT fault not active • EMOP not active **Disable conditions:** • EMOP active	Recurrence Rate: 100 msec	N / 1
Engine Coolant Sensor Performance	**P0116**	This Diagnostic Detects a Stuck ECT sensor signal. An ECT model is used to determine the expected rate of change in the ECT sensor. Once a calibratable delta between ECT model minimum value and ECT model maximum value is reached the decision portion of the diagnostic is entered. If the delta between ECT minimum value and ECT maximum value is less than a calibratable table value the sensor is concidered stuck. Note- Completes before end of 18th cycle of **10°** C FTP.	ECT – ECT at Start < Table value (1.5° C) P0116 = Active If this error is detected then the ECT model temp is used. The error will latch for this drive cycle.	**Enable conditions:** • Ignition Key "ON" • Engine running **Disable conditions:** • ECT faults • EMOP active	Recurrence Rate 1 sec	M \ 2

Engine Coolant Temperature Sensor Electrical Diagnosis (ECT)	**P 0117**
	P 0118
		This Diagnosis is to detect an Electrical malfunction, Short circuit to VB, SCG, OL.	• ECT Volts < .06V
			• Fail Time. > 1.6s
			• P 0117 = Active (SCG)
			• ECT Volts > 4.9V
			• Inlet Air Temp. ≥ -7°C
			• Eng Run Time ≥ 120s
			• Fail Time. > 1.6s
			• P 0118 = Active
				• Short circuit to ground Diagnosis
				• IGN = ON
				• EMOP = Not Active
				  • Short circuit to VB or OL Diagnosis
				• IGN = ON
				  • EMOP = Not Active
					Recurrence Rate: 100 ms	M / 2

Engine Coolant Temperature (ECT) Insufficient for Closed Loop Fuel Control	**P 0125**	Detects if ECT has reached sufficient temperature to allow closed loop fuel using an ECT model vs. measured ECT.	ECT < Table used for Lamda Sensor Closed Loop operation P0125 = Active If this error is detected then the ECT model temp is used. The error will latch for this drive cycle (until power latch occurs).	Disable conditions: • Inlet air temp < -8.25c • Inlet air temp sensor fault • ECT fault • MAF sensor fault • MAF/TP sensor plausibility fault Enable conditions: • Engine running time ≥ Table based **(120 seconds)** • **idle time < 100%** • **fuel cut off time < 100%**	Recurrence Rate: 1 s Currently the normal time to closed loop is 15 seconds. Closed loop is forced after 120 seconds.	M \ 2

Engine Coolant Temperature (ECT) Below Thermostat Regulating Temperature	**P 0128**	Detects a stuck open thermostat, using an ECT model vs. measured ECT.	ECT has not been greater than 73.5°C for 10 seconds OR ECT < **62.25°** C (for catylyst diagnostic enable temperature) and ECT < **62.25°** C (for lamda sensor diagnostic enable temperature)	Disable conditions: • ECT fault • Time to close loop fault • MAF sensor fault • **IAT sensor fault** • MAF/TP sensor plausibility fault • **ECT @ start < -45° C** • ECT @ start > 42° C • **IAT < -9.75° C at engine start** Enable conditions: • ECT model > 90° C • idle time < 95% • fuel cutoff time < 50% • **IAT > -9.75° C**	Recurrence Rate: 500ms Run time varies with the ECT at start. Completes before end of 18th cycle of **10° C** FTP.)	M \ 2
Engine Coolant Sensor Signal Voltage	**P 1114** **P 1115**	This diagnostic will detect an intermittent short to ground or intermittent short to battery voltage / open	• ECT Volts **< .04V** • Fail Time. **> 1.6s** • P 1114 = Active (INT SCG) • ECT Volts **> 4.9V** • Fail Time. **> 1.6s** • P 1115 = Active	• INT Short circuit to ground Diagnosis • IGN = ON • EMOP = Not Active • INT Short circuit to VB or OL Diagnosis • IGN = ON • EMOP = Not Active	Recurrence Rate: 100mS	N / 1
Throttle Position Sensor # 1 Electrical Diagnosis (TP)	**(TP 1)** **Low Volts** **P 0122** **(TP 2)** **High Volts** **P 0123**	This Diagnosis is to detect an Electrical malfunction, Short circuit to VB, SCG, OL.	**TP Volts < .098** Fail Time. = **12 (300ms)** P 0122 = Active (SCG) TP Volts **> 4.89** Fail Time. = **12 (300ms)** P 0123 = Active (SCVB / OL)	Disable Conditions: Ignition Key "ON" - TP DTC's - Limp home active Enable Conditions: Ignition Key "ON"	25 ms	M \ 1
Throttle Position Sensor # 1 Electrical Diagnosis (TP)	**(TP 2)** **Low Volts** **P 0222** **(TP 2)** **High Volts** **P 0223**	The potentiometer voltage for channel 2 must be within the admissible limits. This DTC can distinguish the circuit's low & High Voltage.	**TP Volts < 0.4643 V** Fail timemax = **12 (300ms)** P222 = Active Limp home – RPM limitation **(992 rpm)** TP Volts **> 4.8436 V** Fail timemax = **12 (300ms)** P223 = Active Limp home – RPM limitation **(992 rpm)**	Activation: IGN =1. The error bits, Failure-counters and other variables or bits are initialised Deactivation: IGN =0 or the setting conditions are not fulfilled anymore - TP DTC's - Limp home active	25 ms	M \ 1

Wide Range Air Fuel Sensor # 1 Electrical Diagnosis (B1S1)	**P0131 SCG** **P0132 SCVB** **P167A IC-Source Low**	This Diagnostic is intended to detect a SCG, SCVB, or Open in the signal line or in the WRAF sensor. The Electrical Diagnosis is performed internally through the ECM (BSW) by the CJ120 Register.	If the CJ120 detects an, SCG, or SCVB. Or IC-Source Low Voltage AND Fail time> 100 (500 ms) (inc @ 2) Related P-Codes = Active	<u>This diagnostic is inhibited if any of the following DTC's are present:</u> HO2S <u>Enable Conditions</u> IGN = ON Diagnosis = Active	Recurrence Rate: 10 ms	M / 2
HO2S Slow Response Bank 1 & 2 Sensor 1	**(Bank 1) P0133** **(Bank 2) P0153**	This diagnosis observes the amplitude of the Lambda sensor in response to forced lambda stimulation. The sensor value is compared to a Lambda sensor model and a filtered ratio is generated. This value is filtered by a gain table that is used to standardize the amplitude portion with respect to engine speed and load. The integral of all cycles during the test is then compared to a single threshold to determine the response of the sensor signal. By observing the amplitude of the sensor signal during a given forced stimulation period, the response time of the sensor can be determined. A sensor with slow response time will not achieve the modeled amplitude during a forced stimulation period.	1.) A dynamic parameter of the sensor is calculated by dividing the period of the lambda air/fuel ratio switching characteristic by a multiplication of the amplitude of the lambda by the difference between the lambda set point that includes the period, amplitude and the basic lambda set-point 2.) The value of this dynamic parameter is multiplied by a gain value that is used to standardize the amplitude portion with respect to engine speed and load and added to an integrated value of the dynamic parameter. 3.) This function is equipped with a counter that counts the number of single calculations. Once the minimum number of calculations 15 cyc. is exceeded another calculation is made. This calculation divides the integrated dynamic sensor parameter value by the counter value. This calculation gives the characteristic value of the sensor dynamics. The characteristic value of the sensor dynamic is then compared to the limited diagnosis value for error diagnosis. If Sensor Dynamic Total < .2 P0133 = Active P0153 = Active	Enable conditions HO2S Ready (Lambda Sensor Closed Loop) Lambda forced stimulation active Baro ≥ 740hPa Rpm > 1216 < **3000** MAF > 170 < 400mgstk Catalyst diagnosis active. Catalyst diagnostic generates the forced stimulation used to diagnose the Catalyst OSC and HO2S Response Time simultaneously. <u>This diagnostic is inhibited if any of the following DTC's are present:</u> CKP Sensors CMP Sensors MAF Sensors MAP Sensors Injectors DTC's Ignition Coil DTC's HO2S DTC's Limp home Safety (ETC) EVAP / CPS DTC's TP DTC's ECT DTC's Misfire DTC's	Recurrence Rate: 10 ms During low engine speed and load conditions a longer forced stimulation period is required to assure correct diagnosis. The longest period used is 1.24 seconds. This value is multiplied by 15 cycles to determine the worst case test time. The result is 18.6 seconds. Under most operating conditions the test will complete in one continuos test. However, if the test is interrupted, test results for previous cycles are stored. This means the 15 cycles do not have to be consecutive in order to complete the diagnostic. They must all be within the same key cycle.	M \ 2
HO2S Heater Electrical Circuit Bank 1 Sensor 1 **HO2S Heater Electrical Circuit Bank 2 Sensor 1**	**P 0030 OC** **P 0031 SCG** **P 0032 SCB** **P0050 OC** **P0051 SCG** **P0052 SCB**	The purpose of the diagnostic is intended to detect electrical faults within the oxygen sensor Heater Circuit. This diagnostic takes into consideration the following electrical faults based the heater drivers	**If:** SCB Diagnosis = Enabled PWM signal **≥ 0.39**% DTC = Active P0032 / P0052 **Or if**: Exhaust temp. ≥ 400°C	**<u>Enable Conditions:</u>** IGN =" ON", Eng = "ON" **Batt volts > 10** Diagnostic = Enabled **<u>This diagnostic is inhibited if any of the following DTC's are present:</u>**	Recurrence rate 1 s	M \ 2

		ATM38. Short to B+ by Over-temperature or Overcurrent. Short to ground and Open-line. The heater driver is capable of detecting OL and SCB when in the "ON" State and will detect the SCG only when in the "OFF" state. The heater power is controlled by a PWM signal, the driver will be placed alternately in an "ON" and then "OFF" state.	DTC = Active P0032 / P0052 **If:** SCG Diagnosis = Enabled PWM signal ≤ **99.6**% DTC = Active P0031/ P0051 **If:** OL Diagnosis = Enabled PWM signal ≥ **0.39**% DTC = Active P0030 / P0050	VB DTC's		
HO2S Heater Electrical Circuit Bank 1 Sensor 2 **H02S Heater Electrical Circuit Bank 2 Sensor 2**	**P 0036 OC** **P 0037 SCG** **P 0038 SCB** **P0056 OC** **P0057 SCG** **P0058 SCB**	The purpose of the diagnostic is intended to detect electrical faults within the oxygen sensor Heater Circuit. This diagnostic takes into consideration the following electrical faults based the heater drivers. Short to B+, Short to ground and Open-line. The heater driver is capable of detecting OL and SCB when in the "ON" State and will detect the SCG only when in the "OFF" state. The heater power is controlled by a PWM signal, the driver will be placed alternately in an "ON" and then "OFF" state.	If: SCB Diagnostic Flag = Enabled PWM signal > 0% < 99% Heater state ≠ Preheating DTC = Active Or: Cat Temp ≥ 400 C DTC = Active If: SCG Diagnostic Flag = Enabled DTC = Active If: OL Diagnostic Flag = Enabled DTC = Active	<u>Enable Conditions:</u> IGN = "ON", Eng = "ON" Batt volts > **10 ~~< 16~~** Diagnostic = Enabled <u>This diagnostic is inhibited if any of the following DTC's are present:</u> VB DTC's	Recurrence rate 1 s	M \ 2
HO2S Heater Performance Bank 1 and 2 Sensor 1	**(Bank 1)** **P 0135** **(Bank 2)** **P 0155**	This function will diagnose an upstream oxygen sensor heater failure that would lead to an increase in emissions beyond the legal thresholds. The diagnosis shall be carried out by determining whether the operative readiness of the sensor exceeds a time threshold or whether the measured oxygen sensor ceramic temperature exceeds or falls below set bounds over a number of measurement cycles. The temperature of the sensor is determined by measuring the internal resistance of the sensor.	After the enable criteria are met the sensor is observed for readiness. If the sensor is not ready a timer is started. If this timer exceeds **20 seconds** an exaggerated stimulation is performed to try to force the sensor to ready state. If the sensor is still not active after **25 seconds** of exaggerated stimulation an error is set. If the sensor is ready previous to the timer exceeding the **20 seconds second** test is performed. The test will wait **60 seconds** from the time the engine was started. At this point the sensor temperature is calculated once per second. If the sensor temperature is less than **620C or greater than 900C** a fail counter is incremented. After the **32** test samples the fail counter is observed. If the fail counter exceeds **28** an error is set. **(28 sec)** P0135 = Active	**<u>Enable Conditions:</u>** Engine = ON Heater State not OFF or in Protection Batt Voltage > **10 v** Heater PWM > **14.8** % The calculated exhaust gas temperature has passed the O2 sensor dew point. **<u>This diagnostic is inhibited if any of the following DTC's are present:</u>** WRAF sensor internal resistance DTC's WRAF sensor heater electrical DTC's WRAF sensor signal electrical DTC's VB DTC's	Recurrence rate 1 s	M \ 2

			P0155 = Active	MAF DTC's Load-TP diagnosis DTC's WRAF sensor Plausibility DTC's		
Heated Oxygen Sensor (HO2S) Low Voltage Bank 1 & 2 Sensor 2	**(Bank 1) P0137** **(Bank 2) P0157**	This Diagnostic detects a SCG in the circuit or the Oxygen Sensor	HO2S Down Volts < 2 mV HO2S Down Resistance < 10 Ohms Timer 2 > 5 Sec. (Failure Window) Fail time > 16 (1.6 sec.) P0137 = Active P0157 = Active	<u>This diagnostic is inhibited if any of the following DTC's are present:</u> HO2S Circuit Faults <u>Enable Conditions</u> IGN = ON Dynamic Fuel Trim = Active MAF > 100Kg/h Timer 1 > 25.5 Sec. (Stabilization) Diagnostic = Active	Recurrence rate 100 ms	M / 2

Heated Oxygen Sensor (HO2S) High Voltage Bank 1& 2 Sensor 2	**(Bank 1) P0138** **(Bank2) P0158**	This Diagnostic detects a SCVB in the circuit or the Oxygen Sensor	HO2S Down Volts > 2 volts Fail time> 16 (1.6 sec.) P0138 = Active P0158 = Active	<u>This diagnostic is inhibited if any of the following DTC's are present:</u> HO2S Circuit Faults <u>Enable Conditions</u> IGN = ON Diagnostic = Active	Recurrence Rate: 100ms	M / 2
HO2S Slow Response Bank 1 & 2 Sensor 2	**(Bank 1) P0139** **(Bank 2) P0159**	This diagnosis can detect the sluggish behavior of the rich/lean switch times during the transition to the trailing fuel cut-off. The results are statistically treated. The allowable sensor behavior is based on the sensors signal under different MAF and signal band limits. *Non-Intrusive Monitoring*	After the enable conditions are met and PUC is determined to be active, the current downstream O2 voltage is monitored and stored. If the stored value is above 600mV and MAF > 10 < 200 Kg/h the test is started. Once the sensor voltage drops 15% of the stored value a timer is started. This timer is then stopped when the voltage drops 70% of the stored value. At this point the test is determined to be valid and the diagnostic counter is incremented by one. The switching time value is then converted to a weighted value. This process is repeated for **2** PUC events. Each time the diagnostic counter is incremented the weighted value is added to a total value. At the end of the **2** PUC events the total value is divided by the number of PUC events and another value is developed. This value is then compared to a threshold. If the value exceeds the threshold the	**All monitoring conditions must be met** No inhibition reason for diagnosis Coolant Temp > ~~**70**~~ **65.25 C** Downstream Sensors = Ready Vehicle Speed > 5 < 180 Km/h Cat temp **> ~~450~~ 520** C **<u>This diagnostic is inhibited if any of the following DTC's are present:</u>** Throttle position sensor errors Canister purge solenoid errors Canister purge solenoid mechanical errors Coolant temperature sensor errors Coolant temperature signal stuck errors Coolant temperature signal gradient errors Coolant temp. sensor plausibility errors Manifold pressure sensor errors Crankshaft sensor errors Camshaft sensor errors Injection valve errors Fuel system diagnosis errors Vehicle speed sensor errors O2 sensor up output stage OBD1 errors	Recurrence Rate 20 ms	M \ 2

			sensor is determine to be slow. If Total Response Time > 1.002 P0139 = Active P0159 = Active	O2 sensor heater up OBD1 output stage errors O2 sensor heater up OBD2 errors O2 sensor down OBD1 output stage errors O2 sensor heater down OBD1 output stage errors O2 sensor down OBD2 switching time errors, in case of a Switching errors in the last driving cycle, this condition is faded out O2 sensor heater down OBD2 errors misfire carb A errors misfire carb B errors OBD II downstream oxygen sensor diagnosis enabled If any one of the above errors is active then the diagnosis of the monitoring sensors for will be inhibited.		
Heated Oxygen Sensor (HO2S) insufficient Activity B1S2	**(Bank 1) P0140** **(Bank 2) P0160**	This Diagnostic detects an Open Signal in the Oxygen Sensor or the circuit	HO2S Down Volts **< 560mV** HO2S Down Volts > **312mV** Time **≥ 480** Sec (This timer has been increased to eliminate false failures when high resistance is introduced to the heater circuit. High resistance (120 ohms) on the heater circuit will result in an open circuit resitance reading and a lack of activity during the first 300 seconds of engine operation.) HO2S Down Resistance > 63000 Ohms Fail time > 16 (1.6 sec.) P0140 = Active P0160 = Active	<u>This diagnostic is inhibited if any of the following DTC's are present:</u> HO2S DTC's <u>Enable Conditions</u> IGN = ON Catalyst Temp. > **600C** HO2S Down = Ready (forced ready [by catalyst temperature of 600 C] if no activity) Heater State = Heating Diagnostic = Active	Recurrence Rate 100 ms:	M / 2
Wide Range Air Fuel Sensor # 1 Electrical (Open Circuit) Diagnosis (B1S1)	**P2243 (Reference Voltage)** **P2251 (Virtual Ground)** **P2237 (Pumping Current)** **P2626 (Trim Current)**	This function determines if an open circuit in any of the four electric lines (Reference Voltage, Virtual Ground, Pumping Current and Trim Current) is present WRAF Sensor. This function shall be triggered only if one of the following diagnosis is active (to set the readiness bit), which are Plausibility Check, Plausibility during fuel cutoff, and Sensor Heater OBD2. The function shall go to the state = "active" only if one of the above	**Reference Voltage Failure** The following condition must be meet in order to detect open line on Reference Voltage: - The Oxygen sensor heater fault has been detected - The WRAF sensor signal is found implausible with a signal too rich symptom. Open circuit error flag for Reference Voltage is set high after error symptom detected without debounce. **Virtual Ground Failure**	The following condition must be meet before the open circuit diagnosis is activated: - The WRAF sensor signal is found implausible - The WRAF sensor signal during full cutoff is found implausible - The Oxygen sensor heater faulty - WRAF sensor dynamic diagnosis detects a fault - diagnosis completion timer has not been reached. Diagnosis completion timer < **300sec**	Recurrence Rate 100 ms:	M / 2

		diagnosis debounced a fault. In this state, if a heater OBD2 error exist, the WRAF sensor controller oscillator used to measure the sensor internal resistance shall be disable in order to allow a stable plausibility error detection. At the deactivation of this function the oscillator shall be re-enabled. During the diagnosis state "active" a timer shall runs waiting for any delayed diagnosis. If a plausibility error during PUC or a heater OBD2 or plausibility error could be detected, the timer should be stopped and a symptom set, otherwise it should run until it reaches the max value of 120 Sec (Reference Voltage) if a heater OBD2 error and a plausibility error (symptom "sensor too rich") than an open circuit error in the line Reference Voltage exists. (Virtual Ground) An open circuit in line Virtual Ground can be detected if a heater OBD2 fault is present and the sensor is not active anymore, i.e. its signal stucks near lambda 1. The sensor non-activity can be detected by anyone of the following diagnosis: plausibility (symptom is "sensor not active"), lambda controller output diagnosis or plausibility during PUC (symptom signal too low). (Pumping Current) If the delayed diagnosis timer expired, it is assumed that no heater OBD2 fault exists. If the sensor is not active than an open circuit in the line Pumping Current occurred.	The following condition must be meet in order to detect open line on Virtual Ground: - The Oxygen sensor heater fault operating tip temperature not reached has been detected - The WRAF sensor signal is found implausible with a sensor not active symptom. **OR** The WRAF sensor signal during full cutoff is found implausible with a signal too low symptom. Open circuit error flag for Virtual Ground is set high after error symptom detected without debounce **Pumping Current Failure** The following condition must be meet in order to detect open line on Pumping Current: - open circuit delay timer > calibratbale threshold Open circuit delay Timer > **120sec** - The WRAF sensor signal is found implausible with a sensor not active symptom. **OR** The WRAF sensor signal during full cutoff is found implausible with a signal too low symptom. Open circuit error flag for Pumping Current is set high after error symptom detected without debounce **Trim Current Failure** The following condition must be meet in order to detect open line on Trim Current: - The WRAF sensor signal during full cutoff is found implausible with a signal too high symptom. Open circuit error flag for Trim Current is set high after error symptom detected without debounce if a heater OBD2 error exist the WRAF sensor controller oscillator used to			

		(Trim Current) If the sensor shows an augmented gain, i.e. the sensor signal is higher than the nominal characteristic line, the plausibility test during the fuel cutoff phase shall detect this symptom and an open circuit is assigned to the line Trim Current. If the sensor shows no activity it is also possible that the dynamic diagnosis detects a fault. This is used here to trigger the current diagnosis, but not considered in the open circuit symptom matrix presented above, then the dynamic diagnosis, as implemented currently, cannot distinguish between a slow and non-active sensor. There are enough means to detect sensor non-activity, consequently an improvement in the dynamic diagnosis is not necessary.	measure the sensor internal resistance shall be disable in order to allow a stable			
Wide Range Air Fuel Sensor # 2 Electrical (Open Circuit) Diagnosis (B2S1)	**P2247 ((Reference Voltage)** **P2254 (Virtual Ground)** **P2240 (Pumping Current)** **P2629 (Trim Current)**	This function determines if an open circuit in any of the four electric lines (Reference Voltage, Virtual Ground, Pumping Current and Trim Current) is present WRAF Sensor. This function shall be triggered only if one of the following diagnosis is active (to set the readiness bit), which are Plausibility Check, Plausibility during fuel cutoff, and Sensor Heater OBD2. The function shall go to the state = "active" only if one of the above diagnosis debounced a fault. In this state, if a heater OBD2 error exist, the WRAF sensor controller oscillator used to measure the sensor internal resistance shall be disable in order to allow a stable plausibility error detection. At the deactivation of this function	**Reference Voltage Failure** The following condition must be meet in order to detect open line on Reference Voltage: - The Oxygen sensor heater fault has been detected - The WRAF sensor signal is found implausible with a signal too rich symptom. Open circuit error flag for Reference Voltage is set high after error symptom detected without debounce. **Virtual Ground Failure** The following condition must be meet in order to detect open line on Virtual Ground: - The Oxygen sensor heater fault operating tip temperature not reached has been detected - The WRAF sensor signal is found	The following condition must be meet before the open circuit diagnosis is activated: - The WRAF sensor signal is found implausible - The WRAF sensor signal during full cutoff is found implausible - The Oxygen sensor heater faulty - WRAF sensor dynamic diagnosis detects a fault - diagnosis completion timer has not been reached. Diagnosis completion timer < **300sec**	Recurrence Rate 100 ms:	M / 2

		the oscillator shall be re-enabled. During the diagnosis state "active" a timer shall runs waiting for any delayed diagnosis. If a plausibility error during PUC or a heater OBD2 or plausibility error could be detected, the timer should be stopped and a symptom set, otherwise it should run until it reaches the max value of 120 Sec (Reference Voltage) if a heater OBD2 error and a plausibility error (symptom "sensor too rich") than an open circuit error in the line Reference Voltage exists. (Virtual Ground) An open circuit in line Virtual Ground can be detected if a heater OBD2 fault is present and the sensor is not active anymore, i.e. its signal stucks near lambda 1. The sensor non-activity can be detected by anyone of the following diagnosis: plausibility (symptom is "sensor not active"), lambda controller output diagnosis or plausibility during PUC (symptom signal too low). (Pumping Current) If the delayed diagnosis timer expired, it is assumed that no heater OBD2 fault exists. If the sensor is not active than an open circuit in the line Pumping Current occurred. (Trim Current) If the sensor shows an augmented gain, i.e. the sensor signal is higher than the nominal characteristic line, the plausibility test during the fuel cutoff phase shall detect this symptom and an open circuit is assigned to the	implausible with a sensor not active symptom. **OR** The WRAF sensor signal during full cutoff is found implausible with a signal too low symptom. Open circuit error flag for Virtual Ground is set high after error symptom detected without debounce **Pumping Current Failure** The following condition must be meet in order to detect open line on Pumping Current: - open circuit delay timer > calibratbale threshold Open circuit delay Timer > **120sec** - The WRAF sensor signal is found implausible with a sensor not active symptom. **OR** The WRAF sensor signal during full cutoff is found implausible with a signal too low symptom. Open circuit error flag for Pumping Current is set high after error symptom detected without debounce **Trim Current Failure** The following condition must be meet in order to detect open line on Trim Current: - The WRAF sensor signal during full cutoff is found implausible with a signal too high symptom. Open circuit error flag for Trim Current is set high after error symptom detected without debounce if a heater OBD2 error exist the WRAF sensor controller oscillator used to measure the sensor internal resistance shall be disable in order to allow a stable			

		line Trim Current. If the sensor shows no activity it is also possible that the dynamic diagnosis detects a fault. This is used here to trigger the current diagnosis, but not considered in the open circuit symptom matrix presented above, then the dynamic diagnosis, as implemented currently, cannot distinguish between a slow and non-active sensor. There are enough means to detect sensor non-activity, consequently an improvement in the dynamic diagnosis is not necessary.				
Wide Range Air Fuel Sensor # 1 Electrical Diagnosis (B2S1)	**P 0151 SCG** **P 0152 SCVB** **P167B IC-Source Low**	This Diagnostic is intended to detect a SCG, SCVB, or Open in the signal line or in the WRAF sensor. The Electrical Diagnosis is performed internally through the ECM (BSW) by the CJ120 Register.	If the CJ120 detects an, SCG, or SCVB. or IC-Source Low Voltage AND Fail time> 100 (500 ms) (inc @ 2) Related P-Codes = Active	This diagnostic is inhibited if any of the following DTC's are present: HO2S DTC's Enable Conditions IGN = ON Diagnosis = Active	Recurrence Rate: 10 ms	M / 2
HO2S Heater Performance Bank 1 and 2 Sensor 2	**P 0141 (Bank 1)** **P 0161 (Bank 2)**	After the enable criteria are met a timer is started. When this timer exceeds **180 seconds** the modeled exhaust temperature is compared to a threshold of **950C**. If the temperature is less than the threshold the sensor heat energy is calculated and integrated. Once this integrated value has exceeded a threshold (time to exceed is load dependant, aproximately 2 to 5 minutes), the sensor resistance is observed once per second for **45 seconds**. If the sensor resistance is greater than **1100 ohms** a fail counter is incremented. After the **45 seconds** has elapsed the fail counter is observed. If the fail counter exceeds **40**, an error is set.	After a 180 second timer has expired, the sensor heat energy is calculated and integrated. Once this integrated value has exceeded a threshold (time to exceed is load dependant, approximately 2 to 5 minutes). Approximate worst case run time = 9 minutes. Typical run time = 5 minutes. Post O2 sensor calculated resistance is greater than 1100 ohms for 40 out of 45 test samples.	**Enable Conditions:** Key "ON" Eng "ON" HO2S Heater = "ON" Batt Voltage **> 10 v** Heater PWM **> 20< 99.6%** Exhaust temp. ≤ 950°C **This diagnostic is inhibited if any of the following DTC's are present:** • MAF DTC's • VB DTC's • Load-TP diagnosis DTC's • WRAF sensor electrical DTC's • WRAF sensor heater electrical DTC's	Recurrence rate 1 s	M \ 2

Fuel System Lean Bank 1	**P 0171**	Fuel System correction is monitored to determine if the system is too lean *Non-Intrusive Monitoring*	If the output for the lambda controller + the fuel adapts is greater than the emissions failure threshold for fuel system diagnosis during 100 seconds of a 300 second test period. (Test period timer is only incremented if enable conditions are met) If Short Term + Long Term Fueling > 25% FOR TIME > 100 SEC. P 0171 = Active	**Enable Conditions:** • Closed Loop Active • Application conditions fulfilled • Fuel system diagnosis errors not detected during this trip. • No inhibition due to high charcoal canister saturation. The canister purge system cycles closed for up to 60 seconds after 240 seconds of purge under all circumstances. Once canister purge has cycled off, there is no canister load and thus no canister inhibition due to saturation. • **Rpm > 512** • **MAF > 60mgstk** • **Coolant Temp > 70°C** • **Baro > 740hPa** • **Intake Air Temp > -8.2°C** If any one of the above conditions are not met then the diagnostic function will not activate **This diagnostic is inhibited if any of the following DTC's are present:** TP errors ECT errors IAT errors MAF errors Camshaft sensor errors Misfire Present Canister purge errors Crank shaft sensor errors Fuel system diagnosis inhibited	Recurrence Rate 20 ms	M \ 2
Fuel System Rich Bank 1	**P 0172**	Fuel System correction is monitored to determine if the system is too rich *Non-Intrusive Monitoring*	If the output for the lambda controller + the fuel adapts is greater than the emissions failure threshold for fuel system diagnosis during 100 seconds of a 300 second test period. (Test period timer is only incremented if enable conditions are met) If Short Term + Long Term Fueling < -25% FOR TIME > 100 SEC. P 0172 = Active	**Enable Conditions:** • Closed Loop Active • Application conditions fulfilled • Fuel system diagnosis errors not detected during this trip. • No inhibition due to high charcoal canister saturation. The canister purge system cycles closed for up to 60 seconds after 240 seconds of purge under all circumstances. Once canister purge has cycled off, there is no canister load and thus no canister inhibition due to saturation. • **Rpm > 512** • **MAF > 60mgstk** • **Coolant Temp > 70°C**	Recurrence Rate 20 ms	M \ 2

				• **Baro > 740hPa** • **Intake Air Temp > -8.2°C** If any one of the above conditions are not met then the diagnostic function will not activate **This diagnostic is inhibited if any of the following DTC's are present:** TP errors ECT errors IAT errors MAF errors Camshaft sensor errors Misfire Present Canister purge errors Crank shaft sensor errors Fuel system diagnosis inhibited		
Fuel System Lean Bank 2	**P 0174**	This diagnostic condition is used to observe the output of linear lambda control to determine if the system is too lean *Non-Intrusive Monitoring*	If the output for the lambda controller + the fuel adapts is greater than the emissions failure threshold for fuel system diagnosis during 100 seconds of a 300 second test period. (Test period timer is only incremented if enable conditions are met) If Short Term + Long Term Fueling > 25% FOR TIME > 100 SEC. P 0174 = Active	**Enable Conditions:** • Closed Loop Active • Application conditions fulfilled • Fuel system diagnosis errors not detected during this trip. • No inhibition due to high charcoal canister saturation. The canister purge system cycles closed for up to 60 seconds after 240 seconds of purge under all circumstances. Once canister purge has cycled off, there is no canister load and thus no canister inhibition due to saturation. • **Rpm > 512** • **MAF > 60mgstk** • **Coolant Temp > 70°C** • **Baro > 740hPa** • **Intake Air Temp > -8.2°C** If any one of the above conditions are not met then the diagnostic function will not activate **This diagnostic is inhibited if any of the following DTC's are present:** TP errors ECT errors IAT errors MAF errors Camshaft sensor errors Misfire Present Canister purge errors Crank shaft sensor errors Fuel system diagnosis inhibited	Recurrence Rate 20 ms	M \ 2

Fuel System Rich Bank 2	**P 0175**	This diagnostic condition is used to observe the output of linear lambda control to determine if the system is too rich *Non-Intrusive Monitoring*	If the output for the lambda controller + the fuel adapts is greater than the emissions failure threshold for fuel system diagnosis during 100 seconds of a 300 second test period. (Test period timer is only incremented if enable conditions are met) If Short Term + Long Term Fueling < -25% FOR TIME > 100 SEC. P 0175 = Active	**Enable Conditions:** • Closed Loop Active • Application conditions fulfilled • Fuel system diagnosis errors not detected during this trip. • No inhibition due to high charcoal canister saturation. The canister purge system cycles closed for up to 60 seconds after 240 seconds of purge under all circumstances. Once canister purge has cycled off, there is no canister load and thus no canister inhibition due to saturation. • **Rpm > 512** • **MAF > 60mgstk** • **Coolant Temp > 70°C** • **Baro > 740hPa** • **Intake Air Temp > -8.2°C** If any one of the above conditions are not met then the diagnostic function will not activate **This diagnostic is inhibited if any of the following DTC's are present:** TP errors ECT errors IAT errors MAF errors Camshaft sensor errors Misfire Present Canister purge errors Crank shaft sensor errors Fuel system diagnosis inhibited	Recurrence Rate 20 ms	M \ 2
HO2S Circuit Low Voltage During Power Enrichment Bank 1 & 2 Sensor 2	**(Bank 1) P1137** **(Bank 2) P1157**	The purpose is to diagnose a downstream oxygen sensor that is below a voltage threshold during full load enrichment.	Downstream oxygen sensor voltage **< 698** mV during full load fuel enrichment. AND Fail time> 16 (1.6 sec) P1137 = Active P1157 = Active	**Activation Conditions** • Cat temp > 600C • Downstream sensor is ready and heating • Full load is present for a specified **value of integrated airflow > 100 grams & < 300 grams of integrated airflow** **This diagnostic is inhibited if any of the following DTC's are present:** • Downstream O2 heater errors • Downstream O2 Sensor errors • Injector errors • Canister purge solenoid errors • MAF errors • TP errors • Misfire errors	100ms The diagnostic shall activate at every sensor acquisition.	M / 2

HO2S Circuit High Voltage During Decel Fuel Cut-Off (DFCO) Bank 1 & 2 Sensor 2	**(Bank 1) P1138** **(Bank 2) P1158**	The purpose is to diagnose a downstream oxygen sensor that is above voltage threshold during fuel cut-off.	Downstream oxygen sensor voltage > **30mV during decel fuel cut-off.** AND Fail time> 50 (1 sec) (inc. @ 5) P1138 = Active P1158 = Active	**Activation Conditions** • Cat temp > 650C • Downstream sensor is ready and heating • Decel Fuel Cut-Off is present for a specified **value of integrated airflow** **> 35 grams & < 120 grams of integrated airflow** **This diagnostic is inhibited if any of the following DTC's are present:** • Downstream O2 heater errors • Downstream O2 Sensor errors • Injector errors • Canister purge solenoid errors • MAF errors • TP errors • Misfire errors	100ms The diagnostic shall activate at every sensor acquisition.	M / 2
Post Catalyst Fuel Trim Lean condition Bank 1 and 2 **Fuel Correction Diagnostic, Portion #1**	**P2096** **P2098**	1. The purpose is to diagnose excessive upstream oxygen sensor shift If portion 1 or 2 has failed the other portion will be disabled.	If the post catalyst fuel trim correction has exceeded a calibratible threshold for 24 seconds out of a 25 second test period. Fuel Trim Correction **> 2.93%** FOR Fail TIME > **24 SEC**. P2096 = Active P2098 = Active	**Activation Conditions** • Post Catalyst Fuel Trim is active **This diagnostic is inhibited if any of the following DTC's are present:** • Canister purge solenoid errors • ECT errors • MAF errors • MAP errors • Crankshaft sensor errors • Camshaft sensor errors • Fuel System errors • WRAF Sensor errors • WRAF Sensor HTR errors • Oxygen Sensor errors • Oxygen sensor heater errors • Misfire errors	1 sec	M / 2
Post Catalyst Fuel Trim Lean condition Bank 1 and 2 **Fuel Correction Diagnostic, Portion #2**	**P2096** **P2098**	The purpose is to diagnosis excess deviation of the downstream sensor voltage as compared to the set-point. This can occur due to a shift in the upstream oxygen sensor, or an exhaust system leak between the pre and post O2 sensors. If portion 1 or 2 has failed the other portion will be disabled.	Downstream sensor voltage deviation from set-point: If Downstream O2 voltage is **< 498 mV** from set-point for 74 seconds of a 75 second test period. P2096 = Active P2098 = Active	**Activation Conditions** • Post Catalyst Fuel Trim is active • Canister purge is steady state **This diagnostic is inhibited if any of the following DTC's are present:** • Canister purge solenoid errors • ECT errors • MAF errors • MAP errors • Crankshaft sensor errors • Camshaft sensor errors • Fuel System errors • WRAF Sensor errors	1 sec	M / 2

				• WRAF Sensor HTR errors • Oxygen Sensor errors • Oxygen sensor heater errors • Misfire errors		
Post Catalyst Fuel Trim Rich condition Bank 1 and 2 **Fuel Correction Diagnostic, Portion #1**	**P2097** **P2099**	1. The purpose is to diagnose excessive upstream oxygen sensor shift. If portion 1 or 2 has failed the other portion will be disabled.	If the trim controller has exceeded its ability to keep the downstream sensor in a desired range for 24 seconds out of a 25 second test period. Fuel trim correction **> - 2.93%** FOR TIME > 24 SEC. P2097 = Active P2099 = Active	**Activation Conditions** • Dynamic trim is active for more than 10 seconds • Canister purge is steady state **This diagnostic is inhibited if any of the following DTC's are present:** • Canister purge solenoid errors • ECT errors • MAF errors • MAP errors • Crankshaft sensor errors • Camshaft sensor errors • Fuel System errors • WRAF Sensor errors • WRAF Sensor HTR errors • Oxygen Sensor errors • Oxygen sensor heater errors • Misfire errors	1 sec	M / 2
Post Catalyst Fuel Trim Rich condition Bank 1 and 2 **Fuel Correction Diagnostic, Portion #2**	**P2097** **P2099**	The purpose is to diagnosis excess deviation of the downstream sensor voltage as compared to the set-point. This can occur due to a shift in the upstream oxygen sensor. If portion 1 or 2 has failed the other portion will be disabled.	Downstream sensor voltage deviation from set-point: If Downstream O2 voltage is **> 151 mV** from set-point for 74 seconds of a 75 second test period. P2097 = Active P2099 = Active	**Activation Conditions** • Dynamic trim is active for more than 10 seconds • Canister purge is steady state **This diagnostic is inhibited if any of the following DTC's are present:** • Canister purge solenoid errors • ECT errors • MAF errors • MAP errors • Crankshaft sensor errors • Camshaft sensor errors • Fuel System errors • WRAF Sensor errors • WRAF Sensor HTR errors • Oxygen Sensor errors • Oxygen sensor heater errors • Misfire errors	1 sec	M / 2
HO2S Signal Circuit Shorted to Heater Circuit Bank 1 & 2 Sensor 1 (Heater Coupling)	**(Bank 1) P2231** **(Bank 2) P2234**	The diagnosis detects an increase of leakage current from the heater to the sensor circuit. The leakage is originated by a loss of insulation resistance and induces noise on the signal.	After the enable conditions are met a cycle counter is started. The counter increments each time a heater cycle is complete and a rise and fall value is calculated. If the actual lambda rise or fall calculated value is greater than 5.8% from modeled lambda characteristic a fail	Enable Conditions Eng. = ON Closed Loop Not in Fuel cutoff Heater PWM ≥ 15% or ≤ 85% **(Forced Stimulation Amplitude < 3.35%**	Recurrence Rate 100 ms	**M / 2**

		Through the heater coupling the measured signal of the WRAF sensor is perturbed and the lambda regulation is influenced. The diagnosis criteria is the difference of the sensor voltage measured at specific times, triggered by the rising and falling edge of the heater PWM-signal.	counter is incremented by 1. At the end of 100 cycles, the fail counter is compared to a threshold of 80. If the fail counter exceeds the threshold an error is set. P2231 = Active P2234 = Active	**Forced Stimulation Duration < 1.55 Sec.** **Or forced stimulation OFF)** **Exhaust Temp > 400C** Diagnosis = Active **<u>This diagnostic is inhibited if any of the following DTC's are present</u>**: HO2S Circuit Faults		
Injector Control Circuit Cylinder #1	**P 0201 P 0261 P 0262**	This function will detect an open line, short to ground, and short to battery voltage on Injector Cylinder #1	Detection of injection valve errors are done by hardware diagnosis. Fail time= 16 (1.6s) If Engine speed > 1200 rpm High recurrence 100 ms =1.6s = active If Engine speed < 1200 rpm Diag low recurrence 300 ms=4.8s = active	• <u>OL Diagnosis</u> • <u>Short circuit to ground</u> • <u>Short circuit to VB Diagnosis</u> • IGN = ON • Fuel pump = on • No inhibit on injector circuit • No SPI bus errors	Recurrence Rate high: 100 ms low: 300 ms	M \ 2
Injector Control Circuit Cylinder #2	**P 0202 P 0264 P 0STS**	This function will detect an open line, short to ground, and short to battery voltage on Injector Cylinder #2	Detection of injection valve errors are done by hardware diagnosis. Fail time= 16 (1.6s) If Engine speed > 1200 rpm High recurrence 100 ms =1.6s = active If Engine speed < 1200 rpm Diag low recurrence 300 ms=4.8s = active	• <u>OL Diagnosis</u> • <u>Short circuit to ground</u> • <u>Short circuit to VB Diagnosis</u> • IGN = ON • Fuel pump = on • No inhibit on injector circuit • No SPI bus errors	Recurrence Rate high: 100 ms low: 300 ms	M \ 2
Injector Control Circuit Cylinder #3	**P 0203 P 0267 P 0268**	This function will detect an open line, short to ground, and short to battery voltage on Injector Cylinder #3	Detection of injection valve errors are done by hardware diagnosis. Fail time= 16 (1.6s) If Engine speed > 1200 rpm High recurrence 100 ms =1.6s = active If Engine speed < 1200 rpm Diag low recurrence 300 ms=4.8s = active	• <u>OL Diagnosis</u> • <u>Short circuit to ground</u> • <u>Short circuit to VB Diagnosis</u> • IGN = ON • Fuel pump = on • No inhibit on injector circuit • No SPI bus errors	Recurrence Rate high: 100 ms low: 300 ms	M \ 2
Injector Control Circuit Cylinder #4	**P 0204 P 0270 P 0271**	This function will detect an open line, short to ground, and short to battery voltage on Injector Cylinder #4	Detection of injection valve errors are done by hardware diagnosis. Fail time= 16 (1.6s) If Engine speed > 1200 rpm High recurrence 100 ms =1.6s = active	• <u>OL Diagnosis</u> • <u>Short circuit to ground</u> • <u>Short circuit to VB Diagnosis</u> • IGN = ON • Fuel pump = on • No inhibit on injector circuit • No SPI bus errors	Recurrence Rate high: 100 ms low: 300 ms	M \ 2

			If Engine speed < 1200 rpm Diag low recurrence 300 ms=4.8s = active			
Injector Control Circuit Cylinder #5	**P 0205 P 0273 P 0274**	This function will detect an open line, short to ground, and short to battery voltage on Injector Cylinder #5	Detection of injection valve errors are done by hardware diagnosis. Fail time= 16 (1.6s) If Engine speed > 1200 rpm High recurrence 100 ms =1.6s = active If Engine speed < 1200 rpm Diag low recurrence 300 ms=4.8s = active	• OL Diagnosis • Short circuit to ground • Short circuit to VB Diagnosis • IGN = ON • Fuel pump = on • No inhibit on injector circuit • No SPI bus errors	Recurrence Rate high: 100 ms low: 300 ms	M \ 2
Injector Control Circuit Cylinder #6	**P 0206 P 0276 P 0277**	This function will detect an open line, short to ground, and short to battery voltage on Injector Cylinder #6	Detection of injection valve errors are done by hardware diagnosis. Fail time= 16 (1.6s) If Engine speed > 1200 rpm High recurrence 100 ms =1.6s = active If Engine speed < 1200 rpm Diag low recurrence 300 ms=4.8s = active	• OL Diagnosis • Short circuit to ground • Short circuit to VB Diagnosis • IGN = ON • Fuel pump = on • No inhibit on injector circuit • No SPI bus errors	Recurrence Rate high: 100 ms low: 300 ms	M \ 2
Injector Control Circuit Cylinder #7	**P 0207 P 0279 P 0280**	This function will detect an open line, short to ground, and short to battery voltage on Injector Cylinder #7	Detection of injection valve errors are done by hardware diagnosis. Fail time= 16 (1.6s) If Engine speed > 1200 rpm High recurrence 100 ms =1.6s = active If Engine speed < 1200 rpm Diag low recurrence 300 ms=4.8s = active	• OL Diagnosis • Short circuit to ground • Short circuit to VB Diagnosis • IGN = ON • Fuel pump = on • No inhibit on injector circuit • No SPI bus errors	Recurrence Rate high: 100 ms low: 300 ms	M \ 2
Injector Control Circuit Cylinder #8	**P 0208 P 0282 P 0283**	This function will detect an open line, short to ground, and short to battery voltage on Injector Cylinder #8	Detection of injection valve errors are done by hardware diagnosis. Fail time= 16 (1.6s) If Engine speed > 1200 rpm High recurrence 100 ms =1.6s = active If Engine speed < 1200 rpm Diag low recurrence 300 ms=4.8s = active	• OL Diagnosis • Short circuit to ground • Short circuit to VB Diagnosis • IGN = ON • Fuel pump = on • No inhibit on injector circuit • No SPI bus errors	Recurrence Rate high: 100 ms low: 300 ms	M \ 2
Random Misfires detected	**P0300**	• **CARB A misfire failure criteria:** Risk of catalyst damage, monitoring interval over 200 crankshaft revolutions. • **CARB B1 misfire**	**Monitoring during the 200 crankshaft revolutions:** If the single cylinder misfire detected over a critical threshold **(4000)** **Misfire Cylinder Limp Home Process:** The concerning cylinder is shut off immediately Max **(4)** cylinders will be shut off with this	**Enable Conditions** Ignition "ON" Eng "ON" Rpm = **500** **{150 less than Set-Point, (650)}**	Every segment	"A" M / 1 Flashes "B 1" M / 2 "B 4"

		failure criteria: Emission increase, monitoring interval over the first 1000 crankshaft revolutions. • **CARB B4 misfire failure criteria:** Emission increase, monitoring interval over 1000 crankshaft revolutions. For errors detection, misfire must take place for 4 monitoring intervals.	process. **Monitoring at the end of 200 crankshaft revolutions:** If the global sum of detected misfire is greater than the threshold **(4000)** Or If the sum of detected misfire of each bank is greater than the threshold **(4000)** If RPM < 2700, Load percentage is < 70 and Counter is **> 720**, then engine criteria is in the FTP region **At the end of first 1000 crankshaft revolutions:** If the sum of detected misfire is greater than threshold **(36 GMX215)** **(46 GMTSTS)** **At the end of (other than first) 1000 crankshaft revolutions:** If the sum of detected misfire is greater than threshold **(36 GMX215)** **(46 GMTSTS)** And the number of violation intervals is **equal to (4)** during the driving cycle.			M / 2

Individual Misfire Cylinders # 1 – 8	**P 0301** **P 0302** **P 0303** **P 0304** **P 0305** **P 0306** **P 0307** **P 0308**	During Misfire A monitoring process, if the number of detected misfire on a single cylinder is over a threshold **(4000)** of short term catalyst protection, Misfire cylinder limp home is activated, and Misfire "A" errors is confirmed. At each end of Misfire A, B1, or B4 monitoring intervals, if the misfire errors is confirmed for the interval, the cylinder with the highest misfire rate is determined. **(90%)**	**During the Misfire A monitoring window:** If the sum of detected misfires of a single cylinder is greater than a threshold **(4000)** Misfire cylinder limp home process is activated: **At the end of Misfire A monitoring window:** If misfire A criteria is confirmed, and the number of detected misfire on a cylinder is over the threshold **(4000)** The Errors is stored and MIL =ON (100ms) If RPM < 2700, Load percentage is < 70 and Counter is **> 720**, then engine criteria is in the FTP region **At the end of Misfire B1/B4 window:** If misfire B1/B4 criteria is confirmed, and the number of detected misfire on a cylinder is over the threshold **(36 GMX215)** **(46 GMTSTS** The Errors is stored and MIL = ON (120ms)	Same as above	Every segment	A" M / 1 Flashes "B 1" M / 2 "B 4" M / 2

Crankshaft Angle sensor Errors (CASE Learn) System Variation Not Learned	**P0315**	This Diagnostic incorporates the CASE learning algorithm proprietary to GM. It performs the target wheel learning with a request via the Scan / EOL tool.	**At the end of EOL CASE learning process:** If there is not a sufficient number of TDCs' for learning Or At least one of the ER segment adaptation values at the limit Then The symptom **"CASE learn "** is not successful" P 0315 = Active	**Enable Conditions:** If requested from a Scan / EOL tool and the throttle is depressed to WOT and CASE has not learned in the first cycle, It is recommended to release the throttle and repeat the procedure. Gear = P / N Then CASE learn procedure is active	At EOL testing with Scan / EOL tool.	M / 1
Misfire detected with rough road **Rough road data not available**	**P1380**	Rough road conditions must be detected to prevent erroneous misfire detection. The speed disturbance of vehicle wheels is used to evaluate the rough road condition. A rough road signal coming from the ABS ECM through the CAN. If the CAN rough road index receiving message in failure mode, a specific flag is set to inform that misfire was detected without rough road detection available	If misfire A, B1 or B4 is detected and the CAN rough road index receiving message in failure mode, then P1380 = active	Enable Conditions: When the Driving Cycle has started	Every segment	N / 1
Misfire detected with rough road **No communication with brake control module**	**P1381**	Rough road conditions must be detected to prevent erroneous misfire detection. The speed disturbance of vehicle wheels is used to evaluate the rough road condition. A rough road signal coming from the wheel speed sensors through the CAN. If the loss of communication from wheel speed sensors occurs, a specific flag is set to inform that misfire was detected with no communication with brake control module. (Customer requirement)	If misfire A, B1 or B4 is detected and the communication with ABS module is in failure mode, then P1381 = active	Enable Conditions: When the Driving Cycle has started	Every segment	N / 1
Knock Sensor Circuit (Bank1)	**P0325**	The rationality check on the analog input signal from the ATM40 device to the micro-controller is performed under 2 complementary algorithms: (1) Checks the signal value. (2) Checks scattering of this signal. For the range check, the absolute noise value of the	**Range check:** Every 90° CKP, the absolute noise value of the ATM40 device is checked if it is inside the normal operating range 0.18 – 4.80V. If an errors is detected, the symptom of knock sensor 1 failure is detected as no signal **Master Algorithm:** Every 720° CKP, If the bandwidth	This diagnostic is inhibited if any of the following DTC's are present: Crankshaft Sensor Camshaft Sensor CAN/Communication Failures (SPI) Enable Conditions: IGN = ON Engine state is not in "engine start" or "fuel cut-off"	Every 720 CKP 300 engine revolutions (150 engine cycles)	M / 2

		ATM40 device is checked if it is inside the normal operating range. This basic check on signal is performed on all cylinders. Two algorithms used, Master and Slave, is to observe the signal bandwidth, both algorithms have to show the same state to increment the failure counter. **Master algorithm:** The bandwidth of the signal is evaluated for cylinder 3 and 5. In case of short to ground, short to battery or an open, the bandwidth is smaller than during normal operation. The magnitude is compared with a threshold to detect the knock sensor failure. **Slave algorithm:** The bandwidth of cylinder 3 and 5 are accumulated via an integration method. The accumulated voltage value is compared with the threshold to detect the knock sensor failure. If both algorithms detect a failure, the Fail time is incremented.	magnitude of cylinder 3 and 5 does not exceed the threshold 0.04v, the cycle counter is incremented by 1, this counter is reset as soon as the magnitude of cylinder 3 and 5 exceeds the threshold 0.04v. If the cycle counter reaches the 150, a failure has been **Slave algorithm:** Every 720° CKP, if the accumulated bandwidths value of cylinder 3 and 5 is reached the threshold 3.0v, the cycle counter and accumulated value is reset, otherwise, the cycle counter will be incremented by 1. If the cycle counter reaches the threshold 150, the failure is confirmed. If both detect a failure, the symptom of knock sensor 1 failure is detected as signal plausibility. The Fail timeis incremented. If after the failure has been set, the magnitude of cylinder 3 or 5 exceeds the threshold 0.04v, then the cycle counter is decremented by 5. As soon as the cycle counter equals 0 and no check range errors currently present, the Fail timeis decremented by 1. When the Fail Time. > 16 P 0325 = Active Limp Home: In case of a noise failure the knock control is disabled and spark advance limp home is performed. If the catalyst heating function is active, it is also take into account. With a crankshaft, camshaft, or SPI bus failure present, knock control changes also to limp home. Limp Home value: If conditions for knock control are valid and noise failure is present Then the gradient limitation 4.9deg in retard direction is used. If conditions for knock control are not fulfilled and noise failure is present, Then the gradient limitation 0.8deg in advance direction is used.	MAF > **240 mg/stk** (table value depends on engine speed and coolant temperature) MAF > **220 mg/stk** (min MAF for knock) diagnosis Rpm > 1400rpm (min engine speed for knock diagnosis) Diagnosis = Active		

Knock Sensor Performance (Bank1)	**P 0326**	Two algorithms used, Master and Slave, is to observe the signal bandwidth, both algorithms have to show the same state to increment the failure counter. **Master algorithm:** The bandwidth of the signal is evaluated for cylinder 3 and 5. In case of short to ground, short to battery or an open, the bandwidth is smaller than during normal operation. The magnitude is compared with a threshold to detect the knock sensor failure. **Slave algorithm:** The bandwidth of cylinder 3 and 5 are accumulated via an integration method. The accumulated voltage value is compared with the threshold to detect the knock sensor failure. If both algorithms detect a failure, the Fail timeis incremented.	**Master Algorithm:** Every 720° CKP, If the bandwidth magnitude of cylinder 3 and 5 does not exceed the threshold 0.04v, the cycle counter is incremented by 1, this counter is reset as soon as the magnitude of cylinder 3 and 5 exceeds the threshold 0.04v. If the cycle counter reaches 150, a failure has been detected **Slave algorithm:** Every 720° CKP, if the accumulated bandwidths value of cylinder 3 and 5 is reached the threshold 3.0v, the cycle counter and accumulated value is reset, otherwise, the cycle counter will be incremented by 1. If the cycle counter reaches the threshold 150, the failure is confirmed. If both detect a failure, the symptom of knock sensor 1 failure is detected as signal plausibility. The Fail time is incremented. If after the failure has been set, the magnitude of cylinder 3 or 5 exceeds the threshold 0.04v, then the cycle counter is decremented by 5. As soon as the cycle counter equals 0 and no check range errors currently present, the Fail time is decremented by 1. When the Fail Time. > 16 P 0326 = Active Limp Home: In case of a noise failure the knock control is disabled and spark advance limp home is performed. If the catalyst heating function is active, it is also take into account. With a crankshaft, camshaft, or SPI bus failure present, knock control changes also to limp home. Limp Home value: If conditions for knock control are valid and noise failure is present Then the gradient limitation 4.9deg in retard direction is used. If conditions for knock control are not fulfilled and noise failure is present, Then the gradient limitation 0.8deg in advance direction is used.	**<u>This diagnostic is inhibited if any of the following DTC's are present:</u>** Crankshaft Sensor Camshaft Sensor CAN/Communication Failures (SPI) **<u>Enable Conditions:</u>** IGN = ON Engine state is not in "engine start" or "fuel cut-off" MAF > **240 mg/stk** (table value depends on engine speed and coolant temperature) MAF > **220 mg/stk** (min MAF for knock) Rpm > 1400rpm (min engine speed for knock diagnosis) Diagnosis = Active	Every 720 CKP 300 engine revolutions (150 engine cycles)	M \ 2

Knock Sensor Circuit (Bank2)	**P0330**	The rationality check on the analog input signal from the ATM40 device to the micro-controller is performed under 2 complementary algorithms: (3) Checks the signal value. (4) Checks scattering of this signal. For the range check, the absolute noise value of the ATM40 device is checked if it is inside the normal operating range. This basic check on signal is performed on all cylinders. Two algorithms used, Master and Slave, is to observe the signal bandwidth, both algorithms have to show the same state to increment the failure counter. **Master algorithm:** The bandwidth of the signal is evaluated for cylinder 3 and 5. In case of short to ground, short to battery or an open, the bandwidth is smaller than during normal operation. The magnitude is compared with a threshold to detect the knock sensor failure. **Slave algorithm:** The bandwidth of cylinder 3 and 5 are accumulated via an integration method. The accumulated voltage value is compared with the threshold to detect the knock sensor failure. If both algorithms detect a failure, the Fail timeis incremented.	**Range check:** Every 90° CKP, the absolute noise value of the ATM40 device is checked if it is inside the normal operating range 0.18 – 4.8v. If an errors is detected, the symptom of knock sensor 1 failure is detected as no signal **Master Algorithm:** Every 720° CKP, If the bandwidth magnitude of cylinder 3 and 5 does not exceed the threshold 0.04v, the cycle counter is incremented by 1, this counter is reset as soon as the magnitude of cylinder 3 and 5 exceeds the threshold 0.04v. If the cycle counter reaches the 150, a failure has been detected. **Slave algorithm:** Every 720° CKP, if the accumulated bandwidths value of cylinder 3 and 5 is reached the threshold, the cycle counter and accumulated value is reset, otherwise, the cycle counter will be incremented by 1. If the cycle counter reaches the threshold 150, The failure is confirmed. If both detect a failure, the symptom of knock sensor 1 failure is detected as signal plausibility. The Fail timeis incremented. If after the failure has been set, the magnitude of cylinder 3 or 5 exceeds the threshold 3v, then the cycle counter is decremented by 5. As soon as the cycle counter equals 0 and no check range errors currently present, the Fail timeis decremented by 1. When the Fail Time. > 16 P 0330 = Active Limp Home: In case of a noise failure the knock control is disabled and spark advance limp home is performed. If the catalyst heating function is active, it is also take into account. With a crankshaft, camshaft, or SPI bus failure present, knock control changes also to limp home. Limp Home value:	<u>This diagnostic is inhibited if any of the following DTC's are present:</u> Crankshaft Sensor errors Camshaft Sensor errors CAN/Communication Failures (SPI) Enable Conditions: IGN = ON Engine state is not in "engine start" or "fuel cut-off" MAF > **240 mg/sk** (table value depends on engine speed and coolant temperature) MAF > **240 mg/sk** (min MAF for knock diagnosis) Rpm > 1400rpm (min engine speed for knock diagnosis) Diagnosis = Active	Every 720 CKP 300 engine revolutions (150 engine cycles)	M / 2

			If conditions for knock control are valid and noise failure is present Then the gradient limitation 4.9deg in retard direction is used. If conditions for knock control are not fulfilled and noise failure is present, Then the gradient limitation 0.8v in advance direction is used.			
Knock Sensor Performance (Bank2)	**P 0331**	Two algorithms used, Master and Slave, is to observe the signal bandwidth, both algorithms have to show the same state to increment the failure counter. **Master algorithm:** The bandwidth of the signal is evaluated for cylinder 3 and 5. In case of short to ground, short to battery or an open, the bandwidth is smaller than during normal operation. The magnitude is compared with a threshold to detect the knock sensor failure. **Slave algorithm:** The bandwidth of cylinder 3 and 5 are accumulated via an integration method. The accumulated voltage value is compared with the threshold to detect the knock sensor failure. If both algorithms detect a failure, the Fail timeis incremented.	**Master Algorithm:** Every 720° CKP, If the bandwidth magnitude of cylinder 3 and 5 does not exceed the threshold 0.04v, the cycle counter is incremented by 1, this counter is reset as soon as the magnitude of cylinder 3 and 5 exceeds the threshold 0.04v. If the cycle counter reaches the 150, a failure has been detected. **Slave algorithm:** Every 720° CKP, if the accumulated bandwidths value of cylinder 3 and 5 is reached the threshold, the cycle counter and accumulated value is reset, otherwise, the cycle counter will be incremented by 1. If the cycle counter reaches the threshold (150), the failure is confirmed by this algorithm. If both detect a failure, the symptom of knock sensor 1 failure is detected as signal plausibility. The Fail timeis incremented. If after the failure has been set, the magnitude of cylinder 3 or 5 exceeds the threshold 3v, then the cycle counter is decremented by 5. As soon as the cycle counter equals 0 and no check range errors currently present, the Fail timeis decremented by 1. When the Fail Time. > 16 P 0331 = Active Limp Home: In case of a noise failure the knock control is disabled and spark advance limp home is performed. If the catalyst heating function is active, it is also take into account. With a crankshaft, camshaft, or SPI bus failure present, knock control changes also to limp home.	<u>This diagnostic is inhibited if any of the following DTC's are present:</u> Crankshaft Sensor errors Camshaft Sensor errors CAN/Communication Failures (SPI) Enable Conditions: IGN = ON Engine state is not in "engine start" or "fuel cut-off" MAF > **240 mg/sk** (table value depends on engine speed and coolant temperature) MAF > **240 mg/sk** (min MAF for knock diagnosis) Rpm > 1400rpm (min engine speed for knock diagnosis) Diagnosis = Active	Every 720 CKP 300 engine revolutions (150 engine cycles)	M \ 2

			Limp Home value: If conditions for knock control are valid and noise failure is present Then the gradient limitation 4.9deg in retard direction is used. If conditions for knock control are not fulfilled and noise failure is present, Then the gradient limitation 0.8v in advance direction is used.			
Crankshaft sensor circuit Electrical Diagnosis	**P0335 Crank implausibly** **Missing Signal**	The purpose of the function is to detect a failure if synchronisation on crankshaft signal cannot be achieved. Crankshaft error is detected without debouncing if the crank error is set by the camshaft signal acquisition. This is the case if a number of camshafts signal edges were detected at a plausible speed and gradient, and the system is still not synchronized with the crankshaft signal. If valid crankshaft teeth have already been detected, the symptom will be “implausible signal”, otherwise it will be “no signal”.	If no crankshaft signal is detected after a number of camshaft signal edges are detected **Cam Pulses = 16(200ms)** Then the crankshaft signal is missing If the number crankshaft teeth error is set Then the crankshaft signal is implausibly	Ignition key on Not in crankshaft errors limp home position	Once per crankshaft Revolution	M / 1
Crankshaft performance Diagnosis	**P0336 Loss of Synchronization** **Missing Teeth** **Additional Teeth**	The purpose of the function is to detect crankshaft failure when the system looses synchronization on the crankshaft signal. Synchronization will be lost if the reference gap is not detected at the correct position. The crankshaft signal acquisition may tolerate up to two missing/additional teeth without loosing synchronization, depending on the used target wheel and on configuration data. Synchronization is always lost with counting too many teeth, because the reference gap will be counted as a normal tooth when too many teeth are missing.	The number of teeth per crankshaft revolution is monitored by evaluation of the counter for missing or additional teeth Based on this value of the crankshaft pulse counter the corresponding symptom is set The pule counter > ± **2** The error flag is set after the maximum Fail timeis reached Fail time> **16(200ms)** **<u>If this error is set the following actions are taken:</u>** Engine stop will be set by a time-out if no more crankshaft signal edges are detected. A failure then may be detected by a plausibility test against the camshaft signal. The engine will synchronize and calculated a crank position based on the	Ignition key on Not in crankshaft errors limp home position	Once per crankshaft revolution	M / 1

		Tooth Number Error The number of teeth per crankshaft revolution is monitored by evaluation of the counter for missing or additional teeth. The low byte of this counter counts the missing teeth, the high byte counts the additional teeth. The crankshaft signal acquisition may tolerate up to two missing/additional teeth without loosing synchronization, depending on the used target wheel and on configuration data. If a tooth was missing or added during one revolution, then all variables based on teeth counting will be produced with an error. This concerns e.g. spark advance, segment time, misfire segments, camshaft position, etc. The purpose of the function is to provide an information when the crankshaft signal is inaccurate, in order to take the necessary actions. Depending on the value of crankshaft motoring counter, the symptom will be “missing teeth”, or “additional teeth”	intake camshaft			

Intake Camshaft Position (CMP) Sensor Circuit Bank 1 & 2	**P0340 Missing Signal (bank 1)** **P0345 Missing Signal (bank 2)**	The intake target wheel is an 8x signal consists of 4 long and 4 short high phases and low phases correspondingly. The falling signal edges are numbered from 0 to 7, starting with 0 at the falling edge before logical cylinder 0 TDC. All falling signal edges are having the same distance. A continuous camshaft edge counter is incremented with every plausible falling signal edge. The diagnoses detect camshaft errors: if no signal edge is detected during one crankshaft revolution.	Camshaft segment period (Time between two camshaft signal edges) < min time between two camshaft signal edges **Camshaft segment period < [(1, 1, 1, 0.5, 1, 1, 1, 2) * engine speed based factor]** Camshaft segment period (Time between two camshaft signal edges) > max time between two camshaft signal edges **Camshaft segment period > [(1, 1, 1, 0.5, 1, 1, 1, 2) * engine speed based factor]** No signal edge is detected for a time > max time between two camshaft signal edges **No signal edge is detected for a time > 970 ms** Camshaft edge counter for current segment = 0 Camshaft edge counter for current segment = Camshaft edge counter for pervious segment (no increment) Missing signal flag = 1 IVVT limp home - function is disabled Synchronization off intake cam is disabled	Ignition Key on	Recurrence Rate: **Once pre crankshaft revolution** **Or** **Camshaft signal implausible is detected**	M/2
Ignition Coil Cylinder #1	**P 0351** **P 2300** **P 2301**	This function will detect an open line, short to ground, and short to battery voltage on Ignition Coil Cylinder #1	Detection of coil errors are done by hardware diagnosis. Fail time= 16 (1.6s)	• OL Diagnosis • Short circuit to ground • Short circuit to VB Diagnosis • IGN = ON • No inhibit on coil circuit	Recurrence Rate Every Segment (90° Crank)	M \ 2
Ignition Coil Cylinder #2	**P 0352** **P 2303** **P 2304**	This function will detect an open line, short to ground, and short to battery voltage on Ignition Coil Cylinder #2	Detection of coil errors are done by hardware diagnosis. Fail time= 16 (1.6s)	• OL Diagnosis • Short circuit to ground • Short circuit to VB Diagnosis • IGN = ON • No inhibit on coil circuit	Recurrence Rate Every Segment (90° Crank)	M \ 2
Ignition Coil Cylinder #3	**P 0353** **P 2306** **P 2307**	This function will detect an open line, short to ground, and short to battery voltage on Ignition Coil Cylinder #3	Detection of coil errors are done by hardware diagnosis. Fail time= 16 (1.6s)	• OL Diagnosis • Short circuit to ground • Short circuit to VB Diagnosis • IGN = ON • No inhibit on coil circuit	Recurrence Rate Every Segment (90° Crank)	M \ 2

Ignition Coil Cylinder #4	**P 0354 P 2309 P 2310**	This function will detect an open line, short to ground, and short to battery voltage on Ignition Coil Cylinder #4	Detection of coil errors are done by hardware diagnosis. Fail time= 16 (1.6s)	• OL Diagnosis • Short circuit to ground • Short circuit to VB Diagnosis • IGN = ON • No inhibit on coil circuit	Recurrence Rate Every Segment (90° Crank)	M \ 2
Ignition Coil Cylinder #5	**P 0355 P 2312 P 2313**	This function will detect an open line, short to ground, and short to battery voltage on Ignition Coil Cylinder #5	Detection of coil errors are done by hardware diagnosis. Fail time= 16 (1.6s)	• OL Diagnosis • Short circuit to ground • Short circuit to VB Diagnosis • IGN = ON • No inhibit on coil circuit	Recurrence Rate Every Segment (90° Crank)	M \ 2
Ignition Coil Cylinder #6	**P 0356 P 2315 P 2316**	This function will detect an open line, short to ground, and short to battery voltage on Ignition Coil Cylinder #6	Detection of coil errors are done by hardware diagnosis. Fail time= 16 (1.6s)	• OL Diagnosis • Short circuit to ground • Short circuit to VB Diagnosis • IGN = ON • No inhibit on coil circuit	Recurrence Rate Every Segment (90° Crank)	M \ 2
Ignition Coil Cylinder #7	**P 0357 P 2318 P 2319**	This function will detect an open line, short to ground, and short to battery voltage on Ignition Coil Cylinder #7	Detection of coil errors are done by hardware diagnosis. Fail time= 16 (1.6s)	• OL Diagnosis • Short circuit to ground • Short circuit to VB Diagnosis • IGN = ON • No inhibit on coil circuit	Recurrence Rate Every Segment (90° Crank)	M \ 2
Ignition Coil Cylinder #8	**P 0358 P 2321 P 2322**	This function will detect an open line, short to ground, and short to battery voltage on Ignition Coil Cylinder #8	Detection of coil errors are done by hardware diagnosis. Fail time= 16 (1.6s)	• OL Diagnosis • Short circuit to ground • Short circuit to VB Diagnosis • IGN = ON • No inhibit on coil circuit	Recurrence Rate Every Segment (90° Crank)	M \ 2

Intake Camshaft position (CMP) sensor performance Bank 1 & 2	**P0341 Implausible Signal (bank 1)** **P0346 Implausible Signal (bank 2)**	The 8x signal consists of 4 long and 4 short high phases and low phases correspondingly. The falling signal edges are numbered from 0 to 7, starting with 0 at the falling edge before logical cylinder 0 TDC. All falling signal edges are having the same distance. A plausibility test is done at every falling signal edge. The algorithm has to synchronize on the camshaft signal. A corresponding status flag is set if synchronization is achieved. An errors flag is set if synchronization fails. The diagnoses detect camshaft errors: if synchronization on the signal fails	Camshaft segment time ratio (the period of two consecutive high level divided by the period of two corresponding low levels) is calculated at every falling camshaft signal edge, a match is searched in a table containing one theoretical ratio and the falling edge number. The calculated segment time ration has a threshold to compensate for ration during high engine speed increase. If no time ratio match is found then: Camshaft signal implausible flag is set IVVT limp home – function is disabled Synchronization off intake cam is disabled	Ignition Key on	Recurrence Rate: **Once pre crankshaft revolution** **Or** **Camshaft signal implausible is detected**	M/2

Exhaust Camshaft Position (CMP) Sensor Circuit Bank 1 & 2	**P0365 Missing Signal (bank 1)** **P0390 Missing Signal (bank 2)**	This diagnoses of Segment disc for determining of the relative position of the exhaust CAM. For no signal	No polarity change of the camshaft signal The errors flag for exhaust camshaft missing signal is set after the Fail timemax value is reached Fail time> **16** **<u>The diagnoses is present the following are disabled</u>** - Cam phasing (VCP function) is set to limp home (function Passive) - Deactivation of "Hardware Based Diagnosis with the CJ120 - Deactivate Generator L & F Terminal Monitor - Disable knock Control - Knock control adaptation (Circuit 1) - Maximum end of Pre-injection angle is used & a calibratable constant for start of injection - Disable fuel quality adaptation at start (start injection time adaptation) - Disable downstream lambda trim control - Disable Plausibility check of WARF Sensors - Disable WARF Sensors diagnosis Heater Coupling - Disable Diagnosis of the WRAF Sensor Dynamic - Disable Monitoring Upstream Sensor Signal - Disable Monitoring Upstream Sensor Signal during pull full cutoff (PUC) - Disable downstream oxygen sensor diagnosis - Disable dynamic fuel trim diagnosis - Disable catalyst efficiency diagnosis	Ignition Key on	Recurrence Rate: 100 ms	M/2

Exhaust Camshaft position (CMP) sensor performance Bank 1	**P0366 Implausible Signal (bank 1)** **P0391 Implausible Signal (bank 2)**	This diagnoses of Segment disc for determining of the relative position of the exhaust camshaft. Implausible signal detection	Polarity change occurs on the wrong position. Rising edge (Transition from low to high level) should occur in a window **34 crank tooth and 46 crank Tooth** Falling edge (Transition from high to low level) should occur in a window **34+60 crank tooth and 46+60 crank Tooth** Exhaust camshaft edge must occur with a certain crank tooth window The errors flag for exhaust camshaft implausible signal is set after the Fail timemax value is reached Fail time> **16** **<u>The diagnoses is present the following are disabled</u>** - Cam phasing (VCP function) is set to limp home (function Passive) - Deactivation of "Hardware Based Diagnosis with the CJ120 - Deactivate Generator L & F Terminal Monitor - Disable knock Control - Knock control adaptation (Circuit 1) - Maximum end of Pre-injection angle is used & a calibratable constant for start of injection - Disable fuel quality adaptation at start (start injection time adaptation) - Disable downstream lambda trim control - Disable Plausibility check of WARF Sensors - Disable WARF Sensors diagnosis Heater Coupling - Disable Diagnosis of the WRAF Sensor Dynamic - Disable Monitoring Upstream Sensor Signal - Disable Monitoring Upstream Sensor Signal during pull full cutoff (PUC) - Disable downstream oxygen sensor diagnosis - Disable dynamic fuel trim diagnosis Disable catalyst efficiency diagnosis	Ignition Key on A delay period (C_T_DLY_CAM_DIAG_EX = 0.5 second) has expired after the start has ended No previous failure on the exhaust camshaft being diagnosed	Recurrence Rate: 100 ms	M / 2

Catalyst System Low Efficiency Bank 1	**P 0420**	This DTC detects an insufficient catalyst O2 storage capacity and consequently insufficient conversion properties. This is detected by imposing a forced stimulation and monitoring by a downstream sensor signal During Catalyst test the canister purge is closed. This is to eliminate the need to enable based on canister load.	Monitoring cycle counter must end Catalyst diagnosis value must be greater than the maximum threshold for catalyst diagnosis to detect a catalyst malfunction. The threshold value is set to **1.0** (based on the integrated downstream lambda sensor voltage signal deviation relative to the mean value of the downstream signal)	• Start of a driving cycle **Enable Conditions** Coolant Temp > **62.25 °C** Cat Temp > **576 °C < 901°C** Vehicle Speed > **35 kph < 255kph** Rpm > **1216 < 3000** MAF > **170mgstk, < 400mgstk** Limited dynamic conditions must exist (no extreme variations in speed and load) Lambda controller must be active Forced stimulation of the linear lambda control is active Baro > **740hPa** **<u>This diagnostic is inhibited if any of the following DTC's are present:</u>** Cam sensor errors Crank sensor errors ECT errors IAT errors Vehicle speed errors O2 Sensor errors TP errors Fuel system diagnosis errors Misfire errors	20 ms Once per DC During low engine speed and load conditions a longer forced stimulation period is required to assure correct diagnosis. The longest period used is 1.24 seconds. This value is multiplied by 20 cycles to determine the worst case test time. The result is 24.8 seconds. Under most operating conditions the test will complete in one continuos test. However, if the test is interrupted, test results for previous cycles are stored. This means the 20 cycles do not have to be consecutive in order to complete the diagnostic. They do have to all be within the same key cycle.	M \ 2
Catalyst System Low Efficiency Bank 2	**P 0430**	This DTC detects an insufficient catalyst O2 storage capacity and consequently insufficient conversion properties. This is detected by imposing a forced stimulation and monitoring by a downstream sensor signal During Catalyst test the canister purge is closed. This is to eliminate the need to enable based on canister load.	Monitoring cycle counter must end Catalyst diagnosis value must be greater than the maximum threshold for catalyst diagnosis to detect a catalyst malfunction. The threshold value is set to **1.0** (based on the integrated downstream lambda sensor voltage signal deviation relative to the mean value of the downstream signal)	• Start of a driving cycle **Enable Conditions** Coolant Temp **> 62.25 °C** Cat Temp **> 576 °C < 901°C** Vehicle Speed **> 35 kph < 255kph** Rpm **> 1216 < 3000**	20 ms Once per DC During low engine speed and load conditions a longer forced stimulation period is required to assure correct diagnosis. The longest period used is 1.24	M \ 2

				MAF **> 170mgstk, < 400mgstk** Limited dynamic conditions must exist (no extreme variations in speed and load) Lambda controller must be active Forced stimulation of the linear lambda control is active Baro **> 740hPa** **<u>This diagnostic is inhibited if any of the following DTC's are present:</u>** Cam sensor errors Crank sensor errors ECT errors IAT errors Vehicle speed errors O2 Sensor errors TP errors Fuel system diagnosis errors Misfire errors	seconds. This value is multiplied by 20 cycles to determine the worst case test time. The result is 24.8 seconds. Under most operating conditions the test will complete in one continuos test. However, if the test is interrupted, test results for previous cycles are stored. This means the 20 cycles do not have to be consecutive in order to complete the diagnostic. They do have to all be within the same key cycle.	

Evaporative Emission (EVAP) Purge Solenoid Control Circuit	**P 0443 Open Circuit** **P 0458 SCG** **P 0459 SCVB**	The purpose is to diagnose electrical errors detected by the hardware (depending of output driver used).	The Electrical diagnosis is detected by the hardware internal to the ECM. SCG, SCVB, or Open Line will be detected. Fail Time 16 (3.2sec)	This diagnostic is inhibited if any of the following DTC's are present No CPS Errors Enable Conditions: IGN = ON	Recurrence Rate 200 ms	M / 2
Evaporative Emission (EVAP) Vent Solenoid Control Circuit	**P 0449 Open Circuit** **P 0498 SCG** **P 0499 SCVB**	The purpose is to diagnose electrical errors detected by the hardware (depending of output driver used).	The Electrical diagnosis is detected by the hardware internal to the ECM. SCG, SCVB, or Open Line will be detected. Fail Time 16 (3.2sec)	This diagnostic is inhibited if any of the following DTC's are present EVAP Enable Conditions: IGN = ON	Recurrence Rate 200 ms	M / 2
Fuel Level Sensor # 1 Performance / Rationality Diagnosis	**P 0461**	This Diagnostic checks the integrity of the Fuel Level sensor signal.	Fuel Level > FTL @ Start + .78%. Or Fuel Level < FTL @ Start - .78%. For Time > 1800s and Fail Time = 2 sec P 0461 = Active	Enable Conditions IGN = ON ENG = RUNNING Fuel Level > 7.8 L Fuel Level < 27.73 L Vehicle Spd > 25 kph Diagnosis = Active	Recurrence Rate 1 s	N / 1
Fuel Level Sensor # 1 Electrical Diagnosis	**P 0462**	This Diagnostic Detects a SCG in the Fuel Level Sensor or Circuit	FTL Volts < .5V for Time > 20s and Fail Time. > 5 sec P 0462 = Active	Enable Conditions IGN = ON System Voltage Faults = None	Recurrence Rate 100 ms	N / 1
Fuel Level Sensor # 1 Electrical Diagnosis	**P 0463**	This Diagnostic Detects an Open Signal Line / SCVB in the Fuel Level Sensor or Circuit	FTL Volts > 3v for Time > 20s and Fail Time. > 5 sec P 0463 = Active	Enable Conditions IGN = ON System Voltage Faults = None	Recurrence Rate 100 ms	N / 1
Vehicle Speed Input Signal Diagnosis	**P 0500**	The Vehicle speed input diagnostic is performed by verifying the Can Link is functional and the TCM is sending reliable output shaft data.	IGN = ON Can Message = Invalid Fail Time. > 16 (200ms) P 0500 = Active	This diagnostic is inhibited if any of the following DTC's are present: VSS Can Communication Diagnosis = Active	Recurrence Rate 12.5 ms	M / 2

Engine Oil Pressure (EOP) Sensor Rationality	**P0521 Pressure Sensor plausibility check** **(Stuck Sensor)**	In case of engine speed gradient variation (increasing or decreasing), during this engine speed variation we can check the oil pressure variation to determine a stuck sensor: in case of no variation after s certain delay we set an error assuming we have a failure with the Oil pressure sensor (detection of stuck value).	Absolute value of the delta between the current engine speed value and pervious engine speed value < a calibratable threshold is meet for a period of time greater than a calibratable time Time = **1 second** ABS(RPM(n) – RPM(n-1)) < **25 rpm** Absolute value of the delta between the current acquisition and pervious oil pressure value < a calibratable threshold ABS(EOP_MES(n) – EOP_MES(n-1)) < **0.25 bar** If the condition is meet for a period of time greater than a calibratable period Time = **1.5 second** If a failure is detected an errors flag is set after the Fail timemax value is reached Fail time> **16 (1.6s)** **<u>If this error is set the following actions are taken:</u>** Cam phasing (VCP function) will be engine speed limited (minimum engine speed to activate cam phasing will be increased to 1500 RPM)	No previous failure on the Oil Pressure sensor is present Ignition Key on The coolant must be with in thresholds: Minimum coolant temperature for oil pressure diagnosis < current coolant temperature < maximum coolant temperature for oil pressure diagnosis **20° C < ECT < 100° C** The engine speed must be with in thresholds: Minimum engine speed for oil pressure diagnosis < current engine speed< maximum engine speed for oil pressure diagnosis **600 < RPM < 6300**	100ms	M / 1
Engine Oil Pressure (EOP) Sensor Circuit	**P0522 Low Voltage** **P0523 High Voltage**	The Oil Pressure Sensor is checked for defects by a range check of its output voltage V_POIL. Two different conditions can be detected: - Oil pressure sensor signal line short to ground or open line - Oil pressure sensor signal line short to battery voltage	Short to ground/open circuit (low Voltage) Sensor voltage < threshold for detection short ground/open line Sensor Volts < **.1V** Short to battery (high voltage) Sensor voltage > threshold for detection short to battery Sensor Volts < **4.9V** If any of the electrical failure is detected an errors flag is set after the Fail time max value is reached Fail time> **16 (1.6s)**	Ignition Key on	Recurrence Rate; 100 ms	M / 1

			<u>If this error is set the following actions are taken:</u> Cam phasing (VCP function) will be engine speed limited (minimum engine speed will be increased			
Engine Idle Speed Diagnosis	**P 0506** **P 0507**	This diagnostic detects an out of control Idle Rpm, When Idle conditions are desired.	Rpm > Desired Rpm By TBL (200) Time > 10s Fail Time. > 1.6s P 0507 = Active Or Rpm < Desired Rpm By TBL (100) Time > 10s Fail Time. > 1.6s P 0506 = Active	<u>This diagnostic is inhibited if any of the following DTC's are present:</u> Crankshaft Sensor ETC TP Fuel Injectors Ignition Coils MAF MAP CPS <u>Enable Conditions</u> IGN = ON Eng = Running Throttle = Closed for a Time > 5s TP Adapt = Complete Vehicle Speed = 0 ECT > -7c ECT < 120c MAF < 300 mg/stk CPS Duty Cyc. < 100% Diagnosis = Active	Recurrence Rate; 100 ms	M / 2
A/C System High Side Pressure Sensor	**P 0531**	This Diagnostic will detect a skewed signal, a plausibility check on A/C Pressure Sensor will check if the signal is valid	AC Request = No AC Clutch = No AC Volts > 4.9 for Time > 240s Fail Time. > 16 (1.6) P 0531 = Active	<u>Plausibility diagnosis</u> IGN = ON ENG = RUNNING RPM > 450	Recurrence Rate; 100 ms	N \ 1
A/C System High Side Pressure Sensor	**P 0532** **P 0533**	This Diagnostic will detect an open line, short to ground, and short to battery voltage on A/C Pressure Sensor	Detection of A/C pressure sensor electrical errors are done by hardware diagnosis internal to the ECM. AC Volts > 4.9V Fail Time. > 16 (1.6s) P 0533 = Active AC Volts < .1V Fail Time. > 16 (1.6s) P 0532 = Active	<u>OL Diagnosis, Short circuit to ground</u> <u>Short circuit to VB Diagnosis</u> IGN = ON A/C requested = on Diagnostic = Active If any AC DTC is stored, The AC system will be disabled.	Recurrence Rate; 100 ms	N \ 1

System Voltage Diagnosis	**P 0562**	This Diagnosis detects low system voltage	System Volts < 8v Fail time> 30 (3s) P 0562 = Active	Enable Conditions IGN = ON ENG = RUNNING ENG Runtime > 10s RPM > 500	Recurrence Rate; 100 ms	M / 1
System Voltage Diagnosis	**P 0563**	This Diagnosis detects High system voltage	System Volts > 16v Fail time> 30 (3s) P 0563 = Active	Enable Conditions IGN = ON ENG = RUNNING ENG Runtime > 10s RPM > 500	Recurrence Rate; 100 ms	M / 1
Control Module Read Only Memory (ROM) Diagnosis	**P 0601**	This diagnostic will detect an ECM errors for ROM	Detection of ECM ROM errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 (1.6s)	IGN = ON	Recurrence Rate; 100 ms	M \ 1
Control Module Not Programmed	**P 0602**	This is for service ECU	ECM Not Programmed		Recurrence Rate; 1 s	M / 1
Control Module Random Access Memory (RAM) Diagnosis	**P 0604**	This diagnostic will detect an ECM errors for RAM	Detection of ECM RAM errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 (1.6s)	Enable Conditions Key "ON"	Once per Ignition Cycle (100 ms abc increment)	M \ 1
ETC – LEVEL 3 MONITORING FUNCTIONS. **ECM Self Test** **Control Module Performance (Safety Level 3) Diagnosis**	**P 0606**	The multiple diagnostic monitors associated with this diagnostic trouble code have all been added due to the ETC system. The monitors include RAM and ROM checks; pre-drive check; Can, SPI, Check Sum. instruction set tests; program flow monitoring and communication monitoring by both the main microprocessor and the monitoring microprocessor. There is also a check of the ability to control engine speed without throttle control.	1. It is checked each driving cycle that the monitoring microprocessor can disable through hardware connection the throttle and fuel injector drivers. 2. A special set of instructions are checked continuously with set inputs for proper calculation. 3. The program flow counter is monitored by checking that the level 2 monitors are called at specific time intervals. 4. The communication between the main microprocessor and the monitoring microprocessor is checked that correct signals are sent at specific time intervals. 5. The ROM check tests the algorithm software and the calibration data separately and continuously as well as the entire ROM at startup. 6. The RAM test checks the entire RAM at startup and does continuous complement checks of the level 2	Enable Conditions Key "ON"	Every crankshaft revolution	M / 1

			monitoring flags. 7. Once a level 2 errors has occurred, the engine speed limitation monitor checks that engine speed is controlled below a threshold. Detection of ECM self test errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 cts (Time depends on engine speed) P 0606 = active			
Vehicle Speed output Signal Electrical Diagnosis	**P 0608**	The Hardware detects electrical errors on the vehicle speed output signal ine.	The Hardware detects OL, SCG, & SCVB Fail Time. > 16 (3.2s)	This diagnostic is inhibited if any of the following DTC's are present: VSS Enable Conditions IGN = ON	Recurrence Rate; 200 ms	N / 1
Starter Relay Circuit	**P 0615** **P 0616** **P 0617**	This diagnostic will detect an ECM input open line, short to ground, or short to battery voltage on the Starter Relay Circuit	Detection of Starter Relay Circuit electrical errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 (3.2s) P 0615 = active P 0616 = active P 0617 = active	When the relay is commanded on, an open, or short to battery voltage can be detected. When the relay is commanded off, a short to ground can be detected.	Recurrence Rate; 200 ms	N / 1
Generator F-Terminal Diagnosis	**P 0625** **P 0626**	This diagnostic detects a failure on the Generator F – Terminal. The F – Terminal is monitored by the ECM. There are two Test performed: Key ON & Run	**Key ON Test** Gen Filtered (MMV) Duty Cycle ≥ 65% Time > 5s Fail Time. > 1 (.2s) P 0626 = Active **Run Test** Rpm < 3000 Gen Filtered (MMV) Duty Cycle ≤ 5% Time > 5s Fail Time. > 1 (.2s) P 0625 = Active	This diagnostic is inhibited if any of the following DTC's are present: Crankshaft Sensor Cam Sensor Generator Enable Conditions **Key ON Test** IGN = ON Rpm = 0 **Run Test** IGN ON ENG ON	Recurrence Rate; 200 ms	N / 1
Fuel Pump Speed Control Feedback Circuit	**P 0627** XLR only	This diagnostic will detect ECM input noisy on interface in the Fuel Pump Speed Control Circuit	Detection of Variable Fuel Pump Speed electrical errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 (1.6) P 0627 = active	IGN = ON Fuel pump controlled by fuel pump speed control (FPSC) No SPI bus failures	Recurrence Rate; 100 ms	N / 1

Fuel Pump Speed Control Output Circuit Low Voltage	**P 0628** XLR only	This diagnostic will detect an ECM input open line or short to ground on the Fuel Pump Speed Control Feedback Circuit	Detection of Variable Fuel Pump Speed electrical errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 (1.6) P 0628 = active	IGN = ON Fuel pump controlled by fuel pump speed control (FPSC) No SPI bus failures	Recurrence Rate; 100 ms	N / 1
Fuel Pump Relay Circuit Low Voltage	**P 0628** STS only	This diagnostic will detect an open line or short to ground on Fuel Pump Relay	Detection of Fuel Pump Relay electrical errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 (1.6s) P 0628 = active	IGN = ON Fuel pump **not** controlled by fuel pump speed control (FPSC)	Recurrence Rate; 100 ms	N / 1
Fuel Pump Speed Control Output Circuit High Voltage	**P 0629** XLR only	This diagnostic will detect a short to battery voltage on Fuel Pump Speed control Circuit	Detection of Fuel Pump Speed control electrical errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 (1.6) P 0629 = active	IGN = ON Fuel pump controlled by fuel pump speed control (FPSC)	Recurrence Rate; 100 ms	N / 1
Fuel Pump Relay Circuit High Voltage	**P 0629** STS only	This diagnostic will detect a short to battery voltage on Fuel Pump Relay Circuit	Detection of Fuel Pump Relay electrical errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 (1.6) P 0629 = active	IGN = ON Fuel pump **not** controlled by fuel pump speed control (FPSC)	Recurrence Rate; 100 ms	N / 1
Fuel Pump Speed Control Feedback Circuit	**P 0231** XLR only	This diagnostic will detect a fuel pump open circuit between the Fuel Pump Speed Control Module and the Fuel Pump	Detection of Variable Fuel Pump Speed electrical errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 (1.6) P 0231 = active	IGN = ON Fuel pump controlled by fuel pump speed control (FPSC) No SPI bus failures	Recurrence Rate; 100 ms	N / 1
Fuel Pump Speed Control Feedback Circuit	**P 0232** XLR only	This diagnostic will detect a fuel pump open circuit between the Fuel Pump Speed Control Module and the Fuel Pump	Detection of Variable Fuel Pump Speed electrical errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 (1.6) P 0232 = active	IGN = ON Fuel pump controlled by fuel pump speed control (FPSC) No SPI bus failures	Recurrence Rate; 100 ms	N / 1
Fuel Tank Transfer Pump	**P 2636** XLR only	This diagnostic will detect a failed fuel tank transfer pump	Primary tank fuel almost empty (primary tank fuel total less than **6.25** Litter) **AND** Secondary tank above empty threshold (secondary tank fuel total above **33** Litter) for a period of **60** Second.	IGN = ON	1S	N / 1
Fuel Pump Speed Control Feedback Circuit	**P 1251** XLR only	This diagnostic will detect an output driver failure on the Fuel Pump Speed Control or an FPSC internal Failure	Detection of Variable Fuel Pump Speed electrical errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 (1.6s) P 1251 = active	IGN = ON Fuel pump controlled by fuel pump speed control (FPSC) No SPI bus failures	Recurrence Rate; 100 ms	N / 1

Fuel Pump Speed Control Feedback Circuit	**P 1252** XLR only	This diagnostic will detect an erratic output on the Fuel Pump Speed Control	Detection of Variable Fuel Pump Speed electrical errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 (1.6s) P 1252 = active	IGN = ON Fuel pump controlled by fuel pump speed control (FPSC) No SPI bus failures	Recurrence Rate; 100 ms	N / 1
Fuel Pump Speed Control Feedback Circuit	**P 1253** XLR only	This diagnostic will detect a input failure 100% duty cycle on the Fuel Pump Speed Control Feedback Circuit	Detection of Variable Fuel Pump Speed electrical errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 (1.6s) P 1253 = active	IGN = ON Fuel pump controlled by fuel pump speed control (FPSC) No SPI bus failures	Recurrence Rate; 100 ms	N / 1
Engine Metal Overtemp Protection	**P 1258**	This diagnostic will detect an errors for an Engine Metal Overtemp	Detection of Engine Metal Overtemp is internal to the ECM. Fail Time. > 22 (2.2s) P 1258 = active	IGN = ON Engine running **This Diagnostic inhibits IAT, ECT, Misfire, Lambda, Fuel System, and Cruise Diagnostics from running.**	Recurrence Rate; 100 ms	M / 1
Fuel Pump Speed Control Feedback Circuit	**P 1254** XLR only	This diagnostic will detect a input failure 0% duty cycle on the Fuel Pump Speed Control Feedback Circuit	Detection of Variable Fuel Pump Speed electrical errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 (1.6s) P 1254 = active	IGN = ON Fuel pump controlled by fuel pump speed control (FPSC) No SPI bus failures	Recurrence Rate; 100 ms	N / 1
Multifunction Cruise Switch 1	**P 0564** STS only	This diagnostic will detect an Out of Range Cruise Switch Set/Coast Stuck Cruise Switch Resume/Accel Stuck Cruise Switch,	Detection of an Out of Range Cruise Switch is Fail Time > 48 (4.8s) P 0564 is active	IGN = ON Engine = Running	Recurrence Rate; 100 ms	N / 1
Brake Lamp Switch	**P 0572** **P 0573**	This diagnostic will detect the plausibility of the Brake Lamp Switch, To determine if the BLS is defective the vehicle speed must go above 50 mph and then to a complete stop. If the ECU does not see a switch in states, this will be considered a failed event. After 10 failed events the DTC will be stored.	Detection of Brake Lamp Switch Plausibility is: VS > 50 mph to 0 mph (complete stop) Fail Time. > 10 failed Events P 0572 is active SCG VS > 50mph TPS > 40% BLS = Active Fail Time > 10 Events P 0573 is active SCVB or Stuck Open	IGN = ON Engine = Running VB > 11v VS > 50 mph	Recurrence Rate; 100 ms	N / 1
Extended Travel Brake Switch Circuit (LAV ONLY)	**P 1575**	This diagnostic compares the hardwire input to the message received from the ABS module. When the brake is applied, the BTS has the value of 1, and the BLS has the value of ON.	Error detection is performed internal to the module Fail Time = TBD	**Enable Conditions** No BLS/BTS Errors Ign. “ON” Brake Pedal Depressed	Recurrence Rate; 100 ms	N / 1

		Therefore both should have the same digital value, they are reporting same pedal status.				
Throttle Actuator Position Performance	**P 0638**	This diagnosis is to detect a throttle valve errors. Command Performance	I Duty cycle of the ETC Position Controller I >= 100 % for Time > 0.85 s And if the Time < 1.2s (if breaks free in this amount of time, we do not have an errors) Otherwise : Fail timemax = 12 (60ms) P 0638 = Active Limp home – RPM limitation.	Activation: IGN =1. Deactivation: IGN =0 - LV_ERR_TP already set - Limp home active	Recurrence Rate; 5 ms	M / 1
Reference Voltage #1 Diagnosis (5 V)	**P 0641**	The purpose of this Diagnostic is to detect a failure 0n the 5 V Reference line which is a supply to multiple engine sensors.	Ref V < 2V (SCG) Fail Time. > 8 (.2s) P 0641 = Active Ref V > 3V (SVB) Fail Time. > 8 (.2s) P 0641 = Active Ref V Diff > .5V Fail Time. > 8 (.2s) Ref Signal = Noisy P 0641 = Active	Enable Conditions IGN = ON	Recurrence Rate; 25 ms	M / 1
A/C Compressor Clutch Relay	**P 0646** **P 0647**	This Diagnostic will detect an open line, short to ground, and short to battery voltage on A/C Compressor Clutch Relay	Detection of A/C compressor clutch relay electrical errors are done by hardware diagnosis internal to the ECM. If at Ignition "ON" an errors is detected Fail Time. > 16 (1.6s) P 0646 or P 0647 is Active	OL Diagnosis, Short circuit to ground Short circuit to VB Diagnosis IGN = ON AC Request = ON A/C Clutch = ON Diagnostic = Active	Recurrence Rate; 100 ms	N \ 1
Reference Voltage #2 Diagnosis (5 V)	**P 0651**	The purpose of this Diagnostic is to detect a failure 0n the 5 V Reference line which is a supply to multiple engine sensors.	Ref V < 2V (SCG) Fail Time. > 8 (.2s) P 0651 = Active Ref V > 3V (SVB) Fail Time. > 8 (.2s) P 0651 = Active Ref V Diff > .5V Fail Time. > 8 (.2s) Ref Signal = Noisy P 0651 = Active	Enable Conditions IGN = ON	Recurrence Rate; 25 ms	M / 1

Malfunction Indicator Lamp	**P 0650**	This Diagnosis detects electrical errors: OL/SCG or SCVB, in the Malfunction Indicator Lamp/Circuit	Detection of Malfunction Indicator Lamp errors are done by hardware diagnosis internal to the ECM. Fail time> 254 (Max Value)	IGN = ON Battery voltage > 11V	Recurrence Rate; 200 ms	N / 1
Cooling Fan Relay #1 Control Circuit Low Voltage **(LAV & Seville)**	**P 0691**	This Diagnostic will detect a low voltage / open circuit on Cooling fan	Detection of Cooling Fan electrical errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 (3.2s) P 0691 = Active	OL / SCG Diagnosis IGN = ON	Recurrence Rate; 200 ms	M \ 2
Cooling Fan Relay # 1 Control Circuit High Voltage (LAV & Seville)	**P 0692**	This Diagnostic will detect High voltage on the Cooling fan relay / circuit.	Detection of Cooling Fan electrical errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 (3.2s) P 0692 = Active	Short circuit to battery voltage IGN = ON	Recurrence Rate; 200 ms	M \ 2
Cooling Fan Relay #2 Control Circuit Low Voltage (LAV & Seville)	**P 0693**	This Diagnostic will detect a low voltage / open circuit on Cooling fan **Not Supported on the XLR**	Detection of Cooling Fan electrical errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 (3.2s) P 0693 = Active	OL / SCG Diagnosis IGN = ON	Recurrence Rate; 200 ms	M \ 2
Cooling Fan Relay #2 Control Circuit High Voltage (LAV & Seville)	**P 0694**	This Diagnostic will detect High voltage on the Cooling fan relay / circuit. **Not Supported on the XLR**	Detection of Cooling Fan electrical errors are done by hardware diagnosis internal to the ECM. Fail Time. > 16 (3.2s) P 0694 = Active	Short circuit to battery voltage IGN = ON	Recurrence Rate; 200 ms	M \ 2
Control Module Power Main Relay	**P 0686** **P 0687**	This diagnostic will detect an ECM input open line, short to ground, or short to battery voltage on the Control Module Power Main Relay	Detection of Main Relay Circuit electrical errors are done by hardware diagnosis internal to the ECM. Fail Time. > (2s) P 0686 = active P 0687 = active	IGN = ON	Recurrence Rate; 200 ms	N / 1

Control Module Power Main Relay (Feedback Diag)	**P 0689** **P 0690**	The Diagnosis is performed to detect if the Main Relay has effectively switched and remains on after Key-On. The Diagnosis is also performed to detect if the Main Relay has effectively switched off after Key-Off.	If ignition switch is on and ignition voltage > 11volts And time >1.5 seconds has elapsed. Then if VB (relay voltage) is < 10 volts for 0.200 seconds P0689 = active or If ignition switch is off And time >1.5 seconds has elapsed. Then if VB (relay voltage) is > 10 volts for 0.125 seconds P0690 = active	IGN = ON and ignition voltage > 11 volts OR Ignition Off	Recurrence Rate; 12.5 ms	N / 1
Transmission Control Unit	**P 0700**	This diagnostic will detect an errors for the TCU and report it to the ECM to Light the MIL	Detection of TCU errors are done by hardware diagnosis internal to the ECM Fail Time. > 1 (.1s) P 0700 = active	IGN = ON	Recurrence Rate; 100 ms	M / 1
Brake Lamp Switch	**P 0703**	The brake pedal initial travel achieved signal is used to indicate the brake pedal has been depressed. Cruise is disengaged when the pedal is depressed. Therefore, brake pedal initial travel achieved is considered a critical signal and has various types of signal supervision applied to it, including a validity bit, a rolling count, a protection value, and a frame timeout. For example, if any of these errors have occurred in 11 of 15 frames, cruise is disabled. Recieving good messages for a calibratable period will indicate the signal has recovered. If not a DTC will be stored	Detection of Brake Lamp Switch Plausibility is: No Messages received / recovered Fail Time. > 100ms P 0703 is active	IGN = ON Engine = Running VB > 11v	Recurrence Rate; 100 ms	N / 1
Automatic Gear Shift Signal (Park / Neutral)	**P 0850**	This diagnostic will detect a failure on the Park Neutral Switch through the TCM message from CAN and comparing to actual input, or if the P/N input is active and the failure criteria is within the	Selected Gear = PN PN = Input Active TPS > 20% TQ > 200 nm VS > 50 Kph P 0850 = Active PN = Active	<u>Enable Conditions</u> Key “ON” Eng “ON” VB > 10v < 18v <u>This diagnostic is inhibited if any of the following DTC’s are present:</u> Gear Errors (TCM) CAN Errors	Recurrence Rate; 100ms	N / 1

		failure range, the fault is detected and the DTC will be stored.	Selected Gear ≠ P/N P0850 = Active Fail time> 1.6 s	VSS IGN = ON PN Input = Active		
TCS Drag Reduction Request (LAV ONLY)	**P 1513**	This diagnostic will detect a No Response on TCS Drag Reduction Request	Detection of the TCS Drag Reduction Request is Fail Time > 16 (200ms) P 1513 is active	IGN = ON Engine = Running	Recurrence Rate; 12.5 ms	N / 1
Theft Deterrant System	**P 1626 Signal Lost** **P 1629 Message not Received**	This Diagnostic will detect if the VTD Signal is lost or not received	Detection of the Theft Deterrant Missing Message is performed internal to the ECM Fail Time > 16 (1.6) P 1626 is active P 1629 is Active	IGN = ON	Recurrence Rate; 100 ms	N / 1
Theft Deterrant Learn Mode Active	**P 1630**	This diagnostic will detect an errors on Learn Mode Active for Theft Deterrant	Detection of the Theft Deterrant Learn Mode is performed internal to the ECM Fail Time > 16 (1.6s) P 1630 is active	IGN = ON	Recurrence Rate; 100 ms	N / 1
Theft Deterrant Start Enable Signal Not Correct	**P1631**	This diagnostic will detect an errors on Signal Not Correct for Theft Deterrant	Detection of the Theft Deterrant Start Enable Signal Not Correct is performed internal to the ECM Fail Time > 16 (1.6s) P 1631 is active	IGN = ON	Recurrence Rate; 100 ms	N / 1
Lift / Dive for RTD (Real Time Damping)	**P 1652**	This diagnostic will detect the plausibility for Lift / Dive for RTD	Detection of the Lift / Dive for RTD is Fail Time > 16 (.4s) P 1652 is active	IGN = ON Engine = Running	Recurrence Rate; 25 ms	N / 1
Generator L-Terminal Diagnosis	**P 2500 Generator L- Terminal Low Voltage** **P 2501 Generator L- Terminal High Voltage**	This diagnostic detects a failure on the Generator L – Terminal. The Generator L-terminal is monitored by the Powertrain controller. The Generator voltage regulator indicates a fault condition (i.e., internal fault, broken belt) by pulling the L-terminal input to a "low" state. There are two Test performed: Key ON & Run	The Generator L-terminal output diagnostics indicate a short to power failure or a short to ground failure continuously for a time period, that is greater than or equal to **Key ON Test** Gen Filtered (MMV) Duty Cycle ≥ 97% Time > 15s Fail Time. > 1 (.2s) P 2501 = Active **Run Test** Gen Filtered (MMV) Duty Cycle ≤ 2% Time > 20s Fail Time. > 1 (.2s) P 2500 = Active The generator L-terminal fault diagnostic trouble code (DTC) shall be cleared when	Key-on Test. Run Test This diagnostic is inhibited if any of the following DTC's are present: L –terminal CAM Crank Rpm = 0	Recurrence Rate; 100 ms	N / 1

			the conditions for the L-Terminal fault DTC are not present, or when a Service Test Tool has commanded clearing of the DTC.			
Fuel Level Sensor # 2 Performance / Rationality Diagnosis	**P 2066**	This Diagnostic checks the integrity of the Fuel Level sensor signal.	Fuel Level > FTL @ Start + .78%. Or Fuel Level < FTL @ Start – .78%. For Time > 1800s and Fail Time = 2 P 2066 = Active	Enable Conditions IGN = ON ENG = RUNNING Fuel Level > 7.8 L Fuel Level < 27.73 L Vehicle Spd > 25 kph Diagnosis = Active	Recurrence Rate; 1s	N / 1
Fuel Level Sensor # 2 Electrical Diagnosis	**P 2067**	This Diagnostic Detects a SCG in the Fuel Level Sensor or Circuit	FTL Volts < .5V for Time > 20s and Fail Time. > 5 sec P 2067 = Active	Enable Conditions IGN = ON System Voltage Faults = None	Recurrence Rate; 100 ms	N / 1
Fuel Level Sensor # 2 Electrical Diagnosis	**P 2068**	This Diagnostic Detects an Open Signal Line / SCVB in the Fuel Level Sensor or Circuit	FTL Volts > 3v for Time > 20s and Fail Time. > 5 sec P 2068 = Active	Enable Conditions IGN = ON System Voltage Faults = None	Recurrence Rate; 100 ms	N / 1
Throttle Actuator Control (TAC) Motor Control Circuit	**P2100**	The TAC H-Bridge IC checks every 1ms the MTC if there is a short circuit to battery voltage or ground. In addition the IC is able to detect Overtemp.	TAC H-Bridge IC Flag = 1 Fail time max = ~~12 s~~ 16 (80ms) P 2100 =Active Limp home – RPM limitation.	Activation: IGN =1. The errors bits, Failure-counters and other variables or bits are initialised Deactivation: IGN =0 or the setting conditions are not fulfilled anymore - LV_ERR_TP already set - Limp home active	Recurrence Rate; ~~1s~~ 5ms	M /1
Throttle Actuator Position Performance	**P 2101**	This diagnosis is able to detect a throttle valve errors or a jammed actuator. The given pulse width modulation signal MTCPWM exceeds the position controller permissible maximum value for longer than designated time.	TP Average – TP Set Point | > 1.503 ° TP for the Time > 2 s ~~Fail time max = 12 (60ms)~~ Fail Time = 5ms P 2101 = Active Limp home – RPM limitation	Activation: IGN =1. Deactivation: IGN =0 - LV_ERR_TP already set - Limp home active	Recurrence Rate; 5 ms	M / 1
Throttle Actuator Position Module	**P 2108**	This DTC is able recognize that any of the safety level 2	Any of the level 2 flags enabled : LV_XXX_MON = 1	Activation: IGN = 1 Deactivation: IGN = 0	Recurrence Rate 40 ms	M / 1

Performance – Safety Level 2		flags are enabled (APP, MAF,ADC,ECT, etc) The errors would be set and limp home is enabled.	Fail Time Min = 4 (160ms) Fail time max = 12 (480ms) P 2108 = Active Limp home – RPM limitation	- LV_ERR_TP already set - Limp home active		
Throttle position adaptation	**P 2119**	This diagnosis is to determine the measurement inaccuracy between the two signal voltages. They will be referenced to their supply voltage. After the initial engine start and component change the characteristic Potentiometer value is learnt within an adaptation routine. The value for the lower stop is stored at the end of the driving cycle in the non-volatile memory. A plausibilization unit monitors both sensor signals, as well as the belonging supply voltage and from them establishes the system state of the THR-position acquisition (undisturbed, disturbed, THR-position not recognizable). From the voltages of both TP-channels, the THR-position for each channel is determined, taking into consideration the adaptation values for the lower stop. If the conditions are not fulfilled the errors is set. Ignition and injection would be deactivated.	<u>Start Routine</u> <u>First Check of Limp Home position at Start routine (ST_CHK_CHK_LIH_1)</u> I Voltage_TP_X – 0.84 V | ≤ 0.2490 V P 2119 = Active Ignition and injection remains deactivated NEXT Step : <u>Spring test at the Start routine (ST_CHK_GO_UPPER_POS)</u> |TP_AV – 17.0027 ° | ≤ 1.860 °TP / 5ms P 2119 = Active Limp Home 2 Active <u>2nd Limp Home position at Start routine (ST_CHK_CHK_LIH_2)</u> I Voltage_TP_1/2 – Adapt.value for ch 1/2 I ≤ 0.2490 V P 2119 = Active Limp Home 2 Active <u>Adaptation Routine</u> <u>Adaptation of limp home position (AD_CHK_LIH_1)</u> |Voltage TP Ch 1 / 0.840| ≤ 0.3027 V |Voltage TP Ch 2 / 4.141| ≤ 0.3027 V P 2119 = Active Limp Home 2 Active <u>Spring test at the adaptation routine</u>	Activation: IGN = 1 Deactivation: IGN = 0 - LV_ERR_TP already set - Limp home active	Recurrence Rate 5 ms	M / 1

			|TP_AV – 17.0027 ° | ≤ 1.860 °TP / 5ms P 2119 = Active *Limp Home 2 Active 2nd Limp home check I Voltage_TP_1/2 – Adapt.value for ch 1/2 I <= 0.2490 V P 2119 = Active *Limp Home 2 Active Adaptation of lower mechanical stop (AD_GO_LOWER_STOP) |Voltage_TP _1 - 0.508 V| ≤ 0.0781 |Voltage_TP _1 - 4.492 V| ≤ 0.0781 P 2119 = Active *Limp Home 1 Active Limp home spring Test opening TP_Set point_during adapt ≥ 8.0017 ° Third Check of Limp Home position at Adaptation routine (AD_CHK_LIH_3) IVoltage_TP _1 - 0.508 V| ≤ 0.0781 |Voltage_TP _2 - 4.492 V| ≤ 0.0781 P 2119 = Active *Limp Home 2 Active * ETC Limp Home 1 -Throttle valve without the power(hold by spring in the Limp-Home position) -Engine speed limitation in limp home mode(with considering the drivers request) *ETC Limp Home 2		

			-Throttle valve without the power(hold by spring in the Limp-Home position) -Engine speed limitation in limp home mode(without considering the drivers request)			
Accelerator Pedal Position (APP) Sensor 1 Circuit Low Voltage	**P2122**	This DTC can distinguish the circuit's high voltage. During normal operation, the output voltages of the APP-sensors must lie within a permitted range.	Voltage_PVS_1 < 0.1465 V Fail timemax = 12 (300ms) P2122 = Active Limp home – calibrateble TQ reduction with pedal limitation	Activation: IGN =1. The errors bits, Failure-counters and other variables or bits are initialised Deactivation: IGN =0 or the setting conditions are not fulfilled anymore - LV_ERR_PVS already set - Limp home active	Recurrence Rate 25 ms	M / 1
Accelerator Pedal Position (APP) Sensor 1 Circuit High Voltage	**P2123**	This DTC can distinguish the circuit's high voltage. During the normal operation, the output voltages of the APP-sensors must lie within a permitted range.	V_PVS_1 > 4.8096 V LV_ERR_PVS_H_1 = 1 Fail timemax = 12 (300ms) P2123 = Active Limp home – calibrateble TQ reduction with pedal limitation	Activation: IGN =1 Deactivation: IGN =0 - LV_ERR_PVS already set - Limp home active	Recurrence Rate 25 ms	M / 1
Throttle Position (TP) Sensor 1-2 Correlation	**P 2135**	This DTC detects the rationality between TP 1 and 2. Test performs a comparison between TP 1 voltage vs. TP 2 in order to detect relative deviation of the two TP voltages. (calculated from the maximum value of the both channels).	I TP ratio check calculation I > 0.2688 V Fail timemax = 12 (300ms) Errors is set and P 2135 = Active Limp home – RPM limitation If we have that : MAF_Measured < 519 mg/stk We proceed with calculation of MAF_SUB_X (Maf,IAT,ECT,Baro) and Deviation TP_MAF_DIF_X (for each channel) used for determining which channel is faulty)	Activation: IGN =1. The errors bits, Failure-counters and other variables or bits are initialised Deactivation: IGN =0 or the setting conditions are not fulfilled anymore. - LV_ERR_TP already set - Limp home active	Recurrence Rate 25 ms	M / 1
Accelerator Pedal Position (APP) Sensor 1-2 Correlation	**P 2138**	The objective of the Ratio Check is to detect a relative deviation of the two APP voltages. If the voltages differ more than a permitted Hysteresis, the fault code will be set during	Ratio check calculation of CH 1 & 2 V Diff > .32V Hysteresis (calculated form the max values of the channels) Ratio deviation errors is set (not able to detect the faulty channel)	Activation: IGN = 1. Deactivation: IGN = 0 - LV_ERR_PVS already set - Limp home active	Recurrence Rate 25 ms	M / 1

		debouncing.	Fail timemax = 12 (300ms) P 2138 = Active Limp home – calibratible TQ reduction with pedal limitation			
Accelerator Pedal Position (APP) Sensor 2 Circuit Low Voltage	**P2127**	This DTC can distinguish the circuit's low voltage. During the normal operation, the output voltages of the APP-sensors must lie within a permitted range.	Voltage PVS_2 < 0.1465 V P2127 = Active Fail timemax = 12 (300ms) Limp home – calibratible TQ reduction with pedal limitation	Activation: IGN =1. The errors bits, Failure-counters and other variables or bits are initialised Deactivation: IGN =0 or the setting conditions are not fulfilled anymore. - LV_ERR_PVS already set - Limp home active	Recurrence Rate 25 ms	M / 1
Accelerator Pedal Position (APP) Sensor 2 Circuit High Voltage	**P2128**	This DTC can distinguish the circuit's high voltage. During normal operation, the output voltages of the APP-sensors must lie within a permitted range.	Voltage PVS_2 > 4.5898 Fail timemax = 12 (300ms) P2128 = Active Limp home –calibrateble TQ reduction with pedal limitation	Activation: IGN =1. The errors bits, Failure-counters and other variables or bits are initialised Deactivation: IGN =0 or the setting conditions are not fulfilled anymore. - LV_ERR_PVS already set - Limp home active	Recurrence Rate 25 ms	M / 1
Throttle position start check 1	**P 2176**	This diagnostic checks the following conditions First limp home check and Adaptation of the Limp Home Position Limp home spring test Second limp home check	Voltage_TP_1,2 compared to adaptive Voltages are (.249 V) time > (.05 s) then conditions not met. New adaptation is necessary if engine start cancelled First Limp home check must be fulfilled. The actual value of the throttle position has to reach the setpoint 11.99° within the hysteresis(1.86°/5ms) within a limit maximum of time (.2 S). Limp home-Engine speed limitation. Limp home spring test must be fulfilled. TP V 1,2 compared to adaptive Voltages are > .249 V for time .05 s then conditions not met. New adaptation is necessary if engine start cancelled or else Limp home-Engine speed.	Activation: IGN =1 Each step must be met in order to continue on to the next step Deactivation: IGN=0 - TP adaptation request - Limp home active - Ignition and Injection are active	Recurrence Rate 5 ms	M/1

Evaporative Emission (EVAP) System (≤ 1mm Leak Detected)	**P 0442**	Leak detection based on pressure rise and vacuum method (if necessary). The function closes the SOV (shut off valve/vent valve) and the CPS (canister purge solenoid) so that the entire evap systems is sealed, with the engine off. The sum of the pressure rise and the absolute value of the vacuum (if necessary) is compared to a threshold, and a ratio is calculated.	Ratio_dtp_fil_eonv > 0.40 Fail Time < 40 ms P0442 = Active (0.020)	- Minimum Eng Runtime ≥ 600 s - Barometric Pressure ≥ 740 hPa - ECT ≥ 69.75 □ C - 3.75 C < IAT_ST < 32.25 □C - 1.50 C < TAM < 32.25 □C - 15% < FTL_mmv < 85% - Distance traveled > 5 km - Battery voltage > 10.5 volts - Differential tank pressure fluctuation detected at least once before monitoring active - Service request not active (canister purge valve, venting valve) The monitoring is inhibited if any of the following errors are present : - DTP errors - Canister purge valve errors - Venting valve errors - ECT errors	Recurrence Rate : 1 per trip (true cold start condition)	M / 1
Evaporative Emission (EVAP) Vent System Performance (Stuck Closed)	**P 0446**	During normal in-use conditions the differential pressure (tank, atmosphere) in the fuel tank system has to be greater than a threshold	DTP value < -17 hPa Fail time: 1.5 sec This diagnostic disables the followings : -EVAP emission control -EVAP monitoring -DTP diagnosis	Engine stop phase not active Engine start phase not active Canister purge active The monitoring is inhibited if any of the following errors are present : -DTP errors -Venting valve electrical errors	Recurrence Rate = 50ms	M / 2
Fuel Tank Pressure – Sensor (DTP) Performance	**P 0451**	The DTP sensor performance is performed from two ways : **A-** Constant sensor value detection. From engine start and for calibrated time duration the variation of the DTP signal has to be greater than a calibrated threshold. **B**- Noisy sensor value detection. At idle the DTP signal value variations have to be smaller than 2 thresholds (peak/peak, slope).	**A-** Differential tank pressure variation < 1.0v Fail time: = 1.5 sec This diagnostic disables the followings : -DTP diagnosis -EVAP monitoring -Venting valve stuck close diagnosis **B** Differential tank pressure sensor variation > 1.7 hPa Differential tank pressure sensor slope > 1.5 hPa/s Fail time: = 1.5 sec This diagnostic disables the followings : -DTP diagnosis -EVAP monitoring -Venting valve stuck close diagnosis	**A-** Engine started -Vehicle speed variation > 30 km/h -Canister flow variation > 0.01 kg/h -Differential tank pressure > 0.02V The monitoring is inhibited if any of the following errors are present : -DTP errors (noisy, electrical) -Vehicle speed errors -Canister purge valve errors **B** -Idle speed active -Differential tank pressure fluctuation detected at least once before idle speed active The monitoring is inhibited if any of the following errors are present : -DTP errors (constant, electrical) -Vehicle speed errors -Canister purge valve errors -Venting valve errors	Frequency = 50 ms	M / 2

				-MAF errors -TP errors -IAT errors -ECT errors -Upstream lambda sensor errors -FSD -Injector errors -Misfiring		
Fuel Tank Pressure – Sensor (DTP) Electrical Diagnosis	**P 0452 FTP Circuit Low Volts** **P 0453 FTP Circuit High Volts**	The DTP sensor electrical diagnosis is performed by two ways, **A-** Short to ground **B-** Short to battery or line break	**A-** Differential tank pressure variation < 0.02v Fail time: Increment = 1 Max counter = 30 Fail time = 3 sec This diagnostic disables the followings : -DTP diagnosis -EVAP monitoring -Venting valve stuck close diagnosis **B** Differential tank pressure sensor variation > 0.5 hPa Differential tank pressure sensor slope > 1 hPa/s Fail time: Increment = 1 Max counter = 30 Fail time = 3 sec This diagnostic disables the followings : -DTP diagnosis -EVAP monitoring -Venting valve stuck close diagnosis	**Engine running**	**All the time when engine runs.** **Frequency =100 ms**	M / 2
Fuel Tank Pressure – Sensor (DTP) Intermittent	**P 0454**	The DTP sensor intermittent diagnosis is performed by two ways, **C-** Short to ground **D-** Short to battery or line break	**A-** Differential tank pressure variation < 0.049v **B** Differential tank pressure sensor > 4.95v Fail time: Increment = 1 Max counter = 16 Fail time = **1.6 s** This diagnostic disables the followings : -DTP diagnosis -EVAP monitoring -Venting valve stuck close diagnosis	**Engine running**	**All the time when engine runs.** **Frequency = 100 ms**	N \ 1

Evaporative Emission (EVAP) System (Large Leak Detected)	**P 0455**	The large leak detection is performed from two ways : A-**0.090** leak detection based on decay method. Vacuum is generated in the fuel tank system by means of canister purge valve opening and canister vent valve closed, (evacuation) then the purge is stopped and the EVAP system is sealed. Then leak size is calculated based on decay ratio of the negative pressure relying on the differential pressure sensor (tank, atmosphere). The leak size calculated is compared to a threshold. B. Cap-off/gross leak is detected during EVAC process of EVAP function. When canister valve is opened and shut-off valve closed, the time and pressure drop is continually monitored. If the maximum time has been reached, but pressure drop did not reach the calibrated threshold, then Cap-off/gross leak DTC will be stored.	A- After EVAC (evacuation) process, with the EVAP system sealed, the pressure decay ratio is monitored and the result is compared to a sealed system decay pattern. The difference of the actual pressure - a calculated table value (model) will determine the size of the leak. When leakage diameter **> 0.939 mm**, DTC Time lenght **< 35 sec** P0455 = **.090 Active** B- If Difference of Differential Tank Pressure Sensor (DTP) reading before and after EVAC process **> -12.45 hpa** And Time evacuation **≥ 17 s** Then Cap-off/gross leak is detected Time Length **< 35 sec** P0455 **Gross Leak = Active**	A- External tool is present = FALSE VS **< 10 km/h** AMP **> 740.039 hpa** Rpm **> 600 < 1200** Closed Loop = TRUE ECT **> 69.75** DTP **< 1.0 hPa > -17 hPa** Engine runtime **> 1000s** Canister Load **< 1.2 (60% saturation**) FTL **> 14.84 < 85.15%** IAT calc (Model) **> 2.25 °** The monitoring is inhibited if any of the following errors are present : DTP sensor VS Canister purge valve TCO TIA TPC Lambda Sensor Lambda Sensor Heater Fuel System Diagnosis Miss fire A VB B- Same As above conditions	Recurrence Rate = 1 per trip	M \ 2
Emission (EVAP) System Flow During Non-Purge (Stuck Open)	**P 0496**	The Canister valve opening check is done during the EVAP monitoring. At the beginning of the leak monitoring the vapor level is measured by closing the canister purge valve and the canister vent valve. While the vapor level measurement the differential pressure inside the tank has to be greater than a threshold, otherwise a failure is detected	Time elapsed in Vapor generation phase **< 5 s** DTP variation **> - 5.5 hPa** This diagnostic disables the followings : -Canister Purge valve in minimum mode -Lambda diagnosis – upstream sensor -Lambda diagnosis – downstream sensor -Lambda adaptation -DTP sensor diagnosis -Idle speed adaptation -FSD	Leak detection monitoring in Vapor generation phase The monitoring is inhibited if any of the following errors are present : Same than Evaporative Emission (EVAP) System (≤ 1mm Leak Detected)	Frequency = 1 per trip	M / 2
Lost Communication with TCS	**U 1040**	This diagnostic will detect a failure on the Class 2 Data link connection to the TCS (STS only)	Detection of Class 2 Failure is internal to the ECM. Fail Time. > 16 (200ms) P 1040 = active	IGN = ON Engine = Running	Recurrence Rate 12.5 ms	N / 1

Electrical Class 2 Failure	**U1300 U1301**	This diagnostic will detect an electrical open, short to ground, or short to battery voltage (STS Only)	Detection of Electrical Class 2 Failure is internal to the ECM. Fail Time. > 16 (200ms) P 1300 = active P 1301 = active	IGN = ON	Recurrence Rate 12.5 ms	N / 1
Can Bus Communication Malfunction	**U 0001**	This diagnostic will detect a failure on the Can Bus Data link connection	Detection of Can Bus Failure is internal to the ECM. Fail Time. > 16 (200ms) P 0001 = active	IGN = ON	Recurrence Rate 12.5 ms	N / 1
Lost Communications With Transmission Control System	**U 0101**	Communication is performed internal to the ECM	Detection of Class 2 Failure is internal to the ECM. Fail Time. > 16 (200ms)	IGN = ON	Recurrence Rate 12.5 ms	M / 1
Loss of Module on CAN bus	**U 0002**	Adaptive cruise DTC set only if adaptive cruise is present. (STS only)	Detection of CAN bus is internal to the ECU Fail time> 16 (200ms)	IGN = ON	Recurrence Rate 12.5 ms	N / 1
Lost Communication With BCM System	**U 0140**	Communication is performed internal to the ECM	Detection of BCM is internal to the ECU Fail time> 16 (200ms)	IGN = ON	Recurrence Rate 12.5 ms	N / 1
Lost Communications With Brake/Traction Control System	**U 0121**	Communication is performed internal to the ECM (215 Only)	Detection is internal to the ECU Fail time> 16 (200ms)	IGN = ON	Recurrence Rate 12.5 ms	N / 1
Lost Communications With Powertrain Control (ACC) System	**U 0104**	Communication is performed internal to the ECM (215 Only)	Detection is internal to the ECU Fail time> 16 (200ms)	IGN = ON	Recurrence Rate 12.5 ms	N / 1
Lost Data from DIM	**U 1064**	STS Only	Detection is internal to the ECU Fail time> 16 (200ms)	IGN = ON	Recurrence Rate 12.5 ms	N / 1
Lost Data from CCP	**U 1153**	STS Only	Detection is internal to the ECU Fail time> 16 (200ms)	IGN = ON	Recurrence Rate 12.5 ms	N / 1
Lost Data from VTD	**U 1192**	STS Only	Detection is internal to the ECU Fail time> 16 (200ms)	IGN = ON	Recurrence Rate 12.5 ms	N / 1