



Aston Martin On Board Diagnostics (OBD) Summary Documentation

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Note: The V12 EOBD engine family is certified as a single submission. The calibration content and therefore the data is identical for each model with the V12 engine; V12 Vantage, DBS and DB9.

The Automatic Transmission summary is included but does not apply to the V12 Vantage.



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AML EOBD System Operation Summary



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AML EOBD System Operation Summary for Gasoline Engines.

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Introduction

This document describes in detail the operation of the AML (Aston Martin Lagonda) EOBD System.

The AML EOBD System consists of a series of Monitors designed to observe the operation of strategic aspects of the Emission Control System. For each of the Monitors there is a detailed functional review of the monitor's operation, a listing of the relevant malfunction codes, typical Monitor entry conditions followed by typical malfunction thresholds.

The AML EOBD System also incorporates a Malfunction Indicator Lamp or MIL (symbol shown on the last page). The MIL will only be used to report emission related failures and to indicate emergency start-up or Limp Home routines. It will not be used for any other purpose.

Although this document describes all the Monitors contained within the AML EOBD System, not ALL of these monitors may be utilised on every vehicle built with the AML EOBD System. This is primarily due to the hardware configuration of the particular vehicle in question e.g. Auto vs. Man Transmission OR EGR vs. No EGR. Please refer to the vehicle specific documentation for details of those Monitors that will be operational.

It is important to note that to illuminate the MIL, the failure condition must be observed at least twice. The first occurrence will set a 'pending code' and the second occurrence will illuminate the MIL. The only exception to this is the Type A Misfire failure, which will 'flash' the MIL at the first occurrence of the failure condition. Therefore, if an OBD reset is performed, a minimum of two trips is required to illuminate the MIL, although the Misfire Monitor does require pre-conditioning to learn 'Profile Correction' and will utilize three trips.

De-activation of the MIL can be achieved if, no further separate failure conditions are detected and 3 subsequent and sequential trips have been completed where the original failure condition which illuminated the MIL initially, is no longer detected.

The MIL code will be completely erased if the same failure condition is not detected after 40 trips.



Catalyst Efficiency Monitor

The Catalyst Efficiency Monitor uses an oxygen sensor before and after the catalyst to infer Hydrocarbon conversion efficiency, based on oxygen storage capacity. Under normal closed-loop fuel conditions, high efficiency catalysts have significant oxygen storage, which makes the switching frequency of the rear HO2S quite slow compared with the switching frequency of the front HO2S. As catalyst efficiency deteriorates, its ability to store oxygen declines and the post-catalyst HO2S signal begins to switch more rapidly, approaching the switching frequency of the pre-catalyst HO2S.

In order to assess catalyst oxygen storage, the monitor compares front and rear HO2S signals during closed-loop fuel conditions after the engine is warmed-up and inferred catalyst temperature is within limits. Front HO2S signals are accumulated in up to nine different air mass regions or cells although 3 air mass regions is typical. Rear HO2S signals are counted in a single cell for all air mass regions. Currently there are two algorithms that can be used to compare the front and rear HO2S signals:

1. Switch Ratio method;

The Switch Ratio method compares the 'switch frequencies' of the front and rear HO2S sensors. A 'switch' is counted every time the HO2S voltage output passes through a defined threshold (0.45 V). The catalyst condition is diagnosed by dividing the number of rear HO2S switches by the number of front HO2S switches.

2. Index Ratio method.

The Index Ratio method calculates and compares the length of the front and rear HO2S signals. The catalyst condition is diagnosed by dividing the length of the rear HO2S signal by the length of the front HO2S signal.

A Switch / Index Ratio near 0.0 indicates high oxygen storage capacity, hence high HC efficiency. A Switch / Index Ratio near 1.0 indicates low oxygen storage capacity, hence low efficiency. To improve the robustness of the monitor, the Switch / Index Ratio is calculated using an Exponentially Weighted Moving Average (EWMA) algorithm. If the Switch / Index Ratio exceeds the threshold, the catalyst is considered failed.



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Catalyst Monitor Operation:	
DTCs	P0420 Bank 1, P0430 Bank 2 for Series System (and P0420 Complete System for 'Y pipe' configuration).
Monitor execution	once per driving cycle
Monitor Sequence	HO2S monitor complete and OK
Sensors OK	ECT, IAT, TP, VSS, CPS
Monitoring Duration	Approximately 900 seconds during appropriate conditions (approximately 200 to 600 oxygen sensor switches are collected).

Typical catalyst monitor entry conditions:	Minimum	Maximum
Time since engine start-up (70 °F start)	240 seconds	
Engine Coolant Temp	160 °F	230 °F
Intake Air Temp	20 °F	180 °F
Engine Load	10%	
Throttle Position	Part Throttle	Part Throttle
Time since entering closed loop fuel	30 sec	
Vehicle Speed	5 mph	70 mph
Steady Air Mass Flow	1.0 lb/min	5.0 lb/min
(Note: 25 - 35 mph steady state driving must be performed to complete the monitor)		

Typical malfunction thresholds:
Rear-to-front O2 sensor switch-ratio/ Index Ratio > 0.75

Catalyst Monitor temporary disablement conditions (other than entry requirements) :
EGR, Secondary air, Front and Rear O2 sensor, Engine Coolant Temperature, Mass Air Flow sensor, Air Charge Temperature sensor, Profile Ignition Pickup & Throttle Position monitor failure.



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Misfire Monitor

Neural Network Misfire detection is used in order to achieve "full-range" capability. All software allows for detection of any misfires that occur 6 engine revolutions after initially cranking the engine. This meets the new OBD-II requirement to identify misfires within 2 engine revolutions after exceeding the warm drive, idle rpm.

Neural Network System

The Neural Net Misfire (NNM) monitor uses a dedicated microprocessor in the PCM along with crankshaft position, (36-tooth wheel), camshaft position, and engine load to determine engine misfire. A neural network is different way of computing that uses a large number of simple processing elements with a high degree of interconnection to process complex information. It is based on the parallel architecture of the brain. The processing elements have adaptive characteristics (coefficients) that must be learned through a process called training. During training, the network is fed a sample set of data that consists of the inputs along with the desired output (e.g. misfire/no misfire). The network coefficients are recursively optimized so that the correct output is generated from the set of inputs and error is minimized. Once the coefficients have been learned, the network can process "real" data.

Misfire Monitor (continued)

NNM uses a Motorola Star 12 microprocessor in the PCM to perform the NNM calculations. The Motorola Star 12 is used in all markets for the Aston Martin application. The neural network size is 23 nodes and 469 coefficients.

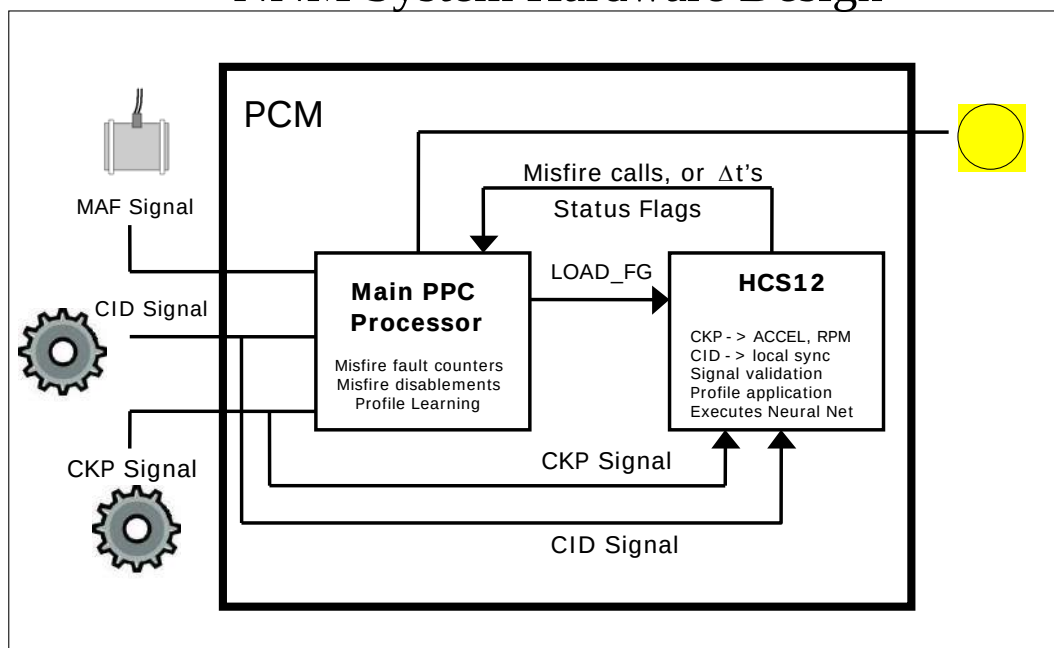
Inputs to Neural Net

- Crankshaft acceleration from the crank position (CKP) sensor
- RPM (calculated from CKP)
- LOAD (normalized for air mass and rpm)
- Indication of cam position from camshaft position (CMP) sensor

Output from Neural Net

- Misfire Call: - 0 (indicating no misfire) or 1 (indicating misfire)

NNM System Hardware Design



Generic Misfire Algorithm Processing.

The acceleration that a piston undergoes during a normal firing event is directly related to the amount of torque that cylinder produces. The calculated piston/cylinder acceleration value(s) are compared to a misfire threshold that is continuously adjusted based on inferred engine torque. Deviant accelerations exceeding the threshold are conditionally labeled as misfires.

The calculated deviant acceleration value(s) are also evaluated for noise. Normally, misfire results in a non-symmetrical loss of cylinder acceleration. Mechanical noise, such as rough roads or high rpm/light load conditions, will produce symmetrical acceleration variations. Cylinder events that indicate excessive



deviant accelerations of this type are considered noise. Noise-free deviant acceleration exceeding a given threshold is labeled a misfire.

The number of misfires are counted over a continuous 200 revolution and 1000 (or 4000) revolution period. (The revolution counters are not reset if the misfire monitor is temporarily disabled such as for negative torque mode, etc.) At the end of the evaluation period, the total misfire rate and the misfire rate for each individual cylinder is computed. The misfire rate evaluated every 200 revolution period (Type A) and compared to a threshold value obtained from an engine speed/load table. This misfire threshold is designed to prevent damage to the catalyst due to sustained excessive temperature. If the misfire threshold is exceeded and the catalyst temperature model calculates a catalyst mid-bed temperature that exceeds the catalyst damage threshold, the MIL blinks at a 1 Hz rate while the misfire is present. If the threshold is again exceeded on a subsequent driving cycle, the MIL is illuminated. If a single cylinder is indicated to be consistently misfiring in excess of the catalyst damage criteria, the fuel injector to that cylinder may be shut off for a period of time to prevent catalyst damage. Up to two cylinders may be disabled at the same time. This fuel shut-off feature is used on many 8-cylinder engines. It is never used on a 4-cylinder or 6-cylinder engine. Next, the misfire rate is evaluated every 1000 (or 4000) rev period and compared to a single (Type B) threshold value to indicate an emission-threshold malfunction. If a 1000 rev period is calibrated, a single 1000 rev exceedence from startup or four subsequent 1000 rev exceedences on a drive cycle after start-up is used as the malfunction criteria. If a 4000 rev period is calibrated, a single 4000 rev exceedence is used to indicate an emission-threshold malfunction.

Misfire Monitor Operation :	
DTCs	P0300 to P0312, P316 ,P1309, P1310, P1311
Monitor execution	Continuous, misfire rate calculated every 200 and 1000 or 4000 revs
Monitor Sequence	none
Sensors OK	CKP, CMP, ECT
Monitoring Duration	Entire driving cycle (see disablement conditions below)

Typical misfire monitor entry conditions	Minimum	Maximum
Time since engine start-up	5 seconds	
Engine Coolant Temp	20 °F	250 °F
RPM Range	idle	as per Directive
Profile correction factors learned in KAM	Yes	

Misfire Monitor temporary disablement conditions (other than entry requirements)	
Closed throttle decels (negative torque, engine being driven)	
Engine Torque Reduction Modes	
Accessory load-state change (A/C, power steering)	
EGR Monitor Flow Test	

Typical misfire monitor malfunction thresholds :	
Type A (catalyst damaging misfire rate)	misfire rate is an rpm/load table ranging from 40% at idle to 4% at high rpm and loads.
Type B (emission threshold rate)	1% to 5%

**Fuel System Monitor**

As fuel system components age or otherwise change over the life of the vehicle, the adaptive fuel strategy learns deviations from stoichiometry while running in closed loop fuel. These learned corrections are stored in Keep Alive Memory as long term fuel trim corrections. They may be stored into an 8x10 rpm/load table or they may be stored as a function of air mass. As components continue to change beyond normal limits or if a malfunction occurs, the long term fuel trim values will reach a calibratable rich or lean limit where the adaptive fuel strategy is no longer allowed to compensate for additional fuel system changes. Long term fuel trim corrections at their limits, in conjunction with a calibratable deviation in short term fuel trim, indicate a rich or lean fuel system malfunction.

Fuel Monitor Operation:	
DTCs	P0171 Bank 1 Lean, P0174 Bank 2 Lean P0172 Bank 1 Rich, P0175 Bank 2 Rich
Monitor execution	continuous while in closed loop fuel
Monitor Sequence	none
Monitoring Duration	2 seconds to register malfunction

Typical fuel monitor entry conditions	Minimum	Maximum
RPM Range	idle	4,000 rpm
Air Mass Range	0.75 lb/min	8.0 lb/min
Purge Duty Cycle	0%	0%

Typical fuel monitor malfunction thresholds:
Long Term Fuel Trim correction cell currently being utilized in conjunction with Short Term Fuel Trim: Lean malfunction: LTFT > 25%, STFT > 5% Rich malfunction: LTFT < 25%, STFT < 10%

Fuel Monitor temporary disablement conditions (other than entry requirements) :
None.

**HO2S Monitor****Front HO2S Signal**

The time between HO2S switches is monitored after vehicle startup and during closed loop fuel conditions. Excessive time between switches or no switches since startup indicate a malfunction. Since 'lack of switching' malfunctions can be caused by HO2S sensor malfunctions or by shifts in the fuel system, DTCs are stored that provide additional information for the 'lack of switching' malfunction. Different DTCs indicate whether the sensor was stuck lean/disconnected (P1131, P1151), stuck rich (P1132, P1152) or stopped switching due to excessive long term fuel trim corrections (P1130, P1150).

HO2S 'Lack of Switching' Operation:	
DTCs	Bank 1 – P0132, P2195, P2196 Bank 2 – P0152, P2197, P2198
Monitor execution	continuous, from startup and while in closed loop fuel
Monitor Sequence	none
Sensors OK	TP, MAF, MAP, ECT, CHT, ACT, IAT
Monitoring Duration	30 to 60 seconds to register a malfunction

Typical HO2S 'Lack of Switching' entry conditions :	Minimum	Maximum
Throttle Position	part throttle	
Idle State (not at idle, part throttle)		
Engine Load	20%	60%
Time since engine start-up	180 seconds	
Inferred Exhaust Temperature	800 °F	

Typical HO2S 'Lack of Switching' malfunction thresholds:
< 5 switches since startup after 30 seconds in test conditions
> 60 seconds since last switch while closed loop
> 30 seconds since last switch while closed loop at Short Term Fuel Trim limit

HO2S lack of switching temporary disablement conditions (other than entry requirements) :
Air Charge Temperature, ACT (or IAT) < -20 °F (minimum Cold Climate Test Temperature).
Failure of the sensors mentioned in the above "Sensors OK" section.

The HO2S is also tested functionally. The response rate is evaluated by entering a fixed frequency square wave, fuel control routine. This routine drives the air/fuel ratio around stoichiometry at a calibratable frequency and magnitude, producing predictable oxygen sensor signal amplitude. A slow sensor will show a reduced amplitude. Oxygen sensor signal amplitude below a minimum threshold indicates a slow sensor malfunction (P0133 Bank 1, P0153 Bank 2).

HO2S Response Rate Operation:	
DTCs	Bank 1 - P0133, Bank 2 - P0153
Monitor execution	once per driving cycle
Monitor Sequence	none
Sensors OK	ECT, IAT, MAF, MAP, VSS, CKP, TP, CMP, no misfire DTCs
Monitoring Duration	4 seconds



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Typical HO2S response rate entry conditions :	Minimum	Maximum
Short Term Fuel Trim Range	90%	110%
Engine Coolant Temp	150 °F	240 °F
Intake Air Temp		140 °F
Engine Load	20%	50%
Vehicle Speed	37 mph	55 mph
Engine RPM	1500 rpm	3000 rpm
Time since entering closed loop fuel	10 seconds	

Typical HO2S response rate malfunction thresholds:
Voltage amplitude: < 0.4 volts

HO2S response rate temporary disablement conditions (other than entry requirements) :
Disabled if a lack of switching fault is present, also sensors noted in "Sensors OK" section.

Rear HO2S Signal.

A functional test of the rear HO2S sensors is done during normal vehicle operation. The peak rich and lean voltages are continuously monitored. Voltages that exceed the calibratable rich and lean thresholds indicate a functional sensor. If the voltages have not exceeded the thresholds after a long period of vehicle operation, the air/fuel ratio may be forced rich or lean in an attempt to get the rear sensor to switch. This situation normally occurs only with a green catalyst (< 500 miles). If the sensor does not exceed the rich and lean peak thresholds, a malfunction is indicated.

Rear HO2S Check Operation:	
DTCs	Bank 1 - P0136, Bank 2 - P0156
Monitor execution	once per driving cycle
Monitor Sequence	after 'Upstream Response' test
Monitoring Duration	20sec for excursion

Typical Rear HO2S check entry conditions :	Minimum	Maximum
Inferred exhaust temperature range	400 °F	1600 °F
Rear HO2S heater-on time	120 seconds	
Throttle position	part throttle	
Engine RPM (forced excursion only)	1000 rpm	none

Typical Rear HO2S check malfunction thresholds:	
Does not exceed rich and lean threshold envelope:	Rich < 0.25 volts Lean > 0.65 volts

Rear HO2S temporary disablement conditions (other than entry requirements) :
None.



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HO2S Heaters, front and rear.

The HO2S heaters are monitored for circuit continuity. A HO2S heater fault is determined by turning the heater on and off and looking for corresponding voltage or current change in the heater output driver circuit in the PCM.

HO2S Heater Monitor Operation:	
DTCs	Bank 1 - P0135 Front, P0141 Rear Bank 2 - P0155 Front, P0161 Rear
Monitor execution	Change of Heater state (at least once per drive cycle).
Monitor Sequence	none
Monitoring Duration	< 5 seconds

Typical HO2S heater check malfunction thresholds:
Indicated voltage or current does not match commanded state.

HO2S heater temporary disablement conditions (other than entry requirements) :
None.

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Differential Pressure Feedback EGR System Monitor

Where a vacuum driven EGR valve is used on the base application, the EGR System Monitor will consist of a series of electrical and functional tests for the various aspects of system operation. First, the Differential Pressure Feedback EGR (DPFE) sensor input circuit is checked for out of range values (P1400 P1401). The Electronic Vacuum Regulator (EVR) output circuit is checked for opens and shorts (P1409).

EGR Electrical Check Operation:	
DTCs	P1400, P1401, P1409
Monitor execution	continuous, during EGR monitor
Monitor Sequence	none
Monitoring Duration	4 seconds to register a malfunction

Typical EGR electrical check entry conditions:
EGR system enabled

Typical EGR electrical check malfunction thresholds:
DPFE sensor outside voltage: > 4.96 volts, < 0.195 volts
EVR solenoid smart driver status indicates open/short

The differential pressure indicated by the DPFE sensor is also checked at idle with zero requested EGR flow to perform the high flow check. If the differential pressure exceeds a calibratable limit, it indicates a stuck open EGR valve or debris temporarily lodged under the EGR valve seat (P0402).

EGR Stuck open Check Operation:	
DTCs	P0402
Monitor execution	once per driving cycle
Monitor Sequence	Done after P1400 and P1401 tests
Sensors OK	CPS, ECT, IAT, MAF, MAP, TP
Monitoring Duration	10 seconds to register a malfunction

Typical EGR stuck open check entry conditions :	Minimum	Maximum
EVR Duty Cycle (EGR commanded off)	0%	0%
Engine RPM (after EGR enabled)	at idle	at idle

Typical EGR stuck open check malfunction thresholds:
DPFE sensor voltage at idle versus engine-off signal: > 0.6 volts



After the vehicle is started, during vehicle acceleration, the differential pressure indicated by the DPFE sensor at zero EGR flow is checked to ensure that both hoses to the DPFE sensor are connected. Under this condition, the differential pressure should be zero. If the differential pressure indicated by the DPFE sensor exceeds a maximum threshold or falls below a minimum threshold, an upstream or downstream DPFE hose malfunction is indicated (P1405 P1406).

EGR Hose Check Operation:	
DTCs	P1405, P1406
Monitor execution	once per driving cycle
Monitor Sequence	Done after P0402 test
Sensors OK	MAF, MAP
Monitoring Duration	2 seconds to register a malfunction

Typical EGR hose check entry conditions :	Minimum	Maximum
EVR duty Cycle (EGR commanded off)	0%	0%
Mass Air Flow		8 lb/min
Inferred exhaust back pressure	13 in H ₂ O	

Typical EGR hose check malfunction thresholds:
DPFE sensor voltage: < -7 in H ₂ O, > 7 in H ₂ O

After the vehicle has warmed up and normal EGR rates are being commanded by the PCM, the low flow check is performed. Since the EGR system is a closed loop system, the EGR system will deliver the requested EGR flow as long as it has the capacity to do so. If the EVR duty cycle is very high (greater than 80% duty cycle), the differential pressure indicated by the DPFE sensor is evaluated to determine the amount of EGR system restriction. If the differential pressure is below a calibratable threshold, a low flow malfunction is indicated (P0401).

EGR Flow Check Operation:	
DTCs	P0401
Monitor execution	once per driving cycle
Monitor Sequence	Done after P1405 and P1406 tests
Sensors OK	CPS, ECT, IAT, MAF, MAP, TP
Monitoring Duration	minimum 70 seconds to register a malfunction

Typical EGR flow check entry conditions:	Minimum	Maximum
EVR Duty Cycle	80%	100%
Engine RPM		2500 rpm
Mass Air Flow Rate of Change		6% prog. loop
Inferred manifold vacuum	6 in Hg	10 in Hg

Typical EGR flow check malfunction thresholds:
DPFE sensor voltage: < 6 in H ₂ O

EGR Monitor temporary disablement conditions (other than entry requirements) :
Non-operational when base feature disabled, including matching base feature temperature disablement.
Low Barometric Pressure Conditions.
Reporting of faults suppressed below 32°F to prevent mis-diagnosis due to ice. Monitor is still operational and continues to check, reporting any faults when temperature > 32°F.



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If the above temporary disablement conditions (inferred ambient temperature and low barometric pressure) are encountered, the flow test will be suspended and a timer will accumulate. Whenever the temporary disablement conditions are no longer present the timer will decrement, and the flow test will operate as normal. However, in extended temporary disablement conditions if the timer reaches a calibrated threshold (typically 800 seconds), the EGR flow test is disabled for the remainder of the current drive cycle, and the EGR monitor I/M readiness bit will be set.

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Electronic Throttle Monitor

Where ETC is used, the system monitor incorporates a complex safety strategy. The main ETC feature is based around a driver demand torque that is delivered as an output shaft torque through the correct positioning of the throttle plate. The Independent Plausibility Check (IPC) feature performs the primary monitoring function. This resides within the main microprocessor and is responsible for determining the driver demand torque and comparing it to an estimate of the actual brake torque delivered. If the generated torque exceeds the driver demanded torque by a specified amount, then the appropriate FMEM action is taken.

With the IPC feature being on the main processor, an intelligent VQZ watchdog is incorporated on a separate processor to monitor the performance of the IPC and the main processor. If the VQZ determines that the IPC function is impaired in any way then it takes the appropriate FMEM action.

Electronic Throttle:	
DTCs	P0606 PCM Microprocessor fault (MIL) P2110 Forced limit RPM mode (MIL) (Default throttle, if this is the only code set then it implies that the IPC detected a power greater than demand occurrence)
Monitor execution	continuous
Monitor Sequence	none
Monitoring Duration	Less than 200ms to register a fault

The Throttle Plate Position Controller (TPPC) controls the throttle plate to the desired throttle angle. It is embedded within a separate chip within the PCM. The output of the TPPC is a voltage signal to the H-bridge driver.

Throttle Plate Position Controller:	
DTCs	P2100 Throttle actuator control motor circuit open (MIL) P2101 Throttle actuator control motor circuit range/performance (MIL) (ETB mis-wired, detected at start-up only) P2107 Throttle actuator control motor processor (MIL) (TP_CMD or H-Bridge or TPPC self test fault) P2111 Throttle actuator control system – stuck open (MIL) P2112 Throttle actuator control system – stuck closed (MIL)
Monitor execution	continuous
Monitor Sequence	none
Monitoring Duration	Less than 1s to register a fault



The system monitor also determines the validity of any inputs to the electronic throttle control feature by checking for opens, shorts, out-of-range values and inconsistencies.

Throttle Position Sensors:	
DTCs	P0121 Throttle position sensor A circuit range/performance (Closed in bore out of range fault) P0122 Throttle position sensor A circuit low input P0123 Throttle position sensor A circuit high input P0124 Throttle position sensor A circuit intermittent P0221 Throttle position sensor B circuit range/performance (Closed in bore out of range fault) P0222 Throttle position sensor B circuit low input P0223 Throttle position sensor B circuit high input P0224 Throttle position sensor B circuit intermittent P2135 Throttle position sensor A/B voltage correlation
Monitor execution	continuous
Monitor Sequence	none
Monitoring Duration	Less than 200ms to register a fault

Accelerator Pedal Position Sensors:	
DTCs	P2121 Pedal position sensor D circuit range/performance P2122 Pedal position sensor D circuit low input P2123 Pedal position sensor D circuit high input P2124 Pedal position sensor D circuit intermittent P2126 Pedal position sensor E circuit range/performance P2127 Pedal position sensor E circuit low input P2128 Pedal position sensor E circuit high input P2129 Pedal position sensor E circuit intermittent P2138 Pedal position sensor D/E voltage correlation
Monitor execution	continuous
Monitor Sequence	none
Monitoring Duration	Less than 200ms to register a fault

Brake Pedal Switches:	
DTCs	P0504 Brake switch A/B correlation (BPS on when BLS is off) P0571 Brake switch A circuit (BPS failed) P0703 Brake switch B circuit (BLS failed) P1572 Brake system input failure (BLS failed then BPS failed) P1703 Brake switch out of self test range (Set when brake is on for KOEO test or when brake on or off state is not seen for KOER test)
Monitor execution	continuous
Monitor Sequence	none
Monitoring Duration	Not time dependent



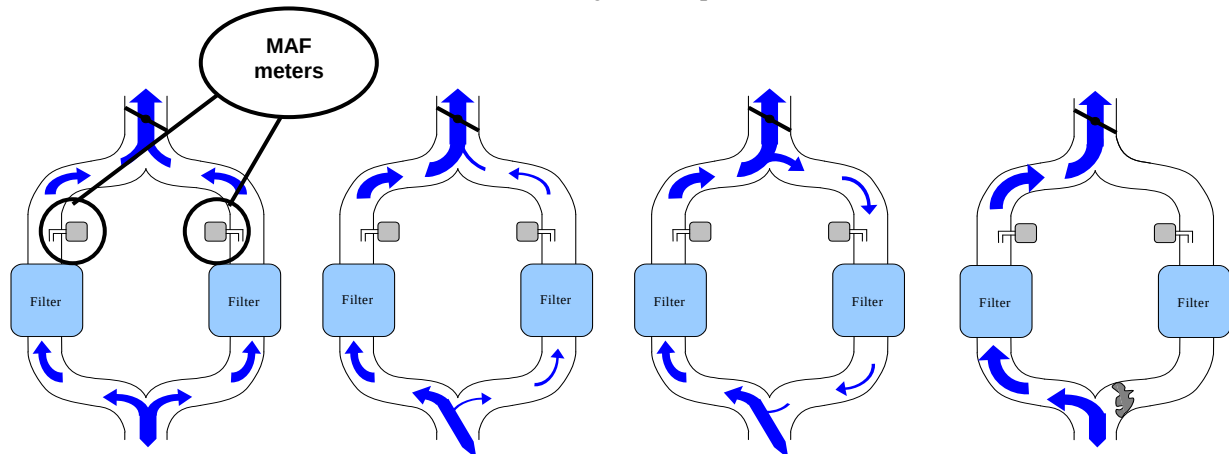
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Dual MAF Diagnostic

Dual MAF Hardware

The V8 uses a common dirty air pick-up, which feeds twin air filters and MAF meters before recombining the two air streams in a junction prior to the throttle.



Normal Operation
MAF meters receive an equal share of the airflow.

Side Wind or Partial Blockage
MAF meters receive unequal airflows. This can either be due to a side wind or a partial blockage. Low engine airflow conditions are particularly susceptible to side wind. Fault judgement is dependant on severity.

Backflow
One MAF meter receives an airflow greater than the total engine consumption. This is due to severe side wind. One MAF meter will measure zero airflow and this needs to be determined to prevent false circuit faults. Fault judgement is dependant on severity.

Total Blockage
One MAF meter receives airflow equal to the total airflow. Fault judgement is dependant on severity.

**Dual MAF Diagnostic Overview**

The dual MAF diagnostic performs 11 separate tests on the measured MAF values. Each test is designed to identify specific faults many of which, are only applicable to the dual MAF hardware configuration.

Many of the tests compare the measured MAF values to the estimated MAF (calculated from throttle position, barometric pressure, act and engine speed). The tests are performed continuously (apart from the conditions outlined later) and are always completed in the same sequence:

Test1	-	Does $MAF1 + MAF2 = \text{estimated MAF}$
Test2	-	Does $MAF1 = \frac{1}{2} \text{ estimated MAF}$
Test3	-	Does $MAF2 = \frac{1}{2} \text{ estimated MAF}$
Test4	-	Is $MAF1 < MAF2$
Test5	-	MAF1 low voltage
Test6	-	MAF2 low voltage
Test7	-	MAF1 high voltage
Test8	-	MAF2 high voltage
Test9	-	Is $MAF1 > \text{estimated MAF}$
Test10	-	Is $MAF2 > \text{estimated MAF}$
Test11	-	Does $MAF1 = MAF2$

By pass/fail combinations of the above tests a variety of conditions can be detected discretely on each MAF:

Partly blocked MAF

Fully blocked MAF

Electrical short to ground MAF

Electrical short high MAF

Backflow

Failed in range MAF



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Fault Matrix

Condition	MAF 1 + MAF 2 = EST	MAF 1 = ½ EST	MAF 2 = ½ EST	MAF 1 < MAF 2	MAF 1 low voltage	MAF 2 low voltage	MAF 1 high voltage	MAF 2 high voltage	MAF 1 > EST	MAF 2 > EST	MAF 1 = MAF 2	Air Charge	P-codes
Normal operating.		Y	Y		N	-	N					f(maf_raw)	None
MAF 1 partly blocked.	Y	N	N	Y	Y	-	N					f(maf_raw)	P010F, P0100
MAF 1 fully blocked @ low load.		N	N		-	N	-	N				f(maf_raw)	P010F, P0100
MAF 2 partly blocked.				N	-	Y	-	N				f(maf_raw)	P010F, P010A
MAF 2 fully blocked @ low load.					-	Y	-	N				f(maf_raw)	P010F, P010A
MAF 1 shorted to ground.		N	Y	-	Y	-	N					f(maf_raw)	P0102
MAF 1 shorted to high.		N	Y	-	N	-	Y					f(maf_raw)	P0103
MAF 1 failed in range.		N	Y	-	N	-	N					f(maf_raw)	P0101
MAF 2 shorted to ground.		Y	N	-	-	Y	-	N				f(maf_raw)	P010C
MAF 2 shorted high.		Y	N	-	-	N	-	Y				f(maf_raw)	P010D
MAF 2 failed in range.		Y	N	-	-	N	-	N				f(maf_raw)	P010B
Estimated value wrong.				-	N	N	N	N	-	-	Y	f(maf_raw)	None
MAF 1 and MAF 2 failed in range.				-	Y	N	N	N	-	-	N	f(fmem)	P0101, P010B
Backflow via MAF 1.				-	Y	N	N	N	-	Y		f(fmem)	P0104
MAF 1 short to ground MAF 2 failed in rng.				-	N	N	Y	N	-	N		f(fmem)	P0102, P010B
MAF 1 shorted high, MAF 2 failed in rng.				-	N	N	Y	N	-			f(fmem)	P0103, P010B
Backflow via MAF 2.				-	N	Y	N	N	Y			f(fmem)	P010E
MAF 1 failed in rng, MAF2 short to ground.				-	Y	N	N	N				f(fmem)	P0101, P010C
MAF 1 failed in rng, MAF 2 shorted high.				-	Y	Y	N	N				f(fmem)	P0101, P010D
MAF 1 & MAF 2 shorted to ground.				-	N	N	Y	Y				f(fmem)	P0102, P010C
MAF 1 & MAF 2 shorted high.				-	N	N	Y	Y				f(fmem)	P0103, P010D
Severe backflow via MAF 2.				-	N	Y	Y	N	Y			f(fmem)	P010E
MAF 2 fully blocked @ high load				-	N	Y	Y	N	N			f(fmem)	P010F, P010B
Severe backflow via MAF 1.				-	Y	N	N	Y	-	Y		f(fmem)	P0104
MAF 1 fully blocked @ high load.				-	Y	N	N	Y	-	N		f(fmem)	P010F, P0101

**Dual MAF Diagnostic Operation:**

DTCs	P0100 – Mass Air Flow A Circuit P0101 – Mass Air Flow A Circuit Range/Performance P0102 – Mass Air Flow A Circuit Low Input P0103 – Mass Air Flow A Circuit High Input P0104 – Mass Air Flow A Circuit Intermittent/Erratic P010A – Mass Air Flow B Circuit P010B – Mass Air Flow B Circuit Range/Performance P010C – Mass Air Flow B Circuit Low Input P010D – Mass Air Flow B Circuit High Input P010E – Mass Air Flow B Circuit Intermittent/Erratic P010F – Mass Air Flow Sensors A/B Correlation
Monitor execution	Continuous (exceptions below)
Monitor Sequence	Continuous (exceptions below)
Sensors/Components OK	No Throttle Position Failure No Vehicle Speed Failure
Monitoring Duration	Continuous (exceptions below)

Global Entry Conditions

Entry condition	Minimum	Maximum
Battery Voltage	11 volts	18 volt

Global Abort Conditions

SAIR monitor running

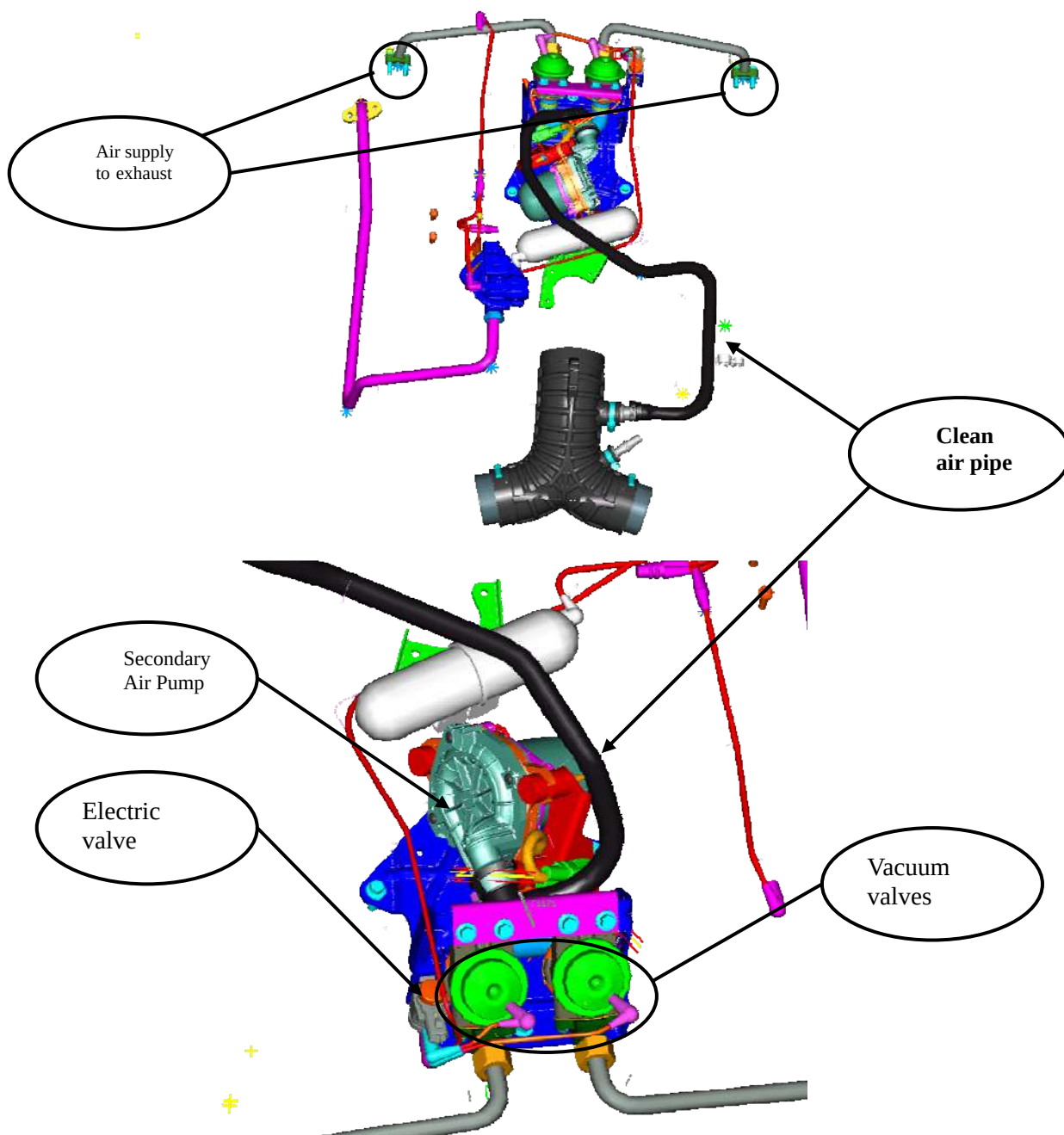
Abort Conditions for P0100,P0101,P010A,P010B,P010F

Throttle position < 3 degrees & Vehicle Speed > 15mph

SAIR Monitor

SAIR Hardware

The V8 uses SAIR to enhance the emissions performance. The SAIR pump is supplied with clean air from the 'Y' junction prior to the throttle. This air is then supplied to the exhaust via two vacuum operated valves, which are controlled from a common electrically operated control valve.





SAIR System Monitor – Flow Check

When the air pump is energized, the MAF sensor will show a corresponding increase in airflow. The SAIR pump flow check monitors the MAF sensor signal and two air flow models during normal secondary air system operation to determine if secondary air is being delivered into the exhaust system. The SAIR pump flow test compares the actual change in MAF during the pump on and off transitions to the expected change in airflow from the secondary air flow model. (A throttle body flow model is used to "zero out" errors in the air meter and to compensate for transient driving conditions.) The actual airflow is divided by the expected airflow to calculate an "On flow ratio" and an "Off flow ratio".

A flow ratio that is much less than 1.0 means that the air pump has no/low flow, or the inlet hose to the pump is disconnected. If secondary air system operation extends into closed loop fuel, fuel trim feedback is used to discriminate between low pump flow and inlet hose disconnection. A low flow ratio with a lean fuel system indicates a disconnected inlet hose. A flow ratio significantly higher than 1.0 (and/or a rich fuel system indication) indicates that the outlet hose from the pump is disconnected.

SAIR Diagnostic

The V8 uses the standard FORD non-intrusive monitor that has been adapted for use on a V-engine. The detection capability is detailed below with the V8 specific modifications highlighted

- P0410 - Pump inlet hose disconnection.
- P0491 - Low airflow into the exhaust on Bank1. Blocked hose OR failed to open vacuum valve.
- P0492 - Low airflow into the exhaust on Bank 2. Blocked hose OR failed to open vacuum valve.**
- P2448 - Low airflow into the exhaust on Bank1. Disconnected outlet hose.
- P2449 - Low airflow into the exhaust on Bank 2. Disconnected outlet hose.**
- P0412 - SAIR electrical circuit fault high/low on ecu control pin.
- P2257 - SAIR electrical circuit fault high on monitor pin.
- P2258 - SAIR electrical circuit fault low on monitor pin.

The determination of which bank is receiving low airflow is performed by monitoring the closed loop fuelling correction supplied from the oxygen sensors. The bank that has the highest enleaning correction is the bank that has the lowest SAIR flow. If closed loop fuelling is not active when the SAIR pump is disabled the diagnostic cannot determine which bank is receiving low flow and so a fault on both banks is raised.

The relative difference between the commanded lambda values for each bank is used to determine a restricted flow to either bank1 or 2 due to a restricted outlet. This enables P0491, P0492 to be raised if the flow ratio is calculated as in range.

The SAIR functional tests run when SAIR is active and the results are stored until the HEGO monitor has completed (150-200 seconds after SAIR is off on a typical FTP74). It is only when the HEGO monitor has completed successfully that any functional SAIR faults and SAIR monitor complete is reported.



SAIR Diagnostic High Level Flow

AIR Monitor Flow Check Operation:

DTCs	P0491 Pump Low Flow Bank1 P0492 Pump Low Flow Bank2 P0410 Pump Inlet Hose Off P2448 Pump Outlet Hose Off Bank1 P2449 Pump Outlet Hose Off Bank2 P0412 primary side circuit check P2257, P2258 secondary side circuit checks
Monitor execution	Flow check - once per driving cycle, circuit checks – continuous
Monitor Sequence	Runs approx. 5 seconds after start during normal SAIR operation
Sensors OK	ECT, IAT, MAF, TP, ETC, and HO2S
Monitoring Duration	From 5 to 70 seconds

Typical AIR flow check entry conditions: (The monitor will run when the air pump runs, the entry conditions below are secondary air system entry conditions.)

Entry condition	Minimum	Maximum
Time since engine start-up	5 seconds	70 seconds
Engine Coolant Temperature	-7°C (20°F)	35°C (90°F)
Predicted Pump Flow	18.5kg/h (0.68lb/min)	
Manifold Vacuum	13.2kPa (3.9"Hg)	
Catalyst Temperature		847°C (1558°F)
Inlet Air Temperature	-12°C (10°F)	
Battery Voltage	11 volts	18 volts
Note: There is a Throttle position stability check that can delay the calculation of the flow ratio. If the throttle is continuously moving, it is possible, to delay calculation of the flow ratio.		

Typical AIR functional check malfunction thresholds:

On Flow ratio < 0.75 (P0491, P0492 - Low Flow or, P0410 - Inlet Hose Off)
Off Flow ratio < 0.75 (P0491, P0492 - Low Flow or, P0410 - Inlet Hose Off)
Fuel Shift >0.3/Long term fuel shift bank1/bank2 (Clears possible outlet blocked P0491/92, but leaves valid P0410)
Bank1 – Bank2 lambda correction error >0.5 (P0491, P0492)
Closed Loop Fuel Control Active >10 seconds (P0491, P0492 – Low Flow)
On Flow ratio > 1.58 (P2448, P2449 – Outlet Hose Off)



VCT Monitor

VCT Hardware

Variable Cam Timing (VCT) enables rotation of the camshaft(s) relative to the crankshaft (phase-shifting) as a function of engine operating conditions. Intake Only (phase-shifting only the intake cam) is used in the AML application.

VCT is used primarily to increase internal residual dilution at part throttle to reduce NO_x, and to improve fuel economy. With Intake Only VCT, the intake camshaft is advanced at part throttle and WOT (at low to mid-range engine speeds) to open the intake valve earlier for increased residual dilution and close the intake valve earlier in the compression stroke for increased power. When the engine is cold, opening the intake valve earlier warms the charge which improves fuel vaporization for less HC emissions; when the engine is warm, the residual burned gasses limit peak combustion temperature to reduce NO_x formation.

The VCT system hardware consists of a control solenoid and a pulse ring on the camshaft. The PCM calculates relative cam position using the CMP input to process variable reluctance sensor pulses coming from the pulse ring mounted on the camshaft. Each pulse wheel has $N + 1$ teeth where N = the number of cylinders per bank. The N equally spaced teeth are used for cam phasing; the remaining tooth is used to determine cylinder # 1 position. Relative cam position is calculated by measuring the time between the rising edge of profile ignition pickup (PIP) and the falling edges of the VCT pulses.

VCT Diagnostic

The PCM continually calculates a cam position error value based on the difference between the desired and actual position and uses this information to calculate a commanded duty cycle for the VCT solenoid valve. When energized, engine oil is allowed to flow to the VCT unit thereby advancing and retarding cam timing. The VCT logic calculates the instantaneous variance in actual cam position (the squared difference between actual cam position and commanded cam position), then calculates the long term variance using a rolling average filter (Exponentially Weighted Moving Average).

If the VCT system is stuck or operates with a constant error relative to the target position, the monitor will detect a variance which will quickly accumulate. There are three variance indices that monitor cam variance in the retard direction, the advance direction, and for V engines, the difference between banks. If any variance index is greater than the malfunction threshold, a VCT target error malfunction will be indicated (P0011, P0012 Bank 1, P0021, P0022 Bank 2).

The VCT solenoid output driver in the PCM is checked electrically for open circuit and shorts (P0010 Bank 1, P0020 Bank 2).

**VCT Monitor Operation:**

DTCs	P0010 - Camshaft Position Actuator Circuit (Bank 1) P0011 - Cam Position Actuator Over Advanced (Bank 1) P0012 - Cam Position Actuator Over Retarded (Bank 1) P0020 - Camshaft Position Actuator Circuit (Bank 2) P0021 - Cam Position Actuator Over Advanced (Bank 2) P0022 - Cam Position Actuator Over Retarded (Bank 2)
Monitor execution	Continuous
Monitor Sequence	None
Sensors OK	IAT, ECT, EOT, IMRC, TP, MAF, CKP, and CMP
Monitoring Duration	5 seconds for circuit faults, 190 seconds for target error

Typical VCT response/functional monitor entry conditions:

Entry condition	Minimum	Maximum
Engine Coolant Temperature	-7 °C	
Engine Oil Temperature	-7 °C	121 °C
VCT control enabled and commanded to advance or retard cam **	n/a	n/a

** VCT control of advance and retard by the engine is disabled in crank mode, when engine oil is cold (< -7 °C), while learning the cam/crank offset, while the control system is "cleaning" the solenoid oil passages, throttle actuator control in failure mode, and if one of the following sensor failures occur: IAT, ECT, EOT, MAF, TP, CKP, CMP, or IMRC.

Typical VCT monitor malfunction thresholds:

VCT solenoid circuit: Open/short fault set by the PCM driver
Response/target error - VCT over-advance variance too high: >12.4°
Response/target error - VCT over-retard variance too high: >12.4°
Response/target error - Cam bank-to-bank variance too high: >16°



Comprehensive Component Monitor - Engine

General Inputs

Analog inputs such as Ambient Air Temperature (P0072, P0073), Intake Air Temperature (P0112, P0113), Engine Coolant Temperature (P0117, P0118), Cylinder Head Temperature (P1289, P1290), Mass Air Flow (P0102, P0103) and Manifold Absolute Pressure (P0107, P0108) are checked for opens, shorts, or out-of-range values by monitoring the analog -to-digital (A/D) input voltage.

Analog Sensor Check Operation:	
DTCs	P0072, P0073, P0112, P0113, P0117, P0118, P0102, P0103, P0107, P0108, P1289, P1290
Monitor execution	continuous
Monitor Sequence	none
Monitoring Duration	5 seconds to register a malfunction

Typical analog sensor check malfunction thresholds:	
Voltage < 0.20 volts or voltage > 4.80 volts	

On Vehicles fitted with Cylinder Head Temperature (CHT) Sensors, 'Fail Safe Cooling' can be applied if the cylinder head temperature is too high. The P1299 DTC will be set under these conditions.

Loss of Keep Alive Memory (KAM) power (a separate wire feeding the PCM) results in a P1633 DTC and immediate MIL illumination.

Loss or corruption of the Vehicle Identification (VID) Block in the PCM results in a P1639 DTC and immediate MIL illumination.

Ignition

Electronic Ignition systems (Electronic Distributorless Ignition System - EDIS or Coil on Plug - COP) systems are used on all applications.

The EDIS system, located in the PCM, processes the 36 (or 40) tooth crankshaft position signal to generate a low data rate PIP signal to control a 4 or 6 terminal 'double-ended' coil pack. The 'double ended' coils fire a pair of spark plugs simultaneously - one is on its compression stroke, the other on its exhaust stroke. The COP system also uses the EDIS system in the same way as described above, however each sparkplug has it's own coil which is fired only once on the compression stroke.

The ignition system is checked by monitoring three ignition signals during normal vehicle operation:

Profile Ignition Pickup (CKP, commonly known as PIP), the timing reference signal derived from the crankshaft 36-tooth wheel and processed by the EDIS system. PIP is a 50% duty cycle, square wave signal that has a rising edge at 10° BTDC.

Camshaft IDentification (CMP, commonly known as CID), a signal derived from the camshaft to identify the #1 cylinder



Ignition Diagnostic Monitor (IDM), a signal which indicates that the primary side of the coil has fired. This signal is received as a digital pulsewidth signal from the EDIS system which process the high voltage flyback signal from the primary side coil.

The relationship between successive PIP events is evaluated to determine whether the PIP signal is rational. Too large a change in 3 successive PIP indicates a missing or noisy PIP signal (P0320 or P0321). Then the CMP edge count is compared to the PIP edge count. If the proper ratio of CMP events to PIP events is not being maintained (for example, 1 CMP edge for every 8 PIP edges for an 8-cylinder engine), it indicates a missing or noisy CMP signal (P0340). Finally, the relationship between IDM edges and PIP edges is evaluated. If there is not an IDM edge (coil firing) for every PIP edge (commanded spark event), the PCM will look for a pattern of failed IDM events to determine which ignition coil has failed circuit continuity (P0351-56).

Ignition System Check Operation:	
DTCs	P0320 / P0321 (CKP), P0340 (CMP), P0351 - P0358 (Coil Primary)
Monitor execution	continuous
Monitor Sequence	none
Monitoring Duration	< 5 seconds

Typical ignition check entry conditions :	Minimum	Maximum
Engine RPM for CKP, CMP	200 rpm	
Engine RPM for coil primary	200 rpm	

Typical ignition check malfunction thresholds:	
For PIP :	Time between PIP edges : > 350 milliseconds Ratio of current PIP period to last two periods : < 0.75 > 1.75
For CMP :	Ratio of PIP events to CMP events: 4:1, 6:1, 8:1 or 10:1 based on engine cyl.
For coils :	Ratio of PIP events to IDM events: 1:1

General Outputs

The Fuel Injectors are checked electrically for open and short circuit (P0201 to P0208).

The Idle Air Control (IAC) solenoid is checked electrically for open and shorts (P1504).

The Purge Solenoid or Vapour Management Valve output circuit is checked for opens and shorts (P0443).

Purge Solenoid / VMV Check Operation:	
DTCs	P0443
Monitor execution	continuous (5 seconds to identify malfunction/obtain smart driver status)
Monitor Sequence	none
Monitoring Duration	5 seconds for electrical malfunctions

Typical Purge Solenoid / VMV component malfunction thresholds:
P0443 open / shorted at 0 and 100% duty cycle



The Intake Manifold Runner Control (IMRC) is a system which uses dual intake runners to supply air to each cylinder. The secondary runners are normally closed, but the PCM opens them under high rpm conditions when the driver is demanding additional power from the engine. The IMRC system can be actuated using an electric motor or a vacuum motor. The IMRC system is functionally checked by monitoring the runner control plates using switches. If the actual position of the runner control plates does not match the commanded position, a malfunction of the IMRC system is indicated (P1518, P1519).

The Swirl Control Valve (SCV) is a system which uses different regions of the Intake plenum to influence the pattern of the airflow into the combustion chamber.

It is important to note that this functional / rationality check **may or may not** be a MIL Code. This is dependent on whether the EOBD Thresholds are exceeded.

IMRC / SCV System Check Operation:	
DTCs	P1520 (IMRC input switch electrical check) P1518, P 1519 (IMRC stuck open functional check)
Monitor execution	continuous
Monitor Sequence	none
Monitoring Duration	5 seconds

Typical IMRC functional check malfunction thresholds
IMRC plates do not match commanded position (functional)
IMRC switches open/shorted (electrical)

Camshaft Position Control (also known as Variable Cam Timing) is a system which is able to advance and retard camshaft timing relative to the crankshaft. This phasing is controlled by a duty-cycled output. The output driver is checked electrically for opens and shorts (P1380). The system is checked functionally by monitoring the closed loop phase control correction. If the proper phasing cannot be maintained and the system has an advance or retard error greater than the malfunction threshold, a CPC control malfunction is indicated (P1381, P1383).

It is important to note that the functional / rationality checks **may or may not** be a MIL Code. This is dependent on whether the EOBD Thresholds are exceeded.

Camshaft Position Control System Check Operation:	
DTCs	P1380 (CPC output electrical check) P1381 (CPC timing over-advanced functional check) P1383 (CPC timing over-retarded functional check)
Monitor execution	continuous
Monitor Sequence	ECT > 150 °F
Monitoring Duration	5 seconds

Typical CPC functional check malfunction thresholds:
timing over-advanced/over-retarded by > 10 crankshaft degrees

Engine CCM temporary disablement conditions (other than entry requirements) :
None, except CPC does not operate (and is therefore not checked) if ACT/IAT, ECT/CHT, MAF/MAP or TP sensors are malfunctioning.



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AML EOBD System Operation Summary**Comprehensive Component Monitor - Manual Transmission.****General.**

The MIL is illuminated for all emissions related electrical component malfunctions. A manual transmission vehicle will have either a Vehicle Speed Sensor (VSS) or an Output Shaft Speed Sensor (OSS). The MIL will illuminate if the speed signal is declared as zero when the vehicle is inferred to be moving.

Transmission Inputs**Vehicle Speed Sensor Check Operation:**

DTCs	P0500
Monitor execution	continuous
Monitor Sequence	none
Monitoring Duration	30 seconds

Typical VSS check entry conditions :	Minimum	Maximum
Load	0.5	
Engine rpm	1900 rpm	4500 rpm

Typical VSS malfunction thresholds:

Vehicle is inferred to be moving with positive driving torque for 5 seconds.

Output Shaft Speed Sensor Functional Check Operation:

DTCs	P0720
Monitor execution	continuous
Monitor Sequence	none
Monitoring Duration	30 seconds

Typical OSS check entry conditions :	Minimum	Maximum
Load	0.5	
Engine rpm	1900 rpm	4500 rpm
Output shaft rpm	100 rpm	

Typical OSS functional check malfunction thresholds:

Vehicle is inferred to be moving with positive driving torque and OSS < 100 to 200 rpm for 5 seconds.

Manual Transmission CCM temporary disablement conditions (other than entry requirements) :

None.

**Comprehensive Component Monitor - Automatic Transmission****General**

The MIL is illuminated for all emissions related electrical component malfunctions. For malfunctions attributable to a mechanical component (such as a clutch, gear, band, valve, etc.), some transmissions are capable of not commanding the mechanically failed component and providing the remaining maximum functionality (functionality is reassessed on each power up). In such case a non-MIL Diagnostic Trouble Code (DTC) will be stored and, if so equipped, a Transmission Control Indicator Light (TCIL) will flash. For example on the CD4E transmission, if a gear ratio is not properly obtained and verified due to a mechanical malfunction, the unobtainable gear is no longer commanded for that power up, the DTC is stored and the TCIL flashes.

Transmission Inputs**Transmission Range Sensor Check Operation:**

DTCs	P0705, P0708 (open/invalid pattern for digital TRS) P0707, P0708 (opens/shorts for analog TRS)
Monitor execution	continuous
Monitor Sequence	none
Monitoring Duration	30 seconds

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

Typical TRS malfunction thresholds:

For digital sensor :	Invalid pattern from 3 (or 5) digital inputs or 1 analog circuit open for 5 seconds
For analog sensor :	Voltage > 4.8 volts or < 0.2 voltage for 5 seconds

Output Shaft Speed Sensor Functional Check Operation:

DTCs	P0720
Monitor execution	continuous
Monitor Sequence	none
Monitoring Duration	30 seconds

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

Typical OSS functional check malfunction thresholds:

Vehicle is inferred to be moving with positive driving torque and OSS < 100 to 200 rpm for 5 seconds
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ASTON MARTIN

AML EOBD System Operation Summary

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

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

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

**Transmission Outputs****Shift Solenoid Check Operation:**

DTCs	SS A - P0750 electrical, P1714 ISIG functional, SS B - P0755 electrical, P1715 ISIG functional, SS C - P0760 electrical, P1716 ISIG functional, SS D - P0765 electrical, P1717 ISIG functional SS E - P0770 electrical
Monitor execution	electrical - continuous, functional - during off to on solenoid transitions
Monitor Sequence	none

Typical SS malfunction thresholds:

Output driver feedback circuit does not match commanded driver state for 5 seconds.
ISIG functional check: ISIG chip hardware circuit does not detect characteristic current dip and rise produced by solenoid movement for 10 solenoid events.

Torque Converter Clutch Check Operation:

DTCs	P0743 electrical, P1740 ISIG functional
Monitor execution	electrical – continuous, functional - during off to on solenoid transitions
Monitor Sequence	none

Typical TCC malfunction thresholds:

Output driver feedback circuit does not match commanded driver state for 5 seconds
(> 1.0 volt if commanded on, < 2.0 volts if commanded off.)
ISIG functional check: ISIG chip hardware circuit does not detect characteristic current dip and rise produced by solenoid movement.

Electronic Pressure Control Check Operation:

DTCs	P1747 electrical, P1789, P0797 short to ground (low pressure) P0745, P0775, P0795 mechanical functional
Monitor execution	Continuous
Monitor Sequence	None
Monitoring Duration	Electrical: 5 seconds, Mechanical functional: up to 30 seconds

Typical EPC malfunction thresholds:

Current feedback circuit is less than commanded current for 5 seconds

Transmission CCM temporary disablement conditions (other than entry requirements) :

None.



6HP26 Automatic Transmission

This transmission is operated by a stand-alone transmission control module (TCM). The MIL related Diagnostic Trouble Codes will be transmitted via CAN to the Engine Control Module (ECM), and the MIL illuminated, for all emissions related electrical and mechanical component malfunctions. For malfunctions attributable to a mechanical component, this transmission may be capable of not commanding the mechanically failed component and providing the remaining maximum functionality (functionality may be reassessed on each power up). The TCM may be interrogated for transmission information attributable to setting either code. The TCM Diagnostic Trouble Codes are addressed via a separate document enclosed.

Auto Shift Manual (ASM) Transmission

The ASM system is based around a standard manual transmission with a clutch and mechanical selection of a set range of gear ratios (in this case 6 speeds). In this application both clutch and gear selection operations are controlled via a Transmission Control Module (TCM) which commands hydraulic actuators based on commands from a number of inputs.

The driver actions of depressing and releasing the clutch pedal to control clutch actuation and the shifting of gears using a gear lever have, in essence, been replaced by a TCM, hydraulic actuators and electronic switches.

With ASM the demand to shift gears can either be direct from the driver (as in a conventional manual transmission), or controlled automatically by the system based on parameters such as road speed, current gear selected and throttle demand.

The MIL is illuminated for all emissions related electrical component malfunctions. For malfunctions attributable to a mechanical component (such as a clutch, gear, actuator, etc.), functionality is reassessed on each power up. In such case a non-MIL or MIL Diagnostic Trouble Code (DTC) will be stored and, if so equipped, a Transmission Control Indicator Light will activate and/or a message will be displayed. For example on the ASM transmission, if a gear selection is not properly obtained and verified due to a mechanical malfunction, then the amber Transmission Control Indicator Light will activate and the message center will display 'GEARBOX FAULT'. In addition, the powertrain MIL will activate and a DTC will be stored. The TCM Diagnostic Trouble Codes are addressed via a separate document enclosed.



ASTON MARTIN

Inspection Maintenance Readiness Code

I/M readiness information indicates whether a full diagnostic check has been completed, i.e. the minimum number of driving cycles necessary for MIL illumination has been completed since computer memory was last cleared. Information available to the test equipment or diagnostic tool includes all the non-continuous monitors. Misfire, Fuel System and CCM monitors are assumed to complete if all the non-continuous monitors have completed.

A P1000 DTC is stored after an OBD reset is performed, until the I/M readiness check is complete.

Tamper Protection

The AML EOBD System shall meet ISO DIS 15031-7 / SAE J2186 - Diagnostic Data Link Security requirements, to write-protect any re-programmable computer code. Additional data will be stored in the PCM Vehicle Identification Block to enable retrieval of VIN (although VIN may not be in the VID block for all vehicles), CALID (CALibration ID identifies the specific calibration) and CVN (Calibration Verification Number, similar to an encrypted checksum). CALID and CVN will be tracked for all initial releases, running changes and field fixes.

To achieve this data retrieval J1979 Mode 09 will be implemented for VIN, CALD and CVN.

Serial Data Link Connector

The connection between the vehicle and the diagnostic tester shall comply with ISO DIS 15031-3 / SAE J1962. Whereby the connector will be located in the passenger compartment in the area bounded by the driver's end of the instrument panel to 300mm beyond the vehicle center line, attached to the instrument panel and accessible from the driver's seat, and permit one handed / blind insertion of the mating connector.

Serial Data Link Communication Protocol

The Communication Protocol used by the AML EOBD system will conform to ISO DIS 15031-4 / SAE J1850, Class B Data Communication Network Interface (41.6kbps) / ISO DIS 15765-4 Diagnostics on Controller Area Network (CAN).

Basic diagnostic data and bi-directional control information will be provided using the format and units as described in ISO DIS 15031-5 / SAE J1979 and will be available to Test equipment and diagnostics tools meeting the requirements of ISO DIS 15031-4 / SAE J1850.



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Serial Data Link MIL Illumination

The instrument cluster on some vehicles use the J1850 serial data link or CAN data link to receive and display various types of information from the PCM. For example, the engine coolant temperature information displayed on the instrument cluster comes from the same ECT sensor used by the PCM for all its internal calculations.

These same vehicles use the J1850 serial data link or CAN data link to illuminate the MIL rather than a circuit, hard-wired to the PCM. The PCM periodically sends the instrument cluster a message that tells it to turn on the MIL, turn off the MIL or blink the MIL. If the instrument cluster fails to receive a message within a 5-second timeout period, the instrument cluster itself illuminates the MIL. If communication is restored, the instrument cluster turns off the MIL after 5 seconds. Due to its limited capabilities, the instrument cluster does not generate or store Diagnostic Trouble Codes.

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Glossary of Terms

A/D	Analogue to Digital
ASM	Auto Shift Manul
BTDC	Before Top Dead Centre
CALID	CALibration IDentification
CD4E	Automatic Transmission for Intermediate size Family saloon.
CID	Camshaft Identification.
CKP	Crankshaft Position
CMP	Camshaft Position
COP	Coil on Plug
CPC	Camshaft Position Control
CVN	Calibration Verification Number
DPFE	Delta Pressure Feedback
DTC	Diagnostic Trouble Code
ECT	Engine Coolant Temperature
EDIS	Electronic Distributorless Ignition System
EGR	Exhaust Gas Re-circulation.
EOBD	European On Bard Diagnostics
EPC	Electronic Pressure Control
ETC	Electronic Throttle Control
ETM	Electronic Throttle Monitor
EVR	Electronic Vacuum Regulator
EWMA	Exponentially Weighted Moving Average
FMEM	Failure Mode and Effects Management
FN	Automatic Transmission for Medium size Family Saloon
FWD	Front Wheel Drive
HDR	High Data Rate
HO2S	Heated Oxygen Sensor.
IAC	Idle Air Control
IDM	Ignition Diagnostic Monitor
IMRC	Inlet Manifold Runner Control
IPC	Independent Plausibility Checker
KAM	Keep Alive Memory
LDR	Low Data Rate
LTFT	Long Term Fuel Trim
MAF	Mass Air Flow
MAP	Manifold Absolute Pressure
MIL	Malfunction Indicator Lamp
OSS	Output Shaft Speed
PCM	Powertrain Control Module
PIP	Profile Ignition Pickup
RWD	Rear Wheel Drive
SAE	Society of Automotive Engineers
SAIR	Secondary AIR
SCV	Swirl Control Valve
STFT	Short Term Fuel Trim
TCC	Torque Converter Clutch
TCIL	Transmission Control Indicator Lamp
TP	Throttle Position
TPPC	Throttle Plate Position Controller
TRS	Transmission Range Sensor
TSS	Turbine Shaft Speed
VID	Vehicle IDentification
VIN	Vehicle Identification No.
VQZ	VQuizzer
VMV	Vapour Management Valve

**MIL Code List**

MIL	Code	Description
X	P0070	Ambient Air Temperature (AAT) Sensor out of range
X	P0106	Manifold Absolute Pressure (MAP) / Barometric Sensor Range/Performance Fault
X	P0107	Manifold Absolute Pressure (MAP) / Barometric Sensor Circuit Low Input
X	P0108	Manifold Absolute Pressure (MAP) / Barometric Sensor Circuit High Input
	P0109	Manifold Absolute Pressure (MAP) / Barometric Sensor Intermittent
X	P0112	Intake Air Temperature (IAT) Circuit Low Input
X	P0113	Intake Air Temperature (IAT) Circuit High Input
X	P0116	Engine Coolant Temperature (ECT) Circuit Range/Performance Fault
X	P0117	Engine Coolant Temperature (ECT) Circuit Low Input
X	P0118	Engine Coolant Temperature (ECT) Circuit High Input
	P0121	Throttle position sensor A circuit Range/Performance
	P0122	Throttle position sensor A circuit Low Input
	P0123	Throttle position sensor A circuit High Input
	P0124	Throttle position sensor A circuit Intermittent
	P0125	Insufficient coolant temperature for closed loop fuel control
X	P0131	Heated Oxygen Sensor (Bank 1, Sensor 1) Low Voltage
X	P0132	Heated Oxygen Sensor (Bank 1, Sensor 1) High Voltage
X	P0133	Heated Oxygen Sensor (Bank 1, Sensor 1) Slow Response
X	P0135	Heated Oxygen Sensor (Bank 1, Sensor 1) Heater Circuit Malfunction
X	P0136	Heated Oxygen Sensor (Bank 1, Sensor 2) Lack Of Switching
X	P0138	Heated Oxygen Sensor (Bank 1, Sensor 2) High Voltage
X	P0141	Heated Oxygen Sensor (Bank 1, Sensor 2) Heater Circuit Malfunction
X	P0171	System Too Lean [Bank 1]
X	P0172	System Too Rich [Bank 1]
X	P0201	Cylinder #1 Injector Circuit Malfunction
X	P0202	Cylinder #2 Injector Circuit Malfunction
X	P0203	Cylinder #3 Injector Circuit Malfunction
X	P0204	Cylinder #4 Injector Circuit Malfunction
	P0221	Throttle position sensor B circuit range/performance
	P0222	Throttle position sensor B circuit low input
	P0223	Throttle position sensor B circuit high input
	P0224	Throttle position sensor B circuit intermittent
	P0230	Fuel Pump Primary Circuit Fault
	P0231	Fuel Pump Secondary Circuit Low Fault
	P0232	Fuel Pump Secondary Circuit High Fault
	P0298	Engine Oil Over-temperature Condition
X	P0300	Random Cylinder Misfire Detected
X	P0301	Cylinder #1 Misfire Detected
X	P0302	Cylinder #2 Misfire Detected
X	P0303	Cylinder #3 Misfire Detected
X	P0304	Cylinder #4 Misfire Detected
X	P0305	Cylinder #5 Misfire Detected
X	P0306	Cylinder #6 Misfire Detected
X	P0307	Cylinder #7 Misfire Detected
X	P0308	Cylinder #8 Misfire Detected
X	P0309	Cylinder #9 Misfire Detected



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X	P0310	Cylinder #10 Misfire Detected
X	P0311	Cylinder #11 Misfire Detected
X	P0312	Cylinder #12 Misfire Detected
X	P0316	Misfire Monitor Disabled; unable to Learn Trigger Wheel Profile
X	P0320	Ignition/Distributor Engine Speed Input Circuit
	P0325	Knock Sensor 1 Circuit
X	P0340	Camshaft Position Sensor (CMP) Circuit Malfunction
X	P0351	Ignition Coil A Primary/Secondary Circuit Malfunction
X	P0352	Ignition Coil B Primary/Secondary Circuit Malfunction
X	P0353	Ignition Coil C Primary/Secondary Circuit Malfunction
X	P0354	Ignition Coil D Primary/Secondary Circuit Malfunction
X	P0400	Exhaust Gas Recirculation Flow
X	P0403	Exhaust Gas Recirculation (EGR) Control Circuit
X	P0420	Catalyst System Efficiency Below Threshold (Bank 1)
X	P0430	Catalyst System Efficiency Below Threshold (Bank 2)
X	P0443	Evaporative Emission Control System (EVAP) Purge Control Valve Circuit Malfunction
**	P0460	Fuel Level (FLI) Sensor Circuit
	P0480	Fan 1 Control Circuit Malfunction
	P0504	Brake switch A/B correlation (BPS on when BLS is off)
	P0505	Idle Air Control System
	P0506	Idle Air Control System – RPM Lower Than Expected
	P0507	Idle Air Control System – RPM Higher Than Expected
	P0571	Brake switch A circuit (BPS failed)
	P0602	Powertrain Control Module Programming Error
	P0603	Powertrain Control Module Keep Alive Memory (KAM) Error
	P0605	Powertrain Control Module Read Only Memory (ROM) Error
X	P0607	Powertrain Control Module Performance
	P0610	Powertrain Control Module Vehicle Options Error
	P0703	Brake switch B circuit (BLS failed)
X	P0720	Output Shaft Speed Sensor (OSS) Circuit Malfunction
	P0721	Output Shaft Speed Sensor (OSS) Circuit Range/Performance
	P0722	Output Shaft Speed Sensor (OSS) Circuit No Signal
	P1000	EOBD System Readiness Test Not Complete
	P1001	KOER Test Not Able To Complete, KOER Aborted
	P1100	Mass Air Flow Sensor Circuit Intermittent
	P1112	Intake Air Temperature (IAT) Circuit Intermittent
	P1116	Engine Coolant Temperature Sensor Out of Self Test Range
	P1117	Engine Coolant Temperature Sensor Circuit Intermittent
	P1125	Throttle Position Sensor A Circuit Intermittent
	P1127	Exhaust Temperature Out of Range – O2 sensor tests not completed
	P1128	Upstream HO2S Sensors Swapped
	P1129	Downstream HO2S Sensors Swapped
X	P1130	Lack of Heated Oxygen Sensor (Bank 1, Sensor 1) Switches, Adaptive Fuel at Limit
X	P1131	Lack of Heated Oxygen Sensor (Bank 1, Sensor 1) Switches, Sensor Indicates Lean
X	P1132	Lack of Heated Oxygen Sensor (Bank 1, Sensor 1) Switches, Sensor Indicates Rich
	P1246	Alternator Load Input
	P1260	Theft Detected, Vehicle Immobilised
	P1270	Engine RPM or Vehicle Speed Limiter Reached
X	P1285	Cylinder Head OverTemperature Condition
X	P1299	Cylinder Head over Temperature Protection Active
	P1408	Exhaust Gas Recirculation Flow Out of Self Test Range



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X	P1431	Misfire Monitor Disabled; unable to Learn Trigger Wheel Profile
	P1432	Thermostat Heater Control Circuit
	P1460	Wide Open Throttle A/C Cut-out Circuit
	P1461	A/C Pressure Sensor Circuit High Input
	P1462	A/C Pressure Sensor Circuit Low Input
	P1463	A/C Pressure Sensor Insufficient Pressure Change
	P1464	A/C Demand Out of Self Test Range
	P1500	Vehicle Speed Sensor
	P1501	Vehicle Speed Sensor Out of Self Test Range
	P1549	Intake Manifold Communication Control Circuit (Bank 1)
	P1572	Brake system input failure (BLS failed then BPS failed)
	P1610	Interactive Reprogramming Code – Replace Module
	P1611	Interactive Reprogramming Code – Diagnose Further
	P1615	Interactive Reprogramming Code – Erase Error
	P1616	Interactive Reprogramming Code – Erase Error, Low Voltage
	P1617	Interactive Reprogramming Code – Block Program Error
	P1618	Interactive Reprogramming Code – Block Program Error, Low Voltage
	P1631	Main Relay (Power Hold)
X	P1633	Keep Alive Power Voltage too Low
	P1635	Tyre/Axle Out of Acceptable Range
	P1639	Vehicle Identification (VID) Block Corrupted. Not Programmed
X	P1656	CAN Link PCM/PCM Circuit/Network
	P1703	Brake switch out of self test range
	P1709	Park/Neutral Position Switch Out of Self Test Range
X	P2008	Intake Manifold Runner Control Open (Bank 1)
X	P2100	Throttle Actuator Control Motor Circuit Open
X	P2101	Throttle Actuator Control Motor Circuit Range/Performance
X	P2107	Throttle actuator control motor processor
X	P2110	Forced limit RPM mode
X	P2111	Throttle actuator control system – stuck closed
X	P2112	Throttle actuator control system – stuck open
	P2121	Pedal position sensor D circuit range/performance
	P2122	Pedal position sensor D circuit low input
	P2123	Pedal position sensor D circuit high input
	P2124	Pedal position sensor D circuit intermittent
	P2126	Pedal position sensor E circuit range/performance
	P2127	Pedal position sensor E circuit low input
	P2128	Pedal position sensor E circuit high input
	P2129	Pedal position sensor E circuit intermittent
	P2135	Throttle position sensor A/B voltage correlation
	P2138	Pedal position sensor D/E voltage correlation
X	P2195	Lack of Heated Oxygen Sensor (Bank 1, Sensor 1) Switches, Sensor Indicates Lean
X	P2196	Lack of Heated Oxygen Sensor (Bank 2, Sensor 1) Switches, Sensor Indicates Lean
X	P2197	Lack of Heated Oxygen Sensor (Bank 1, Sensor 1) Switches, Sensor Indicates Rich
X	P2198	Lack of Heated Oxygen Sensor (Bank 2, Sensor 1) Switches, Sensor Indicates Rich

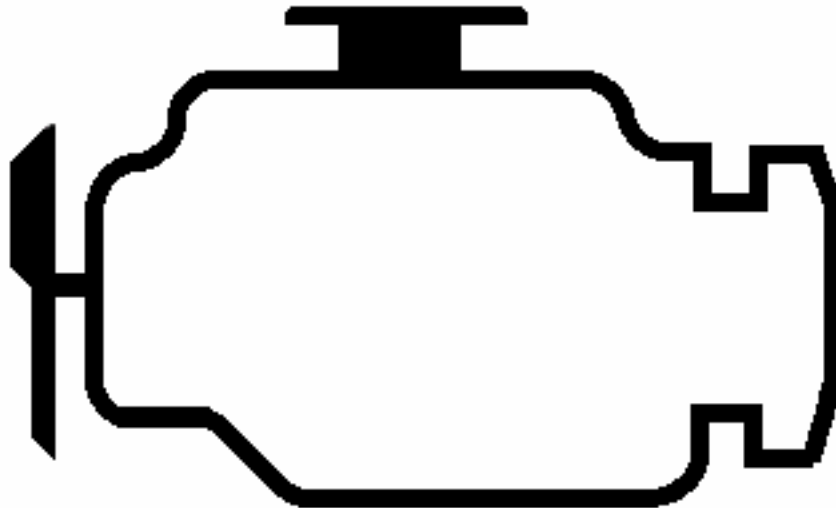
Note.

X MIL codes

* Can be non-mil if below EOBD threshold.



MIL Symbol



ISO MIL Symbol to be used on all AML EOBD Applications.



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Summary Tables

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Catalyst Efficiency Monitor									
Catalyst System Efficiency Below Threshold (Index Monitor)	P0420 (Bank 1)	HC efficiency inferred from oxygen storage capacity	Rear/Front HO2S switch ratio	> 0.396 (Unitless)	Engine coolant temp and ECT sensor OK (P0117/0118)	-7C < Engine coolant < 110C (20 - 230F)	Once per driving cycle	Footnote a)	Footnote c)
	P0430 (Bank 2)			>0.396 (Unitless)	Intake air temp and IAT sensor OK (P0112/0113)	-7C < Inlet Air Tmp < 82C (20-180F)	Approximately 600 sec during appropriate FTP74 conditions		
					Minimum time since start to run Catalyst Monitor	60 sec			
				Air mass range cell 1	HO2S11 switches : 1023 HO2S21 switches: 1023	3.76 - 18.8 g/s (0.5-2.49 lb/min)			
				Air mass range cell 2	HO2S11 switches : 1023 HO2S21 switches: 1023	18.9 - 27.8 g/sec (2.5-3.69 lb/min)			
				Air mass range cell 3	HO2S11 switches : 1023 HO2S21 switches: 1023	27.9 - 36.3 g/s (3.7-4.8 lb/min)			
					Maximum number of HO2S11 (Bank 1 front) switches to allow monitor completion	250			
					Maximum number of HO2S21 (Bank 2 front) switches to allow monitor completion	250			
				Load range for air mass cell 1	HO2S11 switches : 1023 HO2S21 switches: 1023	0.1 * 100 % - 1.99 * 100 %			
				Load range for air mass cell 2	HO2S11 switches : 1023 HO2S21 switches: 1023	0.1 * 100 % - 1.99 * 100 %			
				Load range for air mass cell 3	HO2S11 switches : 1023 HO2S21 switches: 1023	0.1 * 100 % - 1.99 * 100 %			
				Rpm range for air mass cell 1	HO2S11 switches : 1023 HO2S21 switches: 1023	1000 - 4000 rpm			
				Rpm range for air mass cell 2	HO2S11 switches : 1023 HO2S21 switches: 1023	1000 - 4000 rpm			
				Rpm range for air mass cell 3	HO2S11 switches : 1023 HO2S21 switches: 1023	1000 - 4000 rpm			
					Inferred midbed catalyst temp for air mass cell 1 (Bank1/Bank2)	400 - 1000 deg C (752-1832 deg F)			
					Inferred midbed catalyst temp for air mass cell 2 (Bank1/Bank2)	400 - 1000 deg C (752-1832 deg F)			
					Inferred midbed catalyst temp for air mass cell 3 (Bank1/Bank2)	400 - 1000 deg C (752-1832 deg F)			
					Time constant to determine throttle position rate	1.0 (Unitless)			
					Maximum throttle position rate of change	< 30 * 5/ 1024 volts per sec			
					Minimum inferred rear HO2S12/HO2S22 temp to enter test	400 deg C (752 deg F)			
					Time since part-throttle decel	> 1.0 sec			
					Vehicle speed	8 - 76 mph			
					Crankshaft position circuit (PIP) OK (P0320)				
					HO2S Monitor COMPLETE with no DTCs prior to final switch ratio computation				
					Evap system OK, no Evap System DTCs				
					EWMA "fast" filter constant for first 2 driving cycles after KAM cleared	0.99 (Unitless)			
					EWMA "normal" filter constant after first 2 driving cycles	0.99 (Unitless)			
					Fuel level	> 0.15 * 100 %			

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Misfire Monitor									
Cylinder Misfire Detected	P0300 to P0308	Deviations in crankshaft acceleration processed by Neural Network Misfire Monitor software and Catalyst Temperature model	Percentage misfire required to exceed Catalyst Damage Temperature 1000 deg c (1832 deg F) catalyst damage threshold, per engine bank		Type A: See RPM/Load Table FNMISPCT_97 %		Type A: 200 revs (Continuous)	Type A: Footnote b)	Type A: Footnote d)
			Percentage misfire required to exceed emission thresholds	Type B > 0.0323*100%			Type B: 1000 revs (Continuous)	Type B/C: Footnote a)	Type B: Footnote c)
			Percentage misfire required to clear emission pending code	< 0.001 * 100 %	Time since engine start, value based on time and IAT	0 + FNMISACT sec (See Transfer Functions)			
					Time since PCM power up	0 sec			
					Time for NNMM computation queue to fill	4 revs from initial crank (Meets 2 rev start delay requirement)			
					Engine coolant temp	-7 - 115 deg C (20 - 240 degF)			
					Engine rpm	600 - 7250 rpm			
					Net engine torque	> -81 Nm (-60 ft lbs)			
					Engine torque rate of change	> -33.9Nm (-25 ft lbs/sec) or < 33.9Nm (25 ft lbs/sec)			
					Throttle position rate of change	> -30 volts/background loop or < 30 * 5/1024 volts/background loop			
					Engine rpm/load range	See RPM/Load Table FNMISOK_97: Monitor disabled when less than 0.5			
					Crankshaft position circuit (PIP) OK (P0320)				
					Fuel shutoff for rpm or vehicle speed limiting	No fuel cutoff occurring			
					Fuel level	> 0.15 * 100 %			
Misfire Detected At Startup	P0316	Misfire detected during first 1000 engine revs since start	P0316 is set in addition to P0300 - P0308 DTC				1000 revs (Continuous)	Footnote a)	Footnote c)
AICE chip failure in PCM	P0606	NNMM chip to CPU communication fault	Number of attempts	10			Continuous	Footnote a)	Footnote c)
Camshaft/crankshaft synchronization failure	P1336	AICE chip reports inability to synchronize camshaft and crankshaft signals (Replaces P1309)	Number of attempts	> 255			Continuous	Footnote a)	Footnote c)
Unable to learn crankshaft profile	P0315	Unable to learn stable crankshaft profile	Number of attempts	> 6 attempts	Engine speed	>1550rpm <2275rpm	Continuous within profile learning entry conditions	Footnote a)	Footnote c)
					Engine load	>0.075 <0.225			
					Engine coolant temperature	>68.3degC (155degF)			
					Transmission in 6th gear				
					Vehicle speed	>30mph <70mph			
					Maximum rate of engine speed change in decel fuel cut	<500rpm/second			
ROM checksum error	P260F	NNP ROM checksum error	Checksum from NNP does not equal mainline strategy		None		Continuous	Footnote a)	Footnote c)

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Fuel System Monitor									
Fuel System Too Rich Or Too Lean	P0171 (Bank 1 Lean)	Excessive long and short term fuel trim corrections	Long term fuel trim cell currently being utilized exceeds lean limits	> 1.225 * 100 %	Engine rpm	550 - 8000 rpm	Continuous	Footnote a)	Footnote c)
			Short term fuel trim exceeds lean limits	< 0.99 * 100%					
	P0172 (Bank 1 Rich)	Note: Long term fuel trim corrections are learned into an 8x10 cell table as a function of rpm and load or an 8x1 cell table as a function of rpm and air mass	Long term fuel trim cell currently being utilized exceeds rich limits	< 0.805 * 100 %	Engine air mass	0 - 484 g/sec (0 - 63.99 lbs/min)			
			Short term fuel trim exceeds rich limits	> 1.1 * 100 %	Coolant temp and ECT sensor OK (P0117/0118)	44.4C < Engine coolant < 110C (112 - 230F)			
					Intake air temp and IAT sensor OK (P0112/0113)	-28.8C < Intake air < 93.3C (-20 - 200F)			
					Fuel level Closed loop fuel, adaptive fuel learning enabled (Purge duty cycle = 0 %)	>0.15*100% Fuel trim learning enabled			
	P0174 (Bank 2 Lean)				Fuel Rail Pressure sensor OK (P0190/0192/0193)				
	P0175 (Bank 2 Rich)				Fuel trim learning enabled				

Entry Conditions for Closed Loop Fuel									
Initial Closed Loop Fuel Entry Condition					Time since engine start	> FN_TCSTRT sec (See Function)			
					Inferred HO2S temp	> 300 deg C (> 572 deg F) (Temp based on inferred exhaust temp model which is a function of IAT, ECT, MAF, commanded A/F ratio and engine rpm)			

Thermostat Monitor									
Insufficient Coolant Temperature For Closed Loop Fuel Control	P0128	Time to reach minimum engine coolant temp	Time within test entry conditions	See Transfer Function FN654S	Vehicle speed	See transfer function FNWUT_VS	Once per driving cycle	Footnote a)	Footnote c)
			Engine coolant temp	See transfer function FNECTWUT	Engine load	See transfer function FNWUT_LD			
					Minimum soak time	> 60 min			

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Secondary Air Monitor									
Secondary Air System Insufficient Flow	P0410 (Inlet hose disconnection)	Modelled pump flow higher than measured flow via HFM	Ratio of SAIR flow difference at SAIR pump off / on and on/off transition	off/on <0.524	Intake air temp sensor OK (P0112/0113)		Continuous during SAIR operation	Footnote l)	Footnote c)
				on/off <0.671	Engine coolant temp sensor OK (P0117/0118)		Approximately 500 sec during appropriate FTP74 conditions to complete HEGO monitor		
					Mass Air Flow sensor OK (P0101 to P010F)				
Outlet Hose Blockage	P0491 (Low flow Bank1)	Closed loop bank1 lambda correction at first switch AND low measured flow via HFM	First switch correction < threshold * corrected SAIR flow	<1+(0.246*Long term fuel trim)	Time in closed loop fuelling control (only used for bank to bank flow arbitration)	>10seconds			
				off/on <0.524	Intake air temp sensor OK (P0112/0113)				
				on/off <0.671	Engine coolant temp sensor OK (P0117/0118)				
					Mass Air Flow sensor OK (P0101 to P010F)				
				Lambda difference> threshold AND bank1 lambda > bank2 lambda	Not in HEGO FMEM				
				lambda difference>0.435					
	P0492 (Low flow Bank2)	Closed loop bank2 lambda correction at first switch AND low measured flow via HFM	First switch correction < threshold * corrected SAIR flow	<1+(0.246*Long term fuel trim)	Time in closed loop fuelling control (only used for bank to bank flow arbitration)	>10seconds			
				off/on <0.524	Intake air temp sensor OK (P0112/0113)				
				on/off <0.671	Engine coolant temp sensor OK (P0117/0118)				
					Mass Air Flow sensor OK (P0101 to P010F)				
		Closed loop bank1 vs bank2 lambda difference	Lambda difference> threshold AND bank1 lambda < bank2 lambda	lambda difference>0.435	HEGO monitor complete				
Outlet Hose Disconnection	P2448 (Low flow Bank1)	Modelled pump flow higher than measured flow via HFM	Ratio of SAIR flow difference at SAIR pump off / on transition	off/on >1.44	Time with SAIR active	>2seconds		Continuous (circuit checks)	
	P2449 (Low flow Bank2)								
					SAIR off time before re- enable (if SAIR is disabled due to engine conditions)	>3seconds			
					Time in closed loop fuelling control (only used for bank to bank flow arbitration)	>10seconds			
					HEGO monitor complete				
SAIR circuit ecu output high/low	P0412	Circuit malfunction	PCM able to determine failure	Time with fault>5 seconds					
SAIR circuit relay high output	P2257	Circuit malfunction	PCM able to determine failure	Time with fault>5 seconds					
SAIR circuit relay low output	P2258	Circuit malfunction	PCM able to determine failure	Time with fault>5 seconds					

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
ESM (EGR System Module) Exhaust Gas Recirculation Monitor									
Electronic Vacuum Regulator (EVR) Electrical	P0403	Circuit Malfunction - Short to Vbat	PCM able to determine failure		EGR duty cycle	egrdc>0.2*100	Once per driving cycle	Footnote a)	Footnote c+f)
			Time with circuit malfunction	>2 seconds	EGR valve valve warm	cumulative time with egr enabled > 40 seconds			
Pressure Differential Sensor	P0405 Low Input	Circuit malfunction	Signal circuit voltage	<0.049 (4.8kPa) 10*(5/1024)	Ambient Temperature	> -7c (20f)	Continuous	Footnote a)	Footnote c+f)
			Time with circuit malfunction	>2.5 seconds					
	P0406 Low Input	Circuit malfunction	Signal circuit voltage	>4.956 (115.25kPa) 1015*(5/1024)	Ambient Temperature	> -7c (20f)	Continuous	Footnote a)	Footnote c+f)
			Time with circuit malfunction	>2.5 seconds					
EGR Valve	P0402 EGR Excess Flow	Excessive pressure differential across EGR orifice at idle	Pressure differential > Pressure differential at engine off + offset	> 0.366 volts 75*(5/1024)	EGR valve warm	cumulative time with egr enabled > 40 seconds	Once per driving cycle	Footnote a)	Footnote c+f)
			Forced valve actuation complete	2	P0403 test complete and no fault				
			Time exceeding threshold	>5 seconds	P0405 test complete and no fault				
					P0406 test complete and no fault				
					Ambient Temperature	> -7c (20f)			
	P0401 EGR Restricted flow	Low pressure differential across EGR orifice with high valve duty commanded	Low pressure differential	<FN202 (See function)	EGR duty cycle	egrdc>0.75*100	Once per driving cycle	Footnote a)	Footnote c+f)
			Time with fault	>0.7*50 seconds	Manifold vacuum	> 20.3 kPa (6"Hg)			
					Ambient Temperature	> -7c (20f)			
					Not in transient condition (air charge rate of change)	< 0.04 (lb/stk)			
					Engine speed	<3000rpm			
					Air mass	<60.47g/sec (8lb/min)			
					P0403 test complete and no fault				
					P0405 test complete and no fault				
					P0406 test complete and no fault				
					P0402 test complete and no fault				

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Variable Cam Timing Monitor									
VCT actuator malfunction	P0010 (Bank1)	Circuit Malfunction	PCM able to determine failure				Continuous	Footnote a)	Footnote c)
	P0020 (Bank2)	Circuit Malfunction	Time with failure	>5seconds					
VCT target error	P0011 (Bank1)	Measured Cam Position Over advanced	PCM able to determine failure		Engine coolant temperature	>-7c (20f)			
	P0021 (Bank2)		Time with failure	>5seconds	Engine oil temperature	>-7c (20f) <121c (250f)			
			Cam position error vs target	>12.4deg CRK	Cam angle sensitivity modifier for cam position bank1 vs bank2	CAM_RANGE_SENS (See function)			
			Cam position error bank1 vs bank2	>16deg CRK	FNCAM_ACT_FK (See function)				
			Time exceeding threshold	>5 seconds	Filter for target error calculation	0.25*100%			
					Intake air temp sensor OK (P0112/0113)				
					Engine coolant temp sensor OK (P0117/0118)				
					Engine oil temp sensor OK (P0197/0198)				
					Throttle Position Sensor OK (P0122/0123)				
					Crankshaft position circuit (PIP) OK (P0320)				
					Mass Air Flow sensor OK (P0101 to P010F)				
					Camshaft ID circuit (CMP) OK (P0340)				
VCT target error	P0012 (Bank1)	Measured Cam Position Over retarded	Cam position error vs target	>12.4deg CRK	Engine coolant temperature	>-7c (20f)			
	P0022 (Bank2)		Cam position error bank1 vs bank2	>16deg CRK	Engine oil temperature	>-7c (20f) <121c (250f)			
			Time exceeding threshold	>5 seconds	Cam angle sensitivity modifier for cam position bank1 vs bank2	CAM_RANGE_SENS (See function)			
					Cam angle error filter for target error calculation	FNCAM_ACT_FK (See function)			
					Filter for target error calculation	0.25*100%			
					Intake air temp sensor OK (P0112/0113)				
					Engine coolant temp sensor OK (P0117/0118)				
					Engine oil temp sensor OK (P0197/0198)				
					Throttle Position Sensor OK (P0122/0123)				
					Crankshaft position circuit (PIP) OK (P0320)				
					Mass Air Flow sensor OK (P0101 to P010F)				
					Camshaft ID circuit (CMP) OK (P0340)				
CAM / CRANK Misalignment	P0016 (Bank1)	Measured Cam Position with VCT locked fully retarded	Cam position error	>8deg CRK	Engine speed	>600rpm <1100rpm	Once per driving cycle	Footnote a)	Footnote c)
	P0018 (Bank2)				Indicated torque	>25 Nm (18.4ftlb) <95 Nm (70ftlb)			
					Time after start	>25sec <16383sec			
					Engine coolant temperature	>71.1degC (160degF) <104.4degC (220degF)			
					Filter for position error	1.5			
					Air charge temperature	>-17.7degC (0degF) <65.5degC (150degF)			

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
HO2S Monitor									
Stream 1 (Front) O2 Sensor Signal Stuck Lean	P2195 (Bank 1, Sensor 1)	Lack of HO2S switches	Stage 1: (Look for short term fuel trim stuck)		Fuel control	Closed loop or Closed loop desired	Continuous	Footnote a)	Footnote c)
	P2197 (Bank 2, Sensor 1)		Short term fuel trim	> 1 - 0.26 * 100%	Intake air temp sensor OK (P0112/0113)				
			Time with short term fuel trim at limit	> 20 * 1 sec	Engine coolant temp sensor OK (P0117/0118)				
			Stage 2: (Look for HO2S stuck at startup)		Mass Air Flow sensor OK (P0102/0103)				
			Cumulative time in test mode since start up	> 30 sec	Throttle Position Sensor OK (P0122/0123)				
			Number of switches since start up	< 6					
			Fuel control	In FMEM at start up	Fuel level above minimum level	> 0.15 * 100 %			
					Time entry conditions have been present	> 10 sec			
Stream 1 (Front) O2 Sensor Signal Stuck Rich	P2196 (Bank 1, Sensor 1)	Lack of HO2S switches	Stage 1: (Look for short term fuel trim stuck)		Fuel control	Closed loop or Closed loop desired	Continuous	Footnote a)	Footnote c)
	P2198 (Bank 2, Sensor 1)		Short term fuel trim	> 1 + 0.26 * 100%	Intake air temp sensor OK (P0112/0113)				
			Time with short term fuel trim at limit	> 20 * 1 sec	Engine coolant temp sensor OK (P0117/0118)				
			Stage 2: (Look for HO2S stuck at startup)		Mass Air Flow sensor OK (P0102/0103)				
			Cumulative time in test mode since start up	> 30 sec	Throttle Position Sensor OK (P0122/0123)				
			Number of switches since start up	< 6					
			Fuel control	In FMEM at start up	Fuel level above minimum level	> 0.15 * 100 %			
					Time entry conditions have been present	> 10 sec			
Stream 1 (Front) HO2S Overvoltage	P0132 (Bank 1) P0152 (Bank 2)	Monitor HO2S voltage	Voltage greater than malfunction threshold	> 1.1 volts	Fuel control	Closed loop or Closed loop desired	Continuous	Footnote a)	Footnote c)
			Time with sensor voltage out of range	> 18 sec	Stream 1 HO2S: Inferred sensor temp	> 204 deg C (> 400 deg F)			
					HO2S heater OK (P0135, P0053-bank1) (P0155, P0059-bank2)				
Stream 1 (Front) HO2S Circuit Slow Response	P0133 (Bank 1)	Monitor HO2S switching frequency and amplitude (Forced at 1.5 Hz fixed rate)	Switching frequency (Indicates gross failure)	< 0.0 Hz	Time since entering closed loop fuel control	> 10 sec	< 8 sec once per driving cycle	Footnote a)	Footnote c)
	P0153 (Bank 2)		Switching frequency difference from desired (Test run at correct frequency)	< 0.44875 Hz	Short term fuel trim	0.85 - 1.15 * 100 %			
			Signal voltage amplitude	< 0.518 volts	Engine coolant temp and ECT sensor OK (P0117/0118)	65 - 116 deg C (150 - 240 deg F)			
					Fuel level above minimum level	> 0.15 * 100 %			
					Intake air temp and IAT sensor OK (P0112/0113)	< 60 deg C (< 140 deg F)			
					Engine load and MAF sensor OK (P0102/0103)	0.2 - 0.4 * 100 %			
					Vehicle speed and VSS (P0500) sensor OK	37 - 65 mph			
					Engine rpm and crankshaft position circuit (PIP) OK (P0230)	1800 - 2450 rpm			
					Throttle position sensor OK (P0122/0123)				
					Camshaft ID circuit (CMP) OK (P0340)				
					No Misfire Monitor DTCs				
					Fuel rail pressure sensor OK (P0190/0192/0193)				
					Not transitioning into/out of Characteristic Shift Down				
					No Purge System reset				
					Maximum change in engine rpm while running	< 165 rpm			
					Maximum change in engine load while running monitor	< 0.11 * 100%			
					Maximum change in vehicle speed while running monitor	< 10 mph			

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Rear HO2S Circuit Malfunction	P2270 (Bank 1)	Monitor normal signal voltage envelope; forced A/F excursion if required for green catalyst (Rationality check)	HO2S maximum signal voltages stuck lean	< 0.48 volts	Inferred exhaust temp	71 - 792 deg C (160 - 1458 deg F)	Once per driving cycle	Footnote a)	Footnote c)
	P2272 (Bank 2)				Downstream heater on time	> 120 sec			
					Pedal position	Part throttle			
					Engine rpm - for forced excursion only	> 1200 rpm			
					Inferred exhaust temp - for forced excursion only	< 815 deg C ($\leq$ 1500 deg F)			
					Flex fuel composition not changing				
					Upstream sensor(s) tested				
	P2271 (Bank 1)	Monitor normal signal voltage envelope; forced A/F excursion if required for green catalyst (Rationality check)	HO2S minimum signal voltages stuck rich	> 0.42 volts	Inferred exhaust temp	71 - 792 deg C (160 - 1458 deg F)	Once per driving cycle	Footnote a)	Footnote c)
	P2273 (Bank 2)				Downstream heater on time	> 120 sec			
					Pedal position	Part throttle			
					Engine rpm - for forced excursion only	> 1200 rpm			
					Inferred exhaust temp - for forced excursion only	< 815 deg C ($\leq$ 1500 deg F)			
					Flex fuel composition not changing				
					Upstream sensor(s) tested				
Stream 2 (CMS) HO2S Overvoltage	P0138 (Bank 1)	Monitor HO2S voltage	Voltage greater than malfunction threshold	> 1.1 volts	Stream 2 HO2S heater on time	> 90 sec	Continuous	Footnote a)	Footnote c)
	P0158 (Bank 2)		Time with sensor voltage out of range	> 18 sec	Stream 2 HO2S: Inferred sensor temp	> 204 deg C ($\geq$ 400 deg F)			
					HO2S heater OK (P0141, P0054-bank1) (P0161, P0060-bank2)				
HO2S Heater Circuit Malfunction	P0135 (HO2S11)	Circuit continuity check, monitor voltage for opens and shorts	Feedback circuit state matches commanded output state (Digital signal)	Feedback circuit high or low	Stream 1 HO2S: Inferred sensor temp	26.6 - 630.5 deg C (80 - 1167 deg F)	Continuous	Footnote a)	Footnote c)
	P0155 (HO2S21)		Monitor retries allowed for malfunction (Background loops)	RETRY_ALLOW					
	P0053 (HO2S11)	Functional check, monitor min. and max. heater current	Heater circuit current	< 0.465 amps or > 3.0 amps	Stream 1 HO2S: Inferred sensor temp	121 - 593 deg C (250 - 1100 deg F)	Once per driving cycle		
	P0059 (HO2S21)				Stream 1 HO2S heater on time	> 30 sec			
					Stream 1 sensor(s) tested (P0133/P0153 tests completed)				
					Stream2 sensor (s) tested P0136, P0156				
	P0141 (HO2S12)	Circuit continuity check, monitor voltage for opens and shorts	Feedback circuit state matches commanded output state (Digital signal)	Feedback circuit high or low	Stream 2 HO2S: Inferred sensor temp	149 - 760 deg C (300 - 1400 deg F)	Continuous		
	P0161 (HO2S22)		Monitor retries allowed for malfunction (Background loops)	RETRY_ALLOW					
	P0054 (HO2S12)	Functional check, monitor min. and max. heater current	Heater circuit current	< 0.22 amps	Stream 2 HO2S: Inferred sensor temp	121 - 732 deg C (250 - 1350 deg F)	Once per driving cycle		
	P0060 (HO2S22)			> 3.0 amps	Stream 2 HO2S heater on time	> 30 sec			
					Stream 1 sensor(s) tested (P0133/P0153 tests completed)				
					Stream2 sensor (s) tested P0136, P0156				

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Comprehensive Component Monitor									
MAF Sensor Input	P0100 (MAF A Airpath)	Rationality Check - Compares measured MAF vs modelled airflow	MAF1 vs MAF2 low airflow	MAF1< 0.5*estimate - max (0.5*30.23g/sec) OR (0.35* (0.5*estimate))	Vehicle speed VSS (P0500) sensor OK	VSS<30mph OR TPS>5.27deg (60cnts) 11< Voltage <18 >3 seconds >5 seconds	Continuous	Footnote a)	Footnote c)
					Throttle position sensor TPS OK (P0122/0123)				
					Vehicle speed and TPS in range				
					Battery Voltage				
					SAIR not commanded				
					Time with fault				
					P0101 (MAF A Range)				
	Throttle position sensor TPS OK (P0122/0123)								
	Vehicle speed and TPS in range								
	Battery Voltage								
	SAIR not commanded								
	Time with fault								
	P0102 (Low)	Circuit Check	Sensor signal voltage	< 0.024 volts (0g/sec)		Time since last PIP signal (Engine not stalled)			
	P0103 (High)	Circuit Check	Fault filter routine	> 1 sec					
			Sensor signal voltage	> 4.88 volts (293g/sec)	Time since last PIP signal (Engine not stalled)	< 150 msec			
	P0104 (Backflow)	Rationality Check	MAF1+MAF2 not equal to estimate AND MAF1 & 2 do not equal estimate. MAF1 voltage low.	MAF1+MAF2 <estimate - max(30.23g/sec) OR (0.35*estimate) MAF1< 0.5*estimate - max (0.5*30.23g/sec) OR (0.35* (0.5*estimate)) MAF2< 0.5*estimate - max (0.5*30.23g/sec) OR (0.35* (0.5*estimate)) MAF1 voltage < 0.024 (0g/sec)	Vehicle speed VSS (P0500) sensor OK	VSS<30mph OR TPS>5.27deg (60cnts) 11< Voltage <18 >3 seconds >5 seconds			
					Throttle position sensor TPS OK (P0122/0123)				
					Vehicle speed and TPS in range				
					Battery Voltage				
					SAIR not commanded				
					Time with fault				
					P010A (MAF B Airpath)				
	Throttle position sensor TPS OK (P0122/0123)								
	Vehicle speed and TPS in range								
	Battery Voltage								
	SAIR not commanded								
	Time with fault								
	P010B MAF B Range)	Rationality Check - Compares measured MAF vs modelled airflow	MAF1+MAF2 not equal to estimate AND MAF2 vs MAF1 low airflow	MAF1+MAF2 <estimate - max(xg/sec) OR (0.35*estimate) MAF2< 0.5*estimate - max (0.5*30.23g/sec) OR (0.35* (0.5*estimate))	Vehicle speed VSS (P0500) sensor OK	VSS<30mph OR TPS>5.27deg (60cnts) 11< Voltage <18 >3 seconds >5 seconds			
	Throttle position sensor TPS OK (P0122/0123)								
	Vehicle speed and TPS in range								
	Battery Voltage								
	SAIR not commanded								
	Time with fault								
	P010C (Low)	Circuit Check	Sensor signal voltage	< 0.024 volts (0g/sec)	Time since last PIP signal (Engine not stalled)				
	P010D (High)	Circuit Check	Fault filter routine	> 1 sec					
			Sensor signal voltage	> 4.88 volts (293g/sec)	Time since last PIP signal (Engine not stalled)	< 150 msec			
	P010E Backflow)	Rationality Check	MAF1+MAF2 not equal to estimate AND MAF1 & 2 do not equal estimate. MAF2 voltage low.	MAF1+MAF2 <estimate - max(30.23g/sec) OR (0.35*estimate) MAF1< 0.5*estimate - max (0.5*30.23g/sec) OR (0.35* (0.5*estimate)) MAF2< 0.5*estimate - max (0.5*30.23g/sec) OR (0.35* (0.5*estimate)) MAF2 voltage < 0.024 (0g/sec)	Vehicle speed VSS (P0500) sensor OK	VSS<30mph OR TPS>5.27deg (60cnts) 11< Voltage <18 >3 seconds >5 seconds			
					Throttle position sensor TPS OK (P0122/0123)				
					Vehicle speed and TPS in range				
					Battery Voltage				
					SAIR not commanded				
					Time with fault				
					P010F (MAFA/B Correlation)				

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Manifold Pressure Input	P0106 (Rationality)	Rationality Check	Error between inferred manifold pressure and measure manifold pressure	>26.75kPa (7.89"Hg)	Engine speed	>600rpm <8000rpm	Continuous	Footnote a)	Footnote c)
			Time with fault	>1.25 seconds	Throttle position sensor TPS OK (P0122/0123)				
					Throttle position in range	>0cnts (0volts) <1023cnts (4.99volts)			
					Engine not in transient load condition	<0.39*100			
	P0107 (Low)	Range check	Sensor signal voltage	< 0.04 volts 4.64kPa(1.37"Hg)	Battery Voltage	11< Voltage <18			
Barometric Pressure Input	P0069 (Rationality)	Rationality Check	Barometric pressure below manifold pressure	(BP-2.9kPa [0.859"Hg])<MAP	Barometric pressure sensor OK (P2228/2229)		Continuous	Footnote a)	Footnote c)
			Time with fault	>8 seconds	Manifold pressure sensor OK (P0106/0107/0108)				
	P2228 (Low)	Range check	Sensor signal voltage	<2.3 volts 55.13kPa(16.28"Hg)	Battery Voltage	11< Voltage <18			
IAT Sensor Input	P0112 (Low)	Range check	Sensor input	< 0.2 volts 134.3degC (273.7degF)	Battery Voltage	11< Voltage <18	Continuous	Footnote a)	Footnote c)
			Time with sensor input out of range	> 5.0 sec					
			Sensor input	> 4.9 volts -40.7degC(-41.3F)					
			Time with sensor input out of range	> 5.0 sec					
	P0111	IAT Rationality check	Air Charge Temperature stuck	+ / - 16.6degC (30degF) from ECT	IAT_RAT_THRES	soak > 360 min, ECT > -31.6degC (-25F)	Once per drive cycle	Footnote a)	Footnote c)
MATF Sensor Input	P0097 (High)	Range check	Vehicle speed ROA check	VSPD > 12.5 mph	time > 5.5 secs		once per drive cycle / <30 mins		
	P0098 (Low)	Range check	Sensor signal voltage	< 0.13 volts 150.4degC (302.75degF)	Battery Voltage	11< Voltage <18	Continuous	Footnote a)	Footnote c)
EOT Sensor Input	P0197 (Low)	Range check	Sensor input	< 0.2 volts 134.27degC (273.7degF)	Battery Voltage	11< Voltage <18	Continuous	Footnote a)	Footnote c)
			Time with sensor input out of range	> 5.0 sec					
			Sensor input	> 4.9 volts -40.7degC (-41.3degF)					
			Time with sensor input out of range	> 5.0 sec					
	P0196	Rationality	EOT error vs model	> +/-38degC (100degF)	Engine off soak time	>360 minutes			
ECT Sensor Input	P0117 (Low)	Range check	Manifold temperature - IAT	>< +/- 26degC (80degF)	IAT sensor OK (P0112/0113)		Continuous	Footnote a)	Footnote c)
			Sensor input	< 0.2 volts 136.8degC (273.7degF)					
			Time with sensor input out of range	> 5.0 sec					
			Sensor input	> 4.9 volts -40.7degC (-41.3degF)					
	P0116	Rationality check (Stuck high)	Engine coolant temp	110 deg C (> 230 deg F)	Continuous time with engine off prior to start	> 360 min	Once per driving cycle	Footnote a)	Footnote c)
Engine-Off (Soak) Timer Rationality Test	P0606	Rationality check, Engine-Off timer inoperative	Time with high sensor signal	> 30 sec	ECT at start differs from IAT at start	>28 deg C (> 50 deg F)	Once per driving cycle	Footnote a)	Footnote b)
					Catalyst, Misfire, Fuel				
			Soak timer value at startup	< 0.5 * 60 sec (Timer indicates that short soak has occurred)	ECT at previous keyoff was hot	>32.3degC (90degF)			

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Fuel Temperature Sensor Input	P0180	Circuit Malfunction - range check	Sensor input	< 0.2 volts 132.8degC (271.1degF) or > 4.9 volts -41.2degC(-42.1degF)	Battery Voltage	11< Voltage <18	Continuous	Footnote a)	Footnote c)
			Time with sensor input out of range	> 5.0 sec					
	P0182 (Low)	Circuit Malfunction - range check	Sensor input	< 0.2 volts 132.8degC (271.1degF)					
			Time with sensor input out of range	> 5.0 sec					
	P0183 (High)	Circuit Malfunction - range check	Sensor input	> 4.9 volts -41.2degC(-42.1degF)					
			Time with sensor input out of range	> 5.0 sec					
	P0181	Rationality check	ECT-Fuel rail temperature	<> +/-12.3degC (54.1degF)	Engine off time ECU power up timer	>360minutes >0.1seconds	Once per driving cycle	Footnote a)	Footnote c)
Fuel Rail Pressure Input	P0190	Circuit malfunction	Sensor input stuck Large control error	103 +/- 59 kPa > +/-103 kPa (> 15 psig)	Battery Voltage	11< Voltage <18	Continuous	Footnote a)	Footnote c)
			Time with sensor input out of range	> 8.0 sec					
	P0191	Range/Performance check	(Demand - sensed) error too large	> 137 kPa (20 psig)	Demand pressure within limits	< 413 kPa or > 344 kPa (< 60 psig or > 50 psig)			
			Time with sensor input out of range	> 8 sec	Fuel level above minimum level	> 0.15 * 100 %			
	P0192 (Low)	Range check	Sensor input	< 0.95 volts 174.23kPa (25.33psig)	Battery Voltage	11< Voltage <18			
			Time with sensor input out	> 8 sec					
	P0193 (High)	Range check	Sensor input	> 4.88 volts 647kPa (93.95psig)					
			Time with sensor input out	> 8 sec					
Fuel Pump	P1233	Fuel pump driver module	Time with failure	> 5.0 seconds			Continuous	Footnote a)	Footnote c)
	P1235	Fuel pump control out of	Time with failure	> 5.0 seconds					
	P1237	Fuel pump circuit malfunction	Time with failure	> 5.0 seconds					
Fuel Injectors	P0201 P0202 P0203 P0203 P0204 P0205 P0206 P0207 P0208	Circuit continuity check, open or shorted	Smart power driver status	1 = malfunction Increment fault counter by 1 on each event. Set code when counter exceeds 40 (> 8 sec @ 600rpm)	Battery voltage	> 11.0 volts	Continuous	Footnote a)	Footnote c)
					Engine coolant temp	< 116 deg C (< 240 deg F)			
					Intake air temp	<66 deg C (< 150 deg F)			
Ignition System- CKP Circuit Malfunction	P0320	Intermittent/Noisy CKP signal check	Engine rpm (Used to determine crank mode)	> FN384 rpm (See Function)	None		Continuous	Footnote a)	Footnote c)
			Number of CKP edges incorrect, missing tooth in unexpected location. SW loses synchronization with missing tooth location	None	Increment fault counter by 10 on each event. Set code when counter exceeds 100				
					Engine Speed	>550rpm <5000rpm			
Camshaft Position Input	P0340 (BankA)	Rationality check	Ratio of PIP events to CID events	n to 1 (To pass test)	Increment fault counter by 2 on each event. Set code when counter exceeds 50	N/A	Continuous	Footnote a)	Footnote c)
					Engine speed	>550 rpm <2200rpm			
	P0345 (BankB)	Rationality check	Ratio of PIP events to CID events	n to 1 (To pass test)	Increment fault counter by 2 on each event. Set code when counter exceeds 50	N/A			
					Engine speed	>550 rpm <2200rpm			

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Ignition System- Ignition Coil Primary Circuit Malfunction	P0351 P0352 P0353 P0354 P0355 P0356 P0357 P0358	Rationality check	Ratio of PIP events to spark events seen	1 to 1 (To pass test)	Increment fault counter by 20 on each event. Set code when counter exceeds 200	N/A	Continuous	Footnote a)	Footnote c)
			PCM able to determine coil	Yes	Battery Voltage	11.5< Voltage			
					Above neutral torque axis	See RPM/Load Table FNMISOK_97: Monitor disabled when less than 0.5			
IAC Solenoid Overspeed Error	P0507	Functional check - overspeed error	Difference between actual and desired rpm	> -200 rpm	Engine coolant temp	-40 deg C (> -40 deg F)	Continuous	Footnote a)	Footnote c)
			Time with solenoid at limit	> 5 sec	Time since engine start	> 60 sec			
					Fuel control	Closed loop			
					Idle state	At idle			
IAC Solenoid Underspeed Error	P0506	Functional check - underspeed error	Difference between actual and desired rpm	> 100 rpm	Engine coolant temp	-40 deg C (> -40 deg F)	Continuous	Footnote a)	Footnote c)
			Time with solenoid at limit	> 5 sec	Time since engine start	> 60 sec			
					Fuel control	Closed loop			
					Idle state	At idle			
Vehicle ID block not programmed	P1639	VID block not programmed with tire/axle ratio	Time with error present	> 0 sec	None	None	Continuous	Footnote a)	Footnote c)
VID Block checksum	P0602	VID block checksum test failed	Time with error present	> 0 sec	None	None	Continuous		
KAM Failed / reset	P0603	Keep Alive Memory check failed / memory was reset	Time with error present	> 0 sec	None	None	Continuous	Footnote a)	Footnote c)
RAM memory failed	P0604	Random Access Memory test has failed.	Time with error present	> 0 sec	None	None	Continuous	Footnote a)	Footnote c)
ROM checksum test failed	P0605	Read Only Memory test failed	Time with error present	> 0 sec	None	None	Continuous	Footnote a)	Footnote c)
CPU Fault detected	P0607	General fault with the CPU has been detected	Time with error present	> 0 sec	None	None	Continuous		
Keep Alive Memory Power Input	P1633	KAM power input voltage too low/open circuit	Time with error present	> 20 sec	None	None	Continuous	Footnote k)	Footnote i)
Vehicle Speed Sensor	P0500	Invalid / missing data from BCM	BCM reports VSS failure OR no data on CAN bus	1	Time after start	>2 seconds	Continuous	Footnote a)	Footnote c)
Vapor Management Valve Circuit Malfunction	P0443	Circuit continuity test, open or shorted	Commanded duty cycle on or full-off	>=0.5 * 100 % or = 0%	None	N/A	Continuous	Footnote a)	Footnote e)
			Signal circuit voltage	Refer to Appendix for threshold calculation					
			Time with circuit malfunction	> 5 sec					
KNKS Sensor	P0330 Bank1 Sensor1	Sensor range check	Calculated sensor noise (peak to peak variation)	>0.25	Engine speed	>1000rpm	Continuous	Footnote a)	Footnote c)
	P0325 Bank1 Sensor2	Sensor range check			Engine coolant temp	>55degC (131degF)			
	P130A Bank2 Sensor2	Sensor range check							
	P130B Bank2 Sensor2	Sensor range check							
Fuel Level Input Out Of Range	P0460 (Range Check)	Sensor range check	Sensor input	<= 7 or >= 254 A/D counts w/in a range of 256 A/D counts	None	N/A	Continuous	Footnote a)	Footnote j)
	P0462 (Low)	Circuit Check	Sensor input	< 7 A/D counts					
	P0463 (High)	Circuit Check	Sensor input	> 254 A/D counts					
			Time with sensor out of range	> 30 sec					
Fuel Level Input Stuck	P0460 (Rationality)	Sensor rationality check (Stuck sensor)	Compare fuel mass consumed versus observed change in gauge readings (Min. and max. reading)		Fuel consumed (Fuel consumed and fuel gauge reading range are both stored in KAM and reset after a refuelling event or DTC storage)	> 10 %	Continuous	Footnote a)	Footnote e)
		"Fuel consumed" is continuously calculated based on PCM fuel pulse width summation as a percent of fuel tank capacity	Fuel consumed (%) - Range of fuel gauge readings (%)	> 0.125 * 100 % threshold at fuel tank fill from 15% to 85%					
			Fuel consumed (%) - Range of fuel gauge readings (%)	> 0.054 + 0.125 * 100 % threshold if tank overfilled (> 85%)					
			Fuel consumed (%) - Range of fuel gauge readings (%)	> 0.175 + 0.125 * 100 % threshold if tank on reserve (< 15%)					
Fuel Level Input Noisy	P0461 (Rationality)	Sensor rationality check (Noisy sensor)	Change in fuel level	> 0.1925*100%	Fuel level on the data bus	N/A	Continuous	Footnote a)	Footnote e)
			Number of intermittent events	> 5					
I/M Readiness			Number of driving cycles to clear I/M readiness flag at extreme ambient conditions	> 1 driving cycle(s)					

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Electronic Throttle Control									
TPPC chip failure in PCM	P0606	TPPC chip to CPU communication fault	Number of attempts	> 1			Continuous	Footnote a)	Footnote c)
TP Sensor Inconsistent With MAF Sensor	P0068	Rationality check vs. MAF input	Engine rpm	> 1000 rpm	Engine coolant temp	> 15 deg C (> 60 deg F)	Continuous	Footnote a)	Footnote c)
			Sensor signal voltage	< 1.22 volts or > 3.42 volts					
			Engine load	> 0.7 * 100% or < 0.2 * 100%					
			Time with sensor out of range	> 3.0 sec					
TP Sensor 'A' Input Out Of Range	P0122 (Low)	Range check	Time with low throttle voltage at TPPC or PCM	>= 0.176 seconds	None	N/A	Continuous	Footnote a)	Footnote c)
	Sensor signal voltage		< 0.2 volts						
	Time with high throttle voltage at TPPC or PCM		>= 0.176 seconds						
	Sensor signal voltage		> 4.87 volts						
TP Sensor 'B' Input Out Of Range	P0222 (Low)	Range check	Time with low throttle voltage at TPPC or PCM	>= 0.176 seconds	None	N/A	Continuous	Footnote a)	Footnote c)
	Sensor signal voltage		< 0.08 volts						
	Time with high throttle voltage at TPPC or PCM		>= 0.176 seconds						
	Sensor signal voltage		> 4.80 volts						
TP Sensor A/B Correlation	P2135	Rationality check	Time with correlation failure from the TPPC or PCM or Equizzer	>= 240 sec	None	N/A	Continuous	Footnote a)	Footnote c)
	Magnitude of the difference of the relative readings of the sensor signal voltage		> 0.073 volts (6.533deg)						
Throttle Actuator Control System	P2104	ETC FMEM – forced idle	Two or three pedal sensors failed, throttle plate stuck	>= 100 to 400 msec	None	N/A	Continuous	Footnote a)	Footnote c)
	P2105	ETC FMEM – forced engine shutdown	Equizzer detected fault	>= 16 to 960 msec	None	N/A	Continuous	Footnote a)	Footnote c)
	P2106	ETC FMEM – pedal-follower mode	Sensor fault: MAF, one TP, CKP, TSS, OSS, stuck throttle, throttle actuator circuit fault	>= 16 to 960 msec	None	N/A	Continuous	Footnote a)	Footnote c)
	P2110	ETC FMEM – default throttle angle	Two TPs failed; TPPC detected fault	>= 600 to 800 msec	None	N/A	Continuous	Footnote a)	Footnote c)
Throttle Plate Position Controller (TPPC)	P2111 (Stuck Open)	Functional test	Desired throttle angle vs. actual throttle angle measured in a rolling average routine during throttle tip-in	> 3.5 degrees	None	N/A	Continuous	Footnote a)	Footnote c)
	P2112 (Stuck Closed)	Functional test	Desired throttle angle vs. actual throttle angle measured in a rolling average routine during throttle tip-out	> 3.5 degrees	None	N/A	Continuous	Footnote a)	Footnote c)
	P2107	TPPC processor check	Internal processor test, lost communication with main CPU	>= 60 msec	None	N/A	Continuous	Footnote a)	Footnote c)
Throttle Actuator Control Motor	P2100	Circuit check	Throttle actuator circuit open	>= 1750 msec	None	N/A	Continuous	Footnote a)	Footnote c)
	P2101	Range check	Throttle actuator range/performance test, throttle plate angle does not followed commanded angle	>= 500 msec	None	N/A	Continuous	Footnote a)	Footnote c)

Signal circuit voltage threshold calculation for DTC P0443

At 98% DC: $[(42 \times \text{Battery voltage}) - 150] \times 5.0/1024 \text{ volts}$
 At 0% DC: $[(32 \times \text{Battery voltage}) - 200] \times 5.0/1024 \text{ volts}$

FNMISPCT_97

Load \ RPM	700	950	1500	2000	2500	3000	4000	5000	6000	7500
0.1	0.20	0.20	0.20	0.20	0.20	0.20	0.17	0.12	0.12	0.10
0.15	0.20	0.20	0.20	0.20	0.20	0.20	0.17	0.12	0.12	0.10
0.2	0.20	0.20	0.20	0.20	0.20	0.20	0.17	0.12	0.12	0.10
0.3	0.20	0.20	0.20	0.20	0.20	0.16	0.15	0.11	0.12	0.09
0.4	0.20	0.20	0.20	0.20	0.16	0.14	0.12	0.10	0.10	0.09
0.5	0.20	0.20	0.20	0.16	0.16	0.14	0.12	0.09	0.09	0.08
0.7	0.20	0.20	0.20	0.16	0.14	0.13	0.12	0.08	0.08	0.08
0.9	0.20	0.20	0.20	0.16	0.14	0.13	0.12	0.08	0.08	0.08

Misfire Monitor Time Delay Since Engine Start Up = 0 seconds + FNMISACT value

FNMISACT

ACT (degC)	-40	-29	-7	60	66	93
output_axis [s]	180	180	0	0	0	0

FNMISOK_97

Load \ RPM	700	950	1500	2000	2500	3000	4000	5000	6000	7500
0.1	0.043	0.043	0.001	0.043	0	0	0	0	0	0
0.15	0.614	0.614	0.833	0.614	1	0.444	0	0	0	0
0.2	1	1	1	1	1	1	0.474	0.029	0	0
0.3	1	1	1	1	1	1	1	0.885	0.474	0.043
0.4	1	1	1	1	1	1	1	1	1	0.614
0.5	1	1	1	1	1	1	1	1	1	1
0.7	1	1	1	1	1	1	1	1	1	1
0.9	1	1	1	1	1	1	1	1	1	1

FN_TCSTRT (sec)

TCSTRT [degC]	-28.8	-17.7	-6.6	10	26.6	37.7	46.1	82.2	93.3
output_axis [s]	120	93	58	10	8	6	5	5	5

FN384 (RPM)

ECT [degC]	-160	-17.7	10	15.5	32.2	123.3
output_axis [RPM]	200	200	250	250	250	250

FN202 ("H2O)

SYS_DELPR (kPa)	29.09	33.86	40.63	54.18	67.72	88.04
output_axis [kPa]	6.77	6.97	9.41	16.52	26.71	47.74

FN654S (sec)

TCSTRT [degC]	-160	-34.4	-23.3	-15	-6.6	10	48.8	123.3
output_axis [s]	1400	1400	1150	990	870	670	340	340

FNECTWUT (degF)

TCSTRT [degC]	-160	-9.4	-6.6	123.3
output_axis [degC]	71.1	71.1	77.2	77.2

FNWUT_LD

TCSTRT [degC]	-160	-17.7	-6.6	123.3
output_axis	0.3	0.3	0.3	0.3

FNWUT_VS (mph)

TCSTRT [degC]	-160	-17.7	10	26.6	123.3
output_axis [mph]	20	20	25	30	30

FNCAM_ACT_FK

DEG CRK	0	0.2	2	2.8	60
output_axis [mph]	0.01	0.04	0.4	1	1

CAM_RANGE_SENS

DEG CRK	-50	-30	-15	0	20
output_axis	2	2	2	2	2

DMTL total small leak threshold = TDMKLGTF+TDMKLGTF

DMTL total small leak threshold = TDMKLGTF+TDMKLGTF+FN_KFTDSTAB

TDMKLGTF

GVTAF	0.15	0.25	0.5	0.75	0.85
output_axis [s]	115	125	150	188	210

TDMGLGTF

GVTAF	0.15	0.25	0.5	0.75	0.85
output_axis [s]	0.1	0.1	0.1	0.1	0.1

FIPTGLR

IPTGH [A]	0	1	2	3	4	5	6	7	8
output_axis [s]	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

FIPTGLR

IPTGH [A]	0	1	2	3	4	5	6	7	8
output_axis [s]	1	1	1	1	1	1	1	1	1

FN_KFTDSTAB

GVTAF/IPTGH	0	1	2	3	4	5	6	7	8
0.15	76	76	76	76	76	76	76	76	76
0.25	105	105	105	105	105	105	105	105	105
0.35	135	135	135	135	135	135	135	135	135
0.45	167	167	167	167	167	167	167	167	167
0.55	205	205	205	205	205	205	205	205	205
0.65	262	262	262	262	262	262	262	262	262
0.75	318	318	318	318	318	318	318	318	318
0.85	380	380	380	380	380	380	380	380	380

Notes:

- 1) "Continuous" under the "Time Required" column indicates that the specified test cycles at a frequency greater than once every 0.5 seconds whenever the test entry conditions are met.
- 2) "Once per driving cycle" under the "Time Required" column indicates that the specified test will complete during the first 2 bags of an FTP as well as under the test entry conditions specified, on the road.
- 3) All test entry condition parameters are measured instantaneously unless otherwise indicated.

Footnotes

Secondary Parameters

- p) If a 6 hour soak is met, some strategies will not require another continuous 6 hour soak if the customer performs a brief key-off. This has been put into effect to improve evap monitor completion frequency.
- q) Some strategies will have the ability to base evap monitor soak length on the CARB cold soak criteria which consists of an ECT range and ACT/ECT differential.
- r) A minimum soak time has been added to CARB's cold soak criteria (footnote q) to allow calibrators to set a minimum soak time if longer soak times are needed than given by the ACT/ECT-based CARB soak criteria.

DTC Storage:

- a) A pending code will be stored after a malfunction has been detected on one driving cycle; a DTC will be stored after the same malfunction has been detected on the second consecutive driving cycle. The DTC will be erased after 40 warm-up cycles with no malfunction present, after the MIL has been extinguished for the DTC.
- b) A DTC will be stored immediately upon detection of a malfunction. The DTC will be erased after 40 warm-up cycles with no malfunction present, after the MIL has been extinguished for the DTC.
- k) A DTC will be stored after a malfunction has been detected on one drive cycle. The DTC will be erased after 40 warm-up cycles with no malfunction present, after the MIL has been extinguished for that DTC.
- l) A DTC will be stored after a malfunction has been detected on six consecutive drive cycles. The DTC will be erased after 40 warm-up cycles with no malfunction present, after the MIL has been extinguished for that DTC.
- o) For intake air temperatures below 20 deg F, no DTC will set for indicated AIR malfunction.
- s) A DTC will be stored after an evaporative system leak has been detected and the refueling debounce check has been completed on the subsequent driving cycle

MIL Illumination:

- c) The MIL will be illuminated after a malfunction has been detected on two consecutive driving cycles.
The MIL will be extinguished after three consecutive driving cycles where the monitor was run without a malfunction.
- d) The MIL will blink immediately upon detection of a misfire rate that exceeds the catalyst damage threshold, regardless of whether fuel is shut off or not. If the misfire rate drops below the catalyst damage threshold, the MIL will stay on solidly.
The MIL will be extinguished after three consecutive drive cycles where similar conditions have been seen without the malfunction.
- e) The MIL will be illuminated after a malfunction has been detected on two consecutive driving cycles.
The MIL will be extinguished after three consecutive drive cycles where similar conditions have been seen without the malfunction.
- f) For intake air temperatures below 32 deg F, the MIL will not illuminate for the indicated EGR DTCs.
For barometric pressures below 22.5"Hg, the MIL will not illuminate for the indicated EGR DTCs.
For intake air temperatures below 20 deg F, the MIL will not illuminate for the indicated AIR DTCs.
This prevents false MIL illumination due to ice in the EGR hoses or AIR switching valve(s).
- g) This monitor employs EWMA.
The MIL will be illuminated after a malfunction has been detected on two consecutive driving cycles after DTCs have been erased or Keep Alive Memory has been erased (battery disconnect).
The MIL will be illuminated after a malfunction has been detected on up to six consecutive driving cycles during subsequent, "normal" customer driving.
The MIL will be extinguished after up to six consecutive driving cycles without a malfunction.
- h) Some automatic transmission monitors are demonstrated following the USCAR Abbreviated On-Board Diagnostic Test Procedure for Vehicles Equipped with Automatic Transmissions.
This prevents false MIL illumination on this non-turbine speed sensor transmission application.
- i) The MIL will be illuminated after a malfunction has been detected on the first driving cycle.
The MIL will be extinguished after three consecutive driving cycles where the monitor was run without a malfunction.
- j) A DTC will be set after a malfunction has been detected on two consecutive driving cycles.
- m) MIL will be illuminated after a malfunction has been detected on two consecutive driving cycles. MIL will be extinguished after the monitor has run without a malfunction (same or subsequent drive cycle).
- n) A check cap light will be illuminated after a malfunction has been detected on one driving cycle. The check cap light will be extinguished after the monitor has run without a malfunction (same or subsequent drive cycle).



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ASM Gearbox Tables



Component	P Codes	Malfunction Strategy Description	Malfunction Criteria (Fault)	Fault condition (Internal labels)	Threshold Value (Fault condition)	Entry conditions	Entry conditions values	Filter Time to log DTC
Gear Position sensor	P0916	Gear Position sensor short to GND	Gear Position signal low	Output Voltage < th_low	th_low = 0,5V	(Key ON) AND NOT (cranking) AND VSupply inside proper range	VSupply range = 7V-24.5V	500ms
Gear Position sensor	P0917	Gear Position sensor short to battery or open circuit	Gear position signal high	Output Voltage > th_high	th_high = 4,5V	(Key ON) AND NOT (cranking) AND VSupply inside proper range	VSupply range = 7V-24.5V	500ms
Gear Position sensor	P0915	Mechanical damage of magnet holder; Electrical offset. Internal sensor failure	Gear position signal wrong value	The calculated gear from the gear and shift position sensors is different than the last engaged gear (See annexed Chart 1)	th = 3%	(Key ON) AND NOT (cranking) AND VSupply inside proper range	VSupply range = 7V-24.5V	500ms
Shift position	P0907	Gear Position sensor short to battery or open circuit	Shift position signal high	Output Voltage > th_high	th_high = 4,5V	(Key ON) AND NOT (cranking) AND VSupply inside proper range	VSupply range = 7V-24.5V	500ms
Shift position	P0906	Gear Position sensor short to GND	Shift position signal low	Output Voltage < th_low	th_low = 0,5V	(Key ON) AND NOT (cranking) AND VSupply inside proper range	VSupply range = 7V-24.5V	500ms
Shift position	P0905	Mechanical damage of magnet holder; Electrical offset. Internal sensor failure	Shift position signal wrong value	The shift position signal is not coherent with the self tuned value for at least one gear. ShiftPosition (i) - ShiftPositionSelfTuned (i) > th for a timeout where i=1,2,...,7	th = 50 bit timeout = 3s	(Key ON) AND NOT (cranking) AND VSupply inside proper range	VSupply range = 7V-24.5V	500ms
Clutch position sensor	P0807	P1/ P2 wire short circuit to GND	Clutch position sensor - Primary Circuit low	The asic UH05 inside the TCU detects the fault and communicate it to the uP Output Voltage < th_low	th_low = 0,5V	(Key ON) AND NOT (cranking) AND VSupply inside proper range	VSupply range = 7V-24.5V	50ms
Clutch position sensor	P0808	P1/ P2 wire short circuit to battery or open circuit	Clutch position sensor - Primary Circuit high	The asic UH05 inside the TCU detects the fault and communicate it to the uP Output Voltage > th_high	th_high = 4,5V	(Key ON) AND NOT (cranking) AND VSupply inside proper range	VSupply range = 7V-24.5V	50ms
Clutch position sensor	P173A	S1/ S2 wire short circuit to GND	Clutch position sensor - Secondary Circuit low	The asic UH05 inside the TCU detects the fault and communicate it to the uP Output Voltage < th_low	th_low = 0,5V	(Key ON) AND NOT (cranking) AND VSupply inside proper range	VSupply range = 7V-24.5V	50ms



Component	P Codes	Malfunction Strategy Description	Malfunction Criteria (Fault)	Fault condition (Internal labels)	Threshold Value (Fault condition)	Entry conditions	Entry conditions values	Filter Time to log DTC
Clutch position sensor	P173B	S1/ S2 wire short circuit to battery or open circuit	Clutch position sensor - Secondary Circuit high	The asic UH05 inside the TCU detects the fault and communicate it to the uP Output Voltage > th_high	th_high = 4,5V	(Key ON) AND NOT (cranking) AND VSupply inside proper range	VSupply range = 7V-24.5V	50ms
Clutch position sensor	P0805	Short circuit between P1 and P2 or short circuit between S1 and S2	Clutch position sensor - Primary Secondary short circuit	The clutch position signal is a fixed value (around 2.5 V) See annexed Chart 2	th_1= 5 km/h th_2= 2000 bit timeout_1=100ms timeout_2=50ms	(Key ON) AND NOT (cranking) AND VSupply inside proper range	VSupply range = 7V-24.5V	50ms
Hydraulic pressure sensor	P0935	Hydraulic pressure sensor short to GND or open circuit	Hydraulic pressure signal circuit high	Output Voltage < th_low	th_low = 0,39V	(Key ON) AND NOT (cranking) AND VSupply inside proper	VSupply range = 7V-24.5V	500ms
Hydraulic pressure sensor	P0934	Hydraulic pressure sensor short to battery	Hydraulic pressure signal circuit low	Output Voltage > th_high	th_high = 4,79V	(Key ON) AND NOT (cranking) AND VSupply inside proper	VSupply range = 7V-24.5V	500ms
Hydraulic pressure sensor	P0932	Internal Sensor Damage or open circuit on the ground sensor wire	Hydraulic pressure signal wrong value	Wrong constant pressure value detected through a correlation between the pressure variation and an estimation of the oil flow		(Key ON) AND NOT (cranking) AND VSupply inside proper range	VSupply range = 7V-24.5V	500ms
Kl.30 Power Supply	P1794	Open circuit or broken fuse on TCU supply	Kl.30 Power Supply open circuit	Power Supply < V_th	V_th = 3V	(Key ON) AND NOT (cranking)		500ms
External sensors power supply or sensor ground	P0641	Failure of the sensor power voltage supply	External sensors power supply or sensor ground open circuit or short circuit	V_Sensor_Supply inside proper range	V_Sensor_Supply range = 4V-5V	(Key ON) AND NOT (cranking) AND VSupply inside proper range	VSupply range = 7V-24.5V	2500ms
Engine speed from CAN	U0401	Internal Problem on Engine Control System	Engine ECU: Engine speed from CAN. Signal not valid	CAN engine sp = inv_th	inv_th = FFFFh	NOT (Cranking) AND (ECU ON since t_on)	t_on = 200 ms	1000ms
Engine speed from CAN	U1900	Internal Problem on Engine Control System	Engine ECU: Engine speed from CAN. Signal absent (wrong zero rpm signal)	(CAN engine sp = 0) AND (Engine ON)		Engine ON		1000ms
Engine speed from CAN	U1920	Internal Problem on Engine Control System	Engine ECU: Engine speed from CAN. Signal wrong	(CAN engine speed different form Clutch speed) AND (CAN engine speed different from Driveline speed x gear ratio)	Seed tolerance= 500rpm	(Engine ON) AND (clutch closed) AND (gear engaged)		1000ms



Component	P Codes	Malfunction Strategy Description	Malfunction Criteria (Fault)	Fault condition (Internal labels)	Threshold Value (Fault condition)	Entry conditions	Entry conditions values	Filter Time to log DTC
Clutch speed	P0717	Sensor not properly installed on the gearbox or damaged.	Clutch speed. Signal absent (wrong zero rpm signal)	(Clutch speed = 0) AND [(Clutch closed) OR (Driveline speed > Th) AND (Gear engaged)]	Th= 50 rpm	(Key ON) AND NOT (cranking) AND VSupply inside proper range	VSupply range = 7V-24.5V	1000ms
Clutch speed	P0716	Sensor not properly installed on the gearbox or damaged.	Clutch speed. Signal wrong	(Clutch speed different from Engine speed) AND (Clutch speed different from driveline speed x gear ratio)	Seed tolerance= 500rpm	(Key ON) AND NOT (cranking) AND VSupply inside proper range	VSupply range = 7V-24.5V	1000ms
Driveline speed	U2005	Internal Problem on ESP system	ESP: Driveline speed. Signal absent (wrong zero rpm signal)	(Driveline speed = 0) AND [((Clutch closed) AND (Gear engaged)) OR ((Clutch speed > Th) AND (Gear engaged))]	Th= 1300 rpm	(Key ON) AND NOT (cranking) AND VSupply inside proper range	VSupply range = 7V-24.5V	5000ms
Driveline speed	U2511	Internal Problem on ESP system	ESP: Driveline speed. Signal wrong	(Driveline speed different from Engine speed/gear ratio) AND (Driveline speed different from clutch speed/gear ratio)	Seed tolerance= 500rpm	(Key ON) AND NOT (cranking) AND VSupply inside proper range	VSupply range = 7V-24.5V	5000ms
Driveline speed	U0415	Internal Problem on ESP system	ESP: Driveline speed. Signal not valid	Rear wheels sp = inv_th	inv_th = FFFFh	(Key ON) AND NOT (cranking) AND VSupply inside proper	VSupply range = 7V-24.5V	5000ms
CAN Engine ECU communication	U0100	Disconnection from CAN line of engine	CAN Timeout Engine ECU	CAN engine frames not received within timeout	timeout = 500ms	NOT (Cranking) AND (ECU ON since t_on)	t_on = 200 ms	
CAN ESP communication	U0129	Disconnection from CAN line of ESP	CAN Timeout ESP	CAN ESP frames not received within timeout	timeout = 500ms	NOT (Cranking) AND (ECU ON since t_on)	t_on = 200 ms	
Odd gear electrovalve	P0920	Odd gear electrovalve disconnected	Odd gear electrovalve. Open circuit	The asic UH04 inside the TCU detects the fault and communicate it to the uP Driver output voltage > th1 and < th2 during valve off phase	th1= 2.2V th2= 3.2V	NOT (Cranking)		200ms
Odd gear electrovalve	P0923	Odd gear electrovalve connected to battery	Odd gear electrovalve. Short circuit to Vsupply	The asic UH04 inside the TCU detects the fault and communicate it to the uP Driver output voltage > th2 during valve off phase	th2= 3.2V	NOT (Cranking)		200ms



Component	P Codes	Malfunction Strategy Description	Malfunction Criteria (Fault)	Fault condition (Internal labels)	Threshold Value (Fault condition)	Entry conditions	Entry conditions values	Filter Time to log DTC
Odd gear electrovalve	P0922	Odd gear electrovalve connected to GND	Odd gear electrovalve. Short circuit to GND	The asic UH04 inside the TCU detects the fault and communicate it to the uP Driver output current > th3 during valve on phase	th3= 3.7A	NOT (Cranking)		200ms
Even gear electrovalve	P0924	Even gear electrovalve disconnected	Even gear electrovalve. Open circuit	The asic UH04 inside the TCU detects the fault and communicate it to the uP Driver output voltage > th1 and < th2 during valve off phase	th1= 2.2V th2= 3.2V	NOT (Cranking)		200ms
Even gear electrovalve	P0927	Even gear electrovalve connected to battery	Even gear electrovalve. Short circuit to Vsupply	The asic UH04 inside the TCU detects the fault and communicate it to the uP Driver output voltage > th2 during valve off phase	th2= 3.2V	NOT (Cranking)		200ms
Even gear electrovalve	P0926	Even gear electrovalve connected to GND	Even gear electrovalve. Short circuit to GND	The asic UH04 inside the TCU detects the fault and communicate it to the uP Driver output current > th3 during valve on phase	th3= 3.7A	NOT (Cranking)		200ms
Clutch electrovalve	P0900	Clutch electrovalve disconnected	Clutch electrovalve. Open circuit	The asic UH04 inside the TCU detects the fault and communicate it to the uP Driver output voltage > th1 and < th2 during valve off phase	th1= 2.2V th2= 3.2V	NOT (Cranking)		200ms
Clutch electrovalve	P0903	Clutch electrovalve connected to battery	Clutch electrovalve. Short circuit to Vsupply	The asic UH04 inside the TCU detects the fault and communicate it to the uP Driver output voltage > th2 during valve off phase	th2= 3.2V	NOT (Cranking)		200ms



Component	P Codes	Malfunction Strategy Description	Malfunction Criteria (Fault)	Fault condition (Internal labels)	Threshold Value (Fault condition)	Entry conditions	Entry conditions values	Filter Time to log DTC
Clutch electrovalve	P0902	Clutch electrovalve connected to GND	Clutch electrovalve. Short circuit to GND	The asic UH04 inside the TCU detects the fault and communicate it to the uP Driver output current > th3 during valve on phase	th3= 3.7A	NOT (Cranking)		200ms
Shift brake electrovalve. Open circuit	P0928	Shift brake electrovalve disconnected	Shift brake electrovalve. Open circuit	The asic UH04 inside the TCU detects the fault and communicate it to the uP Driver output voltage > th1 and < th2 during valve off phase	th1= 2.2V th2= 3.2V	NOT (Cranking)		200ms
Shift brake electrovalve	P0931	Shift brake electrovalve connected to battery	Shift brake electrovalve. Short circuit to Vsupply	The asic UH04 inside the TCU detects the fault and communicate it to the uP Driver output voltage > th2 during valve off phase	th2= 3.2V	NOT (Cranking)		200ms
Shift brake electrovalve	P0930	Shift brake electrovalve connected GND	Shift brake electrovalve. Short circuit to GND	The asic UH04 inside the TCU detects the fault and communicate it to the uP Driver output current > th3 during valve on phase	th3= 3.7A	NOT (Cranking)		200ms
Pump relay	P0945	Pump relay disconnected	Pump relay Open circuit	The asic UH04 inside the TCU detects the fault and communicate it to the uP Driver output voltage > th1 and < th2 during valve off phase	th1= 2.2V th2= 3.2V	NOT (Cranking)		200ms
Pump relay	P0948	Pump relay connected to battery	Pump relay Short circuit to Vsupply	The asic UH04 inside the TCU detects the fault and communicate it to the uP Driver output voltage > th2 during valve off phase	th2= 3.2V	NOT (Cranking)		200ms



Component	P Codes	Malfunction Strategy Description	Malfunction Criteria (Fault)	Fault condition (Internal labels)	Threshold Value (Fault condition)	Entry conditions	Entry conditions values	Filter Time to log DTC
Pump relay	P0947	Pump relay connected GND	Pump relay Short circuit to GND	The asic UH04 inside the TCU detects the fault and communicate it to the uP Driver output current > th3 during valve on phase	th3= 3.7A	NOT (Cranking)		200ms
Clutch system	P186D	Clutch or actuator or valve damaged	Clutch not opening before gear shifting	Clutch not open in a timeout	timeout = 500ms	(Gear shifting in progress) AND (Clutch opening		
Gear Box system	P1734	Mechanical or hydraulic problem	Gear Box. Disengage failed (mechanical causes)	Gear not disengaged in a timeout	timeout = 500ms	(Gear shifting phase) AND (disengage phase)		
Gear Box system	P1701	Mechanical or hydraulic problem	Gear Box. Wrong gear engagement	The gear which is going to be engaged is not the requested one		(Gear shifting phase)		
Hydraulic circuit	P0868	Hydraulic leakage	Hydraulic circuit. Pressure low	Comparison between sensor pressure signal and threshold = f(oil temperature) pressure < th	Th= 25 bar @ -30°C Th= 40 bar @120°C linear interpolation	(Engine ON) AND NOT (cranking)		200ms
Power grounds	P1710	Power grounds. Disconnection both ground pins	Power grounds. Disconnection both ground pins	The diagnosis is based on the battery voltage modification during the activation of the clutch electrovalve. Ubatt < Ubatt0 - DltUbatt	Ubatt0 = Ubatt before starting the test DltUbatt = 2,5V	Wake-up phase		



V12 Family EOBD Documentation

Data Table

Aston Martin Lagonda Ltd.

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Catalyst Efficiency Monitor									
Catalyst System Efficiency Below Threshold (Index Monitor)	P0420 (Bank 1)	HC efficiency inferred from oxygen storage capacity	Rear/Front HO2S switch ratio	> 0.76 (Unitless)	Engine coolant temp and ECT sensor OK (P0117/0118)	65C < Engine coolant < 110C (150 - 230F)	Once per driving cycle	Footnote a)	Footnote c)
	P0430 (Bank 2)	HC efficiency inferred from oxygen storage capacity	Rear/Front HO2S switch ratio	>0.76 (Unitless)	Intake air temp and IAT sensor OK (P0112/0113)	-7C < Inlet Air Tmp < 82C (20-180F)	Approximately 900 sec		
					Minimum time since start to run Catalyst Monitor	60 sec			
				Air mass range cell 1	HO2S11 switches : 200 HO2S21 switches: 200	3.78 - 11.3 g/s (0.5-1.5 lb/min)			
				Air mass range cell 2	HO2S11 switches : 200 HO2S21 switches: 200	11.3 - 18.9 g/sec (1.5-2.5 lb/min)			
				Air mass range cell 3	HO2S11 switches : 200 HO2S21 switches: FEGO2_MX_CT3	18.9 - 26.5 g/s (2.5-3.5 lb/min)			
					Maximum number of HO2S11 (Bank 1 front) switches to allow monitor completion	300			
					Maximum number of HO2S21 (Bank 2 front) switches to allow monitor completion	300			
				Load range for air mass cell 1	HO2S11 switches : 200 HO2S21 switches: 200	0.1 * 100 % - 1.0 * 100 %			
				Load range for air mass cell 2	HO2S11 switches : 200 HO2S21 switches: 200	0.1 * 100 % - 1.0 * 100 %			
				Load range for air mass cell 3	HO2S11 switches : 200 HO2S21 switches: 200	0.1 * 100 % - 1.0 * 100 %			
				Rpm range for air mass cell 1	HO2S11 switches : 200 HO2S21 switches: 200	0 - 4000 rpm			

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi nation
				Rpm range for air mass cell 2	HO2S11 switches : 200 HO2S21 switches: 200	0 - 4000 rpm			
				Rpm range for air mass cell 3	HO2S11 switches : 200 HO2S21 switches: 200	0 - 4000 rpm			
				Inferred midbed catalyst temp for air mass cell 1 (Bank1/Bank2)	371 - 871 deg C (700-1600 deg F)				
				Inferred midbed catalyst temp for air mass cell 2 (Bank1/Bank2)	371 - 871 deg C (700-1600 deg F)				
				Inferred midbed catalyst temp for air mass cell 3 (Bank1/Bank2)	371 - 871 deg C (700-1600 deg F)				
				Time constant to determine throttle position rate	1.0 (Unitless)				
				Maximum throttle position rate of change	< 50 * 5/ 1024 volts per sec				
				Minimum inferred rear HO2S12/HO2S22 temp to enter test	349 deg C (660 deg F)				
				Time since part-throttle decel	> 1.0 sec				
				Vehicle speed	20 - 80 mph				
				Crankshaft position circuit (PIP) OK (P0320)					
				HO2S Monitor COMPLETE with no DTCs prior to final switch ratio computation					
				Evap system OK, no Evap System DTCs					
				EWMA "fast" filter constant for first 2 driving cycles after KAM cleared	0.99 (Unitless)				
				EWMA "normal" filter constant after first 2 driving cycles	0.99 (Unitless)				
				Fuel level	> .15 * 100 %				

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Misfire Monitor									
Cylinder Misfire Detected	P0300 to P0312	Deviations in crankshaft acceleration processed by Neural Network Misfire Monitor software and Catalyst Temperature model	Percentage misfire required to exceed Catalyst Damage Temperature 900 deg c (1650 deg F) catalyst damage threshold, per engine bank		Type A: See RPM/Load Table FNMISPCT_97 %		Type A: 200 revs (Continuous)	Type A: Footnote b)	Type A: Footnote d)
		Full-range misfire capability	Percentage misfire required to exceed emission thresholds	Type B: > 0.01 * 100 %			Type B: 1000 revs (Continuous)	Type B/C: Footnote a)	Type B: Footnote c)
			Percentage misfire required to clear emission pending code	< 0.001 * 100 %	Time since engine start, value based on time and IAT	0 + FNMISACT sec (See Transfer Functions)			
			Full-range misfire redline: 6900 rpm		Time since PCM power up	0 sec			
			Time for NNMM computation queue to fill		4 revs from initial crank (Meets 2 rev start delay requirement)				
			Engine coolant temp		-7 - 121 deg C (20 - 250 deg)				
			Engine rpm		500 - 4000rpm				
			Engine rpm in neutral (Auto trans. only)		< 3100 rpm				
			Net engine torque		> -68 Nm (-50 ft lbs)				
			Engine torque rate of change		> -34 Nm/s or < 41 Nm/s (> -25 ft lbs/sec or < 30 ft lbs/sec)				
			Throttle position rate of change		> -20 volts/background loop or < 30 * 5/1024 volts/background loop				
			Closed throttle deceleration (Dashpot mode)		Closed throttle, vehicle speed < 4 mph, dashpot airflow adder present				
			Engine rpm/load range		See RPM/Load Table FNMISOK_97: Monitor disabled when less than 0.5				
			Crankshaft position circuit (PIP) OK (P0320)						
			Fuel shutoff for rpm or vehicle speed limiting		No fuel cutoff occurring				
			Fuel level		> 0.15 * 100 %				

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Misfire Detected At Startup	P0316	Misfire detected during first 1000 engine revs since start	P0316 is set in addition to P0300 - P0310 DTC				1000 revs (Continuous)	Footnote a)	Footnote c)
AICE chip failure in PCM	P0606	NNMM chip to CPU communication fault	Number of attempts	10			Continuous	Footnote a)	Footnote c)
Camshaft/crankshaft synchronization failure	P1336	AICE chip reports inability to synchronize camshaft and crankshaft signals (Replaces P1309)	Number of attempts	> 255			Continuous	Footnote a)	Footnote c)
Unable to learn crankshaft profile	P0315	Unable to learn stable crankshaft profile	Number of attempts	> 6 attempts			Continuous within profile learning entry conditions	Footnote a)	Footnote c)
ROM checksum error	P260F	NNP ROM checksum error	Checksum from NNP does not equal mainline strategy				Continuous	Footnote a)	Footnote c)

Fuel System Monitor									
Fuel System Too Rich Or Too Lean	P0171 (Bank 1 Lean)	Excessive long and short term fuel trim corrections	Long term fuel trim cell currently being utilized exceeds lean limits	> 1.24 * 100 %	Engine rpm	600 - 4000 rpm	Continuous	Footnote a)	Footnote c)
			Short term fuel trim exceeds lean limits	< 0.96 * 100%					
	P0172 (Bank 1 Rich)	Note: Long term fuel trim corrections are learned into an 8x10 cell table as a function of rpm and load or an 8x1 cell table as a function of rpm and air mass	Long term fuel trim cell currently being utilized exceeds rich limits	< 0.76 * 100 %	Engine air mass	3.4 - 484 g/sec (0.45 - 63.99 lbs/min)			
			Short term fuel trim exceeds rich limits	> 1.1 * 100 %					
	P0174 (Bank 2 Lean)				Closed loop fuel, adaptive fuel learning enabled (Purge duty cycle = 0 %)	Fuel trim learning enabled	Fuel trim learning enabled		
	P0175 (Bank 2 Rich)				Fuel Rail Pressure sensor OK (P0190/0192/0193)				

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation	
HO2S Monitor										
Stream 1 (Front) O2 Sensor Signal Stuck Lean	P2195 (Bank 1, Sensor 1)	Lack of HO2S switches	Stage 1: (Look for short term fuel trim stuck)		Fuel control	Closed loop or Closed loop desired	Continuous	Footnote a)	Footnote c)	
	P2197 (Bank 2, Sensor 1)		Short term fuel trim	$> 1 + 0.3 * 100\%$	Intake air temp sensor OK (P0112/0113)					
			Time with short term fuel trim at limit	$> 22 * 2 \text{ sec}$	Engine coolant temp sensor OK (P0117/0118)					
			Stage 2: (Look for HO2S stuck at startup)		Mass Air Flow sensor OK (P0102/0103)					
			Cumulative time in test mode since start up	$> 30 \text{ sec}$	Throttle Position Sensor OK (P0122/0123)					
			Number of switches since start up	< 4	Fuel tank pressure low enough and sensor OK (P0451, P0452, P0453)					$< 2,491 \text{ Pa}$ ($< 10 \text{ in H}_2\text{O}$)
			Fuel control	In FMEM at start up	Fuel level above minimum level					$> 0.15 * 100 \%$
					Stuck sensor recovery efforts failed Time entry conditions have been present					$> 10 \text{ sec}$
Stream 1 (Front) O2 Sensor Signal Stuck Rich	P2196 (Bank 1, Sensor 1)	Lack of HO2S switches	Stage 1: (Look for short term fuel trim stuck)		Fuel control	Closed loop or Closed loop desired	Continuous	Footnote a)	Footnote c)	
	P2198 (Bank 2, Sensor 1)		Short term fuel trim	$< 1 - 0.3 * 100\%$	Intake air temp sensor OK (P0112/0113)					
			Time with short term fuel trim at limit	$> 22 * 2 \text{ sec}$	Engine coolant temp sensor OK (P0117/0118)					
			Stage 2: (Look for HO2S stuck at startup)		Mass Air Flow sensor OK (P0102/0103)					
			Cumulative time in test mode since start up	$> 30 \text{ sec}$	Throttle Position Sensor OK (P0122/0123)					
			Number of switches since start up	< 4	Fuel tank pressure low enough and sensor OK (P0451, P0452, P0453)					$< 2,491 \text{ Pa}$ ($< 10 \text{ in H}_2\text{O}$)
			Fuel control	In FMEM at start up	Fuel level above minimum level					$> 0.15 * 100 \%$
					Stuck sensor recovery efforts failed Time entry conditions have been present					$> 10 \text{ sec}$

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Stream 1 (Front) HO2S Circuit Slow Response	P0133 (Bank 1)	Monitor HO2S switching frequency and amplitude (Forced at 1.5 Hz fixed rate)	Switching frequency (Indicates gross failure)	< 0.0 Hz	Time since entering closed loop fuel control	> 10 sec	< 4 sec once per driving cycle	Footnote a)	Footnote c)
	P0153 (Bank 2)		Switching frequency difference from desired (Test run at correct frequency)	< 0.19 Hz	Short term fuel trim	0.9 - 1.1 * 100 %			
			Signal voltage amplitude	< 0.55 volts	Engine coolant temp and ECT sensor OK (P0117/0118)	55 - 116 deg C (130 - 240 deg F)			
				Fuel level above minimum level	> 0.15 * 100 %				
				Intake air temp and IAT sensor OK (P0112/0113)	< 71 deg C ($\leq$ 160 deg F)				
				Engine load and MAF sensor OK (P0102/0103)	0.15 - 0.4 * 100 %				
				Vehicle speed and VSS (P0500) or OSS (P0720) sensor OK	30 - 60 mph				
				Engine rpm and crankshaft position circuit (PIP) OK (P0230)	1000 - 2200 rpm				
				Throttle position sensor OK (P0122/0123)					
				Camshaft ID circuit (CMP) OK (P0340)					
				No Misfire Monitor DTCs					
				Fuel rail pressure sensor OK (P0190/0192/0193)					
				Flex fuel composition not changing					
				Not transitioning into/out of Characteristic Shift Down					
				Not in Phase 0 of Evap Monitor					
				No Purge System reset					
				Maximum change in engine rpm while running monitor	< 160 rpm				
				Maximum change in engine load while running monitor	< 0.13 * 100%				
				Maximum change in vehicle speed while running monitor	< 2.0 mph				
				Maximum change in short term fuel trim while running monitor (PTEC only)	< 0.1				

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Stream 1 (Front) HO2S Overvoltage	P0132 (Bank 1) P0152 (Bank 2)	Monitor HO2S voltage	Voltage greater than malfunction threshold	> 1.1 volts	Fuel control	Closed loop or Closed loop desired	Continuous	Footnote a)	Footnote c)
			Time with sensor voltage out of range	> 25 sec	Stream 1 HO2S: Inferred sensor temp	> 204 deg C (> 400 deg F)			
					HO2S heater OK (P0135, P0053-bank1) (P0155, P0059-bank2)				
Rear HO2S Circuit Malfunction	P0136 (Bank 1)	Monitor normal signal voltage envelope; forced A/F excursion if required for green catalyst (Rationality check)	HO2S min and max signal voltages	Rich- < 0.48 volts Lean- > 0.42 volts	Inferred exhaust temp	149 - 760 deg C (300 - 1400 deg F)	Once per driving cycle	Footnote a)	Footnote c)
	P0156 (Bank 2)				Downstream heater on time	> 90 sec			
					Throttle position	Part throttle			
					Engine rpm - for forced excursion only	> 1000 rpm			
					Inferred exhaust temp - for forced excursion only	< 871 deg C (< 1600 deg F)			
					Flex fuel composition not changing				
					Upstream sensor(s) tested				

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Stream 2 (CMS) O2 Sensor signal Stuck Lean	P2270 (Bank 1)	Monitor normal signal voltage envelope; forced A/F excursion if required for green catalyst (Rationality check)	HO2S maximum signal voltage	< 0.42 volts	Inferred exhaust temp	149 - 760 deg C (300 - 1400 deg F)	Once per driving cycle	Footnote a)	Footnote c)
	P2272 (Bank 2)				Stream 2 heater on time	> 90 sec			
					Fuel level above minimum level	> 0.15 * 100 %			
					Throttle position	Part throttle			
					Engine rpm - for forced excursion only	> 1000 rpm			
					Inferred exhaust temp - for forced excursion only	< 871 deg C (< 1600 deg F)			
					Flex fuel composition not changing				
					Upstream sensor(s) tested				
Stream 2 (CMS) O2 Sensor signal Stuck Rich	P2271 (Bank 1)	Monitor normal signal voltage envelope; forced A/F excursion if required for green catalyst (Rationality check)	HO2S minimum signal voltage	> 0.48 volts	Inferred exhaust temp	149 - 760 deg C (300 - 1400 deg F)	Once per driving cycle	Footnote a)	Footnote c)
	P2273 (Bank 2)				Stream 2 heater on time	> 90 sec			
					Fuel level above minimum level	> 0.15 * 100 %			
					Throttle position	Part throttle			
					Engine rpm - for forced excursion only	> 1000 rpm			
					Inferred exhaust temp - for forced excursion only	< 871 deg C (< 1600 deg F)			
					Flex fuel composition not changing				
					Upstream sensor(s) tested				
Stream 2 (CMS) HO2S Overvoltage	P0138 (Bank 1)	Monitor HO2S voltage	Voltage greater than malfunction threshold	> 1.1 volts	Stream 2 HO2S heater on time	> 90 sec	Continuous	Footnote a)	Footnote c)
	P0158 (Bank 2)		Time with sensor voltage out of range	> 25 sec	Stream 2 HO2S: Inferred sensor temp	> 204 deg C (> 400 deg F)			
					HO2S heater OK (P0141, P0054-bank1) (P0161, P0060-bank2)				

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
HO2S Heater Circuit Malfunction	P0135 (HO2S11)	Circuit continuity check, monitor voltage for opens and shorts	Feedback circuit state matches commanded output state (Digital signal)	Feedback circuit high or low	Stream 1 HO2S: Inferred sensor temp	19 - 649 deg C (67 - 1200 deg F)	Continuous	Footnote a)	Footnote c)
	P0155 (HO2S21)		Monitor retries allowed for malfunction (Background loops)	RETRY_ALLOW					
	P0053 (HO2S11)	Functional check, monitor min and max. heater current	Heater circuit current	< 0.465 amps or > 3.0 amps	Stream 1 HO2S: Inferred sensor temp	121 - 593 deg C (250 - 1100 deg F)	Once per driving cycle		Footnote c)
	P0059 (HO2S21)				Stream 1 HO2S heater on time	> 30 sec			
					Stream 1 sensor(s) tested (P0133/P0153 tests completed)				
					Stream 2 sensor(s) tested (P2270, P2271, 2272, and P2273 tests completed)				
	P0141 (HO2S12)	Circuit continuity check, monitor voltage for opens and shorts	Feedback circuit state matches commanded output state (Digital signal)	Feedback circuit high or low	Stream 2 HO2S: Inferred sensor temp	149 - 760 deg C (300 - 1400 deg F)	Continuous	Footnote a)	Footnote c)
	P0161 (HO2S22)		Monitor retries allowed for malfunction (Background loops)	RETRY_ALLOW					
	P0054 (HO2S12)	Functional check, monitor min and max. heater current	Heater circuit current	< 0.22 amps	Stream 2 HO2S: Inferred sensor temp	121 - 732 deg C (250 - 1350 deg F)	Once per driving cycle		Footnote c)
	P0060 (HO2S22)				> 3.0 amps	Stream 2 HO2S heater on time	> 30 sec		
					Stream 1 sensor(s) tested (P0133/P0153 tests completed)				
					Stream 2 sensor(s) tested (P2270, P2271, 2272, and P2273 tests completed)				
					Stream 3 sensor(s) tested (P2274, P2275, 2276, and P2277 tests completed)				

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Comprehensive Component Monitor- Engine									
MAF Sensor Input	P0102 (Low)	Range check	Sensor signal voltage	< 0.25 volts (0.4498g/sec)	Time since last PIP signal (Engine not stalled)	< 150 msec	Continuous	Footnote a)	Footnote c)
			Fault filter routine	> 5.0 sec	Relative throttle position	> 10 * 5/1024 volts (6.025degrees)			
					Engine mode	Run mode			
	P0103 (High)	Range check	Sensor signal voltage	> 4.39 volts (217g/sec)	Engine rpm	< 6000 rpm			
Barometric Pressure Input	P0107 (Low)	Range check	Sensor signal voltage	< 2.0 volts (49.13kPa)	None	N/A	Continuous	Footnote a)	Footnote c)
	P0108 (High)	Range check	Sensor signal voltage	> 4.8 volts (105.3kPa)					
IAT Sensor Input	P0112 (Low)	Range check	Sensor input	< 0.2 volts (134degC)	None	N/A	Continuous	Footnote a)	Footnote c)
			Time with sensor input out of range	> 5.0 sec					
	P0113 (High)		Sensor input	> 4.93 volts (-45degC)					
			Time with sensor input out of range	> 5.0 sec					
	P0111	IAT Rationality check	Air Charge Temperature stuck	+ / - 16.6degC from ECT	IAT_RAT_THRES	soak > 360 min, ECT > 31c	Once per drive cycle	Footnote a)	Footnote c)
			Vehicle speed ROA check	VSPD > 12.5 mph	time > 5.5 secs		once per drive cycle / < 30 mins		
ECT Sensor Input	P0117 (Low)	Range check	Sensor input	< 0.2 volts (134degC)	None	N/A	Continuous	Footnote a)	Footnote c)
			Time with sensor input out of range	> 5.0 sec					
	P0118 (High)		Sensor input	> 4.93 volts (-45degC)					
			Time with sensor input out of range	> 5.0 sec					

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
ECT Sensor Input	P0116	Rationality check (Stuck high)	Engine coolant temp	110 deg C (≥ 230 deg F)	Continuous time with engine off prior to start	> 360 min	Once per driving cycle	Footnote a)	Footnote c)
			Time with high sensor signal	> 100 sec	ECT at start differs from IAT at start	>28 deg C (≥ 50 deg F)			
					Catalyst, Misfire, Fuel System or HO2S Monitors				
MATF Sensor Input	P0097 (High)	Range check	Sensor signal voltage	> 4.9 volts (-41.25 degF)	Battery Voltage	11< Voltage <18	Continuous	Footnote a)	Footnote c)
	P0098 (Low)	Range check	Fault filter routine	> 5.0 sec					
			Sensor signal voltage	< 0.13 volts (302.75 degF)					
	P009A	Rationality Check - error between manifold temperature and IAT after long soak	Fault filter routine	> 5.0 sec	Engine off soak time	>360 minutes			
Engine-Off (Soak) Timer Rationality Test	P0606	Rationality check, Engine-Off timer inoperative	Manifold temperature - IAT	>< +/- 26degC (80degF)	IAT sensor OK (P0112/0113)		Once per driving cycle	Footnote a)	Footnote b)
			Soak timer value at start	< 0.5 * 60 sec (Timer indicates that short soak has occurred)	Engine coolant temperature at previous key-off	>90degC (indicates hot engine)			
					Engine coolant temperature at previous key-off - coolant at start	> 55 deg C (≥ 100 deg F) (Degree of cooling indicates that a long soak has occurred)			
Vehicle ID block not programmed	P1639	VID block not programmed with tire/axle ratio	Time with error present	> 0 sec	None	None	Continuous	Footnote a)	Footnote c)
VID Block checksum	P0602	VID block checksum test failed	Time with error present	> 0 sec	None	None	Continuous		
KAM Failed / reset	P0603	Keep Alive Memory check failed / memory was reset	Time with error present	> 0 sec	None	None	Continuous	Footnote a)	Footnote c)
RAM memory failed	P0604	Random Access Memory test has failed.	Time with error present	> 0 sec	None	None	Continuous	Footnote a)	Footnote c)
ROM checksum test failed	P0605	Read Only Memory test failed	Time with error present	> 0 sec	None	None	Continuous	Footnote a)	Footnote c)
CPU Fault detected	P0607	General fault with the CPU has been detected	Time with error present	> 0 sec	None	None	Continuous		
Keep Alive Memory Power Input	P1633	KAM power input voltage too low/open circuit	Time with error present	> 20 sec	None	None	Continuous	Footnote k)	Footnote i)
Loss of Communication with TCM	U0101	Monitors CAN bus between ECM and TCM	Time with fault present	> 1.36 seconds			Continuous		
Fuel Temperature Sensor Input	P0180	Circuit Malfunction - range check	Sensor input	< 0.21 volts (131degC) or > 4.93 volts(-45degC)	None	N/A	Continuous	Footnote a)	Footnote c)
			Time with sensor input out of range	> 3.0 sec					
	P0182 (Low)	Circuit Malfunction - range check	Sensor input	< 0.21 volts (131degC)					
			Time with sensor input out of range	> 3.0 sec					
	P0183 (High)	Circuit Malfunction - range check	Sensor input	> 4.93 volts (-45degC)					
			Time with sensor input out of range	> 3.0 sec					

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumin- ation
Fuel Rail Pressure Input	P0190	Circuit malfunction	Sensor input stuck midrange	123 +/- 34 kPa (17.9 +/- 5.0 psig)	None	N/A	Continuous	Footnote a)	Footnote c)
			Large control error	34 kPa (> 5.0 psig)					
			Sensor value not moving	5.5 kPa/second (< 0.8 psig/second)					
			Time with sensor input out of range	> 8.0 sec					
	P0191	Range/Performance check	(Demand - sensed) error too large	> 172 kPa (25.0 psig)	Demand pressure within limits	< 448 kPa or > 241 kPa (< 65.0 psig or > 35.0 psig)			
			Time with sensor input out of range	> 8.0 sec	Fuel level above minimum level	> 0.15 * 100 %			
	P0192 (Low)	Range check	Sensor input	< 0.05 volts (<0kPa)	None	N/A			
			Time with sensor input out of range	> 8.0 sec					
	P0193 (High)		Sensor input	> 4.88 volts (>51.7kPa)					
			Time with sensor input out of range	> 8.0 sec					
Fuel Pump	P1233	Fuel pump driver module disabled or off line	Time with failure	> 3.0 seconds			Continuous	Footnote a)	Footnote c)
	P1235	Fuel pump control out of range	Time with failure	> 3.0 seconds					
Fuel Injectors	P0201	Circuit continuity check, open or shorted	Smart power driver status	1 = malfunction	Battery voltage	> 11.0 volts	Continuous	Footnote a)	Footnote c)
	P0202		Time with circuit malfunction	> 3.5 sec	Engine coolant temp	< 116 deg C (< 240 deg F)			
	P0203				Intake air temp	66 deg C (< 150 deg F)			
	P0204								
	P0205								
	P0206								
Ignition System- CKP Circuit Malfunction	P0320		Engine rpm (Used to determine crank mode)	> FN384A rpm (See Function)	None		Continuous	Footnote a)	Footnote c)
		Intermittent/Noisy CKP signal check	Number of CKP edges incorrect, missing tooth in	None	Increment fault counter by 25 on each event. Set				
	P0322	Engine speed input circuit no signal	Compares engine rpm on one bank to engine rpm or	None	Increment fault counter by 4 on each event. Set				
Camshaft Position Input	P0340	Rationality check	Ratio of PIP events to CID events	n to 1 (To pass test)	None	N/A			Footnote c)

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation		
Ignition System- Ignition Coil Primary Circuit Malfunction	P0351(Coil A)	Rationality check	Ratio of PIP events to spark events seen	1 to 1 (To pass test)	Battery voltage	> 11.0 volts or < 18.0 volts	Continuous	Footnote a)	Footnote c)		
	P0352(Coil B)		PCM able to determine coil	Yes							
	P0353(Coil C)										
	P0354(Coil D)										
	P0355(Coil E)										
	P0356(Coil F)										
IAC Solenoid Overspeed Error	P0507	Functional check - overspeed error	Difference between actual and desired rpm	> -200 rpm	Engine coolant temp	-7 deg C (> 20 deg F)	Continuous	Footnote a)	Footnote c)		
					Time since engine start	> 100 sec					
			Time with solenoid at limit	> 15 sec	Fuel control	Closed loop					
					Idle state	At idle					
IAC Solenoid Underspeed Error	P0506	Functional check - underspeed error	Difference between actual and desired rpm	> 100 rpm	Engine coolant temp	-7 deg C (> 20 deg F)	Continuous	Footnote a)	Footnote c)		
			Closed loop MAF correction	> 4.5 g/sec (> 0.6 lbs/min)	Time since engine start	> 100 sec					
			Time with solenoid at limit	> 10 sec	Fuel control	Closed loop					
					Idle state	At idle					
Vehicle Speed Sensor	P0500	Functional check - operational	Evaluates CAN source VS	> 3 mph	> 4 seconds	Vehicle moving					
Vapor Management Valve Circuit Malfunction	P0443	Circuit continuity test, open or shorted	Commanded dutycycle on or full-off	>=0.135 * 100 % or = 0%	None	N/A	Continuous	Footnote a)	Footnote e)		
			Signal circuit voltage	Refer to Appendix for threshold calculation							
			Time with circuit malfunction	> 5 sec							
Fuel Level Input Out Of Range	P0460 (Range Check)	Sensor range check	Sensor input	<= 7 or >= 254 A/D counts w/in a range of 256 A/D counts	None	N/A	Continuous	Footnote a)	Footnote j)		
	P0462 (Low)			< 7 A/D counts							
	P0463 (High)			> 254 A/D counts							
			Time with sensor out of range	> 30 sec							

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Fuel Level Input Stuck	P0460 (Rationality)	Sensor rationality check (Stuck sensor)	Compare fuel mass consumed versus observed change in gauge readings (Min. and max. reading)		Fuel consumed (Fuel consumed and fuel gauge reading range are both stored in KAM and reset after a refueling event or DTC storage)	> 10 %	Continuous	Footnote a)	Footnote e)
		"Fuel consumed" is continuously calculated based on PCM fuel pulsewidth summation as a percent of fuel tank capacity	Fuel consumed (%) - Range of fuel gauge readings (%)	> 0.05 * 100 % threshold at fuel tank fill from 15% to 85%					
			Fuel consumed (%) - Range of fuel gauge readings (%)	> 0.05 + 0.05 * 100 % threshold if tank overfilled (> 85%)					
			Fuel consumed (%) - Range of fuel gauge readings (%)	> 0.05 + 0.2 * 100 % threshold if tank on reserve (< 15%)					
Fuel Level Input Noisy	P0461 (Rationality)	Sensor rationality check (Noisy sensor)	Change in fuel level	> 0.3	Fuel level on the data bus	N/A	Continuous	Footnote a)	Footnote e)
			Number of intermittent events	> 100					
I/M Readiness			Number of driving cycles to clear I/M readiness flag at extreme ambient conditions	> 1 driving cycle(s)	Monitors which must complete prior to clearing I/M readiness bit for Evap Monitor	Catalyst, Misfire, Secondary Air, HO2S, Fuel System, CCM, EGR	N/A		N/A
					Time within Evap Monitor entry condition except IAT and BARO	> 180 sec			

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Electronic Throttle Control									
TPPC chip failure in PCM	P0606	TPPC chip to CPU communication fault	Number of attempts	> 1			Continuous	Footnote a)	Footnote c)
TP Sensor Inconsistent With MAF Sensor	P0068	Rationality check vs. MAF input	Engine rpm	> 1000 rpm	Engine coolant temp	> 15 deg C (> 60 deg F)	Continuous	Footnote a)	Footnote c)
			Sensor signal voltage	< 0.73 volts or > 3.0 volts					
			Engine load	> 0.7 * 100% or < 0.2 * 100%					
			Time with sensor out of range	> 5.0 sec					
TP Sensor 'A' Input Out Of Range	P0122 (Low)	Range check	Time with low throttle voltage at TPPC or PCM	>= 0.254 seconds	None	N/A	Continuous	Footnote a)	Footnote c)
	Sensor signal voltage		< 0.2 volts						
	P0123 (High)		Time with high throttle voltage at TPPC or PCM	>= 0.254 seconds					
	Sensor signal voltage		> 4.87 volts						
TP Sensor 'B' Input Out Of Range	P0222 (Low)	Range check	Time with low throttle voltage at TPPC or PCM	>= 0.254 seconds	None	N/A	Continuous	Footnote a)	Footnote c)
	Sensor signal voltage		< 0.08 volts						
	P0223 (High)		Time with high throttle voltage at TPPC or PCM	>= 0.254 seconds					
	Sensor signal voltage		> 4.80 volts						
TP Sensor A/B Correlation	P2135	Rationality check	Time with correlation failure from the TPPC or PCM or Equizzer	>= 240 sec	None	N/A	Continuous	Footnote a)	Footnote c)
			Magnitude of the difference of the relative readings of the sensor signal voltage	> 0.25 volts (10.25degrees)					
Throttle Actuator Control System	P2104	ETC FMEM – forced idle	Two or three pedal sensors failed, throttle plate stuck	>= 100 to 400 msec	None	N/A	Continuous	Footnote a)	Footnote c)
	P2105	ETC FMEM – forced engine shutdown	Equizzer detected fault	>= 16 to 960 msec	None	N/A	Continuous	Footnote a)	Footnote c)
	P2106	ETC FMEM – pedal-follower mode	Sensor fault: MAF, one TP, CKP, TSS, OSS, stuck throttle, throttle actuator circuit fault	>= 16 to 960 msec	None	N/A	Continuous	Footnote a)	Footnote c)
	P2110	ETC FMEM – default throttle angle	Two TPs failed; TPPC detected fault	>= 600 to 800 msec	None	N/A	Continuous	Footnote a)	Footnote c)

Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Parameter	Secondary Parameters	Entry Parameters	Time Required	DTC Storage	MIL Illumi- nation
Throttle Plate Position Controller (TPPC)	P2111 (Stuck Open)	Functional test	Desired throttle angle vs. actual throttle angle measured in a rolling average routine during throttle tip-in	> 6 degrees	None	N/A	Continuous	Footnote a)	Footnote c)
	P2112 (Stuck Closed)	Functional test	Desired throttle angle vs. actual throttle angle measured in a rolling average routine during throttle tip-out	> 6 degrees	None	N/A	Continuous	Footnote a)	Footnote c)
	P2107	TPPC processor check	Internal processor test, loss communication with main CPU	>= 60 msec	None	N/A	Continuous	Footnote a)	Footnote c)
Throttle Actuator Control Motor	P2100	Circuit check	Throttle actuator circuit open	>= 1750 msec	None	N/A	Continuous	Footnote a)	Footnote c)
	P2101	Range check	Throttle actuator range/performance test, throttle plate angle does not followed commanded angle	>= 500 msec	None	N/A	Continuous	Footnote a)	Footnote c)

Signal circuit voltage threshold calculation for DTC P0443

At 98% DC: $[(42 \times \text{Battery voltage}) - 150] \times 5.0/1024$ volts
 At 0% DC: $[(32 \times \text{Battery voltage}) - 200] \times 5.0/1024$ volts

Misfire Monitor Time Delay Since Engine Start Up = 0 seconds + FNMISACT value

FNMISPCT_97

Load \ RPM	500	850	1000	1500	1750	2000	3000	5000	6000	7000
0.1	0.16	0.16	0.16	0.16	0.16	0.16	0.11	0.07	0.07	0.07
0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.11	0.06	0.06	0.06
0.2	0.16	0.16	0.16	0.16	0.16	0.16	0.11	0.06	0.06	0.06
0.25	0.16	0.16	0.16	0.16	0.16	0.13	0.08	0.07	0.07	0.06
0.3	0.16	0.16	0.16	0.16	0.15	0.10	0.07	0.07	0.08	0.08
0.35	0.16	0.16	0.16	0.16	0.11	0.09	0.07	0.08	0.08	0.07
0.4	0.15	0.15	0.15	0.11	0.07	0.07	0.08	0.07	0.06	0.05
1	0.10	0.10	0.10	0.09	0.08	0.07	0.07	0.06	0.05	0.05

FNMISACT

ACT (C)	-160	-40	-29	82	88	123
output_axis [s]	180	180	0	0	180	180

FNMISOK_97

Load \ RPM	500	850	1000	1500	1750	2000	3000	7000	6000	7000
0.05	0	0	0	0	0	0	0	0	0	0
0.1	0.72	0.72	0.72	0.8	0.8	0.8	0.2	0	0	0
0.15	1	1	1	1	1	1	0.7	0	0	0
0.2	1	1	1	1	1	1	1	0.3	0	0
0.25	1	1	1	1	1	1	1	0.8	0.3	0
0.3	1	1	1	1	1	1	1	1	0.8	0.4
0.35	1	1	1	1	1	1	1	1	1	0.9
0.4	1	1	1	1	1	1	1	1	1	1

FN654S (sec)

NONE [degC]	-29	-7	21	38	60	123
output_axis [s]	1400	900	475	325	300	300

FN_TCSTRT (sec)

TCSTRT [degc]	-40	-18	-7	4	15	38	60	104	123
output_axis [s]	100	70	24	20	18	15	15	15	20

FN384A (RPM)

ECT [DEG. C]	-160	-160	-29	-18	10	123
output_axis [RPM]	450	450	450	350	350	350

FN_FL_DT_MX (%)

PGM_FUEL_LVL [%]	0	1	1	1	1	1	1
output_axis [%]	0.2	0.2	0.2	0.2	0.2	0.2	0.2

IAT_RAT_THRES (deg F)

BLANK_STRING	0	1	2	3	4	5	6	7	8	9
output_axis [degF]	30	30	30	30	30	-30	-30	-30	-30	-30

Notes:

- 1) "Continuous" under the "Time Required" column indicates that the specified test cycles at a frequency greater than once every 0.5 seconds whenever the test entry conditions are met.
- 2) "Once per driving cycle" under the "Time Required" column indicates that the specified test will complete during the first 2 bags of an FTP as well as under the test entry conditions specified, on the road.
- 3) All test entry condition parameters are measured instantaneously unless otherwise indicated.

Footnotes:**Secondary Parameters:**

- p) If a 6 hour soak is met, some strategies will not require another continuous 6 hour soak if the customer performs a brief key-off. This has been put into effect to improve evap monitor completion frequency.
- q) Some strategies will have the ability to base evap monitor soak length on the CARB cold soak criteria which consists of an ECT range and ACT/ECT differential.
- r) A minimum soak time has been added to CARB's cold soak criteria (footnote q) to allow calibrators to set a minimum soak time if longer soak times are needed than given by the ACT/ECT-based CARB soak criteria.

DTC Storage:

- a) A pending code will be stored after a malfunction has been detected on one driving cycle; a DTC will be stored after the same malfunction has been detected on the second consecutive driving cycle. The DTC will be erased after 40 warm-up cycles with no malfunction present.
- b) A DTC will be stored immediately upon detection of a malfunction. The DTC will be erased after 40 warm-up cycles with no malfunction present, after the MIL has been extinguished for the DTC.
- k) A DTC will be stored after a malfunction has been detected on one drive cycle. The DTC will be erased after 40 warm-up cycles with no malfunction present, after the MIL has been extinguished for that DTC.
- l) A DTC will be stored after a malfunction has been detected on six consecutive drive cycles. The DTC will be erased after 40 warm-up cycles with no malfunction present, after the MIL has been extinguished for that DTC.
- o) For intake air temperatures below 20 deg F, no DTC will set for indicated AIR malfunction.
- s) A pending code will be stored after a malfunction has been detected on upto the 6th trip depending on the size of the fault deviation; a DTC will be stored after the same malfunction has been detected on a second driving cycle. The DTC will be erased after 40 warm-up cycles with no malfunction. This monitor employs EVMA.

MIL Illumination:

- c) The MIL will be illuminated after a malfunction has been detected on two consecutive driving cycles. The MIL will be extinguished after three consecutive driving cycles where the monitor was run without a malfunction.
- d) The MIL will blink immediately upon detection of a misfire rate that exceeds the catalyst damage threshold, regardless of whether fuel is shut off or not.
If the misfire rate drops below the catalyst damage threshold, the MIL will stay on solidly.
The MIL will be extinguished after three consecutive drive cycles where similar conditions have been seen without the malfunction.
- e) The MIL will be illuminated after a malfunction has been detected on two consecutive driving cycles.

- The MIL will be extinguished after three consecutive drive cycles where similar conditions have been seen without the malfunction.
- f) For intake air temperatures below 32 deg F, the MIL will not illuminate for the indicated EGR DTCs.
For intake air temperatures below 20 deg F, the MIL will not illuminate for the indicated AIR DTCs.
This prevents false MIL illumination due to ice in the EGR hoses or AIR switching valve(s).
- g) This monitor employs EWMA.
The MIL will be illuminated after a malfunction has been detected on two consecutive driving cycles after DTCs have been erased or Keep Alive Memory has been erased (battery disconnect).
The MIL will be illuminated after a malfunction has been detected on up to six consecutive driving cycles during subsequent, "normal" customer driving.
The MIL will be extinguished after up to six consecutive driving cycles without a malfunction.
- h) Some automatic transmission monitors are demonstrated following the USCAR Abbreviated On-Board Diagnostic Test Procedure for Vehicles Equipped with Automatic Transmissions.
This prevents false MIL illumination on this non-turbine speed sensor transmission application.
- i) The MIL will be illuminated after a malfunction has been detected on the first driving cycle.
The MIL will be extinguished after three consecutive driving cycles where the monitor was run without a malfunction.
- j) A DTC will be set after a malfunction has been detected on two consecutive driving cycles.
- m) MIL will be illuminated after a malfunction has been detected on two consecutive driving cycles. MIL will be extinguished after the monitor has run without a malfunction (same or subsequent drive cycle).
- n) A check cap light will be illuminated after a malfunction has been detected on one driving cycle. The check cap light will be extinguished after the monitor has run without a malfunction (same or subsequent drive cycle).
- t) The MIL will be illuminated after a pending code has been confirmed. The MIL will be extinguished after three consecutive driving cycles where the monitor was run without a malfunction. This monitor employs EVMA.



ASTON MARTIN

2009MY DB9 & DBS Auto Gearbox Summary

cardiagn.com

System	Component	P- Codes (AML)	Malfunction Strategy Description	Malfunction Criteria (Fault)	Fault condition (Internal labels)	Threshold Value (Fault condition)	Entry conditions	Entry conditions values	Filter Time to log DTC (AML)	EMS controlled MIL Illumination (AML)
CAN Link	Engine	P0725	Engine speed signal	Engine Speed signal QF = 3			No CAN BUS error. No CAN level error and No EMS timeout.		800ms	1 DTC
CAN Link	CAN level	P0614	Incorrect configuration ID received	CANId does not match that stored in the TCM			Engine not in crank. No CAN BUS error Ignition on & Timer after ignition passed. Battery Voltage > threshold	7v	250mS	1 DTC
CAN Link	CAN bus off	P1796	Monitors the CAN for Bus or RAM faults. TCM CAN driver detects CAN bus fault.	Bit, stuff, CRC or form error, (CAN-wiring or CAN-module defective, EMC radiation.)			Battery voltage > Threshold	7v	100mS	1 DTC
Sensor	Temperature Sensor	P0711	ATF temperature sensor short circuit	ATF sensor faulty - Sensor input signals (Vcgt_plus and Vcgt_minus) out of acceptable range	utmsm2_Gt<vcgt_plus<utmsm1_Gt and utmsm2_Gt<vcgt_minus<utmsm1_Gt	utmsm2_Gt = 2.3v utmsm1_Gt = 2.7v and utmsm2_Gt = 2.3v utmsm1_Gt = 2.7v			1.5s	2 DTC
Sensor	Temperature Sensor	P0711	ATF Sensor - stuck value	Stuck Temperature value - ATF temperature is out of an acceptable range of tolerance when compared to the TCM chip temperature sensor value. Range of tolerance is depending on the heating up velocity of transmission .	[Fast heating = wide range of tolerance : Chip sensor temp +/- cgt_tolwt <> ATF temperature OR Slow heating = narrow range of tolerance : Chip sensor temp +/- cgt_toleng <> ATF temperature] AND Temperature cgtf_Neu out of allowed range of tolerance for > zgts_CgtPlausErr * 100ms	cgt_tolwt = 40degC cgt_toleng = 25degC AML: zgts_CgtPlausErr= 6000 (= 10min) Jag+LR: zgts_CgtPlausErr= 9000 (= 15min)	Chip sensor OK Engine speed > threshold Turbine speed > threshold	450rpm 450rpm	1.5s	2 DTC
Sensor	Temperature Sensor	P0713	ATF Sensor short to battery	ATF sensor faulty - Sensor input signals (Vcgt_plus and Vcgt_minus) out of acceptable range	vcgt_plus > utmsu_Gt and vcgt_minus > utmsu_Gt	utmsu_Gt = 4.5v utmsu_Gt = 0.5v			1.5s	2 DTC
Sensor	Temperature Sensor	P0712	ATF Sensor short to GND	ATF sensor faulty - Sensor input signals (Vcgt_plus and Vcgt_minus) out of acceptable range	vcgt_plus < utmsu_Gt and vcgt_minus < utmsu_Gt	utmsu_Gt = 4.5v utmsu_Gt = 0.5v			1.5s	2 DTC
Sensor	Temperature Sensor	P0714	ATF sensor open cct (circuit break)	ATF sensor faulty - Sensor input signals (Vcgt_plus and Vcgt_minus) out of acceptable range	vcgt_plus > utmsu_Gt and vcgt_minus < utmsu_Gt	utmsu_Gt = 4.5v utmsu_Gt = 0.5v			1.5s	2 DTC
Sensor	Temperature Sensor	P0713	ATF temperature sensor value jump or ATF value not warming up quickly enough	Unacceptable temperature jump (Old value - new value <> threshold) within a period of 100ms or ATF temperature (cgt_neu) not warming up quickly enough within a specified time period	cgt_Neu - cgt1_CUew > cgt1_CUew or (cgt_Neu*(tgt1d_CUew) - cgt_Neu*(t=0)) < cgt1d_CUew	cgt1_CUew = 20DegC cgt1d_CUew = 4DegC tgt1d_CUew = 240s	Output speed > Threshold Engine speed > Threshold No Output speed & Engine speed error Temperature cgtf_Neu < Threshold at t=0	Jag * AML / LR 800 / 11000rpm 400 / 11000rpm 20DegC	1.5s	2 DTC
TCM Internal	Impossible substitute functions (monitoring contradictory substitute functions)	P0701	Two Priority 2 faults present at the same time (Currently not possible)	Wheel speed and output speed sensor faults present concurrently.					20ms	2 DTC
TCM Internal	Impossible substitute functions (monitoring contradictory substitute functions)	P0701	OSS fault and wheel speed faults present concurrently (Priority 3)						20ms	2 DTC
TCM Internal	Impossible substitute functions (monitoring contradictory substitute functions)	P0701	Bosch solenoid current monitoring fault						20ms	2 DTC
TCM Internal	EEPROM Flash emulation	P062F	EEPROM emulation lifetime exceeded	Communication disturbed, lifetime exceeded	EEError !=0	=1 400000 Write/Erase-cycles possible. At temperatures over 135°C no EEPROM update is made.	always active	no	0mS	1 DTC
TCM Internal	FLASH checksum	P1603	Checksum incorrect	Calculated checksum does not match stored checksum					0mS	2 DTC
CAN Link	Engine	P1719	Engine Torque signal inaccurate	Engine torque signal QF 0 = 3	fcn_MmmErr	=1	No CAN BUS error. No CAN level error and No EMS timeout.		800ms	2 DTC
CAN Link	Engine Speed	P1920	Engine speed too high	Engine Speed > Engine speed threshold> for a time threshold	n_mot > NS_MOTUEB & Timer smotueb > T_FNMOTUEB	NS_MOTUEB = 7100rpm T_FNMOTUEB=2550mS			T_FNMOTUEB=2550mS	2 DTC
Speed Sensors	Turbine speed sensor	P0715	Turbine speed sensor s/c to battery	Turbine speed sensor s/c to battery supply	sgt_DiNu = 2 (short circuit to plus)	2 (Status of turbine speed sensor signal.	Sensor supply voltage OK	0	800mS	2 DTC
Speed Sensors	Turbine speed sensor	P0717	Turbine speed sensor s/c to gnd or O/C	Turbine speed sensor s/c to gnd or O/C	sgt_DiNu = 0 (short to gnd or O/C)	0 (Status of turbine speed sensor signal.	Sensor supply voltage OK	0	600mS	2 DTC
Speed Sensors	Turbine speed sensor	P0716	Turbine Speed Value too high	Value too high	NTU > NTUmax	ntumax = 8000rpm	Sensor supply voltage OK No electrical error	0	600mS	2 DTC
Speed Sensors	Turbine speed sensor	P0716	Turbine Speed Value too low	Value too low	NTU < ntu_Min	ntu_min = 20 rpm	Sensor supply voltage OK No electrical error engine speed NMO is higher than a threshold: status of NMO-signal is alright output speed NAB is higher than a threshold: status of NAB-signal is alright or substitute	nmos_TuUew = 600rpm nab_TuUew = 250rpm	800mS	2 DTC

System	Component	P Codes (AML)	Malfunction Strategy Description	Malfunction Criteria (Fault)	Fault condition (Internal labels)	Threshold Value (Fault condition)	Entry conditions	Entry conditions values	Filter Time to log DTC (AML)	EMS controlled MIL Illumination (AML)
Position Detection	Position Signal Error (AML)	P0705	Position signal error CAN & Serial Line - Implausible code or Timeout	Invalid position information			Sensor supply OK Sensor supply > threshold	>7v	100mS	
Sensors	Temperature Sensor	P0634	TCM temperature too high resulting in an overtemp shut down of the TCU.	Chip temperature > Threshold	ccu_chip > Cgto_EgeHot rgt_HotErr = KGT_HOTMODE_ERR or rgt_HotErr = KGT_HOTMODE_BAT or rgt_InitHot = 0 (TCM is not in the initialisation)	2D map Battery volts Vs temp - Appendix A Ref 2	Test condition is always fulfilled.		0ms	1 DTC
System Voltage	Battery Voltage	P1793	Power Supply too low	Battery voltage	ugt_Batt < ugtu_Batt or ugt_BattDef	< 7V or < 7V	Engine speed > Turbine speed > Transmission position Mechanical limp home active	1400rpm 1400rpm Park or Neutral False	30ms	2 DTC
Mechatronic Unit	Shift Solenoid	P0771	Solenoid / Valve stuck	Stuck off Solenoid 1 or 2	timer_MV12mechdef <= KL_TUEB3GMV12MECHDEF and (GET_P_SENSOR = 0 or GET_P_SENSOR = 2)	500ms	pumpendruck_vorhanden Park sensor = P (GET_P_SENSOR)	0->1	0ms	2 DTC
System Voltage	Pressure regulator and solenoid power supply	P0657	Pressure regulator supply too low (power supply cannot be switched on)	Sensor voltage too low because power supply cannot be switched ON.	FET off	= true	Battery Voltage >	7v	30mS	2 DTC
System Voltage	Pressure regulator and solenoid power supply	P0659	Voltage applied without activation of the controlling FET	FET cannot be switched on (Short circuit to battery)	Vbatt > udmv_batt	7v			30mS	2 DTC
System Voltage	Pressure regulator and solenoid power supply	P0658	Sensor supply voltage < threshold or Voltage drop across FET is too big	PR supply voltage too low	ugt_dmv < udmv_ksm or ugt_batt-ugt_dmv > ugt_d_fet	0.5v or 1v	Battery Voltage > udmv_batt	7v	30mS	2 DTC
System Voltage	Pressure regulator and solenoid power supply	P0657	Voltage too low due to reset.	PR supply voltage too low	ugt_dmv < Ugtu_batt fgt_Dreset =	Ugtu_batt = 2D map (V vs C) Appendix A, ref 3 True	FET control OK Battery Voltage > udmv_batt	1 7v	30mS	2 DTC
TCM Internal	TCM Watchdog	P0613	Error counter does not reach required value during initialisation	Error counter does not reach required value	sdl_Ufet=1 or sdl_Ufet=4 or sdl_Ufet=6 or sdl_Ufet=8		Battery Voltage > ugt_Ufetini TCU in initialisation phase	7v		2 DTC
TCM Internal	TCM Watchdog	P0613	Error counter exceeds limit	Error counter exceeds limit	Zs_errorCountForUC > 4.	4	Cyclic (operation): Debug-mode not active	0	0ms	2 DTC
TCM Internal	TCM Watchdog	P0613	FET cannot be switched off	FET cannot be switched off (DReset line is high)	DReset line is high (fgtr_Dreset = False)	FALSE	Battery Voltage > ugt_Ufetini TCU in initialisation phase	7v	0ms	2 DTC
TCM Internal	TCM Watchdog	P0613	FET cannot be switched On	FET cannot be switched On (DReset line is low)	Reset line is low (fgtr_Dreset = True)	TRUE	Battery Voltage > ugt_Ufetini TCU in initialisation phase	7v	0ms	2 DTC
TCM Internal	TCM Watchdog	P0613	Safety circuit reset line between CG115 and CG120 is active.	Safety circuit reset line between CG115 and CG120 is active.	Reset line = high (fgtr_Dreset=0)	1=0	Cyclic (operation): Debug-mode not active	0	0ms	2 DTC
TCM Internal	TCM Watchdog	P0613	Watchdog function taking too long.	Watchdog function taking too long.	fgtr_UewFetGes > Threshold	300ms	Battery Voltage > ugt_Ufetini TCU in initialisation phase	7v	0ms	2 DTC
TCM Internal	TCM Watchdog	P0613	FET cannot be switched off at ErrorCountForUC >= 5	FET cannot be switched off at ErrorCountForUC >= 5	FET cannot be switched off at ErrorCountForUC >= 5	5	Battery Voltage > ugt_Ufetini TCU in initialisation phase	7v	0ms	2 DTC
TCM Internal	TCM Watchdog	P0613	FET cannot be switched on at Zsk_ErrorCountForUC<=4	FET cannot be switched on at Zsk_ErrorCountForUC<=4	FET cannot be switched on at Zsk_ErrorCountForUC<=4	4	Battery Voltage > ugt_Ufetini TCU in initialisation phase	7v	0ms	2 DTC
TCM Internal	TCM Watchdog	P0613	CPU watchdog error counter threshold exceeded. (WD to CPU)	CPU watchdog error counter threshold exceeded. (Zsk_ErrorCountForWD>3)	CPU watchdog error counter threshold exceeded. (Zsk_ErrorCountForWD>3)	3	Cyclic (operation): Debug-mode not active	0	0ms	2 DTC
Torque Converter	Torque Converter	P0741	Torque converter slip too high	Torque converter slip > threshold.	KL_NDSKPLDEFECT	25rpm	Slip too high timer expired Closed or Closed Loop Control		0ms 10.0s	2 DTC
Pressure Regulators	PR1	P0973	Pressure regulator 1 short circuit to ground or o/c.	current > threshold or current = 0	idr_Mess1 > idr1 + idrs_high or idr1=0mA	idrs_high = 2D map (Current vs Temp) 0mA	Solenoid Supply > threshold Engine running 0% or 100% measured current PWM	udrsr_prf = 2D map (V vs Temp) See App A, Ref 1	30mS	2 DTC
Pressure Regulators	PR1	P0972	Pressure regulator 1 current too high	current > threshold	idr_Mess1 > idr1 + idrs_high	idrs_high = 2D map (Current vs Temp)	Solenoid Supply > threshold Measured control PWM not = 0 or 100%	udrsr_prf = 2D map (V vs Temp) See App A, Ref 1	30mS	2 DTC
Pressure Regulators	PR1	P0974	Pressure regulator 1 short to battery	current < threshold	idr_Mess1 < idr1 + idrs_low	idrs_low = 2D map (Current vs Temp)	Solenoid Supply > threshold Engine not running	udrsr_prf = 2D map (V vs Temp) See App A, Ref 1	30mS	2 DTC
Pressure Regulators	PR2	P0976	Pressure regulator 2 short circuit to ground or o/c.	current > threshold or current = 0	idr_Mess2 > idr2 + idrs_high or idr1=0mA	idrs_high = 2D map (Current vs Temp) 0mA	Solenoid Supply > threshold Engine running 0% or 100% measured current PWM	udrsr_prf = 2D map (V vs Temp) See App A, Ref 1	50mS	2 DTC
Pressure Regulators	PR2	P0975	Pressure regulator 2 current too low	current < threshold	idr_Mess2 < idr2 + idrs_low	idrs_low = 2D map (Current vs Temp)	Solenoid Supply > threshold Measured control PWM not = 0 or 100%	udrsr_prf = 2D map (V vs Temp) See App A, Ref 1	50mS	2 DTC
Pressure Regulators	PR2	P0977	Pressure regulator 2 short to battery	current < threshold	idr_Mess2 < idr2 + idrs_low	idrs_low = 2D map (Current vs Temp)	Solenoid Supply > threshold Engine not running Measured control signal PWM = 0%	udrsr_prf = 2D map (V vs Temp) See App A, Ref 1	50mS	2 DTC
Pressure Regulators	PR3	P0979	Pressure regulator 3 short circuit to ground or o/c.	current > threshold or current = 0	idr_Mess3 > idr3 + idrs_high or idr1=0mA	idrs_high = 2D map (Current vs Temp) 0mA	Solenoid Supply > threshold Engine running 0% or 100% measured current PWM	udrsr_prf = 2D map (V vs Temp) See App A, Ref 1	50mS	2 DTC
Pressure Regulators	PR3	P0978	Pressure regulator 3 current too high	current > threshold	idr_Mess3 > idr3 + idrs_high	idrs_high = 2D map (Current vs Temp)	Solenoid Supply > threshold Measured control PWM not = 0 or 100%	udrsr_prf = 2D map (V vs Temp) See App A, Ref 1	50mS	2 DTC
Pressure Regulators	PR3	P0980	Pressure regulator 3 short to battery	current < threshold	idr_Mess3 < idr3 + idrs_low	idrs_low = 2D map (Current vs Temp)	Solenoid Supply > threshold Engine not running Measured control signal PWM = 0%	udrsr_prf = 2D map (V vs Temp) See App A, Ref 1	50mS	2 DTC
Pressure Regulators	PR4	P0982	Pressure regulator 4 short circuit to ground or o/c.	current > threshold or current = 0	idr_Mess4 > idr4 + idrs_high or idr1=0mA	idrs_high = 2D map (Current vs Temp) 0mA	Solenoid Supply > threshold Engine running 0% or 100% measured current PWM	udrsr_prf = 2D map (V vs Temp) See App A, Ref 1	50mS	2 DTC

System	Component	P Codes (AML)	Malfunction Strategy Description	Malfunction Criteria (Fault)	Fault condition (Internal labels)	Threshold Value (Fault condition)	Entry conditions	Entry conditions values	Filter Time to log DTC (AML)	AMS controlled MIL Illumination (AML)
Pressure Regulators	PR4	P0981	Pressure regulator 4 current too low	current < threshold	idr_Mess4 < idr4 + idrs_low	ids_low = 2D map (Current vs Temp)	Solenoid Supply > threshold Measured control PWM not = 0 or 100%	udrso_prf = 2D map (V vs Temp) See App A, Ref 1	50mS	2 DTC
Pressure Regulators	PR4	P0983	Pressure regulator 4 short to battery	current < threshold	idr_Mess4 < idr4 + idrs_low	ids_low = 2D map (Current vs Temp)	Solenoid Supply > threshold Engine not running Measured control signal PWM = 0%	udrso_prf = 2D map (V vs Temp) See App A, Ref 1	50mS	2 DTC
Pressure Regulators	PR5	P0962	Pressure regulator 5 short to ground	current > threshold	idr_Mess5 > idr5 + idrs_high	ids_high = 2D map (Current vs Temp)	Solenoid Supply > threshold Engine not running Measured control signal PWM = 0%	udrso_prf = 2D map (V vs Temp) See App A, Ref 1	50mS	2 DTC
Pressure Regulators	PR6	P2764	Pressure regulator 6 short to ground	current > threshold	idr_Mess6 > idr6 + idrs_high	ids_high = 2D map (Current vs Temp)	Solenoid Supply > threshold Engine not running Measured control signal PWM = 0%	udrso_prf = 2D map (V vs Temp) See App A, Ref 1	50mS	2 DTC
Pressure Regulators	PR6	P2763	Pressure regulator 6 short to battery	current < threshold	idr_Mess6 < idr6 + idrs_low	ids_low = 2D map (Current vs Temp)	Solenoid Supply > threshold Engine not running Measured control signal PWM = 0%	udrso_prf = 2D map (V vs Temp) See App A, Ref 1	50mS	2 DTC
Pressure Regulators	PR6	P0740	Pressure regulator 6 open cct	current < threshold	idr_Mess6 < idr6 + idrs_low	ids_low = 2D map (Current vs Temp)	Solenoid Supply > threshold Engine not running Measured control signal PWM = 0% Solenoid driver error flag set Timer expired	udrso_prf = 2D map (V vs Temp) App A, Ref 1 30mS	50mS	2 DTC
Mechatronic Unit	Shift Solenoid	P0985	SV1 S/C Gnd	Target max.7.6%	Hardware register fault or umv1_RLo	<7.6%	FET turned on lowside drivers unlocked	True True	20mS	2 DTC
Mechatronic Unit	Shift Solenoid	P0986	SV1 S/C Battery	PWM target max. 92.4%	umv1_Rhi	>92.4%	FET turned on lowside drivers unlocked	True True	20mS	2 DTC
Mechatronic Unit	Shift Solenoid	P0770	SV1 O/C	PWM target max 7.6	umv1_Rlo	<7.6%	FET turned on lowside drivers unlocked	True True	20mS	2 DTC
Mechatronic Unit	Shift Solenoid	P0998	SV2 S/C Gnd	Target max.7.6%	Hardware register fault or umv2_RLo	<7.6%	FET turned on lowside drivers unlocked	True True	20mS	2 DTC
Mechatronic Unit	Shift Solenoid	P0998	SV2 O/C or S/C Gnd	PWM target max. 92.4%	Hardware register fault	=100%	FET turned on lowside drivers unlocked	True True	20mS	2 DTC
Mechatronic Unit	Shift Solenoid	P0999	SV2 S/C Battery	PWM target max. 92.4%	umv2_Rhi	>92.4%	FET turned on lowside drivers unlocked	True True	20mS	2 DTC
Mechatronic Unit	Shift Solenoid	P2706	SV2 O/C	PWM target max 7.6	umv2_Rlo	<7.6%	FET turned on lowside drivers unlocked	True True	20mS	2 DTC
Mechatronic Unit	Park Solenoid	P2814	SV3 S/C Gnd	Target max.7.6%	Hardware register fault or umv3_RLo	<7.6%	FET turned on lowside drivers unlocked	True True	100mS	2 DTC
Mechatronic Unit	Park Solenoid	P2814	SV3 O/C or S/C Gnd	PWM target max. 92.4%	Hardware register fault	=100%	FET turned on lowside drivers unlocked	True True	100mS	2 DTC
Gear monitoring	1st Gear ratio	P0731	1st Gear slip too high	1st gear slip > threshold	nd_syn > KL_NDUWG1	Outputspeed 0.0 1000 2000 Ndsyn> 400 400 640	ATF temp > threshold output speed > threshold Engine Speed > threshold Turbine Speed > threshold	0DegC 0rpm 550rpm 416rpm	3 Symptoms	2 DTC
Gear monitoring	2nd gear ratio	P0732	2nd Gear slip too high	2nd gear slip > threshold	nd_syn > KL_NDUWG2	Outputspeed 0.0 1000 3300 Ndsyn> 400 400 640	ATF temp > threshold output speed > threshold Engine Speed > threshold Turbine Speed > threshold	0DegC 0rpm 550rpm 416rpm	3 Symptoms	2 DTC
Gear monitoring	3rd gear ratio	P0733	3rd Gear slip too high	3rd gear slip > threshold	nd_syn > KL_NDUWG3	Output speed 0.0 1000 5000 Ndsyn> 400 400 640	ATF temp > threshold output speed > threshold Engine Speed > threshold Turbine Speed > threshold	0DegC 0rpm 550rpm 416rpm	3 Symptoms	2 DTC
Gear monitoring	4th gear ratio	P0734	4th Gear slip too high	4th gear slip > threshold	nd_syn > KL_NDUWG4	Output speed 0.0 1000 6500 Ndsyn> 400 400 640	ATF temp > threshold output speed > threshold Engine Speed > threshold Turbine Speed > threshold	0DegC 0rpm 550rpm 416rpm	3 Symptoms	2 DTC
Gear monitoring	5th gear ratio	P0735	5th Gear slip too high	5th gear slip > threshold	nd_syn > KL_NDUWG5	Output speed 0.0 1000 8160 Ndsyn> 400 400 640	ATF temp > threshold output speed > threshold Engine Speed > threshold Turbine Speed > threshold	0DegC 0rpm 550rpm 416rpm	3 Symptoms	2 DTC
Gear monitoring	6th gear ratio	P0729	6th Gear slip too high	6th gear slip > threshold	nd_syn > KL_NDUWG6	Output speed 0.0 1000 8160 Ndsyn> 400 400 640	ATF temp > threshold output speed > threshold Engine Speed > threshold Turbine Speed > threshold	0DegC 0rpm 550rpm 416rpm	3 Symptoms	2 DTC
Shift Monitoring	Gear load 1-2 shift	P0781	Gear load error during 1-2 shift. Clutch C does not close.	(input speed - output speed x ratio) > threshold	ND_TSUEA12Z	>400rpm	outputspeed > threshold transmission oil temperature > threshold engine speed range position	256rpm 100degC 1200rpm no P, R, N	5 Symptoms	2 DTC
Shift Monitoring	Gear load 1-2 shift	P0781	Gear load error during 1-2 shift. Clutch D does not open.	(input speed - output speed x ratio) (t) - (input speed - output speed x ratio) (t) < threshold	ND_TUNSUEB	<30rpm	output speed > threshold transmission oil temperature > threshold engine speed range position	256rpm 100degC 1200rpm no P, R, N	5 Symptoms	2 DTC
Shift Monitoring	Gear load 2-3 shift	P0782	Gear load error during 2-3 shift. Clutch C does not close.	(input speed - output speed x ratio) > threshold	ND_TSUEA23Z	>300rpm	output speed > threshold transmission oil temperature > threshold engine speed range position	256rpm 100degC 1200rpm no P, R, N	5 Symptoms	2 DTC

System	Component	P Codes (AML)	Malfunction Strategy Description	Malfunction Criteria (Fault)	Fault condition (Internal labels)	Threshold Value (Fault condition)	Entry conditions	Entry conditions values	Filter Time to log DTC (AML)	AMS controlled MIL Illumination (AML)
Shift Monitoring	Gear load 2-3 shift	P0782	Gear load error during 2-3 shift. Clutch B does not open.	(input speed - output speed x ratio) (I) - (input speed - output speed x ratio) (O) < threshold	ND_TUNSUEB	<30rpm	output speed > threshold transmission oil temperature > threshold engine speed range position	256rpm 10DegC 1200rpm no P, R, N	5 Symptoms	2 DTC
Shift Monitoring	Gear load 3-4 shift	P0783	Gear load error during 3-4 shift. Clutch E does not close.	(input speed - output speed x ratio) > threshold	ND_TSUEA342	>500rpm	output speed > threshold transmission oil temperature > threshold engine speed range position	256rpm 10DegC 1200rpm no P, R, N	5 Symptoms	2 DTC
Shift Monitoring	Gear load 3-4 shift	P0783	Gear load error during 3-4 shift. Clutch B does not open.	(input speed - output speed x ratio) (I) - (input speed - output speed x ratio) (O) < threshold	ND_TUNSUEB	<30rpm	output speed > threshold transmission oil temperature > threshold engine speed range position	256rpm 10DegC 1200rpm no P, R, N	5 Symptoms	2 DTC
Shift Monitoring	Gear load 4-5 shift	P0784	Gear load error during 4-5 shift. Clutch B does not close.	(input speed - output speed x ratio) > threshold	ND_TSUEA452	>300rpm	output speed > threshold transmission oil temperature > threshold engine speed range position	256rpm 10DegC 1200rpm no P, R, N	5 Symptoms	2 DTC
Shift Monitoring	Gear load 4-5 shift	P0784	Gear load error during 4-5 shift. Clutch E does not open.	(input speed - output speed x ratio) (I) - (input speed - output speed x ratio) (O) < threshold	ND_TUNSUEB	<30rpm	output speed > threshold transmission oil temperature > threshold engine speed range position	256rpm 10DegC 1200rpm no P, R, N	5 Symptoms	2 DTC
Shift Monitoring	Gear load 5-6 shift	P0829	Gear load error during 5-6 shift. Clutch C does not close.	(input speed - output speed x ratio) > threshold	ND_TSUEA56Z	>300rpm	output speed > threshold transmission oil temperature > threshold engine speed range position	256rpm 10DegC 1200rpm no P, R, N	5 Symptoms	2 DTC
Shift Monitoring	Gear load 5-6 shift	P0829	Gear load error during 5-6 shift. Clutch B does not open.	(input speed - output speed x ratio) (I) - (input speed - output speed x ratio) (O) < threshold	ND_TUNSUEB	<30rpm	output speed > threshold transmission oil temperature > threshold engine speed range position	256rpm 10DegC 1200rpm no P, R, N	5 Symptoms	2 DTC
Shift Monitoring	Gear load 2-1 shift	P0781	Gear load error during 2-1 down shift.	(input speed - output speed x ratio) (I) - (input speed - output speed x ratio) (O) < threshold	ND_TUNSUEB	<30rpm	output speed > threshold transmission oil temperature > threshold engine speed range position	256rpm 10DegC 1200rpm no P, R, N	5 Symptoms	2 DTC
Shift Monitoring	Gear load 3-2 shift	P0782	Gear load error during 3-2 down shift.	(input speed - output speed x ratio) (I) - (input speed - output speed x ratio) (O) < threshold	ND_TUNSUEB	<30rpm	output speed > threshold transmission oil temperature > threshold engine speed range position	256rpm 10DegC 1200rpm no P, R, N	5 Symptoms	2 DTC
Shift Monitoring	Gear load 4-3 shift	P0783	Gear load error during 4-3 down shift.	(input speed - output speed x ratio) (I) - (input speed - output speed x ratio) (O) < threshold	ND_TUNSUEB	<30rpm	output speed > threshold transmission oil temperature > threshold engine speed range position	256rpm 10DegC 1200rpm no P, R, N	5 Symptoms	2 DTC
Shift Monitoring	Gear load 5-4 shift	P0784	Gear load error during 5-4 down shift.	(input speed - output speed x ratio) (I) - (input speed - output speed x ratio) (O) < threshold	ND_TUNSUEB	<30rpm	output speed > threshold transmission oil temperature > threshold engine speed range position	256rpm 10DegC 1200rpm no P, R, N	5 Symptoms	2 DTC
Shift Monitoring	Gear load 6-5 shift.	P0829	Gear load error during 6-5 down shift.	(input speed - output speed x ratio) (I) - (input speed - output speed x ratio) (O) < threshold	-30 > calculated value	<30rpm	output speed > threshold transmission oil temperature > threshold engine speed range position	256rpm 10DegC 1200rpm no P, R, N	5 Symptoms	2 DTC
CAN Link	ECM	P1797	CAN timeout EMS	No EMS CAN messages for a time threshold	off time >= tcn_EcmOff	750mS	Battery voltage > threshold No engine crank in progress No CAN bus off or CAN hi fault logged	9v	500mS	1 DTC
System Voltage	Battery Voltage	P1789	Power Supply too low	Battery voltage	ugt_Batt < ugtls_Ulow	< 9V	Engine speed > Turbine speed > Transmission position Mechanical limp/home active	1400rpm 1400rpm Park or Neutral False	1.0s	2 DTC
TCM Internal	Flash Checksum	P062F	Continual EEPROM emulation checksum monitoring	EEPROM emulation checksum error					0mS	1 DTC
Temperature sensors	Chip Temperature Sensor	P0667	Chip temperature too big	Chip temp > threshold	ucu_Chip > utms0_CcuChip	4.95v			1.5s	2 DTC
Temperature sensors	Chip Temperature Sensor	P0667	Chip temperature too low	Chip temp < threshold	ucu_Chip < utms0_CcuChip	0.1v			1.5s	2 DTC

System	Component	P Codes (AML)	Malfunction Strategy Description	Malfunction Criteria (Fault)	Fault condition (Internal labels)	Threshold Value (Fault condition)	Entry conditions	Entry conditions values	Filter Time to log DTC (AML)	AMS controlled MIL Illumination (AML)
System Voltage	Sensor Supply	P0641	Supply voltage of sensors. Sensor voltage too high	Sensor Voltage > threshold	ugt_Sens >= ugt0_Sens	9v	Battery voltage has to be higher than the lower sensor voltage threshold plus the drop-voltage at the sensor voltage		100ms	2 DTC
System Voltage	Sensor Supply	P0641	Supply voltage of sensors. Sensor voltage too low	Sensor voltage < threshold	ugt_Sens <= ugt0_Sens	6.421v	Battery voltage has to be higher than the lower sensor voltage threshold plus the drop-voltage at the sensor voltage		100ms	2 DTC
Software Monitoring	Positive Tq Strategy	P1608	Processor Fault	Invalid processor calculation	HPYSys error Positive Torque	True	always active	no	0mS	2 DTC
Software Monitoring	SBW Strategy	P1608	Processor Fault	Invalid processor calculation	ssk_Level2Error SBW	True	always active	no	0mS	2 DTC
Software Monitoring	Positive Tq Strategy	P1608	Processor Fault	Invalid processor calculation	ssk_Level2Error Positive Torque	True	always active	no	0mS	2 DTC
TCM Internal	Micro controller	P0613	Processor Fault	RAM error	zsk_errorCountTPURAM >= kwd_TPURAM	3			0mS	2 DTC
TCM Internal	Micro controller	P0613	Processor Fault	Processing lockup	zsk_errorCountPUAlive >= kwd_TPUAlive	6			0mS	2 DTC
TCM Internal	Micro controller	P0613	Processor Fault	ADC conversion errors	zsk_errorCountQADCTest_slight >= kwd_Qadco_slight	6			0mS	2 DTC
TCM Internal	Micro controller	P0613	Processor Fault	ADC conversion errors due to TCM overheat	zsk_errorCountQADCTest_strong >= kwd_Qadco_strong	10	TCM temperature > threshold	137DegC	0mS	2 DTC
System Voltage	Battery Voltage	P1794	Power Supply too high	Battery voltage	ugt_Batt >= ugt0_Batt	>=16V	Engine speed >= No Jumpstart True Mechanical limp/home active	450rpm True False	2.5s	2 DTC
Speed Sensors	Output speed sensor	P0501	Change in output speed too high	Output speed - turbine speed > threshold AND Output speed difference from last measured value > threshold	INABE:ntuel > Nrsv2_NabNtu AND Inabe-nabe_rsv2l > nrsv2_nab	nrsv2_NabNtu = 200rpm AND nrsv2_nab = 1000rpm	Downshift prevention timer expired Gear engaged or shift in progress	200mS	400ms	2 DTC
Mechatronic Unit	Pressure Regulator	P1745	TCM internal fault Short Circuits with high resistance	Current deviation on Pressure Regulator#1	ids_High (powered) ids_Low (unpowered)	> 120 mA (powered) > 170 mA (unpowered)	Fault already detected on Pressure regulator 1 Target Current > Battery Voltage > Supply Voltage >	True 500 mA 9V 9V	20ms	2 DTC
Gear monitoring	Reverse gear	P0736	Reverse Gear slip too high	R gear slip > threshold	nd_syn > KL_NDUWGR	Output speed 0.0 1000 6000 Ndsyn> 400 400 640	ATF temp > threshold output speed > threshold Engine Speed > threshold Turbine Speed > threshold	0DegC 0rpm 550rpm 416rpm	1 Symptom	2 DTC
Level2 calculation Pressure regulators at high speed	PR1, PR2, PR3, PR4	P0755	Check of activation pressure regulator 1, 2, 3, 4 Incorrect pressure regulator current L_ed1, L_ed2, L_ed3, L_ed4	Position Output speed	Position N or P n_ab >= NS_ABNSTOERPOSN	Engaged 1500rpm	Ignition ON Engine speed > threshold	True 430 rpm	0mS	2 DTC
Level2 calculation Pressure regulators at high speed	PR1	P0750	Check of activation pressure regulator 1 Incorrect pressure regulator current L_ed1	Position Output speed	Position N or P n_ab >= NS_ABNSTOERPOSN	Engaged 1500rpm	Ignition ON Engine speed > threshold	True 430 rpm	0mS	2 DTC
Level2 calculation Pressure regulators at high speed	PR2	P0755	Check of activation pressure regulator 2 Incorrect pressure regulator current L_ed2	Position Output speed	Position N or P n_ab >= NS_ABNSTOERPOSN	Engaged 1500rpm	Ignition ON Engine speed > threshold	True 430 rpm	0mS	2 DTC
Level2 calculation Pressure regulators at high speed	PR3	P0760	Check of activation pressure regulator 3 Incorrect pressure regulator current L_ed3	Position Output speed	Position N or P n_ab >= NS_ABNSTOERPOSN	Engaged 1500rpm	Ignition ON Engine speed > threshold	True 430 rpm	0mS	2 DTC
Level2 calculation Pressure regulators at high speed	PR4	P0765	Check of activation pressure regulator 4 Incorrect pressure regulator current L_ed4	Position Output speed	Position N or P n_ab >= NS_ABNSTOERPOSN	Engaged 1500rpm	Ignition ON Engine speed > threshold	True 430 rpm	0mS	2 DTC