2005 ENGINE PERFORMANCE

Self-Diagnostics - MINI

INTRODUCTION

OBD-II Diagnostic Trouble Codes (DTCs) are accessed using a generic scan tool connected to vehicle Data Link Connector (DLC). See**Fig. 1**. MINI trouble codes can be accessed using BMW's GROUP TESTER ONE (GT-1) or DISplus hardware system. These are often referred to as BMW SCAN TOOL.

The OBD-II connector is located in driver's footwell to left of steering column. See **Fig. 2**

Control unit provides a substitute value if a failure occurs in an engine performance related component, such as engine (coolant) temperature sensor, intake air temperature sensor, airflow meter or exhaust gas oxygen sensor. These substitute values are canceled when normal engine operation is resumed.

NOTE:	**All voltage tests should be performed with a Digital Volt-Ohmmeter (DVOM) with a minimum 10-megohm input impedance, unless specifically stated otherwise in testing procedures.**

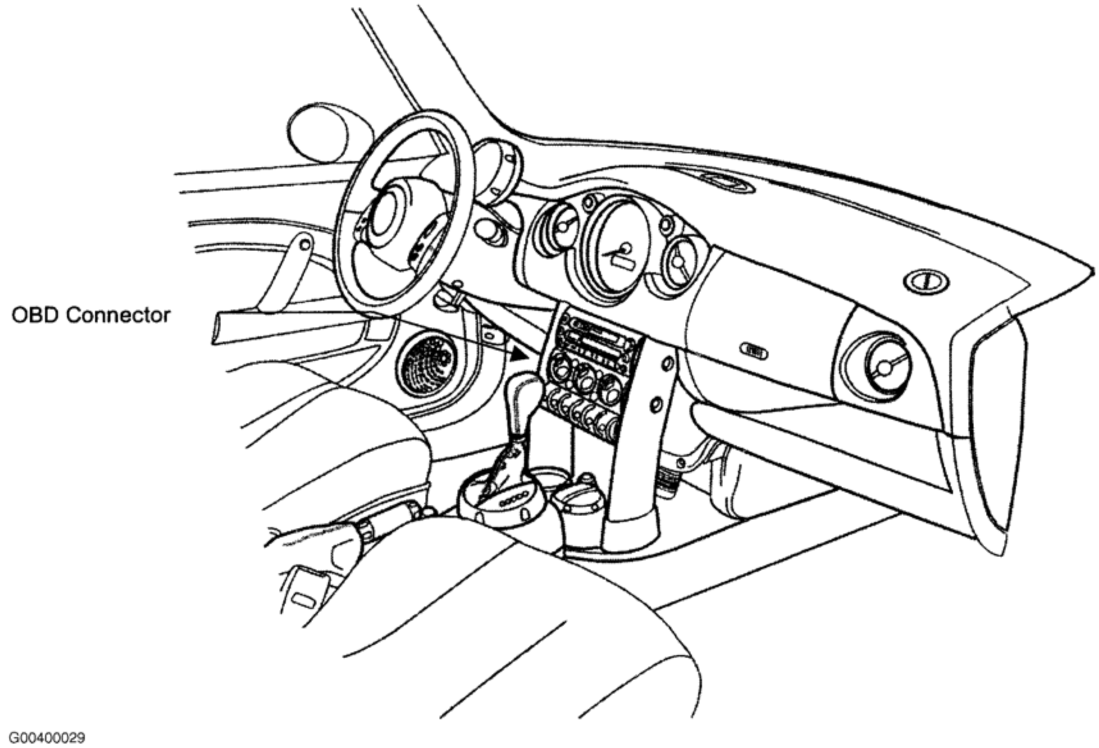


Fig. 1: Locating OBD-II Connector
Courtesy of BMW OF NORTH AMERICA, INC.

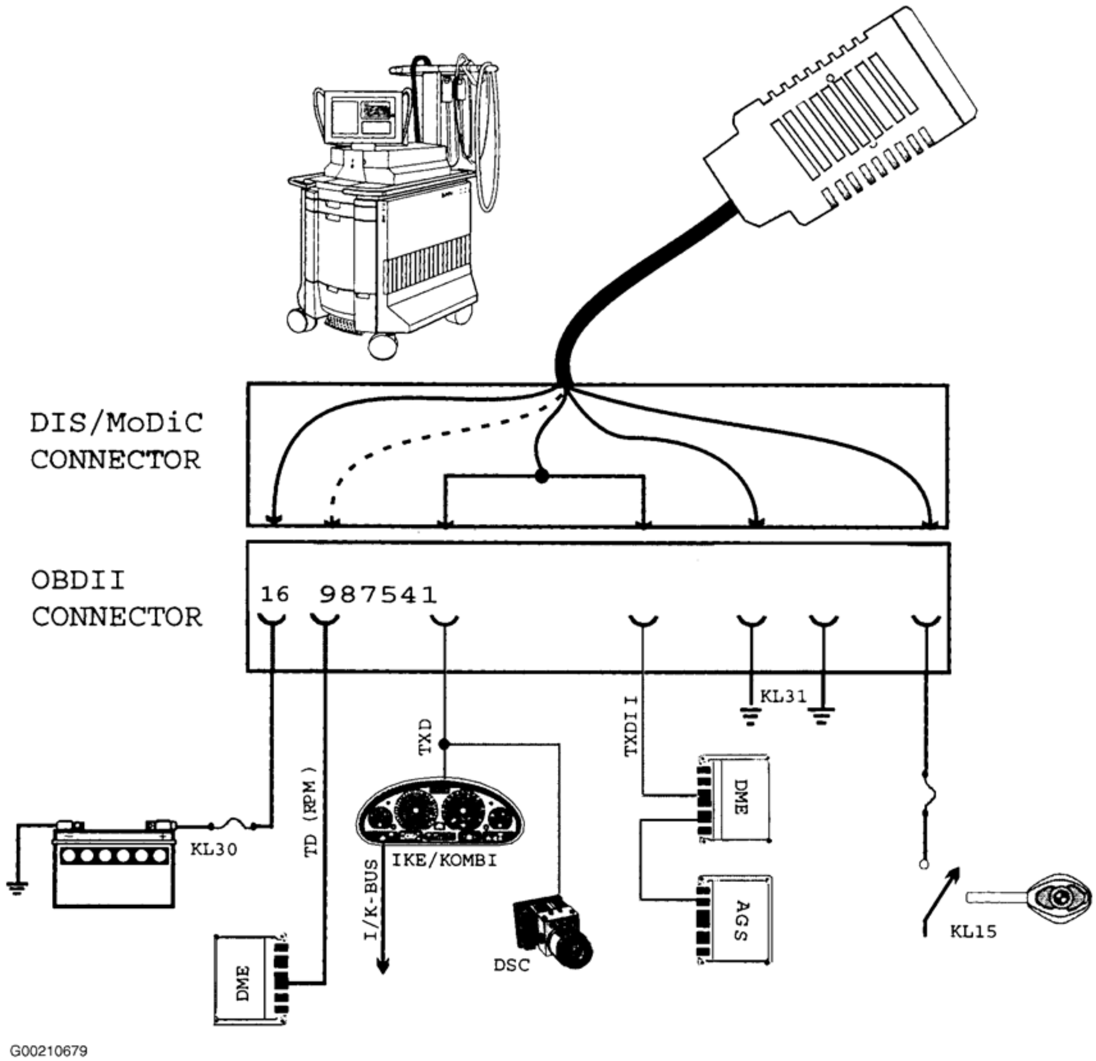


Fig. 2: Diagnosis Using OBD-II Connector
Courtesy of BMW OF NORTH AMERICA, INC.

MALFUNCTION INDICATOR LIGHT

The Malfunction Indicator Light (MIL) will illuminate under the following conditions:

- Upon the completion of the next consecutive driving cycle where the previously faulted system is monitored again and the emissions relevant fault is again present.
- Immediately if a catalyst damaging fault occurs.

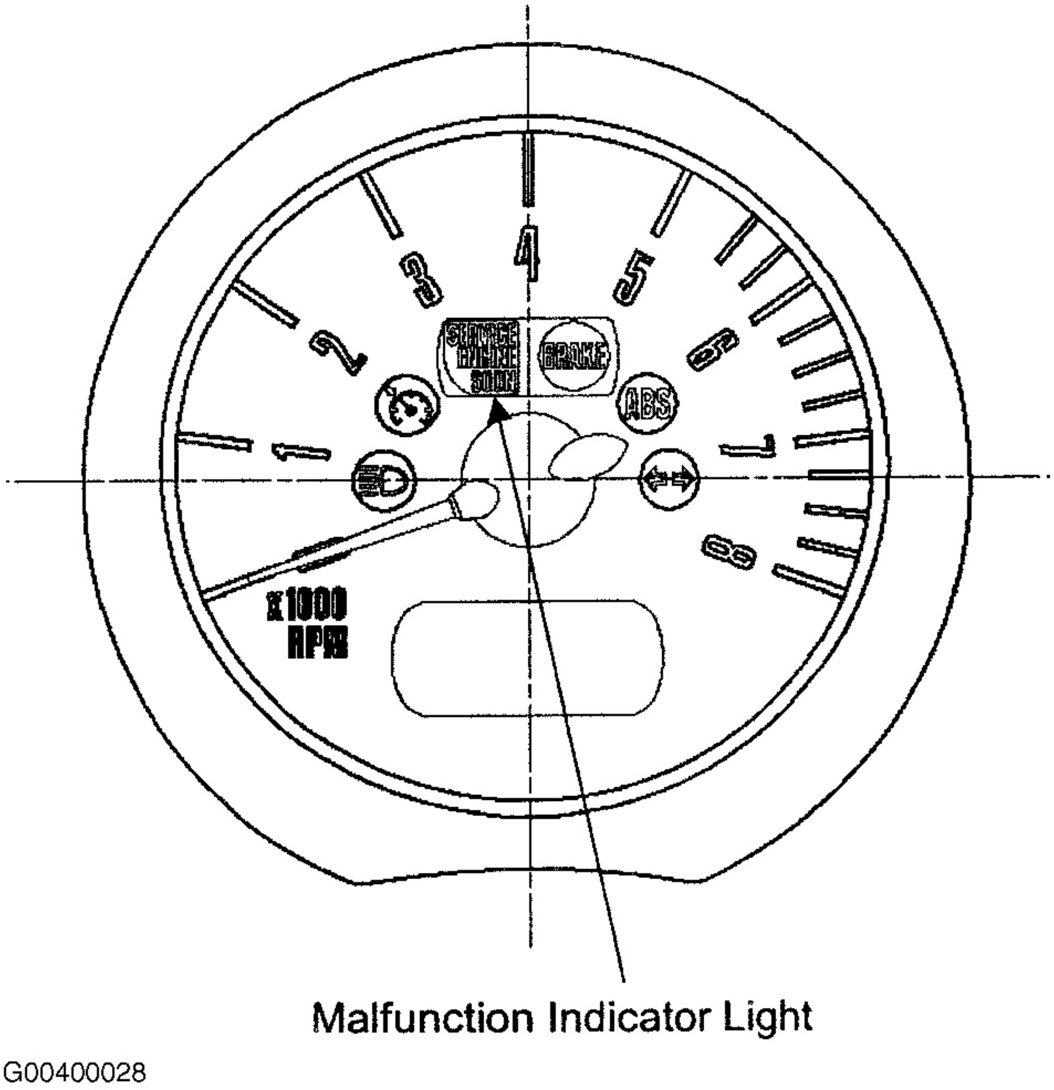


Fig. 3: Identifying Malfunction Indicator Light
Courtesy of BMW OF NORTH AMERICA, INC.

The illumination of the light is performed in accordance with the Federal Test Procedure (FTP) which requires the light to go on when:

- A malfunction of a component that can affect the emission performance of the vehicle occurs and causes emissions to exceed 1.5 times the standards required by FTP.
- Manufacturer-defined specifications are exceeded.

- An implausible input signal is generated.
- Catalyst deterioration causes HC-emissions to exceed a limit equivalent to 1.5 times the standard (FTP).
- Misfire faults occur.
- A leak is detected in the evaporative system, or purging is defective.
- PCM fails to enter closed-loop oxygen sensor control operation within a specified time interval.
- Engine control or automatic transmission control enters a limp home operating mode.
- Ignition is in on position before cranking = bulb check function.

A fault code is stored within the PCM upon the first occurrence of a fault in the system being checked. The Malfunction Indicator Light (MIL) will not be illuminated until the completion of the second consecutive "customer driving cycle" where the previously faulted system is again monitored and a fault is still present or a catalyst damaging fault has occurred. If the second drive cycle was not complete and the specific function was not checked, PCM counts third drive cycle as "next consecutive" drive cycle. MIL is illuminated if the function is checked and the fault is still present. See **Fig. 4**.

	DRIVE CYCLE # 1			DRIVE CYCLE # 2			DRIVE CYCLE # 3			DRIVE CYCLE # 4			DRIVE CYCLE # 5			* DRIVE CYCLE # 43		
TEXT NO.	FUNCTION CHECKED	FAULT CODE SET	MIL STATUS CHECK ENGINE	FUNCTION CHECKED	FAULT CODE SET	MIL STATUS CHECK ENGINE	FUNCTION CHECKED	FAULT CODE SET	MIL STATUS CHECK ENGINE	FUNCTION CHECKED	FAULT CODE SET	MIL STATUS CHECK ENGINE	FUNCTION CHECKED	FAULT CODE SET	MIL STATUS CHECK ENGINE	FUNCTION CHECKED	FAULT CODE ERASED	MIL STATUS CHECK ENGINE
1.	YES	YES	OFF															
2.	YES	YES	OFF	YES	YES	ON												
3.	YES	YES	OFF	NO	NO	OFF	YES	YES	ON									
4.	YES	YES	OFF	YES	NO	OFF	YES	NO	OFF	YES	YES	OFF	YES	YES	ON			
5.	YES	YES	OFF	YES	YES	ON	YES	NO	ON	YES	NO	ON	YES	NO	OFF			
6.	YES	YES	OFF	YES	YES	ON	YES	NO	ON	YES	NO	ON	YES	NO	OFF	YES	FAULT CODE ERASED	OFF

G00210678

Fig. 4: Malfunction Indicator Light (MIL) Illumination During Drive Cycle
Courtesy of BMW OF NORTH AMERICA, INC.

If there is an intermittent fault present and does not cause a fault to be set through multiple drive cycles, 2 complete consecutive drive cycles with the fault present are required for MIL to be illuminated. Once MIL is illuminated it will remain illuminated unless the specific function has been checked without fault through 3 complete consecutive drive cycles. Fault code will also be cleared from memory automatically if specific function is checked through 40 consecutive drive cycles without the fault being detected or with the use of either DISplus, GT-1 or scan tool. In order to clear a catalyst damaging fault from memory, the condition must be evaluated for 80 consecutive cycles without the fault reoccurring.

DIAGNOSTIC TROUBLE CODES

DIAGNOSTIC TROUBLE CODE TABLE

See **MINI DIAGNOSTIC TROUBLE CODES** table to determine which specific Code Description/Diagnostic Link figure applies to a specific code.

NOTE: Diagnosis is not available for that DTCs not listed.

2005 MINI DIAGNOSTIC TROUBLE CODES

DTC	Code Description/Diagnostic Link
P0030	See **Fig. 8**.
P0031	See **Fig. 8**.
P0032	See **Fig. 8**.
P0036	See **Fig. 9**.
P0037	See **Fig. 9**.
P0038	See **Fig. 9**.
P0053	See **Fig. 8**.
P0054	See **Fig. 9**.
P0070	See **Fig. 17**.
P0107	See **Fig. 12**.
P0108	See **Fig. 12**.
P0112	See **Fig. 11**.
P0113	See **Fig. 11**.
P0114	See **Fig. 11**.
P0117	See **Fig. 11**.
P0118	See **Fig. 11**.
P0119	See **Fig. 11**.
P0122	See **Fig. 10**.
P0123	See **Fig. 10**.
P0125	See **Fig. 11**.
P0128	See **Fig. 9**.
P0130	See **Fig. 8**.
P0131	See **Fig. 7**.
P0132	See **Fig. 7**.
P0133	See **Fig. 7**.
P0136	See **Fig. 8**.
P0137	See **Fig. 8**.
P0138	See **Fig. 8**.
P0171	See **Fig. 7**.
P0172	See **Fig. 7**.
P0201	See **Fig. 11**.
P0202	See **Fig. 11**.
P0203	See **Fig. 11**.
P0204	See **Fig. 11**.

P0222	See **Fig. 10**.
P0223	See **Fig. 10**.
P0261	See **Fig. 11**.
P0262	See **Fig. 11**.
P0264	See **Fig. 11**.
P0265	See **Fig. 11**.
P0267	See **Fig. 11**.
P0268	See **Fig. 11**.
P0270	See **Fig. 11**.
P0271	See **Fig. 11**.
P0300	See **Fig. 5**.
P0301	See **Fig. 5**.
P0302	See **Fig. 5**.
P0303	See **Fig. 5**.
P0304	See **Fig. 5**.
P0313	See **Fig. 5**.
P0324	See **Fig. 12**.
P0326	See **Fig. 12**.
P0335	See **Fig. 10**.
P0336	See **Fig. 10**.
P0340	See **Fig. 10**.
P0341	See **Fig. 10**.
P0420	See **Fig. 5**.
P0441	See **Fig. 6**.
P0442	See **Fig. 6**.
P0443	See **Fig. 6**.
P0444	See **Fig. 6**.
P0445	See **Fig. 6**.
P0455	See **Fig. 6**.
P0456	See **Fig. 6**.
P0500	See **Fig. 10**.
P0506	See **Fig. 9**.
P0507	See **Fig. 9**.
P0601	See **Fig. 12**.
P0603	See **Fig. 12**.
P0604	See **Fig. 12**.
P0638	See **Fig. 13**.
P0642	See **Fig. 13**.
P0643	See **Fig. 13**.
P0652	See **Fig. 13**.
P0653	See **Fig. 13**.

	See **Fig. 13**.
P0653	See **Fig. 13**.
P0705	See **Fig. 16**.
P101F	See **Fig. 17**.
P1106	See **Fig. 12**.
P1107	See **Fig. 13**.
P1108	See **Fig. 13**.
P1109	See **Fig. 13**.
P1125	See **Fig. 10**.
P1126	See **Fig. 10**.
P1229	See **Fig. 10**.
P1320	See **Fig. 5**.
P1321	See **Fig. 5**.
P1320	See **Fig. 5**.
P1475	See **Fig. 6**.
P1476	See **Fig. 6**.
P1477	See **Fig. 6**.
P1498	See **Fig. 17**.
P1572	See **Fig. 13**.
P1575	See **Fig. 13**.
P1600	See **Fig. 12**.
P1607	See **Fig. 14**.
P1611	See **Fig. 14**.
P1612	See **Fig. 14**.
P1613	See **Fig. 14**.
P1615	See **Fig. 14**.
P1617	See **Fig. 13**.
P1679	See **Fig. 14**.
P1680	See **Fig. 14**.
P1681	See **Fig. 14**.
P1682	See **Fig. 14**.
P1683	See **Fig. 15**.
P1684	See **Fig. 15**.
P1685	See **Fig. 15**.
P1686	See **Fig. 15**.
P1687	See **Fig. 15**.
P1688	See **Fig. 15**.
P1689	See **Fig. 15**.
P1691	See **Fig. 15**.
P1692	See **Fig. 16**.
P1693	See **Fig. 16**

	See **Fig. 16**.
P1699	See **Fig. 16**.
P1739	See **Fig. 16**.
P1741	See **Fig. 16**.
P1742	See **Fig. 16**.
P1749	See **Fig. 16**.
P1751	See **Fig. 16**.
P1752	See **Fig. 16**.
P1785	See **Fig. 16**.
P1786	See **Fig. 17**.
P1787	See **Fig. 16**.
P1788	See **Fig. 16**.
P1789	See **Fig. 16**.
P2096	See **Fig. 7**.
P2097	See **Fig. 7**.
P2122	See **Fig. 10**.
P2123	See **Fig. 10**.
P2127	See **Fig. 10**.
P2128	See **Fig. 10**.
P2138	See **Fig. 10**.
P2270	See **Fig. 8**.
P2271	See **Fig. 8**.
P2300	See **Fig. 12**.
P2301	See **Fig. 12**.
P2303	See **Fig. 12**.
P2304	See **Fig. 12**.
P2400	See **Fig. 6**.
P2401	See **Fig. 6**.
P2402	See **Fig. 6**.
P2404	See **Fig. 6**.

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Criteria and Signal	Threshold Value	Specified Units	Secondary Parameters	Enable Value	Specified Units	Monitor Time Length Frequency of Checks	MIL Illumination
Catalyst	P0420	Oxygen Storage Capacity	Increase in downstream sensor activity during controlled stimuli (DOWN_DYN_CAT)	> 0.17 - 0.72	g/s	Coolant temperature (TCO) Fuel system closed loop (LV_LSCL_1) Vehicle speed (VS) Engine speed (N_32) Engine load (MAF_KGH) Modelled exhaust gas temperature sufficient (LV_TEG_CAT) Ambient pressure (AMP) Time after start Engine load stability (MAF_KGH - MAF_KGH_MMV)	>= 80.25 1 28.0-80.8 1984-3648 (MT) 1888-3488 (AT) 7.8-25.0(MT) 6.9-25 (AT) 450.01-700 75.001 1 <= 6.94	°C N/A mph rpm g/s °C kPa s g/s	8 half periods (2 seconds), once per drive cycle	Two drive cycles
Misfire (CARB B1)	P0300 P0301 P0302 P0303 P0304	Crankshaft speed variation	Sum of misfires causing an increase in emissions for the first 1000 engine revolutions after start (MIS_SUM_B)	> 30	1/1000 CRK rev	Engine speed Throttle gradient (TPS_GRD)	600+4tdc-7008 (MT) 600+4tdc-6208 (AT) <2987.5	rpm rpm °TPS/s	First 1000 engine revolutions after start (360°crank), once per drive cycle	Two drive cycles
Misfire (CARB B4)	P0300 P0301 P0302 P0303 P0304	Crankshaft speed variation	Sum of misfires causing an increase of emissions after the first 1000 engine revolutions (MIS_SUM_B)	> 30	1/1000 CRK rev	Air mass gradient (only applied if timer > 5s after start) (MAF_DIF) Coolant temperature (TCO) Ambient pressure (AMP) Instantaneous ignition retard (applied if timer > 5s after start) (IGA_DIF_MIS) Engine load (MAF) Time after start AC Switched On	I MAF_DIF I < 1.39mg/tdc (0.1s disabled) > -30 >75.0011 <47.36 (9TDC disabled) >zero torque line 0.01 0	g/rev °C kPa °CRK g/s s s	1000 engine revolutions (360°crank), continuous	Two drive cycles
Misfire (CARB A)	P0300 P0301 P0302 P0303 P0304	Crankshaft speed variation	Sum of misfires causing catalyst damage during 200 engine revolutions (MIS_SUM_A)	> 2857 (>14% ...40%)	1/200 CRK rev	Injection shut off Rough road detection Anti-spin control active ABS/ASR active Crankshaft oscillation (only applied if timer > 5s after start) Low Fuel Level	Misf disabled on considered cyl. (0.1s delay on reinstatement 1 s disabled Misf disabled Misf disabled 7 tdc disabled Misf disabled	N/A N/A N/A N/A N/A N/A	200 engine revolutions (360°crank), continuous	One drive cycle after injector shut-off
Misfire	P0313	Indication of low fuel level when misfire detected	Fuel level below a threshold (FTL)	< 10 % of the nominal tank volume	%	Misfire error already present (LV_DC_MAX_MIS_A/B1/B4)	1	N/A	N/A, continuous	as for misfire above
	P1320	Crankshaft segment adaptation during fuel cut off	Crankshaft segment adaptation at the limit (SEG_AD_MV_x)	+0.1	%	N/A	N/A	N/A	One engine cycle (720°CRK)	Two drive cycles
	P1321	Crank Wheel tooth count	Tooth error	+/-1 or 2 teeth	N/A	N/A	N/A	N/A	N/A, continuous	Two drive cycles

Fig. 5: OBDII Code Table - (1 Of 13)
Courtesy of BMW OF NORTH AMERICA, INC.

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Criteria and Signal	Threshold Value	Specified Units	Secondary Parameters	Enable Value	Specified Units	Monitor Time Length Frequency of Checks	MIL Illumination
EVAP system leak detection	P2402 P2401 P2400	Tank leak detection pump (TLDP) solenoid SCB TLDP solenoid SCG TLDP solenoid OC	Performed by hardware	N/A	N/A	N/A	N/A	N/A	N/A, continuous	Two drive cycles
	P1475	Reed switch open	Reed switch level stays high after activation of solenoid within time threshold (LV_IN_RS_TLDP)	> 0.5	s	Coolant temperature (TCO)	3.75-60	°C	typically 60 seconds, once per drive cycle	Two drive cycles
	P1477	Reed switch closed	Reed switch level continuously low after activation of solenoid within time threshold (LV_IN_RS_TLDP)	> 1	s	Ambient pressure (AMP)	>76.2994	kPa		
	P2404	Pump problem	Reed switch level stays low after de-activation of solenoid within time threshold (LV_IN_RS_TLDP)	> 2	s	Battery voltage (VB)	9.04-16.04	V		
	P0441	Purge valve stuck in closed position	Time period above threshold when purge valve is opened after leak detection check (T_PER_TLDP)	> 1.1	s	Intake air temperature at start (TIA_ST)	4.5-60.0	°C		
	P1476	Clamped tube	Time period of any of 5 first pump cycles (T_PER_TLDP)	> 5	s	Coolant temperature difference between engine start and engine previously stopped (TCO_ES_TLDP-TCO_ST_TLDP)	> 15	°C		
	P0455	Big leak, missing cap	Time period after 92 fast pulses (T_PER_TLDP)	<= 0.52	s	Change in barometric pressure since engine start (AMP - AMP_ST)	< 0.9998	kPa		
	P0456	Leakage over 0.5 mm	Time period after 92 fast pulses (T_PER_TLDP)	<= 6.0	s	Vehicle speed (VS)	< 74.56 all leaks and clamp tube	mph		
	P0442	Leakage over 1.0 mm	Time period after 92 fast pulses (T_PER_TLDP)	> 1	s	Purge valve has opened enough on previous driving cycle (LV_PREV_OPEN) Time after start (T_AST) Rough road recognition (RR) Downhill recognition (DHL)	CPS > 16-48 >=20 and <=360 Disabled for 5s when RR or DHL detection	% s N/A N/A		
Canister purge valve	P0443 P0445 P0444	SCB SCG OC	Performed by hardware	N/A	N/A	N/A	N/A	N/A	1.3 second, 0.13 second	Two drive cycles

Fig. 6: OBDII Code Table - (2 Of 13)
Courtesy of BMW OF NORTH AMERICA, INC.

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Criteria and Signal	Threshold Value	Specified Units	Secondary Parameters	Enable Value	Specified Units	Monitor Time Length Frequency of Checks	MIL Illumination
Fuel system	P0171	Lean limit	Adaptives and controller limits permanent deviation (TI_LAM TI_AD_FAC_MMV_REL_I TI_AD_ADD_MMV_REL_QUO_; T_SUM_MAX_FSD)	> 25% for > 40s in 320 s	%, s	Fuel system closed loop (LV_LSCL_1) Canister load (CL_MMV) MAF stability (MAF_KGH - MAF_KGH_MMV) TPS stability (TPS_GRD) Engine speed (N_32) Coolant temperature (TCO) Ambient pressure (AMP)	1 > 1 < 2.22 < 58.6 > 1408 > -7.5 >75.0011	N/A N/A g/s %/s rpm °C kPa	320 seconds, 0.03 second	Two drive cycles
	P0172	Rich limit		< -25% for > 50s in 320 s	%, s					
	P2096	Rear O2 Dynamic Fuel Trim - system LEAN	Adaption reaches low limit (TI_LAM_COR_AD_x)	< -1.56	N/A	Conditions for adaption: Rear O2 Sensor outside voltage window (VLS_DOWN) Fuel system closed loop (LV_LSCL_1) Key on (LV_KEY_ON) Engine not idling (LV_IS) Engine speed (N_32) Engine Load (MAF) Coolant temperature (TCO) Downstream sensor ready (LV_LS_DOWN) O2 heaters ready (LV_UP_LSH, LV_DOWN_LSH)	-0.0196 / -0.0635 from target 1 1 0 1952-3808 0.22-0.6 (MT) 0.25-0.6 (AT) > 45 1 1	V N/A N/A N/A rpm g/rev °C N/A N/A	N/A 0.01 second	Two drive cycles
	P2097	Rear O2 Dynamic Fuel Trim - system RICH	Adaption reaches high limit (TI_LAM_COR_AD_x)	> 1.56	N/A					
Upstream O2 sensor	P0133	Response time of upstream O2 sensor	Sum of O2 sensor period times (VLS_CYC_SUM_1), limit period time for bank (VLS_CYC_MAX_MES_1) Sum of O2 sensor period times (VLS_CYC_SUM_1)	> sum threshold and <= ave period time * gain > 1.50....2.03 (MT)<= ave period time* 3 > 2.54....3.00 (AT)<= ave period time* 3 > sum threshold * factor > 1.50....2.03 (MT)*2 > 2.54....3.00 (AT)*2	s s	Fuel system closed loop (LV_LSCL_1) Canister load (CL_MMV) Coolant temperature (TCO) O2 sensor heating (LSHPWM_UP/DOWN) Mass air flow (MAF) Engine load (MAF_KGH) Engine speed (N_32) Vehicle speed (VS) Engine load stability (MAF_KGH - MAF_KGH_MMV) Time after start (THD_VLS_AST) Ambient pressure (AMP)	1 < 2 80.25 12.5-98.0 0.2-0.54 6.94-27.78 1984-3488 (MT) 1888_3296 (AT) 24.85 - 68.35 < 1.94 1 >75.00114	N/A N/A °C % g/rev g/s rpm mph g/s s kPa	5 O2 sensor periods, once per drive cycle	Two drive cycles
	P0132	SCB	Sensor voltage above threshold (VLS_UP_I)	> 1.032V for 10s	V, s	Key on (LV_KEY_ON)	1	N/A	10 seconds, 0.01 second	Two drive cycles
	P0131	SCG or air leakage	Sensor voltage below threshold (VLS_UP_I)	< 0.039V for 25s	V, s	Key on (LV_KEY_ON) Fuel system closed loop (LV_LSCL_1) Engine speed (N_32)	1 1 < 8000	N/A N/A rpm	25s, 0.01 second	

Fig. 7: OBDII Code Table - (3 Of 13)
Courtesy of BMW OF NORTH AMERICA, INC.

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Criteria and Signal	Threshold Value	Specified Units	Secondary Parameters	Enable Value	Specified Units	Monitor Time Length Frequency of Checks	MIL Illumination
	P0130	OC	Sensor voltage within threshold (VLS_UP_I)	0.22V < U < 0.611V for 10s	V, s	Key on (LV_KEY_ON) Engine speed (N_32) Fuel cut or closed loop (LV_PUC or LV_LSCL_1)	1 < 8000 1	N/A rpm N/A	10 seconds, 0.01 second	
Upstream O2 sensor heater	P0032 P0031 P0030	SCB SCG OC	Performed by hardware	N/A	N/A	N/A	N/A	N/A	1.3 seconds, 0.13 second	Two drive cycles
	P0053	Resistance out of limits	Calculated resistance (RLSH_UP_1)	< 1.5Ω or > 25.0Ω for 8s	Ω, s	Engine load (MAF_KGH_MMV) Engine Speed (N) Engine running (LV_ES) Engine not cranking (LV_ST) Exhaust gas temp (TEG_CAT) Battery voltage (VB)	6.94-44.44 <=7008 (MT) <=6208 (AT) 1 0 350.006-649.995 10.96-16.04	g/s rpm N/A N/A °C V	8 seconds, continuous	
Downstream O2 sensor	P2271	Lambda is forced lean until rear O2 sensor voltage drops lean - error if no reaction	O2 sensor voltage (VLS_DOWN_1) does not cross threshold.	VLS_DOWN does not cross 0.6794 V after 7s	V, s	Coolant temperature (TCO) Fuel system closed loop (LV_LSCL_1) Vehicle speed (VS) Engine speed (N_32) Engine load (MAF_KGH) Exhaust gas temperature sufficient (LV_TEG_CAT) Ambient pressure (AMP) Engine load stability (MAF_KGH - MAF_KGH_MMV)	> 80.25 1 27.96 - 80.78 1984-3648 7.78 - 25 (MT) 6.94 - 25 (AT) 1 >75.001 6.94	°C N/A mph rpm g/s N/A kPa g/s	7s, only if no response from downstream sensor	Two drive cycles
	P2270	Lambda is forced rich until rear O2 sensor voltage drops rich - error if no reaction	O2 sensor voltage (VLS_DOWN_1) does not cross threshold.	VLS_DOWN does not cross 0.6794 V after 7s	V, s					
	P0138	SCB	Sensor voltage above threshold (VLS_DOWN_1)	> 1.1V for 10s	V, s	Key on (LV_KEY_ON)	1	N/A	10 seconds, 1 second	Two drive cycles
	P0137	SCG or air leakage	Sensor voltage below threshold (VLS_DOWN_1)	< 0.039 V for 15s		Lambda trim active (LV_LAM_COR_AUTH) Engine speed (N_32)	1 <8000	N/A rpm	15 seconds, 1 second	
	P0136	OC	Sensor voltage within threshold (VLS_DOWN_1)	0.22 V < U < 0.611 V for 7s		Fuel cut (LV_PUC) MAF sum in fuel cut (MAF_SUM_PUC) Engine speed (N_32)	1 >5 <8000	N/A g rpm	7 seconds, 1 second	

Fig. 8: OBDII Code Table - (4 Of 13)
Courtesy of BMW OF NORTH AMERICA, INC.

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Criteria and Signal	Threshold Value	Specified Units	Secondary Parameters	Enable Value	Specified Units	Monitor Time Length Frequency of Checks	MIL Illumination
Downstream 02 sensor heater	P0038 P0037 P0036	SCB SCG OC	Performed by HW	N/A	N/A	N/A	N/A	N/A	N/A, continuous	Two drive cycles
	P0054	Resistance out of limits	Calculated resistance (PLSH_DOWN_1)	<1.5Ω or >25.0Ω for 8s	Ω, s	Engine load (MAF_KGH_MMV) Engine speed (N) Engine running (LV_ES) Engine not cranking (LV_ST) Exh gas temp (TEG_CAT) Battery voltage (VB)	6.94-44.44 <=7008 (MT) <=6208 (AT) 1 0 350.006-649.995 10.96-16.04	g/s rpm N/A N/A °C V	8 seconds, continuous	
Idle engine speed setpoint diagnosis	P0506	Monitoring of engine speed deviation from idle speed setpoint	Actual engine speed less than setpoint minus threshold (N)	< setpoint -100	rpm	Idle speed control requested (LV_REQ_ISC) Battery voltage (VB) Vehicle not moving (LV_VS_RUN) Sufficient time since engine start (LV_AST) Time since idle speed state is activated (T_ISC_DIAG)	1 > 10.96 0 0 5	N/A V N/A s s	5 seconds, 0.1 second	Two drive cycles
	P0507	Monitoring of engine speed deviation from idle speed setpoint	Actual engine speed more than setpoint plus threshold (N)	> setpoint + 200	rpm	Coolant temperature (TCO) Motorized throttle not disabled (LV_MTC_CUR_OFF) Mass air flow (MAF_HB) Relative flow from Canister Purge Solenoid Valve (REL_FLOW_CPS_AV) Canister Purge Solenoid Valve Opening (CPPWM)	80.25-110.25 0 < 0.36 <0.149998 <94.9	°C N/A g/rev N/A %		
Thermostat	P0128	Engine coolant temperature (TCO) vs substitute value of coolant temperature (TCO_SUB)	TCO < C_TCO_MIN_OBD_DIAG once TCO_SUB > C_TCO_TH_MIN or TCO not > C_TCO_TH_MIN - C_HYS_TCO_TH_MIN for C_T_TCO_TH_MIN secs once TCO_SUB > C_TCO_TH_MIN	C_TCO_MIN_OBD_DIAG = -48°C C_TCO_TH_MIN = 90°C C_HYS_TCO_TH_MIN = 9.75°C C_T_TCO_TH_MIN = 30secs	°C, s	Substitute coolant temperature (TCO_SUB) After start time (T_AST) % of time in Fuel Cut (PUC) % of time below min air flow (LOAD_MIN_PERC_TH_DIAG) Percentage of time in idle (IS_PERC_TCO_PLAUS_DIAG) Deviation with air temperature at start Coolant temperature at start (TCO_ST) Air temperature at start (TIA_ST)	> 90 > 180...300 < 40 <40 <45.0004 < 5.25 > -12 and < 65.25 -12	°C s % % % °C °C °C	Substitute value of coolant temperature needs to reach >90°C (typically 5 to 25 mins depending on starting temperature and driving style), once per drive cycle	Two drive cycles

Fig. 9: OBDII Code Table - (5 Of 13)
Courtesy of BMW OF NORTH AMERICA, INC.

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Criteria and Signal	Threshold Value	Specified Units	Secondary Parameters	Enable Value	Specified Units	Monitor Time Length Frequency of Checks	MIL Illumination
Throttle position sensor (TPS)	P0123 P0122	SCB or OC SCG	TPS 1 voltage (TPS_1_BAS)	> 4.9071 < 0.0244	V V	Supply voltage correct (LV_V_REF_TPS_ERR_DET)	0	N/A	0.08 second, 0.005 second	One drive cycle
	P0223 P0222	SCB SCG or OC	TPS 2 voltage (TPS_2_BAS)	>4.9560 < 0.0978	V V					
	P1125 P1126	Plausability error Large plausability error	Difference between TPS 1 and TPS 2 (TPS_MTC_1 and TPS_MTC_2)	> 5 > 18	% %	N/A	N/A	N/A	0.39 second, 0.005 second	
	P1229	Throttle adaption outside tolerance	Measured max/min TPS values within hysteresis limits (TPS_x_BAS)	> 0.0244	V	Battery voltage (VB)	> 6.55	V	0.2 second, 0.005 second	
		Spring test error	Filtered throttle position in setpoint window within time threshold (TPS_FIL_MTC)	>23.14 and <26.86 in 800ms	%, ms	Coolant temperature (TCO)	-30<TCO<142.5	°C	0.8 second, 0.005 second	
		Limp home check error	Throttle value in hysteresis area within time threshold (V_TPS_X)	Threshold in 100ms	V, ms	Intake air temperature (TIA)	> -30	°C	0.5 second, 0.005 second	
		Bottom mechanical limit	Throttle value in windown within time threshold (V_TPS_X)	0-0.7186 or 4.2816-5 in 200	V, ms				1.275 second, 0.005 second	
Pedal value sensor (PVS)	P2123 P2122	SCB SCG or OC	Voltage (PVS_1_BAS) Voltage (PVS_1_BAS)	> 4.9022 < 0.0489	V V	Supply voltage correct (LV_V_REF_PVS_1_ERR_DET)	0	N/A	0.15 second, 0.01 second	One drive cycle
	P2128 P2127	SCB SCG or OC	Voltage (PVS_2_BAS) Voltage (PVS_2_BAS)	>2.6002 < 0.0342	V V	Supply voltage correct (LV_V_REF_PVS_2_ERR_DET)	0	N/A		
	P2138	Plausability error	Difference between average of PVS 1 and PVS 2 (PV_AV_1 & PV_AV_2)	> 12.11-25.78	%	N/A	N/A	N/A	0.3 second, 0.01 second	
Camshaft position sensor	P0340 P0341	No signal No plausible signal	N/A Alignment to crankshaft position sensor	N/A Outside allowable window 31st...41st tooth	N/A N/A	N/A	N/A	N/A	10 engine revolutions, continuous	Two drive cycles
Crankshaft position sensor	P0335	No signal	Crankshaft teeth acquisition	No crankshaft tooth seen after 10 camshaft edges recorded - before synchronization			Before synchronization		20 engine revolutions, N/A	Two drive cycles
	P0336	No plausible signal		Teeth number error > 2			After synchronization		12 engine revolutions, N/A	
Vehicle speed signal diagnosis	P0500	Left and right front speed sensor failure	No signal from both left and right front speed sensors (CAN_VRD_LV_ASC and CAN_VRD_RV_ASC)	Diagnosis performed by ABS ECU	N/A	N/A	N/A	N/A	2 seconds, 0.01 second	Two drive cycles

Fig. 10: OBDII Code Table - (6 Of 13)
Courtesy of BMW OF NORTH AMERICA, INC.

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Criteria and Signal	Threshold Value	Specified Units	Secondary Parameters	Enable Value	Specified Units	Monitor Time Length Frequency of Checks	MIL Illumination
Air intake temperature sensor diagnosis	P0113 P0112	SCB or OC SCG	Voltage (TIA_BAS) Voltage (TIA_BAS)	> 4.89 < 0.07	V V	N/A	N/A	N/A	2.5 seconds, 0.1 second	Two drive cycles
	P0114	Intermittent failure	Gradient between filtered and current intake air sensor values exceeds	> 9.75	°C	Engine running (LV_ES) Engine not starting (LV_ST)	0 0	N/A N/A	4 seconds, 1 second	Two drive cycles
Coolant temperature sensor diagnosis	P0118 P0117	SCB or OC SCG	Voltage (TCO_BAS) Voltage (TCO_BAS)	> 4.98 < 0.07	V V	N/A	N/A	N/A	2.5 seconds, 0.1 second	Two drive cycles
	P0119	Intermittent failure	Gradient between filtered and current coolant sensor values exceeds	> 9.75	°C	Engine running (LV_ES) Engine not starting (LV_ST)	0 0	N/A N/A	4 seconds, 1 second	Two drive cycles
Coolant temperature plausibility	P0125	Rationality check, TCO model = f(intake air temperature; mass air flow)	Coolant temperature does not reach closed loop enable threshold (TCO)	< threshold – difference to model temp (approx. 150 secs for fault detection at -7°C and 75 secs for fault detection at 10°C dependent on driving style)	°C, s	Substitute coolant temperature (TCO_SUB) Minimum time after start (T_TCO_MIN) Engine running (LV_ES) Percentage of time in Fuel Cut (PUC_PERC_TCO_PLAUS_DIAG) Percentage of time in idle (IS_PERC_TCO_PLAUS_DIAG) Percentage of time in low load (LOAD_MIN_PERC_TH_DIAG) TIA deviation since start (TIA_DE_TH_DIAG)	> 5.25...20.25 > 30...320 0 < 100 < 100 < 100 < 142.5	°C s N/A % % % °C	75-150s, 0.5 second	Two drive cycles
Injection valve diagnosis	P0262 P0265 P0268 P0271 P0261 P0264 P0267 P0270 P0201 P0202 P0203 P0204	SCB SCG OC	Performed by HW	N/A	N/A	N/A	N/A	N/A	N/A, continuous	Two drive cycles

Fig. 11: OBDII Code Table - (7 Of 13)
Courtesy of BMW OF NORTH AMERICA, INC.

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Criteria and Signal	Threshold Value	Specified Units	Secondary Parameters	Enable Value	Specified Units	Monitor Time Length Frequency of Checks	MIL Illumination
Knock sensor diagnosis	P0326	Relative threshold	Difference between raw and filtered knock sensor signal (Delta KNKS_BAS & KNKS_BAS_MMV)	< 0.0460 - 0.0698	V	Coolant temperature Engine load Engine speed	> 50.25 > 0.36 > 2016	°C g/rev rpm	5 seconds, continuous	Two drive cycles
Knock sensor circuit error	P0324	No reliable SPI communication	Performed by HW	N/A	N/A	Engine running (LV_ES)	0	N/A	5 seconds, continuous	Two drive cycles
ECU selftest	P0604 P1600 P0603	Internal RAM error External RAM error NVMY write error	Performed by hardware	N/A	N/A	N/A	N/A	N/A	N/A, every ECU reset	Two drive cycles
	P0601	CHKSUM error	Performed by hardware	N/A	N/A	N/A	N/A	N/A		
Ignition diagnosis	P2301 P2304	SCB	Performed by basic software (LV_SCP_IGCx or LV_INH_IGCx)	True	N/A	N/A	N/A	N/A	N/A, continuous	Two drive cycles
	P2300 P2303	SCG / OC	Performed by basic software (LV_SCG_IGCx or LV_OC_IGCx)							
Manifold pressure sensor diagnosis	P0108	SCB	RMS of Manifold Pressure Sensor Signal (MAP_SEG)	> 51870	N/A	Engine stopped (LV_ES) Engine running (LV_ES)	1 0	N/A N/A	5 segments, continuous	Two drive cycles
	P0107	SCG or OC	RMS of Manifold Pressure Sensor Signal (MAP_SEG)	< 64	N/A	Throttle/MAF gradient (TPS_MAF_GRD) Key on (LV_KEY_ON)	<2.5°TPS in 15revs True	°TPS, rev N/A		
	P1106	Plausability diagnosis	MAP too low, engine stopped (MAP)	< 60	kPa	Engine stopped (LV_ES) Manifold pressure (MAP) First valid tooth not recognized (LV_FIRST_VLD_TOOTH)	1 <105.0016 0	N/A kPa N/A	8 segments, continuous	

<u>Fig. 12: OBDII Code Table - (8 Of 13)</u>
Courtesy of BMW OF NORTH AMERICA, INC.

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Criteria and Signal	Threshold Value	Specified Units	Secondary Parameters	Enable Value	Specified Units	Monitor Time Length Frequency of Checks	MIL Illumination
	P1107	Plausability diagnosis	MAP too low at idle, engine running (MAP)	< 12	kPa	Engine running (LV_ES) MAP gradient (MAP_SEG_GRD_ERR) Throttle/MAF gradient (TPS_MAF_GRD) Engine speed (N_32) Manifold pressure (MAP) No torque request (LV_CT) Engine idling (LV_IS)	0 10000 in 30revs <2.5°TPS in 15revs < 1504 <105.0016 1 1	N/A N/A, rev °TPS, rev rpm kPa N/A N/A		
	P1108	Plausability diagnosis	MAP too low at full load for low engine speed (MAP)	< 60	kPa	Engine running (LV_ES) MAP gradient (MAP_SEG_GRD_ERR) Throttle/MAF gradient (TPS_MAF_GRD) Engine speed (N_32) Throttle position (TPS) Manifold pressure (MAP) No torque request (LV_CT)	0 10000 in 30revs <2.5°TPS in 15revs < 4000 >80.14 <105.0016 0	N/A N/A, rev °TPS, rev rpm °TPS kPa N/A		
	P1109	Plausability diagnosis	MAP too high in deceleration (MAP)	> 60	kPa	Engine running (LV_ES) MAP gradient (MAP_SEG_GRD_ERR) Throttle/MAF gradient (TPS_MAF_GRD) Engine speed (N_32) Manifold pressure (MAP) No torque request (LV_CT)	0 10000 in 30revs <2.5°TPS in 15revs > 1696 >15.0002 1	N/A N/A, rev °TPS, rev rpm kPa N/A		
Sensors 5V supplies diagnosis	P0643 P0642 P1572 P0653 P0652 P1575	SCB SCG / OC Noisy signal SCB SCG / OC Noisy signal	Voltage (VCC_x) Voltage (VCC_x) Delta voltage & average voltage (VCC_X_DIF) Voltage (VCC_x) Voltage (VCC_x) Delta voltage & average voltage (VCC_X_DIF)	> 5.8160 < 4.2522 > 0.7038 > 5.8160 < 4.2522 > 0.7038	V	N/A	N/A	N/A	0.04 second, continuous	One drive cycle
Motorized throttle(MTC)	P0638	Throttle malfunction	Delta setpoint and actual value (TPS_DIF)	> 5% for 0.38s	%, s	Key on (LV_KEY_ON) Engine running (LV_ES)	1 0	N/A N/A	0.38 second, continuous	One drive cycle
MTC H bridge diagnosis	P1617	Electronic Throttle Control driver failure	Performed by the component driver	N/A	N/A	N/A	N/A	N/A	0.15 second, 0.005 second	One drive cycle

<u>Fig. 13: OBDII Code Table - (9 Of 13)</u>
Courtesy of BMW OF NORTH AMERICA, INC.

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Criteria and Signal	Threshold Value	Specified Units	Secondary Parameters	Enable Value	Specified Units	Monitor Time Length Frequency of Checks	MIL Illumination
CAN bus diagnosis	P1613	ASC module error	Performed by SW	N/A	N/A	Battery voltage (VB)	> 8	V	0.001 second, 0.000025	Two drive cycles
	P1612	INSTR module error	Performed by SW	N/A	N/A				0.23 second, 0.0046 second	
	P1611	Transmission control module error	Performed by SW	N/A	N/A				0.02 second, 0.0008 second	
	P1607	CAN bus error	Performed by SW	N/A	N/A				0.050 second continuous	
SPI-bus diagnosis	P1615	SPI-bus failure	Performed by SW	N/A	N/A	N/A	N/A	N/A	0.3 second, 0.1 second	Two drive cycles
Safety level 2 & 3	P1679	Monitoring of torque losses	Torque loss calculation error (TQ_LOSS_MON)	Limit exceeded in threshold map (-78....-138)	Nm	Torque monitoring active (LV_TQI_MON_ACT_MON)	1	N/A	0.36 second, 0.04 second	One drive cycle
	P1680	Monitoring of A to D conversion	PVS ratio difference exceeds threshold (V_PVS_2_MC - V_PVS_2_MU)	> 0.273	V	Engine running (LV_ES)	1	N/A	0.48 second, 0.04 second	One drive cycle
	P1681	Monitoring of engine speed	Engine speed difference exceeds threshold (N_32 - N_32_SUB_MON)	576	rpm	Engine running (LV_ES)	1	N/A	0.48 second, 0.04 second	One drive cycle
	P1682	Monitoring of proportional derivative (PD) part of idle speed controller	Error in torque demand from PD-part (TQ_DIF_P_D_IS_DIF_MON)	Maximum PD-part limit exceeded (40....52)	Nm	Torque monitoring active (LV_TQI_MON_ACT_MON)	1	N/A	0.48 second, 0.04 second	One drive cycle

<u>Fig. 14: OBDII Code Table - (10 Of 13)</u>
Courtesy of BMW OF NORTH AMERICA, INC.

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Criteria and Signal	Threshold Value	Specified Units	Secondary Parameters	Enable Value	Specified Units	Monitor Time Length Frequency of Checks	MIL Illumination
	P1683	Monitoring of integral (I) part of idle speed controller	Error in torque demand from I-part (TQ_DIF_I_IS_MON)	> 25	Nm	Idle speed controller not in ramp limit operation (LV_PAS_RAMP_ACT_IS)	==0	N/A	0.48 second, 0.04 second	One drive cycle
			Error in torque demand from I-part (TQ_DIF_I_IS_MON and N_DIF_SP_IS_MON)	> 15Nm (MT) > 20Nm (AT) and < 512rpm	Nm, rpm					
			Error in torque demand from I-part (TQ_DIF_I_IS_MON)	> 25	Nm	Idle speed controller in ramp limit operation (LV_PAS_RAMP_ACT_IS)	==1	N/A		
	P1684	Monitoring of minimum torque at clutch	Minimum torque at clutch calculation error (TQ_MIN_CLU_MON)	Limit exceeded in threshold map (38....510)	Nm	Torque monitoring active (LV_TQI_MON_ACT_MON)	1	N/A	0.24 second, 0.04 second	One drive cycle
	P1685	Monitoring of maximum torque at clutch	Maximum torque at clutch calculation error (TQ_MAX_CLU_MON)	Limit exceeded in threshold map (220....250)	Nm	Torque monitoring active (LV_TQI_MON_ACT_MON)	1	N/A	0.24 second, 0.04 second	One drive cycle
	P1686	Monitoring of pedal values	Error in pedal value checks, difference exceeds threshold (PV_AV_1_MON - PV_AV_2_MON)	Limit exceeded in threshold map (15.23....28.91)	%	Monitor engine speed (N_32_MON)	>= 0	rpm	0.48 second, 0.04 second	One drive cycle
	P1687	Monitoring of throttle position	Error in TPS ratio calculation (V_TPS_1_MON - V_TPS_2_MON)	> 0.313	V	Monitor engine speed (N_32_MON)	> 0	rpm	0.48 second, 0.04 second	One drive cycle
	P1688	Monitoring of mass air flow	MAF calculation error, low MAF limit exceeds threshold (MAF_MON)	Low MAF limit exceeded in threshold map (0.044....0.216)	g/rev	Monitor engine speed (N_32_MON)	> 800	rpm	0.48 second, 0.04 second	One drive cycle
	P1689	Monitoring of actual indicated engine torque	Error in torque calculation, torque difference exceeds threshold (TQI_AV_MON - TQI_SP_MON)	Torque limit exceeded in threshold map (30....88)	Nm	Torque monitoring active (LV_TQI_MON_ACT_MON)	1	N/A	0.48 second, 0.04 second	One drive cycle
	P1691	Monitoring of engine speed limit in limphome	Monitored engine speed exceeds threshold (N_32_MON)	> 2656	rpm	Engine running (LV_ES)	1	N/A	0.48 second, 0.04 second	One drive cycle

Fig. 15: OBDII Code Table - (11 Of 13)
Courtesy of BMW OF NORTH AMERICA, INC.

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Criteria and Signal	Threshold Value	Specified Units	Secondary Parameters	Enable Value	Specified Units	Monitor Time Length Frequency of Checks	MIL Illumination
	P1692	Monitoring of processor calculations	Error for final request for disabled power stages of MTC and IV (RST_CTR_MU and ERR_CODE_MU_MU) (RST_CTR_MU_MU and ERR_COD_1_MC_MU)	RST_CTR_MU>7 and ERR_CODE_MU_MU<>0 RST_CTR_MU_MU>7 and ERR_CODE_1_MC_MU<>0	N/A N/A	Key on (LV_KEY_ON)	1	N/A	0.48 second, continuous	One drive cycle
	P1693	Monitoring of processor calculations	Error for temporary request for disabled power stages for MTC and IV (RST_CTR_MU and ERR_CODE_MU_MU) (RST_CTR_MU_MU and ERR_COD_1_MC_MU)	RST_CTR_MU>1 and ERR_CODE_MU_MU<>0 RST_CTR_MU_MU>1 and ERR_CODE_1_MC_MU<>0	N/A N/A	Key on (LV_KEY_ON)	1	N/A	0.48 second, continuous	One drive cycle
Clutch Solenoid	P1741 P1742 P1739	Open circuit Short circuit Communication Error	Performed by GIB (gearbox interface box = dedicated low level control transmission control unit)	N/A	N/A	Battery voltage (VB) CAN bus operational (CAN_CLU_CDN_COD)	>8 1	V N/A	0.200 second, 0.020second	One drive cycle
Secondary Pressure Solenoid	P1751 P1752 P1749	Open circuit Short circuit Communication Error	Performed by GIB	N/A	N/A	Battery voltage (VB) CAN bus operational (CAN_CLU_CDN_COD)	>8 1	V N/A	0.200 second, 0.020second	One drive cycle
Linear Actuator	P1787 P1788 P1789 P1785	Bipolar Stepper Motor, OC Bipolar Stepper Motor, SCG Bipolar stepper motor, motor defaulted Bipolar stepper motor, drive over temperature	Performed by GIB	N/A	N/A	Battery voltage (VB) CAN Bus Operational (CAN_CLU_CDN_COD)	> 8 1	V N/A	25 seconds, 0.010 second	One drive cycle
Switch Inputs	P0705	Communication Error	Performed by GIB	N/A	N/A	Battery voltage (VB) CAN bus operational (CAN_CLU_CDN_COD)	>8 1	V N/A	2 seconds, 0.010 second	One drive cycle
Gearbox Interface Box	P1699 P1698	EPROM Checksum ECU Functionality	Checksum incorrect, performed by GIB Internal Failure, performed by GIB	N/A N/A	N/A N/A	Relay battery voltage CAN bus operational (CAN_CLU_CDN_COD)	>6.04 1	V N/A	Immediate, once at power up	One drive cycle

Fig. 16: OBDII Code Table - (12 Of 13)
Courtesy of BMW OF NORTH AMERICA, INC.

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Criteria and Signal	Threshold Value	Specified Units	Secondary Parameters	Enable Value	Specified Units	Monitor Time Length Frequency of Checks	MIL Illumination
Ratio Control	P1786	Ratio Plausibility	Integrated engine speed error (actual desired) exceeds threshold (MOT_DIAG_CUMUL_ERR)	> 110000	N/A	Battery voltage (VB) CAN bus operational (CAN_CLU_CDN_COD) Vehicle Speed (VS_CVT) Engine speed (N)	> 8 1 >18.64 >2000	V N/A mph rpm	7 seconds, 0.1 second	One drive cycle
Air intake system leak - Block 3	P1498	Comparison of modelled mass air flow at cylinder and mass air flow at throttle	Modelled MAF difference adaption exceeds threshold relative to throttle opening (DIF_AR_RED/AR_RED_TPS)	> 1.3 ...13.5	N/A	Engine running (LV_SYN_ENG) Engine speed stable (ABS N-N_AR_RED_MMV) High pass filtered manifold pressure (MAP_SEG_GRD_ERR) High pass filtered upstream manifold pressure (MAP_UP_SEG_GRD_ERR) Throttle stable (TPS_MAF_GRD) Throttle position (TPS) Manifold pressure (MAP) Engine speed (N_32)	1 < 50 <10000 in 10revs <10000 in 0rev <0.9008*TPS in 10revs <89.98 >15.0000 > 704	N/A rpm N/A, rev N/A, rev *TPS, rev % kPa rpm	0.24 second, 0.000 second	One drive cycle
Ambient temperature sensor	P0070	Ambient Temperature sensor failure	Electrical Check	Diagnosis performed by Instrument Pack ECU	N/A	N/A	N/A	N/A	2 seconds, 0.01 second	Two drive cycles
Ambient temperature sensor and Intake Air Temperature sensor plausibility	P101F	Difference between Ambient Temperature (TAM) Sensor and Intake Air Temperature (TIA) Sensor values after cold start	Difference between TAM and TIA	>20.25	°C	TIA deviation during period after start / Cold start check / Diff TCO at key-off and key-on / Diff TCO and TIA at key-on or / Diff TCO and TAM at key-on	>3 5 >50.25 >3 >3	°C s °C °C °C	tbd	Two drive cycles
		Difference between Ambient Temperature (TAM) and modelled Ambient Temperature when engine hot	Difference between TAM and TAM_MDL	>5	°C	engine warmed-up (T_PLAUS_TAM_HOT) / vehicle conditions stable (load,engine speed,vehicle speed) (T_TAM_STAB) / modelled ambient temperature function of intake air temperature, airflow,vehicle speed (T_TAM_MDL_STAB)	0 0 0	s s s	0.1 seconds	Two drive cycles

Fig. 17: OBDII Code Table - (13 Of 13)
Courtesy of BMW OF NORTH AMERICA, INC.

OBD SYSTEM DESCRIPTION

CATALYST MONITORING

General Description

The solution chosen to fulfill this OBD requirement is based on Oxygen Storage Capacity (OSC).

During a controlled stimuli (special A/F pulses during engine steady state conditions), the downstream O2 sensor signal is analyzed to evaluate the OSC of the catalyst.

The OSC is correlated experimentally with the global HC efficiency and HC emission during cycle. It represents the quantity of oxygen that is really used for the oxidation-reduction reaction by the catalytic converter (stored during the lean excursion and consumed during the rich excursion).

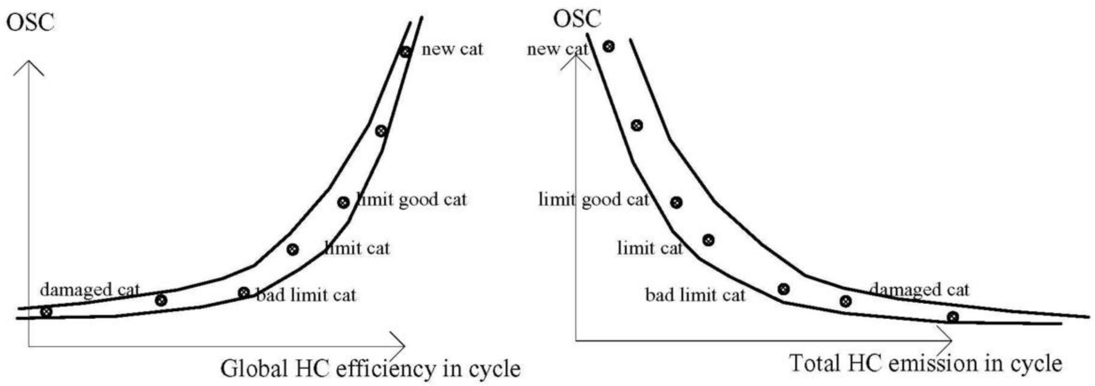


Fig. 18: HC Efficiency And HC Emission Cycle
Courtesy of BMW OF NORTH AMERICA, INC.

Description Of The Open Loop Diagnosis

Catalyst monitoring is a sequential diagnosis made during steady state conditions. This monitoring is intrusive.

Three phases are necessary to complete the diagnosis:

- Engine stabilization
- Controlled stimuli - stabilization
- Controlled stimuli - diagnosis

If a problem has occurred with the downstream sensor during the catalyst diagnosis, a sensor diagnosis is done.

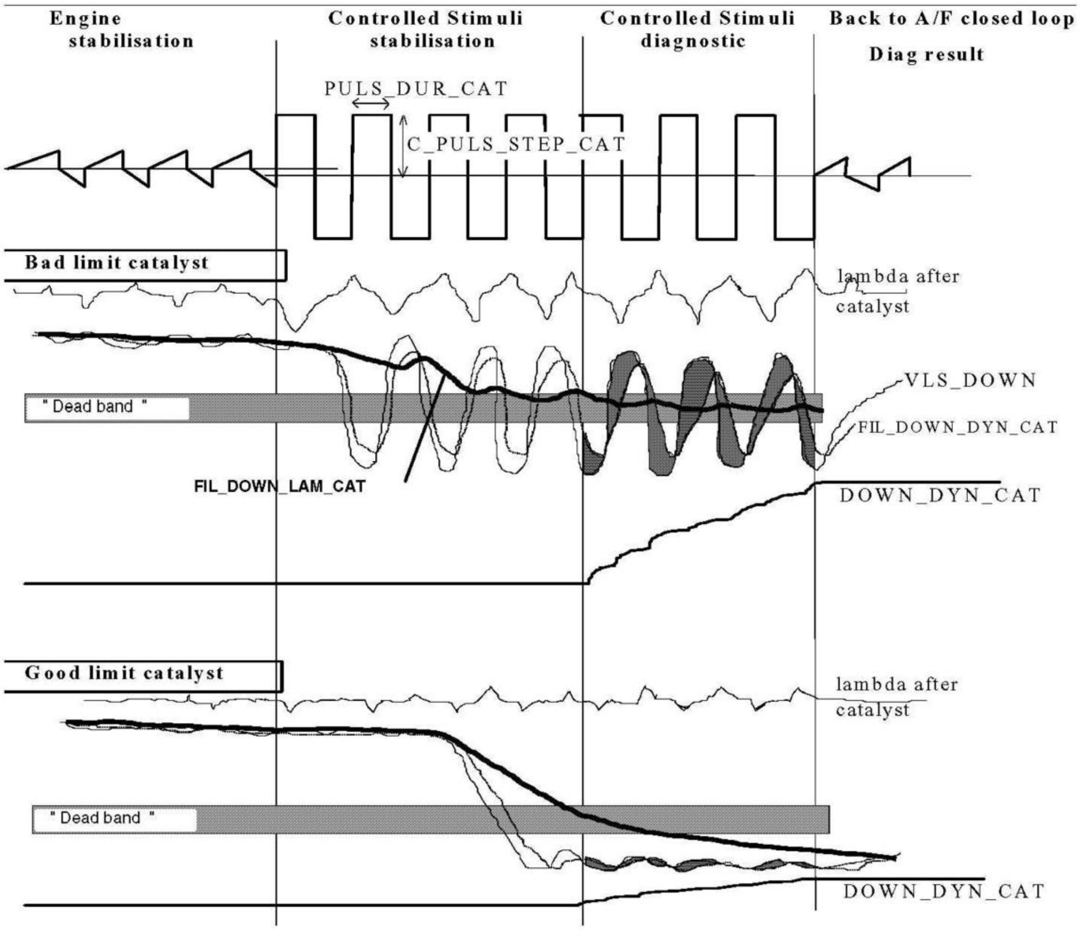


Fig. 19: Catalyst Monitoring And Phases Diagnosis Characteristic Diagram
Courtesy of BMW OF NORTH AMERICA, INC.

VLS_DOWN: Downstream O2 sensor signal

FIL_DOWN_LAM_CAT: filtered signal for DOWN_DYN_CAT (= detection criteria) integration

FIL_DOWN_DYN_CAT: high filtered DW signal for mean richness

During the 'Controlled stimuli - diagnosis phase' the downstream sensor activity is measured and corresponds to the OSC of the catalyst. If this activity is high (low OSC) the diagnosis criteria DOWN_DYN_CAT is high.

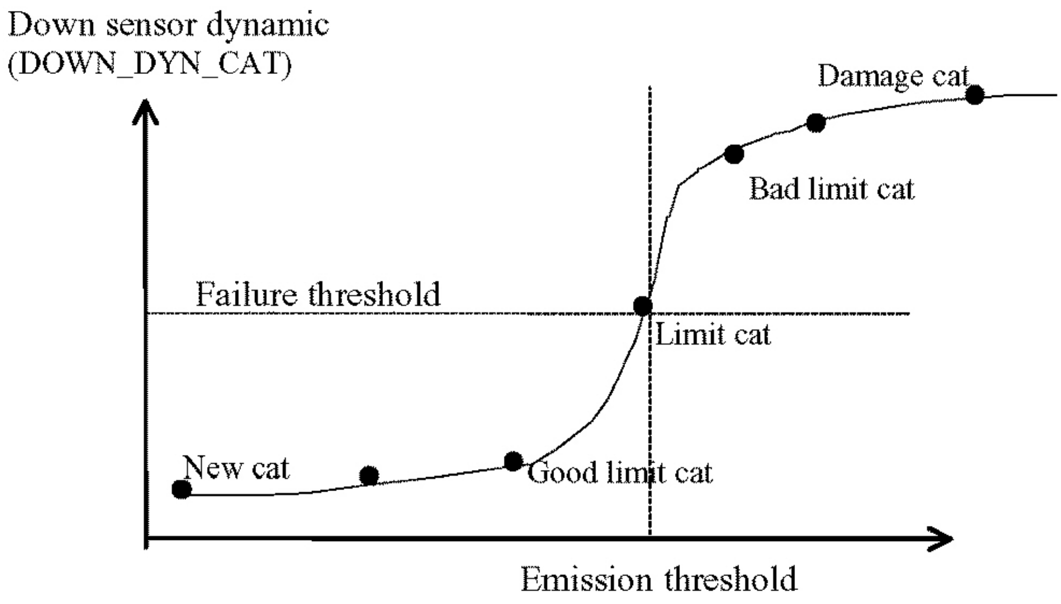


Fig. 20: Downstream O2 Sensor Signal - Graph
Courtesy of BMW OF NORTH AMERICA, INC.

If one of the monitoring conditions is not met or if the mass air flow deviates too much from the value stored at the start of this test phase, the test is interrupted and the system returns to the out of diagnosis state.

Downstream sensor diagnosis phase:

If throughout the CONTROLLED STIMULI phase, repeated several times, the downstream sensor has not reacted, the A/F closed loop mode is delayed in order to test the sensor.

If the downstream sensor sends a signal indicating a rich (lean) mixture, the injection time is forced to lean (rich) until the sensor switches over or until the end of a delay. If this delay expires, the sensor is treated as failed. This may be a result of:

- A leak in the exhaust line,
- A damaged sensor.

Electrical failures (short circuit and open circuit of signal and heater) are detected during the COMPREHENSIVE COMPONENTS diagnostics.

If the catalyst diagnosis has completed without any problem, the downstream sensor is treated as GOOD and a sensor diagnosis is not necessary.

If monitoring conditions for the diagnosis are fulfilled, the system informs the OBD sequencer and waits for its authorization to start catalyst diagnosis. The OBD sequencer manages the priorities in case of multiple diagnosis requests (catalyst diagnosis and O2 sensor diagnosis).

MISFIRE MONITORING

General description

Measurement Principle

Segment period acquisition

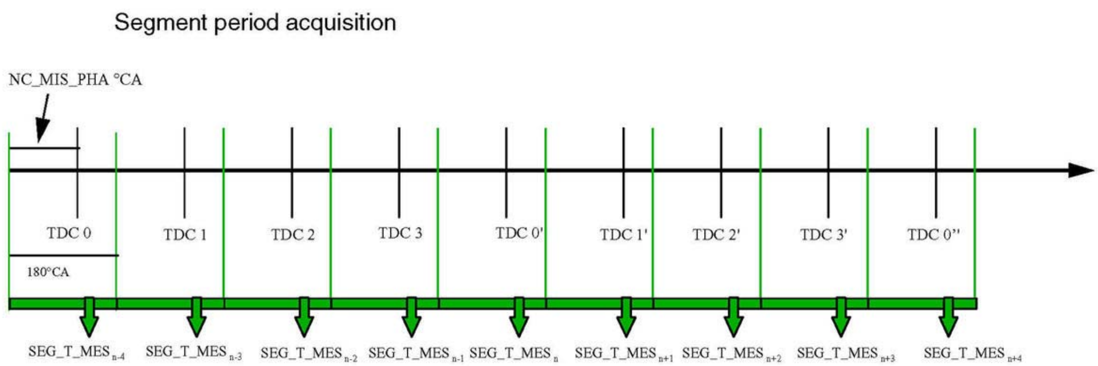


Fig. 21: Segment Period Acquisition
Courtesy of BMW OF NORTH AMERICA, INC.

The acquisition of the segment period is performed through an angular range of 180° crank angle.

NC_CYL_NR is the number of cylinder.

The segment starts NC_MIS_PHA°CA before TDC.

To compute an engine roughness value for a 4 cylinder engine, n = 9 contiguous valid segments are required.

Physical background

Misfire induces a decrease of the engine speed and thus a variation in the segment period. The misfire detection is based on monitoring for this variation of segment period.

Main causes of misfiring: injector shut-off, fuel pressure problems, fuel combustion problems, ignition cut-off.

Limitations Of This Strategy

Variation in the engine torque caused by phenomenon other than misfiring must be recognized in order to avoid false misfire detection and inhibit misfiring monitoring.

For example:

- negative torque
- trailing throttle / acceleration transition
- ignition retardation without change limitation
- rough road detection
- cylinder shut-off (ex: for engine speed limitation, vehicle speed limitation)
- crankshaft oscillation

Algorithm

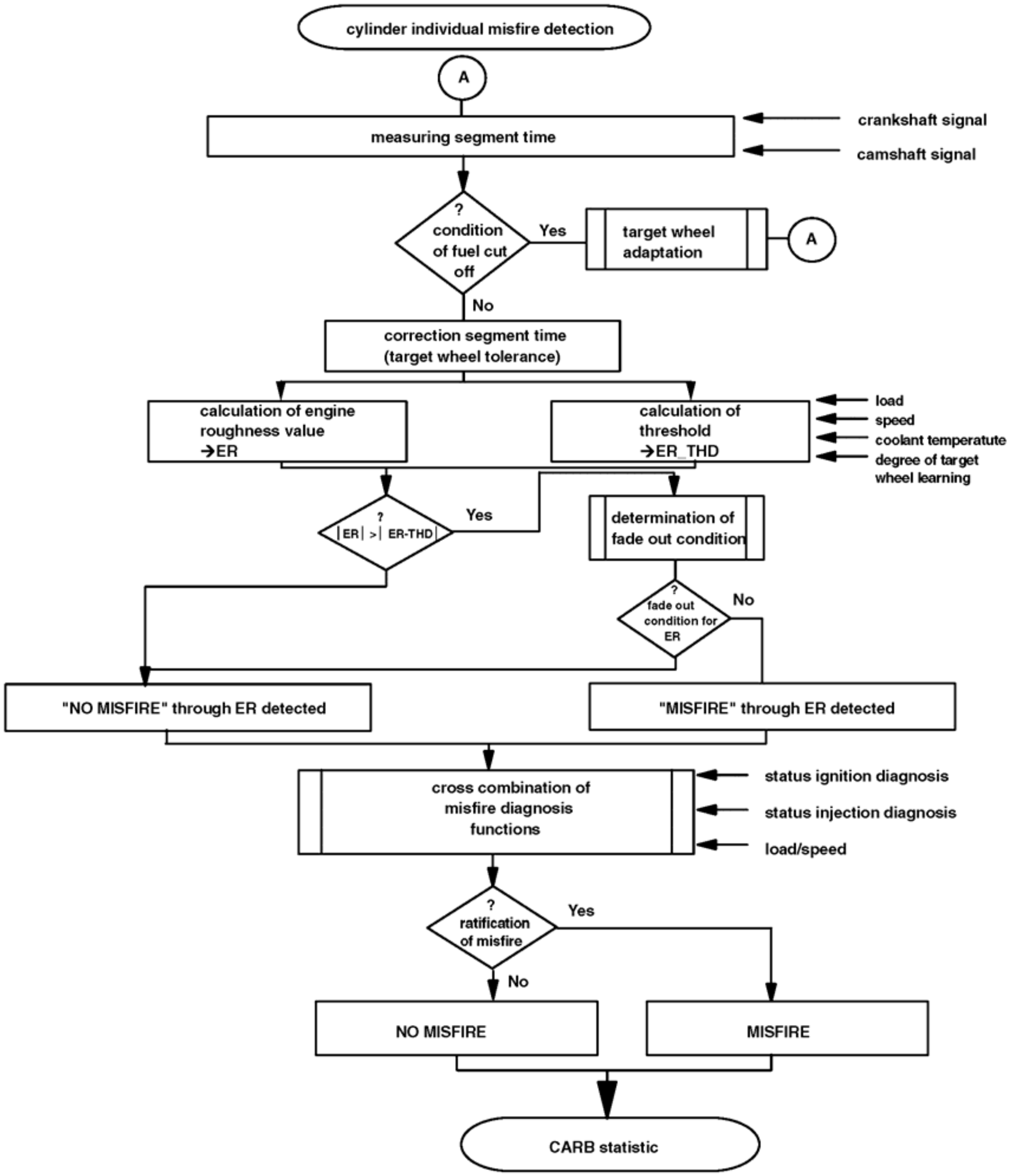


Fig. 22: Flow Chart - Algorithm
Courtesy of BMW OF NORTH AMERICA, INC.

Statistics: Fault Processing

For one driving cycle.

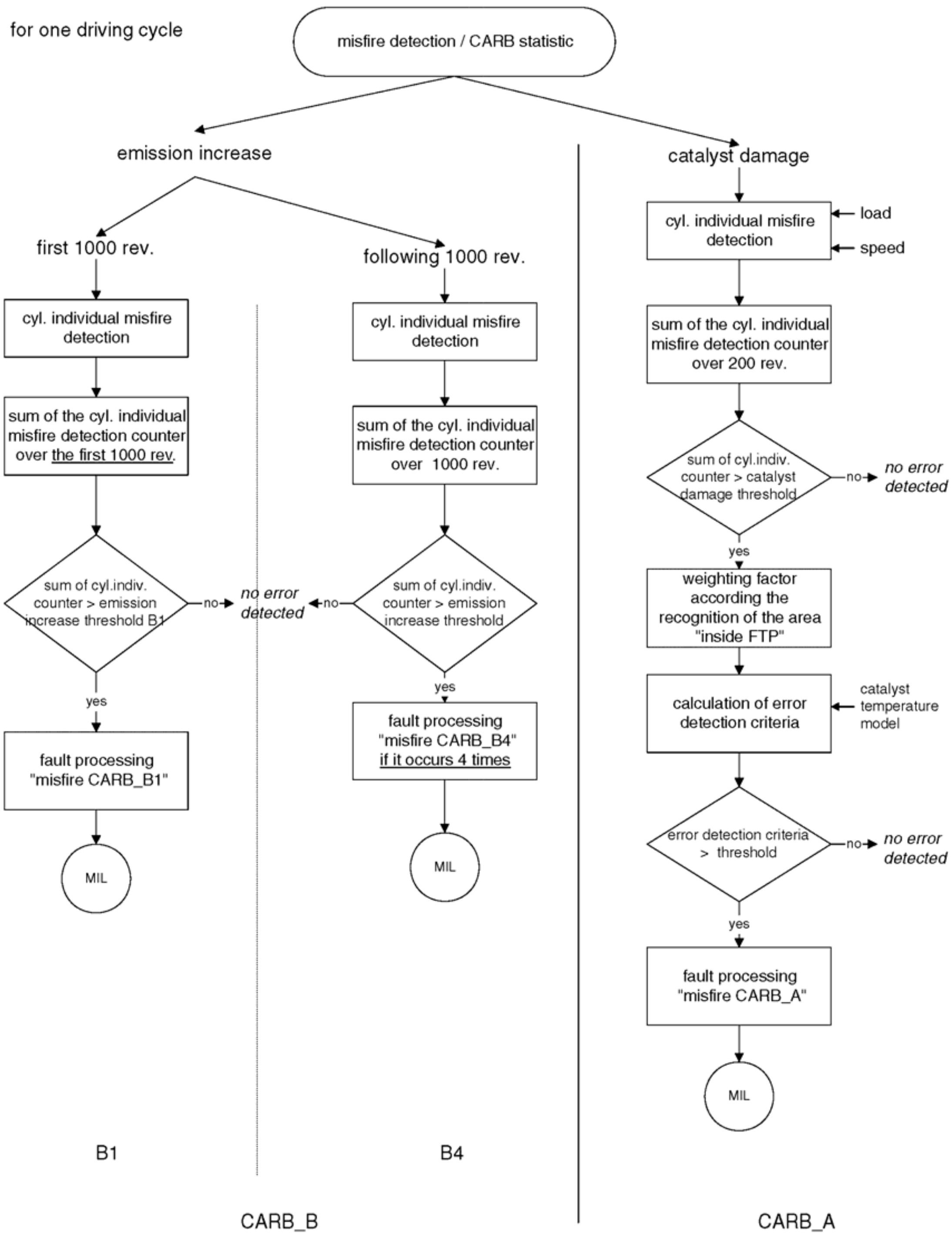


Fig. 23: Flow Chart - Fault Processing
Courtesy of BMW OF NORTH AMERICA, INC.

EVAPORATIVE SYSTEM MONITORING

General Description

The evaporative system monitoring uses a Leak Detection Pump (LDP). The LDP is an electrically/vacuum-actuated device that pressurizes the evaporative emission system for the purpose of detecting leaks and verifying canister purge valve operation.

Leak Detection

The leak detection is performed by means of two main phases:

- Tank system over-pressurizing
- Leak magnitude measurement

During the leak detection, the canister purge valve and the canister vent valve (CVV) are closed.

The ECU (Engine Control Module) causes the pump diaphragm to cycle at fixed frequency and for a fixed number of strokes. As air is drawn from outside and pumped into the fuel tank system, the system pressure increases.

Once the tank system over-pressure phase is finished the leak measurement phase starts. The diaphragm stroke is limited by the top of the diaphragm chamber and a position defined by a reed switch level. If the tank pressure drops below a certain value, the LDP will perform a pump stroke in order to maintain the over-pressure in the tank system. Thus the time between pump strokes ("pulse interval") is an indication of the system tightness.

If there is a leak, the cycling time or "pulse interval" stabilizes at a rate, which compares to the leakage loss.

If there is no leak in the system the cycling time or "pulse interval" becomes longer.

The "pulse interval" is measured by the ECU, which determines whether or not the leak exceeds a defined threshold. Several "pulse interval" measurements are carried out to secure the test.

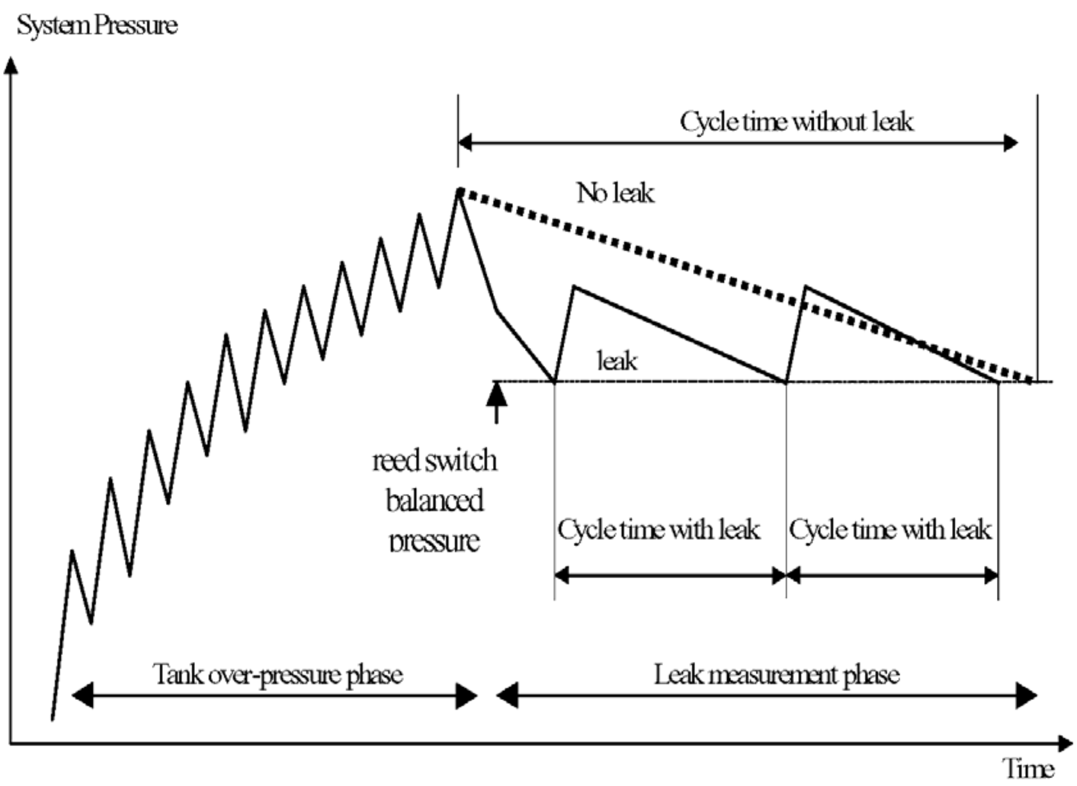


Fig. 24: Tank System Over-Pressure Phase And Leak Measurement Phase Diagram
Courtesy of BMW OF NORTH AMERICA, INC.

Canister Purge Valve Check

When the tank system is tight or the leak measured is smaller than a defined threshold the canister purge valve is checked using the same approach as for the leakage detection. The purge valve is opened and each time the reed switch level is reached the LDP performs a pump stroke in order to maintain the pressure in the tank system.

If the canister purge valve is not blocked the cycling time or "pulse interval" becomes shorter. In this case the purge valve operates correctly (not stuck or blocked).

If the canister purge valve is blocked in a closed position or the connection tube canister/valve is pinched the cycling time or "pulse interval" remains long.

The "pulse interval" is measured by the ECU, which determines whether or not the purge flow exceeds a defined threshold. Several pumping cycles are carried out to secure the test.

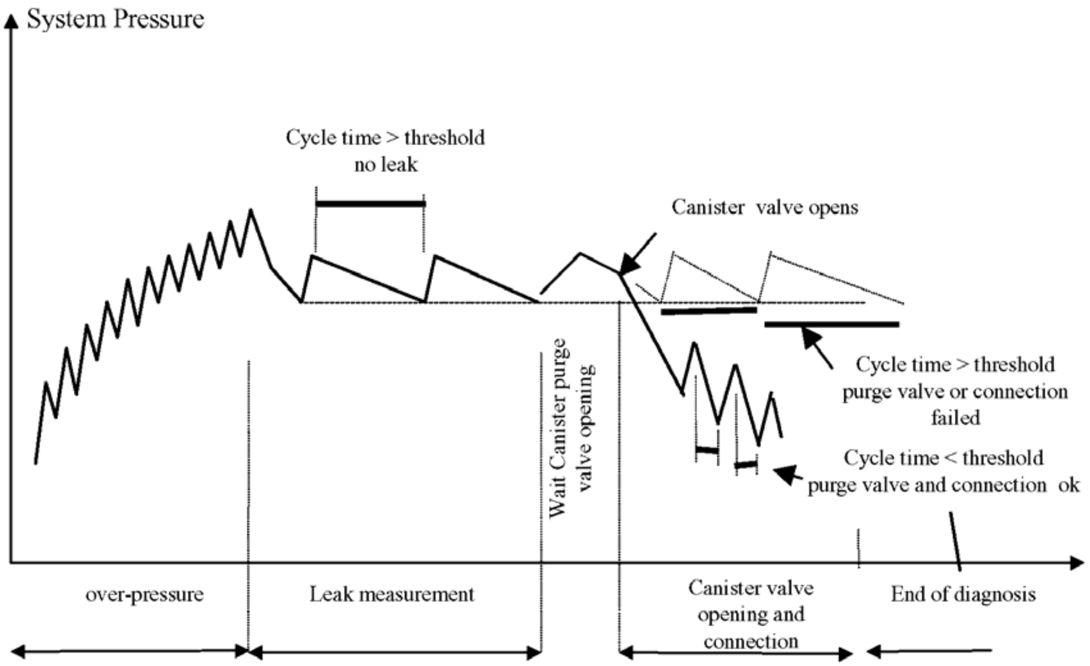


Fig. 25: Canister Purge Valve Pressure Diagram
Courtesy of BMW OF NORTH AMERICA, INC.

Evaporative Monitoring - Block Diagram

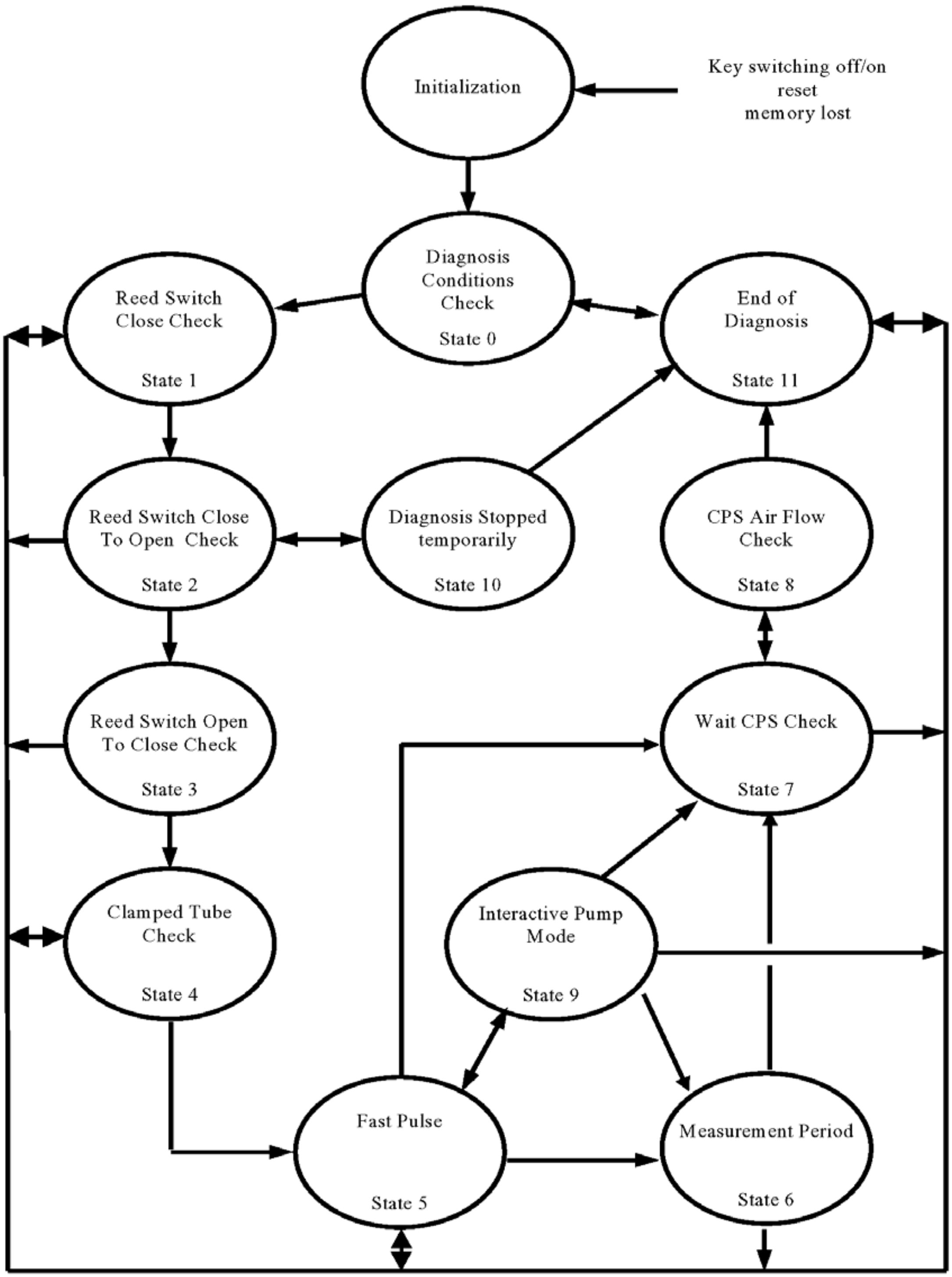


Fig. 26: Evaporative Monitoring - Block Diagram
Courtesy of BMW OF NORTH AMERICA, INC.

FUEL SYSTEM MONITORING

General Overview

The fuel system diagnosis monitors the fuel delivery system for its ability to provide compliance with emission standards.

This diagnosis is continuously performed if enable conditions are fulfilled.

The fuel system diagnosis checks if the sum of short-term fuel trim (only based on upstream sensor voltage monitoring) and long term fuel trim (one additive & one multiplicative term) are within a band.

Out of this band a failure is detected.

Different fuel system problems may occur:

- Fuel pressure problem: short term fuel trim deviation which induces emissions problem, but no effect on the catalyst window set point because of homogenous mixture, in steady engine conditions.
- Cylinder misdistribution problem due to injector failure: short-term fuel trim deviation with effect on the catalyst window set point because non-homogeneous mixture.

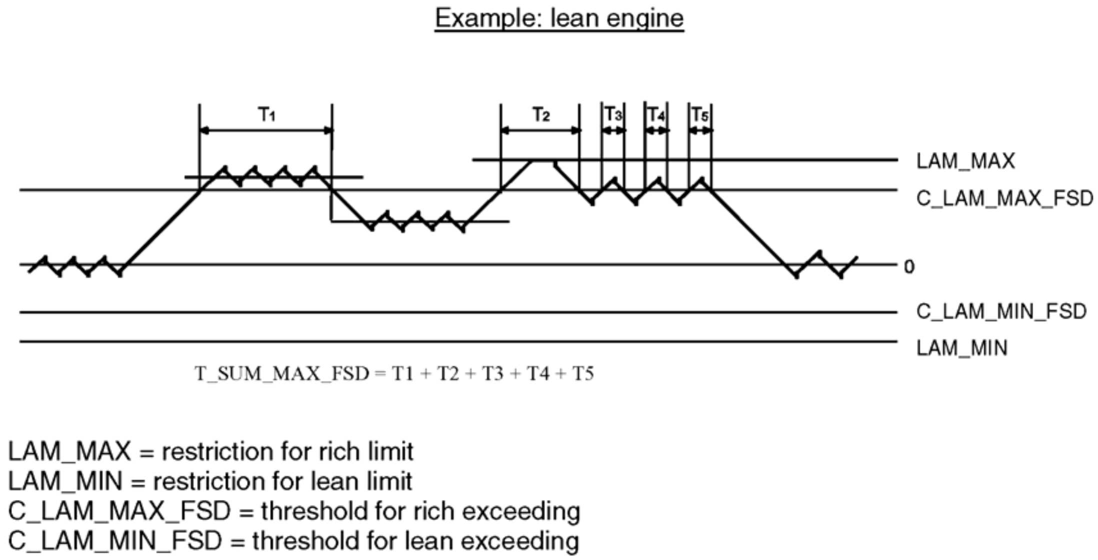


Fig. 27: Fuel System Monitoring Diagram
Courtesy of BMW OF NORTH AMERICA, INC.

OXYGEN SENSOR MONITORING

General Overview

The upstream sensor will cause an emission increase when its response time increases too much (A/F Loop period or frequency check).

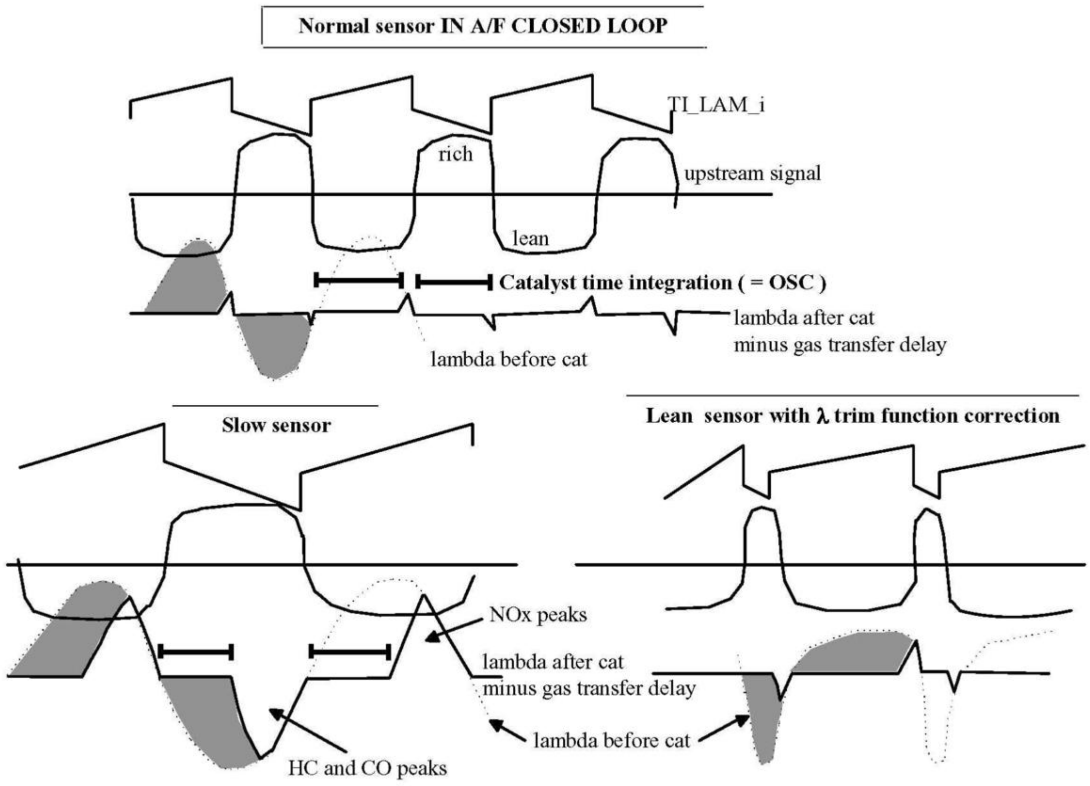


Fig. 28: Oxygen Sensor Monitoring Diagram
Courtesy of BMW OF NORTH AMERICA, INC.

The period of the A/F loop is measured and the number of lean/rich transitions are counted. The sum of valid periods is then calculated.

The corresponding limit period versus operating point (N, MAF) is acquired.

A failure is detected when the sum of the measured periods exceeds the sum of the corresponding limit.

Description Of The Strategy

O2 sensor monitoring is a sequential diagnosis made during steady state conditions.

The diagnosis is composed of two main phases:

Measurement

Diagnosis

Measurement Phase

The algorithm is based on the period measurement (starting from lean to rich sensor transition). To avoid nonrepresentative measurement, the period is valid only if the sensor has been below a low threshold and above a high threshold between 2 consecutive lean/rich transitions.

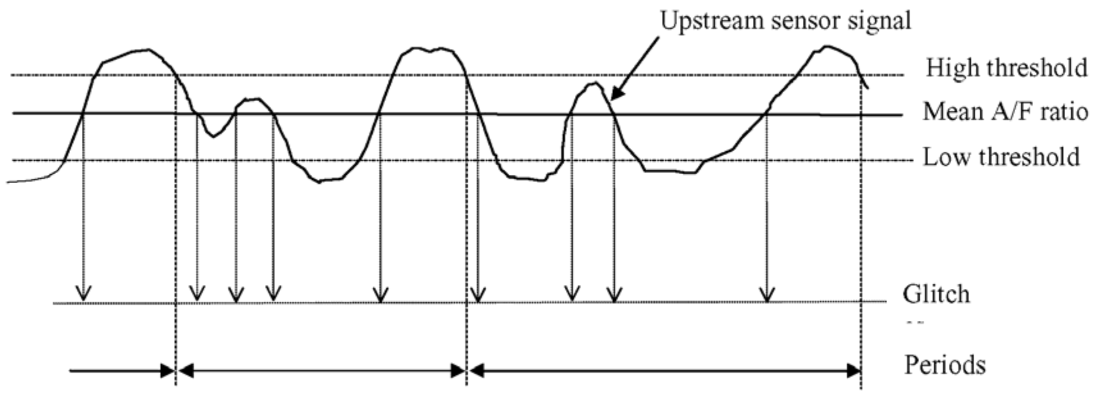


Fig. 29: Upstream Sensor Signal - Graph
Courtesy of BMW OF NORTH AMERICA, INC.

If one of the diagnostic conditions is not met, the test is stopped and the system returns to the OUT OF DIAGNOSIS state.

Diagnosis Phase

The sum of the periods is compared to limits values, to detect a failure.

As an example, the typical behavior of the period criterion versus NOx emissions are shown in the following chart).

Oxygen Sensor Monitoring Diagnosis

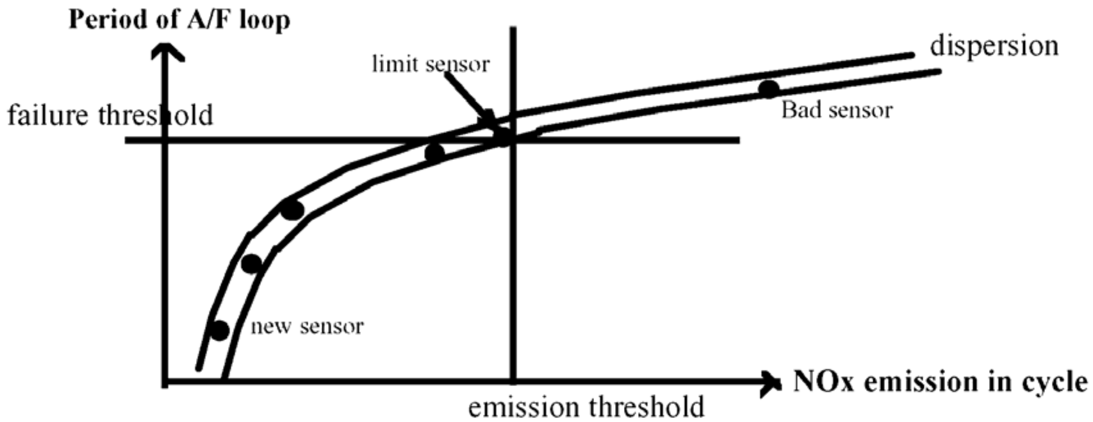


Fig. 30: Oxygen Sensor Monitoring Cycle

Courtesy of BMW OF NORTH AMERICA, INC.

If O2 sensor diagnosis conditions are fulfilled, the system informs the OBD sequencer and waits for its authorization to start the measurement phase. The OBD sequencer manages the priorities in case of multiple diagnosis requests (catalyst diagnosis and O2 sensor diagnosis).

THERMOSTAT MONITORING

General Description Of Thermostat Monitoring

The purpose of the coolant thermostat is to effect a quick engine warm up after start. The thermostat is closed after engine start to limit the coolant circulation to the radiator until the thermostat regulating temperature is reached. If the thermostat is stuck open, the coolant circulation will not be limited after start and the engine warm up time will increase. This may cause an increase in emissions.

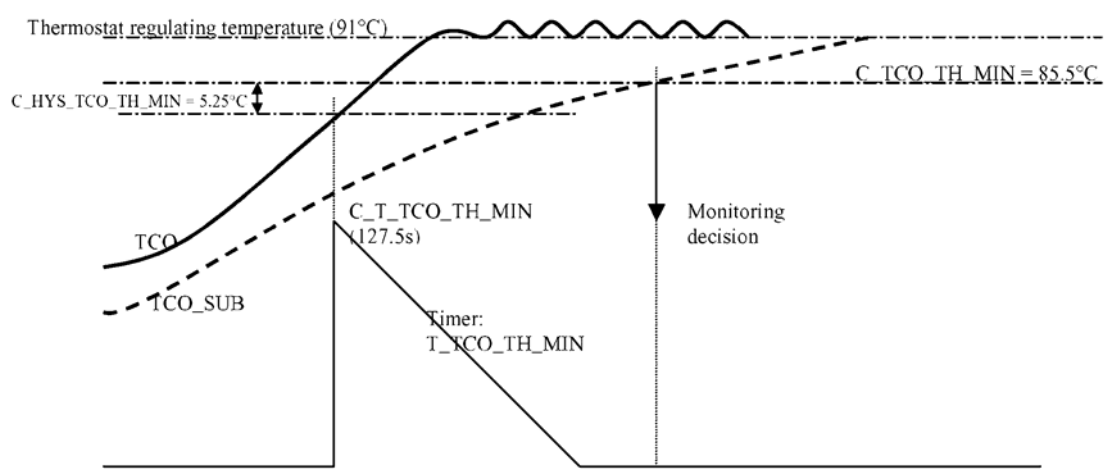
To monitor the thermostat function, a modelled value for coolant temperature is calculated. This monitoring is used for diagnosing a leaking thermostat or a thermostat stuck in the open position. When the temperature model has reached normal operating temperature the actual coolant temperature is checked to confirm that it has been above the normal thermostat opening temperature for sufficient time. If this is not the case the thermostat is declared stuck open.

Graphs showing the diagnostic operation with typical calibration values are given below.

TCO: coolant temperature (sensor)

TCO_SUB: modelled temperature

Normal Thermostat Operation



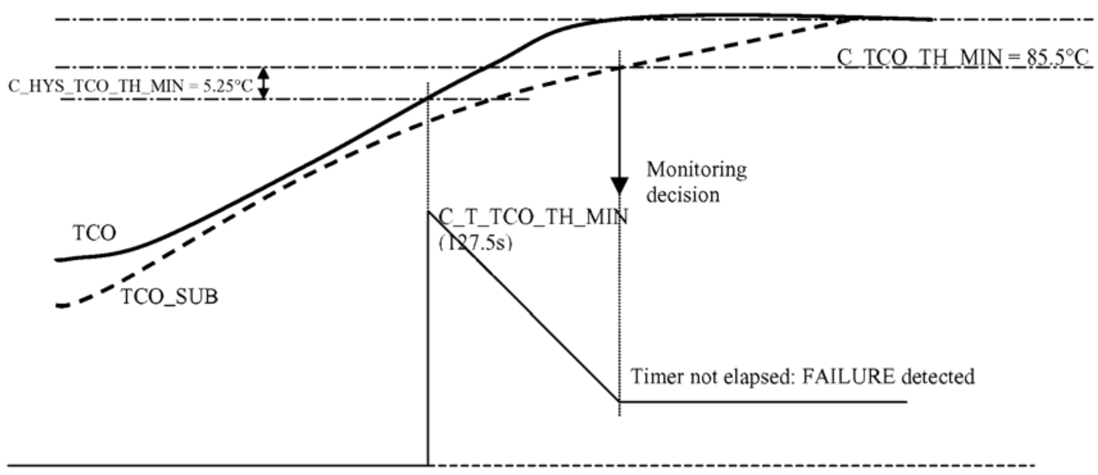
When TCO crosses 80.25°C (C_TCO_TH_MIN - C_HYS_TCO_TH_MIN), a timer is started and decremented as long as TCO>TCO_SUB.
When TCO_SUB crosses 85.5°C (C_TCO_TH_MIN) then decision is taken.

Fig. 31: Normal Thermostat Operation - Graph
Courtesy of BMW OF NORTH AMERICA, INC.

If timer is elapsed then thermostat is declared ok.

Thermostat Failure

Too Slow Coolant Temperature Increase



When TCO crosses 80.25°C (C_TCO_TH_MIN - C_HYS_TCO_TH_MIN), a timer is started and decremented as long as TCO>TCO_SUB.
When TCO_SUB crosses 85.5°C (C_TCO_TH_MIN) then decision is taken.

Fig. 32: Too Slow Coolant Temperature Increase - Graph
Courtesy of BMW OF NORTH AMERICA, INC.

In this case timer is not elapsed: failure is detected. The coolant temperature increase is too slow

Too Low Coolant Temperature

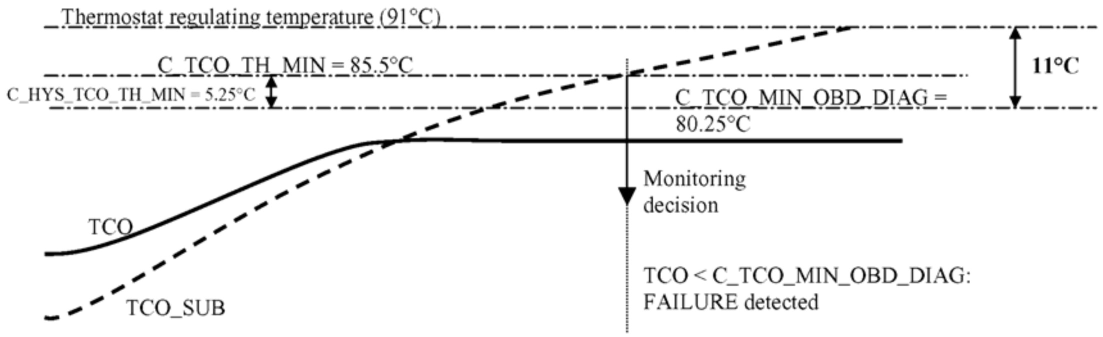


Fig. 33: Too Low Coolant Temperature - Graph
Courtesy of BMW OF NORTH AMERICA, INC.

When TCO_SUB crosses 85.5°C (C_TCO_TH_MIN) then decision is taken.

PLAUSIBILITY DIAGNOSIS

These diagnosis check that some data acquisitions from different sensors correspond to data acquisition from other sensors under given engine operating conditions.

Idle Speed Control Diagnosis

Engine speed deviation from the nominal engine speed set point is monitored when the vehicle is stopped.

If the engine is at idle for a given time and under normal conditions for engine load, coolant temperature, battery voltage and canister vent valve opening the difference between engine speed set point and actual value is too low or too high, then an error is detected.

Camshaft Sensor Diagnosis

The camshaft sensor signal presents one edge (rising or falling) per engine revolution. The position of these edges is known vs. crankshaft long tooth position.

A plausibility diagnosis is performed that compares camshaft (CAM) and crankshaft signals. The CAM edge must be in a defined window of crankshaft teeth in order to declare the CAM signal as valid.

If a CAM error is detected after the camshaft and crankshaft signals have synchronized the engine will remain in normal operation mode.

If insufficient time is available at engine crank to determine the camshaft and crankshaft synchronization before a Cam error is detected the correct firing cylinder bank cannot be determined. In this case:

The sequential fuel injection will run with a constant injection phase of -180° CRK, and the engine will run open loop. In this condition there is a 50% probability of the injection starting at the correct crankshaft position. This "Limp Home" condition minimizes the impact engine responsiveness due to excessive time periods between fuel injection and inlet valve opening.

Each ignition coil is fired every TDC.

Knock correction will take a constant default value.

Intake Manifold Pressure Sensor Diagnosis

Under certain conditions, the MAP (manifold pressure) sensor is checked for a coherent value vs. engine speed and throttle opening. These conditions are:

- MAP too low when engine stopped (in these conditions, MAP cannot be lower than the minimum ambient pressure).
- MAP too low at idle speed engine running (in these conditions, the engine cannot run with too low manifold pressure)
- MAP too low at full load for low engine speed (in these conditions, MAP cannot be lower than the minimum ambient pressure)
- MAP too high in deceleration (the engine management system calibration is tuned so that the MAP target value is 200 hPa during deceleration).

In case of error on MAP acquisition, the MAP information will be built up by using engine speed and throttle position information.

Motorized Throttle Controller (MTC) Diagnosis

In normal conditions, throttle set point and actual value must correspond within a tolerance determined given by controller performance under worst-case conditions (response time, overshoot...).

If an error is detected, then MTC H-bridge driver is switched off and engine speed is limited to a maximum of 2000 RPM.

Clutch Switch Diagnosis

When cruise control is active (clutch switch is only used for cruise control deactivation), it is checked that the clutch sensor does not flag a de-clutched engine.

Coolant Temperature Sensor

After start, a model coolant temperature is calculated based on coolant temperature at start, engine speed and load while running, time spent in idle and fuel shut-off.

When model temperature (TCO_SUB) reaches the threshold for closed loop activation, the system verifies that closed loop has been activated. TCO_SUB is tuned in order to rise slower than TCO and thus permits monitoring the plausibility of the coolant temperature information.

COHERENCE DIAGNOSIS

The following diagnoses check the coherence between two redundant signals:

Throttle Position Sensors

For safety reasons, the system has two sensors for throttle position. Signals from the two sensors are compared and must be within a given tolerance.

Two errors can be raised:

- Small discrepancy: in this case it is difficult to identify which sensor is wrong. For safety reasons, the system selects the highest one
- Large discrepancy: a plausibility check is performed using engine speed and mass air flow in order to determine which sensor is providing incorrect information.

Pedal Position Sensor

In case of discrepancy between the two pedal position sensors, the channel giving the smallest value is selected.

Brake Switches

If the two brake switches give different information, an error is raised. Cruise control is then inhibited.

TABLE OF ECM INPUT / OUTPUT SIGNALS

Power Control Unit (PCU)

INPUT SIGNALS OUTPUT SIGNALS

Input Signals	Output Signals
Gearbox interface unit (GIU)[1]	Gearbox interface unit (GIU)[1]
Coolant Temperature	Throttle Motor H Bridge Driver
Gearbox Oil Temperature (CVT only)	Oxygen Sensor Heater Upstream
TMAP Sensor - combined Intake Air Temperature and Manifold Air Pressure (1.0/2.5 bar)	Oxygen Sensor Heater Downstream
MAP Upstream - Manifold Air Pressure (Cooper S only)	Cannister Purge Solenoid
Knock Sensor	EVAPS Leak Detection Pump Solenoid
Thottle Position Sensor 1 / 2	Immobiliser
Pedal Position Sensor 1 / 2	Engine Speed Sync (Service Tool)
Air-Con Pressue Sensor	CAN
Oxygen Sensor Upstream	K-Line
Oxygen Sensor Heater Upstream	Fuel Pump Relay
Oxygen Sensor Downstream	Main Relay
Oxygen Sensor Heater Downstream	Cooling Fan 1 / 2 Relay

Camshaft Sensor	A / Con Clutch Relay
Crankshaft Sensor	Gearbox Shift Interlock Relay (CVT only)
Gearbox Shaft Speed (CVT only)	Ignition Coil A / B
Clutch Switch	Injector 1 / 2 / 3 / 4
Brake Switch	
Cruise Control Input Signals	
Alternator Load Sensor	
Road Speed (via CAN from ABS-Wheel Speed)	
EVAPS Leak Detection Reed Switch	
CAN	
K-Line	

(1) see table below

Gearbox Interface Unit (GIU) (Model Mini Cooper CVT Only)

INPUT SIGNALS OUTPUT SIGNALS

Input Signals	Output Signals
Print Selector Position	Ratio Control Motor
P/N Gearbox Switch	Clutch Solenoid Drive
Steptronic Switches-Selector	Secondary Pressure Solenoid Drive
Steptronic Switches - Steering Wheel	CAN
CAN	PRND Selector LED'S