COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
Catalyst Bank 1	P0420	oxygen storage of catalyst	normalized oxygen storage	<1factor	exhaust gas mass flow	>8.33g/sec	approx.	0.01 sec	0.4 sec	two driving
			less than normalized oxygen storage		exhaust gas mass flow	<27.78g/sec	1000 sec		continuous	cycles each
			of a limit catalyst		catalyst temp. model	<700° C	during	one	or 4 sec	with: 0.4 sec
					catalyst temp. model	>390° C	active	completed	cumulative	continuous
					engine speed	>1040rpm	driving	test per		or 4 sec
					engine speed	<3520rpm		driving		cumulative
					engine load	>14 …. 17%	one test	cycle		
					engine load	<42….55%				
					modeled catalyst temp. gradient	<2.5° C / sec	(average			
					exhaust gas mass flow gradient	<8.33g/sec²	of 4			
					fuel system closed loop	active--	checks)			
					time after engine start	>235sec	per driving			
					ambient temperature	>-48° C	cycle			
					scheduled by System Manager	TRUE--				
					secondary O2 sensor	ready				
					fuel adaptation fault	FALSE				
					short term fuel trim (< max)	<1.25factor				
					short term fuel trim (> min)	>0.75factor				
					transient fuel control	FALSE				
					critical misfire rate detected	FALSE				
					cat. damaging misfire rate exceeded	FALSE				
					cat oxygen storage neutralization	FALSE				
Misfire		crankshaft speed	emissions relevant misfire rate	>1.4% (emission relevant misfire rate = 1.5%)	engine speed	>450rpm	1000 revs	cylinder	immediate	Fault during
Emission Level		fluctuation cylinder 1 to			engine speed	<6500rpm		firing		1st interval:
Multiple Cylinder	P0300	cylinder 6			indicated torque (idle, no drive)	>3.91%		frequency		2 faults in
Cylinder #1	P0301				indicated torque (drive) (MISALUN)	>3.91 . . . 17.19%			After	2 different
Cylinder #2	P0302				engine speed gradient	<12800rpm/sec (not active)		continuous	detection,	drive cycles.
Cylinder #3	P0303				volumetric efficiency gradient	<768%/rev (not active)			the	
Cylinder #4	P0304				cylinder events after engine start	>6ignitions			diagnostic	Fault during

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
Cylinder #5	P0305				Enabling delay when Coolant temp is below –7 °C at start Delayed until Coolant temp > 21 °C	>-7° C			can only	remaining
Cylinder #6	P0306				rough road	not detected--			pass if	intervals:
					traction control	off--			similar	8 faults in 2
					clutch switch press / release	transitionFALSE-			conditions	different
					leak detection	off--			are	drive cycles
					active handling	not active			encountere	with at least
					ABS	not active--				4 faults in
					engine drag control	not active--				each.
					fuel cut off	not active--				
					fuel level	> 5.93 %				
					OR fuel level	> 5.93 %				
					AND solid misfire MIL	on--				
					OR fuel level error	set--				
					error: throttle position	not set--				
					error: crankshaft sensor	not set--				
					error: ref.mark of crank sensor	not set--				
						--				
						--				
						--				
						--				
			OR							
Catalyst Damaging Level			Catalyst damaging misfire rate	>16.2 . . . 6.8%	Includes all the above with the		1000 revs			First
Multiple Cylinder	P0300			see Misfire	following exceptions:		First interval			occurrence:
Cylinder #1	P0301			supplemental	First interval extension		200 revs			immediate
Cylinder #2	P0302			data	engine coolant temperature	<-48°C	all remaining			flashing
Cylinder #3	P0303			(h) (2.5.1)	fuel level	> 6.19 %	intervals			while error
Cylinder #4	P0304				OR fuel level	> 6.19 %				present, then
Cylinder #5	P0305				AND blinking MIL	blinking--				no MIL
Cylinder #6	P0306				AND NOT first blink event	---				with no error.
										Second occurrence: immediate

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
										flashing while error present, then solid MIL with no error.
evaporative system										
canister ventilation valve (AAV)	P0446	monitoring of tank pressure while	tank pressure too low because	< -10.50049 hPa		>= -9.8 °C	< 20 sec	once per dcy	2,6 secs	2 dcy
					ambient temperature					
		AAV is open and CPV is closed	canister vent. defective & closed		ambient temperature	<= 45 °C				
					ambient pressure	>= 680.00 hPa				
					vehicle speed	<= 1,86 mph				
					engine is in idle mode	true				
					unfiltered tank pressure	>= -18.00 hPa				
					and unfiltered tank pressure	<= 10.00 hPa				
canister purge valve (CPV)	P0496	monitoring of tank pressure while	final pressure too low because	< -1.00098 hPa	battery voltage	>= 10.45 V	ca. 10 sec	once per dcy		
		CPV and AAV are closed	CPV defective and open		and battery voltage	<= 18.00 V				
					lambda control is active	true				
					secondary air pump inactive	true				
					secondary air diagnosis inactive	true				
					air bag hasn't been triggered	true				
					no torque reduction (e.g. resulting from switched-off cylinder)	true				
	P0497	monitoring of tank pressure while	purge control stuck closed		critical misfire rate	false				
		CPV and AAV are closed			ratio intake manifold pressure /ambient pressure	< 0.602				
					fault of canister purge valve in actual driving cycle	false				
tank leak large	P0455	AAV is closed and CPV is open	vacuum pressure built up gradient too low	FWD: < 0.450039 …0.750065 hPa/s **XWD: < 0.566959 …0.666714 hPa/s**	fault of canister ventilation valve in actual driving cycle	false	ca. 18 sec	once per dcy		
			because of large tank leakage		tank fuel level	>= 3.900 l				
			(for example: open gas filler cap)		and tank fuel level	<= 55.100 l				

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
					enabled by diagnostic scheduler	true				
					fuel system adaptation has completed	true				
					or time since engine start exceeds threshold	> 600 sec				
Fuel Evaporative System	P0456	Monitor fuel tank's pressure after engine shutdown			Engine off natural vacuum diagnosis has not been performed in this driving cycle.		100ms in	once per dcy	2.6 secs	2dcy
					Fuel evaporative system monitor (at engine on) didn't run nor detect large leak nor a tight system.		afterrun			
					Engine coolant temperature at start.	true				
					engine coolant temp. At start - intake air temp.	true				
					intake air temperature	true				
					intake air temperature	true				
					ambient air temperature	true				
					ambient air temperature	true				
					engine has been running for a cal. min. time	true				
					engine coolant temp. at engine stop	true				
					driving distance (in current dcy) covered	true				
					charcoal canister load factor	true				
					ambient pressure	true				
					driving distance (for vehicle lifetime) covered	true				
					the fuel tank's level isn't at its minimum					
					the fuel tank's level isn't at its maximum					
					battery's voltage	true				
					no refueling activity					
					the fuel tank pressure is within cal. range					
					no intake air temperature faults					

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
					no the purge control system faults no faults of the purge control valve's power stage no vehicle speed sensor faults no engine coolant temperature sensor faults no tank pressure sensor rationality faults no tank pressure sensor range faults no power supply voltage faults no main load sensor faults no canister vent valve faults no canister ventilation valve's power stage faults no ambient pressure sensor faults					
		Close canister ventilation valve. Look for maximum pressure. Abort if: - max. pressure >= threshold. - max. pressure - current pressure >= threshold. - pressure stays in range near zero for a specific time. - pressure <= threshold for a specific time (vacuum build-up instead of pressure build-up) - pressure-phase-time >= threshold. - diagnostic-time >= threshold	max. pressure max. pressure - current pressure pressure pressure pressure pressure phase time diagnostic time	>= 0.30029 hPa >= -0.69946 hPa <= 0.69946 hPa 500 s <= -0.74951 hPa 30.00 s >= 2400.00 s >= 2900.00 s						

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
		correct max. pressure.								
		open canister ventilation valve for a calibrated time.		400.00 s						
		Look for minimum pressure Abort if: - min pressure <= threshold	min. pressure	<=						
		- diagnostic time >= threshold	diagnostic time	>= 2900.00 s						
		current pressure - min. - pressure >= threshold	current pressure - min. pressure	>= 0.30029 hPa						
		AND min. pressure <= threshold	min. pressure	<= -0.69946 hPa						
		- pressure stays in ambient range for a specific time	pressure pressure	>= -0.69946 hPa <= 0.69946 hPa 500.00 s						
		- canister vent valve re-opened for a more than N times because the pressure exceeds a threshold	no. canister vent valve openings pressure	> 2 0.74951 hPa						
		Calculate difference between corrected max. pressure and min. pressure.								

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
		Calculate normalized result. First divide the pressure difference by a parameter. Then subtract this result from 1. Filter the normalized result with an EWMA filter. Compare filtered result with threshold. N results will be taken into account in order to determine a pass. A fault will be indicated immediately.	Filtered result	> 0.399994 4						
Secondary air system	P0411	passive functional check	relative secondary air mass flow. Ratio from calculated secondary air mass by pressure sensor signal and secondary air mass model	< 0.844 > 1.156	start with catalyst heating secondary air system intake air temperature intake air temperature engine coolant temperature engine coolant temperature ratio: (MAP Model / Baro) no error on altitude detection error: intake air error: motor temperature error: secondary air pump (power stage) error: power supply voltage UB	 > 0 °C < 80.3 °C > 5.3 °C < 120 °C < 0.7	< 5s	one test per dcy (only, if secondary- air-system was active)	2.6 sec	2 dcy

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
					enabled by the diagnostic scheduler					
					fuel cut off					
					steady state					
					mass airflow	> 6 kg/h				
					mass airflow	< 130 kg/h				
					change in air charge per working cycle	<= 6 %				
Pressure sensor secondary air system	P2432	circuit continuity - low	measured sensor voltage	< 0,498 V			0.5 sec	continuous	0.2 sec	2 dcy
	P2433	circuit continuity - high or open	measured sensor voltage	> 4,501 V						
	P2431	rationality -	during ECU init-	< -50 hPa	Barometric pressure signal VALID	TRUE				
		comparison between: SAI system pressure signal & Barometric pressure signal	difference SAI pressure vs BARO pressure	> 50 hPa	secondary air injection during CAT heat executed	TRUE				
					secondary air injection during CAT heat finished	TRUE				
Fuel System Rich/Lean Multiplicative and Additive	P2191	fuel trim limits exceeded	delta lambda correction	>1.175factor	fuel system status	closed loop--	approx.	0.1 sec	0.4 sec	two driving
	P2192	range - multiplicative (load > threshold and air flow > threshold)	or delta lambda correction	<0.825factor	long term fuel trim status	active--	300 sec	continuous	continuous or 4 sec	cycles each with: 0.4 sec
					engine coolant temperature	>50.3°C	from engine			
	P2187	range - additive	delta fuel load correction	>5.25%	purge control	not active--	start (after		cumulative	continuous
	P2188	low speed and low load	or delta fuel load correction	<-5.25%	intake air temperature	<=65.3°C	adaptation			or 4 sec
					fuel level	> 5.92 %	has		After	cumulative
					or fuel level error	set--	stabilized)		detection,	
					integrated air mass	>=2800g			diagnostic can only pass if similar conditions are encountered	

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
demand controlled fuel supply (DECOS)	P0088	difference between measured and set-point fuel rail pressure	fuel rail pressure difference	< - 150 kPa	DECOS fuel pump is active	true	5 sec	continuous	0.2 sec	2 dcy
					DECOS fuel control is enabled	true				
					time after engine start	> 1 sec				
	P0089	difference between actual necessary and pre-control duty cycle	duty cycle difference	< -25 %	time after hot start	> 6 sec				
					no fault of					
					- fuel pressure sensor (DECOS)	true				
					- power stage of demand controlled fuel pump	true				
	P0087	difference between measured and set-point fuel rail pressure	fuel rail pressure difference	> 150 kPa	DECOS fuel pump is active	true				
					DECOS fuel control is enabled	true				
					time after engine start	> 1 sec				
	P0089	difference between actual necessary and pre-control duty cycle	duty cycle difference	> 25 %	time after hot start	> 6 sec				
					no fault of					
					- low pressure fuel sensor (DECOS)	true				
					- power stage of demand controlled fuel pump	true				
					no empty or almost empty fuel tank	true				
fuel pressure sensor (DECOS)	P0193	circuit continuity - high or open	measured sensor voltage	> 4.7 V	fuel supply system is active	true	0.5 sec	continuous	0.2 sec	2 dcy
	P0192	circuit continuity - low	measured sensor voltage	< 0.3 V						
	P0193	range check - high	measured fuel pressure	> 680 kPa			5 sec			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
	P0192	range check - low	measured fuel pressure	< 60 kPa	fuel supply system is active	true	5 sec			
					time after power fail	>= 360 sec				
Diagnosis of Power Control Module					**general enabling conditions**		0.6 sec	continuous	0.2 sec	2 dcy
					battery voltage	< 18 V				
						> 10 V				
					locking request immobilizer	false				
	P0092	diagnosis short circuit to battery voltage			**special enabling condition**					
		only active if powerstage on	backward powerstage voltage of	> 3.9014 V	condition output duty cycle PCM	true				
			fuel pump diagnosis		for power on diagnosis					
			and							
			backward powerstage voltage of	> 2.7979 V						
			fuel pump diagnosis							
			and							
			duty cycle PCM	< 100 %						
		diagnosis short circuit to battery voltage			condition output duty cycle PCM	false				
		only active if powerstage off	backward powerstage voltage of	> 3.9014 V	for power off diagnosis					
			fuel pump diagnosis							
	P0091	diagnosis short circuit to ground			condition output duty cycle PCM	true				
		only active if powerstage on	backward powerstage voltage of	<= 2.3486 V	for power on diagnosis					
			fuel pump diagnosis							
			and							
			duty cycle PCM	> 0 %						
	P0090	diagnosis wire interruption			condition output duty cycle PCM	true				
		only active if powerstage on	backward powerstage voltage of	> 2.4414 V	for power on diagnosis					
			fuel pump diagnosis							
			and							
			duty cycle PCM	< 100 %						
			and							

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
			max-fault; powerstage diagnosis	false						
		diagnosis wire interruption	backward powerstage voltage of	> 2.4414 V	condition output duty cycle PCM	false				
		only active if powerstage off	fuel pump diagnosis **and**		for power off diagnosis					
			backward powerstage voltage of fuel pump diagnosis	< 3.9014 V						
	P0090	powerstage locked	condition fault message of PCM powerstage is locked	true						
Air / Fuel Ratio Sensor (primary A/F)										
sensor voltage		A/F sensor voltage	A/F sensor voltage	>3.7V	A/F sensor heater	TRUE--	10 sec	0.1 sec	0.4 sec	two driving
bank 1 sensor 1	P0130	exceeds threshold	and		at operating temperature			continuous	continuous	cycles each
		but not out of full range	A/F sensor voltage	<4.81V	engine starting	complete--	additional		or 4 sec	with: 0.4 sec
					desired A/F	<1.6lambda	time if		cumulative	continuous
			or		all injectors activated	TRUE--	fuel level			or 4 sec
					scheduled by System Manager	TRUE--	is low and			cumulative
			AF sensor voltage	>2.5V			not failed			
			and				600 sec			
			A/F sensor voltage	<3.06V						
			(if using rich calibration curve characteristic)							
Air / Fuel Ratio Sensor (primary A/F) integrated circuit interface										
bank 1	P0130	A/F sensor voltage	A/F sensor voltage IC corrective value	>0.1V	battery voltage	<18V	10 sec	0.1 sec	0.4 sec	two driving
		IC correction too high			battery voltage	>10.7V		continuous	continuous	cycles each
					engine	running--			or 4 sec	with: 0.4 sec
					engine starting	complete--			cumulative	continuous
										or 4 sec
										cumulative
		A/F sensor IC operating voltage	low voltage	=TRUE-	battery voltage	>10.7V	10 sec			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
		too low			battery voltage	<18V				
				-	engine	running--				
				-	engine starting	complete--				
		A/F sensor IC SPI interface	communication error	=TRUE		>10.7V				
		communication error				<18V				
		A/F sensor IC circuit write error	write error	=TRUE		running--				
		at INIT register				complete--				
Air / Fuel Ratio Sensor (primary A/F)										
pumping current circuit open		lambda control factor change	absolute value of lambda control factor	>0.025lambda	battery voltage	<18V	1.5 sec	0.1 sec	0.4 sec	two driving
bank 1 sensor 1	P2239	above threshold	change from the point when the		battery voltage	>10.7V		continuous	continuous	cycles each
			secondary conditions are met		engine	running--			or 4 sec	with: 0.4 sec
					engine starting	complete--			cumulative	continuous
					A/F sensor voltage	<1.51V				or 4 sec
					A/F sensor voltage	>1.49V				cumulative
					A/F sensor electrical trimming	not active--				
					A/F sensor heater at op.temp.	TRUE--				
					A/F sensor warm up control	complete--				
					lambda closed loop control	TRUE--				
					forced fuel trim amplitude	TRUE--				
					| fuel trim forced amplitude |	>0.015lambda				
					catalyst warm up control	stable--				
					sec. O2 sensor proportional trim	stable--				
					lean mixture inhibit	stable--				
					lambda closed loop control init	FALSE--				
					closed loop control startup	FALSE--				

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Air / Fuel Ratio Sensor (primary A/F)										
pumping current circuit open		A/F sensor voltage within upper	A/F sensor voltage	<1.51V	battery voltage	<18V	approx.	0.1 sec	0.4 sec	two driving
bank 1 sensor 1	P2237	and lower thresholds	and A/F sensor voltage	>1.49V	battery voltage	>10.7V	8 sec	continuous	continuous	cycles each
		and desired lambda is outside			engine	running--	once the		or 4 sec	with: 0.4 sec
		of upper or lower threshold			engine starting	complete--	driving		cumulative	continuous
					target lambda above upper limit	>1.01lambda	condition			or 4 sec
					or below lower limit	<0.99lambda	is met			cumulative
					closed loop control	TRUE--				
					A/F sensor heater	TRUE--				
					at operating temperature					
					A/F sensor electrical trimming	not active--				
					A/F sensor dynamic response	not slow--				
					error: A/F sensor heating	not set--				
					integrated exhaust gas mass	>400g				
Air / Fuel Ratio Sensor (primary A/F)										
pumping current circuit open		A/F sensor not lean enough	A/F sensor voltage	<1.7V	battery voltage	<18V	5 sec	0.1 sec	0.4 sec	two driving
bank 1 sensor 1	P2238	during fuel shut off operation			battery voltage	>10.7V		continuous	continuous	cycles each
					engine	running--			or 4 sec	with: 0.4 sec
					engine starting	complete--			cumulative	continuous
					time after fuel shut off	>3sec				or 4 sec
					A/F sensor heater	TRUE--				cumulative
					at operating temperature					
Air / Fuel Ratio Sensor (primary A/F)										
reference voltage circuit open		A/F sensor voltage	A/F sensor voltage	<0.2V	battery voltage	<18V	2 sec	0.1 sec	0.4 sec	two driving
bank 1 sensor 1	P2243	above upper threshold	A/F sensor voltage	>4.7V	battery voltage	>10.7V		continuous	continuous	cycles each
		or below lower threshold			engine	running--			or 4 sec	with: 0.4 sec
					engine starting	complete--			cumulative	continuous
			for time	>1sec	A/F sensor heating normal	>10sec				or 4 sec
					operation range for time					cumulative
					error: A/F sensor heater circuit	not set--				

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
					A/F sensor internal resistance	>1500Ohms				
Air / Fuel Ratio Sensor (primary A/F)										
reference ground circuit open		measured A/F sensor internal	A/F sensor internal resistance	>1500Ohms	battery voltage	<18V	5 sec	0.1 sec	0.4 sec	two driving
bank 1 sensor 1	P2251	resistance above upper threshold			battery voltage	>10.7V		continuous	continuous	cycles each
					engine	running--			or 4 sec	with: 0.4 sec
			for time	>5sec	engine starting	complete--			cumulative	continuous
					A/F sensor voltage	<1.48V				
					A/F sensor voltage	>1.36V				
					error: A/F sensor heater circuit	not set				
					A/F sensor pump voltage shut off	FALSE--				
					A/F sensor warm up control	complete--				
					A/F sensor heater operation time	>28sec				
					engine run time	>28sec				
					battery voltage below heater switch off voltage for time	>28sec				
					fuel cut in time	>28sec				
					for a fuel cut off time	>10sec				
					battery voltage exceed 11V time	>28sec				
Air / Fuel Ratio Sensor (primary A/F)										
measuring (trim) current		A/F sensor voltage	A/F sensor voltage	>4.81V	battery voltage	<18V	2 sec	0.1 sec	0.4 sec	two driving
circuit open		above threshold			battery voltage	>10.7V		continuous	continuous	cycles each
bank 1 sensor 1	P2626				engine	running--	additional		or 4 sec	with: 0.4 sec
					engine starting	complete--	time if		cumulative	continuous
					fuel cut off	TRUE--	fuel level			or 4 sec
					modeled exhaust temp	<750° C	is low and			cumulative
					in front of catalyst		not failed			
					A/F sensor heater	TRUE--				
					at operating temperature		600 sec			
Air / Fuel Ratio Sensor (primary A/F)										
general error	P0130	general A/F sensor electrical fault	A/F sensor internal resistance	>1500Ohms	A/F sensor heater operation time	>15sec	15 sec	0.1 sec	immediate	two driving
causing open loop					fuel cut in time	>15sec		continuous		cycles

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
					for a fuel cut off time	>3sec				
					battery voltage	>10.7V				
					battery voltage	<18V				
					A/F sensor	ready				
					A/F sensor heater pwr. stage err.	FALSE				
					A/F sensor IC internal error	FALSE				
					A/F sensor pin short circuit error	FALSE				
					modeled exhaust gas temp. invalid	FALSE				
					modeled exhaust gas temperature	>0°C				
			calculated A/F sensor temperature	<640°C	A/F sensor heater operation time	>15sec	15 sec			
					fuel cut in time	>15sec				
					for a fuel cut off time	>3sec				
					battery voltage	>10.7V				
					battery voltage	<18V				
					A/F sensor	ready				
					A/F sensor heater pwr. stage err.	FALSE				
					A/F sensor IC internal error	FALSE				
					A/F sensor pin short circuit error	FALSE				
					modeled exhaust gas temp. invalid	FALSE				
					modeled exhaust gas temperature	>0°C				
			A/F sensor pin UN error set	=TRUE						
				=TRUE						
			A/F sensor pin VM error set	=TRUE						
				=TRUE						
			A/F sensor heater error set by	=TRUE						
			after engine start diagnosis	=TRUE						
			A/F sensor heater error set by	=TRUE						

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
			maximum heater output diagnosis	=TRUE						
Air / Fuel Ratio Sensor (primary A/F) reference ground circuit; reference voltage circuit; or measuring current circuit										
bank 1 sensor 1 - low volt	P0131	A/F sensor signal at VM	IC Circuit Status shorted low	=TRUE-	battery voltage	<18V	25 sec	0.1 sec	0.4 sec	two driving
		(reference ground) below lower limit			battery voltage	>10.7V		continuous	continuous	cycles each
		or A/F sensor signal at UN	IC Circuit Status shorted low	=TRUE-	engine	running--			or 4 sec	with: 0.4 sec
		(reference voltage [Nernst voltage]) below lower limit			engine starting	complete--			cumulative	continuous
		or A/F sensor signal at IA	IC Circuit Status shorted low	=TRUE-						or 4 sec
		(measuring current trim circuit) below lower limit								cumulative
bank 1 sensor 1 - high volt	P0132	A/F sensor signal at VM	IC Circuit Status shorted high	=TRUE-						
		(reference ground) above upper limit								
		or A/F sensor signal at UN	IC Circuit Status shorted high	=TRUE-						
		(reference voltage [Nernst voltage]) above upper limit								
		or A/F sensor signal at IA	IC Circuit Status shorted high	=TRUE-						
		(measuring current trim circuit) above upper limit								
Air / Fuel Ratio Sensor (primary A/F) response		dynamic response	for primary HO2S dynamic detection:		for primary HO2S dynamic detection:		dynamic	0.01 sec	0.4 sec	two driving
bank 1 sensor 1	P0133	slow or low amplitude	(		**(**		test	continuous	continuous	cycles each
			A/F sensor dynamic value	<=0.3ratio	(		sample		or 4 sec	with: 0.4 sec
			for		primary HO2S ready for operation, i.e.		count		cumulative	continuous
			number of valid dynamic measurements per driving cycle	>=35	(					or 4 sec

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
			)		engine speed (engine coolant temperature dependent) at least once after engine start	>640 to 840 rpm	>			cumulative
					temperature of primary HO2S ceramic	>715°C				
					)		35			
					actual A/F ratio (lambda)	<=1.051lambda	samples			
					actual A/F ratio (lambda)	>=0.95lambda				
					engine speed	>=1160rpm	then			
					engine speed	<=2800 rpm	2 sec			
					relative engine load	>17.25%				
					relative engine load	<45%	total time			
					change of engine load per 100 ms	<=3%	= approx.			
					temperature of primary HO2S hexagon	<570°C	600 sec			
					peak-to-peak amplitude of the A/F ratio variation	>0.01lambda				
					forced oscillation of A/F ratio controller	active--				
					(					
					maximum allowed value of A/F ratio controller factor (enrichment)· ->1 + (a)	<=1.25factor				
					with upper limit A/F ratio controller (a)	0.25factor				
					)					
					minimum allowed value of A/F ratio controller (enleanment)	>=0.75factor				
					(					
					correction factor of carbon canister load adaptation for A/F ratio controller	<=15factor				
					engine temperature	>=39.8°C				
					canister purge active	FALSE--				
					)					
					canister purging with high canister load active	FALSE--				
					primary HO2S sufficiently heated, i.e.					

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
					(					
					difference between target and measured ceramic temperature of primary HO2S	<64.992K				
					target ceramic temperature primary HO2S	780°C				
					)					
					diagnosis primary HO2S wire bond IP, electrical check	TRUE--				
					diagnosis of secondary air system	FALSE--				
					all fuel injectors active	TRUE--				
					scheduled by System Manager (FID BDLSU)	TRUE--				
					for time	>=0.5sec				
					gradient of modeled A/F ratio value (reference curve)	>0.12sec				
					)					
					OR					
			for primary HO2S delay time detection:		for primary HO2S delay time detection:					
			(		**(**					
			detection of **large** delay:		(					
			(		primary HO2S ready for operation, i.e.					
			(		(					
			the following two conditions have to be fulfilled in alternating order:		engine speed (engine coolant temperature dependent) at least once after engine start	>640 to 840 rpm				
			A/F ratio controller	>=1.15factor	temperature of primary HO2S ceramic	>715°C				
			for a calibrated period of time	>=0.6sec	)					
			and		engine speed	>=1160rpm				
			A/F ratio controller	<=0.85factor	engine speed	<=2800 rpm				
			for a calibrated period of time	>=0.6sec	relative engine load	>=14%				
			)		relative engine load	<=72%				
			for number of counts	>=8	absolute value of high pass filtered mass airflow	<=20kg/h				

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
					absolute value of delta of engine load	<=10%				
			)							
			OR		time constant for lambda control mode	<=0.6sec				
			(							
			detection of **small** delays:		time constant for lambda control mode	>=0.02sec				
			(		diagnosis primary HO2S wire bond IP, electrical check	TRUE--				
			detection of small delays maxima:		mixture lean-off is not forbidden	not active--				
			(		primary fuel control system status	closed loop				
			relative variance of delay between maxima	<=0.055	absolute value of forced oscillation of A/F ratio control	>=0.025				
			counter for single measurements reaches mean value between maxima	>=6	lambda set point is equal to one	TRUE--				
			mean value time shift between maxima	>0.37sec						
			)		lambda regulator output min.	<0.85				
			or		lambda regulator output max.	>1.15				
			detection of small delays minima:		minimum allowed value of A/F ratio controller (enleanment)	<0.75				
			(		maximum allowed value of A/F ratio controller factor (enrichment)	>1.25				
			relative variance of delay between minima	<=0.055	)					
			counter for single measurements reaches mean value between minima	>=6	all for a calibrated period of time	>=3.1sec				
			mean value time shift between minima	>0.37sec	all for a number of counts	>24				
					scheduled by System Manager (FID BDDEU)	TRUE--				
					)					
			)							
			)							
			)							
			)							

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
Oxygen Sensor (secondary O2) Trim of Air / Fuel Ratio Sensor (primary A/F) primary A/F signal RICH / secondary O2 signal LEAN										
Bank 1	P2096	A/F sensor long term secondary	secondary O2 sensor trim	<-0.03lambda	engine starting	complete- -	2 sec	0.1 sec	0.4 sec	two driving
		trim - rich shift	integral control		secondary O2 trim active	TRUE--		continuous	continuous	cycles each
		- correction below threshold			and secondary O2 oscillation	TRUE- -			or 4 sec	with: 0.4 sec
					check finished				cumulative	continuous
primary A/F signal LEAN / secondary O2 signal RICH					then timer	>25sec				or 4 sec
Bank 1	P2097	A/F sensor long term secondary	secondary O2 sensor trim	>0.03lambda	scheduled by System Manager	TRUE				cumulative
		trim - lean shift	integral control		sec. O2 trim - fast lean correction	FALSE				
		- correction above threshold			sec. O2 trim - fast rich correction	FALSE				
					suspicion A/F sensor lean shift	FALSE				
					secondary O2 oscillation test	checked OK				
Oxygen Sensor (secondary O2) Trim of Air / Fuel Ratio Sensor (primary A/F)										
Bank 1	P2195	secondary O2 sensor operation	secondary O2 sensor voltage	>0.75V	A/F sensor measured lambda	>1.08008lambda	approx.	0.1 sec	0.4 sec	two driving
		too rich - strong correction			short term fuel trim	= MAX1.25factor	100 sec	continuous	continuous	cycles each
					A/F sensor	ready--			or 4 sec	with: 0.4 sec
		A/F sensor measured too lean	or		secondary O2 sensor	ready--			cumulative	continuous
					then					or 4 sec
					accumulated exhaust gas mass	>300g				cumulative
			secondary O2 sensor voltage	>0.75V	A/F sensor measured lambda	>1.08008lambda				
					secondary O2 sensor fuel trim	>0.014008lambda				
					proportional trim dominating					
					secondary O2 aging diagnosis	complete--				

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
					secondary O2 circuit diagnosis	complete--				
					secondary O2 fuel trim active	TRUE--				
					A/F sensor	ready--				
					secondary O2 sensor	ready--				
					then					
					accumulated exhaust gas mass	>300g				
			secondary O2 sensor voltage	>0.75V	target lambda	>1.04lambda	0.9 sec			
					A/F sensor	ready--				
					secondary O2 sensor	ready--				
					lambda closed loop control	active--				
					secondary O2 circuit diagnosis	complete--				
					short term fuel trim (o.k.)	> MIN0.75factor				
					then					
					accumulated exhaust gas mass	>800g				
Oxygen Sensor (secondary O2) Trim of Air / Fuel Ratio Sensor (primary A/F)										
Bank 1	P2196	secondary O2 sensor operation	secondary O2 sensor voltage	<0.2012V	A/F sensor measured lambda	<0.92lambda	approx.	0.1 sec	0.4 sec	two driving
		too lean - strong correction			short term fuel trim	= MIN0.75factor	100 sec	continuous	continuous	cycles each
					A/F sensor	ready--			or 4 sec	with: 0.4 sec
		A/F sensor measured too rich			secondary O2 sensor	ready--			cumulative	continuous
					then					or 4 sec
					accumulated exhaust gas mass	>300g				cumulative
			secondary O2 sensor voltage	<0.2012V	A/F sensor measured lambda	<0.92lambda				
					secondary O2 sensor fuel trim	<0.014lambda				
					proportional trim dominating					
					secondary O2 aging diagnosis	complete--				
					secondary O2 circuit diagnosis	complete--				
					secondary O2 fuel trim active	TRUE--				
					A/F sensor	ready--				
					secondary O2 sensor	ready--				
					then					
					accumulated exhaust gas mass	>300g				
			secondary O2 sensor voltage	<0.2012V	target lambda	<0.96lambda	0.9 sec			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
					A/F sensor	ready--				
					secondary O2 sensor	ready--				
					lambda closed loop control	active--				
					secondary O2 circuit diagnosis	complete--				
					short term fuel trim (o.k.)	< MAX1.25factor				
					then					
					accumulated exhaust gas mass	>800g				
Air / Fuel Ratio Sensor (primary A/F)										
electrical										
wire to wire short circuit		sensor short to heater	filtered maximum pump current variation	>0.00019A	all injectors activated	TRUE--	15 sec	0.01 sec	0.4 sec	two driving
bank 1 sensor 1	P2231		within every 10ms		battery voltage	<18V		continuous	continuous	cycles each
					battery voltage	>10.7V			or 4 sec	with: 0.4 sec
					A/F sensor IC diagnosis	complete--			cumulative	continuous
					error: A/F sensor IC	not set--				or 4 sec
					engine rpm	<1800rpm				cumulative
					modeled exhaust gas temperature	<800° C				
					heater duty cycle	>20%				
					heater duty cycle	<80%				
					A/F sensor heater at op.temp.	TRUE				
					after A/F sensor curve switching for time	>0.06sec				
Diagnosis of Heater upstream HO2S										
	P0032	short circuit to battery voltage	Voltage	IC internal	for time	> 5 sec	5 sec	continuous	0.2 sec	2 dcy
					battery voltage via main relay	<= 18 V				
	P0031	short circuit to ground			battery voltage via main relay	>= 10,7 V				
					condition end of start	True				
	P0030	wire interruption			condition engine speed: n > NMIN	True				

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
A/F Sensor Heating										
heater performance (primary A/F)										
bank 1 sensor 1	P0135	A/F sensor calculated temperature	A/F sensor temperature calculation	<715° C	battery voltage	>10.7V	35 sec	0.1 sec	0.4 sec	two driving
		too low			battery voltage	<18V		continuous	continuous	cycles each
					internal resistance measurement	valid--			or 4 sec	with: 0.4 sec
					all injectors activated	TRUE--			cumulative	continuous
					A/F sensor internal resistance	FALSE--				or 4 sec
					excessive correction required					cumulative
					engine stop time	>5400sec				
					engine temperature at start	>-9.8° C				
					A/F sensor heating ready	TRUE--				
					A/F heater control shut off	FALSE--				
					scheduled by System Manager	TRUE--				
heater performance (primary A/F)										
bank 1 sensor 1 (primary)	P0135	A/F sensor calculated	A/F sensor temperature calculation	<715° C	A/F Heater at Maximum Power	TRUE	60 sec	0.1 sec	0.4 sec	two driving
		temperature below threshold			modeled exhaust temp. at sensor	>300° C		continuous	continuous	cycles each
					timer expires after either:	>50sec			or 4 sec	with: 0.4 sec
					fuel shut off >= 3 sec dur. ends	---			cumulative	continuous
					or initial A/F heater turn on	---				or 4 sec
					battery voltage	>10.7V				cumulative
					battery voltage	<18V				
					A/F heater control shut off	FALSE--				
					modeled exhaust temp. valid	TRUE				
					scheduled by System Manager	TRUE--				
A/F Sensor Heating										
heater performance (secondary O2)										
bank 1 sensor 1	P0053	correction value for A/F sensor	absolute value of correction value for	>45Ohms	battery voltage	>10.7V	40 sec	0.1 sec	0.4 sec	two driving
bank 2 sensor 1		internal resistance measurement	A/F sensor internal resistance		battery voltage	<18V		continuous	continuous	cycles each
		too much			engine starting	complete--			or 4 sec	with: 0.4 sec
									cumulative	continuous

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
										or 4 sec cumulative
Oxygen Sensor sensor circuit (secondary O2)										
bank 1 sensor 2	P0137	short circuit to ground	secondary O2 sensor voltage	<0.06V	secondary O2 heating stable	> 10sec	0.1 sec	0.1 sec	0.4 sec	two driving
					and mod. exhaust gas temp.	>250° C		continuous	continuous	cycles each
					for time	>90sec			or 4 sec	with: 0.4 sec
					engine running	TRUE--			cumulative	continuous
					battery voltage	>10.7V				or 4 sec
					mod. exhaust-gas temp.	<800° C				cumulative
					time after start	<1sec				
					engine temp at stop	>60° C				
					engine temp	<40° C				
					error: engine coolant temp	not set--				
bank 1 sensor 2	P0138	short circuit to battery voltage	secondary O2 sensor voltage >	>1.08V	secondary O2 heating stable	> 10sec	5.1 sec			
					and mod. Exhaust-gas temp.	>250° C				
					for time	>90sec				
					engine running	TRUE--				
					battery voltage	>10.7V				
					mod. exhaust-gas temp.	<800° C				
bank 1 sensor 2	P0140	sensor line disconnection	secondary O2 sensor voltage	>0.401V	secondary O2 heating stable	> 10sec	600 sec			
			and secondary O2 sensor voltage	<0.499V	and mod. Exhaust-gas temp.	>250° C				
					for time	>90sec				
			or		engine running	TRUE--				
			secondary O2 sensor internal resistance	>40000Ohm	battery voltage	>10.7V				
			when modeled exhaust gas temperature	>600° C	mod. exhaust-gas temp.	<800° C				
Oxygen Sensor sensor circuit (secondary O2)										
bank 1 sensor 2	P2232	sensor line short circuit	secondary O2 sensor		secondary O2 heating stable	> 10sec	10 sec	0.01 sec	0.4 sec	two driving
		to heater output line	voltage gradient	>2V	and mod. Exhaust-gas temp.	>250° C		continuous	continuous	cycles each
			within time after heater turn off	<0.04sec	for time	>90sec			or 4 sec	with: 0.4 sec

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
			for occurrences	>4count	engine running	TRUE--			cumulative	continuous
			out of heater turn offs	=6count	battery voltage	>10.7V				or 4 sec
					mod. exhaust-gas temp.	<800° C				cumulative
					time after dew point exceeded	>10sec				
Oxygen Sensor Heating										
heater performance (secondary O2)										
bank 1 sensor 2 (secondary)	P0141	secondary O2 sensor	measured secondary O2 sensor internal		battery voltage	>10.7V	6 sec	0.1 sec	0.4 sec	two driving
		internal resistance	resistance		battery voltage	<18V		continuous	continuous	cycles each
		above threshold	nominal internal resistance	>88 . . . 408Ohms	engine running	TRUE--			or 4 sec	with: 0.4 sec
				KFRINH	engine starting	complete--			cumulative	continuous
			multiply times degradation factor	>3 . . . 20factor	fuel cut off	FALSE--				or 4 sec
				FRINH	sec. O2 internal resistance	valid--				cumulative
			for time	>6sec	intake air temperature	>-9.8C				
					engine off soak time	>120sec				
					modeled exhaust temp.	in range350 . . . 550C				
					at secondary O2 sensor					
					suspicion of secondary	FALSE				
					O2 sensor open circuit					
					secondary O2 voltage supply	ON				
					scheduled by System Manager					
					for time	>120sec				
sensor response (secondary O2)										
bank 1 sensor 2	P2270	oscillation check low	secondary O2 sensor voltage	<0.499 . . . 0.603V	secondary O2 sensor	ready - -	approx.	0.1 sec	0.4 sec	two driving
			for time	>5sec	for time	>10sec	600 sec	continuous	continuous	cycles each
			then		secondary O2 closed loop control	active - -			or 4 sec	with: 0.4 sec
			ramping in enrichment by	=0.25lambda	all injectors activated	TRUE - -	additional		cumulative	continuous
			at gradient	0,0513 l / sec	engine air flow (intrusive test)	9.72g/sec	time if			or 4 sec
			for time (after enrichment limit reached)	>7sec	and engine air flow	33.33g/sec	fuel level			cumulative
					for time	>3sec	is low and			
					engine air flow (passive monitor)	9.72g/sec	not failed			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
					sec. O2 trim - fast lean correction	FALSE	600 sec			
					sec. O2 trim - fast rich correction	FALSE				
					engine	running				
					scheduled by System Manager	TRUE				
bank 1 sensor 2	P2271	oscillation check high	secondary O2 sensor voltage	>0.499 . . . 0.603V	secondary O2 sensor	ready - -	approx.	0.1 sec	0.4 sec	two driving
			for time	>5sec	for time	>10sec	600 sec	continuous	continuous	cycles each
					secondary O2 closed loop control	active			or 4 sec	with: 0.4 sec
			then							
			ramping in enleanment by	=0.07lambda	all injectors activated	TRUE			cumulative	continuous
			at gradient	0,0513 l / sec	engine air flow (intrusive test)	9.72g/sec				or 4 sec
			for time (after enleanment limit reached)	>7sec	and engine air flow	33.33g/sec				cumulative
					for time	>3sec				
					engine air flow (passive monitor)	9.72g/sec				
					sec. O2 trim - fast lean correction	FALSE				
					sec. O2 trim - fast rich correction	FALSE				
					engine	running				
					scheduled by System Manager	TRUE				
bank 1 sensor 2	P2271	fuel cut off check high	secondary O2 sensor voltage	>0.202V	secondary O2 heating stable	> 10sec	0.2 sec	0.1 sec	0.4 sec	two driving
			time after fuel cut off	>2,5sec	secondary O2 dew point exceeded	TRUE - -		continuous	continuous	cycles each
					for time	>30sec			or 4 sec	with: 0.4 sec
					air passed after fuel cut off	>15g			cumulative	continuous
					modeled exhaust temp	>350° C				or 4 sec
					at secondary O2 sensor					cumulative
					scheduled by System Manager	TRUE - -				
					error: cam sensor	not set - -				
					error: evap canister purge sys.	not set - -				
					error: evap purge valve ckt	not set - -				
					error: battery voltage	not set - -				
bank 1 sensor 2	P0139	fuel cut off check high	secondary O2 sensor voltage	>0.152V	secondary O2 heating stable	> 10sec	0.2 sec	0.1 sec	0.4 sec	two driving
			time after fuel cut off	>3,0sec	secondary O2 dew point exceeded	TRUE - -		continuous	continuous	cycles each
			lambda actual value	lambda >2	for time	>30sec			or 9,5 sec	with: 0.4 sec

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
					air passed after fuel cut off	>20g			cumulative	continuous
					bank 1 sensor 2 voltage	>0,6 V				or 9,5 sec
					for time	> 3 sec				cumulative
					battery voltage	> 10,7V				
Camshaft Control										
System - Locking Pin										two driving
Bank 1 Intake	P0011	rationality high	average of actual angle measurements	>10degrees	engine speed	>560rpm	10 sec	0.01 sec	0.4 sec	cycles each
Bank 2 Intake	P0021		versus locked position angle		engine run time	>1sec			continuous	with: 0.4 sec
					camshaft control circuit test	complete--			or 4 sec	continuous
					error: camshaft control circuit	not set--			cumulative	or 4 sec cum
System - Control	P000A	rationality low / high	difference to start test (filtered actual	> 6 . . . 11 degrees	engine speed	>560rpm	approx.	0.01 sec	0.4 sec	two driving
Bank 1 Intake	P000C		angle versus filtered desired angle)		engine run time	>1sec	20 sec	continuous	continuous	cycles each
Bank 2 Intake			(desired must remain above value		camshaft control circuit test	complete--			or 4 sec	with: 0.4 sec
			to test to complete the evaluation)		error: camshaft control circuit	not set--	(4 times		cumulative	continuous
			filtered actual angle remains	<	coolant temperature	< 143° C	for 4 sec			or 4 sec
			filtered desired angle from test start		coolant temperature	>-48° C	each)			cumulative
			within time	=3sec	engine oil temperature	<143° C				
			(detects 5 sec slow [time constant])		engine oil temperature	>-48° C				
					cam-crank alignment adaptation	complete--				
			for multiple activation occurrences	>4count						
			(decrements upon activations where	(same as stated in "time required" column)						
			no difference is seen between desired							
			and actual)							
			difference (filtered actual angle max	>3degrees						
			versus actual at test start)							
			(to detect slow response versus							
			stuck cam if above this limit)							

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
			at time (overlaps with time to detect above) (passes after multiple good activations in both cam phase rotation directions)	=4sec						
System - Cam - Crank Alignment										
Bank 1 Intake	P0016	cam-crank adapted angle	adapted angle	>10degrees	engine run time >	>2sec	approx.	0.2 sec	0.4 sec	two driving
		limit check	or adapted angle	<-18degrees	engine coolant temp >	>9.8° C	600 sec	continuous	continuous	cycles each
Bank 2 Intake	P0018	(applies for each camshaft)	or actual angle with parked cams	>20degrees	engine coolant temp <	<105° C			or 4 sec	with: 0.4 sec
			and	<25degrees	model: engine oil temp <	<140° C	fail after		cumulative	continuous
Bank 1 / Idler Sprocket	P0008		adapted angle for both cams	>10degrees	error: camshaft sensor	not set--	2 adaptation			or 4 sec
Bank 2 / Idler Sprocket	P0009		adapted angle for both cams	<-18degrees	error: camshaft control circuit	not set--	cycles - required			cumulative
Engine coolant	P0117	range check high	coolant temperature	>138.8° C	hot restart timer after engine start	>=60sec	0.1 sec	0.1 sec	0.4 sec	two driving
temperature sensor	P0118	range check low	coolant temperature	<-38.3° C	If Startup ECT+O155	<-38.3° C			continuous	cycles each
					| ECT-Startup ECT | (abs value)	<=2.3° C			or 4 sec	with: 0.4 sec
					integrated air mass increases	>=0g			cumulative	cont. or 4
					and air mass timer	>=30sec				sec cum.
	P0119	intermittent (discontinuity)	delta coolant temperature	<-20.25° C	ignition	=ON	approx.	0.01 sec	immediate	

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
			or				150 sec	continuous		
			delta coolant temperature	>20.25° C						
			(between A/D read sample count offset)	=3count						
Engine coolant	P0116	plausibility check (low side check)	calculated coolant temperature model	>9.8° C	the model temperature increases				or 0.4 sec	two driving
temperature sensor			minus measured temperature		depending on air flow				continuous	cycles each
		plausibility check (high side check)	measured temperature		measured temperature	<93.8° C				
			minus calculated coolant temperature model		engine speed	>520rpm			or 4 sec	with: 0.4 sec
					integrated air mass	> 3000g			cumulative	continuous
					no error engine speed					or 4 sec
					no error air mass flow meter					cumulative
Engine coolant	P050C	difference from intake air	filtered difference		key up IAT - previous min IAT	<1.5° C	160 sec	0.2 sec	immediate	two driving
temperature sensor		temperature after soaking	(ECT at key on - IAT at key on)	>15° C	key up IAT - previous min IAT	>-24.75° C	for block	continuous	additional	cycles each
					previous accumulated air mass	>2000g	heating		after block	with: 0.4 sec
					previous accumulated air mass	>4000g			heater	cumulative
			or		previous engine run time	>500sec			check	
					or					
			filtered difference		ECT at shut down	>84.75° C				
			(ECT at key on - IAT at key on)	<-10° C	Controller Shut Down at end of	last cycle--				
					Strong Wind / Open Hood	not detected--				
					based on IAT rise at shut down					
					Block Heater	not detected--				
Engine Coolant	P0128	Coolant Temperature Below	(calculated reference model coolant temp	>5.3° C	debouncing time	>15sec	approx.	0.1 sec	0.4 sec	two driving
Thermostat Monitoring		Thermostat Regulating	minus measured coolant temperature)		error: engine coolant temp	not set--	900 sec	continuous	continuous	cycles each
		Temperature (plausibility check)			error: vehicle speed sensor	not set--			or 4 sec	with: 0.4 sec
			reference model calculation limit	71.25° C	est. ambient temperature	> -39.8°C			cumulative	continuous
					est. ambient temperature	<140°C				or 4 sec
					vehicle speed	>=3.125mph				cumulative
			Thermostat regulating temperature: 82°C		engine speed	>640rpm				

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
			All critical OBD and emission functions are enabled above 60°C.)		coolant temperature at start integrated air mass flow	< 51.0°C > 1000g				
Intake air temperature sensor	P0111	response check	max intake air temperature - min intake air temperature	>2.3° C	drive period - count each with vehicle speed mass flow mass flow coolant temperature at start no fuel shut-off idle period - count each with vehicle speed coolant temperature at start coolant temperature ECT decrease since prior shutdown	>=5count >=56.25mph <250g / sec > 25.6g/sec <=120° C >=4count <=1.5625mph <=120° C >64.5° C >0° C	2 sec	0.1 sec continuous	0.4 sec continuous or 4 sec cumulative	two driving cycles each with: 0.4 sec continuous or 4 sec cumulative
	P0112	range check low	intake air temperature	>125.3° C						
	P0113	range check high	intake air temperature	<-35.3° C	time after start then time in idle and intake air temperature then | IAT change | (abs value) while integrated air mass increases	> 15sec >3sec <-35.3° C <=2.3° C >=0g				
Mass air flow sensor	P0101	range check low or fuel trim limits exceeded range - multiplicative and correction factor (modeled air mass at throttle / air mass	mass air flow and delta lambda correction correction factor air mass	<1.83 . . . 78.9 g/sec KFMLDMN >0.16factor <0.83factor	battery voltage time after start crankshaft revolution counter error: throttle position sensor ratio: MAP to Baro	>10.5V >0.4sec >150rev not set -- 00 0g/s <1 -	0.40 sec	0.01 sec continuous	0.4 sec continuous or 4 sec cumulative	two driving cycles each with: 0.4 sec continuous or 4 sec cumulative

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
		measured by air mass flow meter)			air mass flow					
					time after start					
		range check high	mass air flow	> 26.9 . . . 312.5 g/sec	errors:					
		or	and	KFMLDMX	throttle body	--				
		fuel trim limits exceeded	delta lambda correction	<-0.175factor	Leak upstream throttle					
		range - multiplicative								
		and								
		correction factor (modeled air	correction factor air mass	>1.1699factor						
		mass at throttle / air mass								
		measured by air mass flow meter)								
	P0102	circuit check low	mass air flow	>10.3g/sec	battery voltage	>7.5V	0.2 sec			
	P0103	circuit check high	mass air flow	>33.3g/sec						
pressure sensor										
upstream throttle valve	P0238	circuit continuity - high or open	measured sensor voltage	> 4.65 V			0.5 sec	continuous	0.2 sec	2 dcy
	P0237	circuit continuity - low	measured sensor voltage	< 0.45 V						
	P0238	range check - high	measured pressure	> 300 kPa	enabled by diagnostic		2 sec			
	P0237	range check - low	measured pressure	< 50 kPa	scheduler	true				
	P0236	rationality -	measured fuel pressure lies below							
		comparison between measured	expected minimum pressure	true						
		pressure and expected								
		(calculated) pressure								
	P0236	rationality -	('measured') compression ratio exceeds							
		comparison between ('measured')	expected maximum compression ratio	true						
		compression ratio and expected								

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
		(calculated) compression ratio								
boost pressure control										
	P2281	comparison between	ratio between	> 0.098	engine speed	> 1520 rpm	1 sec	continuous	0.2 sec	2 dcy
		MAF based pressure ratio	MAF based pressure ratio	to	time after engine start	> 10 sec				
		over the throttle valve	over the throttle valve	1.297	no fault of					
		and	and		- pressure sensor					
		throttle body based pressure ratio	throttle body based pressure ratio		upstream throttle valve	true				
		over the throttle valve	over the throttle valve		- throttle position sensors	true				
					- MAF sensor	true				
		(detection of leakage)	(fine leakage)		boost pressure control					
					is active	true				
			ratio between	> 0.101			1 sec			
			MAF based pressure ratio	to						
			over the throttle valve	1.352						
			and							
			throttle body based pressure ratio							
			over the throttle valve							
			(coarse leakage)							
			ratio between	> 0.109	engine speed	> 1520 rpm	1.8 sec			
			MAF based pressure ratio	to	time after engine start	> 10 sec				
			over the throttle valve	1.398	no fault of					
			and		- pressure sensor					
			throttle body based pressure ratio		upstream throttle valve	true				
			over the throttle valve		- throttle position sensors	true				
					- MAF sensor	true				
			(coarse leakage)		- canister purge system	true				
					boost pressure control					
					is not active	true				
					for time	>				

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
					cruise control not active	true				
					setpoint canister purge rate	< 0.03				
					no dynamic engine condition					
	P0299	comparison between desired boost pressure and current boost pressure	difference (positive) between set-point boost pressure and current boost pressure (boost pressure to low)	25kPa	boost pressure control is active engine speed atmospheric pressure setpoint boost pressure	 true > 2000 rpm or 3120 rpm > 66 kPa > base boost pressure + 5 kPa	6 sec			
	P0234	comparison between desired boost pressure and current boost pressure	difference (negative) between set-point boost pressure and current boost pressure (boost pressure to high) (Remark: for comparison the negative value is converted to an absolute value)	> 22 kPa to 127.5 kPa	pressure upstream throttle valve is valid	 true	1.2 s			
dump valve										
	P2261	counting of increased pulsation in the intake manifold (increased pulsation may occur	normalized difference between measured MAF sensor value and modeled value	 > 0,352	engine coolant temperature intake air temperature pressure in front of throttle valve	> 50.3 °C > -10.5 °C > 60 kPa	0.48 sec	continuous	0.2 sec	2 dcy

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
		when dump valve is jammed in closed position)	for		supervision phase is active	true				
			number of times	> 4 counts	conditions for an active supervision phase are					
					- negative load gradient detected	true				
					- ratio of pressure in front of throttle valve to minimum pressure after air filter	> 1.05 to 3.12				
					- dump valve is active	true				
Barometric Pressure Sensor (ambient air pressure sensor)	P2227	rationality	difference between barometric pressure signal pressure and pressure in front of throttle	>15kPa	plausible pressure signal pressure sensor in front of throttle and throttle angle and engine speed	TRUE <5% <1000rpm	3 sec	0.1 sec	0.4 sec continuous or 4 sec cumulative	two driving cycles each with: 0.4 sec continuous or 4 sec cumulative
		signal discontinuity	or barometric pressure signal pressure jump from previous key off	>10kPa	enabled by scheduler for time Baro from previous drive	>3sec valid--				
			and difference between barometric pressure signal pressure and pressure in front of throttle	>10kPa	difference: Baro substitute model versus sensor engine speed lower and throttle angle both for time	>15kPa < 621 rpm < 5% >3sec				
	P2228	range check low	sensor signal	<45kPa	enabled by scheduler for time	>1sec	2 sec			
			sensor voltage	< 0,45V			0.5 sec			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
	P2229	range check high	sensor signal	>115kPa	enabled by scheduler for time	>1sec	2 sec			
			sensor voltage	>4,8V			0.5 sec			
Idle Speed System										
(disabled during cold start)	P0506	functional check	desired rpm - actual rpm	>100rpm	load (for underspeed only)	<39.75%	10 sec	0.1 sec	0.4 sec	two driving
					coolant temp.	>64.5° C		continuous	continuous	cycles each
	P0507		desired rpm - actual rpm	<-200rpm	intake air temp	>-10.5° C			or 4 sec	with: 0.4 sec
			or		vehicle	at idle			cumulative	continuous
			fuel cut off due to overspeed	>3count	altitude factor (sea level = 1.0)	>0.703factor				or 4 sec
			during this idle		time after engine start	>0sec				cumulative
					cold start idle speed control	FALSE				
					intrusive evap test	not active				
Idle Speed System										
(enabled during cold start)	P0506	functional check	desired rpm - actual rpm	>100rpm	load (for underspeed only)	<39.75%	5 sec	0.1 sec	0.4 sec	two driving
			during catalyst heating on		Engine coolant start temp.	> -10 …. +40° C		continuous	continuous	cycles each
	P0507		desired rpm - actual rpm	<-200rpm	intake air temp	>40° C			or 4 sec	with: 0.4 sec
			during catalyst heating on		vehicle	at idle			cumulative	continuous
					altitude factor (sea level = 1.0)	>0.703factor				or 4 sec
					time after engine start	>0sec				cumulative
					idle speed control catalyst heating	TRUE				
					intrusive evap test	not active				
Vehicle speed sensor										
	P0500	rationality	vehicle speed	>171.875mph	-	---	2 sec	0.1 sec	0.4 sec	two driving
		(high range check)						continuous	continuous	with: 0.4 sec
		rationality	vehicle speed minus	=0mph	vehicle speed	>0mph			or 4 sec	continuous
		(stuck check)	previous vehicle speed		vehicle speed	<319.375mph			cumulative	or 4 sec
					time	>10sec				cumulative
		CAN wheel speed message check	CAN wheel speed message corrupt	=corrupt						
			or missing	=missing						

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
Crankshaft Position Sensor	P0335	circuit continuity	no engine signal	=0rpm	camshaft revolutions detected	>12counts	approx.	0.01 sec	0.4 sec	two driving
			but phase signals available				5 sec	continuous	continuous	cycles each
		rationality check	reference gap missing (sensor signal but no reference)	>6gaps					or 4 sec cumulative	with: 0.4 sec continuous
	P0336	rationality check	unexpected re-synchronization (loss of reference mark)	>6count						or 4 sec cumulative
		rationality check	intermittent loss of engine speed signal	>14count						
	P0338	rationality check	difference in counted teeth between reference gap position events	>8teeth			approx. 2 sec	1 per rev continuous		
Camshaft Position Sensor										
Bank 1 Intake	P0341	plausibility check	no cam position sensor signal	>5count	engine in synchronized mode	TRUE--	10	1 per rev	0.4 sec	two driving
	P0342	circuit low		>			revolutions	continuous	continuous	cycles each
	P0343	circuit continuity or high		>					or 4 sec cumulative	with: 0.4 sec continuous
									cumulative	continuous
Bank 2 Intake	P0345	plausibility check	no cam position sensor signal	>5count						or 4 sec
	P0347	circuit low		>5count						cumulative
	P0348	circuit continuity or high		>5count						
fuel tank pressure sensor					barometric pressure	>= 68 kPa	14 sec	continuous	0.4 sec	2 dcy
	P0453	circuit continuity - high or open	fuel tank pressure	> 3781 Pa	vehicle speed	= 0 mph				
					fuel level	> 6,2 %				
					fuel level	< 87 %				
	P0452	circuit continuity - low	fuel tank pressure	< -4000 Pa	engine start finished	true				
					enabled by diagnostic scheduler	true				
	P0451	rationality -	fuel tank pressure difference	>= 813 Pa			25.5 sec	continuous	0.4 sec	2 dcy

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
		sensor signal change within time	within	= 1 sec	canister vent valve open	true				
		(oscillation check)	for integrated time	>= 25.5 sec	for time	> 3 sec				
					vehicle speed	<= 18.64 mph				
					enabled by diagnostic scheduler	true				
	P0451	rationality - sensor signal stuck (incremental check)	max-min difference of canister purge valve duty cycle	>= 39.84 %	vehicle speed	>= 6.22 mph	25 sec	continuous	0.4 sec	2 dcy
			and		canister purge is active	true				
			max-min difference of fuel tank pressure signal	< 80 Pa	ratio of intake manifold pressure to atmospheric pressure	<= 0.477 -				
			for number of checks	>= 2 counts	atmospheric pressure	>= 68 kPa				
					incremental check without result yet	true				
					fuel level	> 6,2 %				
					fuel level	< 87 %				
					enabled by diagnostic scheduler	true				
	P0327	Monitoring via knock-sensor- and	Cylinder individual signal value	< 0.7422 ... 6.8164 V	- Knock control is active.	true	0,3 sec	continuous	2.6 sec	no MIL
		cylinder-based basic reference noise	(depends on engine speed)		- engine coolant temperature	> 45 °C				
	P0328	signal (voltage).	Cylinder individual signal value	> 57.8908 ... 72.7541 V	- load	> 30 %				
			(depends on engine speed)		- Engine speed for strong signals.	> 2520 rpm				
					- Engine speed for weak signals.	> 2520 rpm				
					- No phase sensor faults during engine start.	true				
					- Engine speed dynamics for knock detection exist.	false				
					- Load dynamics for knock detection exist.	false				
					- No ECM knock-control circuit error.	true				
					- Engine speed limp home function is active.	false				

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
	P0332	Monitoring via knock-sensor- and	Cylinder individual signal value	< 0.7422 ... 6.8164 V	- Knock control is active.	true	0,3 sec	continuous	2.6 sec	no MIL
		cylinder-based basic reference noise	(depends on engine speed)		- engine coolant temperature	> 45 °C				
	P0333	signal (voltage).	Cylinder individual signal value	> 57.8908 ... 72.7541 V	- load	> 30 %				
			(depends on engine speed)		- Engine speed for strong signals.	> 2520 rpm				
					- Engine speed for weak signals	> 2520 rpm				
					- No phase sensor faults during engine start.	true				
					- Engine speed dynamics for knock detection exist.	false				
					- Load dynamics for knock detection exist.	false				
					- No ECM knock-control circuit error.	true				
					- Engine speed limp home function is active.	false				
Knock control sensor's evaluation IC							250 working	Zero and	2.6 s	2 dcy
		Response to Zero Pulse					cycles	Test pulse		
	P0324	monitor IC's integrator offset	integrator's value - 715mV	> 0.215 V	knock control active	true - -		alternate		
					no dynamic condition on engine speed	true - -		250 working		
					no dynamic condition on engine load	true - -		cycles.		
					no fault assumption from knock control test pulse.	true - -				
					the engine speed is within a calibrated range	true - -				
	P0324	monitor IC's integrator gradient	integrator gradient		same as for IC integrator's offset monitoring					
		Response to Test Pulse								

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
	P0324	integrator value check	integrator value of test pulse	< 3.691 V	the engine coolant temperature > calibration	true				
					no dynamic condition on engine speed	true				
					no dynamic condition on engine load	true				
					no fault assumption from the knock					
					control zero test.	true				
Transmission Control Module	P0700	OBD emission fault	signal input	=TCM MILFAULT	-	---	0.01 sec	0.01 sec	immediate	immediate
MIL Illumination Request		detected by the TCM						continuous		
	(Specific TCM DTC shown in freeze frame)									
fuel injector										
cylinder #1	P0201	circuit continuity - open	Voltage	IC internal	engine speed	> 80 rpm	immediately	continuous	0.2 sec	2 dcy
	P0261	circuit continuity - ground			battery voltage	> 9,99 V				
	P0262	circuit continuity - voltage			battery voltage	< 17,99 V				
cylinder #2	P0202	circuit continuity - open			output activated and					
	P0264	circuit continuity - ground			deactivated for complete					
	P0265	circuit continuity - voltage			checking	true				
cylinder #3	P0203	circuit continuity - open								
	P0267	circuit continuity - ground								
	P0268	circuit continuity - voltage								
cylinder #4	P0204	circuit continuity - open								
	P0270	circuit continuity - ground								
	P0271	circuit continuity - voltage								
cylinder #5	P0205	circuit continuity - open								
	P0273	circuit continuity - ground								
	P0274	circuit continuity - voltage								
cylinder #6	P0206	circuit continuity - open								
	P0276	circuit continuity - ground								
	P0277	circuit continuity - voltage								

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
canister ventilation valve	P0449	circuit continuity - open	Voltage	IC internal	engine speed	> 80 rpm	immediately	continuous	0.2 sec	2 dcy
	P0498	circuit continuity - ground			battery voltage	> 9,99 V				
	P0499	circuit continuity - voltage			battery voltage	< 17,99 V				
					output activated and deactivated for complete checking	true				
canister purge valve	P0443	circuit continuity - open	Voltage	IC internal	engine speed	> 80 rpm	immediately	continuous	0.2 sec	2 dcy
	P0458	circuit continuity - ground			battery voltage	> 9,99 V				
	P0459	circuit continuity - voltage			battery voltage	< 17,99 V				
					output activated and deactivated for complete checking	true				
downstream oxygen sensor heater										
Bank #1	P0036	circuit continuity - open	Voltage	IC internal	engine speed	> 80 rpm	immediately	continuous	0.2 sec	2 dcy
	P0037	circuit continuity - ground			battery voltage	> 9,99 V				
	P0038	circuit continuity - voltage			battery voltage	< 17,99 V				
					output activated and deactivated for complete checking	true				
secondary air pump	P0418	circuit continuity - open	Voltage	IC internal	engine speed	> 80 rpm	immediately	continuous	0.2 sec	2 dcy
	P2445	circuit continuity - ground			battery voltage	> 9,99 V				
	P2444	circuit continuity - voltage			battery voltage	< 17,99 V				
					output activated and deactivated for complete checking	true				
intake camshaft control										
Intake Bank #1	P0010	circuit continuity - open	Voltage	IC internal	engine speed	> 80 rpm	immediately	continuous	0.2 sec	2 dcy

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
	P2088	circuit continuity - ground			battery voltage	> 9,99 V				
	P2089	circuit continuity - voltage			battery voltage	< 17,99 V				
Intake Bank #2	P0020	circuit continuity - open			output activated and					
	P2092	circuit continuity - ground			deactivated for complete					
	P2093	circuit continuity - voltage			checking	true				
Dump valve turbo	P0033	circuit continuity - open	Voltage	IC internal	engine speed	> 80 rpm	immediately	continuous	0.2 sec	no MIL
	P0034	circuit continuity - ground			battery voltage	> 9,99 V				
	P0035	circuit continuity - voltage			battery voltage	< 17,99 V				
					output activated and					
					deactivated for complete					
					checking	true				
Boost control valve	P0244	circuit continuity - open	Voltage	IC internal	engine speed	> 80 rpm	immediately	continuous	0.2 sec	no MIL
	P0245	circuit continuity - ground			battery voltage	> 9,99 V				
	P0246	circuit continuity - voltage			battery voltage	< 17,99 V				
					output activated and					
					deactivated for complete					
					checking	true				
Ignition Coil										
circuit continuity										
Cylinder #1	P0351	circuit continuity - open or signal not plausible	Voltage > during	>20revs	engine speed	>600rpm	approx.	engine	0.4 sec	two driving
					engine speed	<5000rpm	1 sec	cycle	continuous	cycles each
			or minimum two fault counters							
	P2300	circuit continuity - ground	Voltage > during	>20revs	battery voltage	>10V		frequency	or 4 sec	with: 0.4 sec
	P2301	circuit continuity - voltage	Voltage > during	>20revs	battery voltage	<18V			cumulative	continuous
Cylinder #2	P0352	circuit continuity - open or signal not plausible	Voltage > during	>20revs				continuous		or 4 sec
			or minimum two fault counters							cumulative
	P2303	circuit continuity - ground	Voltage > during	>20revs						
	P2304	circuit continuity - voltage	Voltage > during	>20revs						
Cylinder #3	P0353	circuit continuity - open	Voltage > during	>20revs						
			or minimum two fault counters							

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
	P2306	circuit continuity - ground	Voltage > during	>20revs						
	P2307	circuit continuity - voltage	Voltage > during	>20revs						
Cylinder #4	P0354	circuit continuity - open	Voltage > during	>20revs						
			or minimum two fault counters							
	P2309	circuit continuity - ground	Voltage > during	>20revs						
	P2310	circuit continuity - voltage	Voltage > during	>20revs						
Cylinder #5	P0355	circuit continuity - open	Voltage > during	>20revs						
			or minimum two fault counters							
	P2312	circuit continuity - ground	Voltage > during	>20revs						
	P2313	circuit continuity - voltage	Voltage > during	>20revs						
Cylinder #6	P0356	circuit continuity - open	Voltage > during	>20revs						
			or minimum two fault counters							
	P2315	circuit continuity - ground	Voltage > during	>20revs						
	P2316	circuit continuity - voltage	Voltage > during	>20revs						
Electronic Throttle Control										
	P0638	motor control range check short term	| powerstage duty cycle | (absolute value)	>80% >80%	battery voltage	>7V	0.6 sec (recoverable)	0.01 sec continuous	immediate	immediate
		motor control range check long term					5.0 sec (latched)			
Electronic Throttle Control										
	P1551	limp-home throttle position out of range	throttle position OR throttle position	<1.8006% >13.0785%	vehicle speed engine speed engine coolant temperature engine coolant temperature intake air temperature intake air temperature battery voltage accelerator pedal position	<=0mph <40rpm >=5.25° C <=84.75° C >=5.25° C <=60° C >9.99V <14.9%	5 sec	0.01 sec at key on	immediate	immediate
Electronic Throttle Control										
	P2100	powerstage circuit switch-off	output circuits not deactivated	=deactivationfault	-	---	0.1 sec	0.01 sec	immediate	immediate

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
			as commanded					at key on		
	P2101	difference between set and actual position of throttle blade	difference between set and actual position of throttle blade	>4 . . . 50% dep. on rate of change	electronic throttle adaptation battery voltage	not active-- >7V	0.5 sec	0.01 sec continuous	immediate	immediate
	P2107	amplifier adjustment of throttle position	amplification value or	<3.9961V	vehicle speed engine speed	<=0mph <40rpm	< 6 sec	0.01 sec once per throttleAdaption	immediate	immediate
			amplification value or offset value or offset value	>4.3242V <-0.1501V >0.1501V	engine coolant temperature engine coolant temperature intake air temperature intake air temperature battery voltage accelerator pedal position	>=5.25° C <=84.75° C >=5.25° C <=60° C >9.99V <14.9%				
	P2119	functionality of return spring	throttle blade return response	>0.56sec	vehicle speed engine speed engine coolant temperature engine coolant temperature intake air temperature intake air temperature battery voltage accelerator pedal position	<=0mph <40rpm >=5.25° C <=84.75° C >=5.25° C <=60° C >9.99V <14.9%	0.56 sec once per ignition on	0.01 sec at key on	immediate	immediate
Electronic Throttle Control										
	P2176	throttle exchange detection learn fail or initial throttle learn failed or learning prohibited due to secondary parameters not met or	range check poti1 value at lower stop throttle potentiometer 1 voltage or throttle potentiometer 1 voltage range check poti2 value at lower stop throttle potentiometer 2 voltage or	<0.212V >0.865V 0 <4.14V	vehicle speed engine speed engine coolant temperature engine coolant temperature intake air temperature intake air temperature battery voltage accelerator pedal position	<=0mph <40rpm >=5.25° C <=84.75° C >=5.25° C <=60° C >9.99V <14.9%	1 sec once per ignition on	0.01 sec at key on	immediate	immediate

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
		minimum throttle position out of range	throttle potentiometer 2 voltage	>4.84						
Throttle Position Sensor 1 (primary)	P0121 P0122 P0123	range check poti voltage plausibility to other poti	sensor difference sensor circuit low voltage sensor circuit high voltage	>9% <0.176V >4.629V	battery voltage	>7V	continuous	0.1 sec continuous	0.4 sec continuous or 4 sec cumulative	two driving cycles each with: 0.4 sec continuous
Sensor 2 (redundant)	P0221 P0222 P0223	range check poti voltage, plausibility to other poti	sensor difference sensor circuit low voltage sensor circuit high voltage	>9% <0.156V >4.883V	battery voltage	>7V	continuous	0.1 sec continuous		or 4 sec cumulative
function monitoring of microcontroller (PCM level 2 command check)	P0606	torque comparison	irreversible error of torque comparison (current and maximum allowed engine torque out of range)	true			5.5 sec	continuous	0.2 sec	2 dcy
		engine load comparison	irreversible error of engine load comparison (calculated and measured engine load out of range)	true						
		engine speed comparison	irreversible error of engine speed comparison (calculated and measured engine speed out of range)	true						

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
		accelerator pedal signal comparison	irreversible error of accelerator pedal signal comparison (synchronism between the two pedal sensors out of range)	true						
		monitoring of AD converter queue	irreversible error of AD-converter queue monitoring (queue not running)	true						
		range check of lower mechanical throttle valve position	irreversible error of lower mechanical throttle valve position limit check (position out of range)	true						
		check of variant coding	irreversible error of variant coding check (coding is incorrect)	true						
		check of AD-converter signal	irreversible error of AD-converter signal check (converted low voltage test impuls out of range)	true						
		check of ignition timing	irreversible error of comparison of ignition timing value	true						

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
			(comparison of ignition timing value with its one's complement is wrong)							
		verification of engine load value	irreversible error of engine load value verification (engine load value and verification value are not identical)	true						
		function controller response check	monitoring module has detected a fault of function controller	true						
		watchdog output signal check	WDA signal activated	true						
		overvoltage detection	internal supply voltage exceeded	true						
ECM Monitoring										
	P0605	rationality check - verification of ROM checksum	wrong ROM checksum	true	PCM after-run time of the last driving cycle completely finished	true	30 sec	at key off once per dcy	2.6 sec	immediately
	P0605	rationality check - verification of ROM checksum	wrong cyclic ROM checksum of critical regions	true			5 sec	0.04 sec continuous	2.6 sec	immediately
	P0604	writeability check of RAM	RAM read and write test failed	true	PCM after-run time of the last driving cycle completely		30 sec	at key off once per	2.6 sec	immediately

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
					finished	true		dcy		
	P0604	writeability check of RAM	cyclic RAM read and write test of critical regions failed	true			1 sec	0.04 sec continuous	2.6 sec	immediately
	P0606	rationality check - programming incomplete	shut down of power stages not possible	true			0.05 sec	at key on once per dcy	2.6 sec	immediately
	P0606	writeability check of Time Processing Unit (TPU) parameter RAM	TPU parameter RAM read and write test failed	true			0.05 sec	at key on once per dcy	2.6 sec	immediately
	P0606	rationality check - verification of Time Processing Unit (TPU) code RAM checksum	wrong TPU code RAM checksum	true			0.3 sec	0.1 sec continuous	2.6 sec	immediately
	P0606	rationality check - time difference check	difference between Time Processing Unit time and PCM time	> 0.001 sec			0.3 sec	0.1 sec continuous	2.6 sec	immediately
accelerator accelerator position sensor		Voltage accelerator position sensor								
	P 2123	range check high	accelerator position sensor voltage 1	> 4.824 V	for time condition batterie voltage is sufficient for 5V accelerator sensor supply	> 0.2 sec true	immediately	continuously	0.2 sec	0.4 sec

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	P 2122	range check low	accelerator sensor voltage 1	< 0.898 V	for time	> 0.2 sec				
			and							
			accelerator sensor voltage 2	< 0.664 V						
			or							
			accelerator sensor voltage 1	< 0.898 V	for time	> 0.2 sec				
			and							
			synchronization between voltages 1 and 2 violated (see values of absolute difference in accelerator sensor voltages depending on ranges in FP1P absolute difference check	true						
			and							
			error reaction accelerator-travel sensor limphome	false						
			and							
			high contact resistance at accelerator voltage 1	false						
	P 2138	absolute difference check	absolute difference between both		condition lower limit violated (see min fault path of FP1P)	false				
		fault time	accelerator sensor voltages in the range		condition lower limit violated (see min fault path of FP2P)	false				
			below 1.25 V	> 0.215 V	error reaction accelerator-travel sensor limphome	false				
			or		condition batterie voltage is sufficient for 5V accelerator sensor supply	true				
			absolute difference between both							
			accelerator sensor voltages in the range							
			from 1.25 V to 3.496 V	> 0.273 V						
			or							
			absolute difference between both							
			accelerator sensor voltages in the range							
			above 3.496 V	> 1.035 V						

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
			and							
			fulfilled for the time	> 0.24 sec						
	P 2128	range check high fault time	accelerator sensor voltage	> 4.824 V	for time	> 0.2 sec				
					condition batterie voltage is sufficient for 5V accelerator sensor supply	true				
	P 2127	range check low	accelerator sensor voltage 1	< 0.898 V	for time	> 0.2 sec				
			and							
			accelerator sensor voltage 2	< 0.684 V						
			or							
			accelerator sensor voltage 2	< 0.684 V	for time	> 0.2 sec				
			and							
			synchronization between potentiometers 1 and 2 violated (see values of absolute difference in accelerator sensor voltages depending on ranges in FP1P absolute difference check below)	true						
			and							
			error reaction accelerator-travel sensor limphome	false						
			and							
			high contact resistance at accelerator voltage 2	false						
Diagnosis of CAN signal timeout – instrument panel	U0212	CAN signal missing	CAN message of Gateway ID 0x380/1 received	< 1.250 s	battery voltage	> 10 V		continuous	immediately	immediately
					battery voltage	< 18 V				
					condition ignition switch on for time	> 3 s	3 s			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	FREQUENCY OF CHECKS	CRITERIA FOR CODE	MIL ILLUM.
					CAN-Status Enable normal message transmission	true				
OBD ISO-15765 Communication Bus										
	U0001	ISO-15765 Bus Error	Invalid Message Received	=invalid	CAN Bus	initialized	0.5 sec	0.01 sec	immediately	immediately
			or Dual Port Ram Hardware Error;	=error	consisting of:	and ready	0.01 sec	continuous		
			or No Communication / Bus Off	=bus off	ignition on for	>3sec	0.03			
					battery voltage	>10V				
					battery voltage	<18V				
					normal bus communication	running--				
	U0101	Communication with TCM	TCM Message Timeout	=message	Automatic Transmission	equipped--	2.5 sec	0.01 sec	immediately	immediately
	U0402		or Invalid Message Content	=missing,	CAN Bus	initialized--		continuous		
				delayed,	consisting of:	and ready				
				or	ignition on for	>3sec				
				invalid	battery voltage	>10V				
				content	battery voltage	<18V				
					normal bus communication	running--				
end										