Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
Camshaft Control													
Electrical													
Bank 1 Intake	P0010	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	0.01 sec	4 sec	two driving
	P2088	circuit continuity - ground				battery voltage	>	10	V		continuous	continuous	cycles each
	P2089	circuit continuity - voltage				battery voltage	<	18.1	V			or 50 sec	with: 4 sec
Bank 1 Exhaust	P0013	circuit continuity - open				output	activated and deactivated for complete checking					cumulative	continuous
	P2090	circuit continuity - ground											or 50 sec
	P2091	circuit continuity - voltage											cumulative
Bank 2 Intake	P0020	circuit continuity - open											
	P2092	circuit continuity - ground											
	P2093	circuit continuity - voltage											
Bank 2 Exhaust	P0023	circuit continuity - open											
	P2094	circuit continuity - ground											
	P2095	circuit continuity - voltage											
System - Control													
Bank 1 Intake	P0011	rationality low / high	difference to start test (filtered actual	6.0 . . . 11.0	degrees	engine speed	>	480	rpm	approx.	0.01 sec	4 sec	two driving
Bank 1 Exhaust	P0014		angle versus filtered desired angle) >	KFDWNWD MXE / 2		engine run time	>	1.8	sec	20 sec	continuous	continuous	cycles each
Bank 2 Intake	P0021		(desired must remain above value	KFDWNWD MXA / 2		camshaft control circuit test	complete	-	-			or 50 sec	with: 4 sec
Bank 2 Exhaust	P0024		to test to complete the evaluation)			error: camshaft control circuit	not set	-	-	(2 times		cumulative	continuous
			same as above, but offset added to the	0	degrees	coolant temperature	<	143	° C	for 2.5 sec			or 50 sec
			difference, during cold start only:			coolant temperature	>	-48	° C	each)			cumulative
			filtered actual angle			engine oil temperature	<	143	° C				
			< filtered desired angle from test start			engine oil temperature	>	-48	° C				
			within time	2.5	sec	cam-crank alignment adaptation	complete	-	-				
			(detects 5 sec slow [time constant])										
			for multiple activation occurrences	10	count								
			(decrements upon activations where	(same as stated in "time required" column)									

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
			no difference is seen between desired and actual)										
			same as above, but during cold start only:	4	count								
			difference (filtered actual angle max	1.5	degrees								
			versus actual at test start) >										
			(to detect slow										
			response versus										
			stuck cam if										
			above this limit)										
			at time	2.5	sec								
			(overlaps with time										
			to detect above)										
			(passes after multiple good activations										
			in both cam phase										
			rotation directions)										
System - Cam - Crank Alignment													
Bank 1 Intake	P0016	cam-crank adapted angle	adapted angle >	14.5	degrees	engine run time >	>	50	sec	approx.	0.2 sec	4 sec	two driving
Bank 1 Exhaust	P0017	limit check	or adapted angle <	14.5	degrees	engine coolant temp >	>	0	° C	600 sec	continuous	continuous	cycles each
Bank 2 Intake	P0018	(applies for each camshaft)	or actual angle with parked cams >	20	degrees	engine coolant temp <	<	95.25	° C			or 50 sec	with: 4 sec
Bank 2 Exhaust	P0019		and <	25	degrees	model: engine oil temp <	<	120	° C	fail after		cumulativ e	continuous
Bank 1 / Idler Sprocket	P0008		adapted angle for both cams >	10.5	degrees	error: camshaft sensor	not set	-	-	2 adaptatio n			or 50 sec
Bank 2 / Idler Sprocket	P0009		adapted angle for both cams <			error: camshaft control circuit	not set	-	-	cycles -			cumulative
										required			
Air / Fuel Ratio Sensor Heating and Oxygen Sensor Heating													
heater circuits - electrical													
bank 1 sensor 1 (primary)	P0030	circuit continuity - open	Voltage	IC Internal	-	engine	running			0.01 sec	0.01 sec	4 sec	two driving
	P0031	circuit continuity - ground				battery voltage	>	10.5	V		continuous	continuou s	cycles each
	P0032	circuit continuity - voltage				battery voltage	<	18.1	V			or 50 sec	with: 4 sec
bank 2 sensor 1 (primary)	P0050	circuit continuity - open				output	activated and deactivated for complete checking					cumulativ e	continuous
	P0051	circuit continuity - ground											or 50 sec

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
	P0052	circuit continuity - voltage											cumulative
bank 1 sensor 2 (secondary)	P0036	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	0.01 sec	4 sec	two driving
	P0037	circuit continuity - ground				battery voltage	>	10	V		continuous	continuous	cycles each
	P0038	circuit continuity - voltage				battery voltage	<	18.1	V			or 50 sec	with: 4 sec
bank 2 sensor 2 (secondary)	P0056	circuit continuity - open				secondary O2 sensor heating	ready					cumulative	continuous
	P0057	circuit continuity - ground				secondary O2 sensor dew point	reached					or 50 sec	
	P0058	circuit continuity - voltage				output	activated and deactivated for complete checking			0.5sec			cumulative
A/F Sensor Heating													
heater performance													
bank 1 sensor 1	P0053	correction value for A/F sensor	absolute value of correction value for	15	Ohms	battery voltage	>	10.5	V	40 sec	0.1 sec	4 sec	two driving
bank 2 sensor 1	P0059	internal resistance measurement	A/F sensor internal resistance >			battery voltage	<	18.1	V		continuous	continuous	cycles each
		too much				engine starting	complete	-	-			or 50 sec	with: 4 sec
												cumulative	continuous
												or 50 sec	
													cumulative
Mass air flow sensor	P0101	range check low	mass air flow <	-1.4 . . . 77.0	g/sec	battery voltage	>	10.5	V	2 sec	0.01 sec	4 sec	two driving
		or		KFMLDMN		time after start	>	0.3	sec		continuous	continuous	cycles each
		fuel trim limits exceeded	> delta lambda correction	0.2	factor	crankshaft revolution counter	>	150	rev			or 50 sec	with: 4 sec
		range - multiplicative				error: throttle position sensor	not set	-	-			cumulative	continuous
		and				engine speed	>	320	rpm			or 50 sec	
		correction factor (modeled air	< correction factor air mass	0.7	factor	air mass	>	11.1	g/s				cumulative
		mass at throttle / air mass				ratio: MAP to Baro	<	0.75	-				
		measured by air mass flow meter)				long term fuel trim active	TRUE	-	-				
		range check high	mass air flow >	31.9 . . . 276	g/sec								
		or		KFMLDMX				-	-				
		fuel trim limits exceeded	< delta lambda correction	-0.2	factor								
		range - multiplicative											
		and											
		correction factor (modeled air	> correction factor air mass	1.3	factor								
		mass at throttle / air mass											
		measured by air mass flow meter)											
	P0102	circuit check low	mass air flow <	-11.7	g/sec	battery voltage	>	7.5	V	3			
	P0103	circuit check high	mass air flow >	294.4	g/sec								

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
Intake air temperature	P0111	response check	max intake air temperature -			drive period - count	>=	16	count	2 sec	0.1 sec	4 sec	two driving
sensor			min intake air temperature >	1.5	° C	each with					continuous	continuous	cycles each
						vehicle speed	>=	34.375	mph			or 50 sec	with: 4 sec
						mass flow	<	42.2	g / sec			cumulative	continuous
						mass flow	>	11.1	g / sec				or 50 sec
						coolant temperature at start	<=	60	° C				cumulative
						no fuel shut-off							
						idle period - count	>=	5	count				
						each with							
						vehicle speed	<=	6.25	mph				
						coolant temperature at start	<=	48	° C				
						coolant temperature	>	60	° C				
						ECT decrease since prior shutdown	>	0	° C				
	P0112	range check low	intake air temperature >	132	° C								
	P0113	range check high	Temperature for closed loop control	-42	° C	time after start	>	180	sec				
						then time in idle	>	10	sec				
						and intake air temperature	<	-42	° C				
						then | IAT change | (abs value)	<=	3.6	° C				
						while							
						integrated air mass increases	>=	1000	g				
Engine coolant	P0116	difference from intake air	filtered difference			key up IAT - previous min IAT	<	2.25	° C	300 sec	0.2 sec	4 sec	immediate
temperature sensor		temperature after soaking	(ECT at key on - IAT at key on) >	10	° C	key up IAT - previous min IAT	>	-30	° C	for block	continuous	additional	once code
						previous accumulated air mass	>	4000	g	heating		after block	has
						previous accumulated air mass	>	4000	g				been set
			or			previous engine run time	>	600	sec	check	one filter	heater	
						or					update per	check when	approx.
			filtered difference			ECT at shut down	>	84.75	° C		cold start	filtered	6 test
			(ECT at key on - IAT at key on) <	-10	° C	Controller Shut Down at end of	last cycle	-	-			difference	average
						Strong Wind / Open Hood	not detected	-	-			exceeds	run length
						based on IAT rise at shut down						threshold	(15°C delta)
						Block Heater	not detected	-	-				
			or										
		plausibility check	calculated coolant temperature model	9.8	° C	the model temperature increases				approx.		or 50 sec	two driving

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
			minus measured temperature >			depending on air flow				500 sec		cumulative	cycles each
													with: 4 sec cont. or 50 sec cum.
Engine coolant	P0117	range check low	coolant temperature >	140.3	° C	If Startup IAT	>	72	° C	0.1 sec	0.1 sec	4 sec	two driving
temperature sensor						hot restart timer	>=	60	sec		continuous	continuous	cycles each
	P0118	range check high	coolant temperature <	-42	° C	If Startup ECT	<	-42	° C			or 50 sec	with: 4 sec
						| ECT-Startup ECT | (abs value)	<=	2.25	° C			cumulative	cont. or 50
						integrated air mass increases	>=	0	g				sec cum.
						and air mass timer	>=	2	sec				
	P0119	intermittent (discontinuity)	delta coolant temperature <	-3.75	° C					approx.	0.01 sec		
			delta coolant temperature >	3.75	° C					300 sec	continuous		
			weighted counter >	60000	count								
			(up 10000 w/jump; down 1 with steady)										
Throttle Position	P0121	range check poti voltage	sensor difference >	9	%	battery voltage	>	7	V	continuous	0.1 sec	4 sec	two driving
Sensor 1 (primary)	P0122	plausibility to other poti	sensor circuit low voltage <	0.176	V						continuous	continuous	cycles each
	P0123		sensor circuit high voltage >	4.629	V							or 50 sec	with: 4 sec
												cumulative	cont. or 50
Sensor 2 (redundant)	P0221	range check poti voltage,	sensor difference >	9	%	battery voltage	>	7	V	continuous	0.1 sec		sec cum.
	P0222	plausibility to other poti	sensor circuit low voltage <	0.156	V						continuous		
	P0223		sensor circuit high voltage >	4.883	V								
Engine Coolant	P0128	Coolant Temperature Below	(calculated reference model coolant temp	10.5	° C	debouncing time	>	20	sec	approx.	0.1 sec	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 50 sec	with: 4 sec
			reference model calculation limit	89.25	° C	est. ambient temperature	>	-10.5	°C			cumulative	continuous
						est. ambient temperature	<	70	°C				or 50 sec
			(development vehicles indicated			vehicle speed	>=	9.375	mph				cumulative
			steady thermostat regulating			engine speed	>	960	rpm				

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
			temperatures of 89°C, as measured			coolant temperature at start	<	70.5	°C				
			by the engine			integrated air mass	>	3000	g				
			coolant temp. sensor.			flow							
			The thermostat opening temp.										
			is 82°C. The thermostat is fully open										
			by 95°C. All critical OBD and										
			emission functions are enabled										
			above 60°C.)										
Air / Fuel Ratio Sensor (primary A/F)													
integrated circuit interface													
bank 1	P0130	A/F sensor voltage	absolute value of A/F sensor voltage			battery voltage	<	18.1	V	0.1 sec	0.1 sec	4 sec	two driving
bank 2	P0150	IC correction too high	IC corrective value >	0.1	V	battery voltage	>	10.7	V		continuous	continuous	cycles each
						engine	running	-	-			or 50 sec	with: 4 sec
						engine starting	complete	-	-			cumulative	continuous
													or 50 sec
													cumulative
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	IC Internal	-	battery voltage	<	18.1	V	2 sec	0.1 sec	4 sec	two driving
bank 2 sensor 1 - low volt	P0151	(reference ground				battery voltage	>	10.7	V		continuous	continuous	cycles each
		) below lower limit											
		or A/F sensor signal at UN	IC Circuit Status shorted low	IC Internal	-	engine	running	-	-			or 50 sec	with: 4 sec
		(reference voltage				engine starting	complete	-	-			cumulative	continuous
		[Nernst voltage])											
		below lower limit											
		or A/F sensor signal at IA	IC Circuit Status shorted low	IC Internal	-								or 50 sec
		(measuring											cumulative
		current trim circuit											
		) below lower limit											
bank 1 sensor 1 - high volt	P0132	A/F sensor signal at VM	IC Circuit Status shorted high	IC Internal	-								
bank 2 sensor 1 - high volt	P0152	(reference ground											
		) above upper limit											
		or A/F sensor signal at UN	IC Circuit Status shorted high	IC Internal	-								
		(reference voltage											
		[Nernst voltage])											
		above upper limit											

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
		or A/F sensor signal at IA	IC Circuit Status shorted high	IC Internal	-								
		(measuring											
		current trim circuit											
		) above upper limit											
Air / Fuel Ratio Sensor (primary A/F)													
response		dynamic response	A/F sensor dynamic value <	0.4	ratio	fuel trim forced amplitude	active	-	-	2 sec			
Bank 1 Sensor 1	P0133	slow or low amplitude				A/F sensor	ready	-	-		0.01 sec	4 sec	two driving
Bank 2 Sensor 1	P0153				(versus	short term fuel trim (o.k.)	< MAX	1.25	factor		continuous	continuous	cycles each
					reference	short term fuel trim (o.k.)	> MIN	0.75	factor			or 50 sec	with: 4 sec
					sensor)	measured A/F minus integral	<	1.06	lambda			cumulative	continuous
						control of secondary O2				then			or 50 sec
						measured A/F minus integral	>	0.94	lambda	dynamic			cumulative
						control of secondary O2				test			
						engine speed	<	2520	rpm	sample			
						engine speed	>	1480	rpm	count			
						volumetric efficiency	<	50	%				
						volumetric efficiency	>	16.5	%	>			
						volumetric efficiency gradient	<	30	%/sec				
						A/F sensor housing model temp	<	570	°C	60			
						absolute value of forced amplitude	>	0.02	lambda	samples			
						filtered purge HC conc. factor	<	15	factor				
						or evap purge	not active						
						all fuel injectors active	TRUE						
						evap purge high HC conc.	FALSE	-	-				
						A/F pumping current circuit	checked OK	-	-				
						error: evap purge valve	not set	-	-				
						error: evap purge valve circuit	not set	-	-				
						scheduled by System Manager	TRUE	-	-				
						heater reached set temperature	TRUE	-	-				
A/F Sensor Heating													
heater performance (primary A/F)													
bank 1 sensor 1	P0135	A/F sensor calculated temperature	A/F sensor temperature calculation <	650	° C	battery voltage	>	10.5	V	70 sec	0.1 sec	4 sec	two driving
bank 2 sensor 1	P0155	too low				battery voltage	<	18.1	V		continuous	continuous	cycles each
						internal resistance measurement	valid	-	-			or 50 sec	with: 4 sec
						all injectors activated	TRUE	-	-			cumulative	continuous
						A/F sensor internal resistance	FALSE	-	-				or 50 sec

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						excessive							cumulative
						correction required							
						engine stop time	>	300	sec				
						engine temperature at start	>	-9.75	° 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 <	740	° C	A/F Heater at Maximum Power	TRUE			60 sec	0.1 sec	4 sec	two driving
bank 2 sensor 1 (primary)	P0155	temperature below threshold		TKERDCMN		modeled exhaust temp. at sensor	>	250	° C		continuous	continuous	cycles each
						timer expires after either:	>	25	sec			or 50 sec	with: 4 sec
						fuel shut off >= 3 sec dur. ends	-	-	-			cumulative	continuous
						or initial A/F heater turn on	-	-	-				or 50 sec
						battery voltage	>	10.5	V				cumulative
						battery voltage	<	18.1	V				
						A/F heater control shut off	FALSE	-	-				
						modeled exhaust temp. valid	FALSE						
						scheduled by System Manager	TRUE	-	-				
Oxygen Sensor													
sensor circuit (secondary O2)													
bank 1 sensor 2	P0137	short circuit to ground	secondary O2 sensor voltage <	0.06	V	secondary O2 heating stable	TRUE	-	-	0.1 sec	0.1 sec	4 sec	two driving
bank 2 sensor 2	P0157					and mod. exhaust gas temp.	>	250	° C		continuous	continuous	cycles each
						for time	>	90	sec			or 50 sec	with: 4 sec
						engine running	TRUE	-	-			cumulative	continuous
						battery voltage	>	10.5	V				or 50 sec
						mod. exhaust-gas temp.	<	800	° C				cumulative
						time after start	<	1	sec				
						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 >	1.05	V	secondary O2 heating stable	TRUE	-	-	5.1 sec			
bank 2 sensor 2	P0158					and mod. Exhaust-gas temp.	>	250	° C				
						for time	>	90	sec				
						engine running	TRUE	-	-				
						battery voltage	>	10.5	V				
						mod. exhaust-gas temp.	<	800	° C				
bank 1 sensor 2	P0140	sensor line disconnection	secondary O2 sensor voltage >	0.401	V	secondary O2 heating stable	TRUE	-	-	60 sec			

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
bank 2 sensor 2	P0160		and secondary O2	0.519	V	and mod. Exhaust-gas	>	250	° C				
			sensor voltage <			temp.							
						for time	>	90	sec				
			or			engine running	TRUE	-	-				
			secondary O2 sensor	40000	Ohm	battery voltage	>	10.5	V				
			internal resistance >										
			when modeled exhaust gas temperature >	600	° C	mod. exhaust-gas temp.	<	800	° C				
Oxygen Sensor (Secondary O2 sensor)						deceleration fuel cut-off (DCFO)	active	-	-	4sec			
Slow response voltage during DCFO	v					secondary O2 sensor voltage	>	0.59	V				
bank 1 sensor 2 (secondary)						since DCFO						4 sec	two driving
bank 2 sensor 2 (secondary)	P0139	secondary O2 sensor	secondary O2 sensor voltage	0.14	V	air mass integration from high	>	15	g			continuous	cycles each
	P0159	response to DFCO	since DCFO			voltage to low voltage							
						during DFCO							
						battery voltage	>	10.5	V				
						secondary O2 sensor readiness	TRUE	-	-				
						or secondary O2 sensor failed	TRUE	-	-				
						DFCO test in DLSAHK function							
						secondary O2 sensor dew point	reached	-	-				
						secondary O2 heating stable	TRUE	-	-				
						primary A/F sensor	ready	-	-				
						primary A/F sensor measured	>	10	lambda				
						A/F value							
Oxygen Sensor Heating													
heater performance (secondary O2)													
bank 1 sensor 2 (secondary)	P0141	secondary O2 sensor	measured secondary O2 sensor internal			battery voltage	>	10.5	V	approx.	0.1 sec	4 sec	two driving
bank 2 sensor 2 (secondary)	P0161	internal resistance	resistance >			battery voltage	<	18.1	V	100 sec	continuous	continuous	cycles each
		above threshold	nominal internal resistance	104 . . . 296	Ohms	engine running	TRUE	-	-			or 50 sec	with: 4 sec
						engine starting	complete	-	-			cumulative	continuous
			multipy times degradation factor	3.5 . . . 7.5	factor	fuel cut off	FALSE	-	-			or 50 sec	
						sec. O2 internal resistance	valid	-	-			cumulative	
			for time	6	sec	intake air temperature	>	-9.75	C				
						engine off soak time	>	120	sec				
						modeled exhaust temp.	in range	360 . . . 500	C				
						at secondary O2 sensor							
						suspicion of secondary	FALSE						
						O2 sensor open circuit							
						secondary O2 voltage supply	ON						

Component/System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						from the deactivation for time	>	120	sec				
Fuel Injector													
circuit continuity													
Cylinder #1	P0201	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	0.01 sec	4 sec	two driving
	P0261	circuit continuity - ground				battery voltage	>	10	V		continuous	continuous	cycles each
	P0262	circuit continuity - voltage				battery voltage	<	18.1	V			or 50 sec	with: 4 sec
Cylinder #2	P0202	circuit continuity - open				output	activated and deactivated for complete checking					cumulative	continuous
	P0264	circuit continuity - ground										or 50 sec	
	P0265	circuit continuity - voltage										cumulative	
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											
Misfire		crankshaft speed	emissions relevant misfire rate	1.82	%	engine speed	>	420	rpm	1000 revs	cylinder	4 sec	Fault during
Emission Level		fluctuation cylinder 1 to				engine speed	<	7000	rpm		firing	continuous	1st interval:
Multiple Cylinder	P0300	cylinder 6				indicated torque (idle, no drive)	>	10.2	%		frequency		2 faults in
Cylinder #1	P0301					indicated torque (drive) (MISALUN)	>	10.5 . . . 29.3	%			After	2 different
Cylinder #2	P0302					engine speed gradient	<	1200 . . . 3620	rpm/sec		continuous	detection,	drive cycles.
Cylinder #3	P0303					volumetric efficiency gradient	<	225 . . . 1350	%/rev			the	
Cylinder #4	P0304					cylinder events after engine start	>	6	ignitions			diagnostic	Fault during
Cylinder #5	P0305					air temperature	>	-30	° 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	transition	FALSE	-			conditions	different
						leak detection	off	-	-			are	drive cycles

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						active handling	not active					encountered	with at least
						ABS	not active	-	-				4 faults in
						engine drag control	not active	-	-				each.
						fuel cut off	not active	-	-				
						fuel level	>	11.6	%				
						OR fuel level	<	11.6	%				
						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			Includes all the above with the				1000 revs			First
Multiple Cylinder	P0300					following exceptions:				First interval			occurance:
Cylinder #1	P0301					First interval extention				200 revs			immediate
Cylinder #2	P0302					engine coolant temperature	<	47	°C	all remaining			flashing
Cylinder #3	P0303					fuel level	>=	11.6	%	intervals			while error
Cylinder #4	P0304		18.1 . . . 5	%		OR fuel level	<	11.6	%				present, then
Cylinder #5	P0305		see Misfire			AND blinking MIL	blinking	-	-				no MIL
Cylinder #6	P0306		supplemental			AND NOT first blink event	-	-	-				with no error.
			data										
			(h) (2.5.1)										Second
													occurance:
													immediate
													flashing
													while error
													present, then
													solid MIL
													with no error.
Knock Control													
Circuit	P0324	zero test (part 1)	| integrator voltage - 715 mV | >	0.215	V	knock control	active	-	-	50 sec	every 510	4 sec	two driving
			(absolute value)			engine speed gradient	<	2300	rpm / sec	cumulative	engine	continuous	cycles each
			for consecutive events	2	count	manifold pressure gradient	<	50 . . . 100	kPa / sec		cycles	or 50 sec	with: 4 sec
			or			test pulse fault assumption	not set	-	-		continuous	cumulative	continuous
	P0324	zero test (part 2)	| integrator gradient | (absolute value) >	60 . . . 40	V / sec	knock control	active	-	-				or 50 sec
			(absolute value)	DKROFN		engine speed gradient	<	2300	rpm / sec				cumulative
			for consecutive events	2	count	manifold pressure gradient	<	50 . . . 100	kPa / sec				
						test pulse fault assumption	not set	-	-				
						engine speed	>	1000	rpm				
						engine speed	<	4200	rpm				

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
	P0324	test pulse	test pulse integral <	3.7	V	engine coolant temp.	>	60	° C				
			for consecutive events	2	count	engine speed gradient	<	2300	rpm / sec				
						engine load gradient	<	50 . . . 100	kPa / sec				
						zero test fault assumption	not set	-	-				
Bank 1	P0327	range check low	reference voltage <	0.7 . . . 2.2	V	engine coolant temperature	>	60	° C	approx.	0.1 sec	4 sec	two driving
Performance				UDKSNU		engine speed	>	2000	rpm	20 sec	continuous	continuous	cycles each
			for consecutive events	100	count	cylinder identification	correct	-	-			or 50 sec	with: 4 sec
	P0328	range check high				engine speed	>	2000	rpm			cumulative	continuous
			reference voltage >	33 . . . 99	V	engine speed gradient	<	2300	rpm / sec				or 50 sec
				UDKSNO		engine load gradient	<	50 . . . 100	kPa / sec				cumulative
			for consecutive events	100	count	error: knock control circuit (IC)	not set	-	-				
						engine speed limp home	not active	-	-				
Bank 2	P0332	range check low	reference voltage <	0.7 . . . 2.2	V	engine coolant temperature	>	60	° C	approx.	0.1 sec	4 sec	two driving
Performance				UDKSNU		engine speed	>	2000	rpm	20 sec	continuous	continuous	cycles each
			for consecutive events	100	count	cylinder identification	correct	-	-			or 50 sec	with: 4 sec
	P0333	range check high				engine speed	>	2000	rpm			cumulative	continuous
			reference voltage >	33 . . . 99	V	engine speed gradient	<	2300	rpm / sec				or 50 sec
				UDKSNO		engine load gradient	<	50 . . . 100	kPa / sec				cumulative
			for consecutive events	100	count	error: knock control circuit (IC)	not set	-	-				
						engine speed limp home	not active	-	-				
Crankshaft Position Sensor	P0335	circuit continuity	no engine signal	0	rpm	camshaft revolutions detected	>	12	counts	approx.	0.01 sec	4 sec	immediate
			but phase signals available							5 sec	continuous	continuous	once code
		rationality check	reference gap missing >	3	gaps							or 50 sec	has
			(sensor signal but no reference)									cumulative	been set
	P0336	rationality check	unexpected re-synchronization >	6	count								with: 4 sec
			(loss of reference mark)										continuous
		rationality check	intermittent loss of engine speed signal >	28	count								or 50 sec
	P0338	rationality check	number of measured teeth per crankshaft	8	count					approx.	1 per rev		cumulative

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
			revolution deviates from expected							2 sec	continuous		
Camshaft Position Sensor													
Bank 1 Intake	P0341	plausibility check	signal erratic or out of position	120	count	engine in synchronized mode	TRUE	-	-	10	1 per rev	4 sec	two driving
	P0342	circuit low	signal permanently low							revolutions	continuous	continuous	cycles each
	P0343	circuit continuity or high	signal permanently high									or 50 sec	with: 4 sec
												cumulative	continuous
Bank 2 Intake	P0346	plausibility check	signal erratic or out of position										or 50 sec
	P0347	circuit low	signal permanently low										cumulative
	P0348	circuit continuity or high	signal permanently high										
Bank 1 Exhaust	P0366	plausibility check	signal erratic or out of position										
	P0367	circuit low	signal permanently low										
	P0368	circuit continuity or high	signal permanently high										
Bank 2 Exhaust	P0391	plausibility check	signal erratic or out of position										
	P0392	circuit low	signal permanently low										
	P0393	circuit continuity or high	signal permanently high										
Ignition Coil													
circuit continuity													
Cylinder #1	P0351	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	600	rpm	20	1 per rev	4 sec	two driving
	P2300	circuit continuity - ground				engine speed	<	5000	rpm	crankshaft	continuous	continuous	cycles each
	P2301	circuit continuity - voltage				battery voltage	>	10	V	revolutions		or 50 sec	with: 4 sec
Cylinder #2	P0352	circuit continuity - open				battery voltage	<	18.1	V			cumulative	continuous
	P2303	circuit continuity - ground											or 50 sec
	P2304	circuit continuity - voltage											cumulative
Cylinder #3	P0353	circuit continuity - open											
	P2306	circuit continuity - ground											
	P2307	circuit continuity - voltage											
Cylinder #4	P0354	circuit continuity - open											
	P2309	circuit continuity - ground											
	P2310	circuit continuity - voltage											
Cylinder #5	P0355	circuit continuity - open											
	P2312	circuit continuity - ground											
	P2313	circuit continuity - voltage											
Cylinder #6	P0356	circuit continuity - open											

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
	P2315	circuit continuity - ground											
	P2316	circuit continuity - voltage											
Catalyst Bank 1	P0420	oxygen storage of catalyst	normalized oxygen storage	1	factor	exhaust gas mass flow	>	7.22	g/sec	approx.	0.01 sec	4 sec	two driving
Catalyst Bank 2	P0430		less than normalized oxygen storage			exhaust gas mass flow	<	15.56	g/sec	1000 sec		continuous	cycles each
			of a limit catalyst <			catalyst temp. model	<	750	° C	during	one		with: 4 sec
						catalyst temp. model	>	500	° C	active	completed		continuous
						engine speed	>	1040	rpm	driving	test per		or 50 sec
						engine speed	<	3000	rpm		driving		cumulative
						engine load	>	15 ….	%	one test	cycle		
						engine load	<	25 ….	%				
						modeled catalyst temp. gradient	<	1	° C / sec	(average			
						exhaust gas mass flow gradient	<	3.89	g/sec 2	of 3			
						fuel system closed loop	active	-	-	checks)			
						time after engine start	>	450	sec	per driving			
						ambient temperature	>	-30	° C	cycle			
						error: secondary O2 aging	not set	-	-				
						error: fuel system	not set	-	-				
						error: cam control diagnosis	not set						
						scheduled by System Manager	TRUE						
						secondary O2 sensor readiness	TRUE						
						short term fuel trim at Upper limit	not set						
						short term fuel trim at lower limit	not set						
						Evap. Leak detection	not active						
						transient compensation	not set						
						catalyst clear out	not set						
						catalyst monitoring device control command	not set						
						primary A/F sensor response	set						
Evaporative System and Leak Monitor													
Small Leak - 0.020 "	P0442	natural	filtered fault index >	0.6	-	Eng. Running Vac.	not set	(see P0455 for details)		approx.	0.1 sec	filtered	immediate
		pressure/vacuum				pull down							
		in tank				or vac. pulldown	0.020" leak	(see P0455 for details)		600 sec	once per	value	
			based on:			suspect leak							
						est amb air temp	>	1.5	° C	each test	engine off	exceeds	once code
			(peak pressure - peak vacuum) <	540 . . . 1430	Pa	est amb air temp	<	32.25	° C		cycle	threshold	has

07_GRP02_All Engines.xls

Component/System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						Engine stop coolant temp	>	74.25	° C	approx.		then	been set
						engine run time	>	600	sec	6 test		4 sec	
						trip distance travelled	>	5.1	miles	average		continuous	approx.
						@ vehicle speed above	>	1.6	mph	run length			6 test
						evap fuel volatility factor	<	8	factor				average
						fuel level	>	11.6	%				run length
						fuel level	<	88.4	%				
						fuel level change from keyoff	<	10.2	%				(The MIL
						error: vehicle speed	not set	-	-				actually is
						error: engine coolant temp	not set	-	-				requested
						error: purge valve	not set	-	-				during shut
						error: fuel tank pressure	not set	-	-				down soak.
						error: system voltage	not set	-	-				It becomes
						error: air mass meter	not set						visible on
						error: intake air temp	not set						the
						error: canister vent valve	not set	-	-				following
						altitude adaption	valid	-	-				drive.)
						tank vacuum out of range	FALSE	-	-				
						start (coolant - intake air)	<	9.75	° C				
						start engine coolant temp	<	42	° C				
						Start intake air temp	>	1.5	° C				
						Start intake air temp	<	32.3	° C				
						time since previous test	>	0	sec				
						amb pressure	>	68	kPa				
						battery voltage	>	10.8	V				
						vehicle odometer	>	12.5	miles				
Evaporative Emission System													
Purge Solenoid	P0443	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	0.01 sec	4 sec	two driving
Control Circuit	P0458	circuit continuity - ground				battery voltage	>	10	V		continuous	continuous	cycles each
	P0459	circuit continuity - voltage				battery voltage	<	18.1	V			or 50 sec	with: 4 sec
						output	activated and deactivated for complete checking					cumulative	continuous
												or 50 sec	cumulative
Evaporative System and Leak Monitor													
EVAP canister vent valve	P0446	underpressure in tank	tank pressure <	-800	Pa	fuel system status	closed loop	-	-	approx.	0.1 sec	4 sec	two driving
						vehicle speed	<	1.9	mph	5 sec		continuous	cycles each
						engine	idling	-	-		one		with: 4 sec
						battery voltage	>	10.5	V	Only one	completed		continuous
						battery voltage	<	18.1	V	test per	test per		or 50 sec

Component/System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						fuel tank pressure	>	-2500	Pa	will be	driving		cumulative
						fuel tank pressure	<	1000	Pa	completed.	cycle		
						ratio: (MAP Model / Baro)	<	0.555	-				
						est amb air temp	>	1.5	° C	The test			
						est amb air temp	<	32.25	° C	will attempt			
						fuel level	>	11.6	%	to run up			
						fuel level	<	88.4	%	to 10 times			
						engine start temp - amb. temp	<	9.75	° C	until it			
						time after engine start	>	600	sec	successfully			
						or fuel mixture adaptation	stable	-	-	completes			
						amb pressure	>	68	kPa	a test			
						maximum number of attempts	<	10	-				
						error: mass air flow	not set	-	-				
						error: coolant temp	not set	-	-				
						error: intake air temp	not set	-	-				
						error: fuel tank pres	not set	-	-				
						error: system voltage	not set	-	-				
						error: purge valve	not set	-	-				
						error: vehicle speed	not set	-	-				
						error: canister vent valve	not set	-	-				
						error: purge valve flow	not set	-	-				
						error: accelerator pedal	not set	-	-				
Evap Vent Solenoid	P0449	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	0.01 sec	4 sec	two driving
Control Circuit	P0498	circuit continuity - ground				battery voltage	>	10	V		continuous	continuous	cycles each
	P0499	circuit continuity - voltage				battery voltage	<	18.1	V	Only one		or 50 sec	with: 4 sec
						output	activated and deactivated for complete checking			test per		cumulative	continuous
												or 50 sec	
													cumulative
Fuel Tank	P0451	rationality - signal oscillation	| delta pressure signal |	813	Pa	ambient temperature model	>	-7	° C	25.5	0.1 sec	4 sec	two driving
Pressure Sensor			(= current pressure - old pressure) >			vehicle speed >=	<=	18.75	mph	sec	continuous	continuous	cycles each
						time after canister vent valve open	>	3	sec			or 50 sec	with: 4 sec
		or											
		rationality - signal range check	sensor signal >=	1500	Pa	time after engine start	>	1	sec	25			
			sensor signal >=	-2970	Pa	time after canister vent valve open	>	3	sec	sec			
						vehicle speed >=	>=	6.25	mph				
						ambient temperature model	>	-7	° C				
	P0452	circuit continuity - ground	sensor signal <	-3969	Pa	vehicle speed	=	0.0	mph	14 sec			or 50 sec

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
	P0453	circuit continuity - voltage	sensor signal >	1719	Pa	ambient pressure	>	68000	Pa				cumulative
						ambient temperature model	>	-7	° C				
						fuel level	>	11.6	%				
						fuel level	<	88.4	%				
Evaporative System and Leak Monitor													
Large leak	P0455	vacuum pulldown slope	absolute value			fuel system status	closed loop	-	-	11 sec	0.1 sec	4 sec	two driving
						vehicle speed	<	1.9	mph			continuous	cycles each
			of vacuum pulldown slope <	30 . . . 70	Pa	engine	idling	-	-	Only one	one		with: 4 sec
				KLGGRTED 05		battery voltage	>	10.5	V	test per	completed		continuous
			OR			battery voltage	<	18.1	V	driving cycle	test per		or 50 sec
Stuck Closed Purge valve	P0455	vacuum pulldown slope				fuel tank pressure	>	-2500	Pa	complete d.	driving		cumulative
			tank vacuum >	-1.221	Pa	fuel tank pressure	<	1000	Pa	cycle			
						ratio: (MAP Model / Baro)	<	0.555	-	The test			
						est amb air temp	>	1.5	° C	will attempt			
						est amb air temp	<	32.25	° C	to run up			
						fuel level	>	11.6	%	to 10 times			
						fuel level	<	88.4	%	until it			
						engine start temp - amb. temp	<	9.75	° C	successfu lly			
						time after engine start	>	600	sec	completes			
						or fuel mixture adaptation	stable	-	-	a test			
						amb pressure	>	68	kPa				
						error: mass air flow	not set	-	-				
						error: coolant temp	not set	-	-				
						error: intake air temp	not set	-	-				
						error: fuel tank pres	not set	-	-				
						error: system voltage	not set	-	-				
						error: purge valve	not set	-	-				
						error: vehicle speed	not set	-	-				
						error: canister vent valve	not set	-	-				
						error: purge valve flow	not set	-	-				
						error: accelerator pedal	not set	-	-				
Fuel Level Sensor Circuit						electrical fuel level sensor(s)					0.1 sec	4 sec	no
fuel level sensor 1						without failure	TRUE	-	-		continuous	continuous	
	P0461	rationality	fuel level sensor signal movement <	1.5	%	battery voltage	>=	10.5	V				
						battery voltage	<=	18.1	V				
						engine started	TRUE	-	-				
						fuel level state stable	TRUE	-	-				
						vehicle speed	>	0.0	mph				
						error: vehicle speed signal	not set	-	-				
						number of checks	>	1	-				

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						difference between fuel consumed							
						by engine and							
						change in fuel level							
						signal	>	45.6	%				
						for time	>	300.0	sec				
	P0462	range check low	voltage <	0.25	V	battery voltage	>=	10.5	V	60 sec	0.1 sec	4 sec cont.	no
						battery voltage	<=	18.1	V		continuous	or 50 sec	
						engine started	TRUE	-	-			cumulative	
	P0463	range check high	voltage >	3.2	V	battery voltage	>=	10.5	V	60 sec	0.1 sec	4 sec cont.	no
						battery voltage	<=	18.1	V		continuous	or 50 sec	
						engine started	TRUE	-	-			cumulative	
Cooling fan 1 relay	P0480	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	0.01 sec	4 sec	two driving
Control Circuit	P0691	circuit continuity - ground				battery voltage	>	10	V		continuous	continuous	cycles each
	P0692	circuit continuity - voltage				battery voltage	<	18.1	V			or 50 sec	with: 4 sec
												cumulative	continuous
Cooling fan 2 relay	P0481	circuit continuity - open	Voltage	IC Internal	-								or 50 sec
Control Circuit	P0693	circuit continuity - ground											cumulative
	P0694	circuit continuity - voltage											
Evaporative System and Leak Monitor													
Leaking purge valve	P0496	underpressure in tank	tank pressure loss gradient <	-60	Pa	fuel system status	closed loop	-	-	about 4 sec	0.1 sec	4 sec	two driving
						vehicle speed	<	1.9	mph			continuous	cycles
						engine	idling	-	-	Only one	one		with: 4 sec
						battery voltage	>	10.5	V	test per	completed		continuous
						battery voltage	<	18.1	V	driving cycle	test per		or 50 sec
						fuel tank pressure	>	-2500	Pa	completed.	driving		cumulative
						fuel tank pressure	<	1000	Pa		cycle		
						ratio: (MAP Model / Baro)	<	0.555	-	The test			
						fuel level	>	11.6	%	will attempt			
						fuel level	<	88.4	%	to run up			
						engine start temp - amb. temp	<	9.75	° C	to 10 times			
						time after engine start	>	600	sec	until it			
						or fuel mixture adaptation	stable	-	-	successfully			
						amb pressure	>	68	kPa	completes			
						maximum number of attempts	<	10	-	a test			
						est amb air temp	>	1.5	° C				

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						est amb air temp	<	32.25	° C				
						error: mass air flow	not set	-	-				
						error: coolant temp	not set	-	-				
						error: intake air temp	not set	-	-				
						error: fuel tank pres	not set	-	-				
						error: system voltage	not set	-	-				
						error: purge valve	not set	-	-				
						error: vehicle speed	not set	-	-				
						error: canister vent valve	not set	-	-				
						error: purge valve flow	not set	-	-				
						error: accelerator pedal	not set	-	-				
Idle Speed System													
(disabled during cold start)	P0506	functional check	desired rpm - actual rpm >	100	rpm	load (for underspeed only)	<	2 . . . 35	%	10 sec	0.1 sec	4 sec	two driving
						coolant temp.	>	-10.5	° C		continuous	continuous	cycles each
	P0507		desired rpm - actual rpm <	-200	rpm	intake air temp	>	-10.5	° C			or 50 sec	with: 4 sec
			or			vehicle	at idle					cumulative	continuous
			fuel cut off due to overspeed >	3	count	altitude factor (sea level = 1.0)	>	0.656	factor				or 50 sec
			during this idle			time after engine start	>	0	sec				
						evap purge (high HC conc.)	FALSE						cumulative
						cold start idle speed control	FALSE						
						intrusive evap test	not active						
						error: throttle position	not set						
						error: vehicle speed	not set						
						error: coolant temperature	not set						
						error: intake air temperature	not set						
						error: evap system	not set						
						error: evap purge valve	not set						
Idle Speed System													
(enabled during cold start)	P050A	functional check	desired rpm - actual rpm >	100	rpm	load (for underspeed only)	<	35	%	5 sec	0.1 sec	4 sec	two driving
			during catalyst heating on			Engine coolant start temp.	>	-10 …. +40	° C		continuous	continuous	cycles each
			desired rpm - actual rpm <	-200	rpm	vehicle	at idle					or 50 sec	with: 4 sec
			during catalyst heating on			altitude factor (sea level = 1.0)	>	0.656	factor			cumulative	continuous
						Engine coolant start temp.	<	80	° C				or 50 sec
						catalyst heating	TRUE	-	-				cumulative
						evap purge (high HC conc.)	FALSE	-	-				
						idle speed control catalyst heating	TRUE	-	-				
						intrusive evap test	not set	-	-				
						error: throttle position	not set	-	-				
						error: vehicle speed	not set	-	-				

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						error: coolant temperature	not set	-	-				
						error: intake air temperature	not set	-	-				
						error: evap system	not set	-	-				
						error: evap purge valve	not set	-	-				
System Voltage													
	P0560	rationality	powertrain supply relay feedback input			engine speed	>	80	rpm	2 sec	0.1 sec	4 sec	no
			voltage <	2.54	V						continuous	continuous	
	P0562	range check low	voltage <	10	V	time after engine start	>	180	sec			or 50 sec	
												cumulative	
	P0563	range check high	voltage >	18	V	time after engine start	>	180	sec				
						vehicle speed	>	3.1	mph				
ECM monitoring													
	P0601	rationality	wrong ROM checksum	-	-	checksum calculation at power	TRUE	-	-	30 sec	0.01 sec	4 sec	code set
						down in the last driving cycle					at key off	continuous	then 5 sec
						completely finished							
		rationality	wrong cyclic ROM checksum of	-	-	partial checksum on critical				30 sec	0.01 sec	4 sec	code set
			critical regions			variables					at key on	continuous	then 5 sec
	P0602	rationality -	service ECU bit set in calibration	service ECU bit set	-	-	-	-	-	1 sec	0.01 sec	4 sec	code set
		programming incomplete									at key on	continuous	then 5 sec
	P0603	ETC monitoring controller reset	SW internal	SW internal		power down calculation	completly	-	-	5 sec	0.01 sec	4 sec	code set
						in the last driving cycle	finished				continuous	continuous	then 5 sec
												or 50 sec	
												cumulative	
	P0604	functional check	RAM writeability check			power down calculation	completly	-	-	5 sec	0.01 sec	4 sec	code set
			read and write test			in the last driving cycle	finished				at key off	continuous	then 5 sec
		cyclic RAM-check	writeability check of RAM											
	P0606	Electronic Throttle Control (ETC) checks	SW internal	SW internal		power down calculation	completly	-	-	5 sec	0.01 sec	4 sec	code set
		ETC monitoring torque comparison				in the last driving cycle	finished				continuous	continuous	then 5 sec
		ETC monitoring engine speed signal										or 50 sec	

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
		ETC monitoring volumetric efficiency signal										cumulativ e	
		ETC mon. vol. Eff., spark advance, A/D conv. grp. A, reaction crosscheck											
		ETC monitoring throttle crosscheck											
		ETC monitoring A/D conv group B, A/D converter supply voltage crosscheck											
		ETC monitoring redundant pedal signal											
Electronic Throttle Control													
	P0638	motor control range check	| circuit duty cycle | >	80	%	battery voltage	>	7	V	0.6 sec	0.01 sec	4 sec	code set
		short term	(absolute value)							(recovera ble)	continuous	continuou s	then 5 sec
												or 50 sec	
		motor control range check								5.0 sec		cumulativ e	
		long term								(latched)			
5V reference voltage										3 sec	0.01 sec	4 sec	code set
monitoring	P0641	circuit continuity - open	Voltage	IC Internal	-	ignition key on	TRUE	-	-			continuou s	then 5 sec
	P0642	circuit continuity - ground				ECM power relay	TRUE	-	-				
	P0643	circuit continuity - voltage											
	P0651	circuit continuity - open	Voltage	IC Internal	-								
	P0652	circuit continuity - ground											
	P0653	circuit continuity - voltage											
	P0697	circuit continuity - open	Voltage	IC Internal	-								
	P0698	circuit continuity - ground											
	P0699	circuit continuity - voltage											
MIL Control Circuit	P0650	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	0.01 sec	4 sec	no
		circuit continuity - ground				battery voltage	>	10	V		continuous	continuou s	(but is
		circuit continuity - voltage				battery voltage	<	18.1	V			or 50 sec	shown in
						output	activated and deactivated for complete checking					cumulativ e	Mode $03)

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
Transmission Control Module	P0700	OBD emission fault	signal input	-	-	-	-	-	-	0.01 sec	0.01 sec	4 sec cont.	code set
MIL Illumination Request		detected by the TCM									continuous	or 50 sec	then 5 sec
	(Specific TCM DTC shown in freeze frame)											cumulative	
Vehicle speed sensor													
Manual Transmission	P0501	rationality	vehicle speed	171.9	mph	-	-	-	-	2 sec	0.1 sec	4 sec	two driving
		(high range check)									continuous	continuous	cycles each
	P0502	rationality	vehicle speed	3.1	mph	engine speed	>	1800	rpm	3 sec		or 50 sec	with: 4 sec
		(low range check)				engine speed	>	3520	rpm			cumulative	continuous
						fuel shut off	TRUE	-	-			or 50 sec	
						coolant temperature	>	40	° C			cumulative	
Clutch Pedal Switch	P0833	rationality -	detected clutch pedal	6	count -	gear changes	>	20	count	approx.	0.1 sec	4 sec	two driving
			press count <			detected							
Manual Transmission		input switch state changes			switch	(ratio of engine speed to				500 sec	continuous	continuous	cycles each
					presses	vehicle speed -- range change)						or 50 sec	with: 4 sec
					detected	with brake pedal	not applied	-	-			cumulative	continuous
						Delay between shift detections	>	4	sec				or 50 sec
						vehicle speed	>	9.4	mph				cumulative
						between gear change detects							
Engine Metal													
Overtemperature Protection	P1258	engine coolant temperature	engine coolant temperature >	129	° C	engine run time	>	30	sec	1 sec	0.1 sec	4 sec cont.	code set
(Limp Home Function Active)		too high				error: engine coolant temp	not set	-	-		continuous	or 50 sec	then 5 sec
												cumulative	
Rough Road Signal	P1380	signal missing	signal missing	-	-	no	-	-	-	5 sec	0.1 sec	4 sec or	no
						error: misfire monitoring	TRUE	-	-		continuous	50 sec cum	
Electronic Throttle Control													code set
	P1551	limp-home throttle position	throttle position <	1.8	%	vehicle speed	<=	0	mph	5 sec	0.01 sec	4 sec	then 5 sec
		out of range	OR			engine speed	<	40	rpm		at key on	continuous	with: 4 secs
			throttle position >	13.1	%	engine coolant temperature	>=	5.25	° C			or 50 sec	continuous
						engine coolant temperature	<=	84.75	° C			cumulative	or 50 sec
						intake air temperature	>=	5.25	° C				cumulative
						intake air temperature	<=	60	° C				
						battery voltage	>	10.0	V				
						accelerator pedal position	<	14.9	%				
Air / Fuel Ratio Sensor (primary A/F)													

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
integrated circuit interface													
bank 1	P167A	A/F sensor IC operating voltage	low voltage	TRUE	-	battery voltage	>	10.7	V	10 sec	0.1 sec	4 sec	two driving
bank 2	P167B	too low				battery voltage	<	18.1	V		continuous	continuous	cycles each
		A/F sensor IC SPI interface	communication error	TRUE	-	engine	running	-	-	0.1 sec		or 50 sec	with: 4 sec
		communication error										cumulative	continuous
		A/F sensor IC circuit write error	write error	TRUE	-	engine starting	TRUE	-	-	0.1 sec		or 50 sec	
		at INIT register										cumulative	
Fuel Level Sensor Circuit						electrical fuel level sensor(s)				300 sec	0.1 sec	4 sec	no
fuel level sensor 2						without failure	TRUE	-	-		continuous	continuous	
	P2066	rationality	fuel level sensor signal movement <	1.5	%	battery voltage	>=	10.5	V				
						battery voltage	<=	18.1	V				
						engine started	TRUE	-	-				
						fuel level state stable	TRUE	-	-				
						vehicle speed	>	0.0	mph				
						error: vehicle speed signal	not set	-	-				
						number of checks	>	1	-				
						difference between fuel consumed							
						by engine and	>	45.6	%				
						change in fuel level							
						signal	<	-45.6	%				
						for time	>	300.0	sec				
	P2067	range check low	voltage <	0.25	V	battery voltage	>=	10.5	V	approx.	0.1 sec	4 sec cont.	no
						battery voltage	<=	18.1	V	60 sec	continuous	or 50 sec	
						engine starting	TRUE	-	-			cumulative	
	P2068	range check high	voltage >	3.2	V	battery voltage	>=	10.5	V	approx.	0.1 sec	4 sec cont.	no
						battery voltage	<=	18.1	V	60 sec	continuous	or 50 sec	
						engine starting	TRUE	-	-			cumulative	
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	-0.03	lambda	engine starting	TRUE	-	-	2 sec	0.1 sec	4 sec	two driving
Bank 2	P2098	trim - rich shift	integral control <			secondary O2 trim active	TRUE	-	-		continuous	continuous	cycles each
		- correction below threshold				and secondary O2 oscillation	TRUE	-	-			or 50 sec	with: 4 sec
						check finished						cumulative	continuous
primary A/F signal LEAN / secondary O2 signal RICH						then timer	>	40	sec				or 50 sec

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
Bank 1	P2097	A/F sensor long term secondary	secondary O2 sensor trim	0.03	lambda	scheduled by System Manager	TRUE						cumulative
Bank 2	P2099	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						
Electronic Throttle Control													
	P2100	circuit switch-off	output circuits not deactivated	-	-	-	-	-	-	0.1 sec	0.01 sec	4 sec	code set
			as commanded								at key on	continuous	then 5 sec
	P2101	difference between set and	difference between set and	4 . . . 50	%	electronic throttle adaptation	not active	-	-	0.5 sec	0.01 sec	4 sec cont.	code set
		actual position of	actual position of	dep. on rate		battery voltage	>	7	V		continuous	or 50 sec	then 5 sec
		throttle blade	throttle blade >	of change								cumulative	
	P2105	Electronic Throttle Control (ETC) checks				power down processing	completly	-	-	5 sec	0.01 sec	4 sec	code set
		ETC monitoring watchdog shutdown path				in the last driving cycle	finished				at key on	continuous	then 5 sec
	P2119	functionality of return spring	throttle blade return response	0.56	sec	vehicle speed	<=	0	mph	0.56 sec	0.01 sec	4 sec	code set
						engine speed	<	40	rpm		at key on	continuous	then 5 sec
						engine coolant temperature	>=	5.25	° C	once			
						engine coolant temperature	<=	84.75	° C	per			
						intake air temperature	>=	5.25	° C	ignition			
						intake air temperature	<=	60	° C	on			
						battery voltage	>	10.0	V				
						accelerator pedal position	<	14.9	%				
Accelerator Pedal Position	P2122	range check low	voltage	0.84	V	battery voltage	>	7	V	0.2 sec	0.01 sec	4 sec cont.	code set
Sensor 1	P2123	range check high		4.82	V						continuous	or 50 sec	then 5 sec
												cumulative	
Accelerator Pedal Position	P2127	range check low	voltage	0.66	V	battery voltage	>	7	V	0.2 sec	0.01 sec	4 sec cont.	code set
Sensor 2	P2128	range check high		4.82	V						continuous	or 50 sec	then 5 sec
												cumulative	
Accelerator Pedal	P2138	plausibility	voltage difference >	0.21	V	-	-	-	-	0.24 sec	0.01 sec	4 sec	code set
Position 1 versus Position 2			idle range	0.27	V						continuous	continuous	then 5 sec
			voltage difference	0.27	V							or 50 sec	

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
			pedal partially pressed >										cumulative
			voltage difference >	1.07	V								
			pedal fully pressed										
		plausibility when leaving idle range	votage pedal 1 >	1.17	V								
			voltage difference pedal 2 >	0.04	V								
Electronic Throttle Control													
	P2176	throttle exchange detection	range check poti1 value at lower stop			vehicle speed	<=	0	mph	1 sec	0.01 sec	4 sec	code set
		learn fail	throttle potentiometer 1 voltage <	0.212	V	engine speed	<	40	rpm	at key on	continuous	then 5 sec	
		or	or			engine coolant temperature	>=	5.25	° C	once			
		initial throttle learn failed	throttle potentiometer 1 voltage >	0.865	V	engine coolant temperature	<=	84.75	° C	per			
		or				intake air temperature	>=	5.25	° C	ignition			
		learning prohibited due to	range check poti2 value at lower stop		0	intake air temperature	<=	60	° C	on			
		secondary parameters not met	throttle potentiometer 2 voltage <	4.14	V	battery voltage	>	10.0	V				
		or	or			accelerator pedal position	<	14.9	%				
		minimum throttle position	throttle potentiometer 2 voltage >	4.84									
		out of range											
Fuel System Lean/Rich						air mass flow	>=	7.5	g/sec	approx.	0.1 sec	4 sec	two driving
Multiplicative						air mass flow	<=	83.3	g/sec	300 sec	continuous	continuous	cycles each
						engine load	>=	17.0	%	from engine		or 50 sec	with: 4 sec
Bank 1	P2177	fuel trim limits exceded	delta lambda correction >	1.23	factor	engine load	<=	45.0	%	start (after		cumulative	continuous
	P2178	range - multiplicative	or delta lambda correction <	0.78	factor	engine speed	>=	1200.0	rpm	adaptation			or 50 sec
		(load > threshold and air flow > threshold)				engine speed	<=	3400.0	rpm	has	After	cumulative	
Bank 2	P2179		delta lambda correction >	1.23	factor	closed loop control	TRUE	-	-				
	P2180		or delta lambda correction <	0.78	factor	throttle angle	<=	99.6	99.6				
						engine coolant temperature	>	60	°C				
						intake air temperature	<=	60	°C				
						primary A/F sensor 1 readiness	TRUE	-	-				
						primary A/F sensor 2 readiness	TRUE	-	-				
						command lambda	<	1.2	-				
						command lambda	>	0.83	-				
						catalyst heating	not set	-	-				

Component/System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						critical misfire rate detected	not set	-	-				
						deceleration fuel cut-off	not set	-	-				
						transient compensation	not set	-	-				
						wide open throttle	not set	-	-				
						integrated fuel mass	>	700.0	g				
						and empty-valid fuel level	not set	-	-				
						error: cam control diagnosis	not set	-	-				
						error: inection value fault	not set	-	-				
						error: catalyst damaging misfire	not set	-	-				
Fuel System Lean/Rich additive													
										0.01 sec	0.01 sec	4 sec	two driving
Bank 1	P2187	range - additive	delta fuel load correction >	7.0	%	air mass flow	>=	1.4	g/sec		continuous	continuous	cycles each
	P2188	low speed and low load	or delta fuel load correction <	-7.0	%	air mass flow	<=	6.7	g/sec			or 50 sec	with: 4 sec
						engine load	>=	7.5	%			cumulative	continuous
Bank 2	P2189		delta fuel load correction >	7.0	%	engine load	<=	24.8	%				or 50 sec
	P2190		or delta fuel load correction <	-7.0	%	engine speed	>=	520.0	rpm				cumulative
						engine speed	<=	1000.0	rpm				
						closed loop control	TRUE	-	-				
						engine coolant temperature	>	60	°C				
						intake air temperature	<=	60	°C				
						primary A/F sensor 1 readiness	TRUE	-	-				
						primary A/F sensor 2 readiness	TRUE	-	-				
						command lambda	<	1.2	-				
						command lambda	>	0.83	-				
						catalyst heating	not set	-	-				
						critical misfire rate detected	not set	-	-				
						deceleration fuel cut-off	not set	-	-				
						transient compensation	not set	-	-				
						wide open throttle	not set	-	-				
						integrated fuel mass	>	700.0	g				
						and empty-valid fuel level	not set	-	-				
						error: cam control diagnosis	not set	-	-				
						error: inection value fault	not set	-	-				
						error: catalyst damaging misfire	not set	-	-				
Oxygen Sensor (secondary O2) Trim of Air / Fuel Ratio Sensor (primary A/F)													
Bank 1	P2195	secondary O2 sensor operation	secondary O2 sensor voltage >	0.85	V	A/F sensor measured lambda	>	1.08	lambda	approx.	0.1 sec	4 sec	two driving
Bank 2	P2197	too rich - strong correction				short term fuel trim	= MAX	1.25	factor	100 sec	continuous	continuous	cycles each

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						A/F sensor	ready	-	-			or 50 sec	with: 4 sec
		A/F sensor measured too lean	or			secondary O2 sensor	ready	-	-			cumulative	continuous
						suspicion A/F sensor not mounted	FALSE	-	-				or 50 sec
						and not confirmed	FALSE	-	-				cumulative
						A/F sensor							
						not mounted	FALSE	-	-				
						then							
						accumulated exhaust gas mass	>	200	g				
			secondary O2 sensor voltage >	0.85	V	A/F sensor measured lambda	>	1.08	lambda				
						secondary O2 sensor fuel trim	>	0.003	lambda				
						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	-	-				
						suspicion A/F sensor not mounted	FALSE	-	-				
						and not confirmed	FALSE	-	-				
						A/F sensor							
						not mounted	FALSE	-	-				
						then							
						accumulated exhaust gas mass	>	200	g				
			secondary O2 sensor voltage >	0.85	V	target lambda	>	1.04	lambda	2 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.)	> MIN	0.75	factor				
						suspicion A/F sensor not mounted	FALSE	-	-				
						and not confirmed	FALSE	-	-				
						A/F sensor							
						not mounted	FALSE	-	-				
						secondary O2 circuit error	FALSE	-	-				
						secondary O2 aging error	FALSE	-	-				
						then							
						accumulated exhaust gas mass	>	800	g				

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
Oxygen Sensor (secondary O2) Trim of Air / Fuel Ratio Sensor (primary A/F)													
Bank 1	P2196	secondary O2 sensor operation	secondary O2 sensor voltage <	0.15	V	A/F sensor measured lambda	<	0.92	lambda	approx.	0.1 sec	4 sec	two driving
Bank 2	P2198	too lean - strong correction				short term fuel trim	= MIN	0.75	factor	100 sec	continuous	continuous	cycles each
						A/F sensor	ready	-	-			or 50 sec	with: 4 sec
		A/F sensor measured too rich				secondary O2 sensor	ready	-	-			cumulative	continuous
						suspicion A/F sensor not mounted	FALSE	-	-				
						and not confirmed A/F sensor	FALSE	-	-				
						not mounted	FALSE	-	-				
						then							or 50 sec
						accumulated exhaust gas mass	>	200	g				cumulative
			secondary O2 sensor voltage <	0.15	V	A/F sensor measured lambda	<	0.92	lambda				
						secondary O2 sensor fuel trim	<	-0.003	lambda				
						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	-	-				
						suspicion A/F sensor not mounted	FALSE	-	-				
						and not confirmed A/F sensor	FALSE	-	-				
						not mounted	FALSE	-	-				
						then							
						accumulated exhaust gas mass	>	200	g				
			secondary O2 sensor voltage <	0.15	V	target lambda	<	0.96	lambda	2 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.)	< MAX	1.25	factor				
						suspicion A/F sensor not mounted	FALSE	-	-				
						and not confirmed A/F sensor	FALSE	-	-				
						not mounted	FALSE	-	-				
						secondary O2 circuit error	FALSE	-	-				
						secondary O2 aging error	FALSE	-	-				

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						then							
						accumulated exhaust gas mass	>	800	g				
Barometric Pressure Sensor													
Rationality													
	P2227	range check high	sensor signal >	115	KPa	error : barometric pressure sensor	not set	-	-	2 sec	continuous	4 sec	two driving
						electrical							cycles each
			or			for time	>	0.2	sec				with: 4 sec
		range check low	sensor signal <	50	KPa	error : barometric pressure sensor	not set	-	-	2 sec	continuous	4 sec	continuous
						electrical							or 50 sec
			or			for time	>	0.2	sec				cumulative
		sensor offset / jump test low	sensor output change within 20 sec period >	5	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	continuous	4 sec	
			OR										
			barometric pressure signal pressure	30	KPa	time since engine start	<	5	sec				
			jump from previous key off >			error : barometric pressure sensor electrical	not set	-	-				
			AND										
			sensor output + THRESHOLD	2	KPa	air mass flow over throttle	>	11.1	g/sec				
			< pressure model			pressure ratio over throttle	<	0.75	-				
						engine running time	>	1	sec				
						Evap. Leak detection active	not set	-	-				
						error: throttle position sensor	not set	-	-				
						error: air flow mass meter	not set	-	-				
						error : barometric pressure sensor electrical	not set	-	-				
			or										
		sensor offset / jump test high	sensor output change within 20 sec period >	5	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	continuous	4 sec	
			OR										
			barometric pressure signal pressure	30	KPa	time since engine start	<	5	sec				
			jump from previous key off >			error : barometric pressure sensor electrical	not set	-	-				
			AND										
			sensor output - THRESHOLD	2	KPa	air mass flow over throttle	>	11.1	g/sec				
			> pressure model			pressure ratio over throttle	<	0.75	-				
						engine running time	>	1	sec				
						Evap. Leak detection active	not set	-	-				
						error: throttle position sensor	not set	-	-				
						error: air flow mass meter	not set	-	-				
	P2228	range check low	voltage <	0.2	V	enabled by scheduler for time	>	1	sec	2 sec			

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
	P2229	range check high	voltage >	4.87	V	enabled by scheduler for time	>	1	sec				
Air / Fuel Ratio Sensor (primary A/F)													
electrical													
wire to wire short circuit		sensor short to heater	A/F sensor voltage gradient	0.08 . . . 0.2	V	within time after heating on/off	<	0.01	sec	10 sec	0.01 sec	4 sec	two driving
bank 1 sensor 1	P2231		at heater control turn on >	KLSDULSUP		heater duty cycle	>	4	%		continuous	continuous	cycles each
bank 2 sensor 1	P2234					A/F sensor fully heated for	>	10	sec	additional		or 50 sec	with: 4 sec
			A/F sensor voltage gradient	-0.08 . . . -0.2	V	volumetric efficiency gradient	<	30	% / sec	time if		cumulative	continuous
			at heater control switch off <	KLSDULSUN		all injectors activated	TRUE	-	-	fuel level			or 50 sec
			(magnitude greater +/- compare)			battery voltage	<	18.1	V	is low and			cumulative
						battery voltage	>	10.5	V	not failed			
			total of above occurrences	35	count	critical misfire rate detected	FALSE	-	-				
			within 10 second			catalyst heating	FALSE	-	-	600 sec			
			monitoring periods			activated							
						A/F sensor IC diagnosis	complete	-	-				
						error: A/F sensor IC	not set	-	-				
						modeled exh. 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	TRUE	-	-	10 sec	0.01 sec	4 sec	two driving
bank 2 sensor 2	P2235	to heater output line	voltage gradient >	2	V	and mod. Exhaust-gas temp.	>	250	° C		continuous	continuous	cycles each
			within time after heater turn off <	0.04	sec	for time	>	90	sec			or 50 sec	with: 4 sec
			for occurrences >	4	count	engine running	TRUE	-	-			cumulative	continuous
			out of heater turn offs	6	count	battery voltage	>	10.5	V				or 50 sec
						mod. exhaust-gas temp.	<	800	° C				cumulative
						time after dew point exceeded	>	10	sec				
Air / Fuel Ratio Sensor (primary A/F)													
pumping current circuit open		lambda control factor change	absolute value of lambda control factor	0.1	lambda	battery voltage	<	18.1	V	1.5 sec	0.1 sec	4 sec	two driving
bank 1 sensor 1	P2237	above threshold	change from the point when the			battery voltage	>	10.7	V		continuous	continuous	cycles each
bank 2 sensor 1	P2240		secondary conditions are met >			engine	running	-	-			or 50 sec	with: 4 sec
						engine starting	complete	-	-			cumulative	continuous
						A/F sensor voltage	<	1.52	V				or 50 sec
						A/F sensor voltage	>	1.48	V				cumulative
						A/F sensor electrical trimming	not active	-	-				

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						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 |	>	0.02	lambda				
						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	-	-				
Air / Fuel Ratio Sensor (primary A/F)													
pumping current circuit open		A/F sensor voltage within upper	A/F sensor voltage <	1.52	V	battery voltage	<	18.1	V	approx.	0.1 sec	4 sec	two driving
bank 1 sensor 1	P2237	and lower thresholds	and A/F sensor voltage >	1.48	V	battery voltage	>	10.7	V	8 sec	continuous	continuous	cycles each
bank 2 sensor 1	P2240	and desired				engine	running	-	-	once the		or 50 sec	with: 4 sec
		lambda is outside											
		of upper or lower threshold				engine starting	complete	-	-	driving		cumulative	continuous
						target lambda above upper limit	>	1.03	lambda	condition			or 50 sec
						or below lower limit	<	0.97	lambda	is met			cumulative
						closed loop control	TRUE	-	-				
						A/F sensor heater	TRUE	-	-				
						at operating temperature							
						A/F sensor electrical trimming	active	-	-				
						A/F sensor dynamic response	not slow	-	-				
						error: A/F sensor heating	not set	-	-				
						integrated exhaust gas mass	>	200	g				
Air / Fuel Ratio Sensor (primary A/F)													
pumping current circuit open		A/F sensor not lean enough	A/F sensor voltage <	1.7	V	battery voltage	<	18.1	V	2 sec	0.1 sec	4 sec	two driving
bank 1 sensor 1	P2237	during fuel shut off operation				battery voltage	>	10.7	V		continuous	continuous	cycles each
bank 2 sensor 1	P2240					engine	running	-	-			or 50 sec	with: 4 sec
						engine starting	complete	-	-			cumulative	continuous
						time after fuel shut off	>	3	sec				or 50 sec
						A/F sensor heater	TRUE	-	-				cumulative
						at operating temperature							
						evap purge cycle flag	TRUE	-	-				
						error: evap purge valve	TRUE	-	-				

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
Air / Fuel Ratio Sensor (primary A/F)													
reference voltage circuit open		A/F sensor voltage	A/F sensor voltage <	0.2	V	battery voltage	<	18.1	V	2 sec	0.1 sec	4 sec	two driving
bank 1 sensor 1	P2243	above upper threshold	A/F sensor voltage >	4.7	V	battery voltage	>	10.7	V		continuous	continuous	cycles each
bank 2 sensor 1	P2247	or below lower threshold				engine	running	-	-			or 50 sec	with: 4 sec
						engine starting	complete	-	-			cumulative	continuous
			for time	1	sec	A/F sensor heating normal	>	20	sec				or 50 sec
						operation range for time							cumulative
						error: A/F sensor heater circuit	not set	-	-				
						A/F sensor internal resistance	>	570	Ohms				
Air / Fuel Ratio Sensor (primary A/F)													
reference ground circuit open		A/F sensor heater coupling	A/F sensor voltage gradient >	0.010	V	battery voltage	<	18.1	V	10 sec	0.1 sec	4 sec	two driving
bank 1 sensor 1	P2251	occurs due to	for number of times	20	count	battery voltage	>	10.7	V		continuous	continuous	cycles each
bank 2 sensor 1	P2254	max heating control reached	monitored in 10 sec intervals			engine	running	-	-			or 50 sec	with: 4 sec
		due to reference ground circuit	with monitoring within 0.05 sec			engine starting	complete	-	-			cumulative	continuous
		disconnection	of each heater circuit activation event			modeled exhaust gas	<	900	° C				or 50 sec
						temperature at A/F sensor							cumulative
						A/F sensor voltage	<	1.53	V				
						A/F sensor voltage	>	1.47	V				
						A/F sensor heating normal	>	20	sec				
						operation range for time							
						A/F sensor internal resistance	>	570	Ohms				
						error: A/F sensor heater circuit	not set	-	-				
						A/F sensor heating ready	TRUE	-	-				
						and engine	running	-	-				
						and A/F heater control shut off	FALSE	-	-				
						and finished fuel cutoff for >	>	2	sec				
						and battery voltage	>	11	V				
						for time	>	30	sec				
Oxygen Sensor						engine running	TRUE	-	-				
sensor response (secondary O2)						battery voltage	>	10.5	V				
bank 1 sensor 2	P2270	oscillation check low	secondary O2 sensor voltage <	0.582 . . . 0.661	V	secondary O2 sensor	ready	-	-	approx.	0.1 sec	4 sec	two driving
bank 2 sensor 2	P2272		for time >	100	sec	for time	>	10	sec	600 sec	continuous	continuous	cycles each
		then				secondary O2 closed loop control	active	-	-			or 50 sec	with: 4 sec
		ramping in enrichment by	0.3	lambda	DFCO	FALSE	-	-	additional			cumulative	continuous
		at gradient	0.017	λ / sec	engine air flow (intrusive test)	>	5.56	g/sec	time if			or 50 sec

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
			for time (after enrichment limit reached)	10	sec	and engine air flow	<	33.33	g/sec	fuel level			cumulative
						for time	>	3	sec	is low and			
						engine air flow (passive monitor)	>	9.72	g/sec	not failed			
						sec. O2 trim - fast lean correction	FALSE			600 sec			
						sec. O2 trim - fast rich correction	FALSE						
						sec. O2 trim - slow correction	FALSE						
						sec. O2 aging DFCO test failed	FALSE						
						engine	running						
						scheduled by System Manager	TRUE						
bank 1 sensor 2	P2271	oscillation check high	secondary O2 sensor voltage >	0.582 . . . 0.661	V	engine running	TRUE	-	-		0.1 sec	4 sec	two driving
bank 2 sensor 2	P2273		for time >	100	sec	battery voltage	>	10.5	V		continuous	continuous	cycles each
			then			secondary O2 sensor	ready	-	-			or 50 sec	with: 4 sec
			ramping in enleanment by	0.07	lambda	for time	>	10	sec			cumulative	continuous
			at gradient	0.017	λ / sec	secondary O2 closed loop control	active						or 50 sec
			for time (after enleanment limit reached)	10	sec	DFCO	FALSE						cumulative
						engine air flow (intrusive test)	>	5.56	g/sec				
						and engine air flow	<	33.33	g/sec				
						for time	>	3	sec				
						engine air flow (passive monitor)	>	9.72	g/sec				
						sec. O2 trim - fast lean correction	FALSE						
						sec. O2 trim - fast rich correction	FALSE						
						sec. O2 trim - slow correction	FALSE						
						sec. O2 aging DFCO test failed	FALSE						
						engine	running						
						scheduled by System Manager	TRUE						
bank 1 sensor 2	P2271	fuel cut off check high	secondary O2 sensor voltage >	0.139	V	engine running	TRUE	-	-	0.2 sec	0.1 sec	4 sec	two driving
bank 2 sensor 2	P2273		time after fuel cut off >	4	sec	battery voltage	>	10.5	V		continuous	continuous	cycles each
						secondary O2 heating stable	TRUE	-	-			or 50 sec	with: 4 sec
						secondary O2 sensor dew point	reached	-	-			cumulative	continuous
						for time	>	30	sec				or 50 sec
						air passed after fuel cut off	>	15	g				cumulative
						modeled exhaust temp	>	350	° C				
						at secondary O2 sensor							
						scheduled by System Manager	TRUE	-	-				

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						error: evap canister purge sys.	not set	-	-				
						error: evap purge valve ckt	not set	-	-				
						error: battery voltage	not set	-	-				
						error: misfire	not set	-	-				
						error: fuel system monitoring	not set	-	-				
						leak detection	not active	-	-				
Air / Fuel Ratio Sensor (primary A/F)													
sensor voltage		A/F sensor voltage	A/F sensor voltage >	3.7	V	A/F sensor heater	TRUE	-	-	10 sec	0.1 sec	4 sec	two driving
bank 1 sensor 1	P2297	exceeds threshold	and			at operating temperature					continuous	continuous	cycles each
bank 2 sensor 1	P2298	but not out of full range	A/F sensor voltage <	4.81	V	engine starting	complete	-	-	additional		or 50 sec	with: 4 sec
						desired A/F	<	1.6	lambda	time if		cumulative	continuous
			or			all injectors activated	TRUE	-	-	fuel level			or 50 sec
						scheduled by System Manager	TRUE	-	-	is low and			cumulative
			AF sensor voltage >	2.5	V	A/F sensor	ready	-	-	not failed			
			and			suspicion A/F sensor lean shift	FALSE	-	-	600 sec			
			A/F sensor voltage <	3.06	V								
			(if using rich calibration										
			curve characteristic)										
Air / Fuel Ratio Sensor (primary A/F)													
measuring (trim) current		A/F sensor voltage	A/F sensor voltage >	4.81	V	battery voltage	<	18.1	V	4 sec	0.1 sec	4 sec	two driving
circuit open		above threshold				battery voltage	>	10.7	V		continuous	continuous	cycles each
bank 1 sensor 1	P2626					engine	running	-	-	additional		or 50 sec	with: 4 sec
bank 2 sensor 1	P2629					engine starting	complete	-	-	time if		cumulative	continuous
						fuel cut off	TRUE	-	-	fuel level			or 50 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			
Fuel Level Sensor Circuit													
fuel transfer pump	P2636	transfer pump failure	fuel level 1 <	10.6	%	sensor signal without failure	TRUE	-	-	240 sec	0.1 sec	4 sec cont.	no
			and			fuel level state stable	TRUE	-	-		continuous	or 50 sec	
			fuel level 2 >	22.8	%	engine starting	complete	-	-			cumulative	
OBD ISO-15765 Communication Bus													
	U0073	ISO-15765 Bus Error	Invalid Message Received			CAN Bus	initialized			1 sec	0.01 sec	4 sec	code set
			or Dual Port Ram Hardware Error;			consisting of:	and ready			0.01 sec	continuous	continuous	then 5 sec

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
			or No Communication / Bus Off			ignition on for	>	3	sec	0.02 sec		or 50 sec	
						battery voltage	>	10.5	V			cumulative	
						battery voltage	<	18.1	V				
						normal bus communication	running	-	-				
	U0101	Communication with TCM	TCM Message Timeout	message		Automatic Transmission	equipped	-	-	2.5 sec	0.01 sec	4 sec	code set
	P0864		or Invalid Message Content	missing,		CAN Bus	initialized	-	-		continuous	continuous	then 5 sec
				delayed,		consisting of:	and ready					or 50 sec	
				or		ignition on for	>	3	sec			cumulative	
				invalid		battery voltage	>	10.5	V				
				content		battery voltage	<	18.1	V				
						normal bus communication	running	-	-				

Calibration Tables

Common to all

applications

Maximum Allowed Deviation - Intake Camshaft Position

degrees crank	Modeled Engine Oil Temperature (°C)				
Engine Speed (rpm)	0	60	80	100	130
800	6.00	6.00	7.00	9.00	11.00
1200	6.00	6.00	6.00	6.00	7.00
1600	6.00	6.00	6.00	6.00	7.00
2000	6.00	6.00	6.00	6.00	6.00
2500	6.00	6.00	6.00	6.00	6.00
4000	6.00	6.00	6.00	6.00	6.00

P0101 KFMLDMN (internal manufacturer cross reference)

Mass Air Flow Threshold - Minimum

Mass Air Flow (kg / h)	Percent Throttle (%)							
Engine Speed (rpm)	0	5	15	25	40	50	60	100
320	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
560	1.0	1.0	5.2	8.5	12.2	13.9	14.9	14.9
1000	1.0	2.4	8.0	19.3	28.2	31.2	32.7	34.5
1520	1.3	3.6	10.9	28.8	47.2	54.6	56.0	57.9
2000	1.7	4.4	14.0	36.3	61.7	71.0	75.1	78.4
3000	2.6	4.8	19.0	53.0	99.0	123.8	127.9	134.8
4000	2.8	5.0	23.8	72.0	138.0	165.8	173.0	187.8
5000	3.0	5.0	27.3	81.5	168.0	206.3	218.5	236.9
6000	3.0	5.0	30.4	81.5	192.0	238.1	255.3	277.1

Mass Air Flow (g / sec)	Percent Throttle (%)							
Engine Speed (rpm)	0	5	15	25	40	50	60	100
320	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
	560	0.3	0.3	1.4	2.4	3.4	3.9	4.1	4.1				
	1000	0.3	0.7	2.2	5.4	7.8	8.7	9.1	9.6				
	1520	0.4	1.0	3.0	8.0	13.1	15.2	15.6	16.1				
	2000	0.5	1.2	3.9	10.1	17.1	19.7	20.9	21.8				
	3000	0.7	1.3	5.3	14.7	27.5	34.4	35.5	37.4				
	4000	0.8	1.4	6.6	20.0	38.3	46.1	48.1	52.2				
	5000	0.8	1.4	7.6	22.6	46.7	57.3	60.7	65.8				
	6000	0.8	1.4	8.4	22.6	53.3	66.1	70.9	77.0				
		MIN	-1.4					MAX	77.0				
P0101	KFMLDMX	(internal manufacturer cross reference)											
	Mass Air Flow Threshold - Maximum												
	Mass Air Flow (kg / h)	Percent Throttle (%)											
	Engine Speed (rpm)	0	5	15	25	40	50	60	100				
	320	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0				
	560	115.0	126.0	142.0	154.0	163.0	165.0	185.0	206.0				
	1000	139.0	149.0	173.0	184.5	195.0	199.0	201.3	215.0				
	1520	173.0	190.0	223.0	250.0	274.0	281.0	282.0	284.9				
	2000	206.0	229.0	282.0	321.0	364.0	381.0	384.0	385.0				
	3000	208.0	230.0	328.0	450.0	546.0	583.0	590.0	592.0				
	4000	217.0	243.0	372.0	529.0	674.0	741.0	745.0	750.0				
	5000	224.0	249.0	403.0	570.0	778.0	865.0	868.0	871.4				
	6000	230.0	271.0	428.0	600.0	819.0	927.0	940.4	992.8				
	Mass Air Flow (g / sec)	Percent Throttle (%)											
	Engine Speed (rpm)	0	5	15	25	40	50	60	100				
	320	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3				
	560	31.9	35.0	39.4	42.8	45.3	45.8	51.4	57.2				
	1000	38.6	41.4	48.1	51.3	54.2	55.3	55.9	59.7				
	1520	48.1	52.8	61.9	69.4	76.1	78.1	78.3	79.1				
	2000	57.2	63.6	78.3	89.2	101.1	105.8	106.7	106.9				
	3000	57.8	63.9	91.1	125.0	151.7	161.9	163.9	164.4				
	4000	60.3	67.5	103.3	146.9	187.2	205.8	206.9	208.3				
	5000	62.2	69.2	111.9	158.3	216.1	240.3	241.1	242.1				
	6000	63.9	75.3	118.9	166.7	227.5	257.5	261.2	275.8				
		MIN	31.9					MAX	275.8				
P0141, P0161	KFRINH / 2	(internal manufacturer cross reference)											
	Sensor Element (Ceramic) Impedance, Nominal Value - Secondary O2 Sensor												
	Ohms	Modeled Exhaust Gas Temperature at Secondary O2 Sensor (° C)											
	O2 Heater Power (watts)	360	400	440	480	520							
	0.7	296	232	200	192	168						296		
	0.8	208	168	152	144	144								
	1.0	128	120	112	104	104								
	FRINH1 / 2	(internal manufacturer cross reference)												

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
Multiplication Factor for Internal Resistance KFRINH Nominal Value - Secondary O2 Sensor													
	Modeled Exhaust Gas Temperature at Secondary O2 Sensor (° C)												
	360	400	440	480	520								
	factor	7.50	6.50	5.50	4.50	3.50							
P0324	**DKROFN**	(internal manufacturer cross reference)											
	Voltage Gradient Limit of Knock Sensor Integrator Rise for zero test												
	Test Period (microseconds)												
	1000	1500	2000	3000	4000	5000							
	Voltage Rise (V / sec)	60.0	50.0	45.0	40.0	40.0	40.0						
	Test Period (sec)												
	0.001	0.0015	0.002	0.003	0.004	0.005							
	Voltage Rise (V / sec)	60.0	50.0	45.0	40.0	40.0	40.0						
P0327, P0332	**UDKSNU**	(internal manufacturer cross reference)											
	Reference voltage threshold for knock sensor diagnosis - Lower Limit												
	Engine Speed (rpm)												
	400	800	1200	1600	2000	2400	2800	3200	3600	4000	4400	4800	5200
	Peak RMS Voltage (V)	0.53	0.53	0.53	0.57	0.66	0.74	0.90	1.00	1.09	1.19	1.31	1.50	1.76
P0328, P0333	**UDKSNO**	(internal manufacturer cross reference)											
	Reference voltage threshold for knock sensor diagnosis - Upper Limit												
	Engine Speed (rpm)												
	400	800	1200	1600	2000	2400	2800	3200	3600	4000	4400	4800	5200
	Peak RMS Voltage (V)	33	33	33	33	33	33	33	33	33	47	47	67	82
P0442	**KFEONVPT**	(internal manufacturer cross reference)											
	Vacuum / Pressure Threshold for Fuel Tank Leak Detection												

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
Vacuum / Pressure (hPa)	Ambient Temperature (Model) (C)												
Fuel Level (%)	0	6.8	9.8	15	19.5	23.3	27	31.5	36	39.8			
5	10.65	12.34	12.67	11.26	10.06	9.73	10.87	12.83	14.12	14.30			
14	10.65	12.34	12.67	11.26	10.06	9.73	10.87	12.83	14.12	14.30			
23	9.82	12.21	12.60	11.20	10.00	9.70	10.46	12.19	13.29	13.70			
32	7.25	8.59	8.99	9.15	9.53	8.00	8.00	9.40	10.89	11.92			
41	7.25	8.50	8.19	8.44	9.38	8.00	7.60	8.30	8.80	8.80			
50	7.25	7.37	6.32	6.40	7.37	6.05	6.05	8.30	8.80	8.80			
59	7.25	7.37	6.82	6.49	6.05	6.05	6.05	8.30	8.80	8.80			
68	5.67	5.73	6.38	6.95	6.31	6.31	6.31	8.30	8.80	8.80			
77	5.38	5.38	5.38	6.98	6.41	6.41	6.41	8.30	8.80	8.80			
86	5.38	5.38	5.38	6.83	6.10	6.10	6.10	8.30	8.80	8.80			
95	5.38	5.38	5.38	6.83	6.10	6.10	6.10	8.30	8.80	8.80			
	Tank Capacity	65.8	Liters										
Vacuum / Pressure (Pa)	Ambient Temperature (Model) (C)												
Fuel Level (%)	0	6.8	9.8	15	19.5	23.3	27	31.5	36	39.8			
5	1065	1234	1267	1126	1006	973	1087	1283	1412	1430			
14	1065	1234	1267	1126	1006	973	1087	1283	1412	1430			
23	982	1221	1260	1120	1000	970	1046	1219	1329	1370			
32	725	859	899	915	953	800	800	940	1089	1192			
41	725	850	819	844	938	800	760	830	880	880			
50	725	737	632	640	737	605	605	830	880	880			
59	725	737	682	649	605	605	605	830	880	880			
68	567	573	638	695	631	631	631	830	880	880			
77	538	538	538	698	641	641	641	830	880	880			
86	538	538	538	683	610	610	610	830	880	880			
95	538	538	538	683	610	610	610	830	880	880			
P0455	**KLGGRTED05**	(internal manufacturer cross reference)											
	Vacuum Gradient Threshold for Fuel Tank Leak Detection												
	Fuel Level liters	0	10	20	30	40	50	60	70	75	80		
	hPa / sec	0.300	0.350	0.400	0.450	0.500	0.550	0.600	0.650	0.675	0.700		
		Tank Capacity	65.8	Liters									
	Fuel Level (%)	0	15.2	30.4	45.6	60.8	76.0	91.2	106.4	114.0	121.6		
	Pa / sec	30.0	35.0	40.0	45.0	50.0	55.0	60.0	65.0	67.5	70.0		
P2101	**DWDKSBAMX**	(internal manufacturer cross reference)											
	Maximum Throttle Angle Deviation per computation cycle												
		Percent Throttle Opening (%)											
		0	0.3	1	5	15							
	Percent Throttle Delta (%)	4	6	11	20	50							
P2231, P2234	**KLSDULSUN**	(internal manufacturer cross reference)											
	Sensor Voltage Delta Down Threshold - Maximum per Computation Cycle												
		Battery Voltage (V)											

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
	11	13	15	17									
Delta Voltage (V)	-0.078	-0.078	-0.117	-0.200									
KLSDULSUP	(internal manufacturer cross reference)												
Sensor Voltage Delta Up Threshold - Maximum per Computation Cycle													
	Battery Voltage (V)												
	11	13	15	17									
Delta Voltage (V)	0.078	0.078	0.117	0.200									

Additional diagnostic codes

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
Engine coolant	P0116	difference from Engine	filtered difference			Engine coolant model (cooled down)	<	50	° C	100 sec	0.2 sec	4 sec	immediate
temperature sensor		temperature model after soaking	(ECT at key on - ECTmod at key on)	10	° C	Soaking time after shut down	>	12600	sec	for block	continuous	additional	once code
(w/ real time clock)										heating		after block	has
						previous accumulated air mass	>	6000	g				
		or				previous engine run time	>	600	sec	check	one filter	heater	been set
						or					update per	check when	
			filtered difference			ECT at shut down	>	75	° C		cold start	filtered	approx.
			-(ECT at key on - ECTmod at key on)	11.25	° C	Controller Shut Down at end of	last cycle	-	-			difference	6 test
						Engine Off Timer value valid	not detected	-	-			exceeds	average
							not detected					threshold	run length
						Block Heater	not detected	-	-				(15°C delta)
Primary O2 Sensor Heating													
heater circuits - electrical													
bank 1 sensor 1	P0030	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	0.01 sec	4 sec	two driving
(primary)	P0031	circuit continuity - ground				battery voltage	>	10.5	V		continuous	continuous	cycles each
	P0032	circuit continuity - voltage				battery voltage	<	18.1	V			or 50 sec	with: 4 sec
bank 2 sensor 1	P0050	circuit continuity - open				output	activated and deactivated for complete checking					cumulative	continuous
(primary)	P0051	circuit continuity - ground										or 50 sec	

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
	P0052	circuit continuity - voltage											cumulative
Mass air flow sensor	P0101	range check low	measured mass air flow * threshold			battery voltage	>	10.5	V		0.01 sec	4 sec	two driving
			< Maximum modeled mass air flow	0.95	factor	for time	>	0.1	sec		continuous	continuous	cycles each
						Airbag not deployed	TRUE					or 50 sec	with: 4 sec
						time after start	>	0.3	sec			cumulative	continuous
		or				crankshaft revolution counter	>	150	rev				or 50 sec
		fuel trim limits exceded	> delta lambda correction	0.15	factor	ambient pressure valid	TRUE	-	-				cumulative
		range - multiplicative				desired cam angle valid	TRUE	-	-				
		and				long term fuel trim	TRUE	-	-				
		correction factor (modeled air	< correction factor air mass	0.8	factor	air flow mass	>	1.39	g/sec				
		mass at throttle / air mass				air flow change gradient	<	0.25	-				
		measured by air mass flow meter)				throttle angle change gradient	<	2	-				
						engine running	TRUE	-	-				
		range check high	measured mass air flow * threshold			engine coolant temperature	>	9.8	° C				
			< minimum modeled mass air flow	1.05	factor	engine running time	>	1	sec				
		or				Air flow meter readiness	TRUE	-	-				
		fuel trim limits exceded				pressure ratio over throttle	<	0.8	-				
		range - multiplicative	delta lambda correction <	-0.15	factor	for time	>	0.5	sec				
		and				error: air flow meter (internal)	not set						
		correction factor (modeled air				error: throttle position sensor	not set	-	-				
		mass at throttle / air mass	correction factor air mass >	1.2	factor	error: intake air temp. sensor	not set	-	-				
		measured by air mass flow meter)											
	P0100	open circuit check	sensor frequency =	0.0	Hz	battery voltage	>	10.5	V	0.1s			
						Engine is running	TRUE						
						Key on	TRUE						
	P0102	range check low	sensor frequency <	1035	Hz	time after start	>	0.3	sec				
	P0103	range check high	sensor frequency >	15152	Hz								
Oxygen Sensor													
sensor circuit (primary O2)													
bank 1 sensor 1	P0131	short circuit to ground	primary O2 sensor voltage <	0.06	V	engine running	TRUE	-	-	0.1 sec	0.1 sec	4 sec	two driving
bank 2 sensor 1	P0151		and secondary O2 sensor voltage >	0.5	V	battery voltage	>	10.5	V		continuous	continuous	cycles each
						commanded lambda	=	1	0			or 50 sec	with: 4 sec
			or			mod. exhaust-gas temp.	<	800	° C			cumulative	continuous
			primary O2 sensor voltage <	0.06	V	primary O2 heater active for	>	5	sec				or 50 sec
			and cold start conditions present			no injector circuit fault	not set	0	0				cumulative

Component/System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						time after start	<	1	sec				
						engine temp at stop	>	60	° C				
						engine temp	<	40	° C				
						error: engine coolant temp	not set	-	-				
bank 1 sensor 1	P0132	short circuit to battery voltage	primary O2 sensor voltage >	1.08	V	engine running	TRUE	-	-	5.1 sec	0.1 sec	4 sec	two driving
bank 2 sensor 1	P0152					battery voltage	>	10.5	V		continuous	continuous	cycles each
						commanded lambda	=	1	0			or 50 sec	with: 4 sec
						mod. exhaust-gas temp.	<	800	° C			cumulative	continuous
						primary O2 heater active for	>	5	sec				or 50 sec
						no injector circuit fault	not set	0	0				cumulative
						time after start	<	1	sec				
						engine temp at stop	>	60	° C				
						engine temp	<	40	° C				
						error: engine coolant temp	not set	-	-				
Primary O2 sensor slow response						closed loop control	active						
Bank 1	P0133	slow response	Continuously filtered normalized			engine speed	>	2400	rpm		0.1 sec	4 sec	two driving
Bank 2	P0153		switching cycle duration	3	s	engine speed	>	1800	rpm		continuous	continuous	cycles each
						engine load	<	70	%			or 50 sec	with: 4 sec
			20 valid closed loop switching cycles			engine load	>	40	%			cumulative	continuous
						exhaust gas temperature model	>	350	° C				or 50 sec
			(note: normalization of cycle duration			purge off or has been on for time	>	10	sec				cumulative
			revised with new enable window and failure			scheduled by System Manager	set						
			threshold)			Primary O2 heater diagnosis finished	set						
						high purge vapor concentration	not set						
						Evap. Leak diagnosis	not set						
						error: fuel adaptation	not set						
						error: purge valve	not set						
						error: misfire	not set						
						error: primary O2 heater	not set						
						error: secondary O2 heater	not set						
						error: secondary O2 slow sensor	not set						
						error: secondary O2 sensor	not set						
Oxygen Sensor													
sensor circuit (primary O2)													
bank 1 sensor 1	P0134	sensor line disconnection	primary O2 sensor voltage >	0.4	V	primary O2 heater duty cycle >	>	0.68		5 sec	0.1 sec	4 sec	two driving
bank 2 sensor 1	P0154		and primary O2 sensor voltage <	0.6	V	and mod. exhaust gas temp.	>	600	° C		continuous	continuous	cycles each

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						and dew point end exceeded	TRUE					or 50 sec	with: 4 sec
			or			and no error detected prev.	not set					cumulative	continuous
			primary O2 sensor internal resistance >	20000	Ohm	for time	>	90	sec				or 50 sec
			and when modeled exhaust gas temperature >	600	° C	engine running	TRUE	-	-				cumulative
						battery voltage	>	10.5	V				
			or			commanded lambda	=	1					
			primary O2 sensor voltage >	0.2	V	mod. exhaust-gas temp.	<	800	° C				
			and secondary O2 sensor voltage >	0.2	V	primary O2 heater active for	>	5	sec				
			and fuel cutoff achieved for time	600	° C	error: injector circuit fault	not set						
						time after start	<	1	sec				
						engine temp at stop	>	60	° C				
						engine temp	<	40	° C				
						error: engine coolant temp	not set	-	-				
Oxygen Sensor Heating													
heater performance (primary O2)													
bank 1 sensor 1 (primary)	P0135	primary O2 sensor	measured primary O2 sensor internal			battery voltage	>	10.5	V	approx.	0.1 sec	4 sec	two driving
bank 2 sensor 1 (primary)	P0155	internal resistance	resistance >			battery voltage	<	18.1	V	100 sec	continuous	continuous	cycles each
		above threshold	nominal internal resistance	88 . . . 392	Ohms	engine running	TRUE	-	-			or 50 sec	with: 4 sec
				KFRINH / 2		engine starting	complete	-	-			cumulative	continuous
			multipy times degradation factor >	5 . . . 63	factor	fuel cut off	FALSE	-	-			or 50 sec	
				FRINH1 / 2		pri. O2 internal resistance	valid	-	-				cumulative
			for time	6	sec	intake air temperature	>	-6.8	C				
						engine off soak time	>	120	sec				
						modeled exhaust temp.	<	550	C				
						suspicion of primary O2 sensor open circuit	FALSE						
						primary O2 voltage supply scheduled by System Manager	ON						
						for time	>	12	sec				
						primary O2 sensor dewpoint exceeded for	>	10	sec				
						no fault clear request during drive cycle	not set						
Knock Control						engine coolant temp.	>	60	° C				
Circuit	P0324	test pulse	test pulse integral <	4	V	knock control	active	-	-		0.1 sec	4 sec	two driving
			for consecutive events	2	count						continuous	continuous	cycles each
												or 50 sec	with: 4 sec

	Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
							zero test , parity fault assumptions	not set	-	-			cumulative	continuous
			or				measuring window	>	1	ms				or 50 sec
														cumulative
			null test (zero test)	absolute value (integrator gradient) >	200	V / sec	engine coolant temp.	>	60	° C				
							knock control	active	-	-				
				for consecutive events	2	count								
			or				test pulse , parity fault assumptions	not set	-	-				
			parity check	coefficient RAM errors in knock IC, per 250 working cycles	5	count	engine coolant temp.	>	60	° C				
			or				test pulse fault assumption	not set						
			SPI communication	check word errors in knock IC, per 250 working cycles	25	count								
	Bank 1						engine coolant temperature	>	60	° C				
	circuit check	P0326	short circuit to B+ or GND	faults detected on knock sensor pins, per 250 working cycles (zkrks) >	25	count	engine speed	>	2200	rpm	approx.	0.1 sec	4 sec	two driving
	Performance	P0327	range check low	reference voltage <	0.088 . . . 0.331	V	engine speed gradient	<	1500 … 2500	rpm / sec	20 sec	continuous	continuous	cycles each
					UDKSNU		engine load gradient	<	50 . . . 100	kPa / sec			or 50 sec	with: 4 sec
							error: knock control circuit (IC)	not set	-	-			cumulative	continuous
														or 50 sec
				for consecutive events	100	count								cumulative
		P0328	range check high											
				reference voltage >	5.7 . . . 30.8	V								
					UDKSNO									
				for consecutive events	100	count								
			short circuit to B+ or GND	faults detected on knock sensor pins, per 250 working cycles (zkrks) >										
	Bank 2						engine coolant temperature	>	60	° C				
		P0331	short circuit to B+ or GND	faults detected on knock sensor pins, per 250 working cycles (zkrks) >	25	count	engine speed gradient	<	1500 … 2500	rpm / sec	approx.	0.1 sec	4 sec	two driving
	Performance	P0332	range check low	reference voltage <	0.088 . . . 0.331	V	engine load gradient	<	50 . . . 100	kPa / sec		continuous	continuous	cycles each
							error: knock control circuit (IC)	not set	-	-			or 50 sec	with: 4 sec

07_GRP02_All Engines.xls

Component/System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
												cumulative	continuous
			for consecutive events	100	count								or 50 sec
	P0333	range check high											cumulative
			reference voltage >	5.7 . . . 30.8	V								
				UDKSNO									
			for consecutive events	100	count								
Catalyst Bank 1	P0420	oxygen storage of	EWMA filtered	0.2	factor	exhaust gas mass flow	>	5.00	g/sec				
		catalyst	catalyst aging factor										
Catalyst Bank 2	P0430		less than catalyst aging factor			exhaust gas mass flow	<	55.56	g/sec	approx.	0.2 sec	4 sec	immediate
			of a limit catalyst <			catalyst temp. model	<	850	° C	1000 sec	continuous	additional	once code
						catalyst temp. model	>	400	° C	during		after block	has
						engine speed	>	1040	rpm	active			been set
						engine speed	<	2760	rpm	driving			
						engine load	>	15	%				
						engine load	<	50	%	3 checks per			approx.
						modeled catalyst temp. gradient	<	6	° C / sec	driving cycle			3 tests
						relative exhaust gas mass flow gradient	<	0.60	%	3 checks per			average
						fuel system closed loop	active	-	-	driving cycle			run length
						time after secondary O2 sensor exceeded	>	10 … 40	sec	1 check per			(9 samples)
						dewpoint				driving cycle			
						ambient temperature	>	-10	° C				
						catalyst damaging misfire rate exceeded	set	-	-				
						error: fuel system	not set	-	-				
						closed loop control at limit	set	-	-				
						strong transient compenstation intervention	set	-	-				
						catalyst clear out active (after fuel cutoff)	set	-	-				
						fast mixture adaptation completed	set	-	-				
						Trigger condition for step change							
Secondary O2 Trim of primary O2 Sensor						engine speed	<	2920	sec	200 sec	0.1 sec	4 sec	two driving
primary O2 sensor signal RICH / secondary O2 sensor signal LEAN						engine speed	>	1200	° C		continuous	continuous	cycles each
Bank1	P2096	secondary O2 sensor fuel	secondary O2 sensor trim			engine load	<					or 50 sec	with: 4 sec
Bank 2	P2098	trim - rich shift	integral control >	0.8	sec	engine load	>	16.5 …. 20.3	%			cumulative	continuous

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
		- correction above threshold				closed loop control active	TRUE	0	0				or 50 sec
						for time	>	3	sec				cumulative
						exhaust gas temp. model	>	300	° C				
						primary closed loop controller							
						at upper limit	not set	-	-				
primary O2 sensor signal LEAN / secondary O2 sensor signal RICH						at lower limit	not set	-	-				
Bank 1	P2097	secondary O2 sensor fuel	secondary O2 sensor trim	-0.8	sec	secondary O2 sensor readiness	not set	-	-				
Bank 2	P2099	trim - lean shift	integral control <			catalyst clear out after DCFO	not set	-	-				
		- correction below threshold				error: catalyst monitoring	not set	-	-				
						error: purge valve	not set	-	-				
						error: secondary O2 sensor							
						response	not set	-	-				
						error: primary O2 heater	not set	-	-				
						error: secondary O2 heater	not set	-	-				
						error: fuel system monitoring	not set	-	-				
						error : Evap. Leak	not set	-	-				
						error : air flow meter	not set	-	-				
Oxygen Sensor													
sensor circuit (primary O2)													
bank 1 sensor 1	P2231	sensor line short circuit	secondary O2 sensor			primary O2 heater duty cycle >	>			0.1 sec	0.1 sec	4 sec	two driving
bank 2 sensor 1	P2234	to heater output line	voltage gradient >	2	V	and mod. exhaust gas temp.	>	600	° C		continuous	continuous	cycles each
			within time after heater turn off <	0.04	s	and dew-point end passed	TRUE					or 50 sec	with: 4 sec
			for occurrences >	4	count	and no error detected prev.	not set					cumulative	continuous
			out of heater turn offs	6	count	for time	>	90	sec				or 50 sec
						engine running	TRUE	-	-				cumulative
						battery voltage	>	10.5	V				
			primary O2 sensor voltage >	0.6	V	commanded lambda	=	1					
			and primary O2 sensor voltage <	1.08	V	mod. exhaust-gas temp.	<	800	° C				
			and secondary O2 sensor voltage <	0.1	V	primary O2 heater active for	>	5	sec				
						no injector circuit fault	not set						
			or			time after start	<	1	sec				
			primary O2 sensor voltage >	0.06	V	engine temp at stop	>	60	° C				
			and primary O2 sensor voltage <	0.4	V	engine temp	<	40	° C				
			and secondary O2 sensor voltage <	0.5	V	error: engine coolant temp	not set	-	-				
Real time clock													
Engine off timer	P2610	engine off timer signal check	engine off timer IC feedback	failed		engine running	TRUE	-	-	0.1 sec	0.1 sec	4 sec	two driving
		(engine off time is provided by	(SPI bus failure or								continuous	continuous	cycles each

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
		the main micro processor clock)	internal IC power supply or										or 50 sec
			hardware failure)										continuous
													or 50 sec
													cumulative

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
Turbocharger Bypass Valve Actuator													
Circuit Continuity													
	P0033	circuit continuity - open	voltage	IC Internal	V	engine speed	>	80	rpm	0.01 sec	continuous	4 sec	two driving
	P0034	circuit continuity - ground				battery voltage	<	18.1	V				cycles each
	P0035	circuit continuity - voltage				battery voltage	>	10	V				with: 4 sec
													continuous
													or 50 sec
													cumulative
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	45	Ohms	battery voltage	>	10.5	V	40 sec	0.1 sec	4 sec	two driving
		internal resistance measurement	A/F sensor internal resistance >			battery voltage	<	18.1	V		continuous	continuous	cycles each
		too much				engine starting	complete	-	-			or 50 sec	with: 4 sec
												cumulative	continuous
													or 50 sec
													cumulative
High Pressure Fuel Control System													
Rationality													
	P0087	pressure deviation from desired - under pressure	difference (desired versus actual fuel rail pressure) >	1500	Kpa	error: electrical diagnosis of fuel volume control valve	not set	-	-	5 sec	continuous	4 sec	immediate once code has been set
						tester request for open fuel flow control valve	FALSE	-	-				
	P0088	pressure deviation from desired - over pressure	difference (desired versus actual fuel rail pressure) <	-2000	Kpa	error: electrical diagnosis of fuel rail pressure sensor	not set	-	-	5 sec	continuous	4 sec	
						airbag deployed	FALSE	-	-				
	P0089	C/L controller output value - above expected	Controller output value ("p" part plus "i" part) >	3000	Kpa	battery voltage	<	18.1	V	5 sec	continuous	4 sec	
						relative injected fuel mass	>	5.016	%				
	P0089	C/L controller output value - below expected	Controller output value ("p" part plus "i" part) <	-3000	Kpa	relative injected fuel mass	<	300	%	5 sec	continuous	4 sec	
						first engine start at assembly plant	FALSE	-	-				
						DFCO active	FALSE						
						engine speed	>	25	rpm				

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						syncronisation reference mark detected	TRUE						
						engine start temperature	>	-48	C				
High Pressure Fuel Volume Control Valve													
Circuit Continuity													
	P0090	circuit rationality - open	voltage test pulse - off command within window	1.001 < x < 4.502	V	battery voltage	>	6	V	0.5 sec	continuous	4 sec	immediate once
	P0091	circuit rationality - ground	voltage test pulse - off command <	1.001	V	battery voltage	<	18.1	V				code has been set
	P0092	circuit rationality - voltage	voltage test pulse - on command >	4.502	V	battery voltage	<	off command voltage	V				
						circuit switched off due to 5 volt supply fault	not set	-	-				
Intake Air Temperature Sensor 2 (Boost Pressure Temperature Sensor)													
Rationality													
	P0096	response check	max intake air temperature - min intake air temperature	1.5	° C	drive period - count	>=	7	count		0.1 sec	4 sec	two driving
						each with					continuous	continuous	cycles each
						coolant temperature at start	<=	66	° C				with: 4 sec
						Intake Air Temperature Sensor 2						or 50 sec	continuous
						Electrical Failure	FALSE					cumulative	or 50 sec
						Mass Air Flow	>	11.1	g / sec				cumulative
						Mass Air Flow	<	138.9	g / sec				
						Vehicle speed	>	25	mph				
						idle period - count	>=	7	count				
						each with							
						coolant temperature at start	<=	66	° C				
						Intake Air Temperature Sensor 2							
						Electrical Failure	FALSE						
						Mass Air Flow	<	7.8	g / sec				
						Vehicle speed	<	6.25	mph				
						engine coolant temperature	>	60	° C				

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
Intake Air Temperature Sensor 2 (Boost Pressure Temperature Sensor)													
Circuit Continuity Check											0.01 sec	4 sec	two driving
	P0097	circuit continuity - low	Intake Air Temperature Sensor 2 Voltage <	0.156	V	Engine Coolant Temperature	>	-10.5	° C			continuous	cycles each
	P0098	circuit continuity - high	Intake Air Temperature Sensor 2 Voltage >	4.66	V							or 50 sec	with: 4 sec
												cumulative	continuous
	P0099	intermittent (discontinuity)	Intake Air Temperature Sensor 2 Raw Voltage -										or 50 sec
			Intake Air Temperature Sensor 2 Filtered Voltage	0.3	V	Intermittent (discontinuous) time	>	1	sec	2 sec			
Mass Air Flow (MAF) Sensor													
Ratoinality													
	P0101	range check low	MAF sensor mass air flow * THRESHOLD < model	1.050018	-	min / max MAP sensor air flow ratio	<	0.3	-	2.1 sec	0.1 sec	4 sec	two driving
		comparison to MAP based model				battery voltage	>	10.5	V				cycles each
						for time	>	0.1	sec				with: 4 sec
						airbag not deployed	TRUE						continuous
						time after start	>	0.3	sec				or 50 sec
						crankshaft revolution counter	>	150	rev				cumulative
			or			turbocharger bypass valve closed	FALSE	-	-				
		fuel trim limits exceeded	delta lambda correction >	15	%	no boost pressure oscillation	FALSE	-	-				
		range - multiplicative				error - intake air temperature sensor #2	not set	-	-				
		and				error : ambient pressure sensor electrical	not set	-	-				
		correction factor (modeled air	correction factor air mass <	80	%	error : ambient pressure sensor rationality	not set	-	-				
		mass at throttle / air mass				error : throttle position sensor	not set	-	-				
		measured by air mass flow meter)				error : boost pressure sensor electrical	not set	-	-				
						error : boost pressure sensor rationality	not set	-	-				
		range check high -	MAF sensor mass air flow * THRESHOLD > model	0.950012	-	error : MAP pressure sensor electrical	not set	-	-				
		comparison to MAP based model				error : MAP pressure sensor rationality	not set	-	-				
			or			Desired cam angle valid	TRUE	-	-				

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
		fuel trim limits exceded	delta lambda correction <	-15	%	Long term fuel trim enabled	TRUE	-	-				
		range - multiplicative				Fuel trim stabilized	TRUE	-	-				
		and				MAF sensor signal valid (until detection)	TRUE	-	-				
		correction factor (modeled air	correction factor air mass >	120	%	Air flow error gradient	<	0.4	-				
		mass at throttle / air mass				Throttle position gradient	<	2	-				
		measured by air mass flow meter)				Engine coolant temperature	>	9.8	° C				
						Engine running time	>	1	sec				
						Pressure ratio across throttle	<	0.8	-				
						for time	>	0.5	sec				
Manifold Absolute Pressure Sensor													
Rationality													
	P0106	range check high	sensor signal >	255	KPa	error : MAP sensor electrical	not set	-	-	2 sec	continuous	4 sec	two driving
													cycles each with: 4 sec
		range check low	sensor signal <	15	KPa	error : MAP sensor electrical	not set	-	-	2 sec	continuous	4 sec	continuous
			or										or 50 sec cumulative
		rationality check low - model	sensor signal + THRESHOLD < model	15	KPa	error : initial throttle learn failed	not set	-	-	2 sec	continuous	4 sec	
						error : throttle potentiometer fault	not set	-	-				
			or			error : intake air temperature sensor fault	not set	-	-				
		rationality check low - baro comparison	sensor signal + THRESHOLD < ambient pressure (baro)	20	KPa	error : under pressure in fuel tank	not set	-	-				
						error : intake / exhaust camshaft control	not set	-	-				
			or			error : intake / exhaust camshaft electrical	not set	-	-				
		rationality check high - model	sensor signal - THRESHOLD > model	15	KPa	error : ambient pressure sensor electrical	not set	-	-				
						error : ambient pressure sensor rationality	not set	-	-				
						error : boost pressure sensor electrical	not set	-	-				
						error : boost pressure sensor rationality	not set	-	-				
						error : MAP sensor electrical	not set	-	-				
						crankshaft revolution counter since engine start	>	200	counts				
						block diagnosis if :							
						start-up coolant temperature	<	-7.5	C				
						until							

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						engine coolant temperature	>	30	C				
						conditions met once during drive cycle							
						throttle position	<	25	%				
						engine speed	>	1500	rpm				
						MAP sensor reading change	>	10	KPa				
			or										
		rationality check high - 3 sensor check	sensor signal - THRESHOLD > mean sensor output	8.5	KPa	engine speed	<	400	rpm	200 ms	during engine	4 sec	two driving
			or			engine off timer	>	4	sec		cranking		cycles each
		rationality check low - 3 sensor check	sensor signal + THRESHOLD < mean sensor output	8.5	KPa	error : ambient pressure sensor electrical	not set	-	-		only		with: 4 sec
						error : boost pressure sensor electrical	not set	-	-				continuous
						error : MAP sensor electrical	not set	-	-				or 50 sec
													cumulative
Manifold Absolute Pressure Sensor													
Electrical													
	P0107	circuit continuity - ground	MAP sensor output voltage <	0.1855	V	engine speed	>	80	rpm	1.0 sec	continuous	4 sec	two driving
	P0108	circuit continuity - voltage	MAP sensor output voltage >	4.805	V								cycles each
													with: 4 sec
													continuous
													or 50 sec
													cumulative
Intake Air Temperature Sensor 1 (MAF Intake Air Temperature Sensor)													
Electrical											0.01 sec	4 sec	two driving
	P0112	circuit continuity - low	Intake Air Temperature Sensor 1 Voltage <	4.66	V	Engine Coolant Temperature	>	-10.5	° C				cycles each
	P0113	circuit continuity - high	Intake Air Temperature Sensor 1 Voltage >	0.176	V								with: 4 sec
													continuous
	P0114	intermittent (discontinuity)	Intake Air Temperature Sensor 1 Raw Voltage -	0.3	V	Intermittent (discontinuous) time	>	1	sec	2 sec			or 50 sec
			Intake Air Temperature Sensor 1 Filtered Voltage										cumulative
Fuel Rail Pressure Sensor													
Electrical													
	P0192	circuit continuity - low	Fuel pressure sensor output voltage <	0.30029	V					0.5 sec	0.01 sec	4 sec	immediate once
	P0193	circuit continuity - high	Fuel pressure sensor output voltage >	4.70001	V					0.5 sec	0.01 sec	4 sec	code has been set

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
High Pressure Fuel Injection Valve													
Circuit Continuity - Low Side													
Cylinder #1	P0201	circuit continuity - open	Voltage	IC Internal		engine speed	>	80	rpm	0.01 sec	0.01 sec	4 sec	two driving
	P0261	circuit continuity - ground				battery voltage	>	8	v				cycles each
	P0262	circuit continuity - voltage				battery voltage	<	18.1	v				with: 4 sec
													continuous
Cylinder #2	P0202	circuit continuity - open											or 50 sec
	P0264	circuit continuity - ground											cumulative
	P0265	circuit continuity - voltage											
Cylinider #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											
SPI Communication	P062B	Internal SPI Communication Fault		IC Internal		engine speed	>	80	rpm	1.10 sec	0.01 sec	4 sec	
		or				battery voltage	>	8	v				
		Internal ADC Voltage Booster Failure		IC Internal		battery voltage	<	18.1	v	0.50 sec	0.01 sec	4 sec	
Circuit Continuity - High Side													
Cylinder #1	P2146	circuit continuity - open	Voltage	IC Internal		engine speed	>	80	rpm	0.01 sec	0.01 sec	4 sec	two driving
	P2147	circuit continuity - ground				battery voltage	>	8	v				cycles each
	P2148	circuit continuity - voltage				battery voltage	<	18.1	v				with: 4 sec
													continuous
Cylinder #2	P2149	circuit continuity - open											or 50 sec
	P2150	circuit continuity - ground											cumulative
	P2151	circuit continuity - voltage											
Cylinider #3	P2152	circuit continuity - open											
	P2153	circuit continuity - ground											
	P2154	circuit continuity - voltage											
Cylinder #4	P2155	circuit continuity - open											
	P2156	circuit continuity - ground											

Component/System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
	P2157	circuit continuity - voltage											
Turbocharger boost control system													
Rationality													
	P0234	actual boost pressure above desired	difference (desired versus actual boost pressure) <	-128…-20	kPa	error : electrical diagnosis of boost pressure sensor	not set	-	-	3.2 sec	continuous	4 sec	two driving
				KLDLUL		error : rationale diagnosis of boost pressure sensor	not set	-	-				cycles each
													with: 4 sec
	P0299	actual boost pressure below desired	difference (desired versus actual boost pressure) >	20	kPa	error : electrical diagnosis of boost pressure sensor	not set	-	-	0.1 sec	continuous	4 sec	continuous
						error : rationale diagnosis of boost pressure sensor	not set	-	-				or 50 sec
						error : turbocharger boost control system	not set	-	-				cumulative
						error : limp home mode activated	not set	-	-				
						error : limp home mode activated with safety fuel cut-off	not set	-	-				
						engine speed	>	2600…3520	rpm				
						desired manifold pressure > base boost pressure	>	110..130	KPa				
						ambient barometric pressure	>	75	KPa				
Boost Pressure Sensor													
Rationality													
	P0236	range check low	sensor signal <	50	KPa	error : boost pressure sensor electrical	not set	-	-	3 sec	continuous	4 sec	two driving
													cycles each with: 4 sec
		rationality check low - baro comparison	sensor signal + THRESHOLD < baro pressure	23	KPa	crankshaft revolution counter since engine start	>	3	counts				continuous
						error : throttle potentiometer fault	not set	-	-				or 50 sec
			or			error : limp home mode	not set	-	-				cumulative
		rationality check high - baro comparison	sensor signal - THRESHOLD > baro pressure	18	KPa	error : boost pressure sensor electrical	not set	-	-				
						error : ambient pressure sensor electrical	not set	-	-				
						error : ambient pressure sensor rationality	not set	-	-				
						engine speed	<	1000	rpm				
						throttle position	<	24	%				
			or										
		rationality check high - 3 sensor check	sensor signal - THRESHOLD > mean sensor output	4	KPa	engine speed	<	400	rpm	200 ms	during engine cranking	4 sec	two driving
						engine off timer	>	4	sec				cycles each

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
			or			error : ambient pressure sensor electrical	not set	-	-		only		with: 4 sec
		rationality check low - 3 sensor check	sensor signal + THRESHOLD < mean sensor output	4	KPa	error : boost pressure sensor electrical	not set	-	-				continuous
						error : MAP sensor electrical	not set	-	-				or 50 sec
													cumulative
Boost Pressure Sensor Electrical													
	P0237	circuit continuity - ground	Boost sensor output voltage <	0.1855	V	engine speed	>	80	rpm	0.20 sec	continuous	4 sec	two driving
	P0238	circuit continuity - voltage	Boost sensor output voltage >	4.85	V								cycles each
													with: 4 sec
													continuous
													or 50 sec
													cumulative
Turbocharger Boost Control Actuator Circuit Continuity													
	P0243	circuit continuity - open	voltage	IC Internal	V	engine speed	>	80	rpm	0.01 sec	continuous	4 sec	two driving
	P0245	circuit continuity - ground				battery voltage	<	18.1	V				cycles each
	P0246	circuit continuity - voltage				battery voltage	>	10	V				with: 4 sec
													continuous
													or 50 sec
													cumulative
Diagnosis of Stuck Open Fuel Injector Rationality													
	P029D	fuel injector stuck open - cylinder #1	fuel pressure deviation from desired -	set		misfire monitor active (see P0300 details)				200 ms	continuous	4 sec	immediate once
			under pressure (P0087)			engine speed	>	240	rpm				code has been set
			and			engine speed	<	6000	rpm				
			camshaft revolution period <	80	rev	relative engine load	<	99.8	%				
			and										
			cylinder # 1 misfire counts >	100	counts								
	P02A1	fuel injector stuck open - cylinder #2	fuel pressure deviation from desired -	set						200 ms	continuous	4 sec	immediate once
			under pressure (P0087)										code has been set
			and										
			camshaft revolution period <	80	rev								
			and										
			cylinder # 2 misfire counts >	100	counts								
	P02A5	fuel injector stuck open - cylinder #3	fuel pressure deviation from desired -	set						200 ms	continuous	4 sec	immediate once
			under pressure (P0087)										code has been set

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
			and										
			camshaft revolution period <	80	rev								
			and										
			cylinder # 3 misfire counts >	100	counts								
	P02A9	fuel injector stuck open - cylinder #4	fuel pressure deviation from desired -	set						200 ms	continuous	4 sec	immediate once
			under pressure (P0087)										code has been set
			and										
			camshaft revolution period <	80	rev								
			and										
			cylinder # 4 misfire counts >	100	counts								
Brake Booster Pressure Sensor													
Rationality	P0556	range check - low	Brake Booster Pressure <	0	kPa					4.0 sec	0.01 sec	4 sec	two driving
	P0556	range check - high	Brake Booster Pressure >	100	kPa						continuous	cycles each
											or 50 sec	with: 4 sec
	P0556	barometric Pressure Check	Brake Booster Pressure - Ambient Pressure >	15	kPa						cumulative	continuous
												or 50 sec
		or											
		Manifold Pressure Check	Brake Booster Pressure - manifold absolute pressure	20	kPa	Brake Switch Active	FALSE						
						Brake Switch Error	FALSE						
						Main Load Sensor Error	FALSE						
						Ambient Pressure Sensor Error	FALSE						
		or				Ambient Pressure - Manifold Absolute							
						Pressre	<	25	kPa				
		System Leak Check	Brake Booster Pressure - Brake Booster Pressure	10	kPa	Time Between Measuring Points	=	2	sec				
			after a period of time			Brake Swirch Off	FALSE						
						for a period of time	>=	1	sec				
						Brake Switch Error	FALSE						
Brake Booster Pressure Sensor													
Circuit Continuity													
	P0557	circuit continuity check - low	Brake Booster pressure sensor voltage <	0.1953	V					2.0 sec	0.01 sec	4 sec	two driving
	P0558	circuit continuity check - high	Brake Booster pressure sensor voltage >	4.8	V						continuous	cycles each
											or 50 sec	with: 4 sec
											cumulative	continuous

	Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
														or 50 sec
	ECM monitoring													
		P0606	Electronic Throttle Control (ETC) checks	SW internal	SW Internal						0.01 sec	0.01	4 sec	immediate
														once
			Same as E55 P0606 data PLUS									continuous		code has been set
			SPI failure of throttle output stage											
	Ignition Coil Driver Circuit Serial Communication													
		P167D	Internal SPI communication fault		IC Internal		battery voltage	<	18.1	v	0.01 sec	0.01 sec	4 sec	two driving
							battery voltage	>	9	v				cycles each
							engine speed	<	6000	rpm				with: 4 sec
														continuous
														or 50 sec
														cumulative
	Oxygen Sensor (secondary O2) Trim of Air / Fuel Ratio Sensor (primary A/F)													
	Bank 1	P2195	secondary O2 sensor operation	secondary O2 sensor voltage >	0.85	V	A/F sensor measured lambda	>	1.06	lambda	approx.	0.1 sec	4 sec	two driving
			too rich - strong correction				short term fuel trim	= MAX	1.25	factor	100 sec	continuous	continuous	cycles each
							A/F sensor	ready	-	-			or 50 sec	with: 4 sec
			A/F sensor measured too lean	or			secondary O2 sensor	ready	-	-			cumulative	continuous
							suspicion A/F sensor not mounted	FALSE	-	-				or 50 sec
							and not confirmed A/F sensor	FALSE	-	-				cumulative
							not mounted	FALSE	-	-				
							then							
							accumulated exhaust gas mass	>	200	g				
				secondary O2 sensor voltage >	0.85	V	A/F sensor measured lambda	>	1.06	lambda				
							secondary O2 sensor fuel trim	>	0.003	lambda				
							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	-	-				
							suspicion A/F sensor not mounted	FALSE	-	-				

Component/System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						and not confirmed A/F sensor	FALSE	-	-				
						not mounted	FALSE	-	-				
						then							
						accumulated exhaust gas mass	>	200	g				
			secondary O2 sensor voltage >	0.85	V	target lambda	>	1.04	lambda	2 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.)	> MIN	0.75	factor				
						suspicion A/F sensor not mounted	FALSE	-	-				
						and not confirmed A/F sensor	FALSE	-	-				
						not mounted	FALSE	-	-				
						secondary O2 circuit error	FALSE	-	-				
						secondary O2 aging error	FALSE	-	-				
						then							
						accumulated exhaust gas mass	>	600	g				
			secondary O2 sensor voltage >	0.85	V	secondary O2 sensor fuel trim	>	0.003	lambda	2 sec			
						proportional trim dominating							
						A/F sensor	ready	-	-				
						secondary O2 sensor	ready	-	-				
						short term fuel trim (o.k.)	> MIN	0.75	factor				
						suspicion A/F sensor not mounted	FALSE	-	-				
						and not confirmed A/F sensor	FALSE	-	-				
						not mounted	FALSE	-	-				
						secondary O2 circuit error	FALSE	-	-				
						secondary O2 aging error	FALSE	-	-				
						then							
						accumulated exhaust gas mass	>	600	g				
Oxygen Sensor (secondary O2) Trim of Air / Fuel Ratio Sensor (primary A/F)													
Bank 1	P2196	secondary O2 sensor operation too lean - strong correction	secondary O2 sensor voltage <	0.15	V	A/F sensor measured lambda	<	0.94	lambda	approx. 0.1 sec	0.1 sec	4 sec	two driving
						short term fuel trim	= MIN	0.75	factor	100 sec	continuous	continuous	cycles each
						A/F sensor	ready	-	-			or 50 sec	with: 4 sec

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
			A/F sensor measured too rich			secondary O2 sensor	ready	-	-			cumulative	continuous
						suspicion A/F sensor not mounted	FALSE	-	-				or 50 sec
						and not confirmed A/F sensor	FALSE	-	-				cumulative
						not mounted	FALSE	-	-				
						then							
						accumulated exhaust gas mass	>	200	g				
			secondary O2 sensor voltage <	0.15	V	A/F sensor measured lambda	<	0.94	lambda				
						secondary O2 sensor fuel trim	<	-0.003	lambda				
						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	-	-				
						suspicion A/F sensor not mounted	FALSE	-	-				
						and not confirmed A/F sensor	FALSE	-	-				
						not mounted	FALSE	-	-				
						then							
						accumulated exhaust gas mass	>	200	g				
			secondary O2 sensor voltage <	0.15	V	target lambda	<	0.96	lambda	2 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.)	< MAX	1.25	factor				
						suspicion A/F sensor not mounted	FALSE	-	-				
						and not confirmed A/F sensor	FALSE	-	-				
						not mounted	FALSE	-	-				
						secondary O2 circuit error	FALSE	-	-				
						secondary O2 aging error	FALSE	-	-				
						then							
						accumulated exhaust gas mass	>	600	g				
			secondary O2 sensor voltage <	0.15	V	secondary O2 sensor fuel trim	<	-0.003	lambda	2 sec			
						proportional trim dominating							
						A/F sensor	ready	-	-				

	Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
							secondary O2 sensor	ready	-	-				
							short term fuel trim (o.k.)	< MAX	1.25	factor				
							suspicion A/F sensor not mounted	FALSE	-	-				
							and not confirmed A/F sensor	FALSE	-	-				
							not mounted	FALSE	-	-				
							secondary O2 circuit error	FALSE	-	-				
							secondary O2 aging error	FALSE	-	-				
							then							
							accumulated exhaust gas mass	>	600	g				
	Intake Air Temperature Sensor 1 (MAF Intake Air Temperature Sensor)													
	Rationality													
		P2199	Intake Air Temperature Correlation Check	Intake Air Temperature Sensor 1 - Intake Air Temperature Sensor 2 >	20	° C	Mass Air Flow	>	8.8889	g / sec	45 sec	0.01 sec	5 seconds	two driving
								<	50	g / sec			after enable	cycles each
							Vehicle Speed	>	43.75	mph			condition	with: 4 sec
							Boost Pressure to Ambient Pressure							continuous
							Ratio	<	-	-				or 50 sec
			Intake Air Temperature Correlation Check	Intake Air Temperature Sensor 1 - Intake Air Temperature Sensor 2 <	20	° C								
	Barometric Pressure Sensor													
	Rationality													
		P2227	range check high	sensor signal >	115	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	continuous	4 sec	two driving
														cycles each with: 4 sec
			range check low	sensor signal <	50	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	continuous	4 sec	continuous
														or 50 sec cumulative
			sensor offset / jump test low	sensor output change within 20 sec period >	5	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	continuous	4 sec	
				OR										
				barometric pressure signal pressure	10	KPa	time since engine start	<	5	sec				
				jump from previous key off >			error : barometric pressure sensor electrical	not set	-	-				

	Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
				AND										
				sensor output + THRESHOLD < boost pressure	5	KPa	engine speed	<	1000	rpm				
				sensor output			throttle position	<	23.99	%				
				or			error : barometric pressure sensor electrical	not set	-	-				
			sensor offset / jump test high	sensor output change within 20 sec period >	5	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	continuous	4 sec	
				OR										
				barometric pressure signal pressure	10	KPa	time since engine start	<	5	sec				
				jump from previous key off >			error : barometric pressure sensor electrical	not set	-	-				
				AND										
				sensor output - THRESHOLD > boost pressure	5	KPa	engine speed	<	1000	rpm				
				sensor output			throttle position	<	23.99	%				
							error : barometric pressure sensor electrical	not set	-	-				
	Barometric Pressure Sensor Electrical													
		P2228	range check low	voltage <	0.2	V	enabled by scheduler for time	>	1	sec	2 sec	continuous	4 sec	
		P2229	range check high	voltage >	4.87	V	enabled by scheduler for time	>	1	sec	2 sec	continuous	4 sec	
	Air / Fuel Ratio Sensor (primary A/F)													
	reference ground circuit open		A/F sensor voltage within range	A/F sensor voltage	1.480	V	battery voltage	<	18.1	V	4sec	0.1 sec	4 sec	two driving
	bank 1 sensor 1	P2251					battery voltage	>	10.7	V		continuous	continuous	cycles each
					1.4	V	engine	running	-	-			or 50 sec	with: 4 sec
							engine starting	complete	-	-			cumulative	continuous
							modeled exhaust gas	<	900	° C				or 50 sec
							temperature at A/F sensor							cumulative
							The following conditions met for	>	5	sec				
							A/F sensor heating normal	>	20	sec				
							operation range for time							
							A/F sensor internal resistance	>	1870	Ohms				
							error: A/F sensor heater circuit	not set						
							The following conditions met for	>	20	sec				
							A/F sensor heating ready	TRUE	-	-				
							and engine	running	-	-				

	Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
							and A/F heater control shut off	FALSE	-	-				
							and finished a DFCO longer than	>	2	sec				
							and battery voltage	>	11	V				
	Turbocharger Bypass Valve (mechanical)													
	Rationality													
		P2261	induction system pulsation	detected pulsations >	7	counts	minimum time - bypass valve activation time	>	1.05	sec	200 ms	continuous	4 sec	two driving
			monitor				bypass valve command							cycles each
							boost versus ambient pressure ratio	>	1.1…3.3	ratio				with: 4 sec
							battery voltage	>	18.1	V				continuous
							error : MAF electrical	not set	-	-				or 50 sec
							error : MAF rationality	not set	-	-				cumulative
							error : ambient pressure sensor electrical	not set	-	-				
							error : ambient pressure sensor rationality	not set	-	-				
							error : battery voltage	not set	-	-				
							error : turbocharger bypass valve electrical	not set	-	-				
							error : throttle valve potentiometer	not set	-	-				
							error : boost pressure sensor electrical	not set	-	-				
							error : boost pressure sensor rationality	not set	-	-				
							error : intake air temperature sensor 2	not set	-	-				
							error : MAP sensor electrical	not set	-	-				
							error : MAP sensor rationality	not set	-	-				
	Brake Booster Vacuum Pump													
	Circuit Continuity													
		P258A	circuit continuity - open	Voltage	IC Internal						0.01 sec	0.01 sec	4 sec	two driving
		P258C	circuit continuity - ground		IC Internal							continuous	continuous	cycles each
		P258D	circuit continuity - voltage		IC Internal								or 50 sec	with: 4 sec
													cumulative	continuous
														or 50 sec
														cumulative

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
Brake Booster Vacuum Pump													
Rationality													
	P258B	Brake Booster Pump On no	Pump on for a period of time	5	sec					2.0 sec	0.01 sec	4 sec	two driving
		vacuum change	Delta between Previous Brake Booster Pressure			Manifold Pressure (from MAP Sensor) <	FALSE					continuous	cycles each
			and Current Brake Booster Pressure after pump off			brake booster pressure plus						or 50 sec	with: 4 sec
			Intake Air Temperature	-10.5	C	no device control from Scan-Tool	FALSE					cumulative	continuous
													or 50 sec

Calibration tables for E77 and E69 controller

P0011, P0021

Maximum

Allowed Deviation

- Intake Camshaft

Position

degrees crank		Modeled Engine Oil Temperature (° C)											
Engine Speed (rpm)		0	60	80	100	130							
	800	6.00	6.00	7.00	9.00	11.00							
	1200	6.00	6.00	6.00	6.00	7.00							
	1600	6.00	6.00	6.00	6.00	7.00							
	2000	6.00	6.00	6.00	6.00	6.00							
	2500	6.00	6.00	6.00	6.00	6.00							
	4000	6.00	6.00	6.00	6.00	6.00							

P0116

Engine coolant temperature model based on ambient temperature + engine off timer output

Time (seconds)		600	7200	10800	14400	18000	21600	28800	####				
Coefficient:		0.988	0.395	0.301	0.203	0.156	0.109	0.055	0.000				

P0135, P0155

Sensor Element (Ceramic) Impedance, Nominal Value - Secondary O2 Sensor

	Ohms	Modeled Exhaust Gas Temperature at Secondary O2 Sensor (° C)											
O2 Heater Power (watts)		350	450	550	650	750							
	0.67	392	312	200	128	88							

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
	0.78	288	224	160	104	88							
	1.03	184	144	112	96	88							
	FRINV1 / 2 Multiplication Factor for Internal Resistance KFRINH Nominal Value - Secondary O2 Sensor												
		Modeled Exhaust Gas Temperature at Secondary O2 Sensor (° C)											
		370	450	520	590	650							
	factor	63.00	16.00	7.00	5.00	5.00							
P0141, P0161													
	Sensor Element (Ceramic) Impedance, Nominal Value - Secondary O2 Sensor												
	Ohms	Modeled Exhaust Gas Temperature at Secondary O2 Sensor (° C)											
O2 Heater Power (watts)		200	300	400	500	550							
	0.620	2040	1504	904	504	448					296		
	0.800	1400	848	448	304	248							
	1.000	752	400	248	192	184							
	Multiplication Factor for Internal Resistance KFRINH Nominal Value - Secondary O2 Sensor												
		Modeled Exhaust Gas Temperature at Secondary O2 Sensor (° C)											
		200	300	400	500	550							
	factor	63.00	50.00	30.00	14.00	14.00							
P0327, P0332, P0328, P0333		RPM dynamic threshold for disabling knock diagnosis											
	RPM	400.0	800.0	1200.0	1600.0	2000.0	2400.0	2800	3200	3600	4000	4400	4800
RPM per second		600.01	800.01	1000.01	1200.02	1400.02	1500.02	1600	1700	1800.02	1900.02	2000.03	2100.03

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
P0327, P0332													
		Reference voltage threshold for knock sensor diagnosis - Lower Limit											
			Engine Speed (rpm)										
			400	800	1200	1600	2000	2400	2800	3200	3600	4000	4400	4800
Peak RMS Voltage (V)			0.040	0.040	0.053	0.074	0.084	0.100	0.128	0.144	0.164	0.229	0.254	0.339
P0328, P0333													
		Reference voltage threshold for knock sensor diagnosis - Upper Limit											
			Engine Speed (rpm)										
			400	800	1200	1600	2000	2400	2800	3200	3600	4000	4400	4800
Peak RMS Voltage (V)			1.450	1.450	1.459	1.577	1.906	2.121	2.574	3.049	3.826	4.751	5.149	6.193
P0442													
		Vacuum / Pressure Threshold for Fuel Tank Leak Detection											
Vacuum / Pressure (hPa)			Ambient Temperature (Model) (C)										
Fuel Level (%)			-2.3	2.3	6	9.8	14.3	18	21.8	26.3	30	33.8		
	5		8.60	9.20	9.80	10.40	11.00	11.60	12.20	12.80	13.40	14.00		
	14		8.46	9.02	9.58	10.14	10.70	11.26	11.82	12.38	12.94	13.50		
	23		8.32	8.84	9.36	9.88	10.40	10.92	11.44	11.96	12.48	13.00		
	32		8.18	8.66	9.14	9.62	10.10	10.58	11.06	11.54	12.02	12.50		
	41		8.04	8.48	8.92	9.36	9.80	10.24	10.68	11.12	11.56	12.00		
	50		7.90	8.30	8.70	9.10	9.50	9.90	10.30	10.70	11.10	11.50		
	59		7.76	8.12	8.48	8.84	9.20	9.56	9.92	10.28	10.64	11.00		
	68		7.62	7.94	8.26	8.58	8.90	9.22	9.54	9.86	10.18	10.50		
	77		7.48	7.76	8.04	8.32	8.60	8.88	9.16	9.44	9.72	10.00		
	86		7.34	7.58	7.82	8.06	8.30	8.54	8.78	9.02	9.26	9.50		
	95		7.20	7.40	7.60	7.80	8.00	8.20	8.40	8.60	8.80	9.00		
		Tank Capacity	65.8	Liters									
Vacuum / Pressure (Pa)		Ambient Temperature (Model) (C)											
Fuel Level (%)			-2.3	2.3	6	9.8	14.3	18	21.8	26.3	30	33.8		
	5		860	920	980	1040	1100	1160	1220	1280	1340	1400		
	14		846	902	958	1014	1070	1126	1182	1238	1294	1350		
	23		832	884	936	988	1040	1092	1144	1196	1248	1300		
	32		818	866	914	962	1010	1058	1106	1154	1202	1250		
	41		804	848	892	936	980	1024	1068	1112	1156	1200		
	50		790	830	870	910	950	990	1030	1070	1110	1150		
	59		776	812	848	884	920	956	992	1028	1064	1100		
	68		762	794	826	858	890	922	954	986	1018	1050		
	77		748	776	804	832	860	888	916	944	972	1000		
	86		734	758	782	806	830	854	878	902	926	950		
	95		720	740	760	780	800	820	840	860	880	900		

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
P0455													
		Vacuum Gradient Threshold for Fuel Tank Leak Detection											
Fuel Level liters			0	10	20	30	40	45	50	55	60	70	
hPa / sec			0.20	0.22	0.24	0.26	0.28	0.29	0.30	0.31	0.32	0.34	
		Tank Capacity	65.8	Liters									
Fuel Level (%)			0	15.2	30.4	45.6	60.8	68.4	76.0	83.6	91.2	106.4	
Pa / sec			20	22	24	26	28	29	30	31	32	34	
P2101													
		Maximum Throttle Angle Deviation per computation cycle											
			Percent Throttle Opening (%)										
			0	0.3	1	5	15						
Percent Throttle Delta (%)			4	6	11	20	50						
Only for the LNF E69 controller													
0	25	50	75	100	120								
-60	-42.5	-32.5	-30	-27.5	-20								
1200	1600	2000	2400	2800	3200	3600	4000	4400	4800	5200	5600	6000	6400
0.104	0.120	0.130	0.136	0.141	0.156	0.179	0.208	0.234	0.260	0.297	0.329	0.352	0.368
1200	1600	2000	2400	2800	3200	3600	4000	4400	4800	5200	5600	6000	6400
3.033	4.288	5.015	5.700	7.200	10.054	15.933	19.200	20.496	####	22.245	22.866	23.677	24.266
80	90												
3.000	3.500												