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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
heater circuits - electrical													
bank 1 sensor 1 (primary)	P0030	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	0.01 sec	4 sec	two driving
	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 (primary)	P0050	circuit continuity - open				engine starting	complete	-	-			cumulative	continuous
	P0051	circuit continuity - ground				output	activated for complete checking						or 50 sec
	P0052	circuit continuity - voltage											cumulative
Mass Air Flow (MAF) Sensor	P0101	range check low	measured mass air flow * threshold			battery voltage	>	10.5	V		0.01 sec	4 sec	two driving
Ratoinality			< Maximum modeled mass air flow	1	factor	for time	>	0.1	sec		continuous	continuous	cycles each
						Condition bordnet voltage HFM supplied	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	0.2	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	1.1	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	-0.2	factor	pressure ratio across throttle during fuel cut off	<						
		and				for time	>	0.5	sec				
		correction factor (modeled air				error: air flow meter (internal)	not set						
		mass at throttle / air mass	> correction factor air mass	1.2	factor	error: throttle position sensor	not set	-	-				
		measured by air mass flow meter)				error: intake air temp. sensor	not set	-	-				
						Condition HFM signal electric valid	TRUE						
	P0100	open circuit check	sensor signal in period time	0.0	uS	battery voltage	>	10.5	V	5 sec			
						Engine is running	TRUE						
						Key on	TRUE						
	P0102	range check low	sensor signal in period time	83.2	uS	time after start	>	0.3	sec	1 sec			
	P0103	range check high	sensor signal in period time	697.6	uS								
Intake Air Temperature Sensor													
Rationality													
	P0111	response check	max intake air temperature - min intake air temperature	1.5	° C	drive period - count	>=	2	count	2 sec	0.1 sec	4 sec	two driving
						each with					continuous	continuous	cycles each
						coolant temperature at start	<=	50	° C				with: 4 sec
						Intake Air Temperature Sensor 2						or 50 sec	continuous
						Electrical Failure	FALSE					cumulative	or 50 sec
						Mass Air Flow	>	42.2	g / sec				cumulative
						Mass Air Flow	<	20.0	g / sec				
						Vehicle speed	>	50	mph				
						idle period - count	>=	2	count				
						each with							
						coolant temperature at start	<=	50.3	° C				
						Intake Air Temperature Sensor 2							
						Electrical Failure	FALSE						
						Mass Air Flow	<	11.1	g / sec				
						Vehicle speed	<	12.5	mph				
						engine coolant temperature	>	80	° C				
Circuit Continuity Check													
	P0112	circuit continuity - high	Intake Air Temperature Sensor 2 Voltage >	4.87	V	Engine Coolant Temperature	>	60	° C	2 sec	0.01 sec	4 sec	two driving
	P0113	circuit continuity - low	Intake Air Temperature Sensor 2 Voltage <	0.21	V	Mass air flow	<	27.8	g / sec			continuous	cycles each
						Vehicle speed	<	2.5	mph			or 50 sec	with: 4 sec
	P0114	intermittent (discontinuity)	Intake Air Temperature Sensor 2 Raw Voltage -									cumulative	continuous
			Intake Air Temperature Sensor 2 Filtered Voltage	0.4	V	Intermittent (discontinuous) time	>	1	sec				or 50 sec
Oxygen Sensor													
sensor circuit (primary O2)													
bank 1 sensor 1	P0130	sensor line short circuit	secondary O2 sensor			engine running	TRUE	TRUE	-		0.1 sec	4 sec	two driving
bank 2 sensor 1	P0150	to heater output line	voltage gradient >	2	V	battery voltage	>	10.4	V		continuous	continuous	cycles each
			within time after heater turn off <	0.04	s	primary O2 heater ever actived	TRUE	TRUE	-			or 50 sec	with: 4 sec
			for occurrences >	4	count	and pri. O2 heater duty cycle	>	0.9	-			cumulative	continuous
			out of heater turn offs	6	count	for time	>	5	sec				or 50 sec
						dew-point end passed	TRUE	TRUE	#REF!				cumulative
						error: injector circuit fault	not set	not set	-				
			or			engine running	TRUE	TRUE	-				
			primary O2 sensor voltage >	0.6	V	battery voltage	>	10.4	V	60 sec			

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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 primary O2 sensor voltage <	1.15	V	primary O2 heater ever actived	TRUE	TRUE	-				
			and secondary O2 sensor voltage <	0.1	V	and pri. O2 heater duty cycle	>	0.9	-				
						for time	>	5	sec				
			or			error: injector circuit fault	not set	not set	-				
			primary O2 sensor voltage >	0.06	V	time after	>	30	sec	60 sec			
			and primary O2 sensor voltage <	0.4	V	dew-point end passed	TRUE	TRUE	-				
			and secondary O2 sensor voltage <	0.5	V	and pri. O2 heater duty cycle	>	0.68	-				
						or Primary Exhaut gas							
						temp. model	>	600	°C				
						Integrated air mass	>	2200	g				
						purge diagnosis	not set	not set	-				
						closed loop control	set	set	-				
bank 1 sensor 1	P0131	short circuit to ground	primary O2 sensor voltage <	0.06	V	engine running	TRUE	TRUE	-	60 sec	0.1 sec	4 sec	two driving
bank 2 sensor 1	P0151		and Secondary O2 sensor voltage >	0.5	V	battery voltage	>	10.4	V		continuous	continuous	cycles each
						primary O2 heater ever actived	TRUE	TRUE	-			or 50 sec	with: 4 sec
						and pri. O2 heater duty cycle	>	0.9	-			cumulative	continuous
						for time	>	5	sec				or 50 sec
						dew-point end passed	TRUE	TRUE	-				cumulative
						error: injector circuit fault	not set	not set					
						Integrated air mass	>	2200	g				
						purge diagnosis	not set	not set	-				
						commanded lambda	<	1.005	lambda				
			primary O2 sensor voltage <	0.06	V	engine running	TRUE	TRUE	-	0.1 sec			
			and cold start conditions present			battery voltage	>	10.4	V				
						primary O2 heater ever actived	TRUE	TRUE	-				
						and pri. O2 heater duty cycle	>	0.9	-				
						for time	>	5	sec				
						dew-point end passed	TRUE	TRUE					
						error: injector circuit fault	not set	not set					
bank 1 sensor 1	P0132	short circuit to battery voltage	primary O2 sensor voltage >	1.15	V	engine running	TRUE	TRUE	-	5	0.1 sec	4 sec	two driving
bank 2 sensor 1	P0152					battery voltage	>	10.4	V		continuous	continuous	cycles each
						primary O2 heater ever actived	TRUE	TRUE	-			or 50 sec	with: 4 sec
						and pri. O2 heater duty cycle	>	0.9	-				
						for time	>	5	sec				
						dew-point end passed	TRUE	TRUE					
						error: injector circuit fault	not set	not set					
						commanded lambda	>	0.995	lambda				
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	1.65	s	engine speed	>	1480	rpm		continuous	continuous	cycles each
						engine load	<	45	%			or 50 sec	with: 4 sec
			20 valid closed loop switching cycles			engine load	>	18	%			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	engine running	TRUE	TRUE	-	10 sec	0.1 sec	4 sec	two driving
bank 2 sensor 1	P0154		and primary O2 sensor voltage <	0.6	V	battery voltage	>	10.4	V		continuous	continuous	cycles each
			Or primary O2 sensor voltage <	0.55	V	primary O2 heater ever actived	TRUE	TRUE	-			or 50 sec	with: 4 sec
			and mod. Exhaust gas temp. >	800	° C	and pri. O2 heater duty cycle	>	0.9	-			cumulative	continuous
			or			for time	>	5	sec				or 50 sec
			primary O2 sensor internal resistance >	20000	Ohm	error: injector circuit fault	not set	not set	-	0.1 sec			cumulative
			and when modeled exhaust gas temperature >	600	° C	time after	>	30	sec				
						dew-point end passed	TRUE	TRUE	-				
			or			and pri. O2 heater duty cycle	>	0.68	-				
			primary O2 sensor voltage >	0.2	V	or Primary Exhaut gas				0.1 sec			
			and secondary O2 sensor voltage >	0.2	V	temp. model	>	600	°C				
			after a getting into fuel cut-off for	3	sec								
Oxygen Sensor Heating													

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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
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	>	-30	C				
						engine off soak time	>	120	sec				
						modeled exhaust temp.	<	525	C				
						suspicion of primary	FALSE						
						O2 sensor open circuit							
						primary O2 voltage supply	ON						
						scheduled by System Manager							
						for time	>	12	sec				
						primary O2 sensor dewpoint exceeded for	>	10	sec				
						no fault clear request during drive cycle	not set						
Oxygen Sensor (Secondary O2 sensor)						deceleration fuel cut-off (DCFO)	active	-	-	4sec		4 sec	two driving
Delayed response voltage during DCFO						Since DCFO, secondary O2 sensor voltage	>	0.59	V			continuous	cycles each
bank 1 sensor 2	P013A	secondary O2 sensor	time from start of DCFO till secondary O2 sensor	3	sec	has ever exceeded upper threshold						or 50 sec	with: 4 sec
bank 2 sensor 2	P013C	delayed response to DFCO	voltage below the lower threshold			battery voltage	>	10.4	V			cumulative	continuous
						secondary O2 sensor readiness	TRUE	-	-				or 50 sec
			or			modeled exhaust gas temperature at	>	450	° C				cumulative
			the oxygen mass integration from start of DCFO	4	g	secondary O2 sensor temperature							
			exceeded upper threshold before the voltage below			secondary O2 sensor internal resistance	<	500	Ohms				
			the lower voltage threshold			secondary O2 sensor has measured lean and rich	TRUE	-	-				
						exhaust gas mass flow rate	>	2.78	g/s				
			lower voltage threshold	0.14	V	primary O2 sensor	ready	-	-				
						primary O2 sensor voltage	<	0.14	V				
Slow response voltage during DCFO						Since DCFO, secondary O2 sensor voltage	>	0.59	V				
bank 1 sensor 2	P013A	secondary O2 sensor	time from secondary O2 sensor voltage crosses	0.4	sec	has ever exceeded upper threshold							
bank 2 sensor 2	P013C	slow response to DFCO	upper threshold till it corsses lower voltage threshold			battery voltage	>	10.4	V				
						secondary O2 sensor readiness	TRUE	-	-				
			upper voltage threshold	0.4	V	modeled exhaust gas temperature at	>	450	° C				
						secondary O2 sensor temperature							
			lower voltage threshold	0.2	V	secondary O2 sensor internal resistance	<	500	Ohms				
						secondary O2 sensor has measured lean and rich	TRUE	-	-				
						exhaust gas mass flow rate	>	2.78	g/s				
						primary O2 sensor	ready	-	-				
						primary O2 sensor voltage	<	0.14	V				
Catalyst Bank 1	P0420	oxygen storage of catalyst	EWMA filtered catalyst aging factor	0.2	factor	exhaust gas mass flow	>	5.00	g/sec	approx.	0.2 sec	4 sec	immediate
Catalyst Bank 2	P0430		less than catalyst aging factor			exhaust gas mass flow	<	16.67	g/sec	1000 sec	continuous	additional	once code
			of a limit catalyst <			catalyst temp. model	<	760	° C	during		after block	has
						catalyst temp. model	>	480	° C	active			been set
						engine speed	>	1040	rpm	driving			
						engine speed	<	2480	rpm				
						engine load	>	12.8	%	3 checks per			approx.
						engine load	<	42	%	driving cycle			3 tests
						modeled catalyst temp. gradient	<	6	° C / sec	3 checks per			average
						relative exhaust gas mass flow gradient	<	2.00	%	driving cycle			run length
						fuel system closed loop	active	-	-	1 check per			(9 samples)
						time after secondary O2 sensor exceeded	>	300 ... 370	sec	driving cycle			
						dewpoint							
						ambient temperature	>	-30	° C				
						catalyst damaging misfire rate exceeded	not set	-	-				
						error: fuel system	not set	-	-				
						closed loop control at limit	not set	-	-				
						strong transient compenstation intervention	not set	-	-				
						catalyst clear out active (after fuel cutoff)	not set	-	-				
						fast mixture adaptation completed	set	-	-				
						Trigger condition for step change							
						Measured OSC < % of EWMA							
						normalized filtered OSC	<	0.71	-				
Engine Metal													
Overtemperature	P1258	engine coolant temperature	engine coolant temperature >	132.8	° C	engine run time	>	30	sec	1 sec	0.1 sec	4 sec cont.	code set
Protection		too high				error: engine coolant temp	not set	-	-		continuous	or 50 sec	then 5 sec
(Limp Home Function Active)												cumulative	
Rough Road Signal	P1380	signal missing	signal missing	-	-	no	-	-	-	5 sec	0.1 sec	4 sec or	no
GMX295 only						error: misfire monitoring	TRUE	-	-		continuous	50 sec cum	
Electronic Throttle Control													code set
	P1551	limp-home throttle position	throttle position <	10.1	%	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 sec
			throttle position >	39.8	%	engine coolant temperature	>=	5.25	° C			or 50 sec	continuous
						engine coolant temperature	<=	100.5	° C			cumulative	or 50 sec

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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	>=	5.25	° C				cumulative
						intake air temperature	<=	143.8	° C				
						battery voltage	>	10.0	V				
						accelerator pedal position	<	14.9	%				
Fuel Level Sensor Circuit fuel level sensor 2	P2066	rationality	fuel level change < and cumulative driving distance >	4.6 / 100.0	% / km	Primary fuel level	>=	41.1	%		0.1 sec continuous	4 sec continuous or 50 sec cumulative	no
						Secondary fuel level	>=	6.2	%				
						Or Primary fuel level	<	41.1	%				
						Secondary fuel level	>	6.2	%				
						and battery voltage	>=	10.5	V				
						battery voltage	<=	18.1	V				
						engine starting	TRUE	-	-				
						electrical fuel level sensor(s) without failure	TRUE	-	-				
			Or cumulative driving distance >=	162.0	km	Primary fuel level	>=	41.1	%				
						Secondary fuel level	<	6.2	%				
						battery voltage	>=	10.5	V				
						battery voltage	<=	18.1	V				
						engine starting	TRUE	-	-				
						electrical fuel level sensor(s) without failure	TRUE	-	-				
	P2067	range check low	voltage <	0.25	V	battery voltage	>=	10.5	V	60 sec	0.1 sec continuous	4 sec cont. or 50 sec cumulative	no
						battery voltage	<=	18.1	V				
						engine starting	TRUE	-	-				
	P2068	range check high	voltage >	3.2	V	battery voltage	>=	10.5	V	60 sec	0.1 sec continuous	4 sec cont. or 50 sec cumulative	no
						battery voltage	<=	18.1	V				
						engine starting	TRUE	-	-				
Secondary O2 Trim of primary O2 Sensor						engine speed	<	3480	rpm	200 sec	0.1 sec	4 sec	two driving
primary O2 sensor signal RICH / secondary O2 sensor signal LEAN						engine speed	>	1280	rpm		continuous	continuous	cycles each
Bank1	P2096	secondary O2 sensor fuel	secondary O2 sensor trim			engine load	<	65.3 …. 65.3	%			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
		- correction above threshold				closed loop control active	TRUE	-	-				or 50 sec
						for time	>	1	sec				cumulative
						exhaust gas temp. model	>	250	° 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		0	0				
						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	-	-				
Accelerator Pedal Position Sensor 1	P2122	range check low	voltage	0.74	V	battery voltage	>	7	V	0.2 sec	0.01 sec continuous	4 sec cont. or 50 sec cumulative	code set then 5 sec
	P2123	range check high		4.82	V								
Accelerator Pedal Position Sensor 2	P2127	range check low	voltage	0.63	V	battery voltage	>	7	V	0.2 sec			
	P2128	range check high		4.82	V								
Accelerator Pedal Position 1 versus Position 2	P2138	plausibility	voltage difference >	0.25	V	-	-	-	-	0.24 sec			
			idle range	0.31	V								
			voltage difference	0.31	V								
			pedal partially pressed >										
			voltage difference >	1.69	V								
			pedal fully pressed										
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

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						electrical							or 50 sec
			or			for time	>	0.2	sec				cumulative
		sensor offset / jump test low	sensor output change within 20 sec period >	10	KPa	error : barometric pressure sensor	not set	-	-	2 sec	continuous	4 sec	
			OR			electrical							
			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	5	KPa	air mass flow meter readiness	TRUE	-	-				
			< pressure model			engine running time	>	1	sec				
						command air flow valid	TRUE	-	-				
						corrector factor calculation							
						for mass-flow substitute							
						load signal	TRUE	-	-				
						air flow meter signal valid	TRUE	-	-				
						enabling air flow meter diag.	TRUE	-	-				
						Evap. Leak detection active	not set	-	-				
						for time	>	1	sec				
						error: throttle position sensor	not set	-	-				
						error: air flow mass meter	not set	-	-				
						error : Baro pressure sensor							
						electrical	not set	-	-				
			or										
		sensor offset / jump test high	sensor output change within 20 sec period >	10	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	5	KPa	air mass flow meter readiness	TRUE	-	-				
			> pressure model			engine running time	>	1	sec				
						command air flow valid	TRUE	-	-				
						corrector factor calculation							
						for mass-flow substitute							
						load signal	TRUE	-	-				
						air flow meter signal valid	TRUE	-	-				
						enabling air flow meter diag.	TRUE	-	-				
						Evap. Leak detection active	not set	-	-				
						for time	>	1	sec				
						error: throttle position sensor	not set	-	-				
						error: air flow mass meter	not set	-	-				
						error : Baro pressure sensor							
						electrical	not set	-	-				
	P2228	range check low	voltage <	0.2	V	enabled by scheduler for time	>	1	sec	2 sec			
	P2229	range check high	voltage >	4.87	V	enabled by scheduler for time	>	1	sec				
Auxiliary Engine Coolant Pump Circuit Continuity													
	P2600	circuit continuity - open	Voltage	IC Internal		engine speed	>	80	rpm	0.01 sec	0.01 sec	4 sec cont.	no / pending
	P2602	circuit continuity - ground	Voltage	IC Internal		battery voltage	>	9.99	V			or 50 sec	
	P2603	circuit continuity - voltage	Voltage	IC Internal		battery voltage	<	18.1	V			cumulative	
Rationality													
	P2601	monitoring of engine coolant temperature profile during soak (engine off period)	temperature change gradient during soak period >	-5.0 … -1.5 [function of ambient temperature]	° C	auxiliary coolant pump enabled (coolant temp. at engine shutdown > 110 C)	TRUE			80 sec	0.1 sec during after-run when pump is enabled only		
						coolant temp. sensor fault (electrical)	FALSE						
						coolant temp. sensor fault (performance)	FALSE						
						coolant temp. sensor fault (intermittent)	FALSE						
						IAT sensor fault (electrical)	FALSE						
						IAT sensor fault (plaus)	FALSE						
						auxiliary coolant pump fault (electrical)	FALSE						
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	

LOOK-UP TABLES (LLT)

P0135, P0155 **KFRINV / 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)	260.006	320.006	380.006	440.006	500.006
0.70	224	216	192	160	136
0.80	168	168	144	128	112
1.00	112	112	112	104	96

FRINV1 / 2 (internal manufacturer cross reference)

Multiplication Factor for Internal Resistance KFRINH Nominal Value - Secondary O2 Sensor

	Modeled Exhaust Gas Temperature at Secondary O2 Sensor (° C)				
	260.006	320.006	380.006	440.006	500.006
factor	10.50	7.50	4.50	3.00	2.00

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)	299.991	359.991	419.991	479.991	539.991
0.700	344	328	304	272	224
0.800	248	240	232	200	168
1.000	200	184	168	152	128

FRINH1 / 2 (internal manufacturer cross reference)

Multiplication Factor for Internal Resistance KFRINH Nominal Value - Secondary O2 Sensor

	Modeled Exhaust Gas Temperature at Secondary O2 Sensor (° C)				
	299.991	359.991	419.991	479.991	539.991
factor	15.00	10.00	6.00	4.00	2.50

P2601 **DDTMOTMIN**

Maximum Second Derivative of tmot in Post Run

tumg (degC)	-20.3	0	15	50.3
2nd derivative (degC)	-5	-3	-2	-1.5

LOOK-UP TABLES (LLT)

DDTMOTMIF

Maximum Second Derivative of tmot in Post Run with Fans Active

tumg (degC)	-20.3	0	15	50.3
2nd derivative (degC)	-5	-3	-2	-1.5

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Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie 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) >	KFDWNWDMXE / 2		engine run time	>	1	sec	20 sec	continuous	continuous	cycles each
Bank 2 Intake	P0021		(desired must remain above value	KFDWNWDMXA / 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)									
			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 >	9.9	degrees	engine run time >	>	50	sec	approx.	0.2 sec	4 sec	two driving
Bank 1 Exhaust	P0017	limit check	or adapted angle <	9.9	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 >	15	degrees	engine coolant temp <	<	95.25	° C			or 50 sec	with: 4 sec
Bank 2 Exhaust	P0019		and <	21	degrees	model: engine oil temp <	<	120	° C	fail after		cumulative	continuous
Bank 1 / Idler Sprocket	P0008		adapted angle for both cams >	6.0	degrees	error: camshaft sensor	not set	-	-	2 adaptation			or 50 sec
Bank 2 / Idler Sprocket	P0009		adapted angle for both cams <			error: camshaft control circuit	not set	-	-	cycles - required			cumulative
Air / Fuel Ratio Sensor Heating and Oxygen Sensor Heating													
heater circuits - electrical													
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						cumulative
High Pressure Fuel Control System Rationality													
	P0088	pressure deviation from desired -	difference (desired versus actual fuel rail pressure	-2000	Kpa	error: electrical diagnosis of fuel volume c	not set	-	-	2 sec	continuous	4 sec	Immdediate once
		over pressure				tester request for open fuel flow control v	FALSE	-	-				code has been set
	P0087	pressure deviation from desired -	difference (desired versus actual fuel rail pressure	1500	Kpa	error: electrical diagnosis of fuel rail press	not set	-	-	2 sec	continuous	4 sec	
		under pressure				airbag deployed	FALSE	-	-				
	P0089	C/L controller output value - above	Controller output value ("p" part plus "i" part) >	2500	Kpa	battery voltage	<	18.1	V	2 sec	continuous	4 sec	
		expected				relative injected fuel mass	>	5.016	%				
	P0089	C/L controller output value - below	Controller output value ("p" part plus "i" part) <	-2500	Kpa	relative injected fuel mass	<	500	%	2 sec	continuous	4 sec	
		expected				first engine start at assembly plant	FALSE	-	-				
						DFCO active	FALSE						
						engine speed	>	25	rpm				
						syncronisation reference mark detected	TRUE						
						engine start temperature	>	-48	C				
High Pressure Fuel Volume Control Valve Circuit rationality													
	P0092	circuit rationality - feed-back voltage	voltage test pulse - on command >	4.502	V	battery voltage	>	6	V	0.5 sec	continuous	4 sec	Immdediate once
	P0091	circuit rationality - feed-back voltage	voltage test pulse - off command <	2.749	V	battery voltage	<	18.1	V				code has been set
	P0090	circuit rationality - feed-back voltage	voltage test pulse - off command within window	49 < Voltage < 4.5	V	battery voltage	<	ff command voltag	V				
						circuit switched off due to 5 volt supply fau	not set	-	-				
Engine coolant temperature sensor	P0116	difference from Engine temperature model after soaking	filtered difference			Engine coolant model (cooled down)	<	50	° C	100 sec	0.2 sec	4 sec	immediate
			(ECT at key on - ECTmodel at key on)	14.3	° C	Soaking time after shut down	>	19800	sec	for block heating	continuous	additional once code after block	has been set
						previous accumulated air mass **AND**	>	6000	g	check			
			or			previous engine run time **or**	>	600	sec		one filter update per	heater check when	
			filtered difference			ECT at shut down	>	81.75	° C		cold start	filtered	approx.
			(ECTmodel at key on - ECT at key on)	14.3	° C	Controller Shut Down at end of last cycle	-	-	-			difference	6 test
						Error - Engine Off Timer	not detected	-	-			exceeds	average
						Powerfail during previous drive	not detected	-	-			threshold	run length
						Block Heater	not detected	-	-				(15°C delta)
Engine coolant	P0117	range check high	coolant temperature >	140.3	° C	if Startup IAT	>	72	° C	0.1 sec	0.1 sec	4 sec	two driving

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Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
temperature sensor						hot restart timer	>=	60	sec		continuous	continuous	cycles each
	P0118	range check low	coolant temperature <	-42	° C	-	-	-	-			or 50 sec	with: 4 sec
												cumulative	cont. or 50
													sec cum.
	P0119	intermittent (discontinuity)	delta coolant temp. during evaluation period <	-4.5	° C		-	-	-	0.1 sec	0.01 sec		
			delta coolant temp. during evaluation period >	4.5	° C						continuous		
			weighted counter >	60000	count								
			(up 5,000 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)											continuous	continuous	cycles each
												or 50 sec	with: 4 sec
												cumulative	cont. or 50
	P0122	plausibility to other poti	sensor circuit low voltage <	0.176	V	battery voltage	>	7	V	continuous	0.1 sec	4 sec	Immdediate once
	P0123		sensor circuit high voltage >	4.629	V						continuous	continuous	code has been set
												or 50 sec	
												cumulative	
Sensor 2 (redundant)	P0221	range check poti voltage,	sensor difference >	9	%	battery voltage	>	7	V	continuous	0.1 sec	4 sec	two driving
											continuous	continuous	cycles each
												or 50 sec	with: 4 sec
												cumulative	cont. or 50
	P0222	plausibility to other poti	sensor circuit low voltage <	0.156	V	battery voltage	>	7	V	continuous	0.1 sec	4 sec	Immdediate once
	P0223		sensor circuit high voltage >	4.883	V						continuous	continuous	code has been set
												or 50 sec	
												cumulative	
Engine Coolant	P0128	Coolant Temperature Below	(calculated reference model coolant temp	10.5	° C	error: engine coolant temp	not set	-	-	5 sec	0.1 sec	4 sec	two driving
Thermostat Monitoring		Thermostat Regulating	minus measured coolant temperature) >			error: vehicle speed sensor	not set	-	-		continuous	continuous	cycles each
		Temperature (plausibility check)				est. ambient temperature	>	-10.5	°C			or 50 sec	with: 4 sec
			reference model calculation limit	89.3	° C	est. ambient temperature	<	70	°C			cumulative	continuous
						vehicle speed	>=	9.375	mph	typical fault			or 50 sec
			(development vehicles indicated			engine speed	>	960	rpm	detection time for			cumulative
			steady thermostat regulating			coolant temperature at start	<	60.8	°C	stuck open t-stat =			
			temperatures of 89°C, as measured			integrated air mass flow	>	3000	g	~ 700 sec			
			by the engine coolant temp. sensor.										
			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.)										
			or										
Engine coolant		plausibility check	calculated coolant temperature model	9.8	° C	the model temperature increases				120 to 300			
temperature sensor			minus measured temperature >			depending on air flow				sec			
						coolant temp at start	<	40.5	°C	approx.			
						ECT Electrical Failure	not set	-	-	500 sec			
						Blockheater Detection	not set	-	-				
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 secondary O2 dew point end	TRUE				continuous	continuous	cycles each
						for time	>	90	sec			or 50 sec	with: 4 sec
						engine running	TRUE	-	-			cumulative	continuous
						battery voltage	>	10.4	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 >	1.15	V	secondary O2 heating stable	TRUE	-	-	5.1 sec			
bank 2 sensor 2	P0158					and secondary O2 dew point end	TRUE						
						for time	>	90	sec				
						engine running	TRUE	-	-				
						battery voltage	>	10.4	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			
bank 2 sensor 2	P0160		and secondary O2 sensor voltage <	0.519	V	and secondary O2 dew point end	TRUE						
						for time	>	90	sec				
			or			engine running	TRUE	-	-				
			secondary O2 sensor internal resistance >	40000	Ohm	battery voltage	>	10.4	V				
			when modeled exhaust gas temperature >	450	° C	mod. exhaust-gas temp.	<	800	° C				
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	>	-30	C				
						engine off soak time	>	120	sec				
						modeled exhaust temp.	in range	300 . . . 550	C				
						at secondary O2 sensor							
						suspicion of secondary	FALSE						
						O2 sensor open circuit							

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Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						secondary O2 voltage supply	ON						
						from the deactivation for time	>	120	sec				
Fuel Rail Pressure Sensor Rationality													
	P0191	rationality check low	Fuel pressure during power up init. <	250	KPa	engine speed	>	25	rpm	0.1 sec	During	4 sec	two driving
			AND			for time	>	0.5	sec		engine	continuous	cycles each
			Fuel system fault exists:			engine run time	>	30	sec		start only		with: 4 sec
			P0087 or P2188 or P2187										continuous
													or 50 sec
													cumulative
			or										
		rationality check high	Fuel pressure during power up init. >	1500	KPa	engine speed	>	25	rpm				
			AND			for time	>	30	sec				
			Fuel system faults exist:			block heater active	-	FALSE	-				
			P0088 or P2187 or P2177			engine coolant at shutdown	>	84.5	C				
						engine coolant at start	<	54.8	C				
						difference : engine coolant at start - intake air temperature	<	35.3	C				
						differenec : intake air temperature - engine coolant at start	<	9.75	C				
						engine off time during soak	>	16000	sec				
			or										
		rationality check high	Fuel pressure during power up init. >	1500	KPa	engine speed	>	25	rpm				
			AND			for time	>	30	sec				
			Fuel pressure rise during fuel pump prime >	3500	KPa	block heater active	-	FALSE	-				
						engine coolant at shutdown	>	84.5	C				
						engine coolant at start	<	54.8	C				
						difference : engine coolant at start - intake air temperature	<	35.3	C				
						differenec : intake air temperature - engine coolant at start	<	9.75	C				
						engine off time during soak	>	16000	sec				
Fuel Rail Pressure Sensor Electrical													
	P0193	circuit continuity - high	Fuel pressure sensor output voltage >	4.70	V		-	-	-	0.5 sec	0.01 sec	4 sec	Immdediate once
	P0192	circuit continuity - low	Fuel pressure sensor output voltage <	0.30	V		-	-	-	0.5 sec	0.01 sec	4 sec	code has been set
High Pressure Fuel Injection Valve Circuit Continuity - High side (HS) and Low Side (LS)													
Cylinder #1	P0201	circuit continuity - open LS or HS	Voltage	IC Internal		engine speed	>	80	rpm	0.01 sec	0.01 sec	4 sec	two driving
	P0261	circuit continuity - ground LS				battery voltage	>	8	v				cycles each
	P0262	circuit continuity - battery LS				battery voltage	<	18.1	v				with: 4 sec
	P2146	circuit continuity - ground or battery HS											continuous
													or 50 sec
Cylinder #2	P0202	circuit continuity - open LS or HS											cumulative
	P0264	circuit continuity - ground LS											
	P0265	circuit continuity - battery LS											
	P2149	circuit continuity - ground or battery HS											
Cylinider #3	P0203	circuit continuity - open LS or HS											
	P0267	circuit continuity - ground LS											
	P0268	circuit continuity - battery LS											
	P2152	circuit continuity - ground or battery HS											
Cylinder #4	P0204	circuit continuity - open LS or HS											
	P0270	circuit continuity - ground LS											
	P0271	circuit continuity - battery LS											
	P2155	circuit continuity - ground or battery HS											
Cylinder #5	P0205	circuit continuity - open LS or HS											
	P0273	circuit continuity - ground LS											
	P0274	circuit continuity - battery LS											
	P216A	circuit continuity - ground or battery HS											
Cylinder #6	P0206	circuit continuity - open LS or HS											
	P0276	circuit continuity - ground LS											
	P0277	circuit continuity - battery LS											
	P216D	circuit continuity - ground or battery HS											
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	
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	Immdediate once
			under pressure (P0087)			engine speed	>	1520	rpm				code has been set
			and			engine speed	<	4520	rpm				
			cylinder # 1 misfire counts >	100	counts	relative engine load	<	114.8	%				
						misfire counters accumulate							
	P02A1	fuel injector stuck open - cylinder #2	fuel pressure deviation from desired -	set		within period <	<	80	rev				
			under pressure (P0087)										
			and										
			cylinder # 2 misfire counts >	100	counts								
	P02A5	fuel injector stuck open - cylinder #3	fuel pressure deviation from desired -	set									
			under pressure (P0087)										
			and										
			cylinder # 3 misfire counts >	100	counts								

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Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
	P02A9	fuel injector stuck open - cylinder #4	fuel pressure deviation from desired -	set									
			under pressure (P0087)										
			and										
			cylinder # 4 misfire counts >	100	counts								
	P02AD	fuel injector stuck open - cylinder #5	fuel pressure deviation from desired -	set									
			under pressure (P0087)										
			and										
			cylinder # 5 misfire counts >	100	counts								
	P02B1	fuel injector stuck open - cylinder #6	fuel pressure deviation from desired -	set									
			under pressure (P0087)										
			and										
			cylinder # 6 misfire counts >	100	counts								
Misfire													
Emission Level													
Multiple Cylinder	P0300	crankshaft speed	emissions relevant misfire rate	1.82	%	engine speed	>	420	rpm	1000 revs	cylinder	4 sec	Fault during
Cylinder #1	P0301	fluctuation cylinder 1 to				engine speed	<	7000	rpm		firing	continuous	1st interval:
Cylinder #2	P0302	cylinder 6				indicated torque (idle, no drive)	>	5.86	%		frequency		2 faults in
Cylinder #3	P0303					indicated torque (drive) (MISALUN)	>	7.05 . . . 29.3	%			After	2 different
Cylinder #4	P0304					engine speed gradient	<	2500 . . . 4600	rpm/sec		continuous	detection,	drive cycles.
Cylinder #5	P0305					volumetric efficiency gradient	<	225 . . . 1350	%/rev			the	
Cylinder #6	P0306					cylinder events after engine start	>	6	ignitions			diagnostic	Fault during
						air temperature	>	-30	° C			can only	remaining
						rough road (GMX295 only)	not detected	-	-			pass if	intervals:
						clutch switch press / release	transition	FALSE	-			similar	8 faults in 2
						leak detection pull-down phase	off	-	-			conditions	different
						fuel cut off	not active	-	-			are	drive cycles
						fuel level	>	11.4	-			encountered	with at least
						OR fuel level	<	11.4	%				4 faults in
						AND solid misfire MIL	on	-	%				each.
						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	>=	11.4	%	intervals			while error
Cylinder #4	P0304			18.1 . . . 5	%	OR fuel level	<	11.4	%				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	test pulse	test pulse integral <	4	V					0.1 sec	0.1 sec	4 sec	two driving
			for consecutive events	4	count	engine coolant temp.	>	60	° C		continuous	continuous	cycles each
						knock control	active	-	-			or 50 sec	with: 4 sec
						zero test , parity fault assumptions	not set	-	-			cumulative	continuous
		or				measuring window	>	1	ms				or 50 sec
		null test (zero test)	absolute value (integrator gradient) >	200	V / sec	engine coolant temp.	>	60	° C				
						knock control	active	-	-				
			for consecutive events	4	count	test pulse , parity fault assumptions	not set	-	-				
		or											
		parity check	ficient RAM errors in knock IC, per 250 working cy	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 cy	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 work	25	count	engine speed	>	2200	rpm	approx.	0.1 sec	4 sec	two driving
Performance	P0327	range check low	reference voltage <	0.055 . . . 0.221	V	engine speed gradient (NGKRWN)	<	500 ... 2300	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	30	count								cumulative
	P0328	range check high											
			reference voltage >	3.1 . . . 39.1	V								
				UDKSNO									
			for consecutive events	30	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				
Circuit check	P0331	short circuit to B+ or GND	faults detected on knock sensor pins, per 250 work	25	count	engine speed gradient (NGKRWN)	<	500 ... 2300	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	20 sec	continuous	continuous	cycles each
						error: knock control circuit (IC)	not set	-	-			or 50 sec	with: 4 sec
												cumulative	continuous

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Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
			for consecutive events	100	count								or 50 sec
	P0333	range check high											cumulative
			reference voltage >	3.1 . . . 39.1	V								
				UDKSNO									
			for consecutive events	100	count								
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 >	6	gaps							or 50 sec	has
			(sensor signal but no reference)									cumulative	been set
	P0336	rationality check	unexpected re-synchronization >	2600	count								
			(loss of reference mark)										
		rationality check	intermittent loss of engine speed signal >	28	count								
	P0338	rationality check	difference in counted teeth between	250	crankshaft					approx.	1 per rev		
			reference gap position events >		teeth					2 sec	continuous		
Camshaft Position Sensor													
Bank 1 Intake	P0341	plausibility check	signal erratic or out of position	4	count	engine in synchronized mode	TRUE	-	-	10	1 per rev	4 sec	two driving
	P0342	circuit low	signal permanently low	5	count					revolutions	continuous	continuous	cycles each
	P0343	circuit continuity or high	signal permanently high	5	count							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	<	6000	rpm	approx.	engine	4 sec	two driving
	P2300	circuit continuity - ground				engine speed	>	9.99	V	1 sec	cycle	continuous	cycles each
	P2301	circuit continuity - voltage				battery voltage	<	18.1	V		frequency	or 50 sec	with: 4 sec
Cylinder #2	P0352	circuit continuity - open				battery voltage						cumulative	continuous
	P2303	circuit continuity - ground									continuous		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											
	P2315	circuit continuity - ground											
	P2316	circuit continuity - voltage											
Ignition Coil Driver Circuit	P167D	Internal SPI communication fault	IC Internal	-		battery voltage	<	18.1	v	0.01 sec			
Serial Communication						battery voltage	>	9	v				
						engine speed	<	6000	rpm				
Evaporative System and Leak Monitor													
Small Leak - 0.020 "	P0442	natural pressure/vacuum	filtered fault index >	0.6	-	Eng. Running Vac. pull down	not set	(see P0455 for details)		approx.	0.1 sec	filtered	immediate
		in tank				or vac. pulldown suspect leak	0.020" leak	(see P0455 for details)		600 sec	once per	value	once code
			based on:			est amb air temp	>	1.5	° C	each test	engine off	exceeds	has
			(peak pressure - peak vacuum) <	540 . . . 1430	Pa	est amb air temp	<	32.25	° C		cycle	threshold	been set
			[Table KFEONVPT]			Engine stop coolant temp	>	74.25	° C	approx.		then	
						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	>	11.0	%				run length
						fuel level	<	88.1	%				
						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													

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Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
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	>	9.99	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													
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
						fuel tank pressure	>	-2500	Pa	will be	driving		cumulative
						fuel tank pressure	<	1300	Pa	completed.	cycle		
						ratio: (MAP Model / Baro)	<	0.812	-				
						est amb air temp	>	1.5	° C	The test			
						est amb air temp	<	32.25	° C	will attempt			
						fuel level	>	11.2	%	to run up			
						fuel level	<	91.2	%	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	>	9.99	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	P0450	rationality - signal oscillation	| delta pressure signal |	813	Pa	ambient temperature model	>	-7.5	° 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	>	4	sec			or 50 sec	with: 4 sec
													or 50 sec
													cumulative
	P0451	rationality - signal range check	sensor signal >=	1750	Pa	time after engine start	>	1	sec	25.5	0.1 sec	4 sec	two driving
			sensor signal >=	-3500	Pa	time after canister vent valve open	>	4	sec	sec	continuous	continuous	cycles each
												or 50 sec	with: 4 sec
		or											or 50 sec
		rationality - drift check	| delta pressure signal |	344	Pa	Vent solenoid valve open	TRUE	-	-				cumulative
			(= current pressure			Caniter purge flow (closed)	<=	0.0	g / sec				
			- reference pressure at start) >			ambient pressure	>	68000	Pa				
						fuel level	<	88.4	%				
						fuel level	>	11.2	%				
						fuel level	<	150	%				
						Or							
						fuel level valid for running							
						Evap. leak detection	TRUE	-	-				
						Vehicle speed	>	0	mph				
						Vehicle speed	<	93.75	mph				
						Or							
						ambient temperature model	<=		° C				
						ambient temperature model	>=		° C				
						time	>	3	sec				
	P0452	circuit continuity - ground	sensor signal voltage <	0.1514	V	engine running	TRUE	TRUE		10 sec	0.1 sec	4 sec	two driving
	P0453	circuit continuity - voltage	sensor signal voltage >	4.702	V						continuous	continuous	cycles each
												or 50 sec	with: 4 sec
													or 50 sec
													cumulative
Large leak	P0455	vacuum pulldown slope	absolute value			fuel system status	closed loop	-	-	11 sec	0.1 sec	4 sec	two driving
			of vacuum pulldown slope <			vehicle speed	<	1.9	mph			continuous	cycles each
				4.5 ... 7.6	Pa/sec	engine	idling	-	-	Only one	one		with: 4 sec
				[KLTLDSFS05]		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	<	1300	Pa		cycle		
						ratio: (MAP Model / Baro)	<	0.81	-	The test			
						est amb air temp	>	1.5	° C	will attempt			
						est amb air temp	<	32.25	° C	to run up			
						fuel level	>	11.4	%	to 10 times			
						fuel level	<	88.1	%	until it			
						engine start temp - amb. temp	<	9.75	° C	successfully			
						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	-	-				

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Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						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	P0461	rationality	fuel level change <	4.6	%	Primary fuel level	<	41.1	%		0.1 sec	4 sec	no
fuel level sensor 1			and			Secondary fuel level	<=	6.2	liter		continuous	continuous	
			cumulative driving distance >	120.0	km	Or						or 50 sec	
						Primary fuel level	<	41.1	liter			cumulative	
						Secondary fuel level	>	6.2	liter				
						and							
						battery voltage	>=	10.5	V				
						battery voltage	<=	18.1	V				
						engine starting	TRUE	-	-				
						electrical fuel level sensor(s) without failure	TRUE	-	-				
			Or			OR							
			cumulative driving distance >=	162.0	km	Primary fuel level	>=	41.1	%				
						Secondary fuel level	<	6.2	%				
						battery voltage	>=	10.5	V				
						battery voltage	<=	18.1	V				
						engine starting	TRUE	-	-				
						electrical fuel level sensor(s) without failure	TRUE	-	-				
	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	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	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	>	9.99	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	<	1300	Pa		cycle		
						ratio: (MAP Model / Baro)	<	0.81	-	The test			
						fuel level	>	11.4	%	will attempt			
						fuel level	<	88.1	%	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				
						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	-	-				
Stuck Closed Purge valve	P0497	vacuum pulldown slope	tank vacuum >			fuel system status	closed loop	-	-	11 sec	0.1 sec	4 sec	two driving
				-1.221	Pa	vehicle speed	<	1.9	mph			continuous	cycles each
						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	<	1300	Pa		cycle		
						ratio: (MAP Model / Baro)	<	0.81	-	The test			
						est amb air temp	>	1.5	° C	will attempt			
						est amb air temp	<	32.25	° C	to run up			
						fuel level	>	11.4	%	to 10 times			
						fuel level	<	88.1	%	until it			
						engine start temp - amb. temp	<	9.75	° C	successfully			
						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	-	-				

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Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						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)	<	99.9 . . . 99.9	%	10 sec	0.1 sec	4 sec	two driving
						coolant temp.	>	-11.3	° C		continuous	continuous	cycles each
	P0507		desired rpm - actual rpm <	-200	rpm	intake air temp	>	-11.3	° 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)	>	0.594	factor				or 50 sec
			during this idle			time after engine start	>	3.84	sec				
						evap purge (high HC conc.)	FALSE						cumulative
						cold start idle speed control	FALSE						
						intrusive evap test	not active						
						intrusive secondary air test (=not applicab	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	Engine coolant start temp.	>	-10 .... +40	° C	7 sec	0.1 sec	4 sec	two driving
			during catalyst heating on			vehicle	at idle				continuous	continuous	cycles each
			desired rpm - actual rpm <	-200	rpm	altitude factor (sea level = 1.0)	>	0.594	factor			or 50 sec	with: 4 sec
			during catalyst heating on			Engine coolant start temp.	<	80	° C			cumulative	continuous
						catalyst heating	TRUE	-	-				or 50 sec
						evap purge (high HC conc.)	FALSE	-	-				cumulative
						idle speed control catalyst heating	TRUE	-	-				
						intrusive evap test	not set	-	-				
						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	-	-				
System Voltage			powertrain supply relay feedback input										
	P0562	range check low	voltage	9.99	V	time after engine start	>	180	sec	2 sec	0.1 sec	4 sec	no
											continuous	continuous	
	P0563	range check high	voltage	18.1	V	time after engine start	>	180	sec			or 50 sec	
						vehicle speed	>	3.1	mph			cumulative	
ECM monitoring													
	P0601	rationality	wrong ROM checksum during initialization reaches ROMRSTA_UM times.	5	times	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 se	-	-	-	-	-	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. Error from shut-down path test reaches DURNPRST_A times	3	times	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	
		ETC monitoring volumetric efficiency signal										cumulative	
		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 (ETC) checks	SW internal	SW Internal									
		SPI failure of throttle output stage											
Fuel Pump Relay Control	P0627	circuit continuity - open	voltage <	2.74	V	pump command off	-	-	-	0.1 sec	0.1 sec	50 sec	two driving
Circuit			voltage >	2.21	V	engine speed	>	80	rpm				cycles each
	P0629	circuit continuity - voltage	voltage >	2.21	V	battery voltage	>	9.99	V			cumulative	with: 4 sec
						battery voltage	<	18.1	V				continuous
													or 50 sec
													cumulative
	P0628	circuit continuity - ground	voltage <	2.21	V	pump command on	-	-	-	0.5 sec			
						engine speed	>	80	rpm				
						battery voltage	>	9.99	V				
						battery voltage	<	18.1	V				
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)							(recoverable)	continuous	continuous	then 5 sec
												or 50 sec	

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Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
		motor control range check								5.0 sec		cumulative	
		long term								(latched)			
5V reference voltage													
monitoring	P0641	circuit continuity - open	Voltage	IC Internal	-	ignition key on	TRUE	-	-	3 sec	0.01 sec	4 sec	code set
	P0642	circuit continuity - ground				ECM power relay	TRUE	-	-			continuous	then 5 sec
	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	continuous	(but is
		circuit continuity - voltage				battery voltage	<	18.1	V			or 50 sec	shown in
						output	activated and deactivated for complete checking					cumulative	Mode $03)
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 Position Sensor	P0806	rationality -	detected clutch pedal press count <	2	count -	gear changes detected	>	20	count	approx.	0.1 sec	4 sec	code set
Manual Transmission		input clutch pos. state changes			senso	(ratio of engine speed to				500 sec	continuous	continuous	then 5 sec
					presses	vehicle speed -- range change)						or 50 sec	
					detected	Delay between shift detections	>	10	sec			cumulative	
						vehicle speed	>	25.0	mph				
						between gear change detects							
	P0807	Circuit Continuity - Ground	Voltage <	0.249	V								
	P0808	Circuit Continuity - Voltage	Voltage >	4.75	V								
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
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 throttle blade	actual position of throttle blade >	dep. on rate of change		battery voltage	>	7	V		continuous	or 50 sec	then 5 sec
			[Table DWDKSBAMX]									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	<=	100.5	° C	per			
						intake air temperature	>=	5.25	° C	ignition			
						intake air temperature	<=	143.8	° C	on			
						battery voltage	>	10.0	V				
						accelerator pedal position	<	14.9	%				
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 <	4.12	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 >	4.55	V	engine coolant temperature	<=	100.5	° C	per			
		or				intake air temperature	>=	5.25	° C	ignition			
		learning prohibited due to	range check poti2 value at lower stop			intake air temperature	<=	143.8	° C	on			
		secondary parameters not met	throttle potentiometer 2 voltage <	0.341	V	battery voltage	>	10.0	V				
		or	or			accelerator pedal position	<	14.9	%				
		minimum throttle position	throttle potentiometer 2 voltage >	0.988	V								
		out of range											
Fuel System Lean/Rich						air mass flow	>=	6.9	g/sec	approx.	0.1 sec	4 sec	two driving
Multiplicative						air mass flow	<=	41.7	g/sec	300 sec	continuous	continuous	cycles each
						engine load	>=	18.0	%	from engine		or 50 sec	with: 4 sec
Bank 1	P2177	fuel trim limits exceded	delta lambda correction >	1.23	factor	engine load	<=	80.0	%	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	<=	4000.0	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				

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Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						intake air temperature	<=	60	°C				
						primary A/F sensor 1 readiness	TRUE	-	-				
						primary A/F sensor 2 readiness	TRUE	-	-				
						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	-	-				
Fuel System Lean/Rich additive													
Bank 1	P2187	range - additive	delta fuel load correction >	6.1	%	air mass flow	>=	1.7	g/sec				
	P2188	low speed and low load	or delta fuel load correction <	-6.0	%	air mass flow	<=	7.8	g/sec				
						engine load	>=	11.0	%				
Bank 2	P2189		delta fuel load correction >	6.1	%	engine load	<=	45.0	%				
	P2190		or delta fuel load correction <	-6.0	%	engine speed	>=	520.0	rpm				
						engine speed	<=	1120.0	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	>	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													
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 secondary O2 dew point end	TRUE				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	>	10.4	V				or 50 sec
						mod. exhaust-gas temp.	<	800	° C				cumulative
						time after dew point exceeded	>	10	sec				
Oxygen Sensor						engine running	TRUE	-	-				
sensor response (secondary O2)						battery voltage	>	10.4	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	0.2	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
			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	-	-				
bank 2 sensor 2	P2273		for time >	100	sec	battery voltage	>	10.4	V				
			then			secondary O2 sensor	ready	-	-				
			ramping in enleanment by	0.07	lambda	for time	>	10	sec				
			at gradient	0.017	λ / sec	secondary O2 closed loop control	active						
			for time (after enleanment limit reached)	10	sec	DFCO	FALSE						
						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						
Real time clock													
Engine Off Timer Status	P2610	engine off timer signal check	engine off timer not valid	3.0		engine start successful during previous dr	TRUE	-	-	0.1 sec	0.1 sec	4 sec	two driving
(performed during						real time clock active	TRUE	-	-		continuous	continuous	cycles each
engine off operation)												or 50 sec	with: 4 sec
												cumulative	continuous
													or 50 sec
													cumulative
Real time clock													
Engine Off Timer Rationality	P2610	engine off timer incremental	reference clock time delta -	6	counts	engine start successful	TRUE	-	-	0.1 sec	0.1 sec	4 sec	two driving

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Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
(performed during		check	engine off timer delta >			failure counts	>=	3	3		continuous	continuous	cycles each
engine running operation)												or 50 sec	with: 4 sec
												cumulative	continuous
(reference clock = independantly			reference clock time delta -	6	counts	engine start successful	TRUE	-	-				or 50 sec
captured time value)			engine off timer delta <			failure counts	>=	3	counts				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
			or No Communication / Bus Off			ignition on for	>	3	sec	0.02 sec		or 50 sec	
						battery voltage	>	9.9	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
				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	>	9.9	V				
				content		battery voltage	<	18.1	V				
						normal bus communication	running	-	-				

LOOK-UP TABLES (COMMON)

P0011, P0021 **KFDWNWDMXE / 2** (internal manufacturer cross reference)

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 **KLTCWCSTAB** (internal manufacturer cross reference)

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

Time (seconds)	1000	7200	10800	14400	21600	32400	43200	50400
Coefficient:	0.996	0.488	0.270	0.191	0.106	0.063	0.031	0.008

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)	300	360	420	480	540
0.7	344	328	304	272	224
0.8	248	240	232	200	168
1.0	200	184	168	152	128

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FRINH1 / 2 (internal manufacturer cross reference)

Multiplication Factor for Internal Resistance KFRINH Nominal Value - Secondary O2 Sensor

	Modeled Exhaust Gas Temperature at Secondary O2 Sensor (° C)				
	300	360	420	480	540
factor	15.00	10.00	6.00	4.00	2.50

LOOK-UP TABLES (COMMON)

P0327, P0332, P0328, P0333

NGKRWN (internal manufacturer cross reference)

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	5200
RPM per second	500.01	600.01	800.01	1000.01	1200.02	1400.02	1600.02	1700.02	1800	1900	2000	2100	2100

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)	0.056	0.060	0.067	0.079	0.089	0.104	0.121	0.132	0.139	0.145	0.155	0.181	0.192

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)	3.120	4.904	5.796	6.815	7.834	9.108	10.000	11.911	18.790	22.714	25.287	27.197	30.637

P0442

KFEONVPT (internal manufacturer cross reference)

Vacuum / Pressure Threshold for Fuel Tank Leak Detection

Vacuum / Pressure **(hPa)**	Ambient Temperature (Model) (C)								
Fuel Level (%)	0	5.3	9.8	15	20.3	24.8	30	34.5	39.8
5%	10.61	12.07	12.60	11.25	9.92	9.67	12.24	14.02	14.32
16%	10.94	12.67	13.19	11.57	10.03	10.08	12.58	14.16	14.22
27%	8.27	9.99	10.91	10.24	9.59	8.29	10.29	12.17	13.60
38%	6.93	8.24	8.14	8.64	9.83	7.44	7.82	8.67	8.95
49%	7.32	8.11	6.36	6.43	7.50	5.24	7.80	8.91	8.76
60%	7.09	7.29	7.01	6.53	5.82	5.60	7.57	8.95	8.78
71%	5.03	4.72	5.71	7.15	6.68	6.16	7.72	8.91	8.78
82%	5.48	5.53	5.30	6.80	6.15	5.67	7.62	8.94	8.78
93%	5.36	5.35	5.40	6.83	6.16	5.63	7.61	8.94	8.78

Tank Capacity **65.8 Liters**

Vacuum / Pressure **(Pa)**	Ambient Temperature (Model) (C)								
Fuel Level (%)	0	5.3	9.8	15	20.3	24.8	30	34.5	39.8
5%	1061	1207	1260	1125	992	967	1224	1402	1432
16%	1094	1267	1319	1157	1003	1008	1258	1416	1422
27%	827	999	1091	1024	959	829	1029	1217	1360
38%	693	824	814	864	983	744	782	867	895
49%	732	811	636	643	750	524	780	891	876
60%	709	729	701	653	582	560	757	895	878
71%	503	472	571	715	668	616	772	891	878
82%	548	553	530	680	615	567	762	894	878
93%	536	535	540	683	616	563	761	894	878

LOOK-UP TABLES (COMMON)

P0455 **KLTLDSFS05** (internal manufacturer cross reference)

Vacuum Gradient Threshold for Fuel Tank Leak Detection

Fuel Level **liters**	0	10	20	25	30	35	40	45	50	60
hPa / sec	0.045	0.045	0.052	0.054	0.055	0.056	0.068	0.076	0.076	0.076

Tank Capacity 68.1 Liters

Fuel Level **(%)**	0	14.7	29.4	36.7	44.1	51.4	58.7	66.1	73.4	88.1
Pa / sec	4.5	4.5	5.2	5.4	5.5	5.6	6.8	7.6	7.6	7.6

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