COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Camshaft Control Electrical											
Bank 1 Intake	P0010	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	two driving
	P2088	circuit continuity - ground				battery voltage	>	10	V		cycles each
	P2089	circuit continuity - voltage				battery voltage	<	18.1	V		with: 1 sec
Bank 1 Exhaust	P0013	circuit continuity - open				output					continuous
	P2090	circuit continuity - ground									or 10 sec
	P2091	circuit continuity - voltage									cumulative
Bank 2 Intake	P0020	circuit continuity - open									
	P2092	circuit continuity - ground				output activated and deactivated for complete checking					
	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 -target error	difference to start test (filtered actual	6.0 . . . 11.0	degrees	engine speed	>	480	rpm	approx.	two driving
Bank 1 Exhaust	P0014		angle versus filtered desired	KFDWNWDMXE / 2		engine run time	>	1.8	sec	20 sec	cycles each
Bank 2 Intake	P0021		angle) >	KFDWNWDMXA / 2		camshaft control circuit test	complete	-	-		with: 1 sec
Bank 2 Exhaust	P0024		(desired must remain above value to test to complete the evaluation)			error: camshaft control circuit	not set	-	-	(2 times	continuous
			same as above, but offset added to the	0	degrees	coolant temperature	<	143	° C	for 2.5 sec	or 10 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 no difference is seen between desired and actual)			(engine oil temperature is a modeled input The primary inputs to the model are:					
			same as above, but during cold start only:	4	count	engine coolant temp, and engine speed					

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
	P000A	rationality - slow response	difference (filtered actual angle max	1.5	degrees	Other inputs include: IAT, and EOT. Each of these inputs are diagnosed for OBD failure.)					
	P000B		versus actual at test start) >								
	P000C		(to detect slow response versus								
	P000D		stuck cam if above this limit) at time (overlaps with time to detect above)	2.5	sec						
			(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.	two driving
Bank 1 Exhaust	P0017	limit check	or adapted angle <	9.9	degrees	engine coolant temp	>	0	° C	600 sec	cycles each
Bank 2 Intake	P0018	(applies for each camshaft)	or actual angle with parked cams >	15	degrees	engine coolant temp	<	95.25	° C		with: 4 sec
Bank 2 Exhaust	P0019		and <	21	degrees	model: engine oil temp	<	120	° C	fail after	continuous
Bank 1 / Idler Sprocket	P0008		adapted angle for both cams >	6.0	degrees	error: camshaft sensor	not set	-	-	2 adaptation	or 30 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	two driving
	P0037	circuit continuity - ground				battery voltage	>	9.9	V		cycles each
	P0038	circuit continuity - voltage				battery voltage	<	18.1	V		with: 4 sec
bank 2 sensor 2 (secondary)	P0056	circuit continuity - open				secondary O2 sensor heating	ready				continuous
	P0057	circuit continuity - ground				secondary O2 sensor dew point	reached	-	-		or 30 sec
	P0058	circuit continuity - voltage				output activated and deactivated for complete checking		-	-		cumulative
High Pressure Fuel Control System											
Rationality											code set
	P0088	pressure deviation from desired -	difference (desired versus actual fuel rail pressure) <	-3500	Kpa	error: electrical diagnosis of fuel volume control valve	not set	-	-	5 sec	

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
		over pressure	difference (desired versus actual fuel rail pressure) >	1500	Kpa	tester request for open fuel flow control valve error: electrical diagnosis of fuel rail pressure sensor airbag deployed (see descriptions for details)	FALSE not set FALSE	- - -	- - -	5 sec	then 5 sec
	P0087	pressure deviation from desired -									
		under pressure									
	P0089	C/L controller output value - above expected	Controller output value ("p" part plus "i" part) >	2500	Kpa	battery voltage relative injected fuel mass	< >	18.1 5.016	V %	5 sec	
	P0089	C/L controller output value - below	Controller output value ("p" part plus "i" part) <	-2500	Kpa	relative injected fuel mass	<	500	%	5 sec	
		expected				first engine start at assembly plant DFCO active engine speed engine start temperature	FALSE FALSE > >	- - 25 -48	- - rpm 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	3 sec	code set
	P0091	circuit rationality - feed-back voltage	voltage test pulse - off command <	2.749	V	battery voltage	<	18.1	V		then 5 sec
	P0090	circuit rationality - feed-back voltage	voltage test pulse - off command within window	2.749 < Voltage < 4.502	V	battery voltage circuit switched off due to 5 volt supply fault	< not set	off command voltage -	V -		
Engine coolant temperature sensor	P0116	difference from Engine temperature model after soaking	filtered difference (ECT at key on - ECTmodel at key on) or filtered difference (ECTmodel at key on - ECT at key on)	14.3 14.3	° C ° C	Engine coolant model (cooled down) Soaking time after shut down previous accumulated air mass previous engine run time **or** previous accumulated air mass ECT at shut down Controller Shut Down at end of last cycle Error - Engine Off Timer	< > > > > > - not detected	50 19800 6000 600 6000 81.75 - -	° C sec g sec g ° C - -	35 for block heating check One filter update per cold start Filter Initialized after powerfail	code set then 5 sec approx. 6 test average run length (15°C delta)

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						Powerfail during previous drive	not detected	-	-	or codeclear	
						Block Heater	not detected	-	-	to 13.0° C	
Engine coolant temperature sensor	P0117	range check high	coolant temperature >	140.3	° C	if Startup IAT hot restart timer	> >=	72 60	° C sec	0.1 sec	two driving cycles each
	P0118	range check low	coolant temperature <	-42	° C	-	-	-	-		with: 4 sec continuous or 30 sec cumulative
	P0119	intermittent (discontinuity)	delta coolant temp. during evaluation period < delta coolant temp. during evaluation period > weighted counter > (up 5,000 w/jump; down 1 with steady) (fail counter intialized to 10000)	-4.5 4.5 60000	° C ° C count		-	-	-	0.1 sec	with: 4 sec continuous
Throttle Position Sensor 1 (primary)	P0121	range check poti voltage	sensor difference >	9	%	battery voltage	>	7	V	0.2 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
	P0122 P0123	plausibility to other poti	sensor circuit low voltage < sensor circuit high voltage >	0.176 4.629	V V	battery voltage	>	7	V	0.2 sec	code set then 5 sec
Sensor 2 (redundant)	P0221	range check poti voltage,	sensor difference >	9	%	battery voltage	>	7	V	0.2 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
	P0222 P0223	plausibility to other poti	sensor circuit low voltage < sensor circuit high voltage >	0.156 4.883	V V	battery voltage	>	7	V	0.2 sec	code set then 5 sec

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Engine coolant Temperature sensor	P0128	Coolant Temperature Below Model Temperature (additional pinpointing for coolant sensor, failures detected would also be detected by Thermostat monitor) OR	calculated coolant temperature model minus measured temperature > coolant temp. reference model calculation limit (detection of blockheater resets modeled engine coolant temperature calculation)	9.8 60	° C ° C	error: engine coolant temp engine speed	not set >	- 25	- rpm	approx. 500 sec	two driving cycles each with: 1 sec cont. or 10 sec cum.
Engine Coolant Thermostat Monitoring		Coolant Temperature Below Thermostat Regulating Temperature (plausibility check)	(calculated reference model coolant temp minus measured coolant temperature) > reference model calculation limit (development vehicles indicated steady thermostat regulating temperatures of 89°C, as measured 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.)	10.5 89.25	° C ° C	debouncing time error: engine coolant temp error: vehicle speed sensor est. ambient temperature est. ambient temperature vehicle speed engine speed coolant temperature at start integrated air mass flow	> not set not set > < >= > < >	10 - - -39 100 4.6875 760 69.8 1000	sec - - °C °C mph rpm °C g	approx. 900 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
Oxygen Sensor sensor circuit (secondary O2) bank 1 sensor 2 bank 2 sensor 2	P0137 P0157	short circuit to ground	secondary O2 sensor voltage <	0.06	V	mod. exhaust-gas temperature at O2 sensor and secondary O2 dew point end	> TRUE	700	° C	5 sec	two driving cycles each

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						for time	>	90	sec		with: 1 sec continuous or 10 sec cumulative
						engine speed	>	240	rpm		
						battery voltage	>	10.4	V		
						mod. exhaust-gas temp.	<	800	° C		
						time after start	<	5.1	sec		
						engine temp at stop	>	60	° C		
						engine temp	<	40	° C		
						error: engine coolant temp	not set	-	-		
						error: O2 sensor heater circuit	not set	-	-		
bank 1 sensor 2 bank 2 sensor 2	P0138 P0158	short circuit to battery voltage	secondary O2 sensor voltage >	1.15	V	secondary O2 heating stable and secondary O2 dew point end	TRUE	-	-	5 sec	
							TRUE		-		
						for time	>	90	sec		
						engine speed	>	240	rpm		
						battery voltage	>	10.4	V		
						mod. exhaust-gas temp.	<	800	° C		
bank 1 sensor 2 bank 2 sensor 2	P0140 P0160	sensor line disconnection	secondary O2 sensor voltage > and secondary O2 sensor voltage <	0.401 0.519	V V	secondary O2 heating stable and secondary O2 dew point end	TRUE	-	-	60 sec	
							TRUE		-		
			or			for time	>	90	sec		
			secondary O2 sensor internal resistance >	40000	Ohm	engine speed	>	240	rpm		
						battery voltage	>	10.4			
			when modeled exhaust gas temperature >	500	° C	mod. exhaust-gas temp.	<	800	V ° 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.	two driving
bank 2 sensor 2 (secondary)	P0161	internal resistance	resistance >			battery voltage	<	18.1	V	100 sec	cycles
		above threshold	nominal internal resistance	104 … 128	Ohms	engine speed	>	240	rpm		
						engine starting	complete	-	-		
			multipy times degradation factor	5.25 … 7.75	factor	fuel cut off	FALSE	-	-		
						sec. O2 internal resistance	valid	-	-		
			for time	6	sec	intake air temperature	>	-30	C		
						engine off soak time	>	0	sec		
						modeled exhaust temp. at secondary O2 sensor	in range	300 . . . 550	C		
						suspicion of secondary O2 sensor open circuit	FALSE				
						secondary O2 voltage supply from the deactivation for time	ON >	120	sec		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Fuel Rail Pressure Sensor											
Rationality											
	P0191	rationality check low	Fuel pressure during power up init. <	120	KPa	engine speed	>	25	rpm	0.1 sec	two driving
		(sensor skewed low in range)	AND			for time	>	0.5	sec		cycles each
			Fuel system fault exists:			engine run time	>	30	sec		with: 4 sec
			P0087 or P2188 or P2187								continuous
											or 30 sec cumulative
		rationality check high	or Fuel pressure during power up init. >	1500	KPa	engine speed	>	25	rpm		
		(sensor skewed high in range)	AND			for time	>	30	sec		
			Fuel system faults exist:			block heater active	-	FALSE	-		
			P0088 or P2187 or P2177			engine coolant at shutdown	>	72	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	>	15000	sec		
		rationality check high	or Fuel pressure during power up init. >	1500	KPa	engine speed	>	25	rpm		
		(sensor skewed high in range)	AND			for time	>	30	sec		
			Fuel pressure rise during fuel pump prime >	350	KPa	block heater active	-	FALSE	-		
						engine coolant at shutdown	>	72	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	>	15000	sec		
Fuel Rail Pressure Sensor											
Electrical											code set
	P0193	circuit continuity - high	Fuel pressure sensor output voltage >	4.70	V					0.5 sec	

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
	P0192	circuit continuity - low	Fuel pressure sensor output voltage <	0.30 V			0.5 sec	then 5 sec
High Pressure Fuel Injection Valve Circuit Continuity - High side (HS) and Low Side (LS)								
Cylinder #1	P0201 P0261 P0262 P2146	circuit continuity - open LS or HS circuit continuity - ground LS circuit continuity - battery LS circuit continuity - ground or battery HS	Voltage	IC Internal	engine speed battery voltage battery voltage	> 80 rpm > 8 V < 18.1 V	0.01 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
Cylinder #2	P0202 P0264 P0265 P2149	circuit continuity - open LS or HS circuit continuity - ground LS circuit continuity - battery LS circuit continuity - ground or battery HS						
Cylinider #3	P0203 P0267 P0268 P2152	circuit continuity - open LS or HS circuit continuity - ground LS circuit continuity - battery LS circuit continuity - ground or battery HS						
Cylinder #4	P0204 P0270 P0271 P2155	circuit continuity - open LS or HS circuit continuity - ground LS circuit continuity - battery LS circuit continuity - ground or battery HS						
Cylinder #5	P0205 P0273 P0274 P216A	circuit continuity - open LS or HS circuit continuity - ground LS circuit continuity - battery LS circuit continuity - ground or battery HS						
Cylinder #6	P0206 P0276 P0277 P216D	circuit continuity - open LS or HS circuit continuity - ground LS circuit continuity - battery LS circuit continuity - ground or battery HS						

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
SPI Communication	P062B	Internal SPI Communication Fault or Internal ADC Voltage Booster Failure		IC Internal		engine speed battery voltage	>	80	rpm	1.10 sec	
							>	8	V		
				IC Internal		battery voltage	<	18.1	V	0.50 sec	
Diagnosis of Stuck Open Fuel Injector Rationality											
	P029D	fuel injector stuck open - cylinder #1	fuel pressure deviation from desired - under pressure (P0087) and	set		misfire monitor active (see P0300 details) engine speed engine speed relative engine load misfire counters accumulate				approx. 20sec	code set then 5 sec
			cylinder # 1 misfire counts >	100	counts		>	1520	rpm		
							<	6000	rpm		
							<	100	%		
	P02A1	fuel injector stuck open - cylinder #2	fuel pressure deviation from desired - under pressure (P0087) and	set		within period <	<	17	rev		
			cylinder # 2 misfire counts >	100	counts						
	P02A5	fuel injector stuck open - cylinder #3	fuel pressure deviation from desired - under pressure (P0087) and	set							
			cylinder # 3 misfire counts >	100	counts						
	P02A9	fuel injector stuck open - cylinder #4	fuel pressure deviation from desired - under pressure (P0087) and	set							
			cylinder # 4 misfire counts >	100	counts						
	P02AD	fuel injector stuck open - cylinder #5	fuel pressure deviation from desired - under pressure (P0087) and	set							
			cylinder # 5 misfire counts >	100	counts						
	P02B1	fuel injector stuck open - cylinder #6	fuel pressure deviation from desired - under pressure (P0087) and	set							
			cylinder # 6 misfire counts >	100	counts						
Misfire Emission Level Multiple Cylinder	P0300	crankshaft speed	emissions relevant misfire rate	1.17 (LLT)	%	engine speed	>	420	rpm	1000 revs	Fault during

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Cylinder #1	P0301	fluctuation cylinder 1 to		2.10 (LNF) %	engine speed	<	7000	rpm		1st interval:
Cylinder #2	P0302	cylinder 6			indicated torque (idle, no drive)	>	5.47	%	After	2 faults in
Cylinder #3	P0303				indicated torque (drive)	>	6.02. . .	%	detection,	2 different
					(MISALUN)		28.9			
Cylinder #4	P0304				engine speed gradient	<	2500 . . . 4600	rpm/sec	the	drive cycles.
Cylinder #5	P0305				volumetric efficiency gradient	<	225 . . . 1350	%/rev	diagnostic	
Cylinder #6	P0306				cylinder events after engine start	>	6	ignitions	can only	Fault during
					air temperature	>	-30	° C	pass if	remaining
					clutch switch press / release	transition	FALSE	-	similar	intervals:
					leak detection pull-down phase	off	-	-	conditions	8 faults in 2
					fuel cut off	not active	-	-	are	different
					fuel level	>	11.0	-	encountered	drive cycles
					OR fuel level	<	11.0	%		with at least
					AND solid misfire MIL	on	-	%		4 faults in
					OR fuel level error	set	-	-		each.
					error: throttle position	not set	-	-		
					error: crankshaft sensor	not set	-	-		
					error: ref.mark of crank sensor	not set	-	-		
					momentary re-enable delay: (temporary delay until re-enablement AT:)	for	4	crank revs		
					(temporary delay until re-enablement MT:)	for	8	crank revs		
					barometric pressure (GMT001 & GMX001 ONLY) (disables for altitudes > 8,600ft based on data)	>	72.8	KPa		
Catalyst Damaging Level Multiple Cylinder			OR Catalyst damaging misfire rate	53.3 . . . 5 % see Misfire supplemental data (h) (2.5.1)	Includes all the above with the following exceptions:				1000 revs First interval	First 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	>=	11.0	%	intervals	while error
Cylinder #4	P0304				OR fuel level	<	11.0	%		present, then
Cylinder #5	P0305				AND blinking MIL	blinking	-	-		no MIL
Cylinder #6	P0306				AND NOT first blink event	-	-	-		with no error.
										Second occurance: immediate flashing while error present, then

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
											solid MIL with no error.
Knock Control Circuit	P0324	test pulse	test pulse integral < for consecutive events	4 4	V count	engine coolant temp. knock control zero test , parity fault assumptions	> active not set	60 - -	° C - -	0.1 sec	two driving cycles each with: 1 sec
		or				measuring window	>	1	ms		continuous or 10 sec cumulative
		null test (zero test)	absolute value (integrator gradient) > for consecutive events	200 4	V / sec count	engine coolant temp. knock control test pulse , parity fault assumptions	> active not set	60 - -	° C - -		
		or									
		parity check or	coefficient RAM errors in knock IC, per 250 working cycles	5	count	engine coolant temp. test pulse fault assumption	> not set	60 -	° C -		
		SPI communication	check word errors in knock IC, per 250 working cycles	25	count						
Bank 1			faults detected on knock sensor pins,			engine coolant temperature	>	60	° C		
circuit check	P0326	short circuit to B+ or GND	per 250 working cycles (zkrks) >	25	count	engine speed	>	2200	rpm	approx.	two driving
Performance	P0327	range check low	reference voltage <	0.03 . . . 0.34 UDKSNU	V	engine speed gradient (NGKRWN) engine load gradient	< <	500 … 2300 50 . . . 100	rpm / sec kPa / sec	20 sec	cycles each with: 1 sec
			for consecutive events	30	count	error: knock control circuit (IC)	not set	-	-		continuous or 10 sec cumulative
	P0328	range check high	reference voltage >	1 . . . 29.5 UDKSNO	V						
			for consecutive events	30	count						
		short circuit to B+ or GND	faults detected on knock sensor pins, per 250 working cycles (zkrks) >	25	count						

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Bank 2			faults detected on knock sensor pins,			engine coolant temperature	>	60	° C		
circuit check	P0331	short circuit to B+ or GND	per 250 working cycles (zkrks) >	25	count	engine speed gradient (NGKRWN)	<	500 … 2300	rpm / sec	approx.	
Performance	P0332	range check low	reference voltage <	0.03 … 0.34	V	engine load gradient	<	50 … 100	kPa / sec	20 sec	
				UDKSNU		error: knock control circuit (IC)	not set	-	-		
			for consecutive events	100	count						
	P0333	range check high	reference voltage >	1 … 29.5	V						
				UDKSNO							
			for consecutive events	100	count						
Crankshaft Position Sensor	P0335	circuit continuity	engine speed =	0	rpm	camshaft revolutions detected	>	12	counts	approx.	code set
			but phase signals available from cams							5 sec	then 5 sec
		rationality check	reference gap missing > (sensor signal but no reference)	6	gaps						
	P0336	rationality check	unexpected re-synchronization > (loss of reference mark)	2600	count						
		rationality check	intermittent loss of engine speed signal >	28	count						
	P0338	rationality check	difference in counted teeth between reference gap position events >	250	crankshaft teeth					approx. 2 sec	
Camshaft Position Sensor											
Bank 1 Intake	P0341	plausibility check	signal erratic or out of position	4	count	engine in synchronized mode	TRUE	-	-	10 revolutions	two driving cycles each with: 1 sec continuous or 10 sec cumulative
	P0342	circuit low	signal permanently low	5	count	engine speed	<	2520	rpm		
	P0343	circuit continuity or high	signal permanently high	5	count						
Bank 2 Intake	P0346	plausibility check	signal erratic or out of position								
	P0347	circuit low	signal permanently low								
	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								

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Bank 2 Exhaust	P0368	circuit continuity or high	signal permanently high							
	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. 1 sec	two driving cycles each with: 4 sec
	P2300	circuit continuity - ground			battery voltage	>	9.99	V		continuous
	P2301	circuit continuity - voltage			battery voltage	<	18.1	V		or 30 sec
Cylinder #2	P0352	circuit continuity - open							engine	cumulative
	P2303	circuit continuity - ground							cycle	
	P2304	circuit continuity - voltage							frequency	
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	-	engine speed	<	6000	rpm	0.01 sec	
Serial Communication					battery voltage	>	9.99	V		
					battery voltage	<	18.1	V		
Evaporative System and Leak Monitor Small Leak - 0.020 "	P0442	natural pressure/vacuum	filtered fault index >	0.6 -	enginge running gross leak test	not complete	(see P0455 for details)		approx.	code set
		in tank			or gross leak test suspects small leak	0.020" leak	(see P0455 for details)		600 sec	then 5 sec
			based on:		calculated ambient air temperature	>	1.5	° C	each test	
			(peak pressure - peak vacuum) <	230 . . . 950 Pa	calculated ambient air temperature	<	32.25	° C		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
				KFEONVPT	engine stop coolant temp	>	74.25	° C	filtered value exceeds threshold	approx. 6 test
					engine run time	>	600	sec		
					trip distance travelled	>	5.1	miles		average run length
					fuel mixture contribution from purge vapor	<	26.7	%	then	
					fuel level	>	11.0	%	4 sec	(The MIL actually is requested during shut down soak. It becomes visible on the following drive.)
					fuel level	<	88.0	%	continuous	
					error: vehicle speed	not set	-	-		
					error: engine coolant temp	not set	-	-		
					error: purge valve	not set	-	-		
					error: fuel tank pressure	not set	-	-		
					error: system voltage	not set	-	-		
					error: air mass meter	not set	-	-		
					error: intake air temp	not set	-	-		
					error: canister vent valve	not set	-	-		
					start (coolant - intake air)	<	9.75	° C		
					start engine coolant temp	<	0	° C		
					barometric pressure	>	68	kPa		
					battery voltage	>	10.8	V		
					vehicle odometer	>	12.5	miles		
Evaporative Emission System Purge Solenoid Control Circuit	P0443 P0458 P0459	circuit continuity - open circuit continuity - ground circuit continuity - voltage	Voltage	IC Internal -	engine speed	>	80	rpm	0.01 sec	two driving cycles each with: 4 sec
					battery voltage	>	9.99	V		
					battery voltage	<	18.1	V		continuous
					output activated and deactivated for complete checking					or 30 sec cumulative
Evaporative System and Leak Monitor Canister Vent Valve	P0446	underpressure in tank	tank pressure <	-1000 Pa	fuel system status	closed loop	-	-	5 sec	two driving cycles each
					vehicle speed	<	1.9	mph		with: 4 sec
					engine idle speed control (no pedal input)	active	-	-		continuous
					battery voltage	>	10.5	V	One	or 30 sec
					battery voltage	<	18.1	V	test per	cumulative
					fuel tank pressure	>	-2500	Pa	will be	
					fuel tank pressure	<	1300	Pa	completed.	
					ratio: (MAP Model / Baro)	<	0.812	-		
					calculated ambient air temperature	>	1.5	° C	The test	
					calculated ambient air temperature	<	32.25	° C	will attempt	
					fuel level	>	11.0	%	to run up	

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						fuel level	<	88.0	%	to 10 times until it successfully completes a test	
						engine start temp - amb. temp	<	9.75	° C		
						time after engine start	>	600	sec		
						fuel trim stabilized:	TRUE	-	-		
						accumulated fuel trim adaptation time and	>	8	sec		
						change in adaptive value over 200ms period	<	3	%		
						barometric pressure	>	68	kPa		
						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 Control Circuit	P0449 P0498 P0499	circuit continuity - open circuit continuity - ground circuit continuity - voltage	Voltage	IC Internal	-	engine speed battery voltage battery voltage output activated and deactivated for complete checking	> > <	80 9.99 18.1	rpm V V	0.01 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
Fuel Tank Pressure Sensor	P0450	rationality - signal oscillation	| delta pressure signal | (= current pressure - old pressure) >	813	Pa	calculated ambient air temperature vehicle speed time after canister vent valve open	> < >	-7.5 18.75 4	° C mph sec	25.5 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
	P0451	rationality - signal range check	sensor signal >= sensor signal >=	1469 -3500	Pa Pa	time after engine start time after canister vent valve open engine idle speed control (no pedal input) vehicle speed after time and integrated purge mass flow calculated ambient air temperature barometric pressure	> > active > > > > >	1 4 - 6.25 30 2 -7.5 68	sec sec - mph sec g ° C KPa		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						fuel level	<	88.0	%		
						fuel level	>	11.0	%		
		or rationality - drift check	| delta pressure signal | (= current pressure	688	Pa	vent solenoid valve open	TRUE	-	-		
						caniter purge flow (closed)	<	0.0	g / sec		
			- reference pressure at start) >			barometric pressure	>	68	KPa		
						fuel level	<	88.0	%		
						fuel level	>	11.0	%		
						fuel level	<	60	%		
						Or					
						fuel level valid for running					
						Evap. leak detection	TRUE	-	-		
						vehicle speed	>	6.25	mph		
						after time	>	30	sec		
						and integrated purge mass flow	>	2	g		
						vehicle speed	<	46.875	mph		
						Or					
						calculated ambient air temperature	<	35.3	° C		
						calculated ambient air temperature	>	3.8	° C		
						time	>	3	sec		
	P0452	circuit continuity - ground	sensor signal voltage <	0.2	V	engine speed	>	240	rpm	10 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
	P0453	circuit continuity - voltage	sensor signal voltage >	4.85	V						
Large leak	P0455	vacuum pulldown slope	integrated air mass flow >	1.3 …. 1.95		fuel system status	closed loop	-	-	< 30 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
			and vacuum pulldown >	-500	Pa	vehicle speed	<	1.9	mph		
			Or			engine idle speed control (no pedal input)	active	-	-	One	
			integrated air mass flow >	2.22	g	battery voltage	>	10.5	V	test per	
			and vacuum pulldown >	-600	Pa	battery voltage	<	18.1	V	driving cycle	
						fuel tank pressure	>	-2500	Pa	completed.	
						fuel tank pressure	<	1300	Pa	< 20sec	
						ratio: (MAP Model / Baro)	<	0.81	-	The test	
						calculated ambient air temperature	>	1.5	° C	will attempt	
						calculated ambient air temperature	<	32.25	° C	to run up	
						fuel level	>	11.0	%	to 10 times	
						fuel level	<	88.0	%	until it	
						engine start temp - amb. temp	<	9.75	° C	successfully	
						time after engine start	>	600	sec	completes	

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						fuel trim stabilized:	TRUE	-	-	a test	
						accumulated fuel trim adaptation time and	>	8	sec		
						change in adaptive value over 200ms period	<	3	%		
						barometric 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 fuel level sensor 1	P0461	rationality	fuel level change < and cumulative driving distance >	4.4 120.0	% km	primary fuel level secondary fuel level Or primary fuel level secondary fuel level and battery voltage battery voltage engine speed error: fuel level sensor/s electrical	< < < > > < > not set	47.0 0.3 47.0 0.3 10.5 18.1 240 -	% % % % V V rpm -	depending on time to reach total required drive distance	two driving cycles each with: 4 sec continuous or 50 sec cumulative
			Or cumulative driving distance >= (while indicated fuel level within un-readable zone)	120.0	km	primary fuel level secondary fuel level battery voltage battery voltage engine speed error: fuel level sensor/s electrical	> < > < > not set	47.0 0.3 10.5 18.1 240 -	% % V V rpm -		
	P0462	range check low	voltage <	0.25	V	battery voltage battery voltage engine speed	> < >	10.5 18 240	V V rpm	60 sec	
	P0463	range check high	voltage >	3.2	V	battery voltage battery voltage engine speed	> < >	10.5 18 240	V V rpm	60 sec	
Cooling fan 1 relay	P0480	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	two driving

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Control Circuit	P0691 P0692	circuit continuity - ground circuit continuity - voltage				battery voltage battery voltage	> <	9.9 18.1	V V		cycles each with: 4 sec continuous
Cooling fan 2 relay Control Circuit	P0481 P0693 P0694	circuit continuity - open circuit continuity - ground circuit continuity - voltage	Voltage	IC Internal	-						or 30 sec cumulative
Evaporative System and Leak Monitor Leaking purge valve	P0496	underpressure in tank	tank pressure loss gradient <	-47	Pa	fuel system status vehicle speed engine idle speed control (no pedal input) battery voltage battery voltage fuel tank pressure fuel tank pressure ratio: (MAP Model / Baro) fuel level	closed loop < active > < > < < >	- 1.9 - 10.5 18.1 -2500 1300 0.81 11.0	- mph - V V Pa Pa - %	< 30 sec One test per driving cycle completed. The test	two driving cycles each with: 4 sec continuous or 30 sec cumulative
Stuck Closed Purge valve	P0497	vacuum pulldown slope	integrated air mass flow > tank vacuum >	0.3 -2.5	g Pa	fuel level engine start temp - amb. temp time after engine start fuel trim stabilized: accumulated fuel trim adaptation time and change in adaptive value over 200ms period barometric pressure maximum number of attempts est amb air temp est amb air temp error: mass air flow error: coolant temp error: intake air temp error: fuel tank pres error: system voltage error: purge valve error: vehicle speed error: canister vent valve error: purge valve flow error: accelerator pedal	< < > TRUE > < > < > < not set not set not set not set not set not set not set not set not set not set	88.0 9.75 600 - 8 3 68 10 1.5 32.25 - - - - - - - - - -	% ° C sec - sec % kPa - ° C ° C - - - - - - - - - -	will attempt to run up to 10 times until test completeion	
Vehicle speed sensor Manual Transmission	P0501	rationality (high range check)	vehicle speed >	171.9	mph	-	-	-	-	2 sec	two driving cycles each

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
	P0502	rationality (low range check)	vehicle speed <	3.1	mph	engine speed engine speed DFCO fuel shut off coolant temperature	> > active >	1800 3520 - 40	rpm rpm - ° C	3 sec	with: 4 sec continuous or 30 sec cumulative

Idle Speed System (disabled during cold start)	P0506
	
	P0507
		functional check	desired rpm - actual rpm >
			
			desired rpm - actual rpm <
			  or
			fuel cut off due to overspeed >
			
			  during this idle
				100
				
				-200
				
				3
					rpm
					
					rpm
					
					count
						load (for underspeed only)
						
						coolant temp.
						intake air temp
						vehicle speed
						engine idle speed control (no pedal input)
						altitude factor (sea level = 1.0)
						time after engine start
						fuel mixture contribution from purge vapor
						intrusive evap test
						
						error: throttle position
						error: vehicle speed
						error: coolant temperature
						error: intake air temperature
						error: evap system
						error: evap purge valve
							<
							
							>
							>
							=
							active
							
							>
							>
							<
							
							not active
							not set
							not set
							not set
							not set
							not set
							not set
								99.9 . . . 99.9
								
								-11.3
								-11.3
								0
								-
								0.656
								4
								40
								
								-
								-
								-
								-
								-
								-
								-
									%
									
									° C
									° C
									mph
									-
									factor
									sec
									%
									
									-
									-
									-
									-
									-
									-
									-
										10 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative

Idle Speed System (enabled during cold start)	P050A	functional check	desired rpm - actual rpm > during catalyst heating on desired rpm - actual rpm < during catalyst heating on	100 -200	rpm rpm	vehicle speed engine idle speed control (no pedal input) altitude factor (sea level = 1.0) engine coolant start temp. catalyst heating cold start strategy error: throttle position error: vehicle speed error: coolant temperature error: intake air temperature error: evap system error: evap purge valve	= active > < active not set not set not set not set not set not set	0 - 0.656 65.3 - - - - - - -	mph - factor ° C - - - - - - -	7 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
System Voltage	P0562	range check low	powertrain supply relay feedback input voltage	9.99	V	time after engine start	>	180	sec	2 sec	no

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
	P0563	range check high	voltage	18.1	V	time after engine start vehicle speed	> >	180 3.1	sec mph		
ECM monitoring	P0601	rationality	wrong ROM checksum during initialization reaches ROMRSTA_UM times.	5	times	checksum calculation at power down in the last driving cycle completely finished	TRUE	-	-	30 sec	code set then 5 sec
		rationality	wrong cyclic ROM checksum of critical regions	-	-	partial checksum on critical variables	-	-	-	30 sec	
	P0602	rationality - programming incomplete	service ECU bit set in calibration	service ECU bit set	-	-	-	-	-	1 sec	
	P0603	ETC monitoring controller reset	SW internal. Error from shut-down path test reaches DURNPRST_A times	3	times	power down calculation in the last driving cycle	completly finished	-	-	5 sec	
	P0604	functional check cyclic RAM-check	RAM writeability check read and write test writeability check of RAM			power down calculation in the last driving cycle	completly finished	-	-	5 sec	
	P0606	Electronic Throttle Control (ETC) checks ETC monitoring torque comparison ETC monitoring engine speed signal ETC monitoring volumetric efficiency signal 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	SW internal	SW internal		power down calculation in the last driving cycle	completly finished	-	-	5 sec	

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
		Electronic Throttle Control (ETC) checks SPI failure of throttle output stage	SW internal	SW Internal							
Fuel Pump Relay Control Circuit	P0627 P0629	circuit continuity - open circuit continuity - voltage	voltage < voltage > voltage >	2.74 2.21 2.21	V V V	pump command off engine speed battery voltage battery voltage	- > > <	- 80 9.99 18.1	- rpm V V	0.1 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
	P0628	circuit continuity - ground	voltage <	2.21	V	pump command on engine speed battery voltage battery voltage	- > > <	- 80 9.99 18.1	- rpm V V	0.5 sec	
Electronic Throttle Control	P0638	motor control range check short term motor control range check long term	| circuit duty cycle | > (absolute value)	80	%	battery voltage	>	7	V	0.6 sec (recoverable) 5.0 sec (latched)	two driving cycles each with: 1 sec continuous or 10 sec cumulative
5V reference voltage monitoring	P0641 P0642 P0643 P0651 P0652 P0653 P0697 P0698 P0699	circuit continuity - open circuit continuity - ground circuit continuity - voltage circuit continuity - open circuit continuity - ground circuit continuity - voltage circuit continuity - open circuit continuity - ground circuit continuity - voltage	Voltage Voltage Voltage	IC Internal IC Internal IC Internal	- - -	ignition key on ECM power relay	TRUE TRUE	- -	- -	2 sec	code set then 5 sec
MIL Control Circuit	P0650	circuit continuity - open circuit continuity - ground circuit continuity - voltage	Voltage	IC Internal	-	engine speed battery voltage battery voltage output activated and deactivated for complete checking	> > <	80 10 18.1	rpm V V	0.01 sec	no (but is shown in Mode $03)

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Transmission Control Module MIL Illumination Request (Specific TCM DTC shown in freeze frame)	P0700	OBD emission fault detected by the TCM	signal input	-	-	-	-	-	-	0.01 sec	code set then 5 sec
Clutch Pedal Position Sensor Manual Transmission	P0806	rationality - input cltuth pos. state changes	detected clutch pedal press count <	2	count - sensor presses detected	gear changes detected (ratio of engine speed to vehicle speed -- range change) Delay between shift detections vehicle speed	> > >	15 4 12.5	count sec mph	approx. 500 sec	code set then 5 sec
	P0807 P0808	Circuit Continuity - Ground Circuit Continuity - Voltage	Voltage < Voltage >	0.249 4.75	V V						
	P080A	rationality - bottom of pedal travel not learned (no start condition exists if position is not learned)	Pedal Position <	94	%	clutch pedal position greater start request from driver	> FALSE	64.9 -	% -	0.1 sec	no
Ignition Coil Driver Circuit Serial Communication	P167D	Internal SPI communication fault		IC Internal	-	battery voltage battery voltage engine speed	< > <	18.1 9 6000	V V rpm	0.01 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
Electronic Throttle Control	P2100	circuit switch-off	output circuits not deactivated as commanded	-	-	-	-	-	-	0.1 sec	code set then 5 sec
	P2101	difference between set and	difference between set and	4 . . . 50	%	electronic throttle adaptation	not active	-	-	0.5 sec	

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
		actual position of throttle blade	actual position of throttle blade > [Table DWDKSBAMX]	dep. on rate of change		battery voltage	>	7	V		
	P2105	Electronic Throttle Control (ETC) checks ETC monitoring watchdog shutdown path				power down processing in the last driving cycle	completly finished	-	-	5 sec	
	P2119	functionality of return spring	throttle blade return response	0.56	sec	vehicle speed engine speed engine coolant temperature engine coolant temperature intake air temperature intake air temperature battery voltage accelerator pedal position	< < > < > < > <	0 40 5.25 100.5 5.25 143.8 10.0 14.9	mph rpm ° C ° C ° C ° C V %	0.56 sec once per ignition on	
Electronic Throttle Control	P2176	throttle exchange detection learn fail or initial throttle learn failed or learning prohibited due to secondary parameters not met or minimum throttle position out of range	range check poti1 value at lower stop throttle potentiometer 1 voltage < or throttle potentiometer 1 voltage > range check poti2 value at lower stop throttle potentiometer 2 voltage < or throttle potentiometer 2 voltage >	4.12 4.55 0.34 0.99	V V V V	vehicle speed engine speed engine coolant temperature engine coolant temperature intake air temperature intake air temperature battery voltage accelerator pedal position	< < > < > < > <	0 40 5.25 100.5 5.25 143.8 10.0 14.9	mph rpm ° C ° C ° C ° C V %	1 sec once per ignition on	code set then 5 sec
Fuel System Lean/Rich Multiplicative Bank 1	P2177 P2178	fuel trim limits exceded range - multiplicative (load > threshold and air flow > threshold)	delta lambda correction > or delta lambda correction <	1.32 0.78	factor factor	engine torque engine torque engine speed	> < >	12.5 40 1200	% % rpm	approx. 300 sec from engine	two driving cycles each with: 4 sec
Bank 2	P2179 P2180		delta lambda correction > or delta lambda correction <	1.32 0.78	factor factor	engine speed intake air temperature primary O2 sensor voltage and primary O2 sensor voltage for time period command lambda	< < > < > >	3400 60 0.5 1.2 0.2 0.83	rpm °C V V sec -	start (after adaptation has begun)	continuous or 30 sec cumulative

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						command lambda	<	1	-		
						catalyst heating cold start strategy	not active	-	-		
						deceleration fuel cut-off (DFCO)	not set	-	-		
						transient compensation	not set	-	-		
						wide open throttle	not set	-	-		
						integrated fuel mass	>	700	g		
						error: fuel level sender	not set	-	-		
						error: cam control diagnosis	not set	-	-		
						error: injection value fault	not set	-	-		
						error: catalyst damaging misfire	not set	-	-		
Fuel System Lean/Rich additive											
Bank 1	P2187 P2188	range - additive low speed and low load	delta fuel load correction > or delta fuel load correction <	6.0 -6.0	% %	engine torque	>=	0.0	%	approx. 300 sec	two driving cycles each
						engine torque	<=	23	%		with: 4 sec
Bank 2	P2189 P2190		delta fuel load correction > or delta fuel load correction <	6.0 -6.0	% %	engine speed	>=	520	rpm	from engine	continuous
						engine speed	<=	1000	rpm	start (after	or 30 sec
						closed loop control	TRUE	-	-	adaptation	cumulative
						engine coolant temperature	>	60	°C	has	
						intake air temperature	<=	60	°C	begun)	
						primary O2 sensor voltage and	>	0.5	V		
						primary O2 sensor voltage	<	1.2	V		
						for time period	>	0.2	sec		
						command lambda	>	0.83	-		
						command lambda	<	1	-		
						catalyst heating cold start strategy	not active	-	-		
						deceleration fuel cut-off (DFCO)	not set	-	-		
						transient compensation	not set	-	-		
						wide open throttle	not set	-	-		
						integrated fuel mass	>	700	g		
						error: fuel level sender	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 bank 2 sensor 2	P2232 P2235	sensor line short circuit to heater output line	secondary O2 sensor voltage gradient > within time after heater turn off <	2 0.04	V sec	secondary O2 heating stable and secondary O2 dew point end for time	TRUE TRUE >	- - 90	- -	10 sec	two driving cycles each with: 1 sec

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
			for occurrences > out of heater turn offs >	4 6	count count	engine running battery voltage mod. exhaust-gas temp. time after dew point exceeded	TRUE > < >	- 10.4 800 10	- V ° C sec		continuous or 10 sec cumulative

Oxygen Sensor sensor response (secondary O2)
bank 1 sensor 2
bank 2 sensor 2
	P2270
	P2272
		oscillation check low	secondary O2 sensor voltage <
			for time >
			
			then
			ramping in enrichment by
			at gradient
			for time (after enrichment limit reached)
				0.629
				100
				
				0.2
				0.017
				10
					V
					sec
					
					lambda
					λ / sec
					sec
						engine running
						battery voltage
						
						secondary O2 sensor
						for time
						
						secondary O2 closed loop control
						DFCO
						engine air flow (intrusive test)
						  and engine air flow
						
						  for time
						engine air flow (passive monitor)
						
						sec. O2 trim - fast lean correction
						
						sec. O2 trim - fast rich correction
						
						sec. O2 trim - slow correction
						sec. O2 aging DFCO test failed
						engine speed
							TRUE
							>
							
							ready
							>
							
							active
							FALSE
							>
							<
							
							>
							>
							
							FALSE
							
							FALSE
							
							FALSE
							FALSE
							>
								-
								10.4
								
								-
								10
								
								-
								-
								5.56
								33.33
								
								3
								9.72
								
								240
									-
									
									V
									-
									sec
									-
									-
									-
									g/sec
									g/sec
									
									sec
									g/sec
									
									rpm
										approx.
										600 sec
										
										additional
										time if
										fuel level
										is low and
										not failed
										600 sec
											two driving cycles each
											with: 4 sec
											continuous or 30 sec cumulative

		Unified Cycle or warm FTP (CVS-72) required for failure detection when on a specific driving cycle									

bank 1 sensor 2
 	
bank 2 sensor 2
	P2271
	
	P2273
		oscillation check high	secondary O2 sensor voltage >
			
			for time >
			then
			ramping in enleanment by
			at gradient
			
			for time (after enleanment limit reached)
				0.629. . . 0.629
				
				100
				
				0.15
				0.017
				
				10
					V
					
					sec
					
					lambda
					λ / sec
					
					sec
						engine running
						
						battery voltage
						secondary O2 sensor
						for time
						
						secondary O2 closed loop control
						DFCO
						
						engine air flow (intrusive test)
						  and engine air flow
						  for time
						engine air flow (passive monitor)
						
						sec. O2 trim - fast lean correction
						
						sec. O2 trim - fast rich correction
						
						sec. O2 trim - slow correction
						sec. O2 aging DFCO test failed
							TRUE
							
							>
							ready
							>
							
							active
							
							FALSE
							>
							<
							>
							>
							
							FALSE
							
							FALSE
							
							FALSE
							FALSE
								-
								
								10.4
								-
								10
								
								5.56
								33.33
								3
								9.72
								
								-
								
								-
								
								-
								-
									-
									V
									-
									sec
									
									g/sec
									g/sec
									sec
									g/sec
									
									-
									
									-
									
									-
									-		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
		Unified Cycle or warm FTP (CVS-72) required for failure detection when on a specific driving cycle				engine speed	>	240	rpm		
Real time clock Engine off timer Status Check	P2610	engine off timer signal check	engine off timer not valid	3.0		engine speed	>	240	rpm	0.1 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
						real time clock active	TRUE	-	-		
Real time clock Engine off timer Rationality check	P2610	engine off timer incremental check	reference clock time delta - Engine Off Timer delta >	6	counts	engine speed	>	240	rpm	0.1 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
						failure counts	>	3	3		
			reference clock time delta - Engine Off Timer delta <	6	counts	engine speed	>	240	rpm		
						failure counts	>	3	counts		
			or								
			reference clock and Engine Off Time required synchronization time >	6	seconds	ECM afterrun complete	TRUE	-	-		
			(reference clock is an independently captured time value based on the ECM processor clock)								
OBD ISO-15765 Communication Bus	U0073	ISO-15765 Bus Error	Invalid Message Received	-	-	CAN Bus	initialized	-	-	1 sec	code set
			or Dual Port Ram Hardware Error;			consisting of:					then 5 sec
			or No Communication / Bus Off			ignition on for	>	3	sec		
						battery voltage	>	9.9	V		
						battery voltage	<	18.1	V		
						normal bus communication	running	-	-		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
	U0101	Communication with TCM	TCM Message Timeout message missing, delayed, or invalid content present	-	-	Automatic Transmission CAN Bus consisting of: ignition on for battery voltage battery voltage normal bus communication	equipped initialized > > < running	- - 3 9.9 18.1 -	- - sec V V -	2.5 sec	code set then 5 sec

Cold Start Emissions Reduction Monitor	--	Cold start spark angle limitation
		
		(spark angle limitation imposed
		
		through torque reserve limit)
			commanded torque reserve forced to remain
			
			above limitation value:
			  value = nominal torque reserve x FACTOR
			   (determination of FACTOR: the reduced level
			   of torque reserve that does not result in a
			   measureable increase in FTP emissions
			   as compared to baseline)
			
			over-ride allowed if requested torque reserve
				0.29	-	limitation active as long as cold
						
						  start strategy is active
							-	-	-	-	-

	--	Momentary spark angle limitation
		
		  over-ride
			deviates below the limitation value	5	%	time since engine start
						
						number of over-ride events
						time duration of current over-ride event
						  above conditions present for time
						
						Cold start strategy extension with over-ride events
						  time extension = number of over ride events
						    x FACTOR
						FACTOR
							>
							
							<
							<
							
							>
							
							=
								2
								
								1
								0.5
								
								1
								
								2
									sec
									
									counts
									sec
									
									sec
									
									sec		

	--										

COMMON CAL TABLES

P0011, P0021
P0021, P0024

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)	350	450	550	650	750
0.7	128	128	120	112	104
0.8	128	128	120	112	104
1.0	128	128	120	112	104

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)				
	350	450	550	650	750
factor	7.75	7.00	6.75	6.25	5.75

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	5600	6000	6400
RPM per second	500	600	800	1000	1200	1400	1600	1700	1800	1900	2000	2100	2100	2100	2300	2300

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	5600	6000	6400
Peak RMS Voltage (V)	0.032	0.036	0.040	0.044	0.048	0.052	0.056	0.067	0.087	0.107	0.107	0.150	0.151	0.219	0.278	0.345

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	5600	6000	6400
Peak RMS Voltage (V)	0.956	1.924	2.655	3.257	5.023	8.029	9.073	10.294	11.365	13.500	14.745	18.182	21.894	26.393	28.636	29.592

P0442 **KFEONVPT** (internal manufacturer cross reference)

COMMON CAL TABLES

Vacuum / Pressure Threshold for Fuel Tank Leak Detection

Vacuum / Pressure **(hPa)**	Ambient Temperature (Model) (C)								
Fuel Level (%)	0	3.8	8.3	12	15.8	20.3	24	27.8	32.3
10%	4.50	5.50	6.00	6.25	7.25	8.50	9.00	9.00	9.50
20%	4.50	5.00	6.00	6.25	7.25	8.50	9.00	9.00	9.50
30%	4.50	4.75	5.75	6.00	6.75	8.00	8.50	8.50	9.50
40%	4.50	4.75	5.75	6.00	6.75	8.00	8.50	8.50	9.25
50%	4.50	4.50	5.25	6.00	6.30	7.00	8.50	8.50	9.25
60%	4.00	4.50	4.00	5.00	6.30	7.00	8.25	8.25	9.00
68%	3.50	4.00	4.00	5.00	6.00	6.50	7.75	8.25	9.00
78%	2.50	3.75	4.00	5.00	6.00	6.00	7.50	8.00	8.50
88%	2.25	3.50	4.00	4.75	5.00	6.00	7.50	8.00	8.50

Tank Capacity **65.8 Liters**

Vacuum / Pressure **(Pa)**	Ambient Temperature (Model) (C)								
Fuel Level (%)	0	3.8	8.3	12	15.8	20.3	24	27.8	32.3
10%	450	550	600	625	725	850	900	900	950
20%	450	500	600	625	725	850	900	900	950
30%	450	475	575	600	675	800	850	850	950
40%	450	475	575	600	675	800	850	850	925
50%	450	450	525	600	630	700	850	850	925
60%	400	450	400	500	630	700	825	825	900
68%	350	400	400	500	600	650	775	825	900
78%	250	375	400	500	600	600	750	800	850
88%	225	350	400	475	500	600	750	800	850

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

Vacuum Gradient Threshold for Fuel Tank Leak Detection

Fuel Level **liters**	0	8	16	24	32	40	48	56	64	72
hPa / sec	0.042	0.041	0.033	0.032	0.036	0.039	0.038	0.046	0.046	0.046

Tank Capacity   82.5 Liters

Fuel Level **(%)**	0	9.7	19.4	29.1	38.8	48.5	58.2	67.9	77.6	87.3
Pa / sec	4.2	4.1	3.3	3.2	3.6	3.9	3.8	4.6	4.6	4.6

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

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Primary O2 Sensor Heating											
heater circuits - electrical bank 1 sensor 1 (primary)	P0030	circuit continuity - open	measured voltage at power stage output within threshold	3.6	V	battery voltage	>	10.5	V	5 sec	two driving
bank 2 sensor 1 (primary)	P0050	circuit continuity - open		2.34	V	battery voltage	<	18.1	V		cycles each
bank 1 sensor 1 (primary)	P0031	circuit continuity - ground	measured voltage at power stage output <	2.34	V	engine speed	>	240	rpm		with: 4 sec
bank 2 sensor 1 (primary)	P0051	circuit continuity - ground				primary O2 voltage supply	ON	-	-		continuous
bank 1 sensor 1 (primary)	P0032	circuit continuity - battery	measured voltage at power stage output >	3.6	V						or 30 sec
bank 2 sensor 1 (primary)	P0052	circuit continuity - battery									cumulative
Mass Air Flow (MAF) Sensor											
Ratoinality	P0101	range check low	measured mass air flow * threshold			battery voltage	>	10.5	V	2 sec	two driving
			< Maximum modeled mass air flow	1	factor	for time	>	0.1	sec		cycles
						Condition bordnet voltage HFM supplied	TRUE	-	-		
						time after start	>	0.3	sec		
		or				crankshaft revolution counter	>	150	rev		
		fuel trim limits exceded	> delta lambda correction	0.18	factor	ambient pressure valid	TRUE	-	-		
		range - multiplicative				desired cam angle valid	TRUE	-	-		
		and				long term fuel trim	TRUE	-	-		
		correction factor (modeled air mass at throttle / air mass measured by air mass flow meter)	< correction factor air mass	0.8	factor	air flow mass	>	0.00	g/sec		
						air flow change gradient	<	0.25	-		
						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	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	-0.18	factor	pressure ratio across throttle	<	0.5			
						during fuel cut off			-		
		and				for time	>	0.5	sec		
		correction factor (modeled air mass at throttle / air mass measured by air mass flow meter)	> correction factor air mass	1.2	factor	error: throttle position sensor	not set	-	-		
						error: intake air temp. sensor	not set	-	-		
						error: MAF sensor electrical	not set	-	-		
	P0100	open circuit check	sensor signal in period time	0.0	uS	battery voltage	>	10.5	V	0.2 sec	
						engine speed	>	240	rpm		
						time after start	>	0.3	sec		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
	P0102	range check low	sensor signal in period time	81.0	uS						
	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	>=	10	count	depending on drive cycle ~ 300 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
						each with coolant temperature at start Intake Air Temperature Sensor 2	<=	110.3	° C		
						electrical Failure	not set	-	-		
						mass Air Flow	>	66.7	g / sec		
						mass Air Flow	<	7.8	g / sec		
						vehicle speed	>	18.75	mph		
						idle period - count	>=	3	count		
						each with coolant temperature at start Intake Air Temperature Sensor 2	<=	110.3	° C		
						electrical Failure	not set	-	-		
						mass Air Flow	<	7.8	g / sec		
						vehicle speed	<	3.1	mph		
						engine coolant temperature	>	66	° C		
Circuit Continuity Check	P0112	circuit continuity - high	Intake Air Temperature Sensor 2 Voltage >	4.87	V	engine coolant temperature	>	-9.8	° C	2 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
	P0113	circuit continuity - low	Intake Air Temperature Sensor 2 Voltage <	0.21	V	mass air flow	<	27.8	g / sec		
						vehicle speed	<	2.5	mph		
Oxygen Sensor sensor circuit (primary O2) bank 1 sensor 1 bank 2 sensor 1	P0130 P0150	sensor line short circuit to heater output line	secondary O2 sensor voltage gradient > within time after heater turn off < for occurrences >	2 0.04 4	V s count	engine speed battery voltage primary O2 heater ever actived and pri. O2 heater duty cycle	> > TRUE >	240 10.4 - - 0.9	rpm V - - -	60 sec	two driving cycles

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
			out of heater turn offs	6	count	for time	>	5	sec		
						dew-point end passed	TRUE	-	-		
						error: injector circuit fault	not set	-	-		
			or			engine speed	>	240	rpm		
			primary O2 sensor voltage >	0.52	V	battery voltage	>	10.4	V	60 sec	
			and primary O2 sensor voltage <	1.15	V	primary O2 heater ever actived	TRUE	-			
									-		
			and secondary O2 sensor voltage <	0.1	V	and pri. O2 heater duty cycle	>	0.9			
									-		
			or			for time	>	5	sec		
						error: injector circuit fault	not set	-	-		
			primary O2 sensor voltage >	0.06	V	time after	>	30	sec	30 sec	
			and primary O2 sensor voltage <	0.4	V	dew-point end passed	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	>	10	g		
						purge diagnosis	not set	-	-		
						closed loop control	set	-	-		
bank 1 sensor 1	P0131	short circuit to ground	primary O2 sensor voltage <	0.06	V	engine speed	>	240	rpm	5 sec	two driving
bank 2 sensor 1	P0151		and Secondary O2 sensor voltage >	0.5	V	battery voltage	>	10.4			cycles
									V		
						primary O2 heater ever actived	TRUE	-	-		
						and pri. O2 heater duty cycle	>	0.9	-		
						for time	>	5	sec		
						dew-point end passed	TRUE	-	-		
						error: injector circuit fault	not set	-			
						Integrated air mass	>	220	g		
						purge diagnosis	not set	-	-		
						commanded lambda	<	1.005			
									lambda		
			primary O2 sensor voltage <	0.06	V	engine speed	>	240	rpm	0.1 sec	
			and cold start conditions present			battery voltage	>	10.4			
									V		
						primary O2 heater ever actived	TRUE	-	-		
						and pri. O2 heater duty cycle	>	0.9	-		
						for time	>	5	sec		
						dew-point end passed	TRUE	-	-		
						error: injector circuit fault	not set	-	-		
bank 1 sensor 1	P0132	short circuit to battery voltage	primary O2 sensor voltage >	1.15	V	engine speed	>	240	rpm	5	two driving
bank 2 sensor 1	P0152					battery voltage	>	10.4	V		cycles
						primary O2 heater ever actived	TRUE	-	-		
						and pri. O2 heater duty cycle	>	0.9	-		
						for time	>	5	sec		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						dew-point end passed	TRUE	-	-		
						error: injector circuit fault	not set	-	-		
						commanded lambda	>	0.995			
									lambda		
Primary O2 sensor slow response Bank 1 Bank 2	P0133 P0153	slow response	Continuously filtered normalized switching cycle duration 20 valid closed loop switching cycles (note: normalization of cycle duration revised with new enable window and failure threshold)	2.5	s	closed loop control	active	-	-	60 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
						engine speed	>	2520	rpm		
						engine speed	>	1200	rpm		
						engine load	<	54.8	%		
								12.8	%		
						engine load	>				
						exhaust gas temperature model	>	350	° C		
								10	sec		
						purge off or has been on for time	>				
						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 bank 2 sensor 1	P0134 P0154	sensor line disconnection	primary O2 sensor voltage > and primary O2 sensor voltage <	0.4 0.52	V V	engine speed battery voltage	> >	240 10.4	rpm V	10 sec	two driving cycles
			Or primary O2 sensor voltage < and mod. Exhaust gas temp. > or	0.55 800	V ° C	primary O2 heater ever actived and pri. O2 heater duty cycle for time	TRUE > >	TRUE 0.9 5	- - sec		
			primary O2 sensor internal resistance > and when modeled exhaust gas temperature >	40000 600	Ohm ° C	error: injector circuit fault time after	not set >	not set 30	- sec	0.1 sec	
			or primary O2 sensor voltage > and secondary O2 sensor voltage >	0.2 0.2	V V	dew-point end passed and pri. O2 heater duty cycle or Primary Exhaut gas temp. model	TRUE > >	TRUE 0.68 600	- - °C	0.1 sec	

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
			after a getting into fuel cut-off for	3	sec						
Oxygen Sensor Heating heater performance (primary O2) bank 1 sensor 1 (primary)		primary O2 sensor	measured primary O2 sensor internal			battery voltage	>	10.5	V	approx.	two driving
bank 2 sensor 1 (primary)	P0135 P0155	internal resistance above threshold	resistance > nominal internal resistance	112 . . . 400 KFRINH / 2	Ohms	battery voltage engine speed engine starting	< > complete	18.1 240 -	V rpm -	100 sec	cycles
			multipy times degradation factor >	6.25 … 7.75 FRINV1 / 2	factor	fuel cut off pri. O2 internal resistance	FALSE valid	- -	- -		
			for time	12	sec	intake air temperature engine off soak time modeled exhaust temp. suspicion of primary O2 sensor open circuit primary O2 voltage supply scheduled by System Manager for time primary O2 sensor dewpoint exceeded for no fault clear request during drive cycle	> > < FALSE ON > > not set	-30 0 750 - - 120 10 -	C sec C - - sec sec -		
Oxygen Sensor (Secondary O2 sensor) Delayed response voltage during DCFO bank 1 sensor 2		secondary O2 sensor	time from start of DCFO till secondary O2 sensor voltage below the lower threshold	4	sec	deceleration fuel cut-off (DCFO) Since DCFO, secondary O2 sensor voltage has ever exceeded upper threshold battery voltage	active > >	- 0.59 10.4	- V V	4sec	two driving
bank 2 sensor 2	P013E P014A	delayed response to DFCO				secondary O2 sensor readiness	TRUE	-	-		cycles each
			or			modeled exhaust gas temperature at secondary O2 sensor temperature	>	450	° C		with: 4 sec continuous
			the oxygen mass integration from start of DCFO exceeded upper threshold before the voltage below the lower voltage threshold	15	g	secondary O2 sensor internal resistance secondary O2 sensor has measured lean and rich	< TRUE	900 -	Ohms -		or 30 sec cumulative
			lower voltage threshold	0.14	V	exhaust gas mass flow rate primary O2 sensor primary O2 sensor voltage	> ready <	2.22 - 0.14	g/s - V		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Slow response voltage during DCFO bank 1 sensor 2 bank 2 sensor 2	P013A P013C	secondary O2 sensor slow response to DFCO	time from secondary O2 sensor voltage crosses upper threshold till it crosses lower voltage threshold	0.8	sec	Since DCFO, secondary O2 sensor voltage has ever exceeded upper threshold battery voltage secondary O2 sensor readiness	> > TRUE	0.59 10.4 -	V V -		
			upper voltage threshold	0.4	V	modeled exhaust gas temperature at secondary O2 sensor temperature	>	450	° C		
			lower voltage threshold	0.2	V	secondary O2 sensor internal resistance secondary O2 sensor has measured lean and rich exhaust gas mass flow rate primary O2 sensor primary O2 sensor voltage	< TRUE > ready <	900 - 2.22 - 0.14	Ohms - g/s - V		
Catalyst System Performance	P0420 P0430	oxygen storage of catalyst	EWMA filtered catalyst aging factor less than catalyst aging factor of a limit catalyst <	0.1875	factor	exhaust gas mass flow exhaust gas mass flow catalyst temp. model catalyst temp. model engine speed engine speed engine load engine load modeled catalyst temp. gradient relative exhaust gas mass flow gradient fuel system closed loop time after secondary O2 sensor exceeded dewpoint ambient temperature catalyst damaging misfire rate exceeded error: fuel system closed loop control at limit strong transient compenstation intervention catalyst clear out active (after fuel cutoff)	> < < > > < > < < < active > > not set not set not set not set not set	2.78 27.78 900 500 1160 2440 12.8… 20.3 54.8... 80.3 8 2.00 - 140 … 210 -30 - - - - -	g/sec g/sec ° C ° C rpm rpm % % ° C / sec % - sec ° C - - - - -	approx. 1000 sec during active driving 3 checks per driving cycle 3 checks per driving cycle 1 check per driving cycle	code set then 5 sec approx. 3 tests average run length (9 samples)

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						fast mixture adaptation completed	set	-	-		
						Trigger condition for step change					
						Measured OSC < % of EWMA normalized filtered OSC	<	0.68	-		
Fuel Pump Control Module MIL Illumination Request **(Lambda Only GMT96X)**	P069E	OBD emission fault detected by the FPCM	signal input	-	-	Fault - U0109	not set	-	-		code set then 5 sec
CAN Gatway Timeout Fuel Pump Control Module **(Lambda Only GMT96X)**	U0109	Communication with CAN High Speed Gateway (FPCM - Fuel Pump Control Module)	CAN Gateway Message Timeout or Invalid Message Content	message missing, delayed, or invalid content		CAN Bus consisting of: ignition on for battery voltage battery voltage normal bus communication	initialized and ready > > < running	- 3 9.9 18.1 -	- sec V V -	100 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
Engine Metal Overtemperature Protection (Limp Home Function Active)	P1258	engine coolant temperature too high	engine coolant temperature >	135.8	° C	engine run time error: engine coolant temp	> not set	30 -	sec -	1 sec	code set then 5 sec
Rough Road Signal	P1380 **GMX295 only**	signal missing	signal missing	-	-	no error: misfire monitoring	- TRUE	- -	- -	5 sec	no
Electronic Throttle Control	P1551	limp-home throttle position out of range	throttle position < OR throttle position >	10.1 39.8	% %	vehicle speed engine speed engine coolant temperature engine coolant temperature intake air temperature intake air temperature battery voltage accelerator pedal position	<= < >= <= >= <= > <	0 40 5.25 100.5 5.25 143.8 10.0 14.9	mph rpm ° C ° C ° C ° C V %	5 sec	code set then 5 sec

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
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 Secondary fuel level Or Primary fuel level Secondary fuel level and battery voltage battery voltage engine speed electrical fuel level sensor(s) without failure	>= >= < > >= <= > TRUE	41.1 6.2 41.1 6.2 10.5 18.1 240 -	% % % % V V rpm -		two driving cycles each with: 4 sec continuous or 30 sec cumulative
			Or cumulative driving distance >=	162.0	km	Primary fuel level Secondary fuel level battery voltage battery voltage engine speed electrical fuel level sensor(s) without failure	>= < >= <= > TRUE	41.1 6.2 10.5 18.1 240 -	% % V V rpm -		
	P2067	range check low	voltage <	0.25	V	battery voltage battery voltage engine speed	>= <= >	10.5 18.1 240	V V rpm	60 sec	
	P2068	range check high	voltage >	3.2	V	battery voltage battery voltage engine speed	>= <= >	10.5 18.1 240	V V rpm	60 sec	
Secondary O2 Trim of primary O2 Sensor primary O2 sensor signal RICH / secondary O2 sensor signal LEAN Bank1 Bank 2	P2096 P2098	secondary O2 sensor fuel trim - rich shift - correction above threshold	secondary O2 sensor trim integral control >	1	sec	engine speed engine speed engine load engine load closed loop control active for time exhaust gas temp. model primary closed loop controller at upper limit	< > > < > > > TRUE > > not set	3480 1280 65.3 65.3 16.5 .... 1 250 -	rpm rpm % .... % sec ° C -	130 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
primary O2 sensor signal LEAN / secondary O2 sensor signal RICH											

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Bank 1 Bank 2	P2097 P2099	secondary O2 sensor fuel trim - lean shift - correction below threshold	secondary O2 sensor trim integral control <	-1	sec	at lower limit	not set	-	-		
								-	-		
						secondary O2 sensor readiness	not set				
						catalyst clear out after DCFO	not set	-	-		
						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	-	-		
Accelerator Pedal Position Sensor 1	P2122 P2123	range check low range check high	voltage < volage >	0.74 4.82	V V	battery voltage	>	7	V	0.2 sec	code set then 5 sec
Accelerator Pedal Position Sensor 2	P2127 P2128	range check low range check high	voltage < voltage >	0.63 4.82	V V	battery voltage	>	7	V	0.2 sec	
Accelerator Pedal Position 1 versus Position 2	P2138	plausibility	voltage difference > idle range	0.25	V	-	-	-	-	0.24 sec	
			voltage difference > pedal partially pressed	0.31	V						
			voltage difference > pedal fully pressed	1.70	V						
Barometric Pressure Sensor Rationality	P2227	range check high	sensor signal > or	115	KPa	error : barometric pressure sensor electrical for time	not set >	- 0.2	- sec	2 sec	two driving cycles each with: 1 sec
		range check low	sensor signal < or	50	KPa	error : barometric pressure sensor electrical for time	not set >	- 0.2	- sec	2 sec	continuous or 10 sec cumulative
		sensor offset / jump test low	sensor output change within 20 sec period > OR	10	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
			barometric pressure signal pressure	30	KPa	time since engine start	<	5	sec		
						error : barometric pressure sensor electrical	not set	-	-		
			jump from previous key off > AND								
			sensor output + THRESHOLD < pressure model	2	KPa	air mass flow meter readiness	TRUE	-	-		
						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	not active	-	-		
						for time	>	0	sec		
						error: throttle position sensor	not set	-	-		
						error: air flow mass meter	not set	-	-		
						error : baro pressure sensor electrical	not set	-	-		
		sensor offset / jump test high	or sensor output change within 20 sec period > OR	10	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	
			barometric pressure signal pressure	30	KPa	time since engine start	<	5	sec		
						error : barometric pressure sensor electrical	not set	-	-		
			jump from previous key off > AND								
			sensor output - THRESHOLD > pressure model	5	KPa	air mass flow meter readiness	TRUE	-	-		
						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	not active	-	-		
						for time	>	0	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		-	-	-	2 sec	
	P2229	range check high	voltage >	4.87	V		-	-	-		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Vehicle speed sensor Automatic Transmission	P2544	CAN message: static rolling count CAN message: implausible signal (2s complement) message validation failed		set set	- -	automatic transmission CAN Bus consisting of: ignition on for battery voltage battery voltage	configured initialized and ready > > <	3 9.8 18.1	sec V V	0.01 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
Auxiliary Engine Coolant Pump Circuit Continuity	P2600 P2602 P2603	circuit continuity - open circuit continuity - ground circuit continuity - voltage	Voltage Voltage Voltage	IC Internal IC Internal IC Internal		engine speed battery voltage battery voltage	> > <	80 9.9 18.1	rpm V V	0.01 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
Rationality	P2601	monitoring of engine coolant temperature profile during soak (engine off period)	temperature change gradient during soak period > DDTMOTMIN/F	-3 … -1	° C	auxiliary coolant pump enabled (coolant temp. at engine shutdown > 110 C) error: coolant temp. sensor electrical error: coolant temp. sensor performance error: coolant temp. sensor intermittent error: IAT sensor electrical error: IAT sensor performance error: auxiliary coolant pump electrical	TRUE not set not set not set not set not set not set	- - - - - - -	- - - - - - -	90 sec after-run when pump is enabled	
Fuel Level Sensor Circuit fuel transfer pump	P2636	transfer pump failure	fuel level 1 < and fuel level 2 >	10.6 22.8	% %	sensor signal without failure fuel level state stable engine speed	TRUE TRUE >	240	rpm	240 sec	no

End LLT Unique

LLT CAL TABLES

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)	350	450	550	650	750
0.70	128	128	120	104	96
0.80	128	128	120	104	96
1.00	128	128	120	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)				
	350	450	550	650	750
factor	7.75	7.00	6.75	6.75	6.25

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)	350	450	550	650	750
0.700	128	128	120	104	96
0.800	128	128	120	104	96
1.000	128	128	120	104	96

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)				
	350	450	550	650	750
factor	7.75	7.00	6.75	6.75	6.25

P2601 **DDTMOTMIN**
Maximum Second Derivative of tmot in Post Run

tumg (degC)	-20.3	0	15	50.3
2nd derivative (degC)	-3	-2.5	-2	-1

DDTMOTMIF
Maximum Second Derivative of tmot in Post Run with Fans Active

tumg (degC)	-20.3	0	15	50.3
2nd derivative (degC)	-3	-2.5	-2	-1

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Air / Fuel Ratio Sensor Heating heater circuits - electrical bank 1 sensor 1 (primary)	P0030 P0031 P0032	circuit continuity - open circuit continuity - ground circuit continuity - voltage	Voltage	IC Internal	-	engine speed battery voltage battery voltage output activated and deactivated for complete checking	> > <	240 10.5 18.1	rpm V V	5 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
heater performance bank 1 sensor 1	P0053	correction value for A/F sensor internal resistance measurement too much	absolute value of correction value for A/F sensor internal resistance >	45	Ohms	battery voltage battery voltage engine speed	> < >	10.5 18.1 240	V V rpm	40 sec	two driving cycles each with: 20 sec continuous or 150 sec cumulative
Turbocharger Bypass Valve Actuator Circuit Continuity	P0035 P0034 P0033	circuit continuity - voltage circuit continuity - ground circuit continuity - open	voltage	IC Internal	V	engine speed battery voltage battery voltage	> < >	80 18.1 9.99	rpm V V	0.01 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
Intake Air Temperature Sensor 2 (Boost Pressure Temperature Sensor) Rationality	P0096	response check	temperature delta during evaluation period: (max intake air temp. - min intake air temp.) <	1.5	° C	drive period - count each with coolant temperature at start Intake Air Temperature Sensor 2 Electrical Failure Mass Air Flow Mass Air Flow	>= <= not set > <	10 110.3 - 111.1 6.7	count ° C - g / sec g / sec	2 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						Vehicle speed	>	25	mph		
						idle period - count	>=	4	count		
						each with					
						coolant temperature at start	<=	110.3	° C		
						Intake Air Temperature Sensor 2					
						Electrical Failure	not set	-	-		
						Mass Air Flow	<	5.6	g / sec		
						Vehicle speed	<	9.4	mph		
						engine coolant temperature	>	60	° C		
Intake Air Temperature Sensor 2 (Boost Pressure Temperature Sensor) Circuit Continuity Check	P0098	circuit continuity - high	Intake Air Temperature Sensor 2 Voltage >	4.76	V	Engine Coolant Temperature	>	60	° C	2 sec	two driving
	P0097	circuit continuity - low	Intake Air Temperature Sensor 2 Voltage <	0.156	V	Mass air flow	<	27.8	g / sec		cycles each
	P0099	intermittent (discontinuity)				Vehicle speed	<	2.5	mph		with: 1 sec
			difference > (Intake Air Temperature Sensor 2 Raw Voltage - Intake Air Temperature Sensor 2 Filtered Voltage)	0.4	V	Intermittent (discontinuous) time	>	1	sec		continuous or 10 sec cumulative
Mass Air Flow (MAF) Sensor Ratoinality	P0101	range check low comparison to MAP based model	MAF sensor mass air flow * THRESHOLD < model	1.16	-	battery voltage	>	10.5	V	3 sec	two driving
						for time	>	0.1	sec		cycles
						time after start	>	0.3	sec		
						crankshaft revolution counter	>	150	rev		
						turbocharger bypass valve closed	TRUE	-	-		
						no boost pressure oscillation	TRUE	-	-		
						change in boost pressure in time period of	=	0.09	sec		
		fuel trim limits exceded	or			less than	<	2	Kpa		
		range - multiplicative	delta lambda correction >	20	%	greater than	>	-6	Kpa		
		and				error - intake air temperature sensor #2	not set	-	-		
		correction factor (modeled air	correction factor air mass <	80	%	error : ambient pressure sensor electrical	not set	-	-		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
		mass at throttle / air mass				error : ambient pressure sensor rationality	not set	-	-		
		measured by air mass flow meter)				error : throttle position sensor	not set	-	-		
						error : boost pressure sensor electrical	not set	-	-		
		range check high -	MAF sensor mass air flow * THRESHOLD > model	0.84	-	error : boost pressure sensor rationality	not set	-	-		
		comparison to MAP based model				error : MAP pressure sensor electrical	not set	-	-		
			or			error : MAP pressure sensor rationality	not set	-	-		
		fuel trim limits exceeded range - multiplicative	delta lambda correction <	-20	%	desired cam angle valid	TRUE	-	-		
		and				long term fuel trim enabled	TRUE	-	-		
						fuel trim stabilized	TRUE	-	-		
		correction factor (modeled air	correction factor air mass >	120	%	accumulated fuel trim adaptation time and	>	8	sec		
		mass at throttle / air mass				change in adaptive value over 200ms period	<	3	%		
		measured by air mass flow meter)				change in airflow evaluated over 200ms	<	40	%		
						throttle position gradient	<	2	Deg / sec		
						engine coolant temperature	>	9.8	° C		
						pressure ratio across throttle	<	0.8	-		
						for time	>	0.5	sec		
	P0100	open circuit check	sensor signal time period =	0	uS	battery voltage	>	10.5	V		
						engine speed	>	240	rpm		
						key on	TRUE	-	-		
	P0102	range check low	sensor signal time period <	66	uS	for time	>	0.1	sec		
	P0103	range check high	sensor signal time period >	2480	uS						
Manifold Absolute Pressure Sensor Rationality	P0106	range check high	sensor signal >	255.0	KPa	error : MAP sensor electrical	not set	-	-	3 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
		range check low	or sensor signal <	12.4	KPa	error : MAP sensor electrical	not set	-	-		
		rationality check low - model	or sensor signal + THRESHOLD < model	3.0	KPa	error : initial throttle learn failed	not set	-	-		
						error : throttle potentiometer fault	not set	-	-		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
		rationality check high - model	or sensor signal - THRESHOLD > model	3.0	KPa	error : intake air temperature sensor fault	not set	-	-		
						error : purge valve min / max flow	not set	-	-		
						error : intake / exhaust camshaft control	not set	-	-		
						error : intake / exhaust camshaft electrical	not set	-	-		
						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 until	<	-7.5	C		
						engine coolant temperature	>	30	C		
						conditions met once during drive cycle					
						throttle position	<	25	%		
						engine speed	>	1500	rpm		
						MAP sensor reading change	>	10	KPa		
		rationality check high : 3 sensor check	or sensor signal - THRESHOLD > mean sensor output	7.5	KPa	engine speed	<	400	rpm	200 ms during engine	
		rationality check low : 3 sensor check	or sensor signal + THRESHOLD < mean sensor output	7.5	KPa	engine off timer	>	4	sec	cranking	
						error : ambient pressure sensor electrical	not set	-	-	only	
						error : boost pressure sensor electrical	not set	-	-		
						error : MAP sensor electrical	not set	-	-		
Manifold Absolute Pressure Sensor Electrical	P0108 P0107	circuit continuity - voltage circuit continuity - ground	MAP sensor output voltage > MAP sensor output voltage <	4.805 0.1855	V V	engine speed	>	80	rpm	2.0 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Intake Air Temperature Sensor 1 (MAF Intake Air Temperature Sensor) Electrical											
	P0113	circuit continuity - high	Intake Air Temperature Sensor 1 Voltage >	4.76	V	Engine Coolant Temperature	>	60	° C	2 sec	two driving
	P0112	circuit continuity - low	Intake Air Temperature Sensor 1 Voltage <	0.175	V						cycles each
											with: 1 sec
	P0114	intermittent (discontinuity)	Intake Air Temperature Sensor 1 Raw Voltage - Intake Air Temperature Sensor 1 Filtered Voltage	0.4	V	Intermittent (discontinuous) time	>	1	sec	2 sec	continuous
											or 10 sec
											cumulative
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	10sec	two driving
		IC correction too high	IC corrective value >	0.15	V	battery voltage	>	10.7	V		cycles each
						engine speed	>	240	rpm		with: 1 sec
											continuous
											or 10 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 (reference ground) below lower limit	IC Circuit Status shorted low	IC Internal	-	battery voltage	<	18.1	V	20 sec	two driving
						battery voltage	>	10.7	V		cycles each
		or A/F sensor signal at UN (reference voltage [Nernst voltage]) below lower limit	IC Circuit Status shorted low	IC Internal	-	engine speed	>	240	rpm		with: 1 sec
		or A/F sensor signal at IA (measuring current trim circuit) below lower limit	IC Circuit Status shorted low	IC Internal	-						continuous
											or 10 sec
											cumulative
bank 1 sensor 1 - high volt	P0132	A/F sensor signal at VM (reference ground) above upper limit	IC Circuit Status shorted high	IC Internal	-						
		or A/F sensor signal at UN (reference voltage [Nernst voltage]) above upper limit	IC Circuit Status shorted high	IC Internal	-						
		or A/F sensor signal at IA	IC Circuit Status shorted high	IC Internal	-						

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
		(measuring current trim circuit) above upper limit									
Air / Fuel Ratio Sensor (primary A/F) response Bank 1 Sensor 1	P0133	dynamic response slope slow or low amplitude (exponentially filtered running average value.	A/F sensor dynamic value <	0.3	-	C/L lambda control temperature of A/F sensor ceramic	active	-	-	1.6 sec	two driving
							>	680	°C	then	cycles each
						C/L lambda control parameter: mean value	<	1.3	factor	dynamic	with: 4 sec
						C/L lambda control parameter: mean value	>	0.75	factor	test	continuous
						measured exhaust lambda	<	1.08	lambda	sample	or 30 sec
						measured exhaust lambda	>	0.92	lambda	count	cumulative
						engine speed	<	3520	rpm	>	
						engine speed	>	1520	rpm	40	
						volumetric efficiency	<	60	%	samples	
						volumetric efficiency	>	20	%		
						volumetric efficiency gradient	<	100	%/sec		
						A/F sensor housing model temp	<	600	°C		
						absolute value of forced amplitude	>	0.01	lambda		
						fuel mixture contribution from purge vapor	<	40	%		
						no active shutdown of fuel injectors	TRUE	-	-		
						error: A/F sensor circuit faults	not set	-	-		
						error: evap purge valve	not set	-	-		
						error: evap purge valve circuit	not set	-	-		
						A/F sensor heater output error (desired - measured)	<	100	°C		
Air / Fuel Ratio Sensor (primary A/F) delayed response Bank 1 Sensor 1	P0133	large A/F control parameter oscillation	C/L control parameter >	15	%	C/L lambda control temperature of A/F sensor ceramic	active	-	-	~ 400 sec	
			for time >	0.86	sec		>	680	°C	during	
			followed by:			target C/L lamdba setpoint	=	1	-	Unified	
			C/L control parameter <	15	%	engine speed	>	1550	rpm	cycle	
			for time >	0.86	sec	engine speed	<	4000	rpm	demonstration	
			then increment fault counter by	1	count	volumetric efficiency	>	30	%		
						volumetric efficiency	<	110	%	~150 sec	

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
			Fault set when fault counter >	10	counts	volumetric efficiency gradient (20ms eval. Period) air mass gradient (20ms eval. Period)	<	9	%	minimum with	
							<	6.94	g/sec	consecutive	
		Or				error: A/F sensor circuit faults	not set	-	-	time in enabling window	
						error: camshaft control	not set	-	-		
		time difference between A/F sensor	from signal maximum:			error: A/F sensor heater performance	not set	-	-		
		response and C/L control parameter	average peak-to-peak time difference >	750	ms						
		(difference calculated from time	with			error: A/F sensor heater electrical	not set	-	-		
						error: secondary O2 sensor trim of primary A/F sensor	not set	-	-		
		filtered C/L control parameter and	number of samples >	6	counts						
		from time filtered A/F signal -	Or			error: purge valve electrical	not set	-	-		
		calculation performed independantly	from signal minimum:								
		at the signal maximum and	average peak-to-peak time difference >	750	ms						
		at signal minimum)	with								
			number of samples >	6	counts						
		* Unified Cycle required for failure detection when on a specific driving cycle									
heater performance (primary A/F) bank 1 sensor 1	P0135	A/F sensor calculated temperature too low	A/F sensor temperature calculation <	620	° C	battery voltage	>	10.5	V	70 sec	two driving cycles
						battery voltage	<	18.1	V		
						error: A/F sensor heater control	not set	-	-		
						no active shutdown of fuel injectors	TRUE	-	-		
						A/F sensor heater control correction value	<	45	Ohm		
						expected - measured resistance					
						engine stop time	>	300	sec		
						engine temperature at start	>	-30	° C		
						engine speed	>	240	rpm		
						dew point end reached	TRUE	-	-		
heater performance (primary A/F)											

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
bank 1 sensor 1 (primary)	P0135	A/F sensor calculated temperature below threshold	A/F sensor temperature calculation <	765 TKERDCMN	° C	A/F Heater at Maximum Power	TRUE	-	-	20 sec	two driving cycles
						modeled exhaust temp. at sensor	>	350	° C		
						timer expires after either:	>	20	sec		
						fuel shut off >= 3 sec dur. ends	-	-	-		
						or initial A/F heater turn on	-	-	-		
						battery voltage	>	10.5	V		
						battery voltage	<	18.1	V		
						A/F heater control shut off	FALSE	-	-		
						error: vehicle speed sensor	not set	-	-		
						error: engine coolant temperature sensor	not set	-	-		
Oxygen Sensor (Secondary O2 sensor) Delayed response voltage during DCFO bank 1 sensor 2	P013E	secondary O2 sensor delayed response to DFCO	time from start of DCFO until secondary O2 sensor voltage falls below lower threshold	4	sec	deceleration fuel cut-off (DCFO)	active	-	-	4sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
						Prior to DCFO, secondary O2 sensor voltage exceeded voltage level	>	0.55	V		
			or the oxygen mass integration from start of DCFO exceeded upper threshold before the voltage below the lower threshold	8	g	battery voltage	>	11	V		
						during drive, secondary O2 sensor voltage was between	>				
						voltage level		0.48	V		
						voltage level	<	1.15	V		
						for time period lasting	>	0.6	sec		
			voltage lower threshold	0.15	V	modeled exhaust gas temperature at secondary O2 sensor	>	500	° C		
						secondary O2 sensor internal resistance	<	500	Ohms		
						secondary O2 sensor has measured lean and rich	TRUE	-	-		
						sensor voltage was above and below	> and <				
								0.6	V		
						for time period lasting (each direction)	>				
								0.5	sec		
						exhaust gas mass flow rate	>	2.78	g/s		
						temperature of A/F sensor ceramic	>	680	° C		
						primary A/F sensor measured lambda	>	3	lambda		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Slow response voltage during DCFO bank 1 sensor 2	P013A	secondary O2 sensor slow response to DFCO	time required for secondary O2 sensor voltage to transition from upper threshold to lower threshold	0.4	sec	Prior to DCFO, secondary O2 sensor voltage exceeded voltage level	>	0.55	V		
			upper voltage threshold	0.4	V	battery voltage during drive, secondary O2 sensor voltage was between voltage level	>	11	V		
						voltage level	>	0.48	V		
						voltage level	<	1.15	V		
						for time period lasting	>	0.6	sec		
			lower voltage threshold	0.2	V	modeled exhaust gas temperature at secondary O2 sensor	>	500	° C		
						secondary O2 sensor internal resistance	<	500	Ohms		
						secondary O2 sensor has measured lean and rich	TRUE	-	-		
						sensor voltage was above and below	> and <	0.6	V		
						for time period lasting (each direction)	>	0.5	sec		
						exhaust gas mass flow rate	>	2.78	g/s		
						temperature of A/F sensor ceramic	>	680	° C		
						primary A/F sensor measured lambda	>	3	lambda		
		Unified Cycle required for failure detection when on a specific driving cycle									
Turbocharger boost control system Rationality	P0234	actual boost pressure above desired	difference (desired versus actual boost pressure) <	-128…-18 KLDLUL	kPa	error : electrical diagnosis of boost pressure sensor	not set	-	-	3.2 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
						error : rationale diagnosis of boost pressure sensor	not set	-	-		
	P0299	actual boost pressure below desired	time filtered deviation (desired versus actual boost pressure) >	20	kPa	error : electrical diagnosis of boost pressure sensor	not set	-	-	8 sec	
						error : rationale diagnosis of boost pressure sensor	not set	-	-		
						error : turbocharger boost control system	not set	-	-		
						error : limp home mode activated	not set	-	-		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						error : limp home mode activated with safety fuel cut-off	not set	-	-		
						engine speed	>	2600… 3520	rpm		
						desired manifold pressure	>	110..13 0	KPa		
						ambient barometric pressure	>	65	KPa		
Boost Pressure Sensor Rationality											
	P0236	range check low	sensor signal <	13	KPa	error : boost pressure sensor electrical	not set	-	-	3 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
		rationality check low - baro comparison	or sensor signal + THRESHOLD < baro pressure	23	KPa	crankshaft revolution counter since engine start	>	3	counts		
		rationality check high - baro comparison	or sensor signal - THRESHOLD > baro pressure	18	KPa	error : throttle potentiometer fault	not set	-	-		
						error : limp home mode	not set	-	-		
						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	%		
		rationality check high - 3 sensor check	or sensor signal - THRESHOLD > mean sensor output	4.5	KPa	engine speed	<	400	rpm	200 ms during engine cranking only	
						engine off timer	>	4	sec		
						error : ambient pressure sensor electrical	not set	-	-		
		rationality check low - 3 sensor check	or sensor signal + THRESHOLD < mean sensor output	4.5	KPa	error : boost pressure sensor electrical	not set	-	-		
						error : MAP sensor electrical	not set	-	-		
Boost Pressure Sensor Electrical											
	P0238	circuit continuity - voltage	Boost sensor output voltage >	4.85	V	engine speed	>	80	rpm	2.0 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
	P0237	circuit continuity - ground	Boost sensor output voltage <	0.1855	V						

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Turbocharger Boost Control Actuator Circuit Continuity	P0246 P0245 P0243	circuit continuity - voltage circuit continuity - ground circuit continuity - open	voltage	IC Internal	V	engine speed battery voltage battery voltage	> < >	80 18.1 9.99	rpm V V	0.01 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
Catalyst System Performance	P0420	oxygen storage of catalyst	EWMA filtered catalyst aging factor less than catalyst aging factor of a limit catalyst <	0.2	factor	exhaust gas mass flow	>	10	g/sec	approx.	code set
						exhaust gas mass flow	<	42	g/sec	1000 sec	then 5 sec
						catalyst temp. model	<	750	° C	during	
						catalyst temp. model	>	525	° C	active	approx.
						engine speed	>	1320	rpm	driving	3 test
						engine speed	<	2840	rpm		average
						engine load	>	21 ... 34	%		run length
						engine load	<	50 ... 68	%		(6 samples)
						modeled catalyst temp. gradient	<	12	° C / sec		
						relative exhaust gas mass flow gradient	<	0	%	**Fast Initialization phase**	
						fuel system closed loop	active	-	-	Up to 4	
						time after secondary O2 sensor exceeded dewpoint	>	20	sec	samples per driving cycle	
						ambient temperature	>	-15	° C	**Step Change phase**	
						measured lambda	>	0.96	-	Up to 4	
						measured lambda	<	1.04	-	samples per	
						catalyst damaging misfire rate exceeded	not set	-	-	driving cycle	
						error: fuel trim monitoring	not set	-	-	**Stablized phase**	
						C/L lambda control parameter: mean value	<	1.3	factor	1 sample per	
						C/L lambda control parameter: mean value	>	0.75	factor	driving cycle	
						catalyst clear out active (after fuel cutoff)	not set	-	-		
						Trigger condition for step change					
						Measured OSC < % of EWMA normalized filtered OSC	<	0.73	-		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Brake Booster Pressure Sensor Rationality	P0556 P0556	range check - low range check - high	Brake Booster Pressure < Brake Booster Pressure >	1.5 107.5	kPa kPa					0.5 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
	P0556	barometric Pressure Check or manifold Pressure Check	Brake Booster Pressure - Ambient Pressure > Brake Booster Pressure - manifold absolute pressure	3.5 15	kPa kPa	brake reservoir pressure increase (brake apply) error: MAF sensor error: ambient pressure sensor ambient Pressure - Manifold Absolute pressure	< not set not set <	0.648 25	kPa kPa		
*** GMX020 / 023 Only**											
Brake Booster Pressure Sensor Circuit Continuity	P0557 P0558	circuit continuity check - low circuit continuity check - high	Brake Booster pressure sensor voltage < Brake Booster pressure sensor voltage >	0.195 4.85	V V					2.0 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
*** GMX020 / 023 Only**											
Air / Fuel Ratio Sensor (primary A/F) integrated circuit interface	P064D	A/F sensor IC operating voltage too low A/F sensor IC SPI interface communication error A/F sensor IC circuit write error at INIT register	low voltage communication error write error	TRUE TRUE TRUE	- - -	battery voltage battery voltage engine speed	> < >	10.7 18.1 240	V V rpm	10 sec 0.1 sec 0.1 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
Electronic Throttle Control	P1551	limp-home throttle position	throttle position <	13.1	%	vehicle speed	<=	0	mph	5 sec	code set

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
		out of range	OR throttle position >	42.8	%	engine speed engine coolant temperature engine coolant temperature intake air temperature intake air temperature battery voltage accelerator pedal position	< >= <= >= <= > <	40 5.25 100.5 5.25 143.8 10.0 14.9	rpm ° C ° C ° C ° C V %	at key on	then 5 sec
Oxygen Sensor (secondary O2) Trim of Air / Fuel Ratio Sensor (primary A/F) Bank 1	P2096	A/F sensor long term secondary trim - rich shift - correction below threshold	secondary O2 sensor trim integral control <	-0.03	lambda	engine speed secondary O2 oscillation test completed successfully see P2270 / P2271 accumulated learn time secondary O2 sensor has measured lean and rich sensor voltage was above and below for time period lasting (each direction) error: dynamic response of A/F sensor error: heater control of A/F sensor error: secondary O2 sensor response error error: A/F sensor circuit faults error: O2 sensor circuit faults	> TRUE > TRUE > and < > not set not set not set not set not set	240 - 60 - 0.6 0.5 - - - - -	rpm - sec - V sec - - - - -	~ 300 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
Bank 1	P2097	A/F sensor long term secondary trim - lean shift - correction above threshold	secondary O2 sensor trim integral control >	0.03	lambda						
Accelerator Pedal Position Sensor 1	P2122 P2123	range check low range check high	accelerator potentiometer 1 voltage < accelerator potentiometer 1 voltage >	0.74 4.82	V V	battery voltage	>	7	V	0.2 sec	code set then 5 sec
Accelerator Pedal Position Sensor 2	P2127 P2128	range check low range check high	accelerator potentiometer 2 voltage < accelerator potentiometer 2 voltage >	0.68 4.82	V V	battery voltage	>	7	V	0.2 sec	
Accelerator Pedal Position 1 versus	P2138	plausibility	voltage difference > idle range	0.18	V	-	-	-	-	0.24 sec	

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Position 2			voltage difference pedal partially pressed >	0.29	V	-	-	-	-		
			voltage difference > pedal fully pressed	1.72	V	-	-	-	-		
Oxygen Sensor (secondary O2) Trim of Air / Fuel Ratio Sensor (primary A/F)											
Bank 1	P2195	A/F sensor offset calculation rich shift - correction below threshold	A/F sensor offset correction <	-0.07	lambda	engine speed secondary O2 oscillation test completed successfully see P2270 / P2271	> TRUE	240 -	rpm -	~ 200 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
						accumulated learn time secondary O2 sensor has measured lean and rich	> TRUE	60 -	sec -		
Bank 1	P2196	A/F sensor offset calculation lean shift - correction above threshold	A/F sensor offset correction >	0.07	lambda	sensor voltage was above and below for time period lasting (each direction)	> and < >	0.6 0.5	V sec		
						error: dynamic response of A/F sensor	not set	-	-		
						error: heater control of A/F sensor error: secondary O2 sensor response error	not set	-	-		
						error: A/F sensor circuit faults	not set	-	-		
						error: O2 sensor circuit faults	not set	-	-		
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 >	24.8	° C	mass air flow	>	6.7	g / sec	25 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
						mass air flow vehicle speed boost pressure to ambient pressure ratio	< > <	83.3 34.4 1.4	g / sec mph ratio		
		Intake Air Temperature Correlation Check	Intake Air Temperature Sensor 1 - Intake Air Temperature Sensor 2 <	20.3	° C						

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Barometric Pressure Sensor Rationality	P2227	range check high	sensor signal >	112	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
			or								
		range check low	sensor signal <	60.5	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	
			or								
		sensor offset / jump test low	sensor output change within 20 sec period >	5	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	
			OR								
			barometric pressure signal pressure	10	KPa	time since engine start	<	5	sec		
						error : barometric pressure sensor electrical	not set	-	-		
			jump from previous key off >								
			AND								
				5	KPa	engine speed	<	1000	rpm		
			sensor output + THRESHOLD <			throttle position	<	23.99	%		
			boost pressure sensor output								
						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	
			OR								
			barometric pressure signal pressure	10	KPa	time since engine start	<	5	sec		
						error : barometric pressure sensor electrical	not set	-	-		
			jump from previous key off >								
			AND								
				5	KPa	engine speed	<	1000	rpm		
			sensor output - THRESHOLD >			throttle position	<	23.99	%		
			boost pressure sensor output								
						error : barometric pressure sensor electrical	not set	-	-		
			or								
		rationality check high - 3 sensor check	sensor signal - THRESHOLD > mean sensor output	4.52	KPa	engine speed	<	400	rpm	200 ms during engine cranking only	
						engine off timer	>	4	sec		
						error : ambient pressure sensor electrical	not set	-	-		
			or								
		rationality check low - 3 sensor check	sensor signal + THRESHOLD < mean sensor output	4.52	KPa	error : boost pressure sensor electrical	not set	-	-		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						error : MAP sensor electrical	not set	-	-		
Barometric Pressure Sensor Electrical											
	P2228	range check low	voltage <	0.332	V					2 sec	
	P2229	range check high	voltage >	4.708	V					2 sec	
Air / Fuel Ratio Sensor (primary A/F) pumping current circuit open		lambda control factor change	absolute value of lambda control factor	0.075	lambda	battery voltage	<	18.1	V	1.5 sec	two driving
	P2237	above threshold	change from the point when the			battery voltage	>	10.7	V		cycles each
			secondary conditions are met >			engine speed	>	240	rpm		with: 1 sec
						A/F sensor voltage	<	1.51	V		continuous
						A/F sensor voltage	>	1.48	V		or 10 sec
						engine run time	>	4	sec		cumulative
						time at idle	>	2.2	sec		
						A/F sensor heater output error (desired - measured)	<	100	°C		
						A/F sensor ceramic temperature	>	650	°C		
						lambda closed loop control	TRUE	-	-		
						for time period	>	1.5	sec		
						| fuel trim forced amplitude |	>	0.01	lambda		
						catalyst heating activity stable time since start or end of catalyst heating	>	1.5	sec		
Air / Fuel Ratio Sensor (primary A/F) pumping current circuit open		A/F sensor voltage within upper	A/F sensor voltage <	1.51	V	battery voltage	<	18.1	V	approx.	two driving
	P2237	and lower thresholds	and A/F sensor voltage >	1.48	V	battery voltage	>	10.7	V	8 sec	cycles each
		and desired lambda is outside				engine speed	>	240	rpm	once the	with: 1 sec
		of upper or lower threshold				target lambda above upper limit	>	1.03	lambda	driving	continuous
						or below lower limit	<	0.97	lambda	condition	or 10 sec
						closed loop control	TRUE	-	-	is met	cumulative
						A/F sensor heater output error (desired - measured)	<	100	°C		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						A/F sensor ceramic temperature	>	650	°C		
						error: A/F sensor dynamic response	not set	-	-		
						error: A/F sensor heating	not set	-	-		
						integrated exhaust gas mass	>	200	g		
Air / Fuel Ratio Sensor (primary A/F) pumping current circuit open	P2237	A/F sensor not lean enough during fuel shut off operation	A/F sensor voltage <	1.7	V	battery voltage	<	18.1	V	2 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
						battery voltage	>	10.7	V		
						engine speed	>	240	rpm		
						time after fuel shut off begins	>	3	sec		
						A/F sensor heater output error (desired - measured)	<	100	°C		
Air / Fuel Ratio Sensor (primary A/F) reference voltage circuit open	P2243	A/F sensor voltage above upper threshold or below lower threshold	A/F sensor voltage < A/F sensor voltage >	0.2 4.7	V V	battery voltage	<	18.1	V	2 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
						battery voltage	>	10.7	V		
						engine speed	>	240	rpm		
						A/F sensor heater operational for time	>	10	sec		
						error: A/F sensor heater circuit	not set	-	-		
						A/F sensor certamic temperature	>	600	°C		
Air / Fuel Ratio Sensor (primary A/F) reference ground circuit open	P2251	A/F sensor voltage within range	A/F sensor voltage below and above	1.480 1.35	V V	battery voltage	<	18.1	V	5sec once conditions met	two driving cycles each with: 1 sec continuous or 10 sec cumulative
						battery voltage	>	10.7	V		
						engine speed	>	240	rpm		
						The following conditions met for	>	5	sec		
						A/F sensor heater operational for time	>	10	sec		
						A/F sensor internal resistance	>	950	Ohms		
						error: A/F sensor heater circuit	not set				
						The following conditions met for	>	20	sec		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						dew-point end reached	TRUE	-	-		
						engine speed	>	240	rpm		
						battery voltage	<	18.1	V		
						end of DFCO reached for	>	2	sec		
						battery voltage	>	11	V		
Turbocharger Bypass Valve (mechanical) Rationality	P2261	induction system pulsation monitor	detected pulsations >	7	counts	minimum time - bypass valve activation time	>	1.05	sec	200 ms once	two driving cycles each
						bypass valve command on					with: 4 sec
						boost versus ambient pressure ratio	>	1.1…3. 3	ratio	conditions met	continuous or 30 sec
						battery voltage	>	18.1	V		cumulative
						error : MAF electrical	not set	-	-		
						error : MAF rationality	not set	-	-		
						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	-	-		
Air / Fuel Ratio Sensor (primary A/F) sensor voltage	P2297	A/F sensor voltage exceeds threshold but not out of full range	A/F sensor voltage > and A/F sensor voltage < or AF sensor voltage >	3.7 4.81 2.5	V V V	A/F sensor heater output error (desired - measured)	<	100	°C	10 sec	two driving cycles
						engine speed	>	240	rpm		
						desired A/F	<	1.6	lambda	additional	
						no active shutdown of fuel injectors	TRUE	-	-	time if	
						temperature of A/F sensor ceramic	>	680	°C	fuel level is low and not failed	

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
			and A/F sensor voltage < (if engine running for less the 2 seconds)	3.06	V					600 sec	
Brake Booster Vacuum Pump Circuit Continuity * GMX020 / 023 Only	P258A P258C P258D	circuit continuity - open circuit continuity - ground circuit continuity - voltage	Voltage	IC Internal IC Internal IC Internal						0.01 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative

Brake Booster Vacuum Pump
 	
      Rationality
 	
* GMX020 / 023 Only
	P258B	Pressure change during pump
		
		   activation
			Pressure difference over evaluation period >	0 … 3.0	Kpa	brake reservoir pressure + offset < MAP
						device control from Scan-Tool
						pump active for period of time
						Intake Air Temperature
						brake reservoir pressure increase (brake apply)
							<
							
							not active
							>
							>
							
							<
								3
								
								-
								
								1.6
								-7.5
								
								0.45
									Kpa
									
									-
									
									sec
									° C
									
									Kpa
										1.60 sec	two driving
											
											cycles each
											
											with: 1 sec
											continuous
											
											or 10 sec
											
											cumulative

Air / Fuel Ratio Sensor (primary A/F) measuring (trim) current circuit open	P2626	A/F sensor voltage above threshold	A/F sensor voltage >	4.81	V	battery voltage battery voltage engine speed fuel cut off modeled exhaust temp in front of catalyst A/F sensor heater output error (desired - measured)	< > > TRUE < <	18.1 10.7 240 - 780 100	V V rpm - ° C °C	2 sec additional time if fuel level is low 600 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative

End LNF Unique

LNF CAL TABLES

P0234 **KLDLUL** (internal manufacturer cross reference)
Pressure deviation for overboost detection

	Difference : Desired manifold pressure - base (mechanical) boost level (KPa)							
	-10	-5	0	25	50	75	100	120
Delta Pressure (kPa)	-127.5	-127.5	-60	-30	-23	-20	-18	-18

P258B **DPBKVPPBKV** (internal manufacturer cross reference)
Pressure difference for brake boost pump performance evaluation

	Reservior pressure at beginning of evaluation (Kpa)			
	0	30	60	100
Delta Pressure (kPa)	0	0	3	3

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
Fuel System Control Module:								
Fuel Rail Pressure (FRP) Sensor Performance (Rationality)	P0191	This DTC detects if the fuel pressure sensor is stuck within the normal operating range	Absolute value of change in fuel pressure as sensed during intrusive test.	<= 30 kPa			Frequency: Continuous; 12.5 ms loop. 60 seconds between intrusive tests that pass	DTC Type A
							Intrusive test requested if fuel system is clamped or fuel pressure error variance <= 0.4 for >= 5 seconds; otherwise report	
					1. FRP Circuit Low DTC (P0192)	not active		
					2. FRP Circuit High DTC (P0193)	not active		
					3. FuelPump Circuit Low DTC (P0231)	not active	Duration of intrusive test is fueling related (5 to 12 seconds).	
					4. FuelPump Circuit High DTC (P0232)	not active		
					5. FuelPump Circuit Open DTC (P023F)	not active		
					6. Reference Voltage DTC (P0641)	not active		
					7. Reference Voltage DTC (P0641)	not failed this trip		
					8. Reference Voltage DTC (P0642)	not active		
					9. Fuel Pump Control Module Driver Over-temperature DTC's (P064A, P1255)	not active		
					10. Control Module Internal Performance DTC (P0606)	not active		
					11. Engine run time	>=5 seconds		
					12. Emissions fuel level (PPEI $3FB)	not low		
					13. Fuel pump control	enabled		
					14. Fuel pump control state	normal or FRP Rationality control Valid		
					15. Engine fuel flow			
					16. ECM fuel control system failure (PPEI $1ED)	failure has not occurred		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
Fuel Rail Pressure (FRP) Sensor Circuit Low Voltage	P0192	This DTC detects if the fuel pressure sensor circuit is shorted to low	FRP sensor voltage	< 0.1 V	Ignition OR HS Comm OR Fuel Pump Control AND Reference Voltage DTC P0641	Run or Crank enabled enabled not active	72 test failures in 80 test samples 1 sample/12.5 ms	DTC Type A
Fuel Rail Pressure (FRP) Sensor Circuit High Voltage	P0193	This DTC detects if the fuel pressure sensor circuit is shorted to high	FRP sensor voltage	> 4.9 V	Ignition OR HS Comm OR Fuel Pump Control AND Reference Voltage DTC P0641	Run or Crank enabled enabled not active	72 test failures in 80 test samples 1 sample/12.5 ms	DTC Type A
Fuel Pump Control Circuit Low Voltage	P0231	This DTC detects if the fuel pump control circuit is shorted to low	Fuel Pump Current	> 14.48A	Ignition OR HS Comm OR Fuel Pump Control AND Ignition Run/Crank Voltage	Run or Crank enabled enabled 9V < voltage < 18V	72 test failures in 80 test samples if Fuel Pump Current <100A 3 test failures in 15 test samples if Fuel Pump Current >=100A 1 sample/12.5 ms	DTC Type A
Fuel Pump Control Circuit High Voltage	P0232	This DTC detects if the fuel pump control circuit is shorted to high	Voltage measured at fuel pump circuit	> 3.86 V	Commanded fuel pump output Fuel pump control enable Time that above conditions are met	0% duty cycle (off) False >=4.0 seconds	36 test failures in 40 test samples 1 sample/12.5 ms Pass/Fail determination made only once per trip	DTC Type A
Fuel Pump Control Circuit (Open)	P023F	This DTC detects if the fuel pump control circuit is open	Fuel Pump Current AND	<=0.5A	Ignition OR	Run or Crank	72 test failures in 80 test samples 1 sample/12.5 ms	DTC Type A

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
			Fuel Pump Duty Cycle	>20%	HS Comm OR Fuel Pump Control AND Ignition Run/Crank Voltage	enabled enabled 9V < voltage < 18V		
Fuel System Control Module Enable Control Circuit	P025A	This DTC detects if there is a fault in the fuel pump control enable circuit	PPEI (PPEI (Powertrain Platform Electrical Interface) Fuel System Request ($1ED)	≠ Fuel Pump Control Module Enable Control Circuit	Ignition OR HS Comm OR Fuel Pump Control AND PPEI Fuel System Request ($1ED)	Run or Crank enabled enabled valid	72 test failures in 80 test samples 1 sample/12.5 ms	DTC Type A
Control Module Read Only Memory (ROM)	P0601	This DTC will be stored if any software or calibration check sum is incorrect	Calculated Checksum (CRC16)	≠ stored checksum for any of the parts (boot, software, application calibration, system calibration)	Ignition OR HS Comm OR Fuel Pump Control	Run or Crank enabled enabled	1 failure if it occurs during the first ROM test of the ignition cycle, otherwise 5 failures Frequency: Runs continuously in the background	DTC Type A
Control Module Not Programmed	P0602	Indicates that the FSCM needs to be programmed	This DTC is set via calibration, when KeMEMD_b_NoStartCal	TRUE	Ignition OR HS Comm OR Fuel Pump Control	Run or Crank enabled enabled	Runs once at power up	DTC Type A
Control Module Long Term Memory Reset	P0603	Non-volatile memory checksum error at controller power-up	Checksum at power-up	≠ checksum at power-down	Ignition OR HS Comm OR Fuel Pump Control	Run or Crank enabled enabled	1 failure Frequency: Once at power-up	DTC Type A

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
Control Module Random Access Memory (RAM)	P0604	Indicates that control module is unable to correctly write and read data to and from RAM	Data read	≠ Data written			1 failure if it occurs during the first RAM test of the ignition cycle, otherwise 5 failures	DTC Type A
					Ignition OR HS Comm	Run or Crank enabled	Frequency: Runs continuously in the background.	
					OR Fuel Pump Control	enabled		
Control Module Internal Performance 1. Main Processor Configuration Register Test	P0606	This DTC indicates the FSCM has detected an internal processor fault or external watchdog fault (PID 2032 can tell what causes the fault.)	1. For all I/O configuration register faults:				Tests 1 and 2 1 test failure Frequency: Continuously (12.5ms)	DTC Type A
			•Register contents	Incorrect value.	Ignition OR HS Comm OR Fuel Pump Control	Run or Crank enabled enabled		
			2. For Processor Clock Fault: •EE latch flag in EEPROM. OR		1. For all I/O configuration register faults: •KeMEMD_b_ProcFltCfgRegEnbl	TRUE	Test 3 3 test failures in 15 test samples Frequency: 1 sample/12.5 ms	
2. Processor clock test			• RAM latch flag.	0x5A5A 0x5A	2. For Processor Clock Fault: •KeMEMD_b_ProcFltCLKDiagEnbl	TRUE		
3. External watchdog test			3. For External Watchdog Fault: • Software control of viper chip.		3. For External Watchdog Fault: •KeFRPD_b_FPExtWDogDiagEnbl			
				Control Lost		TRUE		
Control Module Long Term Memory (EEPROM) Performance	P062F	Indicates that the NVM Error flag has not been cleared	Last EEPROM write	Did not complete			1 test failure Once on controller power-up	DTC Type A
					Ignition OR HS Comm OR Fuel Pump Control	Run or Crank enabled enabled		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
5 Volt Reference Circuit (Short High/Low)	P0641	Detects a continuous short on the #1 5V sensor reference circuit	Reference voltage AND Output OR Reference voltage AND Output OR Reference voltage AND Output	>= 0.5V inactive >= 5.5V active <= 4.5V active	Ignition OR HS Comm OR Fuel Pump Control	Run or Crank enabled enabled	15 test failures in 20 test samples 1 sample/12.5 ms	DTC Type A
Fuel Pump Control Module Performance - Driver Over Temperature 1	P064A	This DTC detects if an internal fuel pump driver overtemperature condition exists under normal operating conditions. (Motorola's responsibility)	Module Range of Operation **AND** Viper Temp	Normal (- FSCM is in normal operating range for module voltage versus PWM duty cycle. Linear range from 100% @ 12.5V to 70% @ 18V.) >190C	Ignition OR HS Comm OR Fuel Pump Control KeFRPD_b_FPOverTempDiagEnbl Ignition Run/Crank	Run or Crank enabled enabled TRUE 9V<voltage<18V	3 test failures in 15 test samples 1 sample/12.5 ms	DTC Type B
5 Volt Reference Circuit (Out of Range)	P06A6	Detects that the #1 5 V sensor reference circuit is out of range	Reference voltage	> 102.5% nominal (i.e. 5.125V) OR < 97.5% nominal (i.e. 4.875V)	Ignition OR HS Comm OR Fuel Pump Control	Run or Crank enabled enabled	72 test failures in 80 test samples 1 sample/12.5 ms	DTC Type A
Fuel Pump Control Module - Driver Over-temperature 2	P1255	This DTC detects if an internal fuel pump driver overtemperature condition exists under extreme operating conditions (GM's responsibility)	Module Range of Operation **AND** Viper Temp	Outside normal range (FSCM is NOT in normal operating range for module voltage versus PWM duty cycle. Linear range from 100% @ 12.5V to 70% @ 18V.) > 190C	Ignition OR HS Comm OR Fuel Pump Control KeFRPD_b_FPOverTempDiagEnbl Ignition Run/Crank	Run or Crank enabled enabled TRUE 9V<voltage<18V	3 test failures in 15 test samples 1 sample/12.5 ms	DTC Type B

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
Ignition 1 Switch Circuit Low Voltage	P2534	This DTC detects if the Ignition1 Switch circuit is shorted to low or open	Ignition 1 voltage	<= 6 V	Engine	Running	144 test failures in 160 test samples 1 sample/12.5 ms	DTC Type A
Fuel Pump Flow Performance	P2635	This DTC detects degradation in the performance of the electronic return-less fuel system	Filtered fuel rail pressure error	<= Low Threshold (function of desired fuel rail pressure and fuel flow rate. Typical values in the range of -30.0 to -90.0 kPa.) **OR** > High Threshold (function of desired fuel rail pressure and fuel flow rate. Typical values in the range of 30.0 to 90.0 kPa.) Please see attached worksheet for threshold values	1. FRP Circuit Low DTC (P0192) 2. FRP Circuit High DTC (P0193) 3. Fuel Rail Pressure Sensor Performance DTC (P0191 4. FuelPump Circuit Low DTC (P0231) 5. FuelPump Circuit High DTC (P0232) 6. FuelPump Circuit Open DTC (P023F) 7. Reference Voltage DTC (P0641) 8. Reference Voltage DTC (P0641) 9. Reference Voltage DTC (P0642) 10. Fuel Pump Control Module Driver Over-temperature DTC's (P064A, P1255) 11. Control Module Internal Performance DTC (P0606) 12. An ECM fuel control system failure (PPEI $1ED) 13. The Barometric pressure (PPEI $4C1) signal 14. Engine run time 15. Emissions fuel level (PPEI $3FB) 16. Fuel pump control 17. Fuel pump control state	not active not active not active not active not active not active not active not failed this trip not active not active not active has not occurred valid (for absolute fuel pressure sensor) >= 30 seconds not low enabled normal	Filtered fuel rail pressure error Time Constant = 12.5 seconds Frequency: Continuous 100 ms loop	DTC Type B

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
					18. Battery Voltage 19. Fuel flow rate 20. Fuel Pressure Control System	11V<=voltage=<18V > 0.05 g/s **AND** <= Max allowed fuel flow rate as a function of desired rail pressure (Typical values in the range of 13 to 20 g/s) Is not responding to an over-pressurization due to pressure build during DFCO or a decreasing desired pressure command.		
Control Module Communication Bus "A" Off	U0073	Detects that a CAN serial data bus shorted condition has occurred to force the CAN device driver to enter a bus-off state	Bus Status	Off	HS Communication OR Ignition Run/Crank	Enabled on	5 test failures in 5 samples (5 seconds)	DTC Type B
Lost Communication With ECM/PCM "A"	U0100	Detects that CAN serial data communication has been lost with the ECM	Message $0C9	Undetected	1. Power mode 2. Ignition Run/Crank Voltage 3. U0073	Run/Crank (11 – 18 V) not active	12 test failures in 12 samples (12 seconds)	DTC Type B

LOOK-UP TABLES

Maximum Fuel Flow above which P2635 is Disabled.

LLT 6 cylinder

Desired Rail Pressure (kPa)

Battery Voltage	200	250	300	350	400	450	500	550	600
4.5	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	19.57031	16.26563	13.01563
6	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	19.57031	16.26563	13.01563
7.5	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	19.57031	16.26563	13.01563
9	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	19.57031	16.26563	13.01563
10.5	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	19.57031	16.26563	13.01563
12	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844
13.5	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844
15	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844
16.5	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844
18	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844
19.5	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844
21	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844
22.5	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844
24	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844
25.5	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844
27	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844
28.5	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844	20.39844

LOOK-UP TABLES

Failure Threshold when estimated rail pressure is ABOVE desired rail pressure
(Error=Desired Rail Pressure-Estimated Rail Pressure)

LLT 6 cylinder

Desired Rail Pressure (kPa)

	200	250	300	350	400	450	500	550	600
0	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
1.5	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
3	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
4.5	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
6	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
7.5	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
9	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
10.5	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
12	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
13.5	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
15	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
16.5	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
18	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
19.5	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
21	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
22.5	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
24	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
25.5	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
27	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
28.5	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
30	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
31.5	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
33	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
34.5	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
36	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
37.5	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
39	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
40.5	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
42	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
43.5	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
45	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
46.5	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90
48	-30	-37.5	-45	-52.5	-60	-67.5	-75	-82.5	-90

Instantaneous Fuel Flow (g/sec)

LOOK-UP TABLES

Failure Threshold when estimated rail pressure is BELOW desired rail pressure
(Error=Desired Rail Pressure-Estimated Rail Pressure)

LLT 6 cylinder

Desired Rail Pressure (kPa)

	200	250	300	350	400	450	500	550	600
0	30	37.5	45	52.5	60	67.5	75	82.5	90
1.5	30	37.5	45	52.5	60	67.5	75	82.5	90
3	30	37.5	45	52.5	60	67.5	75	82.5	90
4.5	30	37.5	45	52.5	60	67.5	75	82.5	90
6	30	37.5	45	52.5	60	67.5	75	82.5	90
7.5	30	37.5	45	52.5	60	67.5	75	82.5	90
9	30	37.5	45	52.5	60	67.5	75	82.5	90
10.5	30	37.5	45	52.5	60	67.5	75	82.5	90
12	30	37.5	45	52.5	60	67.5	75	82.5	90
13.5	30	37.5	45	52.5	60	67.5	75	82.5	90
15	30	37.5	45	52.5	60	67.5	75	82.5	90
16.5	30	37.5	45	52.5	60	67.5	75	82.5	90
18	30	37.5	45	52.5	60	67.5	75	82.5	90
19.5	30	37.5	45	52.5	60	67.5	75	82.5	90
21	30	37.5	45	52.5	60	67.5	75	82.5	90
22.5	30	37.5	45	52.5	60	67.5	75	82.5	90
24	30	37.5	45	52.5	60	67.5	75	82.5	90
25.5	30	37.5	45	52.5	60	67.5	75	82.5	90
27	30	37.5	45	52.5	60	67.5	75	82.5	90
28.5	30	37.5	45	52.5	60	67.5	75	82.5	90
30	30	37.5	45	52.5	60	67.5	75	82.5	90
31.5	30	37.5	45	52.5	60	67.5	75	82.5	90
33	30	37.5	45	52.5	60	67.5	75	82.5	90
34.5	30	37.5	45	52.5	60	67.5	75	82.5	90
36	30	37.5	45	52.5	60	67.5	75	82.5	90
37.5	30	37.5	45	52.5	60	67.5	75	82.5	90
39	30	37.5	45	52.5	60	67.5	75	82.5	90
40.5	30	37.5	45	52.5	60	67.5	75	82.5	90
42	30	37.5	45	52.5	60	67.5	75	82.5	90
43.5	30	37.5	45	52.5	60	67.5	75	82.5	90
45	30	37.5	45	52.5	60	67.5	75	82.5	90
46.5	30	37.5	45	52.5	60	67.5	75	82.5	90
48	30	37.5	45	52.5	60	67.5	75	82.5	90

Instantaneous Fuel Flow (g/sec)