COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
Catalyst Bank 1	P0420	oxygen storage of catalyst	normalized oxygen storage	<1 factor	exhaust gas mass flow	>35kg/h	max. 18 sec.	once per trip	1 trip
			less than normalized oxygen storage of a limit catalyst		exhaust gas mass flow	<150kg/h	continuous		
					catalyst temp. model	<700° C			with: 0.4 sec
					catalyst temp. model	>480°C			continuous
					engine speed	>960rpm			or 4 sec cum
					engine speed	<2760rpm			
					engine load				
					engine load	<70.. .80%			
					modeled catalyst temp. gradient	<2.5° C / sec			
					exhaust gas mass flow gradient	<8.33g/sec²			
					fuel system closed loop	active			
					time after dew point exeeded at secondary O2 sensor *	> 40 sec.			
					ambient temperature	>-48° C			
					secondary O2 sensor voltage	> 0.55 V			
					error: fuel system trim rich or lean (P2177,P2178,P2187,P2188)	not set			
					short term fuel trim (< max)	<1.25factor			
					short term fuel trim (> min)	>0.75factor			
					error: critical misfire rate (P0300-P0306)	not set			
					error: cat. damaging misfire rate exceeded (P0300-P0306)	not set			
Misfire Emission Level Multiple Cylinder	P0300	crankshaft speed fluctuation cylinder 1 to cylinder 6	emissions relevant misfire rate	> 2,38%	engine speed	> 450rpm	first Interval: 1000 revs.	continous	2 trips
Cylinder #1	P0301				engine speed	< 6500rpm			with: 0.4 sec
Cylinder #2	P0302				indicated torque (idle, no drive)	> 5,47%	remaining intervals: 4000 revs.	continous	continuous
Cylinder #3	P0303				indicated torque (drive)	> 5,47 . . . 20,7%			or 4 sec cum
Cylinder #4	P0304				engine speed gradient	<12800rpm/sec			
Cylinder #5	P0305				volumetric efficiency gradient	<768%/rev			
Cylinder #6	P0306				cylinder events after engine start	> 6ignitions			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
					engine coolant temperature intake air temperature error: crankshaft sensor (P0335, P0336, P0338) error: ref.mark of crank sensor (P0016-P0019)	> -30°C > -30°C not set not set			
Catalyst Damaging Level									
Multiple Cylinder	P0300		Catalyst damaging misfire rate	> 16,7 . . . 4,7%	Includes all the above with the following exceptions:				First
Cylinder #1	P0301			see Misfire supplemental data (h) (2.5.1)	First interval when engine coolant start temperature is	< 0 °C	First Interval: 1000 revs	continous	occurance:
Cylinder #2	P0302				First interval when engine coolant start temperature is	> 0 °C	First Interval: 200 revs	continous	immediate
Cylinder #3	P0303								MIL flashing
Cylinder #4	P0304						Remaining intervals	continous	
Cylinder #5	P0305						200 revs		Second occurance: immediate MIL flashing with constant MIL afterwards
Cylinder #6	P0306								
Fuel evaporative system (monitor during engine run)									
	P0446	monitoring of tank pressure while	tank pressure too low because	< -25 hPa	engine start temperature	2 °C ... 38 °C	approx. 10 sec	once per trip	2 trips
canister ventilation valve (AAV)		AAV is open and CPV is closed	canister vent. defective & closed		ambient temperature difference ambient temperature and engine start temperature	2 °C ... 38 °C < 15°C			
canister purge valve (CPV)	P0496	monitoring of tank pressure while	final pressure too low because	< -0.6 hPa	ambient pressure	>= 680.00 hPa	approx. 10 sec	once per trip	

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
tank leak rough	P0497 P0455	CPV and AAV are closed monitoring of tank pressure while CPV and AAV are closed AAV is closed and CPV is open	CPV defective and open purge control stuck closed vacuum pressure built up gradient too low because of large tank leakage (for example: open gas filler cap)	 > -0.2 hPa > 0.15 … 0.19 hPa/s > -13 hPa	vehicle speed angle accelerator pedal unfiltered tank pressure and unfiltered tank pressure battery voltage and battery voltage fuel system status secondary air system * tank fuel level error: fuel system trim rich or lean (P2177,P2178,P2187,P2188) multiplicative fuel trim adaption integrator deviation for time lambda controller deviation or time since engine start exceeds threshold error: tank pressure sensor (P0450-P0453) error: engine speed sensor (P0335, P0336, P0338) error: ambient temperature sensor (U0073) error: canister purge valve (P0496,P0497) error: engine coolant temperature sensor (P0116-P0119) error: canister ventilation valve (P0446) error: critical misfire rate (P0300-P0306) error: fuel level sensor (P0461-P0463, P2066-P2068)	<= 1,86 mph 0 ° >= -40.00 hPa <= 10.00 hPa >= 10.45 V <= 18.00 V closed loop inactive 11l ... 76l not set < 0.015 6 sec. < 0.03 > 400 sec not set not set not set not set not set not set not set not set	approx. 20 sec	once per trip	
Fuel Evaporative System (monitor after ignition off) tank leak smallest	P0442	Monitor fuel tank's pressure after engine stop and ignition off			Engine coolant temperature at start. engine coolant temp. at start - intake air temp.	<= 42°C <= 15°C	max. 4 trips for each trip max. 2900s	once per trip	1 trip

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
		Filter the normalized pressure from each trip with an EWMA filter. Compare filtered result with threshold. Pressure threshold for each trip For each trip following strategy: Look for maximum positive pressure. Abort if: - max. pos. pressure >= threshold. - max. pressure - current pressure >= threshold for a specific time. - pressure stays in range near zero for a specific time. - pressure <= threshold for a specific time (vacuum build-up instead of pressure build-up) - pressure-phase-time >= threshold. - diagnostic-time >= threshold Look for absolut maximum negative pressure	Filtered normalized pressure Absolute max. neg. pressure + Max. pos. pressure Max. pos. pressure max. pressure - current pressure absolute pressure pressure pressure phase time diagnostic time	> 0.5 > 0.4 if previous result detected a leak > 1.20 … 4.00 hPa > 1.20 … 4.00 hPa >= 0.05 hPa 100s 300s <= 0.69946 hPa <= -0.75 hPa 25s >= 2400.00 s >= 2900.00 s	ambient air temperature ambient air temperature engine has been running for a cal. min. time engine coolant temp. at engine stop ambient pressure driving distance (in current trip) covered driving distance (for vehicle lifetime) covered the fuel tank's level isn't at its minimum the fuel tank's level isn't at its maximum battery's voltage no refueling activity error: intake air temperature (P0111-P0114) error: canister purge valve (P0496,P0497) error: ambient pressure sensor (P2227-2229) error: vehicle speed sensor (P0501-P0503) error: engine coolant temperature sensor (P0116-P0119) error: tank pressure sensor (P0450-P0453) error: battery voltage error: air mass flow sensor (P0100 P0103) error: canister ventilation valve (P0446) error: tank leak rough (P0455)	>= 2°C <= 38°C >600sec >60°C >= 680hPa >= 6500m >= 20km 11l 76l >11V not set not set not set not set not set not set not set not set not set not set	continuous after engine stop and ignition off	

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
		Abort if:							
		- max. neg. pressure <= threshold	Abs . max. neg. pressure	> 1.20 … 4.00 hPa					
		- diagnostic time >= threshold	diagnostic time	>= 2900.00 s					
		- current pressure - neg. pressure >= threshold for a specific time	current pressure - neg. pressure	>= 0.05 hPa 100s					
		- pressure stays in ambient range for a specific time	absolute pressure	<= 0.69946 hPa 300s					
		- canister vent valve re-opened for a more than N times	no. canister vent valve openings	> 2					
		because the pressure exceeds a threshold	pressure	0.74951 hPa					
Secondary Air System	P0411	passive functional check	relative secondary air mass flow. Ratio from	< 0.45	catalyst heating *	active	max. 60s	once per trip	2 trips
			calculated secondary air mass by pressure sensor signal and secondary air mass model	> 1.2	secondary air system *	active			
					intake air temperature	> 0 °C			
					intake air temperature	< 80.3 °C			
Secondary Air Valve stuck open check	P2440	Look for pressure pulsations	Top peak of pulsation	> 30 hpa	engine coolant temperature	> 0 °C			
			Bottom peak of pulsation	< -30 hPa	engine coolant temperature	< 120 °C			
			Average of absolute value of pulsations	> 10 hPa	ambient pressure	> 680 hPa.			
					error: ambient pressure sensor (P2227-2229)	not set			
					error: intake air temperature (P0111-P0114)	not set			
					error: engine coolant temperature sensor (P0116-P0119)	not set			
					error: secondary air pump (power stage) (P0418, P2244,P2245)	not set			
					error: battery voltage	not set			
					mass airflow	> 6 kg/h			
					mass airflow	< 130 kg/h			
					change in air charge per working cycle	<= 7 %			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
Pressure sensor	P2432	cirtcuit continuity - low	measured sensor voltage	< 0,498 V			0.5 sec	continuous	2 trips
secondary air system	P2433	cirtcuit continuity - high or open	measured sensor voltage	> 4,501 V					
	P2431	rationality -	during ECU init-	< -50 hPa	error: ambient pressure sensor (P2227-2229)	not set			
		comparisson between:	difference SAI pressure vs BARO pressure	> 50 hPa	secondary air system *	active			
		SAI system pressure signal & Barometric pressure signal							
Fuel System Rich/Lean							35 sec.	continuous	2 trips
					general enable contitions:				with: 0.4 sec continuous or 4 sec cum
Multiplicative and Additive					fuel system status	closed loop			
					for time	>2,6 sec.			
					engine coolant temperature	>60.8°C			
					canister vent valve closed	TRUE			
					intake air temperature	<=65.3°C			
					lambda setpoint	0.98 < x < 1.02			
					error: camshaft control *	not set			
					error: reference mark sensor (P0335,P0336,P0338)	not set			
					error: throttle position sensor (P0121-P0123,P0221-P0223)	not set			
					error: engine coolant temperature sensor (P0116-P0119)	not set			
					error: power supply voltage	not set			
					error: power stage throttle actuator (P0221-P0223)	not set			
					error: intake air temperature (P0111-P0114)	not set			
					error: power stage canister purge valve (P0443, P0458, P0459)	not set			
					error: multiple misfire (P0300-P0306)	not set			
					error: lambda sensor upstream catalyst (P0130-P0134)	not set			
					error: lambda sensor heating upstream catalyst (P0134,P0135)	not set			
					error: canister purge system *	not set			
					special enable contitions				

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
	P2177	fuel trim limits exceedes range multiplicative	delta lambda correction	>1.175factor	indicated torque	> 17% … 11% < 37% .. 46%			
	P2178	fuel trim limits exceedes range multiplicative	or delta lambda correction	<0.825factor	engine speed	>= 1080 rpm <= 3000rpm			
	P2187	system too lean at idle	delta fuel load correction	>5.25%	indicated torque	> 4.8% < 17.3% … 11%			
	P2188	system too rich at idle	or delta fuel load correction	<-5.25%	engine speed	>= 520rpm <= 960rpm			
Diagnosis of Power Control Module					**general enabling conditions**		0.6 sec	continuous	2 trips
					battery voltage	< 17.9 V > 10 V			
					locking request immobilizer	not avtive			
					special enabling condition				
	P0629	diagnosis short circuit to battery voltage	backward powerstage voltage of fuel pump diagnosis for a time and backward powerstage voltage of fuel pump diagnosis	> 2.21 V 0.1 sec. >=- 2.74 V	fuel pump relay commanded "OFF"	TRUE			
	P0628	diagnosis short circiut to ground only active if powerstage on	backward powerstage voltage of fuel pump diagnosis for a time	<= 2.21 V > 0.5 sec.	fuel pump relay commanded "ON"	TRUE			
	P0627	diagnosis wire interruption	backward powerstage voltage of fuel pump diagnosis and max-error: powerstage diagnosis set	> 2.74 V FALSE	condition output duty cycle PCM for power on diagnosis fuel pump relays commanded "OFF"	TRUE TRUE			
	P0627	powerstage locked	condition fault message of PCM powerstage is locked	TRUE					
Oxygen sensor (primary O2) bank 1 sensor 1									

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
	P0131	short circuit to ground	primary sensor voltage	< 0.06 V	engine coolant temperature	< 39.8 °C	0.1 sec.	Monitor runs	2 trips
		for a cold sensor			engine stop temperature last driving cycle	> 60 °C		whenever enable	with: 0.4 sec
					dew point exeeded at primary O2 sensor *	TRUE		conditions are met	continuous
					primary sensor heating active *	TRUE			or 4 sec cum
					heating power primary O2 sensor	> 80 %			
					for more than	10 sec.			
					engine speed	> 680 rpm			
					battery voltage	> 10.5 V			
	P0131	short circuit to ground	primary sensor voltage	< 0.06 V	secondary O2 sensor voltage	> 0.5 V	10 sec.	Monitor runs	2 trips
		for a warm sensor			fuel system status (primary O2 sensor)	closed loop		whenever enable	with: 0.4 sec
					secundary air system *	inactive		conditions are met	continuous
					error: secondary air system (P0411,P0418,P2244,P2245, P2431-P2433)	not set			or 4 sec cum
					Fuel evaporative system monitoring (during engine run)	inactive			
					air passed at primary O2 sensor	2200g			
					dew point exeeded at primary O2 sensor *	TRUE			
					primary sensor heating active *	TRUE			
					heating power primary O2 sensor	> 80 %			
					for more than	10 sec.			
					engine speed	> 680 rpm			
					battery voltage	> 10.5 V			
bank 1 sensor 1	P0132	short circuit to battery voltage	primary O2 sensor voltage	>1.08V	dew point exeeded at primary O2 sensor *	TRUE	5 sec.	Monitor runs	2 trips
					primary sensor heating active *	TRUE		whenever enable	with: 0.4 sec
					heating power primary O2 sensor	> 80 %		conditions are met	continuous
					for more than	10 sec.			or 4 sec cum
					desired A/F ratio	> 0.995			
					engine speed	> 680 rpm			
					battery voltage	> 10.5 V			
bank 1 sensor 1	P0134	open circuit signal or ground line	when modelled exhaust gas temperature		battery voltage	> 10.5 V	9 sec.	Monitor runs	2 trips

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
		primary O2 sensor	at primary O2 sensor	< 800 °C	dew point exeeded at primary O2 sensor *	TRUE		whenever enable	with: 0.4 sec
			primary O2 sensor voltage in a range	0.4 … 0.6 V	for more than	30 sec.		conditions are met	continuous
					air passed at primary O2 sensor	2200g			or 4 sec cum
					for more than	10 sec.			
			when modelled exhaust gas temperature		engine running	> 680 rpm			
			at primary O2 sensor	> 800 °C					
			primary O2 sensor voltage in a range	0.4 … 0.55 V					
bank 1 sensor 1	P0134	open circuit signal or ground line	internal resistance of the				0.1 sec.	Monitor runs	2 trips
		primary O2 sensor	primary O2 sensor	> 20.000 Ohms	battery voltage	> 10.5 V		whenever enable	with: 0.4 sec
					dew point exeeded at primary O2 sensor *	TRUE		conditions are met	continuous
					for more than	30 sec.			or 4 sec cum
					air passed at primary O2 sensor	2200g			
					for more than	10 sec.			
					engine running	> 680 rpm			
					modelled exhaust gas temperature	> 600 °C			
bank 1 sensor 1	P0130	heater coupling to the signal	primary O2 sensor voltage in range of	0.06 … 0.4 V	battery voltage	> 10.5 V	10 sec.	Monitor runs	2 trips
		primary O2 sensor			dew point exeeded at primary O2 sensor *	TRUE		whenever enable	with: 0.4 sec
					for more than	30 sec.		conditions are met	continuous
					air passed at primary O2 sensor	2200g			or 4 sec cum
					for more than	10 sec.			
					engine running	> 680 rpm			
					fuel system status (primary O2 sensor)	closed loop			
					secundary air system *	inactive			
					error: secondary air system (P0411,P0418,P2244,P2245, P2431-P2433)	not set			
					Fuel evaporative system monitoring (during engine run)	inactive			
					secondary O2 sensor voltage	> 0.5 V			
					air passed at primary O2 sensor	2200g			
	P0130	heater coupling to the signal	primary O2 sensor voltage in range of	0.6 … 1.08 V	battery voltage	> 10.5 V	10 sec.	Monitor runs	2 trips
		primary O2 sensor			dew point exeeded at primary O2 sensor *	TRUE		whenever enable	with: 0.4 sec

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
					for more than	30 sec.		conditions are met	continuous
					air passed at primary O2 sensor	2200g			or 4 sec cum
					for more than	10 sec.			
					engine running	> 680 rpm			
					fuel system status (primary O2 sensor)	closed loop			
					secondary O2 sensor voltage	< 0.1 V			
	P0130	heater coupling to the signal	primary O2 sensor voltage	> 2.0 V	dew point exeeded at primary O2 sensor *	TRUE	25 sec.	Monitor runs	2 trips
		primary O2 sensor	within time after heater turn on	<0.04sec	for more than	10 sec.		whenever enable	with: 0.4 sec
			for occurrences	> 4	heating power primary O2 sensor	> 80 %		conditions are met	continuous
			out of heater turn ons	= 6	for more than	10 sec.			or 4 sec cum
					engine running	> 680 rpm			
					battery voltage	> 10.5 V			
Oxgen sensor (primary O2) bank 1 sensor 1	P0133	dynamic response	time of lambda period		fuel system status (primary O2 sensor)	closed loop	10 lambda period	Monitor runs	2 trips
		slow or low amplitude	corrected and weighted over		lambda controller	0.95 - 1.05	measure ments	whenever enable	with: 0.4 sec
			engine speed and load	> 3 sec.	engine speed in a range of	1000 … 3000 rpm		conditions are met	continuous
					engine load in a range of	18 … 79.5 %			or 4 sec cum
					modelled exhaust gas temperature	> 300 °C			
					purge not longer active than	4 sec.			
					secondary air system *	inactive			
					error: fuel system trim rich or lean (P2177,P2178,P2187,P2188)	not set			
					Fuel evaporative system monitoring (during engine run)	inactive			
					Adaption of purge mass	< 25			
					error: camshaft system *	not set			
Oxgen sensor (primary O2) bank 1 sensor 1	P2097	offset check enrichment	adaption value		fuel system status (secondary O2 sensor)	closed loop	60 sec.	Monitor runs	2 trips
			closed loop secondary lambda control	> 0.79 sec.	secondary air system *	inactive		whenever enable	with: 0.4 sec
			after an acummulated monitoring time of	> 60 sec.				conditions are met	continuous
					error: fuel system trim rich or lean (P2177,P2178,P2187,P2188)	not set			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
					Fuel evaporative system monitoring (during engine run)	inactive			or 4 sec cum
					Adaption of purge mass	< 25			
					error: camshaft system *	not set			
	P2096	offset check enleanment	adaption value		fuel system status (secondary O2 sensor)	closed loop			
			closed loop secondary lambda control	< - 0.79 sec.	secondary air system *	inactive			
			after an acummulated monitoring time of	> 60 sec.					
					error: fuel system trim rich or lean (P2177,P2178,P2187,P2188)	not set			
					Fuel evaporative system monitoring (during engine run)	inactive			
					Adaption of purge mass	< 25			
					error: camshaft system *	not set			
Oxygen Sensor Heating heater performance (primary O2) bank 1 sensor 1 (primary)	P0135	primary O2 sensor	measured primary O2 sensor internal		battery voltage	>10.5V	6 sec	continuous	2 trips
		internal resistance	resistance		battery voltage	<18V			with: 0.4 sec
		above threshold	nominal internal resistance	>88 . . . 328Ohms KFRINH	engine running	> 680 rpm			continuous
			multipy times degradation factor	>3 . . . 20factor FRINH	fuel system status	no fuel cut			or 4 sec cum
					dew point exeeded at primary O2 sensor	TRUE			
			for time	>6sec	intake air temperature	>-30°C			
					engine off soak time	>120sec			
					modeled exhaust temp. at primary O2 sensor	in range 300 . . . 550C			
					error: primary O2 sensor electrical (P0130-P0134)	not set			
Oxygen Sensor sensor circuit (secondary O2) bank 1 sensor 2	P0137	short circuit to ground	secondary O2 sensor voltage	<0.06V	secondary O2 heated	> 10sec	40 sec.	Monitor runs whenever enable conditions are met	2 trips
			with a demandet lambda value	<= 1.005	and mod. exhaust gas temp. (dew point exceeded)	>250° C			with: 0.4 sec
					for time	>90sec			continuous
					engine running	> 680 rpm			or 4 sec cum

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
					battery voltage	>10.7V			
					mod. exhaust-gas temp.	<800° C			
					engine temp at stop	>60° C			
					engine coolant temperature	<40° C			
					error: engine coolant temperature sensor (P0116-P0119)	not set			
bank 1 sensor 2	P0138	short circuit to battery voltage	secondary O2 sensor voltage >	>1.08V	secondary O2 heated	> 10sec	5 sec	Monitor runs	2 trips
					and mod. exhaust gas temp. (dew point exceeded)	>250° C		whenever enable	with: 0.4 sec
					for time	>90sec		conditions are met	continuous
					engine running	> 680 rpm			or 4 sec cum
					battery voltage	>10.7V			
					mod. exhaust-gas temp.	<800° C			
bank 1 sensor 2	P0140	sensor line disconnection		>0.401V	secondary O2 heated	> 10sec	max 150 sec	Monitor runs	2 trips
			secondary O2 sensor voltage	<0.499V	and mod. exhaust gas temp. (dew point exceeded)	>250° C		whenever enable	with: 0.4 sec
			and secondary O2 sensor voltage		for time	>90sec		conditions are met	continuous
			or		engine running	> 680 rpm			or 4 sec cum
			secondary O2 sensor internal resistance	>40000Ohm	battery voltage	>10.7V			
			when modeled exhaust gas temperature	>600° C	mod. exhaust-gas temp.	<800° C			
bank 1 sensor 2	P2232	sensor line short circuit	secondary O2 sensor	> 2 V	dew point exeeded at primary O2 sensor *	TRUE	10 sec	Monitor runs	2 trips
		to heater output line	within time after heater turn on	<0.04sec	for more than	20 sec.		whenever enable	with: 0.4 sec
			for occurrences	>4count	heating power primary O2 sensor	> 50 %		conditions are met	continuous
			out of heater turn offs	=6count	for more than	20 sec.			or 4 sec cum
					engine running	> 680 rpm			
					battery voltage	> 10.5 V			
Oxygen Sensor Heating	P0141	secondary O2 sensor	measured secondary O2 sensor internal		battery voltage	>10.7V	6 sec	Monitor runs	2 trips
heater performance (secondary O2)		internal resistance	resistance		battery voltage	<18V		whenever enable	with: 0.4 sec
bank 1 sensor 2 (secondary)		above threshold	nominal internal resistance	>120 . . . 560Ohms	engine running	> 680 rpm		conditions are met	continuous

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
				KFRINH	fuel system status	no fuel cut			or 4 sec cum
			multipy times degradation factor	>3 . . . 30factor	dew point exeeded at secondary O2 sensor *	TRUE			
				FRINH	intake air temperature	>-30°C			
			for time	>6sec	engine off soak time	>150sec			
					modeled exhaust temp. at secondary O2 sensor	350 . . . 550C			
					error: secondary O2 sensor electrical (P0137,P0138,P0140,P2232)	not set			
sensor response bank 1 sensor 2	P2270	oscillation check low	secondary O2 sensor voltage	>0.602 . . . 0.621V	dew point exeeded at secondary O2 sensor *	TRUE	max.	Monitor runs	2 trips
			for time	> 0.2 sec	for time	>10sec	600 sec	whenever enable	with: 0.4 sec
			then		fuel system status (secondary O2 sensor)	closed loop		conditions are met	continuous
			ramping in enrichment by	= 0.15 lambda	all injectors activated	> 0.8 ms			or 4 sec cum
			at gradient	0.0488 l / sec	engine air flow (intrusive test)	>5,56 g/sec			
			for time (after enrichment limit reached)	>7 sec	and engine air flow	<41,6 g/sec			
					for time	>3sec			
					engine air flow (passive monitor)	>7,78 g/sec			
					error: secondary O2 sensor electrical (P0137,P0138,P0140,P2232)	not set			
					lambda controller	0.92 ... 1.07			
					engine running	> 680 rpm			
					battery voltage	>10.7V			
bank 1 sensor 2	P2271	oscillation check high	secondary O2 sensor voltage	>0.602 . . . 0.621V	dew point exeeded at secondary O2 sensor *	TRUE	max.	Monitor runs	2 trips
			for time	> 0.2 sec	for time	>10sec	600 sec	whenever enable	with: 0.4 sec
			then		fuel system status (secondary O2 sensor)	closed loop		conditions are met	continuous
			ramping in enleanment by	=0.10lambda	all injectors activated	> 0.8 ms			or 4 sec cum
			at gradient	0.0488 l / sec	engine air flow (intrusive test)	>5,56 g/sec			
			for time (after enleanment limit reached)	>7 sec	and engine air flow	<41,6 g/sec			
					for time	>3sec			
					engine air flow (passive monitor)	>7,78 g/sec			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
					error: secondary O2 sensor electrical (P0137,P0138,P0140,P2232)	not set			
					lambda controller	0.92 … 1.07			
					engine running	> 680 rpm			
					battery voltage	>10.7V			
bank 1 sensor 2	P2271	fuel cut off check high	secondary O2 sensor voltage	>0.149V	dew point exeeded at secondary O2 sensor *	TRUE	0.2 sec	Monitor runs	2 trips
			time after fuel cut off	>6,2sec	for time	>30sec		whenever enable	with: 0.4 sec
					air passed after fuel cut off	>15g		conditions are met	continuous
					modeled exhaust temp	>350° C			or 4 sec cum
					at secondary O2 sensor				
					dew point exeeded at primary O2 sensor *	TRUE			
					primary O2 sensor voltage	< 0.149 V			
					error: cam sensor *	not set			
					error: evap canister purge sys. *	not set			
					error: evap purge valve electrical (P0443, P0458, P0459)	not set			
					error: battery voltage	not set			
bank 1 sensor 2	P013A	fuel cut off check transient time	secondary O2 sensor time	> 0.15 sec	air passed after fuel cut off	< 3 g	0.15 sec	Monitor runs	1 trip
			for voltage drop from	0.4 V	bank 1 sensor 2 voltage	> 0,5 V		whenever enable	with: 0.4 sec
			to	0.2 V	for time	> 1 sec		conditions are met	continuous
					at fuel cut off				or 4 sec cum
					dew point exeeded at secondary O2 sensor *	TRUE			
					dew point exeeded at primary O2 sensor *	TRUE			
					modeled exhaust temp	> 450° C			
					air flow over catalyst	> 4.17 g/sec			
					engine speed				
					in range	1100 - 3300 rpm			
					engine load				
					in range	10 - 30 %			
					battery voltage	> 11,0V			
bank 1 sensor 2	P013E	fuel cut off check response time	secondary O2 sensor voltage	> 0.152 V	air passed after fuel cut off	< 3 g	5 sec	Monitor runs	1 trip

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
			time after fuel cut off	> 5 sec.	bank 1 sensor 2 voltage	> 0,5 V		whenever enable	with: 0.4 sec
					for time	> 1 sec		conditions are met	continuous
					at fuel cut off				or 4 sec cum
					dew point exeeded at secondary O2 sensor *	TRUE			
					dew point exeeded at primary O2 sensor *	TRUE			
					modeled exhaust temp	> 450° C			
					air flow over catalyst	> 4.17 g/sec			
					engine speed				
					in range	1100 - 3300 rpm			
					engine load				
					in range	10 - 30 %			
					battery voltage	> 11,0V			
Camshaft Control System - Locking Pin									2 trips
Bank 1 Intake	P0011	rationality high	average of actual angle measurements	> +/- 10degrees	engine speed	>560rpm	10 sec	0.01 sec	with: 0.4 sec
Bank 2 Intake	P0021		versus locked position angle		engine run time	< 1 sec.			continuous
Bank 1 Exhaust	P0014				camshaft control circuit test	complete			or 4 sec cum
Bank 2 Exhaust	P0024				error: camshaft control circuit *	not set			
System - Control		rationality low / high	difference to start test (filtered actual	> 6 . . . 11 degrees	engine speed	>560rpm	approx.	0.01 sec	2 trips
Bank 1 Intake	P000A		angle versus filtered desired angle)		engine run time	> 1sec	20 … 80 sec	continuous	with: 0.4 sec
Bank 2 Intake	P000C		(desired must remain above value		camshaft control circuit test	complete	depending on drive pattern		continuous
Bank 1 Exhaust	P000B		to test to complete the evaluation)		error: camshaft control circuit *	not set			or 4 sec cum
Bank 2 Exhaust	P000D		filtered actual angle remains	<	coolant temperature	< 143° C			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
			filtered desired angle from test start		coolant temperature	>-48° C			
			within time	= 1.5 … 2 sec (exhaust)	engine oil temperature	< 180° C			
			(detects 5 sec slow [time constant])	= 1.2 … 2 sec (intake)	engine oil temperature	>-48° C			
					cam-crank alignment adaptation	complete			
			for multiple activation occurrences	>7 counts (exhaust)	catalyst heating *	inactive			
			(decrements upon activations where	>8 counts (intake)					
			no difference is seen between desired and actual)						
			difference (filtered actual angle max versus actual at test start)	>1.8 degrees					
			(to detect slow response versus stuck cam if above this limit)						
			at time	=4sec					
			(overlaps with time to detect above)						
			(passes after multiple good activations in both cam phase rotation directions)						
System Control CSERS									
Bank 1 Intake	P052B		differnce between desired and		engine speed	>560rpm	10 sec	0.01 sec continuous	2 trips with: 0.4 sec
Bank 2 Intake	P052D		actual camshaft angle	> 0°	engine run time	>1sec			
Bank 1 Exhaust	P054B		for time		camshaft control circuit test	complete			continuous
Bank 2 Exhaust	P054D				error: camshaft control circuit *	not set			or 4 sec cum
					coolant temperature	< 143° C			
					coolant temperature	>-48° C			
					engine oil temperature	< 180° C			
					engine oil temperature	>-48° C			
					cam-crank alignment adaptation	complete			
					catalyst heating *	active			
System - Cam - Crank Alignment									

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
Bank 1 Intake	P0016	cam-crank adapted angle	adapted angle	> 10.8 degrees	engine run time >	>2sec	approx.	0.2 sec	2 trips
Bank 2 Intake	P0018	limit chekc	or adapted angle	< -12.7 degrees	offset between camshaft and crankshaft	< 1 °	600 sec	continuous	with: 0.4 sec
Bank 1 Exhaust	P0017	(applies for each camshaft)	or actual angle with parked cams	> 15 degrees	error: camshaft sensor (P0011,P021,P014,P024,P000A-P000D)	not set			continuous
Bank 2 Exhaust	P0019		and	< 21 degrees	error: camshaft control circuit *	not set	fail after		or 4 sec cum
			for a time	> 10 sec.			2 adaptation cycles - required		
Bank 1 / Idler Sprocket	P0008		adapted angle for both cams	> 6.7 degrees					
Bank 2 / Idler Sprocket	P0009		adapted angle for both cams	< -7.9 degrees					
Engine coolant	P0117	range check high	coolant temperature	>142.5°C	intake air temperature	< 75°C	0.1 sec	continous	2 trips
temperature sensor					difference between intake air temp and intake air temp. at engine shut down last driving cycle	< 20…9°C			with: 0.4 sec continuous
	P0118	range check low	coolant temperature	<-38.3° C	error: engine coolant temperature sensor (P0116-P0119)	not set			or 4 sec cum
					or time after engine start	>=60sec			
	P0116	plausibility check (low side check)	calculated coolant temperature model		error: engine coolant temperature sensor (P0116-P0119)	not set	3 sec.	once per trip	2 trips
			minus measured temperature	>9.8° C	measured coolant temperature	<93.8° C			with: 0.4 sec
					engine speed	>1000rpm			continuous
					integrated air mass	>1500g			or 4 sec cum
		plausibility check (high side check)	measured temperature	>9.8°C	error: engine speed sensor (P0335, P0336, P0338)	not set			
			minus calculated coolant temperature model		error: air mass flow sensor (P0100 P0103)	not set			
					error: engine coolant temperature sensor (P0116-P0119)	not set			
	P0119	intermittent (discontinuity)	delta coolant temperature	< -10°C	ignition	=ON	0,03 sec.	continuous	2 trips
			or delta coolant temperature	> 10°C					with: 0.4 sec continuous

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
			(between A/D read sample count offset)	=3count					or 4 sec cum
	P050C	difference from intake air temperature after soaking	filtered difference (ECT at key on - IAT at key on)	>10°C	time after engine start	>= 5 sec	0.1 sec.	continuous	1 trip with: 0.4 sec
					previous accumulated air mass	>4000g			
					previous engine run time	>500sec			continuous
			or		ECT at shut down	>84.75° C			or 4 sec cum
			filtered difference (ECT at key on - IAT at key on)	<-10° C	coolant temp. calculated out of model	<=50.3°C			
					engine off time	>21600sec			
					error: intake air temperature (P0111-P0114)	not set			
					error: range check coolant temperature sensor (P0117.P0118)	not set			
					Block Heater	not detected			
Engine Coolant Thermostat Monitoring	P0128	Coolant Temperature Below Thermostat Regulating Temperature (plausibility check)	calculated coolant temp model minus measured coolant temperature	>5.3° C	debouncing time	>10 sec	approx.	once per trip	2 trips
					error: coolant temperature sensor (P0116-P0119,P050C)	not set	900 sec		with: 0.4 sec
					error: vehicle speed sensor (P0501-P0503)	not set			continuous
			model calculation limit	82°C	est. ambient temperature	> -8.3°C			or 4 sec cum
					est. ambient temperature	<50°C			
					vehicle speed	>=3.125mph			
			Thermostat regulating temperature: 82°C		engine speed	>960rpm			
			(All critical OBD and emission functions are enabled		coolant temperature at start	< 51.0°C			
					integrated air mass flow	>3458g			
			above 64°C.)		time after start to run the model (depending on engine coolant temp at start)	>= 22…16°C			
Engine coolant overtemperature Protection mode	P1258		coolant temperature	> 132.8 °C	error: engine coolant temp (P0116-P0119)	not set	1 sec.	continuous	1 trip
			for a time	> 1 sec.	engine speed	> 80 rpm			
					for a time	> 30 sec.			
Intake air temperature sensor	P0111	response check	difference: max intake air temperature - min intake air temperature	>1,5° C	DRIVE PERIOD - COUNT EACH WITH:		5 x 9 sec.	Monitor runs whenever enable	2 trips with: 0.4 sec

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
					vehicle speed	>=24,8mph		conditions are met	continuous
					mass flow	<250g / sec			or 4 sec cum
					mass flow	>15,6 g/sec			
					coolant temperature at start	<=120° C			
					no fuel shut-off				
					AND				
					IDLE PERIOD - COUNT		5 x 11 sec.		
					vehicle speed	<=1.55mph			
					coolant temperature at start	<=120° C			
					coolant temperature	>75° C			
					integrated air mass increases	> 5200 . . . 15400 g			
	P0111	Difference from coolant temperature sensor	difference: intake air temperature - engine	>+35,3°C	engine temperaure at start	<35,3°C	300 sec. after start	once per trip	2 trips
			coolant temperature	or	coolcant temperature decrease since		(block heater delay)		with: 0.4 sec
				<-20,3°C	engine stall	> 39,8°C			continuous
					minimum coolant temperature				or 4 sec cum
					at engine stall last trip	>80°C			
	P0112	range check low	intake air temperature	>124,9° C	time after start	> 15sec	0.1 sec.	once per trip	2 trips
	P0113	range check high	intake air temperature	<-34,9° C	then time in idle	>3sec			with: 0.4 sec
					and intake air temperature	<-35.3° C			continuous
					then | IAT change | (abs value)	<=2.3° C			or 4 sec cum
					while				
					integrated air mass increases	>=0g			
	P0114	out of range check (Jump check)	difference: sensor signal - low pass filtered sensor signal	> + / - 0.55 V	IGNITION	=ON	5 sec.	continous	2 trips
			for a time	> 5 sec.					
Mass air flow sensor	P0101	plausibility check low	mass air flow	<0 . . . 190g/sec	**general enabling conditions**		2 sec	Monitor runs whenever enable conditions are met	2 trips
		plausibility check high	mass air flow	>7 . . . 390 g/sec	battery voltage	>10.5V			with: 0.4 sec
					time after start	>0.3sec			continuous

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
					crankshaft revolution counter	>150rev		or 4 sec cum
					error: throttle position sensor (P0121-P0123,P0221-P0223)	not set		
					error: intake air temperature (P0111-P0114)	not set		
					error: preassure sensor in front of throttle plate (P236-P238)	not set		
					error: camshaft control *	not set		
					error: power stage throttle actuator (P2100-P2103)	not set		
					error: ambient prassure (P2227-P2229)	not set		
					error: electrical failure air flow sensor (P100,P102,P103)	not set		
					error: canister purge valve (P0443,P0458,P0459,P0496,P0497)	not set		
		or	or					
		fuel trim exceeded a max range limit (multiplicative)	delta lambda correction (1 - fuel trim factor)	>0.12				
		and	and		**special enabling conditions**			
		correction factor (ratio modeled air mass at throttle	correction factor air mass	<0.85	multiplicative fuel trim adaption integrator deviation	< 0.015		
		to air mass measured by air mass flow meter)			for time	6 sec.		
		or	or		lambda controller deviation	< 0.03		
		fuel trim exceeded a min range limit (multiplicative)	delta lambda correction (1 - fuel trim factor)	<-0.12	ratio: manifold pressure to pressure in front of throttle	< 1		
		and	and		time after start	>1 sec		
		correction factor (ratio modeled air mass at throttle to air mass measured by air mass flow meter)	correction factor air mass	>1,15	coolant temperature	>9°C		
	P0101	PCV detection in front of TC	2nd correction factor air mass	< 0.869	**special enabling conditions**			
		correction factor (ratio modeled air mass at throttle to air mass measured by air mass flow meter)	(higher load - boost)		multiplicative fuel trim adaption integrator deviation	< 0.015		
					for time	6 sec.		
					lambda controller deviation	< 0.03		
					ratio: manifold pressure to pressure in front of throttle	< 1		
					time after start	>1 sec		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
					coolant temperature	>9°C			
					throttle position	> 30%			
					throttle position	< 41%			
	P0100	circuit check (short circuit)	duty cylce	0	battery voltage	>7.5V	0.2 sec	continous	2 trips
					key on	> 0.2 sec			with: 0.4 sec
	P0102	circiut check (unsound contact with high frequency)	duty cylce	<32us					continuous
									or 4 sec cum
	P0103	circiut check (unsound contact with low frequency)	duty cylce	>910us					
pressure sensor upstream throttle valve	P0238	cirtcuit continuity - high or open	measured sensor voltage	> 4.65 V	engine speed	> 25 rpm	0.5 sec	continuous	2 trips
	P0237	cirtcuit continuity - low	measured sensor voltage	< 0.45 V					
	P0238	range check - high	measured pressure	> 300 kPa			2 sec		
	P0237	range check - low	measured pressure	< 50 kPa					
	P0236	rationality high -	diefference measured press. (incl. tolerance)	> 0 hPa	engine speed	< 1120 rpm	6 sec	Monitor runs	2 trips
		comparsion between measured pressure and	minus		throttle position	< 10%		whenever enable	
		measured ambient pressure	measured ambient pressure (inc. tolerance)		error: ambient pressure sensor (rationality) (P2227-P2229)	not set		conditions are met	
					error: ambient pressure sensor (electrical) (P2228,P2229)	not set			
					error: pressure sensor upstream throttle plate (electrical) (P0237,P0238)	not set			
					error: throttle position sensor (P0121-P0123,P0221-P0223)	not set			
		rationality low -	diefference measured press. (incl. tolerance)	< 0hPa					
		comparsion between measured pressure and	minus						
		measured ambient pressure	measured ambient pressure (inc. tolerance)						

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
Boost pressure control	P0299	comparison between desired boost pressure and current boost pressure	difference (positive) between set-point boost pressure and measured boost pressure	27kPa	boost pressure control engine speed atmospheric pressure error: boost pressure sensor(P0236/P0237/P0238) error: throttle control unit (P0121-P0123,P0221-P0223,P2100-P2103) error: air mass flow sensor (P0100 P0103) difference between desired boost pressure - pressure before throttle (ambient pressure minus pressure loss of intake)	active > 2120 … 3720 rpm > 66 kPa not set not set not set > 0	6 sec	continuous	2 trips
			(boost pressure too low)						
	P0234	comparison between desired boost pressure and current boost pressure	difference (negative) between set-point boost pressure and measured boost pressure	> 22 kPa to 146.6 kPa	error: boost pressure sensor(P0236/P0237/P0238)	not set	1.2 s	continuous	2 trips
			or						
		max check	measured boost pressure	> 220 …. 250 kPa	intake air temperature	< +30°C	0,15 s	continuous	2 trips
			(boost pressure too high)						

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
Dump valve	P2261	counting of increased pulsation	normalized difference between	>0,5	intake air temperature	> 15 °C	0.48 sec	Monitor runs	2 trips
		in the intake manifold	measured MAF sensor value and		error: intake air temperature (P0111-P0114)	not set		whenever enable	
			modeled value		error: air mass flow sensor (P0101)	not set		conditions are met	
		(increased pulsation may occure							
		when dump valve is jammed	for		conditions for an active supervision phase are				
		in closed position)	number of times	> 9 counts	Rel. load gradient	< 0%			
					- ratio of pressure in front of	> 1.05			
					throttle valve to minimum	to			
					pressure after air filter	3.12			
					- dump valve is active	TRUE			
Barometric Pressure Sensor	P2227	rationality	diefference measured press. (incl. tolerance)	> 0 hPa	error: pressure sensor in front of throttle (P0236-P0238)	not set	9 sec	Monitor runs	2 trips
(ambient air pressure sensor		signal discontinuity			error: ambient pressure sensor (electrical) (P2228, P2229)	not set		whenever enable	with: 0.4 sec
			minus pressure in front of throttle (inc. tolerance)		throttle angle	< 10%		conditions are met	continuous
			or		engine speed	< 1120rpm			or 4 sec cum
			diefference measured press. (incl. tolerance)	< 0hPa					
			minus pressure in front of throttle (inc. tolerance)						
			barometric pressure jump in a curtain time	> 5kPa	difference at start: actual pressure to prassure at last key off	> 10kPa	20 sec	Monitor runs	2 trips
				< 5kPa	error: air mass flow sensor (P0100 P0103)	not set		whenever enable	with: 0.4 sec
					error: intake air temperature (P0111-P0114)	not set		conditions are met	continuous
					error: pressure sensor upstream throttle (P0236-P0238)	not set			or 4 sec cum
					error: throttle position sensor (P0121-P0123,P0221-P0223)	not set			
					error: ambient pressure sensor (electrical) (P2228, P2229)	not set			
	P2228	range check low	sensor signal	<45kPa	key on	> 0.2 sec	2 sec	continous	2 trips

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
			sensor voltage	< 0.2V			0.5 sec		with: 0.4 sec continuous
	P2229	range check high	sensor signal sensor voltage	>115kPa >4,8V	key on	> 0.2 sec			or 4 sec cum
Idle Speed System (disabled during cold start)	P0506	functional check	desired rpm - actual rpm	>100rpm	load (for underspeed only)	<39.75%	10 sec	Monitor runs	2 trips
			and idle speed controler limit reached		coolant temp.	>-11.25° C		whenever enable	with: 0.4 sec
	P0507		desired rpm - actual rpm	<-200rpm	intake air temp	>-11.25° C		conditions are met	continuous
			and idle speed controler limit reached		engine speed	at idle			or 4 sec cum
			or		altitude factor (sea level = 1.0)	>0.703factor			
			fuel cut off due to overspeed during this idle	>3count	time after engine start cat heating *	> 4 sec. inactive			
					intrusive evap test	not active			
					vehicle speed	= 0 km/h			
					engine speed	> 680 rpm			
					error: throttle control unit (P0121-P0123,P0221-P0223,P2100-P2103)	not set			
					error: crankshaft sensor (P0335, P0336, P0338)	not set			
Idle Speed System (enabled during cold start)	P050A	functional check	desired rpm - actual rpm	>100rpm	load (for underspeed only)	<39.75%	5 sec	Monitor runs	2 trips
			during catalyst heating on		Engine coolant start temp.	< 69°C		whenever enable	with: 0.4 sec
	P050A		desired rpm - actual rpm	<-200rpm	engine speed	at idle		conditions are met	continuous
			during catalyst heating on		altitude factor (sea level = 1.0)	>0.703factor			or 4 sec cum
					time after engine start	> 100sec.			
					cat heating active *	TRUE			
					intrusive evap test	not active			
					vehicle speed	= 0 km/h			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
					engine speed	> 680 rpm			
					error: throttle control unit (P0121-P0123,P0221-P0223,P2100-P2103)	not set			
					error: crankshaft sensor (P0335, P0336, P0338)	not set			
Vehicle speed sensor	P0503	rationality	vehicle speed	> 170.87mph			0.4 sec	continous	2 trips
		(high range check)	for time	> 0.2 sec.			continuous or 4 sec		with: 0.4 sec continuous
	P0501	rationality	vehicle speed minus	=0mph	vehicle speed	> 6.213 mph	cumulative		or 4 sec cum
		(stuck check)	previous vehicle speed		vehicle speed	< 317.51 mph			
					time	>10sec			
	P0501	CAN wheel speed message check	CAN wheel speed message corrupt	=corrupt					
			or missing	=missing					
	P0501	plausibility check	vehicle speed	< 3.107 mph	Fuel system status	Fuel cut		Monitor runs whenever enable conditions are met	
		during fuel cut off	engine speed	3000 - 1400 rpm	coolant temperature	> 64.5 °C			
			for a time	> 4 sec.					
	P0501	plausibility check	vehicle speed	< 2.485 mph	coolant temperature	> 64.5 °C			
			engine load	> 80.3 %	all injectors active	> 0,8 ms			
			for a time	> 4 sec.	engine speed	> 3520 rpm			
Crankshaft Position Sensor	P0335	circuit continuity	no engine signal	=0rpm	camshaft revolutions detected	>12counts	approx.	0.01 sec	1 trip
			but phase signals available				5 sec	continuous	with: 0.4 sec continuous
		rationality check	reference gap missing (sensor signal but no reference)	>=6gaps	engine speed signal detected	> 1 rev			or 4 sec cum
	P0336	rationality check	unexpected re-synchronization (loss of reference mark)	>6count					

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
		rationality check	intermittent loss of engine speed signal	> 10 count					
	P0338	rationality check	difference in counted teeth between reference gap position events	>8teeth			approx. 2 sec	1 per rev continuous	1 trip 0.4 s cont. or 4 s cum.
Camshaft Position Sensor									
Bank 1 Intake	P0342	circuit low	differenece between 2 workingcycles	< 1 teeth	engine in synchronized mode	TRUE	10 revolutions	1 per rev continuous	2 trips
			depending on engine speed	> 8 - 72 count					
	P0343	circuit continuity or high	differenece between 2 workingcycles	> 1 teeth					
			depending on engine speed	> 8 - 72 count					
	P0341	plausibility check	differenece between 2 workingcycles	> 1 or < 1 teeth					
			depending on engine speed	> 8 - 72 count					
	P0341	signal check	no cam position sensor signal	> 6 count					
Bank 1 Exhaust	P0366	circuit low	differenece between 2 workingcycles	< 1 teeth	engine in synchronized mode	TRUE			
			depending on engine speed	> 8 - 72 count					
	P0367	circuit continuity or high	differenece between 2 workingcycles	> 1 teeth					
			depending on engine speed	> 8 - 72 count					
	P0368	plausibility check	differenece between 2 workingcycles	> 1 or < 1 teeth					
			depending on engine speed	> 8 - 72 count					
	P0366	signal check	no cam position sensor signal	> 6 count					
Bank 2 Intake	P0346	circuit low	differenece between 2 workingcycles	< 1 teeth	engine in synchronized mode	TRUE			
			depending on engine speed	> 8 - 72 count					
	P0347	circuit continuity or high	differenece between 2 workingcycles	< 1 teeth					
			depending on engine speed	> 8 - 72 count					
	P0348	plausibility check	differenece between 2 workingcycles	< 1 teeth					
			depending on engine speed	> 8 - 72 count					
	P0346	signal check	no cam position sensor signal	> 6 count					

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
Bank 2 Exhaust	P0391	plausibility check	differenece between 2 workingcycles	< 1 teeth	engine in synchronized mode	TRUE			
			depending on engine speed	> 8 - 72 count					
	P0392	circuit low	differenece between 2 workingcycles	> 1 teeth					
			depending on engine speed	> 8 - 72 count					
	P0393	circuit continuity or high	differenece between 2 workingcycles	> 1 or < 1 teeth					
			depending on engine speed	> 8 - 72 count					
	P0391	signal check	no cam position sensor signal	> 6 count					
Fuel tank pressure sensor	P0450	rationality -	fuel tank pressure difference	>= 406.25 Pa	time after canister vent valve open	> 4 sec.	4,5	continous	2 trips
		sensor signal change within time	within	= 1 sec	vehicle speed	<= 62.13 mph			
		(oscillation check)	for integrated time	>= 25.5 sec	calc. ambient temperature	> -7.5 °C			
					canister purge flow (closed)	<= 0 g/sec			
					time after purge valve closes	> 0.2 sec.			
	P0451	rationality - signal range check	change of fuel tank pressure	> 1469 Pa	time after engine start	> 1 sec.	10 sec.		
				< -3968 Pa	time after canister vent valve open	> 4 sec.			
					vehicle speed	> 6.25 mph			
					for time	>= 30 sec.			
					and integrated purge mass flow	>= 0.3 g			
					calculated ambient air temperature	> -7.5 °C			
					ambient pressure	> 68000 Pa			
					fuel level	< 76 l			
					fuel level	> 11 l			
		OR							
		rationality - drift check	difference between fuel tank pressure and fuel tank pressure at engine start	> +/- 688 Pa	time after engine start	> 5 sec.	7 sec.		
					Vent solenoid valve open	TRUE			
					Caniter purge flow (closed)	<= 0 g/sec			
					ambient pressure	> 68000 Pa			
					fuel level	< 76 l			
					fuel level	> 11 l			
					Vehicle speed	> 6.25 mph			
					for time	>= 30 sec.			
					and integrated purge mass flow	>= 0.3 g			
					Vehicle speed	<= 62.13 mph			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
					Canister load	< 6			
					calculated ambient air temperature	3.8 < … < 39.8 °C			
					difference (ECT at start - ambient temperature)	< 9.8°C			
	P0452	circuit continuity - ground	sensor voltage	< 0.1 V	Engine cranking	FALSE	10 sec	continuous	2 trips
	P0453	circuit continuity - voltage	sensor voltage	> 4.9 V					
Knock control sensor's evaluation IC	P0327		Cylinder individual signal value	< 0.15015 - 0.29297 V	Knock control is active.	TRUE	0,3 sec	continuous	2 trips
Bank 1		Monitoring via knock-sensor- and cylinder-based basic reference noise	(depends on engine speed)		engine coolant tempetature	> 45 °C			
	P0328	signal (voltage).	Cylinder individual signal value	> 5 .. 18,6 V	engine load (lower treshold)	35 - 65 %			
			(depends on engine speed)		Engine speed for strong signals.	> 2520 rpm			
					Engine speed for weak signals.	> 2520 rpm			
	P0326	non plausible signal		> 25 counts	Error: Camshaft sensor (during engine start)	not set			
					Engine speed gradient at a working cycle	< 1400 … 3700 1/min*sec.			
					delta partial pressure (10 ms grid) in manifold	< 20 … 35 hPa			
					Error: knock-control circuit (P0324)	not set			
					error: crankshaft sensor (P0335, P0336, P0338)	not set			
Bank 2	P0332	Monitoring via knock-sensor- and	Cylinder individual signal value	< 0.15015 - 0.29297 V	Knock control is active.	TRUE	0,3 sec	continuous	2 trips
		cylinder-based basic reference noise	(depends on engine speed)		engine coolant tempetature	> 45 °C			
	P0333	signal (voltage).	Cylinder individual signal value	> 5 .. 18,6 V	engine load (lower treshold)	35 - 65 %			
			(depends on engine speed)		Engine speed for strong signals.	> 2520 rpm			
					Engine speed for weak signals.	> 2520 rpm			
	P0331	non plausible signal		> 25 counts	Error: Camshaft sensor (during engine start)	not set			
					Engine speed gradient at a working cycle	< 1400 … 3700 1/min*sec.			
					delta partial pressure (10 ms grid) in manifold	< 20 … 35 hPa			
					Error: knock-control circuit (P0324)	not set			
					error: crankshaft sensor (P0335, P0336, P0338)	not set			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
Knock control sensor's evaluation IC	P0324	Parity Check	number of counts	> 5 counts	knock control active	TRUE	250 working	Zero and	2 trips
		monitoring of the coefficient RAM of the IC	out of	600	Engine speed gradient at a working cycle	< 1400 … 3700 1/min*sec.	cylces	Test pulse	
			combustions events		delta partial pressure (10 ms grid) in manifold	< 20 … 35 hPa		alternate every	
					error suspicison: knock control test pulse (P0324)	not set		250 working	
					engine speed	> 2000 rpm		cycles.	
	P0324	Response to Zero Pulse	integrator gradient	< 200 V/s	same as for IC integrator's offset monitoring				
		monitor IC's integrator gradient							
	P0324	Response to Test Pulse	integrator value of test pulse	< 4.0 V	coolant temperature	> 45 °C			
		integrator value check			Engine speed gradient at a working cycle	< 1400 … 3700 1/min*sec.			
					delta partial pressure (10 ms grid) in manifold	< 20 … 35 hPa			
					error suspicison: knock control zero test (P0324)	not set			
fuel injector									
cylinder #1	P0201	circuit continuity - open	Voltage	IC internal	engine speed	> 80 rpm	immediat ely	continuou s	2 trips
	P0261	circuit continuity - ground			battery voltage	> 9,99 V			
	P0262	circuit continuity - voltage			battery voltage	< 17,90 V			
cylinder #2	P0202	circuit continuity - open			output activated and				
	P0264	circuit continuity - ground			deactivated for complete				
	P0265	circuit continuity - voltage			checking	TRUE			
cylinder #3	P0203	circuit continuity - open							
	P0267	circuit continuity - ground							
	P0268	circuit continuity - voltage							
cylinder #4	P0204	circuit continuity - open							
	P0270	circuit continuity - ground							
	P0271	circuit continuity - voltage							

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
cylinder #5	P0205	circuit continuity - open							
	P0273	circuit continuity - ground							
	P0274	circuit continuity - voltage							
cylinder #6	P0206	circuit continuity - open							
	P0276	circuit continuity - ground							
	P0277	circuit continuity - voltage							
canister ventilation valve	P0449	circuit continuity - open	Voltage	IC internal	engine speed	> 80 rpm	immediately	continuous	2 trips
	P0498	circuit continuity - ground			battery voltage	> 9,99 V			
	P0499	circuit continuity - voltage			battery voltage	< 17,90 V			
					output activated and deactivated for complete checking	TRUE			
canister purge valve	P0443	circuit continuity - open	Voltage	IC internal	engine speed	> 80 rpm	immediately	continuous	2 trips
	P0458	circuit continuity - ground			battery voltage	> 9,99 V			
	P0459	circuit continuity - voltage			battery voltage	< 17,90 V			
					output activated and deactivated for complete checking	TRUE			
upstream oxygen sensor heater									
Bank #1	P0030	circuit continuity - open	Voltage	IC internal	engine speed	> 80 rpm	immediately	continuous	2 trips
	P0031	circuit continuity - ground			battery voltage	> 9,99 V			
	P0032	circuit continuity - voltage			battery voltage	< 17,90 V			
					output activated and deactivated for complete checking	TRUE			
downstream oxygen sensor heater									
Bank #1	P0036	circuit continuity - open	Voltage	IC internal	engine speed	> 80 rpm	immediately	continuous	2 trips
	P0037	circuit continuity - ground			battery voltage	> 9,99 V			
	P0038	circuit continuity - voltage			battery voltage	< 17,90 V			
					output activated and deactivated for complete				

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
					checking	TRUE			
secondary air pump	P2444	circuit continuity - open	Voltage	IC internal	engine speed	> 80 rpm	immediately	continuous	2 trips
	P2445	circuit continuity - ground			battery voltage	> 9,99 V			
	P0418	circuit continuity - voltage			battery voltage	< 17,90 V			
					output activated and deactivated for complete checking	TRUE			
intake camshaft control									
Intake Bank #1	P0010	circuit continuity - open	Voltage	IC internal	engine speed	> 80 rpm	immediately	continuous	2 trips
	P2088	circuit continuity - ground			battery voltage	> 9,99 V			with: 0.4 sec
	P2089	circuit continuity - voltage			battery voltage	< 17,99 V			continuous
Intake Bank #2	P0020	circuit continuity - open			output activated and deactivated for complete checking	TRUE			or 4 sec cum
	P2092	circuit continuity - ground							
	P2093	circuit continuity - voltage							
exhaust camshaft control	P0013	circuit continuity - open							
Exhaust Bank #1	P2090	circuit continuity - ground							
	P2091	circuit continuity - voltage							
Exhaust Bank #2	P0023	circuit continuity - open							
	P2094	circuit continuity - ground							
	P2095	circuit continuity - voltage							
Dump valve turbo	P0033	circuit continuity - open	Voltage	IC internal	engine speed	> 80 rpm	immediately	continuous	2 trips
	P0034	circuit continuity - ground			battery voltage	> 9,99 V			
	P0035	circuit continuity - voltage			battery voltage	< 17,90 V			
					output activated and deactivated for complete checking	TRUE			
Boost control valve	P0244	circuit continuity - open	Voltage	IC internal	engine speed	> 80 rpm	immediately	continuous	2 trips
	P0245	circuit continuity - ground			battery voltage	> 9,99 V			
	P0246	circuit continuity - voltage			battery voltage	< 17,90 V			
					output activated and deactivated for complete				

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
					checking	TRUE			
Ignition Coil circuit continuity									
Cylinder #1	P0351	circuit continuity - open or signal not plausible	Voltage > during	>20revs	engine speed	> 400rpm	approx.	engine	2 trips
			or minimum two fault counters		engine speed	<5000rpm	1 sec	cycle	with: 0.4 sec
	P2300	circuit continuity - ground	Voltage > during	>20revs	battery voltage	>10V		frequency	continuous
	P2301	circuit continuity - voltage	Voltage > during	>20revs	battery voltage	<18V			or 4 sec cum
Cylinder #2	P0352	circuit continuity - open or signal not plausible	Voltage > during	>20revs				continuous	
			or minimum two fault counters						
	P2303	circuit continuity - ground	Voltage > during	>20revs					
	P2304	circuit continuity - voltage	Voltage > during	>20revs					
Cylinder #3	P0353	circuit continuity - open	Voltage > during	>20revs					
			or minimum two fault counters						
	P2306	circuit continuity - ground	Voltage > during	>20revs					
	P2307	circuit continuity - voltage	Voltage > during	>20revs					
Cylinder #4	P0354	circuit continuity - open	Voltage > during	>20revs					
			or minimum two fault counters						
	P2309	circuit continuity - ground	Voltage > during	>20revs					
	P2310	circuit continuity - voltage	Voltage > during	>20revs					
Cylinder #5	P0355	circuit continuity - open	Voltage > during	>20revs					
			or minimum two fault counters						
	P2312	circuit continuity - ground	Voltage > during	>20revs					
	P2313	circuit continuity - voltage	Voltage > during	>20revs					
Cylinder #6	P0356	circuit continuity - open	Voltage > during	>20revs					
			or minimum two fault counters						
	P2315	circuit continuity - ground	Voltage > during	>20revs					
	P2316	circuit continuity - voltage	Voltage > during	>20revs					
cold start ignition timing performance (during catalyst heating)	P050B	ignition timing efficiency to small during idle	averaged differnce between current ignition efficiency	> 25%	condition idle	TRUE	10 sec	Monitor runs	2 trips
			and desired ignition efficiency		desired ignition efficiency	< 88%	cumulative	whenever enable	
					cat heating *	active		conditions are met	
					time delay for activation	3 sec			
					fuel system status	no fuel cut			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
		ignition timing efficiency to small during part load	averaged differnce between current ignition efficiency	> 25%	condition idle	FALSE			
			and desired ignition efficiency		desired ignition efficiency	< 97%			
					cat heating *	active			
					time delay for activation	3 sec			
					fuel system status	no fuel cut			
Electronic Throttle Control									
	P0638	motor control range check	| powerstage duty cycle |	>80%	battery voltage	> 8V	0.6 sec	0.01 sec	immediate
		short term	for a time	>0.6 sec.			(recoverable) 5.0 sec (latched)	continuous	
	P0638	motor control range check	(absolute value)	>80%	engine speed	> 400 rpm			
		long term	for a time	> 5 sec.	coolant temperature	> 5.3 °C			
					intake air temperature	> 5.3 °C			
Electronic Throttle Control									
	P1551	limp-home throttle position	throttle position	< 11.3909%	vehicle speed	<=0mph	5 sec	0.01 sec	immediate
		out of range	OR		engine speed	< 250rpm		at key on	
			throttle position	> 38.7808%	engine coolant temperature	>= 5.3° C			
					engine coolant temperature	<=84.75° C			
					intake air temperature	>= 5.3° C			
					intake air temperature	<=60° C			
					battery voltage	> 8V			
					accelerator pedal position	<14.9%			
Electronic Throttle Control									
	P2100	powerstage SPI bus or signal error	output circuits not deactivated	=deactivationfault	-	---	0.1 sec	0.01 sec	immediate
	P2103	powerstage short circuit	as commanded					at key on	
	P2102	powerstage overheating or overcurrent							
	P2101	powerstage open load							
	P2101	difference between set and	difference between set and	>4 . . . 50%	electronic throttle adaptation	not active	0.5 sec	0.01 sec	
		actual position of throttle blade	actual position of throttle blade	dep. on rate of change	battery voltage	> 8V		continuous	
			for a time	> 0.5 sec.					

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
Electronic Throttle Control	P2119	functionality of return spring	throttle blade return response	>0.56sec	vehicle speed	<=0mph	0.56 sec	0.01 sec	immediate
					engine speed	< 250rpm		at key on	
					engine coolant temperature	>= 5.3° C	once		
					engine coolant temperature	<=84.75° C	per		
					intake air temperature	>= 5.3° C	ignition		
					intake air temperature	<=60° C	on		
					battery voltage	> 8V			
					accelerator pedal position	<14.9%			
Electronic Throttle Control	P2176	throttle exchange detection	range check poti1 value at lower stop		vehicle speed	<=0mph	1 sec	0.01 sec	immediate
		learn fail	throttle potentiometer 1 voltage	< 4.102 V	engine speed	<40rpm		at key on	
		or	or		engine coolant temperature	>=5.3° C	once		
	P2176	minimum throttle position	throttle potentiometer 1 voltage	> 4.5642 V	engine coolant temperature	<=100° C	per		
		out of range			intake air temperature	>=5.3° C	ignition		
		or	range check poti2 value at lower stop		intake air temperature	<=143.3° C	on		
	P2176	initial throttle learn failed	throttle potentiometer 2 voltage	< 0.3369 V	battery voltage	>9.99V			
		or	or		accelerator pedal position	<14.9%			
	P2176	learning prohibited due to secondary parameters not met	throttle potentiometer 2 voltage	>1.0 V					
Throttle Position Sensor 1 (primary)	P0121	plausibility to model	sensor difference	>9%	engine speed	> 480 rpm	0.4 sec. continuous	continuous	1 trip with: 0.4 sec continuous or 4 sec cum
			for a time	> 0.28 sec.	accelerator pedal (WOT)	< 48 … 100%			
					vehicle speed	<=0mph			
					engine coolant temperature	>= 5.3° C			
					battery voltage	>8V			
					intake air temperature	>=5.3° C			
	P0122	range check poti voltage	sensor circuit low voltage	<0.176V	vehicle speed	<=0mph			
			for a time	> 0.14 sec	engine speed	< 250rpm			
	P0123	range check poti voltage	sensor circuit high voltage	>4.629V	engine coolant temperature	>=5.3° C			
			for a time	> 0.14 sec	intake air temperature	>= 5.3° C			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
					battery voltage	>8V			
Sensor 2 (redundant)	P0221	plausibility to model	sensor difference	>9%	engine speed	> 480 rpm		continuous	1 trip
			for a time	> 0.28 sec.	accelerator pedal (WOT)	< 48 … 100%	0.4 sec. continuous		with: 0.4 sec
					vehicle speed	<=0mph			continuous
					engine coolant temperature	>= 5.3° C			or 4 sec cum
					battery voltage	>8V			
					intake air temperature	>=5.3° C			
	P0222	range check poti voltage	sensor circuit low voltage	<0.156V	vehicle speed	<=0mph			
			for a time	> 0.14 sec	engine speed	< 250rpm			
	P0223	range check poti voltage	sensor circuit high voltage	>4.883V	engine coolant temperature	>=5.3° C			
			for a time	> 0.14 sec	intake air temperature	>= 5.3° C			
					battery voltage	>8V			
Function Monitoring of Microcontroller (PCM level 2 command check)	P0606	torque comparison	irreversible error of torque comparison (current and maximum allowed engine torque out of range)	TRUE	engine speed	>1200rpm	5sec	continuous	immediate
		engine speed comparison	irreversible error of engine speed comparison (calculated and measured engine speed out of range)	TRUE	engine speed	>1200rpm			
		accelerator pedal signal comparison	irreversible error of accelerator pedal signal comparison (synchronism between the two pedal sensors out of range)	TRUE	engine speed	>1200rpm			
		monitoring of AD converter queue	irreversible error of AD-converter queue monitoring (queue not running)	TRUE	engine speed	>1200rpm			
		check of AD-converter signal	irreversible error of AD-converter signal						

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
			check (converted low voltage test impuls out of range)	TRUE	engine speed	>1200rpm			
		check of ignition timing	irreversible error of comparison of ignition timing value (comparison of ignition timing value with its one's complement is wrong)	TRUE	engine speed	>1200rpm			
		verification of engine load value	irreversible error of engine load value verification (engine load value and verification value are not identical)	TRUE	engine speed	>1200rpm			
		monitoring of injected fuel mass	irreversible error of fuel mass (calculated and measured requested fuel mass out of range)	TRUE	engine speed	>1200rpm			
		monitoring of mixture correction factor	irreversible error of mixture correction factor (adapted fuel mixture is out of range)	TRUE	engine speed	>1200rpm			
		monitoring of desired air/fuel ratio	irreversible error of air/fuel ratio (desired air/fuel ration is out of range)	TRUE	engine speed	>1200rpm			
	P2105	function controller response check	monitoring module has detected a fault of function controller	TRUE	engine speed	>1200rpm			
		watchdog output signal check	WDA signal activated	TRUE					
		overvoltage detection	internal supply voltage exceeded	TRUE					
ECM Monitoring	P0605	rationality check - verification of ROM checksum	wrong ROM checksum	5-times TRUE	PCM after-run time of the last driving cycle completly finished	TRUE	30 sec	at key off once per trip	immediate
	P0605	rationality check - verification of ROM checksum	wrong cyclic ROM checksum of critical regions	TRUE	partialchecksum on critcal variables		5 sec	0.04 sec continous	immediate
	P0604	writeability check of RAM	RAM read and write test failed	TRUE	PCM after-run time of the last driving cycle completly	TRUE	30 sec	at key off once per	immediate

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
					finished			trip	
	P0604	writeability check of RAM	cyclic RAM read and write test of				1 sec	0.04 sec	immediate
			critical regions failed	TRUE	power down calculation in the last driving cycle completly finished	TRUE		continous	
	P0603	rationality check -	shut down of power stages not possible				0.05 sec	at key on	immediate
		programming incomplete		service ECU bits				once per trip	
				TRUE					
	P0603	writeability check of Time Processing	TPU parameter RAM read and write	TRUE			0.05 sec	at key on	immediate
		Unit (TPU) parameter RAM	test failed					once per trip	
	P0603	rationality check -	wrong TPU code RAM checksum	TRUE			0.3 sec	0.1 sec	immediate
		verification of Time Processing Unit (TPU) code RAM checksum						continous	
	P0603	rationality check -	difference between Time Processing Unit				0.3 sec	0.1 sec	immediate
		time difference check	time and PCM time	> 0.001 sec				continous	
Accelerator pedal position sensor	P 2123	range check high	accelerator position sensor voltage 1	> 4.824 V	battery voltage is sufficient for 5V accelerator sensor supply	> 8V	0,4s	continuous	immediate
			for a time	> 0.2 sec.					with: 0.4 sec
	P 2122	range check low	accelerator sensor voltage 1	< 0.742 V	condition upper limit voilated (see max fault path of FP2P) (P2128)	FALSE			continuous
			and		condition upper limit voilated (see max fault path of FP1P) (P2123)	FALSE			or 4 sec cum
			accelerator sensor voltage 2	< 0.625 V	battery voltage is sufficient for 5V accelerator sensor supply	> 8V			
			for a time	> 0.2 sec.	error reaction accelerator-travel sensor limphome (P2127,P2128)	FALSE			
					primary conditions for absolute difference check (P2138)	TRUE			
			or						
			accelerator sensor voltage 1	< 0.742 V	error reaction accelerator-travel sensor limphome	FALSE			
			for time	> 0.2 sec	synchronization between voltages 1 and 2 violated				
					(see values of absolute difference in accelerator sensor				

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
					voltages depending on ranges in FP1			
					FP1P absolute difference check below	TRUE		
					high contact resistance at accelerator voltage 1	FALSE		
	P 2138	absolute difference check	absolute difference between both accelerator sensor voltages in the range		condition lower limit voilated (see min fault path of FP1P) (P2122)	FALSE		
		fault time			condition lower limit voilated (see min fault path of FP2P) (P2127)	FALSE		
			from 1.191 V to 1.25 V	> 0.254 V	error reaction accelerator-travel sensor limphome (P2127,P2128)	FALSE		
			or		battery voltage is sufficient for 5V accelerator sensor supply	> 8V		
			absolute difference between both accelerator sensor voltages in the range		condition upper limit voilated (see max fault path of FP2P) (P2128)	FALSE		
			from 1.25 V to 2.637 V	> 0.313 V	condition upper limit voilated (see max fault path of FP1P) (P2123)	FALSE		
			or					
			absolute difference between both accelerator sensor voltages in the range					
			above 2.637 V	> 1.699 V				
			and					
			fullfilled for the time	> 0.24 sec				
	P 2128	range check high	accelerator sensor voltage	> 4.824 V	battery voltage is sufficient for 5V accelerator sensor supply	> 8V		
		fault time	for a time	> 0.2 sec.				
	P 2127	range check low	accelerator sensor voltage 1	< 0.742 V	condition upper limit voilated (see max fault path of FP2P) (P2122)	FALSE		
			and		condition upper limit voilated (see max fault path of FP1P) (P2127)	FALSE		
			accelerator sensor voltage 2	< 0.625 V	battery voltage is sufficient for 5V accelerator sensor supply	> 8V		
			for time	> 0.2 sec.	error reaction accelerator-travel sensor limphome (P2127,P2128)	FALSE		
					primary conditions for absolute difference check (P2138)	TRUE		
			or					
			accelerator sensor voltage 2	< 0.625 V	error reaction accelerator-travel sensor limphome (P2127,P2128)	FALSE		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
			for time	> 0.2 sec	synchronization between voltages 1 and 2 violated (see values of absolute difference in accelerator sensor voltages depending on ranges in FP1 FP2P absolute difference check below) high contact resistance at accelerator voltage 1 (P2128)	 TRUE FALSE			
Transmission Control Module MIL Illumination requested (Specific TCM DTC shown in freeze frame)	P0700	OBD emission fault detected by the TCM	signal input	=TCM MILFAULT	-	---	0.01 sec	0.01 sec continuous	immediate
demand controlled fuel supply (FSCM) MIL Illumination requested	P069E	OBD emission fault detected by the FSCM	signal input	=FSCM MILFAULT	-	---	0.01 sec	0.01 sec	immediate
OBD ISO-15765 Communication Bus	U0101	Communication with TCM	TCM Message Timeout	=message	Automatic Transmission	equipped	5 sec	0.01 sec	immediate
	U0402		or Invalid Message Content	=missing,	CAN Bus	initialized		continuous	
				delayed,	consisting of:	and ready			
				or	ignition on for	>3sec			
				invalid	battery voltage	>10V			
				content	battery voltage	<18V			
					normal bus communication	running			
	U0073	ISO-15765 Bus Error	Invalid Message Received	=invalid	CAN Bus	initialized	0.5 sec	0.01 sec	immediate
			or Dual Port Ram Hardware Error;	=error	consisting of:	and ready	0.01 sec	continuous	
			or No Communication / Bus Off	=bus off	ignition on for	>3sec	0.03		
					battery voltage	>10V			
					battery voltage	<18V			
					normal bus communication	running--			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
	U0109	Communication with FSCM	FSCM Message Timeout or Invalid Message Content	=message =missing, delayed, or invalid content	FSCM CAN Bus consisting of: ignition on for battery voltage battery voltage normal bus communication	equipped-- initialized-- and ready >3sec >10V <18V running	2 sec	0.01 sec continuous	immediate
Diagnosis Tuning Recognition	P160D	Engine performance identification	internal performance comparison external performance comparison (CAN)	+/- 2 kW +/- 2 kW	engine speed	TRUE	5 sec.	1 sec. continuous	immediate
Diagnosis of ECU programming: RPO	P160E	ECU RAM check	Diagnosis programming of Engine System Regular Production Option Identifier	IC internal	ignition on	TRUE	2 sec.	1 sec. continuous	immediate
Diagnosis of ECU programming: "Service ECU"	P0602	ECU RAM check	Codeword: calibration for service ECM	>0			4 sec.	continuous	
Diagnosis of ECU programming: "Variantcode"	P0610	ECU RAM check	variant code not programmed	IC internal			2 sec.		
Diagnosis of ECU programming: "VIN"	P0630	ECU RAM check	vehicle identification number not programmed	IC internal			2 sec.		
Fuel level sensor	P0463	fuel level sensor short circuit to battery voltage	sensor voltage	> 4.75 V	**general enabling conditions** battery voltage battery voltage	 >10V <18V	2 sec.	continuous	2 trips with: 0.4 sec continuous
	P0462	fuel level sensor short circiut to ground	sensor voltage for a time	< 0.25 V			2 sec.		or 4 sec cum
	P0461	fuel level sensor stuck	fuel level stays in a band of for a distance of	2 l	**special enabeling conditions** Error: fuel level sensor (P0461-P0463) Error: secondary fuel level sensor (P2066-P2068)	 not set not set	279.6 miles		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
					error: vehicle speed sensor (P0501-P0503)	not set			
					engine speed	> 80 rpm			
Diagnosis Tank 2 - fuel level sensor	P2068	secondary fuel level sensor short circuit to battery voltage	sensor voltage	> 4.75 V	**general enabling conditions**		2 sec.	continuous	2 trips
			for a time		battery voltage	>10V			with: 0.4 sec
					battery voltage	<18V			continuous
	P2067	secondary fuel level sensor short circuit to ground	sensor voltage	< 0.25 V			2 sec.		or 4 sec cum
			for a time						
	P2066	secondary fuel level sensor stuck	fuel level stays in a band of	2 l			85.75 miles		
					special enabeling conditions				
			for a distance of		Error: fuel level sensor (P0461-P0463)	not set			
					Error: secondary fuel level sensor (P2066-P2068)	not set			
	P2066	Transfer pump failure	fuel level primary tank	< 4 l	error: vehicle speed sensor (P0501-P0503)	not set	250 sec.		
			and secondary fuel tank level	> 16 l	engine speed	> 80 rpm			
			for a time	> 250 sec.					
Ignition driver 1	P06D1	Internal SPI communication	IC-Internal		Engine speed	< 5000 rpm	4 sec.	0.01 sec.	2 trips
					Battery voltage	> 10 V		continuous	
					Battery voltage	< 18 V			
5V reference voltage monitoring	P0641	circuit continuity - open	Voltage	IC Internal	ignition key on	TRUE		3 sec	2 trips
	P0642	circuit continuity - ground			ECM power relay	TRUE			
	P0643	circuit continuity - voltage							
	P0651	circuit continuity - open	Voltage	IC Internal					
	P0652	circuit continuity - ground							
	P0653	circuit continuity - voltage							
	P0697	circuit continuity - open	Voltage	IC Internal					
	P0698	circuit continuity - ground							

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED		MIL ILLUM.
	P0699	circuit continuity - voltage							
Real time clock Engine off timer Status Check	P2610	engine off timer signal check	engine off timer state >= (State 3 corresponds to engine off time which does not match the time from the ETC watchdog time, and a battery disconnection has not been detected)	3	engine speed real time clock active	> 240 rpm TRUE		0.1 sec.	2 trips
Real time clock Engine off timer Rationality check	P2610	engine off timer incremental check	reference clock time delta - Engine Off Timer delta reference clock time delta - Engine Off Timer delta or reference clock and Engine Off Timer (EOT) required synchronization time > (reference clock is an independently captured time value based on the ECM processor clock)	> 6 counts < 6 counts > 6 seconds	engine speed failure counts engine speed failure counts ECM afterrun complete	> 240 rpm >= 3 counts > 240 rpm >= 3 counts TRUE		0.1 sec.	2 trips

Glossary of Secondary Parameters

Secondary parameters	Enable condition	Definition
dew point exeeded at primary O2 sensor	TRUE	time integrated heat quantity is larger than calibrated map values dependent on engine start temperature (0.46 .. 1262 KJ) exhaust pipe temperature at primary oxygen sensor > 60°C
dew point exeeded at secondary O2 sensor	TRUE	time integrated heat quantity is larger than calibrated map values dependent on engine start temperature (1.8 … 1400 KJ) exhaust pipe temperature at primary oxygen sensor > 60°C
primary sensor heating active	TRUE	dew point exeeded at primary O2 sensor engine speed > 680 rpm battery voltage < 18 V engine temperature > -9.8 °C error: primary oxygen sensor --> not set
secondary air system	active	intake air temperature > - 11 … < 80 °C engine coolant temperature > - 11 … < 120 °C engine speed < 3500 rpm mass airflow < 100 g/sec. battery voltage > 10 … < 18 V cat heating --> active
cat heating	active	nmot > 680rpm altitude < 3000m intake air temp. > -12°C engine start temperature -10,5°C < … < 69,75°C difference of intake air. temp minus engine coolant start temp. <=15°C error: air flow meter --> not set error: intake air temperature sensor -->not set error: engine temperature sensor --> not set error: ambient pressure sensor --> not set
error: camshaft control system	not set	P0011, P0021, P0014, P0024, P000A, P000B, P000C, P000D P0341-P0343, P0366-P0368, P0346-P0348, P0391-P0393

Glossary of Secondary Parameters

Secondary parameters	Enable condition	Definition
error: evap. canister purge system	not set	P0449, P0498, P0499, P0443, P0458, P0459, P0442, P0446, P0455, P0496, P0497
error: camshaft control circuit	not set	P0341-P0346, P0366-P0368, P0346-P0348, P0391-P0393

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
Fuel Rail Pressure (FRP) Sensor Performance (rationality)	P018B	This DTC detects a fuel pressure sensor response stuck within the normal operating range	Absolute value of fuel pressure change as sensed during intrusive test.	<= 30 kPa			Frequency: Continuous; 12.5 ms loop. 60 seconds between intrusive tests that pass Intrusive test requested if fuel system is clamped for >= 5 seconds or fuel pressure error variance <= typically (0.3 to 0.6) (calculated over a 2.5sec period); otherwise report pass	DTC Type A 1 trip
					1. FRP Circuit Low DTC (P018C)	not active		
					2. FRP Circuit High DTC (P018D)	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	Intrusive test is run when fuel flow is below Max allowed fuel flow rate (Typical values in the range of 11 to 50 g/s)	
					6. Reference Voltage DTC (P0641)	not active		
					7. Fuel Pump Control Module Driver Over-temperature DTC (P064A)	not active		
					8. Control Module Internal Performance DTC (P0606)	not active		
					9. Engine run time	>=5 seconds		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
					10. Emissions fuel level (PPEI $3FB) 11. Fuel pump control 12. Fuel pump control state 13. Engine fuel flow 14. ECM fuel control system failure (PPEI $1ED)	not low enabled normal or FRP Rationality control > 0.047 g/s failure has not occurred		
Fuel Rail Pressure (FRP) Sensor Circuit Low Voltage	P018C	This DTC detects if the fuel pressure sensor circuit is shorted low	FRP sensor voltage	< 0.14 V	Ignition	Run or Crank	72 failures out of 80 samples 1 sample/12.5 ms	DTC Type A 1 trip
Fuel Rail Pressure (FRP) Sensor Circuit High Voltage	P018D	This DTC detects if the fuel pressure sensor circuit is shorted high	FRP sensor voltage	> 4.86 V	Ignition	Run or Crank	72 failures out of 80 samples 1 sample/12.5 ms	DTC Type A 1 trip
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 < 32V	72 test failures in 80 test samples if Fuel Pump Current <100A 1 sample/12.5 ms	DTC Type A 1 trip
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	0% duty cycle (off)	36 test failures in 40 test samples; 1 sample/12.5ms	DTC Type A 1 trip

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
					Fuel pump control enable Time that above conditions are met	False >=4.0 seconds	Pass/Fail determination made only once per trip	
Fuel Pump Control Circuit (Open)	P023F	This DTC detects if the fuel pump control circuit is open	Fuel Pump Current AND Fuel Pump Duty Cycle	<=0.5A >20%	Ignition OR HS Comm OR Fuel Pump Control AND Ignition Run/Crank Voltage	Run or Crank enabled enabled 9V < voltage < 32V	72 test failures in 80 test samples; 1 sample/12.5ms	DTC Type A 1 trip
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 AND PPEI Fuel System Request ($1ED)	Run or Crank valid	72 failures out of 80 samples 1 sample/12.5 ms	DTC Type A 1 trip
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 1 trip
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 1 trip

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
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	Frequency: Once at power-up	DTC Type A 1 trip
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	Ignition OR HS Comm OR Fuel Pump Control	Run or Crank enabled enabled	1 failure if it occurs during the first RAM test of the ignition cycle, otherwise 5 failures Frequency: Runs continuously in the background.	DTC Type A 1 trip
Control Module Internal Performance 1. Main Processor Configuration Register Test 2. Processor clock test	P0606	This DTC indicates the FSCM has detected an internal processor fault or external watchdog fault (PID 2032 discriminates the source of the fault)	1. For all I/O configuration register faults: •Register contents 2. For Processor Clock Fault: •EE latch flag in EEPROM. OR • RAM latch flag.	 Incorrect value. 0x5A5A 0x5A	Ignition OR HS Comm OR Fuel Pump Control 1. For all I/O configuration register faults: •KeMEMD_b_ProcFltCfgRegEnbl 2. For Processor Clock Fault: •KeMEMD_b_ProcFltCLKDiagEnbl	Run or Crank enabled enabled TRUE TRUE	Tests 1 and 2 1 failure Frequency: Continuously (12.5ms) Test 3 3 failures out of 15 samples 1 sample/12.5 ms	DTC Type A 1 trip

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
3. External watchdog test			3. For External Watchdog Fault: • Software control of fuel pump driver	Control Lost	3. For External Watchdog Fault: •KeFRPD_b_FPExtWDogDiagEnbl 3. For External Watchdog Fault: •Control Module ROM(P0601) 3. For External Watchdog Fault: •Control Module RAM(P0604)	TRUE not active not active		
Control Module Long Term Memory (EEPROM) Performance	P062F	Indicates that the NVM Error flag has not been cleared	Last EEPROM write	Did not complete	Ignition OR HS Comm OR Fuel Pump Control	Run or Crank enabled enabled	1 test failure Once on controller power-up	DTC Type A 1 trip
5Volt Reference Circuit (Short High/Low/Out of Range)	P0641	Detects continuous short or out of range 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	Run or Crank	15 failures out of 20 samples 1 sample/12.5 ms	DTC Type A 1 trip
			OR Reference voltage □	> 102.5% nominal (i.e., 5.125V) OR <97.5% nominal (i.e., 4.875V)				
Fuel Pump Control Module - Driver Over-temperature 1	P064A	This DTC detects if an internal fuel pump driver overtemperature condition exists under normal operating conditions	Pump Driver Temp	> 150C	Ignition OR HS Comm OR	Run or Crank enabled	3 failures out of 15 samples 1 sample/12.5 ms	DTC Type B 2 trips

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
					Fuel Pump Control KeFRPD_b_FPOverTempDiagEnbl Ignition Run/Crank	enabled TRUE 9V<voltage<32V		
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	180 failures out of 200 samples 1 sample/25.0 ms	DTC Type A 1 trip
Fuel Pump Flow Performance (rationality)	P2635	This DTC detects degradation in the performance of the SIDI electronic return-less fuel system	Filtered fuel rail pressure error	<= Low Threshold (function of desired fuel rail pressure and fuel flow rate. 15% of resultant Target Pressure) OR >= High Threshold (function of desired fuel rail pressure and fuel flow rate. 15% of resultant Target Pressure) **(See Supporting Tables tab)**	1. FRP Circuit Low DTC (P018C)	not active	Filtered fuel rail pressure error Time Constant = 12.5 seconds Frequency: Continuous 12.5 ms loop	DTC Type B 2 trips
					2. FRP Circuit High DTC (P018D)	not active .		
					3. Fuel Rail Pressure Sensor Performance DTC (P018B)	not active		
					4. FuelPump Circuit Low DTC (P0231)	not active		
					5. FuelPump Circuit High DTC (P0232)	not active		
					6. FuelPump Circuit Open DTC (P023F)	not active		
					7. Reference Voltage DTC (P0641)	not active		
					8. Fuel Pump Control Module Driver Over-temperature DTC's (P064A)	not active		
					9. Control Module Internal Performance DTC (P0606)	not active		
					10. An ECM fuel control system failure (PPEI $1ED)	has not occurred		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
					11. The Barometric pressure (PPEI $4C1) signal	valid (for absolute fuel pressure sensor)		
					12. Engine run time	>= 30 seconds		
					13. Emissions fuel level (PPEI $3FB)	not low		
					14. Fuel pump control	enabled		
					15. Fuel pump control state	normal		
					16. Battery Voltage	11V<=voltage=<32V		
					17. Fuel flow rate **(See Supporting Tables tab)**	> 0.047 g/s **AND** <= Max allowed fuel flow rate as a function of desired rail pressure & Vbatt (Typical values in the range of 11 to 50 g/s)		
					18. Fuel Pressure Control System	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	Power mode	Run/Crank	5 failures out of 5 samples (5 seconds)	DTC Type B 2 trips
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 11V<voltage<32V not active	12 failures out of 12 samples (12 seconds)	DTC Type B 2 trips

Supporting Tables

P2635 Fuel Pump Performance Maximum Fuel Flow map (grams / s)

X-axis= Desired Fuel Pressure (kiloPascals)
Y-axis= Battery voltage (volts)

	200	250	300	350	400	450	500	550	600
4.5	25.14063	25.14063	25.14063	25.14063	25.14063	23.10938	19.92969	16.84375	13.83594
6	25.14063	25.14063	25.14063	25.14063	25.14063	23.10938	19.92969	16.84375	13.83594
7.5	25.14063	25.14063	25.14063	25.14063	25.14063	23.10938	19.92969	16.84375	13.83594
9	25.14063	25.14063	25.14063	25.14063	25.14063	23.10938	19.92969	16.84375	13.83594
10.5	25.14063	25.14063	25.14063	25.14063	25.14063	23.10938	19.92969	16.84375	13.83594
12	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	22.66406
13.5	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063
15	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063
16.5	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063
18	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063
19.5	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063
21	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063
22.5	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063
24	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063
25.5	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063
27	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063
28.5	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063	25.14063

Supporting Tables

P2635 Fuel Pump Performance Filtered Pressure Error Fault Threshold High map (kiloPascals)

X-axis= Target Fuel Pressure (kiloPascals)
Y-axis= Fuel Flow (grams / s)

	200	250	300	350	400	450	500	550	600
0	33.29688	47.17188	61.04688	74.92188	88.79688	102.6719	116.5469	130.4219	144.2969
1.5	33.29688	47.17188	61.04688	74.92188	88.79688	102.6719	116.5469	130.4219	144.2969
3	33.29688	47.17188	61.04688	74.92188	88.79688	102.6719	116.5469	130.4219	144.2969
4.5	33.29688	47.17188	61.04688	74.92188	88.79688	102.6719	116.5469	130.4219	144.2969
6	33.29688	47.17188	61.04688	74.92188	88.79688	102.6719	116.5469	130.4219	144.2969
7.5	33.29688	47.17188	61.04688	74.92188	88.79688	102.6719	116.5469	130.4219	144.2969
9	33.29688	47.17188	61.04688	74.92188	88.79688	102.6719	116.5469	130.4219	144.2969
10.5	33.29688	47.17188	61.04688	74.92188	88.79688	102.6719	116.5469	130.4219	144.2969
12	33.29688	47.17188	61.04688	74.92188	88.79688	102.6719	116.5469	130.4219	144.2969
13.5	21.28125	47.17188	61.04688	74.92188	88.79688	102.6719	116.5469	130.4219	144.2969
15	11.70313	47.17188	61.04688	74.92188	88.79688	102.6719	116.5469	130.4219	144.2969
16.5	11.70313	28.76563	61.04688	74.92188	88.79688	102.6719	116.5469	130.4219	144.2969
18	11.70313	16.57813	61.04688	74.92188	88.79688	102.6719	116.5469	130.4219	144.2969
19.5	11.70313	16.57813	29.78125	74.92188	88.79688	102.6719	116.5469	130.4219	144.2969
21	11.70313	16.57813	21.45313	46.28125	88.79688	102.6719	116.5469	130.4219	144.2969
22.5	11.70313	16.57813	21.45313	26.32813	88.79688	102.6719	116.5469	130.4219	144.2969
24	11.70313	16.57813	21.45313	26.32813	31.20313	102.6719	116.5469	130.4219	144.2969
25.5	11.70313	16.57813	21.45313	26.32813	31.20313	47.39063	116.5469	130.4219	144.2969
27	11.70313	16.57813	21.45313	26.32813	31.20313	36.07813	59.71875	130.4219	144.2969
28.5	11.70313	16.57813	21.45313	26.32813	31.20313	36.07813	40.95313	69.59375	144.2969
30	11.70313	16.57813	21.45313	26.32813	31.20313	36.07813	40.95313	45.82813	77.25
31.5	11.70313	16.57813	21.45313	26.32813	31.20313	36.07813	40.95313	45.82813	50.70313
33	11.70313	16.57813	21.45313	26.32813	31.20313	36.07813	40.95313	45.82813	50.70313
34.5	11.70313	16.57813	21.45313	26.32813	31.20313	36.07813	40.95313	45.82813	50.70313
36	11.70313	16.57813	21.45313	26.32813	31.20313	36.07813	40.95313	45.82813	50.70313
37.5	11.70313	16.57813	21.45313	26.32813	31.20313	36.07813	40.95313	45.82813	50.70313
39	11.70313	16.57813	21.45313	26.32813	31.20313	36.07813	40.95313	45.82813	50.70313
40.5	11.70313	16.57813	21.45313	26.32813	31.20313	36.07813	40.95313	45.82813	50.70313
42	11.70313	16.57813	21.45313	26.32813	31.20313	36.07813	40.95313	45.82813	50.70313
43.5	11.70313	16.57813	21.45313	26.32813	31.20313	36.07813	40.95313	45.82813	50.70313
45	11.70313	16.57813	21.45313	26.32813	31.20313	36.07813	40.95313	45.82813	50.70313
46.5	11.70313	16.57813	21.45313	26.32813	31.20313	36.07813	40.95313	45.82813	50.70313
48	11.70313	16.57813	21.45313	26.32813	31.20313	36.07813	40.95313	45.82813	50.70313

Supporting Tables

P2635 Fuel Pump Performance Filtered Pressure Error Fault RePass Threshold High map (kiloPascals)

X-axis= Target Fuel Pressure (kiloPascals)
Y-axis= Fuel Flow (grams / s)

	200	250	300	350	400	450	500	550	600
0	28.3125	40.09375	51.89063	63.6875	75.48438	87.28125	99.0625	110.8594	122.6563
1.5	28.3125	40.09375	51.89063	63.6875	75.48438	87.28125	99.0625	110.8594	122.6563
3	28.3125	40.09375	51.89063	63.6875	75.48438	87.28125	99.0625	110.8594	122.6563
4.5	28.3125	40.09375	51.89063	63.6875	75.48438	87.28125	99.0625	110.8594	122.6563
6	28.3125	40.09375	51.89063	63.6875	75.48438	87.28125	99.0625	110.8594	122.6563
7.5	28.3125	40.09375	51.89063	63.6875	75.48438	87.28125	99.0625	110.8594	122.6563
9	28.3125	40.09375	51.89063	63.6875	75.48438	87.28125	99.0625	110.8594	122.6563
10.5	28.3125	40.09375	51.89063	63.6875	75.48438	87.28125	99.0625	110.8594	122.6563
12	28.3125	40.09375	51.89063	63.6875	75.48438	87.28125	99.0625	110.8594	122.6563
13.5	18.09375	40.09375	51.89063	63.6875	75.48438	87.28125	99.0625	110.8594	122.6563
15	9.9375	40.09375	51.89063	63.6875	75.48438	87.28125	99.0625	110.8594	122.6563
16.5	9.9375	24.45313	51.89063	63.6875	75.48438	87.28125	99.0625	110.8594	122.6563
18	9.9375	14.09375	51.89063	63.6875	75.48438	87.28125	99.0625	110.8594	122.6563
19.5	9.9375	14.09375	25.3125	63.6875	75.48438	87.28125	99.0625	110.8594	122.6563
21	9.9375	14.09375	18.23438	39.34375	75.48438	87.28125	99.0625	110.8594	122.6563
22.5	9.9375	14.09375	18.23438	22.375	75.48438	87.28125	99.0625	110.8594	122.6563
24	9.9375	14.09375	18.23438	22.375	26.51563	87.28125	99.0625	110.8594	122.6563
25.5	9.9375	14.09375	18.23438	22.375	26.51563	40.28125	99.0625	110.8594	122.6563
27	9.9375	14.09375	18.23438	22.375	26.51563	30.65625	50.76563	110.8594	122.6563
28.5	9.9375	14.09375	18.23438	22.375	26.51563	30.65625	34.8125	59.15625	122.6563
30	9.9375	14.09375	18.23438	22.375	26.51563	30.65625	34.8125	38.95313	65.67188
31.5	9.9375	14.09375	18.23438	22.375	26.51563	30.65625	34.8125	38.95313	43.09375
33	9.9375	14.09375	18.23438	22.375	26.51563	30.65625	34.8125	38.95313	43.09375
34.5	9.9375	14.09375	18.23438	22.375	26.51563	30.65625	34.8125	38.95313	43.09375
36	9.9375	14.09375	18.23438	22.375	26.51563	30.65625	34.8125	38.95313	43.09375
37.5	9.9375	14.09375	18.23438	22.375	26.51563	30.65625	34.8125	38.95313	43.09375
39	9.9375	14.09375	18.23438	22.375	26.51563	30.65625	34.8125	38.95313	43.09375
40.5	9.9375	14.09375	18.23438	22.375	26.51563	30.65625	34.8125	38.95313	43.09375
42	9.9375	14.09375	18.23438	22.375	26.51563	30.65625	34.8125	38.95313	43.09375
43.5	9.9375	14.09375	18.23438	22.375	26.51563	30.65625	34.8125	38.95313	43.09375
45	9.9375	14.09375	18.23438	22.375	26.51563	30.65625	34.8125	38.95313	43.09375
46.5	9.9375	14.09375	18.23438	22.375	26.51563	30.65625	34.8125	38.95313	43.09375
48	9.9375	14.09375	18.23438	22.375	26.51563	30.65625	34.8125	38.95313	43.09375

Supporting Tables

P2635 Fuel Pump Performance Filtered Pressure Error Fault Threshold Low map (kiloPascals)

X-axis= Target Fuel Pressure (kiloPascals)
Y-axis= Fuel Flow (grams / s)

	200	250	300	350	400	450	500	550	600
0	-10.5313	-14.4063	-18.0625	-21.5	-24.7656	-27.8594	-30.7656	-33.5313	-36.125
1.5	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
3	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
4.5	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
6	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
7.5	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
9	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
10.5	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
12	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
13.5	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
15	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
16.5	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
18	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
19.5	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
21	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
22.5	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
24	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
25.5	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
27	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
28.5	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
30	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
31.5	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
33	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
34.5	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
36	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
37.5	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
39	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
40.5	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
42	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
43.5	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
45	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
46.5	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703
48	-38.7031	-54.8281	-70.9531	-87.0781	-103.203	-119.328	-135.453	-151.578	-167.703

Supporting Tables

P2635 Fuel Pump Performance Filtered Pressure Error Fault RePass Threshold Low map (kiloPascals)

X-axis= Target Fuel Pressure (kiloPascals)
Y-axis= Fuel Flow (grams / s)

	200	250	300	350	400	450	500	550	600
0	-8.95313	-12.25	-15.3438	-18.2813	-21.0469	-23.6719	-26.1563	-28.5	-30.7031
1.5	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
3	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
4.5	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
6	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
7.5	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
9	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
10.5	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
12	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
13.5	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
15	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
16.5	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
18	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
19.5	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
21	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
22.5	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
24	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
25.5	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
27	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
28.5	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
30	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
31.5	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
33	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
34.5	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
36	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
37.5	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
39	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
40.5	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
42	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
43.5	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
45	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
46.5	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547
48	-32.8906	-46.5938	-60.3125	-74.0156	-87.7188	-101.422	-115.125	-128.844	-142.547

Supporting Tables

P2635 Maximum Engine Intake Boost curve (kiloPascals)

X-axis= barometric pressure (kiloPascals)

40	50	60	70	80	90	100	110	120
0	0	0	0	0	0	0	0	0