Written description (general working principles) for all OBD stage I &II circuit (open circuit, shorted low and high, rationality) and electronics (PCU/ECU internal and communication) diagnostics:

Component / System	Fault code	Monitor Strategy Description	Malfunction Criteria	MIL activation	Secondary Parameters	Preconditioning	Demonstration test
Engine Coolant temperature Sensor	P0118	Circuit check	signal voltage, engine temperature sensor	5 sec. after Fault	N.A.	N.A.	Idle
	P0117	Circuit check	signal voltage, engine temperature sensor	5 sec. after Fault	N.A.	N.A.	Idle
	P0116	engine temperature exceeds plausible threshold	the engine temperature sensor singnal is lower than the threshold after engine start time 2s	5 sec. after Fault	N.A.	N.A.	Idle
	P0126	engine temperature is stuck	The difference between the raw sensor value and low-pass filtered raw sensor value less than the threshold	3 driving cycles	N.A.	N.A.	driving cycle
Fuel injector1	P0262	Circuit check	short to battery plus	5 sec. after Fault	N.A.	N.A.	idle
	P0261		short to ground		N.A.		idle
	P0201		open circuit		N.A.		idle
Fuel pump	P0629	Circuit check	short to battery plus	5 sec. after Fault	N.A.	N.A.	idle
	P0628		short to ground		N.A.		idle
	P0627		open circuit		N.A.		idle
Stepping motor	P0509	Circuit check	short to battery plus	5 sec. after Fault	N.A.	N.A.	idle
	P0508		short to ground		N.A	N.A	
	P0511		open circuit		N.A.	N.A.	
	P0511		Over current		N.A.	N.A.	
Ignition Coil “A” Primary Control	P2300	Circuit check	short to ground	5 sec. after Fault	N.A.	N.A.	idle
MIL	P0650	Circuit check	short to battery plus	OFF	N.A.	N.A.	N.A
			short to ground		N.A.		
			open circuit		N.A.		
	P0414		short to ground		N.A.	N.A.	
	P0413		open circuit		N.A.	N.A.	
Evaporative Emission System Purge Control	P0459	Circuit check	short to battery plus	5 sec. after Fault	N.A.	N.A.	driving cycle
	P0458		short to ground		N.A.	N.A.	
	P0444		open circuit		N.A.	N.A.	

Valve							
Manifold absolute pressure sensor	P0108	Circuit check, max limit exceeds	pressure sensor voltage ＞ UADPSMX	5 sec. after Fault	time after start end ＞ 2sec。	N.A.	idle
	P0107	Circuit check, min limit exceeds	pressure sensor voltage ＞ UADPSMN			N.A.	idle
	P0105	signal check: no pressure drop after start	pressure drop after start	3 driving cycles	engine speed threshold value for SIG fault check >1000rpm no pressure sensor Circuit fault throttle angle referred to lower limit＜20%	N.A.	driving cycle
	P0106	signal non_plausible	the measured intake manifold pressure is used for air charge which is compared with a minimum and maximum modelled air charge	3 driving cycles	time after start end >25sec Delta air charge between unfilted and filtered value ＜2.94% Nmot_w＞1200	N.A.	driving cycle
Crankshaft Position Sensor	P0322	Synchronisation didn't take place by some certain phase sensor signals has been detected.	pressure indicated by pressure sensor	5 sec. after Fault	engine speed	N.A.	driving cycle
			battery voltage, scanned value from ADC (wub)		N.A.	N.A.	
Idle speed control	P0507	actuator blocked at higher position	difference of idle speed precontrol (dns)	3 driving cycles	high canister load (B_tehb)	N.A.	idle
			with idle speed control integrator reach lower limit		idle condition (B_ll)	N.A.	
					Vehicle speed diagnosis completed, and no fault happened.	N.A.	
					vehicle speed (vfzg) =0	N.A.	
					altitude correction factor(fho)＞0.844	N.A.	
	P0506	actuator blocked at lower position	difference of idle speed precontrol (dns)		engine coolant temp.(tmot) ＞69.8℃	N.A.	
			with idle speed control integrator reach upper limit		intake air temperature(tans) ＞ 15℃	N.A.	
Intake Air Temperature Sensor	P0113	Circuit check	signal voltage, intake manifold temperature senso	5 sec. after Fault	N.A	N.A.	idle

	P0112	Circuit check	signal voltage, intake manifold temperature sensor		N.A	N.A.	
	P0111	:intake manifold temperature exceeds plausible threshold	the intake temperature sensor singnal is lower than the threshold after engine start time 2s		N.A	N.A.	
	P0114	intake manifold temperature is stuck	The difference between the maximum and minimum intake manifold temperature during driving cycle.	3 driving cycles	Engine temperature at start ＜40 ℃ air mass flow integrator output ＞23kg/h(when Engine temperature =-10℃)	N.A.	driving cycles
battery voltage (onboard)	P0563	rationality check max limit exceeds	battery voltage, scanned value from ADC (wub）	OFF	engine speed >5000rpm & time after start >3 s	N.A.	driving cycles
	P0562	rationality check min limit exceeds				N.A.	
	P0560	implausibility check				N.A.	
Vehicle speed	P0501	lower limit exceeded during fuel cut off	vehicle speed (vfzg)	5 sec. after Fault	3000rpm ＜engine speed＜8000rpm	N.A.	driving cycles
					Engine temperature＞ 39.76 ℃	N.A.	
					fuel cut off	N.A.	
					clutch pedal no pressed & no neutral gear	N.A.	
Throttle Position Sensor	P0123	Circuit check, max limit exceeds	Throttle/Pedal Pos.Sensor	5 sec. after Fault	engine speed ＞ 192rpm	N.A.	idle
	P0122	Circuit check, min limit exceeds	Throttle/Pedal Pos.Sensor				
Fuel system monitoring	P2177	fuel trim high limits exceded out of idle	multiplicative adaption value reach upper limit	3 driving cycles	fuel adaption close loop control	N.A.	driving cycles
	P2178	fuel trim low limits exceded out of idle	multiplicative adaption value reach lower limit			N.A.	
	P2187	fuel trim high limits exceded at idle	additive adaption value reach upper limit			N.A.	
	P2188	fuel trim high limits exceded at idle	additive adaption value reach lower limit			N.A.	

misfire Cylinder	P0301	misfire rate that harmful to catlyst (mx fault)	fault counter of catalyst damaging misfiring of all cylinders	MIL-blinking at present driving cycle & MIL-blinking off after ti-cutoff	fuel cut off	N.A	driving cycles
	P0301	misfire rate that deteriorate emission (mn fault)	fault counter of emission relevant misfiring of all cylinders	3 driving cycles	engine load		
	P0301	implausible fault	fault counter of emission relevant misfiring of all cylinders at the first interval after start.	3 driving cycles	N.A.		
Oxygen Sensor heater	P0032	Circuit check	short to battery plus	5 sec. after Fault	N.A.	N.A.	idle
	P0031	Circuit check	short to ground		N.A.	N.A.	
	P0030	Circuit check	open circuit		N.A.	N.A.	
	P0053	current sensor resistance is greater than threshold value	current lambda sensor resistance	3 driving cycles	11V ＜battery voltage＜ 16.6V	N.A	driving cycle
					engine speed ＞ 1100rpm		
					lambda sensor reach dew point		
					300℃≤Exhaust gas temperature ≤750 °C		
Oxygen Sensor deterioration (slow response)	P0133	filtered cycle delay time of sensor signal upstream cat.is greater than threshold value	filtered cycle delay time of sensor signal upstream	3 driving cycles	present cycle counter or ready flag of cycle duration monitoring> 1	N.A	driving cycle
					lambda close loop active		
					basic mixture adaptation not disabled		
					engine speed lie in diagnosis window （2600~8000 rpm）		
					main load lie in active window（30~90%）		
O2 sensor signal check(bank1	P0132	O2 Sensor Circuit High Voltage	output voltage O2 sensor upstream catalyst	5 sec. after Fault	general disabling conditions for DLSV	/	idle
					ub battery voltage>11 V		

)					1cyl O2 sensor reach the dew point and no O2 sensor heating fault		
					engine speed＞40rpm		
					no fuel injector fault		
					lamson=1.0 required lambd are ferred to lambda sensor fitting location		
	P0131	O2 Sensor Circuit Low Voltage	output voltage O2 sensor upstream catalyst		general disabling conditions for DLSV	/	
					ub battery voltage>11 V		
					1cyl O2 sensor reach the dew point and no O2 sensor heating fault		
					nmot engine speed＞ 40rpm		

O2 sensor signal check(bank1)	P0134	O2 Sensor Circuit No Activity Detected	output voltage O2 sensor upstream catalyst	/	general disabling conditions for DLSV ub battery voltage>11 V 1cyl O2 sensor reach the dew point and no O2 sensor heating fault	/	/
	P0130	O2 Sensor Voltage has a restricted amplitude Signal	output voltage O2 sensor upstream catalyst	/	condition theoretical lambda sensor operation readyness with heating and status keep ＞60s	/	/
		Sensor Voltage current has leakage to UB	output voltage O2 sensor upstream catalyst				
		O2 Sensor Voltage coupled with heater line	threshold for delta sensor voltage to check heater coupling upstr.cat coupling upstr.cat		general disabling conditions for DLSV ub battery voltage O2 sensor bank1 reach the dew point and no O2 sensor heating fault nmot engine speed＞40rpm Status of completion of heater ramping phase, before cat (LSF with Pumped Reference)		
Oxygen Sensor2 heater	P0038	Circuit check	short to battery plus	5 sec. after Fault	N.A.	N.A.	idle
	P0037	Circuit check	short to ground		N.A.	N.A.	
	P0036	Circuit check	open circuit		N.A.	N.A.	
	P0054	current sensor resistance is greater than threshold value	current lambda sensor resistance	3 driving cycles	11V ＜battery voltage＜16.6V engine speed ＞1100rpm lambda sensor reach dew point 300℃≤Exhaust gas temperature ≤750 °C	N.A	driving cycle
Oxygen Sensor2 deterioration (slow response)	P2270	O2 Sensor Signal Biased&Stuck Lean Bank 1 Sensor 2	Signal stuck	3 driving cycles	Idle Stuck time＞TUSSA	N.A	driving cycle
	P2271	O2 Sensor Signal Biased&Stuck Rich Bank 1 Sensor 2	Signal stuck		Idle Stuck time＞TUSSA		
O2 sensor2 signal	P0138	O2 Sensor2 Circuit High Voltage	output voltage O2 sensor2 upstream	5 sec. after Fault	general disabling conditions for DLSH	/	idle

check(bank1)			catalyst		ub battery voltage>11 V		
					1cyl O2 sensor2 reach the dew point and no O2 sensor heating fault		
					engine speed＞40rpm		
					no fuel injector fault		
					lamson=1.0 required lambd are ferred to lambda sensor2 fitting location		
	P0137	O2 Sensor2 Circuit Low Voltage	output voltage O2 sensor2 upstream catalyst		general disabling conditions for DLSH	/	
					ub battery voltage>11 V		
					1cyl O2 sensor2 reach the dew point and no O2 sensor heating fault		
					nmot engine speed＞40rpm		

	P0136	O2 Sensor2 Circuit No Activity Detected	output voltage O2 sensor2 upstream catalyst	/	general disabling conditions for DLSH ub battery voltage>11 V 1cyl O2 sensor2 reach the dew point and no O2 sensor heating fault	/	
	P2232	O2 Sensor2 Voltage has a restricted amplitude Signal	output voltage O2 sensor2 upstream catalyst	/	condition theoretical lambda sensor2 operation readyness with heating and status keep ＞60s	/	
		Sensor2 Voltage current has leakage to UB	output voltage O2 sensor2 upstream catalyst				
		O2 Sensor2 Voltage coupled with heater line	threshold for delta sensor2 voltage to check heater coupling upstr.cat coupling upstr.cat		general disabling conditions for DLSH ub battery voltage O2 sensor2 bank1 reach the dew point and no O2 sensor2 heating fault nmot engine speed＞ 40rpm Status of completion of heater ramping phase, before cat (LSF with Pumped Reference)		
Catalyst	P0420	Catalyst System Efficiency Below Threshold	Catalyst System Efficiency Below Threshold	3 driving cycles	system output of the ahkat	/	driving cycle
Misfire cyl. 0	P0301	misfire rate that harmful to catlyst (mx fault)	fault counter of catalyst damaging misfiring of all cylinders	/	fuel cut off	/	driving cycle
		misfire rate that deteriorate emission (mn fault)	fault counter of emission relevant misfiring of all cylinders	/	engine load	/	
		implausible fault	fault counter of emission relevant misfiring of all cylinders at the first interval after start.	/	/	/	
Fuel system	P2177	fuel trim high limits exceded out of idle	multiplicative adaption value reach upper limit	3 driving cycles	fuel adaption close loop control	/	driving cycle
	P2178	fuel trim low limits exceded out of idle	multiplicative adaption value reach lower limit			/	