

# 2014 Volkswagen Touareg Quick Reference Specification Book

## TABLE OF CONTENTS

<b>DTC Chart.....</b>	<b>1</b>
Engine Code - CNRB .....	1
Fuel and Air Mixture, Additional Emissions Regulations.....	1
Ignition System .....	23
Additional Exhaust Regulation.....	24
Speed and Idle Control.....	25
Control Module and Output Signals.....	26
Fuel and Air Ratios Control Module .....	32
<b>DTC Chart.....</b>	<b>33</b>
Engine Code - CGFA.....	33
Fuel and Air Mixture, Additional Emissions Regulations.....	33
Ignition System .....	50
Additional Exhaust Regulation.....	52
Speed and Idle Control.....	57
Control Module and Output Signals.....	57
Fuel and Air Ratios Control Module .....	60
Ignition System .....	65
Additional Emissions Regulations .....	66
Fuel and Air Mixture, Additional Emissions Regulations.....	72
HV Battery & Hybrid Power Electrical.....	73
<b>DTC Chart.....</b>	<b>96</b>
Engine Code - CGRA .....	96
Fuel and Air Mixture, Additional Emissions Regulations.....	96
Ignition System .....	109
Additional Exhaust Regulation.....	112
Speed and Idle Control.....	113
Control Module and Output Signals.....	114
Fuel and Air Ratios Control Module .....	116
Ignition System .....	121
Additional Emissions Regulations .....	122



# DTC CHART

## Engine Code - CNRB

### Fuel and Air Mixture, Additional Emissions Regulations

DTC	Error Message	Malfunction Criteria and Threshold Value
P0045	Turbocharger/Supercharger Boost Control "A" Circuit/Open	Diagnostic signal from power stage > 0.8 V (Out 1) and < 2 V (Out 2)
P0047	Turbocharger/Supercharger Boost Control "A" Circuit Low	Signal current > 8.00 to 18.00 A
P0048	Turbocharger/Supercharger Boost Control "A" Circuit High	Signal current > 8.00 to 18.00 A
P0071	Ambient Air Temperature Sensor Circuit "A" Range/Performance	<ul style="list-style-type: none"> <li>• Number of detected faults ≥ 6.00</li> <li>Cross Checks for Fault Detection:</li> <li>• AAT (Outside Air Temperature) vs. ECT @ cylinder head &gt; 40.0 K</li> <li>• AAT (Outside Air Temperature) vs IAT &gt; 45.0 K</li> <li>• AAT (Outside Air Temperature) vs FTS &gt; 45.0 K</li> <li>• AAT (Outside Air Temperature) vs EOT &gt; 40.0 K</li> <li>• AAT (Outside Air Temperature) vs ECT @ radiator outlet &gt; 40.0 K</li> <li>• AAT (Outside Air Temperature) vs ECT @ Cylinder block &gt; 40.0 K</li> </ul>
P0072	Ambient Air Temperature Sensor Circuit "A" Low	AAT (Outside Temperature Sensor) signal short to ground
P0073	Ambient Air Temperature Sensor Circuit "A" High	AAT (Outside Temperature Sensor) signal short to battery / open circuit
P0087	Fuel Rail/System Pressure - Too Low Bank 1	<ul style="list-style-type: none"> <li>• Positive control deviation step 1 &gt; 17000.00 to 50000.00 kPa</li> <li>• Positive control deviation step 2 &gt; 15000.00 kPa</li> <li>• Minimum rail pressure &lt; 0.00 to 12500.00 kPa</li> </ul>

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0088	Fuel Rail/System Pressure - Too High Bank 1	<ul style="list-style-type: none"> <li>• Control deviation &lt; -20,000 to -30,000 kPa</li> <li>• Pressure &gt; 215,000 kPa</li> </ul>
P0090	Fuel Pressure Regulator 1 Control Circuit/Open	Signal voltage < 4.70 V
P0091	Fuel Pressure Regulator 1 Control Circuit Low	Signal voltage 2.97 V
P0092	Fuel Pressure Regulator 1 Control Circuit High	Signal current > 3.00 A
P00AF	<p>Turbocharger/Supercharger Boost Control "A" Module Performance</p> <p>Dynamic response check: measured air mass flow by periodical stimulation of turbocharger</p>	<ul style="list-style-type: none"> <li>• Control deviation &gt; 8.00% or</li> <li>• Control deviation &lt; -8.00%</li> <li>• Actual position <math>\leq</math> 30.0%</li> <li>or</li> <li>• Control deviation &lt; -8.00%</li> <li>• Actual position &gt; 30.0%</li> <li>• Mean amplitude of air mass (characteristic value) &lt; 0.190 to 5.505%</li> </ul>
P00C6	Fuel Rail Pressure Too Low - Engine Cranking Bank 1	Rail high pressure < 12000.00 to 23000.00 kPa
P0101	<p>Mass or Volume Air Flow Sensor "A" Circuit Range/Performance</p> <p>Rationality Check</p>	<ul style="list-style-type: none"> <li>• Ratio of modeled and measured air mass flow &lt; 0.85</li> <li>• Ratio of modeled and measured air mass flow &gt; 1.15</li> </ul>
P0102	Mass or Volume Air Flow Sensor "A" Circuit Low	MAF sensor signal < 83.0 $\mu$ s
P0103	Mass or Volume Air Flow Sensor "A" Circuit High	MAF sensor signal > 4500.0 $\mu$ s
P0104	Mass or Volume Air Flow Sensor "A" Circuit Intermittent	MAF sensor signal period failed

DTC	Error Message	Malfunction Criteria and Threshold Value
P0111	Intake Air Temperature Sensor 1 Circuit Range/Performance Bank 1	<ul style="list-style-type: none"> <li>• Number of detected faults  <math>\geq 6.00</math></li> <li>MAF sensor signal <math>&lt; 83.0 \mu\text{s}</math></li> <li>• IAT vs. ECT @ cylinder head <math>&gt; 35.0 \text{ K}</math></li> <li>• IAT vs. AAT (Outside Air Temperature) <math>&gt; 45.0 \text{ K}</math></li> <li>• IAT vs. FTS <math>&gt; 40.0 \text{ K}</math></li> <li>• IAT vs. EOT <math>&gt; 35.0 \text{ K}</math></li> <li>• IAT vs. ECT @ radiator outlet <math>&gt; 35.0 \text{ K}</math></li> <li>• IAT vs. ECT @ cylinder block <math>&gt; 35.0 \text{ K}</math></li> </ul>
P0112	Intake Air Temperature Sensor 1 Circuit Low Bank 1	Signal voltage $< 0.10 \text{ V}$
P0113	Intake Air Temperature Sensor 1 Circuit High Bank 1	Signal voltage $> 3.255 \text{ V}$
P0116	Engine Coolant Temperature Sensor 1 Circuit Range/Performance  Cross Check	<ul style="list-style-type: none"> <li>• ECT increase <math>&lt; 2.00^\circ \text{ C}</math></li> <li>• ECT <math>&lt; 66.0^\circ \text{ C}</math></li> <li>• Evaluation timer <math>&gt; 80.0</math> to <math>1200.0 \text{ Sec.}</math></li> <li>• Number of detected faults <math>\geq 6.00</math></li> <li>Cross checks for fault detection:</li> <li>• ECT @ cylinder head vs. IAT <math>&gt; 35.0 \text{ K}</math></li> <li>• ECT @ cylinder head vs. FTS <math>&gt; 35.0 \text{ K}</math></li> <li>• ECT @ cylinder head vs. AAT (Outside Air Temperature) <math>&gt; 40.0 \text{ K}</math></li> <li>• ECT @ cylinder head vs. ECT @ radiator outlet <math>&gt; 30.0 \text{ K}</math></li> <li>• ECT @ cylinder head vs. ECT @ cylinder block <math>&gt; 30.0 \text{ K}</math></li> <li>• ECT @ cylinder head vs. EOT <math>&gt; 30.0 \text{ K}</math></li> </ul>
P0117	Engine Coolant Temperature Sensor 1 Circuit Low	Signal voltage $< 0.22 \text{ V}$
P0118	Engine Coolant Temperature Sensor 1 Circuit High	Signal voltage $> 4.92 \text{ V}$

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0121	Throttle/Pedal Position Sensor/Switch "A" Circuit Range/Performance  Out of range	<ul style="list-style-type: none"> <li>• Position sensor signal 0.15 to 0.30 V</li> <li>• Position sensor signal &gt; 1.00 V</li> </ul>
P0122	Throttle/Pedal Position Sensor/Switch "A" Circuit Low	Position sensor signal < 0.15 V
P0123	Throttle/Pedal Position Sensor/Switch "A" Circuit High	Position sensor signal $\geq$ 4.85 V
P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	ECT @ cylinder head < 66.0° C
P0130	O2 Sensor Circuit Bank 1 Sensor 1	Short to Battery Plus
		Virtual mass (VM) > 3.00 V
		Nernst voltage (UN) > 4.00 V
		Adjustment voltage (IA/IP) >1.50 V
		Short to Ground
		Virtual mass (VM) < 2.00 V
		Nernst voltage (UN) < 1.75 V
		Adjustment voltage (IA/IP) < 0.30 V
P0132	O2 Sensor Circuit High Voltage Bank 1 Sensor 1	Signal voltage > 3.20 V
P0133	O2 Sensor Circuit Slow Response Bank 1 Sensor 1	Time to reach 0 to 60% oxygen > 4.00 Sec.
P0134	O2 Sensor Circuit No Activity Detected Bank 1 Sensor 1	<ul style="list-style-type: none"> <li>• Integrated oxygen sensor temperature &gt; 280000 - 917476 Kelvin</li> <li>• Oxygen sensor heating not active</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P0135	O2 Sensor Heater Circuit Bank 1 Sensor 1  Short to Ground  Open Circuit  Rationality Check	<ul style="list-style-type: none"> <li>• Signal current &gt; 2.20 A</li> <li>• Signal voltage &lt; 2.15 V</li> <li>• Signal voltage &gt; 4.40 V</li> <li>• O2S ceramic temp &gt; 840.0° C</li> <li>• O2S ceramic temp &lt; 720.0° C</li> </ul>
P016A	Excessive Time To Enter Closed Loop Air/Fuel Ratio Control	Control intervention 0%
P0171	System Too Lean Bank 1	Fuel mass correction value < -0.03 g/rev
P0172	System Too Rich Bank 1	Fuel mass correction value < -0.03 g/rev
P0181	Fuel Temperature Sensor "A" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Number of detected faults ≥ 6.00</li> </ul> Cross Checks for Fault Detection: <ul style="list-style-type: none"> <li>• FTS vs. ECT @ cylinder head &gt; 35.0 K</li> <li>• FTS vs. IAT &gt; 40.0 K</li> <li>• FTS vs. EOT &gt; 35.0 K</li> <li>• FTS vs. AAT &gt; 45.0 K</li> <li>• FTS vs. ECT @ radiator outlet &gt; 35.0 K</li> <li>• FTS vs. ECT @ cylinder block &gt; 35.0 K</li> </ul>
P0182	Fuel Temperature Sensor "A" Circuit Low	Signal voltage < 0.10 V
P0183	Fuel Temperature Sensor "A" Circuit High	Signal voltage > 4.90 V
P0191	Fuel Rail Pressure Sensor Circuit Range/Performance Bank 1	<ul style="list-style-type: none"> <li>• Adaptation factor of Fuel Rail Pressure Regulator Valve &gt; 125.31%</li> <li>• Adaptation factor of Fuel Rail Pressure Regulator Valve &lt; 83.20%</li> <li>• Offset plausibility check, signal voltage either &lt; 0.428 V or &gt; 0.613 V</li> </ul>
P0192	Fuel Rail Pressure Sensor Circuit Low Bank 1	Signal voltage < 0.20 V

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0193	Fuel Rail Pressure Sensor Circuit High Bank 1	Signal voltage > 4.80 V
P01BA	Engine Oil Temperature Sensor "B" Range/ Performance	<ul style="list-style-type: none"> <li>• EOT cross checks for fault detection: <math>\geq 6</math> detected faults</li> <li>• EOT vs. ECT 3, IAT, FTS, AAT or ECT 2 &gt; 30 Kelvin</li> </ul>
P01BB	Engine Oil Temperature Sensor "B" Circuit Low	Signal voltage < 0.20 V for $\geq 5.00$ Sec.
P01BC	Engine Oil Temperature Sensor "B" Circuit High	Signal voltage > 4.85 V for $\geq 5.00$ Sec.
P01BD	Engine Oil Temperature Sensor "B" Circuit Intermittent/ Erratic	<ul style="list-style-type: none"> <li>• Oil temperature increase &lt; 3.00 K</li> <li>• Oil temperature &lt; 66.0° C</li> <li>• Evaluation timer &gt; 59.0 to 1490 Sec.</li> </ul>
P01E3	Engine Coolant Temperature Sensor 3 Circuit	Signal voltage > 4.92 V
P01E4	Engine Coolant Temperature Sensor 3 Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• Number of detected faults <math>\geq 6.00</math></li> <li>Cross Checks for Fault Detection: <ul style="list-style-type: none"> <li>• ETC @ cylinder block vs. IAT &gt; 35.0 K</li> <li>• ECT @ cylinder block vs FTS &gt; 35.0 K</li> <li>• ECT @ cylinder block vs AAT (Outside Air Temperature) &gt; 40.0 K</li> <li>• ECT @ cylinder block vs ECT @ radiator outlet &gt; 30.0 K</li> <li>• ECT @ cylinder block vs ECT @ Cylinder head &gt; 30.0 K</li> <li>• ECT @ cylinder block vs EOT &gt; 30.0 K</li> </ul> </li> </ul>
P01E5	Engine Coolant Temperature Sensor 3 Circuit Low	Signal voltage < 0.22 V



DTC	Error Message	Malfunction Criteria and Threshold Value
P0201	Cylinder 1 Injector "A" Circuit  Short to Battery Plus (low side)  Short Circuit Over load  Short Circuit (low side)	<ul style="list-style-type: none"> <li>• Signal from power stage &gt; 60.0 V</li> <li>• Signal voltage failed</li>   <li>• Signal voltage &gt; 30.0 V</li>   <li>• Deviation between set and actual signal voltage after charging &gt; 30.0%</li> <li>• Deviation between set and actual signal voltage before charging. 45.0%</li> </ul>
P0202	Cylinder 2 Injector "A" Circuit  Short to Battery Plus (low side)  Short Circuit Over load  Short Circuit (low side)	<ul style="list-style-type: none"> <li>• Signal from power stage &gt; 60.0 V</li> <li>• Signal voltage failed</li>   <li>• Signal voltage &gt; 30.0 V</li>   <li>• Deviation between set and actual signal voltage after charging &gt; 30.0%</li> <li>• Deviation between set and actual signal voltage before charging. 45.0%</li> </ul>
P0203	Cylinder 3 Injector "A" Circuit  Short to Battery Plus (low side)  Short Circuit Over load  Short Circuit (low side)	<ul style="list-style-type: none"> <li>• Signal from power stage &gt; 60.0 V</li> <li>• Signal voltage failed</li>   <li>• Signal voltage &gt; 30.0 V</li>   <li>• Deviation between set and actual signal voltage after charging &gt; 30.0%</li> <li>• Deviation between set and actual signal voltage before charging. 45.0%</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P0204	Cylinder 4 Injector "A" Circuit  Short to Battery Plus (low side)  Short Circuit Over load  Short Circuit (low side)	<ul style="list-style-type: none"> <li>• Signal from power stage &gt; 60.0 V</li> <li>• Signal voltage failed</li>   <li>• Signal voltage &gt; 30.0 V</li>   <li>• Deviation between set and actual signal voltage after charging &gt; 30.0%</li> <li>• Deviation between set and actual signal voltage before charging. 45.0%</li> </ul>
P0205	Cylinder 5 Injector "A" Circuit  Short to Battery Plus (low side)  Short Circuit Over load  Short Circuit (low side)	<ul style="list-style-type: none"> <li>• Signal from power stage &gt; 60.0 V</li> <li>• Signal voltage failed</li>   <li>• Signal voltage &gt; 30.0 V</li>   <li>• Deviation between set and actual signal voltage after charging &gt; 30.0%</li> <li>• Deviation between set and actual signal voltage before charging. 45.0%</li> </ul>
P0206	Cylinder 6 Injector "A" Circuit  Short to Battery Plus (low side)  Short Circuit Over load  Short Circuit (low side)	<ul style="list-style-type: none"> <li>• Signal from power stage &gt; 60.0 V</li> <li>• Signal voltage failed</li>   <li>• Signal voltage &gt; 30.0 V</li>   <li>• Deviation between set and actual signal voltage after charging &gt; 30.0%</li> <li>• Deviation between set and actual signal voltage before charging. 45.0%</li> </ul>
P0234	Turbocharger/Supercharger "A" Overboost Condition	<ul style="list-style-type: none"> <li>• Diff. set value boost pressure vs. actual boost pressure value &lt; -22.0 kPa</li> <li>or</li> <li>• Boost pressure &gt; 160.00 to 300.00 kPa</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P0236	Turbocharger/Supercharger Boost Sensor "A" Circuit Range/Performance	Diff. barometric sensor signal vs. boost pressure signal > 14.00 kPa
P0237	Turbocharger/Supercharger Boost Sensor "A" Circuit Low	Sensor voltage < 0.40 V
P0238	Turbocharger/Supercharger Boost Sensor "A" Circuit High	Sensor voltage >4.90 V
P0263	Cylinder 1 Contribution/Balance	<ul style="list-style-type: none"> <li>Injection balancing amount per cylinder. &gt; 0.0005 to 0.006 g/rev</li> </ul>
P0266	Cylinder 2 Contribution/Balance	<ul style="list-style-type: none"> <li>Injection balancing amount per cylinder. &gt; 0.0005 to 0.006 g/rev</li> <li>Calibration value of injector energizing time either &lt; 109 to 167 or &gt; 224 412 <math>\mu</math>s</li> <li>Diagnostic signal from power stage failed</li> </ul>
P0269	Cylinder 3 Contribution/Balance	<ul style="list-style-type: none"> <li>Injection balancing amount per cylinder. &gt; 0.0005 to 0.006 g/rev</li> <li>Calibration value of injector energizing time either &lt; 109 to 167 or &gt; 224 412 <math>\mu</math>s</li> <li>Diagnostic signal from power stage failed</li> </ul>
P026A	Charge Air Cooler Efficiency Below Threshold	Filtered charge air cooler efficiency < 7
P0272	Cylinder 4 Contribution/Balance	<ul style="list-style-type: none"> <li>Injection balancing amount per cylinder. &gt; 0.0005 to 0.006 g/rev</li> <li>Calibration value of injector energizing time either &lt; 109 to 167 or &gt; 224 412 <math>\mu</math>s</li> <li>Diagnostic signal from power stage failed</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P0275	Cylinder 5 Contribution/ Balance	<ul style="list-style-type: none"> <li>• Injection balancing amount per cylinder. &gt; 0.0005 to 0.006 g/rev</li> <li>• Calibration value of injector energizing time either &lt; 109 to 167 or &gt; 224 412 µs</li> <li>• Diagnostic signal from power stage failed</li> </ul>
P0278	Cylinder 6 Contribution/ Balance	<ul style="list-style-type: none"> <li>• Injection balancing amount per cylinder. &gt; 0.0005 to 0.006 g/rev</li> <li>• Calibration value of injector energizing time either &lt; 109 to 167 or &gt; 224 412 µs</li> <li>• Diagnostic signal from power stage failed</li> </ul>
P0299	Turbocharger/Supercharger "A" Underboost Condition	<ul style="list-style-type: none"> <li>• Diff. set value boost pressure vs. actual boost pressure value: depending on ECT &gt; 30.00 to 99.90 kPa</li> <li>• Diff. set value boost pressure vs. actual boost pressure value: depending on engine speed and fuel quantity &gt; 35.00 to 100.00 kPa</li> <li>• Boost pressure &lt; 0.00 to 85.00 kPa</li> </ul>
P2002	Particulate Filter Efficiency Below Threshold Bank 1  Functional check: missing substrate	<ul style="list-style-type: none"> <li>• PM Sensor signal current &gt; 12.0 µA</li> <li>• Pressure difference between measured and modeled value &lt; 0.00 to 8.05 kPa</li> </ul>
P2004	Intake Manifold Runner Control Stuck Open Bank 1	<ul style="list-style-type: none"> <li>• Control deviation &gt; 10% or</li> <li>• Control deviation &lt; -10%</li> <li>• Actual position &gt; 12.0%</li> </ul>
P2006	Intake Manifold Runner Control Stuck Closed Bank 1	<ul style="list-style-type: none"> <li>• Control deviation &gt; 10% or</li> <li>• Control deviation &lt; -10%</li> <li>• Actual position &gt; 12.0%</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P2008	Intake Manifold Runner Control Circuit/Open Bank 1	<ul style="list-style-type: none"> <li>• Diagnostic signal from power stage &gt; 0.8 V (output 1) and &lt; 2 V (output 2)</li> <li>or</li> <li>• Diagnostic signal from power stage = 8.00 to 18.00 A</li> <li>or</li> <li>• Diagnostic signal from power stage &gt; 5.00 V or &lt; 3.40 V</li> </ul>
P2009	Intake Manifold Runner Control Circuit Low Bank 1	Signal current > 8.00 to 18.0 A
P2010	Intake Manifold Runner Control Circuit High Bank 1	Signal current > 8.00 to 18.0 A
P2015	Intake Manifold Runner Position Sensor/Switch Circuit Range/Performance Bank 1	<ul style="list-style-type: none"> <li>• Position sensor signal &lt; 3550 mV</li> <li>• Position sensor signal &gt; 1450 mV</li> <li>or</li> <li>• Position sensor signal &gt; 550 mV and &lt; 250 mV</li> <li>or</li> <li>• Position sensor signal &gt; 4450 mV and &lt; 4750 mV</li> </ul>
P2016	Intake Manifold Runner Position Sensor/Switch Circuit Low Bank 1	Position sensor signal < 0.15 V
P2017	Intake Manifold Runner Position Sensor/Switch Circuit High Bank 1	Position sensor signal $\geq$ 4.850 V
P202A	Reducing Agent Tank Heater Control Circuit/Open	Conductance during heating $\leq$ 0.10 1/ $\Omega$
P202B	Reductant Tank Heater Control Circuit Low	Conductance @ start heating < 0.30 1/ $\Omega$
P202C	Reductant Tank Heater Control Circuit High	Conductance @ start heating > 0.62 1/ $\Omega$
P2031	Exhaust Gas Temperature Sensor Circuit Bank 1 Sensor 2	Signal voltage > 2.61 V
P2032	Exhaust Gas Temperature Sensor Circuit Low Bank 1 Sensor 2	Signal voltage < 0.68 mV

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P203A	Reductant Level Sensor "A" Circuit Low	<ul style="list-style-type: none"> <li>• Interval between watch dog pulses &gt; 80.0 Sec</li> <li>or</li> <li>• Level signal &lt; 25.0 to &gt; 85.0%</li> </ul>
P203B	Reductant Level Sensor "A" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Diagnostic signal of level sensing module &lt; 34.0%</li> <li>or</li> <li>• Diagnostic signal of level sensing module 34.0 to 43.99%</li> </ul>
P2047	Reductant Injection Valve Circuit/Open Bank 1 Unit 1	Signal voltage < 4.70 V
P2048	Reductant Injection Valve Circuit Low Bank 1 Unit 1	<ul style="list-style-type: none"> <li>• Signal voltage &lt; 2.97 V</li> <li>• Signal current &gt; 1.60 A</li> </ul>
P2049	Reducing Agent Injection Valve Circuit High	<ul style="list-style-type: none"> <li>• Signal current &gt; 1.80 A</li> <li>• Signal current &lt; 0.20 A</li> </ul>
P204A	Reductant Pressure Sensor Circuit	Signal voltage < 0.41 V
P204B	Reductant Pressure Sensor Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Actual pressure SCR delivery system &gt; 50.00 kPa</li> <li>BEFORE PRESSURE BUILD UP</li> </ul>
P204D	Reducing Agent Pressure Sensor Circuit High	Signal voltage > 4.72 V
P205A	Reductant Tank Temperature Sensor Circuit	Signal voltage > 4.70 V
P205B	Reductant Tank Temperature Sensor Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Difference between reductant temperature and AAT (Outside Temperature Sensor) &lt; 52.0 °C</li> <li>• Difference between reductant temperature and AAT (Outside Temperature Sensor) &gt; 30.0 °C</li> </ul>
P205C	Reductant Tank Temperature Sensor Circuit Low	Signal voltage < 0.30 V
P207F	Reducing Agent Quality Performance	Average efficiency < 0.50

DTC	Error Message	Malfunction Criteria and Threshold Value
P2080	Exhaust Gas Temperature Sensor Circuit Range/ Performance Bank 1 Sensor 1  Cross Check	<ul style="list-style-type: none"> <li>• Measured sensor temperature - mean value of modelled temperature &gt; 250.0 or &lt; - 200.0 K</li> <li>• Number of detected faults <math>\geq 4.00</math></li> </ul> Cross Checks for Fault Detection: <ul style="list-style-type: none"> <li>• EGT Sensor upstream Catalyst vs. EGT upstream Turbocharger &gt; 60.0 K</li> <li>• EGT Sensor upstream Catalyst vs. EGT downstream Catalyst &gt; 60.0 K</li> <li>• EGT Sensor upstream Catalyst vs. EGT downstream DPF &gt; 60.0 K</li> <li>• EGT Sensor upstream Catalyst vs. TEGR &gt; 60.0 K</li> </ul>
P2084	Exhaust Gas Temperature Sensor Circuit Range/ Performance Bank 1 Sensor 2  Cross Check	<ul style="list-style-type: none"> <li>• Measured sensor temperature - mean value of modelled temperature &lt; -100.0 K</li> <li>• Number of detected faults <math>\geq 4.00</math></li> </ul> Cross Checks for Fault Detection: <ul style="list-style-type: none"> <li>• EGT Sensor upstream Catalyst vs. EGT upstream Turbocharger &gt; 60.0 K</li> <li>• EGT Sensor upstream Catalyst vs. EGT downstream Catalyst &gt; 60.0 K</li> <li>• EGT Sensor upstream Catalyst vs. EGT downstream DPF &gt; 60.0 K</li> <li>• EGT Sensor upstream Catalyst vs. TEGR &gt; 60.0 K</li> </ul>
P208A	Reductant Pump "A" Control Circuit/Open	Signal voltage 4.70 to 5.40 V
P208C	Reductant Pump "A" Control Circuit Low	Signal voltage < 2.74 V
P208D	Reductant Pump "A" Control Circuit High	Signal current > 4.00 A

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P208E	Reductant Injection Valve Stuck Closed Bank 1 Unit 1	Missing number of signal peaks > 50.0
P20A0	Reductant Purge Control Valve "A" Circuit /Open	Power stage voltage > 2.97 or < 4.70 V
P20A2	Reductant Purge Control Valve "A" Circuit Low	Power stage voltage < 2.97 V
P20A3	Reductant Purge Control Valve "A" Circuit High	Power stage current > 3.00 A
P20A5	Reductant Purge Control Valve "A" Stuck Closed	Difference between pressure at start of pressure reduction and current pressure > 0.00 kPa
P20B5	Reductant Metering Unit Heater Control Circuit/Open	Conductance during heating ≤ 0.10 1/ O
P20B7	Reducing Agent Metering Unit Heater Control Circuit Low	<ul style="list-style-type: none"> <li>• Conductance @ start heating &lt; 0.33 1/ O</li> <li>Conductance @ start heating</li> <li>• Value &lt; 0.18 1/ O</li> <li>or</li> <li>• Value &lt; 0.04 1/ O</li> </ul>
P20B8	Reducing Agent Metering Unit Heater Control Circuit High	<ul style="list-style-type: none"> <li>• Conductance @ start heating &gt; 0.74 1/ O</li> <li>Conductance @ start heating</li> <li>• Value &gt; 0.96 1/ O</li> <li>or</li> <li>• Value &gt; 0.52 1/ O</li> </ul>
P20B9	Reductant Heater "A" Control Circuit/Open	Signal voltage < 4.70 V
P20BB	Reductant Heater "A" Control Circuit Low	Signal voltage < 2.97 V
P20BC	Reductant Heater "A" Control Circuit High	Signal current > 2.20 A
P20BD	Reductant Heater "B" Control Circuit/Open	Diagnostic signal from power stage < 4.70 V
P20BF	Reductant Heater "B" Control Circuit Low	Signal voltage < 2.97 V
P20C0	Reductant Heater "B" Control Circuit High	Diagnostic signal from power stage > 2.20 A
P20E8	Reductant Pressure Too Low	<ul style="list-style-type: none"> <li>• Actual pressure SCR delivery system &lt; 3750.0 kPa</li> <li>• Number of checks &gt; 21.00</li> </ul>



DTC	Error Message	Malfunction Criteria and Threshold Value
P20E9	Reductant Pressure Too High	<ul style="list-style-type: none"> <li>• Actual pressure SCR delivery system &gt; 795.00 kPa</li> <li>or</li> <li>• Actual pressure SCR delivery system &gt; 650.00 kPa</li> </ul>
P20EE	SCR NOx Catalyst Efficiency Below Threshold Bank 1	Average efficiency > 0.20
P20F4	Reductant Consumption Too Low	SCR adaptive value $\geq$ 1.79
P20F5	Reductant Consumption Too High	SCR adaptive value $\leq$ 0.51
P2100	Throttle Actuator "A" Control Motor Circuit/Open	Signal from power stage > 3.26 V and < 5.40 V
P2101	Throttle Actuator "A" Control Motor Circuit Range/Performance	Signal current > 8.00 to 18.0 A
P2102	Throttle Actuator "A" Control Motor Circuit Low	Signal current > 8.00 to 18.0 A
P2103	Throttle Actuator "A" Control Motor Circuit High	Signal current > 8.00 to 18.0 A
P2111	Throttle Actuator "A" Control System - Stuck Open	<ul style="list-style-type: none"> <li>• Control deviation &gt; 10%</li> <li>• Actual position &gt; 30%</li> <li>or</li> <li>• Control deviation &lt; -10%</li> <li>• Actual position <math>\leq</math> 30%</li> </ul>
P2112	Throttle Actuator "A" Control System - Stuck Closed	<ul style="list-style-type: none"> <li>• Control deviation &gt; 10%</li> <li>• Actual position &gt; 30%</li> <li>or</li> <li>• Control deviation &lt; -10%</li> <li>• Actual position &gt; 30%</li> </ul>
P2122	Throttle/Pedal Position Sensor/Switch "D" Circuit Low	Signal voltage < 0.65 V
P2123	Throttle/Pedal Position Sensor/Switch "D" Circuit High	Signal voltage > 4.89 V
P2127	Throttle/Pedal Position Sensor/Switch "E" Circuit Low	Signal voltage < 0.28 V
P2128	Throttle/Pedal Position Sensor/Switch "E" Circuit High	Signal voltage > 2.64 V
P2138	Throttle/Pedal Position Sensor/Switch "D"/"E" Voltage Correlation	Signal voltage sensor 1 vs. sensor 2 > 0.14 to 0.26 V

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P2146	Fuel Injector Group "A" Supply Voltage Circuit/Open	Diagnostic signal from power stage failed
P2149	Fuel Injector Group "B" Supply Voltage Circuit/Open	Diagnostic signal from power stage failed
P2152	Fuel Injector Group "C" Supply Voltage Circuit/Open	Diagnostic signal from power stage failed
P2181	Cooling System Performance	Deviation between target and measured ECT < -7.50 K
P2183	Engine Coolant Temperature Sensor 2 Circuit Range/ Performance	ECT 2 at radiator outlet vs IAT or AAT (Outside Temperature Sensor) or FTS at start up > 35.0 Kelvin
P2184	Engine Coolant Temperature Sensor 2 Circuit Low	Signal voltage < 0.22 V
P2185	Engine Coolant Temperature Sensor 2 Circuit High	Signal voltage > 4.92 V
P2195	O2 Sensor Signal Biased/ Stuck Lean Bank 1 Sensor 1	<ul style="list-style-type: none"> <li>• Measured oxygen concentration @ fuel cutoff &gt; 25.6 or &lt; 14.70%</li> <li>or</li> <li>• Measured oxygen concentration compared with calculated oxygen concentration deviation @ part load &gt; 11.00 or &lt; 32.77%</li> </ul>
P2196	O2 Sensor Signal Biased/ Stuck Rich Bank 1 Sensor 1	Measured oxygen concentration @ fuel cutoff > 25.6 or < 14.70%
P2200	NOx Sensor Circuit Bank 1 Sensor 1	<ul style="list-style-type: none"> <li>• Message from NOx-Sensor failure</li> <li>• NOx sensor signal ratio of validity <math>\geq 0.50</math></li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P2201	NOx Sensor Circuit Range/ Performance Bank 1 Sensor 1  Rationality Check High  NOx Sensor undershoot detection Dynamic check  Offset plausibility check	<ul style="list-style-type: none"> <li>• Measured NOx value vs. calculated NOx value / calculated NOx value &gt; -0.60</li> <li>• Measured NOx value vs. calculated NOx value / calculated NOx value &gt; 0.60</li> <li>• NOx value &lt; -35.00 ppm</li> <li>• Time to decrease 100% to 60% NOx &gt; 4.50 Sec.</li> <li>• Average NOx Offset value &gt; 50.00 ppm</li> <li>• Number of checks 2.00</li> <li>• Average NOx Offset value &lt; -30.00</li> <li>• Number of checks 2.00</li> </ul>
P2202	NOx Sensor Circuit Low Bank 1 Sensor 1	NOx value < -105 ppm
P2203	NOx Sensor Circuit High Bank 1 Sensor 1	NOx value > 1655 ppm
P2209	NOx Sensor Heater Sense Circuit Range/Performance Bank 1 Sensor 1	NOx control active time since dew point exceeded > 180 Sec.
P220A	NOx Sensor Supply Voltage Circuit Bank 1 Sensor 1	Sensor supply voltage > 1.50 V
P220B	NOx Sensor Supply Voltage Circuit Bank 1 Sensor 2	Difference between battery voltage and sensor supply voltage > 1.50 V
P2237	O2 Sensor Positive Current Control Circuit/Open Bank 1 Sensor 1	Measured oxygen concentration (absolute value) < 0.01
P2243	O2 Sensor Reference Voltage Circuit/Open Bank 1 Sensor 1	<ul style="list-style-type: none"> <li>• O2S internal resistance &gt; 3.00 V</li> <li>• Oxygen signal front &lt; -1.30 V or</li> <li>• Oxygen signal front &gt; 1.50 V</li> </ul>
P2251	O2 Sensor Negative Current Control Circuit/Open Bank 1 Sensor 1	<ul style="list-style-type: none"> <li>• O2S internal resistance voltage &gt; 3.00 V</li> <li>• Oxygen signal front = -0.20 to 0.20 V</li> </ul>

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P2263	Turbocharger/Supercharger Boost System Performance	Control deviation > 8%
P2279	MAP/MAF - Throttle Position Correlation	Ratio of measured and modeled mass air flow 0.45 to 0.80
P229E	NOx Sensor (Bank 1 Sensor 2) Circuit	NOx sensor status ratio > 0.5
P2294	Fuel Pressure Regulator 2 Control Circuit/Open	Signal voltage < 4.70 V
P2295	Fuel Pressure Regulator 2 Control Circuit Low	Signal voltage < 2.97 V
P2296	Fuel Pressure Regulator 2 Control Circuit High	Signal current > 3.00 A
P229E	NOx Sensor Circuit Bank 1 Sensor 2 Short to Battery Plus/ Short to Ground NOx Sensor Feedback Check	<ul style="list-style-type: none"> <li>• Message from NOx-Sensor failure</li> <li>• NOx sensor signal ratio of validity <math>\geq 0.50</math></li> </ul>
P229F	NOx Sensor Circuit Range/ Performance Bank 1 Sensor 2  Offset Plausibility Check  Offset Plausibility Check  Signal Range Check  Nox Sensor Self Diagnosis Monitoring  Rationality Check  Dynamic Check	<ul style="list-style-type: none"> <li>• NOx value &lt; -35.00 ppm</li> <li>• Average NOx Offset value &gt; -30.00 ppm</li> <li>• Number of checks 2.00</li> <li>• Average NOx Offset value &gt; 50.00 ppm</li> <li>• Number of checks 2.00</li> <li>• NOx Sensor characteristic line: average self diagnosis value &lt; 60.00 or &gt; 140.00%</li> <li>• Counted self diagnosis aborts &gt; 6.00</li> <li>• Measured oxygen concentration compared with calculated oxygen concentration deviation @ part load &gt; 11.00%</li> <li>• Time to reach 0% to 59% Oxygen &gt; 4.50 Sec</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P22A0	NOx Sensor Circuit Low Bank 1 Sensor 2 Out of Range Low	<ul style="list-style-type: none"> <li>• NOx sensor lambda signal &lt; -0.200</li> <li>• NOx value &lt; -105.0 ppm</li> </ul>
P22A1	NOx Sensor Circuit High Bank 1 Sensor 2 Out of Range High	<ul style="list-style-type: none"> <li>• NOx sensor lambda signal &gt; 1.54</li> <li>• NOx value &lt; 1655.0 ppm</li> </ul>
P22A7	NOx Sensor Heater Sense Circuit Range/Performance Bank 1 Sensor 2	NOx control active time since dew point exceeded > 180 Sec
P240F	EGR Slow Response	<ul style="list-style-type: none"> <li>• Calculated characteristic value: negative gradient of target air mass flow <math>\geq 35.00</math> or</li> <li>• Calculated characteristic value: positive gradient of target air mass flow <math>\geq 30.00</math></li> </ul>
P2425	EGR Cooling Valve Control Circuit/Open	Signal voltage < 4.70 V
P2426	EGR Cooling Valve Control Circuit Low	Signal voltage < 2.97 V
P2427	EGR Cooling Valve Control Circuit High	Signal current > 2.20 A
P242A	Exhaust Gas Temperature Sensor Circuit Bank 1 Sensor 3	Signal voltage > 2.61 V

DTC	Error Message	Malfunction Criteria and Threshold Value
P242B	Exhaust Gas Temperature Sensor Circuit Range/ Performance Bank 1 Sensor 3  Cross Check	<ul style="list-style-type: none"> <li>• Temperature difference to EGR temp, T3, T4, T5, T6 &gt; 60.0° K</li> <li>or</li> <li>• Mean value of modeled - measured T5 &gt; 100.0° K</li> <li>• Number of detected faults ≥ 4.00</li> </ul> Cross Checks for Fault Detection: <ul style="list-style-type: none"> <li>• EGT Sensor downstream Catalyst vs. EGT upstream Catalyst &gt; 60.0 K</li> <li>• EGT Sensor downstream Catalyst vs. EGT upstream Turbocharger &gt; 60.0 K</li> <li>• EGT Sensor downstream Catalyst vs. EGT downstream DPF &gt; 60.0 K</li> <li>• EGT Sensor downstream Catalyst vs. TEGR &gt; 60.0 K</li> </ul>
P242C	Exhaust Gas Temperature Sensor Circuit Low Bank 1 Sensor 3	Signal voltage < 0.68 V
P244C	Exhaust Temperature Too Low For Particulate Filter Regeneration Bank 1	<ul style="list-style-type: none"> <li>• Modelled EGT downstream Catalyst &lt; 350.0° C</li> <li>• EGT sensor response time &gt; 260.0 Sec.</li> </ul>
P2452	Particulate Filter Pressure Sensor "A" Circuit	Sensor voltage > 4.90 V
P2453	Particulate Filter Pressure Sensor "A" Circuit Range/ Performance  Signal range check  Hose Line Sensor DPF Downstream Not Connected	<ul style="list-style-type: none"> <li>• Pressure difference between absolute value and filtered value &gt; 3.00 kPa or &lt; -3.00 kPa</li> <li>• DPF difference pressure &lt; -3.00 kPa</li> <li>• Differential pressure signal &gt; 6.00 to 22.00 kPa</li> </ul>
P2454	Particulate Filter Pressure Sensor "A" Circuit Low	Sensor voltage < 0.20 V
P2458	Particulate Filter Regeneration Duration Bank 1	Accumulated timer of regeneration duration > 93.35 Min
P2459	Particulate Filter Regeneration Frequency Bank 1	Difference soot mass- upper threshold mode > 0.00 g

DTC	Error Message	Malfunction Criteria and Threshold Value
P245B	EGR Cooler Bypass Control Circuit Range/Performance Bank 1	<ul style="list-style-type: none"> <li>Positive difference between measured and target temperature too high 10.0 to 70.0 K</li> </ul> or <ul style="list-style-type: none"> <li>Negative difference between measured and target temperature too low -15.0 to -10.0 K</li> </ul>
P2463	Particulate Filter Restriction - Soot Accumulation Bank 1	<ul style="list-style-type: none"> <li>Calculated PDF loading &gt; 40.0 g</li> <li>Soot mass exceeds maximum value &gt; 44.0 g</li> </ul>
P246E	Exhaust Gas Temperature Sensor Circuit Bank 1 Sensor 4	Signal voltage > 2.61 V
P246F	Exhaust Gas Temperature Sensor Circuit Range/Performance Bank 1 Sensor 4  Cross Check	<ul style="list-style-type: none"> <li>Measured sensor temperature - mean value of modelled temperature &lt; -100.0 K</li> <li>Number of detected faults <math>\geq 4.00</math></li> </ul> Cross Checks for Fault Detection: <ul style="list-style-type: none"> <li>EGT Sensor downstream DPF vs. EGT upstream Catalyst 60.0 K</li> <li>EGT Sensor downstream DPF vs. EGT downstream Catalyst &gt; 60.0 K</li> <li>EGT Sensor downstream DPF vs. EGT upstream Turbocharger &gt; 60.0 K</li> <li>EGT Sensor downstream DPF vs. TEGR &gt; 60.0 K</li> </ul>
P2470	Exhaust Gas Temperature Sensor Circuit Low Bank 1 Sensor 4	Signal voltage < 0.68 V
P247A	Exhaust Gas Temperature Out of Range Bank 1 Sensor 3	Difference between target and measured exhaust gas temperature is either > 200.0 K or < -100.0 K

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P24AE	Particulate Matter Sensor Circuit  Short to Ground  Functional Check	<ul style="list-style-type: none"> <li>• Signal voltage negative connection &gt; 4.70 V</li> <li>• Signal voltage negative connection &lt; 0.30 V</li> <li>• Current (IDE) @ measurement 1 &lt; 2.00 <math>\mu</math>A</li> <li>• Difference between current (IDE) measurement 1 and 2 &lt; 0.15 <math>\mu</math>A</li> </ul>
P24AF	Particulate Matter Sensor Circuit Range/Performance	Accumulated change in heater voltage $\leq$ 0.25 V
P24B0	Particulate Matter Sensor Circuit Low	Signal current (IDE) > 5.00 $\mu$ A
P24B1	Particulate Matter Sensor Circuit High	Signal voltage negative connection (IDE) = 0.00 V or > 4.10 V
P24B3	Particulate Matter Sensor Heater Control Circuit/Open	<ul style="list-style-type: none"> <li>• Heating coil resistance &lt; 1.06 to 2.31 <math>\Omega</math></li> <li>or</li> <li>• Heating coil resistance &lt; 2.94 to 5.13 <math>\Omega</math></li> </ul>
P24B5	Particulate Matter Sensor Heater Control Circuit Low	Heater current < 1.00 or > 15.0 A
P24B6	Particulate Matter Sensor Heater Control Circuit High	Heater current $\geq$ 0.20 A
P24C6	Particulate Matter Sensor Temperature Circuit	<ul style="list-style-type: none"> <li>• Short to ground &gt; 0.30 V</li> <li>• Short to battery &gt; 3.00 V</li> </ul>
P24C7	Particulate Matter Sensor Temperature Circuit Range/Performance  Plausibility Check	PM Temperature Sensor vs. Mean Value of: <ul style="list-style-type: none"> <li>• EGT upstream Catalyst &gt; 60.0 K</li> <li>• Measured sensor temperature vs. mean value of modeled temperature &lt; -100 K</li> </ul>



DTC	Error Message	Malfunction Criteria and Threshold Value
P24D0	Particulate Matter Sensor Supply Voltage Circuit Low  Signal Range Check Low or High	Difference Between Measured Battery Voltage (Ecm) and PM Sensor Supply Wire Voltage: • Value > 1.10 V or > 2.60 V or > 3.00 V Difference Between Measured Pm Sensor Voltage and Battery Voltage (ECM): • Value > 1.90 V or > 2.60 V or > 3.00 V
P2564	Turbocharger Boost Control Position Sensor "A" Circuit Low	Sensor signal voltage < 0.15 V
P2565	Turbocharger Boost Control Position Sensor "A" Circuit High	Sensor signal voltage > 4.85 V
P261A	Coolant Pump "B" Control Circuit/Open	• Open circuit Signal voltage < 5 V • Functional voltage = 3.2 - 3.5 V
P268A	Fuel Injector Calibration Not Learned/Programmed	Deviation to target rail pressure > 1500 - 2000 kPa for > 40 Sec.
P310E	Exhaust Gas Recirculation Cooler Bypass Valve 2 Implausible Signal	Measured temperature < 0.80
P3348	Turbocharger Control Unit Electrical Malfunction	Signal current 8.00 to 18.0 A

## Ignition System

DTC	Error Message	Malfunction Criteria and Threshold Value
P0300	Random/Multiple Cylinder. Misfire Detected	• Counted misfire per cylinder > 180.00 • Number of combustion cycles tested ≥ 220.00 • Number of cylinders with detected misfire > 1.00
P0301	Cylinder 1 Misfire Detected	• Counted misfire per cylinder > 180.00 • Number of combustion cycles tested ≥ 220.00

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0302	Cylinder 2 Misfire Detected	<ul style="list-style-type: none"> <li>Counted misfire per cylinder &gt; 180.00</li> <li>Number of combustion cycles tested <math>\geq</math> 220.00</li> </ul>
P0303	Cylinder 3 Misfire Detected	<ul style="list-style-type: none"> <li>Counted misfire per cylinder &gt; 180.00</li> <li>Number of combustion cycles tested <math>\geq</math> 220.00</li> </ul>
P0304	Cylinder 4 Misfire Detected	<ul style="list-style-type: none"> <li>Counted misfire per cylinder &gt; 180.00</li> <li>Number of combustion cycles tested <math>\geq</math> 220.00</li> </ul>
P0305	Cylinder 5 Misfire Detected	<ul style="list-style-type: none"> <li>Counted misfire per cylinder &gt; 180.00</li> <li>Number of combustion cycles tested <math>\geq</math> 220.00</li> </ul>
P0306	Cylinder 6 Misfire Detected	<ul style="list-style-type: none"> <li>Counted misfire per cylinder &gt; 180.00</li> <li>Number of combustion cycles tested <math>\geq</math> 220.00</li> </ul>
P0321	Ignition/Distributor Engine Speed Input Circuit Range/Performance	<ul style="list-style-type: none"> <li>Counted teeth vs. reference &gt; 200</li> </ul> or <ul style="list-style-type: none"> <li>Monitoring reference gap failure</li> </ul>
P0322	Ignition/Distributor Engine Speed Input Circuit No Signal	<ul style="list-style-type: none"> <li>Camshaft signals &gt; 3.00 and</li> <li>Camshaft signals = no signal</li> </ul>
P0381	Glow Plug/Heater Indicator Control Circuit/Open	Glow plug indicator control (sent message) vs. glow plug indicator (received message) status not equal

### **Additional Exhaust Regulation**

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0401	EGR "A" Flow Insufficient Detected	Control deviation (EGR) < - 45.0 to 200.0 g/rev
P0402	EGR "A" Flow Excessive Detected	Mass air flow ratio calculated from: mass air flow measured vs. mass air flow modeled > 1.29

DTC	Error Message	Malfunction Criteria and Threshold Value
P0403	EGR "A" Control Circuit/Open	<ul style="list-style-type: none"> <li>• Signal current &gt; 8.00 to 18.0 A</li> <li>• Control deviation &gt; 10.00 %</li> </ul> or <ul style="list-style-type: none"> <li>• Control deviation &lt;-10.00%</li> <li>• Actual position &gt; 17.00%</li> </ul>
P0404	EGR "A" Control Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Control deviation &gt; 10%</li> <li>• Actual position &gt; 17%</li> </ul>
P0405	EGR Sensor "A" Circuit Low	Position sensor signal $\geq 0.25$ V
P0406	EGR Sensor "A" Circuit High	Position sensor signal $\geq 4.75$ V
P040B	EGR Temperature Sensor "A" Circuit Range/Performance	Measured sensor temperature - mean value of modelled temperature < -90.0 to -40.0 K
P040C	EGR Temperature Sensor "A" Circuit Low	Signal voltage < 0.68 V
P040D	EGR Temperature Sensor "A" Circuit High	Signal voltage > 2.61 V
P0420	Catalyst System Efficiency Below Threshold Bank 1	Ratio of measured and modeled heat < 0.30
P046C	EGR Sensor "A" Circuit Range/Performance  Out of Range	<ul style="list-style-type: none"> <li>• Position sensor signal &gt; 1.05 V</li> <li>• Position sensor signal 0.25 to 0.35 V</li> </ul>
P04DD	Cold Start EGR "A" Flow Insufficient Detected	Control deviation < f(engine speed, injection quantity, target air mass flow)
P04DE	Cold Start EGR "A" Flow Excessive Detected	Ratio of modeled and measured air mass flow > f(turbo charger position)

### Speed and Idle Control

DTC	Error Message	Malfunction Criteria and Threshold Value
P0501	Vehicle Speed Sensor "A" Circuit Range/Performance	Vehicle speed < 2.00 MPH
P0502	Vehicle Speed Sensor "A" Circuit Low	Sensor signal failure
P0506	Idle Control System RPM - Lower Than Expected	Difference between target and measured idle engine speed < 10.0%

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0507	Idle Control System RPM - Higher Than Expected	Difference between target and measured idle engine speed > 10.0%
P050A	Cold Start Idle Air Control System Performance	Idle speed control deviation more than 10% under or 10% above desired idle speed
P050E	Cold Start Engine Exhaust Temperature Too Low	<ul style="list-style-type: none"> <li>• Calculated SCR-temperature &lt; 150.0 to 200.0° C</li> <li>• Modeled heat quantity ≥ 120.0 to 200.0 kJ</li> </ul>
P052F	Glow Plug Control Module 1 System Voltage	Voltage supply via LIN message = 0.00 V
P0544	Exhaust Gas Temperature Sensor Circuit Bank 1 Sensor 1	Signal voltage > 2.61 V
P0545	Exhaust Gas Temperature Sensor Circuit Low Bank 1 Sensor 1	Signal voltage < 0.68 V
P054E	Idle Control System - Fuel Quantity Lower Than Expected	Expected fuel quantity vs. actual fuel quantity < 0.004 g/rev.
P054F	Idle Control System - Fuel Quantity Higher Than Expected	Expected fuel quantity vs. actual fuel quantity > 0.018 to 0.033 g/rev.

## **Control Module and Output Signals**

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0604	Internal Control Module Random Access Memory (RAM) Error	EEPROM error
P0605	Internal Control Module Read Only Memory (ROM) Error	Internal self test failed
P0606	Control Module Processor	<ul style="list-style-type: none"> <li>• Number of camshaft revolutions with irregular Pol 1 shut offs &gt; 10.00</li> <li>• Number of camshaft revolutions with irregular Pol 2 shut offs &gt; 10.00</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P0607	Control Module Performance Communication Check Signal Range Check Short to Ground Short to Battery / Open Circuit	<ul style="list-style-type: none"> <li>• Supply voltage for IC &lt; 9.00 V</li> <li>• Internal check failed</li> <li>• Oxygen sensor adaption value is either &gt; 0.20 or &lt; -0.20 V</li> <li>• Sensor voltage &lt; 0.94 V</li> <li>• Sensor voltage &gt; 4.76 V</li> </ul>
P0634	Control Module Internal Temperature "A" Too High	Power stage temperature > 150.0° C
P0638	Throttle Actuator Control Range/Performance Bank 1	Diagnostic signal = low state
P0641	Sensor Reference Voltage "A" Circuit/Open	Signal voltage deviation > +/- 0.30 V
P064C	Glow Plug Control Module 1	Message from Glow Plug Control Module incorrect
P0651	Sensor Reference Voltage "B" Circuit/Open	Signal voltage deviation > +/- 0.30 V
P066A	Cylinder 1 Glow Plug Control Circuit Low	Glow current $\geq$ 70 A
P066B	Cylinder 1 Glow Plug Control Circuit High	Message from glow plug control module incorrect
P066C	Cylinder 2 Glow Plug Control Circuit Low	Glow current $\geq$ 70 A
P066D	Cylinder 2 Glow Plug Control Circuit High	Message from glow plug control module incorrect
P066E	Cylinder 3 Glow Plug Control Circuit Low	Glow current $\geq$ 70 A
P066F	Cylinder 3 Glow Plug Control Circuit High	Message from glow plug control module incorrect
P0671	Cylinder 1 Glow Plug Circuit	Glow current $\leq$ 2.20 A
P0672	Cylinder 2 Glow Plug Circuit	Glow current $\leq$ 2.20 A
P0673	Cylinder 3 Glow Plug Circuit	Glow current $\leq$ 2.20 A
P0674	Cylinder 4 Glow Plug Circuit	Glow current $\leq$ 2.20 A
P0675	Cylinder 5 Glow Plug Circuit	Glow current $\leq$ 2.20 A
P0676	Cylinder 6 Glow Plug Circuit	Glow current $\leq$ 2.20 A
P067A	Cylinder 4 Glow Plug Control Circuit Low	Glow current $\geq$ 70.0 A

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P067B	Cylinder 4 Glow Plug Control Circuit High	Message from Glow Plug Control Module incorrect
P067C	Cylinder 5 Glow Plug Control Circuit Low	Glow current $\geq 70.0$ A
P067D	Cylinder 5 Glow Plug Control Circuit High	Message from Glow Plug Control Module incorrect
P067E	Cylinder 6 Glow Plug Control Circuit Low	Glow current $\geq 70.0$ A
P067F	Cylinder 6 Glow Plug Control Circuit High	Message from Glow Plug Control Module incorrect
P0683	Glow Plug Control Module 1 to PCM Communication Circuit	LIN message no feedback
P0697	Sensor Reference Voltage "C" Circuit/Open	Signal voltage deviation $> \pm 0.30$ V
P06B9	Cylinder 1 Glow Plug Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Glow plug resistance (between 4 - 9 Sec.) <math>&lt; 0.3</math> ohm</li> <li>• Glow plug resistance (between 9 - 14 Sec.) <math>&lt; 0.4</math> ohm</li> <li>• Glow plug resistance (after 14 Sec.) <math>&lt; 0.5</math> ohm</li> <li>• Glow plug resistance anytime <math>&gt; 1.2</math> ohm</li> </ul>
P06BA	Cylinder 2 Glow Plug Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Glow plug resistance (between 4 - 9 Sec.) <math>&lt; 0.3</math> ohm</li> <li>• Glow plug resistance (between 9 - 14 Sec.) <math>&lt; 0.4</math> ohm</li> <li>• Glow plug resistance (after 14 Sec.) <math>&lt; 0.5</math> ohm</li> <li>• Glow plug resistance anytime <math>&gt; 1.2</math> ohm</li> </ul>
P06BB	Cylinder 3 Glow Plug Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Glow plug resistance (between 4 - 9 Sec.) <math>&lt; 0.3</math> ohm</li> <li>• Glow plug resistance (between 9 - 14 Sec.) <math>&lt; 0.4</math> ohm</li> <li>• Glow plug resistance (after 14 Sec.) <math>&lt; 0.5</math> ohm</li> <li>• Glow plug resistance anytime <math>&gt; 1.2</math> ohm</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P06BC	Cylinder 4 Glow Plug Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Glow plug resistance (between 4 - 9 Sec.) &lt; 0.3 ohm</li> <li>• Glow plug resistance (between 9 - 14 Sec.) &lt; 0.4 ohm</li> <li>• Glow plug resistance (after 14 Sec.) &lt; 0.5 ohm</li> <li>• Glow plug resistance anytime &gt; 1.2 ohm</li> </ul>
P06BD	Cylinder 5 Glow Plug Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Glow plug resistance (between 4 - 9 Sec.) &lt; 0.3 ohm</li> <li>• Glow plug resistance (between 9 - 14 Sec.) &lt; 0.4 ohm</li> <li>• Glow plug resistance (after 14 Sec.) &lt; 0.5 ohm</li> <li>• Glow plug resistance anytime &gt; 1.2 ohm</li> </ul>
P06BE	Cylinder 6 Glow Plug Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Glow plug resistance (between 4 - 9 Sec.) &lt; 0.3 ohm</li> <li>• Glow plug resistance (between 9 - 14 Sec.) &lt; 0.4 ohm</li> <li>• Glow plug resistance (after 14 Sec.) &lt; 0.5 ohm</li> <li>• Glow plug resistance anytime &gt; 1.2 ohm</li> </ul>
P06C5	Cylinder 1 Glow Plug Incorrect	Internal resistance < 0.11 and > 1.15 Ω
P06C6	Cylinder 2 Glow Plug Incorrect	Internal resistance < 0.11 and > 1.15 Ω
P06C7	Cylinder 3 Glow Plug Incorrect	Internal resistance < 0.11 and > 1.15 Ω
P06C8	Cylinder 4 Glow Plug Incorrect	Internal resistance < 0.11 and > 1.15 Ω
P06C9	Cylinder 5 Glow Plug Incorrect	Internal resistance < 0.11 and > 1.15 Ω
P06CA	Cylinder 6 Glow Plug Incorrect	Internal resistance < 0.11 and > 1.15 Ω
P06E5	Glow Plug Control Module 1 Performance	Ground offset ≥ 1.76 V or ≤ -1.76 V
P06FE	Cold Start Diesel Intake Air Flow Control Performance	Signal Low
U0001	High Speed CAN Communication Bus	CAN message = no feedback

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
U0002	High Speed CAN Communication Bus Performance	Global time out. Receiving no messages.
U0028	Vehicle Communication Bus A	CAN message = no feedback
U0029	Vehicle Communication Bus A Performance	Global time out. Receiving no messages.
U0037	Vehicle Communication Bus B	CAN message = no feedback
U0038	Vehicle Communication Bus B Performance	Global time out. Receiving no messages.
U0101	Lost Communication with TCM	No TCM messages received.
U0106	Lost Communication with Glow Plug Control Module	LIN message No message received
U0121	Lost Communication with Anti-Lock Brake System (ABS) Control Module	No CAN messages received from ABS module
U0140	Lost Communication with Body Control Module	No CAN messages from BCM
U0146	Lost Communication with Gateway "A"	CAN messages from Gateway = no message.
U0155	Lost Communication with Instrument Panel Cluster (IPC) Control Module	No CAN messages received from Instrument cluster
U02A3	Lost Communication with PM Sensor	No CAN message received
U0302	Software Incompatibility with Transmission Control Module	Auto trans messages received from ECM
U0307	Software Incompatibility with Glow Plug Control Module	Software check via LIN message incorrect
U04A4	Invalid Data Received From PM Sensor	Communication PM sensor control unit failed > 600 mSec.
U0402	Invalid Data Received From Transmission Control Module	Received data, implausible message
U0407	Invalid Data Received From Glow Plug Control Module 1	Implausible messages received



DTC	Error Message	Malfunction Criteria and Threshold Value
U0415	Invalid Data Received From Anti-Lock Brake System (ABS) Control Module	<ul style="list-style-type: none"> <li>• Vehicle speed &gt; 202.0 MPH</li> <li>• Speed sensor signal: initialisation error 407.296 MPH</li> <li>• Speed sensor signal: low voltage error 407.290 MPH</li> <li>• Speed sensor signal: sensor error 407.303 MPH</li> <li>• CAN communication with Brake Unit received data, implausible message</li> </ul>
U0423	Invalid Data Received From Instrument Panel Cluster Control Module	<ul style="list-style-type: none"> <li>• Ambient temperature value (initialization) FEh</li> <li>or</li> <li>• Received data implausible message</li> </ul>
U0447	Invalid Data Received From Gateway "A"	Implausible message from gateway
U04A4	Invalid Data Received From PM Sensor  Communication Check  CAN Communication with PM Sensor	<ul style="list-style-type: none"> <li>• Signal sensitivity factor 0.75 to 1.25</li> <li>or</li> <li>• Invalid sensitivity signal <math>\geq 2.00</math> Sec.</li> <li>• Communication PM sensor control unit failed &gt; 0.60 Sec.</li> <li>• Received data implausible message</li> </ul>
U1006	NOx Sensor 1 Bank 1 No communication	No messages from NOx sensor 1 module
U1024	Communication with Instrument Cluster Module	Ambient temperature value (initialization) FDh
U1026	Pressure Control Solenoid "A" Electrical	Clutch signal error message
U102A	Vehicle Communication CAN 2	CAN message = no feedback
U102B	Communication check CAN 2	Global time out. Receiving no messages.
U1034	NOx Sensor 1 (Bank 1) Implausible Signal	Data from NOx sensor 1 module implausible
U10C1	NOx Sensor 1 (Bank 2) Implausible Signal	Data from NOx sensor 2 module implausible

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
U10C2	NOx Sensor 1 Bank 2 No Communication	No messages from NOx sensor 2 module
U1103	Production Mode Vehicle in production mode	Production mode active

### **Fuel and Air Ratios Control Module**

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P1419	Exhaust Gas Recirculation Cooler Switch-over Valve 2 Short Circuit to Voltage	Diagnostic signal from power stage > 1.5 A
P146D	Heater 1 for Reducing Agent Sensor Short Circuit to Voltage	Signal voltage > 4.70 V
P146F	Heater 2 for Reducing Agent Short Circuit to Battery Voltage	Signal voltage > 4.70 V
P148F	Exhaust Gas Recirculation Cooler Switch-Over Valve 2 Electrical Malfunction	Diagnostic signal from power stage < 2.97 V
P1499	Exhaust Gas Recirculation Cooler Switch-Over Valve 2 Open Circuit/Short Circuit to Ground	Diagnostic signal from power stage > 4.5 V
P150A	Engine Off Time Performance	ECM time - IPC time > 12 Sec.
P169A	Transport Mode Vehicle in transport mode	Transport mode active

# DTC CHART

## Engine Code - CGFA

### Fuel and Air Mixture, Additional Emissions Regulations

DTC	Error Message	Malfunction Criteria and Threshold Value
P000A	"A" Camshaft Position Slow Response Bank 1	<ul style="list-style-type: none"> <li>• Difference between target and actual position &gt; 12 to 40° CRK for &gt; 3 Sec.</li> <li>• Adjustment angle ≥ 3° CRK</li> </ul>
P000C	"A" Camshaft Position Slow Response Bank 2	<ul style="list-style-type: none"> <li>• Difference between target and actual position &gt; 12 to 40° CRK for &gt; 3 Sec.</li> <li>• Adjustment angle ≥ 3° CRK</li> </ul>
P0010	"A" Camshaft Position Actuator Circuit/Open Bank 1	Signal voltage > 4.70 - 5.40 V
P0011	"A" Camshaft Position - Timing Over-Advanced or System Performance Bank 1	<ul style="list-style-type: none"> <li>• Difference between target and actual position &gt; 12 to 40° CRK for &gt; 3 Sec.</li> <li>• Adjustment angle ≥ 3° CRK</li> </ul>
P0016	Crankshaft Position - Camshaft Position Correlation Bank 1	<ul style="list-style-type: none"> <li>• Permissible deviation &lt; 14° CRK</li> <li>or</li> <li>• Permissible deviation &gt; 14° CRK</li> </ul>
P0018	Crankshaft Position to Intake Camshaft Position Correlation Bank 2	Permissible deviation < -14° CRK or permissible deviation > 14° CRK
P0020	"A" Camshaft Position Actuator Circuit/Open Bank 2	Signal voltage 4.70 to 5.40 V
P0021	"A" Camshaft Position - Timing Over-Advanced or System Performance Bank 2	<ul style="list-style-type: none"> <li>• Difference between target and actual position &gt; 12 to 40° CRK for &gt; 3 Sec.</li> <li>• Adjustment angle ≥ 3° CRK</li> </ul>
P0030	HO2S Heater Control Circuit Circuit Bank 1, Sensor 1	Heater voltage 4.70 to 5.40 V
P0031	HO2S Heater Control Circuit Low Bank 1 Sensor 1	Heater voltage < 0.0 to 3.26 V
P0032	HO2S Heater Control Circuit High Bank 1 Sensor 1	Heater current > 5.50 A

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0036	HO2S Heater Control Circuit Bank 1 Sensor 2	Heater voltage 2.34 to 3.59 V
P0037	HO2S Heater Control Circuit Low Bank 1 Sensor 2	Heater voltage < 2.34 V
P0038	HO2S Heater Control Circuit High Bank 1 Sensor 2	Heater voltage > 3.59 V
P0040	O2 Sensor Signals Swapped Bank 1 Sensor 1 to Bank 2 Sensor 1	Lambda controllers exceed thresholds in opposite directions
P0043	HO2S Heater Control Circuit Low Bank 1 Sensor 2	<ul style="list-style-type: none"> <li>• SULEV Heater voltage &lt; 3 V</li> <li>• ULEV Heater voltage &lt; 3 V</li> </ul>
P0044	HO2S Heater Control Circuit High Bank 1 Sensor 2	Heater current > 2.70 - 5.50 A
P0050	HO2S Heater Control Circuit Bank 2 Sensor 1	Heater voltage 4.70 to 5.40 V
P0051	HO2S Heater Control Circuit Low Bank 1 Sensor 1	Heater voltage < 0.0 to 3.26 V
P0052	HO2S Heater Control Circuit High Bank 2 Sensor 1	Heater current > 5.50 A
P0056	HO2S Heater Control Circuit Bank 2 Sensor 2	Heater voltage 2.34 to 3.59 V
P0057	HO2S Heater Control Circuit Bank 2 Sensor 2 Low	Heater voltage < 2.34 V
P0058	HO2S Heater Control Circuit Bank 2 Sensor 2 High	Heater voltage > 3.59 V
P0068	MAP/MAF – Throttle Position Correlation	Deviation throttle controller < 43 or > 43%
P007C	Charge Air Temperature Sensor Bank 1 Circuit Low	Intake Air Temperature < 0.099 V
P007D	Charge Air Temperature Sensor Bank 1 Circuit High	Intake Air Temperature > 3.20 V
P0070	Ambient Air Temperature Sensor Circuit	Ambient air temp < -50.0° C

DTC	Error Message	Malfunction Criteria and Threshold Value
P0071	Ambient Air Temperature Sensor Range/Performance	<ul style="list-style-type: none"> <li>• Difference ECT vs. IAT at engine start (depending on engine-off time) &lt; 25.5 K</li> <li>• Difference AAT vs. ECT @ engine start (depending on engine-off time) &gt; 25.5 K</li> <li>• Difference IAT vs. AAT @ engine start (depending on engine-off time) &gt; 25.5 K</li> </ul>
P0072	Ambient Air Temperature Sensor Circuit Low	Ambient air temp > 87.0° C
P008A	Low Pressure Fuel System Pressure Too Low	Actual pressure < 40 kPa
P008B	Low Pressure Fuel System Pressure Too High	Actual pressure > 780 kPa
P0087	Fuel Rail/System Pressure Too Low	<ul style="list-style-type: none"> <li>• Pressure control activity &gt; 2.20 MPa</li> <li>• Fuel trim activity 0.90 to 15.99</li> <li>• Difference between target and actual &gt; 2.20 MPa</li> </ul>
P0088	Fuel Rail/System Pressure - Too High	Fuel rail pressure > 13.9 MPa or 780 kPa
P0089	Fuel Pressure Regulator 1 Performance	Functional check: <ul style="list-style-type: none"> <li>• Difference between actual vs. target pressure &gt; 200 kPa</li> </ul> OR Check 2: <ul style="list-style-type: none"> <li>• Difference between actual vs. target pressure &gt; 150 kPa</li> </ul> OR Check 3: <ul style="list-style-type: none"> <li>• Pressure control activity &gt; 225 kPa</li> </ul> OR Check 4: <ul style="list-style-type: none"> <li>• Pressure control activity &lt; -300 kPa</li> </ul>
P00A2	Charge Air Cooler Temperature Sensor Circuit Low Bank 2	Intake Air Temperature < 0.1 V
P00A3	Charge Air Cooler Temperature Sensor Circuit High Bank 2	Intake Air Temperature > 3.20 V

DTC	Error Message	Malfunction Criteria and Threshold Value
P00AB	Intake Air Temperature Sensor Circuit Range/Performance Bank 2	Rationality check high: <ul style="list-style-type: none"> <li>• Difference between IAT after intercooler 2 vs. ECT at start &gt; 26 °C</li> </ul> or <ul style="list-style-type: none"> <li>• Difference IAT after intercooler 2 @ start vs. IAT after intercooler 1 @ start &gt; 26 [°C]</li> </ul> Rationality check low: <ul style="list-style-type: none"> <li>• Difference between IAT after intercooler 2 vs. ECT at start ≤ 26 °C</li> </ul> or <ul style="list-style-type: none"> <li>• Difference IAT after intercooler 2 @ start vs. IAT after intercooler 1 @ start ≤ 26 [°C]</li> </ul>
P00AC	Intake Air Temperature Sensor Circuit Low Bank 2	IAT > 128° C
P00AD	Intake Air Temperature Sensor Circuit High Bank 2	IAT < -39° C
P00C7	Charge Air Pressure Sensor 1 Correlation	Difference between Boost Pressure sensor 1 and 2 > 10.20 kPa
P0111	Intake Air Temperature Sensor Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Difference IAT vs. ECT at engine start (depending on engine-off time &gt; 25.5 K and</li> <li>• Difference IAT vs. AAT at engine start (depending on engine-off time &gt; 25.5 K</li> </ul>
P0112	Intake Air Temperature Sensor Circuit Low Bank 1	Intake air temperature > 128° C
P0113	Intake Air Temperature Sensor Circuit High Bank 1	Intake air temperature < -39° C
P0116	Engine Coolant Temperature Sensor 1 Circuit Range/Performance.	Stuck high <ul style="list-style-type: none"> <li>• No difference of min to max signal &lt; 1.5K</li> </ul> or <ul style="list-style-type: none"> <li>• Difference between ECT and IAT at cold engine &lt; 25.5 K</li> </ul>
P0117	Engine Coolant Temperature Sensor 1 Circuit Low	Engine coolant temperature 137° C
P0118	Engine Coolant Temperature Sensor 1 Circuit High	Engine coolant temperature < -44° C

DTC	Error Message	Malfunction Criteria and Threshold Value
P012B	Supercharger Inlet Pressure Sensor Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Difference in boost pressure 1 downstream throttle to boost pressure &gt; 83.28 hPa or &lt; -83.28 hPa</li> <li>• Difference in boost pressure 2 downstream throttle to boost pressure &gt; 83.28 hPa or &lt; -83.28 hPa</li> </ul> or <ul style="list-style-type: none"> <li>• Difference pressure downstream throttle to average value of all pressure sensors @ start &lt; -57.17 hPa or &gt; 51.17 hPa</li> </ul>
P012C	Supercharger Inlet Pressure Sensor Circuit Low	Signal voltage < 0.25 V
P012D	Turbocharger/Supercharger Inlet Pressure Sensor Circuit High Downstream of Throttle Valve	Signal voltage > 4.85 V
P0121	Throttle/Pedal Position Sensor/Switch "A" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• TPS 1 vs. TPS 2 &gt; 6.30% and</li> <li>• TPS 1 calculated value &gt; TPS 2 calculated value</li> </ul> or <ul style="list-style-type: none"> <li>• TPS1 - calc.value &gt; 9.00 [%]</li> </ul>
P0122	Throttle/Pedal Position Sensor/Switch "A" Circuit Low	Signal voltage < 0.20 V
P0123	Throttle/Pedal Position Sensor/Switch "A" Circuit High	Signal voltage > 4.81 V
P0127	Intake Air Temperature Too High	IAT 1 > 100° C
P0130	O2 Sensor Circuit Bank 1 Sensor 1 Fault	O2S ceramic temperature < 640° C
P0131	HO2 Sensor Circuit Low Voltage Bank 1 Sensor 1	Shorted to Ground: <ul style="list-style-type: none"> <li>• Virtual mass (VM) &lt; 1.75 V</li> <li>• Nernst voltage (UN) &lt; 1.50 V</li> <li>• Adjustment voltage (IA) &lt; 0.30 V</li> <li>• Adjustment voltage (IP) &lt; 0.30 V</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P0132	HO2 Sensor Circuit High Voltage Bank 1 Sensor 1	Shorted to Battery Voltage: <ul style="list-style-type: none"> <li>• Virtual mass (VM) &gt; 3.25 V</li> <li>• Nernst voltage (UN) &gt; 4.40 V</li> <li>• Adjustment voltage (IA) &gt; 7.00 V</li> <li>• Adjustment voltage (IP) &gt; 7.00 V</li> </ul>
P0133	HO2 Sensor Circuit Slow Response Bank 1 Sensor 1	Symmetric Fault <ul style="list-style-type: none"> <li>• Difference of R2L area ratio vs. L2R area ratio -0.35...0.35 [-]</li> <li>• Max value of both counters for area ratio R2L and L2R <math>\geq 2</math> times</li> </ul> Delay Time: <ul style="list-style-type: none"> <li>• Gradient ratio <math>\geq 0.42</math> [-]</li> <li>• Lower value of both area ratios R2L and L2R &lt; 0.45 [-]</li> </ul> Transient Time: <ul style="list-style-type: none"> <li>• Gradient ratio <math>\geq 0.42</math> [-]</li> <li>• Gradient ratio <math>\leq 0.65</math> [-]</li> <li>• Lower value of both area ratios R2L and L2R &lt; 0.45 [-]</li> </ul> or <ul style="list-style-type: none"> <li>• Lower value of both gradient ratios R2L and L2R &lt; 0.42 [-]</li> </ul> Asymmetric Fault: <ul style="list-style-type: none"> <li>• Difference of R2L area ratio vs. L2R area ratio &lt; -0.35; &gt; 0.35 [-]</li> <li>• Values of both counters for area ratio R2L and L2R <math>\geq 2</math> times</li> </ul> Delay Time: <ul style="list-style-type: none"> <li>• Gradient ratio <math>\geq 0.42</math> [-]</li> <li>• Lower value of both area ratios R2L and L2R &lt; 0.27 [-]</li> </ul> Transient Time: <ul style="list-style-type: none"> <li>• Gradient ratio <math>\geq 0.42</math> [-]</li> <li>• Gradient ratio <math>\leq 0.65</math> [-]</li> <li>• Lower value of both area ratios R2L and L2R &lt; 0.27 [-]</li> </ul> or <ul style="list-style-type: none"> <li>• Lower value of both gradient ratios R2L and L2R &lt; 0.42 [-]</li> </ul>



DTC	Error Message	Malfunction Criteria and Threshold Value
P0135	HO2 Sensor Heater Circuit Bank 1 Sensor 1	<ul style="list-style-type: none"> <li>• O2S ceramic temp &lt; 685° C</li> <li>• Heater duty cycle &gt; 90%</li> </ul> or <ul style="list-style-type: none"> <li>• O2S ceramic temp &lt; 720° C</li> <li>• Time after O2 heater on 40 s</li> </ul>
P0136	HO2 Sensor Circuit Fault Bank 1 Sensor 2	<ul style="list-style-type: none"> <li>• O2S signal rear not oscillating at reference 0.708 V</li> <li>• Signal voltage &gt; 0.02 V</li> </ul>
P0137	HO2 Sensor Circuit Low Voltage Bank 1 Sensor 2	<ul style="list-style-type: none"> <li>• Signal voltage &lt; 0.04 V for &gt; 3 s</li> <li>• Difference of sensor voltage with load pulse and voltage without load pulse (mean value of 3 measurements) &lt; 0.01 V</li> </ul>
P0138	HO2 Sensor Circuit High Voltage Bank 1 Sensor 2	<ul style="list-style-type: none"> <li>• Signal voltage &gt; 1.08 V</li> <li>• for &gt; 5 Sec.</li> </ul>
P0139	O2 Sensor Circuit Slow Response Bank 1 Sensor 2	<ul style="list-style-type: none"> <li>• EWMA filtered transient time at fuel cut off &gt; 0.7 Sec. in voltage range 0.201 - 0.401 mV</li> <li>• Number of checks 3</li> </ul>
P013A	HO2 Sensor Slow Response - Rich to Lean Bank 1 Sensor 2	<ul style="list-style-type: none"> <li>• Arithmetic filtered max differential transient time at fuel cut off <math>\geq 0.75</math> [s]</li> <li>• EWMA filtered max differential transient time at fuel cut off n.a.</li> <li>• Number of checks <math>\geq 1.00</math> [-]</li> </ul>
P013B	HO2 Sensor Slow Response - Lean to Rich Bank 1 Sensor 2	<ul style="list-style-type: none"> <li>• Arithmetic filtered max differential transient time at fuel cut off <math>\geq 1.50</math> [s]</li> <li>• EWMA filtered max differential transient time at fuel cut off n.a.</li> <li>• Number of checks <math>\geq 1.00</math> [-]</li> </ul>
P013C	HO2 Sensor Slow Response - Rich to Lean Bank 2 Sensor 2	<ul style="list-style-type: none"> <li>• Arithmetic filtered max differential transient time at fuel cut off <math>\geq 0.75</math> [s]</li> <li>• EWMA filtered max differential transient time at fuel cut off n.a.</li> <li>• Number of checks <math>\geq 1.00</math> [-]</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P013D	HO2 Sensor Slow Response - Lean to Rich Bank 2 Sensor 2	<ul style="list-style-type: none"> <li>• Arithmetic filtered max differential transient time at fuel cut off <math>\geq 1.50</math> [s]</li> <li>• EWMA filtered max differential transient time at fuel cut off n.a.</li> <li>• Number of checks <math>\geq 1.00</math> [-]</li> </ul>
P013E	HO2 Sensor Delayed Response - Rich to Lean Bank 1 Sensor 2	EWMA filtered max differential delay time at lean to rich transition $\geq 0.75$ s and number of checks $\geq 3$
P013F	HO2 Sensor Slow Response Rich to Lean Bank 1 Sensor 2	EWMA filtered max differential delay time at rich to lean transition $\geq 1.5$ s and number of checks $\geq 1$
P014A	HO2 Sensor Delayed Response - Rich to Lean Bank 2 Sensor 2	<ul style="list-style-type: none"> <li>• Arithmetic filtered max differential delay time at lean to rich transition <math>&gt; 1.0</math> [s]</li> <li>• EWMA filtered max differential delay time at rich to lean transition <math>\geq 1.5</math> s</li> <li>• Number of checks <math>\geq 3</math> [-]</li> </ul>
P014B	HO2 Sensor Delayed Response - Lean to Rich Bank 2 Sensor 2	<ul style="list-style-type: none"> <li>• Arithmetic filtered max differential delay time at lean to rich transition <math>&gt; 0.8</math> [s]</li> <li>• EWMA filtered max differential delay time at rich to lean transition <math>\geq</math> n.a. s</li> <li>• Number of checks <math>\geq 3</math> [-]</li> </ul>
P0140	O2 Sensor Circuit No Activity Detected Bank 1 Sensor 2	<ul style="list-style-type: none"> <li>• Signal voltage .40 - .60 mV for <math>&gt; 3</math> Sec</li> <li>• Voltage difference with vs. without load pulse <math>\geq 2.80</math> V or</li> <li>• Internal resistance <math>&gt; 105000.00</math> [Ohm]</li> <li>• Exhaust temperature <math>&gt; 680</math> [°C]</li> </ul>
P0141	HO2 Sensor Heater Circuit Bank 1 Sensor 2	Heater resistance, $> 728$ to $16632 \Omega$
P0150	HO2 Sensor Circuit Fault Bank 2 Sensor 1	O2S ceramic temperature $< 640^\circ \text{C}$

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0151	HO2 Sensor Circuit Low Voltage Bank 2 Sensor 1	Shorted to Ground: <ul style="list-style-type: none"> <li>• Virtual mass (VM) &lt; 1.75 V</li> <li>• Nernst voltage (UN) &lt; 1.50 V</li> <li>• Adjustment voltage (IA) &lt; 0.30 V</li> <li>• Adjustment voltage (IP) &lt; 0.30 V</li> </ul>
P0152	HO2 Sensor Circuit High Voltage Bank 2 Sensor 1	Short to Battery Voltage: <ul style="list-style-type: none"> <li>• Virtual mass (VM) &gt; 3.25 V</li> <li>• Nernst voltage (UN) &gt; 4.40 V</li> <li>• Adjustment voltage (IA) &gt; 7.00 V</li> <li>• Adjustment voltage (IP) &gt; 7.00 V</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P0153	HO2 Sensor Circuit Slow Response Bank 2 Sensor 1	<p>Symmetric Fault:</p> <ul style="list-style-type: none"> <li>• Difference of R2L area ratio vs. L2R area ratio <math>-0.35 \dots 0.35</math> [-]</li> <li>• Max value of both counters for area ratio R2L and L2R <math>\geq 2</math> times</li> </ul> <p>Delay Time:</p> <ul style="list-style-type: none"> <li>• Gradient ratio <math>\geq 0.42</math> [-]</li> <li>• Lower value of both area ratios R2L and L2R <math>&lt; 0.45</math> [-]</li> </ul> <p>Transient Time:</p> <ul style="list-style-type: none"> <li>• Gradient ratio <math>\geq 0.42</math> [-]</li> <li>• Gradient ratio <math>\leq 0.65</math> [-]</li> <li>• Lower value of both area ratios R2L and L2R <math>&lt; 0.45</math> [-]</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>• Lower value of both gradient ratios R2L and L2R <math>&lt; 0.42</math> [-]</li> </ul> <p>Asymmetric Fault:</p> <ul style="list-style-type: none"> <li>• Difference of R2L area ratio vs. L2R area ratio <math>&lt; -0.35</math>; <math>&gt; 0.35</math> [-]</li> <li>• Values of both counters for area ratio R2L and L2R <math>\geq 2</math> times</li> </ul> <p>Delay Time:</p> <ul style="list-style-type: none"> <li>• Gradient ratio <math>\geq 0.42</math> [-]</li> <li>• Lower value of both area ratios R2L and L2R <math>&lt; 0.27</math> [-]</li> </ul> <p>Transient Time:</p> <ul style="list-style-type: none"> <li>• Gradient ratio <math>\geq 0.42</math> [-]</li> <li>• Gradient ratio <math>\leq 0.65</math> [-]</li> <li>• Lower value of both area ratios R2L and L2R <math>&lt; 0.27</math> [-]</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>• Lower value of both gradient ratios R2L and L2R <math>&lt; 0.42</math> [-]</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P0155	HO2 Sensor Heater Circuit Bank 2 Sensor 1	<ul style="list-style-type: none"> <li>• O2S ceramic temp &lt; 685° C</li> <li>• Heater duty cycle &gt; 90%</li> </ul> or <ul style="list-style-type: none"> <li>• O2S ceramic temp &lt; 720° C</li> <li>• Time after O2 heater on 40 Sec.</li> </ul>
P0156	HO2 Sensor Circuit Fault Bank 2 Sensor 2	<ul style="list-style-type: none"> <li>• O2S signal rear not oscillating at reference 0.708 V</li> <li>• Signal voltage &gt; 0.2 V</li> </ul>
P0157	HO2 Sensor Circuit Low Voltage Bank 2 Sensor 2	<ul style="list-style-type: none"> <li>• Signal voltage &lt; 0.04 V for &gt; 3 Sec.</li> <li>• Difference of sensor voltage with load pulse and voltage without load pulse (mean value of 3 measurements) &lt; 0.01 V</li> </ul>
P0158	HO2 Sensor Circuit High Voltage Bank 2 Sensor 2	Signal voltage > 1.08 V for > 5 Sec.
P0159	O2 Sensor Circuit Slow Response Bank 2 Sensor 2	<ul style="list-style-type: none"> <li>• EWMA filtered transient time at fuel cutoff &gt; 0.7 Sec. in voltage range 0.201 to 0.401 V</li> <li>• Number of checks 3</li> </ul>
P0160	HO2 Sensor Circuit No Activity Detected Bank 2 Sensor 2	<ul style="list-style-type: none"> <li>• Signal voltage, 0.40 to 0.60 V for &gt; 3 Sec.</li> <li>• Difference of sensor voltage with load pulse and voltage without load pulse (mean value of 3 measurements) <math>\geq 2.80</math> V</li> </ul> or <ul style="list-style-type: none"> <li>• Internal resistance &gt; 105000.00 [Ohm]</li> <li>• Exhaust temperature &gt; 680 [° C]</li> </ul>
P0161	HO2 Sensor Heater Circuit Bank 2 Sensor 2	Heater resistance, > 728 to 16632 $\Omega$
P0169	Incorrect Fuel Composition	Air quantity vs. fuel delivery incorrect

DTC	Error Message	Malfunction Criteria and Threshold Value
P017B	Cylinder Head Temperature Sensor Circuit Range / Performance	<ul style="list-style-type: none"> <li>• Difference MAX cylinder head temperature vs. MIN cylinder head <math>\leq 1.6</math> [K]</li> <li>or</li> <li>• Difference model temperature vs. ECT <math>&gt; 9.8</math> [K]</li> <li>• Cylinder head temperature <math>\geq 80</math> [°C]</li> <li>• Difference CHDT (Cylinder Head Temperature) vs. ECT at engine start <math>\geq 25.0</math> [K]</li> <li>• Difference CHDT (Cylinder Head Temperature) vs. IAT at engine start <math>\geq 25.0</math> [K]</li> <li>• Difference CHDT (Cylinder Head Temperature) vs. ECT at engine start <math>\leq -(25.0)</math> [K]</li> <li>• Difference CHDT (Cylinder Head Temperature) vs. IAT at engine start <math>\leq -(25.0)</math> [K]</li> </ul>
P017C	Cylinder Head Temperature Sensor Circuit Low	Signal voltage $< 0.10$ V
P017D	Cylinder Head Temperature Sensor Circuit High	Signal voltage $> 4.65$ V
P0171	Fuel System Too Lean Bank 1	<ul style="list-style-type: none"> <li>• Low pass filtered lambda controller output <math>&gt; 20.00</math> [%]</li> <li>• for time <math>&gt; 40</math> s</li> </ul>
P0172	System Too Rich Bank 1	<ul style="list-style-type: none"> <li>• Low pass filtered lambda controller output <math>&lt; 20.00</math> [%]</li> <li>• for time <math>&gt; 40</math> s</li> </ul>
P0174	Fuel System Too Lean Bank 2	<ul style="list-style-type: none"> <li>• Low pass filtered lambda controller output <math>&gt; 20.00</math> [%]</li> <li>• for time <math>&gt; 40</math> s</li> </ul>
P0175	Fuel System Too Rich Bank 2	<ul style="list-style-type: none"> <li>• Low pass filtered lambda controller output <math>&lt; 20.00</math> [%]</li> <li>• for time <math>&gt; 40</math> s</li> </ul>
P0190	Fuel Rail Pressure Sensor "A" Circuit	Signal voltage $> 4.80$ V
P0191	Fuel Rail Pressure Sensor "A" Circuit Range/Performance	Out of Range High: <ul style="list-style-type: none"> <li>• Actual pressure <math>&gt; 15</math> MPa</li> </ul> Out of Range Low <ul style="list-style-type: none"> <li>• Actual pressure <math>&lt; 0.005</math> MPa</li> </ul>
P0192	Fuel Rail Pressure Sensor "A" Circuit Low Input	Signal voltage $< 0.2$ V

DTC	Error Message	Malfunction Criteria and Threshold Value
P0196	Engine Oil Temperature Sensor Range/Performance	<ul style="list-style-type: none"> <li>• Difference MAX engine oil temperature vs. MIN engine oil temperature <math>\leq 2.0</math> [K]</li> <li>• Difference of engine oil temp @ start vs. ECT @ start <math>&gt; 25</math> K</li> </ul> or <ul style="list-style-type: none"> <li>• Oil temp @ start vs. IAT after inter cooler @ start <math>&gt; 25</math> K</li> <li>• Difference of engine oil temp @ start vs. ECT @ start <math>\leq -(25.0)</math> [K]</li> </ul> or <ul style="list-style-type: none"> <li>• Oil temp @ start vs. IAT after inter cooler @ start <math>\leq -(25.0)</math> [K]</li> </ul>
P0197	Engine Oil Temperature Sensor Circuit Low	Sensor signal short to voltage for $> 10$ Sec.
P0198	Engine Oil Temperature Sensor Circuit High	Sensor signal short to ground for $> 10$ Sec.
P0201	Injector Circuit/Open Cylinder 1	<ul style="list-style-type: none"> <li>• Low side signal current <math>&lt; 2.1</math> A</li> <li>• Internal logic failure</li> </ul>
P0202	Injector Circuit/Open Cylinder 2	<ul style="list-style-type: none"> <li>• Low side signal current <math>&lt; 2.1</math> A</li> <li>• Internal logic failure</li> </ul>
P0203	Injector Circuit/Open Cylinder 3	<ul style="list-style-type: none"> <li>• Low side signal current <math>&lt; 2.1</math> A</li> <li>• Internal logic failure</li> </ul>
P0204	Injector Circuit/Open Cylinder 4	<ul style="list-style-type: none"> <li>• Low side signal current <math>&lt; 2.1</math> A</li> <li>• Internal logic failure</li> </ul>
P0205	Injector Circuit/Open Cylinder 5	<ul style="list-style-type: none"> <li>• Low side signal current <math>&lt; 2.1</math> A</li> <li>• Internal logic failure</li> </ul>
P0206	Injector Circuit/Open Cylinder 6	<ul style="list-style-type: none"> <li>• Low side signal current <math>&lt; 2.1</math> A</li> <li>• Internal logic failure</li> </ul>
P0221	Accelerator Pedal Position Sensor "B" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• TPS 1 vs. TPS 2 <math>&gt; 5.10</math> to 6.30%</li> <li>and</li> <li>• TPS 1 calculated value <math>&gt;</math> TPS 2 calculated value</li> </ul> or <ul style="list-style-type: none"> <li>• <math> TPS1 - calc.value  &gt; 9.00</math> [%]</li> </ul>
P0222	Throttle/Pedal Position Sensor/Switch "B" Circuit Low	Signal voltage $< 0.20$ V

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0223	Throttle/Pedal Position Sensor/Switch "B" Circuit High Input	Signal voltage > 4.81 V
P023A	Charge Air Cooler Coolant Pump Control Circuit Open	Signal voltage 4.8 to 5.3 V
P023B	Charge Air Cooler Coolant Pump Control Circuit Low	Signal voltage < 2.8 to 3.2 V
P023C	Charge Air Cooler Coolant Pump Control Circuit High	Signal current > 2.2 to 4 A
P0234	Turbocharger/Supercharger "A" Overboost Condition	Difference set value boost pressure vs actual boost pressure value > 200... 1275 hPa
P0235	Turbocharger/Supercharger Boost Sensor "A" Circuit Fault	Boost pressure sensor signal vs target value > 27 - 50 kPa, depending on altitude



DTC	Error Message	Malfunction Criteria and Threshold Value
P0236	Turbocharger/Supercharger Boost Sensor "A" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Difference in boost pressure lower threshold model &lt; 0 kPa</li> <li>• Model range lower threshold 173 to 2500 kPa</li> </ul> or <ul style="list-style-type: none"> <li>• Difference in boost pressure upper threshold model &lt; 0 kPa</li> <li>• Model range lower threshold upper threshold 224 to 4419 kPa</li> <li>• Difference boost pressure to average value of all pressure sensors @ start &lt; -5.12 [kPa]</li> </ul> or <ul style="list-style-type: none"> <li>• Difference boost pressure to average value of all pressure sensors @ start &gt; 5.12 [kPa]</li> <li>• Difference between boost pressure 2 and boost pressure 1 &gt; 11.23 [kPa]</li> <li>• Difference boost pressure 2 to pressure downstream throttle &gt; 8.33 [kPa]</li> </ul> or <ul style="list-style-type: none"> <li>• Difference between boost pressure 2 and boost pressure 1 &lt; -11.23 [kPa]</li> <li>• Difference boost pressure 2 to pressure downstream throttle &lt; - 8.33 [kPa]</li> </ul>
P0237	Turbocharger/Supercharger Boost Sensor "A" Circuit Low	Signal voltage < 0.25 V
P0238	Turbocharger/Supercharger Boost Sensor "A" Circuit High	Signal voltage > 4.75 V

DTC	Error Message	Malfunction Criteria and Threshold Value
P0240	Supercharger Boost Sensor "B" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Difference in boost pressure lower threshold model &lt; 0 kPa</li> <li>• Model range lower threshold 173 to 2500 kPa</li> </ul> or <ul style="list-style-type: none"> <li>• Difference in boost pressure upper threshold model &lt; 0 kPa</li> <li>• Model range lower threshold upper threshold 224 to 4419 kPa</li> <li>• Difference boost pressure to average value of all pressure sensors @ start &lt; -5.12 [kPa]</li> </ul> or <ul style="list-style-type: none"> <li>• Difference boost pressure to average value of all pressure sensors @ start &gt; 5.12 [kPa]</li> <li>• Difference difference between boost pressure 2 and boost pressure 1 &gt; 11.23 [kPa]</li> <li>• Difference boost pressure 2 to pressure downstream throttle &gt; 8.33 [kPa]</li> </ul> or <ul style="list-style-type: none"> <li>• Difference between boost pressure 2 and boost pressure 1 &lt; -11.23 [kPa]</li> <li>• Difference boost pressure 2 to pressure downstream throttle &lt; - 8.33 [kPa]</li> </ul>
P0241	Charge Air Pressure Sensor B Circuit Low	Signal voltage < 0.25 V
P0242	Charge Air Pressure Sensor B Circuit High	Signal voltage > 4.75 V
P025A	Fuel Pump Module Control Circuit Open	Signal voltage = 4.8 to 5.3 V
P025C	Fuel Pump Module Control Range/Performance	Signal voltage < 2.7 - 3.25 [V]
P025D	Fuel Pump Module Control Circuit High	Signal current > 0.6 [mA]
P026A	Charge Air Cooler Efficiency Below Threshold	Difference between measured IAT and modeled IAT > 8 K
P0261	Cylinder 1 Injector Circuit Low	Signal current < 2.10 [A]

DTC	Error Message	Malfunction Criteria and Threshold Value
P0262	Cylinder 1 Injector Circuit High	Signal current > 14.70 A
P0264	Cylinder 2 Injector Circuit Low	Signal current < 2.10 [A]
P0265	Cylinder 2 Injector Circuit High	Signal current > 14.70 A
P0267	Cylinder 3 Injector Circuit Low	Signal current < 2.10 [A]
P0268	Cylinder 3 Injector Circuit High	Signal current > 14.70 A
P0270	Cylinder 4 Injector Circuit Low	Signal current < 2.10 [A]
P0271	Cylinder 4 Injector Circuit High	Signal current > 14.70 A
P0273	Cylinder 5 Injector Circuit Low	Signal current < 2.10 [A]
P0274	Cylinder 5 Injector Circuit High	Signal current > 14.70 A
P0276	Cylinder 6 Injector Circuit Low	Signal current < 2.10 [A]
P0277	Cylinder 6 Injector Circuit High	Signal current > 14.70 A
P0299	Turbocharger/Supercharger "A" Underboost Condition	Difference set value boost pressure vs actual boost pressure value, >150 hPa
P2004	Intake Manifold Runner Control Bank 1 Stuck Open	Difference between target and actual position > 40%
P2005	Intake Manifold Runner Control Bank 2 Stuck Open	Difference between target and actual position > 40%
P2006	Intake Manifold Runner Control Bank 1 Stuck Closed	Difference between target and actual position > 40%
P2007	Intake Manifold Runner Control Bank 2 Stuck Closed	Difference between target and actual position > 40%
P2008	Intake Manifold Runner Control Bank 1 Circuit/Open	Signal voltage 4.70 to 5.40 V
P2009	Intake Manifold Runner Bank 1 Control Circuit Low	Signal voltage 0 to 3.26 V
P2010	Manifold Runner Bank 1 Control Circuit High	Signal current > 2.20 A
P2014	Intake Manifold Runner Bank 1 Position Sensor Circuit	Signal voltage < 0.2 V
P2015	Intake Manifold Runner Position Sensor/Switch Circuit Range/Performance Bank 1	Difference between target and actual position > 40%
P2017	Intake Manifold Runner Position Sensor/Switch Circuit High	Signal voltage > 4.88 V
P2019	Intake Manifold Runner Position Sensor/Switch Circuit Bank 2	Signal voltage, < 0.2 V

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P2020	Intake Manifold Runner Position Sensor/Switch Circuit Range/Performance Bank 2	<ul style="list-style-type: none"> <li>• Difference between target and actual position &gt; 40%</li> <li>• Actual position NOT 0 to 100%</li> </ul>
P2022	Intake Manifold Runner Position Sensor Circuit High Bank 2	Signal voltage > 4.88 V
P2088	"A" Camshaft Position Actuator Control Circuit Low Bank 1	Signal voltage 0 to 3.25 V
P2089	"A" Camshaft Position Actuator Control Circuit High Bank 1	Signal current > 2.20 A
P2092	"A" Camshaft Position Actuator Control Circuit Low Bank 2	Signal voltage 0 to 3.25 V
P2093	"A" Camshaft Position Actuator Bank 2 Control Circuit High	Signal current, > 2.20 A
P2096	Post-Catalyst Fuel Trim System Too Lean Bank 1	Integral part of trim control, post cat < -0.035 [-]
P2097	Post-Catalyst Fuel Trim System Too Rich Bank 1	Integral part of trim control, post cat > 0.035 [-]
P2098	Post Catalyst Fuel Trim Too Lean Bank 2	Integral part of trim control, post cat < -0.035 [-]
P2099	Post Catalyst Fuel Trim Too Rich Bank 2	Integral part of trim control, post cat > 0.035 [-]

## Ignition System

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0300	Random / Multiple Cylinder Misfire Detected	• Emission threshold misfire rate (MR) > 1.5%
P0301	Cylinder 1 Misfire Detected	Catalyst damage misfire rate (MR) > 1.2 - 14.0%
P0302	Cylinder 2 Misfire Detected	Catalyst damage misfire rate (MR) > 1.2 - 14.0%
P0303	Cylinder 3 Misfire Detected	Catalyst damage misfire rate (MR) > 1.2 - 14.0%
P0304	Cylinder 4 Misfire Detected	Catalyst damage misfire rate (MR) > 1.2 - 14.0%

DTC	Error Message	Malfunction Criteria and Threshold Value
P0305	Cylinder 5 Misfire Detected	Catalyst damage misfire rate (MR) > 1.2 - 14.0%
P0306	Cylinder 6 Misfire Detected	Catalyst damage misfire rate (MR) > 1.2 - 14.0%
P0321	Engine Speed Sensor Range/Performance	<ul style="list-style-type: none"> <li>• Counted teeth vs. reference incorrect</li> <li>or</li> <li>• Monitoring reference gap failure</li> </ul>
P0322	Engine Speed Sensor, No Signal	<ul style="list-style-type: none"> <li>• Camshaft signals &gt;3[-]</li> <li>• Engine speed no signal</li> </ul>
P0324	Knock Control System Error	<ul style="list-style-type: none"> <li>• Signal fault counter (combustion) &gt; 28.0[-]</li> <li>or</li> <li>• Signal fault counter (measuring window) &gt; 5.00[-]</li> </ul>
P0326	Knock Sensor 1 Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Lower threshold &lt; 0.029 V</li> <li>• Upper threshold &gt; 1.992 V</li> </ul>
P0327	Knock Sensor 1 Circuit Low Bank 1	Lower threshold < -0.70 V
P0328	Knock Sensor 1 Circuit High Bank 1	Upper threshold > 1.00 [V]
P0331	Knock Sensor 2 Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Lower threshold &lt; 0.029 V</li> <li>• Upper threshold &gt; 1.992 V</li> </ul>
P0332	Knock Sensor 2 Circuit Low Bank 2	Lower threshold < -0.70 V
P0333	Knock Sensor 2 Circuit High Input	Upper threshold > 1.00 [V]
P0341	Camshaft Position Sensor Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Signal pattern incorrect</li> <li>• Defect counter at 24.00[-]</li> </ul>
P0342	Camshaft Position Sensor Circuit Low Input	<ul style="list-style-type: none"> <li>• Signal voltage permanently low</li> <li>• Crankshaft signals, 8.0[-]</li> </ul>
P0343	Camshaft Position Sensor Circuit High Input	<ul style="list-style-type: none"> <li>• Signal voltage permanently high</li> <li>• Crankshaft signals, 8.0[-]</li> </ul>
P0346	Camshaft Position Sensor Bank 2 Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Signal pattern incorrect</li> <li>• Defect counter at 24.00[-]</li> </ul>
P0347	Camshaft Position Sensor Bank 2 Circuit Low	<ul style="list-style-type: none"> <li>• Signal voltage permanently low</li> <li>• Crankshaft signals, 8.0[-]</li> </ul>

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0348	Ignition Coil A Primary/ Secondary Circuit	<ul style="list-style-type: none"> <li>• Signal voltage permanently high</li> <li>• Crankshaft signals, 8.0[-]</li> </ul>
P0351	Ignition Coil A Primary/ Secondary Circuit	<ul style="list-style-type: none"> <li>• Signal current &lt; 0.25 to -2.0 mA</li> <li>• Internal check failed</li> </ul>
P0352	Ignition Coil B Primary/ Secondary Circuit	<ul style="list-style-type: none"> <li>• Signal current &lt; 0.25 to -2.0 mA</li> <li>• Internal check failed</li> </ul>
P0353	Ignition Coil C Primary/ Secondary Circuit	<ul style="list-style-type: none"> <li>• Signal current &lt; 0.25 to -2.0 mA</li> <li>• Internal check failed</li> </ul>
P0354	Ignition Coil D Primary/ Secondary Circuit	<ul style="list-style-type: none"> <li>• Signal current &lt; 0.25 to -2.0 mA</li> <li>• Internal check failed</li> </ul>
P0355	Ignition Coil E Primary/ Secondary Circuit	<ul style="list-style-type: none"> <li>• Signal current &lt; 0.25 to -2.0 mA</li> <li>• Internal check failed</li> </ul>
P0356	Ignition Coil F Primary/ Secondary Circuit	<ul style="list-style-type: none"> <li>• Signal current &lt; 0.25 to -2.0 mA</li> <li>• Internal check failed</li> </ul>

### **Additional Exhaust Regulation**

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0410	Secondary Air Injection System Fault	Difference of measured AIR pressure before AIR injection vs. AIR pressure after AIR injection > 2.00 [kPa]
P0413	Secondary Air Injection System Switching Valve "A" Circuit Open	Signal voltage 4.70 to 5.40 V
P0414	Secondary Air Injection System Switching Valve "A" Circuit Shorted	<ul style="list-style-type: none"> <li>• Signal voltage 0.0 to 3.25 V</li> <li>or</li> <li>• Signal current &gt; 2.20 A</li> </ul>
P0415	Secondary Air Injection System Switching Valve "B" Circuit Fault	Signal current 2.20 A
P0416	Secondary Air Injection Switching Valve B Circuit Open	Signal voltage 4.70 to 5.40 V

DTC	Error Message	Malfunction Criteria and Threshold Value
P0417	Secondary Air Injection Switching Valve B Circuit Shorted	<ul style="list-style-type: none"> <li>Signal voltage 0.0 to 3.25 V or</li> <li>Signal current &gt; 2.20 A</li> </ul>
P0418	Secondary Air Injection System Relay Circuit	Signal voltage 4.70 to 5.40 V
P0420	Catalyst System Efficiency Below Threshold Bank 1	Measured Oxygen Storage Content < 1.00
P0430	Catalyst System Efficiency Below Threshold Bank 2	Measured Oxygen Storage Content < 1.00
P043E	Evaporative Emission System Leak Detection Reference Low Flow	During engine off: <ul style="list-style-type: none"> <li>EVAP pump current during reference measurement &lt; 15 mA</li> </ul> During engine on: <ul style="list-style-type: none"> <li>EVAP pump current during reference measurement &gt; 40 m</li> </ul>
P043F	Evaporative Emission System Leak Detection Reference High Flow	During engine off: <ul style="list-style-type: none"> <li>EVAP pump current during reference measurement &lt; 15 mA</li> </ul> During engine on: <ul style="list-style-type: none"> <li>EVAP pump current during reference measurement &gt; 40 m</li> </ul>
P0430*	Catalyst System Bank 2 Efficiency Below Threshold	Measured Oxygen Storage Content < 1.00
P0441	Evaporative Emission System Incorrect Purge Flow	<ul style="list-style-type: none"> <li>Drop of EVAP pump current &lt; 1 mA within 5 Sec.</li> </ul>
P0442	Evaporative Emission System Small Leak Detected	Modeled pressure from pump current < 7.00 hPa
P0444	Evaporative Emission System Purge Control Valve Circuit Open	Signal voltage > 4.70 - 5.40 V
P0445	Evaporative Emission System Purge Control Valve Shorted	Signal voltage < 2.0 V or Signal current > 1.0 A
P0447	Evaporative Emission System Vent Control Circuit Open	Signal voltage > 4.7 to 5.4 V
P0448	Evaporative Emission System Vent Control Circuit Shorted	<ul style="list-style-type: none"> <li>Signal voltage &lt; 2.74 to 3.26 V or</li> <li>Signal current &gt; 2.2 to 4.0 A</li> </ul>

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0455	Evaporative Emission System Gross Leak Detected	Time for pressure drop < 0.6 - 0.7 Sec.
P0456	Evaporative Emission System Leak Detected (very small leak)	EVAP system leakage area calculated from pump current curve > 0.2 (mm <sup>2</sup> )
P0458	Evaporative Emission System Purge Control Valve Circuit Low	Signal voltage 0.0 to 3.26 V
P0459	Evaporative Emission System Purge Control Valve Circuit High	Signal current > 2.20 A



DTC	Error Message	Malfunction Criteria and Threshold Value
P0491	Secondary Air System Bank 1 Insufficient Flow	<ul style="list-style-type: none"> <li>• Difference of measured AIR pressure before AIR injection vs. AIR pressure after AIR injection <math>\leq 2.00</math> [kPa]</li> </ul> <p>Case 1:</p> <ul style="list-style-type: none"> <li>• Blockage: relative AIR pressure measured with AIR pressure sensor vs. modeled <math>&lt; 0.10</math> [-]</li> <li>• Leakage: relative AIR pressure measured with AIR pressure sensor vs. modeled <math>&lt; 0.10</math> [-]</li> </ul> <p>Case 2:</p> <ul style="list-style-type: none"> <li>• Blockage: relative AIR pressure measured with AIR pressure sensor vs. modeled <math>&lt; 0.30</math> [-]</li> <li>• Leakage: relative AIR pressure measured with AIR pressure sensor vs. modeled <math>&lt; 0.40</math> [-]</li> </ul> <p>Case 3:</p> <ul style="list-style-type: none"> <li>• Blockage: relative AIR pressure measured with AIR pressure sensor vs. modeled while valve bank 2 commanded closed <math>&lt; 0.52</math> [-]</li> <li>• Leakage: relative AIR pressure measured with AIR pressure sensor vs. modeled while valve bank 2 commanded closed <math>&lt; 0.68</math> [-]</li> </ul> <p>Case 4:</p> <ul style="list-style-type: none"> <li>• Average pressure difference between absolute value and filtered while valve bank 2 commanded closed <math>&lt; 0.18 - 0.30</math> [kPa]</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P0492	Secondary Air System Bank 2 Insufficient Flow	<ul style="list-style-type: none"> <li>• Difference of measured AIR pressure before AIR injection vs. AIR pressure after AIR injection <math>\leq 2.00</math> [kPa]</li> </ul> <p>Case 1:</p> <ul style="list-style-type: none"> <li>• Blockage: relative AIR pressure measured with AIR pressure sensor vs. modeled <math>&lt; 0.10</math> [-]</li> <li>• Leakage: relative AIR pressure measured with AIR pressure sensor vs. modeled <math>&lt; 0.10</math> [-]</li> </ul> <p>Case 2:</p> <ul style="list-style-type: none"> <li>• Blockage: relative AIR pressure measured with AIR pressure sensor vs. modeled <math>&lt; 0.30</math> [-]</li> <li>• Leakage: relative AIR pressure measured with AIR pressure sensor vs. modeled <math>&lt; 0.40</math> [-]</li> </ul> <p>Case 3:</p> <ul style="list-style-type: none"> <li>• Blockage: relative AIR pressure measured with AIR pressure sensor vs. modeled while valve bank 2 commanded closed <math>&lt; 0.52</math> [-]</li> <li>• Leakage: relative AIR pressure measured with AIR pressure sensor vs. modeled while valve bank 2 commanded closed <math>&lt; 0.68</math> [-]</li> </ul> <p>Case 4:</p> <ul style="list-style-type: none"> <li>• Average pressure difference between absolute value and filtered while valve bank 2 commanded closed <math>&lt; 0.18 - 0.30</math> [kPa]</li> </ul>
P0496	Evaporative Emission System High Purge Flow	Actual EVAP pump current difference between reference measurement to idle divided by pump current difference from the last leak detection phase during engine off $> 1.50$ [-]

## Speed and Idle Control

DTC	Error Message	Malfunction Criteria and Threshold Value
P0501	Vehicle Speed Sensor Range/ Performance	VSS signal < 4 km/h
P0506	Idle Air Control System - RPM Lower Than Expected	<ul style="list-style-type: none"> <li>• Engine speed deviation &gt; 100 RPM</li> <li>• RPM torque value <math>\geq</math> calculated max. value</li> </ul>
P0507	Idle Air Control System - RPM Higher Than Expected	<ul style="list-style-type: none"> <li>• Engine speed deviation &gt; 100 RPM</li> <li>• RPM torque value <math>\geq</math> calculated max. value</li> </ul>
P050A	Cold Start Idle Air Control System Performance	<ul style="list-style-type: none"> <li>• Out of range low</li> <li>• Engine speed deviation &gt; 200 RPM</li> <li>• Out of range high</li> <li>• Engine speed deviation &gt; 80 - 250 RPM</li> </ul>
P050B	Cold Start Ignition Timing Performance	Difference between commanded and actual spark timing > 26%
P052A	Cold Start Camshaft Position Timing Bank 1 Over-Advanced	Difference between target and actual position > 12 to 40° CRK
P052C	Cold Start Camshaft Position Timing Bank 2 Over-Advanced	Difference between target and actual position > 12 to 40° CRK
P053F	Cold Start Fuel Pressure Performance	<ul style="list-style-type: none"> <li>• Difference between target pressure vs. actual pressure, &gt; 1.50 mPa</li> <li>• Difference between target pressure vs. actual pressure, &lt; -1.50 mPa</li> </ul>
P0556	Brake Booster Pressure Sensor Circuit Range/ Performance	Brake booster pressure difference between measurement 1 and 2 < 0.30...5.00 [kPa]
P057B	Brake Pedal Position Sensor "A" Circuit Range/Performance	Duty cycle > 92.00 [%] and/or < 8.00%

## Control Module and Output Signals

DTC	Error Message	Malfunction Criteria and Threshold Value
P0601	Internal Control Module Memory Check Sum Error	Internal check sum, incorrect

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0604	Internal Control Module Random Access Memory (RAM) Error	Write ability check, failed
P0606	Control Module Processor Fault	Internal check failed
P062B	Internal Control Module Fuel Injector Control Performance	SPI communication check identifier failure
P0634	ECM Internal Temperature Too High	Power stage temperature > 170° C
P0638	Throttle Actuator Control Range/Performance	Functional check: close movement <ul style="list-style-type: none"> <li>• Time to close to reference point &gt; 0.6 Sec.</li> <li>• Reference point 2.88% Signal range check at mechanical stop low</li> <li>• TPS 1 signal voltage not 0.40 to 0.80 V</li> </ul> or <ul style="list-style-type: none"> <li>• TPS 2 signal voltage not 4.20 to 5.18 V</li> </ul>
P0641	Sensor Reference Voltage A Circuit/Open	Signal voltage deviation $\pm 0.3$ V
P0651	Sensor Reference Voltage B Circuit/Open	Signal voltage deviation $\pm 0.3$ V
P0697	Sensor Reference Voltage C Circuit/Open	Signal voltage deviation $\pm 0.3$ V
P0703	Brake Switch "B" Circuit Malfunction	Signal Voltage > 2430 [mV] and/or < 6 [mV]
U0001	High Speed CAN Communication Bus	CAN message, no feedback
U0002	High Speed CAN Communication Bus	Global time out, receiving no messages
U0028	Vehicle Communication Bus A	CAN message no feedback
U0029	Vehicle Communication Bus A Performance	Global time out, receiving no messages
U0100	ECM Lost Communication	CAN time out
U0101	Lost Communication with TCM	No message received from TCM
U0110	Lost Communication With Drive Motor Control Module	No CAN messages received from TCM

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
U0111	Lost Communication with Battery Energy Control Module	CAN time out
U0112	Lost Communication with Battery Energy Control Module	No CAN messages received from BECM
U0121	Lost Communication With Anti-Lock Brake System (ABS) Control Module	No CAN communication with ABS, time-out
U0122	CAN Communication with Vehicle Stability Control Module	CAN time out
U0140	Lost Communication with Body Control Module	CAN message no message
U0146	Lost Communication with Gateway	CAN communication with gateway no message received
U0155	Lost Communication With Instrument Panel Cluster (IPC) Control Module	No CAN communication with IPC, time-out
U0302	Software Incompatibility with Transmission Control Module	MT vehicle. ECM coded as AT vehicle.
U0401	CAN communication with ECM	CAN checksum = error signal length information content
U0402	CAN communication with TCM	Implausible message received
U0411	Invalid Data Received From Drive Motor Control Module	Implausible message received from DMCM
U0413	Invalid Data Received From Battery Energy Control Module	Implausible message received from BECM
U0415	Invalid Data Received From Anti-Lock Brake System (ABS) Control Module	Speed sensor signal out of range > 325 km/h or implausible message received from ABS module
U0416	CAN Communication With Vehicle Stability Control Module	CAN signal length
U0422	Invalid Data Received From Body Control Module	Ambient temp. value (initialization), 00h
U0423	Invalid Data Received From Instrument Panel Cluster Control Moduler	Invalid data received from IPC implausible message
U0447	Invalid Data Received From Gateway	Implausible message received from Gateway

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
U10DD	Lost Communication With Clutch Control Unit	No CAN messages received from Clutch Control Unit
U10DE	Invalid Data Received From Clutch Control Unit	Implausible message received from CCU
U1103	Production mode active	Production mode active
U1106	ECM: HEV Service Mode	Vehicle in service mode; HEV service mode
U309C	Separating Clutch Adjuster Mechanical Fault	Actuator voltage failure.

### **Fuel and Air Ratios Control Module**

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P10A0	Actuation Regulating Flap for Intake Air Electrical Error	Signal range check • ECM power stage failure
P10A4	Regulating Flap for Intake Air Mechanical Malfunction	• Duty cycle > 68 to 108% • Deviation between set point and actual angle > 6%
P10A5	Potentiometer regulating flap for intake air Signal too high	Sensor voltage > 4.82 V
P10A6	Potentiometer regulating flap for intake air Signal too low	Sensor voltage < 0.30 V
P10A7	Adaption for Supercharger Control Flap Sticking	Sensor signal > 0.80 V
P10A8	Adaptation Regulating Flap for Intake Air Lower Limit Not Reached	Sensor signal < 0.41 V
P12A1	Fuel Rail Pressure Sensor Inappropriately Low	• Pressure control activity > 0.10 MPa • Fuel trim activity < 0.80 [-] • Difference between target and actual pressure n.a.
P12A2	Fuel Rail Pressure Sensor Inappropriately High	• Pressure control activity < -0.08 MPa • Fuel trim activity > 1.25 • Difference between target and actual pressure n.a.

DTC	Error Message	Malfunction Criteria and Threshold Value
P12A4	Fuel Rail Pump Control Valve Stuck Closed	<ul style="list-style-type: none"> <li>• Pressure control activity &lt; -4.00 MPa</li> <li>• Fuel trim activity 0.75 to .25 [-]</li> <li>• Difference between target vs. actual pressure &lt; -4.00 MPa</li> </ul>
P13EA	Cold Start Ignition Timing Performance Off Idle	Difference between commanded and actual spark timing > 13%
P1335	Engine Torque Monitoring 2 Control Limit Exceeded	Internal calculated engine torque incorrect
P1427	Brake Vacuum Pump Circuit Fault	Signal current > 2.2 A
P1428	Brake Vacuum Pump Activation Short Circuit to Ground	Signal voltage < 2.15 V
P1429	Brake Vacuum Pump Interruption	Signal voltage 4.40 to 5.60 V
P1479	Brake Vacuum System Mechanical Fault	<ul style="list-style-type: none"> <li>• Brake boost pressure high &gt; 1300 hPa or low &lt; 40 hPa or</li> <li>• Difference brake booster pressure vs. ambient pressure &gt; 100 hPa or gradient brake booster pressure &gt; 1.5 kPa</li> </ul>
P150A	Engine Off Time Performance	Difference between engine off time and ECM after run time < -8 or > 8 Sec.
P169A	Vehicle in Transport Mode	Transport mode active
P1609	Crash Shut-Off Was Triggered	Airbags activated
P1912	Brake Booster Pressure Sensor Interruption or Short to Voltage	Sensor voltage > 4.80 V
P1913	Brake Booster Pressure Sensor Short To Ground	Sensor voltage < 0.20 V
P2101	Throttle Actuator A Control Motor Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• Duty cycle &gt; 80%</li> <li>• No ECM power stage failure or</li> <li>• Deviation throttle value angles vs. calculated value &gt; 4 to 50%</li> </ul>

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P2106	Throttle Actuator Control System - Forced Limited Power	Internal check failed
P2122	Throttle/Pedal Position Sensor/Switch "D" Circuit Low	Signal voltage < 0.65 V
P2123	Throttle/Pedal Position Sensor/Switch "D" Circuit High	Signal voltage > 4.89 V
P2127	Throttle/Pedal Position Sensor/Switch "E" Circuit Low	Signal voltage < 0.28 V
P2128	Throttle/Pedal Position Sensor/Switch "E" Circuit High	Signal voltage > 2.64 V
P2138	Throttle/Pedal Position Sensor/Switch "D"/"E" Voltage Correlation	Signal voltage sensor 1 vs 2 > 0.14 - 0.26 V
P2146	Fuel Injector Group A Supply Voltage Circuit Open	Signal current, > 14.90 A or < 2.60 V
P2149	Fuel Injector Group B Supply Voltage Circuit Open	Signal current, > 14.90 A or < 2.60 V
P2152	Fuel Injector Group "C" Supply Voltage Circuit/Open	Signal current, > 14.90 A or < 2.60 V
P2155	Fuel Injector Group "D" Supply Voltage Circuit/Open	Signal current, > 14.90 A or < 2.60 V
P2177	System Too Lean Off Idle Bank 1	Adaptive value > 30%
P2178	System Too Rich Off Idle Bank 1	Adaptive value < -30%
P2179	System Too Lean Off Idle Bank 2	Adaptive value > 30%
P2180	System Too Rich Off Idle Bank 2	Adaptive value < -30%
P2181	Cooling System Performance	<ul style="list-style-type: none"> <li>• ECT temperature too low after a sufficient air mass flow integral &lt; 48 to 75° C</li> <li>• for time &gt;= 5.0 [s]</li> <li>or</li> <li>• Filtered ECT decreases under a threshold value after reaching a high temperature level &lt; 28 to 45° C</li> </ul>
P2184	Engine Coolant Temperature Sensor 2 Circuit Low	Signal voltage < 0.10 V



DTC	Error Message	Malfunction Criteria and Threshold Value
P2185	Engine Coolant Temperature Sensor 2 Circuit High	Signal voltage > 4.94 V
P2187	System Too Lean at Idle Bank 1	Adaptive value > 6%
P2188	System Too Rich at Idle Bank 1	Adaptive value < -6.0%
P2189	System Too Lean at Idle Bank 2	Adaptive value > 6%
P2190	System Too Rich at Idle Bank 2	Adaptive value < -6%
P2195	O2 Sensor Signal Biased/ Stuck Lean Bank 1, Sensor 1	Delta lambda of 2nd lambda control loop > 0.059 [-]
P2196	O2 Sensor Signal Biased/ Stuck Rich Bank 1, Sensor 1	Delta lambda of 2nd lambda control loop < -0.059 V
P2197	O2 Sensor Signal Biased/ Stuck Lean Bank 2 Sensor 1	Delta lambda of 2nd lambda control loop > 0.059 V [-]
P2198	O2 Sensor Signal Biased/ Stuck Rich Bank 2 Sensor 1	Delta lambda of 2nd lambda control loop < -0.059 V
P2199	Intake Air Temperature Sensor 1/2 Correlation	Difference between IMT 1 and IMT 2 > 10° C
P2237	O2 Sensor Positive Current Control Circuit/Open Bank 1, Sensor 1	<p>Open circuit pump current (IP)</p> <ul style="list-style-type: none"> <li>• O2S signal front 1.49 to 1.51 V</li> <li>• Difference between maximum and minimum value of O2S voltage signal front n.a.</li> <li>• Delta lambda controller &gt; 0.07 [-]</li> <li>• Lambda control at min or max limit</li> </ul> <p>Open circuit pump current (IP)</p> <ul style="list-style-type: none"> <li>• O2S signal front 1.49 to 1.51 V</li> <li>• Difference between maximum and minimum value of O2S voltage signal front n.a.</li> <li>• No reaction on commanded stepwise change of lambda setpoint &lt;&gt; 1</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P2240	O2 Sensor Positive Current Control Circuit Open Bank 2 Sensor 1	<p>Open circuit pump current (IP)</p> <ul style="list-style-type: none"> <li>• O2S signal front 1.49 to 1.51 V</li> <li>• Difference between maximum and minimum value of O2S voltage signal front n.a.</li> <li>• Delta lambda controller &gt; 0.07 [-]</li> <li>• Lambda control at min or max limit</li> </ul> <p>Open circuit pump current (IP)</p> <ul style="list-style-type: none"> <li>• O2S signal front 1.49 to 1.51 V</li> <li>• Difference between maximum and minimum value of O2S voltage signal front n.a.</li> <li>• No reaction on commanded stepwise change of lambda setpoint &lt;&gt; 1</li> </ul>
P2243	O2 Sensor Reference Voltage Circuit/Open Bank 1, Sensor 1	<p>Open circuit nernst voltage (UN)</p> <ul style="list-style-type: none"> <li>• O2S signal front &lt; 0.25 V or &gt; 4.80 V</li> <li>• Internal resistance &gt; 950 ohm</li> </ul>
P2247	O2 Sensor Reference Voltage Circuit Open Bank 2 Sensor 1	<p>Open circuit nernst voltage (UN)</p> <ul style="list-style-type: none"> <li>• O2S signal front &lt; 0.25 V or &gt; 4.80 V</li> <li>• Internal resistance &gt; 950 ohm</li> </ul>
P2251	O2 Sensor Negative Current Control Circuit Open (Bank 1 Sensor 1)	<p>Open circuit virtual mass (VM)</p> <ul style="list-style-type: none"> <li>• O2S signal front 1.47 to 1.52 V</li> <li>• Internal resistance &gt; 950 ohm</li> </ul>
P2254	O2 Sensor Negative Current Control Circuit Open Bank 2 Sensor 1	<p>Open circuit virtual mass (VM)</p> <ul style="list-style-type: none"> <li>• O2S signal front 1.47 to 1.52 V</li> <li>• Internal resistance &gt; 950 ohm</li> </ul>
P2257	Secondary Air Injection System Control Circuit Low	Signal voltage 0.0 to 3.26 V
P2258	Secondary Air Injection System Control Circuit High	Signal current 0.60 - 2.40 A
P226B	Supercharger Boost Pressure Too High - Mechanical	Boost pressure > 250 kPa
P2262	Supercharger Boost Pressure Not Detected - Mechanical	Ratio between boost pressure and manifold pressure < 1 to 1.25 [-]
P2263	Supercharger Boost System Performance	Difference between set point and actual boost pressure > 25 to 75 kPa

DTC	Error Message	Malfunction Criteria and Threshold Value
P226B	Supercharger Boost Pressure Too High - Mechanical	Boost pressure > 250 kPa
P2270	O2 Sensor Signal Biased/ Stuck Lean Bank 1 Sensor 2	Sensor voltage < 0.75 V
P2271	HO2 Sensor Signal Biased/ Stuck Rich Bank 1 Sensor 2	Sensor voltage > 0.15 V
P2272	O2 Sensor Signal Biased/ Stuck Lean Bank 2 Sensor 2	Sensor voltage < 0.75 V
P2273	O2 Sensor Signal Biased/ Stuck Rich Bank 2 Sensor 2	Sensor voltage > 0.15 V
P2279	Intake Air System Leak	Offset value throttle mass flow > 15 kg/h
P2293	Fuel Pressure Regulator 2 Performance	<ul style="list-style-type: none"> <li>• Difference between target pressure vs. actual pressure: &gt; 1.50 mPa</li> <li>• Difference between target pressure vs. actual pressure, &lt; -1.50 MPa</li> </ul>
P2294	Fuel Pressure Regulator 2 Control Circuit Open	<ul style="list-style-type: none"> <li>• Signal voltage 1.40 to 3.20 V</li> <li>• Signal pattern incorrect.</li> </ul>
P2295	Fuel Pressure Regulator 2 Control Circuit Low	Signal voltage 1.40 V
P2296	Fuel Pressure Regulator 2 Control Circuit High	Signal voltage > 3.20 V

## Ignition System

DTC	Error Message	Malfunction Criteria and Threshold Value
P2300	Ignition Coil A Primary Control Circuit Low	Signal current > 24.0 mA
P2301	Ignition Coil A Primary Control Circuit High	Signal current > 5.1 - 7.0 V
P2303	Ignition Coil B Primary Control Circuit Low	Signal current > 24.0 mA
P2304	Ignition Coil B Primary Control Circuit High	Signal current > 5.1 - 7.0 V
P2306	Ignition Coil C Primary Control Circuit Low	Signal current > 24.0 mA
P2307	Ignition Coil C Primary Control Circuit High	Signal voltage > 5.1 - 7.0 V

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P2309	Ignition Coil D Primary Control Circuit Low	Signal current > 24.0 mA
P2310	Ignition Coil D Primary Control Circuit High	Signal voltage > 5.1 - 7.0 V
P2312	Ignition Coil E Primary Control Circuit Low	Signal current > 24.0 mA
P2313	Ignition Coil E Primary Control Circuit High	Signal voltage > 5.1 - 7.0 V
P2315	Ignition Coil F Primary Control Circuit Low	Signal current > 24.0 mA
P2316	Ignition Coil F Primary Control Circuit High	Signal voltage > 5.1 - 7.0 V

### **Additional Emissions Regulations**

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P240A	Evaporative Emission System Leak Detection Pump Heater Control Circuit/Open	Signal voltage > 4.7 to 5.4 V
P240B	Evaporative Emission System Leak Detection Pump Heater Control Circuit Low	Signal voltage < 2.74 to 3.26 V
P240C	Evaporative Emission System Leak Detection Pump Heater Control Circuit High	Signal current > 2.2 to 4 A
P2400	Evaporative Emission System Leak Detection Pump Control Circuit/Open	Signal voltage > 4.7 - 5.4 V
P2401	Evaporative Emission System Leak Detection Pump Control Circuit Low	Signal voltage < 2.74 to 3.26 V
P2402	Evaporative Emission System Leak Detection Pump Control Circuit High	Signal voltage at EVAP pump current measuring resistor > 1.80 to 4 V

DTC	Error Message	Malfunction Criteria and Threshold Value
P2407	Evaporative Emission System Leak Detection Pump Circuit Intermittent/Erratic	<p>During engine off:</p> <ul style="list-style-type: none"> <li>• Fluctuation of evap pump current during reference measurement &gt; 1.0 [mA]</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>• Drop of EVAP pump current during pump phase &gt; 6.0 [mA]</li> <li>• for time <math>\geq</math> 3.0 [s]</li> </ul> <p>During engine on:</p> <ul style="list-style-type: none"> <li>• Fluctuation of evap pump current during reference measurement &gt; 1.0 [mA]</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>• Drop of EVAP pump current during pump phase &gt; 6.0 [mA]</li> <li>• for time <math>\geq</math> 3.0 [s]</li> </ul>
P2414	O2 Sensor Exhaust Sample Error Bank 1, Sensor 1	<p>Threshold 1</p> <ul style="list-style-type: none"> <li>• O2S signal front 3.70 to 4.81 V</li> </ul> <p>Threshold 2</p> <ul style="list-style-type: none"> <li>• Signal voltage 2.51 - 3.00 V</li> </ul> <p>Depending on gain factor that actual is used for the threshold is switched</p>
P2415	HO2 Sensor Exhaust Sample Error Bank 2 Sensor 1	<p>Threshold 1</p> <ul style="list-style-type: none"> <li>• O2S signal front 3.70 to 4.81 V</li> </ul> <p>Threshold 2</p> <ul style="list-style-type: none"> <li>• Signal voltage 2.51 - 3.00 V</li> </ul> <p>Depending on gain factor that actual is used for the threshold is switched</p>
P2431	Secondary Air Injection System Air Flow/Pressure Sensor Circuit Range/Performance Bank 1	Difference between AIR pressure and barometric pressure < -6.00; > 6.00 [kPa]
P2432	Secondary Air Injection System Air Flow/Pressure Sensor Circuit Low Bank 1	Signal voltage < 0.5 V
P2433	Secondary Air Injection System Air Flow/Pressure Sensor Circuit High Bank 1	Signal voltage > 4.5 V

DTC	Error Message	Malfunction Criteria and Threshold Value
P2440	Secondary Air Injection System Switching Valve Stuck Open Bank 1	<ul style="list-style-type: none"> <li>• Diff. of measured AIR pressure before AIR injection vs. AIR pressure after AIR injection <math>\leq 2.00</math> [kPa]</li> <li>• Blockage: relative AIR pressure measured with AIR pressure sensor vs. modeled <math>\geq 0.30</math> [-]</li> <li>• Leakage: relative AIR pressure measured with AIR pressure sensor vs. modeled <math>\geq 0.40</math> [-]</li> <li>• Blockage: relative AIR pressure measured with AIR pressure sensor vs. modeled while valve bank 2 commanded closed <math>\geq 0.52</math> [-]</li> <li>• Leakage: relative AIR pressure measured with AIR pressure sensor vs. modeled while valve bank 2 commanded closed</li> <li>• Average pressure difference between absolute value and filtered while valve bank 2 commanded closed <math>\geq 0.18...0.30</math> [kPa]</li> <li>• Relative AIR pressure (measured with AIR pressure sensor vs. modeled) vs. relative AIR pressure (measured with AIR pressure sensor vs. modeled while both AIR valves closed) <math>&gt; 1.22</math> [-]</li> </ul> <p>Case 1:</p> <ul style="list-style-type: none"> <li>• Relative AIR pressure (measured with AIR pressure sensor vs. modeled while valve bank 2 commanded closed) vs. relative AIR pressure (measured with AIR pressure sensor vs. modeled while valve bank 1 commanded closed) <math>&gt; 1.33</math> [-]</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P2440	Secondary Air Injection System Switching Valve Stuck Open Bank 1	Continued Case 2: <ul style="list-style-type: none"> <li>• Relative AIR pressure (measured with AIR pressure sensor vs. modeled while valve bank 2 commanded closed) vs. relative AIR pressure (measured with AIR pressure sensor vs. modeled while valve bank 1 commanded closed) <math>\leq 1.33</math> [-]</li> <li>• Relative AIR pressure (measured with AIR pressure sensor vs. modeled while valve bank 1 commanded closed) vs. relative AIR pressure (measured with AIR pressure sensor vs. modeled while valve bank 2 commanded closed) <math>\leq 1.33</math> [-]</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P2442	Secondary Air Injection System Switching Valve Stuck Open Bank 2	<ul style="list-style-type: none"> <li>• Diff. of measured AIR pressure before AIR injection vs. AIR pressure after AIR injection <math>\leq 2.00</math> [kPa]</li> <li>• Blockage: relative AIR pressure measured with AIR pressure sensor vs. modeled <math>\geq 0.30</math> [-]</li> <li>• Leakage: relative AIR pressure measured with AIR pressure sensor vs. modeled <math>\geq 0.40</math> [-]</li> <li>• Blockage: relative AIR pressure measured with AIR pressure sensor vs. modeled while valve bank 2 commanded closed <math>\geq 0.52</math> [-]</li> <li>• Leakage: relative AIR pressure measured with AIR pressure sensor vs. modeled while valve bank 2 commanded closed <math>\geq 0.68</math> [-]</li> <li>• Average pressure difference between absolute value and filtered while valve bank 2 commanded closed <math>\geq 0.18...0.30</math> [kPa]</li> <li>• Relative AIR pressure (measured with AIR pressure sensor vs. modeled) vs. relative AIR pressure (measured with AIR pressure sensor vs. modeled while both AIR valves closed) <math>&gt; 1.22</math> [-]</li> </ul> <p>Case 1:</p> <ul style="list-style-type: none"> <li>• Relative AIR pressure (measured with AIR pressure sensor vs. modeled while valve bank 2 commanded closed) vs. relative AIR pressure (measured with AIR pressure sensor vs. modeled while valve bank 1 commanded closed) <math>&gt; 1.33</math> [-]</li> </ul>



DTC	Error Message	Malfunction Criteria and Threshold Value
P2442	Secondary Air Injection System Switching Valve Stuck Open Bank 2	Continued Case 2: <ul style="list-style-type: none"> <li>Relative AIR pressure (measured with AIR pressure sensor vs. modeled while valve bank 2 commanded closed) vs. relative AIR pressure (measured with AIR pressure sensor vs. modeled while valve bank 1 commanded closed) <math>\leq 1.33</math> [-]</li> <li>Relative AIR pressure (measured with AIR pressure sensor vs. modeled while valve bank 1 commanded closed) vs. relative AIR pressure (measured with AIR pressure sensor vs. modeled while valve bank 2 commanded closed) <math>\leq 1.33</math> [-]</li> </ul>
P2450	Evaporative Emission System Switching Valve Performance/ Stuck Open	During engine off: <ul style="list-style-type: none"> <li>EVAP pump current difference between reference measurement to idle <math>\leq 4</math> mA</li> </ul> During engine on: <ul style="list-style-type: none"> <li>EVAP pump current difference between reference measurement to idle <math>\leq 3.9</math> [mA]</li> </ul>
P2539	Low Pressure Fuel System Sensor Circuit	Signal voltage $> 4.80$ V
P2540	Low Pressure Fuel System Sensor Circuit Range/ Performance	Actual pressure deviation $< 800$ kPa $< 80$ kPa
P2541	Low Pressure Fuel System Sensor Circuit Low	Signal voltage $< 0.2$ V
P25AF	CAN: Engine Hood Switch Circuit	Communication with Gateway: <ul style="list-style-type: none"> <li>Engine Hood Switch Failure</li> </ul>
P2600	Coolant Pump "A" Control Circuit/Open	Signal voltage 4.8 to 5.3 V
P2602	Coolant Pump "A" Control Circuit Low	Signal voltage $< 2.8$ to 3.2 V
P2603	Coolant Pump "A" Control Circuit High	Signal current $> 5.5$ to 10 A

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P261A	Coolant Pump "B" Control Circuit/Open	Signal voltage 4.8 to 5.3 V
P261C	Coolant Pump "B" Control Circuit Low	Signal voltage < 2.8 to 3.2 V
P261D	Coolant Pump "B" Control Circuit High	Signal current > 2.2 to 4 A
P2626	O2 Sensor Pumping Current Trim Circuit/Open Bank 1 Sensor 1	O2S signal front > 4.81 V
P2629	O2 Sensor Pumping Current Trim Circuit/Open Bank 1 Sensor 1	O2S signal front > 4.81 V
P2681	Engine Coolant Bypass Valve Control Circuit/Open	Signal voltage 4.8 to 5.3 V
P2682	Engine Coolant Bypass Valve Control Circuit Low	Signal voltage < 2.8 to 3.2 V
P2683	Engine Coolant Bypass Valve Control Circuit High	Signal current > 2.2 to 4 A

## **Fuel and Air Mixture, Additional Emissions Regulations**

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P3043	Fuel Pump Mechanical Malfunction	Internal check failed
P3044	Fuel Pump Control Circuit Low	Phase current > 35 [A]
P305C	Intake Air Temperature Sensor 2 Circuit Low	Intake air temperature > 128° C
P305D	Intake Air Temperature Sensor 2 Circuit High	Intake air temperature < -39° C
P305E	Intake air temperature sensor 2 Implausible signal	rationality check high • Downstream IAT vs ECT > 26 or ≤ -26° C or • Downstream IAT vs IAT after intercooler 1 > 26 or ≤ -26° C • Downstream IAT vs ECT > 26 or ≤ -26° C or • Downstream IAT vs IAT after intercooler 1 > 26 or ≤ -26° C

DTC	Error Message	Malfunction Criteria and Threshold Value
P3073	Fuel Pump Control Circuit / Open	Internal check failed
P3081	Engine Temperature Too Low	Difference between modeled and actual ECT > 9.8 K
P308D	Fuel Pump Speed Too Low	<ul style="list-style-type: none"> <li>• Phase current &gt; 35 [A]</li> <li>• Speed deviation &gt; 10%</li> </ul>
P308E	Fuel Pump Electronics Excess Temperature	Over-temperature warning power <ul style="list-style-type: none"> <li>• Power stage temperature &gt; 126° C</li> </ul> Over-temperature power stage <ul style="list-style-type: none"> <li>• Power stage temperature &gt; 130 [°C]</li> </ul>
P309C	Clutch Control Mechanical Fault	Actuator hardware failure or actuator voltage failure
P309D	Clutch Disengagement Actuator Insufficient Slip with Disengaged Clutch	Combustion engine speed is detected while electronic clutch is open > 25 RPM
P309F	Clutch Disengagement Actuator Slip When Clutch Engaged	Difference between combustion engine speed and electric machine speed > 200 to 300 RPM
030A2	Brake Pedal Position Sensor <=> Brake Light Switch Implausible Signal	<ul style="list-style-type: none"> <li>• Brake light switch not active</li> <li>• Brake pedal position &gt; 27.00 [%]</li> </ul>

## HV Battery & Hybrid Power Electrical

DTC	Error Message	Malfunction Criteria and Threshold Value
P062F	ECU EEPROM Check	EEPROM failure
P06B0	Sensor Power Supply "A" Circuit/Open	VDD5 supply voltage too high internal hardware check
P06B1	Sensor Power Supply "A" Circuit Low	Power supply voltage = ground
P06B2	Sensor Power Supply "A" Circuit High	Power supply voltage = battery voltage
P06B4	Sensor Power Supply "B" Circuit Low	Gate driver internal hardware check = ground
P06B5	Sensor Power Supply "B" Circuit High	Gate driver internal hardware check = battery voltage

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0A1B	Drive Motor "A" Control Module	DC link circuit resistance < 0.19 [Ohm] (= DC link voltage / DC link current )
P0A1F	Battery Energy Control Module	<ul style="list-style-type: none"> <li>• Monitor signal for contactor power circuit is High</li> <li>• Monitor signal for contactor power latch circuit is Low</li> <li>• Monitor signal for power sustain circuit in (input signal to CPU from H/W) is High (input signal to CPU from H/W)</li> <li>• Watch Dog counter &gt; 50 count (increment 10ms cycle during malfunction detection)</li> </ul>
P0A2B	Drive Motor "A" Temperature Sensor Circuit Range/ Performance	> 38 [K] and / or > 37 [K]
P0A2C	Drive Motor "A" Temperature Sensor Circuit Low	Stator Temp. > 246 [° C]
P060B	Internal Control Module A/D Processing Performance	Internal hardware check
P0A2D	Drive Motor "A" Temperature Sensor Circuit High	Stator Temp. < - 53 [° C]
P0A40	Drive Motor "A" Position Sensor Circuit Range/ Performance	Signal pattern change too fast < 100 [μs]
P0A41	Drive Motor "A" Position Sensor Circuit Low	Signal pattern wrong 0-0-0 - = ground -
P0A42	Drive Motor "A" Position Sensor Circuit High	Signal pattern change too fast < 100 [μs]
P0A52	Drive Motor "A" Current Sensor Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• DC link current &gt; 230 [A]</li> <li>• DC link current offset &gt; 16 [A]</li> </ul>
P0A53	DC link current sensor short cut to ground or open circuit	DC link current < - 250 [A]
P0A54	Drive Motor "A" Current Sensor Circuit Low	DC link current > 250 [A]

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0A7D	Hybrid/EV Battery Pack State of Charge Low	<ul style="list-style-type: none"> <li>• Minimum block voltage 8.97 to 8.34 [V]</li> <li>• (depending on battery temperature)</li> <li>• Minimum block voltage &lt; 4,8 [V]</li> </ul> or <ul style="list-style-type: none"> <li>• Pack voltage &lt; 180 [V]</li> </ul>
P0A80	Hybrid/EV Battery Pack Current Sensor "A" Circuit Range/Performance	Internal resistance > 4.45 to 1.29 [O]
P0A90	Drive Motor "A" Performance	<ul style="list-style-type: none"> <li>• Loss of drive motor efficiency = 30 [%]</li> <li>• Deviation of measured magnetic flux from nominal magnetic flux during cold drive motor &gt; 15%</li> <li>• During warm drive motor &gt; 20%</li> <li>• Current controller functional check</li> </ul>
P0A95	High Voltage Fuse "A"	Status information from V Sensor indicates fuse malfunction
P0A9C	Hybrid/EV Battery Temperature Sensor "A" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Difference of two temperature sensors &lt; -20° C</li> </ul> or <ul style="list-style-type: none"> <li>• Difference of two temperature sensors &gt; 20° C</li> <li>• Number of checks with a single sensor exceeds threshold value ≥ 5</li> </ul>
P0A9D	Hybrid/EV Battery Temperature Sensor "A" Circuit Low	Thermistor temperature < -45.0° C
P0A9E	Hybrid/EV Battery Temperature Sensor "A" Circuit High	Thermistor temperature > 95.0° C

DTC	Error Message	Malfunction Criteria and Threshold Value
P0AA1	Hybrid/EV Battery Positive Contactor Circuit Stuck Closed	<ul style="list-style-type: none"> <li>• State 1: all contactors off inconsistency</li> <li>• State 2: control negative contactor to close inconsistency</li> <li>• State 3: control precharge contactor to close inconsistency</li> <li>• State 4: control positive contactor to close inconsistency</li> <li>• State 5: control precharge contactor to open in case of malfunction of state 1 to 5 to pin-point: inconsistency</li> <li>• State 6: control negative contactor to open inconsistency</li> <li>• <math>(HVP - CVP) * 100 / HVP \leq 20</math> [%]</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>• <math>(HVN - CVN) * 100 / HVN \leq 20</math> [%]</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P0AA2	Hybrid/EV Battery Positive Contactor Circuit Stuck Open	<ul style="list-style-type: none"> <li>• State 1: all contactors off inconsistency</li> <li>• State 2: control negative contactor to close inconsistency</li> <li>• State 3: control precharge contactor to close inconsistency</li> <li>• State 4: control positive contactor to close inconsistency</li> <li>• State 5: control precharge contactor to open in case of malfunction of state 1 to 5 to pin-point: inconsistency</li> <li>• State 6: control negative contactor to open inconsistency</li> <li>• BECM requests to closed</li> <li>• Battery current &lt; 0,2 [A]</li> <li>• <math>(TV-High - CVP) * 100 / \text{Pack voltage} &gt; 20 [\%]</math></li> <li>• <math>(TV-Low - CVN) * 100 / \text{Pack voltage} &gt; 20 [\%]</math></li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P0AA4	Hybrid/EV Battery Negative Contactor Circuit Stuck Closed	<ul style="list-style-type: none"> <li>• State 1: all contactors off inconsistency</li> <li>• State 2: control negative contactor to close inconsistency</li> <li>• State 3: control precharge contactor to close inconsistency</li> <li>• State 4: control positive contactor to close inconsistency</li> <li>• State 5: control precharge contactor to open in case of malfunction of state 1 to 5 to pin-point: inconsistency</li> <li>• State 6: control negative contactor to open inconsistency</li> <li>• <math>(HVP - CVP) * 100 / HVP \leq 20</math> [%]</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>• <math>(HVN - CVN) * 100 / HVN \leq 20</math> [%]</li> </ul>



DTC	Error Message	Malfunction Criteria and Threshold Value
P0AA5	Hybrid/EV Battery Negative Contactor Circuit Stuck Open	<ul style="list-style-type: none"> <li>• State 1: all contactors off inconsistency</li> <li>• State 2: control negative contactor to close inconsistency</li> <li>• State 3: control precharge contactor to close inconsistency</li> <li>• State 4: control positive contactor to close inconsistency</li> <li>• State 5: control precharge contactor to open in case of malfunction of state 1 to 5 to pin-point: inconsistency</li> <li>• State 6: control negative contactor to open inconsistency</li> <li>• BECM requests to closed</li> <li>• Battery current &lt; 0,2 [A]</li> <li>• <math>(TV-High - CVP) * 100 / \text{Pack voltage} &gt; 20</math> [%]</li> <li>• <math>(TV-Low - CVN) * 100 / \text{Pack voltage} &gt; 20</math> [%]</li> </ul>
P0AAD	Hybrid/EV Battery Pack Air Temperature Sensor "A" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Average of battery temperature - inlet/outlet thermistor temperature &gt; 10° C</li> <li>•  inlet thermistor temperature - outlet thermistor temperature &gt; 10° C</li> <li>• Engine off time &gt; 360 [min]</li> </ul>
P0AAE	Hybrid/EV Battery Pack Air Temperature Sensor "A" Circuit Low	Thermistor temperature < -45.0° C
P0AAF	Hybrid/EV Battery Pack Air Temperature Sensor "A" Circuit High	Thermistor temperature > 95.0° C

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0AB2	Hybrid/EV Battery Pack Air Temperature Sensor "B" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Average of battery temperature - inlet/outlet thermistor temperature &gt; 10° C</li> <li>•  inlet thermistor temperature - outlet thermistor temperature &gt; 10° C</li> <li>• Engine off time &gt; 360 [min]</li> </ul>
P0AB3	Hybrid/EV Battery Pack Air Temperature Sensor "B" Circuit Low	Thermistor temperature < -45.0° C
P0AB4	Hybrid/EV Battery Pack Air Temperature Sensor "B" Circuit High	Thermistor temperature > 95.0° C
P0ABA	Hybrid/EV Battery Pack Voltage Sense "A" Circuit	<ul style="list-style-type: none"> <li>• Time of no communicate with V Sensor &gt; 10 [s]</li> <li>or</li> <li>• V Sensor status indicates circuit malfunction</li> </ul>
P0ABB	Hybrid Battery Pack Voltage Sense "A" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• HVP &gt; 240 [V]</li> <li>• HVP &lt; 24 [V]</li> <li>• TV-High - HVP &gt; 48 [V]</li> <li>• TV-High - CVP &lt; 48 [V]</li> <li>• HVP - CVP &gt; 48 [V]</li> </ul>
P0ABC	Hybrid/EV Battery Pack Voltage Sense "A" Circuit Low	HVP < -248 [V]
P0ABD	Hybrid/EV Battery Pack Voltage Sense "A" Circuit High	HVP > 248 [V]
P0ABF	Hybrid/EV Battery Pack Current Sensor "A" Circuit Range/Performance	The result of H/W check by sub CPU indicates circuit failure

DTC	Error Message	Malfunction Criteria and Threshold Value
P0AC0	Hybrid/EV Battery Pack Current Sensor "A" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Battery current &gt; 130 [A]</li> <li>• Battery current &lt; -190 [A]</li> <li>• Compare P-GND voltage polarization with Current polarization inconsistency</li> <li>• Current offset &gt; 1 [A]</li> <li>• Current offset &lt; -2 [A]</li> <li>• State 1: all contactors off inconsistency</li> <li>• State 2: control negative contactor to close inconsistency</li> <li>• State 3: control precharge contactor to close inconsistency</li> <li>• State 4: control positive contactor to close inconsistency</li> <li>• State 5: control precharge contactor to open in case of malfunction of state 1 to 5 to pin-point: inconsistency</li> <li>• State 6: control negative contactor to open inconsistency</li> </ul>
P0AC1	Hybrid/EV Battery Pack Current Sensor "A" Circuit Low	Battery current < -240 [A]
P0AC2	Hybrid/EV Battery Pack Current Sensor "A" Circuit High	Battery current > 240 [A]
P0AC6	Hybrid/EV Battery Temperature Sensor "B" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Difference of two temperature sensors &lt; -20° C</li> <li>or</li> <li>• Difference of two temperature sensors &gt; 20° C</li> <li>• Number of checks with a single sensor exceeds threshold value <math>\geq 5</math></li> </ul>
P0AC7	Hybrid/EV Battery Temperature Sensor "B" Circuit High	Thermister temperature < -45.0° C
P0AC8	Hybrid/EV Battery Temperature Sensor "B" Circuit High	Thermister temperature > 95.0° C

DTC	Error Message	Malfunction Criteria and Threshold Value
P0ACB	Hybrid/EV Battery Temperature Sensor "C" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Difference of two temperature sensors &lt; -20° C</li> <li>or</li> <li>• Difference of two temperature sensors &gt; 20° C</li> <li>• Number of checks with a single sensor exceeds threshold value ≥ 5</li> </ul>
P0ACC	Hybrid/EV Battery Temperature Sensor "C" Circuit Low	Thermister temperature < -45.0° C
P0ACD	Hybrid/EV Battery Temperature Sensor "C" Circuit High	Thermister temperature > 95.0° C
P0AD9	Hybrid/EV Battery Positive Contactor Control Circuit/ Open	<ul style="list-style-type: none"> <li>• Monitor signal for positive contactor drive circuit is High</li> <li>• BECM requests to closed</li> </ul>
P0ADC	Hybrid/EV Battery Positive Contactor Control Circuit High	<ul style="list-style-type: none"> <li>• Monitor signal for positive contactor drive circuit is High</li> <li>• BECM requests to closed</li> </ul>
P0ADD	Hybrid/EV Battery Negative Contactor Control Circuit/ Open	<ul style="list-style-type: none"> <li>• Monitor signal for positive contactor drive circuit is High</li> <li>• BECM requests to closed</li> </ul>
P0AE2	Hybrid/EV Battery Precharge Contactor Circuit Stuck Closed	<ul style="list-style-type: none"> <li>• State 1: all contactors off inconsistency</li> <li>• State 2: control negative contactor to close inconsistency</li> <li>• State 3: control precharge contactor to close inconsistency</li> <li>• State 4: control positive contactor to close inconsistency</li> <li>• State 5: control precharge contactor to open in case of malfunction of state 1 to 5 to pin-point: inconsistency</li> <li>• State 6: control negative contactor to open inconsistency</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P0AE3	Hybrid/EV Battery Precharge Contactor Circuit Stuck Open	<ul style="list-style-type: none"> <li>• State 1: all contactors off inconsistency</li> <li>• State 2: control negative contactor to close inconsistency</li> <li>• State 3: control precharge contactor to close inconsistency</li> <li>• State 4: control positive contactor to close inconsistency</li> <li>• State 5: control precharge contactor to open in case of malfunction of state 1 to 5 to pin-point: inconsistency</li> <li>• State 6: control negative contactor to open inconsistency</li> <li>• Pack voltage - Contactor voltage <math>\geq 20</math> [V]</li> </ul>
P0AE4	Hybrid/EV Battery Pre-charge Contactor Control Circuit/ Open	<ul style="list-style-type: none"> <li>• Monitor signal for Pre-Charge contactor drive</li> <li>• BECM requests to closed</li> </ul>
P0AE9	Hybrid/EV Battery Temperature Sensor "D" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Difference of two temperature sensors <math>&lt; -20^{\circ}</math> C</li> <li>or</li> <li>• Difference of two temperature sensors <math>&gt; 20^{\circ}</math> C</li> <li>• Number of checks with a single sensor exceeds threshold value <math>\geq 5</math></li> </ul>
P0AEA	Hybrid/EV Battery Temperature Sensor "D" Circuit Low	Thermister temperature $< -45.0^{\circ}$ C
P0AEB	Hybrid/EV Battery Temperature Sensor "D" Circuit High	Thermister temperature $> 95.0^{\circ}$ C
P0AEE	Heat Sink Temperature Sensor Rationality Fault (cross check)	$> 28.5$ [K]
P0AEF	Heat Sink Temperature Sensor Out of Range Low	$< - 55$ [°C]
P0AF0	Heat Sink Temperature Sensor Out of Range High	$> 150$ [°C]

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0AF3	Drive Motor Inverter Temperature Sensor "B" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• PCB temperature - stator temperature &gt; 37 [K]</li> <li>• PCB temperature - heat sink &gt; 28.5 [K]</li> </ul>
P0AF4	Drive Motor Inverter Temperature Sensor "B" Circuit Low	PCB temperature < - 55 [° C]
P0AF5	Drive Motor Inverter Temperature Sensor "B" Circuit High	PCB temperature > + 150 [°C]
P0AF8	Hybrid/EV Battery System Voltage	<ul style="list-style-type: none"> <li>• Battery current ≥ 20 [A]</li> <li>or</li> <li>• Positive Pack Voltage - Negative Pack Voltage &lt; 48 [V]</li> <li>• Positive Backup Pack Voltage - Negative Backup Pack Voltage &lt; 48 [V]</li> </ul>
P0AFA	Hybrid/EV Battery System Voltage Low	Pack voltage < 214 [V]
P0AFB	Hybrid/EV Battery System Voltage High	Pack voltage > 386 [V]
P0B15	Hybrid Battery Pack Voltage Sense "B" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• HVN &gt; -24 [V]</li> <li>• HVN &lt; -240 [V]</li> <li>• TV-Low - HVN &gt; 48 [V]</li> <li>• TV-Low - CVN &lt; 48 [V]</li> <li>• HVN - CVN &gt; 48 [V]</li> </ul>
P0B16	Hybrid/EV Battery Pack Voltage Sense "B" Circuit Low	HVN < -248 [V]
P0B17	Hybrid/EV Battery Pack Voltage Sense "B" Circuit High	HVN > 248 [V]

DTC	Error Message	Malfunction Criteria and Threshold Value
P0B1A	Hybrid Battery Pack Voltage Sense "C" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• CVP &gt; 240 [V]</li> <li>• CVP &lt; 24 [V]</li> <li>• TV-High - HVP &lt; 48 [V]</li> <li>• TV-High - CVP &gt; 48 [V]</li> <li>• HVP - CVP &gt; 48 [V]</li> <li>• State 1: all contactors off inconsistency</li> <li>• State 2: control negative contactor to close inconsistency</li> <li>• State 3: control precharge contactor to close inconsistency</li> <li>• State 4: control positive contactor to close inconsistency</li> <li>• State 5: control precharge contactor to open in case of malfunction of state 1 to 5 to pin-point: inconsistency</li> <li>• State 6: control negative contactor to open inconsistency</li> </ul>
P0B1B	Hybrid/EV Battery Pack Voltage Sense "C" Circuit Low	CVP < -248 [V]
P0B1C	Hybrid/EV Battery Pack Voltage Sense "C" Circuit High	CVP > 248 [V]

DTC	Error Message	Malfunction Criteria and Threshold Value
P0B1F	Hybrid Battery Pack Voltage Sense "D" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• CVN &gt; -24 [V]</li> <li>• CVN &lt; -240 [V]</li> <li>• TV-Low - HVN &gt; 48 [V]</li> <li>• TV-Low - CVN &lt; 48 [V]</li> <li>• HVN - CVN &gt; 48 [V]</li> <li>• State 1: all contactors off inconsistency</li> <li>• State 2: control negative contactor to close inconsistency</li> <li>• State 3: control precharge contactor to close inconsistency</li> <li>• State 4: control positive contactor to close inconsistency</li> <li>• State 5: control precharge contactor to open in case of malfunction of state 1 to 5 to pin-point: inconsistency</li> <li>• State 6: control negative contactor to open inconsistency</li> </ul>
P0B20	Hybrid/EV Battery Pack Voltage Sense "D" Circuit Low	CVN < -248 [V]
P0B21	Hybrid/EV Battery Pack Voltage Sense "D" Circuit High	CVN > 248 [V]
P0B25	Hybrid/EV Battery "A" Voltage Low	Minimum block SOC <= 5 [%]
P0B3C	Hybrid Battery Voltage Sense "A" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• TV-High &gt; 240 [V]</li> <li>• TV-High &lt; 24 [V]</li> <li>• TV-High - HVP &gt; 48 [V]</li> <li>• TV-High - CVP &gt; 48 [V]</li> <li>• HVP - CVP &lt; 48 [V]</li> <li>• Average Block voltage – Minimum Block voltage (8cell) &gt; 1,2 [V]</li> </ul> <p style="text-align: center;">or</p> <ul style="list-style-type: none"> <li>• Minimum Block voltage (8cell) – Minimum Block voltage (16cell) &gt; 0,6 [V]</li> </ul>
P0B3D	Hybrid/EV Battery Voltage Sense "A" Circuit Low	TV-High < -248 [V]
P0B3E	Hybrid/EV Battery Voltage Sense "A" Circuit High	TV-High > 248 [V]



DTC	Error Message	Malfunction Criteria and Threshold Value
P0B41	Hybrid/EV Battery Voltage Sense "B" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• Block Voltage (TMV01) &lt; 20.8 [V]</li> <li>• Block Voltage (TMV01) &gt; 208 [V]</li> <li>• Average Block voltage – Minimum Block voltage (8cell) &gt; 1,2 [V]</li> </ul> or <ul style="list-style-type: none"> <li>• Minimum Block voltage (8cell) – Minimum Block voltage (16cell) &gt; 0.6 [V]</li> </ul>
P0B42	Hybrid/EV Battery Voltage Sense "B" Circuit Low	Block Voltage (TMV01) < -226,572 [V]
P0B43	Hybrid/EV Battery Voltage Sense "B" Circuit High	Block Voltage (TMV01) > 226,572 [V]
P0B46	Hybrid/EV Battery Voltage Sense "C" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• Block Voltage (TMV02) &lt; 17.6 [V]</li> <li>• Block Voltage (TMV02) &gt; 176 [V]</li> <li>• Average Block voltage – Minimum Block voltage (8cell) &gt; 1.2 [V]</li> </ul> or <ul style="list-style-type: none"> <li>• Minimum Block voltage (8cell) – Minimum Block voltage (16cell) &gt; 0.6 [V]</li> </ul>
P0B47	Hybrid/EV Battery Voltage Sense "C" Circuit Low	Block Voltage (TMV02) < -189,068 [V]
P0B48	Hybrid/EV Battery Voltage Sense "C" Circuit High	Block Voltage (TMV02) > 189.068 [V]
P0B4B	Hybrid/EV Battery Voltage Sense "D" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• Block Voltage (TMV03) &lt; 14.4 [V]</li> <li>• Block Voltage (TMV03) &gt; 144 [V]</li> <li>• Average Block voltage – Minimum Block voltage (8cell) &gt; 1.2 [V]</li> </ul> or <ul style="list-style-type: none"> <li>• Minimum Block voltage (8 cell) – Minimum Block voltage (16 cell) &gt; 0.6 [V]</li> </ul>
P0B4C	Hybrid/EV Battery Voltage Sense "D" Circuit Low	Block Voltage (TMV03) < -171,688 [V]

DTC	Error Message	Malfunction Criteria and Threshold Value
P0B4D	Hybrid/EV Battery Voltage Sense "D" Circuit High	Block Voltage (TMV03) > 171,688 [V]
P0B50	Hybrid/EV Battery Voltage Sense "E" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• Block Voltage (TMV04) &lt; 11.2 [V]</li> <li>• Block Voltage (TMV04) &gt; 112 [V]</li> <li>• Average Block voltage – Minimum Block voltage (8cell) &gt; 1.2 [V]</li> </ul> or <ul style="list-style-type: none"> <li>• Minimum Block voltage (8 cell) – Minimum Block voltage (16 cell) &gt; 0.6 [V]</li> </ul>
P0B51	Hybrid/EV Battery Voltage Sense "E" Circuit Low	Block Voltage (TMV04) < -171,688 [V]
P0B52	Hybrid/EV Battery Voltage Sense "E" Circuit High	Block Voltage (TMV04) > 171,688 [V]
P0B55	Hybrid/EV Battery Voltage Sense "F" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• Block Voltage (TMV05) &lt; 8 [V]</li> <li>• Block Voltage (TMV05) &gt; 80 [V]</li> <li>• Average Block voltage – Minimum Block voltage (8cell) &gt; 1,2 [V]</li> </ul> or <ul style="list-style-type: none"> <li>• Minimum Block voltage (8 cell) – Minimum Block voltage (16 cell) &gt; 0.6 [V]</li> </ul>
P0B56	Hybrid/EV Battery Voltage Sense "F" Circuit Low	Block Voltage (TMV05) < -189,461 [V]
P0B57	Hybrid/EV Battery Voltage Sense "F" Circuit High	Block Voltage (TMV05) > 189,461 [V]
P0B5A	Hybrid/EV Battery Voltage Sense "G" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• Block Voltage (TMV06) &lt; 4.8 [V]</li> <li>• Block Voltage (TMV06) &gt; 48 [V]</li> <li>• Average Block voltage – Minimum Block voltage (8 cell) &gt; 1.2 [V]</li> </ul> or <ul style="list-style-type: none"> <li>• Minimum Block voltage (8 cell) – Minimum Block voltage (16 cell) &gt; 0.6 [V]</li> </ul>
P0B5B	Hybrid/EV Battery Voltage Sense "G" Circuit Low	Block Voltage (TMV06) < -192,875 [V]

DTC	Error Message	Malfunction Criteria and Threshold Value
P0B5C	Hybrid/EV Battery Voltage Sense "G" Circuit High	Block Voltage (TMV06) > 192,875 [V]
P0B5F	Hybrid/EV Battery Voltage Sense "H" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• Block Voltage (TMV07) &lt; 1.6 [V]</li> <li>• Block Voltage (TMV07) &gt; 16 [V]</li> <li>• Average Block voltage – Minimum Block voltage (8 cell) &gt; 1.2 [V]</li> </ul> or <ul style="list-style-type: none"> <li>• Minimum Block voltage (8 cell) – Minimum Block voltage (16 cell) &gt; 0.6 [V]</li> </ul>
P0B60	Hybrid/EV Battery Voltage Sense "H" Circuit Low	Block Voltage (TMV07) < -192,875 [V]
P0B61	Hybrid/EV Battery Voltage Sense "H" Circuit High	Block Voltage (TMV07) > 192,875 [V]
P0B63	Hybrid/EV Battery Voltage Sense "I" Circuit	V Sensor status indicates P-GND open
P0B64	Hybrid/EV Battery Voltage Sense "I" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• P-GND (TMV08) &lt; -1,800 [V]</li> <li>• P-GND (TMV08) &gt; 1.8 [V]</li> </ul>
P0B65	Hybrid/EV Battery Voltage Sense "I" Circuit Low	P-GND (TMV08) < -193 [V]
P0B66	Hybrid/EV Battery Voltage Sense "I" Circuit High	P-GND (TMV08) > 193 [V]
P0B69	Hybrid/EV Battery Voltage Sense "J" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• Block Voltage (TMV09) &lt; -32 [V]</li> <li>• Block Voltage (TMV09) &gt; -3.2 [V]</li> <li>• Average Block voltage – Minimum Block voltage (8cell) &gt; 1.2 [V]</li> </ul> or <ul style="list-style-type: none"> <li>• Minimum Block voltage (8 cell) – Minimum Block voltage (16 cell) &gt; 0.6 [V]</li> </ul>
P0B6A	Hybrid/EV Battery Voltage Sense "J" Circuit Low	Block Voltage (TMV09) < -40.074 [V]
P0B6B	Hybrid/EV Battery Voltage Sense "J" Circuit High	Block Voltage (TMV09) > 40.074 [V]

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0B6E	Hybrid/EV Battery Voltage Sense "K" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• Block Voltage (TMV10) &lt; -64 [V]</li> <li>• Block Voltage (TMV10) &gt; -6.4 [V]</li> <li>• Average Block voltage – Minimum Block voltage (8 cell) &gt; 1.2 [V]</li> </ul> or <ul style="list-style-type: none"> <li>• Minimum Block voltage (8 cell) – Minimum Block voltage (16 cell) &gt; 0.6 [V]</li> </ul>
P0B6F	Hybrid/EV Battery Voltage Sense "K" Circuit Low	Block Voltage (TMV10) < -72.319 [V]
P0B70	Hybrid/EV Battery Voltage Sense "K" Circuit High	Block Voltage (TMV10) > 72.319 [V]
P0B73	Hybrid/EV Battery Voltage Sense "L" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• Block Voltage (TMV12) &lt; -128 [V]</li> <li>• Block Voltage (TMV12) &gt; -12.8 [V]</li> <li>• Average Block voltage – Minimum Block voltage (8 cell) &gt; 1.2 [V]</li> </ul> or <ul style="list-style-type: none"> <li>• Minimum Block voltage (8 cell) – Minimum Block voltage (16 cell) &gt; 0.6 [V]</li> </ul>
P0B74	Hybrid/EV Battery Voltage Sense "L" Circuit Low	Block Voltage (TMV11) < -103.692 [V]
P0B75	Hybrid/EV Battery Voltage Sense "L" Circuit High	Block Voltage (TMV11) > 103.692 [V]
P0B78	Hybrid/EV Battery Voltage Sense "M" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• Block Voltage (TMV12) &lt; -128 [V]</li> <li>• Block Voltage (TMV12) &gt; -12.8 [V]</li> <li>• Average Block voltage – Minimum Block voltage (8 cell) &gt; 1.2 [V]</li> </ul> or <ul style="list-style-type: none"> <li>• Minimum Block voltage (8 cell) – Minimum Block voltage (16 cell) &gt; 0.6 [V]</li> </ul>
P0B7A	Hybrid/EV Battery Voltage Sense "M" Circuit High	Block Voltage (TMV12) > 137.680 [V]

DTC	Error Message	Malfunction Criteria and Threshold Value
P0B79	Hybrid/EV Battery Voltage Sense "M" Circuit Low	Block Voltage (TMV12) < -137,680 [V]
P0B7D	Hybrid/EV Battery Voltage Sense "N" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• Block Voltage (TMV13) &lt; -160 [V]</li> <li>• Block Voltage (TMV13) &gt; -16 [V]</li> <li>• Average Block voltage – Minimum Block voltage (8 cell) &gt; 1.2 [V]</li> </ul> or <ul style="list-style-type: none"> <li>• Minimum Block voltage (8 cell) – Minimum Block voltage (16 cell) &gt; 0.6 [V]</li> </ul>
P0B7E	Hybrid/EV Battery Voltage Sense "N" Circuit High	Block Voltage (TMV13) < -165,568 [V]
P0B7F	Hybrid/EV Battery Voltage Sense "N" Circuit High	Block Voltage (TMV13) > 165,568 [V]
P0B82	Hybrid/EV Battery Voltage Sense "O" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• Block Voltage (TMV14) &lt; -189.098 [V]</li> <li>• Block Voltage (TMV14) &gt; -19.2 [V]</li> <li>• Average Block voltage – Minimum Block voltage (8 cell) &gt; 1.2 [V]</li> </ul> or <ul style="list-style-type: none"> <li>• Minimum Block voltage (8 cell) – Minimum Block voltage (16 cell) &gt; 0.6 [V]</li> </ul>
P0B83	Hybrid/EV Battery Voltage Sense "O" Circuit Low	Block Voltage (TMV14) < -189.098 [V]
P0B84	Hybrid/EV Battery Voltage Sense "O" Circuit High	Block Voltage (TMV14) > 189.098 [V]
P0B87	Hybrid/EV Battery Voltage Sense "P" Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• Block Voltage (TMV15) &lt; -224 [V]</li> <li>• Block Voltage (TMV15) &gt; -22.4 [V]</li> <li>• Average Block voltage – Minimum Block voltage (8 cell) &gt; 1.2 [V]</li> </ul> or <ul style="list-style-type: none"> <li>• Minimum Block voltage (8 cell) – Minimum Block voltage (16 cell) &gt; 0.6 [V]</li> </ul>

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0B88	Hybrid/EV Battery Voltage Sense "P" Circuit Low	Block Voltage (TMV15) < -226.572 [V]
P0B89	Hybrid/EV Battery Voltage Sense "P" Circuit High	Block Voltage (TMV15) > 226.572 [V]
P0B8C	Hybrid Battery Voltage Sense "Q" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• TV-Low &gt; -24 [V]</li> <li>• TV-Low &lt; -240 [V]</li> <li>• TV-Low - HVN &gt; 48 [V]</li> <li>• TV-Low - CVN &gt; 48 [V]</li> <li>• HVN - CVN &lt; 48 [V]</li> <li>• Average Block voltage – Minimum Block voltage (8 cell) &gt; 1.2 [V]</li> </ul> or <ul style="list-style-type: none"> <li>• Minimum Block voltage (8cell) – Minimum Block voltage (16cell) &gt; 0.6 [V]</li> </ul>
P0B8D	Hybrid/EV Battery Voltage Sense "Q" Circuit Low	TV-Low < -248 [V]
P0B8E	Hybrid/EV Battery Voltage Sense "Q" Circuit high	TV-Low > 248 [V]
P0BB8	Hybrid/EV Battery Voltage Sense "Z" Circuit	V Sensor status indicates HV-GND open
P0BC3	Hybrid/EV Battery Temperature Sensor "E" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Difference of two temperature sensors &lt; -20° C</li> </ul> or <ul style="list-style-type: none"> <li>• Difference of two temperature sensors &gt; 20° C</li> <li>• Number of checks with a single sensor exceeds threshold value ≥ 5</li> </ul>
P0BC4	Hybrid/EV Battery Temperature Sensor "E" Circuit Low	Thermister temperature < -45.0° C
P0BC5	Hybrid/EV Battery Pack Current Sensor "E" Circuit High	Thermister temperature > 95.0° C
P0BC8	Hybrid/EV Battery Pack Cooling Fan 1 Sense Range/Performance	Fan feedback voltage > 1.37 to 3.43 [V] (depending on fan duty)
P0BC9	Hybrid/EV Battery Pack Cooling Fan 1 Sense Circuit Low	Fan feedback voltage < 0.1 [V]

DTC	Error Message	Malfunction Criteria and Threshold Value
P0BCA	Hybrid/EV Battery Pack Cooling Fan 1 Sense Circuit High	Fan feedback voltage > 3,45 [V]
P0BE6	Drive Motor "A" Phase U Current Sensor Circuit Range/Performance	Phase U current offset   > 20 [A]
P0BE7	Drive Motor "A" Phase U Current Sensor Circuit Range/Performance	Phase U current < - 928 [A]
P0BE8	Drive Motor "A" Phase U Current Sensor Out of Range High	Phase U current > 921 [A]
P0BEE	Drive Motor "A" Phase W Current Rationality Fault Low/High	Phase U current offset   > 20 [A]
P0BEF	Drive Motor "A" Phase W Current Sensor Circuit Low	Phase U current > 921 [A]
P0BF0	Drive Motor "A" Phase W Current Sensor Out Of Range High	Phase U current > 921 [A]
P0BFD	Drive Motor "A" Phase Current U & W Sensors Correlation Rationality Check	Current peak to peak (Phase U - Phase W) > 22 [A]
P0C01	Drive Motor "A" Current High	Phase U/W signal range check > 715 [A] and / or < - 715 [A]
P0C05	Drive Motor "A" Phase U-V-W Circuit/Open	<ul style="list-style-type: none"> <li>• Current amplitude of phase U = + 8 [A]</li> <li>• Current amplitude of Phase V = + 8 [A]</li> <li>• Current amplitude of Phase W = + 8 [A]</li> </ul>
P0C17	Drive Motor "A" Position Sensor Not Learned	<ul style="list-style-type: none"> <li>• Offset angle estimation &lt; - 200 [1/min]</li> <li>• Offset angle deviation &gt; 60°</li> </ul>
P0C30	Hybrid/EV Battery Pack State of Charge High	Maximum block SOC ≥ 95 [%]

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0C34	Hybrid/EV Battery Temperature Sensor "F" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Difference of two temperature sensors &lt; -20° C</li> <li>or</li> <li>• Difference of two temperature sensors &gt; 20° C</li> <li>• Number of checks with a single sensor exceeds threshold value ≥ 5</li> </ul>
P0C35	Hybrid/EV Battery Temperature Sensor "F" Circuit Low	Thermister temperature < -45.0° C
P0C36	Hybrid/EV Battery Pack Current Sensor "F" Circuit High	Thermister temperature > 95.0° C
P0C4E	Drive Motor "A" Position Exceeded Learning Limit	<ul style="list-style-type: none"> <li>• Incorrect order of signal change from position sensor = wrong order</li> <li>• Time for acceleration to long &gt; 2,5 [s]</li> <li>• Drive motor speed while acceleration &gt; 1750 [1/min]</li> <li>• Phase current &gt; 0 [A]</li> <li>• Time to calculate offset angle &gt; 0,5 [s]</li> </ul>
P0C52	Drive Motor "A" Position Sensor Circuit "A" Low	Position sensor signal = 0 (continuously)
P0C53	Drive Motor "A" Position Sensor Circuit "A" Low	Position sensor signal = 1 (continuously)
P0C5C	Drive Motor "A" Position Sensor Circuit "B" Low	Position sensor signal = 0 (continuously)
P0C5D	Drive Motor "A" Position Sensor Circuit "B" High	Position sensor signal = 1 (continuously)
P0C79	Drive Motor "A" Inverter Voltage Too High	<ul style="list-style-type: none"> <li>• DC link voltage &gt; + 425 [V]</li> <li>• DC link voltage &gt; + 409 [V]</li> </ul>
P0C7D	Hybrid/EV Battery Temperature Sensor "G" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Difference of two temperature sensors &lt; -20° C</li> <li>or</li> <li>• Difference of two temperature sensors &gt; 20° C</li> <li>• Number of checks with a single sensor exceeds threshold value ≥ 5</li> </ul>



DTC	Error Message	Malfunction Criteria and Threshold Value
P0C7E	Hybrid/EV Battery Temperature Sensor "G" Circuit Low	Thermister temperature < -45.0° C
P0C7F	Hybrid/EV Battery Pack Current Sensor "G" Circuit High	Thermister temperature > 95.0° C
P0C82	Hybrid/EV Battery Temperature Sensor "H" Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Difference of two temperature sensors &lt; -20° C</li> <li>or</li> <li>• Difference of two temperature sensors &gt; 20° C</li> <li>• Number of checks with a single sensor exceeds threshold value ≥ 5</li> </ul>
P0C83	Hybrid/EV Battery Temperature Sensor "H" Circuit Low	Thermister temperature < -45.0° C
P0C84	Hybrid/EV Battery Pack Current Sensor "H" Circuit High	Thermister temperature > 95.0° C
P0CDC	Drive Motor "A" Position Sensor Circuit "C" Low	Position sensor signal = 0 (continuously)
P0CDD	Drive Motor "A" Position Sensor Circuit "C" High	Position sensor signal = 1 (continuously)
P0D2E	Drive Motor "A" Inverter Voltage Sensor Circuit Range/Performance	DC link voltage (BECM) - DC link voltage (DMCM) > 6 to 34 [V]
P0D60	Hybrid/EV Battery Pack Cooling Fan 2 Sense Range/Performance	Fan feedback voltage > 1.37 to 3,43 [V] (depending on fan duty)
P0D61	Hybrid/EV Battery Pack Cooling Fan 2 Sense Circuit Low	Fan feedback voltage < 0.1 [V]
P0D62	Hybrid/EV Battery Pack Cooling Fan 2 Sense Circuit High	Fan feedback voltage > 3.45 [V]
P151A	Control Module Incorrect Code	Coding - equal coding

# DTC CHART

## Engine Code - CGRA

### Fuel and Air Mixture, Additional Emissions Regulations

DTC	Error Message	Malfunction Criteria and Threshold Value
P000A	Intake Camshaft Position Slow Response Bank 1	Difference between target and actual position > 12 to 40° CRK for > 3 Sec. and Adjustment angle $\geq 3^\circ$ CRK
P000B	Exhaust Camshaft Position Slow Response Bank 1	Difference between target and actual position > 10 to 22° CRK for > 2 to 3 Sec. and Adjustment angle $\geq 3^\circ$ CRK
P0010	Intake Camshaft Position Actuator Circuit Open	Signal voltage > 4.7 - 5.4 V
P0011	Intake Camshaft Position Timing Over-Advanced	Difference between target and actual position > 12 to 40° CRK for > 3 Sec. and Adjustment angle < 3° CRK
P0013	Exhaust Camshaft Position Actuator Circuit	Signal voltage, > 4.7 - 5.4 V
P0014	Exhaust Camshaft Position Timing Over-Advanced/ System Performance	Difference between target and actual position > 10 to 22 °CRK for > 2 Sec. and Adjustment angle < 3 °CRK
P0016	Crankshaft Position vs Camshaft Position Correlation Sensor A	Deviation in camshaft position to crankshaft position > 11.01 or < -11.01 degrees of crank rotation
P0017	Crankshaft Position – Exhaust Camshaft Position Correlation Sensor B	Deviation in camshaft position to crankshaft position > 11.01 or < -11.01 degrees of crank rotation
P025A	Fuel Pump Module Control Circuit Open	Signal voltage > 4.8- 5.3V
P025C	Fuel Pump Module Control Circuit Low	Signal voltage < 2.7 - 3.25 V
P025D	Fuel Pump Module Control Circuit High	Signal current > 0.6 mA

DTC	Error Message	Malfunction Criteria and Threshold Value
P0030	HO2S Heater Control Circuit Bank 1 Sensor 1	Heater voltage 4.70 - 5.40 V
P0031	HO2S Heater Control Circuit Low Bank 1 Sensor 1	Heater voltage 0.0 to 3.26 V
P0032	HO2S Heater Control Circuit High Bank 1 Sensor 1	Heater current > 5.50 A
P0036	HO2S Heater Control Circuit Bank 1 Sensor 2	0.5 Sec
P0037	HO2S Heater Control Circuit Low Bank 1 Sensor 2	Heater voltage > 2.34 V
P0038	HO2S Heater Control Circuit High Bank 1 Sensor 2	Heater voltage 3.59 V
P0040	O2 Sensor Signals Swapped Bank 1 Sensor 1/ Bank 2 Sensor 1	<ul style="list-style-type: none"> <li>• Lambda controllers exceed thresholds in opposite directions &gt; 1.20</li> <li>Case 1:</li> <li>• Lambda control value bank 1 &lt; 0.8</li> <li>and</li> <li>• Lambda control value bank 2 &gt; 1.2</li> <li>Case 2:</li> <li>• Lambda control value bank 1 &gt; 1.2</li> <li>and</li> <li>• Lambda control value bank 2 &lt; 0.8</li> </ul>
P0050	O2 Sensor Heater Control Circuit Bank 2 Sensor 1	Heater voltage 4.70 - 5.40 V
P0051	O2 Sensor Heater Control Circuit Bank 2 Sensor 1 Low	Heater voltage 0.0 to 3.26 V
P0052	O2 Sensor Heater Control Circuit Bank 2 Sensor 1 High	Heater current > 5.50 A
P0056	O2 Sensor Heater Control Circuit Bank 2 Sensor 2	Heater voltage 2.34 - 3.59 V
P0057	O2 Sensor Heater Control Circuit Bank 2 Sensor 2 Low	Heater voltage < 2.34 V
P0058	O2 Sensor Heater Control Circuit Bank 2 Sensor 2 High	Heater voltage 3.59 V

DTC	Error Message	Malfunction Criteria and Threshold Value
P0068	MAF – Throttle Position Correlation	Plausibility with fuel system load survey below threshold <ul style="list-style-type: none"> <li>• Load calculation &lt; -35%</li> </ul> Plausibility with fuel system load survey above threshold <ul style="list-style-type: none"> <li>• Load calculation &gt; 35%</li> </ul>
P008A	Low Pressure Fuel System Pressure - Too Low	Actual pressure < 40 kPa
P008B	Low Pressure Fuel System Pressure - Too High	Actual pressure > 780 kPa
P0087	Fuel Rail System Pressure - Too Low	<ul style="list-style-type: none"> <li>• Pressure control activity &gt; 2.20 MPa</li> <li>• Fuel trim activity 0.80 to 1.20</li> </ul>
P0089	Fuel Pressure Regulator 1 Performance	<ul style="list-style-type: none"> <li>• Difference between target vs. actual pressure &gt; 200 kPa</li> <li>• Difference between target vs. actual pressure &gt; 150 kPa</li> <li>• Pressure control activity &gt; 225 kPa</li> <li>• Pressure control activity &lt;-300 kPa</li> </ul>
P0100	Mass Air Flow Circuit	<ul style="list-style-type: none"> <li>• MAF sensor signal 0 <math>\mu</math>s</li> </ul>
P0101	Mass Air Flow Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• Air mass too low &lt; -10 kg/h</li> <li>• Air mass too high &gt; 1100 kg/hh</li> <li>• Mass air flow vs lower threshold model &lt; 0 to 580 kg/h</li> <li>• Mass air flow vs lower threshold model &lt; 30 to 10 kg/h</li> <li>• Load calculation &gt; 20% and</li> <li>• Fuel trim &lt; -20%</li> <li>or</li> <li>• Load calculation &lt; -20% and</li> <li>• Fuel trim &gt; 20%</li> </ul>
P0102	Mass Air Flow Circuit Low Input	MAF sensor signal < 66 $\mu$ s or MAF sensor signal temp correction < 40 mSec.
P0103	Mass Air Flow Circuit High Input	MAF sensor signal > 910 $\mu$ s or MAF sensor signal temp correction > 65 mSec.

DTC	Error Message	Malfunction Criteria and Threshold Value
P0111	Intake Air Temperature Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Difference of ECT vs. IAT at engine start &lt; 24.8° Kelvin</li> <li>• Difference of IAT vs. AAT at engine start &gt; 24.8° Kelvin</li> <li>• Difference of ECT vs. AAT at engine start &lt; 24.8° Kelvin</li> </ul>
P0112	Intake Air Temperature Sensor Circuit Low Input	Intake air temperature > 130° C
P0113	Intake Air Temperature Sensor Circuit High Input	Intake air temperature < -45° C
P0116	Engine Coolant Temperature Sensor 1 Circuit Range/Performance	<p>Cross Check</p> <ul style="list-style-type: none"> <li>• Difference of ECT vs. IAT at engine start &lt; 24.8 °K (depending on engine off time) and</li> <li>• Difference of IAT vs. AAT at engine start &gt; 24.8° K (depending on engine off time) and</li> <li>• Difference of ECT vs. AAT at engine start &lt; 24.8° K (depending on engine off time)</li> </ul> <p>Stuck high / low - no change on</p> <ul style="list-style-type: none"> <li>• Difference max ECT vs. min ECT &lt; 1.5° K</li> </ul> <p>Stuck in range</p> <ul style="list-style-type: none"> <li>• ECT @ start ≥ 78° C and</li> <li>• ECT @ start ≤ 137° C</li> </ul>
P0117	Engine Coolant Temperature Sensor 1 Circuit Low Input	Engine coolant temperature > 137° C
P0118	Engine Coolant Temperature Sensor 1 Circuit High Input	Engine coolant temperature < -44° C
P0121	Throttle Position Sensor Circuit Range/Performance	<ul style="list-style-type: none"> <li>• TPS 1 - TPS 2 &gt; 5.10 to 6.30% and</li> <li>• Actual TPS 1 calculated value &gt; TPS 2 calculated value or</li> <li>• TPS 2 calculated value &gt; 9%</li> </ul>
P0122	Throttle Position Sensor Circuit Low Input	Signal voltage < 0.20 V
P0123	Throttle Position Sensor Circuit High Input	Signal voltage > 4.81 V

DTC	Error Message	Malfunction Criteria and Threshold Value
P013A	O2 Sensor Bank 1 Sensor 2 Slow Response Rich to Lean	<ul style="list-style-type: none"> <li>• Arithmetic filtered max differential transient time at fuel cut off <math>\geq 0.75</math> Sec</li> <li>or</li> <li>• EWMA filtered max differential transient time at fuel cutoff n.a.</li> <li>and</li> <li>• Number of checks <math>\geq 1</math></li> </ul>
P013B	O2 Sensor Bank1-Sensor2 Slow Response - Lean to Rich	<ul style="list-style-type: none"> <li>• Arithmetic filtered max differential transient time at fuel feed restart <math>\geq 1.50</math> Sec</li> <li>or</li> <li>• EWMA filtered max differential transient time at fuel feed restart n.a.</li> <li>and</li> <li>• Number of checks <math>\geq 1</math></li> </ul>
P013C	O2 Sensor Bank 2 Sensor 2 Slow Response Rich to Lean	<ul style="list-style-type: none"> <li>• Arithmetic filtered max differential transient time at fuel cut off <math>\geq 0.75</math> Sec</li> <li>or</li> <li>• EWMA filtered max differential transient time at fuel cutoff n.a.</li> <li>and</li> <li>• Number of checks <math>\geq 1</math></li> </ul>
P013D	O2 Sensor Bank 2 Sensor 2 Slow Response - Lean to Rich	<ul style="list-style-type: none"> <li>• Arithmetic filtered max differential transient time at fuel feed restart <math>\geq 1.50</math> Sec</li> <li>or</li> <li>• EWMA filtered max differential transient time at fuel feed restart n.a.</li> <li>and</li> <li>• Number of checks <math>\geq 1</math></li> </ul>
P013E	O2 Sensor Bank 1 Sensor 2 Delayed Response - Rich to Lean	<ul style="list-style-type: none"> <li>• Arithmetic filtered max differential delay time at rich to lean transition <math>\geq 0.80</math> Sec</li> <li>or</li> <li>• EWMA filtered max differential delay time at rich to lean transition n.a.</li> <li>and</li> <li>• Number of checks <math>\geq 3</math></li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P013F	O2 Sensor Bank 1 Sensor 2 Delayed Response - Lean to Rich	<ul style="list-style-type: none"> <li>• Arithmetic filtered max differential delay time at lean to rich transition <math>\geq 1.0</math> Sec</li> <li>or</li> <li>• EWMA filtered max differential delay time at lean to rich transition n.a.</li> <li>and</li> <li>• Number of checks <math>\geq 3</math></li> </ul>
P0130	O2 Sensor Circuit - Bank 1 Sensor 1 Performance	O2S ceramic temp. $< 640^{\circ}$ C
P0131	O2 Sensor Circuit Bank 1, Sensor 1 Low Voltage	Short to Ground <ul style="list-style-type: none"> <li>• Virtual Mass (VM) <math>&lt; 1.75</math> V</li> <li>or</li> <li>• Nernst voltage (UN) <math>&lt; 1.50</math> V</li> <li>or</li> <li>• Adjustment voltage (IA) <math>&lt; 0.30</math> V</li> <li>or</li> <li>• Adjustment voltage (IP) <math>&lt; 0.30</math> V</li> </ul>
P0132	O2 Sensor Circuit Bank 1, Sensor 1 High Voltage	Short to Ground <ul style="list-style-type: none"> <li>• Virtual Mass (VM) <math>&gt; 3.25</math> V</li> <li>or</li> <li>• Nernst voltage (UN) <math>&gt; 4.40</math> V</li> <li>or</li> <li>• Adjustment voltage (IA) <math>&gt; 7.00</math> V</li> <li>or</li> <li>• Adjustment voltage (IP) <math>&gt; 7.00</math> V</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P0133	O2 Sensor Circuit Slow Response Bank 1 Sensor 1	<p>Symmtric Fault:</p> <ul style="list-style-type: none"> <li>• Difference of R2L area ratio vs. L2R area ratio -0.32 to 0.32</li> <li>• Max value of both counters for area ratio R2L and L2R <math>\geq</math> 3 times</li> </ul> <p>Delay time:</p> <ul style="list-style-type: none"> <li>• Gradient ratio <math>\geq</math> 0.22</li> <li>• Lower value of both area ratios R2L and L2R <math>&lt;</math> 0.15</li> </ul> <p>Transient Time:</p> <ul style="list-style-type: none"> <li>• Gradient ratio <math>\geq</math> 0.22</li> <li>• Gradient ratio <math>\leq</math> 0.65</li> <li>• Lower value of both area ratios R2L and L2R <math>&lt;</math> 0.20</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>• Lower value of both gradient ratios R2L and L2R <math>&lt;</math> 0.22</li> </ul> <p>Asymmetric Fault:</p> <ul style="list-style-type: none"> <li>• Difference of R2L area ratio vs. L2R area ratio <math>&lt;</math> -0.32 or <math>&gt;</math> 0.32</li> <li>• Values of both counters for area ratio R2L and L2R <math>\geq</math> 3 times</li> </ul> <p>Delay Time:</p> <ul style="list-style-type: none"> <li>• Gradient ratio <math>\geq</math> 0.22</li> <li>• Lower value of both area ratios R2L and L2R <math>&lt;</math> 0.35</li> </ul> <p>Transient Time:</p> <ul style="list-style-type: none"> <li>• Gradient ratio <math>\geq</math> 0.22</li> <li>• Gradient ratio <math>\leq</math> 0.65</li> <li>• Lower value of both area ratios R2L and L2R <math>&lt;</math> 0.35</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>• Lower value of both gradient ratios R2L and L2R <math>&lt;</math> 0.22</li> </ul>
P0135	O2 Sensor Heater Circuit - Bank 1 Sensor 1 Performance	<ul style="list-style-type: none"> <li>• O2S ceramic temperature, <math>&lt;</math> 685° C</li> <li>• Heater duty cycle <math>&gt;</math> 90%</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>• O2S ceramic temp <math>&lt;</math> 720° C</li> <li>• Time after O2S heater on 40 Sec</li> </ul>



DTC	Error Message	Malfunction Criteria and Threshold Value
P0136	O2 Sensor Circuit - Bank 1 Sensor 2 Performance	<ul style="list-style-type: none"> <li>• Delta voltage one step at heater switching &gt; 2.00 V</li> <li>• Number of checks 4</li> </ul>
P0137	O2 Sensor Circuit - Bank 1 Sensor 2 Low Voltage	<ul style="list-style-type: none"> <li>• Signal voltage, &lt; 0.40 V for 3.0 Sec</li> <li>and</li> <li>• Difference of sensor voltage with load pulse and voltage without load pulse (mean value of 3 measurements) &lt; 0.01 V</li> </ul>
P0138	O2 Circuit Bank 1, Sensor 2 High Voltage	<ul style="list-style-type: none"> <li>• Signal voltage &gt; 1.08 V</li> <li>• for time 5 Sec.</li> </ul>
P0139	O2 Circuit Bank 1 Sensor 2 Slow Response	<ul style="list-style-type: none"> <li>• EWMA filtered transient time at fuel cutoff &gt; 0.5 Sec.</li> <li>• In voltage range 200 - 400 mV</li> <li>• Number of checks <math>\geq 3</math></li> </ul>
P014A	O2 Sensor Bank 2 Sensor 2 Delayed Response - Rich to Lean	<ul style="list-style-type: none"> <li>• Arithmetic filtered max differential delay time at rich to lean transition &gt; 0.8 Sec</li> <li>or</li> <li>• EWMA filtered max differential delay time at rich to lean transition &gt; n.a. Sec</li> <li>and</li> <li>• Number of checks <math>\geq 3</math></li> </ul>
P014B	O2 Sensor Bank 2 Sensor 2 Delayed Response - Lean to Rich	<ul style="list-style-type: none"> <li>• Arithmetic filtered max differential delay time at lean to rich transition &gt; 1.0 Sec</li> <li>or</li> <li>• EWMA filtered max differential delay time at lean to rich transition &gt; n.a. Sec</li> <li>and</li> <li>• Number of checks <math>\geq 3</math></li> </ul>
P0140	O2 Sensor Circuit Bank 1 Sensor 2 No Activity Detected	<ul style="list-style-type: none"> <li>• Signal voltage 0.40 - 0.60 V for 3 Sec.</li> <li>• Difference of sensor voltage with load pulse and voltage without load pulse (mean value of 3 measurements) <math>\geq 2.80</math> V</li> <li>• Internal resistance &gt; 105,000 ohm</li> <li>and</li> <li>• Exhaust temperature &gt; 680° C</li> </ul>

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0141	O2 Sensor Heater Circuit - Bank 1 Sensor 2 Performance	Heater resistance, 728 - 16632 Ohm
P0150	O2 Sensor Circuit - Bank 2 Sensor 1 Malfunction	O2S ceramic temperature < 640° C
P0151	O2 Sensor Circuit Bank 2 Sensor 1 Low Voltage	Short to Ground • Virtual Mass (VM) < 1.75 V or • Nernst voltage (UN) < 1.50 V or • Adjustment voltage (IA) < 0.30 V or • Adjustment voltage (IP) < 0.30 V
P0152	O2 Sensor Circuit Bank 2 Sensor 1 High Voltage	Short to Ground • Virtual Mass (VM) > 3.25 V or • Nernst voltage (UN) > 4.40 V or • Adjustment voltage (IA) > 7.00 V or • Adjustment voltage (IP) > 7.00 V

DTC	Error Message	Malfunction Criteria and Threshold Value
P0153	O2 Sensor Circuit Bank 2 Sensor 1 Slow Response	<p>Symmteric Fault:</p> <ul style="list-style-type: none"> <li>• Difference of R2L area ratio vs. L2R area ratio <math>-0.32</math> to <math>0.32</math></li> <li>• Max value of both counters for area ratio R2L and L2R <math>\geq 3</math> times</li> </ul> <p>Delay time:</p> <ul style="list-style-type: none"> <li>• Gradient ratio <math>\geq 0.22</math></li> <li>• Lower value of both area ratios R2L and L2R <math>&lt; 0.15</math></li> </ul> <p>Transient Time:</p> <ul style="list-style-type: none"> <li>• Gradient ratio <math>\geq 0.22</math></li> <li>• Gradient ratio <math>\leq 0.65</math></li> <li>• Lower value of both area ratios R2L and L2R <math>&lt; 0.20</math></li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>• Lower value of both gradient ratios R2L and L2R <math>&lt; 0.22</math></li> </ul> <p>Asymmetric Fault:</p> <ul style="list-style-type: none"> <li>• Difference of R2L area ratio vs. L2R area ratio <math>&lt; -0.32</math> or <math>&gt; 0.32</math></li> <li>• Values of both counters for area ratio R2L and L2R <math>\geq 3</math> times</li> </ul> <p>Delay Time:</p> <ul style="list-style-type: none"> <li>• Gradient ratio <math>\geq 0.22</math></li> <li>• Lower value of both area ratios R2L and L2R <math>&lt; 0.35</math></li> </ul> <p>Transient Time:</p> <ul style="list-style-type: none"> <li>• Gradient ratio <math>\geq 0.22</math></li> <li>• Gradient ratio <math>\leq 0.65</math></li> <li>• Lower value of both area ratios R2L and L2R <math>&lt; 0.35</math></li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>• Lower value of both gradient ratios R2L and L2R <math>&lt; 0.22</math></li> </ul>
P0155	O2 Sensor Heater Circuit Bank 2 Sensor 1 Malfunction	<ul style="list-style-type: none"> <li>• O2S ceramic temperature, <math>&lt; 685^{\circ} \text{C}</math></li> <li>• Heater duty cycle <math>&gt; 90\%</math></li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>• O2S ceramic temp <math>&lt; 720^{\circ} \text{C}</math></li> <li>• Time after O2S heater on 40 Sec.</li> </ul>

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0156	O2 Sensor Circuit Bank 2 Sensor 2 Malfunction	<ul style="list-style-type: none"> <li>• Delta voltage one step at heater switching &gt; 2.00 V</li> <li>• Number of checks 4</li> </ul>
P0157	O2 Sensor Circuit Bank 2 Sensor 2 Low Voltage	<ul style="list-style-type: none"> <li>• Signal voltage, &lt; 0.40 V for 3.0 Sec</li> <li>and</li> <li>• Difference of sensor voltage with load pulse and voltage without load pulse (mean value of 3 measurements) &lt; 0.01 V</li> </ul>
P0158	O2 Sensor Circuit Bank 2 Sensor 2 High Voltage	Signal voltage > 1.08 V for 5 Sec.
P0159	O2 Sensor Circuit Bank 2 Sensor 2 Slow Response	<ul style="list-style-type: none"> <li>• EWMA filtered transient time at fuel cutoff &gt; 0.5 Sec.</li> <li>• In voltage range 200 - 400 mV</li> <li>• Number of checks ≥ 3</li> </ul>
P0160	O2 Sensor Circuit Bank 2 Sensor 2 No Activity Detected	<ul style="list-style-type: none"> <li>Signal voltage</li> <li>• Signal voltage 0.40 - 0.60 V for 3 Sec.</li> <li>and</li> <li>• Difference of sensor voltage with load pulse and voltage without load pulse (mean value of 3 measurements) ≥ 2.80 V</li> <li>• Internal resistance &gt; 105,000 ohm</li> <li>and</li> <li>• Exhaust temperature &gt; 680° C</li> </ul>
P0161	O2 Sensor Heater Circuit Bank 2 Sensor 2 Malfunction	Heater resistance, 728 - 16632 Ohm
P0169	Incorrect Fuel Composition	<ul style="list-style-type: none"> <li>• Comparison with fuel quantity incorrect</li> <li>or</li> <li>• Internal check failed</li> <li>or</li> <li>• Correction factor incorrect</li> <li>or</li> <li>• Fuel quantity incorrect</li> <li>or</li> <li>• ABS difference between predicted and real air mass &gt; 10.50%</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P017B	Cylinder Head Temperature Sensor Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Difference MAX cylinder head temperature vs. MIN cylinder head <math>\leq 0.0^{\circ}</math> K to <math>1.6^{\circ}</math> K</li> <li>or</li> <li>• Cylinder head temperature <math>\geq 70^{\circ}</math> C</li> <li>or</li> <li>• Difference between modeled and measured cylinder head temperature <math>&gt; 9.8^{\circ}</math> K</li> <li>or</li> <li>• Difference CHDT (Cylinder Head Temperature) vs. ECT or IAT at engine start of <math>\geq 24.8^{\circ}</math> K or <math>\leq -(24.8)^{\circ}</math> K</li> </ul>
P017C	Cylinder Head Temperature Sensor Circuit Low	Signal voltage $< 0.30$ V
P017D	Cylinder Head Temperature Sensor Circuit High	Signal voltage $> 4.90$ V
P0171	System Too Lean Bank 1	Low pass filtered lambda controller output $> 20.00\%$ for $> 40.0$ Sec
P0172	Fuel Trim, Bank 2 System too Rich	Low pass filtered lambda controller output $< 20.00\%$ for $> 40.0$ Sec
P0174	System Too Lean Bank 1	Low pass filtered lambda controller output $> 20.00\%$ for $> 40.0$ Sec
P0175	Fuel Trim,Bank2 System too Rich	Low pass filtered lambda controller output $< 20.00\%$ for $> 40.0$ Sec
P0190	Fuel Rail Pressure Sensor Circuit	Signal voltage $> 4.8$ V
P0191	Fuel Rail Pressure Sensor "A" Circuit Range/Performance	Actual pressure $> 14.60$ MPa or $< 0.005$ MPa
P0192	Fuel Rail Pressure Sensor Circuit Low Input	Signal voltage $< 0.20$ V
P0201	Injector Circuit/Open - Cylinder 1	<ul style="list-style-type: none"> <li>• Signal current <math>&lt; 2.10</math> A</li> <li>• Internal logic failure</li> </ul>
P0202	Injector Circuit/Open - Cylinder 2	<ul style="list-style-type: none"> <li>• Signal current <math>&lt; 2.10</math> A</li> <li>• Internal logic failure</li> </ul>
P0203	Injector Circuit/Open - Cylinder 3	<ul style="list-style-type: none"> <li>• Signal current <math>&lt; 2.10</math> A</li> <li>• Internal logic failure</li> </ul>

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0204	Injector Circuit/Open - Cylinder 4	<ul style="list-style-type: none"> <li>• Signal current &lt; 2.10 A</li> <li>• Internal logic failure</li> </ul>
P0205	Injector Circuit/Open - Cylinder 5	<ul style="list-style-type: none"> <li>•• Signal current &lt; 2.10 A</li> <li>• Internal logic failure</li> </ul>
P0206	Injector Circuit/Open - Cylinder 6	<ul style="list-style-type: none"> <li>• Signal current &lt; 2.10 A</li> <li>• Internal logic failure</li> </ul>
P0221	Throttle Position Sensor Circuit Range/Performance	<ul style="list-style-type: none"> <li>• TPS 1 - TPS 2 &gt; 5.10 - 6.30% and</li> <li>• Actual TPS 2 calculated value &gt; actual TPS 1 calculated value</li> <li>or</li> <li>• TPS 2 calculated value &gt; 9.00%</li> </ul>
P0222	Throttle Position Sensor Circuit Low Input	Signal voltage < 0.20 V
P0223	Throttle Position Sensor Circuit High Input	Signal voltage > 4.81 V
P025A	Fuel Pump Module Control Circuit/Open	Signal voltage > 4.80 - 5.30 V
P025C	Fuel Pump Module Control Circuit Low	Signal voltage < 2.70 - 3.25 V
P025D	Fuel Pump Module Control Circuit High	Signal current > 600 mA
P0261	Cylinder 1 Injector Circuit Low	Signal current < 2.10 A
P0262	Cylinder 1 Injector Circuit High	Signal current > 14.70 A
P0264	Cylinder 2 Injector Circuit Low	Signal current < 2.10 A
P0265	Cylinder 2 Injector Circuit High	Signal current > 14.70 A
P0267	Cylinder 3 Injector Circuit Low	Signal current < 2.10 A
P0268	Cylinder 3 Injector Circuit High	Low side signal current > 14.70 A
P0270	Cylinder 4 Injector Circuit Low	Signal current < 2.10 A
P0271	Cylinder 4 Injector Circuit High	Low side signal current > 14.70 A
P0273	Cylinder 5 Injector Circuit Low	Signal current < 2.10 A
P0274	Cylinder 5 Injector Circuit High	Low side signal current > 14.70 A
P0276	Cylinder 6 Injector Circuit Low	Signal current < 2.10 A
P0277	Cylinder 6 Injector Circuit High	Low side signal current > 14.70 A

DTC	Error Message	Malfunction Criteria and Threshold Value
P2088	"A" Camshaft Position Actuator Control Circuit Low	Signal voltage 0.0 - 3.25 V
P2089	"A" Camshaft Position Actuator Control Circuit High - Bank 1	Signal current > 2.2 A
P2090	B Camshaft Position Actuator Control Circuit Low	Signal voltage 0 to 3.25 V
P2091	"B" Camshaft Position Actuator Control Circuit High	Signal current > 2.20 A
P2096	Post Catalyst Fuel Trim System Too Lean	I-portion of 2nd lambda control loop < -0.035
P2097	Post Catalyst Fuel Trim System Too Rich Bank 1	I-portion of 2nd lambda control loop > 0.035
P2098	Post Catalyst Fuel Trim System Bank 2 Too Lean	I-portion of 2nd lambda control loop < -0.035
P2099	Post Catalyst Fuel Trim System Bank 2 Too Rich	I-portion of 2nd lambda control loop > 0.035
P3081	Engine Temperature Too Low	Difference between ECT and modeled ECT > 11.3° K
P308D	Fuel Pump Engine Speed Too Low	Phase current > 35 A or Speed deviation > 10%
P308E	Fuel Pump Electronics Excess Temperature	Output driver temp > 126° C or above 129° C

## Ignition System

DTC	Error Message	Malfunction Criteria and Threshold Value
P0300	Random Misfire Detected	<ul style="list-style-type: none"> <li>• Emission threshold misfire rate (MR) &gt; 2.20%</li> <li>• Catalyst damage misfire rate (MR) &gt; 1.3% - 14%</li> </ul>
P0301	Cylinder 1 Misfire Detected	<ul style="list-style-type: none"> <li>• Emission threshold misfire rate (MR) &gt; 2.20%</li> <li>• Catalyst damage misfire rate (MR) &gt; 1.3% - 14%</li> </ul>
P0302	Cylinder 2 Misfire Detected	<ul style="list-style-type: none"> <li>• Emission threshold misfire rate (MR) &gt; 2.20%</li> <li>• Catalyst damage misfire rate (MR) &gt; 1.3% - 14%</li> </ul>

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0303	Cylinder 3 Misfire Detected	<ul style="list-style-type: none"> <li>• Emission threshold misfire rate (MR) &gt; 2.20%</li> <li>• Catalyst damage misfire rate (MR) &gt; 1.3% - 14%</li> </ul>
P0304	Cylinder 4 Misfire Detected	<ul style="list-style-type: none"> <li>• Emission threshold misfire rate (MR) &gt; 2.20%</li> <li>• Catalyst damage misfire rate (MR) &gt; 1.3% - 14%</li> </ul>
P0305	Cylinder 5 Misfire Detected	<ul style="list-style-type: none"> <li>• Emission threshold misfire rate (MR) &gt; 2.20%</li> <li>• Catalyst damage misfire rate (MR) &gt; 1.3% - 14%</li> </ul>
P0306	Cylinder 6 Misfire Detected	<ul style="list-style-type: none"> <li>• Emission threshold misfire rate (MR) &gt; 2.20%</li> <li>• Catalyst damage misfire rate (MR) &gt; 1.3% - 14%</li> </ul>
P0321	Engine Speed Input Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Comparison of counted teeth vs reference incorrect</li> <li>or</li> <li>• Camshaft signals &gt; 8 and no engine speed signal.</li> <li>or</li> <li>• Monitoring reference gap failure</li> </ul>
P0322	Engine Speed Input Circuit No Signal	<ul style="list-style-type: none"> <li>• Camshaft signal &gt; 3</li> <li>• Engine speed no signal</li> </ul>
P0324	Knock Control System Error	<ul style="list-style-type: none"> <li>• Signal fault counter &gt; 28</li> <li>or</li> <li>• Signal fault counter (measuring window) &gt; 5.00</li> </ul>
P0325	Knock Sensor 1 Circuit Malfunction	Signal voltage < 1.80 V or > 3.20 V
P0327	Knock Sensor 1 Circuit Low Input	<ul style="list-style-type: none"> <li>• Short to ground lower threshold &lt; -0.70 V</li> <li>or</li> <li>• Lower threshold 0.50 to 2.50 V</li> </ul>
P0328	Knock Sensor 1 Circuit High Input	<ul style="list-style-type: none"> <li>• Short to voltage upper threshold &gt; 1.0 V</li> <li>or</li> <li>• Upper threshold 36 to 110.15 V</li> </ul>
P0330	Knock Sensor 2 Circuit	Signal voltage < 1.80 V or > 3.20 V



DTC	Error Message	Malfunction Criteria and Threshold Value
P0332	Knock Sensor 2 Circuit Low Input	<ul style="list-style-type: none"> <li>• Short to ground lower threshold &lt; -0.70 V</li> <li>or</li> <li>• Lower threshold 0.50 to 2.50 V</li> </ul>
P0333	Knock Sensor 2 Circuit High Input	<ul style="list-style-type: none"> <li>• Short to voltage upper threshold &gt; 1.0 V</li> <li>or</li> <li>• Upper threshold 36 to 110.15 V</li> </ul>
P0340	Camshaft Position Sensor 1 Circuit	Cam adaption values out of range <ul style="list-style-type: none"> <li>• &gt; 20° KW</li> <li>• &lt; -20° KW</li> <li>• Difference of adapted and actual values &gt; 9° KW</li> </ul>
P0341	Camshaft Position Sensor Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Signal pattern incorrect or not alternating</li> <li>• Defect counter &gt; 12</li> </ul>
P0342	Camshaft Position Sensor 1 Circuit Low Input	<ul style="list-style-type: none"> <li>• Signal voltage low</li> <li>• Crankshaft signals = 8 revolutions</li> </ul>
P0343	Camshaft Position Sensor 1 Circuit High Input	<ul style="list-style-type: none"> <li>• Signal voltage high</li> <li>• Crankshaft signals = 8 revolutions</li> </ul>
P0351	Ignition Coil Cyl # 1 Primary/ Secondary Circuit	<ul style="list-style-type: none"> <li>• Signal current 0.25 to -2.0 mA</li> <li>• Internal check failed</li> </ul>
P0352	Ignition Coil Cyl # 2 Primary/ Secondary Circuit	<ul style="list-style-type: none"> <li>• Signal current 0.25 to -2.0 mA</li> <li>• Internal check failed</li> </ul>
P0353	Ignition Coil Cyl # 3 Primary/ Secondary Circuit	<ul style="list-style-type: none"> <li>• Signal current 0.25 to -2.0 mA</li> <li>• Internal check failed</li> </ul>
P0354	Ignition Coil Cyl # 4 Primary/ Secondary Circuit	<ul style="list-style-type: none"> <li>• Signal current 0.25 to -2.0 mA</li> <li>• Internal check failed</li> </ul>
P0355	Ignition Coil Cyl # 5 Primary/ Secondary Circuit	<ul style="list-style-type: none"> <li>• Signal current 0.25 to -2.0 mA</li> <li>• Internal check failed</li> </ul>
P0356	Ignition Coil Cyl # 6 Primary/ Secondary Circuit	<ul style="list-style-type: none"> <li>• Signal current 0.25 to -2.0 mA</li> <li>• Internal check failed</li> </ul>

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0366	Camshaft Position Sensor 2 Circuit Range/Performance	<ul style="list-style-type: none"> <li>• Signal voltage incorrect</li> <li>• Crankshaft signals = 12.0 revolutions</li> </ul>
P0367	Camshaft Position Sensor 2 Circuit Low Input	<ul style="list-style-type: none"> <li>• Signal voltage permanently low</li> <li>• Crankshaft signals = 8.0 revolutions</li> </ul>
P0368	Camshaft Position Sensor 2 Circuit High Input	<ul style="list-style-type: none"> <li>• Signal voltage high</li> <li>• Crankshaft signals = 8.0 revolutions</li> </ul>

### **Additional Exhaust Regulation**

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0420/ P0430	Catalyst System Efficiency Below Threshold Bank 1 (P0420) or Bank 2 (P0430)	<ul style="list-style-type: none"> <li>• Measured oxygen storage capacity (OSC) &lt; 1.00 HC correlated</li> <li>• Measured oxygen storage capacity (OSC) catalyst system &lt; 1.00 NOx correlated</li> </ul>
P0441	Evaporative Emission System Incorrect Purge Flow	<ul style="list-style-type: none"> <li>• Deviation lambda controller &lt; 5.0 to 5.5% and</li> <li>• Deviation idle control &lt; 25%</li> </ul>
P0442	Evaporative Emission System Leak Detected Small Leak	Time for pressure drop < 1.70 - 1.90 Sec.
P0444	Evaporative Emission System Purge Control Valve Circuit Open	Signal voltage > 4.70 - 5.40 V
P0455	Evaporative Emission System Leak Detected Gross Leak/ No Flow	Time for pressure drop < 0.9 - 1.2 Sec.
P0456	Evaporative Emission System Leak Detected Very Small Leak	Time for pressure drop, < 6.5 - 7.0 Sec..
P0458	Evaporative Emission System Purge Control Valve Circuit Low	Signal voltage 0 to 3.26 V
P0459	Evaporative Emission System Purge Control Valve Circuit High	Signal current > 2.20 A

DTC	Error Message	Malfunction Criteria and Threshold Value
P0480	Cooling Fan 1 Control Circuit	Signal voltage 4.50 to 5.50 V
P0481	Cooling Fan 2 Control Circuit	Signal voltage 4.50 to 5.50 V

### Speed and Idle Control

DTC	Error Message	Malfunction Criteria and Threshold Value
P050A	Cold Start Idle Air Control System Performance	<ul style="list-style-type: none"> <li>• Engine speed deviation &gt; 100 RPM</li> <li>• RPM controller torque value <math>\geq</math> calculated max. value</li> </ul> or <ul style="list-style-type: none"> <li>• Engine speed deviation &gt; -200 RPM</li> <li>• RPM controller torque <math>\leq</math> calculated min. value</li> </ul>
P050B	Cold Start Ignition Timing Performance	Difference between commanded vs actual spark timing > 20%
P0501	Vehicle Speed Sensor Range/Performance	VSS signal < 4 km/h
P0502	Vehicle Speed Sensor Range/Performance	VSS signal < 4 km/h
P0506	Idle Air Control System - RPM Lower Than Expected	<ul style="list-style-type: none"> <li>• Engine speed Deviation &gt; 100 RPM</li> </ul> and <ul style="list-style-type: none"> <li>• RPM controller torque value <math>\geq</math> calculated max value</li> </ul>
P0507	Idle Air Control System - RPM Higher Than Expected	<ul style="list-style-type: none"> <li>• Engine speed Deviation &gt; 100 RPM</li> </ul> and <ul style="list-style-type: none"> <li>• RPM controller torque value <math>\geq</math> calculated min. value</li> </ul>
P052A	Cold Start "A" Camshaft Position Timing Over-Advanced	Difference between target vs. actual position and position > 12 to 40° CRK
P053F	Cold Start Fuel Pressure Performance	Difference between target vs actual pressure < -1.50 or > 1.50 MPa
P054A	Cold Start "B" Camshaft Position Timing Over-Advanced	Difference between target vs. actual position and position > 10 to 22° CRK

## Control Module and Output Signals

DTC	Error Message	Malfunction Criteria and Threshold Value
P0601	Internal Control Module Memory Check Sum Error	ECM internal checksum incorrect
P0604	Internal Control Module Random Access Memory (RAM) Error	Write ability check, failed
P0605	Internal Control Module Read Only Memory ROM Error	ROM check failed
P0606	ECM Processor	ECM internal check failure
P062B	Internal Control Module Fuel Injector Control Performance	SPI communications check Identifier failure
P0634	ECM Internal Temperature Too High	<ul style="list-style-type: none"> <li>• Power stage temperature &gt; 170° C</li> <li>or</li> <li>• Power stage temperature &gt; 150° C</li> </ul>
P0638	Throttle Actuator Control Range/Performance	<ul style="list-style-type: none"> <li>• Time to close to reference point &gt; 0.6 Sec.</li> <li>• ECM power stage no failure</li> <li>• Reference point 2.88%</li> <li>or</li> <li>• TPS 1 signal voltage &lt; 0.4 or &gt; 0.8 V</li> <li>• TPS 2 signal voltage &lt; 4.20 or &gt; 4.60 V</li> </ul>
P0641	Sensor Reference Voltage A Circuit Open	Signal voltage deviation > ± 0.3 V
P0642	Sensor Reference Voltage A Circuit Low	Signal voltage < 4.60 5.00 V
P0643	Sensor Reference Voltage A Circuit High	Signal voltage, > 5.00 to 5.40 V
P0651	Sensor Reference Voltage B Circuit Open	Signal voltage deviation > ± 0.3 V
P0652	Sensor Reference Voltage B Circuit Low	Signal voltage < 4.6 - 5.0 V
P0653	Sensor Reference Voltage B Circuit High	Signal voltage > 5.00 to 5.40 V
P0657	Actuator Supply Voltage A Circuit Open	Signal voltage, > 4.4 - 5.6 V
P0658	Actuator Supply Voltage A Circuit Low	Signal voltage, < 3.00 V

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P0659	Actuator Supply Voltage A Circuit High	Signal current > 1.1 A
P0685	ECM Power Relay Control Circuit Open	Control voltage > 0.7 V
P0686	ECM Power Relay Control Circuit Low	Control voltage < 0.51 V
P0687	ECM Power Relay Control Circuit High	Control voltage > 4.0 V
P0688	ECM Power Relay Sense Circuit	Sense voltage < 3.0 V
P0691	Fan 1 Control Circuit Low	Signal voltage < 3 V
P0692	Fan 1 Control Circuit High	Signal current, 0.60 to 1.20 A
P0693	Cooling Fan 2 Control Circuit Low	Signal voltage < 3 V
P0694	Cooling Fan 2 Control Circuit High	Signal current, 0.60 to 1.20 A
P0697	Sensor Reference Voltage C Circuit Open	Internal communication failed or signal voltage deviation > $\pm 0.3$ V
P0698	Sensor Reference Voltage C Circuit Low	Signal voltage < 4.60 to 5.00 V
P0699	Sensor Reference Voltage C Circuit High	Signal voltage > 5.00 to 5.40 V
U0001	High Speed CAN Communication Bus	<ul style="list-style-type: none"> <li>• Global time out, receiving no message</li> <li>or</li> <li>• Reading back sent message, no feedback</li> </ul>
U0002	High Speed CAN Communication Bus Performance	Global Time Out failure. No module communication on CAN.
U0101	Lost Communication with TCM	Time Out failure. No message received by ECM from TCM
U0121	Lost Communication with Anti-Lock Brake System (ABS) Control Module	CAN communication with ABS, time out
U0140	Lost Communication with Body Control Module	CAN communication with BCM timed out.
U0141	Lost Communication with Body Control Module	CAN communication with BCM timed out.

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
U0146	Lost Communication with Gateway	CAN communication with gateway no message
U0155	Lost Communication with Instrument Panel Cluster (IPC) Control Module	Received CAN message no message
U0302	Invalid Data Received From Transmission Control Module	AT vehicle ECM coded as MT vehicle
U0402	Invalid Data Received From Transmission Control Module	CAN communication with TCM received data, implausible message
U0415	CAN Communication With ABS Error	<ul style="list-style-type: none"> <li>• Speed sensor initialization failed</li> <li>• Speed sensor low voltage error failed</li> <li>• Speed sensor error &gt; 325 km/h</li> </ul>
U0422	Invalid Data Received From Body Control Module	Ambient air temperature value 00h
U0423	Invalid Data Received From Instrument Panel Cluster Control Module	Implausible messages received
U0447	Invalid Data Received From Gateway	Implausible messages received
U1103	Production Mode Active	Production Mode active

### **Fuel and Air Ratios Control Module**

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P12A1	Fuel Rail Pressure Sensor Out of Range - Low	<ul style="list-style-type: none"> <li>• Pressure control activity &gt; 0.09 MPa</li> <li>and</li> <li>• Fuel trim activity &lt; 0.75</li> <li>and</li> <li>• Difference between target pressure vs. actual pressure n.a.</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P12A2	Fuel Rail Pressure Sensor Out of Range - High	<ul style="list-style-type: none"> <li>• Pressure control activity &lt; -0.11 MPa</li> <li>and</li> <li>• Fuel trim activity &gt; 1.30</li> <li>and</li> <li>• Difference between target pressure vs. actual pressure n.a.</li> </ul>
P12A4	Fuel Rail Pump Control Valve Stuck Closed	<ul style="list-style-type: none"> <li>• Pressure control activity &lt; -4.0 MPa</li> <li>and</li> <li>• Fuel trim activity .80 to 1.20</li> <li>and</li> <li>• Difference between target pressure vs. actual pressure &lt; -4.0 MPa</li> </ul>
P13EA	Cold Start Ignition Timing Performance Off Idle	Difference between commanded vs actual spark timing > 20%
P150A	Engine Off Time Performance	<ul style="list-style-type: none"> <li>• Difference between engine off time and ECM after run time &lt; -8 Sec.</li> <li>or</li> <li>• Difference between engine off time and ECM after run time &gt; 8 Sec.</li> </ul>
P169A	Vehicle in Transport Mode	Transport mode active
P2101	Throttle Actuator A Control Motor Circuit Range/ Performance	<ul style="list-style-type: none"> <li>• Duty cycle &gt;80%</li> <li>• ECM power stage, no failure</li> <li>or</li> <li>• Deviation throttle valve angles vs. calculated value 4.0 - 50.0%</li> </ul>
P2106	Throttle Actuator Control System Forced Limited Power	Internal check failed
P2108	Throttle Actuator Control Module Performance	Time to close under reference point > 0.60 Sec. and reference point 11.56%
P2122	Pedal Position Sensor D Circuit Low Input	Signal voltage < 0.65 V
P2123	Pedal Position Sensor D Circuit High Input	Signal voltage > 4.89 V
P2127	Pedal Position Sensor E Circuit Low Input	Signal voltage < 0.28 V

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P2128	Pedal Position Sensor/Switch E Circuit High Input	Signal voltage > 2.64 V
P2138	Throttle/Pedal Position Sensor/Switch D/E Voltage Correlation	Signal voltage sensor 1 vs. 2 > 0.14 to 0.26 V
P2146	Fuel Injector Group A Supply Voltage Circuit/Open	<ul style="list-style-type: none"> <li>• Signal current &gt; 14.90 A</li> <li>or</li> <li>• High side signal current &lt; 2.60 A</li> </ul>
P2149	Fuel Injector Group B Supply Voltage Circuit Open	<ul style="list-style-type: none"> <li>• Signal current &gt; 14.90 A</li> <li>or</li> <li>• High side signal current &lt; 2.60 A</li> </ul>
P2152	Fuel Injector Group C Supply Voltage Circuit Open	<ul style="list-style-type: none"> <li>• Signal current &gt; 14.90 A</li> <li>or</li> <li>• High side signal current &lt; 2.60 A</li> </ul>
P2155	Fuel Injector Group D Supply Voltage Circuit Open	<ul style="list-style-type: none"> <li>• Signal current &gt; 14.90 A</li> <li>or</li> <li>• High side signal current &lt; 2.60 A</li> </ul>
P2177	System Too Lean Off Idle, Bank 1	Fuel adaptive value > 30%
P2178	System Too Rich Off Idle, Bank 1	Fuel adaptive value < -30%
P2179	System Too Lean Off Idle Bank 2	Fuel adaptive value > 30%
P2180	System Too Rich Off Idle Bank 2	Fuel adaptive value < -30%
P2181	Cooling System Performance	<ul style="list-style-type: none"> <li>• Cooling system temperature too low after a sufficient mass air flow integral 60 - 70° C</li> <li>or</li> <li>• Filtered ECT decreases under a threshold value after reaching a high temperature level &lt; 34 to 47° C</li> </ul>
P2187	System Too Lean at Idle, Bank 1	Fuel adaptive value > 6%
P2188	System Too Rich at Idle, Bank 1	Fuel adaptive value < -6%



DTC	Error Message	Malfunction Criteria and Threshold Value
P2189	System Too Lean at Idle, Bank 2	Fuel adaptive value > 6%
P2190	System Too Rich at Idle, Bank 2	Fuel adaptive value < -6%
P2195	O2 Sensor Signal Biased/ Stuck Lean Bank 1, Sensor 1	Delta lambda of 2nd lambda control loop > 0.059
P2196	O2 Sensor Signal Biased/ Stuck Rich Bank 1, Sensor 1	Delta lambda of 2nd lambda control loop < -0.059
P2197	O2 Sensor Signal Stuck Lean Bank 2 Sensor 1	Delta lambda of 2nd lambda control loop > 0.059
P2198	O2 Sensor Signal Stuck Rich (Bank 2 Sensor 1)	Delta lambda of 2nd lambda control loop < -0.059
P2231	O2 Sensor Bank 1 Sensor 1 Signal Circuit Shorted to Heater Circuit	Delta O2S signal front > 190 uA
P2237	O2 Sensor Positive Current Control Circuit/Open Bank 1, Sensor 1	<ul style="list-style-type: none"> <li>• O2S signal front 1.49 to 1.51 V and</li> <li>• Difference between maximum and minimum value of O2S voltage signal front n.a. and</li> <li>• Delta lambda controller &gt; 0.07 or</li> <li>• Lambda control at min or max limit</li> <li>• O2S signal front 1.49 - 1.51 V and</li> <li>• Difference between maximum and minimum value of O2S voltage signal front n.a. and</li> <li>• No reaction on commanded stepwise change of lambda setpoint &lt;&gt; 1 P0152 short to battery</li> </ul>

DTC	Error Message	Malfunction Criteria and Threshold Value
P2240	O2 Sensor Positive Current Control Circuit Bank 2 Sensor 1 Open	<ul style="list-style-type: none"> <li>• O2S signal front 1.49 to 1.51 V and</li> <li>• Difference between maximum and minimum value of O2S voltage signal front n.a. and</li> <li>• Delta lambda controller &gt; 0.07 or</li> <li>• Lambda control at min or max limit</li> <li>• O2S signal front 1.49 - 1.51 V and</li> <li>• Difference between maximum and minimum value of O2S voltage signal front n.a. and</li> <li>• No reaction on commanded stepwise change of lambda setpoint &lt;&gt; 1 P0152 short to battery</li> </ul>
P2243	O2 Sensor Reference Voltage Circuit Open Bank 1, Sensor 1	<ul style="list-style-type: none"> <li>• O2S signal front 1.47 - 1.52 V and</li> <li>• Internal resistance &gt; 950 Ω</li> </ul>
P2247	O2 Sensor Reference Voltage Circuit Bank 2 Sensor 1 Open	<ul style="list-style-type: none"> <li>• O2S signal front &lt; 0.25 V or &gt; 4.80 V and</li> <li>• Internal resistance &gt; 950 Ω</li> </ul>
P2251	O2 Sensor Negative Current Control Circuit Bank 1 Sensor 1 Open	<ul style="list-style-type: none"> <li>• O2S signal front 1.47 - 1.52 V and</li> <li>• Internal resistance &gt; 950 ohms</li> </ul>
P2254	O2 Sensor Negative Current Control Circuit Bank 2 Sensor 1 Open	<ul style="list-style-type: none"> <li>• O2S signal front 1.47 - 1.52 V and</li> <li>• Internal resistance &gt; 950 ohms</li> </ul>
P2270	O2 Sensor Signal Stuck Lean Bank 1 Sensor 2	Sensor voltage < 0.75 V
P2271	O2 Sensor Signal Stuck Rich Bank 1, Sensor 2	Sensor voltage > 0.15 V
P2272	O2 Sensor Signal Stuck Lean Bank 2 Sensor 2	Sensor voltage < 0.75 V

DTC	Error Message	Malfunction Criteria and Threshold Value
P2273	O2 Sensor Signal Stuck Rich Bank 2 Sensor 2	<ul style="list-style-type: none"> <li>• O2S signal rear not oscillating at reference &gt; 0.65 V</li> <li>or</li> <li>• Response time at fuel cutoff &gt; 5 Sec.</li> <li>• Measurement range from fuel cutoff to voltage threshold ≤ 118 mV</li> <li>• Number of checks ≥ 1</li> <li>• Sensor voltage &gt; 0.15 V</li> </ul>
P2279	Intake Air System Leak	<ul style="list-style-type: none"> <li>• Threshold to detect a defective system &gt; 2.50</li> <li>and</li> <li>• Ratio of the tie system defective during the measurement window to the whole duration of the measurement window &gt; 0.80</li> </ul>
P2293	Fuel Pressure Regulator 2 Performance	<ul style="list-style-type: none"> <li>• Difference between target pressure vs. actual pressure: &gt; 1.50 mPa</li> <li>or</li> <li>• &lt; -1.50 mPa</li> </ul>
P2294	Fuel Pressure Regulator 2 Control Circuit	Signal voltage 1.40 - 3.20 V
P2295	Fuel Pressure Regulator 2 Control Circuit Low	Signal voltage < 1.40 V
P2296	Fuel Pressure Regulator 2 Control Circuit High	Signal voltage < 1.40 V

### Ignition System

DTC	Error Message	Malfunction Criteria and Threshold Value
P2300	Ignition Coil Cyl # 1 Primary Control Circuit Low	Signal current > 24.0 mA
P2301	Ignition Coil Cyl # 1 Primary Control Circuit High	Signal voltage > 5.1 to 7.0 V
P2303	Ignition Coil Cyl # 2 Primary Control Circuit Low	Signal current > 24.0 mA
P2304	Ignition Coil Cyl # 2 Primary Control Circuit High	Signal voltage > 5.1 to 7.0 V

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P2306	Ignition Coil Cyl # 3 Primary Control Circuit Low	Signal current > 24.0 mA
P2307	Ignition Coil Cyl # 3 Primary Control Circuit High	Signal voltage > 5.1 to 7.0 V
P2309	Ignition Coil Cyl # 4 Primary Control Circuit Low	Signal current > 24.0 mA
P2310	Ignition Coil Cyl # 4 Primary Control Circuit High	Signal voltage > 5.1 to 7.0 V
P2312	Ignition Coil Cyl # 5 Primary Control Circuit Low	Signal current > 24.0 mA
P2313	Ignition Coil Cyl # 5 Primary Control Circuit High	Signal voltage > 5.1 to 7.0 V
P2315	Ignition Coil Cyl # 6 Primary Control Circuit Low	Signal current > 24.0 mA
P2316	Ignition Coil Cyl # 6 Primary Control Circuit High	Signal voltage > 5.1 to 7.0 V

### **Additional Emissions Regulations**

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P2400	Evaporative Emission System Leak Detection Pump Control Circuit/Open	Signal voltage > 4.4 - 5.6 V
P2401	Evaporative Emission System Leak Detection Pump Control Circuit Low	Signal voltage < 2.15 to 3.25 V
P2402	Evaporative Emission System Leak Detection Pump Control Circuit High	Signal current > 3.0 A
P2403	Evaporative Emission System Leak Detection Pump Sense Circuit/Open	Low signal voltage > 0.5 Sec.
P2404	Evaporative Emission System Leak Detection Pump Sense Circuit Range/Performance	<ul style="list-style-type: none"> <li>• High signal voltage &gt; 12 Sec.</li> <li>• Number of checks 30</li> <li>• Cumulative time of high signal voltage during pumping &gt; 20 Sec.</li> </ul>

<b>DTC</b>	<b>Error Message</b>	<b>Malfunction Criteria and Threshold Value</b>
P2414	O2 Sensor Exhaust Sample Error Bank 1, Sensor	Threshold 1 • Signal voltage 3.70 - 4.81 V Threshold 2 • Signal voltage 3.0 to 3.70 V
P2415	O2 Sensor Exhaust Sample Error Bank 2 Sensor 1	Threshold 1 • Signal voltage 3.70 - 4.81 V Threshold 2 • Signal voltage 3.0 to 3.70 V
P2539	Low Pressure Fuel System Sensor Circuit	Signal voltage > 4.80 V
P2541	Low Pressure Fuel System Sensor Circuit Low Input	Signal voltage < 0.2 V
P2600	Coolant Pump Control Circuit Open	Signal voltage 4.8 to 5.3 V
P2602	Coolant Pump Control Circuit Low	Signal voltage < 2.8 to 3.2 V
P2603	Coolant Pump Control Circuit High	Signal current > 5.5 to 10.0 A
P261A	Coolant Pump "B" Control Circuit Open	Signal voltage 4.7 V
P261C	Coolant Pump "B" Control Circuit Low	Signal voltage < 2.8 to 3.2 V
P261D	Coolant Pump "B" Control Circuit High	Signal current > 2.2 to 4.4 A
P2626	O2 Sensor Pumping Current Trim Circuit/Open Bank 1 Sensor 1	O2S signal front > 4.81 V
P2629	O2 Sensor Pumping Current Trim Circuit/Open Bank 2, Sensor 1	O2S signal front > 4.81 V

**Volkswagen Group of America works constantly to develop and improve its products. We must therefore reserve the right to change or update any part of this technical manual at any time. No legal commitment can therefore be derived from the information, illustrations or descriptions in this manual.**

**The texts, illustrations and standards in this manual are based on the information available at the time of printing. No part of this manual may be reprinted, reproduced or translated without the written permission of Volkswagen Group of America.**

**All rights under the copyright laws are expressly reserved by Volkswagen Group of America. Subject to alteration and amendment.**

**Printed in the United States of America  
© 2014 Volkswagen Group of America, Inc.**

