



## Specifications

### General Information



This diagram is provided as a diagnostic tool for trained, experienced technicians only. Improper troubleshooting or repair can result in severe personal injury or death or property damage. See important instructions in Service Manual.

### Electrical Specifications

#### DATALINK

- Positive wire to chassis ground (SAE J1587 only)
  - 2.5 to 5.0 VDC
- Negative wire to chassis ground (SAE J1587 only)
  - 0.0 to 2.5 VDC

#### SAE J1939 BACKBONE RESISTANCE

- Positive wire to negative wire
  - 50 to 70 Ω
- SAE J1939 Termination Resistance
  - 110 to 130 Ω

#### ALL CONTINUITY CHECKS

- OK (no open circuit) if less than 10 Ω
- Water-in-Fuel sensor: 82 kΩ (± 1% at 25°C [77°F])

#### ALL SHORTS TO GROUND

- All circuits, OK (no short circuit), if more than 100 kΩ

#### SHORT CIRCUIT TO EXTERNAL VOLTAGE

- OK if less than 1.5 VDC

### Sensor Specifications

#### Intake Manifold Air Pressure Sensor

Torque (threaded style) = 14 N•m [120 in-lb]

Pressure (mmHg)	Pressure [inHg]	Voltage (VDC)
0	0	0.42 to 0.58
646.48	25.45	1.42 to 1.58
1292.88	50.90	2.42 to 2.58
1939.36	76.35	3.42 to 3.58
2585.76	101.80	4.42 to 4.58

#### Oil Pressure Sensor

Torque (threaded style) = 14 N•m [120 in-lb]

Pressure (kPa)	Pressure [psi]	Voltage (VDC)
0	0	0.70 to 1.20
172.37	25	2.10 to 2.70
344.74	50	3.50 to 4.20
414.11	60	4.00 to 4.70

#### Ambient Air/Barometric Pressure Sensor (Harness Mounted)

Altitude (m)	Altitude [ft]	Pressure [psia]	Pressure [in Hg]	Voltage (VDC)
0 (sea level)	0	14.7	29.9	3.65 to 4.28
915	3000	13.2	26.9	3.06 to 3.60

#### 5 V POWER SUPPLY (Sensor Only)

- @ ECM/Harness - 4.75 to 5.25 VDC

#### SOLENOIDS – Fuel Shutoff Valve and Wastegate Controller

- Coil Resistance
  - 12 VDC system 7 to 8 Ω = 20°C [68°F] to 25°C [77°F]
  - 12 VDC system 6 to 10 Ω = resistance at other temperatures
  - 24 VDC system 28 to 32 Ω = 20°C [68°F] to 25°C [77°F]
  - 24 VDC system 24 to 40 Ω = resistance at other temperatures
- Injectors
  - 0.5 to 1.5 ohms after subtracting the multimeter resistance

#### ECM CONNECTOR

- Retaining Cap Screw Torque = 3 N•m [25 in-lb]

#### INJECTOR

- Pigtail Retaining Nut Torque = 1.6 N•m [14 in-lb]

#### Ambient Air/Barometric Pressure Sensor (Harness Mounted)

Altitude (m)	Altitude [ft]	Pressure [psia]	Pressure [in Hg]	Voltage (VDC)
1830	6000	11.8	24.0	2.52 to 2.96
2744	9000	10.5	21.4	2.01 to 2.36
3659	12000	9.35	19.0	1.57 to 1.84

#### Ambient Air Pressure Sensor (Threaded Style)

Torque (capscrew) = 14 N•m [120 in-lb]

Altitude (m)	Altitude [ft]	Pressure (psig)	Voltage (VDC)
0 (sea level)	0	14.7	3.40 to 4.50
915	3000	13.2	2.80 to 3.80
1829	6000	11.8	2.20 to 3.25
2744	9000	10.5	1.70 to 2.70
3659	12000	9.35	1.20 to 2.20

#### All Temperature Sensors

Torque = 14 N•m [120 in-lb]

Temperature (°C)	Temperature [°F]	Resistance (Ω)
0	32	30k to 36k
25	77	9k to 11k
50	122	3k to 4k

#### All Temperature Sensors

Torque = 14 N•m [120 in-lb]

Temperature (°C)	Temperature [°F]	Resistance (Ω)
75	167	1350 to 1500
100	212	600 to 675

#### Water-in-Fuel Sensor

Description	Voltage
Probes in Water	0.50 to 3.00
Probes in Fuel	4.00 to 4.50

#### Vehicle Speed Sensor

Torque = 47 N•m [35 ft-lb]

First Coil Resistance = 750 to 1100 Ω  
Second Coil Resistance = 1100 to 1500 Ω

#### Engine Position Sensor

Torque = 20 N•m [180 in-lb]

First Coil Resistance = 1000 to 2000 Ω  
Second Coil Resistance = 1000 to 2000 Ω



FAULT CODE {LAMP}	J1587 PID(P) SID(S) {FMI}	J1939 SPN(S) {FMI}	REASON	EFFECT
321 {Yellow}	S004 {6}	654 {6}	Amperage detected at number 4 injector when the voltage is turned on.	Amperage to injector is shut off.
322 {Yellow}	S001 {5}	651 {5}	No amperage detected at number 1 injector when the voltage is turned on.	Amperage to injector is shut off.
323 {Yellow}	S005 {5}	655 {5}	No amperage detected at number 5 injector when the voltage is turned on.	Amperage to injector is shut off.
324 {Yellow}	S003 {5}	653 {5}	No amperage detected at number 3 injector when the voltage is turned on.	Amperage to injector is shut off.
325 {Yellow}	S006 {5}	656 {5}	No amperage detected at number 6 injector when the voltage is turned on.	Amperage to injector is shut off.
331 {Yellow}	S002 {5}	652 {5}	No amperage detected at number 2 injector when the voltage is turned on.	Amperage to injector is shut off.
332 {Yellow}	S004 {5}	654 {5}	No amperage detected at number 4 injector when the voltage is turned on.	Amperage to injector is shut off.
341 {Yellow}	S253 {2}	630 {2}	Severe loss of data from the ECM.	Possible no noticeable performance effects or engine dying or hard starting. Fault information, trip information, and maintenance monitor data can be inaccurate.
343 {Yellow}	S254 {12}	629 {12}	Internal ECM error.	Possible none on performance or severe derate.
349 {Yellow}	P191 {0}	191 {16}	A frequency greater than calibrated threshold was detected at the tail shaft governor signal pin of the 31-pin OEM connector.	Calibration dependent power and speed derate.
352 {Yellow}	S232 {4}	1079 {4}	Low voltage detected on the ECM voltage supply line to some sensors (VSEN1 supply).	Engine is derated to no air setting.
381 {Yellow}	S237 {11}	626 {11}	Error detected in the grid heater relay circuit.	Grid heater can <b>not</b> be energized by the ECM. Possible white smoke/hard start.
386 {Yellow}	S232 {3}	1079 {3}	High voltage detected on the ECM voltage supply line to some sensors (VSEN1 supply).	Engine is derated to no air setting.
387 {Yellow}	P221 {3}	1043 {3}	High voltage detected on the ECM voltage supply line to the throttle(s) (VTP supply).	Engine will idle <b>only</b> .
388 {Yellow}	S070 {11}	1072 {11}	Less than 6 VDC detected at engine brake circuit 1 when on indicates an excessive amperage draw from the ECM or faulty ECM output circuit.	Engine brake 1 can <b>not</b> be activated.
392 {Yellow}	S029 {11}	1073 {11}	Less than 6 VDC detected at engine brake circuit 2 when on indicates an excessive amperage draw from the ECM or faulty ECM output circuit.	Engine brake 2 can <b>not</b> be activated.
412 {None}	S250 {2}	608 {2}	Data transmission error on J1587/J1922 datalink	Electronic service tool or other datalink possibly will <b>not</b> operate.
414 {None}	S250 {9}	608 {9}	Data transmission error on J1587/J1922 datalink.	Electronic service tool or other datalink will possibly <b>not</b> operate.
415 {Red}	P100 {1}	100 {1}	Oil pressure signal indicates oil pressure below the very low oil pressure engine protection limit.	Progressive power derate with increasing time from alert. If engine protection shutdown feature is enabled, engine will shut down 30 seconds after red lamp starts flashing.
418 {Maintenance}	P097 {0}	97 {15}	Water has been detected in the fuel filter.	Possible white smoke, loss of power, or hard starting.
419 {Yellow}	P102 {2}	1319 {2}	An error in the intake manifold pressure sensor signal was detected by the ECM.	Engine is derated to no air setting.
422 {Yellow}	P111 {2}	111 {2}	Voltage detected simultaneously on both the coolant level high and low signal circuits or no voltage detected on both circuits.	No engine protection for coolant level.
426 {None}	S231 {2}	639 {2}	Communication between the ECM and the J1939 data link has been lost.	None on performance. J1939 devices will possibly <b>not</b> operate.
427 {None}	S231 {9}	639 {9}	Data transmission on J1939 datalink <b>not</b> occurring at an acceptable rate.	Electronic service tool or other datalink devices will possibly <b>not</b> operate.
428 {Yellow}	P097 {3}	97 {3}	High voltage detected at water-in-fuel sensor.	None on performance.
429 {Yellow}	P087 {4}	97 {4}	Low voltage detected at water-in-fuel sensor.	None on performance.
431 {Yellow}	S230 {2}	558 {2}	Voltage detected simultaneously on both the idle validation off-idle and on-idle circuits.	None on performance.
432 {Red}	S230 {13}	558 {13}	Voltage detected at idle validation on-idle circuit when voltage at throttle position circuit indicates the pedal is <b>not</b> at idle or voltage detected at idle validation off-idle circuit when voltage at throttle position circuit indicates the pedal is at idle.	Engine will idle <b>only</b>

FAULT CODE {LAMP}	J1587 PID(P) SID(S) {FMI}	J1939 SPN(S) {FMI}	REASON	EFFECT
433 {Yellow}	P102 {2}	102 {2}	Voltage signal at intake manifold pressure circuit indicates high intake manifold pressure but other engine characteristics indicate intake manifold pressure <b>must</b> be low.	Derate to no air setting.
434 {Yellow}	S251 {2}	627 {2}	Supply voltage to the ECM fell below 6.2 VDC for a fraction of a second or the ECM was <b>not</b> allowed to power down correctly (retain battery voltage for 30 seconds after key off).	Possible no noticeable performance effects or possibility of engine dying or hard starting. Fault information, trip information, and maintenance monitor data will possibly be inaccurate.
435 {Yellow}	P100 {2}	100 {2}	An error in the oil pressure sensor signal was detected by the ECM.	None on performance. No engine protection for oil pressure.
441 {Yellow}	P168 {1}	168 {18}	Battery voltage below normal operating level.	Possible no noticeable performance effects or possibility of rough idle.
442 {Yellow}	P168 {0}	168 {16}	Battery voltage above normal operation level.	None on performance.
443 {Yellow}	S221 {4}	1043 {4}	Low voltage detected on the ECM voltage supply line to the throttle(s) (VTP supply).	Engine will idle <b>only</b> .
465 {Yellow}	S032 {3}	1188 {3}	High voltage detected at the waste gate actuator number 1 circuit when no voltage was supplied by the ECM.	Engine will run derated.
466 {Yellow}	S032 {4}	188 {4}	Less than positive (+) 6 VDC detected at the wastegate actuator number 1 circuit when on indicates an excessive amperage draw from the ECM or the ECM output circuit.	Engine will run derated.
489 {Yellow}	P191 {1}	191 {18}	Auxiliary speed frequency on input pin indicated that the frequency is below a calibration dependent threshold.	Engine will idle <b>only</b> .
491 {Yellow}	S088 {3}	1189 {3}	High voltage detected at the wastegate number 2 actuator circuit when voltage was <b>not</b> supplied by the ECM.	Engine will run derated.
492 {Yellow}	S088 {4}	1189 {4}	Less than positive (+) 6 VDC detected at the wastegate actuator number 2 circuit when on indicates an excessive amperage draw from the ECM or the ECM output circuit.	Engine will run derated.
497 {Yellow}	S114 {2}	1377 {2}	Error detected in the multiple unit synchronization control switch input pins 34 and 32 of the OEM harness.	Multiple unit synchronization is disabled.
527 {Yellow}	P154 {3}	702 {3}	Less than 17.0 VDC detected at the dual output A signal pin of the 31-pin OEM connector.	No action taken by the ECM.
529 {Yellow}	S051 {3}	703 {3}	Less than 17.0 VDC detected at the dual output B signal pin at the ECM.	No action taken by the ECM.
551 {Yellow}	S230 {4}	558 {4}	No voltage detected simultaneously on both the idle validation off-idle and on-idle circuits.	Engine will idle <b>only</b> .
595 {Yellow}	P103 {0}	103 {16}	Turbocharger overspeed protection fault.	Engine will run derated.
596 {Yellow}	P167 {0}	167 {16}	High battery voltage detected by the battery voltage monitor feature.	Yellow lamp is lit until high battery voltage condition is corrected.
597 {Yellow}	P167 {1}	167 {18}	ICON™ has restarted the engine three times within three hours due to low battery voltage (automotive <b>only</b> ) or low battery voltage detected by the battery voltage monitor feature.	Yellow lamp is lit until low battery voltage condition is corrected. The ECM will possibly increase idle speed and deactivate idle decrement switch if idle speedup is enabled. The engine will run continuously if ICON™ is active (automotive <b>only</b> ).
598 {Red}	P167 {1}	167 {1}	Very low battery voltage detected by the battery voltage monitor feature.	Red lamp lit until very low battery voltage condition is corrected.
611 {None}	S151 {11}	1383 {31}	Engine shutdown by operator before proper engine cool down resulting in filtered load factor above maximum shutdown threshold.	No action taken by the ECM.
649 {Maintenance}	P153 {11}	1378 {31}	Due to an active fault code, Centinel™ system has been disabled over an extended period of time and can <b>not</b> restore engine oil to an acceptable condition.	Maintenance lamp will be lit until fault code(s) are cleared. Lubricating oil and filter <b>must</b> be changed.
951 {None}	P166 {2}	166 {2}	A power imbalance between cylinders was detected by the ECM.	Engine will possibly have rough idle or misfire.

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## Fault Code Information

FAULT CODE {LAMP}	J1587 PID(P) SID(S) {FMI}	J1939 SPN(S) {FMI}	REASON	EFFECT
111 {Red}	S254 {12}	629 {12}	Error internal to the ECM related to memory hardware failures or internal ECM voltage supply circuits.	Engine will <b>not</b> start.
115 {Red}	P190 {2}	190 {2}	No engine speed signal detected at both engine position sensor circuits.	Engine will die and will <b>not</b> start.
121 {Yellow}	P190 {10}	190 {10}	No engine speed signal detected from one of the engine position sensor circuits.	None on performance.
122 {Yellow}	P102 {3}	102 {3}	High voltage detected on the intake manifold pressure circuit.	Derate in power output of the engine.
123 {Yellow}	P102 {4}	102 {4}	Low voltage detected on the intake manifold pressure circuit.	Derate in power output of the engine.
131 {Red}	P091 {3}	91 {3}	High voltage detected at the throttle position signal circuit.	Severe derate (power and speed). Limp home power <b>only</b> .
132 {Red}	P091 {4}	91 {4}	Low voltage detected at the throttle position signal circuit.	Severe derate (power and speed). Limp home power <b>only</b> .
133 {Red}	P029 {3}	974 {3}	High voltage detected at the remote throttle position signal circuit.	None on performance if remote throttle is <b>not</b> used.
134 {Red}	P029 {4}	974 {4}	Low voltage detected at the remote throttle position signal circuit.	None on performance if remote throttle is <b>not</b> used.
135 {Yellow}	P100 {3}	100 {3}	High voltage detected at the oil pressure circuit.	No engine protection for oil pressure.
141 {Yellow}	P100 {4}	100 {4}	Low voltage detected at the oil pressure circuit.	No engine protection for oil pressure.
143 {Yellow}	P100 {1}	100 {18}	Oil pressure signal indicates oil pressure below the low oil pressure engine protection limit.	Progressive power and speed derate with increasing time after alert. If Engine Protection Shutdown feature is enabled, engine will shut down 30 seconds after red lamp starts flashing.
144 {Yellow}	P110 {3}	110 {3}	High voltage detected at the coolant temperature circuit.	Possible white smoke. Fan will stay on if controlled by the electronic control module (ECM). No engine protection for coolant temperature.
145 {Yellow}	P110 {4}	110 {4}	Low voltage detected at the coolant temperature circuit.	Possible white smoke. Fan will stay on if controlled by electronic control module (ECM). No engine protection for coolant temperature.
147 {Red}	P091 {8}	91 {8}	A frequency of less than 100 Hz was detected at the frequency throttle signal pin of the actuator harness connector at the ECM.	Calibration dependent power and speed derate.
148 {Red}	P091 {8}	91 {8}	A frequency of more than 100 Hz was detected at the frequency throttle signal pin of the actuator harness connector at the ECM.	Calibration dependent power and speed derate.
151 {Red}	P110 {0}	110 {0}	Coolant temperature signal indicates coolant temperature above 104°C [220°F].	Progressive power derate with increasing time after alert. If Engine Protection Shutdown feature is enabled, engine will shut down 30 seconds after red lamp starts flashing.
153 {Yellow}	P105 {3}	105 {3}	High voltage detected at the intake manifold temperature circuit.	Possible white smoke. Fan will stay on if controlled by electronic control module (ECM). No engine protection for coolant temperature.
154 {Yellow}	P105 {4}	105 {4}	Low voltage detected at the intake manifold temperature circuit.	Possible white smoke. Fan will stay on if controlled by electronic control module (ECM). No engine protection for coolant temperature.
155 {Red}	P105 {0}	105 {0}	Intake manifold temperature signal indicates temperature above 87.8°C [190°F].	Progressive power derate with increasing time after alert. If Engine Protection Shutdown feature is enabled, engine will shut down 30 seconds after red lamp starts flashing.
187 {Yellow}	S232 {4}	1080 {4}	Low voltage detected on the ECM voltage supply line to some sensors (VSEN2 supply).	Engine runs derated. No engine protection for oil pressure and coolant level.
211 {None}	S216 {11}	1484 {31}	Additional OEM or vehicle diagnostic codes have been logged. Check other ECMs for diagnostic codes.	None on engine performance.
212 {Yellow}	P175 {3}	175 {3}	High voltage detected at the oil temperature circuit.	No engine protection for oil temperature.
213 {Yellow}	P175 {4}	175 {4}	Low voltage detected at the oil temperature circuit.	No engine protection for oil temperature.
214 {Red}	P175 {0}	175 {0}	Oil temperature signal indicates oil temperature above 123.9°C [255°F].	Progressive power derate with increasing time after alert. If Engine Protection Shutdown feature is enabled, engine will shut down 30 seconds after the red lamp starts flashing.
219 {Maintenance}	P017 {1}	1380 {17}	Low oil level was detected in the Centinel™ makeup oil tank.	None on performance. Centinel™ deactivated.

FAULT CODE {LAMP}	J1587 PID(P) SID(S) {FMI}	J1939 SPN(S) {FMI}	REASON	EFFECT
221 {Yellow}	P108 {3}	108 {3}	High voltage detected at the ambient air pressure circuit.	Derate in power output of the engine.
222 {Yellow}	P108 {4}	108 {4}	Low voltage detected at the ambient air pressure circuit.	Derate in power output of the engine.
223 {Yellow}	S085 {4}	1265 {4}	Incorrect voltage detected at the Centinel™ actuator circuit by the ECM.	None on performance. Centinel™ deactivated.
227 {Yellow}	S232 {3}	1080 {3}	High voltage detected on the ECM voltage supply line to some sensors (VSEN2 supply).	Engine will run derated. No engine protection for oil pressure and coolant level.
234 {Red}	P190 {0}	190 {0}	Engine speed signal indicates engine speed is greater than 2730 rpm.	Fuel shutoff valve closes until engine speed falls to 2184 rpm.
235 {Red}	P111 {1}	111 {1}	Coolant level signal indicates coolant level is below the normal range.	Progressive power derate with increasing time after alert. If Engine Protection Shutdown feature is enabled, engine will shut down 30 seconds after red lamp starts flashing.
237 {Yellow}	S030 {2}	644 {2}	Duty cycle of the throttle input signal to the primary or secondary engine for multiple unit synchronization is less than 3 percent or more than 97 percent.	All engines (primary and secondary) are shut down with increasing time after alert if hard-coupled. <b>Only</b> secondary engines are shut down with increasing time after alert if soft-coupled.
241 {Yellow}	P084 {2}	84 {2}	The ECM lost the vehicle speed signal.	Engine speed limited to Maximum Engine Speed without Vehicle Speed Sensor parameter value Cruise Control, Gear-Down Protection and Road Speed Governor will <b>not</b> work (automotive <b>only</b> ).
242 {Yellow}	P084 {10}	84 {10}	Invalid or inappropriate vehicle speed signal detected. Signal indicates an intermittent connection or VSS tampering.	Engine speed limited to Maximum Engine Speed without Vehicle Speed Sensor parameter value Cruise Control, Gear-Down Protection and Road Speed Governor will <b>not</b> work (automotive <b>only</b> ).
245 {Yellow}	S033 {4}	647 {4}	Less than 6 VDC detected at fan clutch circuit when on. Indicates an excessive amperage draw from the ECM or faulty ECM output circuit.	The fan can stay on at all times.
254 {Red}	S017 {4}	632 {4}	Less than 6 VDC detected at fuel shutoff circuit when on. Indicates an excessive amperage draw from the ECM or a faulty ECM output circuit.	The ECM turns off the fuel shutoff supply voltage. The engine will shut down.
255 {Yellow}	S017 {3}	632 {3}	Externally supplied voltage detected going to the fuel shutoff solenoid supply circuit.	None on performance. Fuel shutoff valve will stay open.
285 {Yellow}	S231 {9}	639 {9}	The ECM expected information from a multiplexed device but did <b>not</b> receive it soon enough or did <b>not</b> receive it at all.	At least one multiplexed device will <b>not</b> operate properly.
286 {Yellow}	S231 {13}	639 {13}	The ECM expected information from a multiplexed device but <b>only</b> received a portion of the necessary information.	At least one multiplexed device will <b>not</b> operate properly.
287 {Red}	S091 {2}	91 {19}	The OEM vehicle electronic control unit (VECU) detected a fault with its throttle pedal.	The engine will <b>idle only</b> .
288 {Red}	P029 {2}	974 {19}	The OEM vehicle electronic control unit (VECU) detected a fault with its remote throttle.	The engine will <b>not</b> respond to the remote throttle.
293 {Yellow}	P441 {3}	441 {3}	High voltage detected at the OEM temperature sensor signal pin of the 31-pin OEM connector.	No engine protection for OEM temperature.
294 {Yellow}	P441 {4}	441 {4}	Low voltage detected at the OEM temperature sensor signal pin of the 31-pin OEM connector.	No engine protection for OEM temperature.
295 {Yellow}	P108 {2}	108 {2}	An error in the ambient air pressure sensor signal was detected by the ECM.	Engine is derated to no air setting.
297 {Yellow}	P223 {3}	1387 {3}	High voltage detected at the OEM pressure sensor signal pin of the 31-pin OEM connector.	No engine protection for OEM pressure.
298 {Yellow}	P223 {4}	1387 {4}	Low voltage detected at the OEM pressure sensor signal pin of the 31-pin OEM connector.	No engine protection for OEM pressure.
299 {Yellow}	S029 {14}	1384 {31}	Engine shutdown by device other than keyswitch before proper engine cool down resulting in filtered load factor above maximum shutdown threshold.	No action taken by the ECM.
311 {Yellow}	S001 {6}	651 {6}	Amperage detected at number 1 injector when voltage is turned off.	Amperage to injector is shut off.
312 {Yellow}	S005 {6}	655 {6}	Amperage detected at number 5 injector when voltage is turned off.	Amperage to injector is shut off.
313 {Yellow}	S003 {6}	653 {6}	Amperage detected number 3 injector when the voltage is turned off.	Amperage to injector is shut off.
314 {Yellow}	S006 {6}	656 {6}	Amperage detected at number 6 injector when the voltage is turned off.	Amperage to injector is shut off.
315 {Yellow}	S002 {6}	652 {6}	Amperage detected at number 2 injector when the voltage is turned off.	Amperage to injector is shut off.
319 {Maintenance}	P251 {2}	251 {2}	Real time clock lost power.	None on performance. Data in the ECM will <b>not</b> have accurate time and date information.