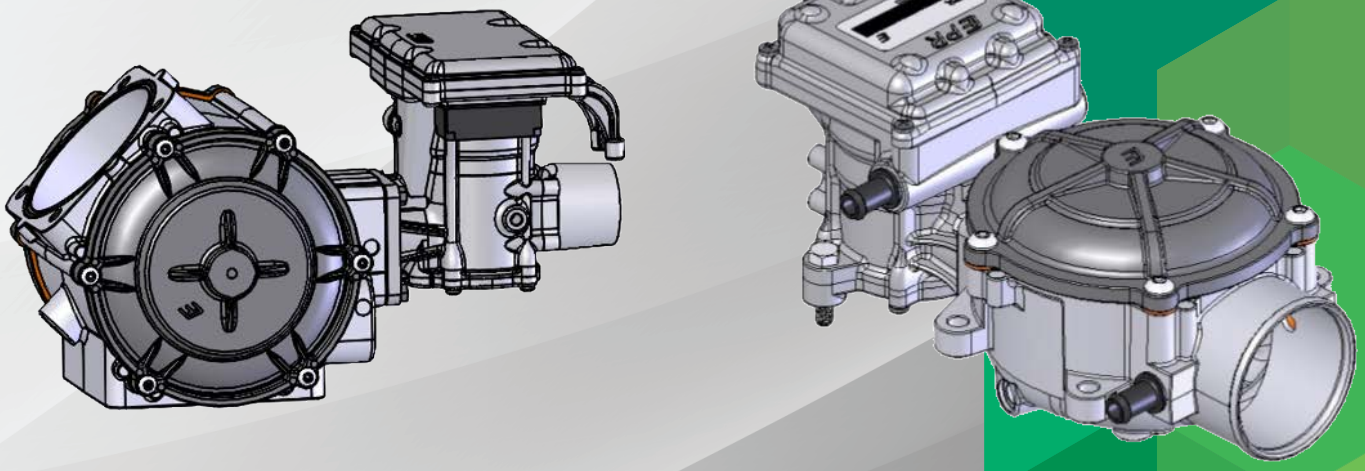
POWER SOLUTIONS INTERNATIONAL

PSI Natural Gas 4.5L - 13L



Diagnostic Manual

7610037-1 04/21

Table of Contents

ABBREVIATIONS..... 9

THOERY OF OPERATIONS.....12

4.5L-13L TURBO AIR INTAKE SYSTEM COMPONENT LOCATION INFORMATION.....18

4.5L-13L TURBO CRANK CASE VENTILATION (CCV) COMPONENT LOCATION INFORMATION.....21

4.5L-13LTURBO FUEL SYSTEM COMPONENT LOCATION INFORMATION.....24

90 PIN ECU LAYOUT..... 34

120 PIN ECU LAYOUT 35

DIAGNOSTIC TROUBLE CODE FAULT DESCRIPTIONS 36

DTC 6 - LOCKOFF OPEN/GROUND SHORT.....42

DTC 7 - LOCKOFF SHORT TO POWER.....43

DTC 16 - NEVER CRANK SYNC AT START.....44

DTC 51 - EGOH2 OPEN/GROUND SHORT 45

DTC 52 - EGOH2 SHORT TO POWER.....47

DTC 107 - MAP LOW VOLTAGE.....49

DTC 107 - MAP LOW VOLTAGE (Trouble Tree).....50

DTC 108 - MAP HIGH PRESSURE.....51

DTC 108 - MAP HIGH PRESSURE (Trouble Tree) 52

DTC 111 - IAT HIGHER THAN EXPECTED STAGE 1 53

DTC 112 - IAT LOW VOLTAGE 54

DTC 112 - IAT LOW VOLTAGE (Trouble Tree)..... 55

DTC 113 - IAT HIGH VOLTAGE 56

DTC 113 - IAT HIGH VOLTAGE (Trouble Tree) 57

DTC 116 - ECT HIGHER THAN EXPECTED (STAGE 1) 58

DTC 117 - ECT / CHT LOW VOLTAGE..... 60

DTC 117 - ECT / CHT LOW VOLTAGE (Trouble Tree)..... 61

DTC 118 - ECT / CHT HIGH VOLTAGE 62
DTC 118 - ECT / CHT HIGH VOLTAGE (Trouble Tree) 63
DTC 121 – TPS1 % LOWER THAN TPS2 % 64
DTC 122 - TPS1 SIGNAL VOLTAGE LOW 67
DTC 122 - TPS1 SIGNAL VOLTAGE LOW (Trouble Tree) 69
DTC 123 - TPS1 SIGNAL VOLTAGE HIGH..... 70
DTC 123 - TPS1 HIGH VOLTAGE (Trouble Tree)..... 72
DTC 127 - IAT HIGHER THAN EXPECTED STAGE 2 73
DTC 129 - BP LOW PRESSURE.....75
DTC 134 – EGO1 OPEN / LAZY (HO2S1) 77
DTC 134 – EGO1 OPEN / LAZY (HO2S1) (Trouble Tree) 78
DTC 154 - EGO2 OPEN/LAZY 79
DTC 187 - FT GASEOUS FUEL LOW..... 81
DTC 188 - FT GASEOUS FUEL HIGH.....83
DTC 217 - ECT HIGHER THAN EXPECTED 2 85
DTC 219 - RPM HIGHER THAN MAX ALLOWED GOVERNED SPEED 87
DTC 221 - TPS1 % HIGHER THAN TPS2 % 88
DTC 221 - TPS1 % HIGHER THAN TPS2 % (TROUBLE TREE)..... 90
DTC 222 - TPS2 SIGNAL VOLTAGE LOW 91
DTC 222 - TPS2 SIGNAL VOLTAGE LOW (TROUBLE TREE)..... 93
DTC 223 - TPS2 SIGNAL VOLTAGE HIGH..... 94
DTC 236 - TIP/TOP ACTIVE 96
DTC 236- TIP Active Trouble Tree 97
DTC 237 - TIP/TOP LOW VOLTAGE 98
DTC 237 - TIP/TOP LOW VOLTAGE (TROUBLE TREE) 99
DTC 238 - TIP/TOP HIGH VOLTAGE..... 100
DTC 298-OILTEMPERATURETOOHIGH..... 102
DTC 326, 331 & 32B – KNOCK 1, 2 & 3 EXCESSIVE OR ERRATIC SIGNAL..... 104
DTC 326, 331 & 32B - KNOCK1, 2 & 3 EXCESSIVE OR ERRATIC SIGNAL(TROUBLE TREE)105

DTC 327, 332 & 32C - KNOCK1, 2 & 3 SENSOR OPEN OR NOT PRESENT..... 106
DTC 327, 332 & 32C - KNOCK1-3 SENSOR OPEN OR NOT PRESENT(TROUBLE TREE).....107
DTC 336 - CRANK INPUT SIGNAL NOISE..... 108
DTC 336 - CRANK INPUT SIGNAL NOISE (TROUBLE TREE)..... 109
DTC 337 – LOSS OF CRANKSHAFT SIGNAL 110
DTC 337 – LOSS OF CRANKSHAFT SIGNAL (DIAGNOSTIC AIDS)..... 110
DTC 341 - CAM INPUT SIGNAL NOISE 111
DTC 341 – CAM INPUT SIGNAL NOISE (TROUBLE TREE) 112
DTC 342 – LOSS OF CAMSHAFT INPUT SIGNAL 113
DTC 342 – LOSS OF CAMSHAFT INPUT SIGNAL (DIAGNOSTIC AIDS) 114
DTC 359 – FUEL RUN-OUT LONGER THAN EXPECTED 115
DTC 520 - OIL PRESSURE LOW STAGE 1 (SENDER)..... 116
DTC 521 - OIL PRESSURE HIGH (SENDER)..... 117
DTC 521 - OIL PRESSURE HIGH (SENDER) (TROUBLE TREE)..... 118
DTC 522 - OIL PRESSURE SENDER LOW VOLTAGE 119
DTC 522 - OIL PRESSURE SENDER LOW VOLTAGE (TROUBLE TREE)..... 120
DTC 523 - OIL PRESSURE SENDER HIGH VOLTAGE..... 121
DTC 523 - OIL PRESSURE SENDER HIGH VOLTAGE (TROUBLE TREE) 122
DTC 524 - OIL PRESSURE LOW STAGE 2 (SENDER)..... 123
DTC 524 - OIL PRESSURE LOW (SENDER) (TROUBLE TREE) 124
DTC 562 - BATTERY VOLTAGE (VBAT) LOW 125
DTC 562 - BATTERY VOLTAGE (VBAT) LOW (TROUBLE TREE) 126
DTC 563 - BATTERY VOLTAGE (VBAT) HIGH 127
DTC 563 - BATTERY VOLTAGE (VBAT) HIGH (TROUBLE TREE)..... 128
DTC 601 - MICROPROCESSOR FAILURE - FLASH 129
DTC 604 - MICROPROCESSOR FAILURE - RAM 131
DTC 604 - MICROPROCESSOR FAILURE – RAM (TROUBLE TREE) 132
DTC 606 - MICROPROCESSOR FAILURE - COP 133
DTC 606 - MICROPROCESSOR FAILURE – COP (TROUBLE TREE) 134

DTC 616 - START RELAY CONTROL GROUND SHORT 135
DTC 616 - START RELAY CONTROL GROUND SHORT (TROUBLE TREE) 136
DTC 642 - SENSOR SUPPLY VOLTAGE 1 LOW (5VEXT1) 137
DTC 642 - SENSOR SUPPLY VOLTAGE 1 LOW (5VEXT1) (TROUBLE TREE) 138
DTC 643 - SENSOR SUPPLY VOLTAGE 1 HIGH (5VEXT1) 139
DTC 652 - SENSOR SUPPLY VOLTAGE 2 LOW (5VEXT2) 141
DTC 652 - SENSOR SUPPLY VOLTAGE 2 LOW (5VEXT2) (TROUBLE TREE) 142
DTC 653 – SENSOR SUPPLY VOLTAGE 2 HIGH (5VEXT2) 143
DTC 653- SENSOR SUPPLY VOLTAGE 2 HIGH (5VEXT2) (TROUBLE TREE) 144
DTC 685 - RELAY COIL OPEN 145
DTC 685 - RELAY COIL OPEN (TROUBLE TREE)..... 146
DTC 686 - RELAY CONTROL GROUND SHORT 147
DTC 687 - RELAY COIL SHORT TO POWER 149
DTC 687 - RELAY COIL SHORT TO POWER (TROUBLE TREE)..... 150
DTC 1068 - MAP HIGHER THAN EXPECTED 151
DTC 1111- RPM ABOVE FUEL REV LIMIT LEVEL 153
DTC 1112- RPM ABOVE SPARK REV LIMIT LEVEL 155
DTC 1113- RPM HIGHER THAN EXPECTED 157
DTC 1151 – CLOSED LOOP HIGH (LPG) 158
DTC 1152 – CLOSED LOOP LOW (LPG) 160
DTC 1153 – CLOSED LOOP HIGH NATURAL GAS 162
DTC 1154 – CLOSED LOOP LOW NATURAL GAS 164
DTC 1161 – AADAPTIVE LEARN HIGH (LPG) 166
DTC 1162 – ADAPTIVE LEARN LOW (LPG) 168
DTC 1163 – ADAPTIVE LEARN HIGH (NATURAL GAS) 170

DTC 1164 – ADAPTIVE LEARN LOW (NATURAL GAS).....172

DTC 1171 - EPR / CFV REGULATION PRESSURE HIGHER THAN EXPECTED.....174

DTC 1172 - EPR / CFV REGULATION PRESSURE LOWER THAN EXPECTED 177

DTC 1172 - EPR / CFV REGULATION PRESSURE LOWER THAN EXPECTED (TROUBLE TREE)..... 179

DTC 1173 - EPR / CFV COMM LOST 180

DTC 1173 - EPR / CFV COMM LOST (TROUBLE TREE) 182

DTC 1174 - EPR / CFV VOLTAGE SUPPLY HIGH.....183

DTC 1175 - EPR / CFV VOLTAGE SUPPLY LOW 184

DTC 1176 - EPR / CFV INTERNAL ACTUATOR FAULT DETECTION 185

DTC 1177 - EPR / CFV INTERNAL CIRCUITRY FAULT DETECTION 186

DTC 1178 - EPR / CFV INTERNAL COMM FAULT DETECTION 187

DTC 1325 - KNOCK RETARD AT LIMIT.....188

DTC 1326 - KNOCK RETARD ABOVE THRESHOLD.....189

DTC 1351 – DTC 1360 – SPARK PLUG OR COIL FAILURE (CYLINDERS 1-10).....190

DTC 1511 - OIL TEMP HIGH VOLTAGE.....192

DTC 1512 - OIL TEMP LOW VOLTAGE.....194

DTC 1514 - AUX ANALOG PULL-UP 2 LOW VOLTAGE FAULT (Oil Level Switch).....196

DTC 1514 - AUX ANALOG PULL-UP 2 LOW VOLTAGE FAULT (Oil Level Switch) (TROUBLE TREE)..... 197

DTC 1515 - AUX ANALOG PULL-DOWN 1 HIGH VOLTAGE 198

DTC 1516 - AUX ANALOG PULL-DOWN 1 LOW VOLTAGE.....200

DTC 1517- AUX ANALOG PULL-UP 3 HIGH VOLTAGE FAULT (Coolant Level Switch).202

DTC 1518- COOLANT LEVEL LOW VOLTAGE.....204

DTC 1602- RELAY OFF HIGH VOLTAGE.....205

DTC 1603- RELAY ON LOW VOLTAGE.....207

DTC 1612, 1613 & 1614 - MICROPROCESSOR FAILURE - RTI 1, 2 & 3 209

DTC 1612, 1613 & 1614 - MICROPROCESSOR FAILURE - RTI 1, 2 7 3 (TROUBLE TREE) .210

DTC 1615- MICROPROCESSOR FAILURE - A/D.....211
DTC 1615 - MICROPROCESSOR FAILURE – A/D (TROUBLE TREE)..... 212
DTC 1616 – MICROPROCESSOR FAILURE – INTERRUPT.....213
DTC 1616 - MICROPROCESSOR FAILURE – INTERRUPT (TROUBLE TREE) 214
DTC 1626 – CAN1 J1939 TRANSMIT (TX) FAULT 215
DTC 1626 – CAN1 J1939 TRANSMIT (TX) FAULT (Diagnostic Aides): 215
DTC 1627 - CAN1 RX FAILURE 216
DTC 1628 - CAN1 ADDRESS CONFLICT FAILURE 217
DTC 1628 - CAN1 ADDRESS CONFLICT FAILURE (TROUBLE TREE)..... 218
DTC 1673 - CALIBRATION CONFIGURATION ERROR.....219
DTC 1674 - HARDWARE ID FAILURE 220
DTC 1674 - HARDWARE ID FAILURE (TROUBLE TREE) 221
DTC 2111 - UNABLE TO REACH LOWER TPS.....222
DTC 2112 - UNABLE TO REACH HIGHER TPS 224
DTC 2122 - FPP1 HIGH VOLTAGE 225
DTC 2123 - FPP1 LOW VOLTAGE 227
DTC 2135 - TPS1/2 SIMULTANEOUS VOLTAGES OUT OF RANGE 229
DTC 2229 - BP HIGH PRESSURE 231
DTC 2300 - PRIMARY LOOP OPEN OR LOW-SIDE SHORT TO GROUND (CURR. MEAS. REQD)(CYLINDER 1) 233
DTC 2300 - PRIMARY LOOP OPEN OR LOW-SIDE SHORT TO GROUND (TROUBLE TREE) 234
DTC 2301 - PRIMARY COIL SHORTED (CURRENT MEASUREMENT REQUIRED)(CYLINDER 1).....235
DTC 2301 - PRIMARY COIL SHORTED (TROUBLE TREE)..... 236
DTC 3011 – UEGO1 INTERNAL PROCESSOR FAULT 237
DTC 3012 - UEGO HEATER SUPPLY HIGH VOLTAGE.....238
DTC 3012 - UEGO HEATER SUPPLY HIGH VOLTAGE (TROUBLE TREE) 240
DTC 3013 – UEGO1 HEATER SUPPLY LOW VOLTAGE 241
DTC 3014 – UEGO1 CAL RESISTOR VOLTAGE HIGH.....243
DTC 3015 – UEGO1 CAL RESISTOR VOLTAGE LOW.....245

DTC 3020 - UEGO SENSE CELL VOLTAGE HIGH 247
DTC 3024 - UEGO1 SENSE CELL SLOW TO WARM UP 249
DTC 3025 - UEGO1 PUMP CELL SLOW TO WARM UP 250
DTC 3026 - UEGO1 SENSE CELL IMPEDANCE HIGH.....251
DTC 3029 - UEGO1 DRIFT IS OUT OF TOLERANCE.....252
DTC 3030 - UEGO1 DRIFT IS OUT OF TOLERANCE - LEVEL 2.....253
DTC 3031 - UEGO HEATER OPEN / GROUND SHORT 254
DTC 3031 - UEGO HEATER OPEN / GROUND SHORT (TROUBLE TREE)..... 255
DTC 3032 - UEGO HEATER SHORT TO POWER 256
DTC 3032 - UEGO HEATER SHORT TO POWER (TROUBLE TREE) 257
4.5L ELETRICAL SCHEMATIC..... 258
6.7L ELETRICAL SCHEMATIC..... 259
6.7L TURBO ELETRICAL SCHEMATIC.....260
10L ELETRICAL SCHEMATIC 261
10L TURBO ELETRICAL SCHEMATIC.....262
13L ELETRICAL SCHEMATIC.....263
REVISON CONTROL INFORMATION.....264

ABBREVIATIONS

ACRONYM	DESCRIPTION
AL	Adaptive Learn
BP	Barometric Pressure
CAN	Controller Area Network
CCP	CAN Calibration Protocol
CHT	Cylinder Head Temperature
CKP	Crank Sensor
CL	Closed Loop
CNG	Compressed Natural Gas
DBW	Drive-By-Wire
DC	Direct Current
DIG	Digital
DM	Diagnostic Message
DMM	Digital Multi-Meter (high impedance)
DST	Diagnostic Scan Tool
DTC	Diagnostic Trouble Code
DVOM	Digital Voltage and Ohm Meter (high impedance)
ECI	EControls Inc.
ECIPP	EControls Inc. Proprietary Protocol
ECM	Engine Control Module
ECOM	EControls COMmunication Interface
ECT	Engine Coolant Temperature
ECU	Engine Control Unit
EDIS	EControls Display and Interface Software
EEPROM	Electrically Erasable Programmable Read-Only Memory
EGO	Exhaust Gas Oxygen Sensor, typically heated
EMWT	Exhaust Manifold Water Temperature
EPR	Electronic Pressure Regulator
ERWT	Exhaust Manifold Riser Temperature
ETB	Electronic Throttle Body
ETC	Electronic Throttle Control
FDR	Flight Data Recorder
FMI	Failure Mode Indicator
FO	Firing Order
FP	Fuel Pressure
FPP	Foot Pedal Position

ACRONYM	DESCRIPTION
FRP	Fuel Rail Pressure
FRT	Fuel Rail Temperature
FSO	Fuel Shut Off
FSS	Fault Snapshot
FT	Fuel Temperature
GCP	Global Control Platform
HDGCP	Heavy-Duty Global Control Platform (On-Road Heavy-Duty)
HEGO	Heated Exhaust Gas Oxygen Sensor (same as HO2S)
HO2S	Heated Oxygen Sensor (same as HEGO)
IAC	Idle Air Control
IAT	Intake Air Temperature
ICAV	Instant Crank Angle Velocity
IVS	Idle Validation Switch
LDGCP	Light-Duty Global Control Platform (Industrial, Smart/Logic Coil)
LED	Light Emitting Diode
LPG	Liquefied Propane Gas
MAP	Manifold Absolute Pressure
MDGCP	Medium-Duty Global Control Platform (Industrial, Dumb Coil)
MGCP	Marine Global Control Platform
μP	Microprocessor
Mfg	Manufacture
MIL	Malfunction Indicator Lamp
NG	Natural Gas
OBD	On-Board Diagnostics
OEM	Original Equipment Manufacture
PC	Personal Computer
PCU	Powertrain Control Unit
PD	Pull-down Resistor/Channel
PFI	Port Fuel Injection
PGN	Parameter Group Number
PU	Pull-up Resistor/Channel
PUD	Pull-up/Pull-down Resistor/Channel
PWM	Pulse Width Modulated
RAM	Random Access Memory
RLV	Redundant Lockoff Verification
RPM	Revolutions Per Minute
Rx	Receive
SAE	Society of Automotive Engineering

ACRONYM	DESCRIPTION
SA	Source Address
SPFI	Sequential Port Fuel Injection
SPN	Suspect Parameter Number
Tach	Tachometer
TBI	Throttle Body Injection
TBD	To be Determined
TDC	Top Dead Center
TIP	Throttle Inlet Pressure
TMAP	Temperature and Manifold Absolute Pressure
TOP	Turbine Outlet Pressure
TPS	Throttle Position Sensor
TSC	Torque/Speed Control
Tx	Transmit
UEGO	Universal Exhaust Gas Oxygen Sensor (also called wide-range EGO)
USB	Universal Serial Bus
VBat	Battery voltage
VDC	Voltage, Direct Current
VR	Variable Reluctance
Vsw	Switched, Ignition Voltage
WGP	Waste-Gate Pressure

4.5L-13 TURBO THEORY OF OPERATIONS

STOICHIOMETRIC, LG & NG Fuel Delivery to Engine

The 4G engine control module is the backbone of the EControls control system. Proven in a multitude of applications around the world, the 4G based engine control system delivers reliable operation and optimal engine operation no matter the environment. The 4G engine control system is essential for highly regulated emissions, it enables operation at the stoichiometric air / fuel ratio with Rich Burn and a 3 Way Catalyst. Stoichiometric engine operation ensures that there is the precise amount of air delivered to completely burn all the fuel. The stoichiometric Air Fuel Ratio (AFR) for natural gas is 17.2:1 and for propane is 15.5:1. With rich burn there is slightly less air delivered relative to fuel resulting in slightly less fuel efficiency, more power and a cooler combustion process. Figure 1A-1E shows the required 4G engine control system configurations for Propane (LPG), Natural Gas (NG) and Bi-Fuel (LPG and NG) for the 4.5L-13L turbo engines.

Bi-FUEL

The 4G Engine Controls System has full engine software control authority, therefore switching from Natural Gas (NG) to Propane (LPG/VPG) fuel is a software command from the operator console or a switch input into the 4G ECM. The PSI 4.5L-13 turbo engines are capable of operating in bi-fuel mode starting from VPG/LPG and switching to NG after the NG pressure develops from operation. With the proper valve and sensor arrangement the fuel supply transition can be made while in operation, under full load, and automatically.

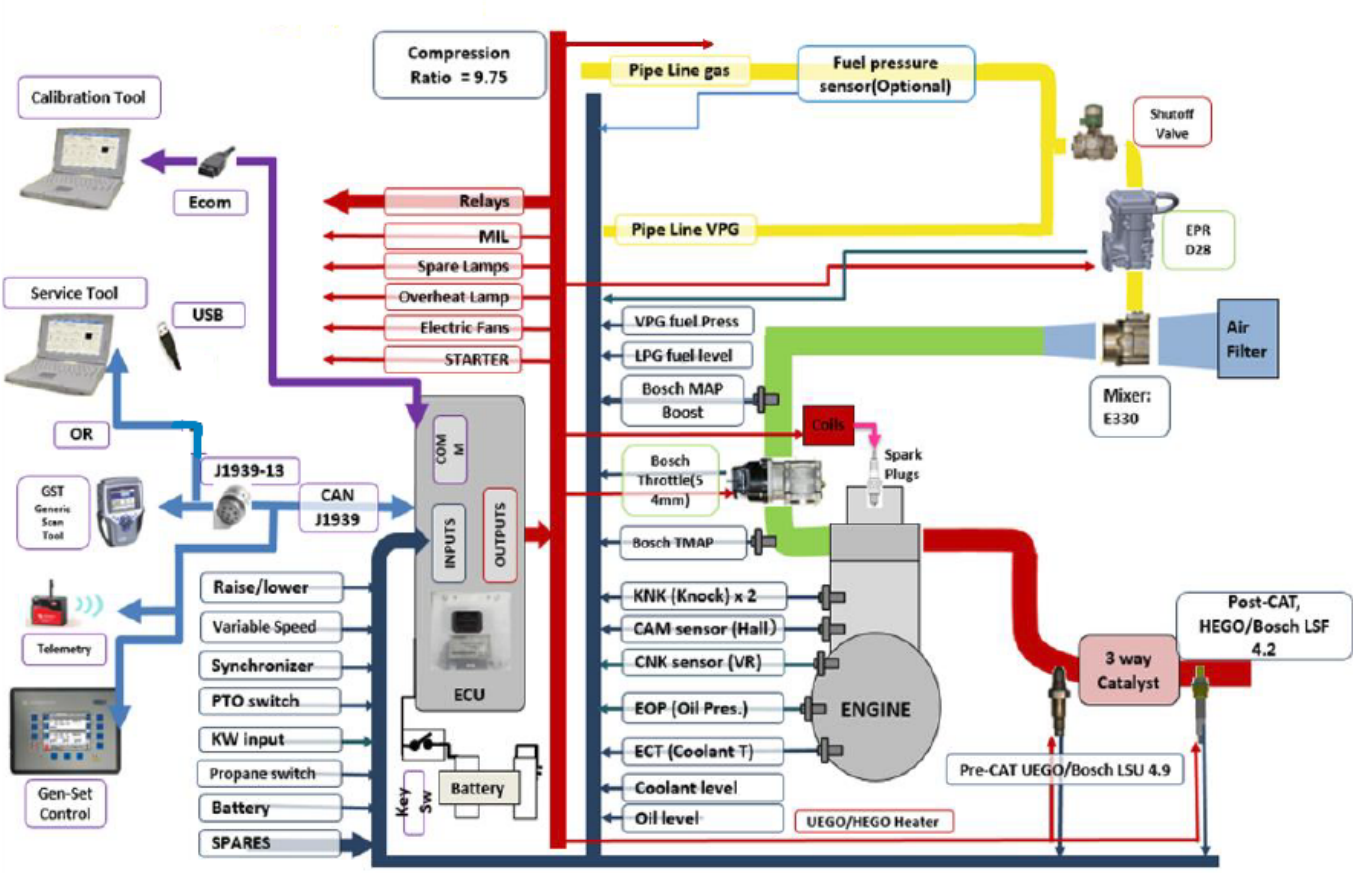


Figure 1A. 4.5L Schematic

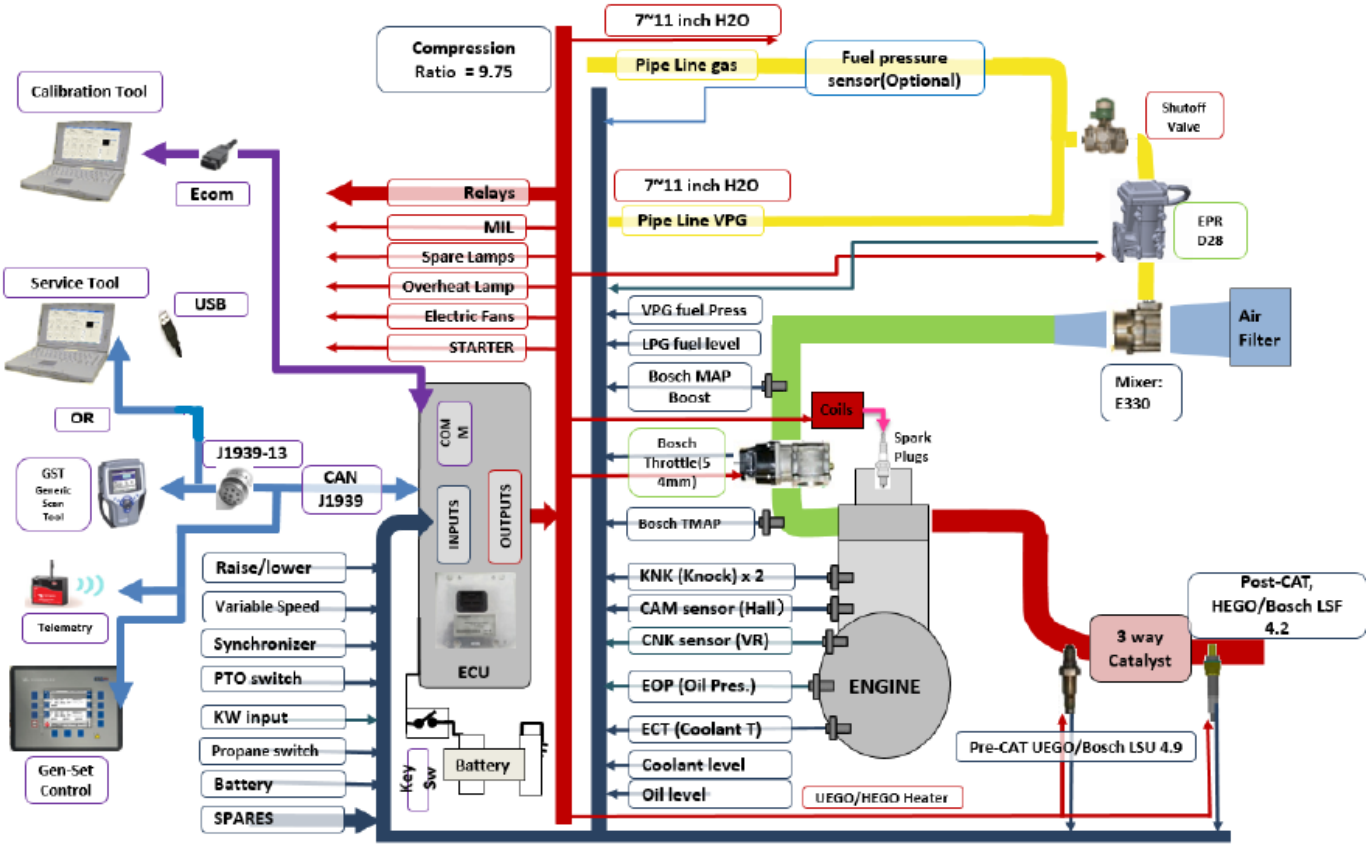


Figure 1B. 6.7L Schematic

4.5L-13 TURBO THEORY OF OPERATIONS - CONTINUED

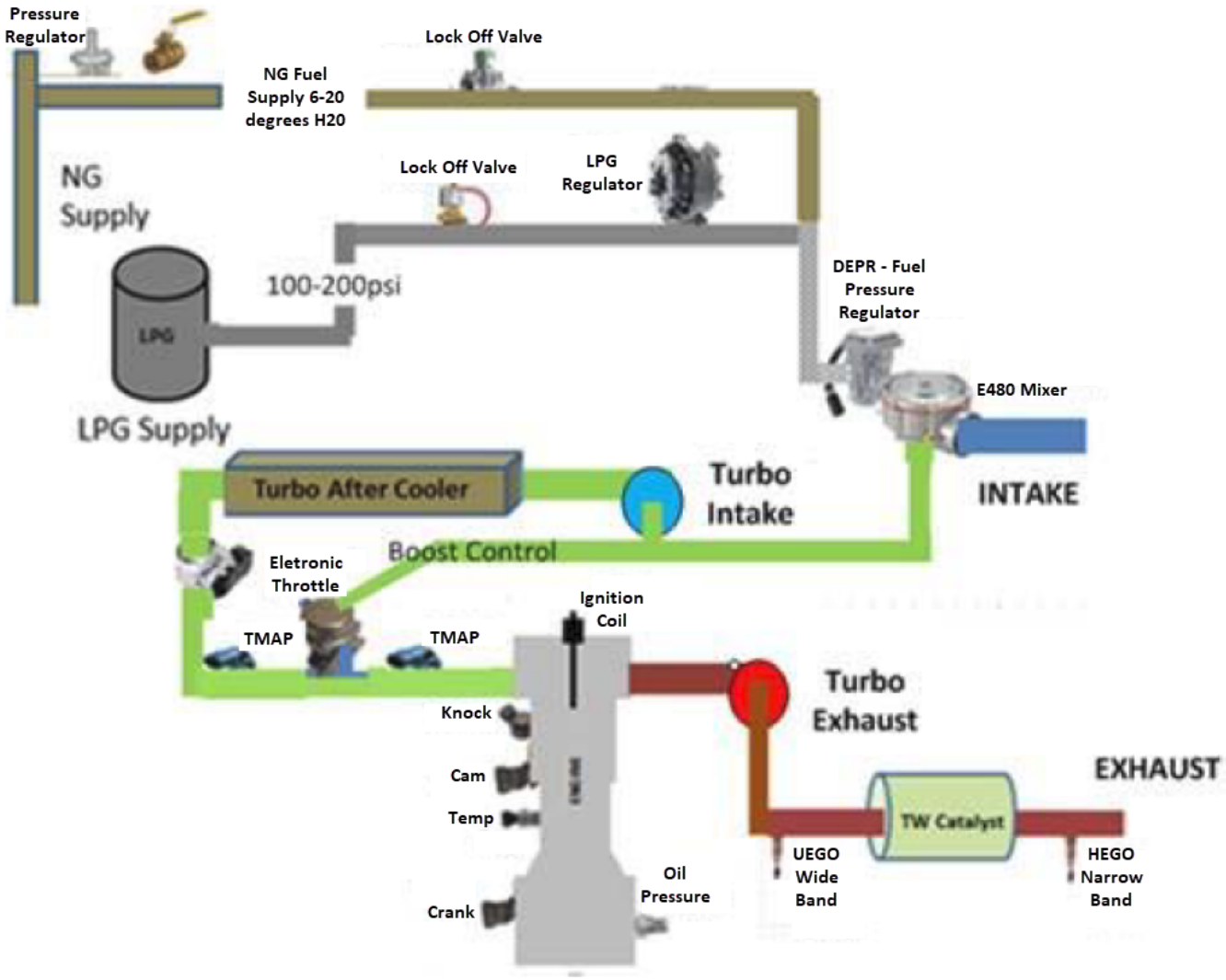


Figure 1C. 6.7L Turbo Schematic

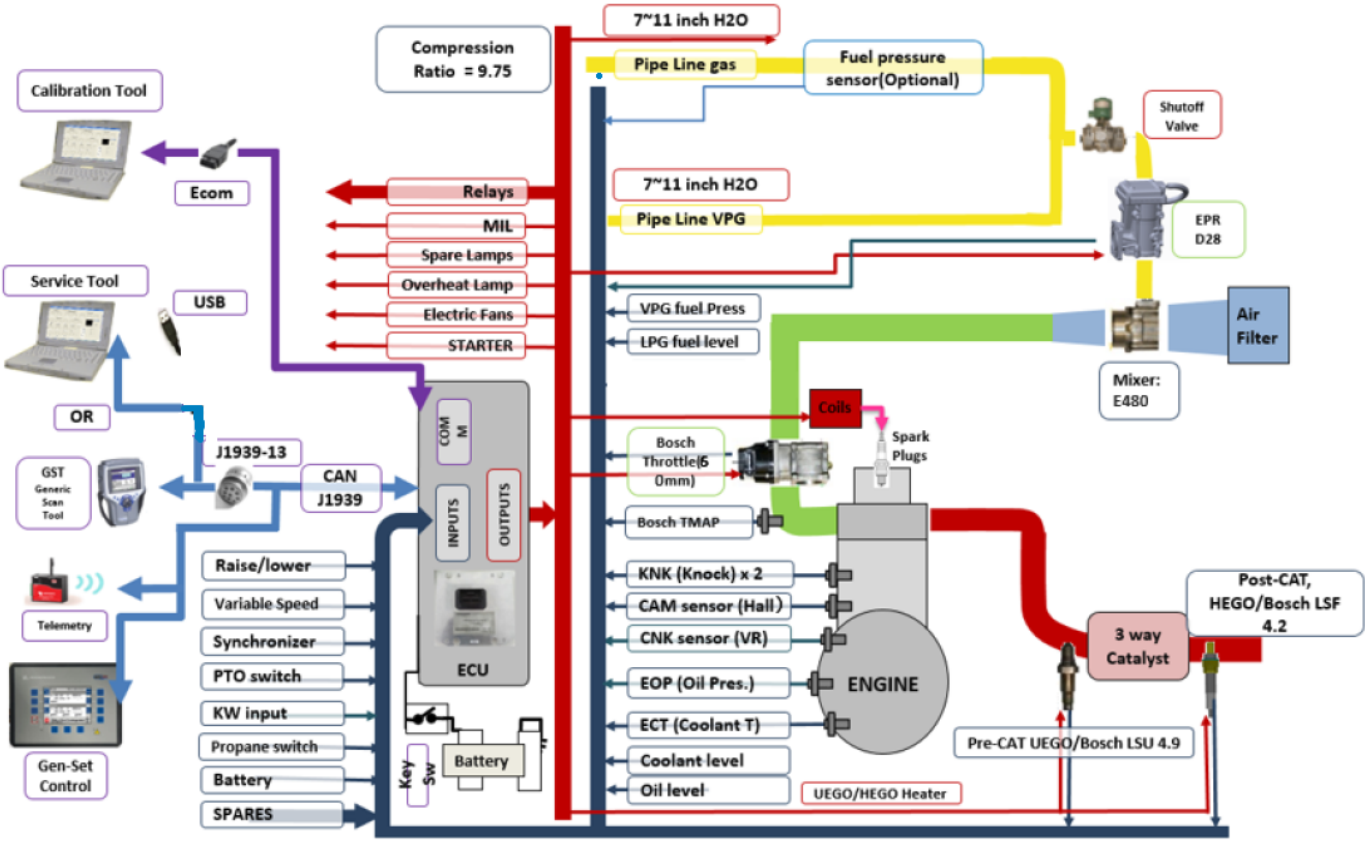


Figure 1D. 10L Schematic

4.5L-13 TURBO THEORY OF OPERATIONS - CONTINUED

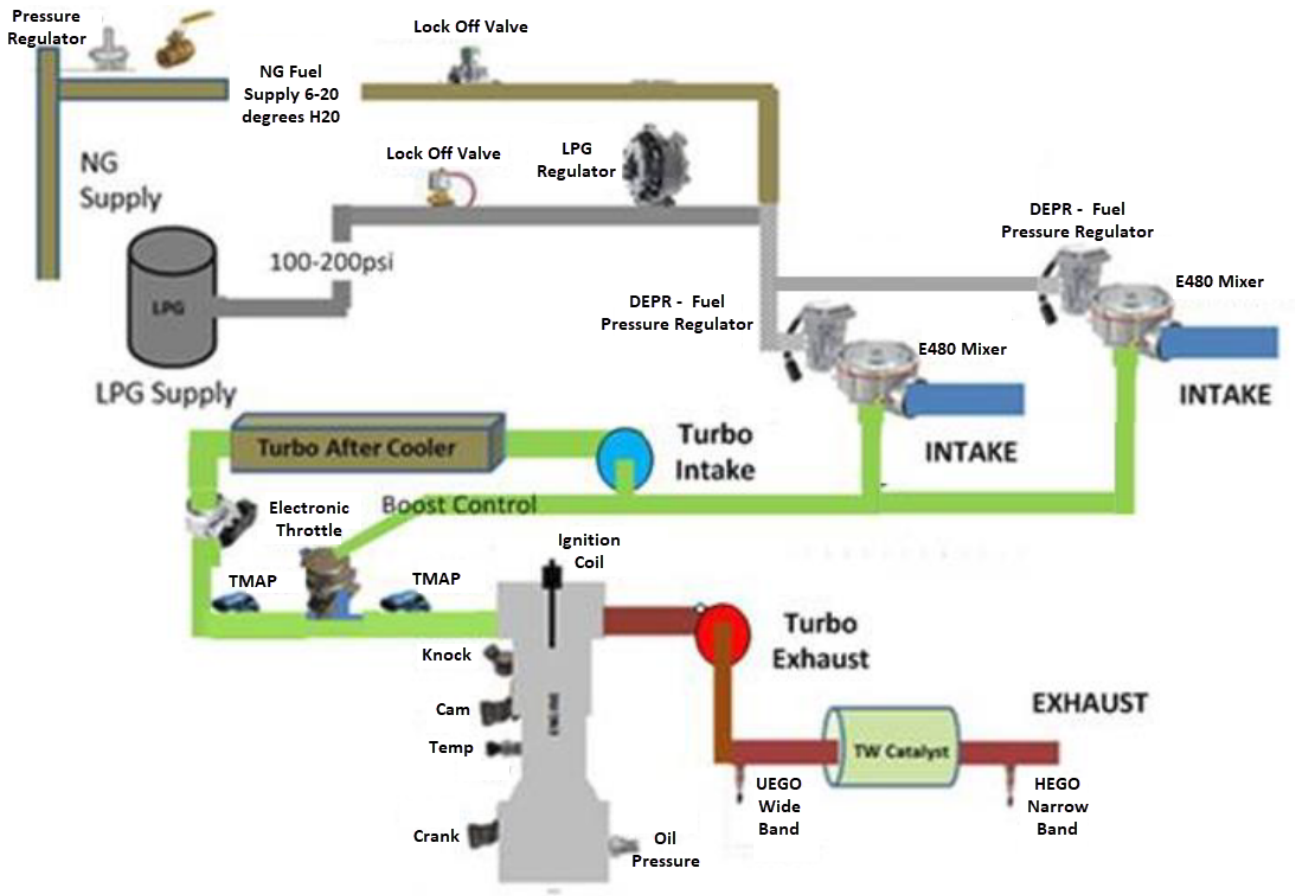


Figure 1E. 10L & 13L Turbo Schematic

4.5L-13L TURBO AIR INTAKE SYSTEM COMPONENT LOCATION INFORMATION

AIR INTAKE SYSTEM

The 4.5L-13L Turbo intake system should be sealed between the mixer inlet and the filter. Proper clamps should be used to ensure unfiltered air is not drawn into the system. Use piping with minimum diameter equal to mixer inlet. When in an enclosure it can sometimes be necessary to use an externally mounted filter. It can be beneficial to engine life and performance to draw in air from the coolest location possible. Utilize Figures 1A-1F below.

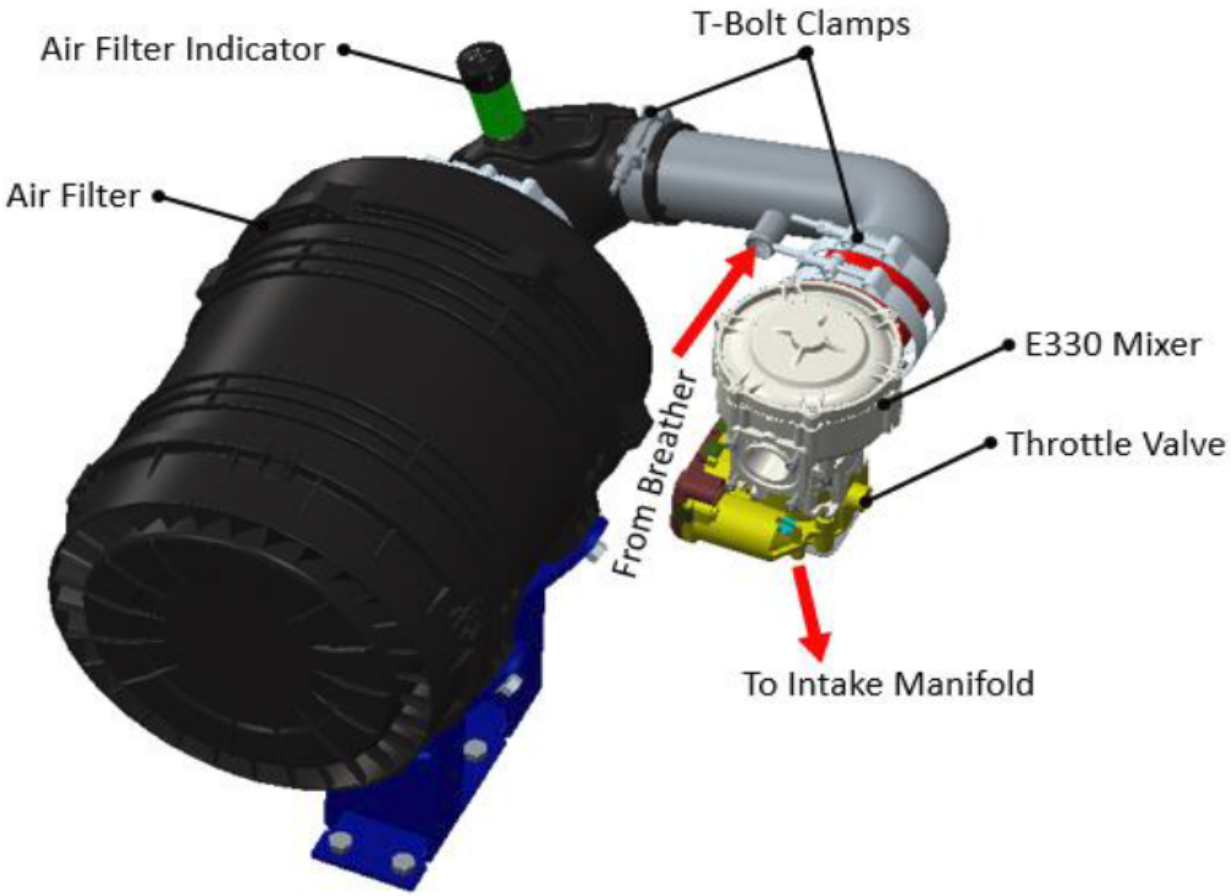


Figure 1A. 4.5L Air Intake System

4.5L-13L TURBO AIR INTAKE SYSTEM COMPONENT LOCATION INFORMATION

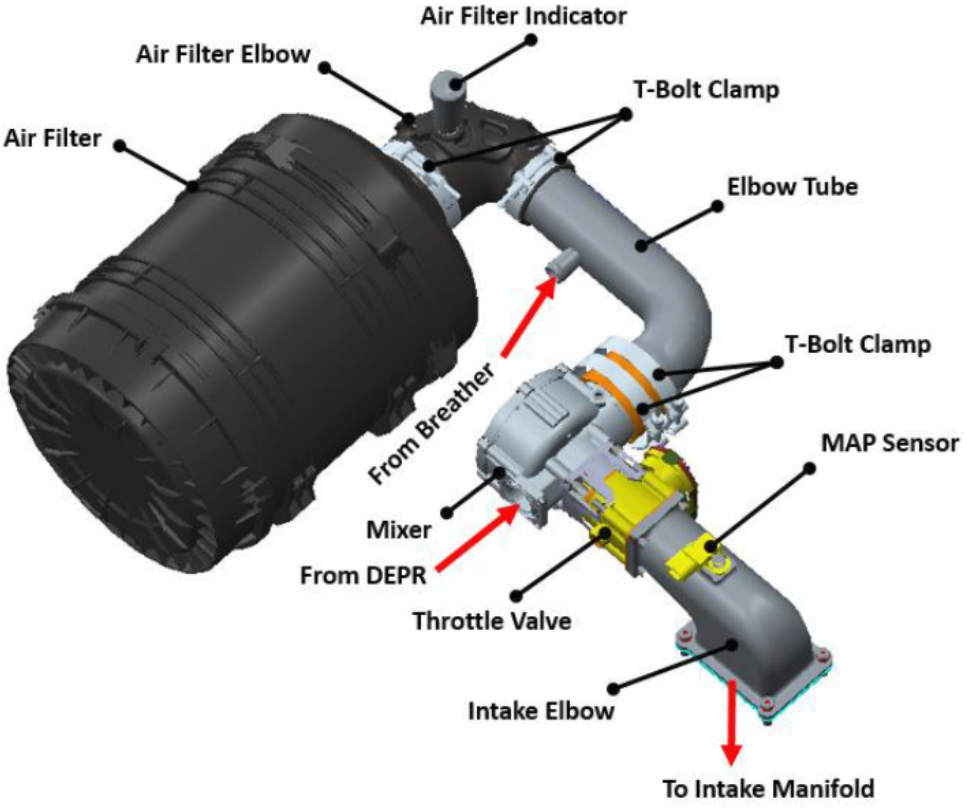


Figure 1B. 6.7L Air Intake System

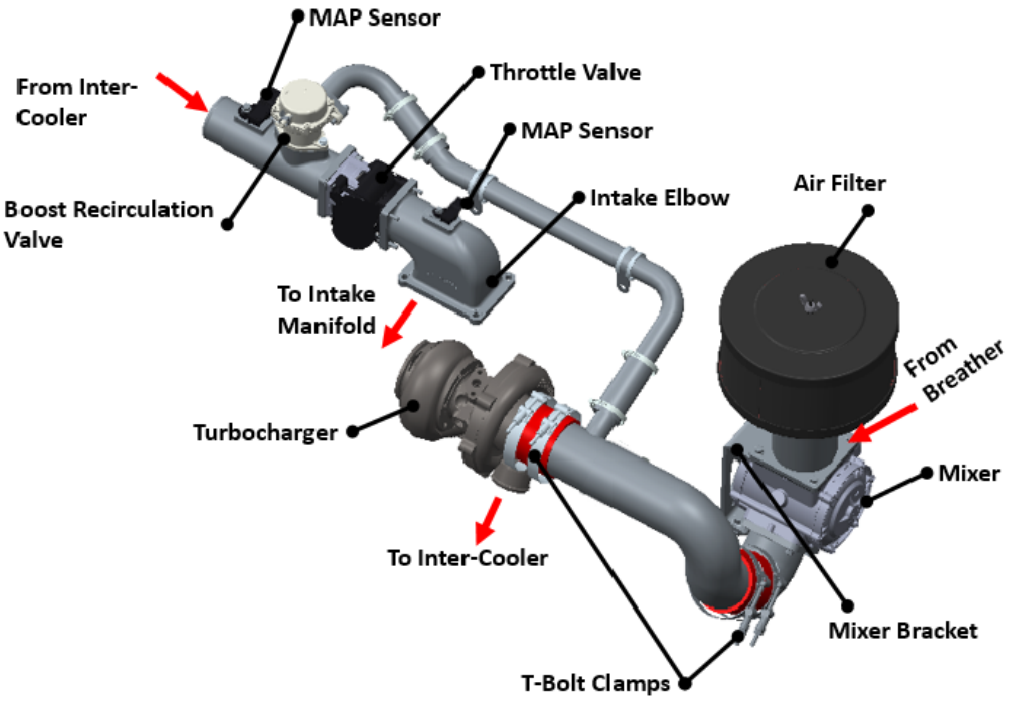


Figure 1C. 6.7L Turbo Air Intake System

4.5L-13L TURBO AIR INTAKE SYSTEM COMPONENT LOCATION INFORMATION

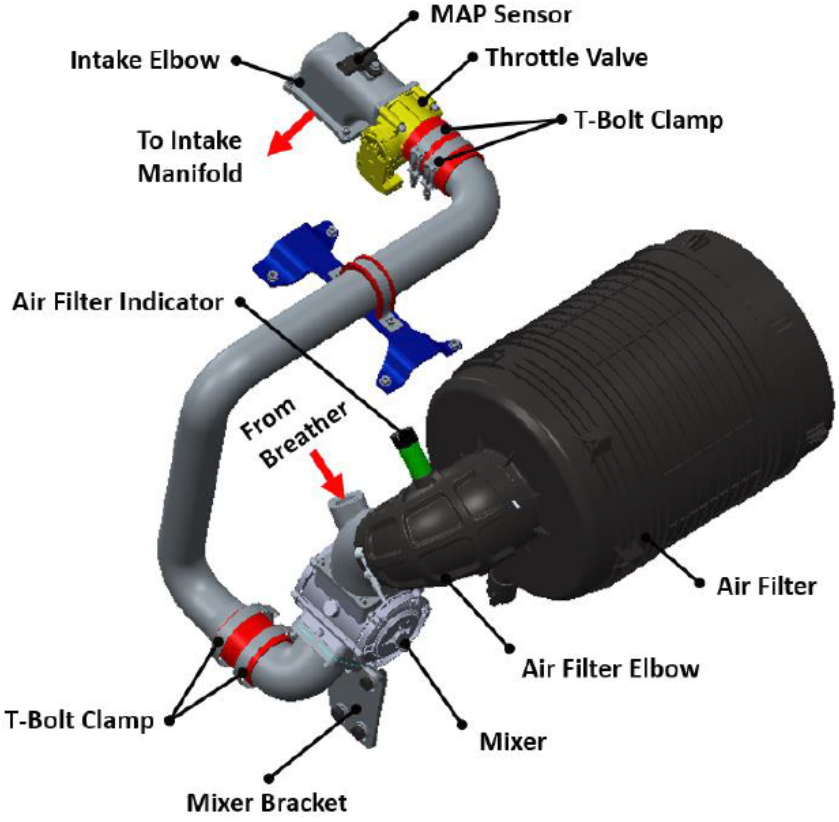


Figure 1D. 10L Air Intake System

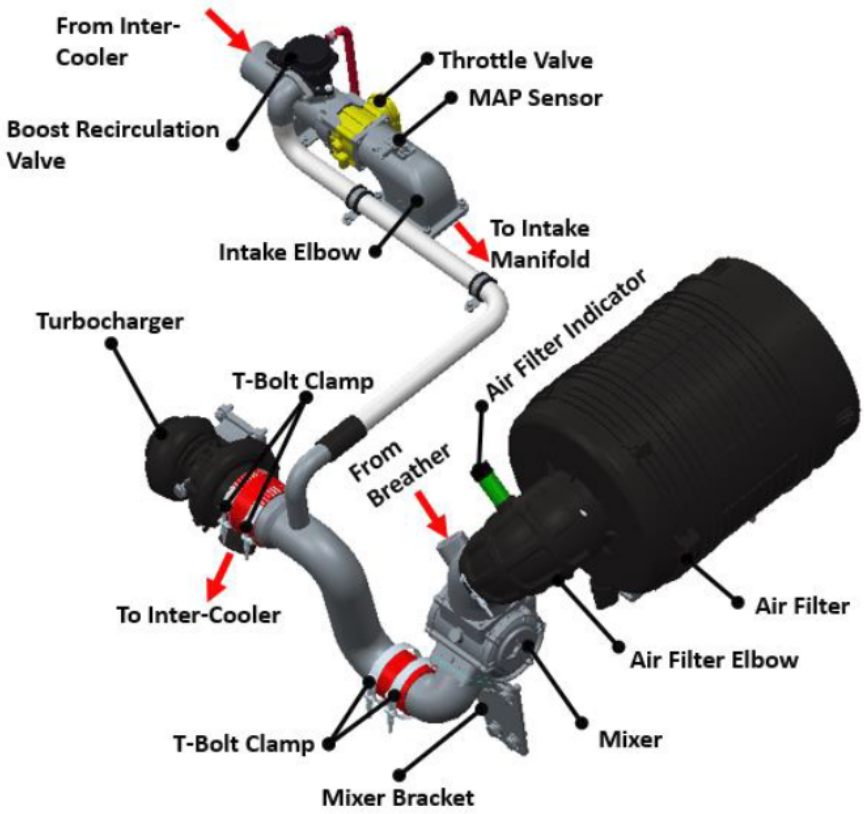


Figure 1E. 10L Turbo Air Intake System

4.5L-13L TURBO AIR INTAKE SYSTEM COMPONENT LOCATION INFORMATION

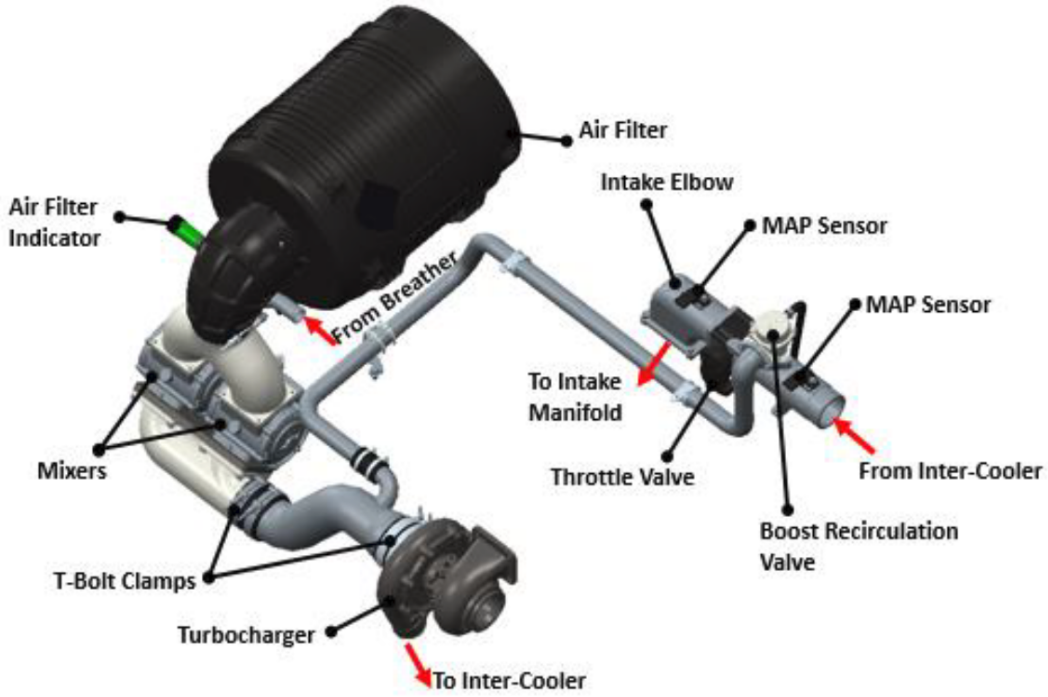


Figure 1F. 13L Turbo Air Intake System

4.5L-13L TURBO CRANK CASE VENTILATION (CCV) COMPONENT LOCATION INFORMATION

CRANK CASE VENTILATION (CCV) CANISTER

All 4.5L-13L Turbo PSI engines use a closed crank case ventilation system as shown in Figures 1A-E. The breather separates the crankcase oil/gas mixture and lets the oil return to the sump and sends the gas into the intake system.

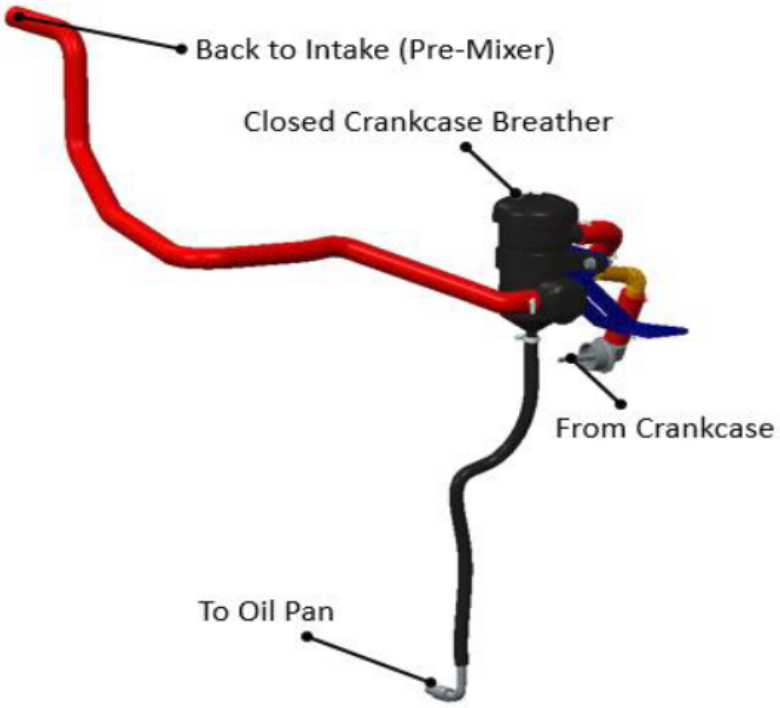


Figure 1A. 4.5L CCV System

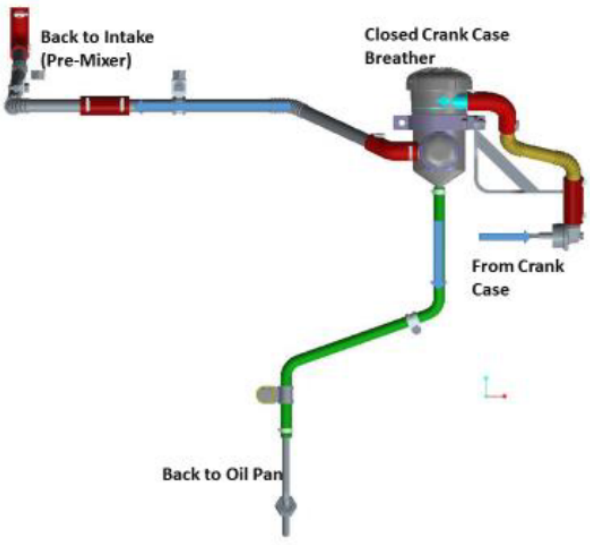


Figure 1B. 6.7L CCV System

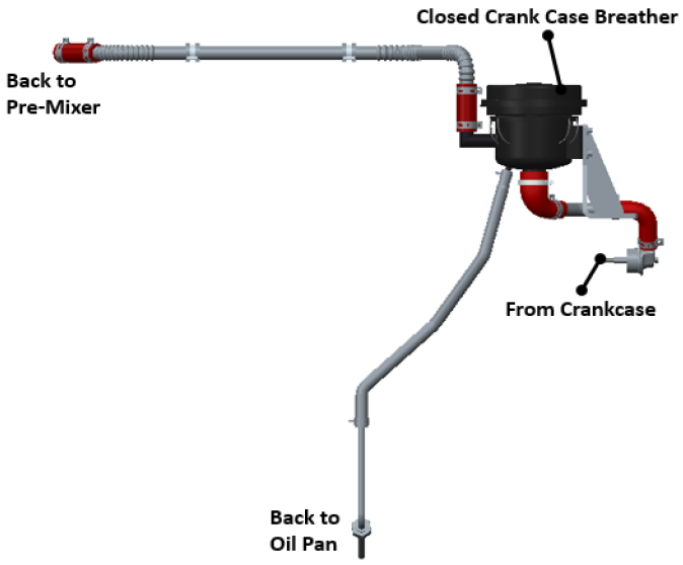


Figure 1C. 6.7L Turbo CCV System

4.5L-13L TURBO CRANK CASE VENTILATION (CCV) COMPONENT LOCATION INFORMATION

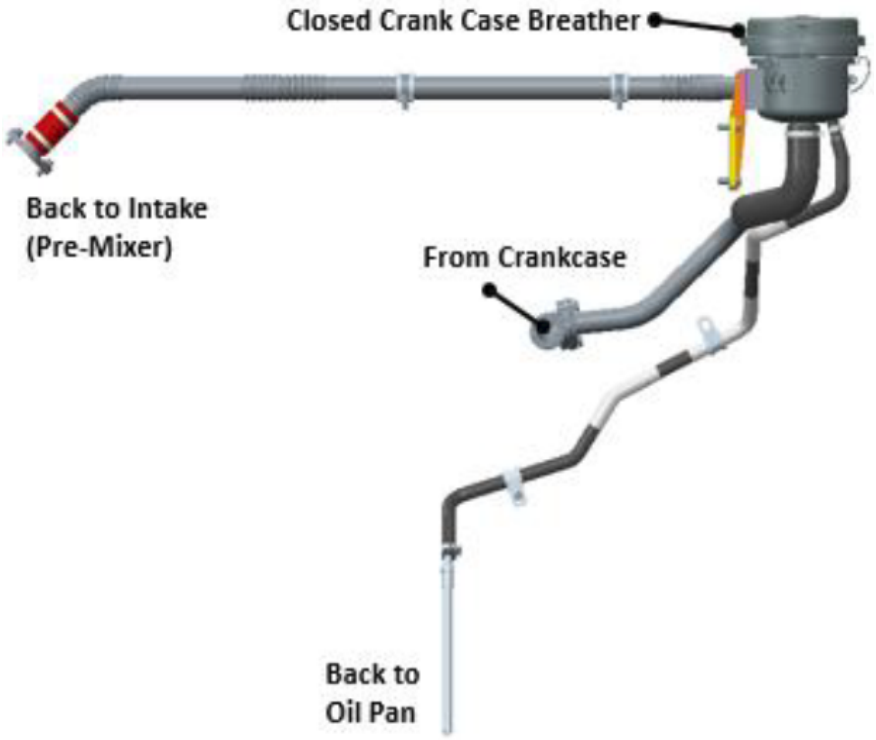


Figure 1D. 10L & 10L Turbo CCV System

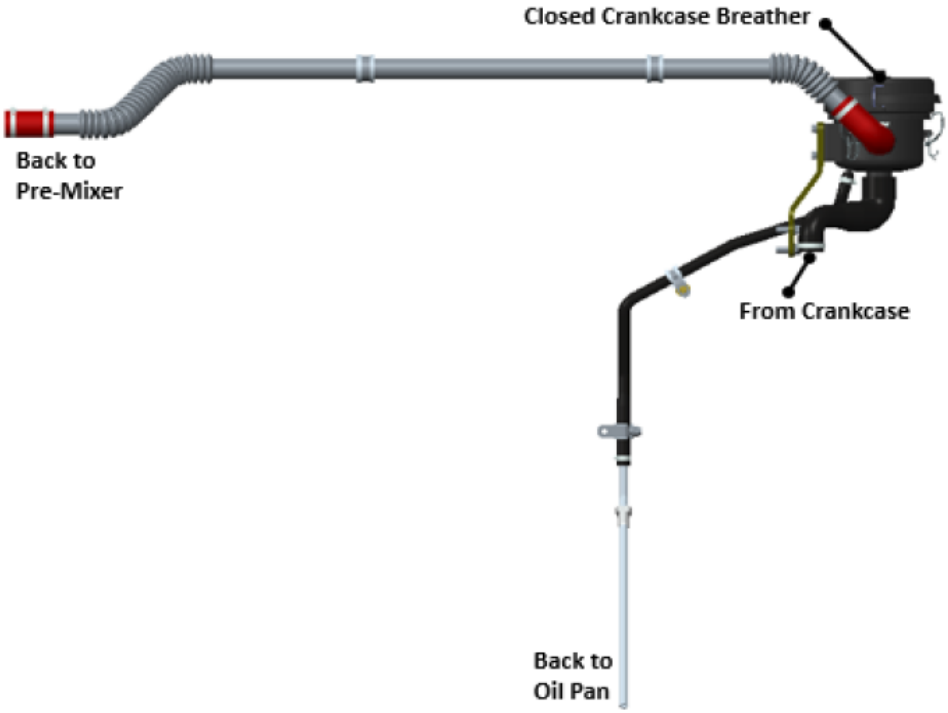


Figure 1E. 13L Turbo CCV System

4.5L-13L TURBO FUEL SYSTEM COMPONENT LOCATION INFORMATION

4.5L NG/WELLHEAD GAS FUEL SYSTEM

The fuel first passes the fuel shut off when the engine starts cranking. Then it goes through the DEPR and flows into the mixer to be mixed with the air from the air filter as shown in Figure 1A.

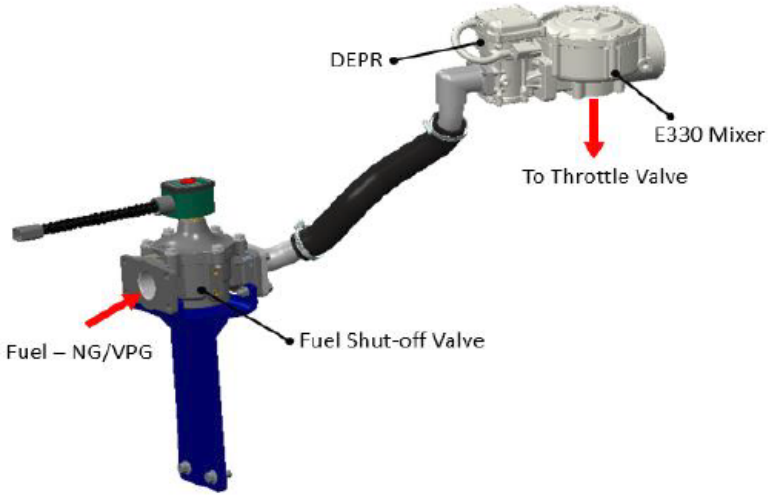


Figure 1A. 4.5L NG/Wellhead Gas Fuel System

4.5L LPG & NG BI-FUEL SYSTEM

When the engine operates with LPG, the NG shutoff valve will be closed. The LPG first enters the LPG shutoff valve and then goes into the LPG evaporator. After the LPG runs its course through the LPG evaporator, it then turns the LPG to vapor and enters the DEPR and mixes with the air in the mixer as shown in Figure 1B.

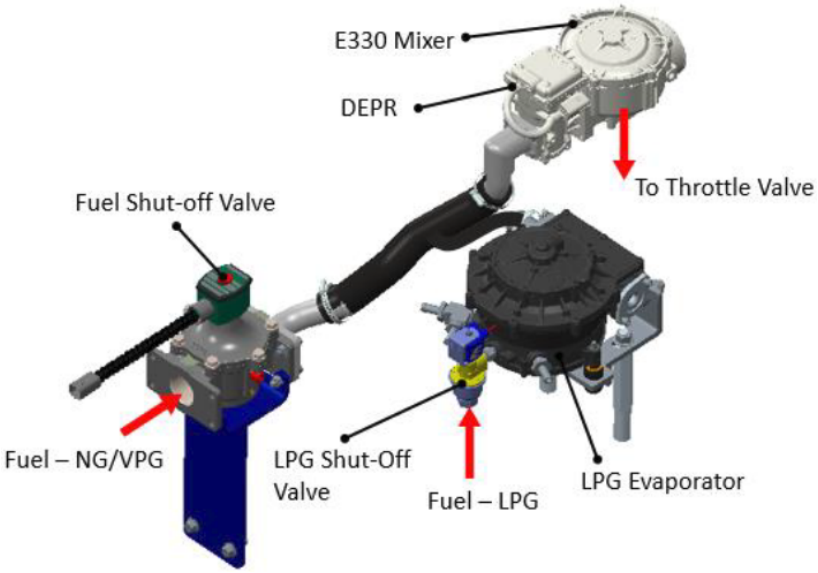


Figure 1B. 4.5L LPG & NG BI-Fuel System

4.5L SINGLE LPG FUEL SYSTEM

For single LPG fuel application, the same shut-off valve as NG is used to turn the fuel on and off. The shut-off valve needs to be connected with the secondary fuel connector from the harness as Secondary Lockoff (LPG) only.

4.5L-13L TURBO FUEL SYSTEM COMPONENT LOCATION INFORMATION

6.7L NG/WELLHEAD GAS FUEL SYSTEM

The fuel first passes the fuel shut off when the engine starts cranking. Then it goes through the DEPR and flows into the mixer to be mixed with the air from the air filter as shown in Figure 1C
PSI 6.7L are capable of running the NG or wellhead gas with energy content from 700 to 1800 BTU per cubic foot. PSI recommends fuel analysis for any gas other than pipeline quality NG, this will ensure the engine fuel and control system are calibrated to run the recommended NG fuel adequately. PSI recommends a natural gas fuel filter at the inlet. Maximum allowable H2S is 55ppm.

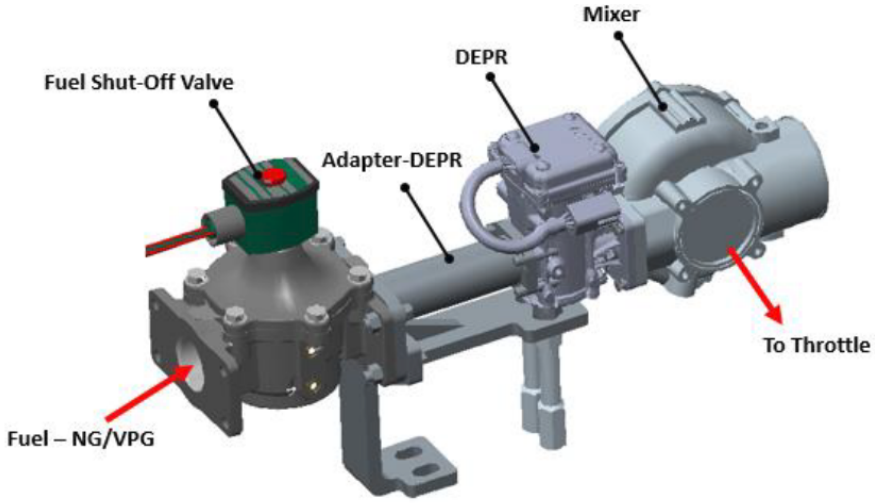


Figure 1C. 6.7L NG/Wellhead Gas Fuel System

6.7L LPG & NG BI-FUEL SYSTEM

When the engine operates with LPG, the NG shutoff valve will be closed. The LPG first enters the LPG shutoff valve and then goes into the LPG evaporator. After the LPG runs its course through the LPG evaporator, it then turns the LPG to vapor and enters the DEPR and mixes with the air in the mixer as shown in Figure 1D.

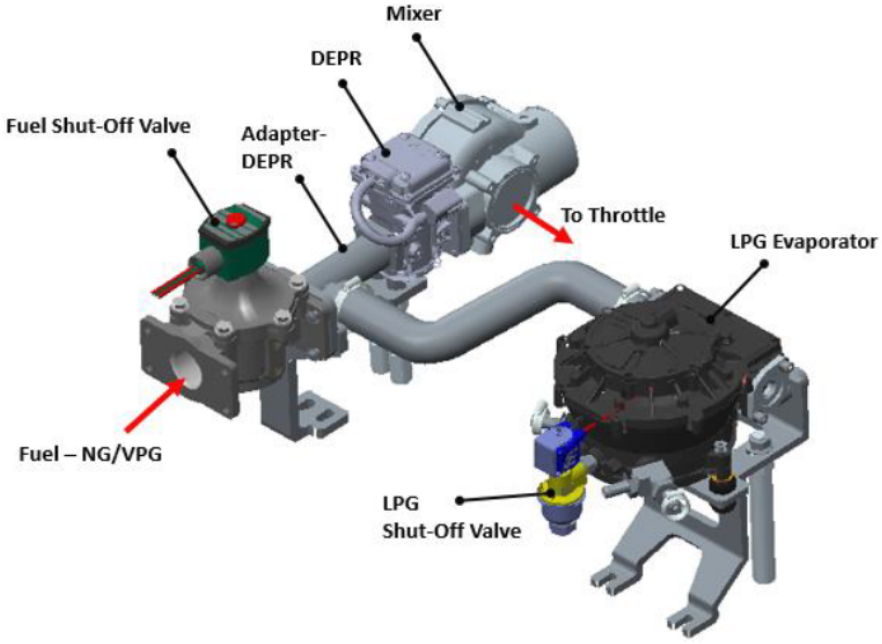


Figure 1D. 6.7L LPG & NG BI-Fuel System

6.7L SINGLE LPG FUEL SYSTEM

For single LPG fuel application, the same shut-off valve as NG is used to turn the fuel on and off. The shut-off valve needs to be connected with the secondary fuel connector from the harness as Secondary Lockoff (LPG) only (Figure 1E).

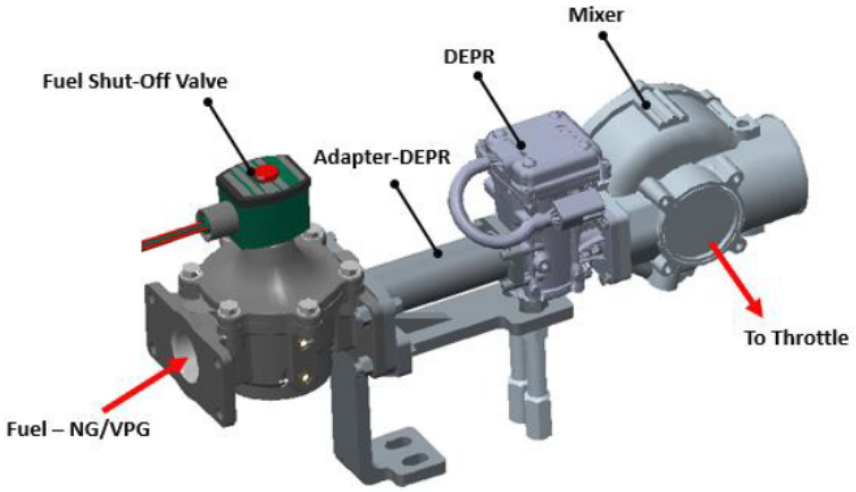


Figure 1E. 6.7L Single LPG Fuel System

6.7L TURBO NG FUEL SYSTEM

The fuel first passes the fuel shut off when the engine starts cranking. Then it goes through the DEPR and flows into the mixer to be mixed with the air from the air filter as shown in Figure 1F below.

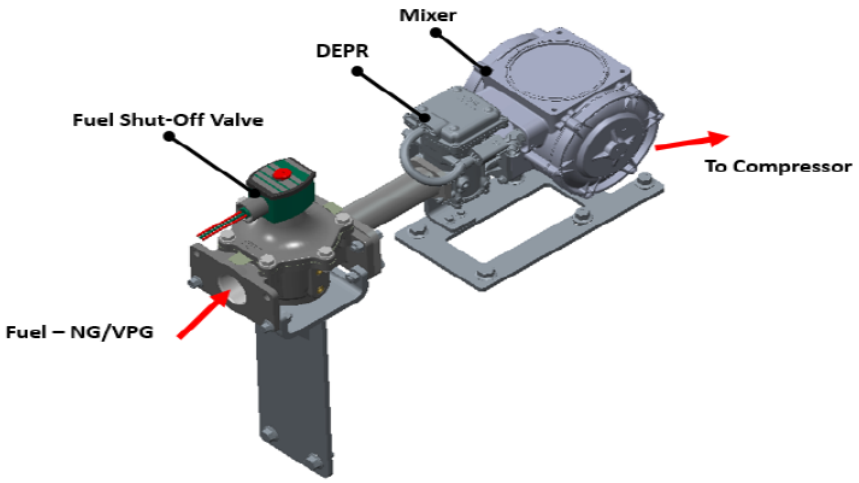


Figure 1F. 6.7L Turbo NG Fuel System

6.7L TURBO LPG & NG BI-FUEL SYSTEM

When the engine operates with LPG, the NG shutoff valve will be closed. The LPG first enters the LPG shutoff valve and then goes into the LPG evaporator. After the LPG runs its course through the LPG evaporator, it then turns the LPG to vapor and enters the DEPR and mixes with the air in the mixer as shown in Figure 1G.

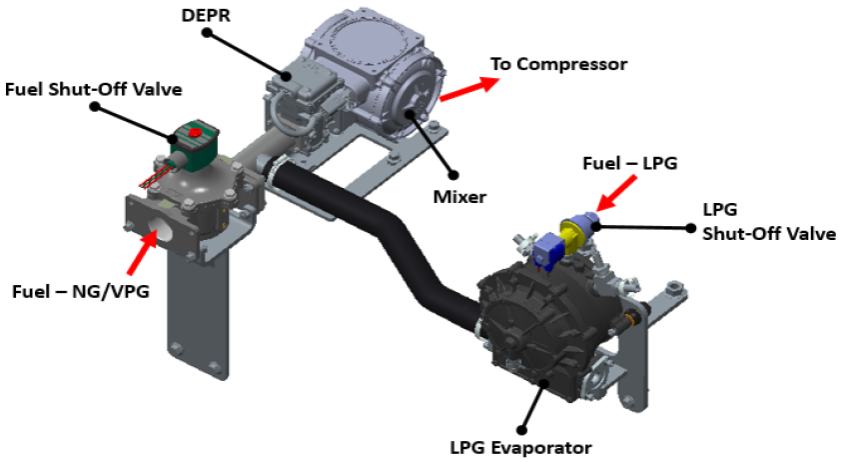


Figure 1G. 6.7L Turbo LPG & NG BI-Fuel System

6.7L TURBO SINGLE LPG FUEL SYSTEM

For single LPG fuel application, the same shut-off valve as NG is used to turn the fuel on and off. The shut-off valve needs to be connected with the secondary fuel connector from the harness as Secondary Lockoff (LPG) only (Figure 1H).

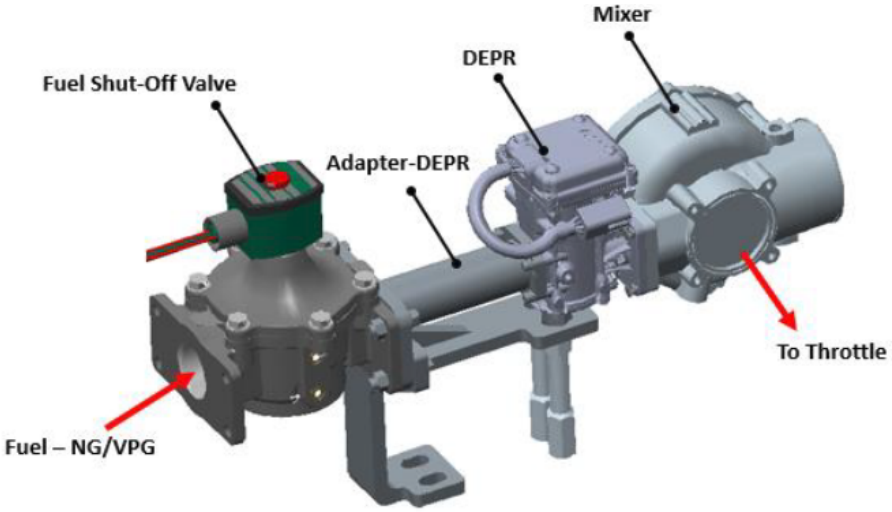


Figure 1H. 6.7L Turbo Single LPG Fuel System

4.5L-13L TURBO FUEL SYSTEM COMPONENT LOCATION INFORMATION

10L & 10L TURBO NG FUEL SYSTEM

The fuel first passes the fuel shut off when the engine starts cranking. Then it goes through the DEPR and flows into the mixer to be mixed with the air from the air filter as shown in Figure 1I below.

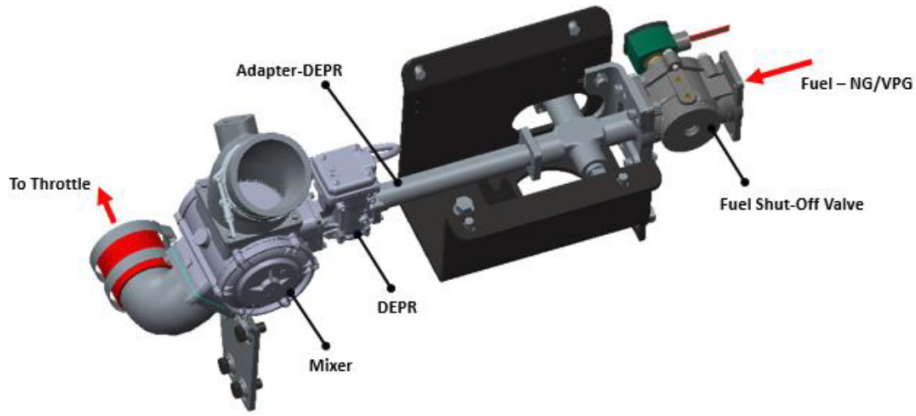


Figure 1I. 10L & 10L Turbo NG Fuel System

10L & 10L TURBO LPG & NG BI-FUEL SYSTEM

When the engine operates with LPG, the NG shutoff valve will be closed. The LPG first enters the LPG shutoff valve and then goes into the LPG evaporator. After the LPG runs its course through the LPG evaporator, it then turns the LPG to vapor and enters the DEPR and mixes with the air in the mixer as shown in Figure 1J.

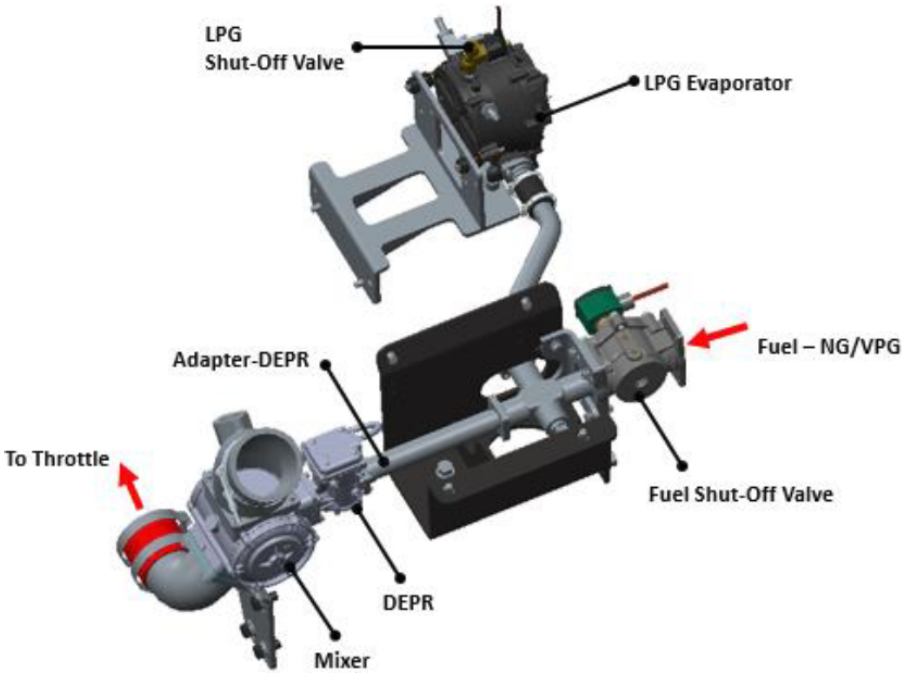


Figure 1J. 10L & 10L Turbo LPG & NG Fuel System

4.5L-13L TURBO FUEL SYSTEM COMPONENT LOCATION INFORMATION

10L & 10L TURBO SINGLE LPG FUEL SYSTEM

For single LPG fuel application, the same shut-off valve as NG is used to turn the fuel on and off. The shut-off valve needs to be connected with the secondary fuel connector from the harness as Secondary Lockoff (LPG) only.

13L TURBO NG FUEL SYSTEM

The fuel first passes the fuel shut off when the engine starts cranking. Then it goes through the DEPR and flows into the mixer to be mixed with the air from the air filter as shown in Figure 1K below.

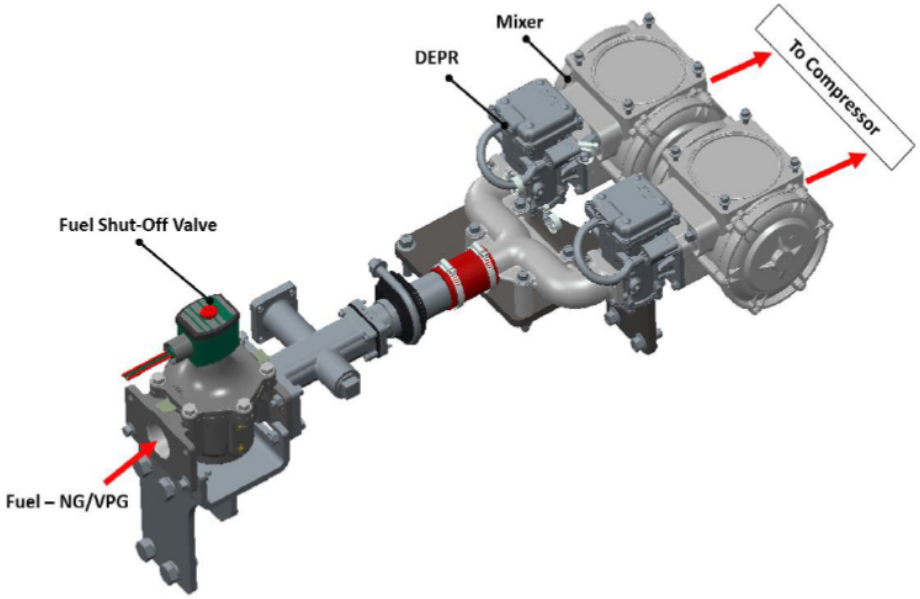


Figure 1K. 13L Turbo NG Fuel System

4.5L-13L TURBO FUEL SYSTEM COMPONENT LOCATION INFORMATION

13L TURBO LPG & NG BI-FUEL SYSTEM

When the engine operates with LPG, the NG shutoff valve will be closed. The LPG first enters the LPG shutoff valve and then goes into the LPG evaporator. After the LPG runs its course through the LPG evaporator, it then turns the LPG to vapor and enters the DEPR and mixes with the air in the mixer as shown in Figure 1L.

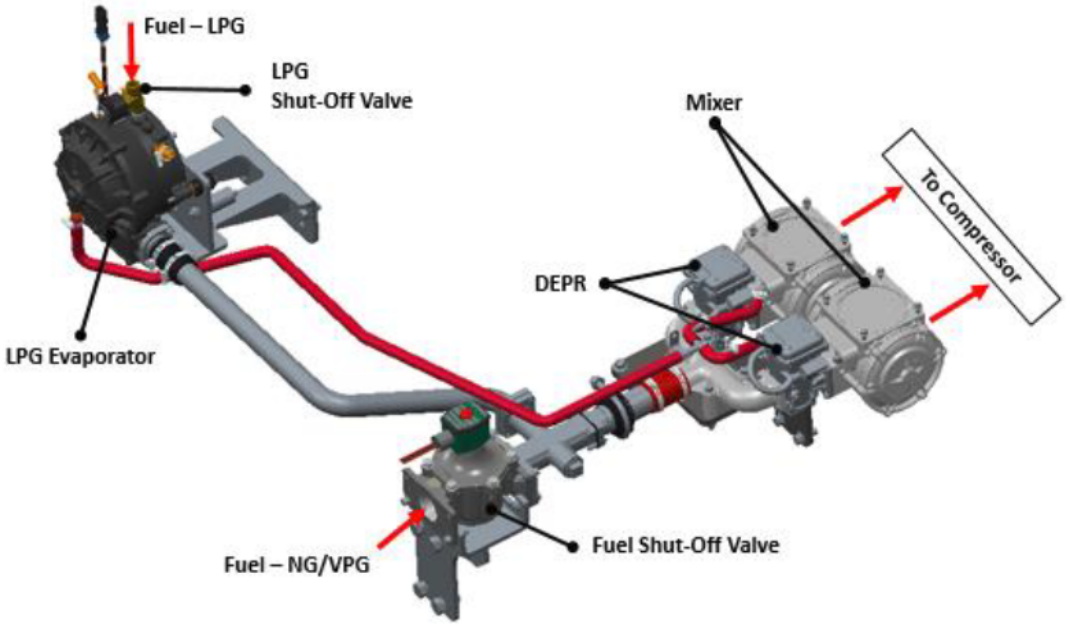


Figure 1L. 13L Turbo LPG & NG Bi-Fuel System

13L TURBO SINGLE LPG FUEL SYSTEM

For single LPG fuel application, the same shut-off valve as NG is used to turn the fuel on and off. The shut-off valve needs to be connected with the secondary fuel connector from the harness as Secondary Lockoff (LPG) only.

4.5L-13L TURBO FUEL SYSTEM COMPONENT LOCATION INFORMATION

4.5L-13L TURBO DIRECT ELETRONIC PRESSURE REGULATOR (DEPR)

The fuel system installed on your engine operates with a Direct Electronic Pressure Regulator (DEPR) and a diaphragm style variable Venturi mixer. The DEPRs regulate the fuel pressure being delivered to the mixers. These parts are not adjustable and should not be tampered with. The DEPR is a single-stage microprocessor based electromechanical fuel pressure regulator that incorporates a high speed actuator. It communicates with the Engine Control Module (ECM) over a Controller Area Network (CAN) link, receiving fuel pressure commands and broadcasting DEPR operating parameters back to the ECM. The DEPR can regulate fuel pressure between +/- 17 inches of water column above the Mixer air inlet pressure, providing sufficient control authority to stall an engine either rich or lean. When the DEPR receives an output pressure command from the ECM, the valve is internally driven to attain targeted fuel pressure, the DEPR then closes the loop internally using a built in fuel pressure sensor to maintain target fuel pressure/fuel flow rate, until another external command from the ECM is received.

Figure 1A. Direct Electronic Pressure Regulator Assembly

4.5L-13L TURBO FUEL SYSTEM COMPONENT LOCATION INFORMATION

4.5L-13L TURBO E330 & E480 MIXER

The PSI 4.5L & 6.7L utilize a variable venturi mixer (E330 shown in Figure 1B) when the DEPR is applied to an engine. The basic principle of the product is to introduce air and fuel into engine. It also aids in introducing turbulence into the air and fuel assisting in its homogeneity. The mixer also acts to increase or decrease the fuel entering the engine proportional to the amount of air flowing in the engine on a volumetric basis.

Figure 1B. E330 Mixer Assembly

The PSI 6.7L Turbo, 10L, 10L Turbo and 13L Turbo utilize a E480 relatively constant pressure drop mixer that is used to draw fuel when coupled with EPR. The basic principle of the product is to introduce air and fuel into engine. It also aids in introducing turbulence into the air and fuel assisting in making it a homogeneous mixture. The mixer also acts to increase or decrease the fuel entering the engine proportional to the amount of air flowing in the engine on a volumetric basis (Figure 1C).

Figure 1C. E480 Mixer Assembly

4.5L-13L TURBO FUEL SYSTEM COMPONENT LOCATION INFORMATION

4.5L-13L TURBO HEAVY-DUTY STAGE REGULATOR (HD-DSR)

All PSI 4.5L-13L Turbo engines are equipped with a heavy-duty dual stage regulator, which vaporizes liquid propane to gaseous form and also regulates the fuel pressure to meet the fuel pressure requirement. The HD-DSR is a two stage fully mechanical regulator that is available in LPG configurations. The HD-DSR is normally open with a positive outlet pressure and must be used with fuel lock-off upstream to prevent fuel flow when the engine is not cranking or running. The HD-DSR is connected to the DEPR, by a low pressure flexible hose. It also has a reference port that is connected to the fuel / air mixer for turbo-charged applications.

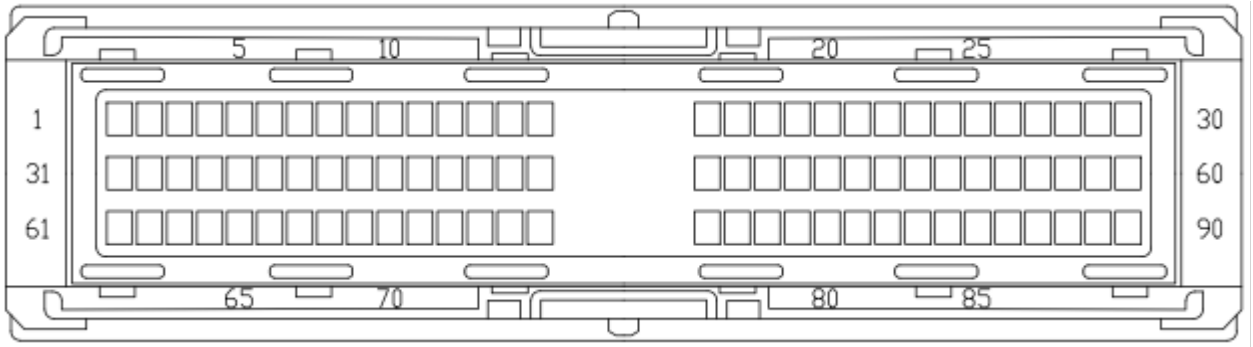
Figure 1D. Heavy-Duty Stage Regulator (HD-DSR)

6.7L, 10L & 13L TURBO BOOST RECIRCULATION VALVE (BRV)

All PSI 6.7L, 10L and 13L Turbo engines come equipped with a Boost Recirculation Valve (BRV), which is a piston-actuated high flow pressure recirculation valve system. It is designed to reduce or eliminate intake system pressure spikes between the throttle plate and the turbocharger, which in turn minimizes wear and fatigue on turbocharger components. This is a normally-closed valve which is actuated by differences in throttle inlet pressure (TIP), compressor inlet pressure (CIP) and manifold absolute pressure (MAP). The MAP connection is the reference pressure used to actuate the BRV.

Figure 1E. Boost Recirculation Valve (BRV) Assembly

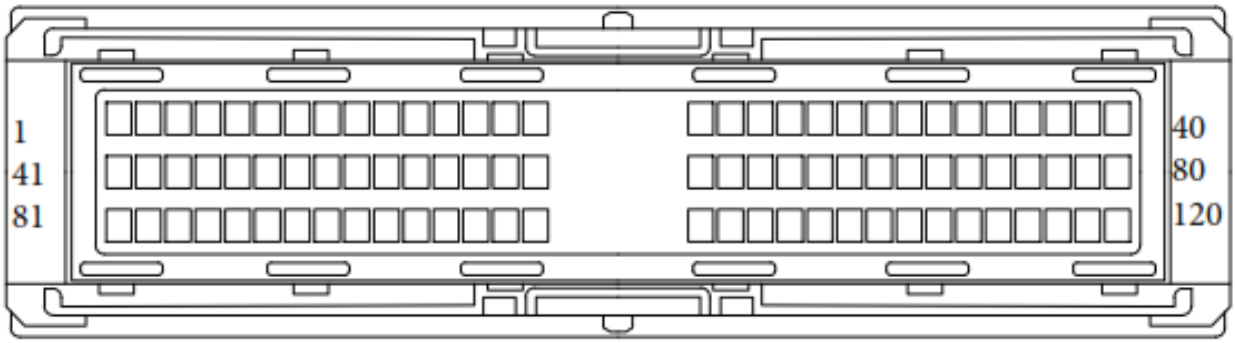
90 PIN ECU LAYOUT



SPK_COIL1A	1	YELLOW/BLACK 18	
SPK_COIL1B	2	YELLOW/RED 18	
SPK_COIL2A	3	YELLOW/WHITE 18	
SPK_GND	4	BLACK 16	
SPK_COIL2B	5	TAN/WHITE 18	
SPK_COIL3A	6	TAN/YELLOW 18	
SPK_COIL3B	7	TAN/DK BLUE 18	
UEGOP/EGO3	8	ORANGE/WHITE 18	
UEGOR	9	DK GREEN 18	
SPK_COIL4a	10		
SPK_COIL4b	11		
AUX ANA PD1	12	WHITE/LT GREEN 18	
AUX ANA PD2	13		
CAN1+	14	BLUE/PINK 18	
CAN1−	15	BLUE/WHITE 18	
CAN2−	16		
CAN2+	17		
AUX ANA PD3	18		
5V EXT1	19	LT GREEN/RED 18	
5V RTN1	20	BLK/LT GREEN 18	
UEGOS/EGO1	21	DK BLUE 18	
EGO2	22	DK GREEN/WHITE 18	
MAP	23	LT GREEN 18	
AUX ANA PUD3	24	DK BLUE/ORANGE 18	
CRANK +	25	PURPLE/WHITE 18	
CRANK −	26	WHITE/PURPLE 18	
CAM +	27	GRAY/BROWN 18	
CAM −	28	PURPLE/ORANGE 18	
SPEED +	29		
SPEED −	30		
5V EXT2	31		
5V RTN2	32		
PULSE IN	33		
GOV1	34	GRAY/DK BLUE 18	
OIL PRESS	35	LT GREEN/BLACK 18	
IAT	36	TAN 18	
ECT	37	TAN/DK GREEN 18	
AUX ANA PU1	38	LT GREEN/WHITE 18	
AUX ANA PU2	39	LT BLUE/BLACK 18	
AUX ANA PU3	40	DK BLUE/RED 18	
AUX DIG3	41		
AUX DIG4	42		
TACH	43		
VSW	44	PINK/TAN 18	
AUX ANA PUD2	45	DK BLUE/RED 18	

AUX ANA PUD1	46	DK BLUE/YELLOW 18
TPS1	47	PURPLE/LT BLUE 18
TPS2	48	LT BLUE/DK BLUE 18
AUX DIG1	49	TAN/BROWN 18
AUX DIG2	50	LT BLUE 18
KNOCK1+	51	BLACK/YELLOW 18
KNOCK1−	52	BLACK 18
FPP1	53	DK BLUE/ORANGE 18
FPP2−IVS	54	
VRELAY	55	PINK/DK GREEN 16
UNUSED	56	
KNOCK2+	57	BLACK/WHITE 18
KNOCK2−	58	BLACK 18
VBAT	59	RED/TAN 16
VBAT	60	RED/TAN 16
EGOH2	61	ORANGE/BLACK 18
UEGOH/EGOH1	62	YELLOW/RED 18
UEGOC	63	WHITE 18
INJ1 LS	64	
INJ2 LS	65	
INJ3 LS	66	
INJ4 LS	67	
INJ5 LS	68	
GROUND	69	BLACK 16
INJ6 LS	70	
INJ8/AUX PWM8	71	
STARTER	72	GRAY/ORANGE 18
RELAY	73	WHITE/ LT BLUE
MIL	74	GREEN/YELLOW 18
UEGOH_3	75	
INJ7/AUX PWM7	76	
LOCKOFF	77	WHITE/BLACK 18
AUX PWM6	78	LT BLUE/WHITE 18
VBAT	79	RED/TAN 16
DBW+	80	PINK/WHITE 18
GROUND	81	BLACK 16
DBW−	82	TAN/ORANGE 18
AUX PWM5 REC	83	PINK/DK GREEN 16
AUX PWM5	84	
AUX PWM1	85	
AUX PWM4	86	
AUX PWM2	87	
AUX PWM4 REC	88	
AUX PWM3 REC	89	
AUX PWM3	90	

120 PIN ECU LAYOUT



SPK_COIL1a	1	YELLOW/BLACK 18
SPK_COIL1b	2	YELLOW/RED 18
AUX_DIG17	3	
AUX_ana_PUD1	4	DK BLUE/YELLOW 18
AUX_ana_PUD2	5	DK BLUE/RED 18
AUX_ana_PUD3/DIG23	6	DK BLUE/ORANGE 18
AUX_ana_PUD4/DIG24	7	
AUX_ana_PUD5/DIG25	8	
AUX_ana_PUD6	9	
AUX_ana_PUD7	10	
AUX_ana_PD2	11	
Speed1_P	12	
Speed1_N	13	
CAN1+	14	BLUE/PINK 18
CAN1−	15	BLUE/WHITE 18
CAN2−	16	
CAN2+	17	
AUX_ana_PD3	18	
5V_ext1	19	LT GREEN/RED 18
5V_rtn1	20	BLK/LT GREEN 18
CRK_POS	21	PURPLE/WHITE 18
CRK_NEG	22	WHITE/PURPLE 18
CAM_POS	23	GRAY/BROWN 18
CAM_NEG	24	PURPLE/ORANGE 18
KNK3+	25	
KNK3−	26	
KNK1+	27	BLACK/YELLOW 18
KNK1−	28	BLACK 18
KNK2+	29	BLACK/WHITE 18
KNK2−	30	BLACK 18
SPK_COIL2a	31	YELLOW/WHITE 18
AUX_DIG18	32	
AUX_PWM5+Recirc	33	
AUX_ana_PUD10	34	
PULSE_IN	35	
RELAY	36	WHITE/ LT BLUE
IAT	37	TAN 18
ECT	38	TAN/DK GREEN 18
TPS1	39	PURPLE/LT BLUE 18
TPS2	40	LT BLUE/DK BLUE 18
MAP	41	LT GREEN 18
FPP1	42	DK BLUE/ORANGE 18
FPP2−IVS	43	
OILP	44	LT GREEN/BLACK 18
Vswitch	45	PINK/TAN 18
EGO_1/UEGO_S	46	DK BLUE 18
EGO_2	47	DK GREEN/WHITE 18
DIG21	48	
DIG22	49	
UEGO1_P	50	ORANGE/WHITE 18
UEGO1_C	51	WHITE 18
UEGO1_R	52	DK GREEN 18
AUX_DIG13	53	
Speed2	54	
AUX_DIG14	55	
AUX_ana_PUD8	56	
AUX_ana_PUD9	57	
Vbat	58	RED/TAN 16
AUX_DIG10	59	
Vrelay	60	PINK/DK GREEN 16

SPK_COIL2b	61	TAN/WHITE 18
SPK_COIL3a	62	TAN/YELLOW 18
EGOH_1/UEGO_H	63	YELLOW/RED 18
EGOH_2	64	ORANGE/BLACK 18
AUX_DIG11	65	
AUX_DIG12	66	
BUZZ	67	
MIL	68	GREEN/YELLOW 18
AUX_ana_PU1	69	LT GREEN/WHITE 18
AUX_ana_PU2	70	LT BLUE/BLACK 18
AUX_ana_PU3	71	DK BLUE/RED 18
GOV1	72	GRAY/DK BLUE 18
GOV2	73	
AUX_DIG6	74	
AUX_DIG7	75	
5V_ext2	76	
5V_rtn2	77	
CAN3+	78	
CAN3−	79	
AUX_DIG8	80	
AUX_DIG9	81	
AUX_ana_PD1	82	WHITE/LT GREEN 18
AUX_DIG1	83	TAN/BROWN 18
AUX_DIG2	84	LT BLUE 18
AUX_DIG3	85	
AUX_DIG4	86	
AUX_DIG5	87	
AUX_PWM1+Recirc	88	
TACH	89	
Vrelay	90	PINK/DK GREEN 16
SPK_COIL3b	91	TAN/DK BLUE 18
GROUND (SPK_GND)	92	BLACK 16
AUX_PWM10	93	
AUX_PWM11	94	
INJ1_LS	95	
INJ2_LS	96	
INJ3_LS	97	
INJ4_LS	98	
INJ5_LS	99	
INJ6_LS	100	
Vrelay	101	PINK/DK GREEN 16
Vrelay	102	PINK/DK GREEN 16
AUX_DIG15	103	
AUX_DIG16	104	
LOCKOFF2	105	
LOCKOFF	106	WHITE/BLACK 18
AUX_PWM4+Recirc/GD	107	
Ground	108	BLACK 16
AUX_PWM6+Recirc	109	LT BLUE/WHITE 18
AUX_PWM7	110	GRAY/ORANGE 18
AUX_PWM8+Recirc	111	
AUX_PWM9+Recirc	112	
HBB+	113	
HBB−	114	
Ground	115	BLACK 16
DBW−	116	TAN/ORANGE 18
DBW+	117	PINK/WHITE 18
HBA+	118	
HBA−	119	
Ground	120	BLACK 16

DIAGNOSTIC TROUBLE CODE FAULT DESCRIPTIONS

DTC to SPN/FMI Cross Reference

DTC	Fault Description	SPN	FMI
6	Lockoff open / ground short	632	4
7	Lockoff short to power	632	3
11	Intake cam / distributor position	520800	7
16	Never crank synced at start	636	8
24	Exhaust cam position	520801	7
107	MAP low voltage	106	4
108	MAP high pressure	106	16
116	ECT higher than expected 1	110	15
117	ECT / CHT low voltage	110	4
118	ECT / CHT high voltage	110	3
217	ECT higher than expected 2	110	0
219	Max govern speed override	515	15
234	Control overboost	102	0
236	TIP/TOP active	102	2
237	TIP/TOP low voltage	102	4
238	TIP/TOP high voltage	102	3
299	Control underboost	102	1
301	Emissions/catalyst damaging misfire (Cylinder 1)	1323	31
302	Emissions/catalyst damaging misfire (Cylinder 2)	1324	31
303	Emissions/catalyst damaging misfire (Cylinder 3)	1325	31
304	Emissions/catalyst damaging misfire (Cylinder 4)	1326	31
305	Emissions/catalyst damaging misfire (Cylinder 5)	1327	31
306	Emissions/catalyst damaging misfire (Cylinder 6)	1328	31
326	Knock1 excessive signal	731	2
327	Knock1 sensor open	731	4
331	Knock2 excessive signal	520197	2
332	Knock2 sensor open	520197	4
336	Crank sync noise	636	2
337	Crank loss	636	4
341	Cam sync noise	723	2
342	Cam loss	723	4
350	External Spark Module Failure	1268	31
351	External Spark Module Coil Failure (Cylinder 1)	1268	31
352	External Spark Module Coil Failure (Cylinder 2)	1269	31
353	External Spark Module Coil Failure (Cylinder 3)	1270	31
354	External Spark Module Coil Failure (Cylinder 4)	1271	31
355	External Spark Module Coil Failure (Cylinder 5)	1272	31
356	External Spark Module Coil Failure (Cylinder 6)	1273	31

520	Oil pressure low stage 1 (sender)	100	18
521	Oil pressure high (sender)	100	0
522	Oil pressure sender low voltage	100	4
523	Oil pressure sender high voltage	100	3
524	Oil pressure low (switch)	100	1
524	Oil pressure low stage 2 (sender)	100	1
562	Voltage low	168	17
563	Voltage high	168	15
601	Flash checksum invalid	628	13
604	RAM failure	630	12
606	COP failure	629	31
615	Start relay coil open	1321	5
616	Start relay control ground short	1321	4
617	Start relay coil short to power	1321	3
642	5VE1 low voltage	1079	4
643	5VE1 high voltage	1079	3
650	MIL open	1213	5
652	5VE2 low voltage	1080	4
653	5VE2 high voltage	1080	3
670	Glow Plug Control Unit Failure	676	11
671	Glow Plug Short to Ground (Cylinder 1)	2899	4
672	Glow Plug Short to Ground (Cylinder 2)	2899	4
673	Glow Plug Short to Ground (Cylinder 3)	2899	4
674	Glow Plug Short to Ground (Cylinder 4)	2899	4
675	Glow Plug Short to Ground (Cylinder 5)	2899	4
676	Glow Plug Short to Ground (Cylinder 6)	2899	4
685	Relay coil open	1485	5
686	Relay control ground short	1485	4
687	Relay coil short to power	1485	3
698	5VE3 low voltage	3511	4
699	5VE3 high voltage	3511	3
916	Shift actuator feedback out-of-range	520226	3
919	Shift unable to reach desired gear	520226	7
920	Shift actuator or drive circuit failure	520226	31
1068	MAP higher than expected	3563	15
1087	Secondary fuel pressure low	94	1
1088	Secondary fuel pressure high	94	0
1111	Fuel rev limit	515	16
1112	Spark rev limit	515	0
1113	RPM higher than expected	515	31
1114	Unable to achieve low target speed	515	15
1131	WGP high voltage	1192	3
1132	WGP low voltage	1192	4
1151	CL high LPG	520206	0

1152	CL low LPG	520206	1
1153	CL high NG	520207	0
1154	CL low NG	520207	1
1155	CL high gasoline bank1	4236	0
1156	CL low gasoline bank1	4236	1
1157	CL high gasoline bank2	4238	0
1158	CL low gasoline bank2	4238	1
1161	AL high LPG	520202	0
1162	AL low LPG	520202	1
1163	AL high NG	520203	0
1164	AL low NG	520203	1
1166	NG cat monitor	3050	11
1171	EPR / CFV regulation pressure higher than expected	520260	0
1172	EPR / CFV regulation pressure lower than expected	520260	1
1173	EPR / CFV comm lost	520260	31
1174	EPR / CFV voltage supply high	520260	3
1175	EPR / CFV voltage supply low	520260	4
1176	EPR / CFV internal actuator fault detection	520260	12
1177	EPR / CFV internal circuitry fault detection	520260	12
1178	EPR / CFV internal comm fault detection	520260	12
1182	Fuel impurity level high	520401	0
1183	EPR autozero / lockoff failed	520803	31
1311	Misfire detected (Cylinder 1)	1323	11
1312	Misfire detected (Cylinder 2)	1324	11
1313	Misfire detected (Cylinder 3)	1325	11
1314	Misfire detected (Cylinder 4)	1326	11
1315	Misfire detected (Cylinder 5)	1327	11
1316	Misfire detected (Cylinder 6)	1328	11
1325	Knock retard at limit	9999	15
1326	Knock retard above threshold	731	15
1351	Spark Plug or Coil Failure (Cylinder 1)	1268	11
1352	Spark Plug or Coil Failure (Cylinder 2)	1269	11
1353	Spark Plug or Coil Failure (Cylinder 3)	1270	11
1354	Spark Plug or Coil Failure (Cylinder 4)	1271	11
1355	Spark Plug or Coil Failure (Cylinder 5)	1272	11
1356	Spark Plug or Coil Failure (Cylinder 6)	1273	11
1514	AUX analog PU2 low (oil level switch)	520217	4
1517	AUX analog PU3 high (coolant level switch)	520218	3
1602	Relay off high voltage	1485	4
1603	Relay on low voltage	1485	4
1604	Service Interval Expired	1350	31
1611	5VE1/2 simultaneous out-of-range	1079	31
1612	RTI 1 loss	629	31
1613	RTI 2 loss	629	31

1614	RTI 3 loss	629	31
1615	A/D loss	629	31
1616	Invalid interrupt	629	31
1621	Rx Inactive	0	31
1622	Rx Noise	0	31
1623	Invalid Packet Format	0	31
1624	Shutdown Request	0	31
1625	Shutdown Request	1110	31
1626	CAN1 Tx failure	639	12
1627	CAN1 Rx failure	639	12
1628	CAN1 address conflict failure	639	13
1629	J1939 TSC1 message receipt lost	695	9
1630	J1939 ETC message receipt lost	91	19
1644	MIL control ground short	1213	4
1645	MIL control short to power	1213	3
1646	CAN2 Tx failure	1231	12
1647	CAN3 Tx failure	1235	12
1648	CAN2 Rx failure	1231	12
1649	CAN3 Rx failure	1235	12
1650	CAN2 address conflict failure	1231	13
1651	J1939 ETC message loss while in-gear	91	9
1653	CAN3 address conflict failure	1235	13
1673	Calibration Configuration Error	1634	13
1674	Hardware ID Failure	1634	2
1675	Start command stuck active	1675	3
2295	Secondary FP low voltage	94	4
2296	Secondary FP high voltage	94	3
2300	Primary Loop Open or Low-Side Short to Ground (curr. meas. reqd)(Cylinder 1)	1268	5
2301	Primary Coil Shorted (current measurement required)(Cylinder 1)	1268	6
2303	Primary Loop Open or Low-Side Short to Ground (curr. meas. reqd)(Cylinder 2)	1269	5
2304	Primary Coil Shorted (current measurement required)(Cylinder 2)	1269	6
2306	Primary Loop Open or Low-Side Short to Ground (curr. meas. reqd)(Cylinder 3)	1270	5
2307	Primary Coil Shorted (current measurement	1270	6
	required)(Cylinder 3)		
2309	Primary Loop Open or Low-Side Short to Ground (curr. meas. reqd)(Cylinder 4)	1271	5
2310	Primary Coil Shorted (current measurement required)(Cylinder 4)	1271	6
2312	Primary Loop Open or Low-Side Short to Ground (curr. meas. reqd)(Cylinder 5)	1272	5

2313	Primary Coil Shorted (current measurement required)(Cylinder 5)	1272	6
2315	Primary Loop Open or Low-Side Short to Ground (curr. meas. reqd)(Cylinder 6)	1273	5
2316	Primary Coil Shorted (current measurement required)(Cylinder 6)	1273	6
3011	UEGO internal processor fault	3221	31
3012	UEGO heater supply high voltage	3222	3
3013	UEGO heater supply low voltage	3222	4
3014	UEGO cal resistor voltage high	3221	3
3015	UEGO cal resistor voltage low	3221	4
3016	UEGO return voltage shorted high	3056	3
3017	UEGO return voltage shorted low	3056	4
3018	UEGO pump voltage shorted high	3218	3
3019	UEGO pump voltage shorted low	3218	4
3020	UEGO sense cell voltage high	3217	3
3021	UEGO sense cell voltage low	3217	4
3022	UEGO pump voltage at high drive limit	3225	3
3023	UEGO pump voltage at low drive limit	3225	4
3024	UEGO sense cell slow to warm up	3222	10
3025	UEGO pump cell slow to warm up	3225	10
3026	UEGO sense cell impedance high	3222	0
3027	UEGO pump cell impedance high	3225	0
3028	UEGO pump cell impedance low	3225	1
3029	UEGO drift is out-of-tolerance	3221	15
3030	UEGO drift is out-of-tolerance - level 2	3221	16
3031	UEGO heater open / ground short	3222	4
3032	UEGO heater short to power	3222	3
3033	UEGO2 internal processor fault	3260	31
3034	UEGO2 drift is out-of-tolerance	3260	15
3036	UEGO2 heater supply high voltage	3261	3
3037	UEGO2 heater supply low voltage	3261	4
3038	UEGO2 cal resistor voltage high	3260	3
3039	UEGO2 cal resistor voltage low	3260	4
3040	UEGO2 return voltage shorted high	3057	3
3041	UEGO2 return voltage shorted low	3057	4
3042	UEGO2 pump voltage shorted high	3257	3
3043	UEGO2 pump voltage shorted low	3257	4
3044	UEGO2 sense cell voltage high	3256	3
3045	UEGO2 sense cell voltage low	3256	4
3046	UEGO2 pump voltage at high drive limit	3264	3
3047	UEGO2 pump voltage at low drive limit	3264	4
3048	UEGO2 sense cell slow to warm up	3261	10
3049	UEGO2 pump cell slow to warm up	3264	10

3050	UEGO2 sense cell impedance high	3261	0
3051	UEGO2 pump cell impedance high	3264	0
3052	UEGO2 pump cell impedance low	3264	1
3053	UEGO2 heater open / ground short	3261	4
3054	UEGO2 heater short to power	3261	3
3999	DBW drive current high	0	6
3999	UEGO internal supply voltage low	0	31
3999	UEGO2 internal supply voltage low	0	31

DTC 6 - LOCKOFF OPEN/GROUND SHORT

DTC	6	SPN	0	FMI	31		

Hardware/Circuit: Lockoff Valve

Hardware/Circuit Description:

A normally closed electromechanical fuel shut-off is used to isolate the Dual Stage Regulator (DSR) or the Continuous Flow Valve (CFV) and all downstream components from the upstream fuel supply when the engine is shut off.
Lockoff open/ground short monitors for electrical / wiring problems with the lockoff or the harness.
The ECM monitors the voltage on the appropriate PWM pin when the lockoff is not energized.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions (as defined in calibration):

• PWM low-side feedback <	**5.0**	% Vbat
• and PWM duty-cycle <	**5.0**	%

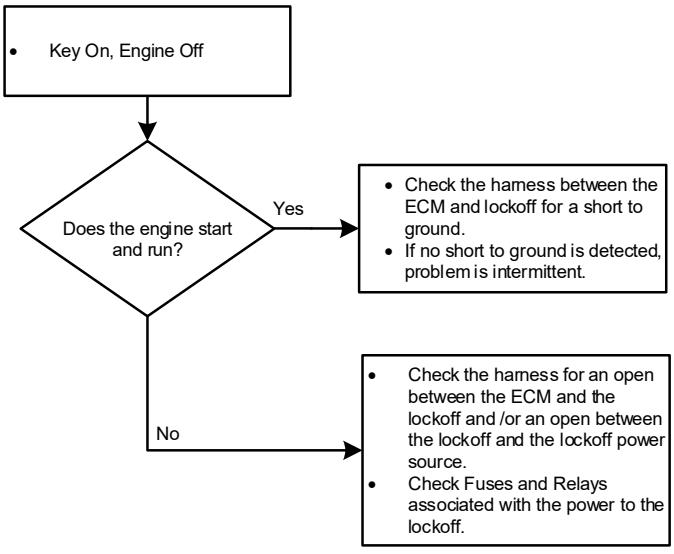
Fault Description:

This fault will set if the ECM detects low feedback voltage (% Vbat) on the lockoff while the lockoff circuit is in the off-state as defined in the diagnostic calibration.

Corrective Actions *(see Table 1 for descriptions of individual corrective actions):*

Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**TBD**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

Diagnostic Trouble Tree



DTC 7 - LOCKOFF SHORT TO POWER

DTC	7	SPN	0	FMI	31		

Hardware/Circuit: Lockoff Valve

Hardware/Circuit Description:

A normally closed electromechanical fuel shut-off is used to isolate the Dual Stage Regulator (DSR) or the Continuous Flow Valve (CFV) and all downstream components from the upstream fuel supply when the engine is shut off.

Lockoff short to power monitors for electrical / wiring problems with the lockoff or the harness.

The ECM monitors the voltage on the appropriate PWM pin when the lockoff is energized.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions (as defined in calibration):

• PWM low-side feedback >	**90**	% Vbat
• and PWM duty-cycle >	**90**	%

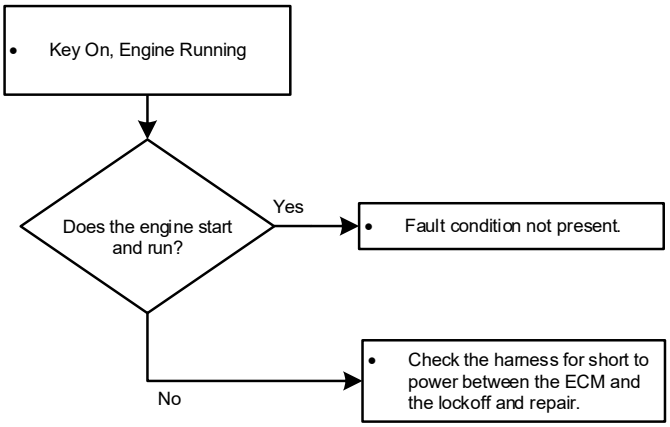
Fault Description:

This fault will set if the ECM detects high feedback voltage (% Vbat) on the lockoff while the lockoff circuit is in the on-state as defined in the calibration.

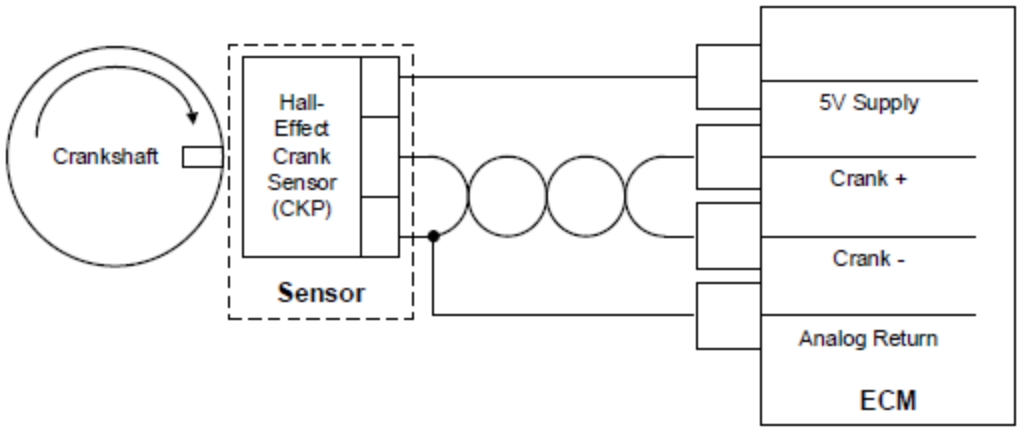
Corrective Actions *(see Table 1 for descriptions of individual corrective actions):*

Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**TBD**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

Diagnostic Aids/Trouble Tree



DTC 16 - NEVER CRANK SYNC AT START



DTC	16	SPN	636	FMI	8		

Hardware/Circuit: Crankshaft Position Sensor/Camshaft Position Sensor

Hardware/Circuit Description:

The crankshaft position sensor is a magnetic sensor (variable reluctant/magnetic pick-up or hall-effect) installed in the engine block adjacent to a "coded" trigger wheel located on the crankshaft. The sensor-trigger wheel combination is used to determine crankshaft position (with respect to TDC cylinder #1 compression) and the rotational engine speed. Determination of the crankshaft position and speed is necessary to properly activate the ignition, fuel injection, and throttle governing systems for precise engine control.

The camshaft position sensor is a magnetic sensor (variable reluctant/magnetic pick-up or hall-effect) installed in the engine block or valve train adjacent to a "coded" trigger wheel located on or off of the camshaft. The sensor-trigger wheel combination is used to determine cam position (with respect to TDC cylinder #1 compression). Determination of the camshaft position is necessary to identify the stroke (or cycle) of the engine to properly activate the fuel injection system and ignition (for coil-on-plug engines) for precise engine control.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

• Cranking revs without sync >	*4.0*	revs
• RPM>	*90*	rpm

Fault Description:

The ECM must see a valid crankshaft position and camshaft position (if applicable) signal properly aligned during cranking before it can synchronize the injection and ignition systems to initiate starting. If engine speed > **x** RPM and the crank and/or cam (if applicable) cannot synchronize within **y** cranking revs (NOTE: x and y defined in application-specific calibration), this fault will set.

Typically, conditions triggering this fault will result in an engine that will not start or run.

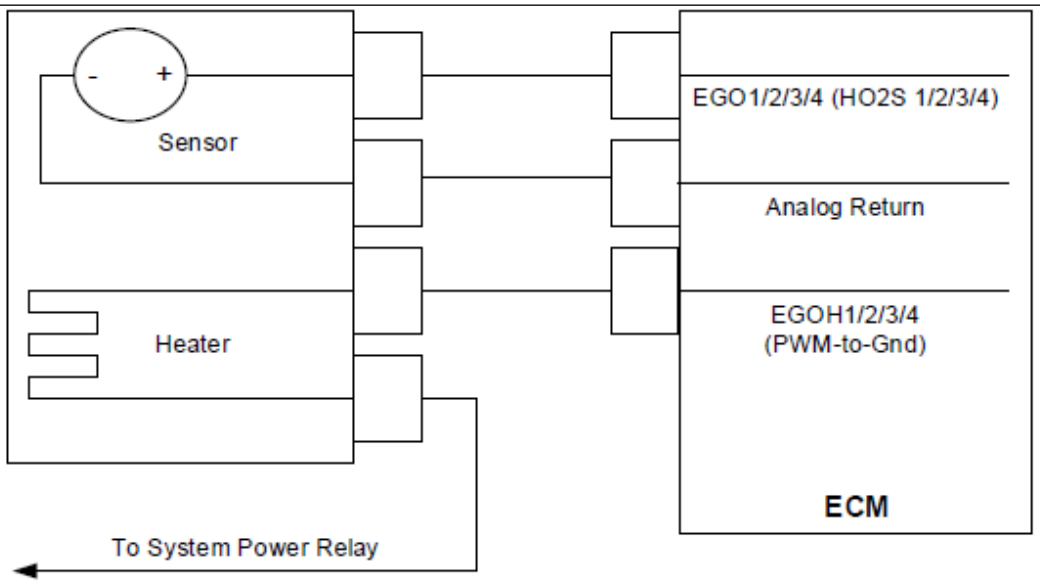
Corrective Actions:

Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**TBD**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

Diagnostic Aids

- ☐ Check that crankshaft and/or camshaft position sensor(s) is/are securely connected to harness.
- ☐ Check that crankshaft and/or camshaft position sensor(s) is/are securely installed into engine block.
- ☐ Check crankshaft and/or camshaft position sensor(s) circuit(s) wiring for open circuit.

DTC 51 - EGOH2 OPEN/GROUND SHORT



DTC	51	SPN	3232	FMI	4		

Sensor/Circuit: Heated Exhaust Gas Oxygen Sensor

Sensor Description:

The HEGO/HO2S sensor is a switching-type sensor about stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear analog output proportional to lambda/equivalence ratio/air-fuel ratio. In either case, if there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted using the Closed Loop multiplier and then "learned" with the Adaptive multiplier. The multipliers only update when the system is in either "CL Active" or "CL + Adapt" control modes.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

• EGOH2 low-side feedback <	**5.0**	**5.0**	**5.0**	**5.0**	% Vbat
• PWM duty-cycle <	**5.0**	**5.0**	**5.0**	**5.0**	%

Fault Description:

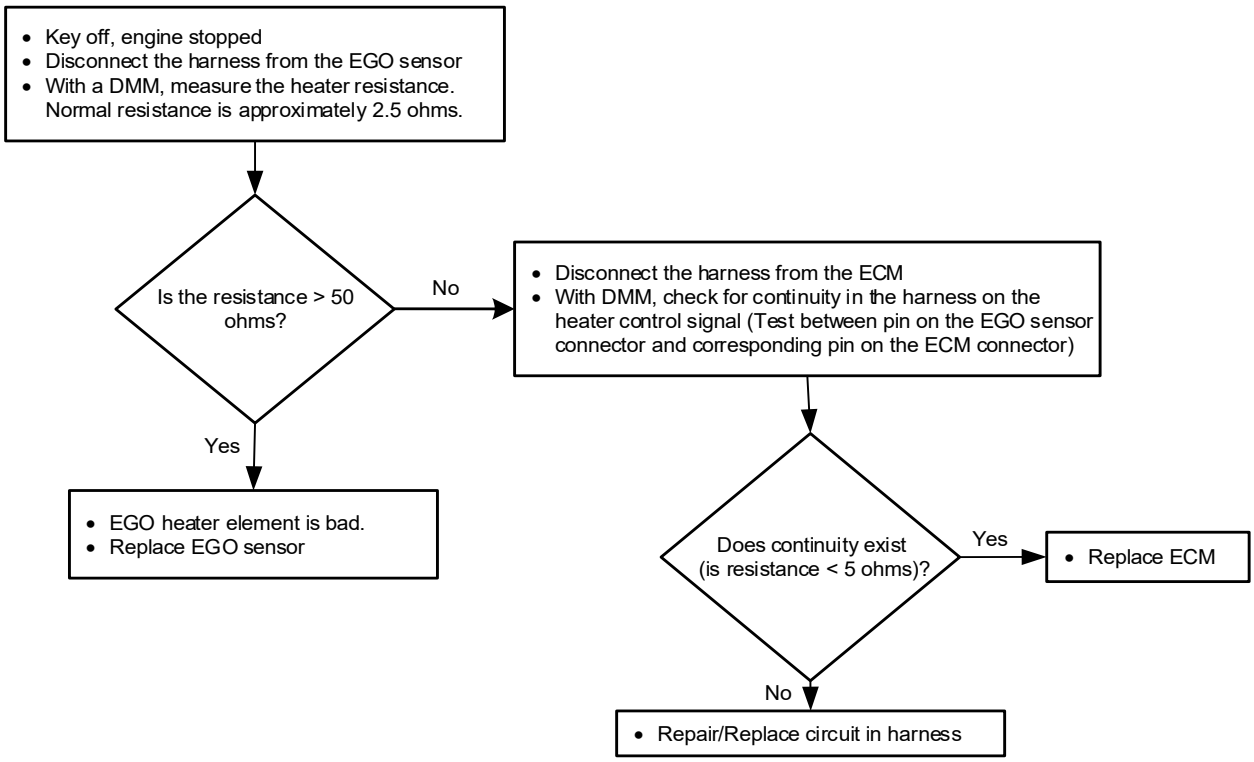
This fault will set when the EGO heater control feedback signal does not see Vbat when the heater is switched off. This may be caused by a bad heater element in the EGO sensor, a break in the wire harness on the heater supply or control circuits, or fault within the ECM.

Corrective Actions

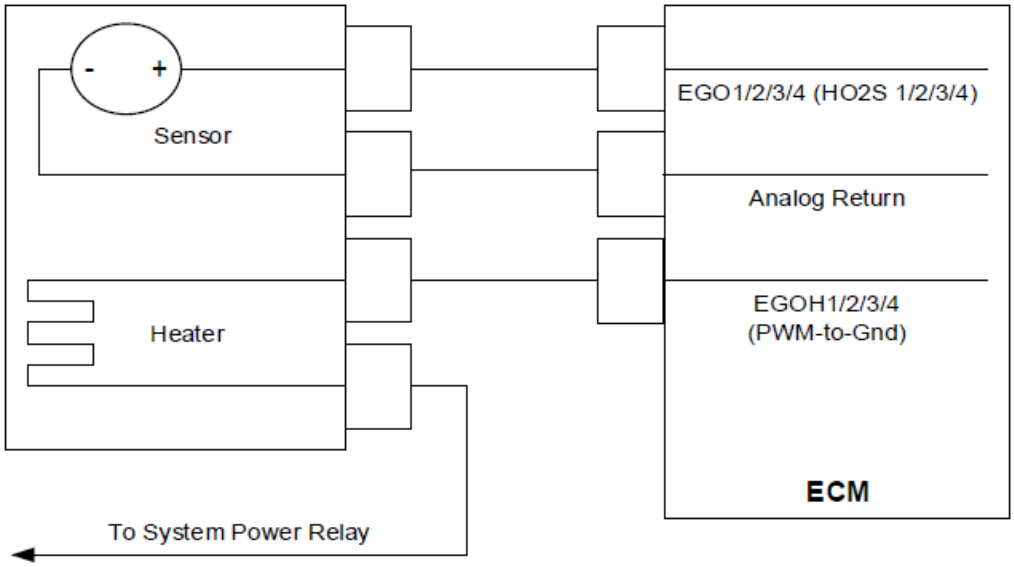
Click individual check boxes to indicate corrective action enabled *:*

UEGO#	Shutdown	Never Forget	Turn On MIL	CL Disable	CL Disable - key-cyc	AL Disable	AL Disable - key-cyc	Power Derate 1	Power Derate 2	Low Rev Limit	Force Idle	Soft Warning	Hard Warning	MIL Persist Disable	
1	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
4	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	

Trouble Tree:



DTC 52 - EGOH2 SHORT TO POWER



DTC	**52**	**SPN**	**3232**	**FMI**	**3**		

Sensor/Circuit: Heated Exhaust Gas Oxygen Sensor

Sensor Description:

The HEGO/HO2S sensor is a switching-type sensor about stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear analog output proportional to lambda/equivalence ratio/air-fuel ratio. In either case, if there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted using the Closed Loop multiplier and then "learned" with the Adaptive multiplier. The multipliers only update when the system is in either "CL Active" or "CL + Adapt" control modes.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

• EGOH2 low-side feedback >	**90.0**	**90.0**	**90.0**	**90.0**	% Vbat
• PWM duty-cycle >	**90.0**	**90.0**	**90.0**	**90.0**	%

Fault Description:

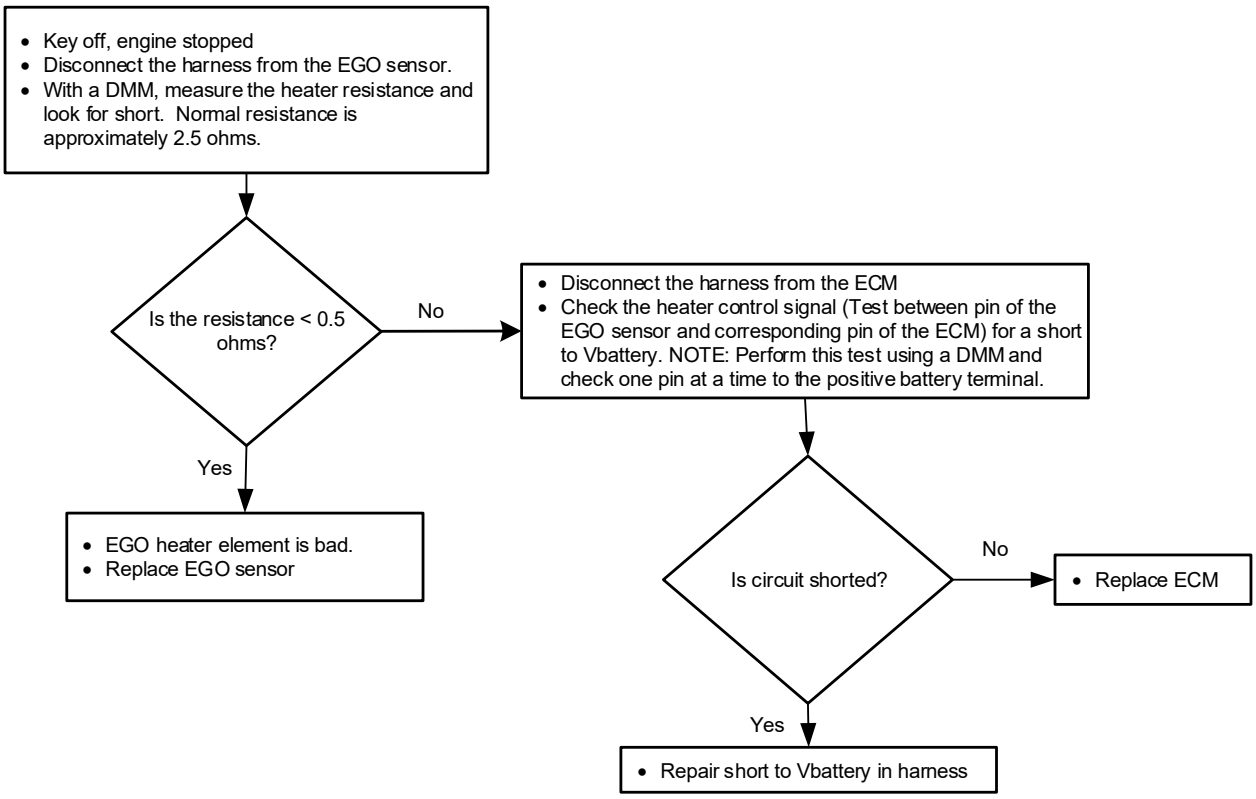
This fault will set when the EGO heater control signal feedback signal does not see zero volts when the heater is switched on. This may be caused by an internal fault within the ECM.

Corrective Actions

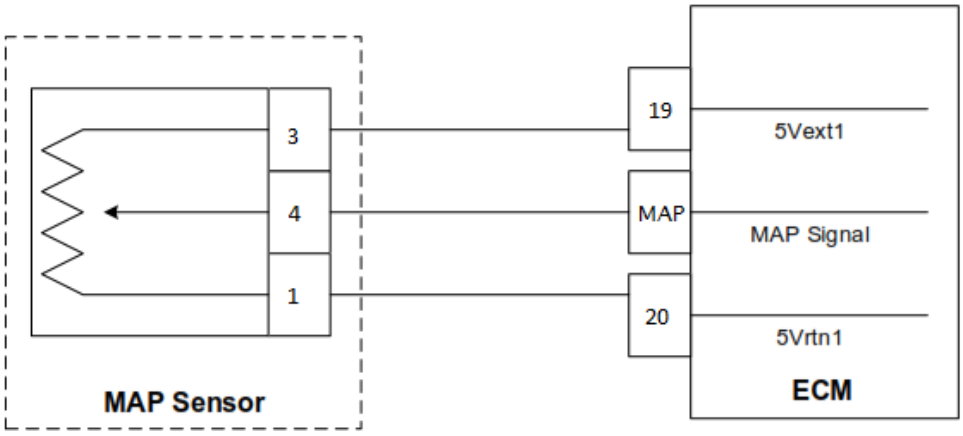
Click individual check boxes to indicate corrective action enabled*:*

UEGO	Shutdown	Never Forget	Turn On MIL	CL Disable	CL Disable - key-cyc	AL Disable	AL Disable - key-cyc	Power Derate 1	Power Derate 2	Low Rev Limit	Force Idle	Soft Warning	Hard Warning	MIL Persist Disable
1	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Trouble Tree:



DTC 107 - MAP LOW VOLTAGE



DTC	107	SPN	106	FMI	4

Hardware: Manifold Absolute Pressure Sensor

Hardware Description:

The Manifold Absolute Pressure sensor is a pressure transducer connected to the intake manifold. It is used to measure the pressure of air in the manifold prior to induction into the engine. The pressure reading is used in conjunction with other inputs to determine the rate of airflow to the engine, which thereby determines the required fuel flow rate.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**YES**
Check Condition:	Engine Cranking or Running

Fault Set Conditions (as defined in calibration):

• MAP voltage <	0.05	volts
• and TPS >	2	%
• and RPM <	7000	rpm
• to unlatch, MAP voltage must be >	0.5	volts

Possible Causes:

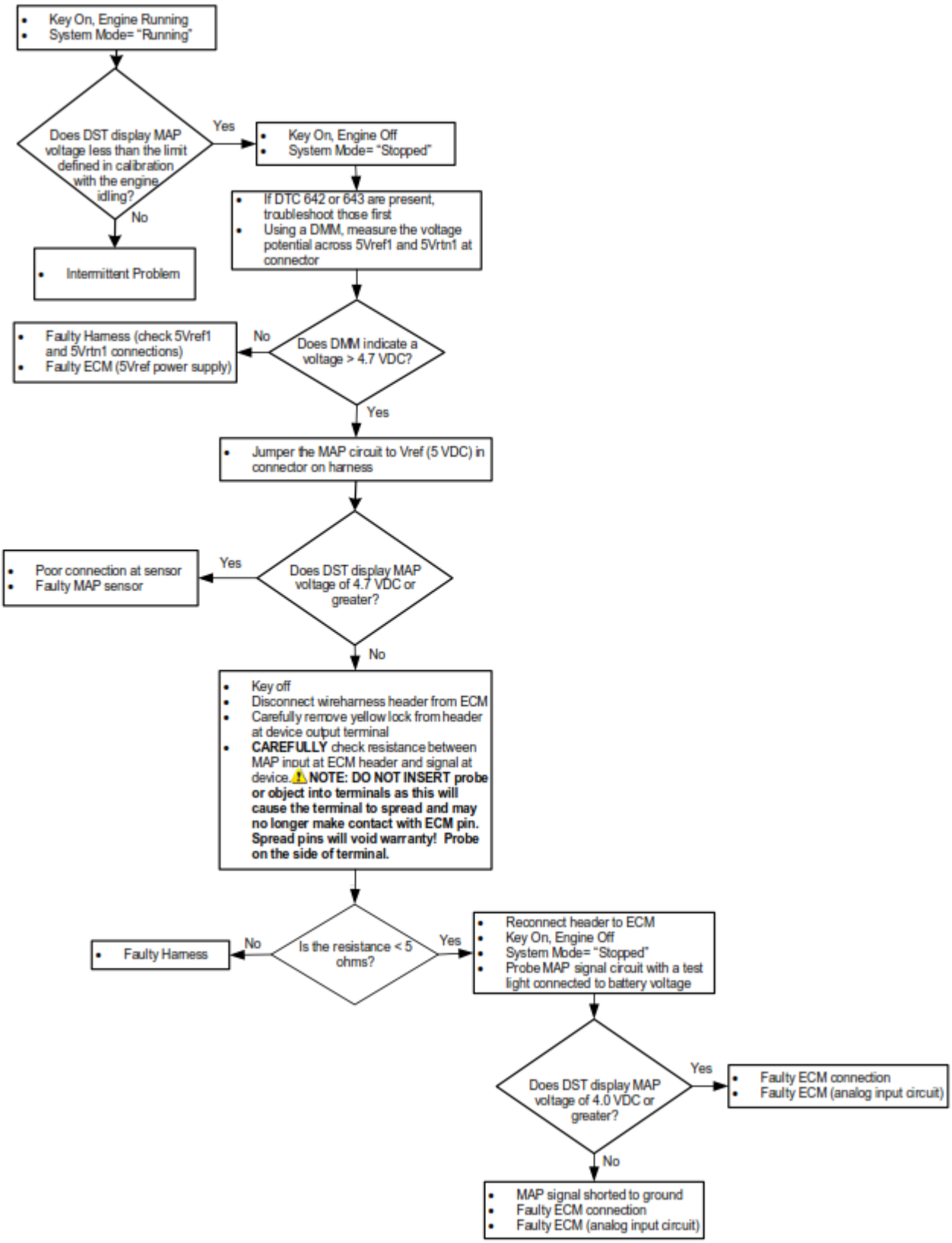
This fault will set when the MAP sensor voltage feedback is sensed as lower than what the sensor should normally produce as set in the diagnostic calibration. The limit is generally set at 0.10 VDC. In many cases, this condition is caused by the MAP sensor being disconnected from the engine harness, an open-circuit or short-to-ground of the MAP circuit in the wire harness, a loss of sensor reference voltage, or a failure of the sensor. When this fault occurs, the ECM operates in a limp home mode in which an estimated MAP based on TPS feedback is used to fuel the engine.

If the MAP sensor is integrated in a TMAP sensor and an IAT High Voltage fault (DTC 113) is also present, the sensor is likely disconnected from the wire harness.

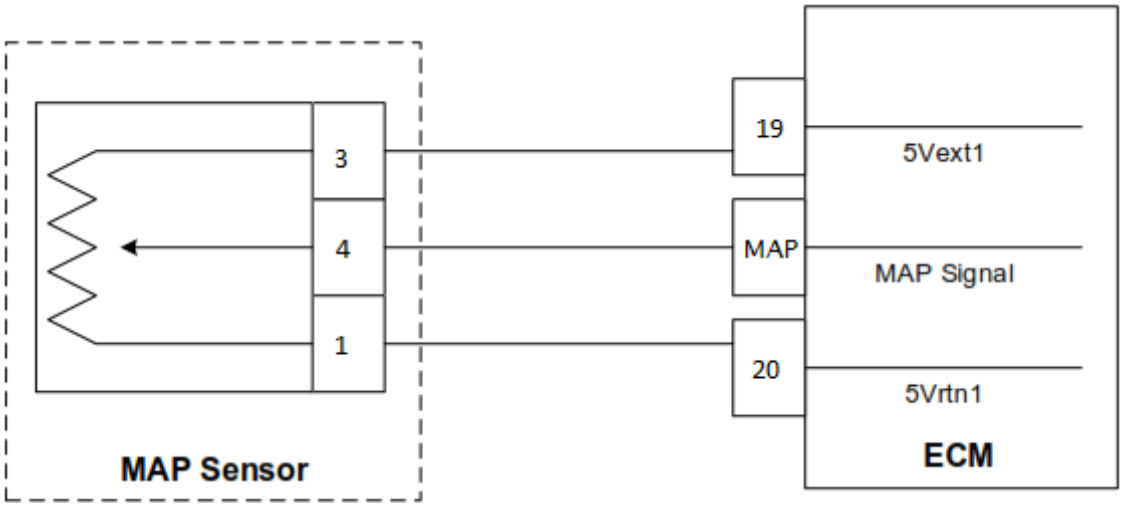
Corrective Actions (see section 4.1 for descriptions of individual corrective actions):

Shutdown	YES	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 107 - MAP LOW VOLTAGE (Trouble Tree)



DTC 108 - MAP HIGH PRESSURE



DTC	108	SPN	106	FMI	16

Hardware: Manifold Absolute Pressure Sensor

Hardware Description:

The Manifold Absolute Pressure sensor is a pressure transducer connected to the intake manifold. It is used to measure the pressure of air in the manifold prior to induction into the engine. The pressure reading is used in conjunction with other inputs to determine the rate of airflow to the engine, which thereby determines the required fuel flow rate.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**YES**
Check Condition:	Engine Cranking or Running

Fault Set Conditions (as defined in calibration):

• MAP pressure >	15.5	psia
• and TPS <	10	%
• and RPM >	1400	rpm
• to unlatch, MAP pressure must be <	8	psia

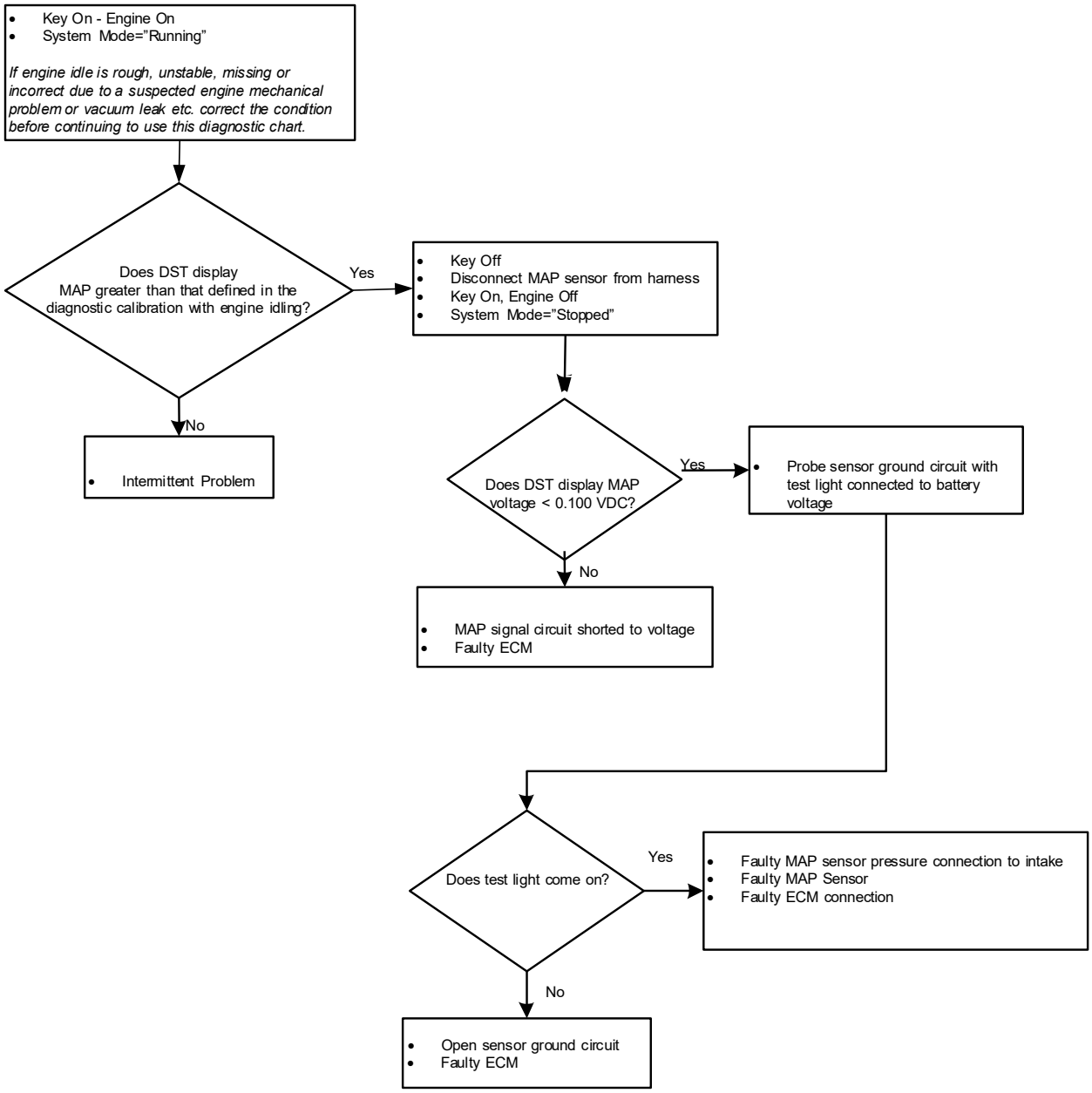
Possible Causes:

This fault will set when the MAP reading is higher than it should be for the given TPS, and RPM. When the fault is set the engine will typically operate in a limp home mode using an estimated MAP based on TPS feedback.

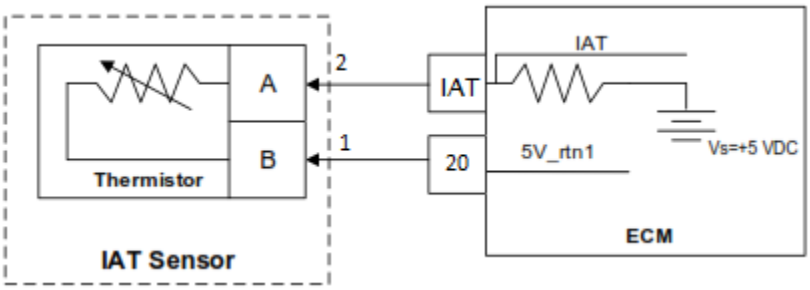
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	YES	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 108 - MAP HIGH PRESSURE (Trouble Tree)



DTC 111 - IAT HIGHER THAN EXPECTED STAGE 1



DTC	111	SPN	105	FMI	15

Hardware: Intake Air Temperature Sensor

Hardware Description:

The Intake Air Temperature sensor is a thermistor (temperature sensitive resistor) located in the intake manifold of the engine. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower when warm.

The Manifold Air Temperature is a calculated value based mainly on the IAT sensor at high airflow and influenced more by the ECT/CHT at low airflow. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the airflow to the engine, and ignition timing.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**NO**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• run-time wait for all IAT HiExp faults:	15	seconds
• IAT >	180	deg F
• and RPM >	900	rpm

Possible Causes:

This fault will set if the Intake Air Temperature is greater than the stage 1 limit and the operating condition is at a speed greater than defined in the diagnostic calibration.

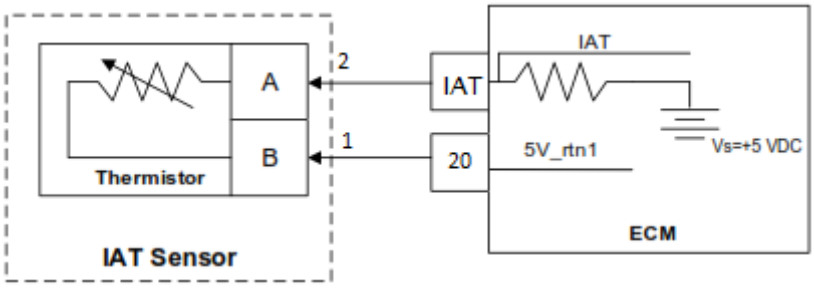
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	YES
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

Diagnostic Aids

- ☐ This fault will set when inlet air is hotter than normal. The most common cause of high inlet air temperature is a result of a problem with routing of the inlet air. Ensure inlet plumbing sources are external, is cool, and is not too close to the exhaust at any point.
- ☐ Inspect the inlet air system for cracks or breaks that may allow unwanted underhood air to enter the engine.
- ☐ If no problem is found, replace the IAT sensor with a known good part and rete

DTC 112 - IAT LOW VOLTAGE



DTC	112	SPN	105	FMI	4
Hardware:	Intake Air Temperature Sensor				

Hardware Description:

The Intake Air Temperature sensor is a thermistor (temperature sensitive resistor) located in the intake manifold of the engine. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower when warm.

The Manifold Air Temperature is a calculated value based mainly on the IAT sensor at high airflow and influenced more by the ECT/CHT at low airflow. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the airflow to the engine, and ignition timing.

Fault Enabled in Calibration?	YES		
Emissions-related Fault?	**NO**		
Check Condition:	Engine Running		
Fault Set Conditions (as defined in calibration):			
• IAT voltage <		0.05	volts

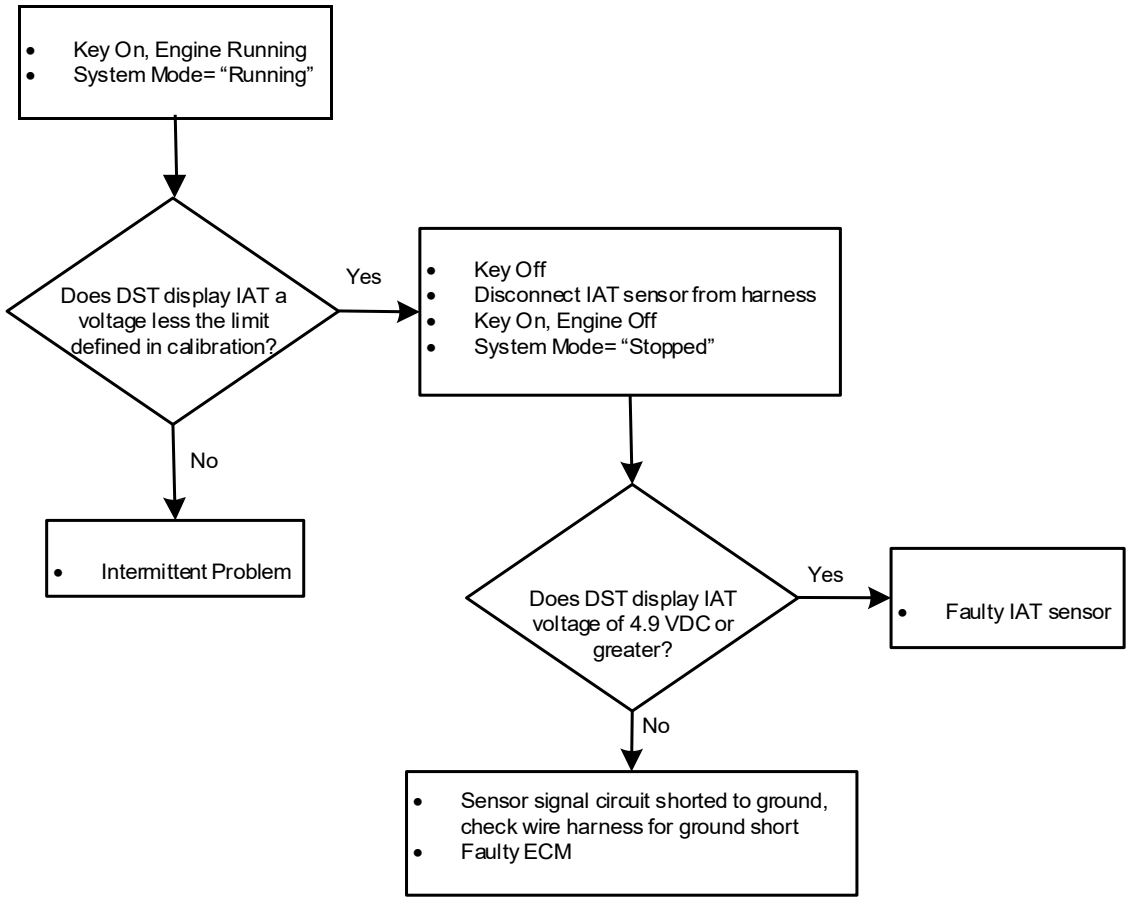
Possible Causes:

This fault will set if the signal voltage is less than the low voltage limit as defined in the diagnostic calibration anytime the engine is running. The limit is generally set to 0.100 VDC. The ECM will use a default value for the IAT sensor in the event of this fault.

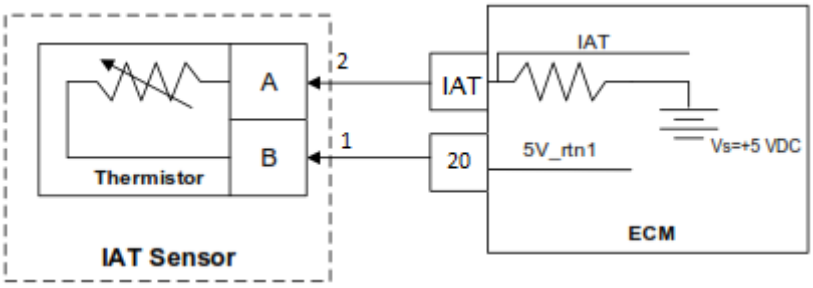
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 112 - IAT LOW VOLTAGE (Trouble Tree)



DTC 113 - IAT HIGH VOLTAGE



DTC	113	SPN	105	FMI	3

Hardware: Intake Air Temperature Sensor

Hardware Description:

The Intake Air Temperature sensor is a thermistor (temperature sensitive resistor) located in the intake manifold of the engine. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower when warm.

The Manifold Air Temperature is a calculated value based mainly on the IAT sensor at high airflow and influenced more by the ECT/CHT at low airflow. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the airflow to the engine, and ignition timing.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**NO**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• IAT voltage >	4.95	volts

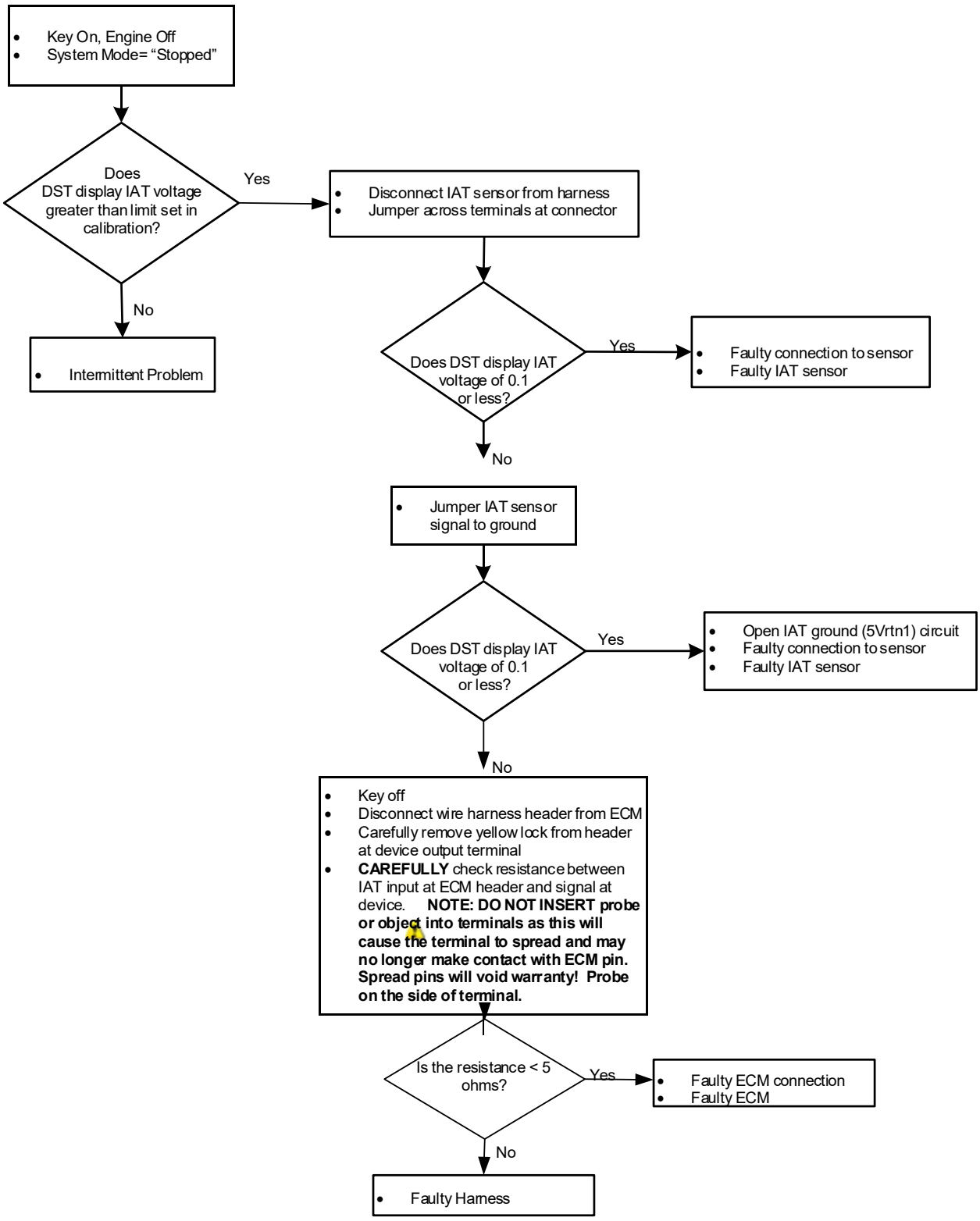
Possible Causes:

This fault will set if the signal voltage is higher than the high voltage limit as defined in the diagnostic calibration anytime the engine is running. The limit is generally set to 4.90 VDC. In many cases, this condition is caused by the IAT sensor being disconnected from the engine harness, an open-circuit or short-to-power of the IAT circuit in the wireharness, or a failure of the sensor. The ECM will use a default value for the IAT sensor in the event of this fault.

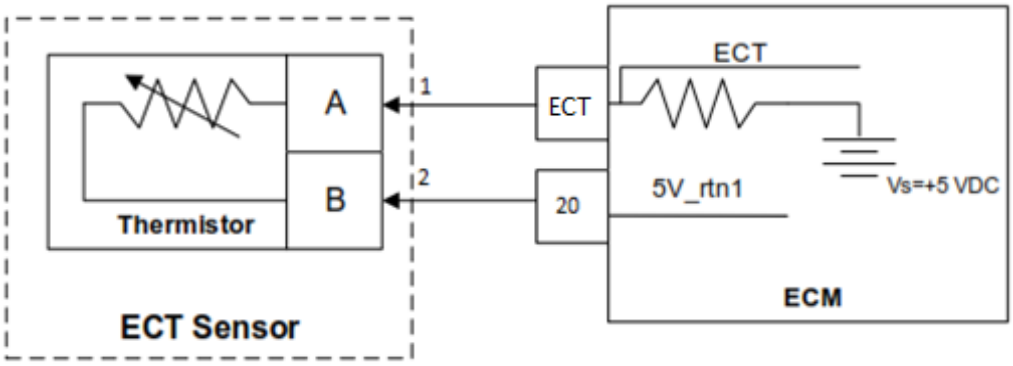
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 113 - IAT HIGH VOLTAGE (Trouble Tree)



DTC 116 - ECT HIGHER THAN EXPECTED (STAGE 1)



DTC	116	SPN	110	FMI	15

Hardware: Engine Coolant Temperature Sensor

Hardware Description:

The Engine Coolant Temperature sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. Some engines use a CHT sensor that is located in the coolant in the cylinder head. Some engines use an ECT (Engine Coolant Temperature) sensor that is located in the coolant near the thermostat. If the engine is equipped with a CHT sensor then the ECT value is estimated. If equipped with an ECT sensor then the CHT value is estimated. They are used for engine airflow calculation, ignition timing control, to enable certain features, and for engine protection.

The ECM provides a voltage divider circuit so when the sensor reading is cool the sensor reads higher voltage, and lower when warm.

Fault Enabled in Calibration?	TBD* (*Application-Specific – see calibration)
Emissions-related Fault?	**NO**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• ECT >	207	deg F
• and RPM >	50	rpm
• and run-time >	15	seconds

Possible Causes:

When the coolant exceeds x deg. F and engine RPM exceeds y RPM for the latch time this fault will set, in order to help protect the engine in the event of over temperature.

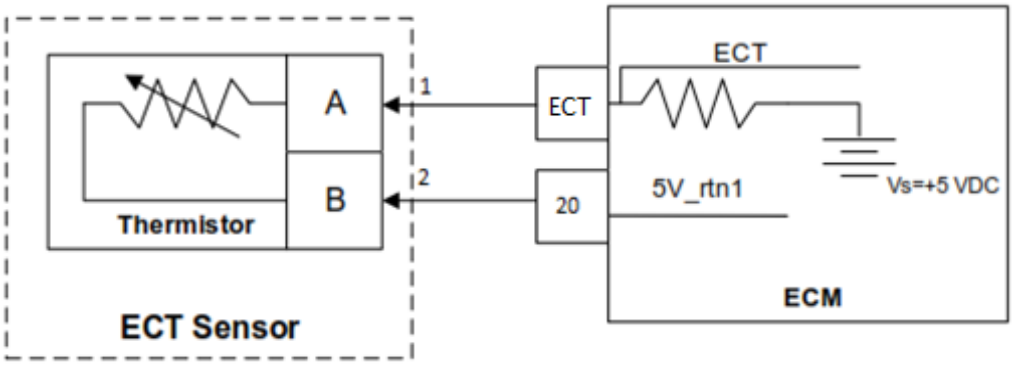
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	yes	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	yes	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

Diagnostic Aids

- ☐ If the "ECT High Voltage" fault is also present, follow the troubleshooting procedures for that fault as it may have caused "ECT Higher Than Expected 1."
- ☐ If the cooling system utilizes an air-to-water heat exchanger (radiator) and fan:
  - Check that the radiator has a proper amount of ethylene glycol/water and that the radiator is not leaking.
  - Ensure that there is no trapped air in the cooling path.
  - Inspect the cooling system (radiator and hoses) for cracks and ensure connections are leak free.
  - Check that the fan is operating properly.
  - Check that the thermostat is not stuck closed.
- ☐ If the cooling system utilizes a water-to-water heat exchanger:
  - Check that the heat exchanger has a proper amount of ethylene glycol/water and that the heat exchanger is not leaking.
  - Ensure that there is no trapped air in the cooling path.
  - Inspect the cooling system (radiator and hoses) for cracks and ensure connections are leak free.
  - Check that the raw water pickup is not blocked/restricted by debris and that the hose is tightly connected.
  - Check that the thermostat is not stuck closed.
  - Check that the raw water pump/impeller is tact and that it is not restricted.

DTC 117 - ECT / CHT LOW VOLTAGE



DTC	116	SPN	110	FMI	4

Hardware: Engine Coolant Temperature Sensor

Hardware Description:

The Engine Coolant Temperature sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. Some engines use a CHT sensor that is located in the coolant in the cylinder head. Some engines use an ECT (Engine Coolant Temperature) sensor that is located in the coolant near the thermostat. If the engine is equipped with a CHT sensor then the ECT value is estimated. If equipped with an ECT sensor then the CHT value is estimated. They are used for engine airflow calculation, ignition timing control, to enable certain features, and for engine protection.

The ECM provides a voltage divider circuit so when the sensor reading is cool the sensor reads higher voltage, and lower when warm.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**NO**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• ECT voltage <	0.05	volts

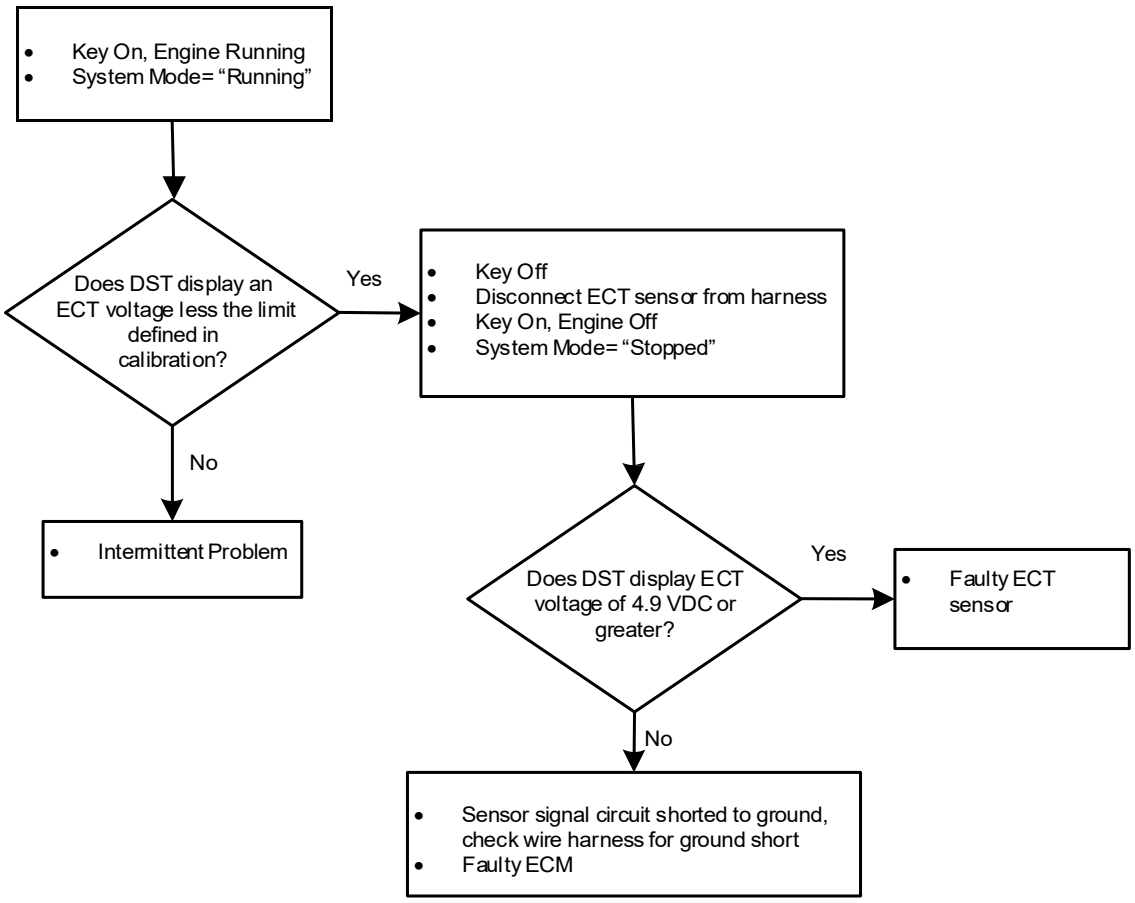
Possible Causes:

This fault will set if the signal voltage is less than the limit defined in the diagnostic calibration anytime the engine is running. The limit is generally set to 0.10 VDC. The ECM will use a default value for the CHT/ECT sensor in the event of this fault.

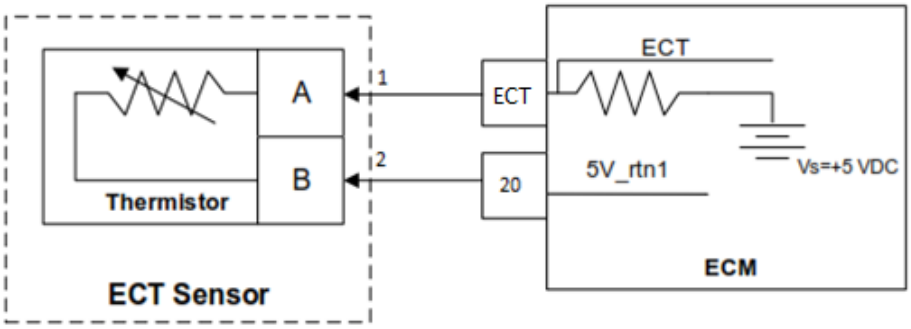
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	YES	Soft Warning	TBD*	NOx Control System	TBD*

DTC 117 - ECT / CHT LOW VOLTAGE (Trouble Tree)



DTC 118 - ECT / CHT HIGH VOLTAGE



DTC	116	SPN	110	FMI	3

Hardware: Engine Coolant Temperature Sensor

Hardware Description:

The Engine Coolant Temperature sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. Some engines use a CHT sensor that is located in the coolant in the cylinder head. Some engines use an ECT (Engine Coolant Temperature) sensor that is located in the coolant near the thermostat. If the engine is equipped with a CHT sensor then the ECT value is estimated. If equipped with an ECT sensor then the CHT value is estimated. They are used for engine airflow calculation, ignition timing control, to enable certain features, and for engine protection.

The ECM provides a voltage divider circuit so when the sensor reading is cool the sensor reads higher voltage, and lower when warm.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**NO**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• ECT voltage >	4.95	volts

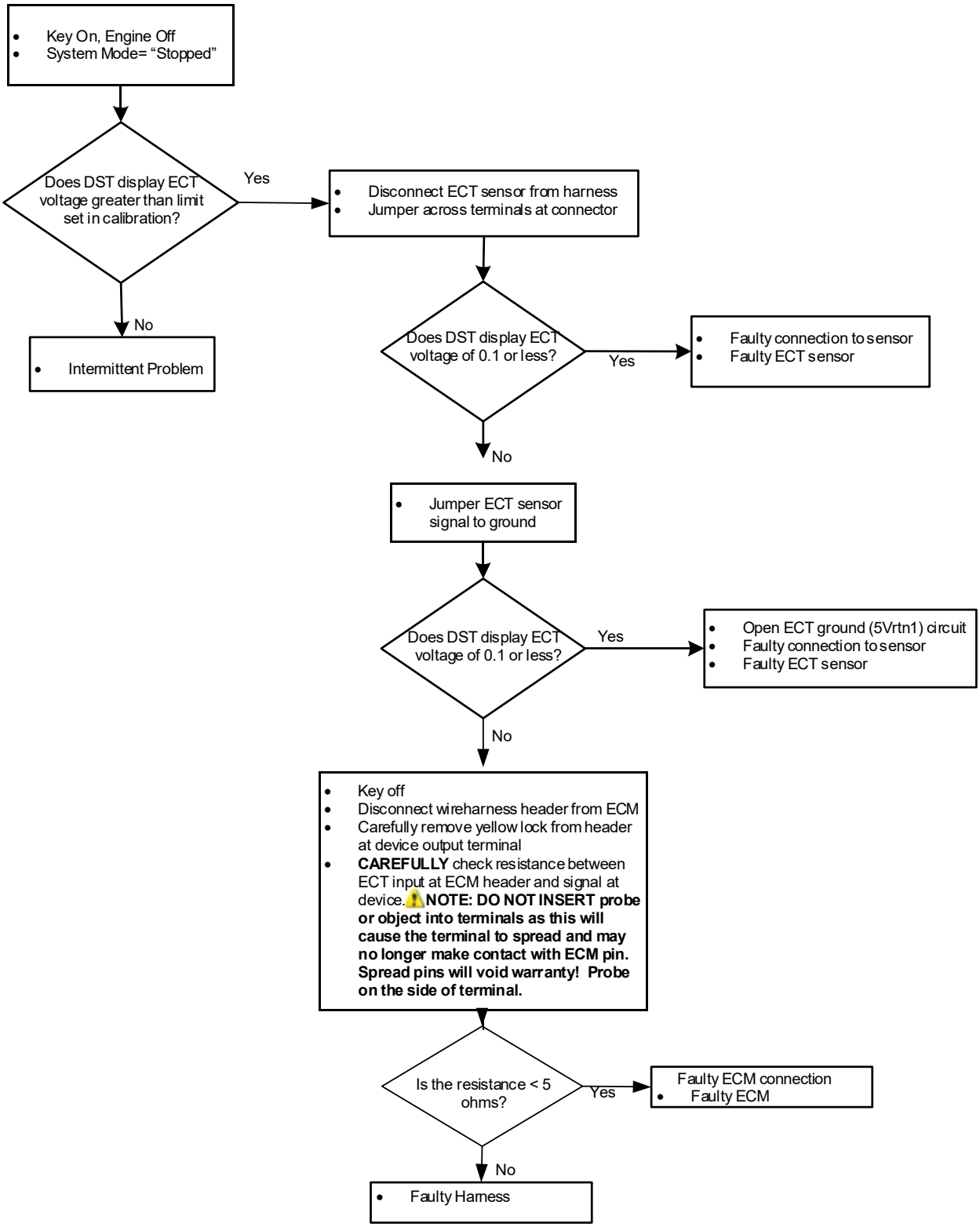
Possible Causes:

This fault will set if the signal voltage is higher than the high voltage limit as defined in the diagnostic calibration anytime the engine is running. The limit is generally set to 4.90 VDC. In many cases, this condition is caused by the CHT/ECT sensor being disconnected from the engine harness, an open-circuit or short-to-power of the CHT/ECT circuit in the wire harness, or a failure of the sensor. The ECM will use a default value for the CHT/ECT sensor in the event of this fault.

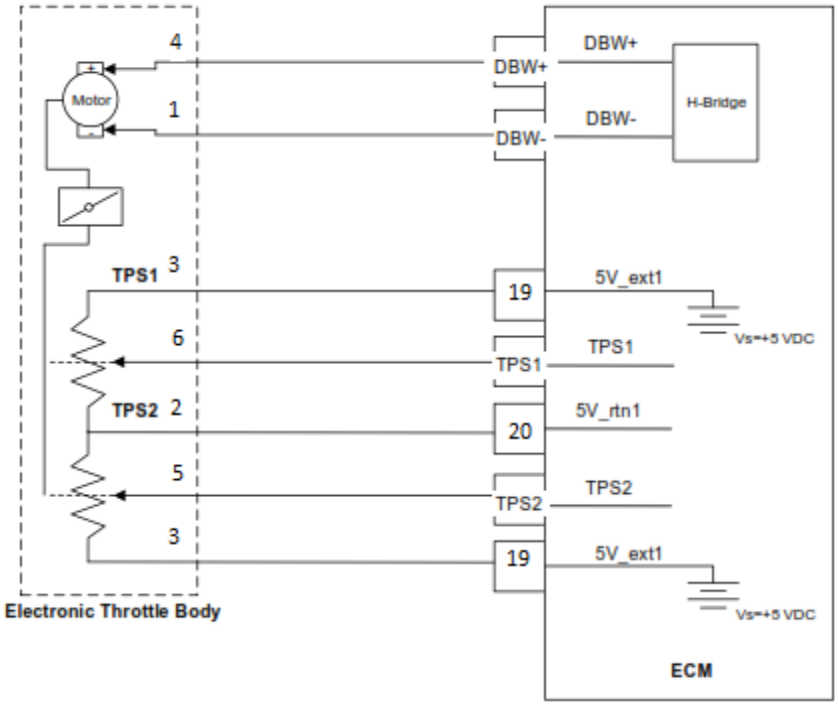
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	YES	Soft Warning	TBD*	NOx Control System	TBD*

DTC 118 - ECT / CHT HIGH VOLTAGE (Trouble Tree)



DTC 121 – TPS1 % LOWER THAN TPS2 %



DTC	121	SPN	51	FMI	1
Hardware:	Throttle Body-Throttle Position Sensor 1 & 2 (electronic throttle body only)				

Hardware Description:

The throttle controls the airflow through the engine, directly affecting the power output of the engine. When the throttle is electronically controlled in an Electronic Throttle Body it can be used to control the idle stability and limit engine speed based on operating conditions.

The Throttle Position Sensor uses either 1) a variable resistor and voltage divider circuit or 2) a non-contact hall-effect sensor to determine throttle plate position, and is located within the throttle body. The output of the TPS is linear with angular position. The TPS input(s) provide angular position feedback of the throttle plate. In mechanical throttle bodies this sensor is typically used to help improve return-to-idle governing when working in combination with an Idle Air Control motor. In an Electronic Throttle Body multiple position feedback sensors (usually two counteracting potentiometers/hall-effects) are used to perform speed governing with improved safety and redundancy.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**NO**
Check Condition:	Key-On, Engine Cranking, or Running

Fault Set Conditions (as defined in calibration):

• (TPS1% - TPS2%) <	-20	%

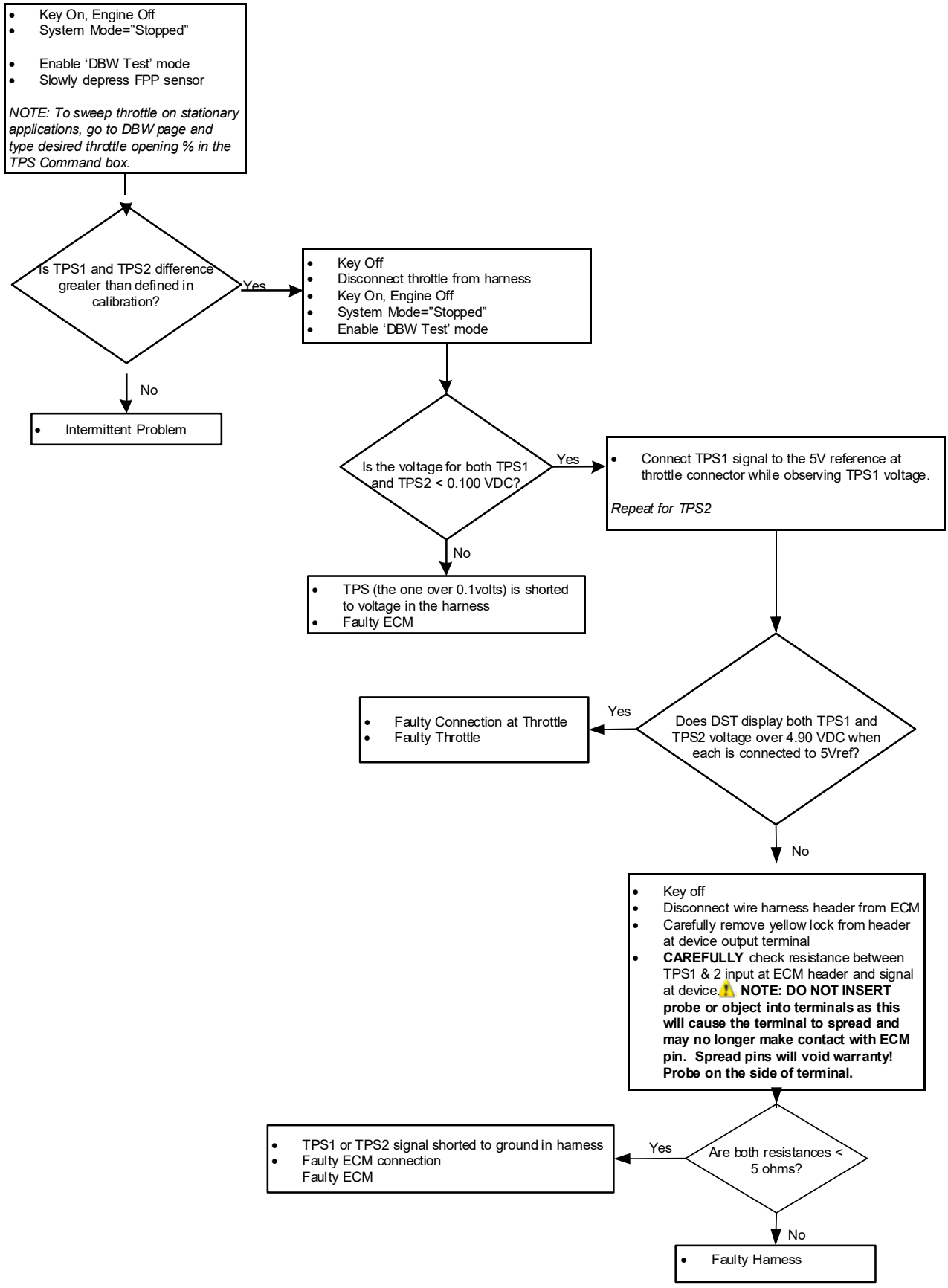
Possible Causes:

This fault will set if TPS1 % is lower than TPS2 % by the amount defined in the diagnostic calibration. At this point the throttle is considered to be out of specification, or there is a problem with the TPS signal circuit.

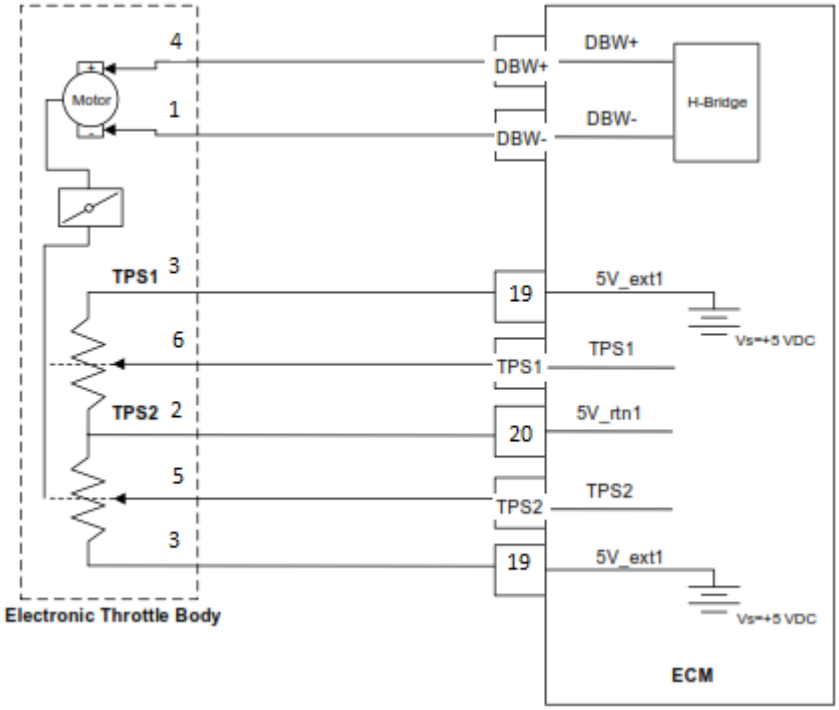
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	YES	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 121 – TPS1 % LOWER THAN TPS2 % (Trouble Tree)



DTC 122 - TPS1 SIGNAL VOLTAGE LOW



DTC	122	SPN	51	FMI	4
Hardware:	Throttle Body-Throttle Position Sensor 1 & 2 (electronic throttle body only)				

Hardware Description:

The throttle controls the airflow through the engine, directly affecting the power output of the engine. When the throttle is electronically controlled in an Electronic Throttle Body it can be used to control the idle stability and limit engine speed based on operating conditions.

The Throttle Position Sensor uses either 1) a variable resistor and voltage divider circuit or 2) a non-contact hall-effect sensor to determine throttle plate position, and is located within the throttle body. The output of the TPS is linear with angular position. The TPS input(s) provide angular position feedback of the throttle plate. In mechanical throttle bodies this sensor is typically used to help improve return-to-idle governing when working in combination with an Idle Air Control motor. In an Electronic Throttle Body multiple position feedback sensors (usually two counteracting potentiometers/hall-effects) are used to perform speed governing with improved safety and redundancy.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**NO**
Check Condition:	Key On, Engine Off

Fault Set Conditions (as defined in calibration):

• TPS1 voltage <	0.2	volts

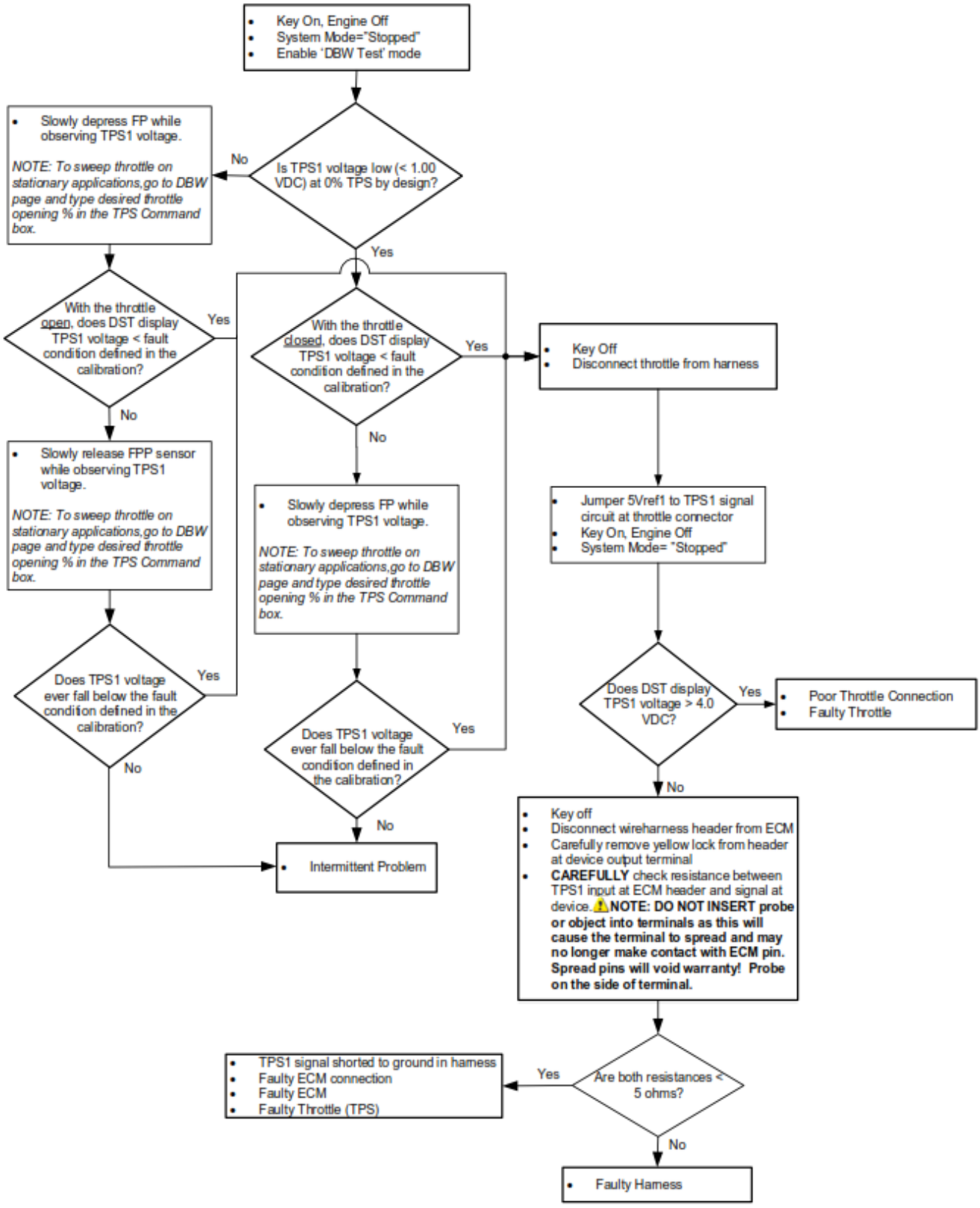
Possible Causes:

This fault will set if TPS1 voltage is lower than the low voltage limit as defined in the diagnostic calibration at any operating condition while the engine is cranking or running. The limit is generally set to 4.90 VDC. In many cases, this condition is caused by the TPS sensor being disconnected from the engine harness, an open-circuit or short-to-ground of the TPS circuit in the wire harness, or a failure of the sensor. This fault should be configured to trigger an engine shutdown and the engine will not start with this fault active.

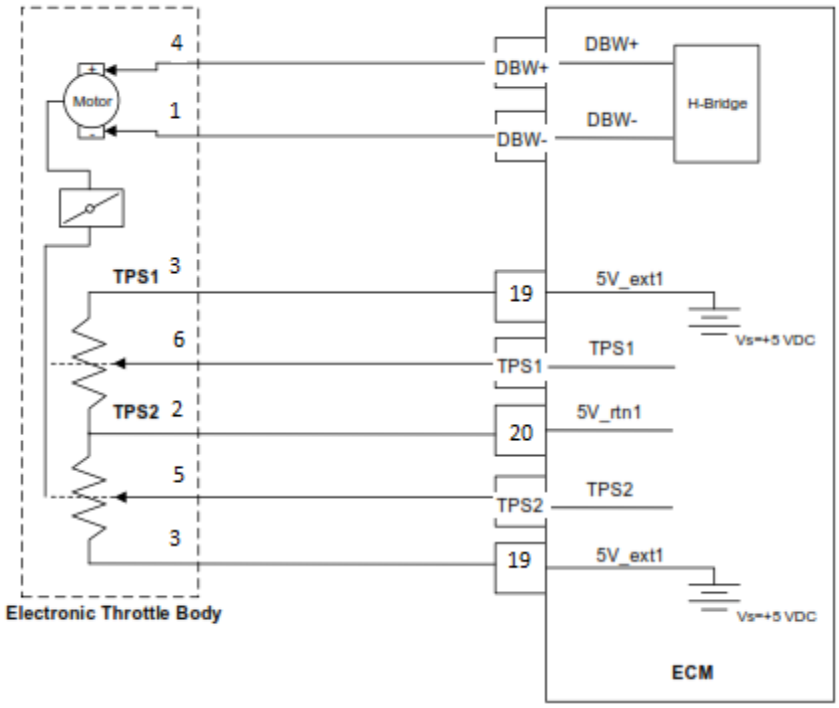
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	YES	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 122 - TPS1 SIGNAL VOLTAGE LOW (Trouble Tree)



DTC 123 - TPS1 SIGNAL VOLTAGE HIGH



DTC	122	SPN	51	FMI	3
Hardware:	Throttle Body-Throttle Position Sensor 1 & 2 (electronic throttle body only)				

Hardware Description:

The throttle controls the airflow through the engine, directly affecting the power output of the engine. When the throttle is electronically controlled in an Electronic Throttle Body it can be used to control the idle stability and limit engine speed based on operating conditions.

The Throttle Position Sensor uses either 1) a variable resistor and voltage divider circuit or 2) a non-contact hall-effect sensor to determine throttle plate position, and is located within the throttle body. The output of the TPS is linear with angular position. The TPS input(s) provide angular position feedback of the throttle plate. In mechanical throttle bodies this sensor is typically used to help improve return-to-idle governing when working in combination with an Idle Air Control motor. In an Electronic Throttle Body multiple position feedback sensors (usually two counteracting potentiometers/hall-effects) are used to perform speed governing with improved safety and redundancy.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**NO**
Check Condition:	Key On, Engine Off

Fault Set Conditions (as defined in calibration):		
• TPS1 voltage >	4.8	volts

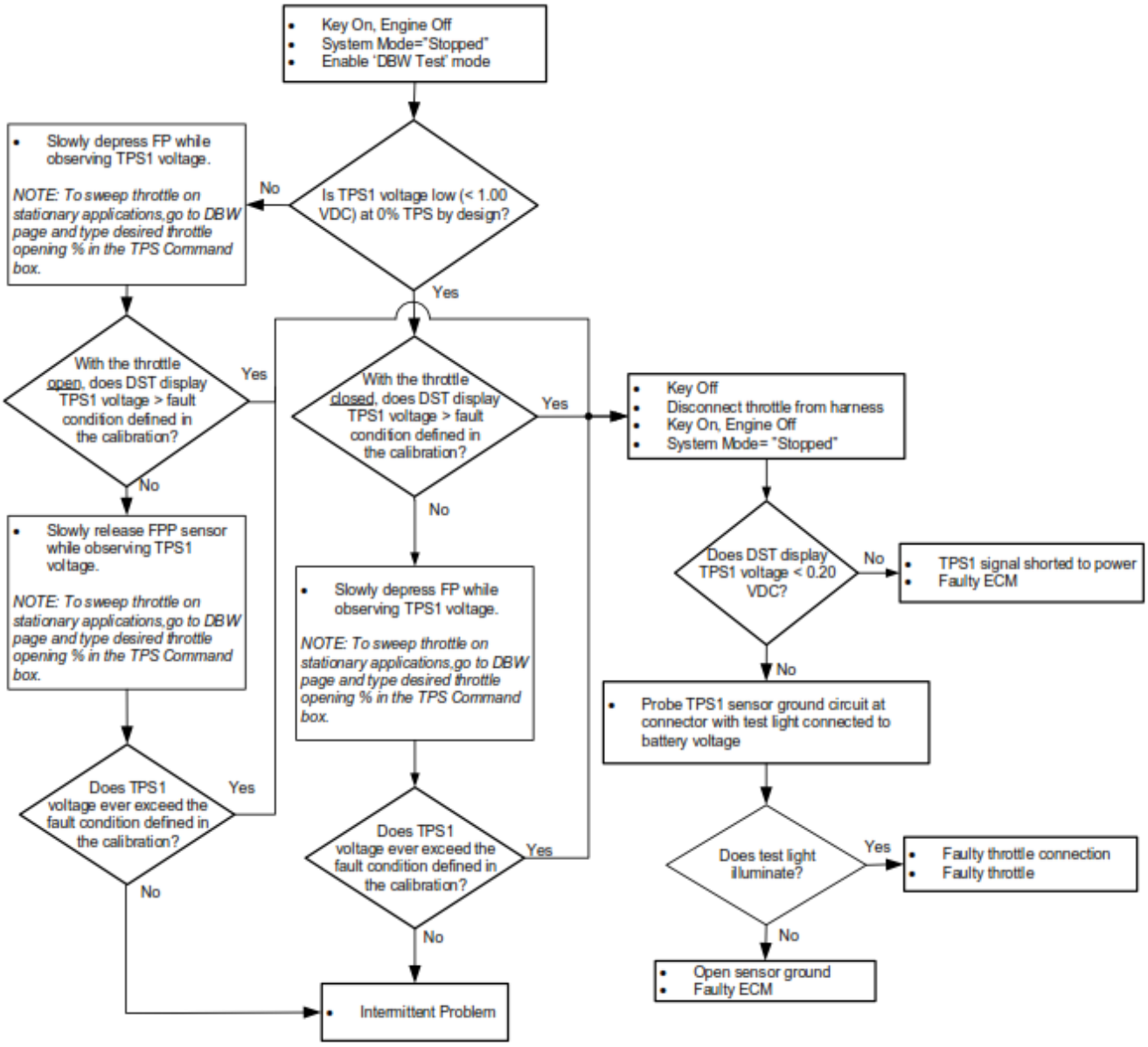
Possible Causes:

This fault will set if TPS1 voltage is higher than the limit set in the diagnostic calibration at any operating condition while the engine is cranking or running. The limit is generally set to 4.90 VDC. In many cases, this condition is caused by a short-to-power of the TPS circuit in the wireharness or a failure of the sensor.

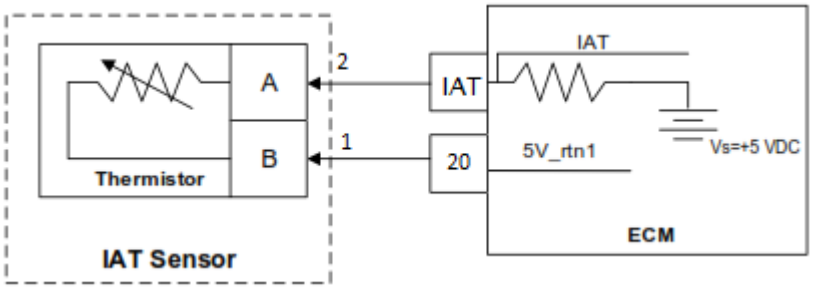
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	YES	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 123 - TPS1 HIGH VOLTAGE (Trouble Tree)



DTC 127 - IAT HIGHER THAN EXPECTED STAGE 2



DTC	127	SPN	105	FMI	0

Hardware: Intake Air Temperature Sensor

Hardware Description:

The Intake Air Temperature sensor is a thermistor (temperature sensitive resistor) located in the intake manifold of the engine. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower when warm.

The Manifold Air Temperature is a calculated value based mainly on the IAT sensor at high airflow and influenced more by the ECT/CHT at low airflow. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the airflow to the engine, and ignition timing.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• IAT >	200	deg F
• and RPM >	900	rpm

Possible Causes:

This fault will set if the Intake Air Temperature is greater than the stage 2 limit and engine speed is greater than defined in the diagnostic calibration. Generally, a severe course of action will be set to prevent possible damage to the engine, specifically due to knock or detonation which cannot be sensed on some engines due to the lack of knock sensors. During this active fault, maximum throttle position is limited and a visual/audible warning will be activated.

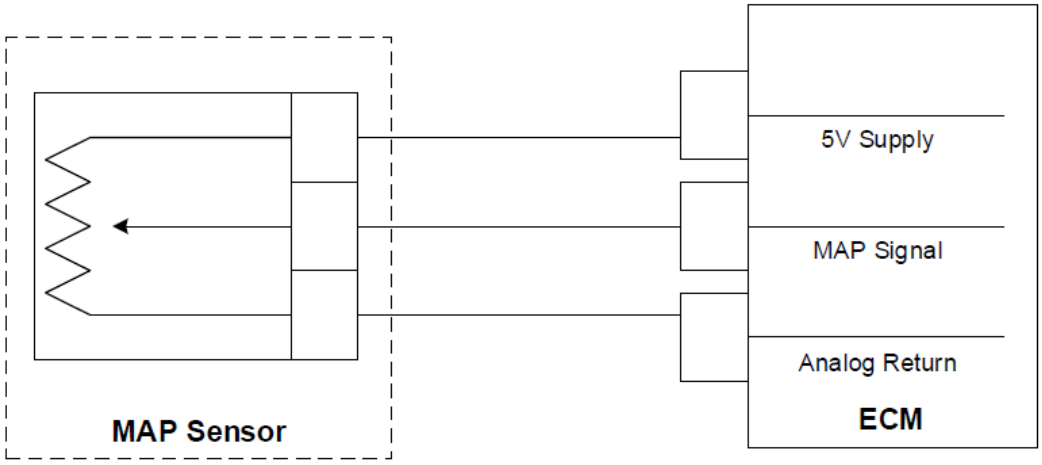
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	YES	Soft Warning	TBD*	NOx Control System	TBD*

Diagnostic Aids

- ☐ This fault will set when inlet air is hotter than normal. The most common cause of high inlet air temperature is a result of a problem with routing of the inlet air. Ensure inlet plumbing sources are external, is cool, and is not too close to the exhaust at any point.
- ☐ Inspect the inlet air system for cracks or breaks that may allow unwanted under-hood air to enter the engine.
- ☐ If no problem is found, replace the IAT sensor with a known good part and retest.

DTC 129 - BP LOW PRESSURE



DTC	129	SPN	108	FMI	1		

Hardware/Circuit: Barometric Temperature / Manifold Absolute Pressure Sensor

Hardware/Circuit Description:

Barometric Pressure is estimated from the MAP sensor at key-on and in some calibrations during low speed/high load operation as defined in the engine's calibration. The barometric pressure value is used for fuel and airflow calculations and equivalence ratio targets based on altitude.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

• BP pressure <	**8.00**	psia

Fault Description:

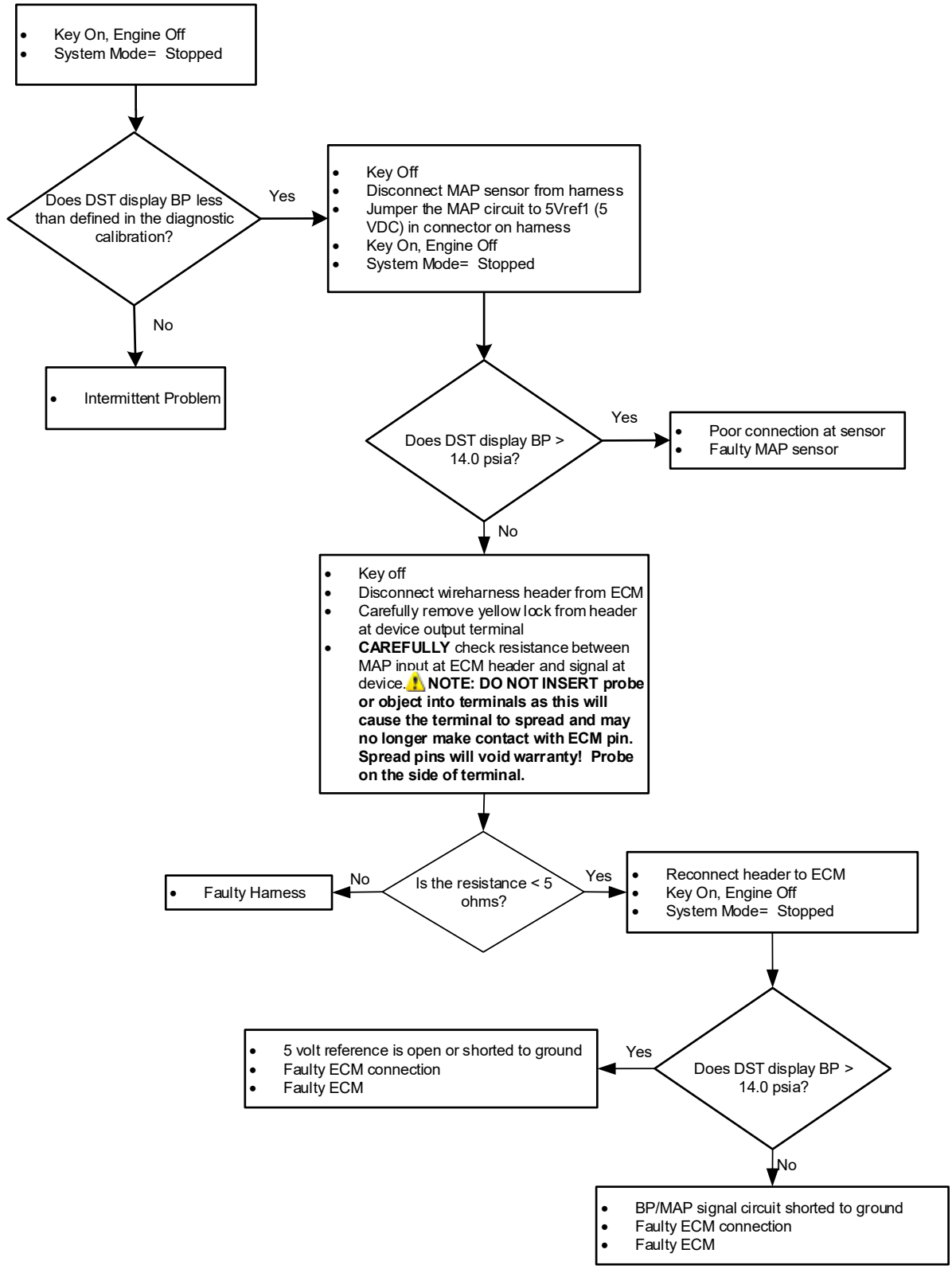
This fault sets if the barometric pressure is lower than the minimum set pressure (psia) as defined in the diagnostic calibration. In the event of an active fault, the MIL is illuminated for the remainder of the key on cycle, an audible warding and/or a secondary warning lamp is activated, and the Adaptive Learn function is disabled to prevent improper learning and population of the table.

Corrective Actions *:*

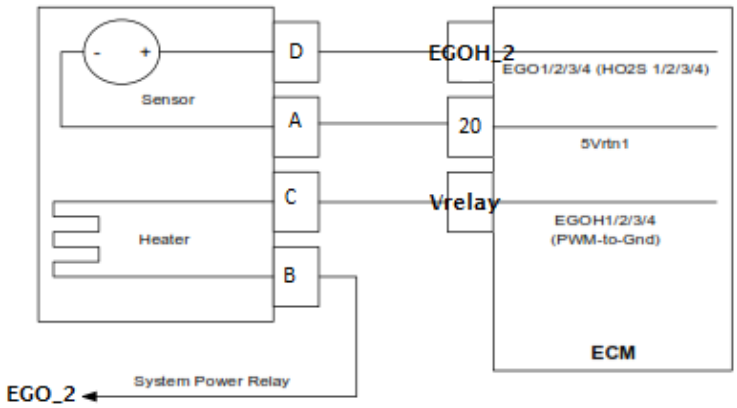
Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**TBD**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

DTC 129 - BP LOW PRESSURE (TROUBLE TREE)

Trouble Tree



DTC 134 – EGO1 OPEN / LAZY (HO2S1)



DTC	134	SPN	3217	FMI	5

Hardware: Heated or Universal Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)

Hardware Description:

The HEGO/HO2S sensor is a switching-type sensor about stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear analog output proportional to lambda/equivalence ratio/air-fuel ratio. In either case, if there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted using the Closed Loop multiplier and then "learned" with the Adaptive multiplier. The multipliers only update when the system is in either "CL Active" or "CL + Adapt" control modes.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• EGO cold persistently >	120	seconds

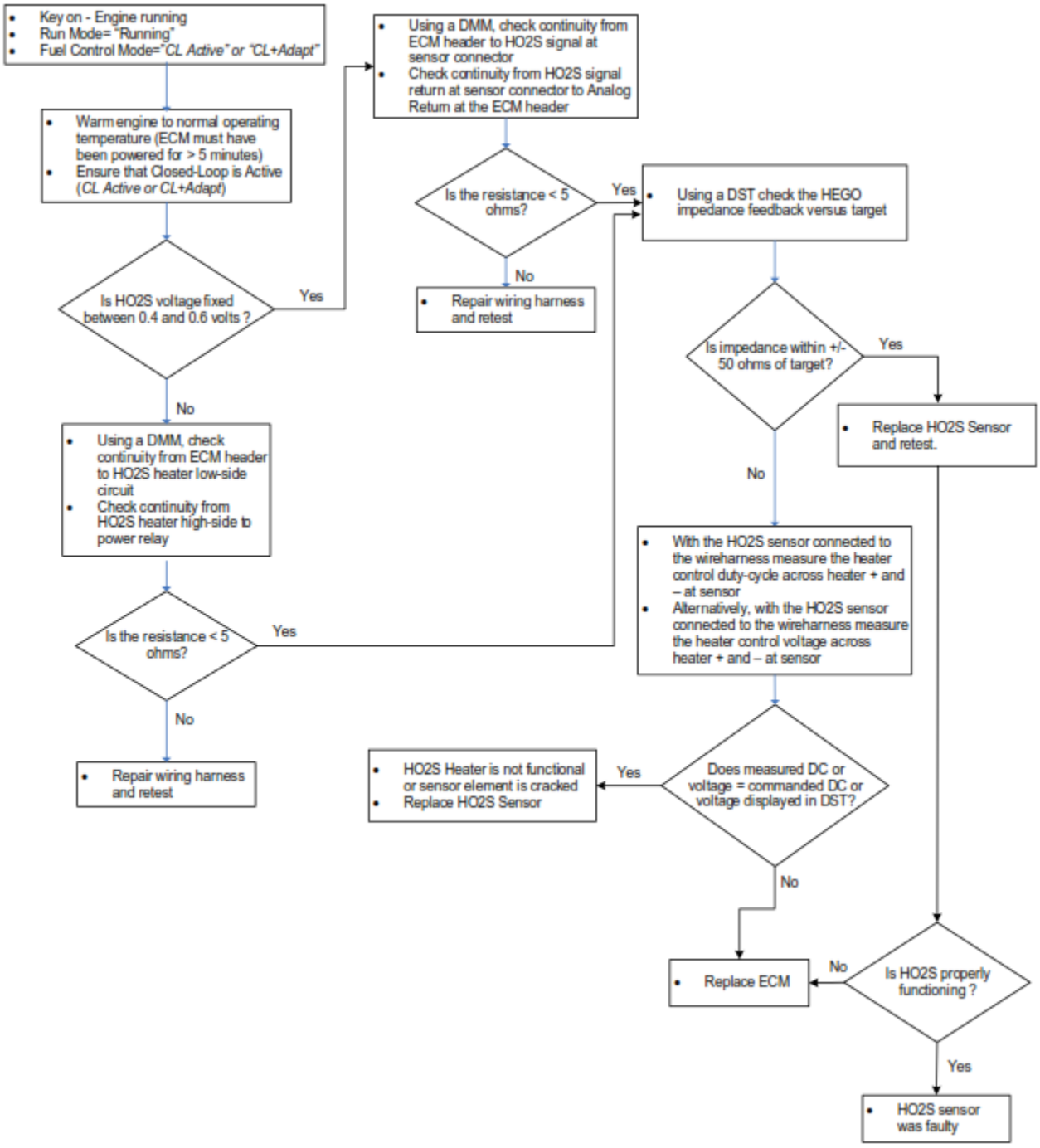
Possible Causes:

This fault will set if the sensor element is cold, non-responsive, or inactive for x seconds as defined in the diagnostic calibration. Cold, non-responsive, or inactive are determined based on two criteria 1) a measurement of the feedback sense element (zirconia) to determine its temperature or 2) a lack of change in sensor feedback.

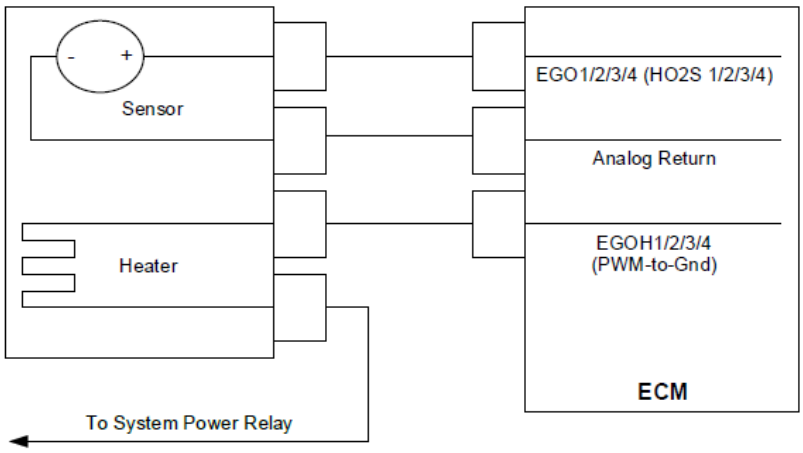
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	YES	Power Derate 1	YES	Soft Warning	TBD*	NOx Control System	TBD*

DTC 134 – EGO1 OPEN / LAZY (HO2S1) (Trouble Tree)



DTC 154 – EGO2 OPEN/LAZY



DTC	**154**	**SPN**	**520208**	**FMI**	**10**		

Hardware/Circuit: Heated or Universal Exhaust Gas Oxygen Sensor
(Bank and Position Assignment as Defined in Calibration)

Hardware/Circuit Description:

The HEGO/HO2S sensor is a switching-type sensor about stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear analog output proportional to lambda/equivalence ratio/air-fuel ratio. In either case, if there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted using the Closed Loop multiplier and then "learned" with the Adaptive multiplier. The multipliers only update when the system is in either "CL Active" or "CL + Adapt" control modes.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

• EGO cold persistently >	**180**	seconds

Fault Description:

This fault will set if the sensor element is cold, non-responsive, or inactive for x seconds as defined in the diagnostic calibration. Cold, non-responsive, or inactive are determined based on two criteria:

1) a measurement of the feedback sense element (zirconia) to determine its temperature, or

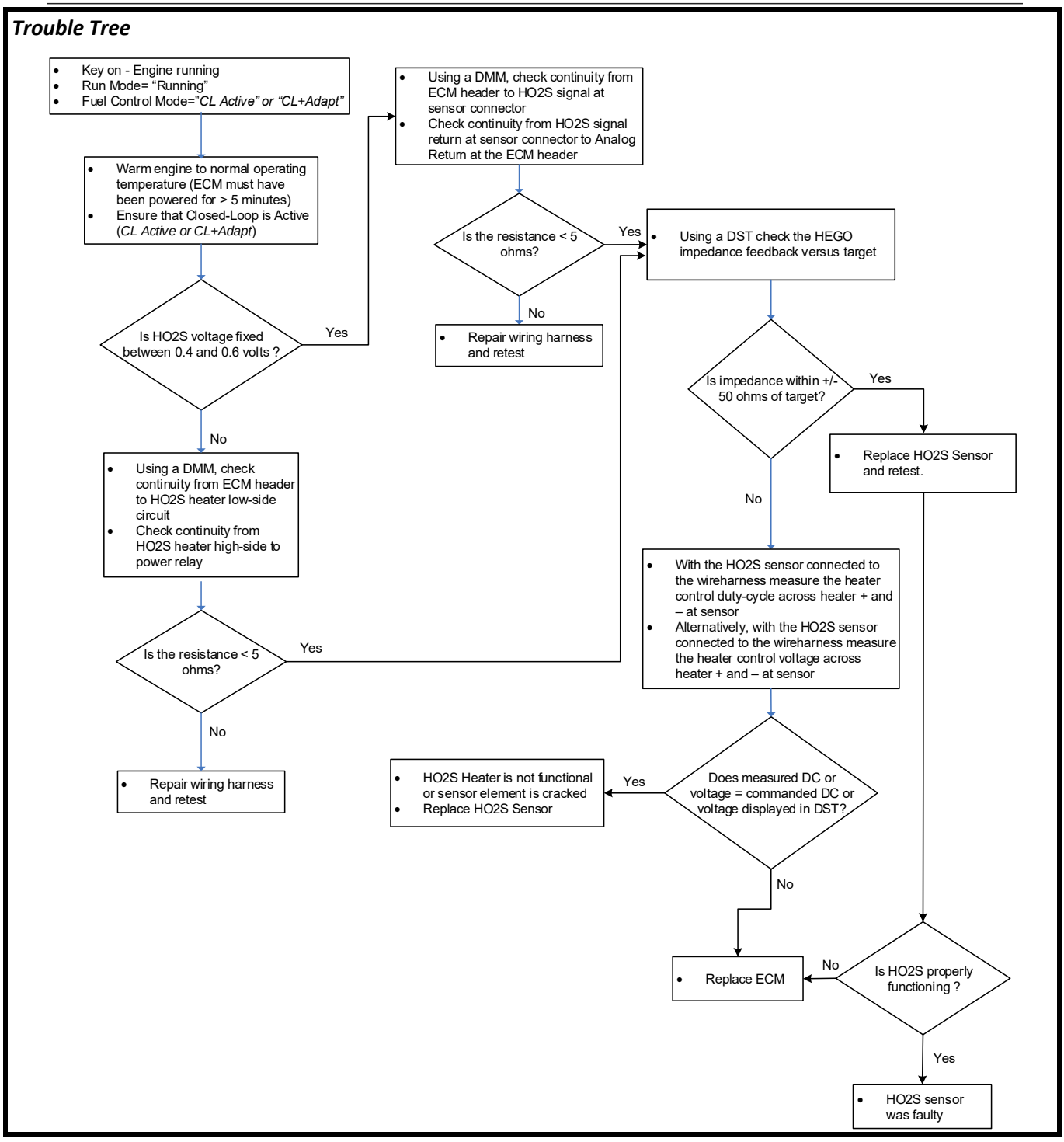
2) a lack of change in sensor feedback, indicated by a slow warm-up time, a CAN-based UEGO diagnostic bit flagging a problem, or the UEGO voltage is out of range per calibration.

Corrective Actions:

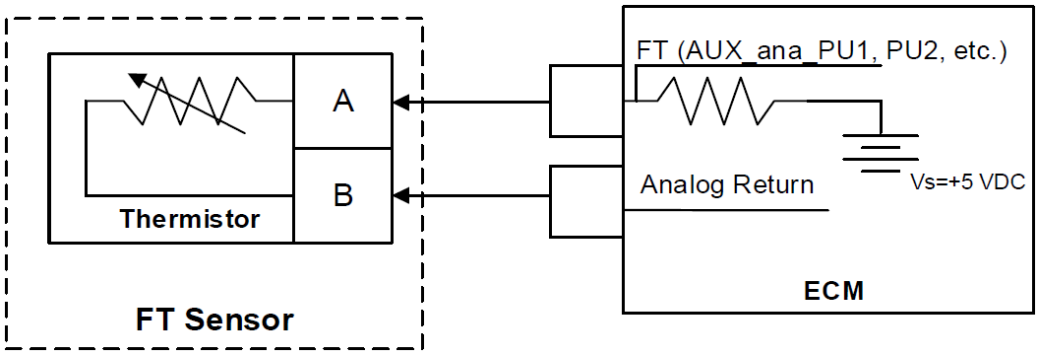
Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**TBD**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

DTC 154 – EGO2 OPEN/LAZY (TROUBLE TREE)

Trouble Tree



DTC 187 – FT GASEOUS FUEL LOW



DTC	187	SPN	520240	FMI	4		

Hardware/Circuit: Gaseous Fuel Temperature Sensor

Hardware/Circuit Description:

The Fuel Temperature sensor is a thermistor (temperature sensitive resistor) that can be an external sensor or an integrated sensor in the EPR/CFV, depending on the type of fuel system. It is used to calculate the fuel mass flow.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

• FT voltage <	**.050**	volts
• or fuel temp <	**-35.0**	deg F

Fault Description:

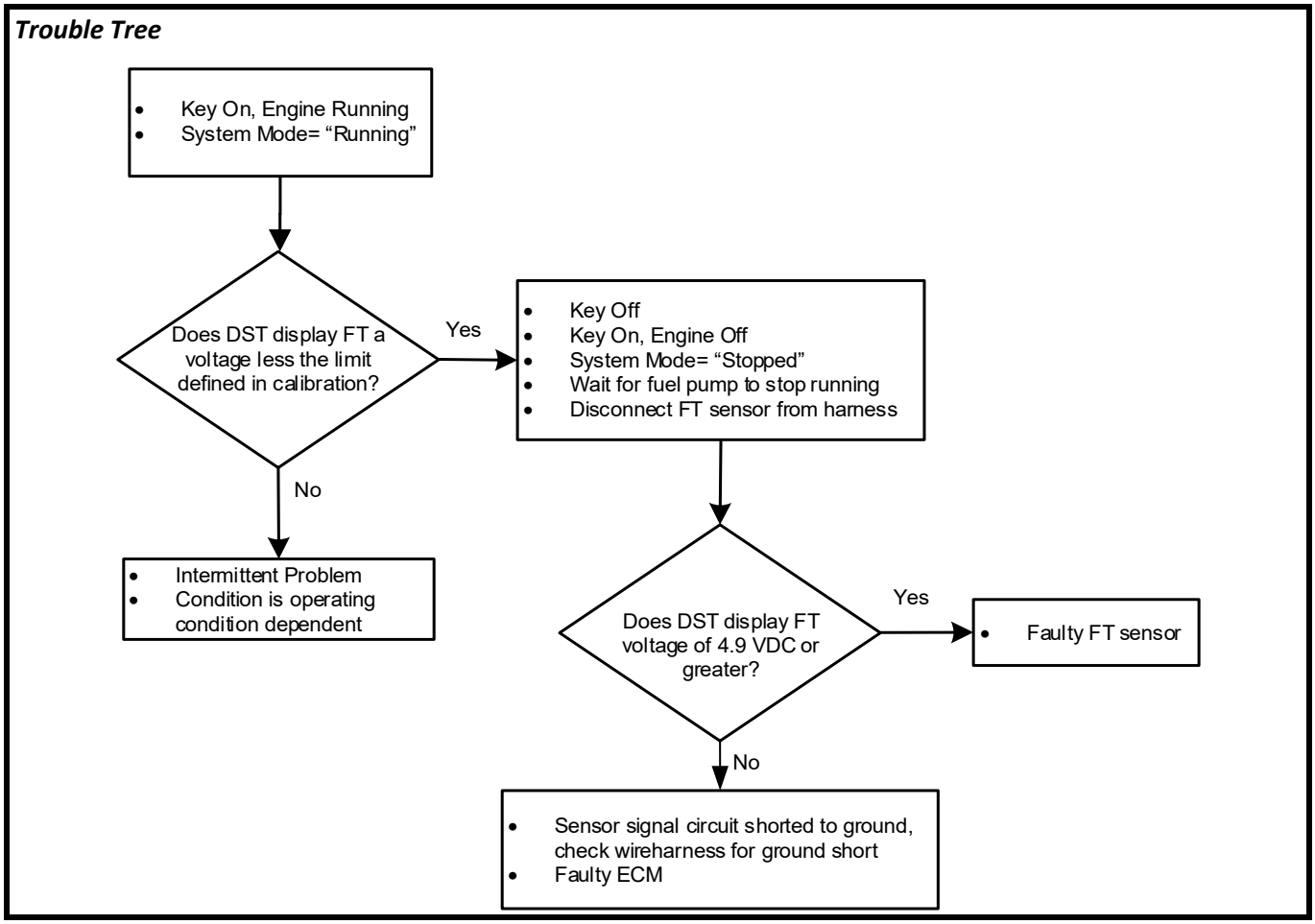
This fault will set if the signal voltage is less than the low voltage limit OR if fuel temperature is less than the low temperature limit as defined in the diagnostic calibration anytime that the engine is running. Fault entry condition is defined in the calibration as **VOLTAGE ONLY**, **TEMPERATURE ONLY**, or **VOLTAGE OR TEMPERATURE** entry conditions.

Corrective Actions:

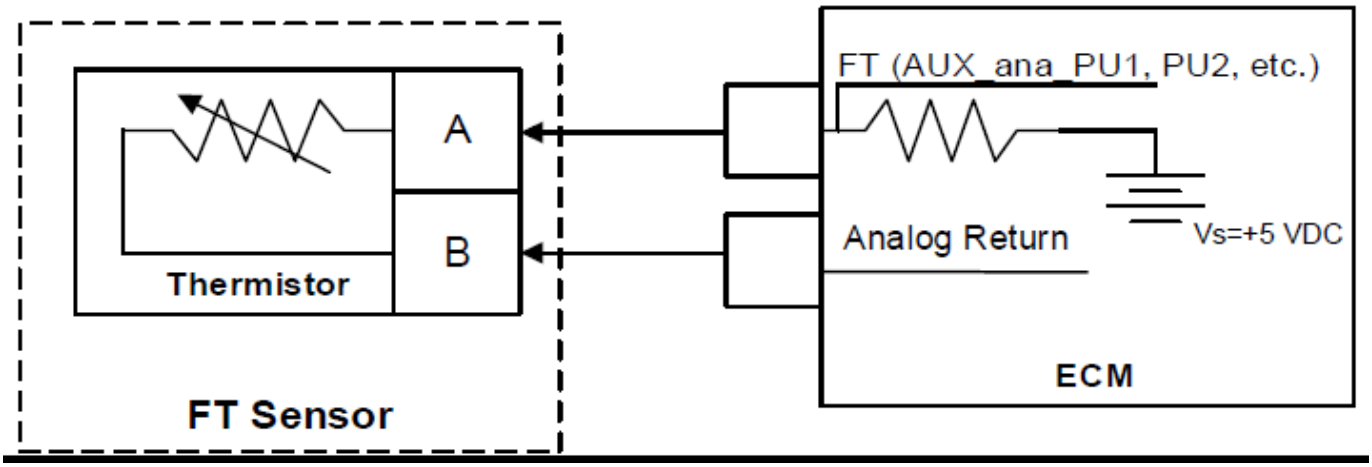
Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**TBD**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

DTC 187 – FT GASEOUS FUEL LOW (TROUBLE TREE)

Trouble Tree



DTC 188 – FT GASEOUS FUEL HIGH



DTC	188	SPN	520240	FMI	3		

Hardware/Circuit: Gaseous Fuel Temperature Sensor

Hardware/Circuit Description:

The Fuel Temperature sensor is a thermistor (temperature sensitive resistor) that can be an external sensor or an integrated sensor in the EPR/CFV, depending on the type of fuel system. It is used to calculate the fuel mass flow.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

• FT voltage >	**4.950**	volts
• or fuel temp >	**250.0**	deg F

Fault Description:

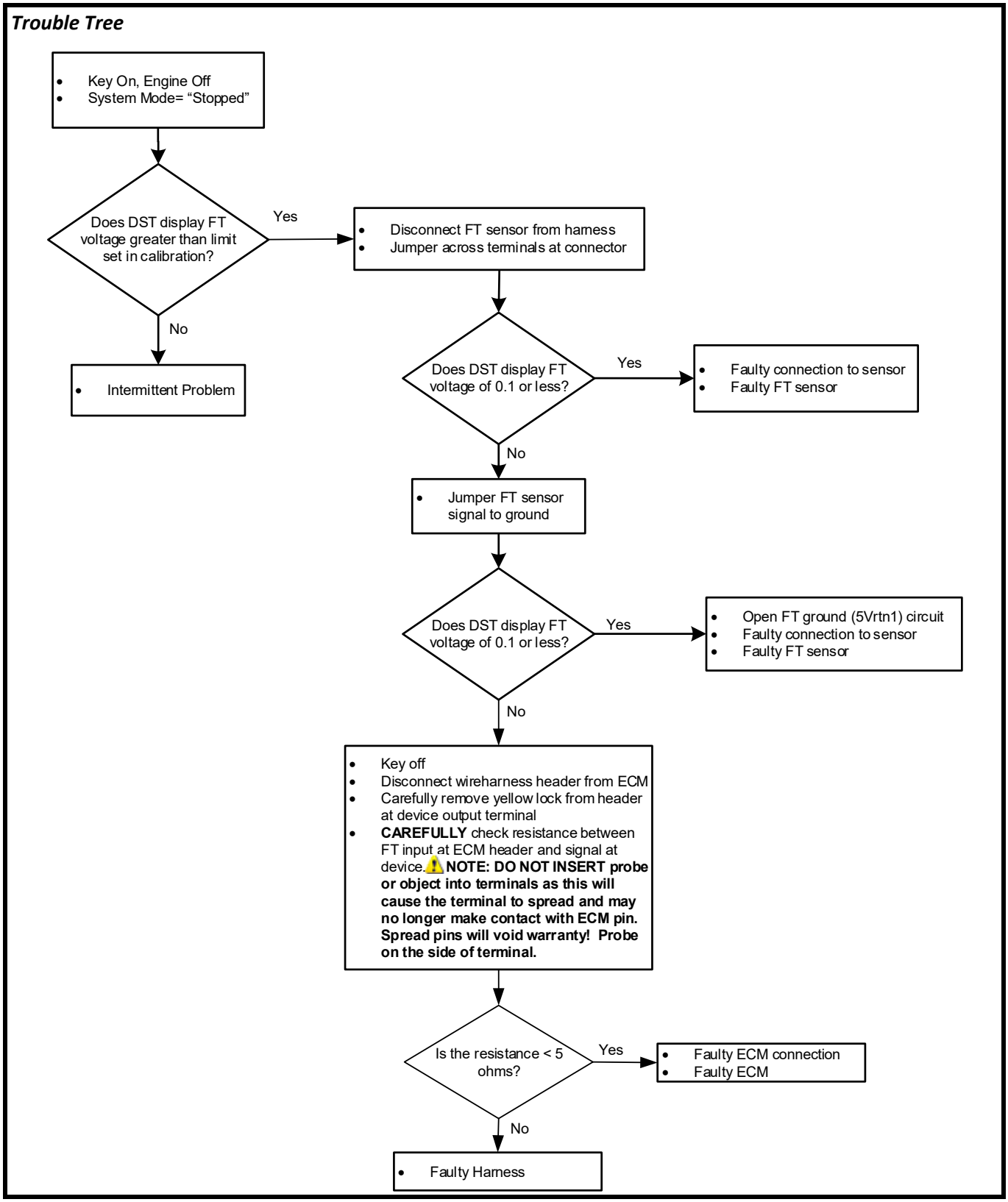
This fault will set if the signal voltage is greater than the high voltage limit OR if fuel temperature is greater than the high temperature limit as defined in the diagnostic calibration anytime that the engine is running. Fault entry condition is defined in the calibration as **VOLTAGE ONLY**, **TEMPERATURE ONLY**, or **VOLTAGE OR TEMPERATURE** entry conditions.

Corrective Actions:

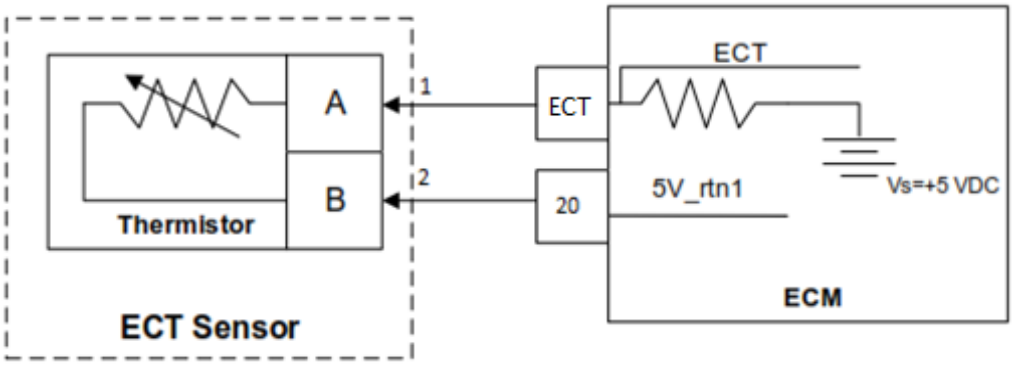
Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**TBD**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

DTC 188 – FT GASEOUS FUEL HIGH (TROUBLE TREE)

Trouble Tree



DTC 217 - ECT HIGHER THAN EXPECTED 2



DTC	217	SPN	110	FMI	0
Hardware:	Engine Coolant Temperature Sensor				

Hardware Description:

The Engine Coolant Temperature sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. Some engines use a CHT sensor that is located in the coolant in the cylinder head. Some engines use an ECT (Engine Coolant Temperature) sensor that is located in the coolant near the thermostat. If the engine is equipped with a CHT sensor then the ECT value is estimated. If equipped with an ECT sensor then the CHT value is estimated. They are used for engine airflow calculation, ignition timing control, to enable certain features, and for engine protection.

The ECM provides a voltage divider circuit so when the sensor reading is cool the sensor reads higher voltage, and lower when warm.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**NO**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• ECT >	230	deg F
• and RPM >	50	rpm
• and run-time >	15	seconds

Possible Causes:

This fault will help protect the engine in the event of over temperature. When the coolant exceeds x deg. F and engine RPM exceeds y RPM for the latch time this fault will set.

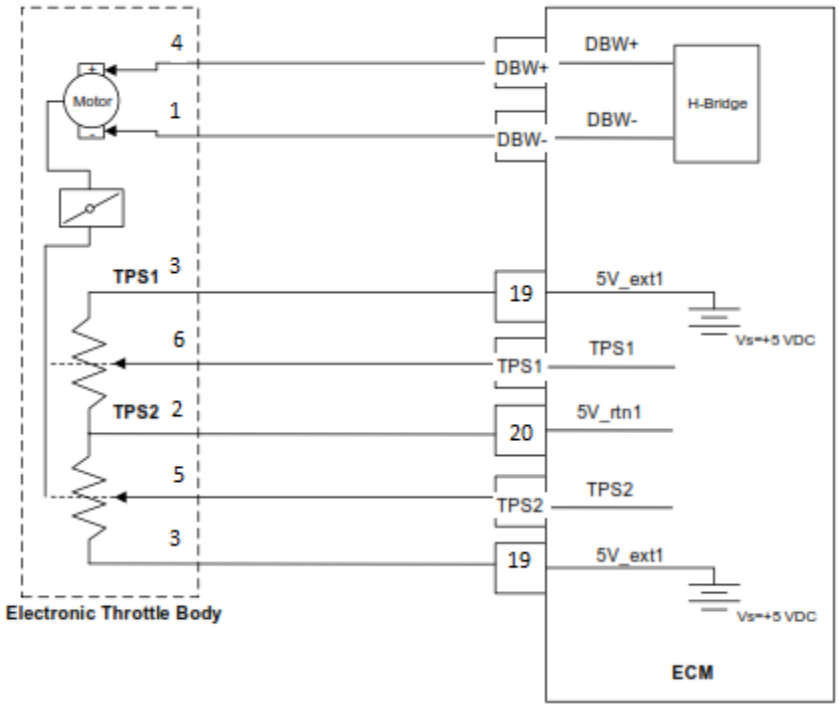
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	YES	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	yes	Soft Warning	TBD*	NOx Control System	TBD*

Diagnostic Aids:

- ☐ If the "ECT High Voltage" fault is also present, follow the troubleshooting procedures for that fault as it may have caused "ECT Higher Than Expected 2."
- ☐ If the cooling system utilizes an air-to-water heat exchanger (radiator) and fan:
  - Check that the radiator has a proper amount of ethylene glycol/water and that the radiator is not leaking
  - Ensure that there is no trapped air in the cooling path
  - Inspect the cooling system (radiator and hoses) for cracks and ensure connections are leak free
  - Check that the fan is operating properly
  - Check that the thermostat is not stuck closed
- ☐ If the cooling system utilizes a water-to-water heat exchanger:
  - Check that the heat exchanger has a proper amount of ethylene glycol/water and that the heat exchanger is not leaking
  - Ensure that there is no trapped air in the cooling path
  - Inspect the cooling system (radiator and hoses) for cracks and ensure connections are leak free
  - Check that the raw water pickup is not blocked/restricted by debris and that the hose is tightly connected
  - Check that the thermostat is not stuck closed
  - Check that the raw water pump/impeller is tact and that it is not restricted

DTC 219 - RPM HIGHER THAN MAX ALLOWED GOVERNED SPEED



DTC	219	SPN	515	FMI	15
Hardware:	Max Govern Speed Override- Crankshaft Position Sensor				

Description:

The Max Allowed Governed Speed overrides any higher max governor speeds programmed by the user. This fault is designed to help prevent engine or equipment damage.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**NO**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• RPM >	2350	rpm

Possible Causes:

This fault will set anytime the engine RPM exceeds the limit set in the diagnostic calibration for the latch time or more.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

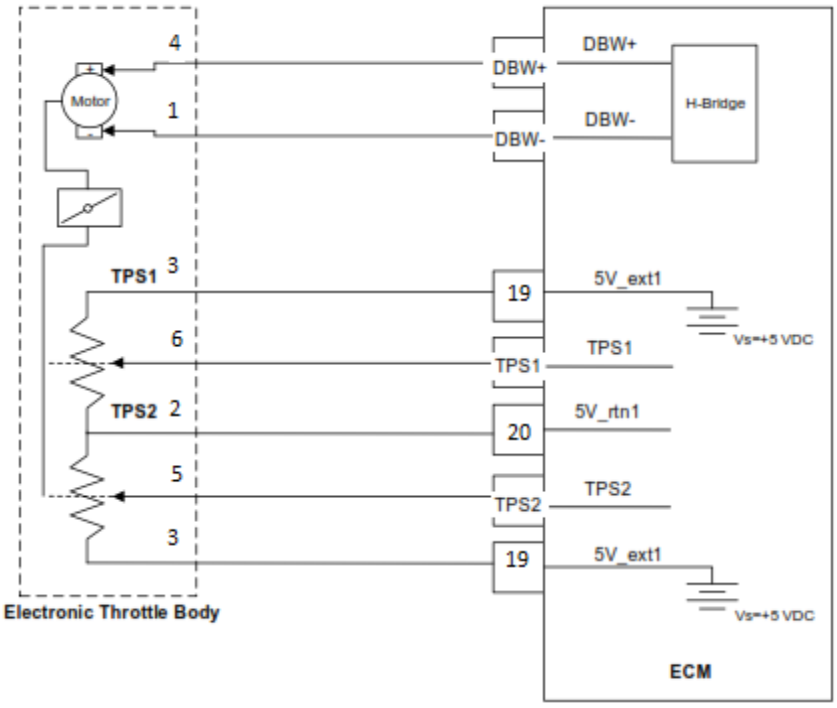
Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	YES	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

Diagnostic Aid:

NOTE: If any other DTCs are present, diagnose those first.

- ☐ Ensure that no programmed governor speeds exceed the limit set in the diagnostic calibration for Max Gov Override Speed
- ☐ Check mechanical operation of the throttle
- ☐ Check the engine intake for large air leaks downstream of the throttle body

DTC 221 - TPS1 % HIGHER THAN TPS2 %



DTC	221	SPN	51	FMI	0

Hardware: Throttle Body-Throttle Position Sensor 1 & 2 (electronic throttle body only)

Hardware Description:

The throttle controls the airflow through the engine, directly affecting the power output of the engine. When the throttle is electronically controlled in an Electronic Throttle Body it can be used to control the idle stability and limit engine speed based on operating conditions.

The Throttle Position Sensor uses either 1) a variable resistor and voltage divider circuit or 2) a non-contact hall-effect sensor to determine throttle plate position, and is located within the throttle body. The output of the TPS is linear with angular position. The TPS input(s) provide angular position feedback of the throttle plate. In an Electronic Throttle Body multiple position feedback sensors (usually two counteracting potentiometers/hall-effects) are used to perform speed governing with improved safety and redundancy.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**NO**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• (TPS1% - TPS2%) >	20	%

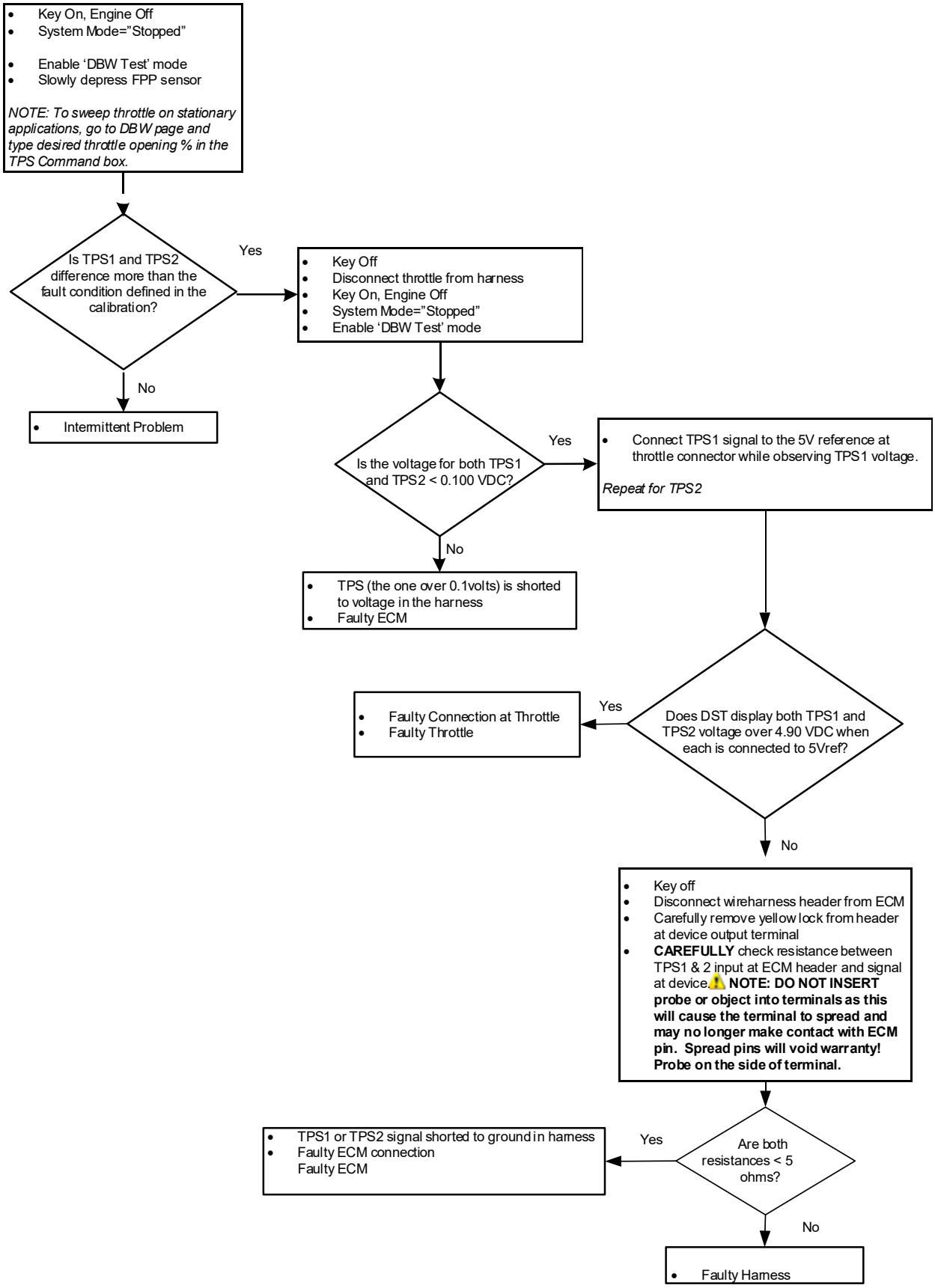
Possible Causes:

This fault will set if TPS1 % is higher than TPS2 % by the amount defined in the diagnostic calibration. At this point the throttle is considered to be out of specification, or there is a problem with the TPS signal circuit. During this active fault, an audible/visual alert device is activated and either an engine shutdown should is triggered or throttle control is set to use the higher of the two feedback signals for control in combination with a low rev limit and/or power derate.

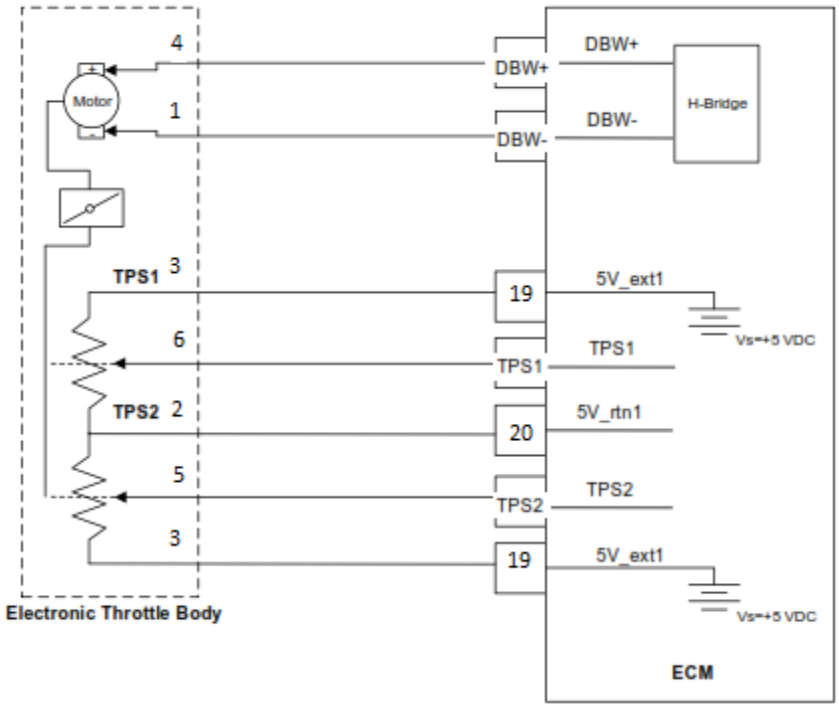
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	YES	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 221 - TPS1 % HIGHER THAN TPS2 % (TROUBLE TREE)



DTC 222 - TPS2 SIGNAL VOLTAGE LOW



DTC	222	SPN	3673	FMI	4
Hardware:	Throttle Body-Throttle Position Sensor 2 (electronic throttle body only)				

Hardware Description:

The throttle controls the airflow through the engine, directly affecting the power output of the engine. When the throttle is electronically controlled in an Electronic Throttle Body it can be used to control the idle stability and limit engine speed based on operating conditions.

The Throttle Position Sensor uses either 1) a variable resistor and voltage divider circuit or 2) a non-contact hall-effect sensor to determine throttle plate position, and is located within the throttle body. The output of the TPS is linear with angular position. The TPS input(s) provide angular position feedback of the throttle plate. In an Electronic Throttle Body multiple position feedback sensors (usually two counteracting potentiometers/hall-effects) are used to perform speed governing with improved safety and redundancy.

Fault Enabled in Calibration?	YES		
Emissions-related Fault?	**NO**		
Check Condition:	Engine Running		
Fault Set Conditions (as defined in calibration):			
• TPS2 voltage <		0.2	volts

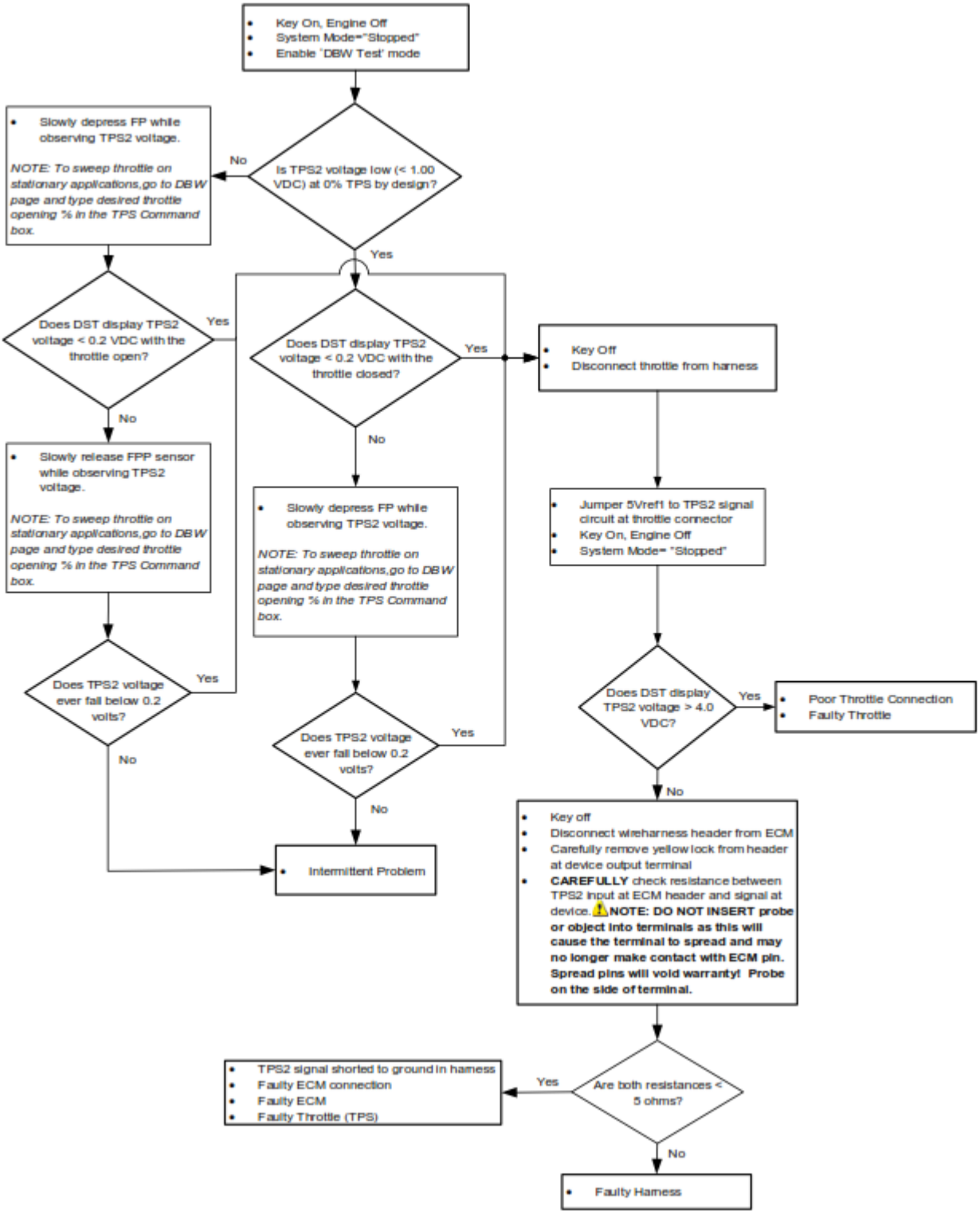
Possible Causes:

This fault will set if TPS2 voltage is lower than the low voltage limit as defined in the diagnostic calibration at any operating condition while the engine is cranking or running. The limit is generally set to 4.90 VDC. In many cases, this condition is caused by the TPS sensor being disconnected from the engine harness, an open-circuit or short-to-ground of the TPS circuit in the wire harness, or a failure of the sensor. This fault should be configured to trigger an engine shutdown and the engine will not start with this fault active.

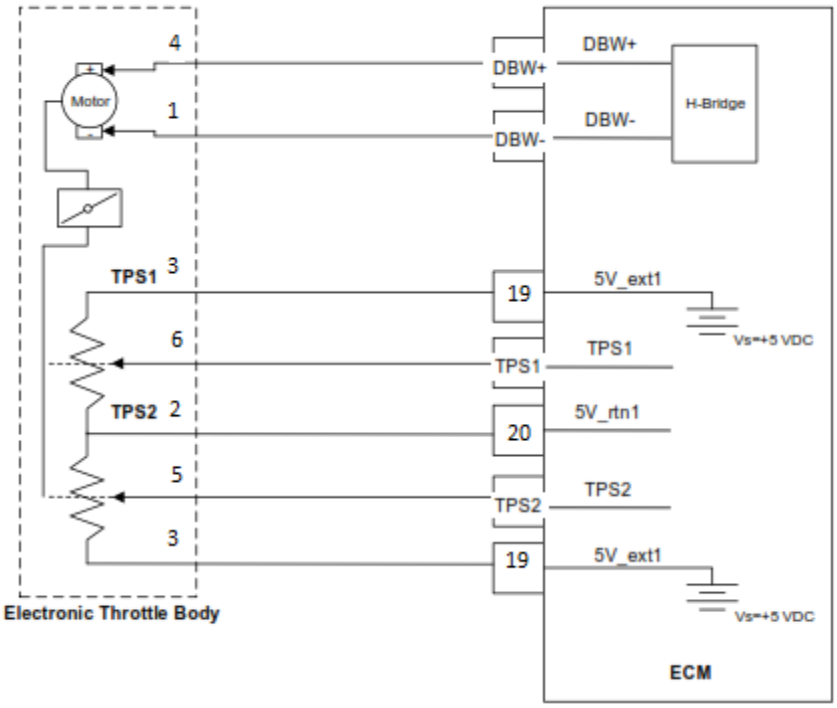
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	YES	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 222 - TPS2 SIGNAL VOLTAGE LOW (TROUBLE TREE)



DTC 223 - TPS2 SIGNAL VOLTAGE HIGH



DTC	223	SPN	3673	FMI	3
Hardware:	Throttle Body-Throttle Position Sensor 2 (electronic throttle body only)				

Hardware Description:

The throttle controls the airflow through the engine, directly affecting the power output of the engine. When the throttle is electronically controlled in an Electronic Throttle Body it can be used to control the idle stability and limit engine speed based on operating conditions.

The Throttle Position Sensor uses either 1) a variable resistor and voltage divider circuit or 2) a non-contact hall-effect sensor to determine throttle plate position, and is located within the throttle body. The output of the TPS is linear with angular position. The TPS input(s) provide angular position feedback of the throttle plate. In an Electronic Throttle Body multiple position feedback sensors (usually two counteracting potentiometers/hall-effects) are used to perform speed governing with improved safety and redundancy.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**NO**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• TPS2 voltage >	4.8	volts

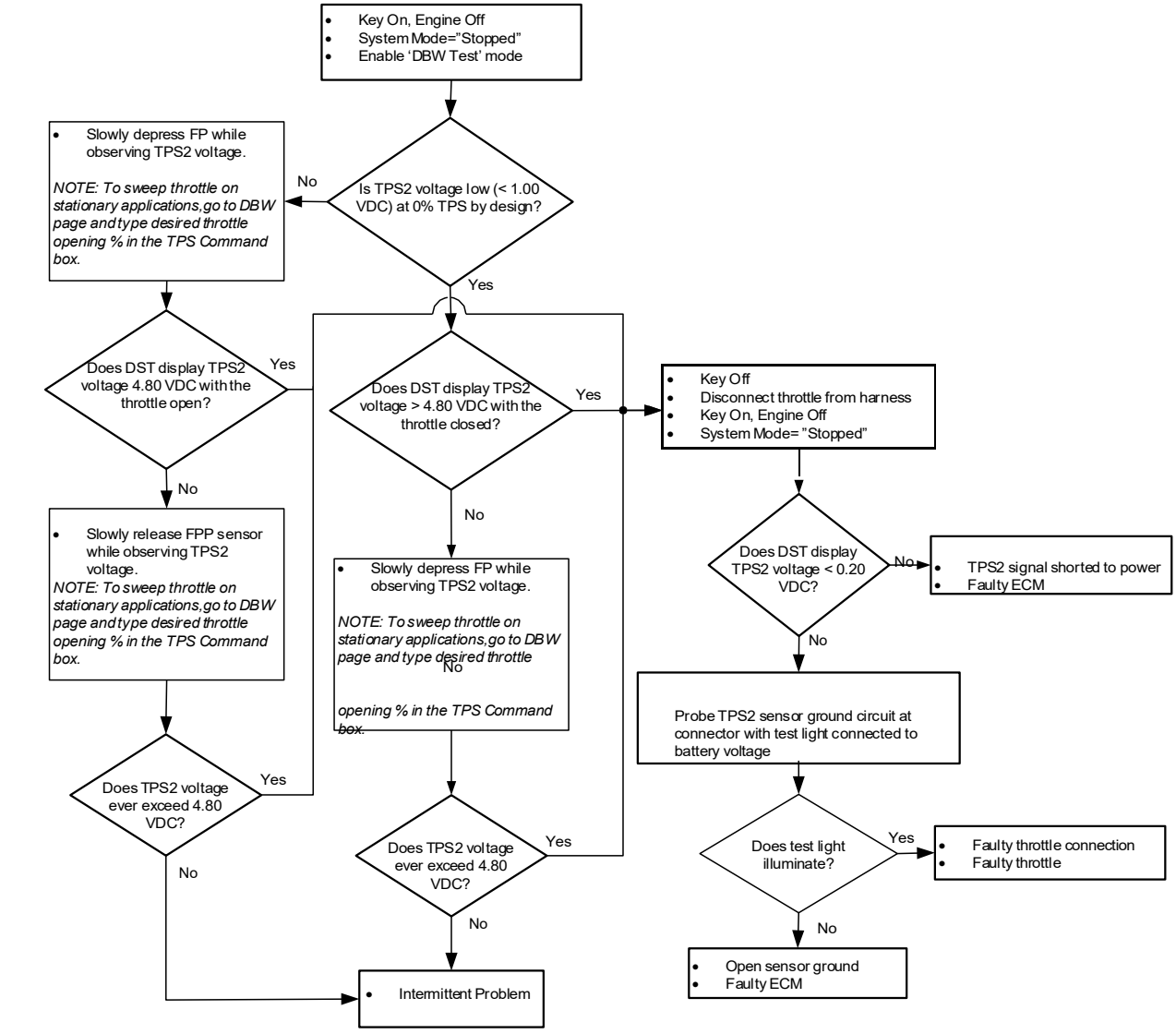
Possible Causes:

This fault will set if TPS2 voltage is higher than the limit set in the diagnostic calibration at any operating condition while the engine is cranking or running. The limit is generally set to 4.90 VDC. In many cases, this condition is caused by a short-to-power of the TPS circuit in the wire harness or a failure of the sensor. This fault should be configured to trigger an engine shutdown and the engine will not start with this fault active.

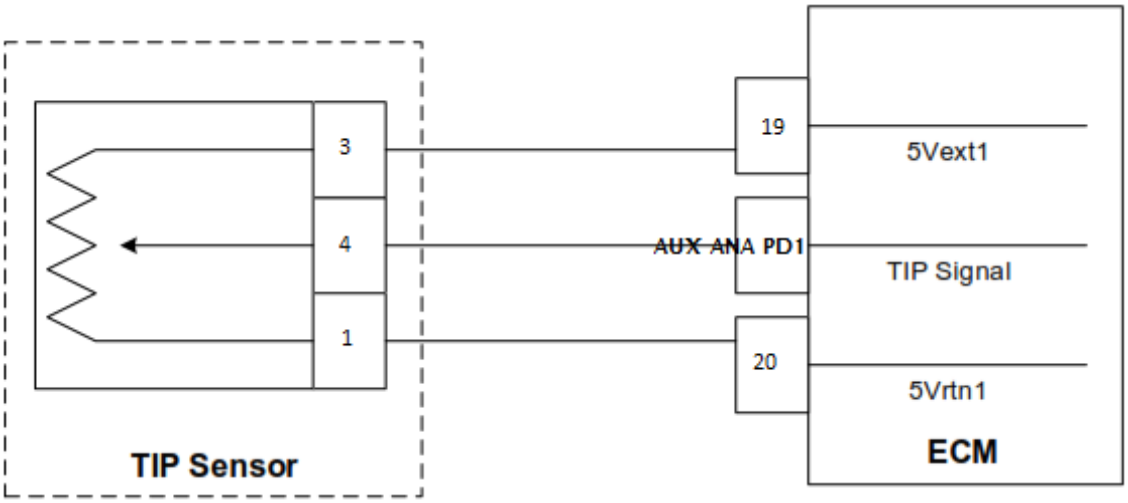
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	YES	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 223 - TPS2 SIGNAL VOLTAGE HIGH



DTC 236 - TIP/TOP ACTIVE



DTC	236	SPN	102	FMI	2

Hardware: Throttle Inlet Pressure (Boost) Sensor

Hardware Description:

The Throttle Inlet Pressure sensor is a pressure transducer located in the intake air stream between the turbocharger or supercharger and the throttle. It is used to measure the boosted air pressure in the intake air stream prior to the throttle. The pressure reading is used in conjunction with other inputs to determine the rate of airflow to the throttle and is used to for boost bypass control.

Fault Enabled in Calibration?	TBD* (*Application-Specific – see calibration)
Emissions-related Fault?	**NO**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• TIP < (turbo) / TOP > (supercharged)	TBD*	psia
• and MAP > (turbo) / MAP < (supercharged)	TBD*	psia

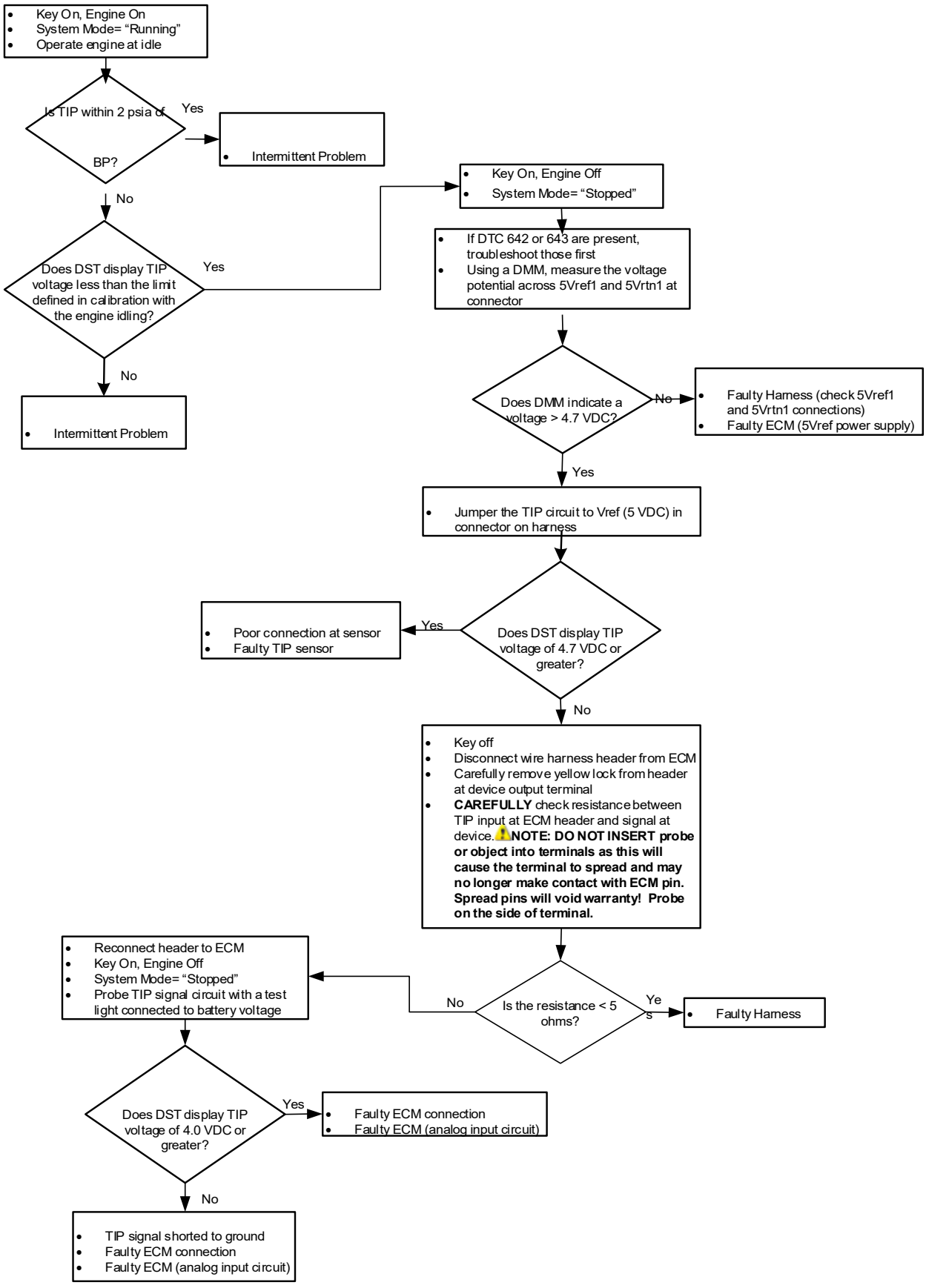
Possible Causes:

This fault detects if the TIP sensor is pneumatically attached to the intake system and whether or not TIP is functional. It sets if MAP is rising without a corresponding change in TIP based on TIP being less than x psia while MAP is greater than y psia as defined in the diagnostic calibration. Recommended corrective action(s) include outputting a warning to the user.

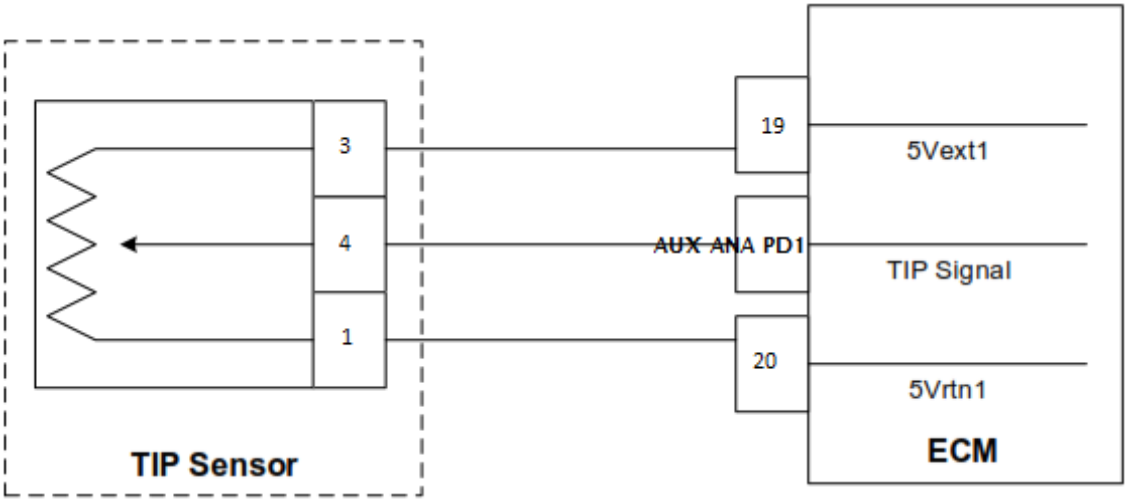
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	TBD*	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 236- TIP Active Trouble Tree



DTC 237 - TIP/TOP LOW VOLTAGE



DTC	237	SPN	102	FMI	4

Hardware: Throttle Inlet Pressure (Boost) Sensor

Hardware Description:

The Throttle Inlet Pressure sensor is a pressure transducer located in the intake air stream between the turbocharger or supercharger and the throttle. It is used to measure the boosted air pressure in the intake air stream prior to the throttle. The pressure reading is used in conjunction with other inputs to determine the rate of airflow to the throttle and is used to for boost bypass control.

Fault Enabled in Calibration?	TBD* (*Application-Specific – see calibration)
Emissions-related Fault?	**NO**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• TIP/TOP voltage <	TBD*	volts

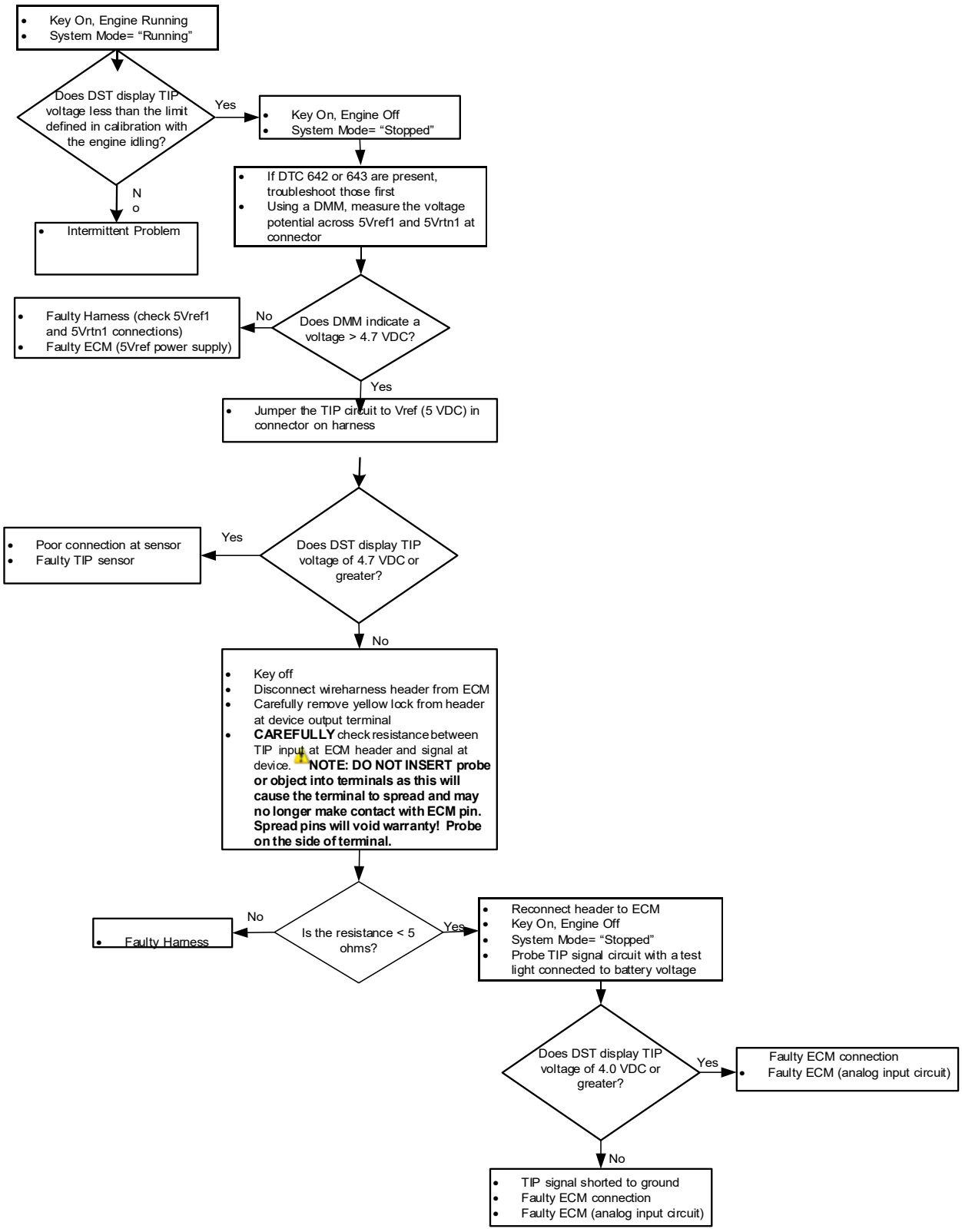
Possible Causes:

This fault will set when the TIP sensor voltage feedback is sensed as lower than the sensor should normally produce as set in the diagnostic calibration. The limit is generally set at 0.10 VDC. In many cases, this condition is caused by the TIP sensor being disconnected from the engine harness, an open-circuit or short-to-ground of the TIP circuit in the wireharness, a loss of sensor reference voltage, or a failure of the sensor. Recommended corrective action(s) include outputting a warning to the user.

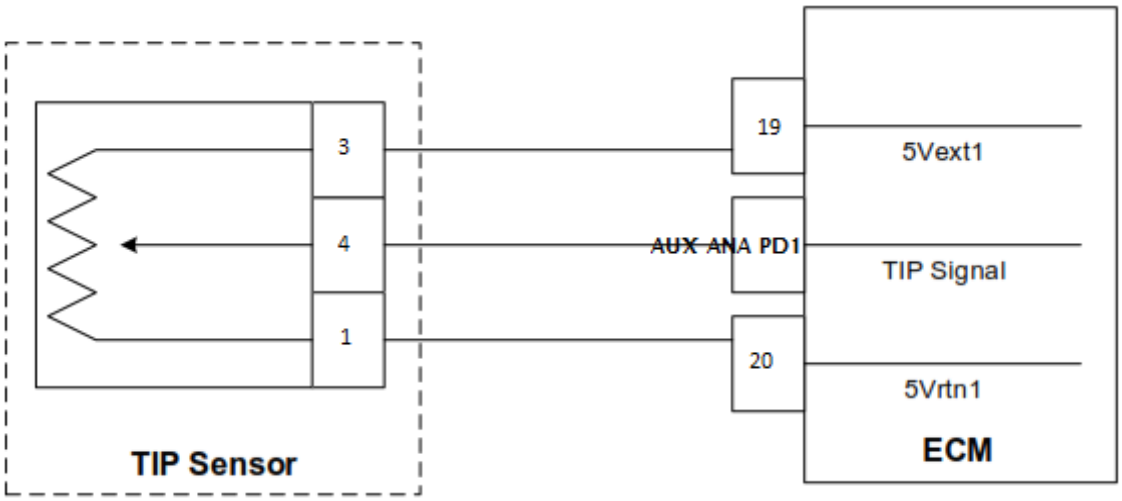
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	TBD*	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 237 - TIP/TOP LOW VOLTAGE (TROUBLE TREE)



DTC 238 - TIP/TOP HIGH VOLTAGE



DTC	238	SPN	102	FMI	3
Hardware:	Throttle Inlet Pressure (Boost) Sensor				

Hardware Description:

The Throttle Inlet Pressure sensor is a pressure transducer located in the intake air stream between the turbocharger or supercharger and the throttle. It is used to measure the boosted air pressure in the intake air stream prior to the throttle. The pressure reading is used in conjunction with other inputs to determine the rate of airflow to the throttle and is used to for boost bypass control.

Fault Enabled in Calibration?	TBD* (*Application-Specific – see calibration)
Emissions-related Fault?	**NO**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• TIP/TOP voltage >	TBD*	volts
• and MAP <	TBD*	psia

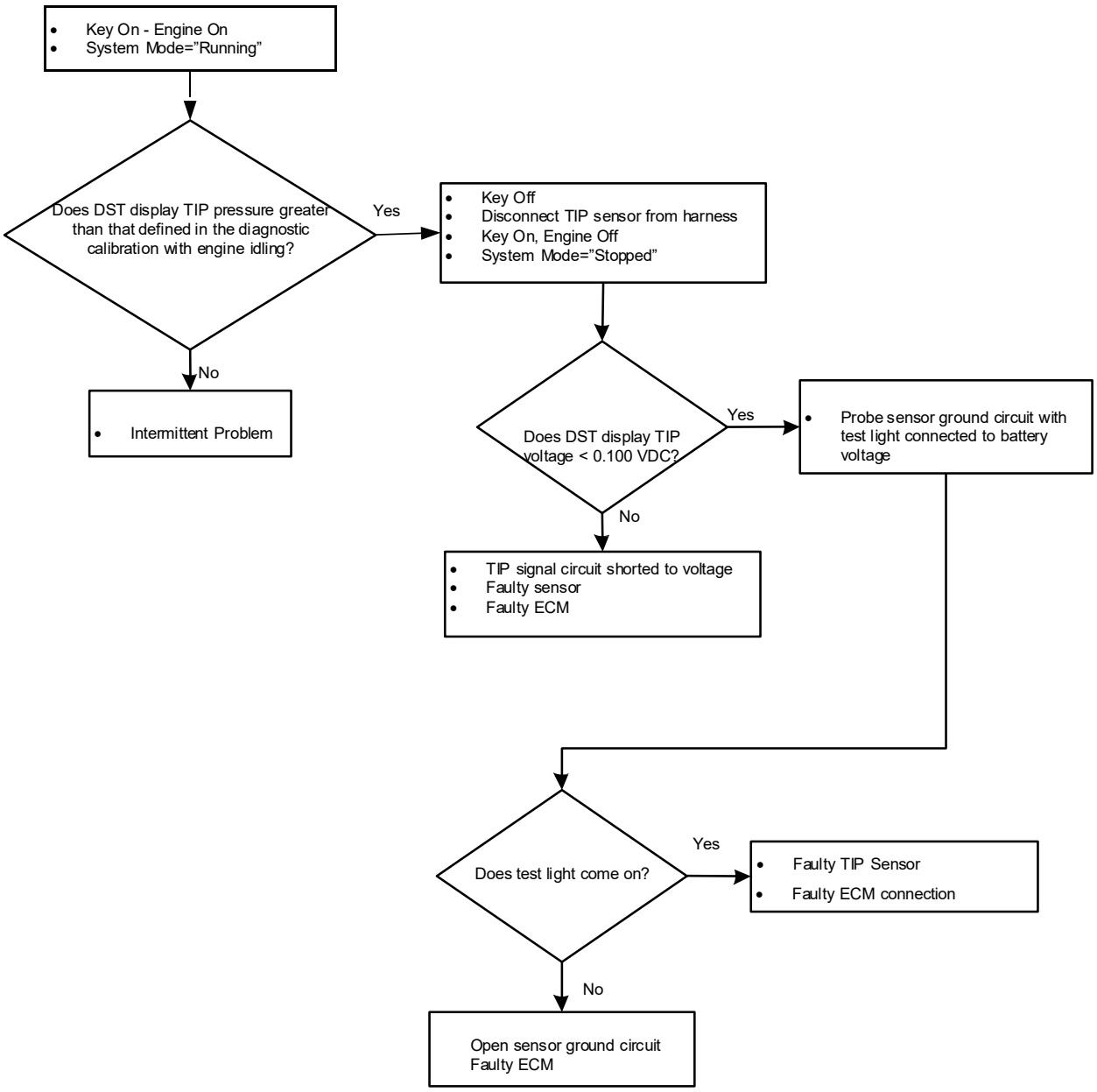
Possible Causes:

This fault will set when the TIP sensor voltage feedback is sensed as higher than the sensor should normally produce while MAP is lower than x psia as set in the diagnostic calibration. Under no circumstances should TIP be lower than MAP. The limit is generally set at 4.80 VDC. In many cases, this condition can be caused by the TIP circuit being shorted to a voltage source or a failure of the sensor. Recommended corrective action(s) include outputting a warning to the user.

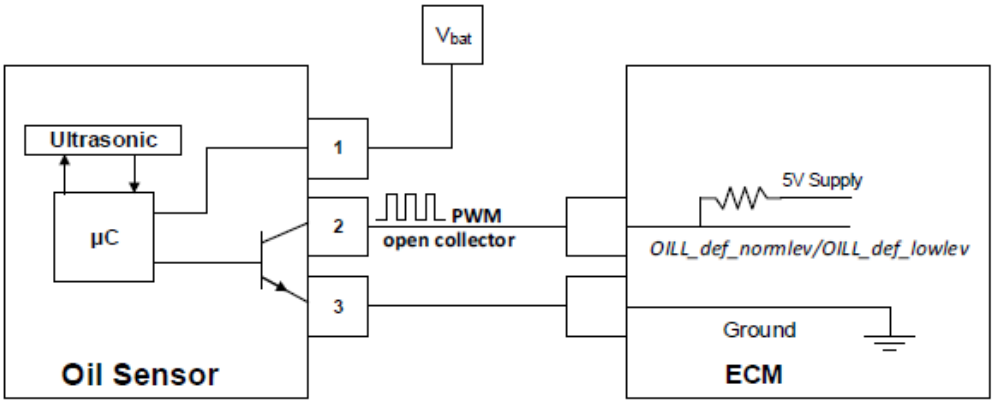
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	TBD*	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 238 - TIP/TOP HIGH VOLTAGE (TROUBLE TREE)



DTC 298 – OIL TEMPERATURE TOO HIGH



DTC	298	SPN	195	FMI	0		

Hardware/Circuit: Oil Temperature and Level

Hardware/Circuit Description:

The Oil Temperature and Level sensor provides continuous measurement of engine oil level and temperature in both static and dynamic engine operating ranges. The sensor provides three pulses at 1 Hz to the ECM. The three pulses report oil temperature (pulse 1), oil level (pulse 2), and oil sensor diagnostics (pulse 3). The duration of each pulse determines the data for the data element – as such, the pulse duration must be measured accurately to properly convert the duration to oil level or temperature.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

• Oil temperature >	235	°F

Fault Description:

This fault sets if the measured oil temperature is outside the upper limit as defined in the calibration. Required entry conditions for evaluation of this fault are the absence of any of the four faults below:

- **Oil Level and Temperature Sensor Loss**
- **Oil Level and Temperature Sensor Voltage Out of Range**
- **Oil Level Out of Range**
- **Oil Temperature Out of Range**

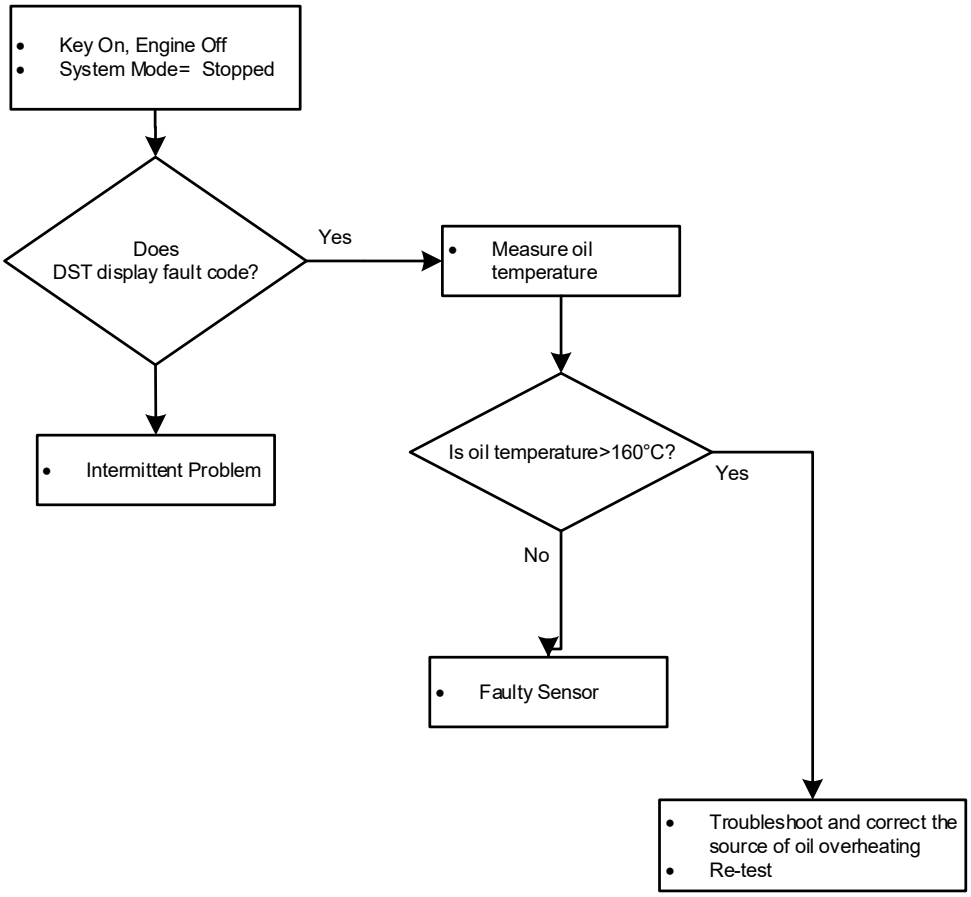
NOTE: The **Oil Temperature Too High** fault is not reported in the EDIS **Oil T/L** diagnostics state field and does not illuminate the LED.

Corrective Actions *:*

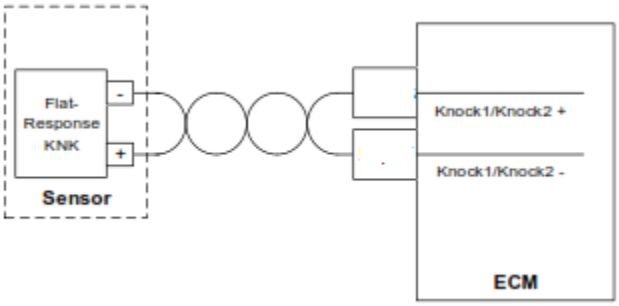
Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**TBD**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

DTC 298 – OIL TEMPERATURE TOO HIGH (TROUBLE TREE)

Trouble Tree



DTC 326, 331 & 32B – KNOCK 1, 2 & 3 EXCESSIVE OR ERRATIC SIGNAL



DTC	326, 331 & 32B	SPN	731, 520198, 520241	FMI	2

Hardware: Knock sensor #1, 2 & 3

Hardware Description:

The knock sensor is used to detect detonation through mechanical vibration in the engine block and/or cylinder heads and provide feedback for the ignition system to retard spark to reduce knock intensity. In most applications the knock sensor is used to protect the engine from damage that can be caused from detonation or knock based on fixed spark advance. In other applications, the knock sensor is used to optimize spark advance and "learn" between spark tables based on fuel quality.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**YES**
Check Condition:	Key On, Engine On

Fault Set Conditions (as defined in calibration):

• KNK1 sensor input >	4	volts
• and MAP <	13	psia
• and knock spark retard at minimum		

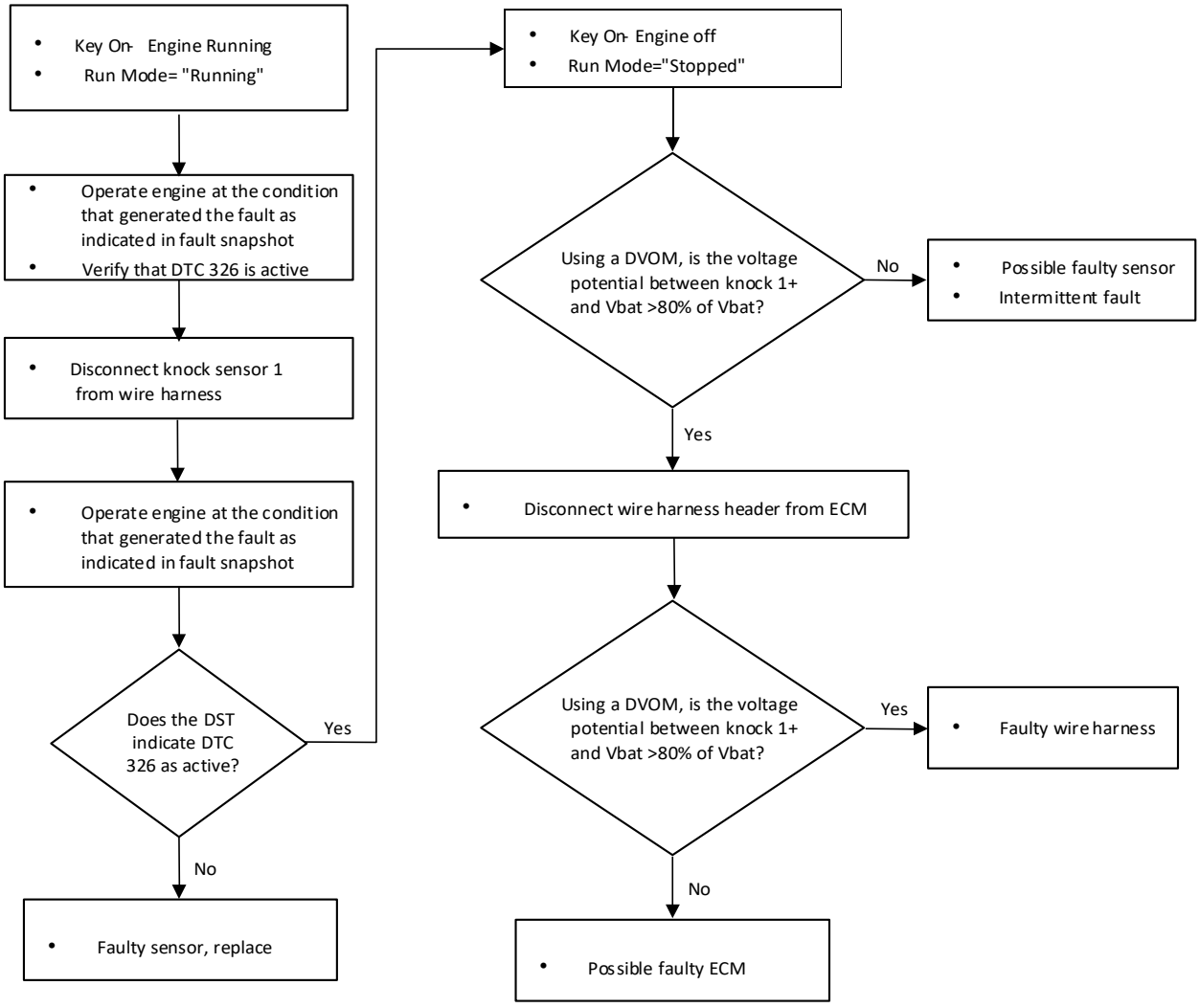
Possible Causes:

This fault sets if the signal from knock sensor 1 is higher than expected for low load operation as defined in calibration. If this fault sets, spark is lowered by the amount defined in calibration for Faulted KNK Retard.

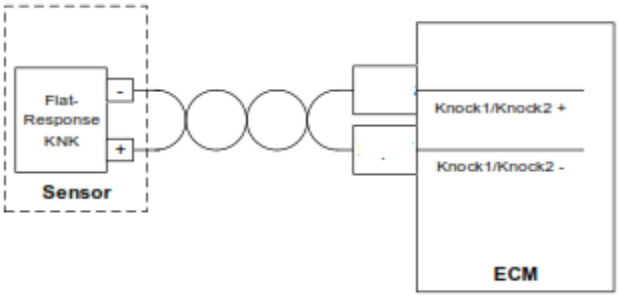
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	YES	Soft Warning	TBD*	NOx Control System	TBD*

DTC 326, 331 & 32B - KNOCK1, 2 & 3 EXCESSIVE OR ERRATIC SIGNAL (TROUBLE TREE)



DTC 327, 332 & 32C - KNOCK1/ KNOCK 2/ KNOCK 3 SENSOR OPEN OR NOT PRESENT



DTC	327	SPN	731	FMI	4

Hardware: Knock sensor #1, 2 & 3

Hardware Description:

The knock sensor is used to detect detonation through mechanical vibration in the engine block and/or cylinder heads and provide feedback for the ignition system to retard spark to reduce knock intensity. In most applications the knock sensor is used to protect the engine from damage that can be caused from detonation or knock based on fixed spark advance. In other applications, the knock sensor is used to optimize spark advance and "learn" between spark tables based on fuel quality.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**YES**
Check Condition:	Key On, Engine On

Fault Set Conditions (as defined in calibration):

• KNK1 sensor input <	0.002	volts
• and RPM >	1300	rpm
• and MAP >	13	psia

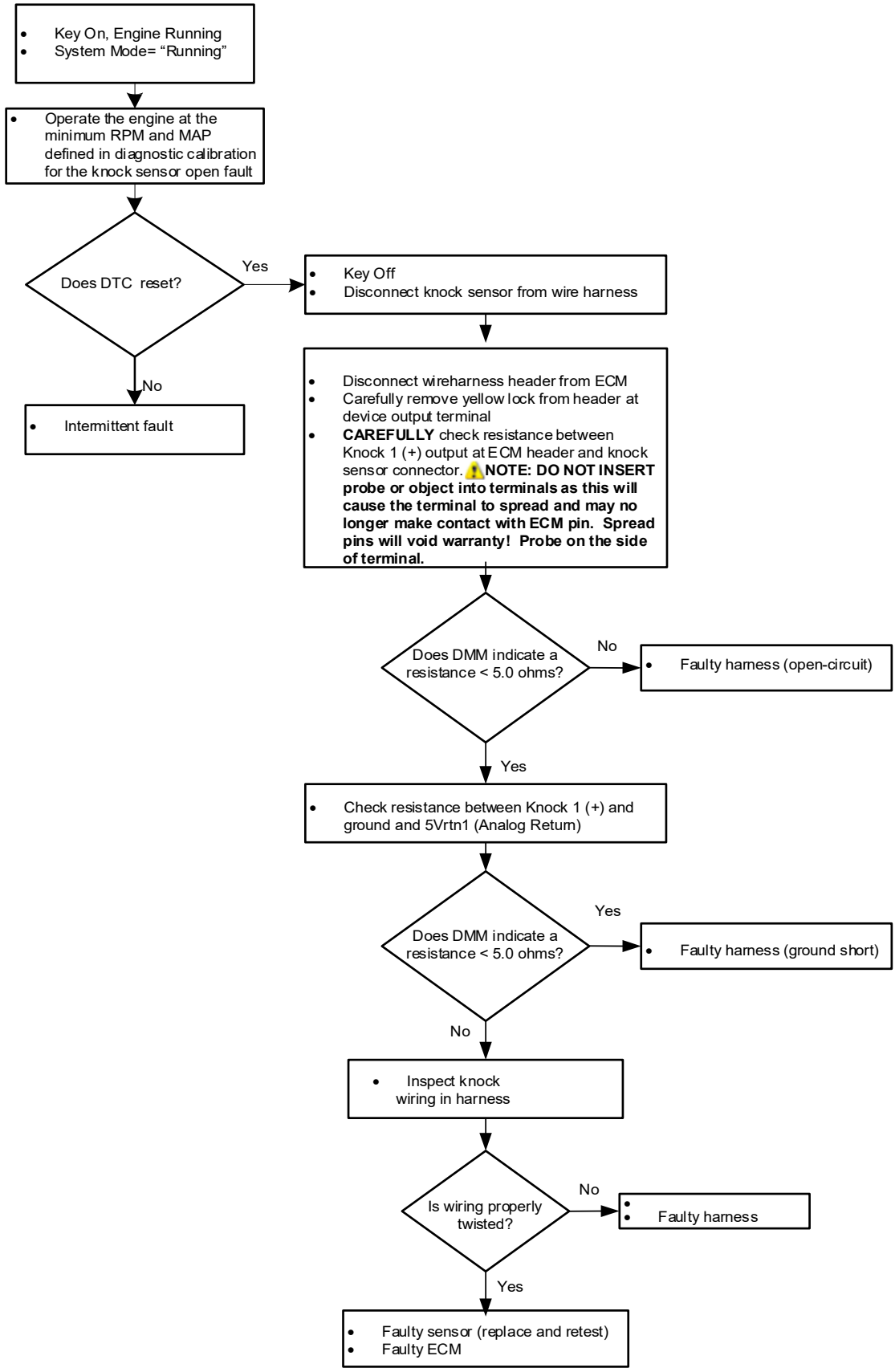
Possible Causes:

This fault sets if the signal from knock sensor 1 is lower than expected for higher speed and load operation as defined in calibration. If this fault sets, spark is lowered by the amount defined in calibration for *Faulted KNK Retard*.

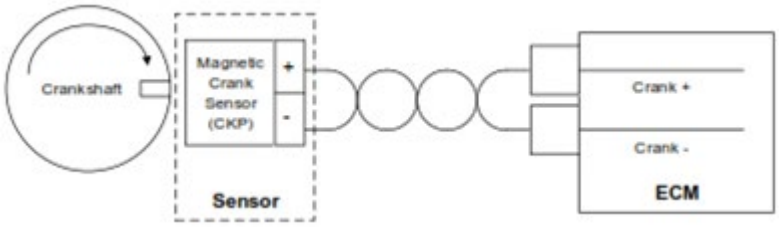
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	YES	Soft Warning	TBD*	NOx Control System	TBD*

DTC 327, 332 & 32C - KNOCK SENSOR OPEN OR NOT PRESENT (TROUBLE TREE)



DTC 336 - CRANK INPUT SIGNAL NOISE



DTC	336	SPN	636	FMI	2

Hardware: Crankshaft Position sensor

Hardware Description:

The crankshaft position sensor is a magnetic sensor (variable reluctant/magnetic pick-up or hall-effect) installed in the engine block adjacent to a "coded" trigger wheel located on the crankshaft. The sensor-trigger wheel combination is used to determine crankshaft position (with respect to TDC cylinder #1 compression) and the rotational engine speed. Determination of the crankshaft position and speed is necessary to properly activate the ignition, fuel injection, and throttle governing systems for precise engine control.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**YES**
Check Condition:	Key On, Engine On

Fault Set Conditions (as defined in calibration):

• Number of invalid crank re-syncs	1	re-syncs
• within a time window of <=	800	ms

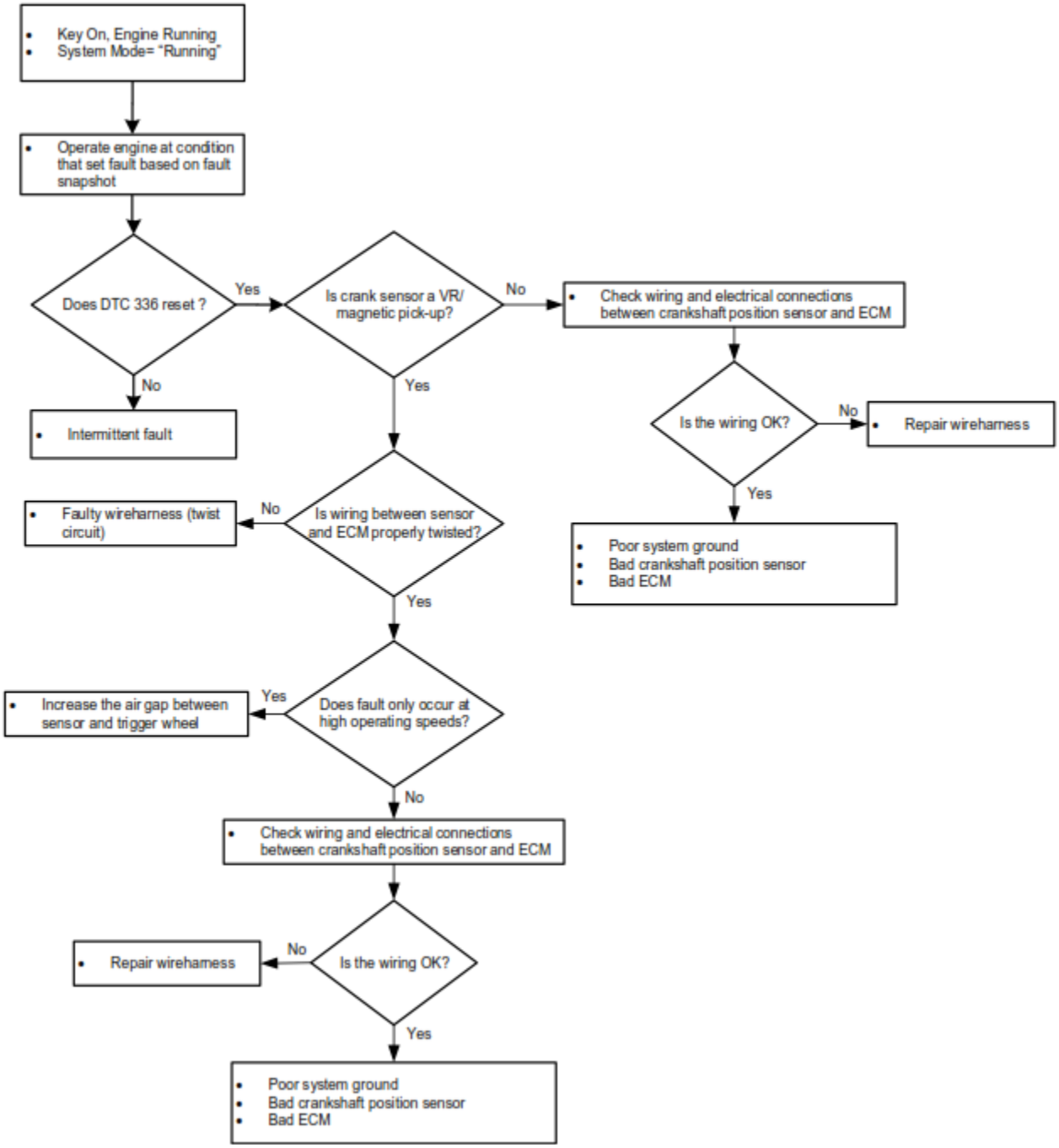
Possible Causes:

The ECM must see a valid crankshaft position signal while running. If no signal is present, the signal amplitude is too high (due to improper air gap with respect to trigger wheel), or an irregular crank pattern is detected causing the ECM to resynchronize x times for y ms or longer as defined in the diagnostic calibration, this fault will set. Irregular crank patterns can be detected by the ECM due to electrical noise, poor machining of trigger wheel, or trigger wheel runout and/or gear lash.

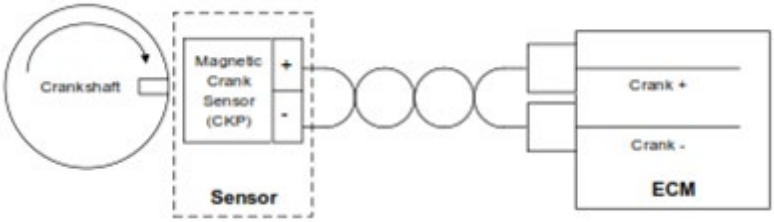
Ensure crank circuit used with VR/magnetic pick-up sensors are properly twisted.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*							
Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 336 - CRANK INPUT SIGNAL NOISE (TROUBLE TREE)



DTC 337 – LOSS OF CRANKSHAFT SIGNAL



DTC	337	SPN	636	FMI	4
Hardware:	Crankshaft Position sensor				

Hardware Description:

The crankshaft position sensor is a magnetic sensor (variable reluctant/magnetic pick-up or hall-effect) installed in the engine block adjacent to a "coded" trigger wheel located on the crankshaft. The sensor-trigger wheel combination is used to determine crankshaft position (with respect to TDC cylinder #1 compression) and the rotational engine speed. Determination of the crankshaft position and speed is necessary to properly activate the ignition, fuel injection, and throttle governing systems for precise engine control.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**YES**
Check Condition:	Key On, Engine On

Fault Set Conditions (as defined in calibration):

• Cam pulses without crank activity >	6	Cam pulses

Possible Causes:

The ECM must see a valid crankshaft position signal while running. If no signal is present while x cam pulses continue the fault will set. The engine typically stalls or dies as a result of this fault condition due to the lack of crankshaft speed input resulting in the inability to control ignition timing.

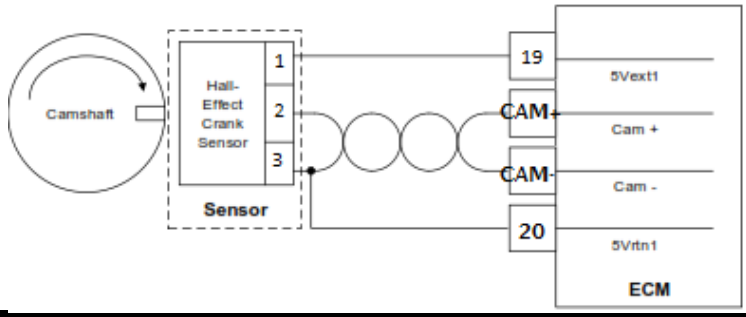
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 337 – LOSS OF CRANKSHAFT SIGNAL (DIAGNOSTIC AIDS)

- ☐ Check that crankshaft position sensor is securely connected to harness
- ☐ Check that crankshaft position sensor is securely installed into engine block
- ☐ Check crankshaft position sensor circuit wiring for open circuit

DTC 341 - CAM INPUT SIGNAL NOISE



DTC	341	SPN	723	FMI	2

Hardware: Crankshaft Position sensor

Hardware Description:

The camshaft position sensor is a magnetic sensor (variable reluctant/magnetic pick-up or hall-effect) installed in the engine block or valve train adjacent to a "coded" trigger wheel located on or off of the camshaft. The sensor-trigger wheel combination is used to determine cam position (with respect to TDC cylinder #1 compression). Determination of the camshaft position is necessary to identify the stroke (or cycle) of the engine to properly activate the fuel injection system and ignition (for coil-on-plug engines) for precise engine control.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**YES**
Check Condition:	Key On, Engine On

Fault Set Conditions (as defined in calibration):

• Number of invalid cam re-syncs	1	re-syncs
• within a time window of <=	700	ms

Possible Causes:

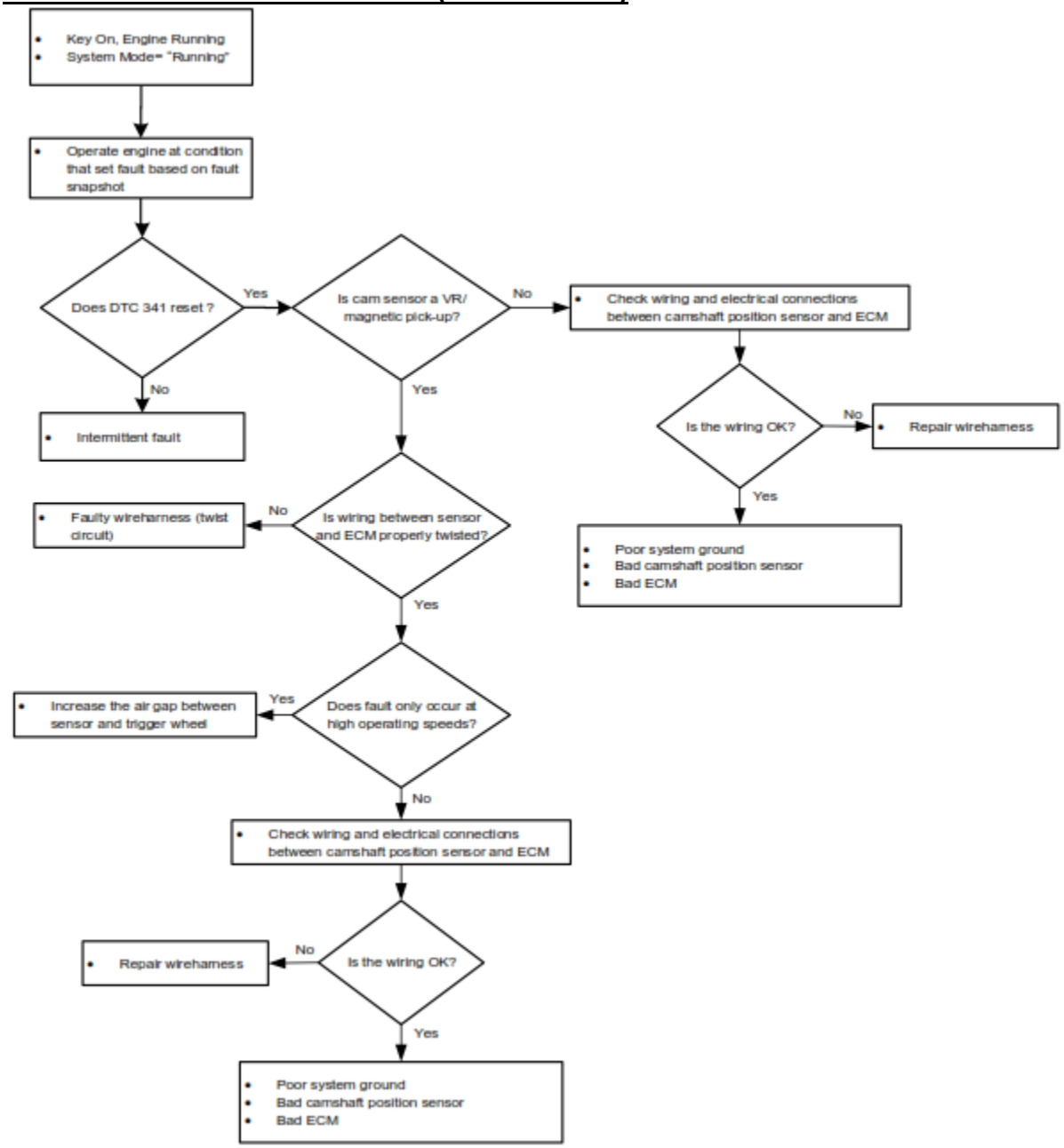
For a cam synchronized engine, the ECM must see a valid camshaft position signal while running. If no signal is present, the signal amplitude is too high (due to improper air gap with respect to trigger wheel), or an irregular cam pattern is detected causing the ECM to resynchronize x times for y ms or longer as defined in the diagnostic calibration, this fault will set. Irregular cam patterns can be detected by the ECM due to electrical noise, poor machining of trigger wheel, or trigger wheel runout and/or gear lash. Normally the engine will continue to run if equipped with a waste-spark or distributor ignition system.

In some instances this fault can cause rough engine operation and can cause the engine to stall or die if equipped with coil-on-plug ignition engines.
Ensure cam circuit used with VR/magnetic pick-up sensors are properly twisted.

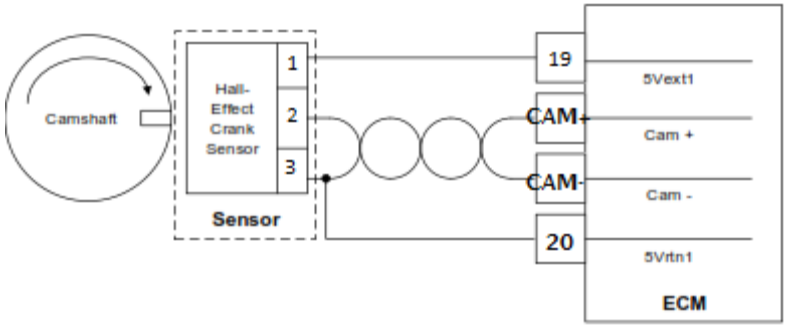
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 341 – CAM INPUT SIGNAL NOISE (TROUBLE TREE)



DTC 342 – LOSS OF CAMSHAFT INPUT SIGNAL



DTC	342	SPN	723	FMI	4

Hardware: Camshaft Position sensor

Hardware Description:

The camshaft position sensor is a magnetic sensor (variable reluctant/magnetic pick-up or hall-effect) installed in the engine block or valve train adjacent to a "coded" trigger wheel located on or off of the camshaft. The sensor-trigger wheel combination is used to determine cam position (with respect to TDC cylinder #1 compression). Determination of the camshaft position is necessary to identify the stroke (or cycle) of the engine to properly activate the fuel injection system and ignition (for coil-on-plug engines) for precise engine control.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**YES**
Check Condition:	Key On, Engine On

Fault Set Conditions (as defined in calibration):

• No cam pulse in	2.5	cycles
• and RPM >	1000	rpm

Possible Causes:

For a cam synchronized engine, the ECM must see a valid camshaft position signal while running. This fault will set if valid crankshaft position data is received for x number of engine cycles while engine speed is greater than y RPM and no camshaft signal is received. Normally the engine will continue to run if equipped with a waste-spark or distributor ignition system. In some instances this fault can cause rough engine operation and can cause the engine to stall or die if equipped with coil-on-plug ignition engines.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 342 – LOSS OF CAMSHAFT INPUT SIGNAL (DIAGNOSTIC AIDS)

- ☐ Check that camshaft position sensor is securely connected to harness
- ☐ Check that camshaft position sensor is securely installed into engine block
- ☐ Check camshaft position sensor circuit wiring for open circuit

DTC 359 – FUEL RUN-OUT LONGER THAN EXPECTED

DTC	359	SPN	1239	FMI	7		

Hardware/Circuit: Lockoff Valve

Hardware/Circuit Description:

A normally closed electromechanical fuel shut-off is used to isolate the Dual Stage Regulator (DSR) or the Continuous Flow Valve (CFV) and all downstream components from the upstream fuel supply when the engine is shut off.

The Fuel Runout Longer Than Expected test is conducted on engine shut down.

The ignition system continues to operate when the key is turned off, but the lockoff is closed, starving the engine of fuel resulting in a shut down.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

• Fuel run-out engine run time >	**1500**	ms
• and ECT >	**-40.0**	deg F
• and ECT > above temp for	**0**	sec
• Historic fault forced indication*	**Disabled**	

* This switch controls the soft or hard warning output if there is a historic fault stored for this lockoff diagnostic. If this switch is set to other than 'Disabled', then that particular warning output channel will be forced to an ON state continuously until the historic fault is cleared by either a technician or the start-cycle auto-clearing mechanism.

Fault Description:

This fault will set when the time past key-off/lockoff-off exceeds a calibrated duration value during fuel runout mode – indicating that there is still fuel flowing despite commanding the lockoff closed

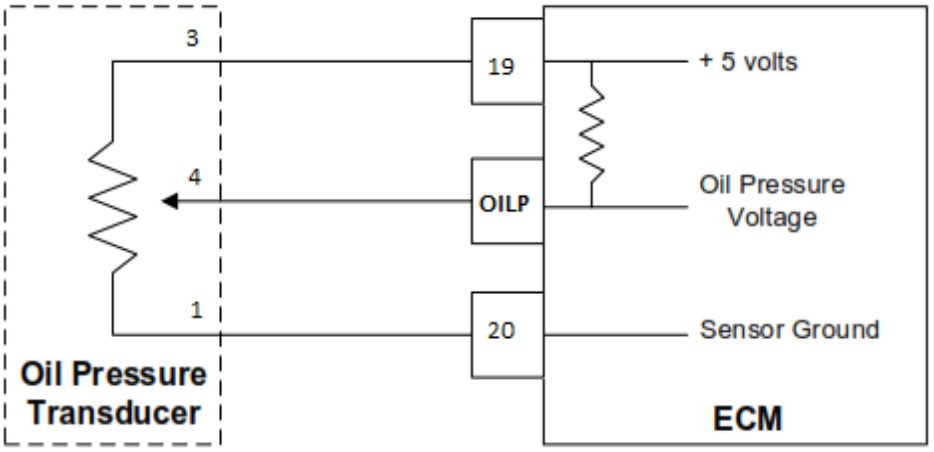
Corrective Actions:

Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**TBD**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

Diagnostic Aids/Trouble Tree

With the engine running disconnect the electrical connector on the fuel shut-off solenoid from the engine harness. If the engine continues to run after 60 seconds replace the fuel shut-off solenoid.

DTC 520 - OIL PRESSURE LOW STAGE 1 (SENDER)



DTC	520	**SPN**	100	**FMI**	18

Measurement: Engine Oil Pressure

Description:

The ECM can be configured to monitor oil pressure through a proportional transducer or through a switch. Oil pressure monitoring is important to prevent engine damage due to low oil pressure resulting in higher friction and lack of lubrication. In addition, high oil pressure can be undesirable because it can cause oil to leak past seals and rings, can be a result of a restriction in the oil flow path, or can be a sign of a malfunctioning oiling system.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**NO**
Check Condition:	Key on, Engine on

Fault Set Conditions (as defined in calibration):

For RPM > lower limit AND RPM <=	TBD*	rpm
• Stage 1: oil pressure <	10	psig
For RPM >=	1800	rpm
• Stage 1: oil pressure <	30	psig

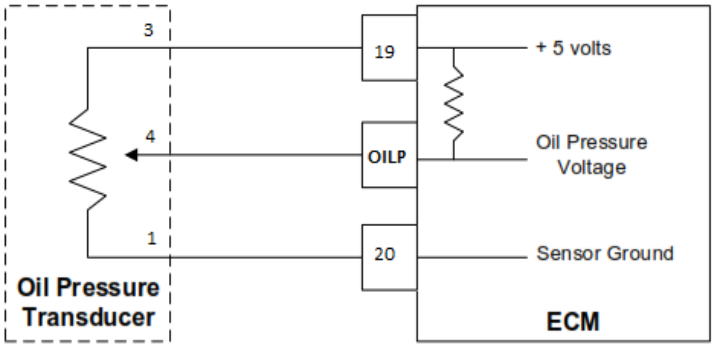
Possible Causes:

This fault sets if the engine oil pressure is lower than x psia and engine speed greater than y RPM as defined in the diagnostic calibration. Recommend a power derate and/or low rev limit to help prevent possible engine damage and reduce oil pressure.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	YES	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 521 - OIL PRESSURE HIGH (SENDER)



DTC	521	SPN	100	FMI	0

Measurement: Engine Oil Pressure

Description:

The ECM can be configured to monitor oil pressure through a proportional transducer or through a switch. Oil pressure monitoring is important to prevent engine damage due to low oil pressure resulting in higher friction and lack of lubrication. In addition, high oil pressure can be undesirable because it can cause oil to leak past seals and rings, can be a result of a restriction in the oil flow path, or can be a sign of a malfunctioning oiling system.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**NO**
Check Condition:	Key on, Engine on

Fault Set Conditions (as defined in calibration):

• Oil pressure >	120	psig
• and RPM <	9999	rpm

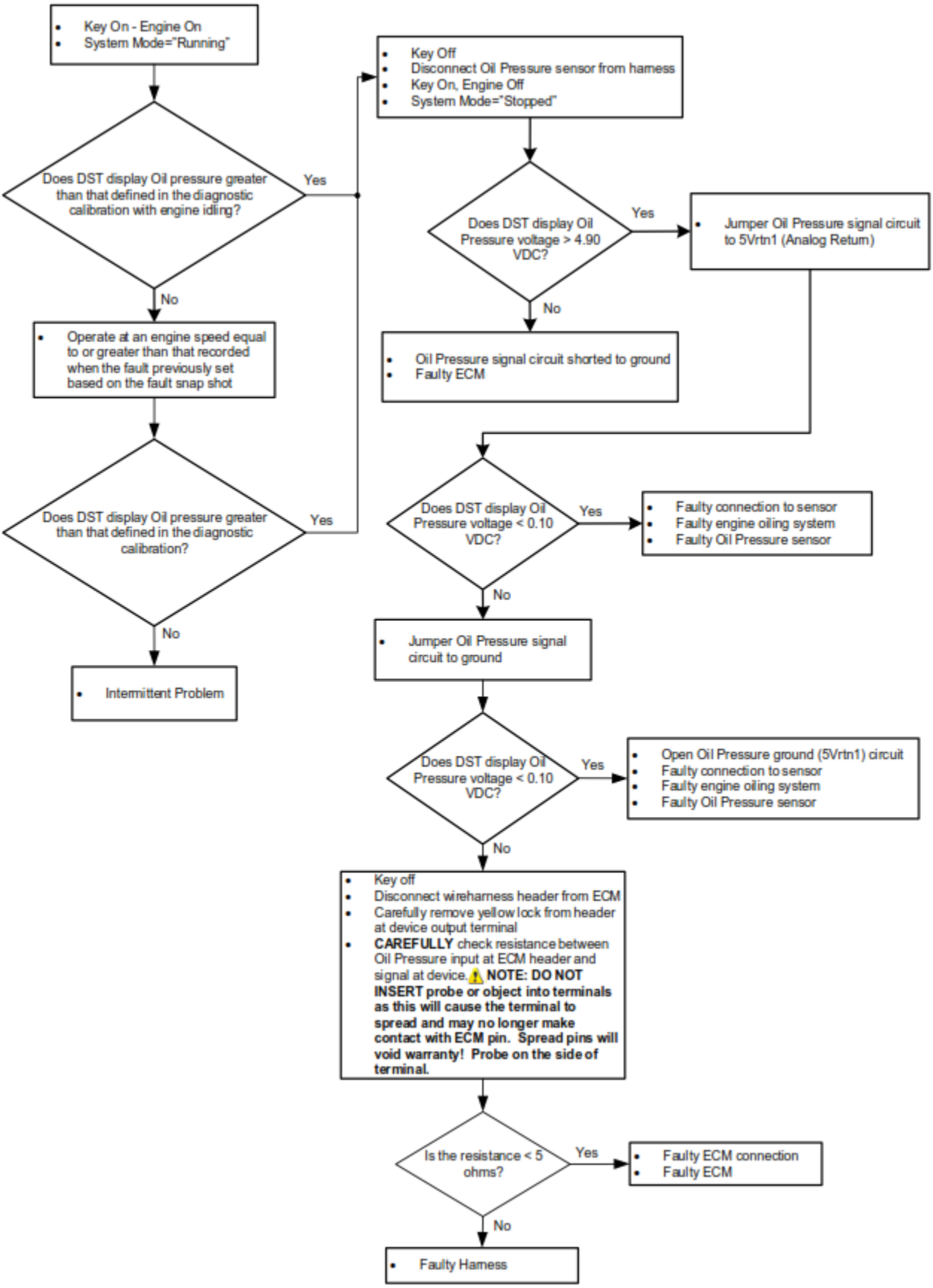
Possible Causes:

This fault sets if the engine oil pressure is higher than x psia and engine speed greater than y RPM as defined in the diagnostic calibration. Recommend a power derate and/or low rev limit to help prevent possible engine damage and reduce oil pressure.

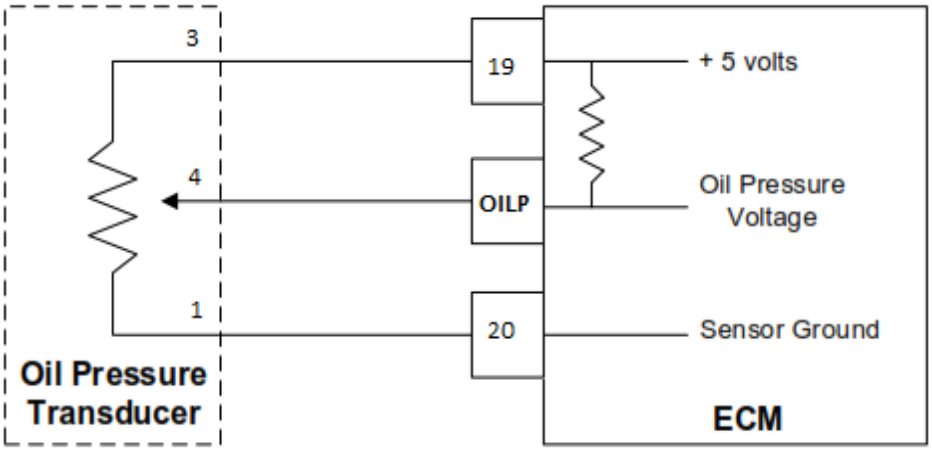
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	YES	Soft Warning	TBD*	NOx Control System	TBD*

DTC 521 - OIL PRESSURE HIGH (SENDER) (TROUBLE TREE)



DTC 522 - OIL PRESSURE SENDER LOW VOLTAGE



DTC	522	**SPN**	100	**FMI**	4

Measurement: Engine Oil Pressure

Description:

The ECM can be configured to monitor oil pressure through a proportional transducer or through a switch. Oil pressure monitoring is important to prevent engine damage due to low oil pressure resulting in higher friction and lack of lubrication. In addition, high oil pressure can be undesirable because it can cause oil to leak past seals and rings, can be a result of a restriction in the oil flow path, or can be a sign of a malfunctioning oiling system.

Fault Enabled in Calibration?	YES
Emissions-related Fault?	**NO**
Check Condition:	Key on, Engine on

Fault Set Conditions (as defined in calibration):

• Oil pressure sender voltage <	0.2	volts

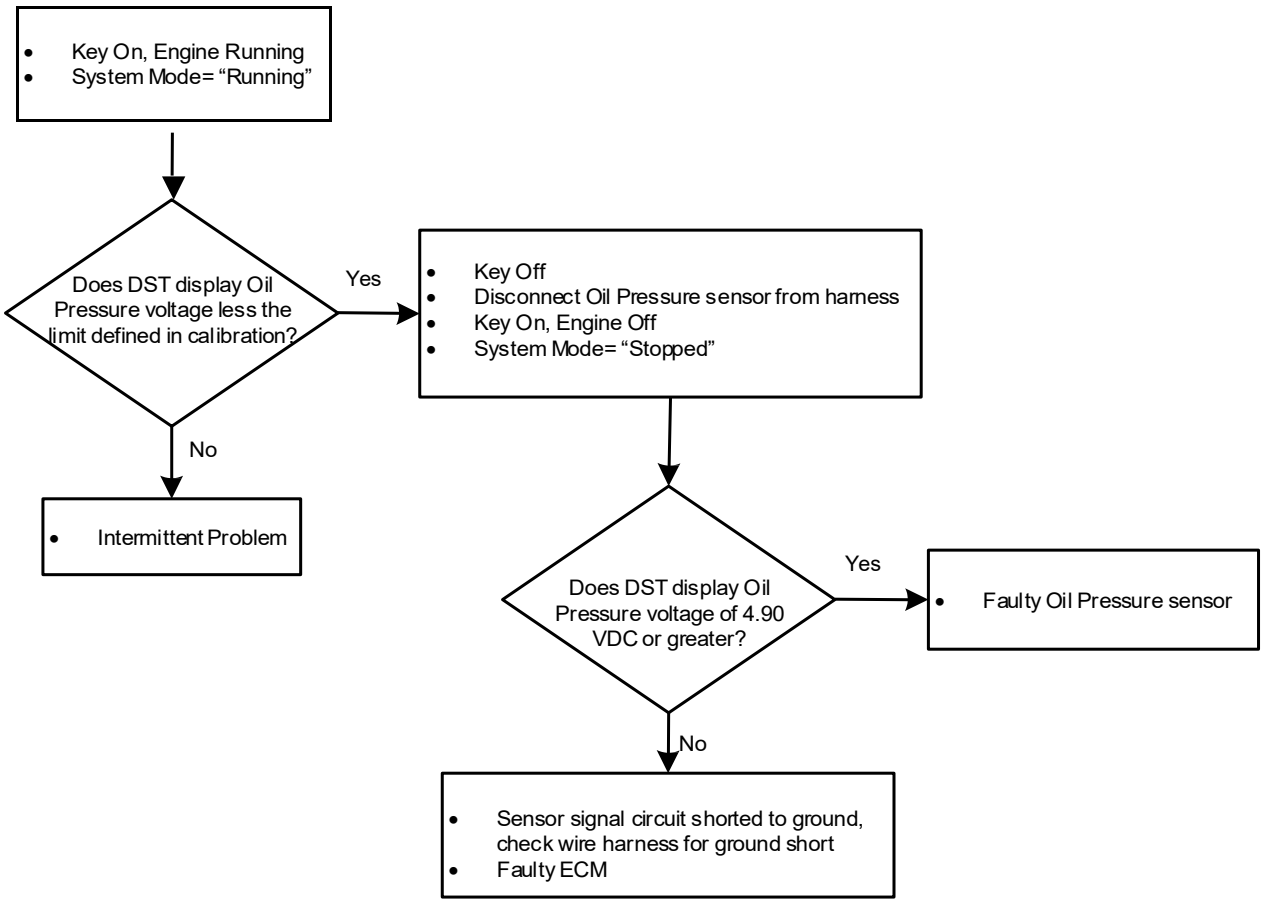
Possible Causes:

This fault sets if the engine oil pressure sender/transducer voltage is lower than defined in the diagnostic calibration. Recommend a power derate and/or low rev limit due to the inability to sense oil pressure and to reduce risk of potential engine damage.

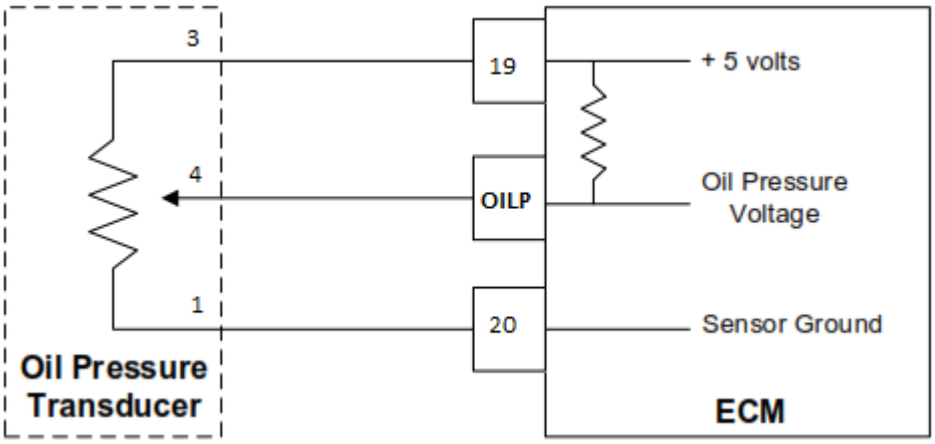
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 522 - OIL PRESSURE SENDER LOW VOLTAGE (TROUBLE TREE)



DTC 523 - OIL PRESSURE SENDER HIGH VOLTAGE



DTC	523	SPN	100	FMI	3

Measurement: Engine Oil Pressure

Description:

The ECM can be configured to monitor oil pressure through a proportional transducer or through a switch. Oil pressure monitoring is important to prevent engine damage due to low oil pressure resulting in higher friction and lack of lubrication. In addition, high oil pressure can be undesirable because it can cause oil to leak past seals and rings, can be a result of a restriction in the oil flow path, or can be a sign of a malfunctioning oiling system.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key on, Engine on

Fault Set Conditions (as defined in calibration):

• Oil pressure sender voltage >	4.8	volts

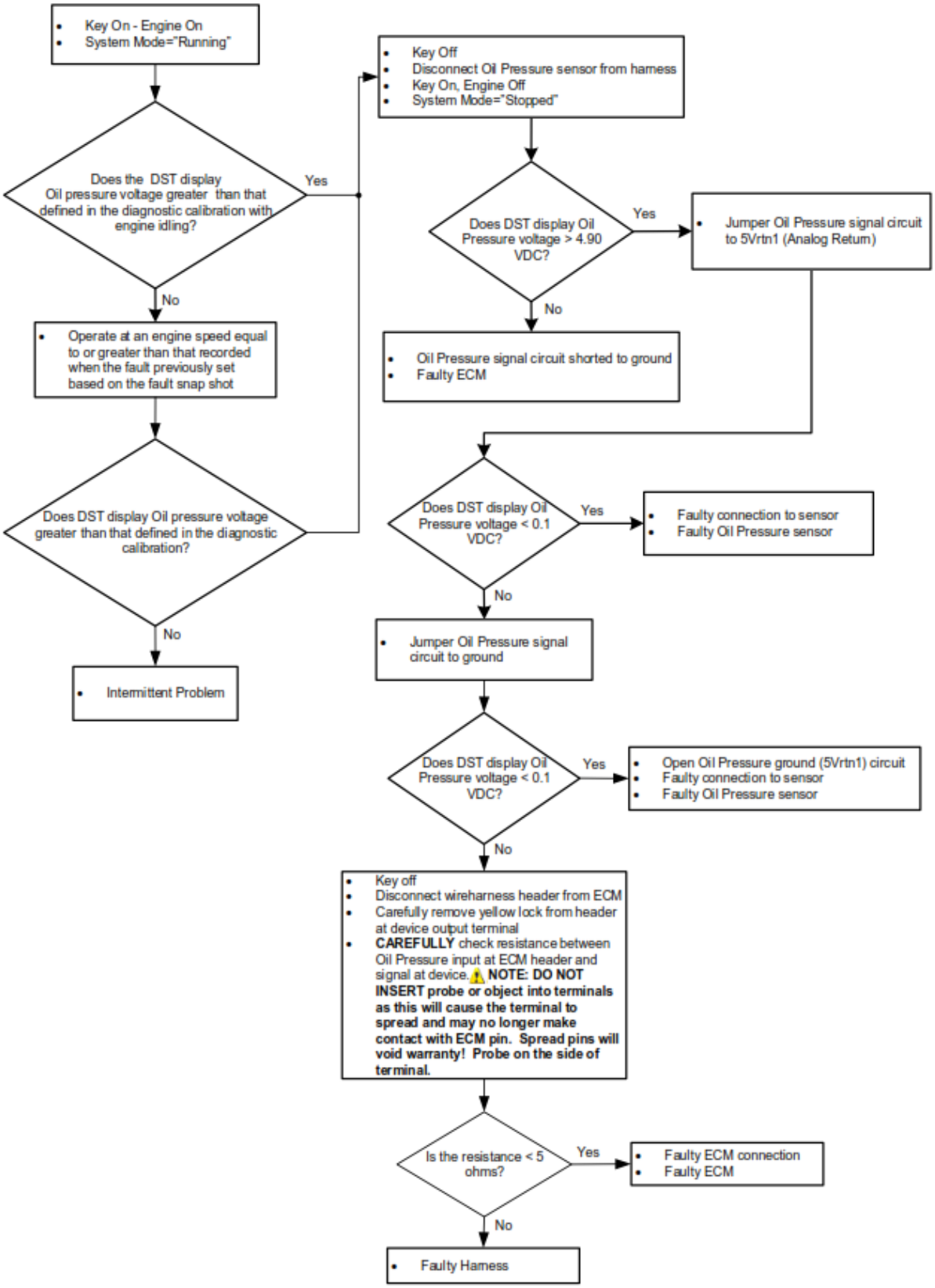
Possible Causes:

This fault sets if the engine oil pressure sender/transducer voltage is lower than defined in the diagnostic calibration. Recommend a power derate and/or low rev limit due to the inability to sense oil pressure and to reduce risk of potential engine damage.

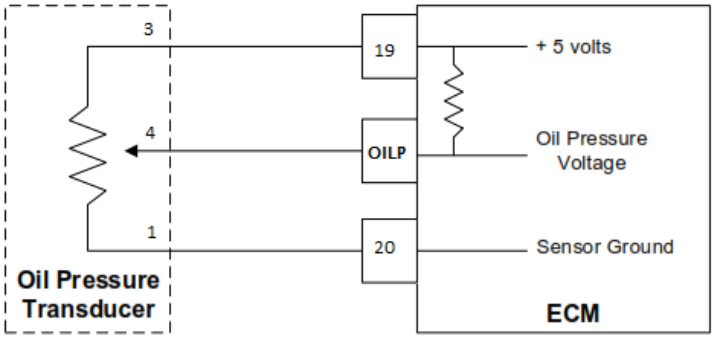
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 523 - OIL PRESSURE SENDER HIGH VOLTAGE (TROUBLE TREE)



DTC 524 - OIL PRESSURE LOW STAGE 2 (SENDER)



DTC	524	SPN	100	FMI	1

Measurement: Engine Oil Pressure

Description:

The ECM can be configured to monitor oil pressure through a proportional transducer or through a switch. Oil pressure monitoring is important to prevent engine damage due to low oil pressure resulting in higher friction and lack of lubrication. In addition, high oil pressure can be undesirable because it can cause oil to leak past seals and rings, can be a result of a restriction in the oil flow path, or can be a sign of a malfunctioning oiling system.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key on, Engine on

Fault Set Conditions (as defined in calibration):

For RPM > lower limit AND RPM <=	TBD*	rpm
• Stage 2: oil pressure <	7	psig
For RPM >=	1800	rpm
• Stage 2: oil pressure <	20	psig

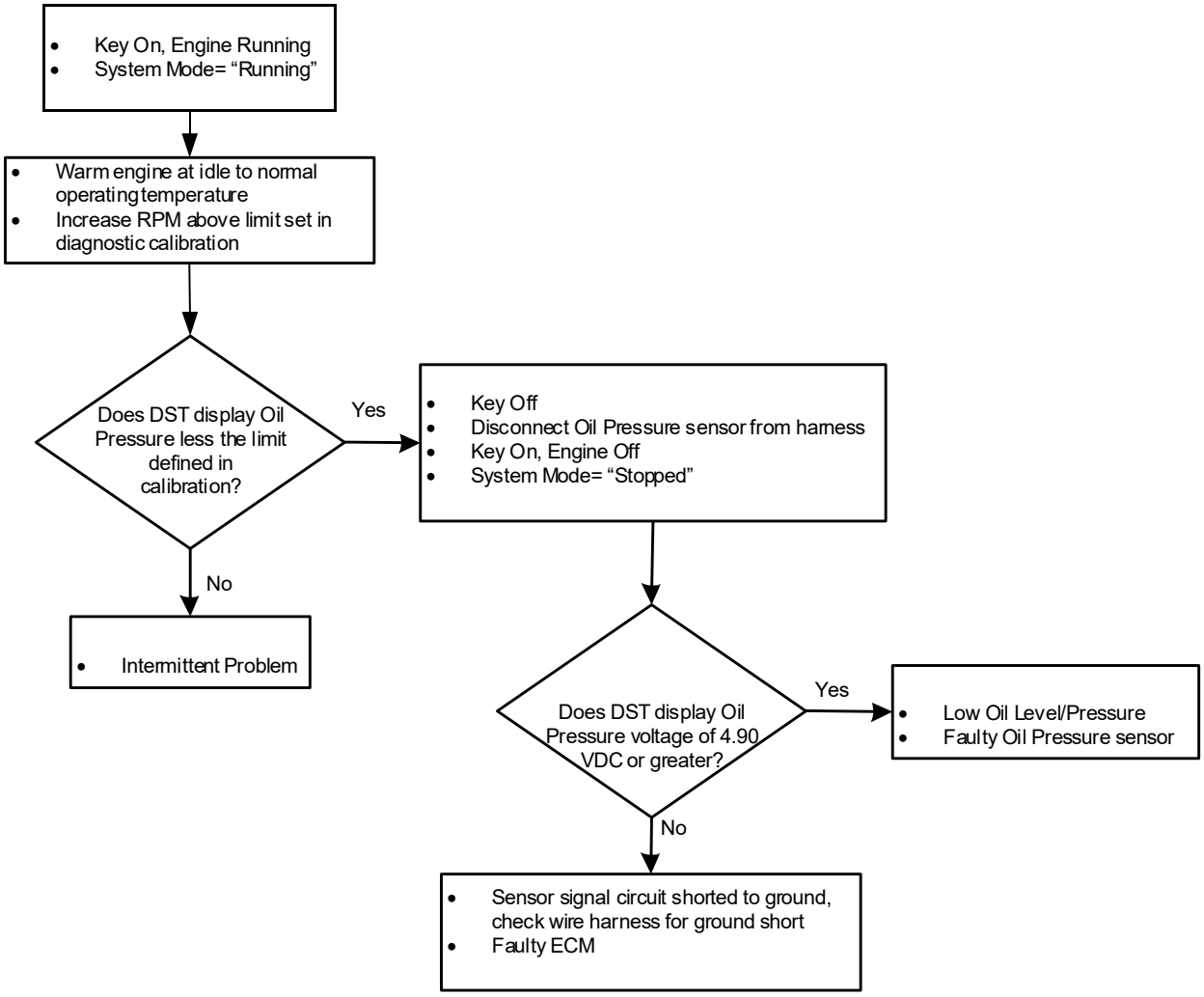
Possible Causes:

For systems that use a transducer, this fault sets if the engine oil pressure is less than x psia and engine speed is greater than y RPM after the engine has been running for z seconds as defined in the diagnostic calibration. The engine will should be configured to derate or force idle and/or shut down in the event of this fault to help prevent possible damage.

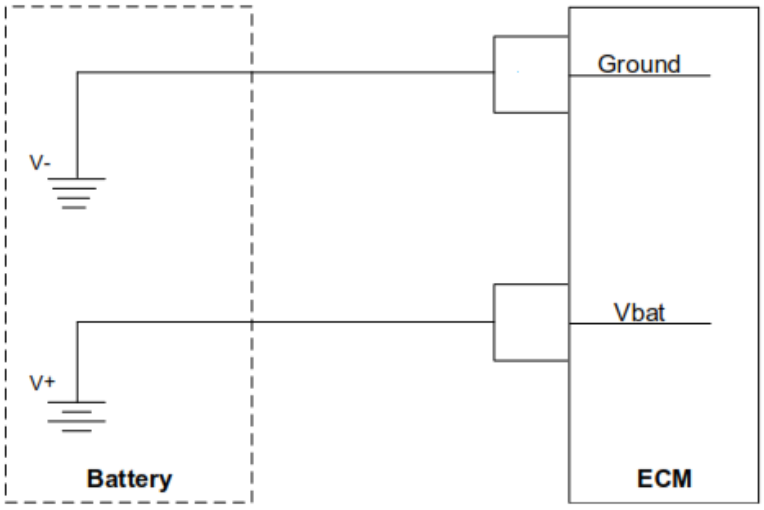
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	YES	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 524 - OIL PRESSURE LOW (SENDER) (TROUBLE TREE)



DTC 562 - BATTERY VOLTAGE (VBAT) LOW



DTC	562	SPN	168	FMI	17

Measurement: System Voltage to ECM

Description:

The battery voltage powers the ECM and must be within limits to correctly operate injector drivers, ignition coils, throttle, power supplies, and other powered devices that the ECM controls.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key on, Engine on

Fault Set Conditions (as defined in calibration):

• Voltage <	8	volts
• and RPM >	1000	rpm

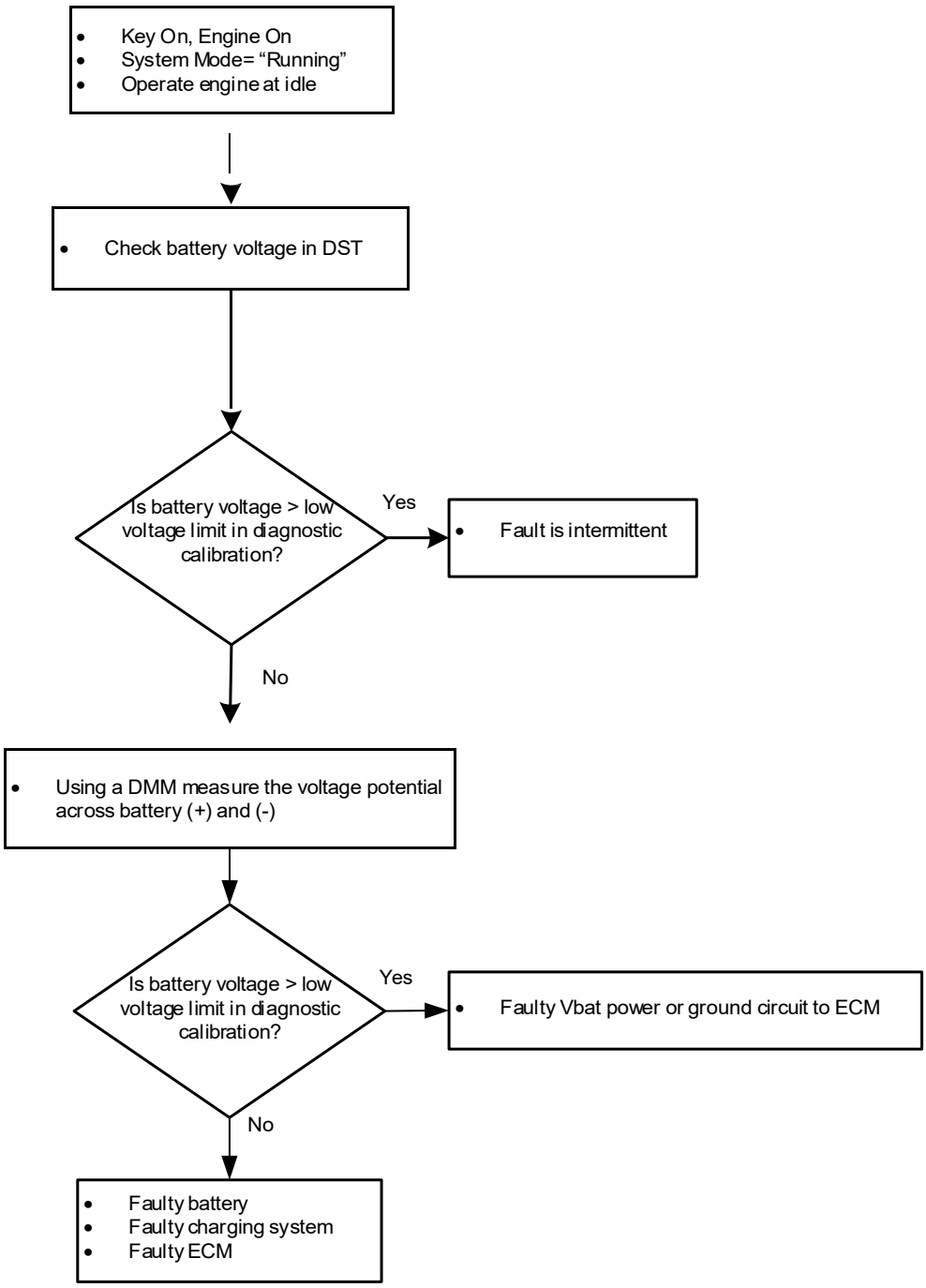
Possible Causes:

This fault will set if the ECM detects system voltage less than x volts while the engine is operating at y RPM as defined in the diagnostic calibration as the alternator should be charging the system. The adaptive learn is disabled to avoid improper adaptive learning due to the inability to correctly time injector firings.

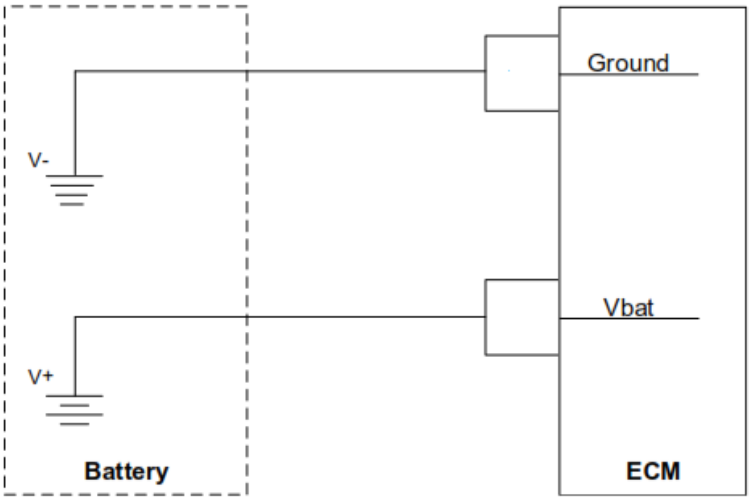
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 562 - BATTERY VOLTAGE (VBAT) LOW (TROUBLE TREE)



DTC 563 - BATTERY VOLTAGE (VBAT) HIGH



DTC	563	SPN	168	FMI	15

Measurement: System Voltage to ECM

Description:

The battery voltage powers the ECM and must be within limits to correctly operate injector drivers, ignition coils, throttle, power supplies, and other powered devices that the ECM controls.

Fault Enabled in Calibration?	**TBD* (*Application-Specific – see calibration)**
Emissions-related Fault?	**NO**
Check Condition:	Key on, Engine Cranking or Running

Fault Set Conditions (as defined in calibration):

• Voltage >	18	volts

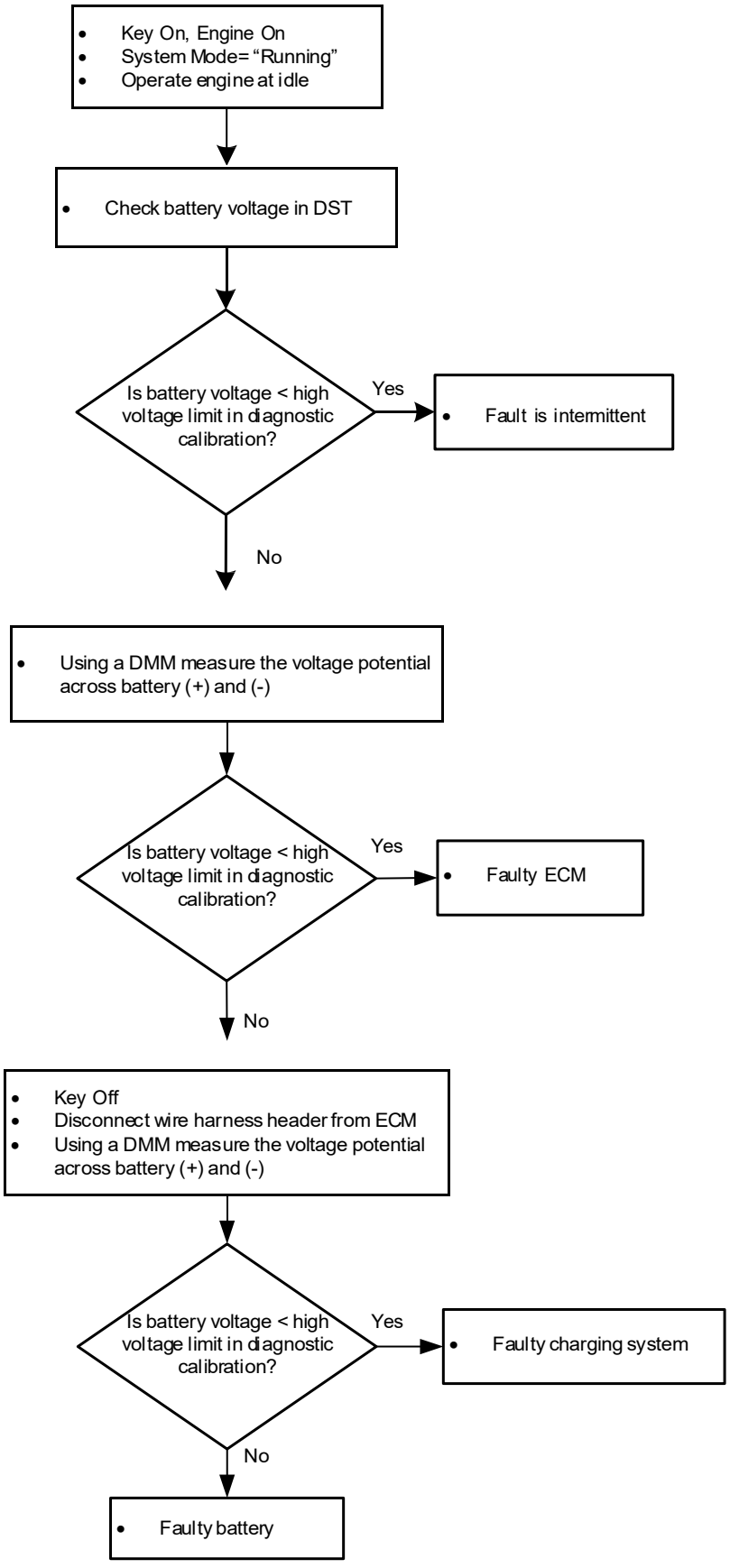
Possible Causes:

This fault will set if the ECM detects system voltage greater than x volts while the engine is running or cranking as defined in the diagnostic calibration. The adaptive learn is disabled to avoid improper adaptive learning.

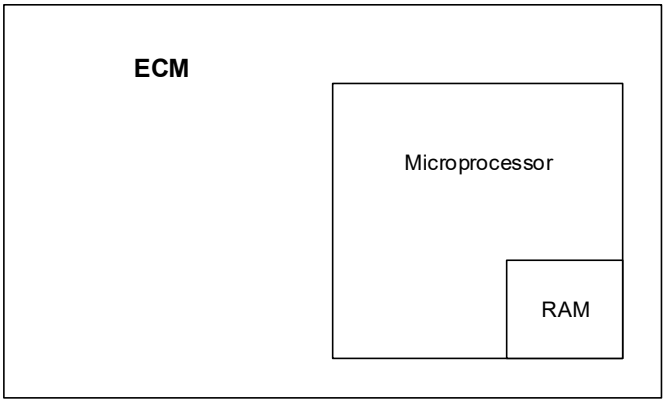
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 563 - BATTERY VOLTAGE (VBAT) HIGH (TROUBLE TREE)



DTC 601 - MICROPROCESSOR FAILURE - FLASH



DTC	601	SPN	628	FMI	13

Hardware: Engine Control Module – Flash Memory

Description:

The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key on

Fault Set Conditions (as defined in calibration):

- Internal microprocessor error

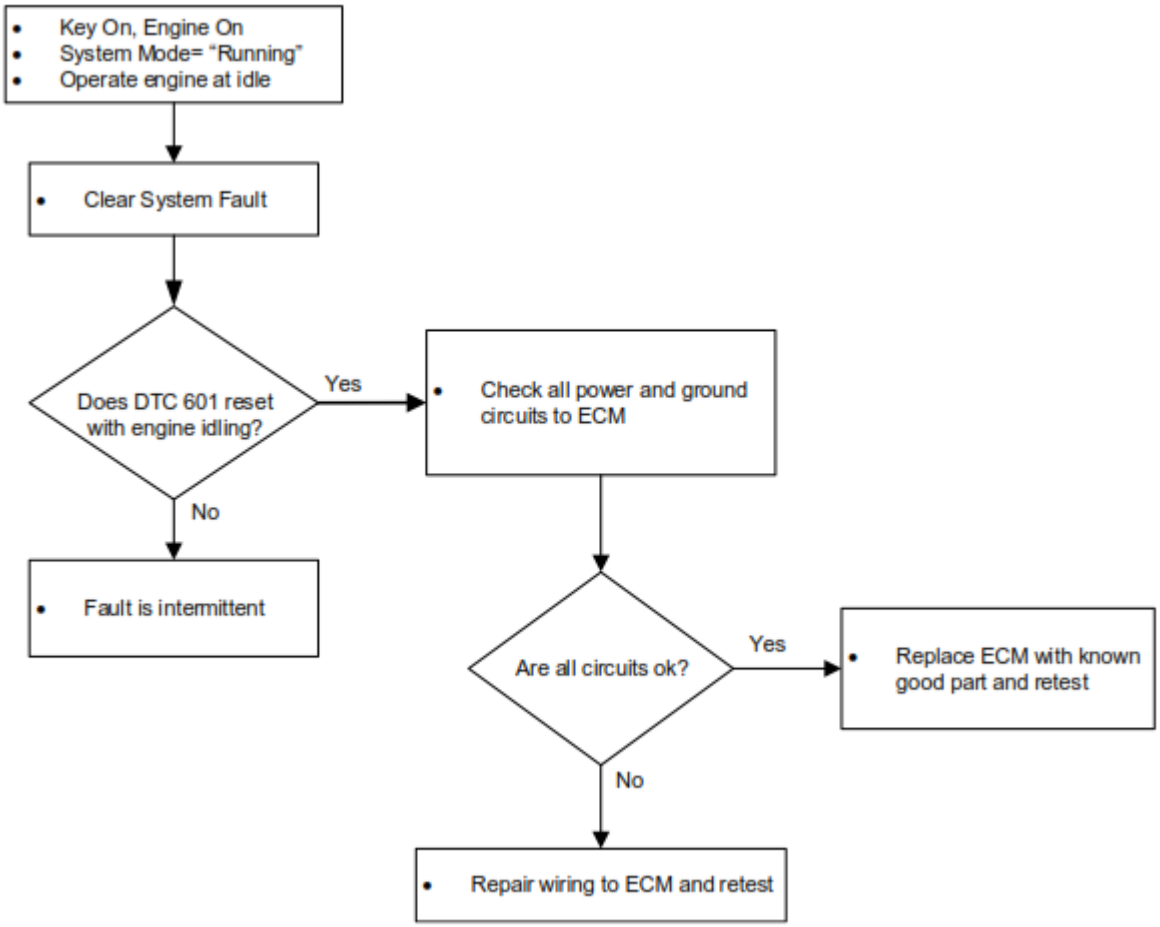
Possible Causes:

If this fault sets, the ECM will reset itself and log the code. The fault should be configured to never forget and will not self-erase and will not clear until a technician performs diagnostics and manually clears the code. This fault should be configured to set a power derate 2 and low rev limit to reduce possible engine damage and reduce possibility of an overspeed condition. A fault of flash memory can occur for any calibration variable set and thus could cause undesirable operation.

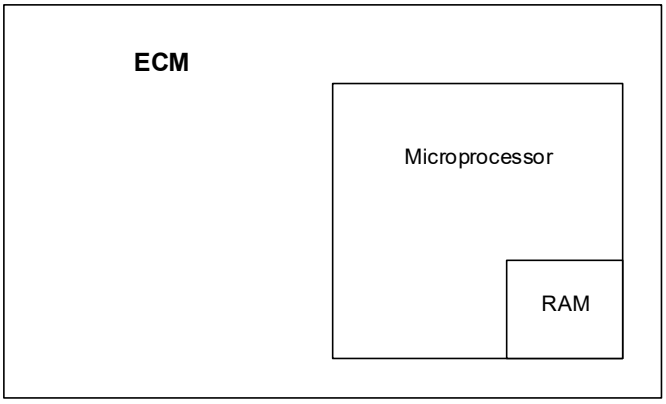
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	YES	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	YES	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 601 - MICROPROCESSOR FAILURE – FLASH (TROUBLE TREE)



DTC 604 - MICROPROCESSOR FAILURE - RAM



DTC	604	SPN	630	FMI	12

Hardware: Engine Control Module – Random Access Memory

Description:

Random Access Memory is located within the microprocessor and can be read from or written to at any time. Data stored in RAM include DTCs (when fault configuration is set to "Battery Power Retained"), adaptive fuel learn tables, octane adaptation table, misfire adaption tables, and closed loop fuel multipliers. The ECM has checks that must be satisfied each time an instruction is executed.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key on

Fault Set Conditions (as defined in calibration):

- Internal microprocessor error

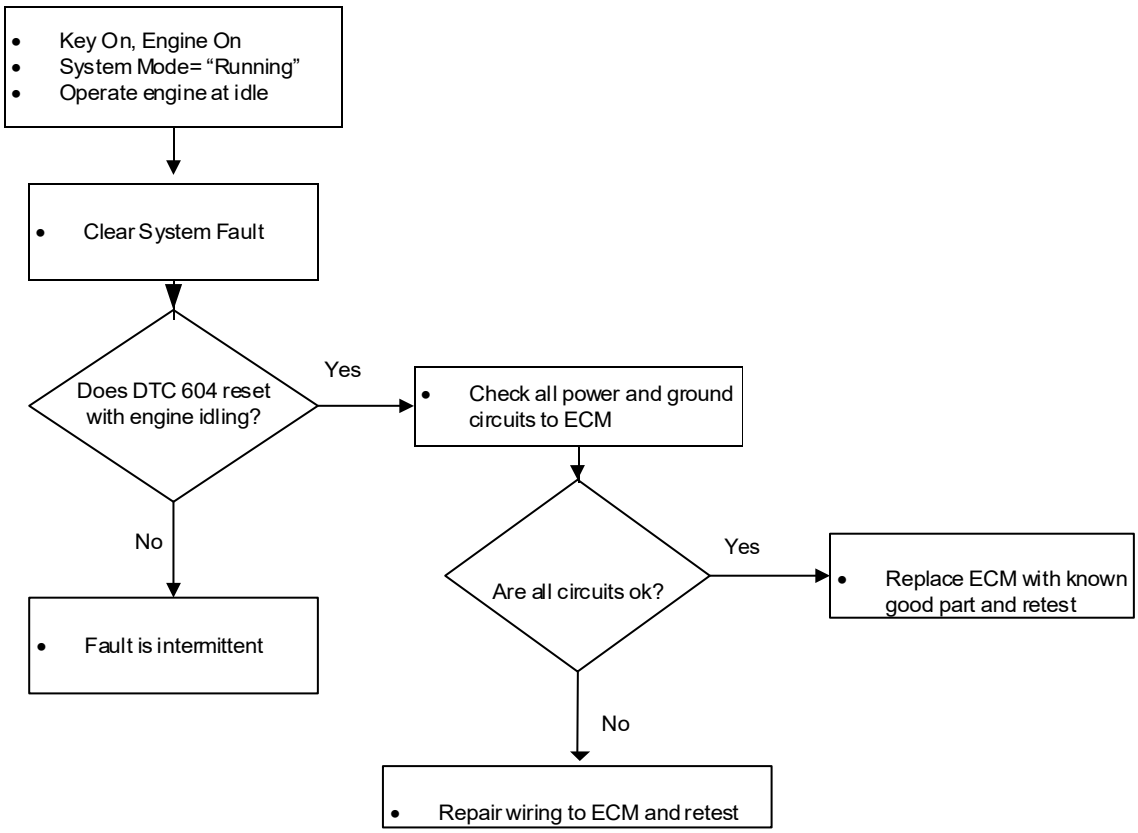
Possible Causes:

This fault will set if the ECM detects a problem accessing or writing information to RAM and should be configured to set a power derate 2 and low rev limit to reduce possible engine damage and reduce possibility of an overspeed condition. If this fault sets, the ECM will reset itself and log the code. This fault should be erased by a technician after diagnostics are performed. The fault should be configured to never forget and will not self-erase.

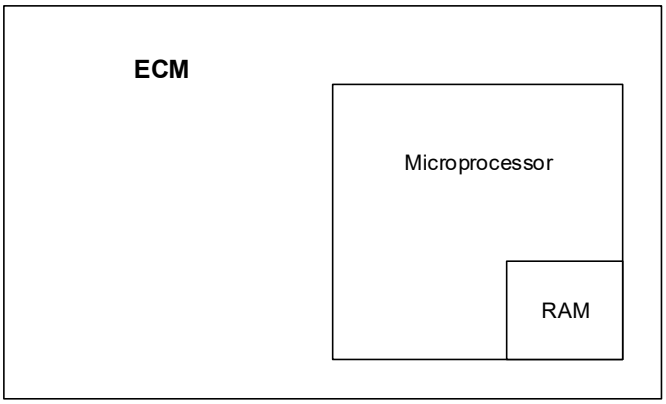
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	YES	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	YES	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 604 - MICROPROCESSOR FAILURE – RAM (TROUBLE TREE)



DTC 606 - MICROPROCESSOR FAILURE - COP



DTC	606	SPN	629	FMI	31

Hardware: Engine Control Module

Description:

The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key on

Fault Set Conditions (as defined in calibration):

- Internal microprocessor error

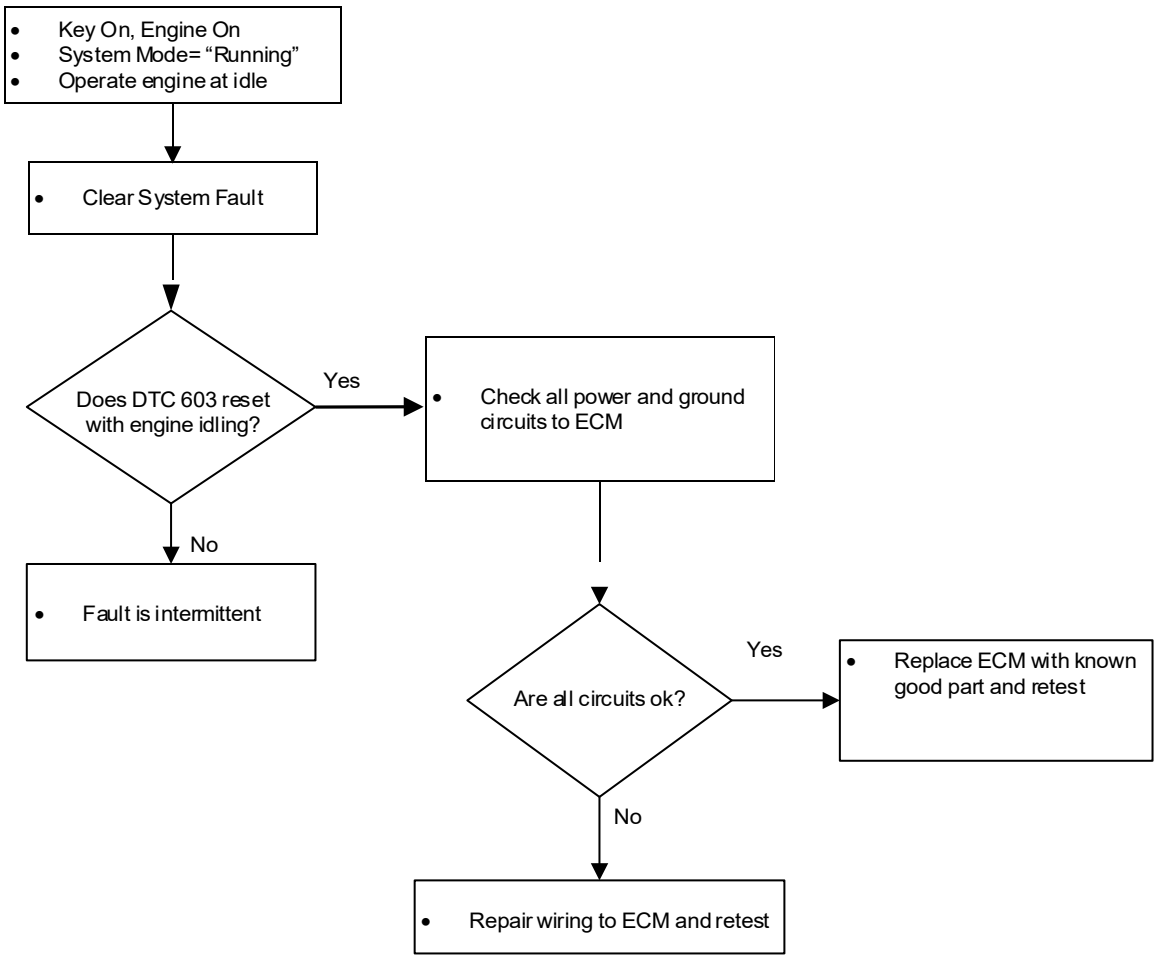
Possible Causes:

If this fault sets, the ECM will reset itself and log the code. The fault should be configured to never forget and will not self-erase and will not clear until a technician performs diagnostics and manually clears the code. This fault should be configured to set a power derate 2 and low rev limit to reduce possible engine damage and reduce possibility of an overspeed condition.

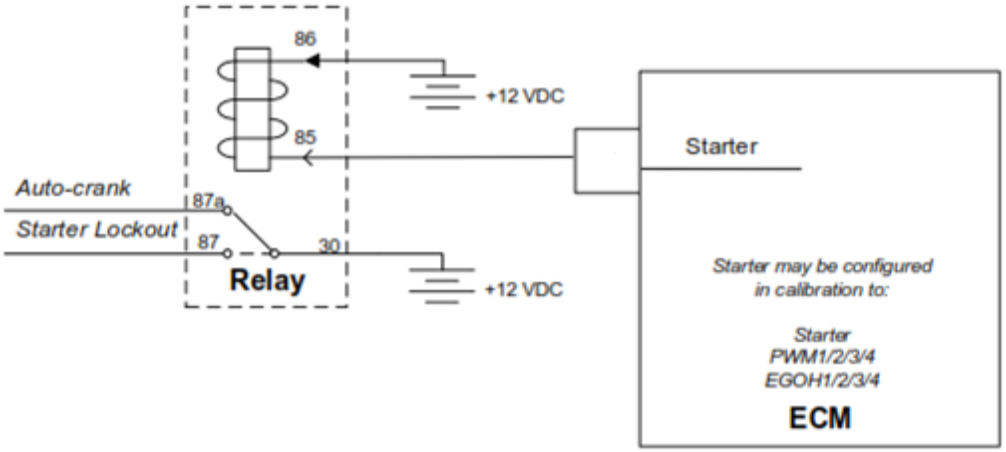
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	YES	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	YES	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 606 - MICROPROCESSOR FAILURE – COP (TROUBLE TREE)



DTC 616 - START RELAY CONTROL GROUND SHORT



DTC	616	SPN	1321	FMI	4

Hardware: Starter Relay

Description:

The ECM has auxiliary low-side drivers that can turn on warning devices or ground electromagnetic relay coils to control power to devices connected to the engine.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key On, Engine Cranking

Fault Set Conditions (as defined in calibration):

- Low-side diagnostics non-adjustable

OR

• high-side feedback <	10	% Vbat

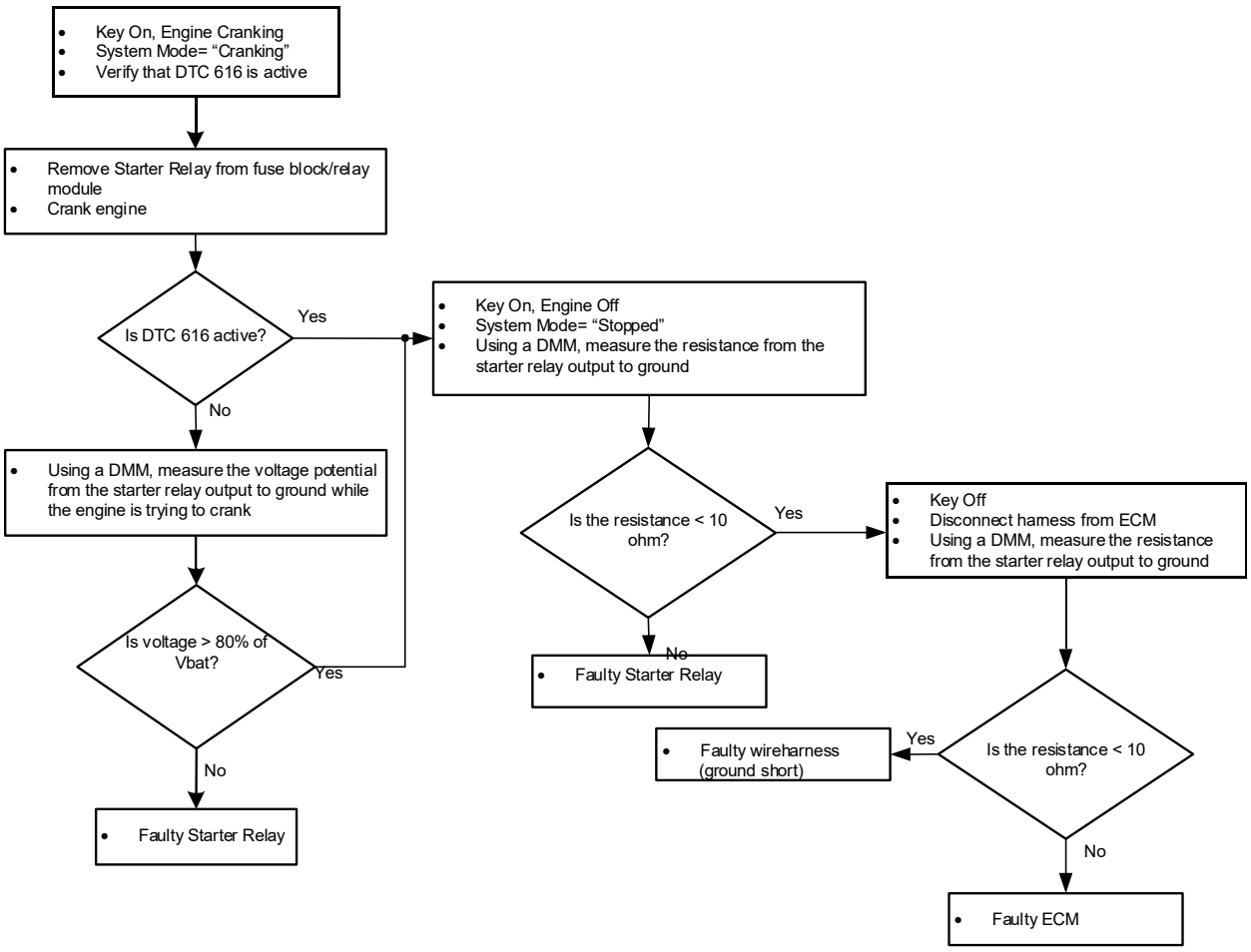
Possible Causes:

This fault sets if the output for the starter relay is detected as an open circuit. If this fault is active the starter motor will not receive power and will not engage.

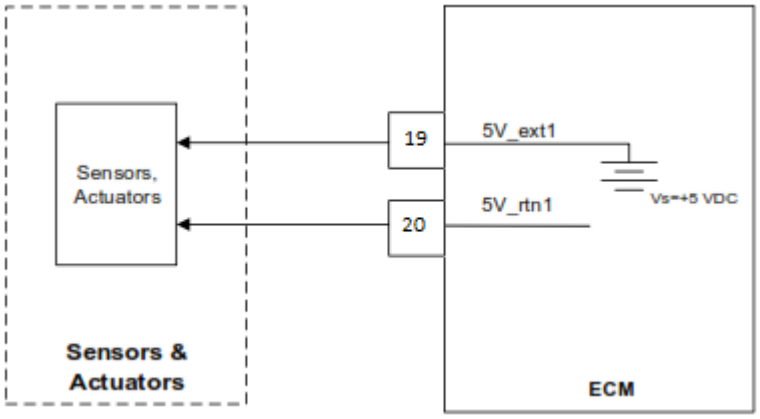
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 616 - START RELAY CONTROL GROUND SHORT (TROUBLE TREE)



DTC 642 - SENSOR SUPPLY VOLTAGE 1 LOW (5VEXT1)



DTC	642	SPN	1079	FMI	4

Hardware: External Sensor Supply Voltage Regulator

Description:

The external 5-volt supply powers sensors and other components in the engine control system. The accuracy of this supply is critical to the accuracy of the sensors' feedback, therefore, it is supplied from a precision regulator whose output is internally monitored by the ECM. The ECM monitors the 5-volt supply to ratio metrically correct sensor feedback and determine if the circuit is overloaded, shorted, or otherwise out of specification.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key On, Engine Off and Running

Fault Set Conditions (as defined in calibration):

• 5VE1 <	4.6	volts

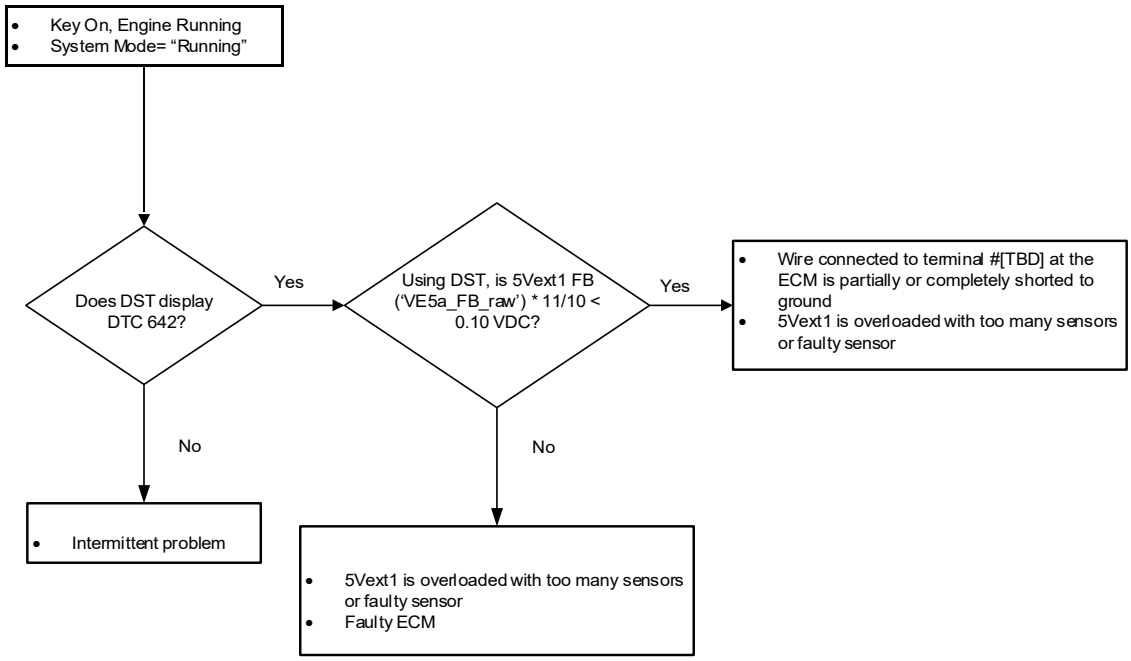
Possible Causes:

This fault will set if the internally measured voltage feedback of the regulator output is lower than the low voltage limit as defined in the diagnostic calibration anytime the engine is running or stopped at key-on (if applicable).

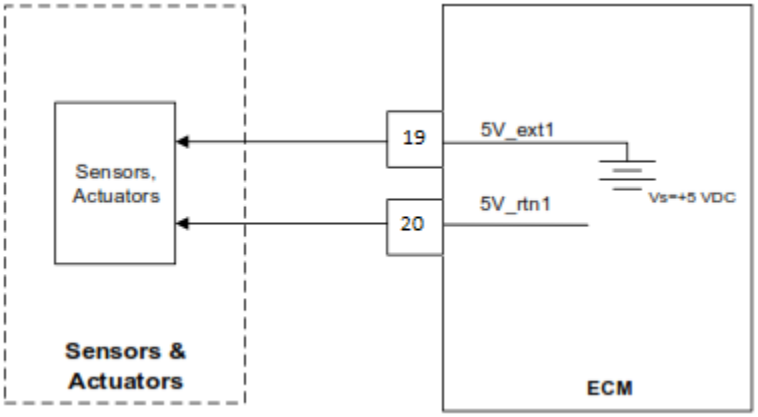
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 642 - SENSOR SUPPLY VOLTAGE 1 LOW (5VEXT1) (TROUBLE TREE)



DTC 643 - SENSOR SUPPLY VOLTAGE 1 HIGH (5VEXT1)



DTC	643	**SPN**	1079	**FMI**	3

Hardware: External Sensor Supply Voltage Regulator

Description:

The external 5-volt supply powers sensors and other components in the engine control system. The accuracy of this supply is critical to the accuracy of the sensors' feedback, therefore, it is supplied from a precision regulator whose output is internally monitored by the ECM. The ECM monitors the 5-volt supply to ratio metrically correct sensor feedback and determine if the circuit is overloaded, shorted, or otherwise out of specification.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key On, Engine Off and Running

Fault Set Conditions (as defined in calibration):

• 5VE1 >	5.4	volts

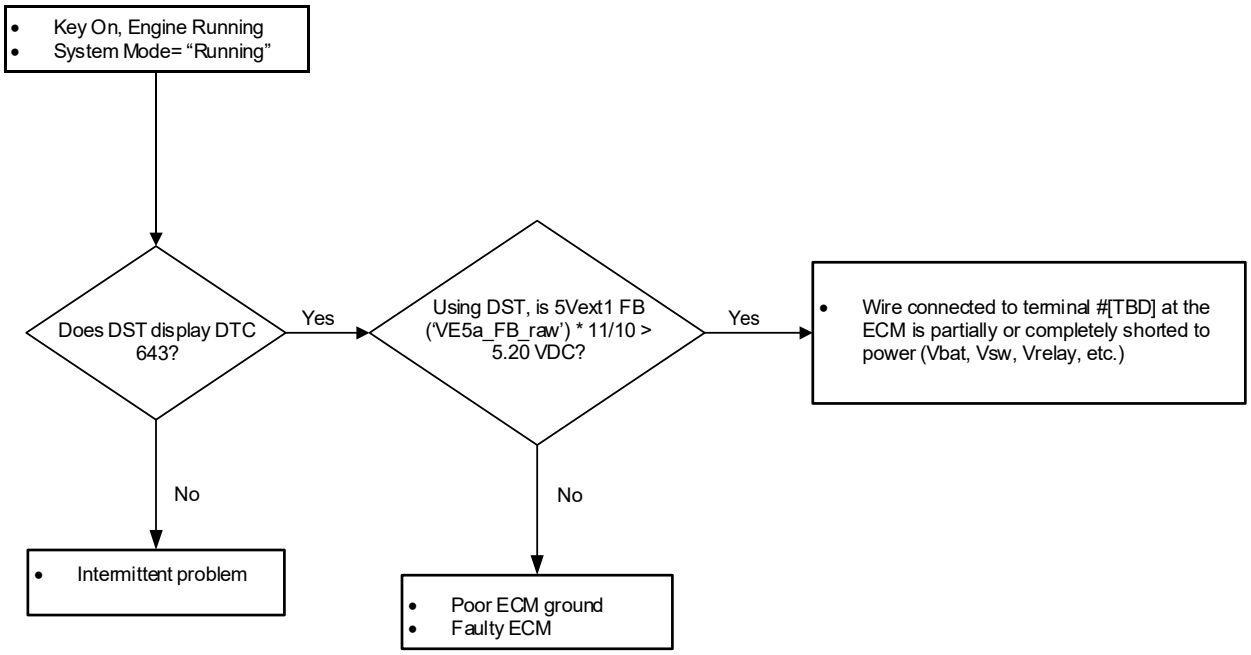
Possible Causes:

This fault will set if the internally measured voltage feedback of the regulator output is higher than the high voltage limit as defined in the diagnostic calibration anytime the engine is running or stopped at key-on (if applicable).

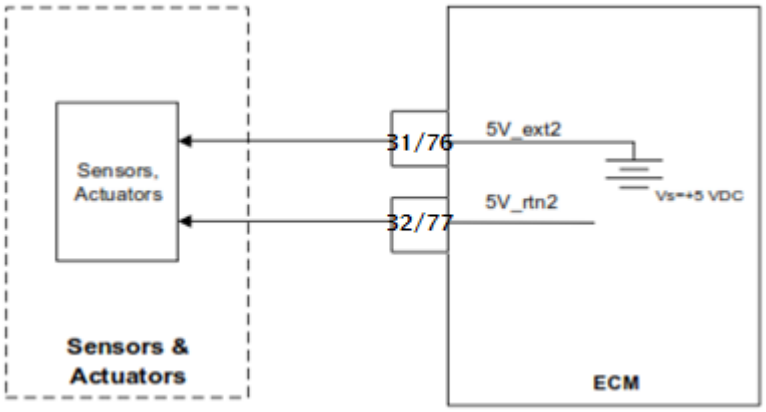
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 643- SENSOR SUPPLY VOLTAGE 1 HIGH (5VEXT1) (TROUBLE TREE)



DTC 652 - SENSOR SUPPLY VOLTAGE 2 LOW (5VEXT2)



DTC	652	SPN	1080	FMI	4

Hardware: External Sensor Supply Voltage Regulator

Description:

The external 5-volt supply powers sensors and other components in the engine control system. The accuracy of this supply is critical to the accuracy of the sensors' feedback, therefore, it is supplied from a precision regulator whose output is internally monitored by the ECM. The ECM monitors the 5-volt supply to ratio metrically correct sensor feedback and determine if the circuit is overloaded, shorted, or otherwise out of specification.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key On, Engine Off and Running

Fault Set Conditions (as defined in calibration):

• 5VE2 <	3	volts

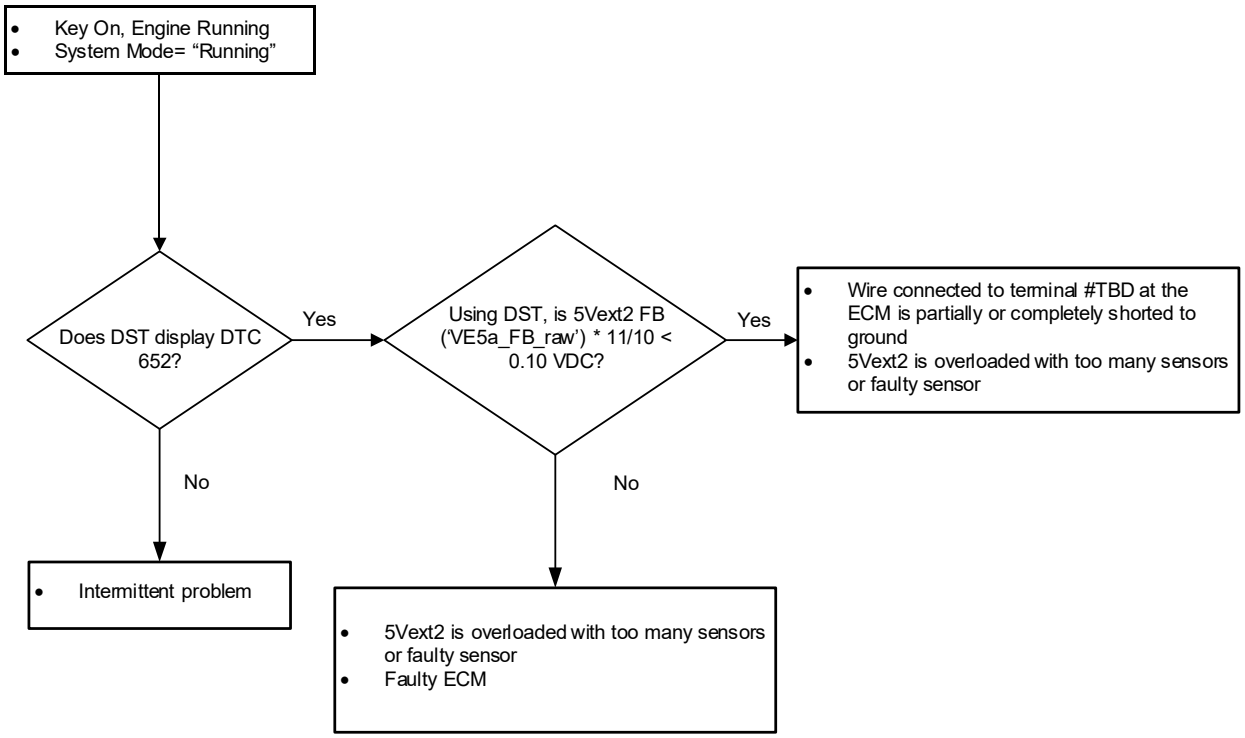
Possible Causes:

This fault will set if the internally measured voltage feedback of the regulator output is lower than the low voltage limit as defined in the diagnostic calibration anytime the engine is running or stopped at key-on (if applicable).

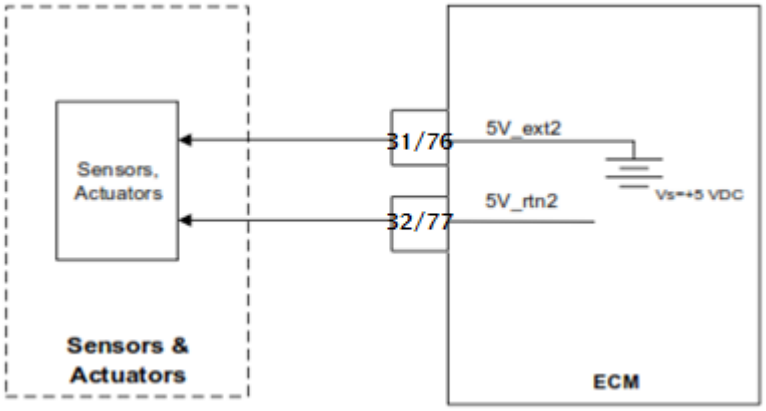
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 652 - SENSOR SUPPLY VOLTAGE 2 LOW (5VEXT2) (TROUBLE TREE)



DTC 653 – SENSOR SUPPLY VOLTAGE 2 HIGH (5VEXT2)



DTC	653	**SPN**	1080	**FMI**	3

Hardware: External Sensor Supply Voltage Regulator

Description:

The external 5-volt supply powers sensors and other components in the engine control system. The accuracy of this supply is critical to the accuracy of the sensors' feedback, therefore, it is supplied from a precision regulator whose output is internally monitored by the ECM. The ECM monitors the 5-volt supply to ratio metrically correct sensor feedback and determine if the circuit is overloaded, shorted, or otherwise out of specification.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key On, Engine Off and Running

Fault Set Conditions (as defined in calibration):

• 5VE2 >	5.4	volts

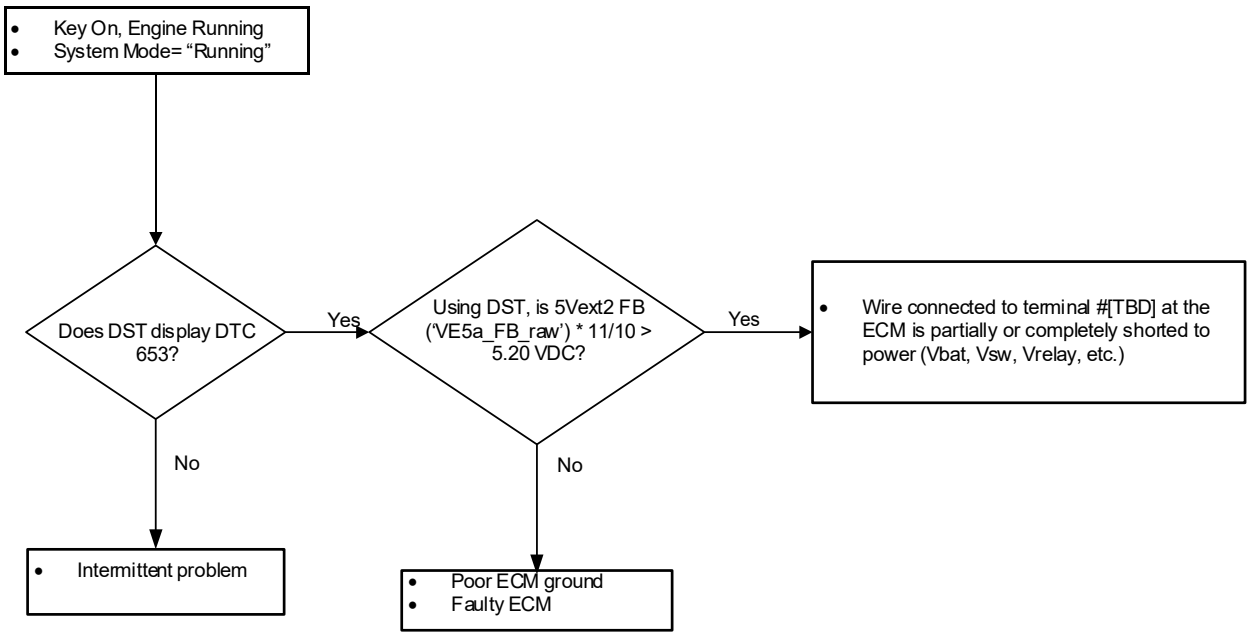
Possible Causes:

This fault will set if the internally measured voltage feedback of the regulator output is higher than the high voltage limit as defined in the diagnostic calibration anytime the engine is running or stopped at key-on (if applicable).

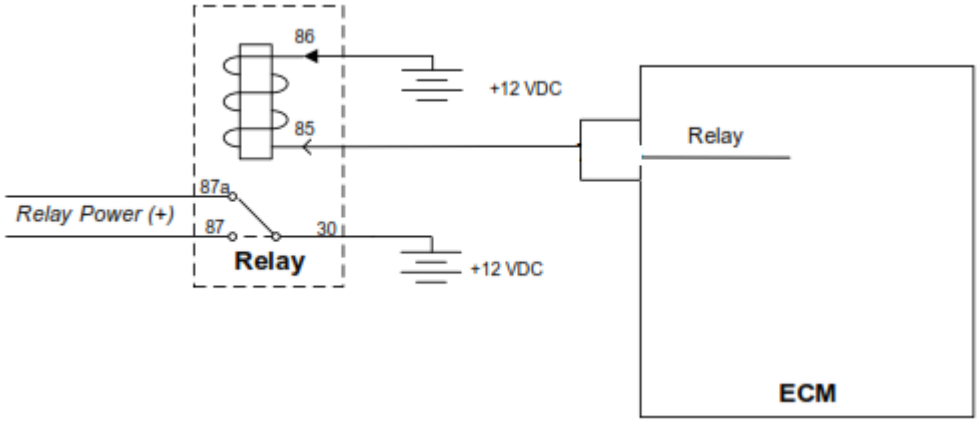
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 653- SENSOR SUPPLY VOLTAGE 2 HIGH (5VEXT2) (TROUBLE TREE)



DTC 685 - RELAY COIL OPEN



DTC	685	SPN	1485	FMI	5
Hardware:	Power Relay				

Description:

The ECM has auxiliary low-side drivers that can turn on warning devices or ground electromagnetic relay coils to control power to devices connected to the engine.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key On, Engine Off

Fault Set Conditions (as defined in calibration):

• Low-side feedback <	10	% Vbat

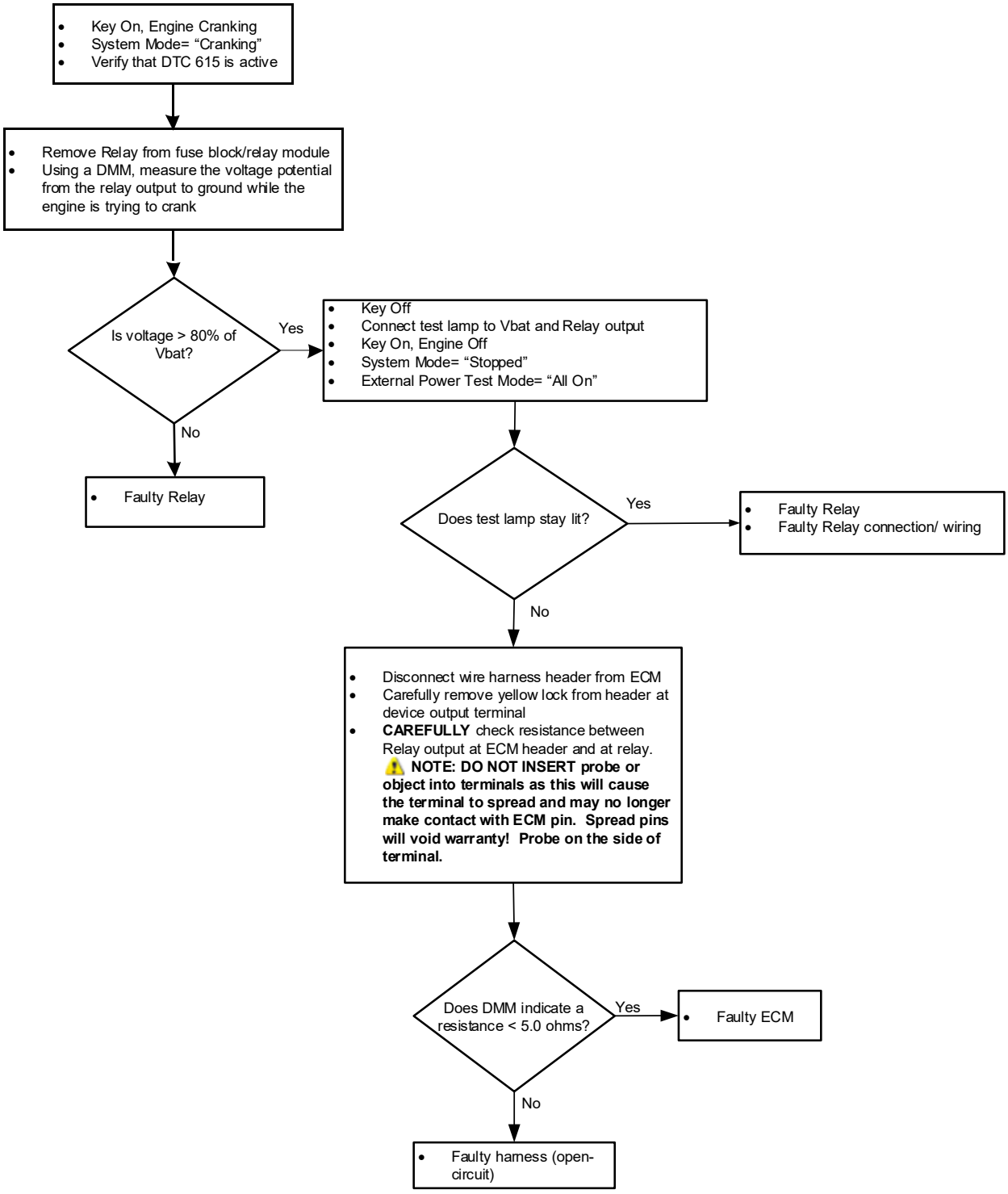
Possible Causes:

This fault sets if the output for the power relay is detected as an open circuit. If this fault is active the relay-powered device(s)(O_2 sensor(s), ignition coil(s), injector(s) or similar) will not receive power and the engine likely will not run.

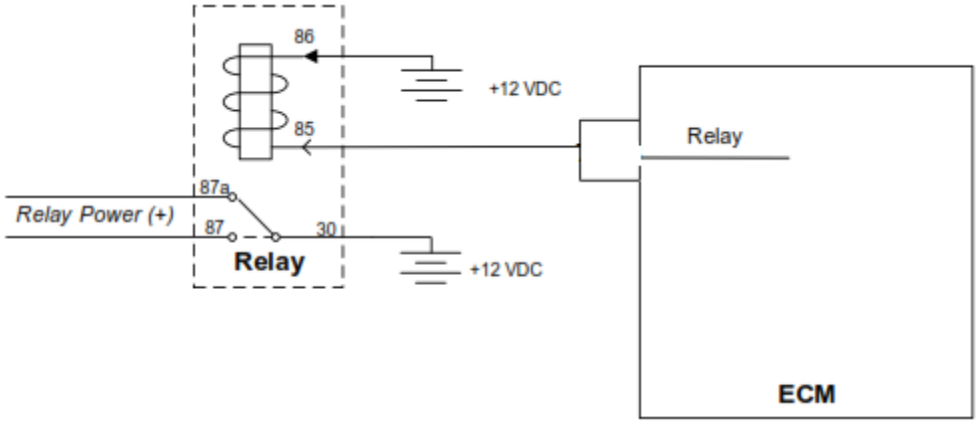
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 685 - RELAY COIL OPEN (TROUBLE TREE)



DTC 686 - RELAY CONTROL GROUND SHORT



DTC	686	SPN	1485	FMI	4

Hardware: Power Relay

Description:

The ECM has auxiliary low-side drivers that can turn on warning devices or ground electromagnetic relay coils to control power to devices connected to the engine.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key On, Engine Off

Fault Set Conditions (as defined in calibration):

• Low-side feedback <	TBD*	% Vbat

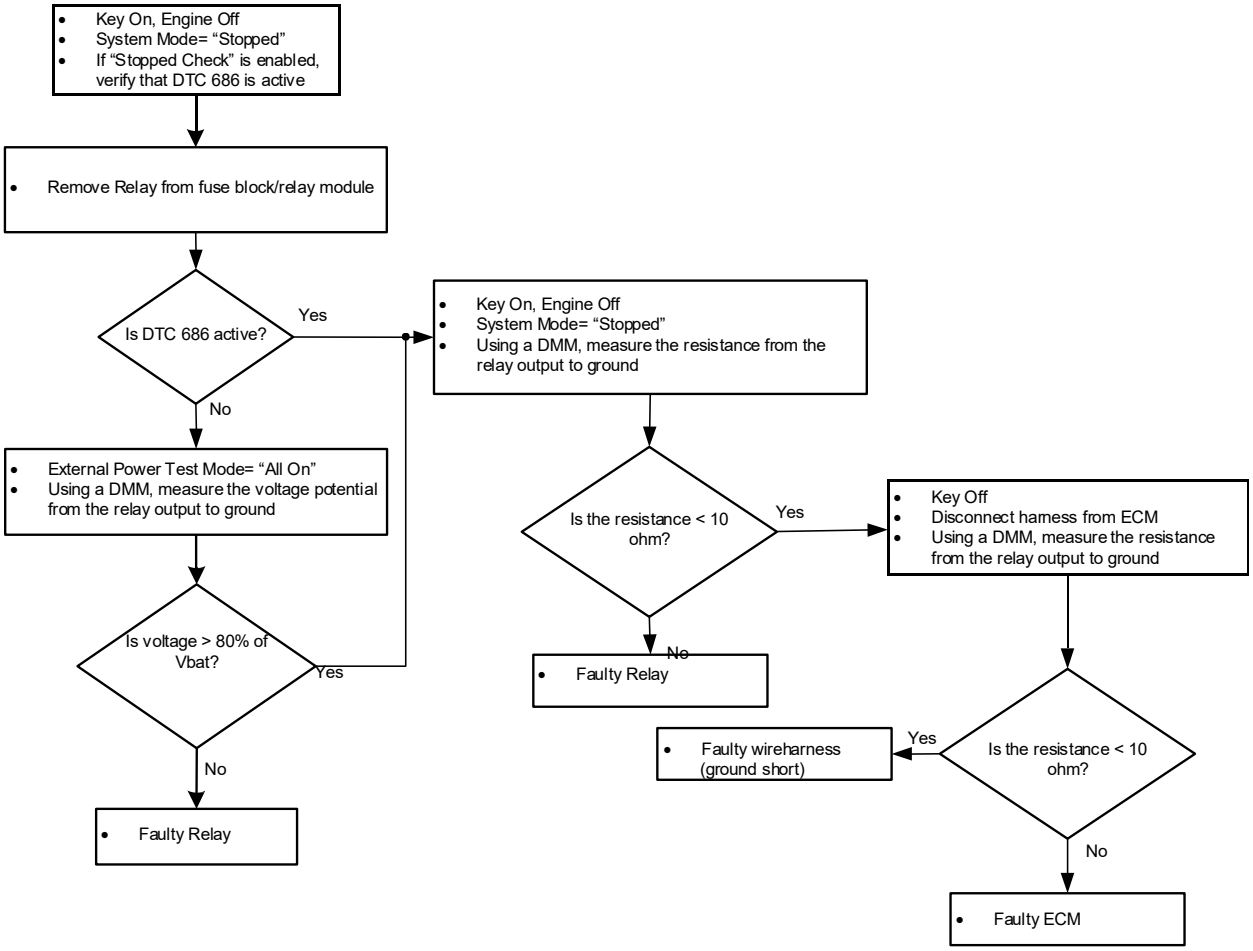
Possible Causes:

This fault sets if the output for the relay is detected as being shorted to ground. If this fault is active and the high-side of the relay is supplied, the relay-powered device(s)(O_2 sensor(s), ignition coil(s), injector(s) or similar) will run until the relay or high-side power is removed.

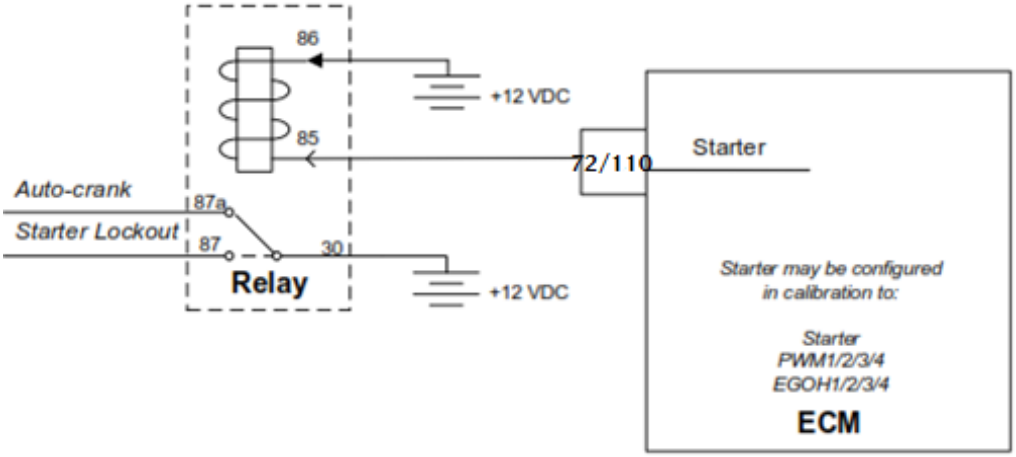
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 686 - RELAY COIL GROUND SHORT (TROUBLE TREE)



DTC 687 - RELAY COIL SHORT TO POWER



DTC	687	SPN	1485	FMI	3

Hardware: Power Relay

Description:

The ECM has auxiliary low-side drivers that can turn on warning devices or ground electromagnetic relay coils to control power to devices connected to the engine.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key On, Engine Off

Fault Set Conditions (as defined in calibration):

• Low-side feedback >	90	% Vbat

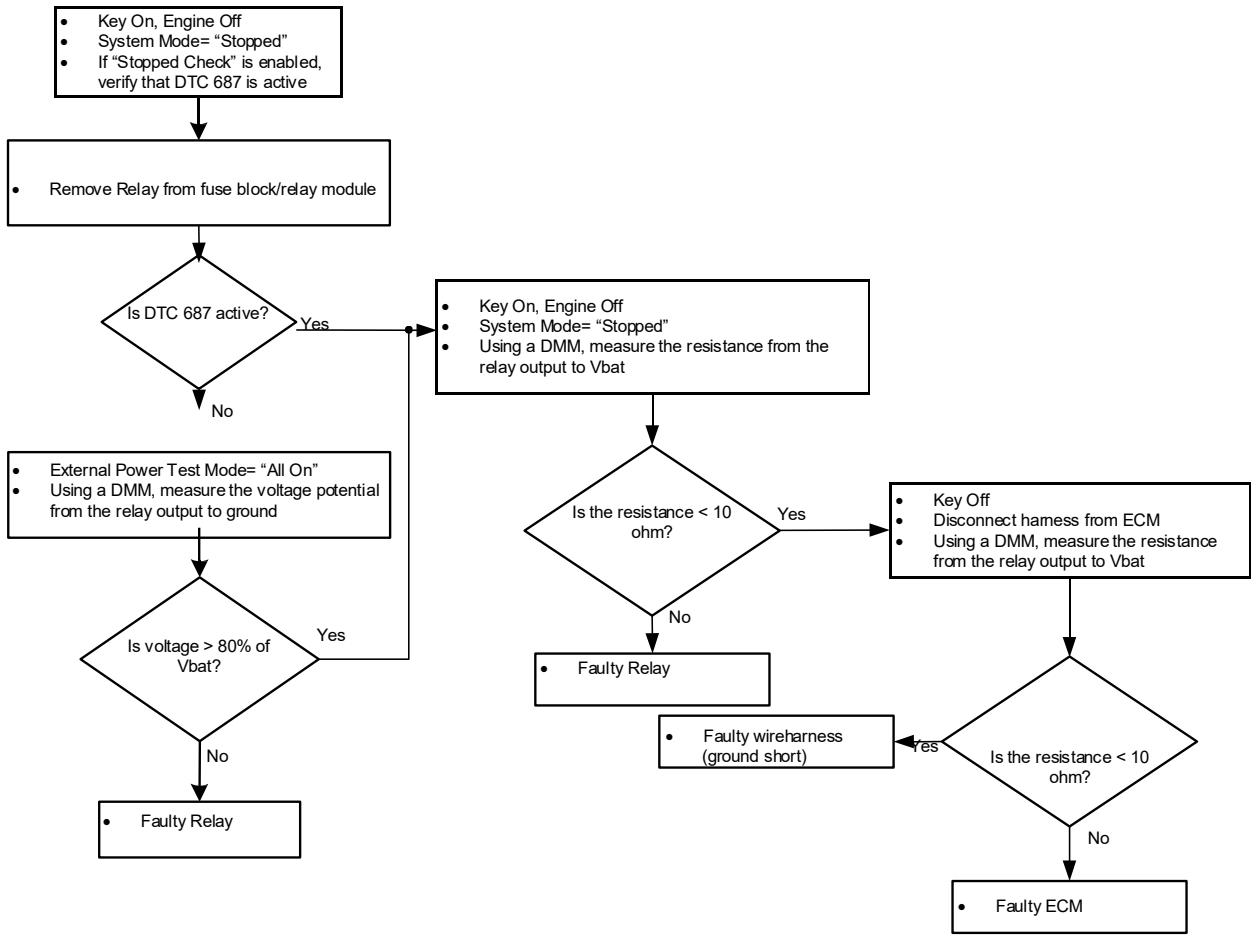
Possible Causes:

This fault sets if the output for the relay is detected as shorted to power. If this fault is active the relay-powered device(s)(O_2 sensor(s), ignition coil(s), injector(s) or similar) will not receive power and will not run.

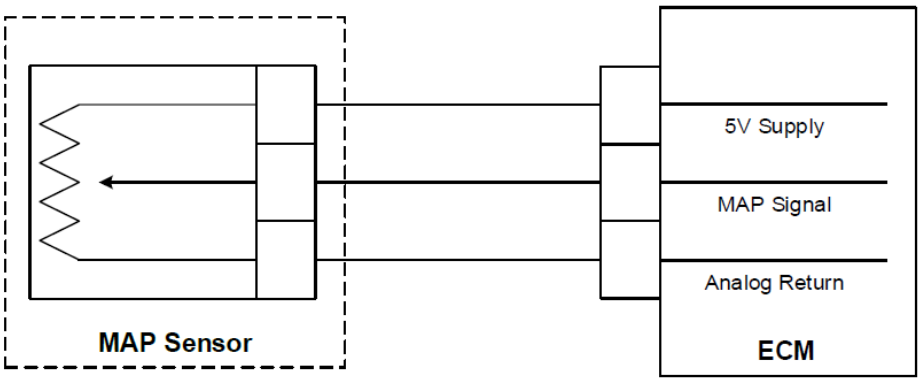
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 687 - RELAY COIL SHORT TO POWER (TROUBLE TREE)



DTC 1068 - MAP HIGHER THAN EXPECTED



DTC	1068	SPN	3563	FMI	15		

Hardware/Circuit: Manifold Absolute Pressure Sensor

Hardware/Circuit Description:

The Manifold Absolute Pressure sensor is a pressure transducer connected to the intake manifold. It is used to measure the pressure of air in the manifold prior to induction into the engine. The pressure reading is used in conjunction with other inputs to determine the rate of airflow to the engine, which thereby determines the required fuel flow rate.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions (as defined in calibration):

• MAP pressure >	**35**	psia
• and TPS <	**10**	%
• and RPM >	**1400**	rpm
• to unlatch, MAP pressure must be <	**15**	psia

Fault Description:

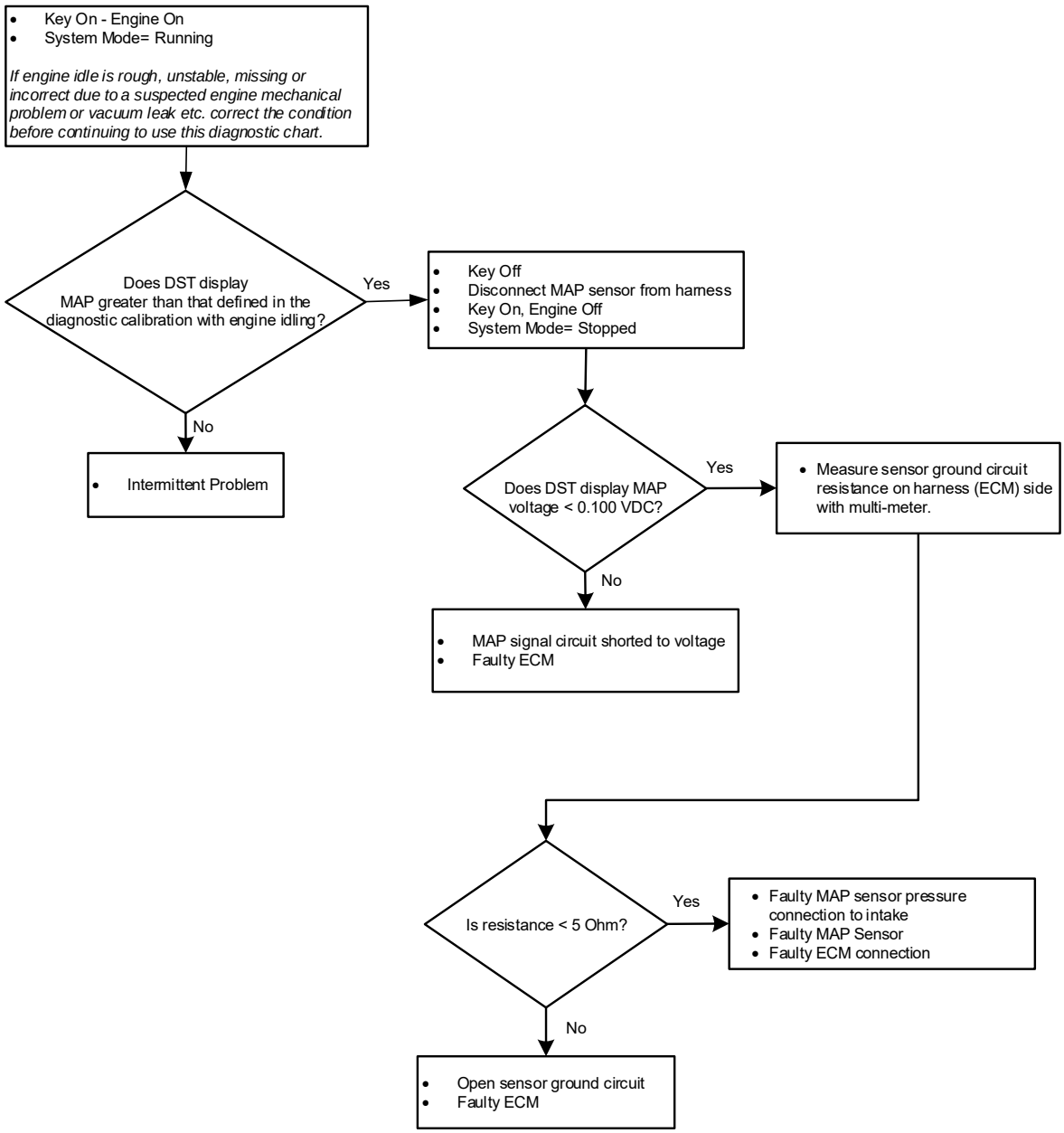
This fault will set when the MAP reading is higher than it should be for the given TPS, and RPM. When the fault is set the engine will typically operate in a limp home mode using an estimated MAP based on TPS feedback.

Corrective Actions *(see Table 1 for descriptions of individual corrective actions):*

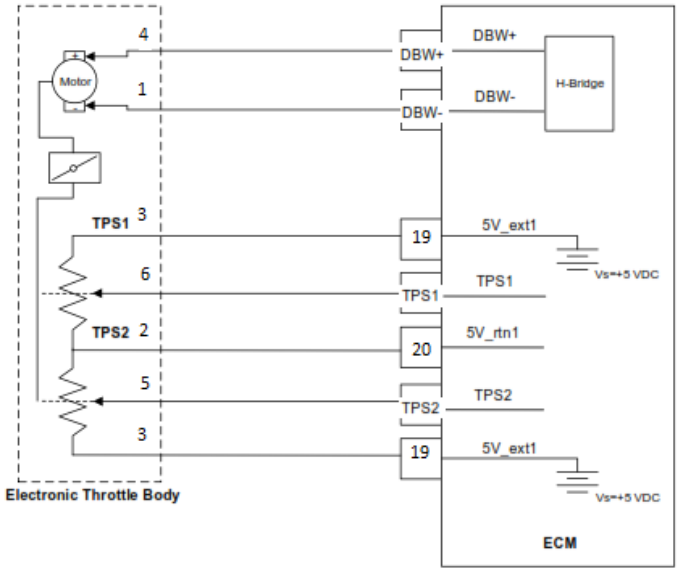
Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**TBD**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

DTC 1068 - MAP HIGHER THAN EXPECTED (TROUBLE TREE)

Trouble Tree



DTC 1111- RPM ABOVE FUEL REV LIMIT LEVEL



DTC	1111	SPN	515	FMI	16

Hardware: Fuel Rev Limit- Crankshaft Position Sensor

Description (includes additional corrective actions):

This fault is designed to help prevent engine or equipment damage and will disable fuel injectors or gaseous fuel actuator to reduce engine speed. The throttle will also be lowered in order to govern the engine to the speed set in the diagnostic calibration for Max Gov Override.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Engine running

Fault Set Conditions (as defined in calibration):

• rpm >	2450	rpm

Possible Causes:

This fault will set anytime the engine RPM exceeds the limit set in the diagnostic calibration for the latch time or more. This speed overrides any higher max governor speeds programmed by the user.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

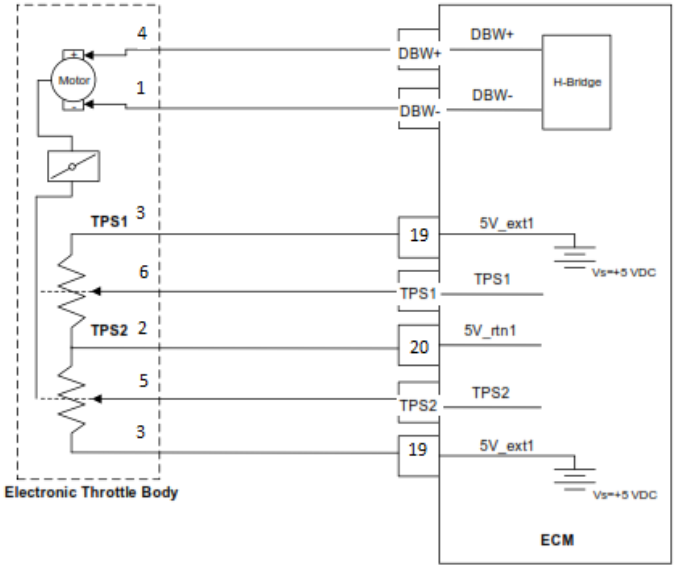
DTC 1111- RPM ABOVE FUEL REV LIMIT LEVEL (DIAGNOSTIC AIDS)

Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

- ☐ Ensure that no programmed governor speeds exceed the limit set in the diagnostic calibration for Max Gov Override Speed
- ☐ Check mechanical operation of the throttle
- ☐ Check the engine intake for large air leaks downstream of the throttle body

DTC 1112- RPM ABOVE SPARK REV LIMIT LEVEL



DTC	1112	SPN	515	FMI	0

Measurement / Hardware: Fuel Rev Limit- Crankshaft Position Sensor

Description (includes additional corrective actions):

This fault is designed to help prevent engine or equipment damage and will disable the ignition coils to reduce engine speed. In addition, the throttle will be lowered in order to govern the engine to the speed set in the diagnostic calibration for Max Gov Override and the fuel injectors or gaseous fuel control actuator will be disabled to reduce the engine speed below the speed set in the diagnostic calibration for Fuel Rev Limit.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Engine running

Fault Set Conditions (as defined in calibration):

• rpm >	2650	rpm

Possible Causes:

This fault will set anytime the engine RPM exceeds the limit set in the diagnostic calibration for the latch time or more. This speed overrides any higher max governor speeds programmed by the user.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

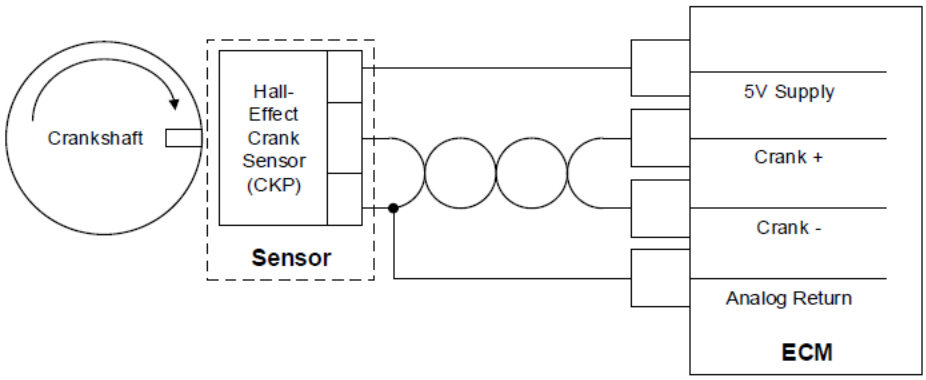
DTC 1112- RPM ABOVE SPARKL REV LIMIT LEVEL (DIAGNOSTIC AIDS)

Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

- ☐ Ensure that no programmed governor speeds exceed the limit set in the diagnostic calibration for Max Gov Override Speed
- ☐ Check mechanical operation of the throttle
- ☐ Check the engine intake for large air leaks downstream of the throttle body

DTC 1113- RPM HIGHER THAN EXPECTED



DTC	1113	SPN	515	FMI	31		

Hardware/Circuit: Crankshaft Position Sensor

Hardware/Circuit Description:

The crankshaft position sensor is a magnetic sensor (variable reluctant/magnetic pick-up or hall-effect) installed in the engine block adjacent to a "coded" trigger wheel located on the crankshaft. The sensor-trigger wheel combination is used to determine crankshaft position (with respect to TDC cylinder #1 compression) and the rotational engine speed. Determination of the crankshaft position and speed is necessary to properly activate the ignition, fuel injection, and throttle governing systems for precise engine control.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

• rpm >	**2550**	rpm

Fault Description:

This fault will set anytime the engine RPM exceeds the entry condition rpm limit set in the diagnostic calibration for the latch time or more. This fault is designed to help prevent engine or equipment damage. The throttle will be closed in order to govern the engine to the speed set in the diagnostic calibration for **Max Gov Override**.

Corrective Actions:

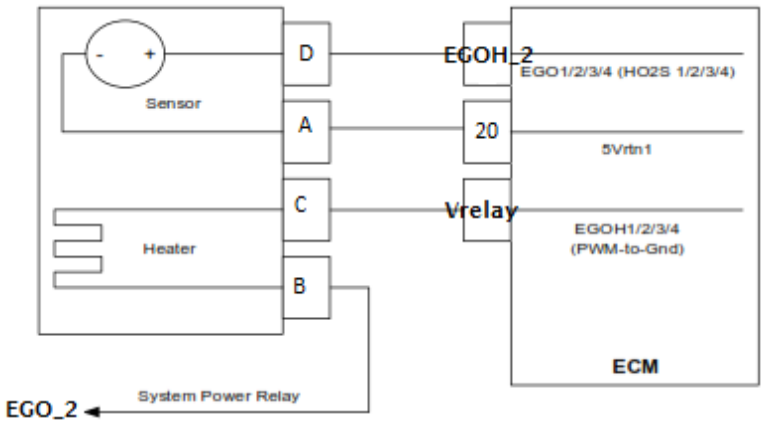
Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**TBD**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

- ☐ Ensure that no programmed governor speeds exceed the entry condition rpm value set in the diagnostic calibration.
- ☐ Verify the crank position sensor is reading properly.
- ☐ Preform Drive by Wire test to verify proper throttle performance
- ☐ Check mechanical operation of the throttle
- ☐ Check the engine intake for large air leaks downstream of the throttle body

DTC 1151 – CLOSED LOOP HIGH (LPG)



DTC	1151	**SPN**	520206	**FMI**	0

Sensor / Circuit: Heated or Universal Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)

Description:

The HEGO/HO2S sensor is a switching-type sensor around stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio. In either case, if there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted for each bank using the Closed Loop multiplier and then "learned" with the Adaptive multiplier. The multipliers only update when the system is in either "CL Active" or "CL + Adapt" control modes. The purpose of the closed loop fuel multiplier is to quickly adjust fuel flow due to variations in fuel composition; engine wear, engine-to-engine build variances, and component degradation prior to adaptive learn fueling correction "learning" the fueling deviation.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• CL_BM >	35	%
• and RPM >=	0	rpm
• and RPM <=	9999	rpm
• and MAP >=	0	psia
• and MAP <=	99	psia

Possible Causes:

This fault sets if the Closed Loop multiplier exceeds the high limit of normal operation indicating that the engine is operating lean (excess oxygen) and requires more fuel than allowed by corrections. Often high positive fueling corrections are a function of one or more of the following conditions: 1) exhaust leaks upstream or near the HEGO sensor, 2) reduced fuel supply pressure to the gaseous fuel control system, 3) a fuel supply or manifold leak, 4) a non-responsive HEGO/UEGO sensor, and/or 5) a defective gaseous fuel control component (actuator/valve and/or mixer). This fault should be configured to disable adaptive learn for the remainder of the key-cycle to avoid improperly learning the adaptive learn table and may be configured to disable closed loop.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

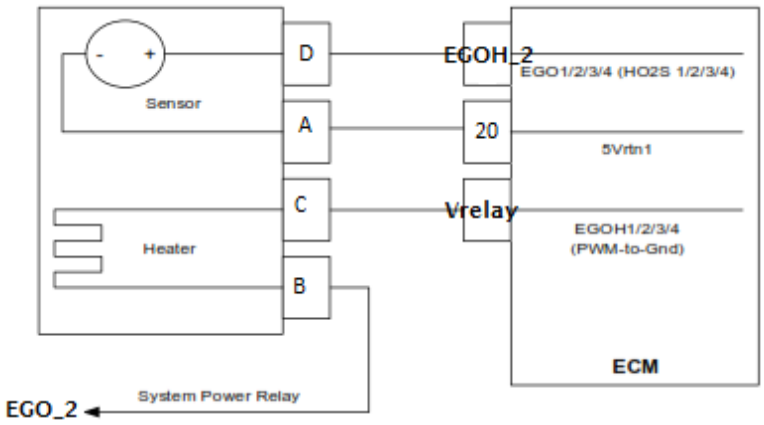
Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

- ☐ Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor sense signal.
- ☐ Vacuum Leaks - Large vacuum leaks and crankcase leaks can cause a lean exhaust condition at light load.
- ☐ Fuel Pressure - System will be lean if fuel pressure is too low. Ensure fuel tank pressure is not too low and that gaseous fuel control actuator/regulator has proper fuel pressure under all operating conditions.
- ☐ Exhaust Leaks - If there is an exhaust leak, outside air can be pulled into the exhaust and past the O2 sensor causing a false lean condition.
- ☐ Fuel Quality - A drastic variation in fuel quality may cause the system to be lean including fuels with high inert gas content.
- ☐ System Grounding - ECM and engine must be grounded to the battery with very little resistance allowing for proper current flow. Faulty grounds can cause current supply issues resulting in many undesired problems.
- ☐ If all tests are OK, replace the HO2S or UEGO sensor with a known good part and retest.

DTC 1152 – CLOSED LOOP LOW (LPG)



DTC	1152	**SPN**	520206	**FMI**	1

Sensor / Circuit: Heated or Universal Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)

Description:

The HEGO/HO2S sensor is a switching-type sensor around stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio. In either case, if there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted for each bank using the Closed Loop multiplier and then "learned" with the Adaptive multiplier. The multipliers only update when the system is in either "CL Active" or "CL + Adapt" control modes. The purpose of the closed loop fuel multiplier is to quickly adjust fuel flow due to variations in fuel composition; engine wear, engine-to-engine build variances, and component degradation prior to adaptive learn fueling correction "learning" the fueling deviation.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• CL_BM <	-35	%
• and RPM >=	TBD*	rpm
• and RPM <=	TBD*	rpm
• and MAP >=	TBD*	psia
• and MAP <=	TBD*	psia

Possible Causes:

This fault sets if the Closed Loop multiplier exceeds the low limit of normal operation indicating that the engine is operating rich (excess fuel) and requires less fuel than allowed by corrections. Often high negative fueling corrections are a function of one or more of the following conditions: 1) high fuel supply pressure to the gaseous fuel control or faulty pressure regulator and/or 2) a non-responsive HEGO/UEGO sensor. This fault should be configured to disable adaptive learn for the remainder of the key-cycle to avoid improperly learning the adaptive learn table and may be configured to disable closed loop.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

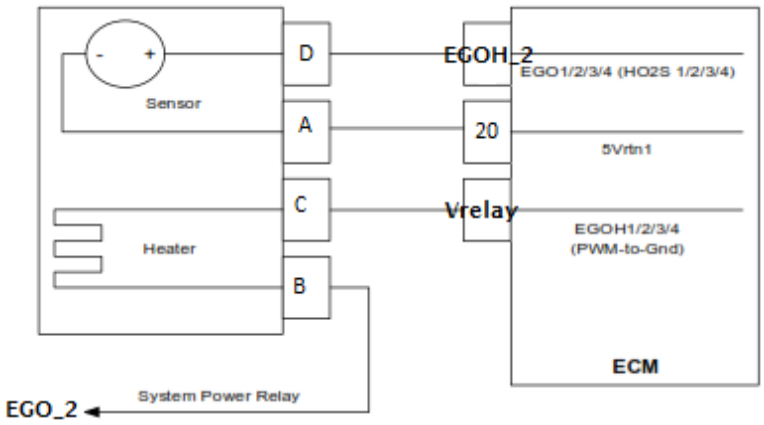
Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

- ☐ Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness
- ☐ Fuel Pressure - System will be rich if fuel delivery pressure is too high to gaseous control system. Check fuel pressure at the control actuator/valve under all operating conditions.
- ☐ System Grounding - ECM and engine must be grounded to the battery with very little resistance allowing for proper current flow. Faulty grounds can cause current supply issues resulting in many undesired problems.
- ☐ If all tests are OK, replace the HO2S or UEGO sensor with a known good part and retest.

DTC 1153 – CLOSED LOOP HIGH NATURAL GAS



DTC	1153	**SPN**	520207	**FMI**	0

Sensor / Circuit: Heated or Universal Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)

Description:

The HEGO/HO2S sensor is a switching-type sensor around stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio. In either case, if there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted for each bank using the Closed Loop multiplier and then "learned" with the Adaptive multiplier. The multipliers only update when the system is in either "CL Active" or "CL + Adapt" control modes. The purpose of the closed loop fuel multiplier is to quickly adjust fuel flow due to variations in fuel composition; engine wear, engine-to-engine build variances, and component degradation prior to adaptive learn fueling correction "learning" the fueling deviation.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• CL_BM >	45	%
• and RPM >=	0	rpm
• and RPM <=	9999	rpm
• and MAP >=	0	psia
• and MAP <=	99	psia

Possible Causes:

This fault sets if the Closed Loop multiplier exceeds the high limit of normal operation indicating that the engine is operating lean (excess oxygen) and requires more fuel than allowed by corrections. Often high positive fueling corrections are a function of one or more of the following conditions: 1) exhaust leaks upstream or near the HEGO sensor, 2) reduced fuel supply pressure to the gaseous fuel control system, 3) a fuel supply or manifold leak, 4) a non-responsive HEGO/UEGO sensor, and/or 5) a defective gaseous fuel control component (actuator/valve and/or mixer). This fault should be configured to disable adaptive learn for the remainder of the key-cycle to avoid improperly learning the adaptive learn table and may be configured to disable closed loop.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

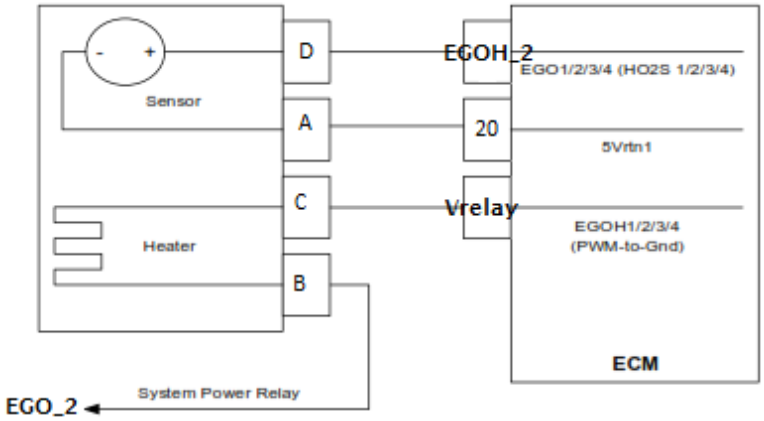
Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

- ☐ Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor sense signal.
- ☐ Vacuum Leaks - Large vacuum leaks and crankcase leaks can cause a lean exhaust condition at light load.
- ☐ Fuel Pressure - System will be lean if fuel pressure is too low. Ensure fuel tank pressure is not too low and that gaseous fuel control actuator/regulator has proper fuel pressure under all operating conditions.
- ☐ Exhaust Leaks - If there is an exhaust leak, outside air can be pulled into the exhaust and past the O2 sensor causing a false lean condition.
- ☐ Fuel Quality - A drastic variation in fuel quality may cause the system to be lean including fuels with high inert gas content.
- ☐ System Grounding - ECM and engine must be grounded to the battery with very little resistance allowing for proper current flow. Faulty grounds can cause current supply issues resulting in many undesired problems.
- ☐ If all tests are OK, replace the HO2S or UEGO sensor with a known good part and retest.

DTC 1154 – CLOSED LOOP LOW NATURAL GAS



DTC	1154	**SPN**	520207	**FMI**	1

Sensor / Circuit: Heated or Universal Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)

Description:

The HEGO/HO2S sensor is a switching-type sensor around stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio. In either case, if there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted for each bank using the Closed Loop multiplier and then "learned" with the Adaptive multiplier. The multipliers only update when the system is in either "CL Active" or "CL + Adapt" control modes. The purpose of the closed loop fuel multiplier is to quickly adjust fuel flow due to variations in fuel composition; engine wear, engine-to-engine build variances, and component degradation prior to adaptive learn fueling correction "learning" the fueling deviation.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• CL_BM <	-45	%
• and RPM >=	TBD*	rpm
• and RPM <=	TBD*	rpm
• and MAP >=	TBD*	psia
• and MAP <=	TBD*	psia

Possible Causes:

This fault sets if the Closed Loop multiplier exceeds the low limit of normal operation indicating that the engine is operating rich (excess fuel) and requires less fuel than allowed by corrections. Often high negative fueling corrections are a function of one or more of the following conditions: 1) high fuel supply pressure to the gaseous fuel control or faulty pressure regulator and/or 2) a non-responsive HEGO/UEGO sensor. This fault should be configured to disable adaptive learn for the remainder of the key-cycle to avoid improperly learning the adaptive learn table and may be configured to disable closed loop.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

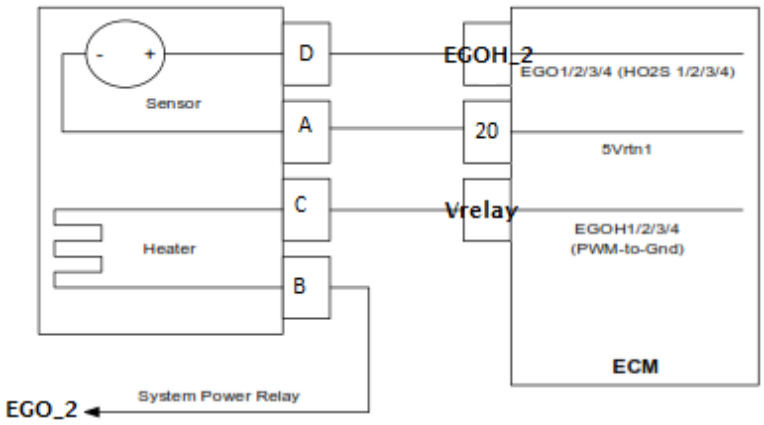
Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

- ☐ Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness
- ☐ Fuel Pressure - System will be rich if fuel delivery pressure is too high to gaseous control system. Check fuel pressure at the control actuator/valve under all operating conditions.
- ☐ System Grounding - ECM and engine must be grounded to the battery with very little resistance allowing for proper current flow. Faulty grounds can cause current supply issues resulting in many undesired problems.
- ☐ If all tests are OK, replace the HO2S or UEGO sensor with a known good part and retest.

DTC 1161 – AADAPTIVE LEARN HIGH (LPG)



DTC	1161	**SPN**	520202	**FMI**	0

Sensor / Circuit: Heated or Universal Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)

Description:

The HEGO/HO2S sensor is a switching-type sensor around stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio. In either case, if there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted for each bank using the Closed Loop multiplier and then "learned" with the Adaptive multiplier. The multipliers only update when the system is in either "CL Active" or "CL + Adapt" control modes. The purpose of the Adaptive Learn fuel multiplier is to adjust fuel flow due to variations in fuel composition, engine wear, engine-to-engine build variances, and component degradation.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• AL_BM >	30	%
• and RPM >=	0	rpm
• and RPM <=	9999	rpm
• and MAP >=	0	psia
• and MAP <=	99	psia

Possible Causes:

This fault sets if the Adaptive multiplier exceeds the high limit of normal operation indicating that the engine is operating lean (excess oxygen) and requires more fuel than allowed by corrections. Often high positive fueling corrections are a function of one or more of the following conditions: 1) exhaust leaks upstream or near the HEGO sensor, 2) reduced fuel supply pressure to the gaseous fuel control system, 3) a fuel supply or manifold leak, 4) a non-responsive HEGO/UEGO sensor, and/or 5) a defective gaseous fuel control component (actuator/valve and/or mixer). This fault should be configured to disable adaptive learn for the remainder of the key-cycle to avoid improperly learning the adaptive learn table and may be configured to disable closed loop.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

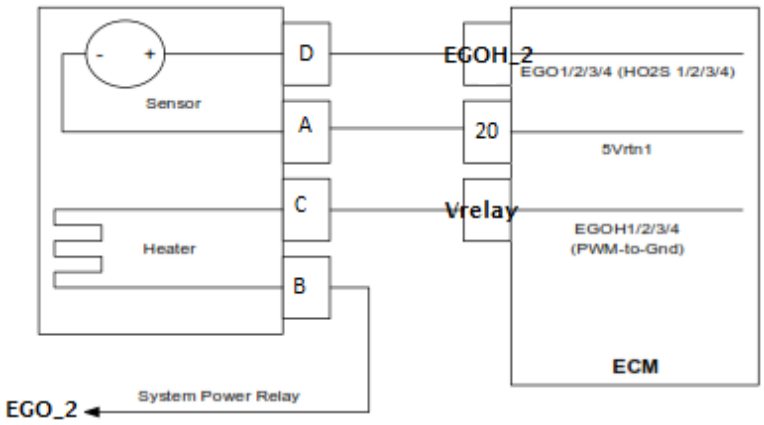
Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

- ☐ Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor sense signal.
- ☐ Vacuum Leaks - Large vacuum leaks and crankcase leaks can cause a lean exhaust condition at light load.
- ☐ Fuel Pressure - System will be lean if fuel pressure is too low. Ensure fuel tank pressure is not too low and that gaseous fuel control actuator/regulator has proper fuel pressure under all operating conditions.
- ☐ Exhaust Leaks - If there is an exhaust leak, outside air can be pulled into the exhaust and past the O2 sensor causing a false lean condition.
- ☐ Fuel Quality - A drastic variation in fuel quality may cause the system to be lean including fuels with high inert gas content.
- ☐ System Grounding - ECM and engine must be grounded to the battery with very little resistance allowing for proper current flow. Faulty grounds can cause current supply issues resulting in many undesired problems.
- ☐ If all tests are OK, replace the HO2S or UEGO sensor with a known good part and retest.

DTC 1162 – ADAPTIVE LEARN LOW (LPG)



DTC	1162	**SPN**	520202	**FMI**	1

Sensor / Circuit: Heated or Universal Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)

Description:

The HEGO/HO2S sensor is a switching-type sensor around stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio. In either case, if there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted for each bank using the Closed Loop multiplier and then "learned" with the Adaptive multiplier. The multipliers only update when the system is in either "CL Active" or "CL + Adapt" control modes. The purpose of the Adaptive Learn fuel multiplier is to adjust fuel flow due to variations in fuel composition, engine wear, engine-to-engine build variances, and component degradation.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• CL_BM <	-30	%
• and RPM >=	TBD*	rpm
• and RPM <=	TBD*	rpm
• and MAP >=	TBD*	psia
• and MAP <=	TBD*	psia

Possible Causes:

This fault sets if the Adaptive multiplier exceeds the low limit of normal operation indicating that the engine is operating rich (excess fuel) and requires less fuel than allowed by corrections. Often high negative fueling corrections are a function of one or more of the following conditions: 1) high fuel supply pressure to the gaseous fuel control or faulty pressure regulator and/or 2) a non-responsive HEGO/UEGO sensor. This fault should be configured to disable adaptive learn for the remainder of the key-cycle to avoid improperly learning the adaptive learn table and may be configured to disable closed loop.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

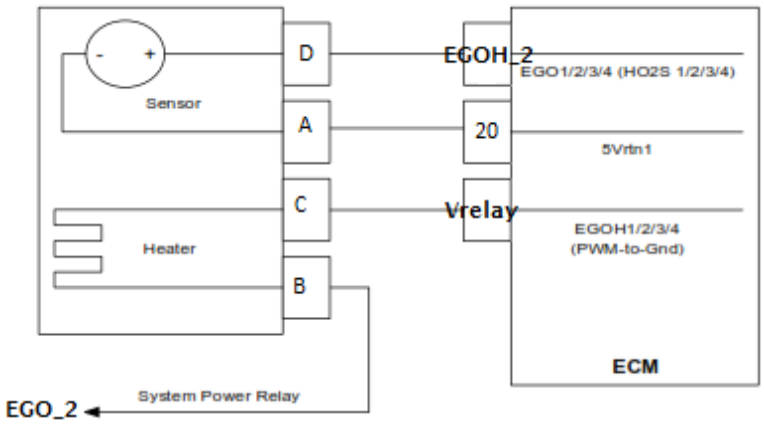
Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

- ☐ Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness
- ☐ Fuel Pressure - System will be rich if fuel delivery pressure is too high to gaseous control system. Check fuel pressure at the control actuator/valve under all operating conditions.
- ☐ System Grounding - ECM and engine must be grounded to the battery with very little resistance allowing for proper current flow. Faulty grounds can cause current supply issues resulting in many undesired problems.
- ☐ If all tests are OK, replace the HO2S or UEGO sensor with a known good part and retest.

DTC 1163 – ADAPTIVE LEARN HIGH (NATURAL GAS)



DTC	1163	**SPN**	520203	**FMI**	0

Sensor / Circuit: Heated or Universal Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)

Description:

The HEGO/HO2S sensor is a switching-type sensor around stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio. In either case, if there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted for each bank using the Closed Loop multiplier and then "learned" with the Adaptive multiplier. The multipliers only update when the system is in either "CL Active" or "CL + Adapt" control modes. The purpose of the Adaptive Learn fuel multiplier is to adjust fuel flow due to variations in fuel composition, engine wear, engine-to-engine build variances, and component degradation.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• AL_BM >	30	%
• and RPM >=	0	rpm
• and RPM <=	9999	rpm
• and MAP >=	0	psia
• and MAP <=	99	psia

Possible Causes:

This fault sets if the Adaptive multiplier exceeds the high limit of normal operation indicating that the engine is operating lean (excess oxygen) and requires more fuel than allowed by corrections. Often high positive fueling corrections are a function of one or more of the following conditions: 1) exhaust leaks upstream or near the HEGO sensor, 2) reduced fuel supply pressure to the gaseous fuel control system, 3) a fuel supply or manifold leak, 4) a non-responsive HEGO/UEGO sensor, and/or 5) a defective gaseous fuel control component (actuator/valve and/or mixer). This fault should be configured to disable adaptive learn for the remainder of the key-cycle to avoid improperly learning the adaptive learn table and may be configured to disable closed loop.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

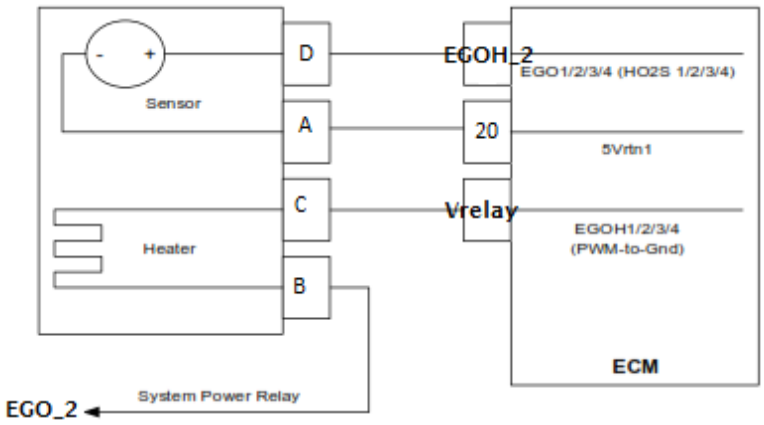
Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

- ☐ Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor sense signal.
- ☐ Vacuum Leaks - Large vacuum leaks and crankcase leaks can cause a lean exhaust condition at light load.
- ☐ Fuel Pressure - System will be lean if fuel pressure is too low. Ensure fuel tank pressure is not too low and that gaseous fuel control actuator/regulator has proper fuel pressure under all operating conditions.
- ☐ Exhaust Leaks - If there is an exhaust leak, outside air can be pulled into the exhaust and past the O2 sensor causing a false lean condition.
- ☐ Fuel Quality - A drastic variation in fuel quality may cause the system to be lean including fuels with high inert gas content.
- ☐ System Grounding - ECM and engine must be grounded to the battery with very little resistance allowing for proper current flow. Faulty grounds can cause current supply issues resulting in many undesired problems.
- ☐ If all tests are OK, replace the HO2S or UEGO sensor with a known good part and retest.

DTC 1164 – ADAPTIVE LEARN LOW (NATURAL GAS)



DTC	1164	**SPN**	520203	**FMI**	1

Sensor / Circuit: Heated or Universal Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)

Description:

The HEGO/HO2S sensor is a switching-type sensor around stoichiometry that measures the oxygen content present in the exhaust to determine if the fuel flow to the engine is correct. A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio. In either case, if there is a deviation between the expected reading and the actual reading, fuel flow is precisely adjusted for each bank using the Closed Loop multiplier and then "learned" with the Adaptive multiplier. The multipliers only update when the system is in either "CL Active" or "CL + Adapt" control modes. The purpose of the Adaptive Learn fuel multiplier is to adjust fuel flow due to variations in fuel composition, engine wear, engine-to-engine build variances, and component degradation.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• CL_BM <	-40	%
• and RPM >=	TBD*	rpm
• and RPM <=	TBD*	rpm
• and MAP >=	TBD*	psia
• and MAP <=	TBD*	psia

Possible Causes:

This fault sets if the Adaptive multiplier exceeds the low limit of normal operation indicating that the engine is operating rich (excess fuel) and requires less fuel than allowed by corrections. Often high negative fueling corrections are a function of one or more of the following conditions: 1) high fuel supply pressure to the gaseous fuel control or faulty pressure regulator and/or 2) a non-responsive HEGO/UEGO sensor. This fault should be configured to disable adaptive learn for the remainder of the key-cycle to avoid improperly learning the adaptive learn table and may be configured to disable closed loop.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

Diagnostic Aids

NOTE: If any other DTCs are present, diagnose those first.

- ☐ Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness
- ☐ Fuel Pressure - System will be rich if fuel delivery pressure is too high to gaseous control system. Check fuel pressure at the control actuator/valve under all operating conditions.
- ☐ System Grounding - ECM and engine must be grounded to the battery with very little resistance allowing for proper current flow. Faulty grounds can cause current supply issues resulting in many undesired problems.
- ☐ If all tests are OK, replace the HO2S or UEGO sensor with a known good part and retest.

DTC 1171 - EPR / CFV REGULATION PRESSURE HIGHER THAN EXPECTED

DTC	1171	**SPN**	520260	**FMI**	0
Hardware:	EPR (HD EPR) or CFV				

Description:

The EPR is the second generation of EControls' Electronic Pressure Regulator found in many industrial and heavy-duty applications. The 2nd generation EPR is a "smart" actuator integrated with the primary stage regulator designed to control gaseous fuel pressure in the secondary stage regulator. The EPR receives fuel pressure commands from the ECM and quickly and precisely modulates fuel pressure to the gaseous fuel mixer. The EPR allows for fast and accurate gaseous fuel control to provide a combustible mixture to the engine.

The third generation of EControls' Electronic Pressure Regulator is the DEPR. The DEPR is a "smart" actuator that is fed supply pressure through a DSR (Dual Stage Regulator). The DSR is fully mechanical. The DEPR receives fuel pressure commands from the ECM and quickly and precisely modulates fuel pressure to the gaseous fuel mixer. The DEPR allows for very fast and very accurate gaseous fuel control to provide a combustible mixture to the engine

The fourth generation of EControls' gaseous fuel control valve is the CFV. The CFV contains both a high-pressure Electronic Pressure Regulator and a precision Continuous Flow Valve. The inlet pressure to the CFV is typically 85 psig (586 kPa). The CFV receives mass flow commands from the ECM and quickly and precisely modulates both the fuel pressure and metering valve to achieve the desired mass flow. The CFV allows for very fast and very accurate gaseous fuel control to provide a combustible mixture to the engine.

Fault Enabled in Calibration?	**YES**		
Emissions-related Fault?	**YES**		
Check Condition:	Engine Running		
Fault Set Conditions (as defined in calibration):			
• EPR (actual-commanded) pressure >		1.5	in H2O
• or CFV (actual-commanded) pressure >		10	psi

Possible Causes:

This fault sets if the actual pressure sensed in the EPR/CFV is greater than the commanded pressure by X. Typical values for X are listed below (may vary per specific engine calibration):

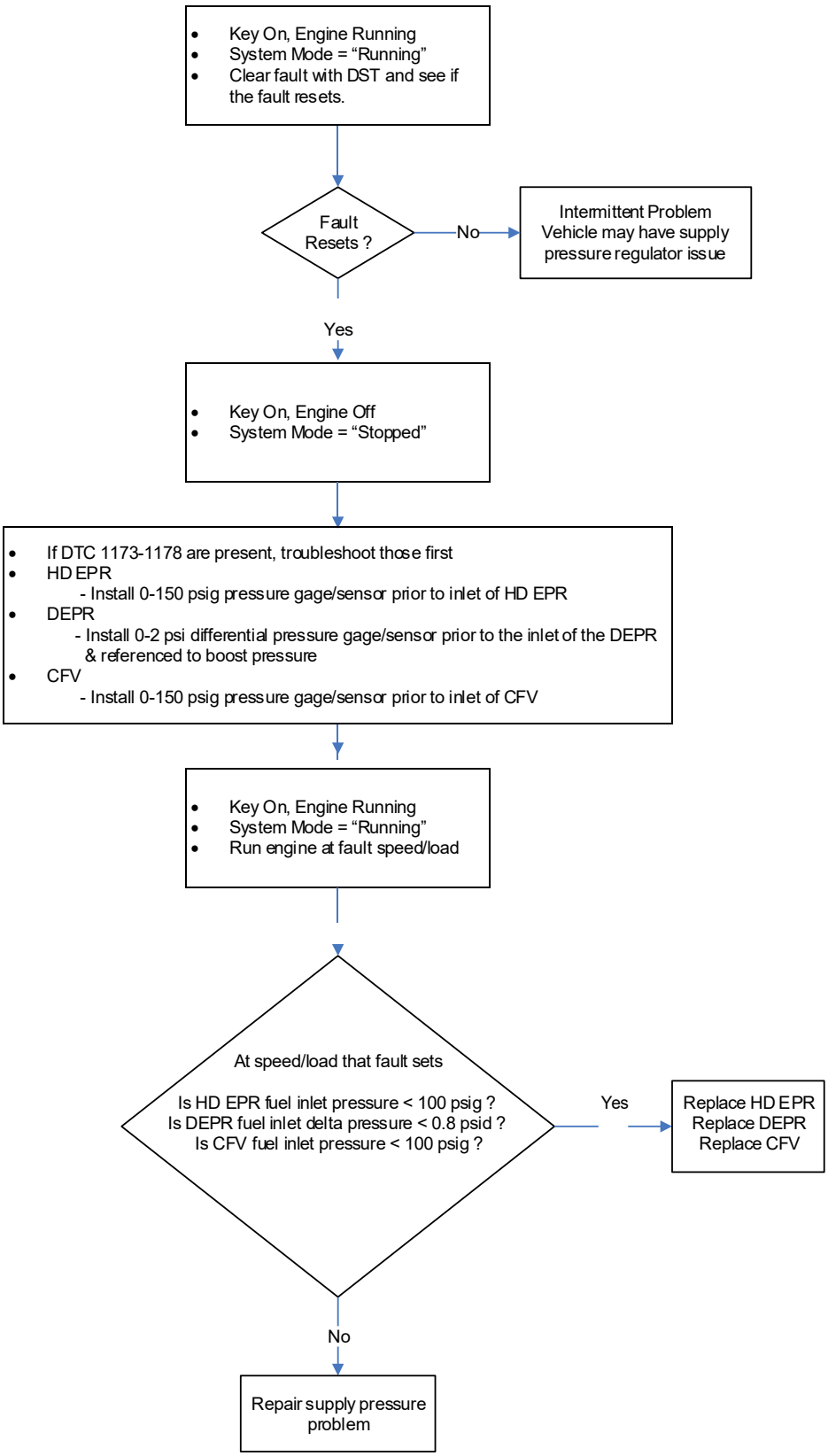
- X = + 2.0 in H2O for EPR (HD EPR or DEPR)
- X = + 10 psi (69 kPa) for CFV

This fault indicates that the device is at its minimum limit of authority and the pressure command cannot be achieved likely due to delivery/supply pressure being higher than expected. Adaptive fueling correction is disabled to avoid improper learning of the fuel correction table due to improper fuel supply pressure, and a Power Derate 1 condition is activated to reduce the possibility of engine damage.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	YES	Soft Warning	TBD*	NOx Control System	TBD*

DTC 1171 - EPR / CFV REGULATION PRESSURE HIGHER THAN EXPECTED (TROUBLE TREE)



DTC 1172 - EPR / CFV REGULATION PRESSURE LOWER THAN EXPECTED

DTC	1172	SPN	520260	FMI	1
Hardware:	EPR (HD EPR) or CFV				

Description:

The EPR is the second generation of EControls' Electronic Pressure Regulator found in many industrial and heavy-duty applications. The 2nd generation EPR is a "smart" actuator integrated with the primary stage regulator designed to control gaseous fuel pressure in the secondary stage regulator. The EPR receives fuel pressure commands from the ECM and quickly and precisely modulates fuel pressure to the gaseous fuel mixer. The EPR allows for fast and accurate gaseous fuel control to provide a combustible mixture to the engine.

The third generation of EControls' Electronic Pressure Regulator is the DEPR. The DEPR is a "smart" actuator that is fed supply pressure through a DSR (Dual Stage Regulator). The DSR is fully mechanical. The DEPR receives fuel pressure commands from the ECM and quickly and precisely modulates fuel pressure to the gaseous fuel mixer. The DEPR allows for very fast and very accurate gaseous fuel control to provide a combustible mixture to the engine

The fourth generation of EControls' gaseous fuel control valve is the CFV. The CFV contains both a high-pressure Electronic Pressure Regulator and a precision Continuous Flow Valve. The inlet pressure to the CFV is typically 85 psig (586 kPa). The CFV receives mass flow commands from the ECM and quickly and precisely modulates both the fuel pressure and metering valve to achieve the desired mass flow. The CFV allows for very fast and very accurate gaseous fuel control to provide a combustible mixture to the engine.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• EPR (actual-commanded) pressure <	-1.5	in H2O
• or CFV (actual-commanded) pressure <	-10	psi

Possible Causes:

This fault sets if the actual pressure sensed in the EPR/CFV is less than the commanded pressure by X. Typical values for X are listed below (may vary per specific engine calibration):

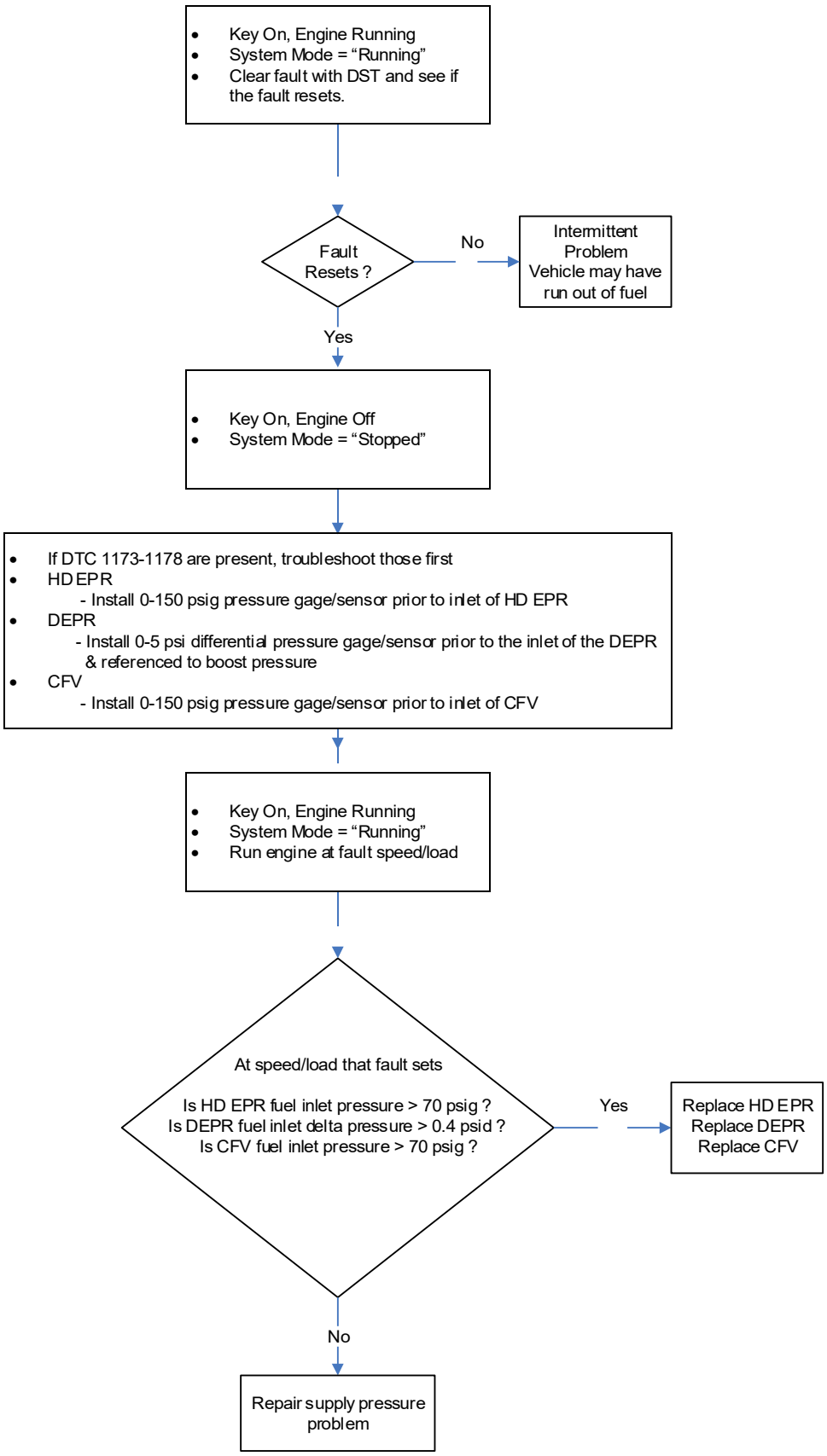
- X = + 2.0 in H2O for EPR (HD EPR or DEPR)
- X = + 10 psi (69 kPa) for CFV

This fault indicates that the device is at its minimum limit of authority and the pressure command cannot be achieved likely due to delivery/supply pressure being lower than expected. Adaptive fueling correction is disabled to avoid improper learning of the fuel correction table due to improper fuel supply pressure, and a Power Derate 1 condition is activated to reduce the possibility of engine damage.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	YES	Soft Warning	TBD*	NOx Control System	TBD*

DTC 1172 - EPR / CFV REGULATION PRESSURE LOWER THAN EXPECTED (TROUBLE TREE)



DTC 1173 - EPR / CFV COMM LOST

DTC	1173	SPN	520260	FMI	31

Hardware: EPR (HD EPR) or CFV

Description:

The EPR is the second generation of EControls' Electronic Pressure Regulator found in many industrial and heavy-duty applications. The 2nd generation EPR is a "smart" actuator integrated with the primary stage regulator designed to control gaseous fuel pressure in the secondary stage regulator. The EPR receives fuel pressure commands from the ECM and quickly and precisely modulates fuel pressure to the gaseous fuel mixer. The EPR allows for fast and accurate gaseous fuel control to provide a combustible mixture to the engine.

The third generation of EControls' Electronic Pressure Regulator is the DEPR. The DEPR is a "smart" actuator that is fed supply pressure through a DSR (Dual Stage Regulator). The DSR is fully mechanical. The DEPR receives fuel pressure commands from the ECM and quickly and precisely modulates fuel pressure to the gaseous fuel mixer. The DEPR allows for very fast and very accurate gaseous fuel control to provide a combustible mixture to the engine

The fourth generation of EControls' gaseous fuel control valve is the CFV. The CFV contains both a high-pressure Electronic Pressure Regulator and a precision Continuous Flow Valve. The inlet pressure to the CFV is typically 85 psig (586 kPa). The CFV receives mass flow commands from the ECM and quickly and precisely modulates both the fuel pressure and metering valve to achieve the desired mass flow. The CFV allows for very fast and very accurate gaseous fuel control to provide a combustible mixture to the engine.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• No EPR / CFV packets received within	500	ms

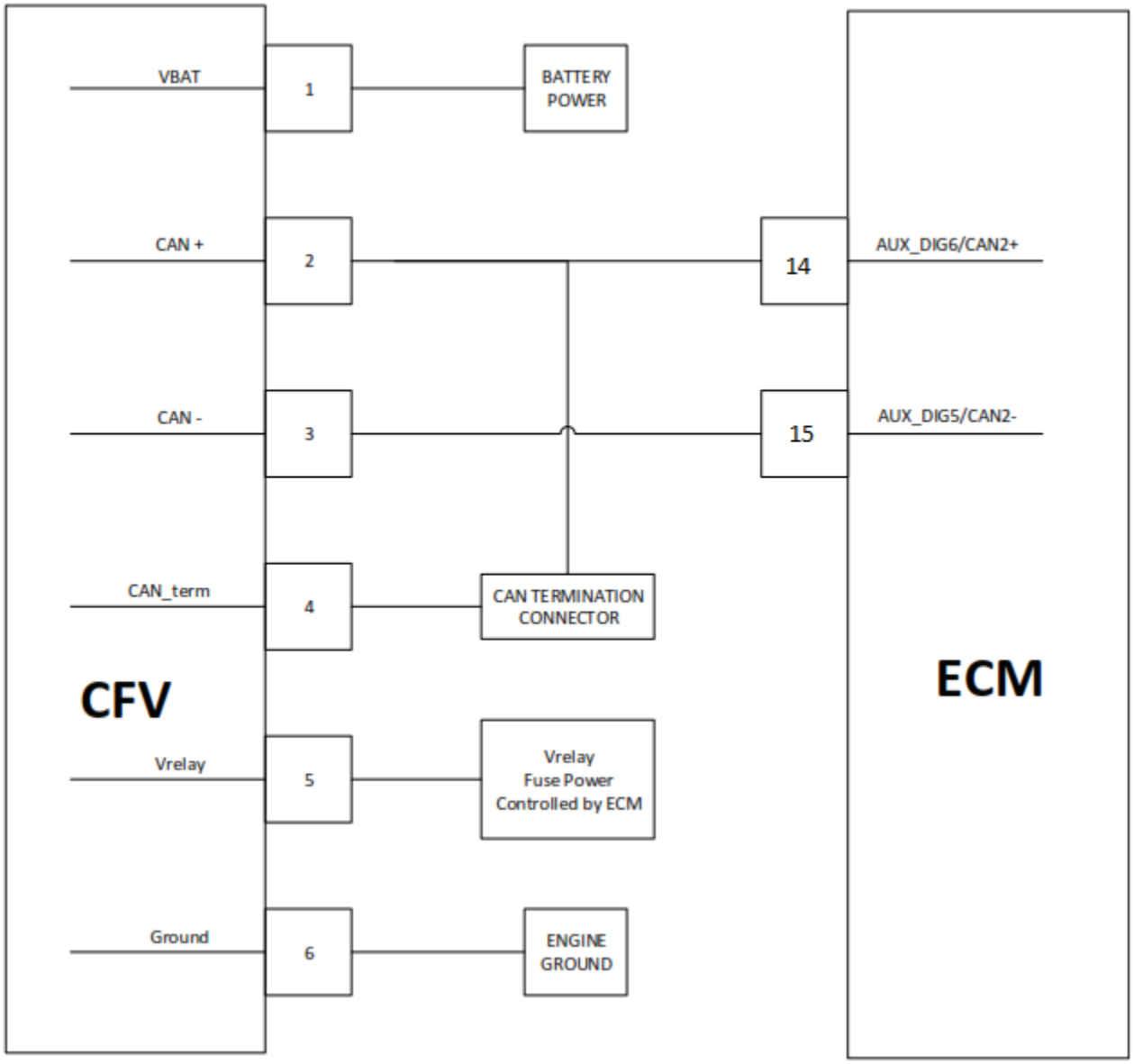
Possible Causes:

This fault sets if the ECM loses CAN communication with the EPR/CFV. This fault indicates that the ECM is no longer receiving CAN packets from the EPR/CFV which also results in the EPR/CFV not receiving communication from the ECM. This is often a result of a power loss at the EPR/CFV or improper CAN termination or wiring. Adaptive fueling correction is disabled to avoid improper learning of the fuel correction table, closed-loop is disabled, and a Power Derate 1 condition is activated to reduce the possibility of engine damage. The MIL is illuminated for the duration of the key on cycle.

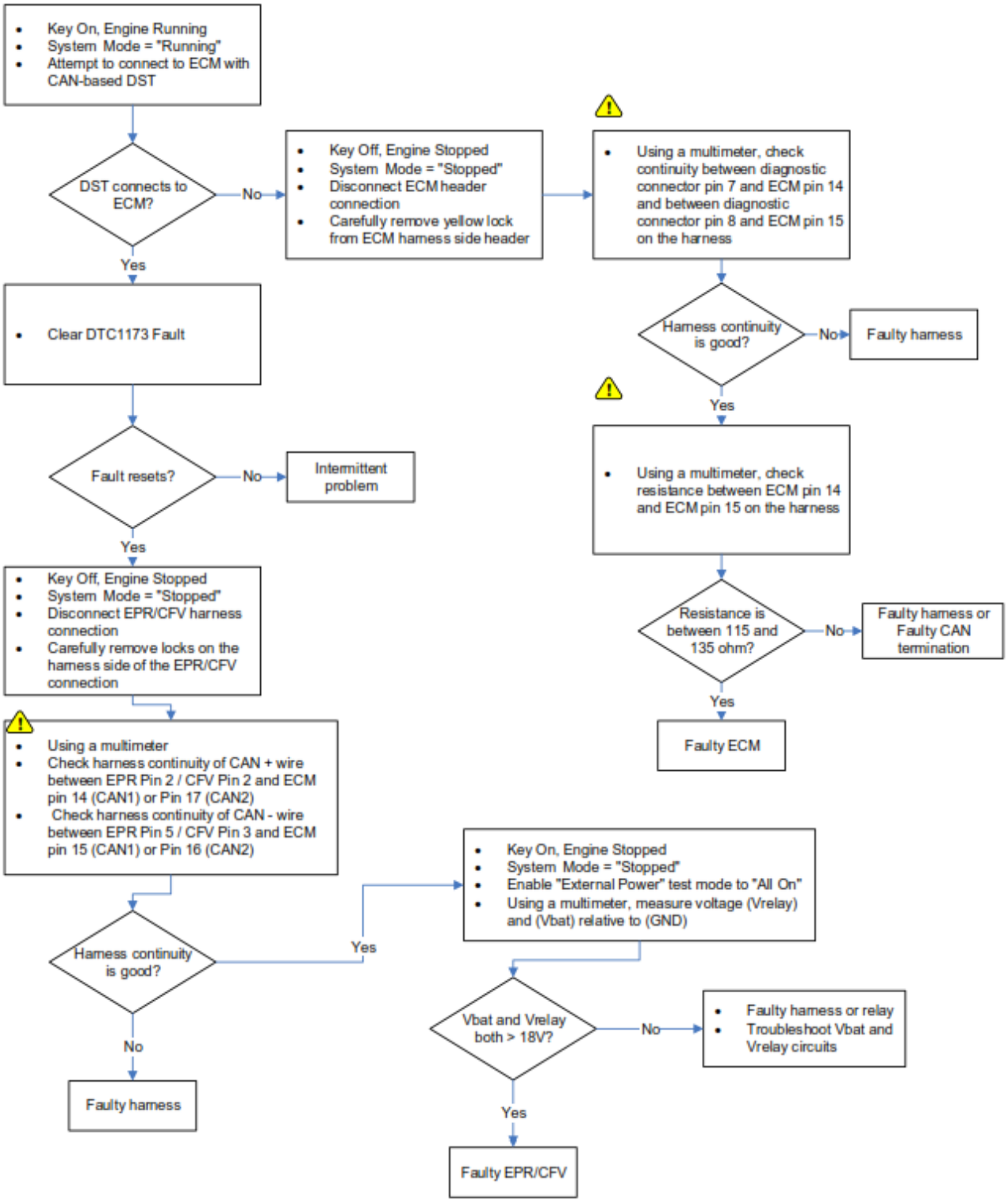
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	YES	Soft Warning	TBD*	NOx Control System	TBD*

DTC 1173 - EPR / CFV COMM LOST (SCHEMATIC)



DTC 1173 - EPR / CFV COMM LOST (TROUBLE TREE)



NOTE: Do not insert probe or object into terminalsas this will cause the terminal to spread and it may no longer make electrical contact with its mate. Spread pins will void warranty. Probe instead on side of terminal.

DTC 1174 - EPR / CFV VOLTAGE SUPPLY HIGH

DTC	1174	SPN	520260	FMI	3
Hardware:	EPR (HD EPR) or CFV				

Description:

The EPR is the second generation of EControls' Electronic Pressure Regulator found in many industrial and heavy-duty applications. The 2nd generation EPR is a "smart" actuator integrated with the primary stage regulator designed to control gaseous fuel pressure in the secondary stage regulator. The EPR receives fuel pressure commands from the ECM and quickly and precisely modulates fuel pressure to the gaseous fuel mixer. The EPR allows for fast and accurate gaseous fuel control to provide a combustible mixture to the engine.

The third generation of EControls' Electronic Pressure Regulator is the DEPR. The DEPR is a "smart" actuator that is fed supply pressure through a DSR (Dual Stage Regulator). The DSR is fully mechanical. The DEPR receives fuel pressure commands from the ECM and quickly and precisely modulates fuel pressure to the gaseous fuel mixer. The DEPR allows for very fast and very accurate gaseous fuel control to provide a combustible mixture to the engine

The fourth generation of EControls' gaseous fuel control valve is the CFV. The CFV contains both a high-pressure Electronic Pressure Regulator and a precision Continuous Flow Valve. The inlet pressure to the CFV is typically 85 psig (586 kPa). The CFV receives mass flow commands from the ECM and quickly and precisely modulates both the fuel pressure and metering valve to achieve the desired mass flow. The CFV allows for very fast and very accurate gaseous fuel control to provide a combustible mixture to the engine.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• Voltage supply to EPR/CFV is >	TBD*	VDC

Possible Causes:

This fault sets if the supply voltage to the EPR/CFV exceeds 33.0 VDC for greater than 3 seconds. Adaptive fueling correction is disabled to avoid improper learning of the fuel correction table. The MIL will be illuminated for the duration of the key on cycle.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 1175 - EPR / CFV VOLTAGE SUPPLY LOW

DTC	1175	SPN	520260	FMI	4

Hardware: EPR (HD EPR) or CFV

Description:

The EPR is the second generation of EControls' Electronic Pressure Regulator found in many industrial and heavy-duty applications. The 2nd generation EPR is a "smart" actuator integrated with the primary stage regulator designed to control gaseous fuel pressure in the secondary stage regulator. The EPR receives fuel pressure commands from the ECM and quickly and precisely modulates fuel pressure to the gaseous fuel mixer. The EPR allows for fast and accurate gaseous fuel control to provide a combustible mixture to the engine.

The third generation of EControls' Electronic Pressure Regulator is the DEPR. The DEPR is a "smart" actuator that is fed supply pressure through a DSR (Dual Stage Regulator). The DSR is fully mechanical. The DEPR receives fuel pressure commands from the ECM and quickly and precisely modulates fuel pressure to the gaseous fuel mixer. The DEPR allows for very fast and very accurate gaseous fuel control to provide a combustible mixture to the engine

The fourth generation of EControls' gaseous fuel control valve is the CFV. The CFV contains both a high-pressure Electronic Pressure Regulator and a precision Continuous Flow Valve. The inlet pressure to the CFV is typically 85 psig (586 kPa). The CFV receives mass flow commands from the ECM and quickly and precisely modulates both the fuel pressure and metering valve to achieve the desired mass flow. The CFV allows for very fast and very accurate gaseous fuel control to provide a combustible mixture to the engine.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• Voltage supply to EPR/CFV is <	TBD*	VDC
• and RPM >	TBD*	rpm

Possible Causes:

This fault sets if the supply voltage to the EPR/CFV is below 18.0 VDC for > 5 seconds while engine RPM > 1000. Adaptive fueling correction is disabled to avoid improper learning of the fuel correction table. The MIL will be illuminated for the duration of the key on cycle.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 1176 - EPR / CFV INTERNAL ACTUATOR FAULT DETECTION

DTC	1176	SPN	520260	FMI	12

Hardware: EPR (HD EPR) or CFV

Description:

The EPR is the second generation of EControls' Electronic Pressure Regulator found in many industrial and heavy-duty applications. The 2nd generation EPR is a "smart" actuator integrated with the primary stage regulator designed to control gaseous fuel pressure in the secondary stage regulator. The EPR receives fuel pressure commands from the ECM and quickly and precisely modulates fuel pressure to the gaseous fuel mixer. The EPR allows for fast and accurate gaseous fuel control to provide a combustible mixture to the engine.

The third generation of EControls' Electronic Pressure Regulator is the DEPR. The DEPR is a "smart" actuator that is fed supply pressure through a DSR (Dual Stage Regulator). The DSR is fully mechanical. The DEPR receives fuel pressure commands from the ECM and quickly and precisely modulates fuel pressure to the gaseous fuel mixer. The DEPR allows for very fast and very accurate gaseous fuel control to provide a combustible mixture to the engine. The fourth generation of EControls' gaseous fuel control valve is the CFV. The CFV contains both a high-pressure Electronic Pressure Regulator and a precision Continuous Flow Valve. The inlet pressure to the CFV is typically 85 psig (586 kPa). The CFV receives mass flow commands from the ECM and quickly and precisely modulates both the fuel pressure and metering valve to achieve the desired mass flow. The CFV allows for very fast and very accurate gaseous fuel control to provide a combustible mixture to the engine.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

- Internal Actuator Fault detected

Possible Causes:

This fault sets if the EPR/CFV detects an internal actuator fault. The fault is transmitted from the EPR/CFV to the ECM via CAN. If the fault is active, Adaptive Learn is disabled to prevent improper learning and updating of the table. The MIL is illuminated for the duration of the key on cycle.
If the EPR/CFV does not trigger either 1171, 1172, or either of the CFV Flow fault code(s), there is no issue with the EPR/CFV. If one or more of these faults are triggered, refer to the appropriate section for diagnostic information.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 1177 - EPR / CFV INTERNAL CIRCUITRY FAULT DETECTION

DTC	1177	SPN	520260	FMI	12

Hardware: EPR (HD EPR) or CFV

Description:

The EPR is the second generation of EControls' Electronic Pressure Regulator found in many industrial and heavy-duty applications. The 2nd generation EPR is a "smart" actuator integrated with the primary stage regulator designed to control gaseous fuel pressure in the secondary stage regulator. The EPR receives fuel pressure commands from the ECM and quickly and precisely modulates fuel pressure to the gaseous fuel mixer. The EPR allows for fast and accurate gaseous fuel control to provide a combustible mixture to the engine.

The third generation of EControls' Electronic Pressure Regulator is the DEPR. The DEPR is a "smart" actuator that is fed supply pressure through a DSR (Dual Stage Regulator). The DSR is fully mechanical. The DEPR receives fuel pressure commands from the ECM and quickly and precisely modulates fuel pressure to the gaseous fuel mixer. The DEPR allows for very fast and very accurate gaseous fuel control to provide a combustible mixture to the engine. The fourth generation of EControls' gaseous fuel control valve is the CFV. The CFV contains both a high-pressure Electronic Pressure Regulator and a precision Continuous Flow Valve. The inlet pressure to the CFV is typically 85 psig (586 kPa). The CFV receives mass flow commands from the ECM and quickly and precisely modulates both the fuel pressure and metering valve to achieve the desired mass flow. The CFV allows for very fast and very accurate gaseous fuel control to provide a combustible mixture to the engine.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

- Internal circuitry fault detected

Possible Causes:

This fault sets if the EPR/CFV detects an internal circuitry fault. The fault is transmitted from the EPR/CFV to the ECM via CAN. If the fault is active, Adaptive Learn is disabled to prevent improper learning and updating of the table. The MIL is illuminated for the duration of the key on cycle.
If the EPR/CFV does not trigger either 1171, 1172, or either of the CFV Flow fault code(s), there is no issue with the EPR/CFV. If one or more of these faults are triggered, refer to the appropriate section for diagnostic information.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 1178 - EPR / CFV INTERNAL COMM FAULT DETECTION

DTC	1178	SPN	520260	FMI	12

Hardware: EPR (HD EPR) or CFV

Description:

The EPR is the second generation of EControls' Electronic Pressure Regulator found in many industrial and heavy-duty applications. The 2nd generation EPR is a "smart" actuator integrated with the primary stage regulator designed to control gaseous fuel pressure in the secondary stage regulator. The EPR receives fuel pressure commands from the ECM and quickly and precisely modulates fuel pressure to the gaseous fuel mixer. The EPR allows for fast and accurate gaseous fuel control to provide a combustible mixture to the engine.

The third generation of EControls' Electronic Pressure Regulator is the DEPR. The DEPR is a "smart" actuator that is fed supply pressure through a DSR (Dual Stage Regulator). The DSR is fully mechanical. The DEPR receives fuel pressure commands from the ECM and quickly and precisely modulates fuel pressure to the gaseous fuel mixer. The DEPR allows for very fast and very accurate gaseous fuel control to provide a combustible mixture to the engine

The fourth generation of EControls' gaseous fuel control valve is the CFV. The CFV contains both a high-pressure Electronic Pressure Regulator and a precision Continuous Flow Valve. The inlet pressure to the CFV is typically 85 psig (586 kPa). The CFV receives mass flow commands from the ECM and quickly and precisely modulates both the fuel pressure and metering valve to achieve the desired mass flow. The CFV allows for very fast and very accurate gaseous fuel control to provide a combustible mixture to the engine.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

- Internal comm fault detected

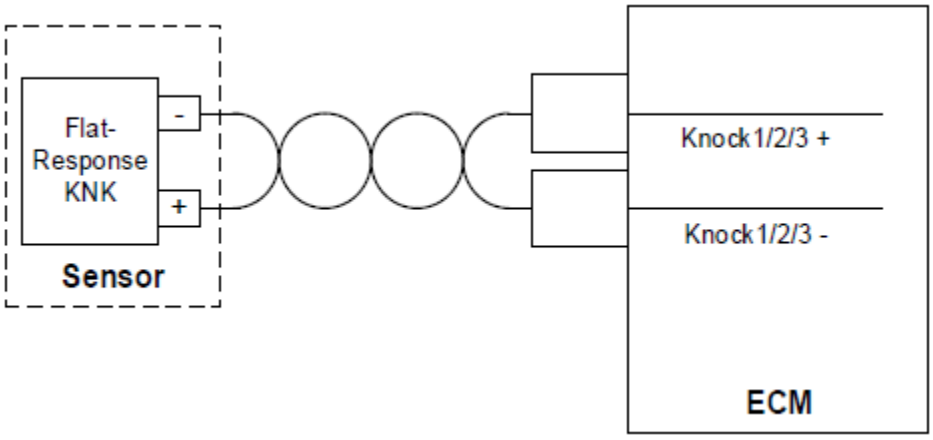
Possible Causes:

This fault sets if the EPR/CFV detects a loss of CAN communication with the ECM. The ECM is configured to illuminate the MIL, disable closed loop fueling correction and adaptive fueling correction, and initiate a Power Derate 1 condition to prevent possible damage to the engine.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 1325 - KNOCK RETARD AT LIMIT



DTC	1325	SPN	9999	FMI	15		

Hardware/Circuit: Knock Sensor 1 / Knock Sensor 2 / Knock Sensor 3

Hardware/Circuit Description:

The knock sensor is used to detect detonation through mechanical vibration in the engine block and/or cylinder heads and provide feedback for the ignition system to retard spark to reduce knock intensity. In most applications the knock sensor is used to protect the engine from damage that can be caused from detonation or knock based on fixed spark advance. In other applications, the knock sensor is used to optimize spark advance and "learn" between spark tables based on fuel quality.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

• RPM >	**1000**	rpm
• and MAP >	**8.00**	psia
• and knock spark retard at percent of maximum	**100**	%
• and octane rating <=	**100**	%

Fault Description:

This fault sets when the engine is actively "hard knocking" and the amount of ignition retard is above the maximum retard threshold

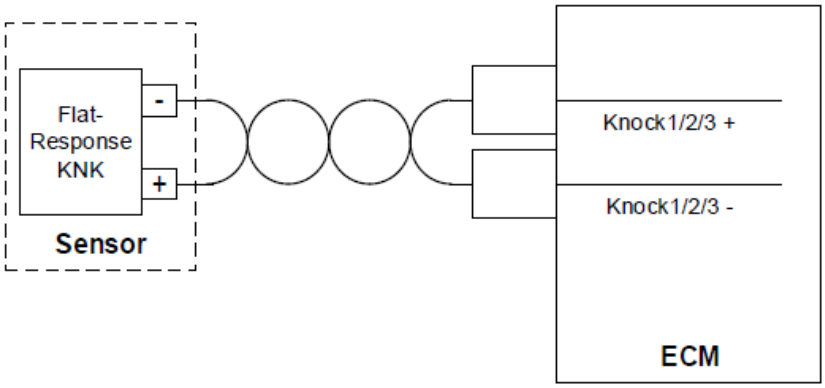
Corrective Actions *(see Table 1 for descriptions of individual corrective actions):*

Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**YES**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

Diagnostic Aids:

- ☐ If other DTCs exist diagnose these first.
- ☐ Refer to the engine manufacturer's service manual for additional information

DTC 1326 - KNOCK RETARD ABOVE THRESHOLD



DTC	1326	SPN	731	FMI	15		

Hardware/Circuit: Knock Sensor 1 / Knock Sensor 2 / Knock Sensor 3

Hardware/Circuit Description:

The knock sensor is used to detect detonation through mechanical vibration in the engine block and/or cylinder heads and provide feedback for the ignition system to retard spark to reduce knock intensity. In most applications the knock sensor is used to protect the engine from damage that can be caused from detonation or knock based on fixed spark advance. In other applications, the knock sensor is used to optimize spark advance and "learn" between spark tables based on fuel quality.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

• RPM >	**1000**	rpm
• and MAP >	**8.00**	psia
• and ECT >	**-40.0**	deg F
• and engine run time >	**120.0**	sec
• and knock spark retard at percent of maximum	**50**	%
• and octane rating <=	**100**	%

Fault Description:

This fault sets when the engine is retarding the ignition timing due to knock. If the amount of retard is above the percentage of the maximum retard (without consideration of 'active knock'– see Knock Retard at Limit fault description) the fault will be set

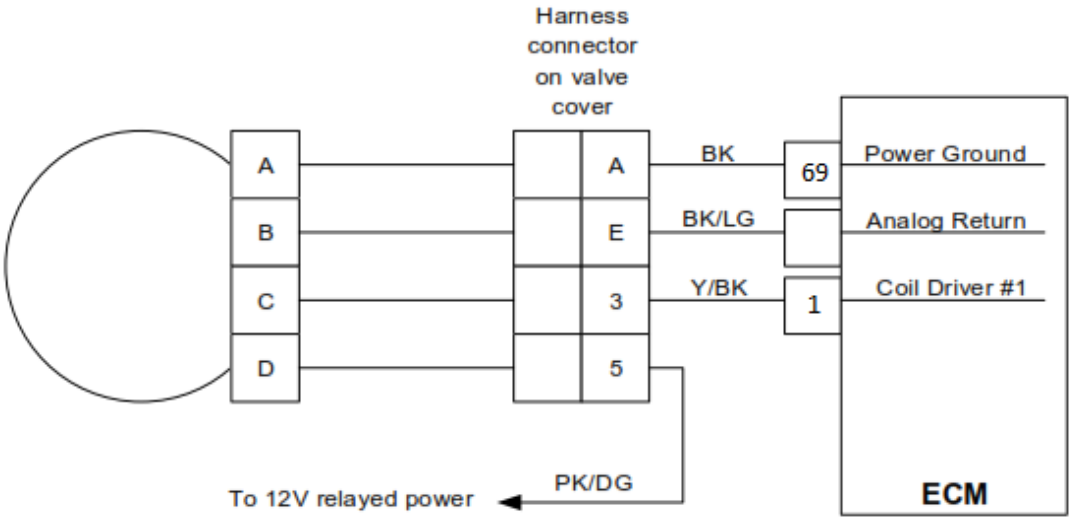
Corrective Actions

Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**YES**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

Diagnostic Aids:

- ☐ If other DTCs exist diagnose these first.
- ☐ Refer to the engine manufacturer's service manual for additional information

DTC 1351 – DTC 1360 – SPARK PLUG OR COIL FAILURE (CYLINDERS 1-10)



DTC	1351	**SPN**	520260	**FMI**	17

Sensor/Circuit: Ignition/Spark Coil, cylinders 1-10 (Dumb-coil ONLY)

Description:

Coil driver #1 (correlates to DTC 1351) fires either the 1st cylinder in the firing order or the 1st cylinder in the block order depending on the configuration of the 'Injector/Spark Diagnostic Numbering' scheme as set in calibration. Drivers 2-10 (correlating to DTCs 1352-1360) follow in-kind.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Key On, Engine On

Fault Set Conditions (as defined in calibration):

- Ignition/Spark drive circuitry (internal to the ECM) is overheating

Possible Causes:

This fault will set if the ECM detects that the spark/ignition drive circuitry within the ECM is over-heating. Once over-heating is detected and this fault is active, the ECM will kill spark on the affected channel until x seconds after the drive circuit cools or until the key switch is cycled depending upon the selection made in the diagnostic calibration.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	YES	Stopped Check	TBD*
CL Disable	YES	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 1351 – DTC 1360 – SPARK PLUG OR COIL FAILURE (CYLINDERS 1-10)
(continued from previous page)

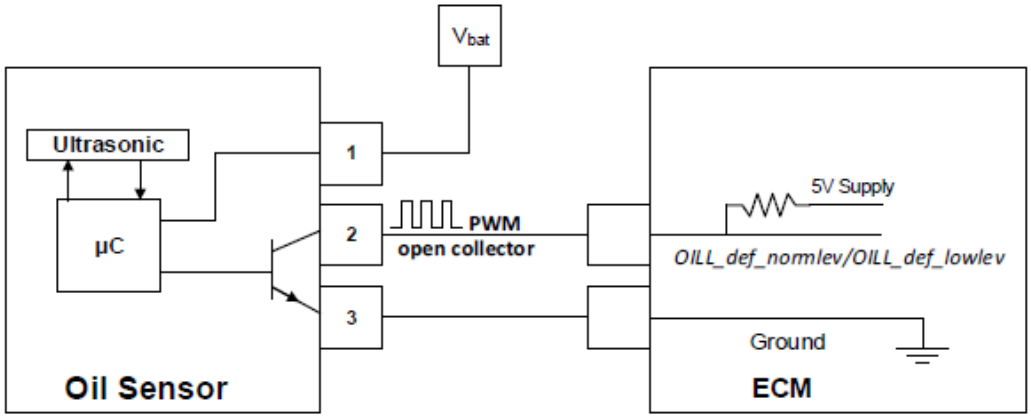
Typical causes of this fault include:

- shorted coil
- poor quality coil
- coil loose from spark plug
- plug gap too large (all inductive energy goes back on driver)
- dwell time is set too long in the diagnostic calibration
- ambient temp too high

Diagnostic Aids:

- ☐ Check plug gap on the cylinder associated with the fault.
- ☐ Check for loose connections at the coil and spark plugs. Look for evidence of charring or arcing around spark plugs.
- ☐ Check coil resistance and verify that it is within specifications. Look for a short internal to the coil.
- ☐ Ensure the use of high quality coils without a history of internal arcing or other failures.
- ☐ Verify that ambient conditions are not exceeding 85C on a continuous basis or 125C for short intervals. If so, verify that this fault stops occurring when ambient temperatures lower.
- ☐ Verify the dwell time set in the diagnostic calibration is not set too long and that adaptive dwell is enabled.

DTC 1511 - OIL TEMP HIGH VOLTAGE



DTC	1511	SPN	520216	FMI	3		

Hardware/Circuit: Oil Voltage and Level

Hardware/Circuit Description:

The Oil Temperature and Level sensor provides continuous measurement of engine oil level and temperature in both static and dynamic engine operating ranges. The sensor provides three pulses at 1 Hz to the ECM. The three pulses report oil temperature (pulse 1), oil level (pulse 2), and oil sensor diagnostics (pulse 3). The duration of each pulse determines the data for the data element – as such, the pulse duration must be measured accurately to properly convert the duration to oil level or temperature.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

• Oil Voltage >	**4.8**	Volts

Fault Description:

This fault sets if the measured oil temperature is outside the upper limit as defined in the calibration. Required entry conditions for evaluation of this fault are the absence of any of the four faults below:

- **Oil Level and Temperature Sensor Loss**
- **Oil Level and Temperature Sensor Voltage Out of Range**
- **Oil Level Out of Range**
- **Oil Temperature Out of Range**

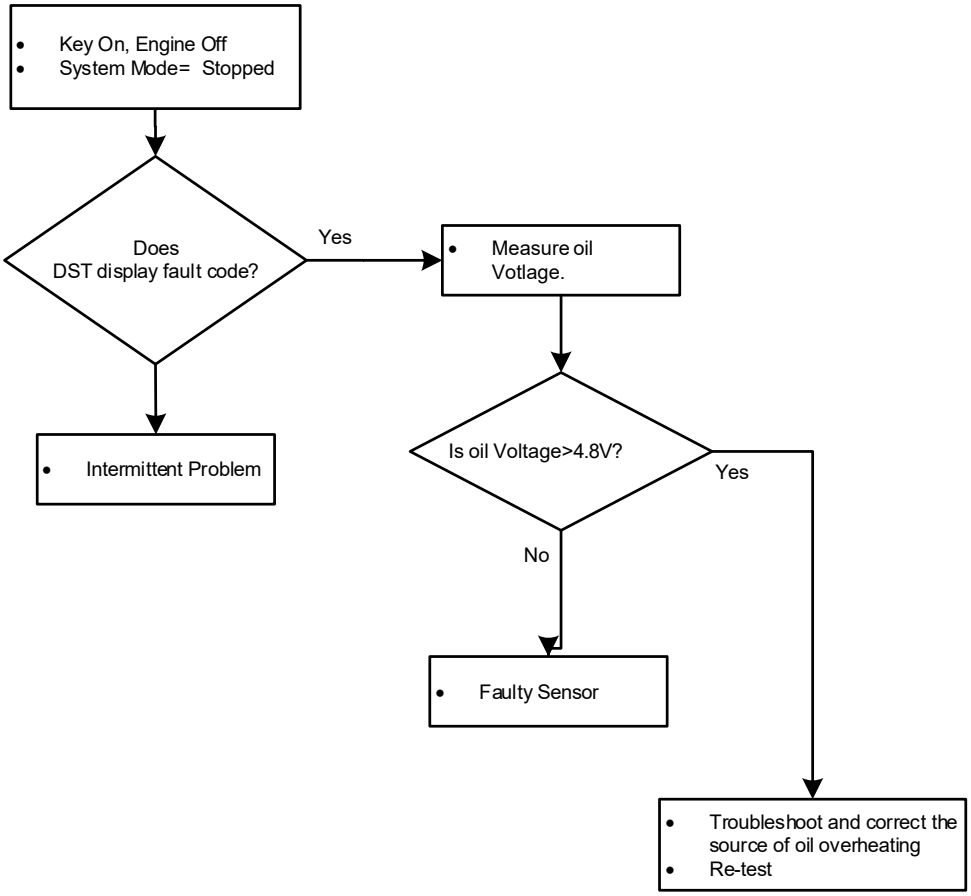
NOTE: The **Oil voltage Too High** fault is not reported in the EDIS **Oil T/L** diagnostics state field and does not illuminate the LED.

Corrective Actions:

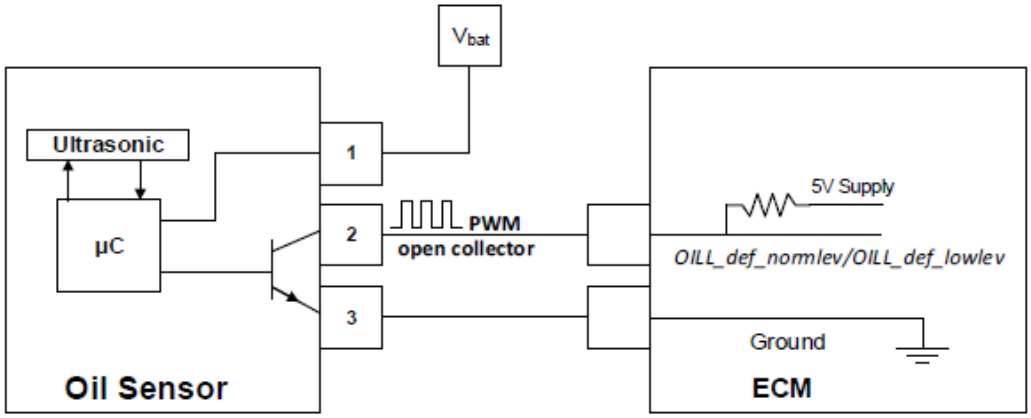
Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**YES**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

DTC 1511 - OIL TEMP HIGH VOLTAGE (TROUBLE TREE)

Trouble Tree



DTC 1512 - OIL TEMP LOW VOLTAGE



DTC	1512	SPN	520216	FMI	4		

Hardware/Circuit: Oil Voltage and Level

Hardware/Circuit Description:

The Oil Temperature and Level sensor provides continuous measurement of engine oil level and temperature in both static and dynamic engine operating ranges. The sensor provides three pulses at 1 Hz to the ECM. The three pulses report oil temperature (pulse 1), oil level (pulse 2), and oil sensor diagnostics (pulse 3). The duration of each pulse determines the data for the data element – as such, the pulse duration must be measured accurately to properly convert the duration to oil level or temperature.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

• Oil Voltage <	**0.2**	Volts

Fault Description:

This fault sets if the measured oil temperature is outside the upper limit as defined in the calibration. Required entry conditions for evaluation of this fault are the absence of any of the four faults below:

- **Oil Level and Temperature Sensor Loss**
- **Oil Level and Temperature Sensor Voltage Out of Range**
- **Oil Level Out of Range**
- **Oil Temperature Out of Range**

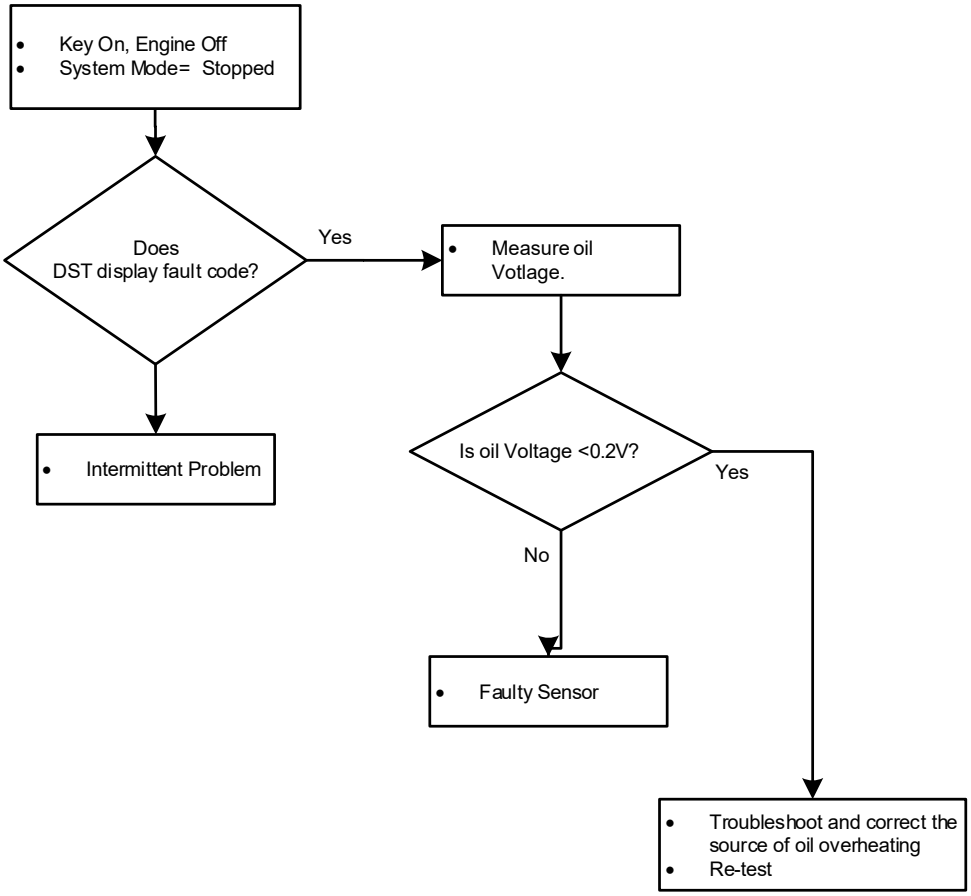
NOTE: The **Oil voltage Too High** fault is not reported in the EDIS **Oil T/L** diagnostics state field and does not illuminate the LED.

Corrective Actions:

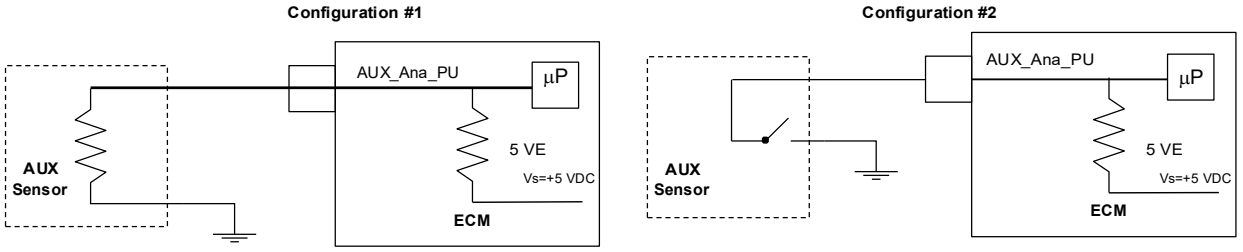
Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**YES**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

DTC 1512 - OIL TEMP LOW VOLTAGE (TROUBLE TREE)

Trouble Tree



DTC 1514 - AUX ANALOG PULL-UP 2 LOW VOLTAGE FAULT (Oil Level Switch)



DTC	1514	SPN	520217	FMI	4

Sensor/Circuit: Configuration #1: Auxiliary Sensor (proportional voltage type),
Configuration #2: Auxiliary Sensor (switch-type)

Description:

The auxiliary analog input circuit is customer specific and can be used to perform an action based on a sensor that switches to ground or a sensor that outputs a proportional voltage. Typical uses of the auxiliary circuit includes switches that activate particular software strategies, switches that act as vehicle safeties to trigger derate or shutdown conditions, or auxiliary senders used to drive gauges.

The circuit internal to the ECM is connected in parallel with the regulated 5 VDC power supply so that when no load is connected to the circuit the feedback voltage is equal to 5 VDC.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key On, Engine On

Fault Set Conditions (as defined in calibration):

• AUX analog PU2 <	0.2	volts

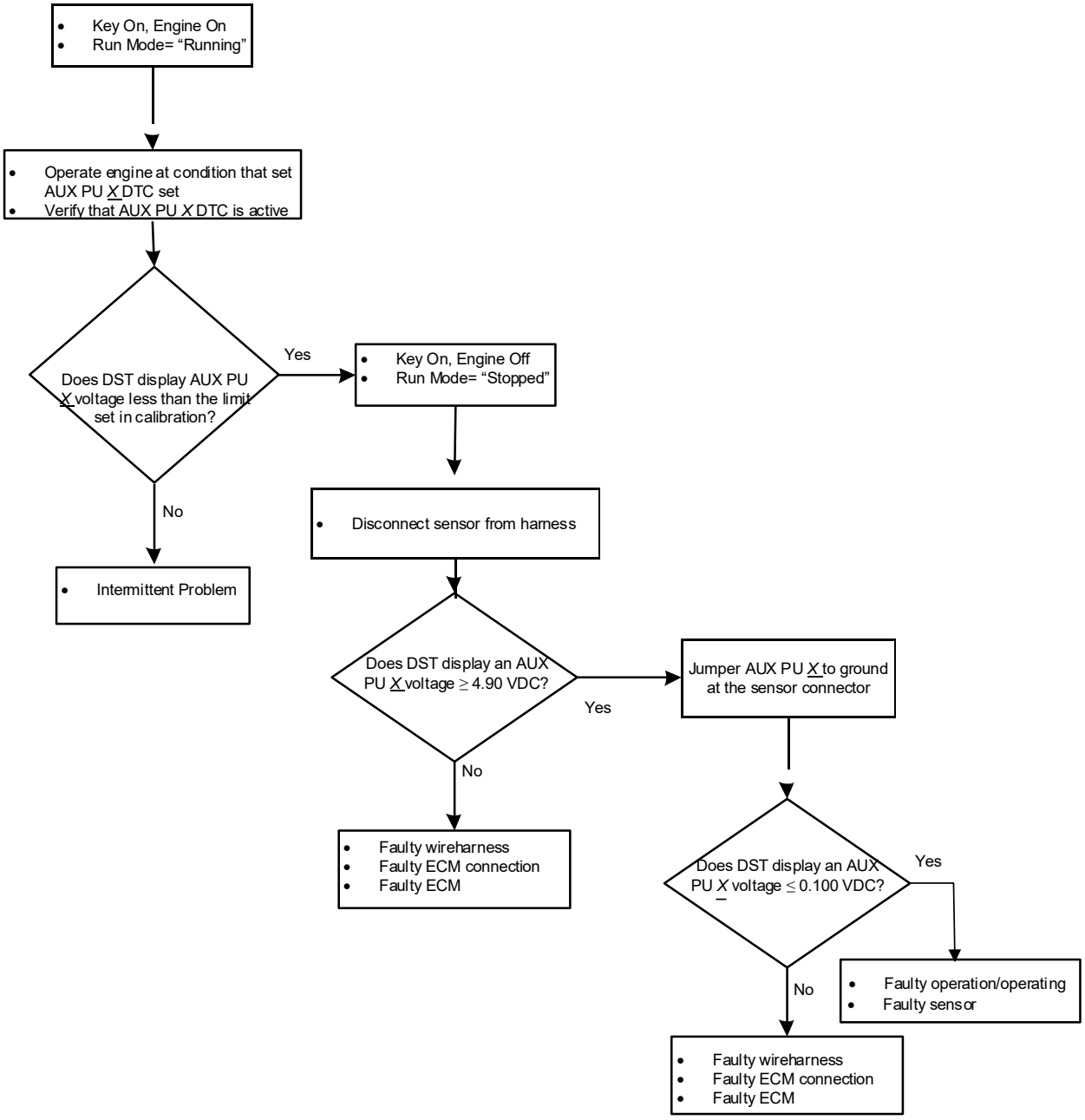
Possible Causes:

This fault is active when the voltage feedback from the sensor is below the limit defined in calibration.

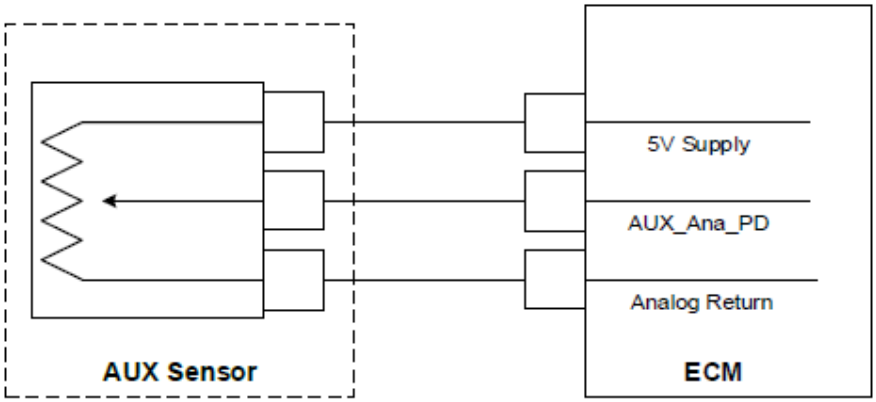
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	YES	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 1514 - AUX ANALOG PULL-UP 2 LOW VOLTAGE FAULT (Oil Level Switch) (TROUBLE TREE)



DTC 1515 - AUX ANALOG PULL-DOWN 1 HIGH VOLTAGE



DTC	1515	SPN	520215	FMI	3		

Hardware/Circuit:Auxiliary Sensor (proportional voltage type),

Circuit Description:

The auxiliary analog input circuit is customer specific and can be used to perform an action based on a sensor that switches to ground or a sensor that outputs a proportional voltage. Typical uses of the auxiliary circuit include switches that activate particular software strategies, switches that act as vehicle safeties to trigger derate or shutdown conditions, or auxiliary senders used to drive gauges.

The circuit internal to the ECM is connected in parallel ground so that when no load is connected to the circuit the feedback voltage is equal to 0 VDC.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

	Aux PD1			
• AUX analog PD >	**4.8**			volts

Fault Description:

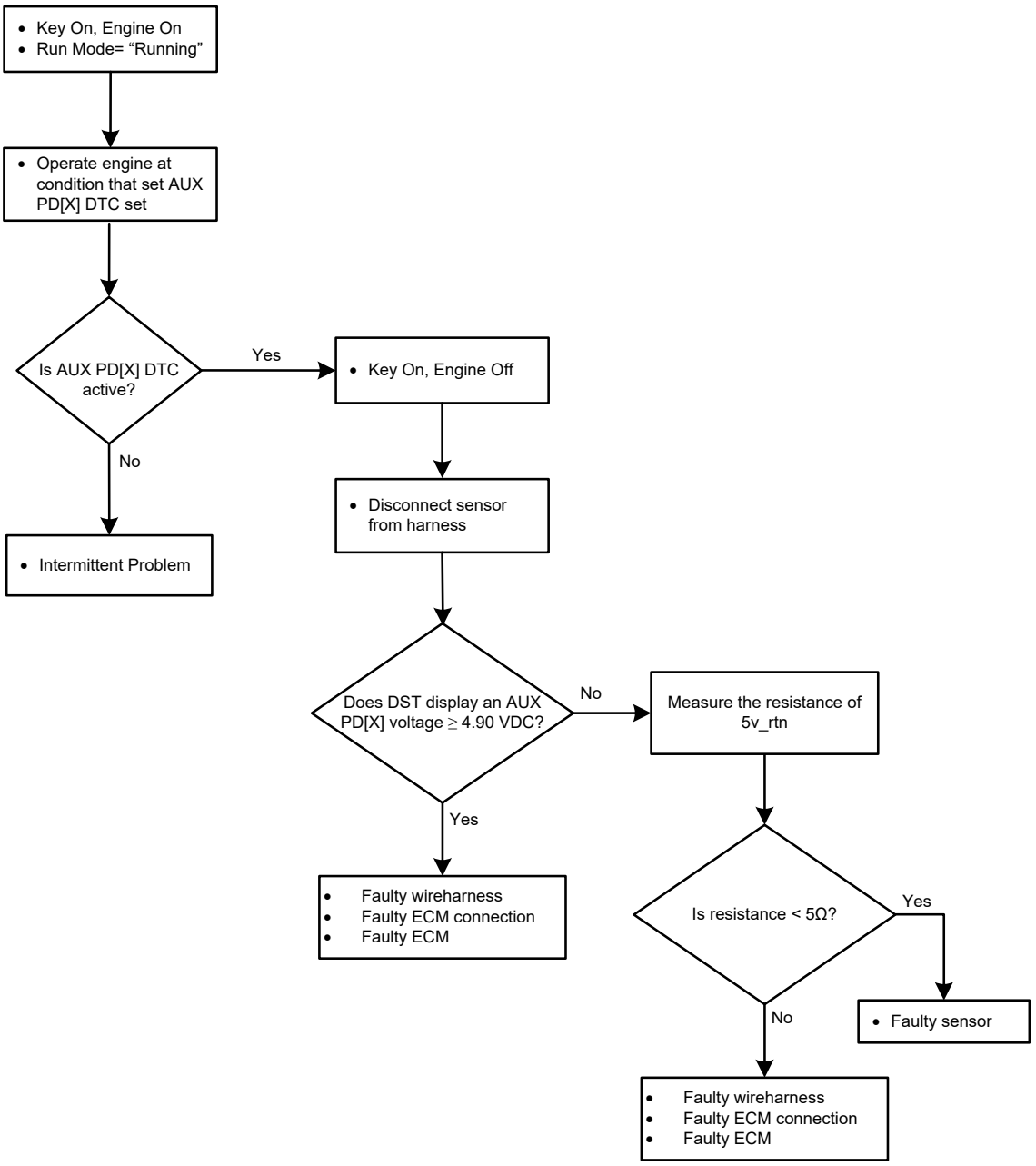
This fault is active when the voltage feedback from the sensor is ABOVE the limit defined in calibration.

Corrective Actions *(see Table 1 for descriptions of individual corrective actions):*

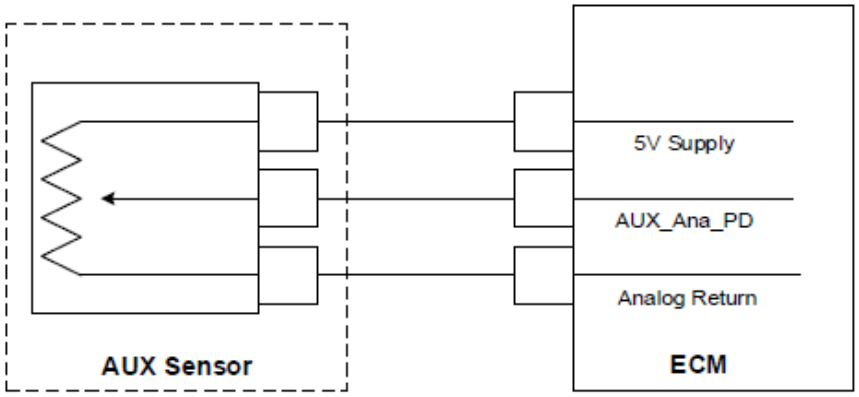
Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**YES**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

DTC 1515 - AUX ANALOG PULL-DOWN 1 HIGH VOLTAGE (TROUBLE TREE)

Trouble Tree



DTC 1516 - AUX ANALOG PULL-DOWN 1 LOW VOLTAGE



DTC	1516	SPN	520215	FMI	4		

Hardware/Circuit: Auxiliary Sensor (proportional voltage type)

Circuit Description:

The auxiliary analog input circuit is customer specific and can be used to perform an action based on a sensor that switches to ground or a sensor that outputs a proportional voltage. Typical uses of the auxiliary circuit include switches that activate particular software strategies, switches that act as vehicle safeties to trigger derate or shutdown conditions, or auxiliary senders used to drive gauges.

The circuit internal to the ECM is connected in parallel ground so that when no load is connected to the circuit the feedback voltage is equal to 0 VDC.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

	Aux PD1			
• AUX analog PD <	**0.2**			volts

Fault Description:

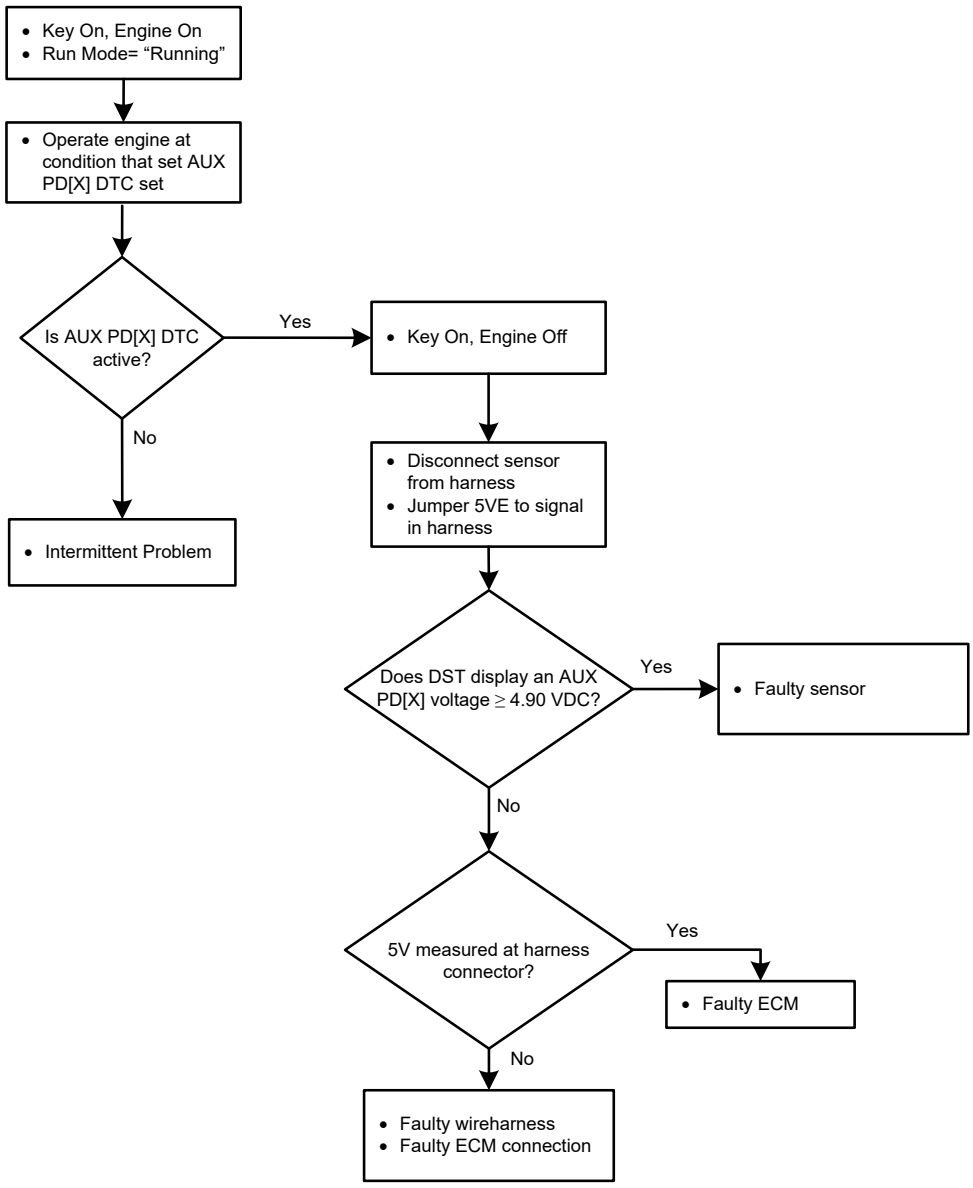
This fault is active when the voltage feedback from the sensor is BELOW the limit defined in calibration.

Corrective Actions *(see Table 1 for descriptions of individual corrective actions):*

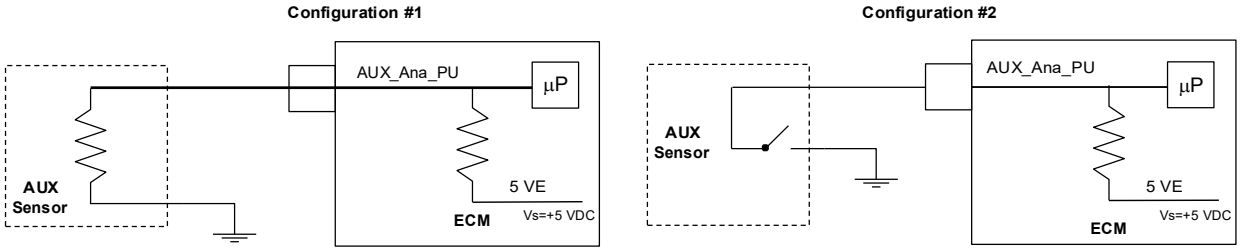
Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**YES**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

DTC 1516 - AUX ANALOG PULL-DOWN 1 LOW VOLTAGE (TROUBLE TREE)

Trouble Tree



DTC 1517- AUX ANALOG PULL-UP 3 HIGH VOLTAGE FAULT (Coolant Level Switch)



DTC	1517	SPN	520218	FMI	3

Sensor/Circuit: Configuration #1: Auxiliary Sensor (proportional voltage type),
Configuration #2: Auxiliary Sensor (switch-type)

Description:

The auxiliary analog input circuit is customer specific and can be used to perform an action based on a sensor that switches to ground or a sensor that outputs a proportional voltage. Typical uses of the auxiliary circuit includes switches that activate particular software strategies, switches that act as vehicle safeties to trigger derate or shutdown conditions, or auxiliary senders used to drive gauges.

The circuit internal to the ECM is connected in parallel with the regulated 5 VDC power supply so that when no load is connected to the circuit the feedback voltage is equal to 5 VDC.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key On, Engine On

Fault Set Conditions (as defined in calibration):

• AUX analog PU3 >	2.5	volts

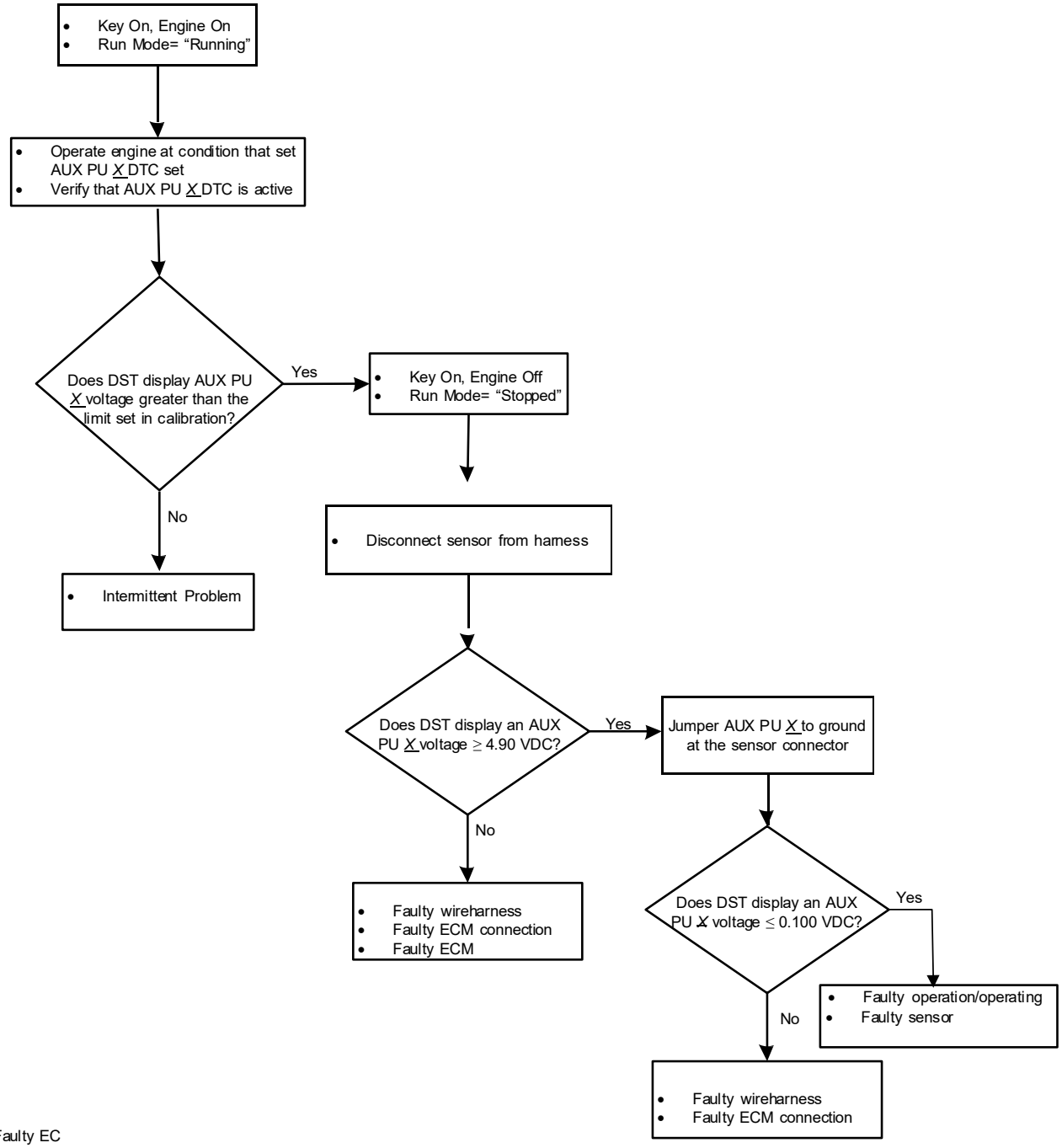
Possible Causes:

This fault is active when the voltage feedback from the sensor is above the limit defined in calibration.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

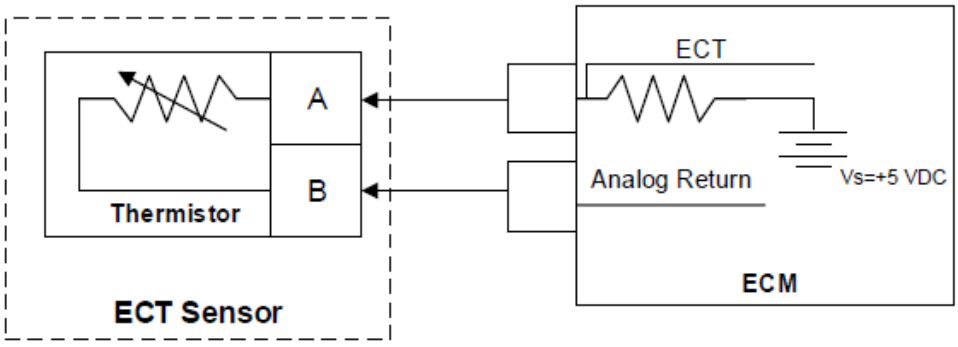
Shutdown	YES	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 1517 - AUX ANALOG PULL-UP 3 HIGH VOLTAGE FAULT (Coolant Level Switch) (TROUBLE TREE)



- Faulty EC

DTC 1518- COOLANT LEVEL LOW VOLTAGE



DTC	1518	SPN	520218	FMI	4		

Hardware/Circuit: Engine Coolant Temperature Sensor

Hardware/Circuit Description:

The Engine Coolant Temperature sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. Some engines use a CHT sensor that is located in the coolant in the cylinder head. Some engines use an ECT (Engine Coolant Temperature) sensor that is located in the coolant near the thermostat. If the engine is equipped with a CHT sensor then the ECT value is estimated. If equipped with an ECT sensor then the CHT value is estimated. They are used for engine airflow calculation, ignition timing control, to enable certain features, and for engine protection.

The ECM provides a voltage divider circuit so when the sensor reading is cool the sensor reads higher voltage, and lower when warm.

The lowest maximum diagnostic monitor enable temperature is the ECT threshold below which all HD OBD monitors will be enabled at the start of a drive cycle. There are currently no supported HD OBD monitors which are disabled at the beginning of a drive cycle based on the initial ECT exceeding a calibratable threshold. While certain Cooling System monitor diagnostics are disabled if the initial ECT is too high (i.e. warm start), this fault is not intended to be set in these normal operating scenarios,

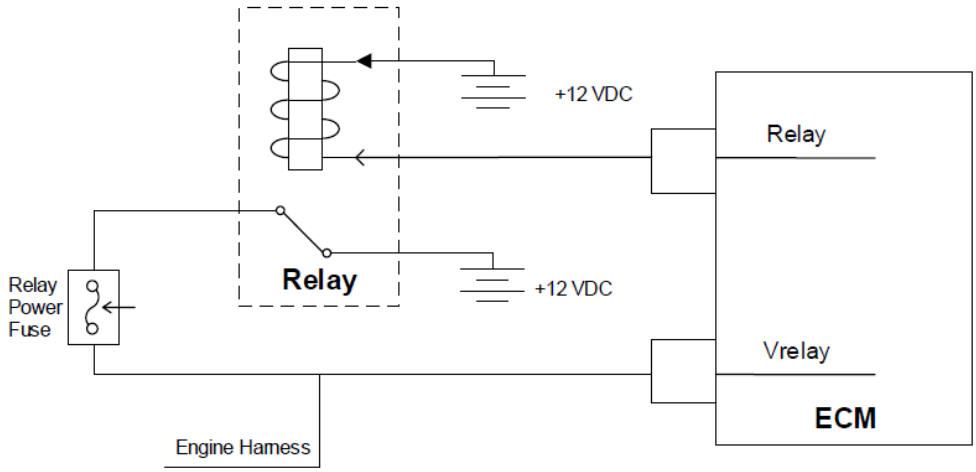
Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

Limits for both AUX PU3 faults:

• AUX analog Pu3	**0.5**	Volts	
• and RPM >=	**600**	rpm	
• and RPM <=	**8000**	rpm	
• and ECT >=	**-40**	Deg F	

DTC 1602- RELAY OFF HIGH VOLTAGE



DTC	1602	SPN	1485	FMI	0		

Hardware/Circuit: Power Relay

Hardware/Circuit Description:

Certain models of the 4G ECM source power for part of the internal circuitry from the VRelay circuit, which also supplies power to the engine harness. The VRelay is controlled by the ECM using one of the low side (LS) drivers.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

• Relay control off with VRelay voltage >	**80.0**	% Vbat

Fault Description:

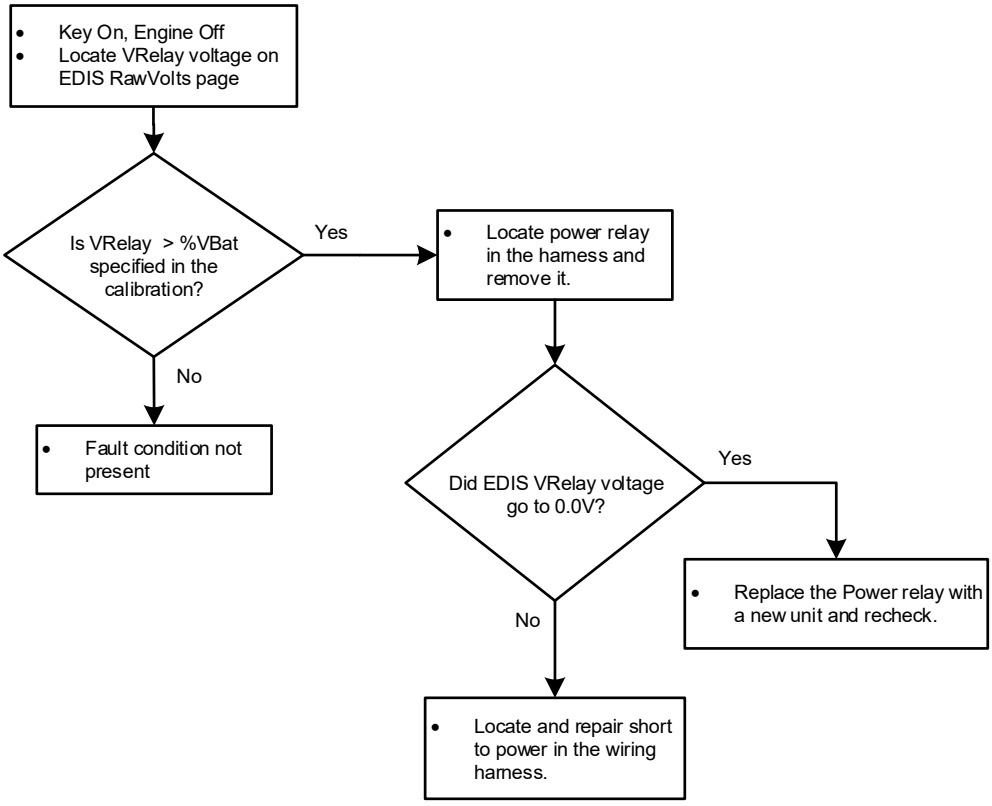
This fault sets if the output for the power relay is off, with VRelay voltage greater than a calibratable percentage of battery voltage.

Corrective Actions *(see Table 1 for descriptions of individual corrective actions):*

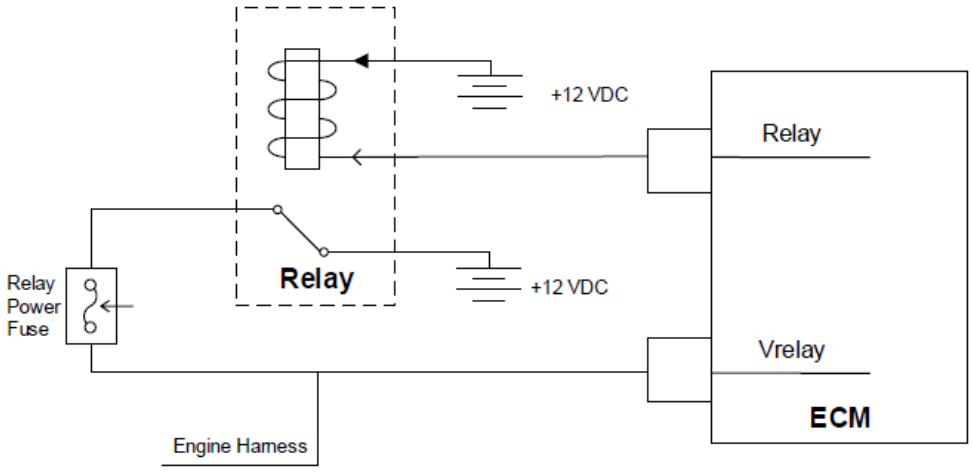
Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**YES**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

DTC 1602- RELAY OFF HIGH VOLTAGE (TROUBLE TREE)

Trouble Tree



DTC 1603- RELAY ON LOW VOLTAGE



DTC	1603	SPN	1485	FMI	1		

Hardware/Circuit: Power Relay

Hardware/Circuit Description:

Certain models of the 4G ECM source power for part of the internal circuitry from the VRelay circuit, which also supplies power to the engine harness. The VRelay is controlled by the ECM using one of the low side (LS) drivers.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

• Relay control on with feedback <	**20.0**	% Vbat
• Injectors relay powered	**YES**	
• Ignition coils relay powered	**YES**	

Fault Description:

This fault sets if the output for the power relay is on, with VRelay voltage less than a calibratable percentage of battery voltage.

Please note:

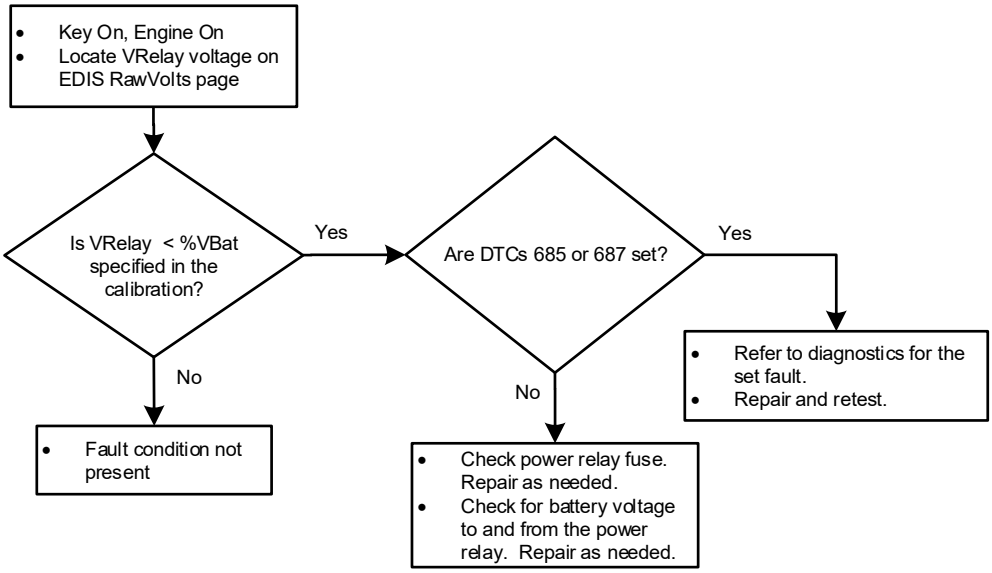
1) If the injectors are relay powered (selection dropdown set to YES), all injector faults will be ignored while this fault is active.
2) If the ignition coils are relay powered (selection dropdown set to YES), all injector faults will be ignored while this fault is active.

Corrective Actions:

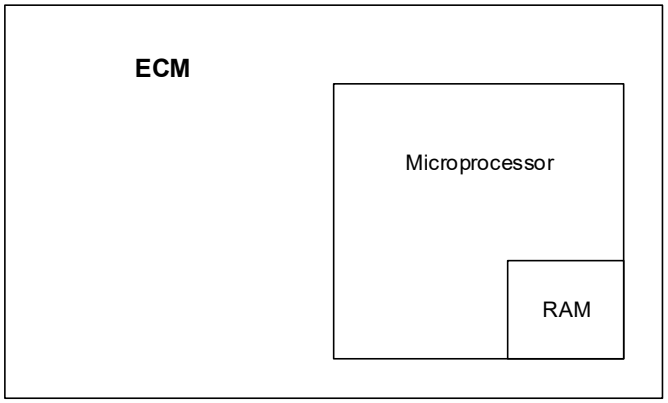
Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**YES**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

DTC 1603- RELAY ON LOW VOLTAGE (TROUBLE TREE)

Trouble Tree



DTC 1612, 1613 & 1614 - MICROPROCESSOR FAILURE - RTI 1, 2 & 3



DTC	1612, 1613 & 1614	SPN	629	FMI	31

Sensor/Circuit: Engine Control Module

Description:

The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased after diagnosis by removing battery power. It will not self-erase.

During this active fault, Power Derate (level 2) will be enforced. When this is enforced, maximum throttle position will be 20%. This is enforced until the fault is manually cleared.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key On

Fault Set Conditions (as defined in calibration):

- Internal microprocessor error

Possible Causes:

The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault.

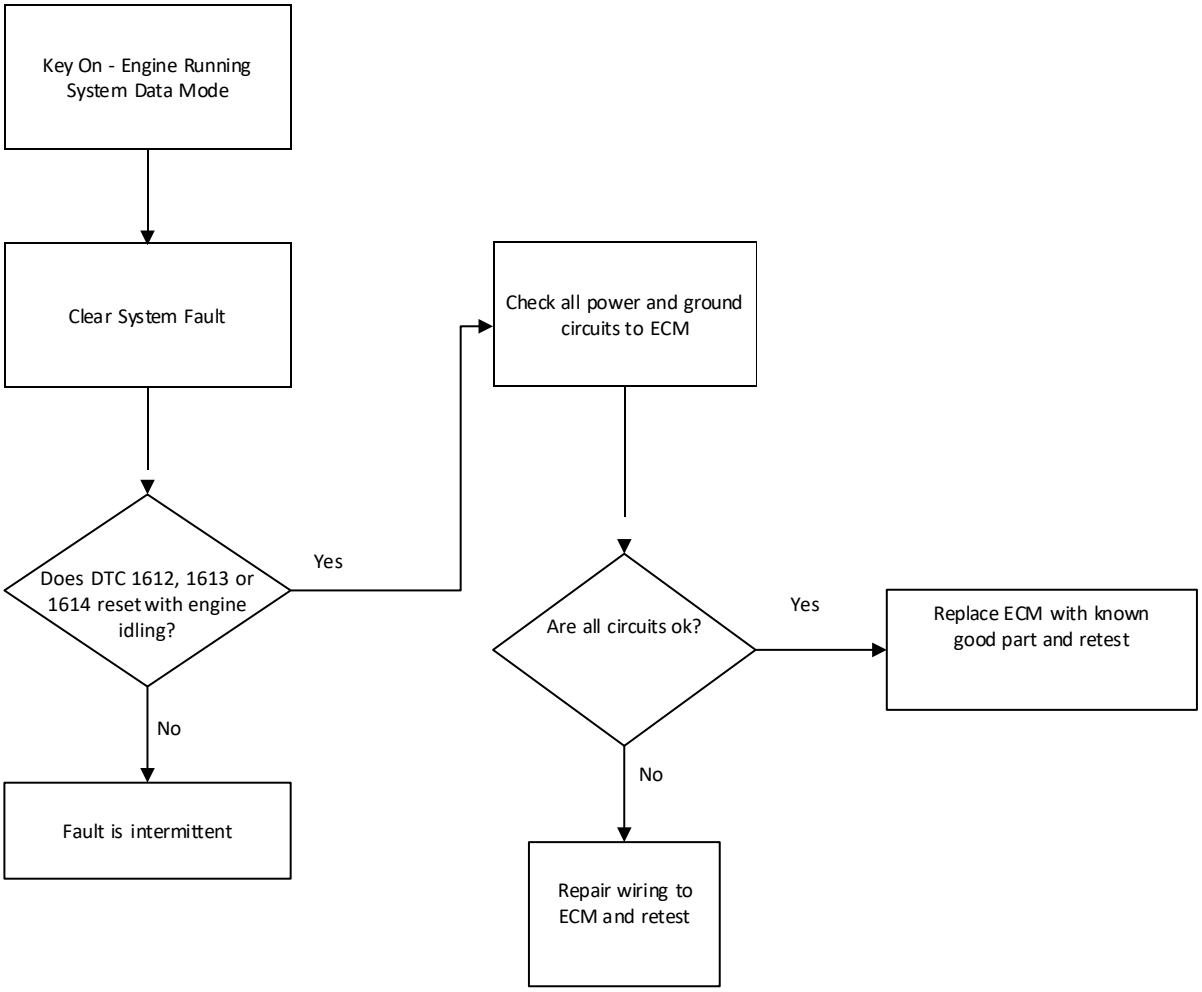
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	YES	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	YES	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

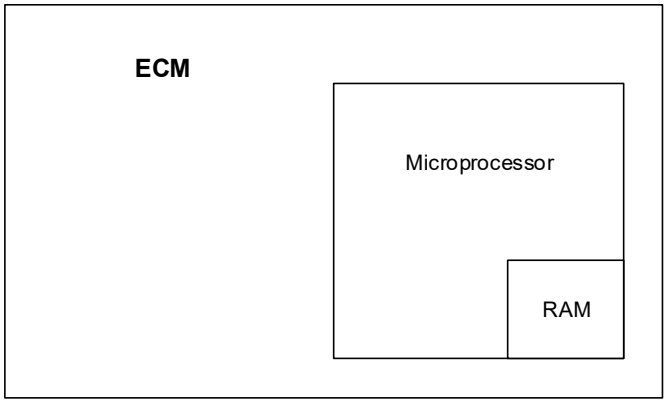
Diagnostic Aids:

- Replace ECM with known good unit and retest.

DTC 1612, 1613 & 1614 - MICROPROCESSOR FAILURE - RTI 1, 2 & 3 (TROUBLE TREE)



DTC 1615- MICROPROCESSOR FAILURE - A/D



DTC	1615	SPN	629	FMI	31

Sensor/Circuit: Engine Control Module

Description:

The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased after diagnosis by removing battery power. It will not self-erase.

During this active fault, Power Derate (level 2) will be enforced. When this is enforced, maximum throttle position will be 20%. This is enforced until the fault is manually cleared.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key On

Fault Set Conditions (as defined in calibration):

- Internal microprocessor error

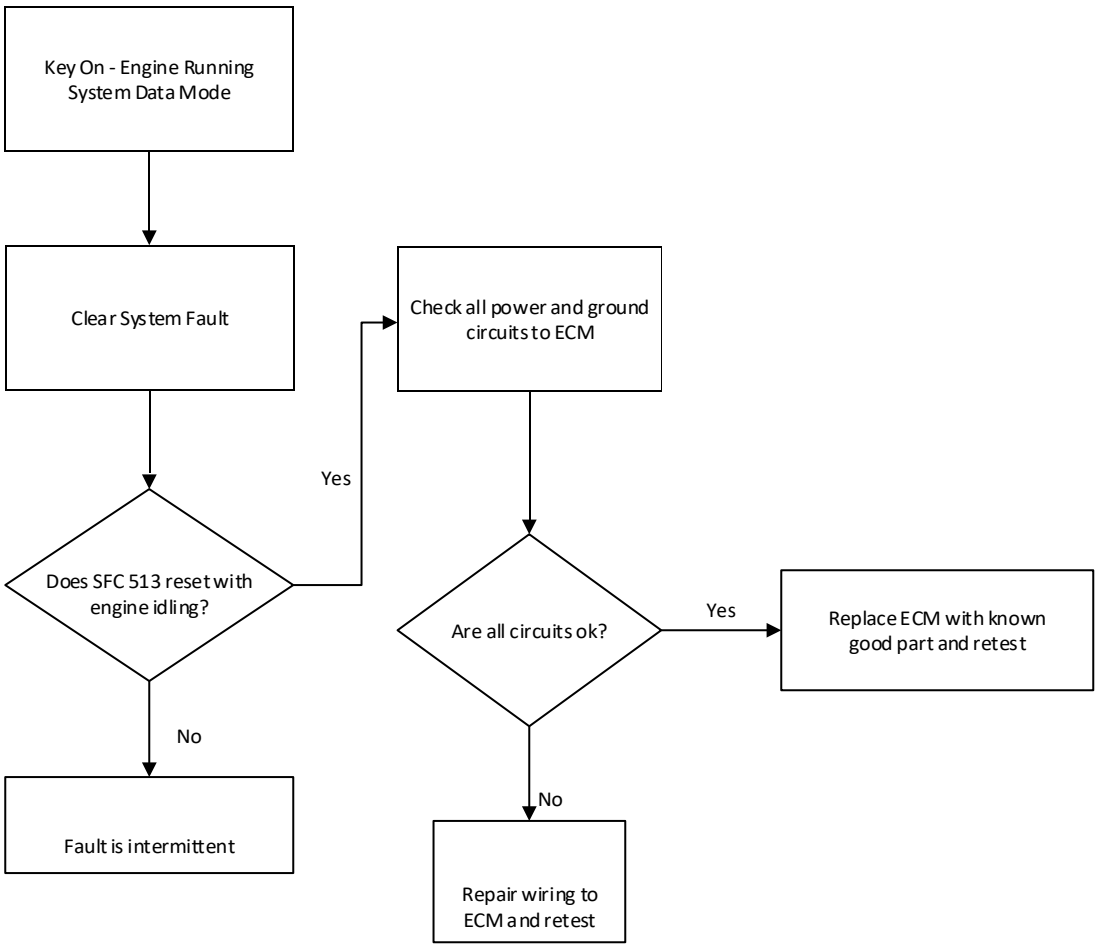
Possible Causes:

The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault.

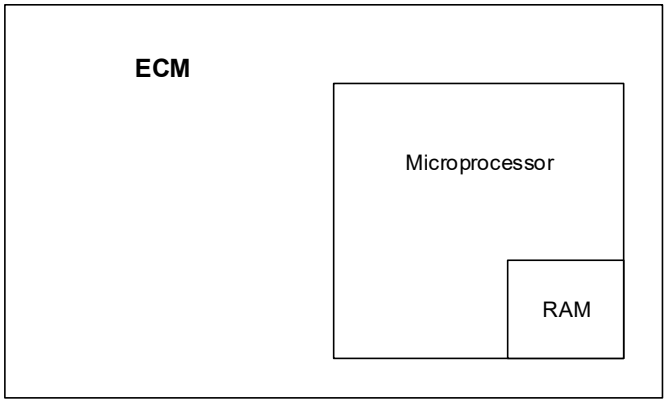
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	YES	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	YES	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 1615 - MICROPROCESSOR FAILURE – A/D (TROUBLE TREE)



DTC 1616 – MICROPROCESSOR FAILURE – INTERRUPT



DTC	1616	SPN	629	FMI	31

Sensor/Circuit: Engine Control Module

Description:

The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased after diagnosis by removing battery power. It will not self-erase.

During this active fault, Power Derate (level 2) will be enforced. When this is enforced, maximum throttle position will be 20%. This is enforced until the fault is manually cleared.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key On

Fault Set Conditions (as defined in calibration):

- Internal microprocessor error

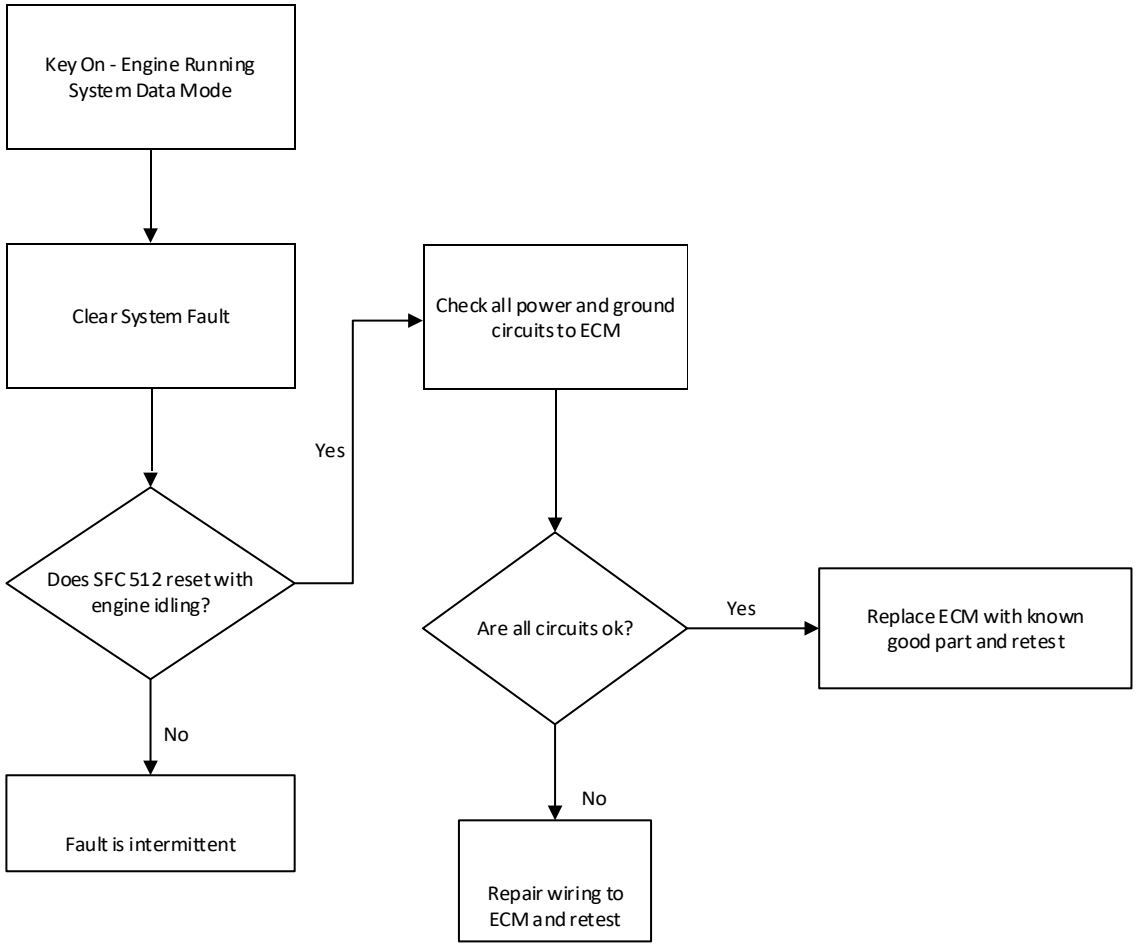
Possible Causes:

The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault.

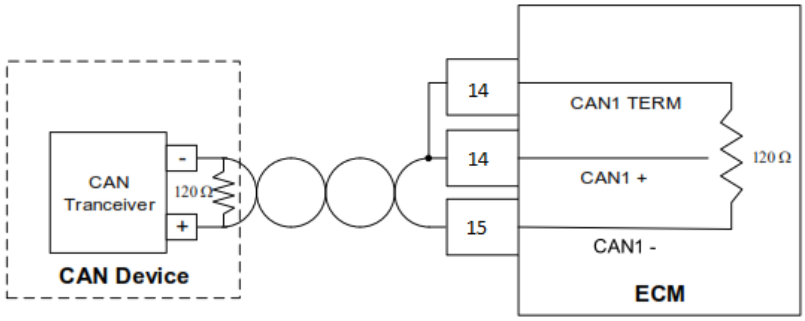
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	YES	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	YES	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 1616 - MICROPROCESSOR FAILURE – INTERRUPT (TROUBLE TREE)



DTC 1626 – CAN1 J1939 TRANSMIT (TX) FAULT



DTC	1626	SPN	639	FMI	12
Sensor/Circuit: Controller Area Network					

Description:

The Controller Area Network (CAN) is a serial communication network used to transmit and receive data between intelligent devices. Systems that utilize CAN communication include smart actuators (EPR), smart sensors (Envirotech), dash panels and gauges, and other microcomputers. Each smart sensor, actuator, or controller incorporates a CAN transceiver that interprets logic level signals on the network and translates the information into digital data.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES (If EPR-Equipped)**
Check Condition:	Key On, Engine Off and/or Running

Fault Set Conditions (as defined in calibration):

• Tx error counter >	120	failures

Possible Causes:

This fault will set if CAN communication is enabled and the ECM transceiver broadcasts a number of packets (as defined in the diagnostic calibration, must be set to less than 125 failures) to the network that are not received.

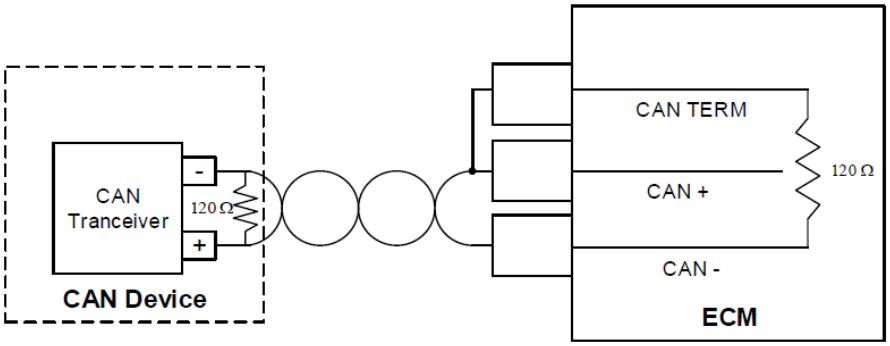
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 1626 – CAN1 J1939 TRANSMIT (TX) FAULT (Diagnostic Aides):

- ☐ Verify that all CAN devices are powered and are properly grounded
- ☐ Verify that the CAN1 network is properly terminated
- ☐ Check CAN1 wire routing with respect to noise sources (ignition coils, spark plug coil wires, etc.) and shield if necessary
- ☐ Check CAN1 (+) and (-) wires for short circuits

DTC 1627 – CAN1 RX FAILURE



DTC	1627	SPN	639	FMI	12		

Hardware/Circuit: Controller Area Network

Hardware/Circuit Description:

The Controller Area Network (CAN) is a serial communication network used to transmit and receive data between intelligent devices. Systems that utilize CAN communication include smart actuators (EPR, CFV), smart sensors (Envirotech, UEGO), dash panels and gauges, and other microcomputers. Each smart sensor, actuator, or controller incorporates a CAN transceiver that interprets logic level signals on the network and translates the information into digital data.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions (as defined in calibration):

	CAN1	
• Rx error counter >	**120**	failures

Fault Description:

This fault will set if CAN communication is enabled and the CAN device broadcasts a number of packets (as defined in the diagnostic calibration) to the ECM that are not received.

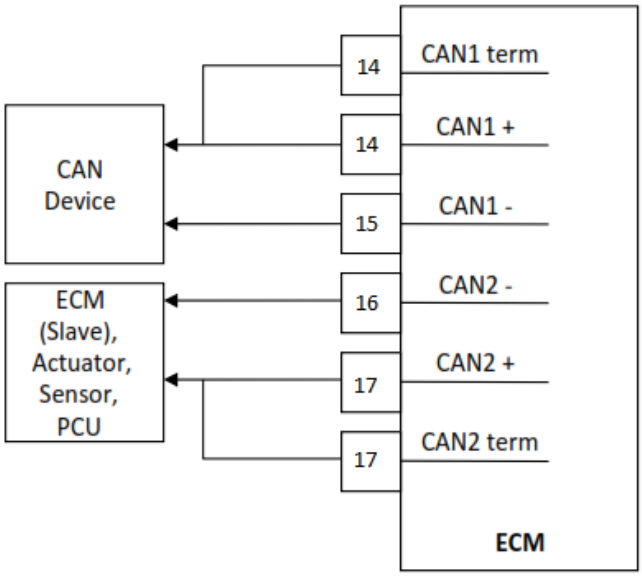
Corrective Actions:

Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**YES**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

Diagnostic Aids

- ☐ Verify that all CAN devices are powered and are properly grounded.
- ☐ Verify that the CAN network is properly terminated per J1939 requirements.
- ☐ Check CAN wire routing with respect to noise sources (coils, coil wires, etc.) and shield if necessary
- ☐ Check CAN (+) and (-) wires for short circuits

DTC 1628 - CAN1 ADDRESS CONFLICT FAILURE



DTC	1628	SPN	639	FMI	12
Sensor/Circuit: CAN Device(s)					

Description:

The controller area network serves as a communication portal between intelligent devices. These devices may be but are not limited to other engine ECMs (slave), diagnostic tools, "smart" gauges, "smart" sensors, powertrain control units, vehicle controllers, actuators, etc. The network permits several devices to communicate with each other receiving and broadcasting commands as programmed. This type of network allows devices to be added to an entire system through only two conductors and permits all other devices to broadcast and receive commands to and from the device when properly commanded. CAN1 is used for general network communication including gauge display, scan tool communication, and other general 3rd party traffic. CAN2 is reserved solely for engine control (engine synchronization, throttle control, vehicle controller commands, etc.) and is limited to EControls Inc. approved devices only.

Fault Enabled in Calibration?	**YES**		
Emissions-related Fault?	**NO**		
Check Condition:	Key On, Engine on		
Fault Set Conditions (as defined in calibration):			
• Address conflict counter >	5	failures	

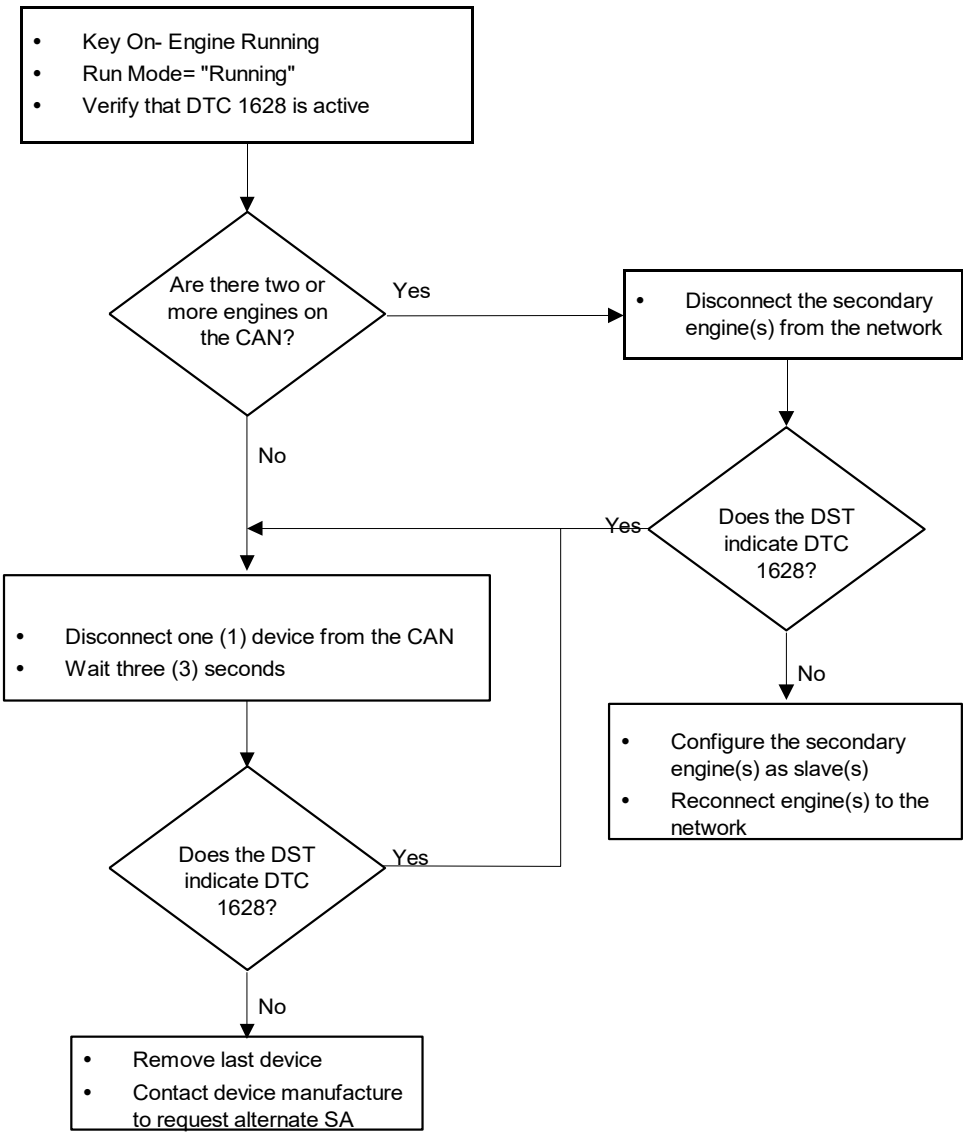
Possible Causes:

This fault indicates that there are two (2) or more devices on the network that use the same source address.

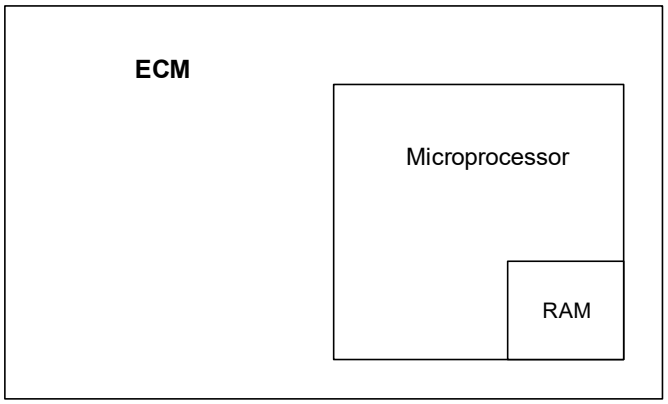
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	YES	NOx Control System	TBD*

DTC 1628 - CAN1 ADDRESS CONFLICT FAILURE (TROUBLE TREE)



DTC 1673 - CALIBRATION CONFIGURATION ERROR



DTC	1673	SPN	1634	FMI	13

Sensor/Circuit: Calibration Configuration Error

Description:

The ECM checks certain safety-related calibration variables for acceptable values or ranges.

During this active fault, Power Derate (level 2) will be enforced. When this is enforced, maximum throttle position will be 20%. This is enforced until the fault is manually cleared. Adaptive Learn will be disabled for the duration of the key on cycle to prevent improper learning and updating of the table. The MIL will be illuminated for the duration of the key on cycle. Additionally, the fault should be configured to never forget and will not self-erase and will not clear until a technician performs diagnostics and manually clears the code.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Key On

Fault Set Conditions (as defined in calibration):

- Specific calibration variable checks do not return expected results

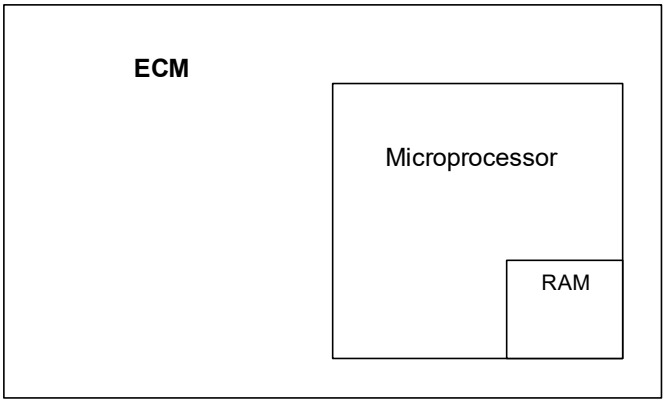
Possible Causes:

Specific calibration variable checks do not return expected results

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	YES	Hard Warning	TBD*
Never Forget	YES	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 1674 - HARDWARE ID FAILURE



DTC	1674	SPN	1634	FMI	2

Sensor/Circuit: Engine Control Module- Hardware ID Failure

Description:

The ECM checks the MOT file against hardware ID tags that indicate the current ECM hardware revisions level.

If this fault sets, the ECM will reset itself and log the code. The fault should be configured to never forget and will not self-erase and will not clear until a technician performs diagnostics and manually clears the code. This fault should be configured to set a power derate 2 and low rev limit to reduce possible engine damage and reduce possibility of an overspeed condition

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Key On

Fault Set Conditions (as defined in calibration):

- MOT file is too old for ECM hardware revision level.

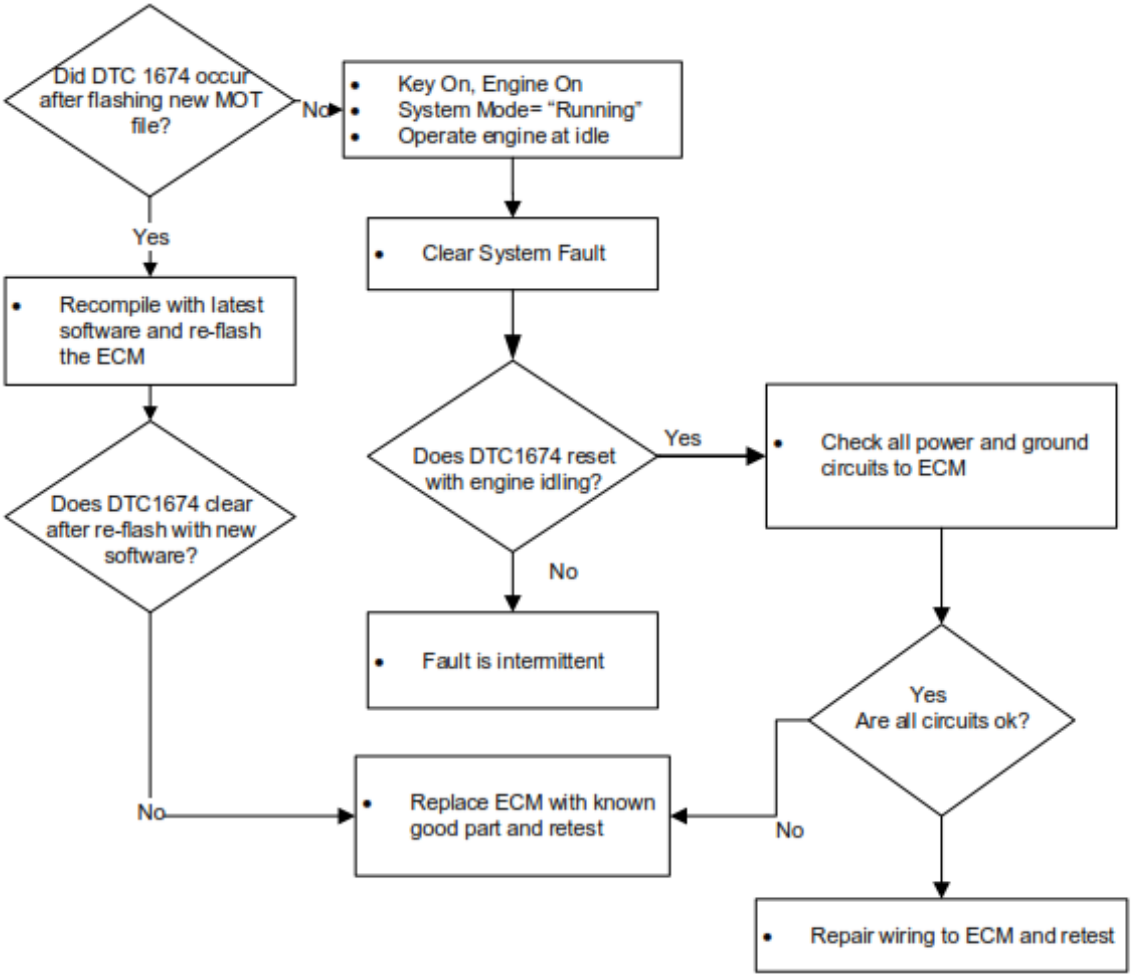
Possible Causes:

This fault will set when programming the ECM with a MOT file that is too old for the given hardware revision level.

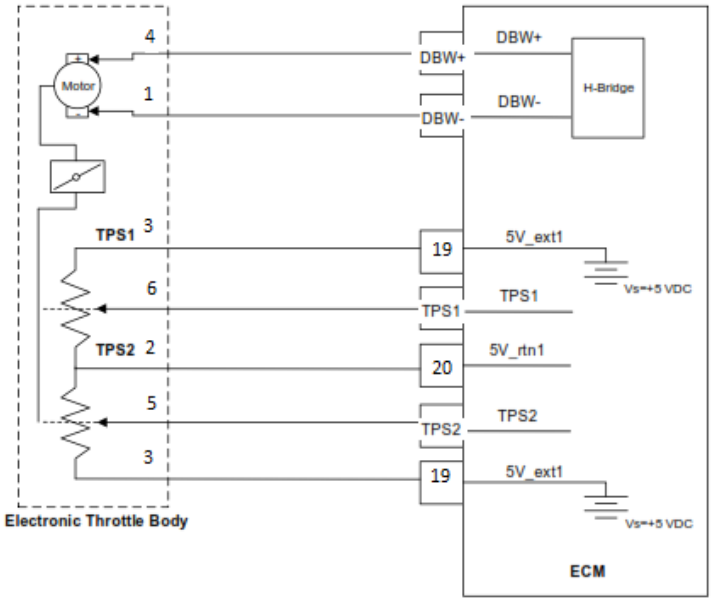
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	YES	Hard Warning	TBD*
Never Forget	YES	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 1674 - HARDWARE ID FAILURE (TROUBLE TREE)



DTC 2111 - UNABLE TO REACH LOWER TPS



DTC	2111	SPN	51	FMI	7

Sensor/Circuit: Throttle Position Sensor

Description:

There are 2 Throttle Position Sensors located within the throttle which use variable resistors to determine signal voltage based on throttle plate position. TPS1 will read low voltage when closed and TPS2 will read high voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Cranking or Running

Fault Set Conditions (as defined in calibration):

- Throttle command is 20% less than throttle position for 200ms or longer

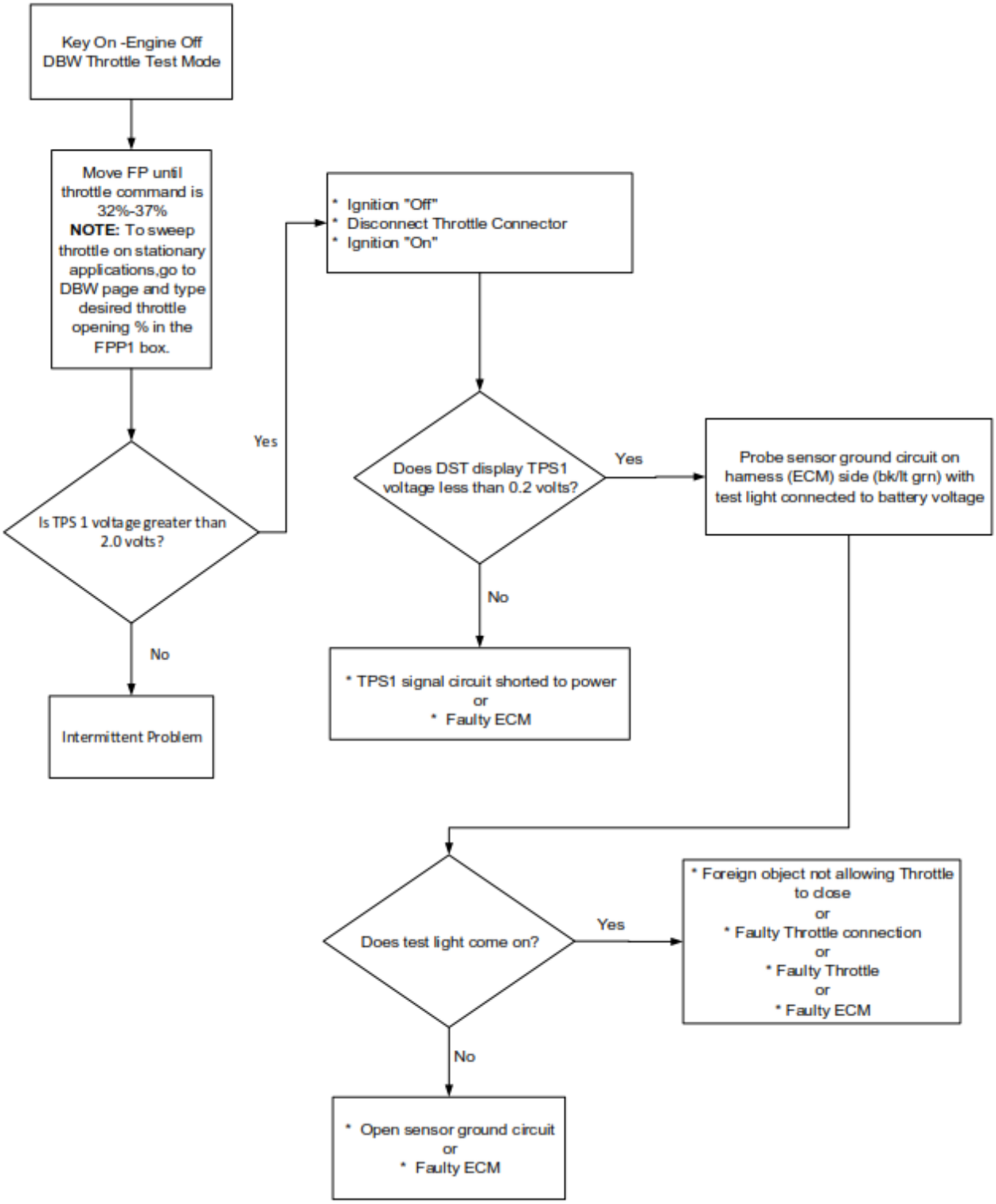
Possible Causes:

This fault will set if the throttle command is 20% less than the actual throttle position. During this active fault the MIL light will be on and the engine will shut down.

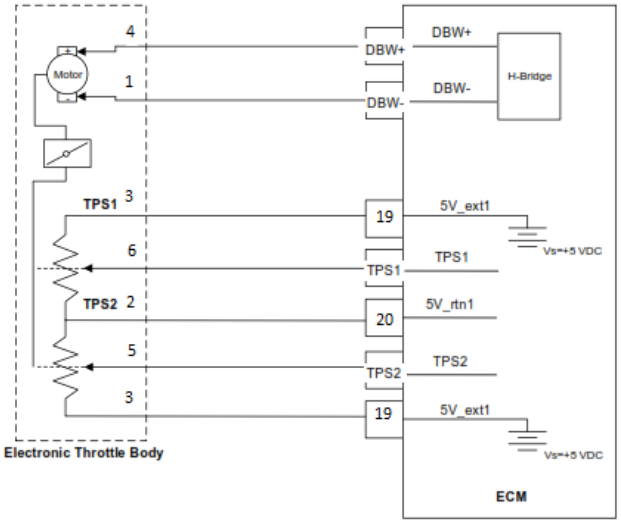
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	YES	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 2111 - UNABLE TO REACH LOWER TPS (TROUBLE TREE)



DTC 2112 - UNABLE TO REACH HIGHER TPS



DTC	2112	SPN	51	FMI	7

Sensor/Circuit: Throttle Position Sensor

Description:

There are 2 Throttle Position Sensors located within the throttle which use variable resistors to determine signal voltage based on throttle plate position. TPS1 will read low voltage when closed and TPS2 will read high voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Cranking or Running

Fault Set Conditions (as defined in calibration):

- Throttle command is 20% more than actual throttle position

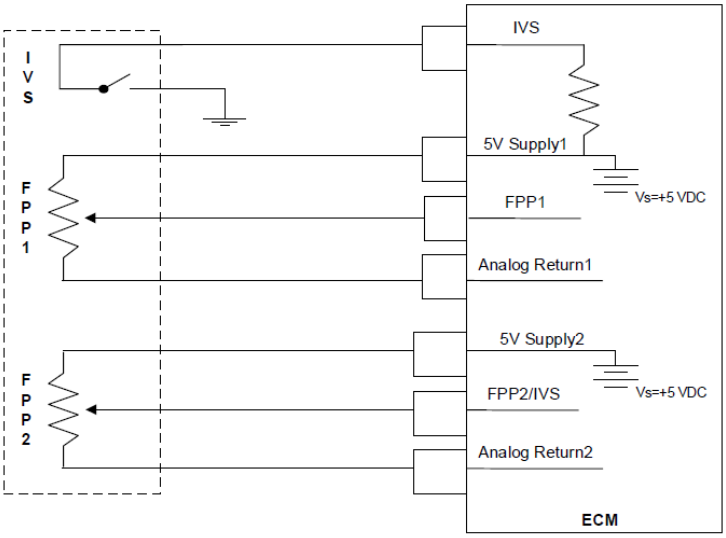
Possible Causes:

This fault will set if the throttle command is 20% or more than the actual throttle position. During this active fault the MIL light will be on and the engine will shut down.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	YES	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	YES	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 2122 - FPP1 HIGH VOLTAGE



DTC	2122	SPN	91	FMI	3		

Hardware/Circuit: Foot Pedal Position Sensor

Hardware/Circuit Description:

The FPP sensor is an electronic device that is coupled to a mechanically driven input as commanded by the vehicle/engine operator. A FPP sensor may be, but is not limited to a foot pedal assembly, a cable-lever-sensor assembly, or a rotary potentiometer. General sensor configurations consist of single potentiometer/hall-effect with IVS, two potentiometers/hall-effects, or two potentiometers/hall-effects with IVS. The FPP sensor outputs are proportional to the commanded input. The ECM uses the FPP sensor input(s) to control the throttle and adjust the engine's load in order to achieve the requested power. Since the FPP sensor inputs directly affect the engine's power output, redundant sensors are generally used to ensure safe, reliable operation. In systems that utilize a mechanical throttle the foot pedal input is used to monitor the position of the mechanical throttle valve in order to activate minimum or maximum governors. In electronic throttle control systems the foot pedal position/throttle control position sensor is used by the engine/equipment operator or system to command either throttle position or a governor speed target proportional to the input in order to achieve desired system behavior.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

	FPP1		
• FPP voltage >	**4.8**		volts

Fault Description:

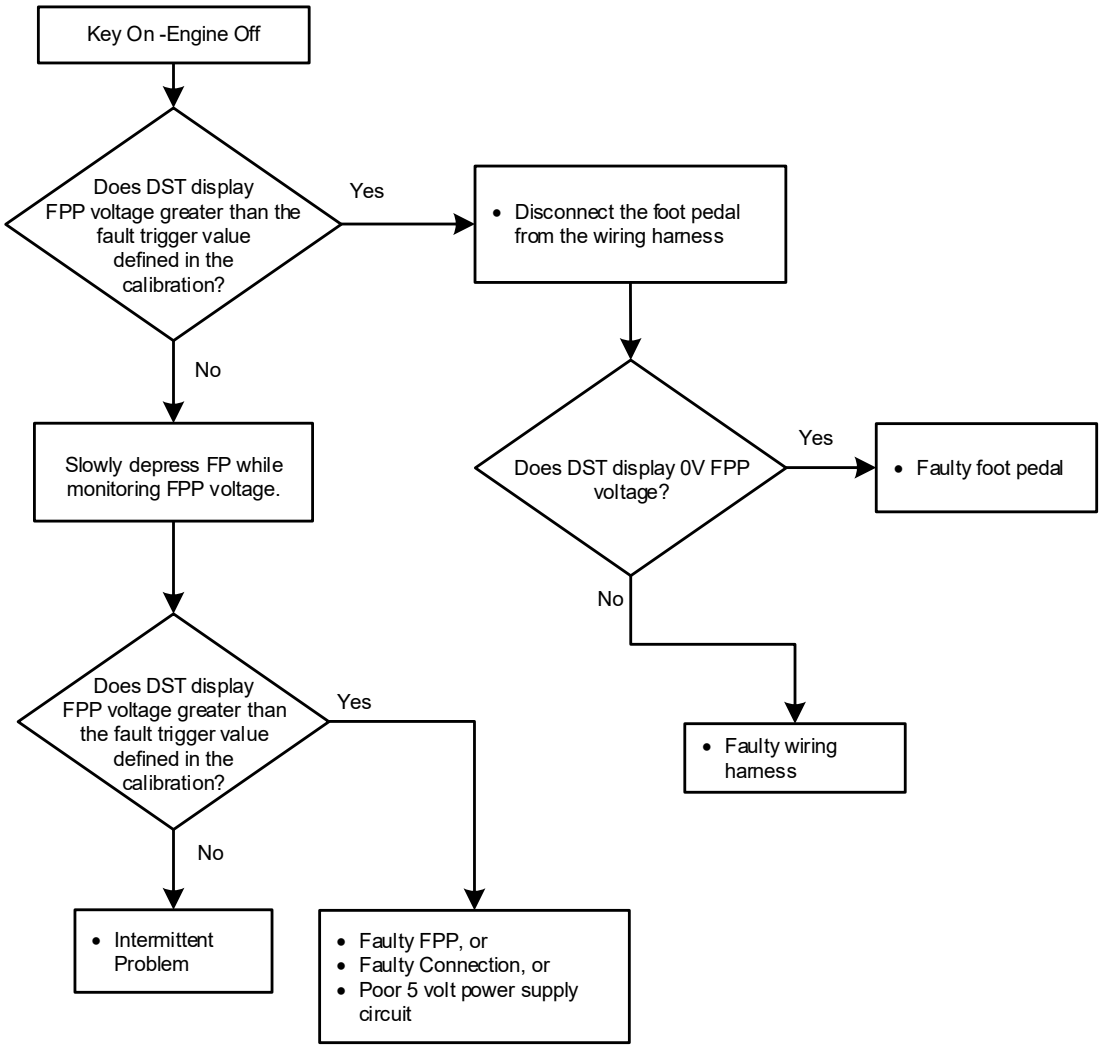
This fault will set if FPP1 voltage is higher than the limit defined in the engine calibration at any operating condition. Fully redundant systems (when three sensors are compared) limited operation may result in setting codes without requiring derates, however, single or non-redundant systems (FPP1 w/IVS) must command forced idle or engine shutdowns depending on the type of system.

Corrective Actions:

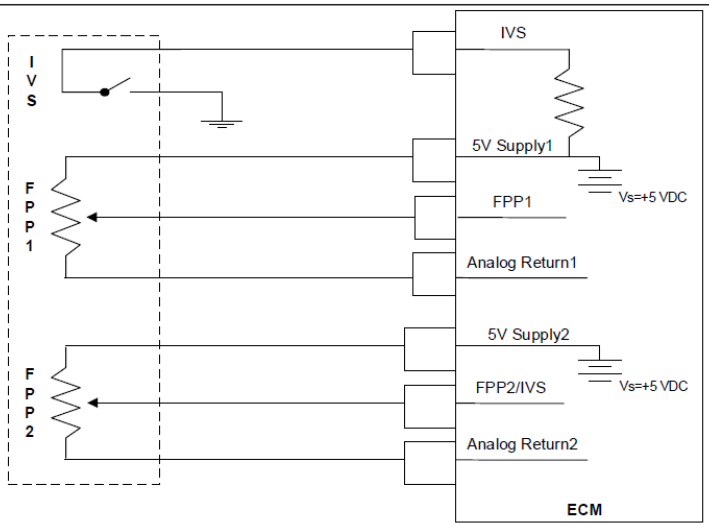
Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**YES**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

DTC 2122 - FPP1 HIGH VOLTAGE (TROUBLE TREE)

Diagnostic Aids/Trouble Tree



DTC 2123 - FPP1 LOW VOLTAGE



DTC	**2123**	**SPN**	**91**	**FMI**	**4**		

Hardware/Circuit: Foot Pedal Position Sensor

Hardware/Circuit Description:

The FPP sensor is an electronic device that is coupled to a mechanically driven input as commanded by the vehicle/engine operator. A FPP sensor may be, but is not limited to a foot pedal assembly, a cable-lever-sensor assembly, or a rotary potentiometer. General sensor configurations consist of single potentiometer/hall-effect with IVS, two potentiometers/hall-effects, or two potentiometers/hall-effects with IVS. The FPP sensor outputs are proportional to the commanded input. The ECM uses the FPP sensor input(s) to control the throttle and adjust the engine's load in order to achieve the requested power. Since the FPP sensor inputs directly affect the engine's power output, redundant sensors are generally used to ensure safe, reliable operation. In systems that utilize a mechanical throttle the foot pedal input is used to monitor the position of the mechanical throttle valve in order to activate minimum or maximum governors. In electronic throttle control systems the foot pedal position/throttle control position sensor is used by the engine/equipment operator or system to command either throttle position or a governor speed target proportional to the input in order to achieve desired system behavior.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

	FPP1		
• FPP voltage <	**0.2**		volts

Fault Description:

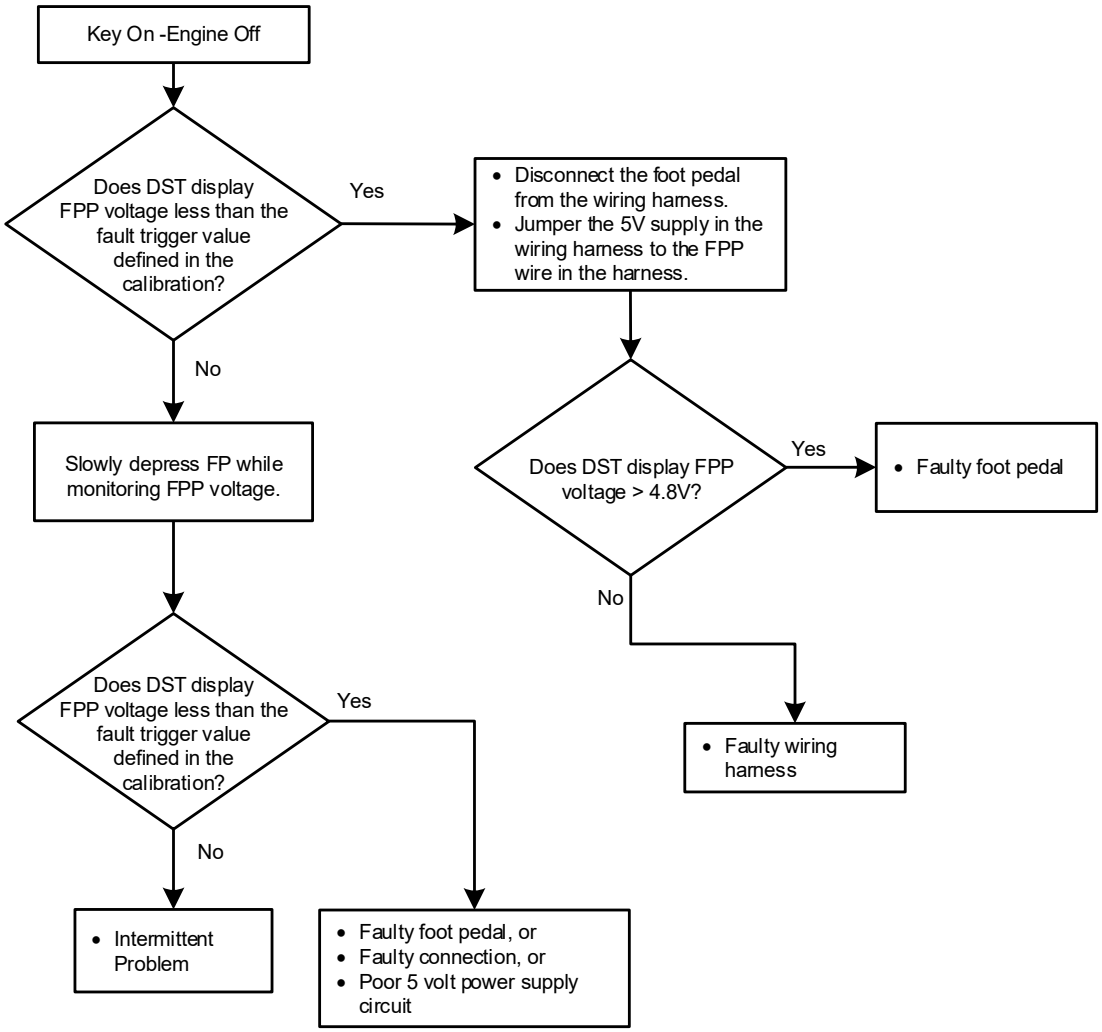
This fault will set if FPP1/FPP2 voltage is lower than the limit defined in the engine calibration at any operating condition. Fully redundant systems (when three sensors are compared) limited operation may result in setting codes without requiring derates, however, single or non-redundant systems (FPP w/IVS) must command forced idle or engine shutdowns depending on the type of system.

Corrective Actions:

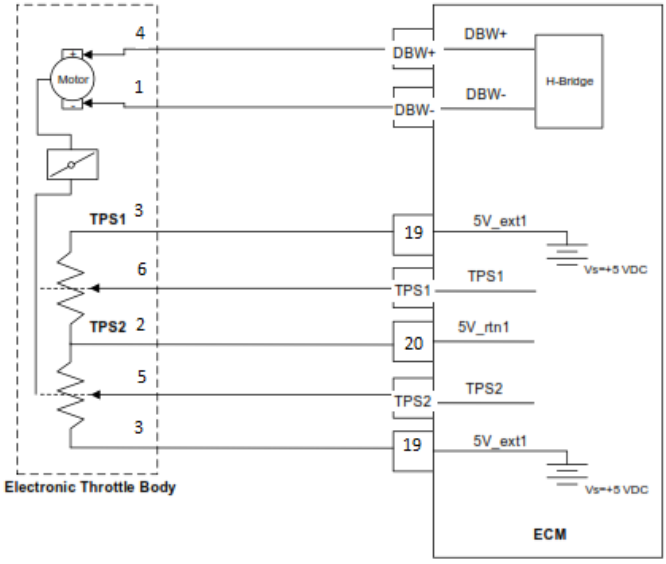
Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**YES**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

DTC 2123 - FPP1 LOW VOLTAGE (TROUBLE TREE)

Diagnostic Aids/Trouble Tree



DTC 2135 - TPS1/2 SIMULTANEOUS VOLTAGES OUT OF RANGE



DTC	2135	SPN	51	FMI	31

Sensor/Circuit: Electronic throttle body

Description:

The throttle is an air valve used to control the amount of air available to the engine for combustion and thereby the engine's power output. An electronic throttle simply means that a motor is controlled electronically through an electronic control system to actuate the throttle valve. Electronic throttle control is advantageous because it tends to offer improved starting, improved idle governing, improved maximum speed governing, excellent load acceptance and steady-state speed governing, permits engine synchronization, and offers flexibility to protect the engine during certain fault conditions.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**NO**
Check Condition:	Key On, Engine On

Fault Set Conditions (as defined in calibration):

• TPS1 voltage >	TBD*	volts
or TPS1 voltage <	TBD*	volts
AND		
• TPS2 voltage >	TBD*	volts
or TPS2 voltage <	TBD*	volts

Possible Causes:

This fault is generated when both feedback sensors in the ETB (TPS1 and TPS2) simultaneously produce out-of-range faults. This fault indicates that there is no feedback of the throttle valve and as a result throttle control cannot take place. This fault is, and should always be, configured to shut the engine down.

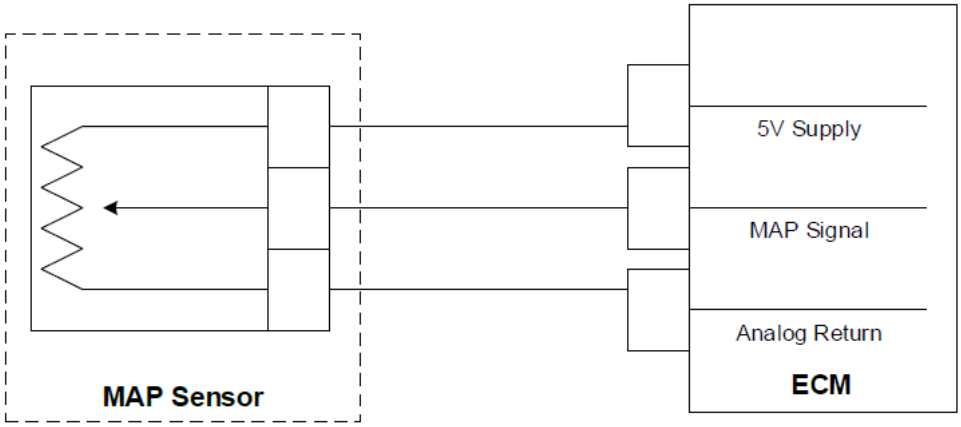
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	YES	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

Diagnostic Aids:

- ☐ Troubleshoot according to TPS1 voltage out-of-range following DTC 122 and 123 procedures.
- ☐ Troubleshoot according to TPS2 voltage out-of-range following DTC 222 and 223 procedures.

DTC 2229 - BP HIGH PRESSURE



DTC	2229	SPN	108	FMI	0		

Hardware/Circuit: Barometric Temperature / Manifold Absolute Pressure Sensor

Hardware/Circuit Description:

Barometric Pressure is estimated from the MAP sensor at key-on and in some calibrations during low speed/high load operation as defined in the engine's calibration. The barometric pressure value is used for fuel and airflow calculations and equivalence ratio targets based on altitude.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

• BP pressure >	**15.50**	psia

Fault Description:

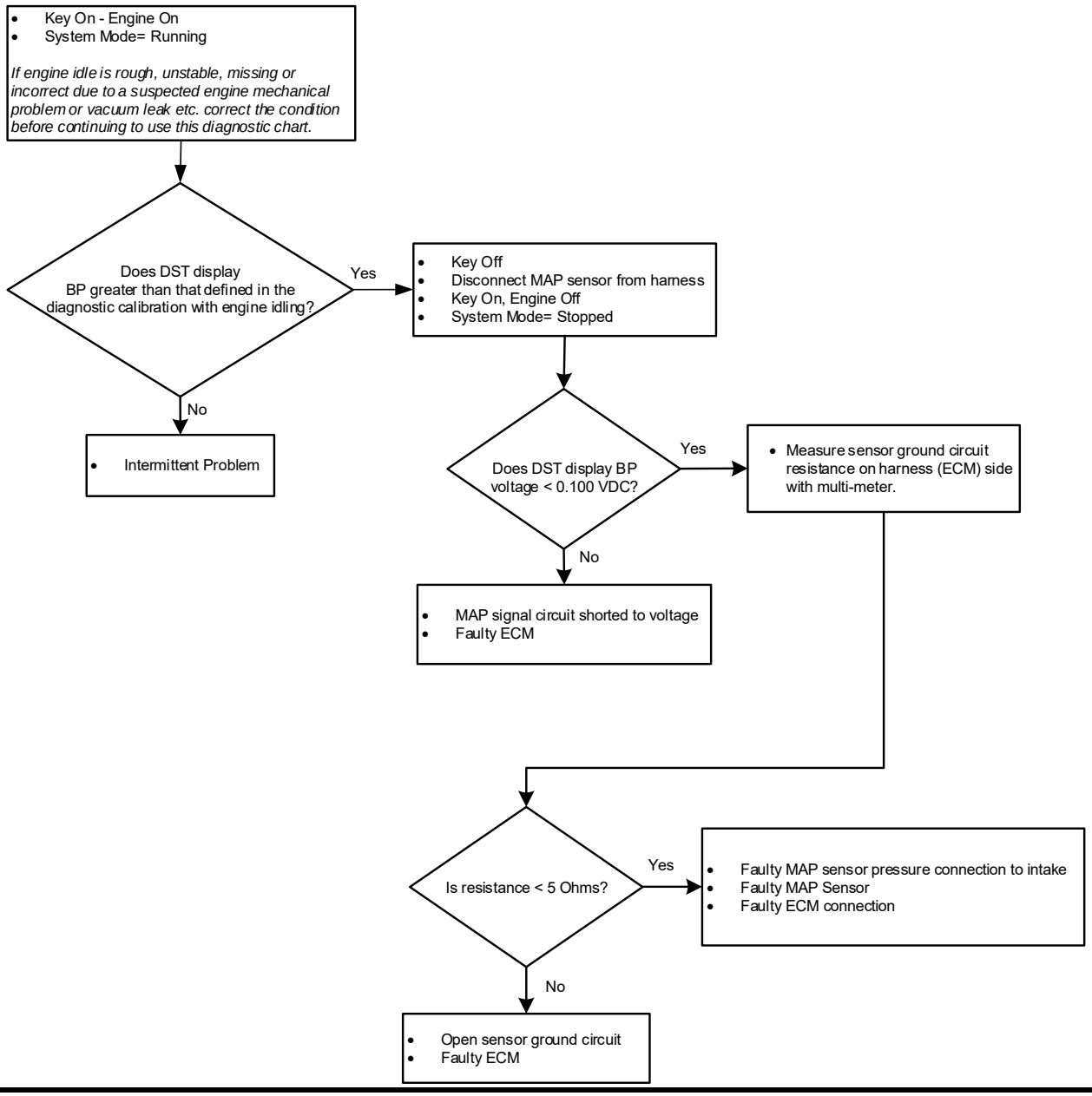
This fault sets if the barometric pressure is higher than the maximum pressure (psia) as defined in the diagnostic calibration.

Corrective Actions:

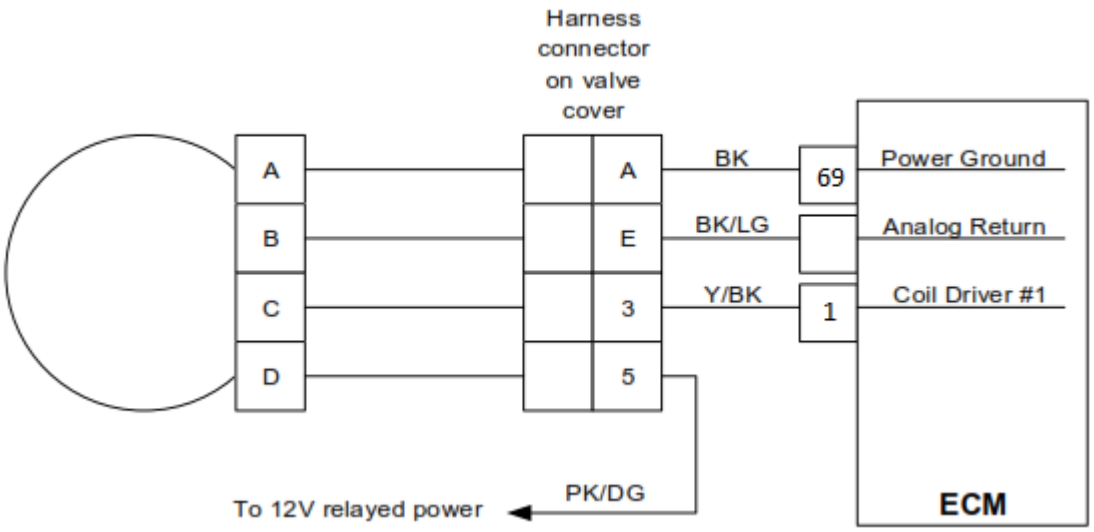
Shutdown	**TBD**	CL Disable key cyc.	**TBD**	Power Derate 2	**TBD**	Hard Warning	**TBD**
Never Forget	**TBD**	AL Disable	**TBD**	Low Rev Limit	**TBD**	MIL Persist Disable	**TBD**
Turn on MIL	**YES**	AL Disable key cyc.	**TBD**	Force Idle	**TBD**		
CL Disable	**TBD**	Power Derate 1	**TBD**	Soft Warning	**TBD**		

DTC 2229 - BP HIGH PRESSURE (TROUBLE TREE)

Diagnostic Aids/Trouble Tree



DTC 2300 - PRIMARY LOOP OPEN OR LOW-SIDE SHORT TO GROUND (CURR. MEAS. REQD)(CYLINDER 1)



DTC	2300	SPN	1268	FMI	5
Sensor/Circuit:	Ignition/Spark Coil, cylinder 1 (Dumb-coil ONLY)				

Description:

Coil driver #1 fires either the 1st cylinder in the firing order or the 1st cylinder in the block order depending on the configuration of the 'Injector/Spark Diagnostic Numbering' scheme as set in calibration. The purpose of this fault is to detect a short-to-ground or open circuit in the harness or internal to the primary coil.

Fault Enabled in Calibration?	**YES**	
Emissions-related Fault?	**YES**	
Check Condition:	Key On, Engine On	
Fault Set Conditions (as defined in calibration):		
• Diagnose faults while cranking	**Disabled/Enabled**	
• Battery voltage >	**TBD***	volts
• Battery voltage <	**TBD***	volts
• External spark module voltage >	**TBD***	volts
If dwell current control = 'Adaptive Dwell':		
• dwell adjustment >=	**1**	ms
• or total dwell >=	**4**	ms
If dwell current control = 'Monitor Only':		
• final current <	**0.5**	amps
• and crank dwell (external module only) <	**90**	ms

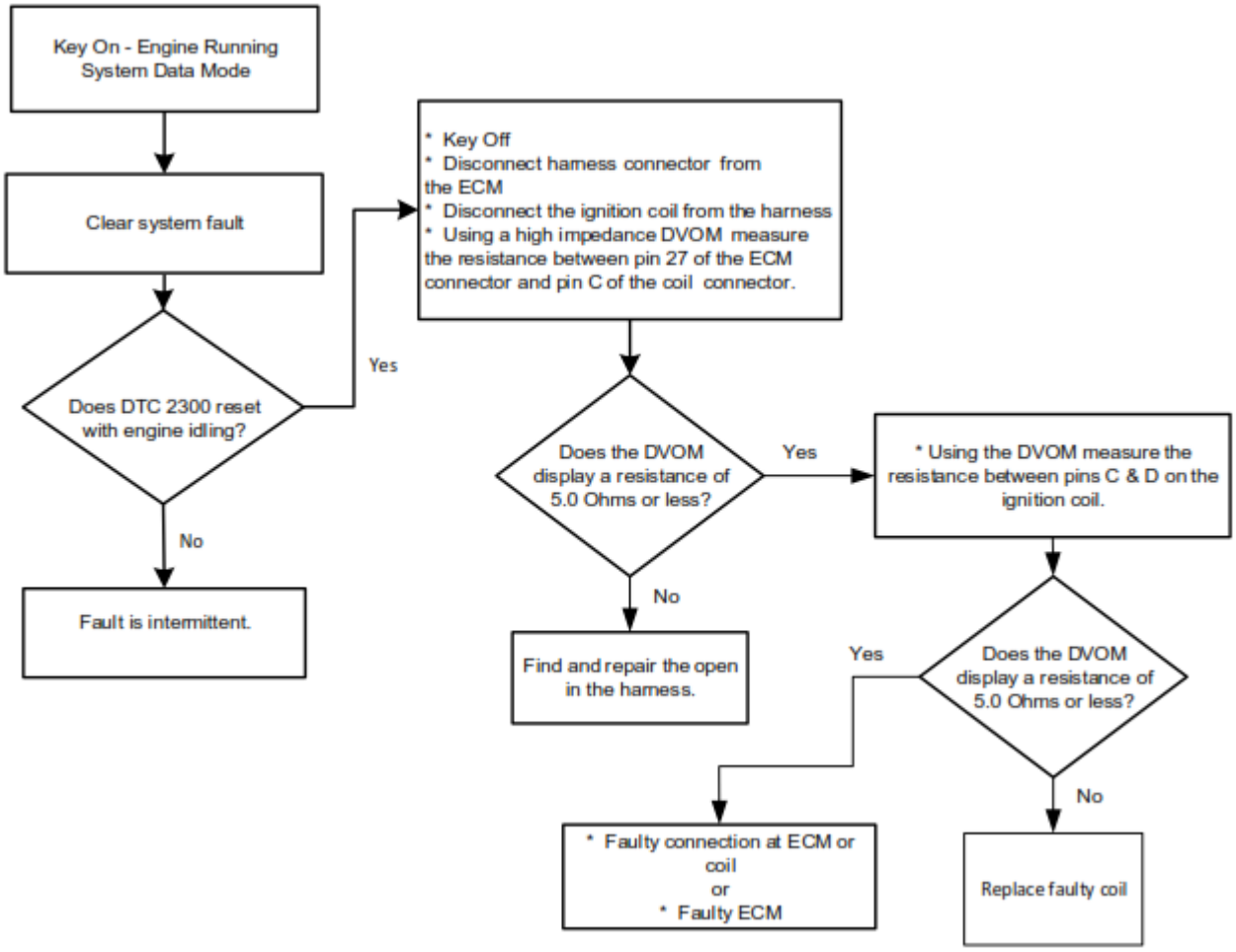
Possible Causes:

This fault will set if the ECM detects **x** number of coil firings in which the adaptive dwell adjustment is greater than **y** ms. or the total dwell is greater than **w** ms. and battery voltage is greater than **z** volts as defined in the diagnostic calibration.

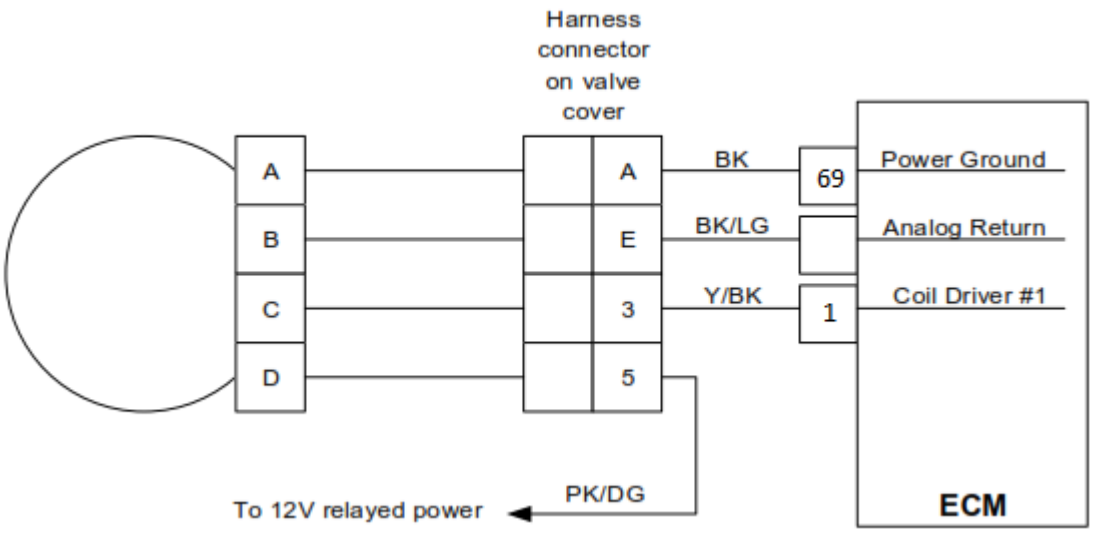
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	TBD*	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 2300 - PRIMARY LOOP OPEN OR LOW-SIDE SHORT TO GROUND (TROUBLE TREE)



DTC 2301 - PRIMARY COIL SHORTED (CURRENT MEASUREMENT REQUIRED)(CYLINDER 1)



DTC	2301	SPN	1268	FMI	6
Sensor/Circuit:	Ignition/Spark Coil, cylinder 1 (Dumb-coil ONLY)				

Description:

Coil driver #1 fires either the 1st cylinder in the firing order or the 1st cylinder in the block order depending on the configuration of the 'Injector/Spark Diagnostic Numbering' scheme as set in calibration. The purpose of this fault is to detect a short-to-ground or open circuit in the harness or internal to the primary coil.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Key On, Engine On

Fault Set Conditions (as defined in calibration):

• Diagnose faults while cranking	**Disabled/Enabled**	
• Battery voltage >	**TBD***	volts
• Battery voltage <	**TBD***	volts
• External spark module voltage >	**TBD***	volts
If dwell current control = 'Adaptive Dwell':		
• dwell adjustment <=	**-1**	ms
• or total dwell <=	**1**	ms
If dwell current control = 'Monitor Only':		
• dwell adjustment <=	**5.5**	amps
• or total dwell <=	**90**	us

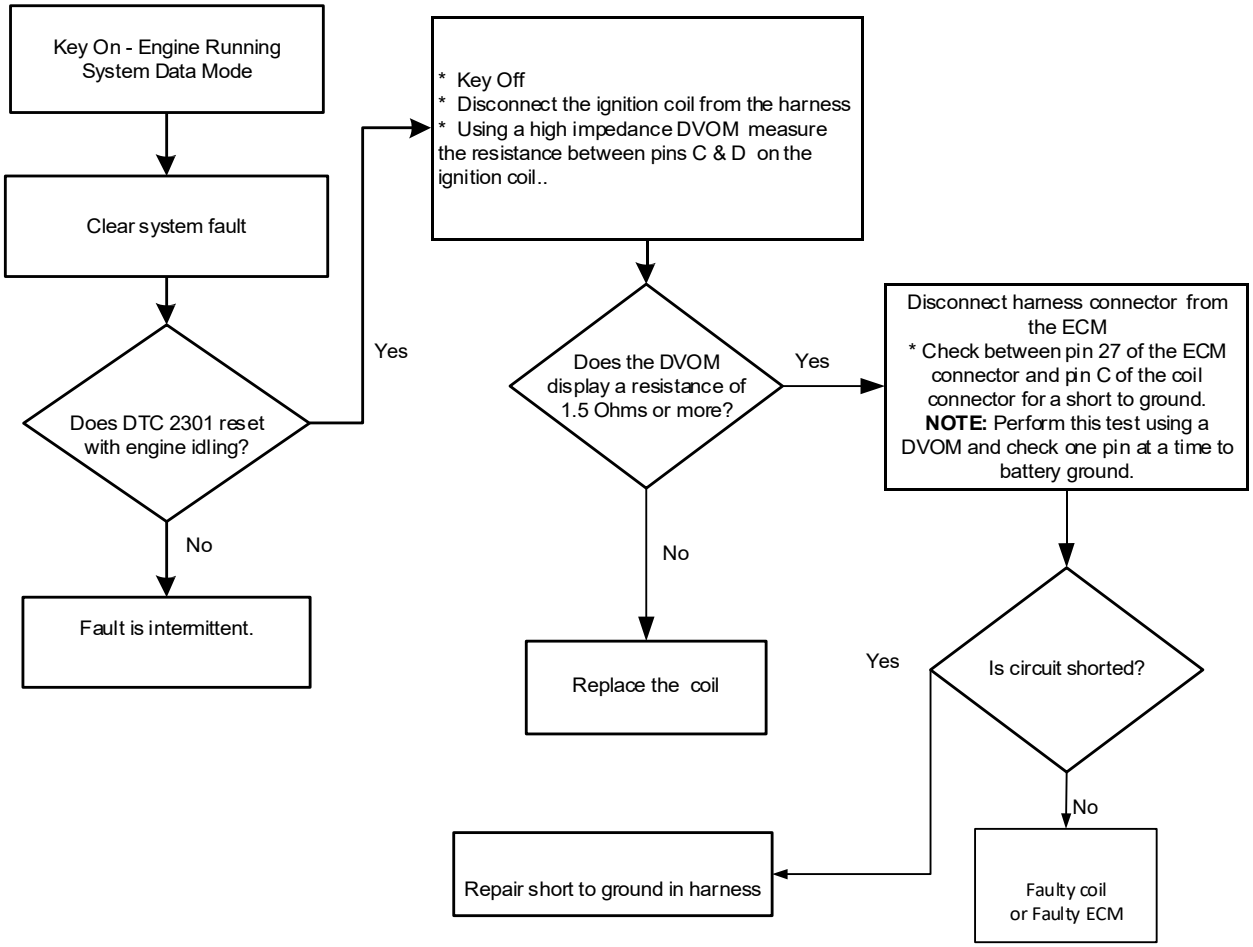
Possible Causes:

This fault will set if the ECM detects **x** number of coil firings in which the adaptive dwell adjustment is less than **y** ms. or the total dwell is less than **w** ms. and battery voltage is less than **z** volts as defined in the diagnostic calibration.

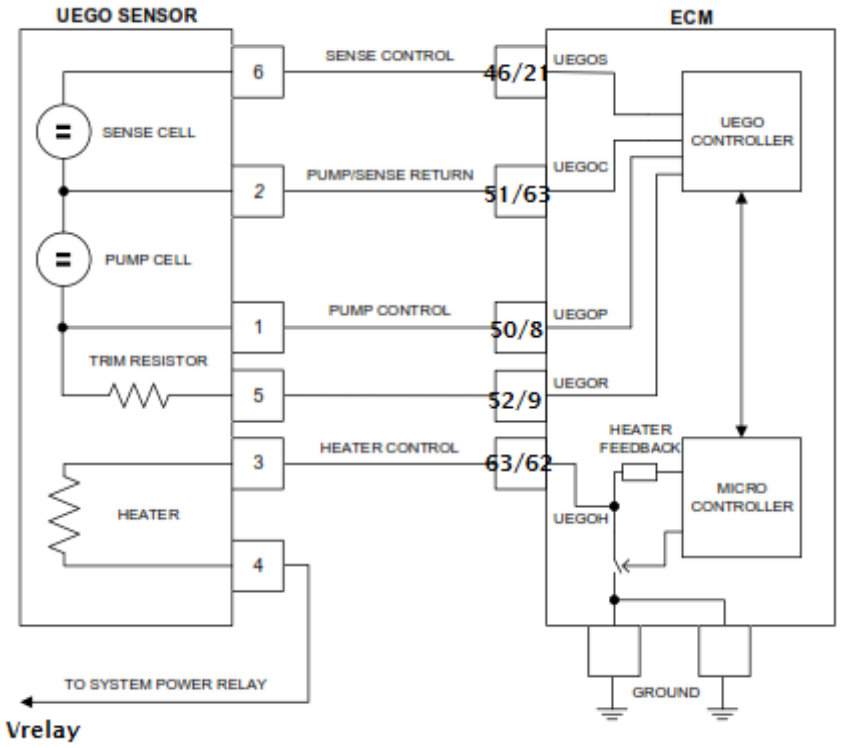
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	YES	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	YES	Power Derate 1	YES	Soft Warning	TBD*	NOx Control System	TBD*

DTC 2301 - PRIMARY COIL SHORTED (TROUBLE TREE)



DTC 3011 – UEGO1 INTERNAL PROCESSOR FAULT



DTC	3011	SPN	3221	FMI	31

Sensor/Circuit: Universal Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)

Description:

A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio. Internal to the ECM there is an application specific integrated circuit/controller that controls the sensor. The UEGO controller communicates internally within the ECM to the main microcontroller. The UEGO controller must always be functioning and communicating with the main microcontroller for proper emissions control.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

- Break in communication has occurred between the UEGO controller and the main micro-controller (both devices inside the ECM). The UEGO controller is no longer responsive.

Possible Causes:

This fault may set if the power supplied to the ECM (alternator or battery power) is excessively noisy and exhibits low voltage dips or dropouts. It may also indicate an internal failure within the ECM. This fault should be configured to disable adaptive learn for the remainder of the key-cycle to avoid improperly learning the adaptive learn table and may be configured to disable closed loop.

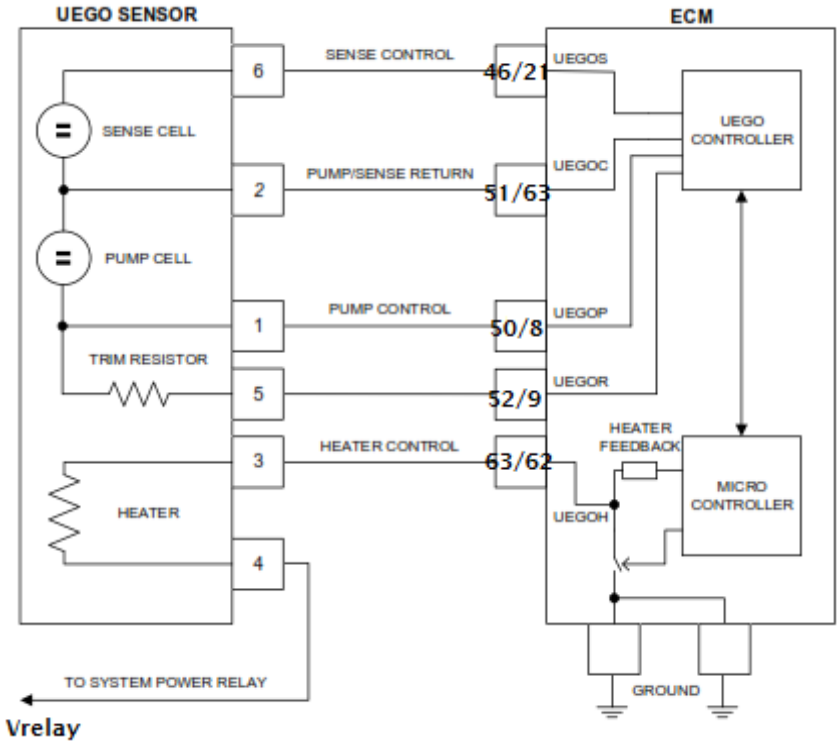
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	YES	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	YES	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

Diagnostic Aids:

- ☐ Verify that the alternator is working properly and there is not excessive noise on the alternator output or battery power from other loads. This fault may occur if power repeatedly dips but does not completely drop to zero.
- ☐ Verify the ECM ground is sufficient (clean and tight to the engine block)
- ☐ Swap ECM with a known good part, run engine for 10 minutes, and then retest.

DTC 3012 - UEGO HEATER SUPPLY HIGH VOLTAGE



DTC	3012	SPN	3222	FMI	3

Sensor/Circuit: Universal Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)

Description:

A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio. The sensor is heated with an internal resistor element that is supplied by the battery voltage and switched on/off by the ECM. The ECM will pull the heater control signal to ground when turning on the heater. The ECM monitors the heater control signal for a short to Vbattery. If the control signal does not reach zero volts when the heater is turned on then the circuit is not functioning properly. The UEGO heater circuit must always be functioning for proper emissions control.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

• UEGO heater supply voltage >	**32**	volts

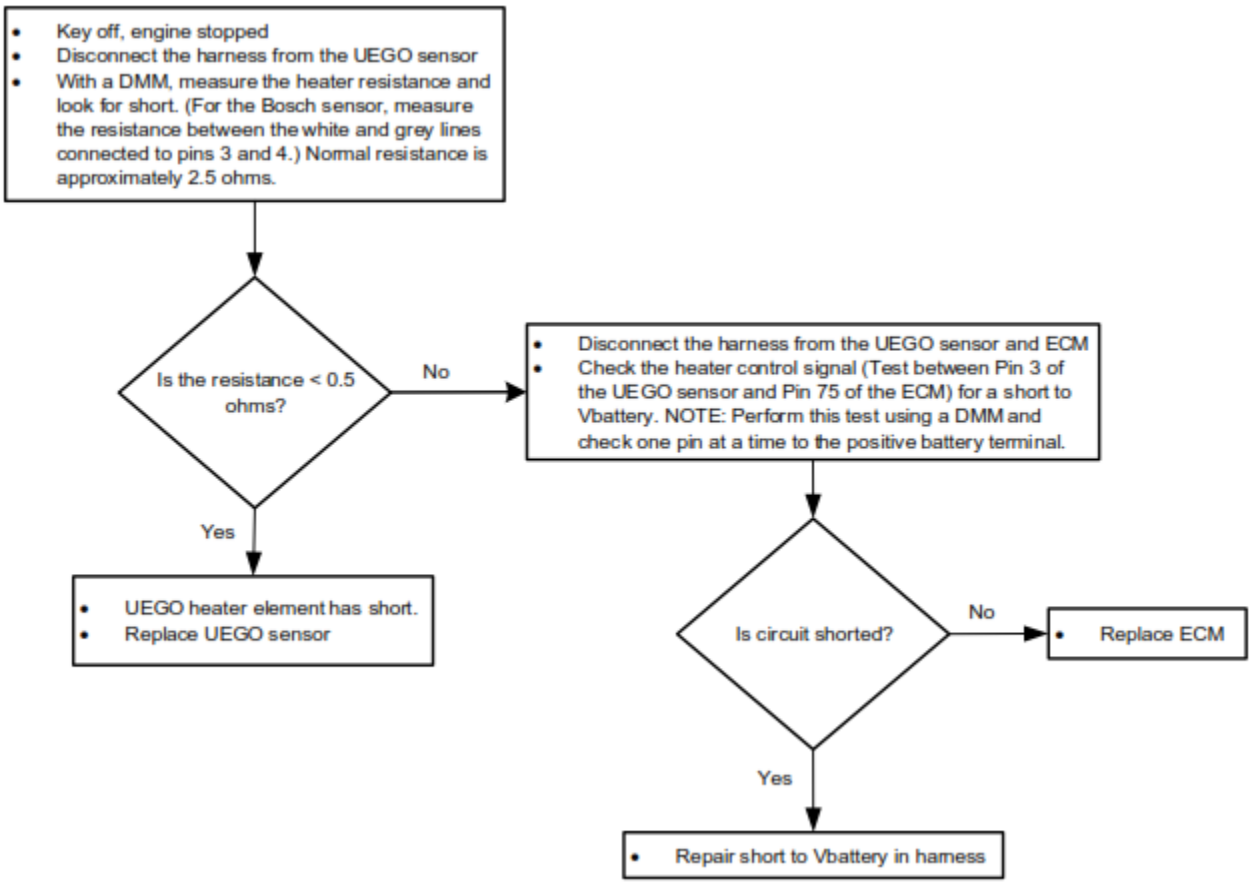
Possible Causes:

This fault will set when the UEGO heater control signal does not achieve zero volts when the heater is switched on. This may be caused by an internal fault within the ECM. This fault should be configured to disable adaptive learn for the remainder of the key-cycle to avoid improperly learning the adaptive learn table and may be configured to disable closed loop.

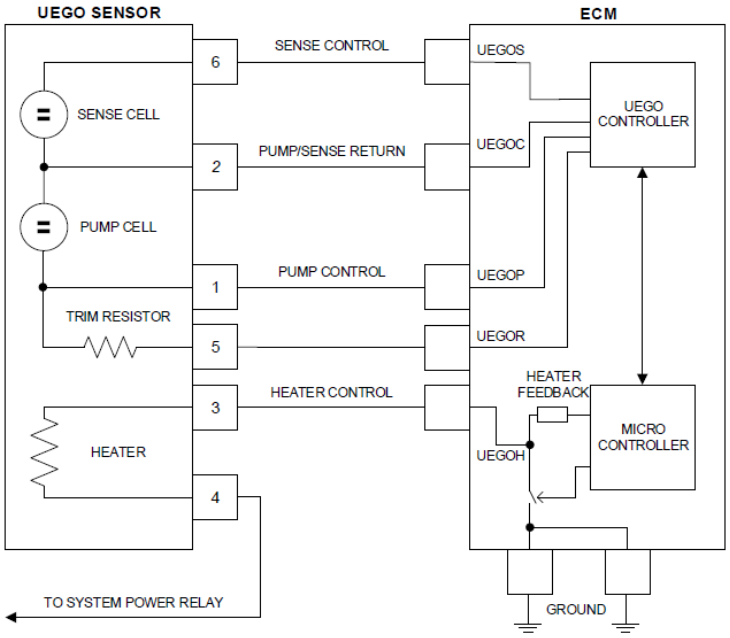
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	YES	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 3012 - UEGO HEATER SUPPLY HIGH VOLTAGE (TROUBLE TREE)



DTC 3013 - UEGO1 HEATER SUPPLY LOW VOLTAGE



DTC	**3013**	**SPN**	**3222**	**FMI**	**4**		

Sensor/Circuit: Universal Exhaust Gas Oxygen Sensor

Sensor Description:

A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio.

UEGO sensors require high temperatures (~750C) for accurate operation, as such have internal heaters

The ECM examines the sensors in order (1-4). The first pre-catalyst sensor found will be associated with Bank 1. The second pre-catalyst sensor will be associated with Bank 2 or will be used for averaging. The first post-catalyst sensor will be associated with Bank 1. The second post-catalyst sensor will be associated with Bank 2.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

	UEGO1				
• UEGO heater supply voltage <	**7.5**				volts

Fault Description:

For non-smart sensors this fault will set when the UEGO heater supply voltage sensed by the ECM is less than the threshold voltage.

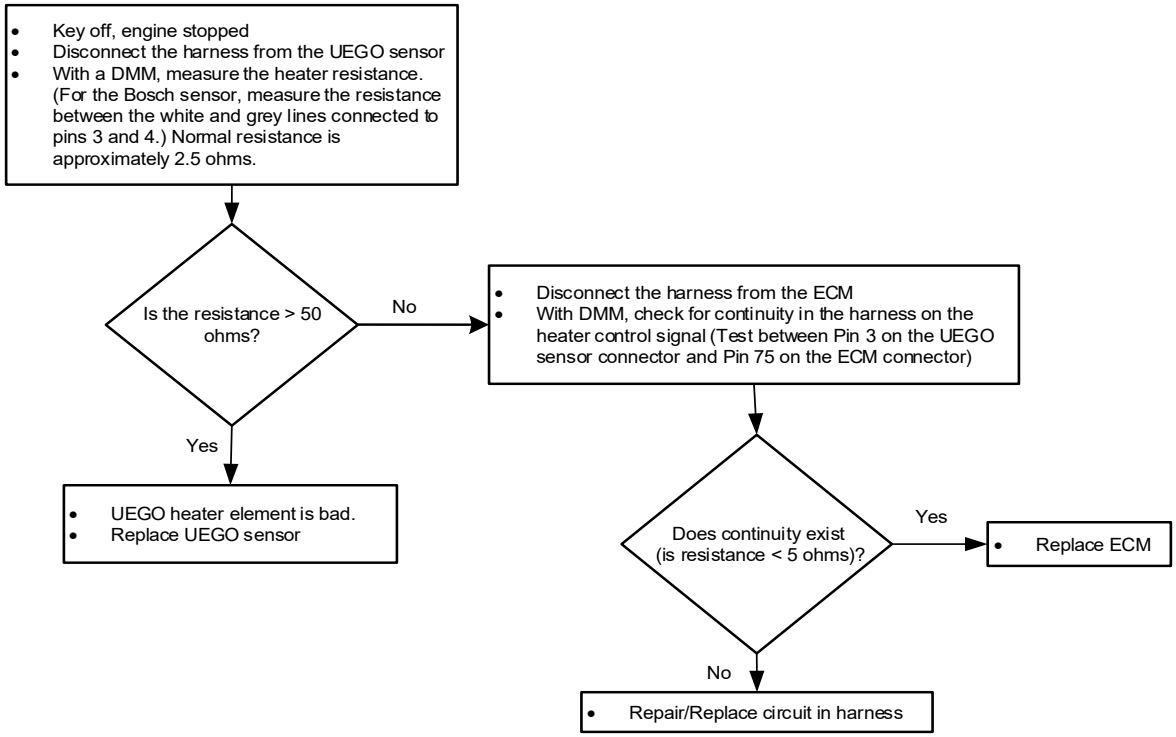
This may be caused by an internal fault within the ECM.

This fault will only set when the supply voltage is below this limit and the heater duty-cycle is at its max (i.e. if heater control is working properly and not impeded by the low supply voltage, this fault will not set).

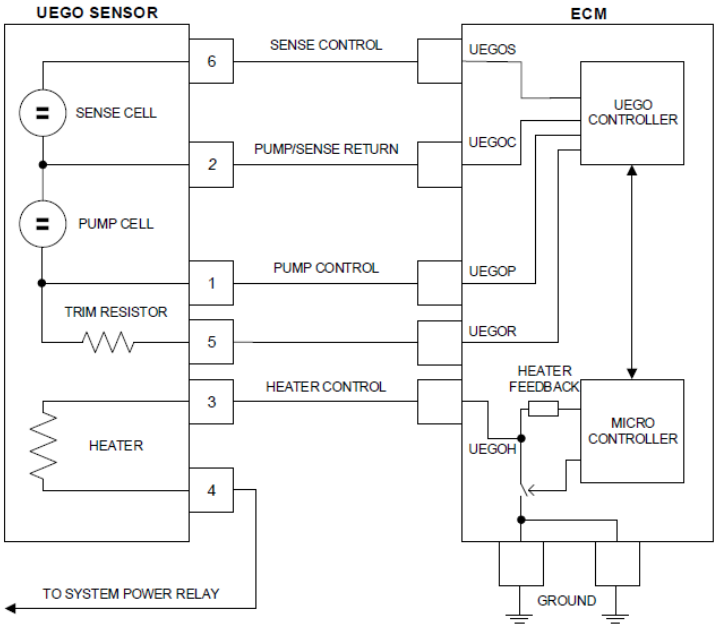
For smart sensors, the heater voltage is read by the sensor and an error communicated to the ECM if too low.

DTC 3013 - UEGO1 HEATER SUPPLY LOW VOLTAGE (TROUBLE TREE)

Trouble Tree:



DTC 3014 - UEGO1 CAL RESISTOR VOLTAGE HIGH



DTC	**3014**	**SPN**	**3221**	**FMI**	**3**		

Sensor/Circuit: Universal Exhaust Gas Oxygen Sensor

Sensor Description:

A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio.

Typically UEGO sensors will have a calibration resistor built into the connector. This provides calibration information to the ECM, allowing the ECM to interpret the signals from the sensor correctly

The ECM examines the sensors in order (1-4). The first pre-catalyst sensor found will be associated with Bank 1. The second pre-catalyst sensor will be associated with Bank 2 or will be used for averaging. The first post-catalyst sensor will be associated with Bank 1. The second post-catalyst sensor will be associated with Bank 2.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

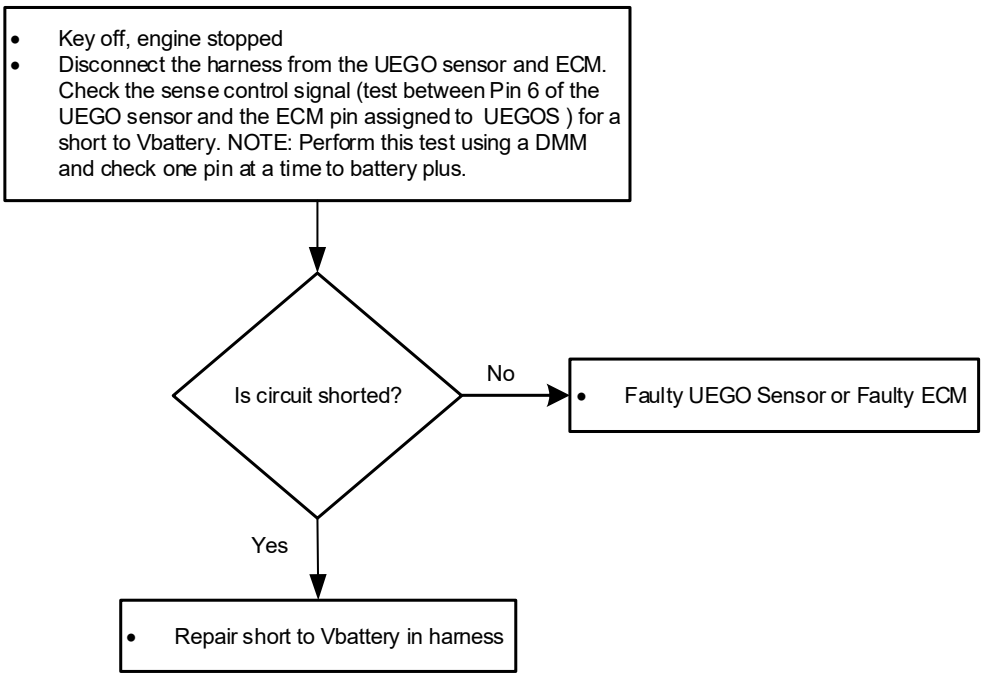
- Voltage feedback from the UEGO calibration resistor is high.

Fault Description:

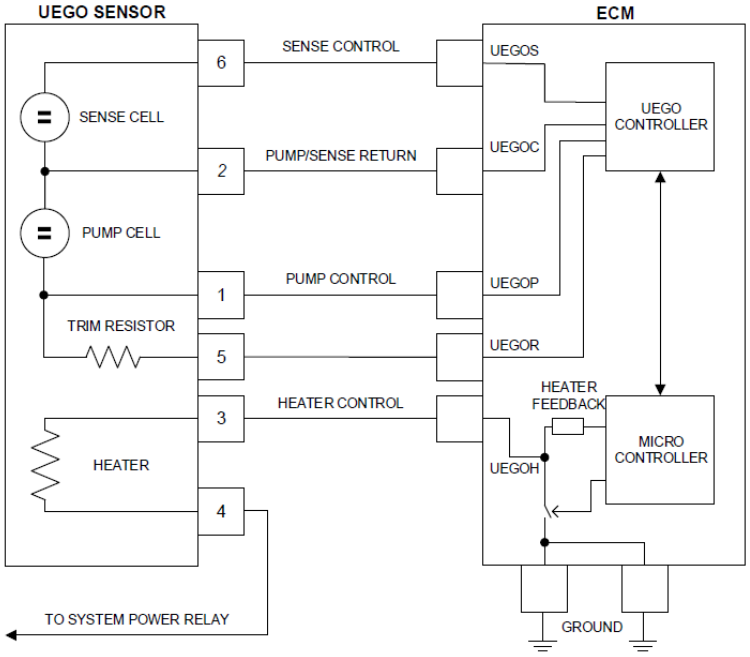
This fault will set when the UEGO calibration resistor signal does not achieve zero volts when the UEGO is switched on. This may be caused by an internal fault within the ECM.

DTC 3014 - UEGO1 CAL RESISTOR VOLTAGE HIGH (TROUBLE TREE)

Trouble Tree:



DTC 3015 - UEGO1 CAL RESISTOR VOLTAGE LOW



DTC	3015	SPN	3221	FMI	4		

Sensor/Circuit: Universal Exhaust Gas Oxygen Sensor

Sensor Description:

A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio.

Typically UEGO sensors will have a calibration resistor built into the connector. This provides calibration information to the ECM, allowing the ECM to interpret the signals from the sensor correctly

The ECM examines the sensors in order (1-4). The first pre-catalyst sensor found will be associated with Bank 1. The second pre-catalyst sensor will be associated with Bank 2 or will be used for averaging. The first post-catalyst sensor will be associated with Bank 1. The second post-catalyst sensor will be associated with Bank 2.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions (as defined in calibration):

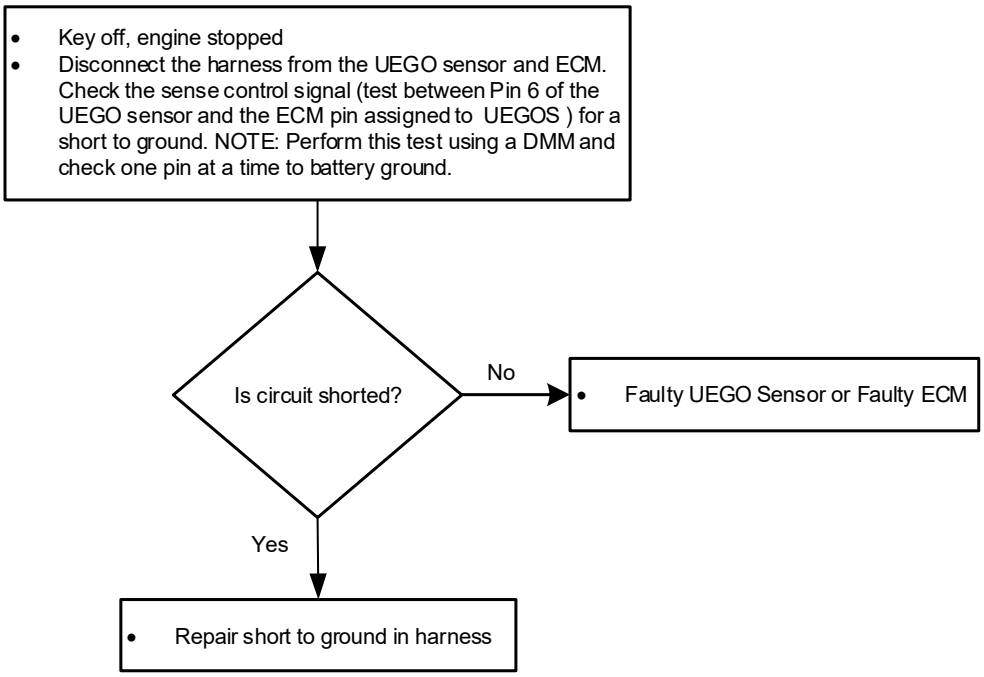
- Voltage feedback from the UEGO sensor sense control signal is low.

Fault Description:

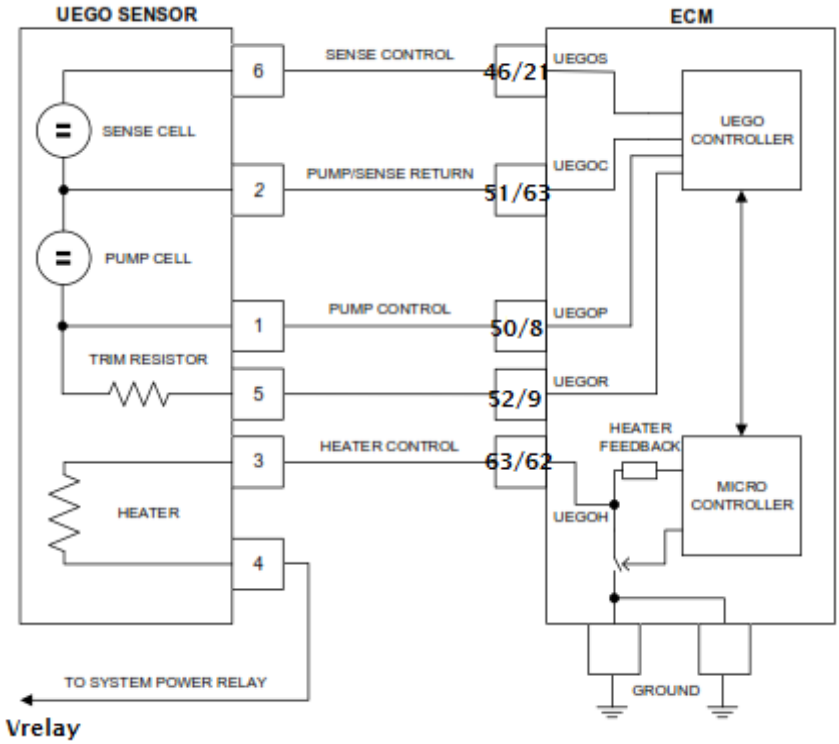
This fault will set when the UEGO calibration resistor signal does not achieve Vbattery when the UEGO is switched off. This may be caused by a break in the wire harness on the calibration resistor circuit, or fault within the ECM.

DTC 3015 - UEGO1 CAL RESISTOR VOLTAGE LOW (TROUBLE TREE)

Trouble Tree:



DTC 3020 - UEGO SENSE CELL VOLTAGE HIGH



DTC	3020	SPN	3217	FMI	3

Sensor/Circuit: Universal Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)

Description:

A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio. The sensor has a sense control signal between the sense cell and the ECM. The ECM monitors the sense control signal for a short to Vbattery. The UEGO sense circuit must always be functioning for proper emissions control.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

- Voltage feedback from the UEGO sensor sense control signal is equal to battery or supply voltage (short to Vbattery.)

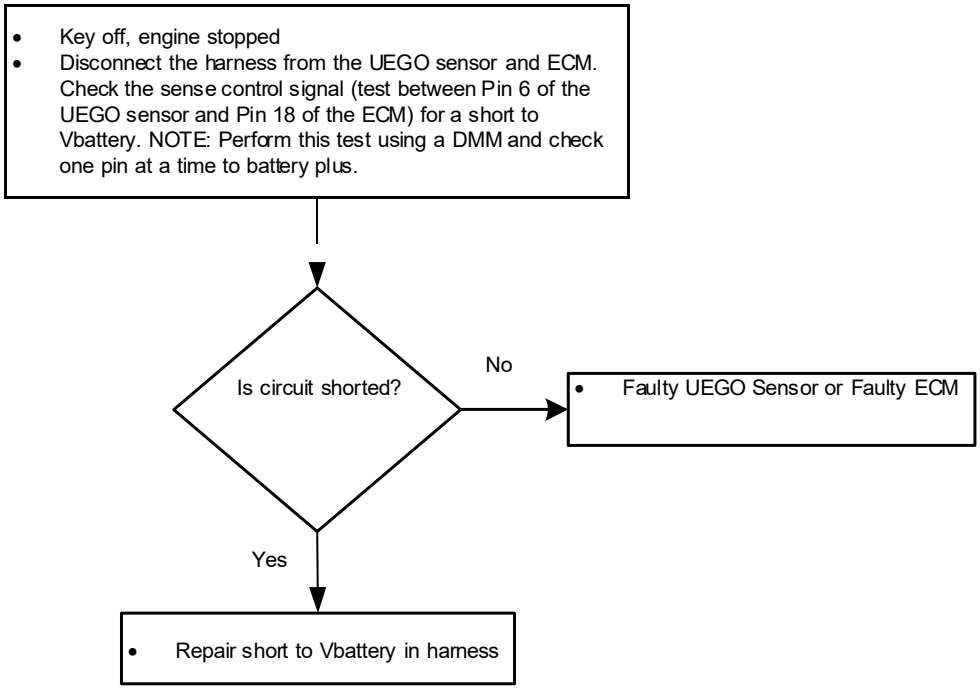
Possible Causes:

This fault will set when the UEGO sense control signal is continuously equal to battery voltage (short to Vbattery.) This may be caused by a faulty UEGO sensor or a short in the harness to Vbattery. This fault should be configured to disable adaptive learn for the remainder of the key-cycle to avoid improperly learning the adaptive learn table and may be configured to disable closed loop.

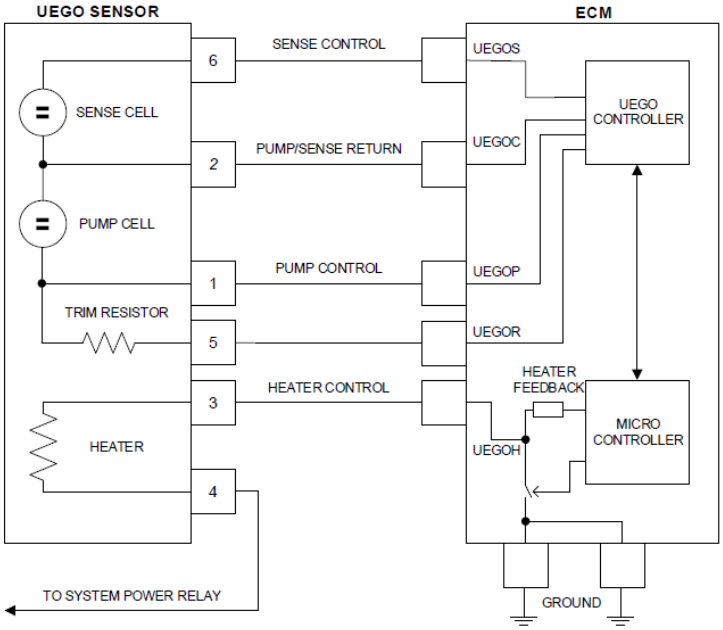
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	YES	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 3020 - UEGO SENSE CELL VOLTAGE HIGH (TROUBLE TREE)



DTC 3024 - UEGO1 SENSE CELL SLOW TO WARM UP



DTC	3024	SPN	3222	FMI	10		

Sensor/Circuit: Universal Exhaust Gas Oxygen Sensor

Sensor Description:

A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio.

UEGO sensors comprise of both a pump cell and a sense cell.

If the pump cell is at it drive limit it means it is no longer in control.

This fault is only applicable to non-smart NGK UEGO sensors.

The ECM examines the sensors in order (1-4). The first pre-catalyst sensor found will be associated with Bank 1. The second pre-catalyst sensor will be associated with Bank 2 or will be used for averaging. The first post-catalyst sensor will be associated with Bank 1. The second post-catalyst sensor will be associated with Bank 2.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

- Internal fault message communicated to ECM over CAN

Fault Description:

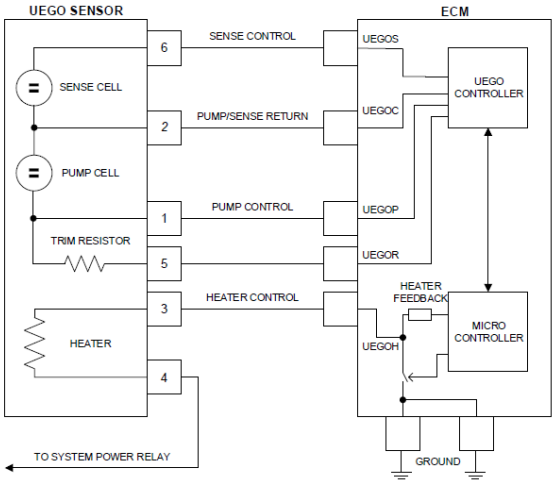
- ☐ Poor harness connections
- ☐ Faulty sensor

NOTE: The UEGO sense cell slow to warm up faults are currently only "set" when running the Closed-Loop test from the Tests page in EDIS. As such these will not complete during normal operation of the engine.

Diagnostic Aids:

- ☐ Check harness (post-control box harness, sensor side) for poor connections
- ☐ Replace sensor with known good unit and re-test

DTC 3025 - UEGO1 PUMP CELL SLOW TO WARM UP



DTC	3025	SPN	3225	FMI	10		

Sensor/Circuit: Universal Exhaust Gas Oxygen Sensor

Sensor Description:

A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio.

UEGO sensors comprise of both a pump cell and a sense cell.

If either the pump cell or the sense cell take too long to warm up it is an indication of a problem

The ECM examines the sensors in order (1-4). The first pre-catalyst sensor found will be associated with Bank 1. The second pre-catalyst sensor will be associated with Bank 2 or will be used for averaging. The first post-catalyst sensor will be associated with Bank 1. The second post-catalyst sensor will be associated with Bank 2.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

UEGO1					
• Pump cell did not warm up within the time limit, or					
• warmup period and additional	**180.0**				seconds
elapsed without achieving normal operation					

Fault Description:

For non-smart sensor this fault is set if the sensor does not warm up and achieve normal operation within the specified time limit. This may be a result of

- ☐ Poor harness connections
- ☐ Faulty sensor

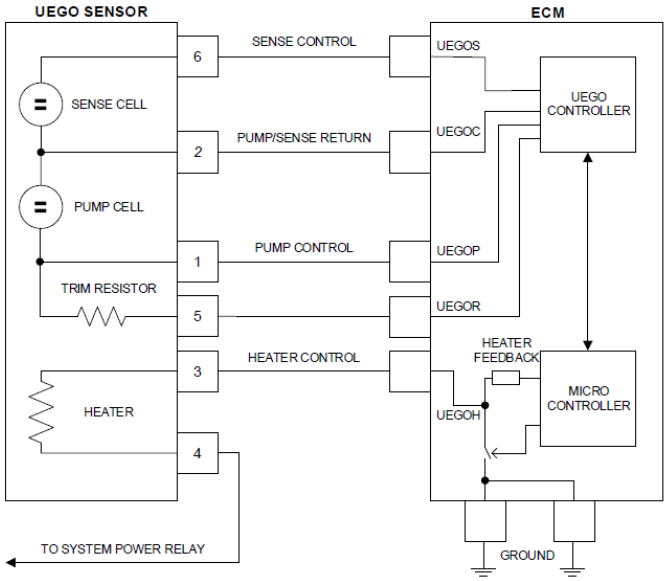
For smart CAN based UEGO sensors this fault is internally triggered and communicated to the ECM via the CAN bus.

NOTE: The **UEGO sense cell slow to warm up** faults are currently only "set" when running the Closed-Loop test from the **Tests** page in EDIS. As such these will not complete during normal operation of the engine.

Diagnostic Aids:

- ☐ Check harness for poor connections
- ☐ Replace sensor with known good unit and re-test

DTC 3026 - UEGO1 SENSE CELL IMPEDANCE HIGH



DTC	3026	SPN	3222	FMI	0		

Sensor/Circuit: Universal Exhaust Gas Oxygen Sensor

Sensor Description:

A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio. Internal to the ECM there is an application specific integrated circuit/controller that controls the sensor. The UEGO controller communicates internally within the ECM to the main microcontroller. The UEGO controller must always be functioning and communicating with the main microcontroller for proper emissions control.

The ECM examines the sensors in order (1-4). The first pre-catalyst sensor found will be associated with Bank 1. The second pre-catalyst sensor will be associated with Bank 2 or will be used for averaging. The first post-catalyst sensor will be associated with Bank 1. The second post-catalyst sensor will be associated with Bank 2.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

- UEGO sense cell impedance is high

Fault Description:

For non-smart CAN based UEGO sensors this fault is triggered when the impedance of sense cell is too high, which indicates that the sensor has not warmed up correctly.

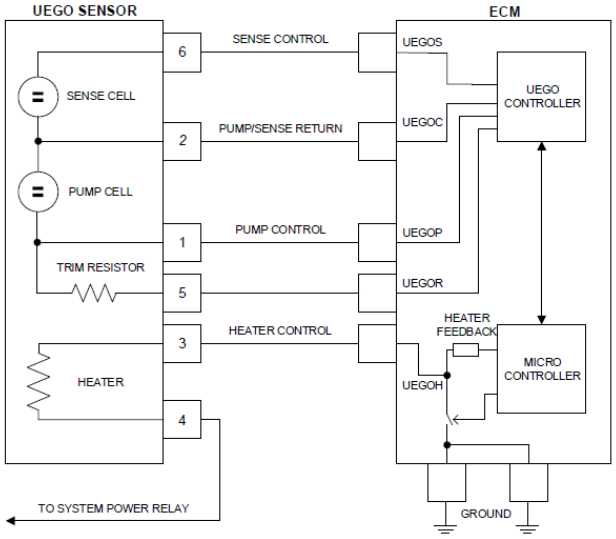
It may be a result of cracked sensor, poor harness or ECM failure.

For smart CAN based sensors, the sensor self-diagnoses a heater failure and transmits the diagnostic to the ECM.

Diagnostic Aids:

- ☐ Check harness (post-control box, sensor side) for poor connections.
- ☐ Replace sensor with known good unit and re-test.

DTC 3029 - UEGO1 DRIFT IS OUT OF TOLERANCE



5¢/	3029	SPN	0	FMI	31		

{Ŝyã2NJK/ƛNJÖdzƛűY ¦ yƛØŜNJăl·f 9ĚKl·dzăű Dl·ă hĚëƎŜy´{Ŝyã2NJ

{Ŝyã2NJ 5ŜăÖNJƛLJűƛ2yY

! ¦9Dh ăŜyã2NJ Y´Ŝl·ădzNJŜă űKŜ ŜĚKl·dzăű Ö2yűŜyű l·ÖNJ2ăă l· ØƛŘŜπNJl·yƎŜ 2ŦT l·ƛNJπŦdzŜf NJl·űƛ2ă ØƛűK l· fŧyŜl·NJ 2dzűLJdzű LJNJ2LJ2NJűƛ2yl·f ű2 fl·Y´ōŘl·κŜljdzƛØl·fŜyÖŜ NJl·űƛ2κl·ƛNJπŦdzŜf NJl·űƛ2Φ

¢KŜ ¦9Dh ăŜyã2NJ ăK2dzfŘ NJŜl·Ř l· ŦAĚŜŘ Ø1·fdzŜ ƛy´ŦNJŜăK l·ƛNJΦ ¢KŜ ¦9Dh ŘNJƛŦű Ôl·y´ōŜ ŘŜúŜNJY´ƛySŘ ōě Ô2Y´LJl·NJƛyƎ űKŜ ŦNJŜăK l·ƛNJ NJŜl·ŘƛyƎ ØƛűK űKŜ ŜĚLJŜÖűŜŘ ŦNJŜăK l·ƛNJ NJŜl·ŘƛyƎΦ

¢KŜ ŦNJŜăK l·ƛNJ NJŜl·ŘƛyƎ ƛă űl·ʅŜy´ŘdzNJƛyƎ CdzŜf {Kdzű 2ŦŦΦ ! yŜØ Y´Ŝl·ădzNJŜY´Ŝyű ƛă l·úúŜY´LJűŜŘ ŘdzNJƛyƎ ŜØŜNJè C{h ŜØŜyű l·yŘ űKŜ ădzÖÖŜăăŦdzf Y´Ŝl·ădzNJŜY´Ŝyűă l·NJŜ ŦŜŘ ƛyű2 l·y´l·ÖÖdzY´dzfl·ű2NJŁ ű2 LJNJ2ØƛŘŜ l· ăY´22űK l·ÖÖdzNJl·ûŜ NJŜl·ŘƛyƎ

¢KŜ 9/ a ŜĚl·Yƛyŝă űKŜ ăŜyã2NJă ƛy´2NJŘŜNJ óMπnú¢ ¢KŜ ŦANJăű LJNJŜπÖl·úl·fĕăű ăŜyã2NJ Ŧ2dzyŘ ØƛffōŜ l·ăă2ÖƛI·ûŜŘ ØƛűK . l·y´l м¢ ¢KŜ ăŜÖ2yŘ LJNJŜπÖl·úl·fĕăű ăŜyã2NJ ØƛffōŜ l·ăă2ÖƛI·ûŜŘ ØƛűK . l·y´l н 2NJ ØƛffōŜ dzăŜŘ Ŧ2NJ l·ØŜNJl·ƎƛyƎ¢ ¢KŜ ŦANJăű LJ2ăúπÖl·úl·fĕăű ăŜyã2NJ ØƛffōŜ l·ăă2ÖƛI·ûŜŘ ØƛűK . l·y´l м¢ ¢KŜ ăŜÖ2yŘ LJ2ăűπÖl·úl·fĕăű ăŜyã2NJ ØƛffōŜ l·ăă2ÖƛI·ûŜŘ ØƛűK . l·y´l н¢

/KŜÖʅ /2yŘƛűƛ2yY	YES	9yƎƛyŜ wdzyƴƛyƎ к {ű2LJLJŜŘ /KŜÖʅŜŘ

Cl·dzfű {Ŝű /2yŘƛűƛ2yãY

	UEGO1				
• ¦9Dh ŘNJƛŦű Ô2Y´LJŜyãl·ûƛ2y´l·ÖÖdzY´dzfl·ű2NJ ŧ	-12.0				⁰⁰ fLJ
• 2NJ ɖ	12.0				⁰⁰ fLJ

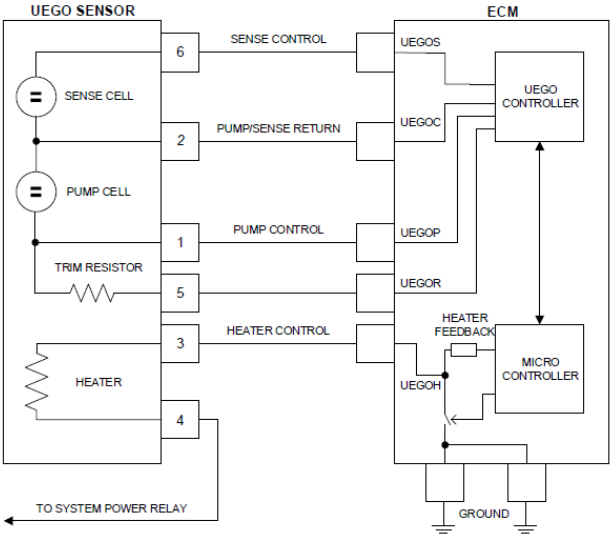
Cl·dzfű 5ŜăÖNJƛLJűƛ2yY

¢Kƛă Ŧl·dzfű ØƛffăŜű ØKŜy´ űKŜ ¦9Dh ŘNJƛŦű l·ŘʔdzăűY´Ŝyű ól·ÖÖdzY´dzfl·ű2NJú ŜĚÖŜŜŘă űKŜ Yl·ĚƛY´dzY´ LJ2ăƛűƛØŜ 2NJ yŜƎl·ûƛØŜ ûKNJŜăK2fŘă óLJdzY´LJ ÖdzNJNJŜyű LLJú ăŜű ƛy´ûKŜ ŘƛI·Ǝy2ăúƛÖ Ol·fƛōNJl·ûƛ2yΦ ¢Kƛă Ŧl·dzfű ƛă Ol·dzăŜŘ ōě l· Ŧl·dzfűě ¦9Dh ăŜyã2NJΦ

5ƛl·Ǝy2ăúƛÖ !ƛŘăY

5dzŜ ű2 ûKŜ yl·ûdzNJŜ 2Ŧ ûKƛă Ŧl·dzfűΣ l·yŘ ƎƛØŜy´ûKŜ ƛyűŜNJyl·f ŘƛI·Ǝy2ăúƛÖ ÖKŜÖʅă ûKl·ú 2ÖÖdzNJ LJNJƛ2NJ ű2 ăŜűúƛyƎ ûKƛă Ŧl·dzfűΣ ûKŜ ōŜăú ŘƛI·Ǝy2ăúƛÖ Ö2dzNJăŜ 2Ŧ l·Öúƛ2y´ƛă ű2 NJŜLJfl·ÖŜ ûKŜ ăŜyã2NJ l·yŘ ÖfŜl·NJ ûKŜ Ö2ŘŜΦ

DTC 3030 - UEGO1 DRIFT IS OUT OF TOLERANCE - **LEVEL 2**



DTC	**3030**	**SPN**	**3221**	**FMI**	**16**		

Sensor/Circuit: Universal Exhaust Gas Oxygen Sensor

Sensor Description:

A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio.

The UEGO sensor should read a fixed value in fresh air. The UEGO drift can be determined by comparing the fresh air reading with the expected fresh air reading.

The fresh air reading is taken during Fuel Shut off. A new measurement is attempted during every FSO event and the successful measurements are fed into an accumulator, to provide a smooth accurate reading

The ECM examines the sensors in order (1-4). The first pre-catalyst sensor found will be associated with Bank 1. The second pre-catalyst sensor will be associated with Bank 2 or will be used for averaging. The first post-catalyst sensor will be associated with Bank 1. The second post-catalyst sensor will be associated with Bank 2.

Check Condition:	**YES**	Engine Running / Stopped Checked

Fault Set Conditions:

	UEGO1				
• UEGO drift compensation accumulator <	**-15.0**				% lp
• or >	**15.0**				%lp

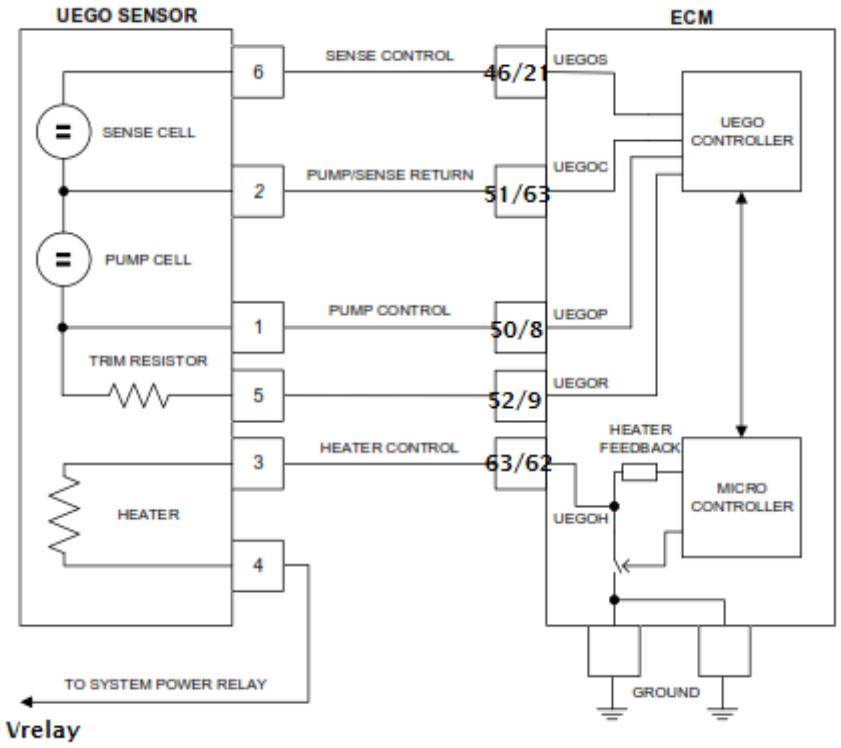
Fault Description:

This fault will set when the UEGO drift adjustment (accumulator) exceeds the maximum positive or negative thresholds (pump current Ip) set in the diagnostic calibration. This fault is caused by a faulty UEGO sensor.

Diagnostic Aids:

Due to the nature of this fault, and given the internal diagnostic checks that occur prior to setting this fault, the best diagnostic course of action is to replace the sensor and clear the code.

DTC 3031 - UEGO HEATER OPEN / GROUND SHORT



DTC	3031	SPN	3222	FMI	4

Sensor/Circuit: Universal Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)

Description:

A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio. The sensor is heated with an internal resistive element that is supplied by the battery voltage and switched on/off by the ECM. The ECM will pull the heater control signal to ground when turning on the heater. The ECM monitors the heater control signal for a short to ground. If the control signal is not equal to Vbattery when the heater is turned off then the circuit is not functioning properly. The UEGO heater circuit must always be functioning for proper emissions control.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

- Voltage feedback from the UEGO sensor heater is always equal to ground voltage.

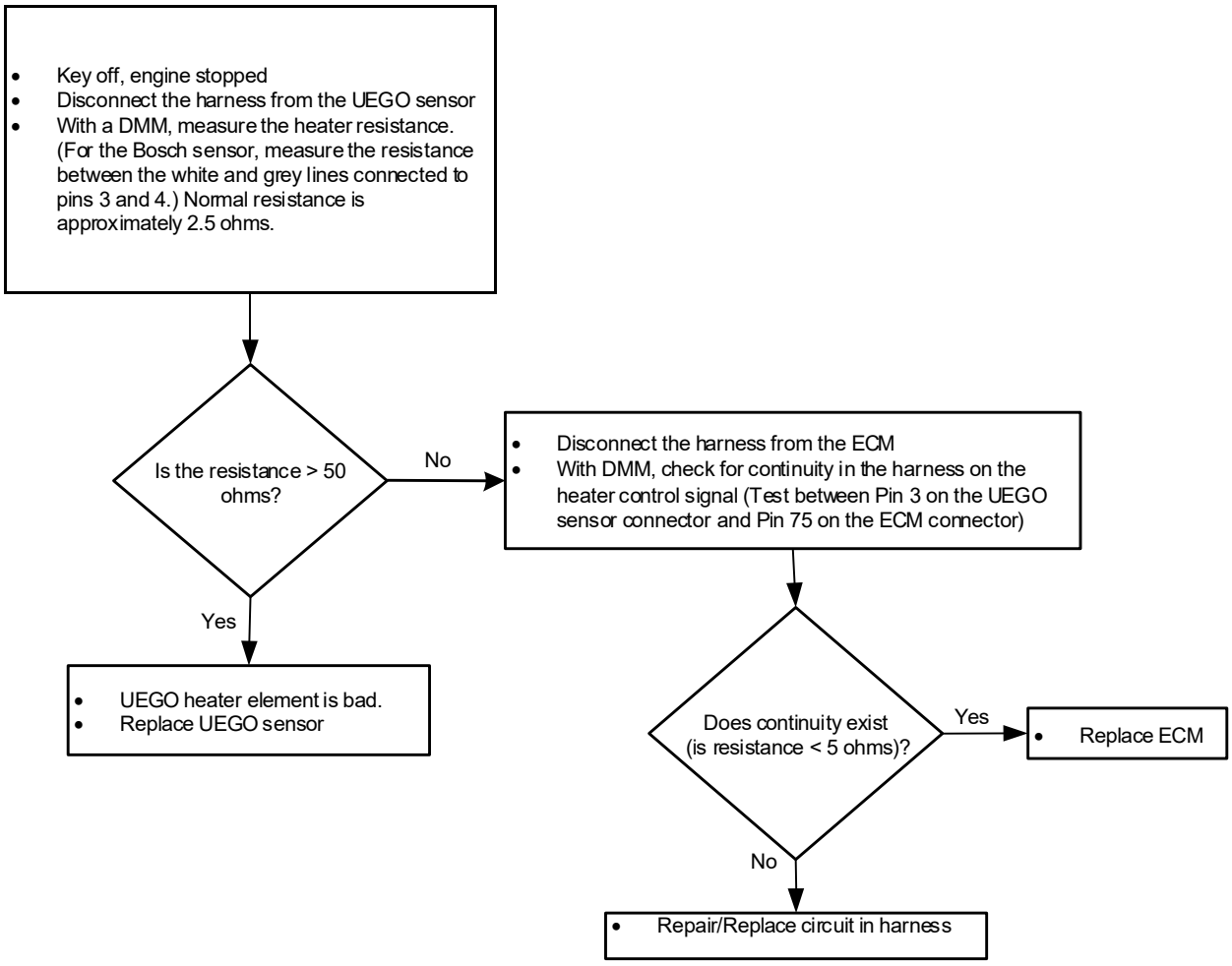
Possible Causes:

This fault will set when the UEGO heater control signal does not achieve Vbattery when the heater is switched off. This may be caused by a bad heater element in the UEGO sensor, a break in the wire harness on the heater supply or control circuits, or fault within the ECM.

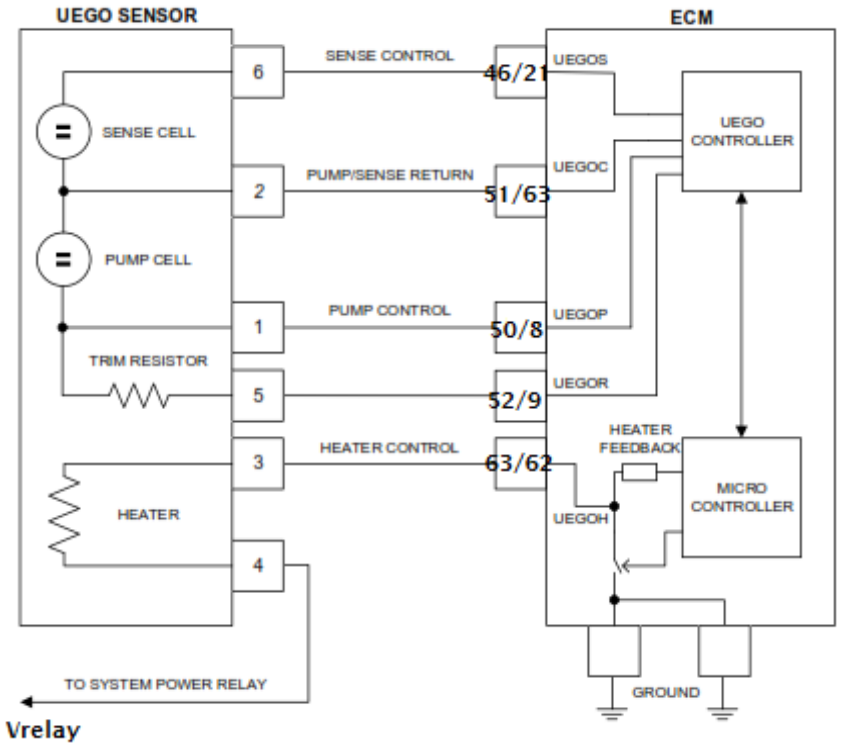
Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*

Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 3031 - UEGO HEATER OPEN / GROUND SHORT (TROUBLE TREE)



DTC 3032 - UEGO HEATER SHORT TO POWER



DTC	3032	SPN	3222	FMI	3

Sensor/Circuit: Universal Exhaust Gas Oxygen Sensor (Bank 1-Sensor 1/Bank 1-Before Catalyst)

Description:

A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio. The sensor is heated with an internal resistive element that is supplied by the battery voltage and switched on/off by the ECM. The ECM will pull the heater control signal to ground when turning on the heater. The ECM monitors the heater control signal for a short to ground. If the control signal is not equal to Vbattery when the heater is turned off then the circuit is not functioning properly. The UEGO heater circuit must always be functioning for proper emissions control.

Fault Enabled in Calibration?	**YES**
Emissions-related Fault?	**YES**
Check Condition:	Engine Running

Fault Set Conditions (as defined in calibration):

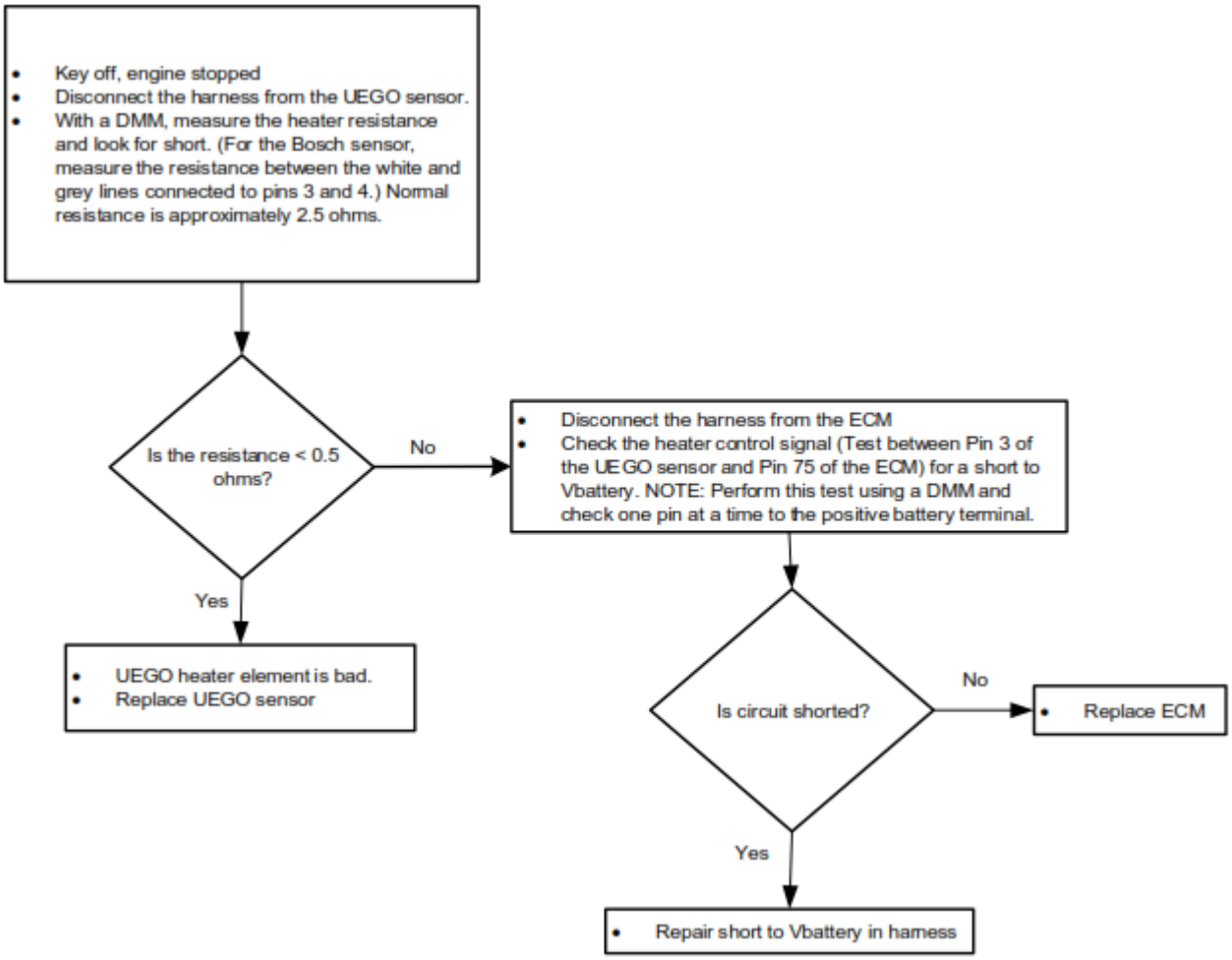
- Voltage feedback from the UEGO sensor heater is always equal to the battery or supply voltage (short to Vbattery.)

Possible Causes:

This fault will set when the UEGO heater control signal does not achieve zero volts when the heater is switched on. This may be caused by an internal fault within the ECM.

Corrective Actions *(see section 4.1 for descriptions of individual corrective actions):*							
Shutdown	TBD*	CL Disable key cyc.	TBD*	Power Derate 2	TBD*	Hard Warning	TBD*
Never Forget	TBD*	AL Disable	TBD*	Low Rev Limit	TBD*	MIL Persist Disable	TBD*
Turn on MIL	YES	AL Disable key cyc.	TBD*	Force Idle	TBD*	Stopped Check	TBD*
CL Disable	TBD*	Power Derate 1	TBD*	Soft Warning	TBD*	NOx Control System	TBD*

DTC 3032 - UEGO HEATER SHORT TO POWER (TROUBLE TREE)



4.5L ELETRICAL SCHEMATIC

BOSCH PRE-CAT UEGO SENSOR
AMP 284716-4 CONNECTOR
AMP_4-964275-1 TERMINAL (GOLD PLATED)
AMP_963530-1 WIRE SEAL

DK BLUE 18
PINK/DK GREEN 18
WHITE 18
ORANGE/WHITE 18
YELLOW/RED 18
DK GREEN 18

FIRING ORDER 1-3-4-2

MD 4G 90-WAY CONNECTOR
FCI
211 PC 90 2S 0809 CONNECTOR
211 A 90 0807 LOCKING CAM
211 A 90 0808 COVER
211 CC 2S 1458 TERMINAL (GOLD)
211 CC 2S 2458 TERMINAL (GOLD)
F18010Q PLUG

SPK_COIL1A	1	YELLOW/BLACK 18
SPK_COIL1B	2	TAN/LT BLUE 18
SPK_COIL2A	3	TAN/YELLOW 18
SPK_GND	4	BLACK 16
SPK_COIL2B	5	TAN/WHITE 18
SPK_COIL3A	6	
SPK_COIL3B	7	
UEGOP/EGO3	8	ORANGE/WHITE 18
UEGOR	9	DK GREEN 18
SPK_COIL4a	10	
SPK_COIL4b	11	
AUX ANA PD1	12	
AUX ANA PD2	13	
CAN1+	14	BLUE/PINK 18
CAN1-	15	BLUE/WHITE 18
CAN2-	16	
CAN2+	17	
AUX ANA PD3	18	
5V EXT1	19	LT GREEN/RED 18
5V RTN1	20	BLK/LT GREEN 18
UEGOS/EGO1	21	DK BLUE 18
EGO2	22	DK GREEN/WHITE 18
MAP	23	LT GREEN 18
AUX ANA PUD3	24	DK BLUE/ORANGE 18
CRANK +	25	PURPLE/WHITE 18
CRANK -	26	WHITE/PURPLE 18
CAM +	27	GRAY/BROWN 18
CAM -	28	PURPLE/ORANGE 18
SPEED +	29	
SPEED -	30	
5V EXT2	31	
5V RTN2	32	
PULSE IN	33	
GOV1	34	GRAY/DK BLUE 18
OIL PRESS	35	LT GREEN/BLACK 18
IAT	36	TAN 18
ECT	37	TAN/DK GREEN 18
AUX ANA PU1	38	LT GREEN/WHITE 18
AUX ANA PU2	39	LT BLUE/BLACK 18
AUX ANA PU3	40	LT BLUE/RED 18
AUX DIG3	41	
AUX DIG4	42	
TACH	43	
VSW	44	PINK/TAN 18
AUX ANA PUD2	45	DK BLUE/RED 18
AUX ANA PUD1	46	DK BLUE/YELLOW 18
TPS1	47	PURPLE/LT BLUE 18
TPS2	48	LT BLUE/DK BLUE 18
AUX DIG1	49	TAN/BROWN 18
AUX DIG2	50	LT BLUE 18
KNOCK1+	51	BLACK/YELLOW 18
KNOCK1-	52	BLACK 18
FPP1	53	DK BLUE/ORANGE 18
FPP2--IVS	54	
VRELAY	55	PINK/DK GREEN 16
UNUSED	56	
KNOCK2+	57	BLACK/WHITE 18
KNOCK2-	58	BLACK 18
VBAT	59	RED/TAN 16
VBAT	60	RED/TAN 16
EGOH2	61	ORANGE/BLACK 18
UEGOH/EGOH1	62	YELLOW/RED 18
UEGOG	63	WHITE 18
INJ1 LS	64	
INJ2 LS	65	
INJ3 LS	66	
INJ4 LS	67	
INJ5 LS	68	
GROUND	69	BLACK 16
INJ6 LS	70	
INJ8/AUX PWM8	71	
STARTER	72	GRAY/ORANGE 18
RELAY	73	WHITE/ LT BLUE
MIL	74	GREEN/YELLOW 18
UEGOH_3	75	
INJ7/AUX PWM7	76	
LOCKOFF	77	WHITE/BLACK 18
AUX PWM6	78	LT BLUE/WHITE 18
VBAT	79	RED/TAN 16
DBW+	80	PINK/WHITE 18
GROUND	81	BLACK 16
DBW-	82	TAN/ORANGE 18
AUX PWM5 REC	83	PINK/DK GREEN 16
AUX PWM5	84	
AUX PWM1	85	
AUX PWM4	86	
AUX PWM2	87	
AUX PWM4 REC	88	
AUX PWM3 REC	89	
AUX PWM3	90	

IGN COIL CYL #1
AMP_1488991-1 CONN
AMP_1418850-1 TERM
AMP_964972-1 SEAL
BLACK 16 — 3
PINK/DK GREEN 16 — 2
YELLOW/BLACK 18 — 1

IGN COIL CYL #2
AMP_1488991-1 CONN
AMP_1418850-1 TERM
AMP_964972-1 SEAL
BLACK 16 — 3
PINK/DK GREEN 16 — 2
TAN/WHITE 18 — 1

IGN COIL CYL #3
AMP_1488991-1 CONN
AMP_1418850-1 TERM
AMP_964972-1 SEAL
BLACK 16 — 3
PINK/DK GREEN 16 — 2
TAN/YELLOW 18 — 1

IGN COIL CYL #4
AMP_1488991-1 CONN
AMP_1418850-1 TERM
AMP_964972-1 SEAL
BLACK 16 — 3
PINK/DK GREEN 16 — 2
TAN/LT BLUE 18 — 1

TWIST WIRES 10 TURNS(360 DEG)/FOOT FULL LENGTH

CRANKSHAFT POSITION SENSOR
PURPLE/WHITE 18 — 19
WHITE/PURPLE 18 — 20
BOSCH_1 928 403 874_CONN
BOSCH_1 928 498 060 TERM
BOSCH_1 928 300 599 SEAL

TMAP SENSOR
BLACK/LT GREEN 18 — 24
LT GREEN/RED 18 — 25
LT GREEN 18 — 26
BOSCH_1-928-403-736 CONN
BOSCH_1-928-498-060 TERM
BOSCH_1-928-300-599 SEAL
BOSCH_1-928-300-601 PLUG

ECT SENSOR
TAN/DK GREEN 18 — 19
BLACK/LT GREEN 18 — 20
BOSCH_1 928 403 874_CONN
BOSCH_1 928 498 060 TERM
BOSCH_1 928 300 599 SEAL

POST-CAT HEGO SENSOR
PINK/DK GREEN 18
BLACK/LT GREEN 18
DK GREEN/WHITE 18
ORANGE/BLACK 18
PED_12168825 CONNECTOR
PED_12177158 TERM (GOLD)
PED_15324976 WIRE SEAL
PED_12176368 LOCK

SECONDARY LOCKOFF (LPG)
PED_12052641 CONNECTOR
PED_12048874 TERMINAL
PED_12052634 LOCK
PED_15324976 SEAL
LT BLUE/WHITE 18 — A — B — PINK/DK GREEN 18

~~PRIMARY~~ LOCKOFF (NATURAL GAS)
PED_12052641 CONNECTOR
PED_12048874 TERMINAL
PED_12052634 LOCK
PED_15324976 SEAL
WHITE/BLACK 18 — A — B — PINK/DK GREEN 18

ENGINE INTERFACE

CAVITY	FUNCTION
A	VSW
B	AUX ANA PUD1
C	AUX ANA PUD2
D	AUX ANA PUD3
E	GOV1
F	START
G	FUEL SELECT
H	MIL
J	UNUSED
K	ANA RTN
L	FPP1
M	5V REF
N	CAN1 +
P	CAN1 -
R	VBAT
S	GROUND

PINK/TAN 18 — F1 5A — VSW — PINK 18

DIAGNOSTIC CONNECTOR
BLACK/LT GREEN 18 — 1
2 — 3 — 4
RED/TAN 18 — 5
BLACK 18 — 6
7 — BLUE/PINK 18
8 — BLUE/WHITE 18
EPC_1F1T-14A624-AA-084 CONN
MOLEX_53003-0089 TERM (18-20)
MOLEX_53003-0081 TERM (14-16)
EPC_CB20-14A466-DA LOCK
DEUTSCH_0413-204-2005 CAV. PLUG
EPC_F5AB-14A466-AA CAP

RED 18 — F5 5A — VBAT — RED/TAN 18

PED_15326863 CONN
PED_15358785 SECONDARY LOCK
PED_12191819 TERM (SN)
PED_15366868 SEAL
PED_15365171 PLUG
BLACK 18 — GREEN/YELLOW 18
RED/TAN 18 — TAN/BROWN 18
BLUE/WHITE 18 — LT BLUE/PINK 18
BLUE/PINK 18 — GRAY/DK BLUE 18
LT GREEN/RED 18 — DK BLUE/ORANGE 18
DK BLUE/ORANGE 18 — DK BLUE/RED 18
BLACK/LT GREEN 18 — DK BLUE/YELLOW 18
UNUSED — PINK 18
ENGINE INTERFACE

ENGINE GROUND
BLACK 16
BLACK 14 — BLACK 12
10MM RING

RED/TAN 14 — F2 20A — ECM — RED 14
RED 12 — BATT + — 10MM RING

12015791 CONN
12124580 TRM FEMALE 14/16
12089188 TRM FEMALE 18/20
12018996 CONN
12089385 TRM MALE 14/16
12089848 TRM MALE 18/20
WHITE 18 — TWP — SKO — WHITE 18
CAN TERMINATION CONNECTOR

PINK/DK GREEN 16 — F4 10A — D-EPR FUSE
PINK/DK GREEN 16 — VRELAY
BLUE/PINK 18 — CAN+
WHITE 18 — CAN TERM
BLACK 16 — GROUND
BLUE/WHITE 18 — CAN-
RED/TAN 16 — VBAT
D-EPR CONNECTOR
AMP 2822346-1 CONN
AMP 174263-7 LOCK
AMP 171662-1 TERM
AMP 2822354-1 SEAL

CAMSHAFT POSITION SENSOR
LT GREEN/RED 18 — 1
GRAY/BROWN 18 — 2
PURPLE/ORANGE 18 — 3
AMP_444072-1 CONN
AMP_927778-1 TERM
AMP_828984-1 SEAL
(SPLICE MUST BE LOCATED 3"-6" FROM CONNECTOR)

BLACK/LT GREEN 18 — BLACK/LT GREEN 18
LT GREEN/WHITE 18 — LT GREEN/WHITE 18
LT GREEN/RED 18 — LT GREEN/RED 18
LT GREEN/BLACK 18 — LT GREEN/BLACK 18
OIL PRESSURE/TEMP SENSOR
BOSCH_1-928-403-736 CONN
BOSCH_1-928-498-060 TERM
BOSCH_1-928-300-599 SEAL
BOSCH_1-928-300-601 PLUG

BLACK 18
BLACK/WHITE 18
KNOCK2
BOSCH_1 928 403 126 CONN
2-927766-1 TERMINAL (AU)
828984-2 SEAL

BLACK 18
BLACK/YELLOW 18
KNOCK1
BOSCH_1 928 403 126 CONN
2-927766-1 TERMINAL (AU)
828984-2 SEAL

STARTER RELAY
RED 14 — 30 — 87A
87 — YELLOW 14
GRAY/ORANGE 18 — 86
LT BLUE/PINK 18 — 85
5MM RING — STARTER SOLENOID

POWER RELAY
RED 14 — 30 — 87A
87 — PINK/DK GREEN 14 — PINK/DK GREEN 16 — F3 20A — VRELAY — PINK/DK GREEN 16
RED 16 — 86
WHITE/LT BLUE 18 — 85

BOSCH THROTTLE
PINK/WHITE 18
LT BLUE/PINK BLUE 18
PURPLE/LT BLUE 18
TAN/ORANGE 18
BLK/LT GREEN 18
LT GREEN/RED 18
AMP_1-967616-1 CONNECTOR
AMP_965986-5 TERMINAL
AMP_967067-1 SEAL

COOLANT LEVEL SWITCH
PED_12152888 CONNECTOR
PED_12045773 TERMINAL (SN)
PED_12052634 SEC. LOCK
A — LT BLUE/RED 18
B — BLACK/LT GREEN 18

OIL LEVEL SWITCH
BOSCH_1 928 403 698_CONN
TYCO_927766-3 TERM (SN)
TYCO_2-927778-1 TERM (AU)
TYCO_828984-2 WIRE SEAL
#1 — BLACK/LT GREEN 18
#2 — LT BLUE/BLACK 18

PED_12018973 CONNECTOR
PED_12089385 TERM MALE (14/16 AWG)
PED_12089848 TERM MALE (18/20 AWG)
CAP
(MATING CONNECTOR WITH CAVITY PLUGS)
A — BLACK/LT GREEN 18
B — LT BLUE 18
NATURAL GAS LOW PRESSURE SW.
PED_12015792 CONNECTOR
PED_12124580 TERM FEMALE (14/16 AWG)
PED_12089188 TERM FEMALE (18/20 AWG)
PED_12015323 SEAL

NOTES:
1) ALL WIRE IS SAE J1128 TXL TYPE
2) ALL CAN CIRCUITS MUST BE TWISTED PAIRS
3) THE MAIN CAN BUS LENGTH SHALL NOT EXCEED 40M
4) EACH CAN CABLE STUB LENGTH SHALL NOT EXCEED 1M

ECONTROLS INC.

Title: **WEICHAI P4- BI-FUEL**
Size: D | Number | Rev
Date: | Drawn By:
Filename: | Sheet 1 of 1

6.7L ELETRICAL SCHEMATIC

FIRING ORDER 1–5–3–6–2–4

MD 4G 90–WAY CONNECTOR

FCI
211 PC 90 2S 0809 CONNECTOR
211 A 90 0807 LOCKING CAM
211 A 90 0808 COVER
211 CC 2S 1458 TERMINAL (GOLD)
211 CC 2S 2468 TERMINAL (GOLD)
F180100 PLUG

SPK_COIL1A	1	YELLOW/BLACK 18
SPK_COIL1B	2	YELLOW/RED 18
SPK_COIL2A	3	YELLOW/WHITE 18
SPK_COIL2B	4	BLACK 16
SPK_GND	5	TAN/WHITE 18
SPK_COIL3B	6	TAN/YELLOW 18
SPK_COIL3A	7	TAN/DK BLUE 18
UEGOP/EGO3	8	ORANGE/WHITE 18
UEGOR	9	DK GREEN 18
SPK_COIL4a	10	
SPK_COIL4b	11	
AUX ANA PD1	12	
AUX ANA PD2	13	
CAN1+	14	BLUE/PINK 18
CAN1–	15	BLUE/WHITE 18
CAN2–	16	
CAN 2+	17	
AUX ANA PD3	18	
5V BKT1	19	LT GREEN/RED 18
5V RTN1	20	BLK/LT GREEN 18
UEGOS/EGO1	21	DK BLUE 18
EGO2	22	DK GREEN/WHITE 18
MAP	23	LT GREEN 18
AUX ANA PUD3	24	DK BLUE/ORANGE 18
CRANK +	25	PURPLE/WHITE 18
CRANK –	26	WHITE/PURPLE 18
CAM +	27	GRAY/BROWN 18
CAM –	28	PURPLE/ORANGE 18
SPEED +	29	
SPEED –	30	
5V BKT2	31	
5V RTN2	32	
PULSE IN	33	
GOV1	34	GRAY/DK BLUE 18
OIL PRESS	35	LT GREEN/BLACK 18
IAT	36	TAN 18
ECT	37	TAN/DK GREEN 18
AUX ANA PU1	38	LT GREEN/WHITE 18
AUX ANA PU2	39	LT BLUE/BLACK 18
AUX ANA PU3	40	DK BLUE/RED 18
AUX DIG3	41	
AUX DIG4	42	
TACH	43	
VSW	44	PINK/TAN 18
AUX ANA PUD2	45	DK BLUE/RED 18
AUX ANA PUD1	46	DK BLUE/YELLOW 18
TPS1	47	PURPLE/LT BLUE 18
TPS2	48	LT BLUE/DK BLUE 18
AUX DIG1	49	TAN/BROWN 18
AUX DIG2	50	LT BLUE 18
KNOCK1+	51	BLACK/YELLOW 18
KNOCK1–	52	BLACK 15
FPP1	53	DK BLUE/ORANGE 18
FPP2–IVS	54	
VRELAY	55	PINK/DK GREEN 16
UNUSED	56	
KNOCK2+	57	BLACK/WHITE 18
KNOCK2–	58	BLACK 18
VBAT	59	RED/TAN 16
VBAT	60	RED/TAN 16
EGOH2	61	ORANGE/BLACK 18
UEGOH/EGOH1	62	YELLOW/RED 18
UEGOC	63	WHITE 18
INJ1 LS	64	
INJ2 LS	65	
INJ3 LS	66	
INJ4 LS	67	
INJ5 LS	68	
GROUND	69	BLACK 16
INJ6 LS	70	
INJB/AUX PWM8	71	
STARTER	72	GRAY/ORANGE 18
RELAY	73	WHITE/LT BLUE
MIL	74	GREEN/YELLOW 18
UEGOH_3	75	
INJ7/AUX PWM7	76	
LOCKOFF	77	WHITE/BLACK 18
AUX PWM6	78	LT BLUE/WHITE 18
VBAT	79	RED/TAN 16
DBW+	80	PINK/WHITE 18
GROUND	81	BLACK 16
DBW–	82	TAN/ORANGE 18
AUX PWM5 REC	83	PINK/DK GREEN 16
AUX PWM5	84	
AUX PWM 1	85	
AUX PWM 4	86	
AUX PWM 2	87	
AUX PWM 4 REC	88	
AUX PWM 3 REC	89	
AUX PWM 3	90	

BOSCH PRE–CAT UEGO SENSOR
AMP 284716–4 CONNECTOR
AMP_4–964275–1 TERMINAL (GOLD PLATED)
AMP_963530–1 WIRE SEAL

DK BLUE 18
PINK/DK GREEN 18
WHITE 18
ORANGE/WHITE 18
YELLOW/RED 18
DK GREEN 18

IGN COIL CYL #1
AMP_1488991–1 CONN
AMP_1418850–1 TERM
AMP_964972–1 SEAL
BLACK 16
PINK/DK GREEN 16
YELLOW/BLACK 18

IGN COIL CYL #2
AMP_1488991–1 CONN
AMP_1418850–1 TERM
AMP_964972–1 SEAL
BLACK 16
PINK/DK GREEN 16
TAN/WHITE 18

IGN COIL CYL #3
AMP_1488991–1 CONN
AMP_1418850–1 TERM
AMP_964972–1 SEAL
BLACK 16
PINK/DK GREEN 16
TAN/YELLOW 18

IGN COIL CYL #4
AMP_1488991–1 CONN
AMP_1418850–1 TERM
AMP_964972–1 SEAL
BLACK 16
PINK/DK GREEN 16
TAN/DK BLUE 18

IGN COIL CYL #5
AMP_1488991–1 CONN
AMP_1418850–1 TERM
AMP_964972–1 SEAL
BLACK 16
PINK/DK GREEN 16
YELLOW/WHITE 18

IGN COIL CYL #6
AMP_1488991–1 CONN
AMP_1418850–1 TERM
AMP_964972–1 SEAL
BLACK 16
PINK/DK GREEN 16
YELLOW/RED 18

TWIST WIRES 10 TURNS(360 DEG)/FOOT FULL LENGTH

CRANKSHAFT POSITION SENSOR
PURPLE/WHITE 18
WHITE/PURPLE 18
BOSCH_1 928 403 874_CONN
BOSCH_1 928 498 060 TERM
BOSCH_1 928 300 599 SEAL

TMAP SENSOR
BLACK/LT GREEN 18
TAN 18
LT GREEN/RED 18
LT GREEN 18
BOSCH_1–928–403–736 CONN
BOSCH_1–928–498–060 TERM
BOSCH_1–928–300–599 SEAL
BOSCH_1–928–300–601 PLUG

ECT SENSOR
TAN/DK GREEN 18
BLACK/LT GREEN 18
BOSCH_1 928 403 874_CONN
BOSCH_1 928 498 060 TERM
BOSCH_1 928 300 599 SEAL

POST–CAT HEGO SENSOR
PINK/DK GREEN 18
BLACK/LT GREEN 18
DK GREEN/WHITE 18
ORANGE/BLACK 18
PED_12160825 CONNECTOR
PED_12177158 TERM (GOLD)
PED_15324976 WIRE SEAL
PED_12176368 LOCK

SECONDARY LOCKOFF (LPG)
PED_12052641 CONNECTOR
PED_12048874 TERMINAL
PED_12052634 LOCK
PED_15324976 SEAL
LT BLUE/WHITE 18
PINK/DK GREEN 18

PRIMARY LOCKOFF (NATURAL GAS)
PED_12052641 CONNECTOR
PED_12048874 TERMINAL
PED_12052634 LOCK
PED_15324976 SEAL
WHITE/BLACK 18
PINK/DK GREEN 18

ENGINE INTERFACE

CAVITY	FUNCTION
A	VSW
B	AUX ANA PUD1
C	AUX ANA PUD2
D	AUX ANA PUD3
E	GOV1
F	START
G	FUEL SELECT
H	MIL
J	UNUSED
K	ANA RTN
L	FPP1
M	5V REF
N	CAN1 +
P	CAN1–
R	VBAT
S	GROUND

PINK/TAN 18
F1 5A VSW
PINK 18

DIAGNOSTIC CONNECTOR
BLACK/LT GREEN 18
RED/TAN 18
BLACK 18
BLUE/WHITE 18
BLUE/PINK 18
EPC_1F1T–14A624–AA–004 CONN
MOLEX_33893–0009 TERM (18–20)
MOLEX_33894–0001 TERM (14–16)
EPC_E8DB–14A466–DA LOCK
DEUTSCH_0413–204–2005 CAV. PLUG
EPC_F5AB–14A666–AA CAP

RED 18
F5 5A VBAT
RED/TAN 18

PED_15326863 CONN
PED_15358785 SECONDARY LOCK
PED_12191819 TERM (SN)
PED_15360660 SEAL
PED_15385171 PLUG

ENGINE INTERFACE
BLACK 18
RED/TAN 18
BLUE/WHITE 18
BLUE/PINK 18
LT GREEN/RED 18
DK BLUE/ORANGE 18
BLACK/LT GREEN 18
UNUSED
GREEN/YELLOW 18
TAN/BROWN 18
LT BLUE/PINK 18
GRAY/DK BLUE 18
DK BLUE/ORANGE 18
DK BLUE/RED 18
DK BLUE/YELLOW 18
PINK 18

ENGINE GROUND
BLACK 16
BLACK 14
BLACK 12
10MM RING

RED/TAN 14
F2 20A ECM
RED 14
RED 12
BATT +
10MM RING

12015791 CONN
12124580 TRM FEMALE 14/16
12089188 TRM FEMALE 18/20
12018996 CONN
12089385 TRM MALE 14/16
12089840 TRM MALE 18/20
WHITE 18
WHITE 18
CAN TERMINATION CONNECTOR

PINK/DK GREEN 16
F4 10A D–EPR FUSE

D–EPR CONNECTOR
PINK/DK GREEN 16 VRELAY
BLUE/PINK 18 CAN+
WHITE 18 CAN TERM
BLACK 16 GROUND
BLUE/WHITE 18 CAN–
RED/TAN 16 VBAT
AMP 2822346–1 CONN
AMP 174263–7 LOCK
AMP 171662–1 TERM
AMP 2822354–1 SEAL

KNOCK2
BOSCH_1 928 403 126 CONN
2–927766–1 TERMINAL (AU)
828984–2 SEAL
BLACK 18
BLACK/WHITE 18

KNOCK1
BOSCH_1 928 403 126 CONN
2–927766–1 TERMINAL (AU)
828984–2 SEAL
BLACK 18
BLACK/YELLOW 18

OIL PRESSURE/TEMP SENSOR
BLACK/LT GREEN 18
LT GREEN/WHITE 18
LT GREEN 18
LT GREEN/BLACK 18
BOSCH_1–928–403–736 CONN
BOSCH_1–928–498–060 TERM
BOSCH_1–928–300–599 SEAL
BOSCH_1–928–300–601 PLUG

CAMSHAFT POSITION SENSOR
BLACK/LT GREEN 18
LT GREEN/RED 18
GRAY/BROWN 18
PURPLE/ORANGE 18
AMP_444072–1 CONN
AMP_927778–1 TERM
AMP_828984–1 SEAL
(SPLICE MUST BE LOCATED 3"–6" FROM CONNECTOR)

STARTER RELAY
RED 14
30
87A
87
YELLOW 14
GRAY/ORANGE 18
86
LT BLUE/PINK 18
85
5MM RING
STARTER SOLENOID

POWER RELAY
RED 14
30
87A
87
PINK/DK GREEN 14
PINK/DK GREEN 16
F3 20A VRELAY
PINK/DK GREEN 16
RED 18
86
WHITE/LT BLUE 18
85

BOSCH THROTTLE
PINK/WHITE 18
LT BLUE/DK BLUE 18
PURPLE/LT BLUE 18
TAN/ORANGE 18
BLK/LT GREEN 18
LT GREEN/RED 18
AMP_1–967616–1 CONNECTOR
AMP_965986–5 TERMINAL
AMP_967067–1 SEAL

COOLANT LEVEL SWITCH
PED_12162000 CONNECTOR
PED_12045773 TERMINAL (Sn)
PED_12052634 SEC. LOCK
A DK BLUE/RED 18
B BLACK/LT GREEN 18

OIL LEVEL SWITCH
BOSCH_1 928 403 698_CONN
TYCO_927756–3 TERM (SN)
TYCO_2–927778–1 TERM (AU)
TYCO_828984–2 WIRE SEAL
#1 BLACK/LT GREEN 18
#2 LT BLUE/BLACK 18

PED_12010973 CONNECTOR
PED_12089385 TERM MALE (14/16 AWG)
PED_12089840 TERM MALE (18/20 AWG)
CAP
(MATING CONNECTOR WITH CAVITY PLUGS)

NATURAL GAS LOW PRESSURE SW.
A BLACK/LT GREEN 18
B LT BLUE 18
PED_12015792 CONNECTOR
PED_12124580 TERM FEMALE (14/16 AWG)
PED_12089188 TERM FEMALE (18/20 AWG)
PED_12015323 SEAL

NOTES:
1) ALL WIRE IS SAE J1128 TXL TYPE
2) ALL CAN CIRCUITS MUST BE TWISTED PAIRS
3) THE MAIN CAN BUS LENGTH SHALL NOT EXCEED 40M
4) EACH CAN CABLE STUB LENGTH SHALL NOT EXCEED 1M

ECONTROLS INC.

Title: **WEICHAI P6, BI–FUEL**
Size: D | Number: E2526000 | Rev: E
Date: 1/11/2016 | Drawn By: J.SUTTON
Filename: 2526000e.sch | Sheet 1 of 1

6.7L T URBO ELETRICAL SCHEMATIC

FIRING ORDER 1-5-3-6-2-4

MD 4G 90-WAY CONNECTOR

F2
211 PC 90 2S 0000 CONNECTOR
211 A 90 0000 LOCKING CAM
211 A 90 0000 COVER
211 CC 2S 1460 TERMINAL (GOLD)
211 CC 2S 2460 TERMINAL (GOLD)
F18000 PLUG

SPK_COIL1A	1	YELLOW/BLACK 18
SPK_COIL1B	2	YELLOW/RED 18
SPK_COIL2A	3	YELLOW/WHITE 18
SPK_GND	4	BLACK 16
SPK_COIL2B	5	TAN/WHITE 18
SPK_COIL3A	6	TAN/YELLOW 18
SPK_COIL3B	7	TAN/DK BLUE 16
UEGOP/EGO3	8	ORANGE/WHITE 18
UEGOR	9	DK GREEN 18
SPK_COIL4C	10	
SPK_COIL4D	11	
AUX ANA PD1	12	WHITE/LT GREEN 18
AUX ANA PD2	13	
CAN1+	14	BLUE/PINK 18
CAN1-	15	BLUE/WHITE 18
CAN2-	16	
CAN2+	17	
AUX ANA PD3	18	
5V EXT1	19	LT GREEN/RED 18
5V RTN1	20	BLK/LT GREEN 18
UEGOS/EGO1	21	DK BLUE 18
EGO2	22	DK GREEN/WHITE 18
MAP	23	LT GREEN 18
AUX ANA PU03	24	DK BLUE/ORANGE 18
CRANK +	25	PURPLE/WHITE 18
CRANK -	26	WHITE/PURPLE 18
CAM +	27	GRAY/BROWN 18
CAM -	28	PURPLE/ORANGE 18
SPEED +	29	
SPEED -	30	
5V EXT2	31	
5V RTN2	32	
PULSE IN	33	
GDV1	34	GRAY/DK BLUE 18
OIL PRESS	35	LT GREEN/BLACK 18
IAT	36	TAN 18
ECT	37	TAN/DK GREEN 18
AUX ANA PU1	38	LT GREEN/WHITE 18
AUX ANA PU2	39	LT BLUE/BLACK 18
AUX ANA PU3	40	DK BLUE/RED 18
AUX DIG3	41	
AUX DIG4	42	
TACH	43	
VSW	44	PINK/TAN 18
AUX ANA PUD2	45	DK BLUE/RED 18
AUX ANA PU01	46	DK BLUE/YELLOW 18
TPS1	47	PURPLE/LT BLUE 18
TPS2	48	LT BLUE/DK BLUE 18
AUX DIG1	49	TAN/BROWN 18
AUX DIG2	50	LT BLUE 18
KNOCK1+	51	BLACK/YELLOW 18
KNOCK1-	52	BLACK 18
FPP1	53	DK BLUE/ORANGE 18
FPP2-IVS	54	
VRELAY	55	PINK/DK GREEN 18
UNUSED	56	
KNOCK2+	57	BLACK/WHITE 18
KNOCK2-	58	BLACK 18
VBAT	59	RED/TAN 16
VBAT	60	RED/TAN 18
EGOH2	61	ORANGE/BLACK 18
UEGOH/EGOH1	62	YELLOW/RED 18
UEGOC	63	WHITE 16
INJ1 LS	64	
INJ2 LS	65	
INJ3 LS	66	
INJ4 LS	67	
INJ5 LS	68	
GROUND	69	BLACK 16
INJ6 LS	70	
INJB/AUX PWM8	71	
STARTER	72	GRAY/ORANGE 18
RELAY	73	WHITE/ LT BLUE
MIL	74	GREEN/YELLOW 18
UEGOH_3	75	
INJ7/AUX PWM7	76	
LOCKOFF	77	WHITE/BLACK 18
AUX PWM6	78	LT BLUE/WHITE 18
VBAT	79	RED/TAN 16
DBW+	80	PINK/WHITE 18
GROUND	81	BLACK 16
DBW-	82	TAN/ORANGE 18
AUX PWM5 REC	83	PINK/DK GREEN 16
AUX PWM5	84	
AUX PWM1	85	
AUX PWM4	86	
AUX PWM2	87	
AUX PWM4 REC	88	
AUX PWM3 REC	89	
AUX PWM3	90	

BOSCH PRE-CAT UEGO SENSOR
AMP 284716-4 CONNECTOR
AMP_4-964275-1 TERMINAL (GOLD PLATED)
AMP_963530-1 WIRE SEAL

DK BLUE 18
PINK/DK GREEN 18
WHITE 18
ORANGE/WHITE 18
YELLOW/RED 18
DK GREEN 18

IGN COIL CYL #1
IGN COIL CYL #2
IGN COIL CYL #3
IGN COIL CYL #4
IGN COIL CYL #5
IGN COIL CYL #6
AMP_1488991-1 CONN
AMP_1418858-1 TERM
AMP_964972-1 SEAL

BLACK 16
PINK/DK GREEN 16
YELLOW/BLACK 18
TAN/WHITE 18
TAN/YELLOW 18
TAN/DK BLUE 18
YELLOW/WHITE 18
YELLOW/RED 18

TWIST WIRES 10 TURNS(360 DEG)/FOOT FULL LENGTH

CRANKSHAFT POSITION SENSOR
PURPLE/WHITE 18
WHITE/PURPLE 18
BOSCH_1 928 403 874_CONN
BOSCH_1 928 498 060 TERM
BOSCH_1 928 300 599 SEAL

TIP SENSOR
BLACK/LT GREEN 18
UNUSED
LT GREEN/RED 18
WHITE/LT GREEN 18
BOSCH_1-928-403-736 CONN
BOSCH_1-928-498-060 TERM
BOSCH_1-928-300-599 SEAL

TMAP SENSOR
BLACK/LT GREEN 18
TAN 18
LT GREEN/RED 18
LT GREEN 18
BOSCH_1-928-403-736 CONN
BOSCH_1-928-498-060 TERM
BOSCH_1-928-300-599 SEAL
BOSCH_1-928-300-601 PLUG

ECT SENSOR
TAN/DK GREEN 18
BLACK/LT GREEN 18
BOSCH_1 928 403 874_CONN
BOSCH_1 928 498 060 TERM
BOSCH_1 928 300 599 SEAL

BLACK 16
PINK/DK GREEN 16

ENGINE GROUND
BLACK 16
BLACK 14
BLACK 12
10MM RING

POST-CAT HEGO SENSOR
BLACK/LT GREEN 18
DK GREEN/WHITE 18
ORANGE/BLACK 18
PED_12160825 CONNECTOR
PED_12177150 TERM (GOLD)
PED_15324076 WIRE SEAL
PED_12176368 LOCK

SECONDARY LOCKOFF (LPG)
PED_12052641 CONNECTOR
PED_12048074 TERMINAL
PED_12052634 LOCK
PED_15324976 SEAL
LT BLUE/WHITE 18
PINK/DK GREEN 18

PRIMARY LOCKOFF (NATURAL GAS)
PED_12052641 CONNECTOR
PED_12048074 TERMINAL
PED_12052634 LOCK
PED_15324976 SEAL
WHITE/BLACK 18
PINK/DK GREEN 18

ENGINE INTERFACE

CAVITY	FUNCTION
A	VSW
B	AUX ANA PUD1
C	AUX ANA PUD2
D	AUX ANA PUD3
E	GDV1
F	STARY
G	FUEL SELECT
H	MIL
J	UNUSED
K	ANA RTN
L	FPP1
M	5V REF
N	CAN1 +
P	CAN1 -
R	VBAT
S	GROUND

PINK/TAN 18
F1
5A
VSW
PINK 18

DIAGNOSTIC CONNECTOR
BLACK/LT GREEN 18
RED/TAN 18
BLACK 18
BLUE/WHITE 18
BLUE/PINK 18
EPC_1F1T-14A624-AA-004 CONN
MOLEX_33803-0009 TERM (18-20)
MOLEX_33804-0001 TERM (14-16)
EPC_EB08-14A468-DA LOCK
DEUTSCH_0413-204-2005 CAV. PLUG
EPC_F5AB-14A666-AA CAP

PED_15326863 CONN
PED_15358785 SECONDARY LOCK
PED_12191819 TERM (SN)
PED_15366060 SEAL
PED_15385171 PLUG

ENGINE INTERFACE
BLACK 18
RED/TAN 18
BLUE/WHITE 18
BLUE/PINK 18
LT GREEN/RED 18
DK BLUE/ORANGE 18
BLACK/LT GREEN 18
UNUSED
GREEN/YELLOW 18
TAN/BROWN 18
LT BLUE/PINK 18
GRAY/DK BLUE 18
DK BLUE/ORANGE 18
DK BLUE/RED 18
DK BLUE/YELLOW 18
PINK 18

RED 18
F5
5A
VBAT
RED/TAN 18

BATT +
RED/TAN 14
F2
20A
ECM
RED 14
RED 12
10MM RING

12015791 CONN
12124580 TRM FEMALE 14/16
12089188 TRM FEMALE 18/20
12018996 CONN
12089305 TRM MALE 14/16
12089040 TRM MALE 18/20
WHITE 18
WHITE 18
CAN TERMINATION CONNECTOR

PINK/DK GREEN 16
F4
10A
D-EPR FUSE

D-EPR CONNECTOR
PINK/DK GREEN 16
BLUE/PINK 18
WHITE 18
BLACK 16
BLUE/WHITE 18
RED/TAN 18
VRELAY
CAN H
CAN TERM
GROUND
CAN L
SHD
AMP 2822346-1 CONN
AMP 174263-7 LOCK
AMP 171662-1 TERM
AMP 2822354-1 SEAL

ENVIROTECH SENSOR
BLUE/WHITE 18
BLUE/PINK 18
BLACK/LT GREEN 18
LT GREEN/RED 18
PED_12162189 CONNECTOR
PED_12124075 TERMINAL

BLACK 18
BLACK/WHITE 18
KNOCK2
BOSCH_1 928 403 126 CONN
2-927766-1 TERMINAL (AU)
828984-2 SEAL

BLACK 18
BLACK/YELLOW 18
KNOCK1
BOSCH_1 928 403 126 CONN
2-927766-1 TERMINAL (AU)
828984-2 SEAL

OIL PRESSURE/TEMP SENSOR
BLACK/LT GREEN 18
LT GREEN/WHITE 18
LT GREEN/RED 18
LT GREEN/BLACK 18
BOSCH_1-928-403-736 CONN
BOSCH_1-928-498-060 TERM
BOSCH_1-928-300-599 SEAL
BOSCH_1-928-300-601 PLUG

CAMSHAFT POSITION SENSOR
LT GREEN/RED 18
GRAY/BROWN 18
PURPLE/ORANGE 18
BLACK/LT GREEN 18
AMP_444072-1 CONN
AMP_927778-1 TERM
AMP_828984-1 SEAL
(SPLICE MUST BE LOCATED 3"-6" FROM CONNECTOR)

STARTER RELAY
RED 14
30
87A
87
YELLOW 14
GRAY/ORANGE 18
86
LT BLUE/PINK 18
85
5MM RING
STARTER SOLENOID

POWER RELAY
RED 14
30
87A
87
PINK/DK GREEN 14
PINK/DK GREEN 16
RED 18
86
WHITE/LT BLUE 18
85
F3
20A
VRELAY
PINK/DK GREEN 16

COOLANT LEVEL SWITCH
PED_12162000 CONNECTOR
PED_12045773 TERMINAL (SN)
PED_12052634 SEC. LOCK
A DK BLUE/RED 18
B BLACK/LT GREEN 18

OIL LEVEL SWITCH
BOSCH_1 928 403 698_CONN
TYCO_927766-3 TERM (SN)
TYCO_2-927778-1 TERM (AU)
TYCO_828984-2 WIRE SEAL
B1 BLACK/LT GREEN 18
B2 LT BLUE/BLACK 18

BOSCH THROTTLE
PINK/WHITE 18
LT BLUE/DK BLUE 18
PURPLE/LT BLUE 18
TAN/ORANGE 18
BLK/LT GREEN 18
LT GREEN/RED 18
AMP_1-967616-1 CONNECTOR
AMP_965986-5 TERMINAL
AMP_967067-1 SEAL

PED_12010973 CONNECTOR
PED_12089305 TERM MALE (14/16 AWG)
PED_12089040 TERM MALE (18/20 AWG)
CAP
(MATING CONNECTOR WITH CAVITY PLUGS)

NATURAL GAS LOW PRESSURE SW.
BLAC K/GREEN 18
LT BLUE 18
PED_12015792 CONNECTOR
PED_12124580 TERM FEMALE (14/16 AWG)
PED_12089188 TERM FEMALE (18/20 AWG)
PED_12015323 SEAL

NOTES:
1) ALL WIRE IS SAE J1128 TXL TYPE
2) ALL CAN CIRCUITS MUST BE TWISTED PAIRS
3) THE MAIN CAN BUS LENGTH SHALL NOT EXCEED 40M
4) EACH CAN CABLE STUB LENGTH SHALL NOT EXCEED 1M

ECONTROLS INC.

Title: P6. BI-FUEL TURBO
Size: D
Number: E2526001
Rev: 1
Date: 6/1/2016
Drawn By: J.SUTTON
Filename: 2526001r1.sch
Sheet 1 of 1

10L ELETRICAL SCHEMATIC

FIRING ORDER 1-5-3-6-2-4

HD_4GU720_STOICH_EGR_YUCHAI
{Value}

IGN COIL CYL #1
AMP_1488991-1 CONN
AMP_1418850-1 TERM
AMP_964972-1 SEAL
BLACK 16
PINK/DK GREEN 16
YELLOW/BLACK 18

IGN COIL CYL #2
AMP_1488991-1 CONN
AMP_1418850-1 TERM
AMP_964972-1 SEAL
BLACK 16
PINK/DK GREEN 16
TAN/WHITE 18

IGN COIL CYL #3
AMP_1488991-1 CONN
AMP_1418850-1 TERM
AMP_964972-1 SEAL
BLACK 16
PINK/DK GREEN 16
TAN/YELLOW 18

IGN COIL CYL #4
AMP_1488991-1 CONN
AMP_1418850-1 TERM
AMP_964972-1 SEAL
BLACK 16
PINK/DK GREEN 16
TAN/DK BLUE 18

IGN COIL CYL #5
AMP_1488991-1 CONN
AMP_1418850-1 TERM
AMP_964972-1 SEAL
BLACK 16
PINK/DK GREEN 16
YELLOW/WHITE 18

IGN COIL CYL #6
AMP_1488991-1 CONN
AMP_1418850-1 TERM
AMP_964972-1 SEAL
BLACK 16
PINK/DK GREEN 16
YELLOW/RED 18

SPK_COIL1a 1 YELLOW/BLACK 18
SPK_COIL1b 2 YELLOW/RED 18
AUX_DIG17 3
AUX_ana_PUD1 4 DK BLUE/YELLOW 18
AUX_ana_PUD2 5 DK BLUE/RED 18
AUX_ana_PUD3/DIG23 6 DK BLUE/ORANGE 18
AUX_ana_PUD4/DIG24 7
AUX_ana_PUD5/DIG25 8
AUX_ana_PUD6 9
AUX_ana_PUD7 10
AUX_ana_PD2 11
Speed1_P 12
Speed1_N 13
CAN1+ 14 BLUE/PINK 18
CAN1- 15 BLUE/WHITE 18
CAN2- 16 TWIST WIRES 18 TURNS(360 DEG)/FOOT FULL LENGTH
CAN2+ 17
AUX_ana_PD3 18
5V_ext1 19 LT GREEN/RED 18
5V_rtn1 20 BLK/LT GREEN 18
CRK_POS 21 PURPLE/WHITE 18
CRK_NEG 22 WHITE/PURPLE 18
CAM_POS 23 GRAY/BROWN 18 TWIST WIRES 18 TURNS(360 DEG)/FOOT FULL LENGTH
CAM_NEG 24 PURPLE/ORANGE 18 TWIST WIRES 18 TURNS(360 DEG)/FOOT FULL LENGTH
KNK3+ 25
KNK3- 26
KNK1+ 27 BLACK/YELLOW 18
KNK1- 28 BLACK 18
KNK2+ 29 BLACK/WHITE 18 TWIST WIRES 18 TURNS(360 DEG)/FOOT FULL LENGTH
KNK2- 30 BLACK 18 TWIST WIRES 18 TURNS(360 DEG)/FOOT FULL LENGTH
SPK_COIL2a 31 YELLOW/WHITE 18 TWIST WIRES 18 TURNS(360 DEG)/FOOT FULL LENGTH
AUX_DIG18 32
AUX_PWM5+Recirc 33
AUX_ana_PUD10 34
PULSE_IN 35
RELAY 36 WHITE/ LT BLUE 18
IAT 37 TAN 18
ECT 38 TAN/DK GREEN 18
TPS1 39 PURPLE/LT BLUE 18
TPS2 40 LT BLUE/DK BLUE 18
MAP 41 LT GREEN 18
FPP1 42 DK BLUE/ORANGE 18
FPP2-IVS 43
OILP 44 LT GREEN/BLACK 18
Vswitch 45 PINK/TAN 18
EGO_1/UEGO_S 46 DK BLUE 18
EGO_2 47 DK GREEN/WHITE 18
DIG21 48
DIG22 49
UEGO1_P 50 ORANGE/WHITE 18
UEGO1_C 51 WHITE 18
UEGO1_R 52 DK GREEN 18
AUX_DIG13 53
Speed2 54
AUX_DIG14 55
AUX_ana_PUD8 56
AUX_ana_PUD9 57
Vbat 58 RED/TAN 16
AUX_DIG10 59
Vrelay 60 PINK/DK GREEN 16
SPK_COIL2b 61 TAN/WHITE 18
SPK_COIL3a 62 TAN/YELLOW 18
EGOH_1/UEGO_H 63 YELLOW/RED 18
EGOH_2 64 ORANGE/BLACK 18
AUX_DIG11 65
AUX_DIG12 66
BUZZ 67
MIL 68 GREEN/YELLOW 18
AUX_ana_PU1 69 LT GREEN/WHITE 18
AUX_ana_PU2 70 LT BLUE/BLACK 18
AUX_ana_PU3 71 DK BLUE/RED 18
GOV1 72 GRAY/DK BLUE 18
GOV2 73
AUX_DIG6 74
AUX_DIG7 75
5V_ext2 76
5V_rtn2 77
CAN3+ 78
CAN3- 79
AUX_DIG8 80
AUX_DIG9 81
AUX_ana_PD1 82
AUX_DIG1 83 TAN/BROWN 18
AUX_DIG2 84 LT BLUE 18
AUX_DIG3 85
AUX_DIG4 86
AUX_DIG5 87
AUX_PWM1+Recirc 88
TACH 89
Vrelay 90 PINK/DK GREEN 16
SPK_COIL3b 91 TAN/DK BLUE 18
GROUND (SPK_GND) 92 BLACK 16
AUX_PWM10 93
AUX_PWM11 94
INJ1_LS 95
INJ2_LS 96
INJ3_LS 97
INJ4_LS 98
INJ5_LS 99
INJ6_LS 100
Vrelay 101 PINK/DK GREEN 16
Vrelay 102 PINK/DK GREEN 16
Vrelay 103
AUX_DIG15 104
AUX_DIG16 105
LOCKOFF2 106 WHITE/BLACK 18
LOCKOFF 107
AUX_PWM4+Recirc/GD 108 BLACK 16
Ground 109 LT BLUE/WHITE 18
AUX_PWM6+Recirc 110 GRAY/ORANGE 18
AUX_PWM7 111
AUX_PWM8+Recirc 112
AUX_PWM9+Recirc 113
HBB+ 114
HBB- 115 BLACK 16
Ground 116 TAN/ORANGE 18
DBW- 117 PINK/WHITE 18
DBW+ 118
HBA+ 119
HBA- 120 BLACK 16
Ground

ECI_E2424188_CONNECTOR
FCI_211 CC 2C 1468_TERMINAL
FCI_210 A 81 5816_PLUG
E2424148 COVER
E2424138 LOCKING CAM
PLT25-M30 TIE STRAP

CRANKSHAFT POSITION SENSOR
BOSCH_1 928 403 874_CONN
BOSCH_1 928 498 860 TERM
BOSCH_1 928 300 599 SEAL
PURPLE/WHITE 18
WHITE/PURPLE 18

TMAP SENSOR
BOSCH_1-928-403-736 CONN
BOSCH_1-928-498-860 TERM
BOSCH_1-928-300-599 SEAL
BOSCH_1-928-300-601 PLUG
BLACK/LT GREEN 18
TAN 18
LT GREEN/RED 18
LT GREEN 18

ECT SENSOR
BOSCH_1 928 403 874_CONN
BOSCH_1 928 498 860 TERM
BOSCH_1 928 300 599 SEAL
TAN/DK GREEN 18
BLACK/LT GREEN 18

BOSCH PRE-CAT UEGO SENSOR
AMP 284716-4 CONNECTOR
AMP_4-964275-1 TERM (AU)
AMP_963530-1 SEAL
DK BLUE 18
PINK/DK GREEN 16
WHITE 18
ORANGE/WHITE 18
YELLOW/RED 18
DK GREEN 18

ENGINE GROUND
10MM RING
BLACK 16
BLACK 14
BLACK 12

POST-CAT HEGO SENSOR
PED_12160825 CONNECTOR
PED_12177150 TERM (GOLD)
PED_15324976 WIRE SEAL
PED_12176368 LOCK
BLACK/LT GREEN 18
DK GREEN/WHITE 18
ORANGE/BLACK 18
PINK/DK GREEN 18

PRIMARY LOCKOFF (NATURAL GAS)
PED_12052641 CONNECTOR
PED_12048074 TERMINAL
PED_12052634 LOCK
PED_15324976 SEAL
WHITE/BLACK 18
PINK/DK GREEN 18

SEC. LOCKOFF CAP
PED_12162000 CONNECTOR
PED_12059168 PLUG
PED_12052634 LOCK

SECONDARY LOCKOFF (LPG)
PED_12052641 CONNECTOR
PED_12048074 TERMINAL
PED_12052634 LOCK
PED_15324976 SEAL
LT BLUE/WHITE 18
PINK/DK GREEN 18

DIAGNOSTIC CONNECTOR
BLACK/LT GREEN 18
RED/TAN 18
BLACK 18
BLUE/WHITE 18
BLUE/PINK 18
EPC_1F1T-14A624-AA-004 CONN
MOLEX_13093-0009 TERM (18-20)
EPC_C608-14A468-DA LOCK
DEUTSCH_0413-204-2005 CAV. PLUG
EPC_F5AB-14A656-AA CAP
TRW_6476883801 XMAS TREE CLIP

PED_15326863 CONN
PED_15358785 SECONDARY LOCK
PED_12191819 TERM (SN)
PED_15366060 SEAL
PED_15385171 PLUG
BLACK 18
RED/TAN 18
BLUE/WHITE 18
BLUE/PINK 18
LT GREEN/RED 18
DK BLUE/ORANGE 18
BLACK/LT GREEN 18
UNUSED
GREEN/YELLOW 18
TAN/BROWN 18
LT BLUE/PINK 18
GRAY/DK BLUE 18
DK BLUE/ORANGE 18
DK BLUE/RED 18
DK BLUE/YELLOW 18
PINK 18
ENGINE INTERFACE

PED_12015791 CONNECTOR
PED_12089188 TERMINAL
PED_15324982 SEAL
PED_12010996 CONNECTOR
PED_12089040 TERMINAL
PED_15324982 SEAL
WHITE 18
WHITE 18
CAN TERMINATION CONNECTOR

D-EPR CONNECTOR
AMP 2822346-1 CONN
AMP 174263-7 LOCK
AMP 171662-1 TERM
AMP 2822354-1 SEAL
PINK/DK GREEN 16 VRELAY
BLUE/PINK 18 CAN+
WHITE 18 CAN TERM
BLACK 16 GROUND
BLUE/WHITE 18 CAN-
RED/TAN 16 VBAT

BLACK/YELLOW 18
BLACK 18
BLACK/WHITE 18
BLACK 18
KNOCK2
BOSCH_1-928-403-126 CONN
2-927766-1 TERMINAL (AU)
828904-2 SEAL
KNOCK1
BOSCH_1-928-403-126 CONN
2-927766-1 TERMINAL (AU)
828904-2 SEAL

BATT +
10MM RING
RED 12
M6 RING
YELLOW 14
STARTER SOLENOID

E-5211 FUSEBLOCK
E-6131 TOP COVER
E-6132 BOTTOM COVER
E-1583 SPACER (ISO RELAY)
E-1865 SPACER (MINI FUSES)
E-8386 SPACER (2 - ISO RELAYS)
YELLOW 14
LT BLUE/PINK 18
RED 14
GRAY/ORANGE 18
RED 18
RED/TAN 18
PINK/DK GREEN 16
PINK/DK GREEN 16
RED/TAN 14
RED 14
PINK/TAN 18
PINK 18
RED 14
WHITE/LT BLUE 18
PINK/DK GREEN 14
RED 18
PINK/DK GREEN 16
PINK/DK GREEN 16
SWITCH
PWR
R1
R2
R3

F 1 = VSW 5A (ATM-5)
F 2 = ECM 20A (ATM-20)
F 3 = VRELAY 20A (ATM-20)
F 4 = DEPR 10A (ATM-10)
F 5 = VBAT 5A (ATM_5)
F 6 = EMPTY

R1 = STARTER RELAY
896H-1CH-C-R1-24VDC
R2 = POWER RELAY
896H-1CH-C-R1-24VDC
R3 = EMPTY
(OR EQUIVALENT RELAYS)

(SPLICE MUST BE LOCATED 3"-6" FROM CONNECTOR)
PURPLE/ORANGE 18
GRAY/BROWN 18
LT GREEN/RED 18
CAMSHAFT POSITION SENSOR
AMP_444072-1 CONN
AMP_927770-1 TERM
AMP_828904-1 SEAL

COOLANT LEVEL SWITCH
PED_12162000 CONNECTOR
PED_12045773 TERMINAL
PED_15324976 SEAL
PED_12052634 LOCK
BLACK/LT GREEN 18
DK BLUE/RED 18

OIL LEVEL SWITCH
BOSCH_1-928-403-698 CONN
TYCO_927766-3 TERM (SN)
TYCO_2-927770-1 TERM (AU)
TYCO_828904-2 WIRE SEAL
BLACK/LT GREEN 18
LT BLUE/BLACK 18
(ADD CAP P478 TO OIL LEVEL SWITCH)

OIL PRESSURE/TEMP SENSOR
BOSCH_1-928-403-736 CONN
BOSCH_1-928-498-060 TERM
BOSCH_1-928-300-599 SEAL
BOSCH_1-928-300-601 PLUG
BLACK/LT GREEN 18
LT GREEN/WHITE 18
LT GREEN/RED 18
LT GREEN/BLACK 18

BOSCH THROTTLE
AMP 284716-4 CONNECTOR
AMP_4-964275-1 TERM (AU)
AMP_963530-1 SEAL
BLK/LT GREEN 18
LT BLUE/DK BLUE 18
LT GREEN/RED 18
PURPLE/LT BLUE 18
PINK/WHITE 18
TAN/ORANGE 18

NATURAL GAS LP SW CAP
PED 12010973 CONN
PED 12010300 PLUG
NATURAL GAS LOW PRESSURE SW.
PED 12015792 CONN
PED 12089188 TERMINAL
PED 15324985 SEAL
BLACK/LT GREEN 18
LT BLUE 18
(MATING CONNECTOR WITH CAVITY PLUGS)

ENGINE INTERFACE

CAVITY	FUNCTION
A	VSW
B	AUX ANA PUD1
C	AUX ANA PUD2
D	AUX ANA PUD3
E	GOV1
F	START
G	FUEL SELECT
H	MIL
J	UNUSED
K	ANA RTN
L	FPP1
M	5V REF
N	CAN1 +
P	CAN1 -
R	VBAT
S	GROUND

NOTES:

1) ALL WIRE IS SAE J1128 TXL TYPE
2) ALL CAN CIRCUITS MUST BE TWISTED PAIRS
3) THE MAIN CAN BUS LENGTH SHALL NOT EXCEED 40M
4) EACH CAN CABLE STUB LENGTH SHALL NOT EXCEED 1M
5) ALL CONVOLUTE TO BE FLAME RETARDANT POLYPROPYLENE

Title
WEICHAI P10, BI-FUEL (NA)

Size	Number	Rev
D	E2526101	A

Date: 3/08/2017 Drawn By: M.JARDON

Filename: 2526101a.sch Sheet 1 of 1

10L TURBO ELETRICAL SCHEMATIC

FIRING ORDER 1-5-3-6-2-4

HD_4GU720_ STOICH_ EGR_ YUCHAI
{Value}

SPK_ COIL1a	1	YELLOW/BLACK 18	
SPK_ COIL1b	2	YELLOW/RED 18	
AUX_ DIG17	3	DK BLUE/YELLOW 18	
AUX_ ana_ PUD1	4	DK BLUE/RED 18	
AUX_ ana_ PUD2	5	DK BLUE/ORANGE 18	
AUX_ ana_ PUD3/DIG23	6		
AUX_ ana_ PUD4/DIG24	7		
AUX_ ana_ PUD5/DIG25	8		
AUX_ ana_ PUD6	9		
AUX_ ana_ PUD7	10		
AUX_ ana_ PUD	11		
Speed1_ F	12		
Speed1_ N	13		
CAN1+	14	BLUE/PINK 18	
CAN1-	15	BLUE/WHITE 18	TWIST WIRES 10 TURNS(360 DEG)/FOOT FULL LENGTH
CAN2-	16		
CAN2+	17		
AUX_ ana_ PUD	18		
5V_ ext1	19	LT GREEN/RED 18	
5V_ rtn1	20	BLK/LT GREEN 18	
CRK_ POS	21	PURPLE/WHITE 18	
CRK_ NEG	22	WHITE/PURPLE 18	
CAM_ POS	23	GRAY/BROWN 18	TWIST WIRES 10 TURNS(360 DEG)/FOOT FULL LENGTH
CAM_ NEG	24	PURPLE/ORANGE 18	
KNK3+	25		TWIST WIRES 10 TURNS(360 DEG)/FOOT FULL LENGTH
KNK3-	26		
KNK1+	27	BLACK/YELLOW 18	
KNK1-	28	BLACK 18	
KNK2+	29	BLACK/WHITE 18	TWIST WIRES 10 TURNS(360 DEG)/FOOT FULL LENGTH
KNK2-	30	BLACK 18	
SPK_ COIL2a	31	YELLOW/WHITE 18	TWIST WIRES 10 TURNS(360 DEG)/FOOT FULL LENGTH
AUX_ DIG18	32		
AUX_ PWM5+Recirc	33		
AUX_ ana_ PUD10	34		
PULSE_ IN	35		
RELAY	36	WHITE/ LT BLUE 18	
IAT	37	TAN 18	
ECT	38	TAN/DK GREEN 18	
TPS1	39	PURPLE/LT BLUE 18	
TPS2	40	LT BLUE/DK BLUE 18	
MAP	41	LT GREEN 18	
FPP1	42	DK BLUE/ORANGE 18	
FPP2-IVS	43		
OILP	44	LT GREEN/BLACK 18	
Vswitch	45	PINK/TAN 18	
EGO_ 1/UEGO_ S	46	DK BLUE 18	
EGO_ 2	47	DK GREEN/WHITE 18	
DIG21	48		
DIG22	49		
UEGO1_ P	50	ORANGE/WHITE 18	
UEGO1_ C	51	WHITE 18	
UEGO1_ R	52	DK GREEN 18	
AUX_ DIG13	53		
Speed2	54		
AUX_ DIG14	55		
AUX_ ana_ PUD8	56		
AUX_ ana_ PUD9	57		
Vbat	58	RED/TAN 16	
AUX_ DIG10	59		
Vrelay	60	PINK/DK GREEN 16	
SPK_ COIL3a	61	TAN/WHITE 18	
SPK_ COIL3a	62	TAN/YELLOW 18	
EGOH_ 1/UEGO_ H	63	YELLOW/RED 18	
EGOH_ 2	64	ORANGE/BLACK 18	
AUX_ DIG11	65		
AUX_ DIG12	66		
BUZZ	67		
MIL	68	GREEN/YELLOW 18	
AUX_ ana_ PU1	69	LT GREEN/WHITE 18	
AUX_ ana_ PU2	70	LT BLUE/BLACK 18	
AUX_ ana_ PU3	71	DK BLUE/RED 18	
GOV1	72	GRAY/DK BLUE 18	
GOV2	73		
AUX_ DIG6	74		
AUX_ DIG7	75		
5V_ ext2	76		
5V_ rtn2	77		
CAN3+	78		
CAN3-	79		
AUX_ DIG8	80		
AUX_ DIG9	81		
AUX_ ana_ PD1	82	WHITE/LT GREEN 18	
AUX_ DIG1	83	TAN/BROWN 18	
AUX_ DIG2	84	LT BLUE 18	
AUX_ DIG3	85		
AUX_ DIG4	86		
AUX_ DIG5	87		
AUX_ PWM1+Recirc	88		
TACH	89		
Vrelay	90	PINK/DK GREEN 16	
SPK_ COIL3b	91	TAN/DK BLUE 18	
GROUND (SPK_ GND)	92	BLACK 16	
AUX_ PWM10	93		
AUX_ PWM11	94		
INJ1_ LS	95		
INJ2_ LS	96		
INJ3_ LS	97		
INJ4_ LS	98		
INJ5_ LS	99		
INJ6_ LS	100		
Vrelay	101	PINK/DK GREEN 16	
Vrelay	102	PINK/DK GREEN 16	
Vrelay	103		
AUX_ DIG15	104		
AUX_ DIG16	105		
LOCKOFF2	106	WHITE/BLACK 18	
LOCKOFF	107		
AUX_ PWM4+Recirc/GD	108	BLACK 16	
Ground	109	LT BLUE/WHITE 18	
AUX_ PWM6+Recirc	110	GRAY/ORANGE 18	
AUX_ PWM7	111		
AUX_ PWM8+Recirc	112		
AUX_ PWM9+Recirc	113		
HBB+	114		
HBB-	115	BLACK 16	
Ground	116	TAN/ORANGE 18	
DBW-	117	PINK/WHITE 18	
DBW+	118		
HBA+	119		
HBA-	120	BLACK 16	

ECI_ E24241BB_ CONNECTOR
FCI_ 211 CC 2C 1468_ TERMINAL
FCI_ 210 A 81 5815_ PLUG
E24241A8 COVER
E24241B LOCKING CAM
FLT25-M30 TIE STRAP

IGN COIL CYL #1
AMP_ 1488991-1 CONN
AMP_ 1418850-1 TERM
AMP_ 964972-1 SEAL
BLACK 16
PINK/DK GREEN 16
YELLOW/BLACK 18

IGN COIL CYL #2
AMP_ 1488991-1 CONN
AMP_ 1418850-1 TERM
AMP_ 964972-1 SEAL
BLACK 16
PINK/DK GREEN 16
TAN/WHITE 18

IGN COIL CYL #3
AMP_ 1488991-1 CONN
AMP_ 1418850-1 TERM
AMP_ 964972-1 SEAL
BLACK 16
PINK/DK GREEN 16
TAN/YELLOW 18

IGN COIL CYL #4
AMP_ 1488991-1 CONN
AMP_ 1418850-1 TERM
AMP_ 964972-1 SEAL
BLACK 16
PINK/DK GREEN 16
TAN/DK BLUE 18

IGN COIL CYL #5
AMP_ 1488991-1 CONN
AMP_ 1418850-1 TERM
AMP_ 964972-1 SEAL
BLACK 16
PINK/DK GREEN 16
YELLOW/WHITE 18

IGN COIL CYL #6
AMP_ 1488991-1 CONN
AMP_ 1418850-1 TERM
AMP_ 964972-1 SEAL
BLACK 16
PINK/DK GREEN 16
YELLOW/RED 18

CRANKSHAFT POSITION SENSOR
PURPLE/WHITE 18
WHITE/PURPLE 18
BOSCH_ 1 928 403 874_ CONN
BOSCH_ 1 928 498 060 TERM
BOSCH_ 1 928 300 599 SEAL

TIP SENSOR
BLACK/LT GREEN 18
UNUSED
LT GREEN/RED 18
WHITE/LT GREEN 18
BOSCH_ 1-928-403-736 CONN
BOSCH_ 1-928-498-060 TERM
BOSCH_ 1-928-300-599 SEAL

TMAP SENSOR
BLACK/LT GREEN 18
TAN 18
LT GREEN/RED 18
LT GREEN 18
BOSCH_ 1-928-403-736 CONN
BOSCH_ 1-928-498-060 TERM
BOSCH_ 1-928-300-599 SEAL
BOSCH_ 1-928-300-601 PLUG

ECT SENSOR
TAN/DK GREEN 18
BLACK/LT GREEN 18
BOSCH_ 1 928 403 874_ CONN
BOSCH_ 1 928 498 060 TERM
BOSCH_ 1 928 300 599 SEAL

BOSCH PRE-CAT UEGO SENSOR
DK BLUE 18
PINK/DK GREEN 16
WHITE 18
ORANGE/WHITE 18
YELLOW/RED 18
DK GREEN 18
AMP 284716-4 CONNECTOR
AMP_ 4-964275-1 TERM (AU)
AMP_ 963530-1 SEAL

ENGINE GROUND
BLACK 16
BLACK 14
BLACK 12
10MM RING

POST-CAT HEGO SENSOR
PED_ 12160825 CONNECTOR
PED_ 12177150 TERM (GOLD)
PED_ 15324976 WIRE SEAL
PED_ 12176368 LOCK
BLACK/LT GREEN 18
DK GREEN/WHITE 18
ORANGE/BLACK 18
PINK/DK GREEN 16

PRIMARY LOCKOFF (NATURAL GAS)
PED_ 12052641 CONNECTOR
PED_ 12048074 TERMINAL
PED_ 12052634 LOCK
PED_ 15324976 SEAL
WHITE/BLACK 18
PINK/DK GREEN 18

SEC. LOCKOFF CAP
PED_ 12162000 CONNECTOR
PED_ 12059168 PLUG
PED_ 12052634 LOCK

SECONDARY LOCKOFF (LPG)
PED_ 12052641 CONNECTOR
PED_ 12048074 TERMINAL
PED_ 12052634 LOCK
PED_ 15324976 SEAL
LT BLUE/WHITE 18
PINK/DK GREEN 18

PED_ 15326863 CONN
PED_ 15358785 SECONDARY LOCK
PED_ 12191819 TERM (SN)
PED_ 15366060 SEAL
PED_ 15385171 PLUG

DIAGNOSTIC CONNECTOR
BLACK/LT GREEN 18
RED/TAN 18
BLACK 18
BLUE/WHITE 18
BLUE/PINK 18
EPC_ 1F1T-14A624-AA-804 CONN
MOLEX_ 13093-8009 TERM (18-20)
EPC_ C808-14A468-DA LOCK
DEUTSCH_ 0413-204-2005 CAV. PLUG
EPC_ F5AB-14E656-AA CAP
TRW_ 6476883801 XMAS TREE CLIP

ENGINE INTERFACE
BLACK 18
RED/TAN 18
BLUE/WHITE 18
BLUE/PINK 18
LT GREEN/RED 18
DK BLUE/ORANGE 18
BLACK/LT GREEN 18
UNUSED
GREEN/YELLOW 18
TAN/BROWN 18
LT BLUE/PINK 18
GRAY/DK BLUE 18
DK BLUE/ORANGE 18
DK BLUE/RED 18
DK BLUE/YELLOW 18
PINK 18

ENGINE INTERFACE	
CAVITY	FUNCTION
A	VSW
B	AUX ANA PUD1
C	AUX ANA PUD2
D	AUX ANA PUD3
E	GOV1
F	START
G	FUEL SELECT
H	MIL
J	UNUSED
K	ANA RTN
L	FPP1
M	5V REF
N	CAN1 +
P	CAN1 -
R	VBAT
S	GROUND

PED_ 12015791 CONNECTOR
PED_ 12089188 TERMINAL
PED_ 15324982 SEAL
PED_ 12010996 CONNECTOR
PED_ 12089040 TERMINAL
PED_ 15324982 SEAL
WHITE 18
CAN TERMINATION CONNECTOR

D-EPR CONNECTOR
PINK/DK GREEN 16
BLUE/PINK 18
WHITE 18
BLACK 16
BLUE/WHITE 18
RED/TAN 16
VRELAY
CAN+
CAN TERM
GROUND
CAN-
VBAT
AMP 2822346-1 CONN
AMP 174263-7 LOCK
AMP 171662-1 TERM
AMP 2822354-1 SEAL

ENVIROTECH
PED_ 15410728 CONN
PED_ 15326267 TERM (SN)
PED_ 15385351 SEAL
PED_ 15385171 PLUG
PED_ 15305028 LOCK
BLUE/WHITE 18
BLUE/PINK 18
BLACK/LT GREEN 18
LT GREEN/RED 18

KNOCK2
BOSCH_ 1-928-403-126 CONN
2-927766-1 TERMINAL (AU)
828904-2 SEAL
BLACK/WHITE 18
BLACK 18

KNOCK1
BOSCH_ 1-928-403-126 CONN
2-927766-1 TERMINAL (AU)
828904-2 SEAL
BLACK/YELLOW 18
BLACK 18

BATT +
10MM RING
RED 12

STARTER SOLENOID
M6 RING
YELLOW 14

E-5211 FUSEBLOCK
E-6131 TOP COVER
E-6132 BOTTOM COVER
E-1583 SPACER (ISO RELAY)
E-1865 SPACER (MINI FUSES)
E-8386 SPACER (2 - ISO RELAYS)
YELLOW 14
LT BLUE/PINK 18
RED 14
GRAY/ORANGE 18
RED 18
RED/TAN 18
PINK/DK GREEN 16
PINK/DK GREEN 16
RED/TAN 14
RED 14
PINK/TAN 18
PINK 18
RED 14
WHITE/LT BLUE 18
PINK/DK GREEN 14
RED 18
PINK/DK GREEN 16
PINK/DK GREEN 16

F 1 = VSW 5A (ATM-5)
F 2 = ECM 20A (ATM-20)
F 3 = VRELAY 20A (ATM-20)
F 4 = DEPR 10A (ATM-10)
F 5 = VBAT 5A (ATM_5)
F 6 = EMPTY

R1 = STARTER RELAY
896H-1CH-C-R1-24VDC
R2 = POWER RELAY
896H-1CH-C-R1-24VDC
R3 = EMPTY
(OR EQUIVALENT RELAYS)

(SPLICE MUST BE LOCATED 3"-6" FROM CONNECTOR)
PURPLE/ORANGE 18
GRAY/BROWN 18
LT GREEN/RED 18
CAMSHAFT POSITION SENSOR
AMP_ 444072-1 CONN
AMP_ 927770-1 TERM
AMP_ 828904-1 SEAL

COOLANT LEVEL SWITCH
PED_ 12162000 CONNECTOR
PED_ 12045773 TERMINAL
PED_ 15324976 SEAL
PED_ 12052634 LOCK
BLACK/LT GREEN 18
DK BLUE/RED 18

OIL PRESSURE/TEMP SENSOR
BLACK/LT GREEN 18
LT GREEN/WHITE 18
LT GREEN/RED 18
LT GREEN/BLACK 18
BOSCH_ 1-928-403-736 CONN
BOSCH_ 1-928-498-060 TERM
BOSCH_ 1-928-300-599 SEAL
BOSCH_ 1-928-300-601 PLUG

OIL LEVEL SWITCH
BOSCH_ 1-928-403-698 CONN
TYCO_ 927766-3 TERM (SN)
TYCO_ 2-927770-1 TERM (AU)
TYCO_ 828904-2 WIRE SEAL
BLACK/LT GREEN 18
LT BLUE/BLACK 18
(ADD CAP P478 TO OIL LEVEL SWITCH)

BOSCH THROTTLE
BLK/LT GREEN 18
LT BLUE/DK BLUE 18
LT GREEN/RED 18
PURPLE/LT BLUE 18
PINK/WHITE 18
TAN/ORANGE 18
AMP 284716-4 CONNECTOR
AMP_ 4-964275-1 TERM (AU)
AMP_ 963530-1 SEAL

NATURAL GAS LP SW CAP
PED 12010973 CONN
PED 12010300 PLUG

NATURAL GAS LOW PRESSURE SW.
PED 12015792 CONN
PED 12089188 TERMINAL
PED 15324985 SEAL
BLACK/LT GREEN 18
LT BLUE 18
(MATING CONNECTOR WITH CAVITY PLUGS)

NOTES:
1) ALL WIRE IS SAE J1128 TXL TYPE
2) ALL CAN CIRCUITS MUST BE TWISTED PAIRS
3) THE MAIN CAN BUS LENGTH SHALL NOT EXCEED 40M
4) EACH CAN CABLE STUB LENGTH SHALL NOT EXCEED 1M
5) ALL CONVOLUTE TO BE FLAME RETARDANT POLYPROPYLENE

Title: WEICHAI P10, BI-FUEL
Size: D | Number: E2526100 | Rev: A
Date: 5/15/2016 | Drawn By: J.SUTTON
Filename: 2526100a.sch | Sheet 1 of 1

13L ELETRICAL SCHEMATIC

FIRING ORDER 1-5-3-6-2-4

IGN COIL CYL #1
AMP_1488991-1 CONN
AMP_1418850-1 TERM
AMP_964972-1 SEAL

IGN COIL CYL #2
AMP_1488991-1 CONN
AMP_1418850-1 TERM
AMP_964972-1 SEAL

IGN COIL CYL #3
AMP_1488991-1 CONN
AMP_1418850-1 TERM
AMP_964972-1 SEAL

IGN COIL CYL #4
AMP_1488991-1 CONN
AMP_1418850-1 TERM
AMP_964972-1 SEAL

IGN COIL CYL #5
AMP_1488991-1 CONN
AMP_1418850-1 TERM
AMP_964972-1 SEAL

IGN COIL CYL #6
AMP_1488991-1 CONN
AMP_1418850-1 TERM
AMP_964972-1 SEAL

SPK_COIL1a	1	YELLOW/BLACK 18	
SPK_COIL1b	2	YELLOW/RED 18	
AUX_DIG17	3		
AUX_ana_PUD1	4	DK BLUE/YELLOW 18	
AUX_ana_PUD2	5	DK BLUE/RED 18	
AUX_ana_PUD3/DIG23	6	DK BLUE/ORANGE 18	
AUX_ana_PUD4/DIG24	7		
AUX_ana_PUD5/DIG25	8		
AUX_ana_PUD6	9		
AUX_ana_PUD7	10		
AUX_ana_PD2	11		
Speed1_P	12		
Speed1_N	13		
CAN1+	14	BLUE/PINK 18	
CAN1-	15	BLUE/WHITE 18	TWIST WIRES 10 TURNS(360 DEG)/FOOT FULL LENGTH
CAN2-	16		
CAN2+	17		
AUX_ana_PD3	18		
5V_ext1	19	LT GREEN/RED 18	
5V_rtn1	20	BLK/LT GREEN 18	
CRK_POS	21	PURPLE/WHITE 18	
CRK_NEG	22	WHITE/PURPLE 18	TWIST WIRES 10 TURNS(360 DEG)/FOOT FULL LENGTH
CAM_POS	23	GRAY/BROWN 18	TWIST WIRES 10 TURNS(360 DEG)/FOOT FULL LENGTH
CAM_NEG	24	PURPLE/ORANGE 18	TWIST WIRES 10 TURNS(360 DEG)/FOOT FULL LENGTH
KNK3+	25		
KNK3-	26		
KNK1+	27	BLACK/YELLOW 18	
KNK1-	28	BLACK 18	
KNK2+	29	BLACK/WHITE 18	TWIST WIRES 10 TURNS(360 DEG)/FOOT FULL LENGTH
KNK2-	30	BLACK 18	
SPK_COIL2a	31	YELLOW/WHITE 18	TWIST WIRES 10 TURNS(360 DEG)/FOOT FULL LENGTH
AUX_DIG18	32		
AUX_PWM5+Recirc	33		
AUX_ana_PUD10	34		
	35		
PULSE_IN	36	WHITE/ LT BLUE 18	
RELAY	37	TAN 18	
IAT	38	TAN/DK GREEN 18	
ECT	39	PURPLE/LT BLUE 18	
TPS1	40	LT BLUE/DK BLUE 18	
TPS2	41	LT GREEN 18	
MAF	42	DK BLUE/ORANGE 18	
FPP1	43		
FPP2-IVS	44	LT GREEN/BLACK 18	
OILP	45	PINK/TAN 18	
Vswitch	46	DK BLUE 18	
EGO_1/UEGO_S	47	DK GREEN/WHITE 18	
EGO_2	48		
DIG21	49		
DIG22	50	ORANGE/WHITE 18	
UEGO1_P	51	WHITE 18	
UEGO1_C	52	DK GREEN 18	
AUX_DIG13	53		
Speed2	54		
AUX_DIG14	55		
AUX_ana_PUD8	56		
AUX_ana_PUD9	57		
Vbat	58	RED/TAN 16	
AUX_DIG19	59		
Vrelay	60	PINK/DK GREEN 16	
SPK_COIL2b	61	TAN/WHITE 18	
SPK_COIL3a	62	TAN/YELLOW 18	
EGOH_1/UEGO_H	63	YELLOW/RED 18	
EGOH_2	64	ORANGE/BLACK 18	
AUX_DIG11	65		
AUX_DIG12	66		
BUZZ	67		
MIL	68	GREEN/YELLOW 18	
AUX_ana_PU1	69	LT GREEN/WHITE 18	
AUX_ana_PU2	70	LT BLUE/BLACK 18	
AUX_ana_PU3	71	DK BLUE/RED 18	
GOV1	72	GRAY/DK BLUE 18	
GOV2	73		
AUX_DIG6	74		
AUX_DIG7	75		
5V_ext2	76		
5V_rtn2	77		
CAN3+	78		
CAN3-	79		
AUX_DIG8	80		
AUX_DIG9	81		
AUX_ana_PD1	82	WHITE/LT GREEN 18	
AUX_DIG1	83	TAN/BROWN 18	
AUX_DIG2	84	LT BLUE 18	
AUX_DIG3	85		
AUX_DIG4	86		
AUX_DIG5	87		
AUX_PWM1+Recirc	88		
TACH	89		
Vrelay	90	PINK/DK GREEN 16	
SPK_COIL3b	91	TAN/DK BLUE 18	
GROUND (SPK_GND)	92	BLACK 16	
AUX_PWM10	93		
AUX_PWM11	94		
INJ1_LS	95		
INJ2_LS	96		
INJ3_LS	97		
INJ4_LS	98		
INJ5_LS	99		
INJ6_LS	100		
Vrelay	101	PINK/DK GREEN 16	
Vrelay	102	PINK/DK GREEN 16	
Vrelay	103		
AUX_DIG15	104		
AUX_DIG16	105		
LOCKOFF2	106	WHITE/BLACK 18	
LOCKOFF	107		
AUX_PWM4+Recirc/GD	108	BLACK 16	
Ground	109	LT BLUE/WHITE 18	
AUX_PWM6+Recirc	110	GRAY/ORANGE 18	
AUX_PWM7	111		
AUX_PWM8+Recirc	112		
AUX_PWM9+Recirc	113		
HBB+	114		
HBB-	115	BLACK 16	
Ground	116	TAN/ORANGE 18	
DBW-	117	PINK/WHITE 18	
DBW+	118		
HBA+	119		
HBA-	120	BLACK 16	

ECI_E24241BB_CONNECTOR
PED_211 CC 2S 1488_TERMINAL
PED_210 A 81 5819_PLUG
E2424140 COVER
E2424138 LOCKING CAM
PLT25-M38 TIE STRAP

CRANKSHAFT POSITION SENSOR
PURPLE/WHITE 18
WHITE/PURPLE 18
BOSCH_1 928 403 874_CONN
BOSCH_1 928 498 060 TERM
BOSCH_1 928 300 599 SEAL

TIP SENSOR
BLACK/LT GREEN 18
UNUSED
LT GREEN/RED 18
WHITE/LT GREEN 18
BOSCH_1-928-403-736 CONN
BOSCH_1-928-498-060 TERM
BOSCH_1-928-300-599 SEAL

TMAP SENSOR
BLACK/LT GREEN 18
TAN 18
LT GREEN/RED 18
LT GREEN 18
BOSCH_1-928-403-736 CONN
BOSCH_1-928-498-060 TERM
BOSCH_1-928-300-599 SEAL
BOSCH_1-928-300-601 PLUG

ECT SENSOR
TAN/DK GREEN 18
BLACK/LT GREEN 18
BOSCH_1 928 403 874_CONN
BOSCH_1 928 498 060 TERM
BOSCH_1 928 300 599 SEAL

BOSCH PRE-CAT UEGO SENSOR
DK BLUE 18
PINK/DK GREEN 18
WHITE 18
ORANGE/WHITE 18
YELLOW/RED 18
DK GREEN 18
AMP 284716-4 CONNECTOR
AMP_4-964275-1 TERM (AU)
AMP_963530-1 SEAL

ENGINE GROUND
BLACK 16
BLACK 14
BLACK 12
10MM RING

KNOCK1
BLACK/YELLOW 18
BLACK 18
BOSCH_1-928-403-126 CONN
2-927766-1 TERMINAL (AU)
828904-2 SEAL

KNOCK2
BLACK/WHITE 18
BLACK 18
BOSCH_1-928-403-126 CONN
2-927766-1 TERMINAL (AU)
828904-2 SEAL

BATT +
10MM RING
RED 12

STARTER SOLENOID
LEAR_18286000002 CONN
LEAR_14816660636 LOCK
LEAR_26788201184 TERM
LEAR_14448627621 SEAL
YELLOW 16
BLACK 16

(SPLICE MUST BE LOCATED 3"-6" FROM CONNECTOR)
PURPLE/ORANGE 18
GRAY/BROWN 18
LT GREEN/RED 18

CAMSHAFT POSITION SENSOR
AMP_444072-1 CONN
AMP_927770-1 TERM
AMP_828904-1 SEAL

COOLANT LEVEL SWITCH
PED_12162000 CONNECTOR
PED_12045773 TERMINAL
PED_15324976 SEAL
PED_12052634 LOCK
BLACK/LT GREEN 18
DK BLUE/RED 18

OIL LEVEL SWITCH
BOSCH_1-928-403-698 CONN
TYCO_927766-3 TERM (SN)
TYCO_2-927778-1 TERM (AU)
TYCO_828904-2 WIRE SEAL
B1 BLACK/LT GREEN 18
B2 LT BLUE/BLACK 18
(ADD CAP P470 TO OIL LEVEL SWITCH)

OIL PRESSURE/TEMP SENSOR
BLACK/LT GREEN 18
LT GREEN/WHITE 18
LT GREEN/RED 18
LT GREEN/BLACK 18
BOSCH_1-928-403-736 CONN
BOSCH_1-928-498-060 TERM
BOSCH_1-928-300-599 SEAL
BOSCH_1-928-300-601 PLUG

BOSCH THROTTLE
BLK/LT GREEN 18
LT BLUE/DK BLUE 18
LT GREEN/RED 18
PURPLE/LT BLUE 18
PINK/WHITE 18
TAN/ORANGE 18
AMP 284716-4 CONNECTOR
AMP_4-964275-1 TERM (AU)
AMP_963530-1 SEAL

NATURAL GAS LP SW CAP
PED 12010973 CONN
PED 12010300 PLUG

NATURAL GAS LOW PRESSURE SW.
PED 12015792 CONN
PED 12089188 TERMINAL
PED 15324985 SEAL
BLACK/LT GREEN 18
LT BLUE 18
(MATING CONNECTOR WITH CAVITY PLUGS)

POST-CAT HEGO SENSOR
PINK/DK GREEN 18
BLACK/LT GREEN 18
DK GREEN/WHITE 18
ORANGE/BLACK 18
PED_12160825 CONNECTOR
PED_12177150 TERM (GOLD)
PED_15324976 WIRE SEAL
PED_12176368 LOCK

PRIMARY LOCKOFF (NATURAL GAS)
PED_12052641 CONNECTOR
PED_12048074 TERMINAL
PED_12052634 LOCK
PED_15324976 SEAL
WHITE/BLACK 18
PINK/DK GREEN 18

SEC. LOCKOFF CAP
PED_12162000 CONNECTOR
PED_12059168 PLUG
PED_12052634 LOCK

SECONDARY LOCKOFF (LPG)
PED_12052641 CONNECTOR
PED_12048074 TERMINAL
PED_12052634 LOCK
PED_15324976 SEAL
LT BLUE/WHITE 18
PINK/DK GREEN 18

DIAGNOSTIC CONNECTOR
BLACK/LT GREEN 18
RED/TAN 18
BLACK 18
BLUE/WHITE 18
BLUE/PINK 18
EPC_1F1T-14A624-AA-004 CONN
MOLEX_33093-0009 TERM (18-20)
EPC_E608-14A468-DA LOCK
DEUTSCH_0413-204-2005 CAV. PLUG
EPC_F5AB-14A666-AA CAP
TRW_0476883801 XMAS TREE CLIP

PED_15326863 CONN
PED_15358785 SECONDARY LOCK
PED_12191819 TERM (SN)
PED_15366060 SEAL
PED_15305171 PLUG

BLACK 18	A	G	GREEN/YELLOW 18
RED/TAN 18	B	H	TAN/BROWN 18
BLUE/WHITE 18	C	I	LT BLUE/PINK 18
BLUE/PINK 18	D	J	GRAY/DK BLUE 18
LT GREEN/RED 18	E	K	DK BLUE/ORANGE 18
DK BLUE/ORANGE 18	F	L	DK BLUE/RED 18
BLACK/LT GREEN 18	G	M	DK BLUE/YELLOW 18
UNUSED	H	A	PINK 18

ENGINE INTERFACE

CAVITY	FUNCTION
A	VSW
B	AUX ANA PUD1
C	AUX ANA PUD2
D	AUX ANA PUD3
E	GDV1
F	START
G	FUEL SELECT
H	MIL
J	UNUSED
K	ANA RTN
L	FPP1
M	5V REF
N	CAN1 +
P	CAN1 -
R	VBAT
S	GROUND

ENVIROTECH
PED_15410728 CONN
PED_15326267 TERM (SN)
PED_15305351 SEAL
PED_15305171 PLUG
PED_15305028 LOCK
A BLUE/WHITE 18
B BLUE/PINK 18
C BLACK/LT GREEN 18
D LT GREEN/RED 18

E-5211 FUSEBLOCK
E-6131 TOP COVER
E-6132 BOTTOM COVER
E-1583 SPACER (ISO RELAY)
E-1865 SPACER (MINI FUSES)
E-0386 SPACER (2 - ISO RELAYS)

F 1 = VSW 5A (ATM-5)
F 2 = ECM 20A (ATM-20)
F 3 = VRELAY 20A (ATM-20)
F 4 = DEPR 10A (ATM-10)
F 5 = VBAT 5A (ATM_5)
F 6 = EMPTY

R1 = STARTER RELAY
896H-1CH-C-R1-24VDC
R2 = POWER RELAY
896H-1CH-C-R1-24VDC
R3 = EMPTY
(OR EQUIVALENT RELAYS)

PED_12015791 CONNECTOR
PED_12089188 TERMINAL
PED_15324982 SEAL
PED_12010996 CONNECTOR
PED_12089040 TERMINAL
PED_15324982 SEAL
CAN TERMINATION CONNECTOR
JUNCTION TO BE WITHIN 6" OF CONNECTOR

D-EPR CONNECTOR 1
PINK/DK GREEN 16 VRELAY
BLUE/PINK 18 CAN+
WHITE 18 CAN TERM
BLACK 16 GROUND
BLUE/WHITE 18 CAN-
RED/TAN 16 VBAT
AMP 2822346-1 CONN
AMP 174263-7 LOCK
AMP 171662-1 TERM
AMP 2822354-1 SEAL

D-EPR CONNECTOR 2
PINK/DK GREEN 16 VRELAY
BLUE/PINK 18 CAN+
WHITE 18 CAN TERM
BLACK 16 GROUND
BLUE/WHITE 18 CAN-
RED/TAN 16 VBAT
AMP 2822346-1 CONN
AMP 174263-7 LOCK
AMP 171662-1 TERM
AMP 2822354-1 SEAL

NOTES:
1) ALL WIRE IS SAE J1128 TXL TYPE
2) ALL CAN CIRCUITS MUST BE TWISTED PAIRS
3) THE MAIN CAN BUS LENGTH SHALL NOT EXCEED 40M
4) EACH CAN CABLE STUB LENGTH SHALL NOT EXCEED 1M
5) ALL CONVOLUTE TO BE FLAME RETARDANT POLYPROPYLENE

ECONTROLS INC.

Title: WEICHAI P13, BI-FUEL
Size: D
Number: E2526130
Rev: C
Date: 7/5/2016
Drawn By: J.SUTTON
Filename: 2526130c.sch
Sheet 1 of 1

REVISION CONTROL INFORMATION

Revision Level	Release Date	Change Description (s)
1	06/21/2021	Initial Release

POWER SOLUTIONS INTERNATIONAL

Power Solutions International, Inc (PSI)
201 Mittel Drive
Wood Dale, IL 60191
USA
630-350-9400

7610037-1 04/21