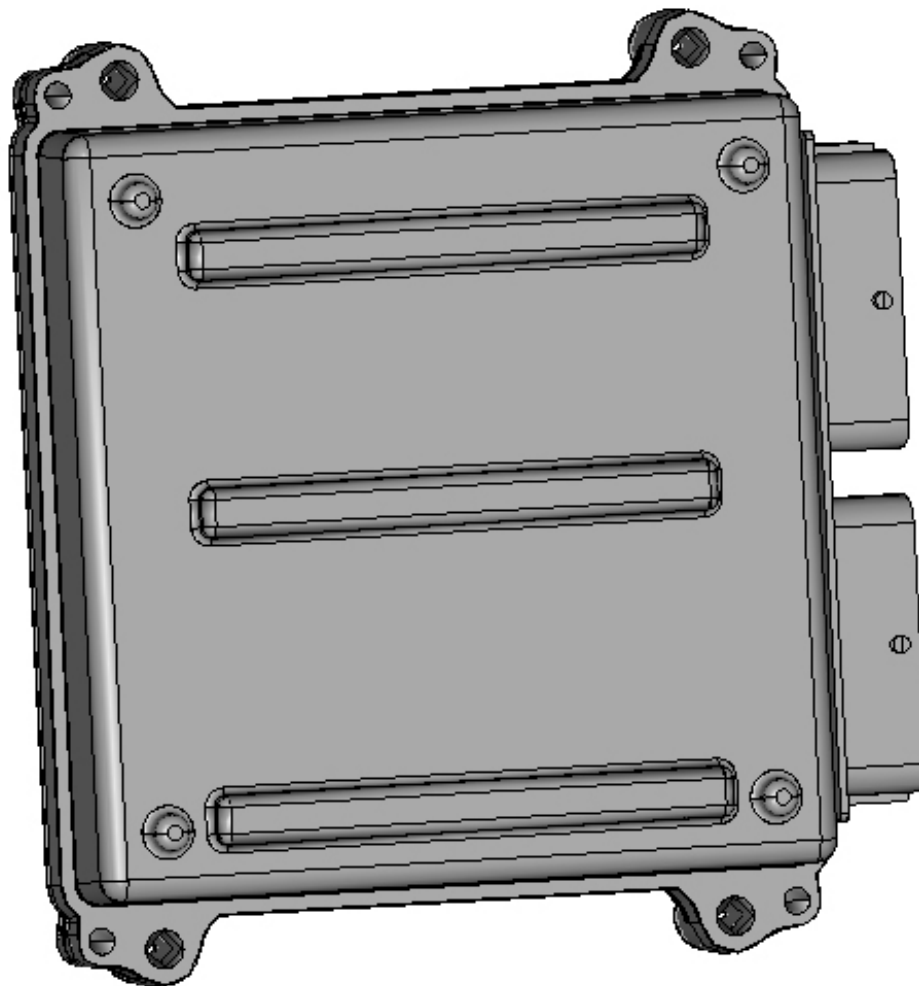


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# Diagnostic Trouble Code Manual EControls Engine Control System Power Solutions, Inc.



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# Definition of Terms & Acronyms

**Active Gov Mode** Speed is governed by one of two modes. Isochronous, which maintains an exact speed, or Droop, which allows speed to drop a predetermined amount based on current engine load.

**AL** Adaptive Learn

**AL Mult** Adaptive Learn Multiplier. The adaptive learn multiplier is a correction to the fuel delivery which is expressed as a percentage (%) and stored in the ECM's RAM.

**Analog** 0 to 5 volt or 0 to 12 volt signals

**Batt** Battery Voltage

**BP** Barometric Pressure. The pressure of the outside air.

**CHT** Cylinder Head Temperature

**CL** Closed Loop

**CL Mult** Closed Loop Multiplier. The closed loop multiplier is a fast acting adjustment to the fuel delivery based on feedback from the HEGO. The closed loop multiplier is expressed as a percentage (%) and is not stored in the ECM's memory.

**Closed Loop** Fuel and timing modified based on feedback from the O2 sensor.

**DBW** Drive by wire.

**DTC** Diagnostic Trouble Code. A code which is stored in the ECM when an ECM initiated test fails.

**ECT** Engine Coolant Temperature.

**ECM** Engine Control Module. The computer that controls the fuel and ignition system on the engine.

**EGO** See HO2S

**FPP** Foot Pedal Position.

**HO2S** Heated Oxygen Sensor

**IAT** Intake Air Temperature

**IVS** Idle Validation Switch

**MAP** Manifold Absolute Pressure. The pressure of the air in the intake manifold.

**MAT** Manifold Air Temperature. The temperature of the air in the intake manifold

**MIL** Malfunction Indicator Light. A dash mounted light that illuminates when the ECM senses a system fault.

**Ms** Milli-seconds. 1/1000 of a second.

**Open Loop** Fuel and timing based strictly on tables stored in the ECM.

**PSIA** Pounds per square inch absolute. 14.7 psia = 0 psig

**RAM** Random Access Memory. The portion of computer memory within the ECM, which changes as the engine is running and is stored while the engine is off.

**TPS** Throttle Position Sensor. The throttle position sensor measures the opening of the throttle.

## Diagnostics Overview of the Control System

The engine control system has built-in diagnostics for trouble shooting. The system utilizes a Malfunction Indicator Lamp (MIL) for indication of system problems. The Diagnostic Trouble Codes discussed in the manual do not all apply to every engine. Diagnostic Trouble Codes are calibration specific. This manual provides an overview of all Diagnostic Trouble Codes. Only use this manual to diagnose trouble codes encountered in use.

### Malfunction Indicator Lamp (MIL)

Most engine control system related problems that affect emissions or driveability of the will set a (DTC) Diagnostic Trouble Code and illuminate the Malfunction Indicator Lamp.

The MIL has the following functions:

1. It notifies the operator of a problem with the fuel system, ignition system, or emission control system so the operator can arrange for service as soon as possible.
2. It will display DTC's that have been stored due to a system malfunction.

The lamp should come on when the key is in the ON position and the engine is not running. This feature verifies that the lamp is in proper working order. If the lamp does not come on with the vehicle key on/engine off, repair it as soon as possible. Once the engine is in start or run mode, the lamp should go off. If the lamp illuminates while the engine is in the start or run mode, there is a current Diagnostic Trouble Code.

### Diagnostic Trouble Codes (DTC)

Diagnostic Trouble Codes (DTC) are set when the Electronic Control Module (ECM) runs a diagnostic self-test and the test fails. When a DTC is set, the ECM will illuminate the Malfunction Indicator Lamp and save the code in memory. The ECM will continue to run the self-test unless the DTC is an oxygen sensor lean, oxygen sensor rich, or an internal ECM related DTC. If the system continues to fail the test, the lamp will stay illuminated and the DTC is current (ACTIVE). All DTC's are stored as historical faults until they are cleared. All DTC's except the ECM related DTC's will automatically clear from memory if the DTC does not reset within 50 consecutive engine-run cycles.

While a Diagnostic Trouble Code is current for a sensor, the ECM may assign a default "limp home" value and use that value in its control algorithms. All of the system diagnostic self-tests run continuously during normal vehicle operation.

The Diagnostic Trouble Codes can be read by using either the MIL lamp or a laptop computer. Refer to *Using a Laptop Computer to Diagnose the System* and *Using a Diagnostic Jumper to Diagnose the ECI System*, located in this section. Diagnostic Trouble Codes can be cleared from memory with a laptop computer or by turning the ignition key to the OFF position and removing the system main power fuse for 15 seconds.

If more than one DTC is detected, always begin with the **lowest number DTC** and diagnose each problem to correction unless directed to do otherwise by the fault tree. The DTC's are numbered in order of importance. Having DTC 112 and DTC 122, both concerning the oxygen sensor, is possible. By repairing DTC 112 first, the problem causing the DTC 122 may also be corrected.

## Using a Laptop Computer to Diagnose the System

A laptop computer is the preferred tool for performing diagnostic testing of the system. A laptop computer, with the system diagnostic cable and diagnostic software, is used to read and clear Diagnostic Trouble codes. It is also used to monitor sensor and actuator values. The diagnostic software also performs several special tests.

The following procedures will assist you in using a laptop computer to diagnose the system:

### **Installing the Diagnostic Software**

#### Loading Software and Connecting the Computer

- Start Windows
- Insert the Diagnostic Interface software CD.
- Click on the **START** button.
- From the Start menu, select **RUN**.
- In the command-line text box, type the letter of your CD-ROM drive, followed by: `\setup` (for example, `e:\setup`), then click **OK**.
- Follow the on screen instructions.

#### Connecting a Laptop Computer to the System

- Connect the system diagnostic cable to the RS232 port on the back of the computer. If you do not have a RS-232 port, use the USB to RS232 adapter cable.
- Connect the diagnostic cable to the diagnostic connector on the engine harness. The diagnostic connector is a square 4-pin connector located near the system ECM.
- Turn the computer ON.
- Start Windows.
- From the **Start** menu select **Programs**.
- Select **PSI Display**.
- Place the ignition key in the ON position.
- The system Gauge screen should now appear and a green banner in the upper left hand will read “Connected”.

# Diagnostic Trouble Codes

The screenshot displays the EDIS ECT Serial Communications software interface. At the top, it shows 'Faults' and 'Connected' status. The main area is divided into several sections:

- Faults Access:** MIL indicator.
- Engine Parameters:** Engine Speed (1401 rpm), Manifold Pressure (4.95 psia), Coolant Temperature (195.0 deg F), Cylinder Head Temp (195.0 deg F), Manifold Temperature (107.5 deg F), Intake Air Temperature (106.7 deg F), Vbat (13.3 volts), Vsw (13.7 volts), Hour meter (2.843 hours), Cumulative starts (13).
- System Status:** Run Mode (Running), Fuel Type (Gasoline), Fuel Control Mode (CL Active), Governor switch state (Gov3), Active governor type (Min), Active governor mode (Droop), Brake input level (Open), Oil pressure state (OK).
- DBW Variables:** TPS command (0.0 %), TPS position (0.1 %), FPP command (0.0 %), FPP position (0.0 %), TPS1 voltage (0.484 volts), TPS2 voltage (4.477 volts), FPP1 voltage (0.442 volts), FPP2 voltage (0.000 volts), IVS voltage (5.000 volts).
- Injector Data:** Table showing Injector Number, Spark Coil dwell ms, and Injector-on/off low-side voltage.
- Closed-Loop Control:** EGD1 (0.592 volts), Closed-loop 1 (1.2 %), Adaptive 1 (0.0 %), EGD2 (0.452 volts), Closed-loop 2 (0.0 %), Adaptive 2 (0.0 %).
- Digital Input Voltages:** Fuel select voltage (10.4 volts), Fuel pump voltage (13.8 volts), Gov1 voltage (20.6 volts), Gov2 voltage (20.6 volts), Overspeed voltage (5.0 volts), Oil pressure voltage (5.0 volts).
- Diagnostic Modes:** Spark kill (Normal), Injector kill (Normal), DBW test mode (Off).
- Historic Faults:** MAP voltage low, IAT voltage high, ECT voltage high.
- Active Faults:** ECT voltage high.
- Flight Data and SnapShot:** Lists various data points like fuel\_state, run\_tm\_sec, rpm, IMAP, IECT, IAT, CL\_BM1, CL\_BM2, PW\_avg, A\_BM1, A\_BM2, Vbat, FPP\_pct, TPS\_pct, EGD1\_volts, EGD2\_volts, PW\_avg, TRIM\_DC, HM\_hours.

The System Fault screen is used to view and clear DTC's, which have been set.

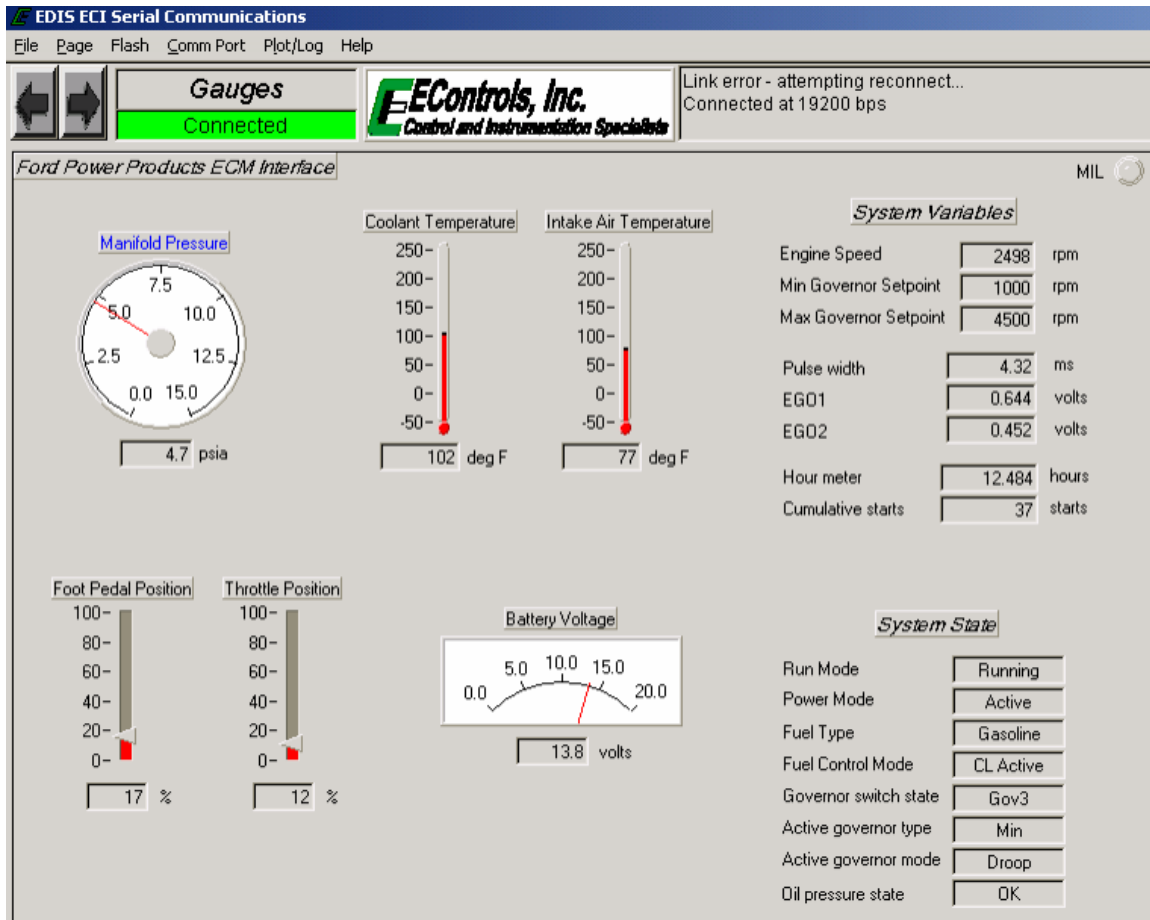
## Checking Diagnostic Trouble Codes

The System Fault screen contains a listing of all of the Historic and Active DTC's set within the system. If a DTC is stored in memory, the screen will display that fault in the History column. If the fault is active it will also show up in that column.

## Clearing Diagnostic Trouble Codes

To clear a DTC from memory use the arrow keys or mouse to move the Press the Enter key to clear the fault from memory. **NOTE:** Record faults before erasing them for reference during diagnostics.

## Gauges Screen – Sensor Data



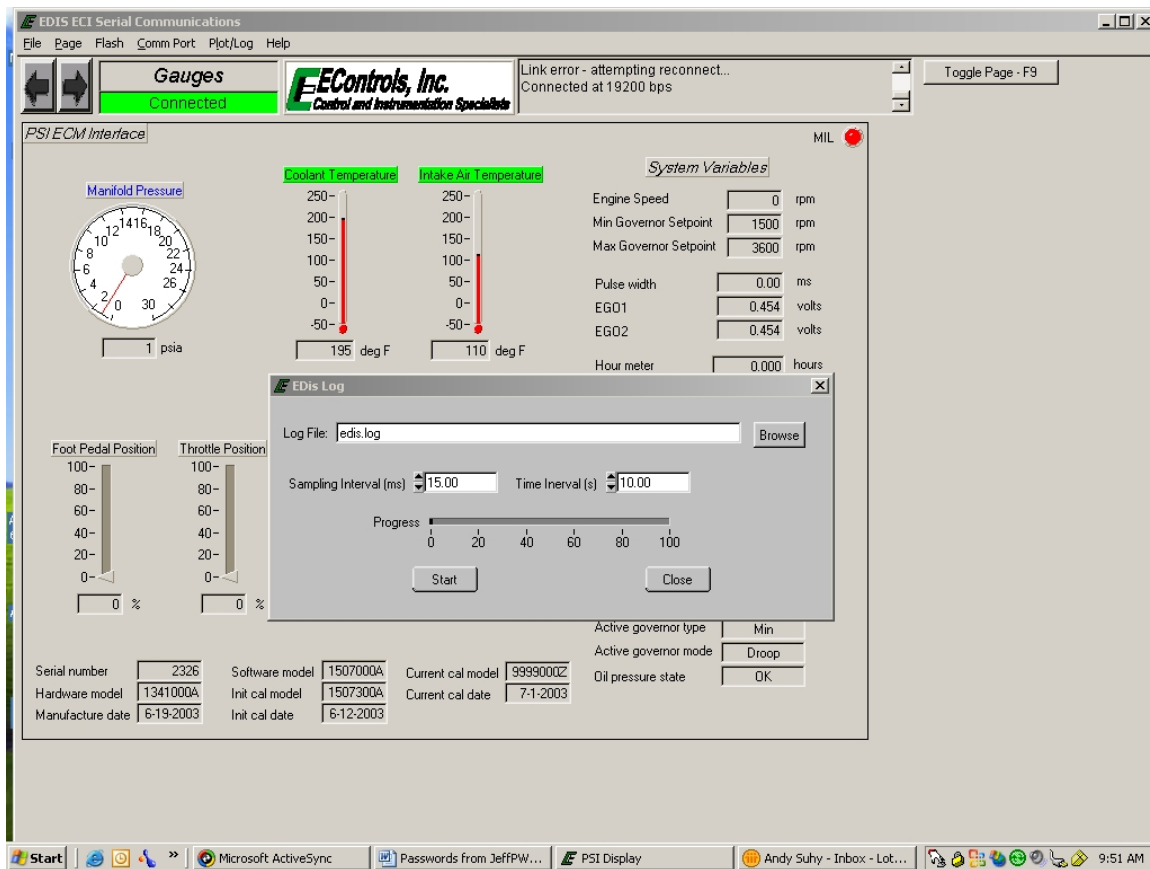
### Reading Sensor and Actuator Values

Most applicable sensor and actuator values are displayed on the Gauges screen. The display shows the value for sensors, voltages and the sensor values in engineering units.

**NOTE:** If a DTC for a sensor is current, the engineering value for that sensor may be a default, limp home value and the voltage value will be the actual sensor voltage. Use the voltage value when performing diagnostics unless directed to do otherwise by the diagnostic trouble tree.



## Graphing and Data Logging



## Graphing/Logging Sensor Data

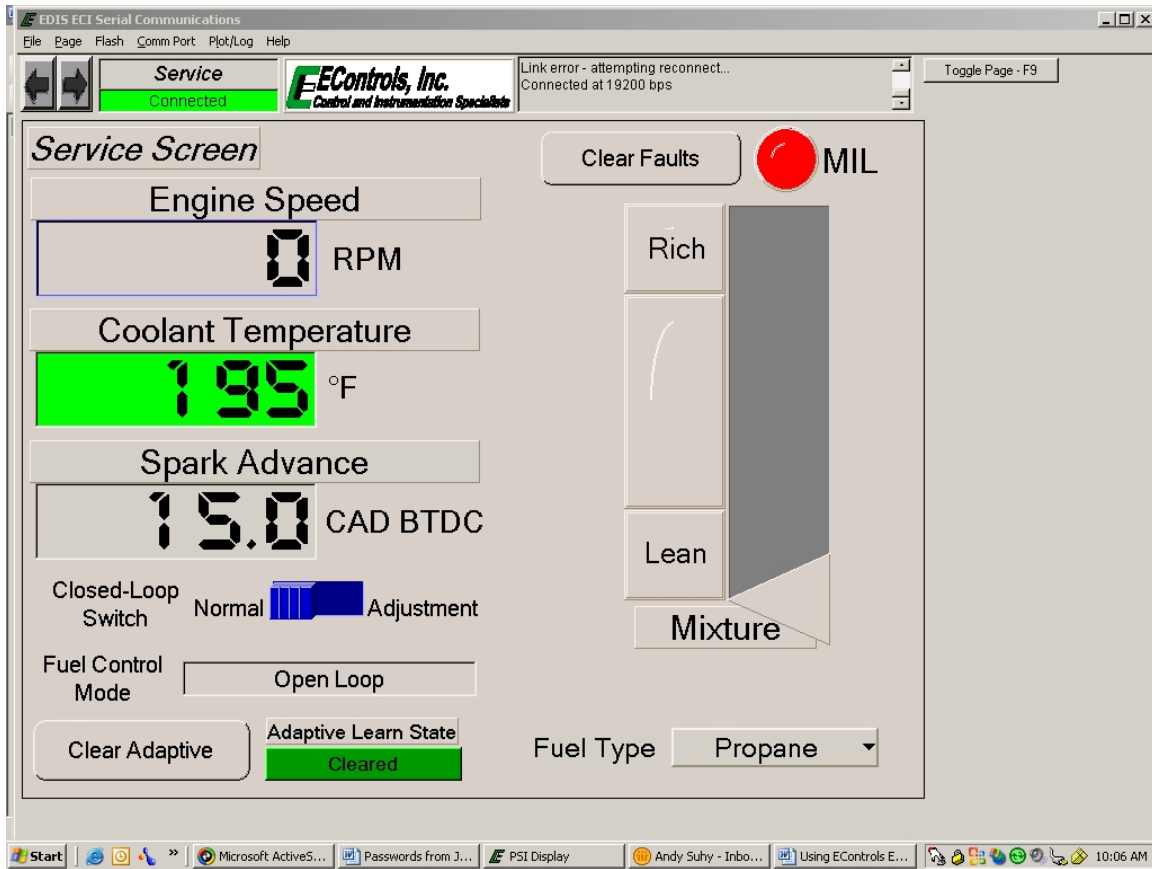
Logging sensor values and voltages can be a very useful tool in doing intermittent diagnosis. The system diagnostic monitoring software includes data logging capability. These features enhance the ability to diagnose and repair possible problems with the system. The logging feature allows sensor inputs and select control output variables to be plotted in real-time while the engine is running.

To log a variable you must first "TAG" the variable you wish to plot. To do this, use the mouse to highlight the variable, and then right click.

Next select *Log Tags* from the *Plot/Log* menu on the top tool bar. A log window will appear. You can select the length of the data log and the sample interval. You will need to specify a file name in the *Log File* window. It is not necessary to specify an extension. You can simply highlight the default *Edis.log* shown in this window and type the file name that you choose.

You are now ready to log the data. Simply click the "START" button and the software will begin to record the data into a file. The progress bar will move from left to right while recording data. Once complete the bar will read at 100%. The file that was created can be found at *C:\PSI Display\the file name you created*. This file can then be opened with Microsoft Excel, and the data can be graphed. The file can also be emailed for additional support.

## Service Screen



## Service Screen

The Service Screen is a tool that displays various pieces of engine information. It also has a button to allow the user to clear DTC's.

# Ignition System Test

The screenshot displays the EControls, Inc. Ignition System Test software. The interface is divided into several sections:

- Top Bar:** Includes menu options (File, Page, Flash, Comm Port, Plot/Log, Help) and a status bar showing 'Link error - attempting reconnect... Connected at 19200 bps'.
- Faults Section:** Shows 'Connected' status and 'Toggle Page - F9' and 'Toggle Test Cell - F10' buttons.
- Engine Access:** Displays MIL status and engine speed (1027 rpm).
- System States:** Shows Run Mode (Running), Fuel Type (Gasoline), Fuel Control Mode (CL Active), Governor switch state (Gov3), Active governor type (Min), Active governor mode (Droop), Brake input level (Open), and Oil pressure state (OK).
- DBW Variables:** Lists TPS command (3.8%), TPS position (3.7%), FPP command (0.0%), FPP position (0.0%), TPS1 voltage (0.696 volts), TPS2 voltage (4.267 volts), FPP1 voltage (0.434 volts), FPP2 voltage (0.000 volts), and IVS voltage (5.000 volts).
- Coil Number / Spark Coil dwell ms:** Shows dwell times for coils 1, 2, and 3 (all at 4.26 ms).
- Injector Number / Injector-on low-side voltage / Injector-off low-side voltage:** Shows voltage levels for injectors 1 through 6.
- Closed-Loop Control:** Displays EGD1, EGD2, and Adaptive 1/2 values.
- Digital Input Voltages:** Shows Fuel select voltage (10.4 volts), Fuel pump voltage (13.6 volts), Gov1 voltage (20.6 volts), Gov2 voltage (20.6 volts), Overspeed voltage (5.0 volts), and Oil pressure voltage (5.0 volts).
- Diagnostic Modes:** A dropdown menu is open, showing 'Spark Kill' selected, with options for Normal, Coil 1 (FO), Coil 2 (FO), Coil 3 (FO), Coil 4 (FO), Coil 5 (FO), and Coil 6 (FO).
- Historic/Active Faults:** Two empty boxes for viewing fault history and active faults.
- Data Definitions:** A list of parameters and their definitions, including fuel\_state, run\_tmw\_sec, rpm, IMAP, IECT, IAT, CL\_BM1, CL\_BM2, Vbat, PW\_avg, A\_BM1, A\_BM2, FFP\_pct, TPS\_pct, EGD1\_volts, EGD2\_volts, PW\_avg, TRIM\_DC, and HM\_hours.

## Spark Kill

The Spark Kill diagnostic mode allows the technician to disable the ignition on individual cylinders. If the Spark Kill diagnostic mode is selected with the engine running below 1000 RPM, the minimum throttle command will lock into the position it was in when the test mode was entered. If the Spark System Test mode is selected with the engine running above 1000 RPM, the throttle will continue to operate normally.

## Disabling Ignition Outputs

To disable the ignition system for an individual cylinder, use the mouse to highlight the “Spark Kill” button and select the desired coil. The spark output can be re-enabled by using the mouse to highlight the “Spark Kill” button and selecting “Normal”. If the engine is running below 1000 RPM, the spark output will stay disabled for 15 seconds and then re-set. If the engine is running above 1000 RPM, the spark output will stay disabled for 5 seconds and then re-set. This test mode has a timeout of 10 minutes. Record the rpm drop related to each spark output disabled.

The Spark outputs are arranged in the order which the engine fires, not by cylinder number.

# Injector Test

The screenshot displays the EDIS ECT Serial Communications software interface. The top menu bar includes 'File', 'Page', 'Flash', 'Comm Port', 'Plot/Log', and 'Help'. The main window is titled 'Faults' and shows a 'Connected' status. The interface is divided into several sections:

- Fault Access:** Shows MIL status as 'Connected'.
- System States:** Includes Run Mode (Running), Fuel Type (Gasoline), Fuel Control Mode (CL Active), Governor switch state (Gov3), Active governor type (Min), Active governor mode (Droop), Brake input level (Open), and Oil pressure state (OK).
- DBW Variables:** Lists TPS command (3.3%), TPS position (3.5%), FPP command (0.0%), FPP position (0.0%), TPS1 voltage (0.686 volts), TPS2 voltage (4.275 volts), FPP1 voltage (0.448 volts), FPP2 voltage (0.000 volts), and IVS voltage (5.000 volts).
- Coil Number (firing order):** Lists coils 1, 2, and 3 with dwell times of 4.25 ms.
- Injector Number (firing order):** Lists injectors 1 through 6 with on-side and off-side voltages.
- Closed-Loop Control:** Shows EGD1 (0.503 volts), Closed-loop 1 (4.5%), Adaptive 1 (0.0%), EGD2 (0.452 volts), Closed-loop 2 (0.0%), and Adaptive 2 (0.0%).
- Digital Input Voltages:** Shows Fuel select voltage (10.2 volts), Fuel pump voltage (13.7 volts), Gov1 voltage (20.6 volts), Gov2 voltage (20.6 volts), Overspeed voltage (5.0 volts), and Oil pressure voltage (5.0 volts).
- Diagnostic Modes:** Includes Spark kill (Normal), Injector kill (Normal), and DBW test mode (Normal).
- Historic and Active Faults:** Two empty panels for recording faults.
- Definitions:** A list of parameters and their definitions, including fuel\_state, fun\_lm\_sec, rpm, IMAP, IECT, IAT, CL\_BM1, CL\_BM2, A\_BM1, A\_BM2, vbat, FPP\_pct, TPS\_pct, EGD1\_volts, EGD2\_volts, PW\_avg, TRIM\_DC, and HM\_hours.

## Injector Kill

The Injector Kill mode is used to disable individual fuel injectors. If the Injector Kill mode is selected with the engine running below 1000 RPM, the minimum throttle command will lock into the position it was in when the test mode was entered. If the Injector Kill mode is selected with the engine running above 1000 RPM, the throttle will continue to operate normally.

## Disabling Injectors

To disable an injector, use the mouse to select the desired. The word "Normal" will change to the Injector you have selected. The injector driver can be re-enabled by selecting again. If the engine is running below 1000 RPM, the injector driver will stay disabled for 15 seconds and then re-set. If the engine is running above 1000 RPM, the injector driver will stay disabled for 5 seconds and then re-set. Record the change in rpm or closed loop multiplier while each driver is disabled.

# Throttle Test

The screenshot displays the EDIS ECI Serial Communications software interface. At the top, there is a menu bar with options: File, Page, Flash, Comm Port, Plot/Log, Help. Below the menu bar, the status bar shows 'Faults Connected' and 'EControls, Inc. Control and Instrumentation Specialists'. A message box indicates 'Link error - attempting reconnect. Connected at 19200 bps'. There are buttons for 'Toggle Page - F9' and 'Toggle Test Cell - F10'.

The main interface is divided into several sections:

- Fault Access:** Shows MIL (Malfunction Indicator Lamp) status.
- System Status:** Includes Engine Speed (0 rpm), Manifold Pressure (14.38 psia), Coolant Temperature (113.3 deg F), Cylinder Head Temp (113.3 deg F), Manifold Temperature (113.3 deg F), Intake Air Temperature (81.6 deg F), Vbat (12.8 volts), Vsw (12.5 volts), Hour meter (12,658 hours), and Cumulative starts (39).
- DBW Variables:** Shows TPS command (0.0 %), TPS position (0.1 %), FPP command (0.0 %), FPP position (0.0 %), TPS1 voltage (0.489 volts), TPS2 voltage (4.472 volts), FPP1 voltage (0.451 volts), FPP2 voltage (0.000 volts), and IVS voltage (5.000 volts).
- Coil Number:** Shows Coil 1 (4.25), Coil 2 (4.25), and Coil 3 (0.00).
- Injector:** Shows Injector Number (1, 2, 3, 4, 5, 6) and Injector-on low-side voltage (0.2, 0.1, 0.2, 0.1, 0.0, 0.0).
- Injector-off low-side voltage:** Shows values (13.4, 13.4, 13.4, 13.4, 0.0, 0.0).
- Closed-Loop Control:** Shows EGO1 (0.000 volts), Closed-loop 1 (0.0 %), Adaptive 1 (0.0 %), EGO2 (0.452 volts), Closed-loop 2 (0.0 %), and Adaptive 2 (0.0 %).
- Digital Input Voltages:** Shows Fuel select voltage (10.4 volts), Fuel pump voltage (0.0 volts), Gov1 voltage (20.6 volts), Gov2 voltage (20.6 volts), Overspeed voltage (5.0 volts), and Oil pressure voltage (0.0 volts).
- Diagnostic Modes:** Shows Spark kill (Normal), Injector kill (Normal), DBW test mode (Enabled), and a dropdown menu with options: Off, Enabled.
- Historic Faults:** An empty box for recording past faults.
- Active Faults:** An empty box for recording current faults.
- Flight Data:** A list of parameters for data logging, including fuel\_state, run\_tmw\_ec, rpm, IMAP, TPS\_pct, IECT, IAT, CL\_BM1, CL\_BM2, A\_BM1, A\_BM2, FPP\_pct, TPS\_pct, EGO1\_volts, EGO2\_volts, PW\_avg, TRIM\_DC, and HM\_hours.

## Throttle Test

To select this test mode the engine must be off but the key must be in the ON position.

The DBW (Drive By Wire) test mode allows the technician to control the throttle directly with the foot pedal or throttle input and is used during the diagnostic routines specified for FPP and TPS for systems that use DBW.

FPP position displays the current position of the foot pedal as a percentage. FPP volts display the voltage which the ECM is reading from the FPP sensor.

TPS Command displays the commanded throttle position expressed as a percentage, which is being sent to the throttle. TPS Position is the actual percent of throttle opening being sent to the ECM from the throttle. TPS volts display the actual TPS signal voltage the ECM is receiving from the throttle.

## Using a Diagnostic Jumper to Diagnose the ECI System

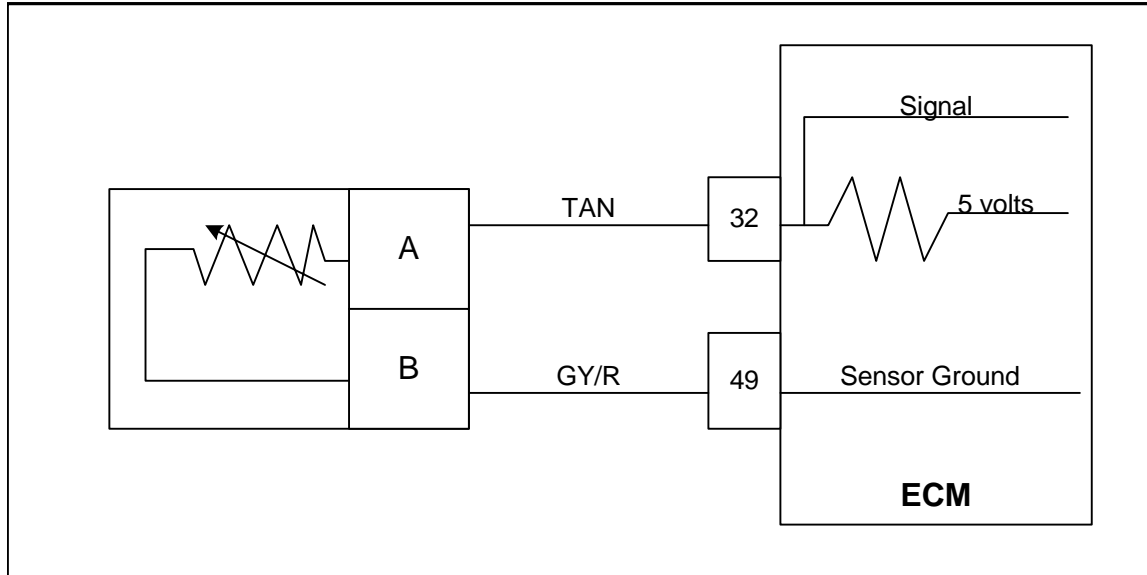
If you do not have access to a laptop computer, it is still possible to access the Diagnostic Trouble Codes stored in the memory of the system ECM using a diagnostic jumper and the Malfunction Indicator Lamp. With the key off connect the diagnostic jumper to the ECI system diagnostic connector located near the ECM. The jumper will connect diagnostic pins A and D. Turn the ignition on but do not start the vehicle. The Malfunction Indicator Lamp (MIL) will begin to flash.

The MIL displays three digit codes by flashing the first digit, pausing, then flashing the second digit, pausing, and then flashing the third digit. There will be a long pause between codes. For example, a code 143 would be one flash followed by four flashes followed by three flashes.

The MIL will first display a 166 three times. Code 166 indicates that the ECM based diagnostic routines are functioning. Then, any Diagnostic Trouble Codes stored in memory will display three times each. The MIL will then start over with the code 166. If the vehicle is started while the diagnostic jumper is in place, the MIL will flash rapidly.

Diagnostic Trouble Codes may be cleared from the system ECM memory by moving the ignition key to the OFF position and removing the (F1) system battery fuse for at least 15 seconds. **Note:** This will erase all of the memory in the computer including the adaptive learn.

## DTC 111-IAT High Voltage



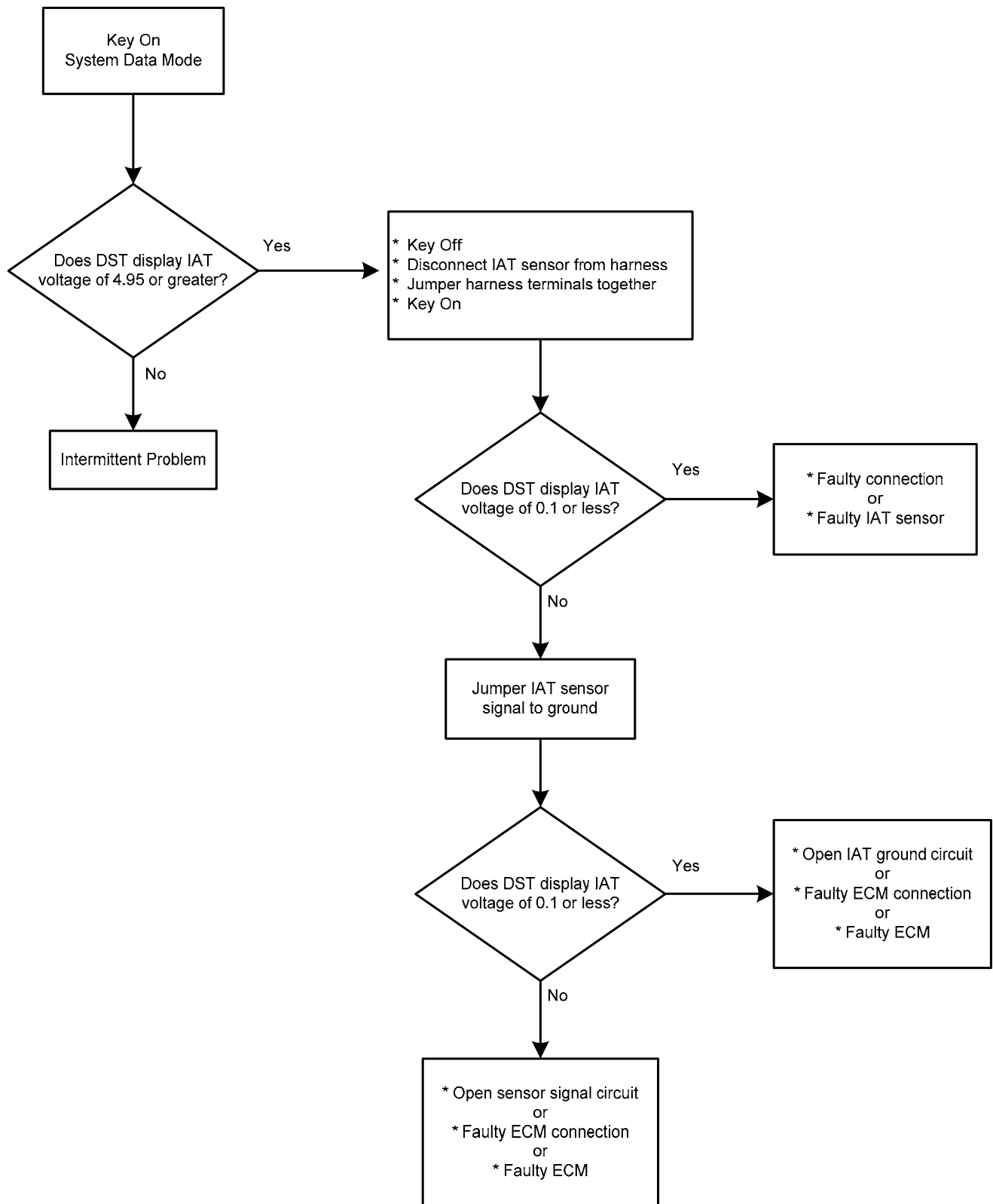
- Intake Air Temperature
- Check Condition-Engine Running
- Fault Condition-IAT Sensor Voltage greater than 4.95
- MIL-On during active fault and for 2 seconds after active fault
- Adaptive-Disabled during active fault
- Closed Loop-Enabled

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.

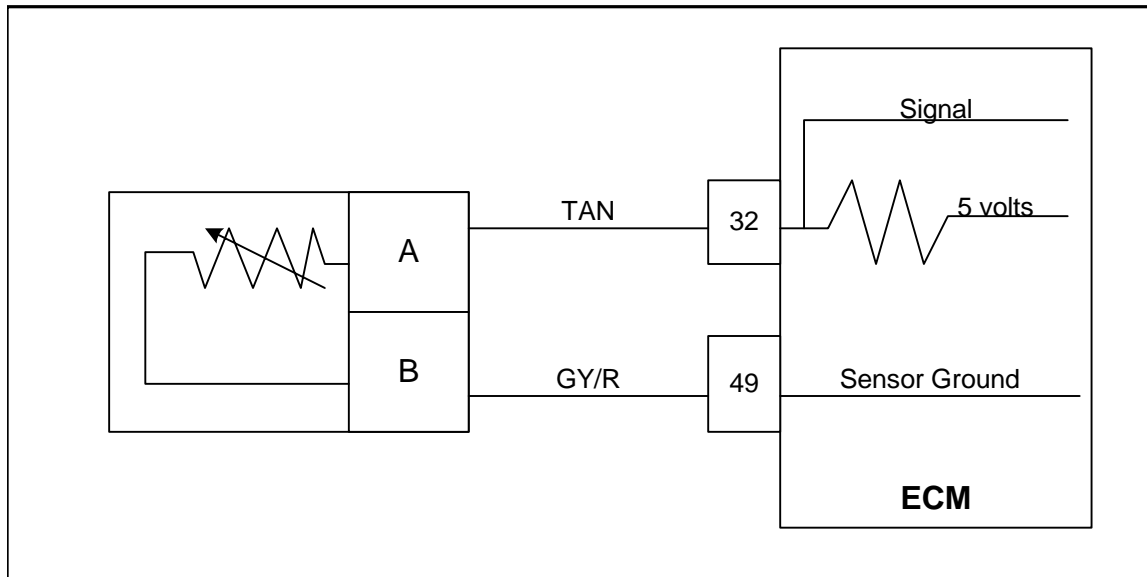
This fault will set if the signal voltage is more than 4.95 volts anytime the engine is running. The ECM will use the default value for the IAT sensor in the event of this fault.

# DTC 111-IAT High Voltage





## DTC 112-IAT Low Voltage



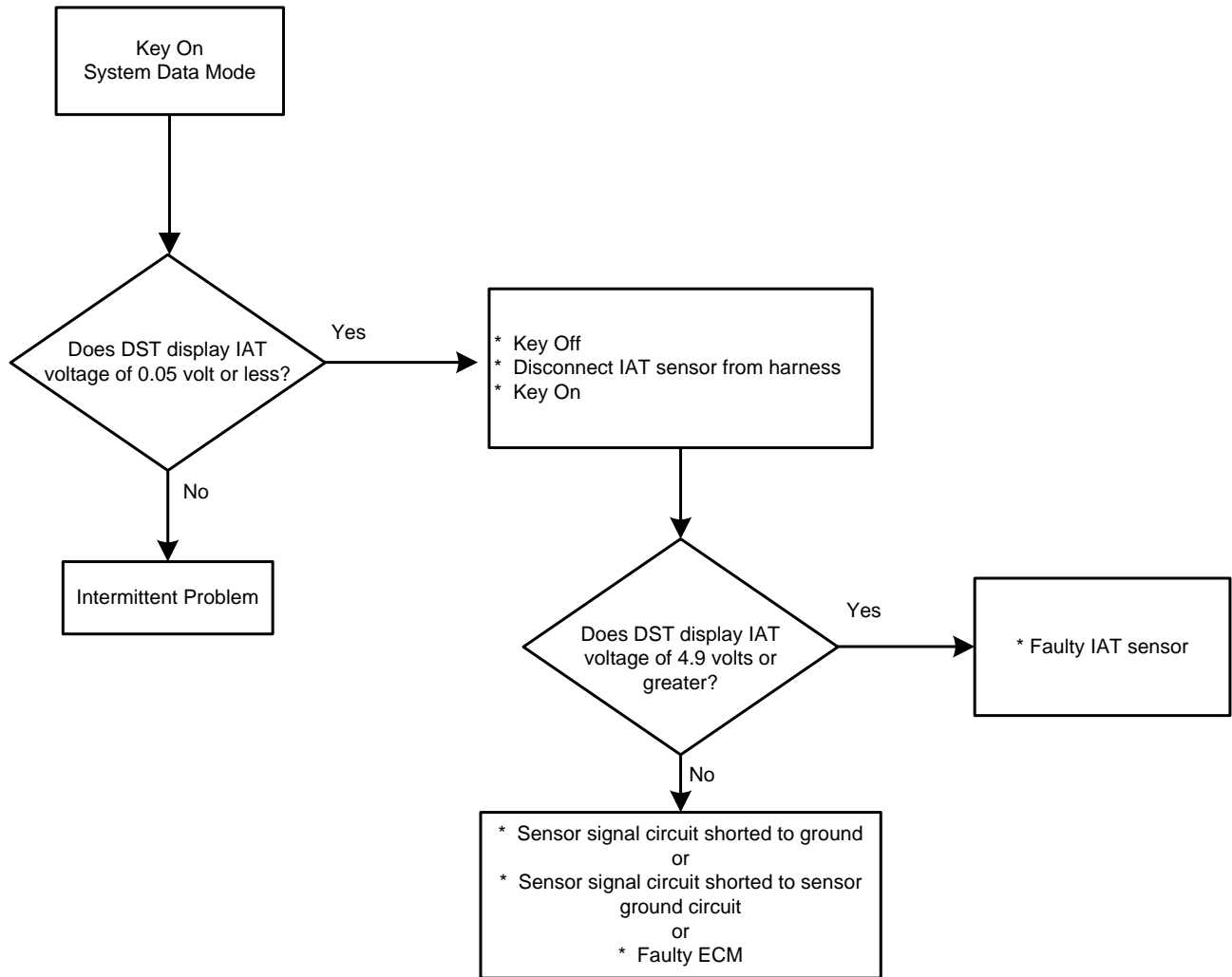
- Intake Air Temperature
- Check Condition-Cranking or Running
- Fault Condition-IAT Sensor voltage less than 0.05
- MIL-On during active fault and for 2 seconds after active fault
- Adaptive-Disabled during active fault
- Closed Loop-Enabled and allowed to stay at limit if needed (will still set limit fault)

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.

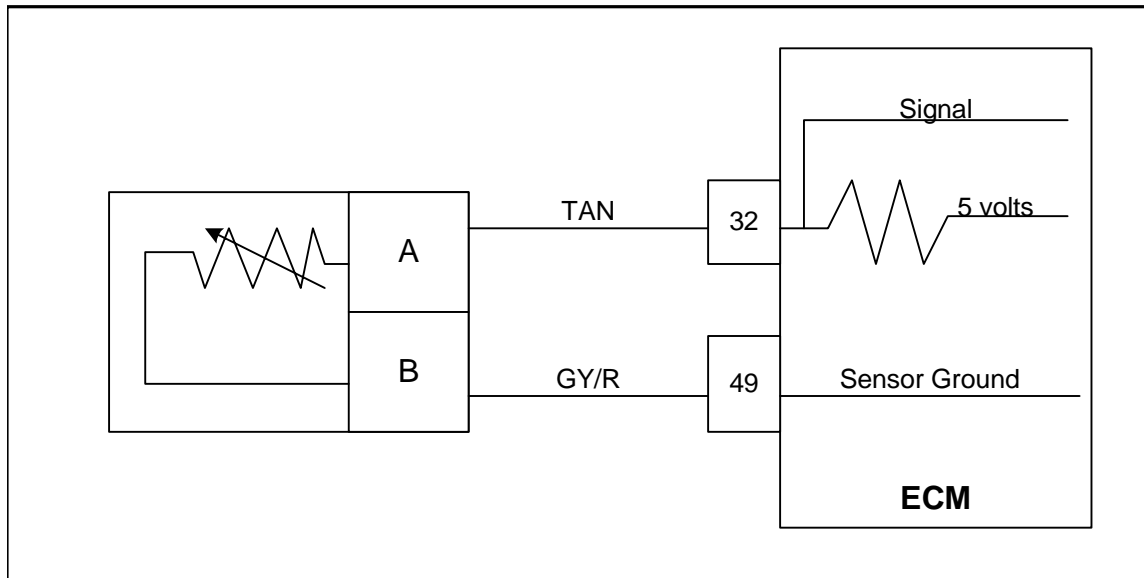
The Manifold Air Temperature is a calculated value based mainly on the IAT sensor at high airflow, and influenced more by the ECT/CHT at low airflow. It is used to monitor incoming air and the output, in conjunction with other sensors, is used to determine the airflow to the engine.

This fault will set if the signal voltage is less than 0.05 volts anytime the engine is cranking or running. The ECM will use a default value for the IAT sensor in the event of this fault.

# DTC 112-IAT Low Voltage



## DTC 113-IAT Higher Than Expected 1



- Intake Air Temperature
- Check Condition-Engine Running
- Fault Condition-Intake Air Temperature greater than 210 deg.F and engine RPM greater than 1000
- MIL-Will flash at 2 Hz (twice per second) during active fault
- Adaptive-Disabled during active fault
- Closed Loop-Enabled
- Power Derate (Level 1)

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.

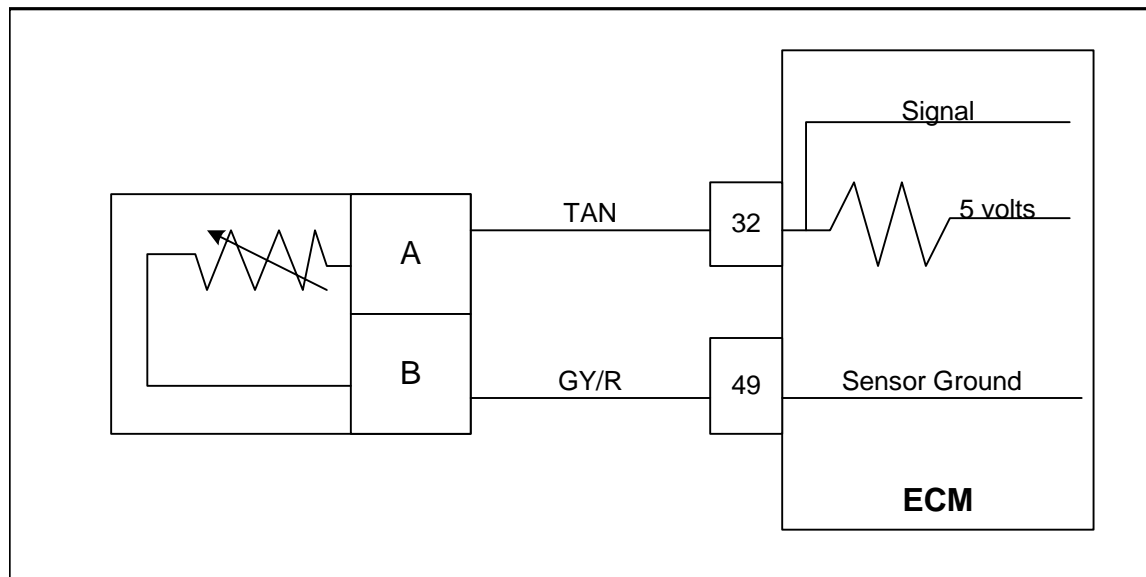
This fault will set if the Intake Air Temperature is greater than 210 deg.F and engine RPM is greater than 1000 and Power Derate 1 will be enforced. During this fault, maximum throttle position is 50% and the MIL light will flash twice per second.

# **DTC 113-IAT Higher Than Expected 1**

## **Diagnostic Aids**

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

## DTC 114-IAT Higher Than Expected 2



- Intake Air Temperature
- Check Condition-Engine Running
- Fault Condition-Intake Air Temperature greater than 220 deg.F and engine RPM greater than 1000
- MIL-On for active fault and for 15 seconds after active fault
- Adaptive-Disabled during active fault
- Closed Loop-Enabled
- Engine Shut Down

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.

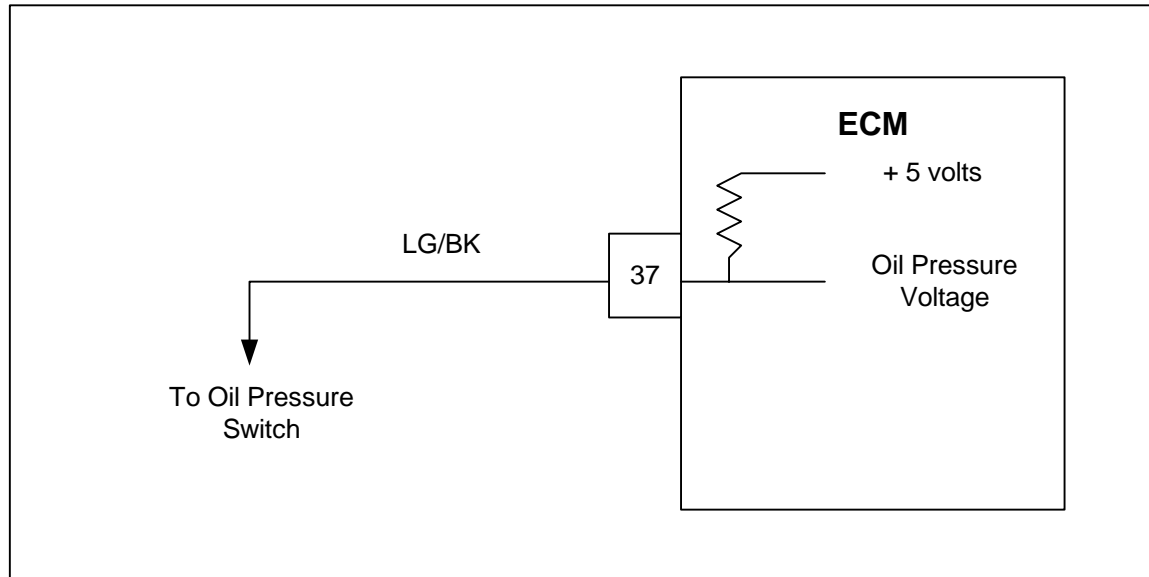
This fault will set if the Intake Air Temperature is greater than 220 deg.F and engine RPM is greater than 1000. The MIL light will be on during this active fault and the engine will shut down.

## **DTC 114-IAT Higher Than Expected 2**

### **Diagnostic Aids**

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

## DTC 115-Oil Pressure Low



- Engine Oil Pressure low
- Check Condition-Engine running for 15 seconds and RPM greater than 1300
- Fault Condition-Depends on configuration of individual ECM (see below)
- MIL-On during active fault and for 3 seconds after active fault
- Adaptive-Enabled
- Closed Loop-Enabled
- Engine Shut Down

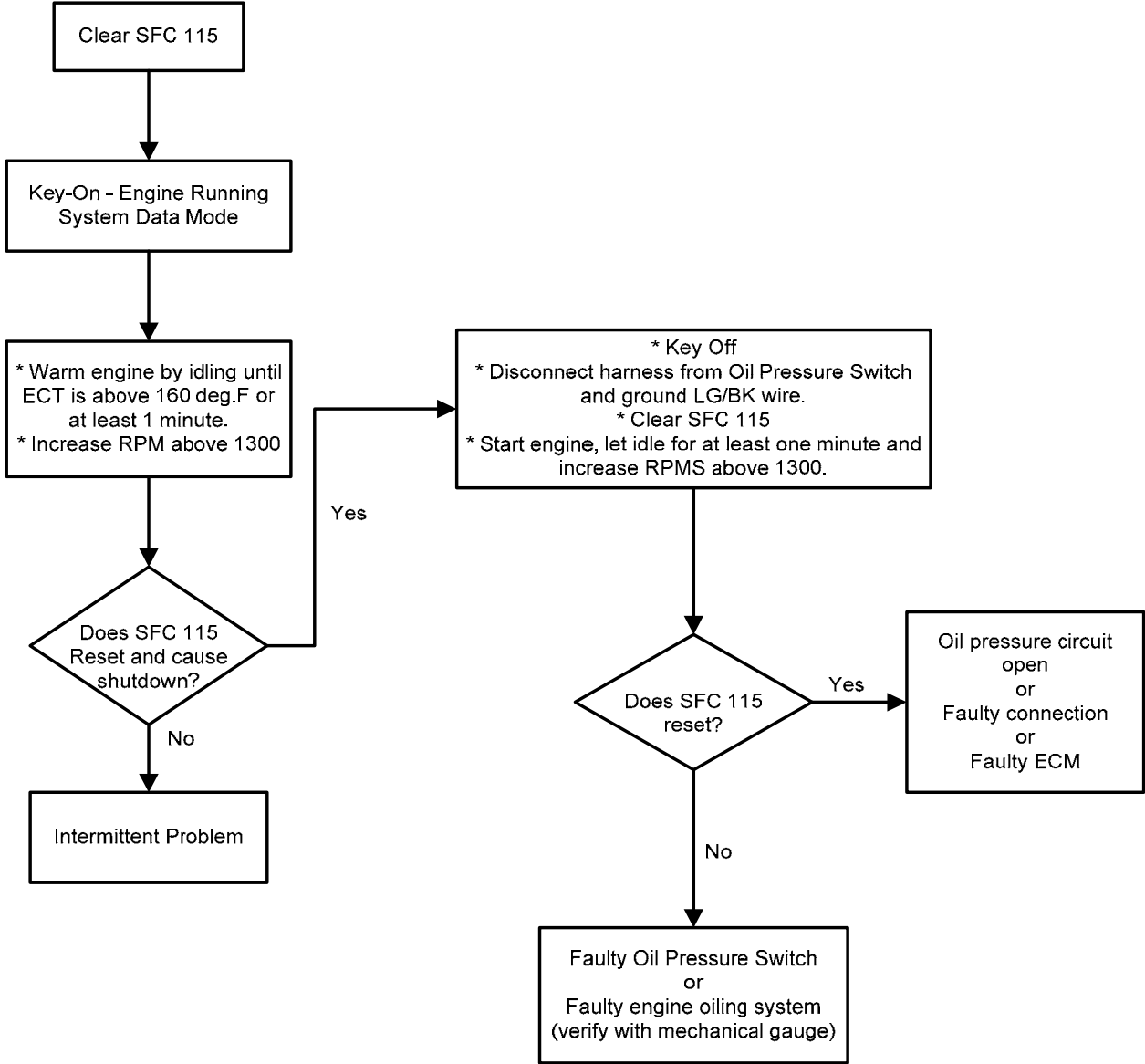
The Oil Pressure Switch is used to indicate a low pressure condition to the ECM. Engine damage can occur if the engine is operated with low oil pressure.

The ECM uses an analog voltage input with an internal 5 volt reference. If the oil pressure circuit is grounded, the input voltage will be near zero. If it is open, the input will be near 5 volts.

This fault can be configured two different ways. It may use a normally closed switch or a normally open switch. If the switch is normally open, the fault will set if the circuit becomes grounded. If the switch is normally closed, the fault will set if the circuit becomes open. Go to the Fault page on Diagnostic Tool to determine how the input is configured. (“Open is OK” is normally open and “Ground is OK” is normally closed)

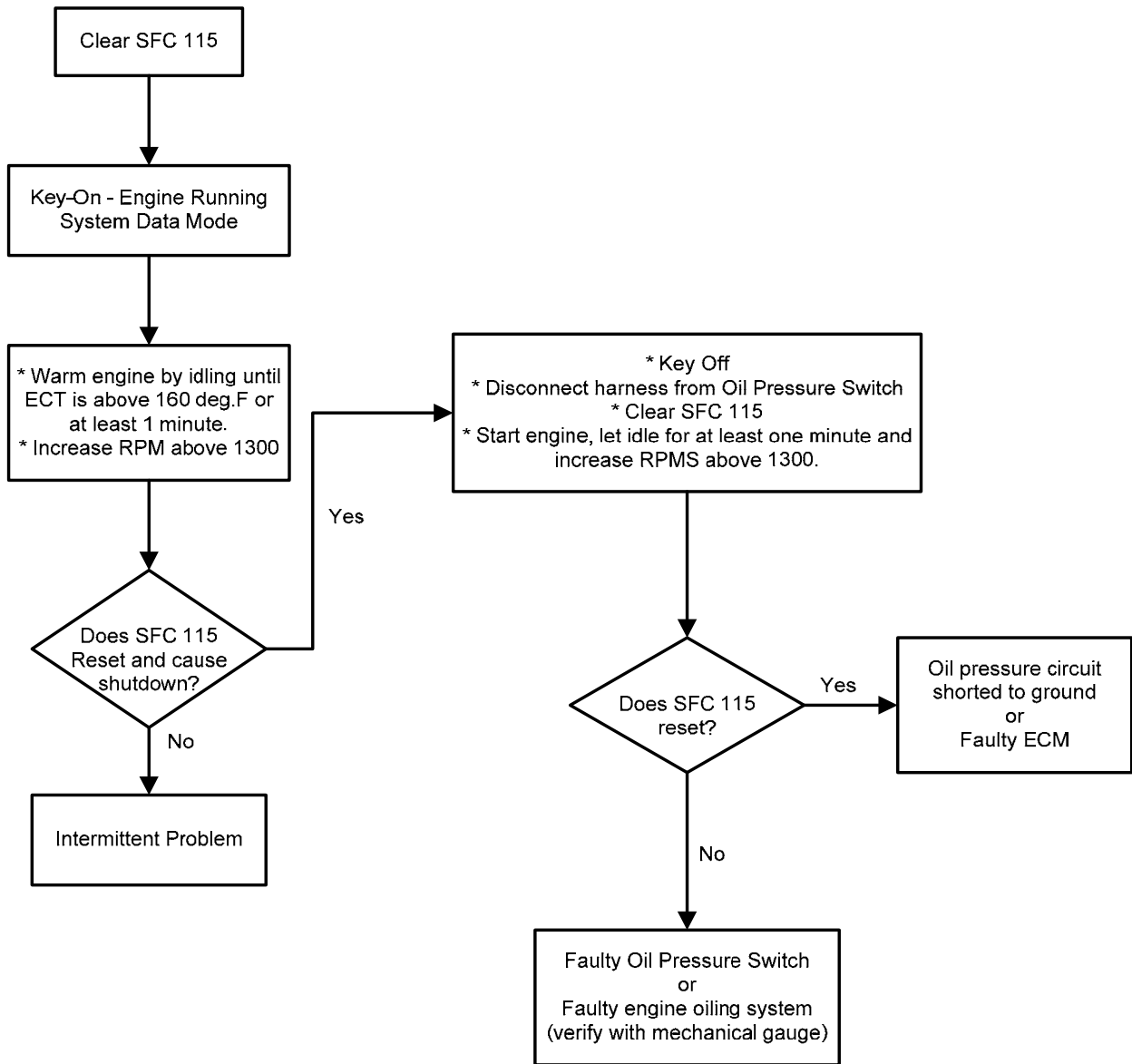
The engine will shut down in the event of this fault to help prevent possible damage.

# DTC 115-Oil Pressure Low (Normally Closed Switch)

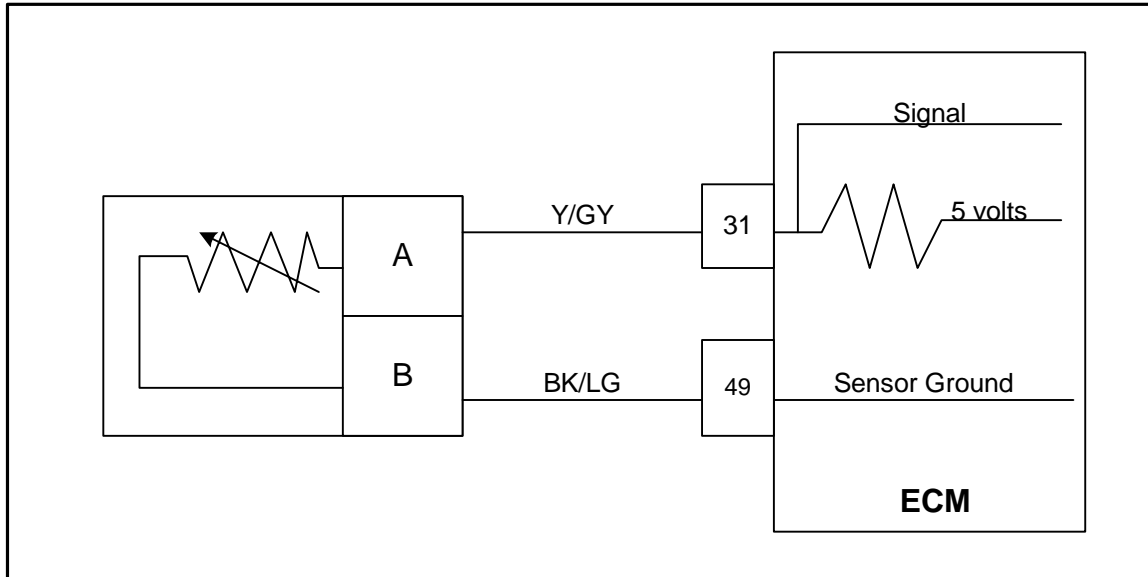




# DTC 115-Oil Pressure Low (Normally Open Switch)



## DTC 121-CHT / ECT High Voltage

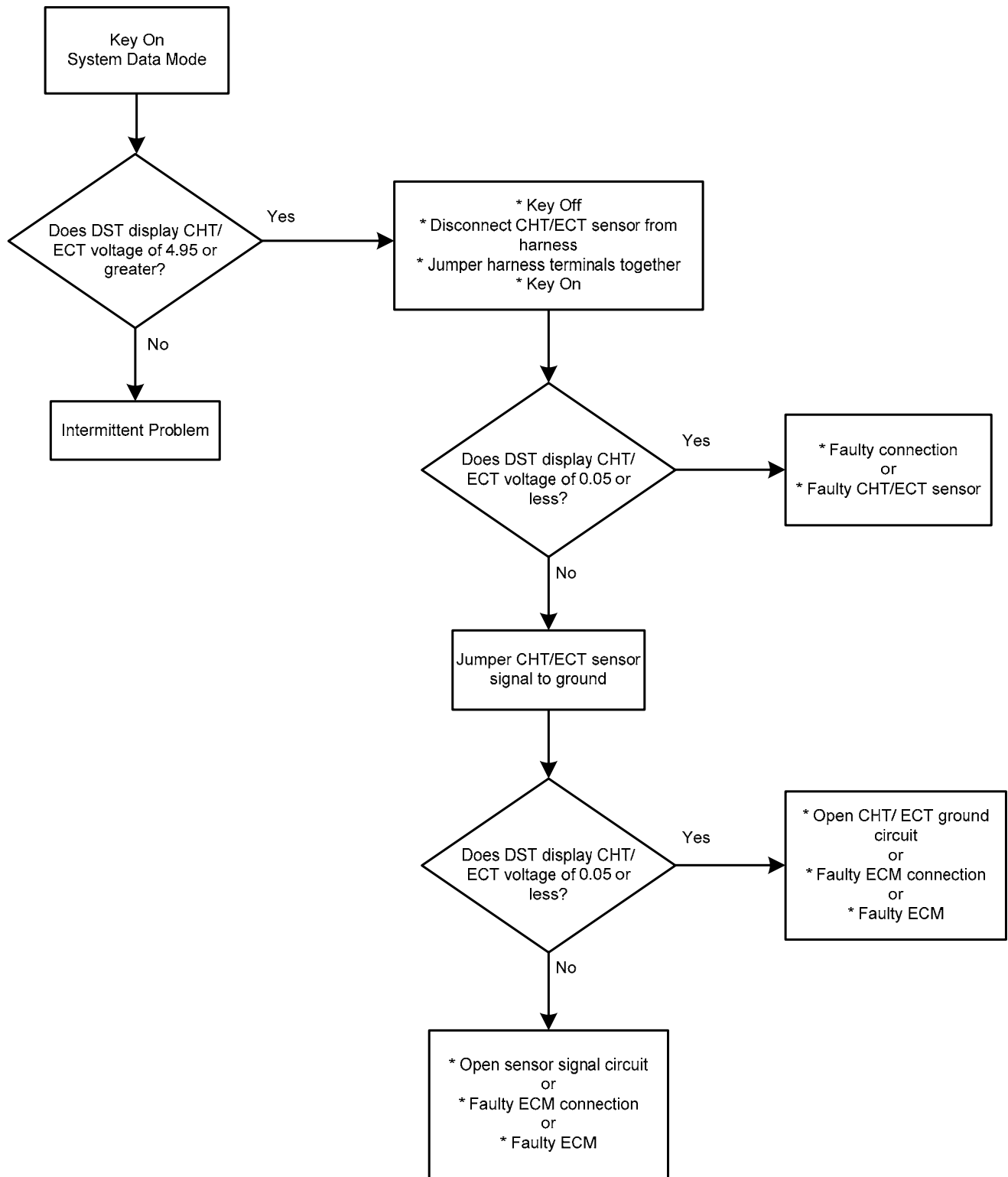


- Engine Coolant Temperature
- Check Condition-Engine Running
- Fault Condition-CHT/ECT sensor voltage exceeds 4.95
- MIL-On during active fault and for 2 seconds after active fault
- Adaptive-Disabled during active fault
- Closed Loop-Enabled

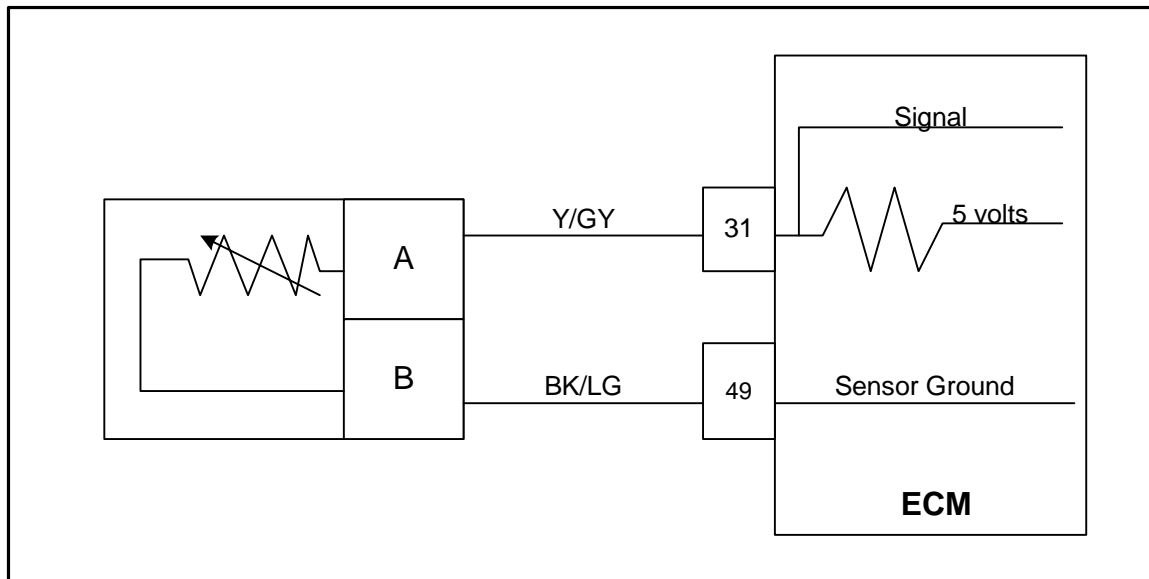
The Engine Coolant Temperature sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. Some engines use an ECT sensor that is located in the coolant near the thermostat. Some engines use a CHT (Cylinder Head Temperature) sensor that is located in the coolant in the cylinder head. If the engine is equipped with an ECT sensor then the CHT value is estimated. If equipped with a CHT sensor then the ECT value is estimated. They are used in the engine airflow calculation, and to enable features. The ECM provides a voltage divider circuit so that when the coolant is cool, the signal reads higher voltage, and lower when warm.

This fault will set if the signal voltage is greater than 4.95 volts anytime the engine is running. The ECM will use a default value for the CHT/ECT sensor in the event of this fault.

# DTC 121-CHT / ECT High Voltage



## DTC 122-CHT / ECT Low Voltage

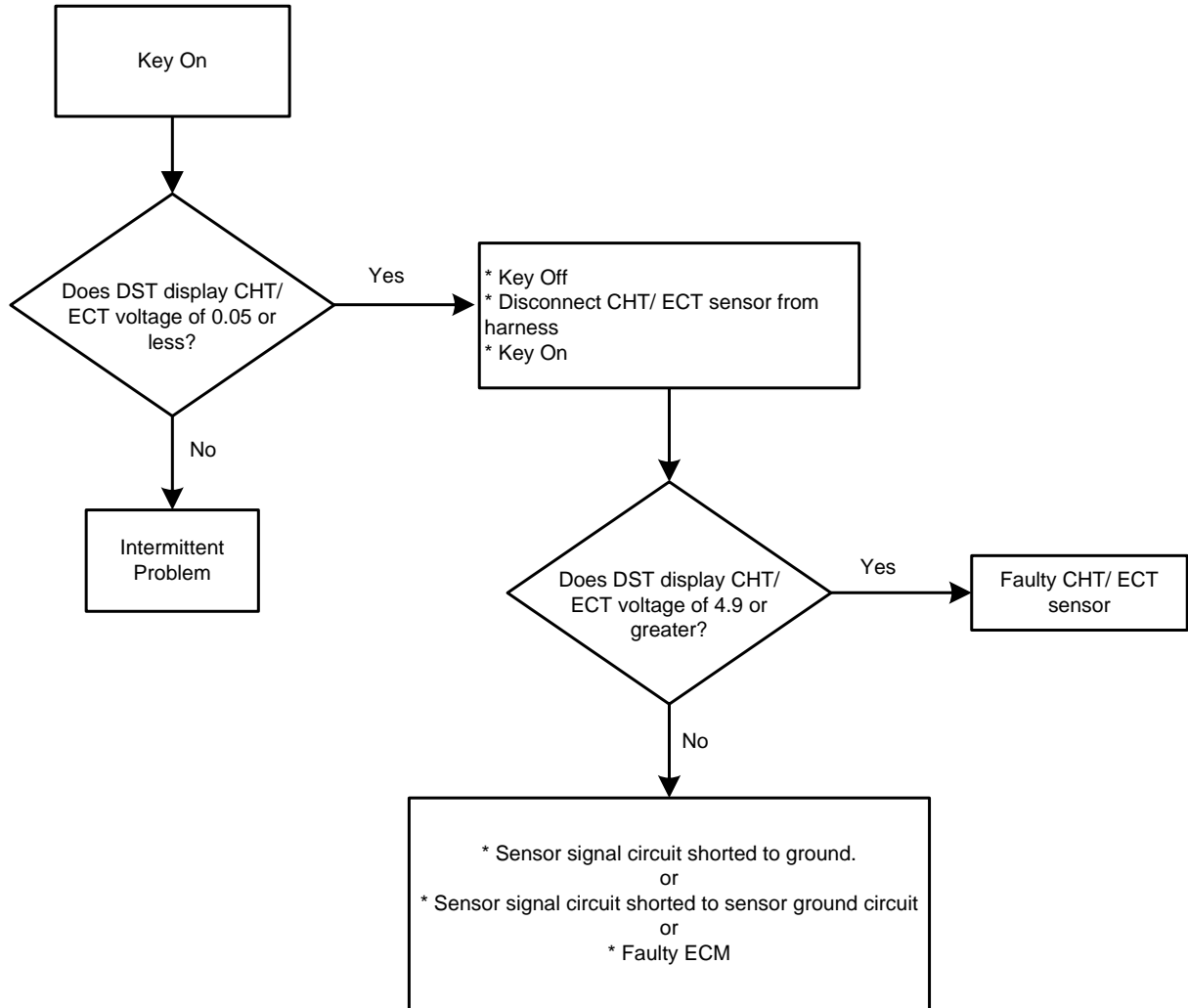


- Engine Coolant Temperature
- Check Condition-Engine Running
- Fault Condition-CHT/ECT sensor voltage less than 0.05
- MIL-On during active fault and for 2 seconds after active fault
- Adaptive-Disabled during active fault
- Closed Loop-Enabled

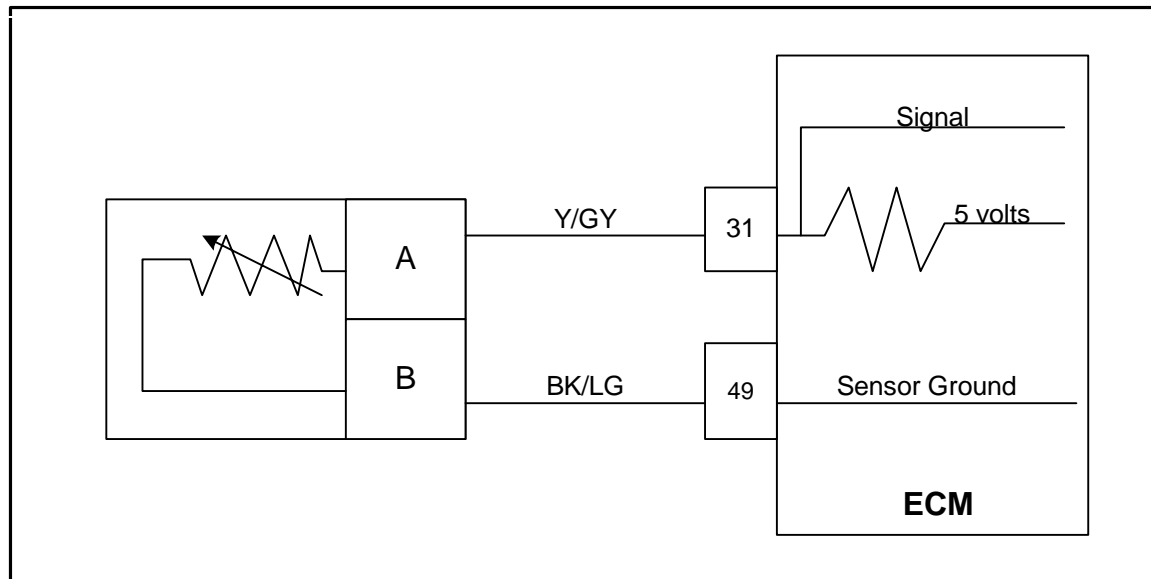
The Engine Coolant Temperature sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. Some engines use an ECT sensor that is located in the coolant near the thermostat. Some engines use a CHT (Cylinder Head Temperature) sensor that is located in the coolant in the cylinder head. If the engine is equipped with an ECT sensor then the CHT value is estimated. If equipped with a CHT sensor then the ECT value is estimated. They are used in the engine airflow calculation, and to enable certain features. The ECM provides a voltage divider circuit so that when the coolant is cool, the signal reads higher voltage, and lower when warm.

This fault will set if the signal voltage is less than 0.05 volts anytime the engine is running. The ECM will use a default value for the CHT/ECT sensor in the event of this fault.

# DTC 122-CHT / ECT Low Voltage



## DTC 123-ECT Higher Than Expected 1

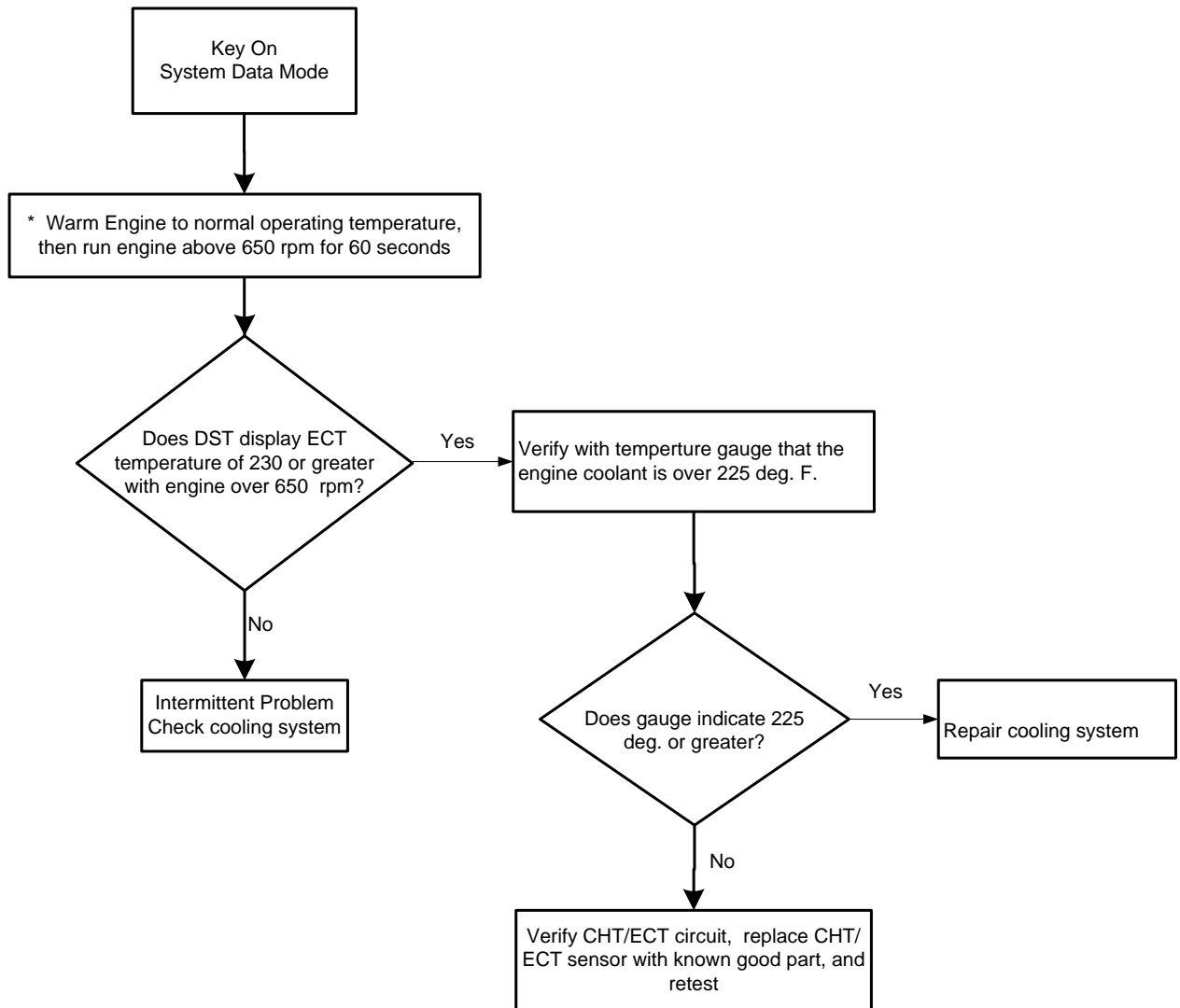


- Engine Coolant Temperature
- Check Condition-Engine Running
- Fault Condition-Engine Coolant Temperature reading or estimate greater than 240 deg. F and engine RPM greater than 650
- MIL-Will flash at 2 Hz (twice per second) during active fault
- Adaptive-Disabled during active fault
- Closed Loop-Enabled and allowed to stay at limit (will still set limit fault)
- Power Derate (level1)

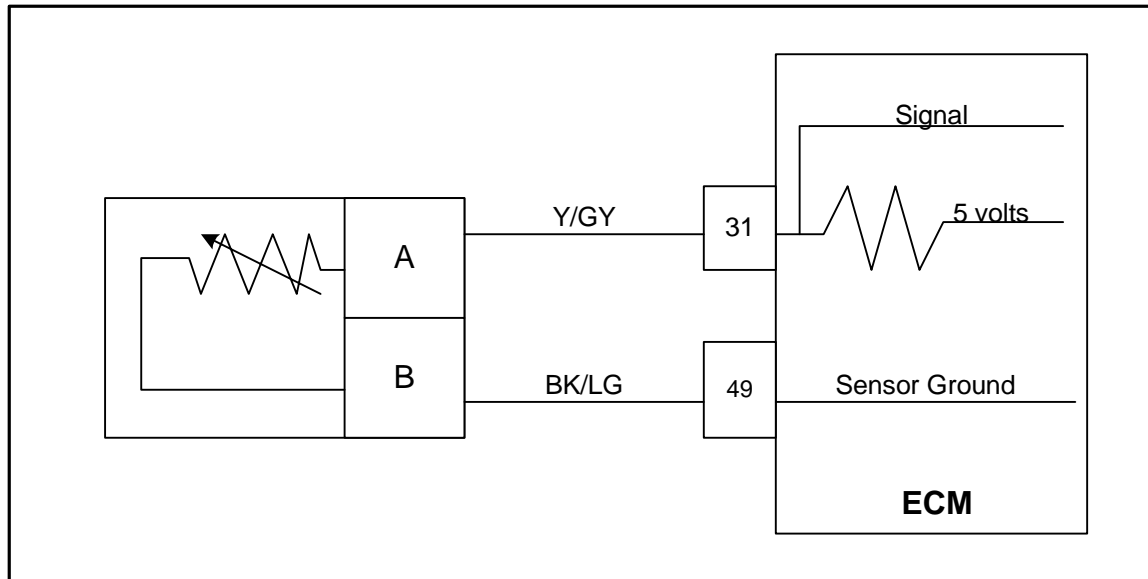
The Engine Coolant Temperature sensor is a thermistor (temperature sensitive resistor) located in the engine coolant. Some engines use a CHT sensor that is located in the coolant in the cylinder head. Some engines use an ECT (Engine Coolant Temperature) sensor that is located in the coolant near the 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.

This fault will help protect the engine in the event of over temperature. When the coolant exceeds 240 deg. F and engine RPM exceeds 650 this fault will set and Power Derate 1 will be enforced. During this fault, maximum throttle position is 50% and the MIL light will flash twice per second.

# DTC 123-ECT Higher Than Expected 1



## DTC 124-ECT Higher Than Expected 2



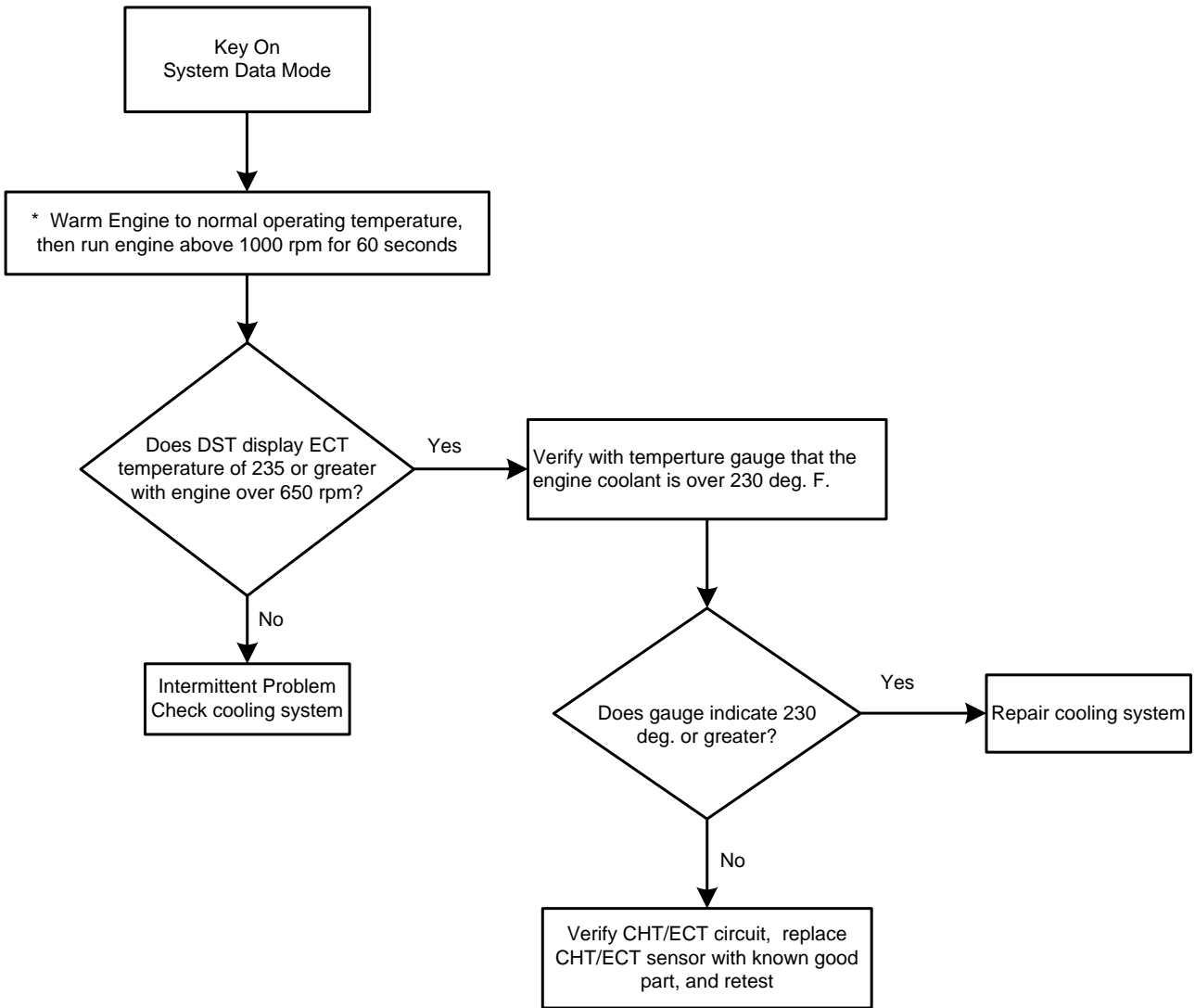
- Engine Coolant Temperature
- Check Condition-Engine Running
- Fault Condition-Engine Coolant temperature reading or estimate greater than 250 deg. F and engine RPM greater than 650
- MIL-On for active fault and for 15 seconds after active fault
- Adaptive-Enabled
- Closed Loop-Enabled and allowed to stay at limit (will still set limit fault)
- Engine Shut Down

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 than 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 signal reads higher voltage, and lower when warm.

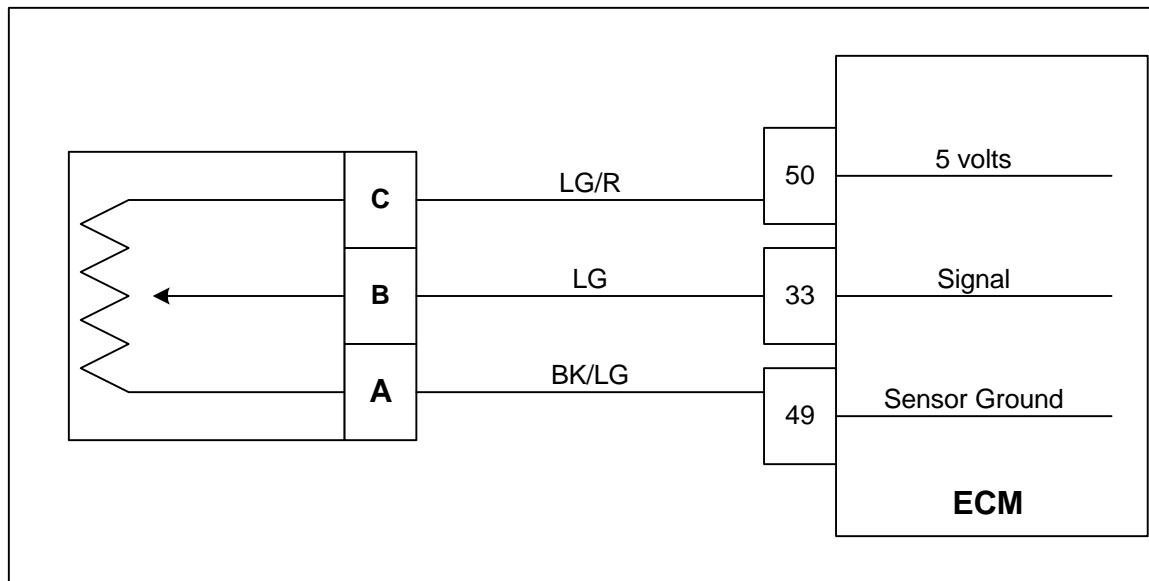
This fault will set to help protect the engine 250 deg.F and engine RPM exceeds in the event of over temperature. When the coolant exceeds 650 this fault will set and the engine will shut down.



# DTC 124-ECT Higher Than Expected 2



## DTC 131-MAP High Pressure

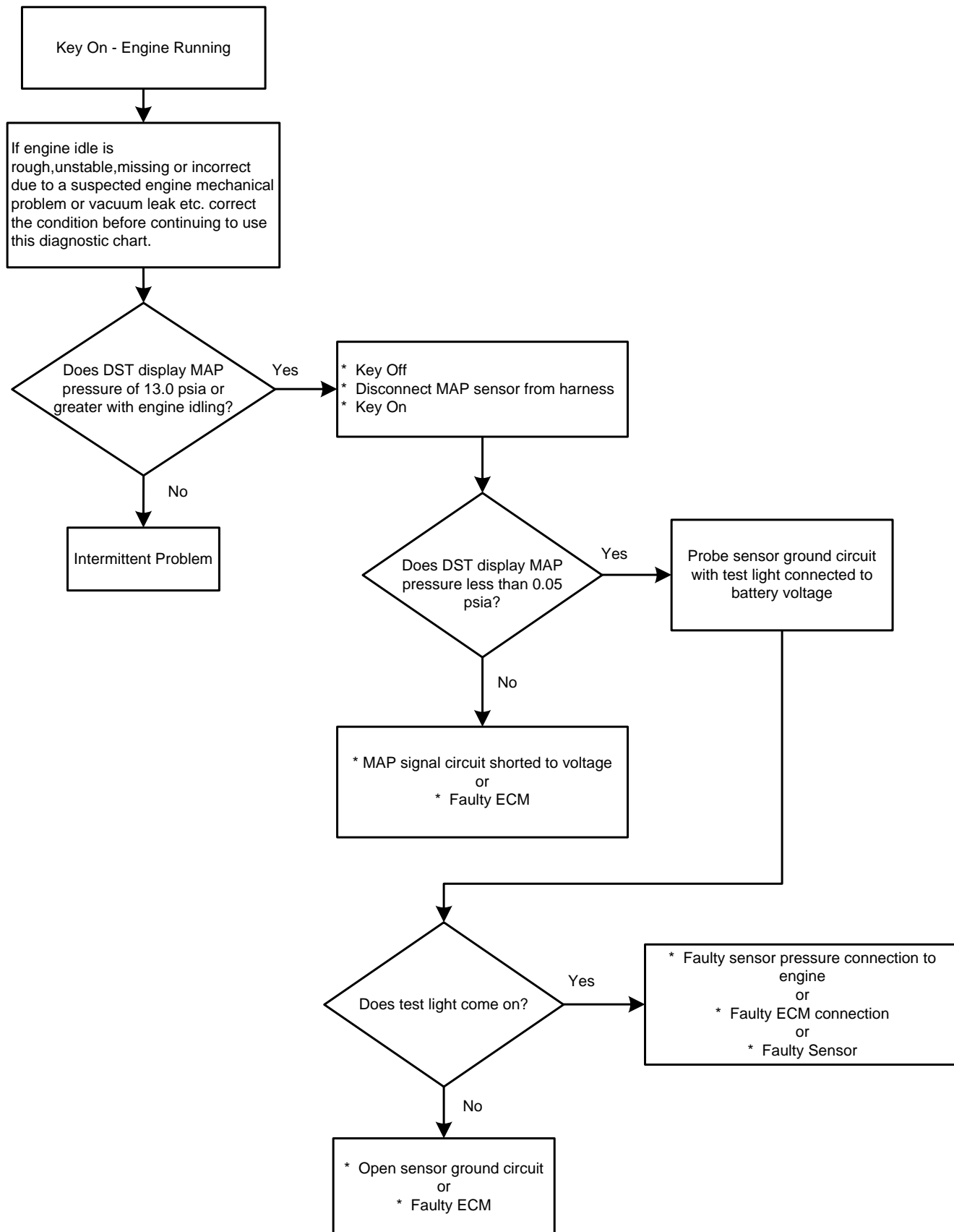


- Manifold Absolute Pressure
- Check Condition-RPM greater than 800, Throttle Command less than 10%, steady MAP and TPS
- Fault Condition-MAP greater than 18 psia, TPS less than 10% and engine RPM greater than 1800.
- MIL-On for remainder of key on cycle
- Adaptive-Disabled for remainder of key on cycle
- Closed Loop-Enabled and allowed to stay at limit
- Misc.-Fueling is based on RPM and TPS Limp-Home Condition during this fault.

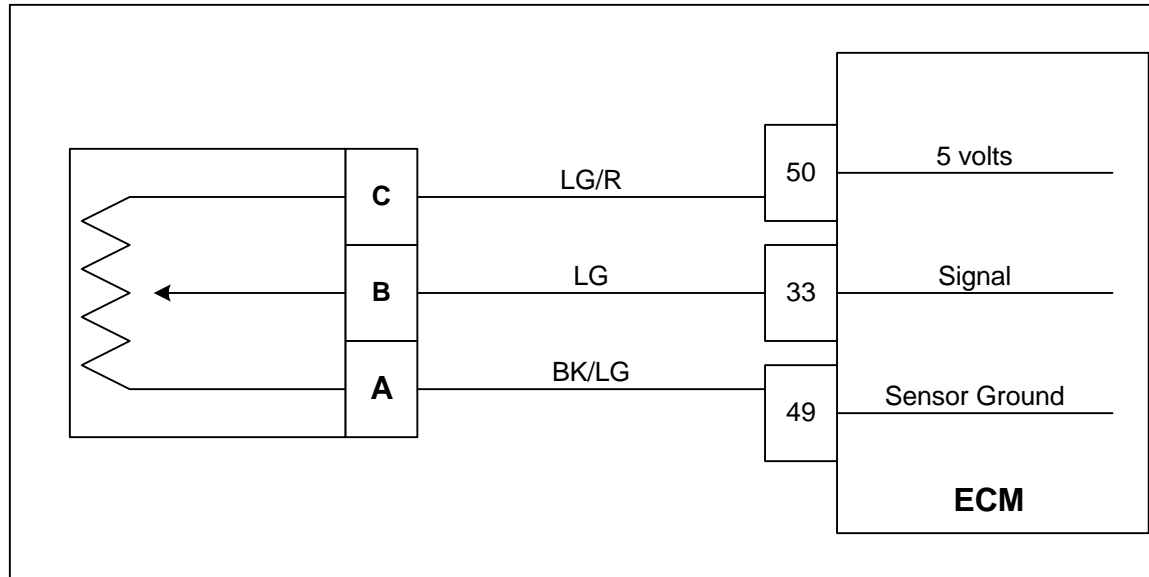
The Manifold Absolute Pressure sensor is a pressure transducer connected to the intake manifold. It is used to measure the pressure of air in the manifold prior to induction into the engine. The pressure reading is used in conjunction with other inputs to determine the airflow rate to the engine, which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

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 Adaptive Learn will be disabled for the remainder of the key on cycle and the MIL will be on. The engine will operate on a default MAP during this active fault.

# DTC 131-MAP High Pressure



## DTC 132-MAP Low Voltage

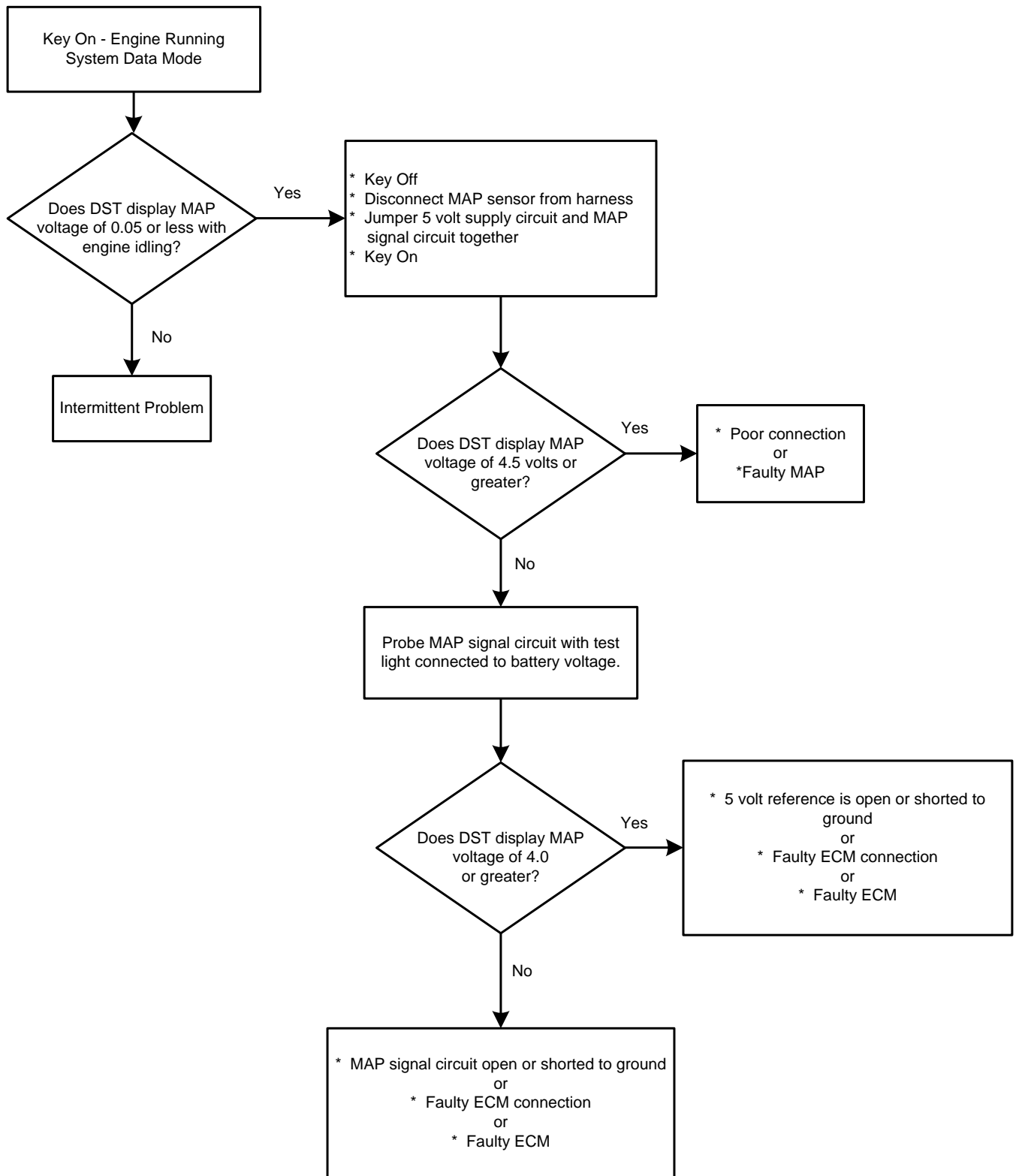


- Manifold Absolute Pressure
- Check Condition-Cranking or Running
- Fault Condition-MAP voltage less than 0.05, Throttle Position greater than 2% and engine RPM less than 7000.
- MIL-On for remainder of key on cycle
- Adaptive-Disabled for remainder of key on cycle
- Closed Loop-Enabled
- Misc.-Fueling is based on RPM and TPS Limp-Home Condition during this fault.

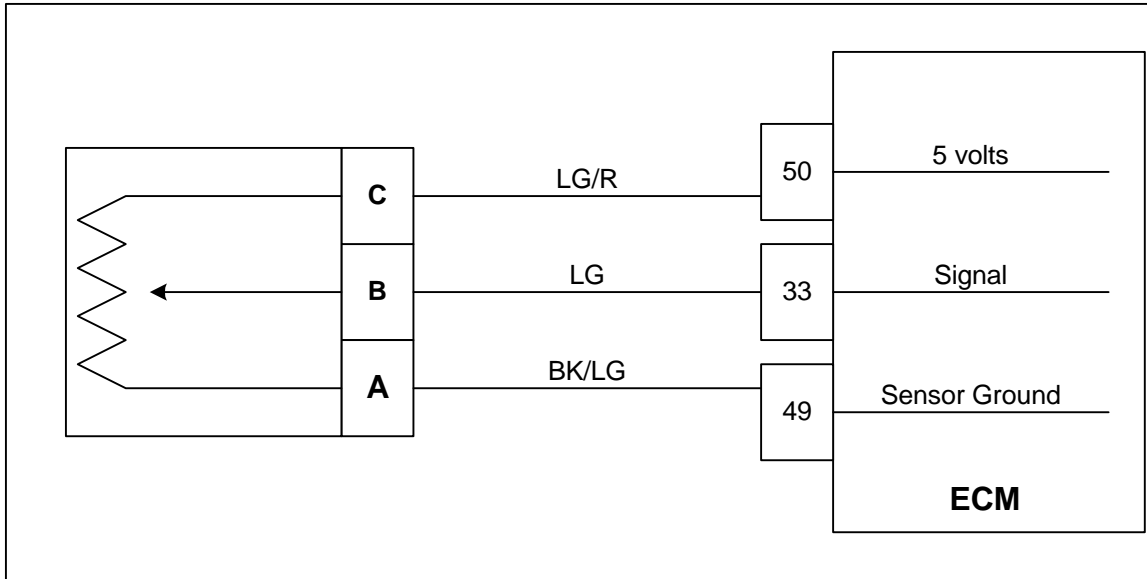
The Manifold Absolute Pressure sensor is a pressure transducer connected to the intake manifold. It is used to measure the pressure of air in the manifold prior to induction into the engine. The pressure reading is used in conjunction with other inputs to determine the airflow rate to the engine, which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

This fault will set when the MAP reading is lower than the sensor should normally produce. When this fault is set the Adaptive Learn will be disabled for the remainder of the key on cycle and the MIL will be on.

# DTC 132-MAP Low Voltage



# DTC 134-BP High Pressure

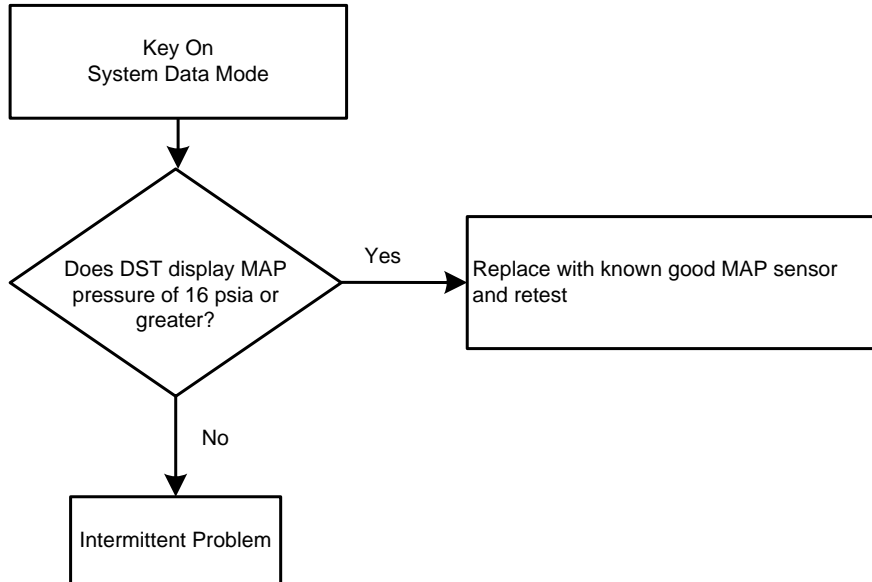


- Barometric Pressure
- Check Condition-Key On
- Fault Condition-BP greater than 16 psia
- MIL-On for active fault and for 2 seconds after active fault
- Adaptive-Disabled for remainder of key on cycle
- Closed Loop-Enabled

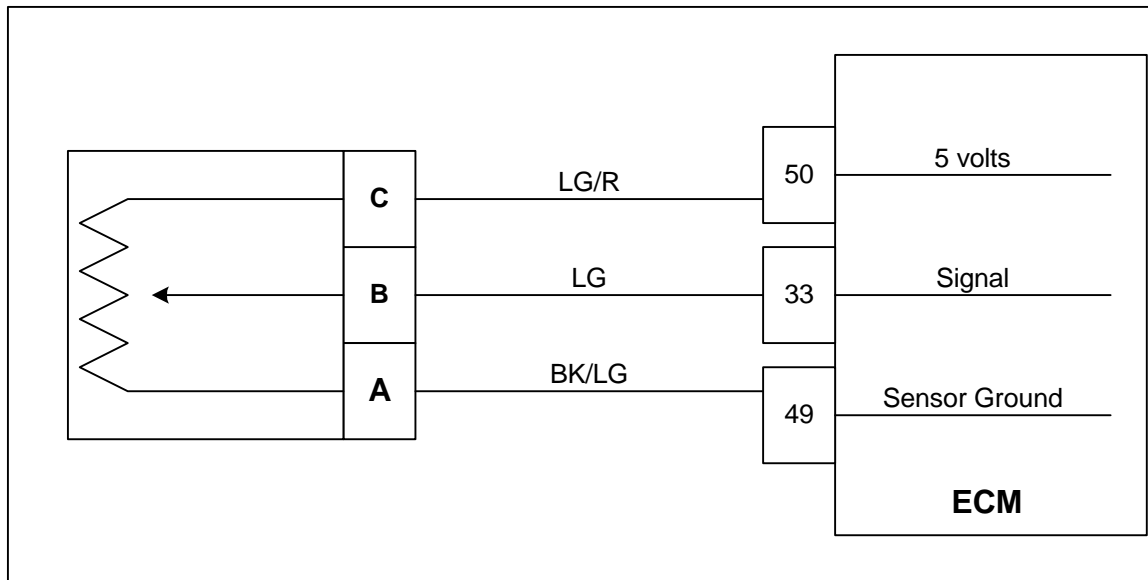
Barometric Pressure is estimated from the MAP sensor. The barometric pressure value is used for fuel and airflow calculations.

This fault sets in the event the BP value is out of the normal range.

# DTC 134-BP High Pressure



## DTC 135-BP Low Pressure



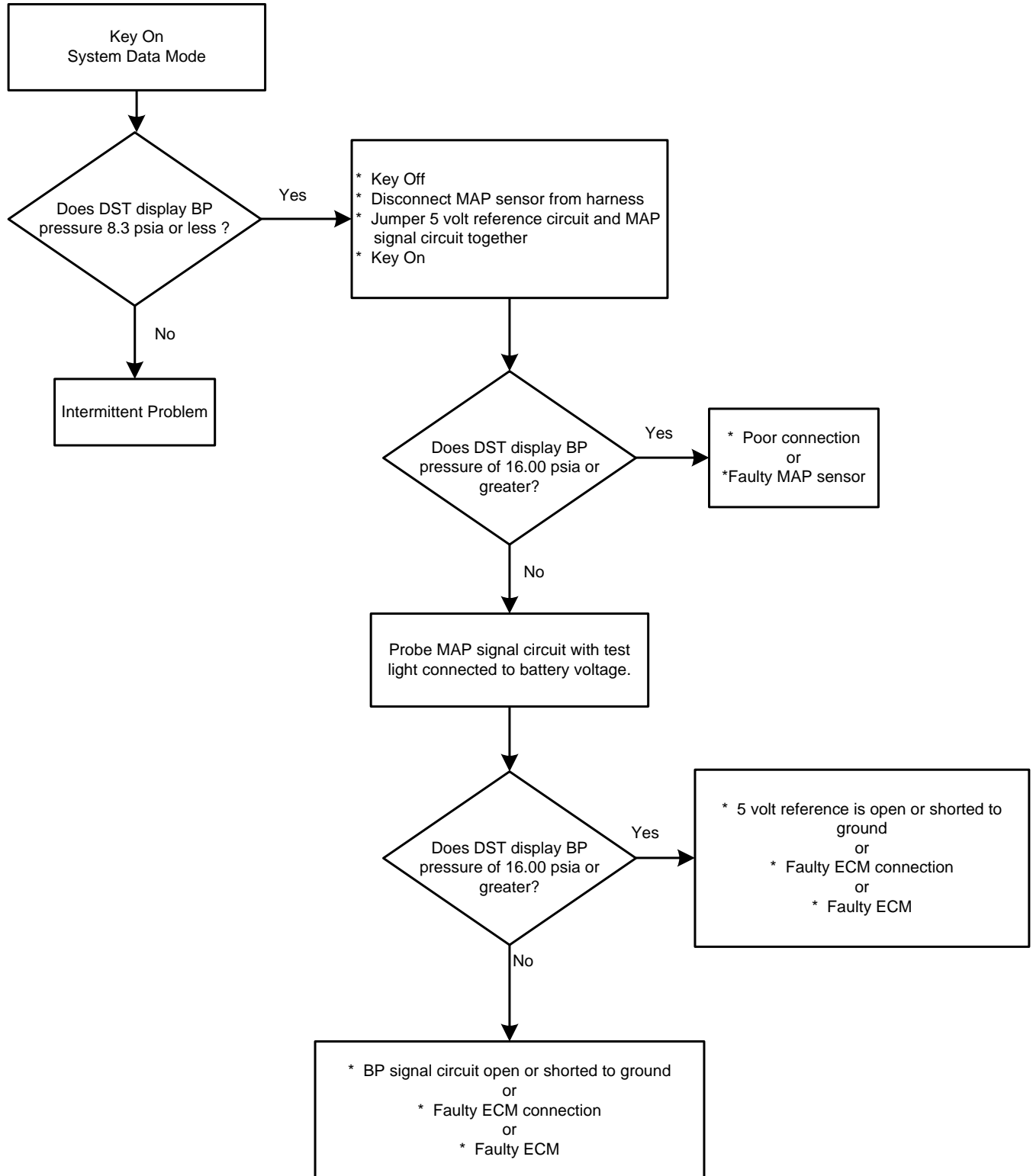
- Barometric Pressure
- Check Condition-Key On
- Fault Condition-BP less than 8.3 psia (approx. 2.5 volts)
- MIL-On for active fault and for 2 seconds after active fault
- Adaptive-Disabled for remainder of key on cycle
- Closed Loop-Enabled

Barometric Pressure is estimated from the MAP sensor. The barometric pressure value is used for fuel and airflow calculations.

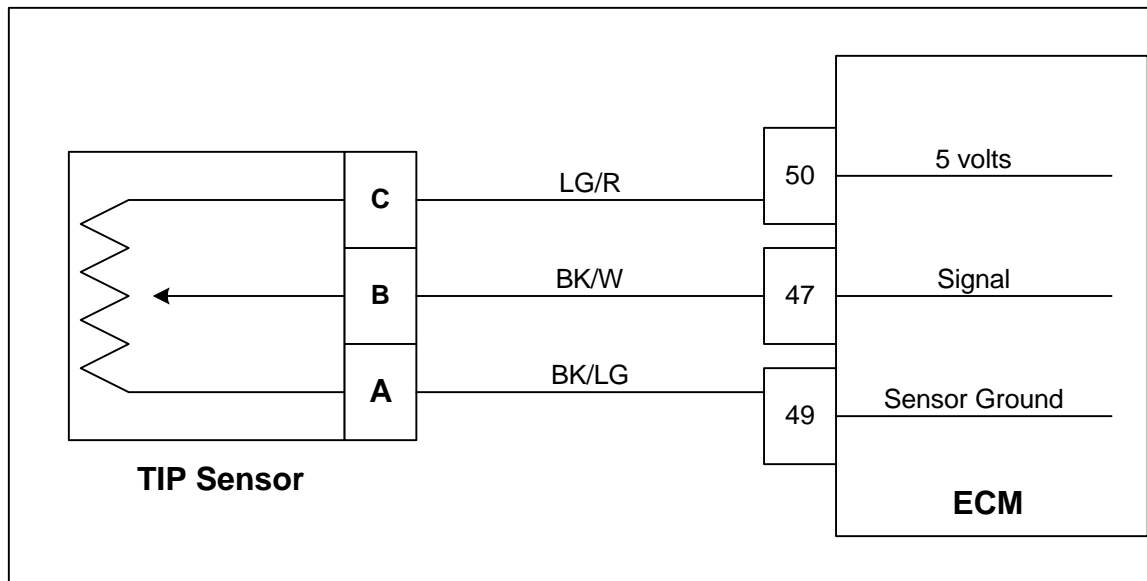
This fault sets in the event the BP value is out of the normal range.



# DTC 135-BP Low Pressure



## DTC 136-TIP Voltage High

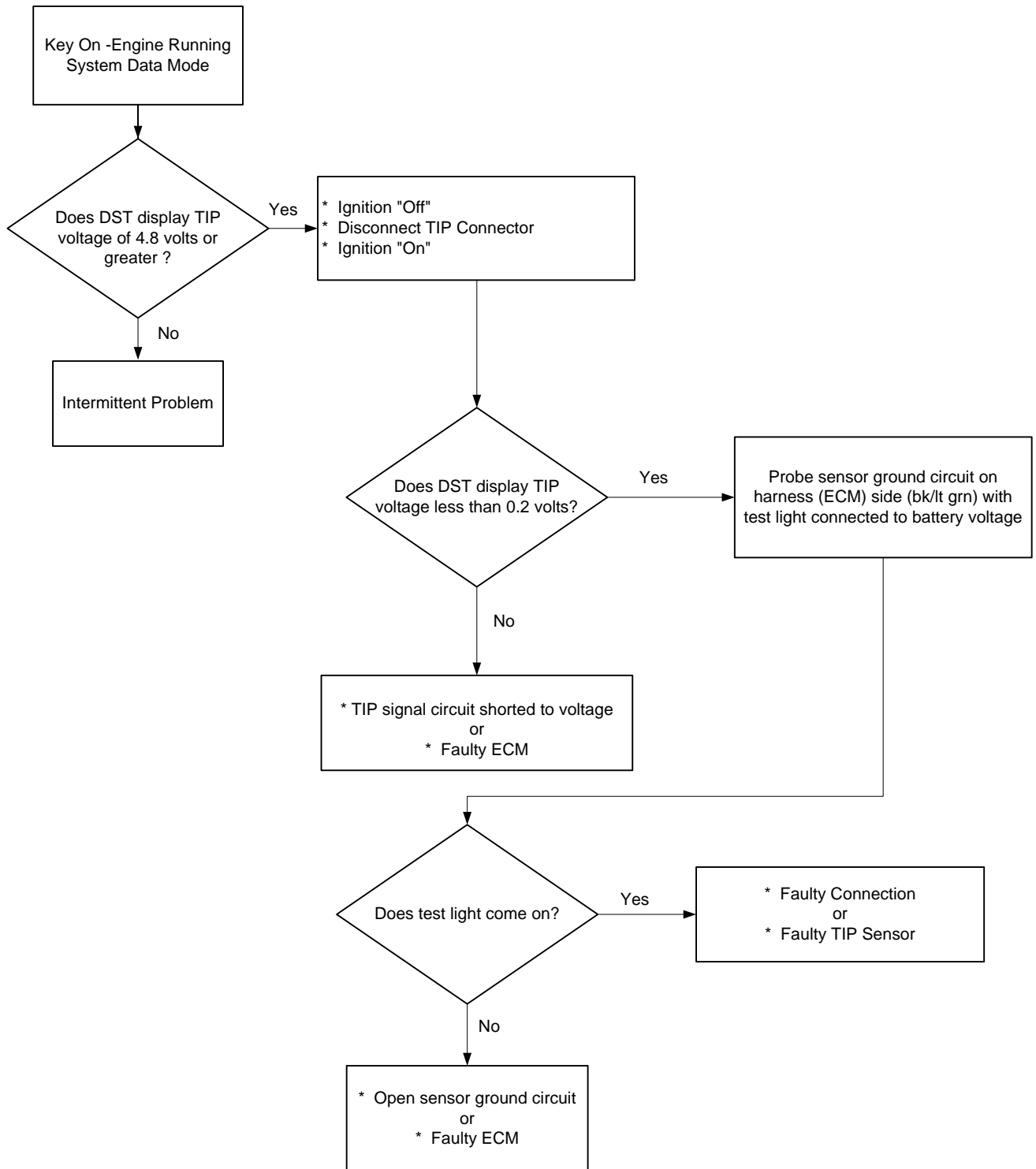


- Throttle Inlet Pressure
- Check Condition- Key-on and engine running
- Fault Condition- TIP voltage greater than 4.8
- MIL- On during active fault
- Adaptive- Enabled
- Closed Loop- Enabled
- Used on turbocharged engines only

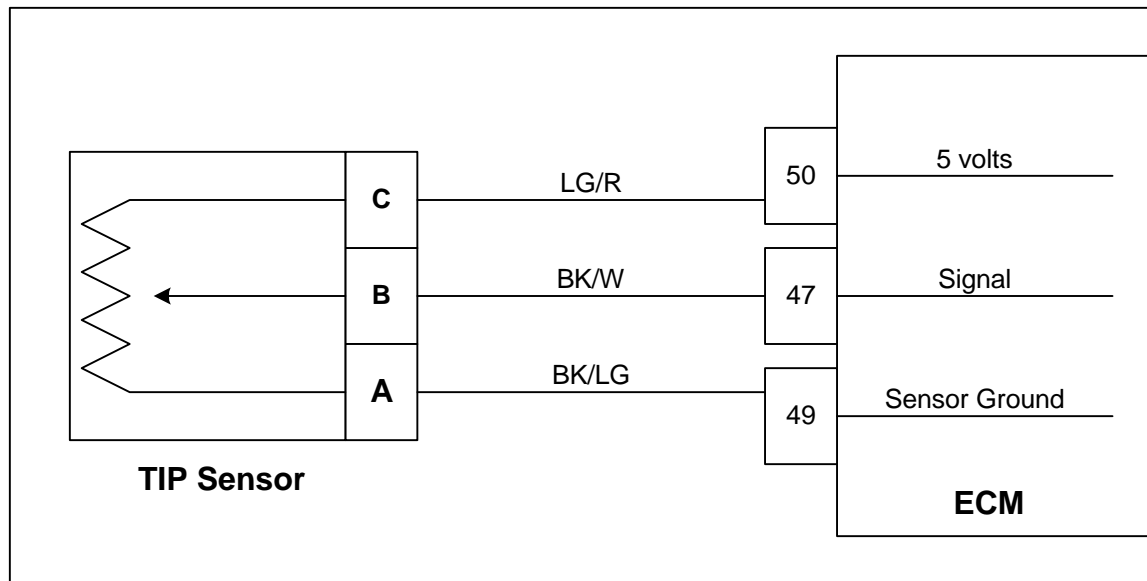
The Throttle Inlet Pressure sensor is a pressure transducer located in the intake air stream between the turbocharger and the throttle. It is used to measure the pressure of air in the intake stream prior to the throttle. The pressure reading is used in conjunction with other inputs to determine the airflow rate to the engine, to aid in engine governing.

This fault will set if the TIP sensor voltage is ever greater than 4.8 volts. During this active fault the MIL will be illuminated.

# DTC 136-TIP Voltage High



## DTC 137-TIP Voltage Low

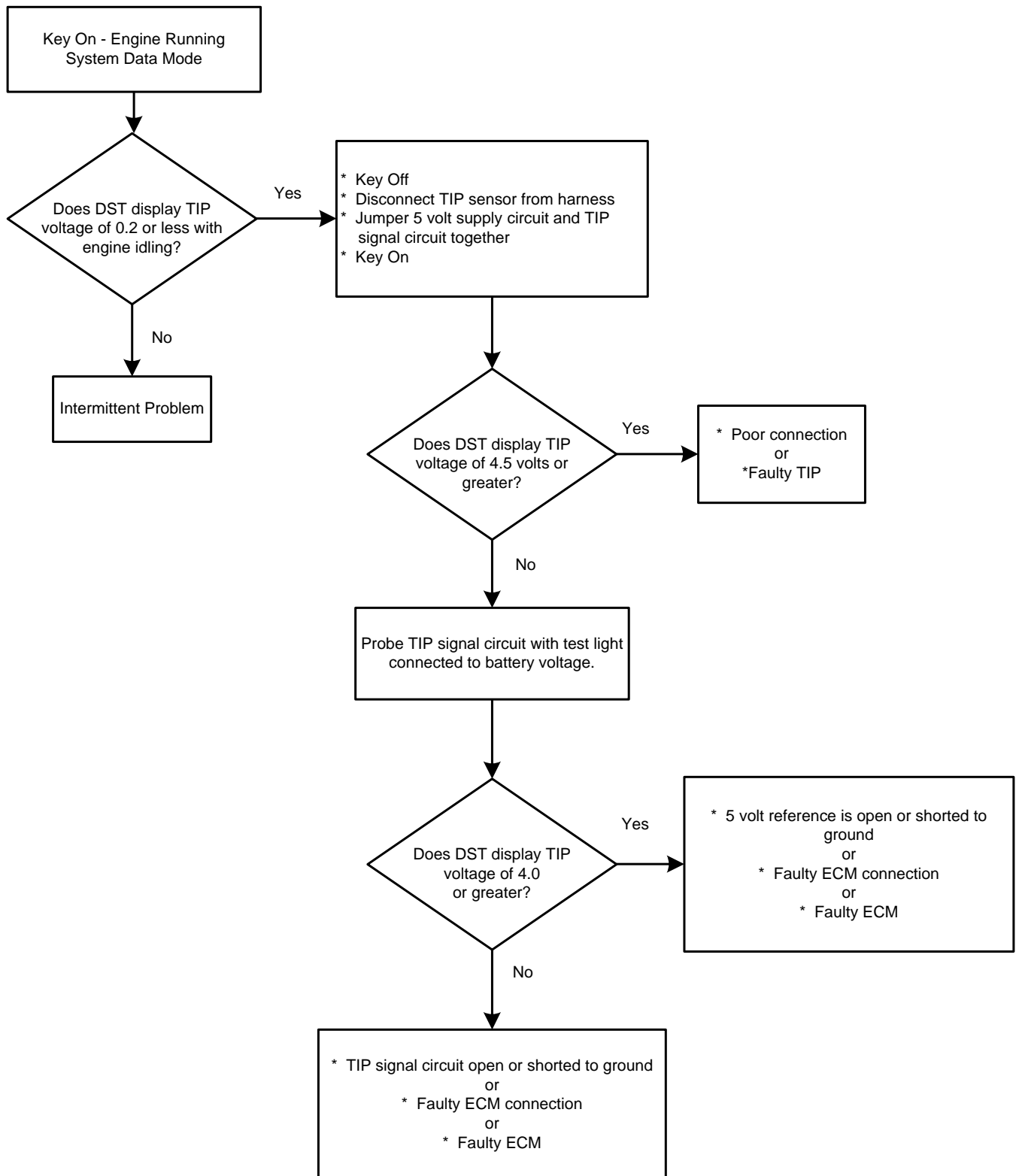


- Throttle Inlet Pressure
- Check Condition- Key-on and engine running
- Fault Condition- TIP voltage less than 0.2
- MIL- On during active fault
- Adaptive- Enabled
- Closed Loop- Enabled
- Used on turbocharged engines only

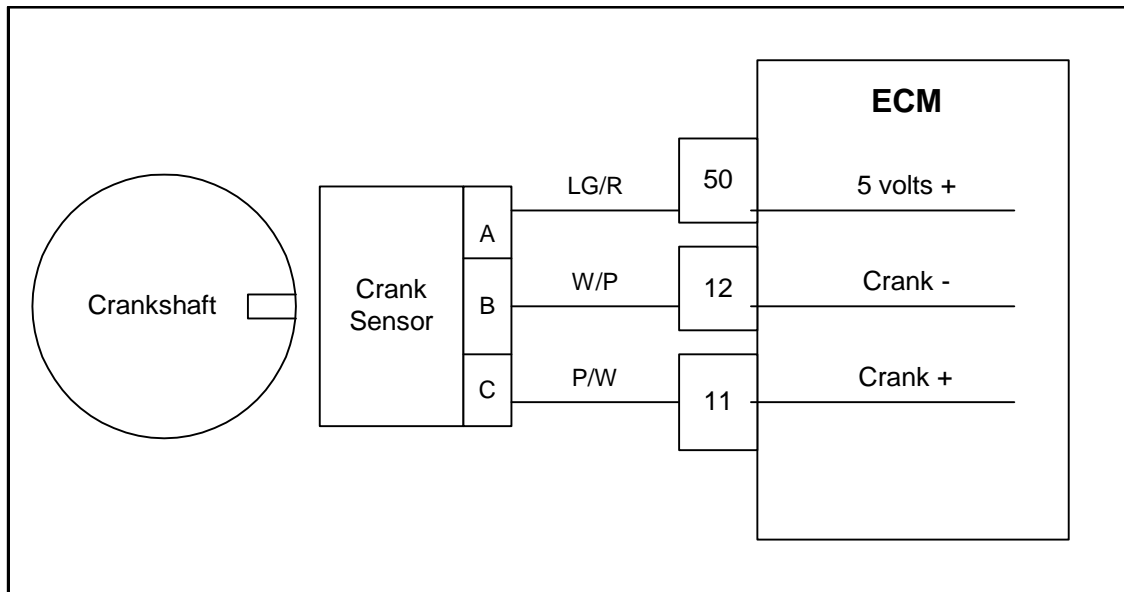
The Throttle Inlet Pressure sensor is a pressure transducer located in the intake air stream between the turbocharger and the throttle. It is used to measure the pressure of air in the intake stream prior to the throttle. The pressure reading is used in conjunction with other inputs to determine the airflow rate to the engine, to aid in engine governing.

This fault will set if the TIP sensor voltage is ever less than 0.2 volts. During this active fault the MIL will be illuminated.

# DTC 137-TIP Voltage Low



## DTC 142-Crank Sync Noise

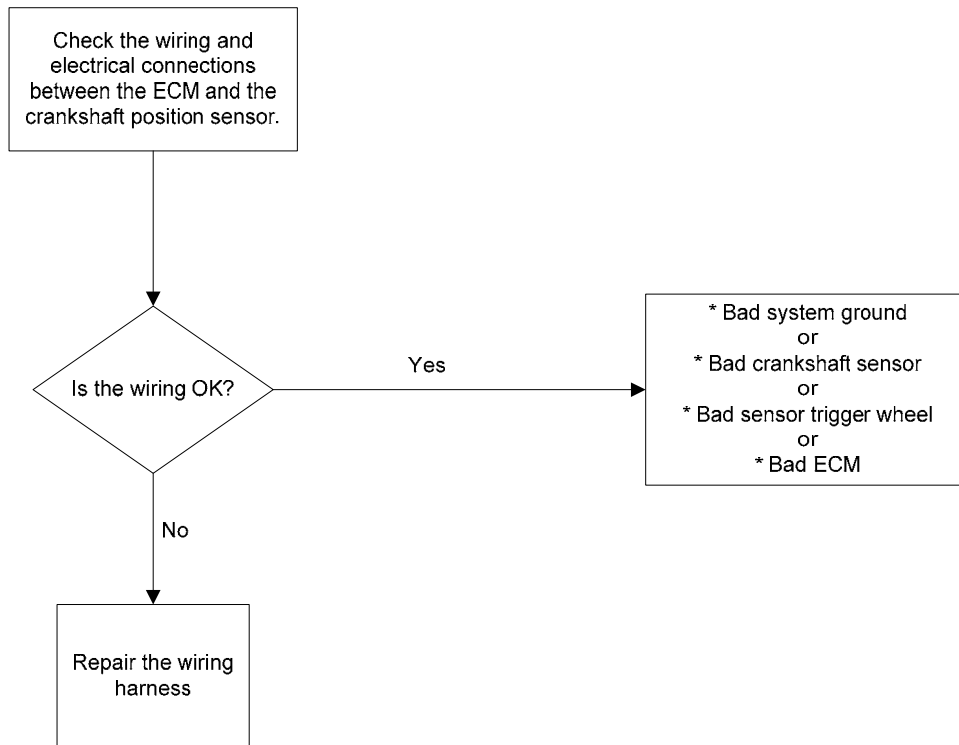


- Crankshaft Position sensor
- Check Condition- Engine running
- Fault Condition- 1 invalid crank re-sync
- MIL- On during active fault and for 10 seconds after active fault
- Adaptive- Disabled for the remainder of the key-on cycle
- Closed Loop- Enabled

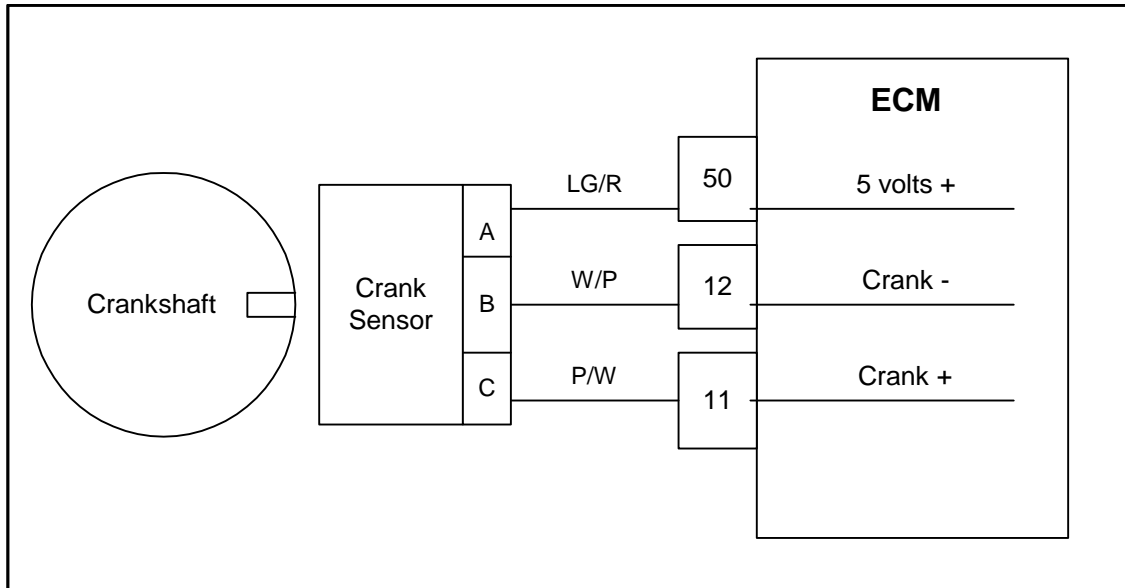
The Crankshaft Position sensor is a magnetic transducer mounted on the engine block adjacent to a pulse wheel located on the crankshaft. It determines crankshaft position by monitoring the pulse wheel. The Crankshaft Position sensor is used to measure engine RPM and its signal is used to synchronize the ignition and fuel systems.

The ECM must see a valid Crankshaft position signal while running. If no signal is present for 800ms or longer, this fault will set.

## DTC 142- Crank Sync Noise



## DTC 143-Never Crank Synced At Start



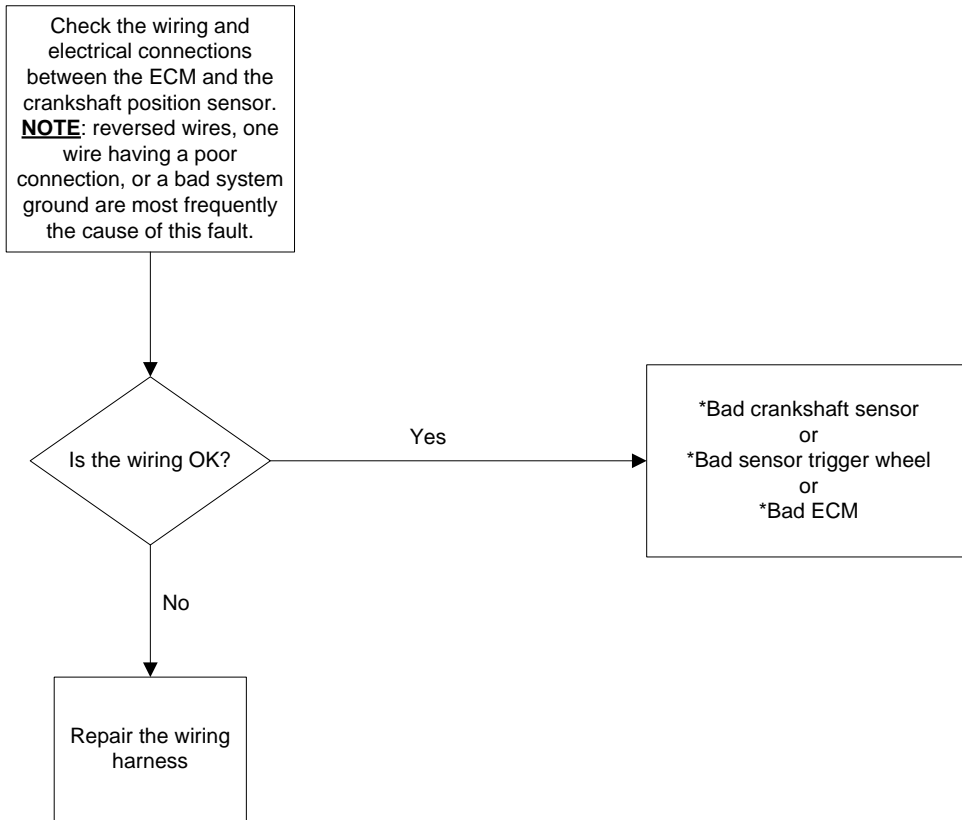
- Crankshaft Position Sensor
- Check Condition- Engine cranking or running
- Adaptive- Enabled
- Fault Condition- 4 cranking revs without sync and engine RPM greater than 90
- MIL- On during active fault
- Closed Loop- Enabled

The Crankshaft position sensor is a magnetic transducer mounted on the engine block adjacent to a pulse wheel located on the crankshaft. It determines crankshaft position by monitoring the pulse wheel. The Crankshaft position sensor is used to measure engine RPM and its signal is used to synchronize the ignition system.

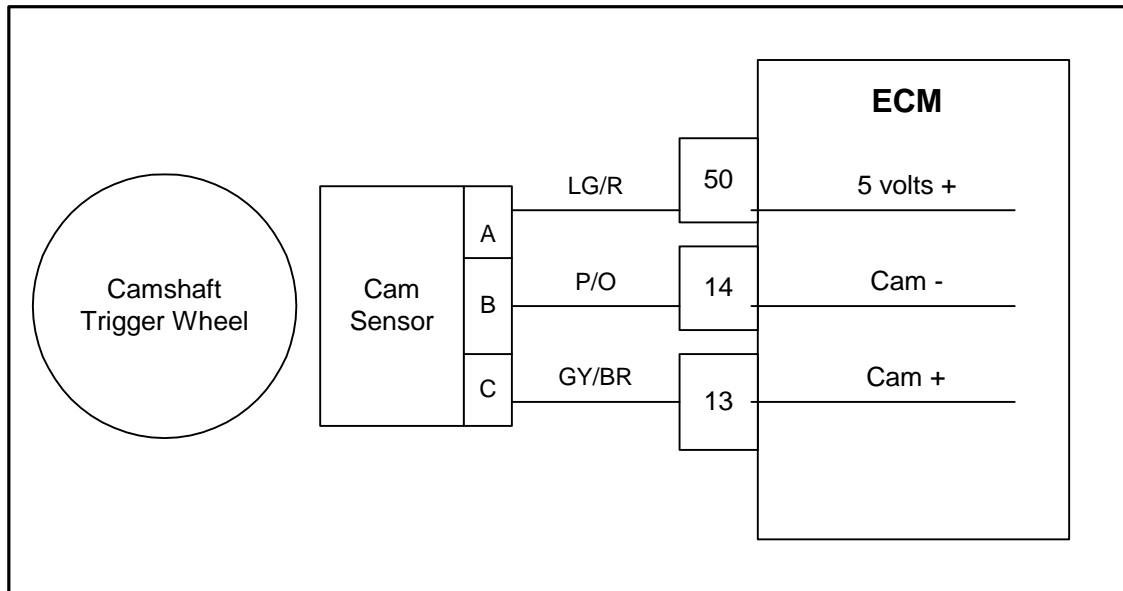
The ECM must see a valid Crankshaft Position signal while cranking before it starts. If no signal is present within 4 cranking revs, this fault will set.



## DTC 143- Never Crank Synced At Start



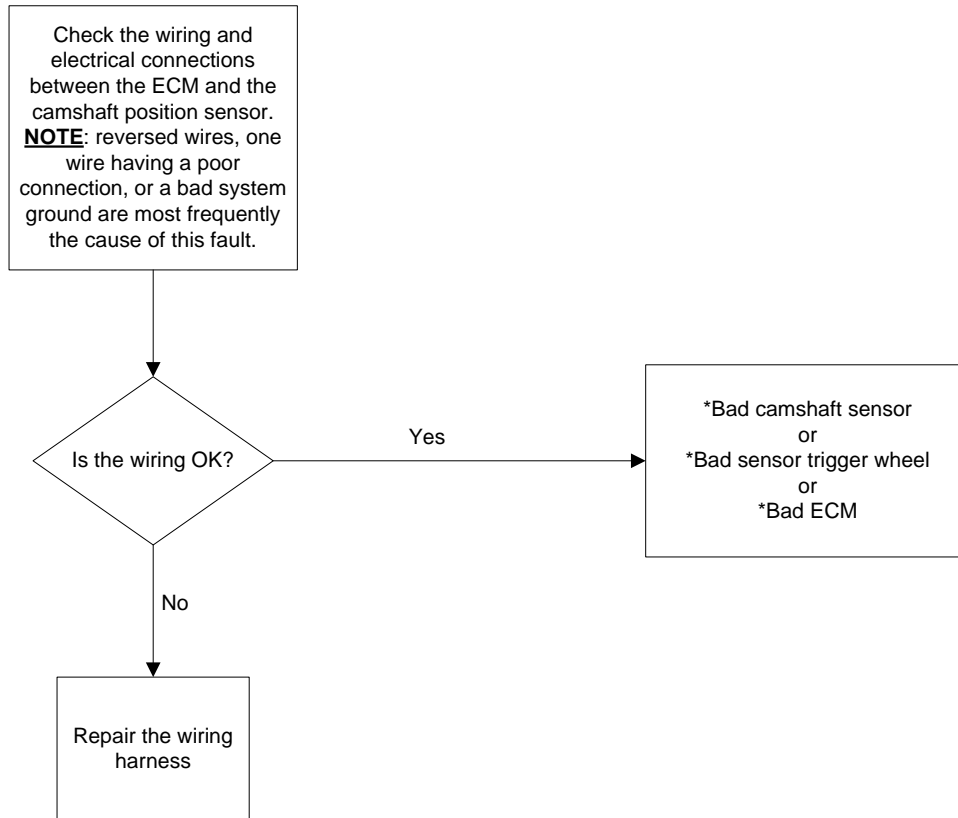
## DTC 144-Camshaft Sensor Loss



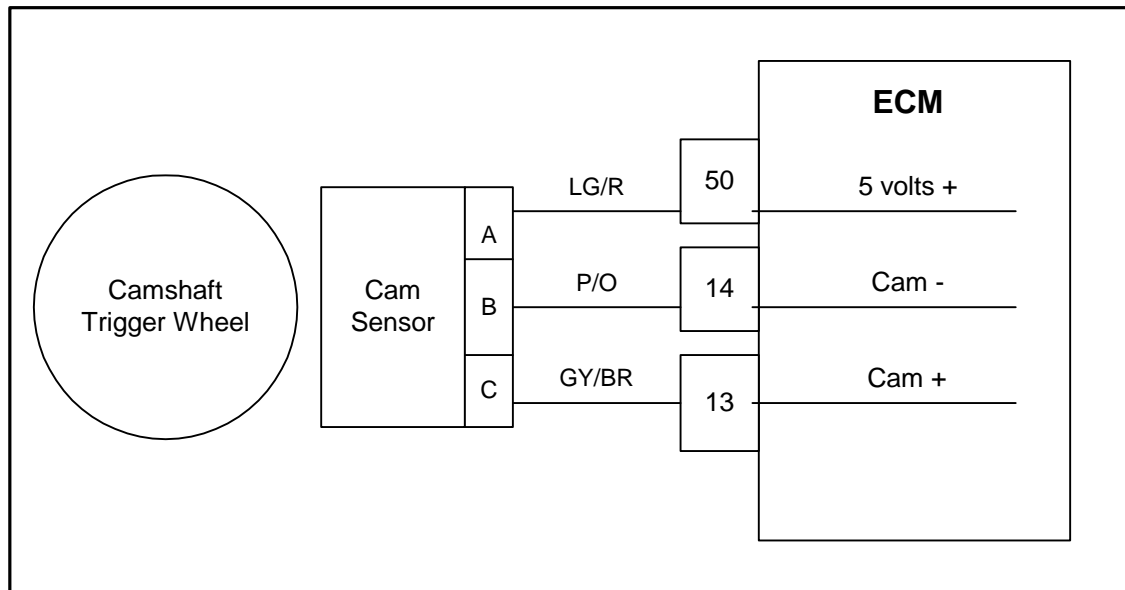
- Camshaft Position Sensor
- Check Condition-Engine Running
- Fault Condition-No cam pulse in 2.5 cycles with RPM greater than 1000
- MIL-On for active fault and for 10 seconds after active fault
- Adaptive-Disabled for remainder of key-on cycle
- Closed Loop-Enabled

The Camshaft Position Sensor is used to determine which cylinder to fire. This fault will set if the ECM does not detect a cam pulse when the RPM is greater than 1000. Normally the engine will run with this fault present. In some instances this fault may cause rough engine operation.

## DTC 144- Camshaft Sensor Loss



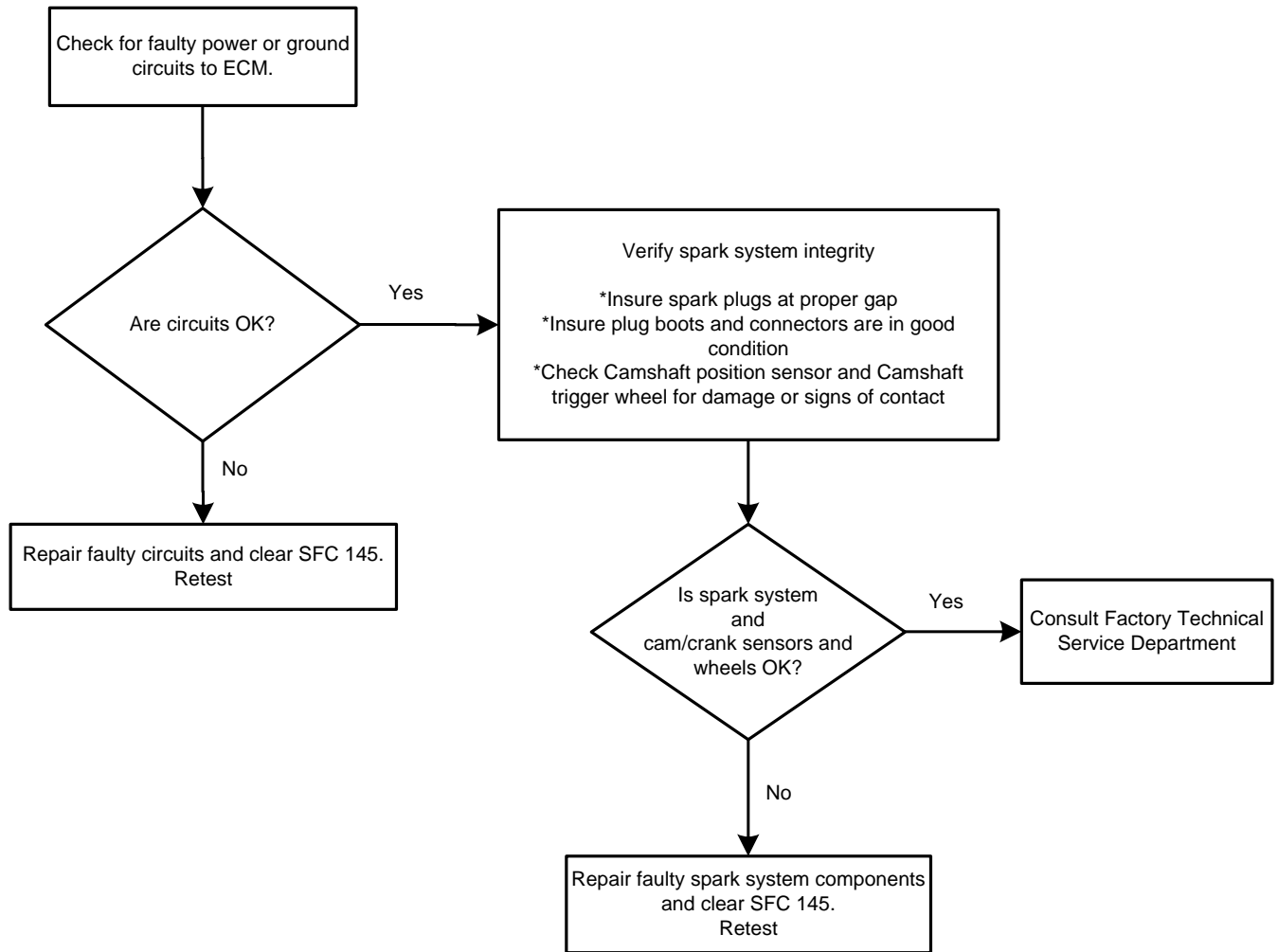
## DTC 145-Camshaft Sensor Noise



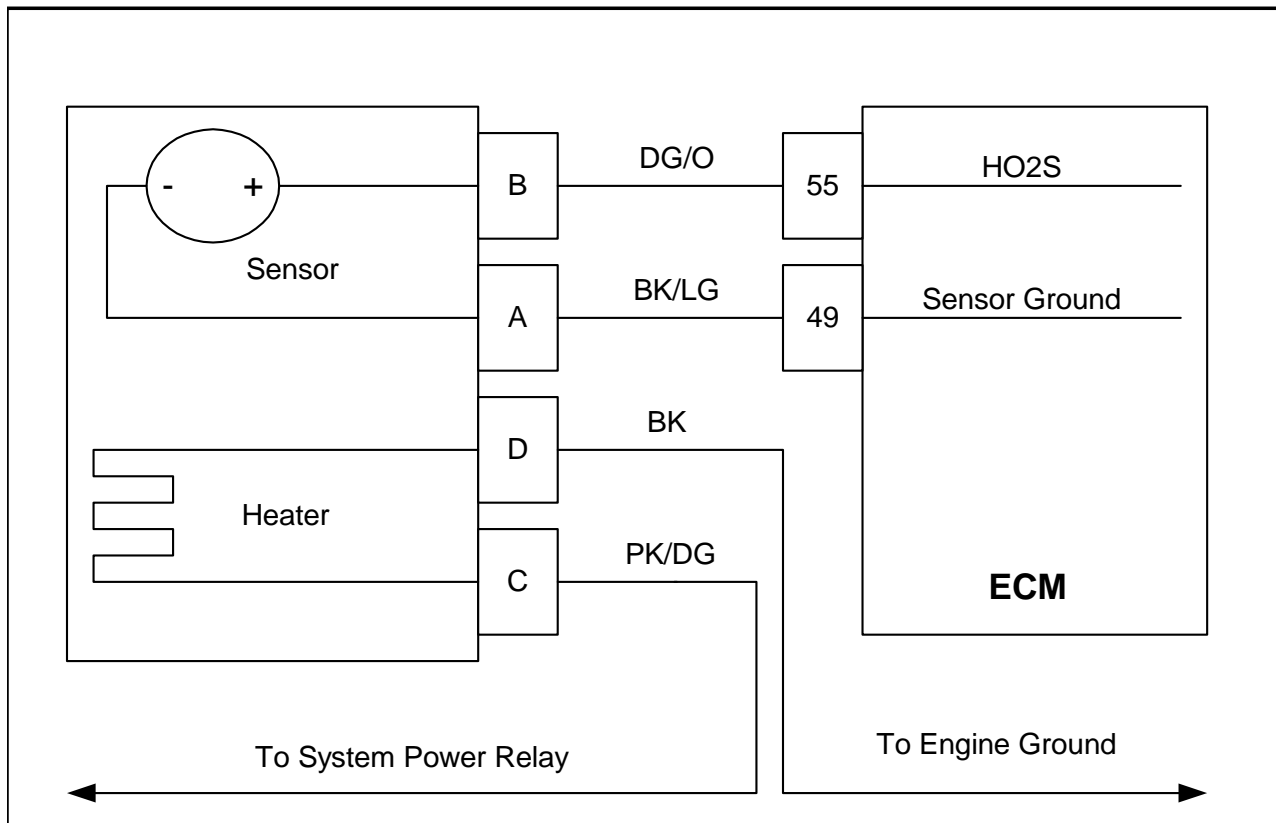
- Camshaft position sensor
- Check Condition-Cranking or Running
- Fault Condition-One invalid cam re-sync
- MIL-On for active fault and for 10 seconds after active fault
- Adaptive-Disabled for the remainder of the key-on cycle
- Closed Loop-Enabled

The camshaft position sensor is used to determine which cylinder to fire. This fault will set if the ECM detects erroneous pulses from the camshaft position sensor causing invalid cam re-sync.

# DTC 145-Camshaft Sensor Noise



## DTC 211- Closed Loop Multiplier High (LPG)



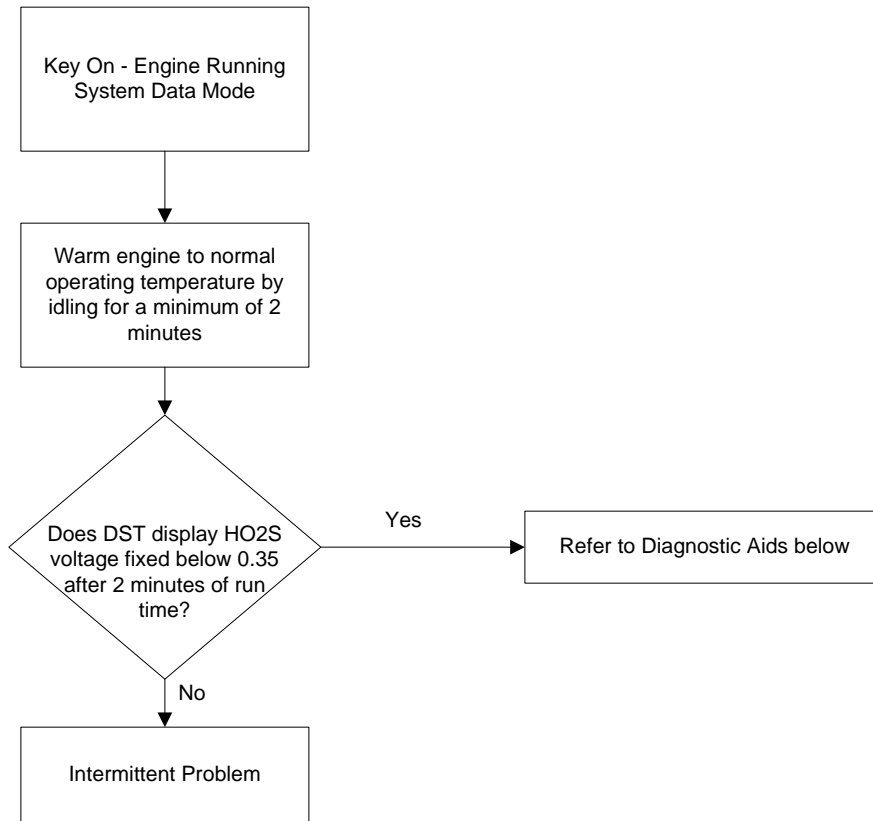
- Heated Oxygen Sensor
- Check Condition- Engine running
- Fault Condition- Closed Loop multiplier out of range (greater than 35%)
- MIL- Disabled
- Adaptive- Enabled but not updated when Closed Loop is at limit
- Closed Loop- Enabled

The HO2S sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the Adaptive multiplier.

This fault sets if the Closed Loop multiplier exceeds the limits of normal operation and cannot correctly modify the fuel flow within its limits.

# DTC 211-Closed Loop Multiplier High (LPG)

**Note:** if any other DTCs are present diagnose those first.



## **Diagnostic Aids**

Oxygen Sensor Wire - Sensor wires may be mispositioned and contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness.

Vacuum Leaks - Large vacuum leaks can cause a lean exhaust condition at light load.

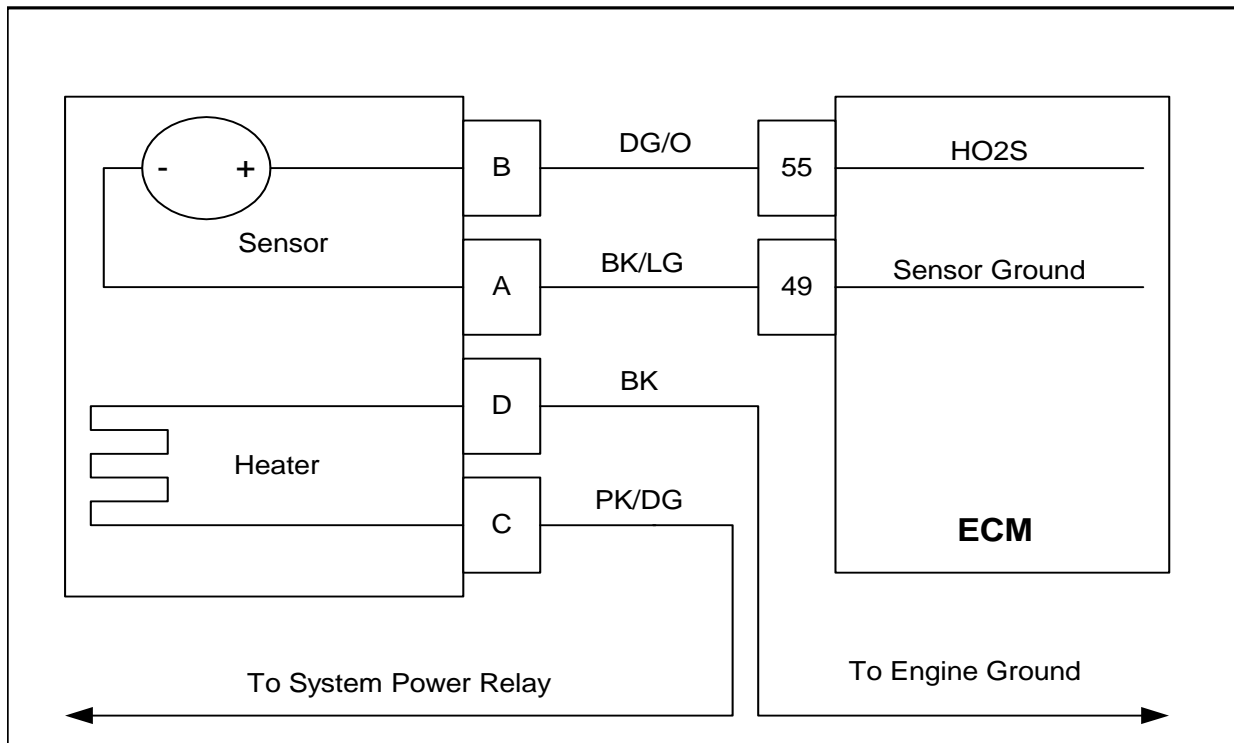
Exhaust Leaks - If there is an exhaust leak, outside air can be pulled into the exhaust and past the O2 sensor causing a false lean condition especially during light load conditions.

Ground Problem - ECM grounds must be good battery or engine grounds. Faulty grounds may cause many unrelated problems as well.

Fuel System - If fuel system is suspected, check and adjust according to PSI guidelines.

If the Fuel System is operating to specification, replace the HO2S sensor with a known good part and retest.

## DTC 212-HO2S Open/Inactive



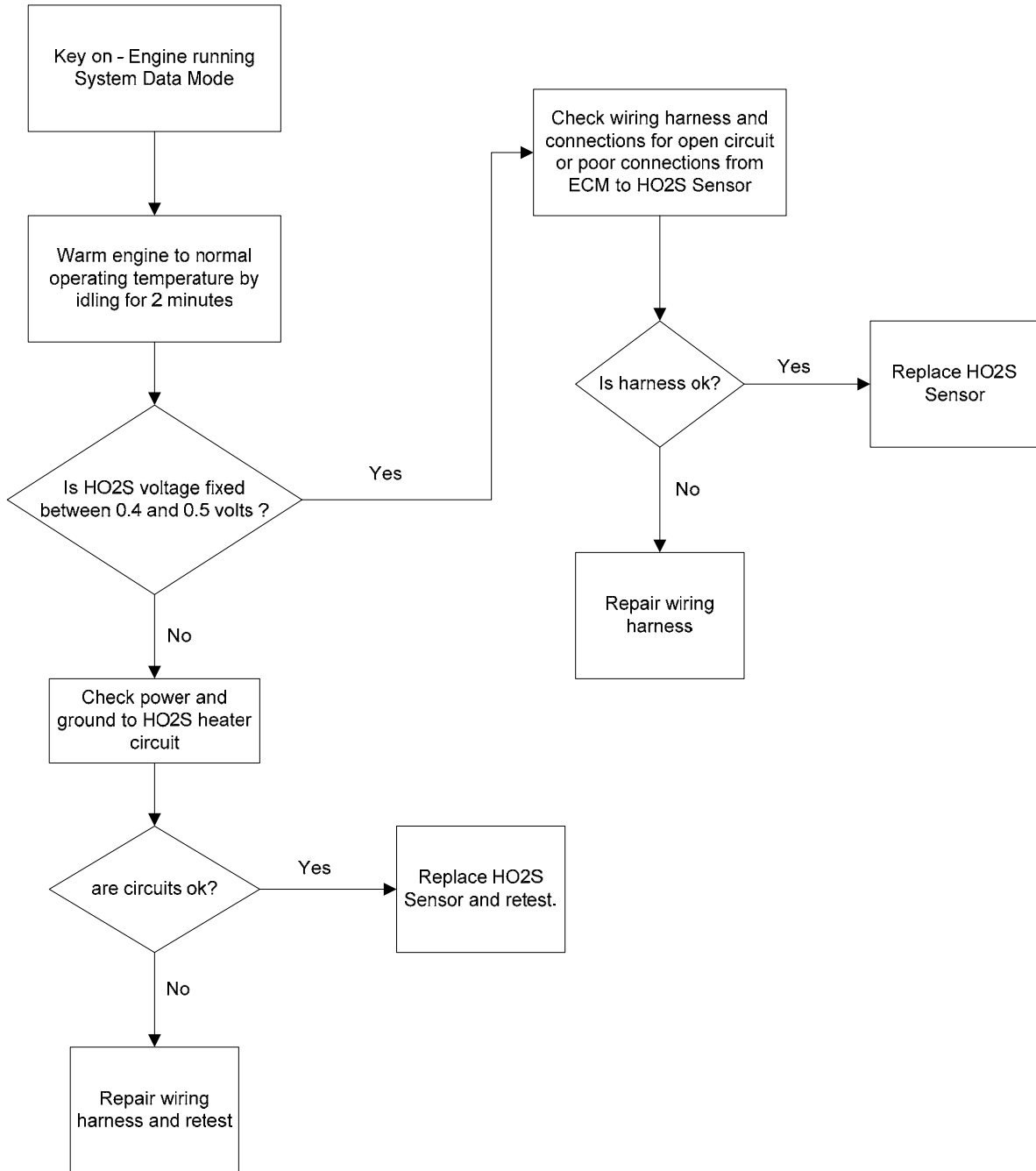
- Heated Oxygen Sensor
- Check condition- Engine running
- Fault condition- HO2S cold persistently more than 120 seconds
- MIL- On during active fault and for 1 second after active fault
- Adaptive- Disabled during active fault
- Closed Loop- Disabled during active fault

The HO2S sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the Adaptive multiplier.

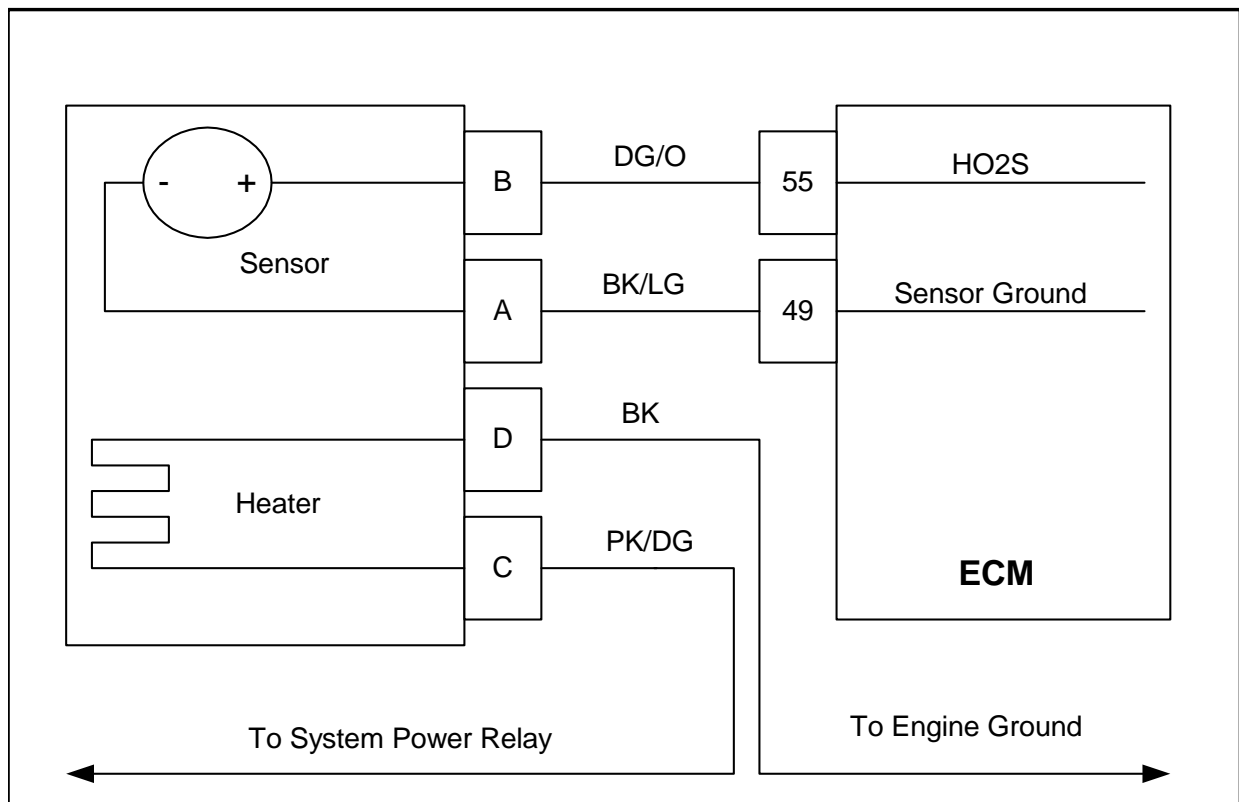
This fault will set if HO2S is cold, non-responsive, or inactive for 120 seconds or longer.



# DTC 212-HO2S Open/Inactive



## DTC 221-Closed Loop Multiplier High (gasoline)



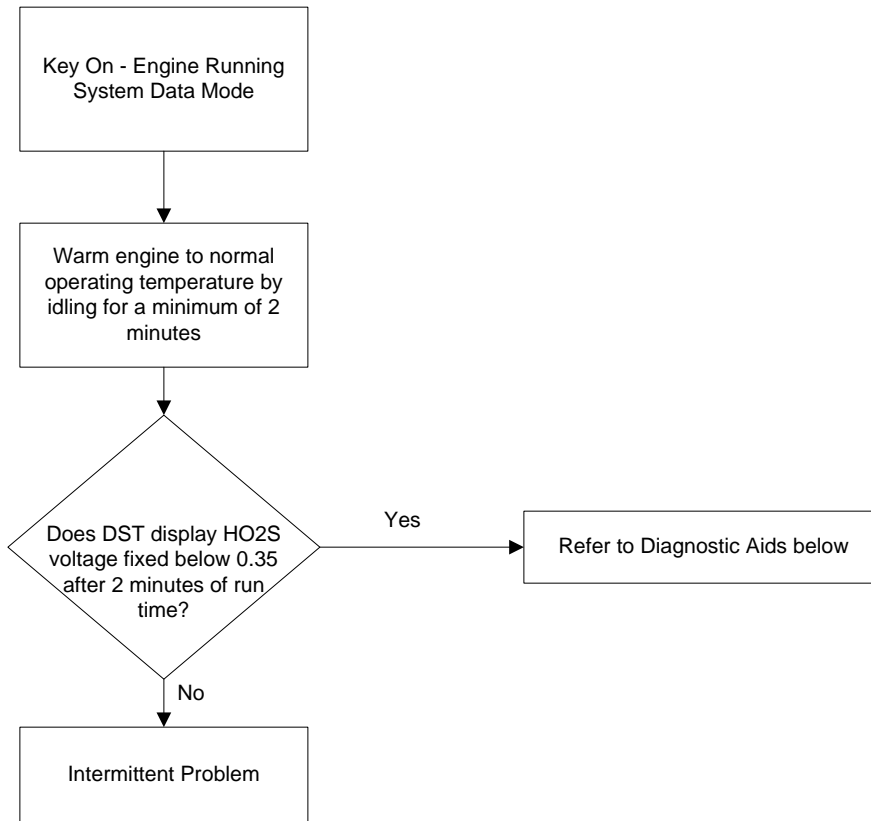
- Heated Oxygen Sensor
- Functional Fault-Closed Loop multiplier out of range (at limit of 35%)
- MIL-On during active fault
- Adaptive-Enabled
- Closed Loop-Enabled

The HO2S sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the Adaptive multiplier.

This fault sets if the Closed Loop multiplier exceeds the limits of normal operation. When the multiplier cannot correctly modify the fuel flow within its limits, the limit is enforced.

# **DTC 221-Closed Loop Multiplier High (gasoline)**

**Note: if any other DTCs are present diagnose those first.**



## **Diagnostic Aids**

Oxygen Sensor Wire - Sensor wires may be mispositioned and contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness.

Vacuum Leaks - Large vacuum leaks can cause a lean exhaust condition at light load.

Injectors - System will be lean if an injector driver or driver circuit fails. The system may also be lean if an injector fails in a closed manner or is dirty. Refer to Injector Driver Test Mode and PSI injector cleaning procedure.

Fuel Pressure - System will be lean if fuel pressure is too low during certain operating conditions. If fuel pressure is suspected, the pressure may be tested in the in the injector manifold during operating conditions with a gauge.

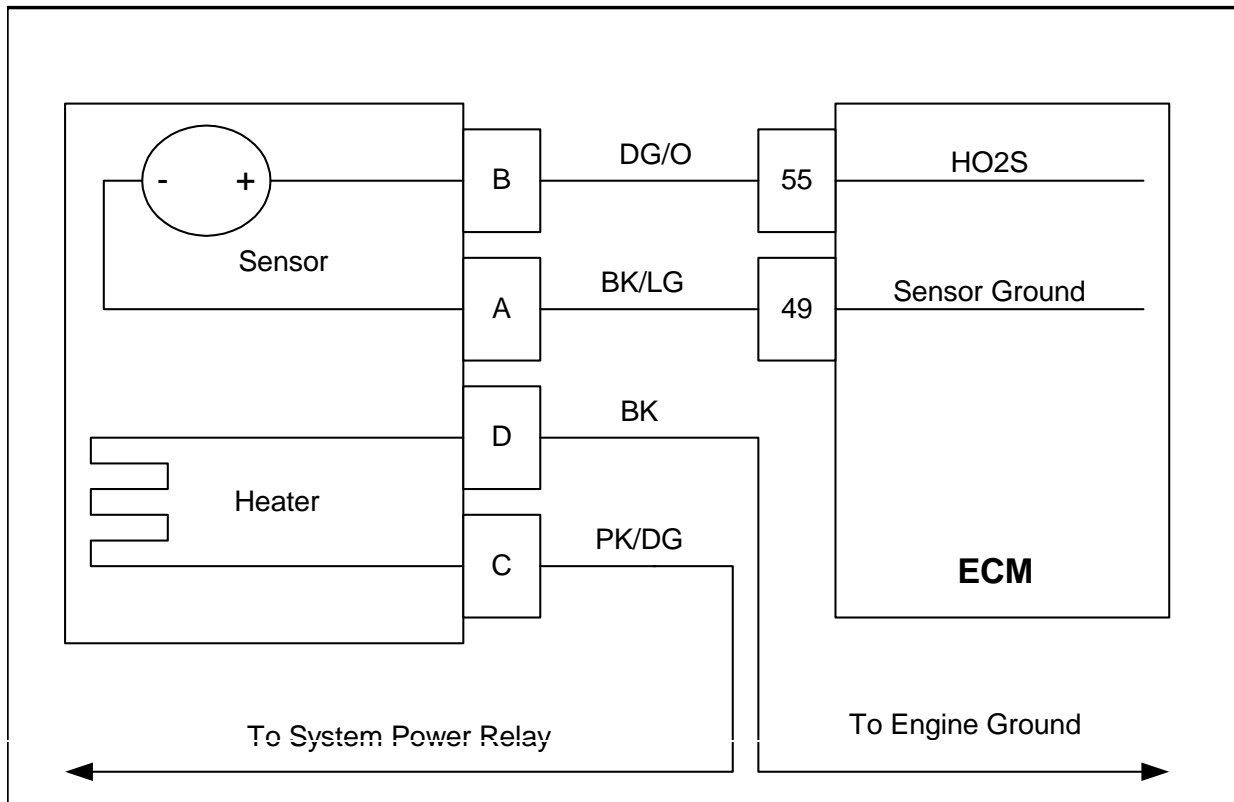
Air in Fuel - If the fuel return is too close to the fuel pickup in the fuel tank, air may be entrained into the fuel supply to the pump. This air will cause a lean condition and driveability problems.

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 especially during light load conditions.

Ground Problem - ECM grounds must be good engine or battery grounds. Faulty grounds may cause many unrelated problems as well.

If all tests are OK, replace the HO2S sensor with a known good part and retest.

## DTC 222- Closed Loop Multiplier Low (gasoline)



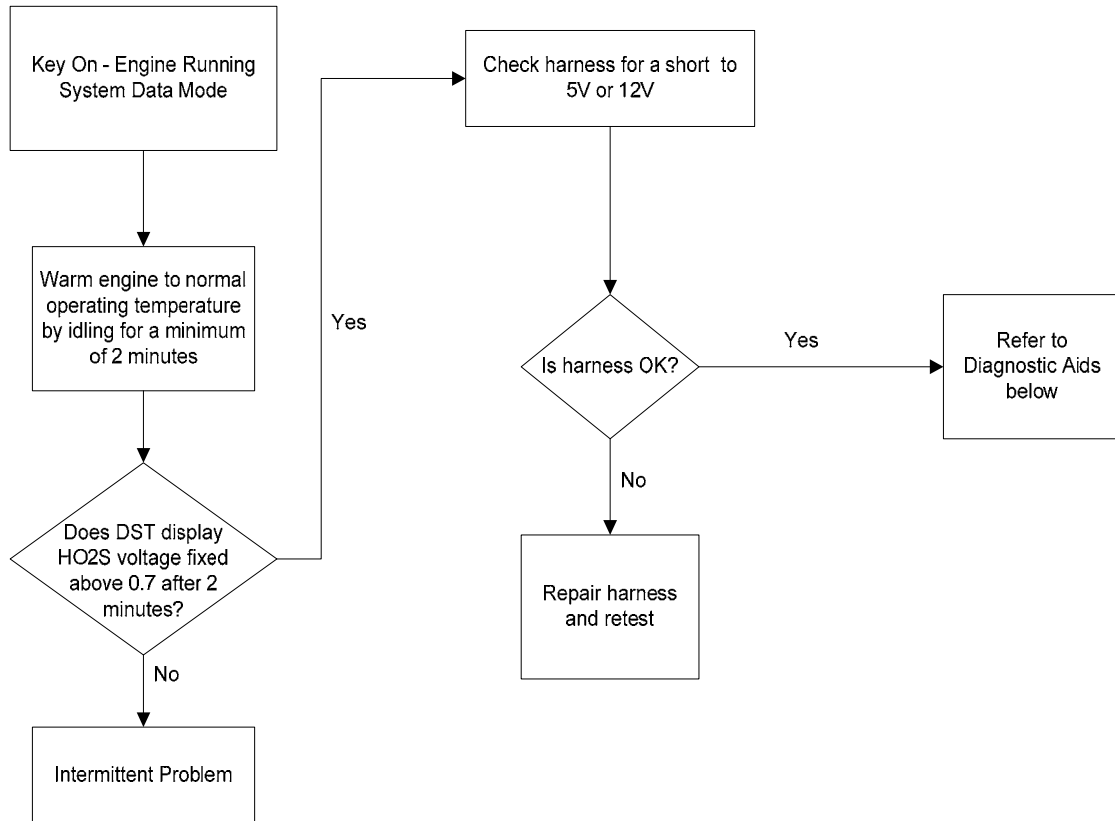
- Heated Oxygen Sensor
- Functional Fault-Closed Loop multiplier out of range (at limit of -35%)
- MIL-On during active fault and for one update after active fault
- Adaptive-Enabled
- Closed Loop-Enabled

The HO2S sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the Adaptive multiplier.

This fault sets if the Closed Loop multiplier exceeds the limits of normal operation. When the multiplier cannot correctly modify the fuel flow within its limits, it is limited at -35%.

# DTC 222- Closed Loop Multiplier Low (gasoline)

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



## **Diagnostic Aids**

Injectors-- system will be rich if an injector fails in an open manner

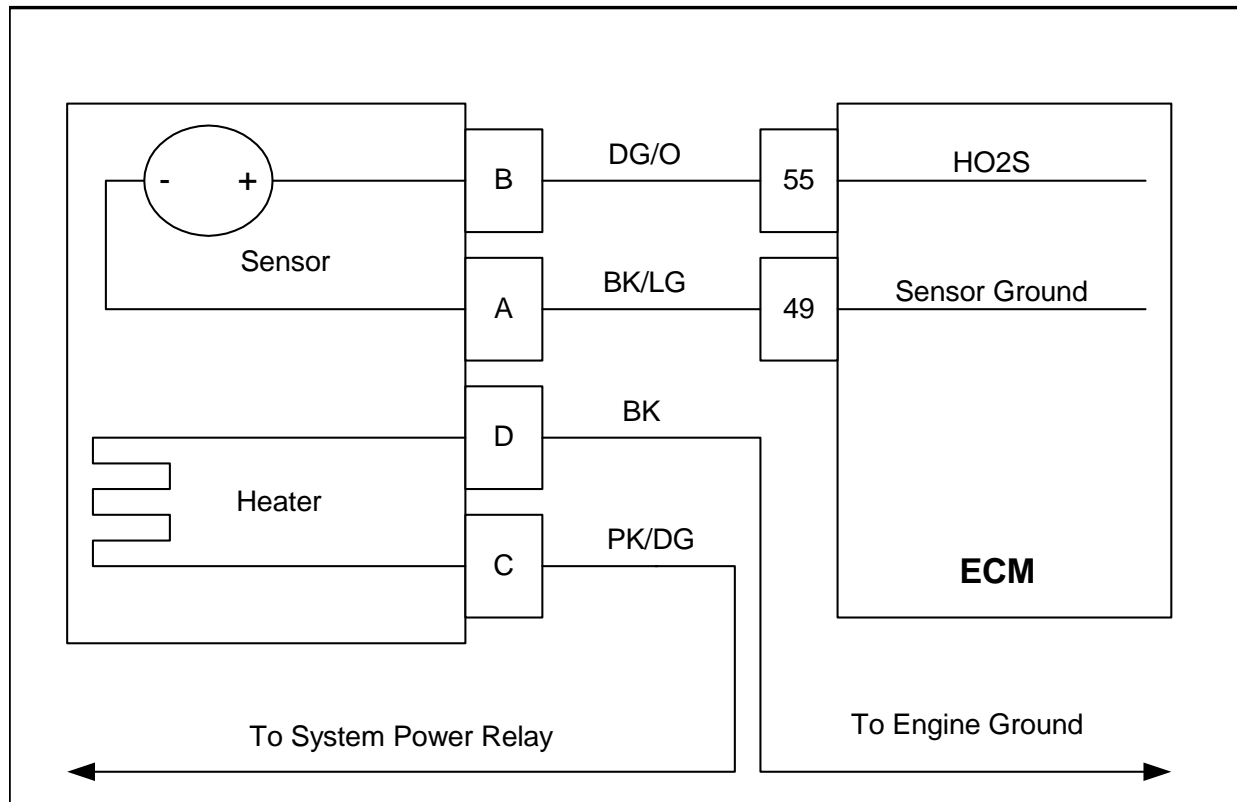
Ignition noise--An open ground circuit to or in the ignition system or ECM may cause EMI noise. Faulty Cam and/or Crank position sensors can also cause EMI noise. This noise can be interpreted by the ECM as ignition pulses, and the sensed RPM becomes higher than the actual speed. The ECM delivers too much fuel, causing the system to go rich.

MAP Sensor--An output that causes the ECM to register a higher manifold pressure than normal can cause the system to go rich. Disconnecting the MAP Sensor will allow the ECM to set a default value for MAP. Substitute a known good MAP Sensor if the rich condition is improved while the sensor is disconnected.

MAT Sensor--Check for a shifted sensor that could cause the ECM to sense too cold of incoming air. This will cause a rich exhaust condition.

ECT Sensor--Check for a shifted sensor that could cause the ECM to sense engine temperature colder than it actually is. This could cause a rich exhaust condition.

## **DTC 224-Closed Loop Multiplier Low (LPG)**



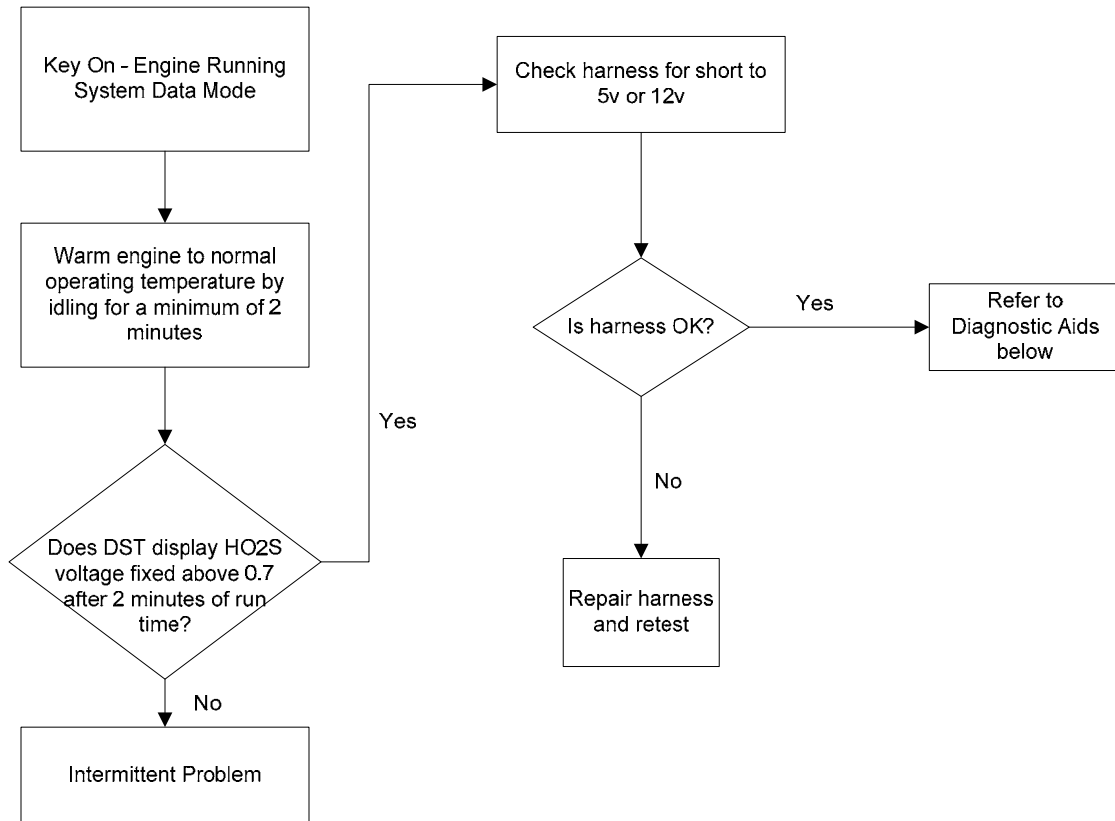
- Heated Oxygen Sensor
- Check Condition- Engine Running
- Fault Condition- Closed Loop multiplier out of range (at limit of -35%)
- MIL- Disabled
- Adaptive- Enabled
- Closed Loop- Enabled

The HO2S sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the Adaptive multiplier.

This fault sets if the Closed Loop multiplier exceeds the limits of normal operation. When the multiplier cannot correctly modify the fuel flow within its limits, it is limited at -35%.

# DTC 224-Closed Loop Multiplier Low (LPG)

**Note: if any other DTCs are present diagnose those first.**



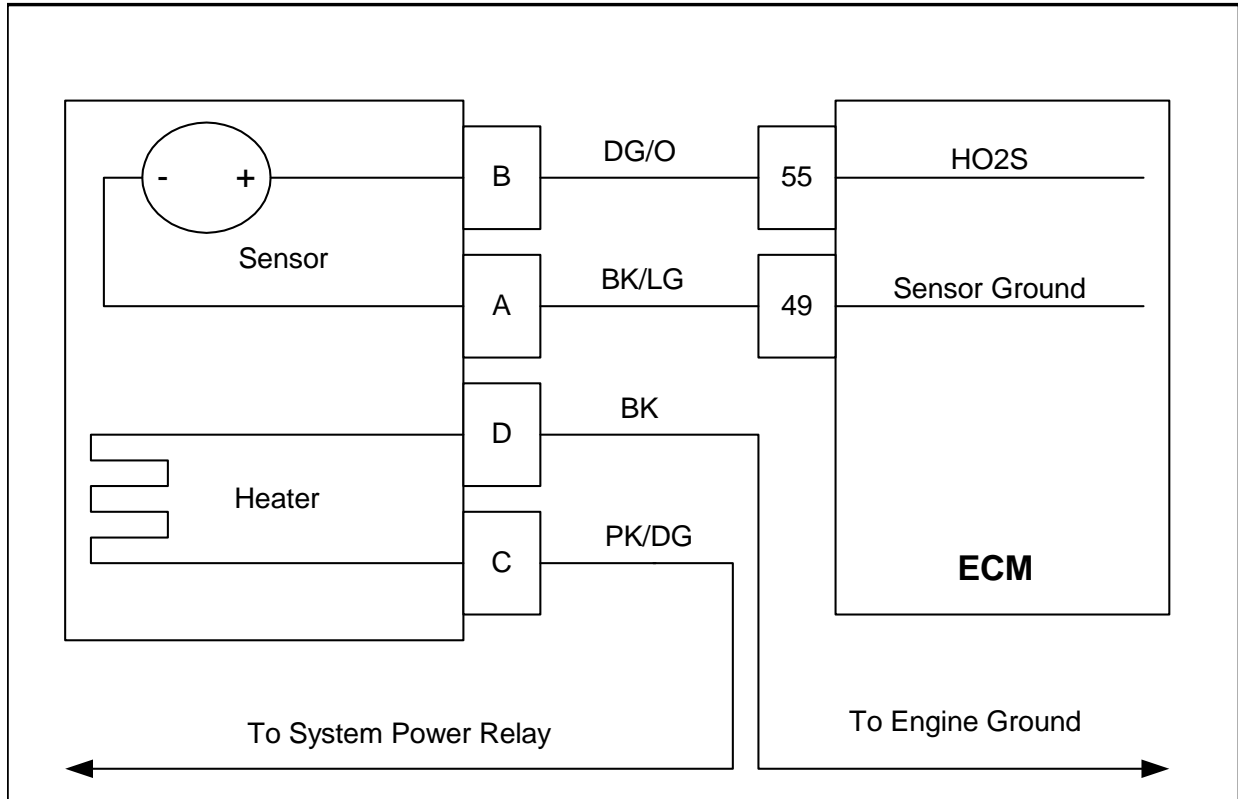
## **Diagnostic Aids**

Fuel Quality - A drastic variation in fuel quality may cause the system to be rich.

Fuel System - If fuel system is suspected, check and adjust according to PSI guidelines.

If Fuel System is operating to specification, replace the HO2S sensor with a known good part and retest.

## DTC 225-Closed Loop Multiplier High (Natural Gas)



- Heated Oxygen Sensor
- Check condition- Engine Running
- Fault Condition- Closed Loop multiplier out of range (at limit of 35%)
- MIL- Disabled
- Adaptive- Enabled
- Closed Loop- Enabled

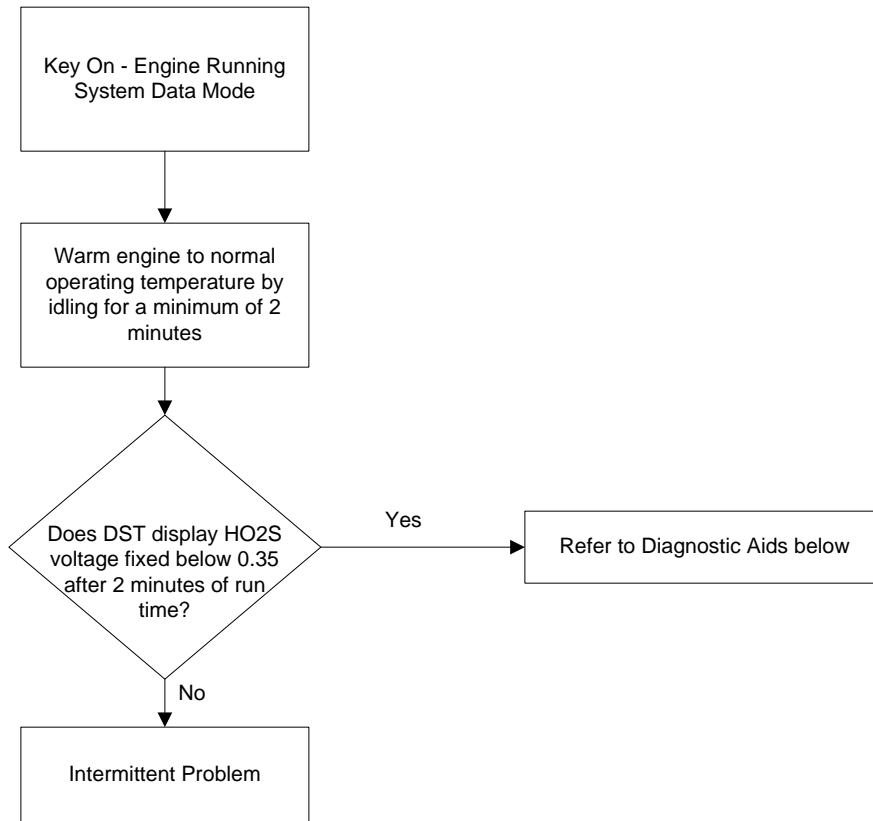
The HO2S sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the Adaptive multiplier.

This fault sets if the Closed Loop multiplier exceeds the limits of normal operation. When the multiplier cannot correctly modify the fuel flow within its limits, it is limited at 35%.



# DTC 225-Closed Loop Multiplier High (Natural Gas)

**Note:** if any other DTCs are present diagnose those first.



## **Diagnostic Aids**

Oxygen Sensor Wire - Sensor wires may be mispositioned and contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness.

Vacuum Leaks - Large vacuum leaks can cause a lean exhaust condition at light load.

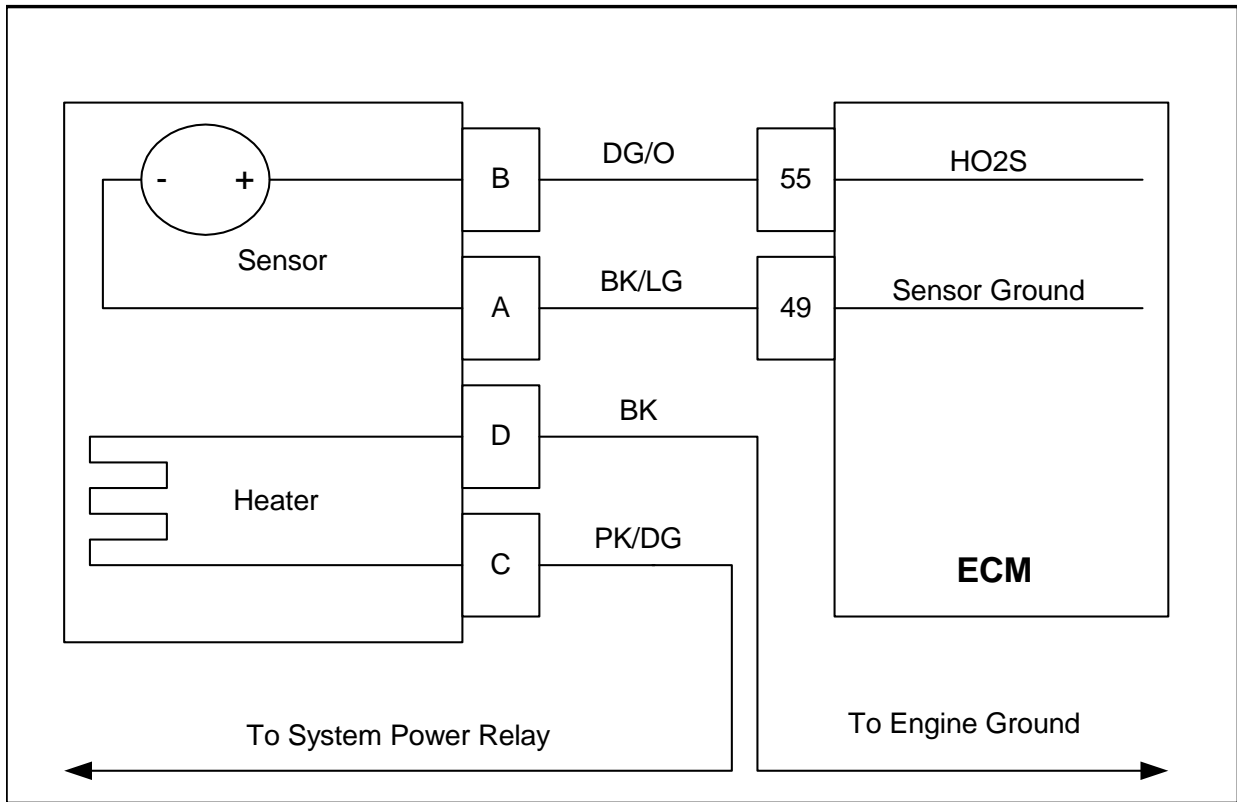
Exhaust Leaks - If there is an exhaust leak, outside air can be pulled into the exhaust and past the O2 sensor causing a false lean condition especially during light load conditions.

Ground Problem - ECM grounds must be good engine or battery grounds. Faulty grounds may cause many unrelated problems as well.

Fuel System - If fuel system is suspected, check and adjust according to PSI guidelines.

If Fuel System is operating to specification, replace the HO2S sensor with a known good part and retest.

## DTC 226-Closed Loop Multiplier Low (Natural Gas)



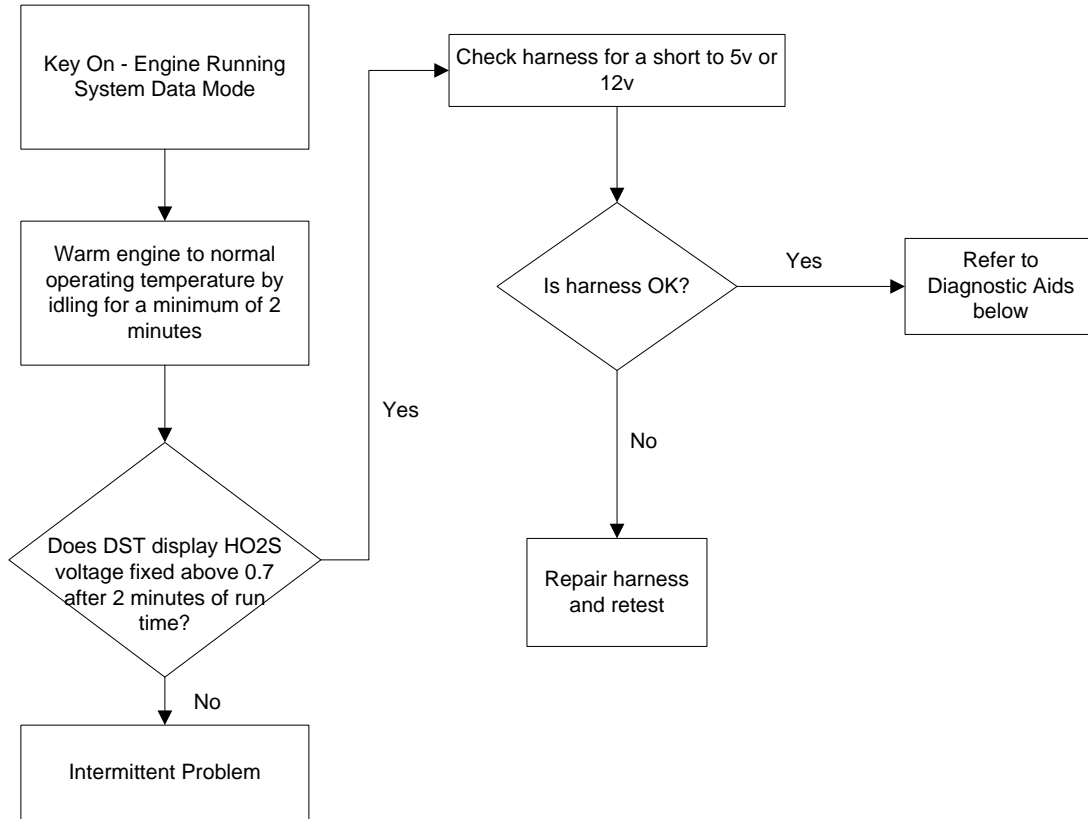
- Heated Oxygen Sensor
- Check Condition- Engine Running
- Fault Condition- Closed Loop multiplier out of range (at limit of -35%)
- MIL- Disabled
- Adaptive- Enabled
- Closed Loop- Enabled

The HO2S sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the Adaptive multiplier.

This fault sets if the Closed Loop multiplier exceeds the limits of normal operation. When the multiplier cannot correctly modify the fuel flow within its limits, it is limited at -35%.

# DTC 226-Closed Loop Multiplier Low (Natural Gas)

Note: if any other DTCs are present diagnose those first.



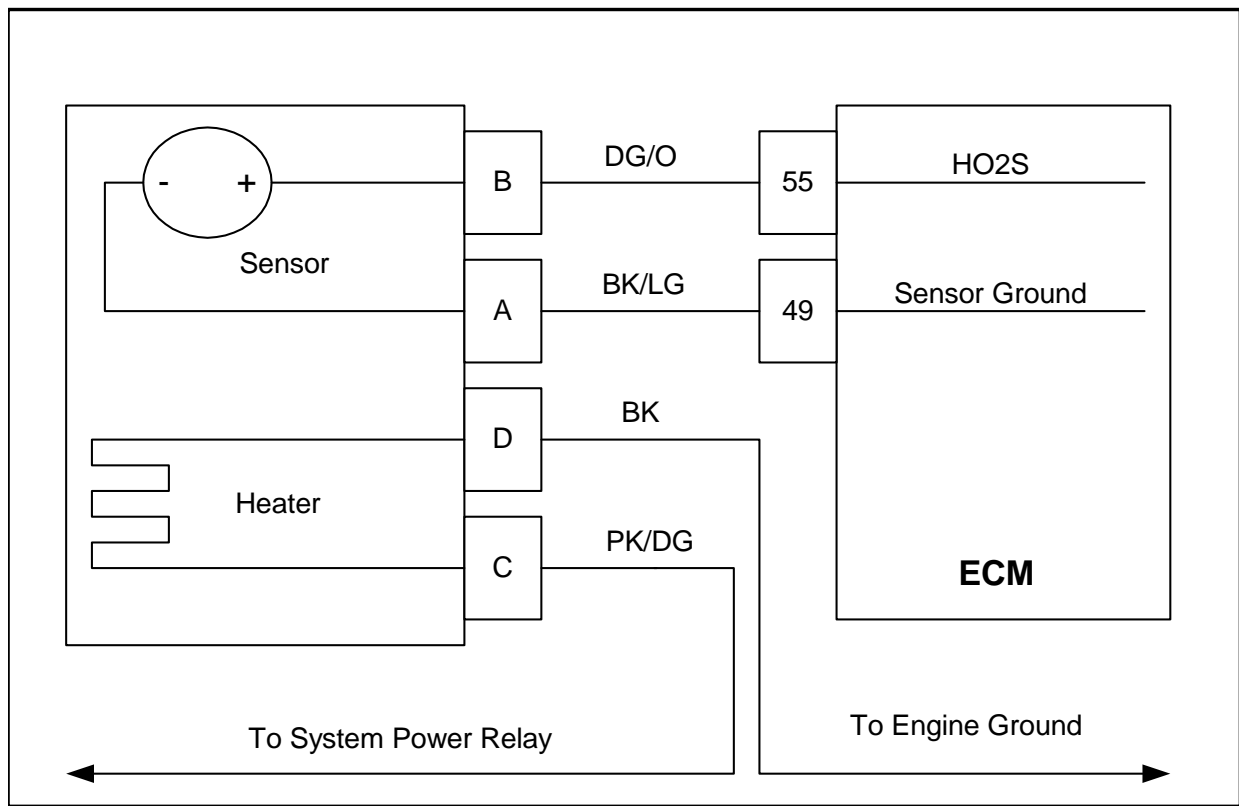
## **Diagnostic Aids**

Fuel Quality - A drastic variation in fuel quality may cause the system to be rich.

Fuel System - If fuel system is suspected, check and adjust according to PSI guidelines.

If Fuel System is operating to specification, replace the HO2S sensor with a known good part and retest.

## DTC 241-Adaptive Lean Fault (high limit-gasoline)



- Heated Oxygen Sensor
- Functional Fault-Adaptive multiplier out of range (greater than 30%)
- MIL-On during active adaptive limit condition
- Adaptive-Enabled
- Closed Loop-Enabled

The HO2S sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the Adaptive multiplier.

This fault sets if the Adaptive multiplier exceeds the limits of normal operation.

# **DTC 241-Adaptive Lean Fault (high limit-gasoline)**

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

The normal purpose of the Adaptive Learn is to compensate fuel flow for variations in fuel composition, engine wear, variances from engine to engine, and component degradation. The Adaptive Learn may reach its limit due to many causes. Refer to the diagnostic aids below for assistance.

## **Diagnostic Aids**

Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness.

Vacuum Leaks - Large vacuum leaks and crankcase leaks can cause a lean exhaust condition at light load.

Injectors - System will be lean if an injector driver or driver circuit fails. The system will also be lean if an injector fails in a closed manner or is dirty. Refer to the Injector Driver Test Mode and PSI cleaning procedure if an injector problem is suspected.

Fuel Pressure - System will be lean if fuel pressure is too low during certain operating conditions. If fuel pressure is suspected, the pressure may be tested in the injector manifold during operating conditions with a gauge.

Air in Fuel - If the fuel return is too close to the fuel pickup in the fuel tank, air may be entrained into the fuel supply to the pump. This air will cause a lean condition and driveability problems.

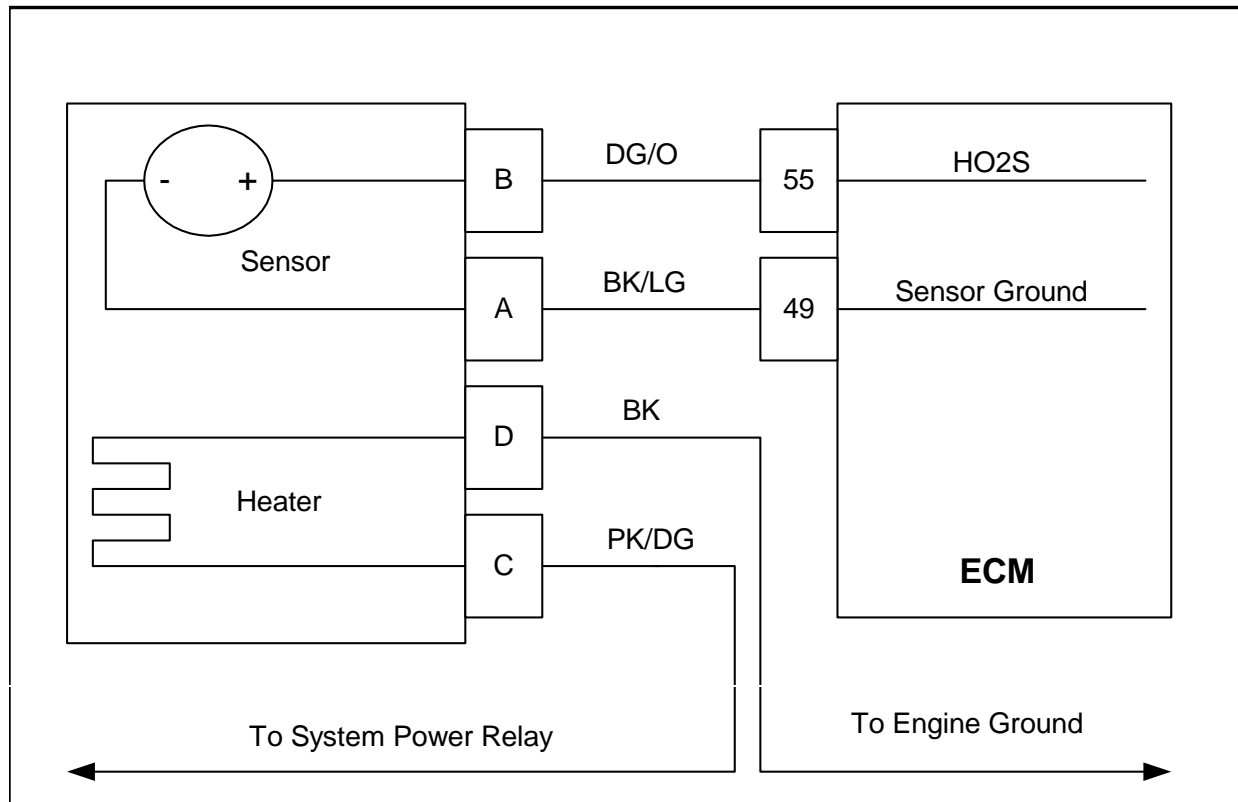
Exhaust Leaks - If there is an exhaust leak, outside air can be pulled into the exhaust and past the O2 sensor causing a false lean condition.

Fuel Quality - A drastic variation in fuel quality may cause the system to be lean.

Ground Problem - ECM grounds must be good battery ground. Faulty grounds may cause many unrelated problems as well.

If all tests are OK, replace the HO2S sensor with a known good part and retest.

## DTC 242-Adaptive Rich Fault (low limit-gasoline)



- Heated Oxygen Sensor
- Functional Fault-Adaptive multiplier out of range (at limit of -30%)
- MIL-On during active adaptive limit condition
- Adaptive-Enabled
- Closed Loop-Enabled

The HO2S sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the Adaptive multiplier.

This fault sets if the Adaptive multiplier exceeds the limits of normal operation.

## **DTC 242-Adaptive Rich Fault (low limit gasoline)**

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

The normal purpose of the Adaptive Learn is to compensate fuel flow for variations in fuel composition, engine wear, variances from engine to engine, and component degradation. The Adaptive Learn may reach its limit due to many causes. Refer to the diagnostic aids below for assistance.

### **Diagnostic Aids**

Injectors – The system will be rich if an injector fails in an open manner. Refer to the Injector Test Mode if injector problems are suspected.

Ignition Noise – An open ground circuit to or in the ignition system or ECM may cause EMI noise. Faulty crank and/or cam position sensors can also cause EMI noise. This noise can be interpreted by the ECM as ignition pulses, and the sensed RPM becomes higher than the actual speed. The ECM delivers too much fuel, causing the system to go rich.

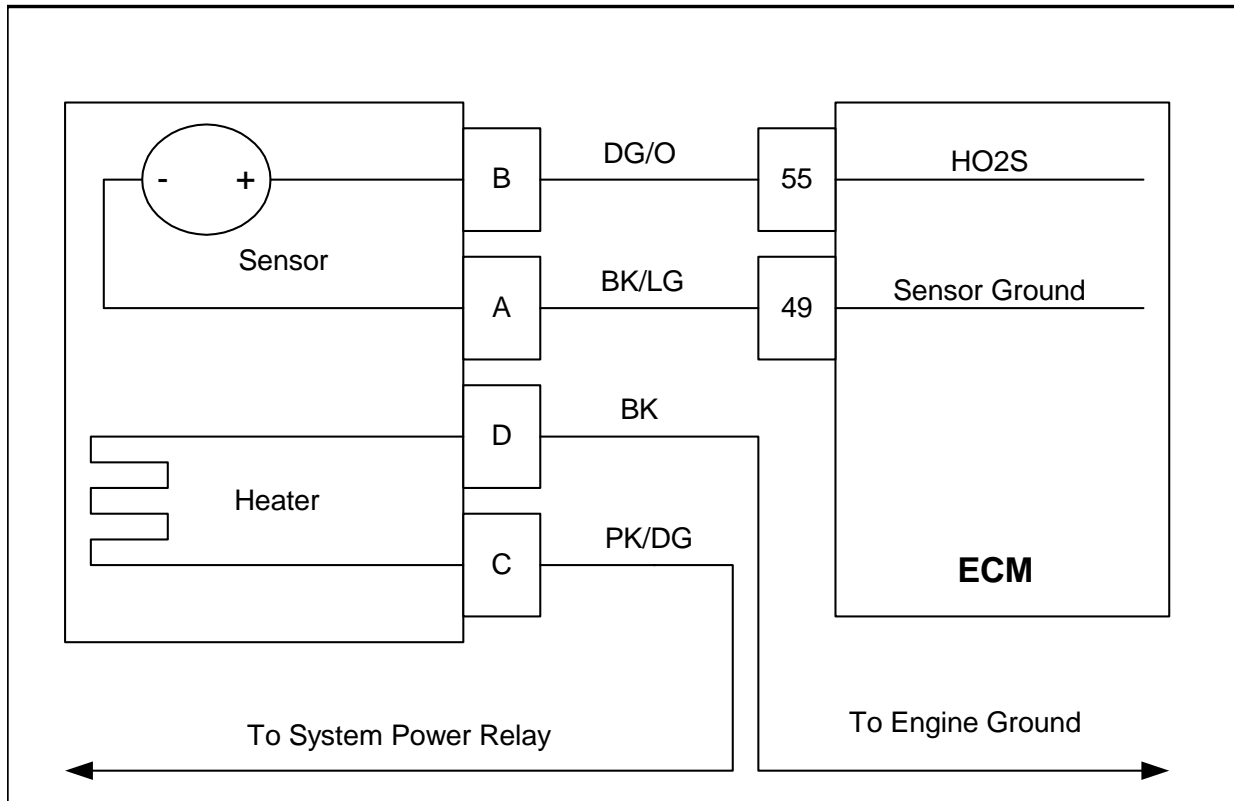
MAP Sensor – An output that causes the ECM to register a higher manifold pressure than normal can cause the system to go rich. Disconnecting the MAP sensor will allow the ECM to set a default value for MAP. Substitute a known good MAP sensor if the rich condition is gone while the sensor is disconnected.

MAT Sensor - Check for a shifted sensor that could cause the ECM to sense too cold of incoming air. This will cause a rich exhaust condition.

ECT Sensor – Check for a shifted sensor that could cause the ECM to sense engine temperature colder than it actually is. This could cause a rich exhaust condition.

If all tests are OK, replace HO2S Sensor with a known good part and retest.

## DTC 243-Adaptive Learn High (LPG)



- Heated Oxygen Sensor
- Check Condition- Engine Running
- Fault Condition- Adaptive multiplier out of range (greater than 30%)
- MIL- Disabled
- Adaptive- Enabled
- Closed Loop- Enabled

The HO2S sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and Adaptive multiplier.

This fault will set if the adaptive multiplier exceeds the limits of normal operation.



## **DTC 243-Adaptive Learn High (LPG)**

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

The normal purpose of the Adaptive Learn is to compensate fuel flow for variations in fuel composition, engine wear, variances from engine to engine, and component degradation. The Adaptive learn may reach its limit due to many causes. Refer to the diagnostic aids below for assistance.

### **Diagnostic Aids**

Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness.

Vacuum Leaks - Large vacuum leaks and crankcase leaks can cause a lean exhaust condition at light load.

Exhaust Leaks - If there is an exhaust leak, outside air can be pulled into the exhaust and past the sensor causing a false lean condition.

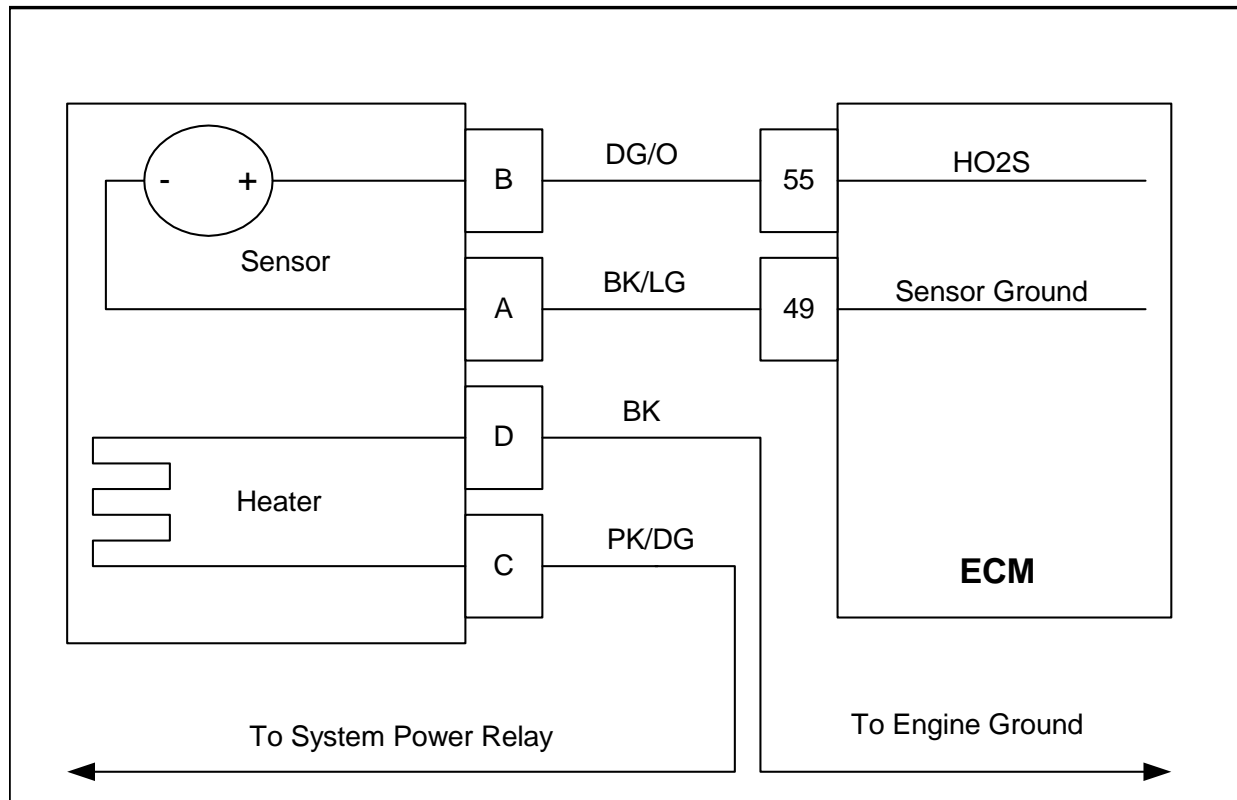
Fuel Quality - A drastic variation in fuel quality can cause the system to be lean.

Ground Problem - ECM grounds must be good engine or battery ground. Faulty grounds may cause many unrelated problems as well.

Fuel System - If the fuel system is suspected, check and adjust according to PSI guidelines.

If fuel system is operating to specification, replace the HO2S sensor with known good part and retest.

## DTC 244-Adaptive Learn Low (LPG)



- Heated Oxygen Sensor
- Check Condition- Engine running
- Fault Condition- Adaptive multiplier out of range (at limit of -30%)
- MIL-Disabled
- Adaptive- Enabled
- Closed Loop- Enabled

The HO2S sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and Adaptive multiplier.

This fault will set if the adaptive multiplier exceeds the limits of normal operation.

## **DTC 244-Adaptive Learn Low (LPG)**

**Note: If any other DTCs are present diagnose those first.**

The purpose of the Adaptive Learn is to compensate fuel flow for variations in fuel composition, engine wear, variances from engine to engine, and component degradation. The Adaptive learn may reach its limit due to many causes. Refer to the diagnostic aids below for assistance.

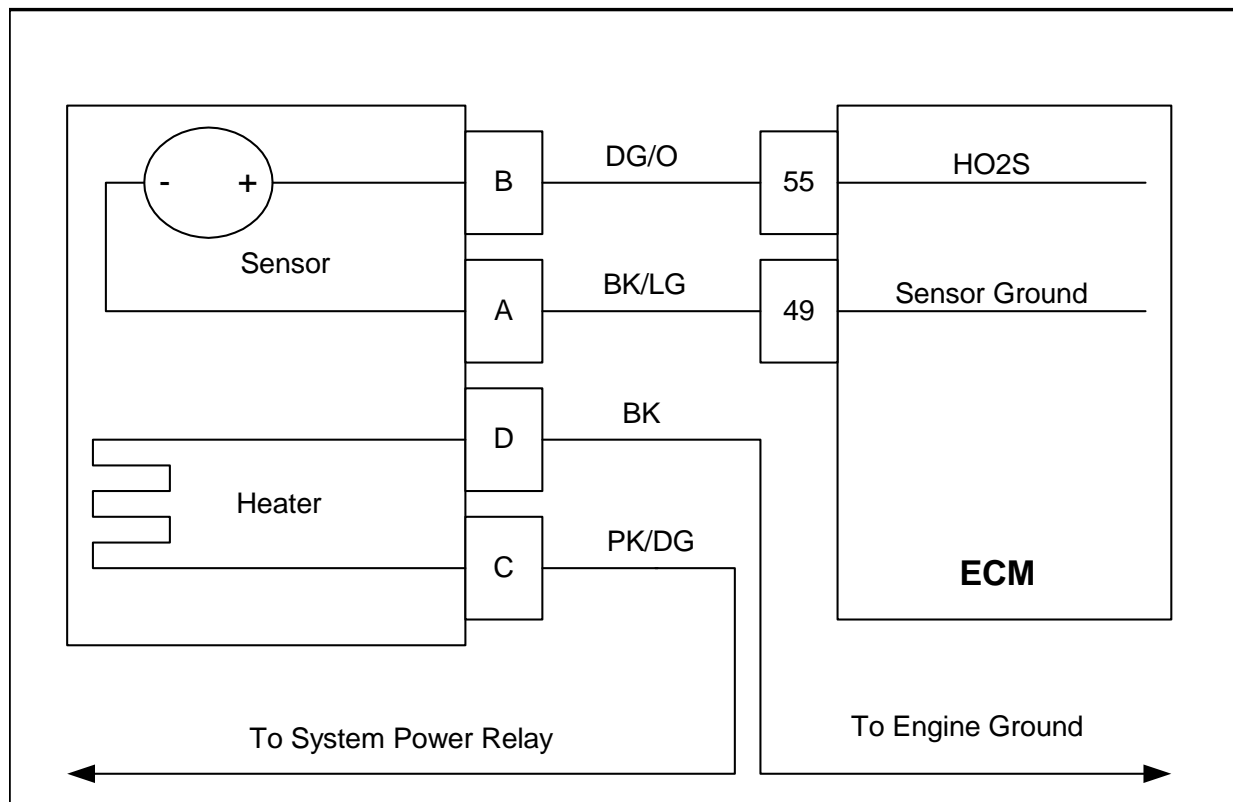
### **Diagnostic Aids**

Wiring Harness- Check harness for an intermittent short to 5v or 12v.

Fuel System- If the fuel system is suspected, check and adjust according to PSI guidelines.

If fuel system is operating to specification, replace the HO2S sensor with a known good part and retest.

## DTC 245-Adaptive Learn High (Natural Gas)



- Heated Oxygen Sensor
- Check Condition- Engine Running
- Fault Condition- Adaptive multiplier out of range (greater than 30%)
- MIL- Disabled
- Adaptive- Enabled
- Closed Loop- Enabled

The HO2S sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the Adaptive multiplier.

This fault will set if the adaptive multiplier exceeds the limits of normal operation.

## **DTC 245-Adaptive Learn High (Natural Gas)**

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

The normal purpose of the Adaptive Learn is to compensate fuel flow for variations in fuel composition, engine wear, variances from engine to engine, and component degradation. The Adaptive Learn may reach its limit due to many causes. Refer to the diagnostic aids below for assistance.

### **Diagnostic Aids**

Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness.

Vacuum Leaks - Large vacuum leaks and crankcase leaks can cause a lean exhaust condition at light load.

Exhaust Leaks - If there is an exhaust leak, outside air can be pulled into the exhaust and past the sensor causing a false lean condition.

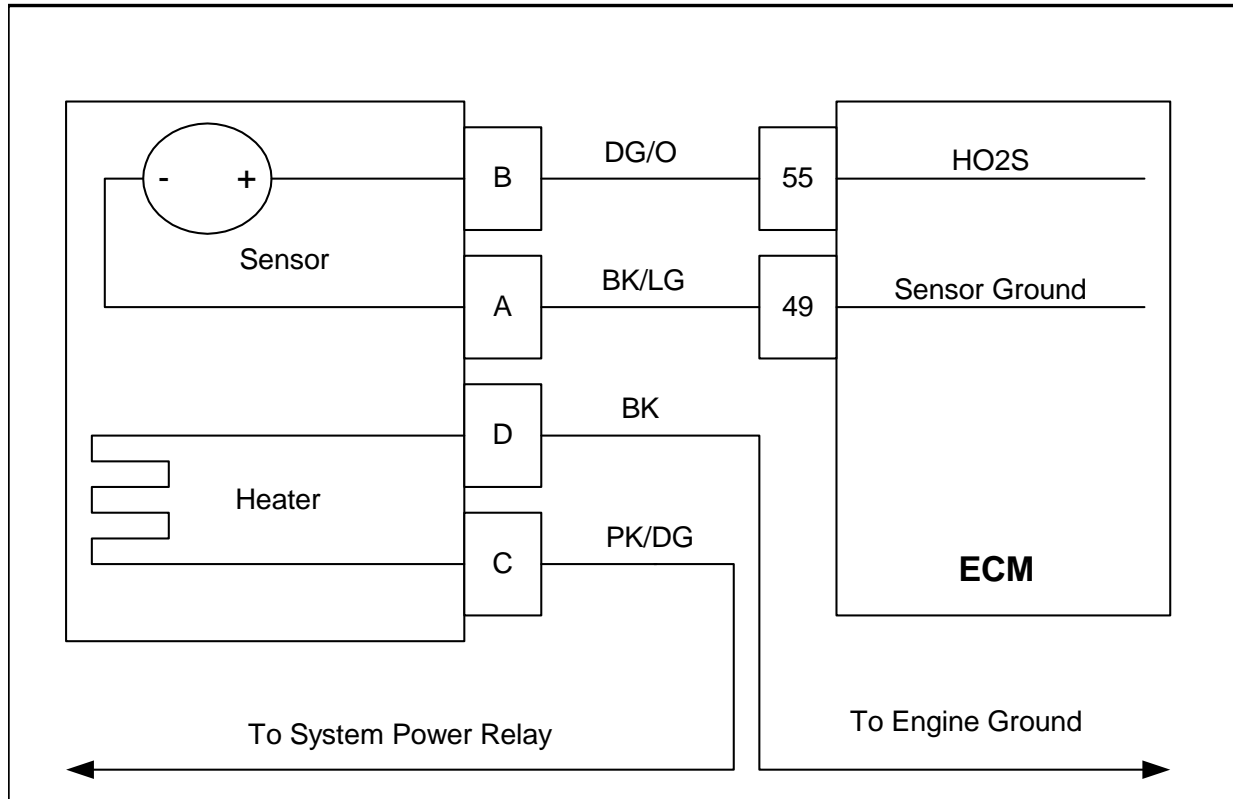
Fuel Quality - A drastic variation in fuel quality can cause the system to be lean. Most gas companies can help verify fuel quality.

Ground Problem - ECM grounds must be good engine or battery ground. Faulty grounds may cause many unrelated problems as well.

Fuel System - If the fuel system is suspected, check and adjust according to PSI guidelines.

If fuel system is operating to specifications, replace the HO2S sensor with known good part and retest.

## DTC 246-Adaptive Learn Low (Natural Gas)



- Heated Oxygen Sensor
- Check Condition- Engine Running
- Fault Condition- Adaptive multiplier out of range (greater than -30%)
- MIL- Disabled
- Adaptive- Enabled
- Closed Loop- Enabled

The HO2S sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the Adaptive multiplier.

This fault will set if the adaptive multiplier exceeds the limits of normal operation.

## **DTC 246-Adaptive Learn Low (Natural Gas)**

**Note:** If any other DTCs are present diagnose those first.

The normal purpose of the Adaptive Learn is to compensate fuel flow for variations in fuel composition, engine wear, variances from engine to engine, and component degradation. The Adaptive learn may reach its limit due to many causes. Refer to the diagnostic aids below for assistance.

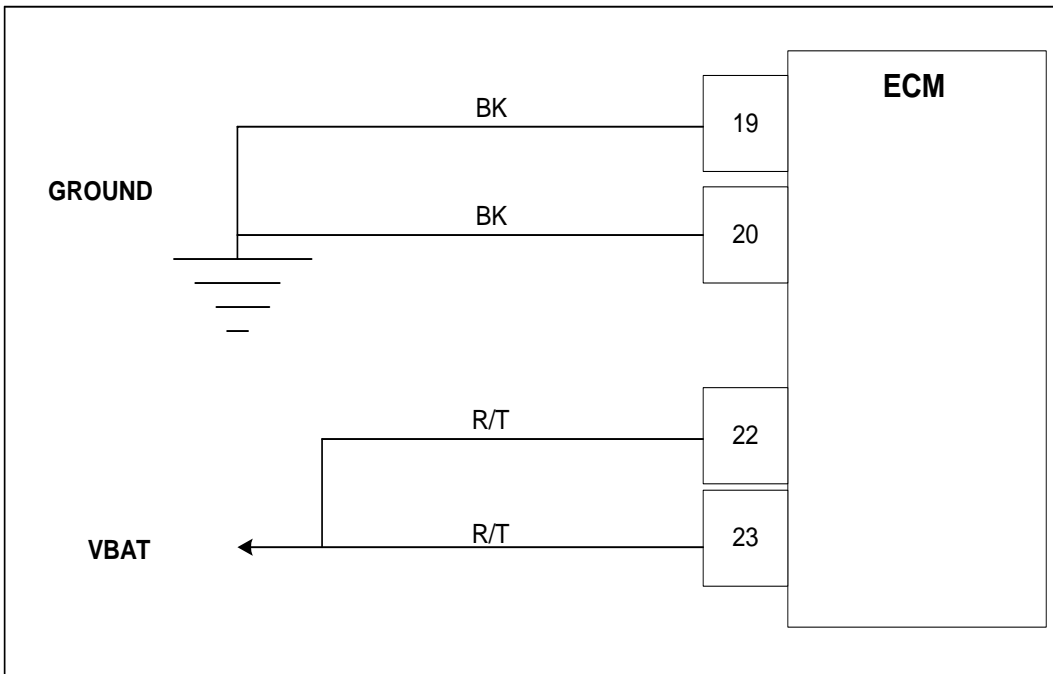
### **Diagnostic Aids**

Fuel Quality – A drastic variation in fuel quality may cause the system to be rich. Most gas companies can help verify fuel quality.

Fuel System – If the fuel system is suspected, check and adjust according to PSI guidelines.

If Fuel System is operating to specification, replace the HO2S sensor with a known good part and retest.

## DTC 261-System Voltage Low



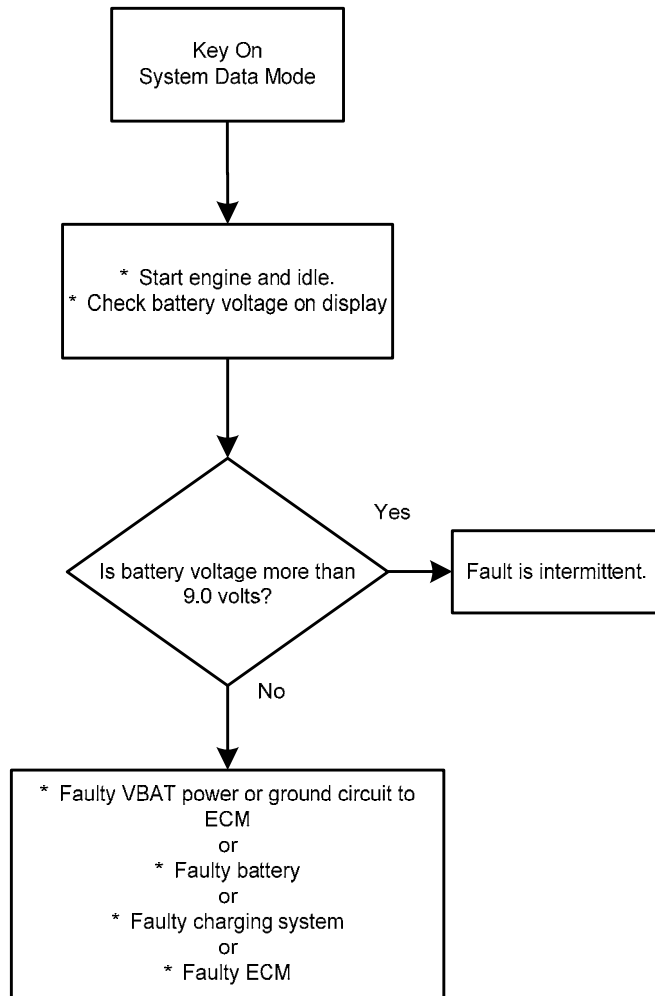
- System Voltage to ECM
- Check Condition-Key on and RPM greater than 1500
- Fault Condition-Battery voltage at ECM less than 9.0 volts continuously for 5 seconds
- MIL-On for active fault and for 10 seconds after active fault
- Adaptive-Disabled for remainder of key on cycle
- Closed Loop-Enabled

The battery voltage powers the ECM and must be measured to correctly operate injector drivers, ignition coils, etc.

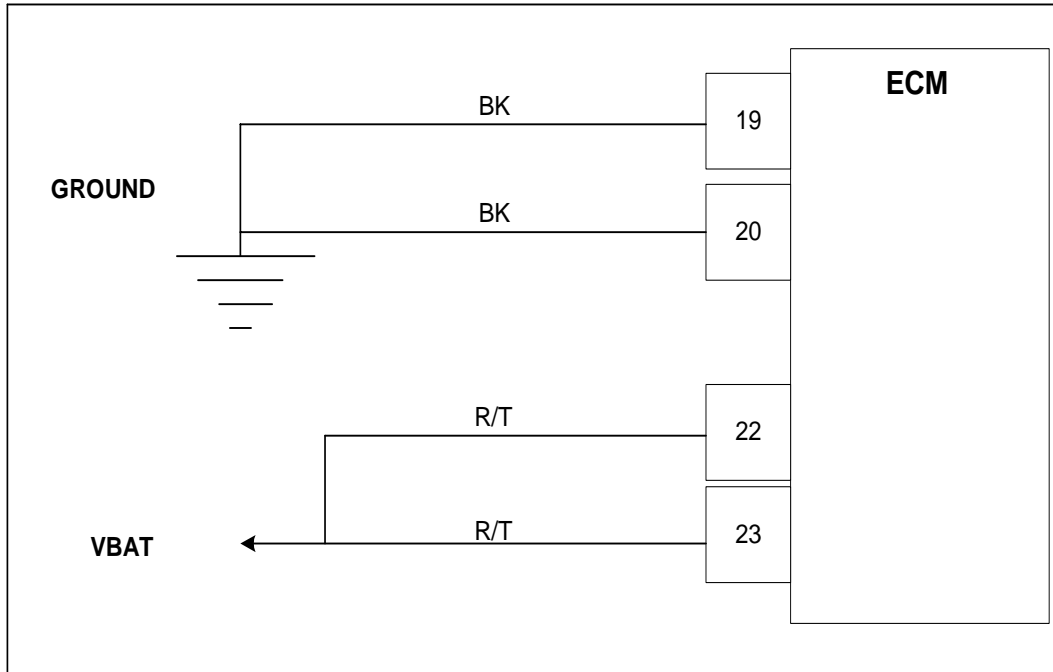
This fault will set if the ECM detects voltage less than 9.0 for 5 seconds or longer while the alternator should be charging. The adaptive learn is disabled due to the inability of the ECM to correctly time injector openings.



## DTC 261-System Voltage Low



## DTC 262-System Voltage High



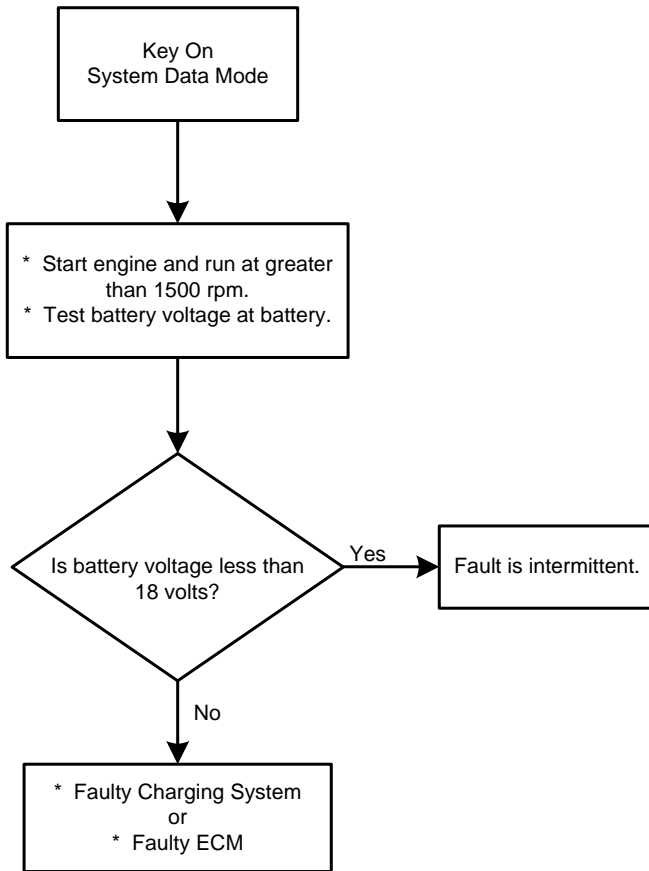
- System Voltage to ECM
- Check Condition-Cranking or Running
- Fault Condition-Switched battery voltage at ECM greater than 18 volts for 3 seconds
- MIL-On for active fault and for 5 seconds after active fault
- Adaptive-Disabled for remainder of key on cycle
- Closed Loop-Enabled

The battery voltage powers the ECM and must be measured to correctly operate injector drivers, ignition coils, etc.

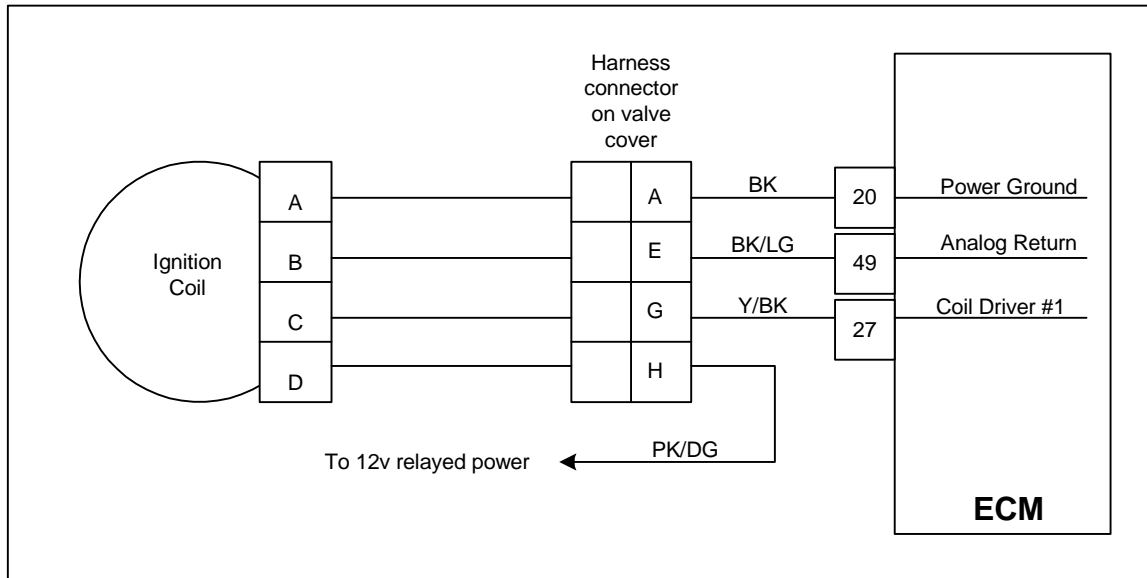
This fault will set if the ECM detects voltage greater than 18 volts for 3 seconds at anytime the engine is cranking or running. The adaptive learn is disabled due to the inability of the ECM to correctly time the injector openings.

The ECM will shut down with internal protection with more than 26 volts. A fuse will then blow in the harness.

## DTC 262-System Voltage High



## DTC 311-Coil Driver #1 Open



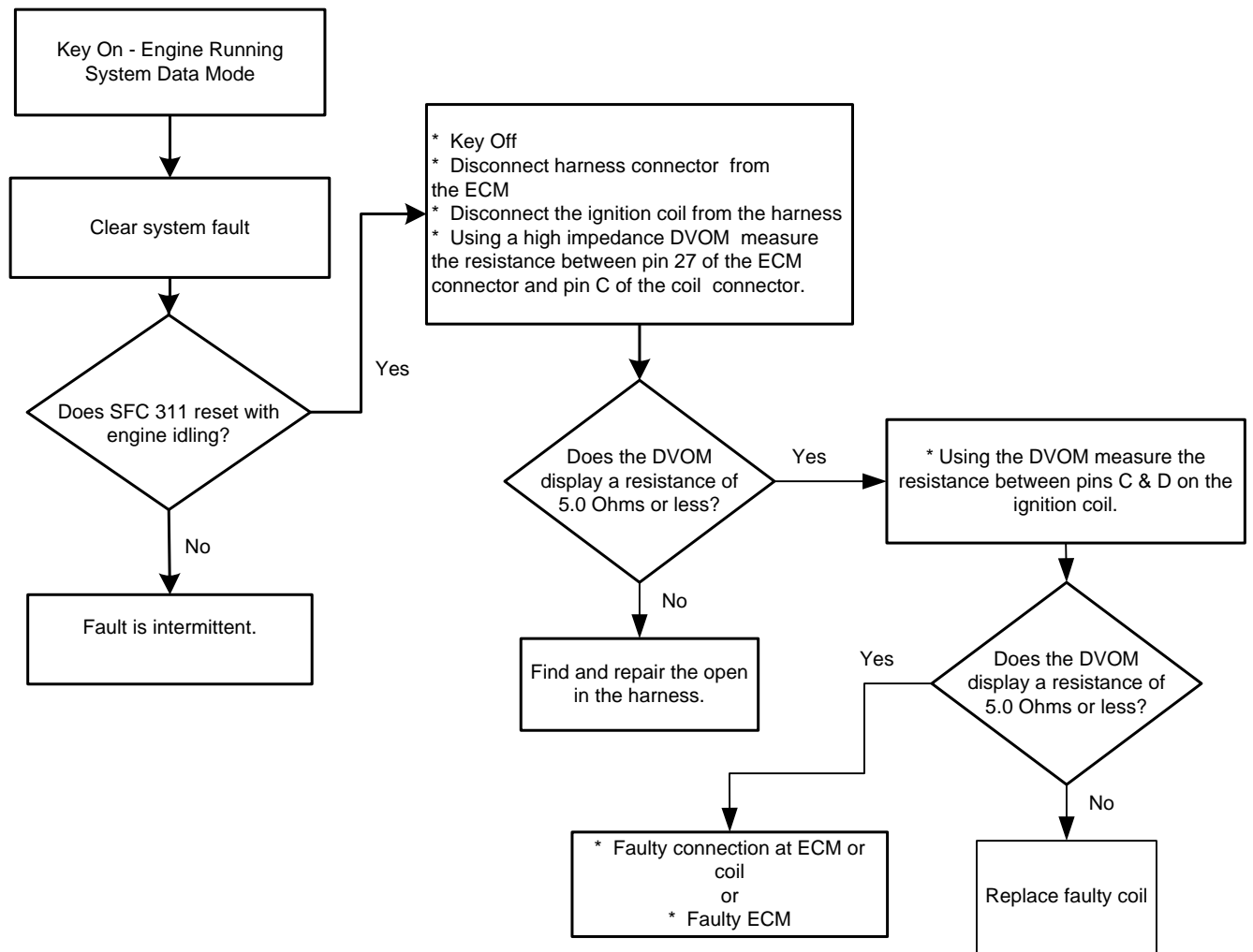
- Primary Loop open or low side short to ground
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM greater than 11 volts and dwell greater than allowed for 10 coil firings
- MIL-On for active fault and for 3 seconds after active fault
- Adaptive-Disabled for remainder of key-on cycle
- Closed Loop-Disabled during active fault

Coil driver #1 fires engine cylinder number 1.

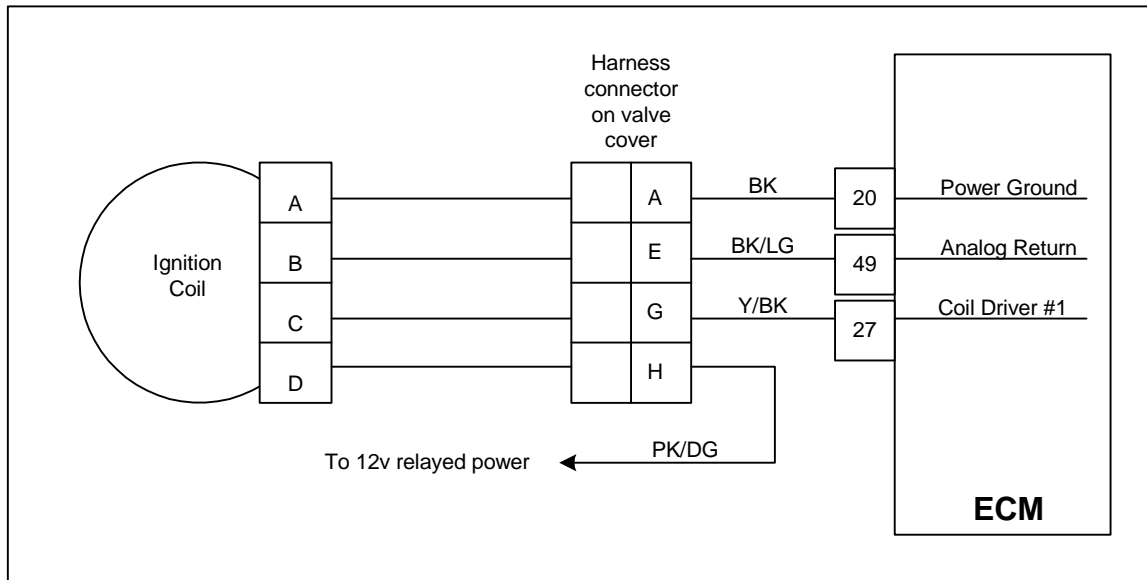
This fault will set if the ECM detects 10 coil firings which require the adaptive dwell to be greater than allowed with the battery voltage above 11 volts.

The purpose of this fault is to detect an open or high impedance circuit to the coil, or an open primary coil.

# DTC 311-Coil Driver #1 Open



## DTC 312-Coil Driver #1 Shorted



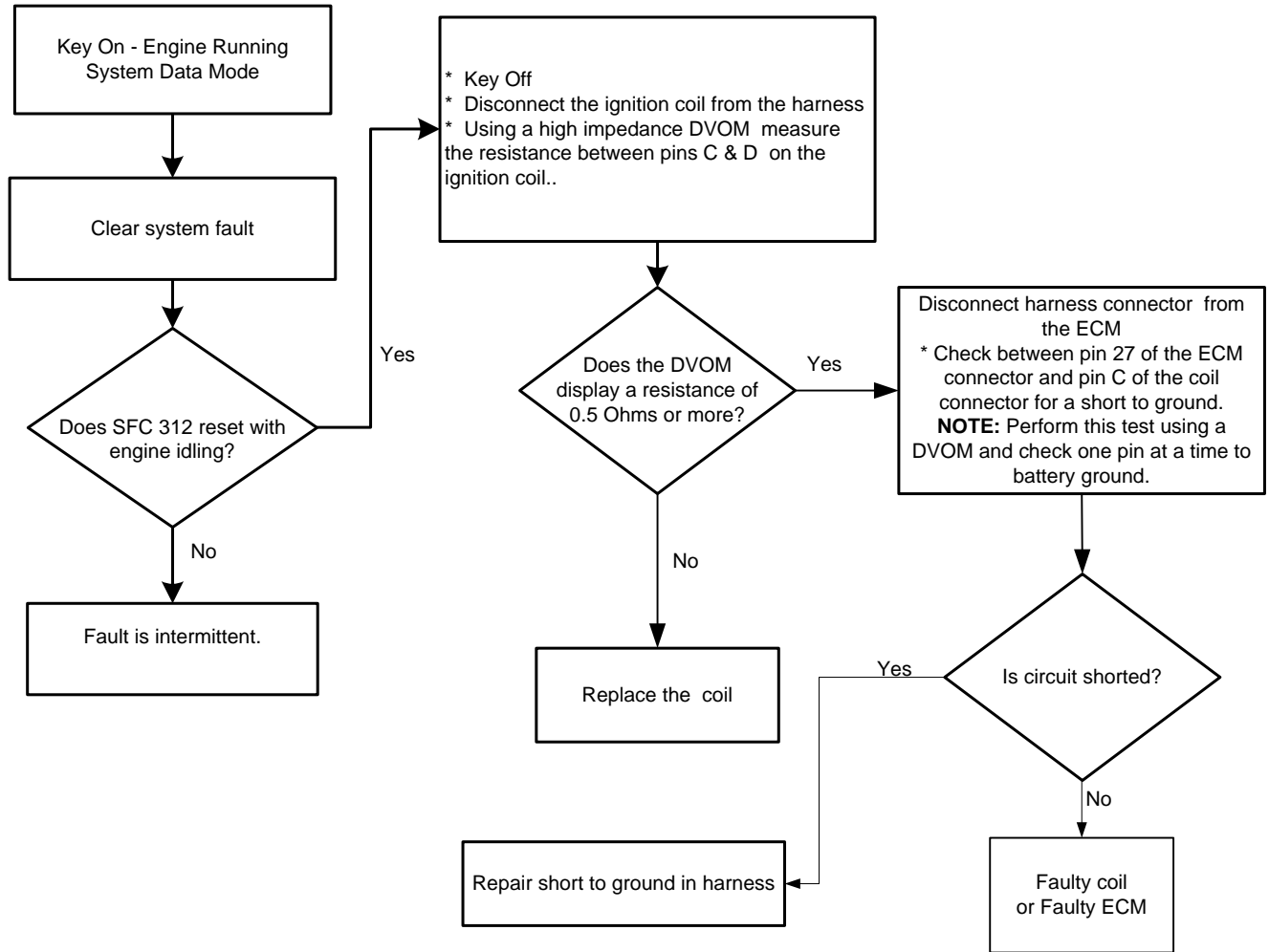
- Primary Coil shorted
- Check Condition-Key On and engine running
- Fault Condition-Battery voltage at ECM less than 16 volts and adaptive dwell less than allowed for 10 coil firings
- MIL-On for active fault and for 5 coil firings after active fault
- Adaptive-Disabled for the remainder of the key-on cycle
- Closed Loop-Disabled during the active fault

Coil driver #1 fires engine cylinder number 1.

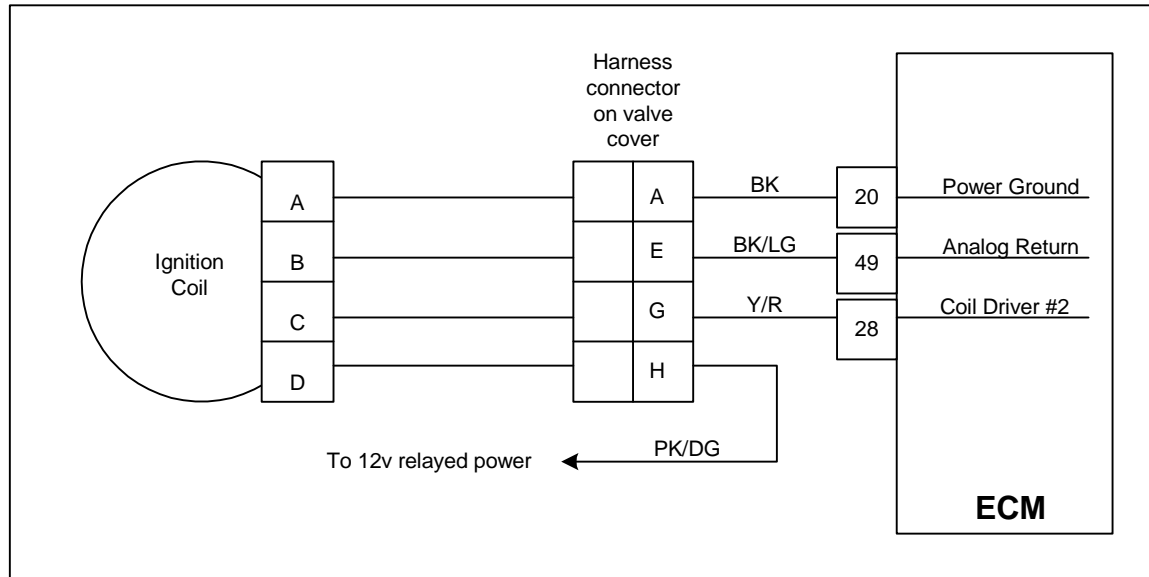
This fault will set if the ECM detects 10 coil firings in which the adaptive dwell is less allowed and battery voltage is less than 16 volts.

The purpose of this fault is to detect a short to ground in the harness, or internally to the primary coil.

# DTC 312-Coil Driver #1 Shorted



## DTC 313-Coil Driver #2 Open



- Primary Loop open or low side short to ground
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM greater than 11 volts and dwell greater than allowed for 10 coil firings
- MIL-On for active fault and for 3 seconds after active fault
- Adaptive-Disabled for remainder of key-on cycle
- Closed Loop-Disabled during active fault

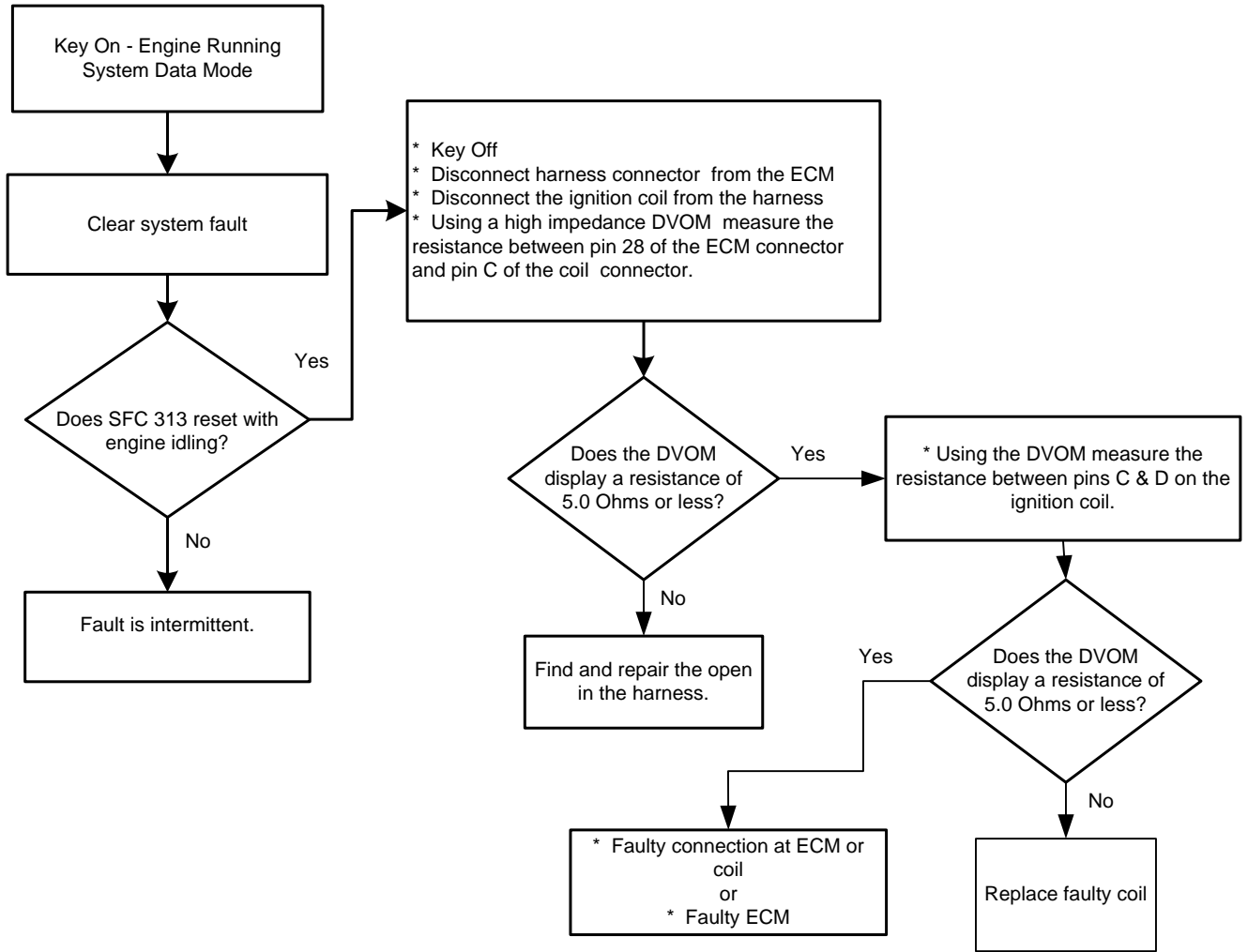
Coil driver #2 fires the 2<sup>nd</sup> cylinder in the firing order.

This fault will set if the ECM detects 10 coil firings which require the adaptive dwell to be greater than allowed with the battery voltage above 11 volts.

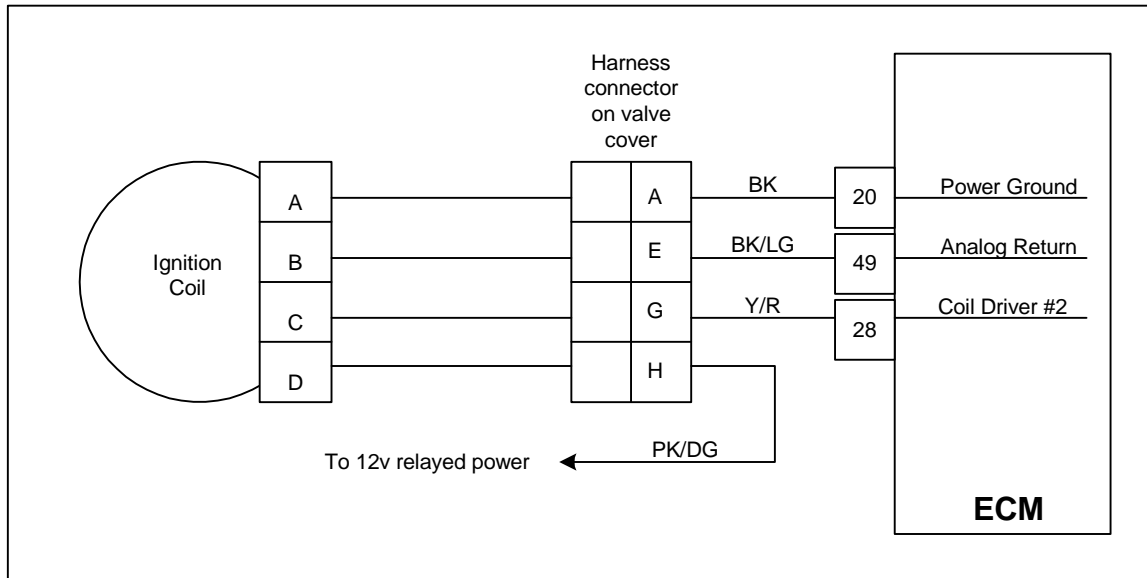
The purpose of this fault is to detect an open or high impedance circuit to the coil, or an open primary coil.



# DTC 313-Coil Driver #2 Open



## DTC 314-Coil Driver #2 Shorted



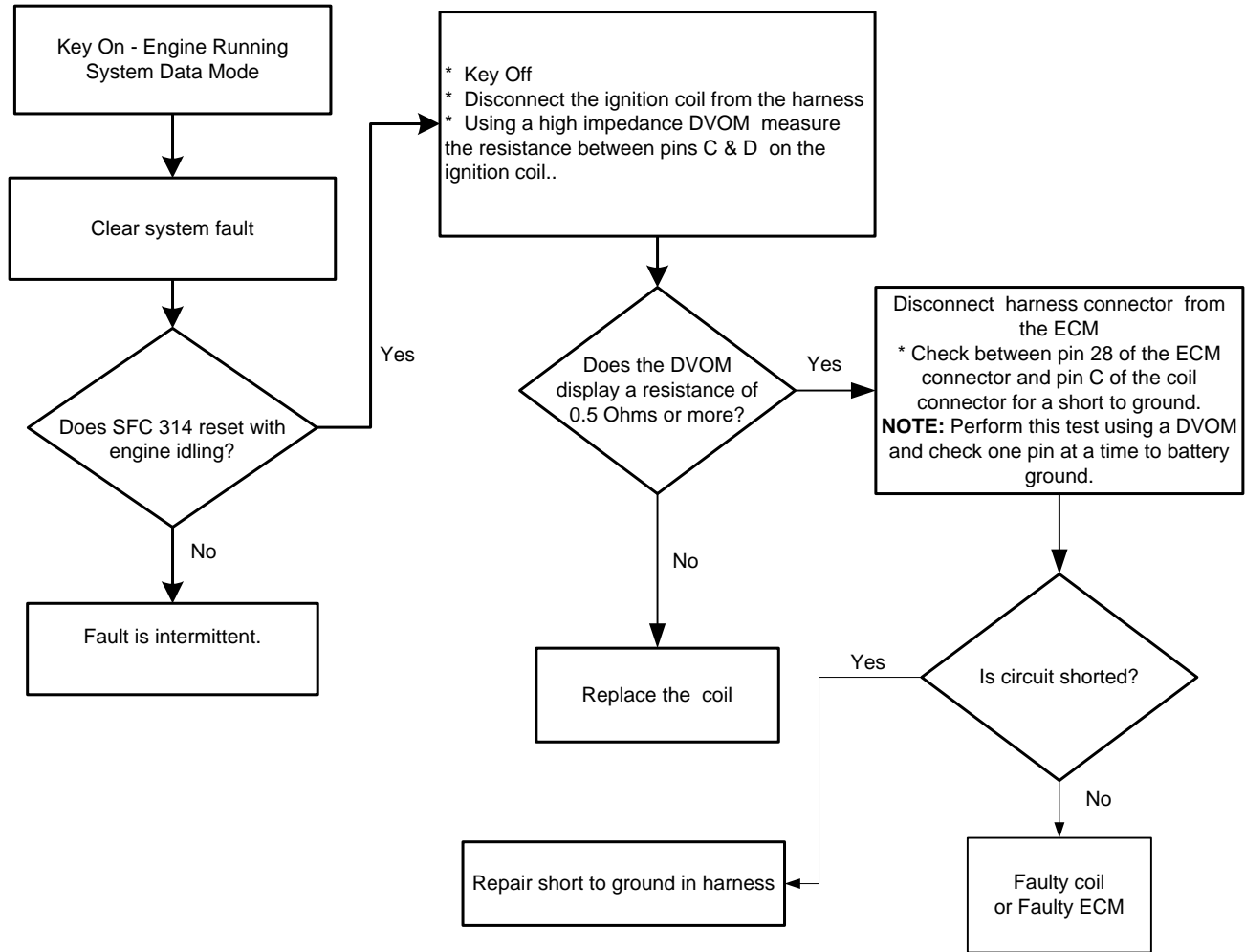
- Primary Coil shorted
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM less than 16 volts and adaptive dwell less allowed for 10 coil firings
- MIL-On during active fault and for 5 coil firings after active fault
- Adaptive-Enabled
- Closed Loop-Enabled

Coil driver #2 fires the 2<sup>nd</sup> cylinder in the firing order.

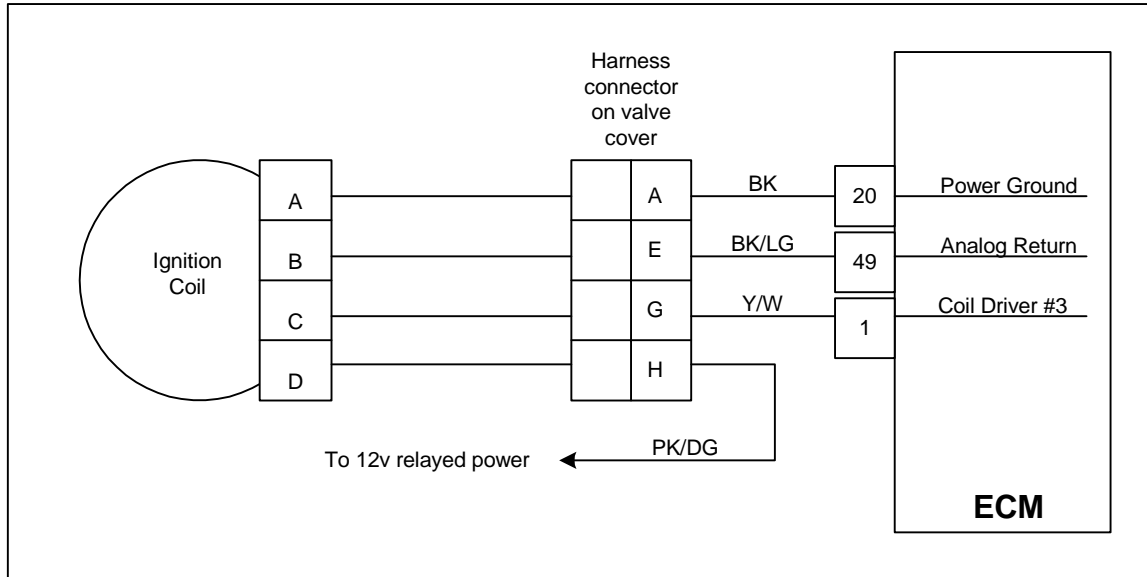
This fault will set if the ECM detects 10 coil firings in which the adaptive dwell is less than allowed and battery voltage is less than 16 volts.

The purpose of this fault is to detect a short to ground in the harness, or internally to the primary coil.

# DTC 314-Coil Driver #2 Shorted



## DTC 315-Coil Driver #3 Open



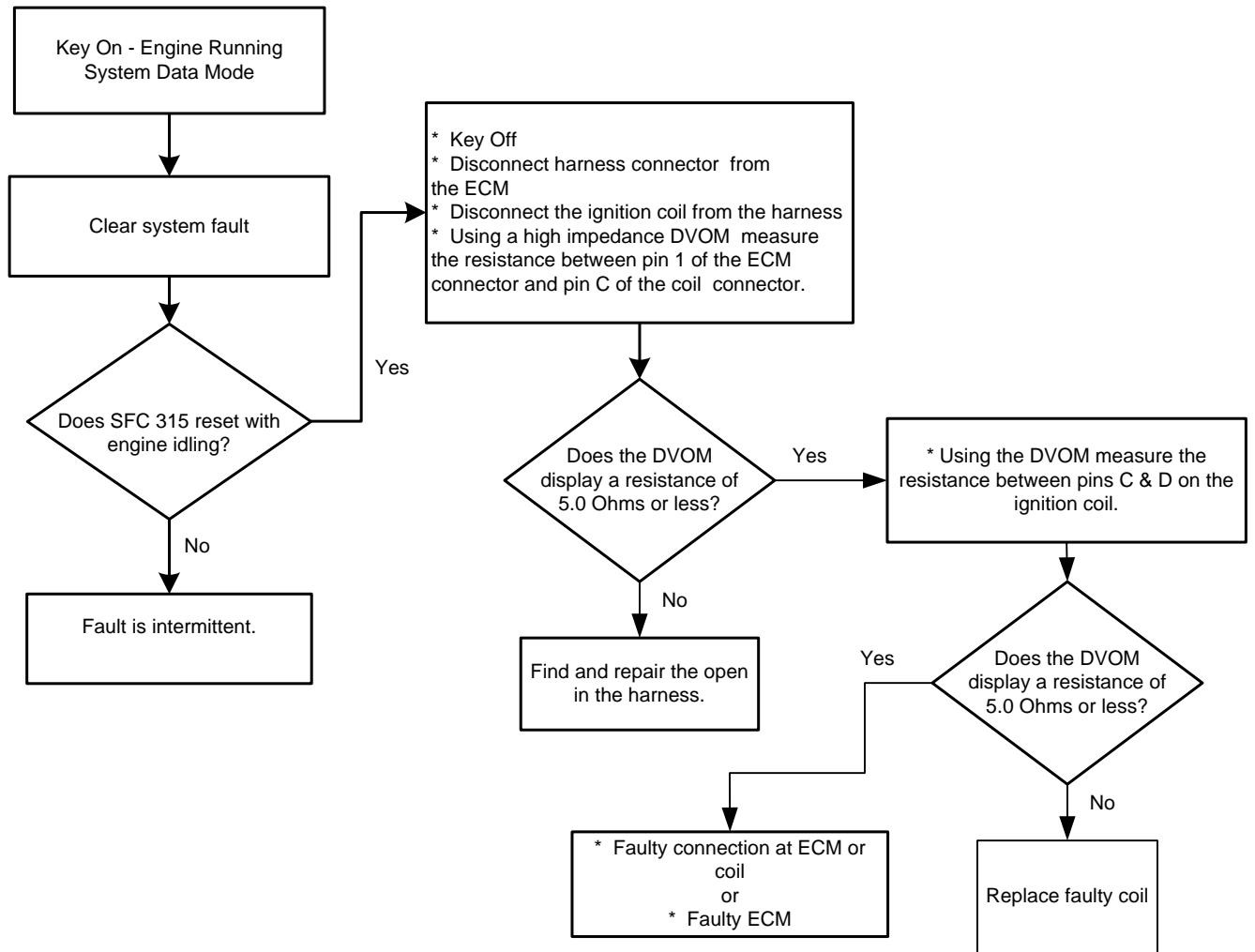
- Primary Loop open or low side short to ground
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM greater than 11 volts and dwell greater than allowed for 10 coil firings
- MIL-On for active fault and for 3 seconds after active fault
- Adaptive-Disabled for remainder of key-on cycle
- Closed Loop-Disabled during active fault

Coil driver #3 fires the 3<sup>rd</sup> cylinder in the firing order.

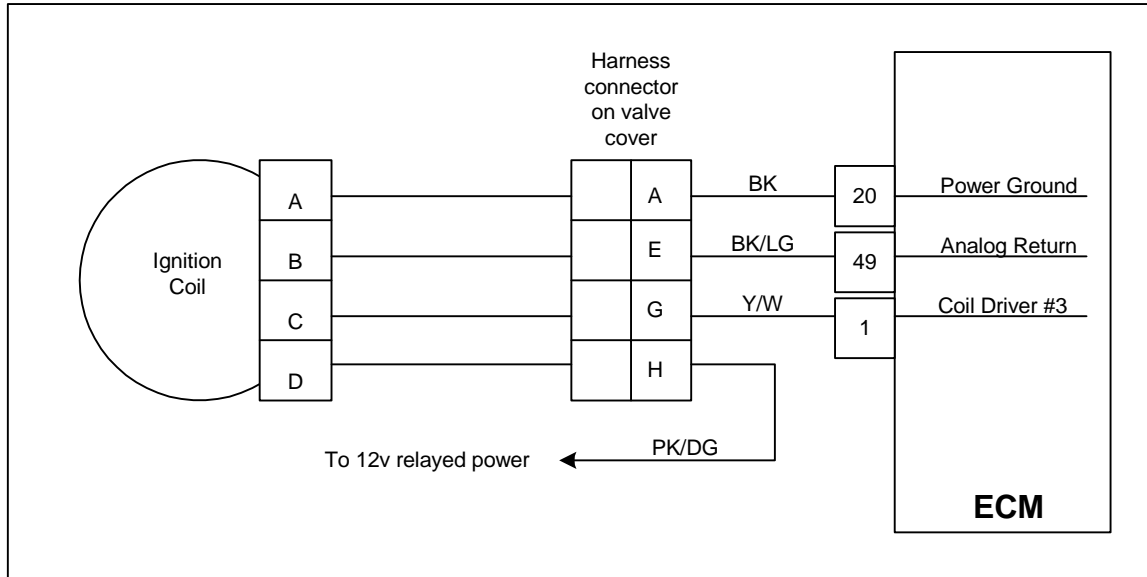
This fault will set if the ECM detects 10 coil firings which require the adaptive dwell to be greater than allowed with the battery voltage above 11 volts.

The purpose of this fault is to detect an open or high impedance circuit to the coil, or an open primary coil.

# DTC 315-Coil Driver #3 Open



## DTC 316-Coil Driver #3 Shorted



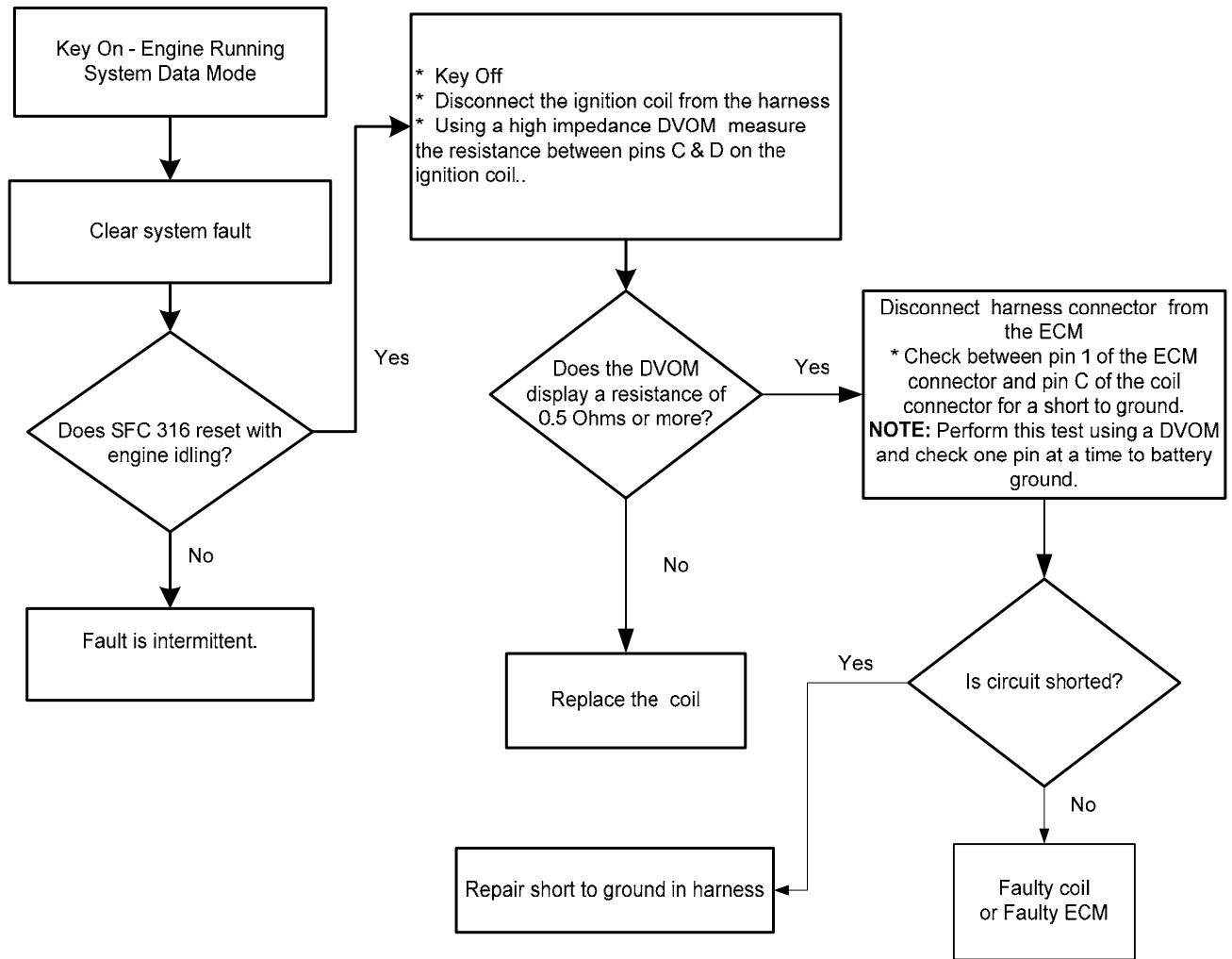
- Primary Coil shorted
- Check Condition-Key On and engine running
- Fault Condition-Battery voltage at ECM less than 16 volts and adaptive dwell less than allowed for 10 coil firings
- MIL-On for active fault and for 5 coil firings after active fault
- Adaptive-Disabled for the remainder of the key-on cycle
- Closed Loop-Disabled during the active fault

Coil driver #3 fires the 3<sup>rd</sup> cylinder in the firing order.

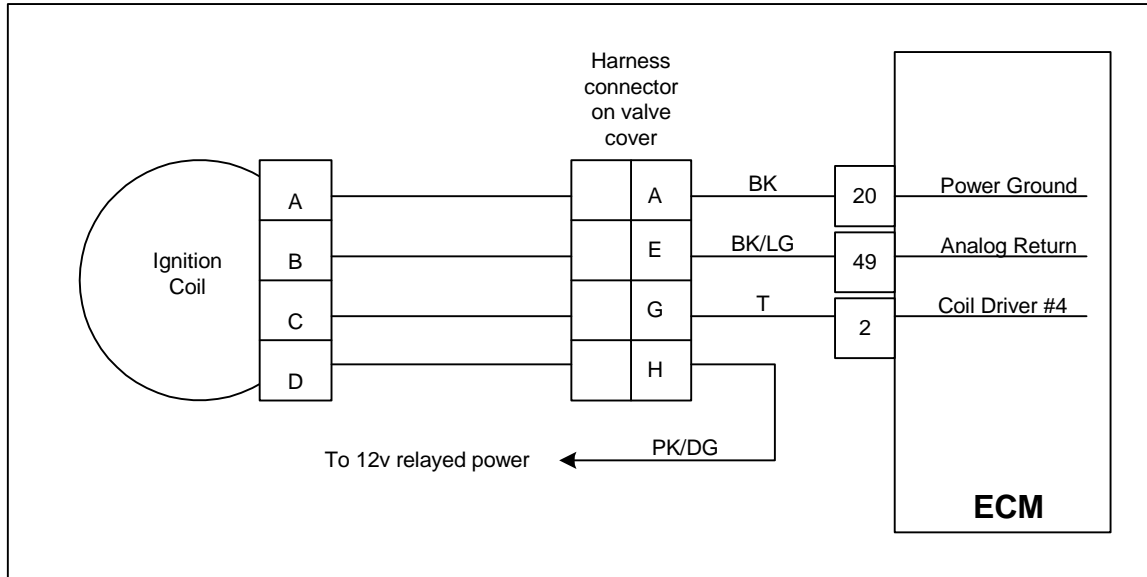
This fault will set if the ECM detects 10 coil firings in which the adaptive dwell is less allowed and battery voltage is less than 16 volts.

The purpose of this fault is to detect a short to ground in the harness, or internally to the primary coil.

# DTC 316-Coil Driver #3 Shorted



## DTC 321-Coil Driver #4 Open



- Primary Loop open or low side short to ground
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM greater than 11 volts and dwell greater than allowed for 10 coil firings
- MIL-On for active fault and for 3 seconds after active fault
- Adaptive-Disabled for remainder of key-on cycle
- Closed Loop-Disabled during active fault

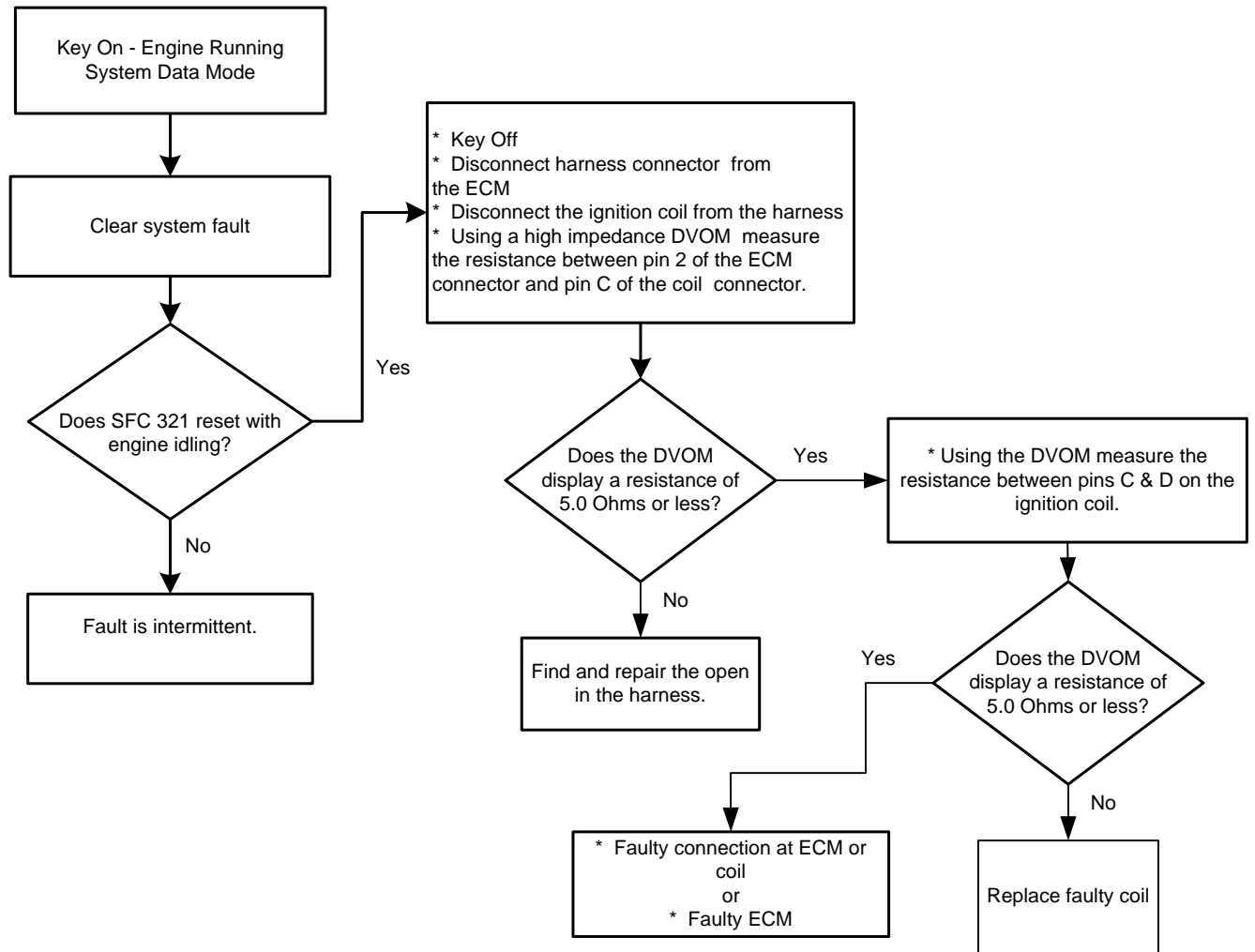
Coil driver #4 fires the 4th cylinder in the firing order.

This fault will set if the ECM detects 10 coil firings which require the adaptive dwell to be greater than allowed with the battery voltage above 11 volts.

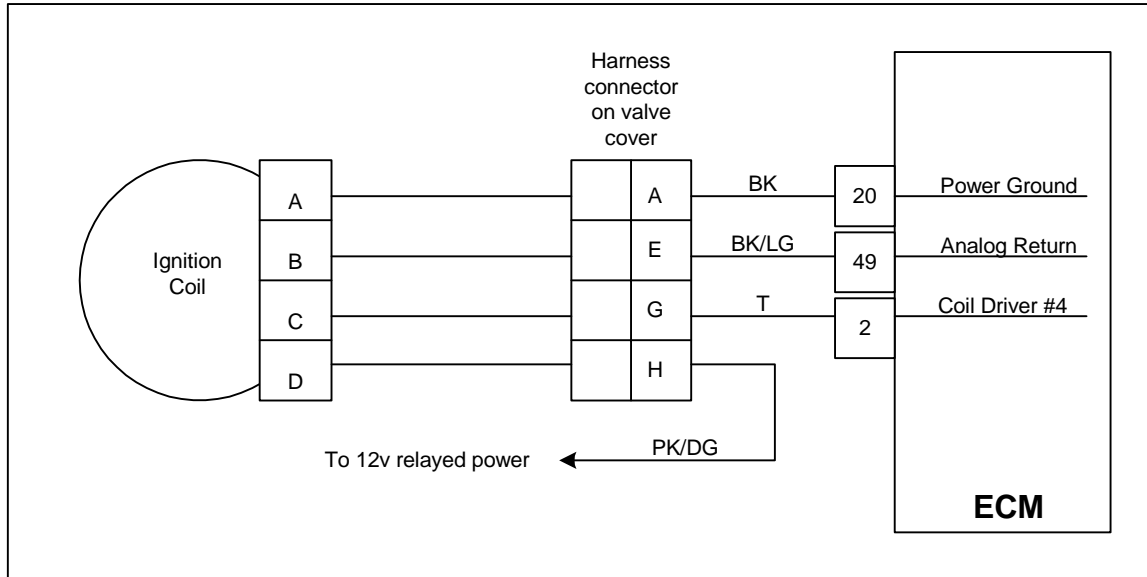
The purpose of this fault is to detect an open or high impedance circuit to the coil, or an open primary coil.



# DTC 321-Coil Driver #4 Open



## DTC 322-Coil Driver #4 Shorted



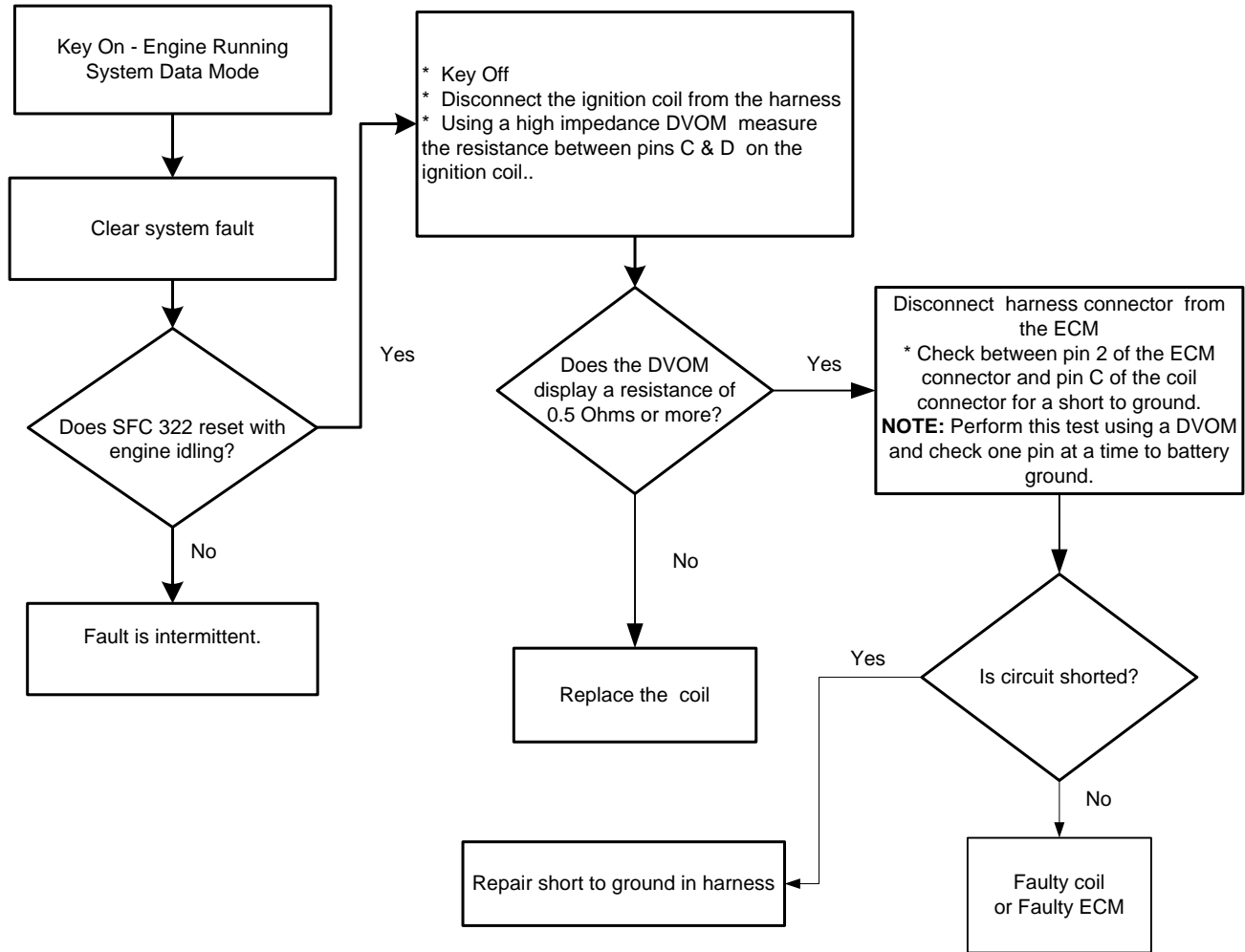
- Primary Coil shorted
- Check Condition-Key On and engine running
- Fault Condition-Battery voltage at ECM less than 16 volts and adaptive dwell less than allowed for 10 coil firings
- MIL-On for active fault and for 5 coil firings after active fault
- Adaptive-Disabled for the remainder of the key-on cycle
- Closed Loop-Disabled during the active fault

Coil driver #4 fires the 4th cylinder in the firing order.

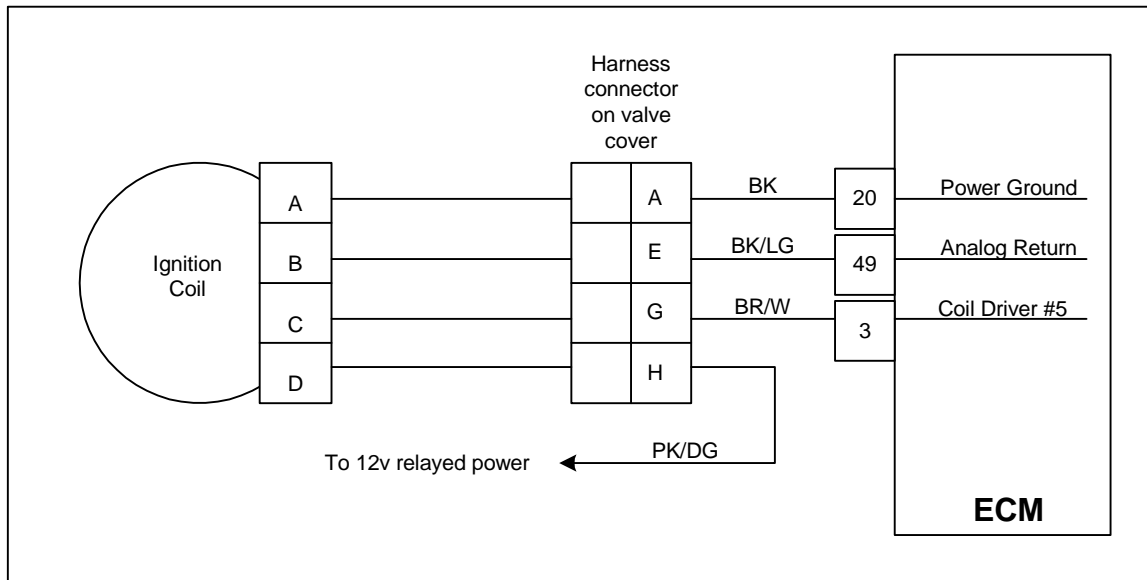
This fault will set if the ECM detects 10 coil firings in which the adaptive dwell is less allowed and battery voltage is less than 16 volts.

The purpose of this fault is to detect a short to ground in the harness, or internally to the primary coil.

# DTC 322-Coil Driver #4 Shorted



## DTC 323-Coil Driver #5 Open



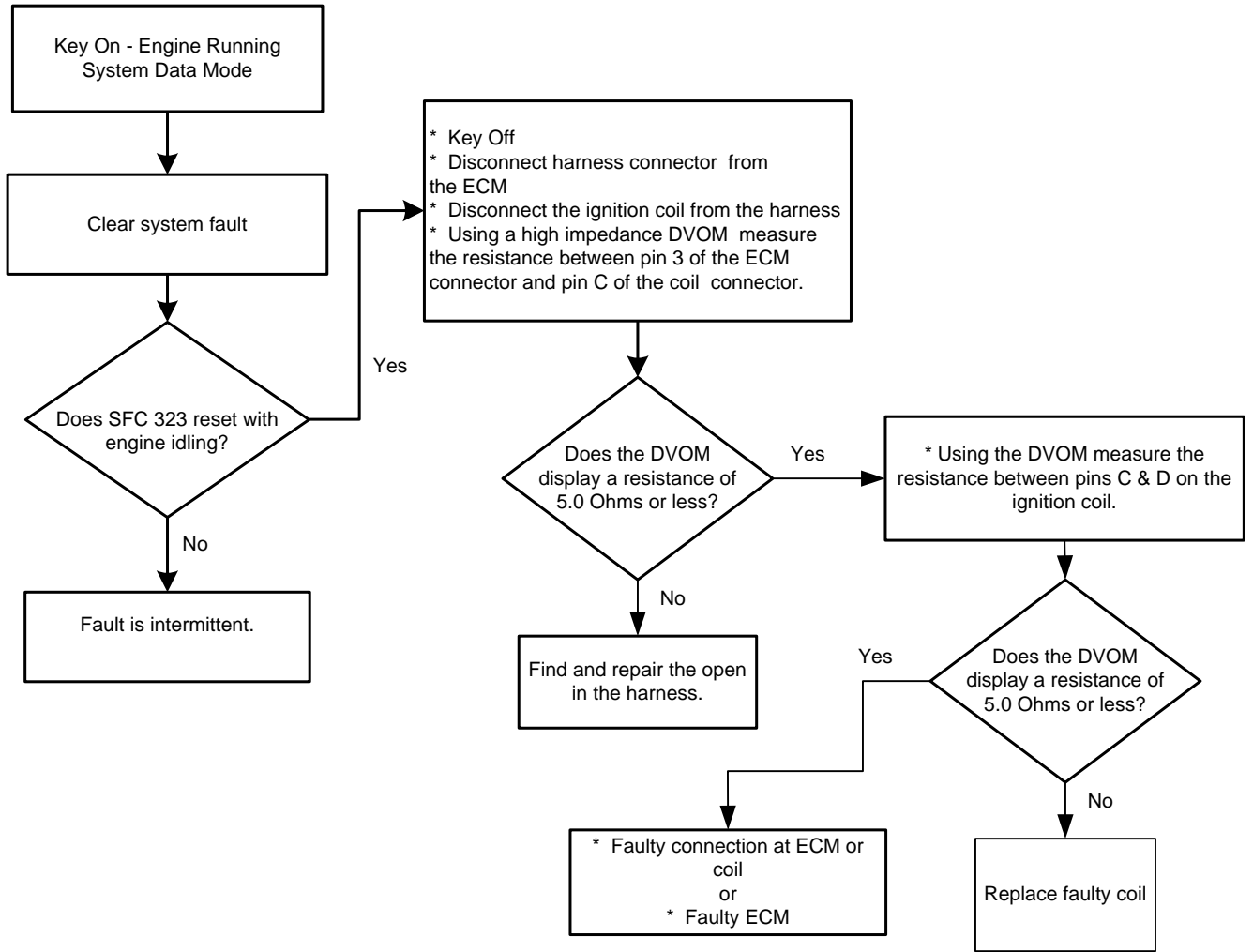
- Primary Loop open or low side short to ground
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM greater than 11 volts and dwell greater than allowed for 10 coil firings
- MIL-On for active fault and for 3 seconds after active fault
- Adaptive-Disabled for remainder of key-on cycle
- Closed Loop-Disabled during active fault

Coil driver #5 fires the 5<sup>th</sup> cylinder in the firing order.

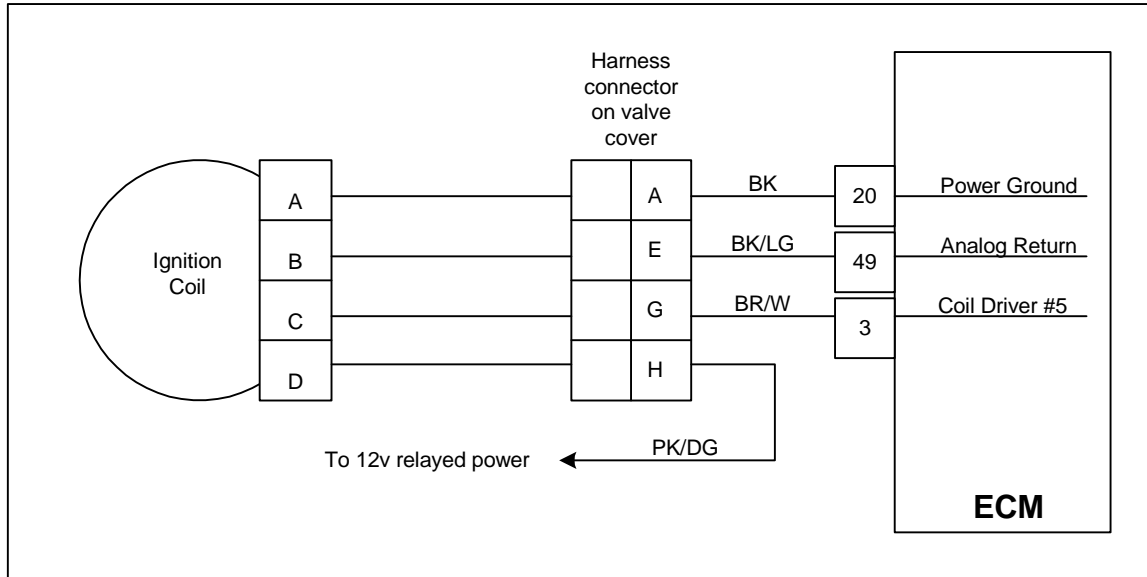
This fault will set if the ECM detects 10 coil firings which require the adaptive dwell to be greater than allowed with the battery voltage above 11 volts.

The purpose of this fault is to detect an open or high impedance circuit to the coil, or an open primary coil.

# DTC 323-Coil Driver #5 Open



## DTC 324-Coil Driver #5 Shorted



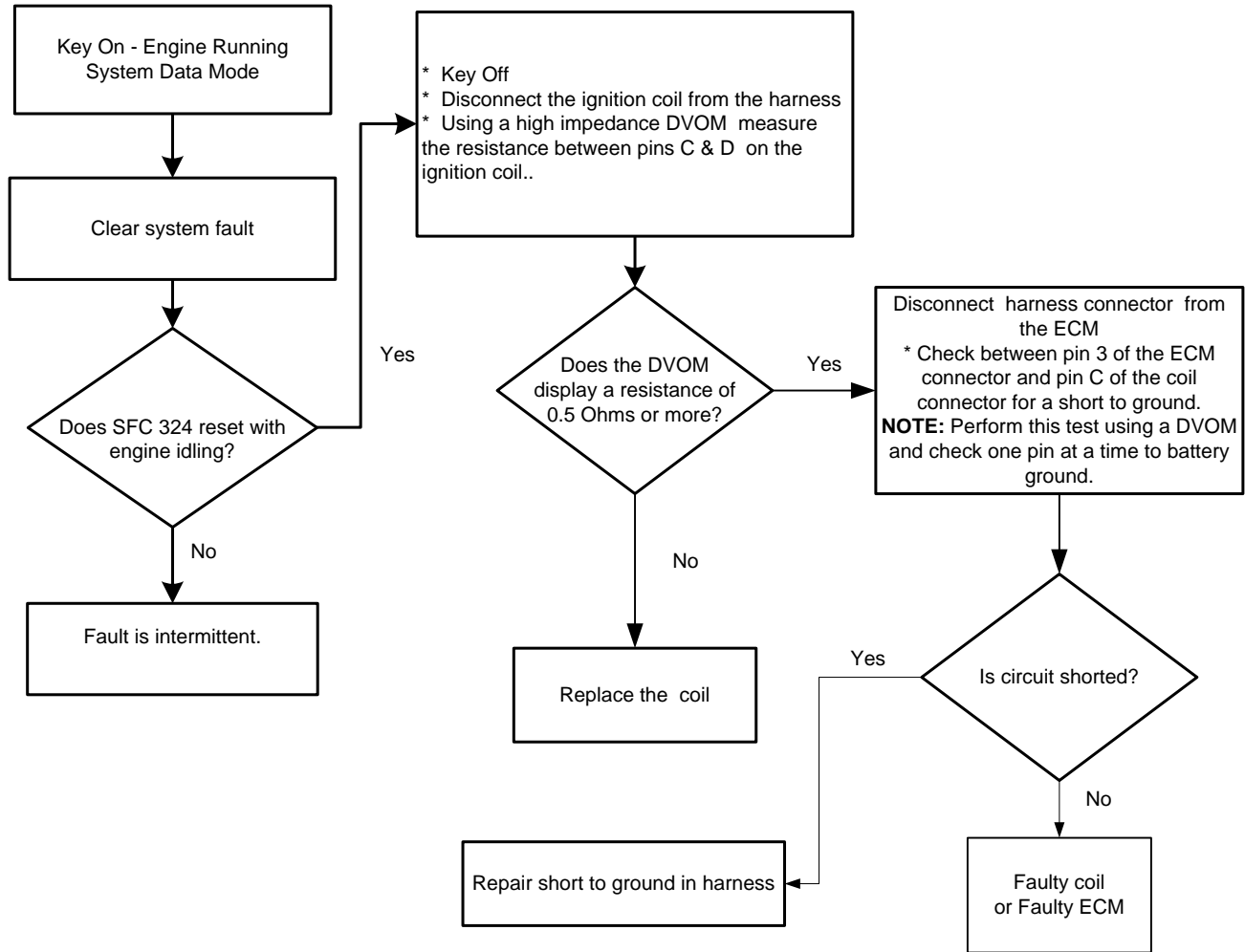
- Primary Coil shorted
- Check Condition-Key On and engine running
- Fault Condition-Battery voltage at ECM less than 16 volts and adaptive dwell less than allowed for 10 coil firings
- MIL-On for active fault and for 5 coil firings after active fault
- Adaptive-Disabled for the remainder of the key-on cycle
- Closed Loop-Disabled during the active fault

Coil driver #5 fires the 5th cylinder in the firing order.

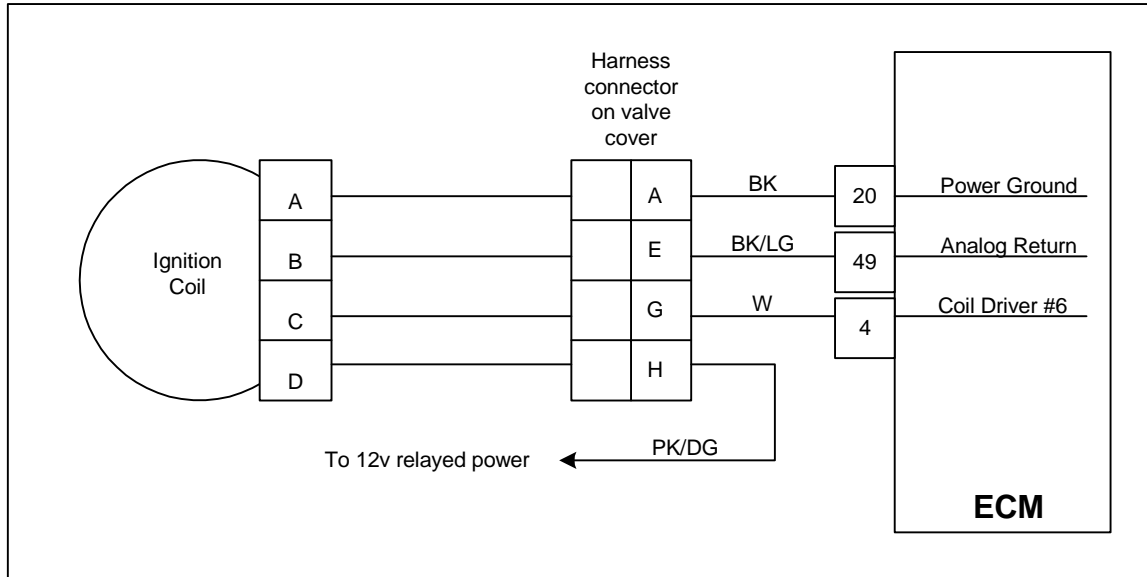
This fault will set if the ECM detects 10 coil firings in which the adaptive dwell is less allowed and battery voltage is less than 16 volts.

The purpose of this fault is to detect a short to ground in the harness, or internally to the primary coil.

# DTC 324-Coil Driver #5 Shorted



## DTC 325-Coil Driver #6 Open



- Primary Loop open or low side short to ground
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM greater than 11 volts and dwell greater than allowed for 10 coil firings
- MIL-On for active fault and for 3 seconds after active fault
- Adaptive-Disabled for remainder of key-on cycle
- Closed Loop-Disabled during active fault

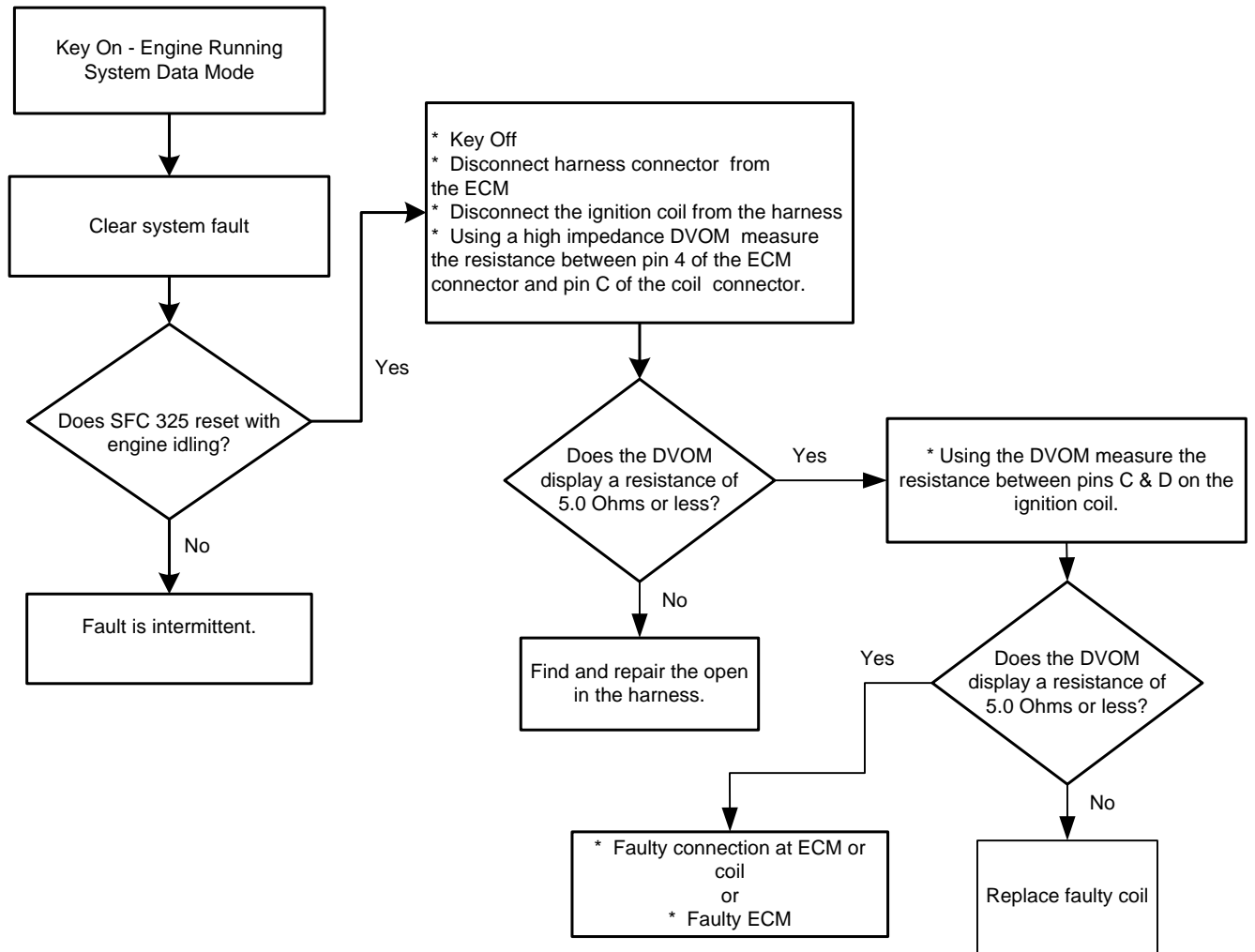
Coil driver #6 fires the 6th cylinder in the firing order.

This fault will set if the ECM detects 10 coil firings which require the adaptive dwell to be greater than allowed with the battery voltage above 11 volts.

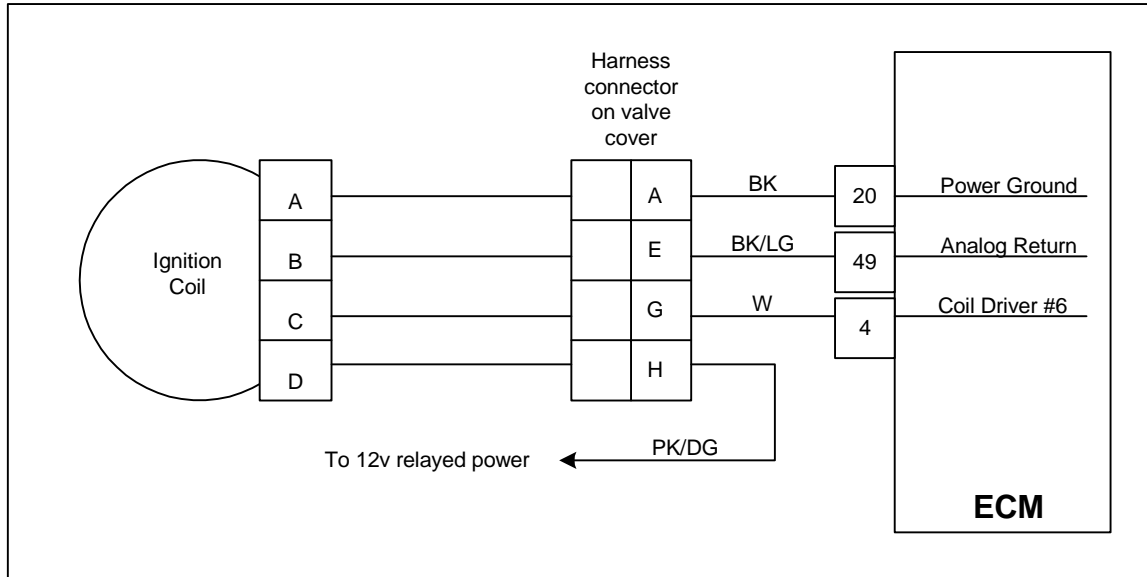
The purpose of this fault is to detect an open or high impedance circuit to the coil, or an open primary coil.



# DTC 325-Coil Driver #6 Open



## DTC 326-Coil Driver #6 Shorted



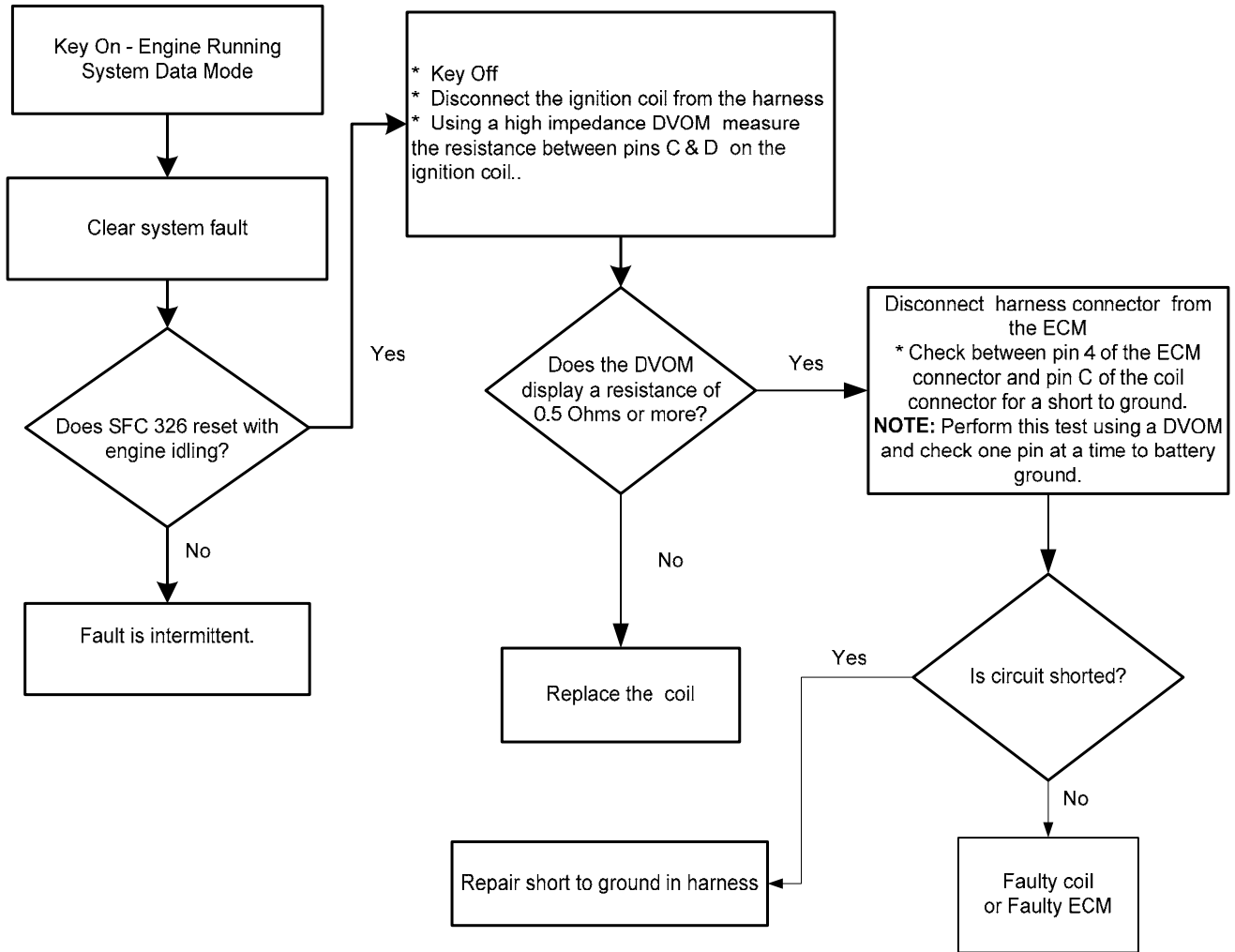
- Primary Coil shorted
- Check Condition-Key On and engine running
- Fault Condition-Battery voltage at ECM less than 16 volts and adaptive dwell less than allowed for 10 coil firings
- MIL-On for active fault and for 5 coil firings after active fault
- Adaptive-Disabled for the remainder of the key-on cycle
- Closed Loop-Disabled during the active fault

Coil driver #6 fires the 6th cylinder in the firing order.

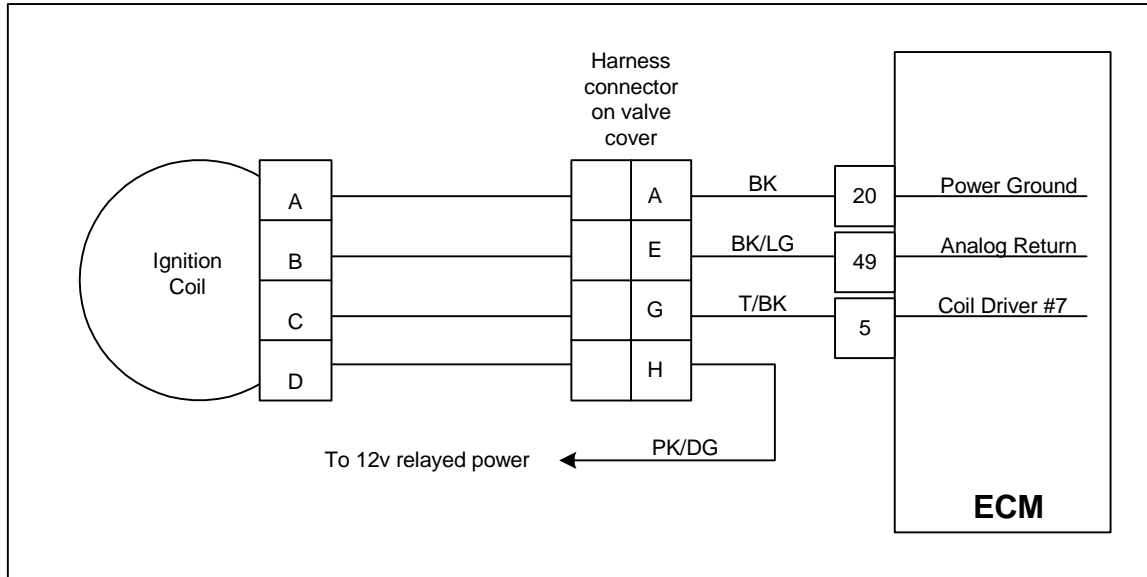
This fault will set if the ECM detects 10 coil firings in which the adaptive dwell is less allowed and battery voltage is less than 16 volts.

The purpose of this fault is to detect a short to ground in the harness, or internally to the primary coil.

# DTC 326-Coil Driver #6 Shorted



## DTC 331-Coil Driver #7 Open



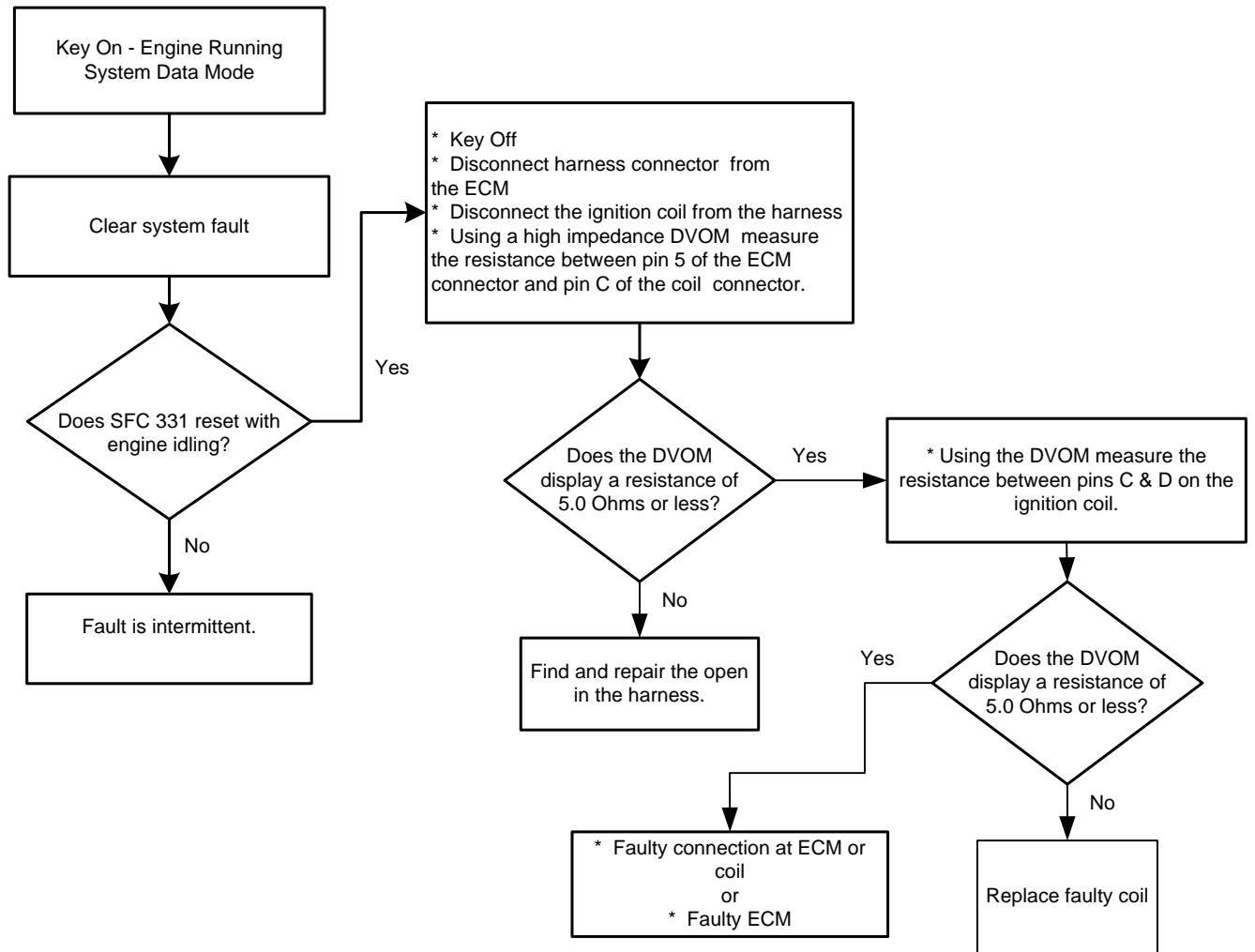
- Primary Loop open or low side short to ground
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM greater than 11 volts and dwell greater than allowed for 10 coil firings
- MIL-On for active fault and for 3 seconds after active fault
- Adaptive-Disabled for remainder of key-on cycle
- Closed Loop-Disabled during active fault

Coil driver #7 fires the 7th cylinder in the firing order.

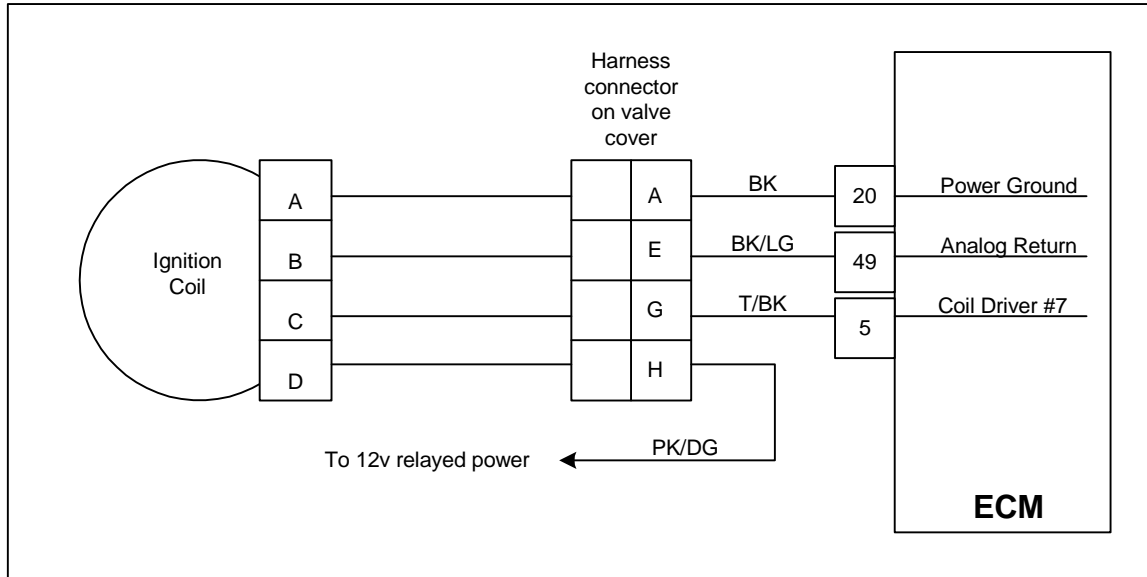
This fault will set if the ECM detects 10 coil firings which require the adaptive dwell to be greater than allowed with the battery voltage above 11 volts.

The purpose of this fault is to detect an open or high impedance circuit to the coil, or an open primary coil.

# DTC 331-Coil Driver #7 Open



## DTC 332-Coil Driver #7 Shorted



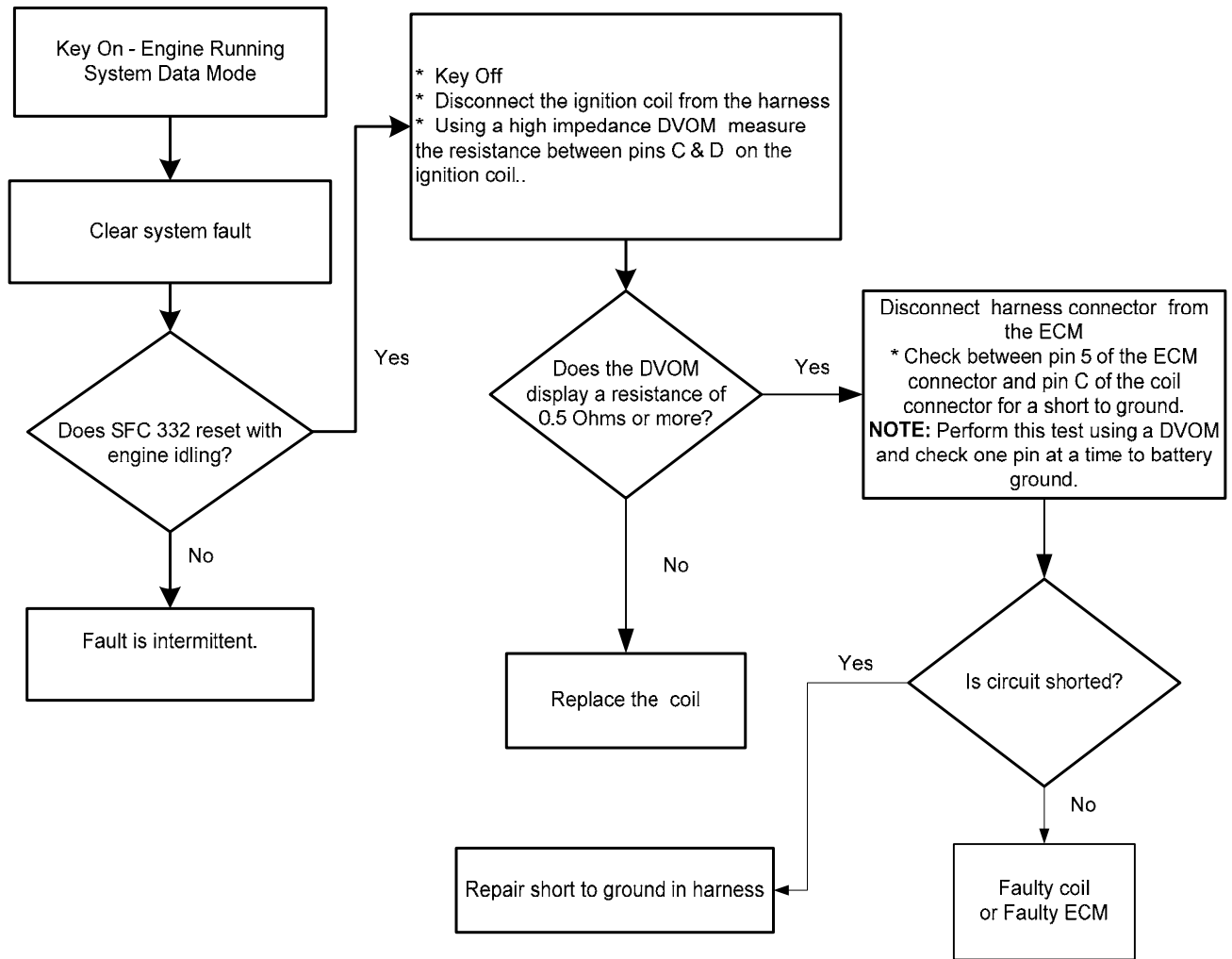
- Primary Coil shorted
- Check Condition-Key On and engine running
- Fault Condition-Battery voltage at ECM less than 16 volts and adaptive dwell less than allowed for 10 coil firings
- MIL-On for active fault and for 5 coil firings after active fault
- Adaptive-Disabled for the remainder of the key-on cycle
- Closed Loop-Disabled during the active fault

Coil driver #7 fires the 7th cylinder in the firing order.

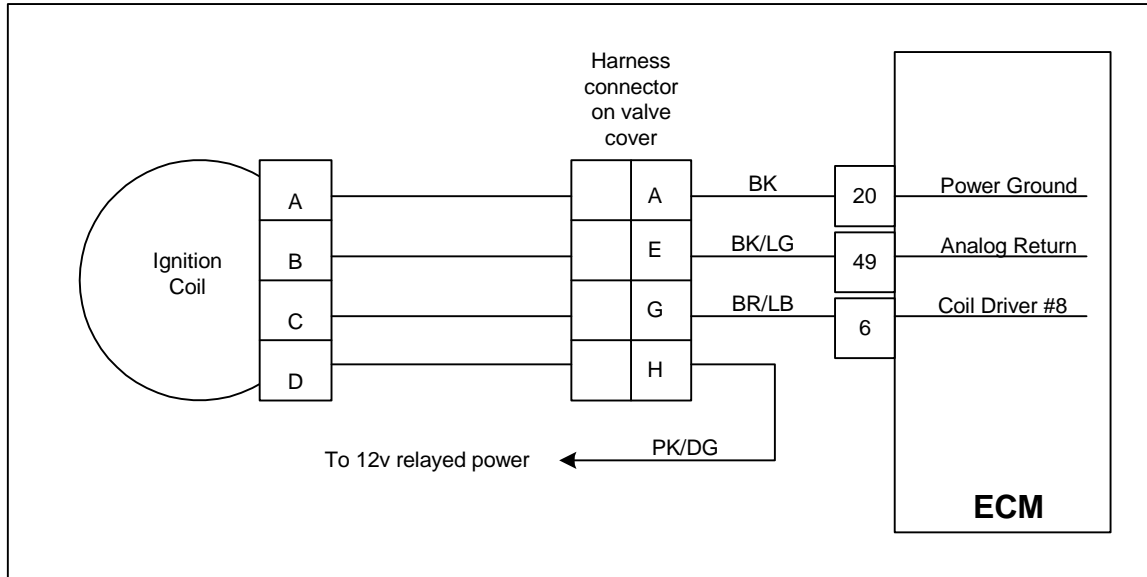
This fault will set if the ECM detects 10 coil firings in which the adaptive dwell is less allowed and battery voltage is less than 16 volts.

The purpose of this fault is to detect a short to ground in the harness, or internally to the primary coil.

# DTC 332-Coil Driver #7 Shorted



## DTC 333-Coil Driver #8 Open



- Primary Loop open or low side short to ground
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM greater than 11 volts and dwell greater than allowed for 10 coil firings
- MIL-On for active fault and for 3 seconds after active fault
- Adaptive-Disabled for remainder of key-on cycle
- Closed Loop-Disabled during active fault

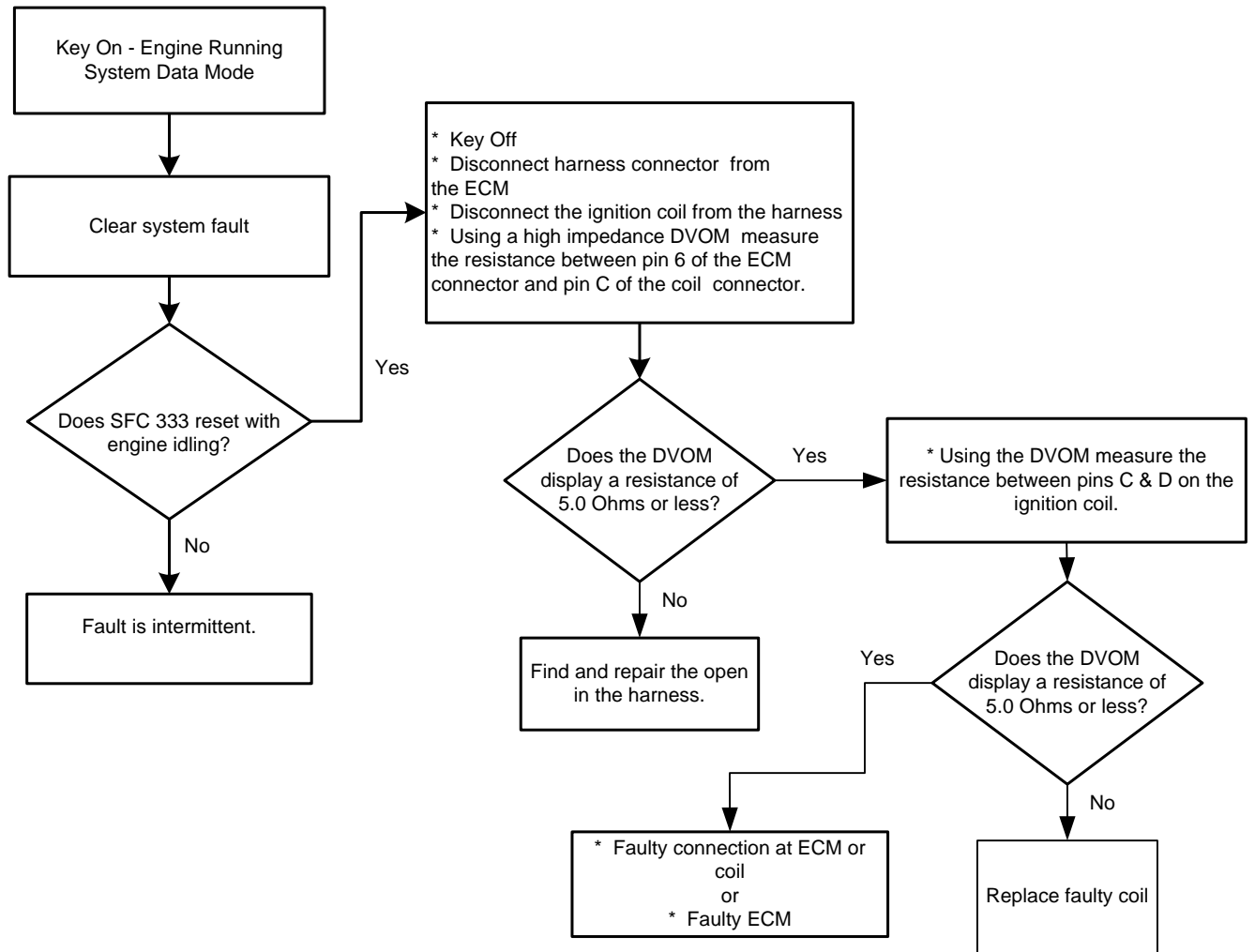
Coil driver #8 fires the 8th cylinder in the firing order.

This fault will set if the ECM detects 10 coil firings which require the adaptive dwell to be greater than allowed with the battery voltage above 11 volts.

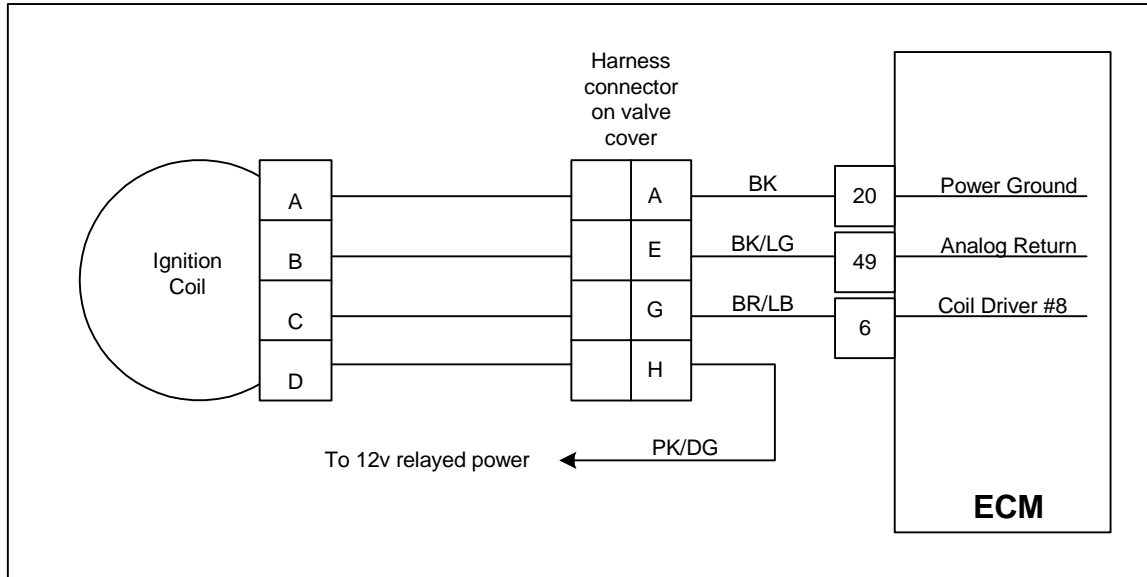
The purpose of this fault is to detect an open or high impedance circuit to the coil, or an open primary coil.



# DTC 333-Coil Driver #8 Open



## DTC 334-Coil Driver #8 Shorted



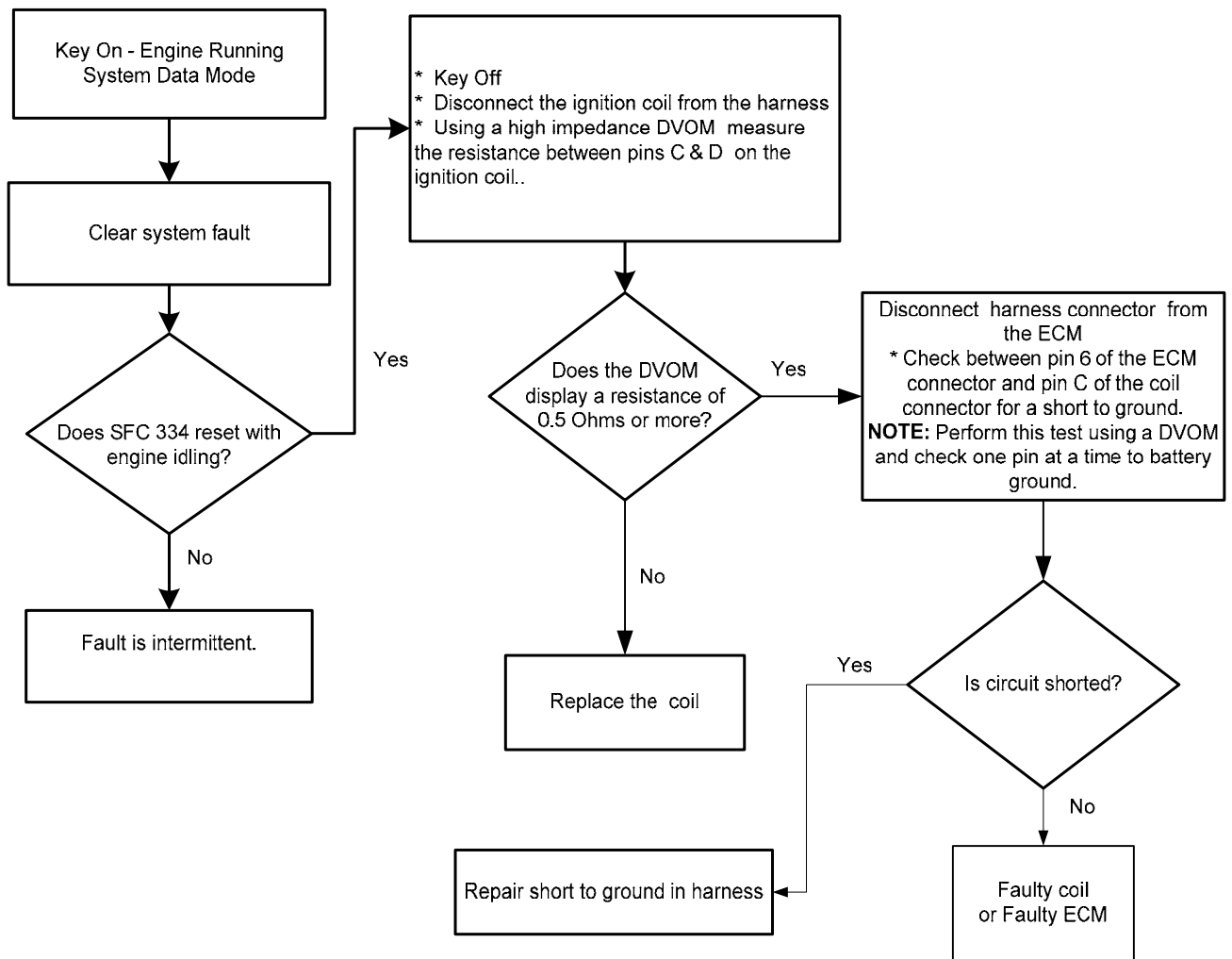
- Primary Coil shorted
- Check Condition-Key On and engine running
- Fault Condition-Battery voltage at ECM less than 16 volts and adaptive dwell less than allowed for 10 coil firings
- MIL-On for active fault and for 5 coil firings after active fault
- Adaptive-Disabled for the remainder of the key-on cycle
- Closed Loop-Disabled during the active fault

Coil driver #8 fires the 8th cylinder in the firing order.

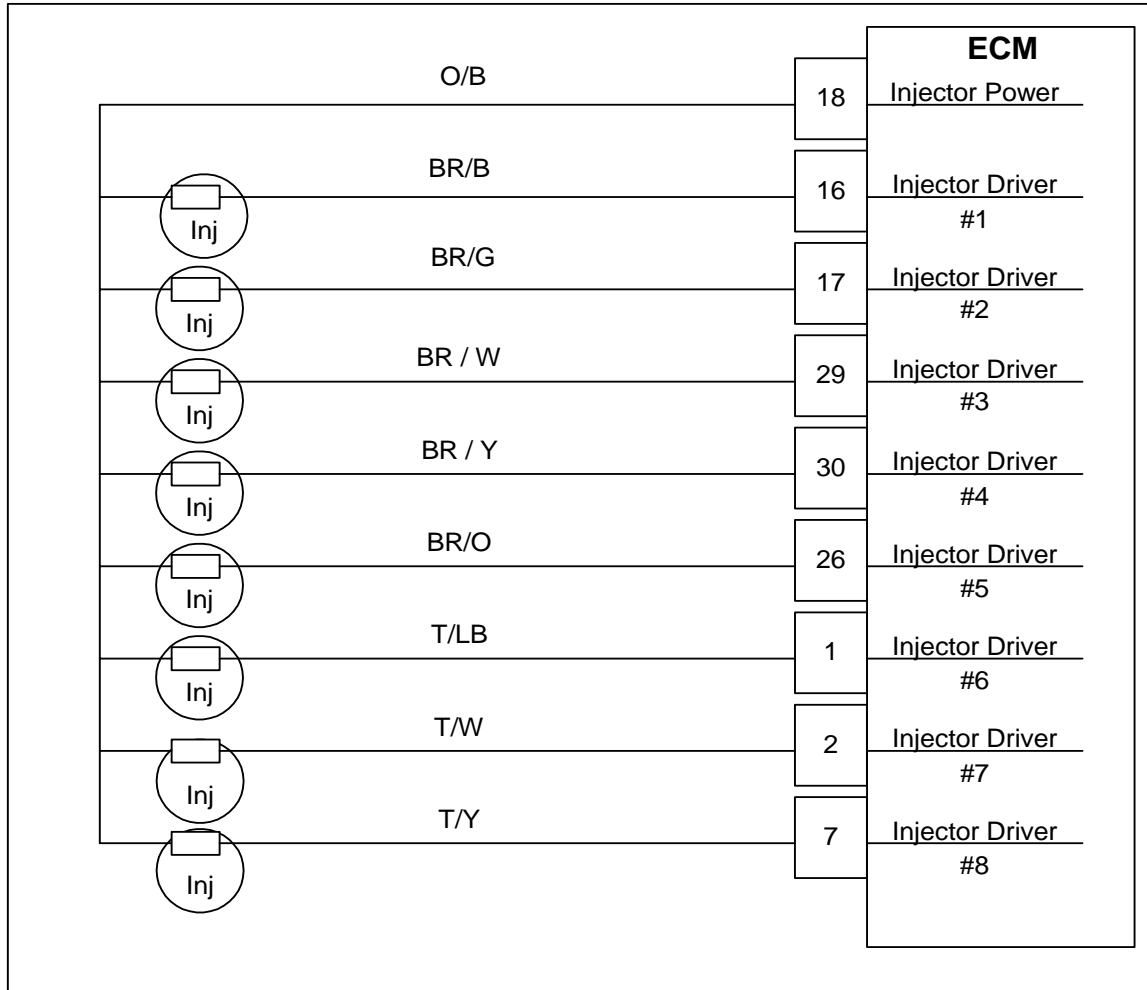
This fault will set if the ECM detects 10 coil firings in which the adaptive dwell is less allowed and battery voltage is less than 16 volts.

The purpose of this fault is to detect a short to ground in the harness, or internally to the primary coil.

# DTC 334-Coil Driver #8 Shorted



## DTC 411- Injector Driver #1 Open

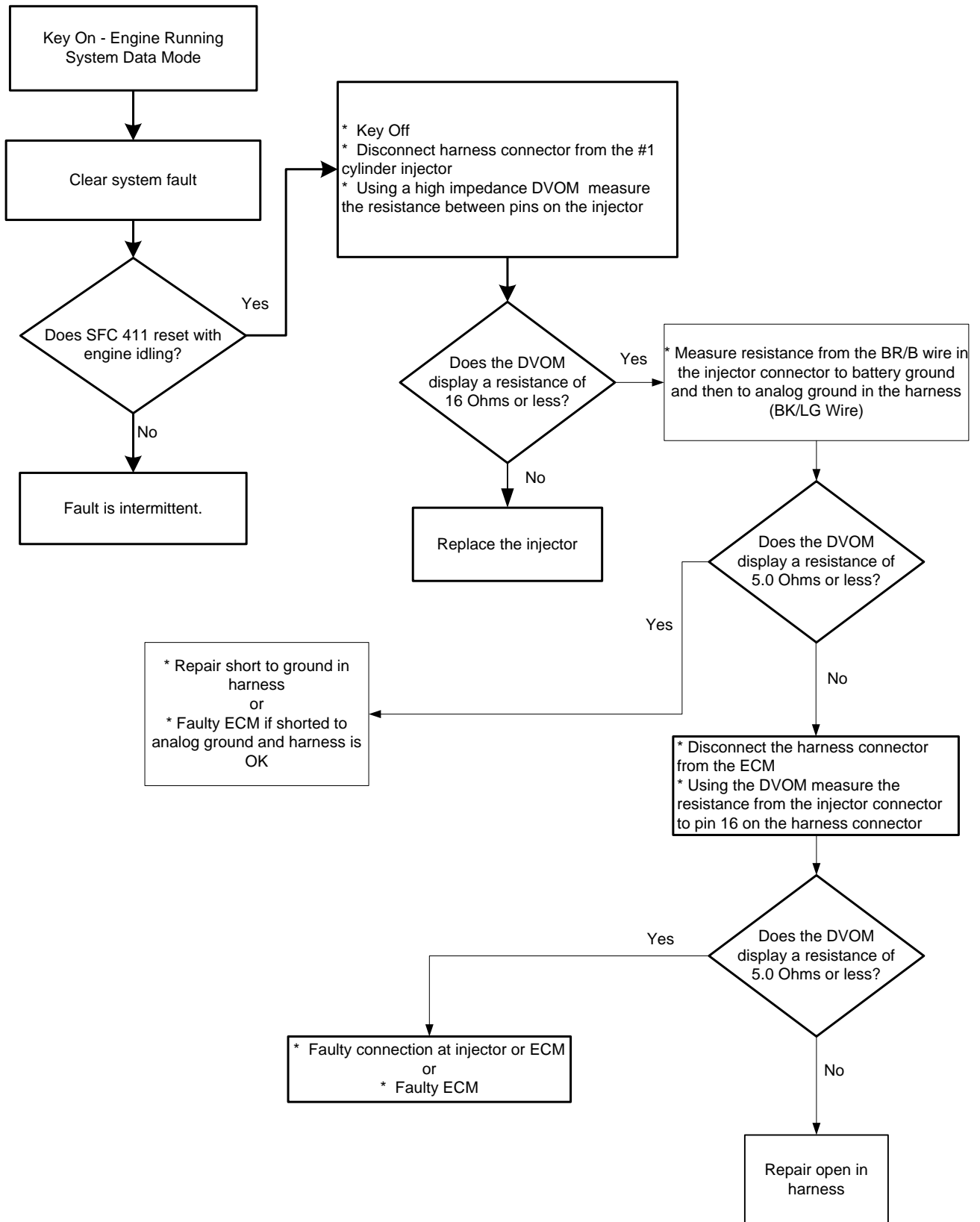


- Injector coil open or driver circuit short
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM greater than 9 volts and injector low-side less than 4 volts for 10 injector firings
- MIL-On for active fault and for 5 seconds after active fault
- Adaptive-Disabled for remainder of key-on cycle
- Closed Loop-Disabled during active fault

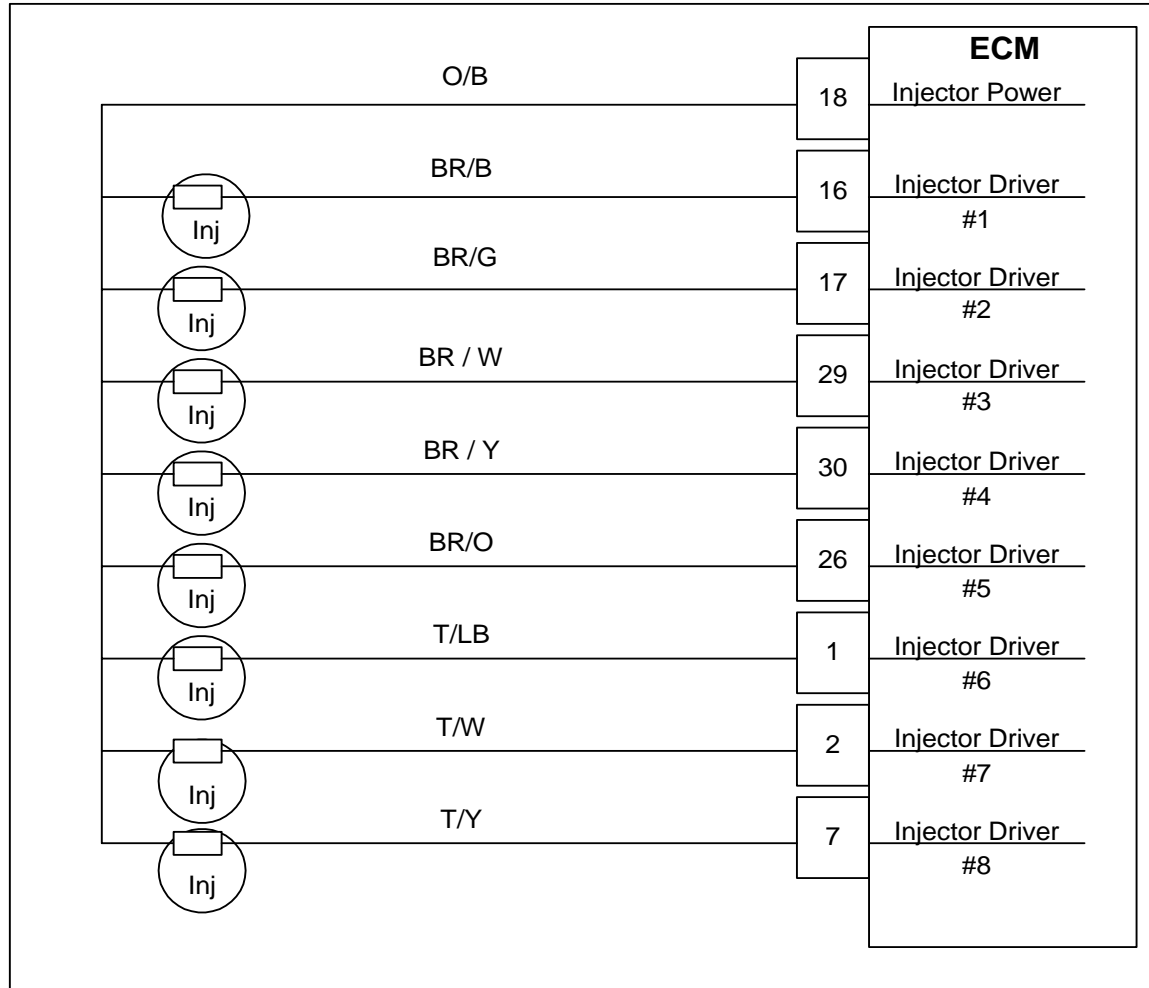
Injector Driver #1 fires the #1 cylinder injector.

This fault will set if the ECM detects low feedback voltage on the internal injector while the injector drive circuit is in the off-state and battery voltage is greater than 9 volts.

# DTC 411- Injector Driver #1 Open



## DTC 412- Injector Driver #1 Shorted

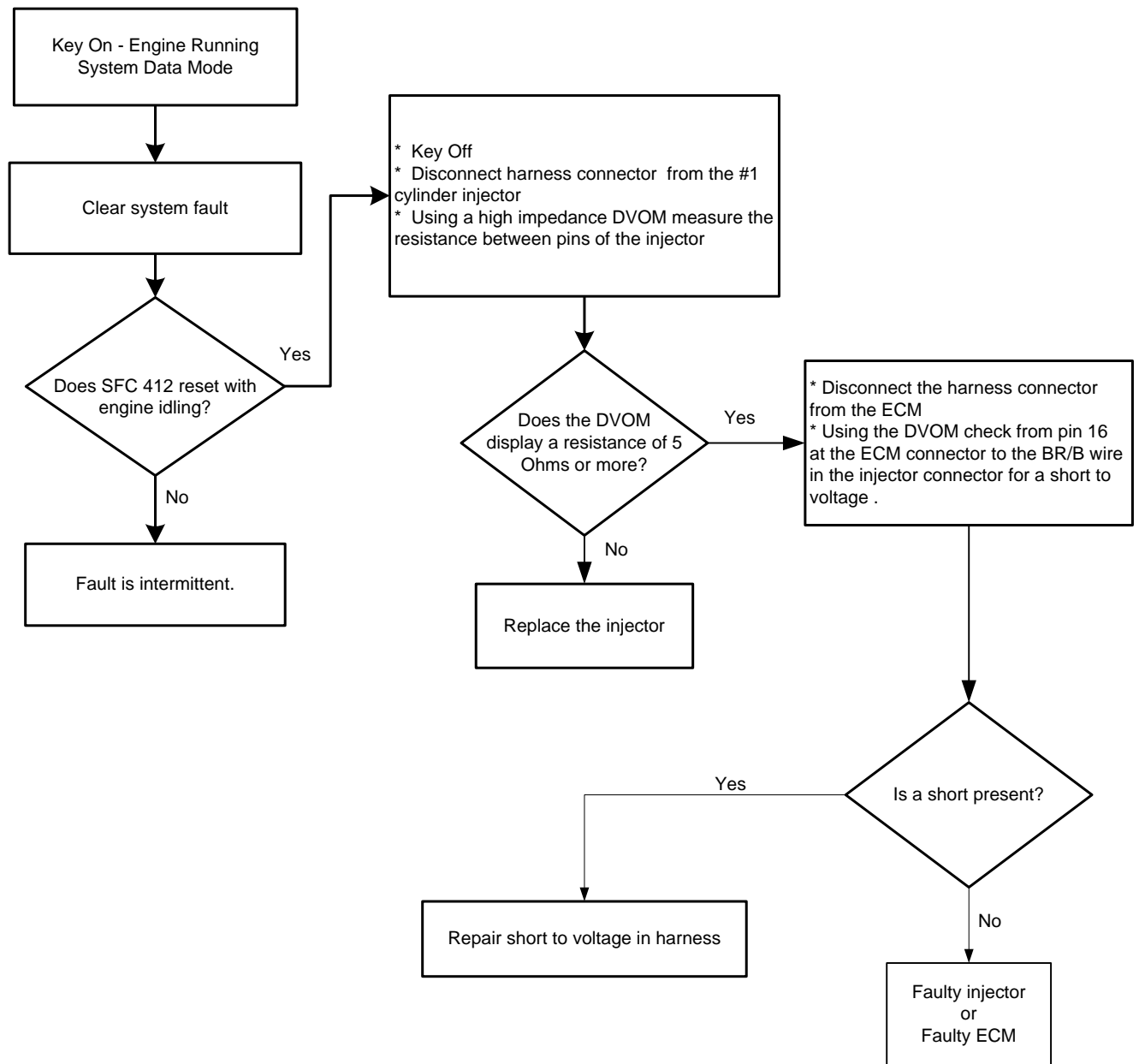


- Injector coil shorted
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM less than 16 volts and injector low-side greater than 4 volts for 10 injector firings
- MIL-On during active fault and for 5 seconds after active fault
- Adaptive-Disabled for remainder of key-on cycle
- Closed Loop-Disabled during active fault

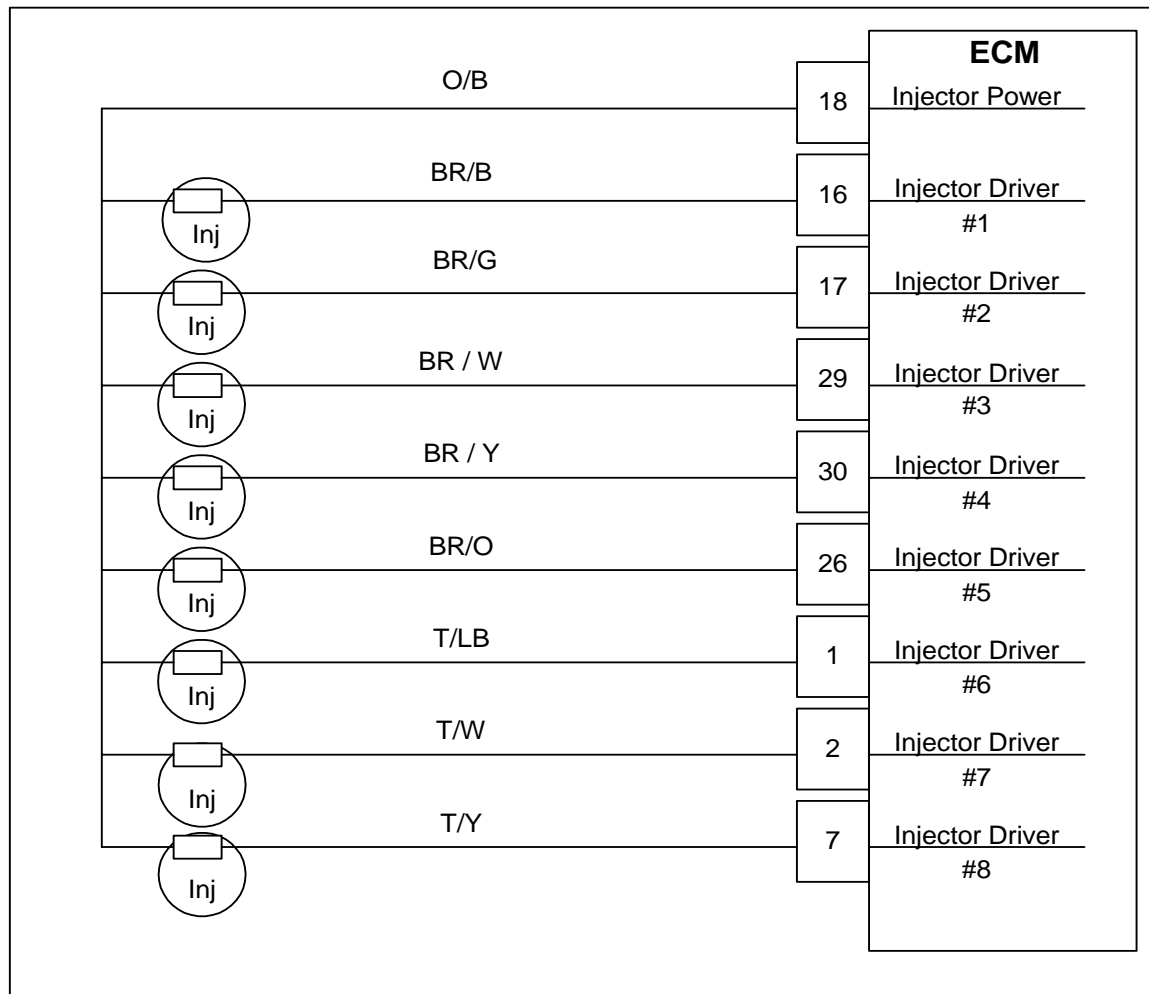
Injector Driver #1 fires the #1 cylinder injector.

This fault will set if the ECM detects 10 injector firings with the internal driver sense voltage greater than 4 volts while the injector is in the on-state and battery voltage is less than 16 volts.

# DTC 412- Injector Driver #1 Shorted



## DTC 413-Injector Driver #2 Open



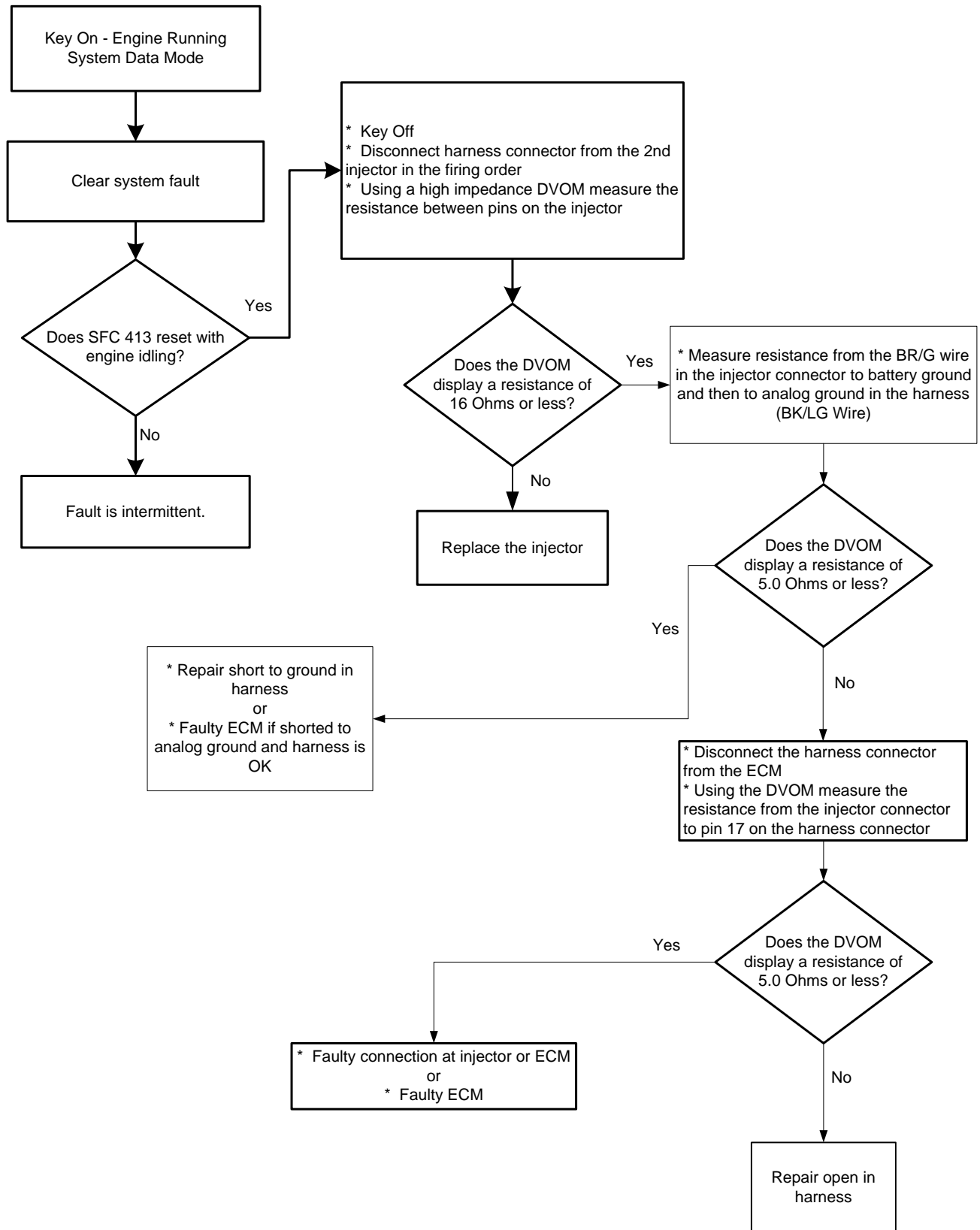
- Injector coil open or driver circuit short
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM greater than 9 volts and injector low-side less than 4 volts for 10 injector firings
- MIL-On for active fault and for 5 seconds after active fault
- Adaptive-Disabled for remainder of key-on cycle
- Closed Loop-Disabled during active fault

Injector Driver #2 fires the injector for the 2<sup>nd</sup> cylinder in the firing order.

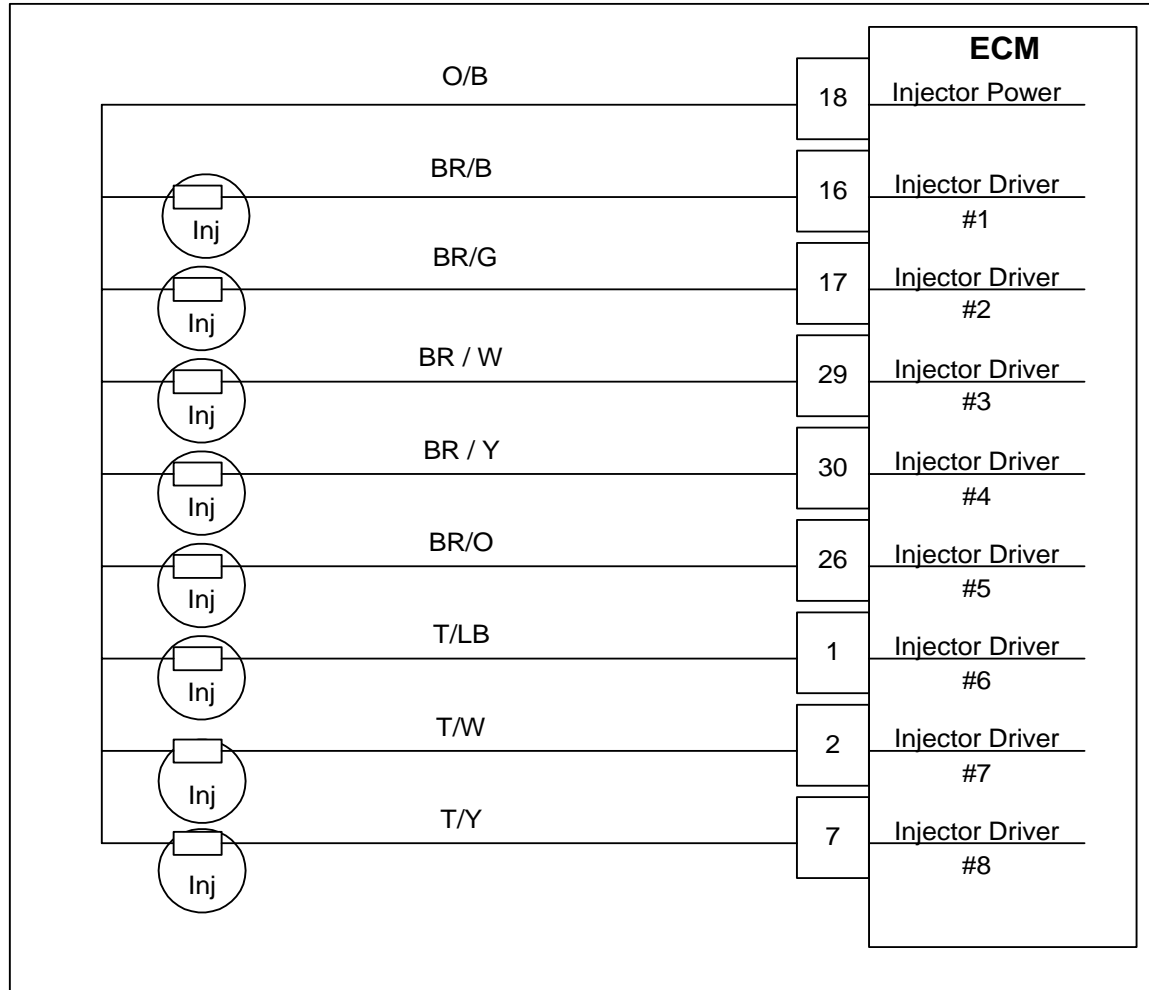
This fault will set if the ECM detects low feedback voltage on the internal injector while the injector drive circuit is in the off-state and battery voltage is greater than 9 volts.



# DTC 413- Injector Driver #2 Open



## DTC 414-Injector Driver #2 Shorted

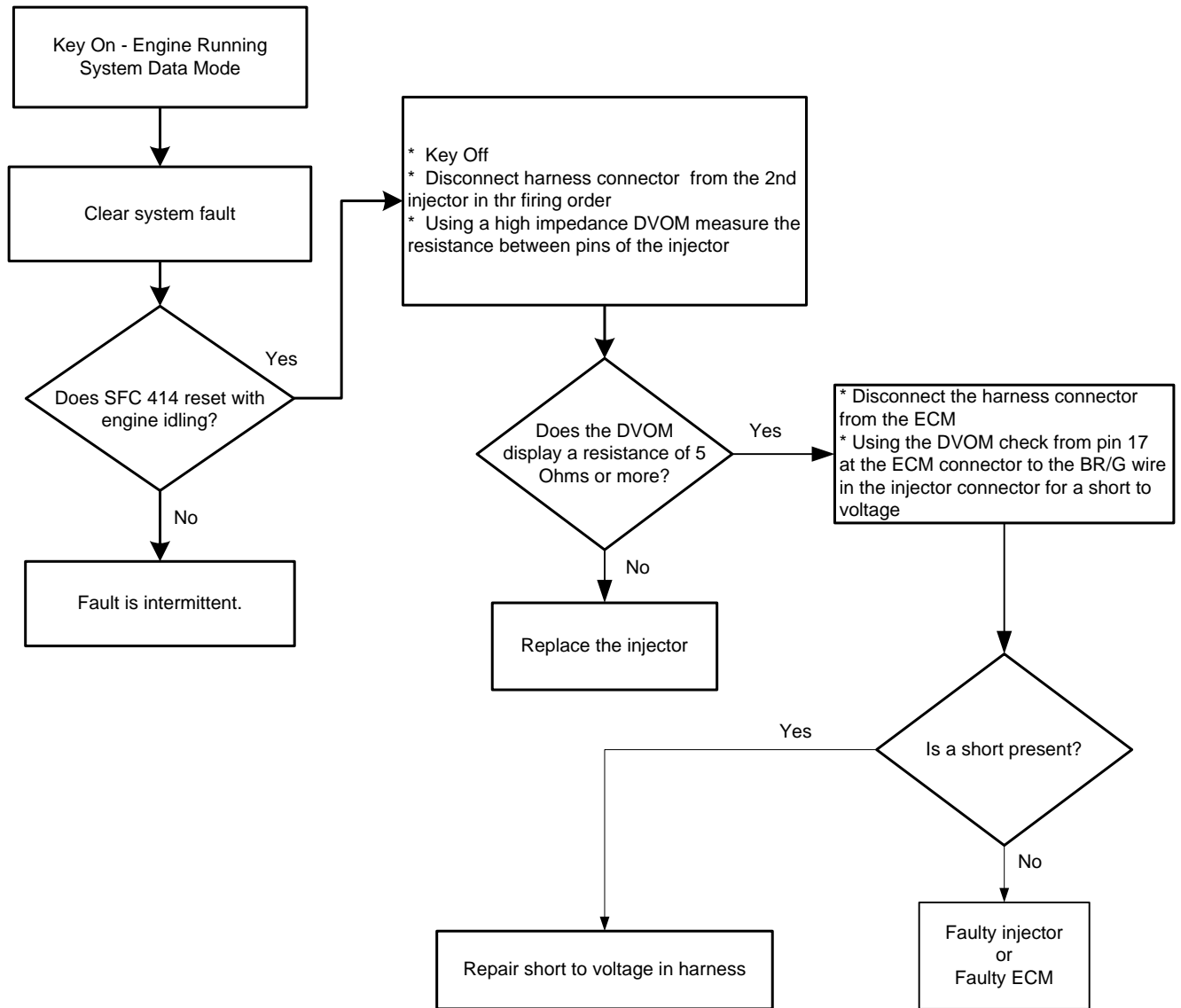


- Injector coil shorted
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM less than 16 volts and injector low-side greater than 4 volts for 10 injector firings
- MIL-On during active fault and for 5 seconds after active fault
- Adaptive-Enabled
- Closed Loop-Enabled

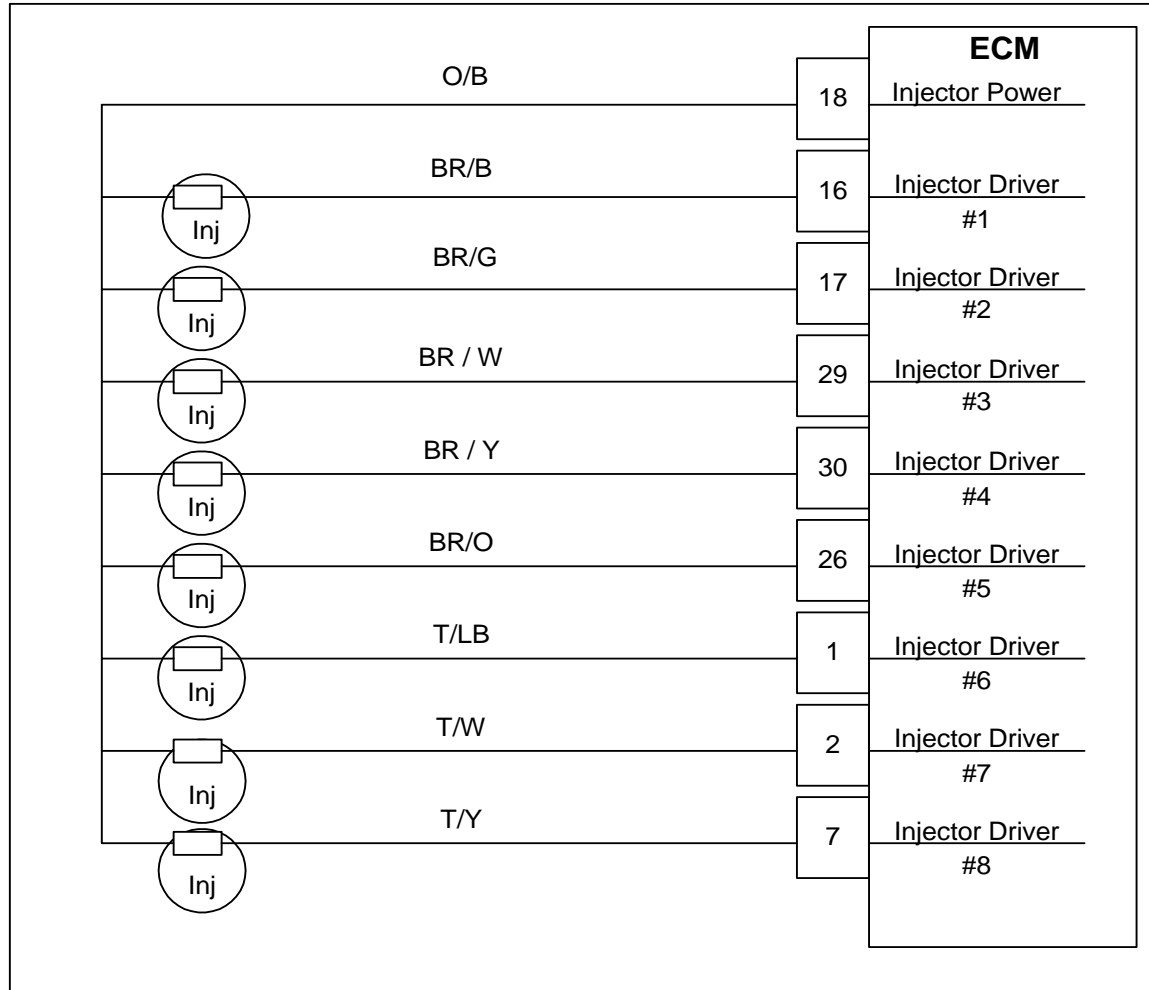
Injector Driver #2 fires the injector for the 2<sup>nd</sup> cylinder in the firing order.

This fault will set if the ECM detects 10 injector firings with the internal driver sense voltage greater than 4 volts while the injector is in the on-state and battery voltage is less than 16 volts.

# DTC 414-Injector #2 Shorted



## DTC 415-Injector Driver #3 Open

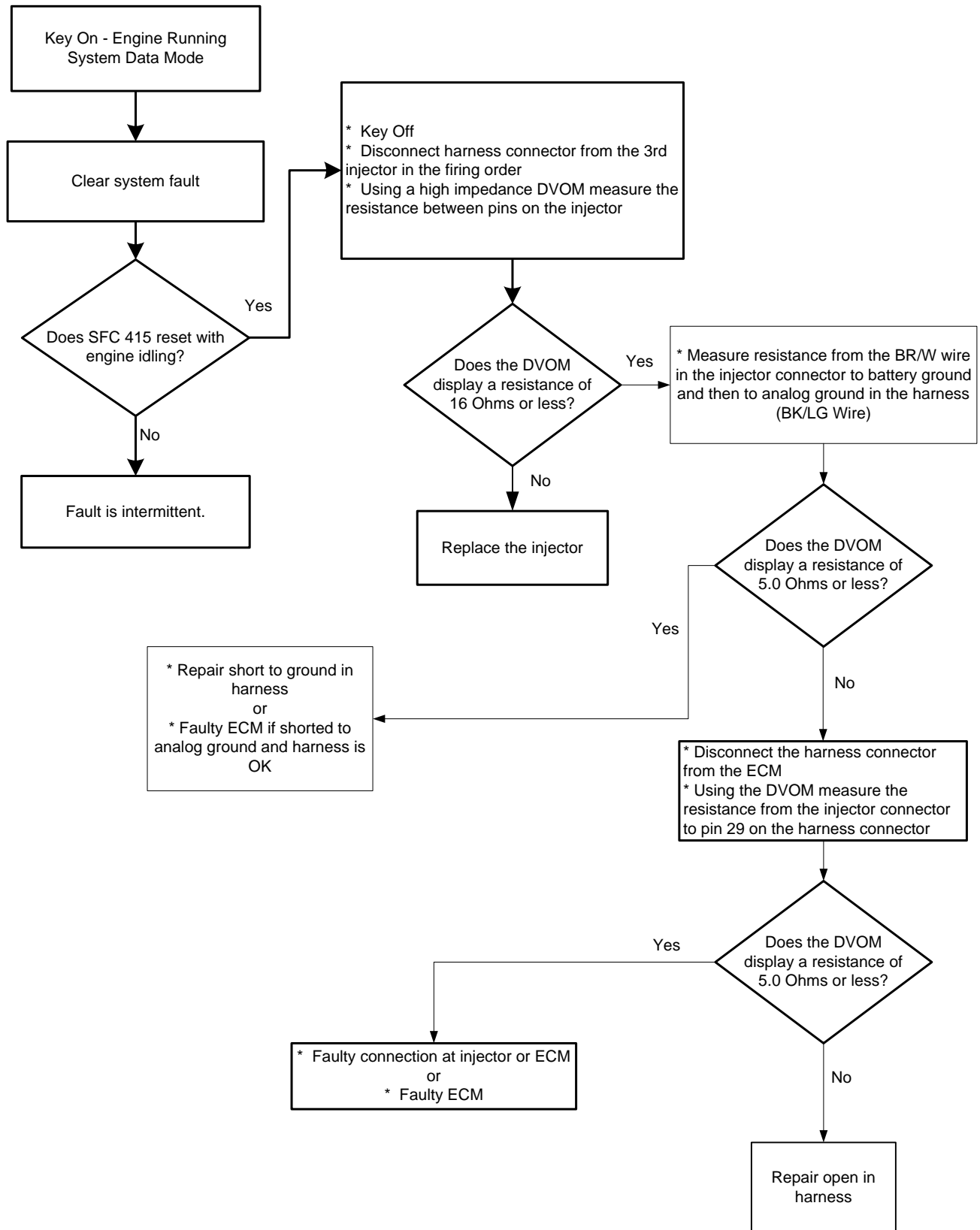


- Injector coil open or driver circuit short
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM greater than 9 volts and injector low-side less than 4 volts for 10 injector firings
- MIL-On for active fault and for 5 seconds after active fault
- Adaptive-Disabled for remainder of key-on cycle
- Closed Loop-Disabled during active fault

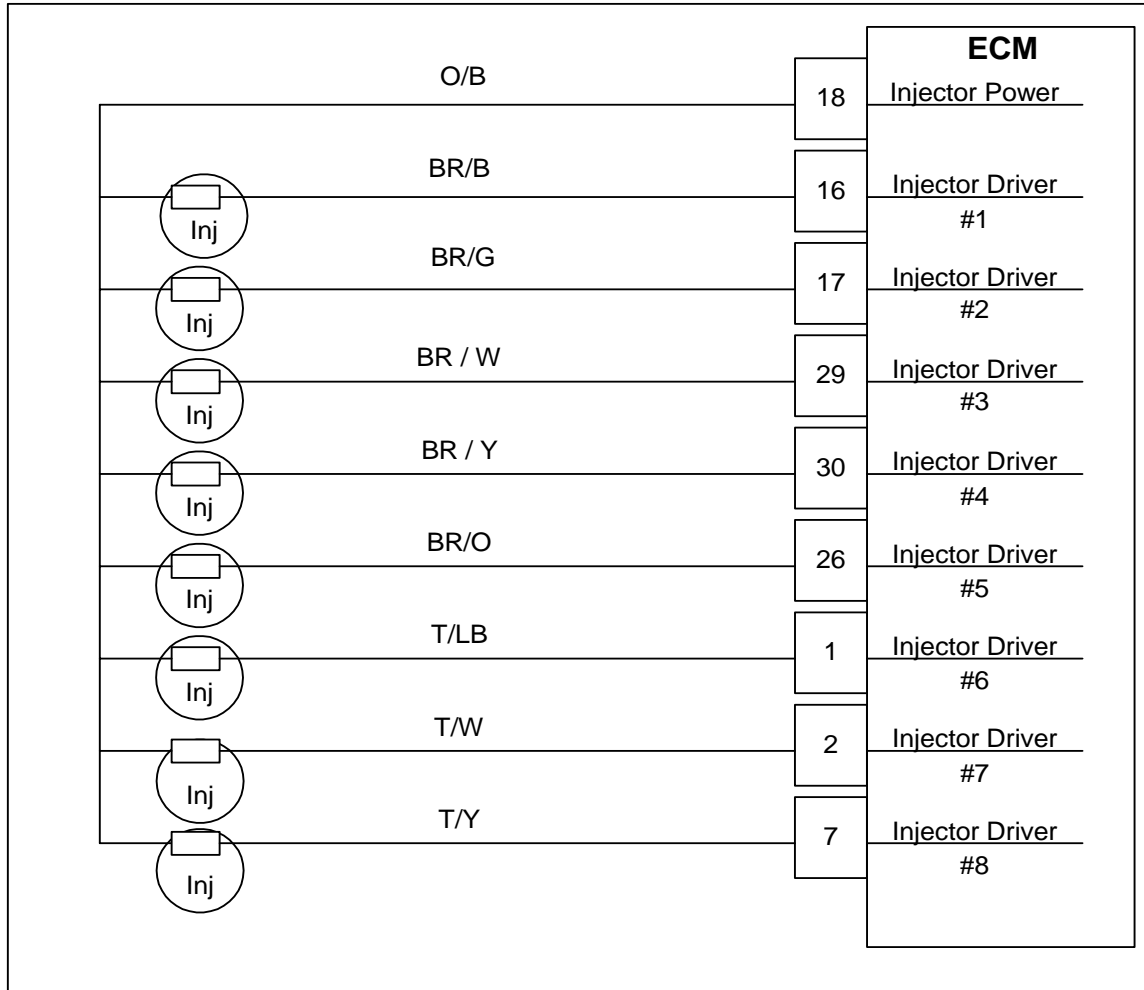
Injector Driver #3 fires the injector for the 3<sup>rd</sup> cylinder in the firing order.

This fault will set if the ECM detects low feedback voltage on the internal injector while the injector drive circuit is in the off-state and battery voltage is greater than 9 volts.

# DTC 415- Injector Driver #3 Open



# DTC 416-Injector Driver #3 Shorted

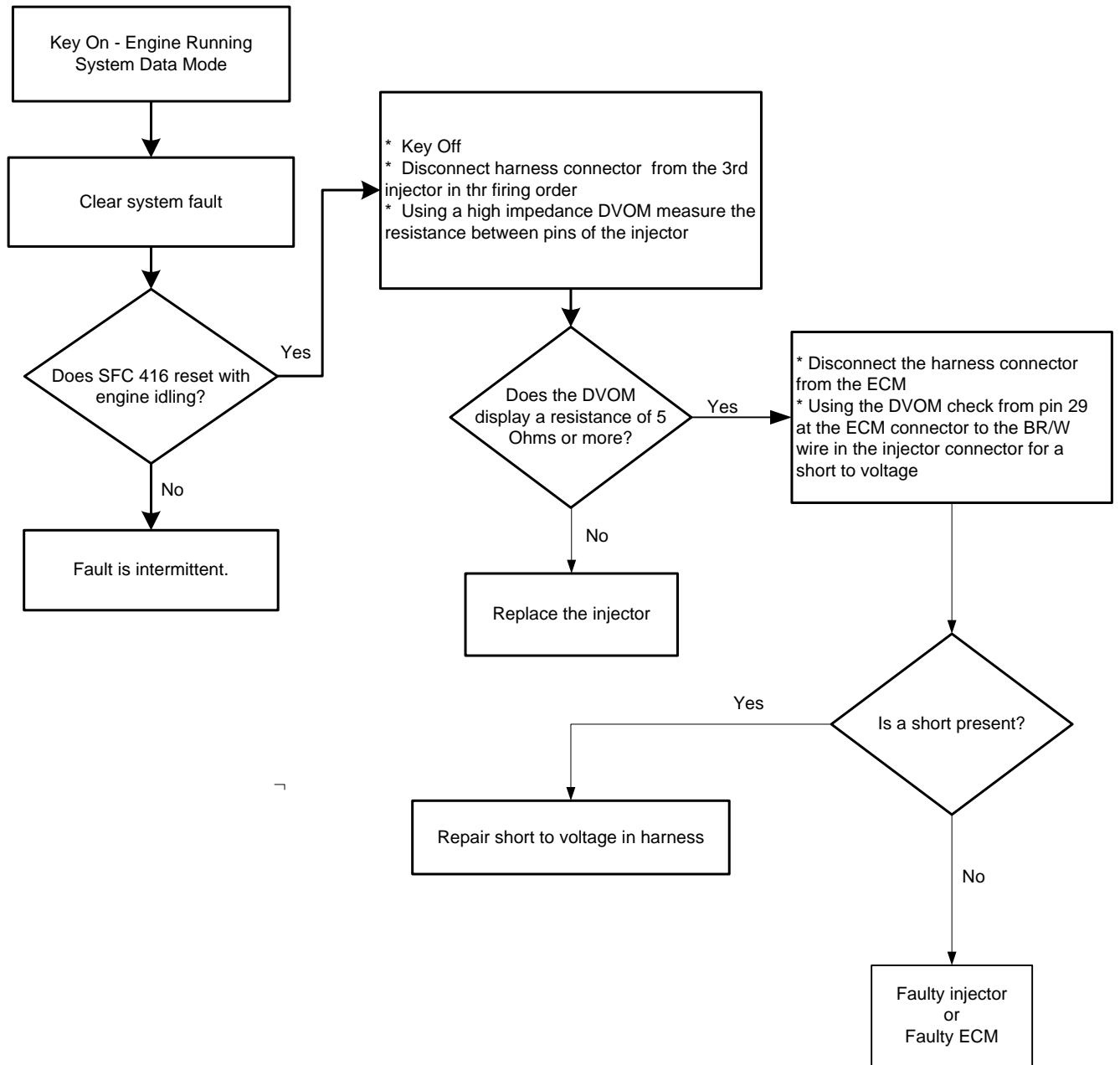


- Injector coil shorted
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM greater than 9 volts and injector low-side greater than 4 volts for 10 injector firings.
- MIL-On for active fault and for 5 seconds after active fault
- Adaptive-Enabled
- Closed Loop-Enabled

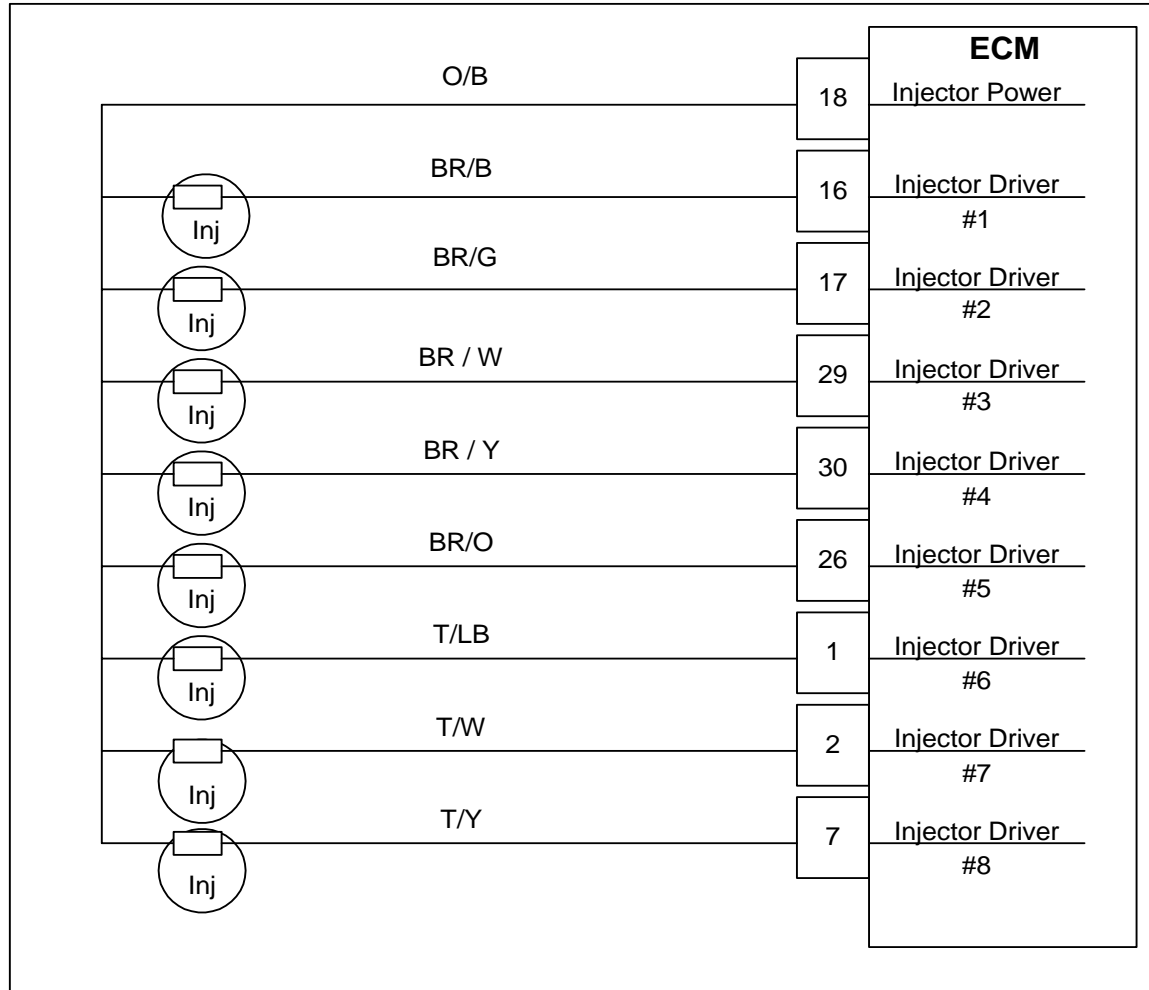
Injector Driver #3 fires the injector for the 3<sup>rd</sup> cylinder in the firing order.

This fault will set if the ECM detects 10 injector firings with the internal driver sense voltage greater than 4 volts while the injector is in the on-state and battery voltage is less than 16 volts.

# DTC 416-Injector Driver #3 Shorted



## DTC 421-Injector Driver #4 Open



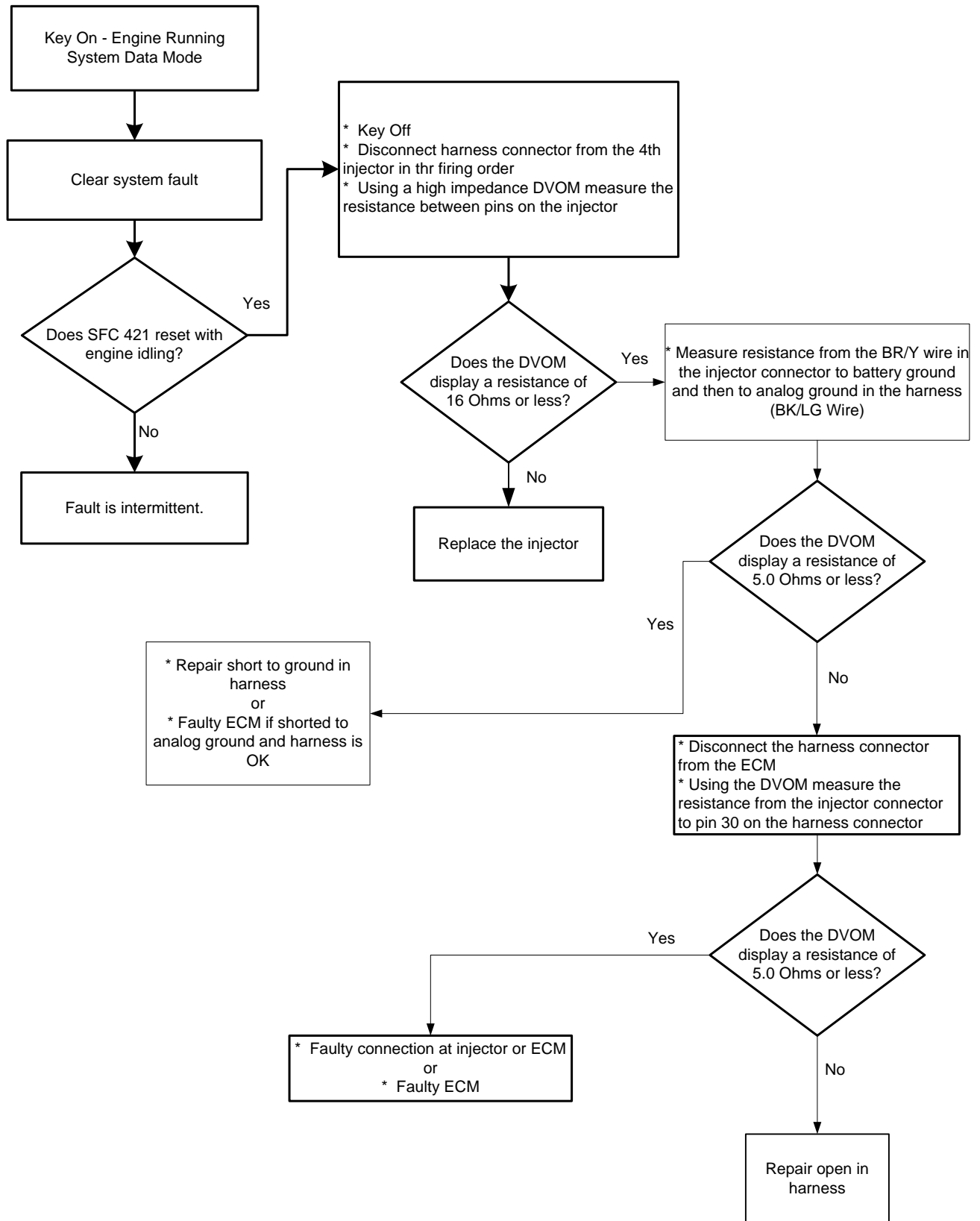
- Injector coil open or driver circuit short
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM greater than 9 volts and injector low-side less than 4 volts for 10 injector firings
- MIL-On for active fault and for 5 seconds after active fault
- Adaptive-Disabled for remainder of key-on cycle
- Closed Loop-Disabled during active fault

Injector Driver #4 fires the injector for the 4<sup>th</sup> cylinder in the firing order.

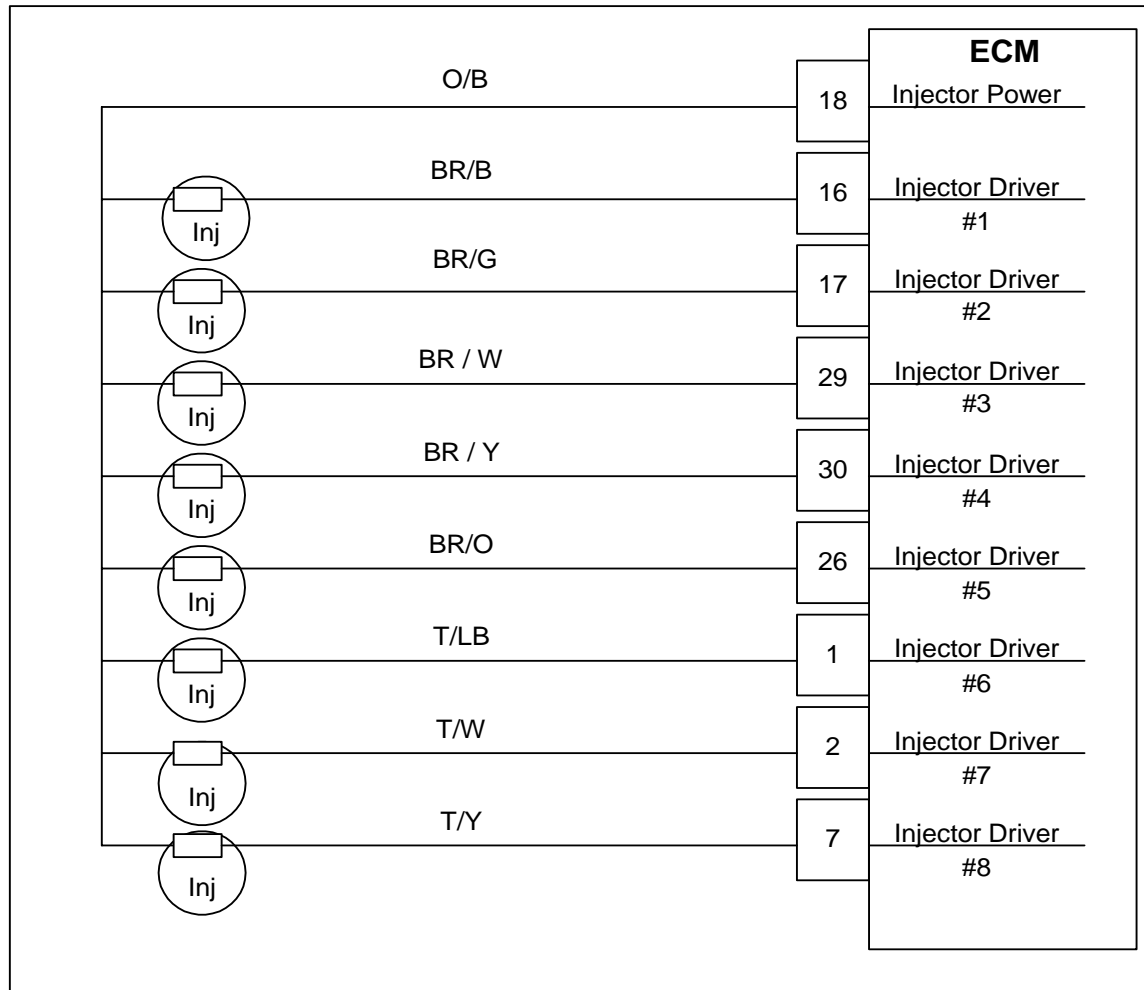
This fault will set if the ECM detects low feedback voltage on the internal injector while the injector drive circuit is in the off-state and battery voltage is greater than 9 volts.



# DTC 421- Injector Driver #4 Open



## DTC 422-Injector Driver #4 Shorted

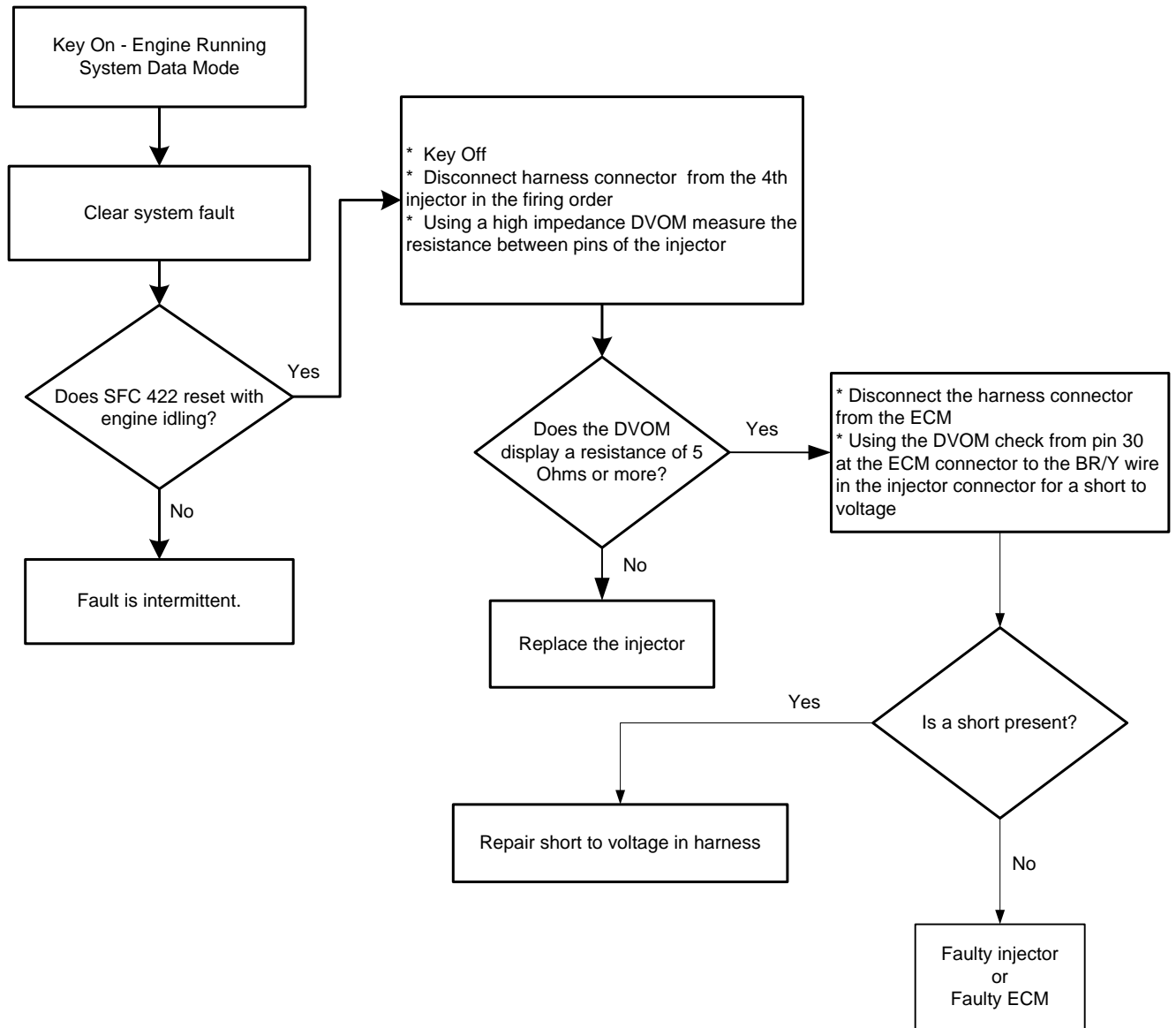


- Injector coil shorted
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM less than 16 volts and injector low-side greater than 4 volts for 10 injector firings
- MIL-On for active fault and for 5 seconds after active fault
- Adaptive-Enabled
- Closed Loop-Enabled

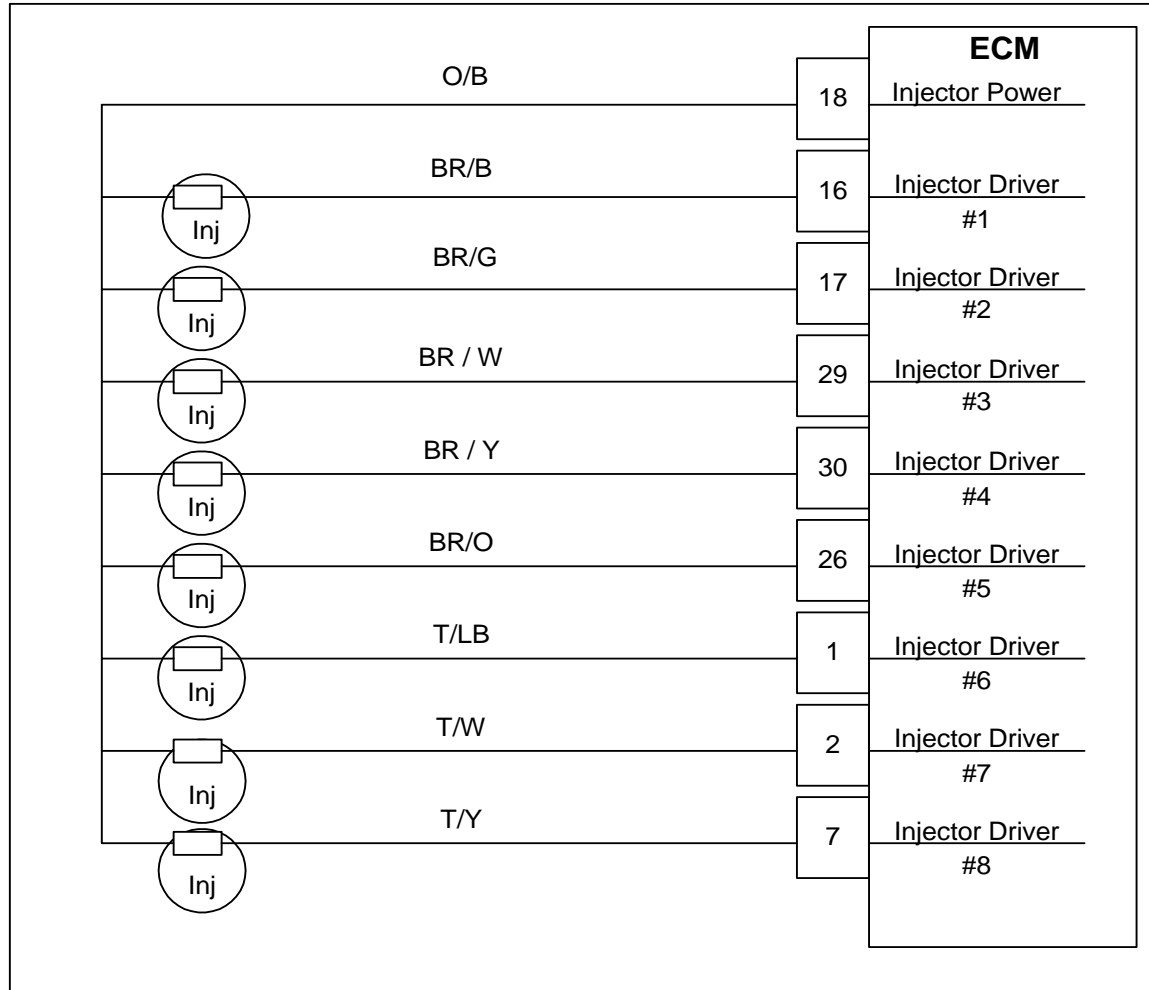
Injector Driver #4 fires the injector for the 4<sup>th</sup> cylinder in the firing order.

This fault will set if the ECM detects 10 injector firings with the injector driver sense voltage greater than 4 volts while the injector is in the on-state and battery voltage is less than 16 volts.

# DTC 422-Injector Driver #4 Shorted



## DTC 423-Injector Driver #5 Open

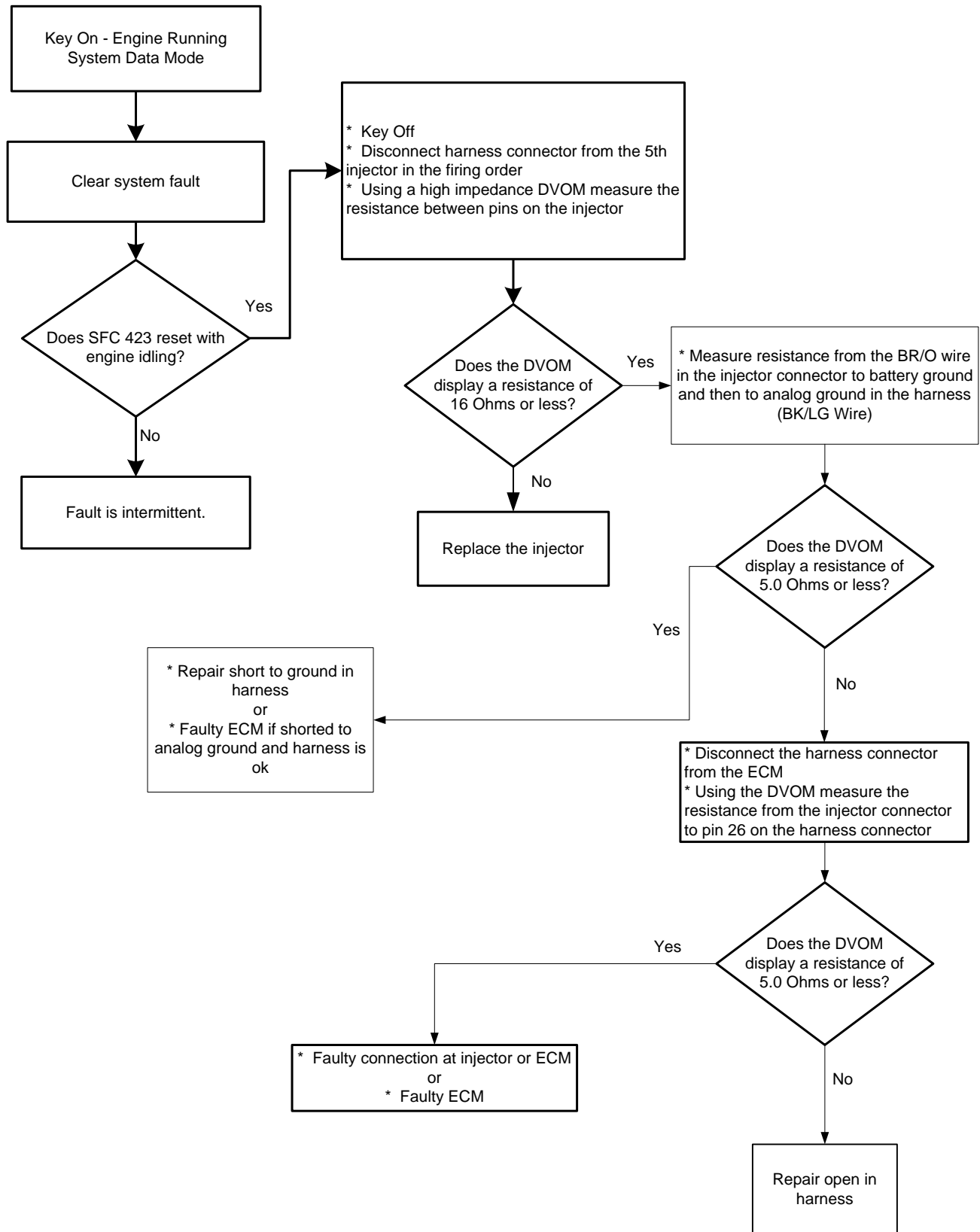


- Injector coil open or driver circuit short
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM greater than 9 volts and injector low-side less than 4 volts for 10 injector firings
- MIL-On for active fault and for 5 seconds after active fault
- Adaptive-Disabled for remainder of key-on cycle
- Closed Loop-Disabled during active fault

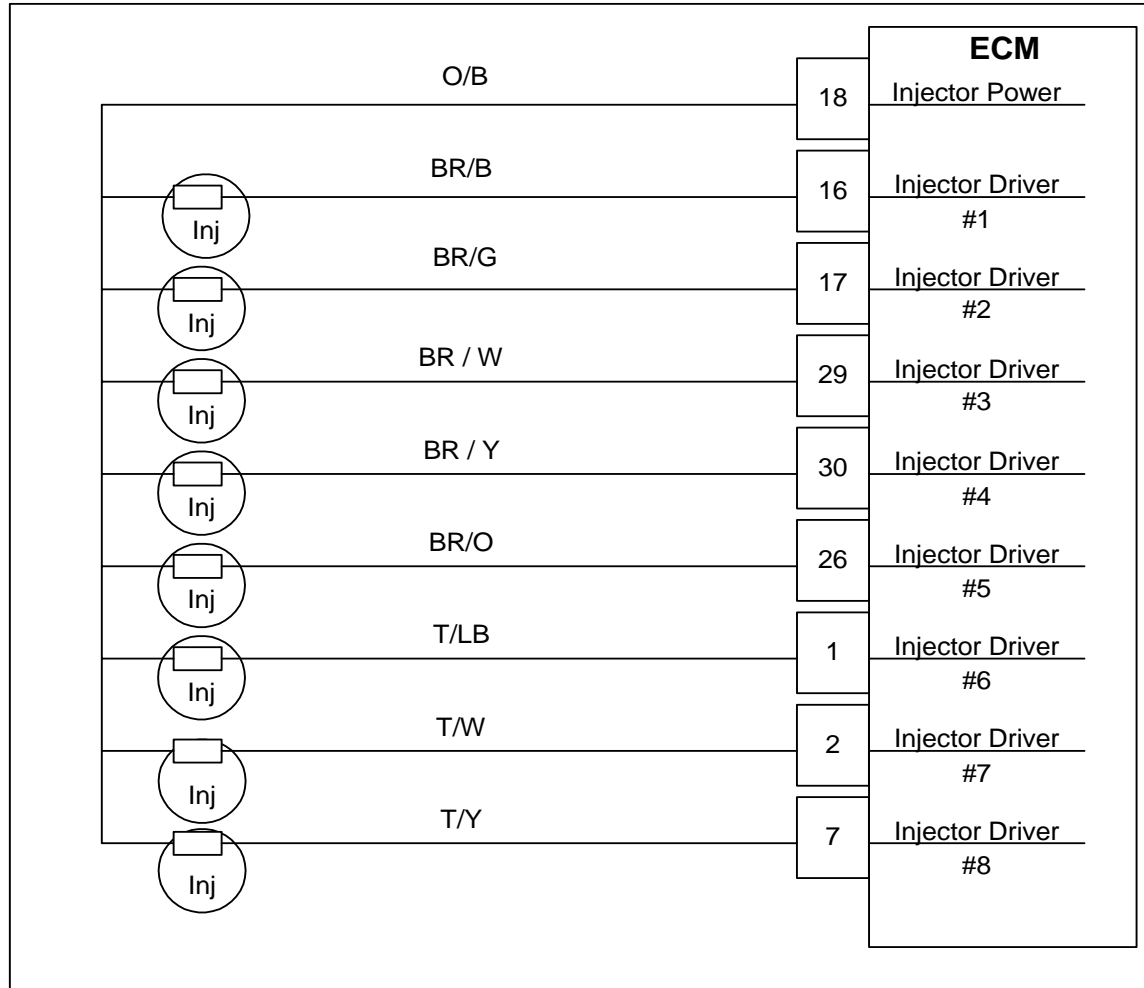
Injector Driver #5 fires the injector for the 5<sup>th</sup> cylinder in the firing order.

This fault will set if the ECM detects low feedback voltage on the internal injector while the injector drive circuit is in the off-state and battery voltage is greater than 9 volts.

# DTC 423- Injector Driver #5 Open



## DTC 424-Injector Driver #5 Shorted

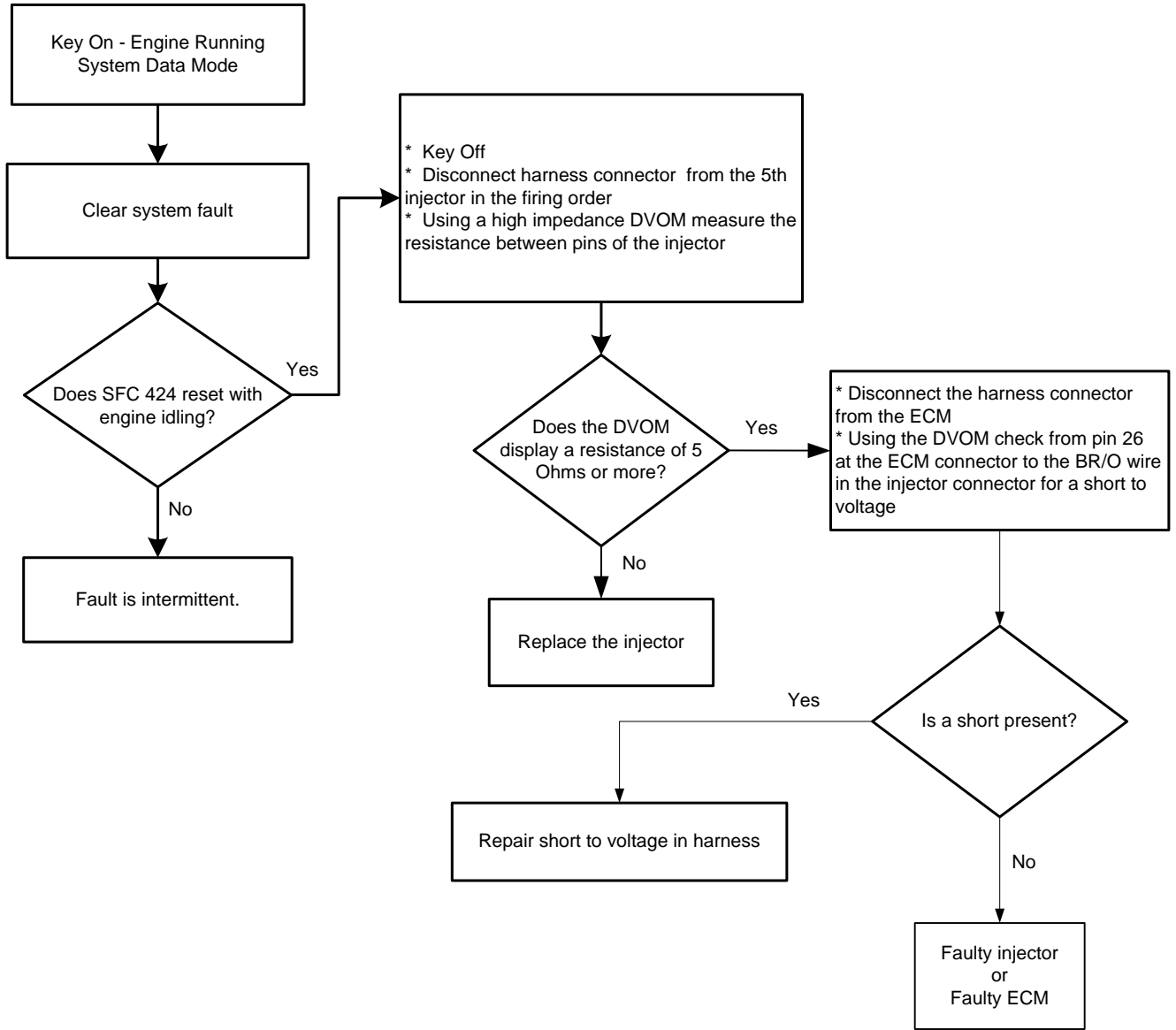


- Injector coil shorted
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM less than 16 volts and injector low-side greater than 4 volts for 10 injector firings
- MIL-On during active fault and for 5 seconds after active fault
- Adaptive-Enabled
- Closed Loop-Enabled

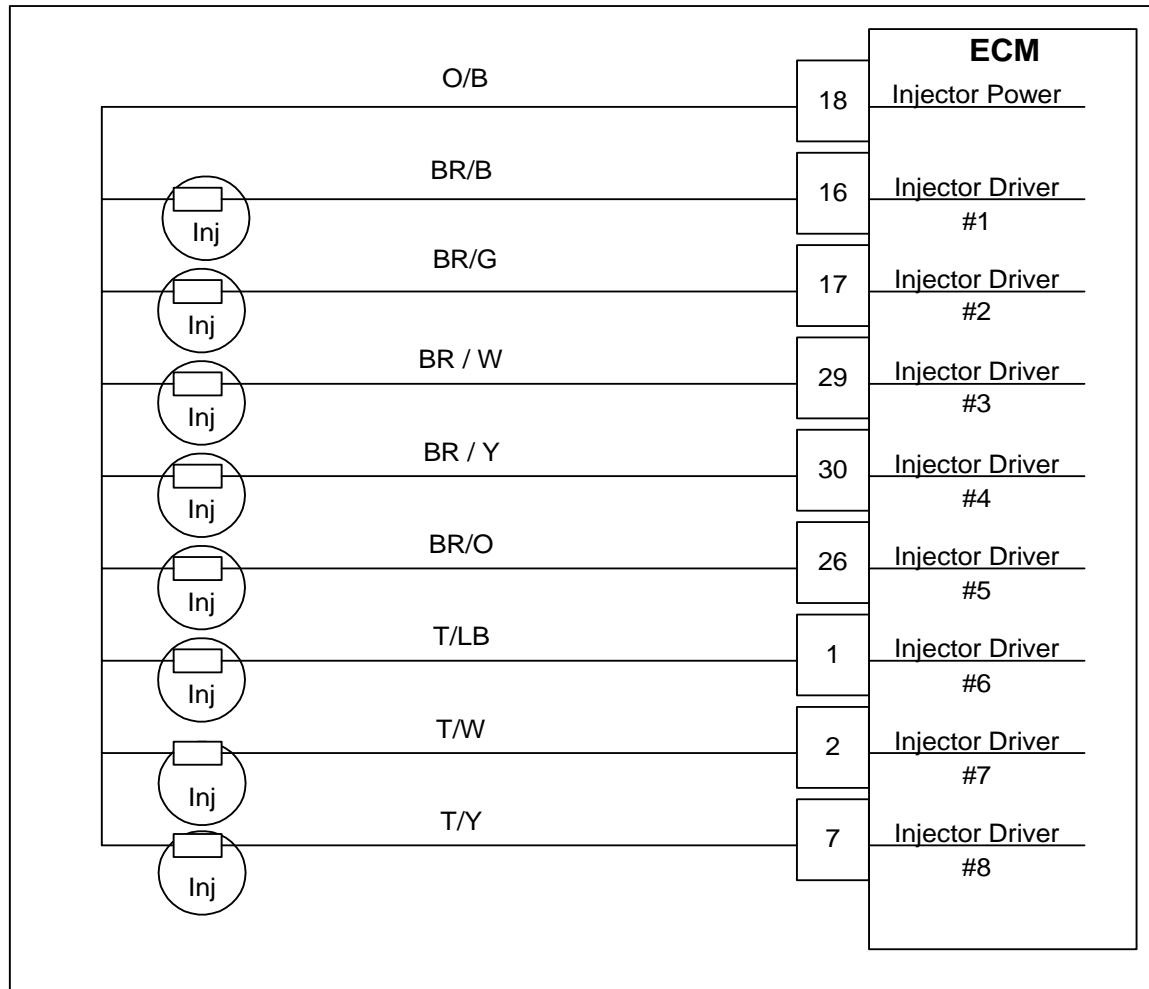
Injector Driver #5 fires the injector for the 5<sup>th</sup> cylinder in the firing order.

This fault will set if the ECM detects 10 injector firings with the internal driver sense voltage greater than 4 volts while the injector is in the on-state and battery voltage is less than 16 volts.

# DTC 424-Injector Driver #5 Shorted



## DTC 425-Injector Driver #6 Open



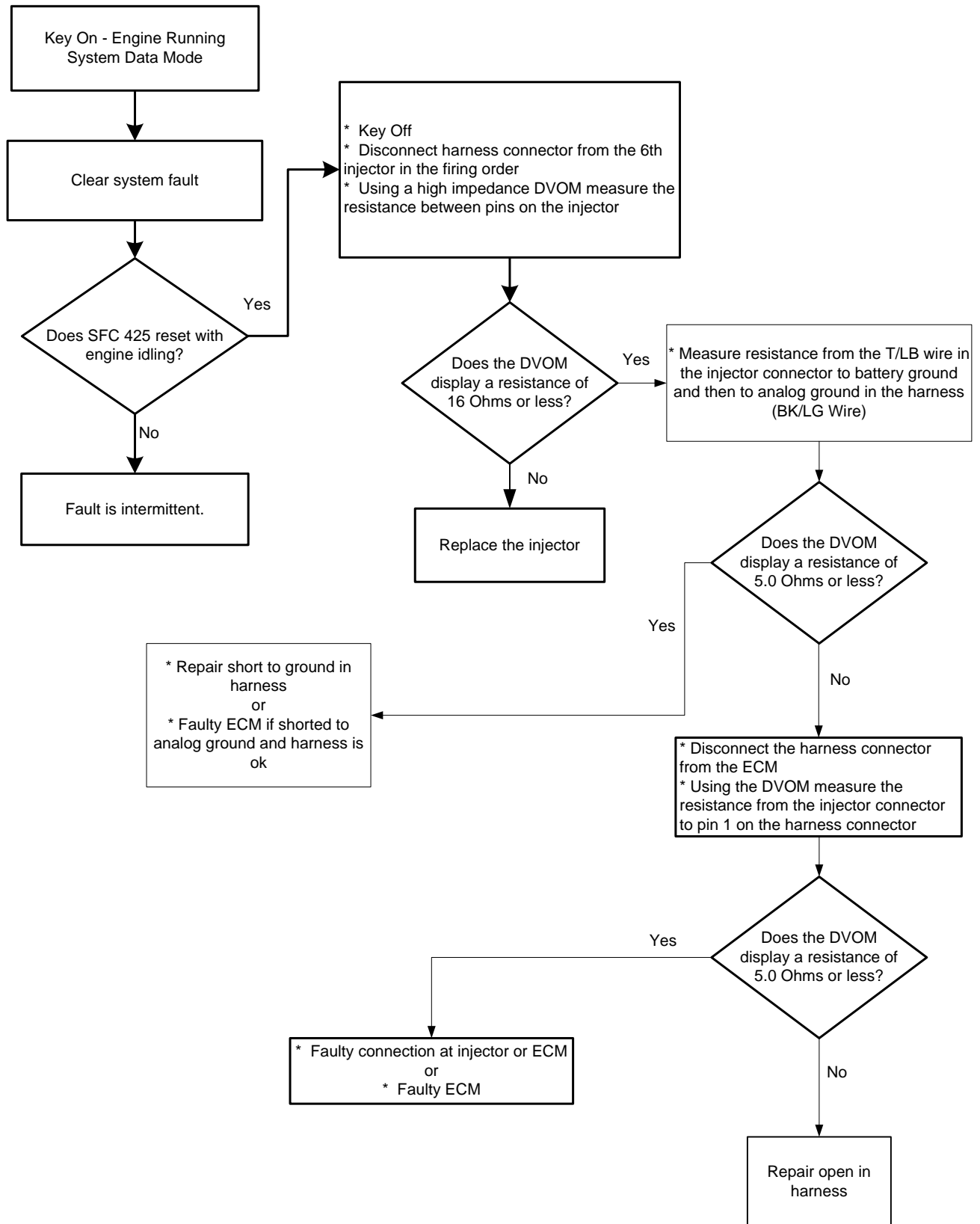
- Injector coil open or driver circuit short
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM greater than 9 volts and injector low-side less than 4 volts for 10 injector firings
- MIL-On for active fault and for 5 seconds after active fault
- Adaptive-Disabled for remainder of key-on cycle
- Closed Loop-Disabled during active fault

Injector Driver #6 fires the injector for the 6<sup>th</sup> cylinder in the firing order.

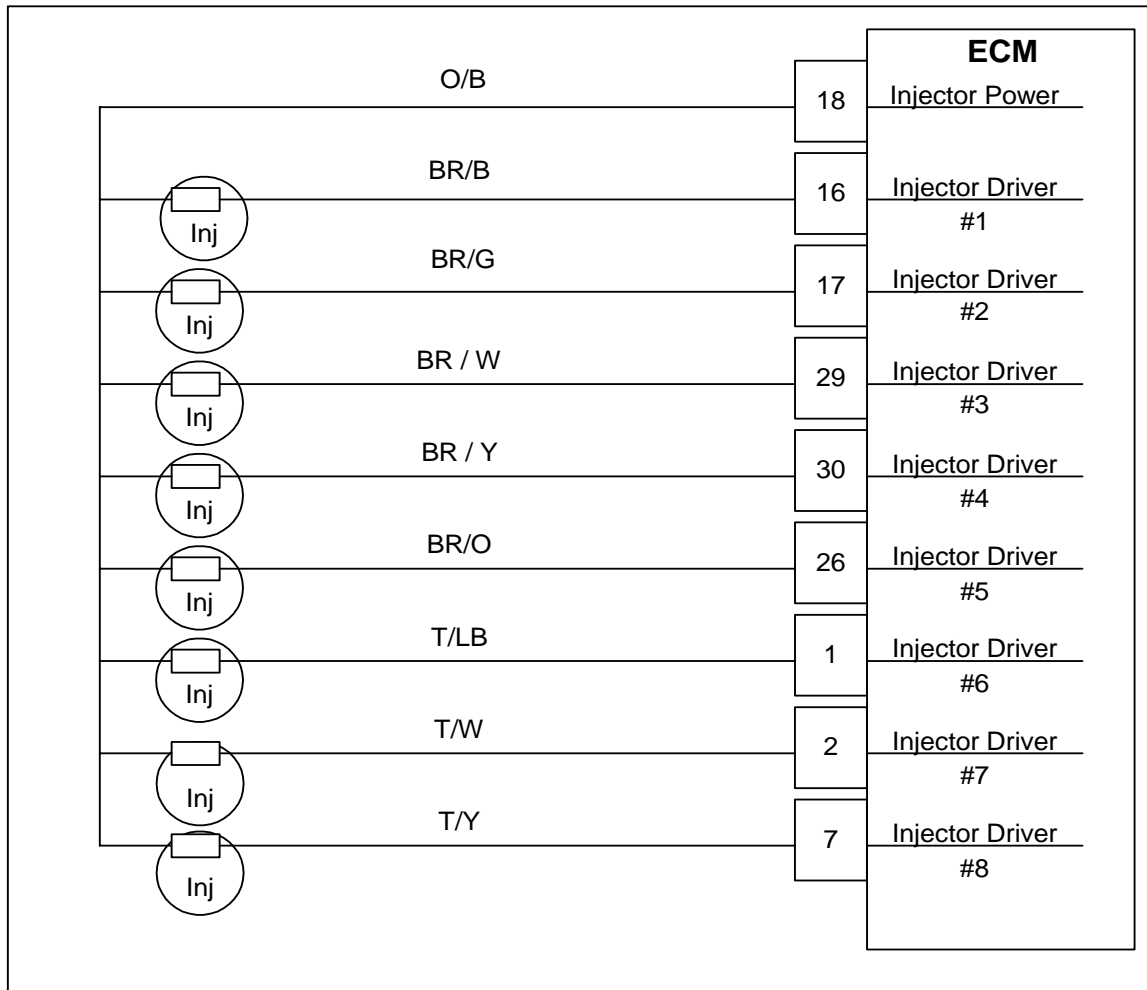
This fault will set if the ECM detects low feedback voltage on the internal injector while the injector drive circuit is in the off-state and battery voltage is greater than 9 volts.



# DTC 425- Injector #6 Open



## DTC 426-Injector Driver #6 Shorted

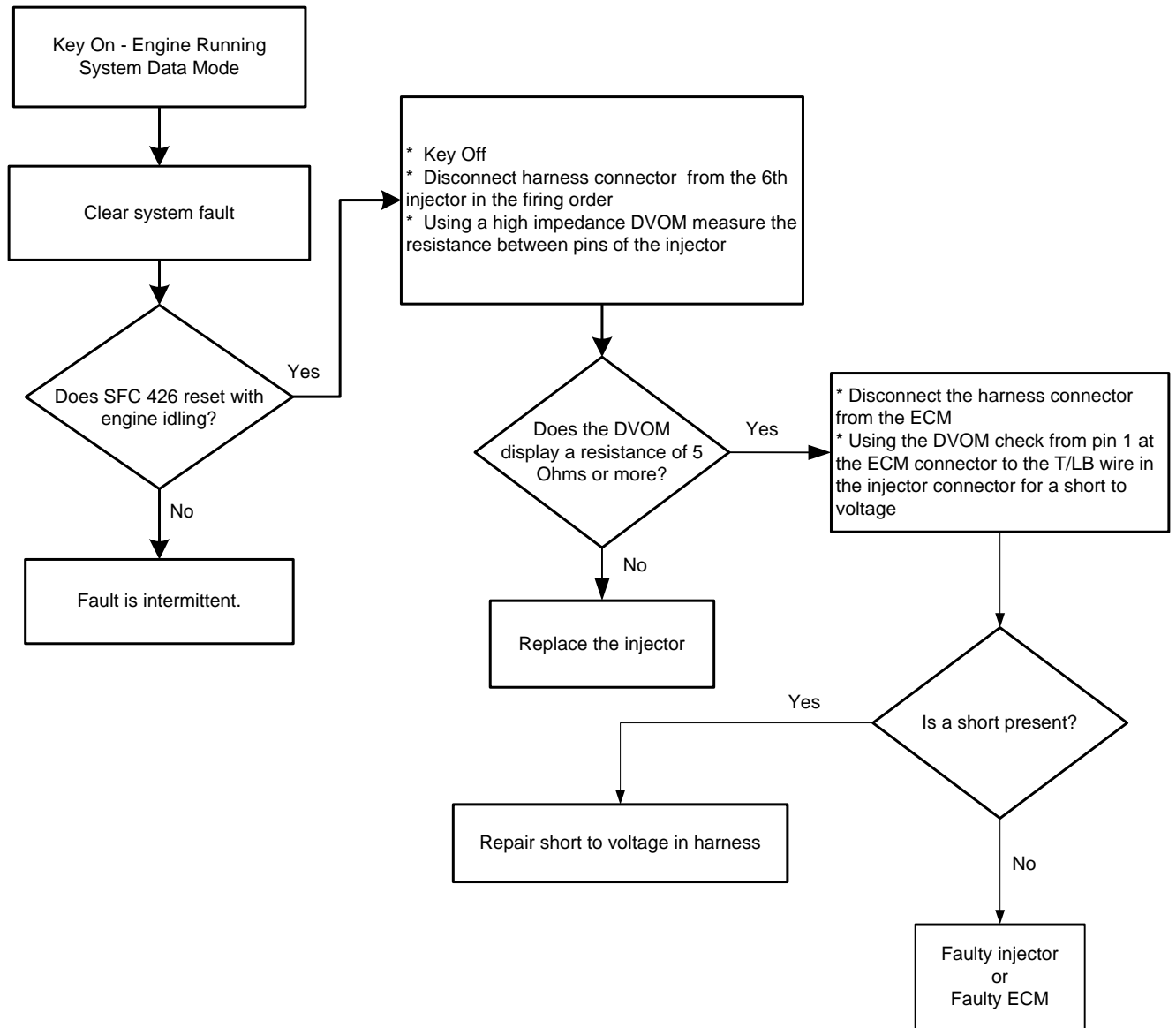


- Injector coil shorted
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM less than 16 volts and injector low-side greater than 4 volts for 10 injector firings
- MIL-On during active fault and for 5 seconds after active fault
- Adaptive-Enabled
- Closed Loop-Enabled

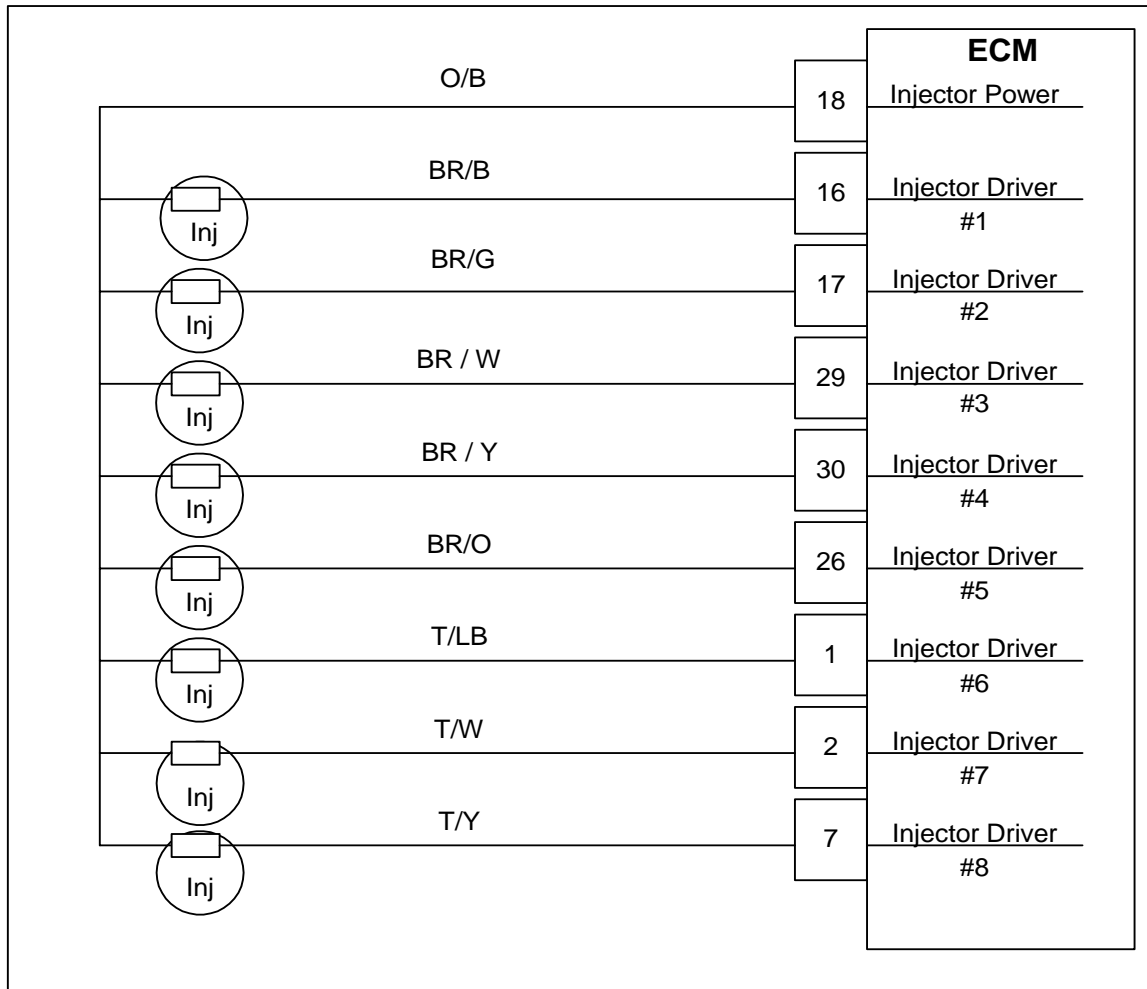
Injector Driver #6 fires the injector for the 6<sup>th</sup> cylinder in the firing order.

This fault will set if the ECM detects 10 injector firings with the internal driver sense voltage greater than 4 volts while the injector is in the on-state and battery voltage is less than 16 volts.

# DTC 426-Injector Driver #6 Shorted



## DTC 431-Injector Driver #7 Open

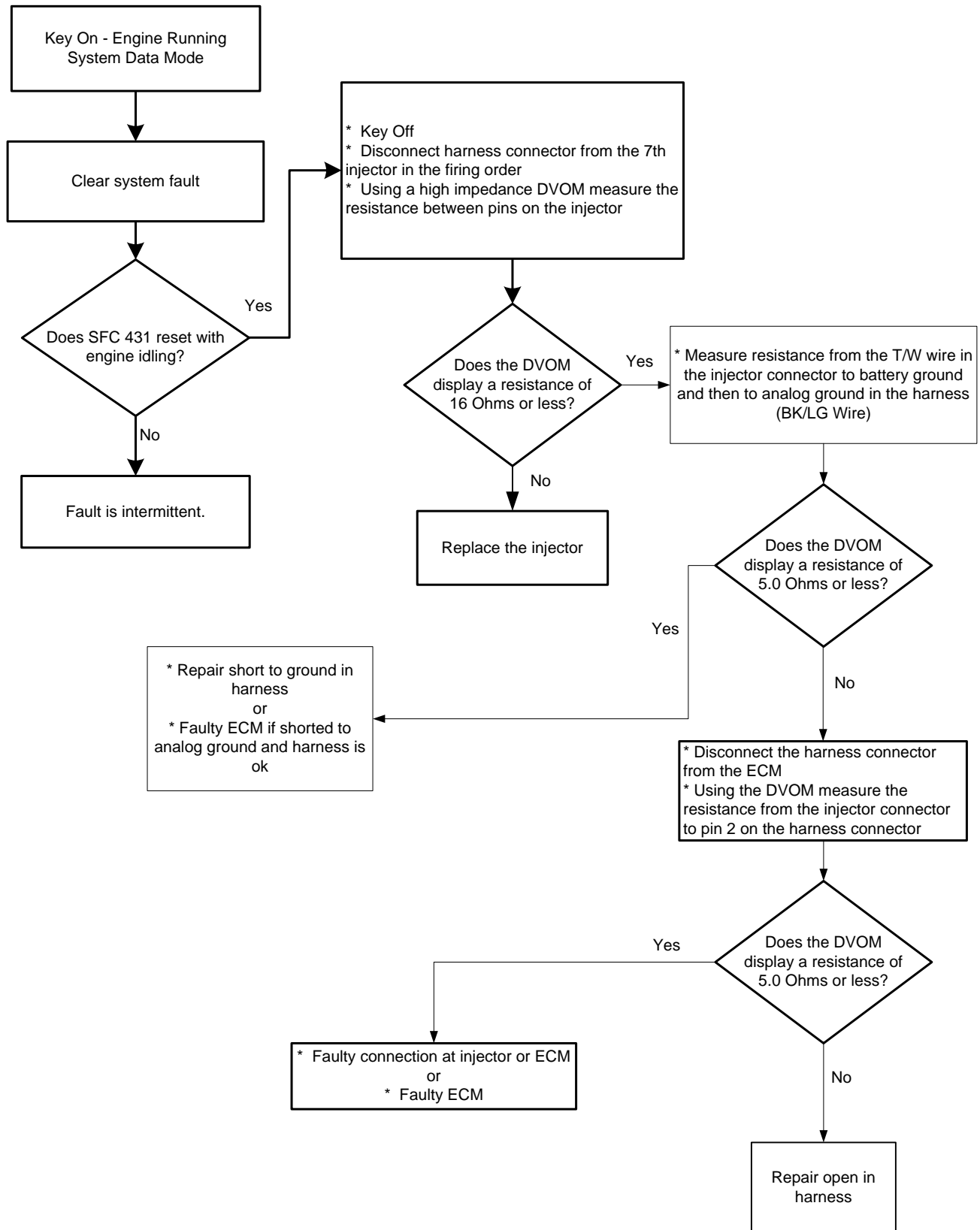


- Injector coil open or driver circuit short
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM greater than 9 volts and injector low-side less than 4 volts for 10 injector firings
- MIL-On for active fault and for 5 seconds after active fault
- Adaptive-Disabled for remainder of key-on cycle
- Closed Loop-Disabled during active fault

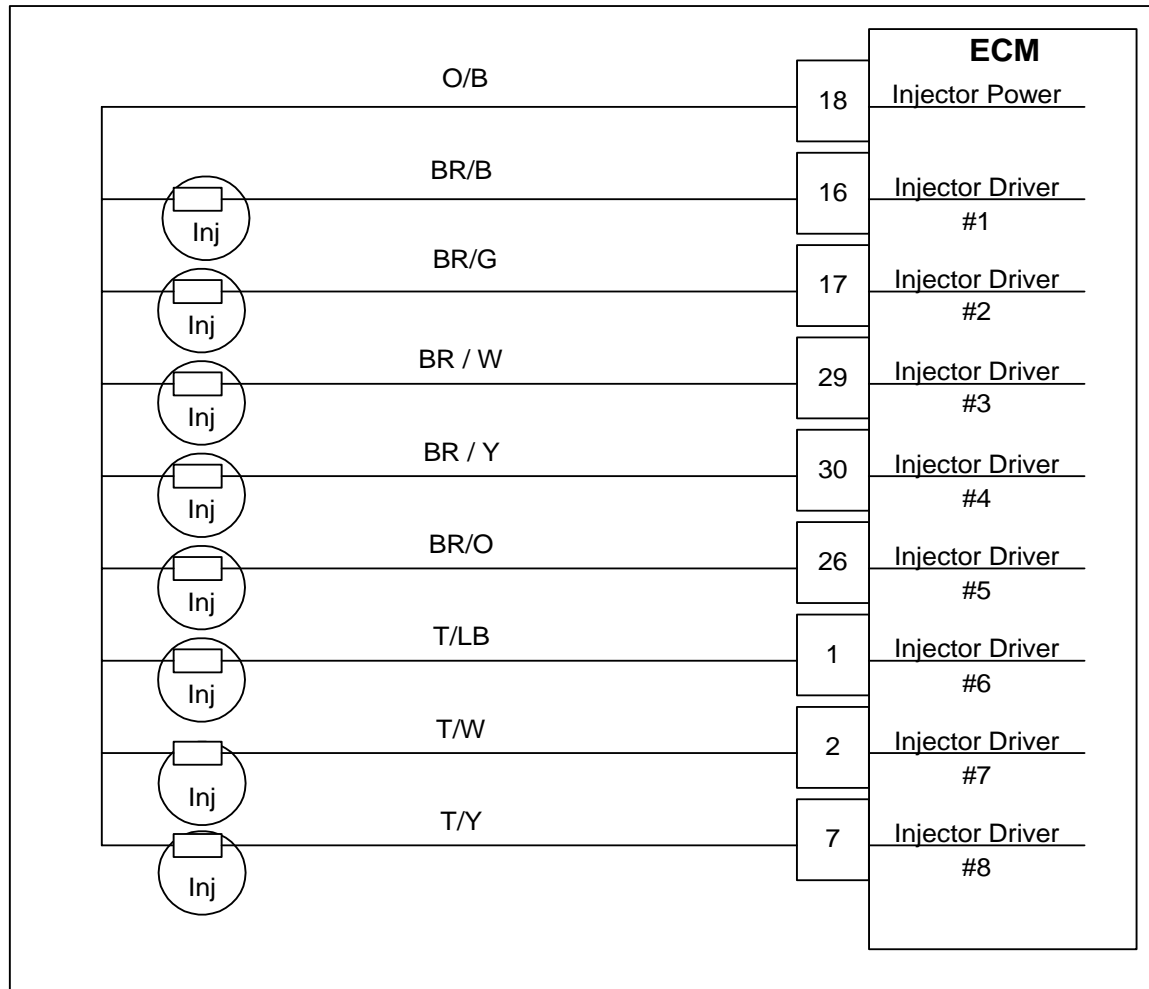
Injector Driver #7 fires the injector for the 7<sup>th</sup> cylinder in the firing order.

This fault will set if the ECM detects low feedback voltage on the internal injector while the injector drive circuit is in the off-state and battery voltage is greater than 9 volts.

# DTC 431- Injector Driver #7 Open



## DTC 432-Injector Driver #7 Shorted

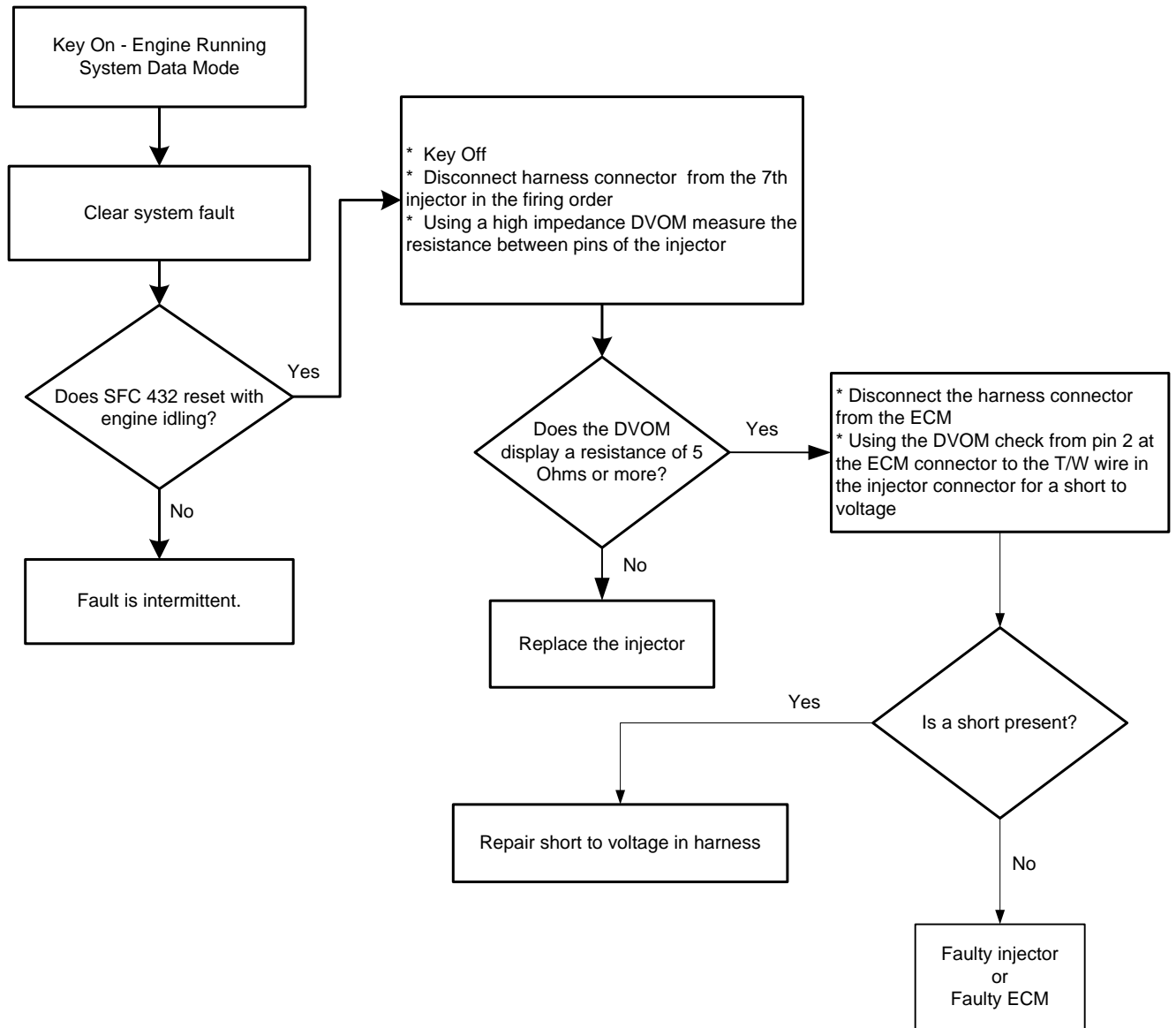


- Injector coil shorted
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM less than 16 volts and injector low-side greater than 4 volts for 10 injector firings
- MIL-On during active fault and for 5 seconds after active fault
- Adaptive-Enabled
- Closed Loop-Enabled

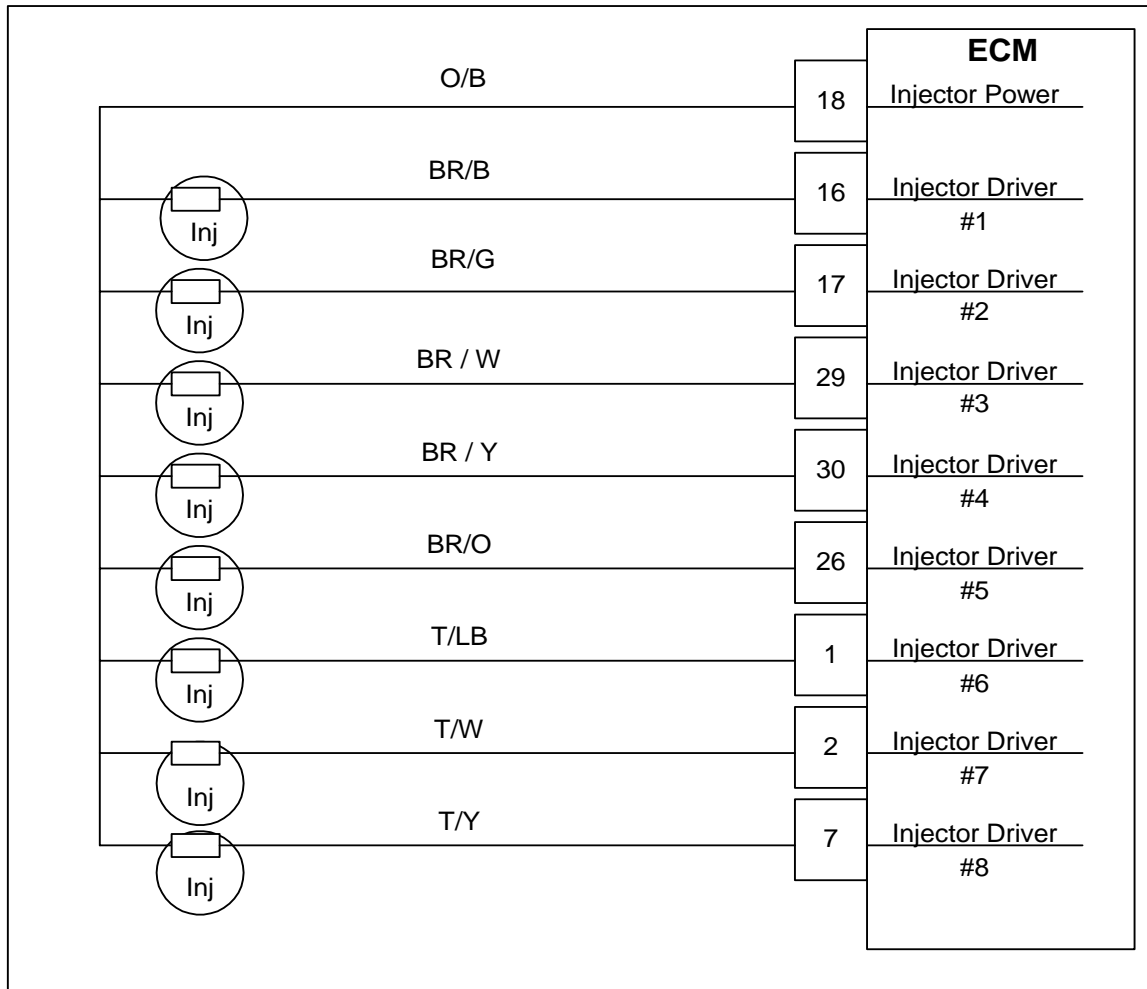
Injector Driver #7 fires the injector for the 7<sup>th</sup> cylinder in the firing order.

This fault will set if the ECM detects 10 injector firings with the internal driver sense voltage greater than 4 volts while the injector is in the on-state and battery voltage is less than 16 volts.

# DTC 432-Injector Driver #7 Shorted



## DTC 433-Injector Driver #8 Open



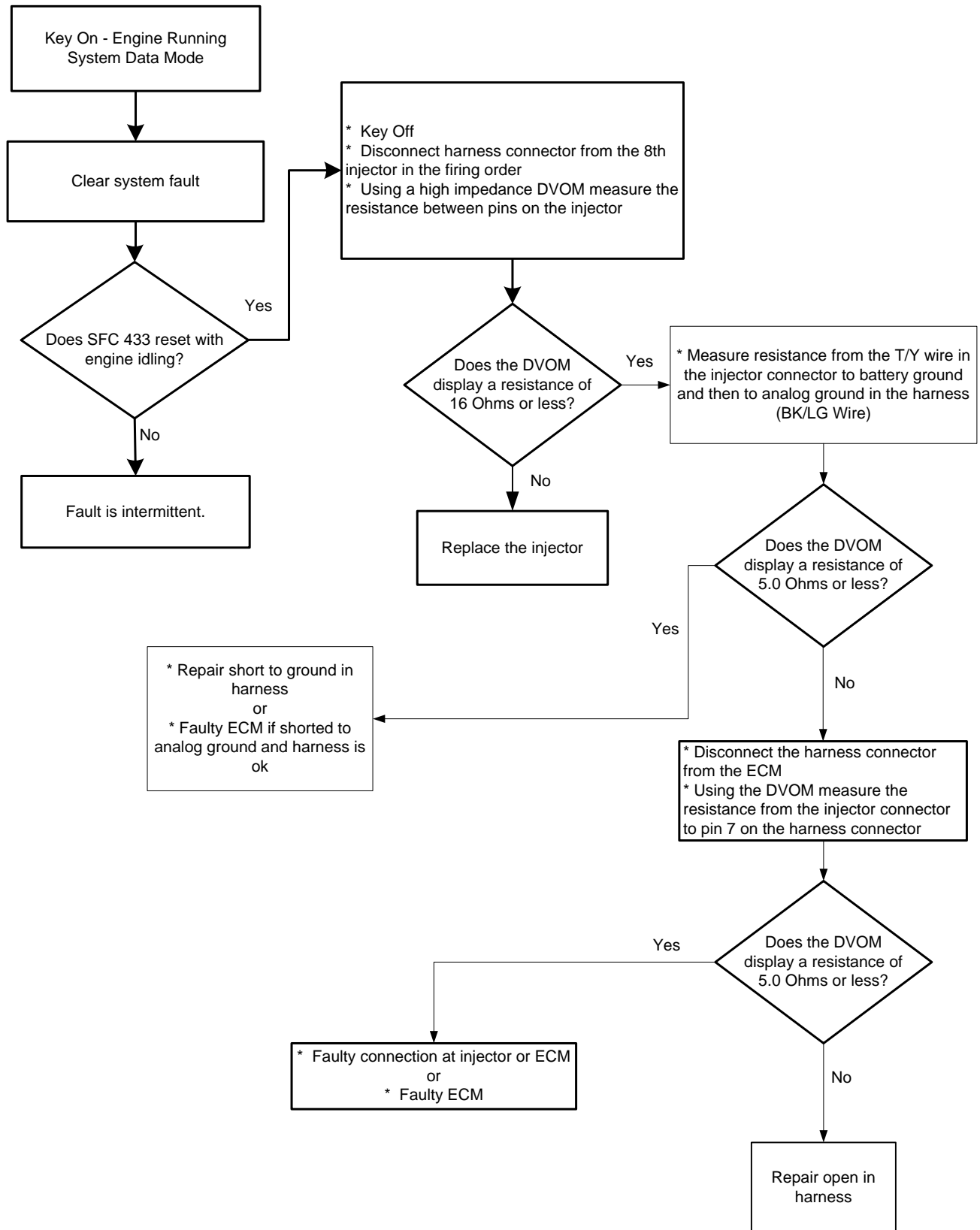
- Injector coil open or driver circuit short
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM greater than 9 volts and injector low-side less than 4 volts for 10 injector firings
- MIL-On for active fault and for 5 seconds after active fault
- Adaptive-Disabled for remainder of key-on cycle
- Closed Loop-Disabled during active fault

Injector Driver #8 fires the injector for the 8<sup>th</sup> cylinder in the firing order.

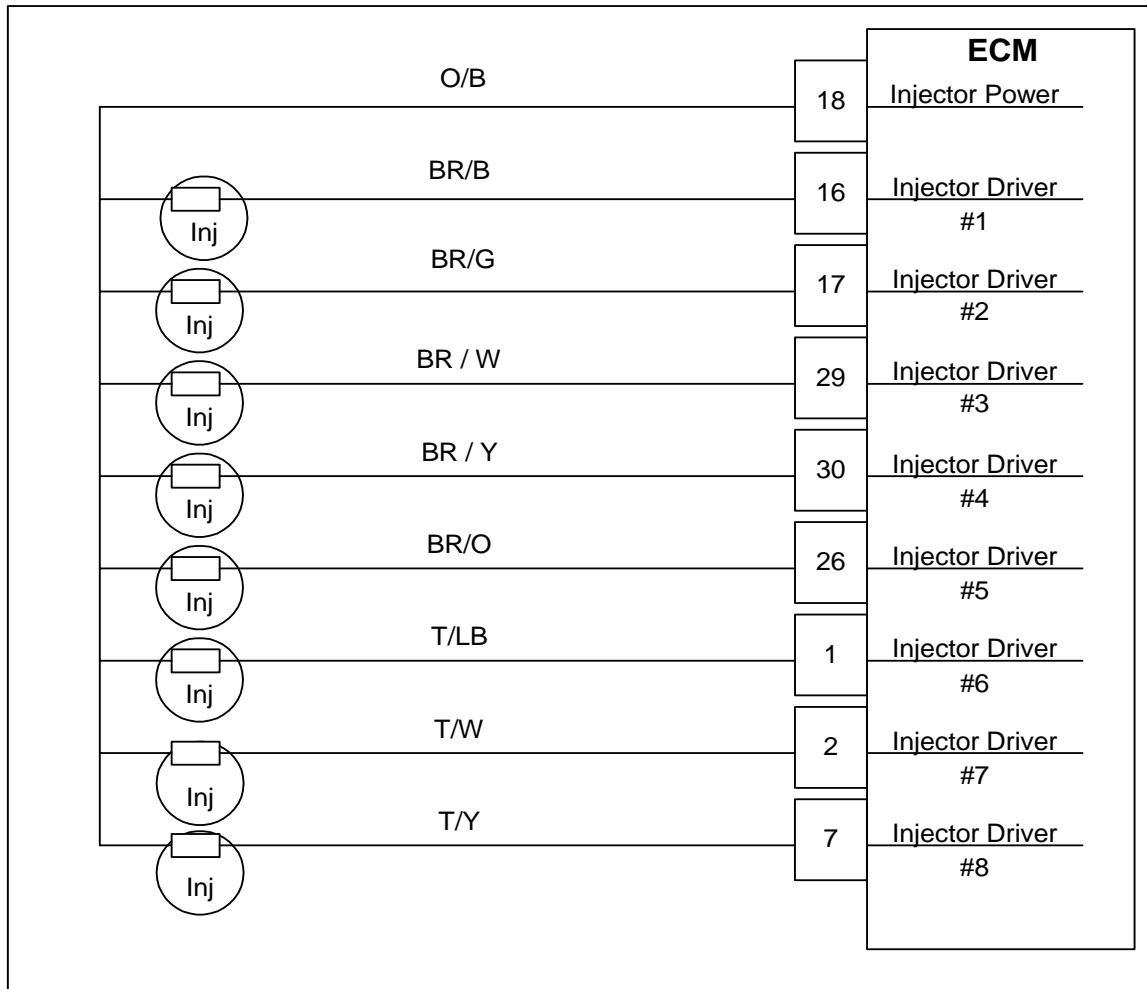
This fault will set if the ECM detects low feedback voltage on the internal injector while the injector drive circuit is in the off-state and battery voltage is greater than 9 volts.



# DTC 433- Injector #8 Open



## DTC 434-Injector Driver #8 Shorted

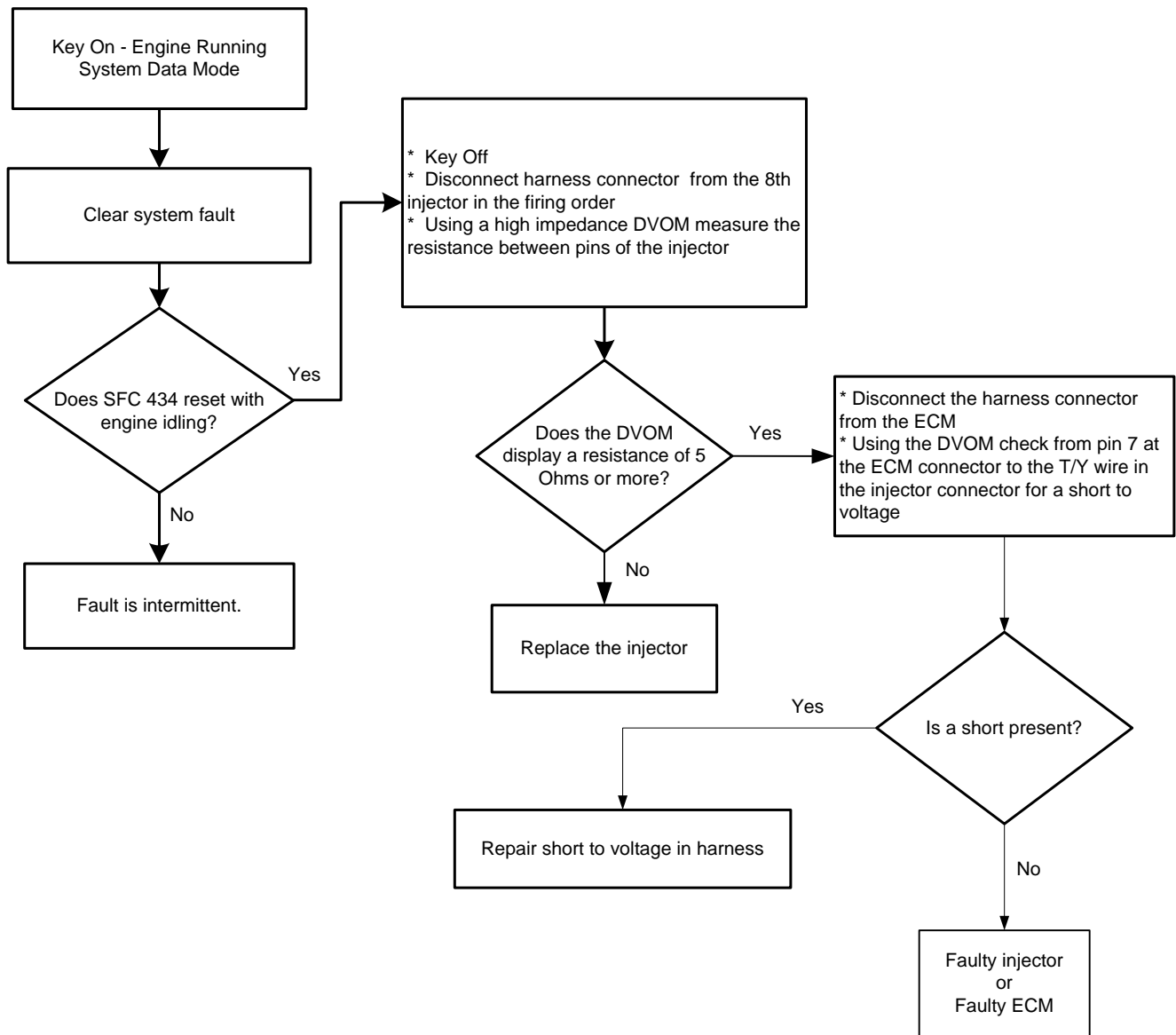


- Injector coil shorted
- Check Condition-Key on and engine running
- Fault Condition-Battery voltage at ECM less than 16 volts and injector low-side greater than 4 volts for 10 injector firings
- MIL-On during active fault and for 5 seconds after active fault
- Adaptive-Enabled
- Closed Loop-Enabled

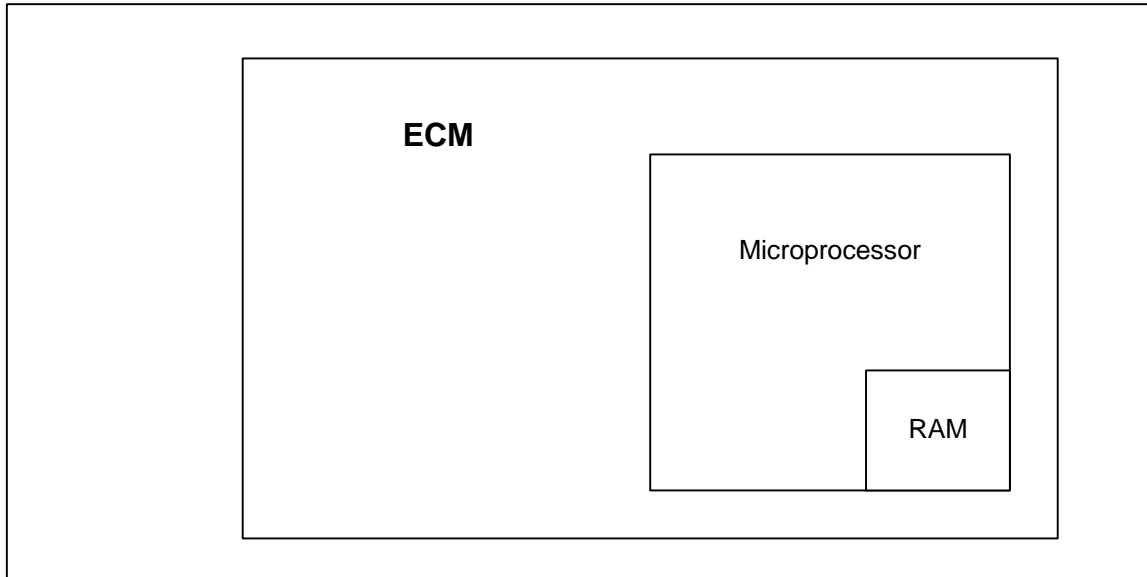
Injector Driver #8 fires the injector for the 8<sup>th</sup> cylinder in the firing order.

This fault will set if the ECM detects 10 injector firings with the internal driver sense voltage greater than 4 volts while the injector is in the on-state and battery voltage is less than 16 volts.

# DTC 434-Injector Driver #8 Shorted



## DTC 511-COP Failure

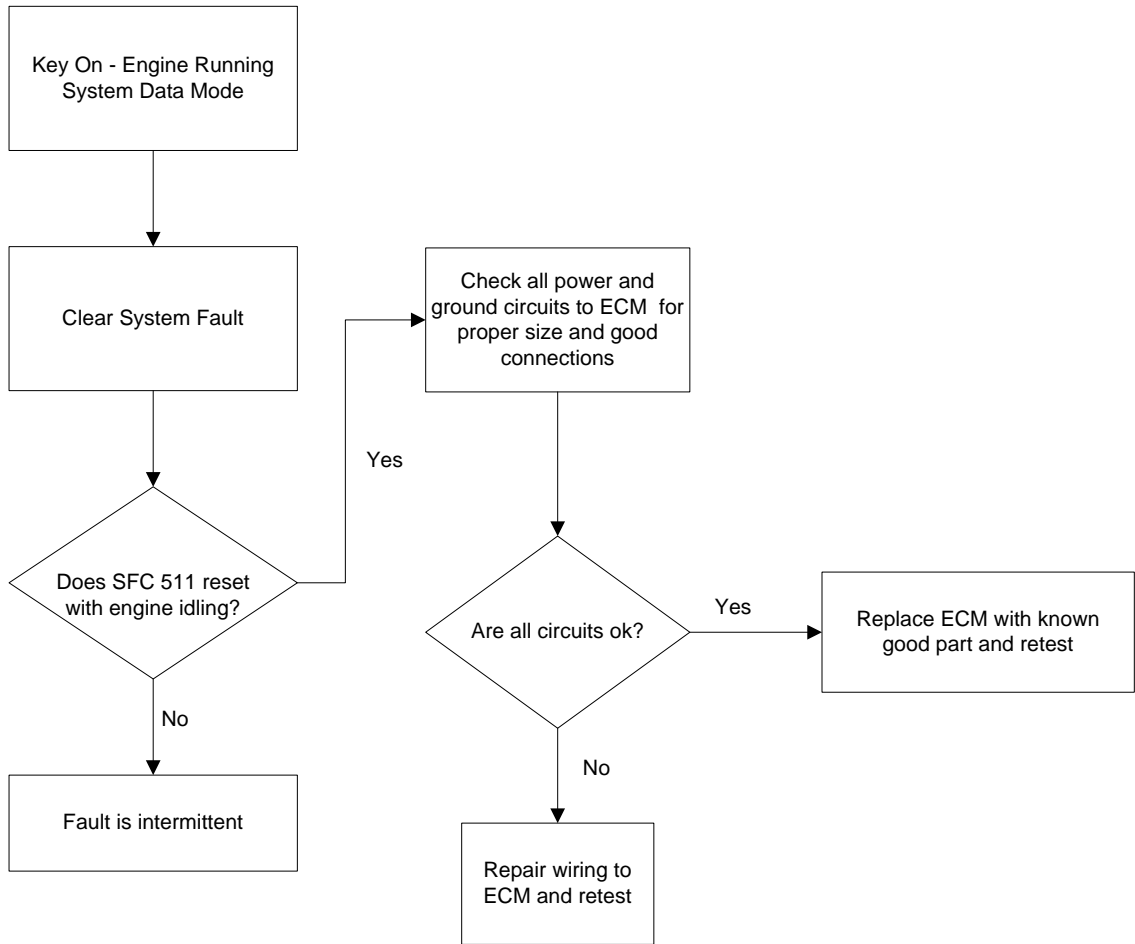


- Engine Control Module
- Check Condition- Key on
- Fault Condition- Internal microprocessor error
- MIL- On until code is cleared by technician
- Adaptive- Disabled for the remainder of the key-on cycle
- Closed Loop- Enabled
- Power Derate (level 2 until fault is cleared manually)

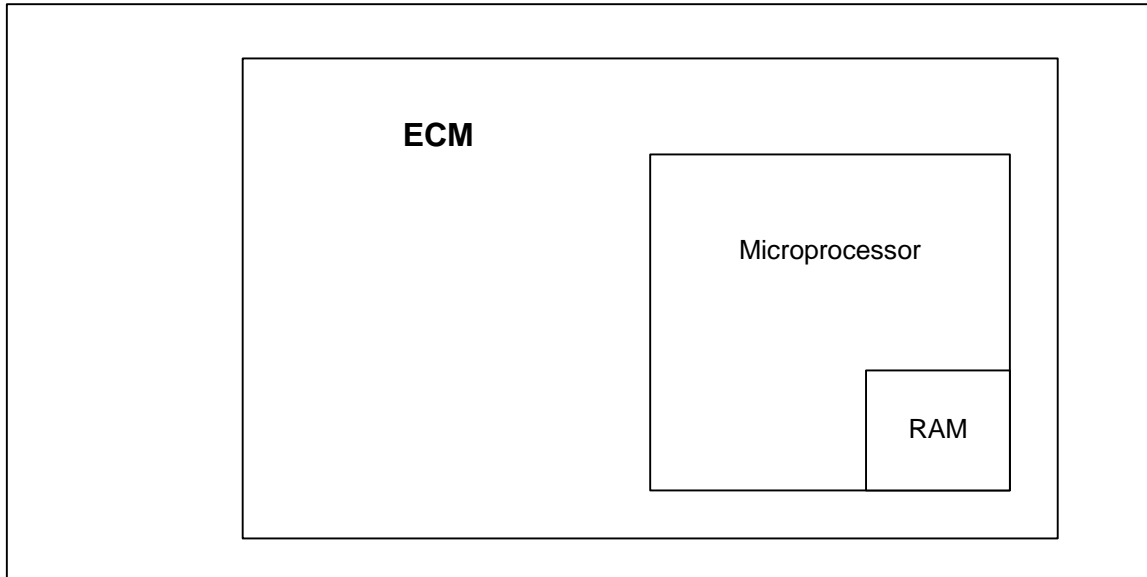
The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased 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.

# DTC 511- COP Failure



## DTC 512-Invalid Interrupt

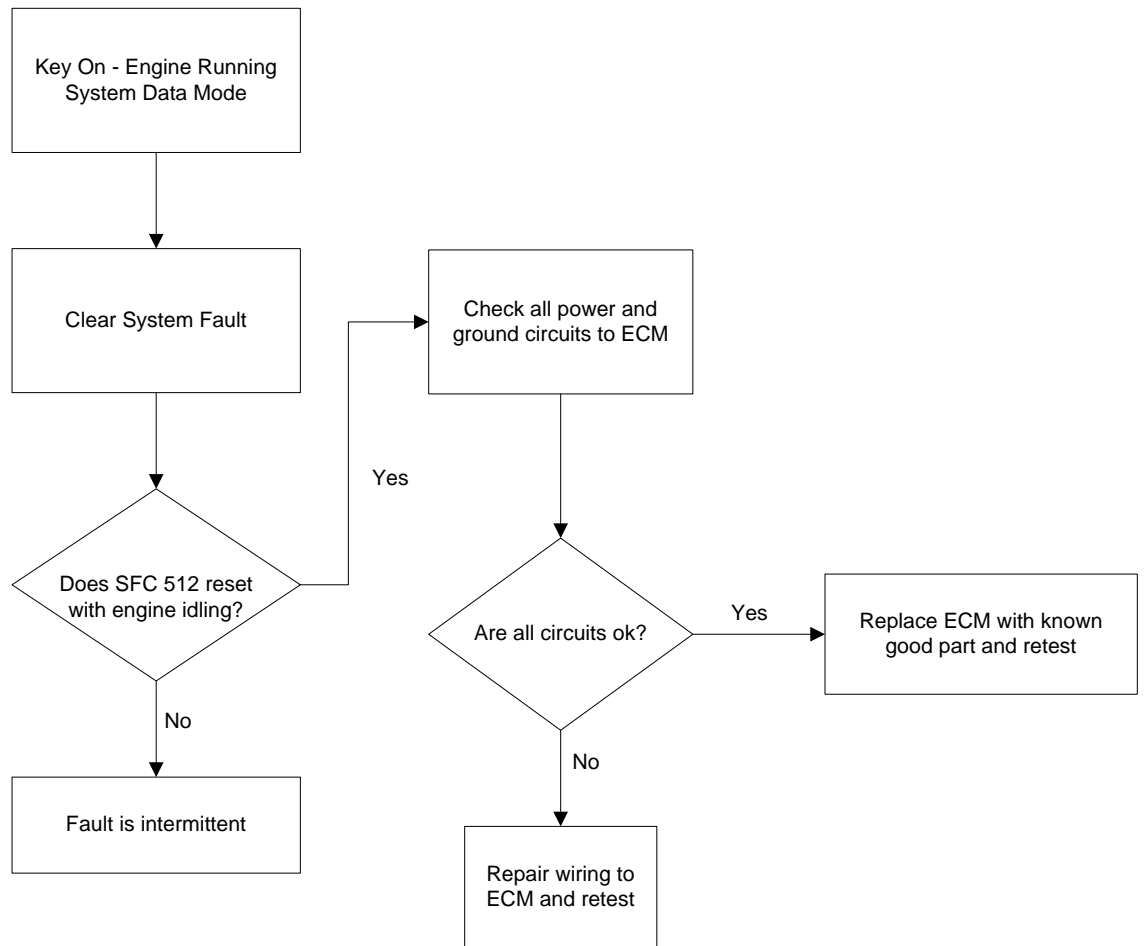


- Engine Control Module
- Check Condition- Key on
- Fault Condition- Internal microprocessor error
- MIL- On until code is cleared by technician
- Adaptive- Disabled for the remainder of the key-on cycle
- Closed Loop- Enabled
- Power Derate (level 2 until fault is cleared manually)

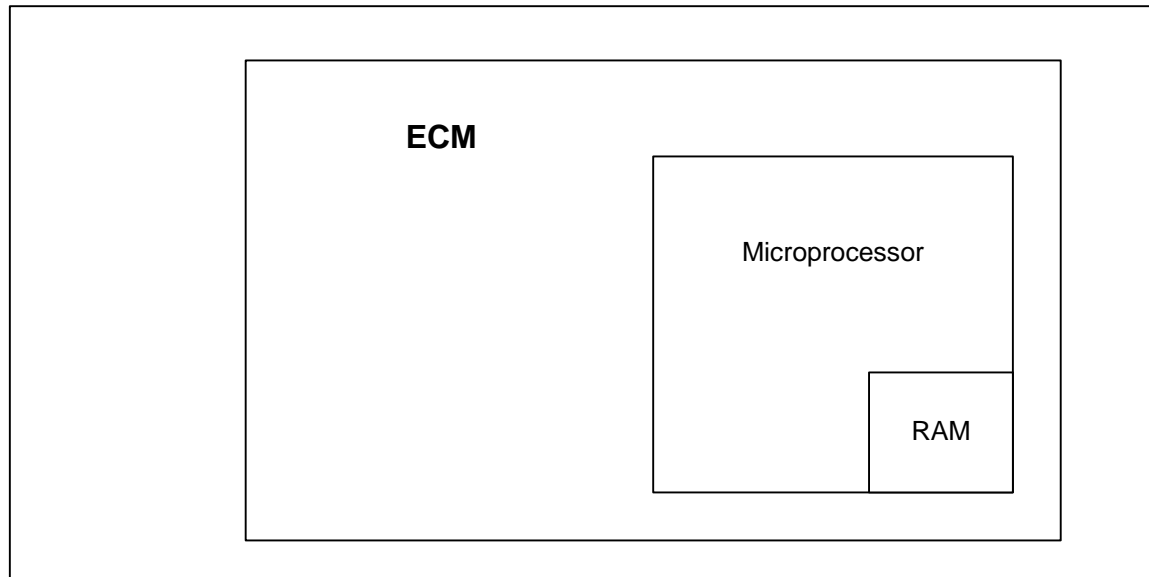
The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased 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.

# DTC 512- Invalid Interrupt



## DTC 513-A/D Loss



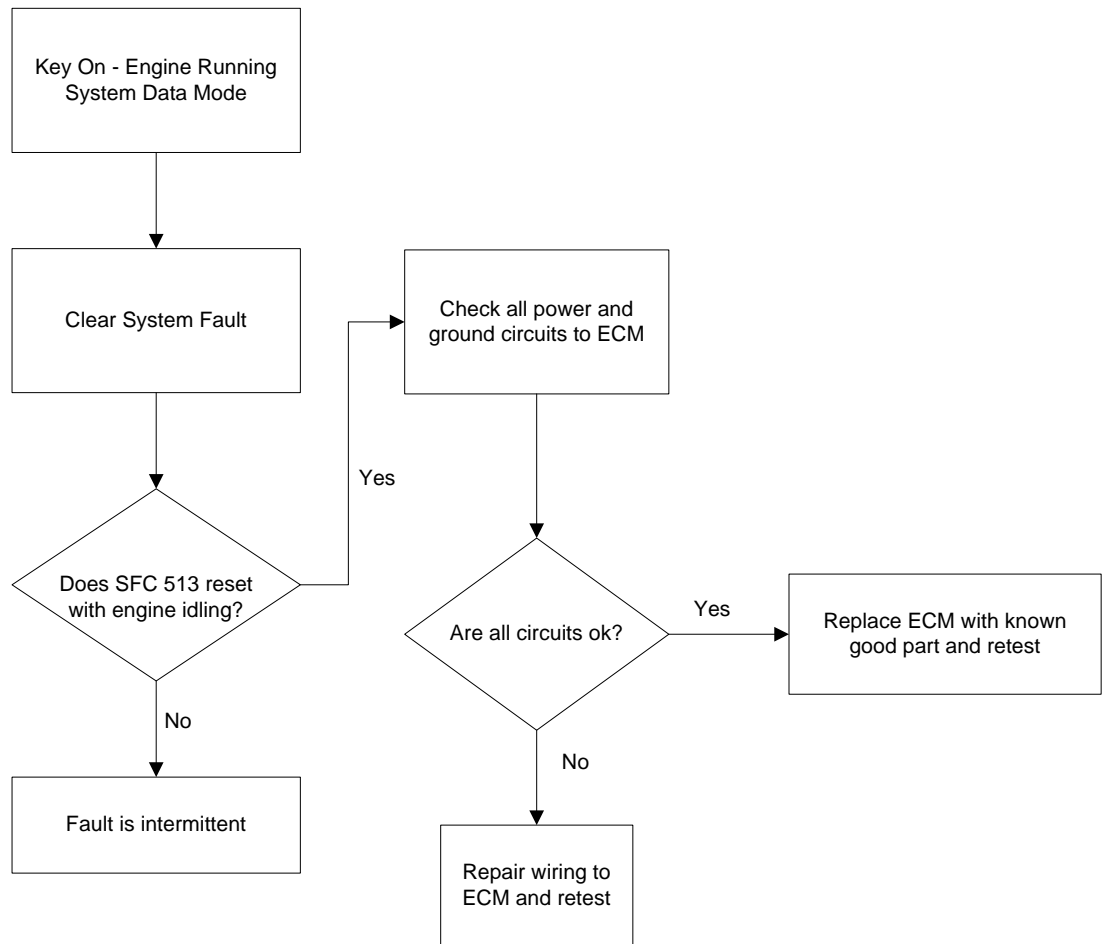
- Engine Control Module
- Check Condition- Key on
- Fault Condition- Internal microprocessor error
- MIL- On until code is cleared by technician
- Adaptive- Disabled for the remainder of the key-on cycle
- Closed Loop- Enabled
- Power Derate (level 2 until fault is cleared manually)

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. 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.

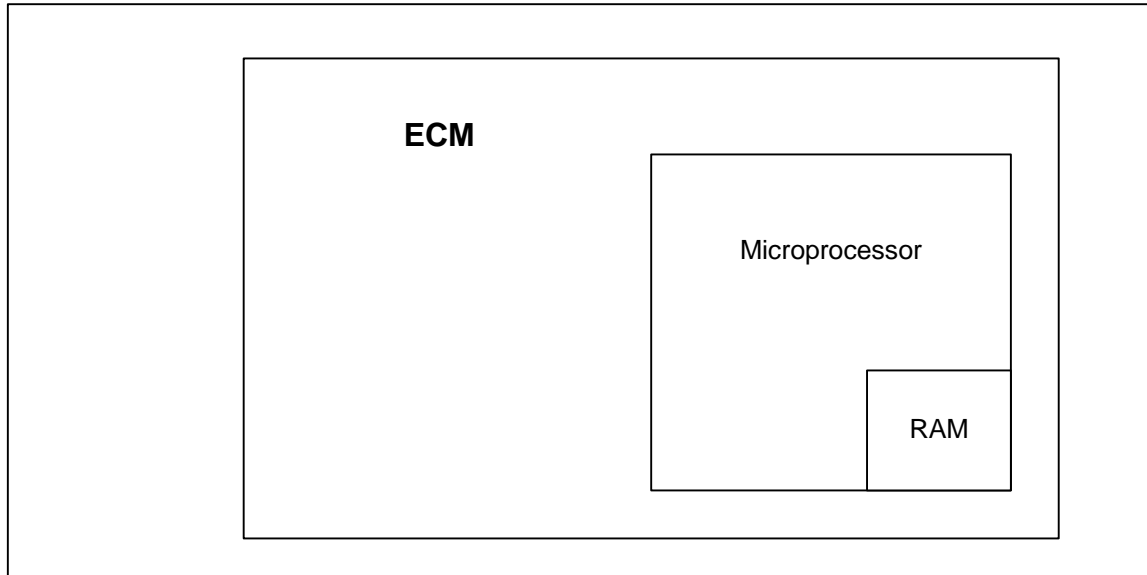
During this active fault, Power Derate (level 2) will be enforced. When this is enforced, maximum throttle position will be 20%. This is enforced until the fault is manually cleared.



# DTC 513- A/D Loss



## DTC 514-RTI 1 Loss

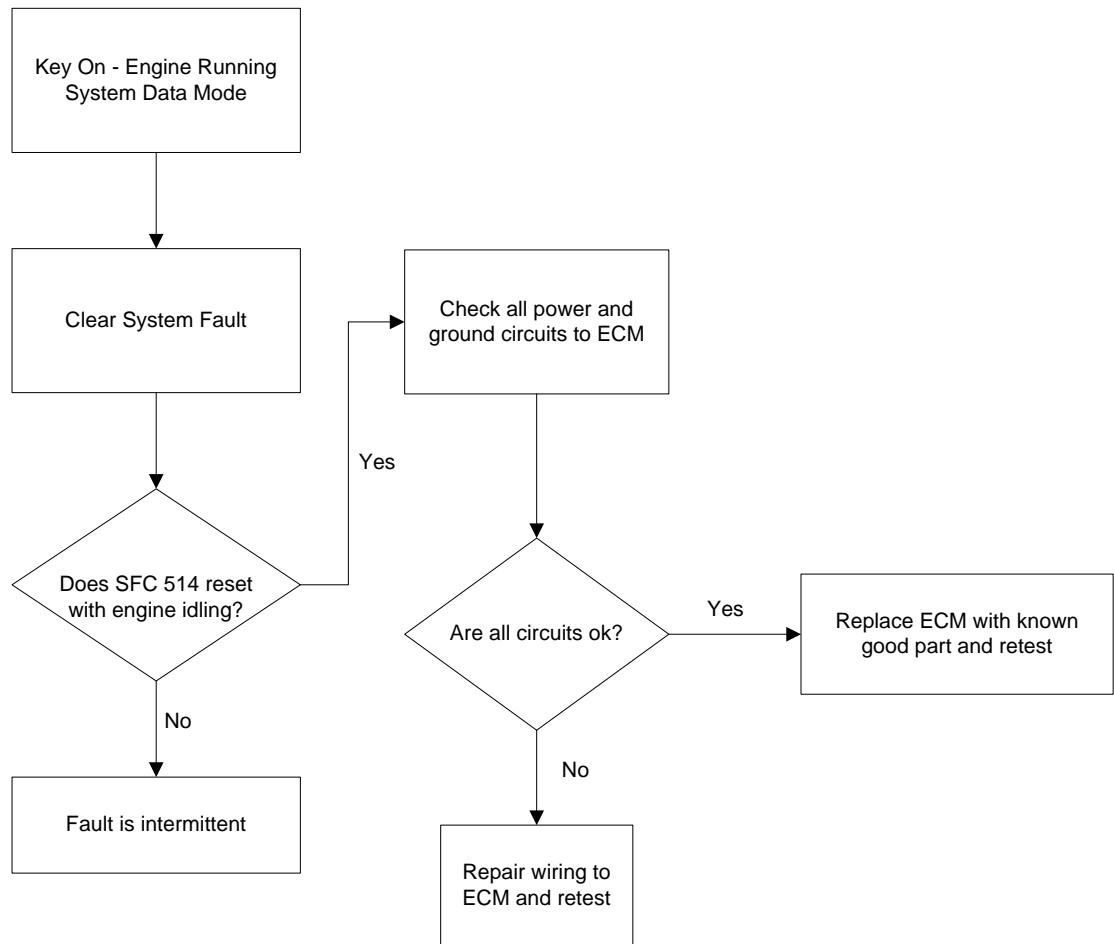


- Engine Control Module
- Check Condition- Key on
- Fault Condition- Internal microprocessor error
- MIL- On until code is cleared by technician
- Adaptive- Disabled for the remainder of the key-on cycle
- Closed Loop- Enabled
- Power Derate (level 2 until fault is cleared manually)

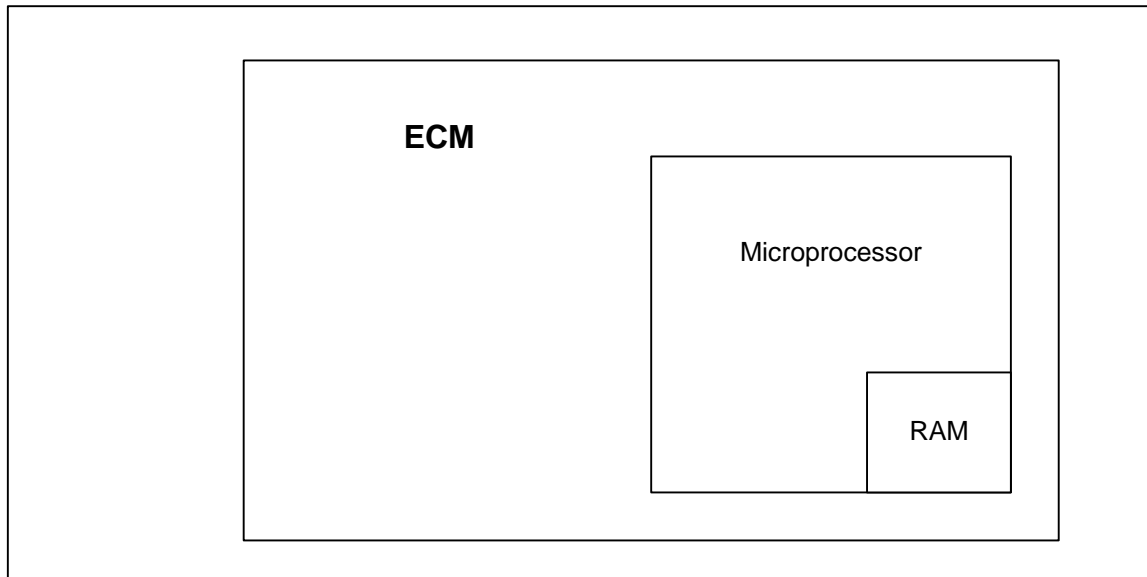
The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased 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.

# DTC 514- RTI 1 Loss



## DTC 515-Flash Checksum Invalid

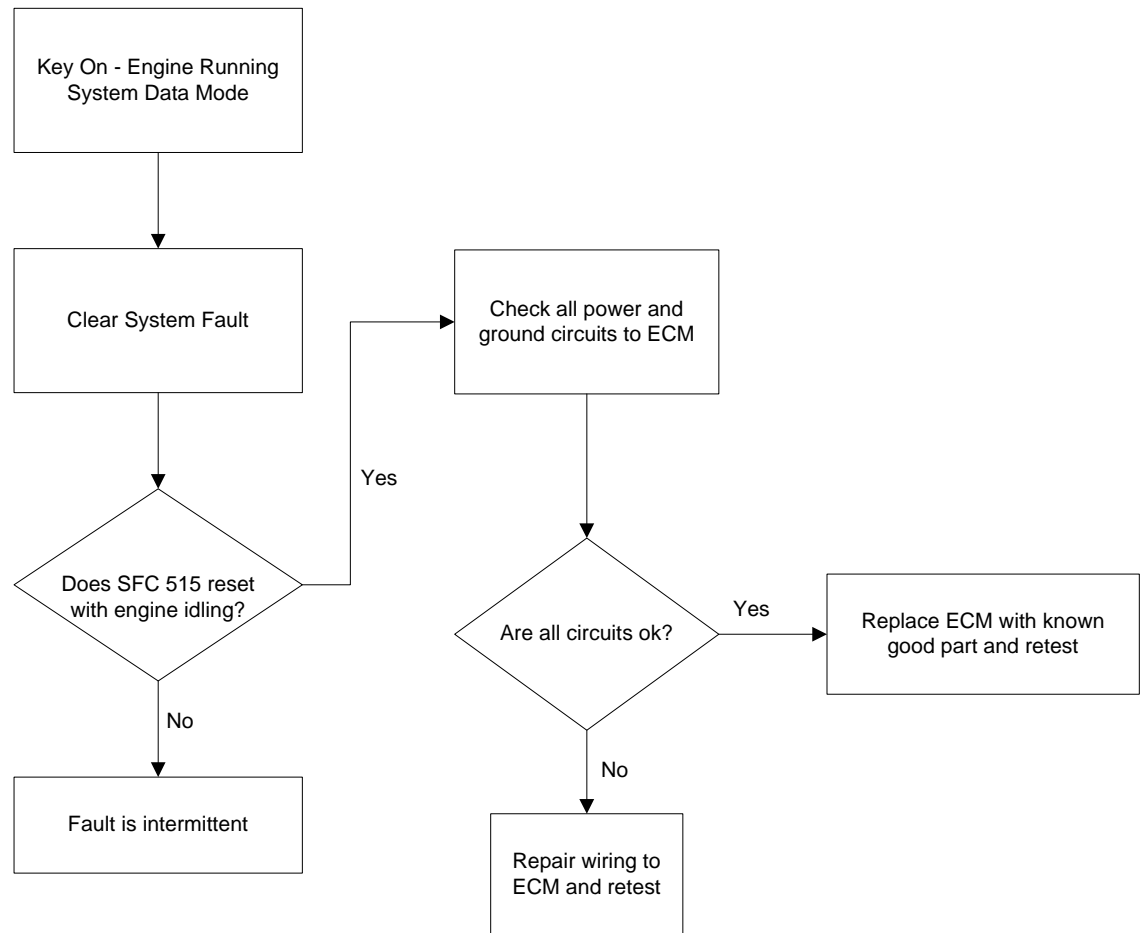


- Engine Control Module
- Check Condition- Key on
- Fault Condition- Internal microprocessor error
- MIL- On until code is cleared by technician
- Adaptive- Disabled for the remainder of the key-on cycle
- Closed Loop- Enabled
- Power Derate (level 2 until fault is cleared manually)

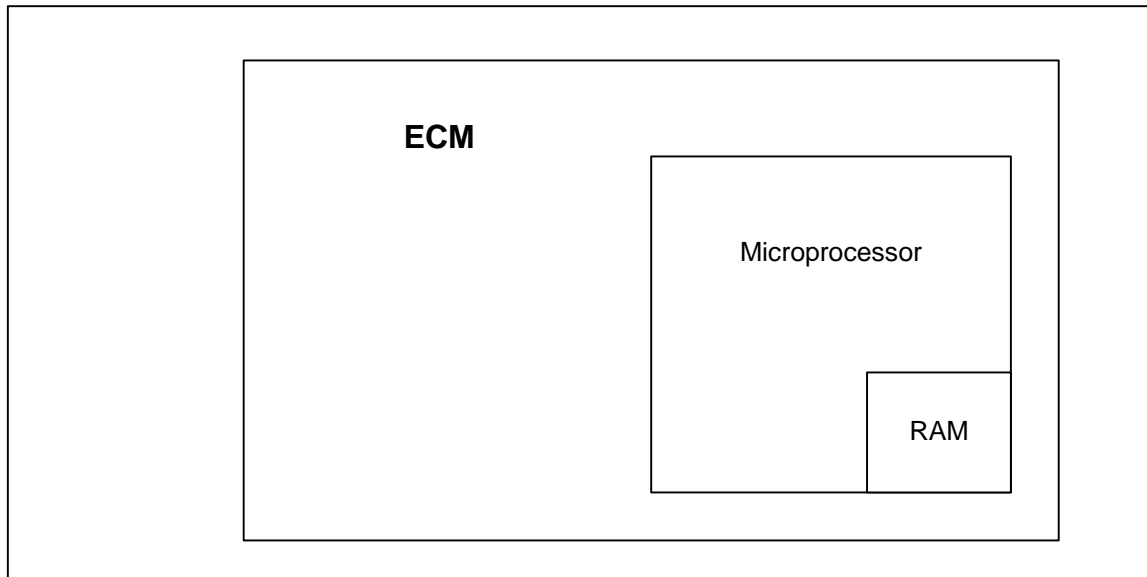
The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased 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.

# DTC 515- Flash Checksum Invalid



## DTC 516-Ram Failure

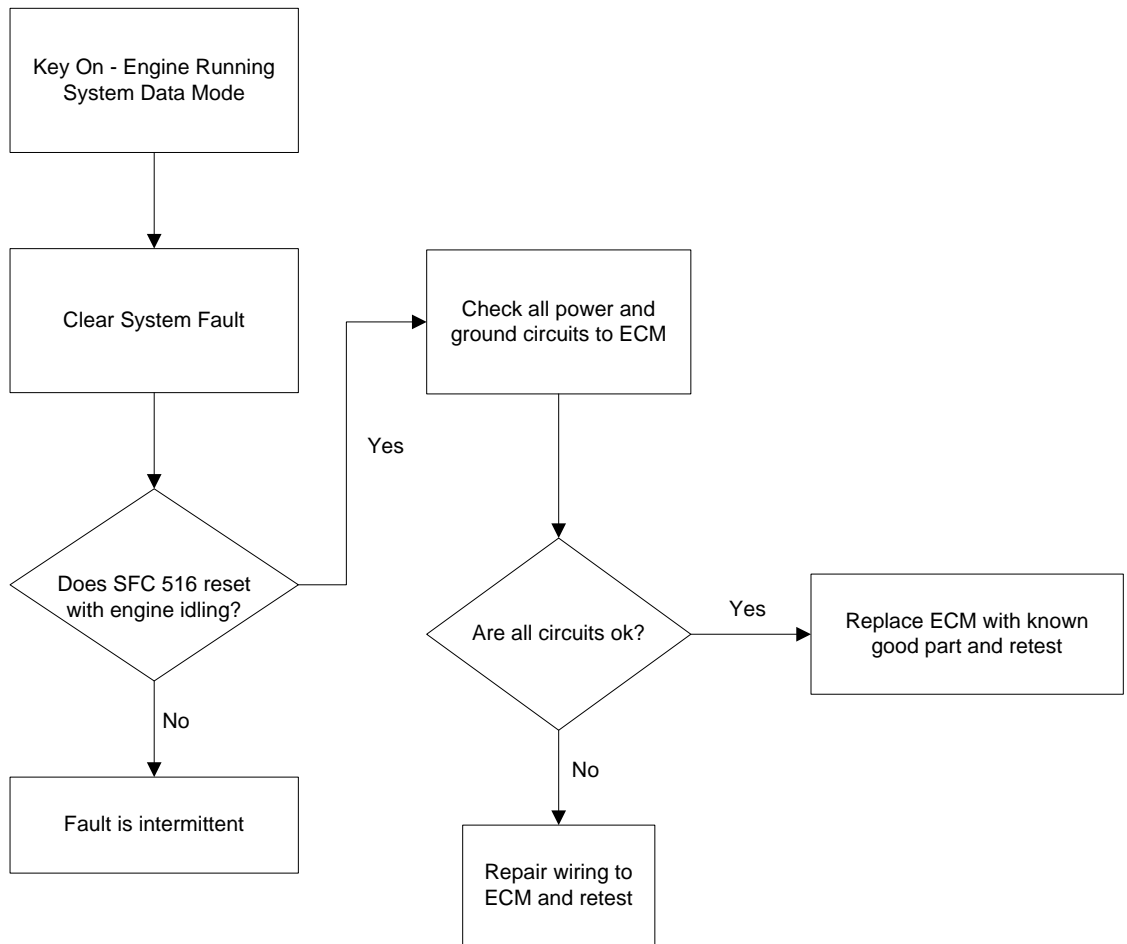


- Random Access Memory
- Check Condition- Key-On
- Fault Condition- Internal ECM memory access failure
- MIL- On until fault is cleared
- Adaptive- Disabled for the remainder of the key-on cycle
- Closed Loop- Enabled
- Power Derate (level 2) enforced

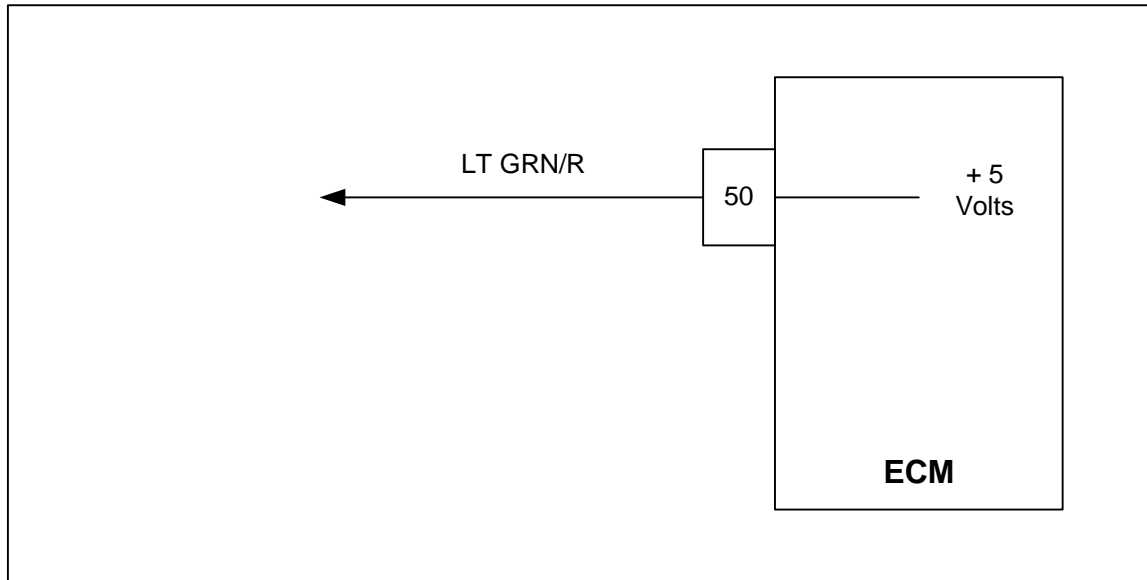
Random Access Memory is located within the microprocessor that can be read from or written to at any time. The System Fault Codes and the Adaptive Learn Table are among the data stored in RAM.

This fault will set if the ECM detects a problem accessing or writing information to RAM. This fault will not self erase and must be cleared manually.

# DTC 516- RAM Failure



## DTC 531-External 5V Ref Lower Than Expected



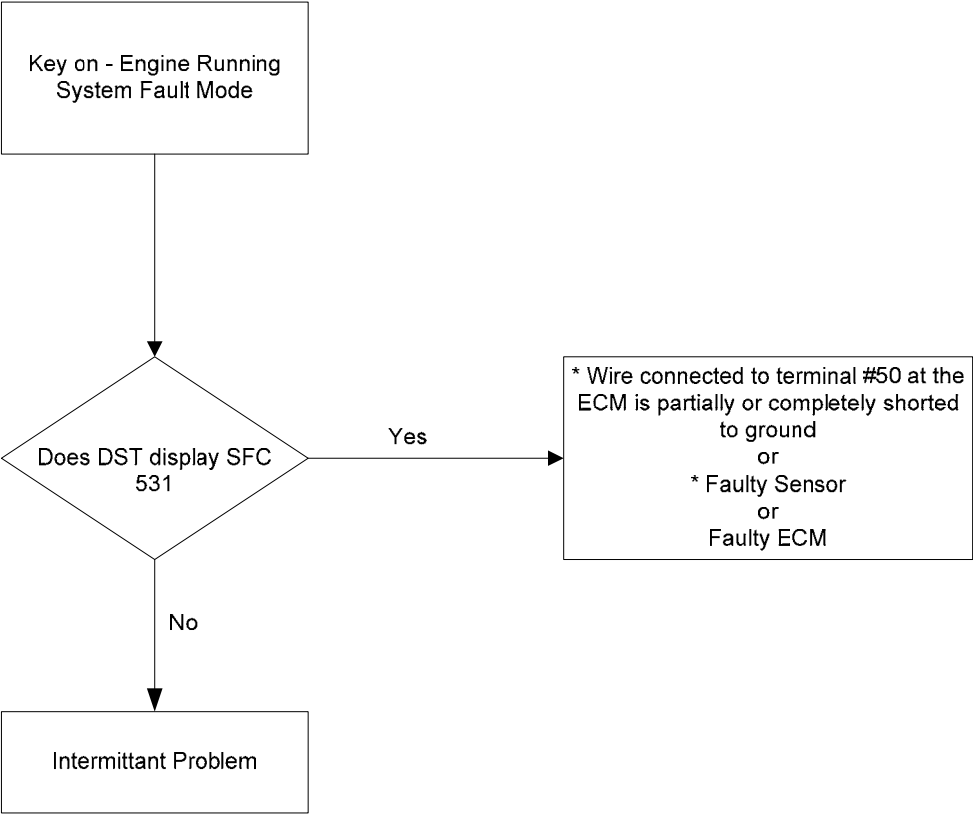
- External 5V reference
- Check Condition-Cranking with battery voltage greater than 8 volts and engine running
- Fault Condition-5V reference voltage lower than 4.6 volts
- MIL-On during active fault and for 2 seconds after active fault
- Adaptive-Disabled during active fault
- Closed Loop-Enabled

The External 5 Volt supply powers some of the sensors and other components in the system. The accuracy of the 5 Volt supply is very important to the accuracy of the sensors and therefore controlled by the ECM. The ECM monitors the 5 volt supply to determine if it is overloaded, shorted, or otherwise out of specification.

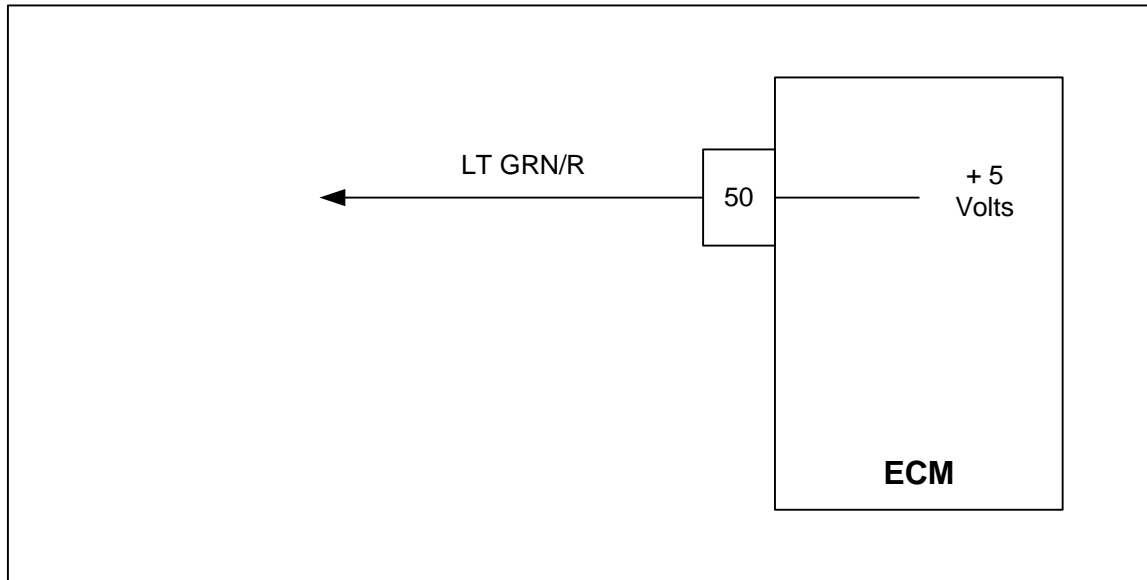
This fault will set if the 5 Volt reference is below 4.6 volts.



# DTC 531-External 5V Ref Lower Than Expected



## DTC 532-External 5 V Ref Higher Than Expected

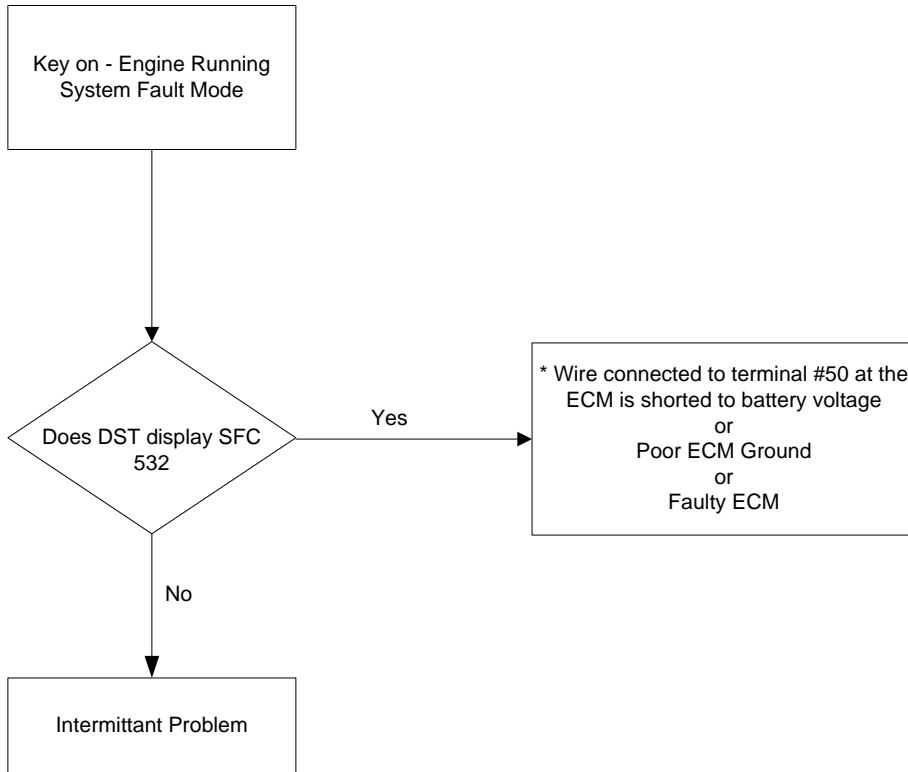


- External 5V reference
- Check Condition-Cranking with battery voltage greater than 8 volts or engine running
- Fault Condition-5V reference voltage higher than 5.4 volts
- MIL-On during active fault and for 2 seconds after active fault
- Adaptive-Disabled during active fault
- Closed Loop-Enabled

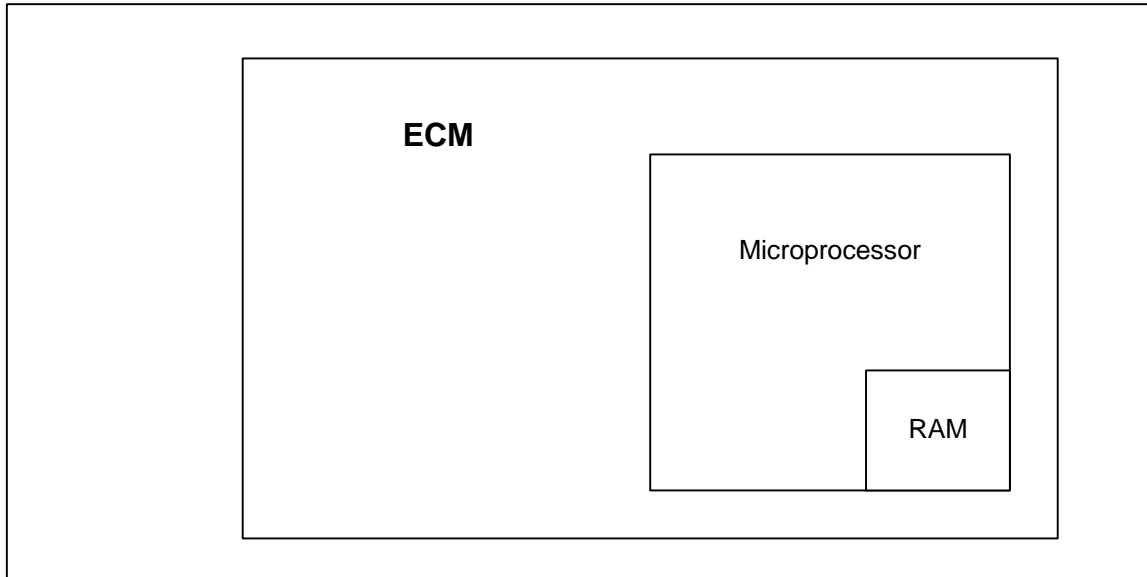
The External 5 Volt supply powers some of the sensors and other components in the system. The accuracy of the 5 Volt supply is very important to the accuracy of the sensors and therefore control by the ECM. The ECM to determine if they are overloaded, shorted, or otherwise out of specification monitors the 5 Volt supply.

This fault will set if the 5 Volt reference is above 5.4 volts.

# DTC 532-External 5V Ref Higher Than Expected



## DTC 555-RTI 2 Loss

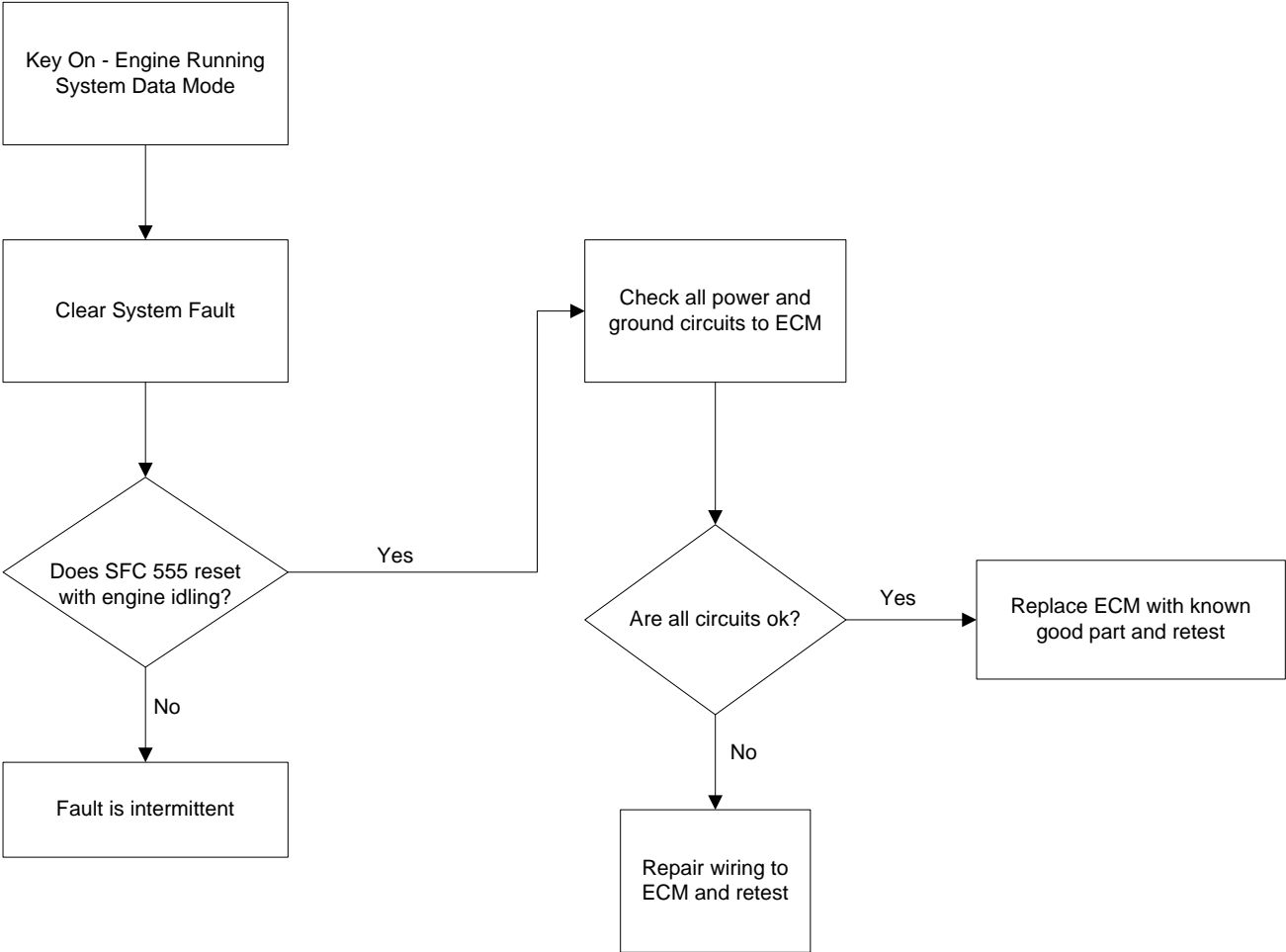


- Engine Control Module
- Check Condition- Key on
- Fault Condition- Internal microprocessor error
- MIL- On until code is cleared by technician
- Adaptive- Disabled for the remainder of the key-on cycle
- Closed Loop- Enabled
- Power Derate (level 2 until fault is cleared manually)

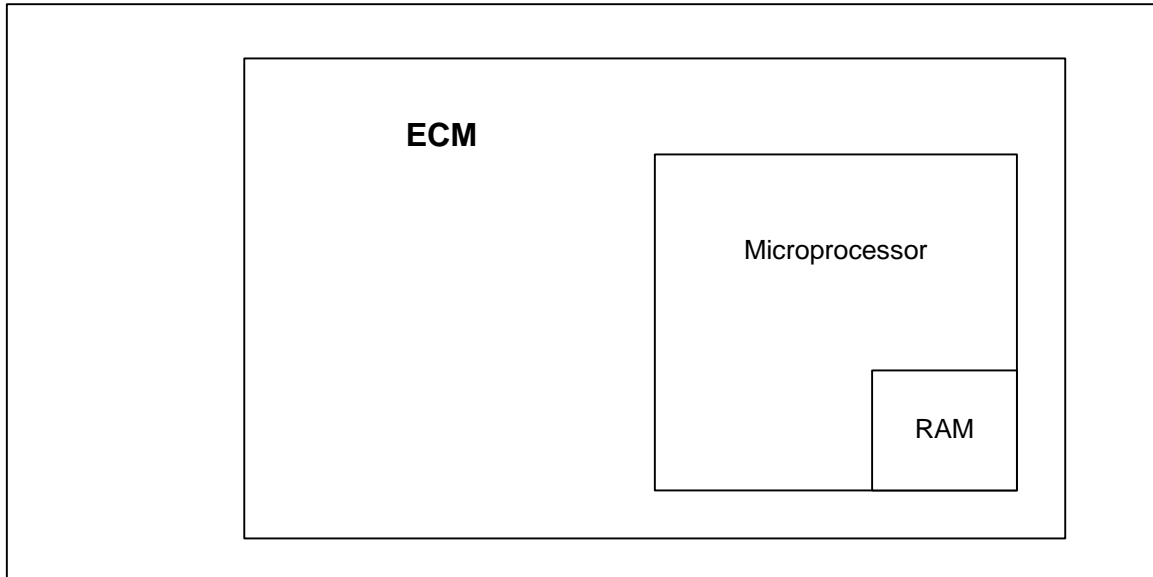
The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased 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.

# DTC 555- RTI 2 Loss



## DTC 556-RTI 3 Loss

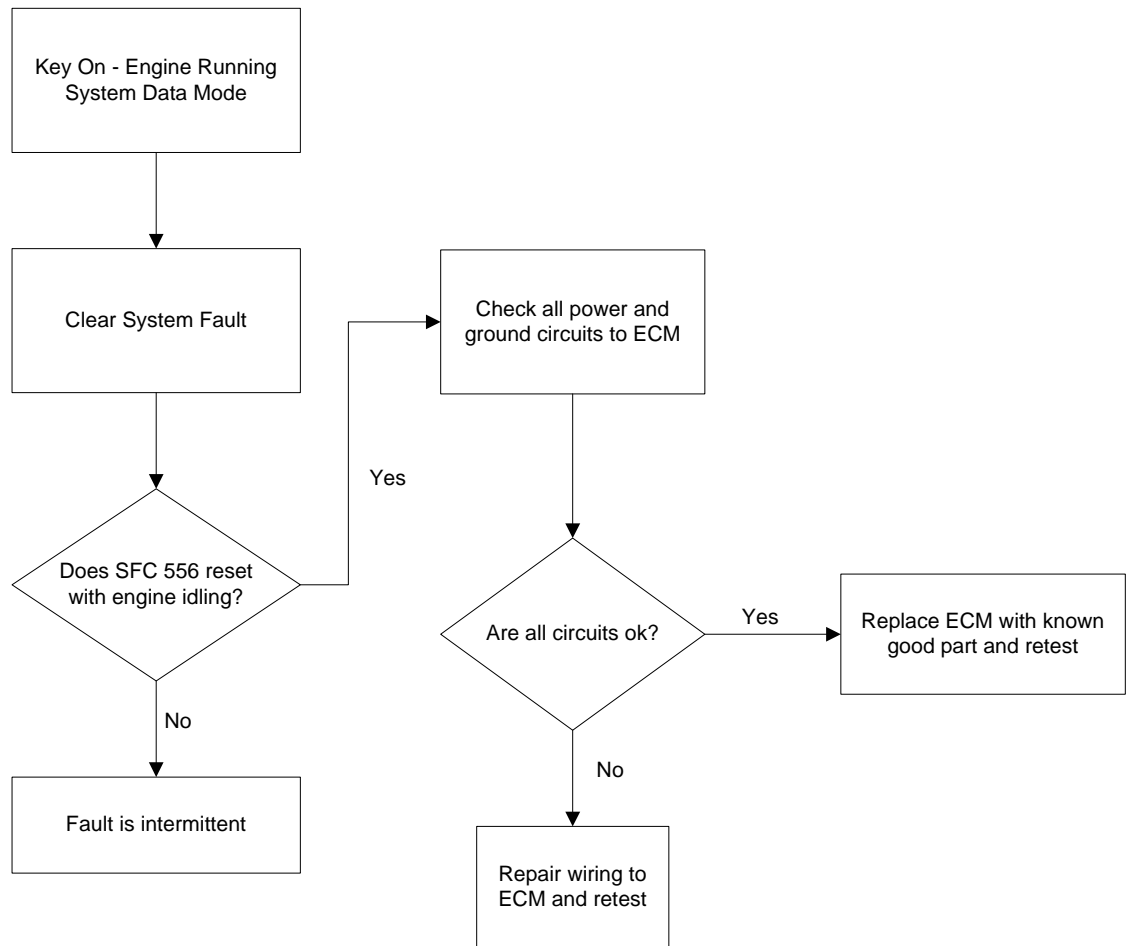


- Engine Control Module
- Check Condition- Key on
- Fault Condition- Internal microprocessor error
- MIL- On until code is cleared by technician
- Adaptive- Disabled for the remainder of the key-on cycle
- Closed Loop- Enabled
- Power Derate (level 2 until fault is cleared manually)

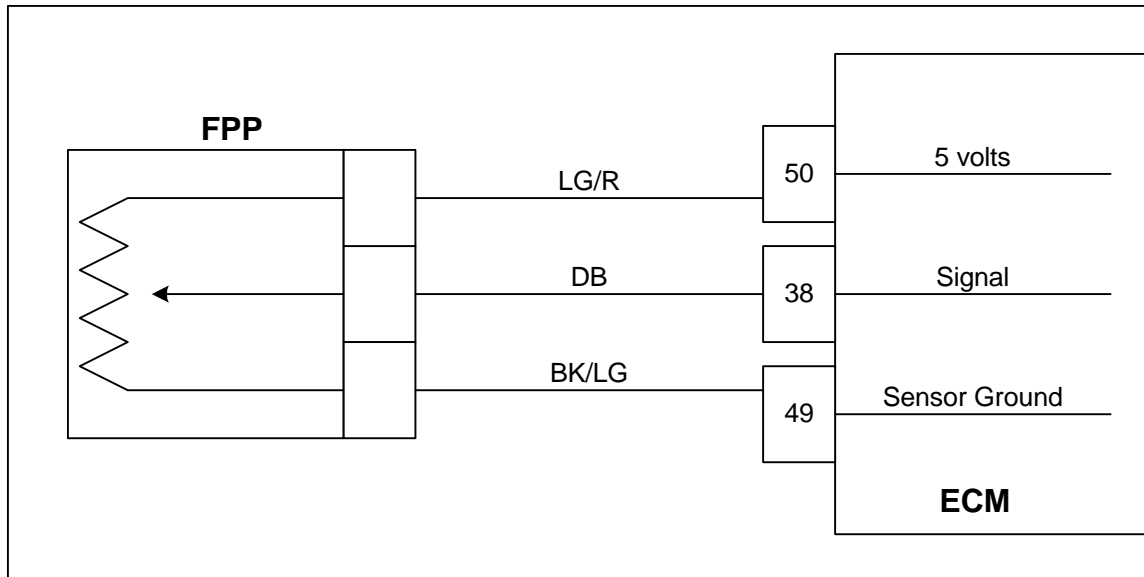
The ECM has checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased 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.

# DTC 556- RTI 3 Loss



## DTC 611-FPP High Voltage



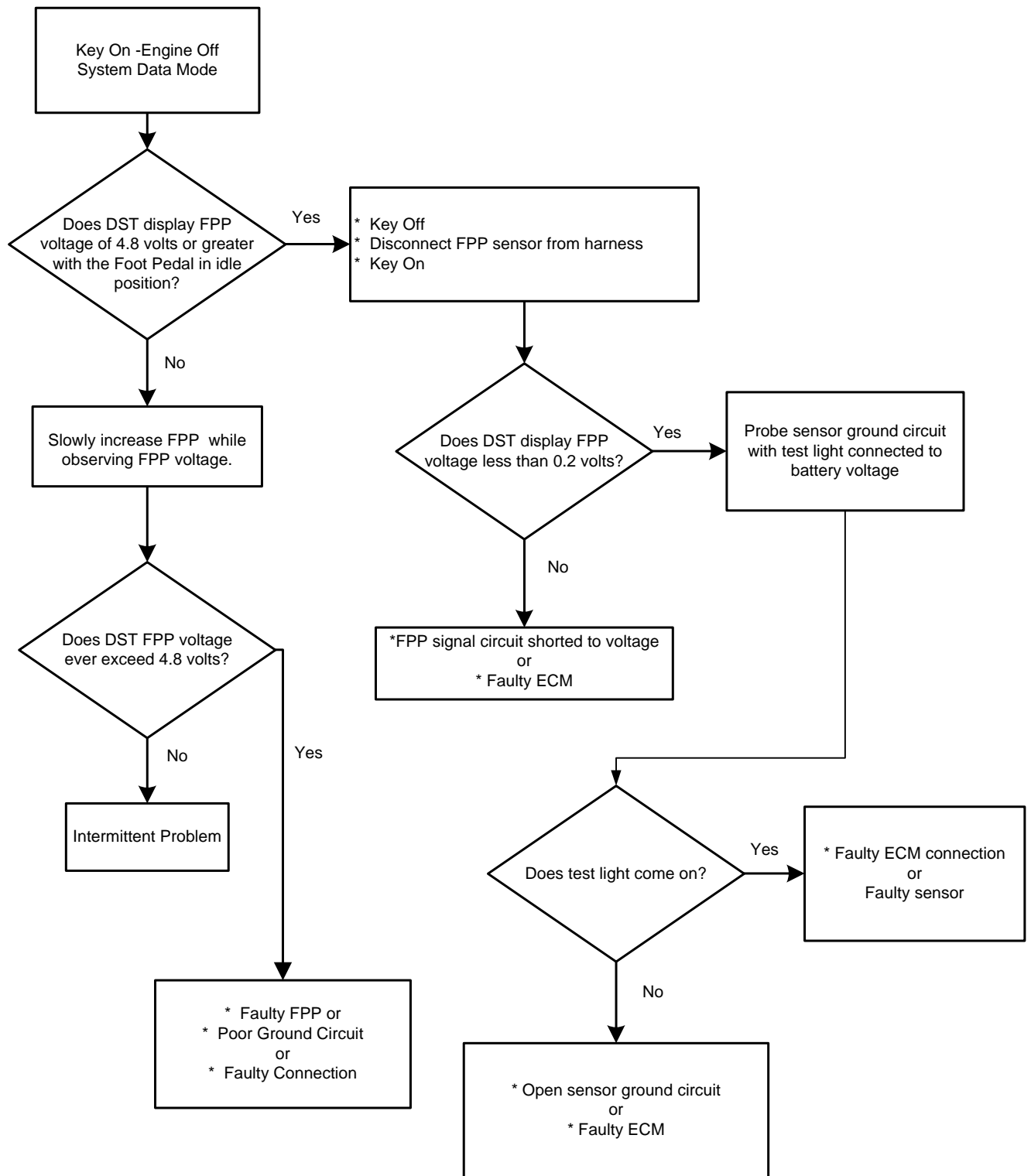
- Foot Pedal Position
- Check Condition-Key On
- Fault Condition-FPP1 sensor voltage exceeds 4.8
- MIL-On during active fault and flashing at 2 Hz (twice per second) after active fault for the remainder of the key-on cycle
- Adaptive-Enabled
- Closed Loop-Enabled
- Power Derate (level 1) and Low Rev Limit enforced

The Foot Pedal Position sensor uses a variable resistor to determine signal voltage based on pedal position. Less depression of pedal results in lower voltage, and greater depression results in higher voltage.

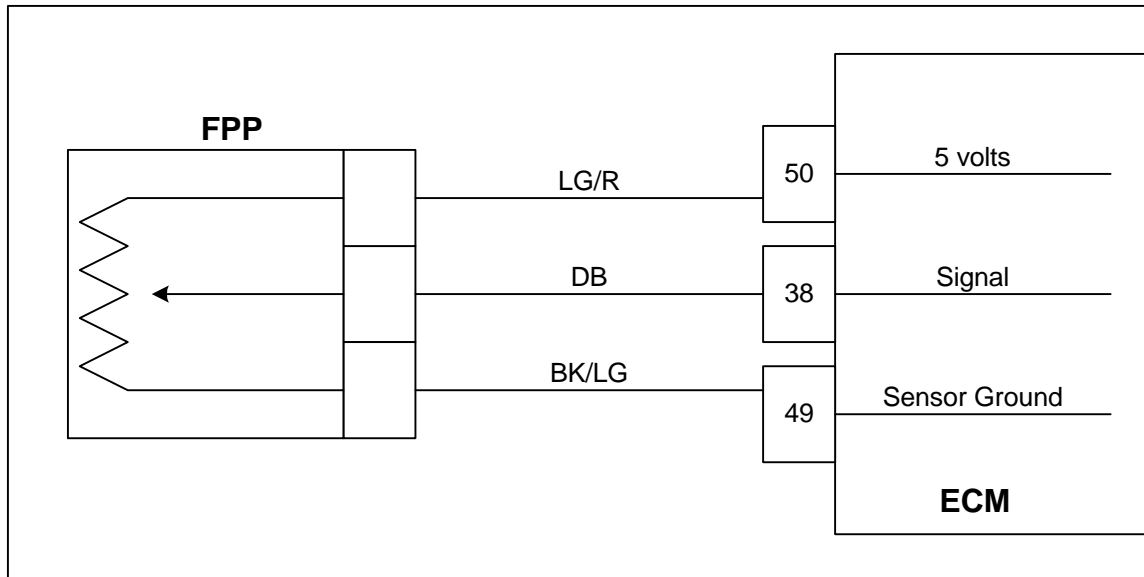
This fault will set if voltage is over 4.8 volts at any operating condition while the key is on. If the voltage exceeds 4.8, then FPP is considered to be out of specifications. At this point the ECM does not have a valid signal, and must therefore enforce the low rev limit and Power Derate (level 1). When these are enforced the maximum throttle position is 50% and the maximum engine speed is 1600 RPM. The Low Rev Limit is enforced for the remainder of the key-on cycle. Rev limit is still enforced if the active fault is no longer present; the MIL light will flash at 2 Hz for the remainder of the key-on cycle. This is a reminder that the Low Rev Limit is still enforced.



# DTC 611-FPP High Voltage



## DTC 612-FPP Low Voltage

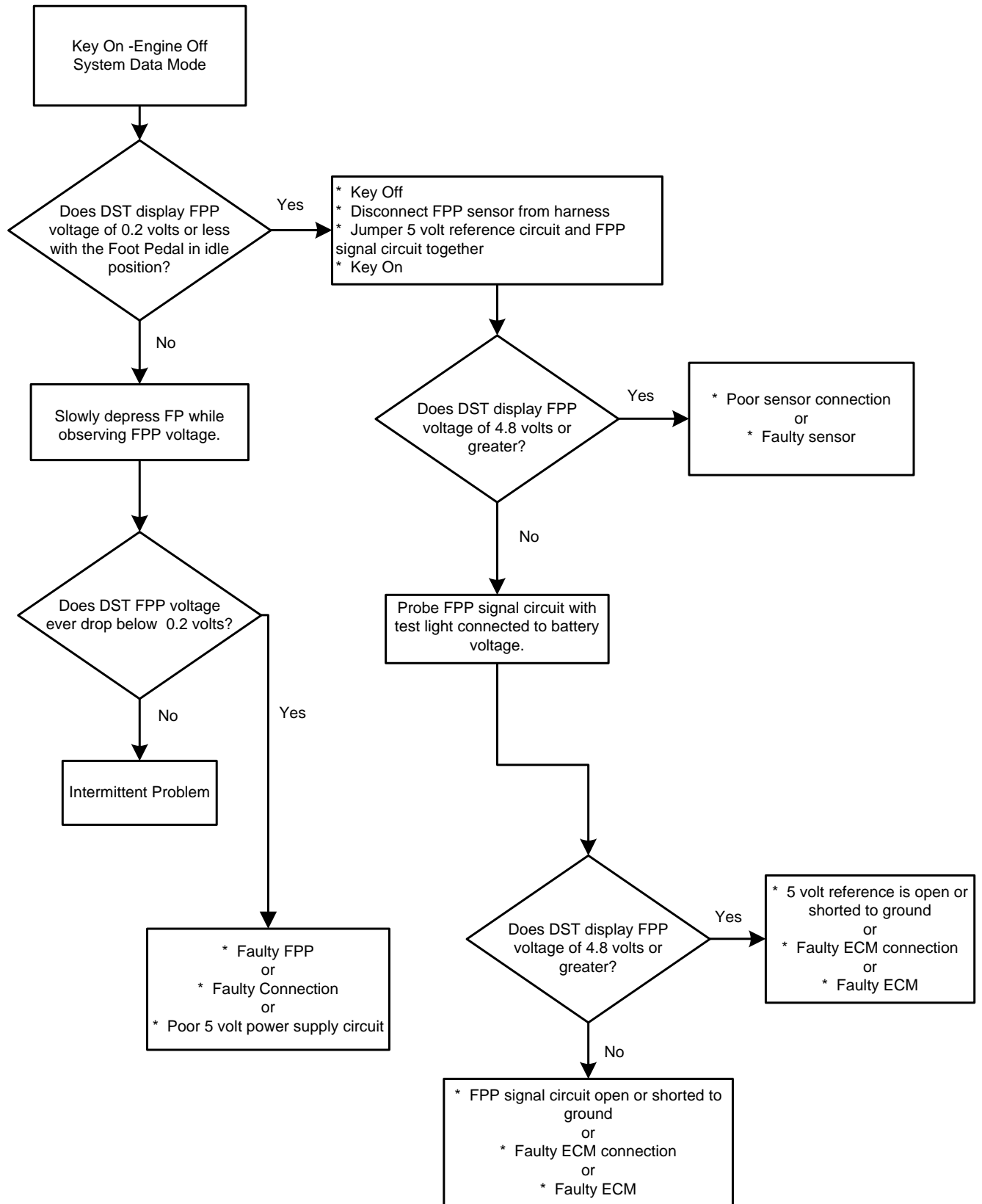


- Foot Pedal Position
- Check Condition-Key On
- Fault Condition-FPP sensor voltage less than 0.2
- MIL-On during active fault and flashing at 2 Hz (twice per second) after active fault for the remainder of the key-on cycle
- Adaptive-Enabled
- Closed Loop-Enabled
- Power Derate (level 1) and Low Rev Limit enforced

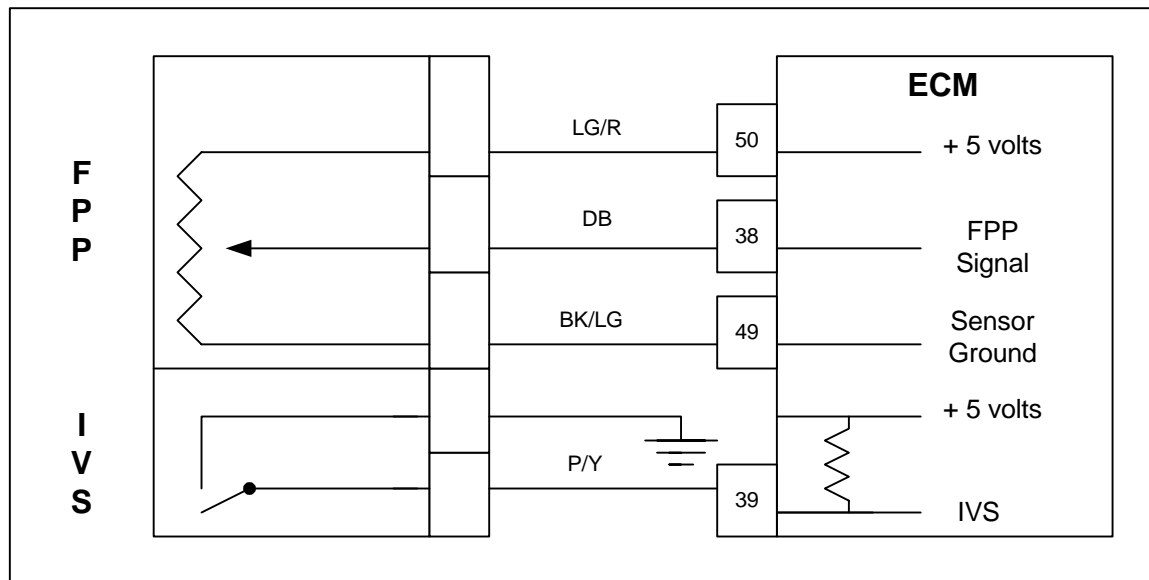
The Foot Pedal Position sensor uses a variable resistor to determine signal voltage based on pedal position. Less depression of pedal results in lower voltage, and greater depression results in higher voltage.

This fault will set if voltage is less than 0.2 volts at any operating condition while the key is on. If the voltage is less than 0.2, then FPP is considered to be out of specifications. At this point the ECM does not have a valid signal, and must therefore enforce the low rev limit and Power Derate (level-1). When these are enforced the maximum throttle position is 50% and the maximum engine speed is 1600 RPM. The low rev limit is enforced for the remainder of the key-on cycle. If the active fault is no longer present, the MIL light will flash at 2 Hz for the remainder of the key-on cycle. This is a reminder that the Low Rev Limit is still enforced.

# DTC 612-FPP Low Voltage



## DTC 613-FPP Higher Than IVS Limit

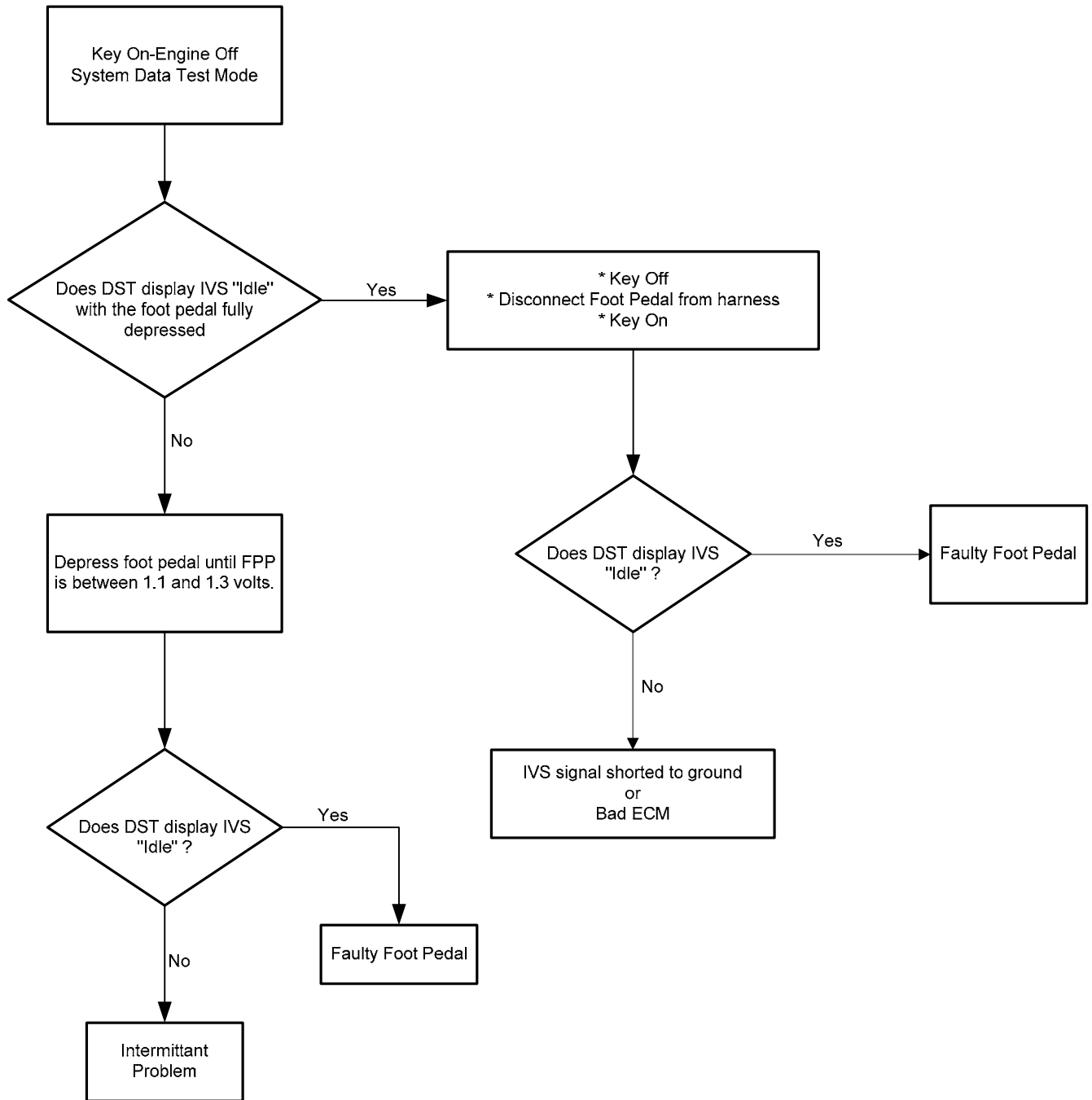


- Foot Pedal Position/Idle Validation Switch
- Check Condition-Engine Cranking or Running
- Fault Condition-IVS at idle and FPP voltage greater than 1.2 volts
- MIL-On during active fault and flashing at 2 Hz (twice per second) after active fault for the remainder of the key-on cycle
- Adaptive-Enabled
- Closed Loop-Enabled
- Power Derate (level 2) and Low Rev Limit enforced for remainder of key-on cycle

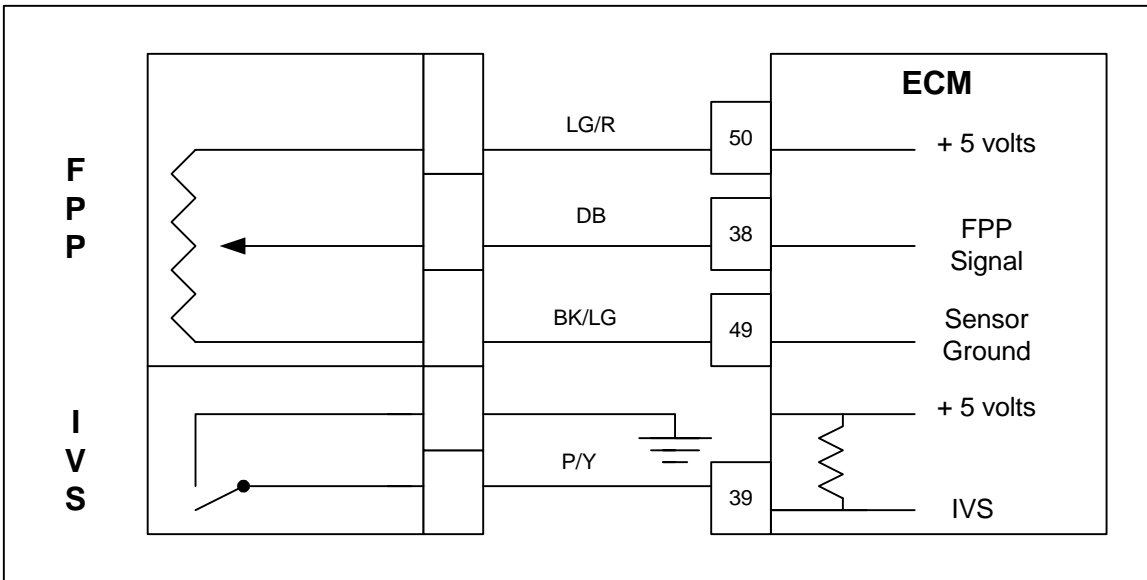
The engine load command to the ECM is determined by operator depression of the electronic foot pedal. The ECM monitors the foot pedal position and controls the throttle to maintain the commanded power level. Because a problem with the foot pedal signal can result in a higher or lower power than intended by the operator, the pedal used with this control system incorporates a sensor with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the pedal is depressed more than the idle position.

This fault will set if the IVS is at idle (open) and the FPP voltage is greater than 1.2 volts. During this fault, Power Derate (level 2) and the Low Rev Limit are enforced. When these are enforced the maximum throttle position is 20% and the maximum engine speed is 1600 RPM. The Low Rev Limit and Power Derate are enforced for the remainder of the key-on cycle. If the active fault is no longer present, the MIL light will flash at 2 Hz for the remainder of the key-on cycle. This is a reminder that the Power Derate and Low Rev Limits are still enforced.

# DTC 613-FPP Higher Than IVS Limit



## DTC 614-FPP Lower Than IVS Limit

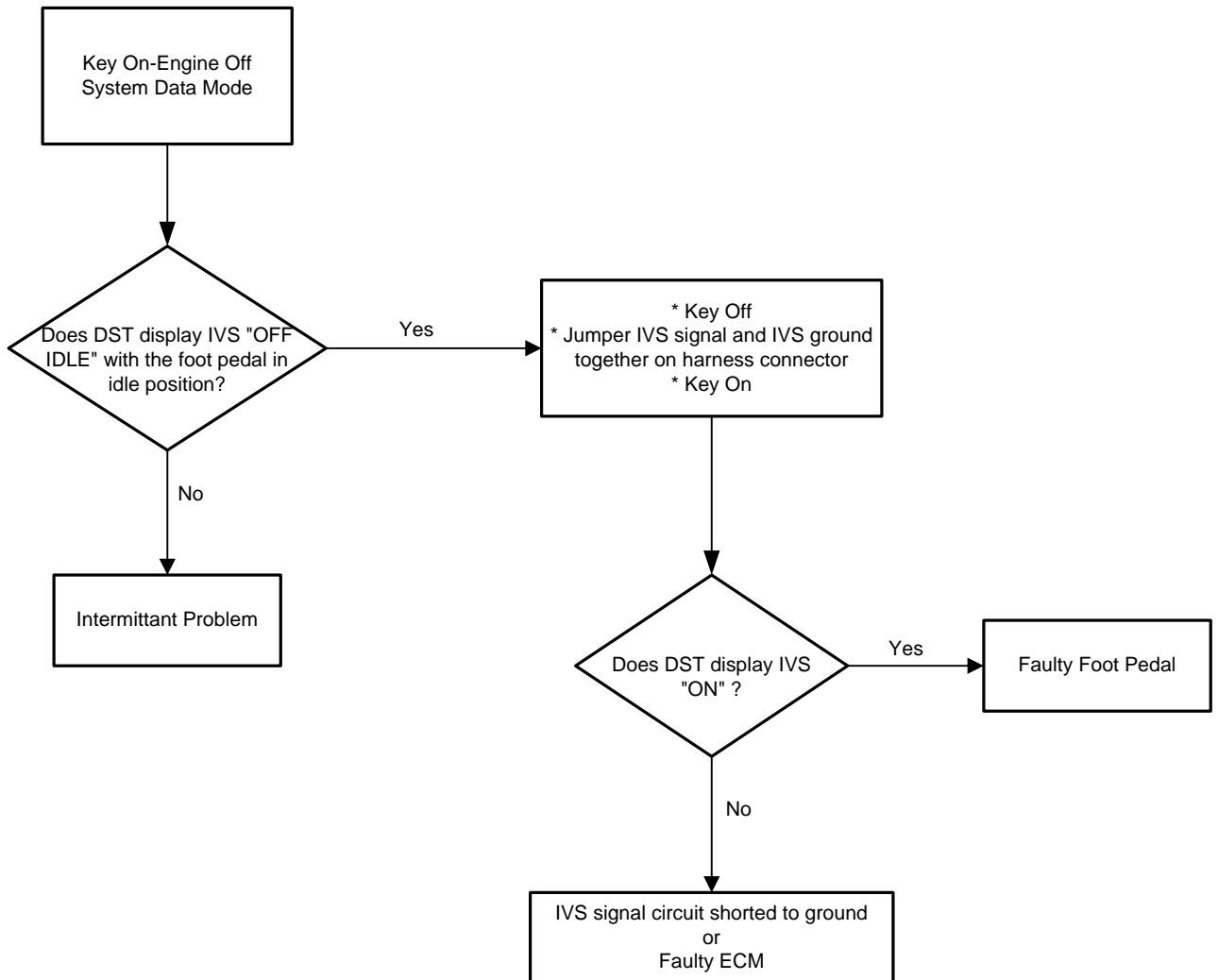


- Foot Pedal Position/Idle Validation Switch
- Check Condition-Engine Cranking or Running
- Fault Condition-IVS off-idle and FPP voltage less than 0.6 volts
- MIL-On during active fault and flashing at 2 Hz (twice per second) after active fault for remainder of key-on cycle
- Adaptive-Enabled
- Closed Loop-Enabled
- Power Derate (level 2) and Low Rev Limit enforced for remainder of key-on cycle

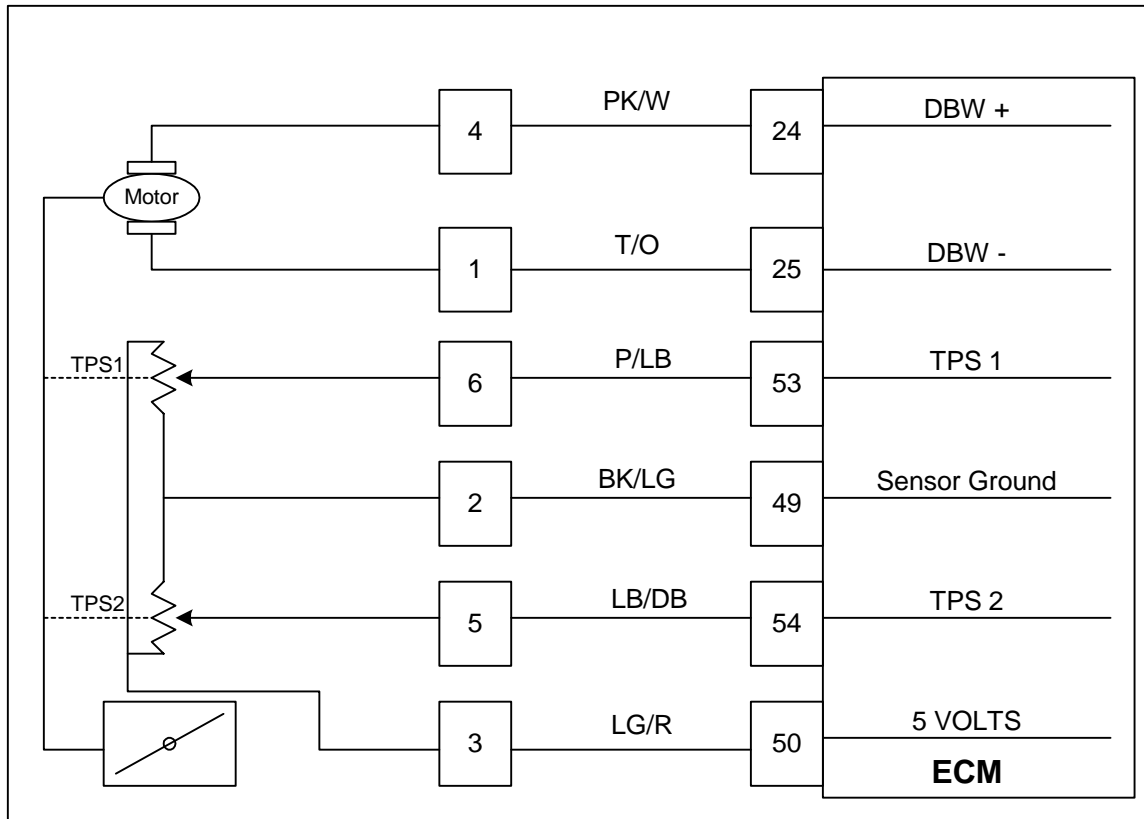
The engine load command to the ECM is determined by operator depression of the electronic foot pedal. The ECM monitors the foot pedal position, and controls the throttle to maintain the commanded power level. Because a problem with the foot pedal signal can result in a higher or lower power than intended by the operator, the pedal used with this control system incorporates a sensor with an idle validation switch. Checks and cross checks are constantly conducted by the ECM to determine the validity of the signals. The Idle Validation Switch (IVS) is a normally open contact (idle) that grounds (closed contacts) the IVS circuit to the ECM when the accelerator pedal is depressed more than the idle position.

This fault will set if the IVS is off-idle (closed) and the FPP voltage is less than 0.6 volts. During this fault, Power Derate (level 2) and the Low Rev Limit are enforced. When these are enforced the maximum throttle position is 20% and the maximum engine speed is 1600 RPM. These are enforced for the remainder of the key-on cycle. If the active fault is no longer present, the MIL light will flash at 2 Hz for the remainder of the key-on cycle. This is a reminder that the Power Derate and Low Rev Limits are still enforced.

# DTC 614-FPP Lower Than IVS Limit



## DTC 631-TPS 1 (Signal Voltage) High



- Throttle Position Sensor #1
- Check Condition-Cranking or Running
- Fault Condition-TPS sensor voltage exceeds 4.8
- MIL-On during active fault
- Engine Shut Down

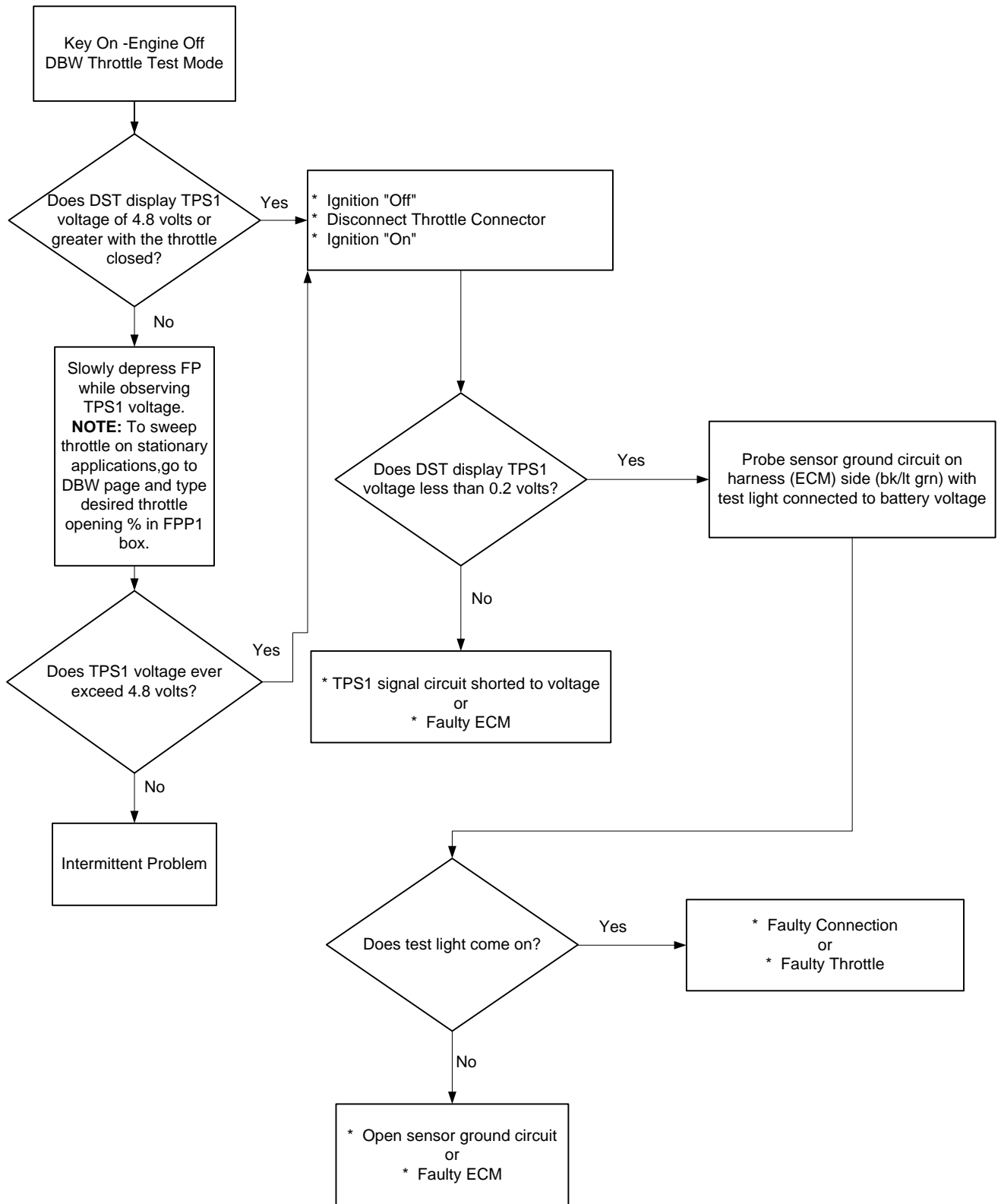
The Electronic Throttle has two counter acting Throttle Position Sensors. Two sensors are used for improved safety and redundancy.

The Throttle Position sensor uses a variable resistor to determine signal voltage based on throttle plate position, and is located within the throttle. Less opening results in lower voltage, and greater opening in higher voltage. The TPS value is used by the ECM to determine if the throttle is opening as commanded.

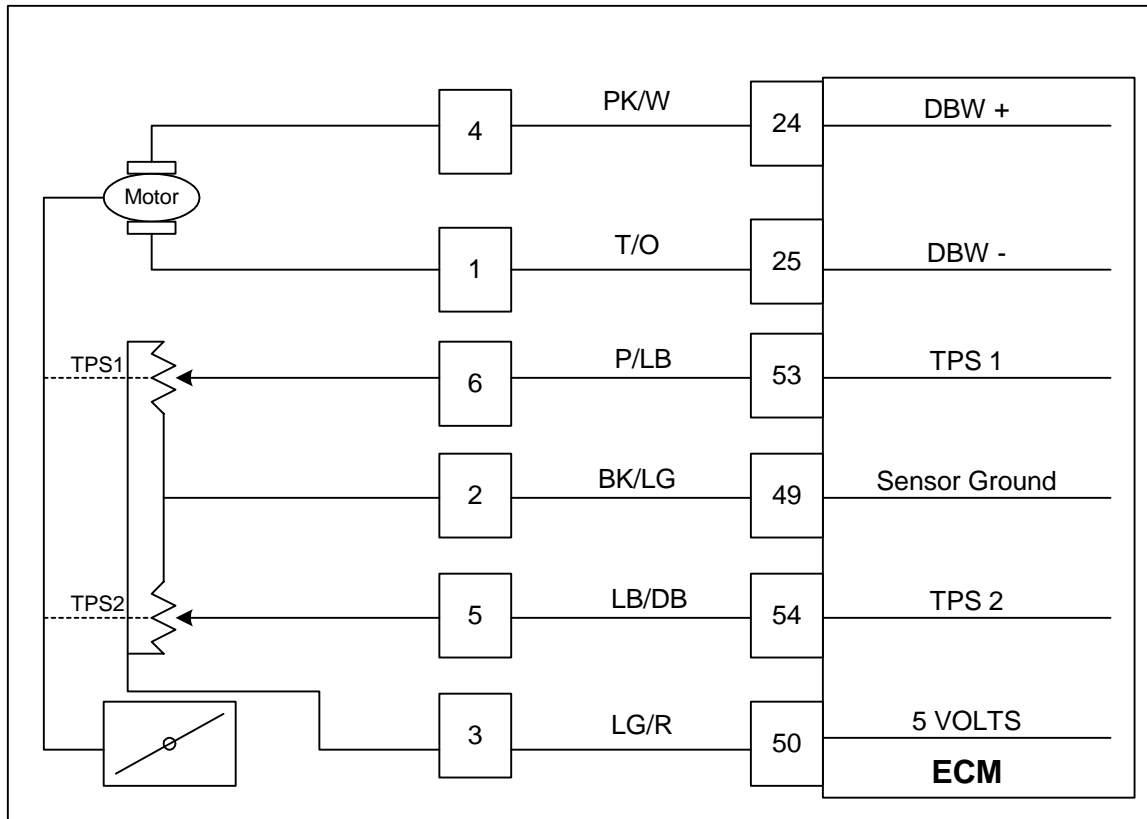
This fault will set if voltage is above 4.8 volts at any operating condition while the engine is cranking or running. The engine will not start or run during this active fault.



# DTC 631-TPS 1 (Signal Voltage) High



## DTC 632-TPS 1 (Signal Voltage) Low



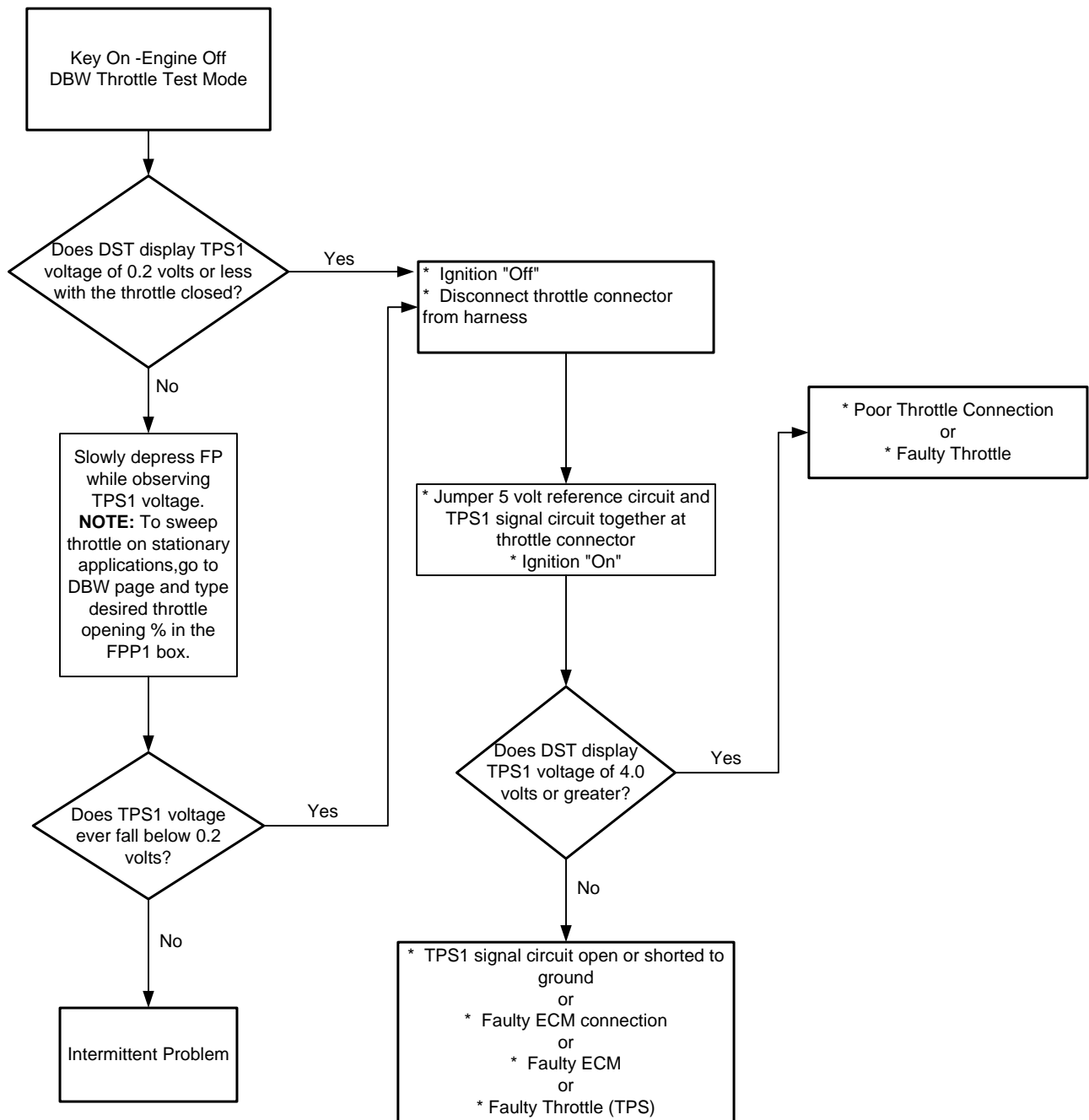
- Throttle Position Sensor #1
- Check Condition-Cranking or Running
- Fault Condition-TPS sensor voltage less than 0.2
- MIL-On during active fault
- Engine Shut Down

The Electronic Throttle has two counter acting Throttle Position Sensors. Two sensors are used for improved safety and redundancy.

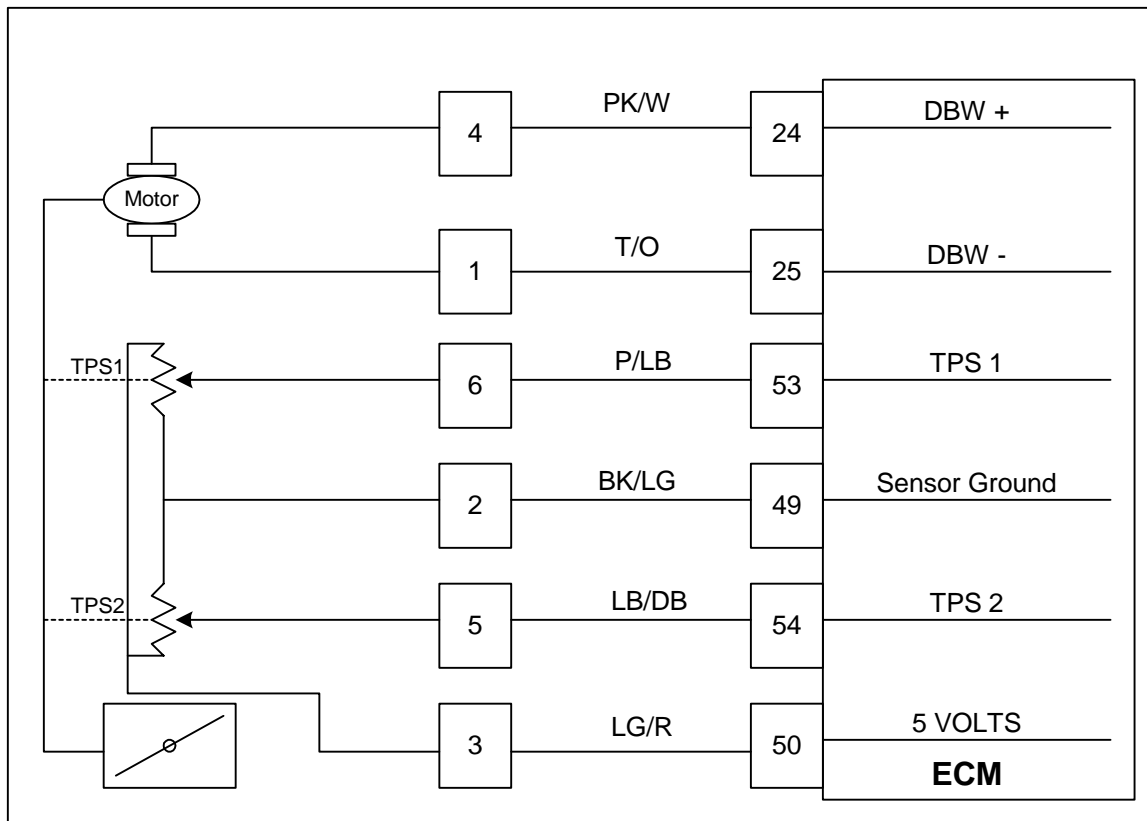
The Throttle Position sensor uses a variable resistor to determine signal voltage based on throttle plate position, and is located within the throttle. Less opening results in lower voltage, and greater opening in higher voltage. The TPS value is used by the ECM to determine if the throttle is opening as commanded.

This fault will set if voltage is less than 0.2 volts at any operating condition while the engine is cranking or running. The engine will not start or run during this active fault.

# DTC 632-TPS 1 (Signal Voltage) Low



## DTC 633-TPS 2 (Signal Voltage) High



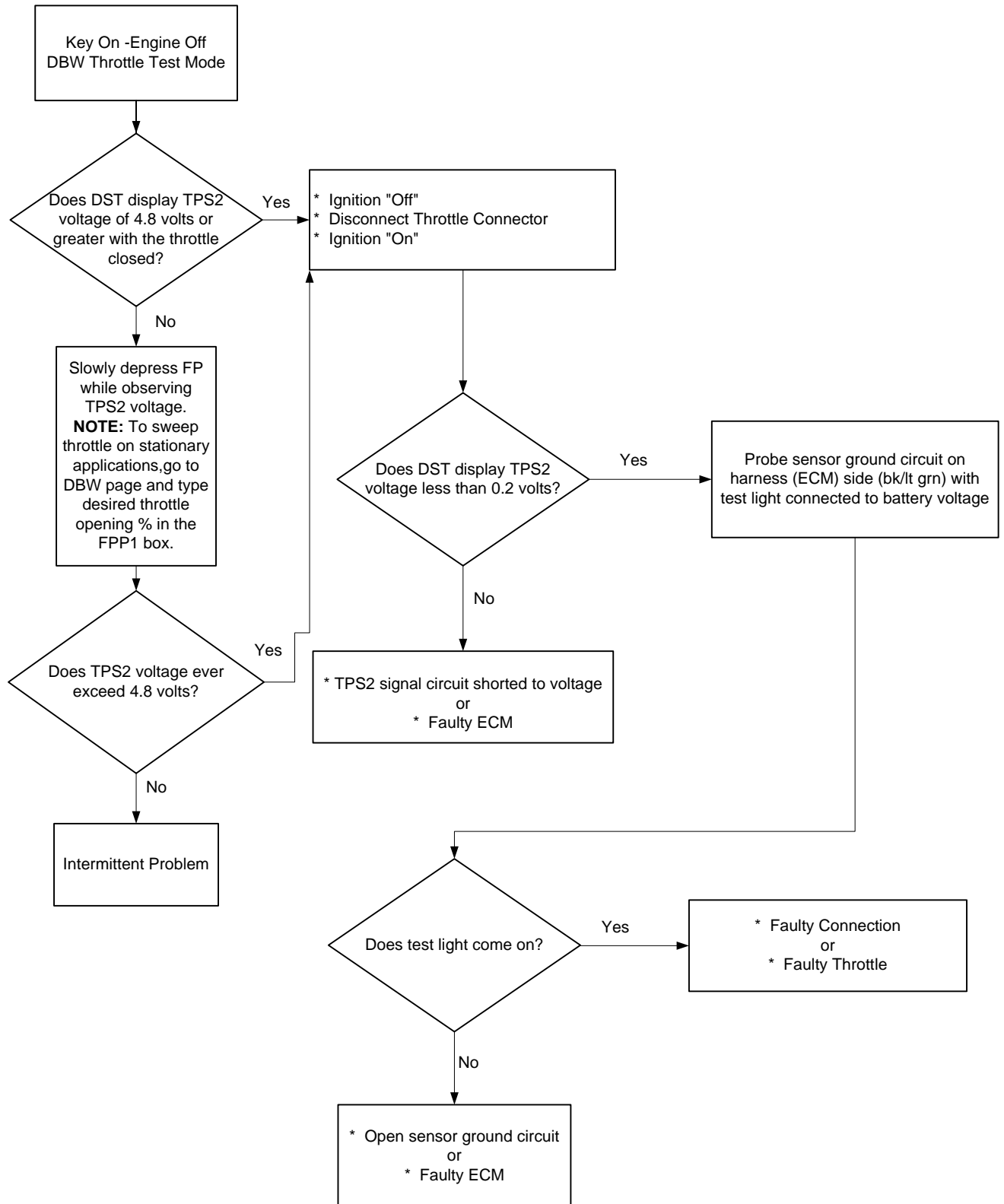
- Throttle Position Sensor #2
- Check Condition-Cranking or Running
- Fault Condition-TPS 2 sensor exceeds 4.8 volts
- MIL-On during active fault
- Engine Shut Down

The Electronic Throttle has two counter acting Throttle position Sensors. Two sensors are used for improved safety and redundancy.

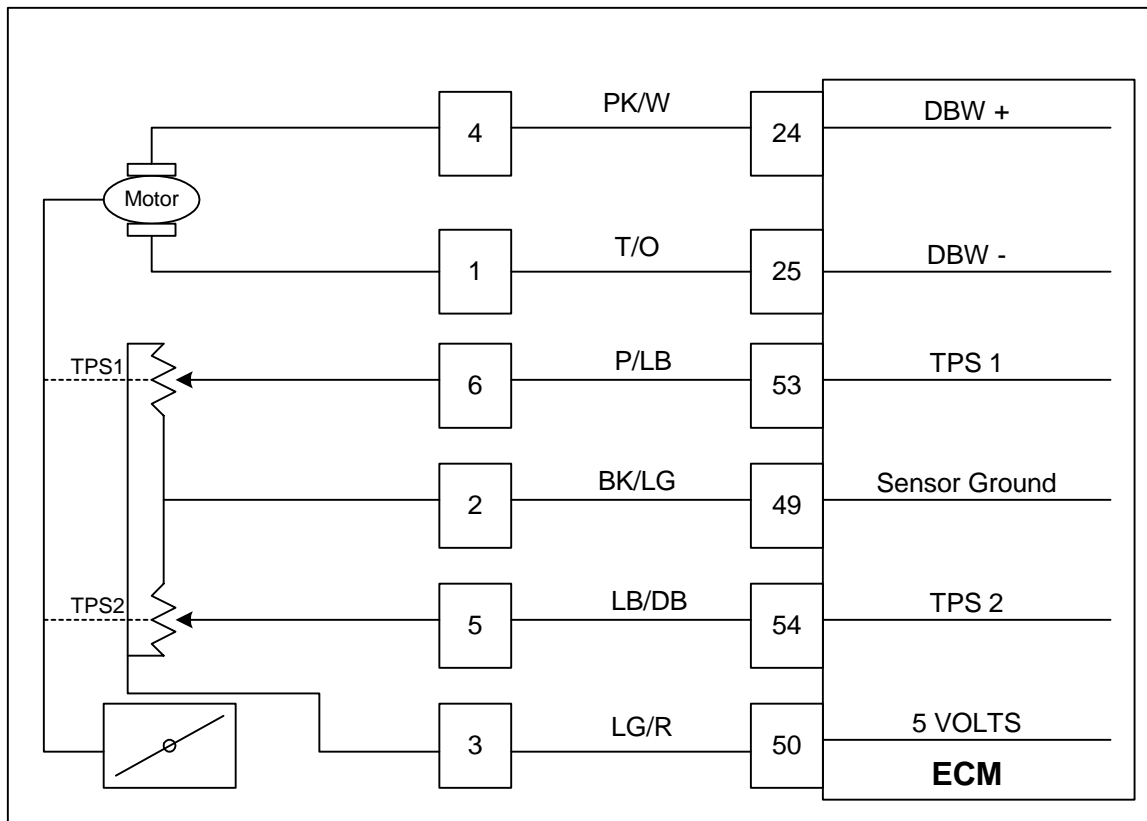
The Throttle Position sensor (TPS2) uses a variable resistor to determine signal voltage based on throttle plate position, and is located within the throttle. Less opening results in higher voltage and greater opening in lower voltage. The TPS value is used by the ECM to determine if the throttle is opening as commanded.

This fault will set if voltage is above 4.8 volts at any operating condition while the engine is cranking or running. The engine will not start or run during this active fault.

# DTC 633-TPS 2 (Signal Voltage) High



## DTC 634-TPS 2 (Signal Voltage) Low



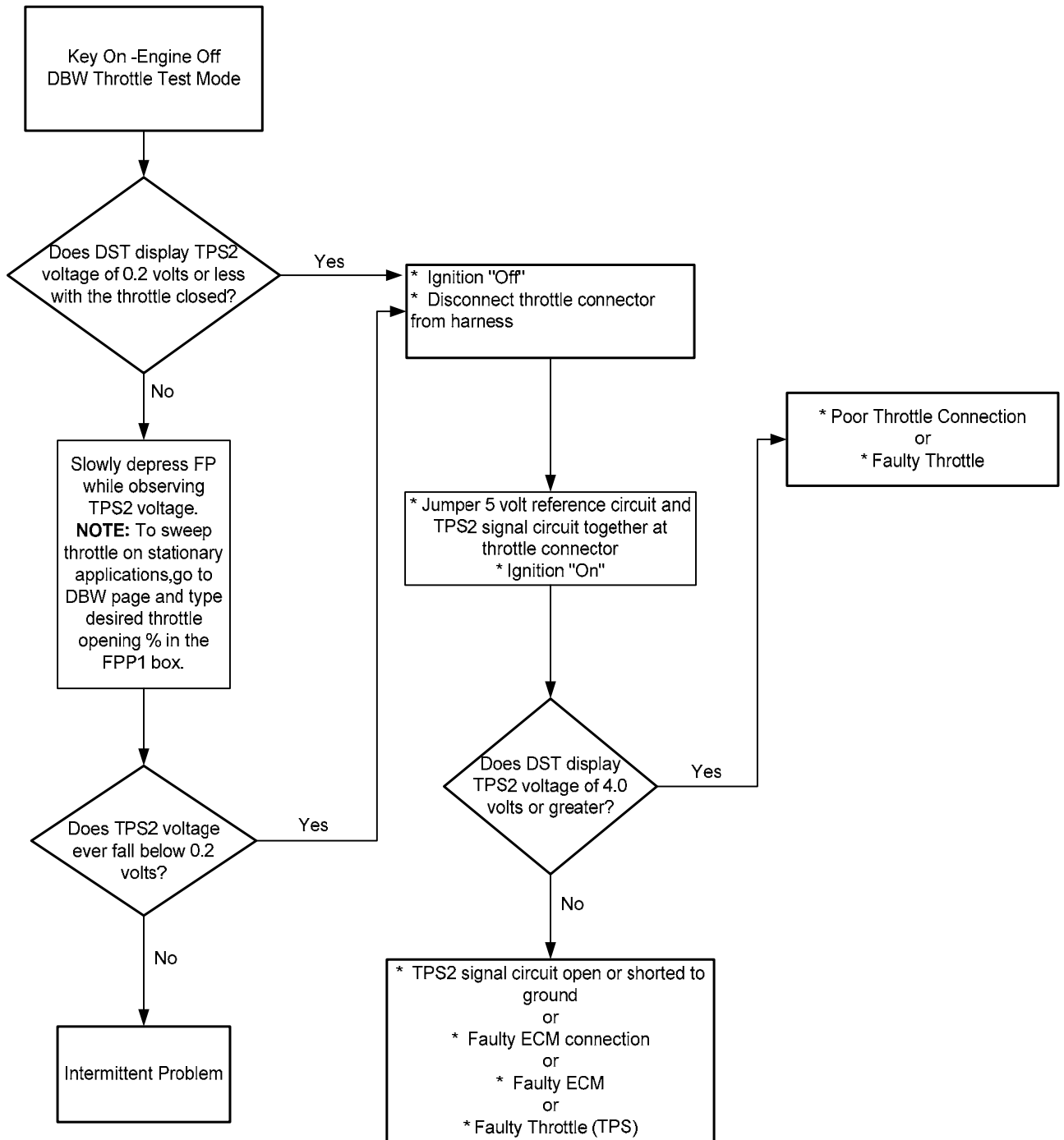
- Throttle Position Sensor #2
- Check Condition-Cranking or Running
- Fault Condition-TPS 2 sensor voltage less than 0.2
- MIL-On during active fault
- Engine Shut Down

The Electronic Throttle has two counter acting Throttle Position sensors. Two sensors are used for improved safety and redundancy.

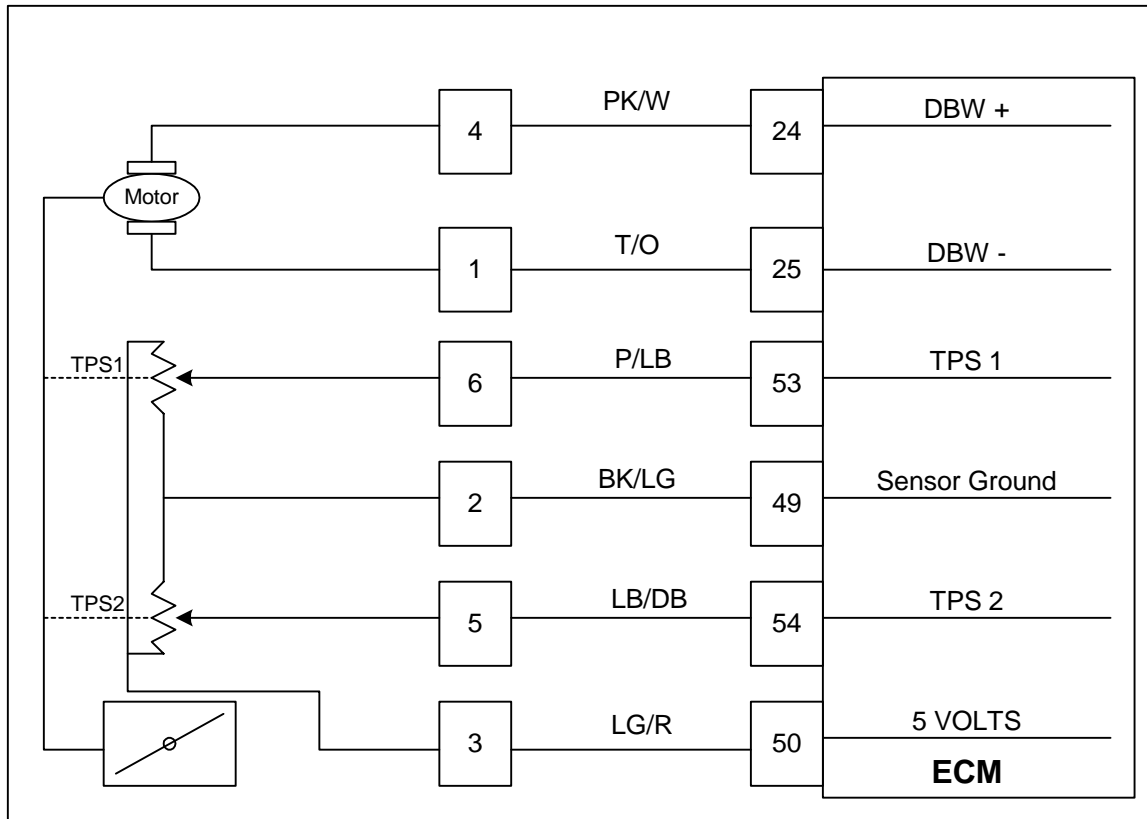
The Throttle Position Sensor (TPS2) uses a variable resistor to determine signal voltage based on throttle plate position, and is located within the throttle. Less opening results in higher voltage and greater opening in lower voltage. The TPS value is used by the ECM to determine if the throttle is opening as commanded.

This fault will set if voltage is below 0.2 volts at any operating condition while the engine is cranking or running. The engine will not start or run during this active fault.

# DTC 634-TPS 2 (Signal Voltage) Low



## DTC 635-TPS1 Higher Than TPS 2



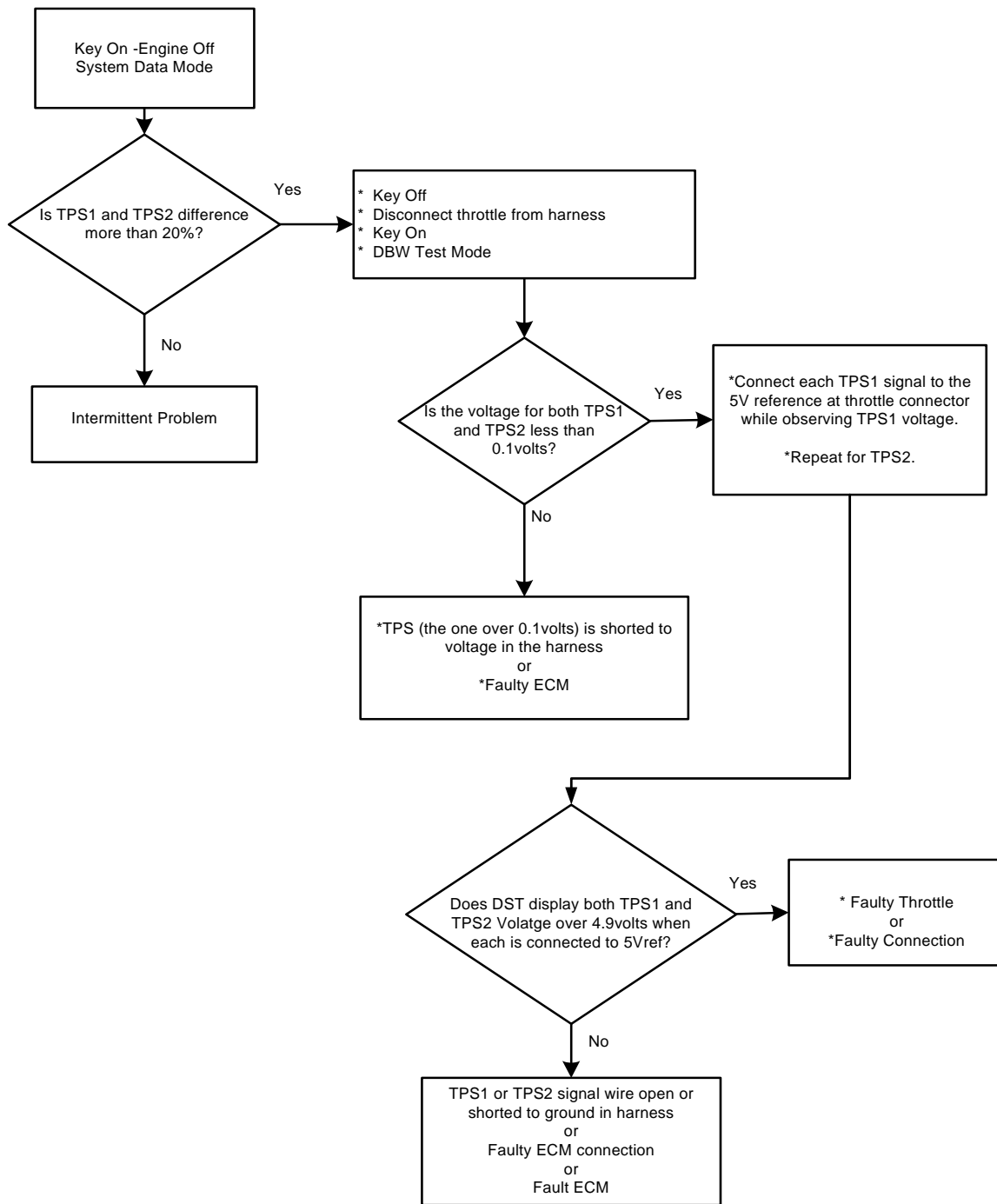
- Throttle Position Sensor 1 & 2
- Check Condition-Key On
- Fault Condition-TPS1 higher than TPS2 (20% difference or more)
- MIL-On for remainder of key on cycle
- Adaptive-Enabled
- Closed Loop-Enabled
- Engine Shut Down

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.

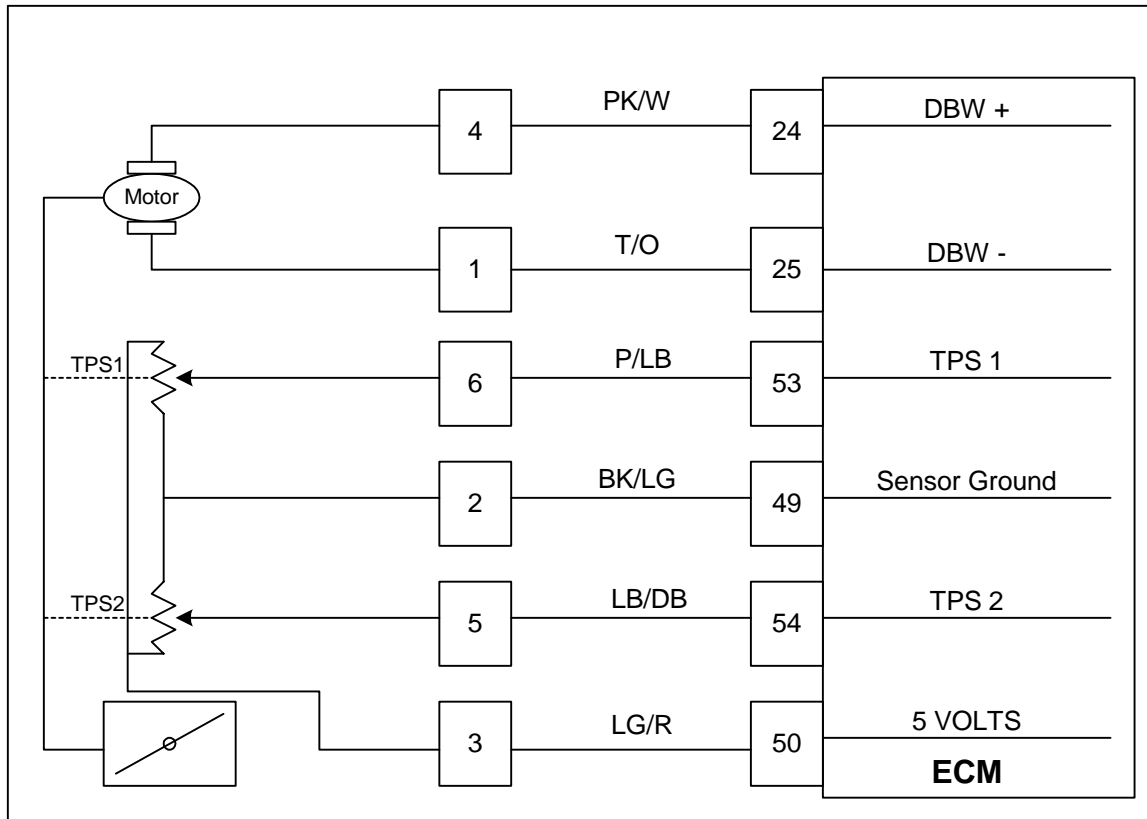
This fault will set if TPS1 is 20% (or more) higher than TPS2. At this point the throttle is considered to be out of specification, or there is a problem with the TPS signal circuit. During this active fault, the MIL light will be on and the engine will shut down.



# DTC 635-TPS1 Higher Than TPS2



## DTC 636-TPS1 Lower Than TPS2

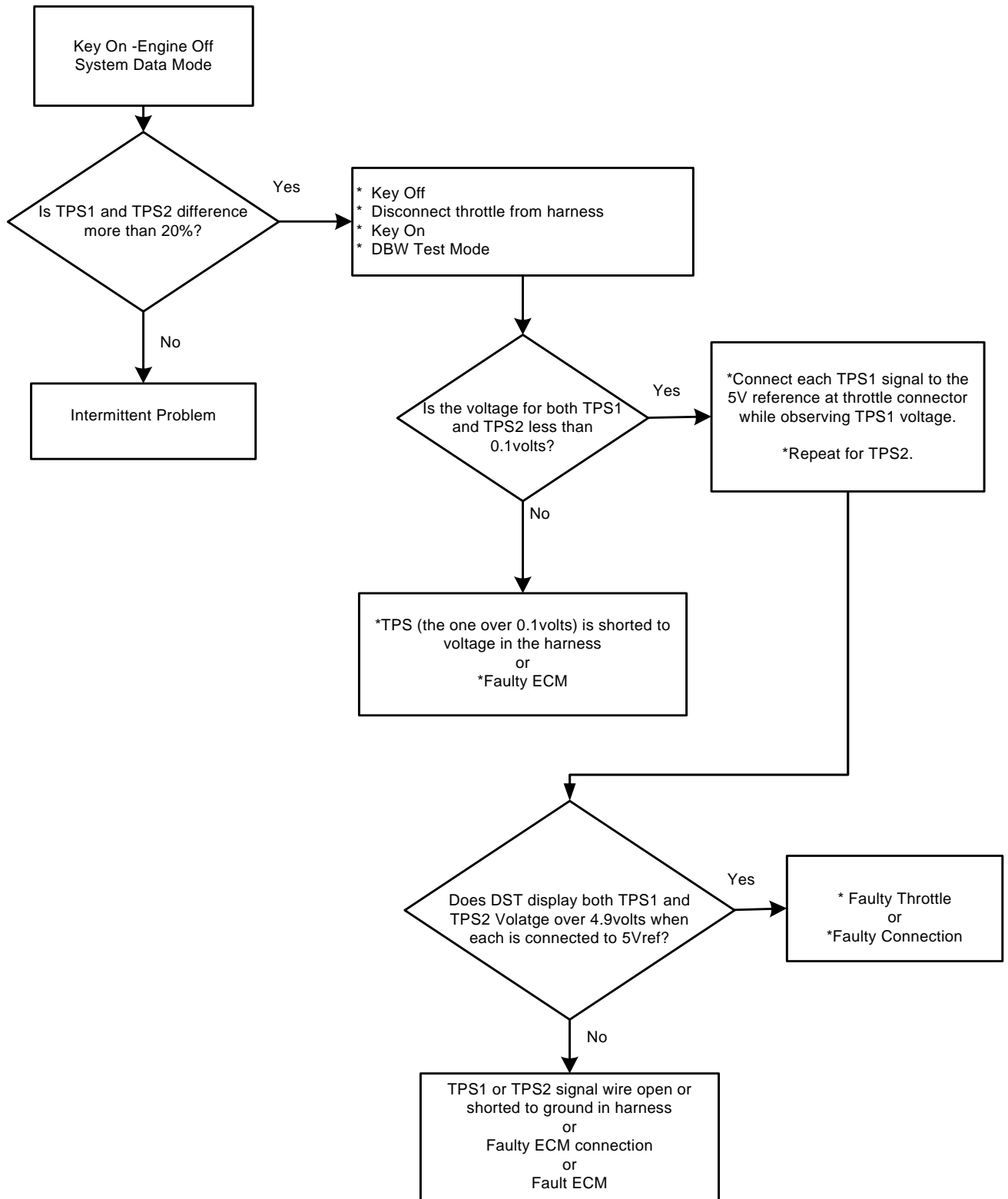


- Throttle Position Sensor 1 & 2
- Check Condition-Key On
- Fault Condition-TPS1 lower than TPS2 (20% difference or more)
- MIL-On for remainder of key on cycle
- Adaptive-Enabled
- Closed Loop-Enabled
- Engine Shut Down

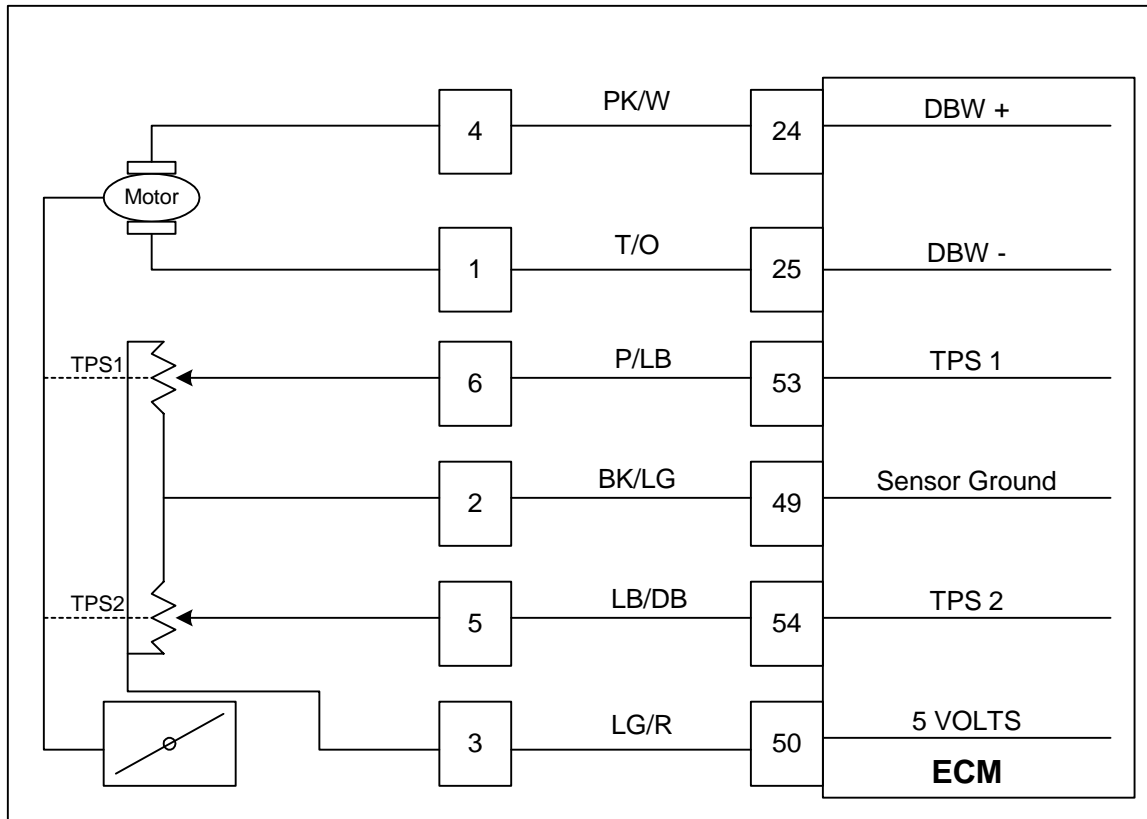
There are 2 Throttle Position Sensors located within the throttle which use variable resistors to determine signal voltage based on throttle plate position. TPS1 will read low voltage when closed and TPS2 will read high voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. 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.

This fault will set if TPS1 is 20% (or more) lower than TPS2. 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, the MIL light will be on and the engine will shut down.

# DTC 636-TPS1 Lower Than TPS2



## DTC 637-Throttle Unable To Open

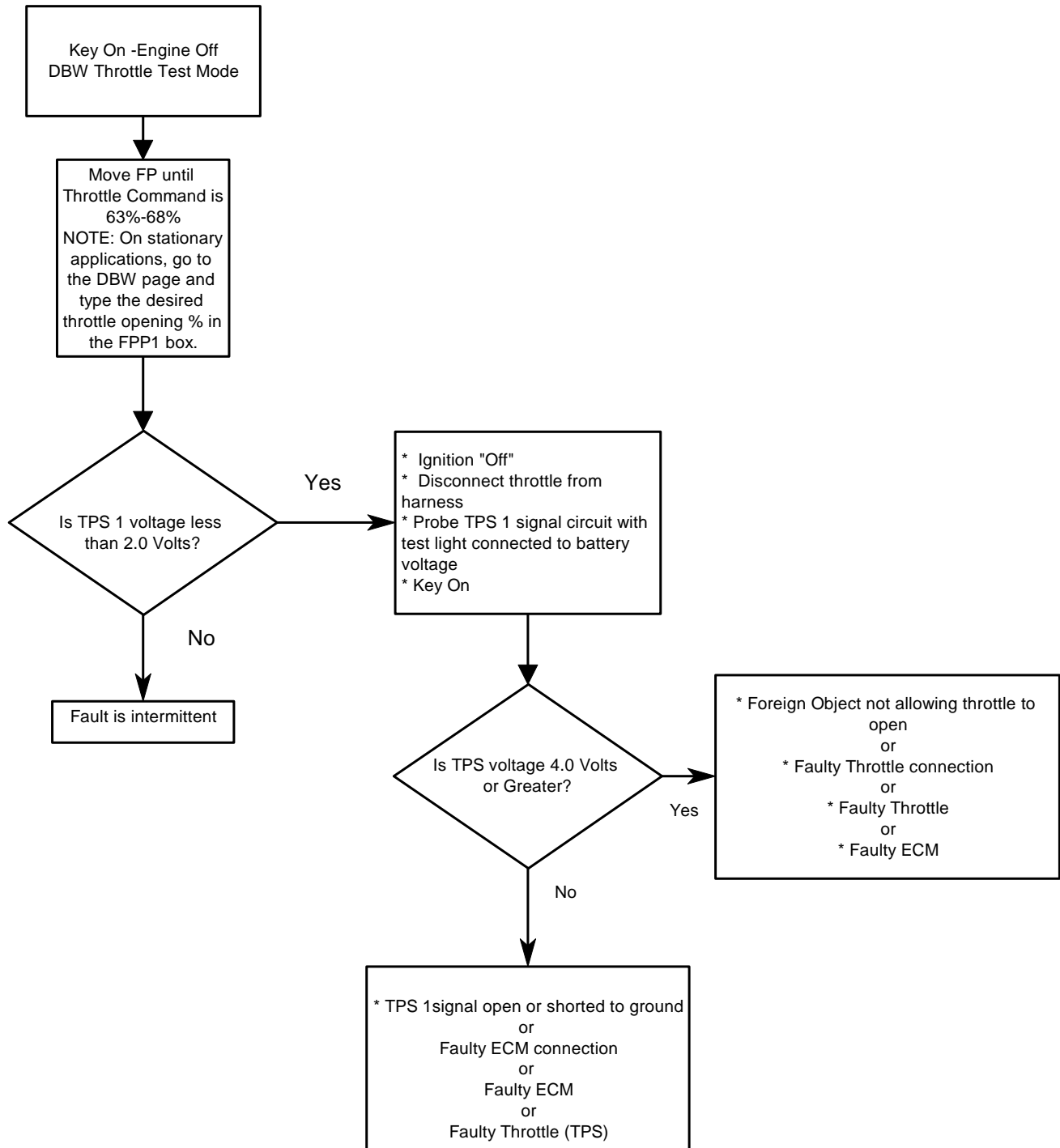


- Throttle Position Sensor
- Check Condition-Cranking or Running
- Fault Condition-Throttle command is 20% more than actual throttle position
- MIL-On during active fault
- Adaptive-Enabled
- Closed Loop-Enabled
- Engine Shut Down

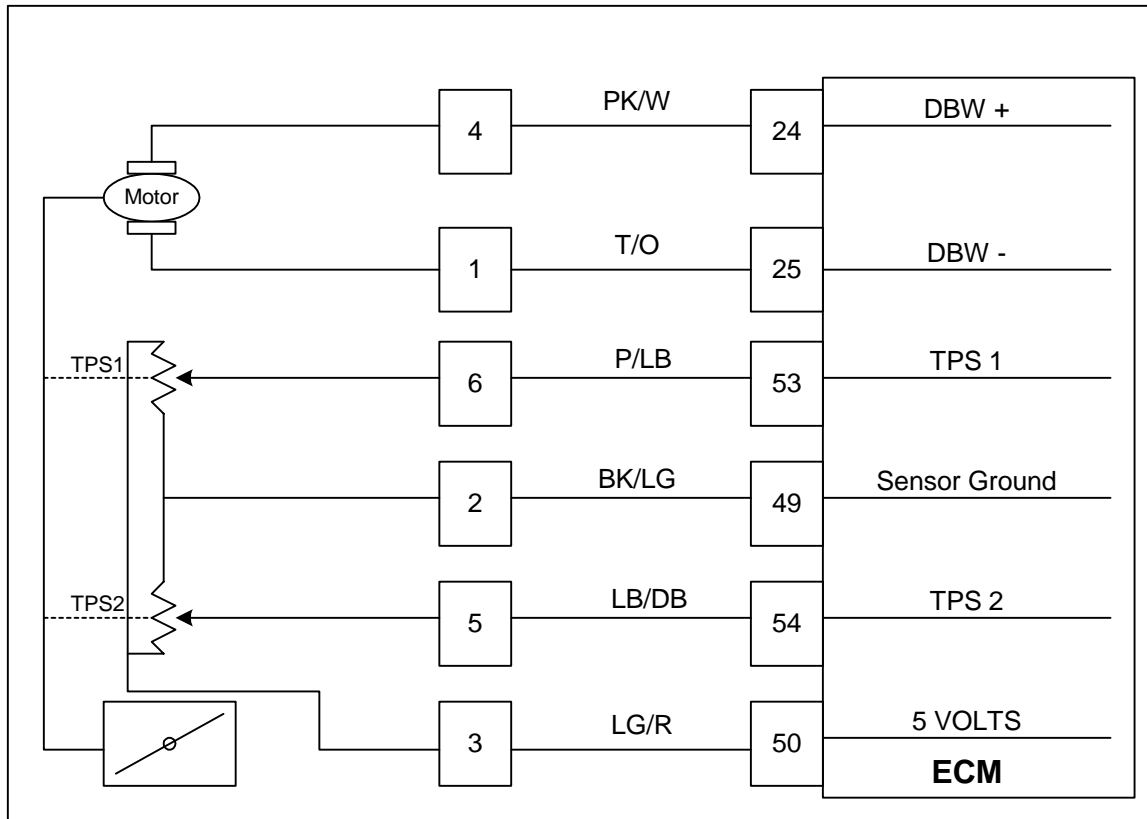
There are 2 Throttle Position Sensors located within the throttle which use variable resistors to determine signal voltage based on throttle plate position. TPS1 will read low voltage when closed and TPS2 will read high voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. 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.

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.

# SFC 637-Throttle Unable To Open



## DTC 638-Throttle Unable To Close

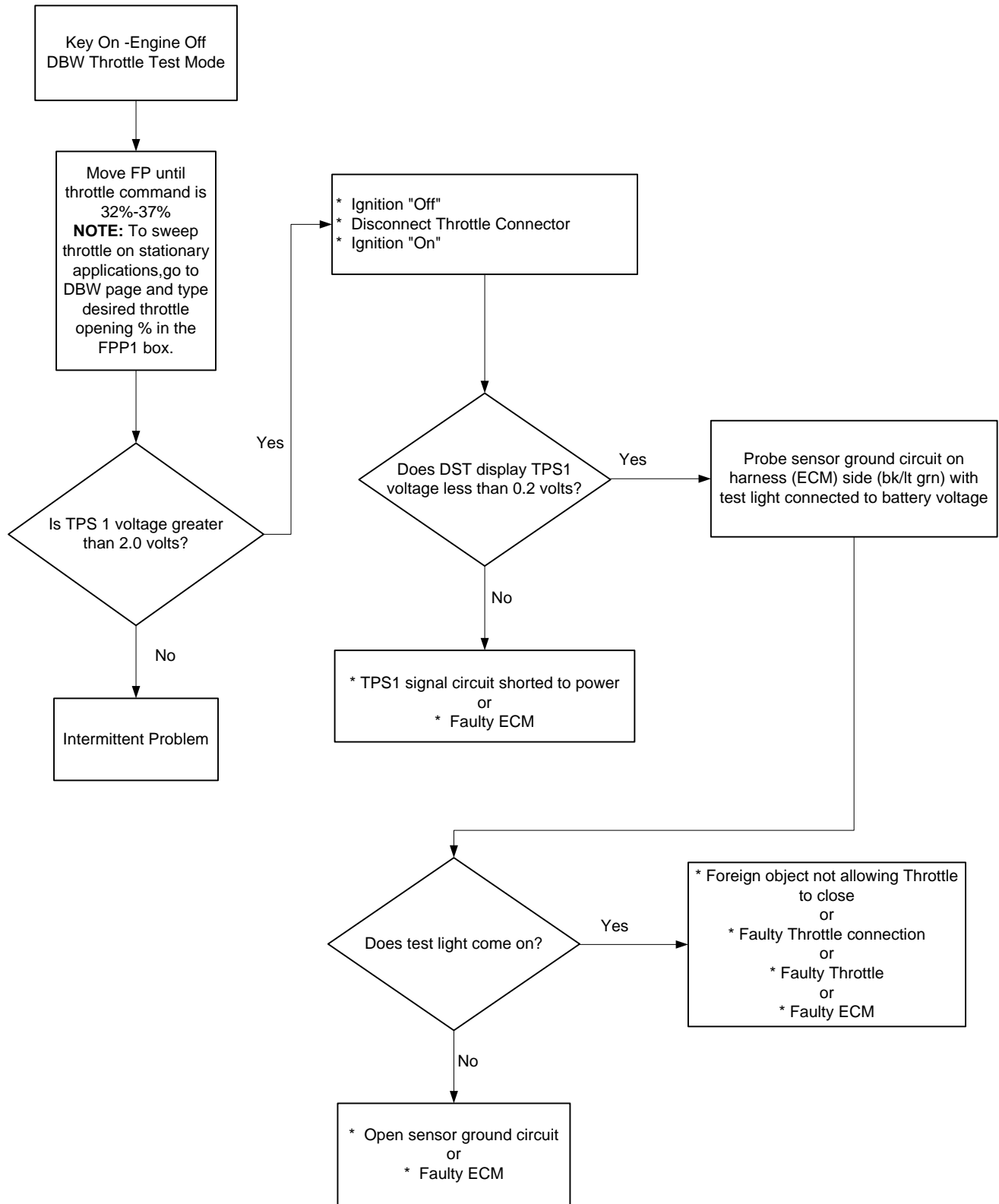


- Throttle Position Sensor
- Check Condition-Cranking or Running
- Fault Condition-Throttle command is 20% less than throttle position for 200ms or longer
- MIL-On during active fault
- Adaptive-Enabled
- Closed Loop-Enabled
- Engine Shut Down

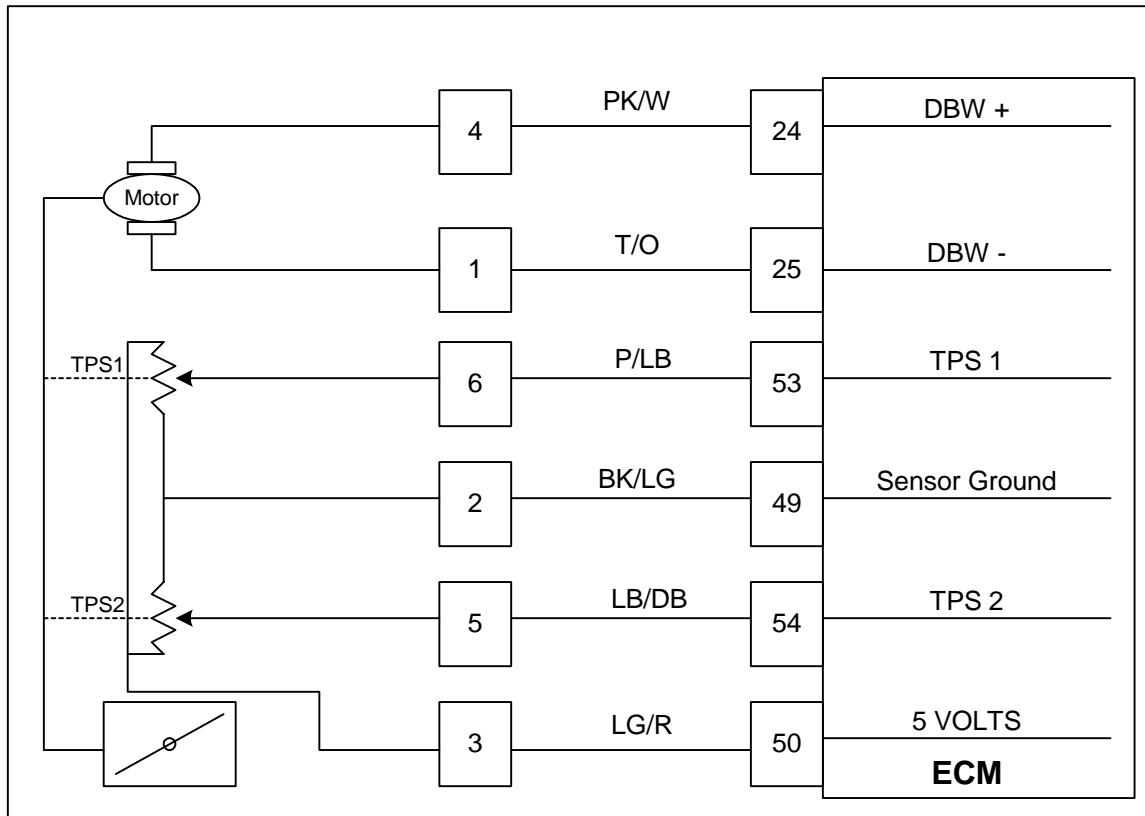
There are 2 Throttle Position Sensors located within the throttle which use variable resistors to determine signal voltage based on throttle plate position. TPS1 will read low voltage when closed and TPS2 will read high voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. 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.

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.

# DTC 638-Throttle Unable To Close



## DTC 651-Max Govern Speed Override



- Max Govern Speed Override
- Check Condition- Engine Running
- Fault Condition- Engine RPM greater than 4000 for 2 seconds continuously
- MIL- On during active fault
- Adaptive- Enabled
- Closed Loop- Enabled

This fault will set anytime the engine RPM exceeds 4000 for 2 seconds or more continuously. This speed overrides any higher max governor speeds programmed by the user. This is to help prevent engine or equipment damage.

The MIL will be on during this active fault.



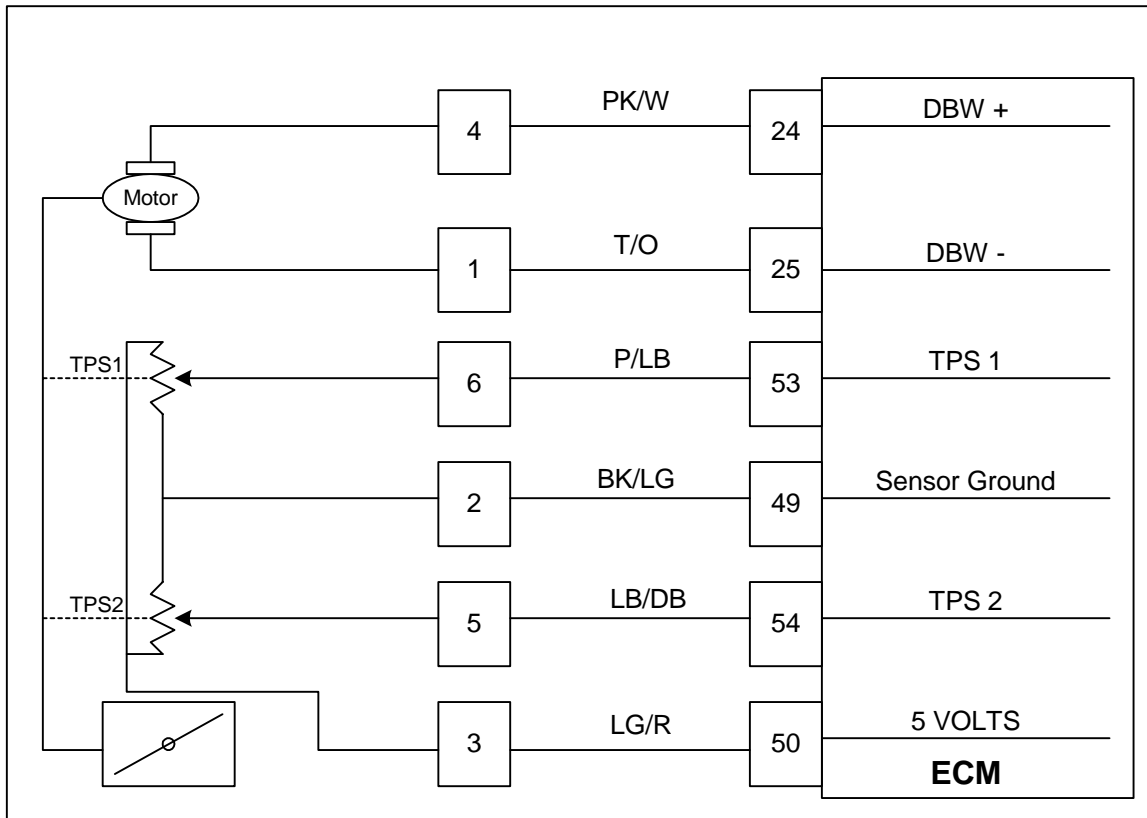
## **DTC 651-Max Govern Speed Override**

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

### **Diagnostic Aids**

- \* Ensure that any programmed governor speeds do not exceed 4000 RPM.
- \* Check the mechanical operation of the throttle.
- \* Check the engine for very large air leaks below the throttle.

## DTC 652-Fuel Rev Limit



- Fuel Rev Limit
- Check Condition- Engine Running
- Fault Condition- Engine RPM greater than 3250 for 2 seconds continuously
- MIL- On during active fault
- Adaptive- Enabled
- Closed Loop- Enabled

This fault will set anytime engine RPM exceeds 3250 for 2 seconds or more continuously. When these conditions are met, the ECM shuts off the fuel injectors. This is to help prevent engine or equipment damage.

The MIL will be on during this active fault.

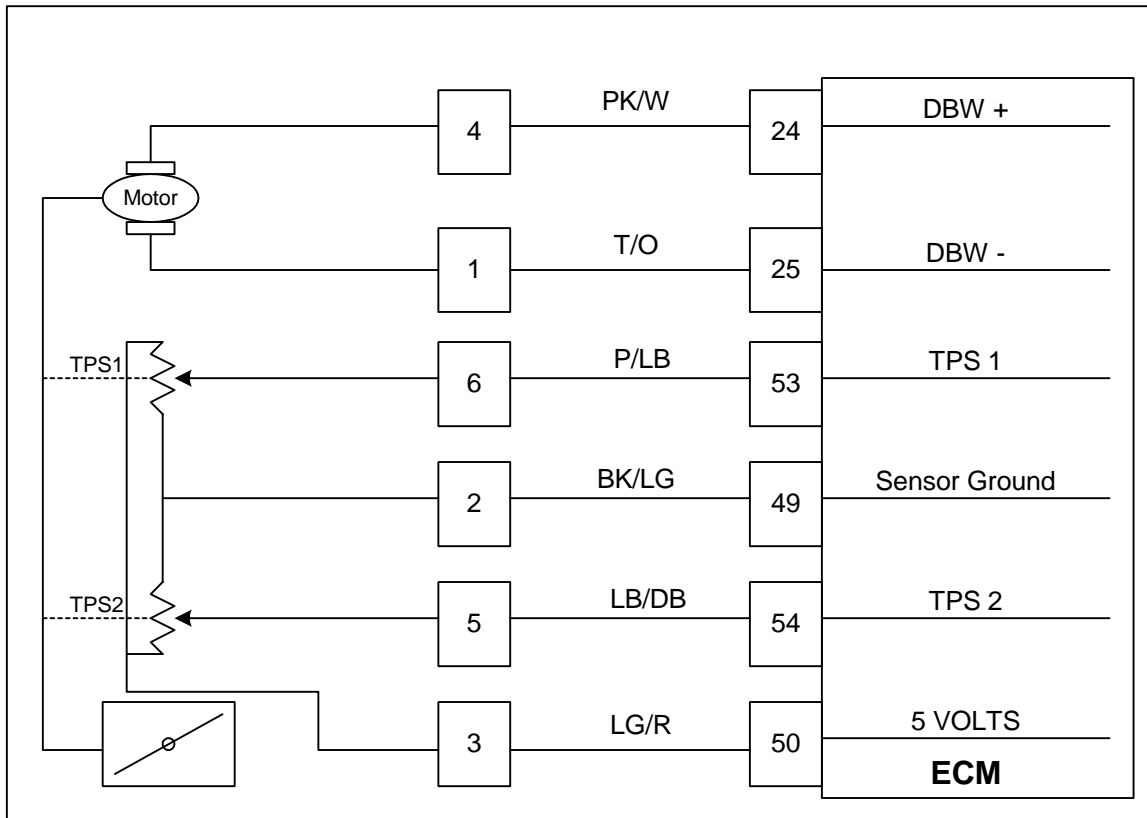
## **DTC 652-Fuel Rev Limit**

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

### **Diagnostic Aids**

- \* Ensure that any programmed governor speeds do not exceed 3250 RPM.
- \* Check the mechanical operation of the throttle.
- \* Check the engine for very large air leaks below the throttle.

## DTC 653-Spark Rev Limit



- Spark Rev Limit
- Check Condition- Engine running
- Fault Condition- Engine RPM greater than 3250 for 2 seconds continuously
- MIL- On during active fault
- Adaptive- Enabled
- Closed Loop- Enabled

This fault will set anytime the engine RPM exceeds 3250 for 2 seconds or more continuously. When these conditions are met, the ECM will shut off spark to the engine. This is to help prevent engine or equipment damage.

The MIL will be on during this active fault.

## **DTC 653-Spark Rev Limit**

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

### **Diagnostic Aids**

- \* Ensure that any programmed governor speeds do not exceed 3250 RPM.
- \* Check the mechanical operation of the throttle.
- \* Check the engine for very large air leaks below the throttle.