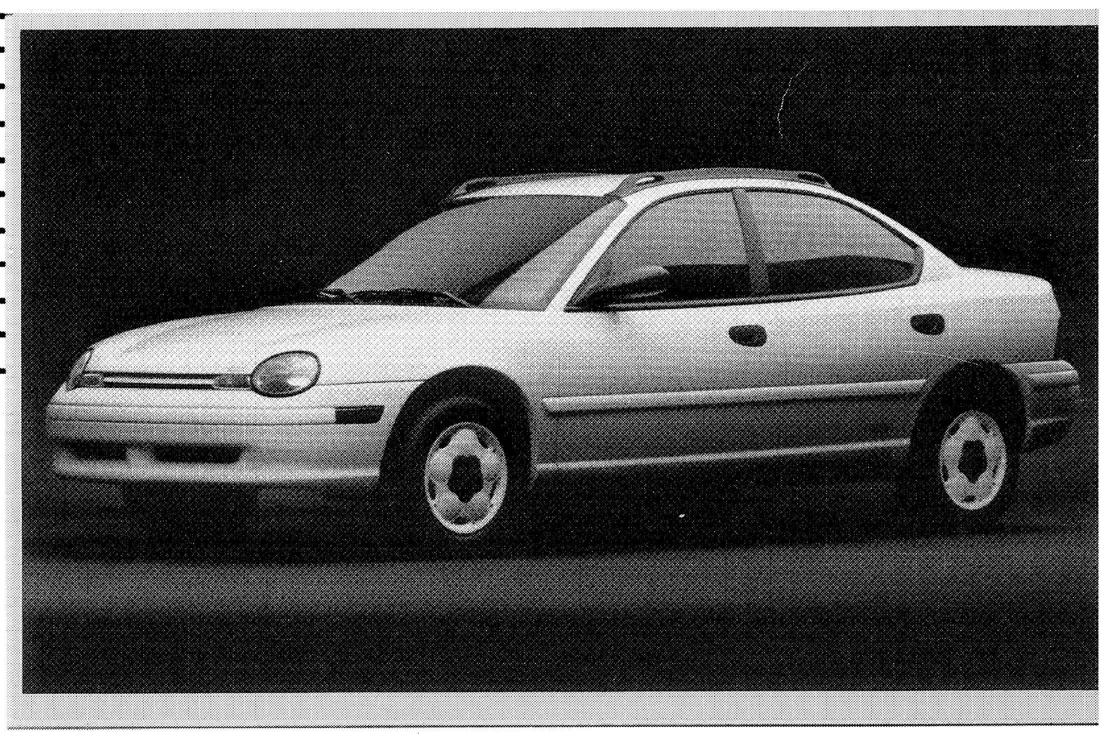
On Board Diagnostics

1995

neon

Student Reference Book



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- Proper service and repair is critical to the safe, reliable operation of all motor vehicles.
- The information in this publication has been developed for service personnel, and can help when diagnosing and performing vehicle repairs.
- Some service procedures require the use of special tools. These special tools must be used as recommended throughout this Technical Training Publication, the Diagnostic Manual, and the Service Manual.
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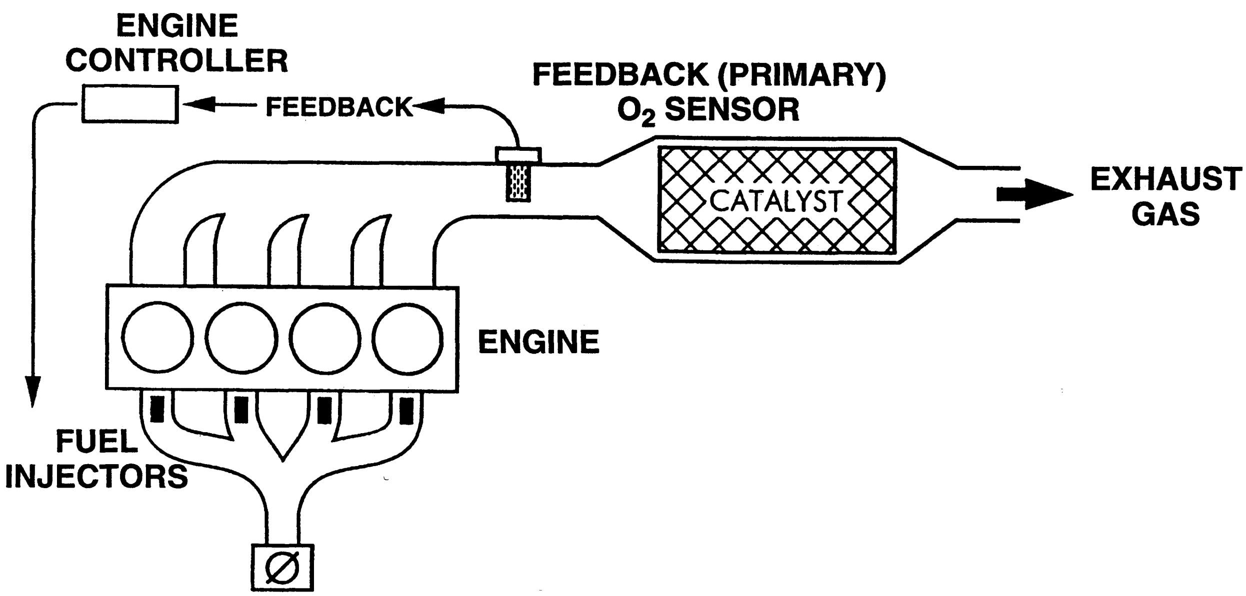
ENGINE
CONTROLLER
FEEDBACK
FEEDBACK (PRIMARY)
O_2 SENSOR
CATALYST
EXHAUST
GAS
ENGINE
FUEL
INJECTORS

On-Board Diagnostics

On-Board Diagnostics

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Flash Code	J 2012-Code*	MIL Lamp On?	Diagnostic Trouble Code Text	See Page
11	P 0335	Yes	No Crank Reference Signal at PCM	38
11	P 1390	Yes	Timing Belt Skipped 1 Tooth or More	38
12			Battery Was Disconnected (Flash Code Only)	39
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* Emissions regulations require that Chrysler supply these codes for use with generic diagnostic scan tools.

Table 1. (continued)

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42		No	Fuel Sender Unit No Change Over Miles	48

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43	P 0352	Yes	Ignition Coil #2 Primary Circuit	48
43	P 0301	Yes	Cylinder #1 Misfire	28
43	P 0302	Yes	Cylinder #2 Misfire	28
43	P 0303	Yes	Cylinder #3 Misfire	28
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43	P 0300	Yes	Multiple Cylinder Misfire	28
44		Yes	Battery Temp Sensor Volts out of Limit	50
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On-Board Diagnostics

On-Board Diagnostics

INTRODUCTION

Student Learning Objectives

After completing this course, the technician will be able to:

- Identify and interpret diagnostic information from the Neon's Powertrain Control Module (PCM).
- Identify proper operation of the Neon's Malfunction Indicator Lamp (MIL).

On-Board Diagnostics

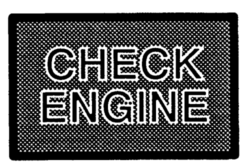
General Information
The 1995 Neon is the first Chrysler vehicle to contain the new OBD II emissions diagnostic system. OBD II stands for On-Board Diagnostics II, the latest evolution of on-vehicle emissions diagnostics that began on Chrysler vehicles with OBD I. OBD II has been developed to allow Chrysler vehicles to meet the requirements of the Federal Clean Air Act and California Air Resources Board (CARB) legislation.

It is impractical (and very expensive) to provide every vehicle on the road with the equipment necessary to measure emissions of carbon monoxide (CO), hydrocarbons (HC) and oxides of nitrogen (NOx). Instead, the proven emissions control devices available for these vehicles are checked for proper operation. In this way, we can be sure that the vehicle is performing up to the standards required by law.

This legislation requires that the driver be informed when an emissions related system or component malfunctions or deteriorates to the extent that vehicle emissions exceed 1½ times the federal tailpipe emissions standard. To do this, the malfunction indicator or CHECK ENGINE lamp (fig. 1) on the instrument panel is illuminated. The law states that the Malfunction Indicator Lamp (MIL) must be illuminated no later than the end of a second consecutive trip in which a failure of this type is observed and illuminated immediately if the catalyst damage is about to occur.

MIL ILLUMINATION:

- FAULT ON TWO SUCCESSIVE TRIPS → MIL ON
- (MIL ON) NO FAULT ON THREE SUCCESSIVE TRIPS → MIL OFF



FAULT CODE STORAGE:

- FAULT ON TWO SUCCESSIVE TRIPS → DIAGNOSTIC TROUBLE CODE STORED
- (DTC) NO FAULT ON 40–80 SUCCESSIVE TRIPS → DIAGNOSTIC TROUBLE CODE ERASED

Figure 1 Malfunction Indicator Lamp (MIL)

In addition to illuminating the MIL lamp, a diagnostic trouble code (DTC) is stored in the Powertrain Control Module (PCM) and can be retrieved by a service technician using a diagnostic scan tool.

To meet these requirements the following systems must be monitored:

- Catalyst
- Fuel System
- Misfire
- Oxygen Sensor and Oxygen Sensor Heater
- Secondary Air*
- Evaporative System (Purge)
- Exhaust Gas Recirculation
- Any other input or output component that can affect emissions

*The Neon does not use a secondary air system as part of its emissions control strategy.

You may be familiar with the monitors available on the DRB diagnostic scan tools. They allow you to view the operating conditions of vehicle components. The OBD II system monitors are different. They are checks made by the PCM's software to determine not only if these specific systems are operating, but if they are operating within pre-established limits. While OBD I tests measure a component's **functionality**, OBD II monitors check a system's **rationality**.

Warranty Requirements
In addition to specifying the conditions that the on-board diagnostic system must recognize, the new legislation sets stringent warranty requirements for the operation of emission system components. These components must remain operable for the useful life of the system. This is defined as ten years or 100,000 miles, whichever comes first, for both federal and California certified vehicles. Chrysler must demonstrate that emission systems are durable enough to meet this requirement **before** the government will certify these vehicles for sale.

Federal regulations require that the PCM monitor emissions related items for 10 years or 100,000 miles. The Neon exceeds this requirement by monitoring these components for the life of the vehicle.

Warranty periods as required by the legislation are indicated in the chart below:

Table 2. OBD II Emissions Warranty

FEDERAL	2 years/24,000 miles	Emissions related components
	8 years/80,000 miles	Major emissions related components
		1. Catalyst
		2. Powertrain Control Module
CALIFORNIA	3 years/50,000 miles	Emissions related components
	7 years/70,000 miles	If replacement cost exceeds:
		1990 – $300
		1991 – $330
		1992 – $340
		1993 – $350
		1994 – $350 + inflation adjustment
		1995 – 1994 + inflation adjustment

The California Air Resources Board (CARB) monitors emission system repairs from several California dealers. If a specific component or system fails on more than 4% of the vehicles sampled, Chrysler is required to research and evaluate the reasons. If the failure is not attributable to owner negligence or misuse, a component failure rate of 4% could lead to vehicle recalls. The federal government is considering a similar program. Chrysler is relying on its technicians throughout the country to appropriately diagnose emissions concerns and replace only those parts that have failed. The sloppy practice of "hanging" parts on a car under emissions warranty could lead to an unnecessary (and expensive) fleet-wide recall.

DIAGNOSTIC SYSTEM OPERATION

Powertrain Control Module (PCM)

There are a large number of components responsible for controlling vehicle emissions. It is the job of the PCM to coordinate their operation and keep them functioning in the most efficient manner possible. The PCM is also responsible for determining if the systems are operating properly. A new piece of software, designed specifically for this job, is the task manager.

Task Manager

During the course of the vehicle's operation, a large number of diagnostic steps must be performed. Most of these must be performed under specific operating conditions (engine temperature, rpm, etc.) in order to be accurate. In addition, a fault may have to occur more than once before the MIL lamp is illuminated or a DTC is recorded. The PCM contains "task manager" software to organize and prioritize the diagnostic procedures and the protocol for recording and displaying their results. Listed below are the responsibilities of the task manager software:

- Readiness Indicator and Trip Indicator
- DTC Identification, Maturation, and Erasure
- Freeze Frame Data Storage and Erasure
- Freeze Frame Priority
- MIL Illumination
- Test Status

Readiness Indicator and Trip Indicator

The task manager reviews PCM inputs during each key cycle to determine if the conditions required for each individual test have been met before it allows that test to be performed. Requirements vary with each test but typically include information such as elapsed time since start-up, engine coolant temperature, rpm, MAP, and throttle position.

"Trip" is a difficult concept to define because the requirements for a trip vary depending on the test being run (fig. 2). These conditions can include seemingly unrelated items such as driving style, length of trip, and ambient temperature. The minimum requirement for a trip is that it includes one key cycle with the vehicle having to meet certain enabling conditions before a test is performed. Vehicle tests vary in length and may be performed only once per trip (catalyst monitor) or may be performed continuously, as in the case of the misfire and fuel system monitors. If the pertinent enabling conditions are not met during that key cycle, the tests may not run at all.

Note: *In California and other states requiring the PCM to indicate that all monitors have passed before issuing license plates, removing the vehicle's battery before testing erases any record of passing a monitor. If the monitor does not complete a trip on subsequent key cycles, the vehicle will fail a licensing test.*

The definition of what constitutes a trip for a particular OBD test is important because in many instances, the vehicle must fail a test on **more than one consecutive trip** before the MIL is illuminated and a DTC is recorded. Tests that illuminate the MIL when a single failure is recorded are known as "one trip" monitors. "Two trip" monitors allow the system to double check itself and help prevent unnecessary MIL illumination.

If the conditions to run the test are not met on consecutive key cycles, the information from the first test is not lost. The task manager waits until the next time the appropriate test conditions occur and continues the count.

There are times that a test is held up, **pending** the resolution of a related problem as indicated by the MIL. Testing the system or component at this time guarantees it will fail erroneously, so the task manager doesn't bother.

At times there are other tests running or existing faults that **conflict** with the operation of this test. In this case, the task manager chooses not to run the test. No trip is completed.

If the enabling conditions for that test require that the vehicle operate at wide open throttle, and the driver does not operate the vehicle in this manner for another ten key cycles, the second trip will not occur. However, the next time the vehicle meets those conditions, the test is run (assuming no pending or conflict situations arise).

A test may run yet have its results **suspended** until the results from another monitor are received. Once this occurs, the trip is completed.

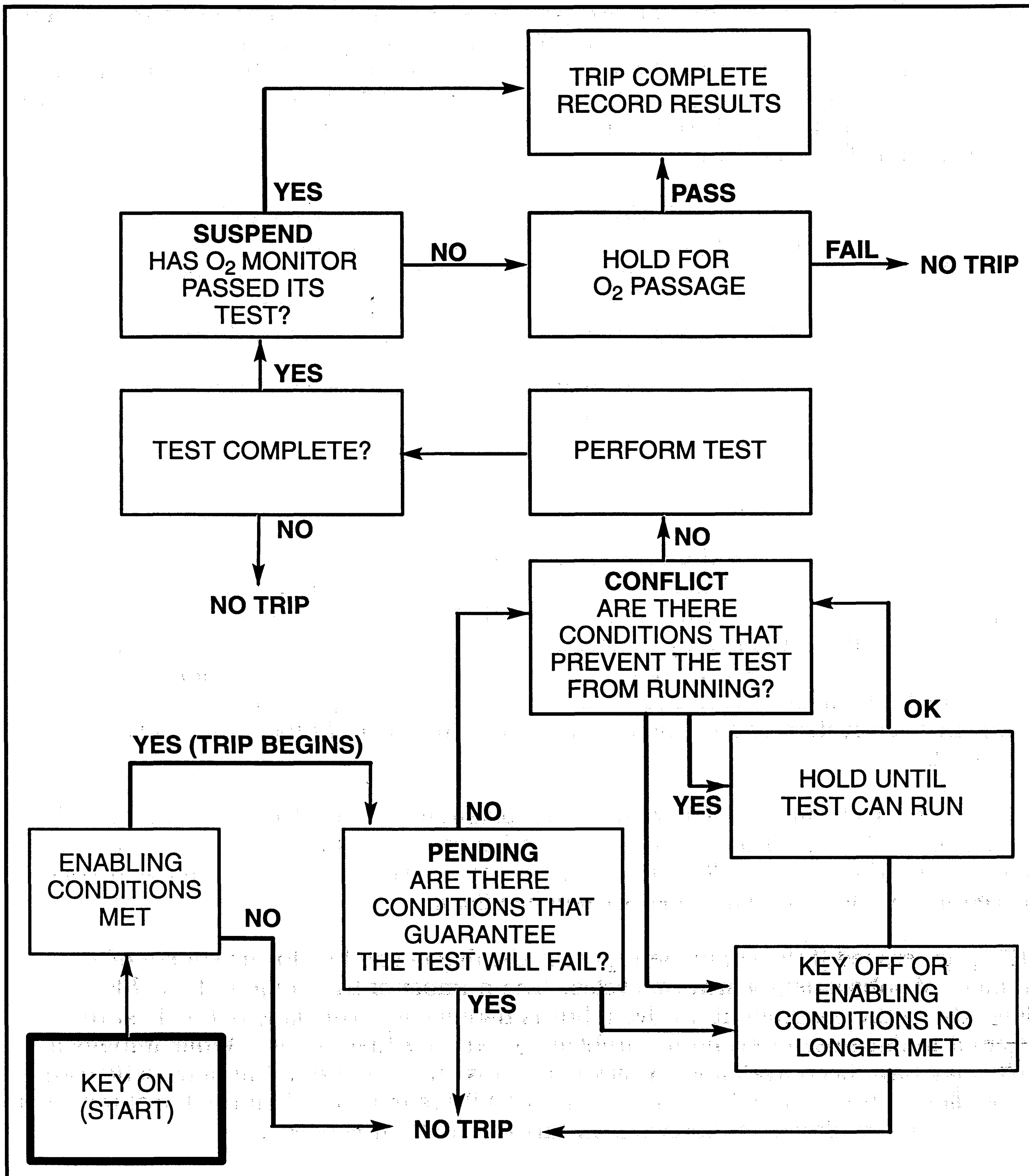


Figure 2 Task Manager's Decision Tree

If this is a "two trip fault" and the test failed the first time, a malfunction the second consecutive time the test is run (even if there were ten key cycles between these tests) will illuminate the MIL. If the malfunction does not occur the second time the test is run, the MIL lamp does not illuminate and no DTC is recorded. In most cases two more consecutive good trips (for a total of three), whenever they occur, erase the maturing code from memory.

The task manager can turn the MIL off if it records three consecutive trips where the system passes the test. However, with the misfire and fuel monitors, the system must past the test under the same circumstances (within 375 rpm) under which it failed the test the **first** time (when talking about a two-trip fault). More information on this is presented in the sections on DTC maturation and freeze frame that follow.

In summary, it is the task manager's job to determine if the conditions are appropriate for a test to be run, know the definition of a trip for each test, and record the results of each test when it is run.

DTC Identification, Maturation, and Erasure

Once a test has been run, the task manager determines whether the system has passed or failed. It must then determine if the test has failed the specified number of times required to illuminate the MIL. If not, the task manager stores a **maturing code**. When this test is run again (on the next "trip") the results are once again either pass or fail. If the component fails the test, a code "matures," and a DTC is set. The MIL lamp is illuminated if an emission component is involved. If the component or system passes the test a specified number of times, the maturing code is erased.

Note: *It is important to understand that a system need not fail a test under exactly the same conditions for a code to mature and trigger the MIL. It must, however, pass a test under the same conditions it failed the* ***first*** *time in order to begin the erasing procedure for the misfire and fuel system monitors.*

DTC's are erased if the component passes the diagnostic test in the course of a number of subsequent warm-up cycles. The number of trips required for this depends on the component involved, but is usually 40. This is why it is best to attempt to diagnose intermittent problems soon after they occur. While initially a DTC may have been available, subsequent trips (and it passing the diagnostic test) have allowed the code to be erased. The OBD II system, based on the latest inputs it received, reconsidered its diagnosis on this intermittent concern.

Of course, a diagnostic scan tool can be used to erase DTC's at any time. In addition, DTC's (along with records of successful trips) are erased whenever the vehicle's battery is disconnected.

Freeze Frame Data Storage and Erasure
All monitored systems provide "freeze frame" data of the vehicle's operating conditions when a maturing code was set. This information can be retrieved using the DRB III diagnostic scan tool (Fig. 3) and may help a technician pinpoint the source of a concern more quickly. When there are multiple monitor failures, the first to occur is stored in freeze frame. The exceptions are the misfire and fuel system monitors. They have priority and can write over other freeze frame data. Information in the freeze frame includes:

- Diagnostic Trouble Code (DTC)
- Engine rpm
- Engine load
- Fuel trim (short term and long term)
- Engine coolant temperature
- Manifold absolute pressure
- Operation mode (open or closed loop)
- Vehicle speed

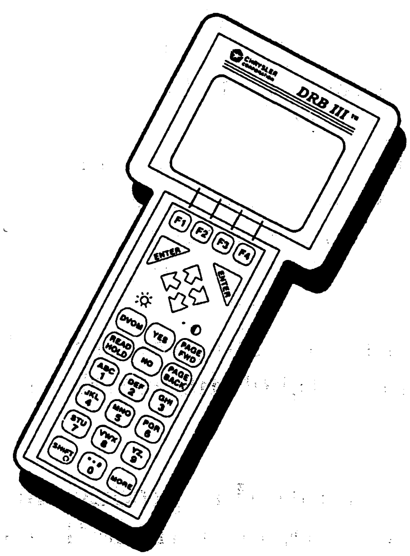


Figure 3 DRB III Diagnostic Scan Tool

Freeze Frame Priority
The freeze frame only indicates the operating conditions under which the maturing code was set. While these conditions are usually the same as those which trigger the maturation of the DTC, there can be exceptions. This first condition is important for fuel system and misfire DTC's as it is the condition the vehicle must repeat successfully during a test to allow the task manager to erase a DTC and turn off the MIL on its own.

Should the task manager determine that the DTC can be erased, the freeze frame related to that code is also eliminated.

MIL Illumination
As described earlier, the PCM task manager is responsible for operation of the MIL lamp. This is an important function as unnecessary operation of this lamp has a negative effect on customer satisfaction. In most cases, if a component or system passes diagnostics on three consecutive trips after the MIL has been illuminated, the MIL is extinguished. This explains how customers can note that the "Check Engine" light went on, and then off, on its own. The OBD II has reconsidered its diagnosis. The DTC remains in the memory until a larger number of warm-up cycles (40) have been successfully completed.

Misfire and fuel system monitor DTC's may be more difficult to erase than others, even when the vehicle is operating within specifications. This is because the vehicle must pass the on-board diagnostics under the same conditions as the maturing code was set. If the problem initially appeared at WOT and high rpm, the customer may not revisit that driving condition for quite some time. Because the PCM has not had the opportunity to retest under those conditions, the MIL lamp remains illuminated and DTC's remain, long after the concern has been eliminated. It is for this reason that you must be sure to erase DTC's after a repair.

The MIL flashes in misfire situations where continued driving could damage the catalytic converter. Continued driving of the vehicle when this condition occurs is not recommended.

As in the past, the MIL lamp can be used to produce diagnostic trouble codes. Quickly turning the key to the RUN position three times allows the MIL to flash out any existing DTC's.

There are a large number of tests waiting to be performed once the vehicle is started. It is the task manager's job to see that these tests are not only performed, but performed under the appropriate conditions.

An additional job of the task manager is to prevent false DTC's from being stored. The task manager accomplishes this by not running certain tests when it recognizes that faults already in the system or tests currently being run could cause the next test to fail erroneously. For example:

> The test for the catalyst monitor does not run if the MIL light is on due to an oxygen sensor fault. The oxygen sensor is a key component in the catalyst monitor test. If the sensor is not functioning properly, there is no reason to run the catalyst monitor – it won't pass. This test will not be run **pending** repair of the sensor concern.
>
> The task manager does not run the test monitoring catalyst operation if the EGR monitor test is being run. The EGR monitor is an "intrusive" test and will cause the catalyst monitor to produce data not representative of normal operating conditions. This represents a **conflict** of test data. The task manager will wait until the EGR monitor is finished before running the catalyst monitor.
>
> Finally, the results from the catalyst monitor are always held until the oxygen sensor test has been successfully completed. The results from the test are **suspended** until the required prerequisite test has been completed.

By reviewing these guidelines, the task manager avoids storing DTC's that are the result of failure of other components in the system. The task manager allows you to use the diagnostic scan tool more confidently in making a diagnosis and repairing a concern.

MAIN MONITORS

To meet OBD II requirements, the on-board diagnostic system must monitor the **rationality** of input signals and the **functionality** of output responses that can have an effect on vehicle emissions. In addition, there are several "main monitors" that review the result of system operations and their effect on emissions. The main monitors are as follows:

- Catalyst
- Fuel System
- Misfire
- Oxygen Sensor
- Exhaust Gas Recirculation

OBD II legislation also requires that secondary air (air injection) systems be monitored. Because the Neon does not use secondary air as part of its emissions control system, it is not included on this vehicle.

Evaporative system leak checks will also fall under the OBD II guidelines in 1995. Look for both secondary air and evaporative monitors on future products.

Each of the main monitors is listed below with a brief background explanation and a description of how the monitor operates. A list of the enabling, pending, conflict, and suspend conditions is also included. Following these conditions is the diagnostic trouble code (DTC) this monitor produces along with the DTC flashout number and a number referred to as a SAE J 2012 or "P" code. SAE J 2012 codes are required by law for use with generic diagnostic scan tools. Finally, each section contains a list of the components that could possibly cause the monitor to fail.

Oxygen Sensor Monitor

Background

Effective control of exhaust emissions is achieved by an oxygen feedback system. The most important element in this system is the oxygen (O_2) sensor mounted in the exhaust manifold (fig. 4).

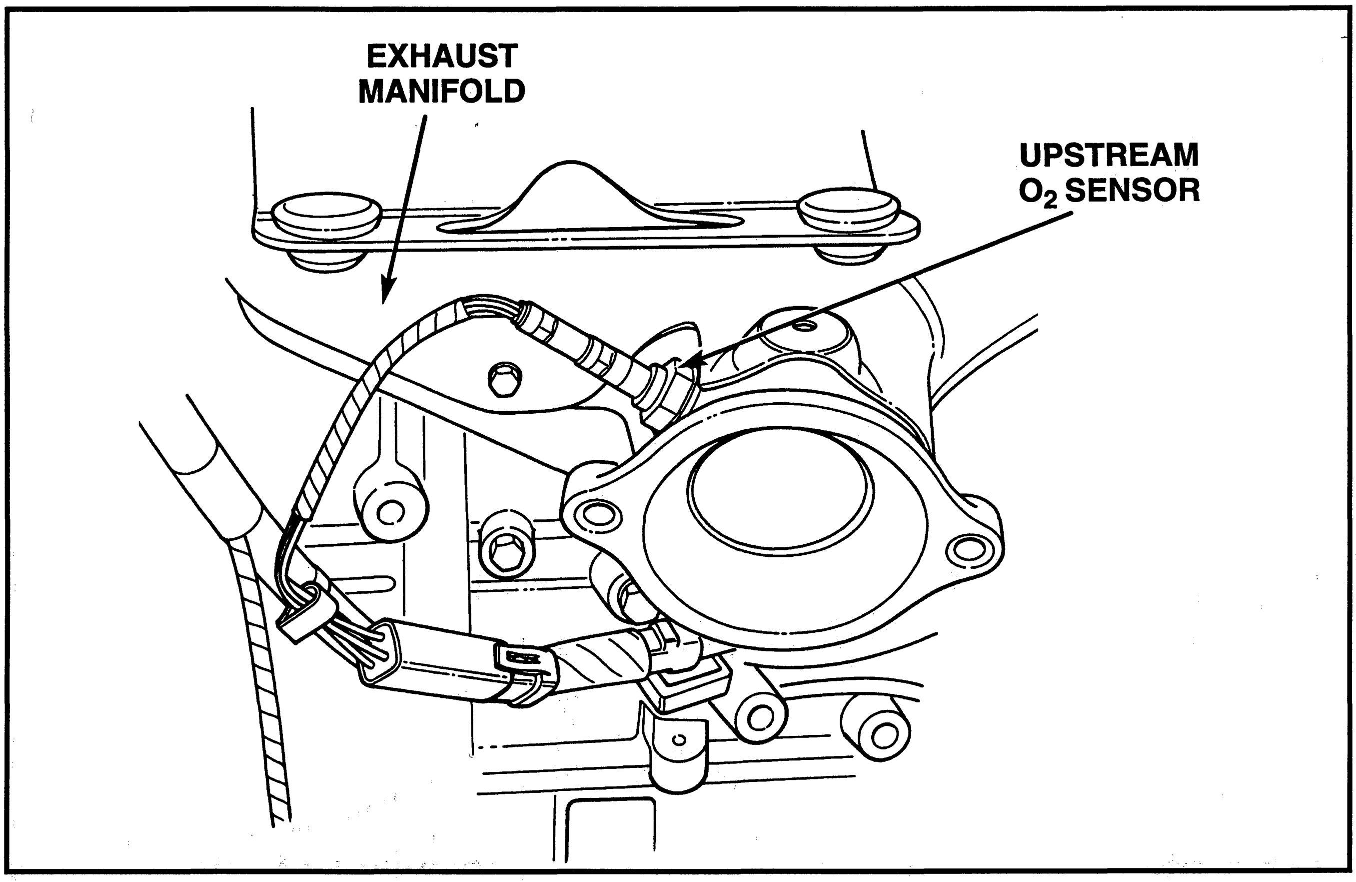


Figure 4 Oxygen Sensor

Operation

Once it reaches its operating temperature of 572° to 662° F, the sensor generates a voltage inversely proportional to the amount of oxygen in the exhaust. This information is used by the PCM to calculate the fuel injector pulse width necessary to provide the critical 14.7 to 1 air/fuel ratio (stoichiometric).

A properly operating sensor must not only be able to generate an output voltage across its operating range of 0 to 1 volt as it is exposed to different O_2 levels, it also must be able to detect these changes quickly. To detect a shift in the air/fuel mixture (lean or rich) the output voltage must change beyond a threshold value. A malfunctioning sensor could have difficulty changing beyond the threshold value.

While there are existing tests that determine if an O_2 sensor is shorted to voltage, contains an open circuit, or does not function at all, prior to OBD II, it was impossible to identify sluggish or marginal sensors.

A slow response rate or reduced voltage output are all signs of an improperly operating oxygen sensor (fig. 5). This could mean longer instances of combustion of less than optimum air/fuel mixtures. This can significantly increase emissions.

The O_2 sensor must have a voltage output of greater than .67 volt in order to pass the test. It must also switch more times over a 120 second period than a given threshold (to demonstrate quick response) or produce a given number of steep slope switches (demonstrating dynamic range and quick response) over the same time period. Data is not stored unless idle time exceeds 10 seconds.

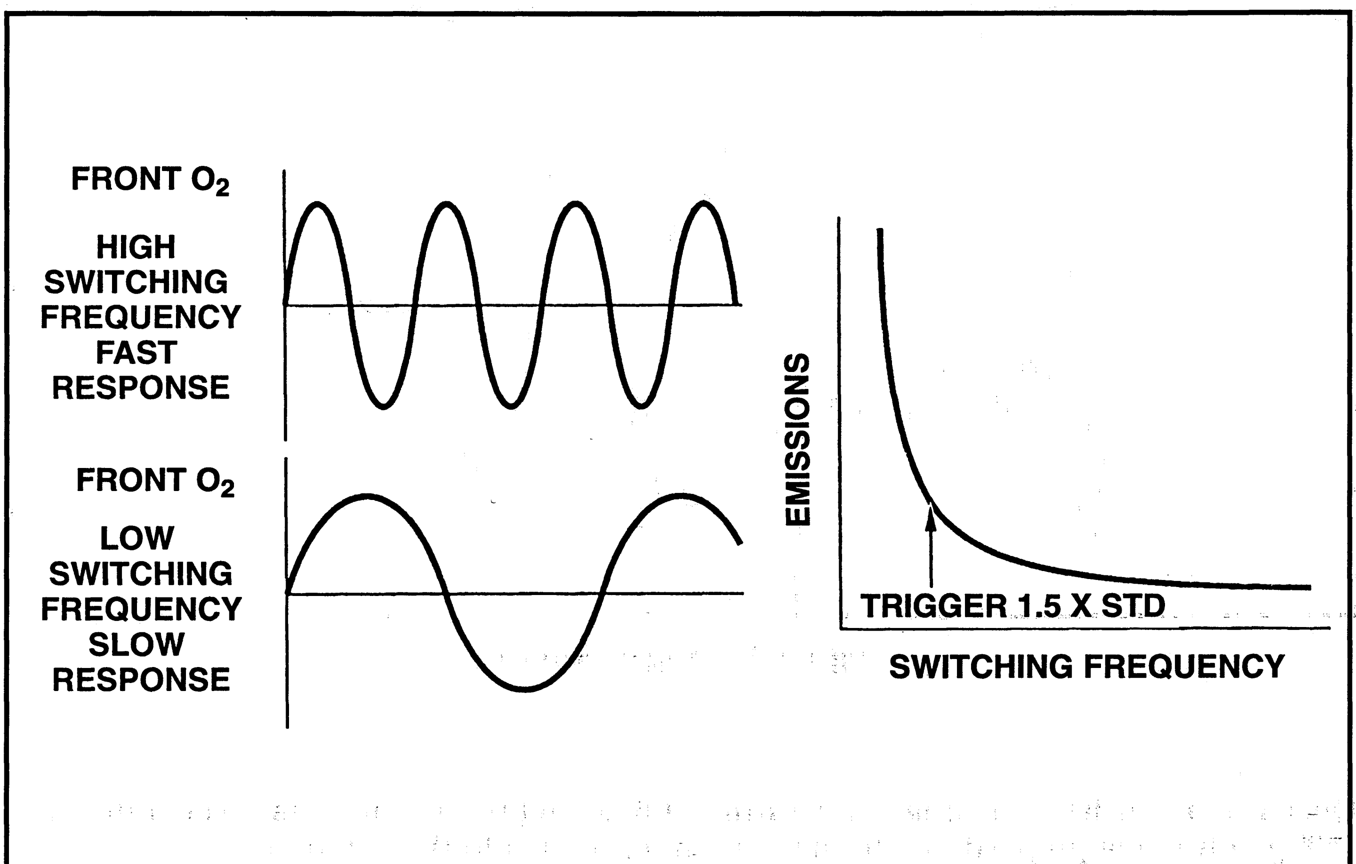


Figure 5 Switching Frequency Response

Enabling Conditions

The following conditions must be met before the oxygen sensor monitor will run:

- Engine coolant temperature greater than 170° F
- Approximately three minutes elapsed time after start-up
- Vehicle has operated at more than 24 mph and 170° F. for a cumulative total of at least two minutes
- Vehicle is in drive (auto trans only)
- High pressure power steering switch is off
- Vehicle is at idle with rpm between 512 and 864
- Vehicle is operating in a purge-free idle memory cell
- This test may be inhibited if the A/C is cycling too rapidly (Testing with the A/C off is suggested)

Pending

The oxygen sensor monitor does not run if the MIL is on due to one of the following:

- Misfire DTC
- Upstream O_2 heater DTC
- Vehicle speed sensor DTC
- The vehicle is in the limp-in mode due to MAP, TPS, or engine temperature DTCs
- Park/Neutral switch rationality DTC
- Front O_2 sensor electrical DTC

Conflict

The oxygen sensor monitor does not run if any of the following are present:

- Fuel system rich intrusive test
- Time after start is less than 60 seconds
- 1 trip misfire maturing code
- Power steering high pressure switch is on
- 1 trip upstream O_2 heater maturing code

Suspend

There are no suspend conditions for the oxygen sensor monitor.

The O_2 monitor runs once each trip after the enabling conditions have been met. The MIL is illuminated and a DTC stored if the O_2 sensor does not produce 0.6 volt output and/or does not perform enough switches within the test threshold for two consecutive trips. The message on the scan tool screen appears as follows:

Upstream O_2S Response
Flash Code – 21 J 2012 Code – P 0133

Downstream O_2S Response
Flash Code – 21 J 2012 Code – P 0139

A functioning converter stores oxygen so it can be used for oxidation of hydrocarbons (HC) and carbon monoxide (CO). The downstream sensor detects a lower oxygen level in the exhaust than the upstream sensor. It indicates this by switching at a significantly slower rate than the upstream sensor.

As the converter deteriorates and loses its ability to store oxygen, the switch rate at the downstream oxygen sensor approaches that of the upstream sensor (fig. 8). The system is monitored so that when the switch rate of the downstream sensor reaches 90% of the switch rate of the upstream sensor(automatic transmissions), the MIL is illuminated. The threshold for manual transmissions is 70%. At this point, exhaust emissions are projected to exceed 1½ times the legal limit.

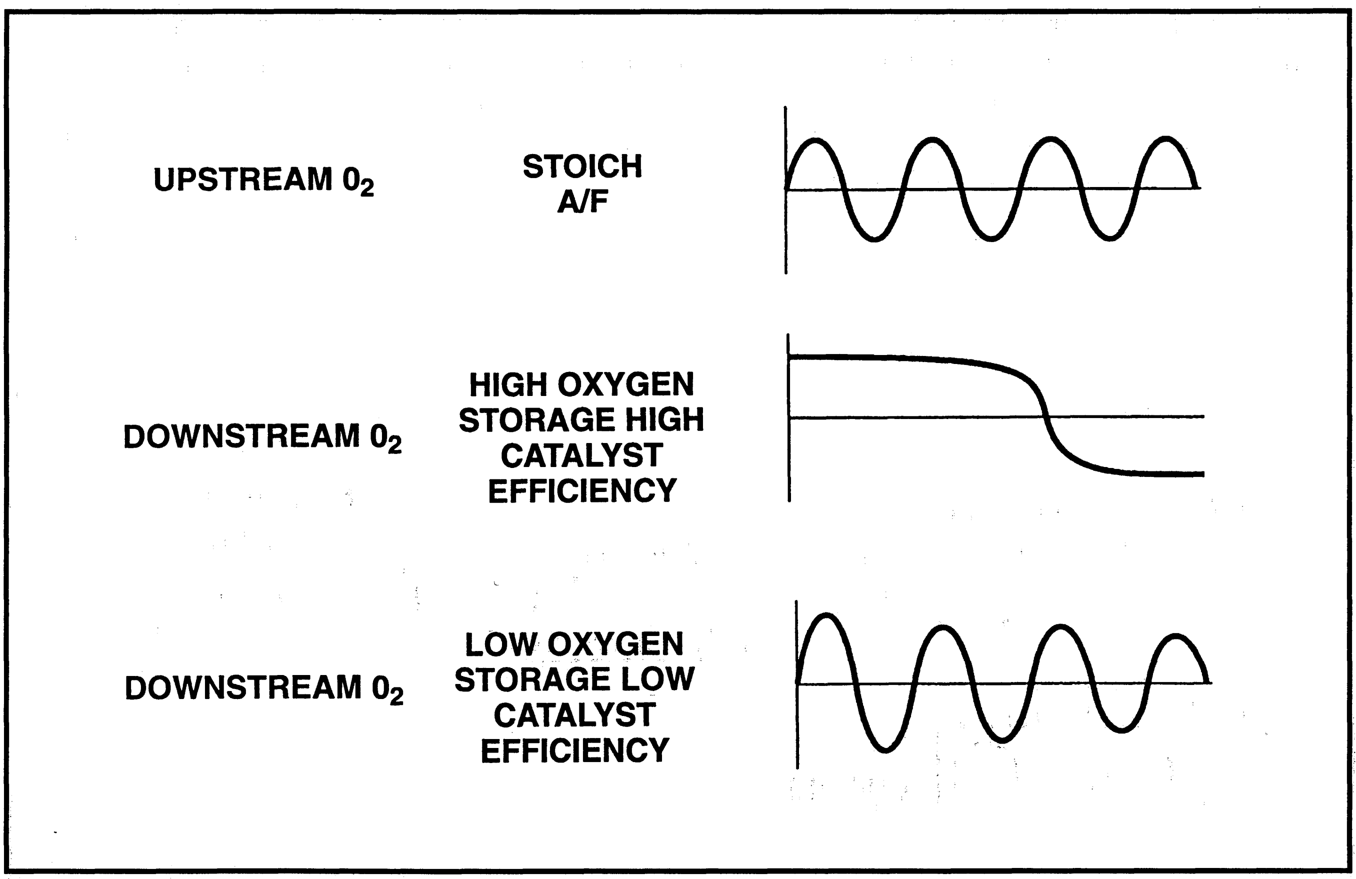


Figure 8 Upstream vs. Downstream Switching Rates

Enabling Conditions

The following conditions must be met before the catalyst monitor will run:

- Engine coolant temperature greater than 170° F
- Vehicle speed greater than 20 mph for 2 minutes
- Open throttle
- Closed loop operation
- RPM between 1248 and 1952 (auto), 1248 and 2400 (manual)
- MAP voltage between 1.50 and 2.60

Pending

The catalyst monitor does not run if the MIL is on due to one of the following:

- Misfire DTC
- O_2 monitor DTC
- Upstream O_2 heater DTC
- Downstream O_2 heater DTC
- Fuel system rich DTC
- Fuel system lean DTC
- Vehicle is in the limp-in mode due to MAP, TPS, or engine temperature DTC
- Upstream O_2 sensor rationality DTC
- Downstream O_2 sensor rationality DTC

Conflict

The monitor does not run if any of the following are present:

- EGR monitor is in progress
- Fuel system rich intrusive test is in progress
- Purge monitor is in progress
- Time since start is less than 60 seconds
- 1 trip misfire maturing code
- 1 trip O_2 monitor maturing code
- 1 trip upstream O_2 heater maturing code
- 1 trip downstream O_2 heater maturing code
- 1 trip fuel system rich maturing code
- 1 trip fuel system lean maturing code

Suspend

Results of the monitor are not recorded until the O_2 monitor passes.

Catalyst efficiency is monitored once each trip. The MIL is illuminated and a DTC stored if the switch rate of the rear O_2 sensor reaches 90% of the front sensor's switch rate (automatic transmissions, 70% for manuals) for a total of two consecutive trips. The message on the scan tool screen appears as follows:

Catalytic Converter Efficiency Failure
Flash Code – 64 J 2012 Code – P 0422

The lamp goes out if the monitor can pass a tougher standard (downstream sensor switch rate at less than 80% of upstream sensor for automatic transmissions) for three consecutive trips. The DTC remains in memory until the monitor has passed at this higher standard for a total of 40 warm-up cycles with no failures.

This malfunction could be caused by the following components:

- Catalytic Converter
  - Worn rings
  - Worn valves
  - Head gasket
  - Cracked head
  - Fuel
- Exhaust Manifold (leaks)
- Wiring Harness/Connectors
- PCM

The fault trees in the Diagnostic Procedures book can help you isolate the source of the problem.

Fuel System Monitor

Background
To control the level of undesirable emissions, the fuel system must be able to maintain strict control of the air/fuel ratio to stoichiometric. An optimum air/fuel ratio is 14.7 to 1. It is at this point that the best balance between the production of HC's and CO's (which drop as the mixture becomes leaner) and NOx (which increases as the air/fuel mix becomes leaner) can be found (fig. 9). This is also the point where the catalytic converter is most efficient at converting all three gases to less harmful compounds. The goal of the PCM is to examine input information and control outputs to produce a constant ratio as close to this as possible.

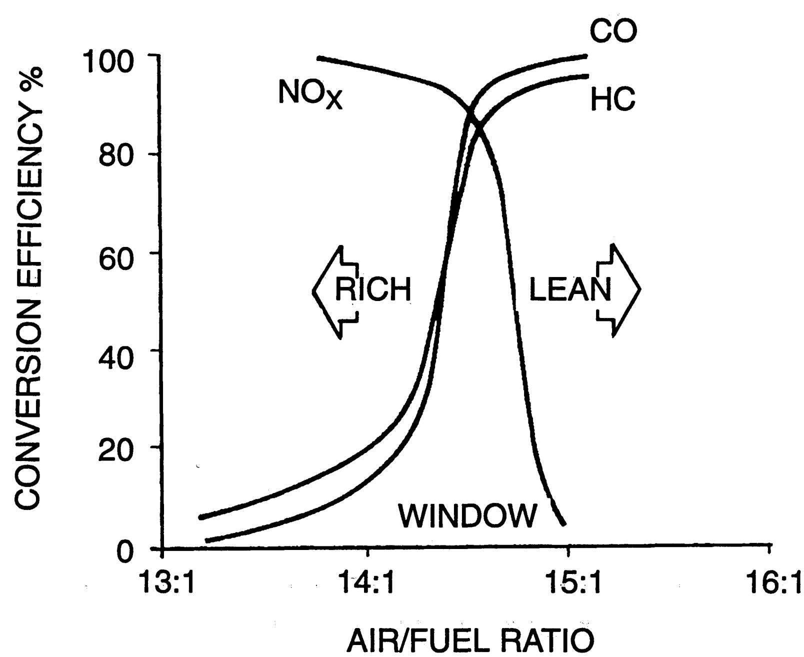


Figure 9 Conversion Efficiencies of a Three-Way Catalyst

Operation

The Powertrain Control Module (PCM) varies the pulse width of the fuel injectors to provide precise control of the air/fuel mixture. Wider pulse widths increase the volume of fuel delivered to the cylinders. The PCM uses the input from a number of sensors in its attempt to reach and maintain this air/fuel ratio. Manifold Absolute Pressure (MAP), engine rpm, and the O_2 sensor have the greatest influence (authority) over injector pulse width. Other inputs such as the Throttle Position Sensor (TPS), Engine Coolant Temperature (ECT) Sensor, Intake Air Temperature (IAT) Sensor, speed sensor, and battery voltage all have varying levels of influence on pulse width, depending on the circumstances.

As noted earlier, the Neon uses two oxygen sensors (fig. 10) both of which monitor the oxygen content of the combustion byproducts on their way out of the engine as exhaust. Only the upstream sensor has authority over fuel injector pulse width.

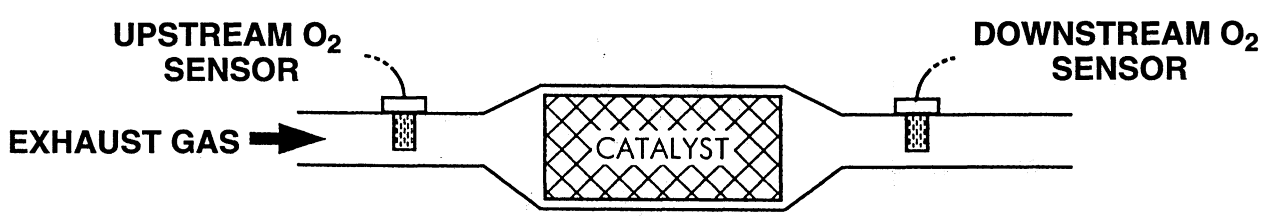


Figure 10 O_2 Sensors

If a large amount of oxygen remains following the combustion process, this sensor produces a low voltage. This indicates a lean condition caused by a ratio greater than stoich. Little oxygen in the exhaust allows the sensor to produce a higher voltage, indicating a rich condition where the air/fuel ratio is less than stoich.

Upstream O_2 sensor feedback to the PCM is used to fine tune injector pulse width to maintain stoichiometric and meet emission standards. It can increase or decrease injector pulse width by as much as 50%. Pulse width is calculated from the data supplied from the MAP, TPS, ECT, IAT, upstream O_2 sensor, battery voltage, rpm (at crank), and speed sensors.

On-Board Diagnostics

To control air/fuel ratio feedback, the PCM uses short term correction and long term memory. Before the PCM can alter the programmed injector pulse width, it must enter closed loop operation. The requirements for closed loop operation are listed below:

- Engine temperature exceeds 35° F
- O_2 sensor is in the ready mode
- All timers have timed out following the START to RUN transfer (The length of these timers varies with engine temperature)

35° F. – 41 sec.
50° F. – 35 sec.
70° F. – 22 sec.
167°F. – 11 sec.

Once in the closed loop, the feedback systems begin to operate. Short term memory works with the long term memory, which is broken down into 14 different cells. Two of these cells (12 and 13) are used only during idle. Each cell represents a manifold pressure and rpm range and can be accessed with the DRB III diagnostic scan tool.

Table 3. Long Term Memory Cells

ABOVE 2048	1	3	5 Purge Free*	7	9	11		13 Idle Neutral MTX Purge Free*
RPM BELOW	0	2 Purge Free*	4	6	8	10		12 Idle Drive ATX Purge Free*

Map Voltage 1.38 2.0 2.64 3.26 3.9

*PCM disables the canister purge function in these cells to gather data used for purge control and diagnostics.

For example:

If the PCM were in cell 3, the MAP voltage must be between 1.38 and 2.0v and engine rpm must be greater than 2048. This is the cell that the control system would update.

If the oxygen sensor registers a rich or lean condition while driving in this cell, the cell will require updating to aid in fuel control. The short term correction is used first. It starts increasing pulse width quickly (kick), then ramps up slowly (fig. 11). Each control is in inverse relation to the signal sent from the O_2 sensor.

For example:

> The O_2 sensor switches lean to rich. Short term compensation kicks in lean, then ramps lean until the O_2 sensor switches lean. At this point short term compensation reverses the process.

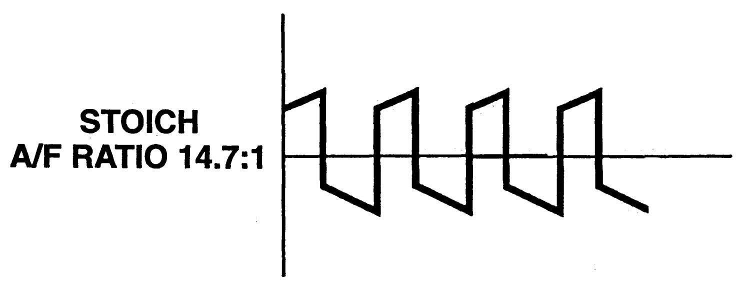


Figure 11 Short Term Fuel Compensation

If the oxygen sensor shows lean, the short term compensation goes rich and multiplies the pulse width from long term memory in that cell by an amount greater than 1. If the sensor shows rich, the short term compensation drives the pulse width narrower by multiplying by a number less than 1 (perhaps 0.97). The short term compensation can multiply pulse width by as much as 1.25 or as little as 0.75 to compensate for lean or rich conditions. In this way, the short term compensation can increase pulse width by up to 25% (by multiplying by 1.25) or decrease pulse width by up to 25% (by multiplying by 0.75).

Example:

> Pulse width 0.05 x 1.25 = 0.0625 (increase of 25%)
>
> Pulse width 0.05 x 0.75 = 0.0375 (decrease of 25%)

Long term memory also has control over pulse width by being able to increase or decrease the pulse width stored in the cell by up to 25%. Long term memory is retained by the battery in the PCM, while short term correction is lost whenever the ignition is turned off.

The long term memory works to bring the short term correction to the point where the average percent of pulse width compensation it provides in this memory cell is 0% (fig. 12). The long term memory returns to this level of pulse width compensation the next time the vehicle enters this cell. It is in this way that the PCM is continually relearning the most appropriate level of control, even as the vehicle ages, internal engine components wear, and operating conditions change.

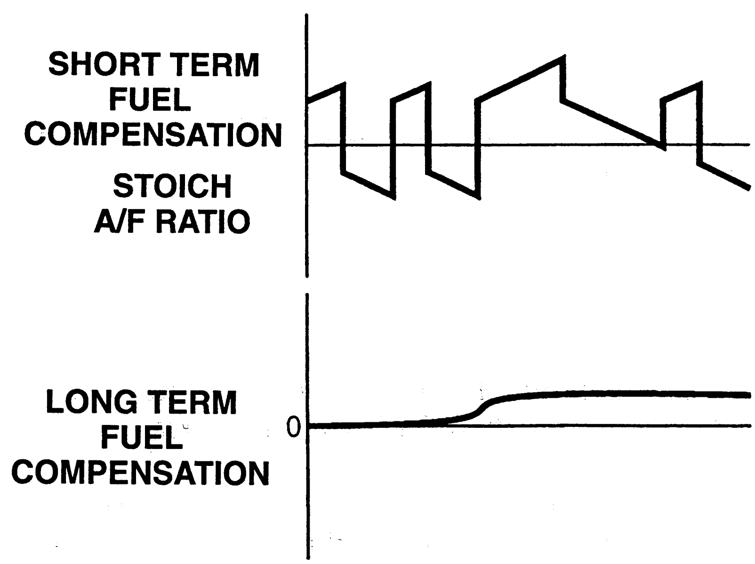


Figure 12 Long Term Memory Adjusts Fuel Compensation

There are several "purge free" cells. These cells contain information on how much effect the canister has on the air/fuel ratio. The purge solenoid is turned on to shut off the purge flow and the cell is allowed to register any purge corruption. The monitor looks at the combination of short and long term fuel control values to see if the system is in control.

Enabling Conditions
The following conditions must be met before the fuel system monitor will run:
- Engine coolant temperature is greater than 170° F
- Closed loop operation

Pending
The fuel system monitor does not run if the MIL lamp is on due to one of the following conditions:
- Misfire DTC
- Purge monitor DTC
- Upstream O_2 sensor heater DTC
- EGR monitor DTC
- Vehicle is in limp-in mode due to MAP, TPS, or engine temperature DTC
- Cam/crank sensor failures
- EGR solenoid DTC
- Purge solenoid DTC
- Upstream O_2 sensor rationality DTC

Conflict
The fuel system monitor does not run if any of the following are present:
- 1 trip misfire maturing code
- 1 trip purge monitor maturing code
- 1 trip upstream O_2 sensor heater maturing code
- 1 trip EGR monitor maturing code

Suspend
There are no suspend conditions for the fuel system monitor. However, the monitor may be disabled if the fuel level reached 0.60 gallons or less.

The fuel system is continuously monitored during each trip once the enabling conditions have been met. Short term and long term values are multiplied together. The test fails if the fuel control system reduces pulse width by 25% long term memory and 7% short term compensation due to a rich condition or increases pulse width by 25% long term memory and 12% short term compensation due to a lean condition. The MIL illuminates and a DTC is set when the adaptive fuel system exceeds these limits for two consecutive trips. The message on the scan tool will appear as follows:

Fuel System Rich
Flash Code – 52 J 2012 Code – P 0172

Fuel System Lean
Flash Code – 51 J 2012 Code – P 0171

When the PCM stores a maturing code, it also stores a freeze frame of the vehicle operating data at the time the fault was set. This information is accessible with the DRB III diagnostic scan tool. The MIL goes out if the malfunction causing it to illuminate is not repeated for three consecutive trips monitored within 10% of the load value and 375 rpm of the original freeze frame conditions.

Malfunction of the fuel monitor can be caused by the following components:

- Catalytic converter
- Charge air temperature sensor
- Ignition coil
- EGR valve assembly
- PCM
- Worn valves
- Worn rings
- Head gasket
- Cracked head
- Exhaust manifold
- Fuel pump
- Fuel filter
- Ignition secondary wires
- Injectors
- Map sensor
- O_2 sensor
- Fuel pressure regulator
- Fuel pump relay
- Spark plugs
- Wiring harness/connectors

The fault trees in the Diagnostic Procedures book can help you isolate the source of the problem.

Misfire Monitor

Background
Misfire is defined by the California Air Resources Board as the lack of combustion in a cylinder due to absence of spark, poor fueling, compression, or any other cause. As a result, the air/fuel mixture will not burn, and during the exhaust stroke, it enters the exhaust system. The raw fuel and excess oxygen adversely affect the fuel system's feedback mechanism (the oxygen sensor) and can cause permanent damage to the catalytic convertor.

Operation
The OBD II misfire monitor uses information provided by the crank position sensor to determine engine rpm and detect slight variations due to engine misfire. Crankshaft rpm is calculated between the 69° and 9° falling edges of the crankshaft position sensor signal (fig. 13).

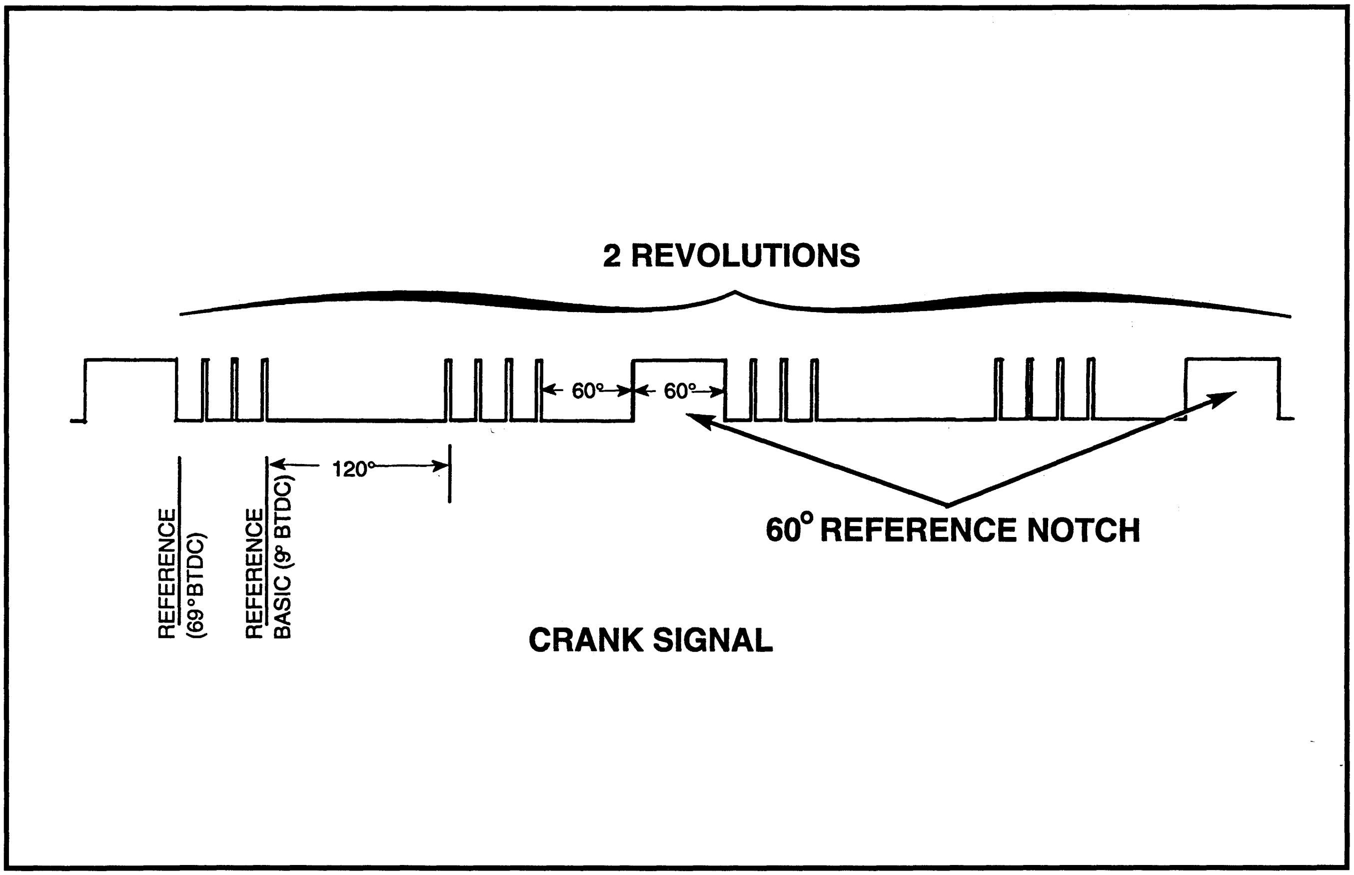


Figure 13 Crankshaft Position Sensor Signal

The threshold for determining what amount of rpm change indicates misfire varies with engine speed and load. This is required because as engine speed increases or load decreases, the overall effect of a single cylinder misfire diminishes due to the momentum of the crankshaft.

The misfire monitor contains an adaptive feature that can take into account component wear, sensor fatigue, and machining tolerances. The PCM notes rpm variance between cylinders during normal vehicle operation and then uses these figures as a foundation for calculating the threshold at which rpm variance is considered to indicate misfire.

Note: *Because the PCM requires normal vehicle operation to update its memory, installing a new PCM in a vehicle that is misfiring disables this monitor. Because the PCM has no reference for "normal operation," it considers the misfire condition to be normal. The same situation can occur anytime battery power to a PCM is lost and a vehicle is misfiring when the controller is reconnected.*

The misfire monitor triggers operation of the MIL in two different operating situations:

1,000 Rev Misfire
Misfire is continuously monitored (in 200 revolution segments) once the enabling conditions have been met. If the monitor detects misfire in more than 2% (auto trans – 1.6% with manual transmission) of the engine cycles in a 1,000 revolution period, a temporary fault is set. Freeze frame data of the operating conditions during the last 200 rpm of that 1,000 revolution period are stored. As with other monitors, failure of the misfire monitor on the next trip matures the code, the MIL illuminates, and a DTC is stored. It is important to note that two trips are required for the code to mature. Continued misfiring during the initial trip does not illuminate the MIL.

200 Rev Misfire
If the monitor detects misfire in more than 15% of cylinder firing opportunities during any 200 revolution monitored segment, the MIL immediately begins flashing. This indicates that engine misfire has reached the point where damage to the catalytic converter is likely to occur. The vehicle defaults to open loop operation to prevent the adaptive fuel controls from dumping additional fuel into the cylinders and accelerating damage to the catalyst. Driving the vehicle with the MIL flashing is not recommended.

Once out of the operating condition where the 15% misfire is occurring, the MIL will stop flashing but remain illuminated. The vehicle may be driven, but should be serviced immediately.

Because some misfire is a common occurrence in a number of driving conditions, MIL illumination due to misfire may occur when no component has failed. Try to identify conditions that could trigger the misfire monitor that are **not** related to component failure. Examples of these are included below:

- Damp ignition system components
- Low fuel/ running out of gas (monitor triggers as engine sputters)
- "Lugging" the engine (manual transmission)
- Pulling heavy loads
- Low quality gasoline

In addition, the following situations could mistakenly trigger the MIL:

- Large potholes
- Extended rough road operation

Enabling Conditions

The following conditions must be met before the misfire monitor will run:

- MAP voltage is less than 1.60
- Rpm is between 2200 and 2800
- Engine coolant temperature is greater than 176° F
- The engine has made a start-to-run transfer
- Vehicle speed less than 3 mph

Pending

The misfire monitor does not run if the MIL is on due to one of the following:

- The vehicle is in the limp-in mode due to MAP, TPS, camshaft or crankshaft position sensors, or engine temperature.
- A speed sensor DTC

Conflict

The misfire monitor does not run if any of the following are present:

- 1 trip fuel system rich maturing code
- 1 trip fuel system lean maturing code
- 1 trip purge monitor maturing code
- 1 trip EGR monitor maturing code

Suspend

There are no suspend conditions for the misfire monitor.

Because false misfire readings could be a customer concern, there are a number of conditions where the misfire monitor is disabled. These include:

- Low fuel level (less than 0.60 gallon)
- Periods where MAP voltages quickly change
- Severe engine deceleration
- Throttle toggles between open and closed
- While cranking (below 598 rpm)
- Rpm greater than 3,000 (automatic transmission), 3,500 (manual transmission)
- Full lean or decel fuel shut-off
- Cold Starts (engine coolant below 100° F.)

If a misfire is detected and a DTC stored, the message on the diagnostic scan tool screen appears as follows:

Multiple Cylinder Misfire
Flash Code – 43   J 2012 Code – P 0300

Cylinder #1 Misfire
Flash Code – 43   J 2012 Code – P 0301

Cylinder #2 Misfire
Flash Code – 43   J 2012 Code – P 0302

Cylinder #3 Misfire
Flash Code – 43   J 2012 Code – P 0303

Cylinder #4 Misfire
Flash Code – 43   J 2012 Code – P 0304

The MIL goes out if the misfire condition does not reoccur during three consecutive trips where the vehicle is operated within 375 rpm and 10% of the load condition stored in the freeze frame. The DTC is erased from memory following the successful completion of 80 monitor warm-up cycles.

This malfunction could be caused by the following components:

- Spark plugs or wires
- Coil
- Crank position sensor
- Timing belt
- Cam or crank sprockets
- Worn piston rings
- Worn valves
- Head gasket
- Cracked head
- Fuel lines and filter
- Fuel rail
- Fuel pump module
- Fuel pressure regulator
- Injectors
- Exhaust pipes and muffler
- Catalytic convertor
- Fuel pump relay
- Wiring harness and connectors
- Crankshaft

The fault trees in the Diagnostic Procedures book can help you isolate the source of the problem.

Exhaust Gas Recirculation Monitor

Background

Exhaust Gas Recirculation (EGR) is a method of reducing oxides of nitrogen (NOx) emissions by introducing non-combustible exhaust gases into the combustion chamber (fig. 14). These gases absorb heat and reduce the high cylinder operating temperatures where NOx is most likely to occur. Lower combustion chamber temperatures result in lower NOx emissions.

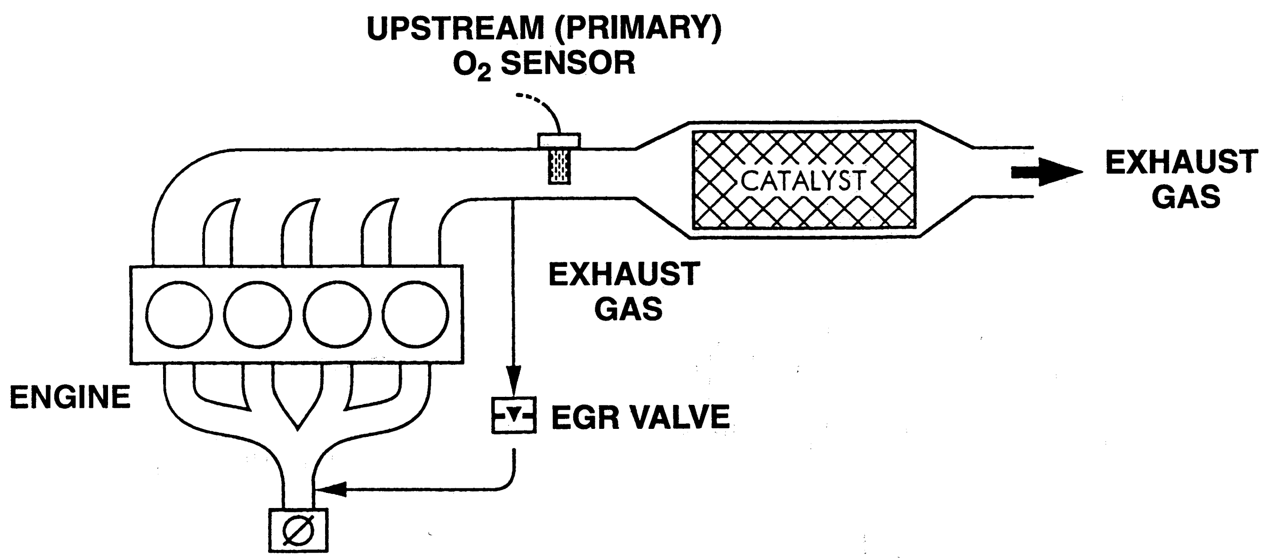


Figure 14 Exhaust Gas Recirculation System

Operation
The EGR system consists of a vacuum solenoid, back pressure transducer and a vacuum operated valve (fig. 15). When activated, the solenoid allows vacuum to flow to the transducer. Negative exhaust backpressure allows manifold vacuum from the solenoid to vent to atmosphere. Positive exhaust backpressure causes the transducer diaphragm to modulate. This allows intake manifold vacuum that would otherwise to reach the EGR valve. The combination of vacuum on one side of the valve diaphragm and exhaust back pressure on the other allows exhaust gases to be introduced into the intake manifold.

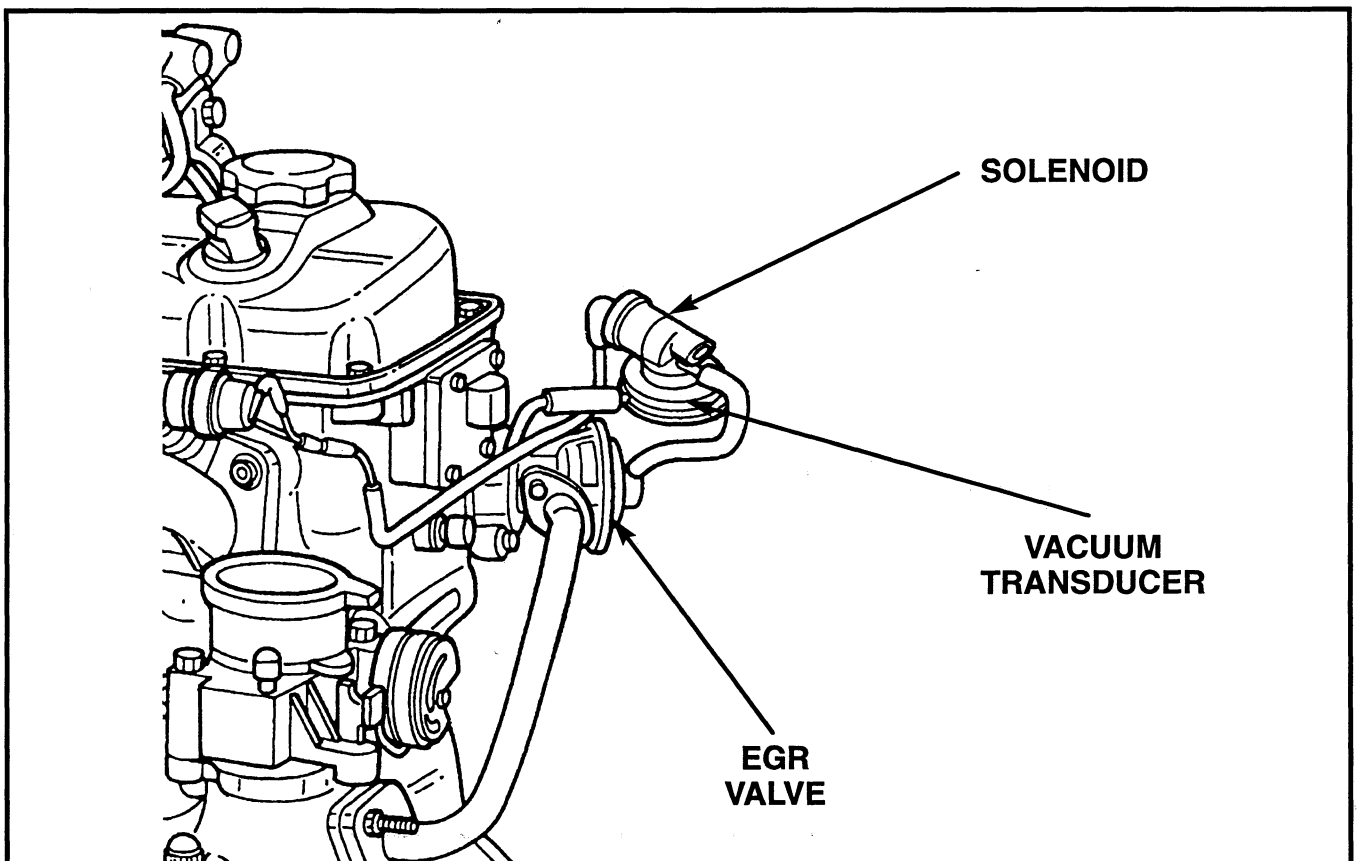


Figure 15 EGR Valve and Transducer

An EGR system stuck in the closed position increases NOx emissions. A system stuck in the open position can increase hydrocarbon emissions, fuel consumption, and produce rough engine operation.

To detect operation of the system, the solenoid is disabled and the O_2 compensation control is monitored. If the EGR system is operating properly, disabling it shifts the air/fuel ratio in the lean direction (fig. 16). O_2 sensor data should indicate an increase in oxygen in the exhaust gases and cause the short term control to shift rich. The amount of the shift indirectly monitors the operation of the system.

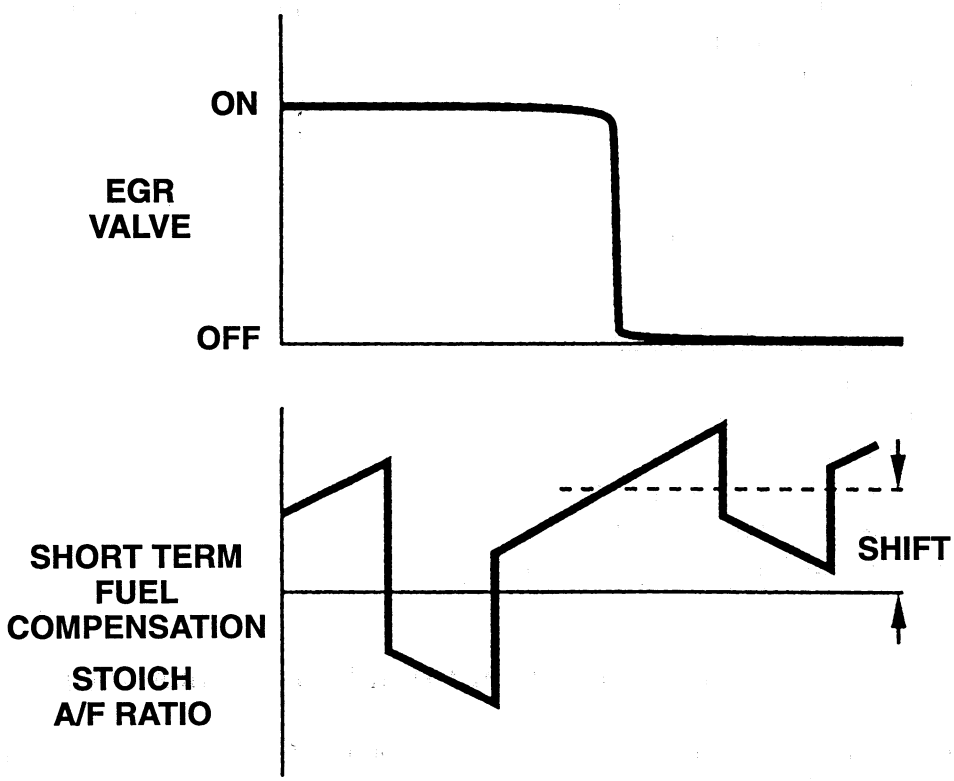


Figure 16 Fuel System Compensation Shift

Enabling Conditions

The following conditions must be met before the EGR monitor will run:

- Engine temperature is greater than 170°F
- More than three minutes have passed since start-up
- Engine rpm is between 2248 and 2688 (auto) or 1952 and 2400 (manual)
- MAP voltage is between 1.80 and 2.70
- TPS voltage is between 0.6 and 1.8
- Vehicle speed exceeds 2.75 mph
- Short term O_2 controller is exhibiting less than + 4.4%

Pending

The EGR monitor does not run if the MIL is on due to one of the following:

- Misfire DTC
- O_2 monitor DTC
- Upstream O_2 heater DTC
- Fuel system rich/lean DTC
- Upstream O_2 shorted high
- Vehicle is in limp-in mode due to MAP, TPS, or engine temperature DTC
- Vehicle speed sensor DTC
- EGR solenoid DTC
- Cam or crank sensor DTC

Conflict

The EGR monitor does not run if...

- The fuel system rich intrusive test is in progress
- Purge monitor is in progress
- Catalyst monitor is in progress
- Time since start is less than 60 seconds
- 1 trip misfire maturing code
- 1 trip O_2 monitor maturing code
- 1 trip upstream O_2 heater maturing code
- 1 trip fuel system rich maturing code
- 1 trip fuel system lean maturing code

Suspend

Results of the EGR monitor not are not recorded until the O_2 monitor passes.

This monitor is performed once each trip. If the measured change in the short-term shift during the test is less than 7.4% or greater than 20.5%, the monitor fails and a maturing code is stored. The MIL illuminates and a DTC is stored if the monitor is outside this range for a total of two consecutive trips. The message on the diagnostic scan tool screen appears as follows:

EGR System Failure
Flash Code – 32   J 2012 Code – P 0401

The MIL goes out if the EGR monitor passes for three consecutive trips. The DTC is erased after 40 successful trips.

This malfunction could be caused by the following mechanical components:

- EGR valve assembly
- EGR tube
- Wiring harness and connectors
- Vacuum hoses

COMPREHENSIVE COMPONENTS

Diagnostic Trouble Codes (DTC's)
The Diagnostic Trouble Codes (DTC's) available for the remaining components on the 2.0L engine are listed on the following pages. In many cases, these codes are carried over from the OBD I diagnostics. Each listing includes a brief explanation of the J 2012 code and its number, and is preceded by the flash code produced by the Malfunction Indicator Lamp (MIL) on the instrument panel.

Generally, types of check are made on each component. First, all components are checked electrically for opens and shorts. Then, inputs are checked for rationality (does this signal make sense?) and outputs are checked for functionality (is this response correct?).

11 No Crank Reference Signal at PCM – (P 0335)
The crankshaft position sensor, located on the engine block just above the oil filter, is a Hall-effect sensor that provides a voltage signal to the PCM at pin 25. Voltage alternates between 0.3 and 5 volts as the crank turns. The PCM supplies 9 volts to the sensor through pin 44 and a sensor ground at pin 51. This DTC would indicate a failure of the sensor or its circuit.

The test is run at start-up. The engine will not operate without a signal from the crank sensor.

11 Timing Belt Skipped 1 Tooth or More – (P 1390)
The PCM uses voltage signals generated by the cam (pin 26) and crank (pin 25) sensors to determine engine synchronization. If these signals become out of sync, this DTC is produced and the engine reverts to the limp-in mode. The PCM uses the values from the start mode. This results in an increase in emissions and a decrease in performance.

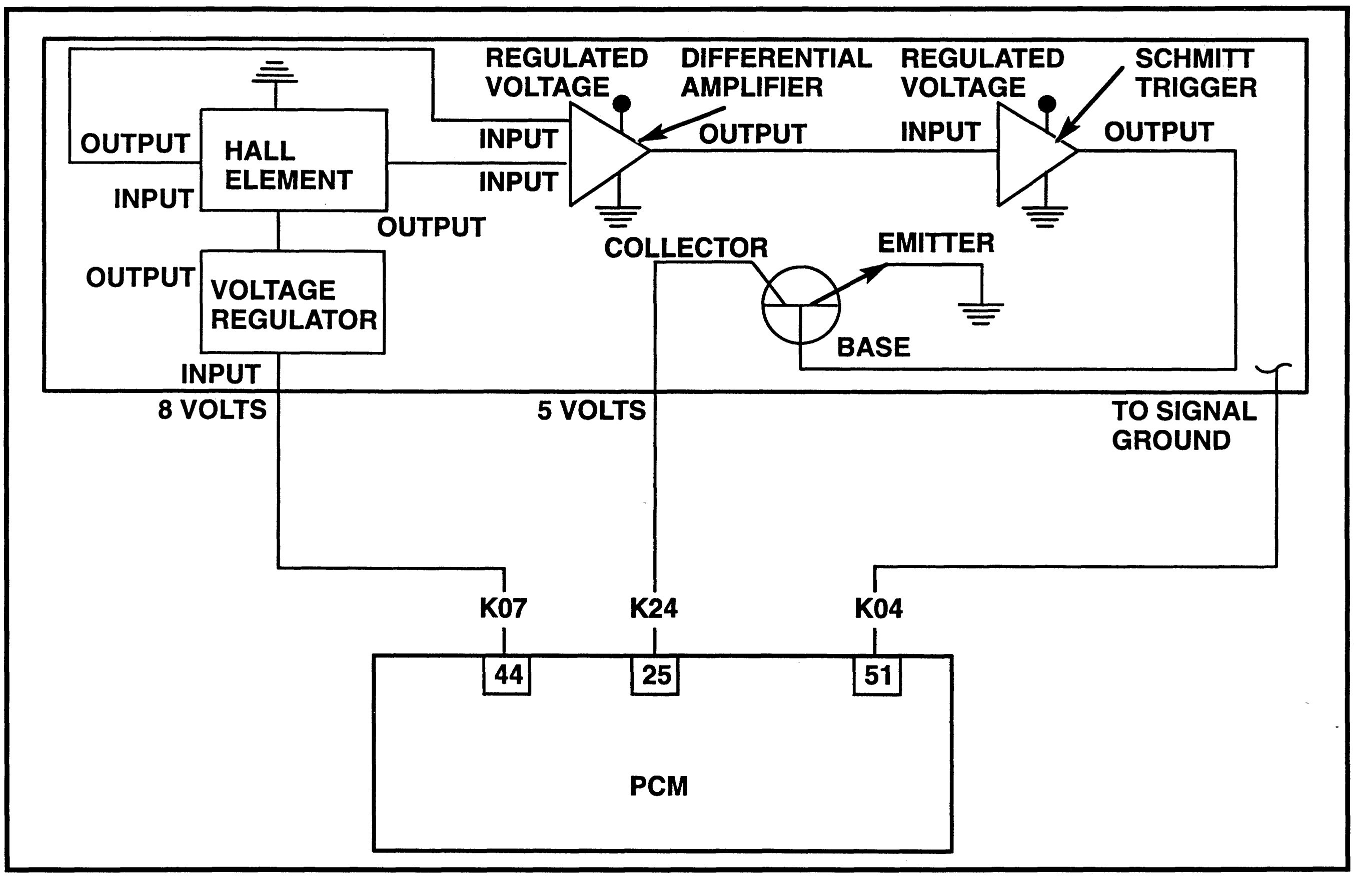


Figure 17 Crankshaft Position Sensor

12 Battery Was Disconnected
This is a flash code only and produces no message on the DRB III diagnostic scan tool screen.

13 No Change in MAP From Start to Run – (P 1297)
The Neon's MAP sensor is mounted directly to the plastic intake manifold, between the runners for cylinders 1 and 2. It serves as a PCM input at pin 29, receiving 5 volts from the PCM at pin 43 with sensor ground at pin 51. This test is run when engine rpm falls between 400-1500 and the throttle is closed.

The pumping action of the cylinders creates a low pressure area in the manifold which draws the air/fuel mixture into the combustion chambers. This information provides an important PCM input for determining fuel injector pulse width. The sensor should measure a difference in barometric pressure between key ON and after the engine is running. If this does not occur, the PCM enters the limp-in mode and uses throttle position and engine rpm to estimate MAP value. A single test failure causes the MIL to illuminate.

14 Map Sensor Voltage Too Low – (P 0107)
When this code is produced, the MAP sensor voltage has fallen below the minimum acceptable voltage of 0.02 volts. This test is run when engine rpm is between 400-1500 and TPS voltage is less than 1.0 volt (closed). As in the situation above, the PCM estimates MAP value to allow the engine to run. MIL operation is the same as above.

14 Map Sensor Voltage Too High – (P 0108)
This code is generated when the MAP sensor voltage exceeds the maximum voltage of 4.667 volts. PCM and MIL operation is identical to the previous MAP examples.

15 No Vehicle Speed Sensor Signal – (P 0500)
The vehicle speed sensor is a Hall-effect sensor mounted on the transmission housing and serves as a PCM input switching voltage between 0 and 5 volts at pin 5. The sensor receives power (9 volts) at PCM pin 44 and is grounded at pin 51.

Once the vehicle is in motion and the throttle is open, information from the sensor is sampled every 11 milliseconds and compared to a minimum threshold equal to 1 mph. If the sensor's output voltage indicates a speed higher than this threshold, the sensor is considered to be operating normally. Failure is defined as no signal from the sensor for more than 11 seconds.

Failure of the sensor would be quite noticeable because the speedometer would fail to operate. Diagnostic features that depend on the speed sensor may never execute if this component fails.

16 Knock Sensor #1 Circuit – (P 0325)
The knock sensor serves as a PCM input at pin 27. It is located near the starter, on the side of the engine block. The sensor consists of a piezoelectric material that constantly vibrates, sending a voltage signal to the PCM when the engine is operating. When the signal exceeds a threshold, the PCM retards engine timing to reduce knock.

17 Closed Loop Temperature Not Reached – (P 0125)
The fuel control system remains in open loop due to low engine temperature.
This DTC will be stored if engine temperature remains below 60° F. for 10 minutes of operation and no engine coolant temperature sensor code has been set. See MIL code 22 for more information

21 Upstream O2S Response — (P 0133)

21 Downstream O2S Response — (P 0139)

21 Upstream O2S Stays at Center — (P 0134)
An electrical check of sensor output voltage is performed. If voltage stays at center instead of switching, an open circuit is likely.

21 Upstream O2S Heater Failure — (P 0135)

21 Downstream O2S Heater Failure — (P 0141)
The PCM continues to monitor this system after the key is off. The PCM uses the battery temperature sensor to sense ambient temperature and waits a measured amount of time, based on this input, to allow the O_2 sensors to cool. Once the PCM has timed out, it energizes the ASD relay and tests for O_2 heater operation.

21 Upstream O2S Shorted to Voltage — (P 0132)

21 Downstream O2S Shorted to Voltage — (P 0138)

Both upstream and downstream oxygen sensors require a heater circuit for proper operation. Both are supplied with battery voltage through the ASD relay to provide this circuit. A failure in the sensor's heater circuit prevents it from providing accurate data to the PCM. If the PCM monitors more than 1.2 volts, the sensor has shorted to voltage.

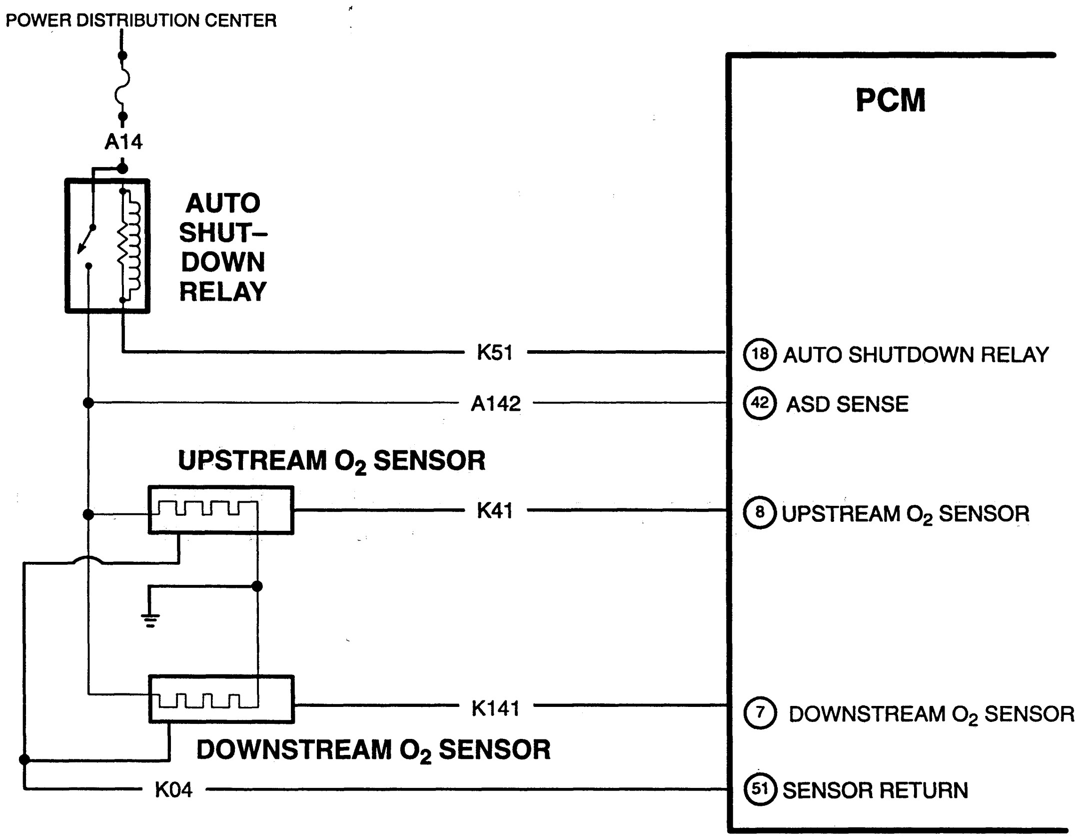


Figure 18 Oxygen Sensor Circuits

22 ECT Sensor Voltage Too Low – (P 0117)
The engine coolant temperature sensor is located on the rear of the cylinder head, just below and to the left of the cam shaft position sensor. It serves as a PCM input through pin 28. Data from the coolant temperature sensor is used in most fuel and spark related control functions. This code occurs when voltage input to the controller is below the threshold value of 0.51 volt.

22 ECT Sensor Voltage Too High – (P 0118)
The upper threshold for coolant temperature sensor output is 4.96 volts. Input to the PCM above this level causes the system's fault code to be set. In each case, the PCM uses a default value as the coolant temperature, and the vehicle enters the limp-in mode. The MIL illuminates because incorrect ECT input can produce excessive emissions and poor vehicle performance.

23 Intake Air Temp Sensor Voltage Low – (P 0112)
Mounted on the plastic intake manifold, the intake air temperature sensor serves as a PCM input at pin 6. When the fuel system is in the open loop mode, the O_2 sensor cannot be used for injector pulse width calculation. In this instance, the system uses information on air mass to determine the correct pulse width necessary to achieve the proper air/fuel ratio. Because air mass is related to temperature, information from the intake air temperature sensor is used.

The sensor has a low voltage threshold of 0.51 volt. If the output voltage falls below this threshold, a fault is set.

23 Intake Air Temp Sensor Voltage High – (P 0113)
The high voltage threshold for this sensor is 4.96 volts. If output voltage exceeds this limit, a fault is set.

24 Throttle Position Sensor Voltage Low – (P 0122)
The throttle position sensor is mounted on the side of the throttle body. The sensor consists of a variable resistor that provides a voltage signal to the PCM at pin 10 based on the position of the throttle blade. The sensor is supplied with 5 volts through pin 43 of the PCM and ground at pin 51.

The PCM uses throttle body position information to adjust ignition timing and fuel injector pulse width. If the sensor fails, the PCM moves to the limp-in mode and uses MAP to estimate throttle position. Engine performance and emissions suffer.

This DTC is set when the voltage input at pin 10 falls below the minimum threshold (0.4 volt). The MIL illuminates immediately when this condition occurs.

24 Throttle Position Sensor Voltage High – (P 0123)
This DTC occurs when the voltage input to the controller is above 4.4 volts (wide open throttle) for a given number of seconds. The MIL illuminates immediately when this occurs.

24 Throttle Position Does Not Agree With Map – (P0121)
This DTC indicates a failure in the rationality check comparing MAP values to throttle position. As with other throttle position sensor failures, a fault is generated and the MIL illuminates.

25 Idle Air Control Motor Circuits – (P 0505)
The Idle Air Control (IAC) stepper motor is located on the throttle body. It is operated as a PCM output through pins 14, 15, 34, and 35. It is used to prevent the engine from stalling at idle. With the throttle plate completely closed, placing a load on the engine (A/C or power steering operation) might cause the engine to stall or run rough. As the PCM anticipates loads, it operates the IAC motor, opening the throttle bypass passage and allowing more air into the intake manifold. Malfunction of this system could cause rough idle and unstable emissions.

A shorted condition in one of the motor circuits for 2.75 seconds causes this DTC to be stored. The MIL illuminates when this code has matured. The PCM cannot detect an open circuit or determine if the stepper motor is stuck in one position.

25 Target Idle Not Reached
This DTC is stored when, with the vehicle at rest and the brake applied, idle rpm differs from target idle by 200 rpm for 12 seconds.47

27 Injector #1 Control Circuit – (P 0201)

27 Injector #2 Control Circuit – (P 0202)

27 Injector #3 Control Circuit – (P 0203)

27 Injector #4 Control Circuit – (P 0204)
Grounds for the injector circuits are provided by the PCM at pins 3, 4, 24, and 25. Battery power is provided through the ASD relay. These DTC's are set if an open or shorted condition is detected in the control circuit for the individual injector.

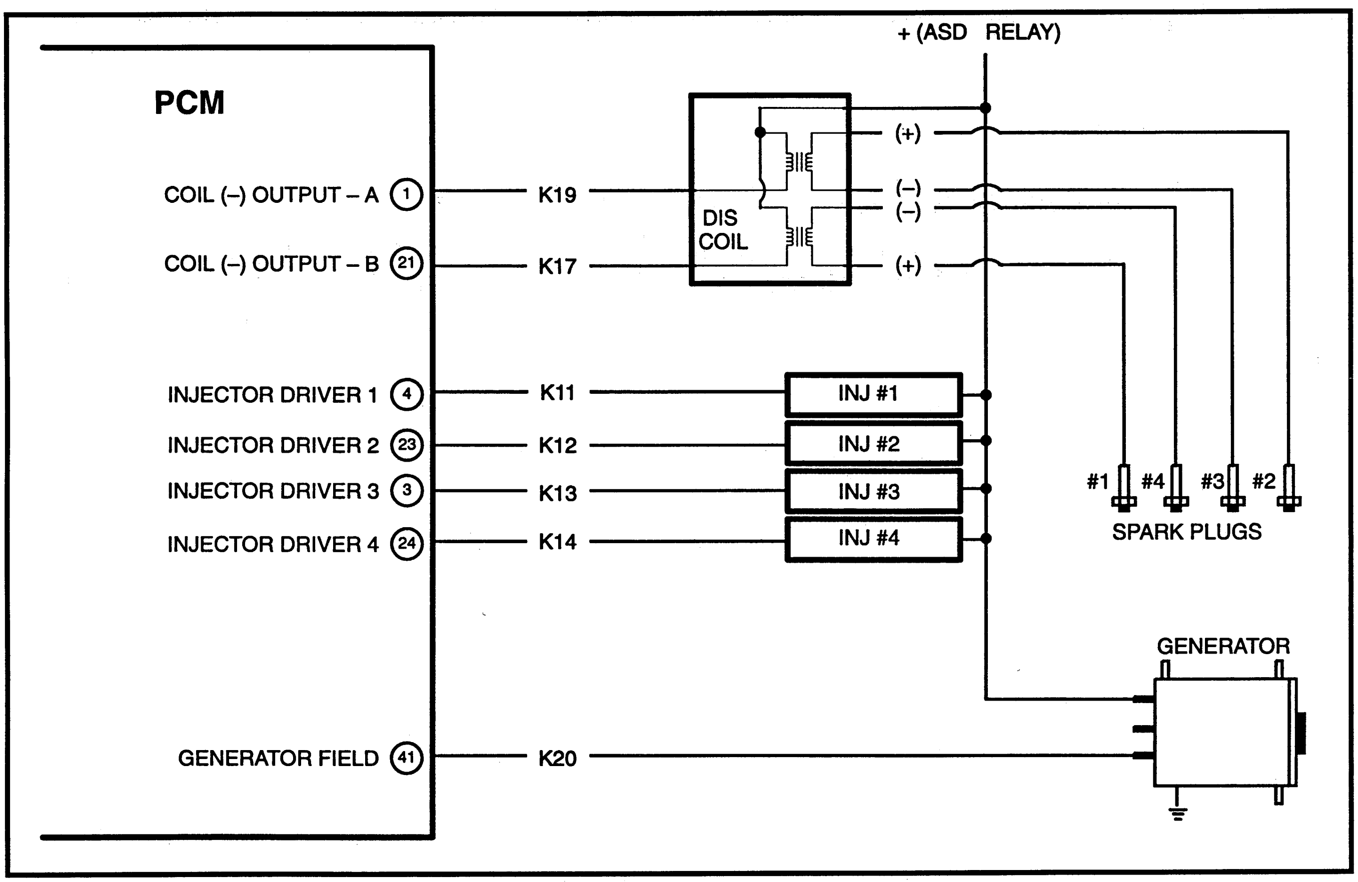


Figure 19 Injector Control Circuit

31 EVAP Solenoid Circuit – (P 0443)
The evaporative purge solenoid is mounted on the passenger side of the engine compartment. It is operated as a PCM output with pin 16 providing a switched ground path once the vehicle enters closed loop operation. This DTC indicates a shorted or open condition in the circuit.

31 Evaporative Purge Flow Monitor Failure – (P 0441)
This is a functionality test. If the fuel control doesn't sense purge vapor flow from the canister, this code will be set.

32 EGR Solenoid Circuit – (P 0403)
The EGR solenoid is mounted on the transducer, located at the back of the cylinder head near the cam shaft position sensor. The PCM provides a switched ground path to the solenoid through pin 39. This DTC indicates an open or shorted condition in the EGR control circuit.

32 EGR System Failure – (P 0401)
See the explanation of the EGR Monitor in the Main Monitor section of this reference guide.

33 A/C Clutch Relay Circuit
The PCM provides a switched ground to the A/C clutch relay at pin 59. By providing it with authority over A/C clutch operation at all times, the PCM can prevent operation of the A/C clutch in selected situations such as during wide open throttle or for a brief period at start-up. This DTC indicates an open or shorted condition in the circuit.

34 Speed Control Solenoid Circuits
The PCM receives a SET signal from the speed control at pin 31 and provides ground for the speed control vent and vacuum circuits at pins 60 and 40. This DTC indicates an open or shorted condition in one of the circuits.

35 Radiator Fan Control Relay Circuit
The PCM operates the radiator fan by providing a ground path for the relay at pin 19. This DTC indicates an open or shorted condition in the control circuit.

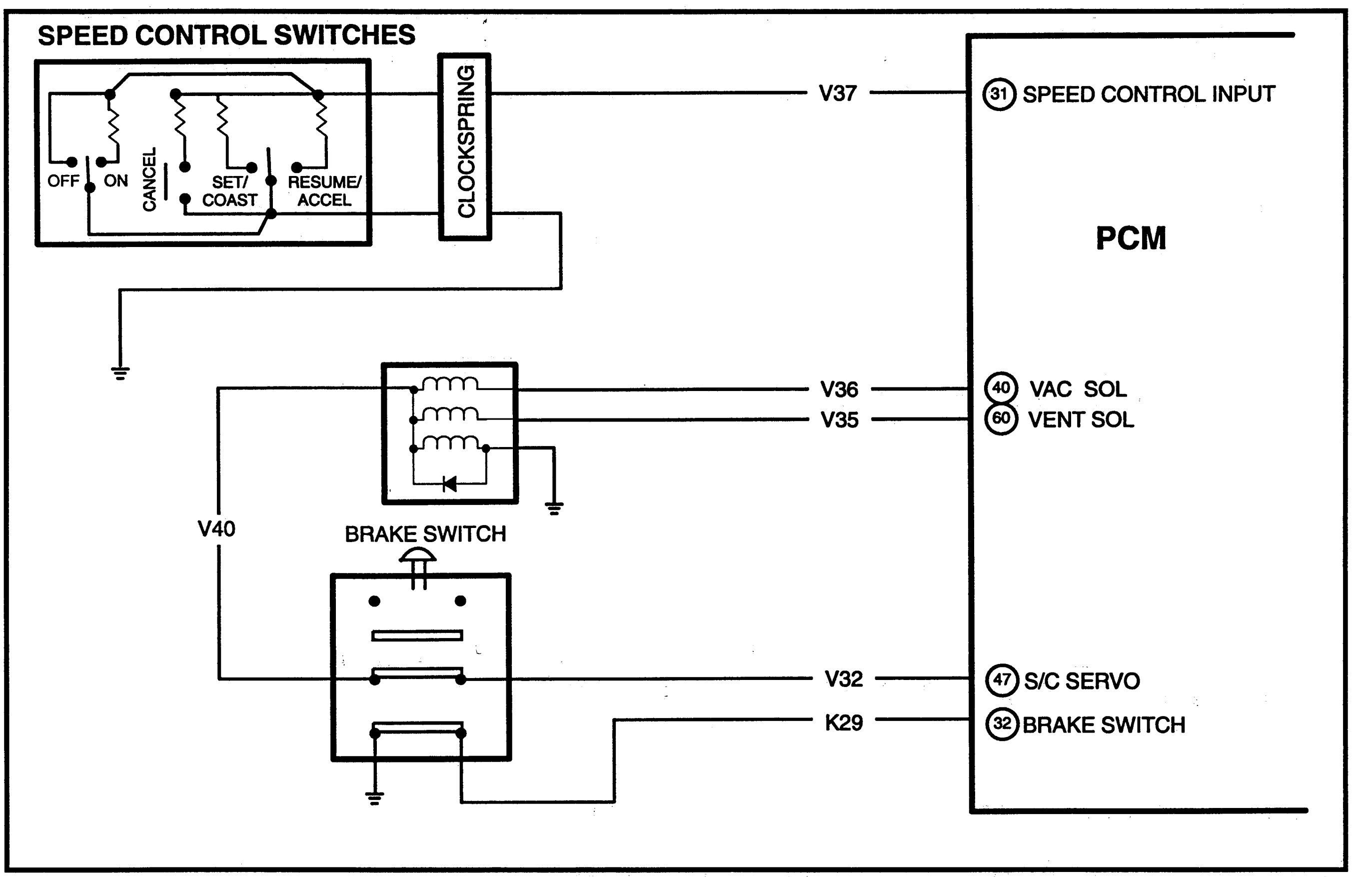


Figure 20 Speed Control Circuits

37 Park/Neutral Switch Failure – (P 1899)
(Automatic transmissions only) The PCM receives input from the Park/Neutral switch at pin 50.

37 Torq Conv Clu. No RPM Drop at Lockup (P 0740)
The PCM controls the solenoid that unlocks the torque converter clutch at partial throttle by controlling the ground path at pin 17.

37 Torque Converter Clutch Solenoid Circuit – (P 0743)
(Automatic transmissions only.)

41 Generator Field Not Switching Properly
The PCM receives generator field input at pin 41. Battery voltage is supplied to the generator through the ASD relay.

42 Auto Shutdown Relay Control Circuit
The Automatic Shutdown Relay (ASD) controls the battery voltage supplied to the fuel injectors, ignition coils, and generator. It is located in the power distribution center. The PCM provides a ground path for the ASD relay at pin 18. This DTC indicates an open or shorted condition in the control circuit.

42 No ASD Relay Output Voltage at PCM
The PCM senses operation of the ASD relay by measuring voltage at pin 42. This DTC indicates that no voltage is being sensed when the ASD relay is being energized.

42 Fuel Pump Relay Control Circuit
Operation of the fuel pump relay is controlled by the PCM which supplies a ground path for the relay's coil at pin 38.

42 Fuel Gauge Sending Unit Volts Too Low

42 Fuel Gauge Sending Unit Volts Too High

42 Fuel Sending Unit No Change Over Miles
If fuel level remains static over a number of miles or a short or open circuit is detected, a DTC will be recorded for the fuel sending unit.

43 Ignition Coil #1 Primary Circuit – (P 1351)

43 Ignition Coil #2 Primary Circuit – (P 1352)
The PCM provides the ground control circuit for the primary side of both ignition coils (coil #1 through pin 21 and coil #2 through pin 1). Battery voltage is supplied through the ASD relay. This trouble code indicates that the primary circuit is not achieving peak current with 5.75 milliseconds dwell.

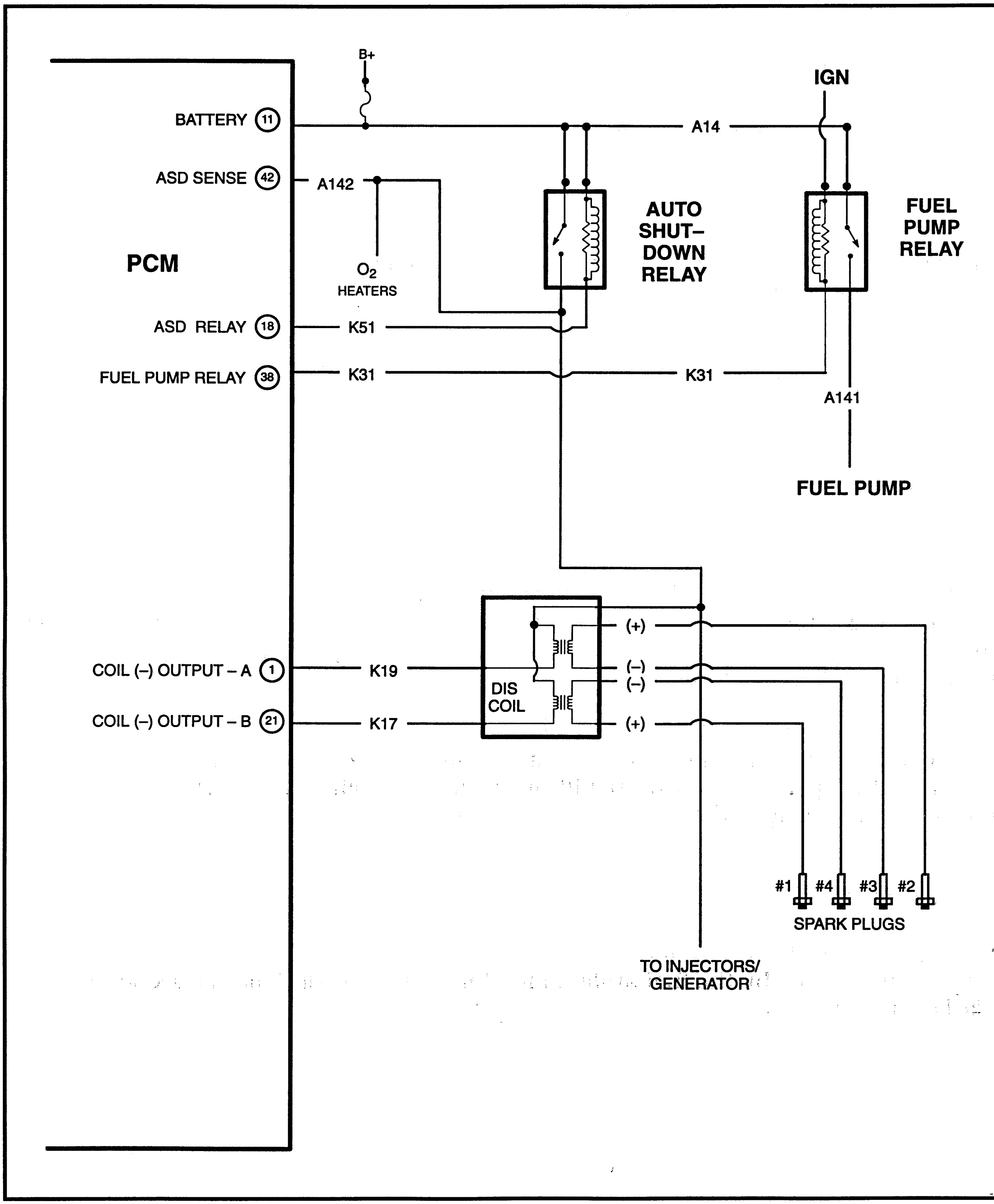


Figure 21 ASD Relay/Ignition Coil Circuit

43 Cylinder #1 Misfire — (P 0301)

43 Cylinder #2 Misfire — (P 0302)

43 Cylinder #3 Misfire — (P 0303)

43 Cylinder #4 Misfire — (P 0304)

43 Multiple Cylinder Misfire — (P 0300)
These codes are set by the misfire monitor. See the Main Monitor section of this reference guide for more information.

44 Battery Temp Sensor Volts out of Limit
The PCM receives a battery temperature input at pin 49. This information is used for the intake air temperature sensor's rationality check. This DTC indicates that the input voltage is not within the acceptable range of .04 to 4.9 volts for a period of 3 or more seconds.

46 Charging System Voltage Too High
The PCM tries to maintain charging system voltage of between 12.9 and 15 volts. This code indicates that the battery voltage input is above the target charging voltage during engine operation and PCM efforts to regulate the generator field do not prevent the voltage from rising.

47 Charging System Voltage Too Low
This code indicates that the battery voltage input is below the target charging voltage during engine operation and no significant change in voltage has been detected during active testing of the alternator output circuit.

51 Fuel System Lean — (P 0171)

52 Fuel System Rich — (P 0172)
These codes are set by the fuel system monitor. See the Main Monitor section in this text for more information.

53 Internal Controller Failure – (P 0605)
An internal fault has been detected in the PCM.

53 PCM Failure SPI Communications

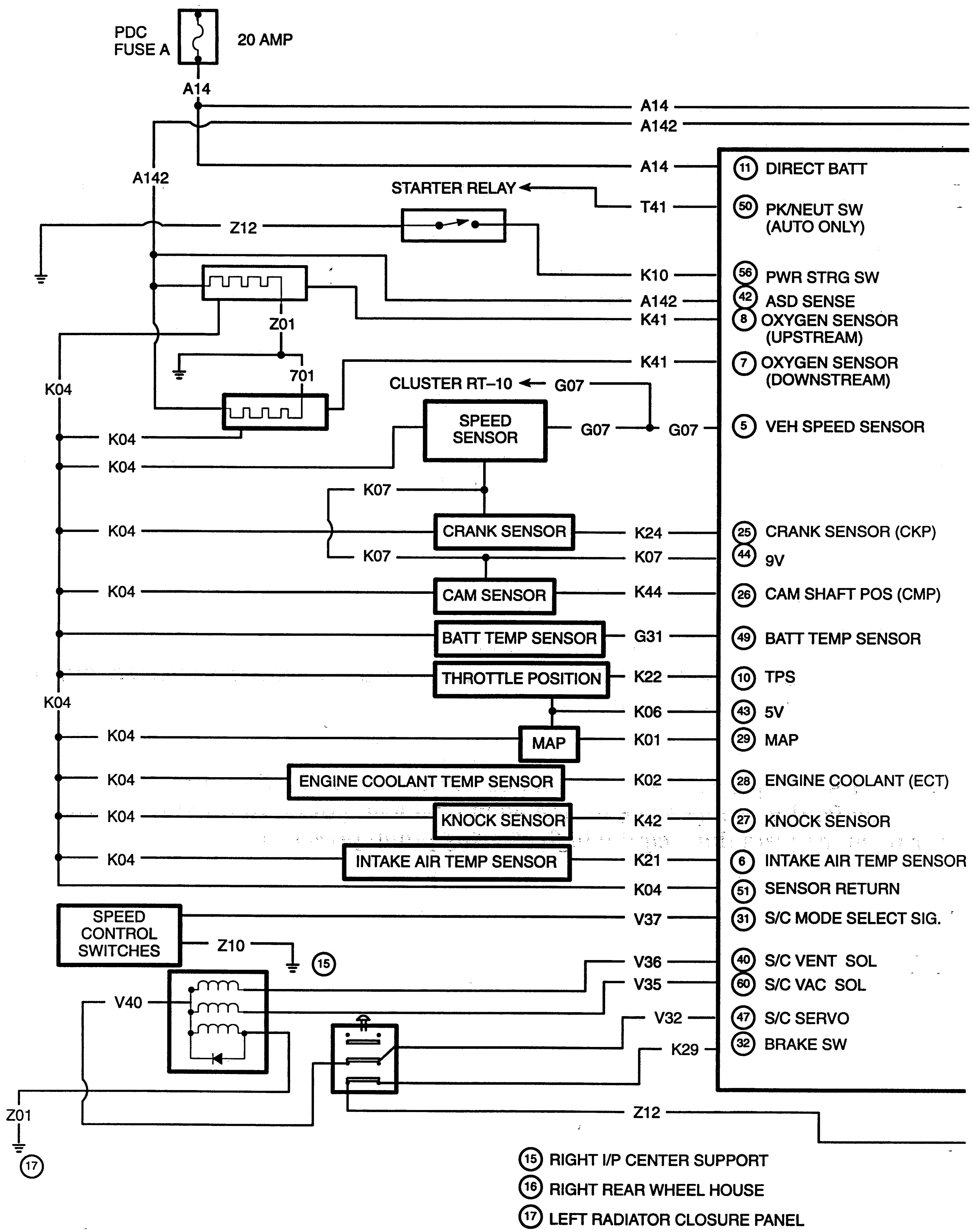
54 No Cam Sync Signal at PCM – (P 0340)
The camshaft position sensor, mounted on the rear of the cylinder head, is a Hall-effect sensor that provides input to the PCM at pin 26. The PCM uses information from both the cam and crank sensors (pin 25) to determine ignition timing. When the cam signal is lost, the PCM relies on the crank signal to allow engine operation. This could result in fuel injection being 180° out of phase, which would result in deterioration of engine performance and emissions. The MIL is illuminated and the DTC is set.

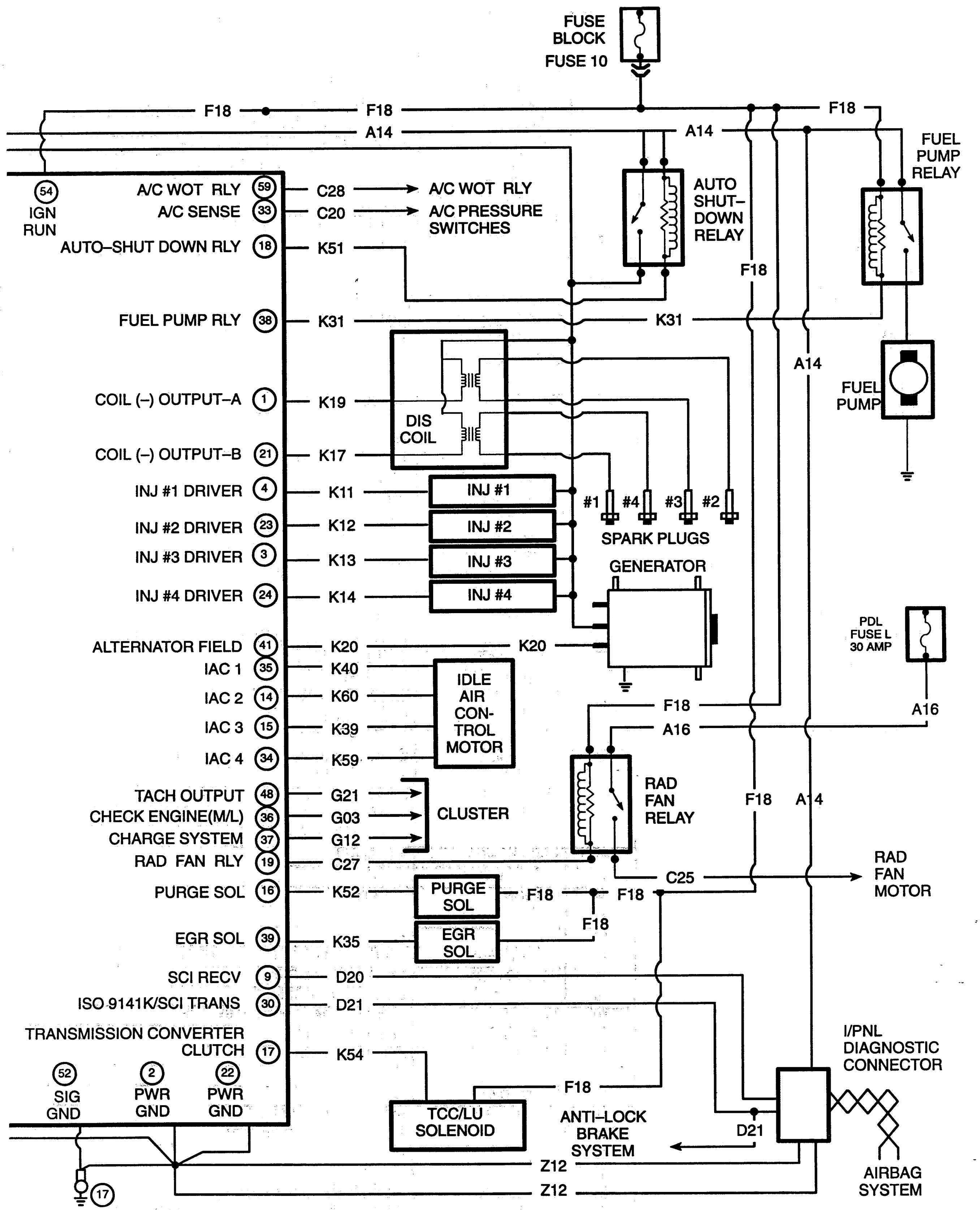
55 End of Message
This is a flash code only and indicates that no further codes are stored. No message will appear on the DRB III diagnostic scan tool screen.

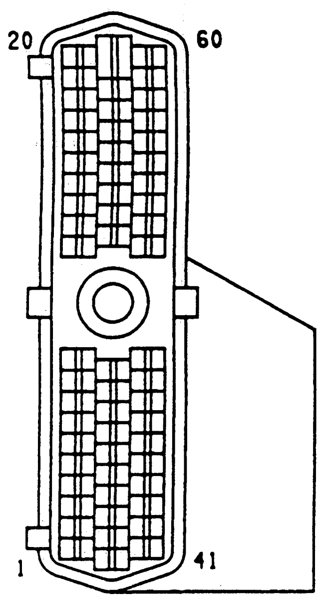
62 PCM Failure SRI Mile Not Stored

64 Catalytic Convertor Efficiency Failure – (P 0422)
This DTC indicates a failure of the catalyst monitor test. For more information, see the Main Monitor section of this text.

65 Power Steering Switch Failure – (P 1596)
The power steering switch serves as a PCM input at pin 56. Data from this switch allows the PCM to compensate for the additional load put on the engine during steering maneuvers that require high steering pump pressure.


PDC
FUSE A
20 AMP
A14
A14
A142
A142
A14
STARTER RELAY
T41
Z12
K10
A142
Z01
K41
K04
701
K41
CLUSTER RT–10
G07
SPEED SENSOR
G07
G07
K04
K04
K07
K04
CRANK SENSOR
K24
K07
K07
K04
CAM SENSOR
K44
BATT TEMP SENSOR
G31
THROTTLE POSITION
K22
K04
K06
K04
MAP
K01
K04
ENGINE COOLANT TEMP SENSOR
K02
K04
KNOCK SENSOR
K42
K04
INTAKE AIR TEMP SENSOR
K21
K04
SPEED CONTROL SWITCHES
V37
Z10
15
V36
V35
V40
V32
K29
Z01
17
Z12
11 DIRECT BATT
50 PK/NEUT SW (AUTO ONLY)
56 PWR STRG SW
42 ASD SENSE
8 OXYGEN SENSOR (UPSTREAM)
7 OXYGEN SENSOR (DOWNSTREAM)
5 VEH SPEED SENSOR
25 CRANK SENSOR (CKP)
44 9V
26 CAM SHAFT POS (CMP)
49 BATT TEMP SENSOR
10 TPS
43 5V
29 MAP
28 ENGINE COOLANT (ECT)
27 KNOCK SENSOR
6 INTAKE AIR TEMP SENSOR
51 SENSOR RETURN
31 S/C MODE SELECT SIG.
40 S/C VENT SOL
60 S/C VAC SOL
47 S/C SERVO
32 BRAKE SW
15 RIGHT I/P CENTER SUPPORT
16 RIGHT REAR WHEEL HOUSE
17 LEFT RADIATOR CLOSURE PANEL


FUSE BLOCK
FUSE 10
F18
F18
A14
A14
F18
FUEL PUMP RELAY
54 IGN RUN
A/C WOT RLY 59
A/C SENSE 33
AUTO-SHUT DOWN RLY 18
C28
C20
A/C WOT RLY
A/C PRESSURE SWITCHES
K51
AUTO SHUT-DOWN RELAY
F18
FUEL PUMP RLY 38
K31
K31
A14
FUEL PUMP
COIL (–) OUTPUT-A 1
K19
DIS COIL
COIL (–) OUTPUT-B 21
K17
INJ #1 DRIVER 4
K11
INJ #1
INJ #2 DRIVER 23
K12
INJ #2
INJ #3 DRIVER 3
K13
INJ #3
INJ #4 DRIVER 24
K14
INJ #4
#1 #4 #3 #2
SPARK PLUGS
GENERATOR
ALTERNATOR FIELD 41
K20
K20
PDL FUSE L 30 AMP
IAC 1 35
K40
IAC 2 14
K60
IAC 3 15
K39
IAC 4 34
K59
IDLE AIR CON-TROL MOTOR
F18
A16
A16
RAD FAN RELAY
F18
A14
TACH OUTPUT 48
G21
CHECK ENGINE(M/L) 36
G03
CHARGE SYSTEM 37
G12
CLUSTER
RAD FAN RLY 19
C27
C25
RAD FAN MOTOR
PURGE SOL 16
K52
PURGE SOL
F18
F18
F18
EGR SOL 39
K35
EGR SOL
SCI RECV 9
D20
ISO 9141K/SCI TRANS 30
D21
TRANSMISSION CONVERTER CLUTCH 17
K54
I/PNL DIAGNOSTIC CONNECTOR
52 SIG GND
2 PWR GND
22 PWR GND
F18
TCC/LU SOLENOID
ANTI-LOCK BRAKE SYSTEM
D21
AIRBAG SYSTEM
Z12
Z12
17



VIEWED FROM
TERMINAL END

CAV	CIRCUIT	FUNCTION
1	K19 20BK/GY*	IGNITION COIL DRIVER
2	Z12 20BK/TN*	POWER GROUND
3	K13 20YL/WT*	FUEL INJECTOR #3
4	K11 20WT/DB*	FUEL INJECTOR #1
5	G7 20WT/OR*	VEHICLE SPEED SENSOR
6	K21 20BK/RD*	INTAKE AIR TEMPERATURE SENSOR
7	K141 20DG/BK*	HEATED OXYGEN SENSOR 2 (DOWNSTREAM)
8	K141 20BK/DG	HEATED OXYGEN SENSOR 1 (UPSTREAM)
9	D20 20LG	DATA LINK
10	K22 20OR/DB*	THROTTLE POSITION (SENSOR)
11	A14 18RD/WT	BATTERY FEED
12	–	–
13	G4	FUEL LEVEL SENDING UNIT
14	K60 20YL/BK*	IDLE AIR CONTROL #2
15	K39 20GY/RD*	IDLE AIR CONTROL #3
16	K52 20PK/BK*	EVAP/PURGE SOLENOID
17	K54 20OR/BK*	TRANSMISSION TCC LU SOLENOID
18	K51 20DB/YL*	AUTOMATIC SHUTDOWN RELAY
19	C27 20DB/PK*	FAN CONTROL RELAY
20	–	–
21	K17 20DB/YL*	IGNITION COIL DRIVER
22	Z12 20BK/TN*	POWER GROUND
23	K12 20TN	FUEL INJECTOR #2
24	K14 20LB/BR*	FUEL INJECTOR #4
25	K24 20GY/BK*	CRANKSHAFT POSITION SENSOR
26	K44 20TN/YL*	CAMSHAFT POSITION SENSOR
27	K42 20BK/LG*	KNOCK SENSOR
28	K2 20TN/BK*	ENGINE COOLANT TEMPERATURE SENSOR
29	K1 20DG/RD*	MAP SENSOR
30	D21 20PK	DATA LINK
31	V37 20RD/LG*	VEHICLE SPEED CONTROL MODE SELECT SIGNAL
32	K29 20WT/PK*	BRAKE SWITCH SENSOR
33	C20 20BR/OR*	A/C SENSE
34	K59 20VT/BK*	IDLE AIR CONTROL #4
35	K40 20BR/WT*	IDLE AIR CONTROL #1
36	G3 20BK/PK*	CHECK ENGINE LAMP (MIL)
37	G12 20TN/BK*	CHARGE SYSTEM LAMP (CLUSTER)
38	K31 20BR	FUEL PUMP RELAY
39	K35 20GY/YL*	EXHAUST GAS RECIRCULATION SOLENOID
40	V36 20TN/RD	VEHICLE SPEED CONTROL VENT SOLENOID
41	K20 18DG	GENERATOR FIELD
42	A142 18DG/OR*	ASD SENSE
43	K6 20VT/WT*	5 VOLTS
44	K7 20OR	9 VOLTS
45	–	–
46	–	–
47	V32 20YL/RD*	VEHICLE SPEED CONTROL SWITCHED IGNITION FEED
48	G21 20GY/LB*	TACHOMETER SIGNAL
49	–	BATTERY TEMP SENSOR
50	T41 20BR/YL*	PARK/NEUTRAL POSITION SWITCH
51	K4 20BK/LB*	SENSOR GROUND
52	Z11 22BK/WT*	SIGNAL GROUND
53	–	–
54	F18 20LG/BK*	IGNITION FEED
55	L1 20VT/OR*	REVERSE INPUT SENSE
56	K10 20WT	POWER STEERING SWITCH
57	–	–
58	–	–
59	C28 20DB/OR*	A/C COMPRESSOR CLUTCH
60	V35 20LG/RD	POSITION FEEDBACK VEHICLE SPEED CONTROL VACUUM SOLENOID

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