ASTON MARTIN

DB7

OBD II Diagnostics Manual

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Aston Martin DB7 Diagnostics Manual

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The Development of On Board Diagnostic (OBD) Systems

Introduction

The operation of the internal combustion engine depends on the ability to rapidly and accurately control several variables. The two main variables are; the quantity of fuel passed to the cylinder and the timing of ignition. Basic control of these variables was, in the past, done with mechanical devices; the carburettor for fuelling, and points, coil and distributor for ignition. As these devices were developed they became more complex and sophisticated.

The function of the carburettor was to keep the air-fuel ratio constant, and complex arrangements of passages, jets, chokes etc. were required to modify the fuelling in response to constantly changing conditions.

Mechanical ignition systems had devices such as vacuum and centrifugal advance mechanisms which modified the timing for changing engine loads and speeds. The calibration of these devices was a skilled task, executed by engineers with years of experience. In the search for refinement and accurate control, the increased complexity affected reliability and increased the need for regular servicing.

The first widespread application of electronics for engine control was in the ignition system where part of the control was made "solid state". The mechanical points were replaced by Hall-effect position sensors and the ignition timing was electronically controlled, however the distributor remained. Fully electronic ignition systems followed, with microcomputer and software controls, solid-state amplifiers and now, a small high tension coil for each spark plug.

Electronic fuel injection appeared at this time, although only on "high performance" cars. In this system, fuel at a constant pressure is injected into the inlet tract by opening an injector for a calculated time. Microcomputer controls are required to calculate the length of time the injector is open, for a given engine speed and load, and also to compensate for conditions such as cold start, overrun, hard acceleration etc.

Although often treated as separate systems, many cars today have both fuel and ignition controls integrated into a single computer known as the Engine Management System or EMS. The EMS measures the running state of the engine through a number of sensors such as crank position, coolant temperature, intake air flow etc. and controls the ignition and fuelling according to look-up tables, or "maps", stored within it's programme. The process of "mapping" during vehicle development is the same task that was previously done by experienced engineers calibrating carburettors and ignition timing, except that now it is done with lap top computers and tables of hexadecimal numbers. The use of electronic controls for engines has increased engine reliability and lengthened the intervals between routine services. They have also enabled manufacturers to meet ever tighter regulations on engine exhaust emissions with improved ancillary systems. New problems have been created for those whose job is the solving of vehicle problems because a traditional mechanic's skills must now be augmented by a knowledge of electronic system fault finding.

The latest developments in automotive engine controls are directed towards integrating the Engine Management System with the powertrain and chassis control systems. This involves techniques such as the use of indirect electronic control of the throttle and distributed control via high speed multiplexed data buses.

On Board Diagnostics II System

Overview

The California Air Resources Board (CARB) began regulation of On Board Diagnostics (OBD) for vehicles sold in California beginning in the 1988 model year. The first phase, OBD I, required monitoring of the fuel metering system, exhaust gas recirculation system, and additional emission related components. The Malfunction Indicator Lamp (MIL) (lamp labelled CHECK ENGINE) was required to light and alert the driver if the emission control system malfunctioned or was in need of service. Associated with the MIL was a fault code identifying the specific area of the fault.

The OBD I strategy was further developed and updated to OBD II to include further monitoring of the emission control system.

When a system or component exceeds emission thresholds or when a component operates outside of tolerance, a Diagnostic Trouble Code (DTC) will be stored and the CHECK ENGINE (MIL) lamp will come on (USA and Canada).

The Powertrain Control Module (PCM) contains all the software to supervise and control the engine management system. The PCM also contains the diagnostic software (the Diagnostic Executive) required to detect any system malfunctions which could increase harmful emissions.

The Diagnostic Executive is the computer programme which monitors aspects of emission related engine performance. This programme controls all the monitor sequences, records DTCs, lights the MIL lamp (USA and Canada) and memorises freeze frame data for later analysis

The freeze frame data may be accessed using the portable diagnostic equipment or other scan tool. The stored data describes engine conditions at the time the malfunction was detected, such as the state of the engine, state of fuel control, spark, rpm, load and warm up status. Previously stored conditions will be replaced only if a fuel or misfire malfunction is detected.

In order to pass all diagnostic monitors, a new vehicle or one in which the PCM memory has been cleared must be driven sufficiently to clear all component checks. Until all checks are complete, a P1000 code will be recorded. The P1000 code will clear when all sections of the OBD II drive cycle are completed. The drive cycles are described later in this section.

The following monitors are included in the diagnostic software:

- Exhaust Gas Recirculation (EGR) Monitor
- Heated Oxygen Sensor (HO2S) Monitor
- Catalyst Efficiency Monitor
- Misfire Detection Monitor
- Fuel System Monitor
- Comprehensive Component Monitor
- Secondary Air Injection Monitor

Comprehensive Component Monitor

The comprehensive component monitor is a self test strategy that detects malfunctions of any electronic powertrain component inputting to the PCM which is not exclusively an input to any other OBD II monitor.

The inputs monitored include the Vehicle Speed Sensor (VSS), Mass Air Flow Meter (MAF, Engine Coolant Temperature (ECT), and Throttle Potentiometer (TP) sensors. Outputs monitored by the comprehensive component monitor include the Ignition System (ID and PIP), Fuel Pump, Fan Control and Idle Speed Control.

An input component malfunction is declared if there is a lack of continuity, the signal is out of range, or if the signal is not in the correct relationship to another associated signal.

An output component malfunction is declared if there is a lack of continuity or if an expected output response to a PCM command does not occur.

In the comprehensive component monitor, when a malfunction has been present for two drive cycles, the DTC is stored in the PCM and the MIL is turned on (USA and Canada).

The MIL is turned off after three consecutive trips without the same malfunction being detected provided that no other DTCs are stored which would independently turn on the MIL. The DTC will be erased from memory after 40 warm-up cycles without the malfunction being detected after the MIL is turned off. The code may also be cleared by performing a PCM reset.

Heated Oxygen Sensor Monitor

OBD II regulations require monitoring of the upstream heated oxygen sensors to detect when deterioration of the sensor has exceeded emission thresholds. Two additional oxygen sensors are located downstream to determine the efficiency of the catalyst. Although the downstream sensors are the same type used for fuel control, they function differently. They are monitored to determine if a voltage is generated. That voltage is then compared to values in memory to determine if the catalyst efficiency is in range.

Operation

The fuel control system attempts to maintain an air/fuel ratio of 14.7:1. The PCM uses the input from the upstream HO2S sensors to fine tune the air fuel mixture.

The heated oxygen sensors are mounted in the exhaust flow between the engine and the catalytic convertors. The sensors operate between zero and one volt output depending on the oxygen content of the exhaust gasses. Lean air/fuel mixture will cause a sensor voltage of 0 - 0.4 volts. Rich air/fuel mixture will cause a voltage of 0.6 - 1.0 volts. The ideal air/fuel mixture would cause a sensor voltage of 0.4 - 0.6 volts to be generated. The actual sensor voltage will fluctuate as the system attempts to reach optimum air/fuel mixture under constantly changing conditions.

The following HO2S system checks are performed:

Upstream sensors are checked by changing the air fuel ratio and monitoring the sensor response.

Downstream sensors are monitored by noting the voltage change for changes in downstream oxygen content.

All sensors are monitored for overvoltage conditions

Sensor heaters are checked by turning them on and off and looking for corresponding changes in the output voltages.

When a HO2S malfunction is detected for two drive cycles, the DTC is stored in memory and the MIL is turned on (USA and Canada). The MIL will be turned off after three consecutive trips without the same malfunction being detected, providing that no other malfunctions are present which would independently turn on the MIL. The DTC will be erased from memory after 40 warm-up cycles provided that the same DTC is not detected. The code may also be cleared by performing a PCM reset.

Catalyst Efficiency Monitor

The catalyst efficiency monitor determines when the catalyst efficiency has fallen below the minimum efficiency requirements.

Upstream and downstream oxygen sensor signals are compared during a range of speed/load conditions. The catalyst must be able to process the exhaust gasses such that the rear oxygen sensors are prevented from switching in the same way as the front.

When a catalyst efficiency malfunction is detected for two drive cycles, the DTC is stored in memory and the MIL is turned on (USA and Canada). The MIL will be turned off after three consecutive trips without the same malfunction being detected, providing that no other malfunctions are present which would independently turn on the MIL. The DTC will be erased from memory after 40 warm-up cycles provided that the same DTC is not detected. The code may also be cleared by performing a PCM reset.

Fuel System Monitor

The fuel system monitor is a self test strategy within the PCM that monitors the adaptive fuel table. This table is used by the fuel control system to compensate for normal variability of the fuel system components due to age or wear. If the fuel system appears biased lean or rich, the adaptive fuel table values will be shifted to remove the bias.

The adaptive fuel system uses the upstream oxygen sensor outputs as its primary input. The system also is capable of adapting fuelling requirements based on, Intake Air Temperature, Engine Coolant Temperature and Mass Air Flow.

As the fuel control and air metering components age or vary from nominal values, the adaptive fuel strategy learns corrections while in closed loop operation. These corrections are stored in a table called 'Long Term Fuel Trim'. The table resides in KAM (Keep Alive Memory) and is used to correct fuel delivery while in open or closed loop control.

As components continue to change, the table will reach its adaptive limit and can no longer cope with additional changes in fuelling components. Further changes in the fuel system components will cause deviation in the closed loop parameter called 'Short Term Fuel Trim'. As this deviation in short term fuel trim approaches 1.5 times the applicable standard, fuel/air control suffers and emissions may increase. At this point, a fuel system fault is declared and a DTC is stored.

The fuel system tests are only run when the following preconditions are satisfied, engine rpm within acceptable range, air mass within calibrated limits, engine coolant temperature indicates the engine fully warmed up, steady throttle opening at a road speed of 30 - 45 mph. Idle and deceleration performances are excluded from fuel system testing.

In the fuel system monitor, when a malfunction has been present for two drive cycles, the DTC is stored and the MIL lamp is turned on (USA and Canada). At the same time, freeze frame data will be stored as described in the system overview. In order to provide the maximum information for fault analysis, the range of freeze frame data stored when a fuel system monitor fault occurs exceeds that required by the Air Resources Board.

The MIL is turned off after three consecutive drive cycles without the same DTC being detected provided that no other DTCs are recorded which would independently turn on the MIL. The DTC will be erased from memory after 40 warm up cycles provided that the same DTC is not detected. The code may also be cleared by performing a PCM reset.

Exhaust Gas Recirculation (EGR) Monitor

Tests the integrity of the circuitry, components and hoses that make up the EGR system. Detects errors in the circuitry or components and detects EGR flow rate errors.

Operation

The EGR monitor uses inputs from the Differential Pressure Feedback Sensor (DPFE) to monitor the EGR system. The monitor is capable of checking the DPFE sensor, Electronic Vacuum Regulator (EVR) solenoid, electrical circuits, pressure signal hoses, and the EGR valve. The EGR monitor sequence is only enabled when certain preconditions have been satisfied. Any failure in the PCM inputs from the engine coolant temperature (ECT), intake air temperature (IAT), throttle position sensor (TP) or mass air flow sensor (MAF) will prevent the EGR monitor sequence from starting.

EGR system components and EGR flow checks are performed.

When an EGR malfunction is detected for two drive cycles, the DTC is stored in memory and the MIL is turned on (USA and Canada). The MIL will be turned off after three consecutive trips without the same malfunction being detected, providing that no other malfunctions are present which would independently turn on the MIL. The DTC will be erased from memory after 40 warm-up cycles provided that the same DTC is not detected. The code may also be cleared by performing a PCM reset.

Purge System Monitor

Tests the integrity and operation of the evaporative loss purge system.

Operation

During vehicle acceleration, the engine fuelling requirements are stabilised and then the vapour management valve is opened . The fuelling correction required to rectify the fuel inbalance caused by the additional fuel vapour is used as an indicator of purge system flow.

Misfire Detection Monitor

Misfire is defined as the lack of proper combustion in the cylinder due to the absence of spark, poor fuel metering or poor compression. Any combustion occurring at an improper time is also defined as a misfire.

The misfire detection monitor detects fuel, ignition or mechanically induced misfires. The intent is to protect the catalysts from permanent damage and to alert the driver to an emission related failure by illuminating the MIL lamp (USA and Canada).

The misfire detection system monitors the crankshaft position sensor to detect abnormalities in crank rotation speed. Acceleration due to each cylinder firing can be calculated and memorised. Any crankshaft acceleration which is significantly less than the recorded value will be detected as a misfire.

When a misfire is detected, the freeze frame function is activated and current data on the operational state of the vehicle is recorded and held in PCM memory. This data can then be accessed by the PDU or scan tool and analysed to find the cause of the misfire.

When a misfire that would cause catalyst damage is detected, the MIL lamp is turned on (USA and Canada) and a diagnostic trouble code (DTC) is logged. If the misfire is the type that will cause an emission failure, the MIL will remain on continuously and a DTC will be stored after two malfunctions on separate drive cycles. DTCs will be erased and the MIL lamp turned off after 40 warm up cycles provided that the fault does not recur. The code may also be cleared by performing a PCM reset.

Secondary Air Injection Monitor

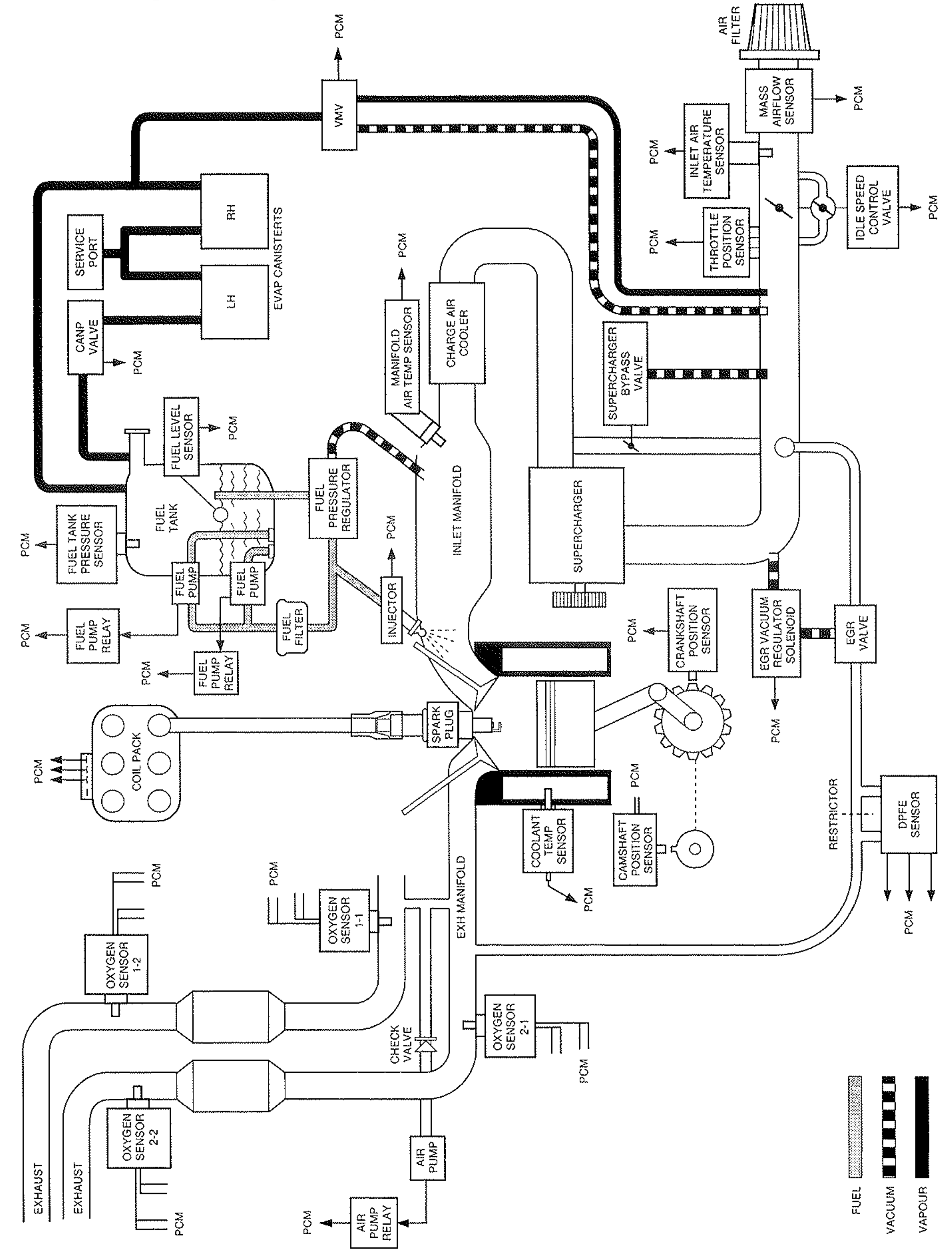
The purpose of the secondary air injection system is to control emissions during the first 20 to 120 seconds after the engine starts. It also provides the additional oxygen required for rapid catalyst warm-up (catalyst light off). Air is forced into the exhaust system to oxidize the additional hydrocarbons and carbon monoxide created by running rich during a cold start. The monitoring of the secondary air injection system will occur only once per drive cycle.

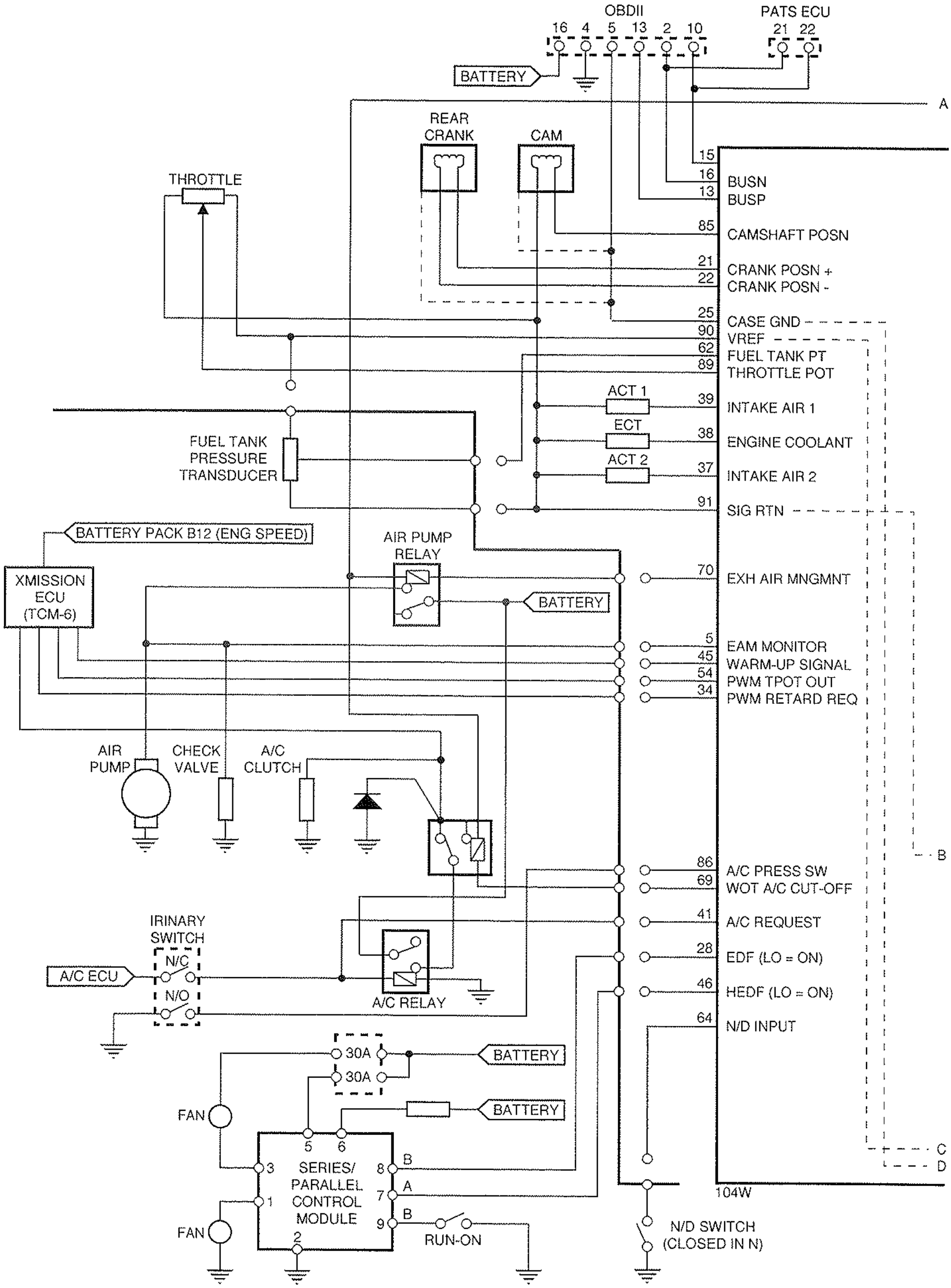
When the engine starts, the PCM signals the air pump relay to energise. The air pump will then provide the additional oxygen required to quickly warm up the catalysts. When the catalyst is up to temperature and the additional air is not required, the PCM signals the relay to switch off the air pump.

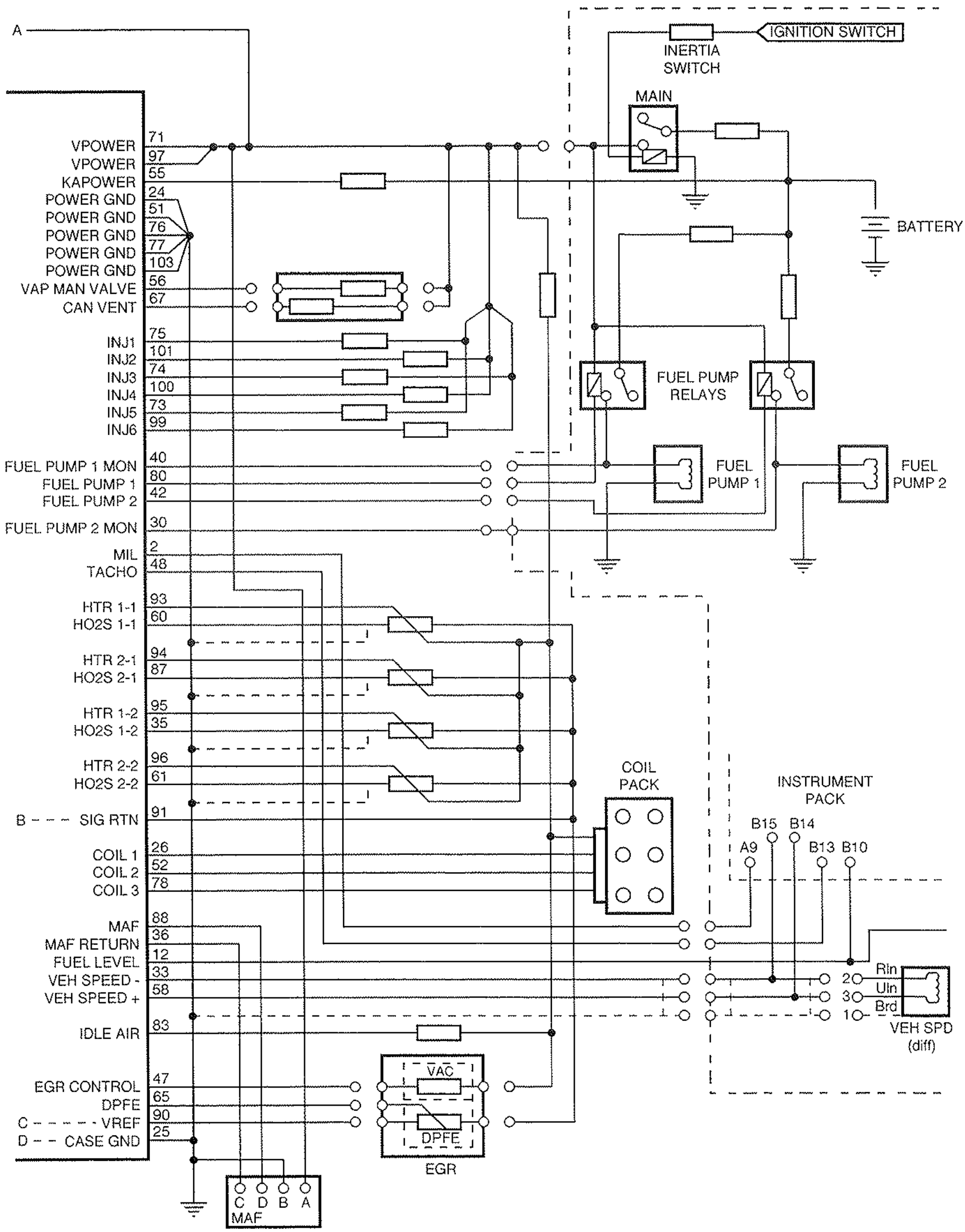
The secondary air injection monitor test switches on the air pump during a warm idle and looks for the upstream oxygen sensors to indicate a lean fuel/air mixture.

In the air system monitor, when a malfunction has been present for two drive cycles, the DTC is stored and the MIL lamp is turned on (USA and Canada). The MIL is turned off after three consecutive drive cycles without the same malfunction being detected provided that no other DTC is stored that would independently turn on the MIL. The DTC will be erased from memory after 40 warm-up cycles without the malfunction being detected after the MIL lamp is turned off. The code may also be cleared by performing a PCM reset.

The EECV Engine Management System




OBDII
16 4 5 13 2 10
PATS ECU
21 22
BATTERY
A
REAR CRANK
CAM
THROTTLE
15
16 BUSN
13 BUSP
85 CAMSHAFT POSN
21 CRANK POSN +
22 CRANK POSN -
25 CASE GND
90 VREF
62 FUEL TANK PT
89 THROTTLE POT
ACT 1
39 INTAKE AIR 1
ECT
38 ENGINE COOLANT
ACT 2
37 INTAKE AIR 2
91 SIG RTN
FUEL TANK PRESSURE TRANSDUCER
BATTERY PACK B12 (ENG SPEED)
XMISSION ECU (TCM-6)
AIR PUMP RELAY
BATTERY
70 EXH AIR MNGMNT
5 EAM MONITOR
45 WARM-UP SIGNAL
54 PWM TPOT OUT
34 PWM RETARD REQ
AIR PUMP
CHECK VALVE
A/C CLUTCH
B
86 A/C PRESS SW
69 WOT A/C CUT-OFF
41 A/C REQUEST
28 EDF (LO = ON)
46 HEDF (LO = ON)
64 N/D INPUT
IRINARY SWITCH
N/C
N/O
A/C ECU
A/C RELAY
30A
30A
BATTERY
BATTERY
FAN
FAN
5 6
3 SERIES/ PARALLEL CONTROL MODULE
1
2
8 B
7 A
9 B
RUN-ON
C
D
104W
N/D SWITCH (CLOSED IN N)


A
VPOWER 71
VPOWER 97
KAPOWER 55
POWER GND 24
POWER GND 51
POWER GND 76
POWER GND 77
POWER GND 103
VAP MAN VALVE 56
CAN VENT 67
INJ1 75
INJ2 101
INJ3 74
INJ4 100
INJ5 73
INJ6 99
FUEL PUMP 1 MON 40
FUEL PUMP 1 80
FUEL PUMP 2 42
FUEL PUMP 2 MON 30
MIL 2
TACHO 48
HTR 1-1 93
HO2S 1-1 60
HTR 2-1 94
HO2S 2-1 87
HTR 1-2 95
HO2S 1-2 35
HTR 2-2 96
HO2S 2-2 61
B - - - SIG RTN 91
COIL 1 26
COIL 2 52
COIL 3 78
MAF 88
MAF RETURN 36
FUEL LEVEL 12
VEH SPEED - 33
VEH SPEED + 58
IDLE AIR 83
EGR CONTROL 47
DPFE 65
C - - - - - VREF 90
D - - CASE GND 25
IGNITION SWITCH
INERTIA SWITCH
MAIN
BATTERY
FUEL PUMP RELAYS
FUEL PUMP 1
FUEL PUMP 2
COIL PACK
INSTRUMENT PACK
B15 B14
A9
B13 B10
Rin
Uin
Brd
2
3
1
VEH SPD (diff)
VAC
DPFE
EGR
C D B A
MAF

The Engine Management System - Description of Components

Powertrain Control Module (PCM)

The engine management system is controlled by the Powertrain Control Module (PCM), which receives signals from the sensors, compares them to the required standards and then modifies the fuel and ignition settings to maintain an optimum, stoichiometric, fuel and air mixture under all conditions. Sensor information is supplied to the Control Module Inputs, and control commands are issued through the Control Module Outputs. The PCM is located in the left footwell, behind a carpetted cover.

The Mass Air Flow Sensor (MAF)

The Mass Air Flow Sensor (MAF), measures the quantity of air drawn into the engine and reports to the ECM.

The Air Temperature Sensors (IAT)

The Inlet Air Temperature Sensor (IAT), measures the temperature of the air entering the throttle body. The Manifold Air Temperature Sensor measures air temperature after the intercooler so that the engine management system can compensate for air density changes through the supercharger and intercooler.

The Idle Speed Control Valve (ICA)

The Idle Speed Control Valve (ISCO), responding to ECM output signals and in conjunction with ignition timing control, governs engine idle speed.

The Engine Coolant Temperature Sensor (ECT)

The Engine Coolant Temperature Sensor (ECT), monitors the engine operating temperature and reports to the PCM.

The Fuel Pumps

The Fuel Pumps, situated in the fuel tank, supply fuel to the Fuel Rail. The Fuel Pressure Regulator, in the Fuel Rail, controls the fuel pressure at the Fuel Injectors.

Fuel Injectors

The six Injector solenoids are operated by the PCM in sequence to inject fuel into the area behind each inlet valve, when commanded by the PCM. The volume of fuel injected is governed by the length of time each injector solenoid is actuated and the pressure in the fuel rail.

Ignition Coil Pack

Ignition is by Spark Plugs supplied with HT voltage from the Ignition Coil Pack, the timing of ignition is varied by the PCM according to speed and load.

Catalytic Convertor
Heated Oxygen Sensors (H02S)

The combustion gases, after passing through the exhaust manifold, enter the Catalytic Convertor, where the quality of the exhaust gas emission is modified. The quality of the exhaust gas emission is constantly checked by the Upstream Heated Oxygen Sensors (H02S 1-1 and 2-1), which are situated at the entrance of the catalysts. The catalyst efficiency is checked by comparing the signal outputs of pre and post catalyst heated oxygen sensors. Using the oxygen sensor signals, the PCM can make corrections to the fuel and ignition settings as necessary. The sensors contain integral Heaters which accelerate the warming-up of the sensors to enable a rapid correction of initial settings which may be causing the emission of low quality exhaust gases.

Throttle Position Sensor (TP)

Throttle position is detected by the Throttle Position Sensor (TP), which reports to the PCM.

The Supercharger Bypass Valve

This vacuum operated valve allows inlet air to bypass the supercharger when the engine is idling or when the throttle opening is small. It also opens the bypass line when the throttle is closed at high engine speed to avoid excessive pressure differences across the supercharger.

The Exhaust Gas Recirculation Valve (EGR)
The vacuum operated Exhaust Gas Recirculation Valve (EGR), when activated by the PCM and EGR Vacuum Regulator, allows exhaust gas to enter the intake air stream to dilute the oxygen content of the combustible fuel / air mixture, so lowering combustion temperatures and consequently NOx emissions.

Differential Pressure Feedback Sensor (DPFE)
The Differential Pressure Feedback Sensor (DPFE) is placed across a restrictor in the EGR line. By measuring the pressure difference across the restrictor, variations in exhaust gas pressure can be detected by the PCM. The setting of the EGR Valve can then be 'fine tuned' to give a more accurate mix of exhaust gas in the inlet manifold.

Crankshaft Position Sensor (CKP)
Camshaft Position Sensor (CMP)
Engine speed is measured from the pulse timing of the Crankshaft Position Sensor (CKP). The CKP signal is also used by the PCM to note the acceleration in crankshaft speed as each cylinder fires. Any particularly low acceleration is logged as a misfire.

Engine position is determined by using the Camshaft Position Sensor (CMP) signal.

Using both the CKP and CMP signals, the PCM can accurately control the start time for ignition and fuel injection events.

The Secondary Air Injection Pump (AIR)
Mechanical Check Valve
At cold engine start, the Secondary Air Injection Pump (AIR), on command from the PCM, via a relay, provides additional air to reduce the level of Carbon Monoxide (CO) and Hydrocarbons (HC), in the exhaust gases. The additional air accelerates the rise in catalyst temperature to rapidly reach operating temperature level. When the relay energises the pump in the AIR system, it also energises the solenoid controlling the Integral Stop Valve, opening the air line, through the Mechanical Check Valve, to the exhaust manifold.

The Fuel Tank
Evaporative Emission Canisters
The Fuel Tank, may be filled to 90% of the actual measured capacity; the 10% air volume above the fuel is vented to atmosphere through the Evaporative Emission Canisters. The carbon elements in the cannisters absorb any displaced fuel vapour. As fuel is withdrawn from the tank, air is drawn in through the canisters to avoid creating a vacuum in the fuel tank.

When the fuel laden air in the tank expands in higher temperatures, pressure is relieved by allowing the displaced air to vent through the canisters which retain the suspended fuel vapour.

The Purge Valve
The Purge Valve opens when the ignition is turned on to enable air flow in the purge lines.

The Vapour Management Valve
The Vapour Management Valve, is controlled by the PCM and opens the canister line to inlet manifold vacuum; when the inlet mmanifold vacuum is sufficient, the vapour management valve will open. Air can then flow through the carbon canisters, carrying fuel vapour into the inlet manifold.

Diagnostic Equipment

The Aston Martin Portable Diagnostic Unit (PDU) is the principal diagnostic tool used by Aston Martin franchised dealers. Non-franchised dealers will require the AML PDU or a compatible scan tool. The Portable Diagnostic Unit installation and use is described in section 9 of the Workshop Manual.

The diagnostic tool connects to diagnostic sockets mounted under the passenger side knee bolster.

The Vehicle Identification Number and the Emissions Label may be found on a plate on the right front inner wing (see diagram below).

Accessing the PCM using a Generic Scan Tool

Input Tests and Logged Data

Connect the scan tool and establish communications with the PCM following the manufacturers instructions. Continue to follow the manufacturers instructions to access input signal values and any data logged in the PCM memory. The Parameter Identification (PID) list on the following pages gives the PID address for each signal.

A string of characters must be entered into the generic scan tool to perform output tests. The generic keystroke entry for this specific function is provided below. Also refer to the scan tool manufacturers instructions for additional information.

Generic Keystrokes for Output Test Mode

Output test mode has four separate forms to enter:

- All outputs on (except cooling fans)
- All outputs off
- Low speed cooling fans on/off
- High speed cooling fans on/off

Refer to the scan tool manufacturers manual for specific information on which cables to use or how to manually enter character strings for the following examples.

- Perform the necessary safety precautions and visual inspection.
- Turn the ignition key to the On position.
- Verify that the tool is connected and communicating properly by entering the OBD II system readiness test.
- Enter the strings separately and in the order shown.

Output Test Mode:

All Outputs On:

- 02, 20, 20, C4 10 25,,9E 00 A1 91 00 03, 16
- 03, 22, 20, C4 10 31 84,,9E 00 A1 91 00 04, AA
- 04, 2A, 20, C4 10 B1 00 25 02,,9E 00 41 4C 4C 20 4F 4E, 36

All Outputs Off

- 05, 28, 20, C4 10 32 84,,9E 00 41 4C 4C 20 4F 46 46, 51

Low Speed Fans On

- 02, 20, 20, C4 10 25,,9E 00 A1 91 00 03, 16
- 03, 22, 20, C4 10 31 84,,9E 00 A1 91 00 04, AA
- 04, 2A, 20, C4 10 B1 00 25 03,,9E 00 4C 46 43 20 4F 4E, 33

Low Speed Fans Off

- 05, 28, 20, C4 10 32 84,,9E 00 41 4C 4C 20 4F 46 46, 51

High Speed Fans On

- 02, 20, 20, C4 10 25,,9E 00 A1 91 00 03, 16
- 03, 22, 20, C4 10 31 84,,9E 00 A1 91 00 04, AA
- 04, 2A, 20, C4 10 B1 00 25 04,,9E 00 48 46 43 20 4F 4E, 2F

High Speed Fans Off

- 05, 28, 20, C4 10 32 84, 9E 00 41 4C 4C 20 4F 46 46, 51

Normally On Outputs Off

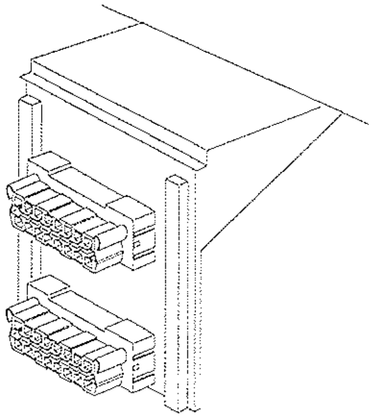
- 02, 20, 20, C4 10 25,,9E 00 A1 91 00 03, 16
- 03, 22, 20, C4 10 31 84,,9E 00 A1 91 00 04, AA
- 04, 2A, 20, C4 10 B1 00 25 01,,9E 00 4F 2F 50 20 4F 46 46 , 6C

Return to Normal State

- 05, 28, 20, C4 10 32 84,,9E 00 41 4C 4C 20 4F 46 46, 51

Diagnostic Socket Location and Use

The two diagnostic sockets are located behind the passenger side underscuttle trim panel. The sockets are mounted on a bracket and labelled Upper and Lower. The following systems are accessed from each socket:



Upper Socket

Transmission Control Module (TCM)
Security System
Air Bag System
Anti-Lock Braking System

Lower Socket

Powertrain Control Module (PCM)
Passive Anti-Theft System
Seat Belt Pretensioner System

The connections to each socket are shown on the lists below:

Upper (Transmission) Socket - ISO 9141

Pin	Function	Use on DB7
1	Ignition Relay Activation	
2	J1850 Bus+ (Ford SCP)	
3	Airbag Serial Data Burst	Air Bag Data Pin 4
4	Chassis Ground	
5	Signal Ground	Air Bag Ground
6	Class 'C' Link (Bus+)	
7	K Line : ISO9141	TCM Pin 45, ABS Pin 28, Security ECU
8	S/W Link Controlled Trigger In	
9	Battery Power (Switched)	
10	J1850 Bus- (Ford SCP)	
11	Not Assigned	
12	2nd. Flash EPROM Prog. Signal	
13	1st. Flash EPROM Prog. Signal	
14	Class 'C' Link (Bus-)	
15	L Line : ISO9141	TCM Pin 16
16	Battery Power (Unswitched)	Battery Voltage

Lower (Engine) Socket - Ford SCP

Pin	Function	Use on DB7
1	Ignition Relay Activation	
2	J1850 Bus+ (Ford SCP)	PCM Pin 16 and PATS Controller Pin 21
3	Seat Belt Pretensioner (Autoliv)	Seat Belt Pretensioner
4	Chassis Ground	
5	Signal Ground	PCM Pins 24, 51, 76, 77 and 103
6	Class 'C' Link (Bus+)	
7	K Line : ISO9141	
8	S/W Link Controlled Trigger In	
9	Battery Power (Switched)	
10	J1850 Bus- (Ford SCP)	PCM Pin 15 and PATS Controller Pin 22
11	Not Assigned	
12	2nd. Flash EPROM Prog. Signal	
13	1st. Flash EPROM Prog. Signal	
14	Class 'C' Link (Bus-)	
15	L Line : ISO9141	
16	Battery Power (Unswitched)	Battery Voltage

OBD II Drive Cycle

Drive Cycle Routine

The following diagram illustrates the sequence of tests when the drive cycle is run from the Portable Diagnostic Unit (PDU) on a rolling road. Running the drive cycle during a road test may take significantly longer than the times shown.

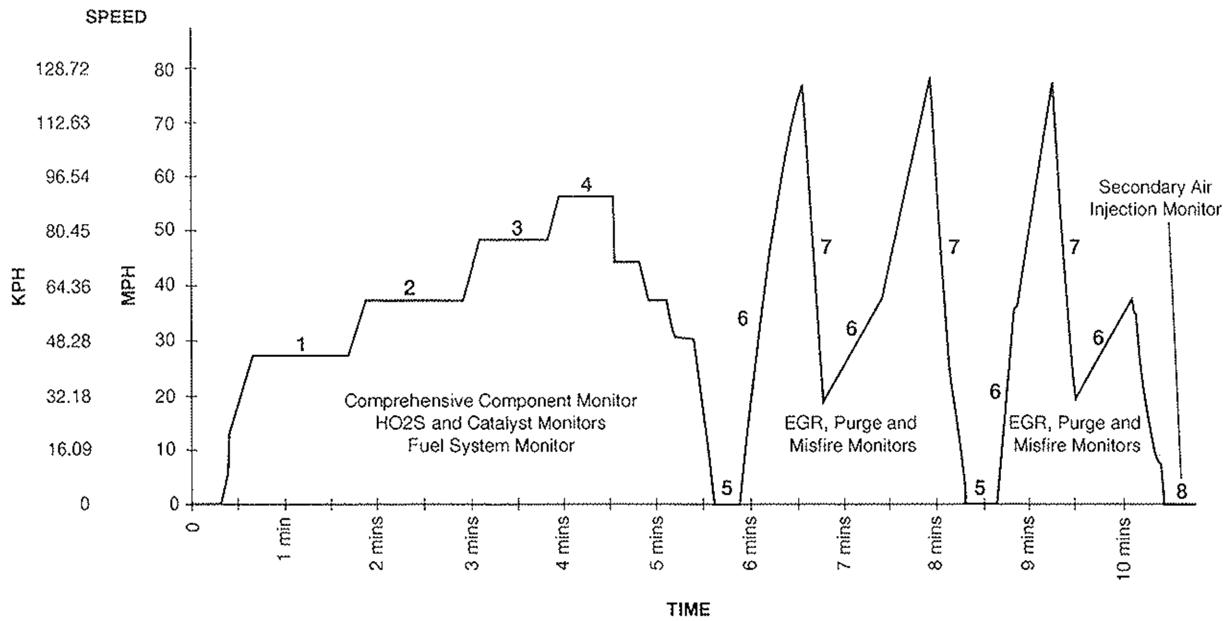
The maximum speeds during the rolling road cycle are significantly greater than the legal limit in some countries. The monitor tests will complete at a maximum speed of 55 mph providing that the PCM has not been disconnected and KAM memory lost. If the KAM memory has been lost, the misfire monitor will require decelerations from at least 55 mph to complete. If your maximum speed limit is below 55 mph, run the drive cycle on a rolling road.

WARNING: Do not exceed local speed limits.

In most cases, it is not necessary to run the cycle in the order shown although the Comprehensive Component Monitor is a prerequisite for all other tests, and the HO2S monitor is a prerequisite for the secondary air and purge tests.

The vehicle must be fully warmed up and have run for a minimum of 200 seconds before this cycle will start.

A P1000 code will only be cleared when all the monitor tests have been satisfactorily completed.



Comprehensive Component Monitor (Drive Cycle Phase 1-4)

This test is run continuously but for the purposes of clearing down a P1000 code, this monitor will clear if all sensors and actuators have no out of range values. The engine needs to have warmed up from an ambient start, idled for a short time and then the car must be driven for a short time. If the engine has been warmed up using an extended idle period and the cycle is driven as shown in the diagram, the component monitor tests will complete during stage 1.

Heated Oxygen Sensor (HO2S) Monitor (Drive Cycle Phase 1-4)

The HO2S sensors and their heater circuits will be tested and cleared down during stages 1 and 2 of the drive cycle. Periods 1 and 2 from the diagram are each of 60 seconds duration where the engine speed is 1130 and then 1310 rpm (approximately 27 and then 37 mph). Constant throttle opening must be maintained during these periods.

Catalyst Monitor (Drive Cycle Phase 1-4)

Stages 1, 2, 3 and 4 of the cycle provide the optimum conditions to ensure completion of the Catalyst Monitor. The sequence is not important but the vehicle must spend at least 60 seconds at each speed. Stage 1 at 1130 rpm (27-31 mph), Stage 2 at 1310 rpm (37-42 mph), Stage 3 at 1700 rpm (48-54 mph) and Stage 4 at 1860 rpm (53-59 mph). If constant speed cannot be maintained, then accelerating and decelerating gently between each speed will have the same effect but may take longer to complete the catalyst monitor test.

Exhaust Gas Recirculation (EGR) Monitor (Drive Cycle Phase 5-7)

The EGR Monitor requires two conditions, the first requires a short period at idle and then a positive acceleration to over 50 mph in approximately 20 seconds. Speed must then be reduced to 20 mph or below. A second period of gentle acceleration is then required from 20-40 mph over a period of 40 seconds. This second phase of the EGR monitor will also complete during a gentle cruise between 30 and 40 mph.

These two stages of the EGR monitor must be performed in the order given for the test to complete.

Misfire Monitor (Drive Cycle Phase 7)

Powertrain Control Module Memory Intact

The Misfire Monitor is a continuous test and will clear quickly if the PCM keep alive memory power has not been interrupted.

Powertrain Control Module Memory Interrupted (e.g. PCM or battery disconnected)

If the power source to the keep alive memory has been interrupted, the system needs to re-learn ignition and other correction factors before it can complete the misfire monitor tests. These correction factors are learned during long deceleration periods as in stages 7 of the diagram. A closed throttle deceleration from 55+ mph down to 30 mph is appropriate. It may require two or three deceleration cycles for the system to acquire the necessary corrections, after which the misfire monitor tests will clear quickly.

Purge Monitor (Drive Cycle Phase 6)

The Purge Monitor tests the vapour flow from the fuel tank and carbon canisters through into the engine. This monitor has two methods of completion.

The first and most common method occurs during an acceleration cycle from 30 to 50 mph over a 20 second period. The system looks for a minimum fuelling correction for a minimum purge valve duty cycle. This method will usually be successful since there is nearly always sufficient fuel vapour available to cause a recognisable fuelling correction.

The second method is used in cold ambient conditions when the quantity of fuel vapour available will be at a minimum. The engine is run for a period of several minutes at idle during which the effect of purge vapour flow on engine idle speed control is assessed.

If the purge monitor does not clear during the first method, leave the engine idling for 5-10 minutes. During this time, the purge control monitor will then complete using the second method.

Fuel System Monitor (Drive Cycle Phase 1-4)

The capability of the EEC V system to control fuelling under closed loop conditions is assessed continuously but will be tested during phases 1 - 4 of the test sequence as the HO2S and catalyst tests are completed.

Secondary Air System Monitor (Drive Cycle Phase 8)

After the engine has run for over 10 minutes, the air pump will run during the next engine idle condition. The HO2S monitor must be completed before the secondary air test will run.

NOTE: This monitor test may commence running and can complete during the engine idle periods (Phase 5). If not completed in phase 5, it will start again at phase 8 and run to a satisfactory completion if the test detects an appropriate change in exhaust gas oxygen content when the secondary air pump is running.

The secondary air test may be delayed if the second type of purge monitor test is still running or if very high levels of fuel vapour are being generated due to high ambient temperatures.

The secondary air test requires about 20 seconds of uninterrupted engine idle and often runs during stationary periods whilst waiting at traffic lights, road junctions, etc.

If the secondary air test does not complete due to high levels of fuel vapour, drive the vehicle for a few miles so that the purge system has opportunity to reduce the amounts of fuel vapour. Then return to idle for more than 20 seconds in order that the secondary air monitor test may complete.

PCM and TCM Reset Procedure

Both the Powertrain Control Module (PCM) and the Transmission Control Module (TCM) may be reset using either of two following methods.

1. With the ignition switched off, disconnect the module harness connector. This will remove power from the Keep Alive Memory in the module and all fault code data, history files, etc. will be lost.
2. With the PDU connected to the module diagnostic socket, command the clearing of all DTCs. This will clear all fault code data, history files, etc.

Caution:
If a transmission DTC is logged in the PCM, the TCM must be reset before the PCM. If the PCM is reset first, the TCM P0700 fault code will be re-entered into PCM memory when the PCM power is reconnected.

Diagnostic Trouble Code (DTC) Report Form

The DTC Report Form exists so that dealer technical staff may report occurences of DTCs back to the manufacturer. Please complete this report according to the instructions on the form.

By Appointment to His Royal Highness the Prince of Wales Motor Car Manufacturers and Repairers

ASTON MARTIN | LAGONDA

ASTON MARTIN LAGONDA LIMITED
Tickford Street, Newport Pagnell, Buckinghamshire, MK16 9AN England.
Telephone 01908 610620. Facsimile 01908 613708.

DIAGNOSTIC TROUBLE CODE REPORT FORM

Owner ______

Dealer ______ Date ______

VIN ______ Mileage ______ Miles/Km

Powertrain Control Module Part No. ☐☐ - ☐☐☐☐☐☐ Issue Number ☐☐☐

Transmission Control Module Part No. ☐☐ - ☐☐☐☐☐☐ Issue Number ☐☐☐

PDU Software No. PDU. ☐☐☐

This work is being carried out because:

- the 'CHECK ENGINE' warning was on ☐
- the 'TRANSMISSION WARNING ' lights were on ☐
- the'CHECK ENGINE' and 'TRANSMISSION WARNING' lights were on ☐
- customer complaint (no warning light illuminated) ☐
- AML Service Operations Instructions ☐

The following DIAGNOSTIC TROUBLE CODES have been logged:

Example: P 0 1 0 1

P	1	2	4	3					

The following FREEZE FRAME DATA has been stored

ONLY USE THIS SECTION WHEN 2 FIELDS OF DATA ARE STORED

Field Ref.	Record	Example	Record
SUPP	$7F980000	$7f980000	
FCFF	1243	$0131	
FSS	(#1)1C(#2)$1	(#1)$2/(#2)$2	(#1) (#2)
CLV	27.8 .	38.8	.
ECT		088 Degree C	
STFT-B1	.	0.7%	.
LIFT-B1	.	-9.3%	.
STFT-B2	.	-6.2%	.
LIFT-B2	.	-10.1%	.
RPM		1851 r/min.	
VS		84 Km/h	

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DB7

Acronyms used in OBD II Diagnostic Documentation

A/C	Air Conditioning
A/T	Auto Transmission
ACC	Air Con Clutch
ACCS	Air Con Cycling Switch
ACD	Air Con Demand
ACON	Air Con On
ACP	Air Con Pressure
ACPSW	Air Con Pressure Switch
AIR	Secondary Air Injection
AIRB	Secondary Air Injection Bypass
AP	Absolutre Pressure
ATDC	After TDC
B+	Battery Positive Voltage
BARO	Barometric Pressure
BOO	Brake On/Off
BPA	Bypass Air
CANP	Canister Purge
CCS	Coast Control Switch
CCRM	Constant Control Relay Module
CHT	Cylinder Head Temperature
CID	Cylinder Identification
CKP	Crankshaft Position
CMP	Camshaft Position
CO	Carbon Monoxide
CO2	Carbon Dioxide
CPP	Clutch Pedal Position
CSE GND	Case Ground (PCM Ground)
DLC	Data Link Connector
DOL	Data Output Line
DPFE	Differential Pressure Feedback
DTC	Diagnostic Trouble Code
DTM	Diagnostic Test Mode
DVOM	Digital Volt-Ohm Meter
EAIR	Electronic Secondary Air Injection
ECT	Engine Coolant Temperature
EEC	Electronic Engine Control
EGR	Exhaust Gas Recirculation
EPC	Electronic Pressure Control
EVAP	Evaporative Emissions
EVR	EGR Vacuum Regulator
FC	Fan Control
FMEM	Failure Modes Effects Management
FP	Fuel Pump
FPM	Fuel Pump Monitor
GEN	Generator
GND	Ground
GVW	Gross Vehicle Weight
HC	Hydrocarbon
HFC	High Fan Control
HFP	High Fuel Pump
HLOS	Hardware Limited Operating Strategy
HO	High Output
HO2S	Heated Oxygen Sensor
IAC	Idle Air Control
IAT	Intake Air Temperature
ICM	Ignition Control Module
IDM	Ignition Diagnostic Monitor
IFS	Inertia Fuel Shut-Off
IMRC	Intake Manifold Runner Control
KAM	Keep Alive Memory
KAPWR	KAM Power
KOEO	Key On Engine Off Test
KOER	Key On Engine Running Test
KS	Knock Sensor
LFC	Low Fan Control
LFP	Low Fuel Pump
M/T	Manual Transmission
MAF	Mass Air Flow
MAF RTN	Mass Air Flow Return
MFI	Multiport Fuel Injection
MIL	Malfunction Indicator Lamp
NAAO	North American Auto Operations
NC	Normally Closed
NO	Normally Open
NOx	Oxides of Nitrogen
OBD	On Board Diagnostics
OC	Oxidation Catalytic Convertor
OCT ADJ	Octane Adjust
OSS	Output Shaft Speed
PAIR	Pulsed Secondary Air Injection
PATS	Passive Anti Theft System
PCM	Powertrain Control Module
PCV	Positive Crankcase Ventilation
PF	Purge Flow
PFE	Pressure Feedback EGR
PIP	Profile Ignition Pickup
PNP	Park Neutral Switch
PSOM	Programmable Speedometer Module
PSP	Power Steering Pressure
PWR GND	Power Ground
RABS	Rear Antilock Brake System
REDOX	Reduction Oxidation Cat Convertor
RM	Relay Module
RPM	Engine Revolutions per Minute
RTN	Return
SC	Supercharged
SFI	Sequential Multiport Fuel Injection
SIG RTN	Signal Return
SIL	Shift Indicator Lamp
SPOUT	Spark Output
SS	Shift Solenoid (n)
ST	Scan Tool
TA	Traction Assist
TACH	Tachometer
TCC	Torque Convertor Clutch
TCIL	Transmission Control Indicator Lamp
TCS	Transmission Control Switch
TFT	Transmission Fluid Temperature
TR	Transmission Range
TRRS	Torque Reduction Request Signal
TSS	Turbine Shaft Speed
VCRM	Variable Control Relay Module
VECI Label	Vehicle Emission Control Information
VPWR	Vbatt+ switched Supply
VLCM	Variable Load Control Module
VREF	Reference Voltage
VSS	Vehicle Speed Sensor
WAC	Wide Open Throttle A/C Cut-Off
WOT	Wide Open Throttle

Mass Airflow Sensor - MAFS

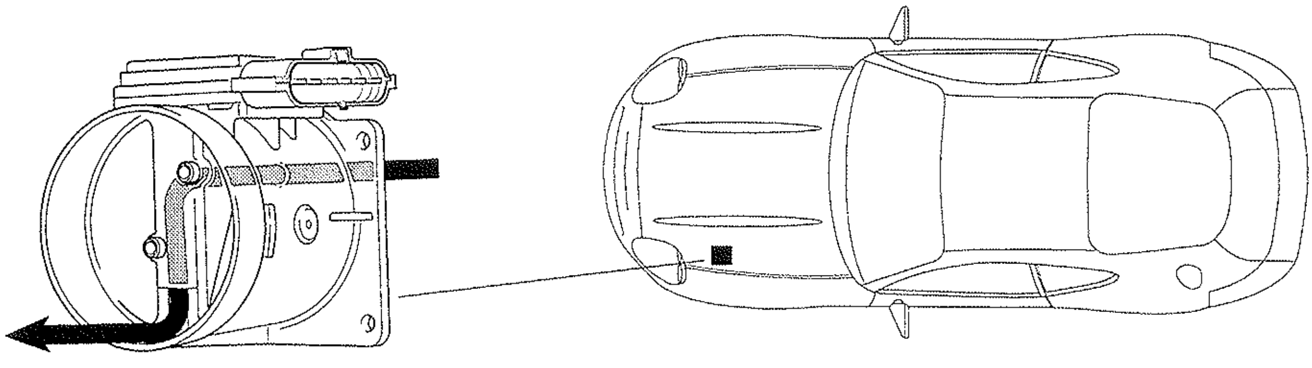


Figure 1. MAFS Location

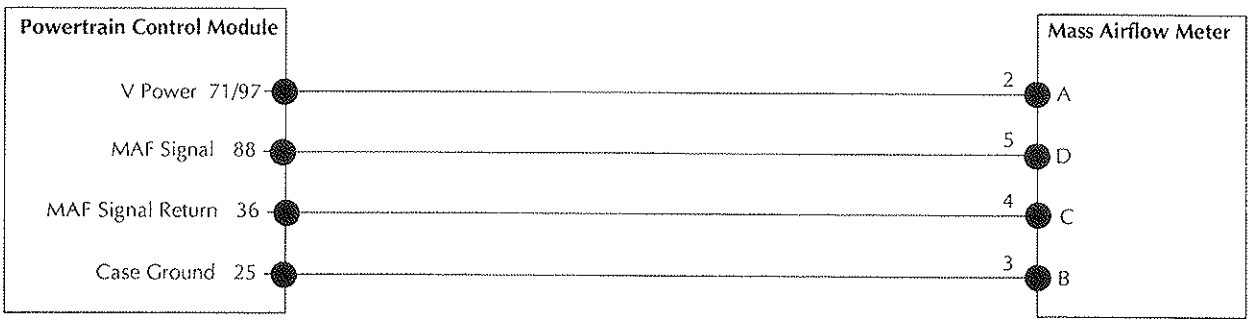


Figure 2. MAFS - ECM Interface Circuit

Fault Code Definition

P0102 - The MAF signal went below 0.39 volts during normal engine running.

Fault Analysis Procedure

1. Connect the PDU or Scan Tool. Check that fault code P0102 is present
2. Check the air filter and all ducting for blockage or leaks. Repair if necessary.
3. Run the engine up to 1500 rpm for 5 seconds. Read PID 10h - Mass Air Flow and check that the MAF voltage is less than 0.39V (i.e. below minimum volts, see Fig 3)
4. Key off, disconnect the MAF Sensor, key on engine off. Measure the voltage across MAF connector pin A - B. The supply voltage must be greater than 10.5 Volts.
5. If the supply voltage is below 10.5 volts, check for correct supply to the PCM and for continuity of the 12V and return lines to the MAF sensor.
6. Key off, reconnect the MAF sensor, key on and start the engine. Check the MAF signal level between pins C and D of the sensor connector. If the signal is below 0.39 volts, check for continuity and/or shorts between MAFS pin D and PCM pin 88 (MAF signal) and check between MAFS pin C and PCM pin 36 (MAF signal return).
7. If the signal lines are good, replace the MAF sensor.
8. If the signal level is above 0.39 volts and code P0102 persists, change the PCM. Perform the KOER test to ensure that the problem is resolved.

Mass Airflow Sensor - MAFS

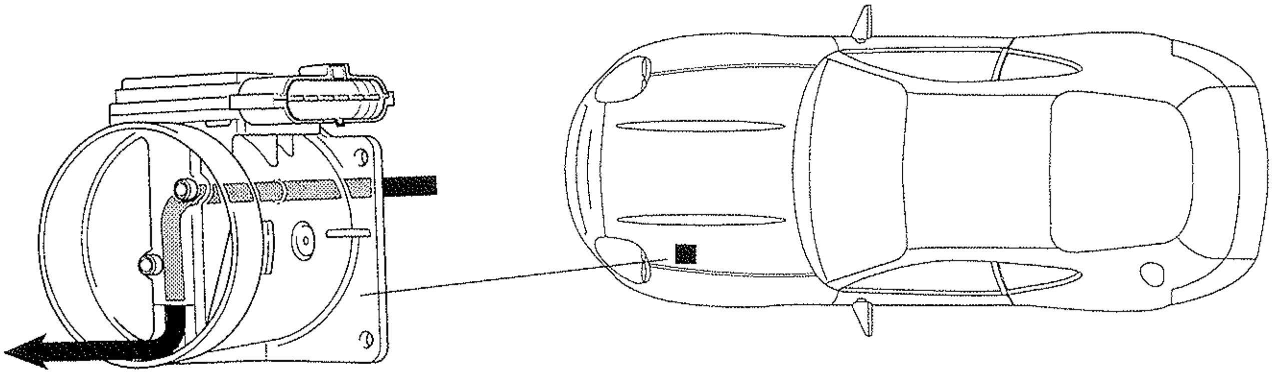


Figure 1. MAFS Location

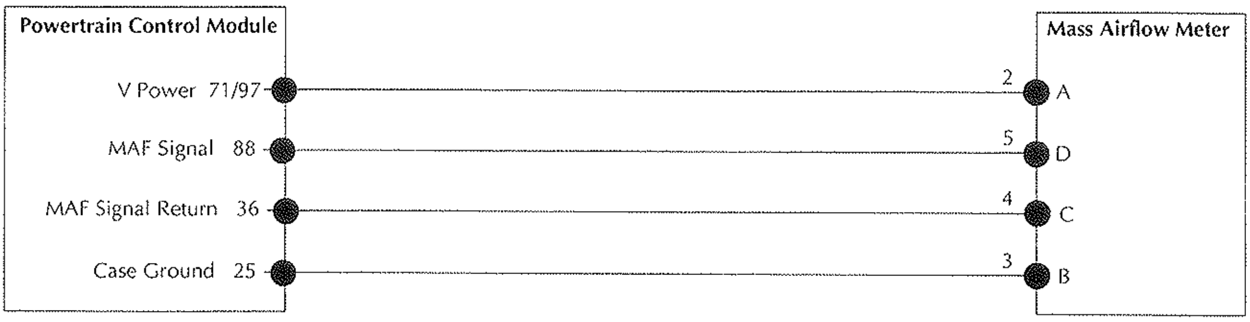


Figure 2. MAFS - ECM Interface Circuit

Fault Code Definition

P0103 - The MAF signal went above 4.60 volts during normal engine running.

P0103 Fault Analysis

1. Connect the PDU or Scan Tool. Check that fault code P0103 is present

2. P0103 can be caused by a contaminated sensor. Remove the sensor and check for contamination on the sensor screen. If contamination is present, replace the MAF sensor and overhaul the air intake system to repair the contamination source. Retest after reassembly. If P0103 is still present, carry out the following analysis.

3. Run the engine up to 1500 rpm for 5 seconds. Read PID 10h - Mass Air Flow and check that the MAF voltage is above 4.60V.

4. Key off, disconnect the MAF sensor, key on. Check PID 10h again.

   If the voltage is still above 4.60V, there is a short between VPower (PCM pin 71/97) and the MAF signal line to PCM pin 88. Repair the short circuit and go to step 5.

   If the voltage has dropped to below 0.39 volts, there is an internal short from Vpower to the MAF signal line inside the sensor. Replace the MAF sensor.

5. Clear the P0103 code. Run the KOER test and check that P0103 does not recur.

Intake Air Temperature - IAT

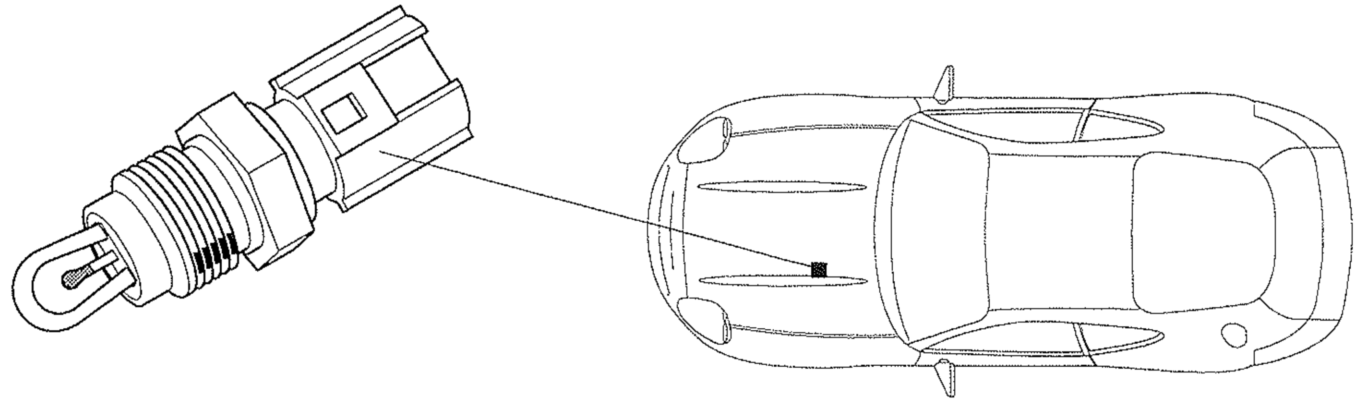


Figure 1. IAT Location

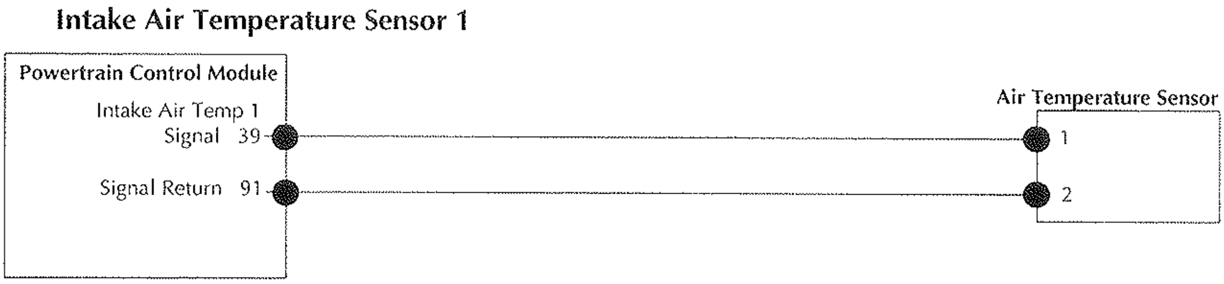


Figure 2. IAT - ECM Interface Circuit

Fault Code Definition

P0112 - The IAT 1 signal went below 0.2 volts during continuous testing.

P0113 - The IAT 1 signal went above 4.60 volts during continuous testing.

P0112/P0113 Fault Analysis

1. Connect the PDU or scan tool and confirm that P0112 or P0113 is present.
2. Run the engine and read the voltage of the intake air temperature signal. The voltage should be in the range 0.25 - 3.50 volts (see figure 3).
3. P0112 - For low voltage readings, suspect a short circuit of the signal (PCM pin 39) to ground or to signal return (PCM pin 91). Key off, check for short circuit between the lines from PCM pin 39 to the IAT sensor and from the IAT sensor to PCM pin 91. Also check for short circuit to ground on the line from PCM pin 39 to the IAT sensor.
4. P0113 - For high voltage readings (above 3.50 volts) suspect an open circuit in the sensor wiring or internally within the sensor.

   Key off, disconnect the IAT sensor, measure the voltage across the IAT sensor connector. Approximately 5.0 volts should be present. If not, there is an open circuit in the line from PCM pin39 or in the signal return line to PCM pin 91.

   If approximately 5.0 volts is present, check the resistance of the IAT sensor. Consult the table below, the resistance should be within 15% of the values in the table. If the resistance is very high or infinite, change the IAT sensor.
5. Clear the P0112/P0113 code, run the drive cycle to ensure that the problem is solved.

Table of IAT Sensor Values

Temperature		Voltage	Resistance
°F	°C	Volts	K Ohms
248	120	0.27	1.18
230	110	0.35	1.55
212	100	0.46	2.07
194	90	0.60	2.80
176	80	0.78	3.84
158	70	1.02	5.37
140	60	1.33	7.70
122	50	1.70	10.97
104	40	2.13	16.15
86	30	2.60	24.27
68	20	3.07	37.30
50	10	3.51	58.75

Engine Coolant Temperature - ECT

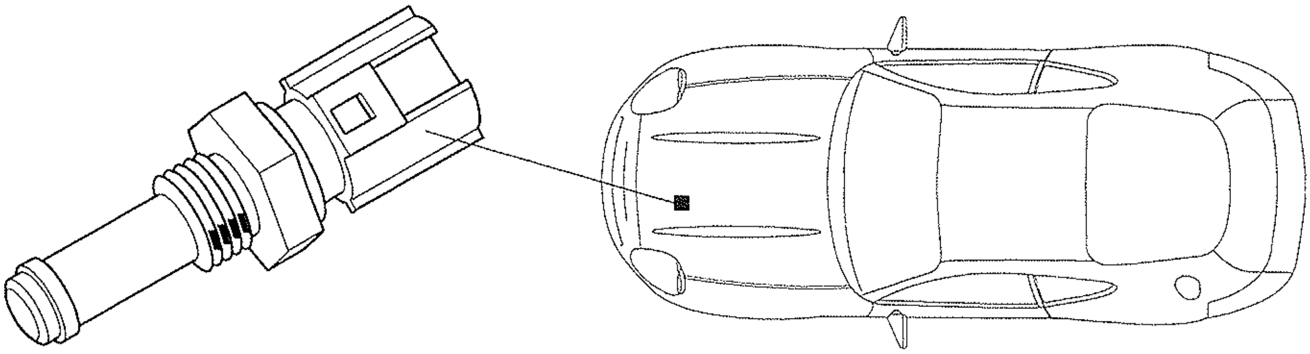


Figure 1. ECT Location

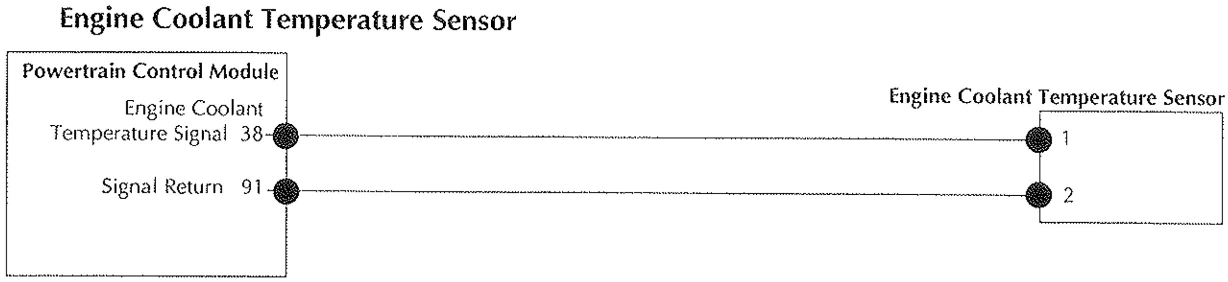


Figure 2. ECT - ECM Interface Circuit

Fault Code Definition

P0117/P0118 Fault Analysis

P0117 - The ECT signal went below 0.2 volts during continuous testing.

P0118 - The ECT signal went above 4.60 volts during continuous testing.

1. Connect the PDU or scan tool and confirm that P0117 or P0118 is present.

2. Run the engine and read the voltage of the engine coolant temperature signal. The voltage should be in the range 0.25 - 3.50 volts (see figure 3).

3. P0117 - For low voltage readings, suspect a short circuit of the signal (PCM pin 38) to ground or to signal return (PCM pin 91). Key off, check for short circuit between the lines from PCM pin 38 to the ECT sensor and from the ECT sensor to PCM pin 91. Also check for short circuit to ground on the line from PCM pin 38 to the ECT sensor.

4. P0113 - For high voltage readings (above 3.50 volts) suspect an open circuit in the sensor wiring or internally within the sensor.

   Key off, disconnect the ECT sensor, measure the voltage across the ECT sensor connector. Approximately 5.0 volts should be present. If not, there is an open circuit in the line from PCM pin38 or in the signal return line to PCM pin 91.

   If approximately 5.0 volts is present, check the resistance of the ECT sensor. Consult the table below, the resistance should be within 15% of the values in the table. If the resistance is very high or infinite, change the IAT sensor.

5. Clear the P0117/P0118 code, run the drive cycle to ensure that the problem is solved.

Table of ECT Sensor Values

Temperature		Voltage	Resistance
°F	°C	Volts	K Ohms
248	120	0.27	1.18
230	110	0.35	1.55
212	100	0.46	2.07
194	90	0.60	2.80
176	80	0.78	3.84
158	70	1.02	5.37
140	60	1.33	7.70
122	50	1.70	10.97
104	40	2.13	16.15
86	30	2.60	24.27
68	20	3.07	37.30
50	10	3.51	58.75

Throttle Position Sensor - TP

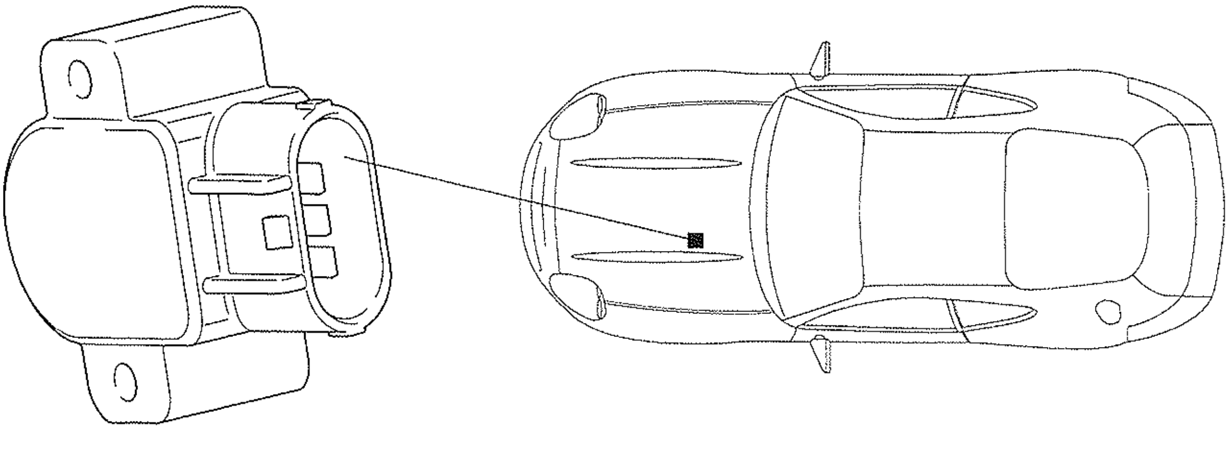


Figure 1. TP Location

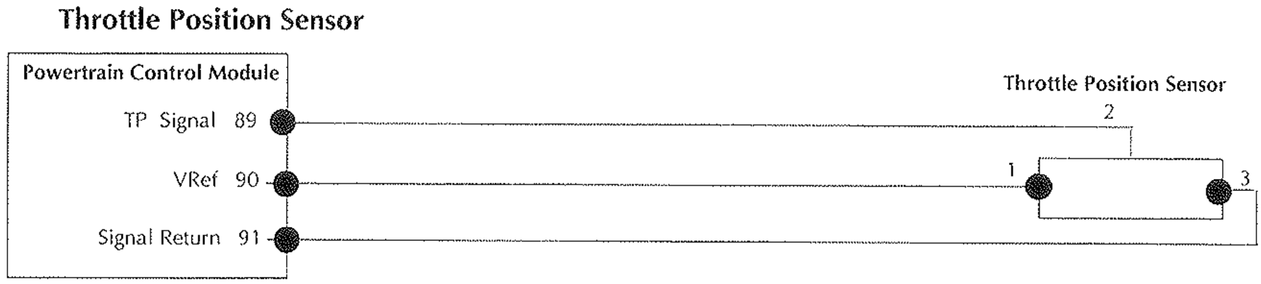


Figure 2. TP - ECM Interface Circuit

Fault Code Definition

P0121 - The PCM detected a TP signal circuit failure whilst the TP signal was in range.

P0121 Fault Analysis

1. Connect the PDU or scan tool and perform the KOER test sequence. Confirm that a P0121 fault is detected.
2. Attempt to drive the vehicle for some distance with the PDU or scan tool still connected. Stop the car, switch off the ignition and wait 15 seconds. Restart the car and again activate the KOER test. Check that P0121 is detected.
3. Check for an intermittent open circuit fault in the TP signal line to PCM pin 89 and in the TP signal return line connection to PCM pin 91.
4. If a fault is identified in the signal or return lines, repair it and re-run the KOER test to confirm that the fault is cleared.

   If the signal lines are good, replace the throttle potentiometer. Run the KOER test to confirm that the fault is cleared.

Throttle Position Sensor - TP

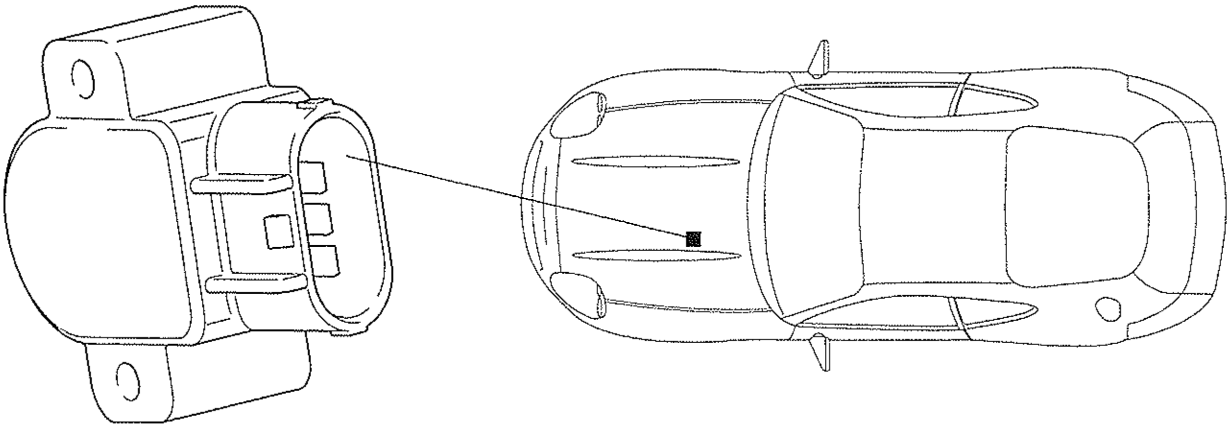


Figure 1. TP Location

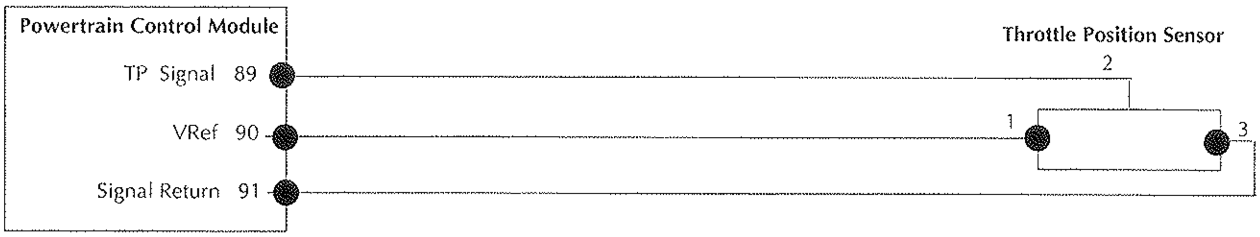


Figure 2. TP - ECM Interface Circuit

Fault Code Definition

P0122 - The TP signal went below 0.17 volts during continuous testing.

P0123 - The TP signal went above 4.60 volts during continuous testing.

P0122/P0123 Fault Analysis

1. Connect the PDU or scan tool and confirm that P0122 or P0123 is present.

2. Run the engine and read the voltage of the throttle potentiometer signal. The voltage should be in the range 0.6 - 4.50 volts (see figure 3).

3. P0122 - For low voltage readings, suspect a short circuit of Vref (nominal 5.0V supply from PCM pin 90) to ground or to signal return (PCM pin 91). Key off, check for short circuit between the lines from PCM pin 90 to the TP sensor and from the TP sensor to PCM pin 91. Also check for short circuit to ground on the signal line from the throttle potentiometer to PCM pin 89.

4. P0123 - For high voltage readings (above 3.50 volts) suspect a short circuit in the sensor wiring from Vref pin 90 to the signal line pin 89, or internally within the potentiometer.

   Key off, disconnect the TP sensor, key on. Measure the voltage between the Vref and TP signal lines, approximately 5.0 volts should be present. If not, investigate and rectify the problem in the Vref supply or in the signal lines.

   If approximately 5.0 volts is present, replace the TP sensor.

5. Clear the P0122/P0123 code, run the drive cycle to ensure that the problem is solved.

Engine Coolant Temperature - ECT

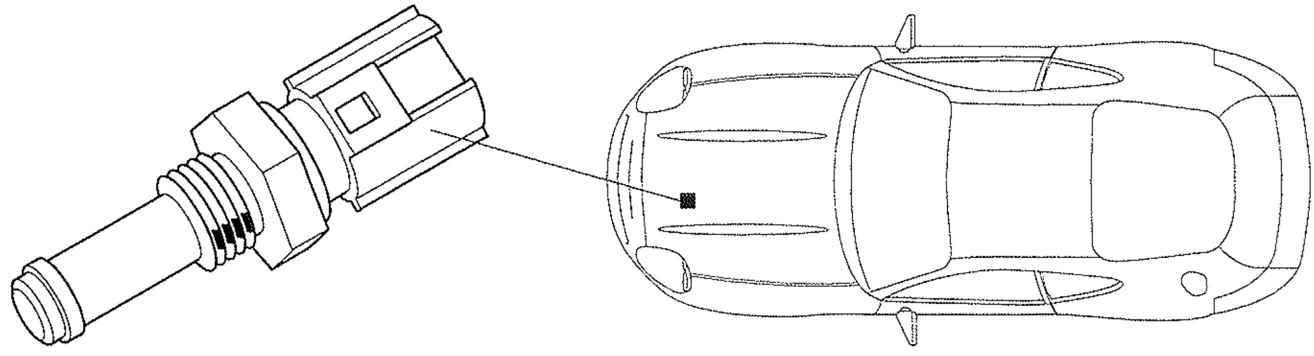


Figure 1. ECT Location

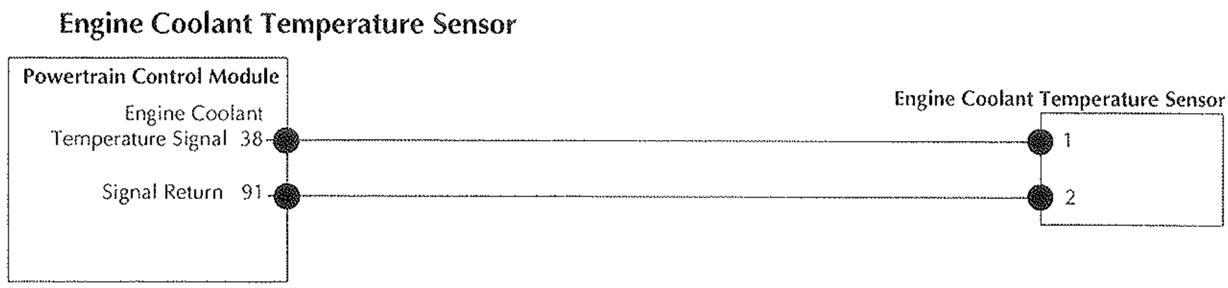


Figure 2. ECT - ECM Interface Circuit

Fault Code Definition

P0125 - The ECT sensor did not reach sufficient temperature for the system to enter closed loop control within a set time after starting the engine. This DTC will light the MIL lamp.

P0125 Fault Analysis

1. Check for the following conditions:

   Insufficient warm-up time.
   Extremely low ambient temperature
   Leaky or stuck open thermostat
   Low engine coolant level

   If any of these conditions is present, rectify the cause, clear the code and rerun the KOER test.

   If none of the above conditions is present, go to step 2.

2. Check the thermostat (Workshop Manual 1.7.07 and 1.7.04 Thermostat Test).

   The thermostat should open at 88°C and be fully open at 97°C. If the thermostat meets the above specification, go on to step 3.

   If the thermostat is defective, fit a replacement thermostat. Clear the P0125 code and rerun the KOER test to confirm that the problem is cleared.

3. Check the ECT sensor signal output against the values in the table below. If the output is not within 10% of the table values, replace the sensor.

4. Clear the P0117/P0118 code, run the drive cycle to ensure that the problem is solved.

Table of ECT Sensor Values

Temperature		Voltage	Resistance
°F	°C	Volts	K Ohms
248	120	0.27	1.18
230	110	0.35	1.55
212	100	0.46	2.07
194	90	0.60	2.80
176	80	0.78	3.84
158	70	1.02	5.37
140	60	1.33	7.70
122	50	1.70	10.97
104	40	2.13	16.15
86	30	2.60	24.27
68	20	3.07	37.30
50	10	3.51	58.75

Heated Oxygen Sensors - HO2S

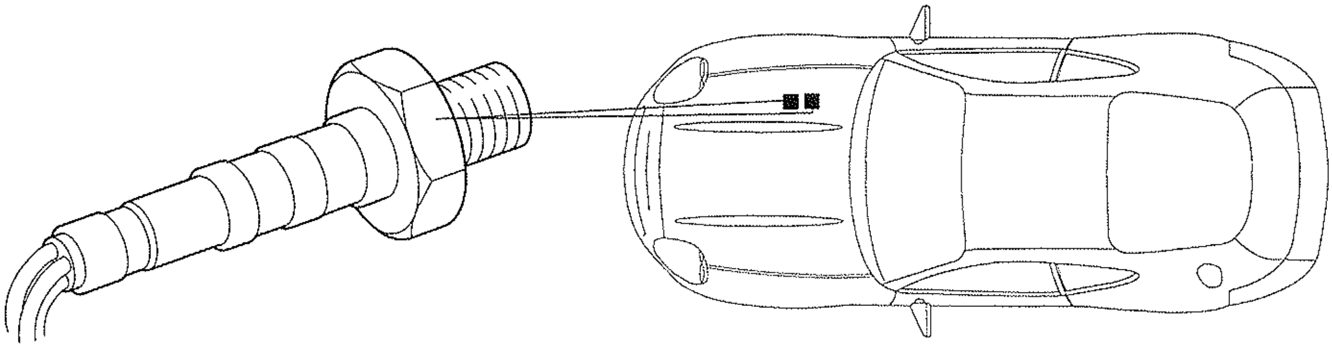


Figure 1. HO2S Location

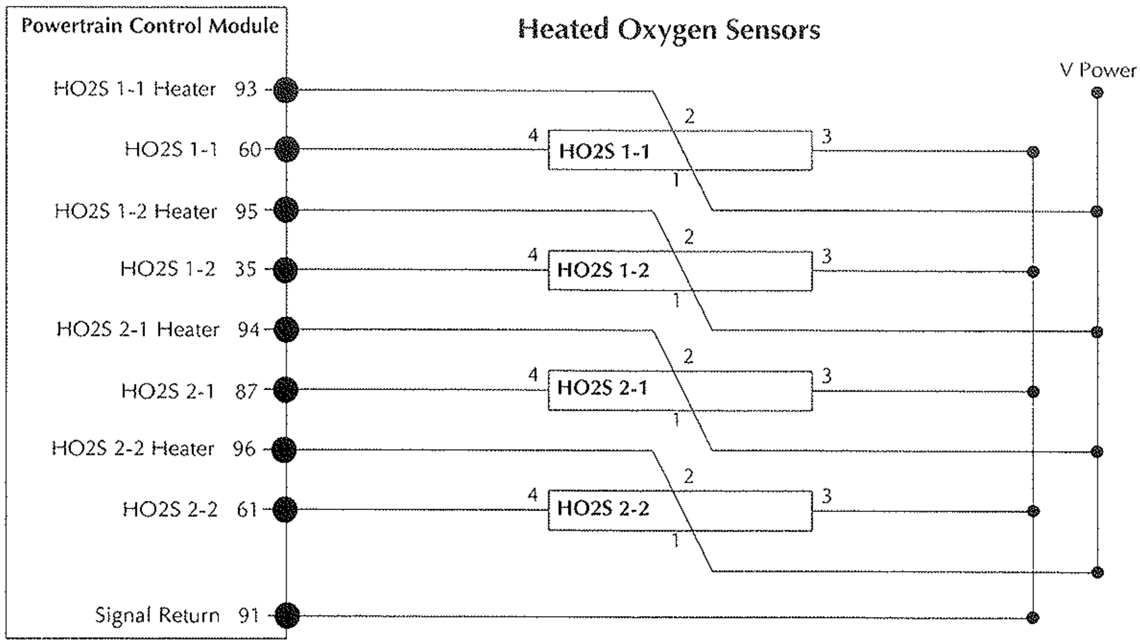


Figure 2. HO2S - PCM Interface Circuit

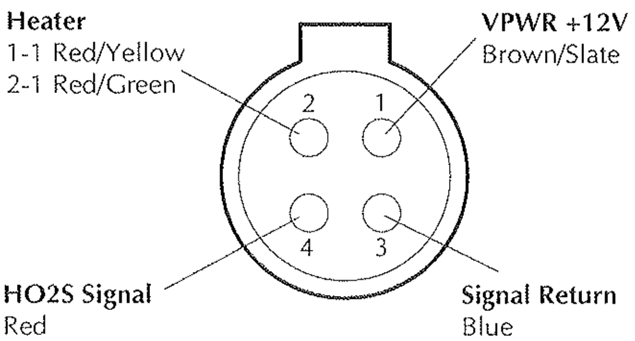
Fault Code Definition

P0131 - HO2S 1-1 generated a negative voltage
P0151 - HO2S 2-1 generated a negative voltage

P0131, P0151 Fault Analysis

1. Access the front HO2S sensors and check the sensors, wiring and connectors for water ingress. (Water ingress to the connector will cause a short circuit between the signal and return lines). Dry out the connector, do not reconnect at this point.

2. Disconnect the PCM. Check for cross connection of the sensor circuits from the PCM harness connector to the sensor connector. Also check for correct wiring of the sensor connector. Repair the wiring if necessary. The connections must be as shown on the diagram below.



3. Reconnect the sensors and the PCM. Re-run the KOER test. If the P0131 or P0151 code is detected, replace the affected oxygen sensor.

Heated Oxygen Sensors - HO2S

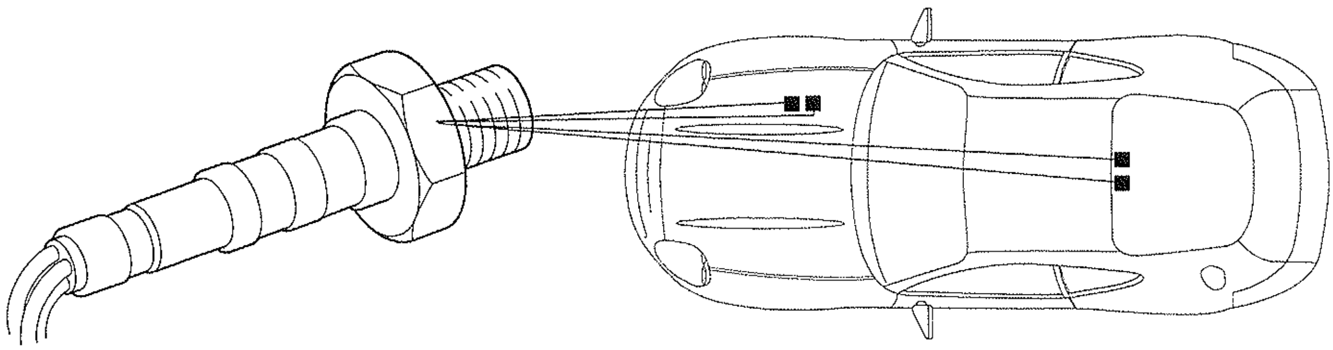


Figure 1. HO2S Location

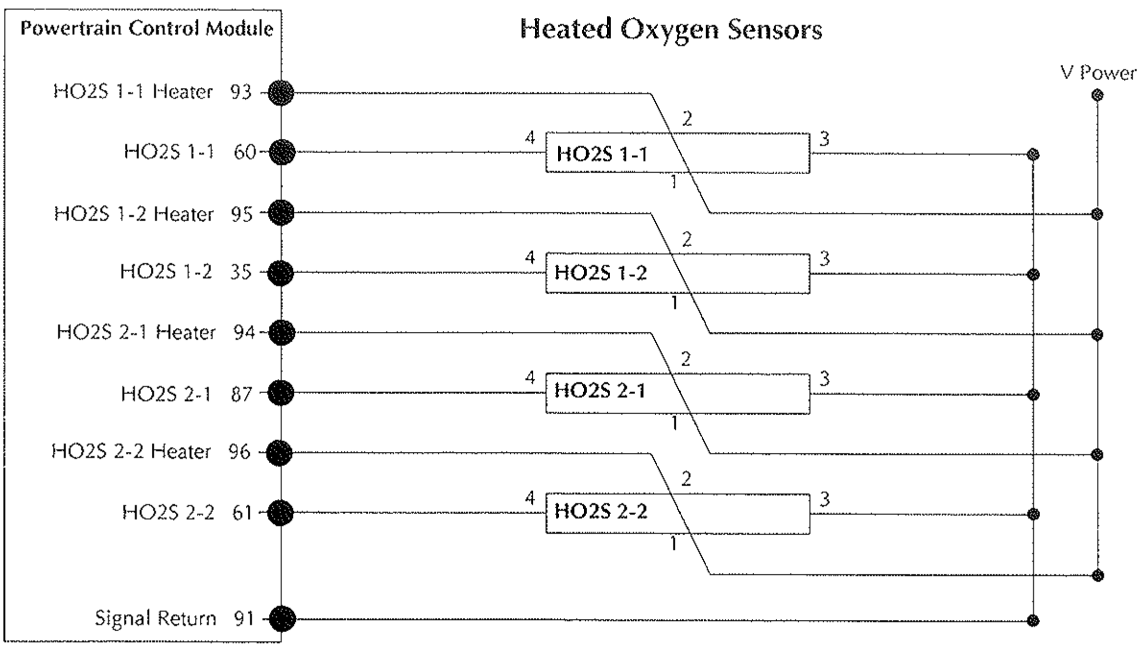


Figure 2. HO2S - PCM Interface Circuit

Fault Code Definition

P0132 - HO2S 1-1 overvoltage
P0138 - HO2S 1-2 overvoltage
P0152 - HO2S 2-1 overvoltage
P0158 - HO2S 2-2 overvoltage

P0132, P0138, P0152, P0158 Fault Analysis

1. Connect the PDU or scan tool. Key on engine off (KOEO) and access the PID for the diagnostic code:

DTC No.	PID No.	Sensor No.
P0132	0014	HO2S 11 (Cyl 1-3 front sensor)
P0138	0015	HO2S 12 (Cyl 1-3 rear sensor)
P0152	0018	HO2S 21 (Cyl 4-6 front sensor)
P0158	0019	HO2S 22 (Cyl 4-6 rear sensor)

Check the voltage for the selected signal. An overvoltage exists if the signal level is above 1.0 volts. If the voltage is below 1.0 volt, the fault is not present.

2. For voltages above 1.0 volts, switch of the ignition, disconnect the affected sensor.

   Disconnect the PCM.

3. Inspect the connectors for damaged pins, corrosion, loose wires, etc and repair as necessary.

4. Measure the harness resistance for the affected sensor between the following points on the PCM cable connector.

Sensor No.	Measure from:	Measure to:
HO2S 11	pin 60	pins 71, 90, 93, and 97
HO2S 12	pin 35	pins 71, 90, 95 and 97
HO2S 21	pin 87	pins 71, 90, 94 and 97
HO2S 22	pin 61	pins 71, 90, 96 and 97

If the resistance is below 10KΩ, there is a partial or complete short in the sensor harness. Repair the short.

5. If the resistance measured in step 4 is greater than 10KΩ, suspect a short of the oxygen sensor signal to the heater circuit within the sensor.

   Reconnect the PDU or scan tool to the PCM and reconnect the PCM harness. Leave the suspect sensor disconnected.

6. Access the suspect sensor PID (see list in step 1) and run the KOEO test sequence. Read the HO2S sensor signal voltage. If the voltage is now below 0.2 volts, the sensor is faulty, replace the sensor.

7. If the voltage is above 0.2 volts, the PCM is suspect. Replace the PCM.

Heated Oxygen Sensors - HO2S

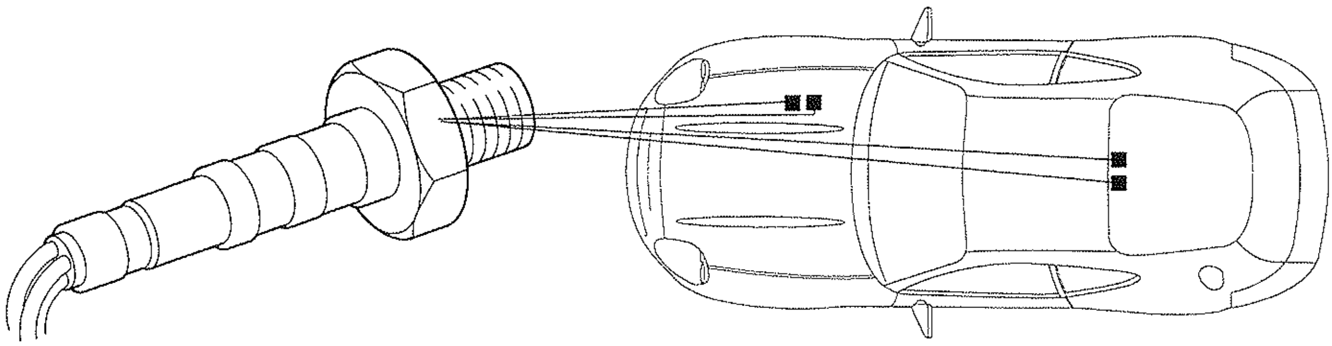


Figure 1. HO2S Location

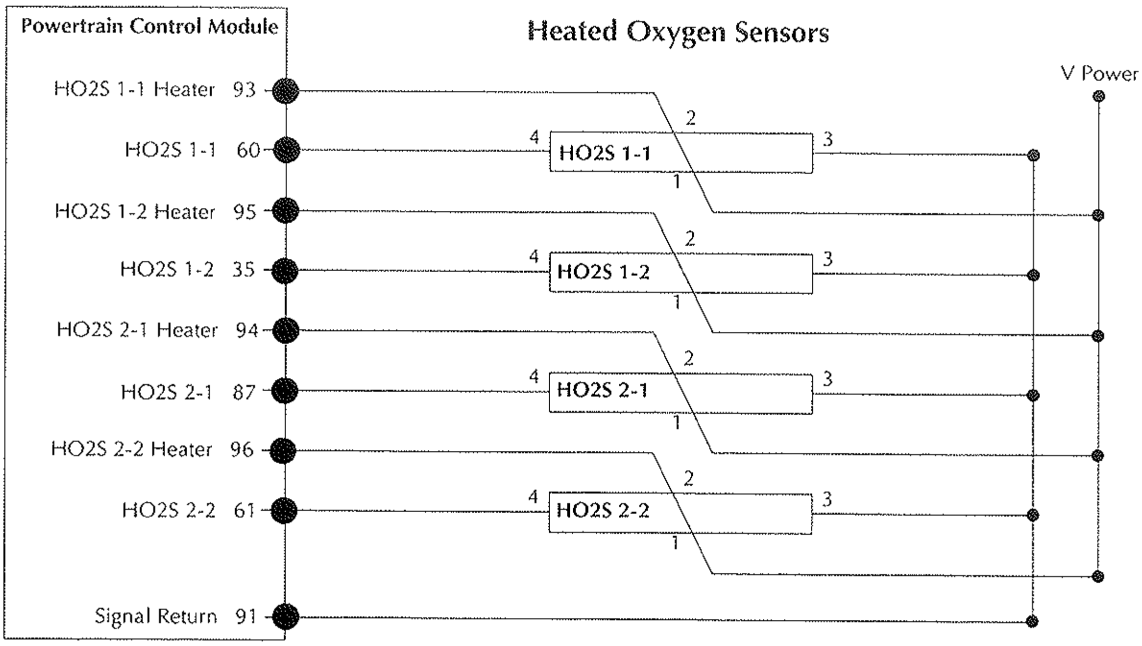


Figure 2. HO2S - PCM Interface Circuit

Fault Code Definition

P0133 - HO2S 1-1 slow response
P0153 - HO2S 2-1 slow response

P0133, P0153 Fault Analysis

This code will only occur if the oxygen sensor performance is seriously degraded.

If a P0133 or P0153 code is present and possible circuit faults have been eliminated, replace the affected sensors.

Heated Oxygen Sensors - HO2S

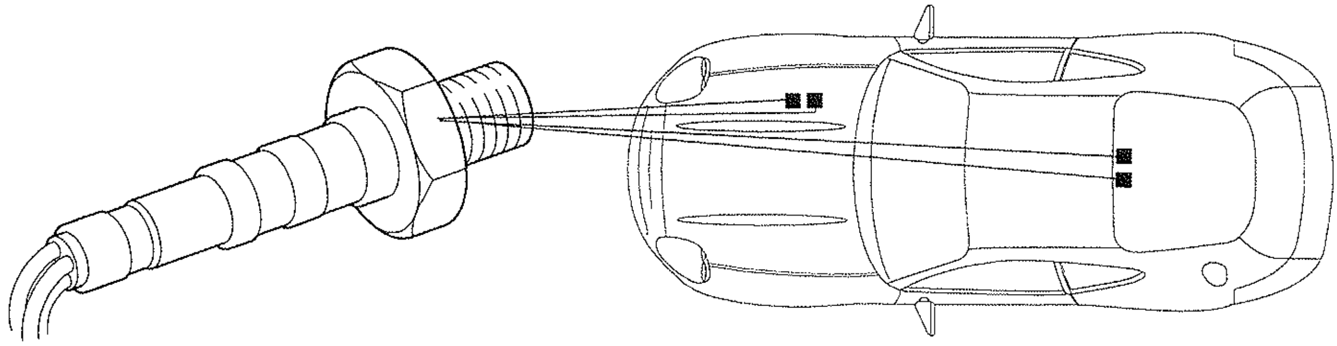


Figure 1. HO2S Location

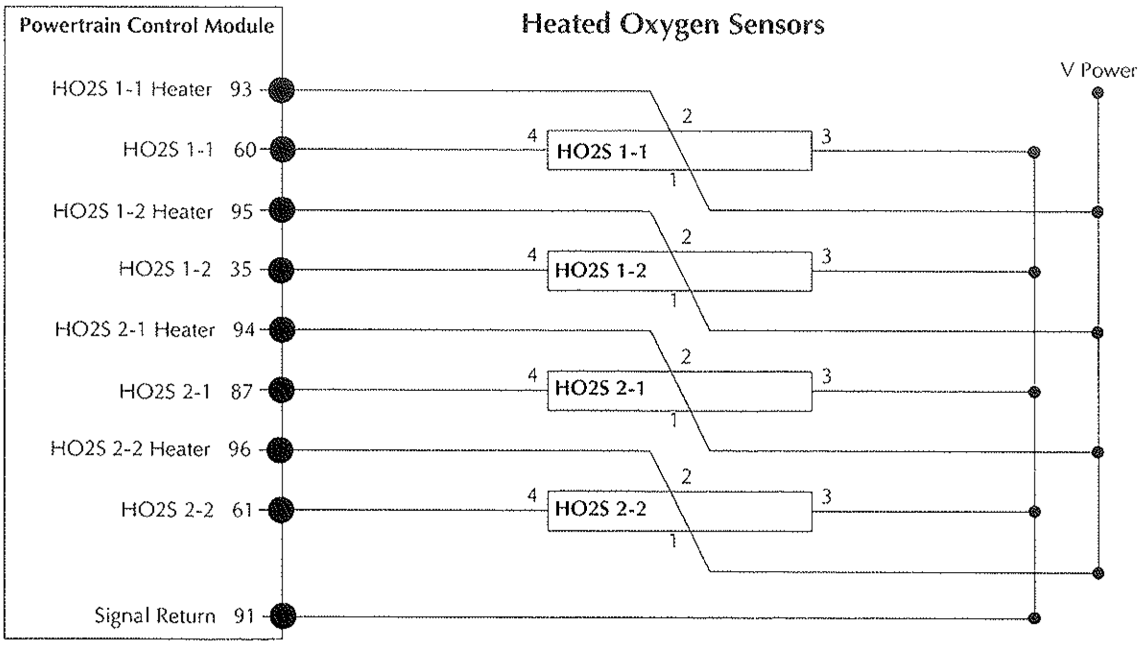


Figure 2. HO2S - PCM Interface Circuit

Fault Code Definition

P0135 - HO2S 1-1 heater circuit malfunction
P0141 - HO2S 1-2 heater circuit malfunction
P0155 - HO2S 2-1 heater circuit malfunction
P0161 - HO2S 2-2 heater circuit malfunction

P0135, P0141, P0155, P0161 Fault Analysis

1. Access the oxygen sensor connections and visually inspect for exposed wires, contamination, corrosion and proper assembly. Service or repair any obvious defects.
2. Connect the PDU or scan tool. Start the engine and run at idle for 10 minutes. Run the KOER test sequence. Check that code P0135, P0141, P0155 or P0161 is present. Switch off the engine.
3. Disconnect the appropriate heated oxygen sensor and inspect both ends of the connectors for damaged or pushed out pins, moisture, corrosion, contamination, etc. Service as necessary.
4. Switch on the ignition. Measure the voltage between Vpower and the heater return lines at the HO2S vehicle harness connector. The voltage should be above 10.5 volts. Switch off the ignition.
5. If a low voltage was detected in step 4, check for a partial or complete open circuit in the Vpower or heater return lines to the sensor connector. Repair the wiring as necessary.
6. If the applied voltage measured in step 4 is above 10.5 volts, check the resistance of the HO2S heater which should be between 3 and 5Ω when cold. If the heater resistance is not within range, replace the oxygen sensor.
7. If the heater resistance is in specification, check for a short circuit to ground within the sensor. Measure from the sensor Vpower connection to the sensor case. If the resistance is less than 10kΩ, replace the sensor.
8. If the resistance in step 7 is greater than 10kΩ, Check for shorts to other grounds and to Vpower in the heater ground harness circuits. Measure resistance from:

   HO2S 1-1 pin 93 to pins 24, 76, 103, 91 and 97

   HO2S 1-2 pin 95 to pins 24, 76, 103, 91 and 97

   HO2S 2-1 pin 94 to pins 24, 76, 103, 91 and 97

   HO2S 2-2 pin 96 to pins 24, 76, 103, 91 and 97

   If any resistance reading is less than 10kΩ repair or replace the affected wiring.
9. If continuity is good, replace the PCM. Reconnect all circuits and run the drive cycle to confirm that the fault is cleared.

Heated Oxygen Sensors - HO2S

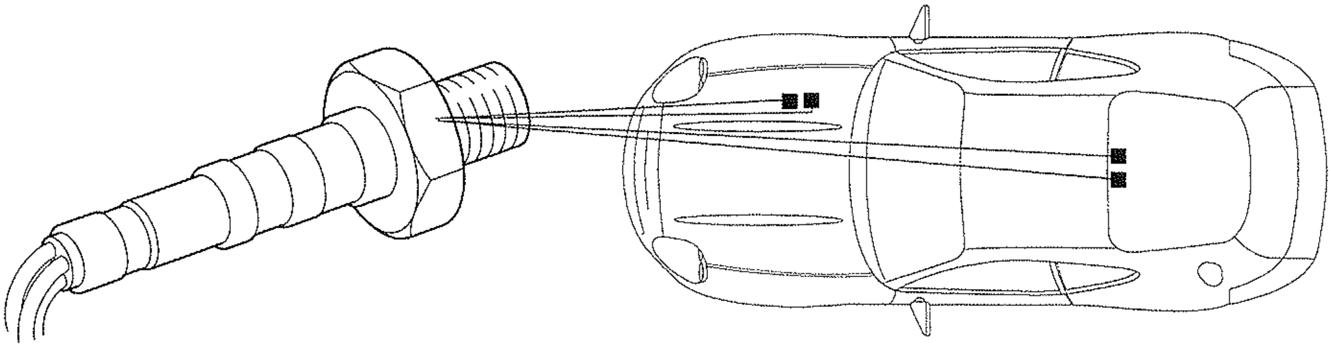


Figure 1. HO2S Location

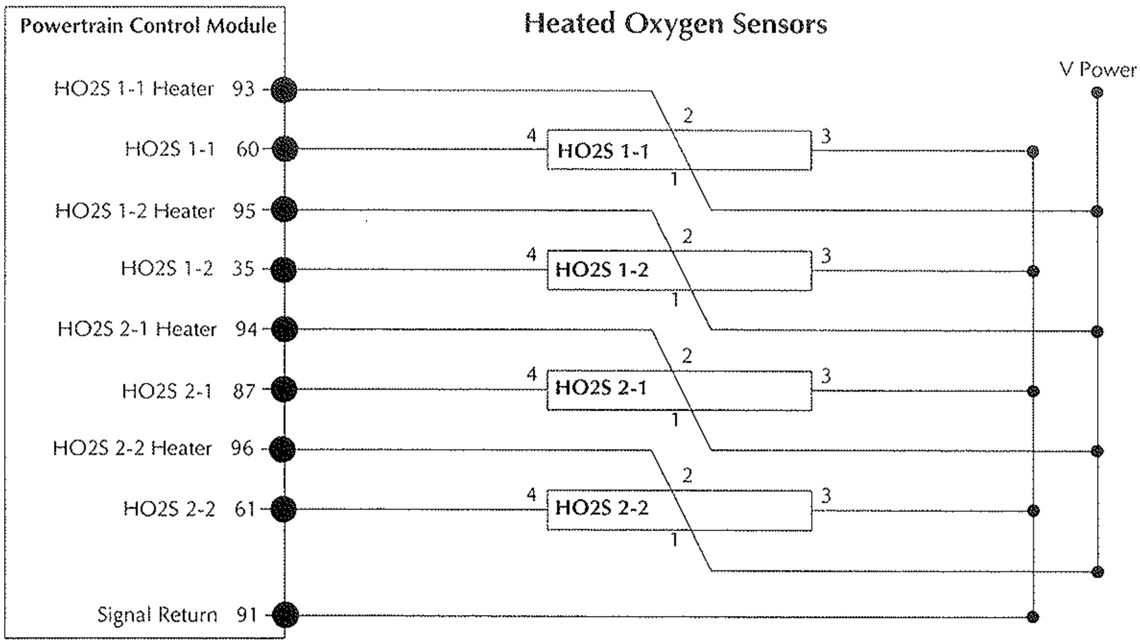


Figure 2. HO2S - PCM Interface Circuit

Fault Code Definition

P0136 - HO2S 1-2 circuit malfunction
P0156 - HO2S 2-2 circuit malfunction

P0136, P0156 Fault Analysis

1. Access the oxygen sensor connections and visually inspect for exposed wires, contamination, corrosion and proper assembly. Service or repair any obvious defects. If defects are found and rectified, reset the PCM memory and perform the KOER test sequence to check that the fault is corrected.

2. Check the exhaust system for leaks. Remove the affected oxygen sensor and check for contamination or damage. If defects are found and rectified, reset the PCM memory and perform the KOER test sequence to check that the fault is corrected.

3. Check for crossed HO2S harness connections. Disconnect the appropriate heated oxygen sensor and perform the KOEO test sequence. Check that the correct heater DTC is detected.

HO2S	Original DTC	Heater DTC
HO2S 1-2	P0136	P0141
HO2S 2-2	P0156	P0161

If the wrong heater DTC is detected, correct the wiring error and retest.

4. Raise the vehicle on a hoist and recheck for exhaust system leaks between the engine and the rear sensors. Check particularly at the following points:

Exhaust flanges
Punctures or cracks in the catalyst and pipes
Oxygen sensor mounting flanges

Repair or replace items as required. If defects are found and rectified, reset the PCM memory and perform the KOER test sequence to check that the fault is corrected.

5. Using the connection diagram (Figure 2), check the affected circuit for the following:

Short circuit of signal line to VPWR or to Ground
Continuity of HO2S and HO2S Ground circuits

If defects are found and rectified, reset the PCM memory and perform the KOER test sequence to check that the fault is corrected.

6. Check the continuity of the ground circuit in the PCM by measuring the resistance between PCM signal return pin 91 and Power Ground pins 24, 51, 76, 77, 103.

7. If continuity is good (less than 5.0Ω), the fault is in the oxygen sensor. Replace the sensor, reset the PCM memory and perform the KOER test sequence to check that the fault is corrected.

8. If continuity in step 7 is poor (more than 5Ω, replace the PCM and perform the KOER test sequence to check that the fault is corrected.

Fuel System

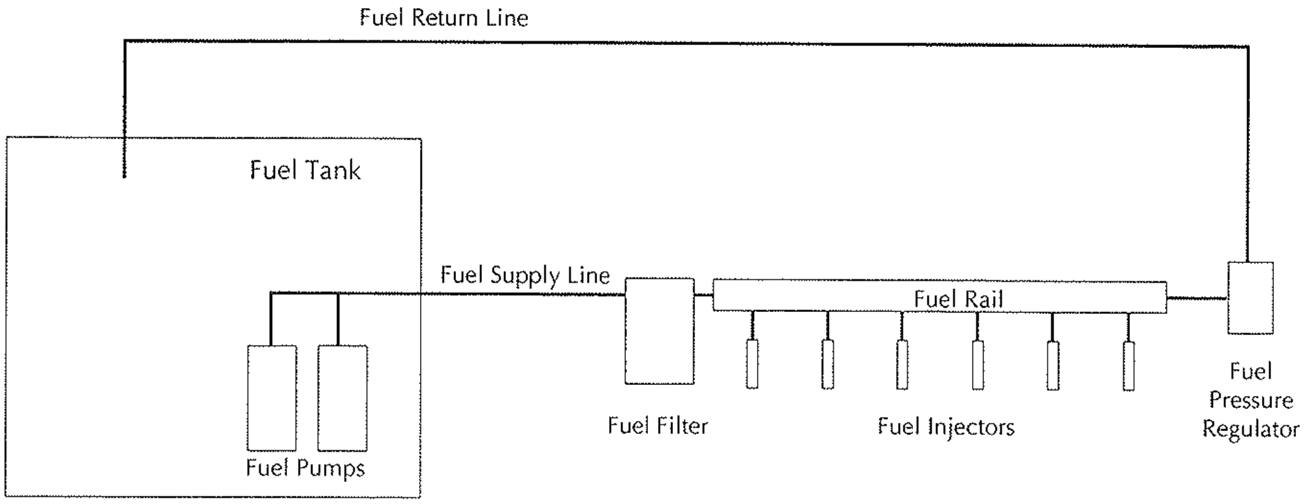


Figure 1. Fuel System Components

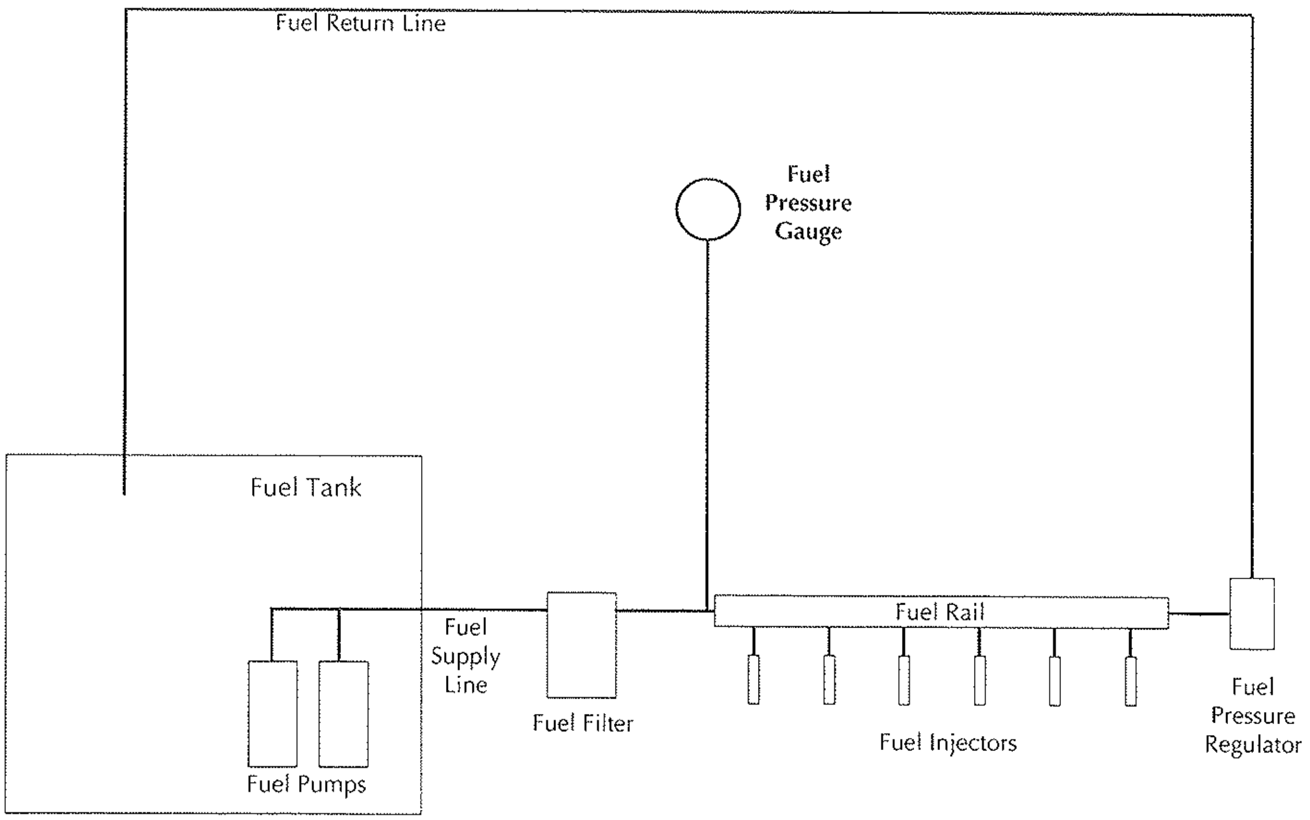


Figure 2. Fuel Pressure Gauge Installation

Fault Code Definition

P0171 - Cylinders 1-3 fuel/air ratio too lean
P0174 - Cylinders 4-6 fuel/air ratio too lean
Adaptive fuel correction at the limit.

P0171, P0174 Fault Analysis

1. Verify that the vehicle did not run out of fuel before the Check Engine light came on.

   If a No Fuel condition has been present, connect the PDU or scan tool and clear the P0171/P0174 code. Perform the KOER test sequence to check that the fuel adaption is now functioning correctly.

   If the vehicle has not recently run out of fuel, analyse the problem using the following procedure.

2. Carry out a thorough visual inspection of the vehicle, concentrating on the following possible causes of the lean mixture:

   Fuel System

   Leaking fuel injectors
   Leaking fuel pressure regulator
   Low fuel pressure
   Blocked fuel injectors
   Damaged/disconnected HO2S circuits

   Induction System

   Air leaks after the air flow meter
   Vacuum leaks
   Restricted air inlet
   Positive Crankcase Ventilation system

   Base Engine

   Oil overfill
   Cam timing
   Compression pressure

   Ignition System

   Coil secondary windings
   Ignition HT leads
   Spark plugs

   Repair any problems identified in the visual inspection, clear the P0171/P0174 fault codes and repeat the KOER Test. If the P0171/P0174 code is detected proceed as follows.

3. Connect the PDU or scan tool. Perform the KOER test sequence.

   If any adaptive fuel codes are detected, go to step 4. For other codes, go to the appropriate procedure in this section of the fault analysis manual.

4. Check the fuel pressure as follows:

   Switch off the ignition. Install the fuel pressure gauge using a 'T' adaptor at the rear of the fuel rail. Verify the pressure source to the fuel pressure regulator.

   Start the engine and run at idle speed. Record the fuel pressure.

   Increase the engine speed to 2500 rpm and maintain for 1 minute. Record the fuel pressure.

   The fuel system must be capable of maintaining 30-45 psi (210-310kPa).

   If the fuel pressure is low, repair or service the fuel system to meet the fuel pressure specification.

5. Check the fuel system ability to hold fuel pressure.

   Cycle the ignition key on and off several times. Verify that there are no external fuel leaks (repair as necessary)

   Verify that with the ignition key off, the fuel pressure remains within 5 psi of the highest reading after 1 minute.

   If excessive pressure loss is detected, service or repair the fuel system to correct the problem.

6. Again cycle the ignition key on and then off several times. Turn the key on, engine off and monitor the fuel pressure.

   The fuel pressure must remain within 5 psi of the highest reading after 10 seconds.

   If excessive pressure loss is detected, there is a problem in the fuel injectors or their electrical circuits.

7. Key off. Disconnect the PCM. Check the resistance of the fuel injectors and harness at the following pins on the PCM harness connector:

Injector	PCM Connector Pins
1	75 to 71/97
2	101 to 71/97
3	74 to 71/97
4	100 to 71/97
5	73 to 71/97
6	99 to 71/97

   Each resistance should be in the range 11 - 18Ω

   Low resistance - check the affected circuits for shorts to power or ground.

   High resistance - check the affected circuits for high resistance connections or complete open circuits.

8. Reconnect the PCM.

   Check the injector driver signals:

   Set up the PDU to monitor all six injector signals using the datalogger function (for alternative scan tools, follow the manufacturers instructions).

   Start the engine and start logging data. Log a convenient period at both idle and high rpm.

   Stop recording on the datalogger and switch off the engine.

   Review the datalogger records of each injector drive signal. All injectors must show a stable pattern of injector pulses, short pulses at idle (approx 2mS) and slightly increasing pulse length when running at higher rpm with no significant engine load.

   If any injector driver signal goes continually low or continually high, or is erratic in comparison with the other injector drive signals, replace the PCM.

   If all signals are consistent, with pulse lengths increasing with engine speed, the electrical control circuits are good.

9. Flow test the injectors:

   Use a Rotunda Injector Tester or equivalent to flow test the injectors according to the manufacturers instructions.

   If any injector flow rate is not within specification, replace the defective injector. Rerun the KOER Test.

   If the injector flow rates are all within specification, the problem is not fuel related.

10. Check the cylinder compression pressures using the service manual procedure 1.0.02.

    The compression pressures should all be in the range 160 - 170 psi.

    If any compression pressure is low, repair the engine as necessary.

    If the compression pressures are in specification, carry out further analysis as for DTCs P1131 and P1151 to check the heated oxygen sensors and circuits.

Fuel System

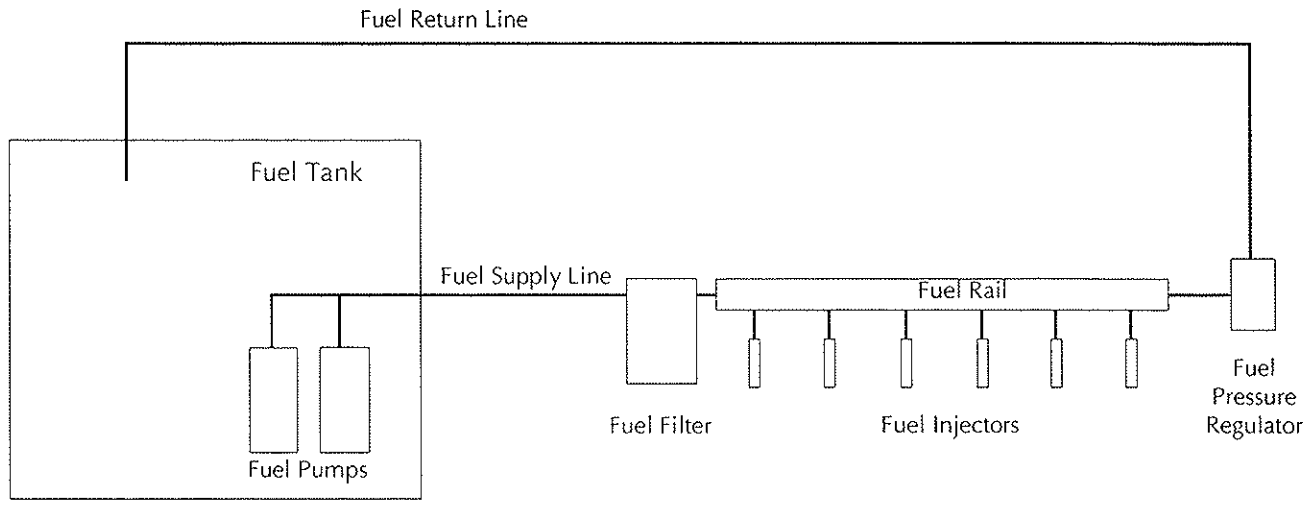


Figure 1. Fuel System Components

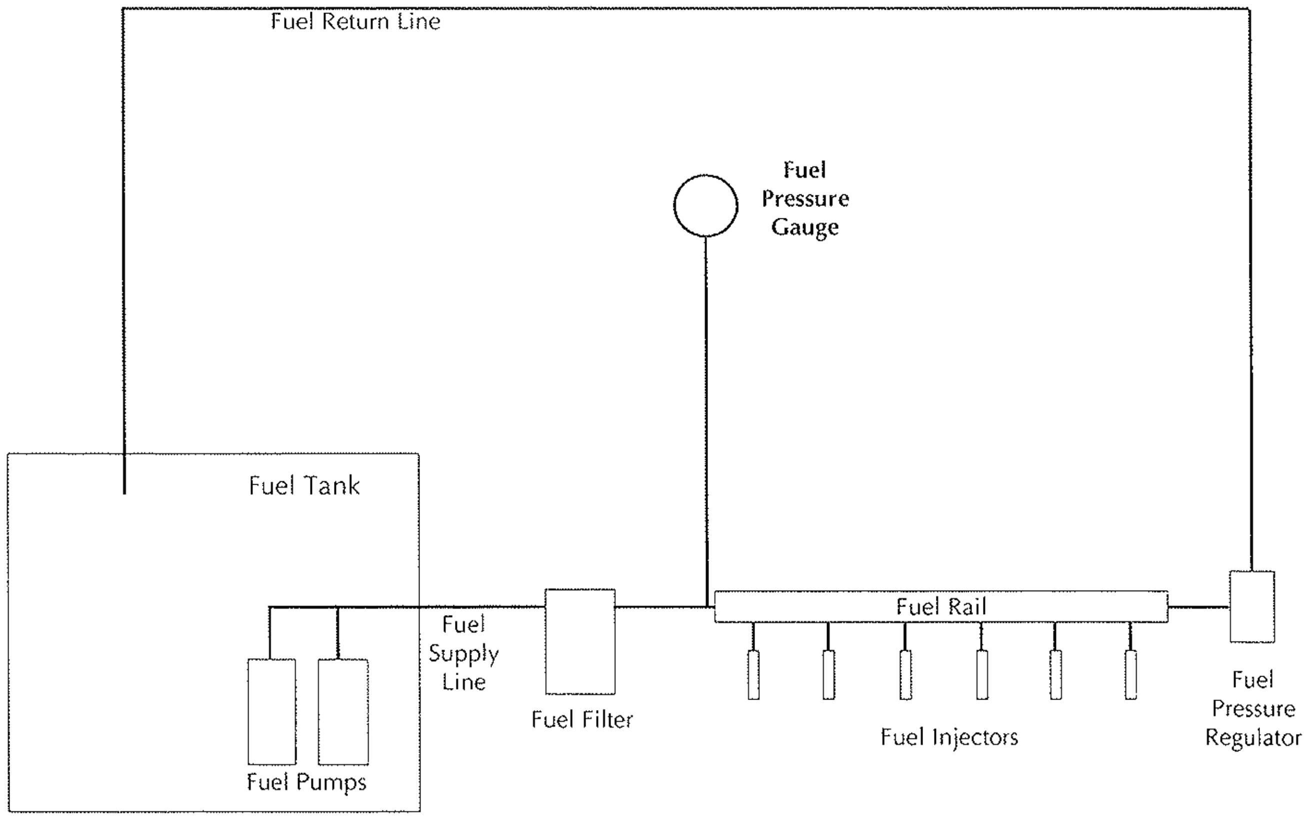


Figure 2. Fuel Pressure Gauge Installation

Fault Code Definition

P0172 - Cylinders 1-3 fuel/air ratio too rich
P0175 - Cylinders 4-6 fuel/air ratio too rich
Adaptive fuel correction at the limit.

P0172, P0175 Fault Analysis

1. Verify that the vehicle did not run out of fuel before the Check Engine light came on.

   If a No Fuel condition has been present, conect the PDU or scan tool and clear the P0171/P0174 code. Perform the KOER test sequence to check that the fuel adaption is now functioning correctly.

   If the vehicle has not recently run out of fuel, analyse the problem using the following procedure.

2. Carry out a thorough visual inspection of the vehicle, concentrating on the following possible causes of the rich mixture:

   Fuel System

   Leaking fuel injectors
   Leaking fuel pressure regulator
   High fuel pressure
   Damaged/disconnected HO2S circuits

   Induction System

   Air leaks after the air flow meter
   Vacuum leaks
   Restricted air inlet
   Positive Crankcase Ventilation system

   Base Engine

   Oil overfill
   Cam timing
   Compression pressure

   Ignition System

   Coil secondary windings
   Ignition HT leds
   Spark plugs

   Repair any problems identified in the visual inspection, clear the P0171/P0174 fault codes and repeat the KOER Test.

   If the P0172/P0175 code is detected proceed as follows.

3. Connect the PDU or scan tool. Perform the KOER test sequence.

   If any adaptive fuel codes are detected, go to step 4. For other codes, go to the appropriate procedure in this section of the fault analysis manual.

4. Check the fuel pressure as follows:

   Switch off the ignition. Install the fuel pressure gauge.

   Verify the pressure source to the fuel pressure regulator.

   Start the engine and run at idle speed. Record the fuel pressure. Increase the engine speed to 2500 rpm and maintain for 1 minute. Record the fuel pressure.

   The fuel system must be capable of maintaining 30-45 psi (210-310kPa).

   If the fuel pressure is high, check for blockage or restriction of the fuel return line. If the return line is good, check that only one fuel pump is running. If both fuel pumps run continuously, investigate any problem in the fuel pump relay circuits. If the fuel pump control is good, replace the pressure regulator. Recheck that the fuel pressure is now in specification.

5. Check the fuel system ability to hold fuel pressure.

   Cycle the ignition key on and off several times. Check for external fuel leaks (repair as necessary)

   Verify that with the ignition off, fuel pressure stays within 5 psi of the highest reading for 1 minute. If excessive pressure loss is detected, service or repair the fuel system to correct the problem.

6. Check the systems ability to hold fuel pressure with the ignition on.

   Again cycle the ignition key on and then off several times. Turn the key on, engine off, and monitor the fuel pressure.

   The fuel pressure must remain within 5 psi of the highest reading after 10 seconds. If excessive pressure loss is detected, there is a problem in the fuel injectors or electrical circuits.

7. Check the resistance of the fuel injectors and harness at the following test points:

Injector	Test Points
1	75 to 71/97
2	101 to 71/97
3	74 to 71/97
4	100 to 71/97
5	73 to 71/97
6	99 to 71/97

Each resistance should be in the range 11 - 18Ω

Low resistance - check the affected circuits for shorts to power or ground.

High resistance - check the affected circuits for high resistance connections or complete open circuits.

8. Check the injector driver signals:

Set up the PDU to monitor all six injector signals using the datalogger function (for alternative scan tools, follow the manufacturers instructions).

Start the engine and start logging data. Log a convenient period at both idle and at high rpm.

Stop recording on the datalogger and switch off the engine.

Review the datalogger records of each injector drive signal. All injectors must show a stable pattern of injector pulses, short pulses (approx 2ms) at idle and steadily increasing pulse length as rpm is increased. (Under high load and maximum power demand, the injectors would be on almost continually).

If any injector driver signal goes continually low or continually high, or is erratic in comparison with the other injector drive signals, replace the PCM.

If all signals are consistent, with pulse lengths increasing with engine speed (from approx 2 ms at idle), the electrical control circuits are good.

9. Flow test the injectors:

Use a Rotunda Injector Tester or equivalent to flow test the injectors according to the manufacturers instructions.

If any injector flow rate is not within specification, replace the defective injector. Rerun the KOER Test.

If the injector flow rates are all within specification, the problem is not fuel related.

10. Check the cylinder compression pressures using the service manual procedure 1.0.02.

The compression pressures should all be in the range 160 - 170 psi.

If any compression pressure is low, repair the engine as necessary.

If the compression pressures are in specification, carry out further analysis as for DTCs P1131 and P1151 to check the heated oxygen sensors and circuits.

Fuel Pumps

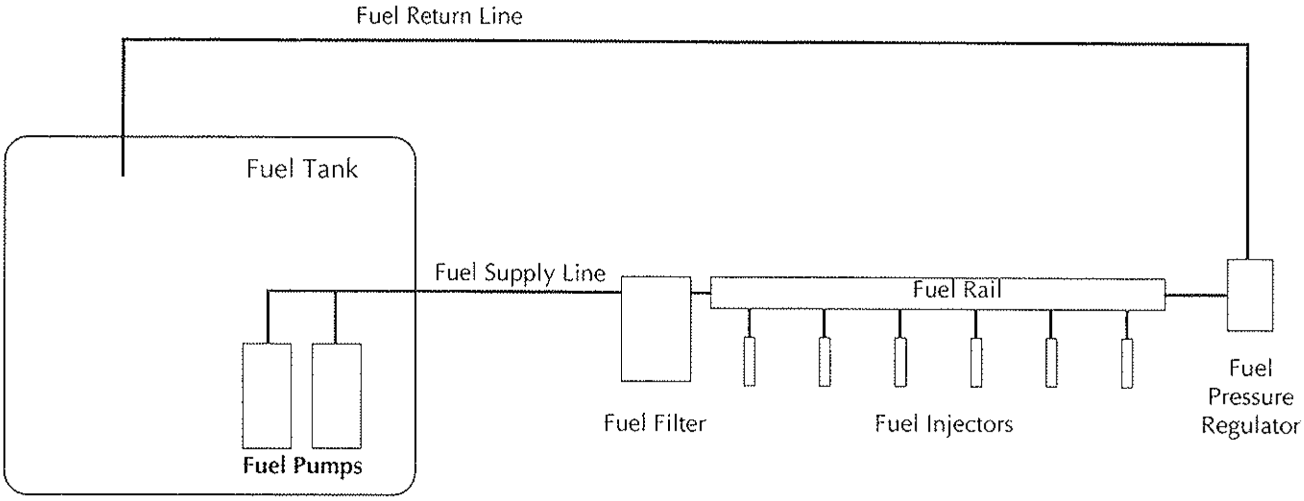


Figure 1. Fuel Pump Installation

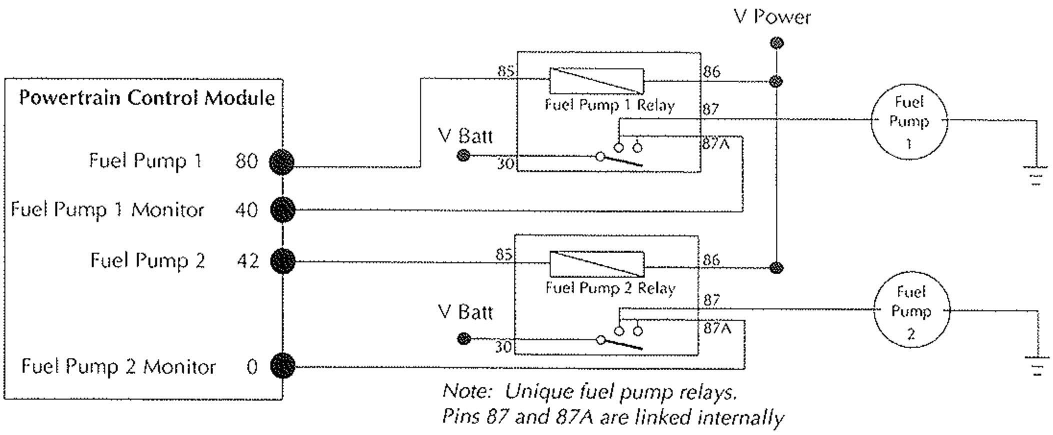


Figure 2. Fuel Pump Circuits

Fault Code Definition

P0230 - During normal running, a fuel pump 1 primary circuit failure has occured.

P0230 Fault Analysis

1. Disconnect the fuel pump relays. Switch on the ignition. Measure the voltage from VPWR circuit at the relay base pin 86 to chassis ground.

   The voltage should be greater than 10.5 volts.

   If the voltage is low, investigate for an open circuit between VPWR (Main Relay pin 87) and the fuel pump 1 relay.

2. Check the fuel pump 1 relay:

   Measure the resistance between pins 85 and 86 on fuel pump 1 relay. The resistance should be between 40 and 85Ω.

   Check for internal shorts on the relay by measuring the resistance from pin 85 to pin 30 and to pin 87. The resistance value should be greater than 10kΩ. If the resistance check does not meet specification, replace the defective relay.

   With the relay installed, touch the relay whilst a collegue switches on the ignition. A destinctive click should be felt as the relay energises.

3. Check the fuel pump circuits for shorts to VPWR:

   Remove the fuel pump 1relay and disconnect the PCM. Check the PCM connector for damaged or pushed out pins, corrosion or loose wires. Service as necessary.

   Switch on the ignition and check the voltage from PCM connector pin 80 to chassis ground. If the voltage is less than 1.0 volts, continue on to step 4. If the voltage is higher than 10.5 volts, there is a short to VPWR. Rectify the short circuit.

4. Check the fuel pump 1 circuit for short circuit to ground:

   Measure the resistance from PCM connector pin 80 to PCM connector pins 51/103 (PWR GND) and pin 91 (SIG RTN). The resistance must be greater than 10kΩ. If not, rectify the short to ground. If the resistance is higher than 10kΩ, continue to step 5.

5. Check the fuel pump circuit continuity:

   With the fuel pump 1 relay removed and the PCM disconnected, check the continuity from PCM connector pin 80 and pin 85 at fuel pump 1 relay base.

   If continuity is good (less than 5Ω) replace the PCM, otherwise, repair the open circuit.

6. Clear the P0230 code and road test the vehicle to ensure that the problem is resolved.

Fuel Pumps

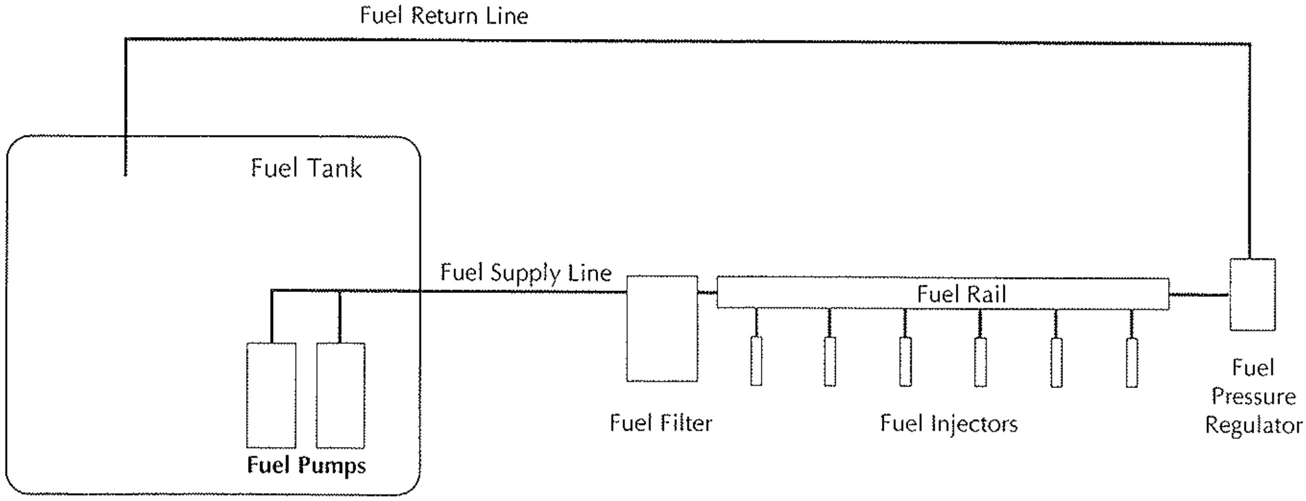


Figure 1. Fuel Pump Installation

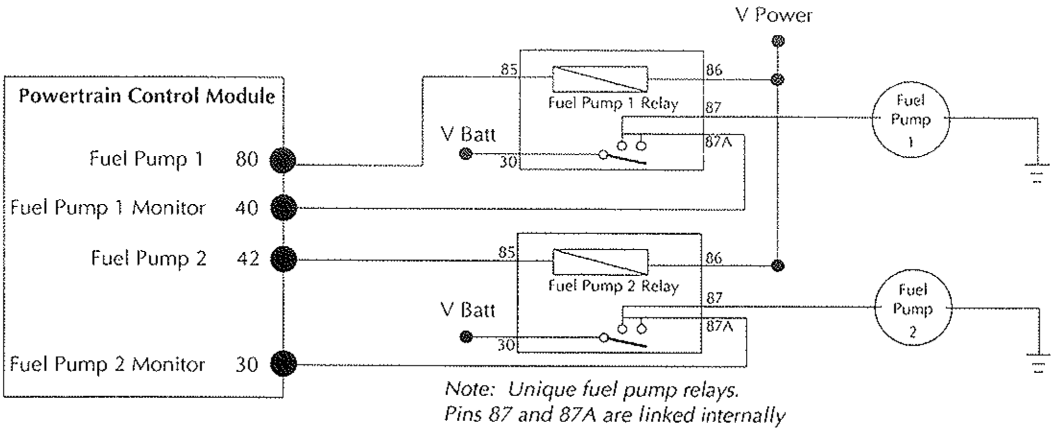


Figure 2. Fuel Pump Circuits

Fault Code Definition

P0231 - During normal running, when fuel pump 1 was commanded on, the fuel pump 1 monitor circuit voltage went low.

(Since code P0230 is not logged, the primary circuit is assumed to be good)

P0231 Fault Analysis

1. Connect the PDU or scan tool. Switch on the ignition.

2. Switch on the fuel pump outputs using the PDU controls.

3. Measure the voltage on fuel pump 1 relay base pin 30.

   If 12 volts is present, go to step 4.

   If the voltage on pin 30 is less than 10.5 volts, check fuse 1 (20A) in the rear fusebox and the VPWR wiring to pin 30 of the fuel pump wiring. Repair as necessary and run the KOER test to ensure that the problem is resolved.

4. Measure the voltage on pin 87/87A of the fuel pump 1 relay base.

   If less than 10.5 volts is available, change the relay.

   If 10.5 volts or more is available, go to step 5.

5. Key off. Remove the fuel pump 1 relay. Disconnect the PCM.

   Check continuity from pin 87A at the relay base to pin 40 of the PCM harness connector.

   If a continuity fault is identified, service the wiring as necessary. reconnect all components and run the KOER test to ensure that the problemn is resolved.

   If continuity from relay base pin 87A to PCM pin 40 is good, replace the PCM and run the KOER test to ensure that the problem is resolved.

Fuel Pumps

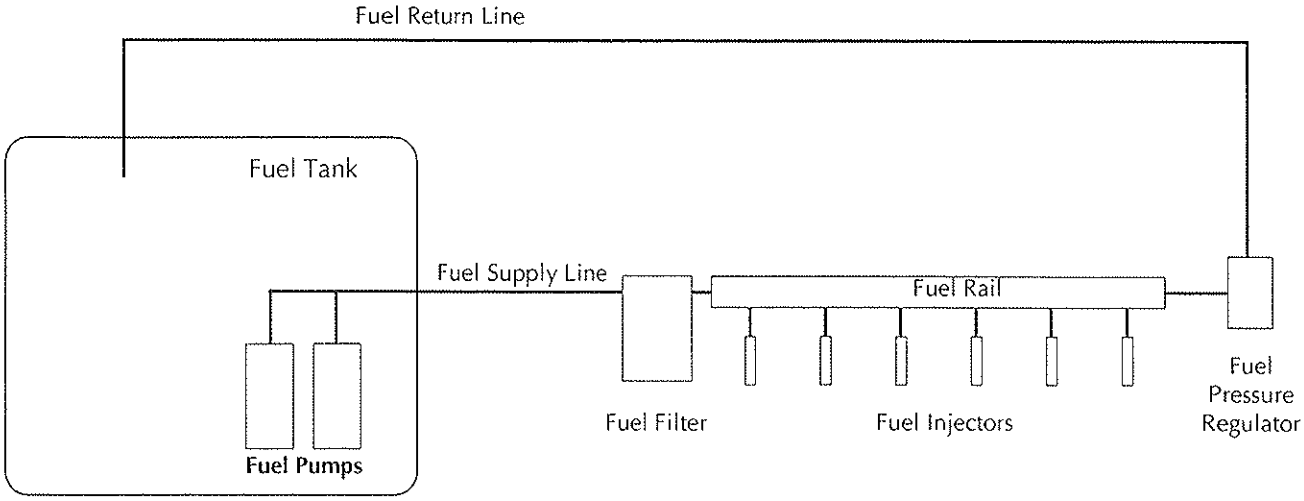


Figure 1. Fuel Pump Installation

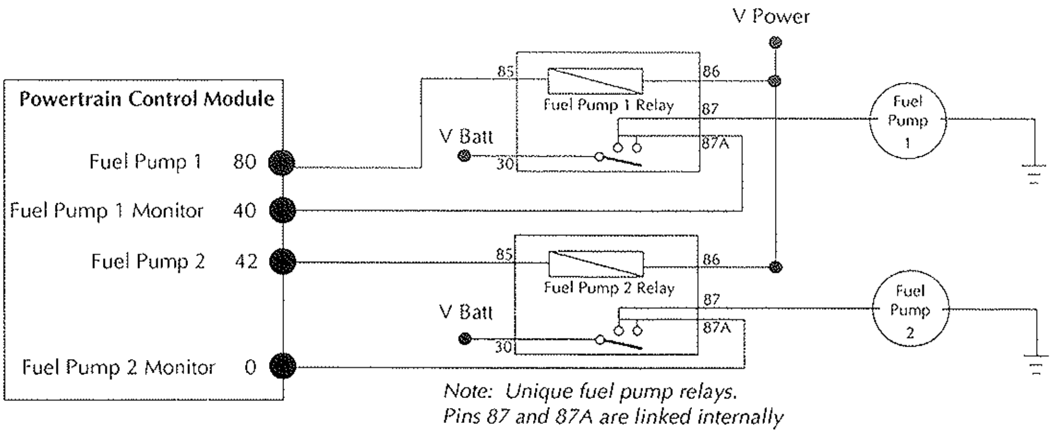


Figure 2. Fuel Pump Circuits

Fault Code Definition

P0232 - Fuel Pump 1 secondary circuit high.

P0232 Fault Analysis

1. Connect the PDU or scan tool. Switch on the ignition. Check that a P0232 code is logged.

2. Key off. Remove the fuel pump 1 relay. Disconnect the PCM.

   Check for short circuit to earth from relay base pin 85.

   If no short circuit is detected, go to step 3.

   If a short circuit is detected, repair the wiring from relay base pin 85 to PCM harness connector pin 80. Run the KOEO test to ensure that the problem is resolved.

3. Check the voltage on relay base pin 87A.

   If 0 volts is present, replace the fuel pump relay. Run the KOEO Test to ensure that the problem is resolved.

   If 12 volts is present, service the short circuit from relay base pin 87A to 12 volts supply (VBAT or VPWR). Reconnect all components and run the KOEO Test to ensure that the problem is resolved.

Misfiring

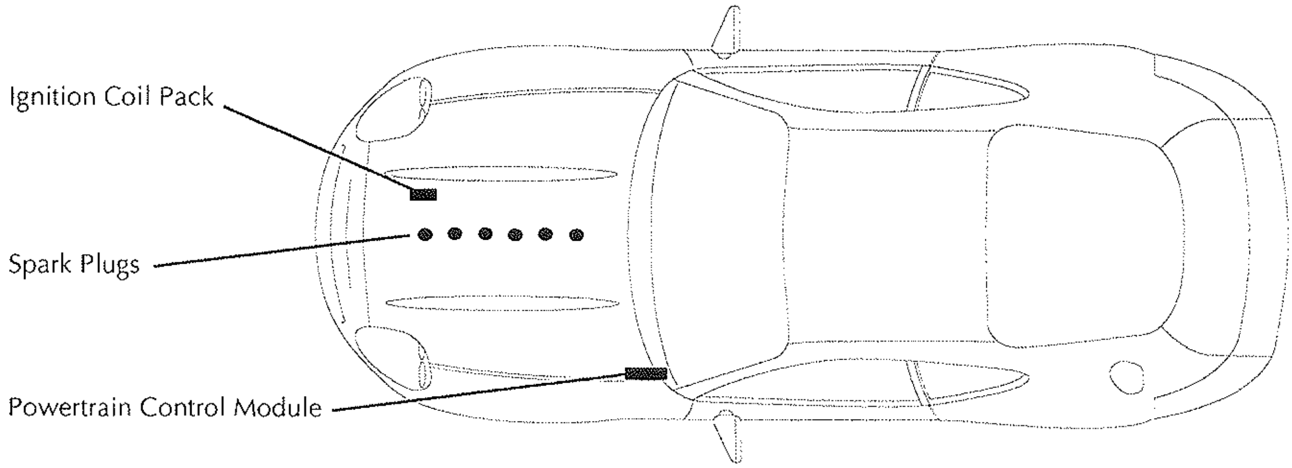


Figure 1. Ignition component location

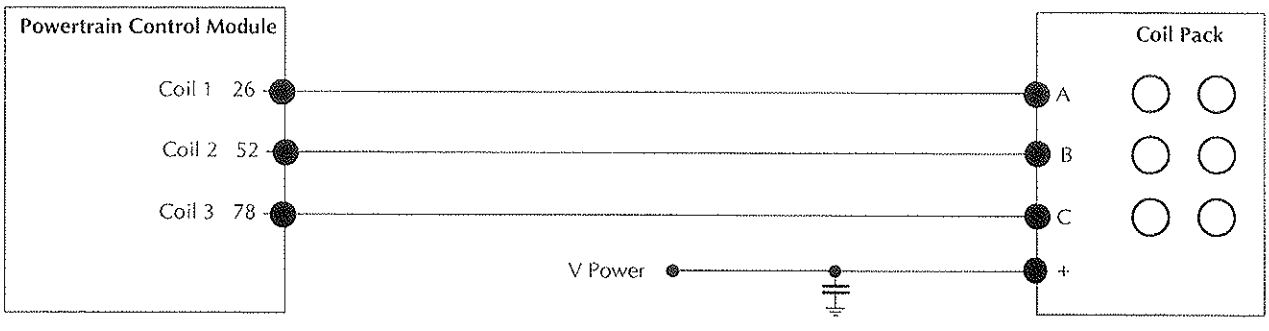


Figure 2. Ignition system Wiring

Add Service Port Location

Figure 3. Normal Ignition Voltage Display

Fault Code Definition

P0300 - Multiple cylinder misfiring, or cannot identify the cylinder due to camshaft position sensor failure.

P0300 Fault Analysis

Preliminary Checks

1. Check if the vehicle has recently run out of fuel. If so, reset the PCM to clear the DTCs and retest.
2. If code P0300 is detected again, check for other relevant DTCs:

   Camshaft position sensor P0340
   Ignition coil primary circuit P0350

   If either of these codes are present, disregard the misfire codes at this time and analyse the cam position sensor and/or ignition coil primary codes. On completion, retest for misfiring and, if present, then analyse the misfire codes as follows:
3. Check for other DTCs and rectify any other outstanding faults before analysing the misfire DTCs.

Ignition System Checks

1. Connect an engine analyser and, following the manufacturers instructions, enter the necessary vehicle data. Select the 'Scope' function and make the necessary connections to monitor the ignition voltages for all cylinders. Start the engine and allow it to warm up to normal operating temperature.
2. Observe the ignition voltage display and assess if the ignition voltages meet the following criteria:

   The average spark plug firing voltage should be less than 20kV with evenness of 8kV or less. (see figure 3). These are the normal values for a properly operating ignition system. If the current display meets these criteria, the misfiring is most likely to be fuel or base engine related.
3. If any spark plug firing voltage exceeds 20 kV then suspect wide spark plug gaps, or high resistance plug or plug lead connections. Set all spark plug gaps to specification. Check all plug lead connections. Measure the resistance of the plug leads and replace the leads if the resistance is greater than 7000Ω per foot of lead.
4. If any plug shows a consistently low spark plug firing voltage, suspect narrow spark plug gaps or fouled plugs. Inspect the plugs and clean/regap/ replace as necessary.
5. If the spark plug voltage trace shows no indication of the above problems, the misfiring is most likely to be fuel or base engine related.

Fuel System Checks

1. Check the resistance of the fuel injectors and harness at the following test points:

Injector	Test Points
1	75 to 71/97
2	101 to 71/97
3	74 to 71/97
4	100 to 71/97
5	73 to 71/97
6	99 to 71/97

   Each resistance should be in the range 11 - 18Ω

   Low resistance - check the affected circuits for shorts to power or ground.

   High resistance - check the affected circuits for high resistance connections or complete open circuits.
2. Check the injector driver signals:

   Set up the PDU to monitor all six injector signals using the datalogger function (for alternative scan tools, follow the manufacturers instructions).

   Start the engine and start logging data. Log a convenient period at both idle and at high rpm.

   Stop recording on the datalogger and switch off the engine.

   Review the datalogger records of each injector drive signal. All injectors must show a stable pattern of injector pulses, short pulses (approx 2ms) at idle and steadily increasing pulse length as rpm is increased. (Under high load and maximum power demand, the injectors would be on almost continually).

   If any injector driver signal goes continually low or continually high, or is erratic in comparison with the other injector drive signals, replace the PCM.

   If all signals are consistent, with pulse lengths increasing with engine speed (from approx 2 ms at idle), the electrical control circuits are good.
3. Check the fuel pressure as follows:

   Switch off the ignition. Install the fuel pressue gauge. Verify the vacuum source to the fuel pressure regulator.

   Start the engine and run at idle speed. Record the fuel pressure. Increase the engine speed to 2500 rpm and maintain for 1 minute. Record the fuel pressure.

   The fuel system must be capable of maintaining 30-45 psi (210-310kPa).

If the fuel pressure is high, check for blockage or restriction of the fuel return line. If the return line is good, check that only one fuel pump is running. If both fuel pumps run continuously, investigate any problem in the fuel pump relay circuits. If the fuel pump control is good, replace the pressure regulator. Recheck that the fuel pressure is now in specification.

4. Check the fuel system ability to hold fuel pressure.

   Cycle the ignition key on and off several times. Check for external fuel leaks (repair as necessary)

   Verify that with the ignition off, fuel pressure stays within 5 psi of the highest reading for 1 minute. If excessive pressure loss is detected, service or repair the fuel system to correct the problem.

5. Flow test the injectors:

   Use a Rotunda Injector Tester or equivalent to flow test the injectors according to the manufacturers instructions.

   If any injector flow rate is not within specification, replace the defective injector. Rerun the KOER Test.

   If the injector flow rates are all within specification, the problem is not fuel related.

Vacuum System Checks

1. Visually inspect all vacuum lines for damage, such as pinched lines, cracks, proper routing and assembly. Service or repair the vacuum system as necessary.

Check Evap Emission System

The misfire monitor can be influenced by the evaporative emission system. The following steps will evaluate the evaporative emission system.

1. Check the carbon cannisters for fuel saturation. If excessive liquid fuel is present, replace the carbon cannisters.

2. Fit a pressure gauge and pressure source to the service port. Supply air up to a maximum of 0.75 psi. If the system does not hold this pressure, repair or service the system as necessary.

3. Check for blockage/restrictions or cut hoses between the engine vacuum port and the carbon cannisters. Check for any blockage in the fuel tank venting system.

   If any fault is detected, replace or repair the affected parts. Rerun the KOER Test.

4. Check the mechanical integrity of the cannister purge valve as follows:

   a)Key off. Disconnect the cannister purge valve vacuum lines.

   b)Connect a 53kPa (16 in-Hg) vacuum source to the manifold side of the cannister purge valve.

   Energise the CANP solenoid using the PDU controls. Check that the cannister purge valve passes air freely.

If the above checks are OK, the evaporative loss system is functioning properly.

Check Base Engine

1. Check the cylinder compression pressures using the service manual procedure 1.0.02.

   The compression pressures should all be in the range 160 - 170 psi.

   If any compression pressure is low, repair the engine as necessary.

2. Check for correct operation and timing of the valve gear (see service manual - section 1).

3. Check for correct operation of the positive crankcase ventilation system.

Conclusion

The misfiring DTCs are intermittent. Go to the Intermittent Ignition Procedure.

Single Cylinder Misfire Detected

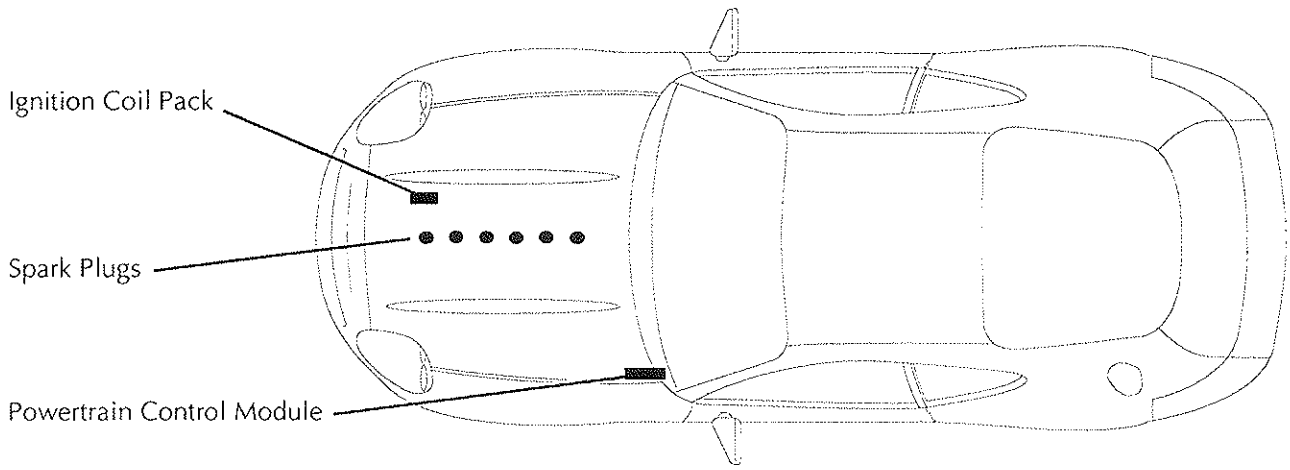


Figure 1. Ignition component location

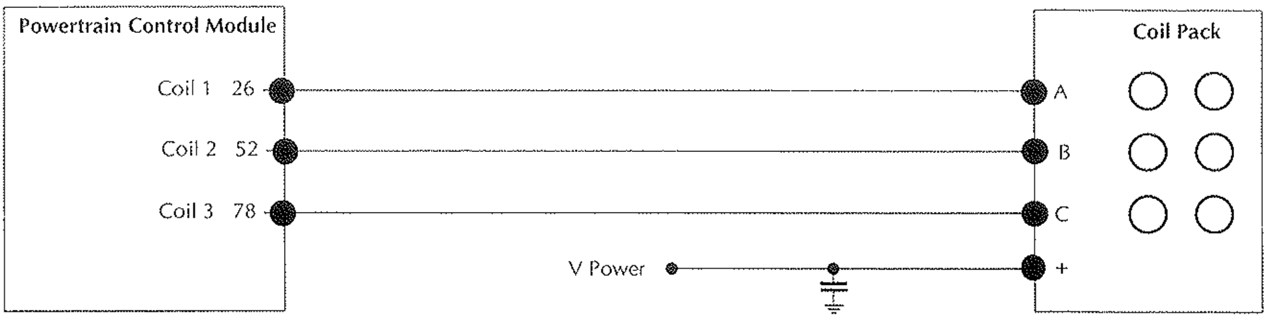


Figure 2. Ignition system Wiring

Figure 3. Normal Ignition Voltage Display

Fault Code Definition

P0301 - P0306 - Single cylinder misfiring.

P0301 - P0306 Fault Analysis

Preliminary Checks

1. Check if the vehicle has recently run out of fuel. If so, reset the PCM to clear the DTCs and retest.

2. If code P0301 - P0306 is detected again, check for other relevant DTCs:

   Camshaft position sensor P0340
   Ignition coil primary circuit P0350

   If either of these codes are present, disregard the misfire codes at this time and analyse the cam position sensor and/or ignition coil primary codes. On completion, retest for misfiring and, if present, then analyse the misfire codes as follows:

3. Check for other DTCs and rectify any other outstanding faults before analysing the misfire DTCs.

Ignition System Checks

1. Connect an engine analyser and, following the manufacturers instructions, enter the necessary vehicle data. Select the 'Scope' function and make the necessary connections to monitor the ignition voltages for all cylinders. Start the engine and allow it to warm up to normal operating temperature.

2. Observe the ignition voltage display and assess if the ignition voltages meet the following criteria:

   The average spark plug firing voltage should be less than 20kV with evenness of 8kV or less. (see figure 3). These are the normal values for a properly operating ignition system. If the current display meets these criteria, the misfiring is most likely to be fuel or base engine related.

3. If the spark plug firing voltage for the suspect cylinder exceeds 20 kV then suspect a wide spark plug gap, or high resistance plug or plug lead connection. Set the spark plug gap to specification. Check the plug lead connection. Measure the resistance of the plug lead and replace the lead if the resistance is greater than 7kΩ per foot of lead.

4. If the plug shows a consistently low spark plug firing voltage, suspect a narrow spark plug gap or fouled plug. Inspect the plug and clean/regap/replace as necessary.

5. If the spark plug voltage trace shows no indication of the above problems, the misfiring is most likely to be fuel or base engine related.

Fuel System Checks

1. Check the resistance of the suspect fuel injector and harness at the relevant test point from the following list of PCM connections:

Injector	Test Points
1	75 to 71/97
2	101 to 71/97
3	74 to 71/97
4	100 to 71/97
5	73 to 71/97
6	99 to 71/97

   The resistance should be in the range 11 - 18Ω

   Low resistance - check the affected circuits for shorts to power or ground.

   High resistance - check the affected circuits for high resistance connections or complete open circuits.

2. Check the injector driver signal:

   Set up the PDU to monitor all six injector signals using the datalogger function (for alternative scan tools, follow the manufacturers instructions).

   Start the engine and start logging data. Log a convenient period at both idle and at high rpm.

   Stop recording on the datalogger and switch off the engine.

   Review the data logger record of the suspect injector drive signal and compare with the other injectors. All injectors must show a stable pattern of injector pulses, short pulses (approx 2ms) at idle and steadily increasing pulse length as rpm is increased. (Under high load and maximum power demand, the injectors would be on almost continually).

   If the injector driver signal goes continually low or continually high, or is erratic in comparison with the other injector drive signals, replace the PCM.

   If all signals are consistent, with pulse lengths increasing with engine speed (from approx 2 ms at idle), the electrical control circuits are good.

3. Check the fuel pressure as follows:

   Switch off the ignition. Install the fuel pressue gauge. Verify the vacuum source to the fuel pressure regulator.

   Start the engine and run at idle speed. Record the fuel pressure. Increase the engine speed to 2500 rpm and maintain for 1 minute. Record the fuel pressure.

The fuel system must be capable of maintaining 30-45 psi (210-310kPa).

If the fuel pressure is high, check for blockage or restriction of the fuel return line. If the return line is good, check that only one fuel pump is running. If both fuel pumps run continuously, investigate any problem in the fuel pump relay circuits. If the fuel pump control is good, replace the pressure regulator. Recheck that the fuel pressure is now in specification.

4. Check the fuel system ability to hold fuel pressure.

   Cycle the ignition key on and off several times. Check for external fuel leaks (repair as necessary)

   Verify that with the ignition off, fuel pressure stays within 5 psi of the highest reading for 1 minute. If excessive pressure loss is detected, service or repair the fuel system to correct the problem.

5. Flow test the injectors:

   Use a Rotunda Injector Tester or equivalent to flow test the injector according to the manufacturers instructions.

   If the injector flow rate is not within specification, replace the defective injector. Rerun the KOER Test.

   If the injector flow rate is within specification, the problem is not fuel related.

Vacuum System Checks

1. Visually inspect all vacuum lines for damage, such as pinched lines, cracks, proper routing and assembly. Service or repair the vacuum system as necessary.

Check Evap Emission System

The misfire monitor can be influenced by the evaporative emission system. The following steps will evaluate the evaporative emission system.

1. Check the carbon cannisters for fuel saturation. If excessive liquid fuel is present, replace the carbon cannisters.

2. Fit a pressure gauge and pressure source to the service port. Supply air up to a maximum of 0.75 psi. If the system does not hold this pressure, repair or service the system as necessary.

3. Check for blockage/restrictions or cut hoses between the engine vacuum port and the carbon cannisters. Check for any blockage in the fuel tank vanting system.

   If any fault is detected, replace or repair the affected parts. Rerun the KOER Test.

4. Check the mechanical integrity of the cannister purge valve as follows:

   a)Key off. Disconnect the cannister purge valve vacuum lines.

   b)Connect a 53kPa (16 in-Hg) vacuum source to the manifold side of the cannister purge valve.

   Energise the CANP solenoid using the PDU controls. Check that the cannister purge valve passes air freely.

If the above checks are OK, the evaporative loss system is functioning properly.

Check Base Engine

1. Check the cylinder compression pressures using the service manual procedure 1.0.02.

   The compression pressures should all be in the range 160 - 170 psi.

   If any compression pressure is low, repair the engine as necessary.

2. Check for correct operation and timing of the valve gear.

3. Check for correct operation of the positive crankcase ventilation system.

If any base engine problems are identified, repair as necessary and then rerun the KOER Test.

Conclusion

If misfiring continues, the DTCs are intermittent. Go to the Intermittent Ignition Procedure.

PIP Input Circuit Malfunction

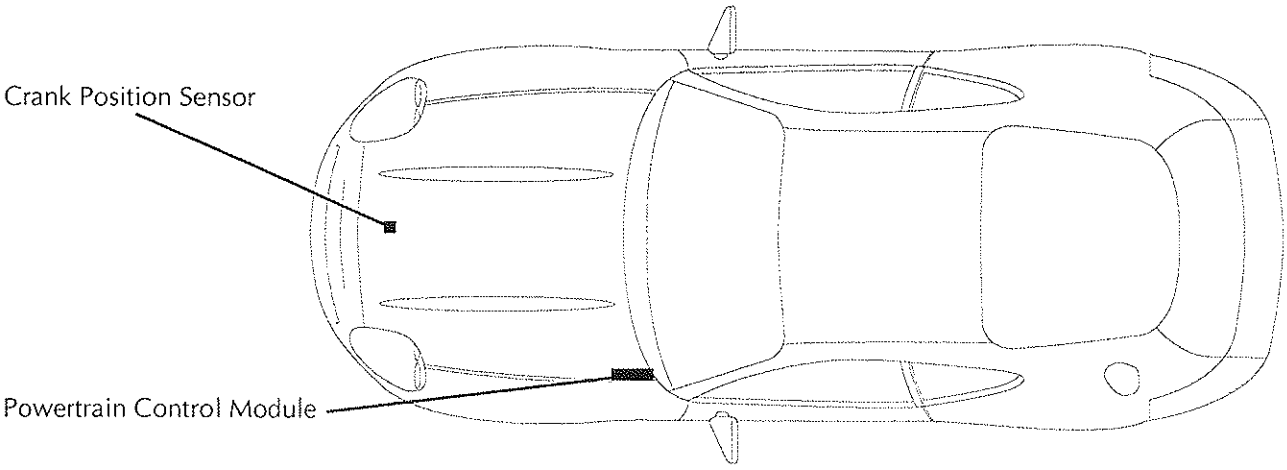


Figure 1. Powertrain Control Module location

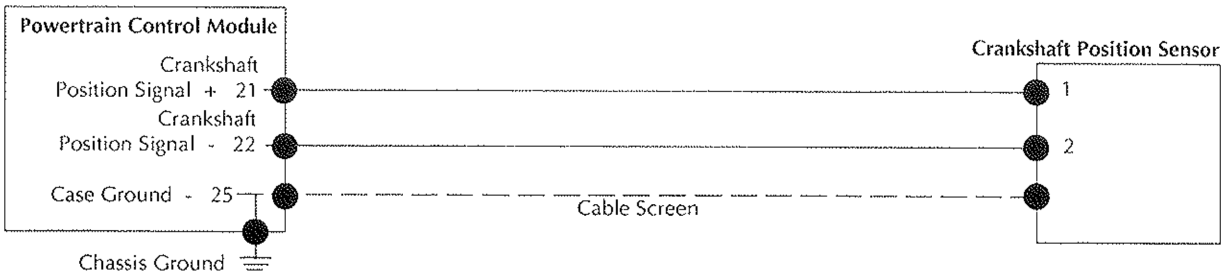


Figure 2. Crankshaft Position Sensor Wiring

Figure 3. Normal Ignition Voltage Display

Fault Code Definition

P0320 - Two successive erratic Profile Ignition Pickup (PIP) pulses occurred, resulting in a possible engine miss or stall.

Note: The PIP signal is derived from the Crankshaft position signal. The PIP signal and ignition control circuits are internal within the PCM.

P0320 Fault Analysis

1. Radio Interference may be caused by RF wiring running close to the PCM harness. If a two way radio or cellular telephone is fitted, check for correct installation. Carefully check for correct routing of antenna and power leads away from ignition control signal lines to avoid radio interference.

   If any such problems are present, re-route the RF wiring, reset the PCM and retest.

   If no RF wiring problems exist, go to step 2.

2. Check the continuity from the crank sensor cable screen to chassis ground.

   If any defect is identified in the screen continuity, service as necessary, reset the PCM and retest.

   If no defects are identified in the screen continuity, go to step 3.

3. Connect the PDU or scan tool. Note all logged DTCs. Reset the PCM and rerun the KOER test. If P0320 reoccurs, go to step 4.

   If P0320 is not recorded, use the intermittent signal procedure to check the Crank Position Sensor Signal. If no problems are identified, substitute a known good PCM and retest.

4. Check the Crank Position Sensor mountings and security. If the mounting is faulty, secure the sensor, reset the PCM and rerun the drive cycle to ensure that the problem is resolved.

   If the sensor mounting is correct, go to step 5.

5. Disconnect the PCM and check continuity from PCM harness connector pin 21 to pin 22. The sensor resistance should be approximately 1 kΩ.

   If the circuit resistance is significantly greater than 1 kΩ, repair the open circuit or replace the defective sensor. Reset the PCM and rerun the KOER Test to ensure that the problem is resolved.

   If the circuit resistance is correct, substitute a known good PCM and rerun the KOER Test to ensure that the problem is resolved.

Camshaft Position Sensor Circuit Malfunction

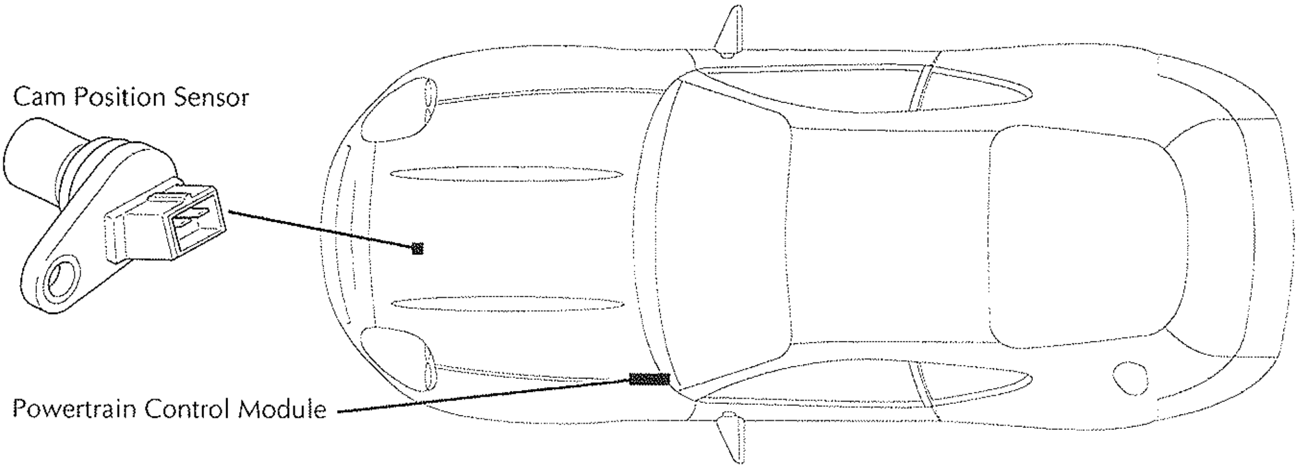


Figure 1. Camshaft Position Sensor location

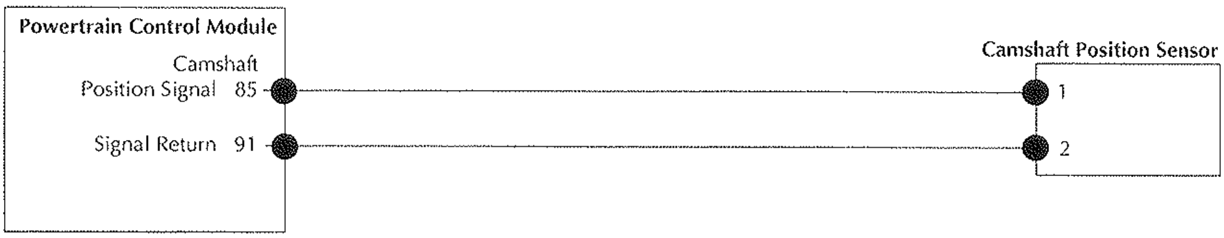


Figure 2. Camshaft Position Sensor Wiring

Figure 3. Normal Camshaft Position Sensor Signal

Fault Code Definition

P0340 - During self-test, a camshaft position (CMP) sensor circuit failure was detected.

P0340 Fault Analysis

1. Connect the PDU or scan tool. Complete the PCM reset procedure to clear all DTCs.

2. Check the continuity from the cam sensor cable screen to chassis ground.

   If any defect is identified in the screen continuity, service as necessary, reset the PCM and retest.

   If no defects are identified in the screen continuity, go to step 3.

3. Set the PDU or scan tool to monitor the cam position sensor signal. Start the engine. Whilst monitoring the camshaft position sensor signal, increase engine revs to greater than 1500 for 10 seconds and allow it to return to idle speed. Repeat this sequence twice more.

   The camshaft position sensor signal must show a regular pattern of pulses, one pulse per two engine revolutions.

   If the pulse pattern is irregular or has missing pulses, go on to step 4.

   If the pulse pattern is regular, the P0340 fault is intermittent, go to the Intermittent Signal Procedure.

4. Using the Workshop Manual procedure, check and if necessary adjust the camshaft position sensor.

   If no adjustment is necessary, go to step 5.

   If the sensor is adjusted, clear the P0340 code and run the KOER Test to ensure that the problem is resolved.

5. Disconnect the camshaft position sensor. Check continuity of the signal lines to PCM pin 85 (Cam Position) and PCM pin 91 (Signal Return). Both lines should measure less than 5.0Ω. If a resistance higher than 5.0Ω is measured, repair or replace the wiring as necessary. If continuity meets specification, continue to step 6.

6. Check the security of the camshaft position sensor physical mounting. If loose, secure and retest. If the sensor is already secure, replace the sensor and retest. If the fault continues, replace the PCM and run the KOER test to ensure that the problem is resolved.

Ignition Coil Malfunction

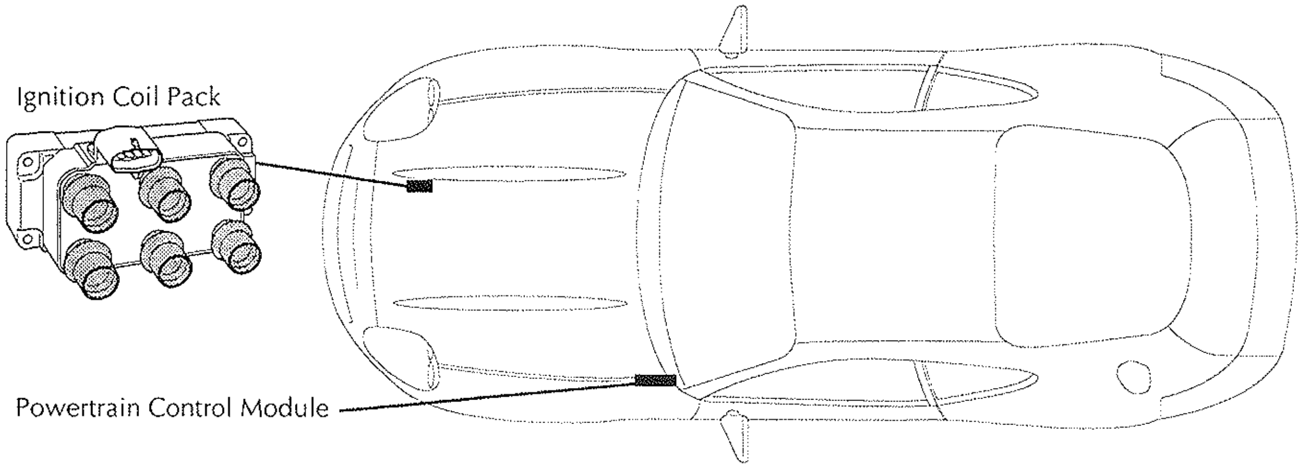


Figure 1. Ignition Coil Pack location

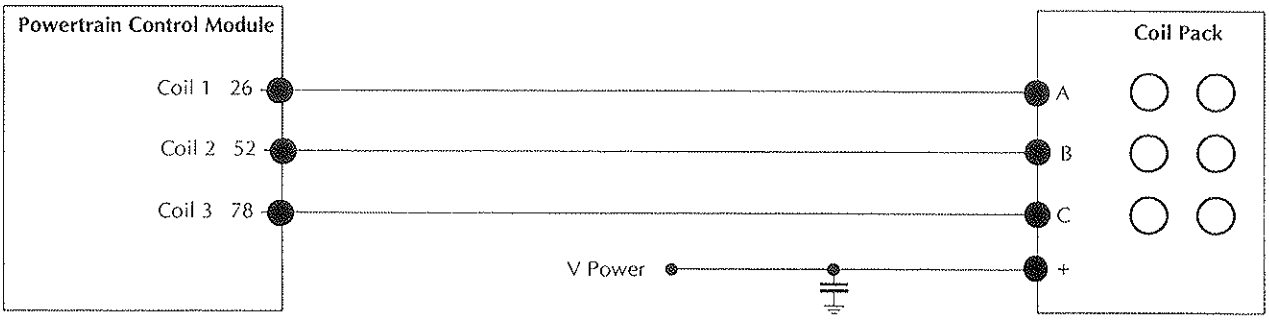


Figure 2. Ignition Coil Wiring

Figure 3. Spark Plug Firing Voltage

Fault Code Definition

P0350 - Ignition coil primary malfunction
P0351 - Ignition coil A primary malfunction
P0352 - Ignition coil B primary malfunction
P0353 - Ignition coil C primary malfunction

P0350, 51, 52, 53 Fault Analysis

1. Connect an engine analyser to monitor both the low tension and high tension sides of the ignition coil pack.

2. Following the manufacturers instructions, enter the necessary vehicle data. Select the 'Scope' function to monitor the ignition voltages for all cylinders. Start the engine and allow it to warm up to normal operating temperature.

3. Observe the ignition voltage display and assess if the ignition voltages meet the following criteria:

   The average spark plug firing voltage should be less than 20kV with evenness of 8kV or less. (see figure 3). These are the normal values for a properly operating ignition system. If the current display meets these criteria, the ignition primary fault is intermittent. Go to the intermittent ignition procedure. If any pair of spark plugs show inconsistent firing or are not firing at all, go on to step 4.

4. Check the ignition coil primary voltage for the suspect plugs. The primary voltage should drop every 360° of crankshaft rotation. If the primary voltage remains at above 10.5 volts, the fault is in either the primary leads from the PCM or the PCM is defective.

5. Switch off the engine and disconnect the engine analyser. Connect the PDU or scan tool and set up to analyse the ignition coil primary signals at the PCM. Start the engine and monitor the ignition coil primary voltage for the suspect plugs. If the primary signal for the suspect plugs is dropping every 360° of crankshaft rotation, the fault is in the wiring from PCM pins 26, 52 or 78 to the suspect coil. Check the suspect wire for continuity and repair as necessary.

   If the primary voltage for the suspect plugs is not dropping at the PCM, replace the PCM.

   Disconnect the PDU or scan tool and repeat the KOER Test to verify that the fault has been rectified.

EGR System Malfunction

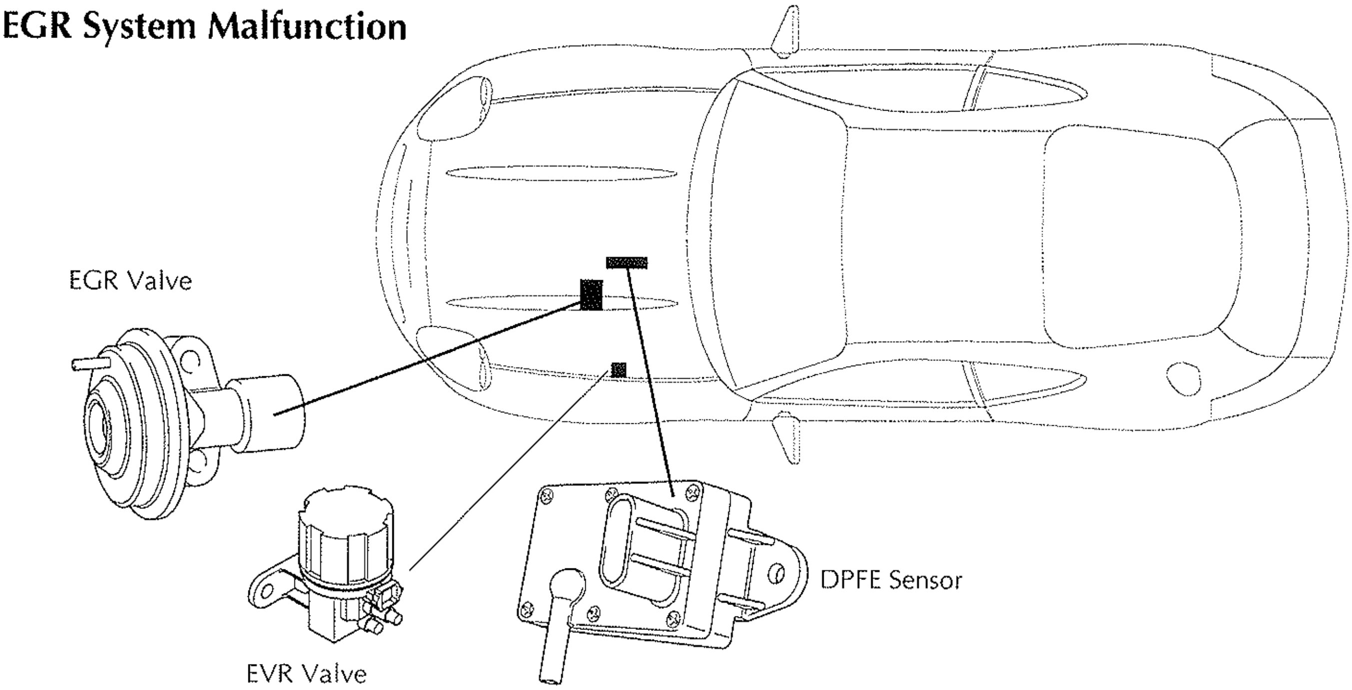


Figure 1. EGR Component Location

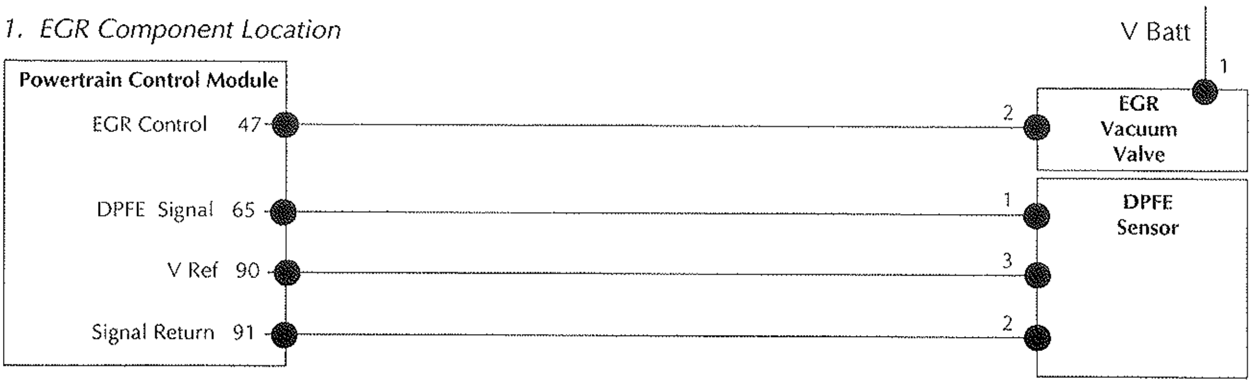


Figure 2. EGR System Wiring.

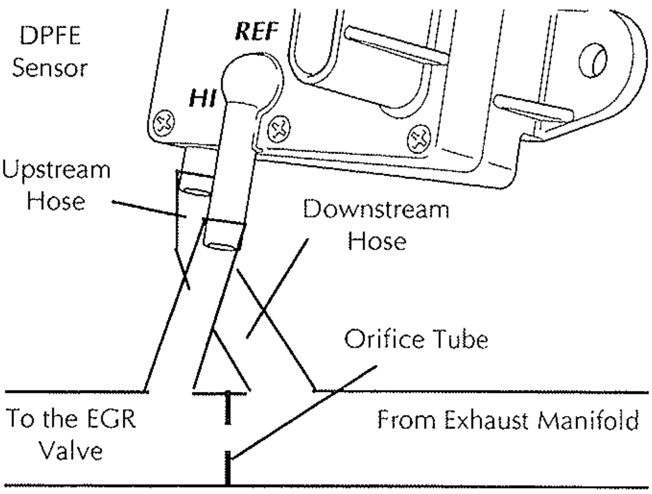


Figure 3. DPFE Hose Connections

Fault Code Definition

P0401 - Self test has detected insufficient EGR flow.

P0401 Fault Analysis

1. Connect the PDU or scan tool.
2. Run the KOER self-test. Switch off the engine and verify that P0401 is output.
3. Disconnect the vacuum hose at the EGR vacuum valve. Install a vacuum gauge to the hose.
4. Run the KOER test again whilst observing the vacuum gauge. Approximately 30 seconds into the KOER test, EGR flow will be requested for a few seconds. The vacuum at this time should increase above 1.6 in-Hg to open the valve.

   If the vacuum rises to 3.0 in-Hg or more the vacuum is sufficient to open the EGR vacuum valve. The problem is unlikely to be in EGR vacuum control. Go to step 5.

   If vacuum remains under 3.0 in-Hg, go to step 10.

5. Key off. Visually inspect both DPFE sensor hoses for kinking, blockage or improper routing.

   Check the apertures in the DPFE sensor and in the orifice tube assembly for restrictions or contamination.

   If any faults are detected, service as necessary. Clear the P0401 code and rerun the KOER test to verify that the fault is cleared.

   If no faults are detected, go to step 6.

6. Measure VREF voltage at the DPFE sensor connector.

   If VREF is outside the range 4.0 - 6.0 volts, there is a VREF problem. Go to the VREF fault analysis procedure.

   If VREF is in the range 4.0 - 6.0 volts, go to step 7.

7. Measure the DPFE sensor output as follows:

   Disconnect the DPFE sensor pressure hoses. Connect a hand vacuum pump to DPFE sensor 'REF' pipe.

   Key on, engine off.

   Monitor the DPFE signal on the PDU, the voltage should be 0.45 ±0.25 volts with no vacuum applied to the sensor.

   Apply 8-9 in-Hg vacuum to the DPFE sensor 'REF' hose. The DPFE signal should rise above 4.0 volts. Quickly release the vacuum. The DPFE signal should drop below 1.0 volt in less than 3 seconds.

   If the DPFE signal voltage meets the above specification, the DPFE sensor is good, reconnect the hoses and go to step 8.

   If the DPFE signal voltage does not meet the above specification, replace the DPFE sensor. Reset the PCM and rerun the KOER Test to verify that the problem is cleared.

8. Check the EGR valve function as follows:

   Disconnect the vacuum hose at the EGR valve and plug the hose. Connect a hand vacuum pump to the EGR valve. Start the engine and bring to idle.

   Monitor the DPFE and RPM signals on the PDU.

   Slowly apply 5-10 in-Hg vacuum to the EGR valve and hold for 10 seconds. If the engine wants to stall, increase the rpm with the throttle to hold an engine speed of approximately 800 rpm. Check for the following:

   a) The EGR valve starts opening at 1.6 in-Hg, indicated by an increasing DPFE signal voltage.

   b) DPFE signal voltage increases until the EGR valve is fully open. The DPFE signal should read 2.5 volts minimum with full vacuum applied.

   c) The DPFE signal volts should remain steady when the vacuum is held. If the voltage drops within a few seconds, the EGR valve or vacuum source could be leaking.

   If the EGR valve functions correctly as indicated by the DPFE signal changes, reconnect all hoses and go to step 9.

   If the DPFE signal changes indicate a problem with the EGR valve, remove the valve. Check for obstructions in the EGR port and clear if necessary. If the port is clear, replace the EGR valve. Reconnect all components and rerun the KOER Test to confirm that the problem is cleared.

9. Check the EGR Vacuum Regulator Solenoid:

   Key off. Disconnect the vacuum hose at the EGR valve and connect to a vacuum gauge.

   Key on, engine running. With the engine at idle, short PCM pin 47 (EGRVR control) to chassis ground.

   The vacuum gauge should indicate 4.0 in-Hg or greater.

   If the vacuum reading is 4.0 in-Hg or greater, replace the damaged PCM. Reconnect all components and rerun the KOER Test.

   If the vacuum is below 4.0 in-Hg replace the damaged EGR Valve. Reset the PCM and rerun the KOER Test to ensure that the problem is resolved.

10. Check the vacuum source and vacuum hoses at the EGR Vacuum Regulator Solenoid as follows:

    Disconnect the vacuum hoses at the EGRVR solenoid and connect the vacuum supply hose to a vacuum gauge.

    Check the vacuum hoses for leaks, kinks, incorrect routing or blockage. Service if necessary.

    Key on engine running at idle. The vacuum at idle must be a minimum of 15 in-Hg.

    If the vacuum is low, service the inlet tract and/or vacuum supply hose as necessary. Complete a PCM reset and rerun the KOER Test to ensure that the problem is resolved.

    If the vacuum is 15 in-Hg or above, replace the damaged PCM, reconnect all components and rerun the KOER Test to ensure that the problem is resolved.

P0402 EGR System Malfunction

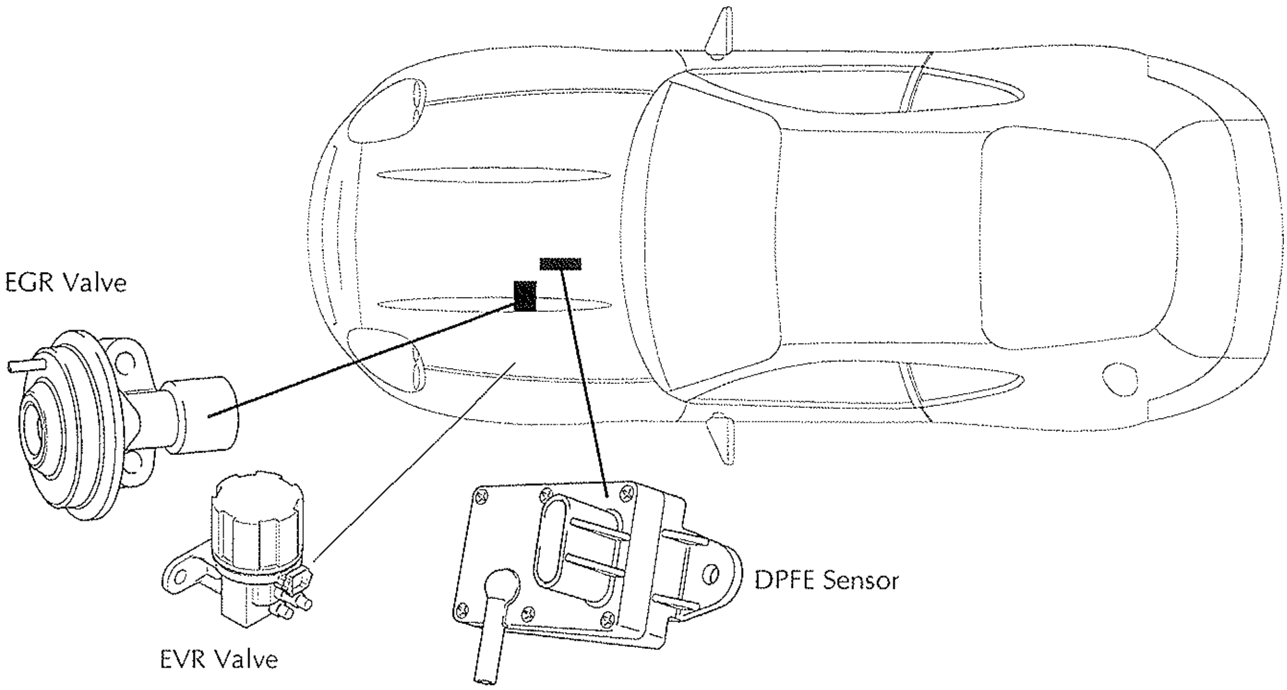


Figure 1. EGR Component Location

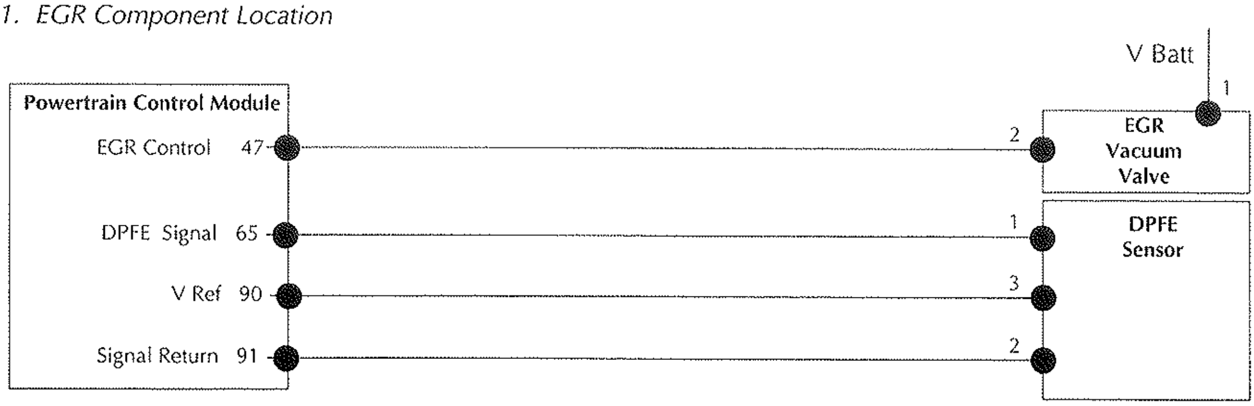


Figure 2. EGR System Wiring.

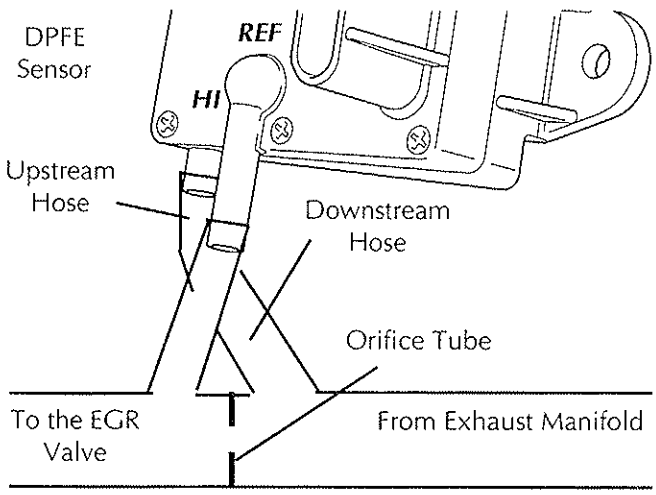


Figure 3. DPFE Hose Connections

Fault Code Definition

P0402 - Self test has detected EGR flow at idle.

Note: If DTC P1405 is present, diagnose the P1405 code first.

P0402 Fault Analysis

1. Key off. Disconnect the vacuum hose at the EGR valve and plug the hose.

2. Run the KOER self test. If P0402 is still detected, the EGR valve is suspect. Remove the EGR valve and service or replace as necessary. Check and if necessary clean the EGR port in the supercharger inlet assembly. Reconnect all components, reset the PCM and rerun the KOER Test.

   If P0402 is detected, go to step 3.

   If P0402 is not detected, the cause is intermittent.

3. Check for blocked/pinched vacuum hoses:

   Check the vacuum hoses from the EGR valve to the EVR solenoid, and from the EVR solenoid to the Bypass Housing.

   Note: A pinched or blocked hose can trap vacuum on the EGR side of the blockage and prevent the EGR valve from closing.

   If all hoses are serviceable, go to step 4.

   If any hose defects are identified, service as necessary, reconnect all components. Reset the PCM and rerun the KOER Test.

4. Check the DPFE sensor output using an external vacuum source.

   Key off. Disconnect the pressure hoses at the DPFE sensor. Connect a hand vacuum pump to the downstream pickup marked 'REF' on the DPFE.

   Connect the PDU or scan tool. Key on engine off. Monitor the DPFE input to PCM pin 65. The DPFE signal should be at 0.45 ±0.25 volts.

   Apply 8-9 in-Hg vacuum to the DPFE sensor. The DPFE signal level should rise to above 4.0 volts.

   Quickly release the vacuum from the sensor. The DPFE signal level should drop to less than 1 volt in less than 1 second.

   If the DPFE signal level changes are correct, go to step 5.

   If the DPFE signal level changes indicate a problem, replace the defective DPFE sensor. Reconnect all components. Reset the PCM and run the KOER Test.

5. Check for EGR flow with the EVR solenoid connector off:

   Key off. Disconnect the vacuum hose at the EGR valve and connect the hose to a vacuum gauge. Key on, start the engine and bring to idle.

   While monitoring the vacuum gauge, disconnect the EVR solenoid connector. The EGR valve requires vacuum greater than 1.6 in-Hg to begin to open.

   If the EGR vacuum falls below 1.6 in-Hg when the EVR solenoid is disconnected, the EVR valve is mechanically serviceable, go to step 6 to check the solenoid and circuit.

   If the vacuum reading remains greater than 1.6 in-Hg after the EVR solenoid is electrically disconnected, this indicates a mechanical fault in the EVR assembly.

   Service the EVR valve with particular attention to the EVR vent and filter. Reconnect all comonents, complete a PCM reset and rerun the KOER Test.

6. Measure the EVR solenoid coil resistance:

   Measure the resistance across the EVR solenoid coil. The resistance should be between 26 and 40Ω.

   If the coil resistance is good, go to step 7.

   If the coil resistance is not between 26 and 40Ω, replace the defective EVR solenoid. Reconnect all components. Reset the PCM and rerun the KOER Test.

7. Check the EVR circuit for short to ground:

   Disconnect the PCM

   Check the PCM connector for pushed out pins, corrosion, loose wires, etc. Service if necessary.

   Measure the resistance between PCM pin 47 (EVR) and pins 51 and 103 (PWR GND). The resistance should be greater than 10kΩ.

   If the resistance is greater than 10kΩ, replace the defective PCM. Reconnect all components. Rerun the KOER Test.

   If the resistance is less than 10kΩ, service the short circuit between the EVR solenoid and ground. Reconnect all components. Rerun the KOER Test.

Secondary Air Injection

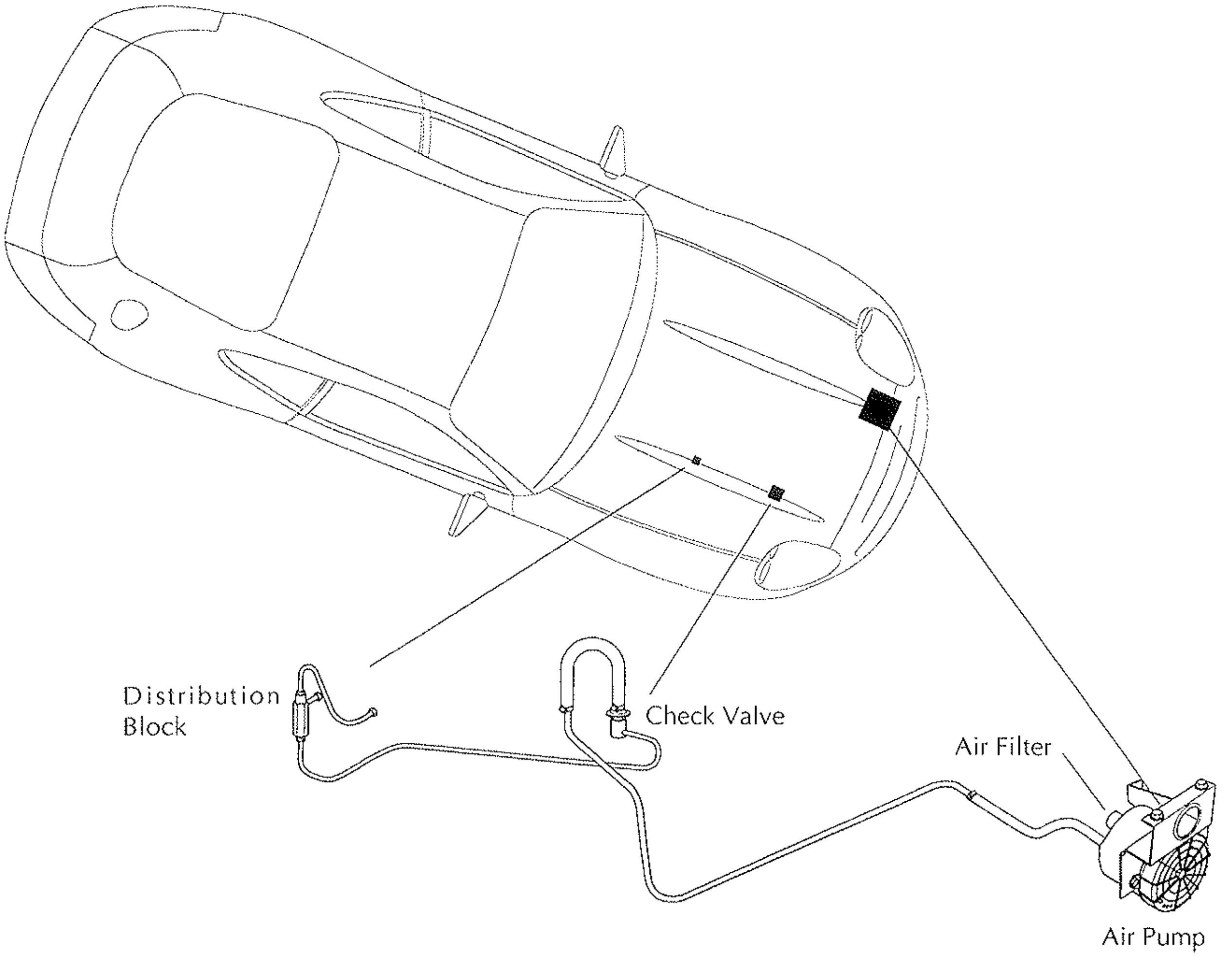


Figure 1. Secondary Air System Components

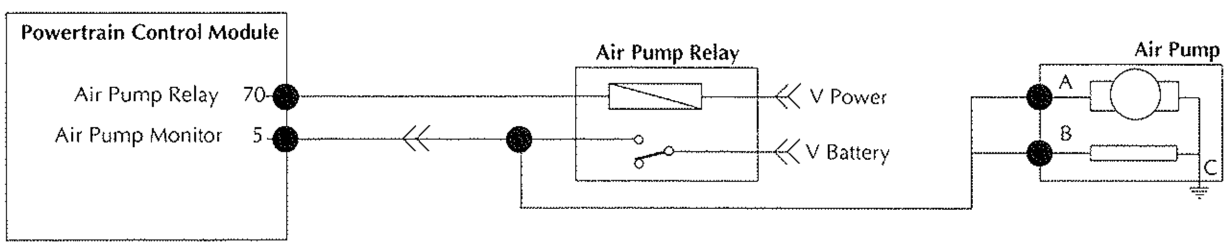


Figure 2. Secondary Air System Wiring

Fault Code Definition

P0411 - Indicates that secondary air injection was not detected.

P0411 Fault Analysis

1. Visually inspect the secondary air injection system for disconnected, crimped or blocked pipes. Service if necessary.

   If faults where found, connect the PDU and clear the P0411 code and run the KOER Test to verify that the problem is cleared.

   If no faults where found, go to step 2.

2. Disconnect the air pump outlet hose at the top of the check valve.

   Connect the PDU or scan tool and, using the component control function, switch on the air pump. Check the air flow at the outlet hose.

   If full air flow is present, go to step 3.

   If restricted or no air flow is present, go to step 4.

3. Test the air flow through the check valve as follows:

   Disconnect an air tube at the engine side of the check valve. Switch on the air pump and check for air flow from the disconnected tube.

   If air flow is present, check for blockage in the air inlets to the exhaust manifolds. Service as necessary, clear the P0411 code and rerun the KOER test to ensure that the problem is resolved.

   If air flow is not present, replace the check valve. Clear the P0411 code, rerun the KOER test to ensure that the problem is resolved.

4. Switch on the air pump using the component control function of the PDU.

   If the air pump motor runs, go to step 5.

   If the air pump motor does not run, go to step 6.

5. Check the air pump inlet filter and clean as necessary.

   Disconnect the outlet hose at the air pump. Switch on the pump and check for air flow at the outlet.

   If full air flow is not present, replace the air pump. Clear the P0411 code and rerun the KOER test to confirm that the fault is cleared.

   If full air flow is present, reconnect the outlet hose and disconnect the hose at the top of the check valve. Run the air pump again to check the air pump to check valve hose.

   If restricted air flow is present, service the restriction in the air pump to check valve path.

   Clear the P0411 code and rerun the KOER test to check that the fault is cleared.

6. Connect the PDU or scan tool.

   Monitor the voltage at PCM pin 5 (EAM Monitor) and switch on the air pump. The voltage should rise to above 10.5 volts.

   If the EAM Monitor voltage remains at 0V, there is no output from the air pump relay, go to step 7

   If the voltage is above 10.5 volts, check the voltage at the air pump connector pin A. If above 10.5V, the air pump motor is faulty. Replace the air pump.

   If the voltage at the connector is below 10.5V when the EAM Monitor is above 10.5V, repair the air pump wiring from the air pump relay to the air pump.

7. Monitor the signal at PCM pin 70 (AIR MNGMNT) and switch on the air pump. The signal should switch low to energise the air pump relay.

   If the AIR MNGMNT signal remains high, the PCM is defective. Replace the PCM. Rerun the KOER Test to verify that the problem is cleared.

   If the AIR MNGMNT signal switches low, check the wiring from the PCM to the air pump relay and repair if necessary. If the wiring is good, replace the air pump relay and rerun the KOER Test to verify that the problem is cleared.

Secondary Air Injection

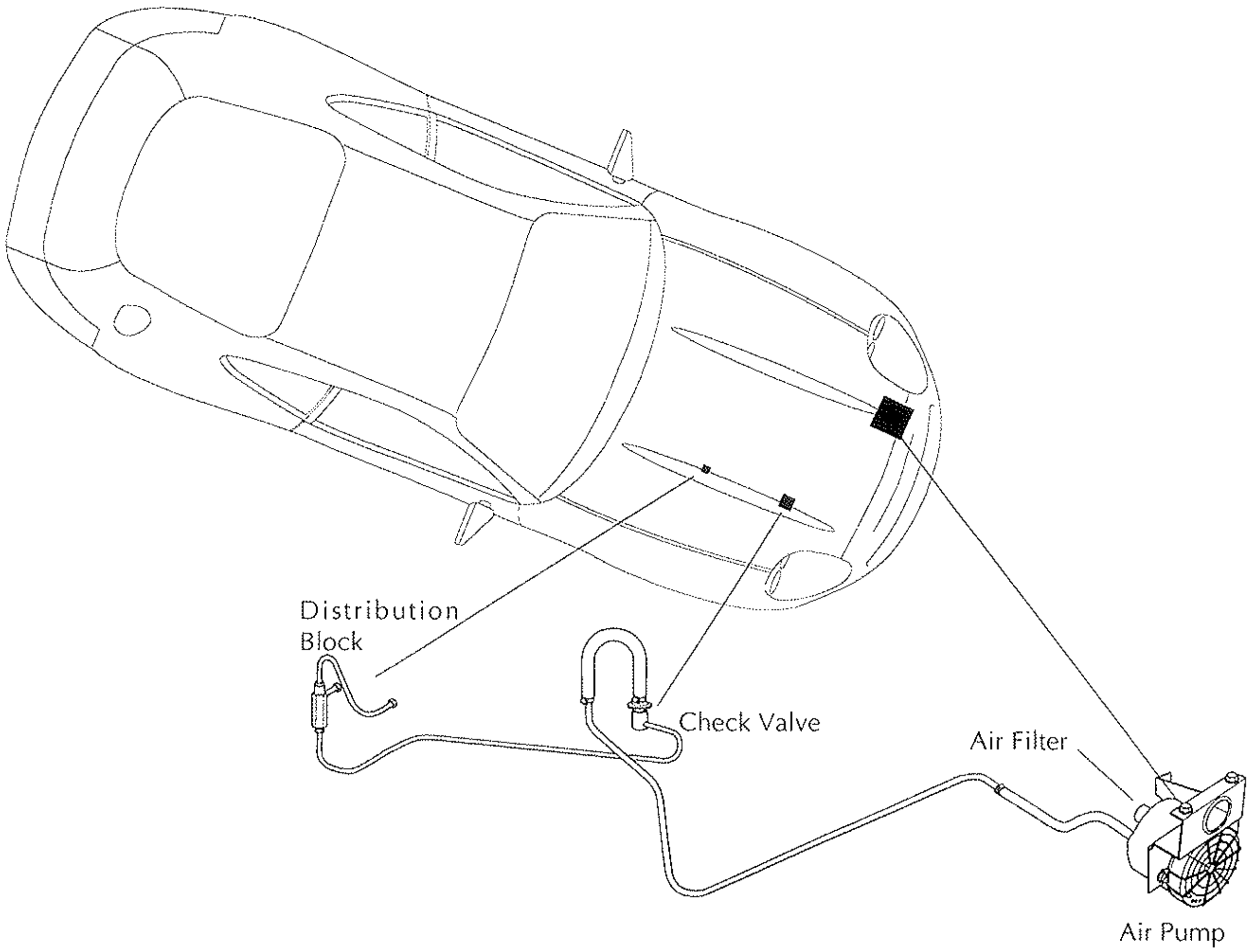


Figure 1. Secondary Air System Components

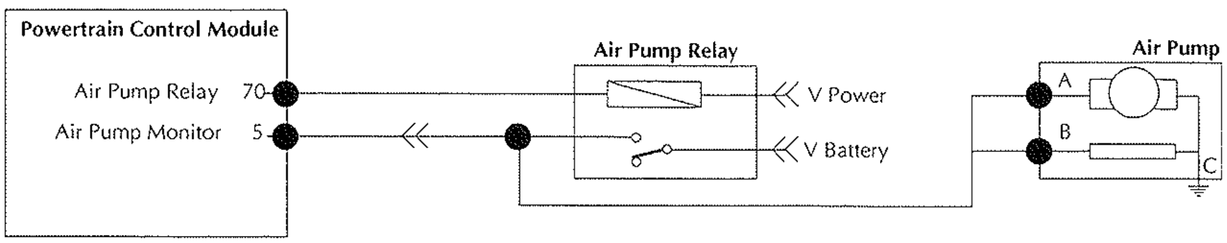


Figure 2. Secondary Air System Circuit

Fault Code Definition

P0412 - Indicates an EAIR primary circuit malfunction.

P0412 Fault Analysis

1. Key off, remove the air pump relay, key on engine off. Measure voltage from pin 86 at the relay base to battery negative.

   If the voltage is greater than 10.5 volts, the supply is OK. Go to step 2.

   If the voltage is less than 10.5 volts, check the continuity of the 12 volt supply from the main relay to air pump relay base pin 86

2. Check the continuity of the EAIR circuit:

   Key off. Disconnect the PCM.

   Check the PCM connector for pushed out pins, corrosion, loose wires, etc. Service as necessary.

   Measure resistance from air pump relay base pin 85 to PCM connector pin 70.

   If the resistance is more than 5Ω, repair the wiring. reconnect all components. Complete a PCM reset and rerun the KOER Test sequence to confirm that the fault is cleared.

   If the resistance reading is less than 5Ω, the EAIR circuit is OK, go to step 3.

3. Replace the air pump relay. Connect the PDU or scan tool and clear the P0412 code. Run the KOER Test to ensure that the problem is resolved.

Heated Oxygen Sensors

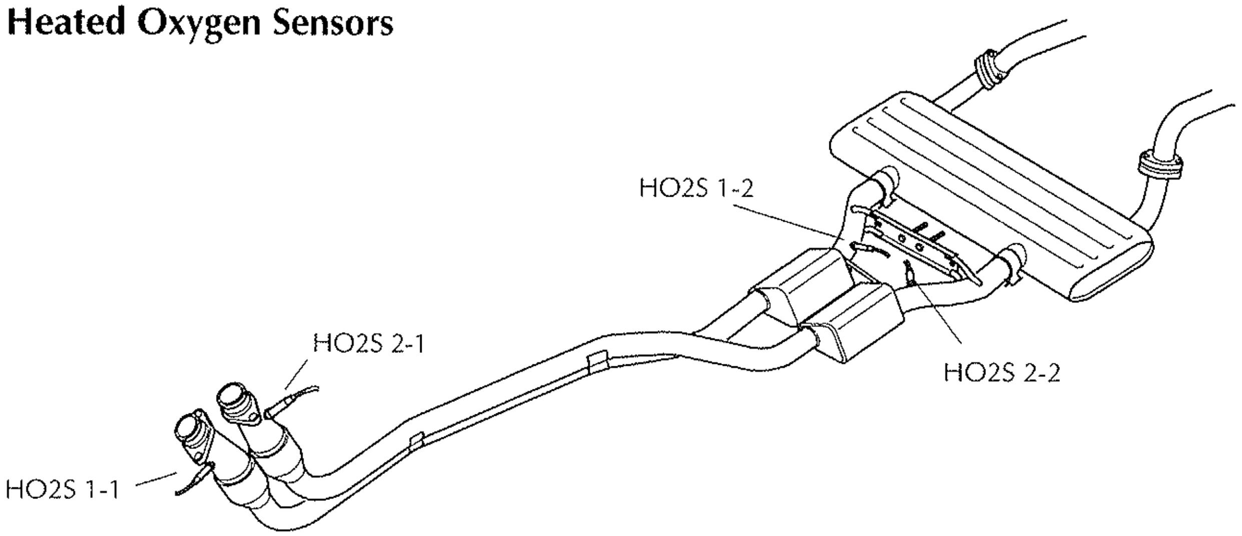


Figure 1. Catalyst Efficiency System Components

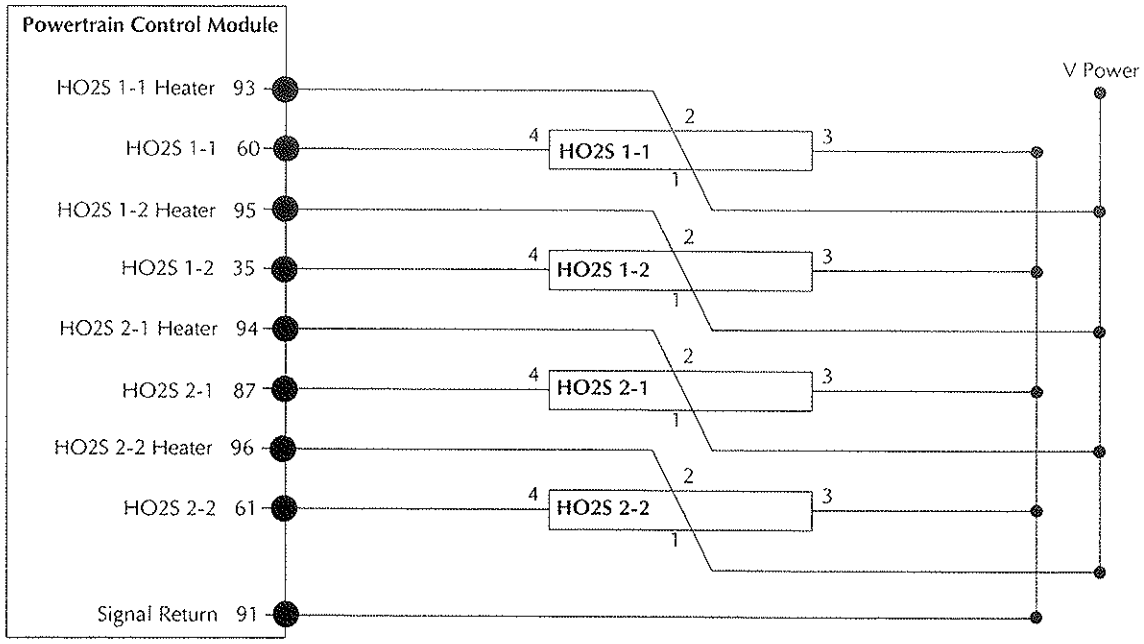


Figure 2. Heated Oxygen Sensor Wiring

Fault Code Definition

P0420 - Indicates that cylinders 1,2,3 catalyst system efficiency is below the acceptable threshold.

P0430 - Indicates that cylinders 4,5,6 catalyst system efficiency is below the acceptable threshold.

P0420/P0430 Fault Analysis

Notes

1. Complete the spark timing check in the KOER Test before continuing with this procedure.

2. Ensure that the customer has not refueled the vehicle with leaded fuel

3. Ensure that the customer has not experienced high oil consumption.

4. Internal deterioration of a catalytic convertor is usually caused by abnormal engine operation upstream of the catalyst. Events which may produce higher than normal temperatures in the catalyst are particularly suspect. For example, misfiring can cause higher than normal catalyst operating temperatures.

1. If any misfire DTCs P0300 - P0306 are recorded, analyse the misfire problem, then return to this procedure.

2. If any HO2S DTCs P0136, P0138, P0141, P0156, P0158 or P0161 are recorded, analyse these problems, then return to this procedure.

3. If any ECT sensor DTCs are recordedP0117, P0118, P0125 or P1117, analyse these problems, then return to this procedure.

4. If any other DTCs are recorded (not including the initial P0420/P0430) analyse these codes, then return to this procedure.

5. Check the wiring of each rear heated oxygen sensor. If any electrical connection is reversed, the catalyst efficiency test will be failed. If any wiring error is found, correct it, then reset the PCM memory and rerun the KOER Test to check that the problem is resolved. If no wiring errors are found, go to step 6.

6. Check the fuel pressure.

WARNING: The fuel system will remain pressurised when the engine is not running. To prevent injury or fire, use caution when working on the fuel system.

Note: Fuel pressure above specification may produce an abnormally rich mixture. The rich mixture may cause higher than normal catalyst operating temperatures.

Key off. Check the fuel pressure regulator hose for proper installation, cracks, etc. Service as necessary.

Install a fuel pressure gauge (0 - 50psi).

Verify the vacuum source to the fuel pressure regulator.

Start and run the engine at idle. Record the fuel pressure.

Increase engine speed to 2500 rpm and maintain for one minute. Record the fuel pressure.

The fuel pressure specification is 30-40 psi (210-310 kPa)

If fuel pressure is in specification, remove the pressure gauge and go on to step 7.

If fuel pressure is out of specification, refer to the Fuel Delivery System Checkout to analyse this problem.

7. Check for leaks or damage in the exhaust system. Examine all flanges for security and leaks. Examine all components for splits or serious corrosion. Examine all supports for security to avoid any flexing of the system under road shock. Check the complete system for damage which could cause restrictions.

If any defects are identified, repair or replace components as necessary and retest the vehicle to check for complete resolution of the problem. If no defects are found, go to step 8.

8. Check the inlet manifold vacuum:

Attach a vacuum gauge to the inlet manifold. Start the engine and allow it to run at idle speed whilst observing the vacuum gauge.

Note: The vacuum gauge reading may be normal when the engine is first started and idled. However, excessive restriction in the exhaust system will cause the vacuum to diminish even when the engine is idling.

Note the initial gauge reading and any change in the reading during the initial period at idle speed.

Steadily increase engine speed to 2000 rpm, then allow it to slowly decrease back to idle speed.

The manifold vacuum must rise to at least 16 inches Hg with the engine at 2000 rpm.

If a vacuum of less than 16 inches Hg at 2000 rpm is observed, remove the exhaust system and check for restrictions or blockage.

If the manifold vacuum met the basic specification, the P0420/P0430 codes are caused by poor catalyst performance, change the catalytic convertors and run the drive cycle to ensure that the problem is resolved.

Vapour Management Valve

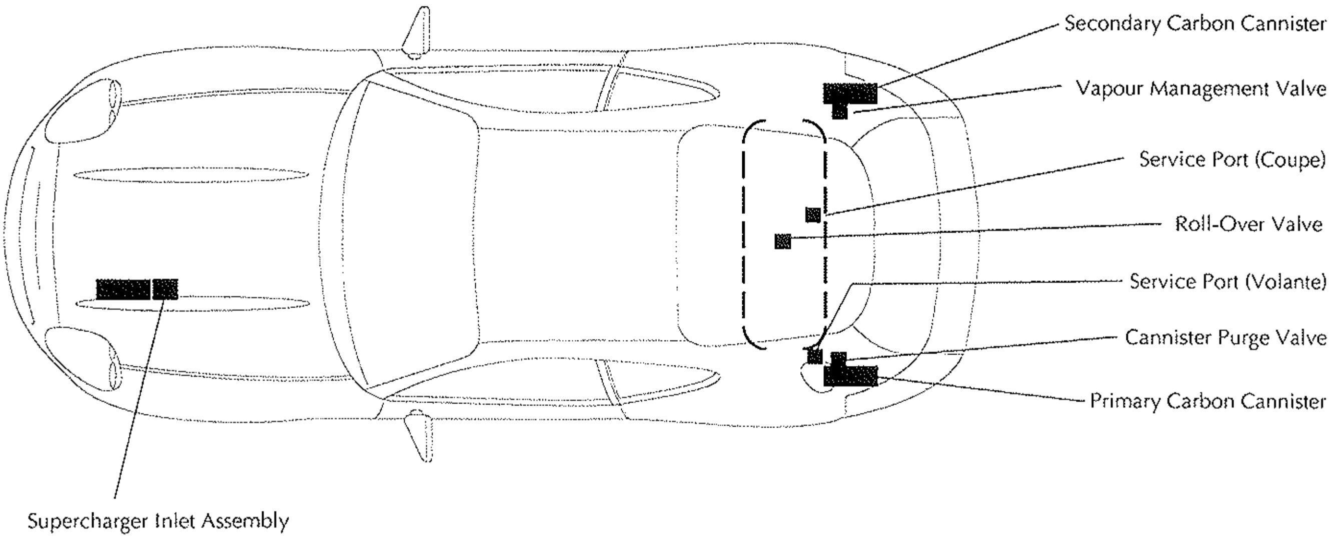


Figure 1. Evaporative Loss System Components

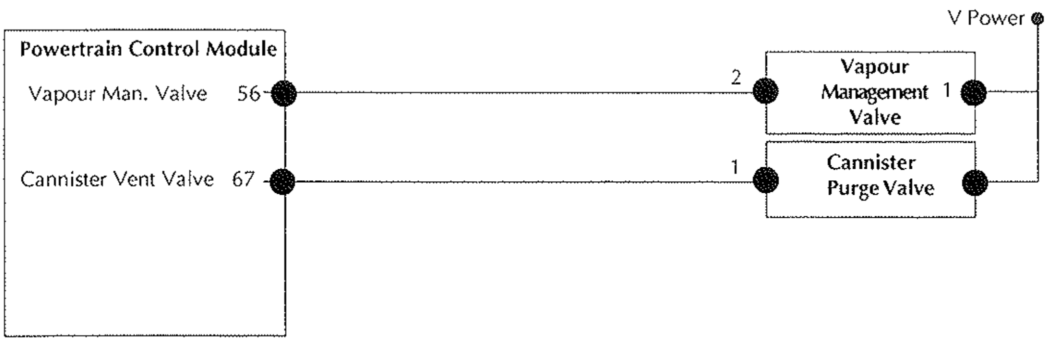


Figure 2. Evaporative Loss Circuit

Fault Code Definition

P0443 - This code indicates a failure in the VMV solenoid circuit.

P0443 Fault Analysis

1. Key off. Disconnect the VMV. Key on, engine off. Measure the voltage between VPWR at the VMV connector and battery ground.

   The voltage must be greater than 10.5 volts.

   If the voltage is above 10.5 volts, go to step 2.

   If the voltage is below 10.5 volts, repair the open circuit in the VPWR circuit, complete a PCM reset and rerun the KOER Test to verify that the problem is cleared.

2. Key off. Disconnect the VMV. Measure the resistance of the VMV. The resistance must be between 30 and 90Ω.

   If the resistance is in the range 30-90Ω, go to step 3.

   If the resistance is outside the range 30-90Ω, replace the vapour management valve. Reset the PCM and rerun the KOER Test to verify that the problem is cleared.

3. Check for open circuits in the VMV signal line:

   Key off. Disconnect the PCM and cannister purge solenoid. Check continuity from PCM connector pin 56 and the VMV signal line at the solenoid connector.

   If an open circuit is detected, repair it. Reset the PCM and rerun the KOER to verify that the problem is cleared.

   If no open circuit is found, go to step 4.

4. Check for short circuits in the VMV signal lines:

   Measure the resistance between PCM connector pin 56 and PCM connector pins 24 and 103 (PWR GND).

   The resistance must be greater than 10kΩ.

   If a resistance lower than 10kΩ is measured, repair the short circuit between the VMV signal line and PWR GND. Reset the PCM and rerun the KOER Test to verify that the problem is cleared.

   If the resistance is greater than 10kΩ, the fault lies in the PCM. Replace the PCM. Reset the PCM and rerun the KOER Test to verify that the problem is cleared.

Vehicle Speed Sensor

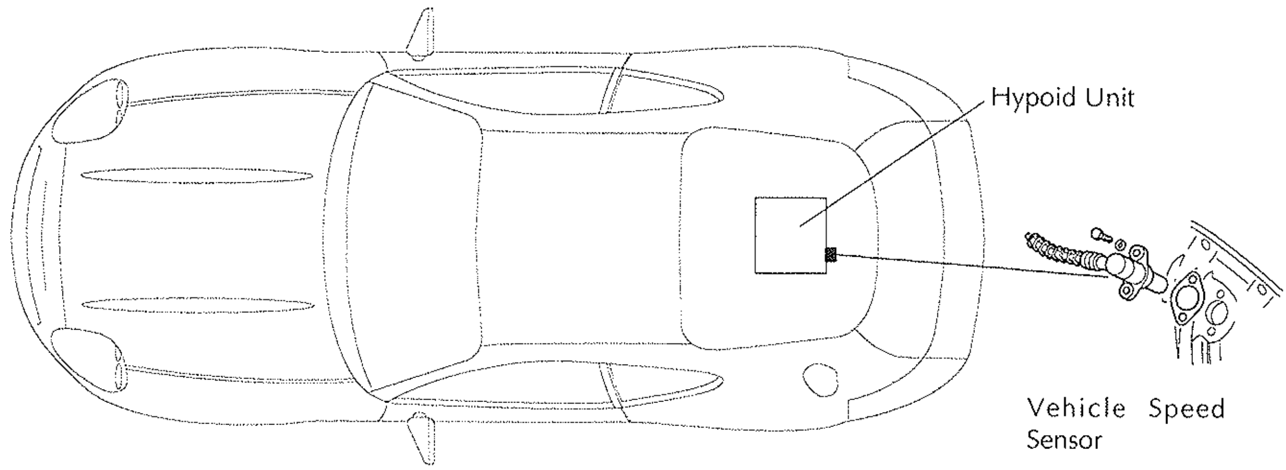


Figure 1. Vehicle Speed Sensor Location

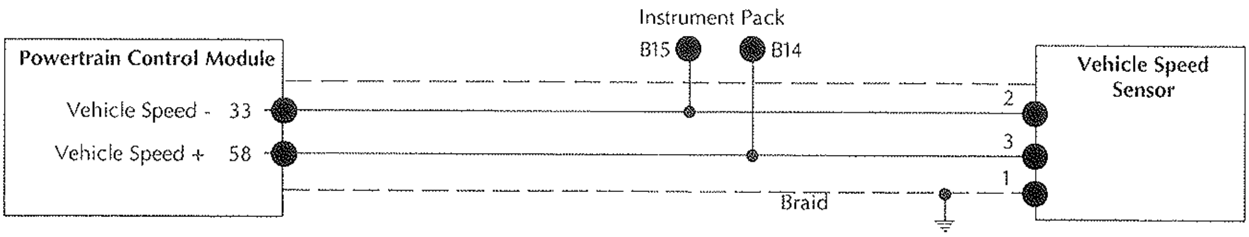


Figure 2. Vehicle Speed Sensor Circuit

Fault Code Definition

P0500 - Vehicle speed sensor malfunction.
P0503 - Vehicle Speed sensor circuit intermittent
P1500 - Intermittent VSS signal
P1501 - VSS signal out of self test range

P0500, P0503, P1500, P1501 Fault Analysis

1. Drive the vehicle at normal road speeds and note the indications of the speedometer needle.

   If any 'dithering' of the needle occurs, check and if necessary adjust the sensor gap as detailed in the Service Manual (3.9.07).

   If the needle continually indicates a low speed or remains at zero, check the sensor mounting in the differential unit.

   Also check the sensor loom, particularly at the point where it passes into the vehicle body. Check for condition of the body grommet and for cut or damaged wires at this point.

   Repair or adjust as necessary. Retest and return to step 2 of this procedure if code P0500 occurs again.

2. Connect the PDU or scan tool and set-up to monitor the VSS signal during a road test.

   Drive the vehicle at normal road speeds (or run on a rolling road) and note the VSS signal level and the speedometer indication.

   If either indication is faulty, use the following circuit checks and the observations made in this step to isolate the fault cause.

3. Circuit Check - VSS Sensor

   Disconnect the VSS sensor and measure resistance from pin 2 to pin 3. The sensor resistance should be 190 - 250Ω. Note the sensor resistance if in range, if not, replace the sensor.

   Circuit Check - VSS to Instrument Pack

   Disconnect the VSS connector in the boot and the instrument pack connector.

   Check continuity from VSS connector pin 3 to instrument pack connector pin B14. Check continuity from VSS connector pin 2 to instrument pack pin B15.

   Reconnect the VSS sensor. Check resistance from instrument pack connector pin B14 to pin B15. The resistance should be the same as the bare sensor resistance noted above. if a low resistance is measured, locate and rectify the short circuit between the VSS signal and return lines.

   Circuit Check - VSS to PCM

   Disconnect the PCM connector.

   Measure continuity from VSS connector pin 3 to PCM connector pin 58.

   Measure continuity from VSS connector pin 2 to PCM pin 33.

   If either resistance is greater than 5.0Ω, repair the partial or complete open circuit in the faulty line.

   If no circuit faults are identified, go to step 4.

   If any circuit faults are identified, service as necessary. Clear the P0500 code and run the KOER Test to ensure that the problem is resolved.

4. Check the continuity of the VSS signal screening from both the VSS and PCM terminations to chassis ground.

   Also check for the proximity of any sources of interference close to the sensor leads. Reroute any suspect sources of radio interference.

   If any circuit faults are identified, service as necessary. Clear the P0500 code and run the KOER Test to ensure that the problem is resolved.

5. If all the previous checks are satisfactory, replace the PCM and road test the vehicle to ensure that the problem is resolved.

Idle Speed Control

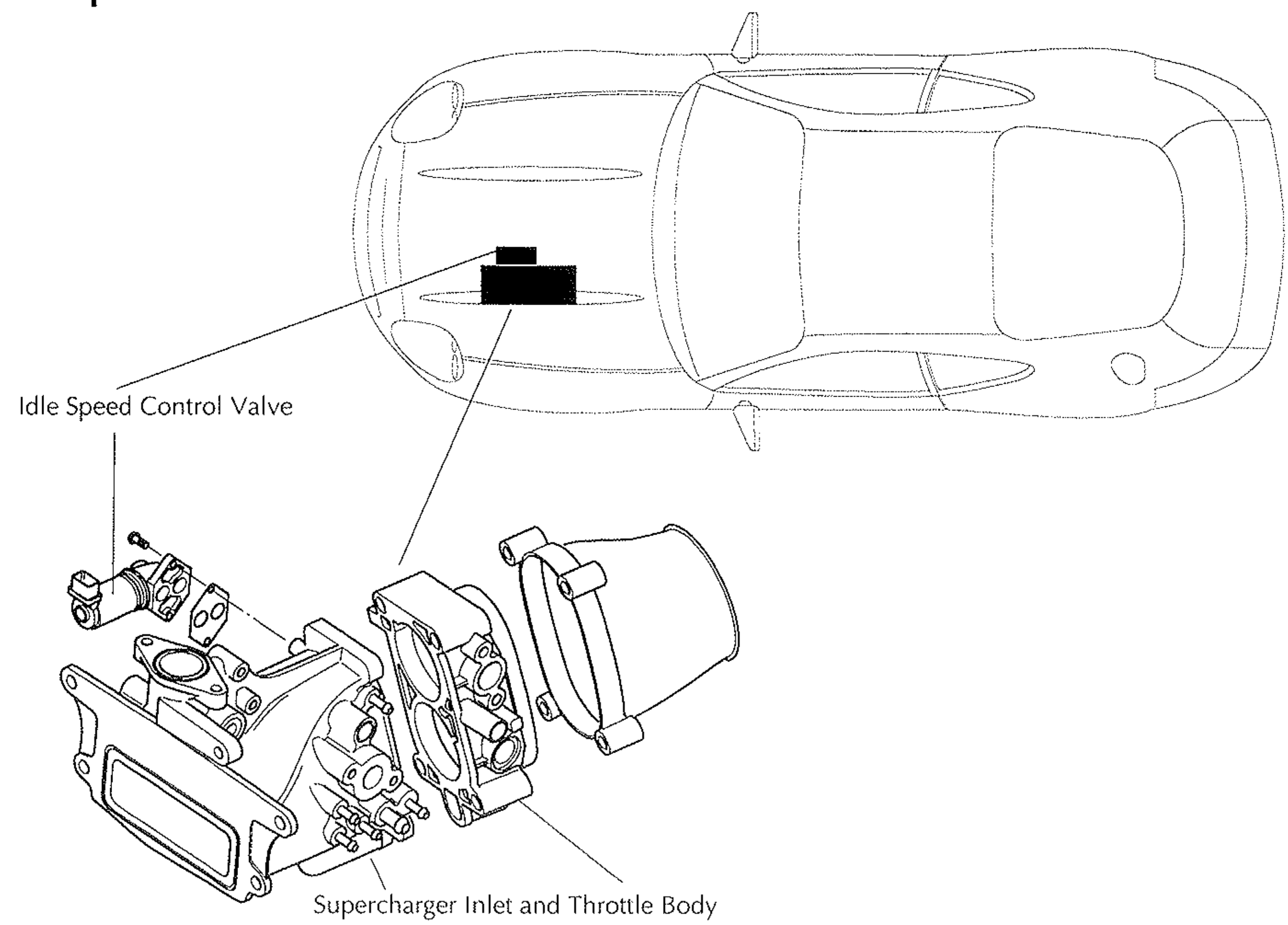


Figure 1. Idle Speed Control Valve Location

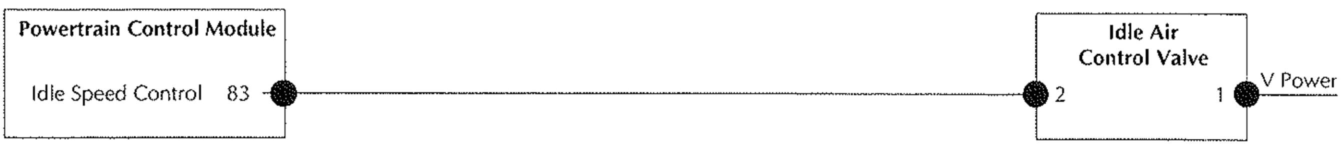


Figure 2. Idle Speed Control Valve Circuit

Fault Code Definition

P0505 - Idle speed control system malfunction.

P0505 Fault Analysis

1. Check for any serious restriction in the air filter housing or inlet tract. Such restrictions would seriously degrade the performance of the idle speed system.

   If no restriction is present, go to step 2.

   If a restriction is identified, service as necessary, clear the P0505 code and retest to ensure that the problem is resolved.

2. Disconnect the IAC valve. Key on. Measure the voltage from VPWR line at the IAC connector to battery ground.

   If the voltage is above 10.5 volts, go on to step 2.

   If the voltage is below 10.5 volts, service the open circuit in the VPWR to IAC solenoid circuit.

3. Check the IAC solenoid resistance:

   With the IAC solenoid disconnected, measure the resistance across the solenoid connector pins. The solenoid resistance must be in the range 6.0 - 13.0Ω.

   If the resistance is outside the 6.0 - 13.0Ω range, replace the IAC solenoid. If the solenoid resistance is good, go on to step 3.

4. Check for an internal solenoid short to the case.

   Measure the resistance from either solenoid lead to the IAC case. If the resistance is less than 10kΩ, replace the IAC solenoid. If the resistance exceeds 10kΩ, go to step 4.

5. Check the IAC circuit continuity:

   Disconnect the PCM. Inspect the connector for damaged or suspect pins and service if necessary. Measure continuity between PCM connector pin 83 and the IAC signal line at the IAC valve. If the resistance is less than 5.0Ω, go to step 5. If greater than 5.0Ω is measured, service the open circuit in the IAC signal line.

6. Check for short circuits to ground in the IAC circuit:

   Measure the resistance from PCM connector pin 83 to PCM connector pins 51 and 103. If the resistance is less than10kΩ, service the short circuit. If greater than 10kΩ, go to step 6.

7. Connect the PDU or scan tool, reconnect the PCM and IAC solenoid. Set up the PDU to monitor the IAC signal voltage. Key on, engine running. Slowly increase the engine rpm to 3000. Read the IAC signal voltage. The IAC signal voltage must be in the range 3.0 - 11.5 volts.

   If the voltage is in the range 3.0 - 11.5 volts, check the throttle stop and throttle cable adjustments and service as necessary. if OK, replace the IAC valve . Reset the PCM memory and rerun the KOER Test to confirm resolution of the problem.

   If the voltage is not in the range 3.0 - 11.5 volts, replace the PCM and rerun the KOER Test to confirm resolution of the problem.

Keep Alive Power

Read Only Memory

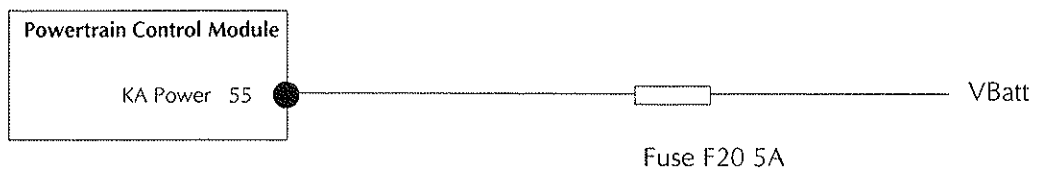


Figure 1. Keep Alive Power Circuit

P0603 Fault Analysis

P0603 - The PCM has detected a power interrupt in the KAPWR (Keep Alive Power) supply to the PCM memory.

Note: If KAPWR is interrupted to the PCM by disconnecting the battery or any connection in the VBATT supply circuit to the PCM, P0603 may be generated on the first power up after reconnection.

1. Key off. Inspect the battery cables and VBAT supply circuit for loose connections, corrosion, etc. Repair as necessary.

2. Inspect the engine compartment wiring for proximity of EEC-V wiring to the ignition system. Reroute wiring as necessary to prevent electronic interference.

3. Disconnect the PCM, inspect the connector for pushed out pins, damage, corrosion, etc. Repair if necessary.

   Measure voltage between PCM harness connector pin 55 (KAPWR) and PCM harness connector pins 51 and 103. Whilst measuring the voltage, grasp the EEC-V harness and wiggle, shake or bend a small section while working from the PCM to the dash panel.

   If the voltage drops below 10.5 volts, service the open circuit in the KAPWR circuit. Reconnect all components and rerun the KOER Test to verify that the problem is resolved.

   If the voltage remains above 10.5 volts, rerun the KOEO self test. If P0603 is detected, replace the PCM. If P0603 is not detected, the P0603 code was due to some service action as described in the note following the code description.

P0605 Fault Analysis

P0605 - The PCM has detected an error in accessing the Read Only Memory (ROM) data.

If P0605 occurs under any conditions, the PCM memory is faulty. Replace the PCM.

Transmission Controller

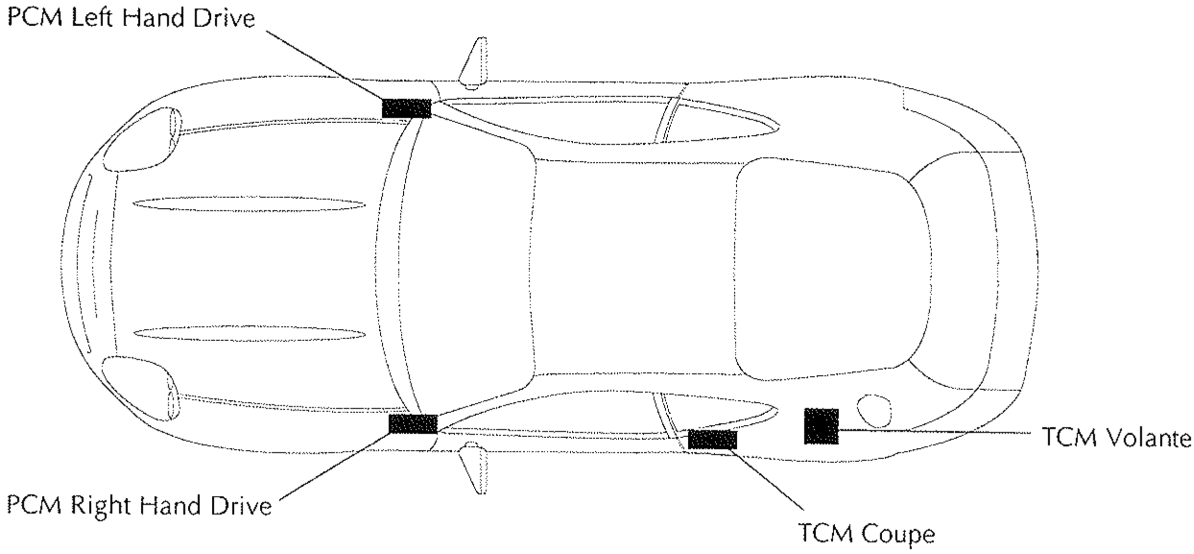


Figure 1. Transmission Controller location

Figure 2. TCM - PCM Interface Circuit

Fault Code Description

P0700 - Transmission controller indicates an OBDII fault

P0700 Fault Analysis

1. Connect the PDU or scan tool to the TCM. Record all logged DTC's. Resolve all problems using the procedures in this manual.
2. Reset the TCM.
3. Connect the PDU to the PCM. Clear the P0700 code.
4. Run the drive cycle to ensure that the problem is resolved.

Fault Code Definition

P1000 - All of the OBDII monitors have not yet been successfully tested.

A P1000 code will be set by the PCM with any of the following conditions:

- The vehicle is new from the factory and has not yet been through a complete OBDII drive cycle.
- The battery or the PCM has been disconnected.
- An OBDII monitor fault has occured before completion of the drive cycle.
- The PCM DTCs have been erased with the PDU or scan tool as part of the normal repair process

P1000 may not be removed from the PCM memory because:

- There is a thermostat stuck open and a DTC is not output.
- There is an open VSS circuit and a DTC is not output.

Note: The only way a DTC P1000 can be removed from memory is when all the OBDII monitors have successfully completed during normal vehicle operation.

P1000 Fault Analysis

1. Where any other DTCs detected with P1000?

   If other codes are present, analyse and correct the other codes first. Complete an OBDII drive cycle and return to step 2 if the P1000 code is not cleared.

2. If the P1000 code is not cleared by an OBDII drive cycle, Check the VSS and ECT signals:

   Connect the PDU for a road test and set up to monitor the VSS signal and the Engine Coolant Temperature signal at the PCM.

   Drive the vehicle long enough to achieve the highest engine operating temperature. Monitor the VSS and ECT signals during this road test.

3. If the VSS signal indicated actual road speed, this was not the cause of the P1000. Go to step 4.

   If the VSS signal does not indicate actual road speed, analyse the VSS problem using the procedure in P0500 analysis.

   Run the OBDII drive cycle to clear the P1000 code.

4. Monitor the engine coolant temperature. If the ECT reading was greater than 180°F (82°C), this is not the cause of the uncleared P1000. Complete a full OBDII drive cycle to reset the code.

   If the ECT reading does not indicate 180°F (82°C) for a fully warmed up engine, analyse the ECT problem using the procedure in P0117 analysis.

   Run the OBDII drive cycle to clear the P1000 code.

Fault Code Definition

P1001 - Key On Engine Running (KOER) self test not able to complete. This code will be logged if any of the following conditions exist during a KOER test.

- The PCM is unable to access continuous memory DTCs.
- The PCM is unable to activate a KOEO test.
- The PCM is unable to initiate a KOER test.
- There is a PDU or scan tool communication problem.
- The DTC displayed on the PDU or scan tool is not listed.

Note: The only way a DTC P1001 can be removed from memory is when all the OBDII monitors have successfully completed during normal vehicle operation.

P1001 Fault Analysis

1. Check that VREF is in range:

   Key off. Disconnect the throttle potentiometer. Key on.

   Measure VREF at the TP vehicle harness connector.

   If VREF is in the range 4-6 volts, go to step 2.

   If VREF is outside the range 4-6 volts, go to the VREF fault analysis procedure.

2. Can continuous memory DTCs be accessed?

   If continuous memory DTCs can be accessed, go to step 3.

   If continuous memory DTCs cannot be accessed, go to step 6.

3. Can a KOEO self test be activated?

   If a KOEO self test can be activated, go to step 4.

   If a KOEO self test cannot be activated, go to step 5.

4. Can a KOER self test be activated?

   If a KOER self test can be activated, the logged DTC is not listed for this vehicle. Check that the correct PCM is installed. Also check for any service bulletins indicating a PCM change. Service as necessary.

   If a KOER self test cannot be activated, go to step 5.

5. Record all logged DTCs. If failures are present in any of the following systems, this could cause the P1001 code:

   Idle speed control
   EGR system
   Fuel control system
   Secondary air injection system
   Vehicle speed sensor circuits
   Mass air flow system
   Transmission range sensor circuits

   If no relevant DTCs are present, go to step 6.

   If any DTCs relevant to the above systems are present, resolve all relevant problems using the fault analysis procedures in this manual. Run the KOER Test to ensure that the problem is resolved.

6. Check the 12 volt supply line at the diagnostic socket:

   Check for B+ 12 volt supply on the diagnostic connector pin 16 measured to the battery negative terminal.

   Check the 12 volt return line at the diagnostic socket:

   Repeat the B+ 12 volt check from the diagnostic connector pin 16 measured to diagnostic connector pin 4.

   If the 12 volt supply and return lines are good, go to step 7.

   If either the 12 volt supply or the 12 volt return lines are faulty, service as necessary. Run the KOER Test to ensure that the problem is resolved.

7. Check the communications line from the diagnostic socket to the PCM:

   Check continuity from PCM pin 16 to diagnostic socket pin 2 and from PCM pin 15 to diagnostic socket pin10.

   If a continuity problem is identified, service as necessary. Run the KOER test to ensure that the problem is resolved.

   If no continuity problem is identified, replace the PCM and run the KOER test to ensure that the problem is resolved.

Mass Airflow Sensor

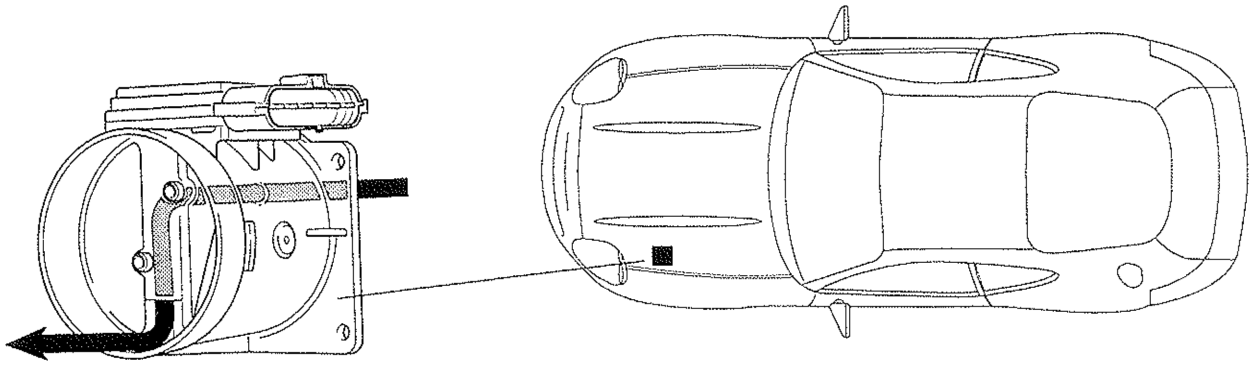


Figure 1. MAFS Location

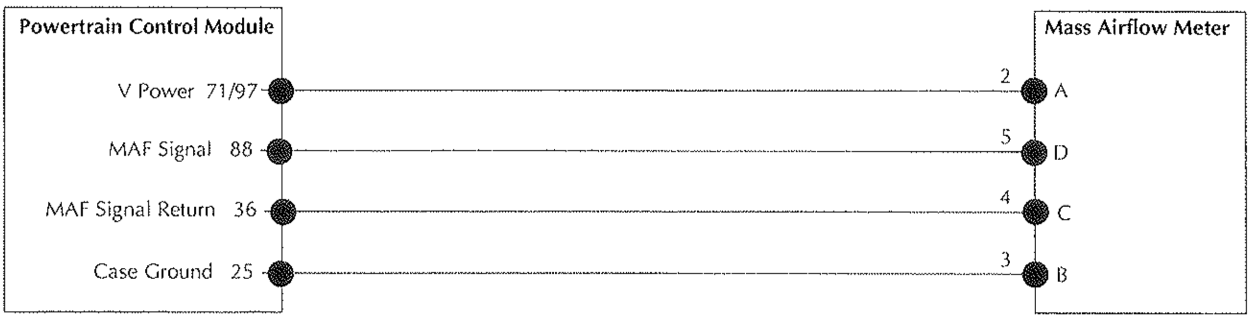


Figure 2. MAFS - ECM Interface Circuit

Fault Code Definition

P1100 - The MAF sensor signal was intermittent during normal engine running.

P1101 - The MAF sensor signal went outside the range 0.34 - 1.96 volts during normal engine running.

> *Note: DTC P1101 could be generated by a low charge battery. Check the battery condition and service if necessary before continuing with this procedure.*

P1100/1101 Fault Analysis

1. Connect the PDU or Scan Tool. Check that fault code P1100 or P1101 is present
2. Check the air filter and all ducting for blockage or leaks. Repair if necessary.
3. Run the engine up to 1500 rpm for 5 seconds. Read PID 10h - Mass Air Flow and check that the MAF voltage less than 0.39V (i.e. below minimum volts, see Fig 3)
4. Key off, disconnect the MAF Sensor, key on engine off. Measure the voltage across MAF connector pin A - B. The supply voltage must be greater than 10.5 Volts.
5. If the supply voltage is below 10.5 volts, check for correct supply to the PCM and for continuity of the 12V and return lines to the MAF sensor.
6. Key off, reconnect the MAF sensor, key on and start the engine. Check the MAF signal level between pins C and D of the sensor connector. If the signal is above 0.39 volts, check for continuity and/or shorts between MAFS pin D and PCM pin 88 (MAF signal) and check between MAFS pin C and PCM pin 36 (MAF signal return).
7. If the signal lines are good, replace the MAF sensor.
8. If the signal level is above 0.39 volts and code P1100/P1101 persists, change the PCM and run the KOER test to ensure that the problem is resolved.

Intake Air Temperature

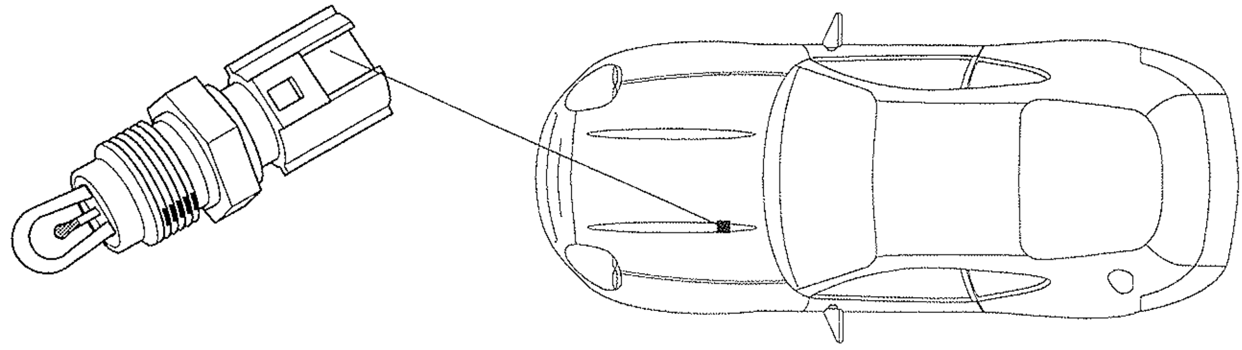


Figure 1. IAT 1 Location

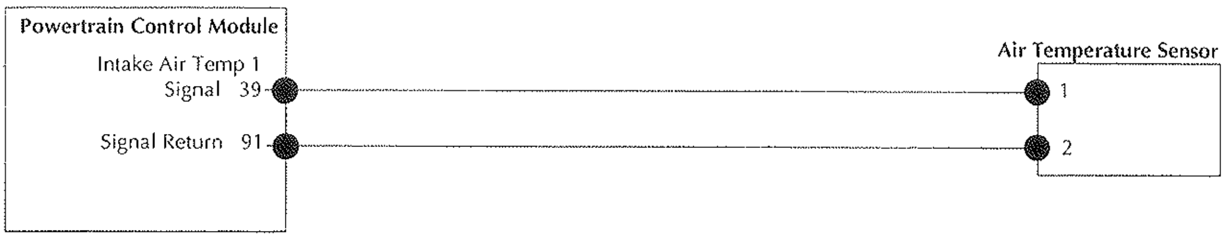


Figure 2. IAT 1 - PCM Interface Circuit

Fault Code Definition

P1112 - The IAT 1 sensor signal was intermittent during normal engine running.

P1112 Fault Analysis

1. Connect the PDU or Scan Tool. Check that fault code P1112 is present.
2. Monitor the Intake Air Temperature signal with the engine running.
3. Tap on the sensor to simulate road shock.

   If there is any change in sensor reading, replace the sensor.

   Reset the PCM and run a KOER Test to verify that the problem is cleared.

   If there is no change in sensor reading, go on to step 4.
4. Wiggle the IAT sensor harness and connector.

   If there is any change in sensor reading, repair or replace the defective wiring.

   Reset the PCM and run a KOER Test to verify that the problem is cleared.

   If there is no change in sensor reading, go on to step 5.
5. Key off. Disconnect the PCM. Inspect the PCM connector for damaged, pushed out pins or other causes of intermittent connection. If any problem is found, repair or replace as necessary.

   Reset the PCM and run a KOER Test to verify that the problem is cleared.

Table of IAT Sensor Values

Temperature		Voltage	Resistance
°F	°C	Volts	K Ohms
248	120	0.27	1.18
230	110	0.35	1.55
212	100	0.46	2.07
194	90	0.60	2.80
176	80	0.78	3.84
158	70	1.02	5.37
140	60	1.33	7.70
122	50	1.70	10.97
104	40	2.13	16.15
86	30	2.60	24.27
68	20	3.07	37.30
50	10	3.51	58.75

Intake Air Temperature 2 - IAT

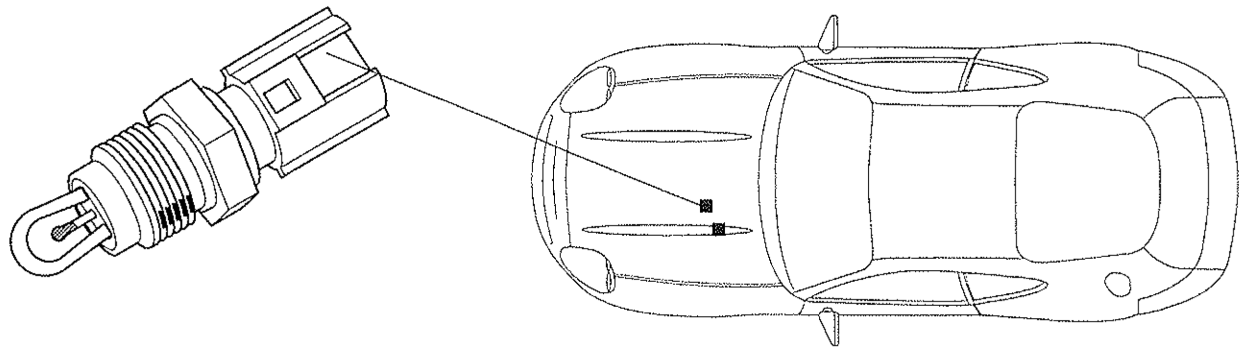


Figure 1. IAT 2 Location

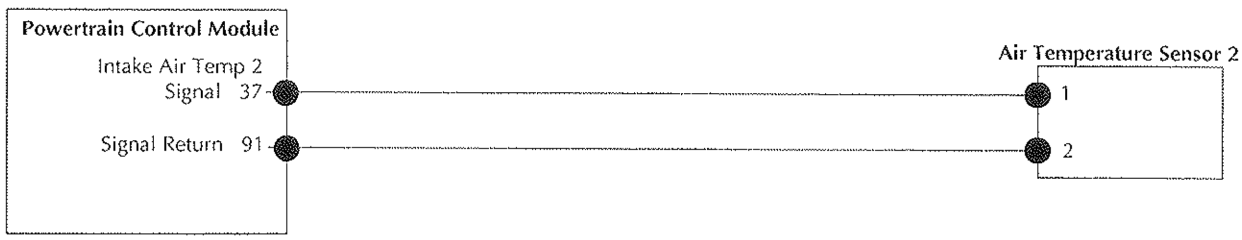


Figure 2. IAT 2 - PCM Interface Circuit

Fault Code Definition

P1114 - The IAT 2 signal went below 0.2 volts during continuous testing.

P1115 - The IAT 2 signal went above 4.60 volts during continuous testing.

P1114/P1115 Fault Analysis

1. Connect the PDU or scan tool and confirm that P1114 or P1115 is present.

2. Run the engine and read the voltage of the intake air temperature (IAT2) signal. The voltage should be in the range 0.25 - 3.50 volts (see table below).

3. P1115 - For high voltage readings (above 3.50 volts) suspect an open circuit in the sensor wiring or internally within the sensor.

   Key off, disconnect the IAT 2 sensor, key on. Measure the voltage across the IAT 2 sensor connector. Approximately 5.0 volts should be present. If not, there is an open circuit in the line from PCM pin39 or in the signal return line to PCM pin 91.

   If approximately 5.0 volts is present, check the resistance of the IAT 2 sensor. Consult the table of IAT sensor values, the resistance should be within 15% of the values in the table. If the resistance is very high or infinite, change the IAT 2 sensor.

4. P1114 - For low voltage readings, suspect a short circuit of Vref (nominal 5.0V supply from PCM pin 37) to ground or to signal return (PCM pin 91). Key off, check for short circuit between the lines from PCM pin 37 to the IAT 2 sensor and from the IAT 2 sensor to PCM pin 91. Also check for short circuit to ground on the line from PCM pin 37 to the IAT 2 sensor.

   If approximately 5.0 volts is present, check the resistance of the IAT 2 sensor. Consult the table of IAT sensor values, the resistance should be within 15% of the values in the table. If the resistance is very high or infinite, change the IAT 2 sensor.

5. Clear the P1114/P1115 code, run a road test to ensure that the problem is solved.

Table of IAT Sensor Values

Temperature		Voltage	Resistance
°F	°C	Volts	K Ohms
248	120	0.27	1.18
230	110	0.35	1.55
212	100	0.46	2.07
194	90	0.60	2.80
176	80	0.78	3.84
158	70	1.02	5.37
140	60	1.33	7.70
122	50	1.70	10.97
104	40	2.13	16.15
86	30	2.60	24.27
68	20	3.07	37.30
50	10	3.51	58.75

P1116 Engine Coolant Temperature

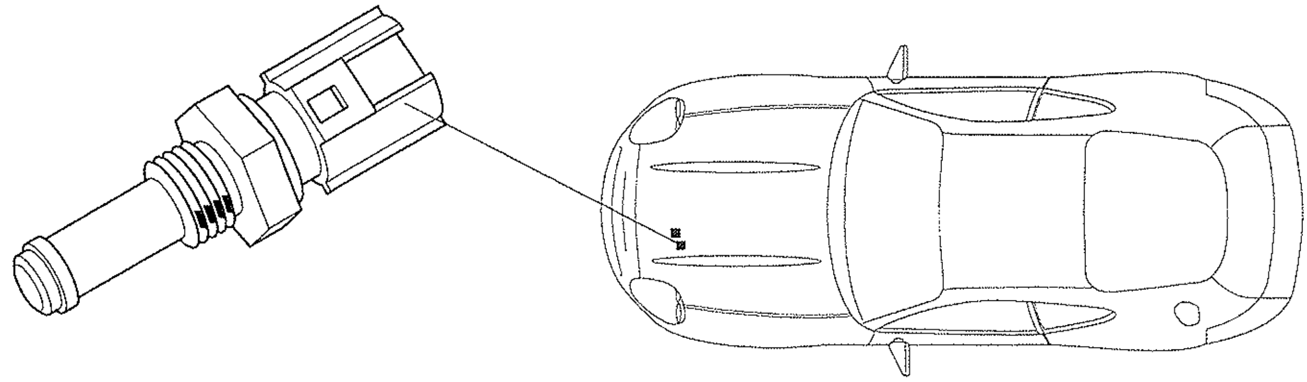


Figure 1. ECT Location

Figure 2. ECT - PCM Interface Circuit

Fault Code Definition

P1116 - The ECT sensor signal was out of self test range (0.25 - 3.50 volts) during KOEO and/or KOER tests.

Note: The engine coolant temperature must be above 82°C before running the KOEO or KOER tests.

If P1116 is logged but P0117 and/or P0118 are not logged, the temperature is out of range but not faulty. Check the ECT sensor resistance against the indicated engine temperature using the values in the table at the end of this procedure. If OK, warm up the engine as required before running the KOEO and KOER tests again.

P1116 Fault Analysis

1. Connect the PDU or scan tool and confirm that P0117 or P0118 is present.

2. Run the engine and read the voltage of the engine coolant temperature signal. The voltage should be in the range 0.25 - 3.50 volts (see ECT sensor values table).

3. For intermittent low voltage readings, suspect a short circuit of Vref (nominal 5.0V supply from PCM pin 38) to ground or to signal return (PCM pin 91). Key off. Shake, wiggle and tap the sensor and circuits during the following test to simulate road shock. Check for short circuit between the lines from PCM pin 38 to the ECT sensor and from the ECT sensor to PCM pin 91. Also check for short circuit to ground on the line from PCM pin 38 to the ECT sensor.

   If any wiring problem is found, repair the wiring as necessary.

4. For intermittent high voltage readings, (above 3.50 volts) suspect an open circuit in the sensor wiring or internally within the sensor.

   Key off, disconnect the ECT sensor, measure the voltage across the ECT sensor connector. Approximately 5.0 volts should be present. If not, there is an open circuit in the line from PCM pin38 or in the signal return line to PCM pin 91.

   If approximately 5.0 volts is present, check the resistance of the ECT sensor. Consult the table of ECT sensor values, the resistance should be within 15% of the values in the table. If the resistance is very high or infinite, change the IAT sensor.

5. Clear the P1116 code, run the KOER test to ensure that the problem is solved.

Table of ECT Sensor Values

Temperature		Voltage	Resistance
°F	°C	Volts	K Ohms
248	120	0.27	1.18
230	110	0.35	1.55
212	100	0.46	2.07
194	90	0.60	2.80
176	80	0.78	3.84
158	70	1.02	5.37
140	60	1.33	7.70
122	50	1.70	10.97
104	40	2.13	16.15
86	30	2.60	24.27
68	20	3.07	37.30
50	10	3.51	58.75

Engine Coolant Temperature

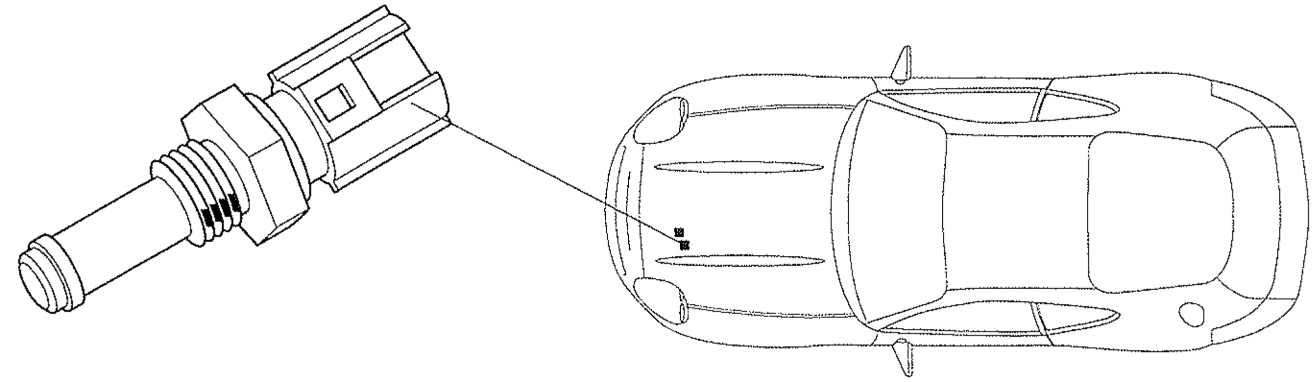


Figure 1. ECT Location

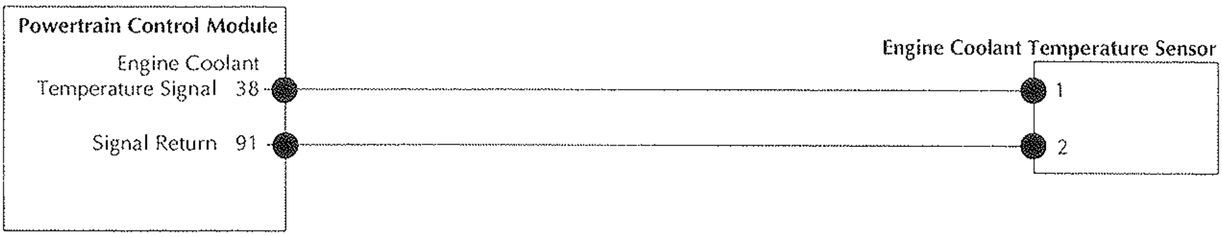


Figure 2. ECT - ECM Interface Circuit

Fault Code Definition

P1117 - The ECT sensor signal was intermittent during KOEO and/or KOER tests.

P1117 Fault Analysis

1. Connect the PDU or scan tool and confirm that P0117 is present.

2. Run the engine and read the voltage of the engine coolant temperature signal. The voltage should be in the range 0.25 - 3.50 volts (see figure 3).

3. For intermittent low voltage readings, suspect a short circuit of Vref (nominal 5.0V supply from PCM pin 38) to ground or to signal return (PCM pin 91). Key off.

   Shake, wiggle and tap the sensor and circuits during the following test to simulate road shock. Check for short circuit between the lines from PCM pin 38 to the ECT sensor and from the ECT sensor to PCM pin 91. Also check for short circuit to ground on the line from PCM pin 38 to the ECT sensor.

   If any wiring problem is found, repair the wiring as necessary.

4. For intermittent high voltage readings, (above 3.50 volts) suspect an open circuit in the sensor wiring or internally within the sensor.

   Key off, disconnect the ECT sensor, measure the voltage across the ECT sensor connector. Approximately 5.0 volts should be present. If not, there is an open circuit in the line from PCM pin38 or in the signal return line to PCM pin 91.

   If approximately 5.0 volts is present, check the resistance of the ECT sensor. Consult the table of ECT sensor values, the resistance should be within 15% of the values in the table. If the resistance is very high or infinite, change the ECT sensor.

5. Clear the P1117 code, run the KOER test to ensure that the problem is solved.

Table of ECT Sensor Values

Temperature		Voltage	Resistance
°F	°C	Volts	K Ohms
248	120	0.27	1.18
230	110	0.35	1.55
212	100	0.46	2.07
194	90	0.60	2.80
176	80	0.78	3.84
158	70	1.02	5.37
140	60	1.33	7.70
122	50	1.70	10.97
104	40	2.13	16.15
86	30	2.60	24.27
68	20	3.07	37.30
50	10	3.51	58.75

Throttle Position Sensor - TP

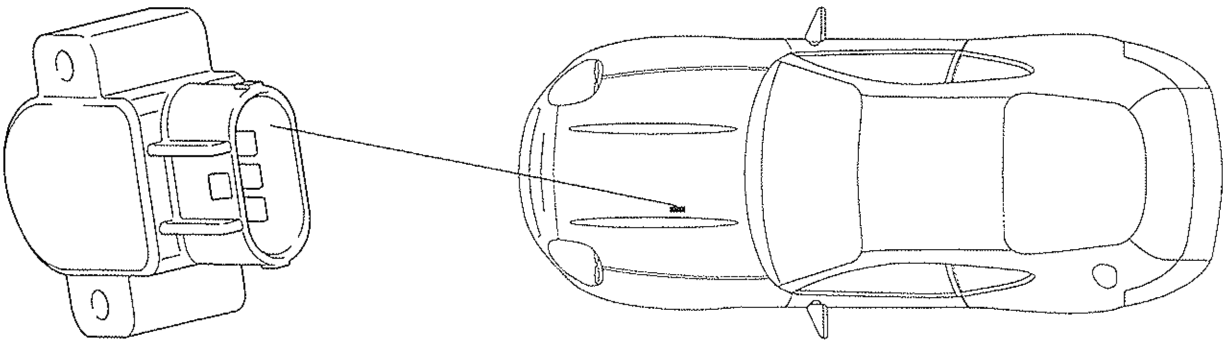


Figure 1. TP Location

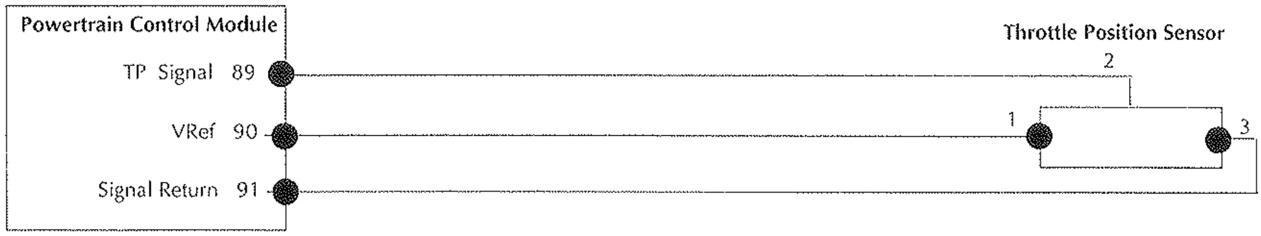


Figure 2. TP - ECM Interface Circuit

Fault Code Definition

P1120 - TP signal out of range low. (Below 0.49 volts at closed throttle)

P1120 Fault Analysis

1. Connect the PDU or scan tool and perform the KOER test sequence. Confirm that a P1120 fault is present.

2. Key off. Remove the air inlet casting from the throttle body and manually operate the throttle linkage.

   Check for free movement of the throttle mechanism and for a consistent return to the stop position.

   Also check for security of the throttle potentiometer mountings.

   If any defects are found, repair, service as necessary. If no defects are found, go to step 3.

3. Key on, engine off. Monitor the Throttle Potentiometer signal. Move the throttle gently throughout its range several times whilst observing the TP signal voltage. If the signal drops suddenly below 0.49 volts at any time, replace the defective throttle potentiometer.

   If the signal is always in range (0.49 - 4.60 volts) and correctly follows physical throttle movement, go to step 4.

4. Key off. Disconnect the PCM and examine the PCM connector for damaged or pushed out pins, corrosion, loose wires, etc and service as necessary.

5. Reconnect the PCM connector and the PDU or scan tool.

   Key on, engine off. Monitor the TP signal. Wiggle, shake and bend the harnesss to check for a possible signal short to earth. If the signal drops below 0.49 volts, repair the wiring loom and run the KOER test to ensure that the problem is resolved.

   If no defects are identified, go to the Intermittent Signal Procedure.

Throttle Position Sensor - TP

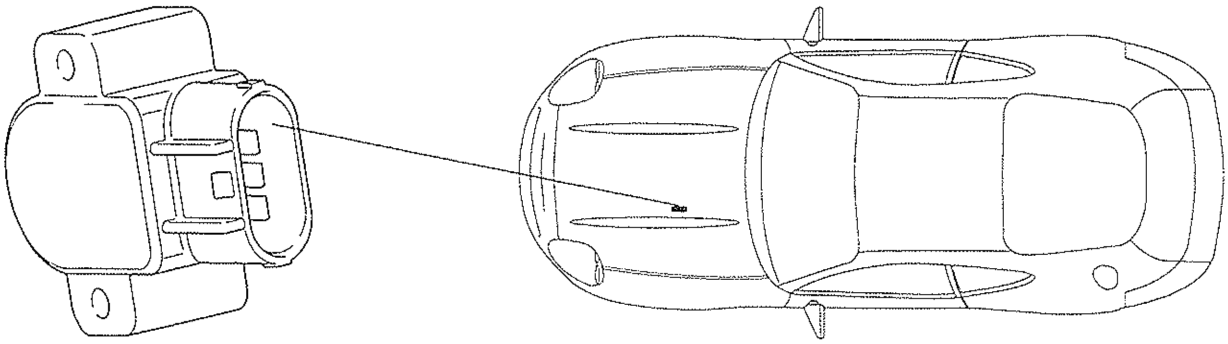


Figure 1. TP Location

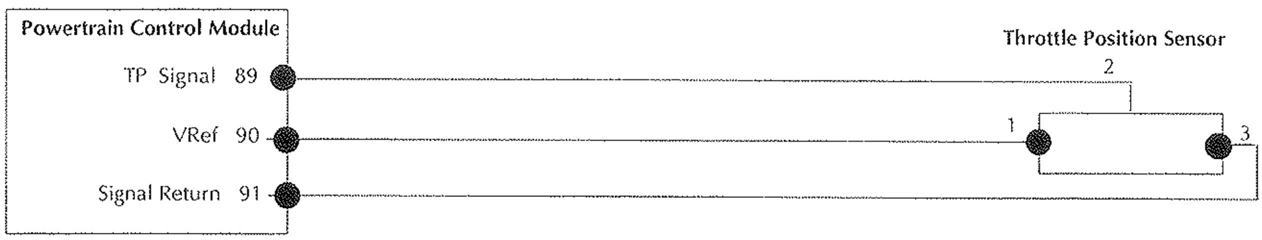


Figure 2. TP - ECM Interface Circuit

Fault Code Definition

P1121 - TP signal inconsistent with MAF signal.

P1121 Fault Analysis

1. Check for major air leaks, cracks and openings between the MAF sensor and the throttle body.

   Check for correct mounting of the throttle position sensor to the throttle body. If loose, secure the throttle potentiometer. Check for security of the throttle body mounting. Service or repair as necessary.

2. Connect the PDU or scan tool and monitor the TP signal.

   Key on, engine off. Slowly move the throttle from fully closed to fully open and watch for a steady change in the TP signal level. The signal level should move within the range 0.66 - 1.20 volts.

   If there is a sudden rise or sudden drop in the sensor signal level, replace the throttle potentiometer and rerun the KOER Test.

   If the TP signal shows smooth transitions within the above range, go to step 3.

3. Set up the PDU or scan tool to log the TP signal and the MAF signal during a road test.

   Drive the vehicle and use the datalogger to record the TP and MAF signal levels.

   The MAF signal level should follow changes in the TP signal level allowing a delay for the engine to accelerate or decelerate to a new speed following a change in throttle position.

   If the MAF signal does not follow the TP signal and is consistently low or high within its normal 0.39 - 4.60 volt range, change the MAF sensor.

   If the MAF sensor signal does follow the TP signal correctly, clear the P1121 code and rerun the KOER Test to ensure that the problem is resolved.

Throttle Position Sensor - TP

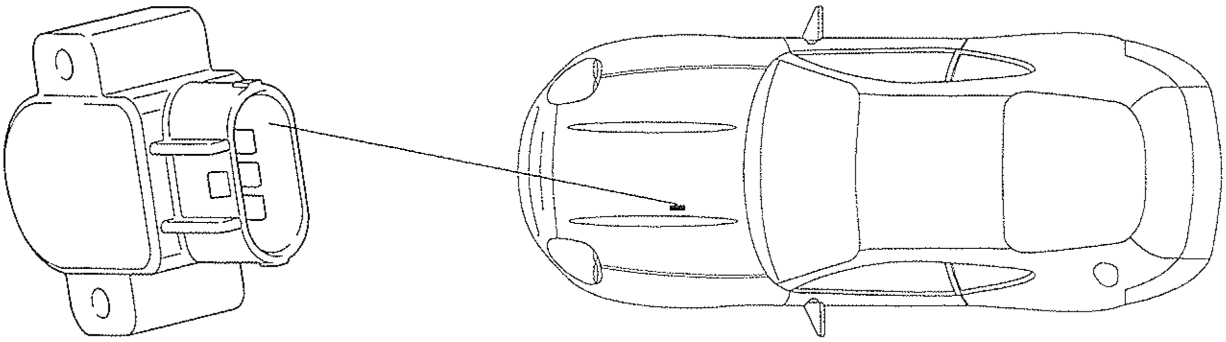


Figure 1. TP Location

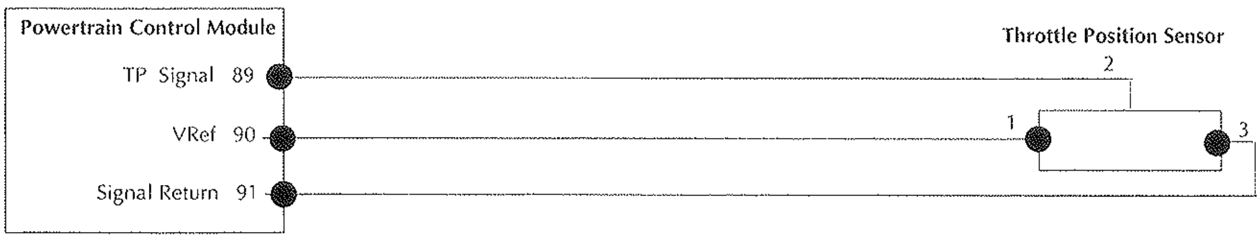


Figure 2. TP - ECM Interface Circuit

Fault Code Definition

P1124 - TP signal out of self-test range. (0.66 - 1.20 volts) when the throttle is closed during KOEO or KOER tests.

P1124 Fault Analysis

1. Connect the PDU or scan tool and perform the KOER test sequence. Confirm that a P1124 fault is present.

2. Key off. Check the security of the throttle potentiometer mounting.

   If the potentiometer is secure, go to step 3.

   If the mounting is loose, secure the potentiometer and rerun the KOEO test to ensure that the problem is resolved.

3. Disconnect the throttle potentiometer. Measure the VREF voltage from pin 1 of the harness connector to chassis ground.

   If the voltage is stable and in the range 4.0 - 6.0 volts, go to step 4.

   If the voltage is unstable or outside the range 4.0 - 6.0 volts, go to the VREF fault analysis procedure in this manual.

4. Remove the air inlet casting from the throttle body and manually operate the throttle linkage.

   Check for free movement of the throttle mechanism and for a consistent return to the stop position.

   If any defects are found, service or adjust as necessary. If no defects are found, reassemble all components and reconnect the potentiometer. Go to step 5.

5. Key on, engine off. Monitor the Throttle Potentiometer signal. Move the throttle gently throughout its range several times whilst observing the TP signal voltage.

   If the signal voltage does not smoothly follow the physical throttle movement, or if the closed throttle voltage is not consistent and in the range 0.6 - 1.2 volts, replace the throttle potentiometer. Run the KOER test to ensure that the problem is resolved.

Throttle Position Sensor

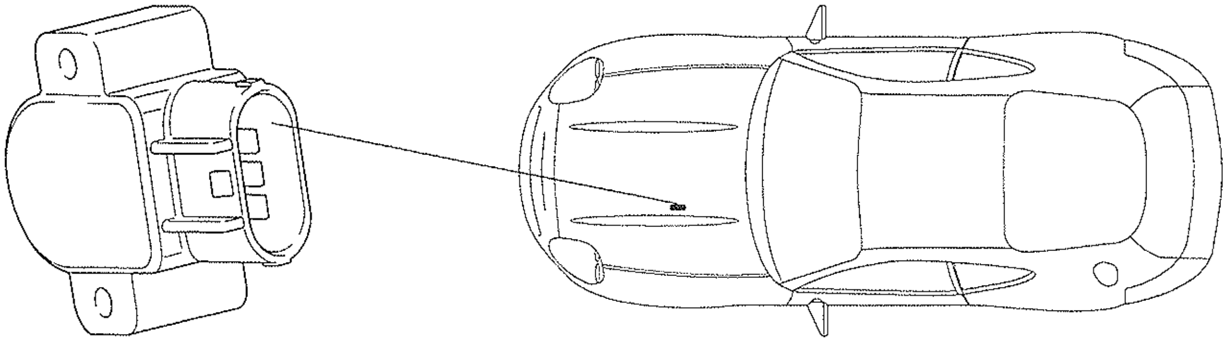


Figure 1. TP Location

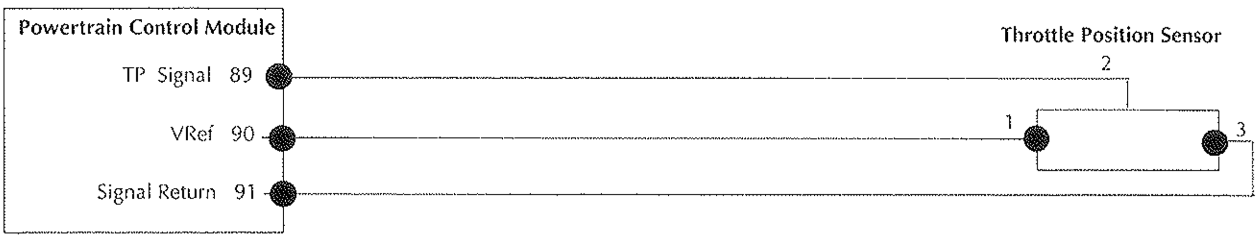


Figure 2. TP - ECM Interface Circuit

Fault Code Definition

P1125 - TP signal intermittent.

P1125 Fault Analysis

1. Connect the PDU or scan tool and perform the KOER test sequence. Confirm that a P1125 fault is present.

2. Access the TP signal and monitor whilst tapping the throttle potentiometer to simulate road shock. If the signal moves outside the range 0.49 - 4.60 volts, replace the throttle potentiometer.

   If the signal level is steady, go to step 3.

3. Whilst still monitoring the throttle potentiometer signal, wiggle, shake and bend the harness from the throttle potentiometer to the PCM.

   If there are any significant changes in signal level, repair the wiring or connector as necessary.

   If there is no change in signal level, go to step 4.

4. Key off. Open each connector in the TP to PCM circuit and examine for damaged or pushed out pins, loose wires, etc. Repair any identified defects and run a road test to ensure that the problem is resolved.

   If no defects are found, the cause of the P1125 code cannot be identified at this time.

Heated Oxygen Sensors

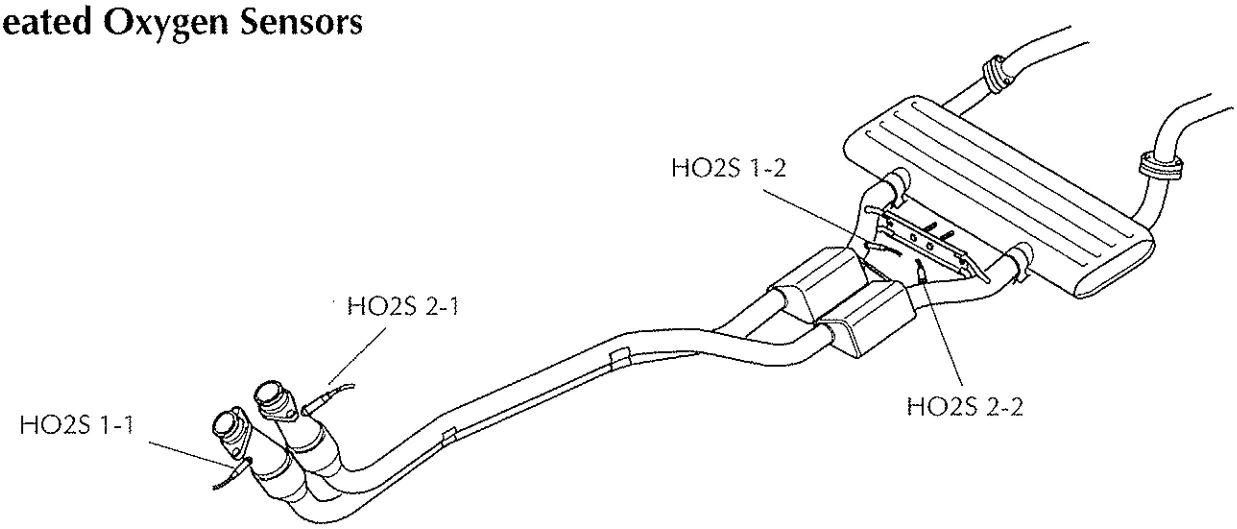


Figure 1. HO2S Location

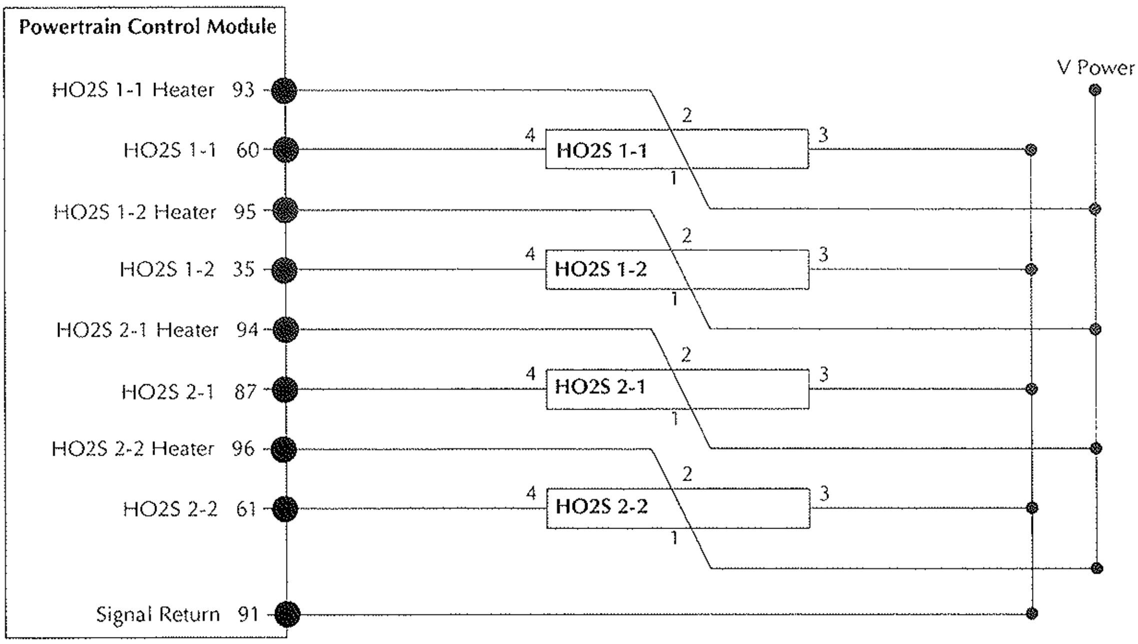


Figure 2. HO2S - PCM Interface Circuit

Fault Code Definition

P1127 - Exhaust not warm enough, downstream oxygen sensors not tested.

> *Note: During engine warm-up at idle speed with the vehicle stationary, the rear oxygen sensors may not reach operating temperature. If this is suspected, run the vehicle on the road through a vigorous series of acceleration cycles to fully warm up the exhaust and then repeat the KOER test sequence.*

P1127 Fault Analysis

1. Connect the PDU or scan tool. Key on.
2. Run the engine and monitor the oxygen sensor heaters. The heaters should come on and remain on when the engine is warm.

   When the engine is fully warmed up and all HO2S heaters are on, run the KOER test to ensure that there is not a problem.

Heated Oxygen Sensors

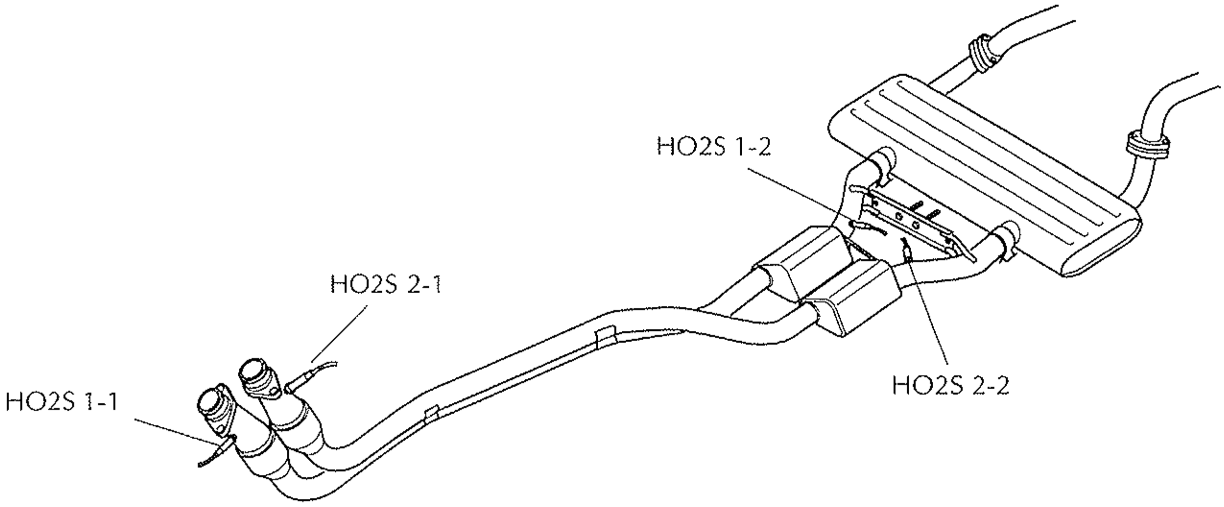


Figure 1. HO2S Location

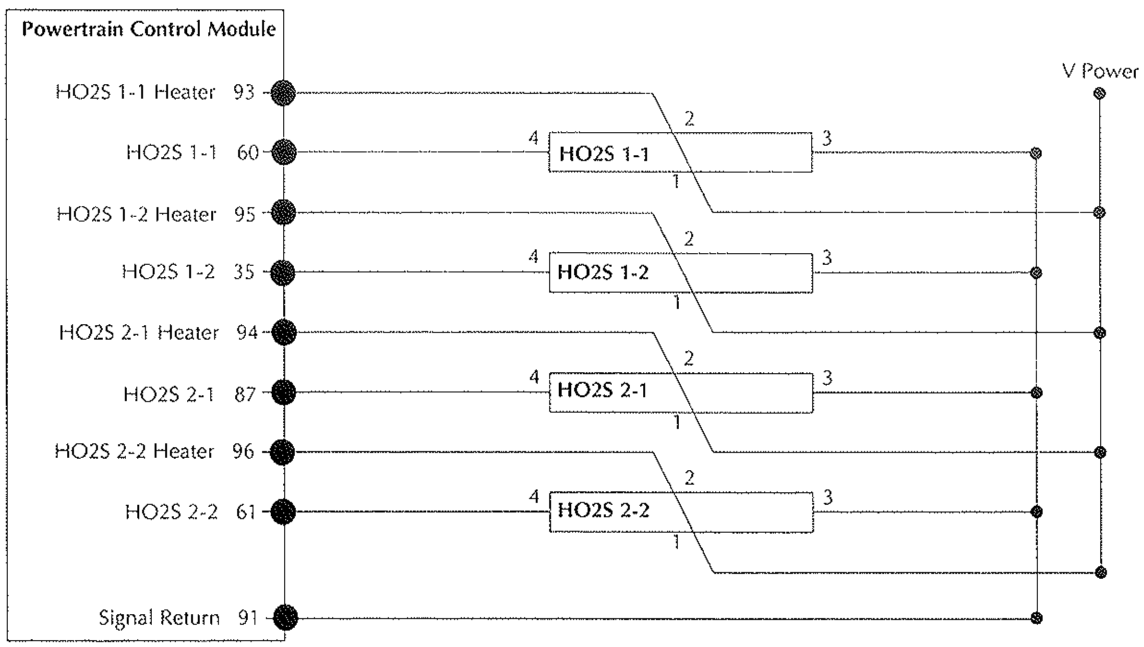


Figure 2. HO2S - PCM Interface Circuit

Fault Code Definition

Note: These codes are most likely to occur following service work on the exhaust system when the HO2 sensors could be incorrectly reconnected.

P1128 - Upstream HO2 sensors swapped. Fuelling changes on cylinders 1,2,3 cause changes in readings on upstream HO2 sensor for cylinders 4,5,6 and vice versa.

P1129 - Downstream HO2 sensors swapped. Fuelling changes on cylinders 1,2,3 cause changes in readings on downstream HO2 sensor for cylinders 4,5,6 and vice versa.

P1128 , P1129 Fault Analysis

1. Check the connectors at the affected sensors. The connectors are identified by labels as 1-1, 1-2, 2-1 and 2-2. They may be further identified as follows:

HO2S 1-1 pin 2	Red/Yellow
HO2S 1-2 pin 2	Yellow/Brown wire
HO2S 2-1 pin 2	Red/Green
HO2S 2-2 pin 2	Yellow/Orange wire

If the connector positions are incorrect, rectify the error, clear the P1128/P1129 codes and rerun the KOER test to ensure that the problem is cleared.

The problem is most unlikely to be in the harness wiring except on a new harness or on a harness in which the wiring has been disturbed. Check the wiring if the harness is new or disturbed.

Otherwise, substitute a known good PCM and rerun the KOER test to ensure that the problem is resolved.

Heated Oxygen Sensors

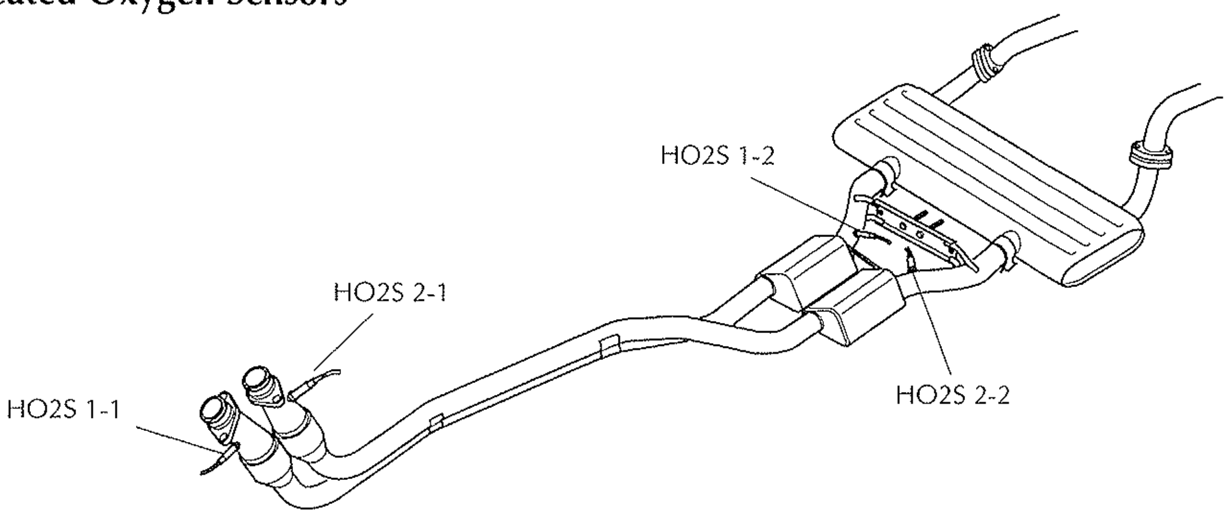


Figure 1. HO2S Location

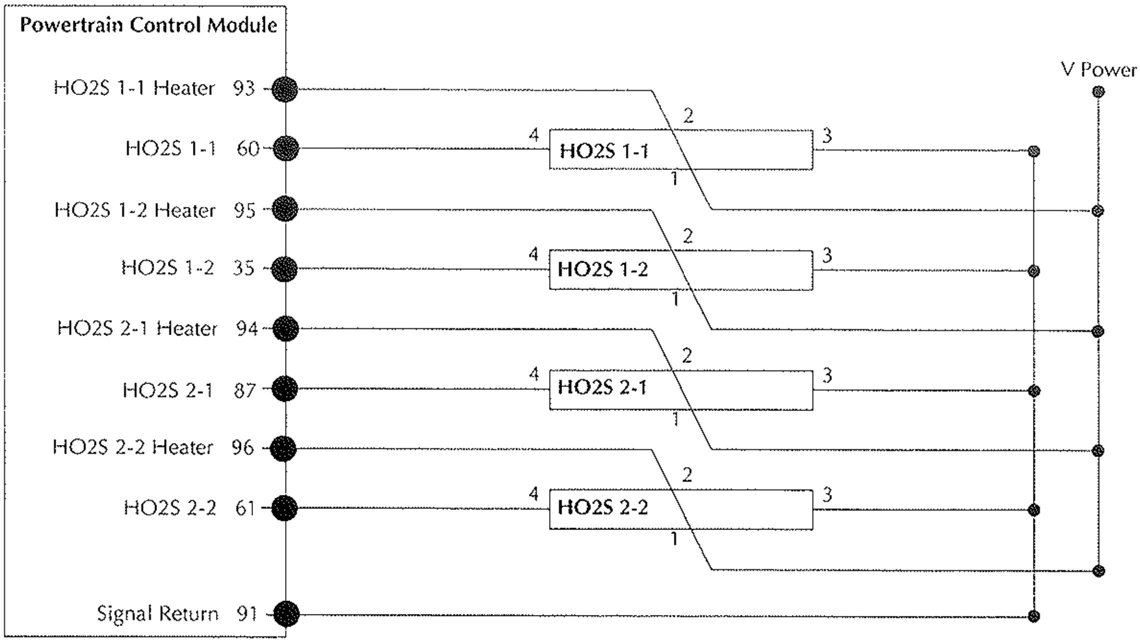


Figure 2. HO2S - PCM Interface Circuit

Fault Code Definition

P1130 - Fuel control system (cylinders 1-3) has reached its maximum compensation for a lean or rich condition and HO2S 1-1 is not switching.

P1150 - Fuel control system (cylinders 4-6) has reached its maximum compensation for a lean or rich condition and HO2S 2-1 is not switching.

P1130 , P1150 Fault Analysis

1. Check the engine air intake for leaks, obstructions or damage, particularly between the MAF sensor and inlet manifold.

   Check the air filter and housing for obstructions or blockage.

   Check the positive crankcase ventilation system integrity.

   Check the engine vacuum system integrity.

   Service any identified defects and rerun the KOER Test to check if the problem is resolved. If P1130, P1150 are still present, go on to step 2.

2. Connect the PDU or scan tool. Perform a KOER test sequence. If any of DTCs P1131, P1132, P1151 or P1152 are present, resolve these problems first, then return here to step 3 to analyse the P1130, P1150 problem if still present.

3. Check the fuel pressure:

   WARNING: The fuel system is pressurised when the engine is not running. To prevent injury or fire, use caution when working on the fuel system

   Key off. Install a fuel pressure gauge. Verify the vacuum source to the fuel pressure regulator.

   Start the engine and run at idle speed. Note the fuel pressure.

   Increase engine speed to 2500 rpm and maintain for 1 minute. Note the fuel pressure.

   If the fuel pressure is outside the range 30-45 psi, service the fuel system as necessary and retest for a P1130/P1150 condition.

   If the fuel pressure is between 30-45 psi, Go to step 4.

4. Check the fuel system ability to hold fuel pressure:

   Cycle the key on and off several times, noting the maximum fuel pressure. Leave the key on for at least 10 seconds whilst observing the pressure gauge reading. Does the fuel pressure remain within 5 psi of the maximum reading after 10 seconds.

   Cycle the key on and off several times and then switch off.

   Check that there are no external fuel leaks (repair as necessary).

   Does the fuel pressure remain within 5 psi of the highest reading for one minute after switching the ignition key off.

   If the fuel pressure drops excessively, service the fuel system as necesary and retest for a P1130, P1150 condition.

   If the fuel pressure is held within 5 psi of the highest reading after one minute, go to step 5.

5. Check the fuel injector circuits:

   Measure the resistance of each injector between the following PCM injector pins and VPower at PCM pins 71/97.

Injector	1	2	3	4	5	6
PCM pins	75	101	74	100	73	99

   The resistance of each injector should be 11.0 - 18.0Ω.

   If the resistance of each injector and its wiring is in the range 11 - 18Ω, the fuel injectors and harness resistance is OK. Go to step 6.

   If the resistance is outside the range 11.0 - 18.0Ω, service or replace the injectors and wiring as necessary.

6. Check the injector drive signal on the PDU pulse width display:

   The pulse width should be approximately 2mS at idle and increase progresively as the throttle opening is increased.

   If the injector pulse width does not follow engine power demand (throttle opening) replace the PCM.

   If the injector pulse width does follow engine power demand, go to step 7.

7. Flow test the injectors:

   Using the Rotunda Injector Tester or equivalent, test flow the injectors according to the test equipment instructions.

   If any injector fails the flow or leak tests, replace it and rerun the KOER Test.

   If the injectors pass all tests, go to step 8.

8. Check the HO2S signal circuits for shorts to ground.

   Key off. Disconnect the PCM and the HO2S connectors. Measure the resistance from PCM connector pins 60 (HO2S 1-1) and 87 (HO2S 2-1) to pin 91 (SIG RTN). Each resistance should be greater than 10kΩ.

   If both resistance values are greatrer than 10kΩ, go to step 9.

   If either resistance value is less than 10kΩ, repair the short circuit, reconnect all components and rerun the KOER Test to check that the problem is resolved.

9. Check the HO2S signal circuits from PCM connector pins 60 (HO2S 1-1) and 87 (HO2S 2-1) for short circuit to the following points:

   VPWR - Pins 71/97

   HO2S heaters - Pins 93 and 94

   If all resistance values are above 10kΩ, go to step 10.

   If any resistance value is below 10kΩ, repair the short circuit, reconnect all components and rerun the KOER Test.

10. Disconnect the suspect HO2 sensor. Key on, engine off.

    Monitor the HO2S signal for the suspect sensor.

    If the voltage is below 0.2 volts, the sensor is defective. Replace the sensor, reconnect all components and rerun the KOER Test.

    If the voltage is above 0.2 volts, the PCM is defective. Replace the PCM, reconnect all components and rerun the KOER Test.

Heated Oxygen Sensors

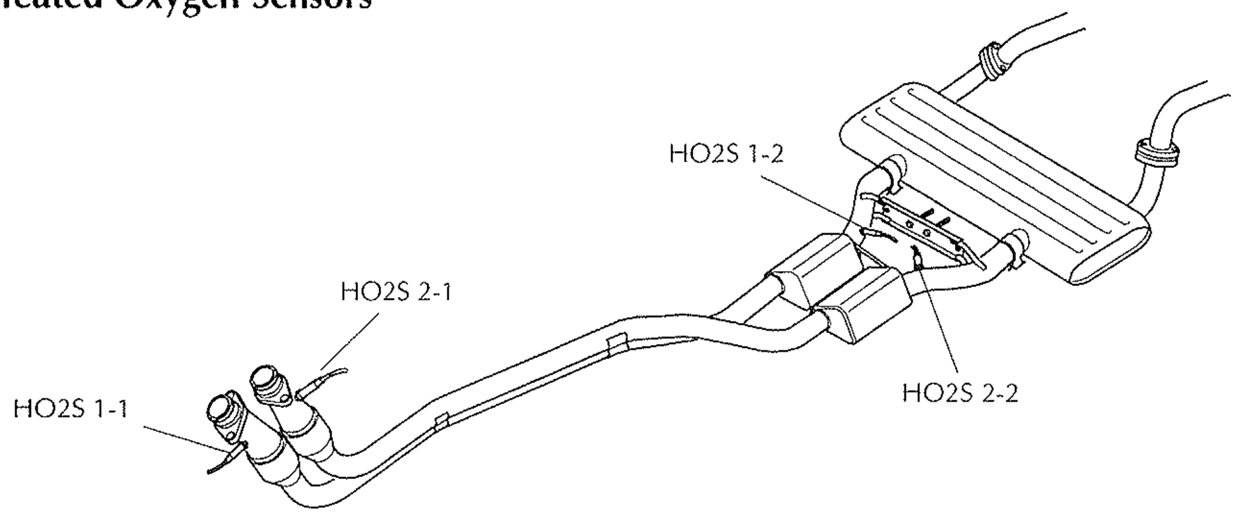


Figure 1. HO2S Location

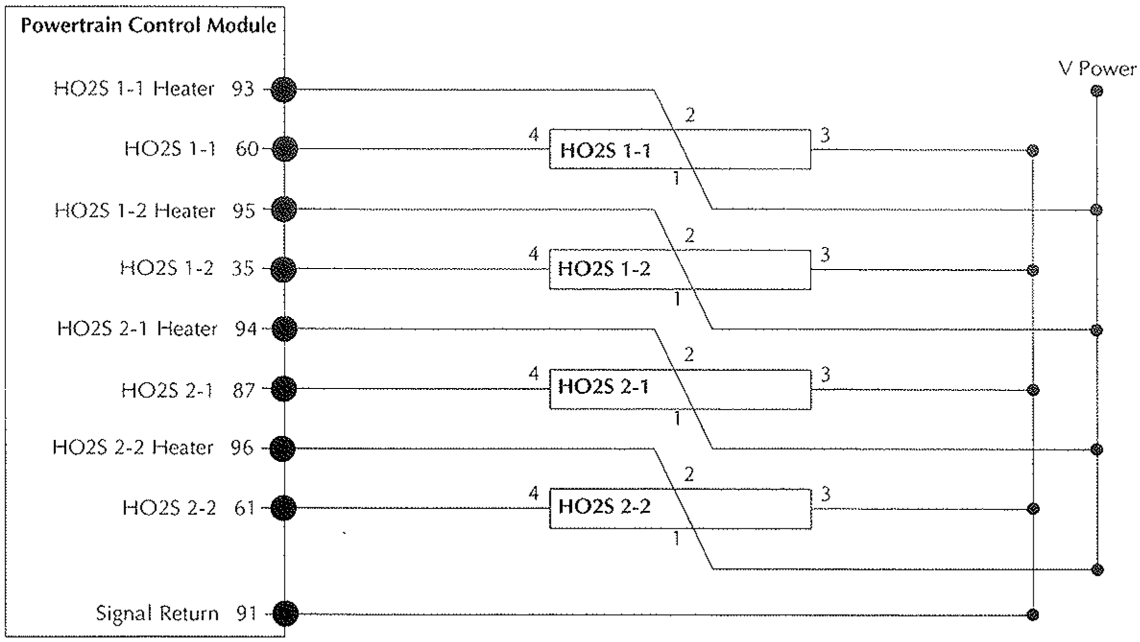


Figure 2. HO2S - PCM Interface Circuit

Fault Code Definition

P1131 - Fuel control system (cylinders 1-3) has reached its maximum compensation for a lean condition and HO2S 1-1 voltage is less than 0.45 volts.

P1151 - Fuel control system (cylinders 4-6) has reached its maximum compensation for a lean condition and HO2S 2-1 voltage is less than 0.45 volts.

P1131, P1151 Fault Analysis

1. Check the engine air intake for leaks, obstructions or damage, particularly between the MAF sensor and inlet manifold.

   Check the air filter and housing for obstructions or blockage.

   Check the positive crankcase ventilation system integrity.

   Check the engine vacuum system integrity.

   Service any identified defects and rerun the KOER Test to check if the problem is resolved. If P1131, P1151 are still present, go on to step 2.

2. Run a KOER test sequence and check the logged DTCs.

   If any of DTCs P1128, P1129, P1132 or P1152 are present, resolve these trouble codes first in the order in which they are logged. Then return to step 3 of this procedure if P1131 or P1151 are logged on completion of the other procedures.

3. Check the fuel pressure:

   WARNING: The fuel system is pressurised when the engine is not running. To prevent injury or fire, use caution when working on the fuel system

   Key off. Install a fuel pressure gauge. Verify the vacuum source to the fuel pressure regulator.

   Start the engine and run at idle speed. Note the fuel pressure.

   Increase engine speed to 2500 rpm and maintain for 1 minute. Note the fuel pressure.

   If the fuel pressure is outside the range 30-45 psi, service the fuel system as necessary and retest.

   If the fuel pressure is between 30-45 psi, Go to step 4.

4. Check the fuel system ability to hold fuel pressure:

   Cycle the key on and off several times, noting the maximum fuel pressure. Leave the key on for at least 10 seconds whilst observing the pressure gauge reading. Does the fuel pressure remain within 5 psi of the maximum reading after 10 seconds.

   Cycle the key on and off several times and then switch off.

   Check that there are no external fuel leaks (repair as necessary).

   Does the fuel pressure remain within 5 psi of the highest reading for one minute after switching the ignition key off.

   If the fuel pressure drops excessively, service the fuel system as necessary and retest.

   If the fuel pressure is held within 5 psi of the highest reading after one minute, go to step 5.

5. Flow test the injectors:

   Using the Rotunda Injector Tester or equivalent, test flow the injectors according to the test equipment instructions.

   If any injector fails the flow or leak tests, replace it and rerun the KOER Test.

   If the injectors pass all tests, go to step 6.

6. Check for secondary air intrusion:

   Note: The following procedure may induce a P0411 code. Ignore this code for the moment, it will be cleared during step 14.

   Key off. Disconnect the secondary air injection tube close to the exhaust manifold and plug the engine side of the secondary air system.

   Key on, engine on. Run the engine up to normal operating temperature.

   Activate an engine running self-test and check if P1131 or P1151 are present.

   If P1131 or P1151 is not present, the cause of the DTC is in the secondary air injection system. Service the system as required and rerun the KOER Test.

   If P1131 or P1151 is present, go on to step 7.

7. Check the cylinder compression pressures as detailed in the service manual (1.0.02).

   If the cylinder pressures are within specification, go to step 8.

   If the cylinder pressures are not within specification, service the engine as necessary. Complete a PCM reset and run the KOER Test to verify that the problem is resolved.

8. Check the HO2S integrity:

   Check the HO2S wiring for damage, poor connections or contamination with moisture, lubricants, coolant etc. and service if necessary.

   Key on, engine running for 2 minutes at 2000 rpm.

   Initiate a KOER test and monitor logged DTCs on completion.

   If P1131 and/or P1151 are logged, go to step 9.

   If P1131 and/or P1151 are not logged, the fuelling fault is not present at this time and testing is complete.

9. Check the sensor ability to generate a signal greater than 0.5 volt:

   Key off. Disconnect the suspect sensor. Connect a digital voltmeter to the sensor signal and signal return leads. Set the DVOM to the 20 volt scale.

   Key on, engine running. Run the engine at 2000 rpm for 2 minutes.

   Rerun the KOER test and monitor the voltage generated by the sensor. The signal voltage from the sensor should be greater than 0.5 volts at some time during or at the end of this test.

   If the signal does rise above 0.5 volts, go to step 10.

   If the signal does not rise above 0.5 volts, replace the sensor and rerun the KOER Test.

10. Check the continuity of the HO2S signal and signal return lines from the sensor connector to the PCM connector.

    If continuity is good, go to step 11.

    If a continuity fault is detected, service as necessary and rerun the KOER Test.

11. Check the HO2S signal and signal return lines for short circuit to ground.

    If no short circuit is found, go to step 12.

    If a short circuit is detected, service as necessary and rerun the KOER Test.

12. Check the HO2S response:

    Disconnect the suspect sensor. Connect a digital voltmeter to the sensor signal and return circuits in the sensor connector. Set the DVOM to the 20 volt scale.

    Disconnect a vacuum hose (not the fuel pressure regulator) from the supercharger inlet.

    Run the engine at 2000 rpm. The signal voltage should fall below 0.4 volts within 30 seconds.

    If the signal does fall below 0.4 volts within 30 seconds, reconnect the sensor and vacuum tube and go to step 13.

    If the signal does not fall below 0.4 volts within 30 seconds, replace the sensor. Reconnect the vacuum hose and rerun the KOER Test.

13. Connect the PDU or scan tool. Key on, engine running.

    Monitor the suspect sensor signal whilst wiggling, bending and shaking small sections of the harness from the PCM to the suspect sensor. The signal voltage should not make any rapid transitions in response to harness manipulation.

    If the voltage level does not respond to harness movement, go to step 14.

    If the signal level changes in response to harness manipulation, isolate and repair the harness fault. Reconnect all components and rerun the KOER Test.

14. Test drive the vehicle with the PDU connected and a collegue monitoring the suspect HO2S signal. Drive the vehicle under a range of conditions and attempt to simulate the original fault.

    If the HO2S signal switches correctly and you are unable to duplicate the fault, clear all DTCs. Testing is complete at this time.

    If the HO2S signal does not switch correctly, replace the suspect sensor, reset the PCM and rerun the KOER Test to ensure that the problem is resolved.

Heated Oxygen Sensors

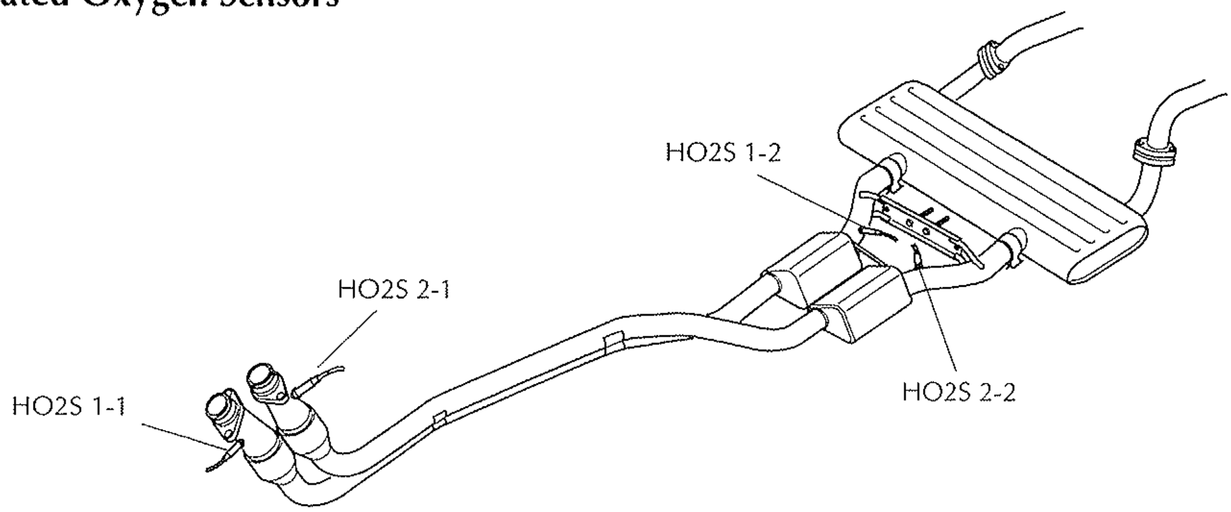


Figure 1. HO2S Location

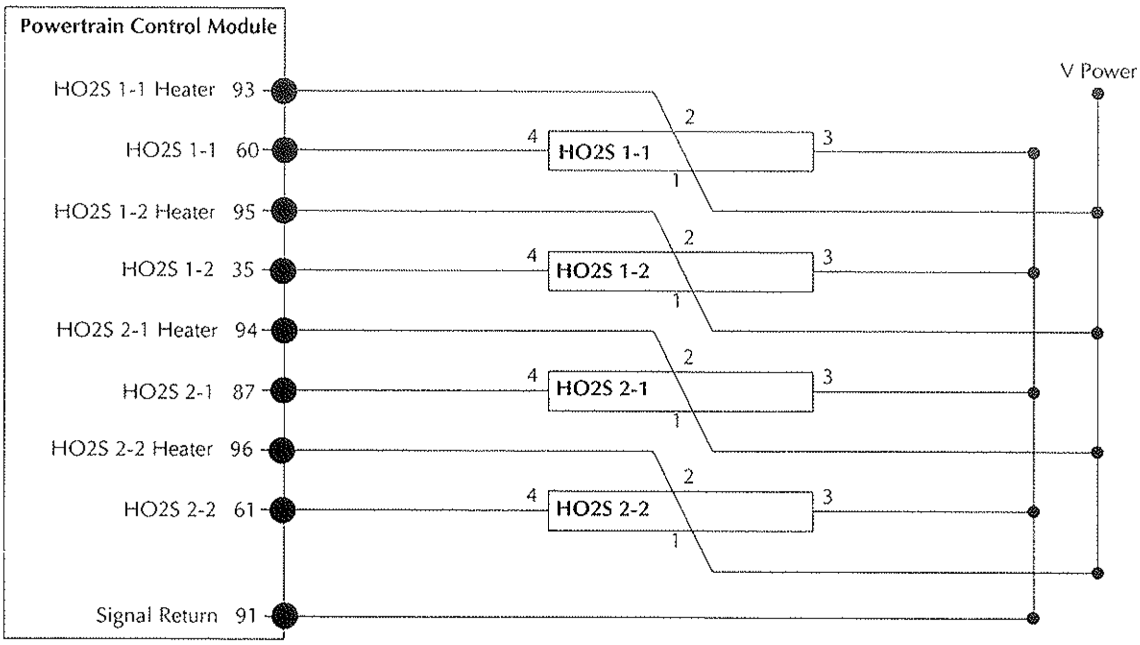


Figure 2. HO2S - PCM Interface Circuit

Fault Code Definition

P1132 - Fuel control system (cylinders 1-3) has reached its maximum compensation for a rich condition and HO2S 1-1 voltage is greater than 0.45 volts.

P1152 - Fuel control system (cylinders 4-6) has reached its maximum compensation for a rich condition and HO2S 2-1 voltage is greater than 0.45 volts.

P1132, P1152 Fault Analysis

1. Check the engine air intake for leaks, obstructions or damage, particularly between the MAF sensor and inlet manifold.

   Check air filter/housing for obstructions or blockage.

   Check the crankcase ventilation system integrity.

   Check the engine vacuum system integrity.

   Service any identified defects and rerun the KOER Test to check if the problem is resolved. If P1132, P1152 are still present, go on to step 2.

2. Check for excess fuel vapour from the evaporative loss system:

   Key off. Connect the PDU or scan tool.

   Disconnect the fuel vapour line at the supercharger inlet and plug the inlet pipe to prevent an air leak into the inlet tract.

   Start the engine and run at 2000 rpm for 1 minute and then return to idle.

   Key off, then run a KOER test and check the logged DTCs. Remove the plug and reconnect the fuel vapour line.

   If only DTCs P1132 and/or P1152 are present go to step 3.

   If DTCs P1132 and/or P1152 are no longer present, analyse the fault in the evaporative loss system as for a P1443 code.

   If P1127, P1128 or P1129 are present, resolve these codes first and return to this procedure only if the P1132 and/or P1152 recur after clearing the P1127, P1128 or P1129 codes.

   If DTCs P1130, P1150, P0171, P0174, P0172 or P0175 are present, resolve these problems first and return to this procedure only if the P1132 and/or P1152 recur after clearing the previous codes.

3. Check the fuel pressure:

   WARNING: The fuel system is pressurised when the engine is not running. To prevent injury or fire, use caution when working on the fuel system

   Key off. Install a fuel pressure gauge. Verify the vacuum source to the fuel pressure regulator.

   Start the engine and run at idle speed. Note the fuel pressure.

   Increase engine speed to 2500 rpm and maintain for 1 minute. Note the fuel pressure.

   If the fuel pressure is outside the range 30-45 psi, service the fuel system as necessary and retest for a P1130/P1150 condition.

   If the fuel pressure is between 30-45 psi, Go to step 4.

4. Flow test the injectors:

   Using the Rotunda Injector Tester or equivalent, test flow the injectors according to the test equipment instructions.

   If any injector fails the flow or leak tests, replace it and rerun the KOER Test.

   If the injectors pass all tests, go to step 5.

5. Check the cylinder compression pressures as detailed in the service manual.

   If the compression pressures are below specification, service the engine as necessary.

   If the compression pressures all meet specification, go to step 6.

6. Check for codes P1132 and P1152 with codes P1130 and P1150

   Activate a KOER test and allow it to complete. Check the logged DTCs. If P1132 and P1152 are logged together with P1130/P1150, go to step 7.

   If P1132 and P1152 are not logged together with P1130 and P1150, the fault which produced the P1132 and/or P1152 is intermittent. Go to the Intermittent Signal fault analysis procedure.

7. Check for HO2S signals shorted to power.

   Key on, engine off. PDU or scan tool connected.

   Monitor the voltage levels of the upstream oxygen sensors. If the voltage is greater than 1.0 and less than 4.0 volts, go to step 8.

   If the voltage is not greater than 1.0 and less than 4.0 volts, go to step 10.

8. Check for short circuit to voltage source in the affected circuit.

   Key off. Suspect sensor disconnected. PCM disconnected. Inspect the connectors for damage, pushed out pins, corrosion, loose wires, etc and service as necessary.

   Measure the resistance from PCM connector pin 60 to PCM connector pins 71, 93 and 97. Also measure the resistance from PCM connector pin 87 to PCM connector pins 71, 93 and 97. Each resistance should be greater than 10kΩ.

   If any resistance is less than 10kΩ, repair the short circuit, reconnect all components and rerun the KOER test.

   If resistance values are above 10kΩ, go to step 9.

9. Check for HO2S signal shorted to HO2S Heater signal within the sensor.

   Disconnect the suspect HO2S sensor. Key on, engine off.

   Monitor the suspect HO2S signal level. Is the HO2S signal level less than 0.2 volts?

   If the suspect HO2S signal level is less than 0.2 volts, replace the HO2S sensor, reconnect all components and rerun the KOER Test.

   If the suspect signal level is not less than 0.2 volts, replace the PCM. Reconnect all components and rerun the KOER Test.

10. Attempt to generate DTCs P1131 and P1151:

    Disconnect the suspect sensor. Fit a jumper lead from the HO2S signal line at the harness connector to battery negative. Run a KOER Test and check the logged DTCs.

    Note: With the signal shorted to ground, other codes will be logged, ignore additional codes and carry on with this procedure.

    If P1131 or P1151 is present, remove the jumper lead and go to step 11.

    If P1131 or P1151 is not present, Check the harness and connectors from the affected sensor to the PCM. Service as necessary. If the connectors are good, replace the PCM and rerun the KOER Test.

11. Check the HO2S response:

    Disconnect the suspect sensor. Connect a digital voltmeter to the sensor signal and return circuits in the sensor connector. Set the DVOM to the 20 volt scale. Disconnect a vacuum hose (not the fuel pressure regulator) from the supercharger inlet.

    Run the engine at 2000 rpm. The signal voltage should fall below 0.4 volts within 30 seconds.

    If the signal does fall below 0.4 volts within 30 seconds, reconnect the sensor and vacuum tube and go to step 12.

    If the signal does not fall below 0.4 volts within 30 seconds, replace the sensor. Reconnect the vacuum hose and rerun the KOER Test.

12. Connect the PDU or scan tool. Key on, engine running. Monitor the suspect sensor signal whilst wiggling, bending and shaking small sections of the harness from the PCM to the suspect sensor. The signal voltage should not make any rapid transitions in response to harness manipulation.

    If the voltage level does not respond to harness movement, go to step 13.

    If the signal level changes in response to harness manipulation, isolate and repair the harness fault. Reconnect all components and rerun the KOER Test.

13. Test drive the vehicle with the PDU connected and a collegue monitoring the suspect HO2S signal. Drive the vehicle under a range of conditions and attempt to simulate the original fault.

    If the HO2S signal switches correctly and you are unable to duplicate the fault, clear all DTCs. Testing is complete at this time.

    If the HO2S signal does not switch correctly, replace the suspect sensor, reset the PCM and rerun the KOER Test to ensure that the problem is resolved.

Heated Oxygen Sensors

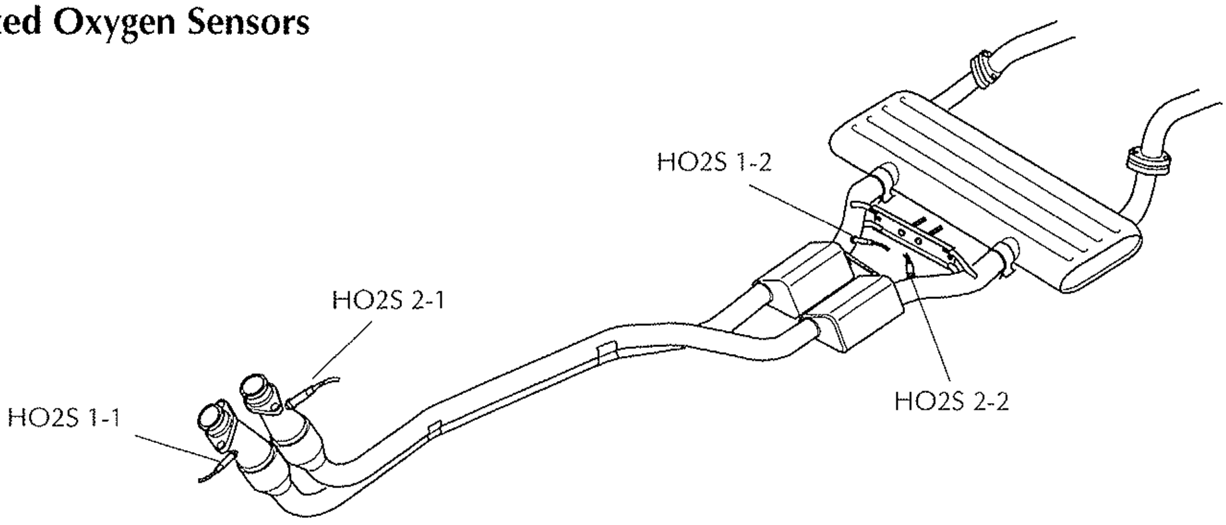


Figure 1. Heated Oxygen Sensor Location

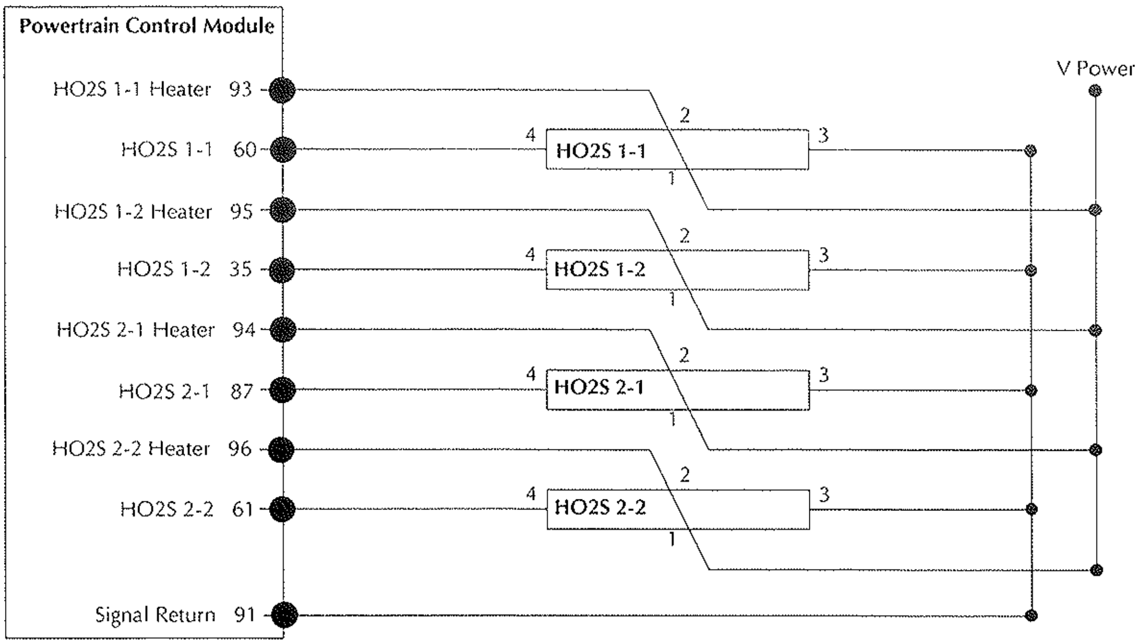


Figure 2. HO2S - PCM Interface Circuit

Fault Code Definition

P1137 - HO2S 1-1 not switching
P1138 - HO2S 1-2 not switching
P1157 - HO2S 2-1 not switching
P1158 - HO2S 2-2 not switching

P1137, P1138, P1157, P1158 Fault Analysis

1. Check the exhaust system for leaks.

   Check the HO2S wiring for crossed connections, damaged pins or damaged harness.

   Remove each oxygen sensor and check for contamination or damage.

   Service any defects identified in the above checks.

   Run the KOER Test and check for DTCs P1137, P1138, P1157, P1158 on completion.

If any of DTCs P1137, P1138, P1157, P1158 are present, go to step 2.

If none of DTCs P1137, P1138, P1157, P1158 are present, the fault is not present at this time and testing is complete.

2. Check the HO2S harness circuits for shorts to VPWR or to ground:

   Disconnect the PCM

   Disconnect all HO2S connectors.

   Check for short circuits in each sensor wiringby measuring resistance between the following points:

   from signal to SIG RTN,
   from signal to VPWR,
   from signal to VREF,
   from signal to PWR GND.

   If each resitance is above 10kΩ, go to step 3.

   If any resistance is below 10kΩ, repair the short circuit. Reset the PCM and rerun the Quick Test to ensure that the problem is resolved.

3. Check the continuity of the HO2S circuits:

   Measure the continuity from the PCM connector to the HO2S connector for the signal and signal return line of the suspect sensor.

   If the continuity reading is less than 5Ω, go to step 4.

   If the continuity is more than 5Ω, repair the open circuit and rerun the Quick Test to ensure that the problem is resolved.

4. Check the circuit continuity with all connections made:

   Reconnect the HO2S connectors and the PCM connector.

   Access the HO2S signals using the PDU datalogger function.

   Key on, engine off.

   Monitor the signal voltage values for HO2S 1-2 and HO2S 2-2.

   If the signal voltage is greater than 1.5 volts, go to step 5.

   If the signal voltage is 1.5 volts or below, go to step 6.

5. Check for overvoltage on the HO2S circuit at the PCM:

   PCM connected, HO2S disconnected.

   Key on.

   Measure the voltage from signal return and battery negative at the HO2S connector.

   Measure the voltage between the HO2S signal and battery negative.

   If any reading is above 1.5 volts, replace the PCM, reconnect all components and rerun the Quick Test.

   If any voltage readings is below 1.5 volts, replace the affected sensor, reconnect all components and rerun the Quick Test.

6. Check the continuity of the HO2S ground circuit in the PCM:

   Key off. PCM disconnected. Measure the resistance between SIG RTN (PCM pin 91) and PWR GND (PCM pins 24, 51, 76, 77, 103).

   If the resistance is less than 5.0Ω, go to step 7.

   If the resistance is more than 5.0Ω, replace the PCM. Reconnect all components and run the KOER Test to ensure that the problem is resolved.

7. Apply 12 volts to the suspect HO2S circuit:

   Key off. Disconnect the suspect HO2S connector.

   Install a jumper lead from the HO2S signal terminal to the VPWR terminal at the HO2S connector.

   Key on. Monitor the HO2S signal using the PDU.

   If the signal voltage is above 1.5 volts, replace the defective HO2S sensor. Reconnect all components. Complete a HO2S monitor drive cycle. Rerun the KOER Test to ensure that the problem is resolved.

   If the signal voltage is less than 1.5 volts, Replace the PCM. Reconnect all components. Complete a HO2S monitor drive cycle. Rerun the KOER Test to ensure that the problem is resoved.

Fuel Pump 2 Monitor

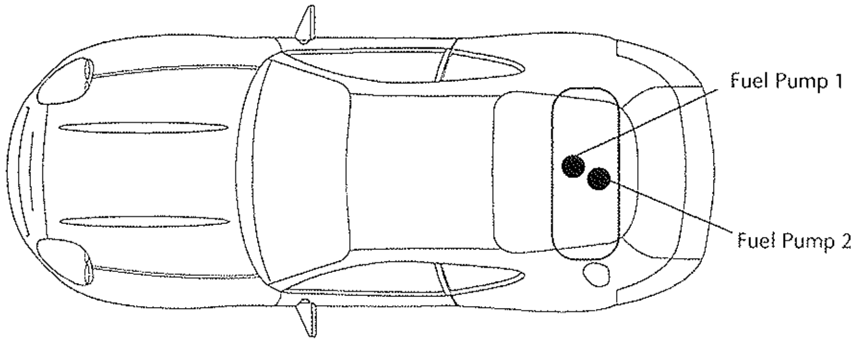


Figure 1. Fuel Pump 2 Location

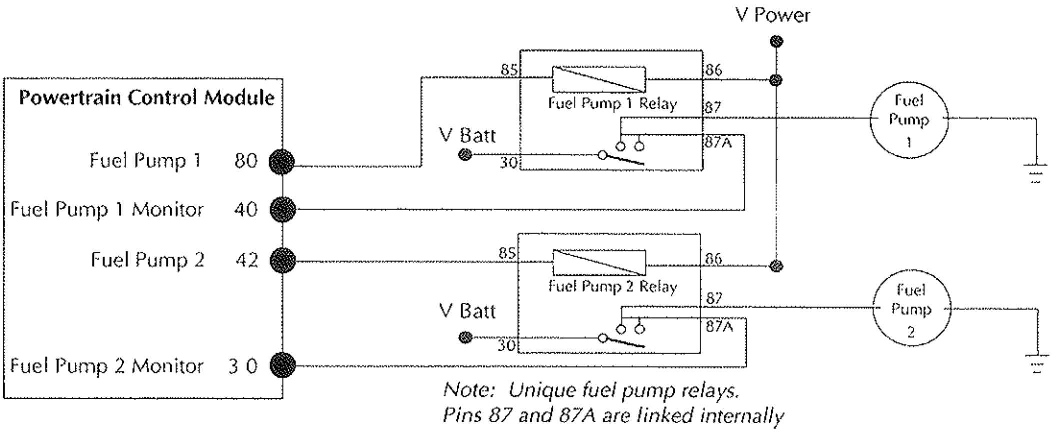


Figure 2. Fuel Pump 2 Circuit

Fault Code Definition

P1239 - Fuel pump 2 monitor is off when the pump is commanded on.

P1239 Fault Analysis

1. Connect the PDU or scan tool and clear the P1239 code. Set to check the fuel pump 2 monitor signal on PCM pin 30 and the fuel pump 2 drive signal on PCM pin 42.

2. Switch on the ignition. As the fuel pump 2 driver signal goes to 0 volts, the fuel pump 2 monitor should go to 12 volts.

   If the fuel pump 2 monitor does not go to 12 volts as the ignition is switched on, go to step 3.

   If the fuel pump 2 monitor does go to 12 volts and a P1239 code is logged, the PCM is faulty. Replace the PCM and run the KOEO test to ensure that the problem is resolved.

3. Key off. Remove the fuel pump 2 relay. Key on. Check for 12 volts supply on fuel pump 2 relay base pin 86.

   If 12 volts is present, go to step 4.

   If 12 volts is not present, isolate and repair the fault in the 12 volt line to the fuel pump relays pin 86 from the main relay. Reconnect all components and run the KOEO test to ensure that the problem is resolved.

4. Check the resistance of the relay coil from pins 85 to 86 of the relay.

   If the resistance is 50Ω ± 10%, go to step 5.

   If the resistance is not in the range 50Ω ± 10%, replace the relay. Reconnect all components and run the KOEO test to ensure that the problem is resolved.

5. Key off. Disconnect the PCM. Check the continuity of the line from fuel pump relay base pin 85 to PCM harness connector pin 42.

   If continuity is good, refit the fuel pump 2 relay and go to step 6.

   If a continuity problem is identified, repair the wiring as necessary. Reconnect all components and run the KOEO test to ensure that the problem is resolved.

6. Key on. Measure the voltage on pins 87/87A of the relay base.

   If 12 volts is absent from pin 87/87A of the relay base, go to step 7.

   If 12 volts is measured, repair the open circuit in the line from pin 87A of the relay base to PCM connector pin 30. Reconnect all components and run the KOEO test to ensure that the problem is resoved.

7. Key off. Remove the fuel pump 2 relay, key on. Check the 12 volt supply (VBAT) on fuel pump 2 relay base pin 30.

   If 12 volts is present, replace the fuel pump 2 relay and run the KOEO test to ensure that the problem is resolved.

   If 12 volts is absent, check the supply from the battery to fuel pump 2 relay pin 30 via boot fuse F12 and repair as necessary. Run the KOEO test to ensure that the problem is resolved.

Fuel Pump 2 Monitor

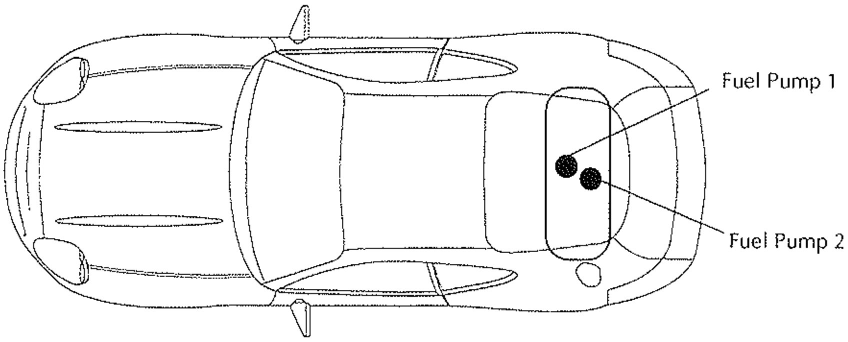


Figure 1. Fuel Pump 2 Location

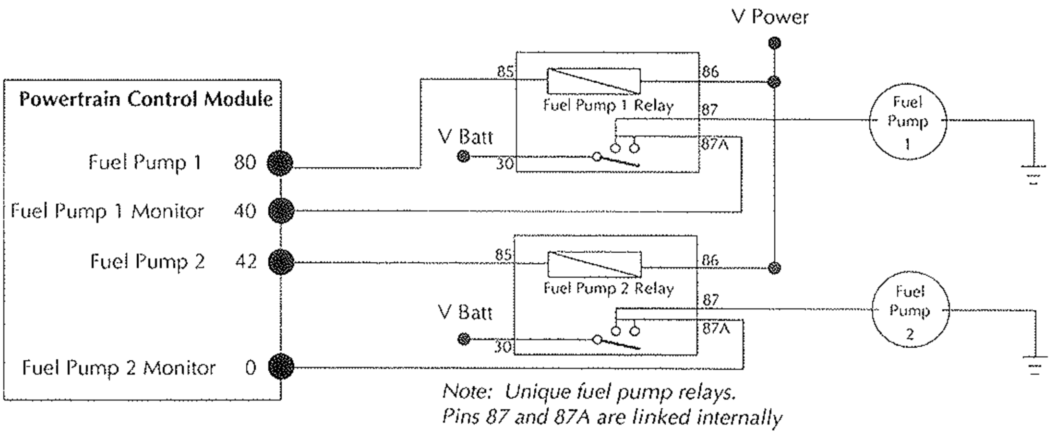


Figure 2. Fuel Pump 2 Circuit

Fault Code Definition

P1243 - Fuel pump 2 monitor is on when the pump is commanded off.

P1243 Fault Analysis

1. Connect the PDU or scan tool. Key on. Check that P1243 is logged.

2. Key off. Remove the fuel pump 2 relay. Disconnect the PCM.

   Check for a short circuit to earth from relay base pin 85.

   If no short circuit is detected, go to step 3.

   If a short circuit is detected, repair the wiring from relay base pin 85 to PCM connector pin 42. Run the KOER test to ensure that the problem is resolved.

3. Check the voltage on relay base pin 87A.

   If 0 volts is present, replace the fuel pump 2 relay. Run the KOEO test to ensure that the problem is resolved.

   If 12 volts is present, service the short circuit from relay base pin 87A to 12 volts supply (VBAT or VPWR). Reconnect all components and run the KOEO test to ensure that the problem is resolved.

Vehicle Theft

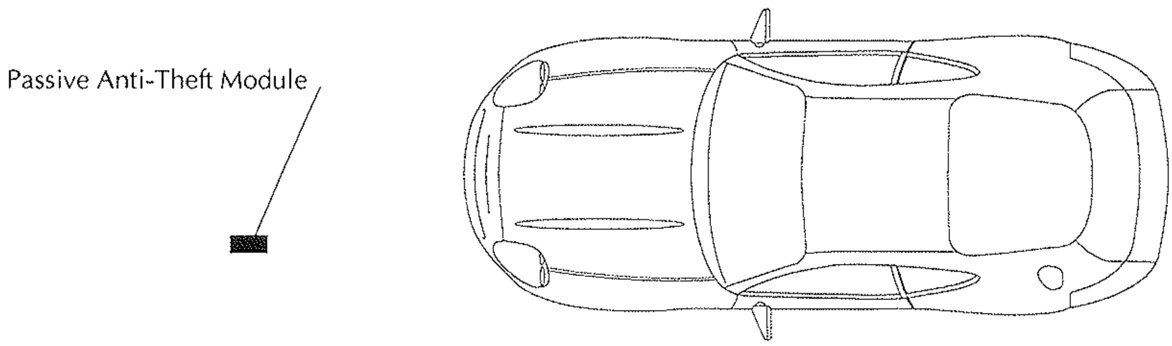


Figure 1. PATS Module Location

Fault Code Description

P1260 - Engine disabled due to vehicle theft detected.

P1260 Fault Analysis

1. If this code is logged as a result of a genuine vehicle theft, repair any access damage and go to step 2.
2. Connect the PDU or scan tool and record any logged faults in the PATS module. Resolve any recorded DTCs using the procedures in the security manual.
3. Connect the PDU to the PCM and clear the P1260 code.
4. Run the KOER test to ensure that the problem is resolved.

Differential Pressure Feedback Sensor

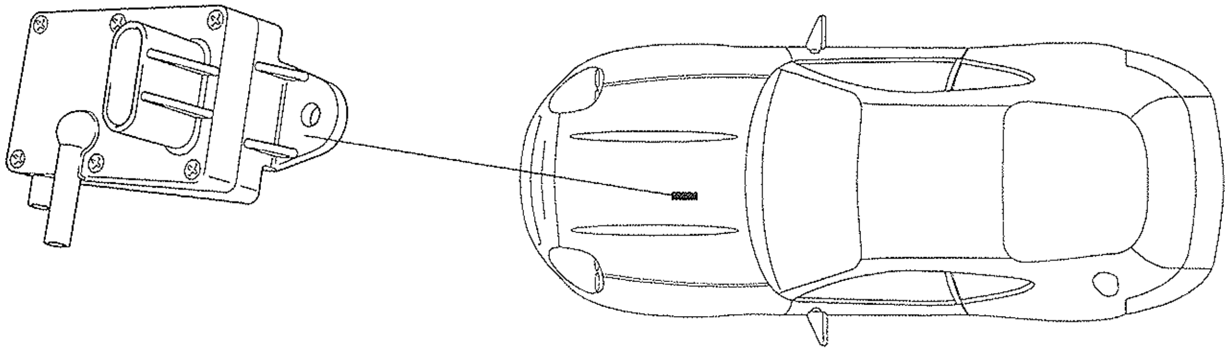


Figure 1. DPFE Sensor Location

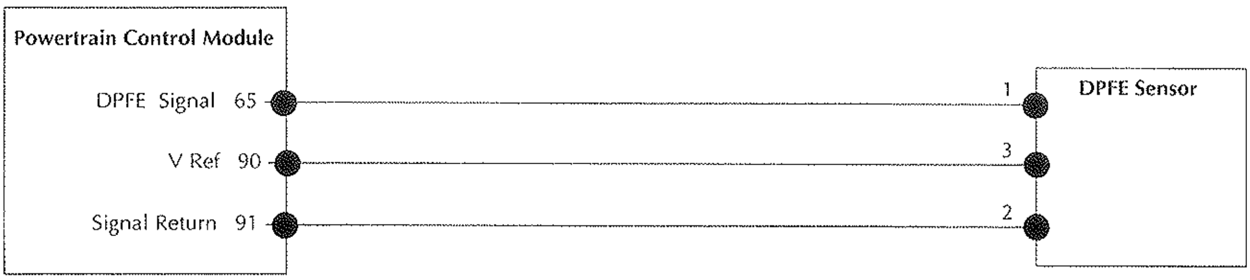


Figure 2. DPFE - PCM Interface Circuit

Fault Code Definition

P1400 - The PCM has detected the DPFE signal below the minimum level (0.2 volts)

P1400 Fault Analysis

1. Connect the PDU or scan tool. Monitor the DPFE signal.

   Key on, engine off. The DPFE signal should be 0.45 ±0.25 volts.

   If the signal level is at 0.45 ±0.25 volts, inspect the pressure signal hoses and the EGR hoses for leaks. Service as necessary.

   If the signal level is below 0.45 ± 0.25 volts, go to step 2.

2. Check the DPFE wiring continuity and PCM response as follows:

   Key off. Disconnect the DPFE sensor connector. Connect a jumper wire from the VREF pin to the DPFE signal pin at the connector.

   Key on, engine off. Monitor the DPFE signal.

   If the signal level is 4.0 - 6.0 volts, the DPFE wiring and the PCM response are OK. Replace the DPFE sensor.

   If the signal level is not 4.0 - 6.0 volts, go to step 3.

3. Measure VREF at the DPFE sensor connector. The VREF voltage should be in the range 4.0 - 6.0 volts.

   If VREF is out of range, go to the VREF fault analysis procedure in this section.

   If VREF is in range, go to step 4.

4. Key off. DPFE sensor disconnected. Inspect the connector for pushed out pins, corrosion, loose wires, etc. Service as necessary. Go to step 5.

5. Using the PDU, measure resistance from PCM pin 65 (DPFE signal) to PCM pin 91 (sig return). Also measure resistance from PCM pin 65 to pin 51/103 (PWR GND).

   If each resistance is more than 10kΩ, replace the defective PCM.

   If any resistance is less than 10kΩ, repair the short circuit, reconnect all components and re-run the KOER Test.

Differential Pressure Feedback Sensor

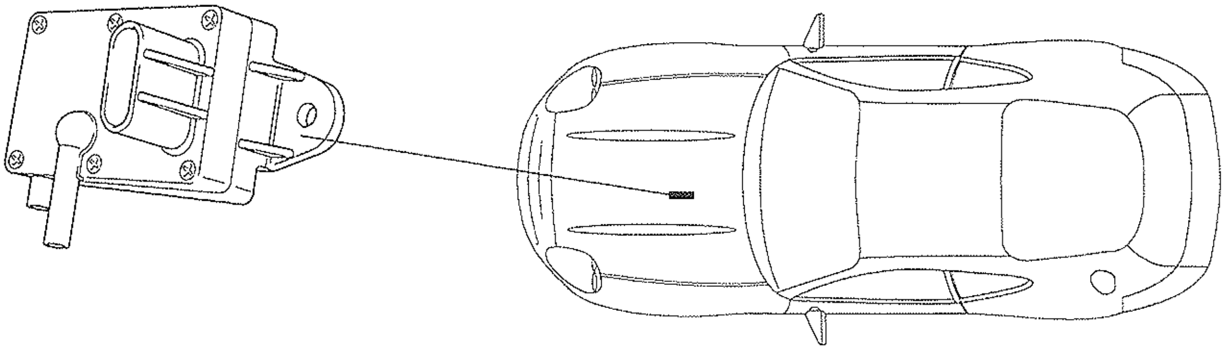


Figure 1. DPFE Sensor Location

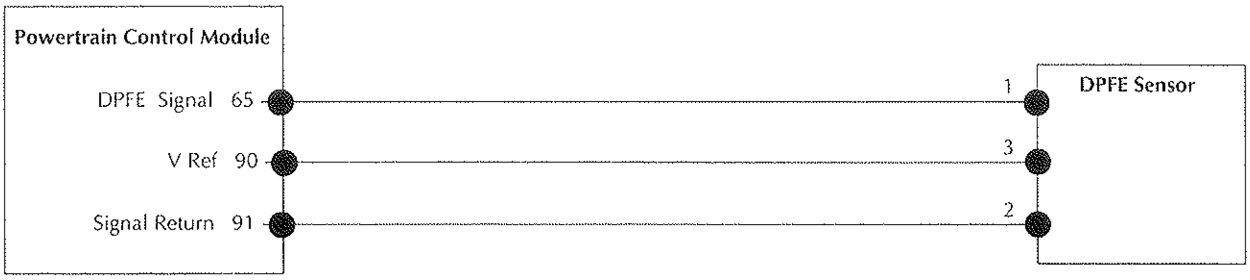


Figure 2. DPFE - PCM Interface Circuit

Fault Code Definition

P1401 - The PCM has detected the DPFE signal above the maximum level (4.0 volts)

P1401 Fault Analysis

1. Connect the PDU or scan tool. Monitor the PDFE signal.

   Key on, engine off. The DPFE signal should be 0.45 ±0.25 volts.

   If the signal level is greater than 4.0 volts, go to step 2.

   If the signal level is 0.45 ±0.25 volts, the P1041 fault is possibly an intermittent short circuit. Go to the intermittent signal procedure.

2. Key off. Disconnect the PCM and the DPFE sensor.

   Check the continuity from PCM harness connector pin 65 (DPFE signal) to PCM harnes connector pins 90 (VREF) and 71/97 (VPWR).

   Check continuity from PCM harness connector pin 91 (signal return) to DPFE sensor harness connector pin 2 (signal return).

   If no wiring faults are detected, go to step 3.

   If any short or open circuit is detected, service the wiring as necessary. Reconnect all components, clear the P1401 code and retest to ensure that the problem is resolved.

3. Open circuit the DPFE signal wire at the PCM connector. Reconnect the PCM and the DPFE sensor.

   Key on. Measure the voltage from the disconnected DPFE signal wire to chassis ground.

   If the voltage is greater than 4.0 volts, the DPFE sensor is faulty. Replace the sensor, clear the P1401 code and run the KOEO test to ensure that the problem is resolved.

   If the voltage is less than 4.0 volts, the PCM is faulty. Replace the PCM and run the KOEO test to ensure that the problem is resolved.

Differential Pressure Feedback Sensor

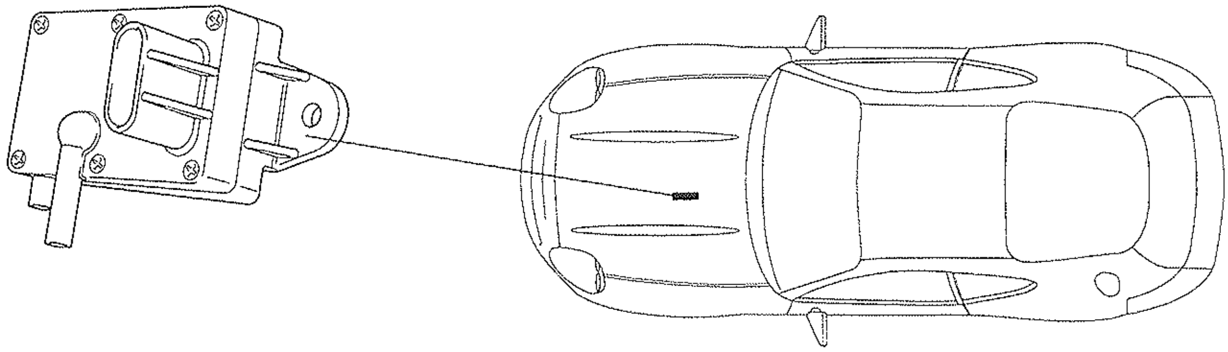


Figure 1. DPFE Sensor Location

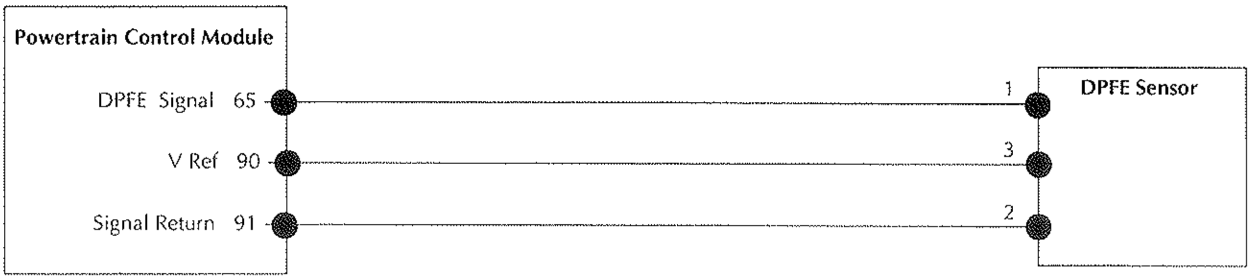


Figure 2. DPFE - PCM Interface Circuit

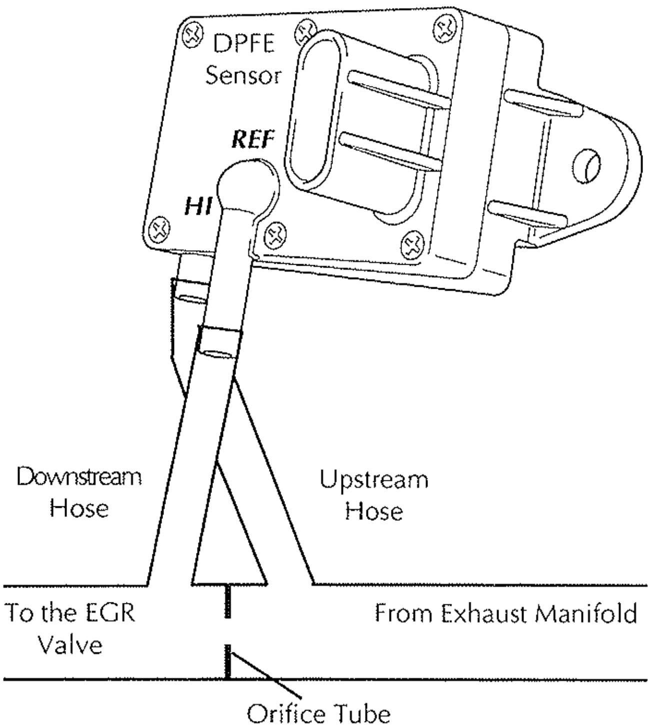


Figure 3. DPFE Hose Connections

Fault Code Definition

P1405 - The PCM has detected the DPFE sensor upstream (exhaust manifold side) hose is off or blocked.

P1405 Fault Analysis

1. Key off. Inspect the upstream DPFE hose for disconnection, kinking, blocking, poor connection or dips where water could gather and freeze, service as necessary.

   If the tube has to be repaired or replaced, reset the PCM and complete the EGR Monitor Drive Cycle. Re-run the KOER Test to check that the fault is cleared.

   If the tube is serviceable, go to step 2.

2. Carefully disconnect the hoses from the DPFE sensor and the orifice tube assembly.

   Inspect the orifice tube assembly, upstream hose and the DPFE sensor HI connection for contamination, blockage or damage. Service as necessary.

   If the components are repaired or replaced, reassemble the system. Reset the PCM and complete the EGR Monitor Drive Cycle. Re-run the KOER Test to check that the fault is cleared.

   If the components are serviceable, go to step 3.

3. Connect a hand pressure pump to the downstream pickup marked 'HI' on the DPFE sensor.

   Connect the PDU or scan tool and set to monitor the DPFE signal voltage.

   Key on, engine off. The DPFE signal should be 0.45 ±0.25 volts.

   Apply 8-9 in-Hg pressure to the DPFE sensor. The DPFE signal should rise to above 4.0 volts.

   Quickly release the pressure, the signal volts should drop to less than 1 volt in under one second.

   If the sensor signal levels are not correct, replace the sensor. Reset the PCM and complete the EGR Monitor Drive Cycle. Re-run the KOER Test to check that the fault is cleared.

   If the sensor signal levels are correct, the fault cause may have been cleared during recent servicing, without clearing the P1405 code. Reconnect all components, complete a PCM reset and re-run the KOER Test.

Differential Pressure Feedback Sensor

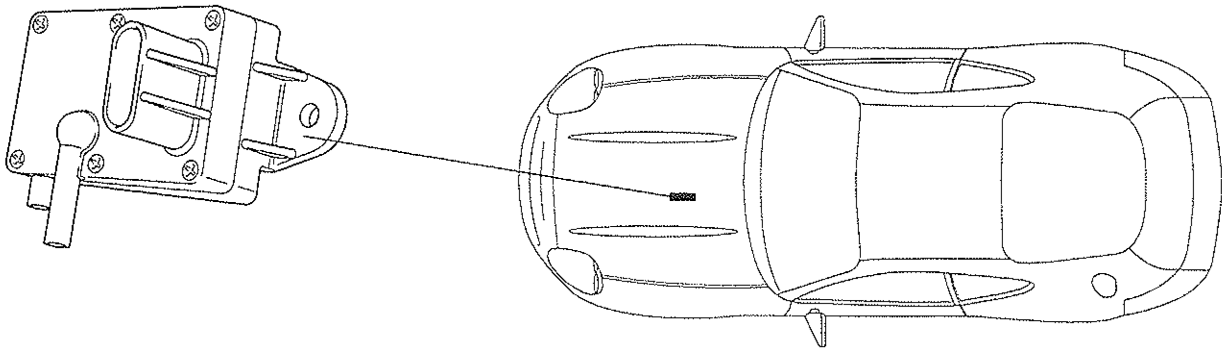


Figure 1. DPFE Sensor Location

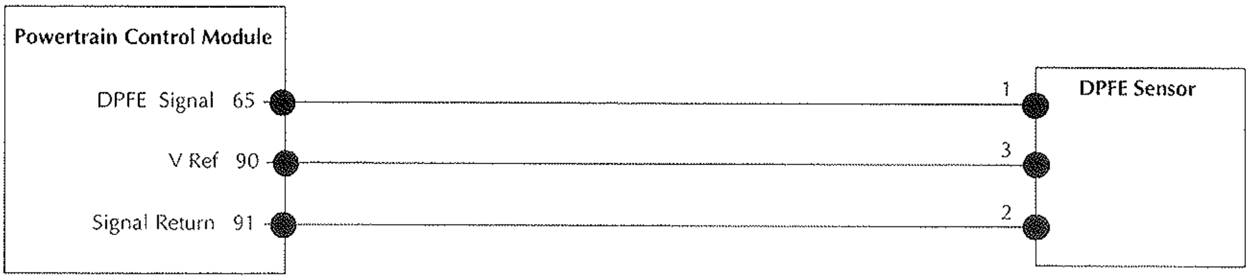


Figure 2. DPFE - PCM Interface Circuit

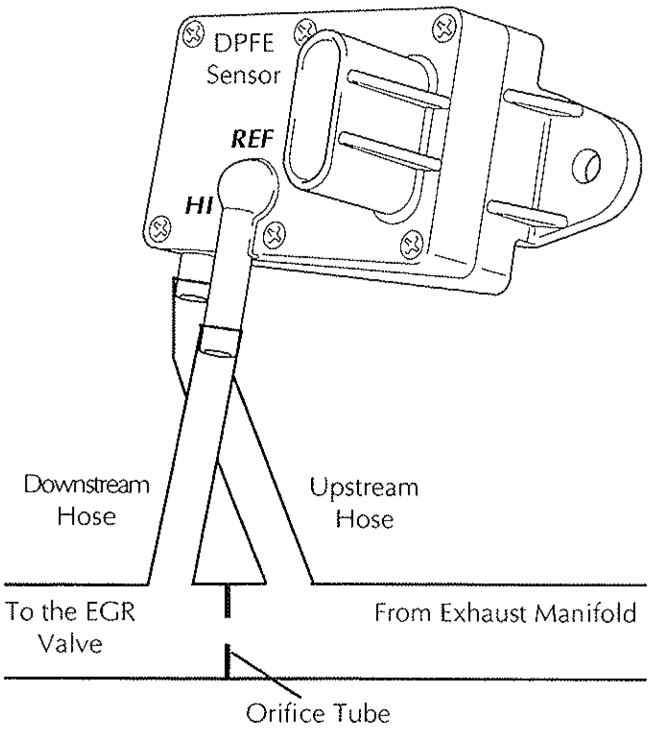


Figure 3. DPFE Hose Connections

Fault Code Definition

P1406 - The PCM has detected the DPFE sensor downstream (inlet manifold side) hose is off or blocked.

P1406 Fault Analysis

1. Key off. Inspect the downstream DPFE hose for disconnection, kinking, blocking, poor connection or dips where water could gather and freeze, service as necessary.

   If the tube is repaired or replaced, reset the PCM and complete the EGR Monitor Drive Cycle. Re-run the KOER Test to check that the fault is cleared.

   If the tube is serviceable, go to step 2.

2. Carefullty disconnect the hoses from the DPFE sensor and the orifice tube assembly.

   Inspect the orifice tube assembly, downstream hose and the DPFE sensor REF connection for contamination, blockage or damage. Service as necessary.

   If the components are repaired or replaced, reassemble the system. Reset the PCM and complete the EGR Monitor Drive Cycle. Re-run the KOER Test to check that the fault is cleared.

   If the components are serviceable, go to step 3.

3. Connect a hand vacuum pump to the downstream pickup marked 'REF' on the DPFE sensor.

   Connect the PDU or scan tool and set to monitor the DPFE signal voltage.

   Key on, engine off. The DPFE signal should be 0.45 ±0.25 volts.

   Apply 8-9 in-Hg vacuum to the DPFE sensor REF connection. The DPFE signal should rise to above 4.0 volts.

   Quickly release the vacuum, the signal volts should drop to less than 1 volt in under one second.

   If the sensor signal levels are not correct, replace the sensor. Reset the PCM and complete the EGR Monitor Drive Cycle. Re-run the KOER Test to check that the fault is cleared.

   If the sensor signal levels are correct, the fault cause may have been cleared during recent servicing, without clearing the P1406 code. Reconnect all components, complete a PCM reset and re-run the KOER Test.

Differential Pressure Feedback Sensor

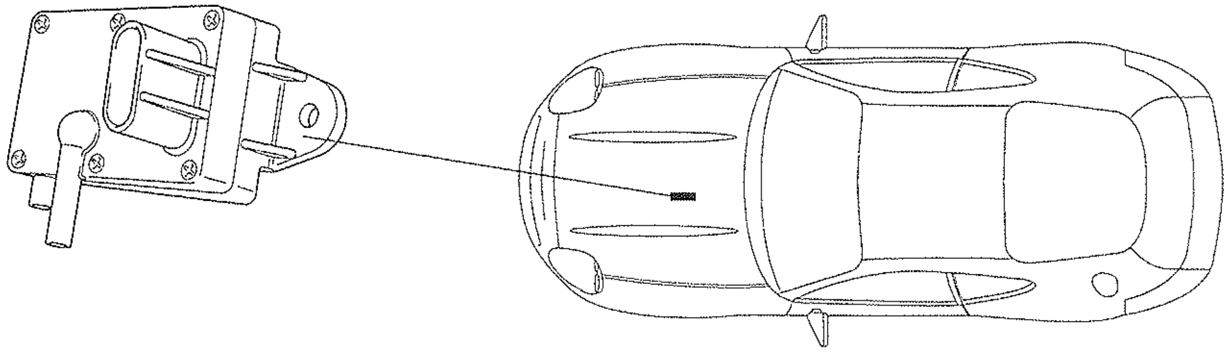


Figure 1. DPFE Sensor Location

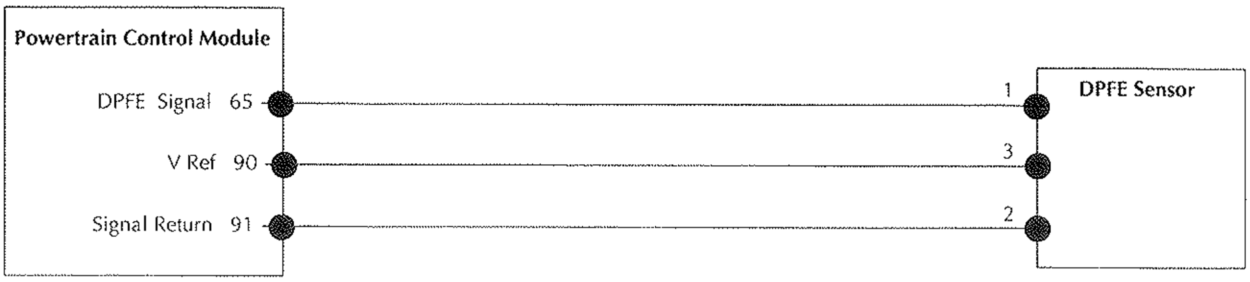


Figure 2. DPFE - PCM Interface Circuit

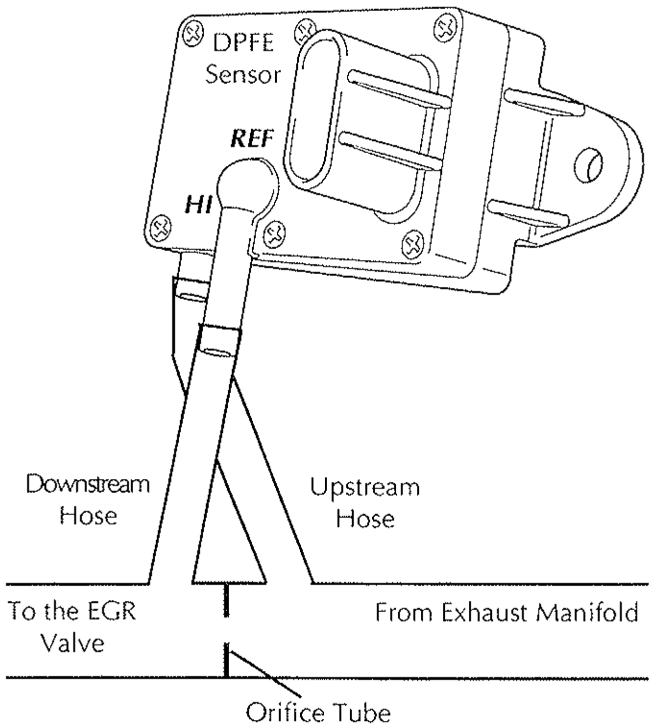


Figure 3. DPFE Hose Connections

Fault Code Definition

P1408 - The KOER Self Test has detected the EGR flow out of range.

P1408 Fault Analysis

1. Connect the PDU or scan tool and read all recorded DTCs.

   If other DTCs other than P1408 are recorded, resolve these problems first, reset the PCM and then re-run the KOER self test to ensure that P1408 is still present. If so, go to step 2.

2. Key off. Disconnect the vacuum hose at the EGR valve and connect the hose to a vacuum gauge.

   Run the KOER self test whilst monitoring the the vacuum gauge. Approximately 30 seconds into the test, EGR flow will be requested for a few seconds. During this time, the vacuum should increase above 1.6 in-Hg to open the EGR valve.

   Note: Since the EGR vacuum hose is disconnected, ignore DTCs arising during this test.

   If the gauge rises above 3.0 in-Hg, the EGR vacuum is OK, go to step 3.

   If the gauge does not rise above 3.0 in-Hg, go to the EGR Vacuum Checks step 8.

3. Key off. Visually inspect the DPFE sensor hoses for reversed connection, leaks or blockage, improper routing, pinching or dips where water could settle and freeze.

   Inspect the DPFE sensor and orifice tube assembly for blockage or damage at the pick up tubes.

   Service any defects as necessary.

   If defects are identified and corrected, reconnect all components. Complete a PCM reset and re-run the KOER Test.

   If the DPFE system is serviceable, go to step 4.

4. Measure VREF at the DPFE sensor:

   Disconnect the sensor. Key on, engine off. Measure the voltage between the sensor VREF circuit and the SIG RTN circuit at the sensor connector.

   If VREF is in the range 4.0 to 6.0 volts, the supply is in specification. Reconnect the sensor and go to step 5.

   If VREF is not in the range 4.0 to 6.0 volts, go to the VREF fault analysis procedure.

5. Check the DPFE sensor output:

   Key off. Disconnect the pressure hoses at the DPFE sensor. Connect a vacuum hand pump to the sensor 'REF' connector.

   Key on engine off. Read the PDFE sensor output voltage on the PDU or scan tool. The PDFE signal should read 0.45 ±0.25 volts.

   Apply 8-9 in-Hg vacuum to the PDFE sensor. The signal should rise to above 4.0 volts.

   Quickly release the vacuum. The signal should drop to less than 1.0 volts in under 3 seconds.

   If any part of this test is failed, replace the PDFE sensor. Reconnect all components, complete a PCM reset and re-run the KOER Test.

   If all parts of the test are passed, go to step 6.

6. Check the EGR valve:

   Key off. Disconnect the vacuum hose at the EGR valve and plug the hose.

   Connect a hand vacuum pump to the EGR valve.

   Start the engine and bring to idle speed.

   Read the DPFE and RPM values on the PDU or scan tool.

   Slowly apply 5-10 in-Hg of vacuum to the EGR valve and hold for 10 seconds. (If the engine wants to stall, increase rpm with the throttle just enough to maintain idle rpm.

   Observe the following:

   - EGR valve starts opening at about 1.6 in-Hg, indicated by increasing DPFE signal voltage.
   - DPFE signal volts increasing until the EGR valve is fully open. DPFE should read 2.5 volts minimum with full vacuum applied.
   - DPFE signal volts are steady if vacuum is held. Any voltage drop indicates that the EGR valve or the vacuum source is leaking.

   If the EGR valve passes all parts of this test, go to step 7.

   If the system fails any part of this test, remove and inspect the EGR valve for contamination, or other problems. If any problems are present, replace the EGR valve. Check for obstruction in the EGR port. Refit all components, reset the PCM and re-run the KOER Test.

7. Check the EVR vacuum output:

   Key off. EVR solenoid connected.

   Disconnect the vacuum hose at the EGR valve and connect to a vacuum gauge.

   Key on, engine running. With the engine at idle, short test pin 47 (EVR) to chassis ground.

   If the vacuum gauge reads 4.0 in-Hg or greater, the PCM is defective. Replace the PCM, reconnect all components and re-run the KOER Test.

   If the vacuum gauge does not rise to 4.0 in-Hg or greater, replace the damaged EVR solenoid. Reconnect all components, complete a PCM reset and re-run the KOER Test.

EGR Valve Vacuum Checks

Note: Only proceed with the following tests if the EGR vacuum supply checks failed in step 2 of this procedure.

8. Key off, Disconnect the vacuum hose at the EVR solenoid valve. Connect the vacuum supply hose to a vacuum gauge.

   With the engine at idle, take a vacuum gauge reading.

   Inspect the vacuum lines for kinks, disconnections, blockage, routing or other damage.

   If the vacuum at idle is less than 15 in-Hg, isolate the vacuum fault and service as necessary. Reset the PCM and re-run the KOER Test.

   If the vacuum lines are good and the vacuum at idle is 15 in-Hg, go to step 9.

9. Check VPWR to the EVR solenoid:

   Disconnect the EVR solenoid. Key on, engine off.

   Measure the voltage between the VPWR circuit and chassis ground at the EVR connector.

   If the EVR VPWR supply is less than 10.5 volts, service the open circuit in the VPWR circuit. Reconnect all components, reset the PCM and re-run the KOER Test.

   If the VPWR supply is good, go to step 10.

10. Measure the resistance of the EVR solenoid. The reading should be in the range 26 - 40Ω.

    If the resistance is outside the range 26 - 40Ω, replace the EVR solenoid. Reconnect all components, reset the PCM and re-run the KOER Test.

    If the resistance is within the range 26 - 40Ω, go to step 11.

11. Check the EVR circuit:

    Key off. Disconnect the EVR solenoid and the PCM. Key on, engine off. Measure voltage from connector pin 47 to chassis ground.

    If the voltage is greater than 1.0 volts, service the EVR circuit for a short to PWR. Reconnect all components, reset the PCM and run a KOER Test.

    If the voltage is lower than 1.0 volts, go to step 12.

12. Check the EVR circuit for an open in the harness:

    Measure the resistance from pin 47 at the PCM connector and the EVR circuit at the solenoid connector.

    If the resistance is greater than 5Ω, service an open EVR circuit. reconnect all components, reset the PCM and re-run the KOER Test.

    If the resistance is less than 5Ω, reconnect the EVR solenoid and go to step 13.

13. Check the EVR vacuum output:

    Key off. EVR solenoid connected.

    Disconnect the vacuum hose at the EGR valve and connect to a vacuum gauge.

    Key on, engine running. With the engine at idle, short test pin 47 (EVR) to chassis ground.

    If the vacuum gauge reads 4.0 in-Hg or greater, the PCM is defective. Replace the PCM, reconnect all components and re-run the KOER Test.

    If the vacuum gauge does not rise to 4.0 in-Hg or greater, replace the damaged EVR solenoid. Reconnect all components, complete a PCM reset and re-run the KOER Test.

Differential Pressure Feedback Sensor

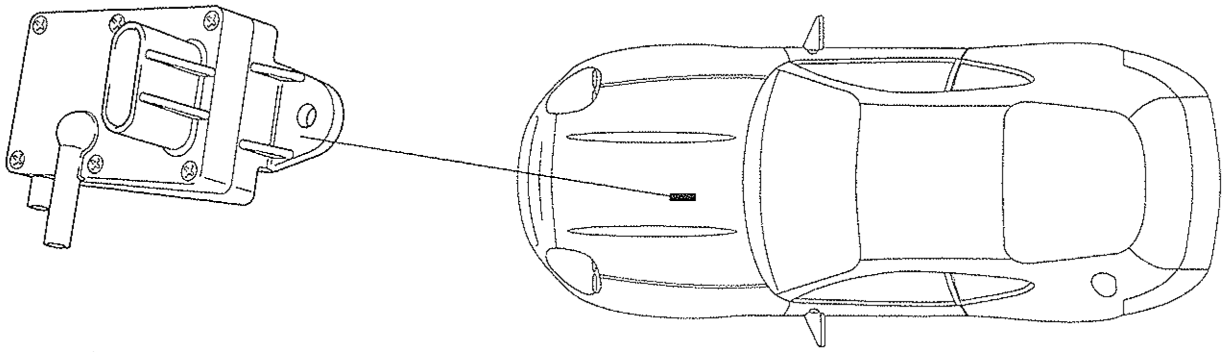


Figure 1. DPFE Sensor Location

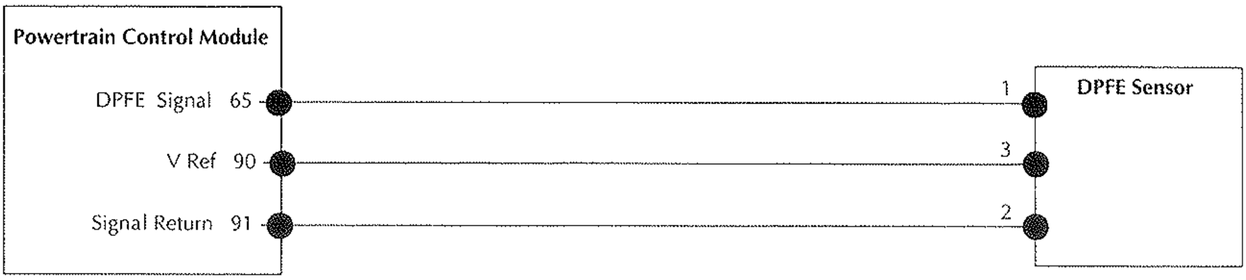


Figure 2. DPFE - PCM Interface Circuit

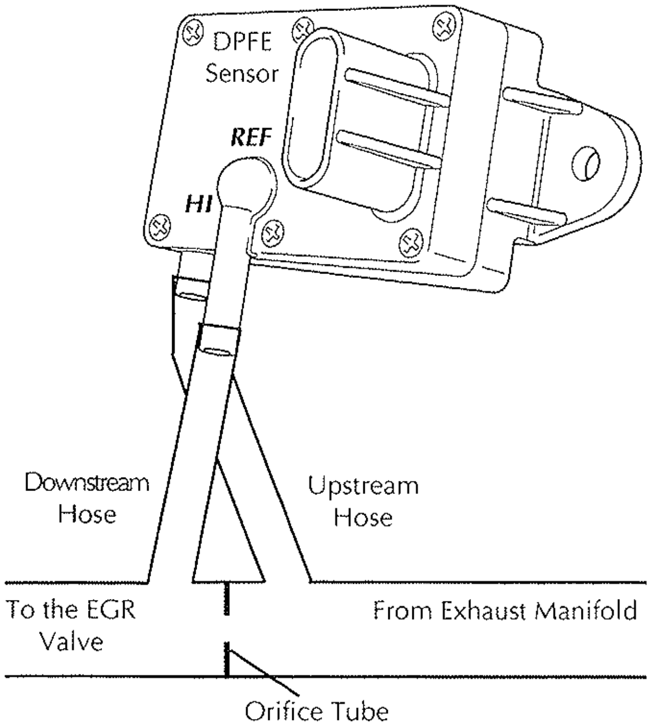


Figure 3. DPFE Hose Connections

Fault Code Definition

P1409 - The KOER Self Test has detected an electrical malfunction in the EVR circuit

P1409 Fault Analysis

1. Key of. Disconnect the EVR solenoid.

   Measure the EVR solenoid resistance.

   If the resistance is in the range 26 - 40Ω, go to step 2.

   If the solenoid resistance is outside the range 26 - 40Ω, replace the EVR solenoid. Reconnect all components and reset the PCM. Re-run the KOER Test.

2. Check the VPWR circuit at the EVR solenoid:

   Measure the voltage between the VPWR circuit at the solenoid connector and chassis ground.

   If the voltage is more than 10.5 volts, go to step 3.

   If the voltage is less than 10.5 volts, service the open circuit in the VPWR line to the EVR solenoid. Reconnect all components. Reset the PCM and re-run the KOER Test.

3. Check the EVR circuit continuity:

   Disconnect the PCM. Inspect the connector for pushed out pins, corrosion, loose wires, etc. Service as necessary.

   Measure resistance from PCM connector pin 47 to the EVR circuit at the EVR connector.

   If the resistance is less than 5Ω, go to step 4.

   If the resistance is more than 5Ω, service the open circuit in the EVR line. Reconnect all components and re-run the KOER Test.

4. Check the EVR circuit for shorts to power or ground:

   Key off. With EVR solenoid and the PCM disconnected, measure resistance from PCM connector pin 47 to pins 71/97 (VPWR) and to pins 24/103 (PWR GND).

   If both resistance readings are in excess of 10kΩ, replace the defective PCM, reconnect all components and re-run the KOER Test.

   If any resistance is less than 10kΩ, service the short circuit in the affected line, reconnect all componments and re-run the KOER Test.

Secondary Air Injection

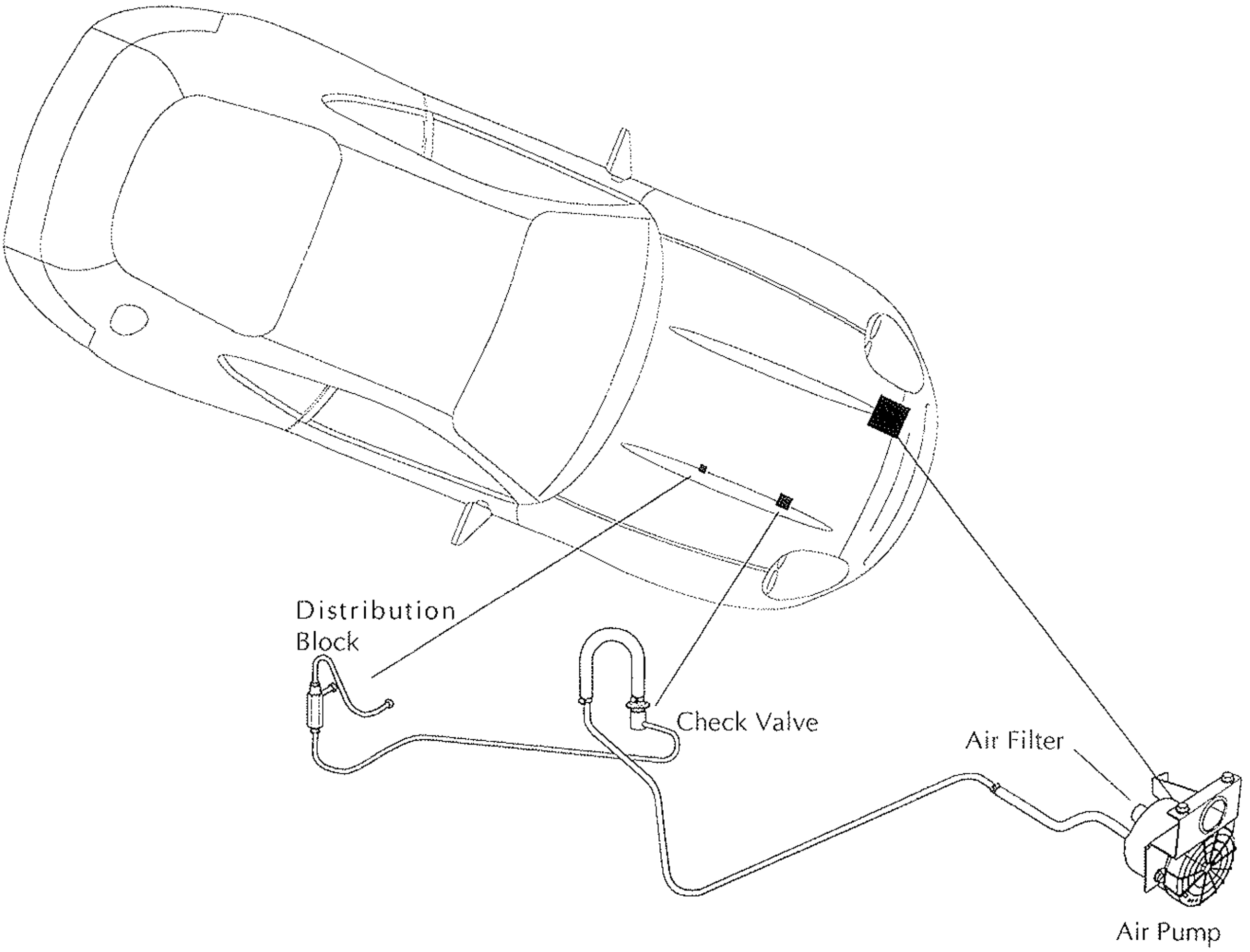


Figure 1. EAIR Component Location

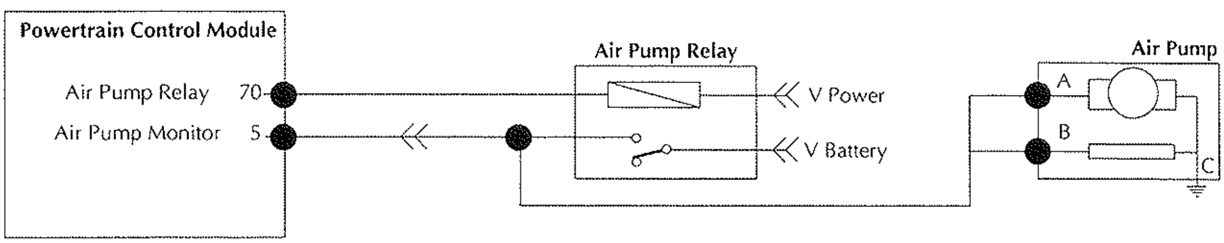


Figure 2. EAIR - PCM Interface Circuit

Fault Code Definition

P1413 - The Air Pump was commanded On, but the EAIR Monitor indicates that the air pump is off.

P1413 Fault Analysis

1. Connect the PDU or scan tool and monitor the logged DTCs. If P0412 is logged, resolve this problem first and return to this procedure only if P1413 is logged after clearing the P0412 fault.

   Set up to check the voltage on the Air Pump Monitor signal.

   Key on. Start the engine. Approximately 5 seconds after engine start, the Air Management signal (PCM pin 70) should switch to 0 volts to energise the air pump relay. At the same time, the Air Pump Monitor signal (PCM pin 5) should go to 12 volts as the air pump relay is energised.

   If PCM pin 5 is permanently at 0 volts, go to step 2.

   If PCM pin 5 does switch to 12 volts, go to step 3.

2. Remove the air pump relay and check for 12 volts at relay base pin 30.

   If 12 volts is present, check continuity from air pump relay base pin 87 to PCM harness connector pin 5.

   If continuity is good, replace the air pump relay.

   If a continuity problem exists, repair the wiring.

   Run the KOER test to ensure that the problem is resolved.

3. If PCM pin 5 goes to 12 volts and a P1413 code is generated, the PCM is faulty. Replace the PCM and run the KOER test to ensure that the problem is resolved.

Secondary Air Injection

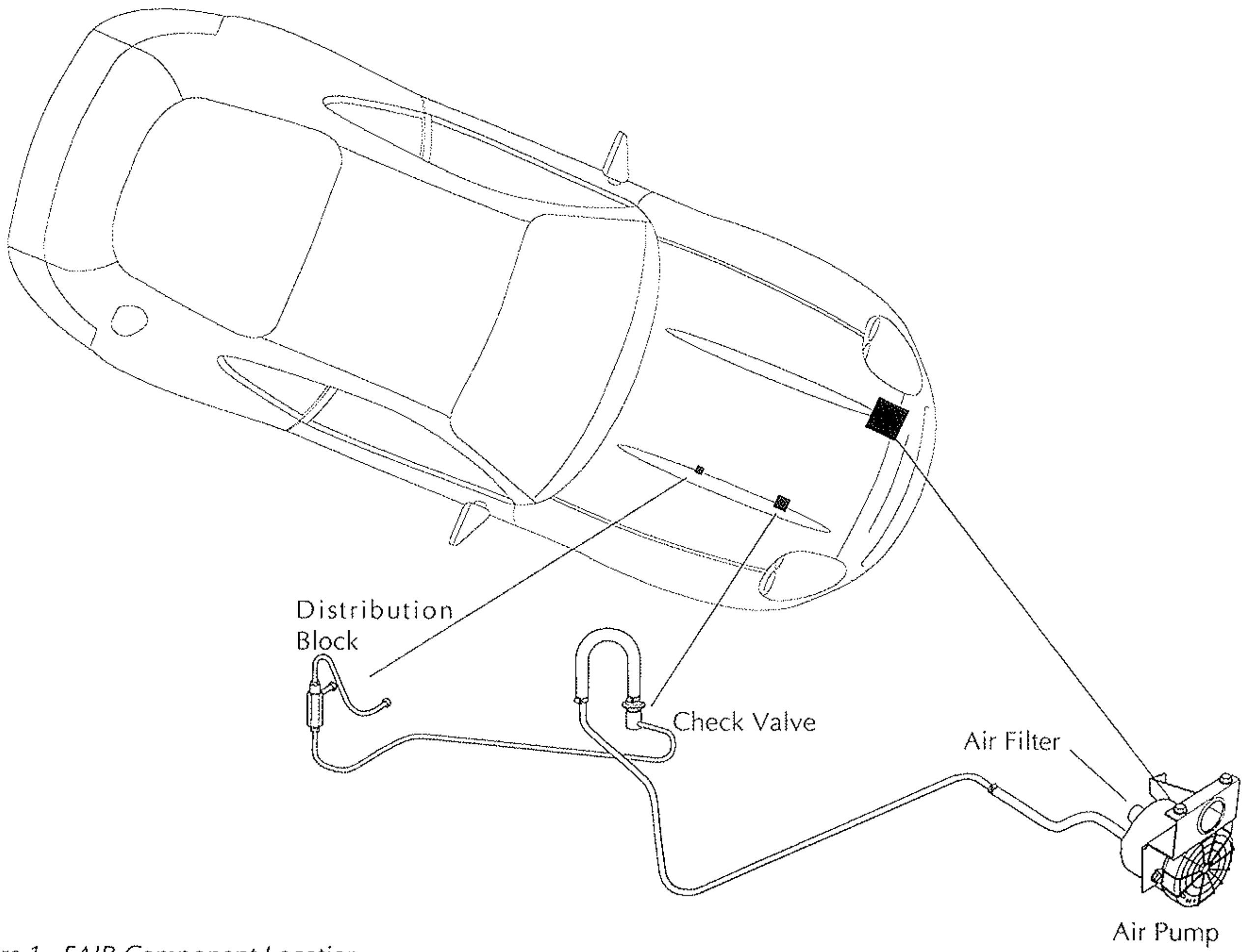


Figure 1. EAIR Component Location

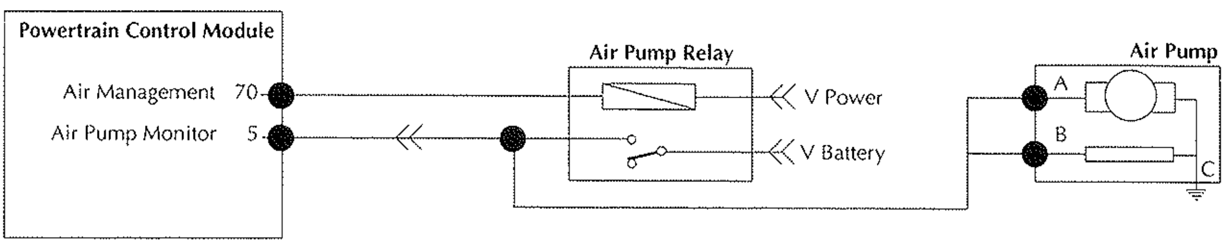


Figure 2. EAIR - PCM Interface Circuit

Fault Code Definition

P1414 - The air pump is commanded Off, but the PCM indicates air pump On.

P1414 Fault Analysis

1. Key off. Connect the PDU or scan tool and monitor the logged DTCs. If P0412 is logged, resolve this problem first and return to step 2 of this procedure only if P1414 is logged after clearing the P0412 fault.

2. Set the PDU to monitor PCM pin 5 (air pump monitor circuit).

   If PCM pin 5 is always at 12 volts, go to step 3.

   If PCM pin 5 is always at 0 volts, go to step 5.

3. Key off. Disconnect the PCM. Key on. Measure the voltage on PCM harness connector pin 5.

   If 12 volts is present, go to step 4.

   If the voltage on PCM pin 5 is 0 volts, the air pump relay is faulty, replace the relay and run the KOER test to ensure that the problem is resolved.

4. Remove the air pump relay and recheck the voltage level on PCM harness connector pin 5.

   If the voltage on PCM connector pin 5 is 12 volts with the air pump relay removed, isolate and repair the short circuit from PCM connector pin 5 to VPWR or VBAT within the harness. Run the KOER test to ensure that the problem is resolved.

5. If PCM pin 5 remains at 0 volts and a P1414 trouble code is logged, the PCM is faulty. Replace the PCM and run the KOER test to ensure that the problem is resolved.

Evaporative Emission

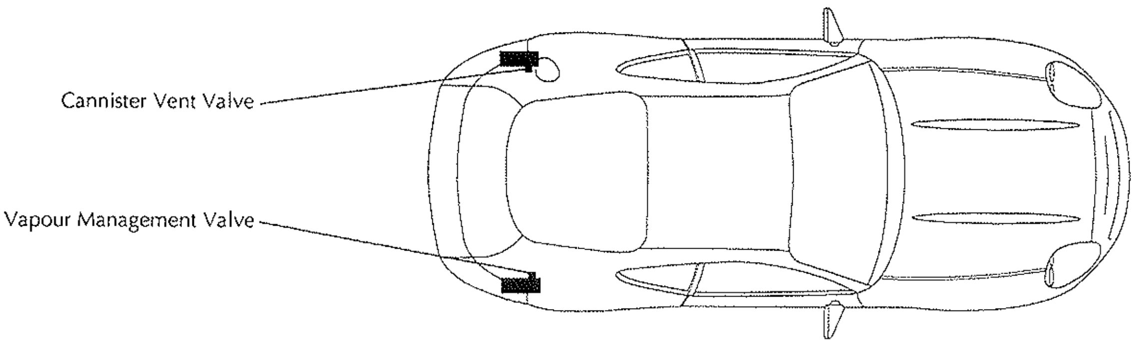


Figure 1. EVAP Component Location

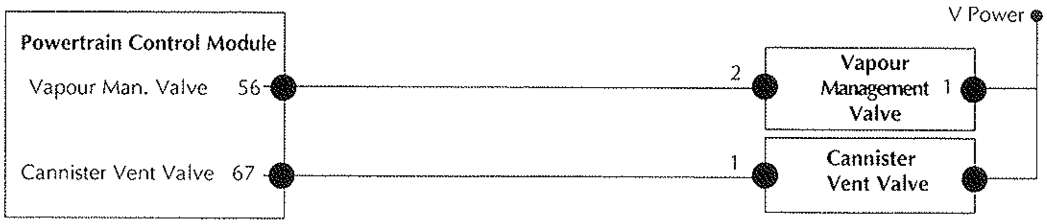


Figure 2. EVAP - PCM Interface Circuit

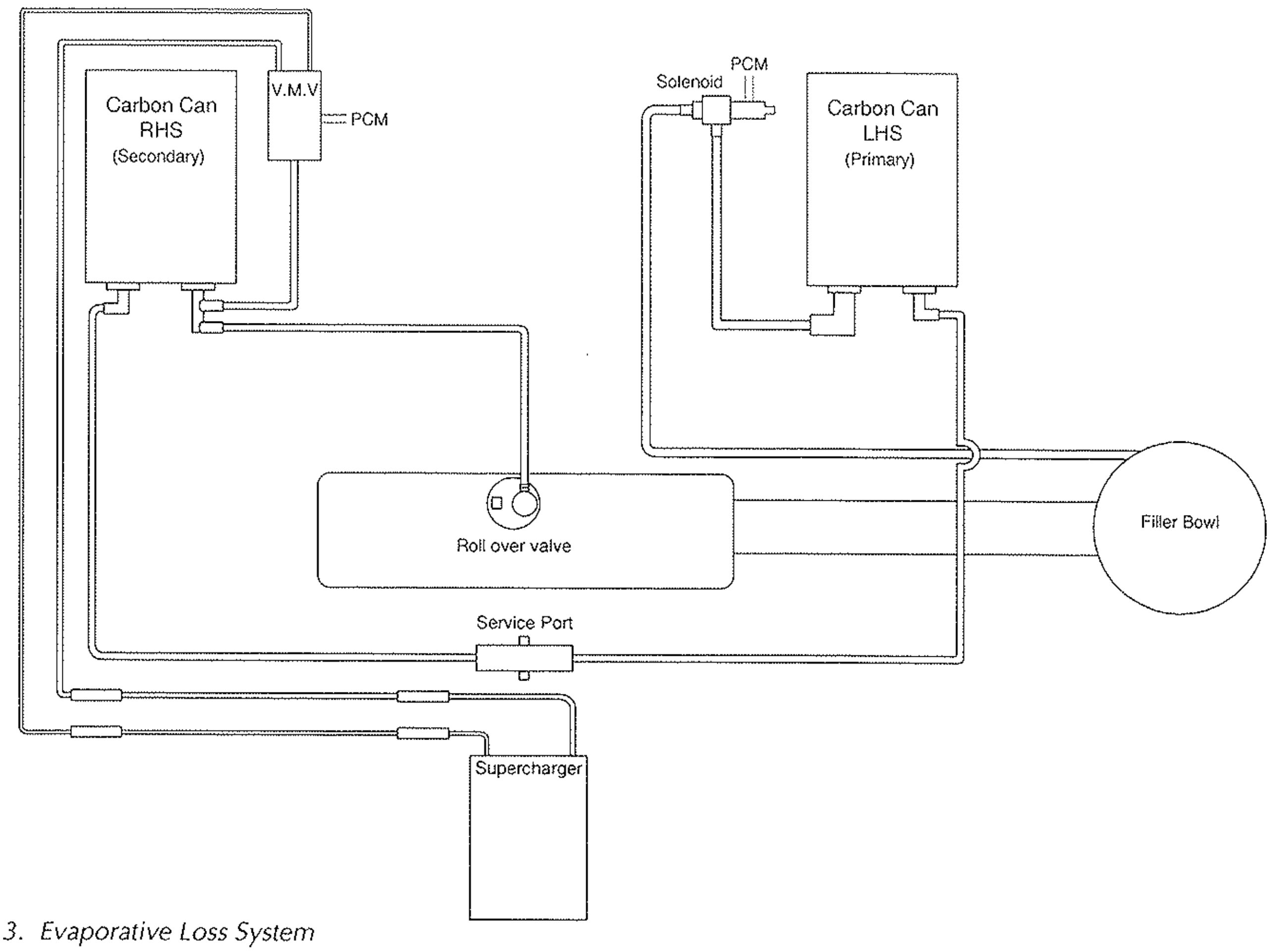


Figure 3. Evaporative Loss System

Fault Code Definition

P1443 - Evaporative emission control system malfunction.

P1443 Fault Analysis

Note: The evaporative emission control system is checked by looking for changes in idle speed as the vapour management valve is opened. If a P1443 occurs, the idle speed control system must be checked before investigating for problems in the evaporative loss system.

1. Key off, connect the PDU or scan tool.

   Key on, engine off. Check all logged DTCs.

   If P1507 is logged, diagnose this problem first and then clear the PCM memory and re-run the KOER Test.

   Monitor the IAC, TP and RPM parameters with the PDU. With the engine at normal operating temperature, accessories off and at idle, the IAC duty cycle should be between 20 and 45 %.

   Observe the IAC and RPM displays for a fault indication whilst performing the following:

   - While at idle, wiggle the IAC connector and the harness between IAC and PCM. Any sudden increase in RPM and decrease in IAC duty cycle indicates a fault.
   - Blip the throttle several times while looking for a slow return to idle (observe the TP display on the PDU) this may indicate a sticking IAC valve.

   If no faults are indicated, go to step 2.

   If any fault(s) is indicated, service as necessary, reconnect all components, reset the PCM and re-run the KOER Test.

2. Check the carbon cannisters:

   Check the cannisters for damage or cracks.

   Check for excessive liquid fuel in the cannisters.

   If the cannisters are serviceable, go to step 3.

   If the cannisters are not serviceable or are flooded with liquid fuel, replace them. (Investigate and repair the cause of any cannister flooding). Reconnect all components, reset the PCM and re-run the KOER Test.

3. Pressure check the fuel vapour system:

   Install a pressure/vacuum pump with gauge to the service port. Using the hand pump, slowly increase the pressure in the fuel vapour line. Monitor the gauge indication.

   The guage reading should drop at 1.5 - 2.0 psi as the fuel tank pressure control valve opens. and should not rise further if an attempt is made to increase the pressure.

   If the gauge readings meet the above specification, remove the pressure pump from the service port and go to step 4.

   If the gauge readings do not meet the above specification, service the fuel vapour line and fuel tank pressure control valve as necessary. Reset the PCM and re-run the KOER Test.

4. Disconnect the purge tube (8 mm tube) from the vapour management valve and connect a vacuum gauge.

   Start the engine. Whilst observing the gauge reading, slightly open the throttle several times. Initially, the inlet vacuum should be indicated on the gauge and the gauge reading should drop significantly as the throttle is opened.

   If the vacuum gauge reading shows the initial inlet vacuum and correctly reflects changes in throttle opening, reconnect the purge tube and go to step 5.

   If the vacuum gauge does not show the initial inlet vacuum or does not correctly reflect changes in throttle opening, service the restriction in the purge line. Clear the P1443 code and run the drive cycle to confirm that the problem is resolved.

5. Disconnect the signal tube (4 mm tube) from the vapour management valve and connect a vacuum gauge.

   Start the engine. Whilst observing the gauge reading, slightly open the throttle several times. Initially, the inlet vacuum should be indicated on the gauge and the gauge reading should drop significantly as the throttle is opened.

   If the vacuum gauge reading shows the initial inlet vacuum and correctly reflects changes in throttle opening, the cause of the P1443 code is not present at this time.

   If the vacuum gauge does not show the initial inlet vacuum or does not correctly reflect changes in throttle opening, service the restriction in the signal line. Clear the P1443 code and run the drive cycle to confirm that the problem is resolved.

Wide Open Throttle A/C Cut-Off (WAC)

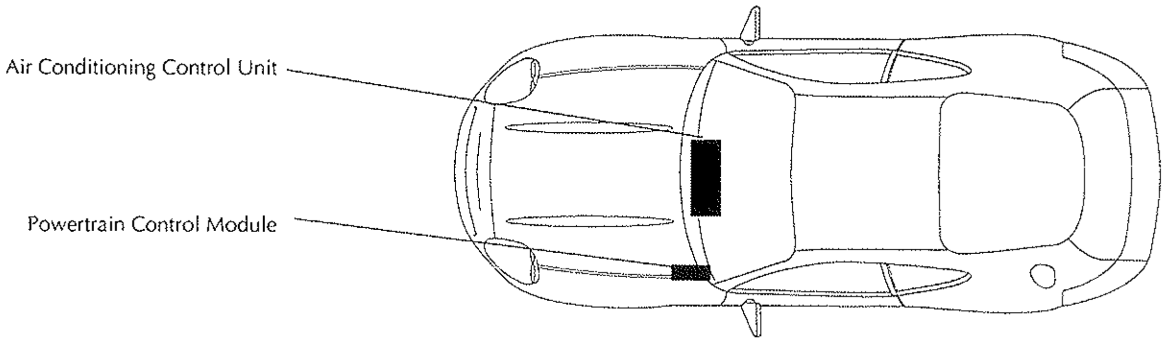


Figure 1. WAC Component Location

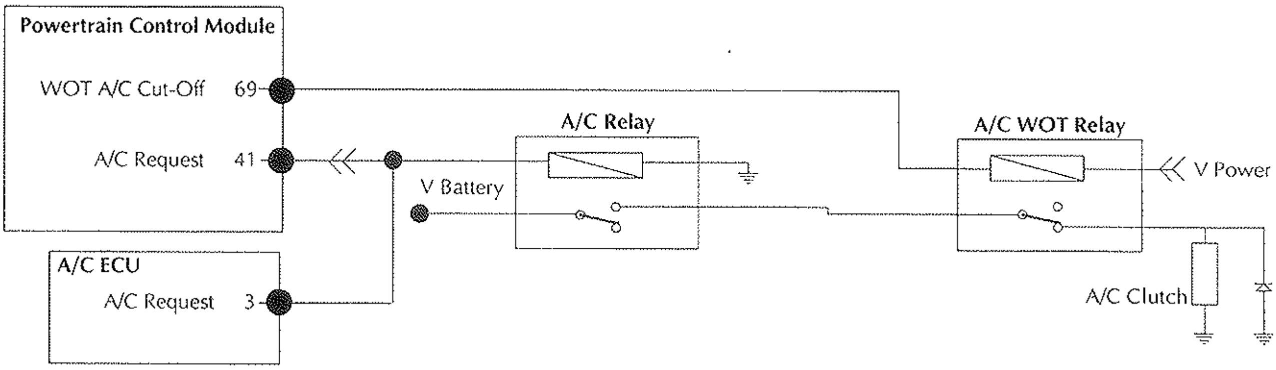


Figure 2. WAC Circuit

Fault Code Definition

P1460 - KOEO or KOER DTC 1460 indicates either that the A/C was on during self test or that there is a WAC circuit fault.

P1460 will be logged if the A/C is on or Defrost selected during KOEO or KOER self tests. If this is suspected. reset the PCM and rerun the KOEO self test with the A/C and Defrost off. If P1460 is logged again, proceed to step 1.

P1460 Fault Analysis

1. Connect the PDU or scan tool and monitor the level of the A/C Request signal.

   If the A/C Request signal is at 12 volts, analyse the problem using the P1464 procedure.

   If the A/C Request signal remains at 0 volts, go to step 2.

2. Connect the PDU or scan tool. Key on, engine running, switch on the A/C (Mode switch from ECO to A/C for immediate response). Observe the A/C compressor clutch. Does the A/C clutch energise.

   Switch off the A/C (Mode switch from A/C to ECO). Does the A/C clutch de-energise.

   If the WAC relay is correctly controlling the A/C clutch, go to step 3.

   If the WAC relay is not correctly controlling the A/C clutch, go to step 4.

3. Check the level of the A/C Request signal:

   Monitor the A/C Request signal at PCM pin 41 whilst switching the A/C system on and off.

   The A/C Request signal should be at 12 volts with the A/C system On.

   If the A/C Request signal remains at 12 volts, check for a short from this line to VPWR.

   If no short circuit exists, replace the PCM.

   If a short circuit is detected, repair the defect. Reset the PCM and rerun the KOER Test.

4. Check the WAC relay:

   Remove the WAC relay and check the coil resistance. Measure between relay pins 85 and 86. The coil resistance should be between 40 and 85Ω. If the coil resistance is incorrect, replace the relay. Reset the PCM and rerun the KOER Test.

   Check for internal shorts in the relay:

   Measure resistance from relay pin 85 to pins 30, 87 and 87A. The resistance should be greater than 10kΩ. If the resistance is less than 10kΩ, replace the relay.

   If the relay resistance checks are good, refit the relay and go to step 5.

   If the relay is defective and is replaced, reset the PCM and rerun the KOER Test.

5. Check the WAC relay circuit:

   Disconnect the PCM. Key on, check for greater than 10.5 volts at PCM connector pin 69. If greater than 10.5 volts is not present, service the open circuit in the VPWR or the WAC signal lines.

   Key off. Reconnect the PCM. Key on. Switch on the A/C (Mode switch from ECO to A/C for immediate response). Check for greater than 10.5 volts at WAC relay pin 30. If the voltage is less than 10.5 volts, go to step 5.

   If the voltage is greater than 10.5 volts, the supply from the A/C relay is good.

   Measure the voltage at WAC relay pin 87. If less than 10.5 volts with the A/C selected on, the WAC relay is defective. Replace the relay, reset the PCM and rerun the KOER Test.

A/C Demand

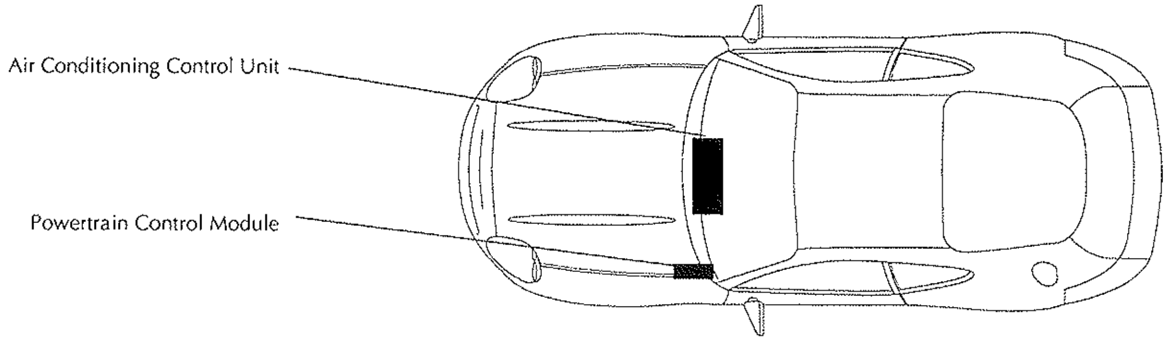


Figure 1. WAC Component Location

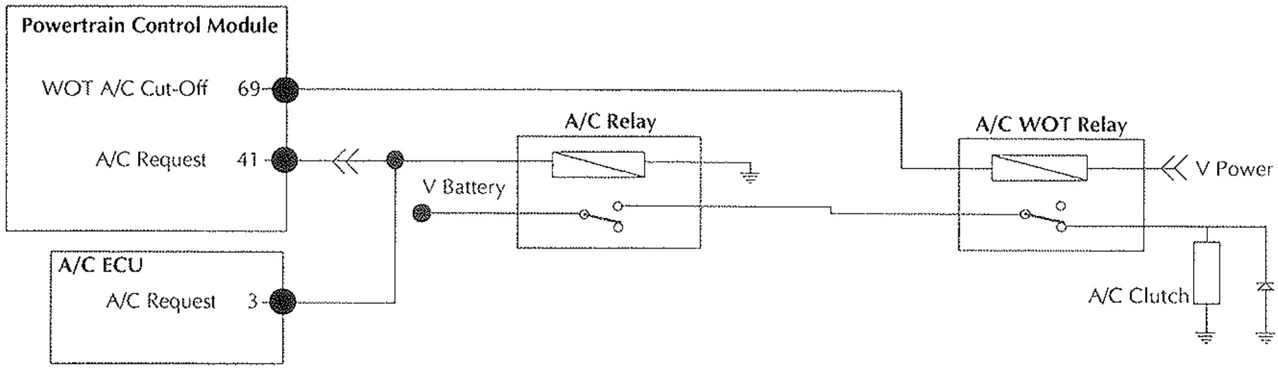


Figure 2. WAC Circuit

Fault Code Definition

P1464 - The A/C Request signal is high (12 volts) when it should be low during KOEO or KOER tests.

P1464 Fault Analysis

1. Connect the PDU or scan tool and set to monitor the A/C Request signal (PCM pin 41). Key on. Switch on and off the A/C system (switch from ECO to A/C) whilst monitoring the A/C Request signal.

   If the signal remains at 12 volts, go to step 2.

   If the signal switches between 0 volts (A/C off) and 12 volts (A/C on), go to step 3.

2. Key off. Disconnect the A/C Controller and disconnect pin 3 from the connector. reconnect the A/C Controller. Key on.

   With the A/C switched off (switch to ECO position) measure the voltage on A/C controller pin 3.

   If the voltage on pin 3 is 12 volts, there is a fault in the A/C control system. Go to the A/C diagnostics section of the Workshop Manual.

   If the voltage on pin 3 is 0 volts, check for a short circuit from the A/C Request signal line to VPWR or VBAT within the wiring harness. Repair the wiring as necessary and run the KOEO test to ensure that the problem is resolved.

3. Using the intermittent signal procedure, check for intermittent shorts to VPWR or to VBAT on the A/C Request signal line.

   If no fault is indicated, the PCM is faulty. Replace the PCM and run the KOEO test to ensure that the problem is resolved.

Fan Control

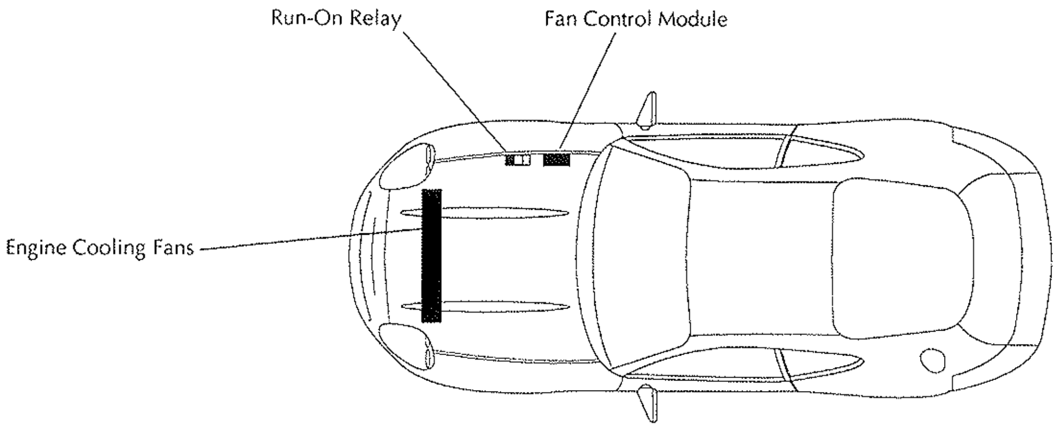
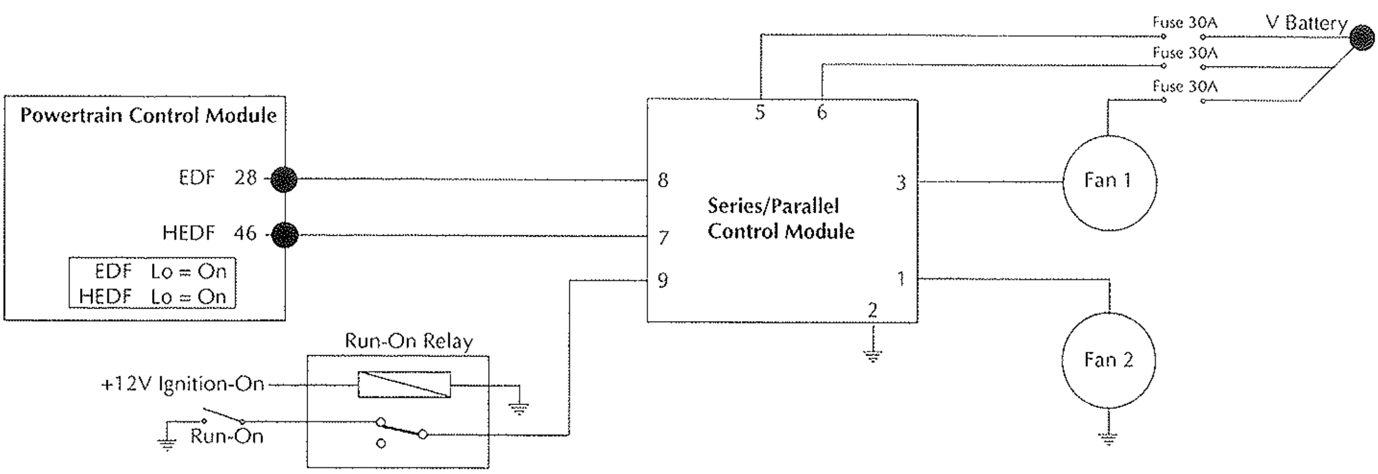


Figure 1. Fan Location



Control Signals		**Fan Configuration**
EDF	**HEDF**	
Hi	Lo	Fans In Series (Low Speed)
Hi	Hi	Fans Off
Lo	Hi	Fans In Parallel (High Speed)
Lo	Lo	Fans In Parallel (High Speed)

Figure 2. Fan Control Circuits

Fault Code Definition

P1474 - Low fan control primary circuit malfunction.

P1474 Fault Analysis

1. Key on. Check the voltage on fan control module pin 6.

   If the voltage is 12 volts, go to step 2.

   If the voltage is 0 volts, check 30A fuse F13 (passenger side fusebox) and the wiring from VBAT to fan control module pin 6. Repair as necessary and run the KOER test to ensure that the problem is resolved.

2. Key off. Remove the run-on relay and disconnect the PCM, Key on.

   If the fans do not run, refit the run on relay and go to step 3.

   If the fans run, switch off and check for short circuit to ground on the wire from fan control module pin 9 to run on relay base pin 30, and from fan control module pin 7 to PCM pin 28.

   Service the wiring as necessary, reconnect all components. Run the KOER test to ensure that the problem is resolved.

3. With the PCM disconnected and the run on relay fitted, switch the key on.

   If the fans do not run, go to step 4.

   If the fans run, check for 12 volts between pins 86 and 85 of the run-on relay.

   If 12 volts is measured, replace the relay.

   If 0 volts is present, repair the wiring from run on relay base pin 86 to the ignition supply, or from relay base pin 85 to chassis ground.

4. Ground pin 28 in the PCM harness connector.

   If the fans run, the fault lies in the PCM. Replace the PCM, reconnect all comonents and run the KOEO test to ensure that the problem is resolved.

   If the fans do not run, The wire from PCM harness connector pin 28 to fan control module pin 8 is open circuit. Service the wiring as necessary and run the KOER test to ensure that the problem is resolved.

Fan Control

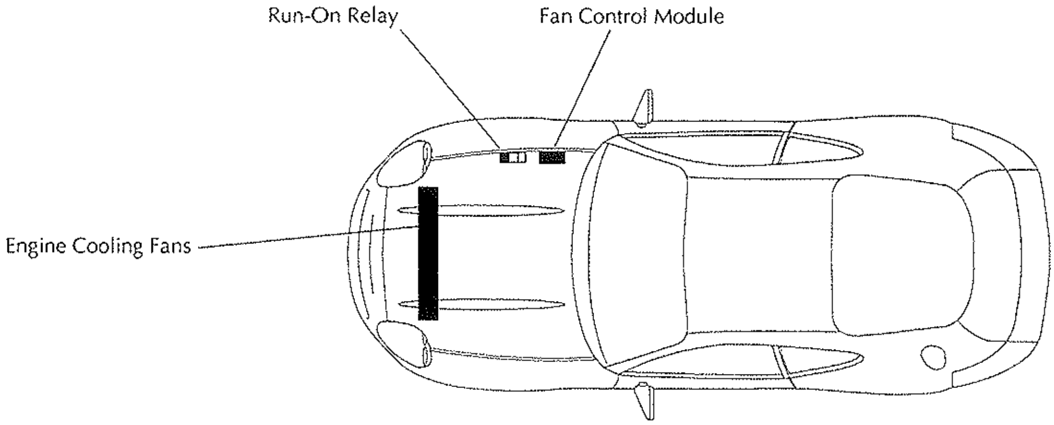
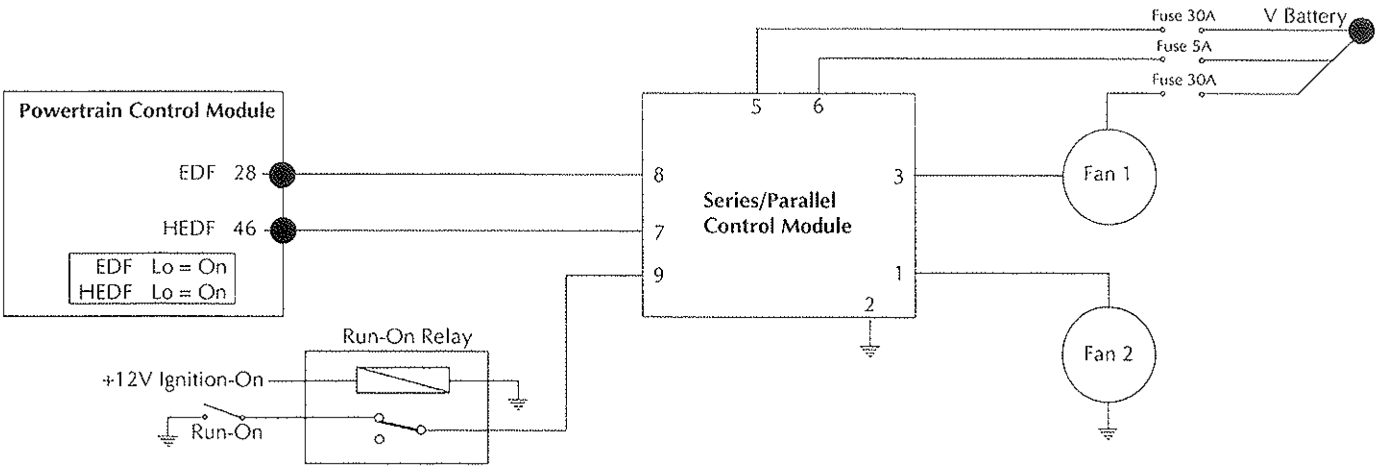


Figure 1. Fan Location



Control Signals		**Fan Configuration**
EDF	**HEDF**	
Hi	Lo	Fans In Series (Low Speed)
Hi	Hi	Fans Off
Lo	Hi	Fans In Parallel (High Speed)
Lo	Lo	Fans In Parallel (High Speed)

Figure 2. Fan Control Circuits

Fault Code Definition

P1479 - High fan control primary circuit malfunction.

P1479 Fault Analysis

1. Switch on and check if the engine cooling fans are running.

   If the fans are not running, go to step 2.

   If the fans are on continuously when the ignition is switched on, switch off. Disconnect the PCM and fan control module. Check for a short circuit to ground on the wire from PCM connector pin 46 to fan control module pin 7.

   If no short circuit is detected, the PCM is defective. Replace the PCM and run the KOER test to ensure that the problem is resolved.

2. Check for 12 volts on fan control module pin 6.

   If 12 volts is available, go to step 3.

   If 12 volts is absent from fan control module pin 6, isolate and repair the open circuit from the main relay pin 87 to fan control module pin 6 via 30 A fuse F13 in the passenger side fusebox. Clear the P1479 code and run the KOER test to ensure that the problem is resolved.

3. Ground pin 7 of the fan control module. The fans should start.

   If the fans do start, go to step 4.

   If the fans do not start, the fan control module is faulty. Replace the module and run the KOER test to ensure that the problem is resolved.

4. Ground PCM pin 46. The fans should start.

   If the fans do start, the PCM is faulty. Replace the PCM and run the KOER test to ensure that the problem is resolved.

   If the fans do not start, isolate and repair the open circuit between PCM pin 46 and fan control module pin 7. Reconnect all components and run the KOER test to ensure that the problem is resolved.

Idle Air Control

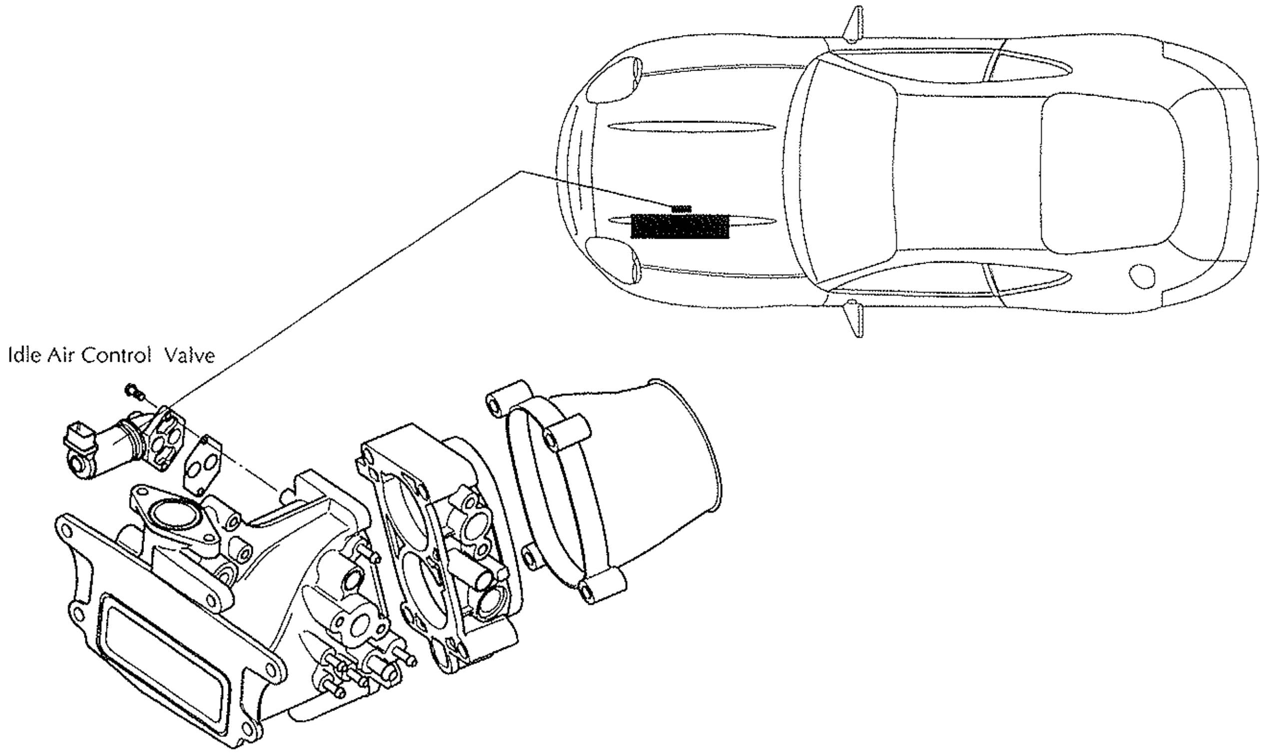


Figure 1. IAC Valve Location

Idle Air Control

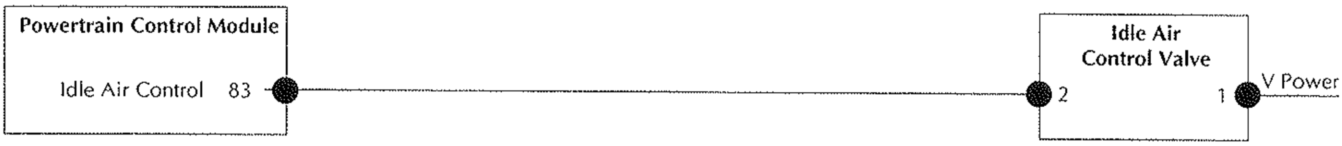


Figure 2. IAC Circuit

Fault Code Description

P1504 - Self test has detected an IAC circuit malfunction

P1504 Fault Analysis

1. Key off. Disconnect the IAC solenoid connector. Key on.

   Measure the voltage from the VPWR terminal in the connector to battery ground.

   If the voltage is less than 10.5 volts, service the open circuit in the VPWR supply. Reconnect all components and rerun the KOER Test.

   If the voltage is 10.5 volts or above, go to step 2.

2. Check the IAC solenoid resistance:

   Note: The solenoid diode will cause incorrect resistance readings if the DVOM leads are incorrectly connected.

   Measure the solenoid resistance placing the DVOM positive lead on the VPWR pin of the solenoid and the DVOM negative lead on the solenoid IAC signal terminal. The solenoid resistance should be 6 - 13Ω.

   If the resistance is correct,go to step 3.

   If the resistance is outside the range 6 - 13Ω, replace the IAC valve assembly, reconnect all components and erun the KOER Test to verify that the problem is cleared.

3. Check for internal short circuit in the IAC solenoid:

   Key off. IAC solenoid disconnected.

   Measure the resistance from either IAC solenoid terminal to the IAC solenoid case. The resistance must be greater than 10kΩ

   If the resistance is greater than 10kΩ, go to step 4.

   If the resistance is less than 10kΩ, replace the IAC solenoid, reconnect all components and rerun the KOER Test.

4. Check the IAC circuit continuity.

   Disconnect the PCM and IAC connectors.

   Check for pushed out or damaged pins. Measure resistance from PCM connector pin 83 to the IAC terminal of the idle air valve connector. The resistance must be less than 5Ω.

   If the resistance is less than 5Ω, go to step 5.

   If the resistance is more than 5Ω, service the open circuit in the IAC signal line. Reconnect all components and rerun the KOER Test.

5. Check for short circuit to VPWR:

   IAC solenoid disconnected. Key on. Measure the voltage from the IAC signal line at the harness connector to battery ground. The voltage must be less than 1.0 volts.

   If the voltage is less than 1.0 volts, go to step 6.

   If the voltage is 1.0 volt or greater, service the short circuit from the IAC signal line to VPWR. Reconnect all components and rerun the KOER Test.

6. Check the IAC circuit for short circuit to PWR GND:

   Key off. Disconnect the PCM. Disconnect the IAC solenoid. Measure resistance from the IAC signal line (PCM connector pin 83) to PWR GND (PCM connector pins 51/103). The resistance must be greater than 10kΩ.

   If the resistance is greater than 10kΩ, go to step 7.

   If the resistance is less than 10kΩ, service the short circuit from the IAC signal line to PWR GND. Reconnect all components and rerun the KOER Test.

7. Check the IAC signal with engine running:

   Monitor the voltage from the IAC signal line (from PCM pin 83) to PWR GND (from PCM pin 51). Key on engine running.

   Slowly increase the engine speed to 3000 rpm whilst monitoring the IAC signal. The signal level must respond within the range 3.0 to 11.5 volts.

   If the signal level does respond within the range 3.0 to 11.5 volts, go to step 8.

   If the signal level does not change within the range 3.0 to 11.5 volts, replace the PCM. Reconnect all components and rerun the KOER Test to ensure that the problem is resolved.

8. Check the IAC system for intermittent open or short circuits:

   Key off. Connect the PDU or scan tool and set to monitor the IAC and RPM signals. Key on, engine running at normal operating temperature. The IAC duty cycle at idle should be in the range 20% - 45%.

   Whilst observing the IAC and RPM signals, lightly tap the IAC valve assembly to simulate road shock. Also shake and bend the harness from the Iac solenoid to the PCM.

   If any sudden changes in the IAC duty cycle or in the engine rpm occur, isolate and service the fault as necessary. Reset the PCM and rerun the KOER Test.

   If no sudden changes occur in the IAC duty cycle or in the engine rpm and the fault is idle quality, starting or stalling problems, replace the IAC solenoid valve. Complete a PCM reset and rerun the KOER Test to ensure that the problem is resolved.

   If no sudden changes occur in the IAC duty cycle or in the engine rpm and the fault is other than idle quality, starting or stalling problems, unable to duplicate the fault at this time.

Idle Air Control

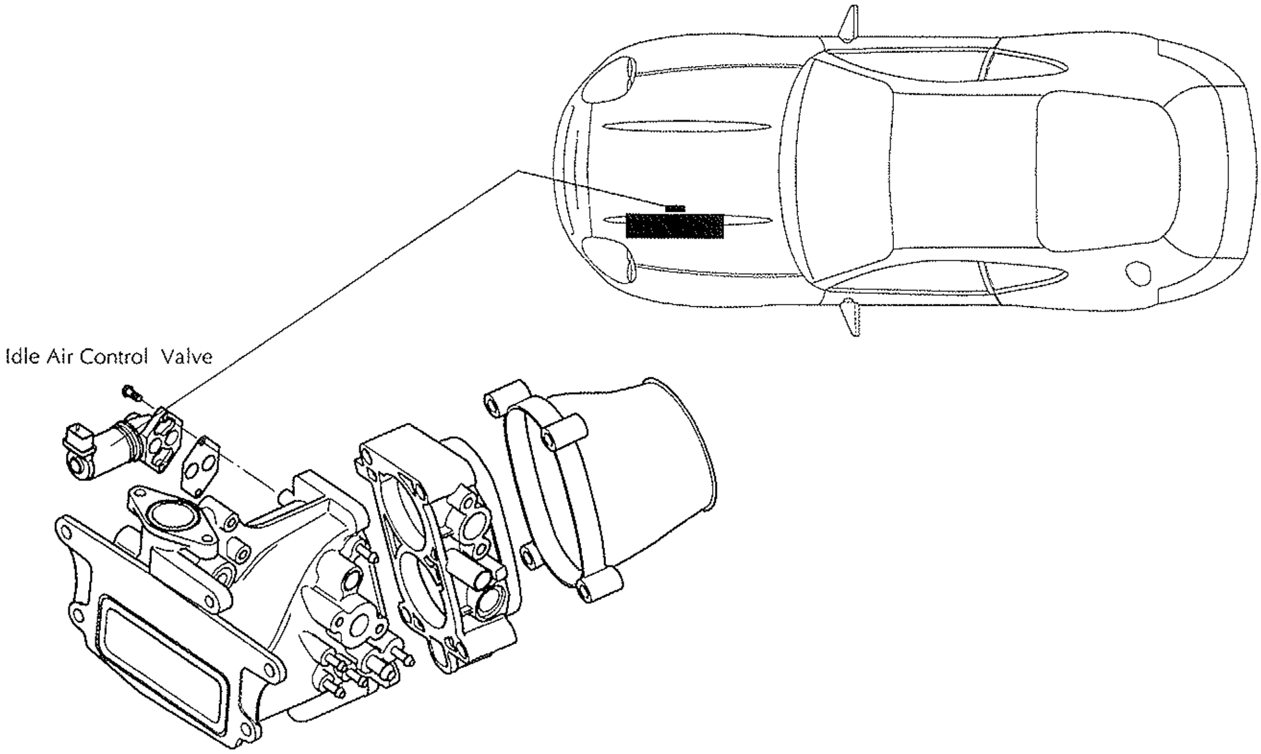


Figure 1. IAC Valve Location

Idle Air Control

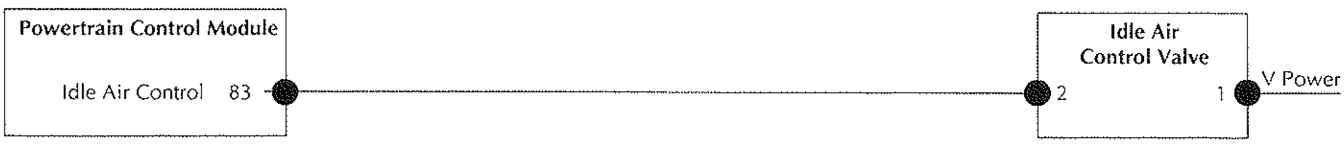


Figure 2. IAC Circuit

Fault Code Definition

P1506 - IAC overspeed error

P1506 Fault Analysis

1. Check for vacuum leaks:

   Key on, engine running. With the engine at idle, listen for vacuum leaks. Listen to the air flow in the following areas:

   - Air inlet casting
   - Air connections at the MAF and throttle body
   - All connections to the supercharger inlet assy.
   - IAC valve assembly and connections.
   - EGR valve gasket seal leak to inlet manifold.
   - Inlet manifold gasket.
   - EGR valve diaphragm or control solenoid.
   - Vacuum supply connectors and hoses.
   - PCV connectors and hose.
   - Charge air cooler connection to inlet manifold

   If no leaks are detected, go to step 2.

   If any leaks are detected, service as necessary. Reset the PCM and re-run the KOER Test.

2. Check the idle speed control solenoid for proper function:

   A/C heater and all accessories off. Engine to normal operating temperature and fan off. Key on, engine running. Disconnect the IAC solenoid connector.

   If there is no change in engine idle speed, the IAC valve is defective. Replace the IAC solenoid valve assembly, reset the PCM and re-run the KOER Test to vertify that the problem is resolved.

   If the engine stalls or the idle speed drops, go to step 3.

3. Check for faults in the IAC circuit:

   Key off. IAC solenoid disconnected. Disconnect the PCM and inspect the connector for damaged, pushed out pins, corrosion, loose wires, etc. Service as necessary.

   Measure the resistance from PCM connector pin 83 (IAC) and pins 51/103 (PWR GND).

   If the resistance is greater than 10kΩ, replace the PCM. Reconnect all components, reset the PCM and re-run the KOER Test.

   If the resistance is less than 10kΩ, service the short circuit to ground in the IAC line. Reset the PCM and re-run the KOER Test.

Idle Air Control

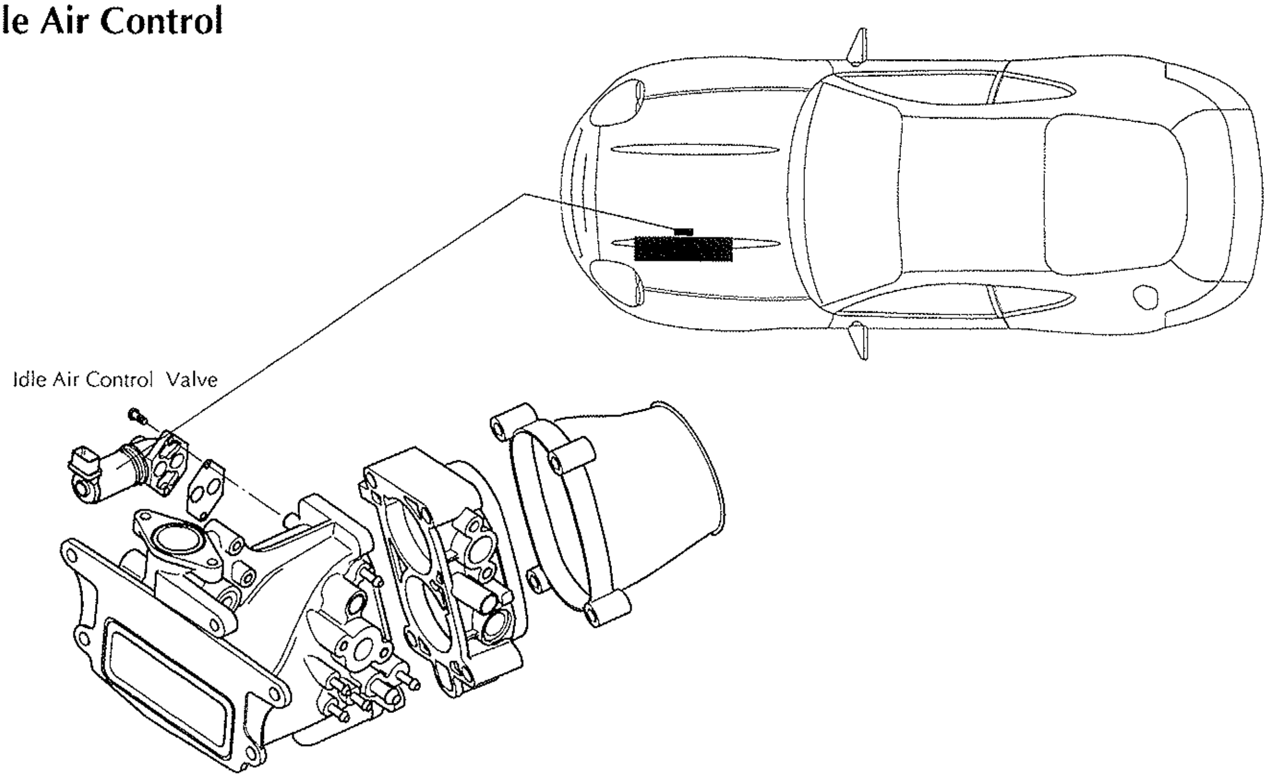


Figure 1. IAC Valve Location

Idle Air Control

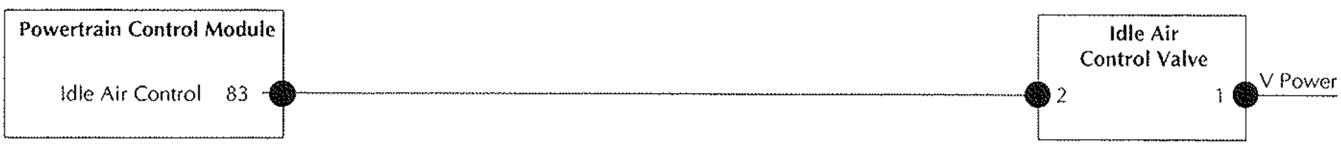


Figure 2. IAC Circuit

Fault Code Definition

P1507 - IAC underspeed error

P1507 Fault Analysis

1. Connect the PDU or scan tool.

   Monitor the IAC, TP and RPM signals. Key on, engine running.

   The IAC duty cycle should be between 20 and 45%

   Observe the IAC and RPM displays for indications of a fault while performing the following

   - While at idle, wiggle the IAC connector and the vehicle harness between the IAC and the PCM. A fault is indicated by a sudden decrease in rpm and an increase in the IAC duty cycle.

   - Blip the throttle several times while looking for poor idle or hesitation during return to idle speed. The IAC duty cycle would suddenly increase to compensate. This would indicate a sticking IAC valve.

   If no fault is indicated, go to step 2.

   If any fault is indicated, isolate the fault and service as necessary.

2. Check for any airway restrictions in the IAC vale assembly or in the throttle body airways.

   Service as necessary and run the KOER test to ensure that the problem is resolved.

Torque Reduction Request

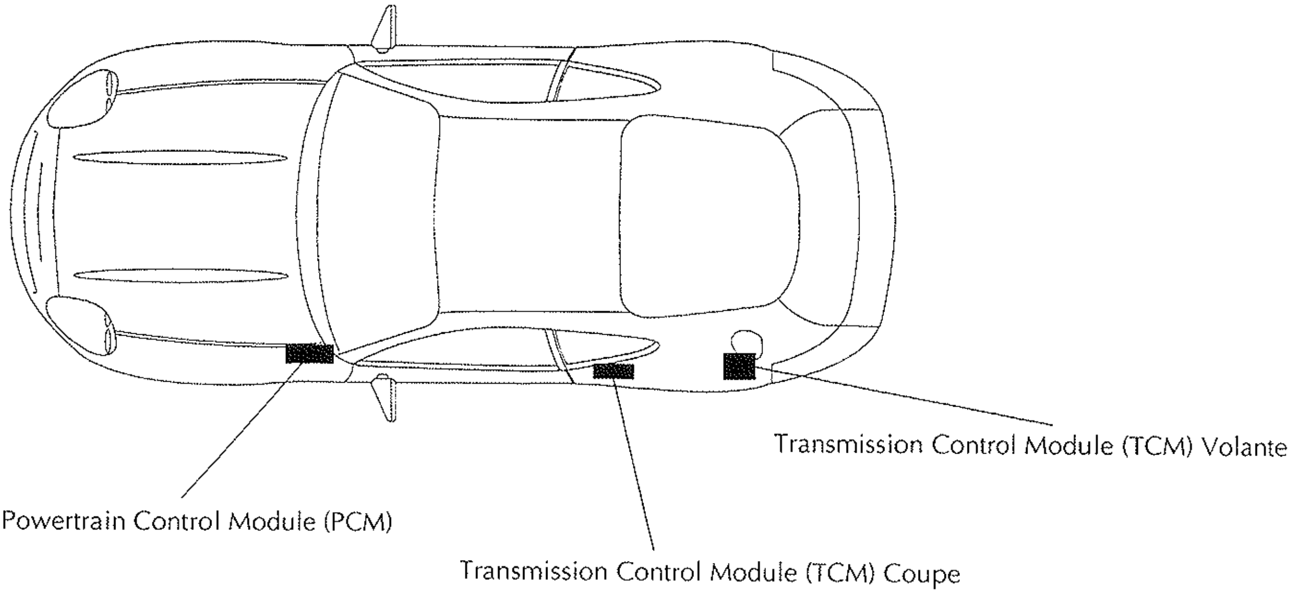


Figure 1. Control Module Location

Fault Code Description

P1712 - Transmission controller to PCM - Torque reduction request signal absent.

The torque reduction request signal operates on a 12 volt supply which is rapidly switched to give a PWM (pulse width modulated) signal to the Torque Convertor Clutch. The TCC duty cycle varies between 17% at idle to 90% during gear changes when driving.

Caution - When resetting the controllers following a P1712 code, the following sequence must be observed:

- ***Reset the TCM***
- ***Reset the PCM***

If the PCM is reset first, the fault code will be logged again at the next vehicle start.

P1712 Fault Analysis

1. Connect the PDU or scan tool and set to monitor the torque reduction request signal.
2. Reset the TCM and then reset the PCM to clear the P1712 code.
3. Whilst running the vehicle on a rolling road or during a road test., monitor the torque reduction request signal through a sequence of gear changes.

   If the torque reduction request signal is absent, go to step 4.

   If the torque reduction request is always in the range 20% - 90% when gear changes take place during driving and is 17% at idle, and the P1712 code is logged again, the PCM is faulty. Replace the PCM, reset the TCM and run the road or rolling road test again to ensure that the problem is resolved.
4. If the torque reduction request signal is absent, key off, disconnect the wire from TCM connector pin 7. Key on, check the 5 volt supply from PCM pin 34.

   If 5 volts is present, go to step 5.

   If PCM pin 34 does not rise to 5 volts, the PCM is faulty. Replace the PCM, reset the TCM and run the drive cycle to ensure that the prroblem is resolved.
5. Key off. disconnect the PCM and TCM. Check the continuity from PCM harness connector pin 34 to TCM harness connector pin 7.

   If the continuity is good, replace the TCM. Reset the PCM and run the drive cycle to ensure that the problem is resolved.

   If the continuity is defective, repair the wiring. Reset the TCM and then the PCM and run the drive cycle to ensure that the problem is resolved.

GM 4L80-E Transmission

Barometric Pressure Sensor

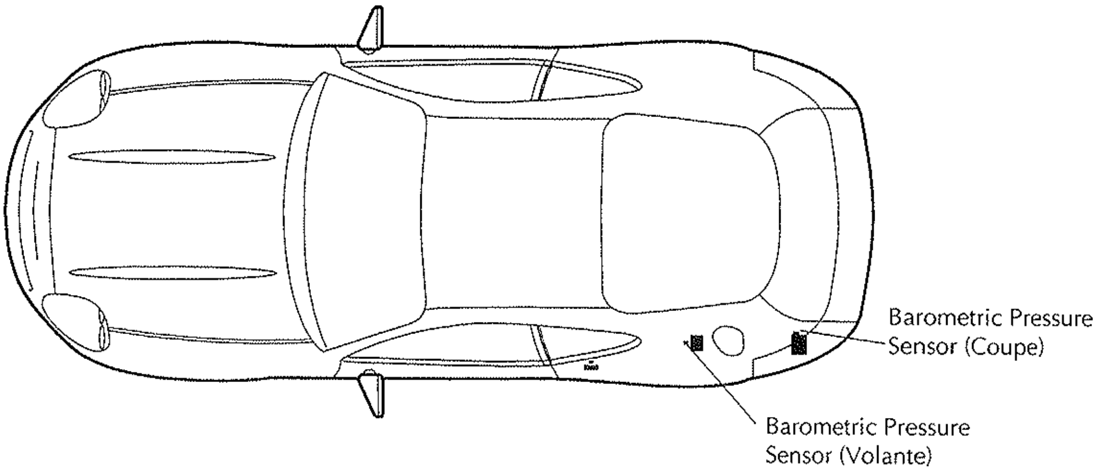


Figure 1. Barometric Pressure Sensor Location

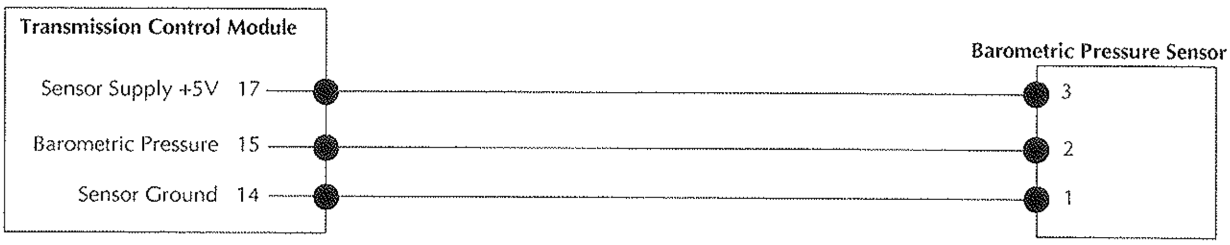


Figure 2. Barometric Pressure Sensor Circuit

Fault Code Description

P0107 - Barometric pressure sensor - low input

P0107 Fault Analysis

1. Connect the PDU or scan tool to the TCM. Switch on the ignition and note the barometric pressure signal level at TCM connector pin 15.

   The signal level should be in the following range:

   1.764 to 2.088 volts at 0.5 bar (7.5 psi) to

   4.816 to 4.978 volts at 1.5 bar (22.5 psi)

   If the value is below the above range, go to step 2.

   If the current value is within the above range, the cause of the P0107 code is not present at this time, go to the intermittent signal procedure.

2. Switch off the ignition.

   Check the continuity of the 5 volt supply line from TCM pin 17 to barometric pressure sensor pin 3.

   Check continuity of the barometric pressure signal line from the sensor pin 2 to TCM connector pin 15

   If continuity is good, go to step 3.

   If a continuity problem is present, service as necessary.

   Reset the TCM and run the KOER test to ensure that the problem is resolved.

3. Switch off the ignition.

   Check for short circuit to ground on the 5 volt supply line from TCM pin 17 to barometric pressure sensor pin 3.

   Check for short circuit to ground on the barometric pressure signal line from the sensor pin 2 to TCM connector pin 15

   If the circuit is good, go to step 4.

   If any short circuit problem is identified, service as necessary.

   Reset the TCM and run the engine to ensure that the problem is resolved.

4. Replace the barometric pressure sensor. Reset the TCM and run the engine to ensure that the problem is resolved.

   If the P0107 code is repeated, replace the TCM and run the engine to ensure that the problem is resolved.

Barometric Pressure Sensor

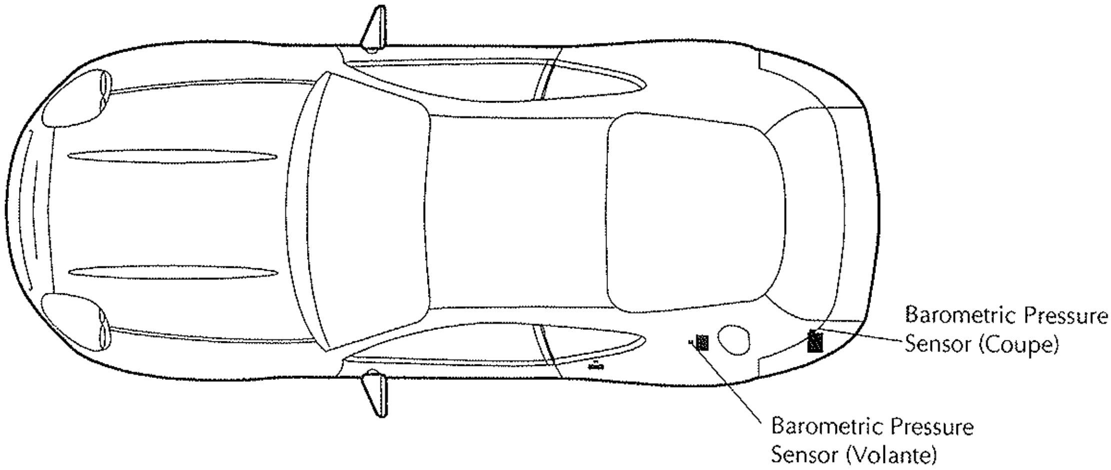


Figure 1. Barometric Pressure Sensor Location

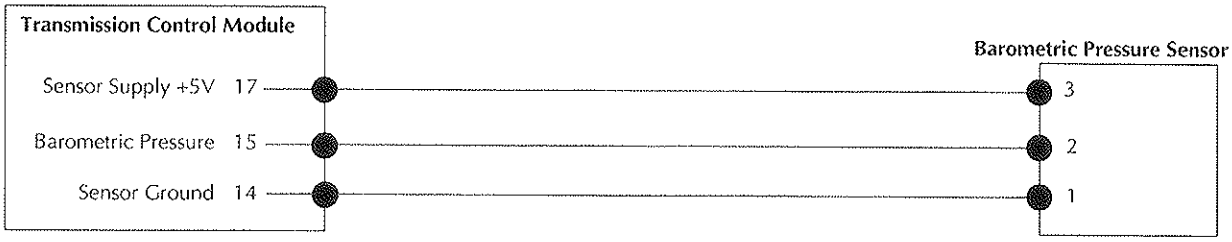


Figure 2. Barometric Pressure Sensor Circuit

Fault Code Desscription

P0108 - Barometric pressure sensor - high input

P0108 Fault Analysis

1. Connect the PDU or scan tool to the TCM. Switch on the ignition and note the barometric pressure signal level at TCM connector pin 15.

   The signal level should be in the following range:

   1.764 to 2.088 volts at 0.5 bar (7.5 psi) to

   4.816 to 4.978 volts at 1.5 bar (22.5 psi)

   If the current value is above the specified range, go to step 2.

   If the current value is within the above range, the cause of the P0108code is not present at this time, go to the intermittent signal procedure.

2. Switch off the ignition.

   Check for a short circuit from the sensor 5V supply line TCM pin 17 to the sensor signal line TCM pin 15.

   If no short circuit is detected, go to step 3.

   If a short circuit is detected, service as necessary. Reset the TCM and run the KOER test to ensure that the problem is resolved.

3. Check for a short circuit from the 12V supply lines to the sensor 5 V supply line TCM pin 17 or to the sensor signal line TCM pin 15.

   If no short circuit from 12V supply is detected, go to step 3.

   If a short circuit is detected, service as necessary. Reset the TCM and run the engine to ensure that the problem is resolved.

4. Replace the barometric pressure sensor. Reset the TCM and run the engine to ensure that the problem is resolved.

   If the P0108code is repeated, replace the TCM and run the engine to ensure that the problem is resolved.

Brake Switch Input

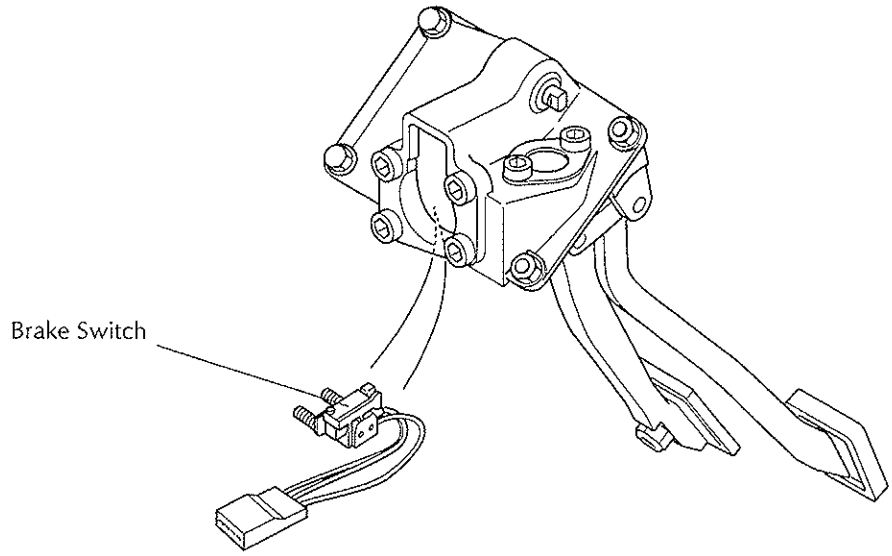


Figure 1. Brake Switch Location

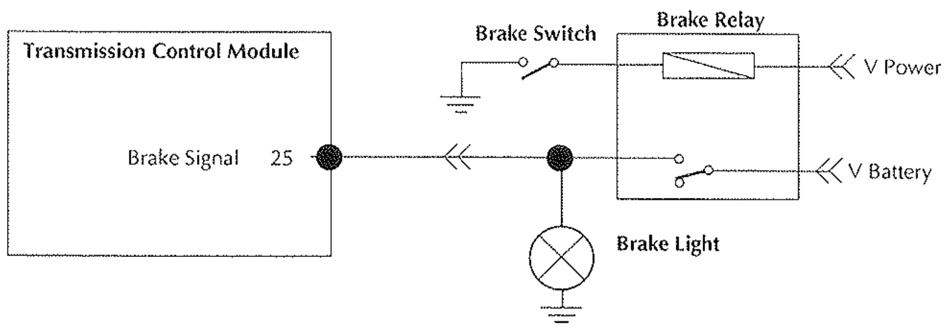


Figure 2. Brake Switch Circuit

Fault Code Definition

P0703 - The brake switch was closed during deceleration or open during acceleration.

Note: The TCM sets the P0703 code after a long fault analysis process. A long drive cycle of accelerations and decelerations will be necessary to prove that the problem is resolved.

P0703 Fault Analysis

1. Switch on the ignition and press the brake pedal whilst a collegue checks the brake lamp operation.

   If the brake lamps operate correctly, go to step 2.

   If the brake lamp operation is defective, service the brake lamp circuit as necessary. Reset the TCM and run a rolling road or road test to ensure that the problem is resolved.

2. Check the continuity from brake relay base pin 87 to TCM pin 25.

   If continuity is good, go to step 3.

   If continuity is defective, service the circuit as necessary. Reset the TCM and run a rolling road or road test to ensure that the problem is resolved.

3. Connect the PDU or scan tool to the TCM and switch on the ignition. Check the brake input signal to the TCM for switching as the brake pedal is pressed.

   If the brake signal does not switch upon pressing the brake pedal but the brake light operation and brake signal line continuity are good, replace the TCM. Run a rolling road or road test to ensure that the problem is resolved.

   If the brake signal input to the TCM does switch correctly upon pressing the brake pedal, go to the intermittent signal procedure.

Transmission Range Sensor

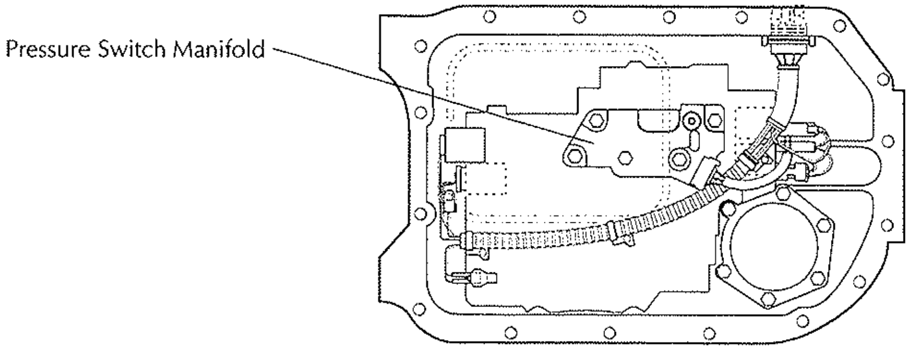


Figure 1. Pressure Switch Manifold Location

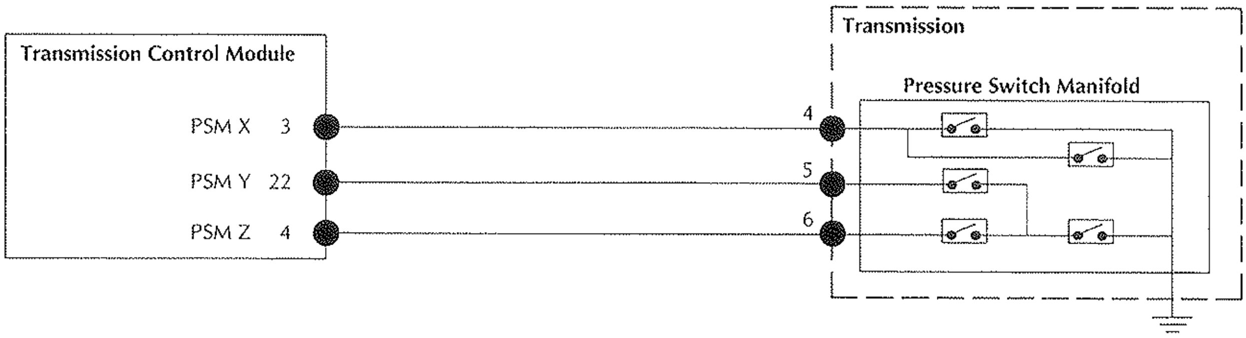


Figure 2. Pressure Switch Circuits

Fault Code Definition

P0706 - Transmission range sensor - range/performance. This code will be set under the following conditions

a) An illegal setting of the switches in the pressure switch manifold is sensed.

b) PSM switches indicate a change from drive to park whilst the engine is started.

c)
1. PSM switches indicate the transmission in park but speed sensors indicate the vehicle moving.
2. PSM switches indicate the transmission in reverse and speed sensors indicate the vehicle moving forward.
3. PSM switches indicate the transmission in a forward gear and speed sensors indicate the vehicle moving backwards.

P0706 Fault Analysis

1. Connect the PDU or scan tool. Monitor and note the TCM inputs PSM X, Y and Z whilst moving the gear selector to each position on the selector gate. Compare the PSM switch states with the table below (0 = 0 volts, 1 = 12 volts).

Range	**Switch state**		
	X	Y	Z
P	0	0	0
R	1	0	1
N	0	0	0
D	1	0	0
3	0	1	1
2	0	1	0

If the switch settings for each gear selector lever position do not match the values in the table above, check for short or open circuits in the PSM switch wiring.

If no wiring faults are detected, replace the pressure switch assembly. Reset the TCM and PCM. Run a rolling road or road test to ensure that the problem is resolved.

If the P0706 code returns, there is a significant hydraulic or mechanical problem in the transmission. Service the transmission using the procedures in the Workshop Manual.

Transmission Fluid Temperature

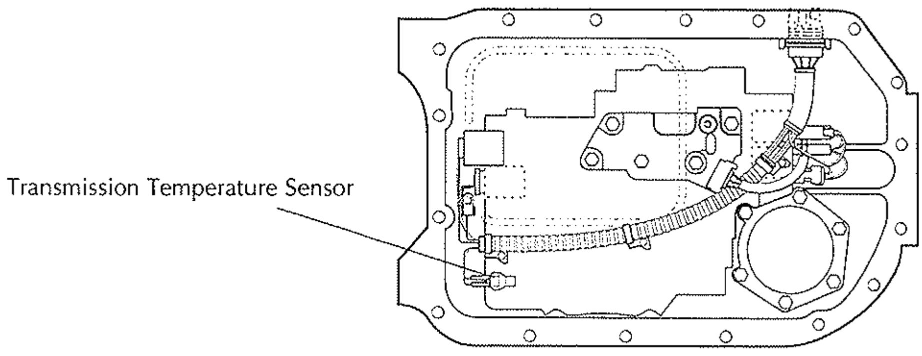


Figure 1. Transmission temperature sensor

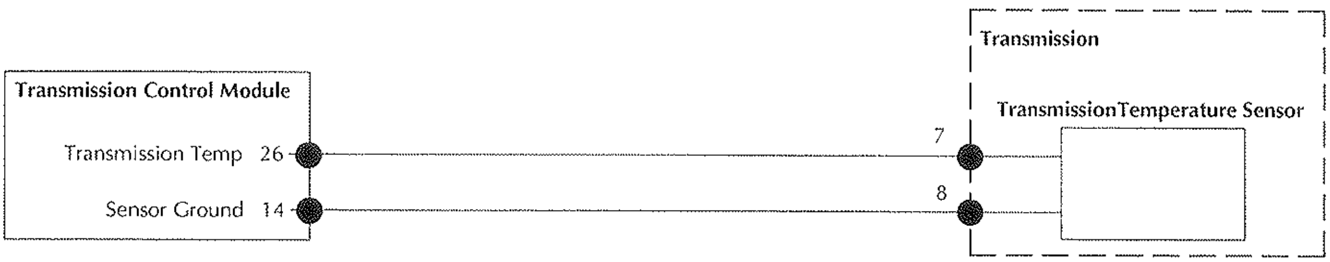


Figure 2. Transmission temperature sensor

P0712 Fault Analysis

P0712 - Transmission fluid temperature sensor circuit - Low input (high temperature indicated)

Note: The sensor is a thermistor connected between a +5 volt source and ground. The voltage on the supply line will be high with the transmission cold and will drop to 1.5 to 2.0 volts when the transmission reaches normal operating temperature of approximately 100°C (212°F)

The P0712 code will be logged approximately 30 seconds after switching on the ignition if there is a transmission fluid temperature signal problem.

1. Check and if necessary top-up the transmission fluid level using the procedure in the workshop manual.

   If the fluid level was seriously low, excessive heat will be generated during gearbox operation. Allow the transmission to cool.

   Connect the PDU or scan tool. Record any relevant DTCs and freeze frame data then reset the TCM to clear the P0712 code. Drive the vehicle until the transmission is fully warm and then check if the P0712 code is logged again.

   If the P0712 is not logged again, then it was probably caused by low fluid level.

   If the P0712 code is logged again, go to step 2.

2 Attempt to generate a P0713 code as follows:

   Key off. Disconnect the transmission connector and examine for pushed out pins, loose wires, etc. Service as necessary

   Run the engine for more than 60 seconds with the transmission disconnected. Is DTC P0713 logged.

   Note: Ignore any other DTCs generated at this time.

   If P0713 is logged, the cause of the P0712 is not within the transmission. Go to step 3.

   If P0713 is not logged, the fault is in the transmission assembly, go to step 4.

3. With the gearbox and TCM disconnected, check for short circuits to ground from TCM harness connector pin 26.

   If a short circuit to ground is identified, service the wiring as necessary. Reconnect all components and reset the TCM. Run the engine for more than 60 seconds to ensure that the problem is resolved.

   If no short circuit is identified, replace the TCM and run the engine for more than 60 seconds to ensure that the problem is resolved.

4. Check the continuity from gearbox connector pin G to H. The temperature sensor resistance should be within 15% of the value given in the table below.

Temperature	Sensor Resistance
-20°C	28,491 Ω
0°C	9,379 Ω
20°C	3,500 Ω
40°C	1,460 Ω
60°C	668 Ω
80°C	332 Ω
100°C	177 Ω
120°C	100 Ω
140°C	60 Ω
160°C	36 Ω
180°C	21 Ω
200°C	13 Ω

   If the resistance check indicates a short circuit, drain the transmission and remove the sump pan. Service the short circuit in the sensor wiring. Reassemble the transmission and refill with the correct fluid. Clear the P0712 code and rerun the engine for more than 60 seconds to ensure that the problem is resolved.

   If the circuit wiring is good, replace the transmission temperature sensor. Reassemble the transmission and refill with the correct fluid. Clear the P0712 code and rerun the engine for more than 60 seconds to ensure that the problem is resolved.

Transmission Fluid Temperature

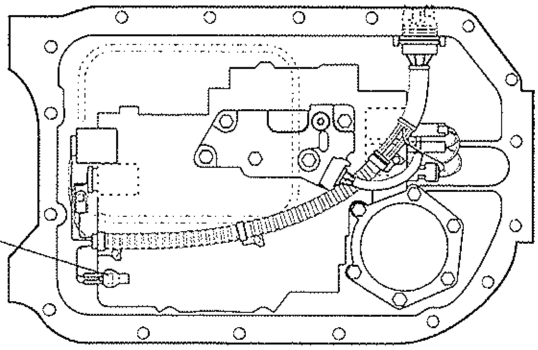


Figure 1. Transmission temperature sensor

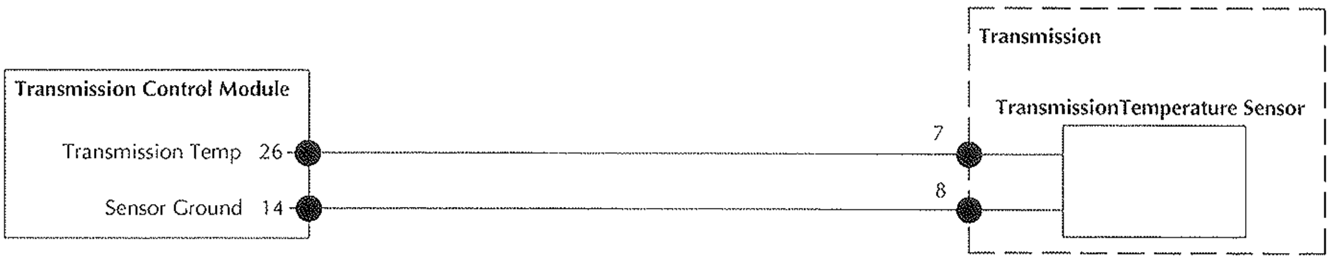


Figure 2. Transmission temperature sensor circuit

P0713 Fault Analysis

P0713 - Transmission fluid temperature sensor circuit - High input (low temperature indicated)

Note: The sensor is a thermistor connected between a +5 volt source and ground. The voltage on the supply line will be high with the transmission cold and will drop to 1.5 to 2.0 volts when the transmission reaches normal operating temperature of approximately 100°C (212°F).

The P0713 code will be logged if a voltage of more than 4.92 volts is sensed on the signal line for more than 60 seconds.

1. Connect the PDU or scan tool. Record any relevant DTCs and freeze frame data then reset the TCM to clear the P0713 code.

2 Check and if necessary top-up the transmission fluid level using the procedure in the workshop manual.

3. Monitor the transmission fluid temperature signal and note the signal level.

   If the signal level is above 4.92 volts, go to step 4.

   If the signal level is below 4.92 volts, the cause of the P0713 code is not evident at this time, go to the intermittent signal procedure.

4. Turn off the ignition. Disconnect the transmission connector and the TCM connector.

   Check for an open circuit from TCM connector pin 26 to transmission connector pin 7.

   Also check for an open circuit from TCM connector pin 14 to transmission connector pin 8.

   If circuit continuity is good, go to step 5.

   If any open circuit is detected, service the wiring as necessary. Run the engine for more than 60 seconds to ensure that the problem is resolved.

5. Check the continuity from gearbox connector pin 7 to pin 8. The temperature sensor resistance should be within 15% of the value given in the table below.

Temperature	Sensor Resistance
-20°C	28,491 Ω
0°C	9,379 Ω
20°C	3,500 Ω
40°C	1,460 Ω
60°C	668 Ω
80°C	332 Ω
100°C	177 Ω
120°C	100 Ω
140°C	60 Ω
160°C	36 Ω
180°C	21 Ω
200°C	13 Ω

If the resistance check indicates a short circuit, drain the transmission and remove the sump pan. Service the short circuit in the sensor wiring. Reassemble the transmission and refill with the correct fluid. Run the engine for more than 60 seconds to ensure that the problem is resolved.

If the circuit wiring is good, replace the transmission temperature sensor. Reassemble the transmission and refill with the correct fluid. Run the engine for more than 60 seconds to ensure that the problem is resolved.

Input Speed Sensor

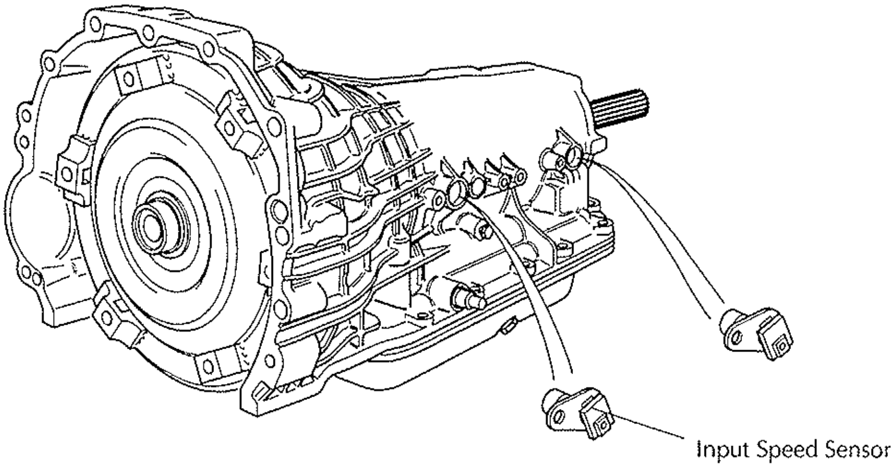


Figure 1. Input Speed Sensor Location

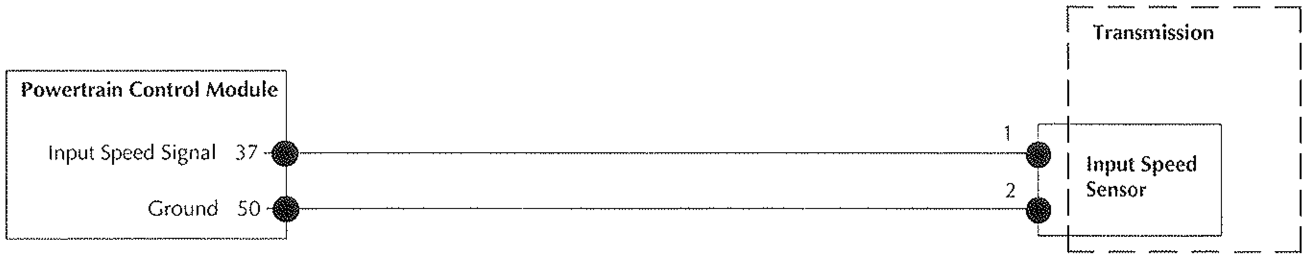


Figure 2. Input Speed Sensor Circuit

P0715 Fault Analysis

P0715 - The input speed is low whilst the output speed is high.

1. Connect the PDU or scan tool and monitor all logged DTCs. Record all relevant freeze frame data. Resolve any engine related DTCs first. When all engine DTCs are cleared, rerun the quick test to verify that P0715 is logged. If so, go to step 2.

2. Raise the vehicle on axle stands. Disconnect the Input Speed Sensor.

   Connect a digital voltmeter, set on the 10VAC scale, across the terminals of the input speed sensor.

   Start the engine with the transmission in Park. Note the DVOM reading.

   Note: The sensor output can change within the range 0.5 volts @ 100rpm to 100 volts @ 8000rpm. Sensor resistance should be 1260 - 1540Ω.

   If the reading is above 0.5 volts, go to step 3.

   If the reading is below 0.5 volts, go to step 4.

3. Reconnect the input speed sensor and disconnect the TCM connector

   Recheck the signal voltage (TCM connector pins 37 & 50) with the engine running at idle and the transmission in Park..

   If the signal voltage level is above 0.5 volts at idle, replace the TCM.

   If the signal level is below 0.5 volts, repair the wiring or connector defect. Reset the TCM and PCM. Retest the vehicle by running in Drive with engine speed changes of less than 1000 rpm/ second.

4. Check for damaged wiring to the input speed sensor and repair if necessary. Retest if wiring defects are identified and corrected.

   If the input speed sensor wiring is good, replace the input speed sensor. Clear the P0715 code and run a rolling road or road test to ensure that the problem is resolved.

Transmission - Input Speed Sensor

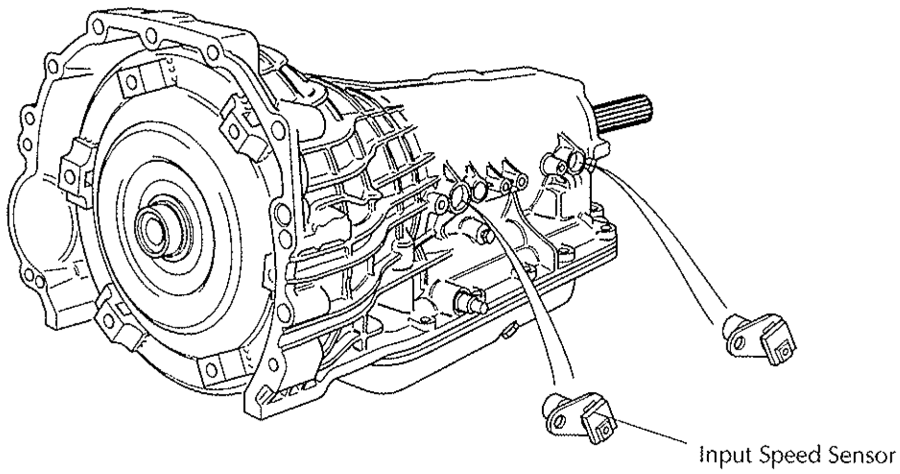


Figure 1. Transmission input speed sensor

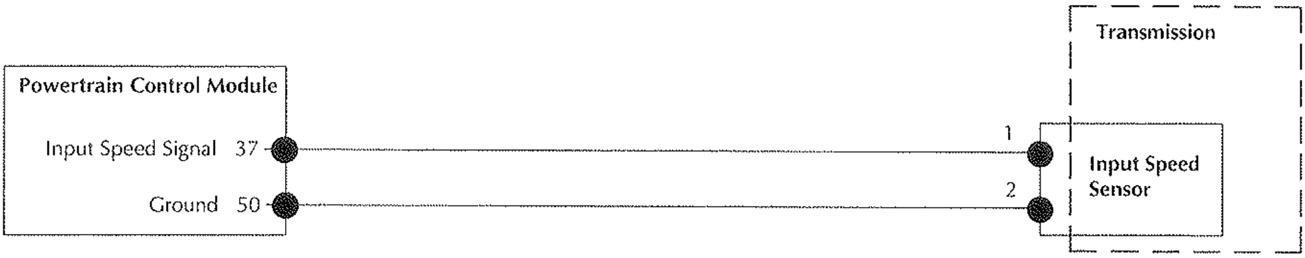


Figure 2. Transmission input speed sensor circuit

P0716 Fault Analysis

P0716 - The transmission input speed sensor signal showed an error in range or performance.

1. Connect the PDU or scan tool and monitor all logged DTCs. Record all relevant freeze frame data. Resolve any engine related DTCs first. When all engine DTCs are cleared, rerun the quick test to verify that P0716 is logged. If so, go to step 2.

2. Raise the vehicle on axle stands. Disconnect the Input Speed Sensor.

   Connect a digital voltmeter, set on the 10VAC scale, across the terminals of the input speed sensor.

   Start the engine with the transmission in Park. Note the DVOM reading.

   Note: The sensor output can change within the range 0.5 volts @ 100rpm to 100 volts @ 8000rpm. Sensor resistance should be 1260 - 1540Ω.

   If the reading is above 0.5 volts, go to step 3.

   If the reading is below 0.5 volts, go to step 4.

3. Reconnect the input speed sensor and disconnect the TCM connector

   Recheck the signal voltage (TCM connector pins 37 & 50) with the engine running at idle and the transmission in Park..

   If the signal voltage level is above 0.5 volts at idle, replace the TCM.

   If the signal level is below 0.5 volts, repair the wiring or connector defect. Reset the TCM and PCM. Retest the vehicle by running in Drive with engine speed changes of less than 1000 rpm/ second.

4. Check for damaged wiring to the input speed sensor and repair if necessary. Retest if wiring defects are identified and corrected.

   If the input speed sensor wiring is good, replace the input speed sensor. Clear the P0716 code and road test the vehicle to ensure that the problem is resolved.

Transmission Output Speed

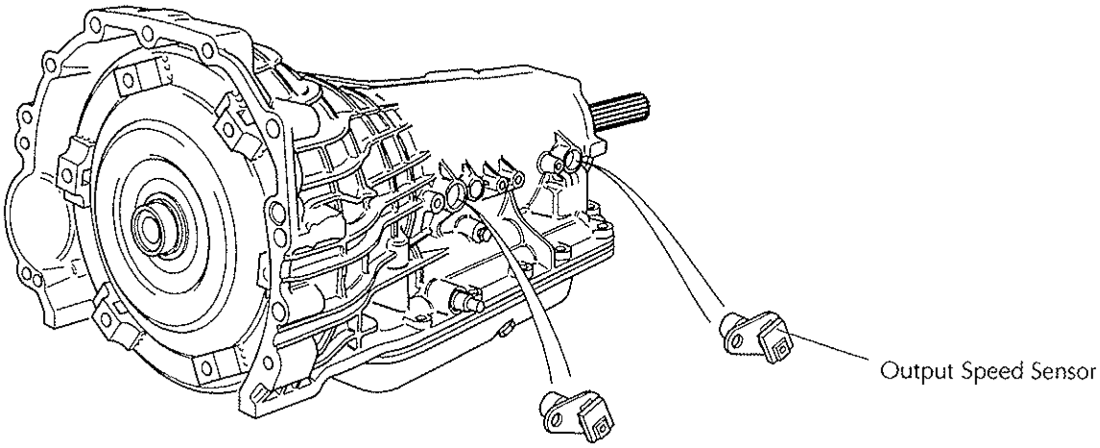


Figure 1. Transmission output speed sensor

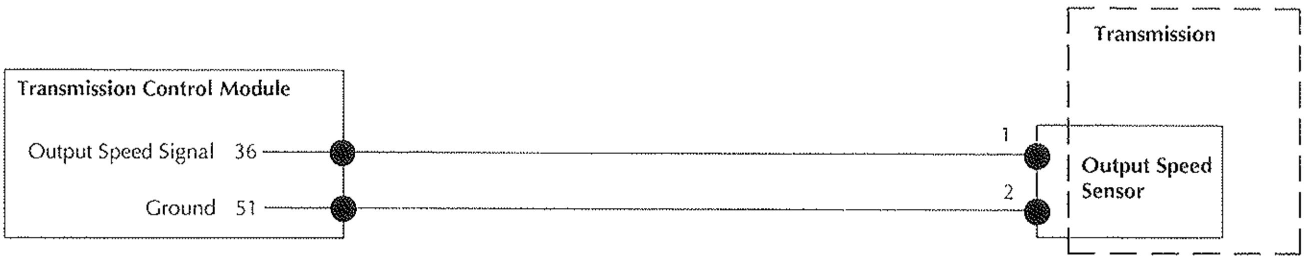


Figure 2. Transmission output speed sensor circuit

Fault Code Definition

P0720 - The transmission output speed sensor signal showed less than 200 rpm for at least 1 second whilst the input speed sensor showed at least 3000 rpm.

P0720 Fault Analysis

1. Connect the PDU or scan tool and monitor all logged DTCs. Record all relevant freeze frame data. Clear any engine related DTCs first. When all engine DTCs are resolved, rerun the drive cycle to verify that P0720 is logged. If so, go to step 2.

2. Raise the vehicle drive wheels. Disconnect the Output Speed Sensor.

   Connect a digital voltmeter, set on the 10VAC scale, across the terminals of the output speed sensor.

   Start the engine. Place the transmission in drive. Note the DVOM reading.

   Note: The sensor output can change within the range 0.5 volts @ 100rpm to 100 volts @ 8000rpm. Sensor resistance should be 1260 - 1540Ω

   If the reading is above 0.5 volts, go to step 3.

   If the reading is below 0.5 volts, go to step 4.

3. Reconnect the output speed sensor and disconnect the TCM connector

   Recheck the signal voltage (TCM connector pins 36 & 51) with the engine running at idle and the transmission in Drive.

   If the signal voltage level is above 0.5 volts at idle, replace the TCM.

   If the signal level is below 0.5 volts, repair the wiring or connector defect. Reset the TCM and retest the vehicle by running in Drive with engine speed changes of less than 1000 rpm/second.

4. Check for damaged wiring to the output speed sensor and repair if necessary. Retest if wiring defects are identified and corrected.

   If the output speed sensor wiring is good, replace the output speed sensor. Clear the P0720 code and road test the vehicle to ensure that the problem is resolved.

Transmission Output Speed

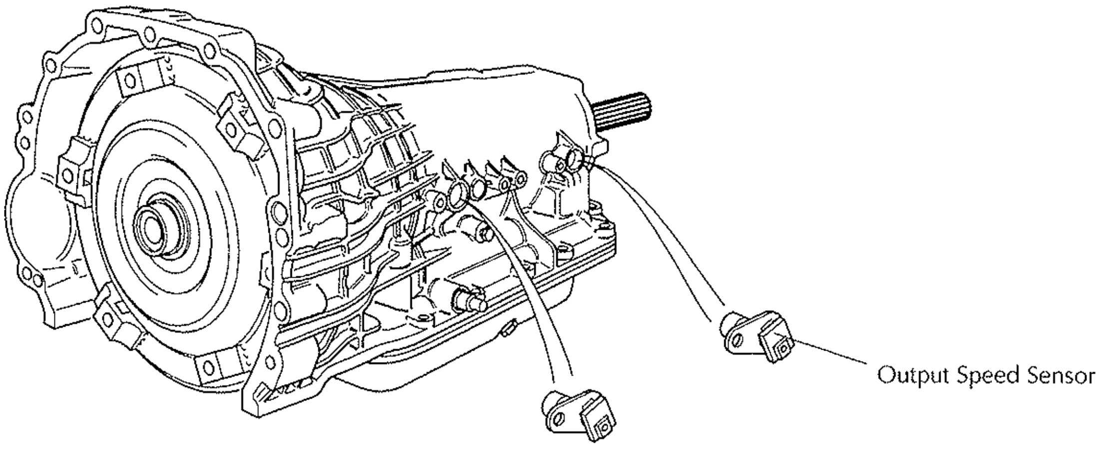


Figure 1. Transmission output speed sensor

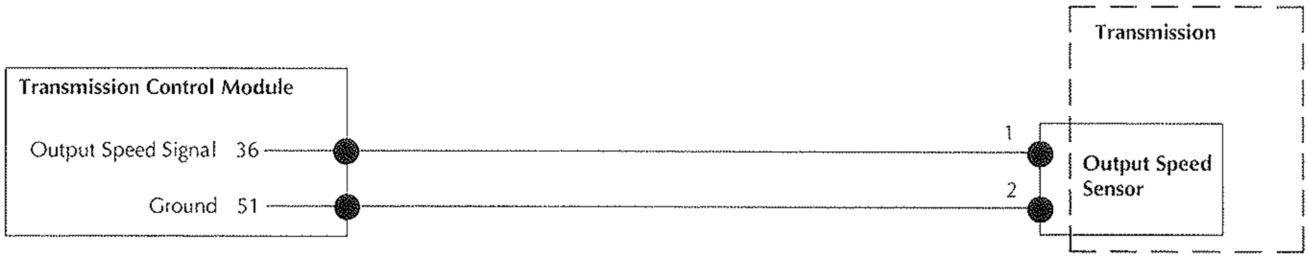


Figure 2. Transmission output speed sensor circuit

Fault Code Definition

P0721 - The transmission output speed sensor signal showed an error in range or performance.

P0721 Fault Analysis

1. Connect the PDU or scan tool and monitor all logged DTCs. Record all relevant freeze frame data. Clear any engine related DTCs first. When all engine DTCs are resolved, rerun the quick test to verify that P0721 is logged. If so, go to step 2.

2. Raise the vehicle on axle stands. Disconnect the Output Speed Sensor.

   Connect a digital voltmeter, set on the 10VAC scale, across the terminals of the output speed sensor.

   Start the engine. Place the transmission in drive. Note the DVOM reading.

   Note: The sensor output can change within the range 0.5 volts @ 100rpm to 100 volts @ 8000rpm. Sensor resistance should be 1260 - 1540Ω

   If the reading is above 0.5 volts, go to step 3.

   If the reading is below 0.5 volts, go to step 4.

3. Reconnect the output speed sensor and disconnect the TCM connector

   Recheck the signal voltage (TCM connector pins 36 & 51) with the engine running at idle and the transmission in Drive.

   If the signal voltage level is above 0.5 volts at idle, switch the voltmeter to the 100 volt range and check that the output speed sensor signal level increases as the output speed is increasesed. If the signal level responds correctly, replace the TCM.

   If the signal level is below 0.5 volts, repair the wiring or connector defect. Reset the TCM and retest the vehicle by running in Drive with engine speed changes of less than 1000 rpm/second.

4. Check for damaged wiring to the output speed sensor and repair if necessary. Retest if wiring defects are identified and corrected.

   If the output speed sensor wiring is good, replace the output speed sensor. Clear the P0721 code and road test the vehicle to ensure that the problem is resolved.

Engine Speed

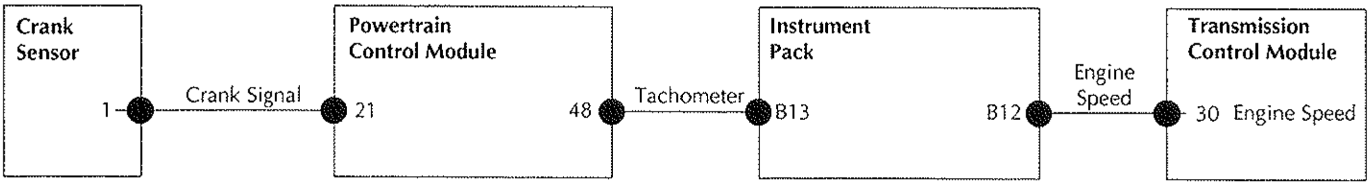


Figure 1. Engine Speed Sensor Circuit

Fault Code Definition

P0726 - Transmission engine speed input malfunction

P0726 Fault Analysis

Note: The engine speed signal is derived as follows:

The crank sensor signal enters the PCM at pin 21. This signal is cleaned up and sent via PCM pin 48 as the Tachometer signal to instrument pack pin B13. The instrument pack then inverts the tachometer signal and sends it out via instrument pack pin B12 to TCM pin 30 as the Engine Speed Signal.

1. Run the engine from idle to higher speed several times and observe the tachometer indications.

   If the tachometer indications correctly follow the engine speed changes, go to step 2.

   If the tachometer indications do not correctly follow the engine speed changes, resolve the problem in the tachometer input to instrument pack pin B13. Clear the DTCs and rerun the Quick test. Return to this procedure only if a P0726 code is logged again after clearing the tachometer signal problem and the P0726 code.

2. Connect the PDU or scan tool to the TCM. Set up to monitor the engine speed signal. Run the engine from idle to higher engine speed and back to idle speed several times whilst observing the signal changes on the PDU.

   If the engine speed signal closely follows actual changes in engine speed, the engine speed input to the TCM is currently OK. Check the wiring from instrument pack pin B12 to TCM pin 30 for intermittent open circuits or for short circuit to ground.

   If any wiring defect is identified, repair the defect, clear the P0726 code and run the Quick Test to ensure that the problem is resolved.

   If the wiring from instrument pack pin B12 to TCM pin 30 is good, replace the TCM and rerun the Quick test to ensure that the problem is resolved.

Engine Speed Signal

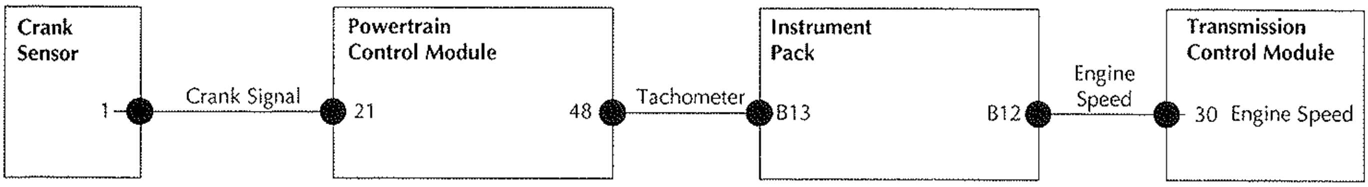


Figure 1. Engine Speed Signal Circuit

Fault Code Definition

P0727 - Transmission controller engine speed signal missing.

P0727 Fault Analysis

Note: The engine speed signal is derived as follows:

The crank sensor signal enters the PCM at pin 21. This signal is cleaned up and sent via PCM pin 48 as the Tachometer signal to instrument pack pin B13. The instrument pack then inverts the tachometer signal and sends it out via instrument pack pin B12 to TCM pin 30 as the Engine Speed Signal.

1. Run the engine from idle to higher speed several times and observe the tachometer indications.

   If the tachometer indications correctly follow the engine speed changes, go to step 2.

   If the tachometer indications do not correctly follow the engine speed changes, resolve the problem in the tachometer input to instrument pack pin B13. Clear the DTCs and rerun the Quick test. Return to this procedure only if a P0726 code is still present after clearing the tachometer signal problem.

2. Connect the PDU or scan tool to the TCM. Set up to monitor the engine speed signal. Run the engine from idle to higher engine speed and back to idle speed several times whilst observing the signal changes on the PDU.

   If the engine speed signal closely follows actual changes in engine speed, the engine speed input to the TCM is currently OK. Check the wiring from instrument pack pin B12 to TCM pin 30 for intermittent open circuits or for short circuit to ground.

   If any wiring defect is identified, repair the defect, clear the P0726 code and run the Quick Test to ensure that the problem is resolved.

   If the wiring from instrument pack pin B12 to TCM pin 30 is good, replace the TCM and rerun the Quick test to ensure that the problem is resolved.

Incorrect Gear Ratio

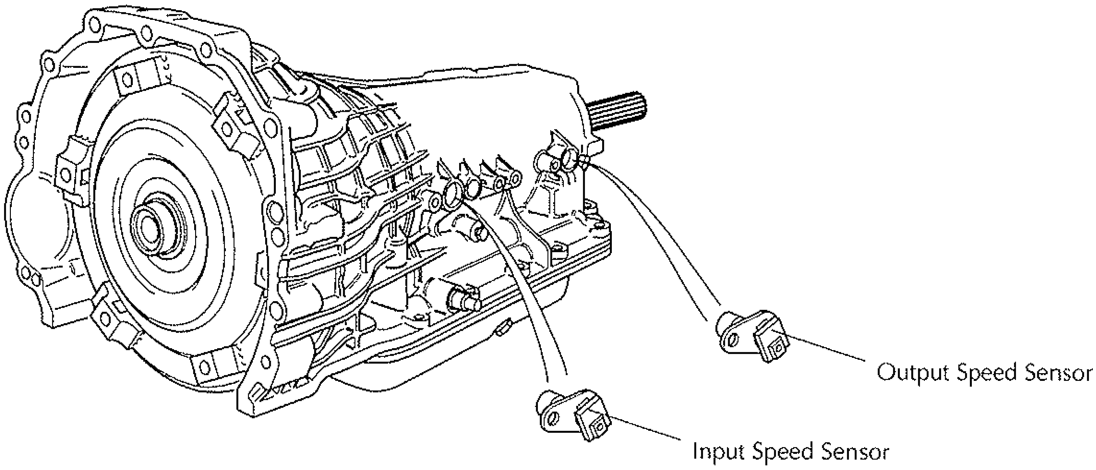


Figure 1. Input and Output Speed Sensor Locations

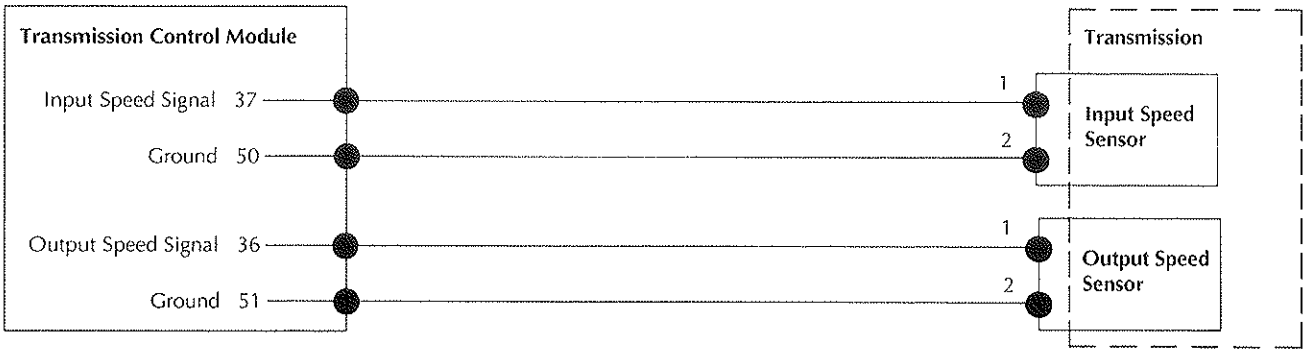


Figure 2. Input and Output Speed Sensor Circuits

Fault Code Definition

P0730 - Incorrect gear ratio.

P0730 Fault Analysis

Note: The TCM confirms the currently engaged gear by calculating the ratio of the input speed signal frequency to the output speed signal frequency.

1. Connect the PDU or scan tool to the TCM and set to monitor the input and output speed sensor signals.

2. Place the vehicle on a 'rolling road' or run a road test as follows. Start the engine and run in drive over the full range of gear ratios whilst observing the input and output speed sensor signal traces.

   If either the input or output speed signal is missing or intermittent, go to step 3.

   If the speed sensor signals closely follow changes in engine speed and gear ratio, check the sensor wiring for possible intermittent contacts and service if necessary. If the wiring is good, replace the TCM and run the Quick Test to ensure that the problem is resolved.

3. Check the sensor mountings to the transmission and secure if necessary. Check the security of the sensor connectors and reconnect if necessary. Check the continuity of the sensor signal and return lines to the TCM pins shown on the circuit diagram.

   If a wiring defect is identified, repair as necessary and rerun the Quick Test to ensure that the problem is resolved.

   If no wiring defect is identified, replace the suspect sensor and run the Quick Test to ensure that the problem is resolved.

Torque Convertor Clutch

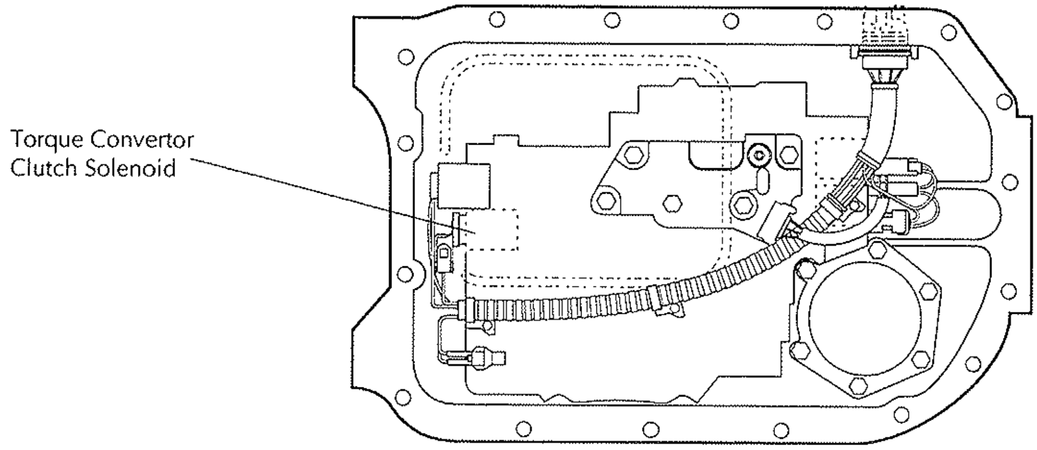


Figure 1. PWM(TCC) Solenoid Location

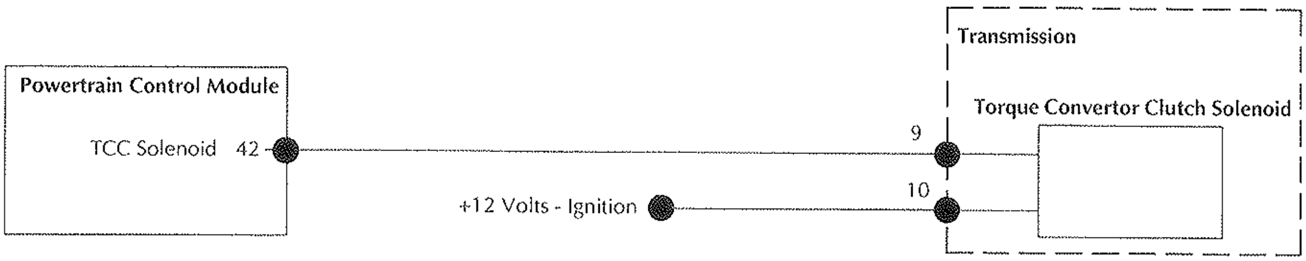


Figure 2. PWM(TCC) Solenoid Circuit

Fault Code Description

P0741 - Torque Convertor Clutch (TCC) stuck off.

P0741 Fault Analysis

1. Connect the PDU or scan tool to the TCM and set the datalogger to monitor and record the pulse width modulated torque convertor clutch signal.

2. Prepare the vehicle for a rolling road or road test. Start the engine and run the test with the gear selector in 'D'. When safe to do so, run until 4th gear is selected. At this time the PWM(TCC) solenoid should begin operation. Trigger the datalogger and record the PWM(TCC) signal through a 4th gear - accelerate - steady speed - decelerate cycle. Stop the road test. Analyse the datalogger record as follows:

   The 12 volt signal on the PWM solenoid should switch to 0 volts at 32 cycles per second in 4th gear only. The 0 volt pulse widths will increase as the PWM duty cycle increases from 0% up to a maximum of 80%.

   Note: If the transmission temperature is above 122°C the TCC will come on in 2nd, 3rd and 4th gears.

   If the PWM(TCC) signal shows negative going pulses of increasing pulsewidth, go to step 3.

   If the PWM(TCC) signal does not show negative going pulses of increasing pulse width, replace the TCM and run the Quick Test to confirm that the problem is resolved.

3. Check the continuity of the wiring from TCM connector pin 42 to transmission connector pin 9.

   If continuity is good, go to step 4.

   If a wiring defect is identified, service as necessary, reset the TCM and PCM. Run a rolling road or road test to ensure that the problem is resolved.

4. Check the continuity across the PWM(TCC) solenoid.

   Disconnect the transmission connector and measure the resistance between pins 9 and 10. The solenoid resistance should be 10Ω at 20°C but will change with the high transmission temperatures.

   If the solenoid resistance is not approximately 10Ω at 20°C, change the solenoid and retest the vehicle to ensure that the problem is resolved.

   If the solenoid resistance is approximately 10Ω at 20°C, service the transmission for a mechanical or hydraulic fault using the workshop manual procedures.

Torque Convertor Clutch

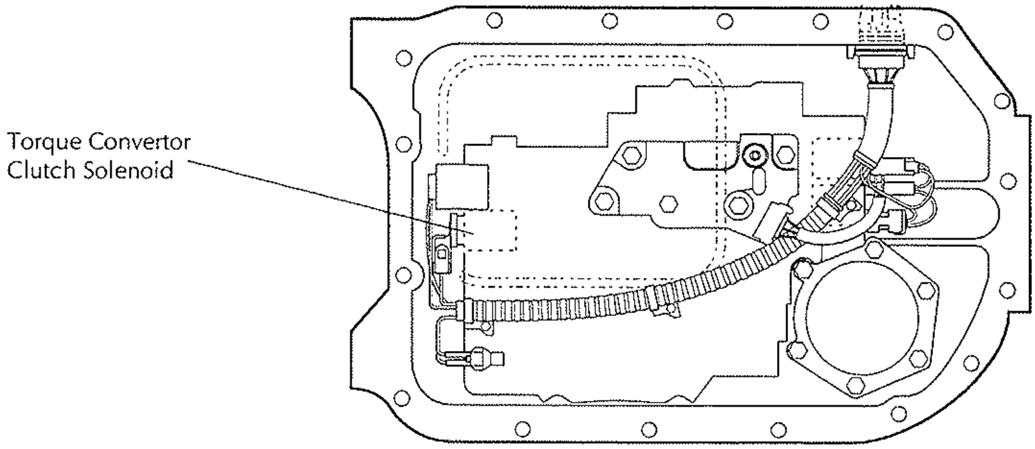


Figure 1. PWM(TCC) Solenoid Location

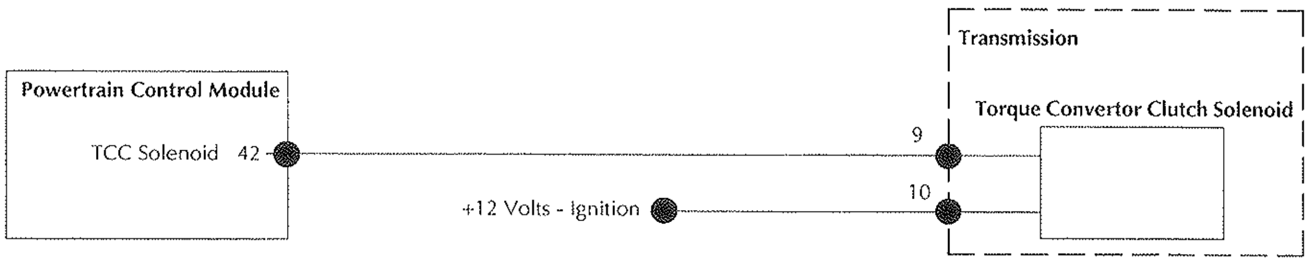


Figure 2. PWM(TCC) Solenoid Circuit

Fault Code Description

P0742 - Torque Convertor Clutch (TCC) stuck on.

P0742 Fault Analysis

1. Connect the PDU or scan tool to the TCM and set the datalogger to monitor and record the pulse width modulated torque convertor clutch signal.

2. Prepare the vehicle for a rolling road or road test. Start the engine and run the test with the gear selector in 'D'. When safe to do so, run until 4th gear is selected. At this time the PWM(TCC) solenoid should begin operation. Trigger the datalogger and record the PWM(TCC) signal through a 4th gear - accelerate - steady speed - decelerate cycle. Stop the test. Analyse the datalogger record as follows:

   The 12 volt signal on the PWM solenoid should switch to 0 volts at 32 cycles per second in 4th gear only. The 0 volt pulse widths will increase as the PWM duty cycle increases from 0% up to a maximum of 80%.

   Note: If the transmission temperature is above 122°C the TCC will come on in 2nd, 3rd and 4th gears.

   If the PWM(TCC) signal shows negative going pulses of increasing pulsewidth, go to step 3.

   If the PWM(TCC) signal goes low and remains low, Check for short circuit to ground from TCM pin 42.

   If a short circuit is detected, repair the wiring and rerun the road test to ensure that the problem is resolved.

   If no short circuit is detected, replace the TCM and run the Quick Test to confirm that the problem is resolved.

3. Check the continuity across the PWM(TCC) solenoid.

   Disconnect the transmission connector and measure the resistance between pins 9 and 10. The solenoid resistance should be 10Ω at 20°C but will change with the high temperatures in the transmission assembly.

   If the solenoid resistance is not approximately 10Ω at 20°C, change the solenoid and retest the vehicle to ensure that the problem is resolved.

   If the solenoid resistance is approximately 10Ω at 20°C, service the transmission for a mechanical or hydraulic fault using the workshop manual procedures.

Torque Convertor Clutch

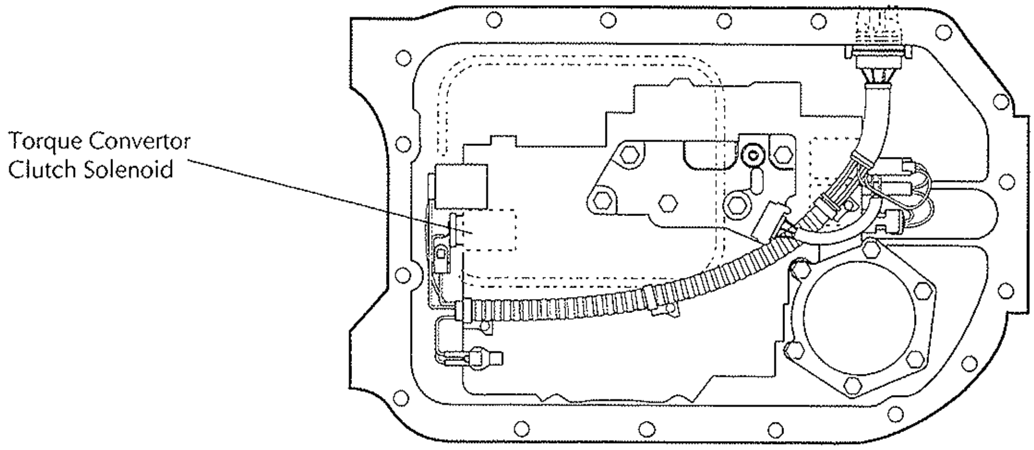


Figure 1. PWM(TCC) Solenoid Location

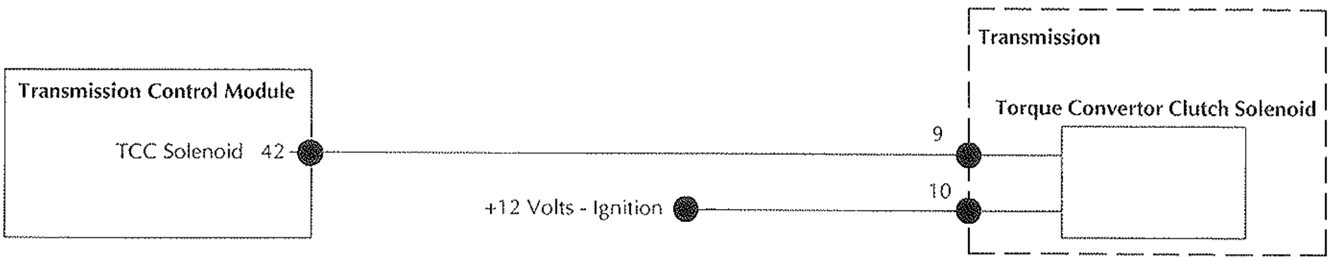


Figure 2. PWM(TCC) Solenoid Circuit

Fault Code Description

P0743 - Torque Convertor Clutch (TCC) signal is low when the TCC is commanded off.

P0743 Fault Analysis

1. Connect the PDU or scan tool and set to monitor the TCC signal. This signal should be high (TCM pin 42 at approx 12V) when drivng in 1st, 2nd or 3rd gear when the transmission temperature is below 122°C.

   The 12 volt signal on the PWM solenoid should switch to 0 volts at 32 cycles per second in 4th gear only. The 0 volt pulse widths will increase as the PWM duty cycle increases from 0% up to a maximum of 80%.

   Note: The TCC is also commanded on in 2nd and 3rd gears when the transmission fluid temperature exceeds 122°C.

2. When safe to do so, rolling road or road test the vehicle and switch on datalogger to log the TCC signal over a cold start test from standing start up to high speed in 4th gear and then back down to a stop. Stop the datalogger and analyse the test results as follows.

   If the TCC signal does not go low at any time during 1st, 2nd or 3rd gear operation when the transmission temperature is below 122°C, clear the P0743 code and repeat the road test. If the fault does not recur, testing is complete.

   If the TCC signal goes low at any time during 1st, 2nd or 3rd gear operation when the transmission fluid temperature is below 122°C, there is either an open circuit in the 12V supply line or a short circuit to ground on the TCC signal line to TCM pin 42. Go to step 3.

3. Key off. Disconnect the transmission harness connector and the TCM. Check continuity from TCM harness connector pin 42 to chassis ground.

   If no short circuit is detected, go to step 4.

   If a short circuit exists, repair the wiring, clear the P0743 code and retest the vehicle to ensure that the problem is resolved.

4. Reconnect the transmission harness connector. Switch on the ignition and check for 12 volts at TCM harness connector pin 42.

   If 12 volts is present, shake and twist the wiring from the TCM to the gearbox connector to recreate the open circuit.

   If no voltage drop can be simulated, reconnect all components. Replace the TCM. When safe to do so, repeat the road test over a cold start test from standing start up to high speed in 4th gear and then back down to a stop. Ensure that the P0743 code is not logged again.

   If the 12 volt supply drops during harness manipulation, repair the wiring defect. Clear the P0743 code and retest to ensure that the problem is resolved.

Force Motor

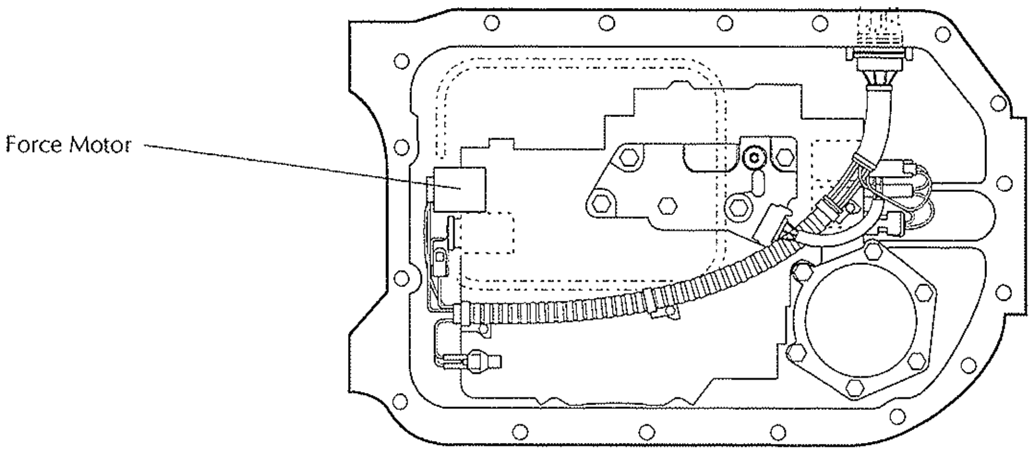


Figure 1. Force Motor Location

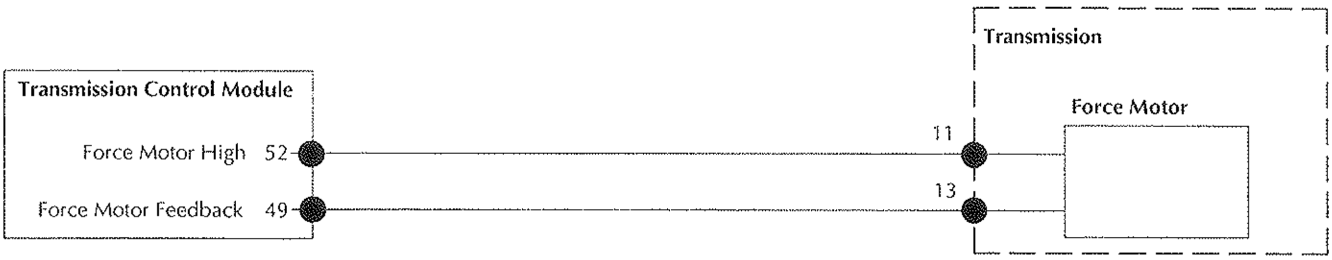


Figure 2. Force Motor Circuit

Fault Code Description

P0748 - The TCM has detected a continuous open circuiut or a short circuit to ground in the Force Motor wiring.

Note: The Force Motor Solenoid is a current regulated device controlled by the TCM. The Force Motor current should be in the range 0.1 to 1.1 amps.

P0748 Fault Analysis

1. Connect the PDU or scan tool and set to monitor the force motor current (FMA) and the force motor commanded (MD) signals. These signals should be in the range 0.1 - 1.1 amps.

   Run a rolling road or road test with the transmission in 'D'.

   Run the vehicle at modest loads and note the FMA and MD readings. Accelerate briefly and again note the FMA and MD signal levels during the period of heavier engine load. Stop the rolling road test.

   Note: High FMA current indicates a short circuit. Low FMA current indicates an open circuit.

   If the FMA signal differs from the MD signal by more than 0.16 amps, go to step 2.

   If the FMA signal is always within 0.16 amps of the MD signal, the cause of the P0748 code is intermittent, analyse the problem using the intermittent signal procedure.

2. Key off. Disconnect the TCM. Measure the resistance of the force motor solenoid between TCM harness connector pins 49 and 52.

   If the resistance is in the range 3-7Ω, go to step 3.

   If the resistance is outside the range 3-7Ω, go to step 4.

3. There is a short circuit from the force motor wiring to ground. Disconnect the transmission connector and check the resistance from transmission connector pins 11 and 13 to the gearbox case.

   If the resistance is approximately 0Ω, the short circuit is inside the gearbox. Drain the transmission and service the short circuit in the force motor solenoid or gearbox harness. Reconnect all components and run the rolling road test again to confirm that the problem is resolved.

   If the resistance is in the range 3-7Ω, the short circuit is in the transmission harness. Service the wiring from the TCM connector to the transmission connector. Reconnect all components and repeat the rolling road test to ensure that the problem is resolved.

4. Disconnect the transmission connector and repeat the solenoid resistance check at transmission connector pins 11 and 13.

   If the resistance is inside the range 3-7Ω, there is an open circuit or high resistance connection in the wiring from the TCM to the transmission connector. Service the wiring as necessary and reconnect all components. Run the rolling road or road test to ensure that the problem is resolved.

   If the resistance is outside the range 3-7Ω, there is an open circuit in the solenoid or wiring inside the gearbox. Drain the transmission and remove the sump pan. Service the open circuit in the solenoid or gearbox harness. Reassemble and refill the transmission. Run the rolling road test to ensure that the problem is resolved.

P0751

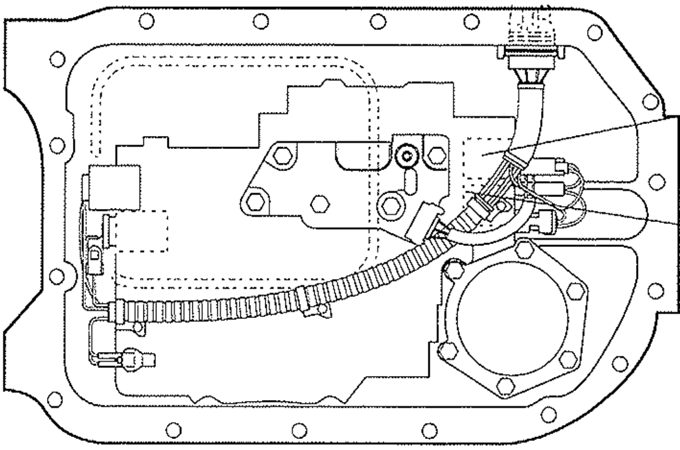


Figure 1. Shift Solenoid Locations

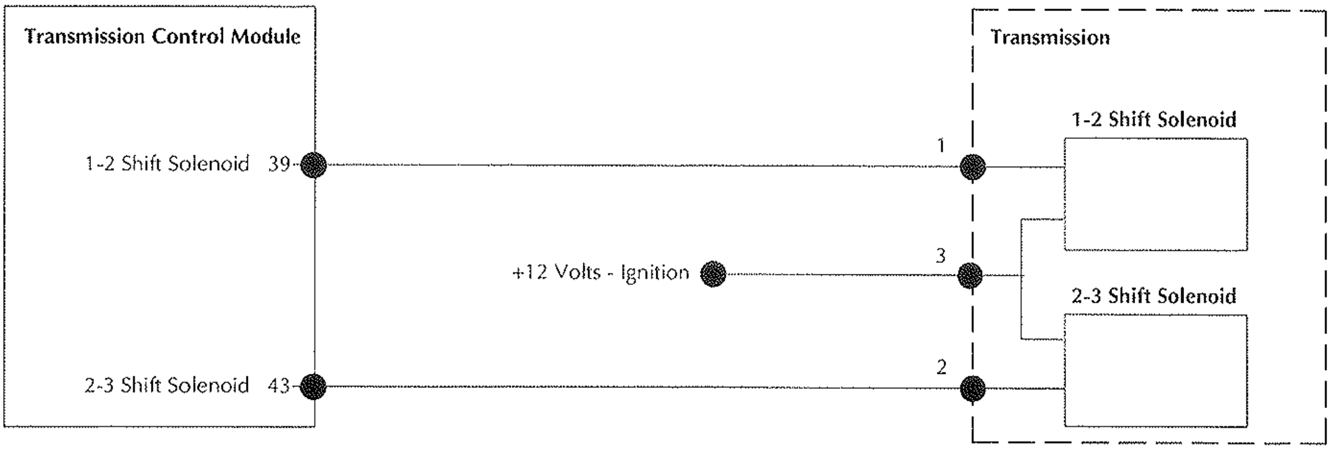


Figure 2. Shift Solenoid Circuits

4L80-E Shift Chart		
Gear	1-2 Shift Solenoid	2-3 Shift Solenoid
1	On	Off
2	Off	Off
3	Off	On
4	On	On

Figure 3. 4L80-E Shift Speed Chart

Fault Code Description

P0751 - The TCM has detected that the current gear ratio is maintained for longer than a defined time after a gear change has been commanded.

P0751 Fault Analysis

This code will be logged under the following conditions:

Stuck Off: (after 2 occurences)

1st gear is commanded and the ratio is equal to 2nd gear for greater than 1.7 seconds.

4th gear is commanded (with TCC locked) and the ratio is equal to 3rd gear for greater than 3 seconds.

Stuck On: (after 5 occurences)

2nd gear is commanded and the ratio is equal to 1st gear for greater than 2.5 seconds.

1. Connect the PDU or scan tool to the PCM and monitor any logged PCM DTCs.

   If no engine DTCs are logged, go to step 2.

   If any engine DTCs are logged, clear these problems first and then return to step 2 of this procedure.

2. Transfer the PDU or scan tool to the TCM connector. Monitor the transmission range inputs to the TCM.

   With the engine running and the brake pedal applied, select each position of the gear selector lever.

   If the TCM input matches the gear selector position, go to step 3.

   If the TCM input does not match the gear selector position, service the gear selector assembly as necessary, clear the P0751 code and retest to ensure that the problem is resolved.

3. Run a rolling road or road test. Place the transmission in D.

   Using the PDU, monitor the 1-2 and 3-4 gear shift solenoid signals. The solenoid actuation for each gear is shown in figure 3. Increase the engine speed gently to create a 1-2-3-4 shift pattern.

   If any shift error is detected, go to step 4.

   If all shifts occur correctly, check the following:

   - That the transmisison meets the specifications in the 4L80-E shift chart.
   - Other internal transmission failures may cause more than one shift to occur.
   - Any engine or throttle position sensor faults may influence transmission performance, clear these codes first.

   Rectify any problems identified in the above checks, clear the P0751 code and retest to ensure that the problem is resolved.

4. Service the transmission with particular attention to the following:

   - One or both shift solenoids for internal malfunction.
   - Damaged seals on one or both shift solenoids.

   After servicing the transmission, check and if necessary clear any logged DTCs before running the following drive cycle.

   Start the vehicle on a rolling road or road test with the transmission in D and the 1st gear inhibit function deselected. Hold the throttle at 20% and accelerate gently to 55 mph (If the throttle moves more than 3%, stop the vehicle and restart the test).

   The TCM must see the proper ratio for each commanded gear for greater than 1 second in 1st, 2nd, 3rd and 4th gears whilst the throttle opening is 20%.

   Stop the test and check that the P0751 problem is resolved.

1-2 Shift Solenoid

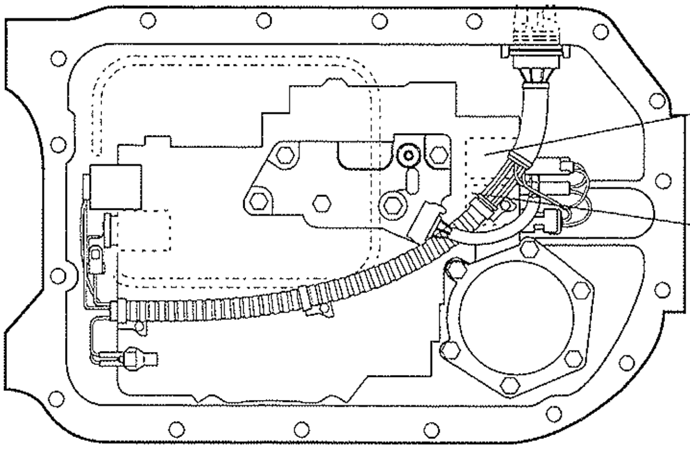


Figure 1. Shift Solenoid Locations

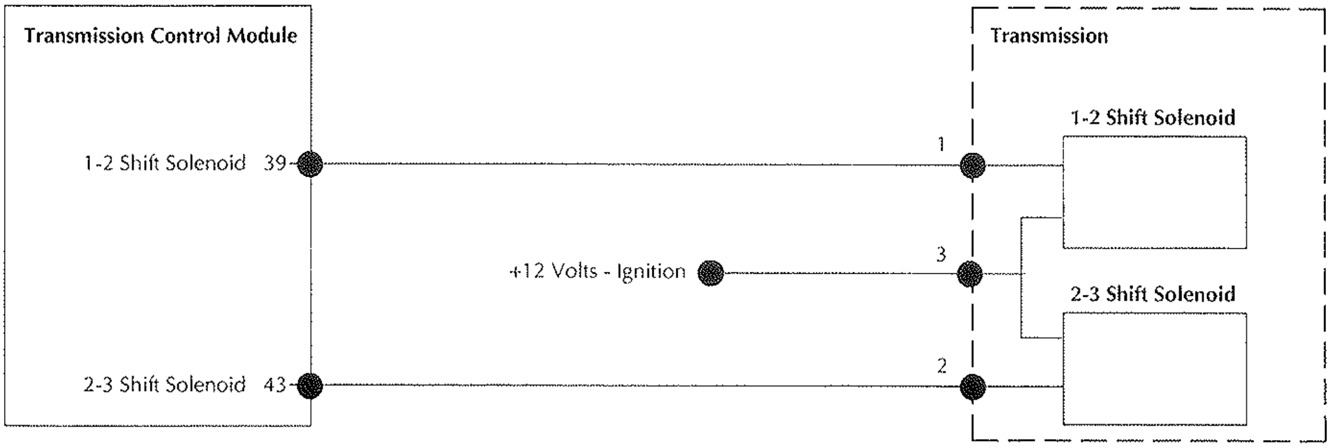


Figure 2. Shift Solenoid Circuits

Fault Code Description

P0753 - The TCM has detected a continuous open circuit or a continuous short circuit to ground in the 1-2 shift solenoid or in the associated wiring.

This code will be logged if the 1-2 shift solenoid signal is in an invalid state for more than 4.3 seconds.

P0753 Fault Analysis

1. Inspect the wiring harness and connectors from the TCM to the transmission for poor electrical connections, bent, backed out, deformed or damaged terminals. Inspect the harness for chafed wires which could short to other wiring or to bare metal.

   If no defects are identified, go to step 2.

   If any defects are identified, repair the defect. Clear the P0753 code and retest to ensure that the problem is resolved.

2. Disconnect the transmission connector. Measure the resistance of the 1-2 shift solenoid between pins 1 and 3 of the transmission plug.

   If the resistance is in the range 19-31Ω, go to step 3.

   If the resistance is outside the range 19-31Ω, drain the transmission and remove the sump pan. Service the open circuit solenoid or wiring as necessary. Reassemble and refill the transmission, reconnect all components. Road test the vehicle to ensure that the problem is resolved.

3. Check the resistance from transmission connector pins 1 and 3 to the gearbox case.

   If the resistance is greater than 10kΩ, go to step 4.

   If the resistance is less than 10kΩ, drain the transmission and remove the sump pan. Service the short circuit in the solenoid or wiring as necessary. Reassemble and refill the transmission, reconnect all components. Run a rolling road or road test to ensure that the problem is resolved.

4. Disconnect the TCM. Measure the resistance from TCM harness connector pin 39 to transmission connector pin 1.

   If the resistance is less than 5Ω, go to step 5.

   If the resistance is greater than 5Ω, service the open circuit in the wiring from harness connector pin 1 to TCM harness connector pin 39. Reconnect all components and run a rolling road or road test to ensure that the problem is resolved.

5. Measure the resistance from TCM connector pin 39 to chassis ground.

   If the resistance is less than 10kΩ, service the short circuit to ground on the line from TCM connector pin 39 to transmission connector pin 1.

   If the resistance is greater than 10kΩ, the cause of the P0753 fault is not evident at this time. go to the intermittent signal procedure.

2-3 Shift Solenoid Performance

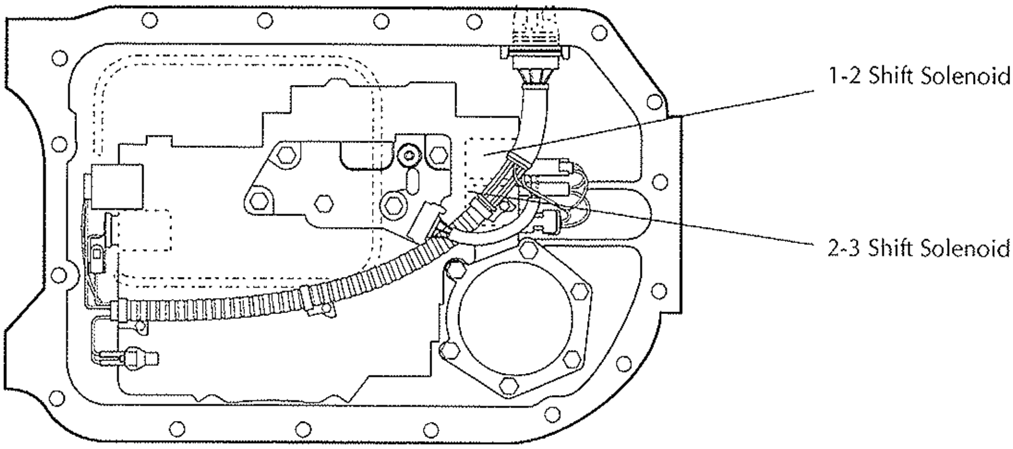


Figure 1. Shift Solenoid Locations

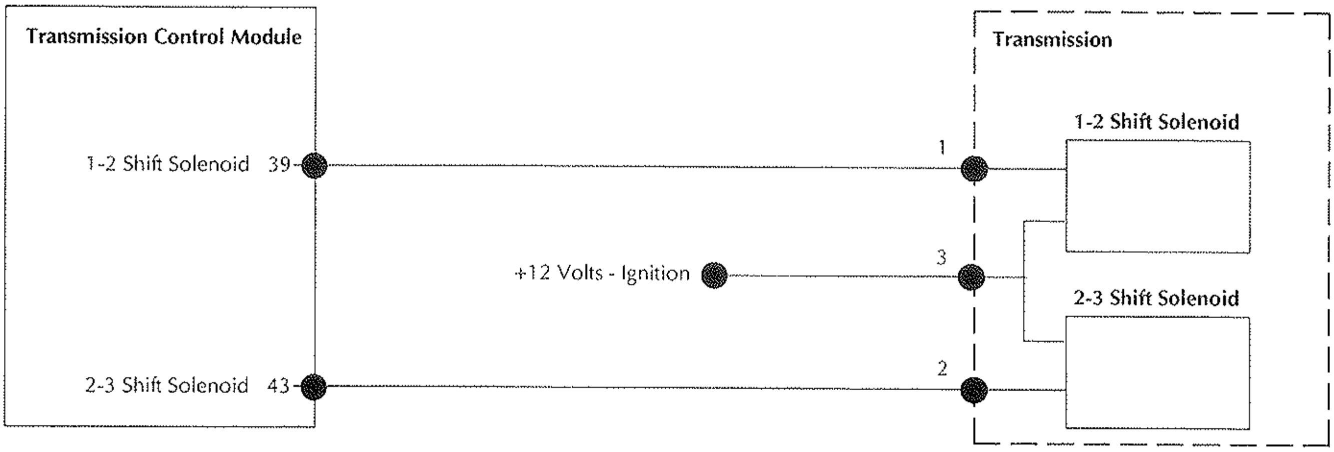


Figure 2. Shift Solenoid Circuits

Fault Code Description

P0756 - This code will be logged if other than 1st gear is engaged when 1st gear is commanded or if 1st gear is engaged when 4th gear is commanded.

P0756 Fault Analysis

1. Connect the PDU or scan tool to the PCM and monitor any logged PCM DTCs.

   If no engine DTCs are logged, go to step 2.

   If any engine DTCs are logged, clear these problems first and then return to step 2 of this procedure.

2. Transfer the PDU or scan tool to the TCM connector. Monitor the transmission range inputs to the TCM.

   With the engine running and the brake pedal applied, select each position of the gear selector lever.

   If the TCM input matches the gear selector position, go to step 3.

   If the TCM input does not match the gear selector position, service the gear selector assembly as necessary, clear the P0756 code and retest to ensure that the problem is resolved.

3. Raise the drive wheels of the vehicle on secure stands. Place the transmission in D.

   Using the PDU, monitor the 1-2 and 2-3 gear shift solenoid signals. The solenoid actuation for each gear is shown in figure 3. Increase the engine speed gently to create a 1-2-3-4 shift pattern.

   If any shift error is detected, go to step 4.

   If all shifts occur correctly, check the following:

   - That the transmisison meets the specifications in the 4L80-E shift chart.
   - Other internal transmission failures may cause more than one shift to occur.
   - Any engine or throttle position sensor faults may influence transmission performance, clear these codes first.

   Rectify any problems identified in the above checks, clear the P0756 code and retest to ensure that the problem is resolved.

4. Service the transmission with particular attention to the following:

   - One or both shift solenoids for internal malfunction.
   - Damaged seals on one or both shift solenoids.

   After servicing the transmission, check and if necessary clear any logged DTCs before running the following drive cycle.

   Start the vehicle on a road or rolling road test with the transmission in D and the 1st gear inhibit function deselected. Hold the throttle at 20% and accelerate gently to 55 mph (If the throttle moves more than 3%, stop the vehicle and restart the test).

   The TCM must see the proper ratio for each commanded gear for greater than 1 second in 1st, 2nd, 3rd and 4th gears whilst the throttle opening is 20%.

   Stop the test and check that the P0756 problem is resolved.

2-3 Shift Solenoid

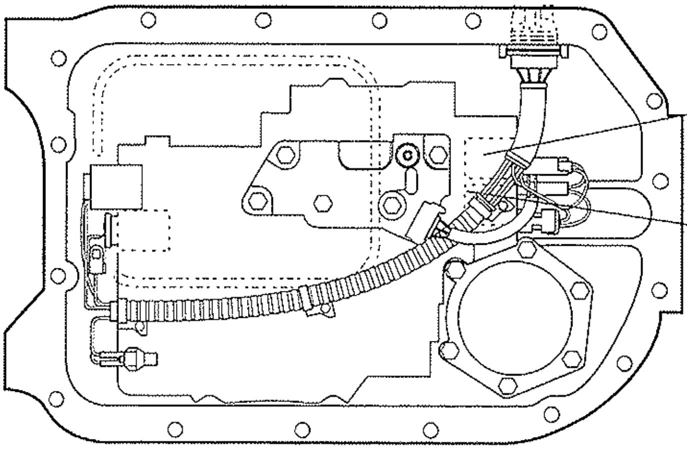


Figure 1. Shift Solenoid Locations

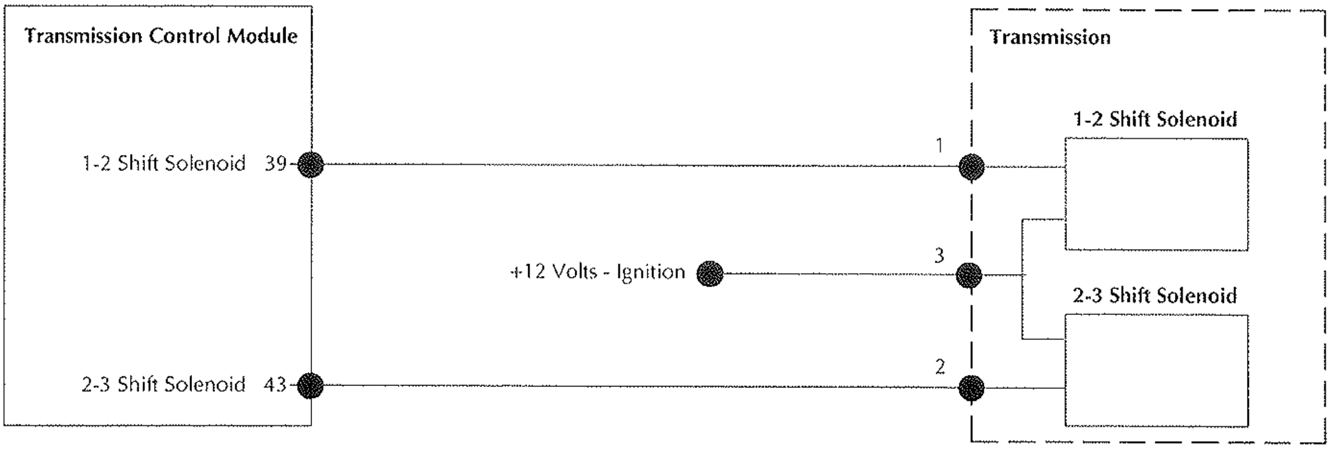


Figure 2. Shift Solenoid Circuits

Fault Code Description

P0758 - This DTC will be logged if the TCM detects a continuous open circuit or a continuous short circuit to ground in the 2-3 shift solenoid or circuit.

P0758 Fault Analysis

1. Inspect the wiring harness and connectors from the TCM to the transmission for poor electrical connections, bent, backed out, deformed or damaged terminals. Inspect the harness for chafed wires which could short to other wiring or to bare metal.

   If no defects are identified, go to step 2.

   If any defects are identified, repair the defect. Clear the P0758 code and retest to ensure that the problem is resolved.

2. Disconnect the transmission connector. Measure the resistance of the 2-3 shift solenoid between pins 2 and 3 of the transmission plug.

   If the resistance is in the range 19-31Ω, go to step 3.

   If the resistance is outside the range 19-31Ω, drain the transmission and remove the sump pan. Service the open circuit solenoid or wiring as necessary. Reassemble and refill the transmission, reconnect all components. Run a rolling road or road test to ensure that the problem is resolved.

3. Check the resistance from transmission connector pins 2 and 3 to the gearbox case.

   If the resistance is greater than 10kΩ, go to step 4.

   If the resistance is less than 10kΩ, drain the transmission and remove the sump pan. Service the short circuit in the solenoid or wiring as necessary. Reassemble and refill the transmission, reconnect all components. Run a rolling road or road test to ensure that the problem is resolved.

4. Disconnect the TCM. Measure the resistance from TCM harness connector pin 43 to transmission connector pin 2.

   If the resistance is less than 5Ω, go to step 5.

   If the resistance is greater than 5Ω, service the open circuit in the wiring from harness connector pin 2 to TCM harness connector pin 43. Reconnect all components and run a rolling road or road test to ensure that the problem is resolved.

5. Measure the resistance from TCM connector pin 43 to chassis ground.

   If the resistance is less than 10kΩ, service the short circuit to ground on the line from TCM connector pin 43 to transmission connector pin 2.

   If the resistance is greater than 10kΩ, the cause of the P0758 fault is not evident at this time. go to the intermittent signal procedure.

Long Shift Adaptation

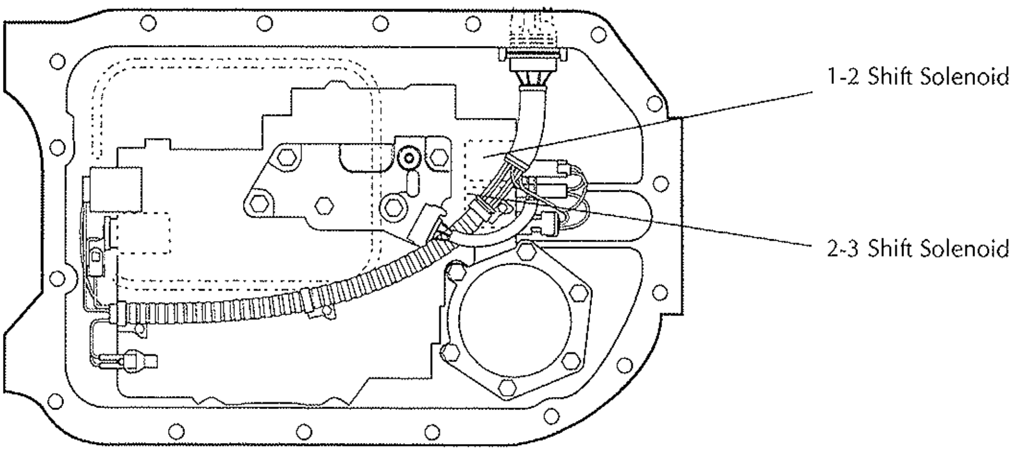


Figure 1. Shift Solenoid Locations

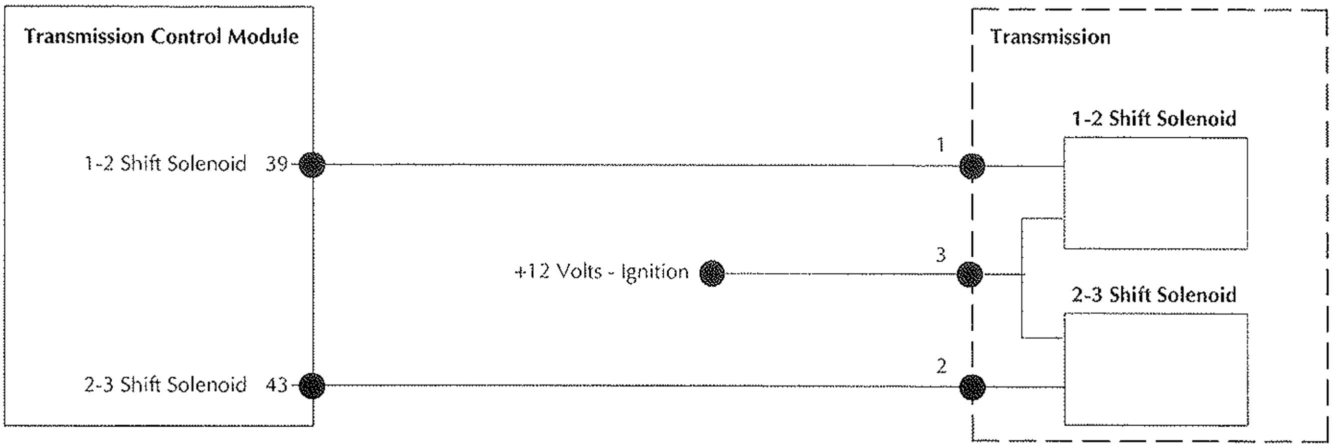


Figure 2. Shift Solenoid Circuits

Fault Code Description

P0780 - Maximum adapts - long shifts

P0780 Fault Analysis

This diagnostic trouble code is logged when the transmission controller can no longer compensate for the increasing slip during gear changes. This increasing slip occurs because of wear or deterioration in the transmission components. The P0780 code is more likely to occur on high mileage vehicles.

1. Should this code be logged, check for other transmission component codes and rectify those problems first.
2. If the P0780 code alone is logged, the transmission is possibly due for a complete service. Have the transmission serviced and then refit it.
3. Reset the TCM and then the PCM and road test the vehicle to ensure that the problem is resolved.

Transmission Component Slipping

Fault Code Description

P1739 - This DTC will be logged if in 4th gear with the TCC engaged, the difference between input and output speeds is greater than ±20 rpm.

P1739 Fault Analysis

1. Connect the PDU or scan tool to the transmission diagnostic socket. Monitor the logged DTCs.

   If any speed signal, shift solenoid or torque convertor clutch code is logged, resolve these problems first and return to step 2 of this procedure if the P1739 code is logged again.

2. Check and if necessary top-up the transmission fluid level using the procedure in the service manual.

   If the transmission fluid level is correct, go to step 3.

   If the transmission fluid level was low, clear the P1739 code. When safe to do so, run a road test in 4th gear with the torque convertor clutch engaged. Check that the transmission slip problem is resolved. If the P1739 code is logged again, go to step 3.

3. There is a significant hydraulic or mechanical problem in the transmission.

   Service the transmission according to the manufacturers instructions if qualified and equipped to do so. Otherwise, replace the transmission.

Torque Reduction Request Signal

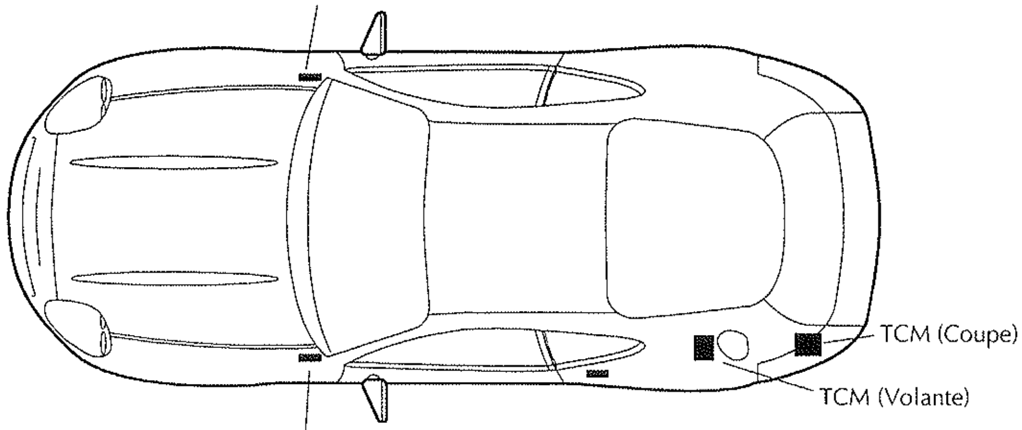


Figure 1. PCM and TCM Locations

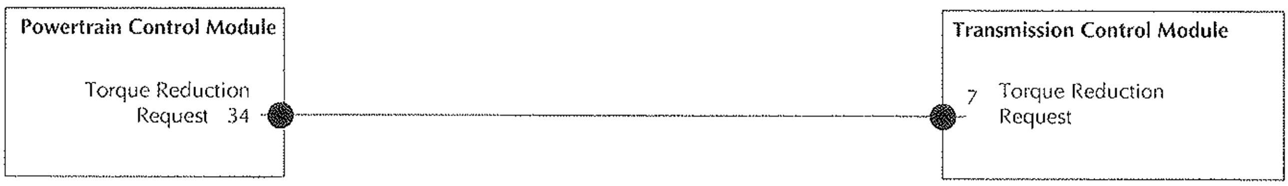


Figure 2. Torque Reduction Signal Circuit

Fault Code Description

P1780 - The torque reduction request signal is either short or open circuit.

P1780 Fault Analysis

1. Connect the PDU or scan tool to the PCM. Analyse and rectify any PCM DTCs before continuing with step 2 of this procedure.

2. Disconnect the TCM. Switch on the ignition.

   Measure the voltage from TCM connector pin 7 to chassis ground.

   If 0 volts is present, go to step 3.

   If 5 volts is present, go to the intermittent signal procedure.

3. Switch off the ignition. Disconnect the PCM.

   Check continuity from TCM connector pin 7 to PCM connector pin 34.

   If continuity is good, go to step 4.

   If a continuity fault exists. service the wiring as necessary. Reconnect all components and run a rolling road or road test to ensure that the problem is resolved.

4. Check for a short circuit to ground from the TCM pin 7.

   If a short circuit is detected, repair the wiring as necessary. Reset the PCM and then the TCM. Run a rolling road or road test to ensure that the problem is resolved.

   If no short circuit is detected, replace the PCM. Reset the PCM and then the TCM. Run a rolling road or road test to ensure that the problem is resolved.

Transmission Fluid Temperature

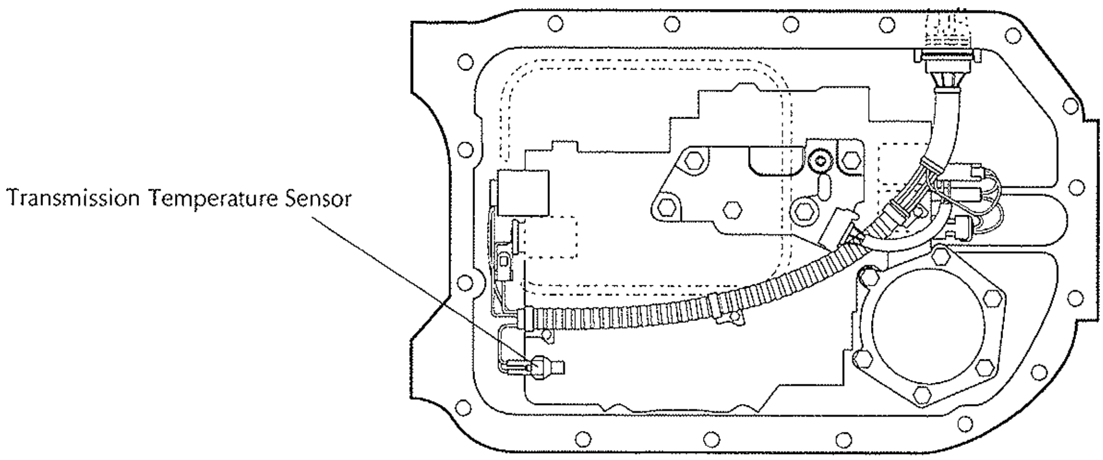


Figure 1.   Temperature Sensor Location

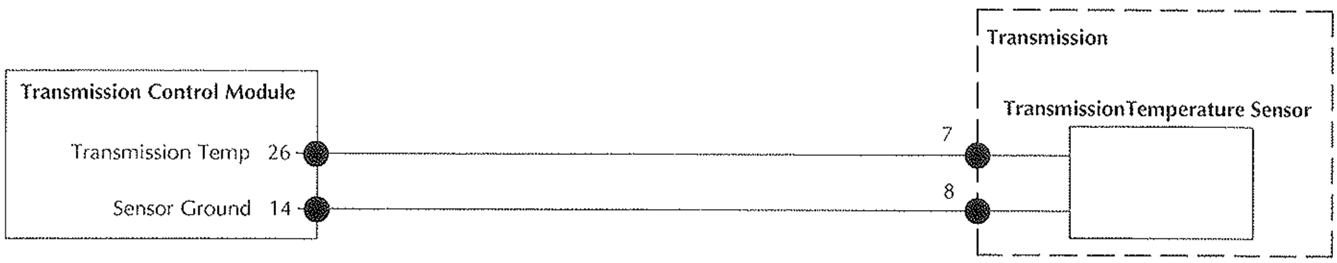


Figure 2.   Temperature Sensor Circuit

Fault Code Description

P1783 - The transmission temperature has exceeded 146°C.

P1783 Fault Analysis

1. Check the transmission fluid level using the workshop manual procedure.

   If the fluid level is correct, go to step 2.

   If the fluid level is low, top up as necessary. Clear the P0753 code and retest to ensure that the problem is resolved.

2. Run the vehicle until the transmission is warm. Connect the PDU or scan tool and check the transmission temperature signal at TCM pin 26. The signal level at normal transmission temperature (100°C - 212°F) should be in the range 1.5 to 2.0 volts.

   If outside the range 1.5 to 2.0 volts, go to step 3.

   If inside the range 1.5 to 2.0 volts, the cause of the P1783 code is not evident at this time. Check for the following:

   - Excessively hard driving.
   - Excessive vehicle loading
   - Poor transmission cooling (blocked radiator)

   If none of the above are relevant, go to the intermittent signal procedure.

3. For high voltage readings, disconnect the TCM and transmission connectors. Check for open circuit conditions in the wiring from TCM pin 26 to transmission connector pin 7.

   If the circuit resistance is below 5Ω, go to step 4.

   If the circuit resistance is greater than 5Ω, service the open circuit. Reconnect all components and run a rolling road or road test to ensure that the problem is resolved.

4. Check the resistance of the temperature sensor between transmission connector pins 7 and 8. Compare the reading with the resistance values in the table below.

Temperature °C	°F	NormalSensor Resistance (Ω)
0	32	9379
20	68	3500
40	104	1460
60	140	668
80	176	333
100	212	177
120	248	100
140	284	60
160	320	36
180	356	21

   If the sensor resistance is within 15% of the normal value, go to step 5.

   If the sensor resistance is more than 15% from the normal value, drain the transmission and remove the sump pan. Replace the transmission temperature sensor. Reassemble and refill the transmission. Run a rolling road or road test to ensure that the problem is resolved.

5. Reconnect the transmission connector. Check the resistance from TCM connector pin 26 to ground.

   If the resistance is more than ±15% below the value in step 4, there is a short circuit to ground. Service the short circuit as necessary (The sensor is wired between pins 7 and 8 of the transmission connector). Reconnect all components. Run a rolling road or road test to ensure that the problem is resolved.

System Voltage

Fault Code Description

P1794 - The system voltage is less than 10.5 volts or greater than 19 volts.

Fault Analysis Procedure

Note: The TCM has two 12 volt feeds. The battery feed is supplied to TCM pin 55. The ignition feed is supplied to TCM pin 53. Ground is connected to TCM pin 54.

Note: This code may be logged if the vehicle is jump started because of a discharged battery. As the fully charged 'slave' battery is disconnected after engine start, the alternator output will surge as it senses the discharged vehicle battery. In this situation, alternator output may momentarily exceed the upper voltage limit. This situation could also be met as you switch off a high output battery charger after using it to aid engine start.

P1794 Fault Analysis

1. Check if the P1794 code was logged during jump starting or battery charging using an external charger.

   If not, go to step 2.

   If the P1794 code was logged during jump starting or battery charging using an external charger, reset the TCM and PCM. Isolate and rectify the cause of the discharged battery.

2. With the ignition off, measure and note the battery voltage across the battery terminals.

   If the voltage is greater than 10.5 volts, go to step 3.

   If the voltage is 10.5 volts or below, service the battery and charging system as necessary. Clear the P1794 code. Return to step 3 of this procedure if the P1794 code is logged again after resolving the battery charge problem.

3. Disconnect the TCM. Switch on the ignition. Check the voltage from TCM connector pins 53 and 55 to chassis ground.

   If the voltage is within 0.5 volts of the measurement in step 2, go to step 4.

   If the voltage difference between the measurements in step 2 and step 3 is more than 0.5 volts, service the defective wiring from the battery or the main relay. Reconnect the TCM. Clear the P1794 code and road test to ensure that the problem is resolved.

4. Check the security of the battery terminals, the battery ground lead and the alternator connections.

   If the terminals are secure, go to step 5.

   If the terminals are loose, service the defect as necessary. Clear the P1794 code and run a rolling road or road test to ensure that the problem is resolved.

5. Connect the voltmeter across the battery. Start the engine. Increase the engine speed to greater than 1500 rpm.

   If the voltage at 1500+ rpm is in the range 13-15 volts, the charge and voltage regulation systems are currently in specification. Go to the intermittent signal procedure and check for intermittent open circuits or for intermittent short circuits to ground.

   If the voltage at 1500+ rpm is outside the range 13-15 volts, service the charging system as necessary. Reconnect all components and clear the P1794 code. Run a rolling road or road test to ensure that the problem is resolved.

Warm-Up Signal

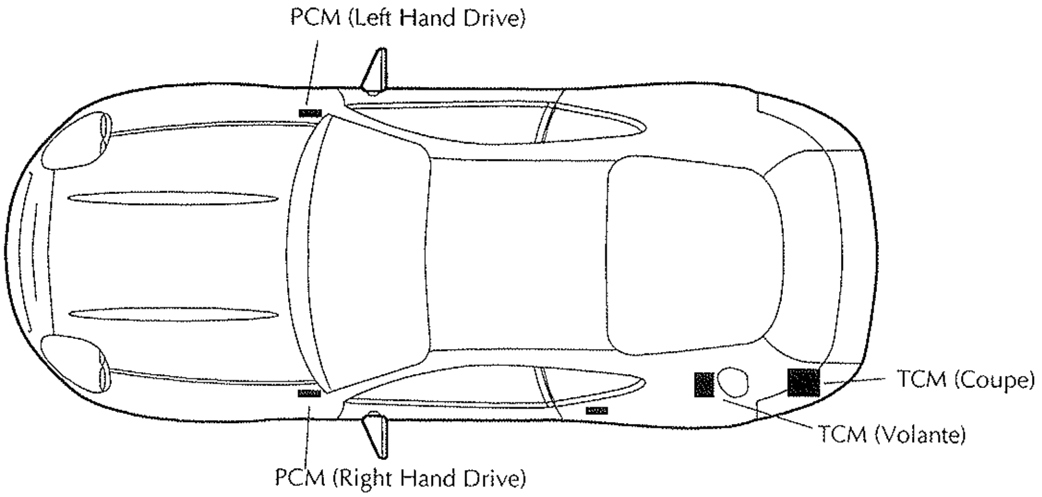


Figure 1. PCM and TCM Locations

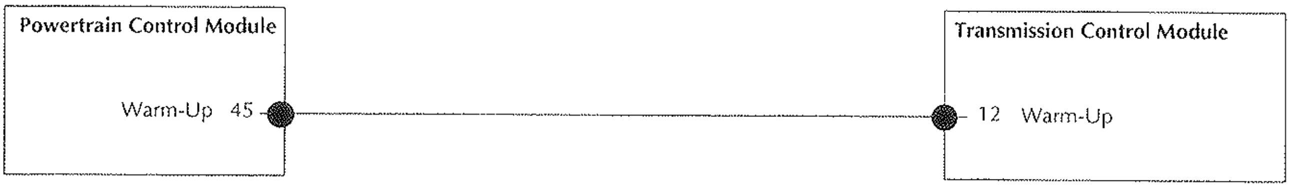


Figure 2. Warm-Up Signal Circuit

Fault Code Description

P1897 - Warm-up signal circuit malfunction

P1897 Fault Analysis

1. Connect the PDU or scan tool. Start the engine. Monitor the warm-up signal input to the TCM.

   The 5 volt warm up signal is modulated between 7% and 93% dependant on the state of the engine management system as follows:

   7% for 10 seconds as warm up is completed.

   50% during standby

   93% if the PCM has any problem interpreting the torque reduction request signal from the TCM.

   If the signal does not meet the above specification, go to step 2.

   If the signal meets the above specification, the cause of the problem is not present at this time. Go to the intermittent signal procedure.

2. Disconnect the TCM and PCM. Check the continuity between TCM connector pin 7 and PCM connector pin 45.

   If continuity is good, go to step 3.

   If a continuity fault is identified, service the wiring as necessary. Reset the TCM and the PCM. Run the KOER test to ensure that the problem is resolved.

3. Replace the PCM. reconnect all components and run the engine to ensure that the problem is resolved.

Contents

Diagnostic Reference Values

The following table records normal expected values for each input and output at the PCM.

Signal Name	PCM Pin	Value				Units
		KOEO	*Hot Idle*	*30mph*	*55 mph*	
Air Pump Monitor	5	0-off/12-on	0	0	0	volts
Crank Position +ve	21	35 x Engine RPM				
Crank Position -ve	22	0	0	0	0	volts
Power Ground	24	0	0	0	0	volts
Case Ground	25	0	0	0	0	volts
Ignition Coil 1	26	1 pulse per engine revolution				Hz
Low Speed Fan Control	28	0 volts - fans on / 12 volts - fans off				volts
Vehicle Speed -ve	33	0	0	0	0	volts
TRRS from TCM (100Hz sq wave)	34	Normal = 17% (up to 90% during gear change)				duty cycle
HO2S 1-2 (Cyl 1-3 rear)	35	0.05 approx	0.2 - 0.8	0.2 - 0.8	0.2 - 0.8	volts
MAF Return	36	0	0	0	0	volts
Inlet Air Temperature (IAT1)	37	3.51 at 10°C to 0.27 at 120°C				volts
Engine Coolant Temperature (ECT)	38	3.51 at 10°C to 0.27 at 120°C				volts
Inlet Air Temperature (IAT2)	39	3.51 at 10°C to 0.27 at 120°C				volts
Fuel Pump Monitor (pump 1)	40	0-off/12-on	12	12	12	volts
A/C Clutch	41	0-off	0-off/12-on	0-off/12-on	0-off/12-on	volts
Fuel Pump 2 Relay	42	0-on/12-on	12	12	12	volts
PWMWU (warm up to TCM)	45	50%	50%	50%	50%	duty cycle
High Speed Fan Control	46	0-off/12-on	0-off/12-on	0-off/12-on	0-off/12-on	volts
EGR Vacuum Valve	47	100%	0%	0%	40-60%	duty cycle
Tachometer (echo PIP)	48	3 x engine rpm				Hz
Power Ground (PWR GND)	51	0	0	0	0	volts
Ignition Coil 2 (cyl 5 & 2)	52	1 pulse per engine revolution				Hz
PWMTP (TP REL PWM to TCM)	54	10%	10%	10-90%	10-90%	duty cycle
Keep Alive Memory (KAM) Batt +ve	55	12	12	12	12	volts
Vapour Management Valve	56	0%	0-100%	0-100%	0-100%	duty cycle
Vehicle Speed +ve	58	2.28 Hz per 1 mph				Hz
HO2S 1-1 (Cyl 1-3 front)	60	0.05 approx	0.2-0.8	0.2-0.8	0.2-0.8	volts
HO2S 2-2 (Cyl 4-6 rear)	61					

Signal Name	PCM Pin	Value				Units
		KOEO	Hot Idle	30mph	55 mph	
Neutral Drive Switch (PRNDL)	64	0	0	12	12	volts
Differential Pressure Feedback (DPFE)	65	0.5	0.5	0.5	1.2-1.3	volts
Cannister Vent Valve	67	0	0-off/12-on	0	0	volts
A/C Cut Off (WAC)	69	0-off/12-on	0	0	0	volts
Air Pump Relay	70	0-on/12-off	12	12	12	volts
Ignition Supply	71	12	12	12	12	volts
Fuel Injector 5	73	0mS	2.8Ms	400-430mS	400-430mS	pulse width
Fuel Injector 3	74	0mS	2.8Ms	400-430mS	400-430mS	pulse width
Fuel Injector 1	75	0mS	2.8Ms	400-430mS	400-430mS	pulse width
Power Ground (PWR GND)	76	0	0	0	0	volts
Power Ground (PWR GND)	77	0	0	0	0	volts
Ignition Coil 3 (cyl 3 & 4)	78	1 pulse per engine revolution				Hz
Fuel Pump Relay (pump 1)	80	0-on/12-off	0	0	0	volts
Idle Speed Control Valve	83	0	30-55%	55%	55%	duty cycle
Cylinder ID (Cam Sensor) (CID +ve)	85	Half engine rpm				Hz
HO2S 2-1 (rear upper)	87	0.05 approx	0.2 - 0.8	0.2 - 0.8	0.2 - 0.8	volts
Mass Air Flow (MAF)	88	0	0.71	1.2	1.5	volts
Throttle Position Sensor (TPS)	89	0.66-1.20	0.66-1.20	0.66-4.78	0.66-4.78	volts
+5V Voltage Reference (VREF)	90	5	5	5	5	volts
Signal Return	91	0	0	0	0	volts
HO2S 1-1 Heater (front upper)	93	12-off/0-on	12-off.0-on	12-off/0-on	12-off/0-on	volts
HO2S 2-1 Heater (rear upper)	94	12-off/0-on	12-off.0-on	12-off/0-on	12-off/0-on	volts
HO2S 1-2 Heater (front lower)	95	12-off/0-on	12-off.0-on	12-off/0-on	12-off/0-on	volts
HO2S 2-2 Heater (rear lower)	96	12-off/0-on	12-off.0-on	12-off/0-on	12-off/0-on	volts
Ignition Supply	97	+12	+12	+12	+12	volts
Fuel Injector 6	99	0mS	2.8Ms	400-430mS	400-430mS	pulse width
Fuel Injector 4	100	0mS	2.8Ms	400-430mS	400-430mS	pulse width
Fuel Injector 2	101	0mS	2.8Ms	400-430mS	400-430mS	pulse width
Power Ground (PWR GND)	103	0	0	0	0	volts

Signal Names

The following list contains the signal names and descriptions for the powertrain control system of DB7. These signal titles are met most frequently in the datalogger function.

Signal	Description
ACCS	Air-Con Control Switch - 1 = A/C On
ACP	Air-Con Pressure Sensor - 1 = A/C pressure high
ACT MAX	Maximum Intake Air Temperature signal during normal running
Adap Fuel 1	Current Adaptive Fuel Correction - (% of range)
Adap Fuel 2	Current Adaptive Fuel Correction - (% of range)
ADPT1F	Adaptive Fuel - Table 1 failure mode
ADPT2F	Adaptive Fuel - Table 2 failure mode
AIR	Air Pump On/Off - 1 = Pump On
AIRM	Air Pump Monitor - 1 = high, pump on
B+	Battery Positive - Volts
BARO	Barometric Pressure
CID	Cylinder Identification - Cam sensor status
CMP STAT	Cam Position Sensor - 1 = CID mis, not currently reliable
DRVCNT	Number of OBDII Drive Cycles Completed
DSDRPM	Desired engine speed (RPM)
DTCCNT	Diagnostic Trouble Codes Count (Fault codes + pending codes. MIL and non-MIL)
ECT MAX	Maximum Engine Coolant Temperature signal during normal running
ECT STAT	Engine Coolant Temperature - In or out of range
ECT-C	Engine Coolant Temperature - °C or raw counts
ECT-V	Engine Coolant Temperature - Volts or raw counts
EGR STAT	EVP EGR sensor failure
ENGLOAD	Engine Load (Ratio of air charge over standard)
ENGRPM	Engine Speed - RPM
EPT	DPFE Sensor feedback
EVAP DC	Cannister Purge Duty Cycle (% on)
EVAPCVA	Vapour Management Valve (VMV) fault detected
Evts HI	Cumulative cylinder events total carried over from previous background logic executions
Evts LO	Cumulative cylinder events total carried over from previous background logic executions
FPM	Fuel Pump Monitor - 0 = pump off, 1 = pump on
FPUMP DC	Desired Fuel Pump Duty Cycle - 0% or 100%
H02S12	Sensor Output - Volts
H02S21	Sensor Output - Volts
H02S22	Sensor Output - Volts
H02SII	Sensor Output - Volts
HFC	High Speed Fan Status
Htr11 ret	Highest number of retries seen on the HO2S 11 heater
Htr12 ret	Highest number of retries seen on the HO2S 12 heater
Htr21 ret	Highest number of retries seen on the HO2S 21 heater
Htr22 ret	Highest number of retries seen on the HO2S 22 heater
HTRCM11	HO2S 11 heater current
HTRCM12	HO2S 12 heater current
HTRCM21	HO2S 21 heater current
HTRCM22	HO2S 22 heater current
IACDTCY	Idle Air Control Duty Cycle (% open)
IAT	Intake Air Temperature - °C or raw input counts
IAT STAT	Air Temperature - Temperature sensor failure
IAT-V	Intake Air Temperature - Volts or raw counts
IGN	Desired Ignition Timing - ° BTDC
INDS	Input from manual lever position sensor (counts)
IPWA	Injector Pulse Width in mS- Bank A (Cylinders 1-3)
IPWB	Injector Pulse Width in mS- Bank B (Cylinders 4-6)

Signal	Description
LAMSE1	Current Short Term Fuel Trim 1, adjustment from stoich - (% of range)
LAMSE2	Current Short Term Fuel Trim 2, adjustment from stoich - (% of range)
LFC	Low Speed Fan Status
LOOP	Fuel Control - 1 = Open Loop, 0 = Closed Loop
MAF MAX	Maximum Mass Air Flow signal during normal running
MAF	Raw MAF sensor output (A/D counts)
MAF STAT	Mass Air Flow Meter - MAF sensor failure
MIL	Malf. Indicator Lamp Status - 1 = Lamp On
Mis HI	Cumulative misfires detected by misfire test (Hi bit).
Mis LO	Cumulative misfires detected by misfire test (Lo bit).
Mis nc HI	Cumulative misfires detected by a misfire test (Hi bit).
Mis nc LO	Cumulative misfires detected by a misfire test.
Mis1 HI	Cumulative misfires detected by cylinder 1 misfire test (Hi bit).
Mis1 LO	Cumulative misfires detected by cylinder 1 misfire test (Lo bit).
Mis2 HI	Cumulative misfires detected by cylinder 2 misfire test (Hi bit).
Mis2 LO	Cumulative misfires detected by cylinder 2 misfire test (Lo bit).
Mis3 HI	Cumulative misfires detected by cylinder 3 misfire test (Hi bit).
Mis3 LO	Cumulative misfires detected by cylinder 3 misfire test (Lo bit).
Mis4 HI	Cumulative misfires detected by cylinder 4 misfire test (Hi bit).
Mis4 LO	Cumulative misfires detected by cylinder 4 misfire test (Lo bit).
Mis5 HI	Cumulative misfires detected by cylinder 5 misfire test (Hi bit).
Mis5 LO	Cumulative misfires detected by cylinder 5 misfire test (Lo bit).
Mis6 HI	Cumulative misfires detected by cylinder 6 misfire test (Hi bit).
Mis6 LO	Cumulative misfires detected by cylinder 6 misfire test (Lo bit).
MISF	Misfire Monitor - 1 = Currently misfiring
ODCODES	Total number of on-demand codes currently stored.
PGM CVS DC	Purge Management Duty Cycle (% on)
PIP	Profile Ignition Pick-Up - PIP input level
PNP	Park Neutral Position Switch
R-BIAS1	Rear bias trim (Bank 1, cylinders 1-3)
R-BIAS2	Rear bias trim (Bank 2, cylinders 4-6)
RATCH	Lowest TP reading during driving
TP MAX	Maximum Throttle Potentiometer signal during normal running
TP STAT	Throttle Position Sensor - TP sensor failure
TP	Throttle Potentiometer - Volts or counts
TPR-V	Raw counts from sensor
TQ-NET	Net torque into the torque convertor
TRIP	OBDII Drive Cycle Complete (except cat monitor) - 1 = Trip completed
TRIPCNT	Number of Completed OBDII Trips
VS MAX	Maximum Vehicle Speed signal during normal running
VS STAT	Vehicle Speed Sensor mode flag
VS	Vehicle Speed - MPH
WAC	Wide Open Throttle A/C Cut-Off - 1 = High (WOT Relay)

PID No.	EECV Name	Datalogger Name	Description
0100	TRIP_COUNT	TRIPCNT	This is the number of complete OBDII drive cycles that have been completed since the last scan tool reset. A complete OBDII drive cycle means that all the OBDII monitors have completed. A scan tool reset happens during fault (P code) clearance.
0101	DRIVE_COUNT	DRVCNT	This is the number of trips, during which, the vehicle has entered closed loop fuel control since the last scan tool reset.
0200	CODES_COUNT	DTCCNT	This is the total number of pending/non-pending, MIL/non-MIL codes stored in the EECV memory.
0202	OD_CODE_CNT	ODCODES	This is the total number of "on demand" fault codes stored in memory. On demand codes are specific to KOEO/KOER tests.
1101 bit 0	ACSW	ACCS	This flag indicates the state of the EECV A/C input. 1 = A/C demanded
1101 bit 3	NDSFLG	PNP	This flag reflects the state of the neutral/drive EECV input. This applies to automatic vehicles only and should show a state of 0 (neutral) when P or N is engaged on the PRND23 selector. When R,D,2 or 3 are selected the flag state should be 1 indicating drive.
1102 bit 0	ACPSW	ACP	This flag reflects the state of the A/C medium pressure switch. Depending on engine conditions, the EECV will turn on the high speed fan in response to this flag.
1102 bit 4	PIP_HIGH	PIP	This flag toggles with the engine speed signal output on EECV pin 48 (3 pulses/engine rev). As this flag toggles rapidly (depending upon engine speed), it is unlikely that each state will be captured by the scan tool/PDU.
1102 bit 5	FFG_MISFIRE	MISF	This flag indicates that the OBDII system is currently detecting an engine misfire. 1 = misfire
1103 bit 2	LSF_FLG	LFC	This flag indicates that the EECV has commanded the low speed fan on. 1 = on
1103 bit 3	HSF_FLG	HFC	This flag indicates that the EECV has commanded the high speed fan on. 1 = on
1103 bit 5	MIL_ON	MIL	This flag indicated the MIL lamp is commanded on. 1 = on
1103 bit 6	OLFLG	LOOP	This flag reflects the state of the fuel system. 1 = open loop. 0 = closed loop using the oxygen sensors for feedback control.
1103 bit 7	TRIP	TRIP	This flag will assume a value of 1 when all the OBDII monitors have run. At this point TRIP_CNT will be incremented by 1.
1104 bit 0	ACCFLG	WAC	Flag indicating the state A/C control from the EECV. 1 = A/C on 0 = A/C off

PID No.	EECV Name	Datalogger Name	Description
1104 bit 4	EAM	AIR	Flag showing the state of the electric air injection command. 1 = Electric air commanded on
1104 bit 6	CID_HIGH	CID	Flag indicating the state of the CID (camshaft) sensor input to the EECV. 1 = high 0 = low. The duration of this signal is short compared to the sampling rate of the scan tool/PDU. Many of these edges will be missed and this should not be taken to be an intermittent fault on the sensor or associated wiring.
1106 bit 1	VSFMFLG	VS stat	This flag indicates a fault with the vehicle speed sensor or its' circuit. 1 = fault present
1106 bit 2	EFMFLG	EGR stat	This flag indicates a fault with the EGR system. 1 = fault is present
1106 bit 4	MFMFLG	MAF stat	This flag indicates a fault with the mass air flow meter or its' circuit. 1 = fault is present
1106 bit 5	TFMFLG	TP stat	This flag indicates a fault with the throttle position sensor or its' circuit. 1 = fault is present
1106 bit 6	CFMFLG	ECT stat	This flag indicates a fault with the engine coolant temperature sensor or its' circuit. 1 = fault is present
1106 bit 7	AFMFLG	IAT stat	This flag indicates a fault with the throttle body air charge temperature sensor or its' circuit. 1 = fault is present
1107 bit 0	FFG_CID	CMP stat	This flag indicates a fault with the camshaft position sensor or its' circuit. 1 = fault is present
1107 bit 6	ADT2FMFLG	ADPT2F	This flag indicates a failure in the fuel system, or its' associated components, which has caused the adaptive fuel control to exceed normal limits. This flag applies to bank 2 (rear 3 cylinders)
1107 bit 7	ADT1FMFLG	ADPT1F	This flag indicates a failure in the fuel system, or its' associated components, which has caused the adaptive fuel control to exceed normal limits. This flag applies to bank 1 (front 3 cylinders)
110C bit 0	F_PUMP_S_MON	FPM	This flag follows the 1st fuel pump monitor input to the EECV. With the pump running the flag should assume a value of 1. - Pin 40
110C bit 1	EAMM	AIRM	This flag follows the electric air pump monitor input to the EECV. With the pump running the flag should assume a value of 1. (Pin 5)
1123	IAT	IAT-C	This is the throttle body intake air temperature.
1125	APT	TMODE	This 3 state flag represents the throttle mode. Closed/Part/Full
1126	ATMR1	AST	This parameter counts up seconds from engine start, it has a maximum value of 255.

PID No.	EECV Name	Datalogger Name	Description
1127	BP	BARO	This parameter represents the calculated barometric pressure. As the value is calculated it should not be used for diagnostic purposes.
1135	DSDRPM	DSDRPM	This is the target engine speed during closed loop engine speed control (hot/cold idle)
1139	ECT	ECT-C	This is the engine coolant temperature
1141	FUELPW1	IPWA	This is the corrected fuel injector pulse width in mS for bank 1 (cyls 1,2 & 3). The actual measured pulse width will vary slightly from this reported value due to battery voltage correction.
1142	FUELPW2	IPWB	This is the corrected fuel injector pulse width in mS for bank 2 (cyls 4,5 & 6). The actual measured pulse width will vary slightly from this reported value due to battery voltage correction.
114A	ACT_CNTS	IAT-V	This is the throttle body air charge temperature voltage signal. (Pin 39)
114D	ECT_CNTS	ECT-V	This is the throttle body engine coolant temperature voltage signal. (Pin 38)
114E	IEGR	EPT	This is the EGR delta pressure sensor voltage signal. (Pin 65)
1151	INDS	INDS	This is the neutral/drive switch voltage signal. This switch is only present on vehicles with automatic transmission and is the raw signal upon which the flag PNP is calculated from. (Pin 64)
1153	ISCDTY	IACDTCY	This is the duty cycle of the idle speed control valve
1154	TP_ENG	TP	This is the throttle position sensor voltage signal. (Pin 89)
1156	KAMRF1	Adap Fuel 1	This is the adaptive (long term) fuelling trim being applied during the present engine speed/load conditions. This applies to Bank 1 (cyls 1,2 & 3).
1157	KAMRF2	Adap Fuel 2	This is the adaptive (long term) fuelling trim being applied during the present engine speed/load conditions. This applies to Bank 2 (cyls 4,5 & 6).
1158	LAMBSE1	LAMBSE1	This is the corrective (short term) fuelling trim being applied during the present engine speed/load conditions. This value will vary in response to the oxygen sensor voltage. Lambse1 applies to Bank 1 (cyls 1,2 & 3).
1159	LAMBSE2	LAMBSE2	This is the corrective (short term) fuelling trim being applied during the present engine speed/load conditions. This value will vary in response to the oxygen sensor voltage. Lambse2 applies to Bank 1 (cyls 4,5 & 6).

PID No.	EECV Name	Datalogger Name	Description
115A	LOAD	ENGLOAD	This is a percent load value similar in concept to volumetric efficiency except that it is calculated using mass air flow. The actual value can exceed 100% because the engine is supercharged.
1165	N	ENGRPM	This value is engine speed.
1166	PG_DC	EVAP DC	This value is the vapour management valve (purge valve) duty cycle. The higher the value, the more purge vapours are being ingested by the engine.
1167	PGM_CVS_DC	PGM CVS DC	This value is the duty cycle of the carbon canister vent valve. Under normal purge conditions the vent valve is fully open (100%). The valve closes when running certain purge system diagnostics. (0%)
1169	RATCH	RATCH	This value represents the learned closed throttle (idle) voltage from the throttle position sensor.
116B	SAFTOT	IGN	This value is the calculated ignition advance in degrees before top dead centre. A negative value reads as degrees after top dead centre.
1172	VBAT	B+	This is battery voltage as measured at the EECV ignition supply.
1173	VEGO11	HO2S11	This is the voltage of the bank 1 up stream oxygen sensor. The value will vary between approximately 0.1v and 0.8v in response to fuelling changes when the engine is under closed loop fuel control,(see Lambse1). HO2S11 reacts to the exhaust gasses from cylinders 1,2 & 3.
1174	VEGO12	HO2S12	This is the voltage of the bank 1 down stream oxygen sensor, (catalyst monitor sensor located down stream of the under floor catalyst). The voltages of oxygen sensors located after the catalyst, typically, do not exhibit the characteristic lean rich cycle associated with the fuel control sensors located before the catalyst. The damping effect that the catalyst has on the down stream sensor is used to diagnose failing or non-functioning catalysts. HO2S12 reacts to the exhaust gasses from cylinders 1,2 & 3.
1175	VEGO21	HO2S21	This is the voltage of the bank 2 up stream oxygen sensor. The value will vary between approximately 0.1v and 0.8v in response to fuelling changes when the engine is under closed loop fuel control,(see Lambse2). HO2S21 reacts to the exhaust gasses from cylinders 4,5 & 6.

PID No.	EECV Name	Datalogger Name	Description
1176	VEGO22	HO2S22	This is the voltage of the bank 2 down stream oxygen sensor, (catalyst monitor sensor located down stream of the under floor catalyst). The voltages of oxygen sensors located after the catalyst, typically, do not exhibit the characteristic lean rich cycle associated with the fuel control sensors located before the catalyst. The damping effect that the catalyst has on the down stream sensor is used to diagnose failing or non-functioning catalysts. HO2S22 reacts to the exhaust gasses from cylinders 4,5 & 6.
11C1	VS	VS	This value is measured vehicle speed.
160E	nummis1	Mis1 lo	This is the cumulative total number of SUSPECTED misfires for cylinder No.1. The OBDII system attempts to detect the presence of cylinder misfires The MIL lamp will be turned on if the misfire level is sufficient to degrade the vehicle emission performance or damage the catalyst.
160F	nummis2	Mis2 lo	This is the cumulative total number of SUSPECTED misfires for cylinder No.2. The OBDII system attempts to detect the presence of cylinder misfires The MIL lamp will be turned on if the misfire level is sufficient to degrade the vehicle emission performance or damage the catalyst.
1610	nummis3	Mis3 lo	This is the cumulative total number of SUSPECTED misfires for cylinder No.3. The OBDII system attempts to detect the presence of cylinder misfires The MIL lamp will be turned on if the misfire level is sufficient to degrade the vehicle emission performance or damage the catalyst.
1611	nummis4	Mis4 lo	This is the cumulative total number of SUSPECTED misfires for cylinder No.4. The OBDII system attempts to detect the presence of cylinder misfires The MIL lamp will be turned on if the misfire level is sufficient to degrade the vehicle emission performance or damage the catalyst.
1612	nummis5	Mis5 lo	This is the cumulative total number of SUSPECTED misfires for cylinder No.5. The OBDII system attempts to detect the presence of cylinder misfires The MIL lamp will be turned on if the misfire level is sufficient to degrade the vehicle emission performance or damage the catalyst.
1613	nummis6	Mis6 lo	This is the cumulative total number of SUSPECTED misfires for cylinder No.6. The OBDII system attempts to detect the presence of cylinder misfires The MIL lamp will be turned on if the misfire level is sufficient to degrade the vehicle emission performance or damage the catalyst.
1616	nummis	Mis lo	This is the cumulative total number of SUSPECTED misfires for all cylinders. The OBDII system attempts to detect the presence of cylinder misfires The MIL lamp will be turned on if the misfire level is sufficient to degrade the vehicle emission performance or damage the catalyst.

PID No.	EECV Name	Datalogger Name	Description
1633	IMAF	MAF	This is the mass air flow meter voltage. (Pin 88)
1639	TPR_CNTS	TPR-V	This is the fuel tank pressure sensor voltage.
163E	R_BIAS1	R-BIAS1	This parameter represents the amount of fuelling bias which is being applied due to the oxygen sensor located down stream of the bank 1 catalysts. This trim is used as a final adjustment to engine fuelling to minimise exhaust emissions.
163F	R_BIAS2	R-BIAS2	This parameter represents the amount of fuelling bias which is being applied due to the oxygen sensor located down stream of the bank 2 catalysts. This trim is used as a final adjustment to engine fuelling to minimise exhaust emissions.
1672	FPUMP_DC	FPUMP DC	This parameter represents the commanded state of the first fuel pump. 0% off 100% on.
1679	HTRCM11	HTRCM11	This is the current measured when the bank 1 up stream oxygen sensor heater is tested by the OBDII system. (cyls 1,2 &3)
167A	HTRCM12	HTRCM12	This is the current measured when the bank 1 down stream oxygen sensor heater is tested by the OBDII system. (cyls 1,2 & 3)
167B	HTRCM21	HTRCM21	This is the current measured when the bank 2 up stream oxygen sensor heater is tested by the OBDII system. (cyls 4,5 &6)
167C	HTRCM22	HTRCM22	This is the current measured when the bank 2 up stream oxygen sensor heater is tested by the OBDII system. (cyls 4,5 &6)
1631 bit 0	HEGOHTR11	HTR11	0 = Off/OK This is a flag indicating that the oxygen sensor heater is commanded on - bank 1, up stream. (cyls 1,2 & 3)
1631 bit 1	HEGOHTR12	HTR12	This is a flag indicating that the oxygen sensor heater is commanded on - bank 1, down stream (cyls 1,2 & 3)
1631 bit 2	HEGOHTR21	HTR21	This is a flag indicating that the oxygen sensor heater is commanded on - bank 2, upstream. (cyls 4,5 & 6)
1631 bit 3	HEGOHTR22	HTR22	This is a flag indicating that the oxygen sensor heater is commanded on - bank 2, down stream. (cyls 4,5 & 6)
1631 bit 4	HTR_FAULT11	HTRF11	This is a flag indicating that the oxygen sensor heater is faulty - bank 1, up stream. (cyls 1,2 & 3)
1631 bit 5	HTR_FAULT12	HTRF12	This is a flag indicating that the oxygen sensor heater is faulty - bank 1, down stream. (cyls 1,2 & 3)
1631 bit 6	HTR_FAULT21	HTRF21	This is a flag indicating that the oxygen sensor heater is faulty - bank 2, up stream. (cyls 4,5 & 6)

PID No.	EECV Name	Datalogger Name	Description
1631 bit 7	HTR_FAULT22	HTRF22	This is a flag indicating that the oxygen sensor heater is faulty - bank 2, down stream. (cyls 4,5 & 6)
162F bit 0	EDF_STATUS	LSF stat	This flag indicates a fault with the low speed fan relay pull in circuit (primary circuit)
162F bit 1	HEDF_STATUS	HSF stat	This flag indicates a fault with the high speed fan relay pull in circuit (primary circuit)
162F bit 3	EAM_FAULT	EAM stat	This flag indicates a fault with the electric air management pull in circuit (primary circuit)
162D bit 0	INJ1_FAULT	INJ1F	This flag indicates a fault with injector 1 or its' circuit.
162D bit 1	INJ2_FAULT	INJ2F	This flag indicates a fault with injector 2 or its' circuit.
162D bit 2	INJ3_FAULT	INJ3F	This flag indicates a fault with injector 3 or its' circuit.
162D bit 3	INJ4_FAULT	INJ4F	This flag indicates a fault with injector 4 or its' circuit.
162D bit 4	INJ5_FAULT	INJ5F	This flag indicates a fault with injector 5 or its' circuit.
162D bit 5	INJ6_FAULT	INJ6F	This flag indicates a fault with injector 6 or its' circuit.
1107 bit 4	EGO2FMFLG	EGO2 stat	This flag indicates a fault present with the bank 2 up stream oxygen sensor (cyls 4,5 & 6)
1107 bit 5	EGO1FMFLG	EGO1 stat	This flag indicates a fault present with the bank 1 up stream oxygen sensor (cyls 1,2 & 3)
1689 bit 2	PGM_CVS_FM	PGM_CVS stat	This flag indicates a fault present with the canister vent valve
1107 bit 3	PGM_TPR_FM	TPR stat	This flag indicates a fault present with the fuel tank pressure sensor
16A9 bit 0	FFG_ACT2	IAT2 stat	This flag indicates a fault present with the plenum located inlet air temperature sensor.
16B1 bit 3	TRR_LVL	TRR	This flag toggles with the square wave signal transmitted from the transmission controller to the EECV module. This signal requests a degree of torque reduction during gear changes. As this flag toggles rapidly (depending upon engine speed), it is unlikely that each state will be captured by the scan tool/ PDU. (The signal will alias badly). This signal is only present on vehicles with automatic transmission.
16B1 bit 4	F_PMP2_S_MON	FPM2	This flag reflects the state of the second fuel pump monitor EECV input. During large throttle openings (greater than 3/4 pedal travel) this flag should read on.
113C	EGRDC	EGRDC	This is the commanded duty cycle sent to the EGR vacuum valve.

PID No.	EECV Name	Datalogger Name	Description
162E bit 0	IAC_NO_CUR	IACOC	This flag is set if the idle speed controller circuit is disconnected or shorted to ground. (Pin 83)
162E bit 1	IAC_OVER_CUR	IACSC	This flag is set if the idle speed controller circuit is shorted to battery voltage. - (Pin 83)
162E bit 2	EVR_OPEN	EVROC	This flag is set if the EGR vacuum regulator circuit is disconnected or shorted to ground. - (Pin 47)
162E bit 3	EVR_SHORT	EVRSC	This flag is set if the EGR vacuum regulator circuit is shorted to battery voltage . - (Pin 47)
162E bit 4	MIL_FAULT	MIL stat	This flag indicates a fault with the MIL circuit (bulb or associated wiring) - (Pin 2)
162E bit 5	ACC_STATUS	AC stat	This flag indicates a fault with the A/C cut out circuit. Certain operating conditions cause the EECV to disable the A/C, this is accomplished by activating a normally closed relay. This relay circuit is the one monitored by AC stat. - (Pin 69)
162E bit 6	F_PUMP_ERROR	FP stat	This flag indicates a fault with the 1st fuel pump relay circuit (primary). - (Pin 80)
1630 bit 3	CANVT_FAULT	PGMCVSF	This flag indicates a fault with the canister vent valve circuit.
1687	PGM_TANK_PRS	TANKPRS	This parameter represents the fuel tank pressure. Units inches of water
1699	S_VEGO12	SHO2S12	This parameter represents the signed voltage of the bank 1 (cyls 1,2 & 3) down stream oxygen sensor. The value is the same as HO2S12 except that this parameter can display a negative voltage. Under certain failure conditions, oxygen sensors can reverse their polarity.
169A	S_VEGO22	SHO2S22	This parameter represents the signed voltage of the bank 2 (cyls 4,5 & 6) down stream oxygen sensor. The value is the same as HO2S22 except that this parameter can display a negative voltage. Under certain failure conditions, oxygen sensors can reverse their polarity.
16A7	ACT2_CNTS	IAT2-V	This parameter represents the voltage input from the plenum located air intake temperature sensor . - (Pin 37)
16A8	ACT2_ENG	IAT2-C	This parameter represents the temperature of the air in the plenum chamber

PID No.	EECV Name	Datalogger Name	Description
16BC	S_VEGO11	SHO2S11	This parameter represents the signed voltage of the bank 1 (cyls 1,2 & 3) up stream oxygen sensor. The value is the same as HO2S11 except that this parameter can display a negative voltage. Under certain failure conditions, oxygen sensors can reverse their polarity.
16BD	S_VEGO21	SHO2S21	This parameter represents the signed voltage of the bank 2 (cyls 4,5 & 6) up stream oxygen sensor. The value is the same as HO2S21 except that this parameter can display a negative voltage. Under certain failure conditions, oxygen sensors can reverse their polarity.
16CB	TCM_WU_DTY	WUDC	This parameter represents the duty cycle of the warm up signal sent from the EECV to the transmission controller.

Intermittent Diagnostic Techniques

Intermittent diagnostic techniques help to find and isolate the root cause of intermittent faults associated with the EEC-V system. The material is organised to help- find the fault and perform the repair. There are examples that illustrate the diagnostic techniques. The process of finding and isolating an intermittent starts with recreating a fault symptom, accumulating PCM data and comparing that data to typical values and analysing the results.

Before proceeding, be sure that:

- Customary mechanical system tests and inspections do not reveal a problem.
- Review any Service Bulletins or other technical information sources for the latest relevant data.
- Quick test and associated fault analysis procedures have been completed without finding a fault, and the symptom is still occurring.

Recreating the Fault

Recreating the fault is the first step in isolating the cause of the intermittent symptom. A thorough investigation should start with the customer information regarding the specific symptoms and the conditions under which they occur. If freeze frame data is available, it may help in recreating the conditions at the time the fault occured. Monitoring of the following types of data may be relevant:

- Engine Temperature
- Engine RPM
- Engine Load
- Engine Idle/Accel./Decel.
- Ambient Temperature
- Moisture Conditions
- Road Conditions

PCM Data

PCM data can be accumulated in a number of ways. Gather as much data as possible when the malfunction is occurring to prevent misdiagnosis. Data should be accumulated during different operating conditions and based on the customer description of the fault. Reference the known good data values at the end of the Fault Analysis section of this manual. This will require recording data under four conditions for comparison:

1) KOEO 2) Hot Idle 3) 30 MPH 4) 55 MPH

Acquisition of PCM data using the PDU or scan tool is one of the easiest ways to gather information. Listed below are instructions for gathering data using the Aston Martin Lagonda - Portable Diagnostic Unit (PDU).

Recording PCM Input and Output Signals

Follow the instructions in the PDU Users Guide (at the rear of this manual and in section 9 of the Workshop Manual) to select the signals to be monitored (up to 32 signals).Also select the most appropriate trigger and the recording period to effectively gather the required data. Prepare the vehicle for test (clear PCM memory etc. if appropriate). Operate the vehicle in the required mode (KOEO, KOER or Road Test) and ensure that sufficient data is recorded.

The selected Record Time (test duration) will be automatically divided equally before and after the selected fault trigger. Thus if a 'Record Time' of 10 minutes is chosen, actual recording will be from 5 minutes before the trigger to 5 minutes after the trigger.

Access the recorded data and view all relevant signals. Look for abnormal behaviour or values which are clearly incorrect. Inspect signal waveforms for abrupt or unexpected changes. High spikes on low voltage waveforms are often due to interference from the HT side of the ignition system. Abrupt changes during periods of steady cruising are particularly suspect.

Look for agreement in related signals. For example if TP is changed by opening the throttle during a road test, there should be a corresponding change in IAC, RPM and the PIP signal.

Compare signal levels to the Reference Values included in this manual.

Analysing Data

Once the fault area is identified, the circuits must be checked to determine if the wiring or component is at fault. When making circuit and component measurements, make sure that all accessories and interior lights are off. Use one of the following methods to diagnose a suspected input or output device and its associated circuits. Select the most appropriate method from the list below.

Change Condition to Cause Response

The purpose is to verify that a sensor receives and responds to changes.

- Monitor the sensor signal
- Change the conditions (temperature, pressure, etc as appropriate).
- Monitor for corresponding change in signal level.

Example: Monitor Engine Coolant Temperature while the engine warms up.

Change Input and Verify Output Response

The purpose is to verify how the PCM and actuator circuit responds to sensor input.

- Monitor the appropriate sensor signals
- Cause a change in the input conditions.
- Observe the response in the PCM output.

Example: Increase TP under load, observe change in IAC output.

Click Testing

The purpose is to actuate a solenoid or relay from the PCM by entering the appropriate output test mode.

- Key on,
- Turn outputs on and off.
- Monitor for corresponding changes in controlled signals.

Example: Cooling fan relay.

Coil Resistance

The purpose is to measure the correct resistance value of a device.

- Key off.
- Disconect the component from the vehicle harness.
- Measure the static resistance of the component and compare with nominal values in the Static Resistance Chart in this manual.

Example: Any relay coil.

Harness Open Circuits

The purpose is to check for open circuits in component wiring.

- Key off.
- Disconect the component from the vehicle harness
- Measure the continuity of the isolated circuit.
- The resistance should be less than 5Ω.

Example: Any component circuit.

Harness Short Circuits

The purpose is to check the harness for short circuits to ground or to power.

- Key off.
- Disconnect the circuit from the vehicle harness.
- Measure resistance between the component circuit and the signal return and ground circuits.
- If the resistance is less than 10kΩ, then the two circuits may be shorted.

Example: Any component circuit

Intermittent Ignition Diagnostic Techniques

Intermittent ignition diagnostic techniques help to find and isolate the root cause of intermittent faults associated with the ignition system. The material is organised to help- find the fault and perform the repair. The process of finding and isolating an intermittent ignition fault starts with recreating a fault symptom, accumulating PCM data and comparing that data to typical values and analysing the results.

Before proceeding, be sure that:

- Customary mechanical system tests and inspections do not reveal a problem.
- Review any Service Bulletins or other technical information sources for the latest relevant data.
- KOEO and KOER test and associated fault analysis procedures have been completed without finding a fault, and the symptom is still occurring.

Recreating the Fault

Recreating the fault is the first step in isolating the cause of the intermittent ignition symptom. A thorough investigation should start with the customer information regarding the specific symptoms and the conditions under which they occur. If freeze frame data is available, it may help in recreating the conditions at the time the fault occured. Monitoring of the following types of data may be relevant:

- Engine Temperature
- Engine RPM
- Engine Load
- Engine Idle/Accel./Decel.
- Ambient Temperature
- Moisture Conditions
- Road Conditions

PCM Data

PCM data can be accumulated in a number of ways. Gather as much data as possible when the malfunction is occurring to prevent misdiagnosis. Data should be accumulated during different operating conditions and based on the customer description of the fault. Reference the known good data values at the end of the Fault Analysis section of this manual. This will require recording data under four conditions for comparison:

1) KOEO 2) Hot Idle 3) 30 MPH 4) 55 MPH

Acquisition of PCM data using the PDU or scan tool is one of the easiest ways to gather information. Listed below are instructions for gathering data using the Aston Martin Lagonda - Portable Diagnostic Unit (PDU).

Recording PCM Input and Output Signals

Follow the instructions in the PDU Users Guide (in section 9 of the Workshop Manual) to select the signals to be monitored (up to 32 signals). Also select the most appropriate trigger and the recording period to effectively gather the required data. Prepare the vehicle for test (clear PCM memory etc. if appropriate). Operate the vehicle in the required mode (KOEO, KOER or Road Test) and ensure that sufficient data is recorded.

The selected Record Time (test duration) will be automatically divided equally before and after the selected fault trigger. Thus if a 'Record Time' of 10 minutes is chosen, actual recording will be from 5 minutes before the trigger to 5 minutes after the trigger.

Access the recorded data and view all relevant signals. Look for abnormal behaviour or values which are clearly incorrect. Inspect signal waveforms for abrupt or unexpected changes. High spikes on low voltage waveforms are often due to interference from the HT side of the ignition system. Abrupt changes during periods of steady cruising are particularly suspect.

Look for agreement in related signals. For example if TP is changed by opening the throttle during a road test, there should be a corresponding change in IAC, RPM and the PIP signal.

Compare signal levels to the Reference Values included in this manual.

Analysing Data

Once the fault area is identified, the circuits must be checked to determine if the wiring or component is at fault. When making circuit and component measurements, make sure that all accessories and interior lights are off. Use one of the following methods to diagnose a suspected input or output device and its associated circuits. Select the most appropriate method from the list below.

Change Condition to Cause Response

The purpose is to verify that the coil pack receives and responds to changes.

- Monitor the coil 1, 2 and 3 signals from the PCM.
- Change the conditions (e.g. throttle opening as appropriate).
- Monitor for corresponding change in the ignition coil signals.

Change Input and Verify Output Response

The purpose is to verify how the coil circuits responds to changes in signal input.

- Monitor the appropriate coil signals from the PCM
- Cause a change in the input conditions (e.g. throttle opening as appropriate).
- Using an engine analyser, observe the response in the coil HT output.

Harness Open Circuits

The purpose is to check for open circuits in the PCM to coil pack wiring.

- Key off.
- Disconnect the coil pack and PCM from the vehicle harness
- Measure the continuity of the isolated circuits.
- The resistance should be less than 5Ω.

Harness Short Circuits

The purpose is to check the PCM to coil pack harness for short circuits to ground or to power.

- Key off.
- Disconnect the coil pack and PCM from the vehicle harness.
- Measure resistance between the coil circuits and the signal return and ground circuits.
- If the resistance is less than 10kΩ, then the two circuits may be shorted.

HT Tracking

The purpose is to check if the HT voltage is causing tracking to ground at the coil pack or spark plugs.

- Key off.
- Park the vehicle in a darkened location. Open the bonnet and remove the spark plug lead cover from the cam cover.
- Start the engine and watch for HT discharge (blue flashes) in the areas of the coil pack, spark plug leads and spark plugs.
- If any flashes are observed, replace the faulty component(s).
- If no flashes are observed, use heavily insulated pliers to move the ignition leads and see if any HT discharges occur.

Component Substitution

The purpose is to replace components in turn to eliminate the problem.

Replace the ignition components in turn in the following order. Run a KOER test after each component change and stop the substitution process when the fault is eliminated.

- The Spark Plugs.
- The Spark Plug Leads
- The Ignition Coil Pack
- The Powertrain Control Module
- The Engine Harness