SECTION 3
CONTROL MODULE SYSTEM
CONTENTS

GENERAL DESCRIPTION

The control module system has a computer, Powertrain Control Module (PCM) to control fuel delivery, timing, and some emission control systems.

The control module system, monitors a number of engine and vehicle functions (Figure 3-1) and controls the following operations:

- Fuel control.
- Fuel injection timing.
- Exhaust gas recirculation.
- Transmission shift and shift quality functions. Specific transmission control diagnostics are covered in SECTION 10 of this service manual.

POWERTRAIN CONTROL MODULE (PCM) *Figure 3-2*

The diesel Powertrain Control Module (PCM) is located in the passenger compartment and is the control center of the control module system. The PCM used on the electronic fuel injected 6.5L diesel is referred to as PCME.

The PCM constantly looks at the information from various sensors, and controls the systems that affect vehicle performance. The PCM performs the diagnostic function of the system. It can recognize operational problems, alert the driver through the MIL (Service Engine Soon), and store one or more DTCs which identify the problem areas to aid the technician in making repairs. See diagnosis section for more information.

The PCM is designed to process the various input information (Figure 3-1) and then sends the necessary electrical responses to control fuel delivery, timing and other emission control systems. The input information has an interrelation to more than one output, therefore, if the one input failed it could effect more than one systems operation.

PCM Learning Ability

The PCM has a "learning" ability which allows it to make corrections for minor variations in the fuel system to improve driveability. If the battery is disconnected to clear DTCs, or for repair, the "learning" process has to begin all over again.

A change may be noted in the vehicle's performance. To "teach" the vehicle, make sure the engine is at operating temperature, and drive at part throttle, with moderate acceleration and idle conditions, until normal performance returns.

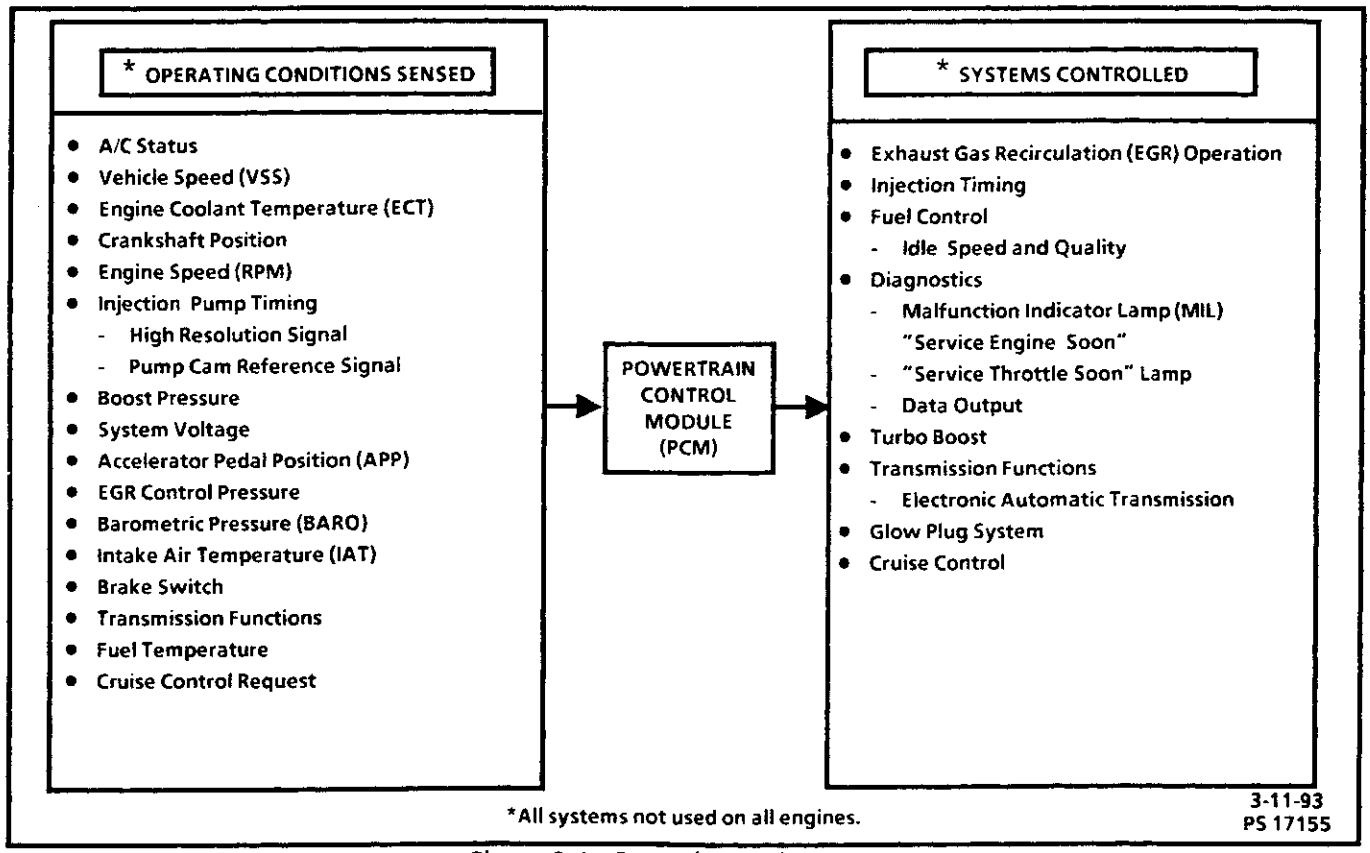


Figure 3-1 - Control Module System

NOTICE: The PCM must be maintained at a temperature below 85°C (185°F) at all times. This is most essential if the vehicle is put through a paint baking process. The PCM will become inoperative if its temperature exceeds 85°C (185°F). Therefore, it is recommended that temporary insulation be placed around the PCM during the time the vehicle is in a paint oven or other high temperature processes.

Electrostatic Discharge Damage

Electronic components used in control systems are often designed to carry very low voltage, and are very susceptible to damage caused by electrostatic discharge. It is possible for less than 100 volts of static electricity to cause damage to some electronic components. By comparison, it takes as much as 4,000 volts for a person to even feel the zap of a static discharge.

There are several ways for a person to become statically charged. The most common methods of charging are by friction and by induction. An example of charging by friction is a person sliding across a car seat, in which a charge of as much as 25,000 volts can build up. Charging by induction occurs when a person with well insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off, leaving the person highly charged with the opposite polarity. Static charges of either type can cause damage, therefore, it is important to use care when handling and testing electronic components.

NOTICE: To prevent possible Electrostatic Discharge damage:

- Do Not touch the PCM connector pins or soldered components on the PCM circuit board.
- When handling a PROM, Do Not touch the component leads, and Do Not remove integrated circuit from carrier.
- Be sure to follow the guidelines listed below if servicing any of these electronic components.

1. Do not open the replacement part package until it is time to install the part.
2. Avoid touching electrical terminals of the part.
3. Before removing the part from its package, ground the package to a known good ground on the vehicle.
4. Always touch a known good ground before handling the part. This step should be repeated before installing the part if the part has been handled while sliding across the seat, while sitting down from a standing position, or while walking a distance.

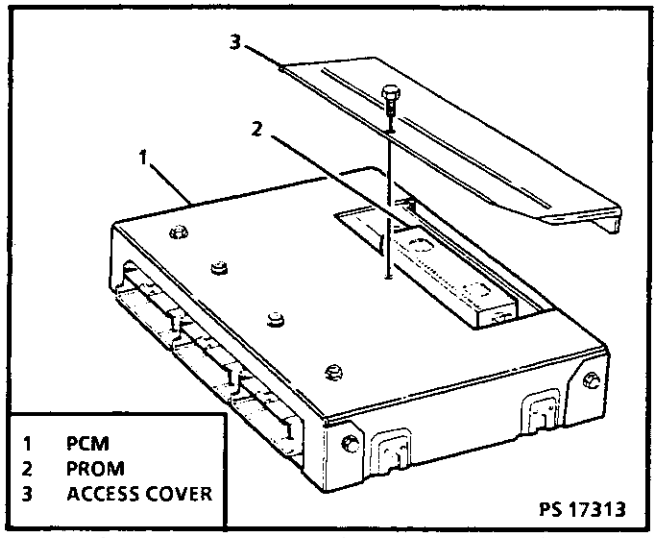


Figure 3-2 - Powertrain Control Module

PCM FUNCTION

The PCM supplies a buffered 5 or 12 volts to power various sensors or switches. This is done through resistances in the PCM which are so high in value that a test light will not light when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. Therefore, the use of a 10 megohm input impedance digital voltmeter is necessary to assure accurate voltage readings.

The input/output devices in the PCM include analog to digital converters, signal buffers, counters, and special drivers. The PCM controls output circuits such as the inject solenoids, etc. by controlling the ground circuit through transistors or a device called a driver in the PCM.

MEMORY

There are three types of memory storage within the PCM: ROM, RAM and PROM.

ROM

Read Only Memory (ROM) is a permanent memory that is physically soldered to the circuit boards within the PCM. The ROM contains the overall control algorithms. Once the ROM is programmed, it cannot be changed. The ROM memory is non-volatile, and does not need power to be retained.

RAM

Random Access Memory (RAM) is the microprocessor "scratch pad." The processor can write into, or read from this memory as needed.

This memory is volatile and needs a constant supply of voltage to be retained. If the voltage is lost, the memory is lost.

PROM
Figure 3-4

Programmable Read Only Memory (PROM) is the portion of the PCM that contains the different engine calibration information that is specific to year, model and emissions.

The PROM also contains specific calibration information used to allow fuel delivery if other parts of the PCM are damaged. The PROM is a non-volatile memory that is read only by the PCM.

While one PCM part number can be used by many vehicle lines, a PROM is very specific and must be used for the right vehicle. For this reason, it is very important to check the latest parts book and service bulletin information for the correct part number when replacing a PROM.

A PCM used for service comes without a PROM. The PROM should be retained with the vehicle following PCM replacement. The PROM from an old PCM must be carefully removed and installed in the new PCM refer to "On-Vehicle Service."

PCM SENSORS AND INPUT SIGNALS

In addition to the PCM, the control module system has some or all of the following information sensors:

- Engine Coolant Temperature (ECT) sensor.
- Accelerator Pedal Position (APP) module.
- Optical sensor.
- Fuel temperature sensor.
- Crankshaft position sensor.
- Intake Air Temperature (IAT) sensor.
- EGR control pressure sensor.
- Barometric Pressure (BARO) sensor.
- Boost sensor.
- Vehicle Speed Sensor (VSS).

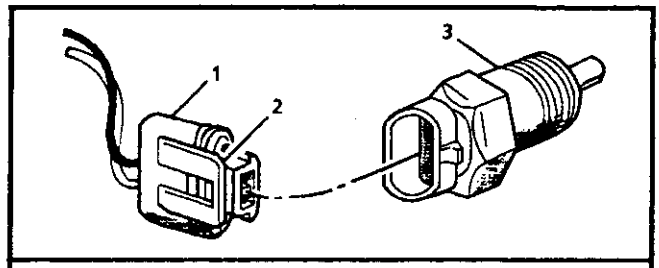
And some or all of the following input signals:

- Fuel inject signal.
- Brake switch signals.
- Glow plug signal.
- Cruise control signals.
- A/C signal.
- Automatic transmission sensors and signals.

Engine Coolant Temperature (ECT) Sensor
Figure 3-3

The Engine Coolant Temperature (ECT) sensor is a thermistor (a resistor which changes value based on temperature) mounted in the engine coolant stream. Low coolant temperature produces a high resistance (100,000 ohms at -40°C/-40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F).

The PCM supplies a 5 volt signal to the Engine Coolant Temperature (ECT) sensor through a resistor in the PCM and measures the voltage. The voltage will be high when the engine is cold, and low when the engine is hot. By measuring the voltage, the PCM knows the engine coolant temperature. Engine coolant temperature affects fuel control and the glow plug system.



1 HARNESS CONNECTOR
2 LOCKING TAB
3 SENSOR

5S 1640-6E

Figure 3-3 - Engine Coolant Temperature (ECT) Sensor

Accelerator Pedal Position (APP) Module
Figure 3-4

The APP module contains three potentiometers (a device for measuring an unknown voltage or potential difference by comparison to a standard voltage). Each of the APP sensors send a varying voltage to the PCM.

By monitoring the output voltage from the Accelerator Pedal Position (APP) module, the PCM can determine fuel delivery based on the accelerator pedal position (driver demand).

Optical Sensor

The optical sensor sends what is called a High Resolution Signal and a Pump Cam signal to the PCM.

High Resolution Signal

The PCM uses this signal to determine injection timing and for fuel control and is one of the most important inputs to the PCM.

Pump Cam Signal

The Pump Cam signal reference pulses are used by the PCM to calculate injection timing and is one of the most important inputs to the PCM.

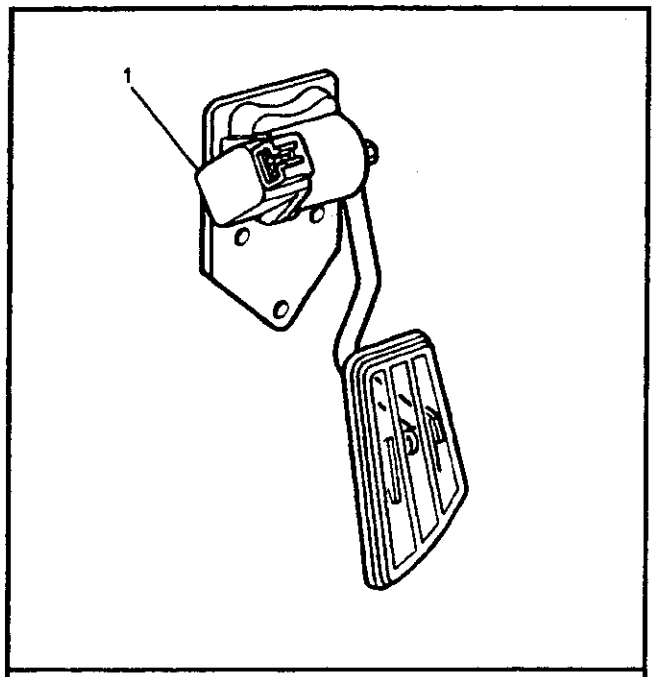


Figure 3-4 - Accelerator Pedal Position (APP) Module

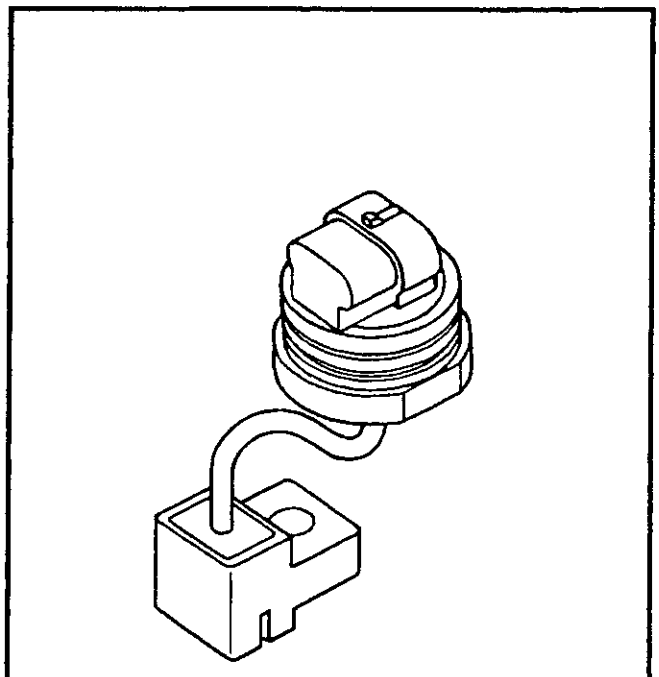


Figure 3-5 - Optical/Fuel Temperature Sensor

Fuel Temperature Sensor
Figure 3-5

The fuel temperature sensor is part of the optical/fuel temperature sensor. The PCM uses the fuel temperature signal for fuel control.

Crankshaft Position Sensor

The crankshaft position sensor provides a signal which the PCM uses as reference to calculate RPM and crankshaft position.

Intake Air Temperature (IAT) Sensor
Figure 3-6

The Intake Air Temperature (IAT) sensor is a thermistor (a resistor which changes value based on temperature) mounted in the intake manifold.

Low temperature produces a high resistance (100,000 ohms at -40°C/-40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F).

The control module supplies a 5 volt signal to the sensor through a resistor in the control module and measures the voltage. The voltage will be high when the intake air is cold, and low when the air is hot. By measuring the voltage, the control module knows the intake air temperature .

The IAT signal is used by the control module to control fuel.

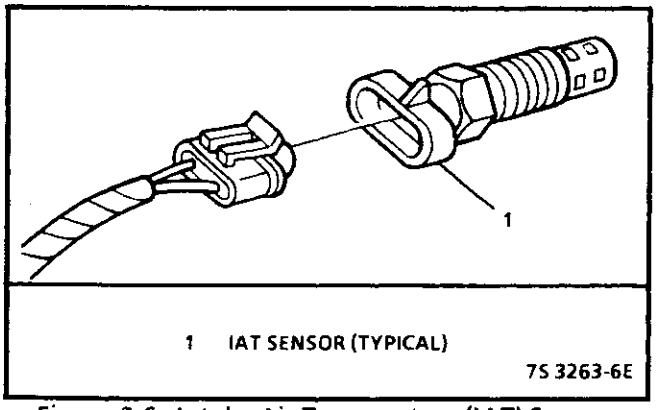


Figure 3-6 - Intake Air Temperature (IAT) Sensor

EGR Control Pressure/BARO Sensor
Figure 3-7

On vehicles equipped with EGR, the EGR control pressure/BARO sensor, mounted on the left side of the cowl, is used to monitor the amount of vacuum in the EGR circuit. It senses the actual vacuum in the EGR vacuum line and sends a signal back to the PCM. The signal is compared to the desired EGR calculated by the PCM. If there is a difference in the PCM command and what is at the EGR valve sensed by the EGR control pressure/BARO sensor on vehicles not equipt with EGR this sensor is used only to measure BARO, the PCM makes minor adjustments to correct.

When a major difference is sensed, the PCM recognizes a fault and sends a maximum EGR signal. This sensor is also used to measure barometric pressure (BARO) under certain conditions, which allows the PCM to automatically adjust for different altitudes.

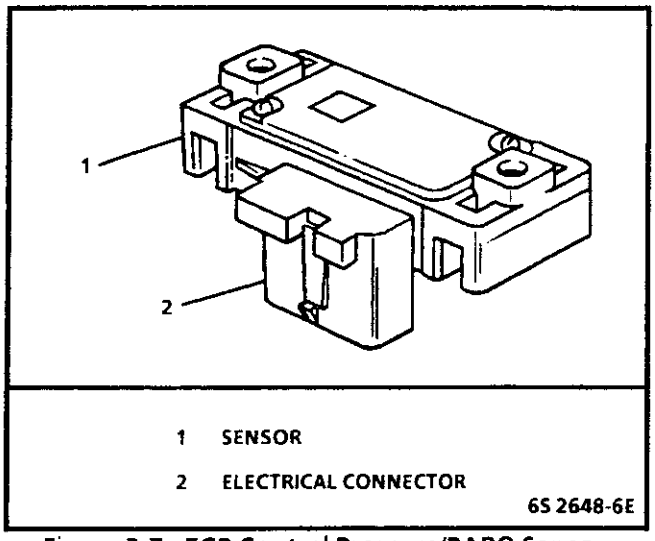


Figure 3-7 - EGR Control Pressure/BARO Sensor

Boost Sensor
Figure 3-8

The boost sensor measures the changes in the intake manifold pressure. The boost sensor converts engine load and speed changes, then converts the change in readings to voltage output.

The PCM sends a 5 volt reference signal to the boost sensor. As the manifold pressure changes, the electrical resistance of the boost sensor also changes. By monitoring the sensor output voltage, the PCM detects the boost pressure. A high pressure (high voltage) requires more fuel. A lower pressure (low voltage) required less fuel.

The control module uses the boost pressure signal to control fuel delivery.

Vehicle Speed Sensor (VSS)

The VSS is attached to the output shaft housing. This device contains a permanent magnet surrounded by a coil of wire producing a magnetic field which is interrupted by rotor teeth pressed on an output shaft. As the rotor interrupts the magnetic field an AC voltage is generated in the circuit.

Vehicle Speed Signal (VSS) Buffer Module

The VSS buffer module is an electronic device. The VSS buffer module process inputs from the vehicle speed sensor and outputs various signals. The VSS buffer module outputs a 4000 pulse per mile signal. This signal is used by the PCM to determine vehicle speed. The PCM uses vehicle speed signal input for cruise control and fuel cutoff. The VSS buffer module is matched to the vehicle based on transmission, final drive ratio and tire size. The VSS buffer module is located behind the instrument panel.

Fuel Inject Signal

The fuel injector driver receives an inject command signal from the PCM and provides a current regulated output to the fuel solenoid that controls injection. It also returns an injection pulse width signal back to the PCM to inform it when the fuel solenoid has actually seated.

Brake Switch Signals

The TCC normally closed brake switch supplies a B+ signal into the PCM. The signal voltage is opened when the brakes are applied.

The cruise control normally open brake switch supplies a B+ signal to the PCM when the brake is applied. These signals are used by the PCM to control transmission and cruise control functions. The brake switches are part of the stoplamp switch.

Glow Plug Signal

The glow plug system is used to assist in providing the heat required to begin combustion during engine starting at cold ambient temperatures.

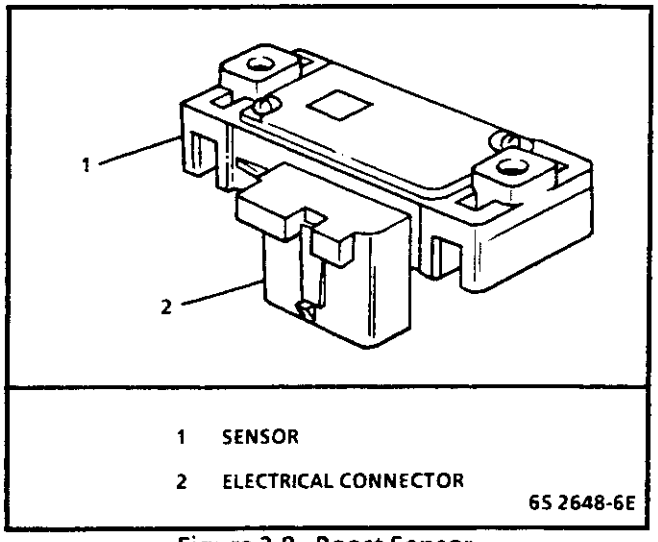


Figure 3-8 - Boost Sensor

The glow plugs are heated before and during cranking, as well as initial engine operation. The PCM monitors the glow plug relay output.

Cruise Control Signal

The cruise control switches are part of the mulitfunction turn signal lever. These switches enable the driver to control the cruise on/off, set/coast and resume/accel signals. These signals are inputs to the fuel control portion of the PCM and allow the PCM to maintain a desired vehicle speed under normal driving conditions.

A/C Signal

This signal indicated that the A/C compressor clutch is engaged. The PCM uses this signal to adjust the idle speed.

Automatic Transmission Sensors and Signals

Refer to SECTION 10 of this service manual for a description of automatic transmission sensors and signals.

DIAGNOSIS

DIAGNOSTIC INFORMATION

The diagnostic "tree" charts and functional checks in this manual are designed to locate a faulty circuit or component through logic based on the process of elimination.

The charts are prepared with the requirements that the vehicle functioned correctly at the time of assembly and that there are no multiple failures.

The PCM performs a continual self-diagnosis on certain control functions. This diagnostic capability is complemented by the diagnostic procedures contained in this manual. The PCM's language for communicating the source of a malfunction is a system of Diagnostic Trouble Codes (DTCs). The DTCs are two digit numbers that can range from 12 to 99. When a malfunction is detected by the PCM, a DTC is set and the Malfunction Indicator Lamp (MIL) is illuminated.

Malfunction Indicator Lamp (MIL) "Service Engine Soon"

This light is on the instrument panel and has the following functions:

- It informs the driver that a problem has occurred and that the vehicle should be taken in for service as soon as reasonably possible.
- It displays DTCs stored by the PCM which help the technician diagnose system problems.

As a bulb and system check, the light will come "ON" with the key "ON" and the engine not running. When the engine is started, the light will turn "OFF." If the light remains "ON", the self-diagnostic system has detected a problem. If the problem goes away, the light will go out in most cases after 10 seconds, but a DTC will remain stored in the PCM.

When the light remains "ON" while the engine is running, or when a malfunction is suspected due to a driveability or emissions problem, an "On-Board Diagnostic (OBD) System Check" must be performed. This check will expose malfunctions which may not be detected if other diagnostics are performed prematurely.

"Service Throttle Soon" Lamp

This light is on the instrument panel and has the following functions:

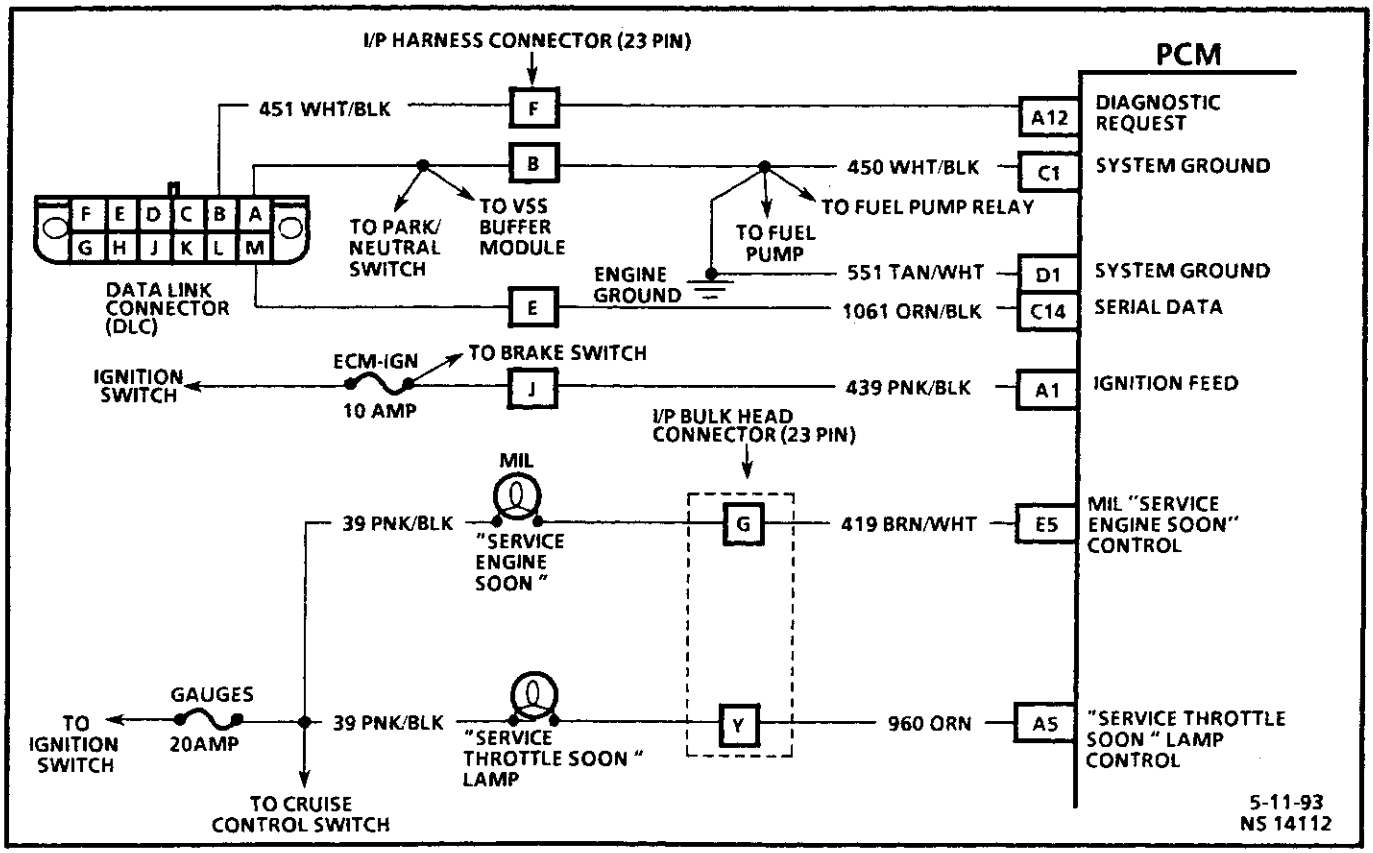
- It informs the driver that a problem has occurred in the Accelerator Pedal Position (APP) circuit and the vehicle should be taken in for service as soon a reasonably possible.
- If APP DTCs are stored by the PCM, the MIL will display these. The "Service Throttle Soon" Lamp will not display DTCs.

As a bulb and system check, the light will come "ON" with the key "ON" for 2 seconds. When the engine is started, the light will turn "OFF." If the light remains "ON," the self-diagnostic system has detected a problem. If the problem goes away, the light will go out in most cases after 10 seconds, but a DTC will remain stored in the PCM.

When the light remains "ON" while the engine is running, or when a malfunction is suspected, an "On-Board Diagnostic (OBD) System Check" must be performed. This check will expose malfunctions which may not be detected if other diagnostics are performed prematurely.

ON-BOARD DIAGNOSTIC (OBD) SYSTEM CHECK

After the visual/physical underhood inspection, the on-board diagnostic system check, is the starting point for all diagnostic procedures or finding the cause of an emission test failure.



ON-BOARD DIAGNOSTIC (OBD) SYSTEM CHECK

(WITH TECH 1 SCAN TOOL)

Circuit Description:

The "On-Board Diagnostic (OBD) System Check" is an organized approach to identifying a problem created by a control module system malfunction. It must be the starting point for any driveability complaint diagnosis, this will direct the service technician to the next logical step in diagnosing the complaint. Understanding the chart and using it properly will reduce diagnostic time and prevent the unnecessary replacement of good parts.

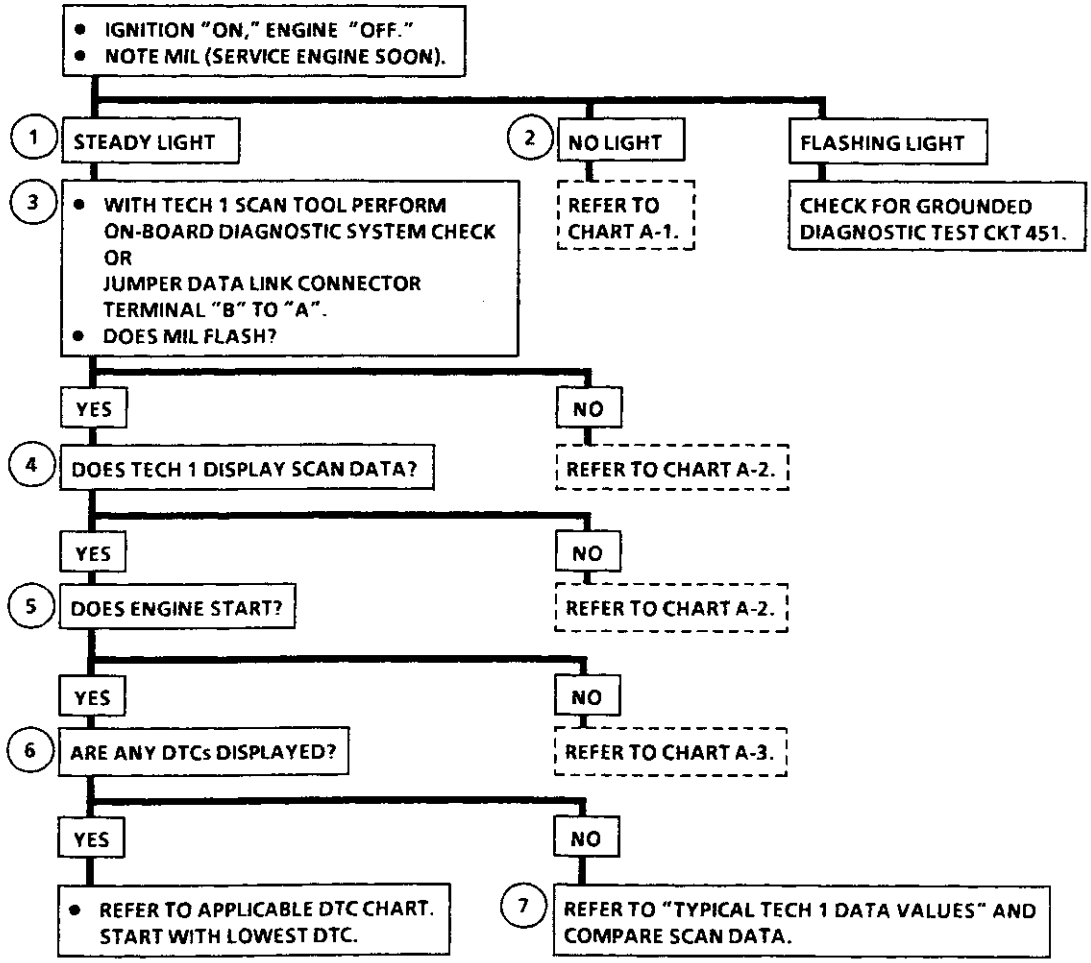
Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. When the ignition switch is cycled to "ON," the MIL should turn "ON" briefly, then "OFF" briefly, then remain "ON" steady. This sequence will determine that the vehicle diagnostics are operational.
2. This step will isolate if the customer complaint is a MIL or driveability problem.
3. Although the control module is powered up, a symptom could exist because of a system fault.
4. Use Tech 1 to aid diagnosis, therefore, serial data must be available. If a PROM (MEM-CAL) error is present, the PCM may have been able to flash DTC 12/51, but not enable serial data.
5. Although the PCM is powered up, a "Cranks But Will Not Run" symptom could exist because of a PCM or system problem.
6. This step will isolate if the customer complaint is a MIL or driveability problem with no MIL. Refer to "Diagnostic Trouble Code Identification" in this section for a list of valid DTCs. An invalid DTC may be the result of a faulty scan tool, PROM or PCM.
7. Comparison of actual control system data with the Typical Tech 1 Data Values is a quick check to determine if any parameter is not within limits. A base engine problem (i.e., advanced cam timing may substantially alter sensor values).

NOTICE: The PCM utilizes a 24 pin "Pink" connector, a 32 pin "Pink" connector and a 32 pin "Blue" connector. The 24 pin "Pink" connector is labeled "A" and "B", the 32 pin "Pink" connector is labeled "C" and "D" and the 32 pin "Blue" connector is labeled "C" and "D". When referencing PCM connector pin outs, the "Blue" PCM connector will be referred to as the "E" and "F" connector.

ON-BOARD DIAGNOSTIC (OBD) SYSTEM CHECK

(WITH TECH 1 SCAN TOOL)



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

If after completing the On-Board Diagnostic (OBD) system check and finding the Tech 1 diagnostics functioning properly and no DTC(s) displayed, the "Typical Tech 1 Engine Data Values" may be used for comparison with values obtained on the vehicle being diagnosed. The "Typical Tech 1 Engine Data Values" are an average of display values recorded from normally operating vehicles and are intended to represent what a normally functioning system would display.

A SCAN TOOL THAT DISPLAYS FAULTY DATA SHOULD NOT BE USED, AND THE PROBLEM SHOULD BE REPORTED TO THE MANUFACTURER. THE USE OF A FAULTY SCAN TOOL CAN RESULT IN MISDIAGNOSIS AND UNNECESSARY PARTS REPLACEMENT.

Only the parameters listed below are used in this manual for diagnosing. If a scan tool displays other parameters, the values are not recommended by General Motors for use in diagnosing. For more description on the values and use of the Tech 1 to diagnosis PCM inputs, refer to the applicable diagnosis section in "Component Systems." If all varies are within the range illustrated, refer to "Symptoms," section.

TYPICAL TECH 1 ENGINE DATA VALUES

Idle / Lower Radiator Hose Hot / Closed Throttle / Park or Neutral / Accessories Off

SCAN Position	Units Displayed	Typical Data Value	Refer To Section:
ENGINE SPEED	RPM	± 100 RPM from desired	
DESIRED IDLE	RPM	PCM commanded (based on temp.)	
ENG COOL TEMP.	C°/F°	85°C - 105°C (185°F - 221°F)	
INTAKE AIR TEMP.	C°/F°	10°C - 87°C (50°F - 194°F) (depends on underhood temperature)	
BARO	kPa/Volts	70 - 100/3.5-4.5 (varies with altitude)	
EGR PRESSURE	kPa/Volts	50 - 100 kPa/2.8 - 3.0V (varies)	
EGR DUTY CYCLE	Percentage	50 - 100% (may vary)	
WASTEGATE SOL DC	Percentage	60 - 100% (may vary)	
BOOST PRESSURE	kPa/Volts	99 - 160 kPa/1.0-2.5 volts	
FUEL TEMPERATURE	C°/F°	21°C-43°C (70°F - 110°F)	
FUEL RATE	Millimeters	0-40 mm (varies with engine load)	
GLOW PLUG RELAY	Volts	12.0-14.5	
GLOW PLUG VOLTS	Volts	12.0-14.5	
DESIRED INJ TIM	# of degrees	Varies	
MEASURED INJ TIM	# of degrees	Varies	
THROTTLE ANGLE	Percentage	0%	
ACCEL PED POS 1	Volts	0.35-0.95V	
ACCEL PED POS 2	Volts	4.0-4.5V	
ACCEL PED POS 3	Volts	3.6-4.0V	
CRUISE CONTROL	On/Off	Off	
C/C BRAKE SWITCH	Open/Closed	Open	
TCC BRAKE SWITCH	Closed/Open	Closed	
TDC OFFSET	# of degrees	0-2.02 (varies)	
A/C CLUTCH	On/Off	Off	
SYSTEM VOLTAGE	Volts	12.0 - 14.5	
ENG SHUT OFF	On/Off	On	
INJ PULSE WIDTH	Milliseconds	1.70-1.90 ms (may vary)	
CRANK REF MISSED	Counts	0	
CAM REF MISSED	Counts	0	
1-2 SOL/2-3 SOL	On/Off	On/On	
TCC SOLENOID	On/Off	Off	
4WD LOW SWITCH	On/Off	Off	
TRANS RANGE SW	Invalid, Rev Drive 4, Drive 3, Drive 2, Low, Park/Neut	Park/Neut	
CALIBRATION ID	0-9999	Internal	
TIME FROM START	Hrs/Mins/Sec	Varies	

ENGINE TECH 1 DATA DEFINITIONS

A list of each data message displayed on the Tech 1 scan tool will be explained in two groups; "Engine" or "Transmission." This information will assist in emission or driveability problems. The displays can be viewed while the vehicle is being driven. Always perform the "On-Board Diagnostic (OBD) System Check" first. The "OBD System Check" will confirm proper system operation.

For transmission data refer to SECTION 10.

ENGINE DATA

ENGINE SPEED - Range 0-9999 RPM - Engine speed is computed by the PCM from the distributor reference input (low resolution circuit). It should remain close to desired idle under various engine loads with engine idling.

DESIRED IDLE - Range 0-3187 RPM - The idle speed that is commanded by the PCM. The PCM will compensate for various engine loads based on engine coolant temperature to keep the engine at the desired speed.

ENG COOL TEMP - Range -40°C to 151°C, -40°F to 304°F - The Engine Coolant Temperature (ECT) sensor is mounted in the coolant pump and sends engine temperature information to the PCM. The PCM supplies 5 volts to the ECT sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes. When the sensor is cold (internal resistance high), the PCM monitors a high signal voltage and interprets it as a cold engine. As the sensor warms (internal resistance decreases), the voltage signal will decrease and the PCM will interpret the lower voltage as a warm engine.

INTAKE AIR TEMP - Range -40°C to 151°C, -40°F to 304°F - The PCM converts the resistance of the intake air temperature sensor to degrees. Intake Air Temperature (IAT) is used by the PCM to adjust fuel delivery and spark timing according to incoming air density.

BARO - Range 10-105 kPa/0.00-5.00 Volts - The BARO reading displayed is determined from the MAP sensor at ignition "ON," engine "OFF," and WOT conditions. The BARO reading displayed represents barometric pressure and is used to compensate for altitude differences.

THROTTLE ANGLE - Range 0 - 100% - Computed by the PCM from APP module voltage (throttle position) and should display 0% at idle and 100% at wide open throttle. Refer to DTC 21 if TP sensor angle is not 0% at idle.

ACCELERATOR PEDAL POSITION (APP 1) - Range 0-5 Volts - Used by the PCM to determine the amount of throttle demanded by the driver. Should read about .35-.95 volts at idle to above 4.0 volts at Wide Open Throttle (WOT).

ACCELERATOR PEDAL POSITION (APP 2) - Range 0-5 Volts - Used by the PCM to determine the amount of throttle demanded by the driver. Should read about 4.5 volts at idle and steadily decrease to about 1.0 volt at wide open throttle.

ACCELERATOR PEDAL POSITION (APP 3) - Range 0-5 Volts - Used by the PCM to determine the amount of throttle demanded by the driver. Should read about 4.0 volts at idle and steadily decrease to about 2.5 volts at wide open throttle.

CRANK REFERENCE PULSE - Range 0-8 Counts - This is used by the PCM to determine crankshaft position. The scan tool will display the number of crank pulses missed. At idle it should read 0.

CAM REFERENCE PULSE - Range 0-8 Counts - This is used by the PCM to determine injection pump cam position. The scan tool will display the number of cam pulses missed. At idle it should read 0.

BOOST PRESSURE - Range 10-200 kPa/0-5.0 Volts - The amount of turbo boost pressure in the intake manifold. This is measured in kPa and volts. True boost pressure is determined by subtracting BARO from the actual reading.

FUEL TEMP - Range -40°C to 151°C, -40°F to 304°F - There is a thermistor located in the high resolution sensor that determines fuel temperature. When the sensor is cold (internal resistance high) the PCM monitors a high signal voltage which it interprets as low fuel temperature. As the sensor warms (internal resistance low) the voltage signal will decrease and the PCM will interpret the low voltage as warm fuel.

FUEL RATE - Range 0-80 mm - This reading is displayed in millimeters (mm). This is the amount of fuel the PCM is requesting.

GLOW PLUG RELAY - Range 0-25.5 Volts - This is the amount of volts the PCM is requesting to be sent to the glow plug relay. The PCM will cycle the voltage "ON" and "OFF." Cycling timing will increase when engine is cold and decrease at warmer temperatures.

GLOW PLUG VOLTS - Range 0-25.5 Volts - This is used by the PCM to determine if there is voltage coming out of the relay and going towards the glow plugs. During normal operation the volts reading will be lower than glow plug relay voltage because of the high resistance in the glow plugs.

DESIRED INJECTION TIMING - Range 0-25.5 Volts - The amount of injection timing requested by the PCM.

MEASURED INJECTION TIMING - Range 0-25.0 Degrees - Current actual injection timing.

TDC OFFSET - Range 0-4.00 Degrees - The PCM has the ability to determine the amount of offset needed to bring the engine to top dead center. This is used by the PCM to determine proper injection timing and fuel delivery. This value may be displayed as a positive or negative number.

EGR DESIRED POSITION - Range 10-103 kPa - The PCM command for EGR vacuum that is desired.

EGR ACTUAL POSITION - Range 10-103 kPa - Current actual EGR vacuum.

4WD LOW SWITCH - Indicator to PCM when driver selects 4WD.

MPH/km/h - Vehicle speed is a PCM internal parameter. It is computed by timing pulses coming from the Vehicle Speed Sensor (VSS). Vehicle speed is used in checking TCC lock-up speed or speedometer accuracy. Speed is displayed in both Miles Per Hour (mph) and Kilometers Per Hour (km/h).

PROM ID - The PROM identification parameter describes the particular PROM used in the PCM being tested. The PROM contains the PCM program. PROM ID is used when it is necessary to replace the PROM. PROM ID must be specified when ordering new PROMs. PROM ID should not be confused with "Part Number."

INJECTOR PULSE WIDTH - Tech 1 Range 0.0-4.00 milliseconds - Indicates the closure time of the fuel solenoid. When engine load is increased, injector pulse width will fluctuate.

EGR DUTY CYCLE - Range 0-100% - The PCM cycles the EGR solenoid valve "ON" and "OFF." The "ON" time (duty cycle) of the EGR solenoid valve, expressed as a percent, determines how much the exhaust gas is recirculated.

A/C REQUEST - Tech 1 displays "YES"/"NO" - Represents if the A/C request from the control head is being received by the PCM.

PARK/NEUTRAL POS - Tech 1 displays - "P-N"-- or -"R-DL" - "P-N"-- displayed indicates that the gear select lever is in park or neutral.

CRUISE CONTROL - Tech 1 Displays "OFF"/"ON" - This will indicate when the cruise control has been enabled. This signal is used by the PCM to adjust TCC engagement scheduling.

1 - 2 SHIFT SOL - Tech 1 displays "ON"/"OFF" - When the transmission in in first or fourth gear, the Tech 1 should display "ON." When the transmission is in second or third gear, the Tech 1 should indicate "OFF."

2 - 3 SHIFT SOL - Tech 1 displays "ON"/"OFF" - When the automatic transmission is in first or second gear, the Tech 1 should indicate "ON." When the transmission is in third or fourth gear, the Tech 1 should display "OFF."

C/C BRAKE SWITCH - Tech 1 displays "OPEN"/"CLOSED" - When the brake pedal is applied, the switch sends a signal to the PCM to disengage cruise control.

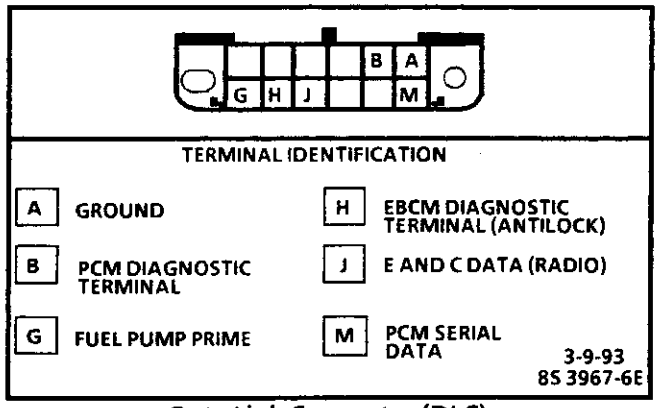
TCC BRAKE SWITCH - Tech 1 displays "CLOSED"/"OPEN" - When the brake pedal is applied, the switch sends a signal to the PCM to disengage the TCC solenoid.

TIME FROM START - Range 0:00:00-18:12:15 HR/MIN/SEC - A measure of how long the engine has been operating. When the ignition is cycled to "OFF" the value is reset to zero.

TECH 1 SCAN TOOL

The diagnostic procedures in this manual assume the use of a Tech 1 scan tool. Since the Tech 1, produced by Expertec, is able to perform functions, such as, bidirectional communication that other scan tools are unable to perform, it has been made an essential tool. Although, the term scan tool will continue to be used for simplicity's sake, we recommend the Tech 1 be used whenever possible. Explicit instructions on connecting and using the various Tech 1 functions are contained in the Tech 1 owner's manual.

The PCM can communicate a variety of information through Data Link Connector (DLC) terminal "M". This data is transmitted at high frequency which requires a scan tool for interpretation.



Data Link Connector (DLC)

With an understanding of the data which the scan tool displays, and knowledge of the circuits involved, the scan tool can be very useful in obtaining information which would be more difficult or impossible to obtain with other equipment.

Scan tools do not make the use of diagnostic charts unnecessary, nor can they indicate exactly where a problem is in a particular circuit. Diagnostic tree charts incorporate diagnosis procedures using a scan tool where possible and most charts *require* the use of a scan tool when it is applicable.

A SCAN TOOL THAT DISPLAYS FAULTY DATA SHOULD NOT BE USED AND THE PROBLEM SHOULD BE REPORTED TO THE MANUFACTURER. THE USE OF A FAULTY SCAN TOOL CAN RESULT IN MISDIAGNOSIS AND UNNECESSARY PARTS REPLACEMENT.

The scan tool has the ability to save time in diagnosis and prevent the replacement of good parts. The key to using the scan tool successfully for diagnosis lies in the technician's ability to understand the system being diagnosed, as well as an understanding of the scan tool's limitations.

PCM INFORMATION MODES

The PCM has two modes for transmitting information. The following information will describe the system operation in each of the modes.

Normal (Open) Mode

On engines that can be monitored in the "Open" mode, certain parameters can be observed without changing the engine operating characteristics. The parameters capable of being read vary with engine families.

Diagnostic Mode

When the diagnostic terminal is grounded with the ignition "ON" and the engine "OFF," the system will enter what is called the diagnostic mode. In this mode the PCM will:

1. Display a DTC 12 by flashing the MIL.
2. Display any stored DTC by flashing the MIL. Each DTC will be flashed three times.

Reading Diagnostic Trouble Codes

The means of communicating with the control module is the Data Link Connector (DLC) (refer to Figure 3-9) located under the instrument panel and is sometimes covered by a plastic cover labeled "DIAGNOSTIC CONNECTOR." The DLC is used in the assembly plant to receive engine information to determine proper operation before it leaves the plant. The DTC(s) stored in the control module memory can be displayed either through the Tech 1 scan tool, a hand-held diagnostic scanner plugged into the DLC connector, or by counting the number of flashes of the Malfunction Indicator Lamp (MIL) "Service Engine Soon" when the diagnostic terminal of the DLC is grounded. The DLC terminal "B" (diagnostic terminal) is the second terminal from the right of the DLC top row. The terminal is most easily grounded by connecting it to terminal "A" (internal control module ground), which is located to the right of terminal "B" on top row of the DLC.

DTC 12

When terminals "A" and "B" have been connected, the ignition switch turned to the "ON" position with the engine not operating, the MIL (Service Engine Soon) should flash DTC 12 three times consequently. This will be the following flash sequence: "flash, pause, flash-flash, long pause, flash, pause, flash-flash, long pause, flash, pause, flash-flash." DTC 12 indicates that the control module diagnostic system is operating properly.

If the DTC 12 is not indicated, a fault is present within the diagnostic system itself, and should be addressed by consulting the appropriate diagnostic chart in this section.

The malfunction indicator lamp will indicate a Diagnostic Trouble Code (DTC) three times if a DTC is present, or it will simply continue to output DTC 12. If more than one diagnostic trouble code has been stored in the control module memory, the DTC(s) will be displayed from the lowest to the highest with each DTC being displayed three times.

Clearing Diagnostic Trouble Codes

To clear the DTC(s) from the memory of the control module, either to determine if the malfunction will occur again or because repair has been completed, the Tech 1 scan tool should be used to clear the DTC(s). If a scan tool is not available the following must be performed when all repairs have been completed. This will allow all DTC(s) to be cleared.

1. Ignition "OFF."
2. Ground diagnostic terminal "A" to "B" of DLC.
3. Ignition "ON."
4. Fully apply brake pedal.
5. Fully apply accelerator pedal.
6. Check MIL (Service Engine Soon) for DTC 12.
7. Release brake pedal.
8. Release accelerator pedal.
9. Check MIL (Service Engine Soon) for DTC 12.
10. Remove jumper from DLC connector.
11. Turn ignition "OFF."

NOTICE: To prevent control module damage, the key must be "OFF" when disconnecting or reconnecting module power.

Intermittents

In case of an "Intermittent" problem, the MIL will light for ten (10) seconds and then will go out. However, the corresponding DTC will be stored in the memory of the PCM as a history DTC until DTCs have been cleared. When unexpected DTCs appear during the code reading process, one can assume that these DTCs were set by an intermittent malfunction and could be helpful in diagnosing the system.

An intermittent DTC may or may not re-set. **If it is an intermittent failure, a Diagnostic Trouble Code (DTC) chart is not used**. Consult the "Diagnostic Aids" on the page facing the diagnostic chart corresponding to the intermittent DTC. SECTION "2" also covers the topic of "Intermittents." A physical inspection of the applicable sub-system most often will not resolve the problem.

Scan Tool Use With Intermittents

In some scan tool applications, the data update rate makes the tool less effective than a voltmeter, such as when trying to detect an intermittent problem which lasts for a very short time. However, the scan tool allows manipulation of wiring harnesses or components under the hood with the engine not running, while observing the scan tool readout.

The scan tool can be plugged in and observed while driving the vehicle under the condition when the MIL "Service Engine Soon" light turns "ON" momentarily or when the engine driveability is momentarily poor. If the problem seems to be related to certain parameters that can be checked on the scan tool, they should be checked while driving the vehicle. If there does not seem to be any correlation between the problem and any specific circuit, the scan tool can be checked on each position, watching for a period of time to see if there is any change in the readings that indicates intermittent operation.

The scan tool is also an easy way to compare the operating parameters of a poorly operating engine with those of a known good one. For example, a sensor may shift in value but not set a DTC. Comparing the sensor's readings with those of a known good vehicle may uncover the problem.

The scan tool has the ability to save time in diagnosis and prevent the replacement of good parts. The key to using the scan tool successfully for diagnosis lies in the technician's ability to understand the system he is trying to diagnose as well as an understanding of the scan tool operation and limitations. The technician should read the tool manufacturer's operating manual to become familiar with the tool's operation.

T100 - GM CAMS

The T100-GM CAMS (Computerized Automotive Maintenance System) is a computerized technician's terminal unit. When connected to a vehicle, performs engine, electronic circuits and systems test to find possible vehicle problems in the engine system or the PCM.

The terminal diagnoses as follows:

- Circuit diagnostic procedures provide information on how to isolate a problem and repair requirements.
- If no problem exists, engine performance problems are diagnosed.
- DTCs stored in the PCM are read and diagnosed by the system.

Also needed are a test light, ohmmeter, digital voltmeter with 10 megohms impedance (J 39200), vacuum gage and jumper wires for diagnosis. Special tools which are required for system service and the ones described above are illustrated in SECTION 13.

PCM DIAGNOSIS

Since the PCM can have a failure which may affect only one circuit, following the diagnostic procedures in this section can reliably tell when a failure has occurred in the PCM. Also, a DTC 54 indicates a failure of the PCM.

If a diagnostic chart indicates that the PCM connections or PCM is the cause of a problem, and the PCM is replaced, but does not correct the problem, one of the following may be the reason:

- There is a problem with the PCM terminal connections. - The diagnostic chart will say PCM connections or PCM. The terminals may have to be removed from the connector in order to check them properly.
- The PCM or PROM is not correct for the application. - The incorrect PCM or PROM may cause a malfunction and may or may not set a DTC.
- The problem is intermittent. - This means that the problem is not present at the time the system is being checked. In this case, refer to "Driveability Symptoms" portion of the manual and make a careful physical inspection of all portions of the system involved.
- Shorted solenoid, relay coil, or harness. - Solenoids and relays are turned "ON" and "OFF" by the PCM, using internal electronic switches called "Drivers."

A shorted solenoid, relay coil, or harness will not damage the PCM, but will cause the circuit and controlled component to be inoperative. When the circuit fault is not present or has been repaired, the driver will again operate in a normal manner due to it's fault protected design. If a fault has been repaired in a circuit controlled by a driver, the original PCM should be reinstalled and the circuit checked for proper operation. PCM replacement will not be necessary if the repair circuit or component now operates correctly.

J 34636 or BT-8405 testers or equivalent provide a fast, accurate means of checking for a shorted coil or a short to battery voltage.

- The PROM may be faulty. - Although the PROM rarely fails, it operates as part of the PCM. Therefore, it could be the cause of the problem. Substitute a known good PROM.
- The replacement PCM may be faulty. - After the PCM is replaced, the system should be rechecked for proper operation. If the diagnostic chart again indicates the PCM is the problem, substitute a known good PCM. Although this is a rare condition, it could happen.

PROM

A PROM that has failed or was installed improperly will generally set a DTC 51.

FUEL CONTROL

Fuel delivery is controlled by the control module system.

The diagnosis of fuel control starts with "Engine Cranks But Will Not Run" CHART A-3. This chart will test the fuel system and if there is a problem, will lead you to checking the fuel lift pump, diagnosing the injection pump circuit or diagnosing the fuel system.

PCM SENSORS AND INPUT SIGNALS

All of the sensors and input signals can be diagnosed by the use of a scan tool. Following is a short description of how the sensors and signals can be diagnosed by the use of a scan tool. A scan tool can also be used to compare the values for a normal running engine with the engine you're diagnosing. Refer to "Typical Scan Tech 1 Engine Data Values."

Engine Coolant Temperature (ECT) Sensor

A scan tool displays engine coolant temperature in degrees (Celsius & Fahrenheit). After engine is started, the temperature should rise steadily to about 90°C (194°F) then stabilize when thermostat opens.

DTC 14 or DTC 15 indicates a failure in Engine Coolant Temperature (ECT) sensor circuit.

The DTC charts also contain a chart to check for ECT sensor resistance values relative to temperature.

Accelerator Pedal Position (APP) Module

If the PCM has determined that there is a fault in one APP sensor, the PCM will store a current and history DTC, but, it will not turn on the "Service Throttle Soon" lamp. The vehicle and throttle pedal will operate normally if only one of the three APP sensors if found have a fault. If the PCM has determined two APP sensors are faulty, a current and history DTC will set and the PCM will turn on the "Service Throttle Soon" lamp. At this point, some engine performance will be lost. If three APP sensors malfunction, a current and history DTC will be stored, the "Service Throttle Soon" lamp will come "ON," and the PCM will only allow the vehicle to idle. If the PCM has recognized an intermittent fault (a fault not recognized by the normal APP DTC setting criteria), it will then only allow the vehicle to operate under limited performance and store a DTC 84.

A scan tool reads APP 1 position in voltage, and should read about .50 volt while the engine is idling. Voltage should increase at a steady rate as accelerator pedal is moved to Wide Open Throttle (WOT). APP 2 position is also read in voltage, and should read about 4.5 volts at idle, and should steadily decrease to a about 1.5 volts as accelerator pedal is moved to WOT. APP 3 is also read in voltage, and should read about 4.0 volts at idle, and should steadily decrease to about 2.0 volts. Its possible idle voltage may vary, because the PCM has a "learning" ability which allows it to make corrections for minor variations.

Pump Cam Signal

Loss of cam signal reference pulses will set a DTC 18. If the cam signal is lost while the engine is running, the fuel injection system will shift to a calculated fuel injection (backup fuel) mode based on the last fuel injection pulse, and the engine will continue to run. The engine can be restarted and will run in the calculated fuel injection mode as long as the fault is present.

See DTC 18 for further information.

Fuel Temperature Sensor

The scan tool displays fuel temperature in degrees (celsius/fahrenheit). DTC 42 or DTC 43 indicate a failure in the fuel temperature sensor circuit.

Crankshaft Position Sensor

A scan tool displays engine speed in RPM. RPM will still be displayed with a fault in this circuit. If the signal is lost while the engine is running, the fuel injection system will shift to a calculated fuel injection mode based on the last fuel injection pulse, and the engine will continue to run. The engine can be restarted and will run in the backup fuel mode as long as fault is present. See DTC 19 for further information.

Intake Air Temperature (IAT) Sensor

A scan tool displays temperature of the air entering the engine and should read close to ambient air temperature when the engine is cold, and rise as underhood temperature increases. If the engine has not been run for several hours (overnight), the IAT sensor temperature and engine coolant temperature should read close to each other. A failure in the IAT sensor circuit should set DTC 47 or 48. The DTC chart also contains a "Diagnostic Aid" to check for sensor resistance values relative to temperature.

EGR Control Pressure/BARO Sensor

A scan tool displays EGR pressure in volts. Low pressure (high vacuum) reads a low voltage while a high pressure (low vacuum) reads a high voltage. A failure in the EGR control pressure/BARO sensor circuit should set a DTC 31 or 33 and using the chart will find the cause of the problem. Any other failure in the EGR system should set a DTC 32, 44 or 45. On vehicles using only a BARO sensor a failure in the sensor circuit should set a DTC 31 or 33. Also refer to "EGR Control Pressure/BARO Sensor Output Check" in this section.

Boost Sensor

At idle, the scan tool will display boost pressure about the same reading as barometric pressure. When at a full load, with WOT the boost pressure will indicate high pressure or voltage. When at a decel with throttle closed, the boost sensor will display low pressure or voltage. The boost pressure reading is the opposite of what you would measure on a vacuum gage. When manifold pressure is high , vacuum is low. A failure in the boost sensor circuit should set a DTC 61 or 62.

Vehicle Speed Sensor (VSS)

A scan tool display of mph / km/h should closely match with the speedometer display. A failure in the VSS input circuit should set a DTC 24 or DTC 16.

Fuel Inject Signal

A scan tool will display the injection pulse width feedback in milliseconds. If the PCM detects an error in the fuel inject response time, a DTC 35 or DTC 36 will set.

Brake Switches

A scan tool will display the status of the brake switches. The cruise control brake switch is normally open and TCC brake switch normally closed. A malfunction in the brake switches circuit should set a DTC 37, 38 or 41.

Glow Plug Signal

A scan tool will display this signal in voltage. A malfunction in this system should set a DTC 29 or refer to SECTION 7 for diagnosis of the glow plug control system.

Cruise Control

A scan tool will display cruise control "ON/OFF" status. For diagnosis of the cruise control refer to "Cruise Control Diagnosis." A malfunction in the set/coast switch circuit should set a DTC 71. A malfunction in the resume/accel switch circuit should set a DTC 76.

A/C Signal

The scan tool should indicate A/C clutch "ON" when A/C is selected. Refer to "A/C Signal Diagnosis" for diagnosis of the A/C signal.

Automatic Transmission Sensors and Signals

Refer to SECTION 10 of this service manual for diagnosis of automatic transmission sensors and signals.

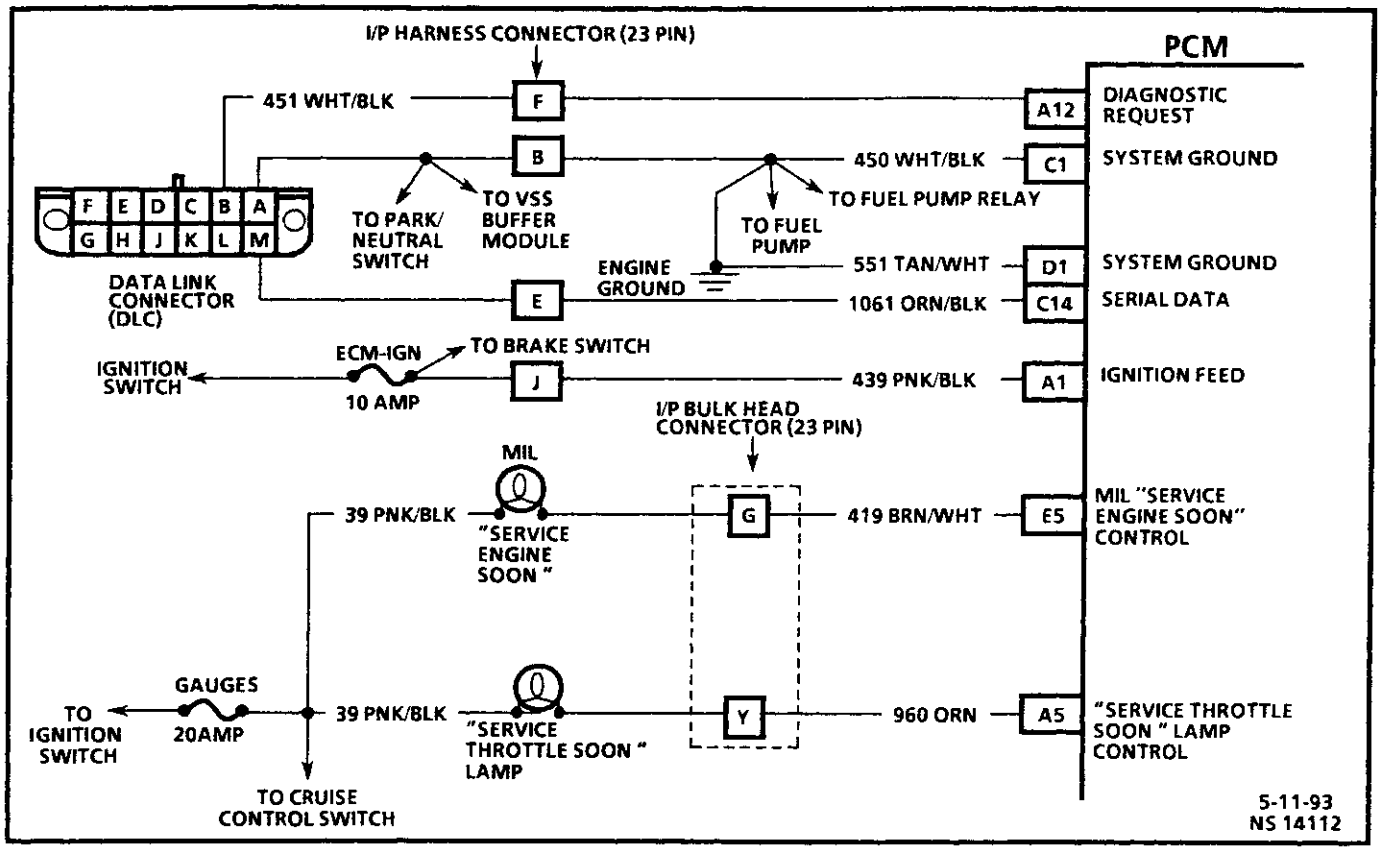


CHART A-1

NO MIL (SERVICE ENGINE SOON)

Circuit Description:

There should always be a steady MIL with the ignition "ON" and engine "OFF." Switched battery voltage is supplied to the lamp. The PCM will control the lamp and turn it "ON" by providing a ground path through CKT 419.

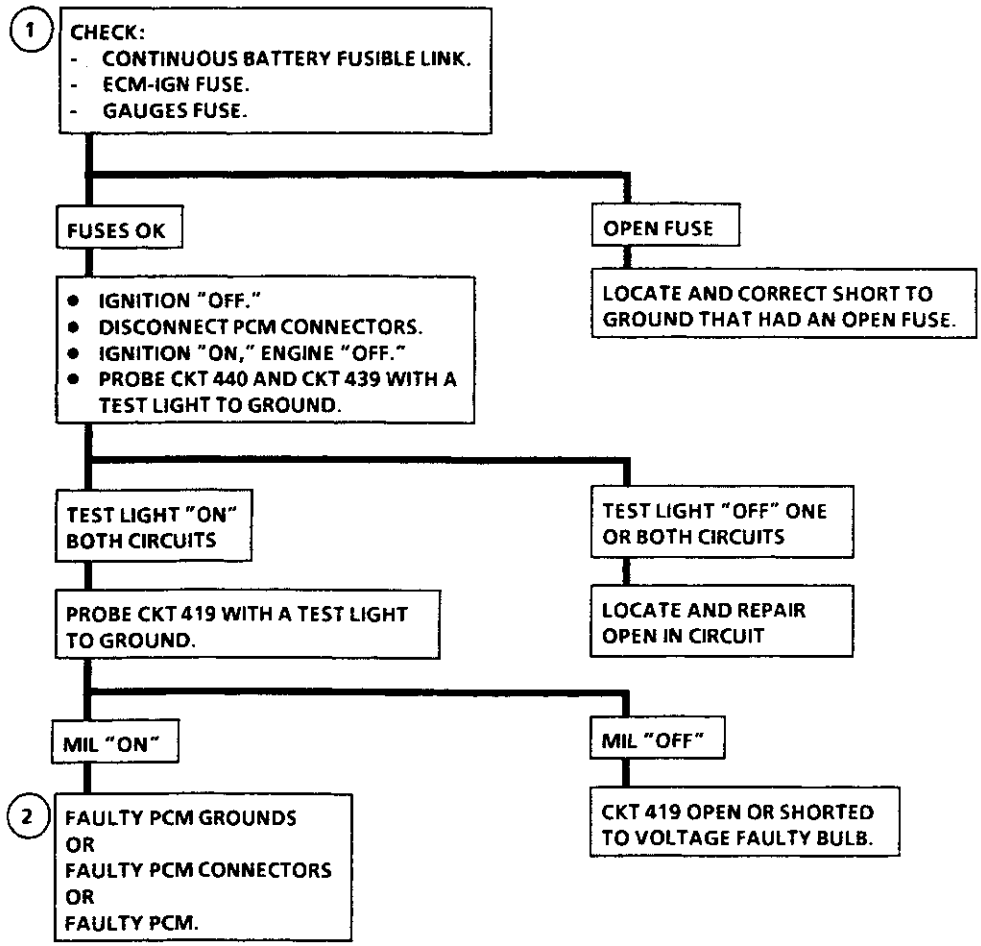
Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. If the fusible link is open, refer to wiring diagrams for complete circuit.
2. Using a test light connected to 12 volts, probe each of the system ground circuits and check that a good ground is present. Refer to "PCM Terminal End View" in this section for PCM pin locations of ground circuits.

Diagnostic Aids: If the engine operates OK, check:

- Faulty light bulb.
- CKT 419 open.
- Gauges fuse open. This will result in no brake warning light, oil or generator lights, seat belt reminder, etc.

CHART A-1
NO MIL (SERVICE ENGINE SOON)



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MS 13407

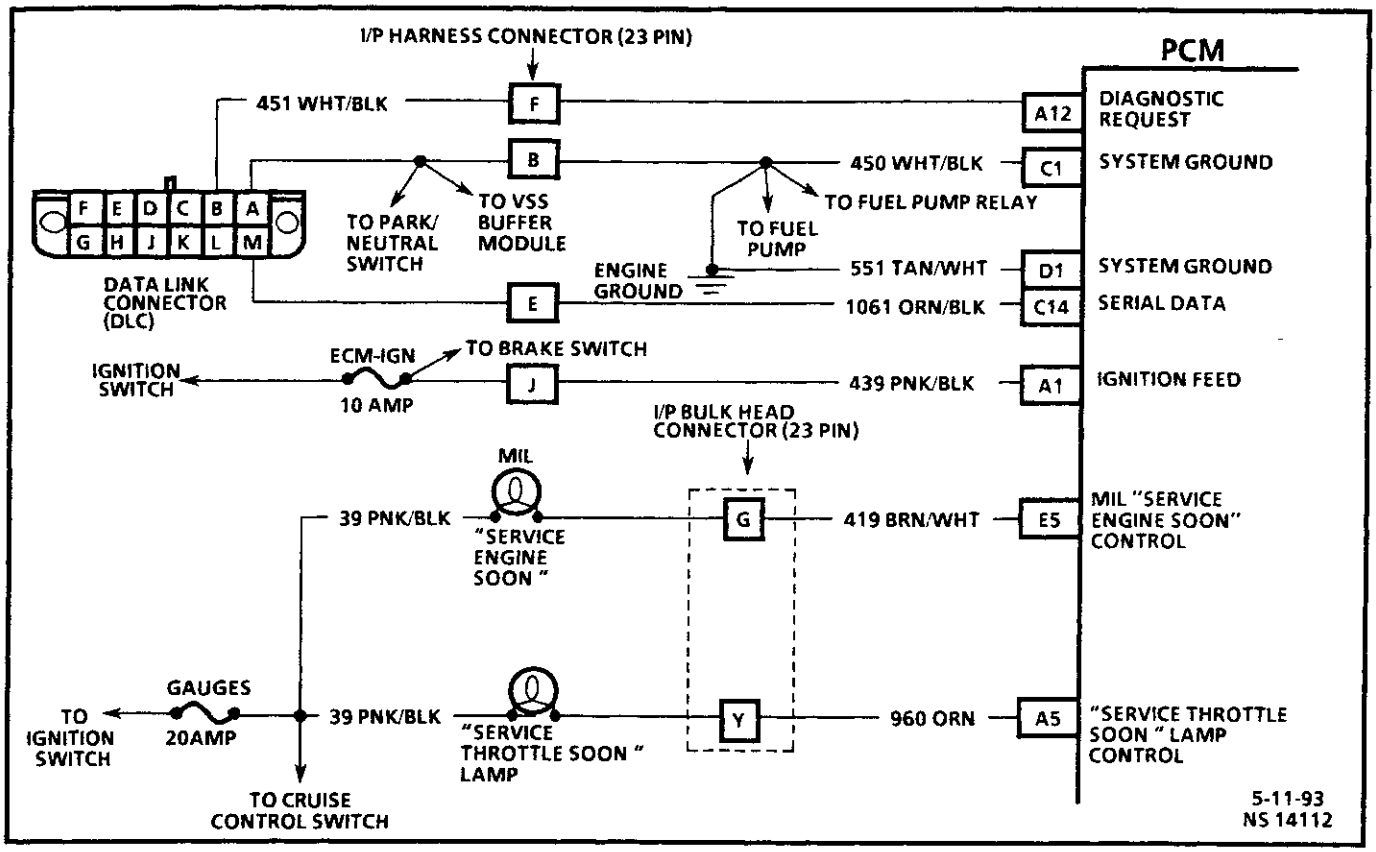


CHART A-2

NO SCAN DATA OR WILL NOT FLASH MIL OR MIL (SERVICE ENGINE SOON) "ON" STEADY

Circuit Description:

There should always be a steady Malfunction Indicator Lamp (MIL) when the ignition is "ON" and engine "OFF." Battery ignition voltage is supplied to the lamp. The PCM will turn the lamp "ON" by grounding CKT 419.

With the "diagnostic" terminal grounded, the lamp should flash a DTC 12, followed by any Diagnostic Trouble Code (DTC) stored in memory.

A steady lamp indicates a short to ground in the lamp control CKT 419 or an open in diagnostic CKT 451, or no engine speed sensor signal on the diesel.

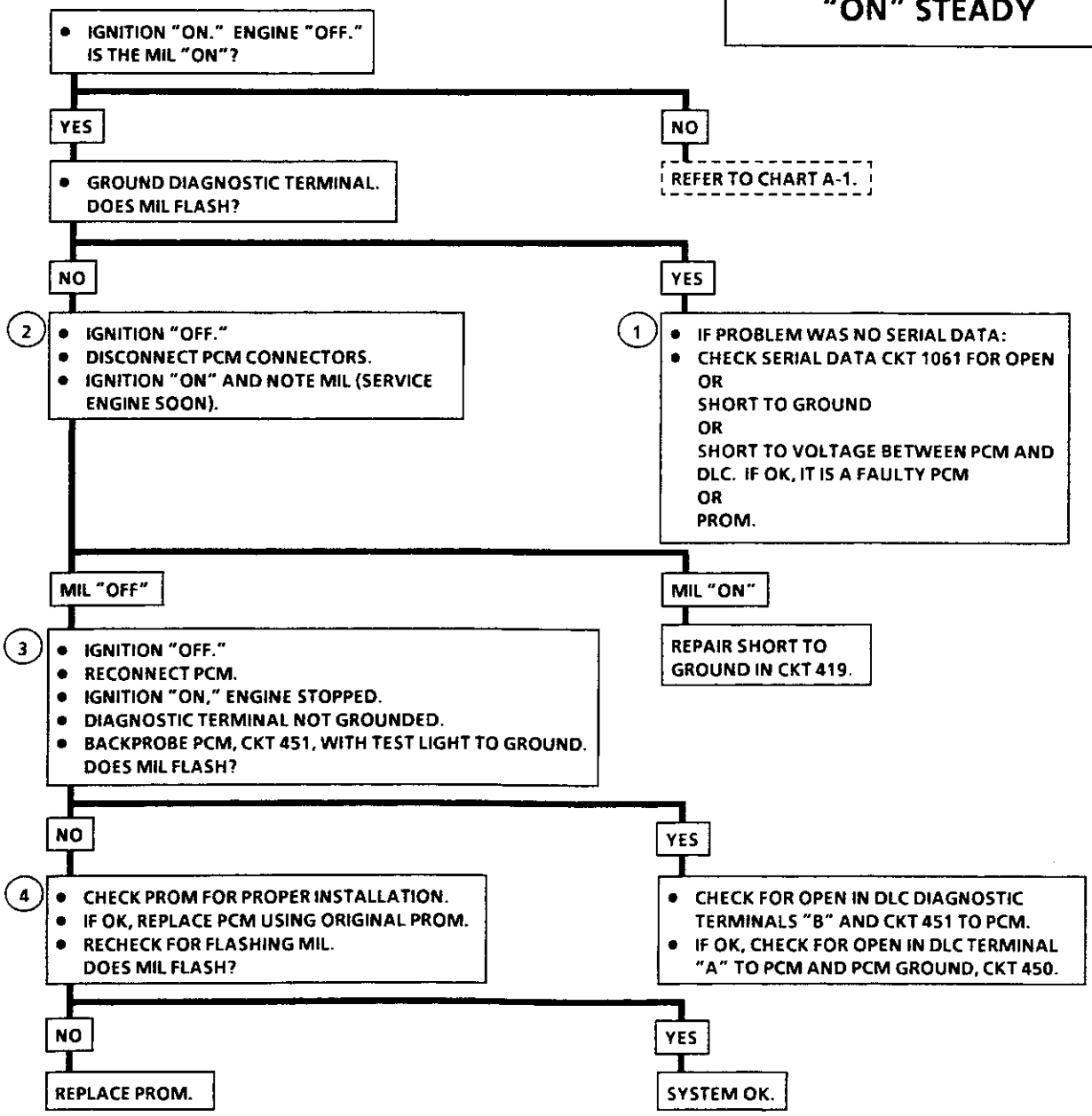
Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart..

1. If there is a problem with the PCM that causes a scan tool not to read serial data, then the PCM should not flash a MIL. If MIL does flash, check that the scan tool is functioning properly on another vehicle. If the scan is functioning properly, and CKT 1061 is OK, the PROM or PCM may be at fault for the NO DLC symptom.
2. If the light goes "OFF" when the PCM connector is disconnected, then CKT 419 is not shorted to ground.
3. This step will check for an open diagnostic CKT 451.
4. At this point, the MIL wiring is OK. The problem is a faulty PROM. If MIL does not flash, the PCM should be replaced using the original PROM. Replace the PROM only after trying a PCM. A defective PROM usually is an unlikely cause of the problem.

CHART A-2

NO SCAN DATA OR WILL NOT FLASH MIL OR MIL (SERVICE ENGINE SOON) "ON" STEADY



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

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PS 17831

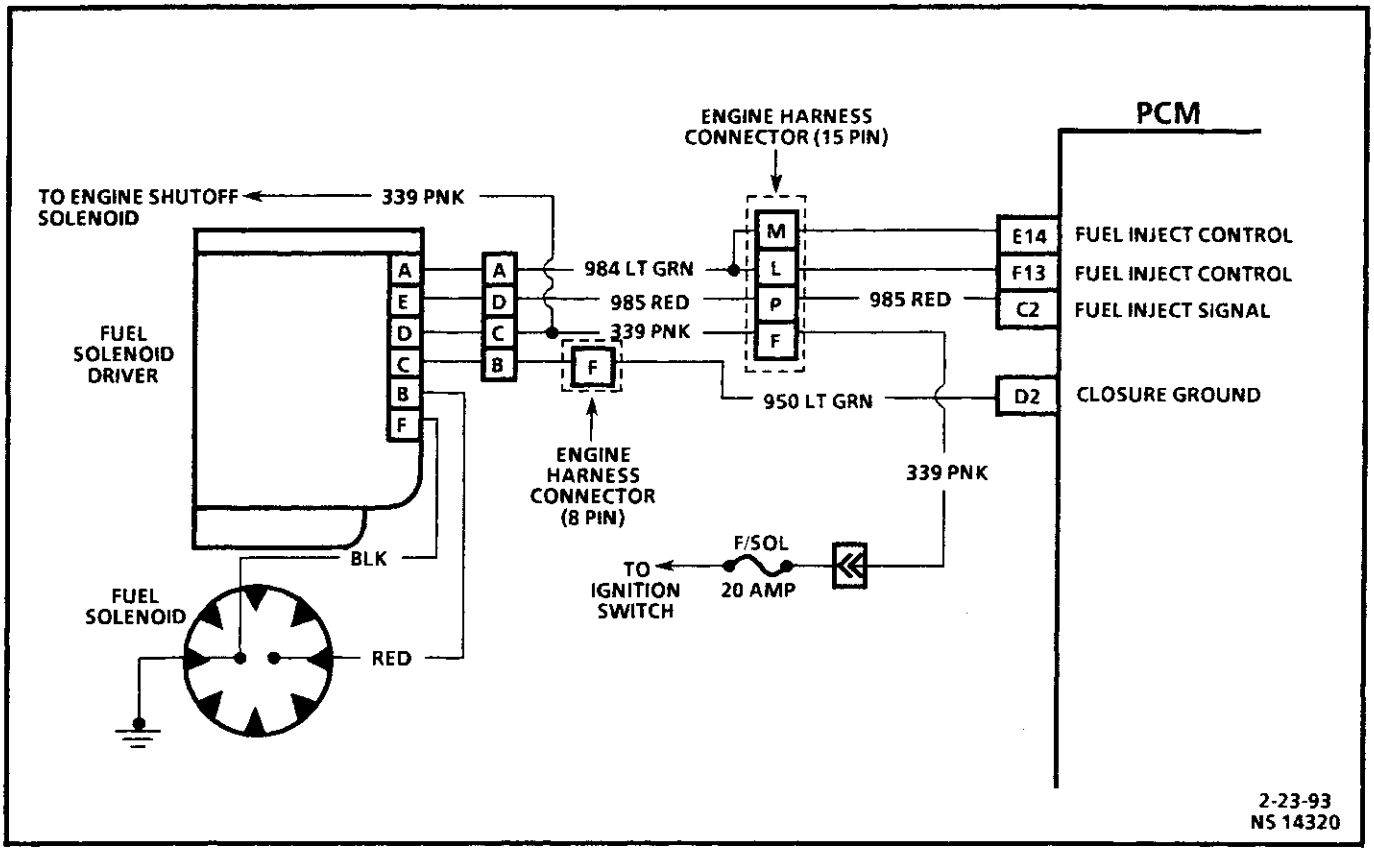


CHART A-3

ENGINE CRANKS BUT WILL NOT RUN

Circuit Description:

This chart assumes that battery condition and engine cranking speed are OK, adequate fuel in the tank, and glow plug system operating OK.

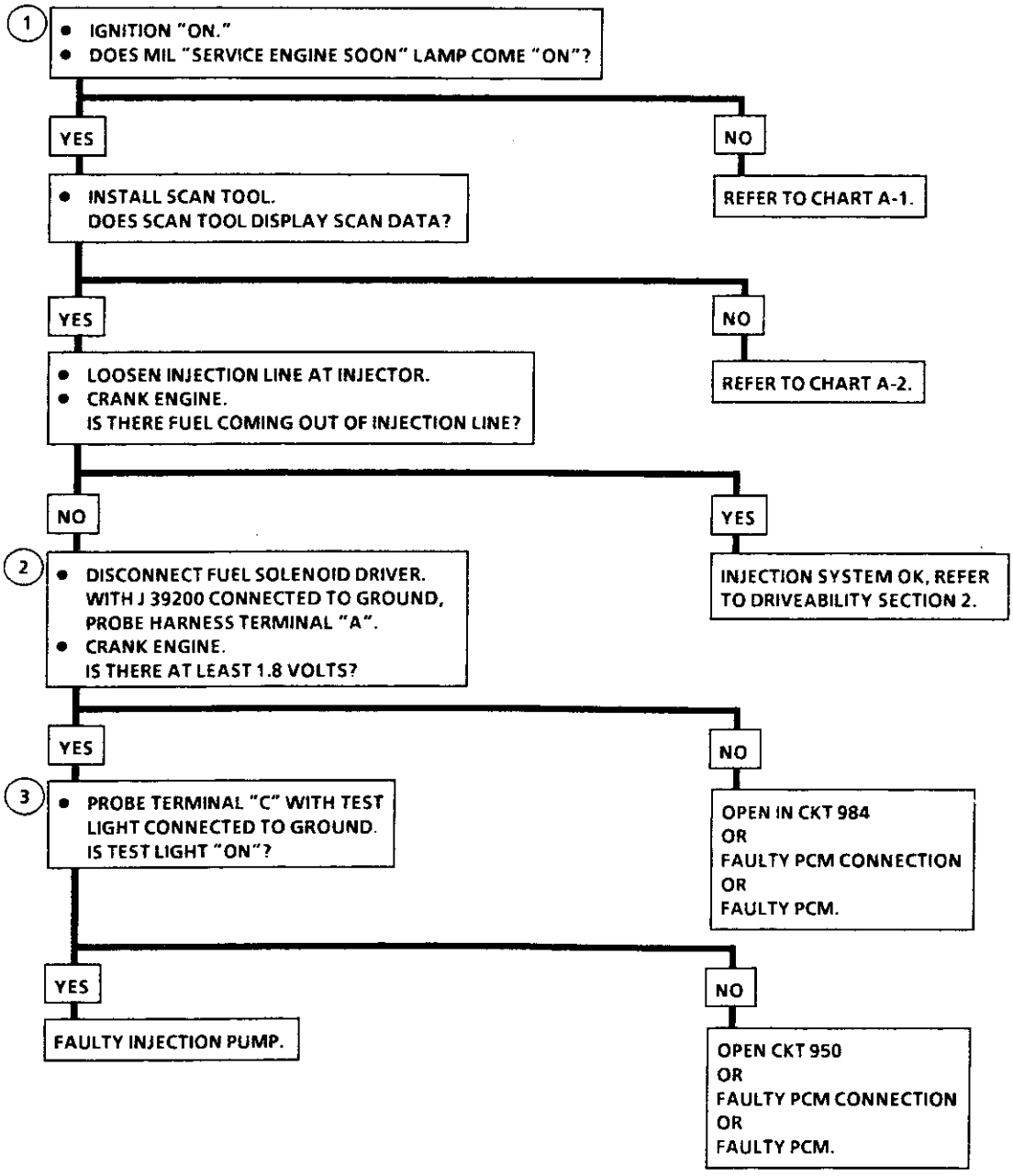
Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. A Malfunction Indicator Lamp (MIL) "ON" is a basic test to determine if there is a 12 volt supply and ignition 12 volts to PCM. No DLC may be due to a PCM problem and CHART A-2 will diagnose the PCM.
2. This step will check to see if there is an inject command coming from the PCM.
3. This step will check ground circuit.

Diagnostic Aids: If no trouble is found in the fuel pump circuit or ignition system and the cause of a "Engine Cranks But Will Not Run" has not been found, check for:

- Low fuel pressure.
- Water or foreign material in the fuel system.
- Basic engine problem.

CHART A-3
ENGINE CRANKS BUT WILL NOT RUN



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

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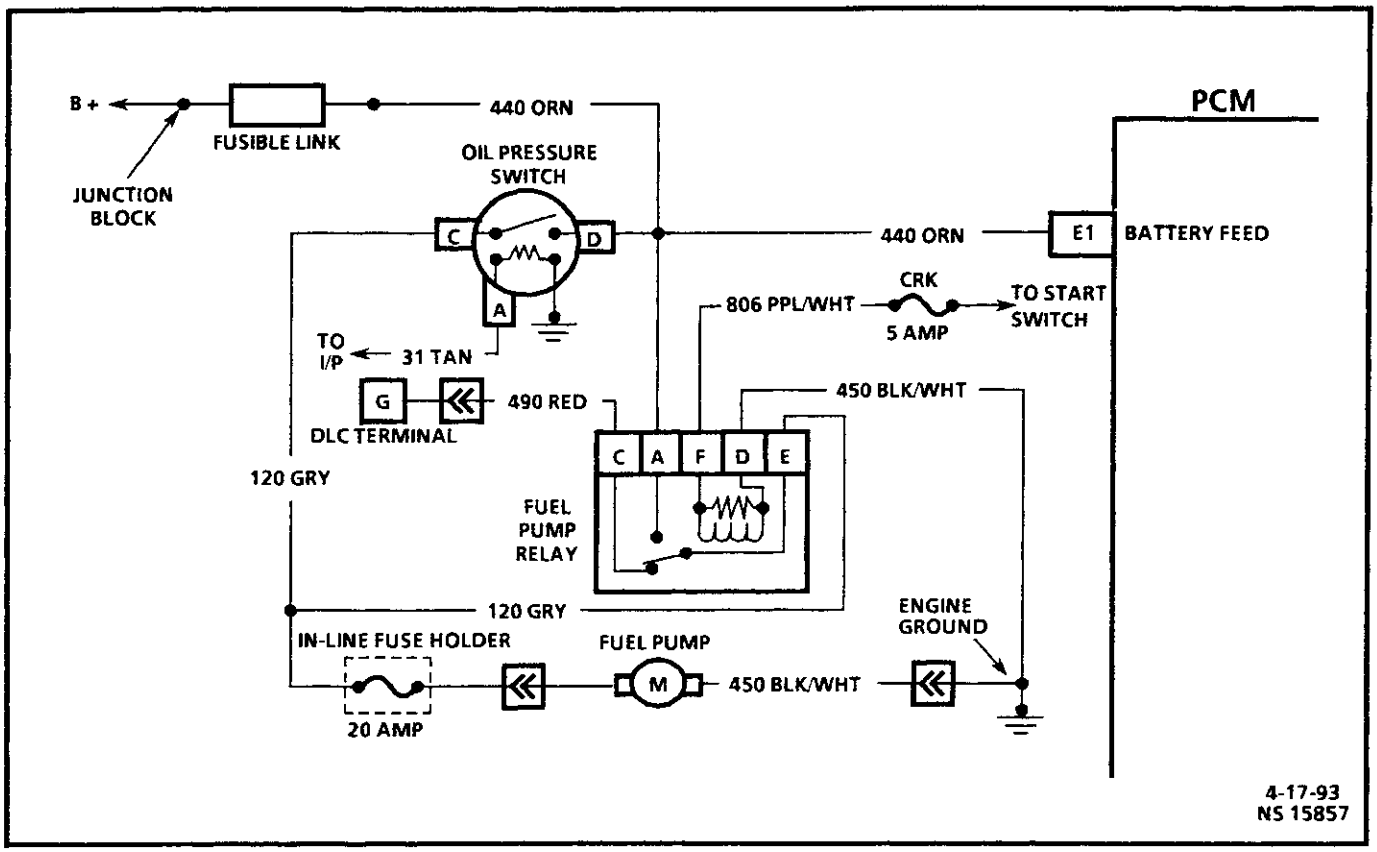


CHART A-5

FUEL PUMP RELAY CIRCUIT DIAGNOSIS

Circuit Description:

When the ignition switch is in the CRANK position, the lift pump circuit is completed through the relay contacts. During this time, oil pressure is building to the point of closing the contacts of the oil pressure switch. A minimum of 28 kPa (4 psi) is required to close the switch contacts.

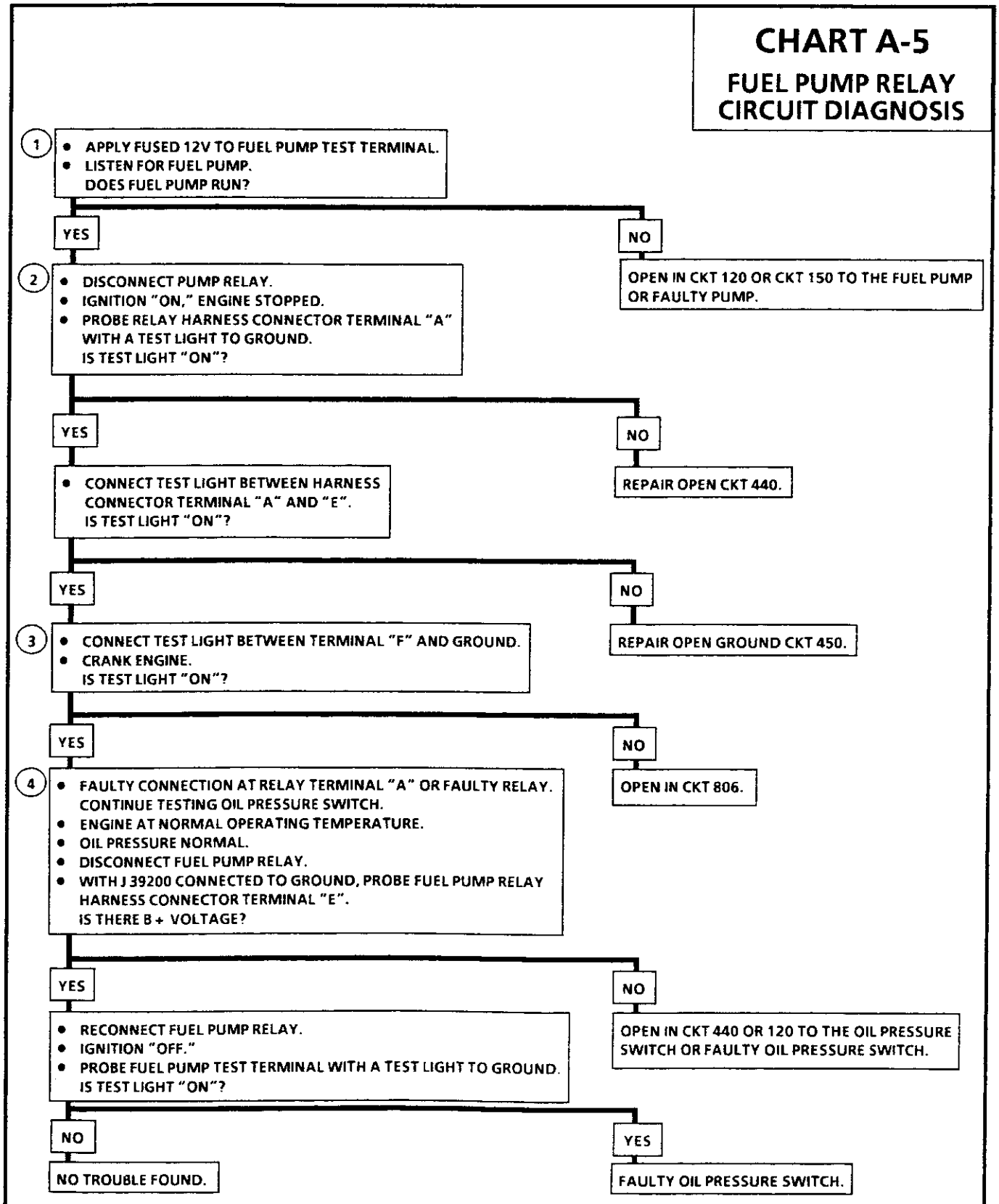
When the ignition is returned to the RUN position, the oil pressure of the running engine maintains electrical power to the lift pump.

Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This procedure applies direct voltage to run the fuel pump. If the pump runs, it may be a fuel pump relay circuit problem which the following step will locate.
2. This step checks voltage from the battery and the ground circuit to the relay.
3. This test determines if there is voltage from the PCM, terminal "A" to terminal "D" on the relay connector.
4. This completes the fuel pump relay circuit, but the oil pressure switch should also be diagnosed.

Diagnostic Aids: If engine oil pressure drops below 28 kPa (4 psi), the engine will run poorly or stall when the lift pump circuit opens.

CHART A-5
FUEL PUMP RELAY CIRCUIT DIAGNOSIS



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

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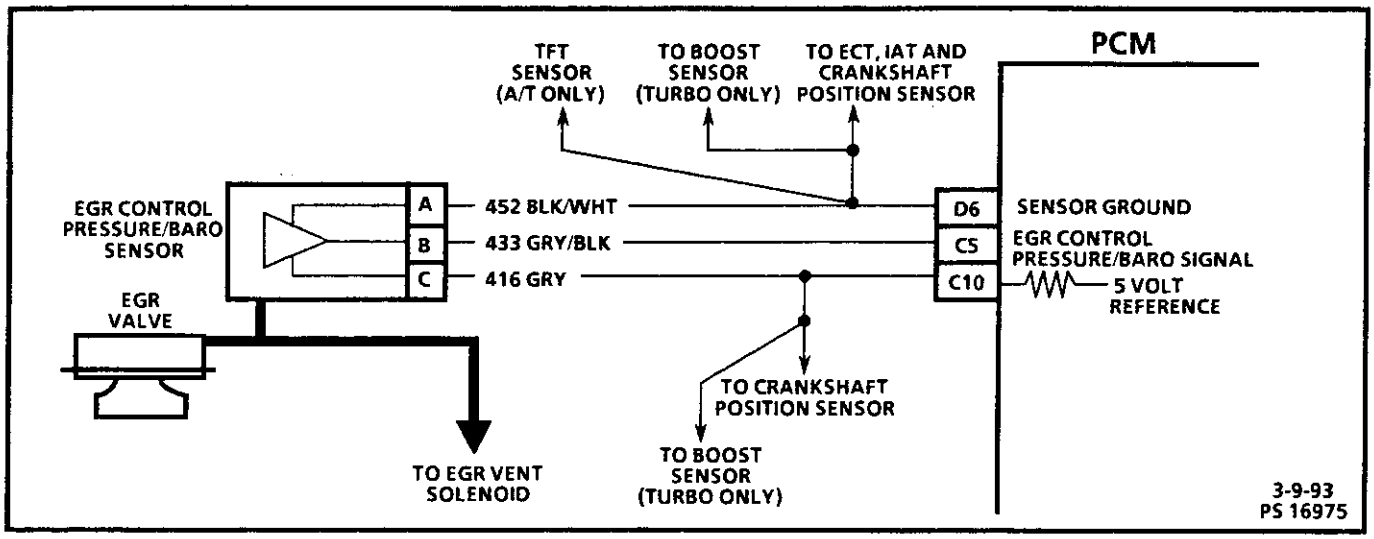
PS 17142



EGR CONTROL PRESSURE/BARO SENSOR OUTPUT CHECK

Circuit Description:

An EGR control pressure/BARO sensor is used to monitor the amount of vacuum in the EGR circuit. It senses the actual vacuum in the EGR vacuum line and sends a signal back to the PCM. The signal is compared to the EGR duty cycle calculated by the PCM. On vehicles not equipped with EGR, this sensor is only used for a BARO reading.

Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

Important

- Be sure to use the same diagnostic test equipment for all measurements.

1. Checks sensor output voltage to the PCM. This voltage, without engine running, represents a barometer reading to the PCM.
   - When comparing Tech 1 scan readings to a known good vehicle, it is important to compare vehicles which use a sensor having the same color insert or having the same "Hot Stamped" number. Refer to figures on facing page.
2. Applying 34 kPa (10" Hg) vacuum to the sensor should cause the voltage to change. Subtract second reading from the first. Voltage value should be greater than 1.5 volts. When applying vacuum to the sensor, the change in voltage should be instantaneous. A slow voltage change indicates a faulty sensor.
3. Check vacuum hose to sensor for leaking or restriction. Be sure that no other vacuum devices are connected to the sensor hose.

   NOTICE: Make sure electrical connector remains securely fastened.

4. Disconnect sensor from bracket and twist sensor by hand (only) to check for intermittent connection. Output changes greater that .1 volt indicates a bad connector or connection. If OK, replace sensor.

EGR CONTROL PRESSURE/BARO SENSOR OUTPUT CHECK

1
- IF ANY DTC(s) ARE STORED. REFER TO THOSE CHARTS FIRST.
- IGNITION "ON," ENGINE "OFF."
- TECH 1 SCAN TOOL SHOULD DISPLAY A SENSOR VOLTAGE.
- COMPARE THIS READING WITH THE READING OF A KNOWN GOOD VEHICLE. SEE FACING PAGE TEST DESCRIPTION, STEP 1. VOLTAGE READING SHOULD BE WITHIN ± .4 VOLT. IS IT?

YES

2
- DISCONNECT AND PLUG VACUUM SOURCE TO SENSOR.
- CONNECT A HAND VACUUM PUMP TO SENSOR.
- START ENGINE.
- NOTE SENSOR VOLTAGE.
- APPLY 34 kPa (10" Hg) OF VACUUM AND NOTE VOLTAGE CHANGE. SUBTRACT SECOND READING FROM THE FIRST. VOLTAGE VALUE SHOULD BE GREATER THAN 1.5 VOLTS. IS IT?

YES

3 NO TROUBLE FOUND. CHECK SENSOR VACUUM SOURCE FOR LEAKAGE OR RESTRICTION. BE SURE THIS SOURCE SUPPLIES VACUUM TO SENSOR ONLY.

NO

4 CHECK SENSOR CONNECTION. IF OK, REPLACE EGR CONTROL PRESSURE/BARO SENSOR.

NO

REPLACE EGR CONTROL PRESSURE/BARO. SENSOR.

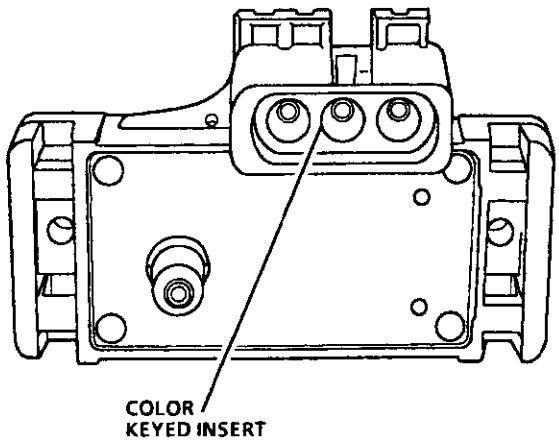


Figure 1 - Color Key Insert

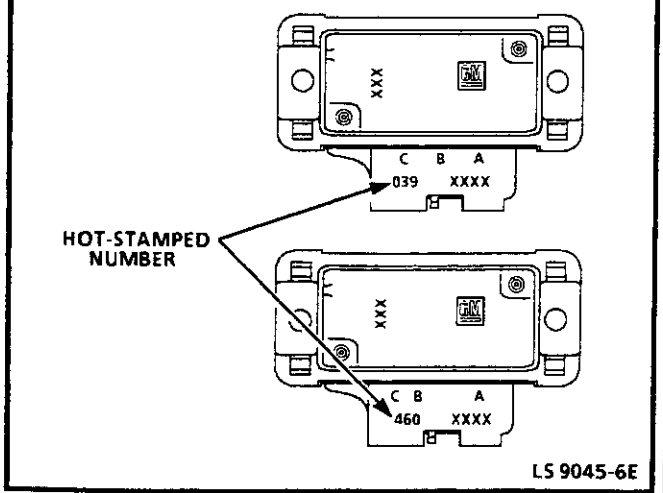


Figure 2 - Hot Stamped Number

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

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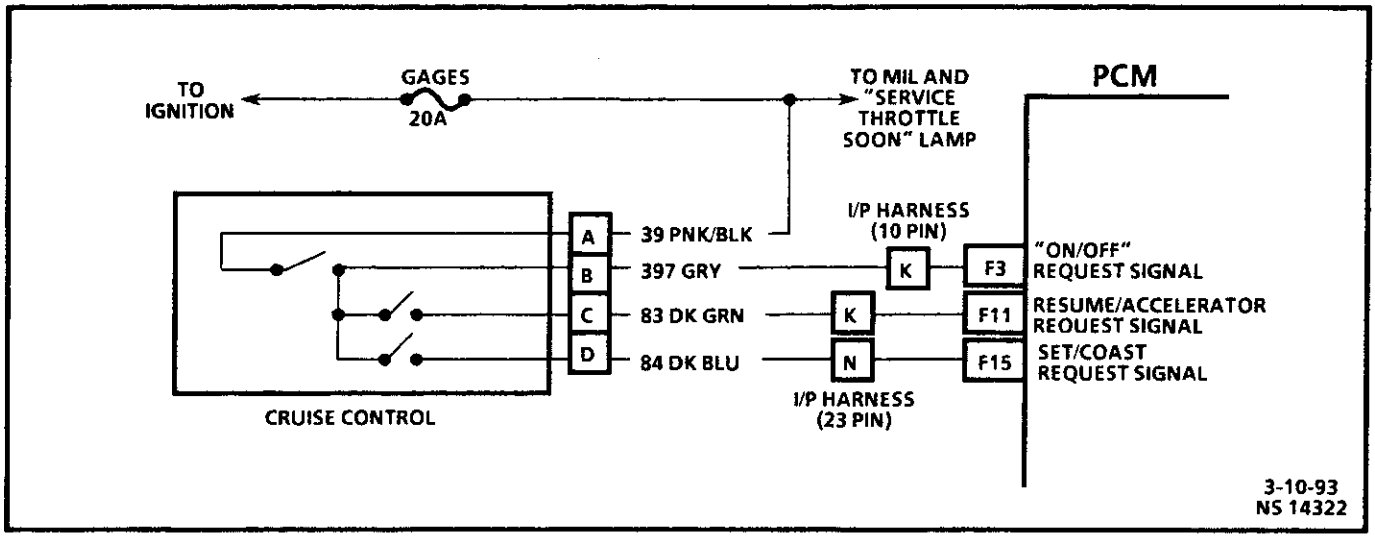
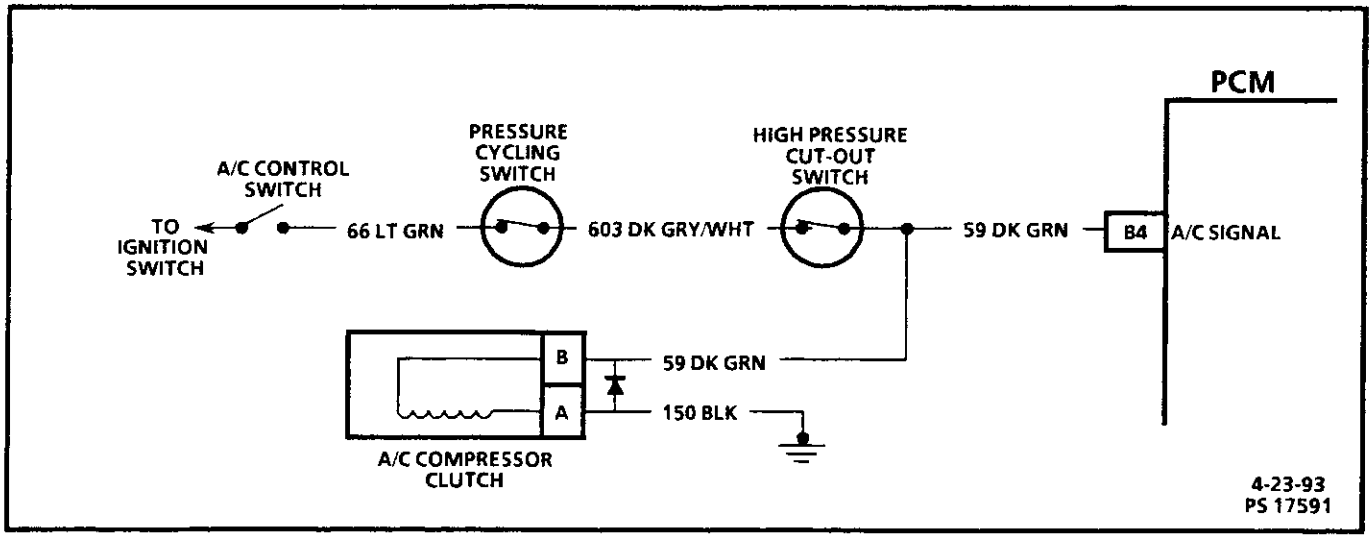
PS 17307



CRUISE CONTROL SIGNAL DIAGNOSIS

Circuit Description:

The cruise on/off, set/coast and resume/accel signals are inputs to the fuel control portion of the PCM. These inputs allow the PCM to control and hold a requested speed. If cruise is inoperative, and no DTC(s) are stored, check for faulty cruise switch, wiring harness for opens or faulty connections.



A/C SIGNAL DIAGNOSIS

Circuit Description:

Turning "ON" the air conditioning supplies CKT 59 battery voltage to the A/C compressor clutch and to terminal "B4" of the PCM to increase and maintain idle speed.

The PCM does not control the A/C compressor clutch. Therefore, if A/C does not function, refer to the A/C section of the service manual for diagnosis of the system.

If A/C is operating properly and idle speed dips too low when the A/C compressor turns "ON" or flares too high when the A/C compressor turns "OFF," check for an open CKT 59 to the PCM. If circuits are OK, it is a faulty PCM connector terminal "B4" or PCM.

RESTRICTED EXHAUST SYSTEM CHECK

Proper diagnosis for a restricted exhaust system is essential before any components are replaced. The following procedure may be used for diagnosis:

DIAGNOSIS:

1. Inspect the entire exhaust system for a collapsed pipe, heat distress, or possible internal muffler failure.
2. If there are no obvious reasons for the excessive backpressure, the catalytic converter is suspected to be restricted and should be replaced using current recommended procedures. Refer to SECTION 6F of the appropriate service manual.

DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

The MIL (Service Engine Soon) will be "ON" if an emission malfunction exists. If the malfunction clears, the lamp will go "OFF" and the DTC will be stored in the PCM. Any DTCs stored will be cleared if no problem recurs within 50 engine starts.

Important

- All DTCs with the sign * are transmission related DTCs and have descriptions, diagnostic charts are in SECTION 10A (4L60E)/10B (4L80E). Remember, always start with the lowest numerical engine DTC first. When diagnosing some engine DTCs, other transmission symptoms can occur.

DTC NUMBER AND NAME	SECTION	DTC NUMBER AND NAME	SECTION
DTC 13 - Engine Shutoff Solenoid Circuit Fault	3	DTC 23 - Accelerator Pedal Position 1 Circuit Range Fault	3
DTC 14 - Engine Coolant Temperature (ECT) Sensor Circuit Low (High Temperature Indicated)	3	*DTC 24 - Vehicle Speed Sensor Circuit Low (Output Speed Signal)	10A (4L60E) 10B (4L80E)
DTC 15 - Engine Coolant Temperature (ECT) Sensor Circuit High (Low Temperature Indicated)	3	DTC 25 - Accelerator Pedal Position 2 Circuit High	3
DTC 16 - Vehicle Speed Sensor Buffer Fault	3	DTC 26 - Accelerator Pedal Position 2 Circuit Low	3
DTC 17 - High Resolution Circuit Fault	3	DTC 27 - Accelerator Pedal Position 2 Circuit Range Fault	3
DTC 18 - Pump Cam Reference Pulse Error	3	*DTC 28 - Trans Range Pressure Switch Circuit	10A (4L60E) 10B (4L80E)
DTC 19 - Crankshaft Position Reference Error	3	DTC 29 - Glow Plug Relay Fault	3
DTC 21 - Accelerator Pedal Position 1 Circuit High	3	DTC 31 - EGR Control Pressure/Baro Sensor Circuit Low (High Vacuum)	3
DTC 22 - Accelerator Pedal Position 1 Circuit Low	3	DTC 32 EGR Circuit Error	3

DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

The MIL (Service Engine Soon) will be "ON" if an emission malfunction exists. If the malfunction clears, the lamp will go "OFF" and the DTC will be stored in the PCM. Any DTCs stored will be cleared if no problem recurs within 50 engine starts.

Important

- All DTCs with the sign * are transmission related DTCs and have descriptions, diagnostic charts are in SECTION 10A (4L60E)/10B (4L80E). Remember, always start with the lowest numerical engine DTC first. When diagnosing some engine DTCs, other transmission symptoms can occur.

DTC NUMBER AND NAME	SECTION	DTC NUMBER AND NAME	SECTION
DTC 33 - EGR Control Pressure/Baro Sensor Circuit High	3	DTC 47 - Intake Air Temperature Sensor Circuit Low (High Temp Indicated)	3
DTC 34 - Injection Timing Stepper Motor Fault	3	DTC 48 - Intake Air Temperature Sensor Circuit High (Low Temp Indicated)	3
DTC 35 - Injection Pulse Width Error (Response Time Short)	3	DTC 49 - Service Throttle Soon Lamp Circuit Fault	3
DTC 36 - Injection Pulse Width Error (Response Time Long)	3	DTC 51 - PROM Error	3
*DTC 37 - TCC Brake Switch Stuck "ON"	10A (4L60E) 10B (4L80E)	*DTC 52 - System Voltage High Long	10A (4L60E) 10B (4L80E)
*DTC 38 - TCC Brake Switch Stuck "OFF"	10A (4L60E) 10B (4L80E)	*DTC 53 - System Voltage High	10A (4L60E) 10B (4L80E)
*DTC 39 - TCC Stuck "OFF"	10B (4L80E)	DTC 56 - Injection Pump Calibration Resistor Error	3
DTC 41 - Brake Switch Circuit Fault	3	DTC 57 - PCM 5 Volt Shorted	3
DTC 42 - Fuel Temperature Circuit Low (High Temp Indicated)	3	*DTC 58 - Trans Fluid Temp Circuit Low	10A (4L60E) 10B (4L80E)
DTC 43 - Fuel Temperature Circuit High (Low Temp Indicated)	3	*DTC 59 - Trans Fluid Temp Circuit High	10A (4L60E) 10B (4L80E)
DTC 44 - EGR Pulse Width Error	3	DTC 61 - Turbo Boost Sensor Circuit High	3
DTC 45 - EGR Vent Error	3	DTC 62 - Turbo Boost Sensor Circuit Low	3
DTC 46 - Malfunction Indicator Lamp Circuit Fault	3		

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DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

The MIL (Service Engine Soon) will be "ON" if an emission malfunction exists. If the malfunction clears, the lamp will go "OFF" and the DTC will be stored in the PCM. Any DTCs stored will be cleared if no problem recurs within 50 engine starts.

Important

- All DTCs with the sign * are transmission related DTCs and have descriptions, diagnostic charts are in SECTION 10A (4L60E)/10B (4L80E). Remember, always start with the lowest numerical engine DTC first. When diagnosing some engine DTCs, other transmission symptoms can occur.

DTC NUMBER AND NAME	SECTION
DTC 63 - Accelerator Pedal Position 3 Circuit High	3
DTC 64 - Accelerator Pedal Position 3 Circuit Low	3
DTC 65 - Accelerator Pedal Position 3 Circuit Range Fault	3
*DTC 66 - 3-2 Control Solenoid Circuit	10A (4L60E)
*DTC 67 - TCC Solenoid Circuit	10A (4L60E)
*DTC 68 - Trans Component Slipping	10A (4L60E) 10B (4L80E)
*DTC 69 - TCC Stuck "ON"	10A (4L60E) 10B (4L80E)
DTC 71 - Set/Coast Switch Fault	3
*DTC 72 - Vehicle Speed Sensor Circuit Loss (Output Speed Signal)	10A (4L60E) 10B (4L80E)
*DTC 73 - Pressure Control Solenoid Circuit	10A (4L60E) 10B (4L80E)
*DTC 74 - Trans Input Speed Sensor Circuit	10B (4L80E)
*DTC 75 - System Voltage Low	10A (4L60E) 10B (4L80E)
DTC 76 - Resume/Accel Switch Fault	3
DTC 78 - Wastegate Solenoid Fault	3
*DTC 79 - Trans Fluid Overtemp	10A (4L60E)
*DTC 81 - 2-3 Shift Solenoid Circuit	10A (4L60E) 10B (4L80E)
*DTC 82 - 1-2 Shift Solenoid Circuit	10A (4L60E) 10B (4L80E)
*DTC 83 - TCC Pwm Solenoid Circuit	10B (4L80E)
*DTC 84 - Accelerator Pedal Position Circuit Fault	10B (4L80E)
*DTC 85 - Undefined Ratio Error	10B (4L80E)
*DTC 86 - Low Ratio Error	10B (4L80E)
*DTC 87 - High Ratio Error	10B (4L80E)
DTC 88 - TDC Offset Error	3
DTC 91 - Cylinder Balance Fault #1 Cyl	3
DTC 92 - Cylinder Balance Fault #2 Cyl	3
DTC 93 - Cylinder Balance Fault #3 Cyl	3
DTC 94 - Cylinder Balance Fault #4 Cyl	3
DTC 95 - Cylinder Balance Fault #5 Cyl	3
DTC 96 - Cylinder Balance Fault #6 Cyl	3
DTC 97 - Cylinder Balance Fault #7 Cyl	3
DTC 98 - Cylinder Balance Fault #8 Cyl	3
DTC 99 - Accelerator Pedal Position 2 (5 Volt Reference Fault)	3

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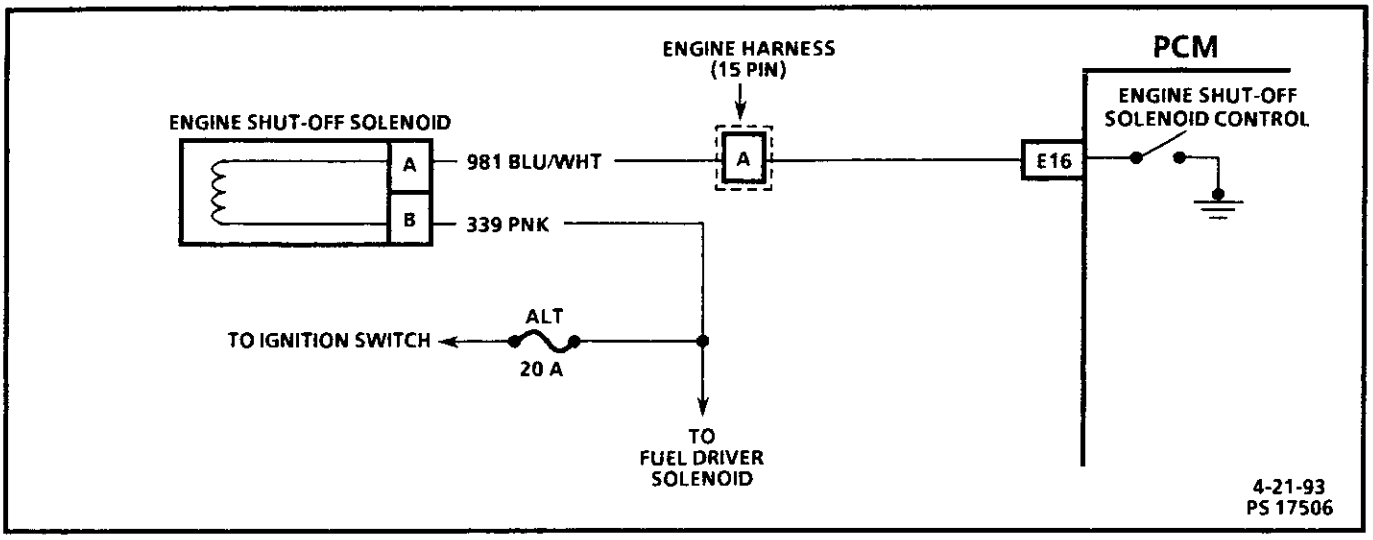


DTC 13

ENGINE SHUTOFF SOLENOID CIRCUIT FAULT

Circuit Description:

When the ignition switch is in the "OFF" position, the engine shutoff solenoid is in the "No Fuel" position. By providing a ground path, the PCM energizes the solenoid which then allows fuel to pass into the injection pump.

DTC 13 Will Set When: No ignition voltage on terminal "E16" when PCM is requesting engine shutoff solenoid "ON."

Action Taken (PCM will default to): A current and history DTC 13 will be stored.

DTC 13 Will Clear When: The fault condition(s) no longer exist.

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

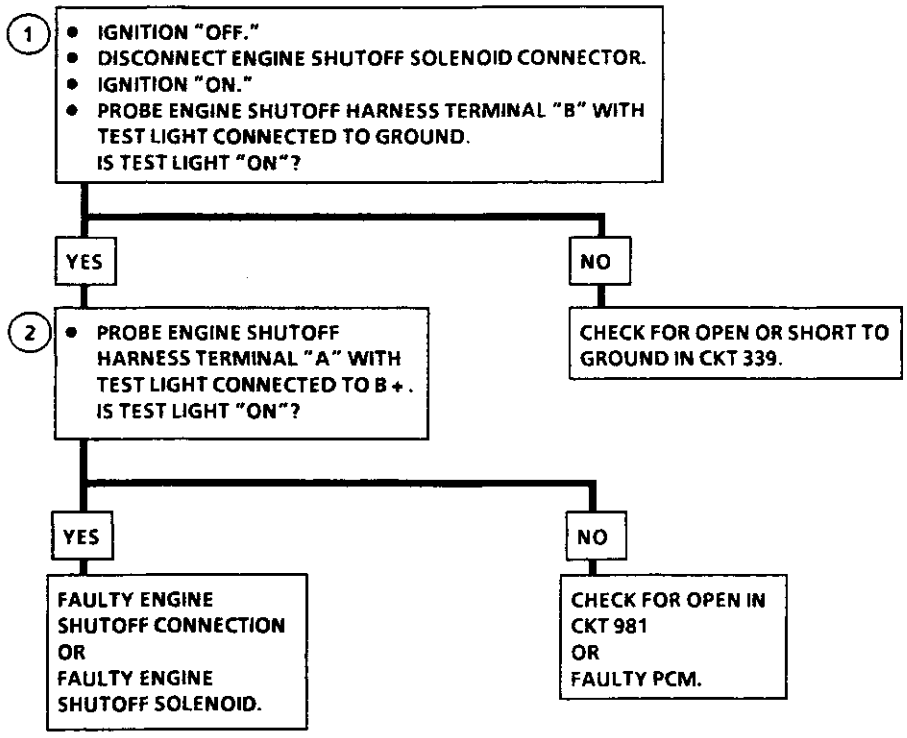
1. Check for open circuit from ignition switch to the solenoid.
2. Check CKT 981 from solenoid to PCM for open.

Diagnostic Aids: An open in CKT 981 or 339 will cause a DTC 13.

Also a no start condition will exist.

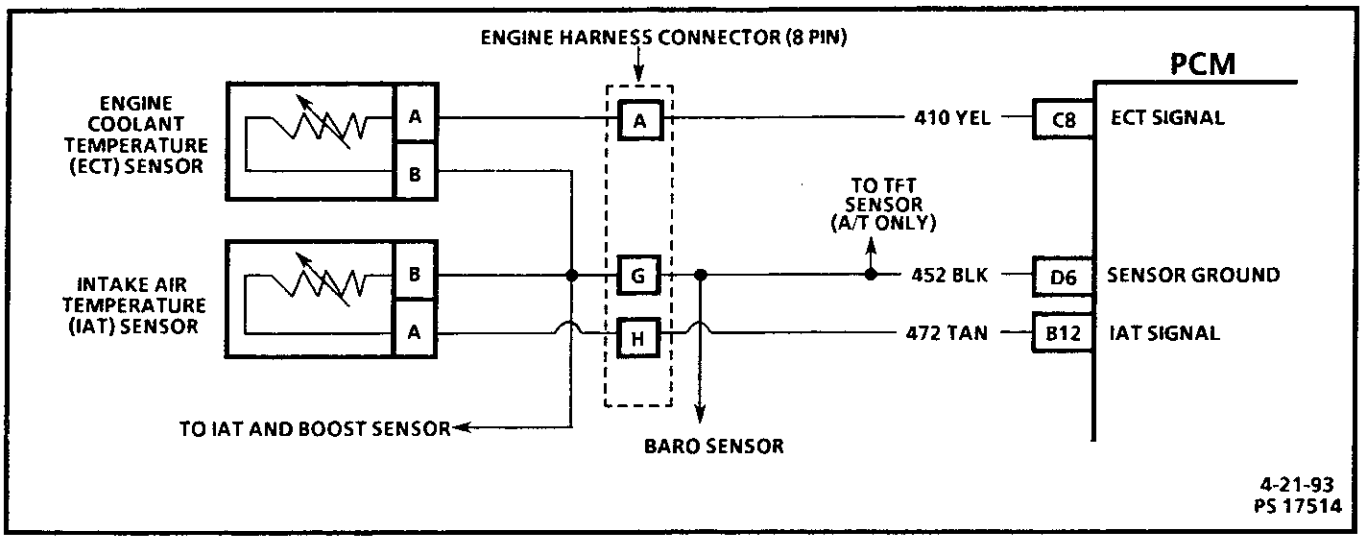
DTC 13

ENGINE SHUTOFF SOLENOID CIRCUIT FAULT



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 14

ENGINE COOLANT TEMPERATURE (ECT) CIRCUIT LOW (HIGH TEMPERATURE INDICATED)

Circuit Description:

The Engine Coolant Temperature (ECT) sensor is a thermistor that controls signal voltage to the PCM. When the engine is cold, the sensor resistance is high, therefore the PCM will see high signal voltage. As the engine warms, sensor resistance becomes less and voltage drops.

DTC 14 Will Set When: Engine coolant temperature greater than 151°C (304°F) for 2 seconds.

Action Taken (PCM will default to): The PCM will default to 77°C (171°F) and to fast idle.

DTC 14 Will Clear When: The fault condition(s) no longer exist.

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step determines if DTC 14 is a hard failure or an intermittent condition.
2. This test will determine if CKT is shorted to ground.

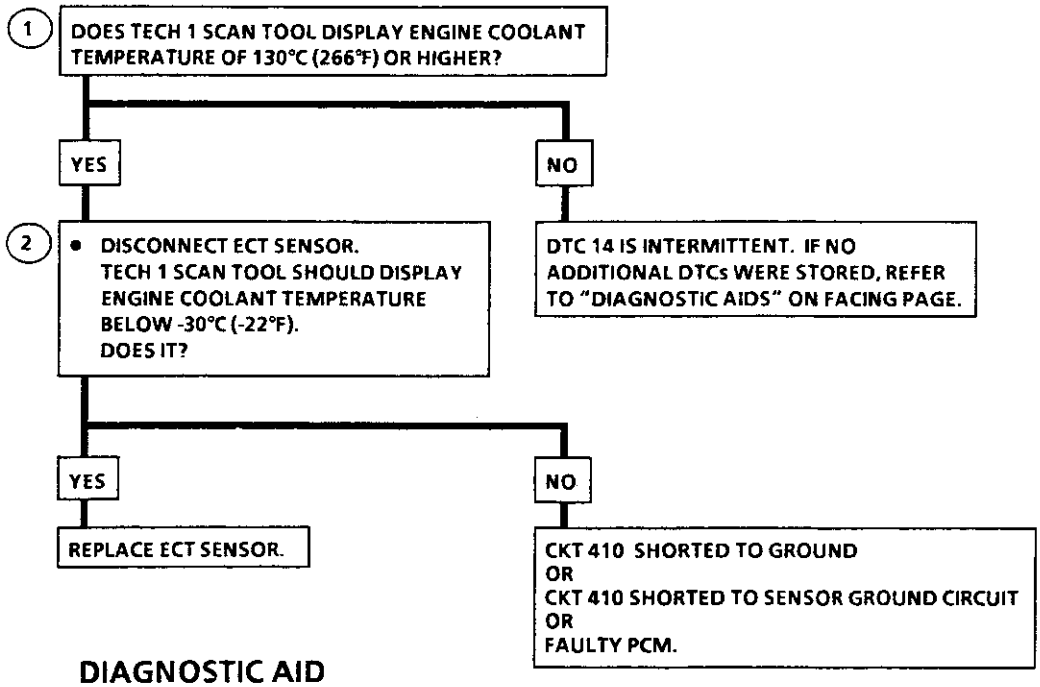
Diagnostic Aids: Check harness routing for a potential short to ground.

After engine is started, the coolant temperature should rise steadily to about 85°C (185°F).

The PCM default value will flash on the data screen intermittently.

DTC 14

ENGINE COOLANT TEMPERATURE (ECT) CIRCUIT LOW (HIGH TEMPERATURE INDICATED)

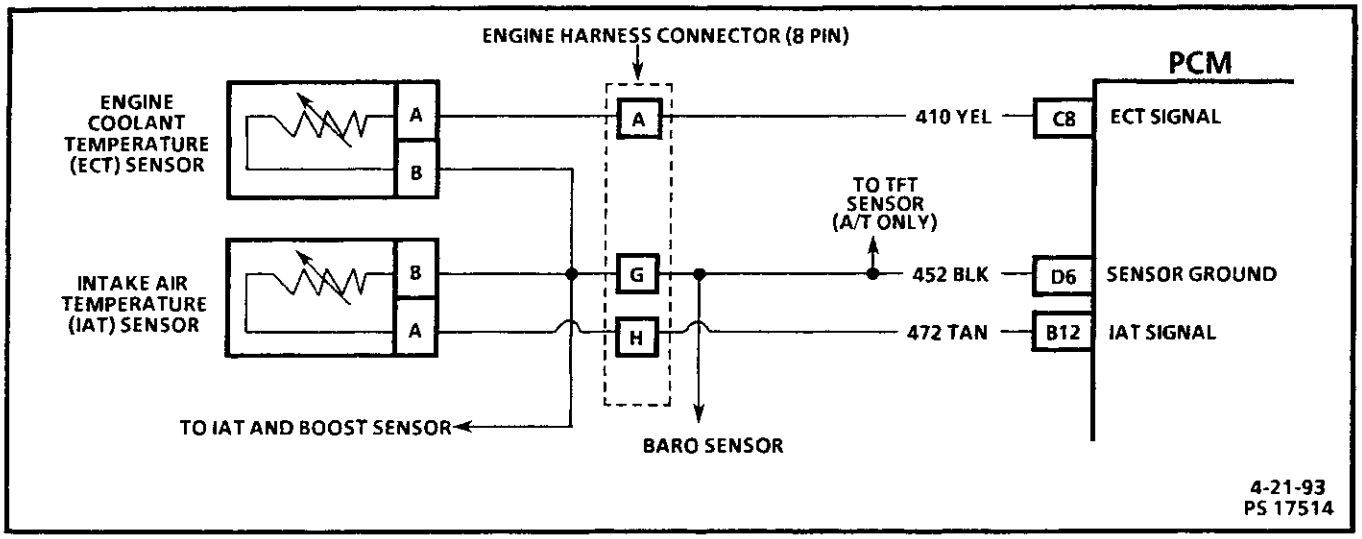


DIAGNOSTIC AID

ENGINE COOLANT TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
-5	23	12300
-10	14	16180
-15	5	21450
-20	-4	28680
-30	-22	52700
-40	-40	100700

IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 15

ENGINE COOLANT TEMPERATURE (ECT) SENSOR CIRCUIT HIGH (LOW TEMPERATURE INDICATED)

Circuit Description:

The Engine Coolant Temperature (ECT) sensor is a thermistor that controls signal voltage to the PCM. When the engine is cold, the sensor resistance is high, therefore the PCM will see high signal voltage. As the engine warms, the sensor resistance becomes less and the voltage drops.

DTC 15 Will Set When:

- Engine coolant temperature less than -36°C (-33°F).
- Engine running for at least 8 minutes.

Action Taken (PCM will default to): The PCM will default to 77°C (171°F) and fast idle.

DTC 15 Will Clear When: The fault condition(s) no longer exist.

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test determines if DTC 15 is a hard failure or an intermittent condition.
2. This test will determine if CKT 410 is shorted to ground.
3. This test will determine if CKT 410 is open, or a faulty PCM.

Diagnostic Aids: Check harness routing for a potential short to ground. After engine is started, the ECT temperature should rise steady to about 85°C (185°F). The default value will flash intermittently on the data screen.

DTC 15

ENGINE COOLANT TEMPERATURE (ECT) SENSOR CIRCUIT HIGH (LOW TEMPERATURE INDICATED)

1. • DOES TECH 1 SCAN TOOL DISPLAY ECT OF -30°C (-22°F) OR LESS?
   - NO → DTC 15 IS INTERMITTENT. IF NO ADDITIONAL DTCs WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - YES →
2. • DISCONNECT ECT SENSOR.
   • JUMPER HARNESS TERMINALS TOGETHER.
   • TECH 1 SCAN TOOL SHOULD DISPLAY 130°C (266°F) OR MORE. DOES IT?
   - YES → FAULTY CONNECTION OR ENGINE COOLANT TEMPERATURE SENSOR.
   - NO →
3. • JUMPER CKT 410 TO GROUND.
   • TECH 1 SCAN TOOL SHOULD DISPLAY OVER 130°C (266°F). DOES IT?
   - YES → OPEN ECT SENSOR GROUND CIRCUIT, FAULTY CONNECTION OR FAULTY PCM.
   - NO → OPEN CKT 410, FAULTY CONNECTION AT PCM, OR FAULTY PCM.

DIAGNOSTIC AID

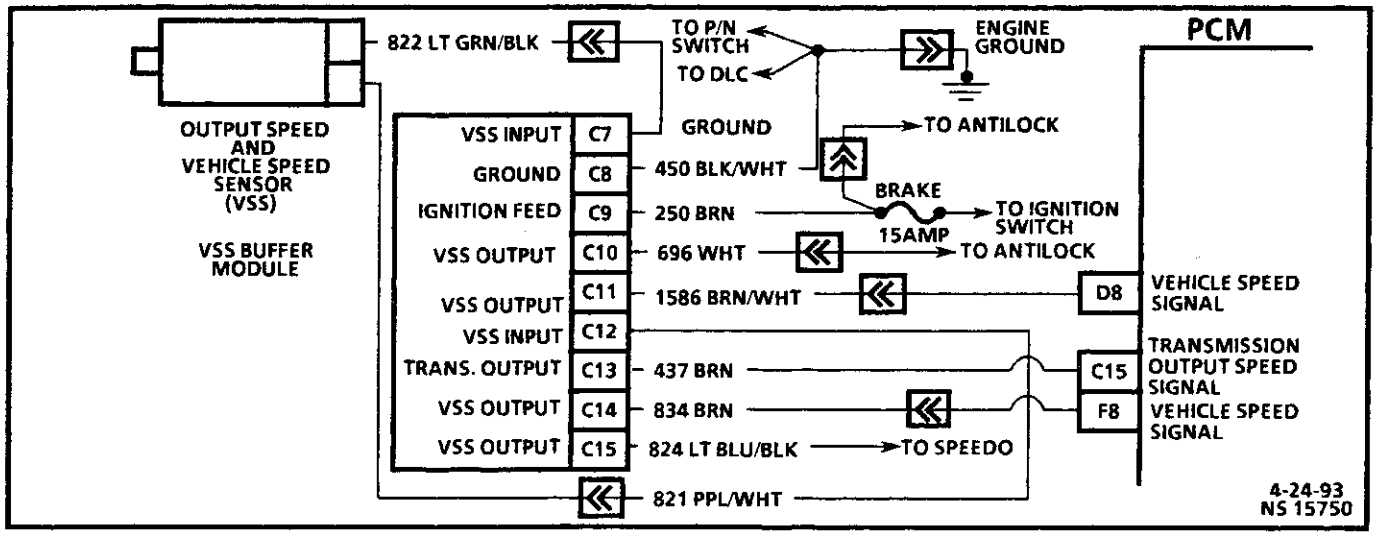
ENGINE COOLANT TEMPERATURE SENSOR

TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)

°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
-5	23	12300
-10	14	16180
-15	5	21450
-20	-4	28680
-30	-22	52700
-40	-40	100700

IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 16

VEHICLE SPEED SIGNAL BUFFER FAULT

Circuit Description:

The speed sensor circuit consists of a magnetic induction type sensor, a vehicle speed sensor buffer module and wiring. Gear teeth pressed on the output shaft induce an alternating current in the sensor. This signal is transmitted to the buffer. The buffer compensates for various axle ratios and converts the signal into a square wave for use by the speedometer, cruise control, antilock brake and PCM. The buffer sends two different signals to the PCM. The CKT 437 circuit relays the transmission output speed which is used to control shift points, line pressure, TCC, DTC 24 and DTC 72. The CKT 817 circuit relays the vehicle speed which is used to control engine operating functions and DTC 16. When DTC 24 or 72 is set, second gear only at maximum line pressure will occur.

DTC 16 Will Set When:

- Greater than 20 mph.
- 1000 to 4400 RPM.
- CKT 817 open or grounded.
- All conditions must be met for 2 seconds.

Action Taken (PCM will default to): No cruise control or fuel cutoff.

DTC 16 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This tests for B+ at VSS buffer.
2. This tests for proper ground path for vehicle speed sensor signal buffer.
3. This tests for vehicle speed sensor signal buffer signal to PCM.
4. This tests for a signal from VSS buffer to the PCM.

Diagnostic Aids: Check connections at VSS buffer and PCM. Refer to "4L80E or 4L60E Diagnostic Trouble Codes," Section "10" if DTC 24 or DTC 72 is also set.

DTC 16
VEHICLE SPEED SIGNAL BUFFER FAULT

- INSTALL TECH 1.
- RECORD, THEN CLEAR DTC(s).
- RAISE DRIVE WHEELS.
- ENGINE OPERATING.
- TRANSMISSION IN ANY DRIVE RANGE.

WITH DRIVE WHEELS ROTATING, DOES "VEHICLE SPEED" INCREASE WITH DRIVE WHEEL SPEED INCREASE?

NO

YES → PROBLEM IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS."

1. TRANSMISSION IN PARK.
- BACKPROBE VSS BUFFER MODULE HARNESS CONNECTOR TERMINAL "C9" WITH A TEST LIGHT TO GROUND.

IS TEST LIGHT "ON"?

YES

NO → REPAIR OPEN IGNITION FEED CIRCUIT TO VSS BUFFER MODULE.

2. BACKPROBE VSS BUFFER MODULE HARNESS CONNECTOR TERMINAL "C9" TO TERMINAL "C8" WITH A TEST LIGHT.

IS TEST LIGHT "ON"?

YES

NO → REPAIR OPEN GROUND CIRCUIT FROM VSS BUFFER MODULE.

3. BACKPROBE VSS BUFFER MODULE HARNESS CONNECTOR TERMINAL "C7" TO TERMINAL "C12" WITH J 39200 DVM ON A/C SCALE.
- TRANSMISSION IN ANY DRIVE RANGE WITH DRIVE WHEELS ROTATING.

DOES VOLTAGE INCREASE ON J 39200 DVM WITH DRIVE WHEEL SPEED INCREASE?

YES

NO → CHECK CKTs 821 OR 822 FOR OPEN SHORT TO GROUND OR FAULTY CONNECTIONS. IF OK, REPLACE VSS.

4. DOES TECH 1 DISPLAY TRANS OUTPUT SPEED (MPH) INCREASE WITH DRIVE WHEEL SPEED INCREASE?

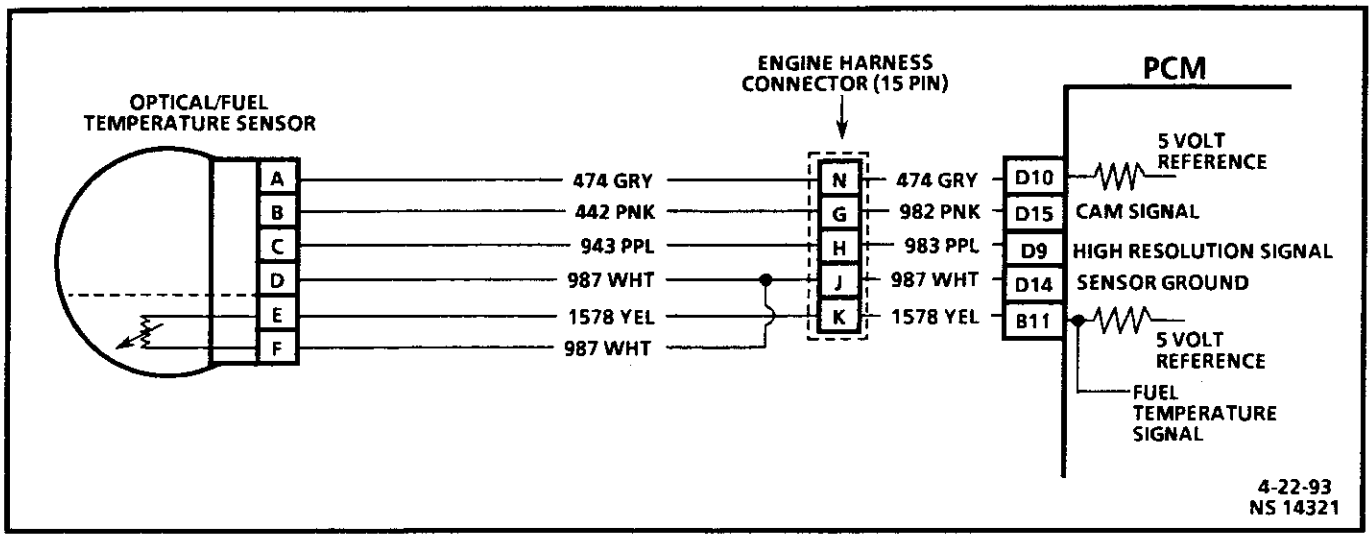
YES

NO → CHECK VSS BUFFER CONNECTIONS. IF OK, REPLACE VSS BUFFER.

CHECK CKT 834 FOR OPEN, SHORT, OR FAULTY CONNECTIONS AT VSS SIGNAL BUFFER CONNECTOR AND PCM CONNECTOR. IF OK, REPLACE PCM.

IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 17

HIGH RESOLUTION CIRCUIT FAULT

Circuit Description:

The high resolution sensor provides a signal to the PCM by counting pulses on the sensor disk located in the injection pump. The high resolution is one of the most important inputs by the PCM for fuel control and timing.

DTC 17 Will Set When: 8 cam reference pulses without and increase in high resolution counts (internal to PCM).

Action Taken (PCM will default to): Backup fuel.

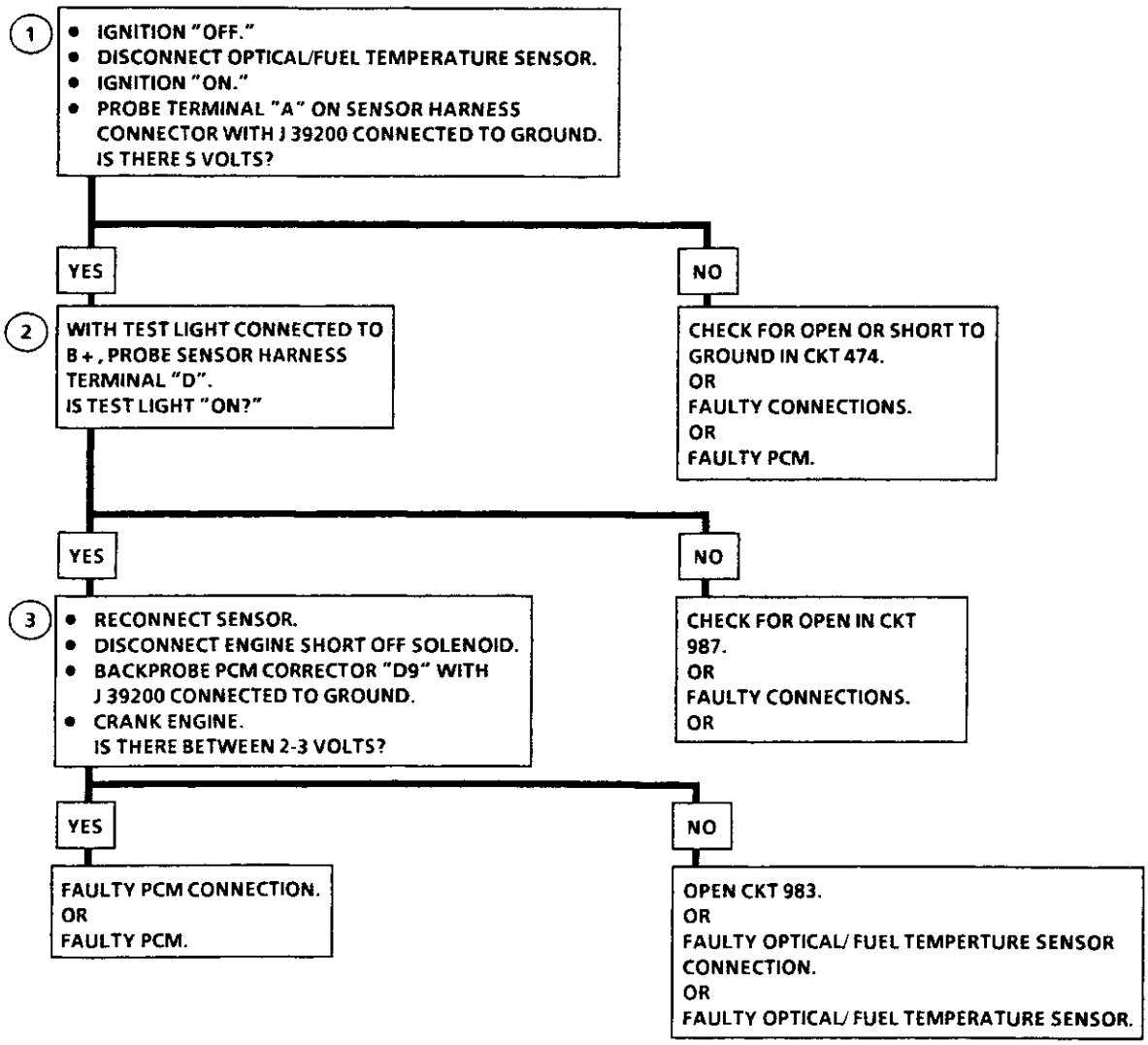
DTC 17 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step will determine if there is a 5 volt reference.
2. This step checks the ground circuit.
3. This step will check to see if the sensor is sending a signal back to the PCM.

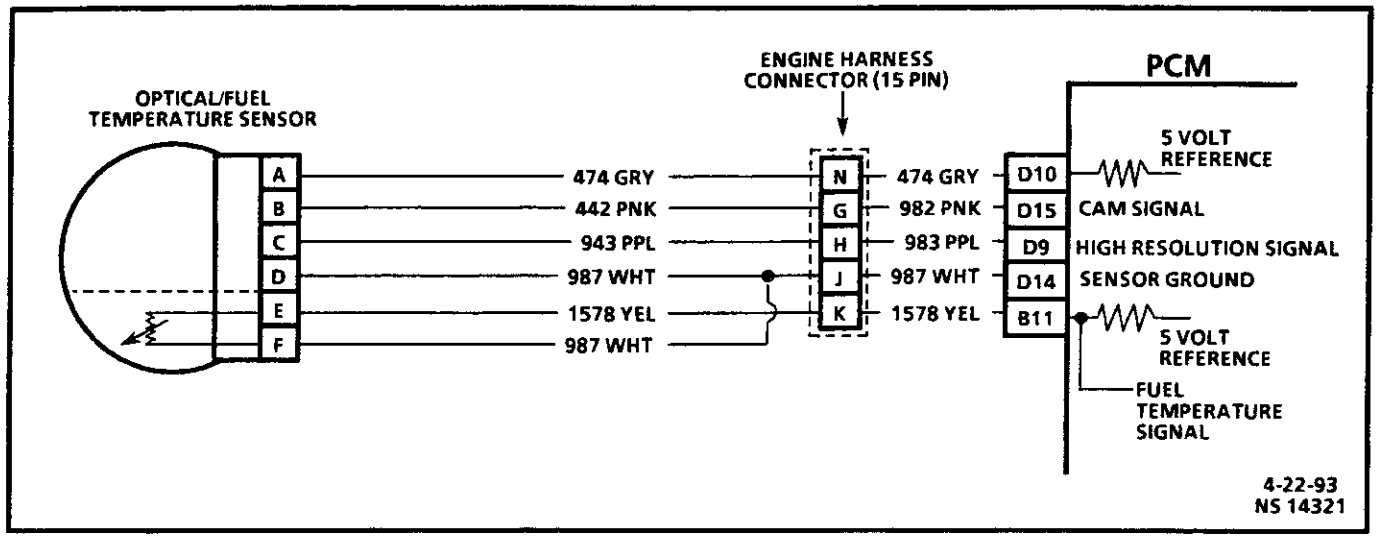
Diagnostic Aids: When PCM is in backup fuel, fast idle and poor performance problems will exist. If DTC 18 is also stored, there is a possible problem with CKTs 474 or 987. It is possible DTC 17 may set if there is air in the fuel system, refer to SECTION 4.

DTC 17
HIGH RESOLUTION CIRCUIT FAULT



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 18

PUMP CAM REFERENCE PULSE ERROR

Circuit Description:

The high resolution sensor also provides a Pump Cam signal to the PCM by counting pulses on the sensor disk located in the injection pump. The Pump Cam reference pulse is one of the most important inputs by the PCM for timing and start of injection.

DTC 18 Will Set When: 8 cam reference pulses missed for every crankshaft position pulse.

Action Taken (PCM will default to): Backup fuel.

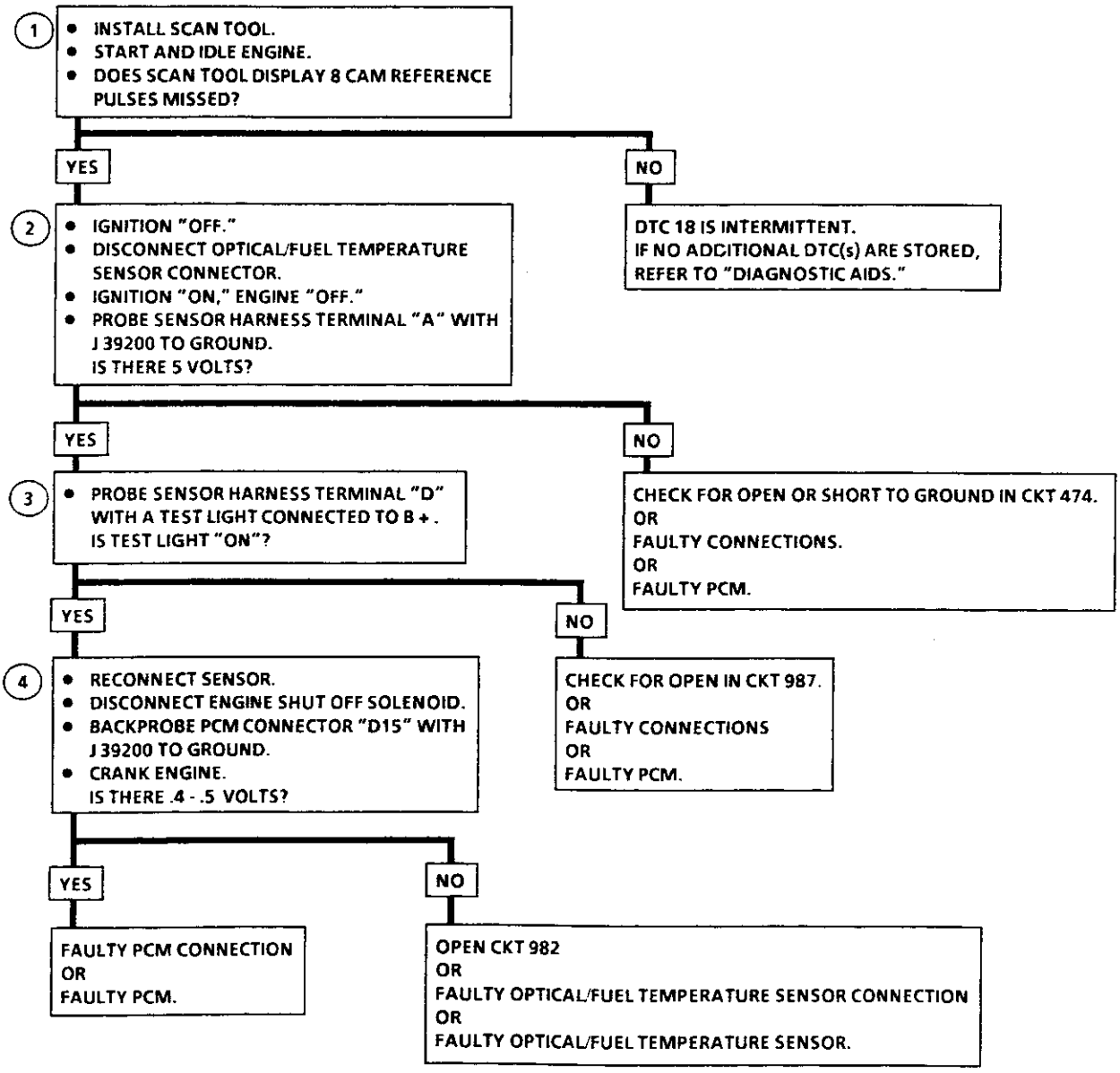
DTC 18 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step determines if it is the result of a hard failure or intermittent.
2. This step checks 5 volt reference circuits.
3. This step checks ground circuit.
4. This step checks to see if the optical/fuel temperature sensor is sending a signal to the PCM and to check CKT 982 for an open.

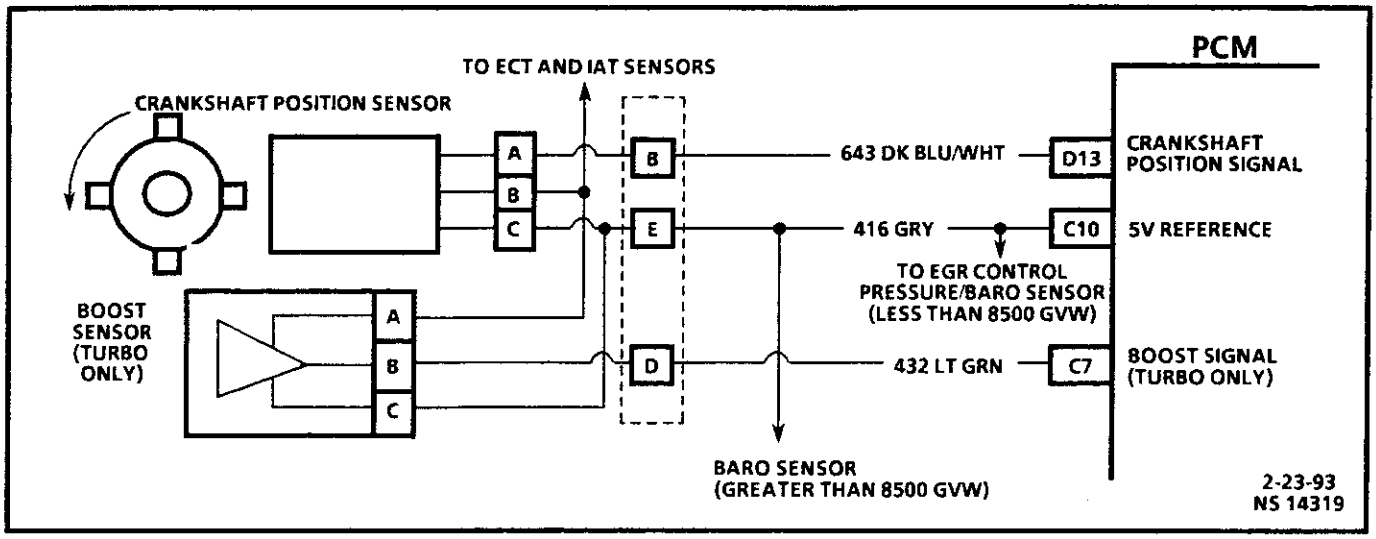
Diagnostic Aids: When the PCM is in backup fuel, rough idle and poor performance problems will exist. If DTC 17 is stored, there is a possible problem with CKTs 474 or 987.

DTC 18
PUMP CAM REFERENCE PULSE ERROR



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 19

CRANKSHAFT POSITION REFERENCE ERROR

Circuit Description:

The crankshaft position sensor is a magnetic induction type sensor that monitors crankshaft position and speed. There are four teeth 90° apart on the front of the crankshaft sprocket that induce an alternating current in the sensor which is transmitted to the PCM.

DTC 19 Will Set When: 8 crankshaft position pulses missed for every cam reference pulse.

Action Taken (PCM will default to): Backup fuel.

DTC 19 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

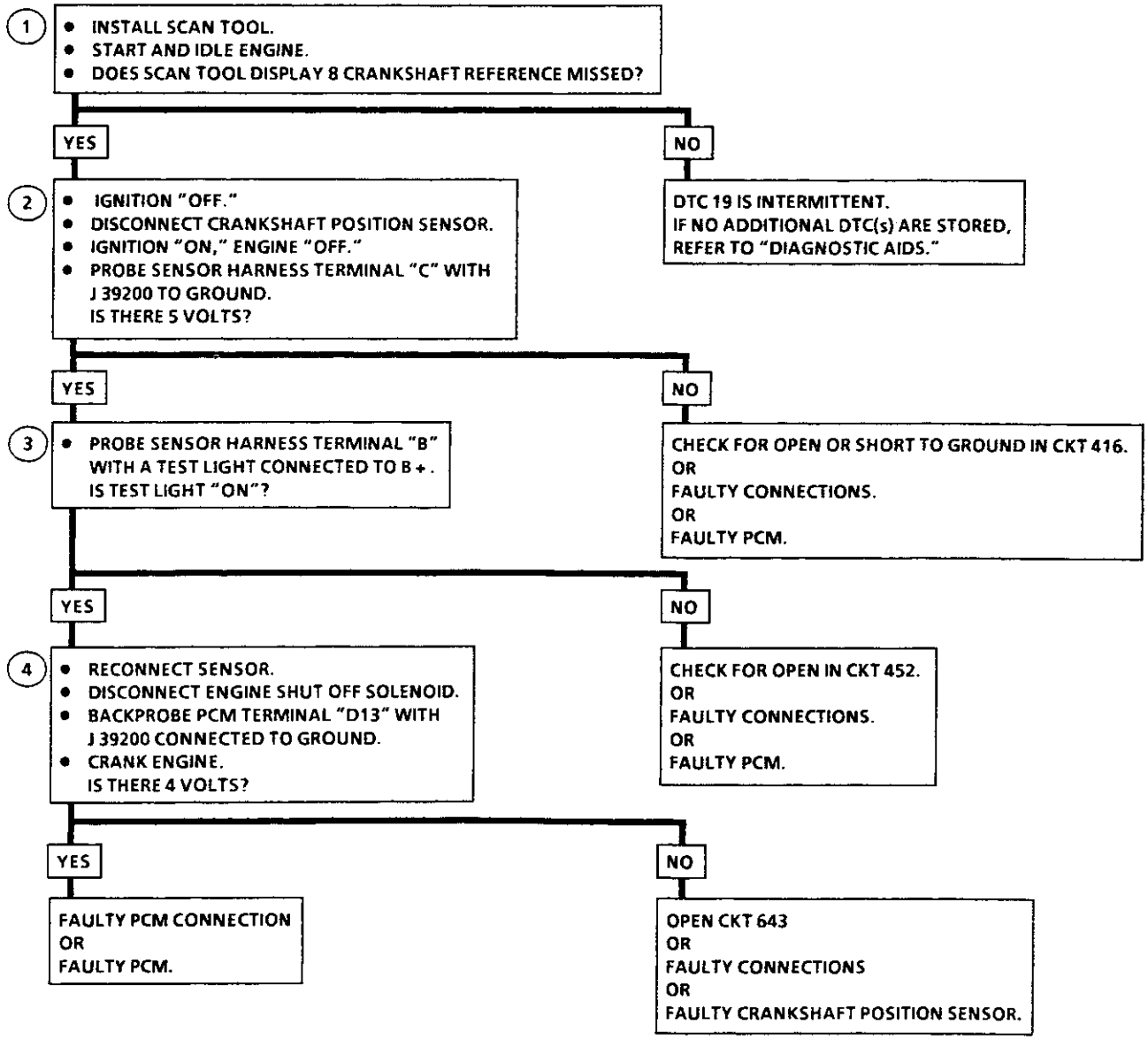
DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step will determine if DTC 19 is the result of a hard failure or an intermittent condition.
2. This step checks the 5 volt reference.
3. This step checks the ground circuit.
4. This step checks the sensor and harness wiring.

Diagnostic Aids: When PCM is in backup fuel, fast idle and poor performance will exist.

Check for good connection at crankshaft position sensor and at PCM.

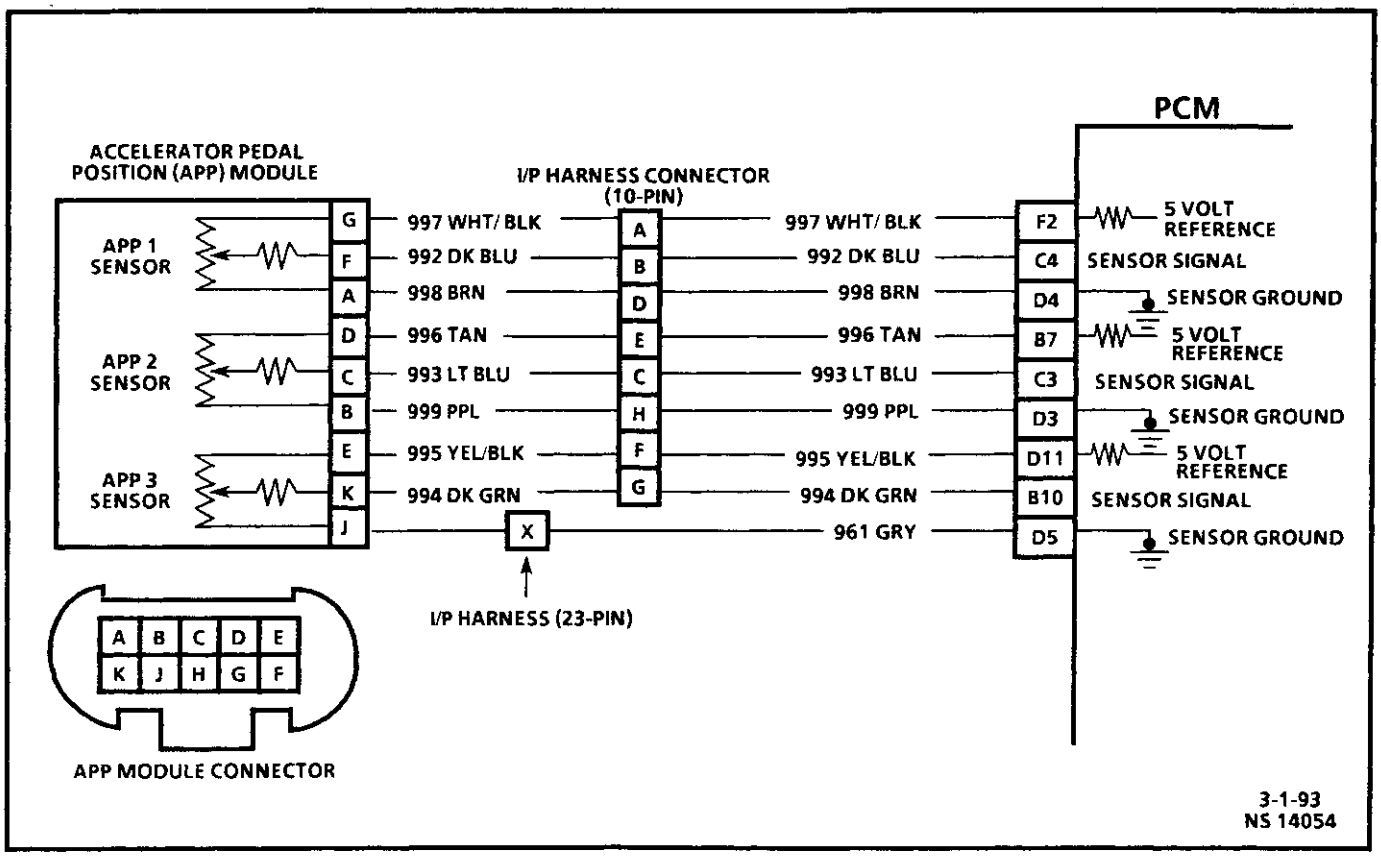
DTC 19
CRANKSHAFT POSITION REFERENCE ERROR



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

4-23-93
NS 15524



DTC 21

ACCELERATOR PEDAL POSITION (APP) 1 CIRCUIT HIGH

Circuit Description:

The Accelerator Pedal Position (APP) module provides a voltage signal that changes relative to accelerator position. There are three sensors located within the APP module that are scaled differently.

DTC 21 Will Set When: Voltage is greater than 4.75 volts for 2 seconds on APP 1 sensor.

Action Taken (PCM will default to): The input from APP 1 sensor is ignored. A current and history DTC will set but it will not turn on the "Service Throttle Soon" lamp. The throttle will operate normally as long as there is only one sensor malfunctioning. If two different APP sensors have a malfunction, the "Service Throttle Soon" lamp will light and the PCM will limit power. If three APP sensors have a malfunction present, the "Service Throttle Soon" lamp will light and the PCM will only allow the engine to operate at idle.

DTC 21 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step determines if DTC 21 is the result of a hard failure or an intermittent condition.
2. This step checks the PCM and wiring.
3. This will check for an open in ground CKT 998.

Diagnostic Aids: A scan tool reads APP 1 position in volts. Should read about .45 to .95 volt with throttle closed and ignition "ON" or at idle. Voltage should increase at a steady rate as throttle is moved toward Wide Open Throttle (WOT).

Also, 90% pedal travel is acceptable for correct APP operation.

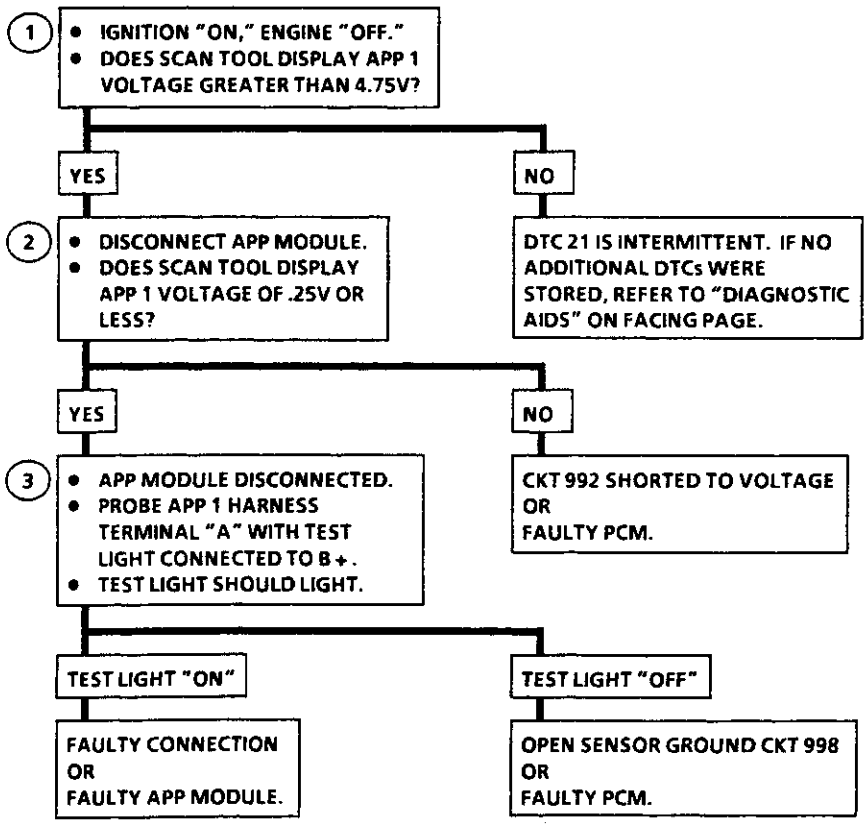
Scan APP 1 sensor while depressing accelerator pedal with engine stopped and ignition "ON." Display should vary from about .74 volt when throttle was closed to about 3.7 volt when throttle is held at Wide Open Throttle (WOT) position.

A DTC 21 will result if CKT 998 is open or CKT 992 is shorted to voltage.

Refer to "Intermittent" in SECTION 2.

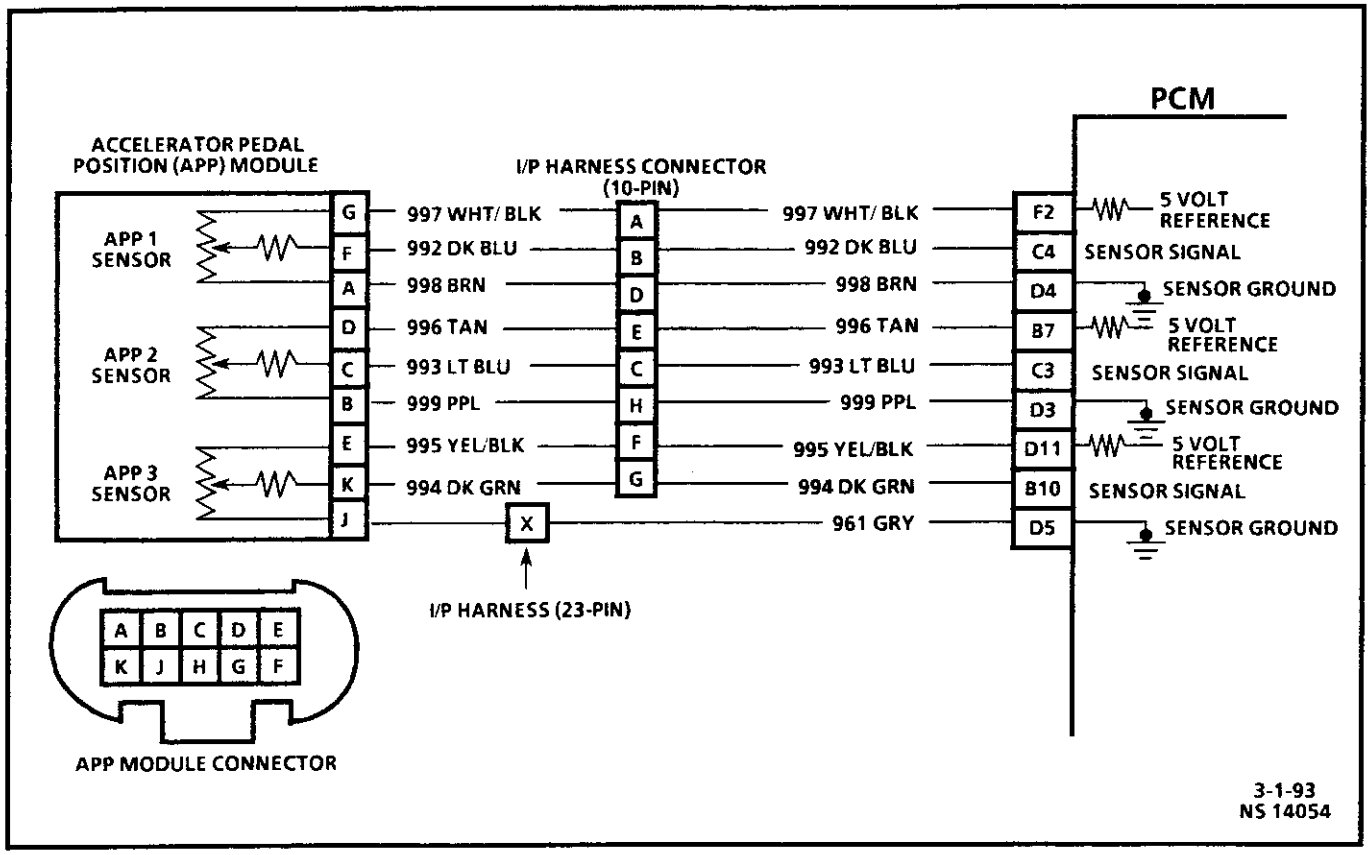
DTC 21

ACCELERATOR PEDAL POSITION (APP) 1 CIRCUIT HIGH



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 22

ACCELERATOR PEDAL POSITION (APP) 1 CIRCUIT LOW

Circuit Description:

The Accelerator Pedal Position (APP) module provides a voltage signal that changes relative to accelerator position. There are three sensors located within the APP module that are scaled differently.

DTC 22 Will Set When: Voltage is less than .25 volt for 2 seconds on APP 1 sensor.

Action Taken (PCM will default to): The input from APP 1 sensor is ignored. A current and history DTC will set but it will not turn on the "Service Throttle Soon" lamp. The throttle will operate normally as long as there is only one sensor malfunctioning. If two different APP sensors have a malfunction, the "Service Throttle Soon" lamp will light and the PCM will limit power. If three APP sensors have a malfunction present, the "Service Throttle Soon" lamp will light and the PCM will only allow the engine to operate at idle.

DTC 22 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step determines if DTC 22 is the result of a hard failure or an intermittent condition.
2. This step checks the PCM and wiring.
3. This step will determine if there is a faulty connection or sensor.
4. This step will check the ground circuit.

Diagnostic Aids: A scan tool reads APP 1 position in volts. Should read about .45 to .95 volt with throttle closed and ignition "ON" or at idle. Voltage should increase at a steady rate as throttle is moved toward Wide Open Throttle (WOT).

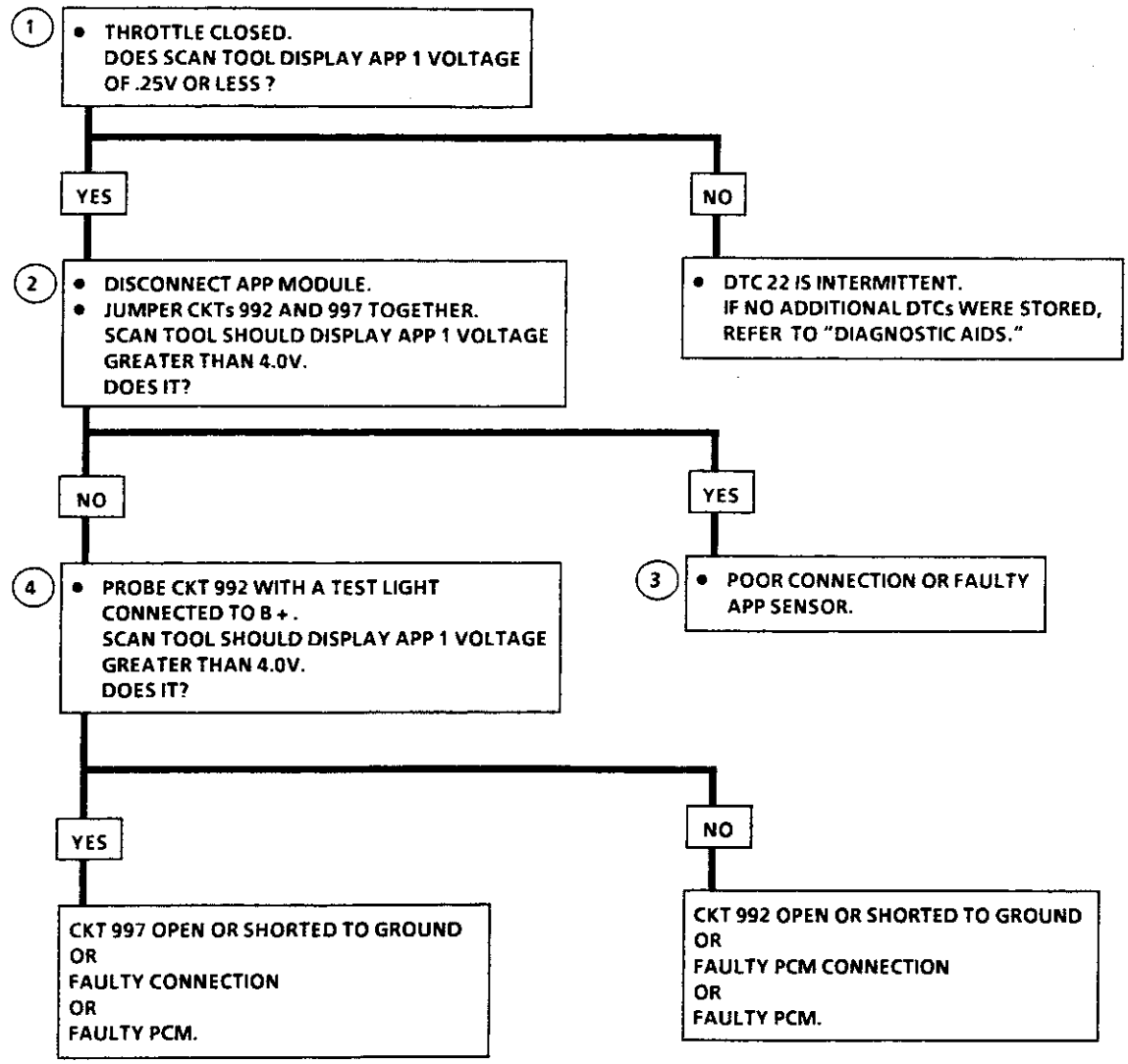
Also, 90% pedal travel is acceptable for correct APP operation.

Scan TP sensor while depressing accelerator pedal with engine stopped and ignition "ON." Display should vary from about .74 volt when throttle is closed to about 3.7 volts when throttle is held at Wide Open Throttle (WOT) position.

A DTC 22 will result if circuit is open.

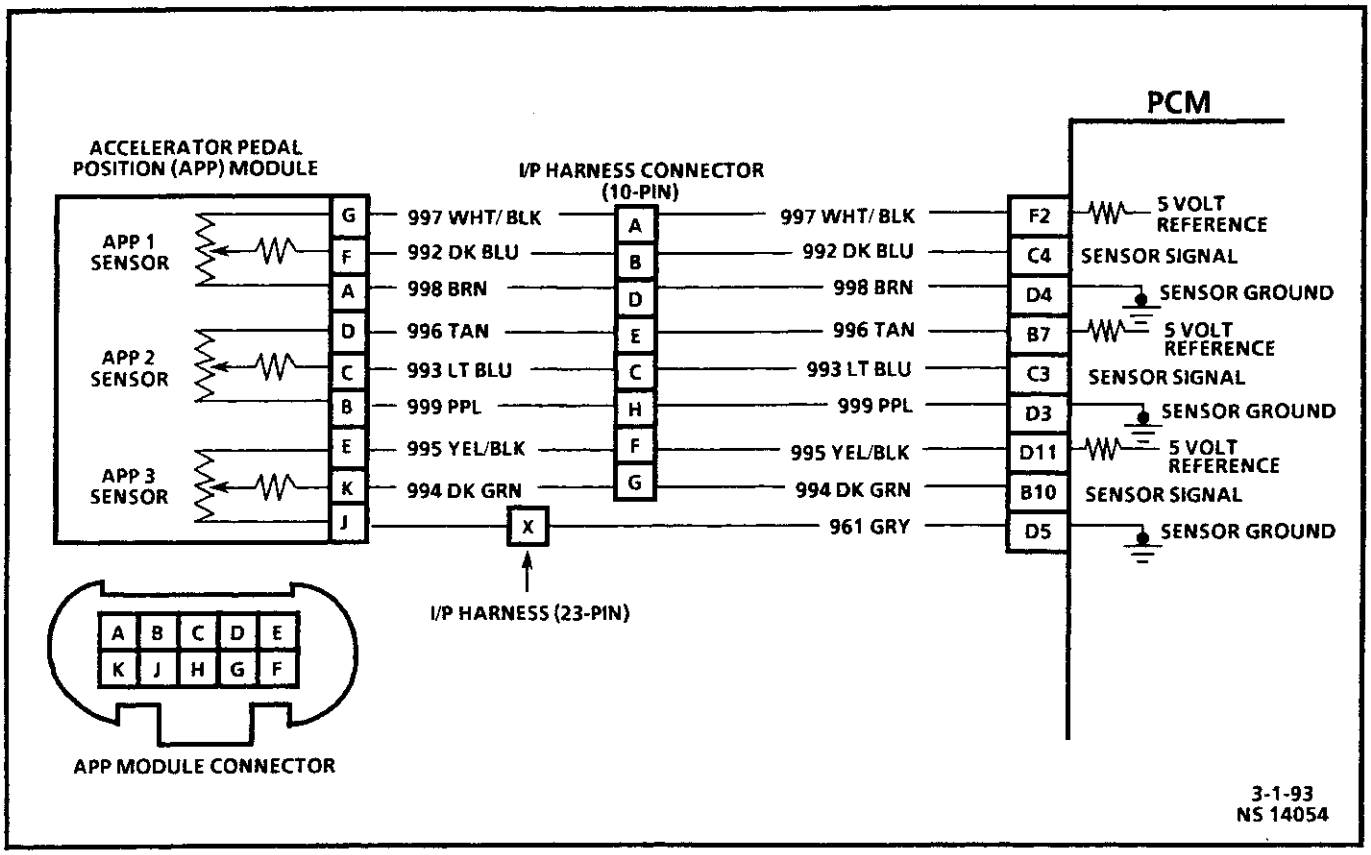
DTC 22

ACCELERATOR PEDAL POSITION (APP) 1 CIRCUIT LOW



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 23

ACCELERATOR PEDAL POSITION (APP) 1 CIRCUIT RANGE FAULT

Circuit Description:

The Accelerator Pedal Position (APP) module provides a voltage signal that changes relative to accelerator pedal position. There are three sensors located within the APP module that are scaled differently.

DTC 23 Will Set When: PCM has recognized a "skewed" (mis-scaled) sensor. The PCM compares all three sensors to each other and determines if there is a 6% difference between APP 1 and APP 2 and a 10% difference to APP 3.

Action Taken (PCM will default to): The input from APP 1 sensor is ignored. A current and history DTC will set but it will not turn on the "Service Throttle Soon" lamp. Throttle will operate normally as long as there is only one malfunction present. If there are two APP malfunctions present, the PCM will turn "ON" the "Service Throttle Soon" lamp and limit power. If a third APP malfunction is present, the "Service Throttle Soon" lamp will be "ON" and only allow the engine to operate at idle.

DTC 23 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step determines if there is a good 5 volt reference.
2. This step will check for an open in the ground circuit.

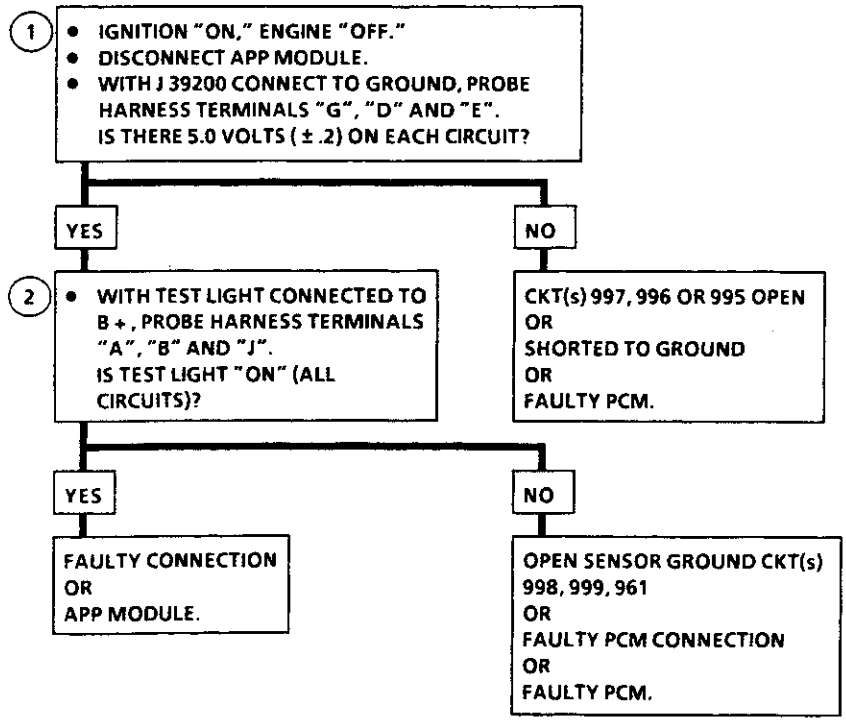
Diagnostic Aids: A scan tool reads APP 1 position in volts. Should read about .45 to .95 volt with throttle closed and ignition "ON" or at idle. Voltage should increase at a steady rate as throttle is moved toward Wide Open Throttle (WOT).

Also, 90% pedal travel is acceptable for correct APP operation.

Scan APP 1 sensor while depressing accelerator pedal with engine stopped and ignition "ON." Display should vary from about .74 volt when throttle was closed to over about 3.7 volts when throttle is held at Wide Open Throttle (WOT) position.

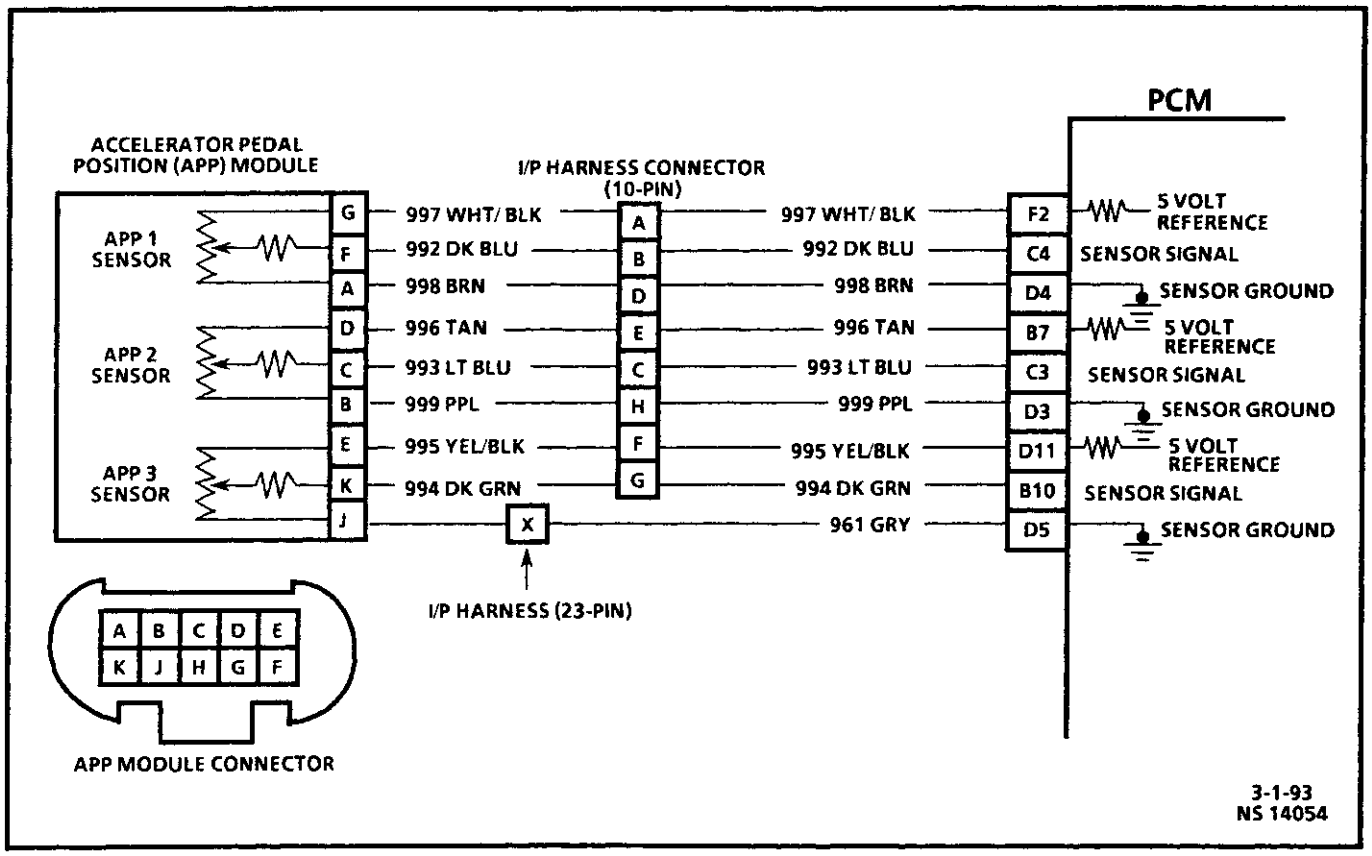
DTC 23

ACCELERATOR PEDAL POSITION (APP) 1 CIRCUIT RANGE FAULT



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 25

ACCELERATOR PEDAL POSITION (APP) 2 CIRCUIT HIGH

Circuit Description:

The Accelerator Pedal Position (APP) module provides a voltage signal that changes relative to accelerator position. There are three sensors located within the APP module that are scaled differently.

DTC 25 Will Set When: Voltage is greater than 4.75 volts for 2 seconds on APP 2 sensor.

Action Taken (PCM will default to): The input from APP 2 sensor is ignored. A current and history DTC will set but it will not turn on the "Service Throttle Soon" lamp. The throttle will operate normally as long as there is only one malfunction present. If two different APP sensors have a malfunction, the "Service Throttle Soon" lamp will light and the PCM will limit power. If three APP sensors have a malfunction present, the "Service Throttle Soon" lamp will light and the PCM will only allow the engine to operate at idle.

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step determines if DTC 25 is a hard failure or an intermittent condition.
2. This will check for an open in ground CKT 999.
3. This step checks the PCM and wiring.

Diagnostic Aids: A Tech 1 scan tool reads APP 2 position in volts and should read about 4.5 volts with throttle closed and ignition "ON" or at idle. Voltage should decrease at a steady rate as throttle is moved toward WOT.

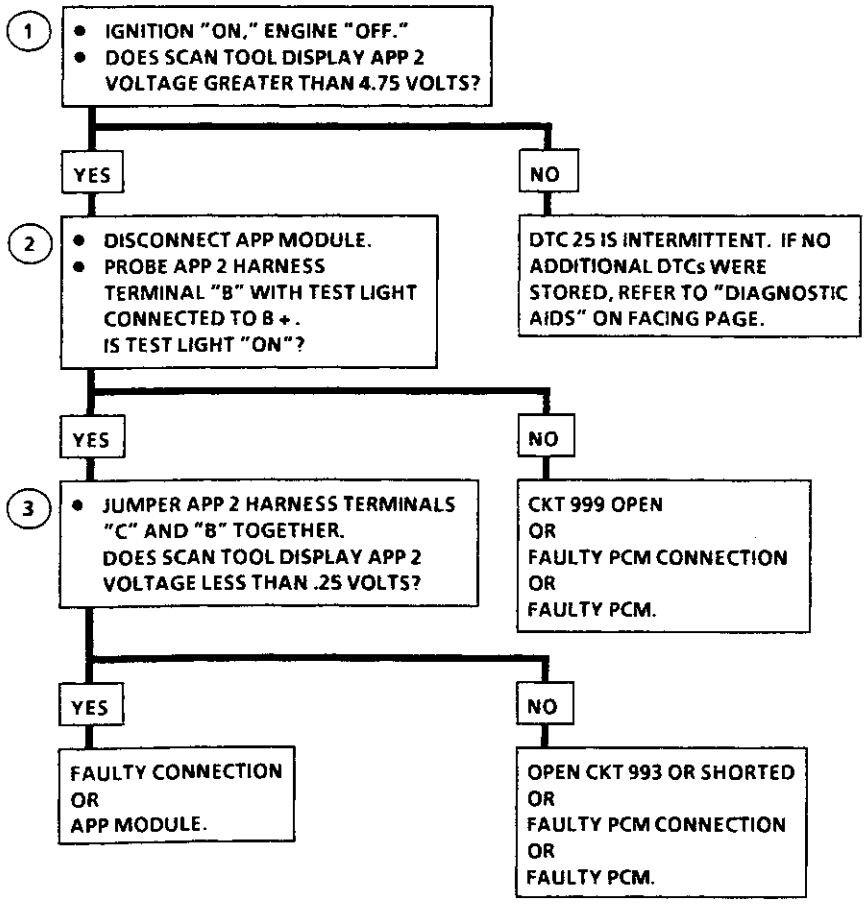
Also, 90% pedal travel is acceptable for correct APP operation.

Refer to SECTION 2 for "Intermittents."

Scan APP 2 signal while depressing accelerator pedal with engine stopped and ignition "ON." Display should vary from about 4.5 volts when throttle was closed to about 1.5 volts when throttle is held at Wide Open Throttle (WOT) position.

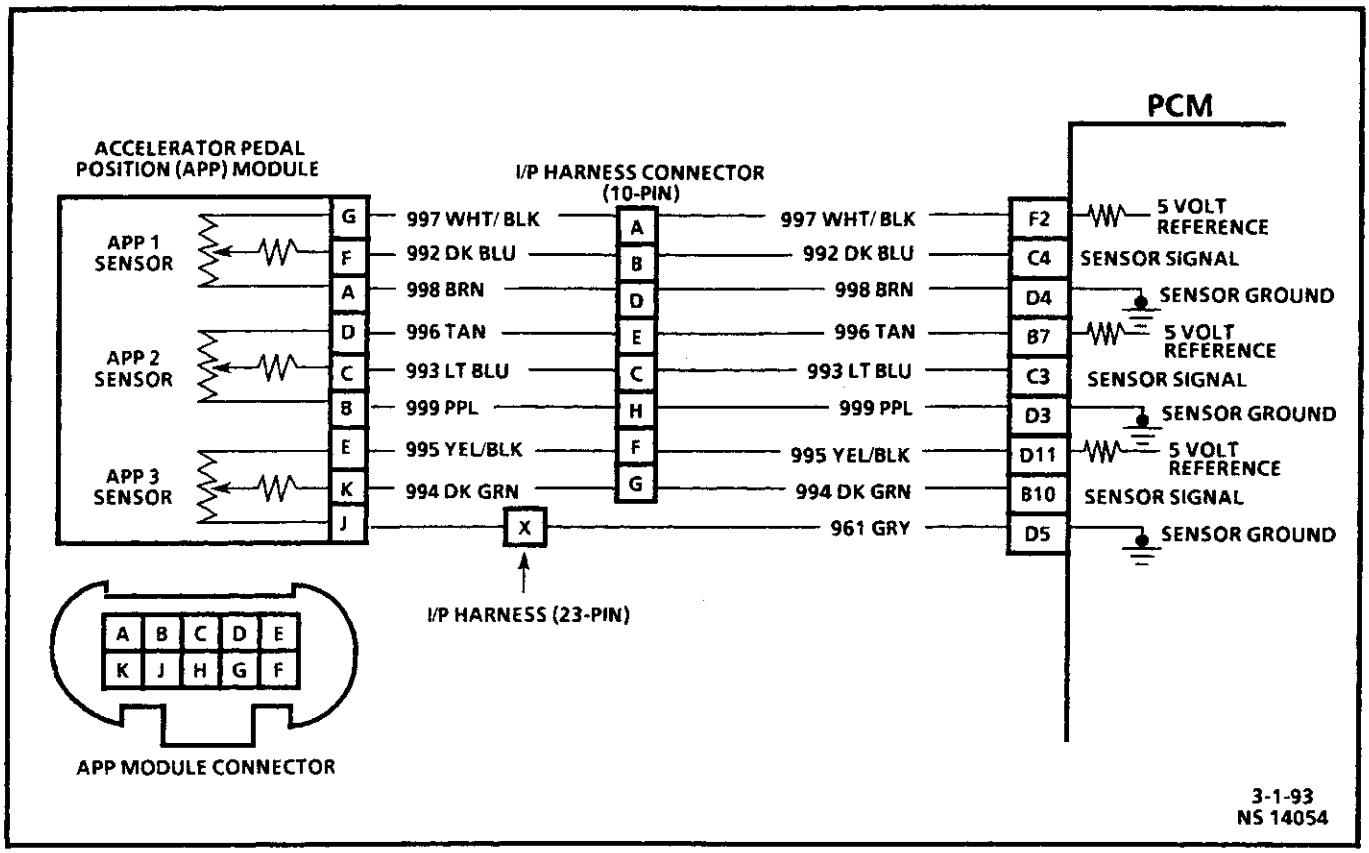
DTC 25

ACCELERATOR PEDAL POSITION (APP) 2 CIRCUIT HIGH



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 26

ACCELERATOR PEDAL POSITION (APP) 2 CIRCUIT LOW

Circuit Description:

The Accelerator Pedal Position (APP) module provides a voltage signal that changes relative to accelerator position. There are three sensors located within the APP module that are scaled differently.

DTC 26 Will Set When: Voltage is less than .25 volt for 2 seconds on APP 1 sensor.

Action Taken (PCM will default to): The input from the sensor is ignored. A current and history DTC will set but it will not turn on the "Service Throttle Soon" lamp. The throttle will operate normally as long as there is only one malfunction present. If two different APP sensors have a malfunction, the "Service Throttle Soon" lamp will light and the PCM will limit power. If three APP sensors have a malfunction present, the "Service Throttle Soon" lamp will light and the PCM will only allow the engine to operate at idle.

DTC 26 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step determines if DTC 26 is the result of a hard failure or an intermittent condition.
2. This step checks the PCM and wiring.
3. This will check the PCM and CKT 993.

Diagnostic Aids: A Tech 1 scan tool reads APP 2 position in volts and should read about 4.5 volts with throttle closed and ignition "ON" or at idle. Voltage should decrease at a steady rate as throttle is moved toward WOT.

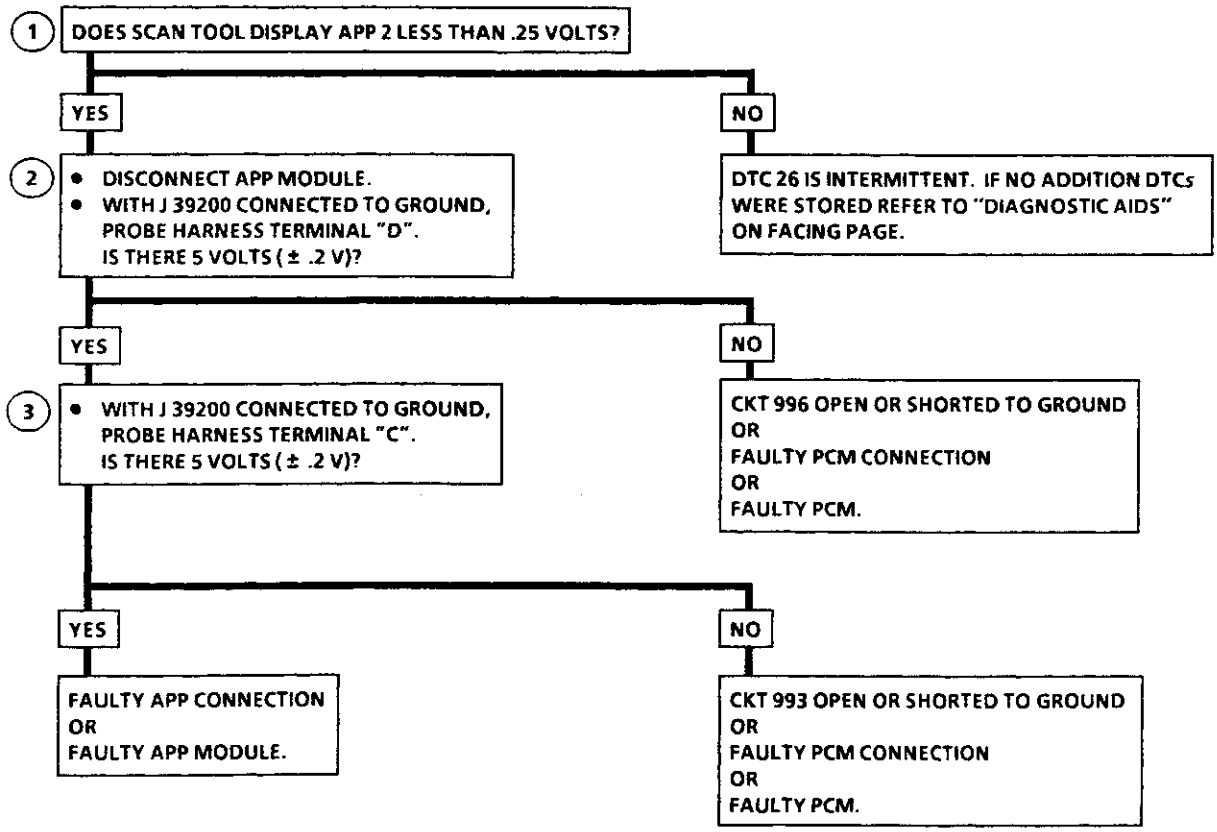
An open or short to ground in CKT 996 or 993 will result in a DTC 26.

Refer to SECTION 2 for "Intermittents."

Scan APP 2 sensor while depressing accelerator pedal with engine stopped and ignition "ON." Display should vary from about 4.5 volts when throttle was closed to about 1.5 volts when throttle is held at Wide Open Throttle (WOT) position.

DTC 26

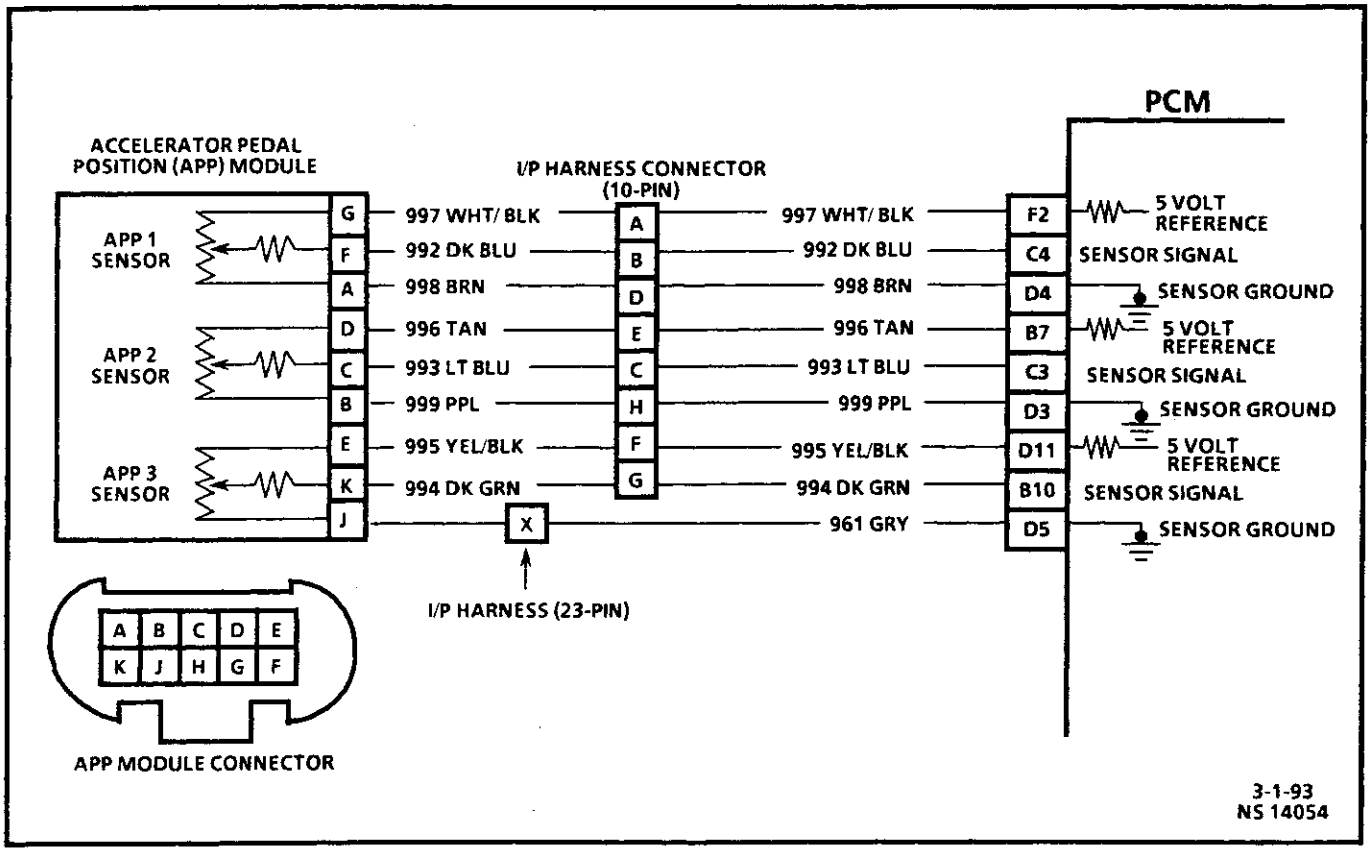
ACCELERATOR PEDAL POSITION (APP) 2 CIRCUIT LOW



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

4-16-93
NS 15529



DTC 27

ACCELERATOR PEDAL POSITION (APP) 2 CIRCUIT RANGE FAULT

Circuit Description:

The Accelerator Pedal Position (APP) module provides a voltage signal that changes relative to accelerator position. There are three sensors located within the APP module that are scaled differently.

DTC 27 Will Set When: PCM has recognized a "skewed" (mis-scaled) sensor. The PCM compares all three sensors to each other (percentage to voltage chart) and determines if there is a 6% difference between APP 1 and APP 2 and a 10% difference to APP 3.

Action Taken (PCM will default to): The input from APP 2 sensor is ignored. A current and history DTC will set but it will not turn on the "Service Throttle Soon" lamp. Throttle will operate normally as long as there is only one malfunction present. If there are two APP malfunctions present, the PCM will then turn "ON" the "Service Throttle Soon" lamp and limit power. If a third APP malfunction is present, the "Service Throttle Soon" lamp will be "ON" and will only allow the engine to operate at idle.

DTC 27 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step determines if there is a good 5 volt reference.
2. This step will check for an open in the ground circuits.

Diagnostic Aids: A Tech 1 scan tool reads APP 2 position in volts and should read about 4.5 volts with throttle closed and ignition "ON" or at idle. Voltage should decrease at a steady rate as throttle is moved toward WOT.

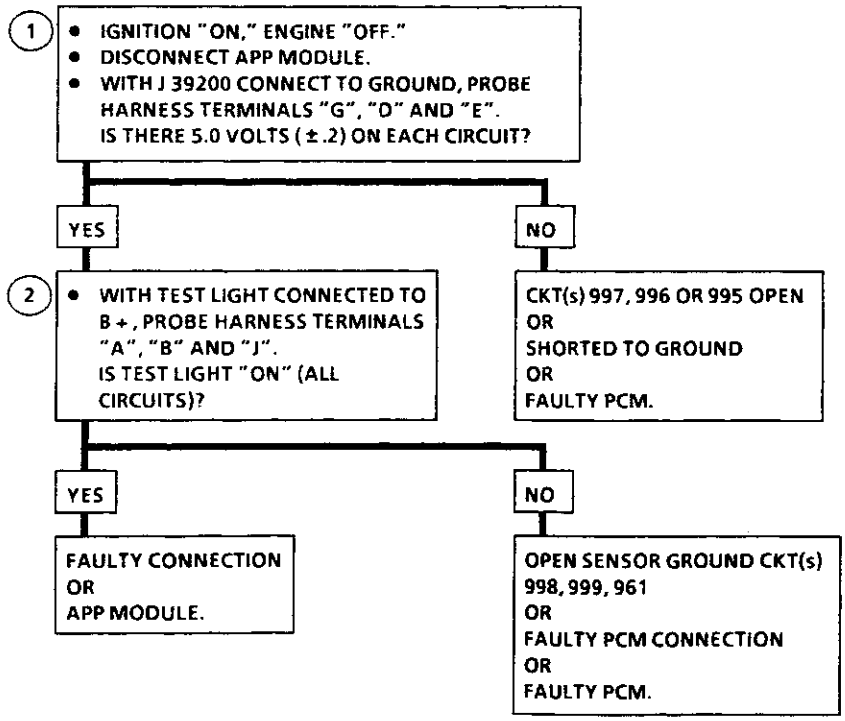
Also, 90% pedal travel is acceptable for correct APP operation.

Refer to SECTION 2 for "Intermittents."

Scan APP 2 sensor while depressing accelerator pedal with engine stopped and ignition "ON." Display should vary from about 4.5 volts when throttle was closed to about 1.5 volts when throttle is held at Wide Open Throttle (WOT) position.

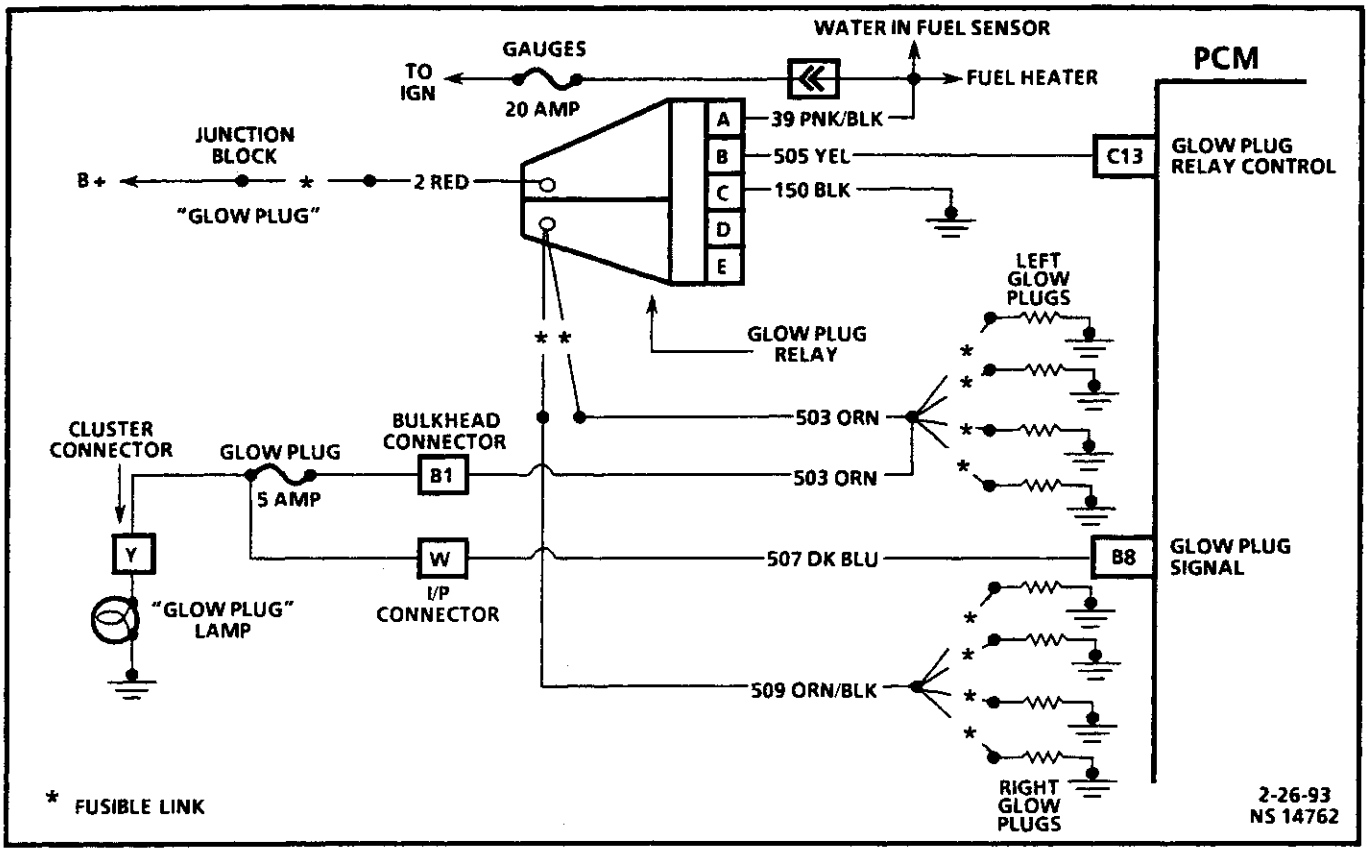
DTC 27

ACCELERATOR PEDAL POSITION (APP) 2 CIRCUIT RANGE FAULT



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 29

GLOW PLUG RELAY CIRCUIT FAULT

Circuit Description:

The glow plug system is used to assist in providing the heat required to begin combustion during engine starting at cold ambient temperatures. The glow plugs are heated before and during cranking, as well as initial engine operation. The PCM controls the glow plugs by sending a B+ signal.

DTC 29 Will Set When:

- Glow plugs commanded "ON" and "glow plug volts" is less than .8 volt.
  OR
- Glow plugs "OFF" and "glow plug volts" is greater that .8 volt.
  OR
- "System voltage" exceeds "glow plug volts" by 2 volts.

Action Taken (PCM will default to): Hard start.

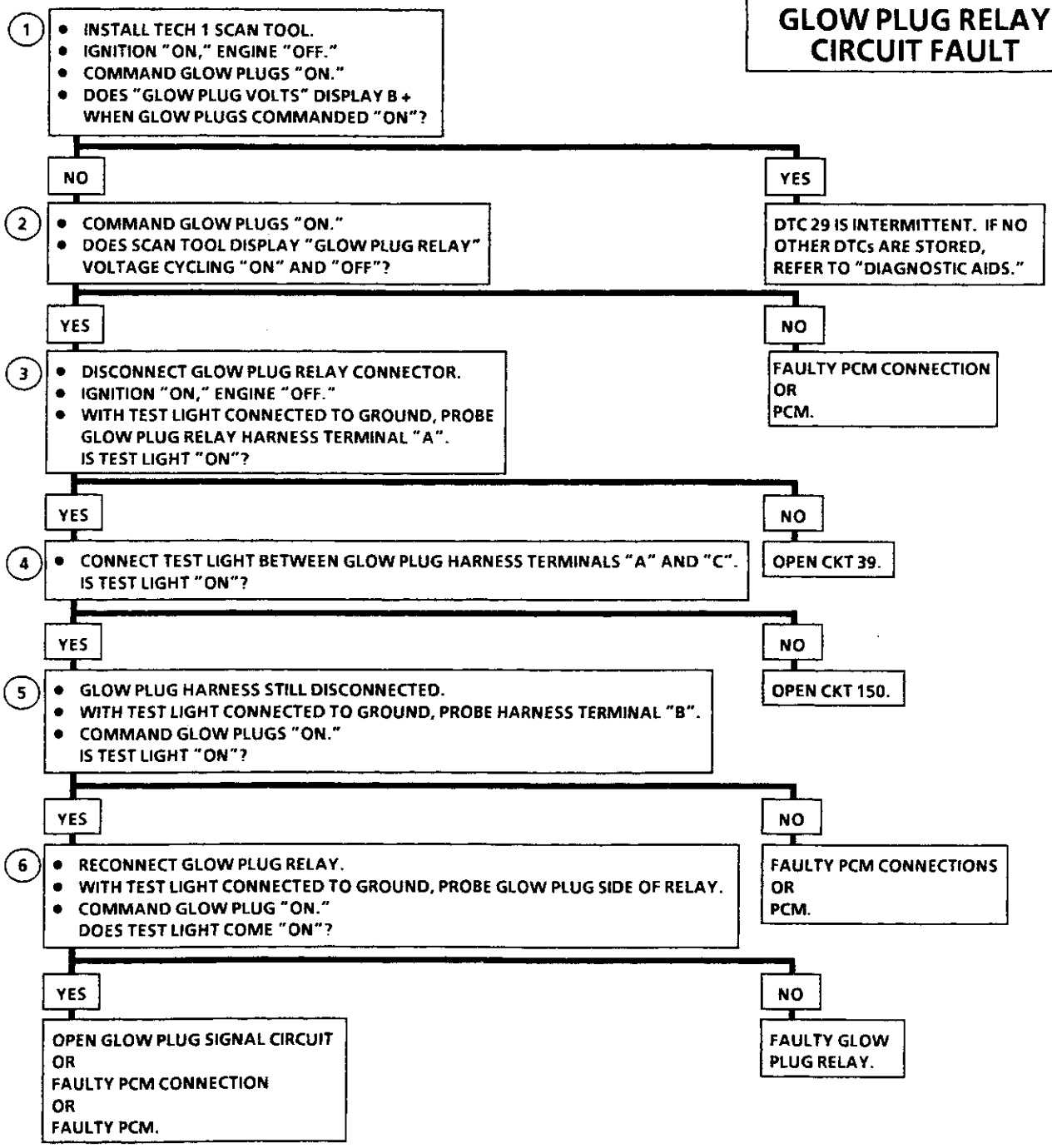
DTC 29 Will Clear When: The fault condition(s) no longer exist.

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1 This step will determine if DTC 29 is a hard failure.
2. The Tech 1 scan tool may not display system voltage. The important thing is that the PCM is cycling voltage "ON" and "OFF" indicating that the PCM is OK.
3. This step will check relay feed circuit.
4. This step will check relay ground.
5. This step will determine if CKT 505 is open.
6. This step will check relay and wiring.

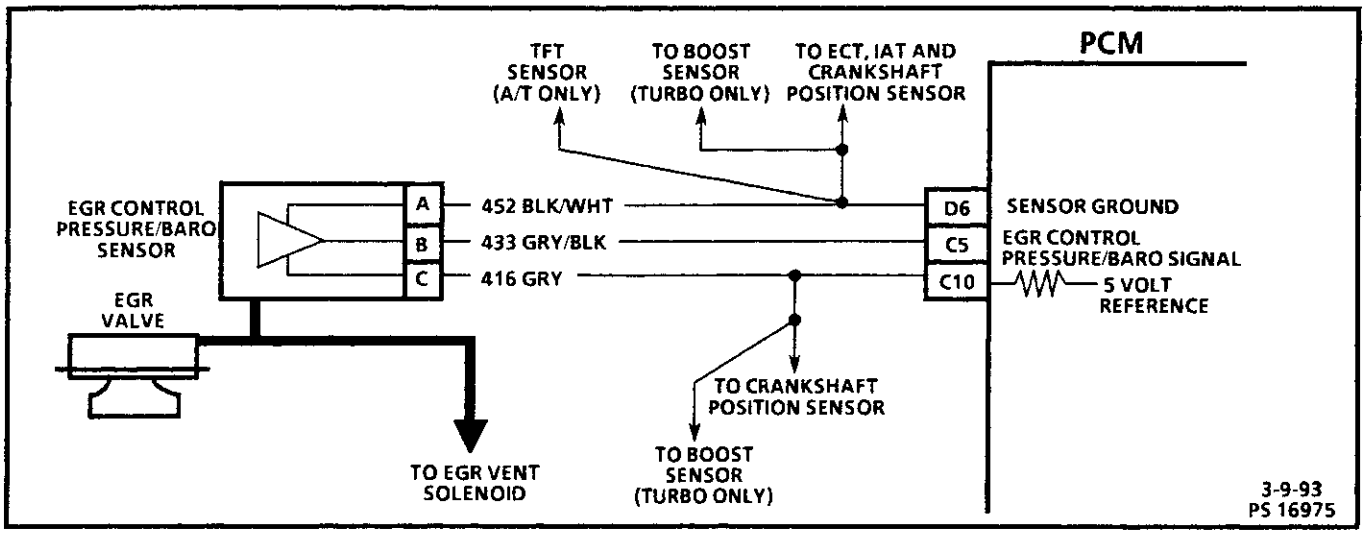
Diagnostic Aids: If glow plug relay was stuck in the "ON" position, check for proper operation of glow plugs, refer to SECTION 7. When glow plugs are commanded "ON" by the Tech 1, an internal PCM timer protects the glow plugs from damage by cycling them "ON" for 3 seconds and the "OFF" for 12 seconds.

DTC 29
GLOW PLUG RELAY CIRCUIT FAULT



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 31

EGR CONTROL PRESSURE/BARO SENSOR CIRCUIT LOW (HIGH VACUUM)

Circuit Description:

A MAP sensor is used to monitor the amount of vacuum in the EGR circuit. It senses the actual vacuum in the EGR vacuum line and sends a signal back to the PCM. The signal is compared to the EGR duty cycle calculated by the PCM.

DTC 31 Will Set When: Actual EGR pressure is less than 15 kPa for 2 seconds.

Action Taken (PCM will default to): The PCM will shut down the EGR system.

DTC 31 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" the "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

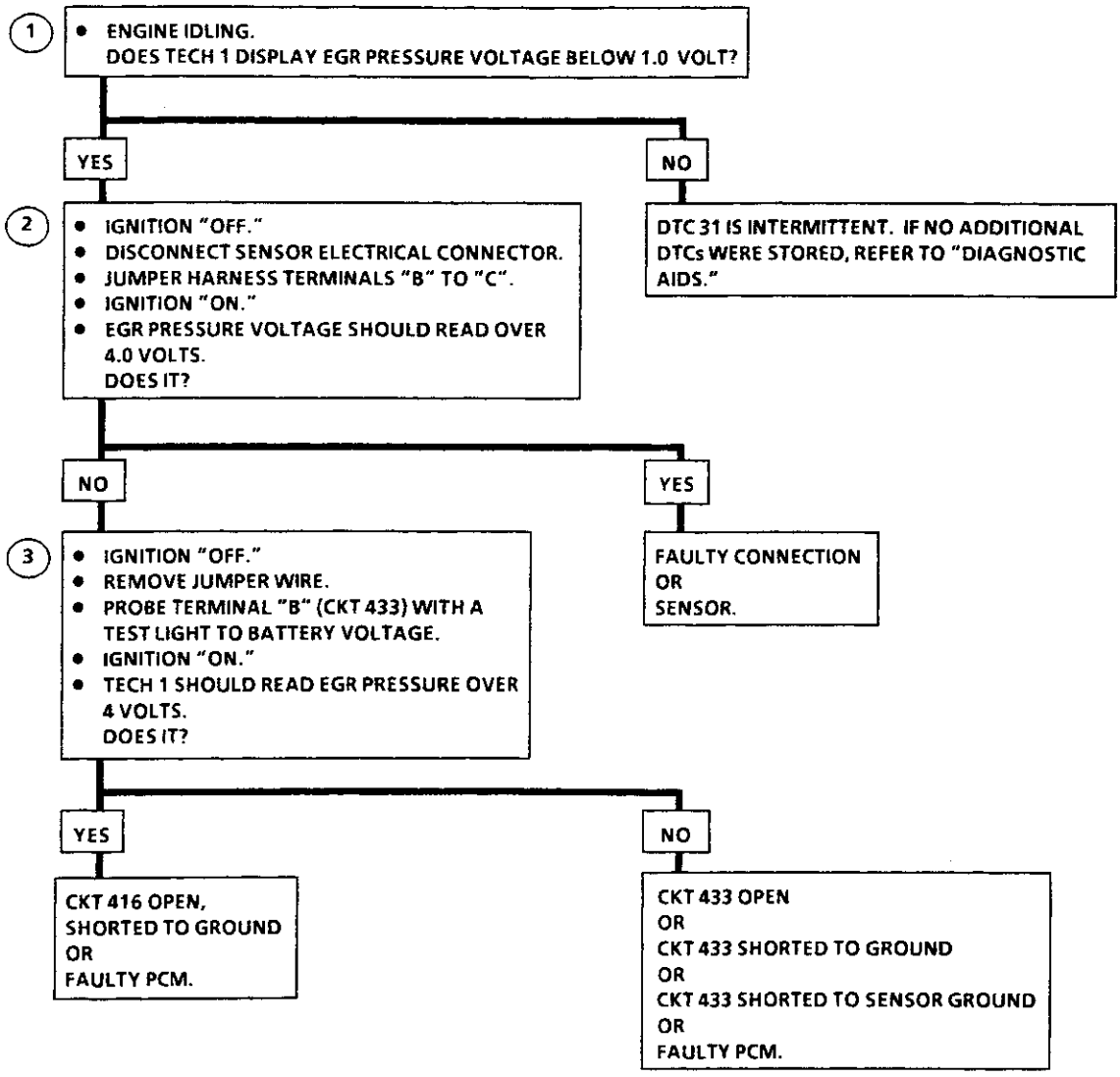
1. This step determines if DTC 31 is a hard failure or an intermittent condition..
2. Jumpering harness terminals "B" to "C" (5 volts to signal circuit) will determine if the sensor is at fault, or if there is a problem with the PCM or wiring.
3. The Tech 1 scan tool may not display 5 volts. The important thing is that the PCM recognized the voltage as more than 4 volts, indicating that the PCM and CKT 433 are OK.

Diagnostic Aids: With the ignition "ON" and the engine stopped, the EGR pressure is equal to atmospheric pressure with the signal voltage being high. The information is used by the PCM as an indication of vehicle altitude. Comparison of this reading with a known good vehicle with the same sensor is a good way to check accuracy of a "suspect" sensor. Readings should be the same ± .4 volt.

An intermittent open in CKT 433 or CKT 416 will result in a DTC 31.

DTC 31

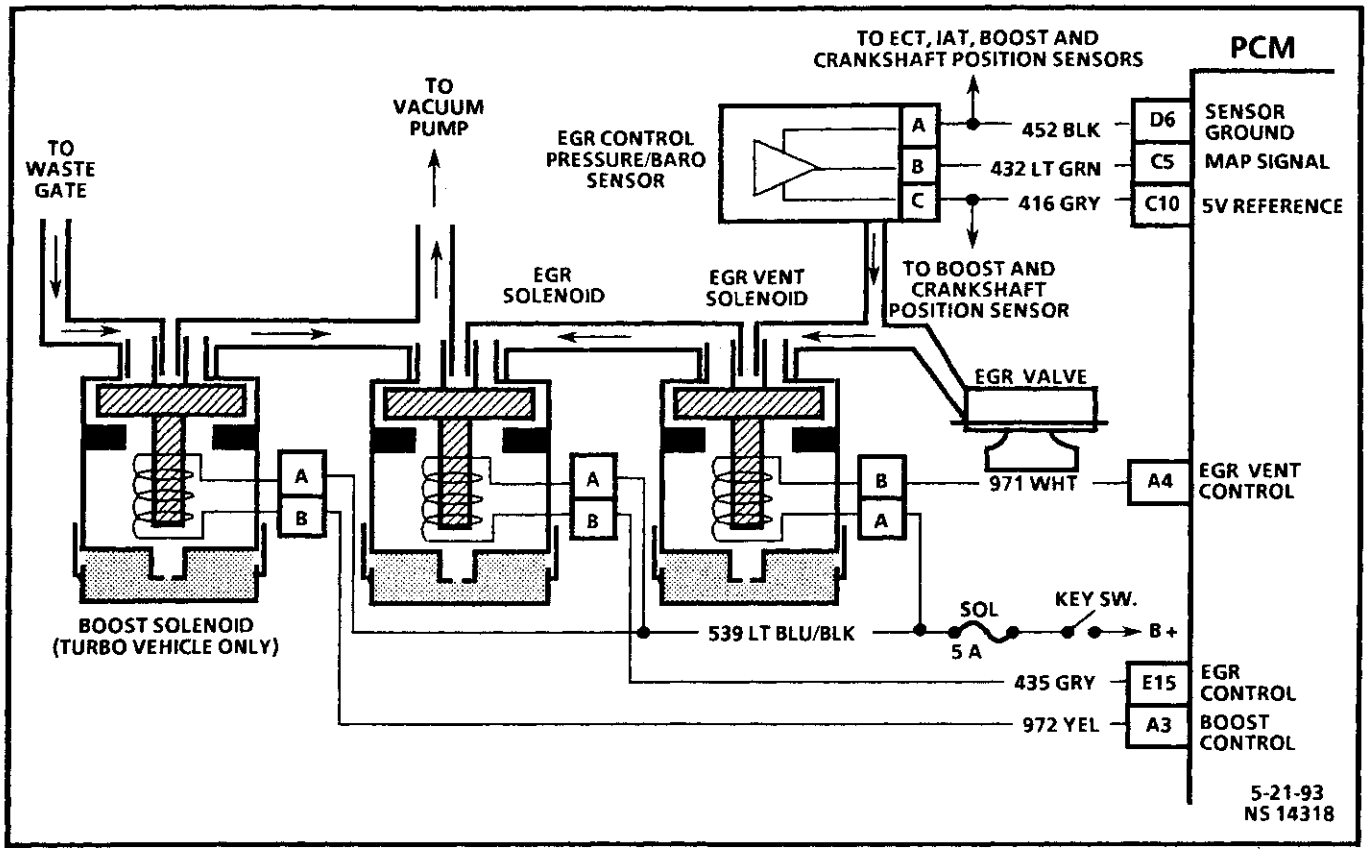
EGR CONTROL PRESSURE/BARO SENSOR CIRCUIT LOW (HIGH VACUUM)



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

4-19-93
NS 15531



DTC 32

EGR CIRCUIT ERROR

Circuit Description:

The PCM operates a solenoid to control the EGR valve. This solenoid is normally open. By providing a ground path the PCM energizes the solenoid which then allows vacuum to pass to the EGR.

During normal operation, the PCM compares its EGR duty cycle signal with the EGR pressure signal and makes corrections in the duty cycle accordingly. If there is a difference in the PCM command and what is at the EGR valved sensed by the EGR control pressure/BARO sensor, the PCM makes minor adjustments to correct.

DTC 32 Will Set When:

- RPM greater than 506.
- No DTC 31 or 33 stored.
- 50 kPa difference between desired EGR and EGR pressure for 25.5 seconds.

Action Taken (PCM will default to): The PCM will shut down the EGR.

DTC 32 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

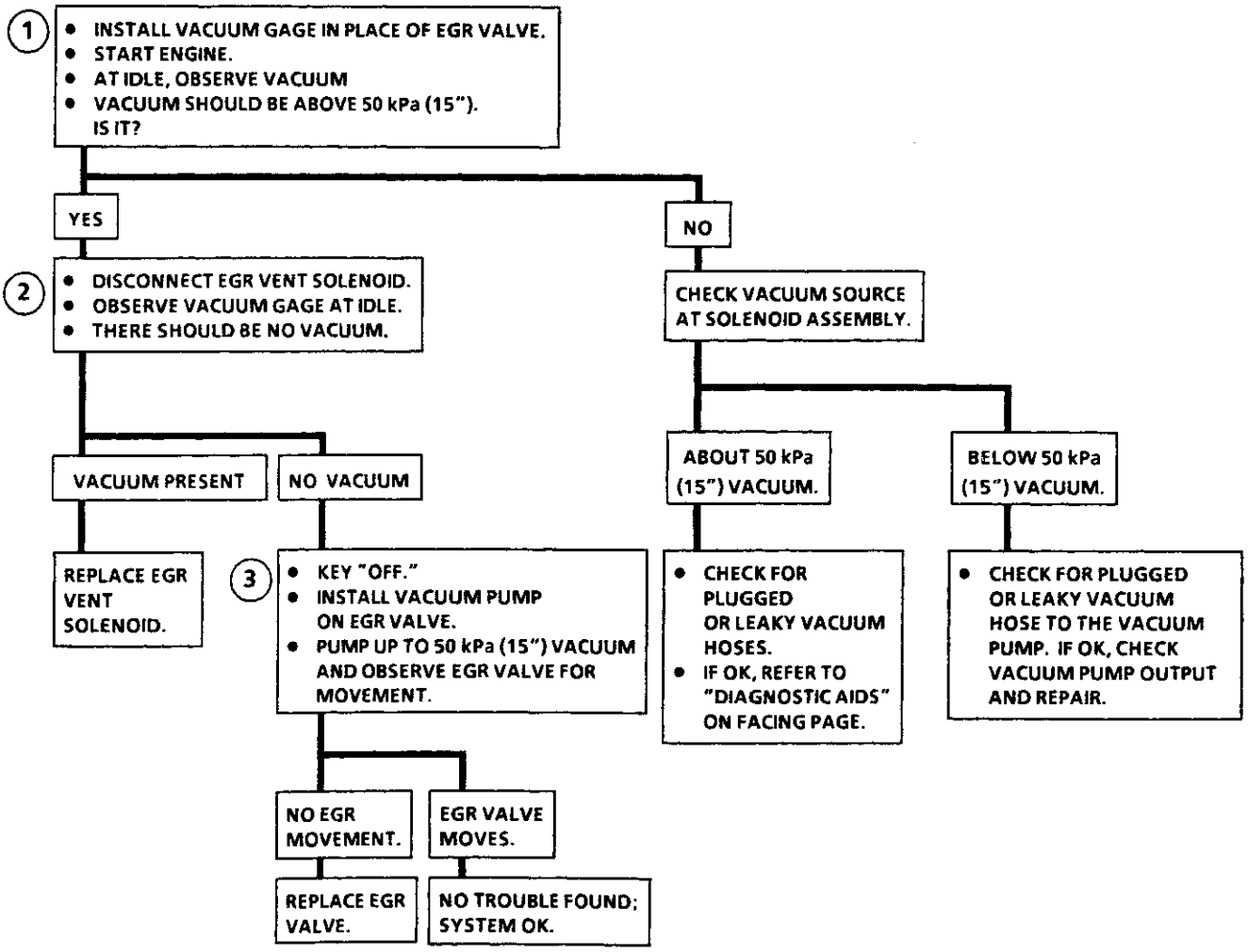
1. This step determines if DTC 32 is a hard failure or an intermittent.
2. This step checks vacuum at idle.
3. This step checks the EGR valve.

Diagnostic Aids: A vacuum leak or a pinched vacuum line may cause a DTC 32. Check all vacuum lines and components connected to the hoses for leaks or sharp bends. Check vacuum source to EGR solenoid.

DTC 32
EGR CIRCUIT ERROR

IMPORTANT:

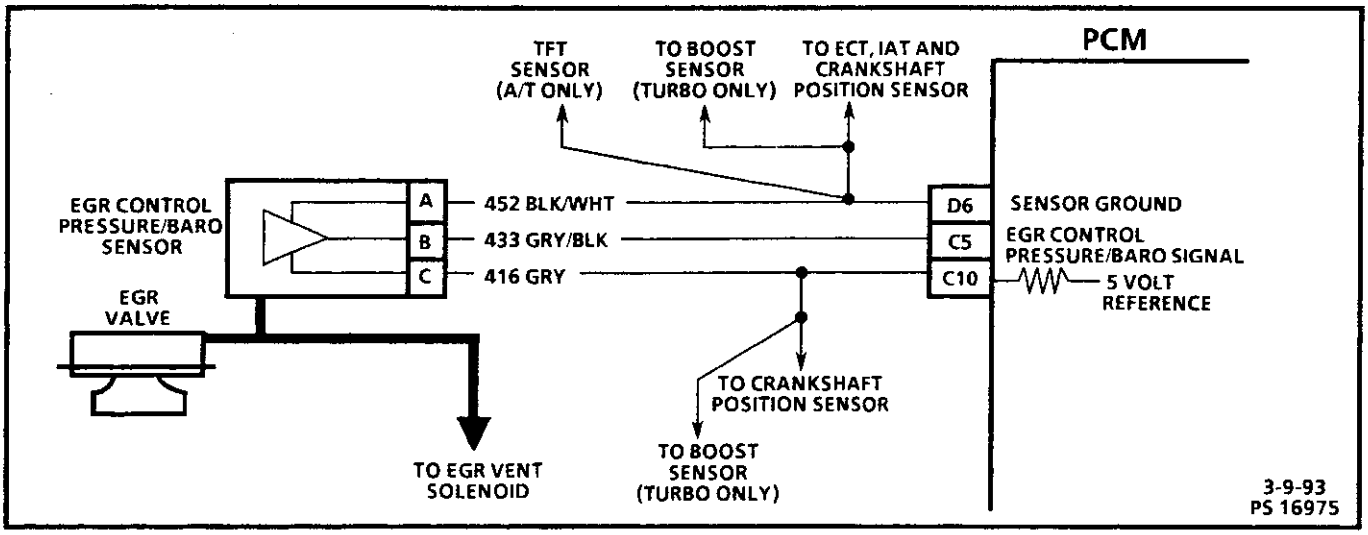
THE PCM WILL SHUT DOWN THE EGR SYSTEM IN 15 SECONDS. TO PROPERLY DIAGNOSIS EGR SYSTEM, IGNITION SHOULD BE CYCLED "ON" AND "OFF" BEFORE EACH PROCEDURE.



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

5-6-93
NS 14047



DTC 33

EGR CONTROL PRESSURE/BARO SENSOR CIRCUIT HIGH (LOW VACUUM)

Circuit Description:

A EGR control pressure/BARO sensor is used to monitor the amount of vacuum in the EGR circuit. It senses the actual vacuum in the EGR vacuum line and sends a signal back to the PCM. The signal is compared to the EGR duty cycle calculated by the PCM.

DTC 33 Will Set When:

- EGR vent "OFF."
- Desired EGR is less than 60 kPa from EGR pressure.

Action Taken (PCM will default to): PCM will shut off EGR system.

DTC 33 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step determines if DTC 33 is a hard failure or an intermittent condition.
2. This step simulates conditions for a DTC 31. If the PCM recognizes the change, the PCM and CKT 433 and CKT 416 are OK.

Diagnostic Aids: With the ignition "ON" and the engine stopped, the manifold pressure is equal to atmospheric pressure with the signal voltage being high. This information is used by the PCM as an indicator of vehicle altitude.

Comparison of the reading with a known good vehicle with the same sensor is a good way to check accuracy of a "suspect" sensor. Readings should be the same ± .4 volt.

A DTC 33 will result if CKT 452 is open or if CKT 433 is shorted to voltage or to CKT 416.

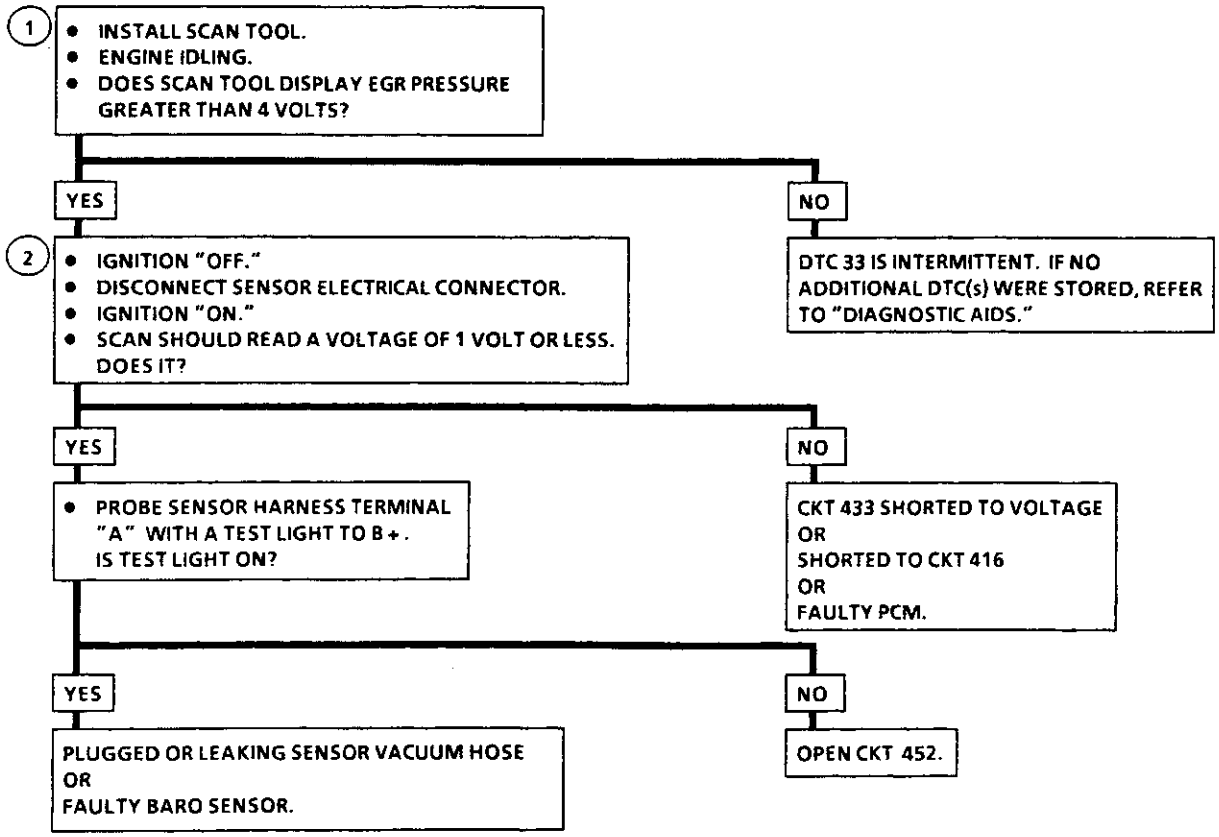
If DTC 33 is intermittent, refer to SECTION 2.

NOTICE: Make sure electrical connector remains securly fastened.

- Refer to "EGR Control Pressure/BARO Sensor Output Check" for further diagnosis.

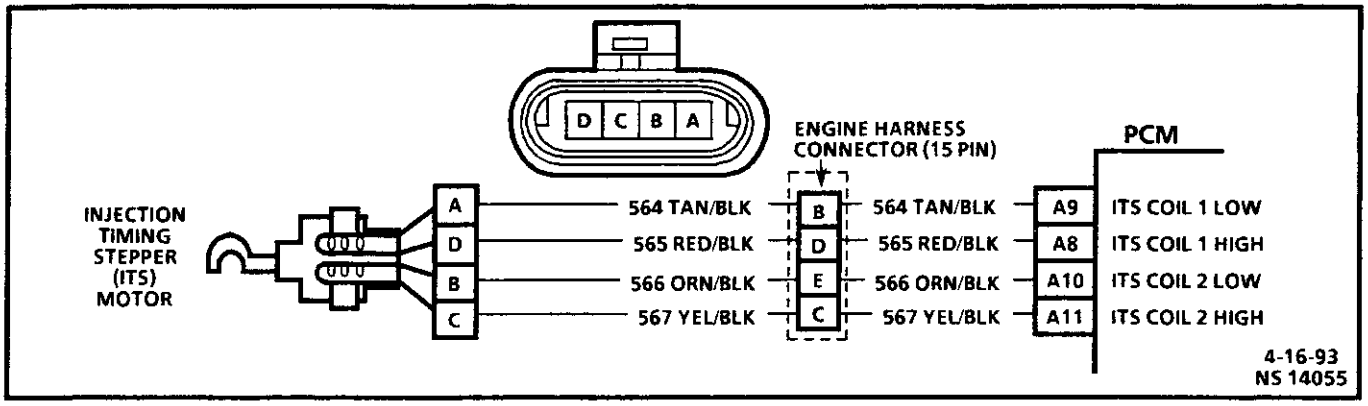
DTC 33

EGR CONTROL PRESSURE/BARO SENSOR CIRCUIT HIGH (LOW VACUUM)



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 34

INJECTION TIMING STEPPER (ITS) MOTOR CIRCUIT FAULT

Circuit Description:

The PCM controls injection timing with the injection timing stepper motor. To increase injection timing the PCM extends the stepper motor. To retard injection timing the PCM retracts the stepper motor.

DTC 34 Will Set When:

- Engine operating at steady RPM.
- A 5° difference between measured and desired injection timing for 20.8 seconds.

Action Taken (PCM will default to): None.

DTC 34 Will Clear When: The fault condition(s) no longer exist.

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

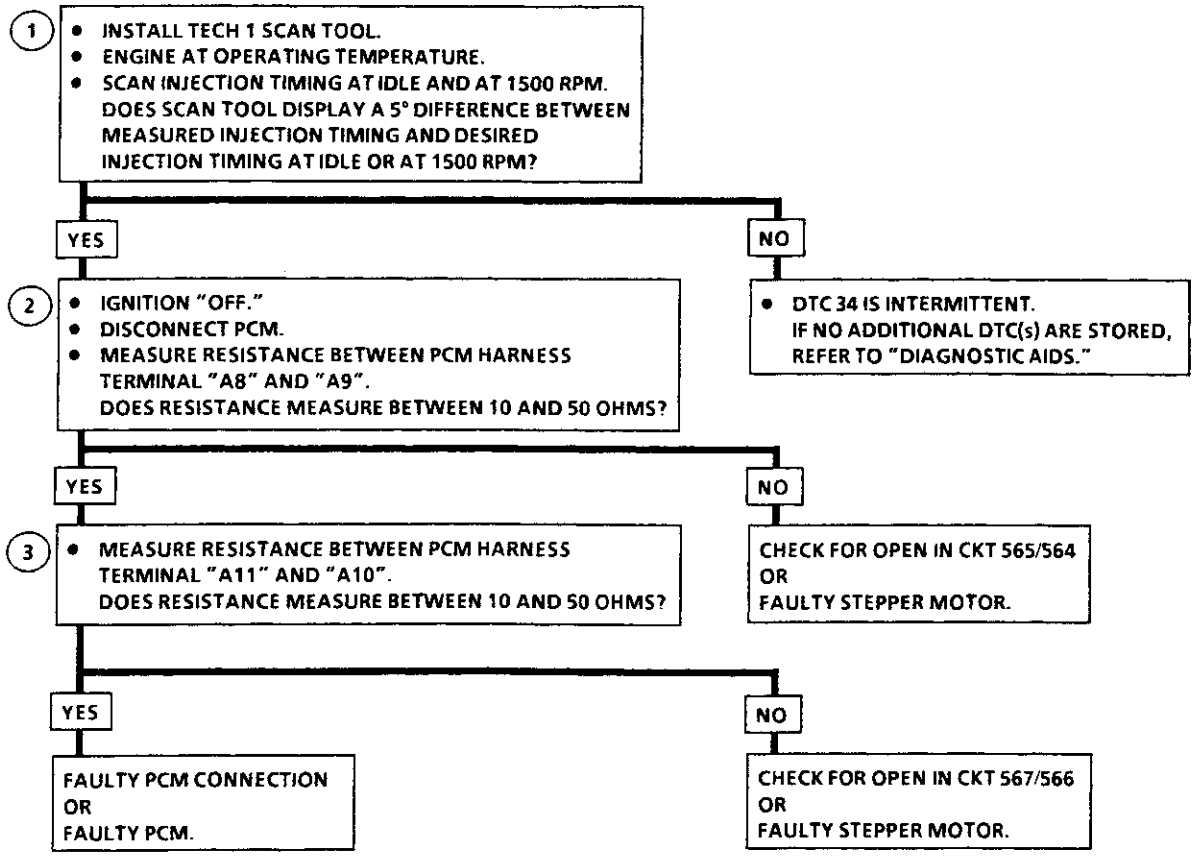
1. This step determines if DTC 34 is a hard failure or an intermittent.
2. This step checks for an open or short in CKTs 564 and 565.
3. This step checks for an open or short in CKTs 566 and 567.

Diagnostic Aids: A hard start and possible poor performance condition might exist.

Measured injection timing will freeze at the point of the fault.

DTC 34

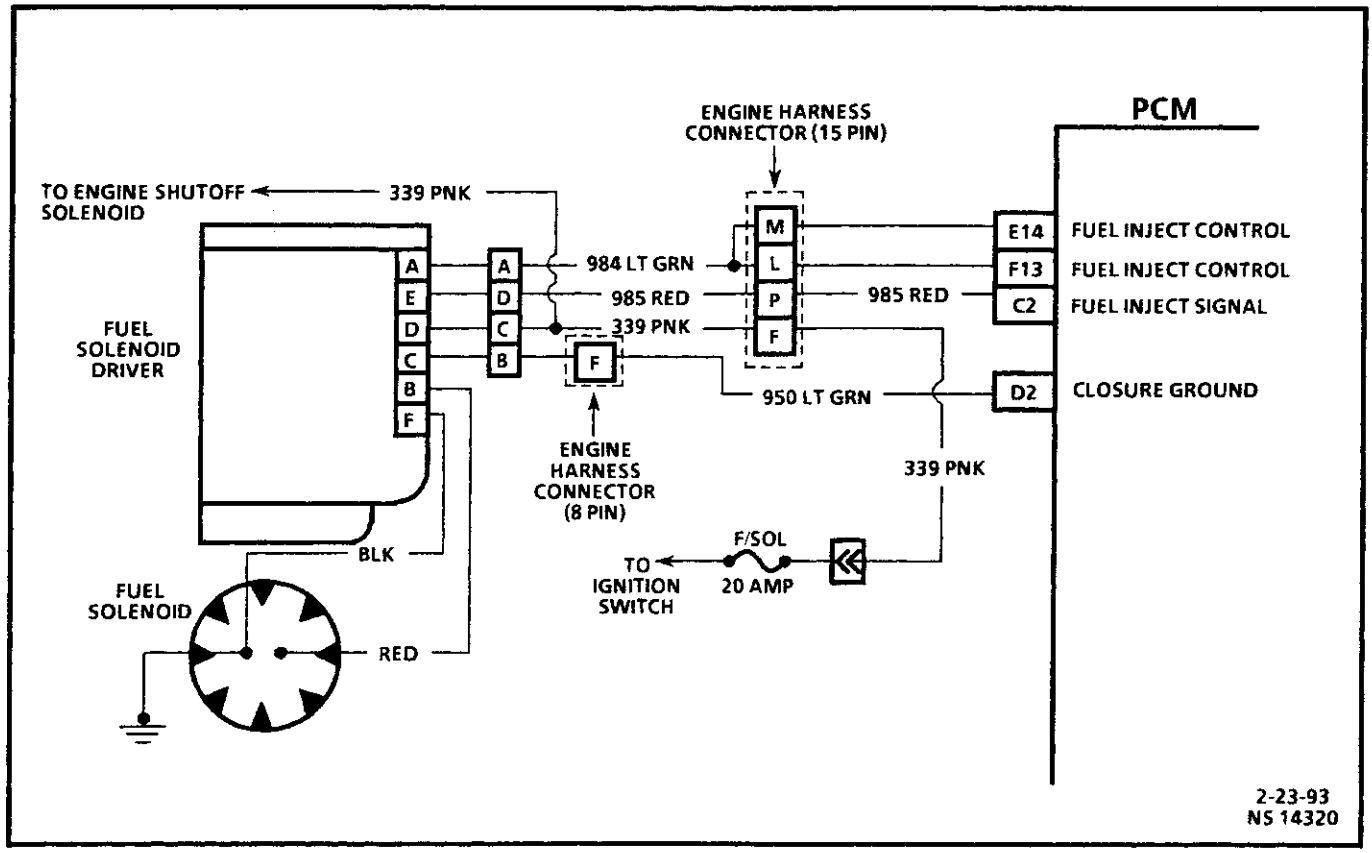
INJECTION TIMING STEPPER (ITS) MOTOR CIRCUIT FAULT



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

4-23-93
PS 16983



DTC 35

INJECTION PULSE WIDTH ERROR (RESPONSE TIME SHORT)

Circuit Description:

The fuel injector driver receives an inject command signal from the PCM and provides a current regulated output to the fuel solenoid that controls injection. It also returns an injection pulse width signal back to the PCM to inform it when the fuel solenoid has actually seated. This injection pulse width signal is measured in micro seconds.

DTC 35 Will Set When:

- Battery voltage greater than 10 volts.
- Engine coolant temperature greater that 20°C (68°F).
- Injection pulse width less that 1.5 milliseconds.

Action Taken (PCM will default to): Fixed injection pulse width valve.

DTC 35 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

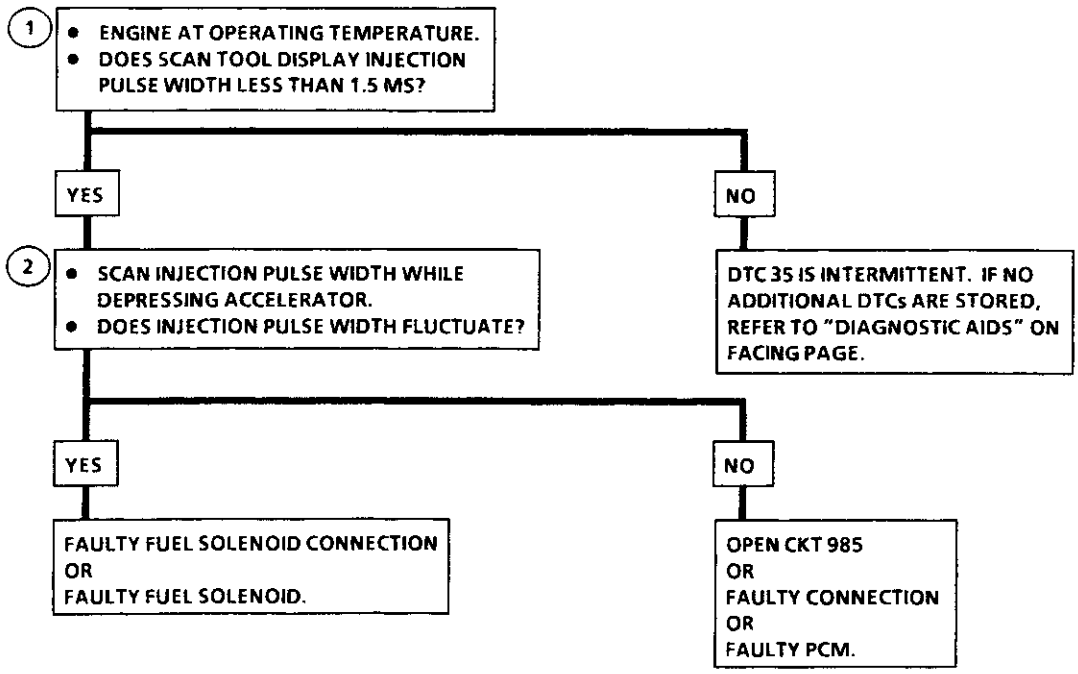
DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step will determine if DTC 35 is the result of a hard failure or an intermittent.
2. This will check CKT 985 for an open.

Diagnostic Aids: The injection pulse width will fluctuate slightly when throttle is depressed.

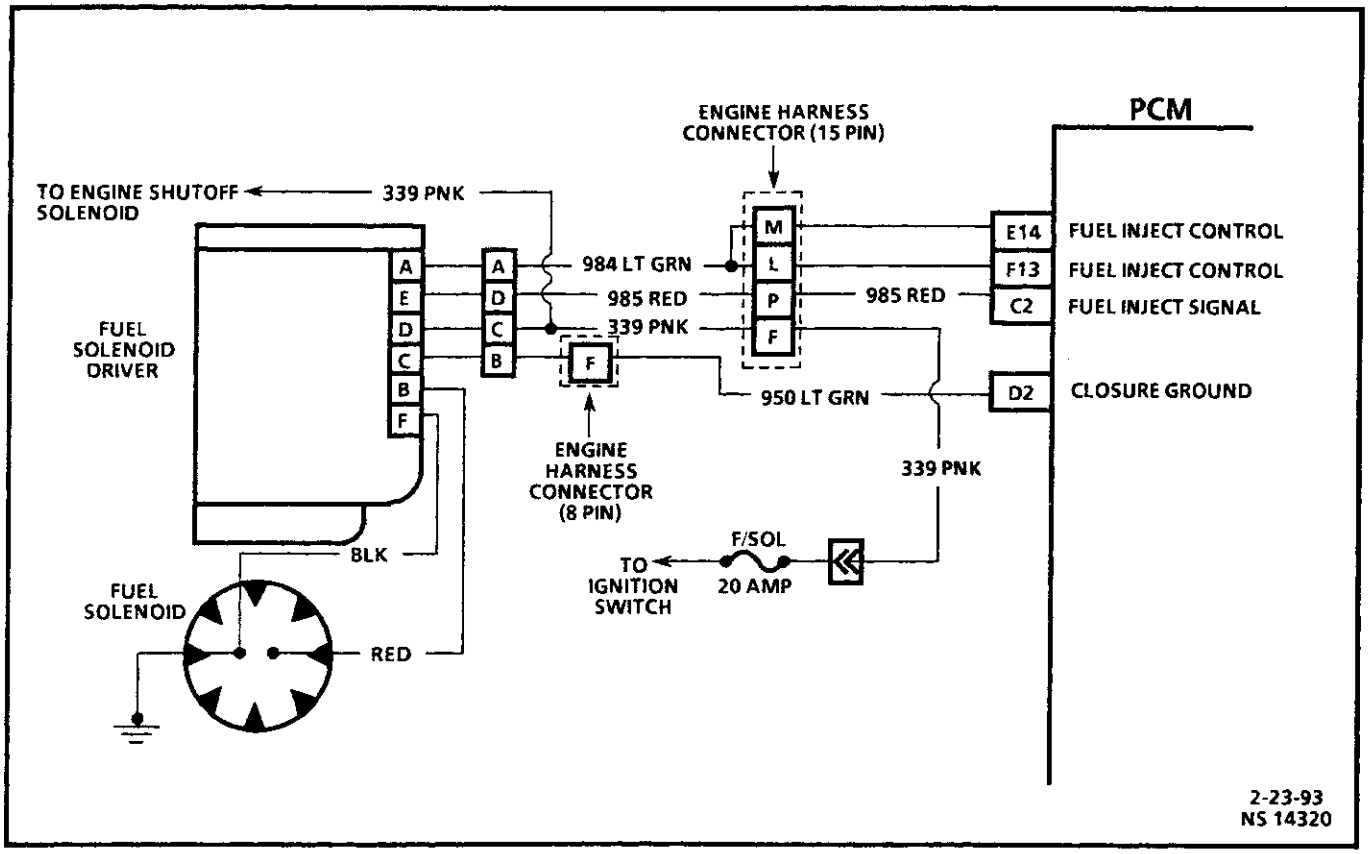
DTC 35

INJECTION PULSE WIDTH ERROR (RESPONSE TIME SHORT)



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 36

INJECTION PULSE WIDTH ERROR (RESPONSE TIME LONG)

Circuit Description:

The fuel injection driver receives an inject command signal from the PCM and provides a current regulated output to the fuel solenoid that controls injection. It also returns an injection pulse width signal back to the PCM to inform it when the fuel solenoid has actually seated. This injection pulse width signal is measured in micro seconds.

DTC 36 Will Set When:

- Battery voltage greater than 10 volts.
- Coolant temperature greater than 20°C (68°F).
- Injection pulse width greater than 2.5 milliseconds.

Action Taken (PCM will default to): Fixed injection pulse width.

DTC 36 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

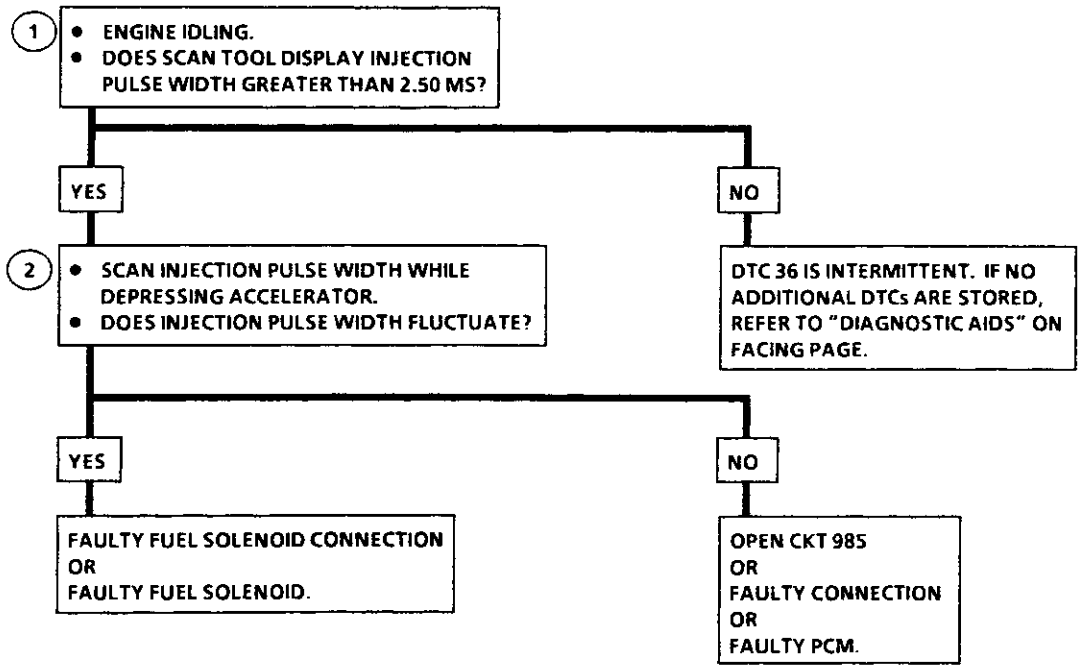
1. This step determines if DTC 36 is a hard failure or an intermittent.
2. This step sill determine if the solenoid is at fault, or if there is a problem with the PCM or wiring.

Diagnostic Aids: The injection pulse width will fluctuate when throttle is depressed.

A weak (mechanical failure) fuel solenoid will result in a DTC 36.

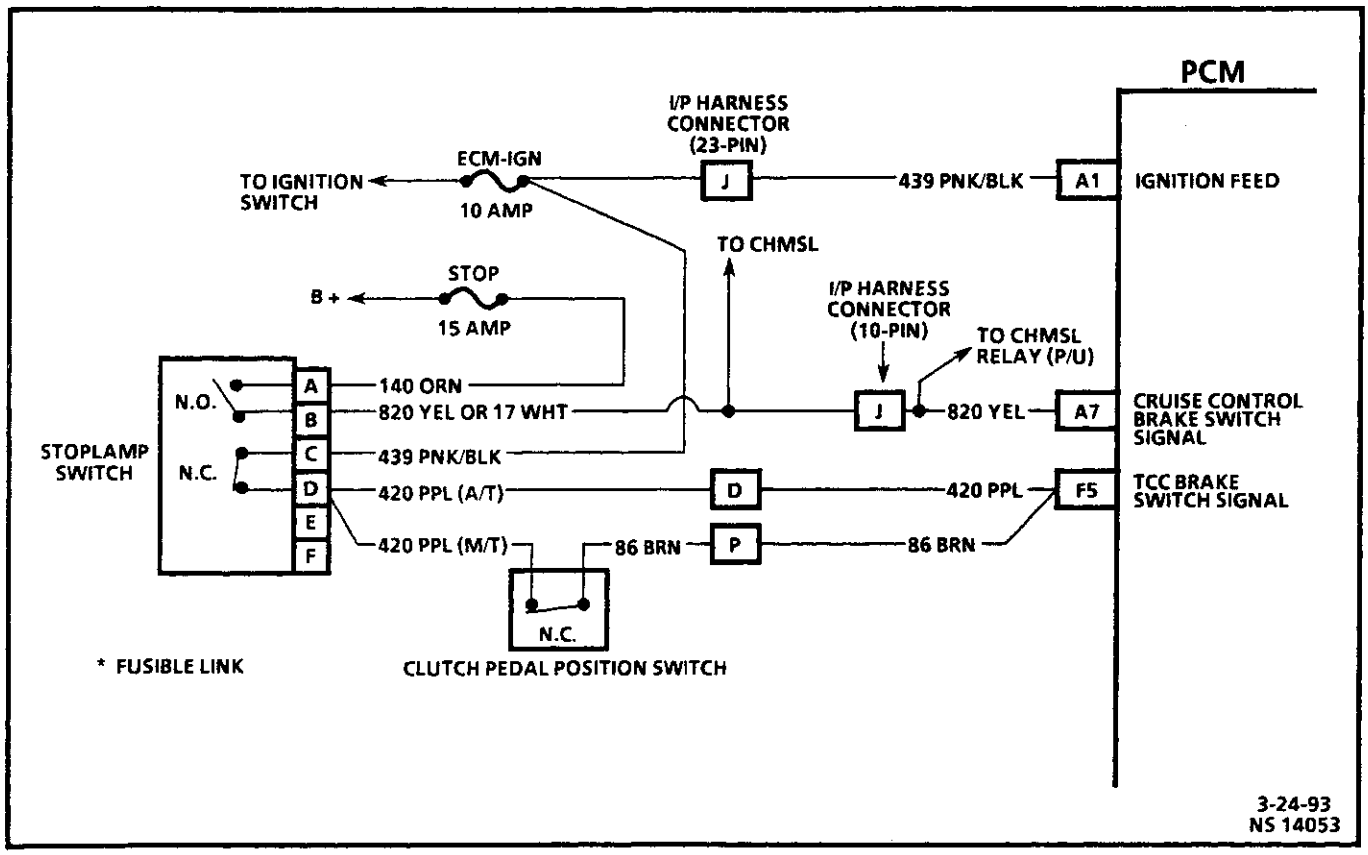
DTC 36

INJECTION PULSE WIDTH ERROR (RESPONSE TIME LONG)



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 41

BRAKE SWITCH CIRCUIT FAULT

Circuit Description:

The TCC normally closed brake switch supplies a B+ signal on CKT 420 to the PCM. The circuit is opened when the brakes are applied.

The stop lamp/cruise control normally open brake switch supplies a B+ signal on CKT 820 to the PCM when the brake is applied.

DTC 41 Will Set When:

- Vehicle on decel.
- TCC and cruise control brake switches are not toggling "open" and "closed," during 6 brake applications on same ignition cycle.

Action Taken (PCM will default to): An incorrect brake signal can affect TCC, fourth gear operation, in hot mode and cruise control.

DTC 41 Will Clear When: The fault condition(s) no longer exist.

DTC Chart Test Description:

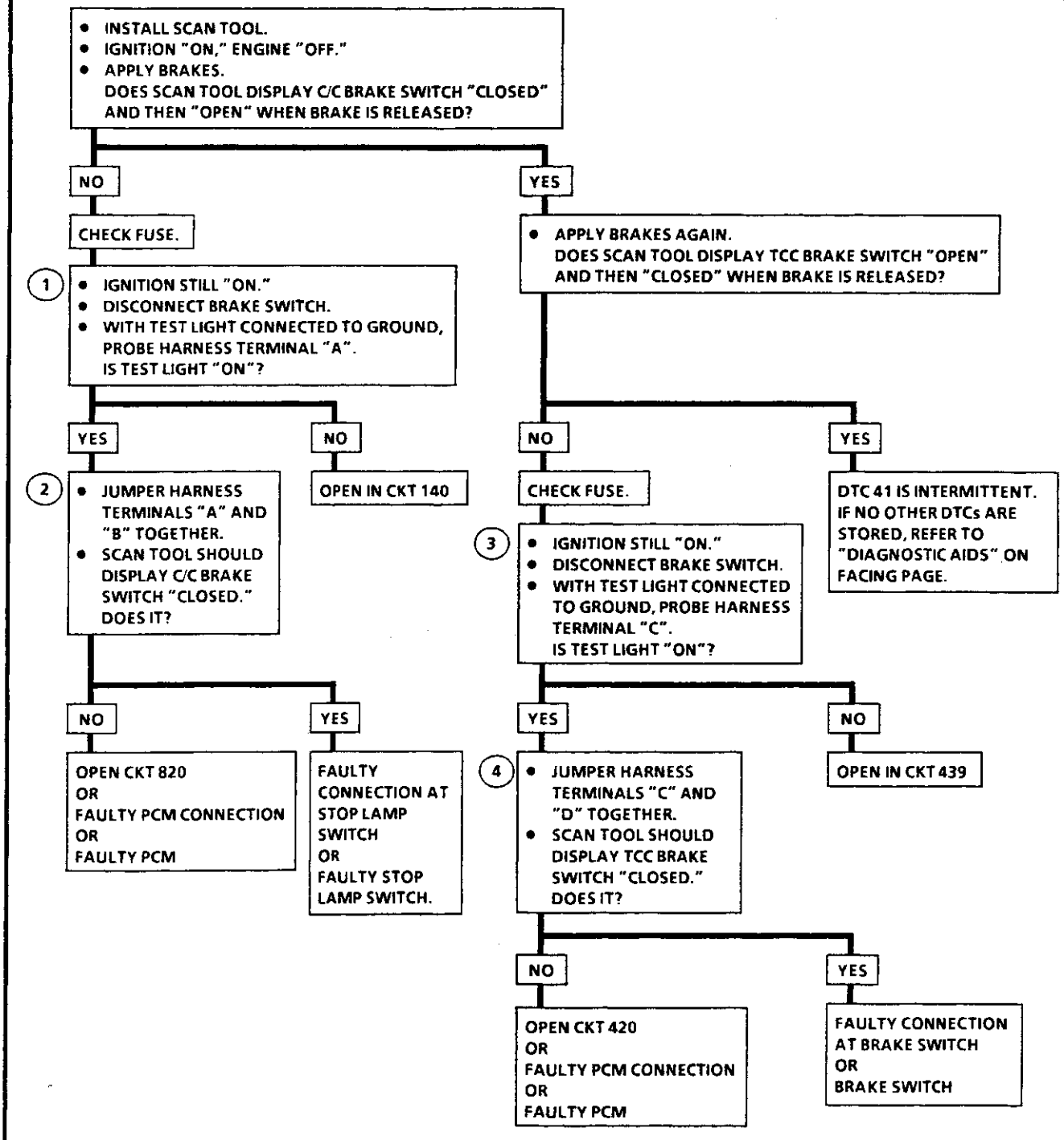
Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks for voltage at brake switch.
2. This test simulates brake switch closed or brakes "OFF."
3. This test checks for ignition feed to TCC brake switch.
4. This test checks CKT 420 and simulates brakes being applied.

Diagnostic Aids:

- Refer to "PCM Intermittent Diagnostic Trouble Codes or Performance."
- Check customer driving habits and/or unusual traffic conditions (i.e. stop and go expressway traffic).

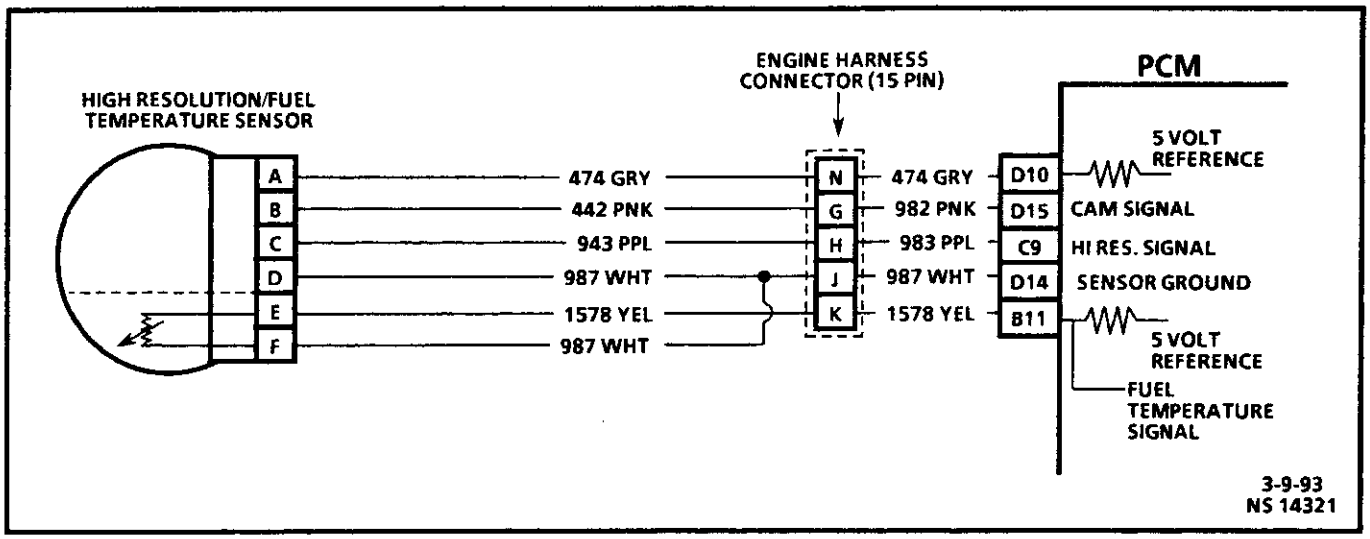
DTC 41
BRAKE SWITCH CIRCUIT FAULT



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

4-21-93
PS 17512



DTC 42

FUEL TEMPERATURE CIRCUIT LOW (HIGH TEMPERATURE INDICATED)

Circuit Description:

The fuel temperature sensor is a thermistor that controls signal voltage to the PCM. When the fuel is cold, the sensor resistance is high, therefore the PCM will see high signal voltage. As fuel warms, sensor resistance becomes less and voltage drops. The fuel temperature sensor is integrated with the optical sensor.

DTC 42 Will Set When: Fuel temperature greater than 102°C (215°F) for 2 seconds.

Action Taken (PCM will default to): Poor idle quality during hot conditions.

DTC 42 Will Clear When: The fault condition(s) no longer exist.

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step determines if DTC 42 is a hard failure or an intermittent condition.
2. This test will determine if CKT 1578 is shorted to ground.

Diagnostic Aids: A scan tool reads fuel temperature in degrees centigrade. After engine is started, the fuel temperature should rise steadily.

A faulty connection, or an open in CKTs 1578 or 987 will result in a DTC 43.

The "Temperature To Resistance Value" scale at the right may be used to test the fuel sensor at various temperature levels to evaluate the possibility of a "skewed" (mis-scaled) sensor.

DTC 42

FUEL TEMPERATURE CIRCUIT LOW (HIGH TEMPERATURE INDICATED)

1. DOES TECH 1 SCAN TOOL DISPLAY ENGINE FUEL TEMPERATURE OF 102°C (215°F) OR HIGHER?

YES

2. • DISCONNECT SENSOR. TECH 1 SCAN TOOL SHOULD DISPLAY FUEL TEMPERATURE BELOW -26°C (-15°F). DOES IT?

YES

FAULTY OPTICAL/FUEL TEMPERATURE SENSOR.

NO

CKT 1578 SHORTED TO GROUND
OR
CKT 1578 SHORTED TO SENSOR GROUND CIRCUIT
OR
FAULTY PCM.

IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

NO

DTC 42 IS INTERMITTENT. IF NO ADDITIONAL DTCs WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

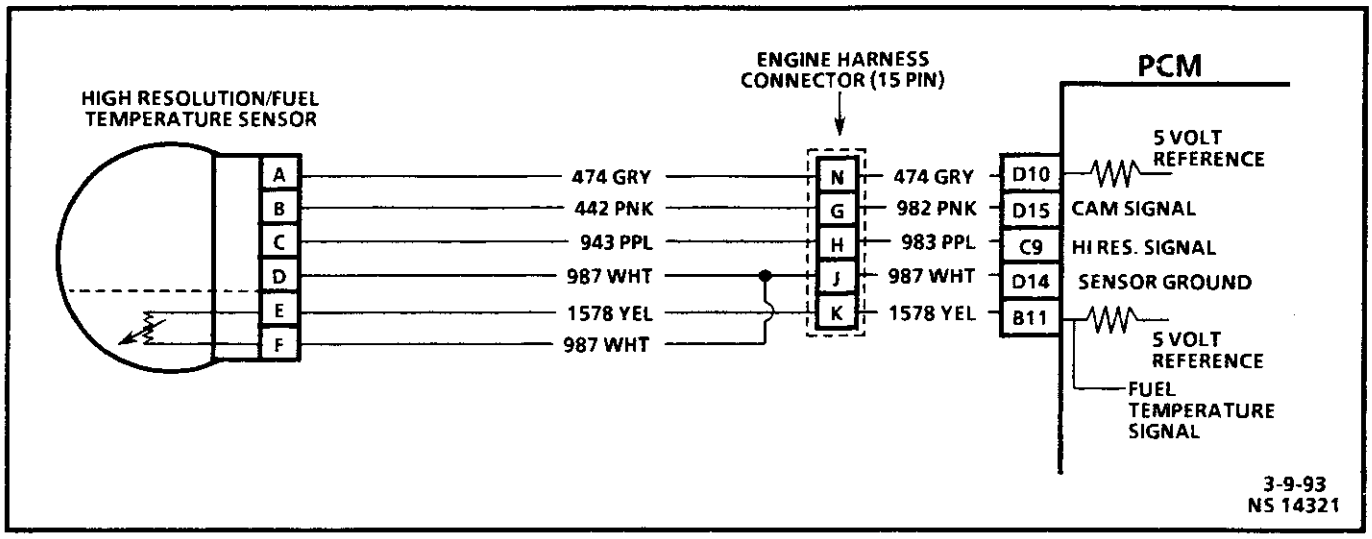
DIAGNOSTIC AID

FUEL TEMPERATURE SENSOR

TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)

°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
-5	23	12300
-10	14	16180
-15	5	21450
-20	-4	28680
-30	-22	52700
-40	-40	100700

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 43

FUEL TEMPERATURE CIRCUIT HIGH (LOW TEMPERATURE INDICATED)

Circuit Description:

The fuel temperature sensor is a thermistor that controls signal voltage to the PCM. When the fuel is cold, the sensor resistance is high, therefore the PCM will see high signal voltage. As fuel warms, sensor resistance becomes less and voltage drops. The fuel temperature sensor is integrated with the optical sensor.

DTC 43 Will Set When:

- Fuel temperature less than -14°C (6°F).
- Engine running for at least 2 minutes.

Action Taken (PCM will default to): Poor idle quality during hot conditions.

DTC 43 Will Clear When: The fault condition(s) no longer exist.

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step determines if DTC 43 is a hard failure or an intermittent condition.
2. This test simulates a DTC 42. If the PCM recognizes the low signal voltage (high temp) the PCM and wiring are OK.
3. This test will determine if CKT 1578 is open. There should be 5 volts at sensor connector if measured with J 39200-DVM. This will determine if there is a wiring problem or a faulty PCM.

Diagnostic Aids: A scan tool reads fuel temperature in degrees centigrade. After engine is started, the temperature should rise steadily.

A faulty connection, or an open in CKTs 1578 or 987 will result in a DTC 43.

The "Temperature To Resistance Value" scale at the right may be used to test the fuel sensor at various temperature levels to evaluate the possibility of a "skewed" (mis-scaled) sensor.

DTC 43

FUEL TEMPERATURE CIRCUIT HIGH (LOW TEMPERATURE INDICATED)

1. • DOES TECH 1 SCAN TOOL DISPLAY FUEL TEMP OF -14°C (6°F) OR LESS?

   - YES
   - NO: DTC 14 IS INTERMITTENT. IF NO ADDITIONAL DTCs WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

2. • DISCONNECT SENSOR.
   • JUMPER HARNESS TERMINALS "E" AND "F" TOGETHER.
   • TECH 1 SCAN TOOL SHOULD DISPLAY 107°C (244°F) OR MORE. DOES IT?

   - NO
   - YES: FAULTY CONNECTION OR OPTICAL/FUEL TEMPERATURE SENSOR.

3. • JUMPER CKT 1578 TO GROUND.
   • TECH 1 SCAN TOOL SHOULD DISPLAY OVER 107°C (244°F). DOES IT?

   - YES: OPEN SENSOR GROUND CIRCUIT, FAULTY CONNECTION OR FAULTY PCM.
   - NO: OPEN CKT 1578, FAULTY CONNECTION AT PCM, OR FAULTY PCM.

DIAGNOSTIC AID

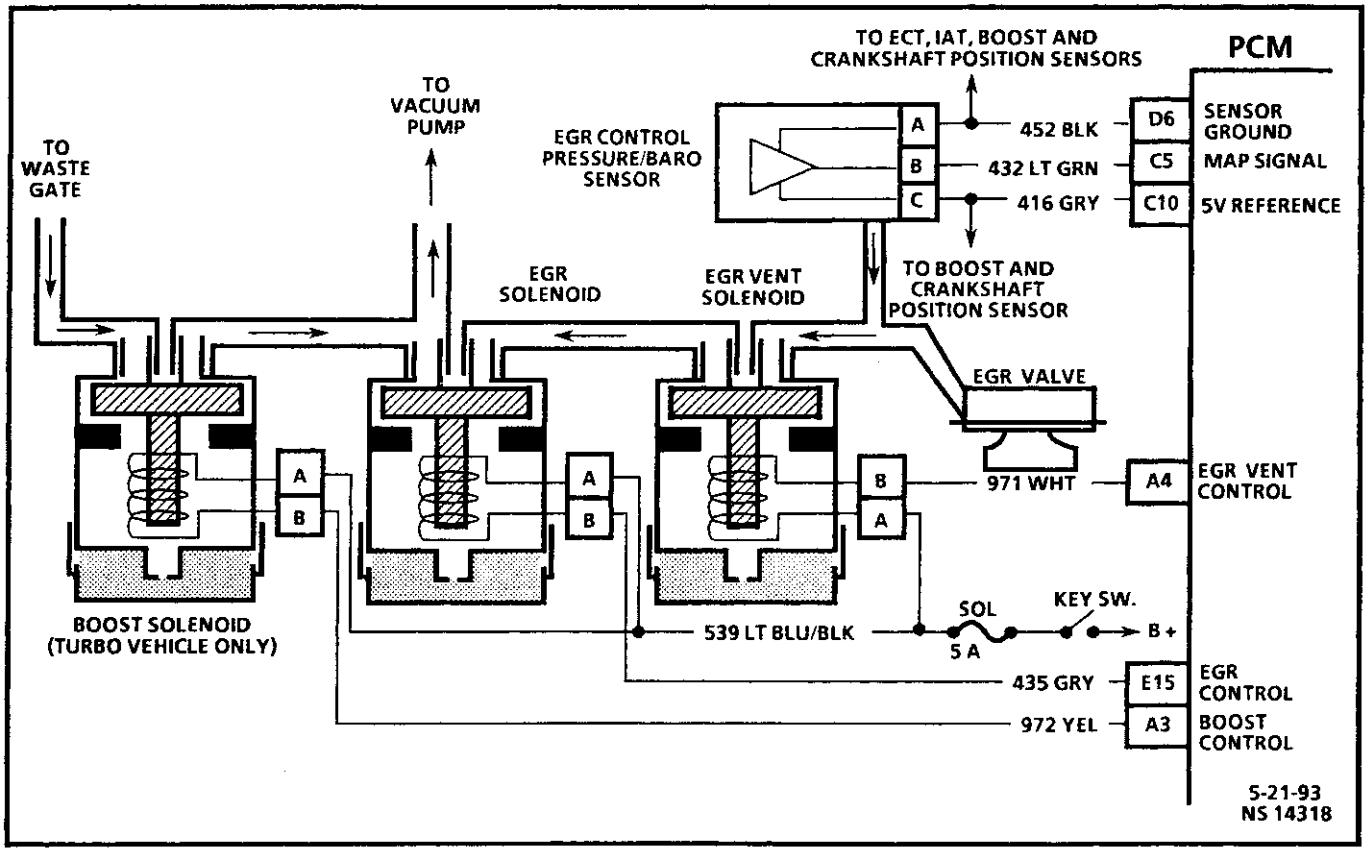
FUEL TEMPERATURE SENSOR
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)

°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
-5	23	12300
-10	14	16180
-15	5	21450
-20	-4	28680
-30	-22	52700
-40	-40	100700

IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

5-7-93
NS 15534



DTC 44

EGR PULSE WIDTH ERROR

Circuit Description:

The PCM operates a solenoid to control the EGR valve. This solenoid is normally open. By providing a ground path the PCM energizes the solenoid which then allows vacuum to pass to the EGR.

During normal operation, the PCM compares its EGR duty cycle signal with the EGR control pressure/BARO signal and makes corrections in the duty cycle accordingly. If there is a difference in the PCM command and what is at the EGR valve sensed by the EGR control pressure/BARO, the PCM makes minor adjustments to correct.

DTC 44 Will Set When: No ignition voltage on Terminal "E15" when EGR solenoid is commanded "ON."

Action Taken (PCM will default to): The PCM will shut down the EGR.

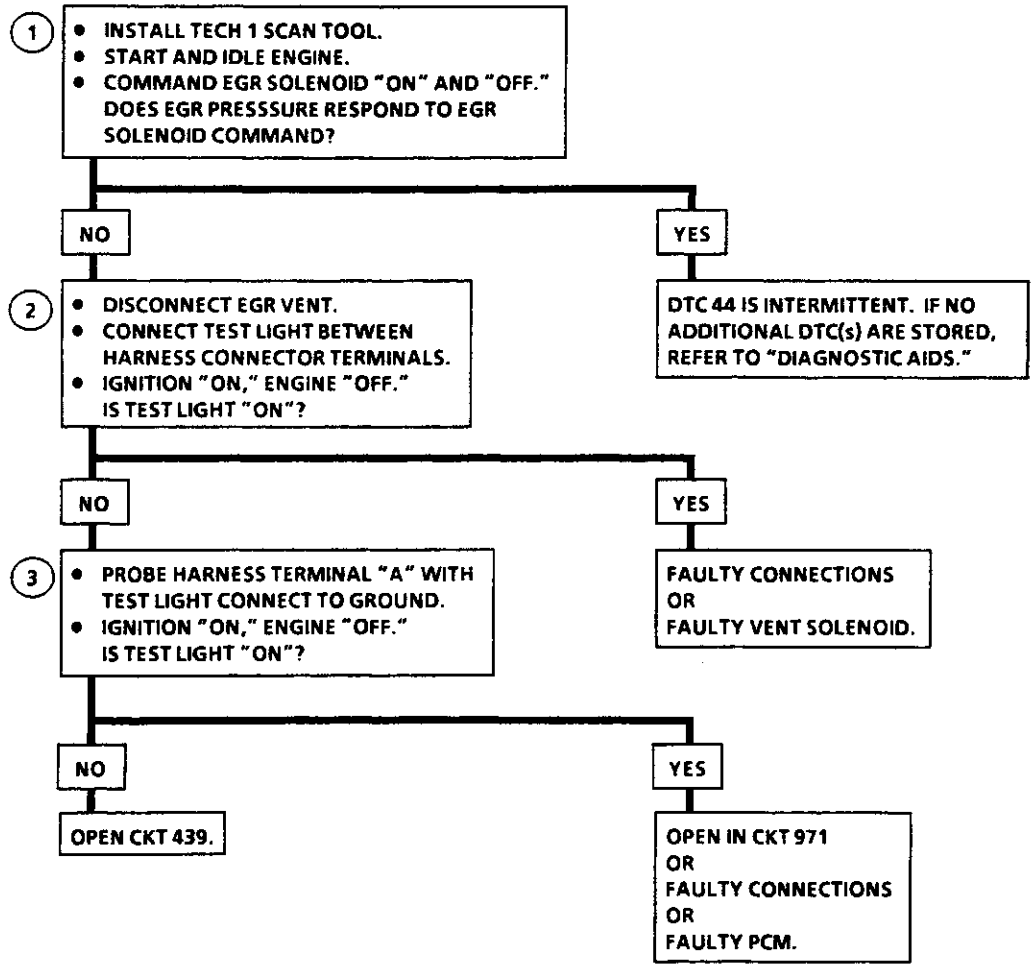
DTC 44 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step determines if DTC 44 is a hard failure or an intermittent.
2. This step checks to see if PCM and wiring are OK.
3. This step checks the EGR solenoid.

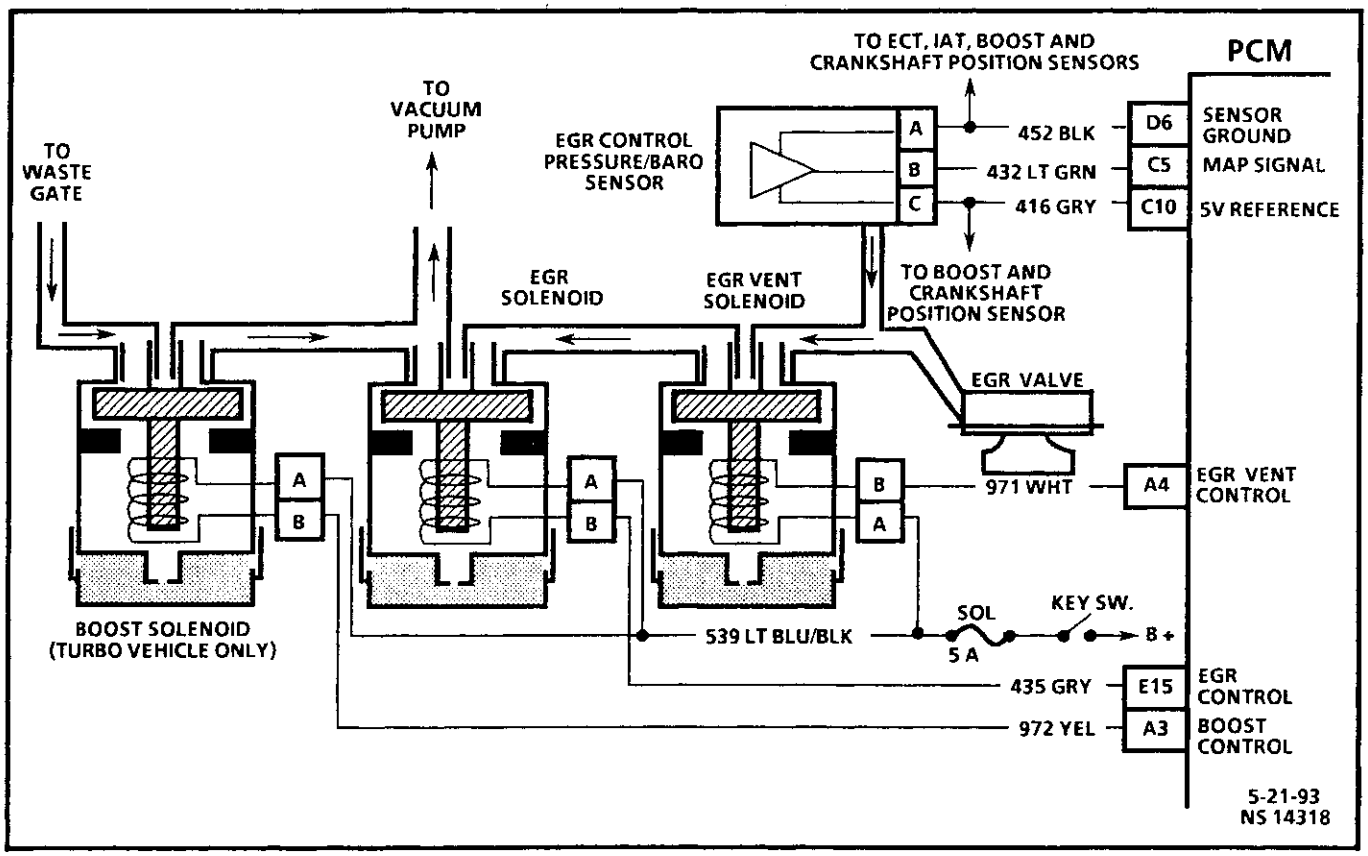
Diagnostic Aids: An open in CKT 439 or 435 will set a DTC 44.

DTC 44
EGR PULSE WIDTH ERROR



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 45

EGR VENT ERROR

Circuit Description:

When the PCM recognizes the operating range for no EGR, the PCM energizes the EGR vent solenoid which allows rapid venting of EGR vacuum. This solenoid is normally open.

DTC 45 Will Set When: No ignition voltage on Terminal "A4" when EGR vent commanded "ON."

Action Taken (PCM will default to): The PCM will shut "OFF" EGR system.

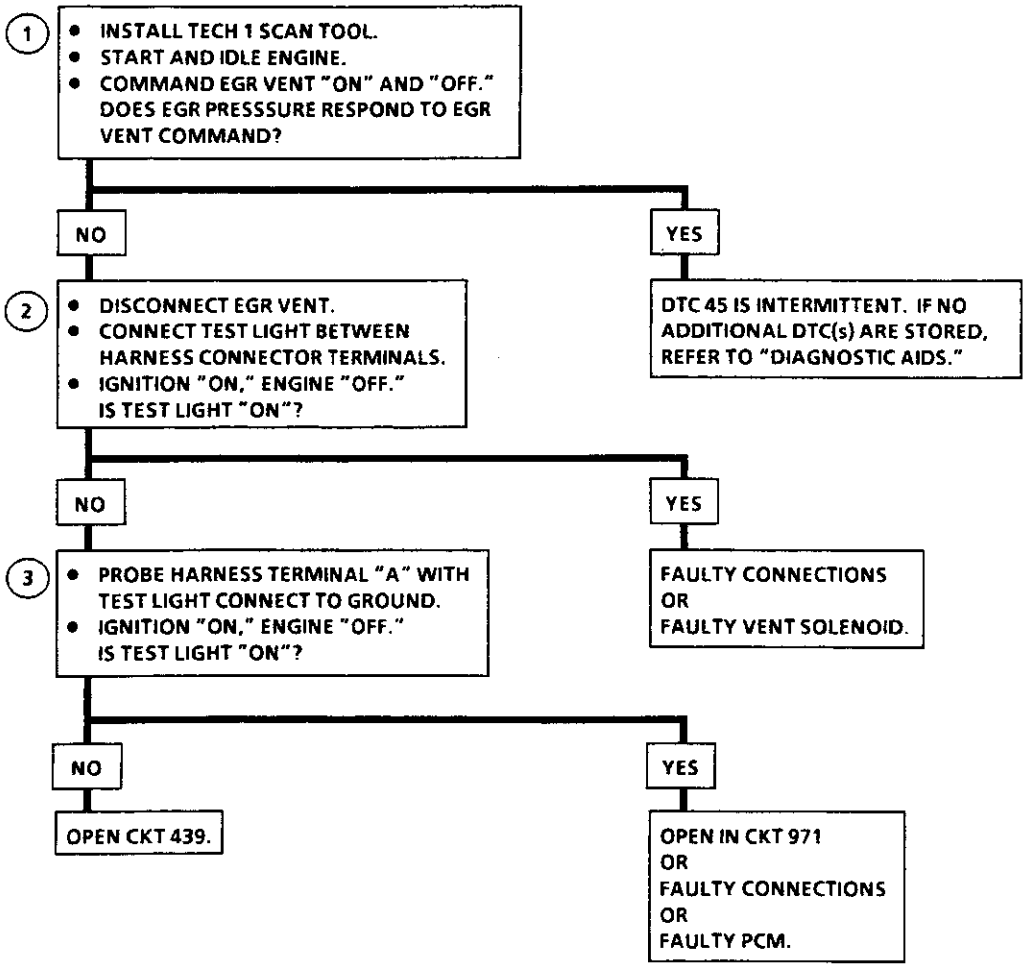
DTC 45 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

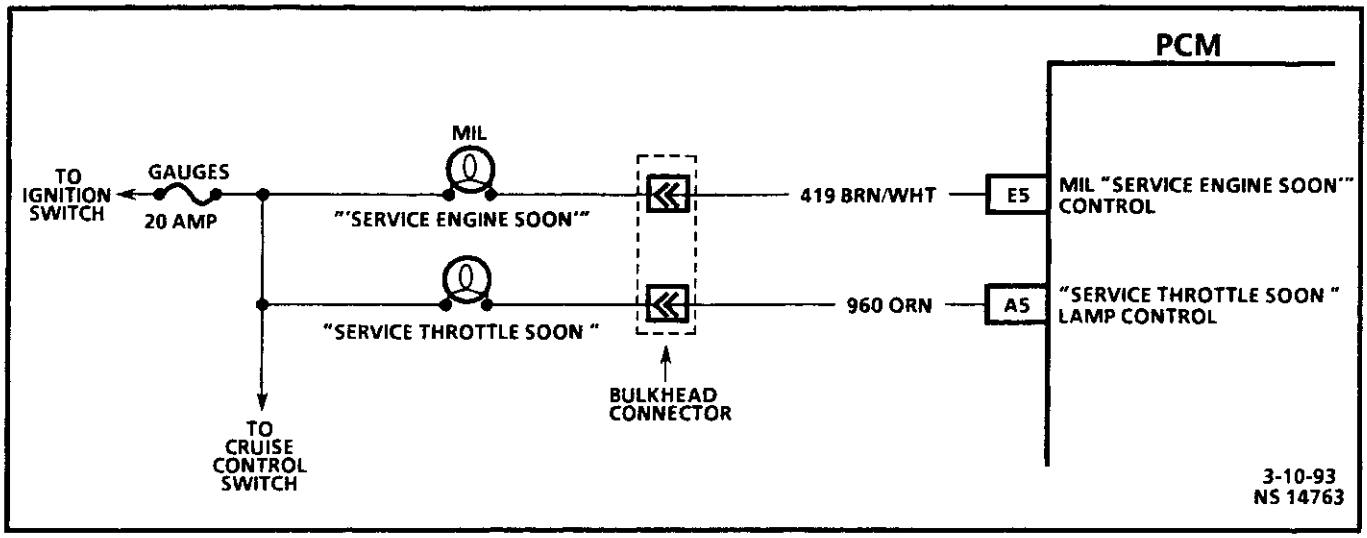
1. This step will determine if DTC 45 is the result of a hard failure or an intermittent condition.
2. This step checks the PCM and wiring.
3. This step checks power and control circuit.

Diagnostic Aids: DTC 45 will set if CKT 971 or 439 is open.

DTC 45
EGR VENT ERROR



WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 46

MIL "SERVICE ENGINE SOON" CIRCUIT FAULT

Circuit Description:

There should always be a MIL "Service Engine Soon" when the ignition is "ON" and the engine stopped. The PCM will control the MIL and turn it "ON" by providing a ground path.

DTC 46 Will Set When: No ignition voltage on Terminal "E5" when PCM is requesting MIL "ON."

Action Taken (PCM will default to): No MIL.

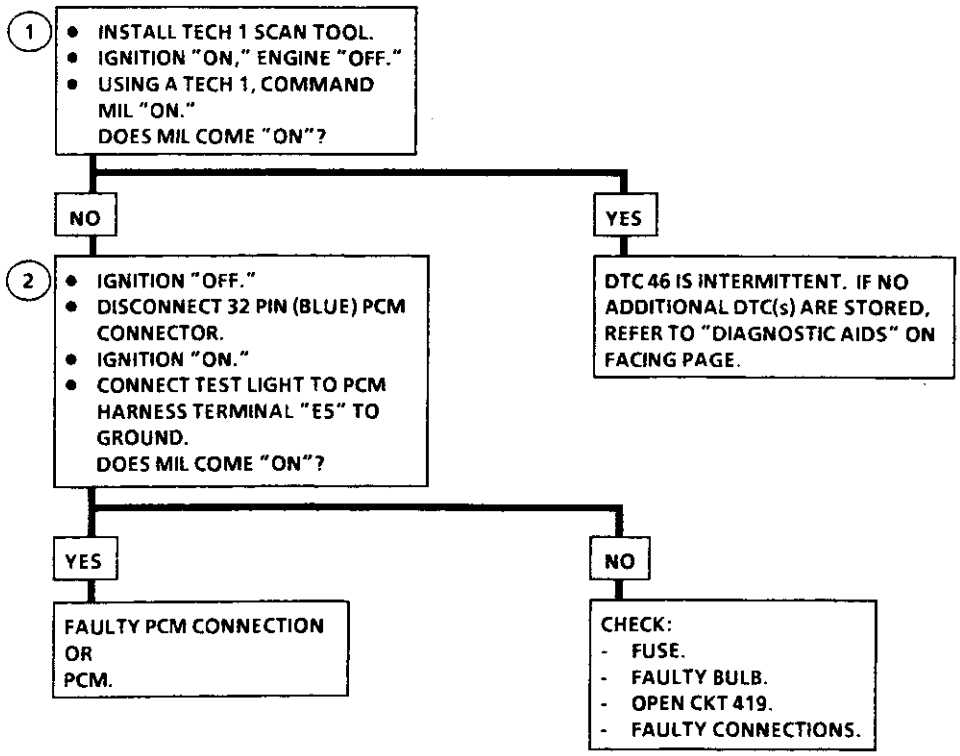
DTC 46 Will Clear When: The fault condition(s) no longer exist.

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks the ability of the PCM to command the MIL.
2. This test will determine if there is an open in ignition feed circuit.

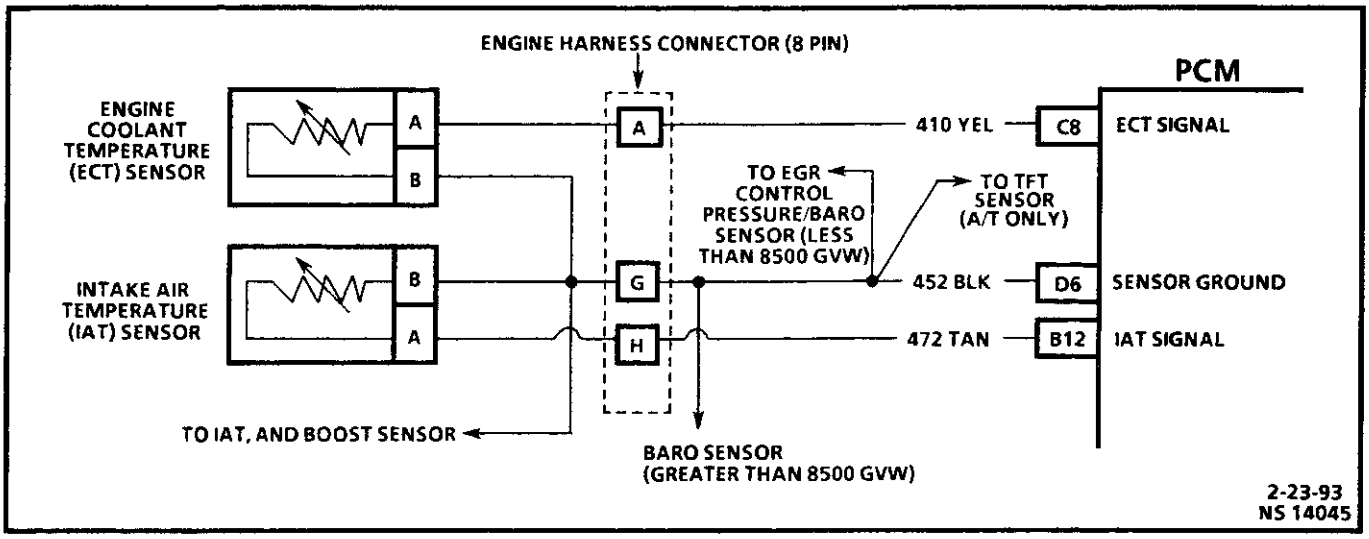
Diagnostic Aids: Check for faulty bulb or fuse. An open in CKT 419 will cause a DTC 46 to set.

DTC 46
MIL "SERVICE ENGINE SOON" CIRCUIT FAULT



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 47

INTAKE AIR TEMPERATURE (IAT) CIRCUIT LOW
(HIGH TEMPERATURE INDICATED)

Circuit Description:

The intake air temperature sensor is a thermistor that controls signal voltage to the PCM. When the air is cold, the sensor resistance is high, therefore the PCM will see high signal voltage. As air warms, sensor resistance becomes less and voltage drops.

DTC 47 Will Set When:

- Engine coolant temperature less than 38°C (100°F).
- Intake air temperature is greater than 96°C (205°F) for 2 seconds.

Action Taken (PCM will default to): Poor performance during cold operation.

DTC 47 Will Clear When: The fault condition(s) no longer exist.

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step determines if DTC 47 is a hard failure or an intermittent condition.
2. This test will determine if CKT 472 is shorted to ground.

Diagnostic Aids: Check harness routing for a potential short to ground in CKT 472.

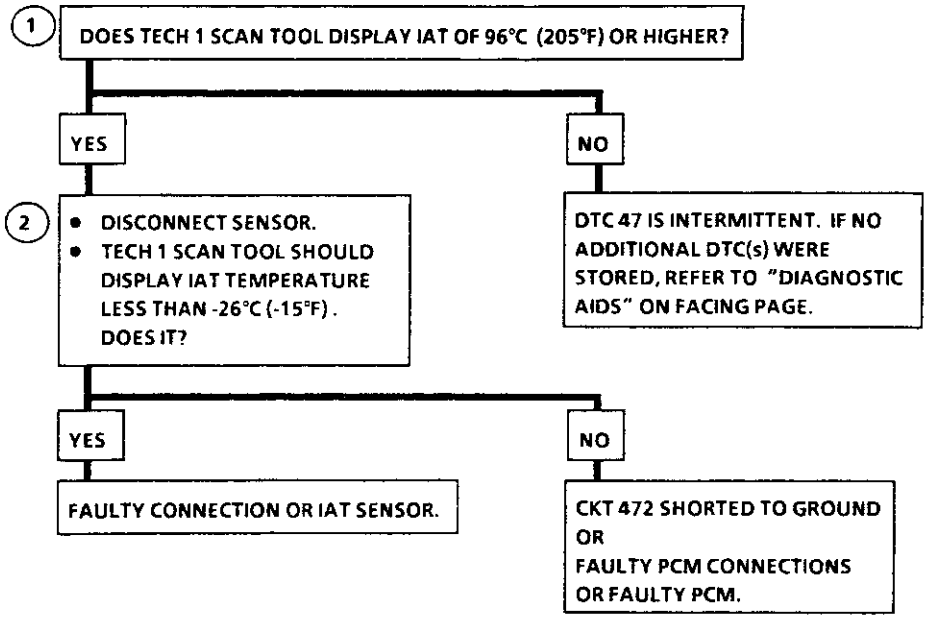
Tech 1 scan tool displays intake air temperature in degrees centigrade.

Refer to "Intermittents" in SECTION 2.

The "Temperature to Resistance Value" scale at the right may be used to test the intake air temperature sensor at various temperature levels to evaluate the possibility of a "skewed" (mis-scaled) sensor. A "skewed" sensor could result in poor driveability complaints.

DTC 47

INTAKE AIR TEMPERATURE (IAT) CIRCUIT LOW
(HIGH TEMPERATURE INDICATED)



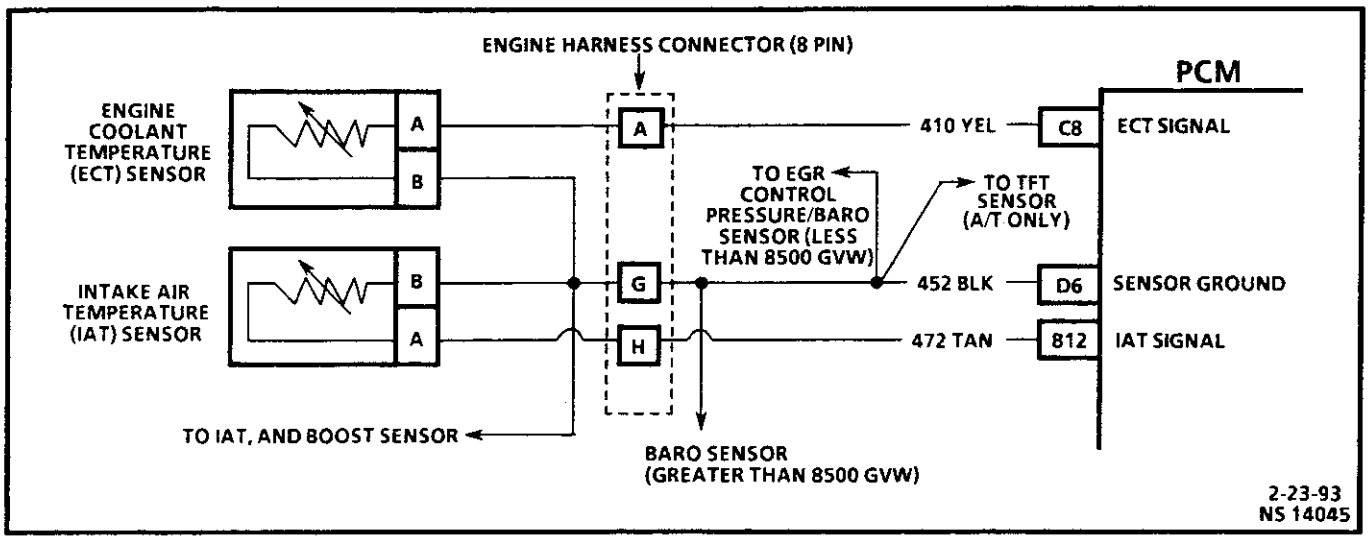
DIAGNOSTIC AID

INTAKE AIR TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
-5	23	12300
-10	14	16180
-15	5	21450
-20	-4	28680
-30	-22	52700
-40	-40	100700

IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

4-23-93
NS 14050



DTC 48

INTAKE AIR TEMPERATURE (IAT) CIRCUIT HIGH (LOW TEMPERATURE INDICATED)

Circuit Description:

The intake air temperature sensor is a thermistor that controls signal voltage to the PCM. When the air is cold, the sensor resistance is high, therefore the PCM will see high signal voltage. As air warms, sensor resistance becomes less and voltage drops.

DTC 48 Will Set When: Intake air temperature less than -38°C (-39°F) for 2 minutes.

Action Taken (PCM will default to): Possible poor performance during cold operation.

DTC 48 Will Clear When: The fault condition(s) no longer exist.

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step determines if DTC 48 is a hard failure or an intermittent condition.
2. This test will determine if circuit is shorted to ground.
3. This step will determine if there is a wiring problem or a faulty PCM.

Diagnostic Aids: Check harness routing for a potential short to ground in CKT 472.

Tech 1 scan tool displays intake air temperature in degrees centigrade.

Refer to "Intermittents" in SECTION 2.

The "Temperature to Resistance Value" scaled at the right may be used to test the engine coolant sensor at various temperature levels to evaluate the possibility of a "skewed" (mis-scaled) sensor. A "skewed" sensor could result in poor driveability complaints.

DTC 48

INTAKE AIR TEMPERATURE (IAT) CIRCUIT HIGH (LOW TEMPERATURE INDICATED)

1. • DOES TECH 1 SCAN TOOL DISPLAY IAT -30°C (-22°F) OR COLDER?

YES

2. • DISCONNECT SENSOR.
   • JUMPER HARNESS TERMINALS TOGETHER.
   • TECH 1 SCAN TOOL SHOULD DISPLAY TEMPERATURE OVER 130°C (266°F). DOES IT?

YES

FAULTY CONNECTION OR SENSOR.

NO

DTC 48 IS INTERMITTENT. IF NO ADDITIONAL DTC(s) WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO

3. • JUMPER CKT 472 TO GROUND.
   • TECH 1 SCAN TOOL SHOULD DISPLAY TEMPERATURE OVER 130°C (266°F). DOES IT?

YES

OPEN SENSOR GROUND CIRCUIT, FAULTY CONNECTION OR FAULTY PCM.

NO

OPEN CKT 472, FAULTY CONNECTION OR FAULTY PCM.

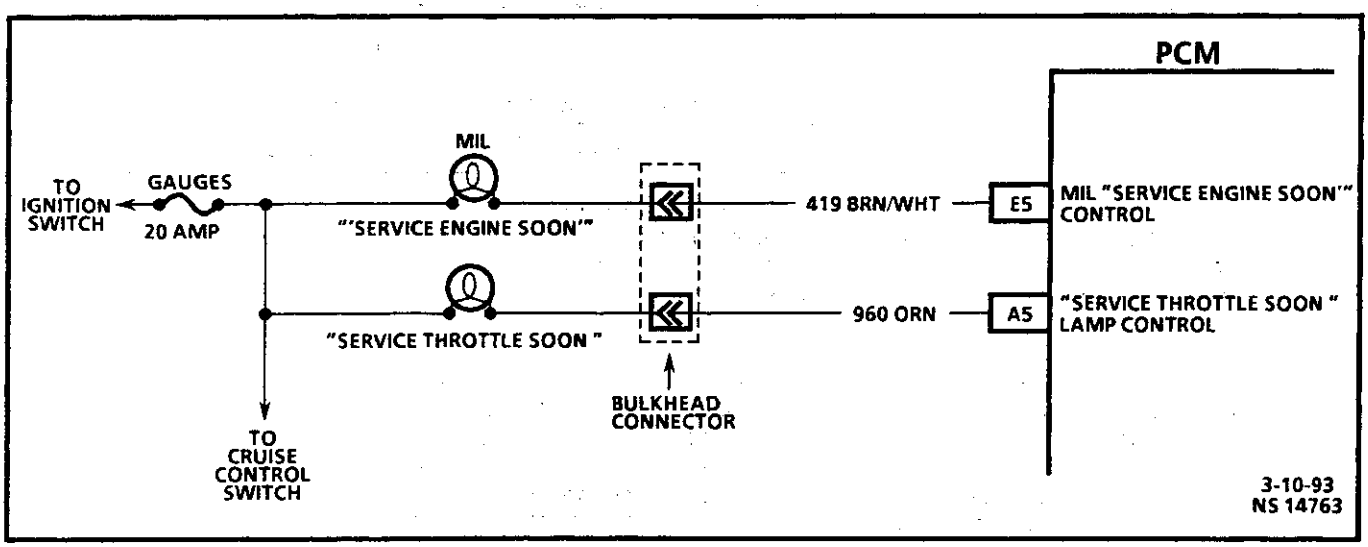
DIAGNOSTIC AID

INTAKE AIR TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
-5	23	12300
-10	14	16180
-15	5	21450
-20	-4	28680
-30	-22	52700
-40	-40	100700

IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

3-16-93
NS 14051



DTC 49

"SERVICE THROTTLE SOON" LAMP CIRCUIT FAULT

Circuit Description:

There should be a "Service Throttle Soon" lamp when the ignition is "ON" and the engine "OFF" for 2 seconds. The PCM will control the "Service Throttle Soon" and turn it "ON" by providing a ground path.

DTC 49 Will Set When: No ignition voltage on Terminal "A5" when PCM is requesting "Service Throttle Soon" lamp "ON."

Action Taken (PCM will default to): DTC 49 will not turn "ON" the MIL, but will set a current and history DTC.

DTC 49 Will Clear When: The fault condition(s) no longer exist.

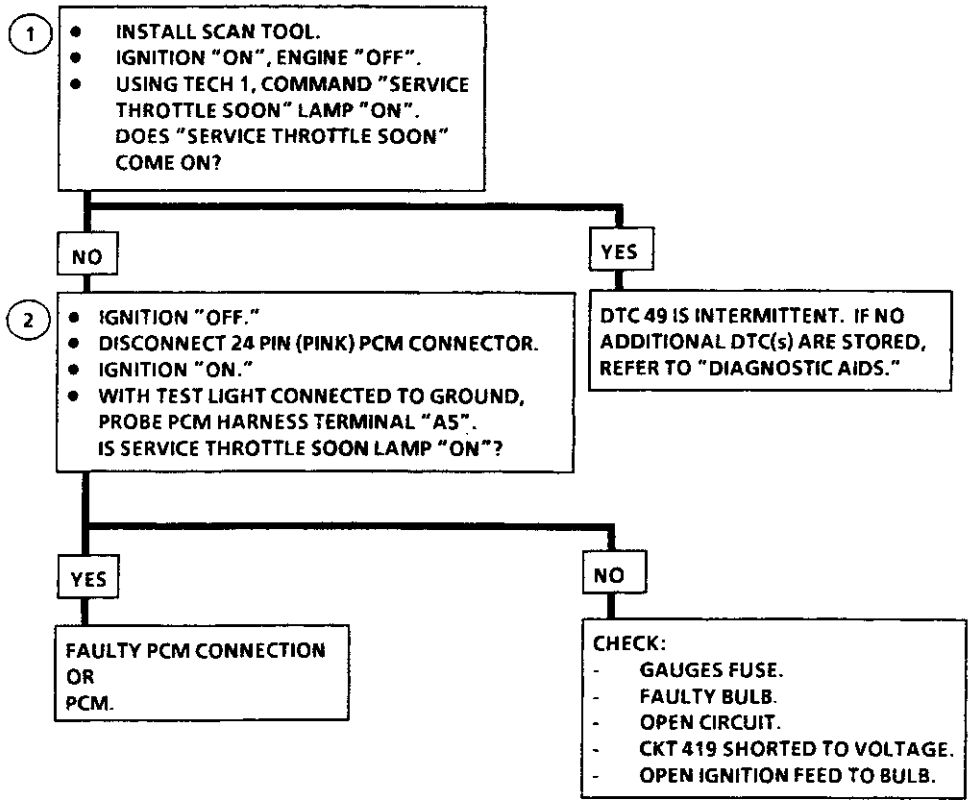
DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This test checks the ability of the PCM to command the STS lamp.
2. This test will determine if there is an open in ignition feed circuit.

Diagnostic Aids: Check for faulty bulb or fuse. An open in CKT 960 will cause a DTC 49 to set.

DTC 49

"SERVICE THROTTLE SOON" LAMP CIRCUIT FAULT



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

BLANK

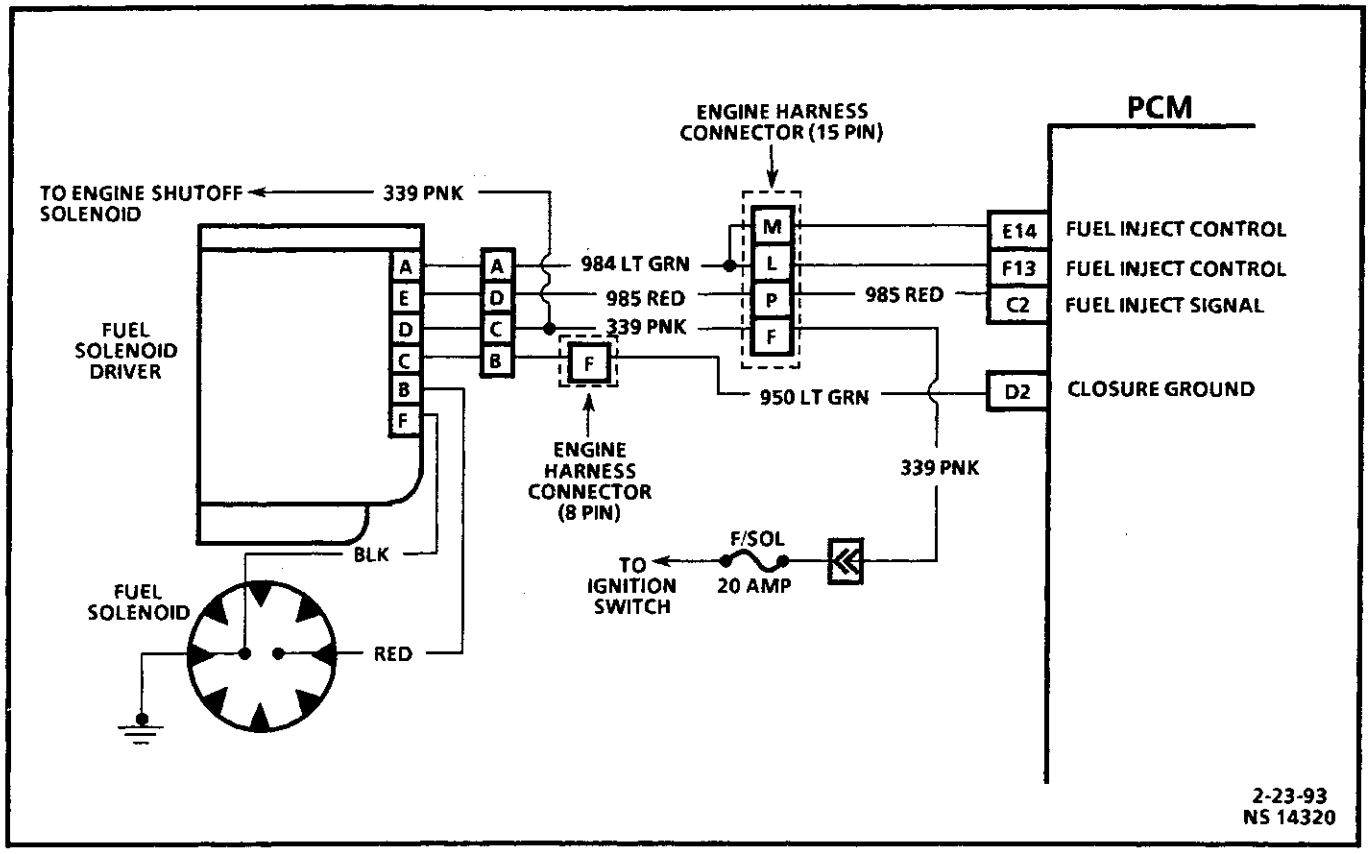
DTC 51

PROM ERROR
(FAULTY OR INCORRECT PROM)

CHECK THAT ALL PINS ARE FULLY INSERTED IN THE SOCKET. IF OK, REPLACE PROM, CLEAR MEMORY AND RECHECK. IF DTC 51 REAPPEARS, REPLACE PCM.

IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 56

INJECTION PUMP CALIBRATION RESISTOR ERROR

Circuit Description:

The PCM uses a calibrated resistor mounted internally in the injection pump to determine fuel rates. The resistor value is stored in the PCM memory. If the PCM memory has been disturbed or the PCM has been replaced, the PCM will relearn the resistor value on the next ignition cycle.

DTC 56 Will Set When: PCM has lost its memory and is unable to read a resistor value on CKT 960 on the next ignition cycle. Possible poor performance problem.

Action Taken (PCM will default to): A current and history DTC will store and turn "ON" the MIL. The PCM will default to the lowest fuel table.

DTC 56 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

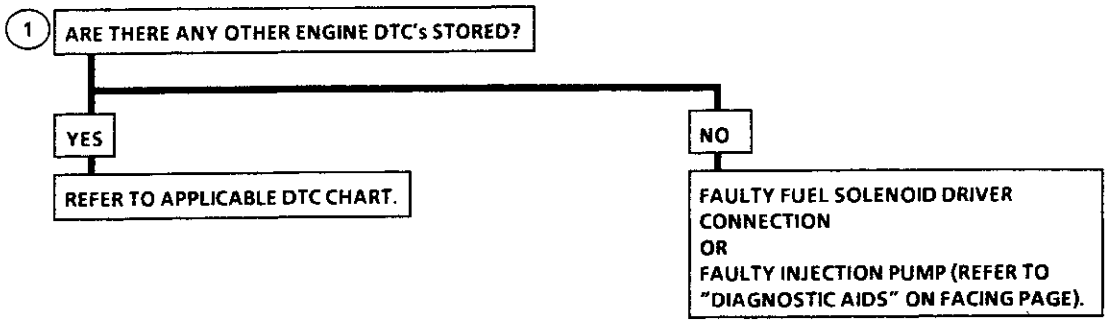
DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step will determine if DTC 56 is a hard failure.

Diagnostic Aids: Check connection at fuel injector driver. Clear DTC, and cycle ignition. If DTC clears, treat condition as an intermittent.

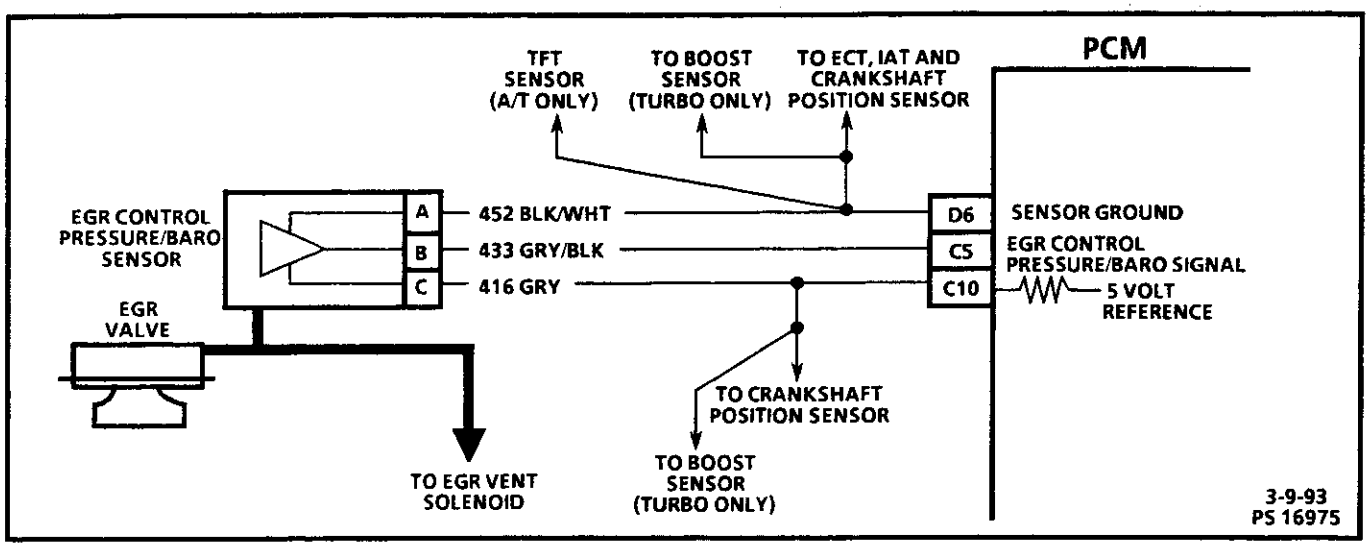
DTC 56

INJECTION PUMP CALIBRATION RESISTOR ERROR



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 57

PCM 5 VOLT SHORTED

Circuit Description:

The 5 volt reference is a non-varying calculated voltage.

DTC 57 Will Set When: 5 volt reference is less than 1 volt.

Action Taken (PCM will default to): Backup fuel, no EGR and no turbo boost.

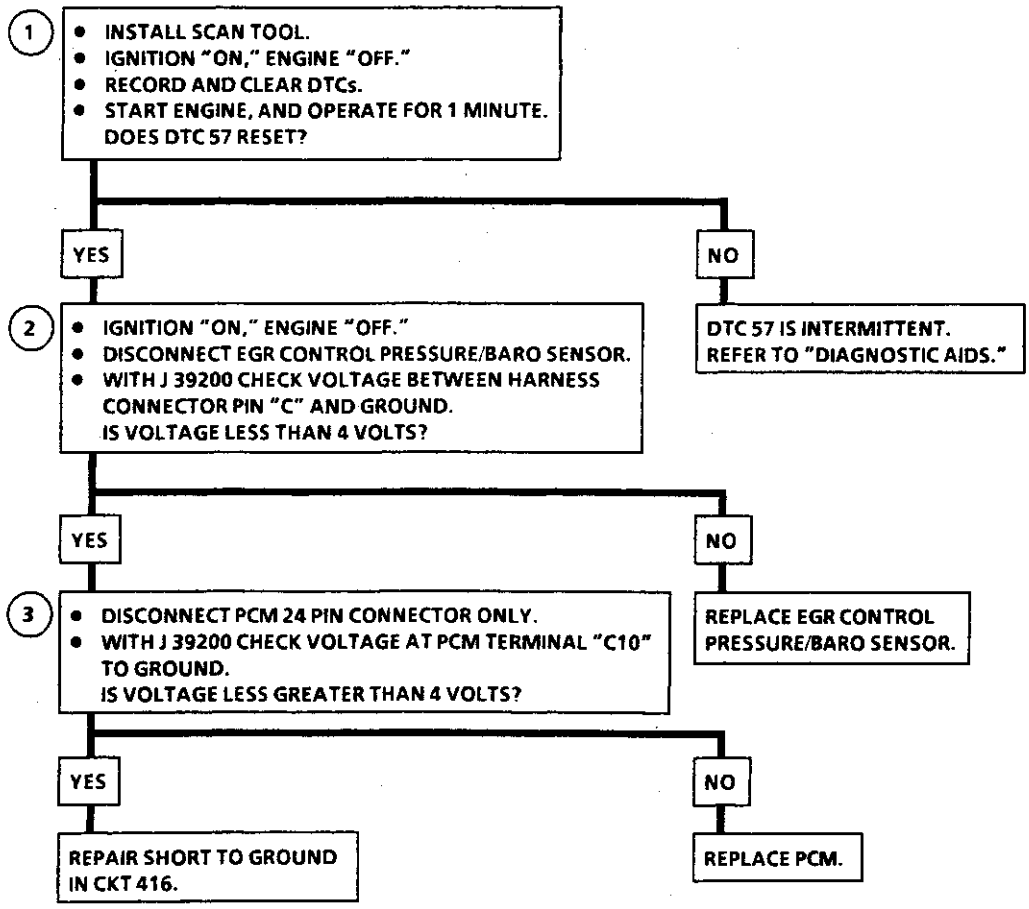
DTC 57 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. Checks to confirm that a DTC is still present.
2. Checks to determine if there is a 5 volt reference from the PCM.
3. Checks to determine if there is a short-to-ground in CKT 416, or a short-to-ground in the PCM.

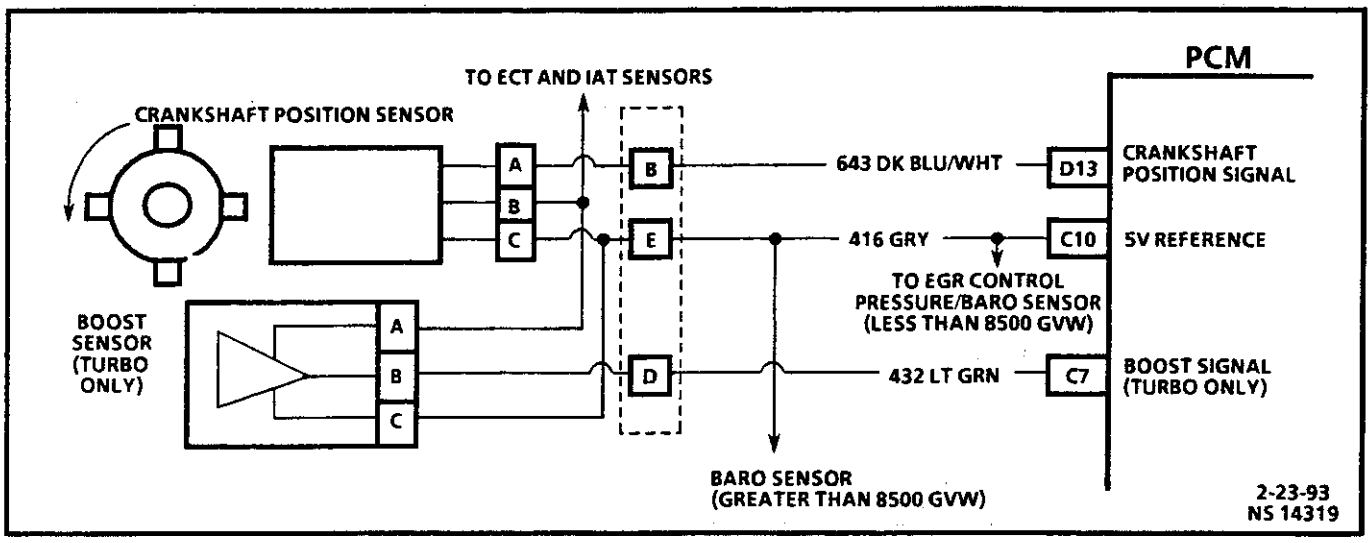
Diagnostic Aids: During the time the failure is present, the setting of additional DTCs may result.

DTC 57
PCM 5 VOLT SHORTED



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 61

TURBO BOOST SENSOR CIRCUIT HIGH

Circuit Description:

The PCM sends a 5 volt reference signal to the boost sensor. As manifold pressure changes, the electrical resistance of the boost sensor also changes. By monitoring the sensor output voltage, the PCM detects how much pressure is being produced by the turbocharger in the intake manifold. The PCM uses the boost sensor to control turbo boost and fuel at different loads.

DTC 61 Will Set When:

- Boost signal voltage greater than 3.9 volts.
- RPM less than 3500.

Action Taken (PCM will default to): No turbo boost. Poor performance.

DTC 61 Will Clear When: The fault condition(s) no longer exist.

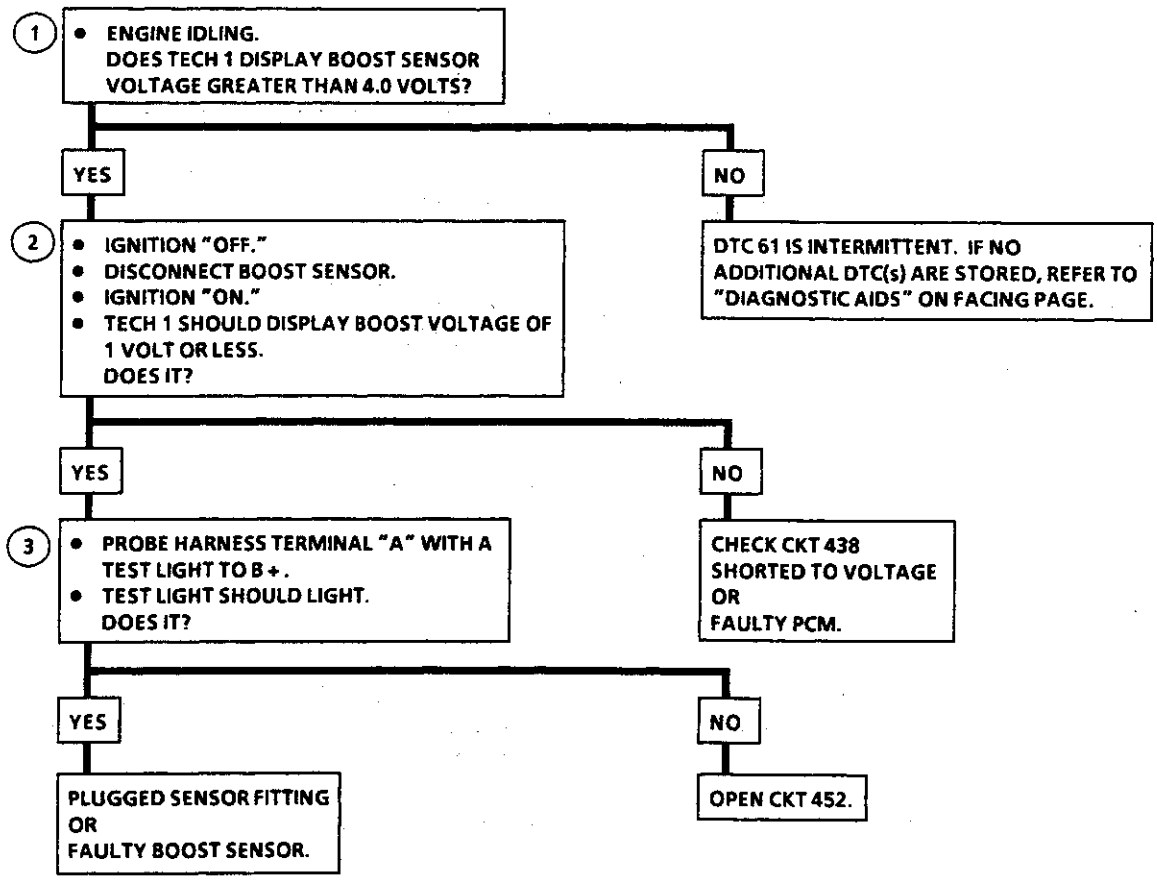
DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step will determine if DTC 61 is the result of a hard failure or an intermittent condition.
2. This step simulates conditions for a DTC 62. If the PCM recognizes the change, the PCM and CKT 416 and CKT 432 are OK.
3. This step will check for an open in ground circuit.

Diagnostic Aids: With the ignition "ON" and the engine stopped, boost pressure is equal to atmospheric pressure with the signal voltage being high.

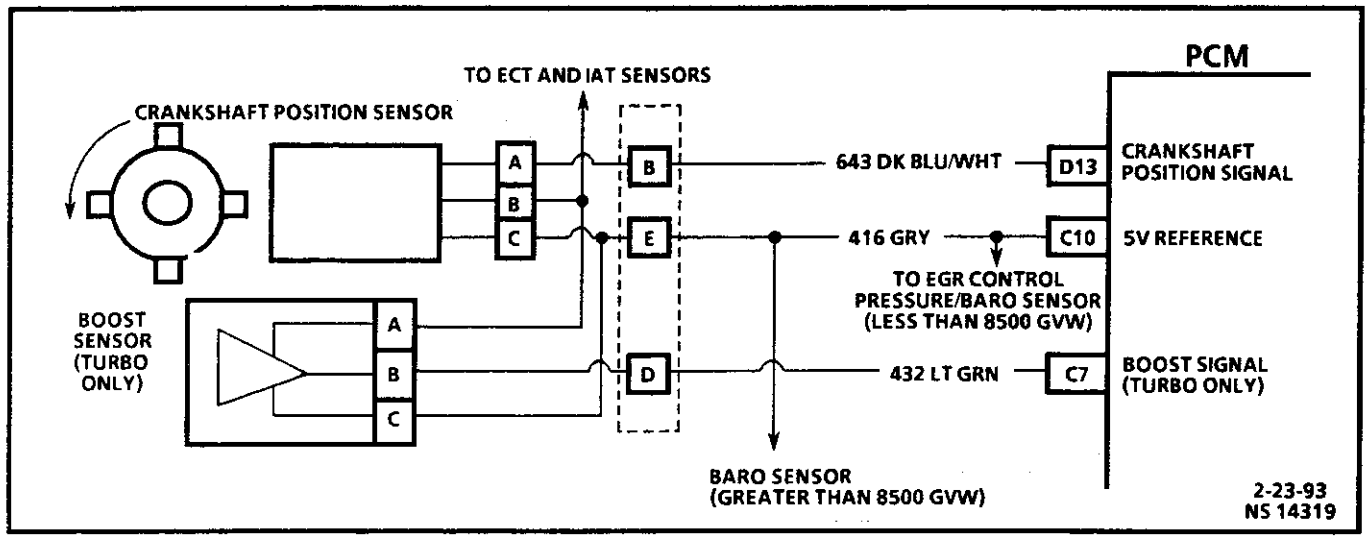
Comparison of this reading with a known good vehicle using the same sensor is a good way to check accuracy of a "suspect" sensor. Readings should be the same ± .4 volt.

DTC 61
TURBO BOOST SENSOR CIRCUIT HIGH



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 62

TURBO BOOST SENSOR CIRCUIT LOW

Circuit Description:

The PCM sends a 5 volt reference signal to the boost sensor. As manifold pressure changes, the electrical resistance of the boost sensor also changes. By monitoring the sensor output voltage, the PCM detects how much pressure is being produced by the turbocharger in the intake manifold. The PCM uses the boost sensor to control turbo boost and fuel at different loads.

DTC 62 Will Set When: Boost signal voltage less than .8 volt.

Action Taken (PCM will default to): No turbo boost and limited fuel.

DTC 62 Will Clear When: The fault condition(s) no longer exist.

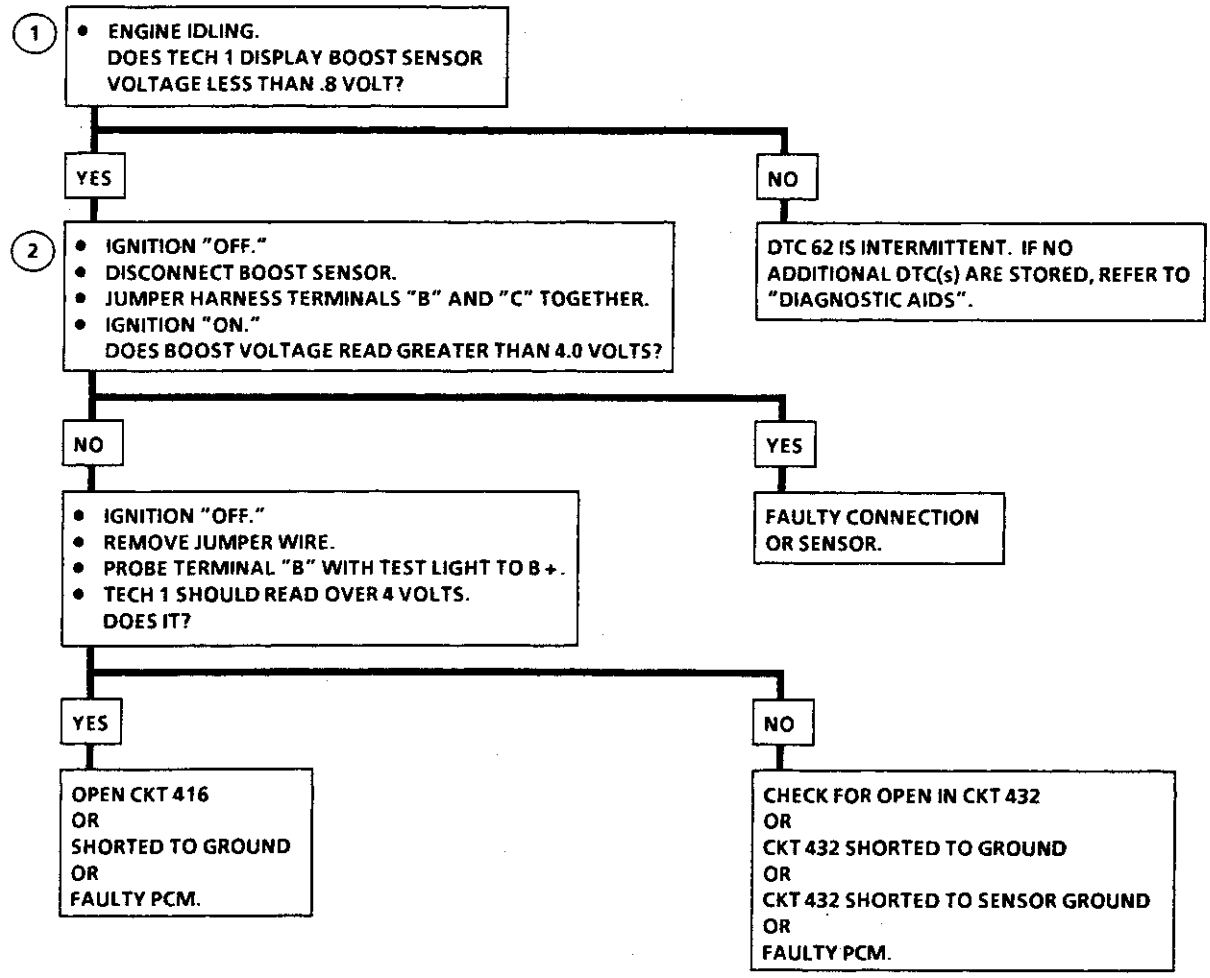
DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step will determine if DTC 62 is the result of a hard failure or an intermittent condition.
2. This step simulates conditions for a DTC 61. If the PCM recognizes the change, the PCM and CKT 416 and CKT 432 are OK.

Diagnostic Aids: With the ignition "ON" and the engine stopped, boost pressure is equal to atmospheric pressure with the signal voltage being high.

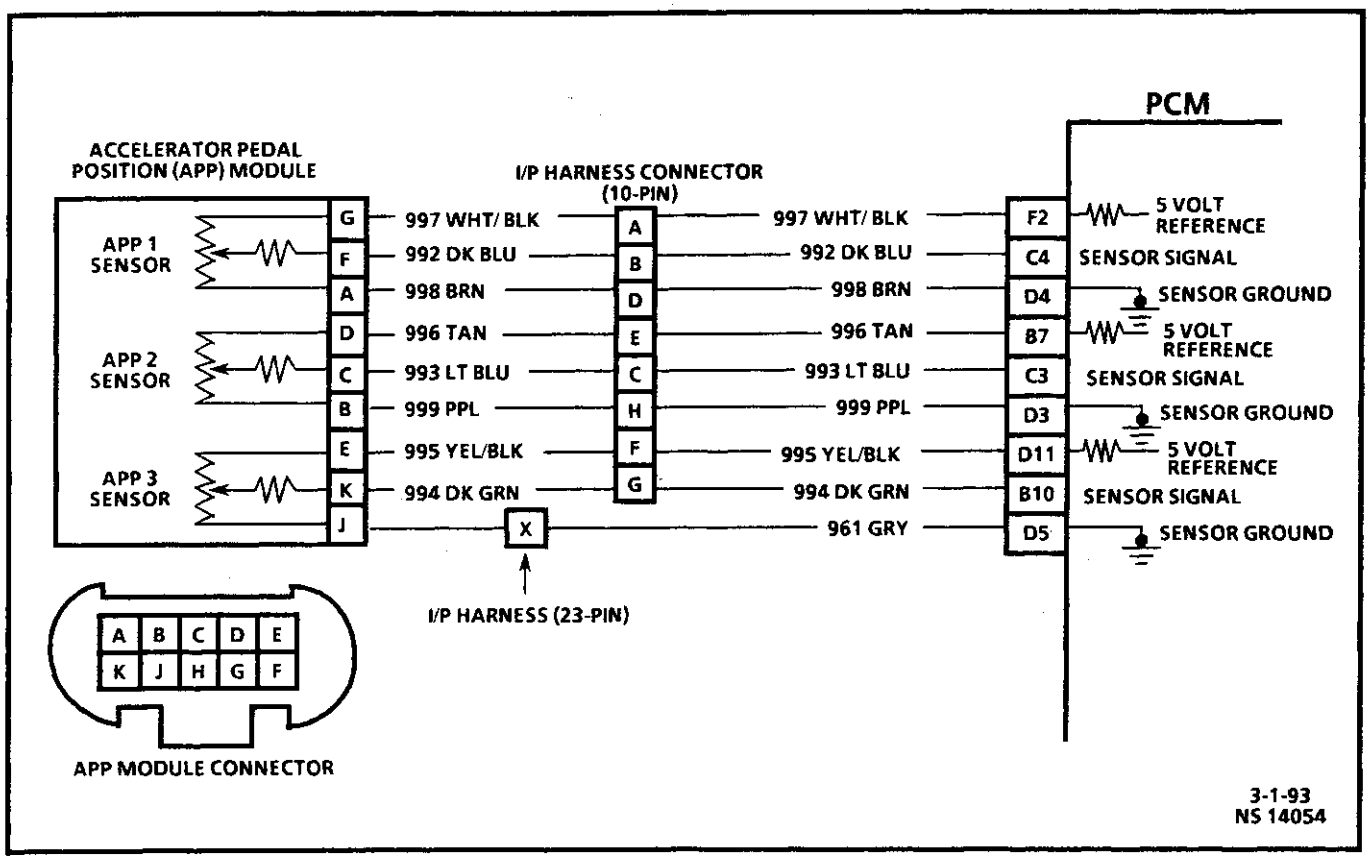
Comparison of this reading with a known good vehicle using the same sensor is a good way to check accuracy of a "suspect" sensor. Readings should be the same ± .4 volt.

DTC 62
TURBO BOOST SENSOR CIRCUIT LOW



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 63

ACCELERATOR PEDAL POSITION (APP) 3 CIRCUIT HIGH

Circuit Description:

The Accelerator Pedal Position (APP) module provides a voltage signal that changes relative to accelerator position. There are three sensors located within the APP module that are scaled differently.

DTC 63 Will Set When: Voltage is greater than 4.75 volts for 2 seconds on APP 3 sensor.

Action Taken (PCM will default to): The input from APP 3 sensor is ignored. A current and history DTC will set but it will not turn "ON" the "Service Throttle Soon" lamp. The throttle will operate normally as long as there is only one malfunction present. If two different APP sensors have a malfunction, the "Service Throttle Soon" lamp will light and the PCM will limit power. If three APP sensors have a malfunction present, the "Service Throttle Soon" lamp will light and the PCM will only allow the engine to operate at idle.

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step will determine if DTC 63 is the result of a hard failure or an intermittent condition.
2. This step checks the PCM and wiring.
3. This will check for an open in ground CKT 994 and PCM.

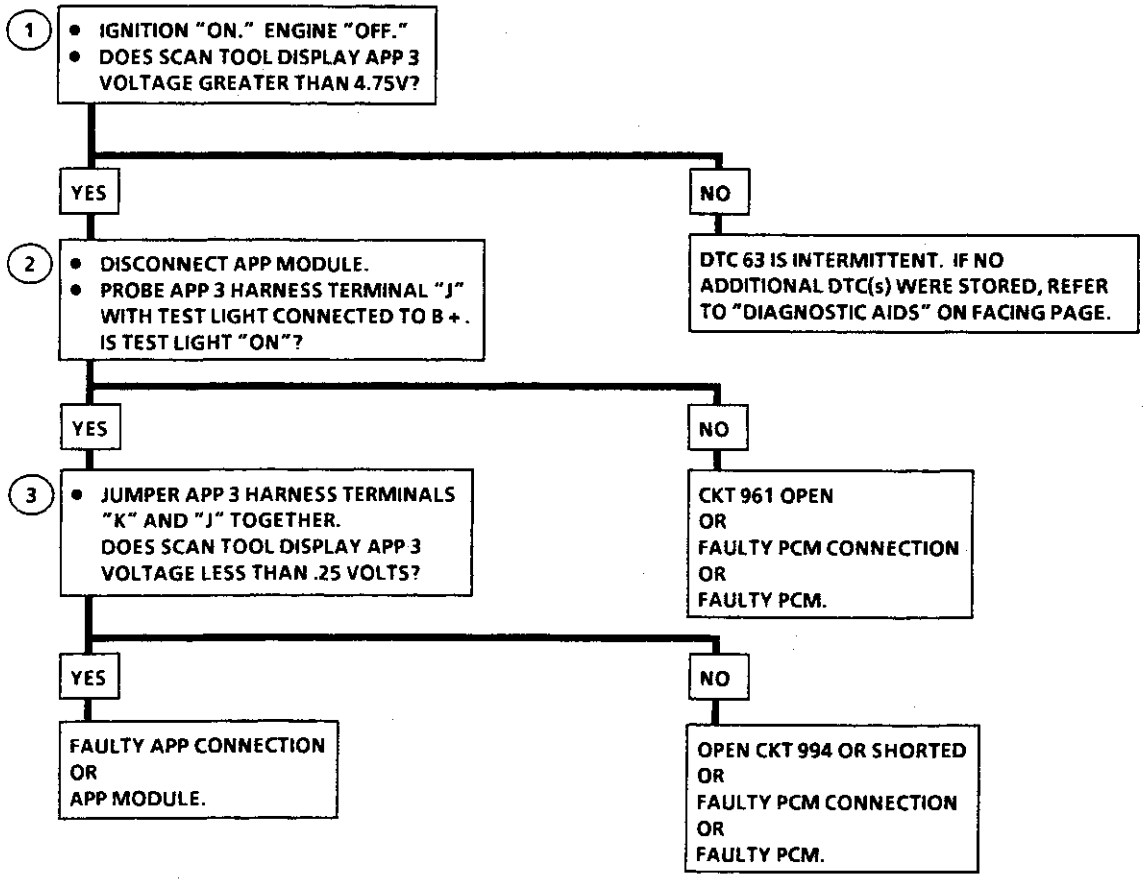
Diagnostic Aids: A scan tool reads APP 3 position in volts. Should read about 4.0 volts with throttle closed and ignition "ON" or at idle. Voltage should decrease at a steady rate as throttle is moved toward Wide Open Throttle (WOT).

Also, 90% pedal travel is acceptable for correct APP operation.

Scan APP 3 sensor while depressing accelerator pedal with engine stopped and ignition "ON." Display should vary from about 4.0 volts when throttle was closed to about 2.0 volts when throttle is held at Wide Open Throttle (WOT) position.

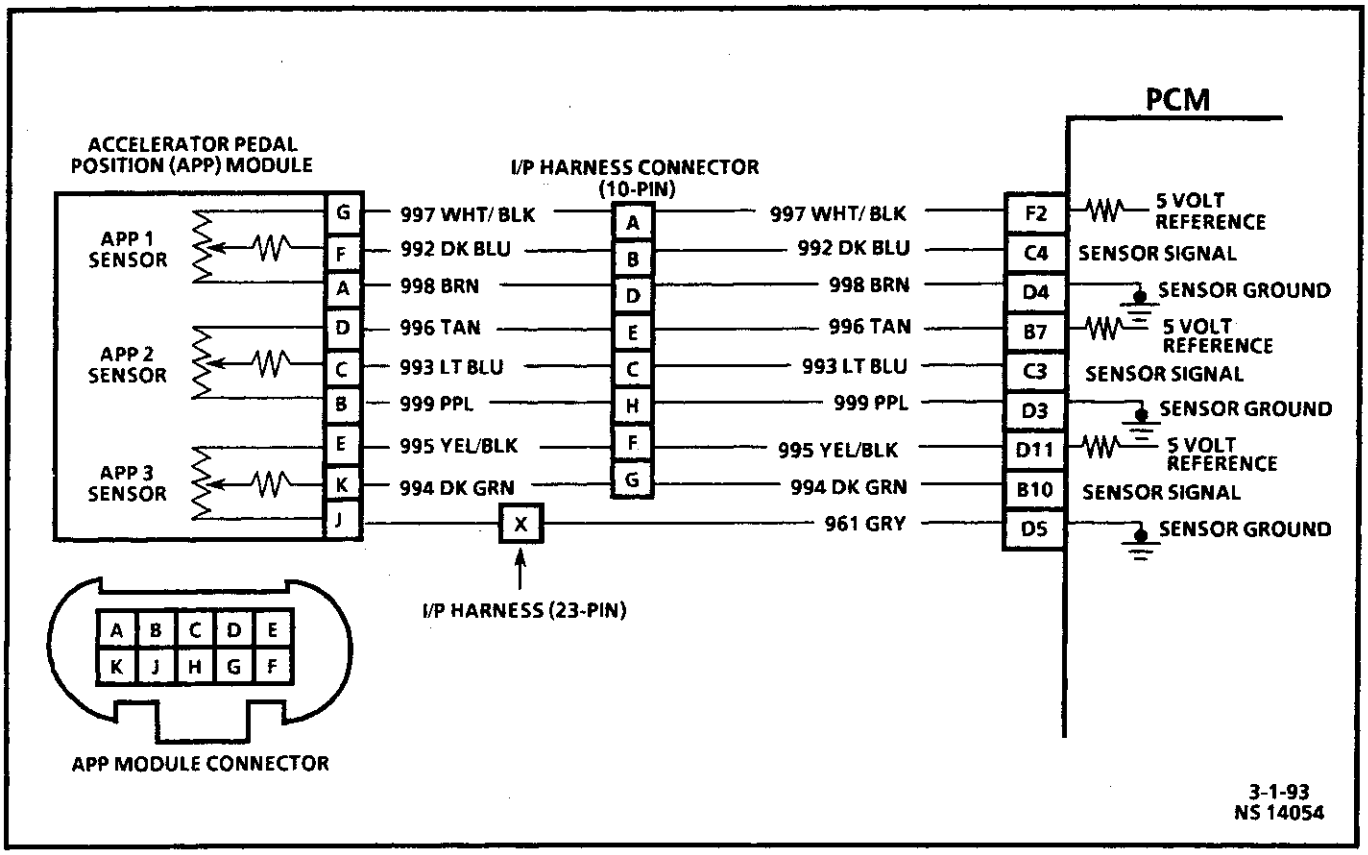
DTC 63

ACCELERATOR PEDAL POSITION (APP) 3 CIRCUIT HIGH



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 64

ACCELERATOR PEDAL POSITION (APP) 3 CIRCUIT LOW

Circuit Description:

The Accelerator Pedal Position (APP) module provides a voltage signal that changes relative to accelerator position. There are three sensors located within the APP module that are scaled differently.

DTC 64 Will Set When: Voltage is less than .25 volt for 2 seconds on APP 3 sensor.

Action Taken (PCM will default to): The input from APP 3 sensor is ignored. A current and history DTC will set but it will not turn "ON" the "Service Throttle Soon" lamp. The throttle will operate normally as long as there is only one malfunction present. If two different APP sensors have a malfunction, the "Service Throttle Soon" lamp will light and the PCM will limit power. If three APP sensors have a malfunction present, the "Service Throttle Soon" lamp will light and the PCM will only allow the engine to operate at idle.

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step will determine if DTC 64 is the result of a hard failure or an intermittent condition.
2. This step checks the PCM and wiring.
3. This will check the PCM and CKT 994.

Diagnostic Aids: A scan tool reads APP 3 position in volts. Should read about 4.0 volts with throttle closed and ignition "ON" or at idle. Voltage should decrease at a steady rate as throttle is moved toward Wide Open Throttle (WOT) position.

Also, 90% pedal travel is acceptable for correct APP operation.

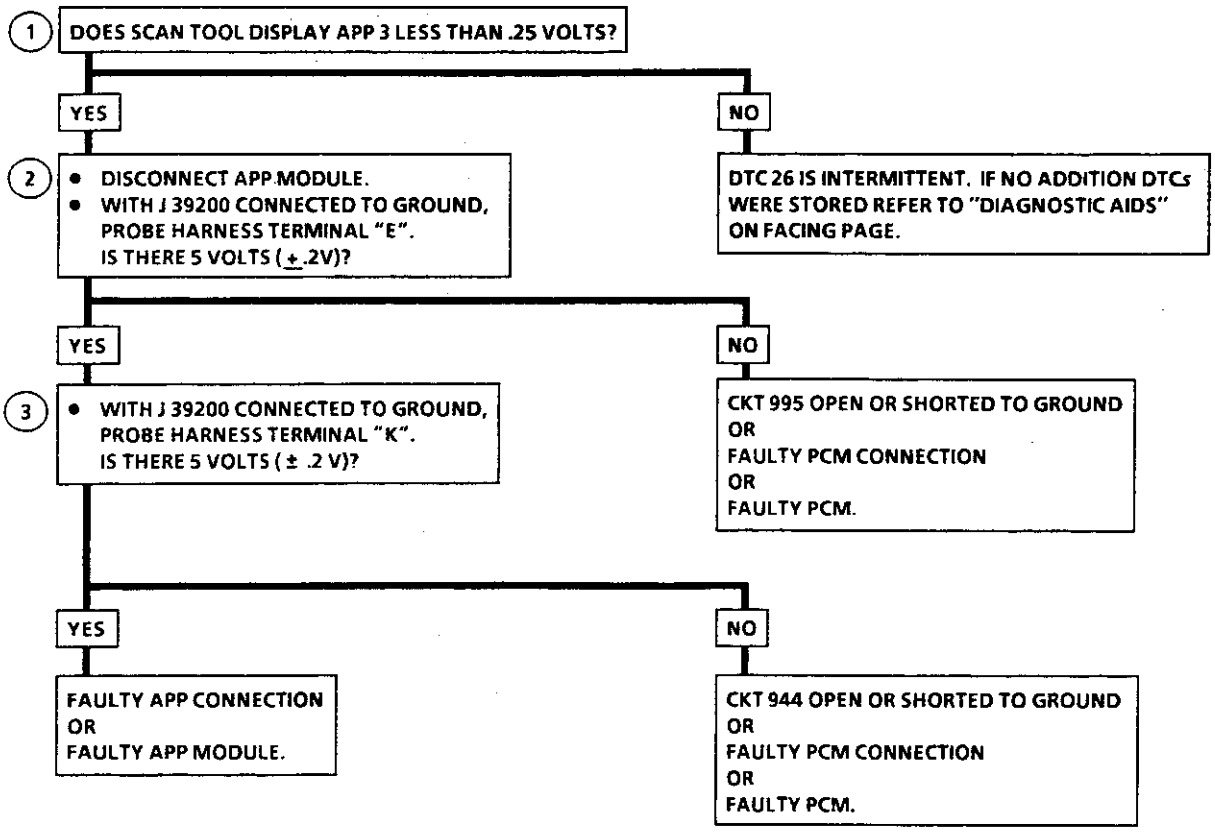
Scan APP 3 sensor while depressing accelerator pedal with engine stopped and ignition "ON." Display should vary from about 4.0 volts when throttle was closed to about 2.0 volts when throttle is held at Wide Open Throttle (WOT) position.

A DTC 64 will result if CKT 995 is open or CKT 994 is shorted to ground.

Refer to "Intermittents," in SECTION 2.

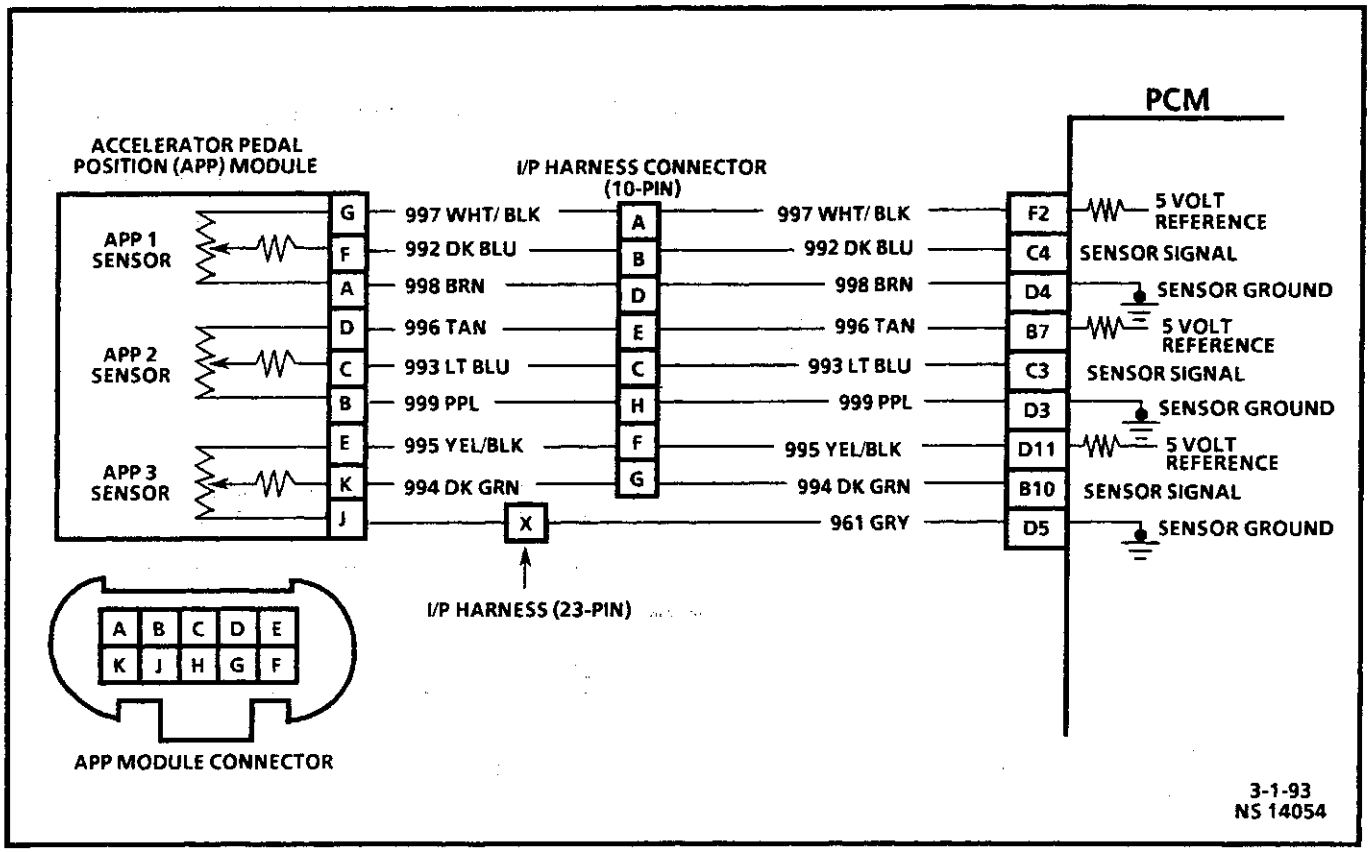
DTC 64

ACCELERATOR PEDAL POSITION (APP) 3 CIRCUIT LOW



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 65

ACCELERATOR PEDAL POSITION (APP) 3 CIRCUIT RANGE FAULT

Circuit Description:

The Accelerator Pedal Position (APP) module provides a voltage signal that changes relative to accelerator pedal position. There are three sensors located within the APP module that are scaled differently.

DTC 65 Will Set When: PCM has recognized a "skewed" (mis-scaled) sensor. The PCM compares all three sensors to each other (percentage to voltage chart) and determines if there is a 6% difference between APP 1 and APP 2 and a 10 difference to APP 3.

Action Taken (PCM will default to): The input from APP 3 sensor is ignored. A current and history DTC will set but it will not turn "ON" a "Service Throttle Soon" lamp. Throttle will operate normally as long as there is only one malfunction present. If there are two APP malfunctions present the PCM will then turn "ON" the "Service Throttle Soon" lamp and limit power. If a third APP malfunction is present the "Service Throttle Soon" lamp will be "ON" and only allow the engine to operate at idle.

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step determines if there is a good 5 volt reference.
2. This step will check the ground circuits.

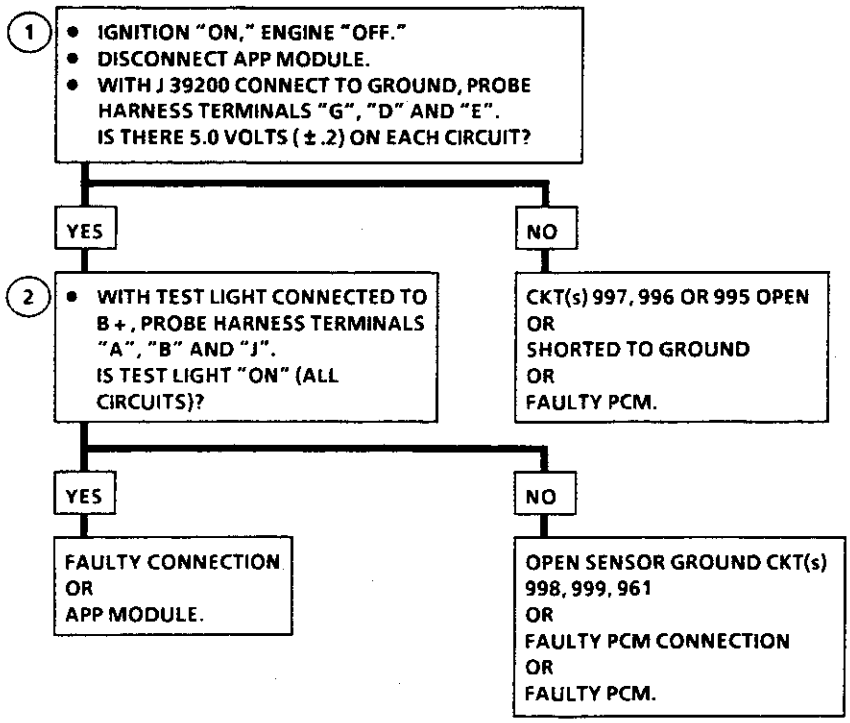
Diagnostic Aids: A scan tool reads APP 3 position in volts. Should read about 4.0 volts with throttle closed and ignition "ON" or at idle. Voltage should decrease at a steady rate as throttle is moved toward Wide Open Throttle (WOT).

Also, 90% pedal travel is acceptable for correct APP operation.

Scan APP 3 sensor while depressing accelerator pedal with engine stopped and ignition "ON." Display should vary from about 4.0 volts when throttle was closed to about 2.0 volts when throttle is held at Wide Open Throttle (WOT) position.

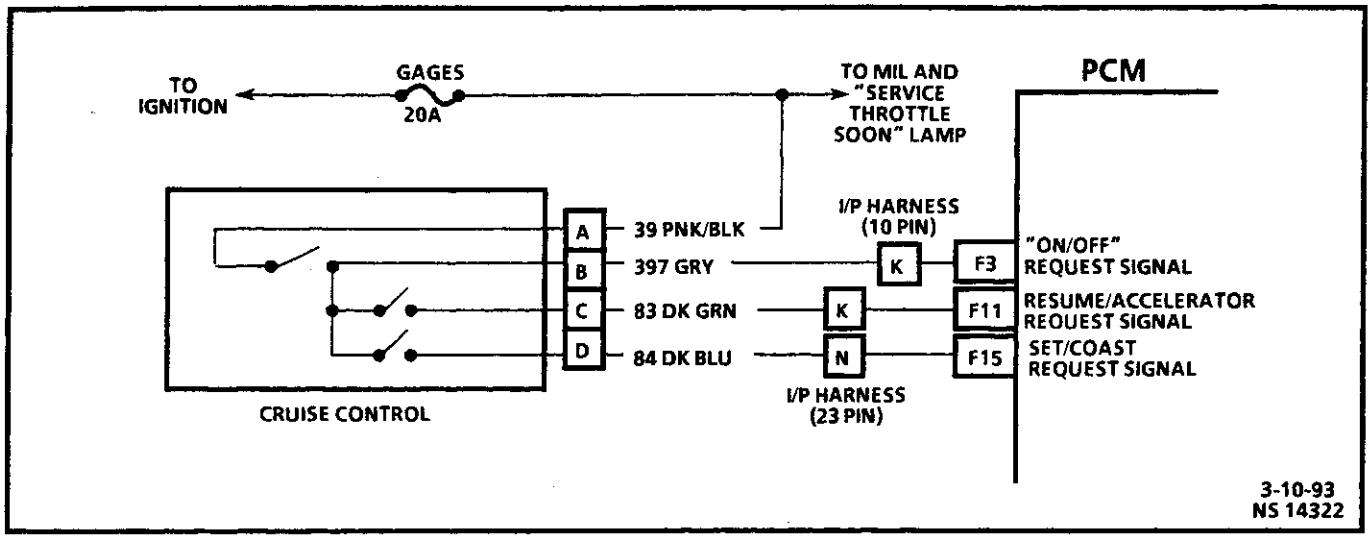
DTC 65

ACCELERATOR PEDAL POSITION (APP) 3 CIRCUIT RANGE FAULT



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 71

SET/COAST SWITCH FAULT

Circuit Description:

The cruise "ON/OFF," "set/coast" and "resume/accel" switches are inputs to the fuel control portion of the PCM. These inputs allow the PCM to control and hold a requested speed. CKT 84 supplies ignition voltage to the PCM when set/coast is depressed.

DTC 71 Will Set When:

- Cruise control "ON."
- Ignition voltage on Terminal "F15" for more than 20 seconds.

Action Taken (PCM will default to): The PCM will disallow all cruise inputs. TCC shift schedules may be affected.

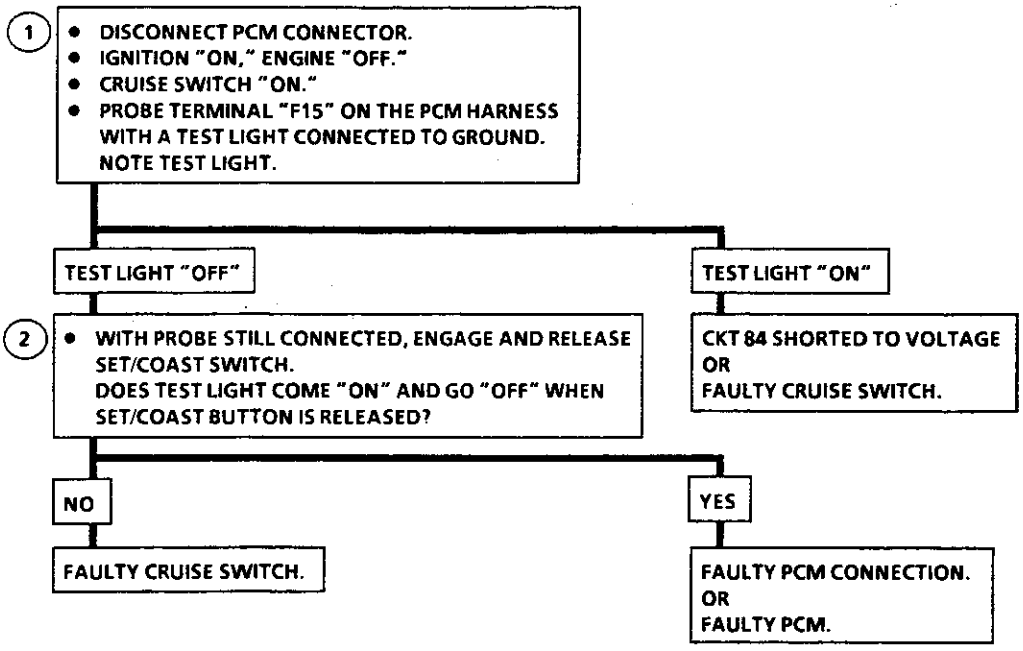
DTC 71 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step determines if the cruise control switch is OK.
2. This step determines if the PCM or switch is at fault.

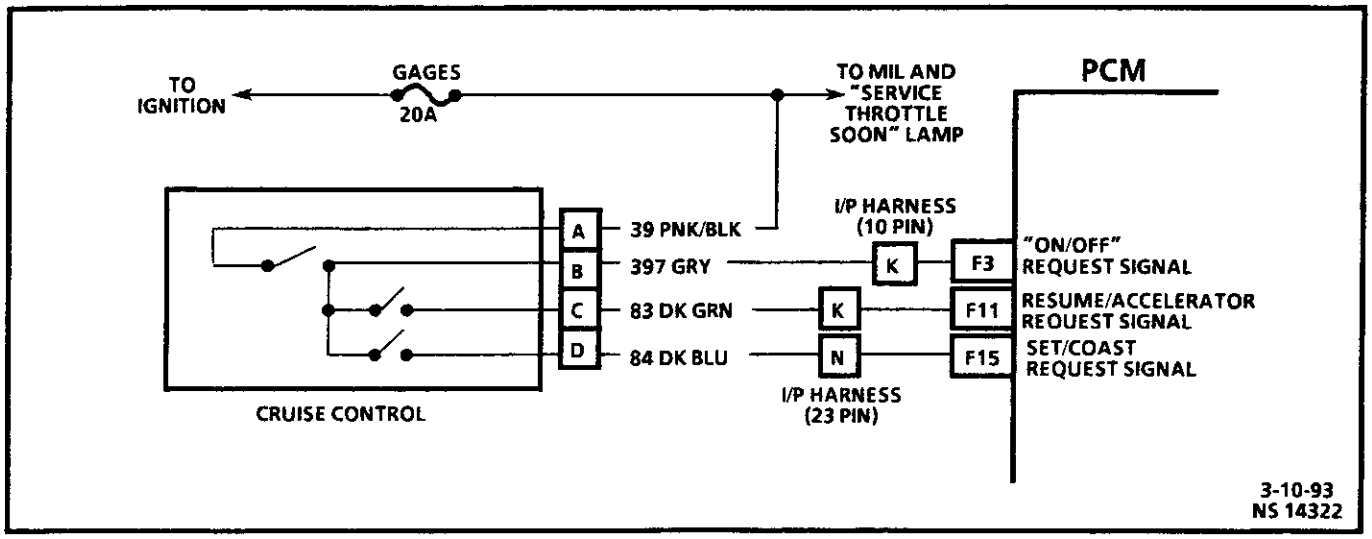
Diagnostic Aids: Check for a set/coast switch stuck in the engage position or CKT 84 shorted to voltage.

DTC 71
SET/COAST SWITCH FAULT



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 76

RESUME/ACCEL SWITCH FAULT

Circuit Description:

The cruise "ON/OFF," "set/coast" and "resume/accel" switches are inputs to the fuel control portion of the PCM. These inputs allow the PCM to control and hold a requested speed. CKT 83 supplies ignition voltage to the PCM.

DTC 76 Will Set When:

- Cruise control "ON."
- Ignition voltage on Terminal "F11" for more than 20 seconds.

Action Taken (PCM will default to): The PCM will disallow all cruise inputs. TCC shift schedules may be affected.

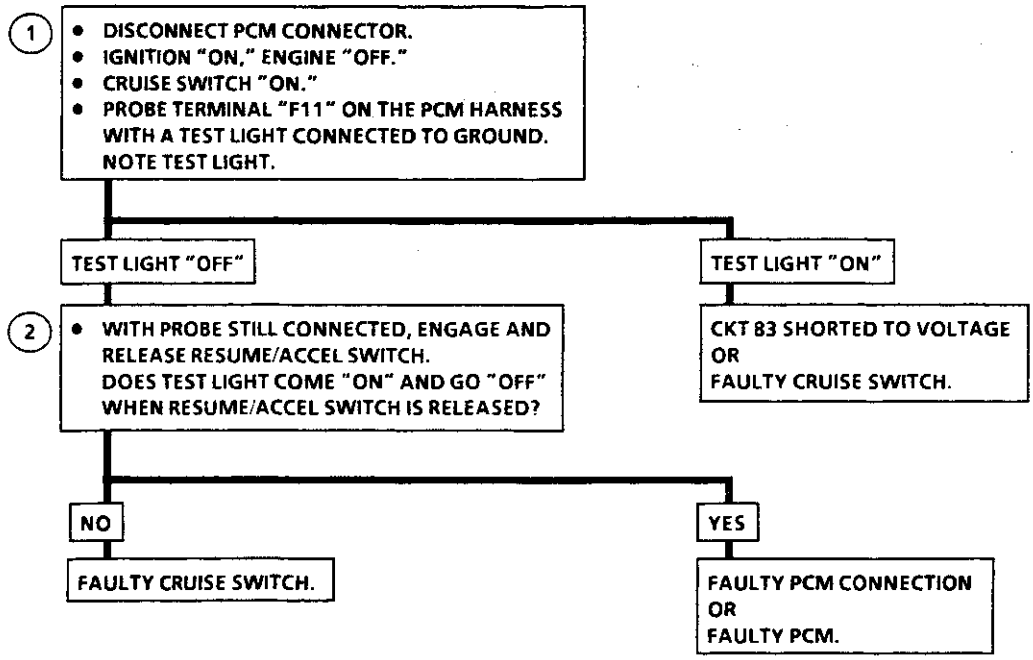
DTC 76 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step determines if CKT 83 is shorted to voltage.
2. This step determines if the PCM or switch is at fault.

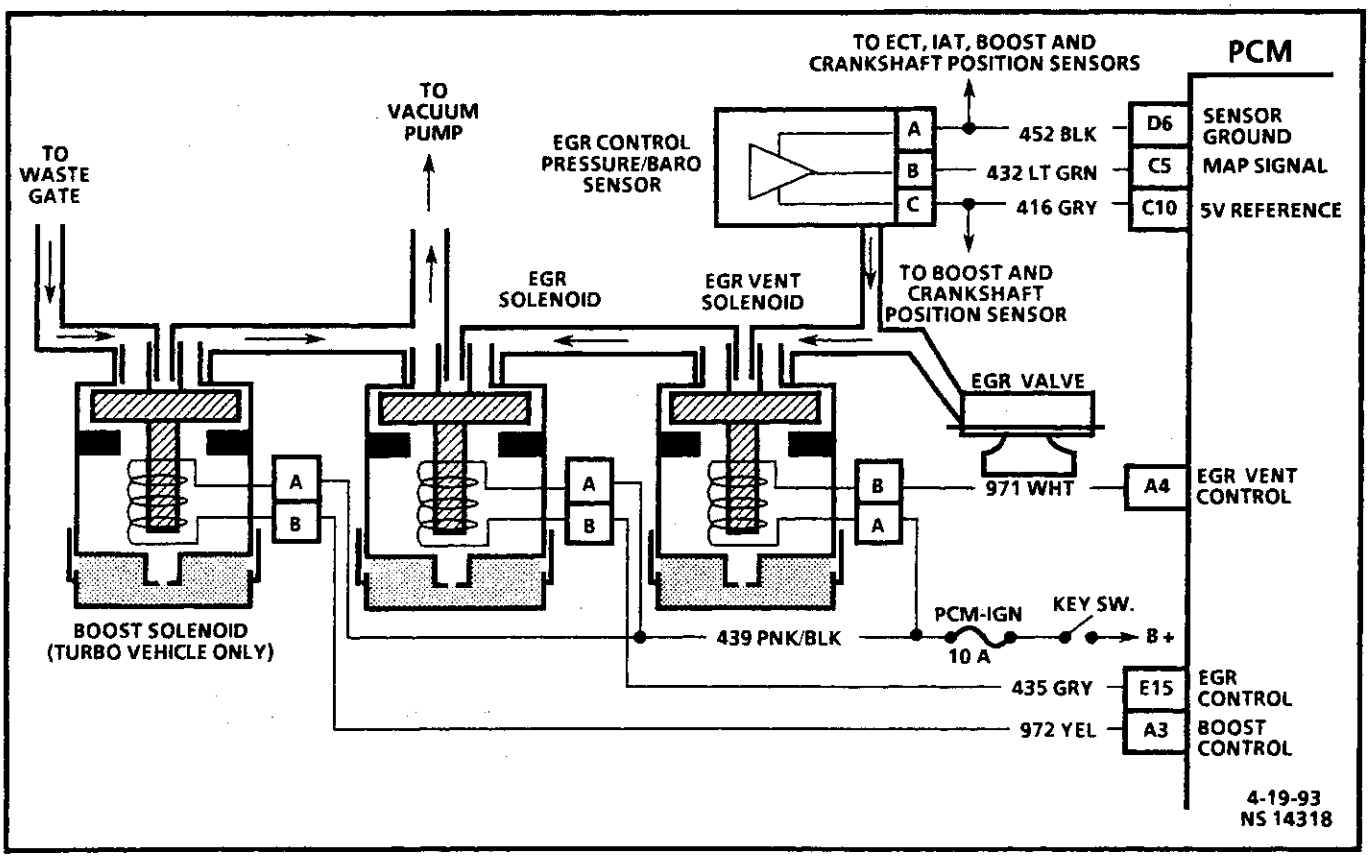
Diagnostic Aids: Check for a set/coast switch stuck in the engage position or CKT 83 shorted to voltage.

DTC 76
RESUME/ACCEL SWITCH FAULT



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 78

WASTEGATE SOLENOID FAULT

Circuit Description:

The PCM operates a solenoid to control boost. This solenoid is normally open. By providing a ground path the PCM energizes the solenoid which then allows vacuum to pass to the wastegate valve.

During normal operation, the PCM compares its wastegate duty cycle signal with the boost signal and makes corrections in the duty cycle accordingly.

DTC 78 Will Set When:

- RPM greater than 1800.
- Fuel rate greater than 20 mm.
- Boost pressure greater than or less than desired (internal to PCM).

Action Taken (PCM will default to): Boost will shut down. Reduce maximum fuel.

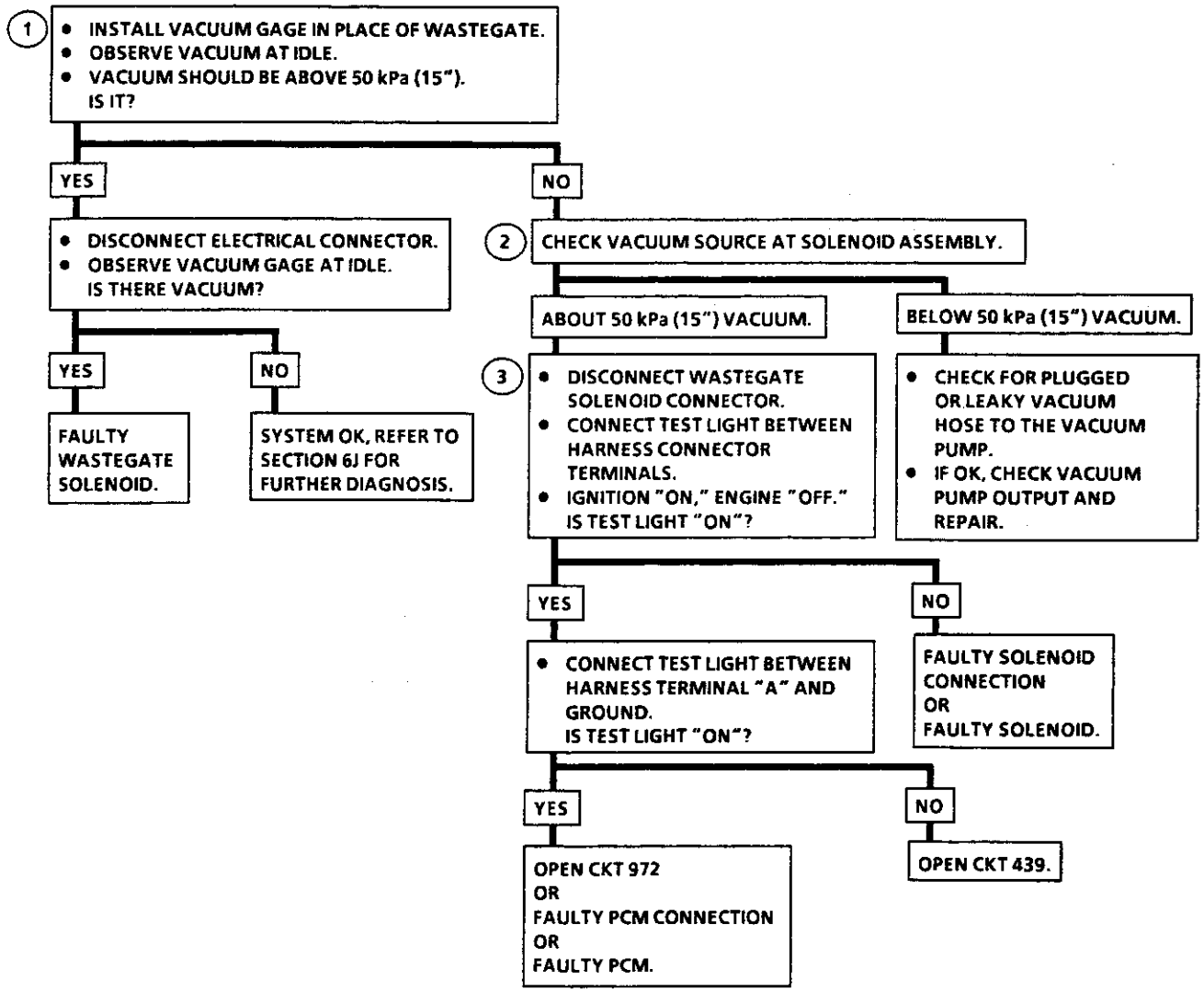
DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step will check for a good vacuum source.
2. This step will check for a faulty vacuum line or pump.
3. This step checks the solenoid wiring.

Diagnostic Aids: A vacuum leak or a pinched vacuum line may cause a DTC 78. Check all vacuum lines and components connected to the hoses for leaks or sharp bends.

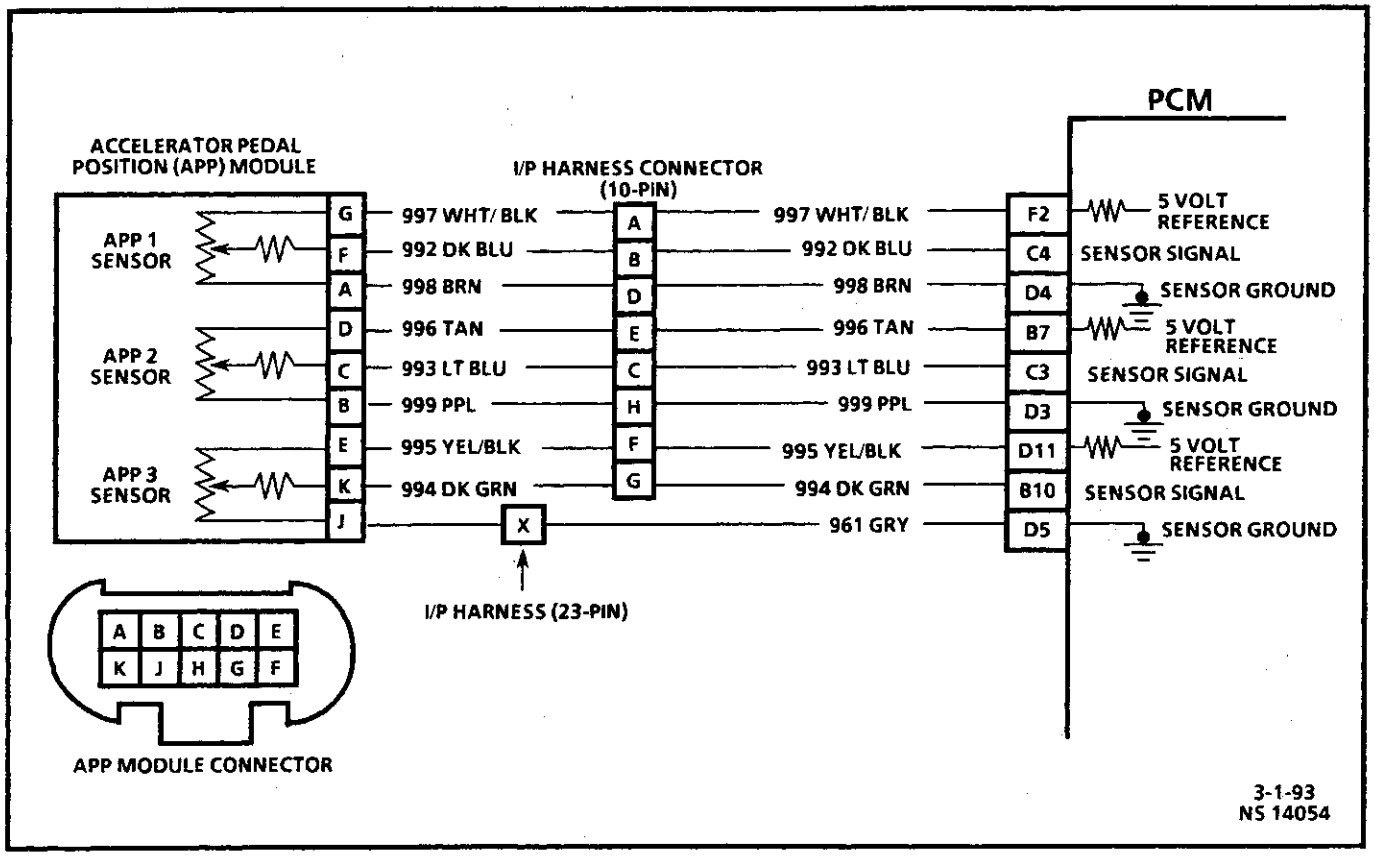
Check vacuum source. A possible DTC 32 will store if there is a problem with the vacuum source.

DTC 78
WASTEGATE SOLENOID FAULT



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.



DTC 84

ACCELERATOR PEDAL POSITION (APP) CIRCUIT FAULT

Circuit Description:

The Accelerator Pedal Position (APP) module provides a voltage signal that changes relative to accelerator position. There are three sensors located within the APP module that are scaled differently.

DTC 84 Will Set When: PCM has recognized an intermittent APP fault and there are no other current APP faults stored.

Action Taken (PCM will default to): When DTC 84 is set, a current and history DTC will set, but will not light the "Service Throttle Soon" lamp, and the vehicle will operate at limited power.

DTC 84 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step determines if DTC 84 is a hard failure or an intermittent condition.

Diagnostic Aids: Check for faulty connections at APP module, PCM and I/P connector.

DTC 84

ACCELERATOR PEDAL POSITION (APP) CIRCUIT FAULT

(1)
- CHECK COMPLETE APP HARNESS FOR INTERMITTENT SHORTS OR OPENS.
- IF OK, REPLACE APP MODULE.
- IF DTC RESETS, REPLACE PCM.

IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

DTC 88
TDC OFFSET ERROR

DTC 88
TDC OFFSET ERROR

THIS DTC INDICATES THERE IS A PUMP TIMING PROBLEM.

- THIS DTC WILL SET IF TDC OFFSET IS GREATER THAN ± 2.0°, OR THE PCM HAS LOST MEMORY (TDC OFFSET IS STORED IN PCM MEMORY).
- CHECK INJECTION PUMP TIMING, IF OK, REFER TO "ON-VEHICLE SERVICE" TDC OFFSET.

DTC 91
CYLINDER BALANCE FAULT

- IF ANY OTHER DTC(s) ARE STORED, DIAGNOSE THEM FIRST.
- DTC 91 INDICATES THERE IS A POSSIBLE MECHANICAL ERROR WITH CYLINDER #1.
- DTC 91 WILL NOT TURN ON THE MIL, BUT WILL BE STORED AS A CURRENT AND HISTORY DTC.

DTC 92
CYLINDER BALANCE FAULT

- IF ANY OTHER DTC(s) ARE STORED, DIAGNOSE THEM FIRST.
- DTC 92 INDICATES THERE IS A POSSIBLE MECHANICAL ERROR WITH CYLINDER #2.
- DTC 92 WILL NOT TURN ON THE MIL, BUT WILL BE STORED AS A CURRENT AND HISTORY DTC.

DTC 93
CYLINDER BALANCE FAULT

- IF ANY OTHER DTC(s) ARE STORED, DIAGNOSE THEM FIRST.
- DTC 93 INDICATES THERE IS A POSSIBLE MECHANICAL ERROR WITH CYLINDER #3.
- DTC 93 WILL NOT TURN ON THE MIL, BUT WILL BE STORED AS A CURRENT AND HISTORY DTC.

DTC 94
CYLINDER BALANCE FAULT

- IF ANY OTHER DTC(s) ARE STORED, DIAGNOSE THEM FIRST.
- DTC 94 INDICATES THERE IS A POSSIBLE MECHANICAL ERROR WITH CYLINDER #4.
- DTC 94 WILL NOT TURN ON THE MIL, BUT WILL BE STORED AS A CURRENT AND HISTORY DTC.

CONT'D

DTC 95
CYLINDER BALANCE FAULT

- IF ANY OTHER DTC(s) ARE STORED, DIAGNOSE THEM FIRST.
- DTC 95 INDICATES THERE IS A POSSIBLE MECHANICAL ERROR WITH CYLINDER #5.
- DTC 95 WILL NOT TURN ON THE MIL, BUT WILL BE STORED AS A CURRENT AND HISTORY DTC.

DTC 96
CYLINDER BALANCE FAULT

- IF ANY OTHER DTC(s) ARE STORED, DIAGNOSE THEM FIRST.
- DTC 96 INDICATES THERE IS A POSSIBLE MECHANICAL ERROR WITH CYLINDER #6.
- DTC 96 WILL NOT TURN ON THE MIL, BUT WILL BE STORED AS A CURRENT AND HISTORY DTC.

DTC 97
CYLINDER BALANCE FAULT

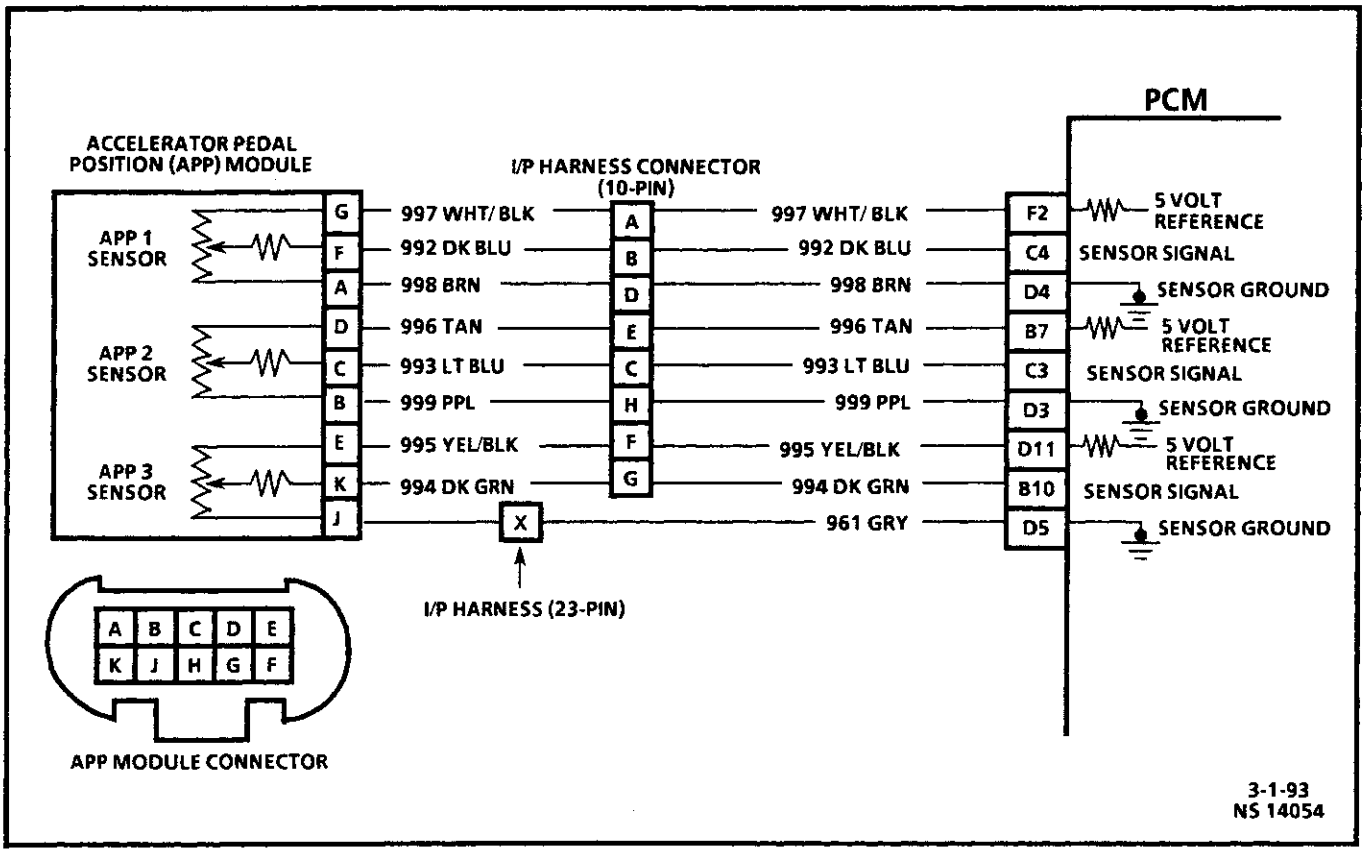
- IF ANY OTHER DTC(s) ARE STORED, DIAGNOSE THEM FIRST.
- DTC 97 INDICATES THERE IS A POSSIBLE MECHANICAL ERROR WITH CYLINDER #7.
- DTC 97 WILL NOT TURN ON THE MIL, BUT WILL BE STORED AS A CURRENT AND HISTORY DTC.

DTC 98
CYLINDER BALANCE FAULT

- IF ANY OTHER DTC(s) ARE STORED, DIAGNOSE THEM FIRST.
- DTC 98 INDICATES THERE IS A POSSIBLE MECHANICAL ERROR WITH CYLINDER #8.
- DTC 98 WILL NOT TURN ON THE MIL, BUT WILL BE STORED AS A CURRENT AND HISTORY DTC.

2-11-93
PS 16755

BLANK



DTC 99

ACCELERATOR PEDAL POSITION (APP) 2 5 VOLT REFERENCE FAULT

Circuit Description:

The Accelerator Pedal Position (APP) module provides a voltage signal that changes relative to accelerator pedal position. There are three sensors located within the APP module that are scaled differently.

DTC 99 Will Set When: Reference voltage on APP 2 below 4.8 volts for 2 seconds.

Action Taken (PCM will default to): If DTC 99 is present, the PCM will turn "ON" the "Service Throttle Soon" lamp and limit power.

DTC 99 Will Clear When: The fault condition(s) no longer exist, and the ignition switch is cycled "OFF" then "ON."

DTC Chart Test Description: Number(s) below refer to circled number(s) on the diagnostic chart.

1. This step will determine if there is a good 5 volt reference.

Diagnostic Aids: A Tech 1 scan tool reads APP 2 position in volts. It should read about 4.5 volts with throttle closed and ignition "ON" or at idle. Voltage should decrease at a steady rate as throttle is moved toward Wide Open Throttle (WOT).

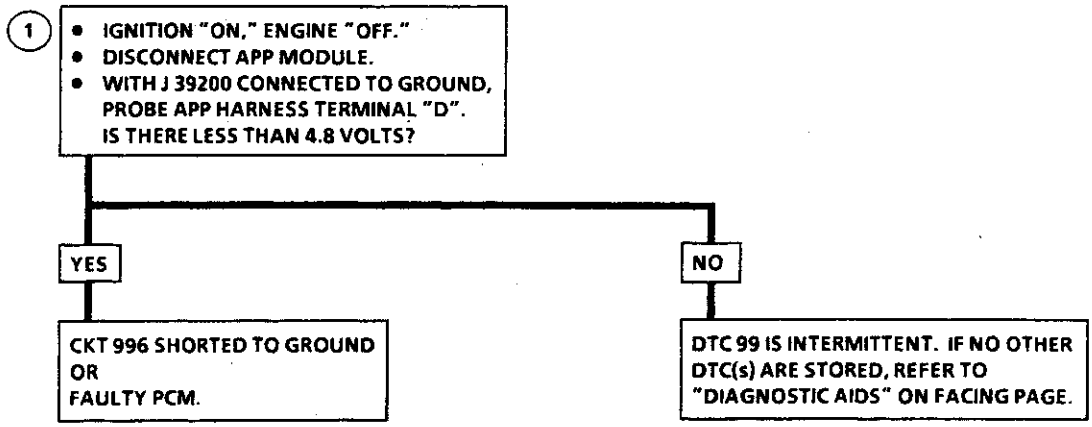
A short to ground in CKT 996 will result in a DTC 99.

Refer to SECTION 2 for "Intermittents."

Scan APP 2 signal while depressing accelerator pedal with engine stopped and ignition "ON." Display should vary from about 4.5 volts when throttle was closed, to about 1.5 volts when throttle is held at Wide Open Throttle (WOT) position.

DTC 99

ACCELERATOR PEDAL POSITION (APP) 2 5 VOLT REFERENCE FAULT



IF PCM IS FAULTY AND MUST BE REPLACED, "TDC OFFSET" MUST BE PROGRAMMED INTO THE NEW PCM. REFER TO "ON-VEHICLE SERVICE" IN THIS SECTION.

WHEN ALL DIAGNOSIS AND REPAIRS ARE COMPLETED, CLEAR DTC(s) AND VERIFY PROPER OPERATION.

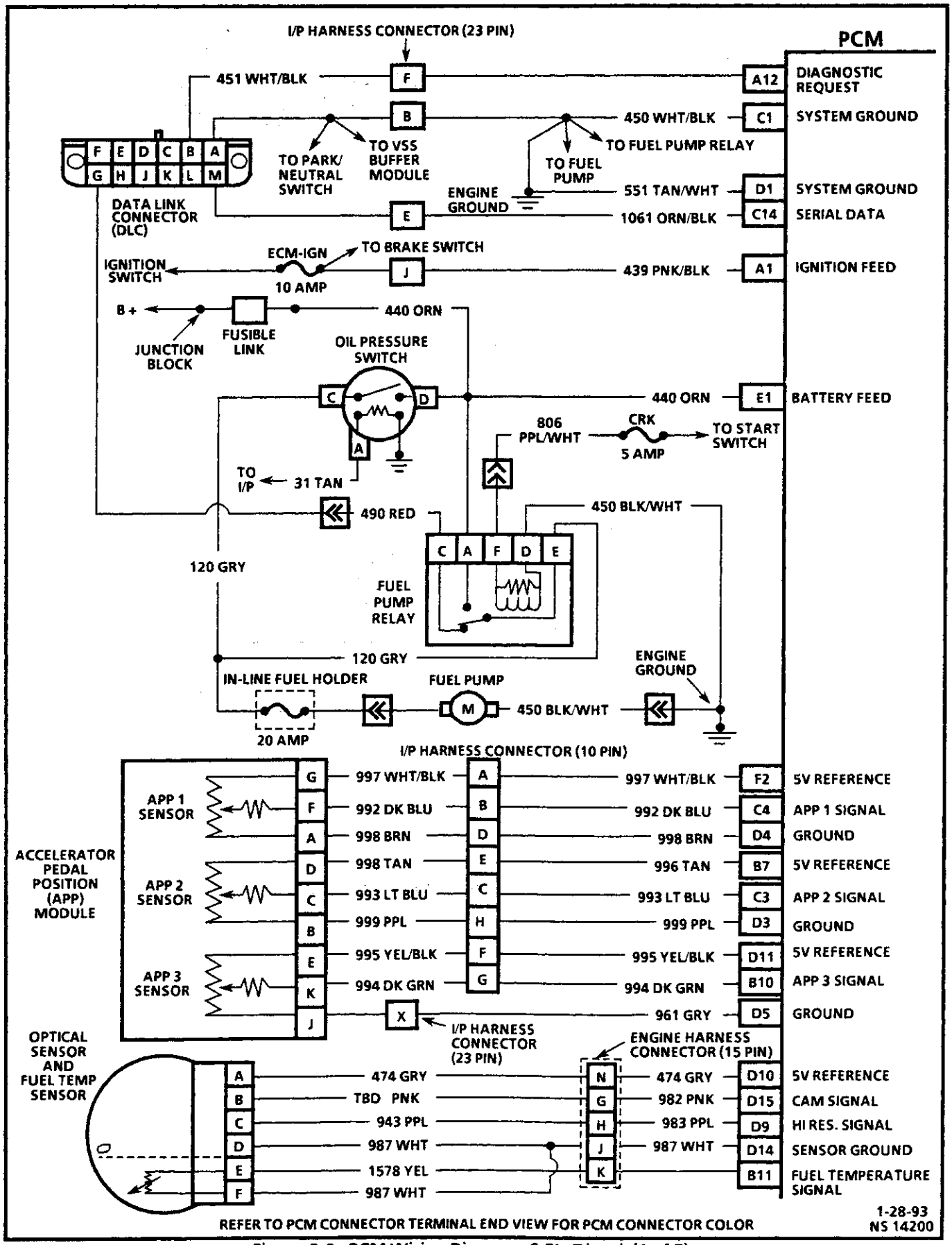


Figure 3-9 - PCM Wiring Diagram 6.5L Diesel (1 of 7)

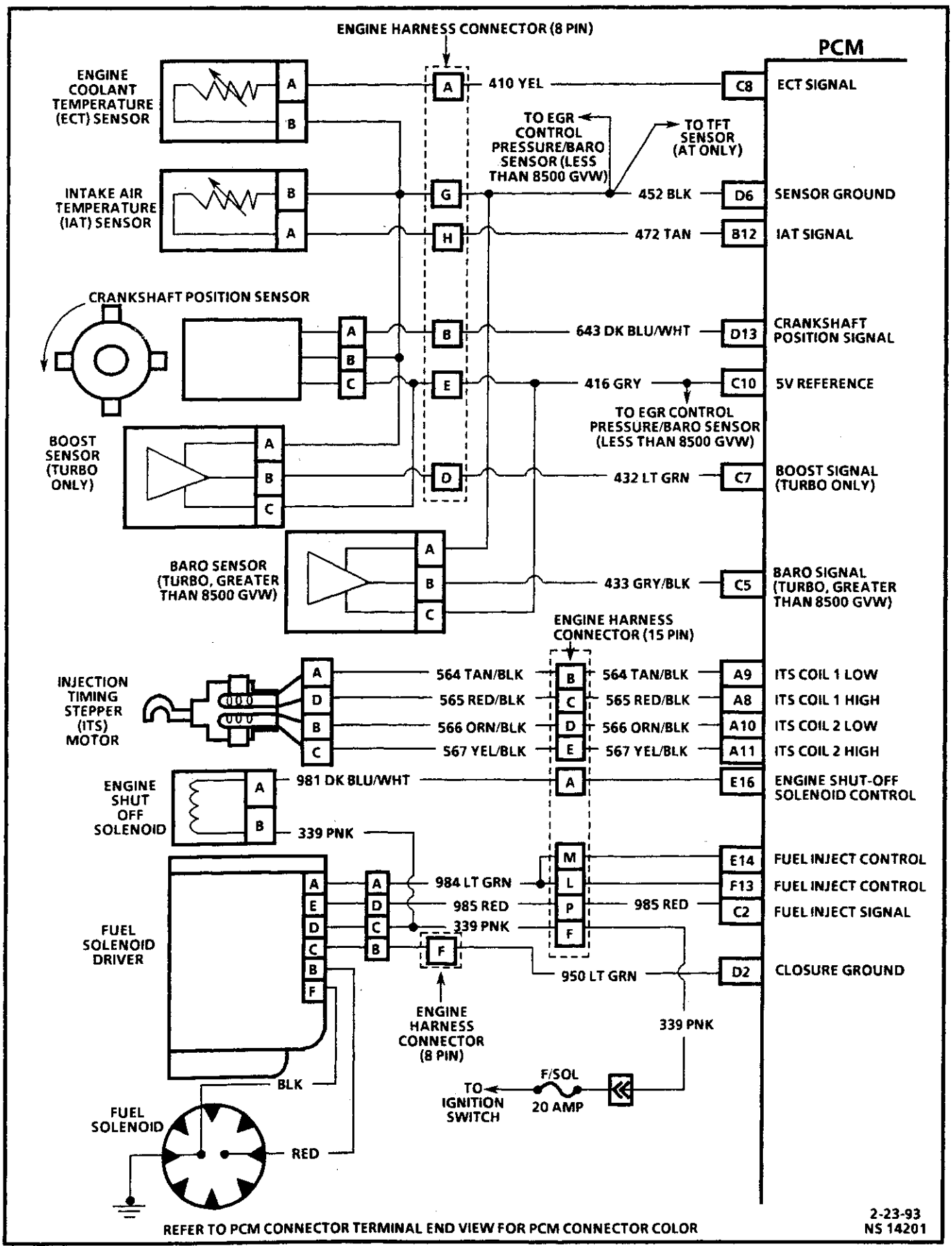


Figure 3-10 - PCM Wiring Diagram 6.5L Diesel (2 of 7)

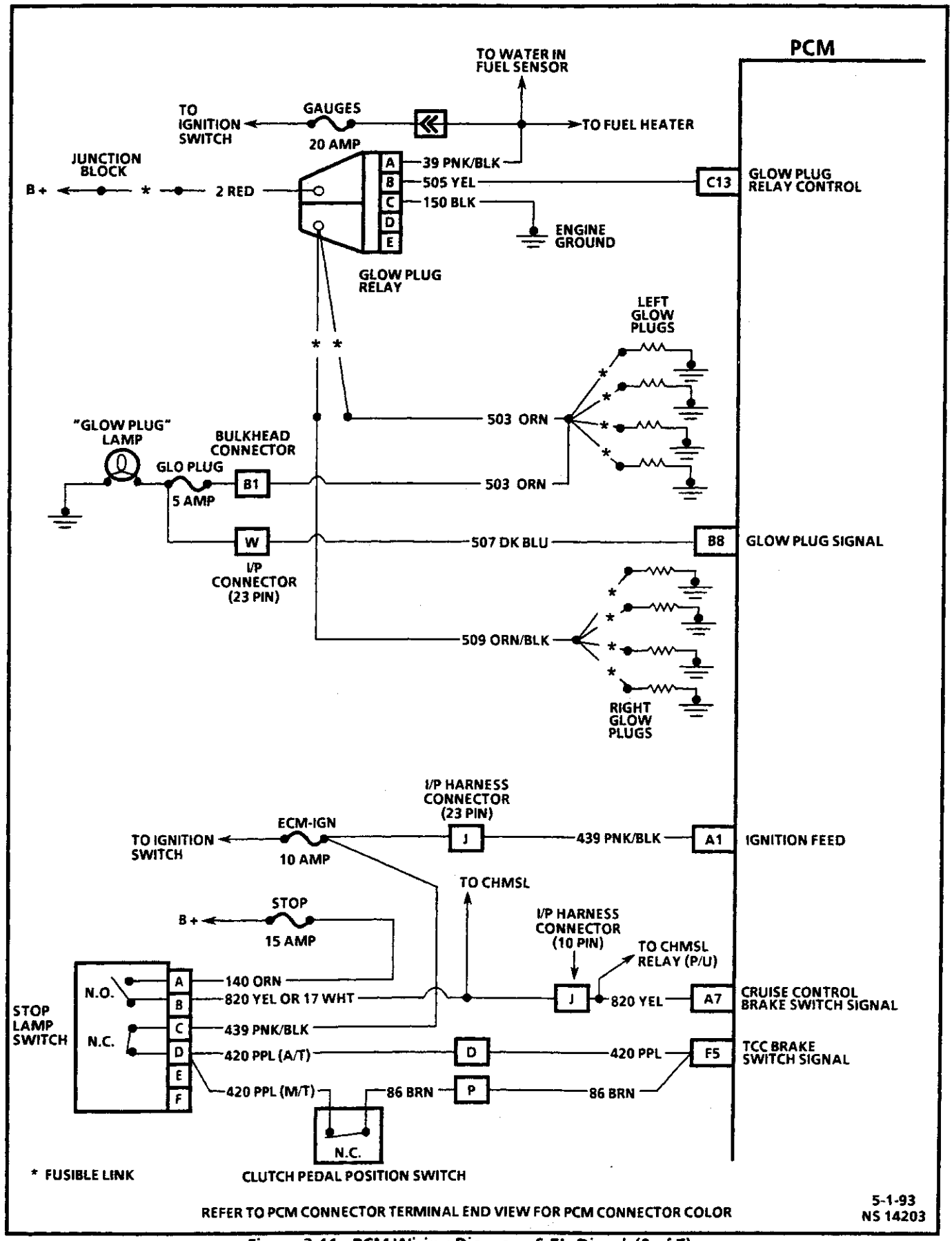


Figure 3-11 - PCM Wiring Diagram 6.5L Diesel (3 of 7)

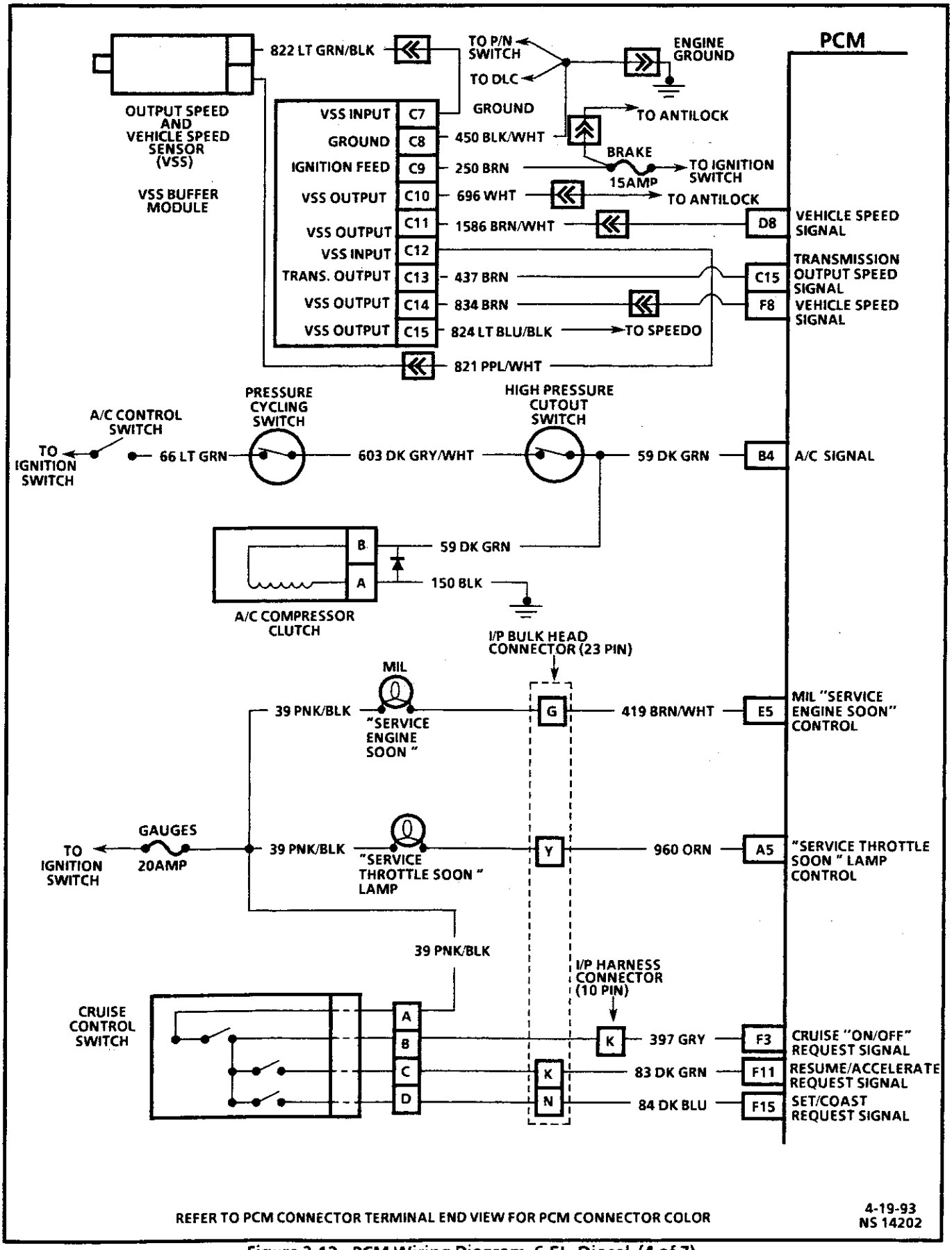


Figure 3-12 - PCM Wiring Diagram 6.5L Diesel (4 of 7)

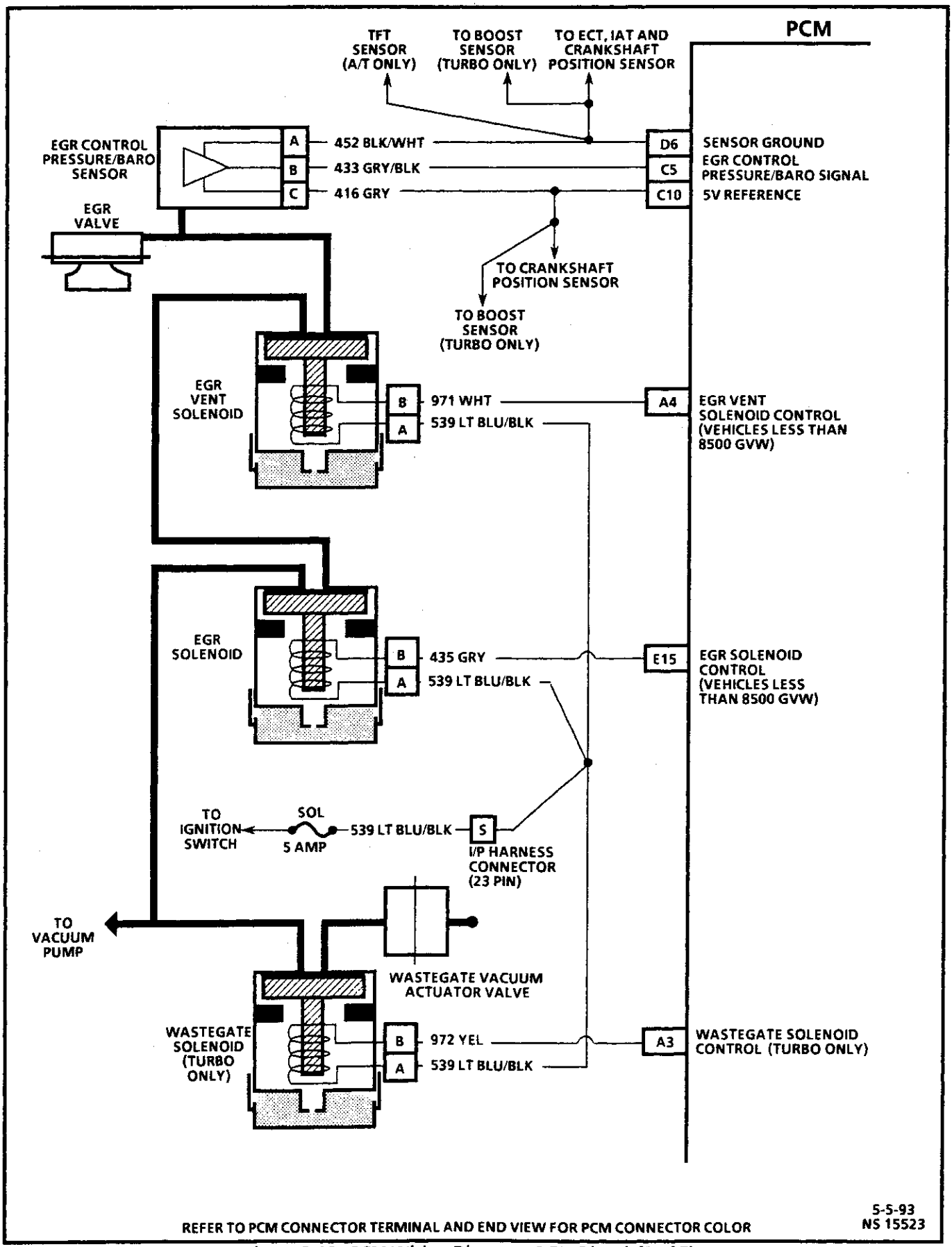


Figure 3-13 - PCM Wiring Diagram 6.5L Diesel (5 of 7)

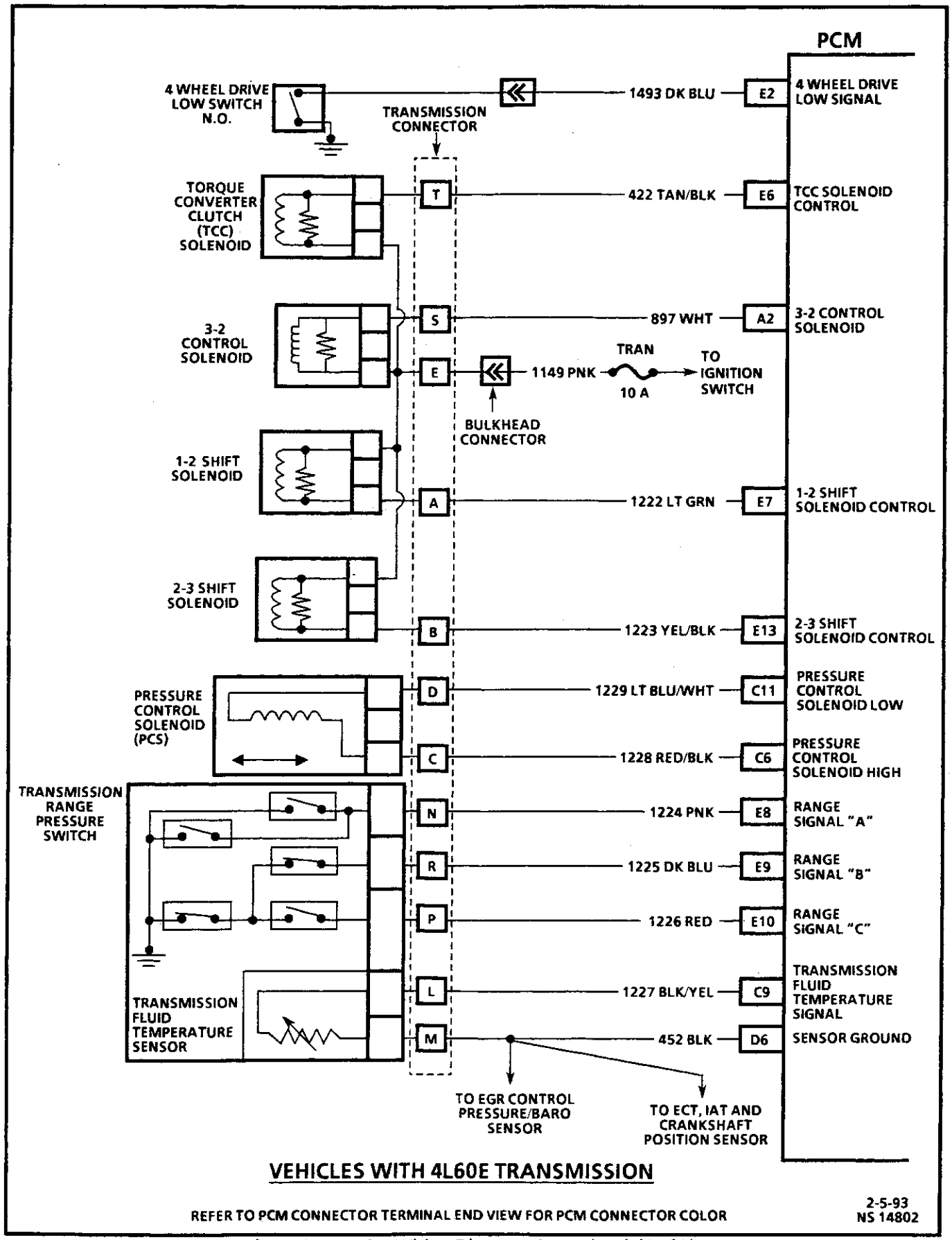


Figure 3-14 - PCM Wiring Diagram 6.5L Diesel (6 of 7)

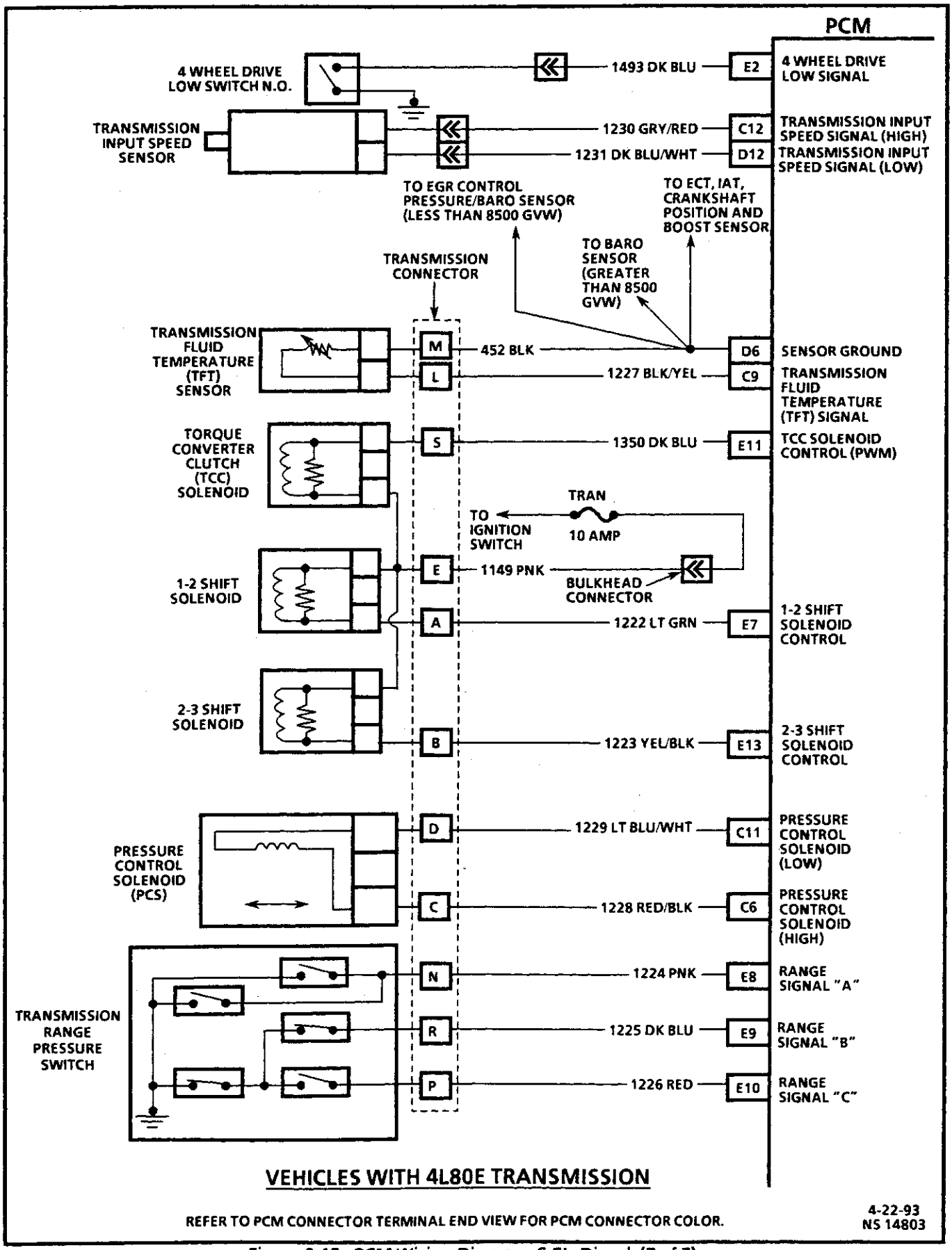


Figure 3-15 - PCM Wiring Diagram 6.5L Diesel (7 of 7)

PCM Connector and Driveability Symptoms Identification

This PCM voltage chart is for use with a J 39200 to further aid in diagnosis. These voltages were derived from a known good vehicle. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

The "B + " symbol indicates a nominal system voltage of 12-14 volts.

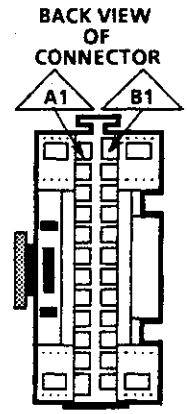
THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

• Engine at operating temperature • Engine idling (for "Engine Operating" column)
• Test terminal not grounded • Scan tool not installed

PINK 24 PIN A-B CONNECTOR

PIN	PIN FUNCTION	CKT #	WIRE COLOR	NORMAL VOLTAGE		DTC(s) AFFECTED	POSSIBLE SYMPTOMS
				KEY "ON"	ENGINE OPERATING		
A1	IGNITION FEED	439	PNK/BLK	B +	B +	-	NO START
A2	3-2 CONTROL SOLENOID CONTROL Δ	897	WHT	B +	B +	66	3rd GEAR ONLY
A3	WASTEGATE SOLENOID CONTROL ▸	972	YEL	B +	B +	62	NO TURBO BOOST
A4	EGR VENT SOLENOID CONTROL (VIN P, VIN S)	971	LT BLU	B +	B +	31, 45	NO EGR
A5	SERVICE THROTTLE SOON LAMP CONTROL	960	YEL	(4)	(4)	49	NO SERVICE THROTTLE SOON LAMP
A6	NOT USED			-	-	-	-
A7	CRUISE CONTROL BRAKE SWITCH SIGNAL	820	YEL	0	0	37, 38, 41	NO BRAKE LIGHTS
A8	ITS COIL 1 HIGH	565	RED/BLK	.9V	B +	34	POOR PERFORMANCE
A9	ITS COIL 1 LOW	564	TAN/BLK	B +	.9V	34	POOR PERFORMANCE
A10	ITS COIL 2 LOW	566	ORN/BLK	B +	.9V	34	POOR PERFORMANCE
A11	ITS COIL 2 HIGH	567	YEL/BLK	.9V	B +	34	POOR PERFORMANCE
A12	DIAGNOSTIC REQUEST	451	WHT/BLK	5V	5V	NONE	-

(1) VARIES.
(2) OPEN CIRCUIT.
(3) GROUNDED CIRCUIT.
(4) OPEN/GROUNDED CIRCUIT.
(5) LESS THAN 1 VOLT.
(6) LESS THAN .5 VOLT (500 mV).
Δ 4L60E.
▸ TURBO CHARGED.



VEHICLE: C/K TRUCK
ENGINE: 6.5L DIESEL VIN P (L49)
VIN S (L56)
VIN F (L65)
TRANSMISSION: 4L60E, 4L80E AND MANUAL

5-1-93
NS 14549

Figure 3-16 - PCM Connector Terminal End View (1 of 6)

PCM Connector and Driveability Symptoms Identification

This PCM voltage chart is for use with a J 39200 to further aid in diagnosis. These voltages were derived from a known good vehicle. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

The "B + " symbol indicates a nominal system voltage of 12-14 volts.

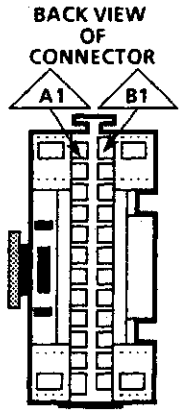
THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

• Engine at operating temperature • Engine idling (for "Engine Operating" column)
• Test terminal not grounded • Scan tool not installed

PINK 24 PIN A-B CONNECTOR

PIN	PIN FUNCTION	CKT #	WIRE COLOR	NORMAL VOLTAGE		DTC(s) AFFECTED	POSSIBLE SYMPTOMS
				KEY "ON"	ENGINE OPERATING		
B1	NOT USED	-	-	-	-	-	-
B2	NOT USED	-	-	-	-	-	-
B3	NOT USED	-	-	-	-	-	-
B4	A/C SIGNAL	59	DK GRN	0*Δ	0*Δ	NONE	A/C STATUS
B5	NOT USED	-	-	-	-	-	-
B6	NOT USED	-	-	-	-	-	-
B7	APP 2 SENSOR 5V REFERENCE	996	TAN	5v	4.3v	25, 26, 27, 84, 99	POOR PERFORMANCE
B8	GLOW PLUG SIGNAL	507	DK BLU	B+	0	29	HARD START
B9	NOT USED	-	-	-	-	-	-
B10	APP 3 SENSOR SIGNAL	994	DK GRN	4v	4v	64, 65, 84	POOR PERFORMANCE
B11	FUEL TEMP SIGNAL	1578	YEL	(2)	1.5v (2)	42, 43	POOR PERFORMANCE IN COLD TEMPS
B12	IAT SIGNAL	472	TAN	(2)	1.6v (2)	47, 48	POOR PERFORMANCE IN COLD TEMPS

(1) VARIES.
(2) VARIES WITH TEMPERATURE.
(3) OPEN CIRCUIT.
(4) GROUNDED CIRCUIT.
(5) OPEN/GROUNDED CIRCUIT.
(6) LESS THAN 1 VOLT.
* LESS THAN .5 VOLT (500 mV).
Δ B + WITH A/C "ON."



24 PIN A-B CONNECTOR (PINK)

VEHICLE: C/K TRUCK
ENGINE: 6.5L DIESEL VIN P (L49)
VIN S (L56)
VIN F (L65)
TRANSMISSION: 4L60E, 4L80E AND MANUAL

5-1-93
NS 14550

Figure 3-17 - PCM Connector Terminal End View (2 of 6)

PCM Connector and Driveability Symptoms Identification

This PCM voltage chart is for use with a J 39200 to further aid in diagnosis. These voltages were derived from a known good vehicle. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

The "B + " symbol indicates a nominal system voltage of 12-14 volts.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

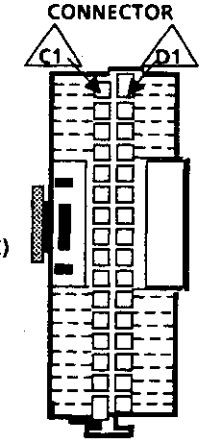
• Engine at operating temperature • Engine idling (for "Engine Operating" column)
• Test terminal not grounded • Scan tool not installed

PINK 32 PIN C-D CONNECTOR

PIN	PIN FUNCTION	CKT #	WIRE COLOR	NORMAL VOLTAGE		DTC(s) AFFECTED	POSSIBLE SYMPTOMS
				KEY "ON"	ENGINE OPERATING		
C1	SYSTEM GROUND	450	WHT/BLK	0*	0*	NONE	-
C2	FUEL INJECT SIGNAL	985	RED	5.6V	4.0V	NONE	NONE
C3	APP SENSOR 2 SIGNAL	993	LT BLU	4.3V	4.3V	26, 27, 84	POOR PERFORMANCE
C4	APP SENSOR 1 SIGNAL	992	DK BLU	.5V	.5V	22, 23, 84	POOR PERFORMANCE
C5	EGR CONTROL PRESS/BARO SIGNAL (VIN P, VIN S) BARO SIGNAL (VIN F)	433	GRY/BLK	4.8V	3.2V	31, 33	NO EGR
C6	PRESSURE CONTROL SOLENOID (HIGH) Δ •	1228	RED/BLK	0*	6.3V	73	HARSH SHIFT
C7	BOOST SIGNAL ▸	432	LT GRN	1.4V	1.4V	61, 62	NO TURBO BOOST
C8	ECT SIGNAL	410	YEL	3.4V (3)	3.0V (3)	14, 15	EARLY TCC
C9	TRANSMISSION FLUID TEMPERATURE (TFT) SIGNAL Δ •	1227	BLK/YEL	3.5V	2.8V	58, 59, 79	EARLY TCC
C10	CRANKSHAFT POSITION EGR CONTROL PRESS/BARO AND BOOST SENSOR 5 VOLT REFERENCE	416	GRY	5V	5V	19, 31	BACK UP FUEL, NO EGR
C11	PRESSURE CONTROL SOLENOID (LOW) Δ •	1229	LT BLU/ WHT	0*	1.5V	73	HARSH SHIFT
C12	TRANS INPUT SPEED SIGNAL (HIGH) •	1230	GRY/RED	0*	0*	74	NO TCC APPLY NO 4th GEAR IN HOT MODE
C13	GLOW PLUG RELAY CONTROL	505	YEL	B+	0	29	HARD START
C14	SERIAL DATA	1061	ORN/BLK	5V	5V	NONE	NO SCAN TOOL DATA
C15	TRANSMISSION OUTPUT SPEED SIGNAL	437	BRN	0*	0*	24, 72	2nd GEAR ONLY
C16	NOT USED	-	-	-	-	-	-

(1) VARIES FROM 0 TO BATTERY VOLTAGE, DEPENDING ON POSITION OF DRIVE WHEELS.
(2) VARIES.
(3) VARIES WITH TEMPERATURE.
(4) OPEN CIRCUIT.
(5) GROUNDED CIRCUIT.
(6) OPEN/GROUNDED CIRCUIT.
(7) LESS THAN 1 VOLT.
(8) B + WHEN GLOW PLUG LAMP "ON."
* LESS THAN .5 VOLT (500 mV).
Δ 4L60E.
• 4L80E.
▸ TURBO CHARGED.

BACK VIEW OF CONNECTOR



32 PIN C-D CONNECTOR (PINK)

VEHICLE: C/K TRUCK
ENGINE: 6.5L DIESEL VIN P (L49)
VIN S (L56)
VIN F (L65)
TRANSMISSION: 4L60E, 4L80E AND MANUAL

5-12-93
NS 14551

Figure 3-18 - PCM Connector Terminal End View (3 of 6)

PCM Connector and Driveability Symptoms Identification

This PCM voltage chart is for use with a J 39200 to further aid in diagnosis. These voltages were derived from a known good vehicle. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

The "B + " symbol indicates a nominal system voltage of 12-14 volts.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

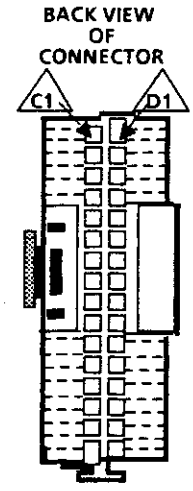
• Engine at operating temperature • Engine idling (for "Engine Operating" column)
• Test terminal not grounded • Scan tool not installed

PINK 32 PIN C-D CONNECTOR

PIN	PIN FUNCTION	CKT #	WIRE COLOR	NORMAL VOLTAGE		DTC(s) AFFECTED	POSSIBLE SYMPTOMS
				KEY "ON"	ENGINE OPERATING		
D1	SYSTEM GROUND	551	TAN/WHT	0*	0*	NONE	-
D2	CLOSURE GROUND	950	LT GRN	(4)	(4)	NONE	NO START
D3	APP 2 SENSOR GROUND	999	PPL	0	0	26, 27, 84	POOR PERFORMANCE
D4	APP 1 SENSOR GROUND	998	BRN	0	0	22, 23, 84	POOR PERFORMANCE
D5	APP 3 SENSOR GROUND	961	RED	0	0	64, 65, 84	POOR PERFORMANCE
D6	ECT, IAT, CRANKSHAFT POSITION, TFT AND EGR CONTROL PRESSURE SENSOR GROUND	452	BLK	0*	0*	14, 47, 19, 58	FAST IDLE, BACK UP FUEL
D7	NOT USED	-	-	-	-	-	-
D8	VEHICLE SPEED SIGNAL	1586	BRN/WHT	0*	0*	16	FUEL CUTOFF
D9	HIGH RESOLUTION SIGNAL	983	PPL	5V	2.5V	17	BACK UP FUEL
D10	OPTICAL SENSOR 5V REFERENCE	474	GRY	5V	5V	17, 18	BACK UP FUEL
D11	APP 3 SENSOR 5V REFERENCE	995	YEL/BLK	5V	5V	64, 65, 84	POOR PERFORMANCE
D12	TRANSMISSION INPUT SPEED SIGNAL (LOW) •	1231	DK BLU/ WHT	0*	0*	74	NO TCC APPLY, NO 4th GEAR IN HOT MODE
D13	CRANKSHAFT POSITION SIGNAL	643	BLU/WHT	5V	4.5V	19	BACK UP FUEL
D14	OPTICAL SENSOR GROUND	987	GRN/WHT	0*	0*	17, 18	BACK UP FUEL
D15	OPTICAL SENSOR CAM SIGNAL	442	PNK	.2V	.5V	18	BACK UP FUEL
D16	NOT USED	-	-	-	-	-	-

(1) VARIES FROM 0 TO BATTERY VOLTAGE, DEPENDING ON POSITION OF DRIVE WHEELS.
(2) VARIES.
(3) OPEN CIRCUIT.
(4) GROUNDED CIRCUIT.
(5) OPEN/GROUNDED CIRCUIT.
(6) LESS THAN 1 VOLT.
* LESS THAN .5 VOLT (500 mV).
• 4L80E.

VEHICLE: C/K TRUCK
ENGINE: 6.5L DIESEL VIN P (L49)
VIN S (L56)
VIN F (L65)
TRANSMISSION: 4L60E, 4L80E AND MANUAL



32 PIN C-D CONNECTOR (PINK)

5-1-93
NS 14552

Figure 3-19 - PCM Connector Terminal End View (4 of 6)

PCM Connector and Driveability Symptoms Identification

This PCM voltage chart is for use with a J 39200 to further aid in diagnosis. These voltages were derived from a known good vehicle. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

The "B + " symbol indicates a nominal system voltage of 12-14 volts.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

• Engine at operating temperature • Engine idling (for "Engine Operating" column)
• Test terminal not grounded • Scan tool not installed

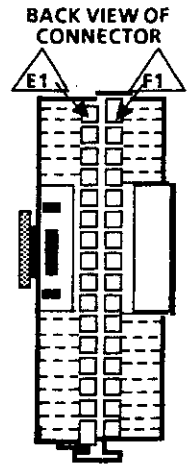
LT BLUE 32 PIN E-F CONNECTOR

PIN	PIN FUNCTION	CKT #	WIRE COLOR	NORMAL VOLTAGE		DTC(s) AFFECTED	POSSIBLE SYMPTOMS
				KEY "ON"	ENGINE OPERATING		
E1	BATTERY FEED	440	ORN	B +	B +	NONE	NO START
E2	FWD LOW SWITCH Δ •	1493	DK BLU	B +	B +	NONE	POOR START
E3	NOT USED	-	-	-	-	-	-
E4	NOT USED	-	-	-	-	-	-
E5	MIL "SERVICE ENGINE SOON" CONTROL	419	BRN/WHT	(5)	(5)	46	NO MIL
E6	TCC SOLENOID CONTROL Δ	422	TAN/BLK	B +	B +	67, 69	POOR FUEL ECONOMY
E7	1-2 SHIFT SOLENOID CONTROL Δ •	1222	LT GRN	B +	.4V	82	NO 3rd/4th GEAR
E8	RANGE SIGNAL "A" Δ •	1224	PNK	B +	B +	24, 28, 72	-
E9	RANGE SIGNAL "B" Δ •	1225	DK BLU	0	0	24, 28, 72	-
E10	RANGE SIGNAL "C" Δ •	1226	RED	B +	B +	24, 28, 72	-
E11	TCC SOLENOID CONTROL (PWM) •	1350	TAN/BLK	B +	.4V	67 - 4L60E 8E - 4L80E	-
E12	NOT USED	-	-	-	-	-	-
E13	2-3 SHIFT SOLENOID CONTROL Δ •	1223	YEL/BLK	B +	.4V	81	-
E14	FUEL INJECT CONTROL	984	LT GRN	0	1.9V	NONE	NONE
E15	EGR SOLENOID CONTROL (VIN P AND S)	435	GRY	B +	9.5V	32, 44	NO EGR
E16	ENGINE SHUT-OFF SOLENOID CONTROL	981	DK BLU/WHT	(5)	(5)	13	NO START

NOTICE: THE PCM UTILIZES A 24 PIN "PINK" CONNECTOR, A 32 PIN "PINK" CONNECTOR AND A 32 PIN "BLUE" CONNECTOR. THE 24 PIN "PINK" CONNECTOR IS LABELED "A" AND "B", THE 32 PIN "PINK" CONNECTOR IS LABELED "C" AND "D" AND THE 32 PIN "BLUE" CONNECTOR IS LABELED "C" AND "D". WHEN REFERENCING PCM CONNECTOR PIN OUTS, THE "BLUE" PCM CONNECTOR WILL BE REFERRED TO AS THE "E" AND "F" CONNECTOR.

(1) VARIES.
(2) READS BATTERY VOLTAGE IN GEAR.
(3) OPEN CIRCUIT.
(4) GROUNDED CIRCUIT.
(5) OPEN/GROUNDED CIRCUIT.
(6) LESS THAN 1 VOLT.
* LESS THAN .5 VOLT (500 mV)
Δ 4L60E.
• 4L80E.

VEHICLE: C/K TRUCK
ENGINE: 6.5L DIESEL VIN P (L49)
VIN S (L56)
VIN F (L65)
TRANSMISSION: 4L60E, 4L80E AND MANUAL



32 PIN E-F CONNECTOR (LT BLUE)

5-12-93
NS 14553

Figure 3-20 - PCM Connector Terminal End View (5 of 6)

PCM Connector and Driveability Symptoms Identification

This PCM voltage chart is for use with a J 39200 to further aid in diagnosis. These voltages were derived from a known good vehicle. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

The "B + " symbol indicates a nominal system voltage of 12-14 volts.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

• Engine at operating temperature • Engine idling (for "Engine Operating" column)
• Test terminal not grounded • Scan tool not installed

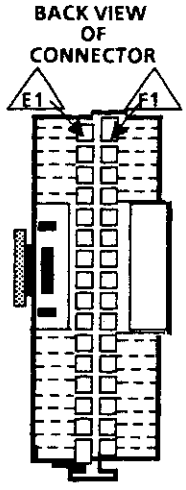
LT BLUE 32 PIN E-F CONNECTOR

PIN	PIN FUNCTION	CKT #	WIRE COLOR	NORMAL VOLTAGE		DTC(s) AFFECTED	POSSIBLE SYMPTOMS
				KEY "ON"	ENGINE OPERATING		
F1	NOT USED	-	-	-	-	-	-
F2	APP 1 SENSOR 5V REFERENCE	997	WHT/BLK	5V	5V	21, 22, 23, 84	POOR PERFORMANCE
F3	CRUISE "ON/OFF" REQUEST SIGNAL	397	GRY	(4)	(4)	NONE	NO CRUISE
F4	NOT USED	-	-	-	-	-	-
F5	TCC BRAKE SWITCH	420 86	PPL	B +	B +	37, 38, 41	NO TCC
F6	NOT USED	-	-	-	-	-	-
F7	NOT USED	-	-	-	-	-	-
F8	VEHICLE SPEED SIGNAL	834	BRN	*	*	16	NO CRUISE
F9	NOT USED	-	-	-	-	-	-
F10	NOT USED	-	-	-	-	-	-
F11	RESUME/ACCEL REQUEST SIGNAL	83	DK GRN	B +	B +	76	NO CRUISE
F12	NOT USED	-	-	-	-	-	-
F13	FUEL INJECT CONTROL	984	LT GRN	0	1.9V	NONE	NONE
F14	NOT USED	-	-	-	-	-	-
F15	SET/COAST REQUEST SIGNAL	84	DK BLU	B +	B +	71	NO CRUISE
F16	NOT USED	-	-	-	-	-	-

NOTICE: THE PCM UTILIZES A 24 PIN "PINK" CONNECTOR, A 32 PIN "PINK" CONNECTOR AND A 32 PIN "BLUE" CONNECTOR. THE 24 PIN "PINK" CONNECTOR IS LABELED "A" AND "B", THE 32 PIN "PINK" CONNECTOR IS LABELED "C" AND "D" AND THE 32 PIN "BLUE" CONNECTOR IS LABELED "C" AND "D". WHEN REFERENCING PCM CONNECTOR PIN OUTS, THE "BLUE" PCM CONNECTOR WILL BE REFERRED TO AS THE "E" AND "F" CONNECTOR.

(1) VARIES.
(2) OPEN CIRCUIT.
(3) GROUNDED CIRCUIT.
(4) OPEN/GROUNDED CIRCUIT.
(5) LESS THAN 1 VOLT.
* LESS THAN .5 VOLT (500 mV)
\# MANUAL TRANSMISSION.
Δ 4L60E.
• 4L80E.

VEHICLE: C/K TRUCK
ENGINE: 6.5L DIESEL VIN P (L49)
VIN S (L56)
VIN F (L65)
TRANSMISSION: 4L60E, 4L80E AND MANUAL



32 PIN E-F CONNECTOR (LT BLUE)

5-3-93
NS 14554

Figure 3-21 - PCM Connector Terminal End View (6 of 6)

ON-VEHICLE SERVICE

WIRE HARNESS

The PCM harness electrically connects the PCM to the various solenoids, switches, and sensors in vehicle engine transmission and passenger compartment.

Wire harnesses should be replaced with proper part number harnesses. When signal wires are spliced, into a harness, use wire with high temperature insulation only.

With the low current and voltage levels found in the system, it is important that the best possible bond at all wire splices be made by soldering the splices, as shown in Figure 3-22.

Molded on connectors require complete replacement of the connector. This means splicing a new connector assembly into the harness.

Replacement connectors and terminals are listed in Group 8.965, of the Standard Parts Catalog.

CONNECTORS AND TERMINALS

Use care, when probing a connector or replacing terminals in them. It is possible to short between opposite terminals. If this happens, to the wrong terminal pair, it is possible to damage certain components. Always use jumper wires between connectors, for circuit checking. NEVER probe through the Weather-Pack seals. Use tachometer adapter J 35812, or equivalent, which provides an easy hook up of the tach. lead. The connector test adapter kit J 35616, or equivalent, contains an assortment of flexible connectors, used to probe terminals during diagnosis. Fuse remover and test tool BT 8616, or equivalent, is used for removing a fuse and to adapt fuse holder, with a meter, for diagnosis.

When diagnosing, open circuits are often difficult to locate by sight, because oxidation, or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor, or in the wiring harness, may correct the open circuit condition. This should always be considered, when an open circuit, or failed sensor is indicated. Intermittent problems may, also, be caused by oxidized or loose connections.

Before making a connector repair, be certain of the type of connector. Weather-Pack and Compact Three connectors look similar, but are serviced differently.

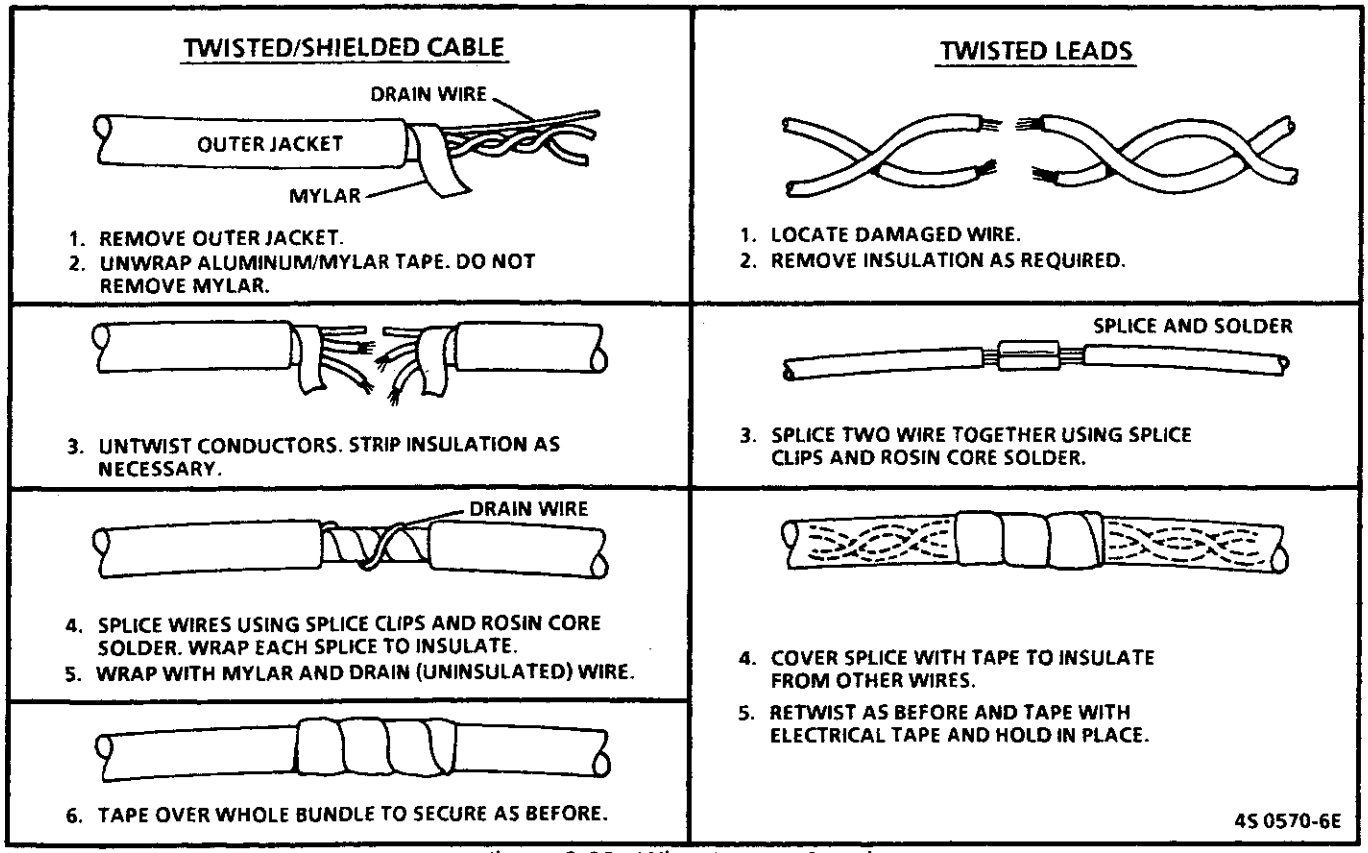


Figure 3-22 - Wire Harness Repair

Micro-Pack

Refer to Figure 3-23 and repair procedure for replacement of a Micro-Pack terminal.

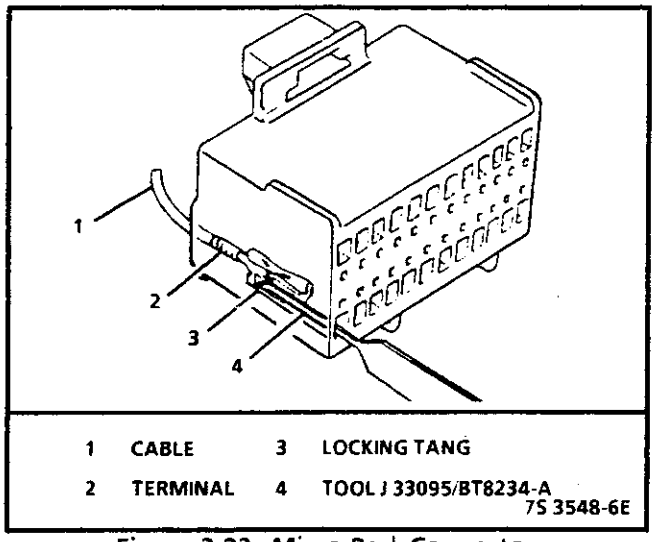


Figure 3-23 - Micro-Pack Connector

Metri-Pack

Some connectors use terminals called Metri-Pack Series 150 (Figure 3-24). These may be used at the coolant sensor, as well as TBI/CPI units.

They are also called "Pull-To-Seat" terminals, because, to install a terminal on a wire, the wire is first inserted through the seal (5) and connector (4). The terminal is then crimped on the wire and the terminal pulled back into the connector to seat it in place.

To remove a terminal:

1. Slide the seal back on the wire.
2. Insert tool (3) BT-8518, or J 35689, or equivalent, as shown in insert "A" and "B," to release the terminal locking tab (2).
3. Push the wire and terminal out through the connector.

If reusing the terminal, reshape the locking tang (2).

Weather-Pack

A Weather-Pack connector can be identified by a rubber seal, at the rear of the connector. This connector, which is used in the engine compartment, protects against moisture and dirt, which could create oxidation and deposits on the terminals. This protection is important, because of the very low voltage and current levels found in the electronic system.

Repair of a Weather-Pack terminal is shown in Figure 3-25. Use tool J M28742, or BT-8234-A to remove the pin and sleeve terminals.

If removal is attempted with an ordinary pick, there is a good chance that the terminal will be bent, or deformed. Unlike standard blade type terminals, these terminals cannot be straightened once they are bent.

Make certain that the connectors are properly seated and all of the sealing rings in place, when connecting leads. The hinge type flap provides a backup, or secondary locking feature for the connector. They are used to improve the connector reliability by retaining the terminals, if the small terminal lock tangs are not positioned properly.

Weather-Pack connections cannot be replaced with standard connections. Instructions are provided with Weather-Pack connector and terminal packages.

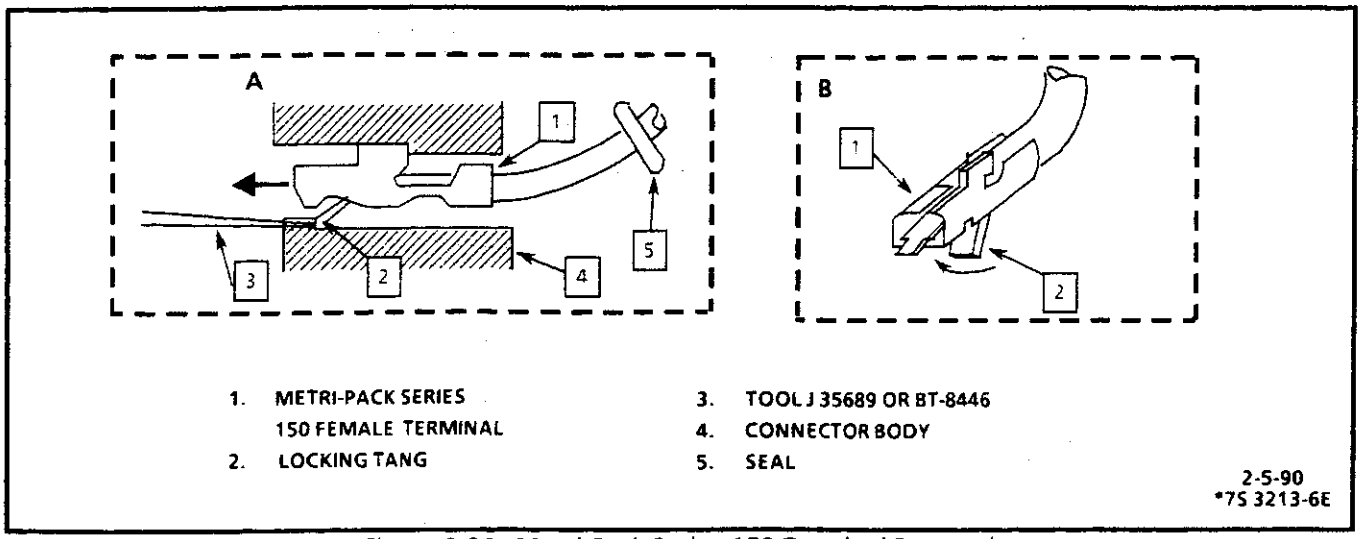


Figure 3-24 - Metri-Pack Series 150 Terminal Removal

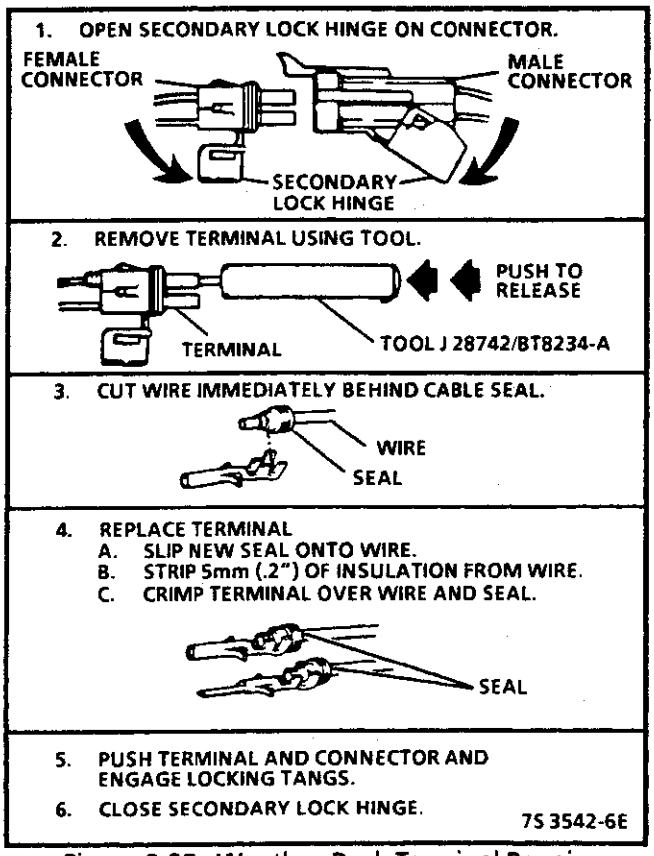


Figure 3-25 - Weather-Pack Terminal Repair

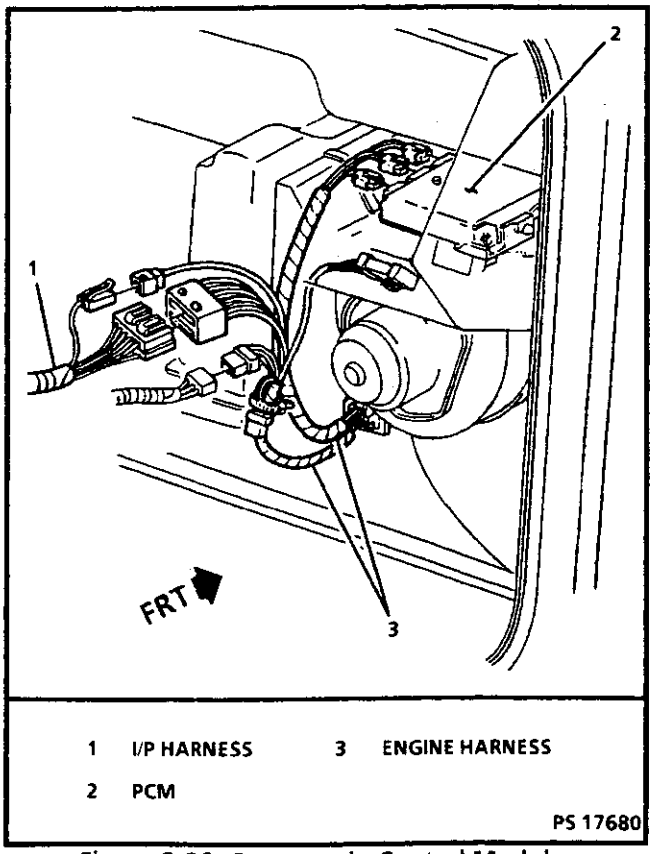


Figure 3-26 - Powertrain Control Module

Compact Three

The Compact Three connector, which looks similar to a Weather-Pack connector, is not sealed and is used where resistance to the environment is not required. This type of connector, most likely, is used at the air control solenoid. Use the standard method, when repairing a terminal. Do not use the Weather-Pack terminal tool J 28742, or BT-8234-A, as these will damage the terminals.

POWERTRAIN CONTROL MODULE (PCM)

Service of the PCM should normally consist of either replacement of the PCM or a PROM change.

If the diagnostic procedures call for the PCM to be replaced, the PROM and PCM should be checked first to see if they are the correct parts. If they are, remove the PROM from the faulty PCM and install it in the new service PCM. THE SERVICE PCM WILL NOT CONTAIN A PROM. DTC 51 indicates the PROM is installed improperly or has malfunctioned. When DTC 51 is obtained, check the PCM installation for bent pins or pin not fully seated in the socket. If it is installed correctly and DTC 51 is still displayed, replace the PROM.

Important

- When replacing the production PCM with a service PCM, a DTC 88 will be stored. It is important to program "TDC Offset" into the service PCM. Refer to "TDC Offset Program Procedure."

Important

- When replacing the production PCM with a service PCM (controller), it is important to transfer the broadcast code and production PCM number to the service PCM label. Please Do Not record on PCM cover. This will allow positive identification of PCM parts throughout the service life of the vehicle.

Important

- To prevent internal PCM damage, the ignition must be "OFF" when disconnecting or reconnecting power to PCM (for example, battery cable, PCM pigtail, PCM fuse, jumper cables, etc.). The ignition should be "OFF" for at least 30 seconds before disconnecting power to the PCM.

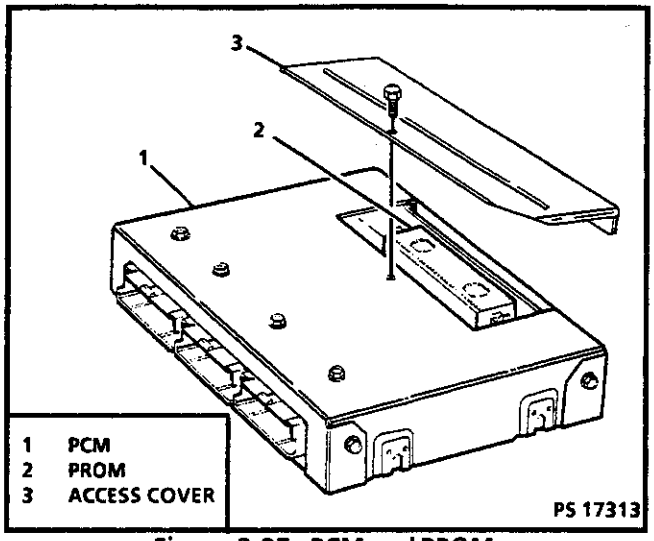


Figure 3-27 - PCM and PROM

PCM OR PROM REPLACEMENT
Figure 3-26

Remove or Disconnect

1. Negative battery cable.
2. Connectors from PCM.
3. PCM mounting hardware.
4. PCM from passenger compartment.
5. PCM access cover (Figure 3-27).
6. PROM.

Important

- A replacement Powertrain Control Module (PCM) is supplied without a PROM, so care should be used when removing it from the defective PCM because it will be reused in the new PCM.

NOTICE: To prevent possible electrostatic discharge to the PCM or PROM, do not touch the component leads, and do not remove integrated circuit from carrier.

Using two fingers, grasp the PROM at both ends and lift it up out of the socket. Do not remove the cover of the PROM. Use of unapproved PROM removal methods may cause damage to the PROM or socket.

Inspect

- For alignment notches of the PROM and carefully set it aside.

IF PCM IS BEING REPLACED

Remove or Disconnect

1. New PCM from its packaging and check the service number to make sure it is the same as the defective PCM.
2. Access cover.

Install or Connect

1. PROM in PROM socket.

Important

- Gently press down on PROM.

2. Access cover on PCM.
3. PCM in passenger compartment.
4. Connectors to PCM.

Functional Check

1. Turn ignition "ON."
2. Enter diagnostics mode.
   A. DTC 12 should flash three times (if no other DTCs are present). This indicates the PROM is installed properly, and the PCM is functioning.
   B. If DTC 51 occurs, or if the MIL (Service Engine Soon) is "ON" constantly with no DTC(s), the PROM is not fully seated or is defective.
      - If not fully seated, press firmly on the ends of the PROM.
      - If it is necessary to remove the PROM, follow the previous removal instructions.

TDC OFFSET PROGRAM PROCEDURE

This procedure allows the PCM memory to be updated with the correct TDC offset for the vehicle.

DTC 88 will be stored until this procedure has been completed.

Set up:

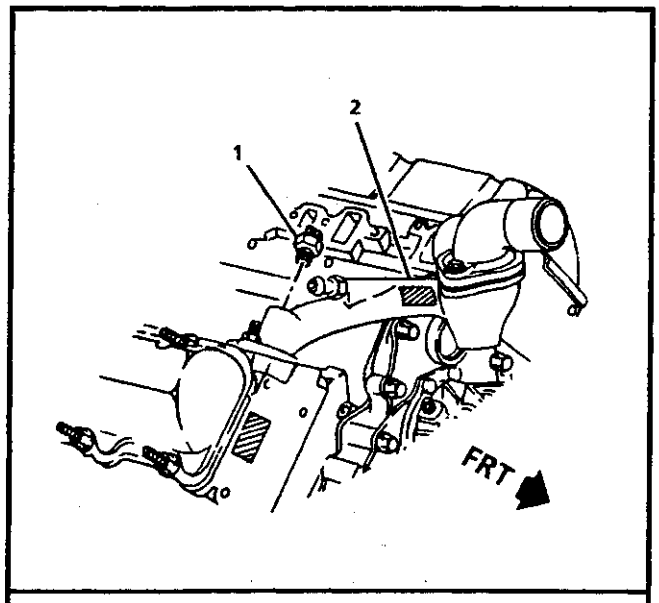
- Battery is fully charged.
- Engine operating at idle.
- Vehicle at operating temperature.
- Connect Tech 1 scan tool.
- Select "OUTPUT TESTS" and "INJ. PUMP."
- Activate "TDC LEARN."

NOTICE: It takes PCM 20 seconds to learn TDC offset.

- Verify "TDC OFFSET" in data list.
- DTC 88 will be stored if procedure has not been done correctly.

NOTICE: If the PCM fails to program the TDC OFFSET, do the following:

- Check all PCM connections.
- Check Techline terminal/equipment for latest software version.
- Try again to program the PCM. If it fails again replace the PCM. Refer to "PCM Replacement."



1 ENGINE COOLANT TEMPERATURE SENSOR

2 CROSSOVER THERMOSTAT HOUSING

NS 15745

Figure 3-28 - Engine Coolant Temperature (ECT) Sensor

PCM SENSORS AND INPUT SWITCHES

Engine Coolant Temperature (ECT) Sensor
Figure 3-28

NOTICE: Care must be taken, when handling sensor. Damage to sensor will affect proper operation of the fuel control system.

Remove or Disconnect

1. Negative battery cable.
2. Drain cooling system below level of sensor.
3. Electrical connector releasing locking tab.
4. Sensor.

Install or Connect

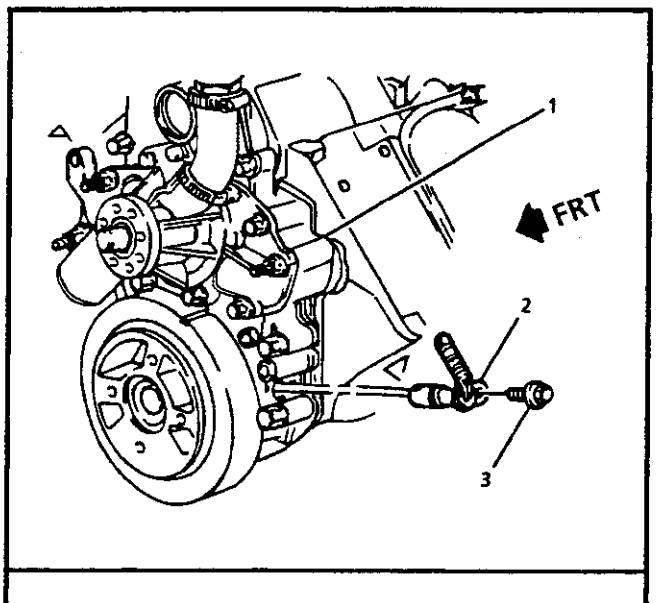
1. Sensor in engine.
2. Electrical connector.
3. Refill coolant system.
4. Negative battery cable.

Accelerator Pedal Position (APP) Module

Refer to SECTION 4 for replacement.

Optical/Fuel Temperature Sensor

These sensors are only serviceable with electronic fuel injection pump. Refer to SECTION 4.



1 FRONT COVER

2 CRANKSHAFT POSITION SENSOR

3 BOLT

NS 15749

Figure 3-29 - Crankshaft Position Sensor

Crankshaft Position Sensor
Figure 3-29

Remove or Disconnect

1. Negative battery cable.
2. Sensor electrical connector.
3. Sensor bolt.
4. Sensor from engine.

Inspect

- Sensor O-ring for wear, cracks or leakage. Replace if necessary. Lube new O-ring with engine oil before installing.

Install or Connect

1. Sensor in engine.
2. Sensor bolt, tighten to 25 N·m (17 lb. ft.).
3. Sensor electrical connector.
4. Negative battery cable.

Important

- The procedure, called the "TDC Offset Program Procedure," utilizes the capabilities of the Tech 1 scan tool. This procedure must be done when a crankshaft position sensor is replaced. Refer to "TDC Offset Program Procedure."

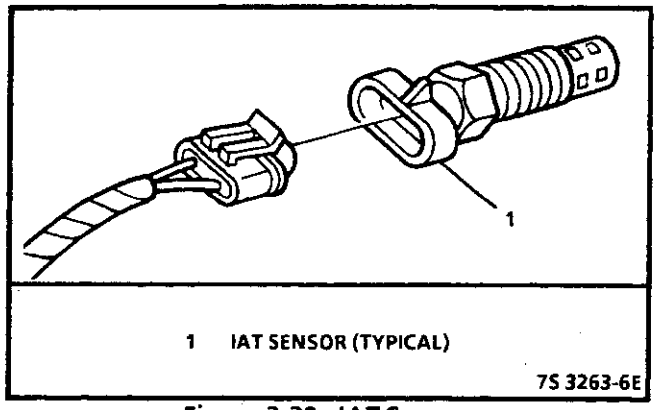


Figure 3-30 - IAT Sensor

Intake Air Temperature (IAT) Sensor
Figure 3-30

Remove or Disconnect
1. Negative battery cable.
2. Electrical connector releasing locking tab.
3. IAT sensor.

Install or Connect
1. IAT sensor.
2. Electrical connector.
3. Negative battery cable.

EGR Control Pressure/BARO Sensor
Figure 3-31

Other than checking for loose hoses and electrical connections, the only service possible is unit replacement if diagnosis shows sensor to be faulty.

Remove or Disconnect
1. Negative battery cable.
2. Vacuum harness assembly. (If equipped.)
3. Electrical connector releasing locking tab.
4. Bolts or release lock tabs and remove sensor.

Install or Connect
1. Bolts (3.5 N·m 27 lb. in.) or snap sensor on bracket.
2. Electrical connector.
3. Vacuum harness. (If equipped.)
4. Negative battery cable.

Boost Sensor
Figure 3-32

Other than checking for loose electrical connections, the only service possible is unit replacement if diagnosis shows sensor to be faulty.

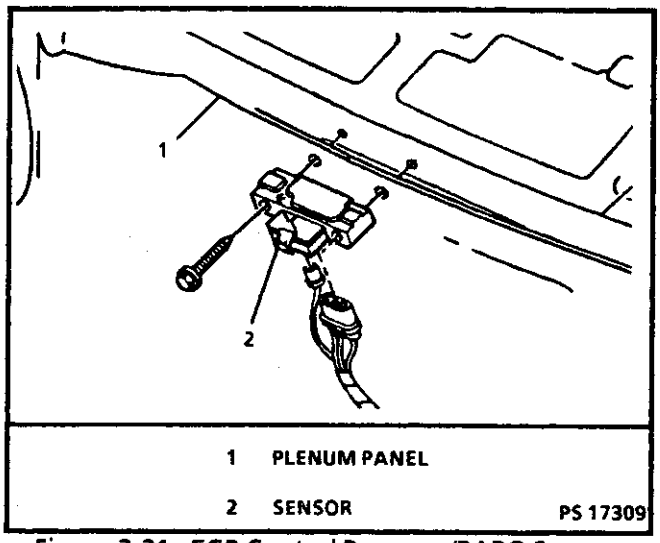


Figure 3-31 - EGR Control Pressure/BARO Sensor

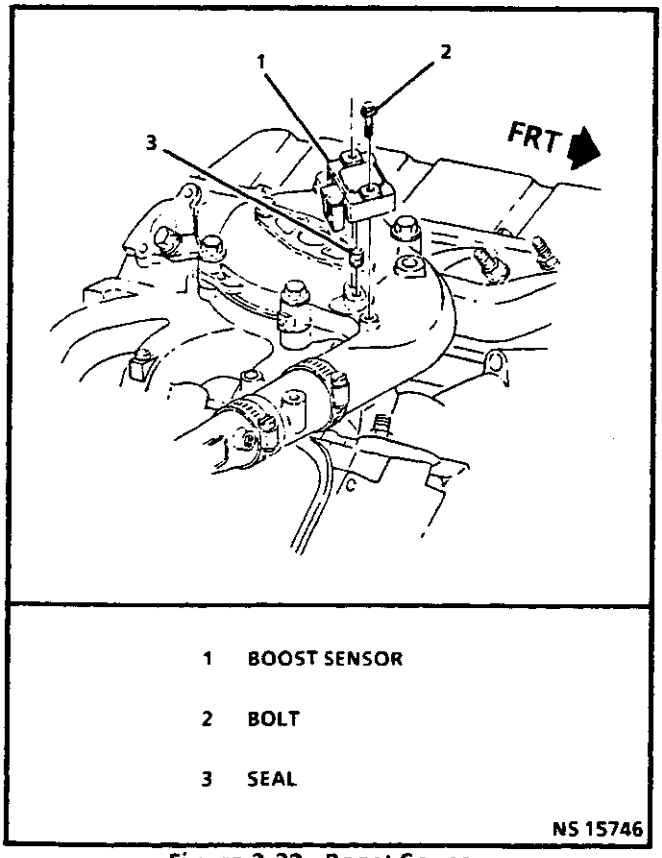


Figure 3-32 - Boost Sensor

Remove or Disconnect
1. Negative battery cable.
2. Vacuum harness assembly.
3. Electrical connector releasing locking tab.
4. Bolts.

Install or Connect

1. Bolts (3.5 N·m 27 lb. in.).
2. Electrical connector.
3. Vacuum harness.
4. Negative battery cable.

Wastegate Solenoid
Figure 3-34

Remove or Disconnect

1. Negative battery cables.
2 Electrical connector from the solenoid.
3 Vacuum hoses.
4. Wastegate solenoid.

Install or Connect

1 Wastegate solenoid.
2. Vacuum hoses.
3. Electrical connector from the solenoid.
4. Negative battery cables.
5. Perform "On-Board Diagnostic (OBD) System Check."

Vehicle Speed Sensor (VSS)

Refer to SECTION 10 for on-vehicle service of the transmission mounted VSS.

VSS Buffer Module
Figure 3-33

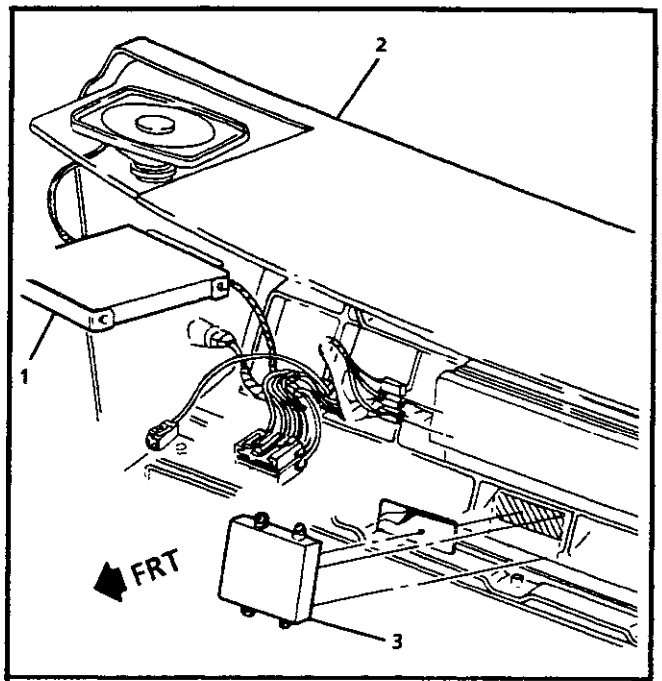
The VSS buffer module is mounted in the instrument panel. Refer to SECTION 8C of the appropriate service manual for on-vehicle service.

Brake Switches

Refer to SECTION 5 of the appropriate service manual for on-vehicle service of the brake (stoplamp) switches.

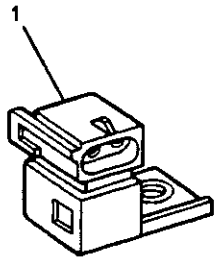
Cruise Control Switches

The cruise control switches are part of the multi-function turn signal lever. Refer to SECTION 3F of the appropriate service manual.



1 CONTROL MODULE
2 INSTRUMENT PANEL
3 VSS BUFFER MODULE
MS 12398

Figure 3-33 - VSS Buffer Module



1 WASTEGATE SOLENOID
PS 17583

Figure 3-34 - Wastegate Solenoid

PARTS INFORMATION

PART NAME	GROUP
Module, Eng. Cont.	3.670
PROM, ECM	3.670
Sensor, Engine Coolant Temp	3.682

BLANK