VIPER

FUEL AND IGNITION

CHRYSLER CORPORATION

STUDENT WORKBOOK

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This publications purpose is to provide Technical training information to individuals in the automotive trade. All test and repair procedures must be performed in accordance with manufacturers service and diagnostic manuals. All ***warnings, cautions,*** and ***notes*** must be observed for safety reasons. The following is a list of general guidelines:

- Proper service and repair is critical to the safe, reliable operation of all motor vehicles.
- The information in this publication has been developed for service personnel, and can help when diagnosing and performing vehicle repairs.
- Some service procedures require the use of special tools. These special tools must be used as recommended throughout this Technical Training Publication, the diagnostic Manual, and the Service Manual.
- Special attention should be exercised when working with spring-or tension-loaded fasteners and devices such as E-Clips, Cir-clips, Snap rings, etc., careless removal may cause personal injury.
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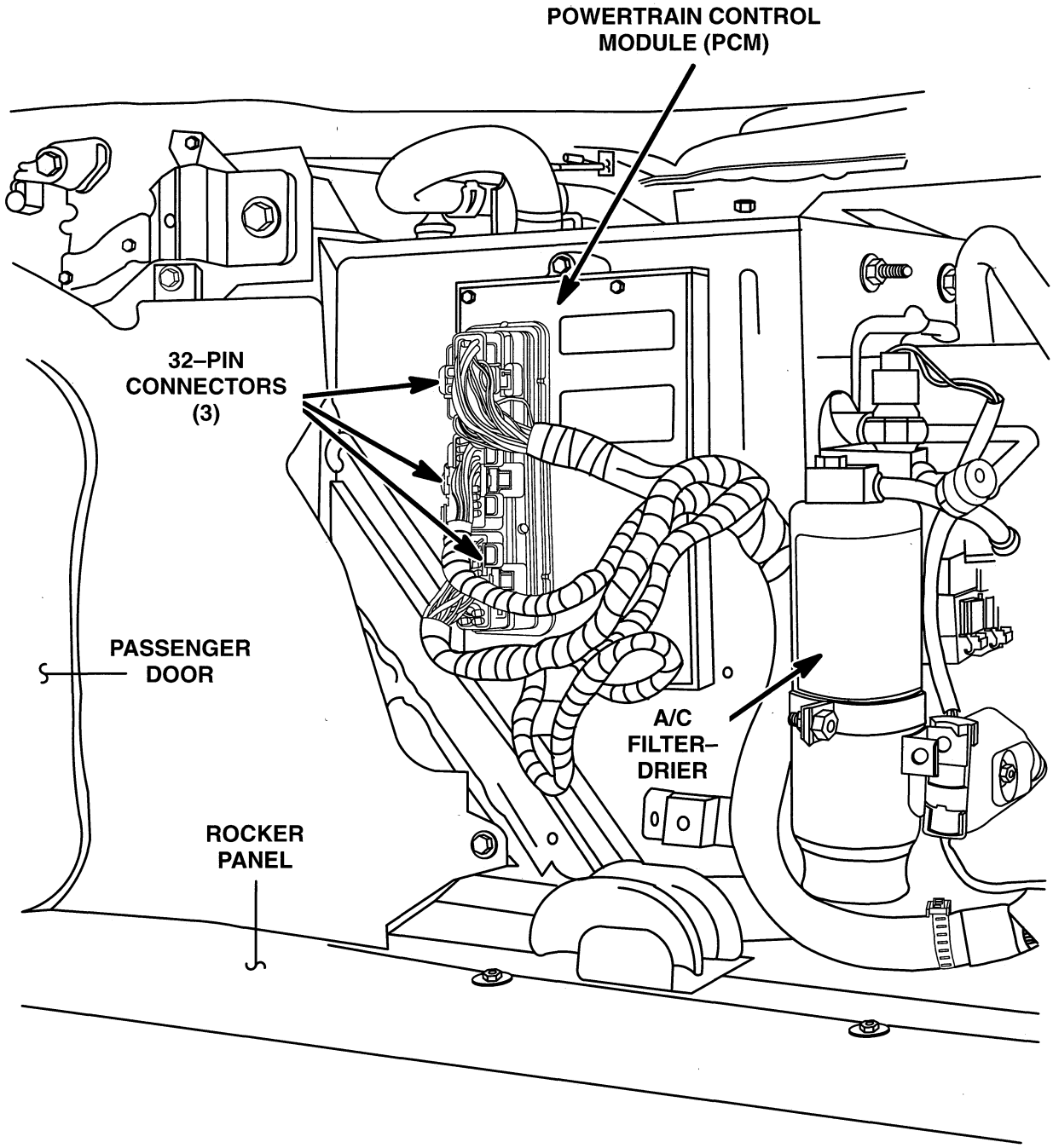


1996 JTEC POWERTRAIN CONTROL MODULE (ROADSTER)

Fuel and Ignition

Fuel and Ignition

TABLE OF CONTENTS

Fuel and Ignition

ACRONYMS

ASD	Automatic Shutdown
CARB	California Air Resources Board
CCD	Chrysler Collision Detection
CKP	Crankshaft Position Sensor
CMP	Camshaft Position Sensor
dB	Decibel
DLC	Data Link Connector
DRB III Scan Tool	Diagnostic Read-out Box
DTC	Diagnostic Trouble Code
ECT	Engine Coolant Temperature
IAC	Idle Air Control
IAT	Intake Air Temperature
ISO	International Standards Organization
JTEC	Jeep Truck Engine Controller
MAP	Manifold Absolute Pressure
MIL	Malfunction Indicator Lamp
OBD II	On-Board Diagnostics Generation Two
PCM	Powertrain Control Module
RPM	Revolutions Per Minute
SAE	Society of Automotive Engineers
TPS	Throttle Position Sensor
VSS	Vehicle Speed Sensor

Fuel and Ignition

NOTES:

Fuel and Ignition

INTRODUCTION AND OBJECTIVES

The 1996 Viper "Fuel and Ignition" Book covers information regarding fuel and spark control operations for both the 1996 Roadster and 1996 Coupe.

The changes to the fuel and spark control systems on the 1996 V-10 are significant. Federal regulation regarding emissions controls and the implementation of OBD II has resulted in many changes to the fuel and spark control strategies for the Viper V-10.

The 1996 Viper is unique in that it is 50 state certified, as built, and still retains all of its high performance characteristics. In fact, an increase in horsepower is achieved by redesigning the exhaust for the added O_2 Sensors.

Upon completion of this book, you should be able to perform the following tasks:

- Describe fuel and spark control strategies for the 1996 Roadster and Coupe
- Describe the purpose of and define the OBD II Emissions Warranty Coverage
- Explain the PCM-controlled charging system on the Coupe

The following section covers information about revisions to the fuel and spark control operations for 1996.

1996 ROADSTER

POWERTRAIN CONTROL MODULE (PCM)

In order to comply with OBD II requirements, a Jeep Truck Engine Controller (JTEC) Powertrain Control Module (PCM) is used. This replaces the PCM and VIC used previously. Now, the PCM receives **ALL** of the inputs required to control injector pulse width and spark control. This change has also resulted in the deletion of the MUX circuit which provided the communication path between the PCM and VIC.

The PCM is located underhood next to the Heater Motor Blower Housing (fig. 1). The new JTEC PCM has three 32–way connectors.

JTEC PCM SOFTWARE

The software for the PCM has been written to enable the PCM to meet most OBD II requirements. This new PCM performs all of the Task Manager responsibilities for OBD II diagnostics. By continuously monitoring the condition of engine components, the PCM is able to adjust injector pulse width and spark to achieve the most efficient use of fuel and reduce exhaust emissions.

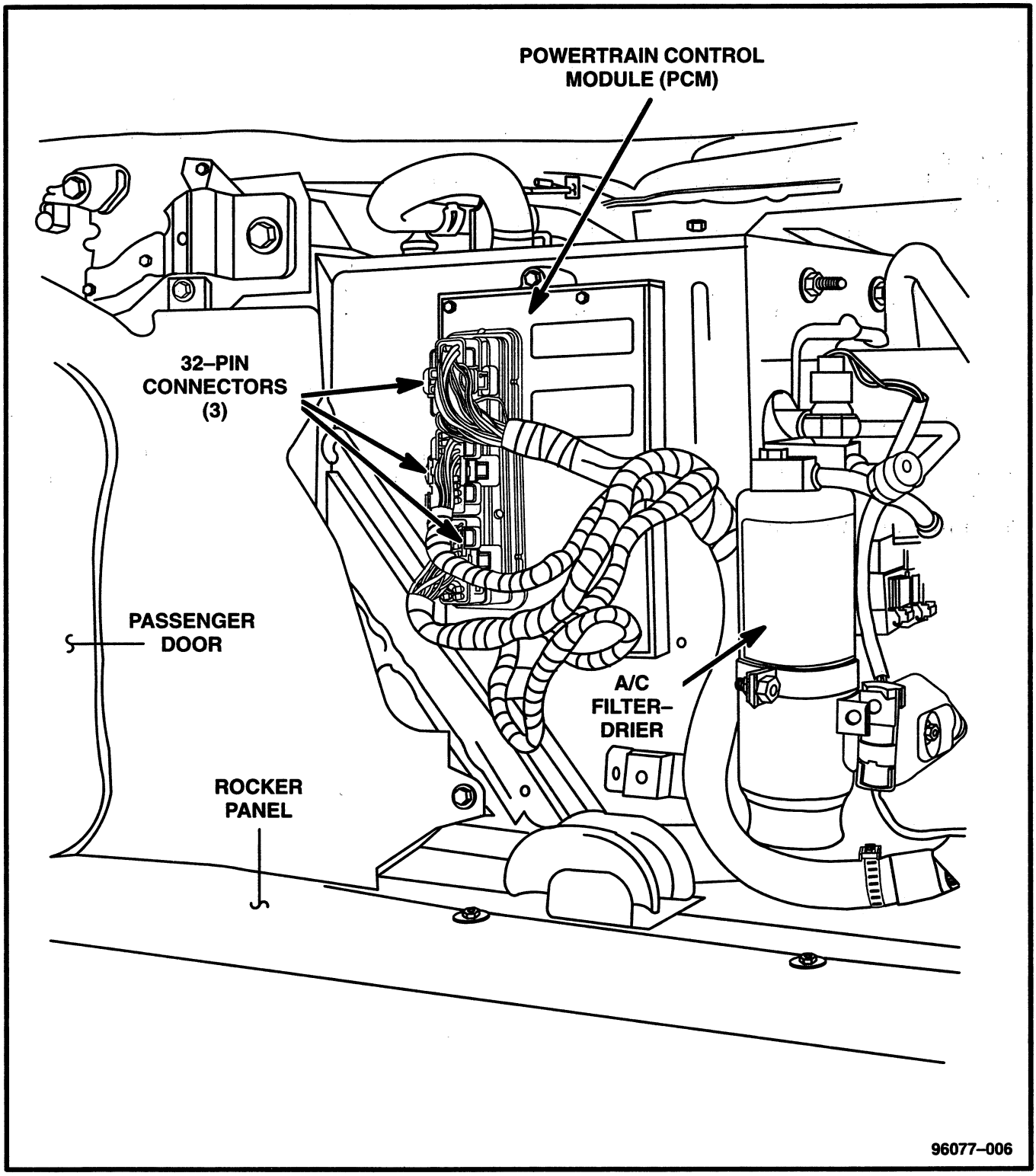


Figure 1 Roadster JTEC Powertrain Control Module (PCM)

Power and Grounds

Fused battery voltage is supplied to pin A22 of the PCM. Pins A31 and A32 provide a ground (fig. 2). The grounding point is under the PCM on the frame of the vehicle. The PCM monitors battery voltage continuously during engine operation. If the output voltage of the battery falls, the PCM corrects the pulse width of the injectors to compensate for the low voltage (figs. 3 through 6).

NOTES:

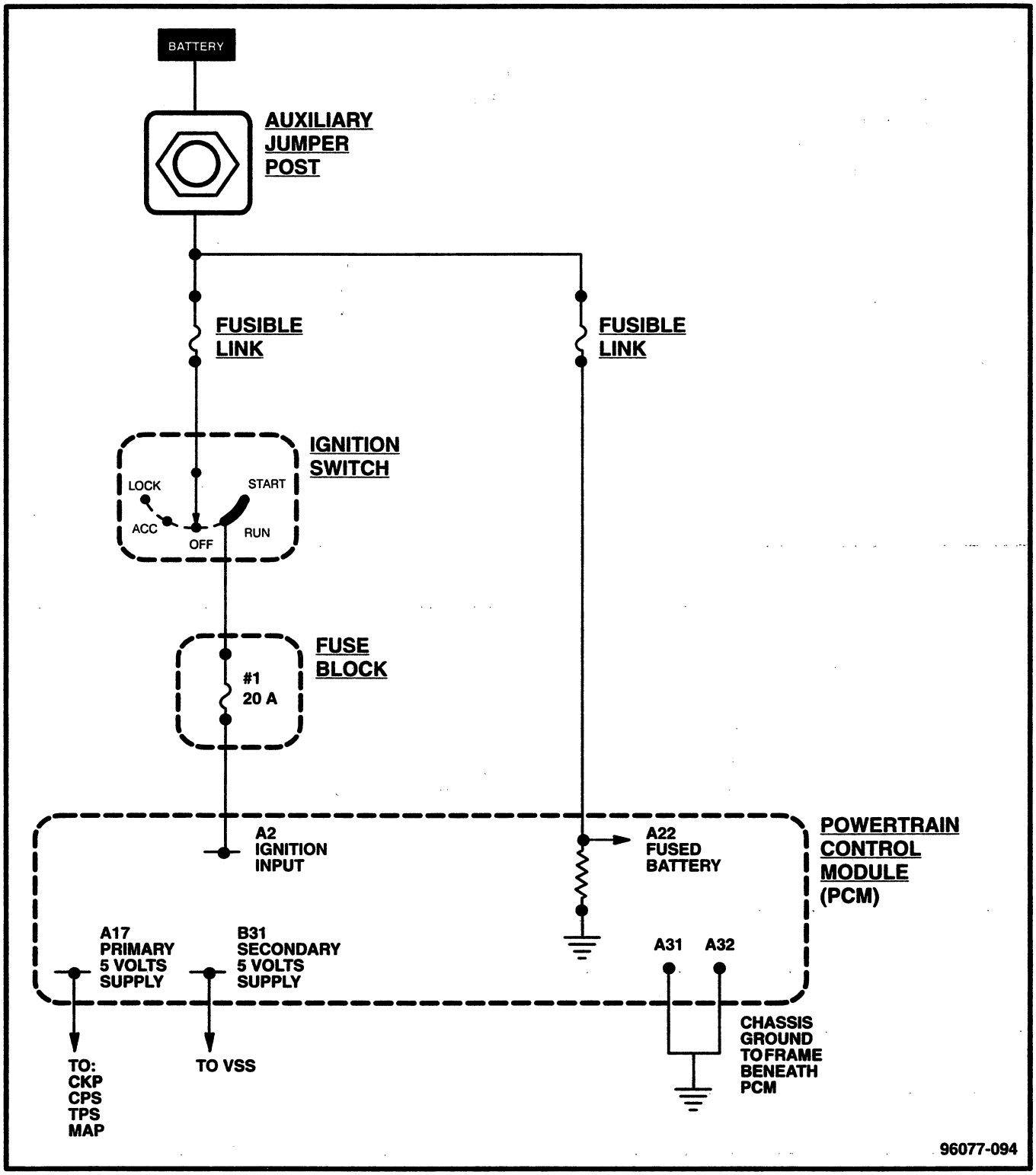


Figure 2 JTEC PCM Power and Grounds

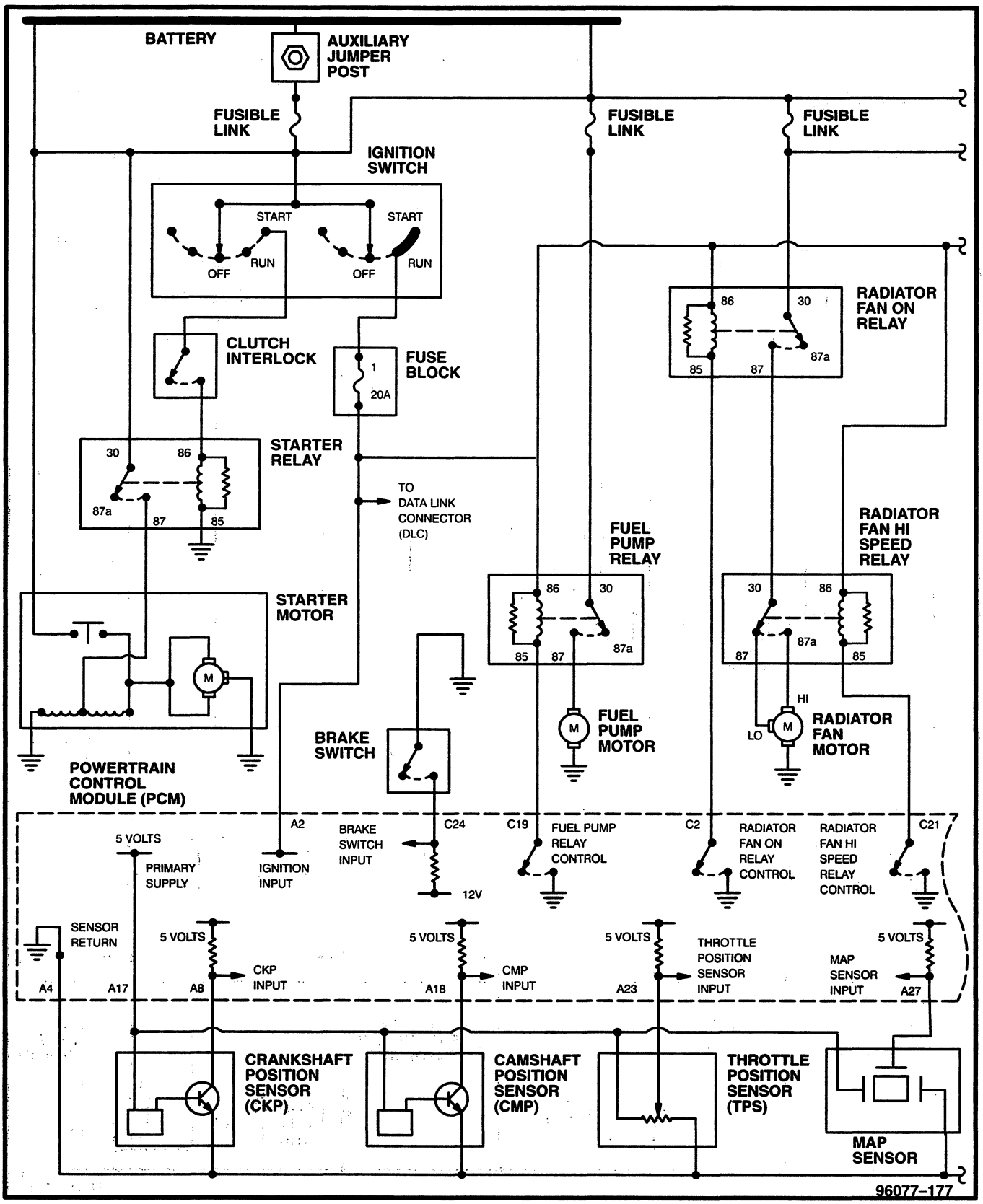


Figure 3 1996 Roadster Powertrain Control Module (PCM) Schematic

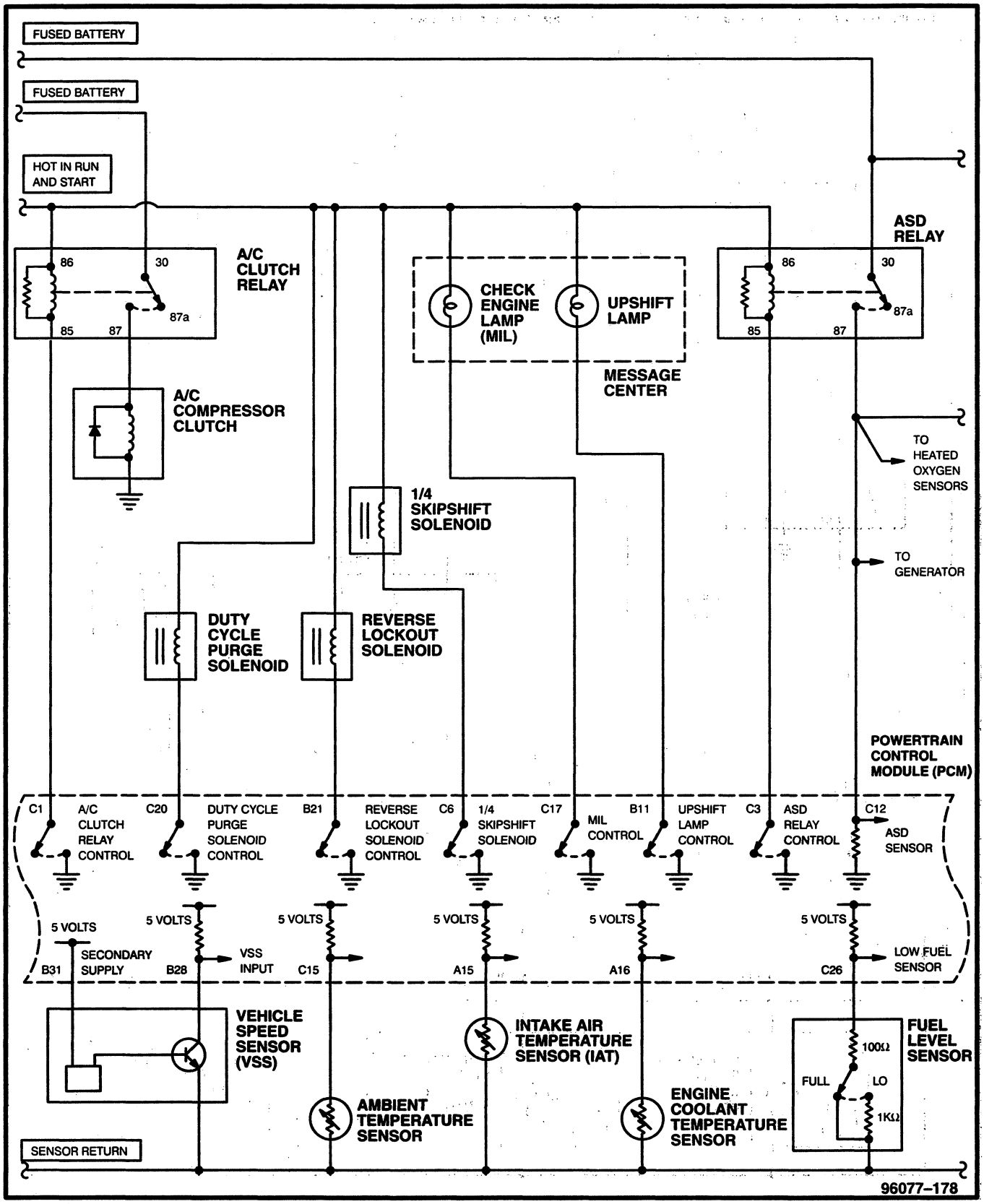


Figure 4 1996 Roadster Powertrain Control Module (PCM) Schematic

JTEC HARDWARE

The PCM contains a voltage regulator that changes battery voltage to a regulated five volts DC to power the sensors.

The PCM has two internal five volt supply circuits. A primary five volt supply provides operating voltage for the following sensors:

- Crankshaft Position Sensor (CKP)
- Camshaft Position Sensor (CMP)
- Throttle Position Sensor (TPS)
- Manifold Absolute Pressure Sensor (MAP)

A secondary supply provides voltage to the Vehicle Speed Sensor (VSS).

FUEL CONTROL

The following is a comparison of the previous year's fuel control operations with the strategy for 1996.

REQUIREMENTS FOR PCM TO ENTER CLOSED LOOP OPERATION	
1995	**1996**
• 134 seconds have passed since start-up • Engine coolant temperature is above 140 degrees Fahrenheit	• Engine coolant temperature must be over 35 degrees Fahrenheit • If the coolant is over 35 degrees, the PCM will wait 44 seconds • If the coolant is over 50 degrees, the PCM will wait 38 seconds • If the coolant is over 167 degrees, the PCM will wait 11 seconds

ENGINE START-UP MODE OPERATION (OPEN LOOP)	
1995	**1996**
• Engine coolant temperature • Engine RPM • Number of engine revolutions since cranking was initiated	Same as 1995, add: • Battery voltage • Intake air temperature (IAT) • Throttle position During start-up the PCM maintains ignition timing at 9° BTDC.

ENGINE WARM-UP MODE (CLOSED LOOP)	
1995	**1996**
• Intake air temperature • Engine coolant temperature • Manifold absolute pressure (MAP) • Crankshaft position sensor • Throttle position • A/C switch • Battery voltage	Same as 1995, add: • O2 Sensors

CRUISE AND IDLE MODE (CLOSED LOOP)	
1995	**1996**
• Engine coolant temperature • MAP • Crankshaft position sensor • Throttle position • Exhaust gas oxygen content • A/C control positions • Battery voltage	Same as 1995, add: • Intake air temperature

DECELERATION MODE (CLOSED LOOP)	
1995	**1996**
• Engine coolant temperature • MAP • Crankshaft position sensor • Throttle position • Exhaust gas oxygen content • A/C control positions • Battery voltage	Same as 1995, no A/C control position input, and add: • A/C sense • Intake air temperature

Ambient Air Sensor

The Ambient Air Sensor provides the PCM with outside air temperature information. The PCM uses this information for OBD II O_2 Heater Monitor operation. The sensor is located at the driver's side front fascia.

Downstream O_2 Sensors

The two Downstream O_2 Sensors are located near the muffler (fig. 7). The PCM compares the signals of the upstream and downstream sensors to determine Catalytic Converter efficiency. Under normal conditions, the switch rate of the Downstream Sensor is much slower than the Upstream Sensor. As the Catalytic Converter's efficiency declines, its ability to convert decreases. If the Downstream Sensor signal exceeds 70% of the Upstream Sensor, then the PCM can determine that the catalyst is faulty and store a DTC (fig. 8).

Short and Long-Term Adaptive Memory

There are a total of 44 long-term adaptive memory cells for the Viper. There are 22 for each Upstream O_2 Sensor. There is one short-term adaptive memory cell for each Upstream O_2 Sensor.

Short term memory is retained by ignition voltage. Whenever ignition voltage is removed, short term memory is lost. Long term memory is retained by battery voltage. There are two ways that long term memory can be lost:

- Disconnecting the Battery
- By running the "Reset Engine Values" program on the DRB III

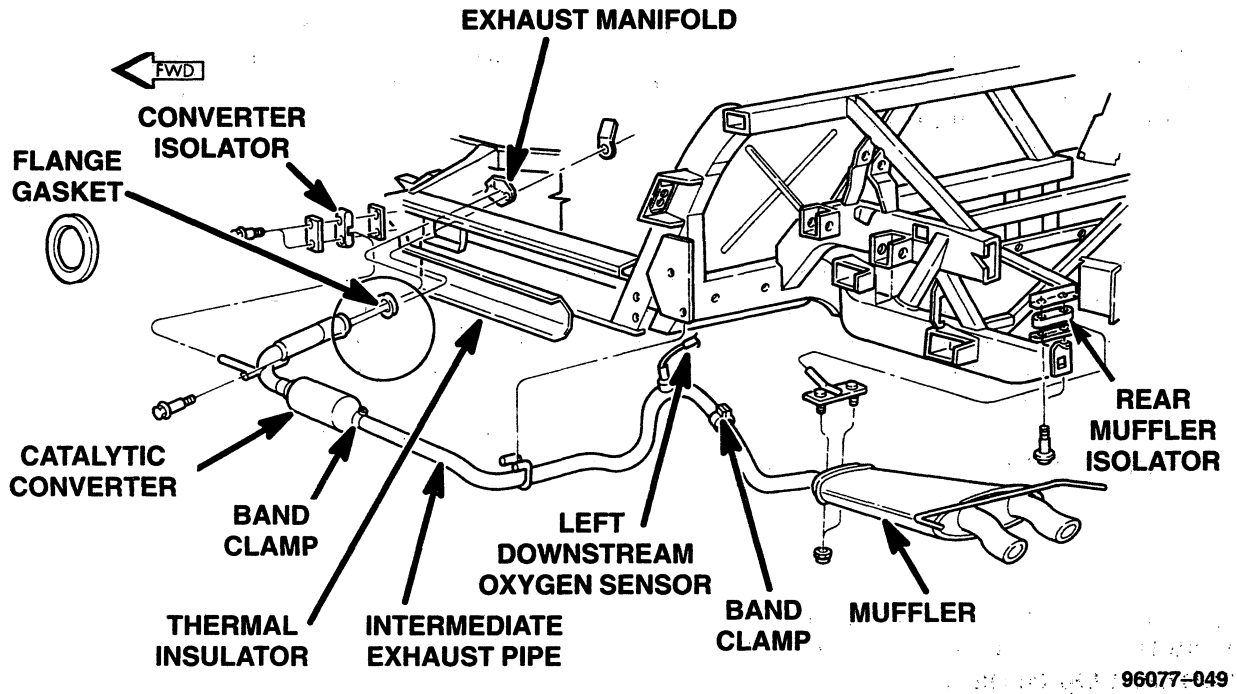


Figure 7 Left Downstream Heated Oxygen Sensor

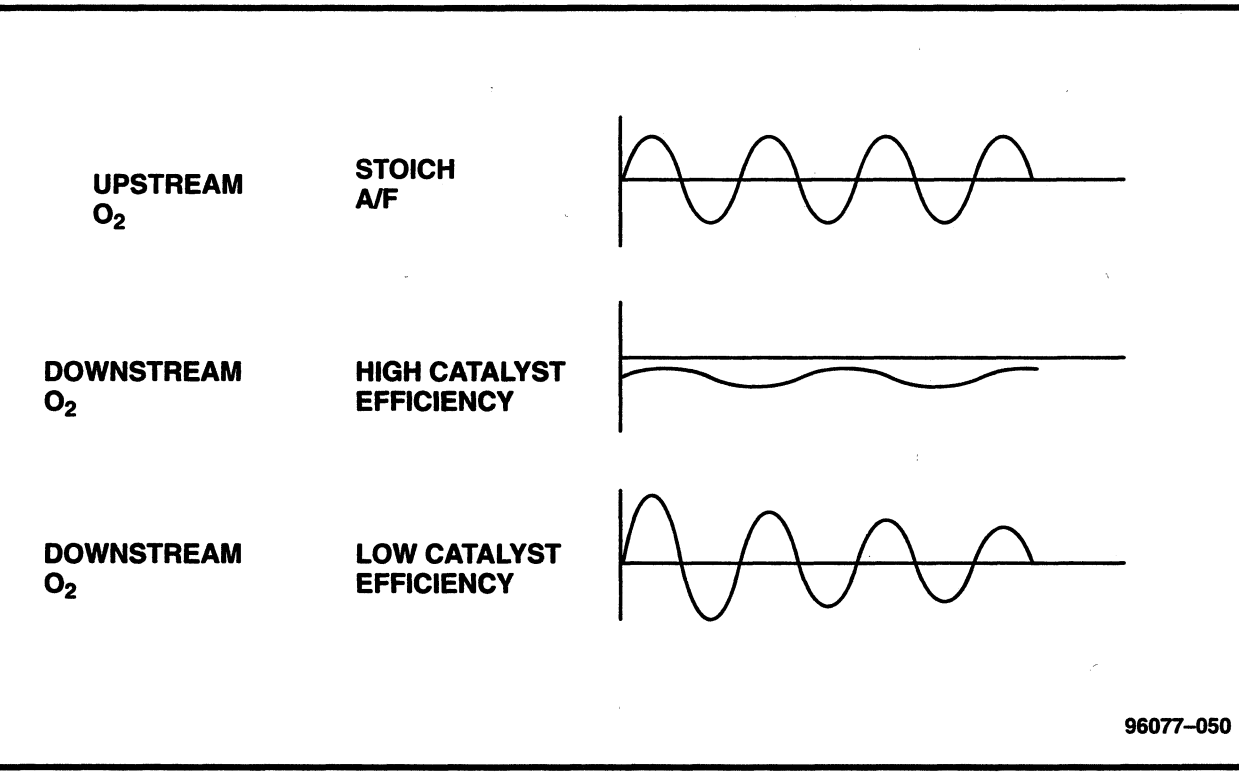


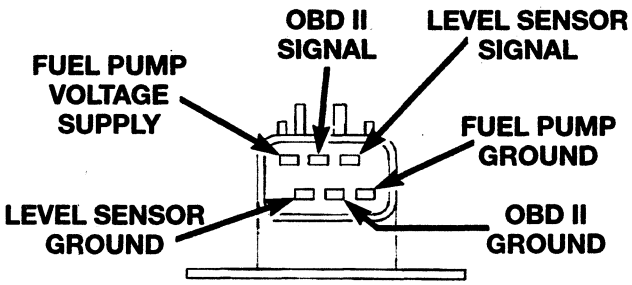
Figure 8 Upstream vs. Downstream

Fuel Level Sensor

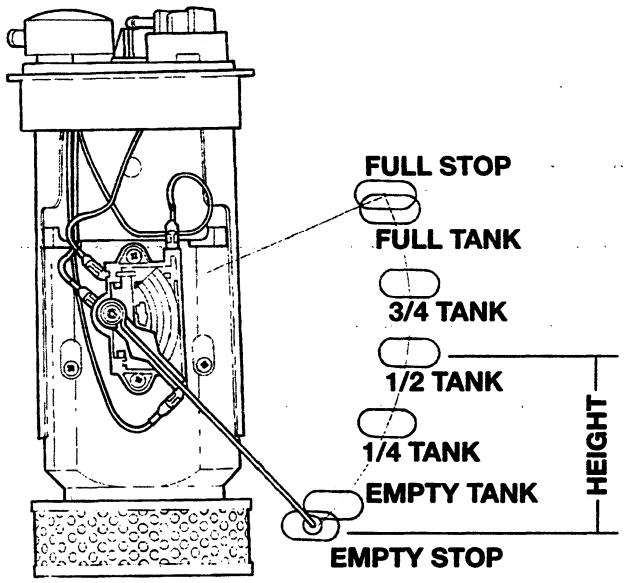
The Fuel Level Sensor has a new connector harness and pinouts (fig. 9). A second trace (resistor strip) has been added in order to provide a separate output for on-board diagnostics. The PCM uses the Fuel Level Sensor input to prevent a false setting of fuel system monitor trouble codes. The PCM may not run OBD II major monitors when the fuel level is less than 15% capacity.

NOTES:

FUEL PUMP MODULE CONNECTOR TERMINAL PIN-OUTS (VIEW INTO CONNECTOR)



FLOAT POSITION



FLOAT POSITION (HEIGHT)	RESISTANCE
205.7 mm (Sensor Full Stop)	8.0 maximum
195.6 mm (Tank Full)	12 ± 1.5 Ohms
145.0 mm (3/4 position)	29 ± 3.0 Ohms
98.3 mm (1/2 position)	44 ± 3.0 Ohms
54.1 mm (1/4 position)	58 ± 3.0 Ohms
13.9 mm (Tank Empty)	83 ± 3.0 Ohms
9.4 mm (Sensor Empty Stop)	102.25 ± 5.75 Ohms

*RESISTANCE VALUES FOR FUEL GAUGE OPERATION

96077–028

Figure 9 Roadster Fuel Level Sensor

DIAGNOSTICS

The PCM performs several diagnostic routines. They include the following:

- Oxygen sensor response
- Oxygen sensor heater diagnostics during OPEN LOOP operation
- Fuel system monitor
- Purge/evaporative system monitor
- All inputs monitored for proper voltage range
- Catalyst efficiency

The PCM continuously monitors the engine control components and when a malfunction is detected, it stores a Diagnostic Trouble Code (DTC).

Note: Refer to the Service Manual for two trip codes.

If a problem is related to an emissions component or system, the PCM illuminates the Malfunction Indicator Lamp (MIL) and the associated DTC should only be erased after verifying that the monitor runs correctly.

The Technician should access DTCs by connecting the DRB Scan Tool and accessing "Read DTCs".

Malfunction Indicator Lamp (MIL)

On the Viper this is the "Check Engine" Lamp. This term is a result of a standardization of terms as set forth in SAE document J1930. The MIL illuminates under the following conditions:

- When the PCM detects an emissions related DTC
- For approximately 2 seconds at start-up as part of the bulb check

Once the lamp is illuminated, the PCM will turn the lamp off only after both of the following conditions have occurred:

- Once the monitors have been run, the component or system must be tested good to be considered as passing a trip.
- Three consecutive good trips of a previously failed monitor or component will result in extinguishing the MIL.

DTC's that were stored can be automatically erased only after the MIL has been extinguished.

J1962 DATA LINK CONNECTOR (DLC)

The Data Link Connector (DLC) is a 16–way connector that is used to provide a means for connecting the DRB. The DLC for pre–1996 Vipers is located next to the PCM. The new DLC is located inside the vehicle, below the Instrument Panel and to the left of the Clutch Pedal (fig. 10). This change is a result of OBD II requirements.

The DRB communicates with the PCM through the DLC. This communication path also allows the DRB to communicate with other on-board components. All OBD II information is transmitted at a rate of 10.4 kilobytes per second.

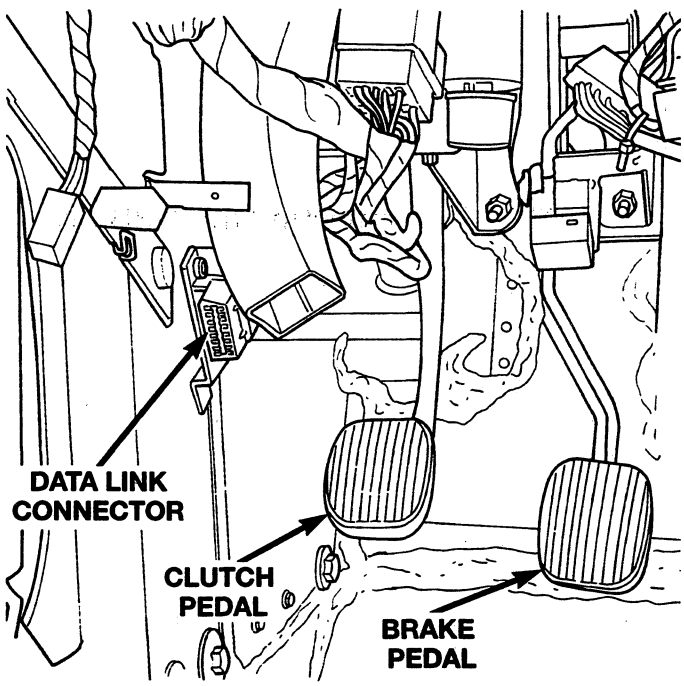


Figure 10 Data Link Connector (DLC)

MISCELLANEOUS IMPROVEMENTS

FUEL TANK

The 22 gallon fuel tank has been replaced with a re-shaped, 19 gallon, plastic fuel tank. The new fuel tank is not retro-fittable and can only fit the revised 1996 rear clip. There is an access panel inside the trunk that must be removed to gain access to the Fuel Pump Module.

REVISED REAR DUAL EXHAUST

One of the reasons for changing the exhaust system is to accommodate the additional Oxygen Sensors for OBD II. The dual rear exhaust no longer exits from the side sills, but from the rear of the vehicle (fig. 11). It has less restriction for improved performance. The pipes pass over the rear suspension and enter a tandem muffler with dual outlets on the centerline of the car. The muffler outlets have a polished ceramic coating for long-lasting quality appearance. An aluminum shield protects the trunk floor and fuel tank against heat from the exhaust system.

The rear-exit, dual exhaust is two to four decibels (dB) louder than the one used in 1995 and has a deeper, throatier sound. Back pressure has been reduced from 22 in. mercury to 11 in. mercury

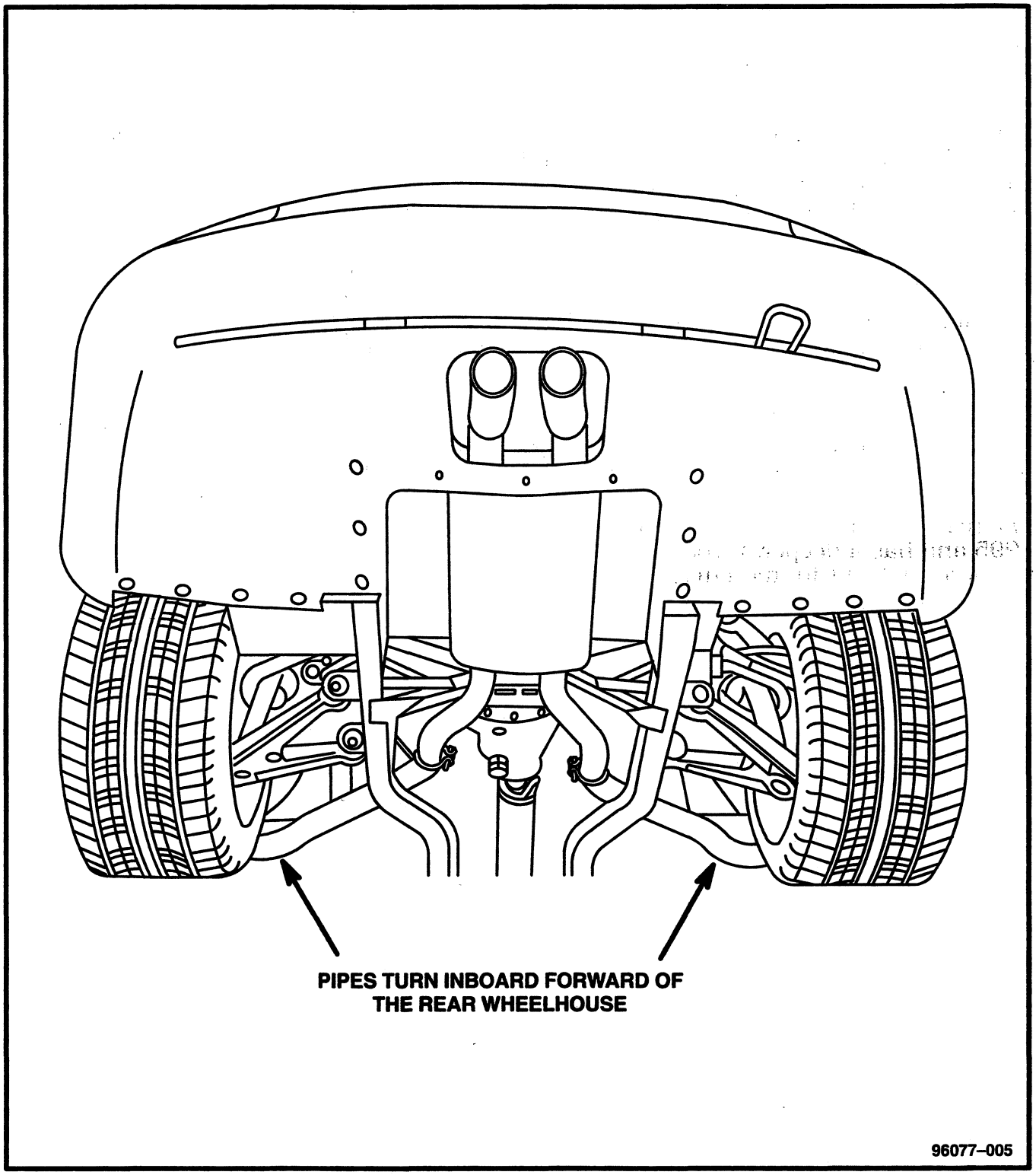


Figure 11 Viper Exhaust

BATTERY

A side post, EXIDE battery is used on 1996 Roadsters. This replaces the Delco battery used before. This is actually a running change from March 1995. The battery is located in the rear wheelhouse area. The construction of the battery is different for improved charging and long-term storage.

Follow the procedures listed below for battery charging:

1. Examine and replace the battery if physical damage and/or loss of acid is present.

2. Ensure that all connections are clean and tight at the battery, starter, and remote jumping post.

3. Check the battery voltage at the battery. To ensure an accurate measurement, the voltage should be checked only after the vehicle has sat a minimum of 24 hours with the engine off. If this is not possible, then turn the headlights on for one minute, then turn them off and read the voltage after one minute. The battery should be charged whenever the voltage drops below 12.40 volts. When charging the battery, the positive connection is to be made at the remote jumping terminal under the protective cover. The grounding stud is the preferred location for the negative (ground) connection.

4. Charge the battery with at least a 10 amp automatic type charger on the Maintenance Free setting or a High Rate charger on the Low setting. The recommended charging times are listed for each voltage range (Table Two).

5. If the battery is completely discharged (i.e., less than 10.0 volts), it may take at least two hours for the battery to begin accepting a charge. If the battery does not accept a charge after two hours, it should be replaced.

6. If the battery becomes hot, smells badly, and/or the amperage on the High Rate charger does not drop after eight hours, turn the charger off and let the battery cool down. Do <u>not</u> attempt to recharge.

Table 2 Battery Charging Times

BATTERY VOLTAGE	CHARGE TIME
12.40 or higher	No charge needed
12.20 – 12.39	16 hours
Less than 12.20	24 hours

Fuel and Ignition

NOTES:

1996 COUPE FUEL AND SPARK CONTROL

Fuel and spark control is very similar for the Coupe compared to the Roadster. You may reference the Roadster section of this book for detailed information. There are some differences that you must be aware of when making any comparison between fuel and spark control on the Roadster and Coupe. These differences are covered in this section.

BATTERY

The battery used on the Coupe is similar to the one on the Roadster. The difference between the two is that a Battery Temperature Sensor is used on the Coupe. The Battery Temperature Sensor is located in the battery tray housing and is used to sense battery temperature (fig. 12). The voltage output of the sensor ranges between 0.5 volts to approximately 4.9 volts. This represents temperature data which, along with data from monitored line voltage, is used by the PCM to vary the battery charging rate. This is done by cycling the ground path of the Generator to control the strength of the rotor magnetic field. The PCM then compensates and regulates Generator current output accordingly.

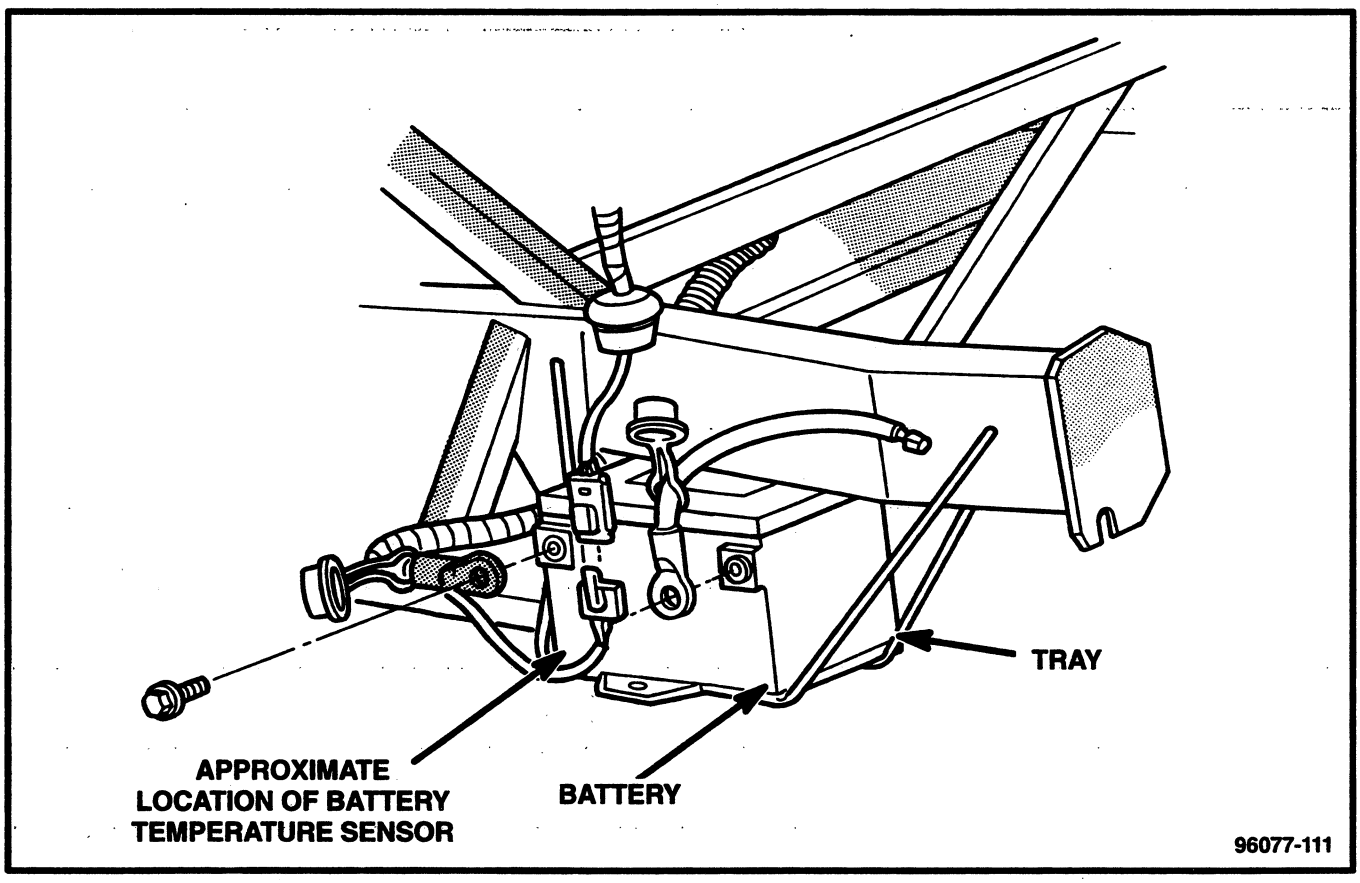


Figure 12 Battery Temperature Sensor

For example, at high temperatures, the PCM regulates the voltage output of the generator at a lower level. During cold temperature conditions, the PCM permits the output of the generator to increase. The PCM can determine the need for increase or decrease by way of the Battery Temperature Sensor.

The Battery Temperature Sensor can be tested for continuity at the two-wire pigtail that connects the sensor to the engine harness. At a temperature of between 75 to 85 degrees Fahrenheit the resistance across the sensor should be 9K to 10K Ohms.

NOTES:

GENERATOR

The Generator assembly has been relocated so that it is slightly lower and closer inboard to the engine (fig. 13). The mounting bracket has also been reduced in size. This was done to permit the integration of the Throttle Synchronization Shaft.

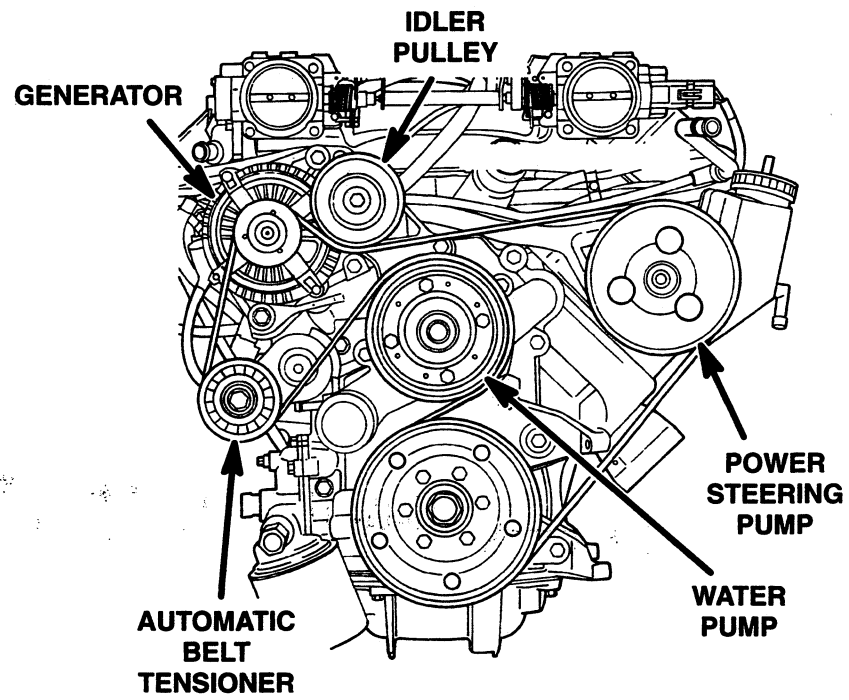


Figure 13 Generator Location

Operation of the generator is the same as before except for voltage regulation. On the 1996 Roadster the amount of DC voltage produced by the generator is controlled by a voltage regulator internal to the generator. On the Coupe, voltage regulation is controlled by an Electronic Voltage Regulator (EVR), or field control circuitry, contained within the PCM (fig. 14). This circuitry is connected in series with the second rotor field terminal and ground. If the generator fails due to an EVR circuitry malfunction, the PCM will need to be replaced.

Voltage Regulation

The PCM maintains system voltage between 12.9 and 15.0 volts. The voltage that the PCM tries to maintain for the charging system is referred to as "control voltage". The control voltage is determined from the Battery Temperature Sensor input along with the monitored system (or line) voltage. The control voltage is compared continuously to monitored system voltage while the engine is running. If the sensed voltage is less than the control voltage, the ground path of the Generator is left on longer, thereby increasing the strength of the magnetic field. Likewise, if sensed voltage is greater than the chosen control voltage, the PCM does just the opposite.

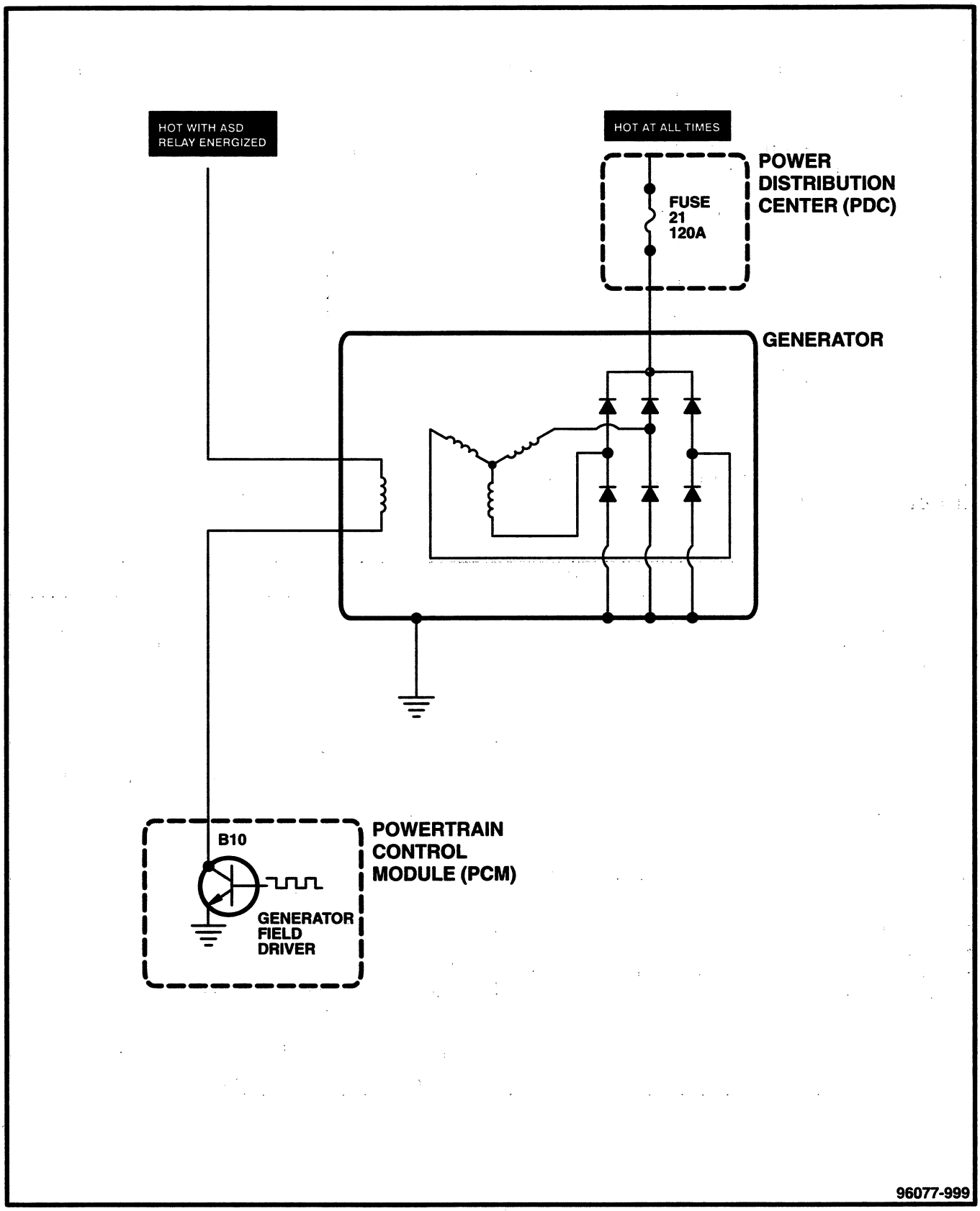


Figure 14 Generator Field Control Circuit

Diagnostic Trouble Codes (DTC's)

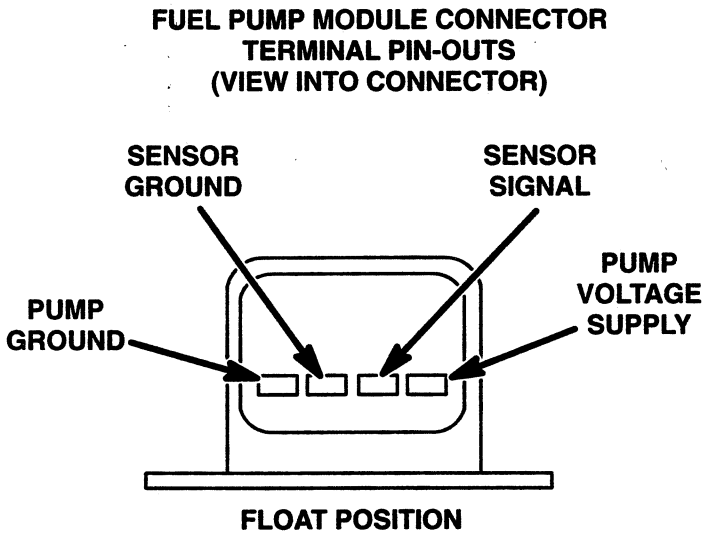
There are five Diagnostic Trouble Codes (DTC's) added to the diagnostic capabilities of the PCM related to the battery and generator. These codes will appear on the DRB Scan Tool as follows:

- "Generator field not switching properly"
- "Battery temp voltage low"
- "Battery temp voltage high"
- "Charging system voltage too high"
- "Charging system voltage too low"

Refer to the appropriate Diagnostic Procedures Manual for further information.

FUEL PUMP MODULE AND FUEL LEVEL SENSOR

As previously explained, the Fuel Level Sensor on the Roadster uses a dual trace to transmit fuel level status to the PCM. On the Coupe, the Fuel Level Sensor has been redesigned (fig. 15). There is no extra resistor strip used for dual trace output. The sensor is wired directly to the PCM. A low fuel level results in the PCM disabling OBD II major monitors.



FLOAT POSITION (HEIGHT)	RESISTANCE
199.6 mm (Sensor Full Stop)	4.0 maximum
182.4 mm (Tank Full)	12.0 ± 1.5 Ohms
138.2 mm (3/4 position)	28.5 ± 3.0 Ohms
92.2 mm (1/2 position)	42.2 ± 3.0 Ohms
48.0 mm (1/4 position)	59.0 ± 3.0 Ohms
20.0 mm (Tank Empty)	90.0 ± 3.0 Ohms
3.3 mm (Sensor Empty Stop)	102.0 ± 5.75 Ohms

*RESISTANCE VALUES FOR FUEL GAUGE OPERATION

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Figure 15 Coupe Fuel Level Sensor Connector and Float Positions

JTEC

The JTEC PCM for the Coupe is located on the left front frame rail, beneath the PDC (fig. 16). The addition of the Power Distribution Center has affected the circuitry of the JTEC PCM as far as wire routing is concerned. A comparison of the Coupe PCM schematic to the Roadster schematic reveals these differences (figs. 17 thru 20).

Note: Generator Field Driver Circuit not shown for simplicity.

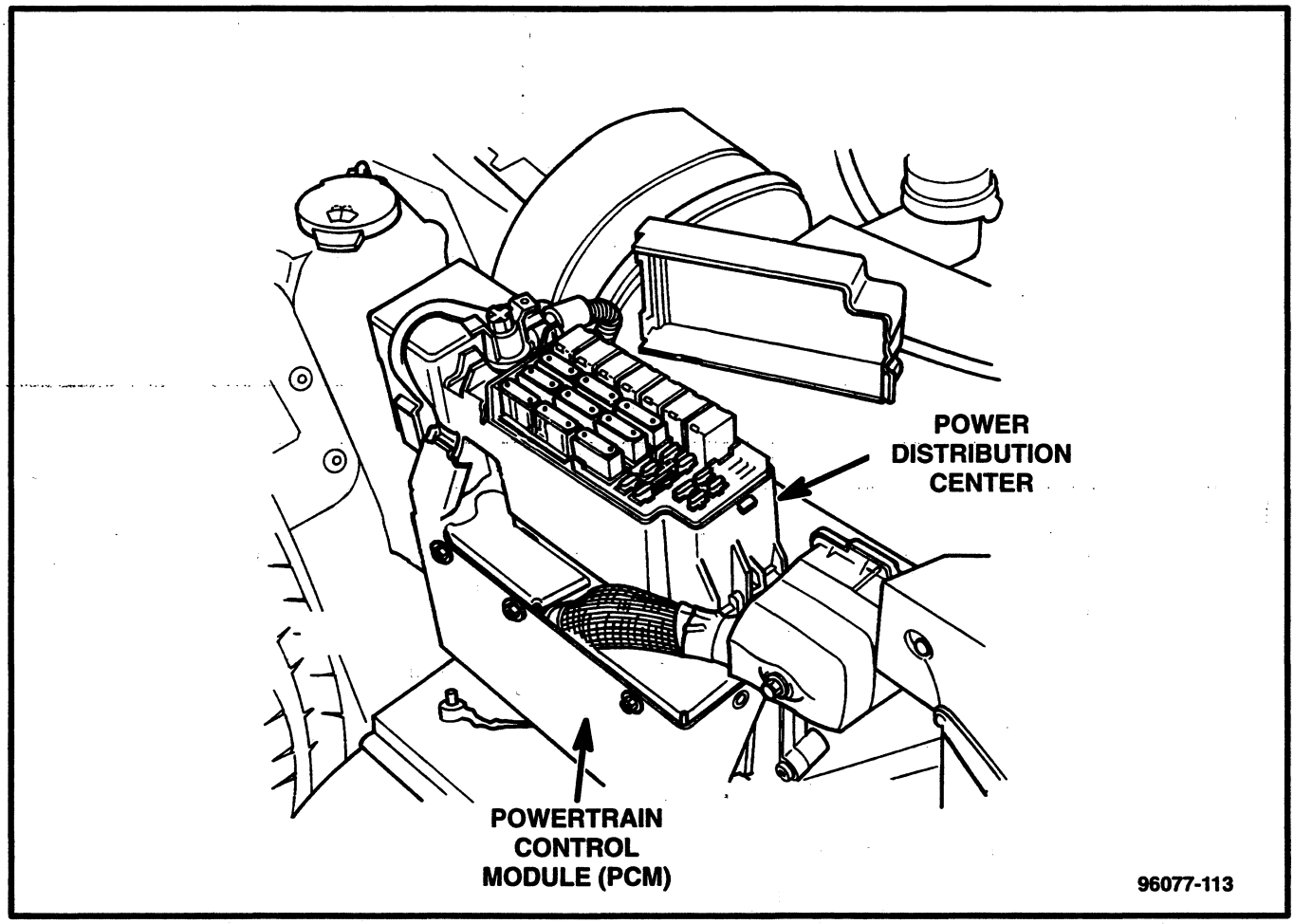

Figure 16 Coupe JTEC PCM

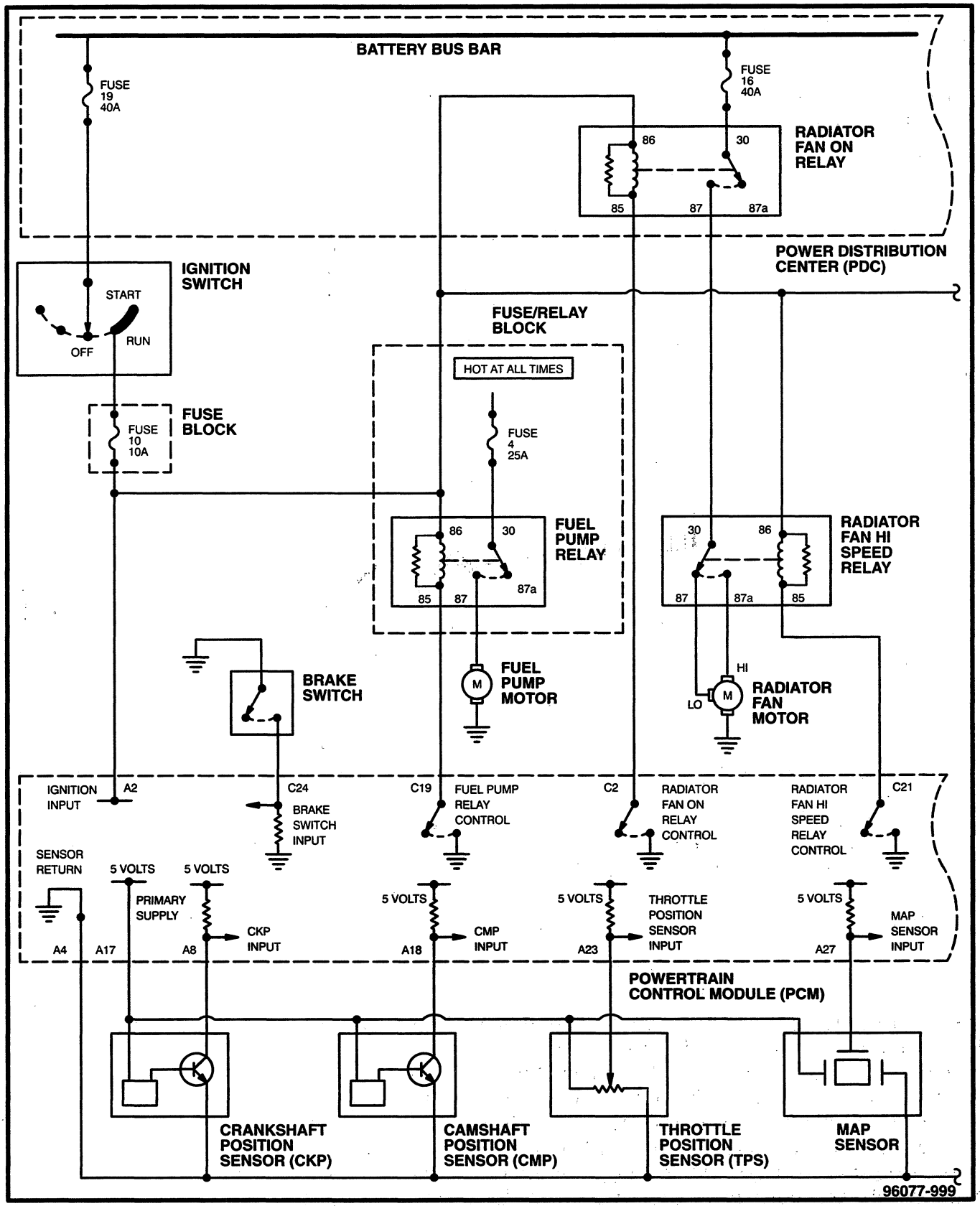

Figure 17 1996 Viper Coupe Powertrain Control Module Schematic

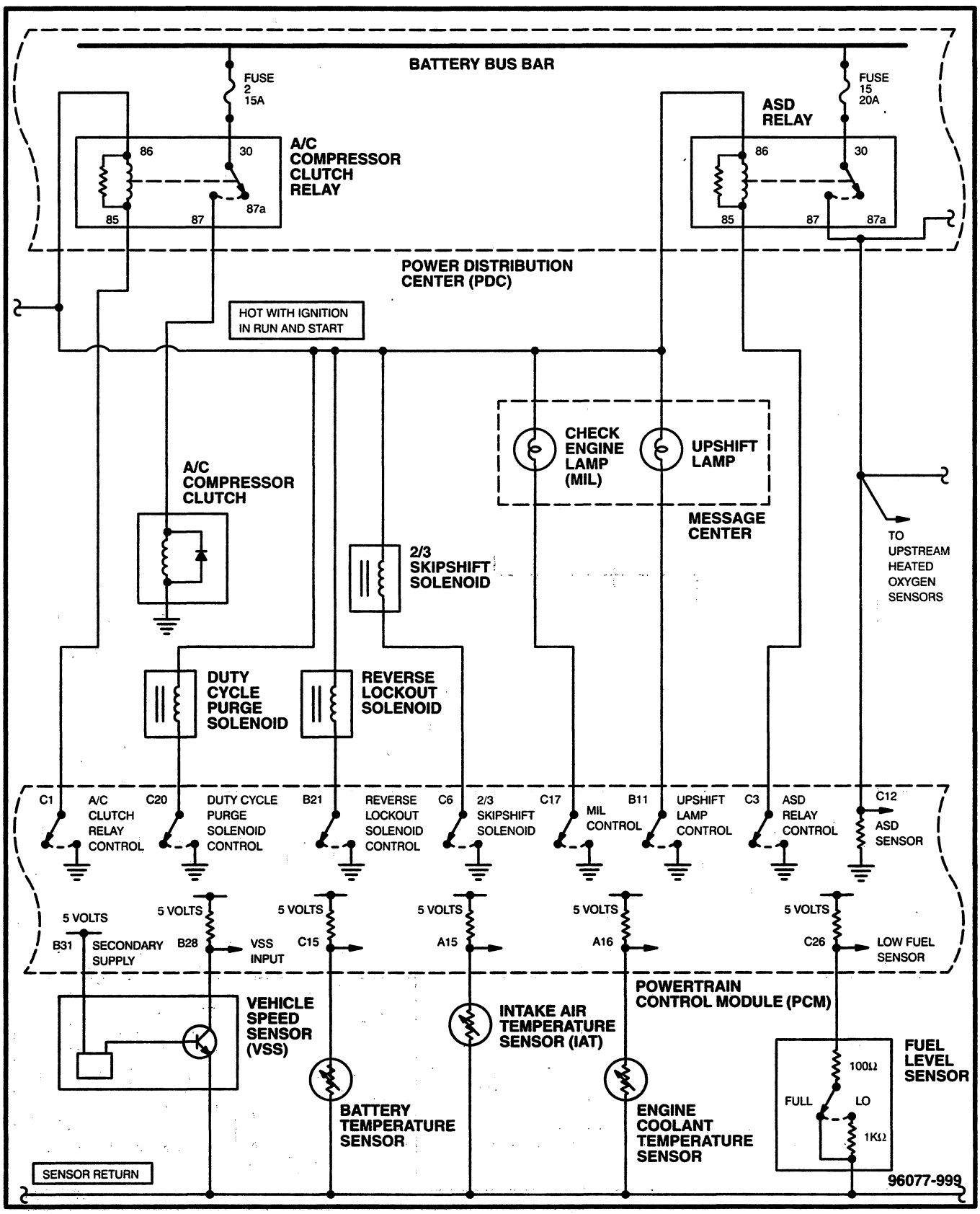

Figure 18 1996 Viper Coupe Powertrain Control Module Schematic

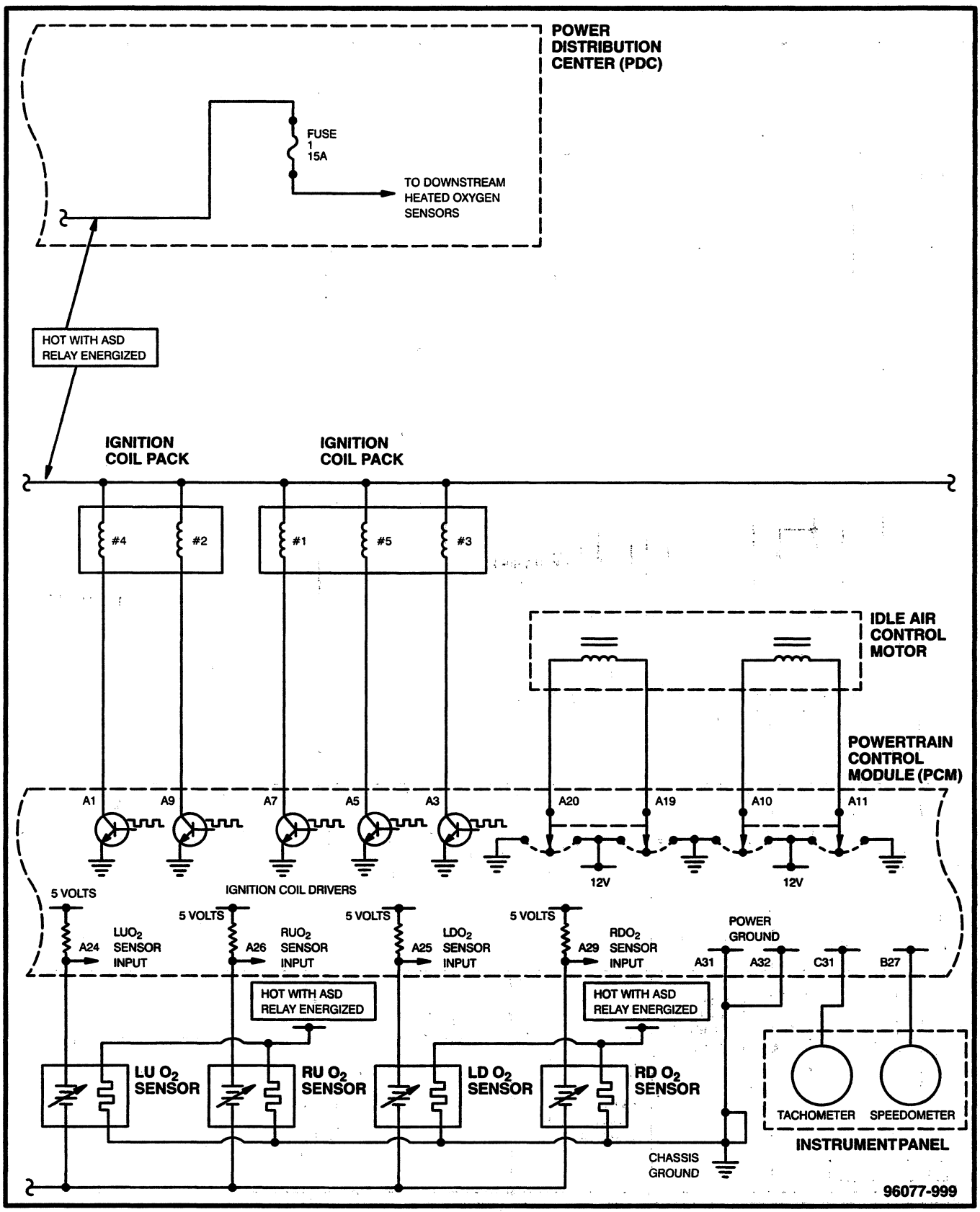

Figure 19 1996 Viper Coupe Powertrain Control Module Schematic

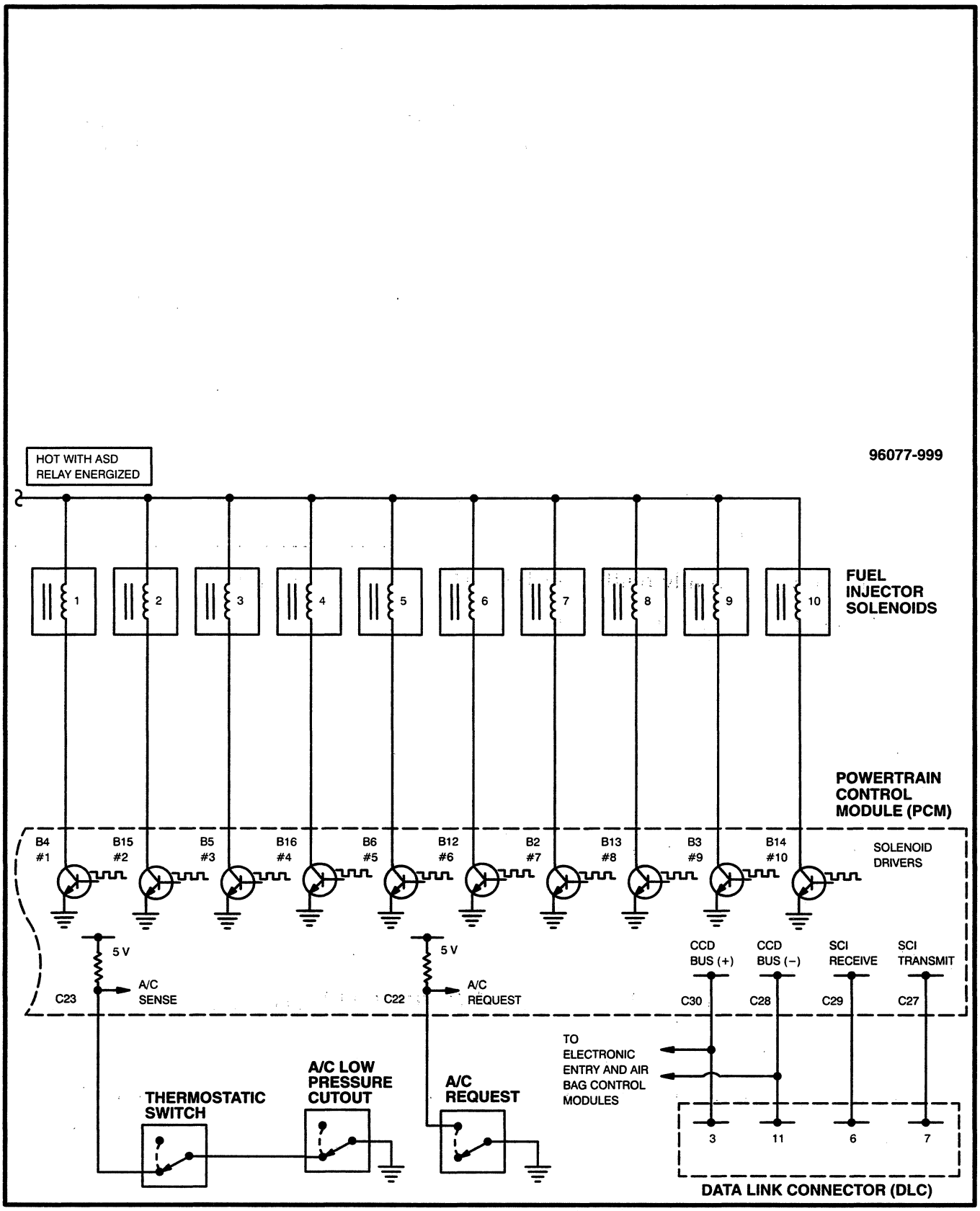

Figure 20 1996 Viper Coupe Powertrain Control Module Schematic

ACTIVITY SEVEN
FUEL CONTROL ANALYSIS

For this Activity, you will use the DRB III Scan Tool to access various fuel control monitors and systems. You Instructor will be demonstrating how to effectively use the DRB to assess engine operation. As you progress through this Activity, answer all questions.

Task One:

1. Connect the DRB to the classroom vehicle and place the ignition to RUN.

2. Access the Actuator Tests screen.

3. Perform actuator tests on the various engine components and answer the following questions:

   What type of components are you checking for proper operation of by performing an actuator test?

   PCM OUTPUTS

   What are you actually testing for by performing an actuator test?

   PROPER CIRCUIT OPERATION

4. When you have finished the actuator tests, access the O2 Heater Test screen.

5. Start the vehicle.

6. Press number six on the DRB.

7. As the O2 Sensor is being tested, observe the voltage values change.

8. Access the Monitor Display screen.

9. What are the two options given to observe adaptive memory?

   RIGHT BANK ADAPTIVE AND LEFT BANK ADAPTIVE

10. Select Right Bank Adaptive Memory.

    How many adaptive memory cells are used for the right bank O2 Sensor?

    22

11. Go to the left bank adaptive memory.

    How many adaptive memory cells are used for the left bank O2 Sensor? **22**

12. Perform a Wiggle Test with the DRB.

    How will the engine RPM be affected if the wiggle test reveals no malfunctions?

    ENGINE RPM WILL FLUCTUATE

13. Perform a Fuel Injector Kill Test and record the RPM drop for each injector below:

INJECTOR	IDLE RPM	RPM DROP DURING KILL TEST
#1		
#2		
#3		
#4		
#5		
#6		
#7		
#8		
#9		
#10		

Task Two:

14. Shut off the engine and actuate the Generator field driver circuit with the DRB.

15. Backprobe the ASD Relay output circuit at the back of the Generator.

16. What is your voltage measurement?

    ACTUAL VOLTAGE READ, SHOULD BE ABOVE 10.0 VOLTS

17. Backprobe the Generator Field Driver circuit at the back of the Generator.

18. What is your voltage measurement now?

    SHOULD VARY FROM HIGH TO LOW

19. Is this indicative of proper circuit operation?

    YES NO

20. Place a check mark next to all the true statements below:

_____ The Battery Temperature Sensor is varying the length of time that the ground circuit is completed to the Generator rotor field.

__X__ The PCM on the Coupe is controlling the length of time that ground is supplied to the field circuit of the Generator, based on Battery Temperature Sensor input.

_____ If the Battery Temperature Sensor fails, the PCM will utilize the Intake Air Temperature Sensor in its place.

_____ On the Roadster, the PCM uses the Ambient Air Temperature Sensor to control the Generator output.

__X__ On the Roadster, Generator output is determined by an internal regulator circuit.

21. Suppose you were troubleshooting DTC 41 (Generator Filed Not Switching Properly) and during your procedures you obtained the same results as in this Activity. What action should you take?

PERFORM A WIGGLE TEST ON THE HARNESS BETWEEN THE GENERATOR AND PCM

Task Three:

22. Disconnect the Battery Temperature Sensor pigtail harness from the engine harness.

23. Measure the resistance across the pigtail connector.

24. Record your reading here:

SHOULD BE ABOUT 9K TO 10K OHMS AT 75 - 80 DEGREES FAHRENHEIT

25. If the resistance is above or below specification, replace the sensor.

26. Return all equipment to normal condition.

Fuel and Ignition

NOTES:

Fuel and Ignition

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Fuel and Ignition

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Technical Service Training is offered year-round, tuition-free, at these Chrysler Corporation Training Centers. The Centers are designed to advance the technical knowledge of Chrysler Corporation authorized Dealers and their personnel. Employees from Fleet Accounts, Municipal and Government Agencies are invited also.

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