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Product: 2000-2001 Jeep Cherokee (XJ) Service Repair Workshop Manual

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1.0 INTRODUCTION

The procedures contained in this manual include specifications, instructions, and graphics needed to diagnose the PCM Powertrain System. The diagnostics in this manual are based on the failure condition or symptom being present at time of diagnosis.

Please follow the recommendations below when choosing your diagnostic path.

1. First make sure the DRBIII® is communicating with the appropriate modules; ie., if the DRBIII® displays a “No Response” condition, you must diagnose this first before proceeding.
2. Read DTC's (diagnostic trouble codes) with the DRBIII®.
3. If no DTC's are present, identify the customer complaint.
4. Once the DTC or customer complaint is identified, locate the matching test in the Table of Contents and begin to diagnose the symptom.

All component location views are in Section 8.0. All connector pinouts are in Section 9.0. All system schematics are in Section 10.0.

An * placed before the symptom description indicates a customer complaint.

When repairs are required, refer to the appropriate service manual for the proper removal and repair procedure.

Diagnostic procedures change every year. New diagnostic systems may be added; carryover systems may be enhanced. **READ THIS MANUAL BEFORE TRYING TO DIAGNOSE A VEHICLE DTC.** It is recommended that you review the entire manual to become familiar with all new and changed diagnostic procedures.

After using this book, if you have any comments or recommendations, please fill out the form at the back of the book and mail it back to us.

1.1 SYSTEM COVERAGE

This diagnostic procedures manual covers the 2001 XJ Jeep Cherokee with 4.0L engines.

1.2 SIX-STEP TROUBLESHOOTING PROCEDURE

Diagnosis of the powertrain control module (PCM) is done in six basic steps:

- verification of complaint
- verification of any related symptoms
- symptom analysis
- problem isolation
- repair of isolated problem
- verification of proper operation

2.0 IDENTIFICATION OF SYSTEM

The Powertrain Control Module (PCM) monitors and controls:

- Fuel system
- Ignition system
- charging system
- speed control system
- cooling system

3.0 SYSTEM DESCRIPTION AND FUNCTIONAL OPERATION

3.1 GENERAL DESCRIPTION

These Sequential Fuel Injection (SFI) engine systems have the latest in technical advances. The on-board Euro Stage III OBD diagnostics incorporated with the powertrain control module (PCM) are intended to assist the field technician in repairing vehicle problems by the quickest means.

3.2 FUNCTION OPERATION

3.2.1 FUEL CONTROL

The PCM controls the air/fuel ratio of the engine by varying fuel injector on time. Mass air flow is calculated using the speed density method using engine speed, manifold absolute pressure, and air temperature change.

Different fuel calculation strategies are used dependent on the operational state of the engine. During crank mode, a prime shot fuel pulse is delivered followed by fuel pulses determined by a crank time strategy. Cold engine operation is determined via an open loop strategy until the O2 sensors have reached operating temperature. At this point, the strategy enters a closed loop mode where fuel requirements are based upon the state of the O2 sensors, engine speed, MAP, throttle position, air temperature, battery voltage, and coolant temperature.

3.2.2 ON-BOARD DIAGNOSTICS

The PCM has been programmed to monitor many different circuits of the fuel injection system. This monitoring is called “on-board diagnosis.”

Certain criteria, or “arming conditions,” must be met for a DTC to be entered into the PCM memory. The criteria may be a range of: engine rpm, engine temperature, and/or input voltage to the PCM. If a problem is sensed with a monitored circuit, and all

GENERAL INFORMATION

of the criteria or arming conditions are met, then a DTC will be stored in the PCM.

It is possible that a DTC for a monitored circuit may not be entered into the PCM memory even though a malfunction has occurred. This may happen because one of the trouble code criteria (arming conditions) have not been met.

The PCM compares input signal voltages from each input device with specifications (the established high and low limits of the range) that are programmed into it for that device. If the input voltage is not within specifications and other DTC criteria (arming conditions) are met, a DTC will be stored in the PCM memory.

The On Board Diagnostics have evolved to the third Generation of Diagnostics referred to as Euro Stage III OBD. These Euro Stage III OBD Diagnostics control the functions necessary to meet the requirements of Euro Stage III OBD regulation. These requirements specify the inclusion of a Malfunction Indicator Light (MIL) located on the instrument panel for all 1994 and subsequent model-year passenger cars, light duty trucks, and medium-duty vehicles. The purpose of the MIL is to inform the vehicle operator in the event of a malfunction of any emission system or component.

The following table summarizes the various Euro Stage III OBD monitors operation.

EURO STAGE III OBD MONITOR INFORMATION

Comprehensive Components Monitor	Major Monitors Non Fuel Control & Non Misfire	Major Monitors Fuel Control & Misfire
Run constantly Includes All Engine Hardware - Sensors, Switches, Solenoids, etc.	Run Once Per Trip Monitors Entire Emission System	Run Constantly Monitors Entire System
One Trip Faults - Turns On The MIL and Sets DTC After One Failure	Two Trip Faults - Turns On The MIL and Sets DTC After Two Consecutive Failures	Two Trip Faults - Turns On The MIL and Sets DTC After Two Consecutive Failures
Priority 3	Priority 1 or 3	Priority 2 or 4
All Checked For Continuity Open Short To Ground Short To Voltage	Done Stop Testing = Yes Oxygen Sensor Heater Oxygen Sensor Response	<p>Fuel Control Monitor Monitors Fuel Control System For:</p> <p style="padding-left: 40px;">Fuel System Lean Fuel System Rich</p> <p>Requires 3 Consecutive <i>Fuel System Good Trips</i> To Extinguish The MIL</p>
Inputs Checked For Rationality	Catalytic Converter Efficiency Except EWMA - up to 6 tests per trip and a one trip fault	
Outputs Checked For Functionality	EGR System Evaporative Emission System	<p>Misfire Monitor Monitors For Engine Misfire at:</p> <p style="padding-left: 40px;">1000 RPM Counter (Type B) **200 RPM Counter (Type A)</p> <p>Requires 3 Consecutive <i>Misfire Good Trips</i> To Extinguish the MIL</p> <p>**Type A misfire is a one trip failure. The MIL will illuminate and blink at the first failure.</p>
Requires 3 Consecutive <i>Global/Alternate Good Trips</i> to Extinguish the MIL*	Requires 3 Consecutive <i>Global Good Trips</i> to Extinguish the MIL*	
*40 Warm Up Cycles are required to erase DTC's after the MIL has been extinguished.		

GENERAL INFORMATION

3.2.3 TRANSMISSION CONTROL

The automatic transmission for this vehicle is an AW4 model controlled by a separate controller. Further explanation of the transmission control and operation can be found in the AW4 transmission diagnostic manual.

3.2.4 OTHER CONTROLS

CHARGING SYSTEM

The charging system is turned on when the engine is started and ASD relay energized. When the ASD relay is on, ASD output voltage is supplied to the ASD sense circuit at the PCM. This voltage is connected in some cases, through the PCM and supplied to one of the generator field terminals (Gen Source +). All others, the Gen field is connected directly to the ASD output voltage. The amount of current produced by the generator is controlled by the Electronic Voltage Regulator (EVR) circuitry, in the PCM. A battery temperature sensor, located either in the battery tray, using the ambient sensor, or in the PCM itself, is used to sense battery temperature. This temperature along with sensed line voltage, is used by the PCM to vary the battery charging rate. This is done by cycling the ground path to the other generator field terminal (Gen field driver).

SPEED CONTROL SYSTEM

The PCM controls vehicle speed by operation of the speed control servo vacuum and vent solenoids. Energizing the vacuum solenoid applies vacuum to the servo to increase throttle position. Operation of the vent solenoid slowly releases the vacuum allowing throttle position to decrease. A special dump solenoid allows immediate release of throttle position caused by braking, cruise control switch turned off, shifting into neutral, excessive RPM (tires spinning) or ignition off.

LEAK DETECTION PUMP SYSTEM

The leak detection pump is a device that pressurizes the evaporative system to determine if there are any leaks. When certain conditions are met, the PCM will activate the pump and start counting pump strokes. If the pump stops within a calibrated number of strokes, the system is determined to be normal. If the pump does not stop or stops too soon, a DTC will be set.

3.2.5 PCM OPERATING MODES

As input signals to the powertrain control module (PCM) change, the PCM adjusts its response to output devices. For example, the PCM must calculate a different injector pulse width and ignition timing for idle than it does for wide open throttle.

There are several different modes of operation that determine how the PCM responds to the various input signals.

There are two types of engine control operation: **open loop** and **closed loop**.

In **open loop** operation, the PCM receives input signals and responds according to preset programming. Inputs from the heated oxygen sensors are not monitored.

In **closed loop** operation, the PCM monitors the inputs from the heated oxygen sensors. This input indicates to the PCM whether or not the calculated injector pulse width results in the ideal air-fuel ratio of 14.7 parts air to 1 part fuel. By monitoring the exhaust oxygen content through the oxygen sensor, the PCM can fine tune injector pulse width. Fine tuning injector pulse width allows the PCM to achieve the lowest emission levels while maintaining optimum fuel economy.

The engine start-up (crank), engine warm-up, and wide open throttle modes are open loop modes. Under most operating conditions, closed loop modes occur with the engine at operating temperature.

IGNITION SWITCH ON (ENGINE OFF) MODE

When the ignition switch activates the fuel injection system, the following actions occur:

1. The PCM determines atmospheric air pressure from the MAP sensor input to determine basic fuel strategy.
2. The PCM monitors the engine coolant temperature sensor and throttle position sensor input. The PCM modifies fuel strategy based on this input.

When the key is in the "on" position and the engine is not running (zero rpm), the auto shut-down relay and fuel pump relay are not energized. Therefore, voltage is not supplied to the fuel pump, ignition coil, and fuel injectors.

Engine Start-up Mode — This is an open loop mode. The following actions occur when the starter motor is engaged:

1. The auto shutdown and fuel pump relays are energized. If the PCM does not receive the camshaft and crankshaft signal within approximately one second, these relays are de-energized.
2. The PCM energizes all fuel injectors until it determines crankshaft position from the camshaft and crankshaft signals. The PCM determines crankshaft position within one engine revolution. After the crankshaft position has been determined, the PCM energizes the fuel injectors in sequence. The PCM adjusts the injector pulse width and synchronizes the fuel injectors by controlling the fuel injectors' ground paths.

Once the auto shutdown and fuel pump relays have been energized, the PCM determines the fuel injector pulse width based on the following:

- engine coolant temperature
- manifold absolute pressure
- intake air temperature
- engine revolutions
- throttle position

The PCM determines the spark advance based on the following:

- engine coolant temperature
- crankshaft position
- camshaft position
- intake air temperature
- manifold absolute pressure
- throttle position

Engine Warm-Up Mode – This is an open loop mode. The PCM adjusts injector pulse width and controls injector synchronization by controlling the fuel injectors' ground paths. The PCM adjusts ignition timing and engine idle speed. The PCM adjusts the idle speed by controlling the idle air control motor.

Cruise or Idle Mode – When the engine is at normal operating temperature, this is a closed loop mode. During certain idle conditions, the PCM may enter into a variable idle speed strategy. At this time, the PCM adjusts engine speed based on the following inputs:

- throttle position
- battery voltage
- engine coolant temperature

Acceleration Mode – This is a closed loop mode. The PCM recognizes an increase in throttle position and a decrease in Manifold Vacuum as engine load increases. In response, the PCM increases the injector pulse width to meet the increased load.

Deceleration Mode – This is a closed loop mode. The PCM recognizes a decrease in throttle position and an increase in Manifold Vacuum as engine load decreases. In response, the PCM decreases the injector pulse width to meet the decreased load.

Wide Open Throttle Mode – This is an open loop mode. The throttle position sensor notifies the PCM of a wide open throttle condition. The PCM adjusts injector pulse width to supply a predetermined amount of additional fuel.

3.2.6 NON-MONITORED CIRCUITS

The PCM does not monitor the following circuits, systems, and conditions even though they could have malfunctions that result in driveability problems. A DTC may not be displayed for the following conditions. However, problems with these systems

may cause a DTC to be displayed for other systems. For example, a fuel pressure problem will not register a DTC directly, but could cause a rich or lean condition. This could cause an oxygen sensor, fuel system, or misfire monitor DTC to be stored in the PCM.

Engine Timing – The PCM cannot detect an incorrectly indexed timing chain, camshaft sprocket, or crankshaft sprocket. The PCM also cannot detect an incorrectly indexed distributor.(*)

Fuel Pressure – Fuel pressure is controlled by the fuel pressure regulator. The PCM cannot detect a clogged fuel pump inlet filter, clogged in-line filter, or a pinched fuel supply.(*)

Fuel Injectors – The PCM cannot detect if a fuel injector is clogged, the pintle is sticking, or the wrong injectors are installed.(*)

Fuel Requirements – Poor quality gasoline can cause problems such as hard starting, stalling, and stumble. Use of methanol-gasoline blends may result in starting and driveability problems. (See individual symptoms and their definitions in Section 6.0 (Glossary of Terms).

PCM Grounds – The PCM cannot detect a poor system ground. However, a diagnostic trouble code may be stored in the PCM as a result of this condition.

Throttle Body Air Flow – The PCM cannot detect a clogged or restricted air cleaner inlet or filter element.(*)

Exhaust System – The PCM cannot detect a plugged, restricted, or leaking exhaust system.(*)

Cylinder Compression – The PCM cannot detect uneven, low, or high engine cylinder compression.(*)

Excessive Oil Consumption – Although the PCM monitors the exhaust stream oxygen content through the oxygen sensor when the system is in a closed loop, it cannot determine excessive oil consumption.

(*)**NOTE:** Any of these conditions could result in a rich or lean condition causing an oxygen sensor DTC to be stored in the PCM, or the vehicle may exhibit one or more of the driveability symptoms listed in the Table of Contents.

3.2.7 SKIS OVERVIEW

The Sentry Key Immobilizer System (SKIS) is an immobilizer system design to prevent unauthorized vehicle operation. The system consists of a Sentry Key Immobilizer Module (SKIM), ignition key(s) equipped with a transponder chip and engine controller. When the ignition switch is turned on, the SKIM interrogates the ignition key. If the ignition key is "Valid" or "Invalid" the SKIM sends a CCD Bus message to the engine controller indicating ignition key status valid ignition key. Upon receiv-

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ing this message the PCM will terminate engine operation or allow the engine to continue to operate.

3.2.8 SKIM ON-BOARD DIAGNOSTICS

The SKIM has been programmed to transmit and monitor many different coded messages as well as CCD Bus messages. This monitoring is called “On Board Diagnosis”.

Certain criteria must be met for a diagnostic trouble code to be entered into the SKIM memory. The criteria may be a range of; Input voltage, CCD Bus message, or coded messages to the SKIM. If all of the criteria for monitoring a circuit or function are met and a fault is sensed, a DTC will be stored in the SKIM memory.

3.2.9 SKIS OPERATION

When ignition power is supplied to the SKIM, the SKIM performs an internal self-test. After the self-test is completed, the SKIM energizes the antenna (this activates the transponder chip) and sends a challenge to the transponder chip. The transponder chip responds to the challenge by generating an encrypted response message using the following:

Secret Key - This is an electronically stored value (identification number) that is unique to each SKIS. The secret key is stored in the SKIM, PCM and all ignition key transponders.

Challenge - This is a random number that is generated by the SKIM at each ignition key cycle.

The secret key and challenge are the two variables used in the algorithm that produces the encrypted response message. The transponder uses the crypto algorithm to receive, decode and respond to the message sent by the SKIM. After responding to the coded message, the transponder sends a transponder I.D. message to the SKIM. The SKIM compares the transponder I.D. to the available valid key codes in the SKIM memory (8 key maximum). After validating the ignition key the SKIM sends CCD Bus message called a “Seed Request” to the engine controller then waits for a PCM response. If the PCM does not respond, the SKIM will send the seed request again. After three failed attempts the SKIM will stop sending the seed request and store a trouble code. If the PCM sends a seed response, the SKIM sends a valid/invalid key message to the PCM. This is an encrypted message that is generated using the following:

VIN - Vehicle Identification Number

Seed - This is a random number that is generated by the PCM at each ignition key cycle.

The VIN and seed are the two variables used in the rolling code algorithm that encrypts the “valid/invalid key” message. The PCM uses the rolling code algorithm to receive, decode and respond to the valid/invalid key message sent by the SKIM. After sending the valid/invalid key message the SKIM waits 3.5 seconds for a PCM status message from the PCM. If the PCM does not respond with a valid key message to the SKIM, a fault is detected and a trouble code is stored.

The SKIS incorporates a warning lamp located in the instrument cluster. The lamp receives power and ground from the instrument cluster. The lamp is actuated when the SKIM sends a CCD Bus message to the instrument cluster requesting the lamp on. The SKIM will request lamp operation for the following:

- bulb checks at ignition on
- to alert the vehicle operator to a SKIS malfunction
- customer key programming mode

For all faults except transponder faults and VIN mismatch, the lamp remains on steady. In the event of a transponder fault the light flashes at a rate of 1 Hz (once per second). If a fault is present the lamp will remain on or flashing for the complete ignition cycle. If a fault is stored in SKIM memory which prevents the system from operating properly, the PCM will allow the engine to start and run (for 2 seconds) up to six times. After the sixth attempt, the PCM will not allow the engine to start.

3.2.10 PROGRAMMING THE POWERTRAIN CONTROL MODULE

Important Note: Before replacing the PCM for a failed driver, control circuit or ground circuit, be sure to check the related component/circuit integrity for failures not detected due to a double fault in the circuit. Most PCM driver/control circuit failures are caused by internal failure to components (i.e. relay and solenoids) and short circuits (i.e. 12-volt pull-ups, drivers and ground sensors). These failures are difficult to detect when a double fault has occurred and only one DTC has set.

NOTE: IF THE PCM AND THE SKIM ARE REPLACED AT THE SAME TIME, PROGRAM THE VIN INTO THE PCM FIRST. ALL VEHICLE KEYS WILL THEN NEED TO BE REPLACED AND PROGRAMMED TO THE NEW SKIM.

The SKIS “Secret Key” is an I.D. code that is unique to each SKIS. This code is programmed and

stored in the SKIM, engine controller and transponder chip (ignition key). When replacing the PCM it is necessary to program the secret key into the PCM.

1. Turn the ignition on (transmission in park/neutral).
2. Use the DRBIII® and select "THEFT ALARM", "SKIM" then "MISCELLANEOUS".
3. Select "PCM REPLACED".
4. Enter secured access mode by entering the vehicle four-digit PIN.

NOTE: IF THREE ATTEMPTS ARE MADE TO ENTER THE SECURE ACCESS MODE USING AN INCORRECT PIN, SECURED ACCESS MODE WILL BE LOCKED OUT FOR ONE HOUR. TO EXIT THIS LOCKOUT MODE, TURN THE IGNITION TO THE RUN POSITION FOR ONE HOUR THEN ENTER THE CORRECT PIN. (ENSURE ALL ACCESSORIES ARE TURNED OFF. ALSO MONITOR THE BATTERY STATE AND CONNECT A BATTERY CHARGER IF NECESSARY).

5. Press "ENTER" to transfer the secret key (the SKIM will send the secret key to the PCM).

3.2.11 PROGRAMMING THE SENTRY KEY IMMOBILIZER MODULE

NOTE: IF THE PCM AND THE SKIM ARE REPLACED AT THE SAME TIME, PROGRAM THE VIN INTO THE PCM FIRST. ALL VEHICLE KEYS WILL THEN NEED TO BE REPLACED AND PROGRAMMED TO THE NEW SKIM.

1. Turn the ignition on (transmission in park/neutral).
2. Use the DRBIII® and select "THEFT ALARM", "SKIM" then "MISCELLANEOUS".
3. Select "SKIM MODULE REPLACEMENT (GASOLINE)".
4. Program the vehicle four-digit PIN into the SKIM.
5. Select "COUNTRY CODE" and enter the correct country.

NOTE: BE SURE TO ENTER THE CORRECT COUNTRY CODE. IF THE INCORRECT COUNTRY CODE IS PROGRAMMED INTO SKIM, THE SKIM MUST BE REPLACED.

6. Select "UPDATE VIN" (the SKIM will learn the VIN from the PCM).
7. Press "ENTER" to transfer the secret key (the PCM will send the secret key to the SKIM).

8. The DRBIII® will ask if you want to transfer the secret key. Select "ENTER" to transfer secret key from the PCM. This will ensure the current vehicle ignition keys will still operate the SKIS system.

3.2.12 PROGRAMMING THE IGNITION KEYS TO THE SENTRY KEY IMMOBILIZER MODULE

1. Turn the ignition on (transmission in park/neutral).
2. Use the DRBIII® and select "THEFT ALARM", "SKIM", then "MISCELLANEOUS".
3. Select "PROGRAM IGNITION KEYS".
4. Enter secured access mode by entering the vehicle four-digit PIN.

NOTE: A MAXIMUM OF EIGHT KEYS CAN BE LEARNED TO EACH SKIM. ONCE A KEY IS LEARNED TO A SKIM IT (THE KEY) CANNOT BE TRANSFERRED TO ANOTHER VEHICLE.

If ignition key programming is unsuccessful, the DRB will display one of the following messages:

Programming Not Attempted - The DRBIII® attempts to read the programmed key status and there are no keys programmed in the SKIM memory.

Programming Key Failed - (Possible Used Key From Wrong Vehicle) - SKIM is unable to program key due to one of the following:

- faulty ignition key transponder
- ignition key is programmed to another vehicle.

8 Keys Already Learned, Programming Not Done - SKIM transponder ID memory is full.

1. Obtain ignition keys to be programmed from customer (8 keys maximum)
2. Using the DRBIII®, erase all ignition keys by selecting "MISCELLANEOUS" and "ERASE ALL CURRENT IGN. KEYS"
3. Program all ignition keys.

Learned Key In Ignition - Ignition key transponder ID is currently programmed in SKIM memory.

3.3 DIAGNOSTIC TROUBLE CODES

Each diagnostic trouble code is diagnosed by following a specific testing procedure. The diagnostic test procedures contain step-by-step instructions for determining the cause of DTC as well as no trouble code problems. It is not necessary to perform all of the tests in this book to diagnose an individual DTC.

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Always begin by reading the diagnostic trouble codes using the DRBIII®.

3.3.1 HARD CODE

A diagnostic trouble code that comes back within one cycle of the ignition key is a “hard” code. This means that the defect is there every time the powertrain control module checks that circuit or function. Procedures in this manual verify if the DTC is a hard code at the beginning of each test. When it is not a hard code, an “intermittent” test must be performed.

DTC's that are for Euro Stage III OBD monitors will not set with just the ignition key on. Comparing these to non-emission DTC's, they will seem like an intermittent. These DTC's require a set of parameters to be performed (The DRBIII® pre-test screens will help with this for MONITOR DTC's), this is called a “TRIP”. All Euro Stage III OBD DTCs will be set after one or in some cases two trip failures, and the MIL will be turned on. These DTC's require three successful, no failures, TRIPS to extinguish the MIL, followed by 40 warm-up cycles to erase the DTC. For further explanation of TRIPS, Pre-test screens, Warm-up cycles, and the use of the DRBIII®, refer to the On Board Diagnostic training booklet #81-699-97094.

3.3.2 INTERMITTENT CODE

A diagnostic trouble code that is not there every time the PCM checks the circuit is an “intermittent” DTC. Most intermittent DTC's are caused by wiring or connector problems. Defects that come and go like this are the most difficult to diagnose; they must be looked for under specific conditions that cause them. The following checks may assist you in identifying a possible intermittent problem:

- Visually inspect related wire harness connectors. Look for broken, bent, pushed out, or corroded terminals.
- Visually inspect the related harnesses. Look for chafed, pierced, or partially broken wire.
- Refer to any technical service bulletins that may apply.
- Use the DRBIII® data recorder or co-pilot.

3.3.3 DISTANCE SINCE MI SET

The Euro Stage III OBD directive requires that the distance traveled by the vehicle while the **MI** is

activated must be available at any instant through the serial port on the standard data link connector. This feature works as follows:

1. If the MI is illuminated due to a fault, the distance count is updated (i.e. it is counting).
2. If there is a “stale” MI fault (i.e. the fault is still frozen in memory but the MI has been extinguished due to 3 good trips), the distance count is held (i.e. frozen).
3. If the distance count is being held due to (Item 2.) and the fault is cleared, the distance is cleared (set to zero).
4. If the distance count is being held due to (Item 2.) and another MI occurs, the distance count is reset (to 0) and begins updating anew.
5. If a fault occurs while the MI is already illuminated due to a previous fault (the distance count is updating), then the distance count continues to update w/out interruption.
6. If the MI is flashing due to active misfire and there is an “active” fault (i.e. matured fault for which 3 good trips have not occurred), the distance count behaves as the MI in ON.
7. If the MI is flashing due to active misfire and there is no “active” fault (i.e. the MI is flashing for a 1 malf.), the distance count behaves as if the MI is off (because it is not yet a matured fault).
8. The distance count is cleared whenever the fault is cleared. (Via 40 warm up cycles, or via scan tool).

3.3.4 HANDLING NO DTC PROBLEMS

Symptom checks cannot be used properly unless the driveability problem characteristic actually happens while the vehicle is being tested.

Select the symptom that most accurately describes the vehicle's driveability problem and then perform the test routine that pertains to this symptom. Perform each routine test in sequence until the problem is found. For definitions, see Section 6.0 Glossary Of Terms.

SYMPTOM	DIAGNOSTIC TEST
HARD START	CHECKING THE FUEL PRESSURE CHECKING COOLANT SENSOR CALIBRATION CHECKING THROTTLE POSITION SENSOR CALIBRATION CHECKING MAP SENSOR CALIBRATION CHECKING THE MINIMUM IDLE AIR FLOW CHECKING IDLE AIR CONTROL MOTOR OPERATION CHECKING EVAP EMISSION SYSTEM CHECKING IAT SENSOR
START AND STALL	CHECKING PCM POWER AND GND CKT CHECKING THE FUEL PRESSURE CHECKING COOLANT SENSOR CALIBRATION CHECKING THROTTLE POSITION SENSOR CALIBRATION CHECKING MAP SENSOR CALIBRATION CHECKING THE MINIMUM IDLE AIR FLOW CHECKING IDLE AIR CONTROL MOTOR OPERATION
HESITATION/SAG/STUMBLE	CHECKING PCM POWER AND GND CKT CHECKING THE FUEL PRESSURE CHECKING COOLANT SENSOR CALIBRATION CHECKING THROTTLE POSITION SENSOR CALIBRATION CHECKING MAP SENSOR CALIBRATION CHECKING THE MINIMUM IDLE AIR FLOW CHECKING IDLE AIR CONTROL MOTOR OPERATION CHECKING EVAP EMISSION SYSTEM CHECKING IAT SENSOR
ENGINE STALLS IN GEAR	CHECK TCC OPERATION
SURGE	CHECKING PCM POWER AND GND CKT CHECKING THE FUEL PRESSURE CHECKING COOLANT SENSOR CALIBRATION CHECKING THROTTLE POSITION SENSOR CALIBRATION CHECKING MAP SENSOR CALIBRATION CHECKING THE MINIMUM IDLE AIR FLOW CHECKING IDLE AIR CONTROL MOTOR OPERATION CHECKING EVAP EMISSION SYSTEM
LACK OF POWER/SLUGGISH	CHECKING PCM POWER AND GND CKT CHECKING THE FUEL PRESSURE CHECKING COOLANT SENSOR CALIBRATION CHECKING THROTTLE POSITION SENSOR CALIBRATION CHECKING MAP SENSOR CALIBRATION CHECKING THE MINIMUM IDLE AIR FLOW CHECKING IDLE AIR CONTROL MOTOR OPERATION

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SYMPTOM	DIAGNOSTIC TEST
SPARK KNOCK/DETONATION	CHECKING PCM POWER AND GND CKT CHECKING THE FUEL PRESSURE CHECKING COOLANT SENSOR CALIBRATION CHECKING THROTTLE POSITION SENSOR CALIBRATION CHECKING MAP SENSOR CALIBRATION CHECKING THE MINIMUM IDLE AIR FLOW CHECKING IDLE AIR CONTROL MOTOR OPERATION CHECKING EVAP EMISSION SYSTEM
CUTS OUT/MISSES	CHECKING PCM POWER AND GND CKT CHECKING THE FUEL PRESSURE CHECKING THE MINIMUM IDLE AIR FLOW CHECKING IDLE AIR CONTROL MOTOR OPERATION
BACKFIRE/POPBACK	CHECKING PCM POWER AND GND CKT CHECKING THE FUEL PRESSURE CHECKING MAP SENSOR CALIBRATION CHECKING THE MINIMUM IDLE AIR FLOW
RUNS ROUGH/UNSTABLE/ ERRATIC IDLE	CHECKING PCM POWER AND GND CKT CHECKING THE FUEL PRESSURE CHECKING COOLANT SENSOR CALIBRATION CHECKING THROTTLE POSITION SENSOR CALIBRATION CHECKING MAP SENSOR CALIBRATION CHECKING THE MINIMUM IDLE AIR FLOW CHECKING IDLE AIR CONTROL MOTOR OPERATION CHECKING EVAP EMISSION SYSTEM CHECKING IAT SENSOR
POOR FUEL ECONOMY	CHECKING PCM POWER AND GND CKT CHECKING THE FUEL PRESSURE CHECKING COOLANT SENSOR CALIBRATION CHECKING THROTTLE POSITION SENSOR CALIBRATION CHECKING MAP SENSOR CALIBRATION CHECKING THE MINIMUM IDLE AIR FLOW CHECKING IDLE AIR CONTROL MOTOR OPERATION CHECKING EVAP EMISSION SYSTEM CHECKING IAT SENSOR

3.3.5 NO START INFORMATION

IMPORTANT NOTE:

If the Powertrain Control Module has been changed and the correct VIN and mileage have not been programmed, a DTC will be set in the ABS and Air bag modules. In addition, if the vehicle is equipped with a Sentry Key Immobilizer Module (SKIM), Secret Key data must be updated to enable starting.

FOR ABS AND AIR BAG SYSTEMS:

1. Enter correct VIN and Mileage in PCM.
2. Erase DTC's in ABS and Air Bag modules.

FOR SKIM THEFT ALARM:

1. Connect the DRBIII® to the data link connector.
2. Go to Theft Alarm, SKIM, Misc. and place the SKIM in *secured access* mode, by using the appropriate PIN code for this vehicle.
3. Select Update the Secret Key data, data will be transferred from the SKIM to the PCM (This is required to allow the vehicle to start with the new PCM).
4. If three attempts are made to enter *secured access* mode using the incorrect PIN, *secured access* mode will be locked out for one hour. To exit this lock out mode, leave the ignition key in the Run/Start position for one hour. Ensure all accessories are turned off. Also monitor the battery state and connect a battery charger if necessary.

3.4 USING THE DRBIII®

Refer to the DRBIII® user's guide for instructions and assistance with reading DTC's, erasing DTC's, and other DRBIII® functions.

3.5 DRBIII® ERROR MESSAGES AND BLANK SCREEN

Under normal operation, the DRBIII® will display one of only two error messages:

- User-Requested WARM Boot by pressing MORE and NO at the same time.

```
ver: 2.29
date: 1 Oct93
file: key_itf.cc
date: Jan 12 1994
line: 544
err: 0x1
User-Requested WARM Boot
```

Press MORE to switch between this display and the application screen.
Press F4 when done noting information.

or User-Requested COLD Boot by pressing MORE and YES at the same time.

```
ver: 2.29
date: 1 Oct99
file: key_hndi.cc
date: Mar 8 2000
line: 1297
err: 0x1
User-Requested COLD Boot
```

Press MORE to switch between this display and the application screen.
Press F4 when done noting information.

3.5.1 DRBIII® DOES NOT POWER UP

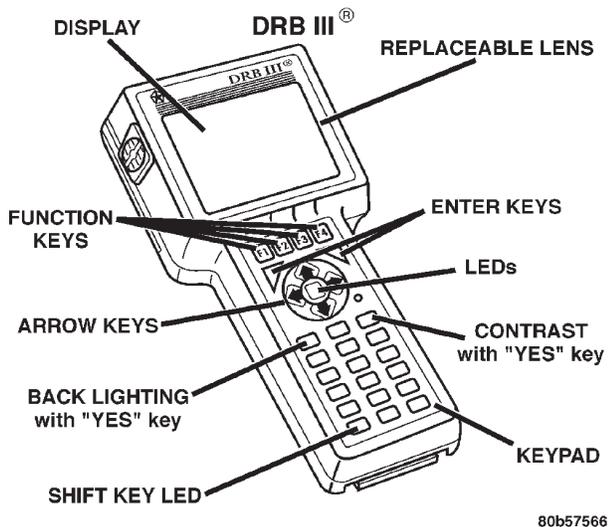
If the LED's do not light or no sound is emitted at start up, check for loose cable connections or a bad cable. Check the vehicle battery voltage (data link connector cavity 16). Check for proper ground connection at DLC cavity 4. A minimum of 11 volts is required to adequately power the DRBIII®.

If all connections are proper between the DRBIII® and the vehicle or other devices, and the vehicle battery is fully charged, and inoperative DRBIII® may be the result of faulty cable or vehicle wiring. For a blank screen, refer to the appropriate body diagnostics manual.

3.5.2 DISPLAY IS NOT VISIBLE

Low temperatures will affect the visibility of the display. Adjust the contrast to compensate for this condition

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4.0 DISCLAIMERS, SAFETY, WARNINGS

4.1 DISCLAIMERS

All information, illustrations, and specifications contained in this manual are based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice.

4.2 SAFETY

4.2.1 TECHNICIAN SAFETY INFORMATION

WARNING: ENGINES PRODUCE CARBON MONOXIDE THAT IS ODORLESS, CAUSES SLOWER REACTION TIME, AND CAN LEAD TO SERIOUS INJURY. WHEN THE ENGINE IS OPERATING, KEEP SERVICE AREAS WELL VENTILATED OR ATTACH THE VEHICLE EXHAUST SYSTEM TO THE SHOP EXHAUST REMOVAL SYSTEM.

Set the parking brake and block the wheels before testing or repairing the vehicle. It is especially important to block the wheels on front-wheel drive vehicles; the parking brake does not hold the drive wheels.

When servicing a vehicle, always wear eye protection, and remove any metal jewelry such as watchbands or bracelets that might make an inadvertent electrical contact.

When diagnosing a powertrain system problem, it is important to follow approved procedures where applicable. These procedures can be found in service manual procedures. Following these procedures is very important to the safety of individuals performing diagnostic tests.

4.2.2 VEHICLE PREPARATION FOR TESTING

Make sure the vehicle being tested has a fully charged battery. If it does not, false diagnostic codes or error messages may occur.

4.2.3 SERVICING SUB ASSEMBLIES

Some components of the powertrain system are intended to be serviced in assembly only. Attempting to remove or repair certain system sub-components may result in personal injury and/or improper system operation. Only those components with approved repair and installation procedures in the service manual should be serviced.

4.2.4 DRBIII® SAFETY INFORMATION

WARNING: EXCEEDING THE LIMITS OF THE DRB MULTIMETER IS DANGEROUS. IT CAN EXPOSE YOU TO SERIOUS INJURY. CAREFULLY READ AND UNDERSTAND THE CAUTIONS AND THE SPECIFICATION LIMITS.

Follow the vehicle manufacturer's service specifications at all times.

- Do not use the DRBIII® if it has been damaged.
- Do not use the test leads if the insulation is damaged or if metal is exposed.
- To avoid electrical shock, do not touch the test leads, tips, or the circuit being tested.
- Choose the proper range and function for the measurement. Do not try voltage or current measurements that may exceed the rated capacity.

- Do not exceed the limits shown in the table below:

FUNCTION	INPUT LIMIT
Volts	0 - 500 peak volts AC 0 - 500 volts DC
Ohms (resistance)*	0 - 1.12 megohms
Frequency Measured Frequency Generated	0 - 10 kHz
Temperature	-58 - 1100°F -50 - 600°C

* Ohms cannot be measured if voltage is present. Ohms can be measured only in a non-powered circuit.

- Voltage between any terminal and ground must not exceed 500v DC or 500v peak AC.
- Use caution when measuring voltage above 25v DC or 25v AC.
- The circuit being tested must be protected by a 10A fuse or circuit breaker.
- Use the low current shunt to measure circuits up to 10A. Use the high current clamp to measure circuits exceeding 10A.
- When testing for the presence of voltage or current, make sure the meter is functioning correctly. Take a reading of a known voltage or current before accepting a zero reading.
- When measuring current, connect the meter in series with the load.
- Disconnect the live test lead before disconnecting the common test lead.
- When using the meter function, keep the DRBIII® away from spark plug or coil wires to avoid measuring error from outside interference.

4.3 WARNINGS AND CAUTIONS

4.3.1 ROAD TEST WARNINGS

Some complaints will require a test drive as part of the repair verification procedure. The purpose of the test drive is to try to duplicate the diagnostic code or symptom condition.

CAUTION: BEFORE ROAD TESTING A VEHICLE, BE SURE THAT ALL COMPONENTS ARE REASSEMBLED. DURING THE TEST DRIVE, DO NOT TRY TO READ THE DRBIII® SCREEN WHILE IN MOTION. DO NOT HANG THE DRBIII® FROM THE REAR VIEW MIRROR OR OPERATE IT YOURSELF. HAVE AN ASSISTANT AVAILABLE TO OPERATE THE DRBIII®.

4.3.2 VEHICLE DAMAGE CAUTIONS

Before disconnecting any control module, make sure the ignition is “off”. Failure to do so could damage the module.

When testing voltage or continuity at any control module, use the terminal side (not the wire end) of the connector. Do not probe a wire through the insulation; this will damage it and eventually cause it to fail because of corrosion.

Be careful when performing electrical tests so as to prevent accidental shorting of terminals. Such mistakes can damage fuses or components. Also, a second DTC could be set, making diagnosis of the original problem more difficult.

5.0 REQUIRED TOOLS AND EQUIPMENT

- DRBIII® (diagnostic read-out box) scan tool
- fuel pressure adapter (C-6631) or #6539
- fuel pressure kit (C-4799-B) or #5069
- fuel release hose (C-4799-1)
- Min Air flow fitting #6714
- jumper wires
- ohmmeter
- oscilloscope
- vacuum gauge
- voltmeter
- 12 volt test light minimum 25 ohms resistance with probe #6801

CAUTION: A 12 VOLT TEST LIGHT SHOULD NOT BE USED FOR THE FOLLOWING CIRCUITS, DAMAGE TO THE POWERTRAIN CONTROLLER WILL OCCUR.

- 5 Volt Supply
- 8 Volt Supply
- J1850 PCI Bus
- CCD Bus
- CKP Sensor Signal
- CMP Sensor Signal
- Vehicle Speed Sensor Signal
- O2 Sensor Signal

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6.0 GLOSSARY OF TERMS

ABS	anti-lock brake system	lack of power, sluggish	The engine has less than expected power, with little or no increase in vehicle speed when the throttle is opened.
backfire, popback	fuel ignites in either the intake or the exhaust system	MAP	manifold absolute pressure sensor
CKP	crank position sensor	MIL	malfunction indicator lamp
CMP	camshaft position sensor	MTV	manifold tuning valve
cuts out, misses	a steady pulsation or the inability of the engine to maintain a consistent rpm	O2S	oxygen sensor
DLC	data link connector (previously called "engine diagnostic connector")	PCI	programmable communication interface
detonation, spark knock	a mild to severe ping, especially under loaded engine conditions	PCM	powertrain control module
ECT	engine coolant temperature sensor	PCV	positive crankcase ventilation
EGR	exhaust gas recirculation valve and system	PEP	peripheral expansion port
EMCC	electronic modulated convertor clutch	poor fuel economy	There is significantly less fuel mileage than other vehicles of the same design and configuration
generator	previously called "alternator"	rough, unstable, or erratic idle stalling	The engine runs unevenly at idle and causes the engine to shake if it is severe enough. The engine idle rpm may vary (called "hunting"). This condition may cause stalling if it is severe enough.
hard start	The engine takes longer than usual to start, even though it is able to crank normally.	start & stall	The engine starts but immediately dies.
hesitation, sag, stumble	There is a momentary lack of response when the throttle is opened. This can occur at all vehicle speeds. If it is severe enough, the engine may stall.	surge	engine rpm fluctuation without corresponding change in throttle position sensor
IAT	intake air temperature sensor	TCC	torque converter clutch
IAC	idle air control motor	TPS	throttle position sensor
JTEC	Combined engine and transmission control module	TRS	transmission range sensor
		VSS	vehicle speed sensor/signal

7.0

DIAGNOSTIC INFORMATION AND
PROCEDURES

Symptom:

P0622-GENERATOR FIELD NOT SWITCHING PROPERLY

When Monitored and Set Condition:

P0622-GENERATOR FIELD NOT SWITCHING PROPERLY

When Monitored: With the ignition key on and the engine running.

Set Condition: When the PCM tries to regulate the generator field with no result during monitoring.

POSSIBLE CAUSES

GENERATOR FIELD WIRING HARNESS INTERMITTENT PROBLEM
 GENERATOR FIELD WIRING HARNESS OBSERVABLE PROBLEM
 GENERATOR FIELD DRIVER CIRCUIT OPEN
 GENERATOR FIELD DRIVER CIRCUIT SHORTED TO GROUND
 GENERATOR FIELD RESISTANCE ≥ 5.0 OHMS
 GENERATOR FIELD SOURCE (+) CIRCUIT OPEN
 POWERTRAIN CONTROL MODULE

TEST	ACTION	APPLICABILITY
1	Ignition on, engine not running. With the DRBIII®, actuate the Generator Field Driver Circuit. Using a 12-volt test light, backprobe the Generator Field Driver Circuit at the back of the Generator. Did the light blink? Yes → Go To 2 No → Go To 3	All
2	Ignition on, engine not running. With the DRBIII® actuate the Generator Field Driver Circuit. Note: Actuator Test should still be running. Wiggle Wiring Harness from the Generator to PCM. With the DRBIII®, read DTC's. Does the Generator Field Driver (-) Circuit code return? Yes → Repair as necessary where wiggling caused problem to appear. Perform POWERTRAIN VERIFICATION TEST VER - 3. No → Test Complete.	All

P0622-GENERATOR FIELD NOT SWITCHING PROPERLY — Continued

TEST	ACTION	APPLICABILITY
3	Ignition on, engine not running. Record all DTC's and freeze frame data, now erase Codes. Carefully inspect all Connectors for corrosion or spread Terminals before continuing. With the DRBIII® actuate the Generator Field Driver Circuit. Backprobe the Generator Field Source (+) Circuit at back of Generator. Is the voltage above 10.0 volts? Yes → Go To 4 No → Repair the open Generator Field Source (+) Circuit from Generator. Perform POWERTRAIN VERIFICATION TEST VER - 3.	All
4	Turn the ignition off. Disconnect the PCM harness connector(s). Disconnect the Generator Field harness connector. Measure the Generator Field Driver Circuit from PCM Connector to ground. Is the resistance below 5.0 ohms? Yes → Repair the Generator Field Driver Circuit shorted to ground. Perform POWERTRAIN VERIFICATION TEST VER - 3. No → Go To 5	All
5	Turn the ignition off. Disconnect the PCM harness connectors. Disconnect the Generator Field harness connector. Note: Check Connectors - Clean/repair as necessary. Measure the Generator Field Driver Circuit from PCM to Generator. Is the resistance below 5.0 ohms? Yes → Go To 6 No → Repair the open Generator Field Driver Circuit. Perform POWERTRAIN VERIFICATION TEST VER - 3.	All
6	Turn the ignition off. Disconnect the Generator Field harness connector at back of the Generator. Note: Check connectors - Clean/repair as necessary. Measure resistance across the Generator Field Terminals at the Generator. Is the resistance below 5.0 ohms? Yes → Repair the Generator as necessary. Perform POWERTRAIN VERIFICATION TEST VER - 3. No → Go To 7	All
7	If there are no possible causes remaining, view repair. Repair Replace the Powertrain Control Module. Perform POWERTRAIN VERIFICATION TEST VER - 3.	All

CHARGING

Symptom:

P1492-AMBIENT/BATT TEMP SEN VOLTS TOO HIGH

When Monitored and Set Condition:

P1492-AMBIENT/BATT TEMP SEN VOLTS TOO HIGH

When Monitored: With the ignition key on.

Set Condition: The PCM senses the voltage from the AMBIENT/BATT temperature sensor to be above 4.9 volts for 3 seconds.

POSSIBLE CAUSES

SENSOR GROUND CIRCUIT OPEN
 AMBIENT/BATT SIGNAL CIRCUIT SHORTED TO VOLTAGE
 AMBIENT/BATT SIGNAL CIRCUIT OPEN
 AMBIENT/BATT TEMPERATURE SENSOR
 PCM
 WIRING HARNESS INTERMITTENT

TEST	ACTION	APPLICABILITY
1	Turn the ignition on. With the DRBIII®, read DTC's. Is the DTC Good Trip Counter displayed and equal to zero for P1492? Yes → Go To 2 No → Go To 7	All
2	Turn the ignition off. Disconnect the AMBIENT/BATT Temperature Sensor harness connector. Measure the resistance between the Sensor Ground circuit and ground at the AMBIENT/BATT Temperature Sensor connector. Is the resistance below 5.0 ohms? No → Repair the open Sensor Ground circuit. Perform POWERTRAIN VERIFICATION TEST VER - 3. Yes → Go To 3	All
3	Turn the ignition off. Disconnect the AMBIENT/BATT connector. Start the engine. Allow engine to idle. Measure the AMBIENT/BATT Signal circuit voltage at the AMBIENT/BATT connector. Is the voltage above 5.5 volts? Yes → Repair the short to voltage. Perform POWERTRAIN VERIFICATION TEST VER - 3. No → Go To 4	All

P1492-AMBIENT/BATT TEMP SEN VOLTS TOO HIGH — Continued

TEST	ACTION	APPLICABILITY
4	<p>Turn the ignition off. Disconnect the AMBIENT/BATT connector. Disconnect the PCM harness connector(s). Measure the resistance of the AMBIENT/BATT Signal circuit from the AMBIENT/BATT connector to the PCM connector. Is the resistance below 5.0 ohms?</p> <p>No → Repair the open circuit. Perform POWERTRAIN VERIFICATION TEST VER - 3.</p> <p>Yes → Go To 5</p>	All
5	<p>Turn the ignition off. Disconnect the AMBIENT/BATT Temperature Sensor connector. Turn the ignition on. With the DRBIII® in sensors, read the "Ambient/Bat Tmp Vlt" value. Connect a jumper wire between the AMB/BATT Signal circuit and the Sensor Ground circuit at the AMB/BATT connector. Voltage should change from greater than 4.5 volts to less than 1.0 volt. Did the "Ambient/Bat Tmp Vlt" value change from greater than 4.5 volts to less than 1.0 volt?</p> <p>Yes → Replace the AMBIENT/BATT Temperature Sensor. Perform POWERTRAIN VERIFICATION TEST VER - 3.</p> <p>No → Go To 6</p>	All
6	<p>If there are no possible causes remaining, view repair. View repair options.</p> <p>Repair</p> <p>Replace the PCM. Perform POWERTRAIN VERIFICATION TEST VER - 3.</p>	All
7	<p>Turn the ignition off.</p> <p>Note: Visually inspect the related wiring harness. Look for any chafed, pierced, pinched, or partially broken wires.</p> <p>Note: Visually inspect the related wire harness connectors. Look for broken, bent, pushed out, or corroded terminals.</p> <p>Note: Refer to any Technical Service Bulletins (TSB) that may apply.</p> <p>Perform a wiggle test on the related wiring harnesses with the engine running. Were any problems found?</p> <p>Yes → Repair wiring harness/connectors as necessary. Perform POWERTRAIN VERIFICATION TEST VER - 3.</p> <p>No → Test Complete.</p>	All

Symptom:

P1493-AMBIENT/BATT TEMP SEN VOLTS TOO LOW

When Monitored and Set Condition:

P1493-AMBIENT/BATT TEMP SEN VOLTS TOO LOW

When Monitored: With the ignition on.

Set Condition: The PCM senses the voltage from the AMBIENT/BATT temperature sensor to be below 0.5 volt for 3 seconds.

POSSIBLE CAUSES

AMBIENT/BATT TEMP SENSOR SIGNAL CIRCUIT SHORTED TO THE SENSOR GROUND CIRCUIT

AMBIENT/BATT TEMPERATURE SIGNAL CIRCUIT SHORTED TO GROUND

AMBIENT/BATT TEMPERATURE SENSOR

PCM

WIRING HARNESS INTERMITTENT

TEST	ACTION	APPLICABILITY
1	Turn the ignition on. With the DRBIII®, read DTC's. Is the DTC Specific Good Trip Counter displayed and equal to zero for P1493? Yes → Go To 2 No → Go To 6	All
2	Turn the ignition on. With the DRBIII® in sensors, read the "Ambient/Bat Tmp Vlt" value. Disconnect the AMBIENT/BATT Temperature Sensor connector. Did the "Ambient/Bat Tmp Vlt" value change from below 1.0 volt to above 4.5 volts? Yes → Replace the AMBIENT/BATT Temperature Sensor. Perform POWERTRAIN VERIFICATION TEST VER - 3. No → Go To 3	All
3	Turn the ignition off. Disconnect the AMBIENT/BATT connector. Disconnect the PCM harness connector(s). Measure the AMBIENT/BATT temperature sensor Signal circuit to ground. Is the resistance below 5.0 ohms? Yes → Repair the short to ground. Perform POWERTRAIN VERIFICATION TEST VER - 3. No → Go To 4	All

P1493-AMBIENT/BATT TEMP SEN VOLTS TOO LOW — Continued

TEST	ACTION	APPLICABILITY
4	Turn the ignition off. Disconnect the AMBIENT/BATT temperature sensor connector. Disconnect the PCM harness connectors. Measure the resistance between the AMBIENT/BATT temperature sensor Signal circuit and the Sensor Ground circuit. Is the resistance below 5.0 ohms? Yes → Repair the shorted circuit. Perform POWERTRAIN VERIFICATION TEST VER - 3. No → Go To 5	All
5	If there are no possible causes remaining, view repair. Repair Replace the PCM. Perform POWERTRAIN VERIFICATION TEST VER - 3.	All
6	Turn the ignition off. Note: Visually inspect the related wiring harness. Look for any chafed, pierced, pinched, or partially broken wires. Note: Visually inspect the related wire harness connectors. Look for broken, bent, pushed out, or corroded terminals. Note: Refer to any Technical Service Bulletins (TSB) that may apply. Perform a wiggle test on the related wiring harnesses with the engine running. Were any problems found? Yes → Repair wiring harness/connectors as necessary. Perform POWERTRAIN VERIFICATION TEST VER - 3. No → Test Complete.	All

CHARGING

Symptom:

P1594-CHARGING SYSTEM VOLTAGE TOO HIGH

When Monitored and Set Condition:

P1594-CHARGING SYSTEM VOLTAGE TOO HIGH

When Monitored: With the ignition key on and the engine speed greater than 0 RPM.

Set Condition: When the PCM regulates the generator field and there are no detected field problems, but the voltage output does not decrease.

POSSIBLE CAUSES

AMBIENT/BATT TEMPERATURE SENSOR
 GENERATOR FIELD DRIVER CIRCUIT SHORTED TO GROUND
 GENERATOR FIELD SHORTED TO GROUND
 AMBIENT/BATT TEMPERATURE SENSOR
 POWERTRAIN CONTROL MODULE (BATTERY VOLTAGE)
 POWERTRAIN CONTROL MODULE (GENERATOR RESISTANCE)

TEST	ACTION	APPLICABILITY
1	Ignition on, engine not running. With the DRBIII®, actuate the Generator Field Driver. With a 12-volt test light, backprobe the Generator Field Driver Circuit in back of Generator. Did the light blink? Yes → Go To 2 No → Go To 6	All
2	Ignition on, engine not running. With the DRBIII®, actuate the Generator Field Driver. With DRBIII®, stop the Generator Field Driver actuation. With DRBIII®, read the Target Charging voltage. Is the Target Charging voltage above 0 volts? Yes → Go To 3 No → Go To 4	All
3	Start the engine. Manually set the engine speed to 1600 RPM. With DRBIII®, read both the Battery voltage and the Target Charging voltage. Compare the "Target Voltage" to the "Battery Voltage" reading. Monitor voltage for 5 minutes, if necessary. Look for a 1.0 volt difference or more. Was there more than a 1.0 volt difference? Yes → Replace the Powertrain Control Module. Perform POWERTRAIN VERIFICATION TEST VER - 3. No → Test Complete.	All

P1594-CHARGING SYSTEM VOLTAGE TOO HIGH — Continued

TEST	ACTION	APPLICABILITY
4	Ignition on, engine not running. .With the DRBIII® in Inputs/Outputs, read the AMBIENT/BATT temperature. Using a thermometer measure under hood temperature near Battery tray. Is the temperature within 10 deg of Battery temperature? Yes → Go To 5 No → Replace AMBIENT/BATT Temperature Sensor. Perform POWERTRAIN VERIFICATION TEST VER - 3.	All
5	If there are no possible causes remaining, view repair. Repair Replace the AMBIENT/BATT TEMP SENSOR. Perform POWERTRAIN VERIFICATION TEST VER - 3.	All
6	Turn the ignition off. Disconnect the PCM harness connector(s). Disconnect the Generator Field harness connector. Measure the Generator Field Driver Circuit from PCM Harness Connector to ground. Is the resistance below 5.0 ohms? Yes → Repair the Generator Field Driver Circuit shorted to ground. Perform POWERTRAIN VERIFICATION TEST VER - 3. No → Go To 7	All
7	Turn the ignition off. Disconnect the Field Harness Connector at back of the Generator. Note: Check connectors - Clean/repair as necessary. Measure resistance of the Generator Field Driver Circuit at the Generator to Ground. Is the resistance below 5.0 ohms? Yes → Repair or replace the shorted Generator as necessary. Perform POWERTRAIN VERIFICATION TEST VER - 3. No → Go To 8	All
8	If there are no possible causes remaining, view repair. Repair Replace the Powertrain Control Module. Perform POWERTRAIN VERIFICATION TEST VER - 3.	All

Symptom:

P1682-CHARGING SYSTEM VOLTAGE TOO LOW

When Monitored and Set Condition:

P1682-CHARGING SYSTEM VOLTAGE TOO LOW

When Monitored: With the ignition key on and the engine running over 1500 RPM after 25 seconds.

Set Condition: When the PCM regulates the generator field and there are no detected field problems, but the voltage output does not increase.

POSSIBLE CAUSES
AMBIENT/BATT TEMPERATURE SENSOR B (+) CIRCUIT HIGH RESISTANCE GENERATOR GROUND HIGH RESISTANCE GENERATOR FIELD DRIVER CIRCUIT OPEN GENERATOR FIELD DRIVER CIRCUIT SHORTED TO GROUND GENERATOR FIELD SOURCE CIRCUIT SHORTED TO GROUND GENERATOR FIELD SOURCE (+) CIRCUIT OPEN PCM

TEST	ACTION	APPLICABILITY
1	Turn the ignition off. Note: Battery must be fully charged. Note: Generator Belt tension and condition must be checked before continuing. Start the engine. With the DRBIII®, read the target charging voltage. Is the target charging voltage above 15.1 volts? Yes → Go To 2 No → Go To 9	All
2	Turn the ignition off. Note: Battery must be fully charged. Note: Generator Belt tension and condition must be checked before continuing. Start the engine. Allow the engine to reach normal operating temperature. With the DRBIII® in Inputs/Outputs, read the AMBIENT/BATT Temperature. Using a Thermometer, measure under hood temperature. Is the temperature within 10 F degrees of Battery temperature? Yes → Go To 9 No → Go To 3	All