ELECTRONIC CONTROL MODULES

TABLE OF CONTENTS

CENTRAL TIMER MODULE

DESCRIPTION

Three versions of the Central Timer Module (CTM) are available on this vehicle, a base version (Fig. 1), a high-line version (Fig. 2), and a premium version. Whichever version of the CTM the vehicle is equipped with, it is concealed under the driver side end of the instrument panel inboard of the instrument panel steering column opening, where it is secured to a stamped steel bracket that is integral to the instrument panel armature. The CTM is enclosed in a molded plastic housing with one (base) or two (high-line/premium) integral external connector receptacles that connect it to the vehicle electrical system through one (base) or two (high-line/premium) take outs with connectors from the instrument panel wire harness.

The base version of the CTM is used on base models of this vehicle. It is also sometimes referred to as the Integrated Electronic Module (IEM). The base version of the CTM combines the functions of a chime module and an intermittent wipe module in a single unit. The high-line version of the CTM is used on high-line vehicles. The high-line CTM provides all of the functions of the base version of the CTM, but also is used to control and integrate many additional electronic functions and features included on high-line models. The premium version of the CTM is the same as the high-line version, but is used only on models equipped with the heated seat option.

The high-line and premium versions of the CTM utilize integrated circuitry and information carried on the Chrysler Collision Detection (CCD) data bus network along with many hard wired inputs to monitor many sensor and switch inputs throughout the vehicle. In response to those inputs, the internal circuitry and programming of the CTM allow it to control and integrate many electronic functions and features of the vehicle through both hard wired outputs and the transmission of electronic message outputs to other electronic modules in the vehicle over the CCD data bus.

CENTRAL TIMER MODULE (Continued)

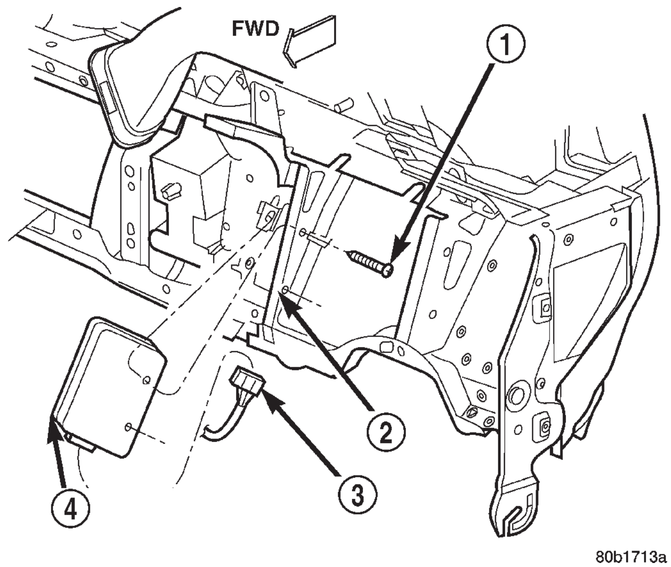

Fig. 1 Central Timer Module (Base)

1 - SCREWS
2 - BRACKET
3 - WIRE HARNESS CONNECTOR
4 - CENTRAL TIMER MODULE

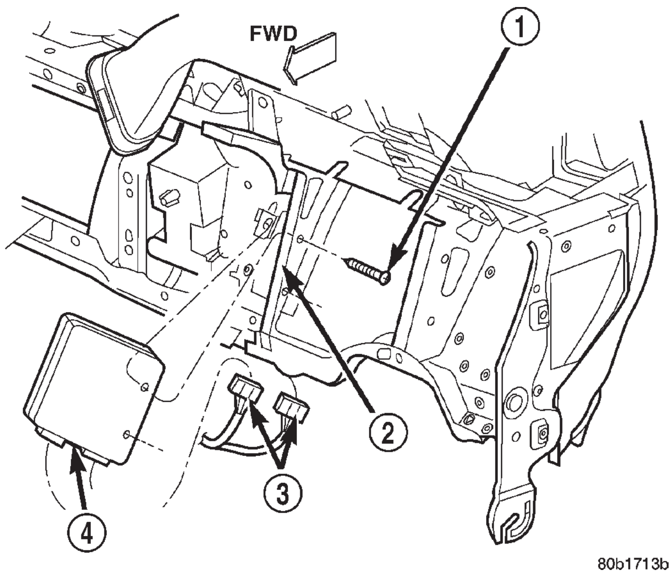

Fig. 2 Central Timer Module (High-Line/Premium)

1 - SCREWS
2 - BRACKET
3 - WIRE HARNESS CONNECTORS
4 - CENTRAL TIMER MODULE

The features that the CTM supports or controls include the following:

- **Automatic Door Lock** - The high-line/premium CTM provides an optional automatic door lock feature (also known as rolling door locks). This is a programmable feature.
- **Central Locking** - The high-line/premium CTM provides an optional central locking/unlocking feature.
- **Chimes** - All versions of the CTM provide chime service through an integral chime tone generator.
- **Courtesy Lamps** - The high-line/premium CTM provides courtesy lamp control with timed load shedding.
- **Door Lock Inhibit** - The high-line/premium CTM provides a door lock inhibit feature.
- **Enhanced Accident Response** - The high-line/premium CTM provides an optional enhanced accident response feature. This is a programmable feature.
- **Heated Seats** - The premium CTM controls the optional heated seat system by controlling the operation of the heated seat relay.
- **Illuminated Entry** - The high-line/premium CTM provides a timed illuminated entry feature.
- **Intermittent Wipe Control** - All versions of the CTM provide control of the intermittent wipe delay, and wipe-after-wash features.
- **Panic Mode** - The high-line/premium CTM provides support for the optional RKE system panic mode features.
- **Power Lock Control** - The high-line/premium CTM provides the optional power lock system features, including support for the automatic door lock and door lock inhibit modes.
- **Programmable Features** - The high-line/premium CTM provides support for certain programmable features.
- **Remote Keyless Entry** - The high-line/premium CTM provides the optional Remote Keyless Entry (RKE) system features, including support for the RKE Lock (with optional horn chirp), Unlock, Panic, and illuminated entry modes, as well as the ability to be programmed to recognize up to four RKE transmitters. The RKE horn chirp is a programmable feature.
- **Remote Radio Switch Interface** - The high-line/premium CTM monitors and transmits the status of the optional remote radio switches.
- **Speed Sensitive Intermittent Wipe Control** - The high-line/premium CTM provides the speed sensitive intermittent wipe feature.
- **Vehicle Theft Alarm** - The high-line/premium CTM provides control of the optional Vehicle Theft Alarm features, including support for the central locking/unlocking mode.

Hard wired circuitry connects the CTM to the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the

CENTRAL TIMER MODULE (Continued)

CTM through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

All versions of the CTM for this model are serviced only as a complete unit. Many of the electronic features in the vehicle controlled or supported by the high-line or premium versions of the CTM are programmable using the DRBIII® scan tool.However, if any of the CTM hardware components are damaged or faulty, the entire CTM unit must be replaced. The base version of the CTM and the hard wired inputs or outputs of all CTM versions can be diagnosed using conventional diagnostic tools and methods; however, for diagnosis of the high-line or premium versions of the CTM or the CCD data bus, the use of a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

OPERATION

The Central Timer Module (CTM) is designed to control and integrate many of the electronic features and functions of the vehicle. The base version of the CTM monitors only hard wired inputs and responds with the proper hard wired outputs. The microprocessor-based high-line/premium version of the CTM monitors many hard wired switch and sensor inputs as well as those resources it shares with other electronic modules in the vehicle through its communication over the Chrysler Collision Detection (CCD) data bus network. The internal programming and all of these inputs allow the high-line/premium CTM microprocessor to determine the tasks it needs to perform and their priorities, as well as both the standard and optional features that it should provide. The high-line/premium CTM programming then performs those tasks and provides those features through both CCD data bus communication with other electronic modules and through hard wired outputs to a number of circuits, relays, and actuators. These outputs allow the high-line/premium CTM the ability to control numerous accessory systems in the vehicle.

All versions of the CTM operate on battery current received through fuses in the Junction Block (JB) on a non-switched fused B(+) circuit, a fused ignition switch output (st-run) circuit (base version only), and a fused ignition switch output (run-acc) circuit (high-line/premium version only). This arrangement allows the CTM to provide some features regardless of the ignition switch position, while other features will operate only with the ignition switch in the Accessory, On, and/or Start positions. All versions of the CTM are grounded through their connector and take out of the instrument panel wire harness. The high-line/premium CTM has another ground received through a second connector and take out of the instrument panel wire harness. The first ground circuit receives ground through a take out with an eyelet terminal connector of the instrument panel wire harness that is secured by a nut to a ground stud located on the left instrument panel end bracket, while the second ground circuit (high-line/premium version only) receives ground through a take out with an eyelet terminal connector of the instrument panel wire harness that is secured by a nut to a ground stud located on the back of the instrument panel armature above the inboard side of the instrument panel steering column opening.

The high-line/premium CTM monitors its own internal circuitry as well as many of its input and output circuits, and will store a Diagnostic Trouble Code (DTC) in electronic memory for any failure it detects. These DTCs can be retrieved and diagnosed using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

HARD WIRED INPUTS

The hard wired inputs to the CTM include the following:

- CCD bus– - high-line/premium version only
- CCD bus+ - high-line/premium version only
- Cylinder lock switch mux - high-line premium version only
- Driver door ajar switch sense
- Fused B(+)
- Fused ignition switch output (run-acc) - high-line/premium version only
- Fused ignition switch output (st-run) - base version only
- Ground (one circuit - base version, two circuits - high-line/premium version)
- Key-in ignition switch sense
- Passenger door ajar switch sense - high-line/premium version only
- Power door lock motor B(+) lock - high-line/premium version only
- Power door lock motor B(+) unlock - high-line/premium version only
- Radio control mux - high-line/premium version only
- Tone request signal
- Washer switch sense
- Wiper park switch sense
- Wiper switch mode sense
- Wiper switch mode signal

CENTRAL TIMER MODULE (Continued)

HARD WIRED OUTPUTS

The hard wired outputs of the CTM include the following:

- CCD bus– - high-line/premium version only
- CCD bus+ - high-line/premium version only
- Courtesy lamp switch output - high-line/premium version only
- Door lock driver - high-line/premium version only
- Door unlock driver - high-line/premium version only
- Headlamp relay control - high-line/premium version only
- Heated seat relay control - premium version only
- Horn relay control - high-line/premium version only
- VTSS indicator driver - high-line/premium version only
- Wiper motor relay control

MESSAGING

The high-line/premium CTM uses the following messages received from other electronic modules over the CCD data bus:

- Airbag Deploy (ACM)
- Charging System Failure (PCM)
- Engine RPM (PCM)
- System Voltage (PCM)
- Vehicle Speed (PCM)
- Voltage Fault (PCM)

The high-line/premium CTM provides the following messages to other electronic modules over the CCD data bus:

- Engine Enable (PCM)
- Radio Seek Up (Radio)
- Radio Seek Down (Radio)
- Radio Volume Up (Radio)
- Radio Volume Down (Radio)
- Preset Scan (Radio)

DIAGNOSIS AND TESTING - CENTRAL TIMER MODULE

The hard wired inputs to and outputs from the Central Timer Module (CTM) may be diagnosed and tested using conventional diagnostic tools and methods. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

However, conventional diagnostic methods may not prove conclusive in the diagnosis of the high-line/premium CTM. In order to obtain conclusive testing of the high-line/premium CTM, the Chrysler Collision Detection (CCD) data bus network and all of the electronic modules that provide inputs to or receive outputs from the CTM must also be checked. The most reliable, efficient, and accurate means to diagnose the high-line/premium CTM, the CCD data bus network, and the electronic modules that provide inputs to or receive outputs from the high-line/premium CTM requires the use of a DRBIII® scan tool and the appropriate diagnostic information. The DRBIII® scan tool can provide confirmation that the CCD data bus network is functional, that all of the electronic modules are sending and receiving the proper messages over the CCD data bus, and that the CTM is receiving the proper hard wired inputs and responding with the proper hard wired outputs needed to perform its many functions.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

NOTE: The following tests may not prove conclusive in the diagnosis of the high-line or premium versions of the Central Timer Module (CTM). The most reliable, efficient, and accurate means to diagnose the high-line or premium CTM requires the use of a DRBIII® scan tool and the appropriate diagnostic information.

(1) Check the fused B(+) fuse (Fuse 13 - 10 ampere) in the Junction Block (JB). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Check for battery voltage at the fused B(+) fuse (Fuse 13 - 10 ampere) in the JB. If OK, go to Step 3. If not OK, repair the open fused B(+) circuit between the JB and the Power Distribution Center (PDC) as required.

(3) For a base version CTM, check the fused ignition switch output (st-run) fuse (Fuse 11 - 10 ampere) in the JB. For a high-line/premium version CTM, check the fused ignition switch output (run-acc) fuse (Fuse 6 - 25 ampere) in the JB. If OK, go to Step 4. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

CENTRAL TIMER MODULE (Continued)

(4) Turn the ignition switch to the On position. For a base version CTM, check for battery voltage at the fused ignition switch output (st-run) fuse (Fuse 11 - 10 ampere) in the JB. For a high-line/premium version CTM, check for battery voltage at the fused ignition switch output (run-acc) fuse (Fuse 6 - 25 ampere) in the JB. If OK, go to Step 5. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(5) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the CTM from its mounting bracket to access the CTM wire harness connector(s). Disconnect the instrument panel wire harness connector(s) for the CTM from the CTM connector receptacle(s). Check the wire harness connectors and the CTM receptacles for loose, corroded, or damaged terminals and pins. If OK, go to Step 6. If not OK, repair as required.

(6) Check for continuity between the ground circuit cavity of the instrument panel wire harness connector (Connector C1) for the CTM and a good ground. For the high-line/premium version of the CTM only, repeat the check between the ground circuit cavity of the instrument panel wire harness connector (Connector C2) for the CTM and a good ground. In each case, there should be continuity. If OK, go to Step 7. If not OK, repair the open ground circuit(s) to ground as required.

(7) Reconnect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the instrument panel wire harness connector (Connector C1) for the CTM. If OK, go to Step 8. If not OK, repair the open fused B(+) circuit between the CTM and the JB as required.

(8) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (st-run) circuit cavity (base version) or fused ignition switch output (run-acc) circuit cavity (high-line/premium version) of the instrument panel wire harness connector (Connector C1) for the CTM. If OK with a base version CTM, replace the faulty CTM. If OK with a high-line/premium version CTM, use a DRBIII® scan tool and the appropriate diagnostic information to perform further diagnosis of the CTM. If not OK, repair the open fused ignition switch output circuit between the CTM and the JB.

REMOVAL

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NOTE: Before replacing a high-line/premium version Central Timer Module (CTM), use a DRBIII® scan tool to retrieve the current settings for the CTM programmable features. Refer to the appropriate diagnostic information. These settings should be duplicated in the replacement high-line/premium CTM using the DRBIII® scan tool before returning the vehicle to service.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column opening cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(3) Remove the two screws that secure the Central Timer Module (CTM) to the bracket on the inboard side of the instrument panel steering column opening (Fig. 3) or (Fig. 4).

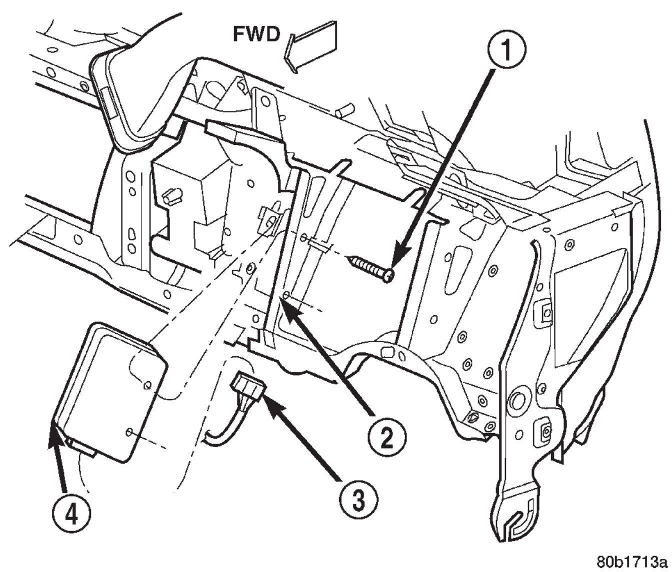

Fig. 3 Central Timer Module (Base) Remove/Install

1 - SCREWS
2 - BRACKET
3 - WIRE HARNESS CONNECTOR
4 - CENTRAL TIMER MODULE

(4) Pull the CTM into the instrument panel steering column opening far enough to access the instrument panel wire harness connector(s).

CENTRAL TIMER MODULE (Continued)

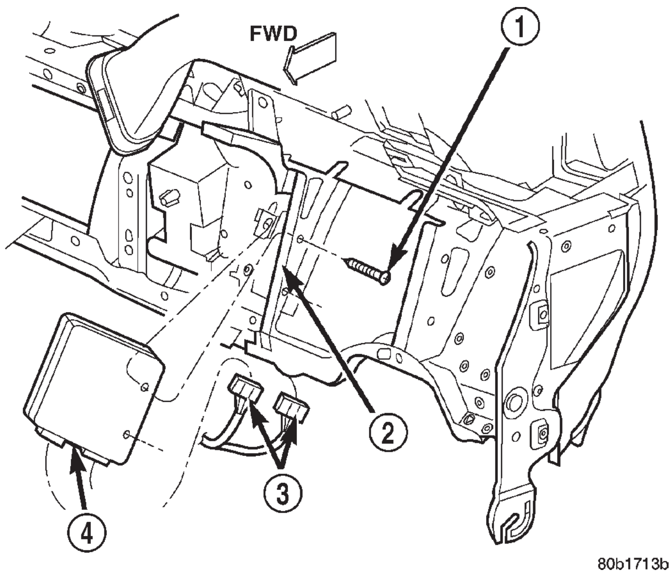

Fig. 4 Central Timer Module (High-Line/Premium) Remove/Install

1 - SCREWS
2 - BRACKET
3 - WIRE HARNESS CONNECTORS
4 - CENTRAL TIMER MODULE

(5) Disconnect the instrument panel wire harness connector(s) (one connector for the base version CTM, two connectors for the high-line/premium version) from the CTM connector receptacle(s).

(6) Remove the CTM from the instrument panel.

INSTALLATION

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NOTE: Before replacing a high-line/premium version Central Timer Module (CTM), use a DRBIII® scan tool to retrieve the current settings for the CTM programmable features. Refer to the appropriate diagnostic information. These settings should be duplicated in the replacement high-line/premium CTM using the DRBIII® scan tool before returning the vehicle to service.

(1) Position the CTM to the inboard side of the instrument panel steering column opening.

(2) Reconnect the instrument panel wire harness connector(s) for the CTM (one connector for the base version CTM, two connectors for the high-line/premium version) to the CTM connector receptacle(s) (Fig. 3) or (Fig. 4).

(3) Position the CTM to the bracket on the inboard side of the instrument panel steering column opening.

(4) Install and tighten the two screws that secure the CTM to the bracket on the inboard side of instrument panel steering column opening. Tighten the screws to 1.6 N·m (15 in. lbs.).

(5) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(6) Reconnect the battery negative cable.

COMMUNICATION

DESCRIPTION - CCD DATA BUS

The Chrysler Collision Detection (also referred to as CCD or CD) data bus system is a multiplex system used for vehicle communications on many DaimlerChrysler Corporation vehicles. Within the context of the CCD system, the term "collision" refers to the system's ability to avoid collisions of the electronic data that enters the data bus from various electronic control modules at approximately the same time.

Multiplexing is a system that enables the transmission of several messages over a single channel or circuit. Many DaimlerChrysler vehicles use this principle for communication between the various microprocessor-based electronic control modules.

Many of the electronic control modules in a vehicle require information from the same sensing device. In the past, if information from one sensing device was required by several controllers, a wire from each controller needed to be connected in parallel to that sensor. In addition, each controller utilizing analog sensors required an Analog/Digital (A/D) converter in order to "read" these sensor inputs. Multiplexing reduces wire harness complexity, sensor current loads and controller hardware because each sensing device is connected to only one controller, which reads and distributes the sensor information to the other controllers over the data bus. Also, because each controller on the data bus can access the controller sensor inputs to every other controller on the data bus, more function and feature capabilities are possible.

COMMUNICATION (Continued)

In addition to reducing wire harness complexity, component sensor current loads and controller hardware, multiplexing offers a diagnostic advantage. A multiplex system allows the information flowing between controllers to be monitored using a diagnostic scan tool. The DaimlerChrysler system allows an electronic control module to broadcast message data out onto the bus where all other electronic control modules can “hear” the messages that are being sent. When a module hears a message on the data bus that it requires, it relays that message to its microprocessor. Each module ignores the messages on the data bus that are being sent to other electronic control modules.

With a diagnostic scan tool connected into the CCD circuit, a technician is able to observe many of the electronic control module function and message outputs while; at the same time, controlling many of the sensor message inputs. The CCD data bus, along with the use of a DRBIII® diagnostic scan tool and a logic-based approach to test procedures, as found in the appropriate diagnostic procedures manuals, allows the trained automotive technician to more easily, accurately and efficiently diagnose the many complex and integrated electronic functions and features found on today’s vehicles.

OPERATION - CCD DATA BUS

The CCD data bus system was designed to run at a 7812.5 baud rate (or 7812.5 bits per second). In order to successfully transmit and receive binary messages over the CCD data bus, the system requires the following:

- Bus (+) and Bus (–) Circuits
- CCD Chips in Each Electronic Control Module
- Bus Bias and Termination
- Bus Messaging
- Bus Message Coding

Following are additional details of each of the above system requirements.

BUS (+) AND BUS (–) CIRCUITS

The two wires (sometimes referred to as the “twisted pair”) that comprise the CCD data bus are the D1 circuit [Bus (+)], and the D2 circuit [Bus (–)]. The ″D″ in D1 and D2 identify these as diagnostic circuits. Transmission and receipt of binary messages on the CCD data bus is accomplished by cycling the voltage differential between the Bus (+) and Bus (–) circuits.

The two data bus wires are twisted together in order to shield the wires from the effects of any Electro-Magnetic Interference (EMI) from switched voltage sources. An induced EMI voltage can be generated in any wire by a nearby switched voltage or switched ground circuit. By twisting the data bus wires together, the induced voltage spike (either up or down) affects both wires equally. Since both wires are affected equally, a voltage differential still exists between the Bus (+) and Bus (–) circuits, and the data bus messages can still be broadcast or received. The correct specification for data bus wire twisting is one turn for every 44.45 millimeters (1 ¾ inches) of wire.

CCD CHIPS

In order for an electronic control module to communicate on the CCD data bus, it must have a CCD chip (Fig. 5). The CCD chip contains a differential transmitter/receiver (or transceiver), which is used to send and receive messages. Each module is wired in parallel to the data bus through its CCD chip.

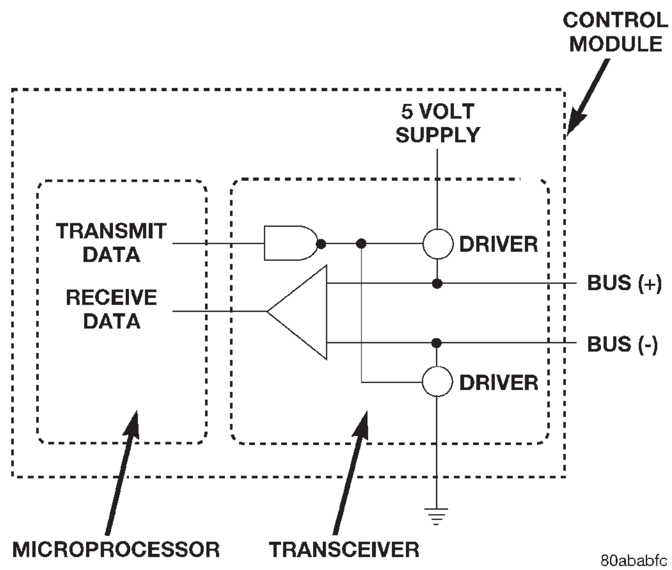

Fig. 5 CCD Chip

The differential transceiver sends messages by using two current drivers: one current source driver, and one current sink driver. The current drivers are matched and allow 0.006 ampere to flow through the data bus circuits. When the transceiver drivers are turned On, the Bus (+) voltage increases slightly, and the Bus (–) voltage decreases slightly. By cycling the drivers On and Off, the CCD chip causes the voltage on the data bus circuit to fluctuate to reflect the message.

Once a message is broadcast over the CCD data bus, all electronic control modules on the data bus have the ability to receive it through their CCD chip. Reception of CCD messages is also carried out by the transceiver in the CCD chip. The transceiver monitors the voltage on the data bus for any fluctuations. When data bus voltage fluctuations are detected, they are interpreted by the transceiver as binary messages and sent to the electronic control module’s microprocessor.

COMMUNICATION (Continued)

BUS BIAS AND TERMINATION

The voltage network used by the CCD data bus to transmit messages requires both bias and termination. At least one electronic control module on the data bus must provide a voltage source for the CCD data bus network known as bus bias, and there must be at least one bus termination point for the data bus circuit to be complete. However, while bias and termination are both required for data bus operation, they both do not have to be within the same electronic control module. The CCD data bus is biased to approximately 2.5 volts. With each of the electronic control modules wired in parallel to the data bus, all modules utilize the same bus bias. Therefore, based upon vehicle options, the data bus can accommodate two or twenty electronic control modules without affecting bus voltage.

The power supplied to the data bus is known as bus biasing. Bus bias is provided through a series circuit. To properly bias the data bus circuits, a 5 volt supply is provided through a 13 kilohm resistor to the Bus (–) circuit (Fig. 6). Voltage from the Bus (–) circuit flows through a 120 ohm termination resistor to the Bus (+) circuit. The Bus (+) circuit is grounded through another 13 kilohm resistor. While at least one termination resistor is required for the system to operate, most DaimlerChrysler systems use two. The second termination resistor serves as a backup (Fig. 7). The termination resistor provides a path for the bus bias voltage. Without a termination point, voltage biasing would not occur. Voltage would go to 5 volts on one bus wire and 0 volts on the other bus wire.

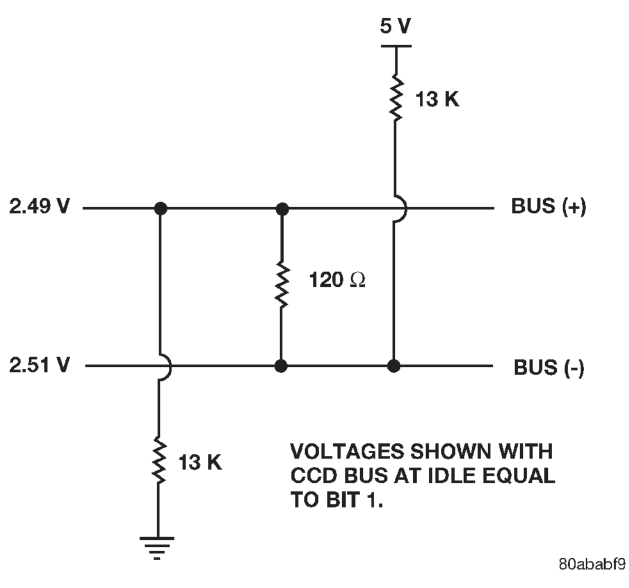

Fig. 6 Bus Biasing

The voltage drop through the termination resistor creates 2.51 volts on Bus (–), and 2.49 volts on Bus (+). The voltage difference between the two circuits is 0.02 volts. When the data bus voltage differential is a steady 0.02 volts, the CCD system is considered “idle.” When no input is received from any module and the ignition switch is in the Off position for a pre-programmed length of time, the bus data becomes inactive or enters the ”sleep mode.” Electronic control modules that provide bus bias can be programmed to ”wake up” the data bus and become active upon receiving any predetermined input or when the ignition switch is turned to the On position.

BUS MESSAGING

The electronic control modules used in the CCD data bus system contain microprocessors. Digital signals are the means by which microprocessors operate internally and communicate messages to other microprocessors. Digital signals are limited to two states, voltage high or voltage low, corresponding to either a one or a zero. Unlike conventional binary code, the CCD data bus systems translate a small voltage difference as a one (1), and a larger voltage difference as a zero (0). The use of the 0 and 1 is referred to as binary coding. Each binary number is called a bit, and eight bits make up a byte. For example: 01011101 represents a message. The controllers in the multiplex system are able to send thousands of these bytes strung together to communicate a variety of messages. Through the use of binary data transmission, all electronic control modules on the data bus can communicate with each other.

The microprocessors in the CCD data bus system translate the binary messages into Hexadecimal Code (or Hex Code). Hex code is the means by which microprocessors communicate and interpret messages. When fault codes are received by the DRBIII® scan tool, they are translated into text for display on the DRBIII® screen. Although not displayed by the DRBIII® for Body Systems, hex codes are shown by the DRBIII® for Engine System faults.

When the microprocessor signals the transceiver in the CCD chip to broadcast a message, the transceiver turns the current drivers On and Off, which cycles the voltage on the CCD data bus circuits to correspond to the message. At idle, the CCD system recognizes the 0.02 voltage differential as a binary bit 1. When the current drivers are actuated, the voltage differential from idle must increase by 0.02 volt for the CCD system to recognize a binary bit 0 (Fig. 8). The nominal voltage differential for a 0 bit is 0.100 volts. However, data bus voltage differentials can range anywhere between 0.02 and 0.120 volt.

COMMUNICATION (Continued)

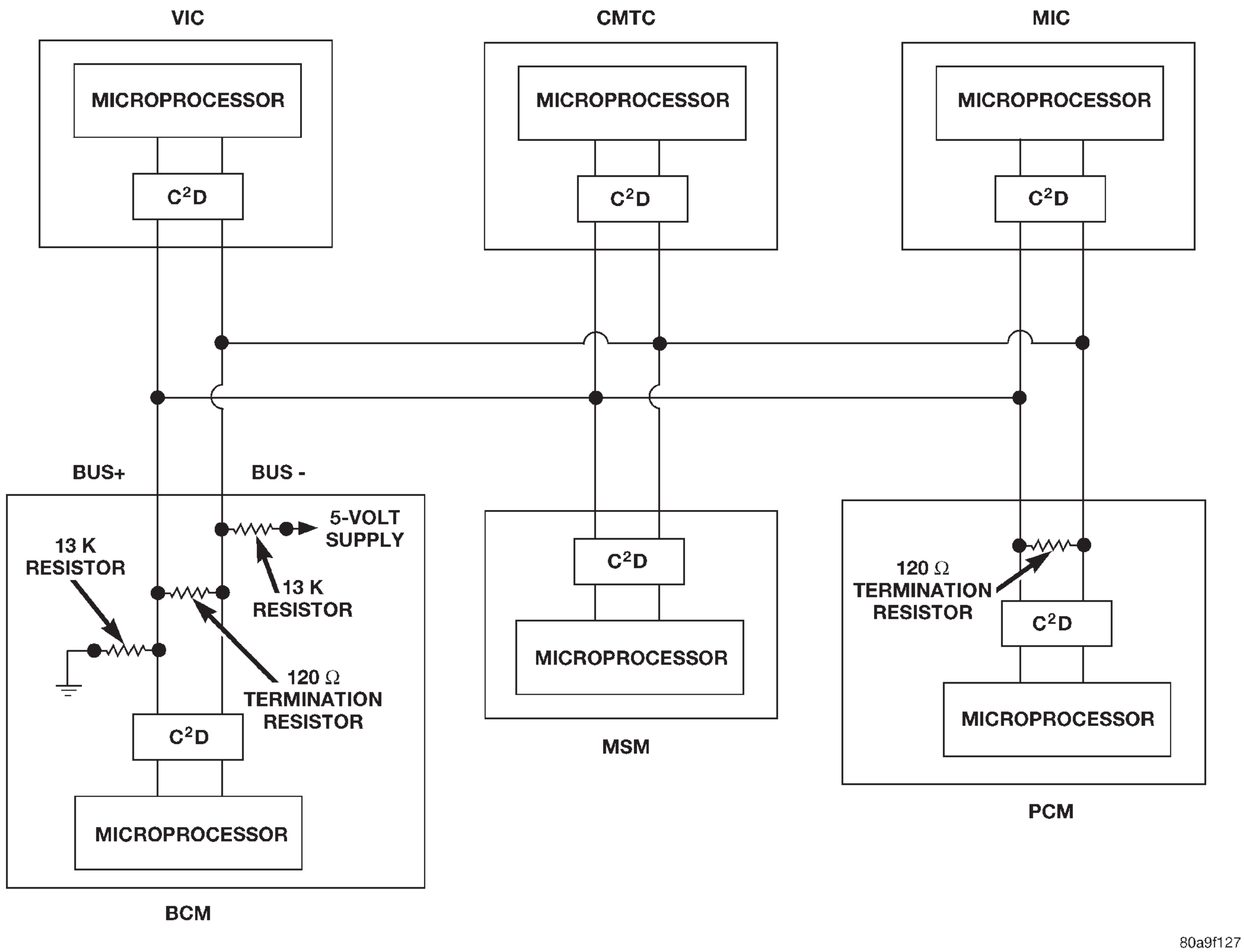

Fig. 7 Bus Termination

BUS MESSAGE CODING

The first part of a data bus message has an Identification (ID) byte. The ID byte contains message priority, message identification, message content and message length information. All messages sent over the data bus are coded for both priority and identification.

PRIORITY

Messages can be broadcast almost simultaneously by modules over the CCD data bus. Therefore, all messages are defined and ranked by a predetermined priority. When two CCD chips start a message at exactly the same time, non-destructive arbitration occurs between the two CCD chips. Arbitration will occur based upon the priority code, to determine which message takes priority on the data bus and to prevent data collision. If a CCD chip senses a message of higher priority being transmitted, it stops transmitting its message. The higher priority message is then transmitted in its entirety without interruption. The other CCD chips on the data bus do not allow any other messages to be broadcast.

To determine the winner in an arbitration, all messages start with an ID byte which contains the predetermined priority code. In the digital broadcast, zero is the dominant bit. All ID bytes start with a zero. This is the start of the message. With zeros being the dominant bit, messages starting with more zeros have a higher priority. For example: of the two messages below, Message #2 loses arbitration at the second bit, where Message #1 has a zero and Message #2 has a one (Fig. 9). After the message is broadcast, an idle period occurs while all microprocessors can queue, if necessary, and attempt to broadcast their messages again.

- Message #1 = 00010110
- Message #2 = 01010101

COMMUNICATION (Continued)

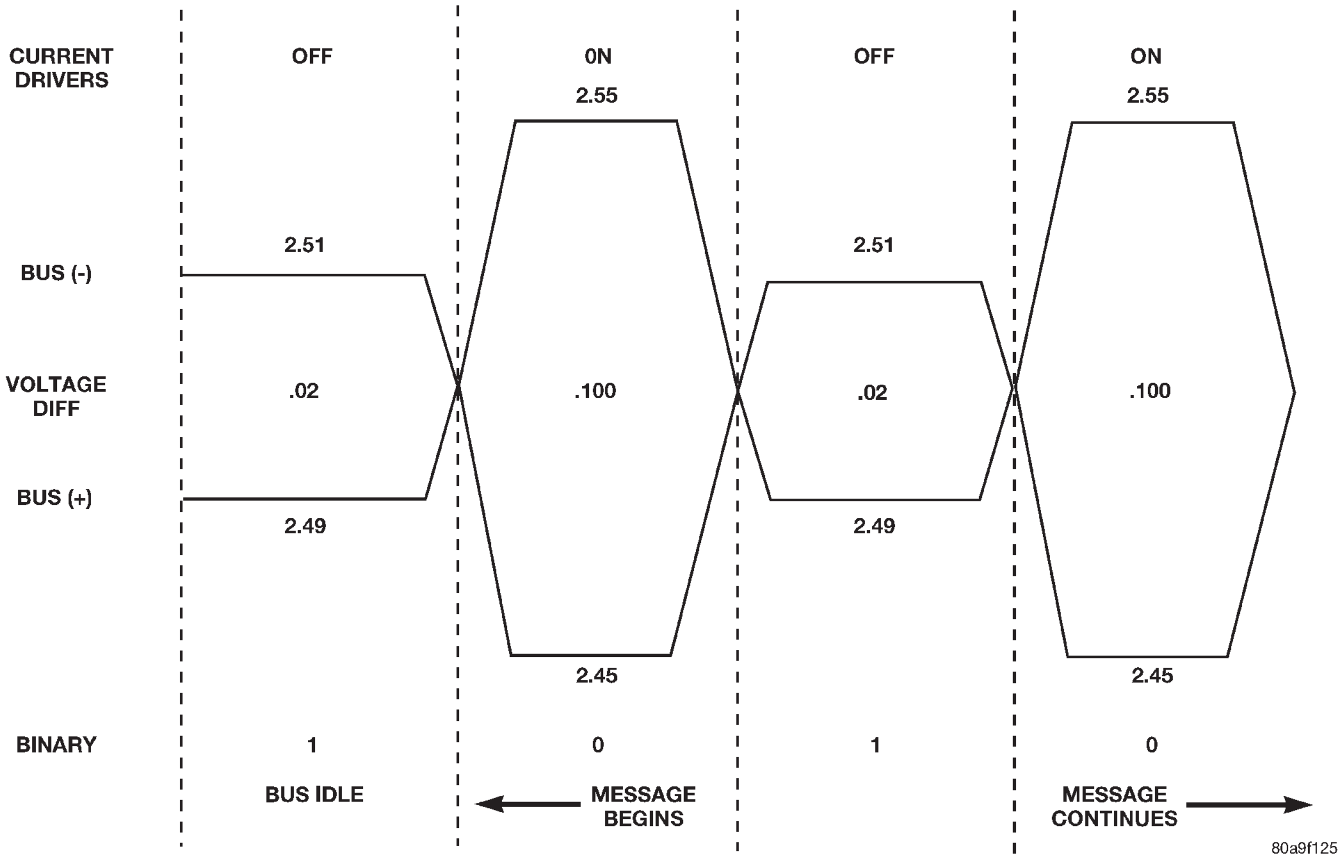

Fig. 8 Voltage Cycling to Correspond to Message

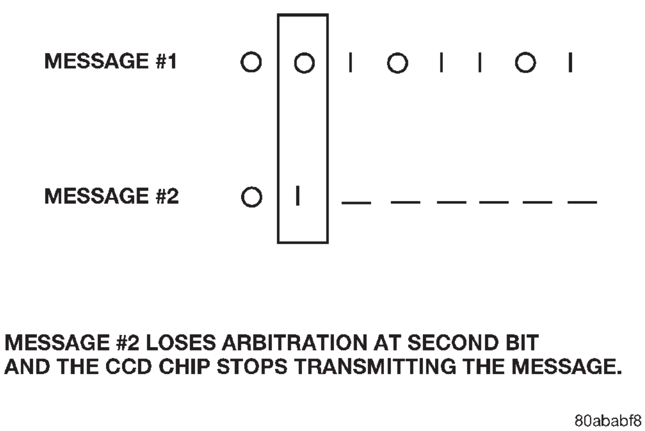

Fig. 9 Message Arbitration

MESSAGE IDENTIFICATION

Because messages are broadcast over the data bus, all modules can receive them, yet not all modules need all messages. In order to enhance microprocessor speed, unneeded messages are filtered out. The ID byte, along with showing message priority, also identifies the data, content and length. The electronic control module, through its CCD chip transceiver, monitors the ID code of the messages. If the message is not for that particular module, the message is simply ignored. Once the module recognizes a message that it requires, the rest of the message is monitored and processed.

TRANSMISSION VERIFICATION

Once a CCD chip transmits a message over the CCD data bus, the message is received by the transmitting module at the same time through the CCD chip differential transceiver. The module knows the message was broadcast correctly when it receives its own message back. If the message received does not match the message transmitted, the message is said to be corrupt.

Corruption occurs when the message is incorrectly transmitted on the data bus. Corruption can also occur from interference, wiring problems, or other data bus problems. In the case of a corrupt message, the module attempts to have the CCD chip re-send the message.

COMMUNICATION (Continued)

DIAGNOSIS AND TESTING - CCD DATA BUS

CCD BUS FAILURE

The CCD data bus can be monitored using the DRBIII® scan tool. However, it is possible for the data bus to pass all tests since the voltage parameters will be in “range“ and false signals are being sent. There are essentially 12 “hard failures“ that can occur with the CCD data bus:

- Bus Shorted to Battery
- Bus Shorted to 5 Volts
- Bus Shorted to Ground
- Bus (+) Shorted to Bus (–)
- Bus (–) and Bus (+) Open
- Bus (+) Open
- Bus (–) Open
- No Bus Bias
- Bus Bias Level Too High
- Bus Bias Level Too Low
- No Bus Termination
- Not Receiving Bus Messages Correctly

Refer to the appropriate diagnostic information for details on how to diagnose these faults using a DRBIII® scan tool.

BUS FAILURE VISUAL SYMPTOM DIAGNOSIS

The following visible symptoms or customer complaints, alone or in combination, may indicate a CCD data bus failure:

- Airbag Indicator and Malfunction Indicator Lamp (MIL) Illuminated
- Instrument Cluster Gauges (All) Inoperative
- No Compass Mini-Trip Computer (CMTC) Operation (if equipped)

CONTROLLER ANTILOCK BRAKE

DESCRIPTION

The Controller Antilock Brakes (CAB) is a microprocessor which handles testing, monitoring and controlling the ABS brake system operation (Fig. 10). The CAB functions are:

- Perform self-test diagnostics.
- Monitor the RWAL brake system for proper operation.
- Control the RWAL valve solenoids.

NOTE: If the CAB needs to be replaced, the rear axle type and tire revolutions per mile must be programed into the new CAB. For axle type refer to Group 3 Differential and Driveline. For tire revolutions per mile,(Refer to 22 - TIRES/WHEELS/TIRES - SPECIFICATIONS) . To program the CAB refer to the Chassis Diagnostic Manual.

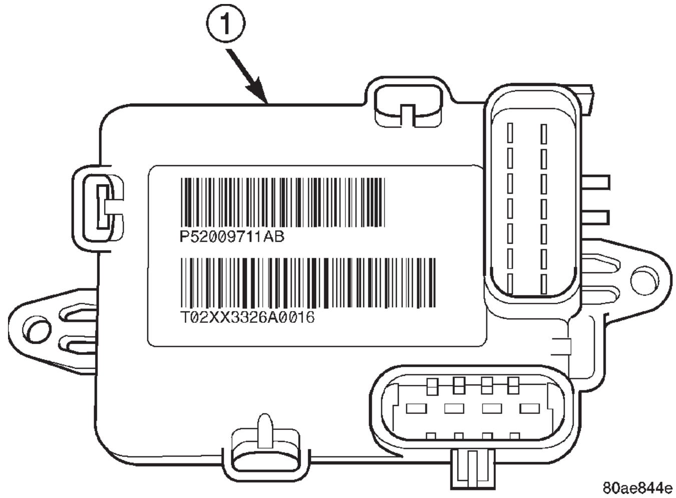

Fig. 10 RWAL CAB

1 - RWAL CAB

OPERATION

SYSTEM SELF-TEST

When the ignition switch is turned-on the microprocessor RAM and ROM are tested. If an error occurs during the test, a DTC will be set into the RAM memory. However it is possible the DTC will not be stored in memory if the error has occurred in the RAM module were the DTC's are stored. Also it is possible a DTC may not be stored if the error has occurred in the ROM which signals the RAM to store the DTC.

CAB INPUTS

The CAB continuously monitors the speed of the differential ring gear by monitoring signals generated by the rear wheel speed sensor. The CAB determines a wheel locking tendency when it recognizes the ring gear is decelerating too rapidly. The CAB monitors the following inputs to determine when a wheel locking tendency may exists:

- Rear Wheel Speed Sensor
- Brake Lamp Switch
- Brake Warning Lamp Switch
- Reset Switch
- 4WD Switch (If equipped)

CAB OUTPUTS

The CAB controls the following outputs for antilock braking and brake warning information:

- RWAL Valve
- ABS Warning Lamp
- Brake Warning Lamp

REMOVAL

(1) Disconnect battery negative cable.

CONTROLLER ANTILOCK BRAKE (Continued)

(2) Push the harness connector locks to release the locks, (Fig. 11) then remove the connectors from the CAB.

(3) Disconnect the pump motor connector (Fig. 12) .

(4) Remove screws attaching CAB to the HCU (Fig. 13) .

(5) Remove the CAB.

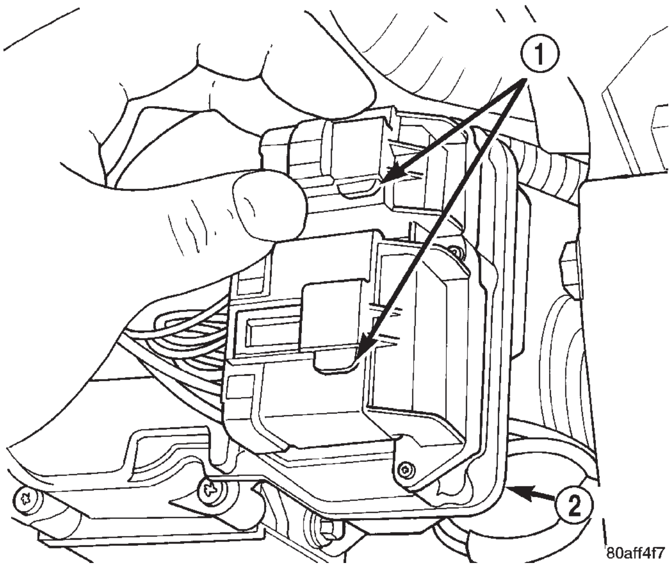

Fig. 11 Harness Connector Locks

1 - CONNECTOR LOCK
2 - CAB

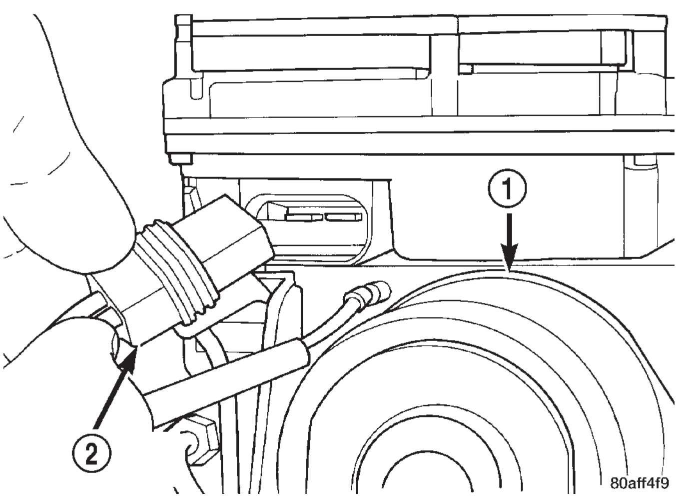

Fig. 12 Pump

1 - PUMP MOTOR
2 - PUMP CONNECTOR

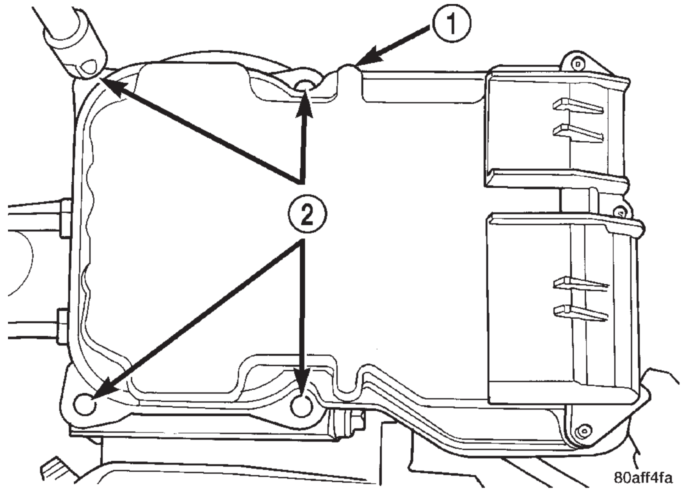

Fig. 13 Controller Mounting Screws

1 - CAB
2 - MOUNTING LOCATIONS

INSTALLATION

(1) Place the CAB onto the HCU.

NOTE: Insure the CAB seal is in position before installation.

(2) Install the mounting screws and tighten to 4-4.7 N·m (36-42 in. lbs.).

(3) Connect the pump motor harness.

(4) Connect the harnesses to the CAB and lock the connectors.

(5) Connect battery.

DATA LINK CONNECTOR

DESCRIPTION - DATA LINK CONNECTOR

The data link connector (DLC) is located at the lower edge of the instrument panel near the steering column.

OPERATION - DATA LINK CONNECTOR

The 16–way data link connector (diagnostic scan tool connector) links the Diagnostic Readout Box (DRB) scan tool or the Mopar Diagnostic System (MDS) with the Powertrain Control Module (PCM).

ENGINE CONTROL MODULE

DESCRIPTION - ECM

The ECM is bolted to the left side of the engine behind the fuel filter (Fig. 14). It is a separate component and can be serviced. The FPCM is internal to the fuel injection pump (Fig. 15) and cannot be serviced.

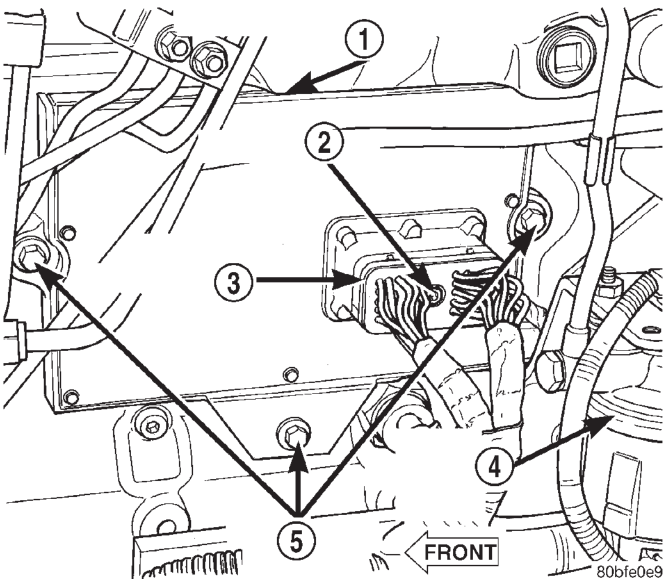

Fig. 14 Engine Control Module (ECM) Location

1 - ENGINE CONTROL MODULE (ECM)
2 - HEX HEADED BOLT
3 - 50-WAY CONNECTOR
4 - FUEL TRANSFER PUMP
5 - MOUNTING BOLTS (3)

OPERATION - ECM

The main functions of the Engine Control Module (ECM) and Fuel Injection Pump Control Module (FPCM) are to electrically control the fuel system. The Powertrain Control Module (PCM) **does not control** the fuel system.

The ECM can adapt its programming to meet changing operating conditions. **If the ECM has been replaced, flashed or re-calibrated, the ECM must learn the Accelerator Pedal Position Sensor (APPS) idle voltage. Failure to learn this voltage may result in unnecessary diagnostic trouble codes. Refer to ECM Removal/Installation for learning procedures.**

The ECM receives input signals from various switches and sensors. Based on these inputs, the ECM regulates various engine and vehicle operations through different system components. These components are referred to as **ECM Outputs.** The sensors and switches that provide inputs to the ECM are considered **ECM Inputs.**

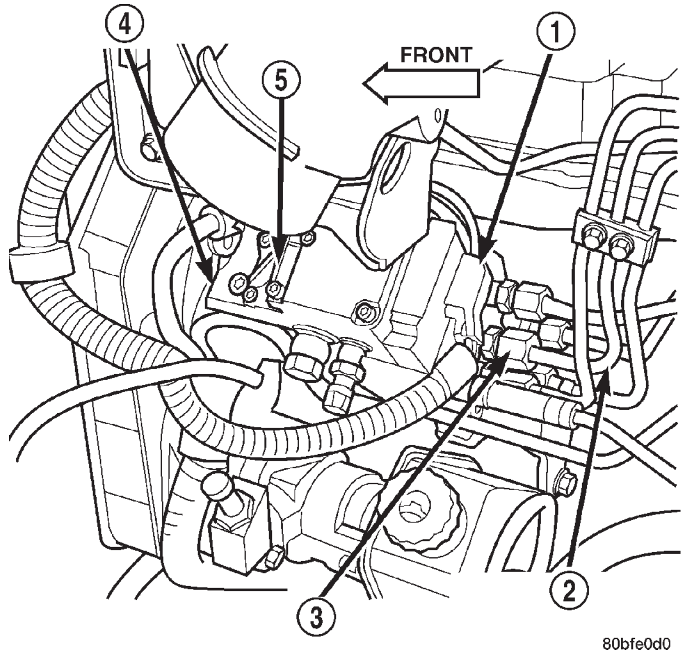

Fig. 15 Fuel Injection Pump Control Module (FPCM) Location

1 - FPCM ELECTRICAL CONNECTOR
2 - HIGH-PRESSURE FUEL LINES
3 - FITTINGS
4 - FUEL INJECTION PUMP
5 - FPCM

NOTE: ECM Inputs:

- Accelerator Pedal Position Sensor (APPS) Volts
- APPS Idle Validation Switches #1 and #2
- Battery voltage
- Camshaft Position Sensor (CMP)
- CCD bus (+) circuits
- CCD bus (-) circuits
- Crankshaft Position Sensor (CKP)
- Data link connection for DRB scan tool
- (FPCM) Fuel Injection Pump Control Module
- Engine Coolant Temperature (ECT) sensor
- Ground circuits
- Intake manifold Air Temperature (IAT) sensor
- Manifold Air Pressure Sensor (Boost Pressure Sensor)
- Oil pressure sensor
- PCM
- Power Take Off (PTO)
- Power ground
- Sensor return
- Signal ground
- Water-In-Fuel (WIF) sensor

ENGINE CONTROL MODULE (Continued)

NOTE: ECM Outputs:

After inputs are received by the ECM, certain sensors, switches and components are controlled or regulated by the ECM. These are considered **ECM Outputs.** These outputs are for:

- CCD bus (+) circuits
- CCD bus (-) circuits
- CKP and APPS outputs to the PCM
- Data link connection for DRB scan tool
- Five volt sensor supply
- Fuel injection pump
- Fuel injection pump relay
- (FPCM) Fuel Pump Control Module
- Fuel transfer (lift) pump
- Intake manifold air heater relays #1 and #2 control circuits
- Malfunction indicator lamp (Check engine lamp)
- Oil pressure gauge/warning lamp
- PCM
- Wait-to-start warning lamp
- Water-In-Fuel (WIF) warning lamp

REMOVAL

The ECM is bolted to the engine block behind the fuel filter (Fig. 16).

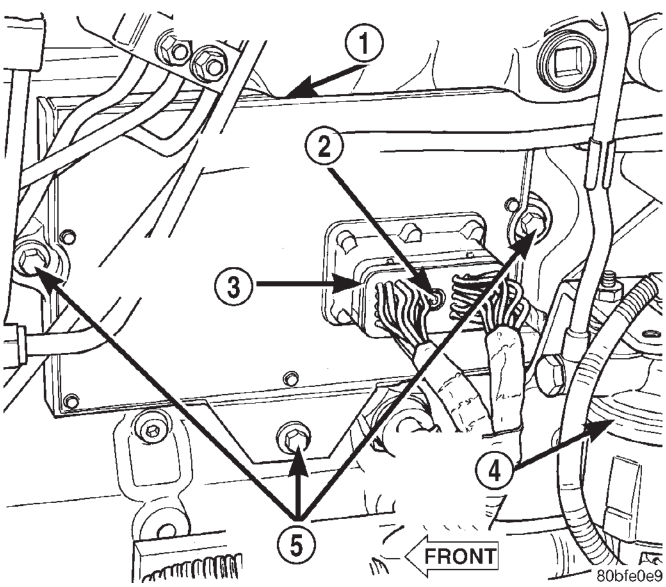

Fig. 16 Engine Control Module (ECM) Location and Mounting

1 - ENGINE CONTROL MODULE (ECM)
2 - HEX HEADED BOLT
3 - 50-WAY CONNECTOR
4 - FUEL TRANSFER PUMP
5 - MOUNTING BOLTS (3)

(1) Record any Diagnostic Trouble Codes (DTC's) found in the PCM or ECM.

To avoid possible voltage spike damage to either the Powertrain Control Module (PCM) or ECM, ignition key must be off, and negative battery cables must be disconnected before unplugging ECM connectors.

(2) Disconnect both negative battery cables at both batteries.

(3) Remove 50–way electrical connector bolt at ECM (Fig. 16). Note: Connector bolt is female 4mm hex head. To remove bolt, use a ball-hex bit or ball-hex screwdriver such as Snap-On ® 4mm SDABM4 (5/32" may also be used). As bolt is being removed, very carefully remove connector from ECM.

(4) Remove three ECM mounting bolts and remove ECM from vehicle.

INSTALLATION

Do not apply paint to back of ECM. Poor ground will result.

(1) Clean ECM mounting points at engine block.

(2) Position ECM to engine block and install 3 mounting bolts. Tighten bolts to 24 N·m (18 ft. lbs.).

(3) Check pin connectors in ECM and 50–way connector for corrosion or damage. Repair as necessary.

(4) Clean pins in 50–way electrical connector with a quick-dry electrical contact cleaner.

(5) Very carefully install 50–way connector to ECM. Tighten connector hex bolt.

(6) Install battery cables.

(7) **Turn key to ON position. Without starting engine, slowly press throttle pedal to floor and then slowly release. This step must be done (one time) to ensure accelerator pedal position sensor calibration has been learned by ECM. If not done, possible DTC's may be set.**

(8) Use DRB scan tool to erase any stored companion DTC's from PCM.

POWERTRAIN CONTROL MODULE

DESCRIPTION

DESCRIPTION - PCM

The Powertrain Control Module (PCM) is located in the engine compartment (Fig. 17). The PCM is referred to as JTEC.

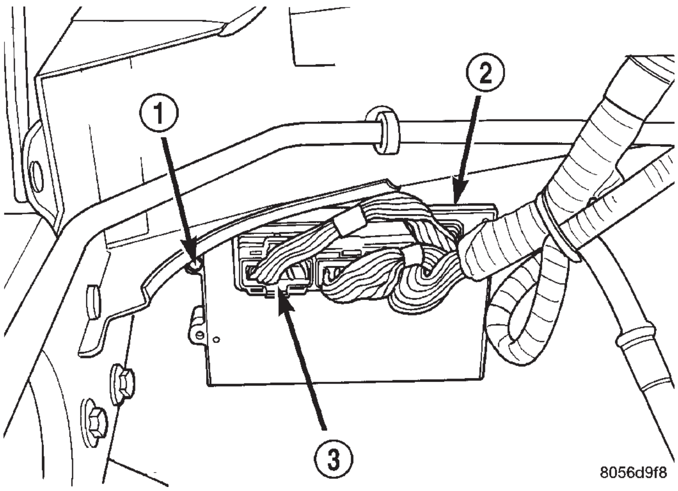

Fig. 17 PCM Location

1 - PCM MOUNTING BOLTS (3)
2 - POWERTRAIN CONTROL MODULE (PCM)
3 - (3) 32–WAY CONNECTORS

DESCRIPTION - MODES OF OPERATION

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

The PCM will operate in two different modes: **Open Loop and Closed Loop**.

During Open Loop modes, the PCM receives input signals and responds only according to preset PCM programming. Input from the oxygen (O2S) sensors is not monitored during Open Loop modes.

During Closed Loop modes, the PCM will monitor the oxygen (O2S) sensors input. This input indicates to the PCM whether or not the calculated injector pulse width results in the ideal air-fuel ratio. This ratio is 14.7 parts air-to-1 part fuel. By monitoring the exhaust oxygen content through the O2S sensor, the PCM can fine tune the injector pulse width. This is done to achieve optimum fuel economy combined with low emission engine performance.

The fuel injection system has the following modes of operation:

- Ignition switch ON
- Engine start-up (crank)
- Engine warm-up
- Idle
- Cruise
- Acceleration
- Deceleration
- Wide open throttle (WOT)
- Ignition switch OFF

The ignition switch On, engine start-up (crank), engine warm-up, acceleration, deceleration and wide open throttle modes are Open Loop modes. The idle and cruise modes, (with the engine at operating temperature) are Closed Loop modes.

IGNITION SWITCH (KEY-ON) MODE

This is an Open Loop mode. When the fuel system is activated by the ignition switch, the following actions occur:

- The PCM pre-positions the idle air control (IAC) motor.
- The PCM determines atmospheric air pressure from the MAP sensor input to determine basic fuel strategy.
- The PCM monitors the engine coolant temperature sensor input. The PCM modifies fuel strategy based on this input.
- Intake manifold air temperature sensor input is monitored.
- Throttle position sensor (TPS) is monitored.
- The auto shutdown (ASD) relay is energized by the PCM for approximately three seconds.
- The fuel pump is energized through the fuel pump relay by the PCM. The fuel pump will operate for approximately three seconds unless the engine is operating or the starter motor is engaged.
- The O2S sensor heater element is energized via the ASD relay. The O2S sensor input is not used by the PCM to calibrate air-fuel ratio during this mode of operation.

ENGINE START-UP MODE

This is an Open Loop mode. The following actions occur when the starter motor is engaged.

The PCM receives inputs from:

- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Starter motor relay
- Camshaft position sensor signal

The PCM monitors the crankshaft position sensor. If the PCM does not receive a crankshaft position sensor signal within 3 seconds of cranking the engine, it will shut down the fuel injection system.

POWERTRAIN CONTROL MODULE (Continued)

The fuel pump is activated by the PCM through the fuel pump relay.

Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.

The PCM determines the proper ignition timing according to input received from the crankshaft position sensor.

ENGINE WARM-UP MODE

This is an Open Loop mode. During engine warm-up, the PCM receives inputs from:

- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)

Based on these inputs the following occurs:

- Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.
- The PCM adjusts engine idle speed through the idle air control (IAC) motor and adjusts ignition timing.
- The PCM operates the A/C compressor clutch through the clutch relay. This is done if A/C has been selected by the vehicle operator and requested by the A/C thermostat.
- When engine has reached operating temperature, the PCM will begin monitoring O2S sensor input. The system will then leave the warm-up mode and go into closed loop operation.

IDLE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At idle speed, the PCM receives inputs from:

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Battery voltage
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Oxygen sensors

Based on these inputs, the following occurs:

- Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then control injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.
- The PCM monitors the O2S sensor input and adjusts air-fuel ratio by varying injector pulse width. It also adjusts engine idle speed through the idle air control (IAC) motor.
- The PCM adjusts ignition timing by increasing and decreasing spark advance.
- The PCM operates the A/C compressor clutch through the clutch relay. This happens if A/C has been selected by the vehicle operator and requested by the A/C thermostat.

CRUISE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At cruising speed, the PCM receives inputs from:

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Oxygen (O2S) sensors

Based on these inputs, the following occurs:

- Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then adjust the injector pulse width by turning the ground circuit to each individual injector on and off.
- The PCM monitors the O2S sensor input and adjusts air-fuel ratio. It also adjusts engine idle speed through the idle air control (IAC) motor.
- The PCM adjusts ignition timing by turning the ground path to the coil on and off.
- The PCM operates the A/C compressor clutch through the clutch relay. This happens if A/C has been selected by the vehicle operator and requested by the A/C thermostat.

POWERTRAIN CONTROL MODULE (Continued)

ACCELERATION MODE

This is an Open Loop mode. The PCM recognizes an abrupt increase in throttle position or MAP pressure as a demand for increased engine output and vehicle acceleration. The PCM increases injector pulse width in response to increased throttle opening.

DECELERATION MODE

When the engine is at operating temperature, this is an Open Loop mode. During hard deceleration, the PCM receives the following inputs.

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Vehicle speed sensor

If the vehicle is under hard deceleration with the proper rpm and closed throttle conditions, the PCM will ignore the oxygen sensor input signal. The PCM will enter a fuel cut-off strategy in which it will not supply a ground to the injectors. If a hard deceleration does not exist, the PCM will determine the proper injector pulse width and continue injection.

Based on the above inputs, the PCM will adjust engine idle speed through the idle air control (IAC) motor.

The PCM adjusts ignition timing by turning the ground path to the coil on and off.

WIDE OPEN THROTTLE MODE

This is an Open Loop mode. During wide open throttle operation, the PCM receives the following inputs.

- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)

During wide open throttle conditions, the following occurs:

- Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off. The PCM ignores the oxygen sensor input signal and provides a predetermined amount of additional fuel. This is done by adjusting injector pulse width.
- The PCM adjusts ignition timing by turning the ground path to the coil on and off.

IGNITION SWITCH OFF MODE

When ignition switch is turned to OFF position, the PCM stops operating the injectors, ignition coil, ASD relay and fuel pump relay.

DESCRIPTION - 5 VOLT SUPPLIES

Two different Powertrain Control Module (PCM) five volt supply circuits are used; primary and secondary.

DESCRIPTION - IGNITION CIRCUIT SENSE

This circuit ties the ignition switch to the Powertrain Control Module (PCM).

DESCRIPTION - POWER GROUNDS

The Powertrain Control Module (PCM) has 2 main grounds. Both of these grounds are referred to as power grounds. All of the high-current, noisy, electrical devices are connected to these grounds as well as all of the sensor returns. The sensor return comes into the sensor return circuit, passes through noise suppression, and is then connected to the power ground.

The power ground is used to control ground circuits for the following PCM loads:

- Generator field winding
- Fuel injectors
- Ignition coil(s)
- Certain relays/solenoids
- Certain sensors

DESCRIPTION - SENSOR RETURN

The Sensor Return circuits are internal to the Powertrain Control Module (PCM).

Sensor Return provides a low–noise ground reference for all engine control system sensors. Refer to Power Grounds for more information.

DESCRIPTION - SIGNAL GROUND

Signal ground provides a low noise ground to the data link connector.

POWERTRAIN CONTROL MODULE (Continued)

OPERATION

OPERATION - PCM - GAS ENGINES

The PCM operates the fuel system. The PCM is a pre-programmed, triple microprocessor digital computer. It regulates ignition timing, air-fuel ratio, emission control devices, charging system, certain transmission features, speed control, air conditioning compressor clutch engagement and idle speed. The PCM can adapt its programming to meet changing operating conditions.

The PCM receives input signals from various switches and sensors. Based on these inputs, the PCM regulates various engine and vehicle operations through different system components. These components are referred to as Powertrain Control Module (PCM) Outputs. The sensors and switches that provide inputs to the PCM are considered Powertrain Control Module (PCM) Inputs.

The PCM adjusts ignition timing based upon inputs it receives from sensors that react to: engine rpm, manifold absolute pressure, engine coolant temperature, throttle position, transmission gear selection (automatic transmission), vehicle speed and the brake switch.

The PCM adjusts idle speed based on inputs it receives from sensors that react to: throttle position, vehicle speed, transmission gear selection, engine coolant temperature and from inputs it receives from the air conditioning clutch switch and brake switch.

Based on inputs that it receives, the PCM adjusts ignition coil dwell. The PCM also adjusts the generator charge rate through control of the generator field and provides speed control operation.

NOTE: PCM Inputs:

- A/C request (if equipped with factory A/C)
- A/C select (if equipped with factory A/C)
- Auto shutdown (ASD) sense
- Battery temperature
- Battery voltage
- Brake switch
- CCD bus (+) circuits
- CCD bus (-) circuits
- Camshaft position sensor signal
- Crankshaft position sensor
- Data link connection for DRB scan tool
- Engine coolant temperature sensor
- Fuel level
- Generator (battery voltage) output
- Ignition circuit sense (ignition switch in on/off/crank/run position)
- Intake manifold air temperature sensor
- Leak detection pump (switch) sense (if equipped)
- Manifold absolute pressure (MAP) sensor
- Oil pressure
- Output shaft speed sensor
- Overdrive/override switch
- Oxygen sensors
- Park/neutral switch (auto. trans. only)
- Power ground
- Sensor return
- Signal ground
- Speed control multiplexed single wire input
- Throttle position sensor
- Transmission governor pressure sensor
- Transmission temperature sensor
- Vehicle speed inputs from ABS or RWAL system

NOTE: PCM Outputs:

- A/C clutch relay
- Auto shutdown (ASD) relay
- CCD bus (+/-) circuits for: speedometer, voltmeter, fuel gauge, oil pressure gauge/lamp, engine temp. gauge and speed control warn. lamp
- Data link connection for DRB scan tool
- EGR valve control solenoid (if equipped)
- EVAP canister purge solenoid
- Five volt sensor supply (primary)
- Five volt sensor supply (secondary)
- Fuel injectors
- Fuel pump relay
- Generator field driver (-)
- Generator field driver (+)
- Generator lamp (if equipped)
- Idle air control (IAC) motor
- Ignition coil
- Leak detection pump (if equipped)
- Malfunction indicator lamp (Check engine lamp). Driven through CCD circuits.
- Overdrive indicator lamp (if equipped)
- Service Reminder Indicator (SRI) Lamp (MAINT REQ'D lamp). Driven through CCD circuits.
- Speed control vacuum solenoid
- Speed control vent solenoid
- Tachometer (if equipped). Driven through CCD circuits.
- Transmission convertor clutch circuit
- Transmission 3–4 shift solenoid
- Transmission relay
- Transmission temperature lamp (if equipped)
- Transmission variable force solenoid

OPERATION - DIESEL

Two different control modules are used: The Powertrain Control Module (PCM), and the Engine Control Module (ECM). The ECM **controls** the fuel system. The PCM **does not control** the fuel system.

The PCM's main function is to control: the vehicle charging system, speed control system, transmission, air conditioning system and certain bussed messages.

POWERTRAIN CONTROL MODULE (Continued)

The PCM can adapt its programming to meet changing operating conditions.

The PCM receives input signals from various switches and sensors. Based on these inputs, the PCM regulates various engine and vehicle operations through different system components. These components are referred to as **PCM Outputs.** The sensors and switches that provide inputs to the PCM are considered **PCM Inputs.**

NOTE: PCM Inputs:

- A/C request (if equipped with factory A/C)
- A/C select (if equipped with factory A/C)
- Accelerator Pedal Position Sensor (APPS) output from ECM
- Auto shutdown (ASD) relay sense
- Battery temperature sensor
- Battery voltage
- Brake switch
- CCD bus (+) circuits
- CCD bus (-) circuits
- Crankshaft Position Sensor (CKP) output from ECM
- Data link connection for DRB scan tool
- Fuel level sensor
- Generator (battery voltage) output
- Ignition sense
- Output shaft speed sensor
- Overdrive/override switch
- Park/neutral switch (auto. trans. only)
- Power ground
- Sensor return
- Signal ground
- Speed control resume switch
- Speed control set switch
- Speed control on/off switch
- Transmission governor pressure sensor
- Transmission temperature sensor
- Vehicle speed inputs from ABS or RWAL system

NOTE: PCM Outputs:

After inputs are received by the PCM, certain sensors, switches and components are controlled or regulated by the PCM. These are considered **PCM Outputs.** These outputs are for:

- A/C clutch relay and A/C clutch
- Auto shutdown (ASD) relay
- CCD bus (+/-) circuits for: speedometer, voltmeter, fuel gauge, oil pressure gauge/lamp, engine temp. gauge and speed control warn. lamp
- Data link connection for DRB scan tool
- Five volt sensor supply
- Generator field driver (-)
- Generator field driver (+)
- Generator lamp (if equipped)
- Malfunction indicator lamp (Check engine lamp)
- Overdrive warning lamp (if equipped)
- Speed control vacuum solenoid
- Speed control vent solenoid
- Tachometer (if equipped)
- Transmission convertor clutch circuit
- Transmission 3–4 shift solenoid
- Transmission relay
- Transmission temperature lamp (if equipped)
- Transmission variable force solenoid (governor sol.)

OPERATION - 5 VOLT SUPPLIES

Primary 5–volt supply:

- supplies the required 5 volt power source to the Crankshaft Position (CKP) sensor.
- supplies the required 5 volt power source to the Camshaft Position (CMP) sensor.
- supplies a reference voltage for the Manifold Absolute Pressure (MAP) sensor.
- supplies a reference voltage for the Throttle Position Sensor (TPS) sensor.

Secondary 5–volt supply:

- supplies the required 5 volt power source to the oil pressure sensor.
- supplies the required 5 volt power source for the Vehicle Speed Sensor (VSS) (if equipped).
- supplies the 5 volt power source to the transmission pressure sensor (if equipped with an RE automatic transmission).

OPERATION - IGNITION CIRCUIT SENSE

The ignition circuit sense input tells the PCM the ignition switch has energized the ignition circuit.

Battery voltage is also supplied to the PCM through the ignition switch when the ignition is in the RUN or START position. This is referred to as the ″ignition sense″ circuit and is used to ″wake up″ the PCM. Voltage on the ignition input can be as low as 6 volts and the PCM will still function. Voltage is supplied to this circuit to power the PCM's 8-volt regulator and to allow the PCM to perform fuel, ignition and emissions control functions.

REMOVAL

USE THE DRB SCAN TOOL TO REPROGRAM THE NEW POWERTRAIN CONTROL MODULE (PCM) WITH THE VEHICLES ORIGINAL IDENTIFICATION NUMBER (VIN) AND THE VEHICLES ORIGINAL MILEAGE. IF THIS STEP IS NOT DONE, A DIAGNOSTIC TROUBLE CODE (DTC) MAY BE SET.

The PCM is located in the engine compartment (Fig. 18).

POWERTRAIN CONTROL MODULE (Continued)

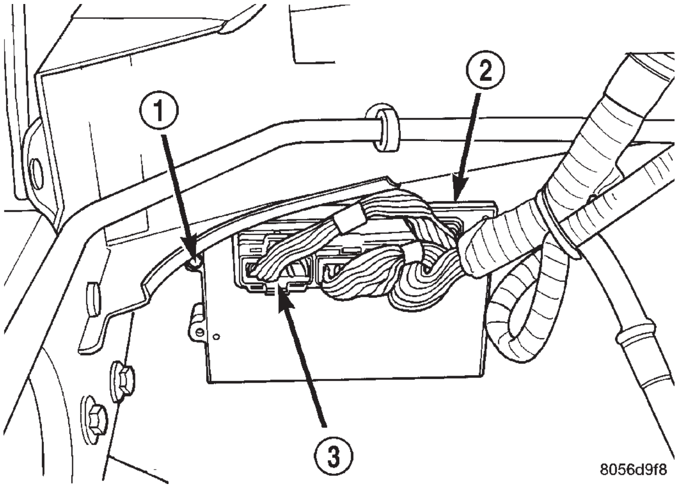

Fig. 18 PCM Location and Mounting

1 - PCM MOUNTING BOLTS (3)
2 - POWERTRAIN CONTROL MODULE (PCM)
3 - (3) 32–WAY CONNECTORS

To avoid possible voltage spike damage to the PCM, ignition key must be off, and negative battery cable must be disconnected before unplugging PCM connectors.

(1) Disconnect negative battery cable(s) at battery(s).

(2) Remove cover over electrical connectors. Cover snaps onto PCM.

(3) Carefully unplug the three 32–way connectors from PCM.

(4) Remove three PCM mounting bolts and remove PCM from vehicle.

INSTALLATION

USE THE DRB SCAN TOOL TO REPROGRAM THE NEW POWERTRAIN CONTROL MODULE (PCM) WITH THE VEHICLES ORIGINAL IDENTIFICATION NUMBER (VIN) AND THE VEHICLES ORIGINAL MILEAGE. IF THIS STEP IS NOT DONE, A DIAGNOSTIC TROUBLE CODE (DTC) MAY BE SET.

(1) Install PCM and mounting bolts to vehicle.

(2) Tighten bolts to 4 N·m (35 in. lbs.).

(3) Check pin connectors in the PCM and the three 32–way connectors for corrosion or damage. Repair as necessary.

(4) Install three 32–way connectors.

(5) Install cover over electrical connectors. Cover snaps onto PCM.

(6) Install battery cable(s).

(7) Use the DRB scan tool to reprogram new PCM with vehicles original Identification Number (VIN) and original vehicle mileage. If this step is not done, a Diagnostic Trouble Code (DTC) may be set.

HEATED SEAT MODULE

DESCRIPTION

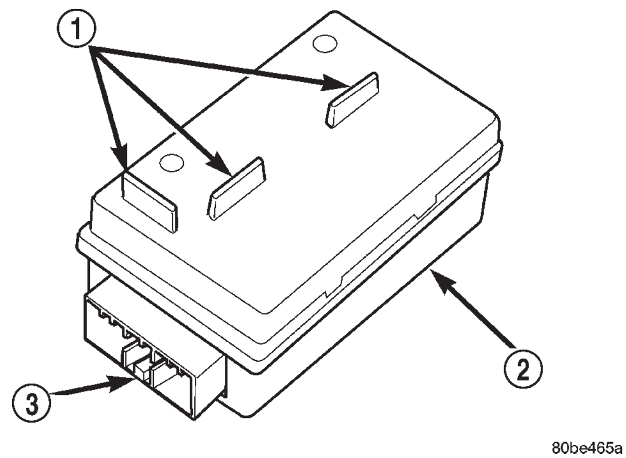

Fig. 19 Heated Seat Module

1 - MOUNTING TABS
2 - HEATED SEAT MODULE
3 - CONNECTOR RECEPTACLE

The heated seat module is also known as the Seat Heat Interface Module. The heated seat module (Fig. 19) is located under the front seat center cushion, where it is secured to a mounting bracket that also serves as the support for the slide-out rear seat cup holder unit. The mounting tabs that are molded into the plastic housing of the heated seat module are inserted through holes in the mounting bracket and then secured by push on retainers. The heated seat module has a single connector receptacle that allows the module to be connected to all of the required inputs and outputs through the seat wire harness.

The heated seat module is an electronic microprocessor controlled device designed and programmed to use inputs from the heated seat relay, the two heated seat switches and the two heated seat sensors to operate and control the heated seat elements in both front seats and the two heated seat indicator lamp Light-Emitting Diodes (LEDs) in each heated seat switch. The heated seat module is also programmed to perform self-diagnosis of certain heated seat system functions and provide feedback of that diagnosis through the heated seat switch indicator lamps.

The heated seat module cannot be repaired. If the heated seat module is damaged or faulty, the entire module must be replaced.

OPERATION

The heated seat module operates on fused battery current received from the heated seat relay. The module is grounded at all times through a ground screw located below the left rear speaker in the cab

HEATED SEAT MODULE (Continued)

of the vehicle. Inputs to the module include a resistor multiplexed heated seat switch request circuit for each of the two heated seat switches and the heated seat sensor inputs from the seat cushions of each front seat. In response to those inputs the heated seat module controls battery current feeds to the heated seat elements and sensors, and controls the ground for the heated seat switch indicator lamps.

NOTE: The vehicle's engine must be running in order for the heated seat system to function. This eliminates the possibility of draining the vehicles battery voltage while operating the heated seat system.

When a heated seat switch (Driver or Passenger) is depressed a signal is received by the heated seat module, the module energizes the proper indicator LED (Low or High) in the switch by grounding the indicator lamp circuit to indicate that the heated seat system is operating. At the same time, the heated seat module energizes the selected heated seat sensor circuit and the sensor provides the module with an input indicating the surface temperature of the selected seat cushion.

The Low heat set point is about 36° C (96.8° F), and the High heat set point is about 42° C (107.6° F). If the seat cushion surface temperature input is below the temperature set point for the selected temperature setting, the heated seat module energizes an N-channel Field Effect Transistor (N-FET) within the module which energizes the heated seat elements in the selected seat cushion and back. When the sensor input to the module indicates the correct temperature set point has been achieved, the module de-energizes the N-FET which de-energizes the heated seat elements. The heated seat module will continue to cycle the N-FET as needed to maintain the selected temperature set point.

If the heated seat module detects a heated seat sensor value input that is out of range or a shorted or open heated seat element circuit, it will notify the vehicle operator or the repair technician of this condition by flashing the High and/or Low indicator lamps in the affected heated seat switch. Refer to **Diagnosis and Testing Heated Seat System** in Heated Systems for flashing LED diagnosis and testing procedures. Refer to **Diagnosis and Testing Heated Seat Module** in this section for heated seat module diagnosis and testing procedures. Also refer to the Body Diagnostic Manual for additional diagnosis and testing procedures.

DIAGNOSIS AND TESTING - HEATED SEAT MODULE

If a heated seat fails to heat and one or both of the indicator lamps on a heated seat switch flash, refer to **Heated Seat System Diagnosis and Testing** in Heated Systems for flashing LED failure identification. Refer to **Wiring Diagrams** in for complete heated seat system wiring diagrams.

(1) Remove the heated seat module from its mounting location (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/MEMORY HEATED SEAT/MIRROR MODULE - REMOVAL).

NOTE: IN ORDER TO PERFORM THE FOLLOWING TESTS IT WILL BE NECESSARY TO REMOVE THE HEATED SEAT RELAY AND INSTALL A JUMPER WIRE IN TERMINALS 87 AND 30, BYPASSING THE HEATED SEAT RELAY.

NOTE: ANY RESISTANCE VALUES (OHMS Ω) GIVEN IN THE FOLLOWING TEXT ARE SUPPLIED USING THE AUTOMATIC RANGE GENERATED BY A FLUKE® AUTOMOTIVE METER. IF ANOTHER TYPE OF MEASURING DEVICE IS USED THE VALUES GENERATED MAY NOT BE THE SAME AS THE RESULTS SHOWN HERE, OR MAY HAVE TO BE CONVERTED TO THE RANGE USED HERE.

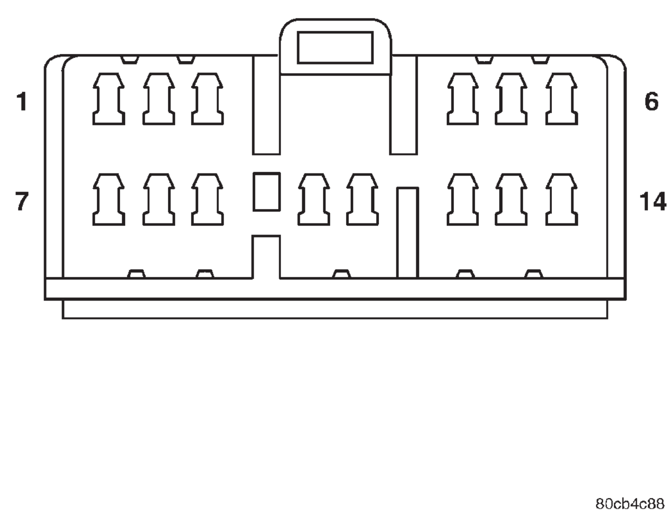

Fig. 20 Heated Seat Module Electrical Connector

HEATED SEAT MODULE (Continued)

RIGHT SEAT HEATER INOPERATIVE

(1) If a heated seat heats but one or both indicator lamps (LED's) on the heated seat switch fail to illuminate, check the driver circuit with the inoperative LED for a short to ground. If OK, replace the heated seat switch. If NOT OK repair the short to ground as required and than replace the heated seat switch.

NOTE: IF THE RIGHT SEAT CUSHION IS ALREADY WARM THE FOLLOWING STEP WILL NOT PROVE CONCLUSIVE.

(2) Back-probe the heated seat module wire harness connector (Fig. 20) , do not disconnect. Check cavity #3 for battery voltage when the right heated seat switch is turned “ON”, voltage should be present, If OK go to Step 3 If NOT OK, test the right heated seat switch (Refer to 8 - ELECTRICAL/ HEATED SEATS/PASSENGER HEATED SEAT SWITCH - DIAGNOSIS AND TESTING). If the switch tests OK, check for continuity between the switch and control module on the MUX circuit, If OK replace the heated seat control module. If NOT OK, repair the open or shorted MUX circuit as required.

NOTE: BE CERTAIN THE BATTERY IS FULLY CHARGED BEFORE TESTING. FAILURE TO DO SO CAN RESULT IN INCORRECT READINGS.

(3) Back-probe the heated seat module wire harness connector (Fig. 20) , do not disconnect. Check cavity #10 for battery voltage, while observing the voltmeter depress the right heated seat switch **low** setting twice, voltage should toggle between approx.12v and 8v, If OK go to Step 4. If NOT OK check for continuity between the switch and control module on the low heat driver circuit, If OK replace the heated seat control module.

(4) Back-probe the heated seat module wire harness connector (Fig. 20) , do not disconnect. Check cavity #11 for battery voltage, while observing the voltmeter depress the right heated seat switch **high** setting twice, voltage should toggle between approx.12v and 8v, If OK go to Step 5. If NOT OK check for continuity between the switch and control module on the high heat driver circuit, If OK replace the heated seat control module.

(5) Back-probe the heated seat module wire harness connector (Fig. 20) , do not disconnect. Check cavity #2 for approx. 5v, voltage should be present, If OK go to Step 6. If NOT OK replace the heated seat control module.

(6) Back-probe the heated seat module wire harness connector, do not disconnect. Check cavity #7 for a range in voltage from 1.72v (warm seat) – 3.0v (cold seat). It should be within this range, If OK replace the heated seat module. If NOT OK test the Heated Seat Sensor. If NOT OK, replace the right heated seat element and sensor assembly. If the heated seat sensor tests OK, check for continuity between the right heated seat cushion connector and control module connector on the 5v supply circuit, If NOT OK, repair the open or shorted 5v supply circuit as required. If OK check for continuity between the right heated seat cushion connector and control module connector on the temperature sensor input circuit. If NOT OK, repair the open or shorted temperature sensor input circuit as required. If OK replace the heated seat control module.

LEFT SEAT HEATER INOPERATIVE

(1) If a heated seat heats but one or both indicator lamps (LED's) on the heated seat switch fail to illuminate, check the driver circuit with the inoperative LED for a short to ground. If OK, replace the heated seat switch. If NOT OK repair the short to ground as required and than replace the heated seat switch.

NOTE: IF THE LEFT SEAT CUSHION IS ALREADY WARM THE FOLLOWING STEP WILL NOT PROVE CONCLUSIVE.

(2) Back-probe the heated seat module wire harness connector (Fig. 20) , do not disconnect. Check cavity #5 for battery voltage when the left heated seat switch is turned “ON”, voltage should be present, If OK go to Step 3 If NOT OK, test the left heated seat switch (Refer to 8 - ELECTRICAL/ HEATED SEATS/DRIVER HEATED SEAT SWITCH - DIAGNOSIS AND TESTING). If the switch tests OK, check for continuity between the switch and control module on the MUX circuit, If OK replace the heated seat control module. If NOT OK, repair the open or shorted MUX circuit as required.

(3) Back-probe the heated seat module wire harness connector (Fig. 20) , do not disconnect. Check cavity #12 for battery voltage, while observing the voltmeter depress the left heated seat switch **low** setting twice, voltage should toggle between approx.12v and 8v, If OK go to Step 4. If NOT OK check for continuity between the switch and control module on the low heat driver circuit, If OK replace the heated seat control module.

(4) Back-probe the heated seat module wire harness connector (Fig. 20) , do not disconnect. Check cavity #14 for battery voltage, while observing the voltmeter depress the left heated seat switch **high** setting twice, voltage should toggle between approx.12v and 8v, If OK go to Step 5. If NOT OK check for continuity between the switch and control module on the high heat driver circuit, If OK replace the heated seat control module.

HEATED SEAT MODULE (Continued)

(5) Back-probe the heated seat module wire harness connector (Fig. 20) , do not disconnect. Check cavity #2 for approx. 5v, 5 voltage should be present, If OK go to Step 6. If NOT OK replace the heated seat control module.

(6) Back-probe the heated seat module wire harness connector, do not disconnect. Check cavity #8 for a range in voltage from 1.72v (warm seat) – 3.0v (cold seat). It should be within this range, If OK replace the heated seat control module. If NOT OK, test the Heated Seat Sensor. If NOT OK, replace the left heated seat element and sensor assembly. If the heated seat sensor tests OK, check for continuity between the left heated seat cushion connector and control module connector on the 5v supply circuit, If NOT OK, repair the open or shorted 5v supply circuit as required. If OK check for continuity between the left heated seat cushion connector and control module connector on the temperature sensor input circuit. If NOT OK, repair the open or shorted temperature sensor input circuit as required. If OK replace the heated seat control module.

BOTH SEATS INOPERATIVE

If both seats (driver and passenger) fail to heat and the indicator lamps on the heated seat switches for both seats fail to operate, test the heated seat relay and/or fuses. Refer to **Relay Diagnosis and Testing** in the Power Distribution section for heated seat relay diagnosis and testing procedures. If the heated seat relay checks OK, go to Step 1.

(1) Back-probe the heated seat module wire harness connector (Fig. 20) , do not disconnect. Check for continuity between the ground circuit cavity #13 of the heated seat module connector and a good ground. If OK go to Step 2. If NOT OK, repair the open or shorted ground circuit as required.

(2) Back-probe the heated seat module wire harness connector (Fig. 20) , do not disconnect. Check cavity #4 and #6 for battery voltage, voltage should be present, If OK go to Step 3. If NOT OK repair the open or shorted fused B(+) circuit as required.

(3) Back-probe the heated seat module wire harness connector, do not disconnect. Check cavity #2 for approx. 5v, voltage should be present, replace the heated seat control module with a known good module and verify system operation.

REMOVAL

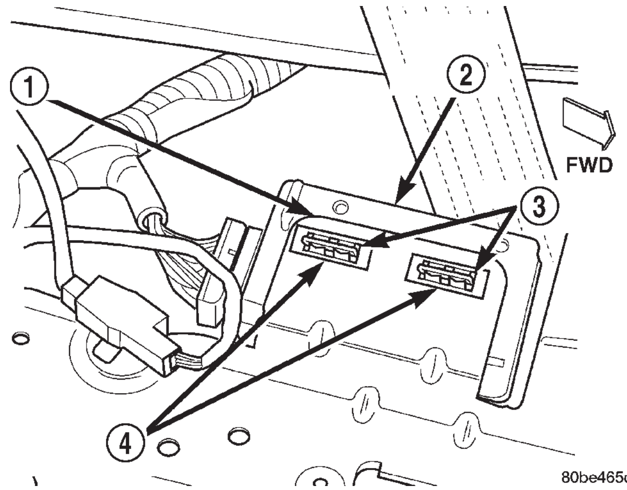

Fig. 21 Heated Seat Module Remove/Install

1 - MOUNTING BRACKET
2 - HEATED SEAT MODULE
3 - MOUNTING TABS
4 - PUSH-ON RETAINERS

(1) Working under the center front seat console, cut the tiestrap and remove the two push-on retainers that secure the mounting tabs of the heated seat module to the of the mounting bracket.

(2) Position the driver seat to the full forward and inclined position and working under the center of the front seat, from behind the seat, disconnect the seat wire harness connector from the connector receptacle on the back of the heated seat module (Fig. 21).

(3) Remove the heated seat module from under the front seat.

INSTALLATION

(1) Working under the front seat connect the seat wire harness connector to the connector receptacle on the back of the heated seat module.

(2) Position the driver seat in the full rearward and reclined position, and working under the front of the seat, install the two push-on retainers onto the heated seat module mounting tabs to secure the module to the top of the mounting bracket or install tiestrap.