CCD and PCI: A Mobile Internet

Did you know when connecting a scan tool to a DaimlerChrysler vehicle that the scan tool links into a network of up to 32 modules? Like most manufacturers, DaimlerChrysler uses a communication bus to allow different modules to share information. Diagnosing transmission problems require the integrity of the communication bus primarily because the scan tool utilizes the bus to accomplish all of its diagnostic tasks. When receiving a "no response from transmission controller" message, diagnosis of the communications bus is necessary before diagnosis of the transmission concern.

DaimlerChrysler is currently using two types of module communications: Chrysler Collision Detection (CCD) and Programmable Communications Interface (PCI). The CCD bus system was introduced in 1988 and is currently found only on Ram truck and van models. The PCI system, introduced in 1998, is found on most current DaimlerChrysler vehicles. The following chart identifies the type of communication system found on DaimlerChrysler vehicles.

Vehicle	Diagnostic Communication
Intrepid, Concord, LHS, etc (LH) 1998 -	PCI Bus
Intrepid, Concord, LHS, etc (LH) 1993 - 97	CCD Bus
Stratus/Cirrus/Breeze (JA) 1995 - 1999	CCD Bus
Sebring/Stratus Sedan (JA/JX) 2000 -	PCI Bus
Neon (PL) 1995 - 1999	CCD Bus
Neon (PL) 2000 -	PCI Bus
Caravan/Voyager (AS) 1989-95	CCD Bus
Caravan/Voyager (NS) 1996-99	CCD Bus
Caravan/Voyager (RS) 2000-	PCI Bus
Jeep Wrangler (TJ)	ISO-K (SCI)
Jeep Grand Cherokee (ZJ)	ISO-K (SCI)
Jeep Grand Cherokee (WJ) 1999-	PCI Bus

Bus System Benefits:

The CCD communication bus allows up to 32 modules (depending on the type) to communicate across one or two wires. The benefits include:

- Wire reduction: multiple modules, which may require input from a variety of sensors, might only be wired to one module and then transmitted across the bus to any module that needs the sensor information.
- Elimination of internal module hardware: modules do not need the additional circuitry to handle dedicated inputs that are transmitted across the bus.
- Reduced component load: sensors only need to send information to one module, as opposed to sending information to all of the modules, resulting in less current flow through the sensors.
- Enhanced diagnostics: the technician can diagnose all of the modules on the CCD bus through one diagnostic connector. Bi-directional communication (including

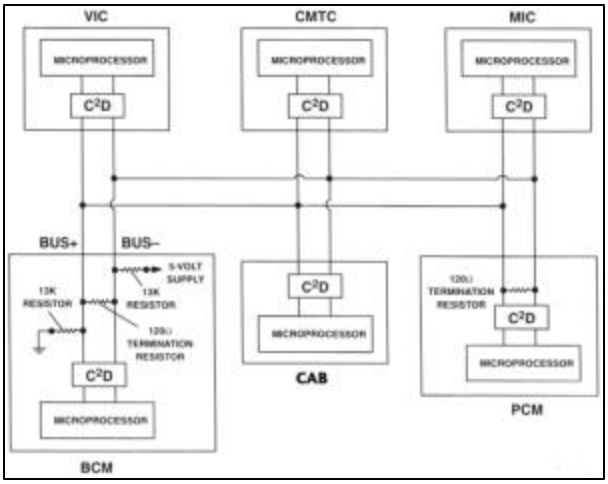
programming, output controls, and data stream input) is possible since the scan tool actually becomes a module communicating on the CCD bus.

- Module configuration: the modules have their own "ID byte," which is a message identifying the type of module (TCM,PCM,CAB,etc.). When connected to the CCD bus, the individual modules are programmed with messages that other modules might need and transmits those messages when necessary. Each module listens to relevant messages and ignores irrelevant messages.

CCD Operation:

In 1989, the CCD bus system was revolutionary and more than fast enough to share information between modules (7812.5bps). The CCD system uses two-wires twisted one-turn every 1 3/4 inch to eliminate any electro-magnetic interference from power sources. The wires are connected to all of the modules that need to share information. Some common modules connected to the CCD bus include: powertrain control module (PCM), transmission control module (TCM), controller antilock brake (CAB), mechanical information cluster (MIC), body control module (BCM), airbag control module (ACM), and many others depending on vehicle options. Every module on the CCD bus has a CCD chip that toggles the voltage on the two bus wires either up or down when sending a message. The CCD bus system has a "bus +" and a "bus -" wire connected to each module on the bus. One module provides bus "bias," which is the power supply to the bus. Two modules contain a 120-ohm resistor to "terminate" the two bus wires together, and all of the modules contain a CCD chip to control the voltages on the bus wires. The following describes the purpose and operation of the bus-, bus+, bias, and termination.

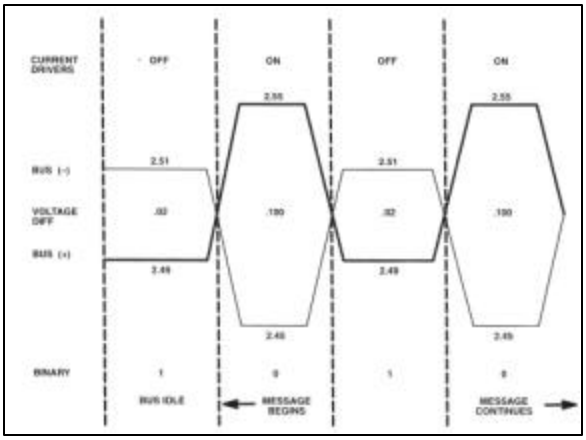
Bias and termination: As stated above, the bias is the power supply to the CCD bus. 5 volts are applied through a 13K-ohm resistor to the BUS - circuit. Current flow travels through two 120 ohm resistors found in two different modules to the BUS + circuit. Current then flows through another13K-ohm resistor to ground in the module that provides bias. The result is a slight difference in voltage between the bus - (approx 2.51v) and the bus + (approx 2.49v). This is the normal state of the bus when no messages are being sent and the bus state is considered to be at "idle," which is a difference in bus + and bus - voltage around .02v.



When a module wants to send a message, the CCD chip in the module controls the voltage on the bus - and bus + wires through current drivers that pass only 6 milliamps. When the module sends data, the CCD chip drives the bus - to a lower voltage and drives the bus + to a higher voltage. The difference is slight, only about .1 volt. As long as the voltage differential between the bus - and bus + wires change more than .02 volts, the modules recognize this as a message being sent.

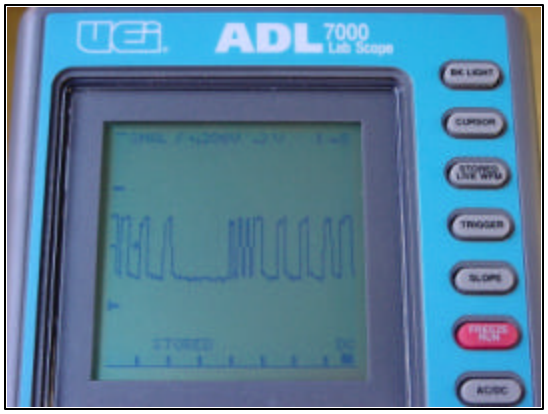
Since scan tool communication to the different modules requires the CCD bus, a "no response from controller" message could indicate a problem with the CCD bus wires or modules. Depending on the failure, and because scan tool diagnostics requires the use of the CCD bus, diagnosis might be limited. 12 "hard faults" that can occur with the CCD bus include:

- 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



CCD Diagnosis:

CCD diagnosis can be frustrating. When the bus is shorted to ground, battery, or 5-volts, the diagnostic procedure involves disconnecting the modules on the bus until the CCD bus becomes active. The diagnosis concludes that the last module disconnected is the module responsible for the failure. It is important to follow the service manual when disconnecting the modules since one module is providing the bias to the CCD bus and two modules are providing termination. If you disconnect the module providing bias and then later disconnect the shorted module, you will not see the CCD bus become active. The service manual will have the technician disconnect the module that provides bias last (usually the BCM or TCM). If the problem still exists after disconnecting all of the modules (including the scan tool), the CCD bus wires are at fault.



PCI Description:

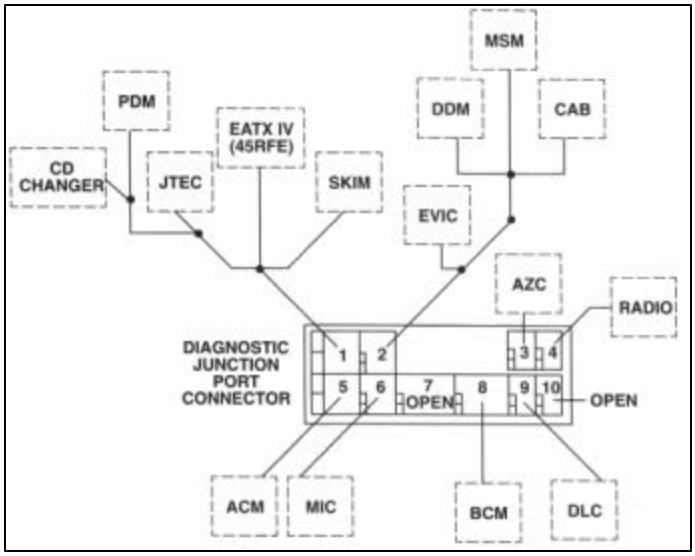
Similar to the CCD bus system, the PCI bus system is designed to share information between the different modules found on a vehicle. Once communication networks became popular among the vehicle manufacturers, SAE established the "J1850" protocol requiring all manufacturers to follow certain guidelines for engine controller to scan tool communication. The standard identifies a communication

network that transfers information across a single wire at 10.4K bits per second (bps) by toggling voltage between 0v and 7v. The modules recognize the toggling voltage on the bus as a message. Some of the benefits of PCI vs. CCD are as follows:

Feature	CCD bus	PCI bus
Transmission media	Twisted pair	Single wire
Speed	7,812.5 bps	10.4Kbps
Meets industry standard?	No	Yes
SAE protocol?	No	Yes
OBD II compliant?	No	Yes
Bus bias required?	Yes	No
Maximum # of modules	13	32

On most current DaimlerChrysler vehicles, scan tools rely on the integrity of the PCI bus for communication to the TCM. If the PCI bus fails, scan tool communication might not be available. If there is no response from the TCM, accessing the PCM with a scan tool might provide some diagnostics to the PCI bus, including DTC's.

PCI Diagnosis:



The PCI bus will experience complete failure when the bus is shorted to ground or the bus is shorted to battery. Unlike CCD, each module has the ability to control the voltage on the bus. If one module fails or if a module's PCI bus circuit opens, the PCI bus does not completely fail. The PCI bus will not recognize the effected module, but all of the other modules should still be able to communicate successfully. This is a good fact to know when diagnosing a "no response from controller" problem. Try accessing different modules to determine if the bus failure includes more than one module. If the scan tool cannot communicate with any module, either the PCI line to the DLC is open or shorted, or the bus has experienced complete failure (short to power/ground). If the scan tool can communicate with other modules, the failure is either an open in the bus circuit to the effected module or the module itself. Vehicles with PCI contain a "hub" where all of the different modules join their PCI wires. On some vehicles, the hub is the Body Control Module (BCM) or the hub might be a simple "diagnostic port adapter", which is used on Jeep Grand Cherokees. The hub allows the

technician to isolate different modules to determine what module or circuit is causing the bus to fail.