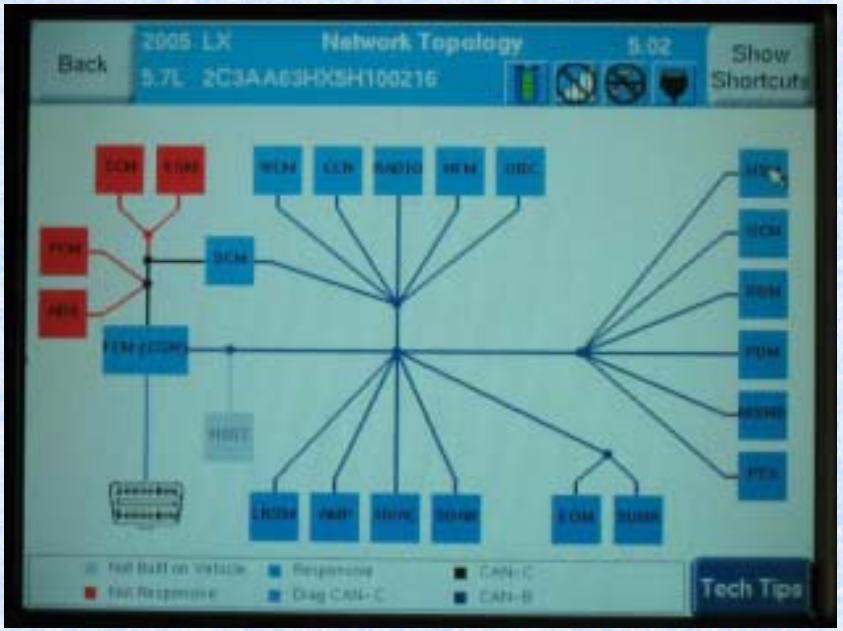
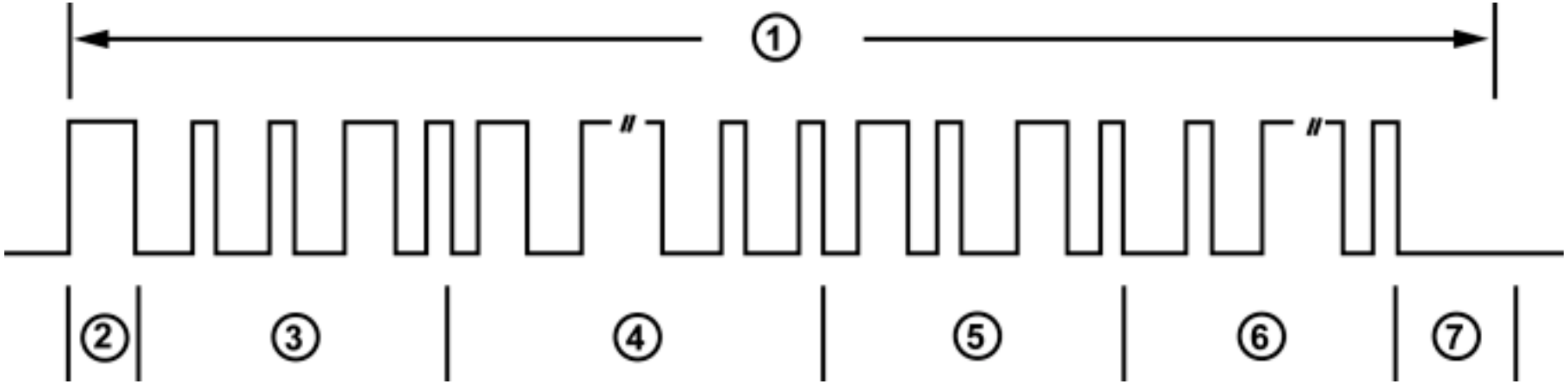
DCX Networks

- **SCI** (Serial Communication Interface): The system uses two wires; one to transmit and one to receive.
- **ISO-K** is the adaptation of the 9141 standards allowing two-way communication on a single line.
  CCD (Chrysler Collision Detection): uses twisted pair wiring for communication between the modules.
- **PCI** (Programmable Communication Interface): J1850 specification. The system uses a single wire pulse-width modulated signal to communicate between modules.
- **CAN** (Controller Area Network): SAE J2284 and ISO 11898. The system uses twisted pair wiring to communicate between modules.



Message Composition



1	Frame
2	Start of Frame
3	Header Message
4	Data Byte(s)
5	CRC Byte
6	In Frame Response
7	End of Frame

SCI - Serial Communication Interface

- PCM uses SCI for transmit and receive functions
- TCM uses the receive function for flash reprogramming
- Antilock Brake Modules and the Speed Proportional Steering Module use SCI.

SCI - Serial Communication Interface

- SCI consists of:
  - Dedicated point-to-point, dual-wire, non-multiplexed serial communication interface
  - Supports both diagnostics and flash re-programming capability
  - Supports multiple baud rates to accommodate both the low-speed diagnostic command mode (at 7812.5 bps) and the high-speed parameter interrogation command mode (at 62,500K bps)

SCI - Serial Communication Interface

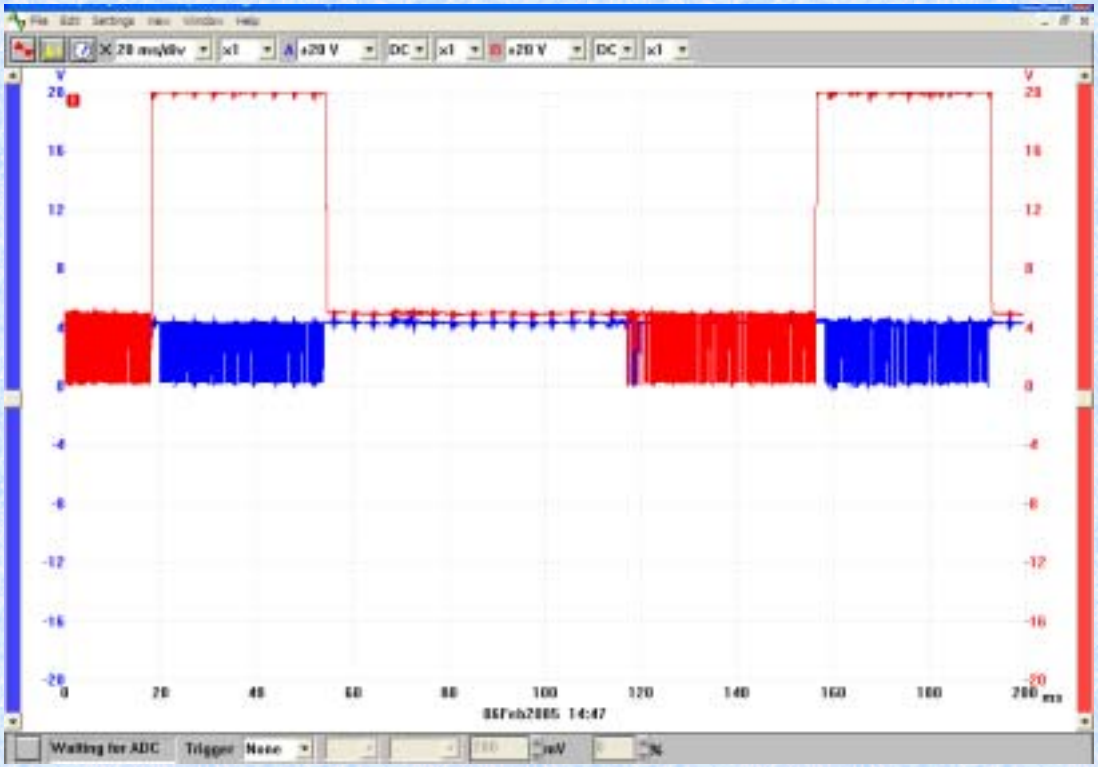
- Transmit refers to the module transmitting data to the scan tool
- Receive refers to the module receiving data from the scan tool
- The **scan tool** supplies the bias to the module on the Tx circuit
  - The module pulls the voltage low to transmit data to the scan tool
- The **module** supplies bias on the Rx circuit
  - The scan tool pulls the voltage low to send data to the module
- Therefore, the component receiving the data supplies the bias

SCI - Serial Communication Interface

- With the key ON:
- No scan tool connected to the DLC; there should be 5 volts at the Rx circuit.
- No scan tool connected to the DLC; there should be no voltage at the Tx circuit.
- The scan tool connected to the DLC; there should be 12 volts* at the Tx circuit.
- The scan tool connected to the DLC and Engine selected from the Select System menu; there should be 5 volts at the Tx circuit.

* This is the default voltage for ISO-K. When the Engine is selected from the Select System menu the tool will turn off the 12 volts and apply 5 volts to attempt SCI communication

SCI - Serial Communication Interface



Flash Programming:

- Scan tool pulls voltage down when sending Data on Rx
- Scan tool raises voltage on Rx circuit to 20 volts (indicates flash)
- Module sends message back for error detection

Pre 03 SCI used pins 6 and 14 for SCI

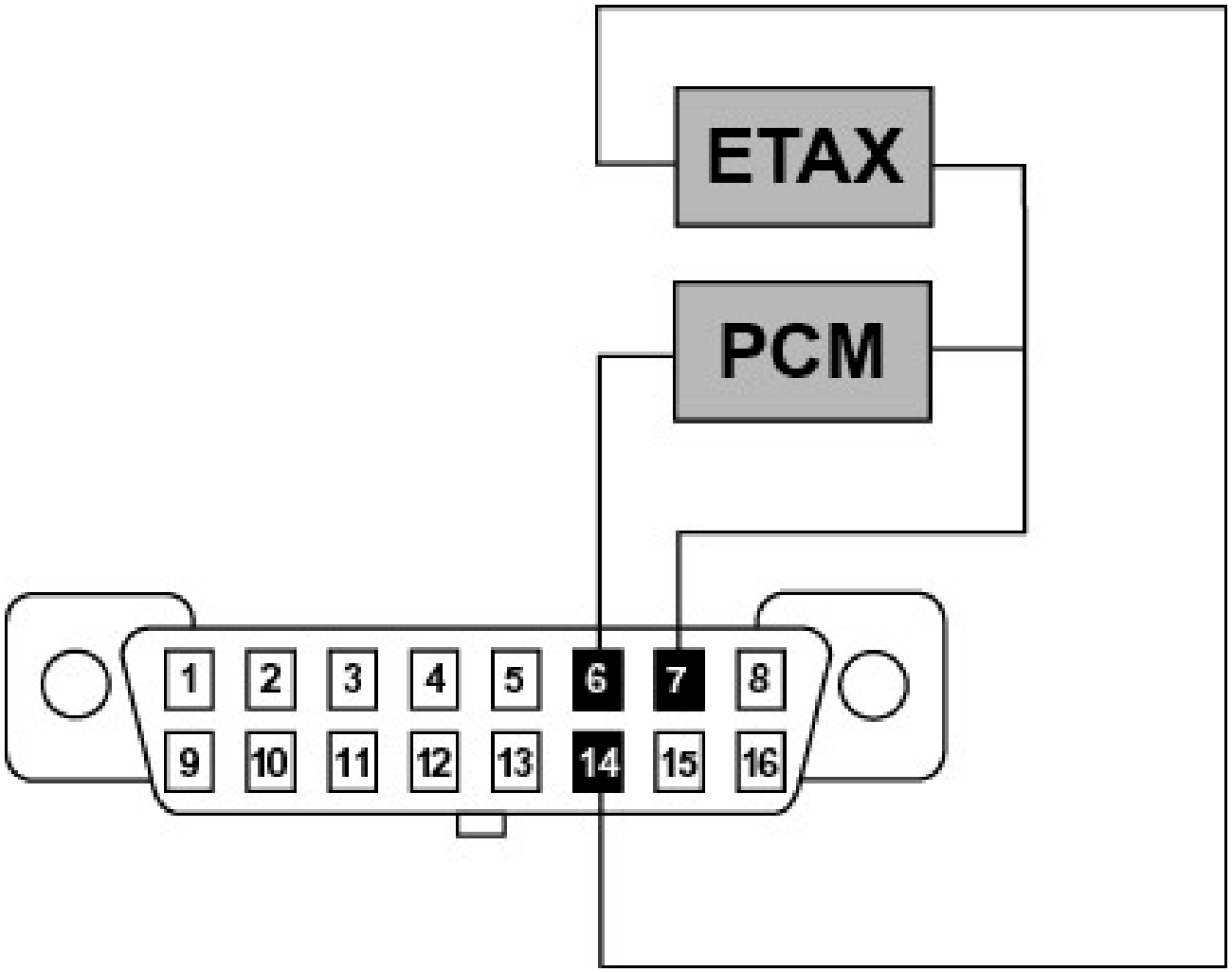


Figure 14 SCI Configuration A

Those circuits had to move for CAN

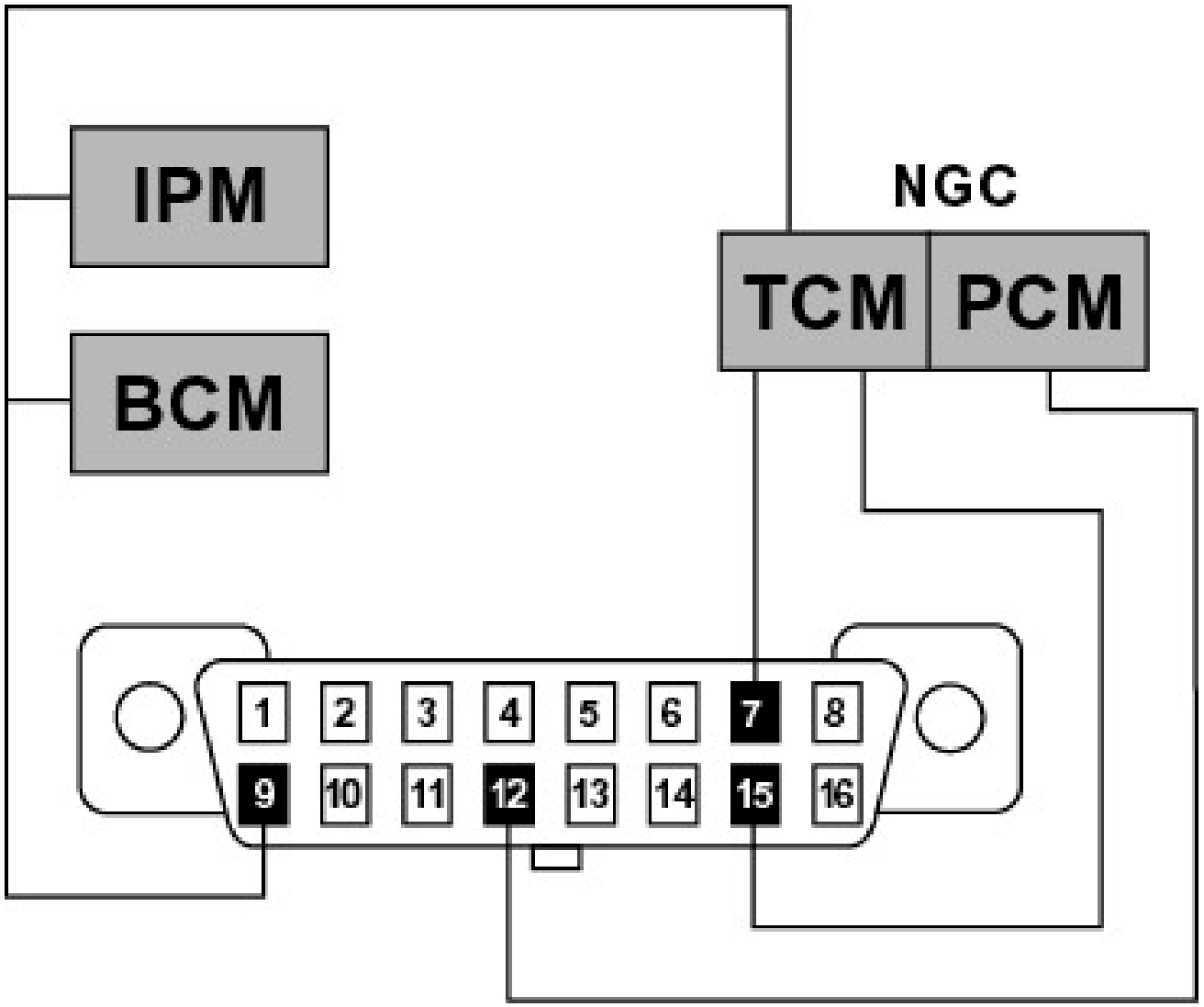


Figure 15 SCI Configuration B

ISO – K: Single Wire ISO 9141

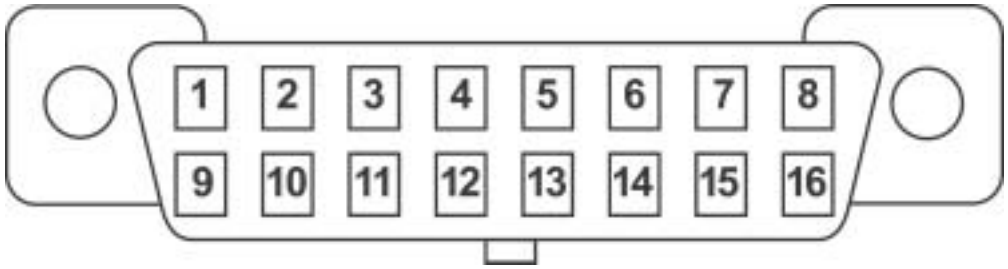
- ISO-K allows two-way communication on a single line
- ISO-K is a dedicated point-to-point
- Generic scan tool or the DRB III in generic scan tool mode
- It is not used to permit communication between multiple modules.

ISO – K: Single Wire ISO 9141

- Used w/CCD to meet OBD2
  - ISO-K circuit can be combined with the SCI Tx line
- Scan tool biases the circuit to 12 volts.
  - The data is transferred when the 12-volt bias is pulled low
  - Engine select biases to 5 volts
- Data is transferred at a fixed baud rate of 10.4K bps.

ISO – K: Single Wire ISO 9141

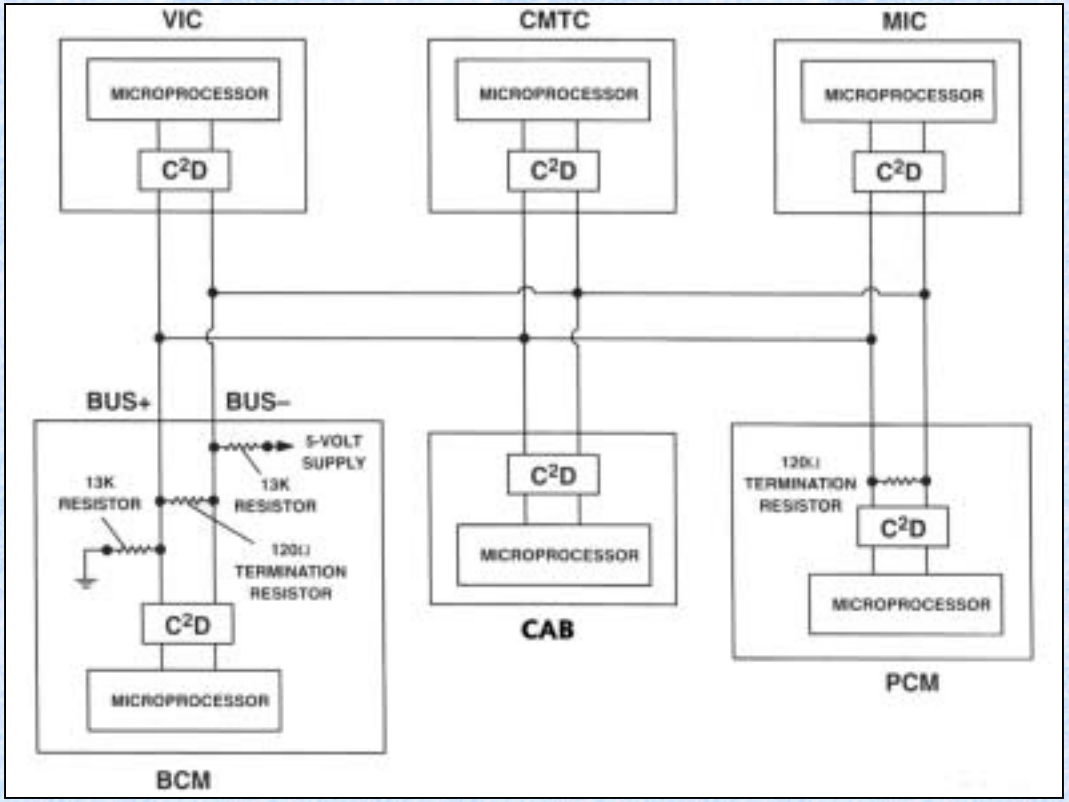
- No scan tool connected to the DLC
  - There should be no voltage at the Tx circuit.
- With scan tool connected to the DLC
  - 12 volts default at Tx
  - 5 volts when selecting engine with DRB3 at Tx



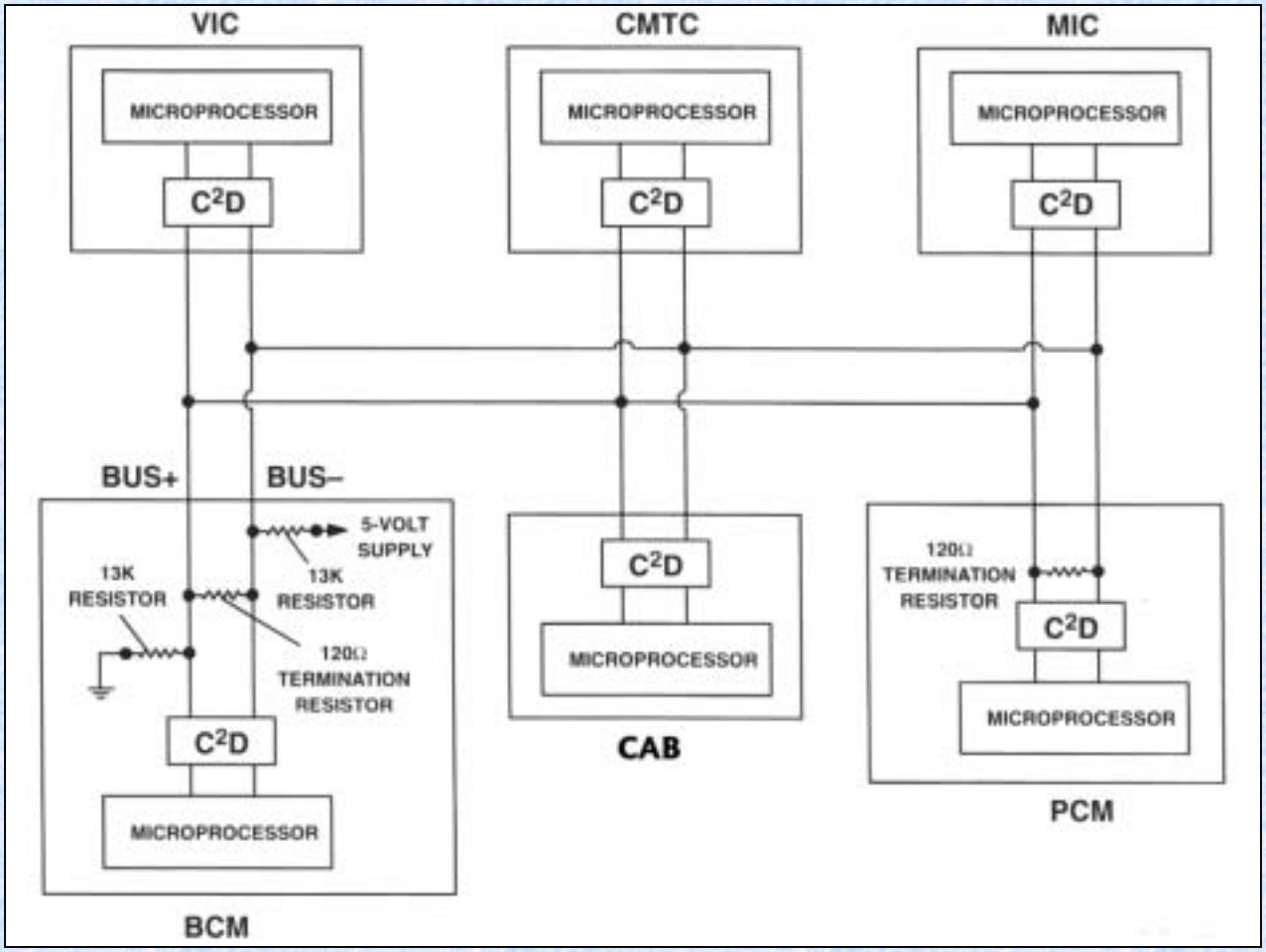
TERMINAL ASSIGNMENT & FUNCTION			
		DaimlerChrysler Corporation	
Pin	SAE/ ISO	A (1994MY - 2002MY+)	B (2002MY+)
1	Manufacturer Discretionary	RKE Programming Input	not used
2	SAE J1850 (+)	SAE J1850 10.4 Kbps	SAE J1850 10.4 Kbps
3	Manufacturer Discretionary	CCD (+)	not used
4	Chassis Ground	Power Ground	Power Ground
5	Signal Ground	Signal Ground	Signal Ground
6	ISO 15765-4 CAN-C (+)	SCI A Rx (Receive) (*Engine*)	ISO 15765-4 CAN-C (+)
7	ISO 9141-2 K-line ISO 1423-4 K-line	ISO 9141-2 K-line/ SCI Tx (Transmit) (*Engine/Transmission*)	SCI Tx (Transmit) (*Engine*)
8	Manufacturer Discretionary	A/D Signal Output/Switched Ignition	Switched Ignition
9	Manufacturer Discretionary	SCI B Rx (Receive)/ J1850 Flash Enable	SCI Rx (Receive) (*Trans.*)/ J1850 Flash Enable
10	SAE J1850 (-)	Reserved	Reserved
11	Manufacturer Discretionary	CCD (-)	not used
12	Manufacturer Discretionary	SCI C Rx (Receive)	SCI Rx (Receive) (*Engine*)
13	Manufacturer Discretionary	Lo-Driver/SCI Tx (Transmit) (*Body/Chassis*)	not used
14	ISO 1565-4 CAN-C (-)	SCI D Rx (Receive) (*Transmission*)	ISO 15765-4 CAN-C (-)
15	ISO 9141-2 L-line/ ISO 14230-4 L-line	Inverted SCI Tx (Transmit)	SCI Tx Transmit (*Trans.)*
16	Unswitched Battery Voltage	Battery Voltage	Battery Voltage

CCD Operations

- First DCX multiplex in 1989
- Allows Module to Module communication
- 2-wire twisted

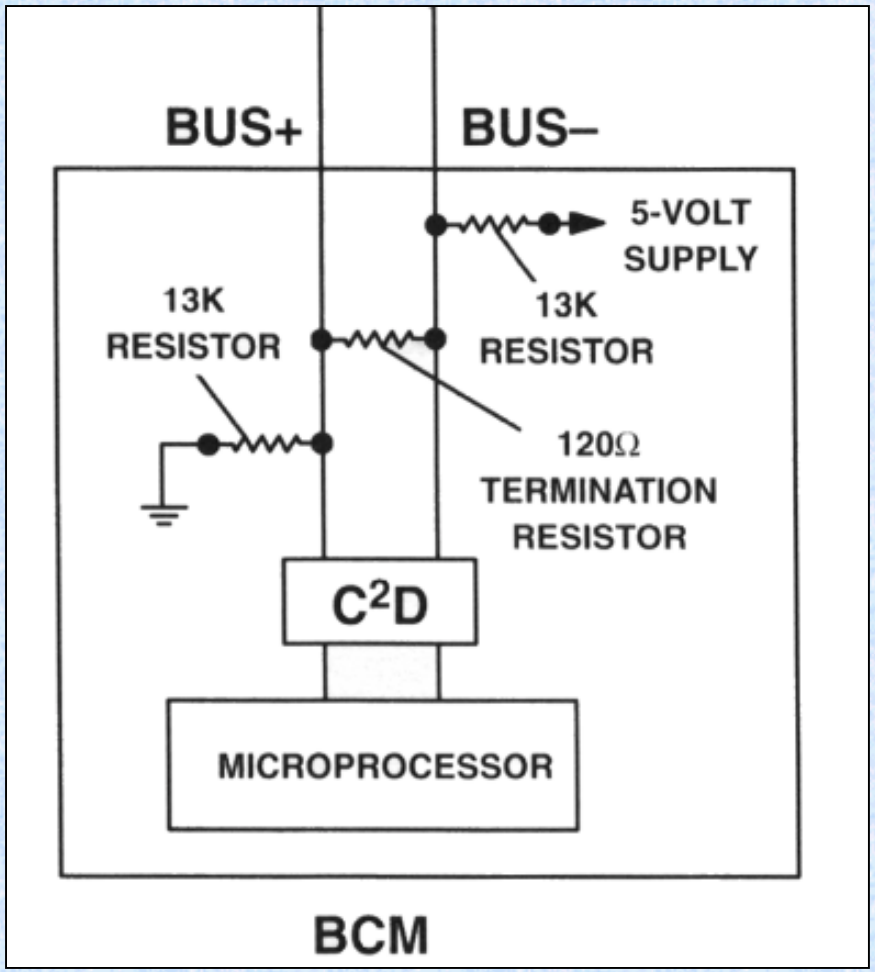


The CCD chips sense a “change of state” in the voltage difference between the two CCD wires



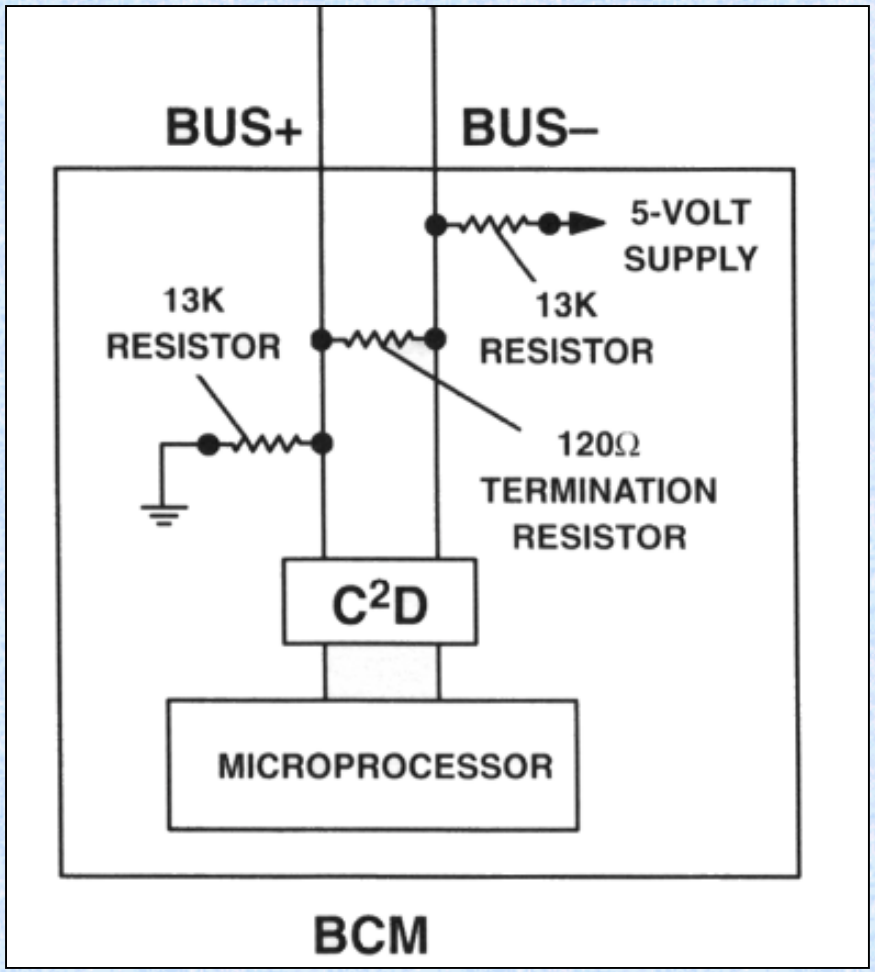
Bias

- One module (usually the BCM or TCM) provides the power supply to the CCD bus
- 5 volts pass through a 13k ohm resistor to the CCD - wire
- The module providing bias also provides the ground for the CCD bus through a 13k ohm resistor



Termination

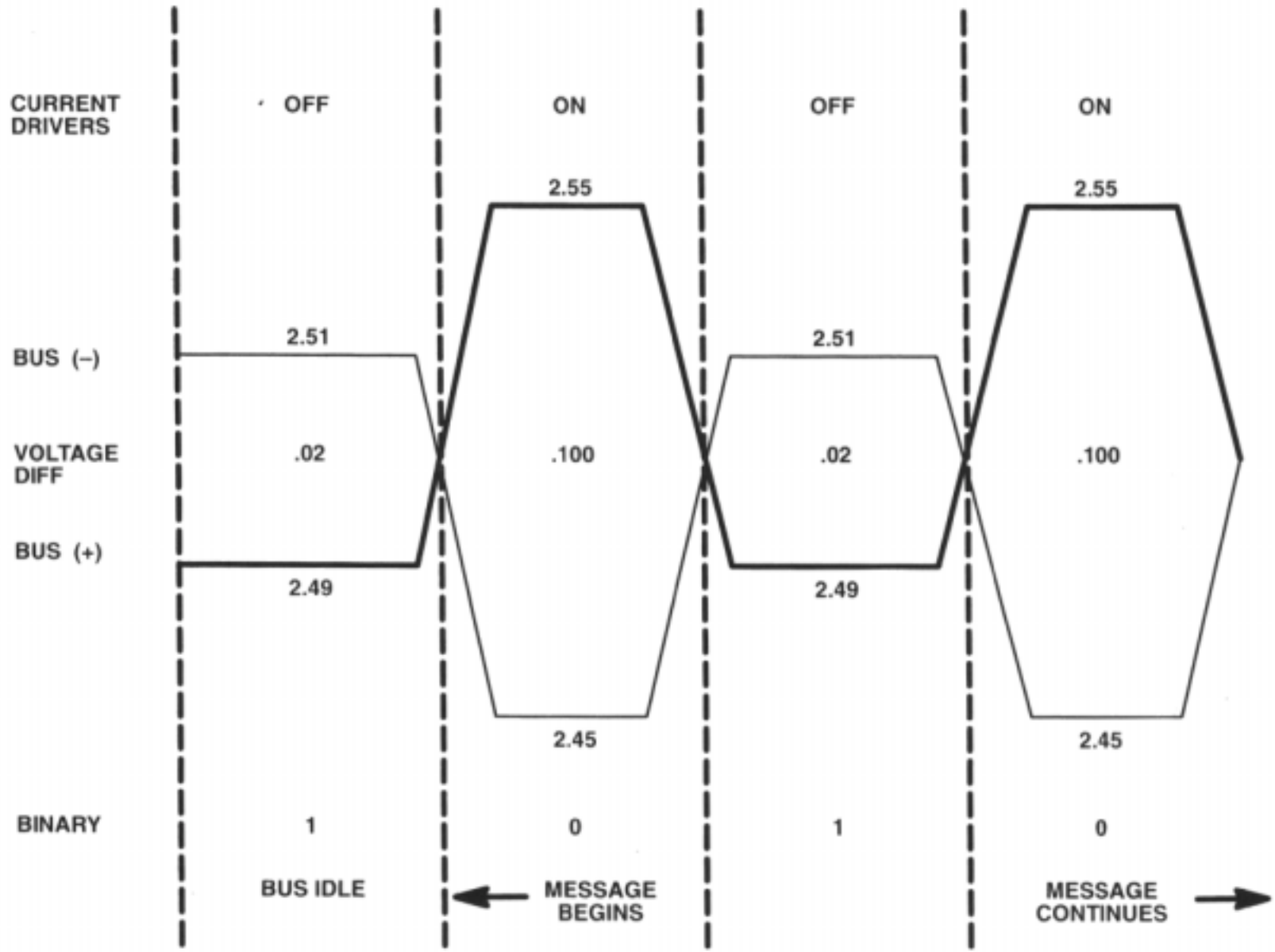
- Two modules contain “termination” resistors
- Termination is accomplished through two 120 ohm resistor placed across the CCD wires
- Without termination, the CCD circuit would be open, resulting in no communication



CCD Operation

- Modules on the CCD bus send and receive messages
- Messages have a priority, based on their importance
- A more important message will offset a less important message based on it’s “ID Byte”

The modules on the bus see this voltage change and recognize a message being sent

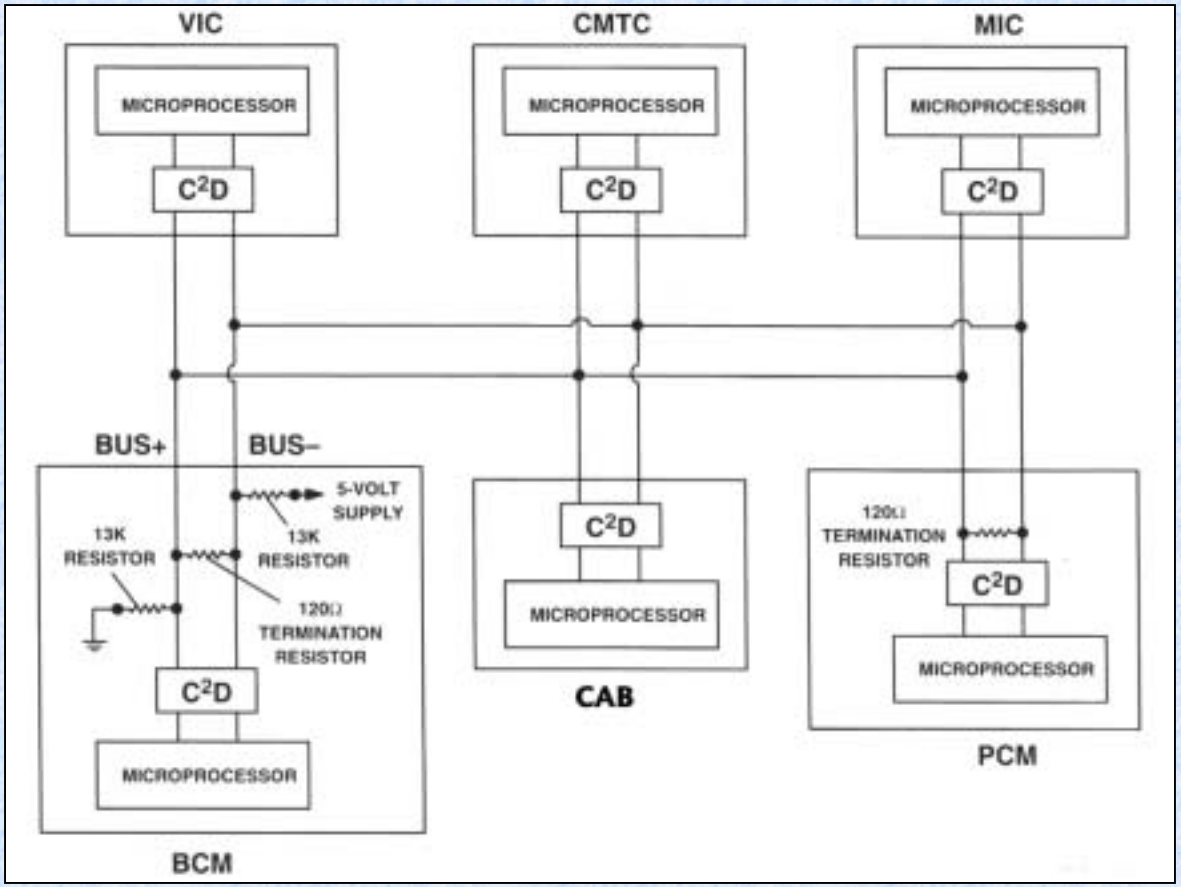


CCD Failures

- An open, short to power, short to ground, or signal interference can cause a controller to display a “no response from controller” message

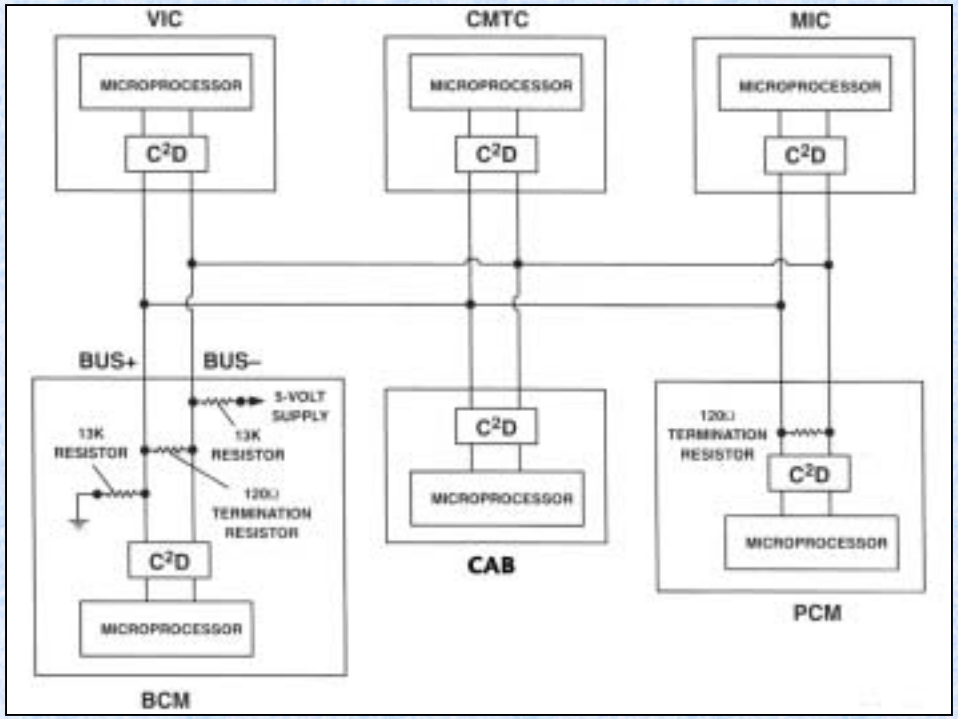
CCD Diagnostics

- CCD integrity is important since the scan tool communicates with the modules through the CCD Bus



CCD Diagnostics

- Diagnostics are limited
- Checking DLC pins 3 and 11 should reveal 60 ohms
- Use ohmmeter to check for short to grounds, voltmeter to check for opens and short to power
- If bus appears to be shorted to ground or B+, disconnect each module on the bus until communication is restored
- Disconnect the module that provides BIAS last

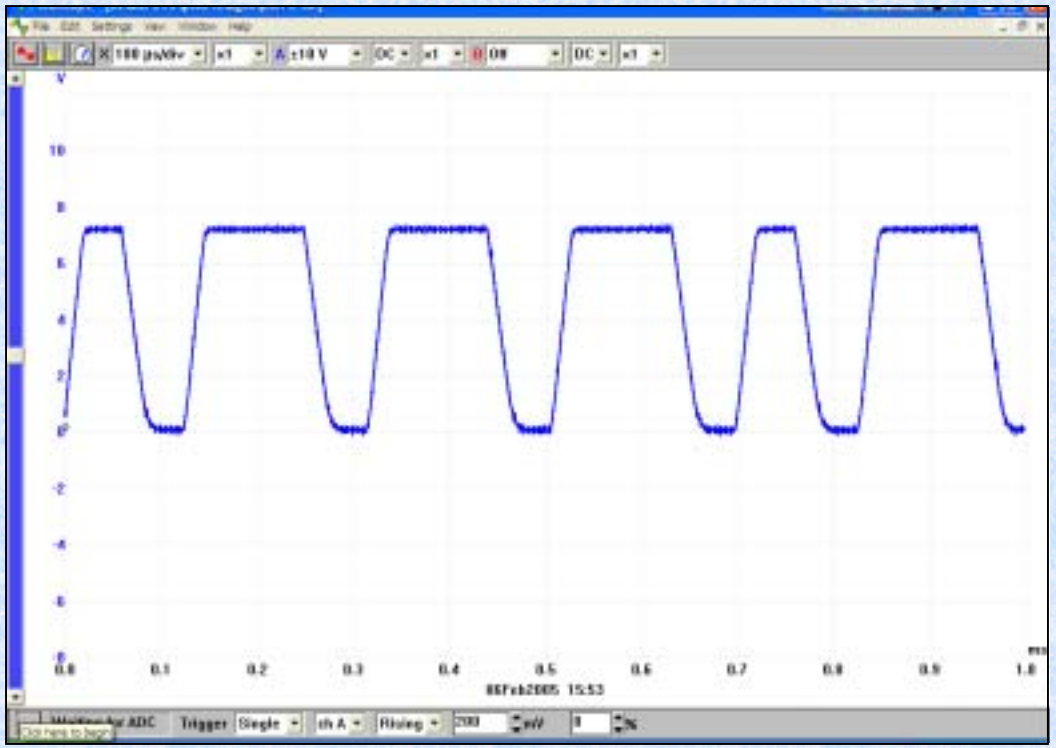


PCI Bus

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

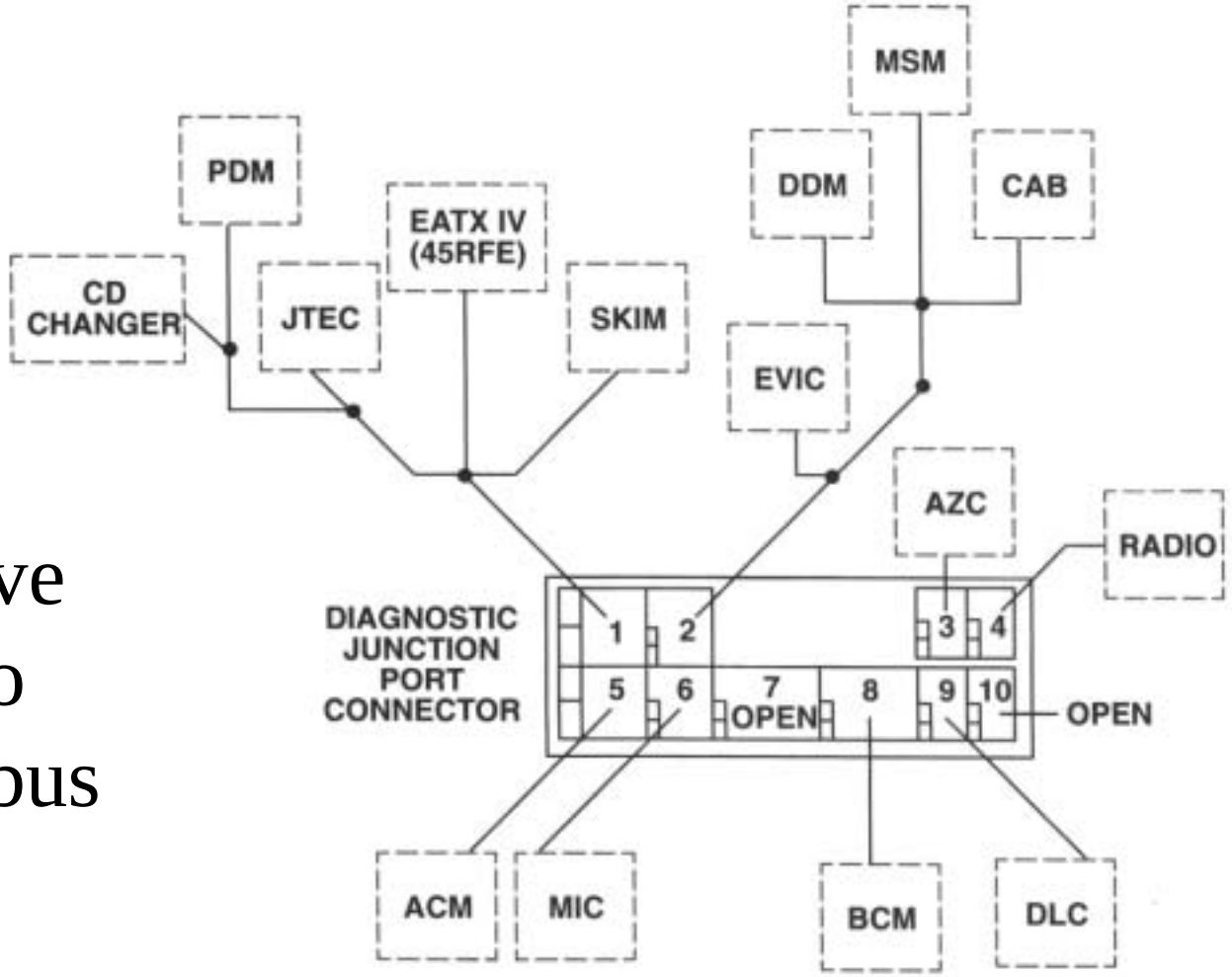
PCI Operation

- Single wire switching between 0 and 7 volts
- Pulse width and voltage state make the message



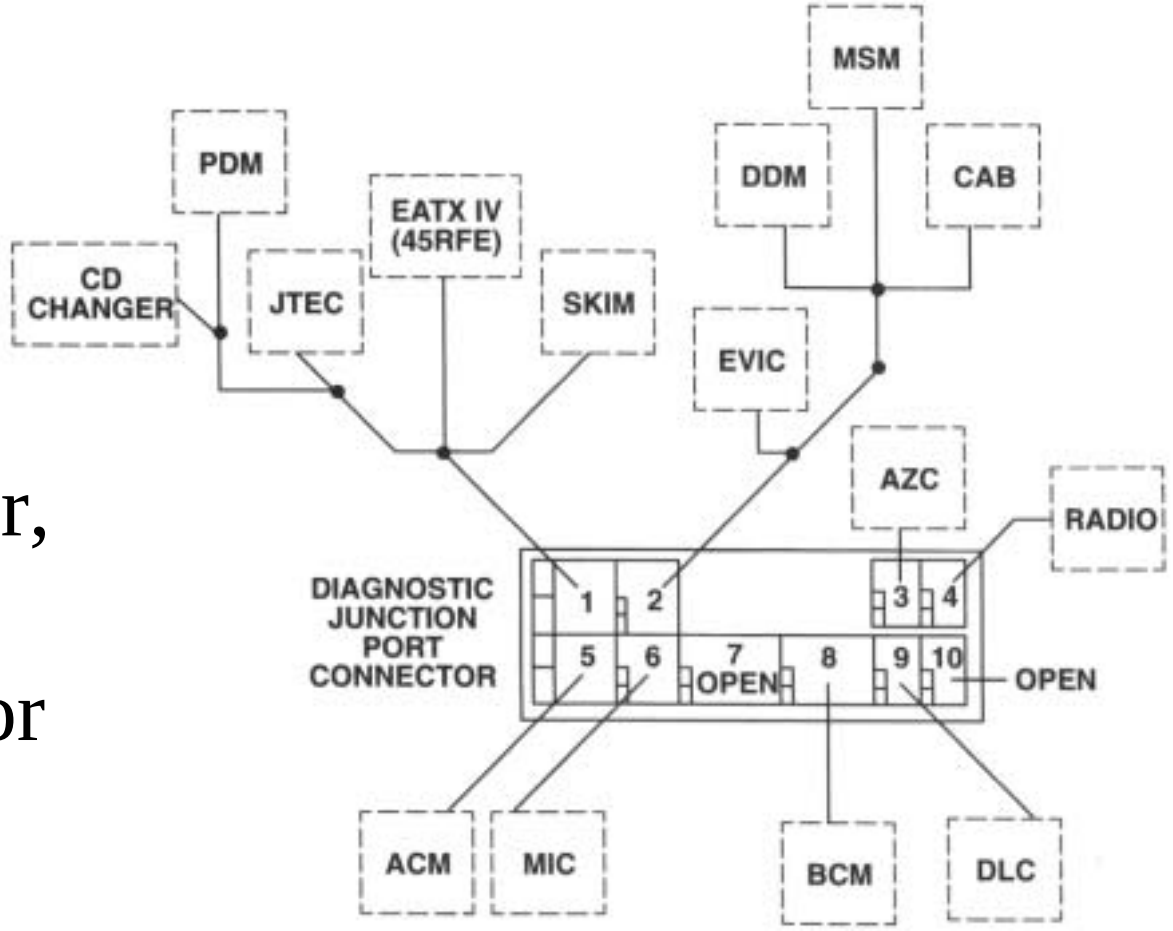
PCI Operation

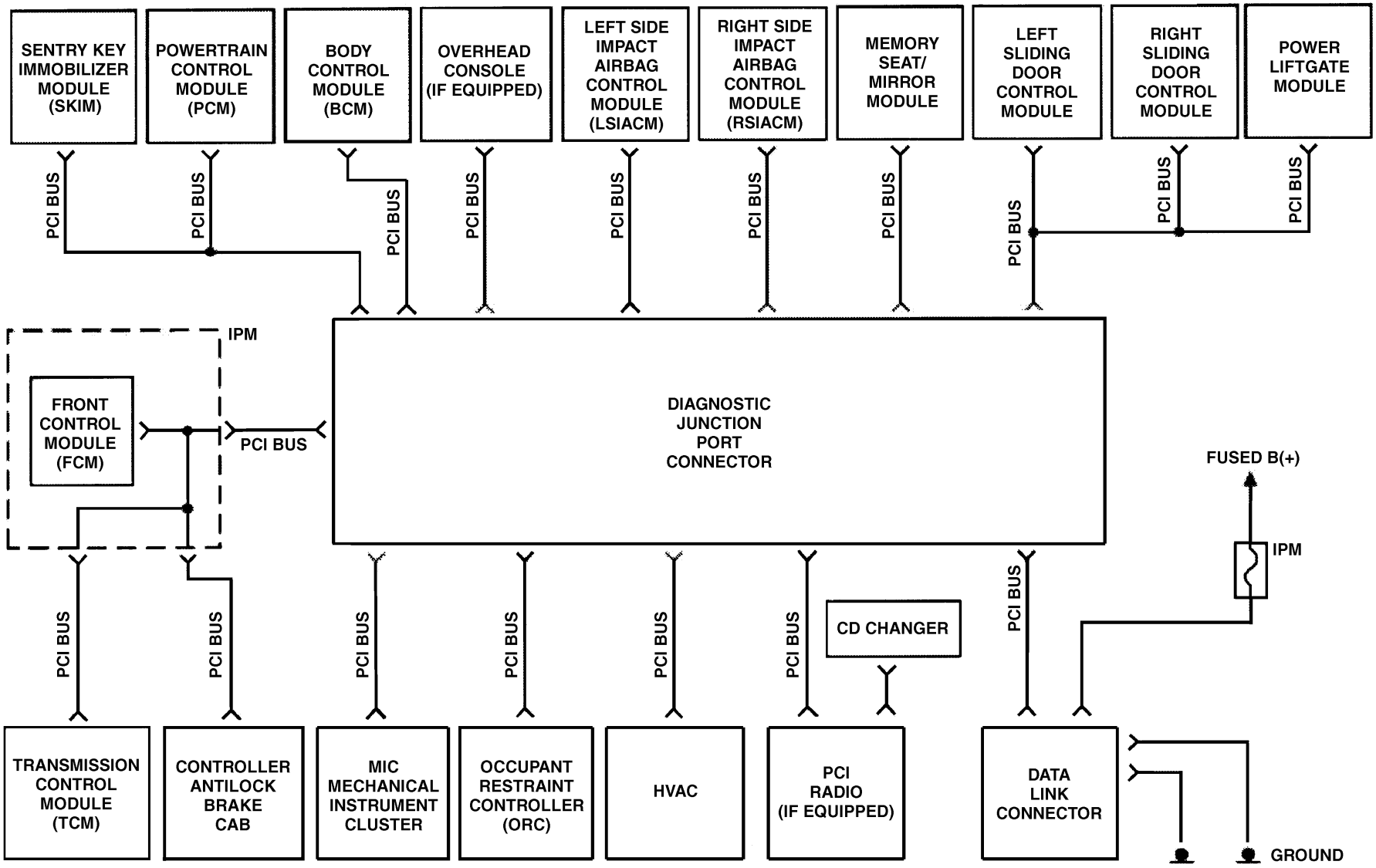
- No biasing module
- All of the modules have the ability to control the bus



PCI Operation

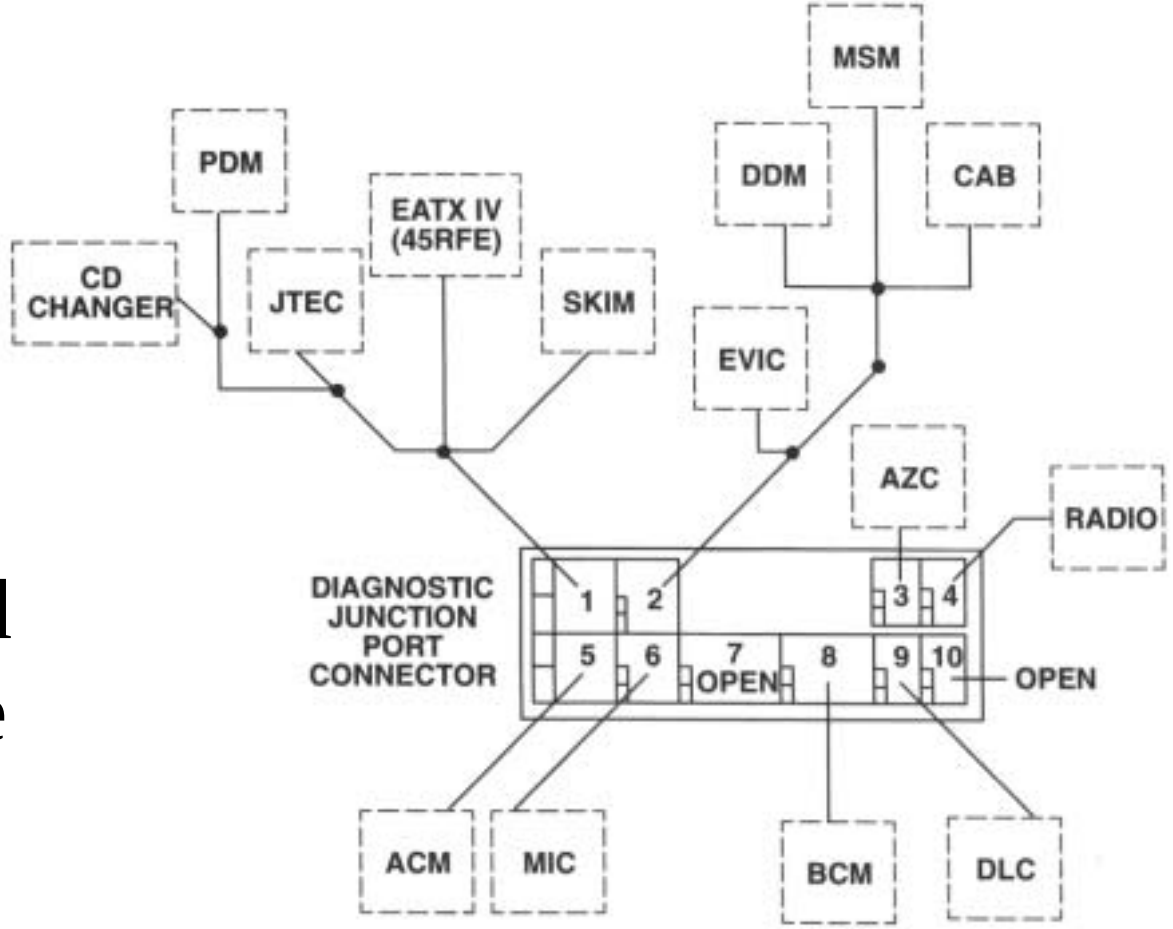
- No termination
- A single wire connects all modules together, usually at a “junction port” or the BCM




SENTRY KEY IMMOBILIZER MODULE (SKIM)
POWERTRAIN CONTROL MODULE (PCM)
BODY CONTROL MODULE (BCM)
OVERHEAD CONSOLE (IF EQUIPPED)
LEFT SIDE IMPACT AIRBAG CONTROL MODULE (LSIACM)
RIGHT SIDE IMPACT AIRBAG CONTROL MODULE (RSIACM)
MEMORY SEAT/ MIRROR MODULE
LEFT SLIDING DOOR CONTROL MODULE
RIGHT SLIDING DOOR CONTROL MODULE
POWER LIFTGATE MODULE
PCI BUS
IPM
FRONT CONTROL MODULE (FCM)
DIAGNOSTIC JUNCTION PORT CONNECTOR
FUSED B(+)
CD CHANGER
TRANSMISSION CONTROL MODULE (TCM)
CONTROLLER ANTILOCK BRAKE CAB
MIC MECHANICAL INSTRUMENT CLUSTER
OCCUPANT RESTRAINT CONTROLLER (ORC)
HVAC
PCI RADIO (IF EQUIPPED)
DATA LINK CONNECTOR
GROUND

PCI Failures

- If one module fails or only one PCI wire opens, only the effected module will lose communication



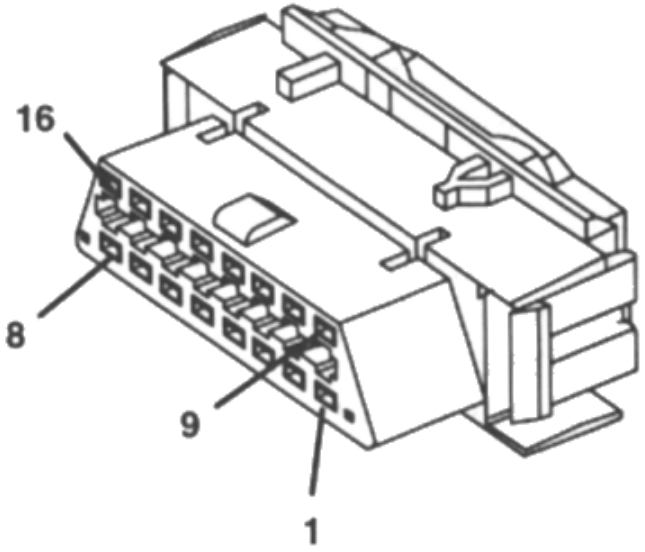
PCI Failures

- PCI will completely fail if the bus becomes shorted to power or ground

PCI Diagnostics

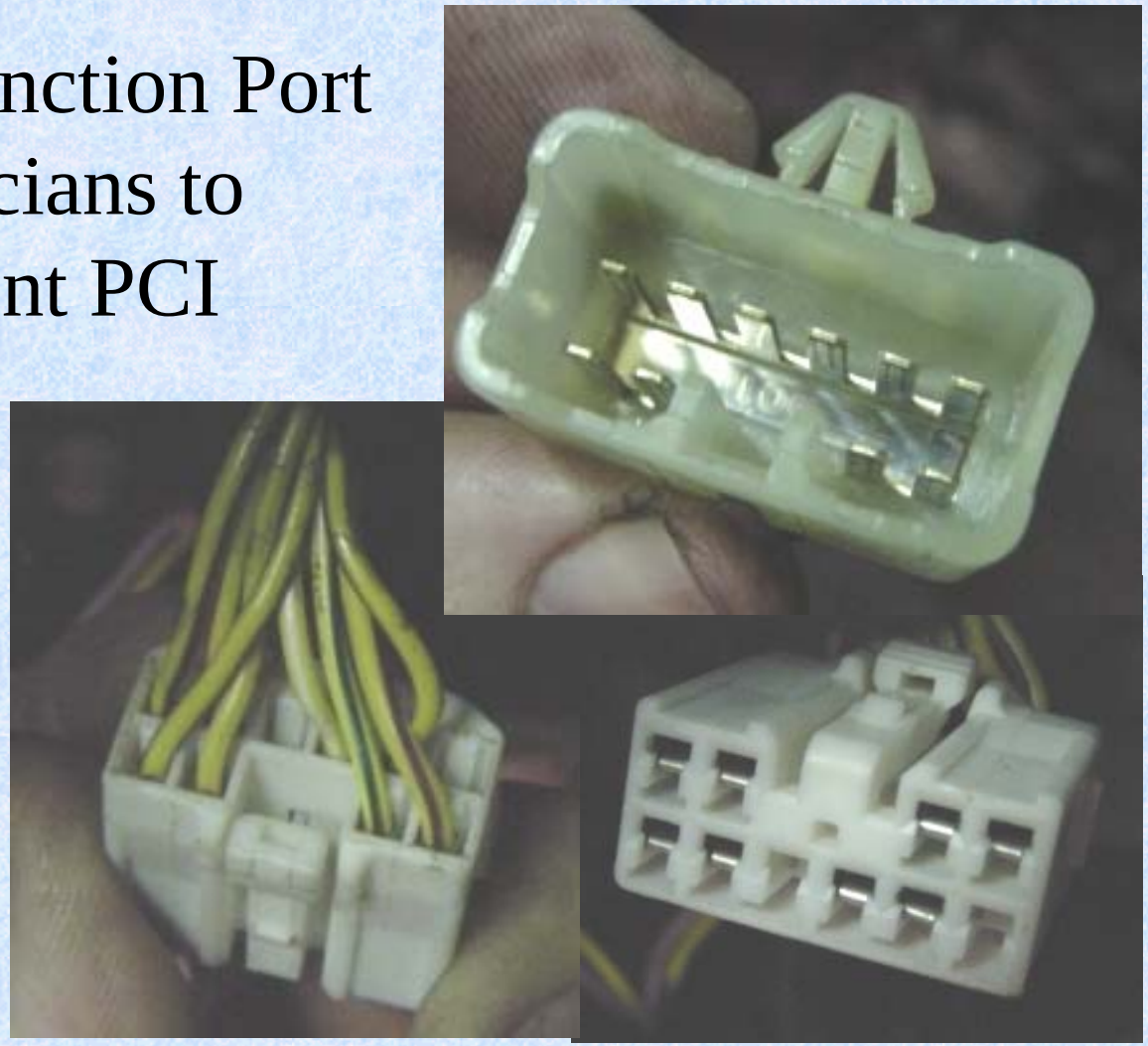
"no response from controller" messages can occur from poor DLC connections or by not having the key in the run position

CAV	FUNCTION
1	RKE Module Program Enable (if equipped)
2	PCI Bus
3	CCD Bus (+)
4	Ground
5	Ground
6	SCI Receive (PCM)
7	SCI Transmit (PCM)
8	Fused Ignition Output
11	CCD Bus (–)
14	SCI Receive (TCM)
16	Fused B(+)



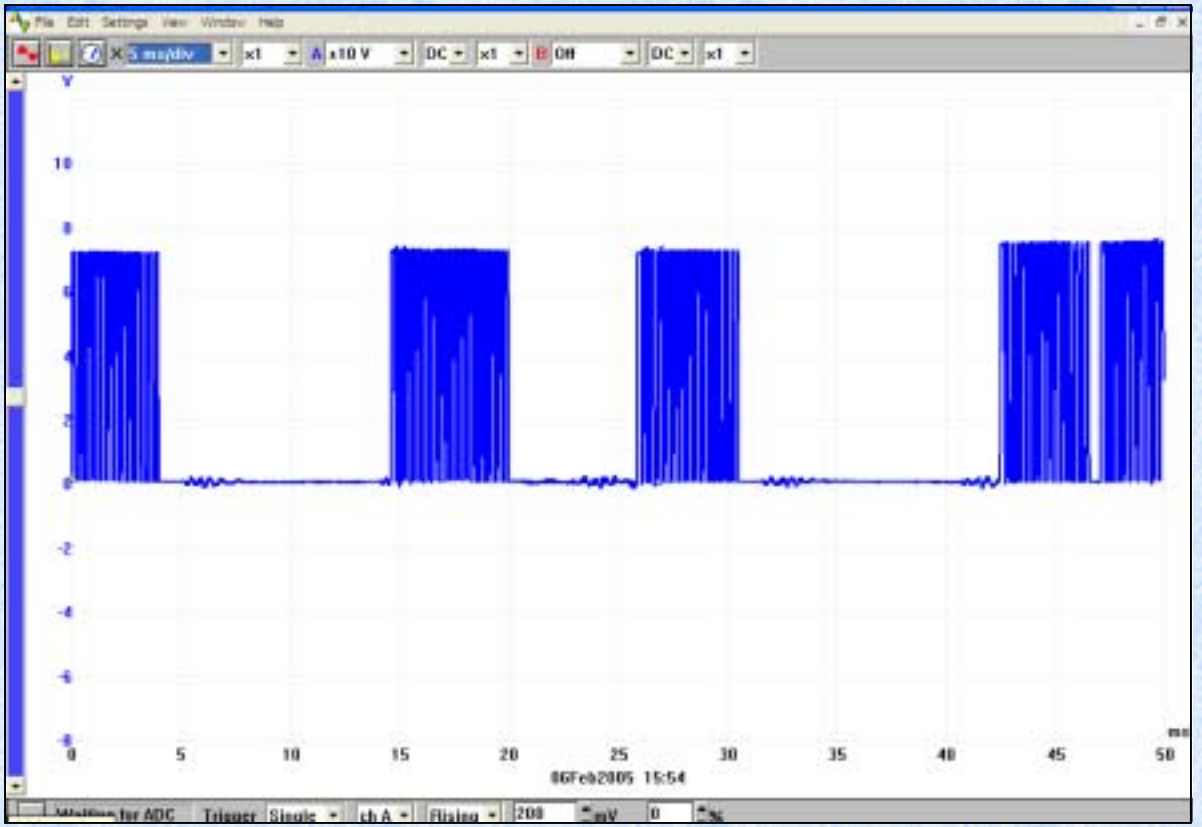
PCI Diagnostics

- Diagnostic Junction Port allows technicians to isolate different PCI circuits



PCI Diagnostics

Use a lab scope to check for activity on the bus at different modules



Dominant Modules = Lower Resistance

Module	Approx. Termination Resistance (Ohms)	Module	Approx. Termination Resistance (Ohms)
Powertrain Control Module (All Except 98 LH)	3,300	Body Control Module (All Except 2002 WJ)	10,800
Powertrain Control Module (98 LH)	1,100	Body Control Module (2002 WJ)	8,000
Sentry Key Immobilizer Module	10,800	Data Link Connector	Open (11,400 with DRB III connected)
Transmission Control Module	10,800	Passenger Door Module (99-01)	10,800
Controller Antilock Brake	10,800	Passenger Door Module (2002)	8,200
Radio (Premium)	10,800	Driver Door Module (99-01)	10,800
Compass Mini Trip Computer	10,800	Driver Door Module (2002)	8,200

Dominant Modules = Lower Resistance

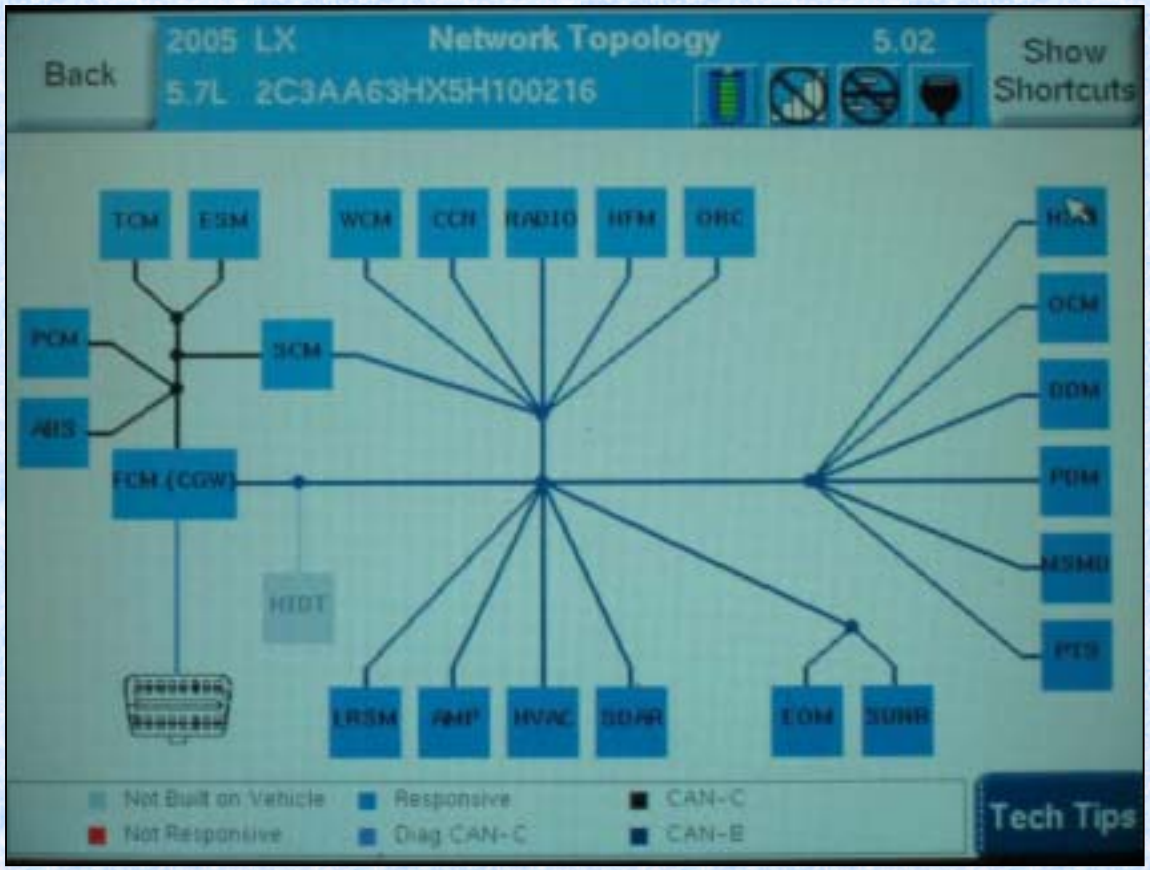
Module	Approx. Termination Resistance (Ohms)	Module	Approx. Termination Resistance (Ohms)
Left-side Impact Airbag Control Module	10,800	Memory Heated Seat Module	10,800
Right-side Impact Airbag Control Module	10,800	Electronic Vehicle Information Center (CMTC, Traveler)	10,800
CD Changer	10,800	Automatic Zone Control (HVAC/ATC Control Heads)	10,800
Occupant Restraint Controller	10,800	Transfer Case Control Module	10,800
Mechanical Instrument Cluster (All Except 98 LH and WJ)	3,300	Front Control Module	10,800
Mechanical Instrument Cluster (98 LH)	10,800	Rain Sensor	10,800
Mechanical Instrument Cluster (99-01 WJ)	2,400	Adjustable Pedal Module	10,800
Mechanical Instrument Cluster (02 WJ)	1,200	Intrusion Sensor (BUX)	10,800

CCD – PCI – CAN B – CAN C

Feature	CCD Bus	PCI Bus	CAN-B	CAN-C
Transmission Media	Twisted Pair	Single Wire	Twisted Pair	Twisted Pair
Speed	7.8 BPS	10.4 KBPS	83.3 KBPS	500 KBPS
Meets Industry Standard	No	Yes (J1850)	No	Yes (J2284)
OBD II Compliant	No	Yes	Yes	Yes
Bus Biasing Required	Yes	No	Yes	Yes
Maximum No. Modules per Bus	13	31 (32 with Scan Tool)	32	12

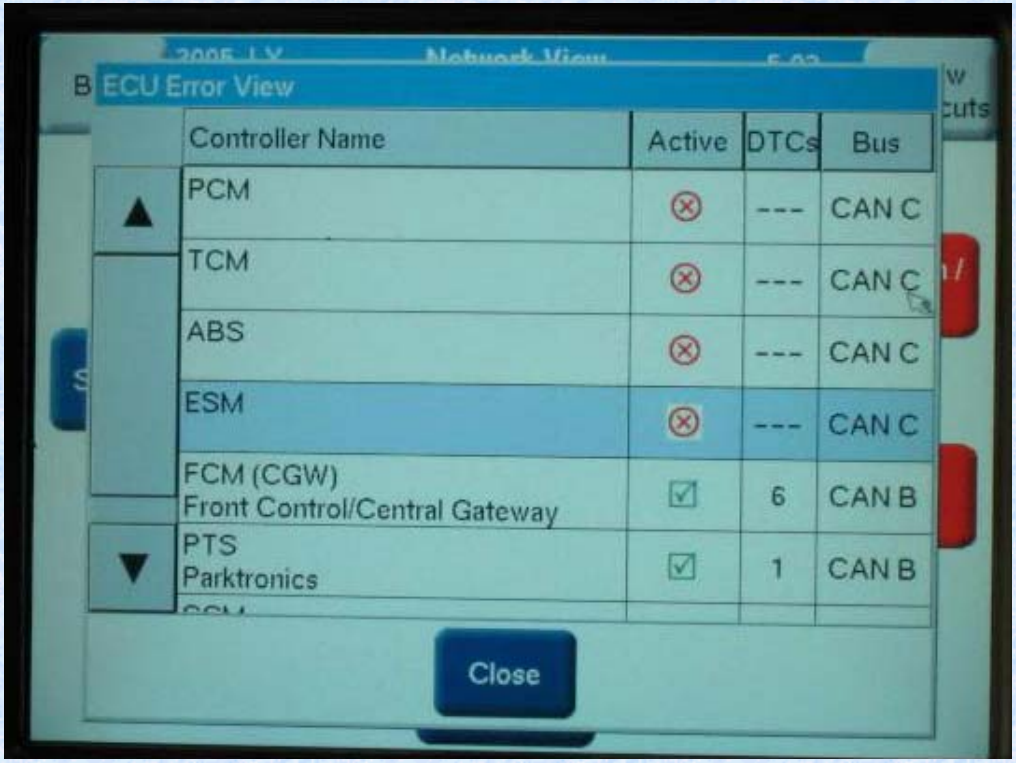
CAN Bus – DCX

- Introduced with 03 Durango
- Can C
  - High speed, 500 kbps to 1,000 kbps
  - Two wire
  - NOT fault tolerant
- Can B
  - Lower speed, 83 kbps
  - Two Wire
  - Fault Tolerant



CAN Bus – DCX

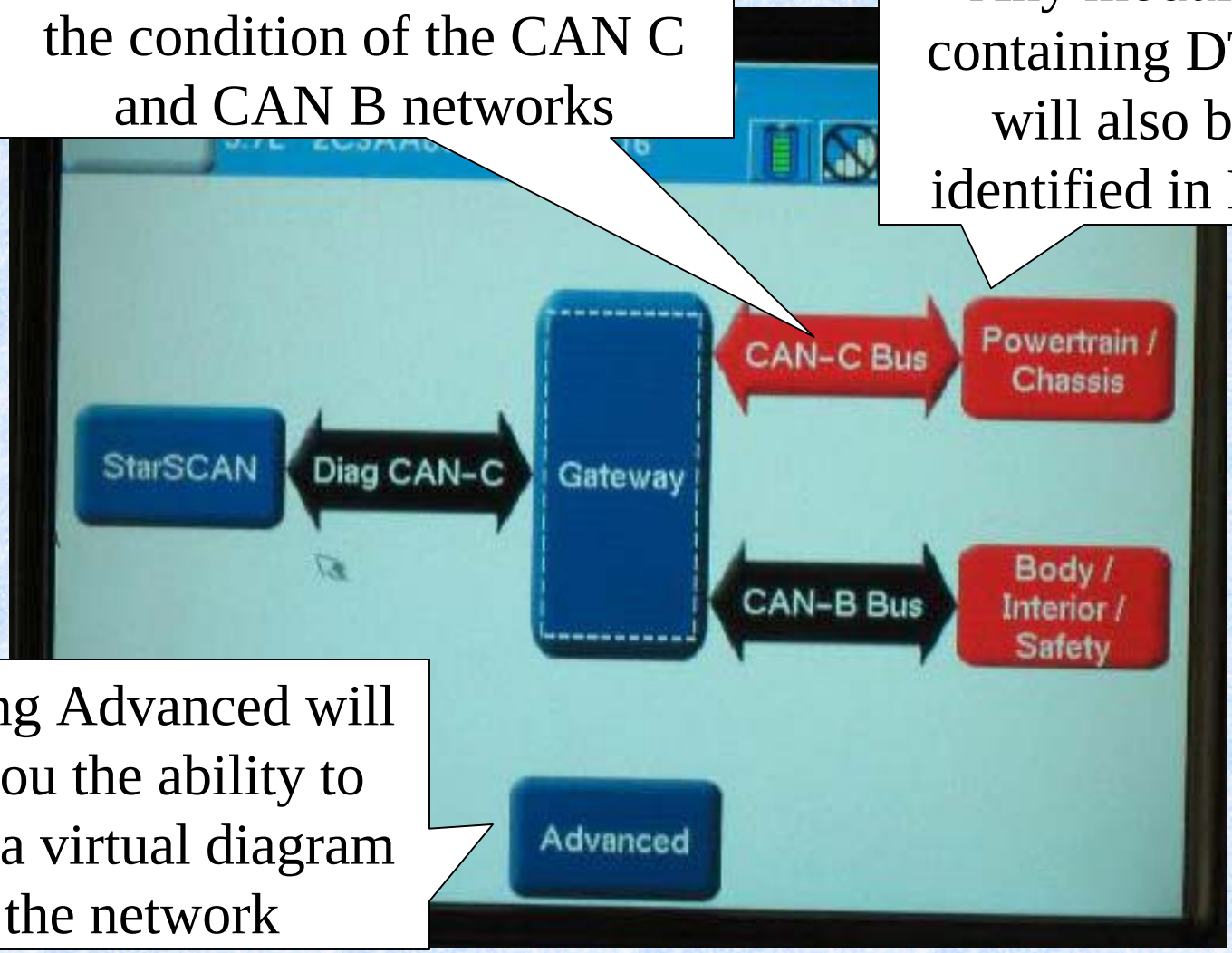
- Starscan can check for modules communicating on the network
- Any modules not communication will show up as not active
- DTCs will set in modules that can communicate



CAN Bus – DCX

Starscan network view show the condition of the CAN C and CAN B networks

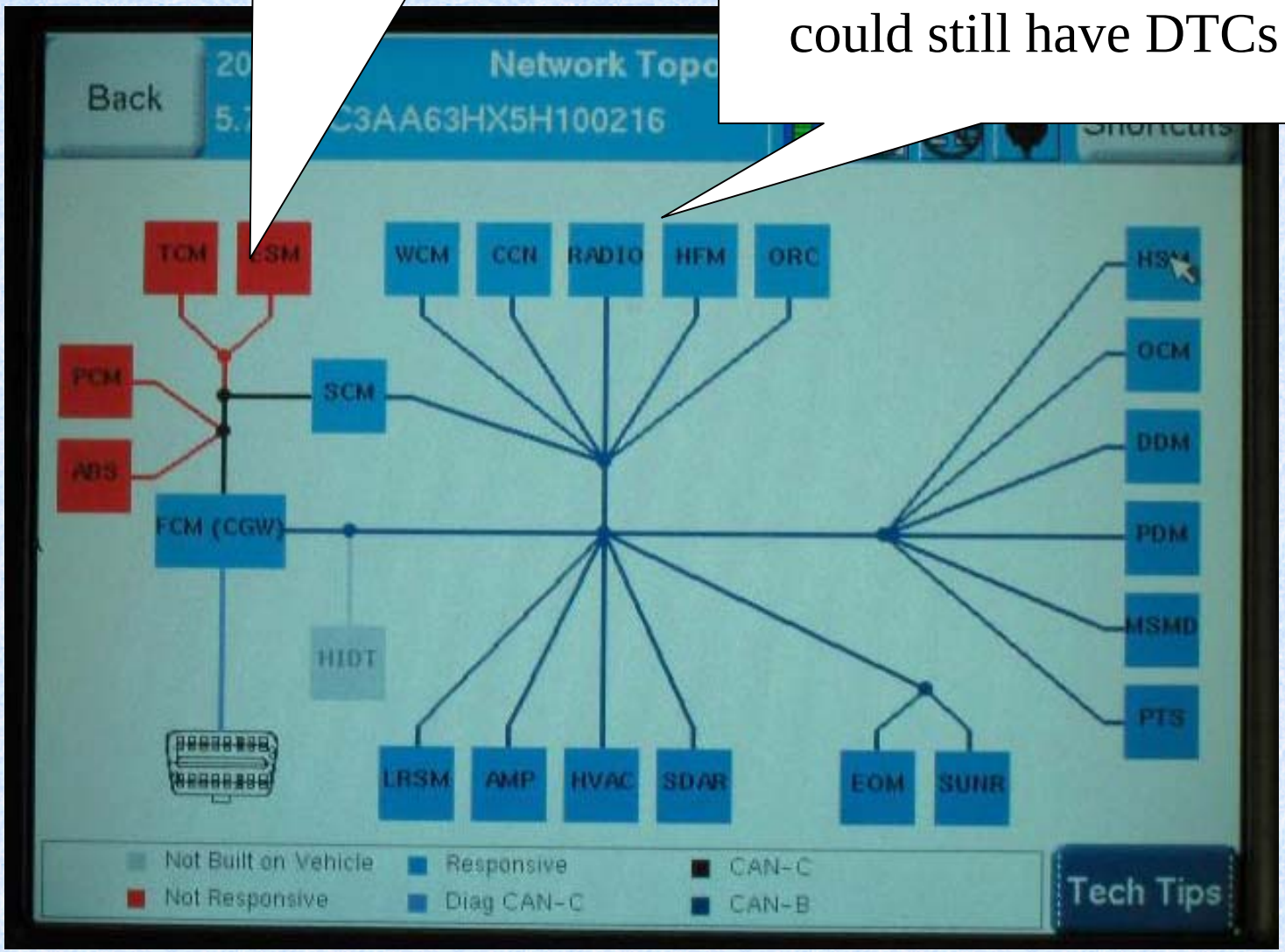
Any modules containing DTCs will also be identified in Red

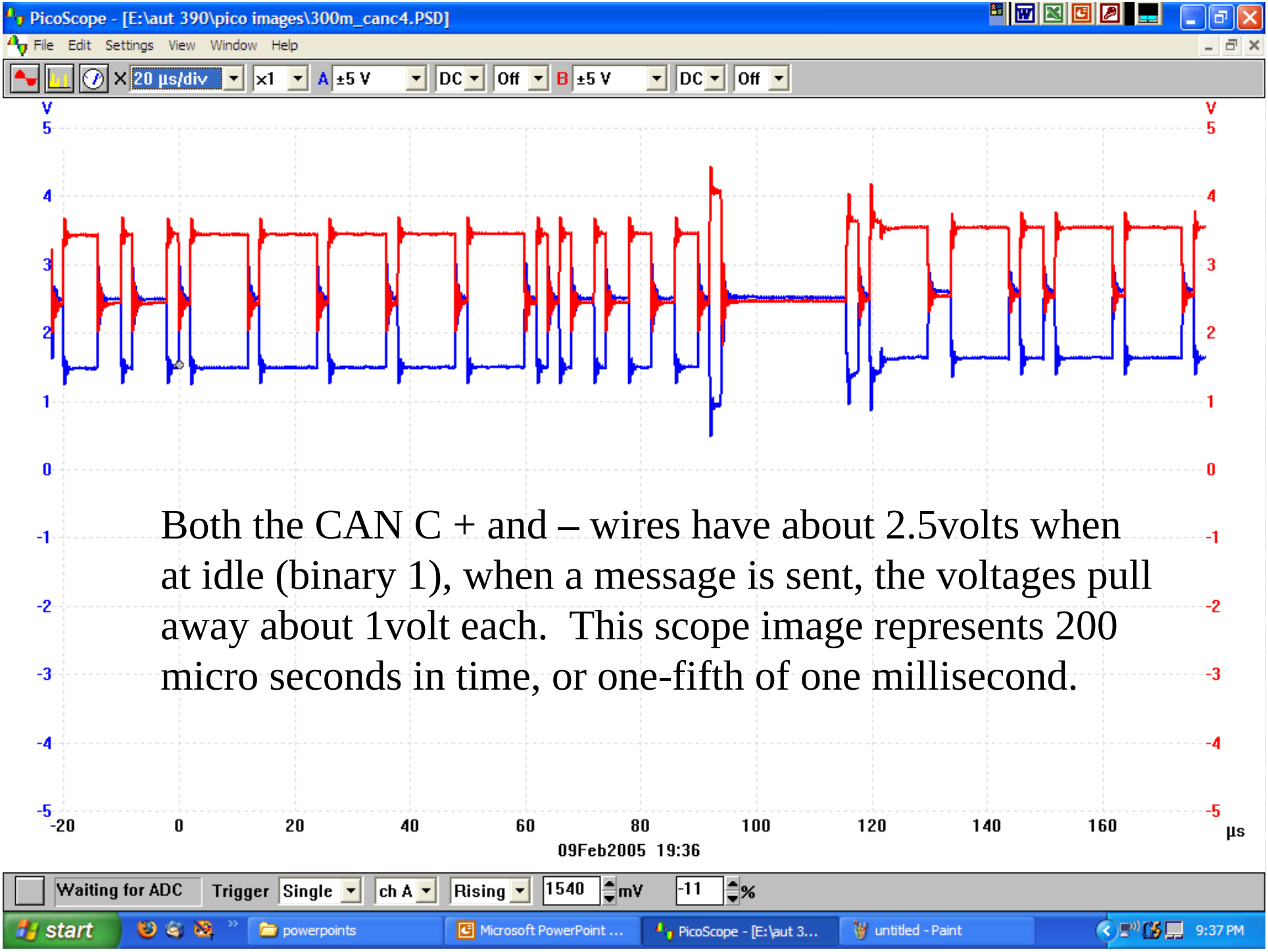


Selecting Advanced will give you the ability to look at a virtual diagram of the network

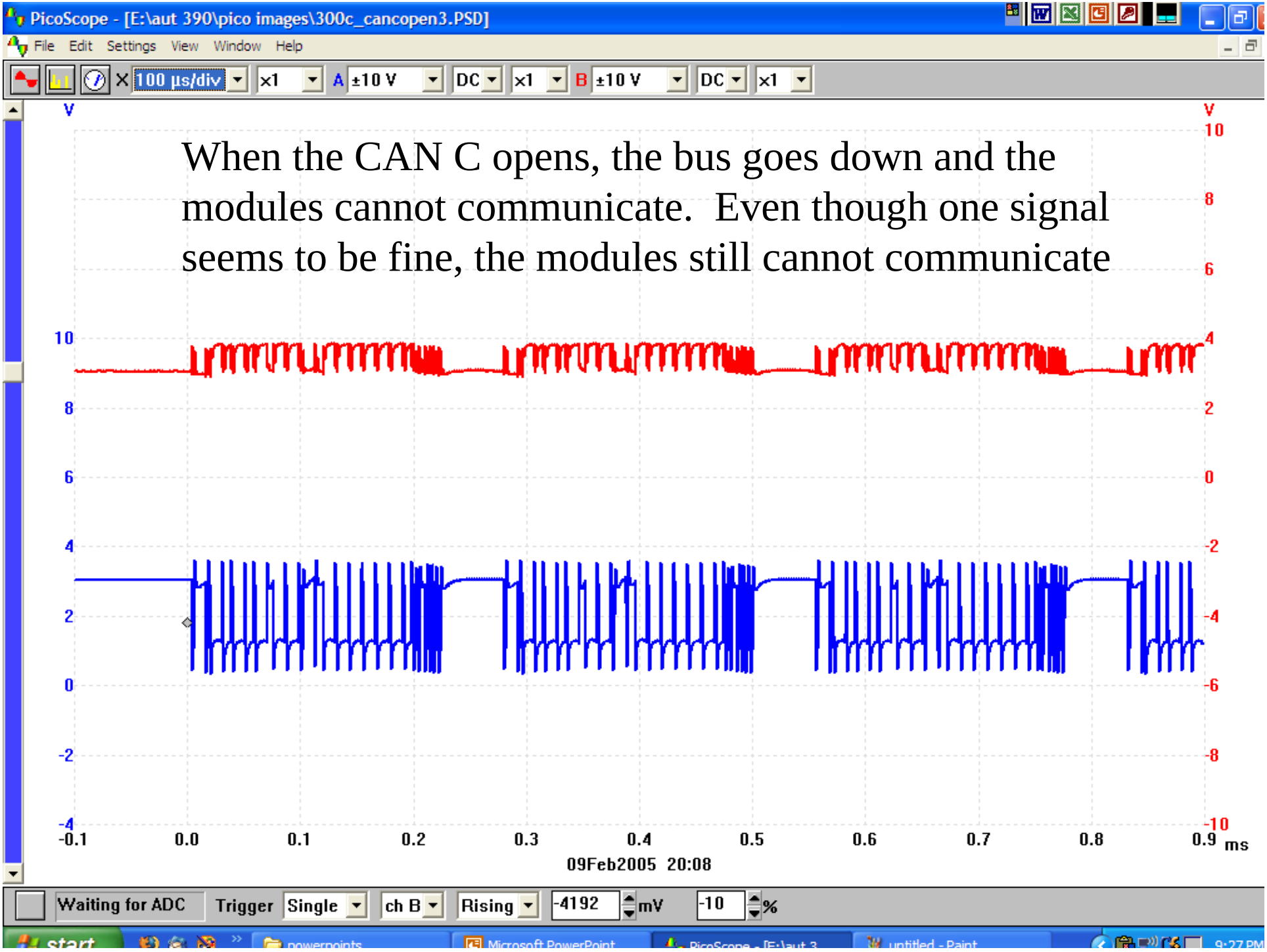
Modules in red are down and not communicating

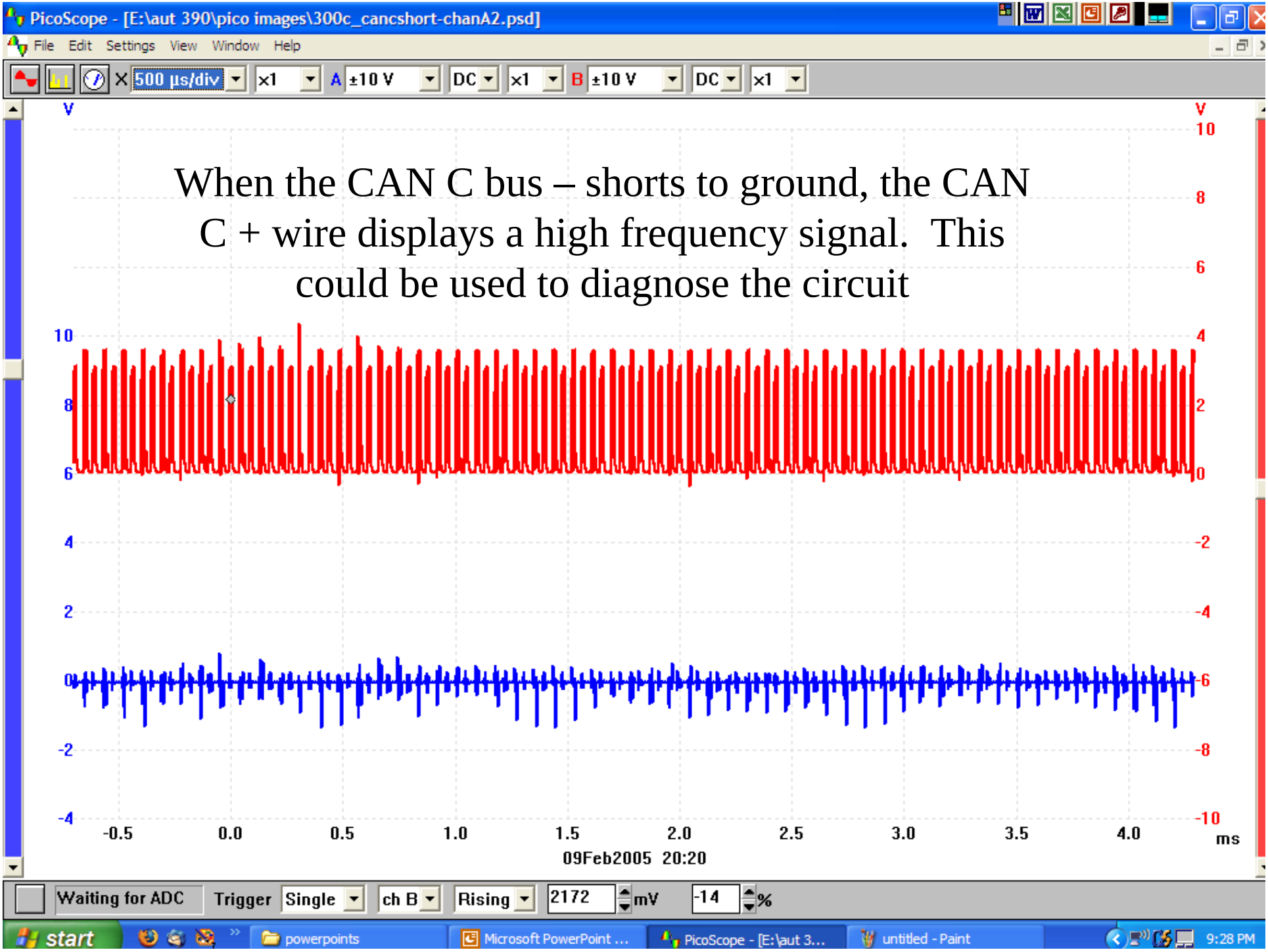
Blue modules are successfully communicating, but they could still have DTCs

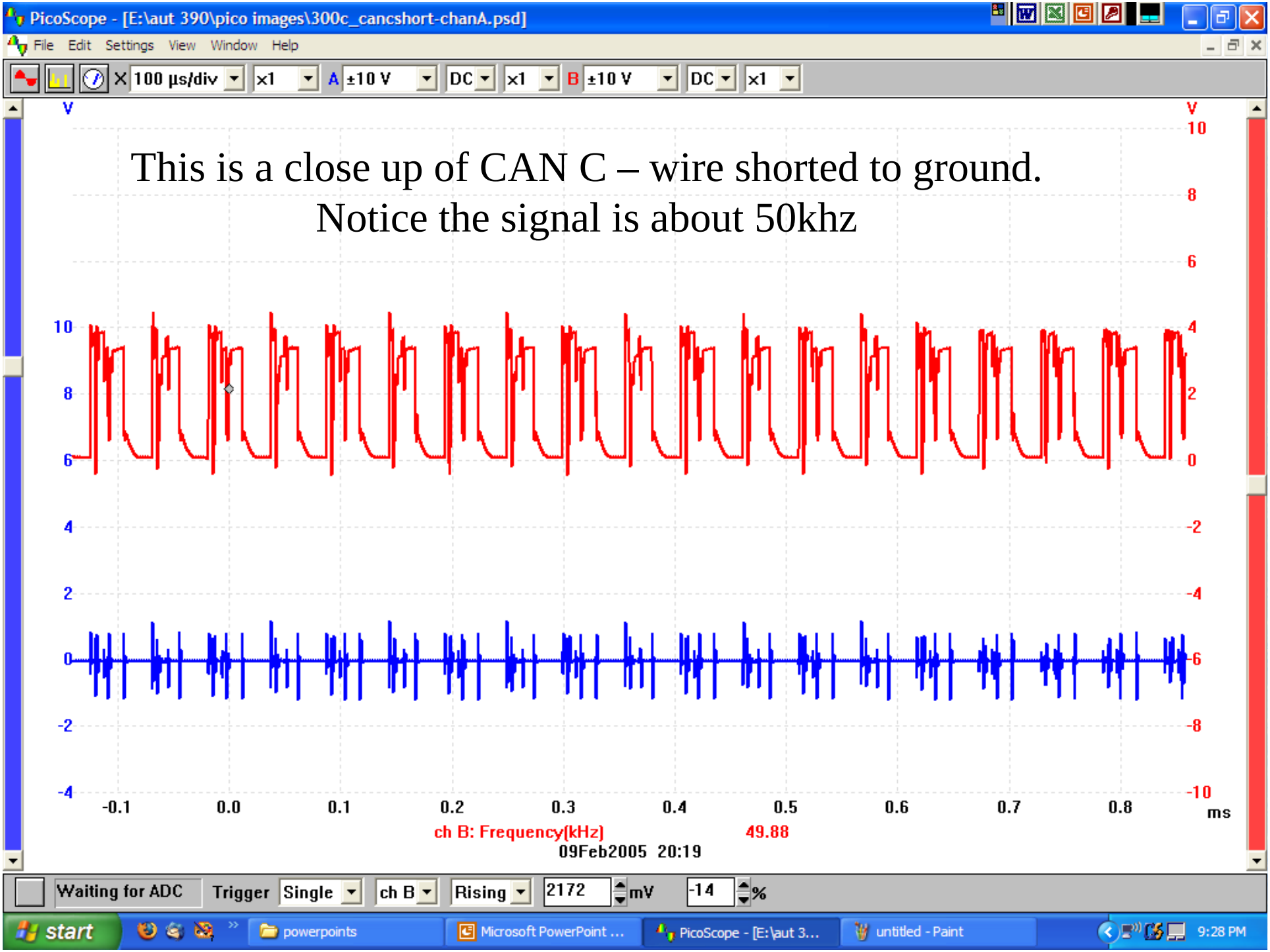


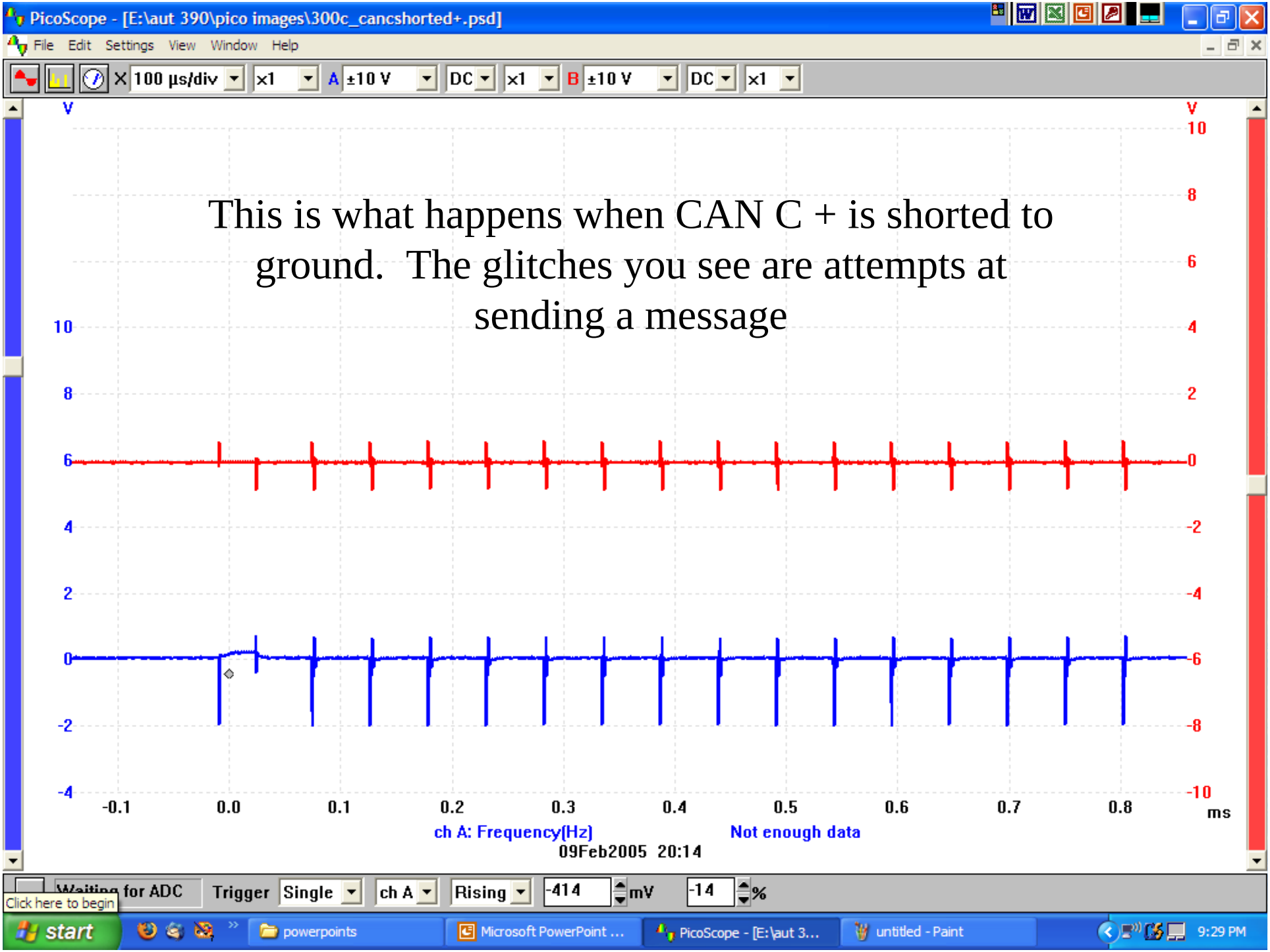


Both the CAN C + and – wires have about 2.5volts when at idle (binary 1), when a message is sent, the voltages pull away about 1volt each. This scope image represents 200 micro seconds in time, or one-fifth of one millisecond.


PicoScope - [E:\aut 390\pico images\300c_cancopen3.PSD]
File Edit Settings View Window Help
100 µs/div
A ±10 V
DC
B ±10 V
DC
When the CAN C opens, the bus goes down and the modules cannot communicate. Even though one signal seems to be fine, the modules still cannot communicate
V
10
8
6
4
2
0
-2
-4
-0.1 0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 ms
09Feb2005 20:08
Waiting for ADC
Trigger
Single
ch B
Rising
-4192
mV
-10
%

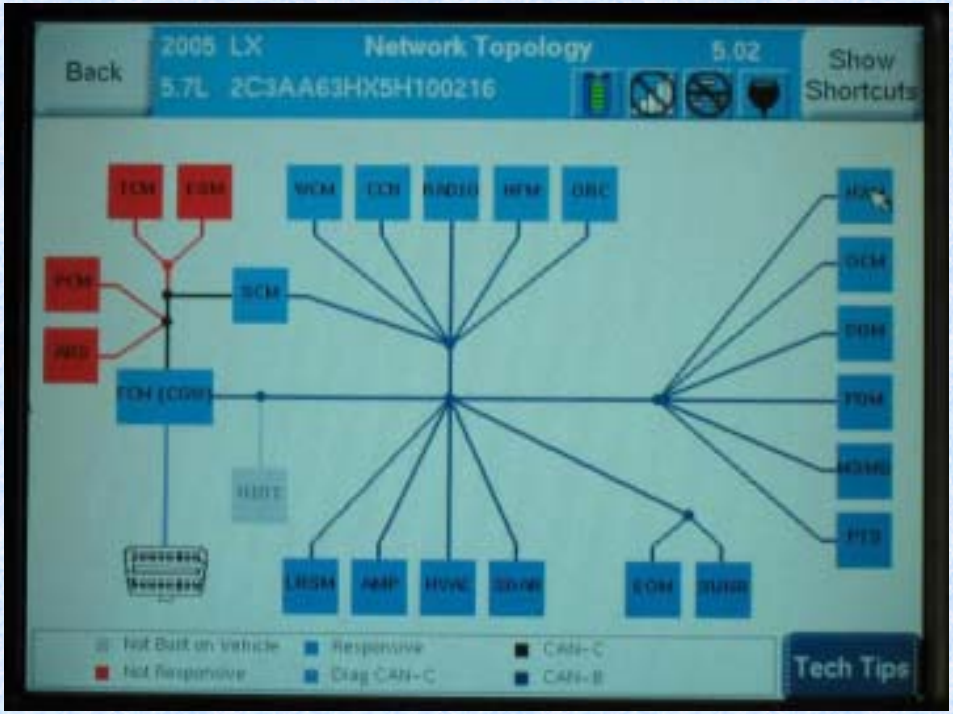

PicoScope - [E:\aut 390\pico images\300c_cancshort-chanA2.psd]
File Edit Settings View Window Help
500 µs/div
A ±10 V
DC
B ±10 V
DC
When the CAN C bus – shorts to ground, the CAN C + wire displays a high frequency signal. This could be used to diagnose the circuit
V
10
8
6
4
2
0
-2
-4
-6
-8
-10
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
ms
09Feb2005 20:20
Waiting for ADC
Trigger
Single
ch B
Rising
2172
mV
-14
%
start
powerpoints
Microsoft PowerPoint ...
PicoScope - [E:\aut 3...
untitled - Paint
9:28 PM


PicoScope - [E:\aut 390\pico images\300c_cancshort-chanA.psd]
File Edit Settings View Window Help
100 µs/div
A ±10 V
DC
B ±10 V
DC
This is a close up of CAN C – wire shorted to ground.
Notice the signal is about 50khz
V
10
8
6
4
2
0
-2
-4
-10
-0.1
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
ms
ch B: Frequency(kHz)
49.88
09Feb2005 20:19
Waiting for ADC
Trigger
Single
ch B
Rising
2172
mV
-14
%
start
powerpoints
Microsoft PowerPoint ...
PicoScope - [E:\aut 3...
untitled - Paint
9:28 PM


PicoScope - [E:\aut 390\pico images\300c_cancshorted+.psd]
File Edit Settings View Window Help
100 µs/div
A ±10 V
DC
B ±10 V
DC
V
10
8
6
4
2
0
-2
-4
-6
-8
-10
-0.1
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
ms
This is what happens when CAN C + is shorted to ground. The glitches you see are attempts at sending a message
ch A: Frequency(Hz)
Not enough data
09Feb2005 20:14
Waiting for ADC
Click here to begin
Trigger
Single
ch A
Rising
-414
mV
-14
%
start
powerpoints
Microsoft PowerPoint ...
PicoScope - [E:\aut 3...
untitled - Paint
9:29 PM

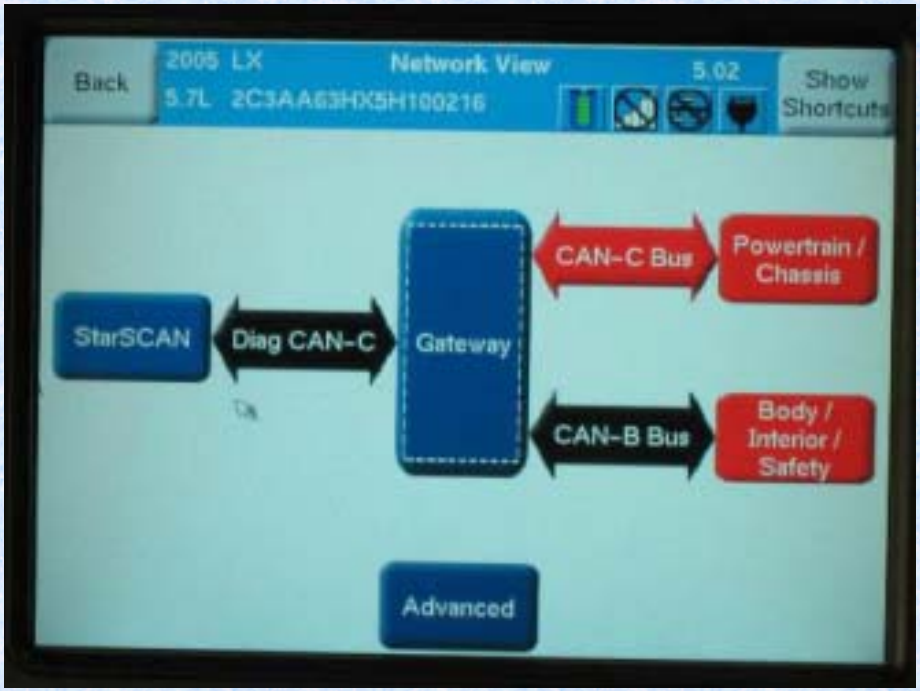
CAN C = NOT FAULT TOLERANT

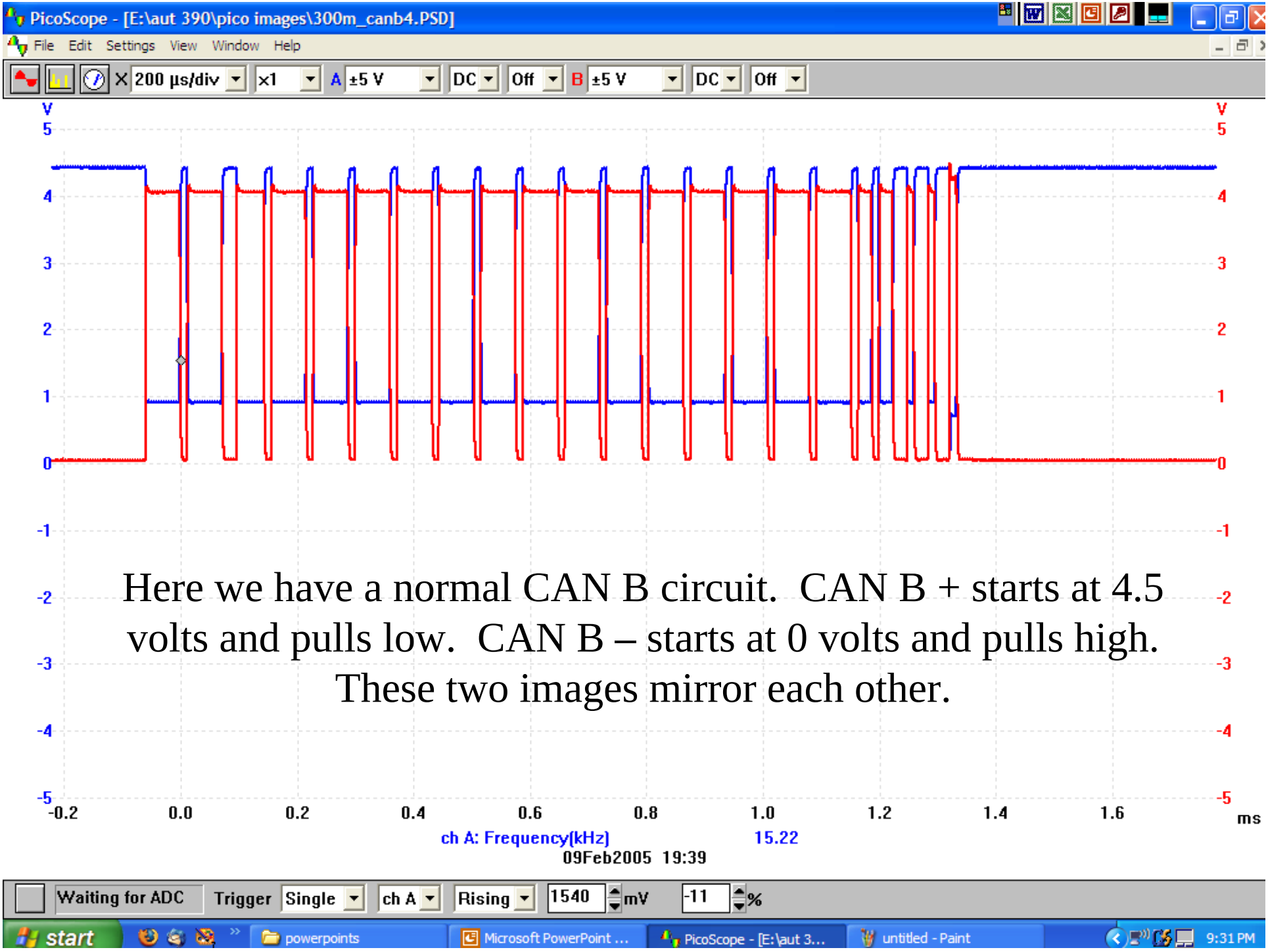
- When the CAN C fails, the whole CAN C network goes down and the vehicle will not RESTART if it has theft deterrent
- This is true even if only one wire fails



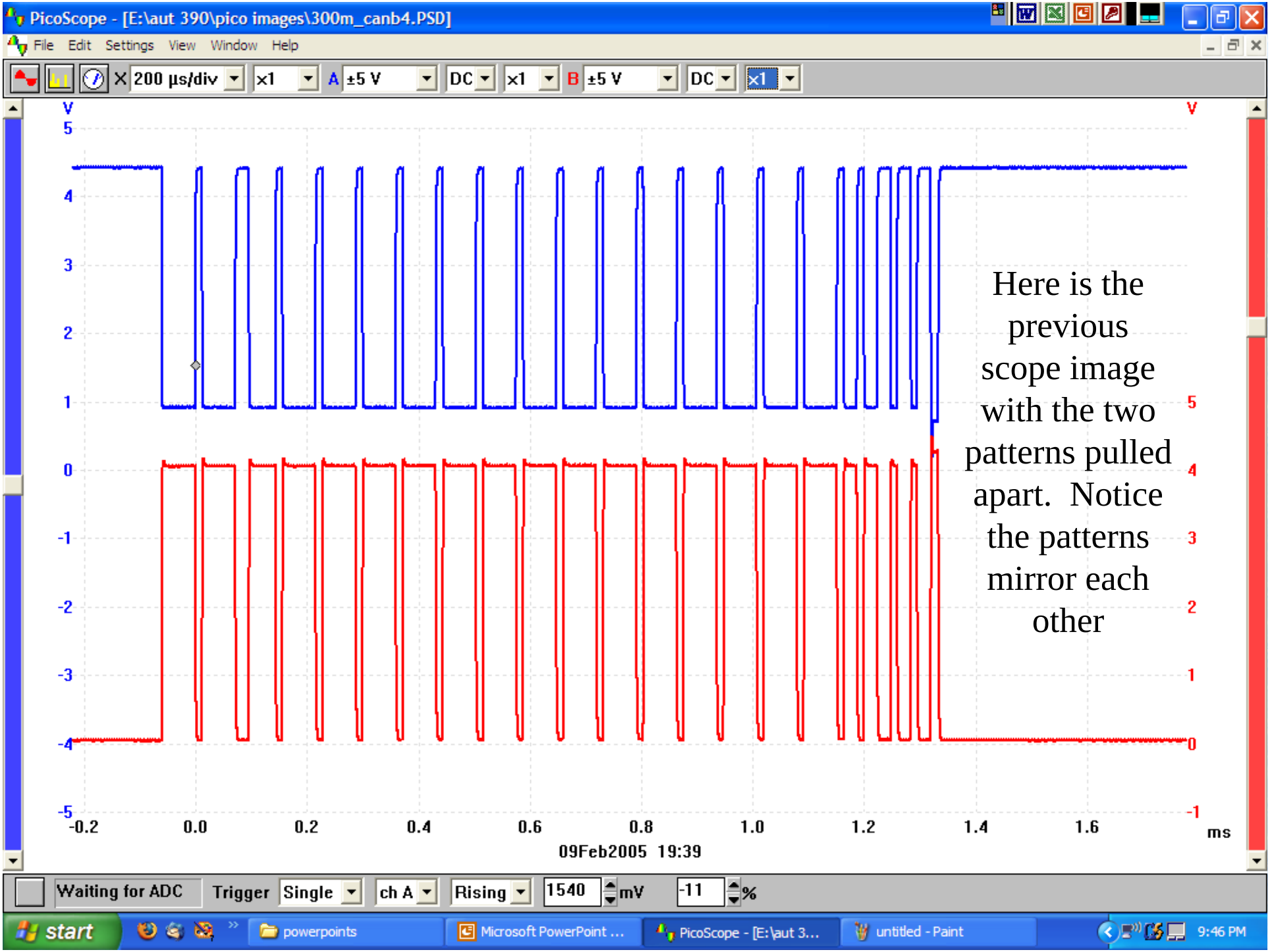
CAN B

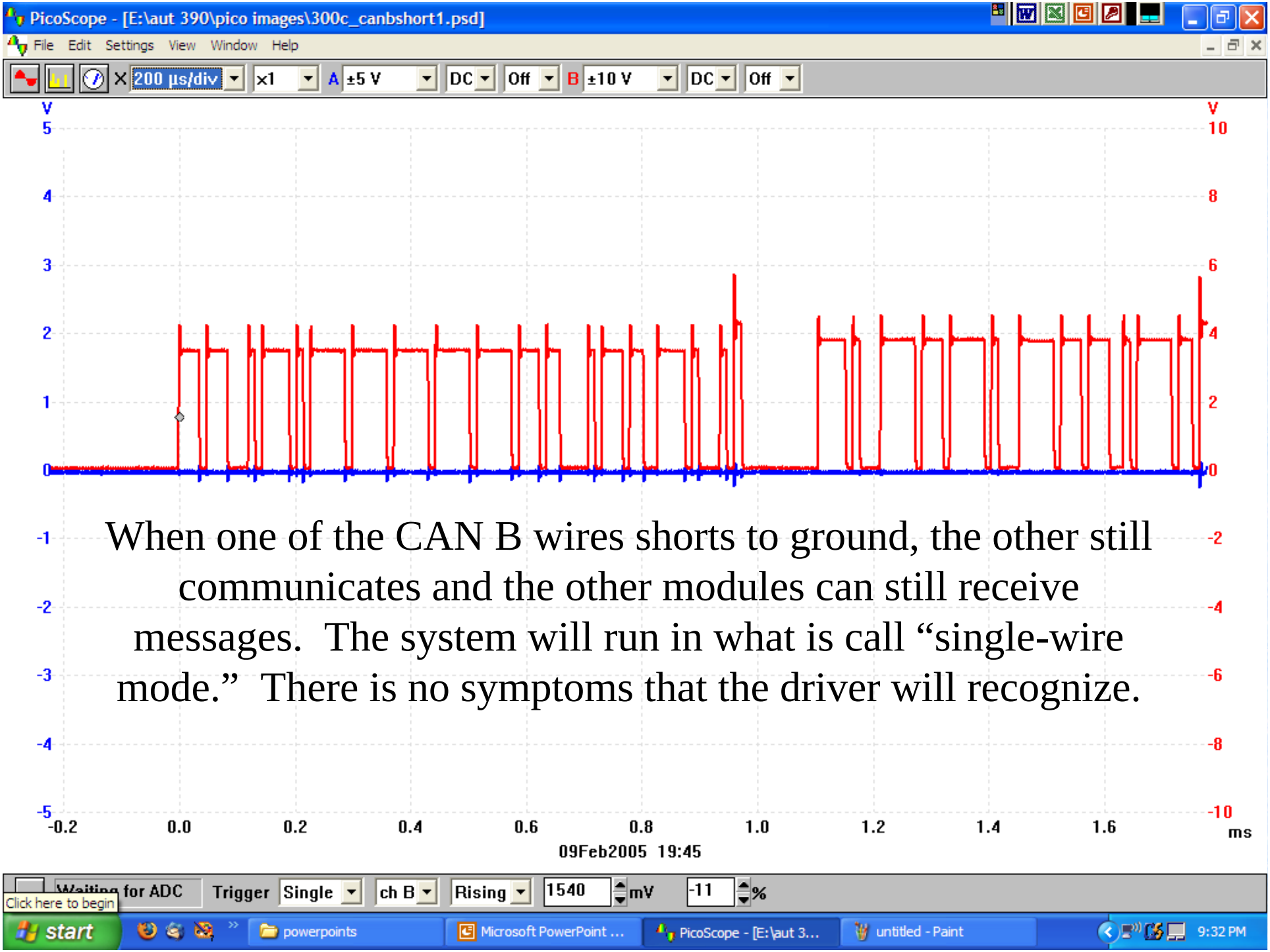
- Slower network for connecting body modules together
- CAN B and CAN C can communicate through a GATEWAY but they cannot directly communicate together
- CAN B is fault tolerant





Here we have a normal CAN B circuit. CAN B + starts at 4.5 volts and pulls low. CAN B – starts at 0 volts and pulls high. These two images mirror each other.

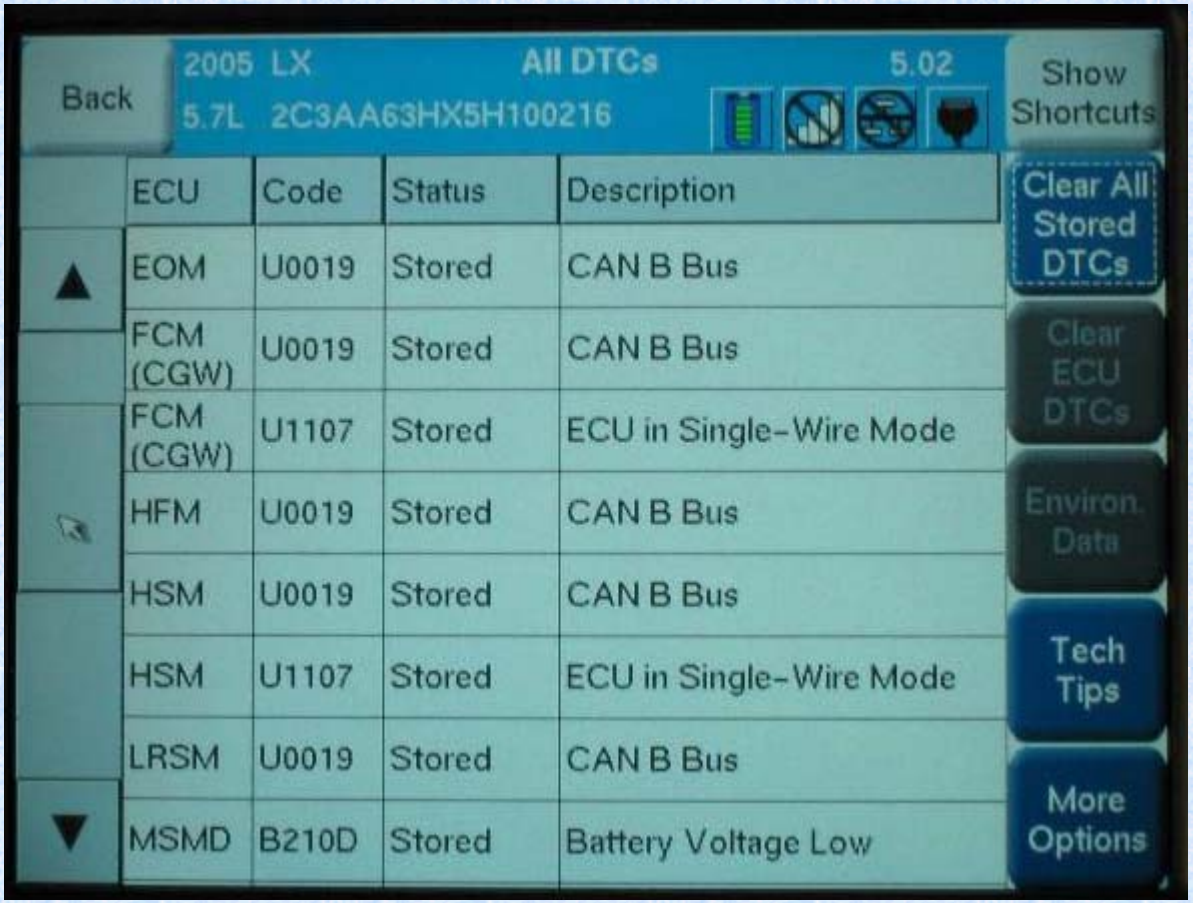

PicoScope - [E:\aut 390\pico images\300m_canb4.PSD]
File Edit Settings View Window Help
200 µs/div
A ±5 V
DC
B ±5 V
DC
V
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.2
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
ms
09Feb2005 19:39
Here is the previous scope image with the two patterns pulled apart. Notice the patterns mirror each other
Waiting for ADC
Trigger
Single
ch A
Rising
1540
mV
-11
%
start
powerpoints
Microsoft PowerPoint ...
PicoScope - [E:\aut 3...
untitled - Paint
9:46 PM



When one of the CAN B wires shorts to ground, the other still communicates and the other modules can still receive messages. The system will run in what is call “single-wire mode.” There is no symptoms that the driver will recognize.

CAN B

- When a single wire fails on the CAN B network, the system goes into single-wire mode
- DTCs will still be set



CAN C Pin Assignment

- CAN C wires will always be found in DLC pins 6 and 14
- DCX uses a Diagnostic CAN C to communicate to the GATEWAY