



1



2



## *Your Instructor For This Webinar*

### "G" Jerry Truglia

- National Trainer, ASE World Class, Master Auto, Truck, School Bus, L1, L3, CNG and...
- **ATTP Master Instructor, New York State, CT and New Jersey**
- STS (Service Technician Society) 2003 President
- **TST (Technicians Service Training) Founder and President**
- Author / Co Author/ Technical adviser on 25 plus books including OBD II and Mode 6, and Understanding and Diagnosing Hybrid Vehicles
- **Published articles for multiple newsletters, and magazines**
- Picked as one of the Top Instructors in the country by EPA & SAE
- **Numerous Radio, TV, Internet, and SAE Video appearances**
- PTEN, MotorAge and TST Webcast Instructor
- **Motor Magazine Top 20 award winner**
- Provider of OBD II Training for 14 states, Ontario Canada and the US EPA
- **Guest speaker at SAE Congress, IM Solutions and Clean Air Conference**

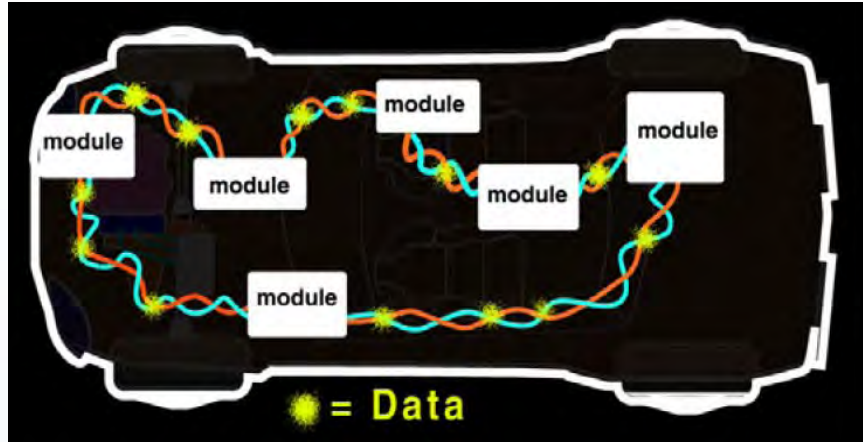
3

## **What Will Be Covered:**

- Networks - How They Work
- **Network Fundamentals**
- Twisted Pairs - System Topology - Protocol Speeds
- **Communication**
- Tools To Use - BOB (break out box) Meters and Labsopes
- **And More...**

4

## Things You Should Know About Networks

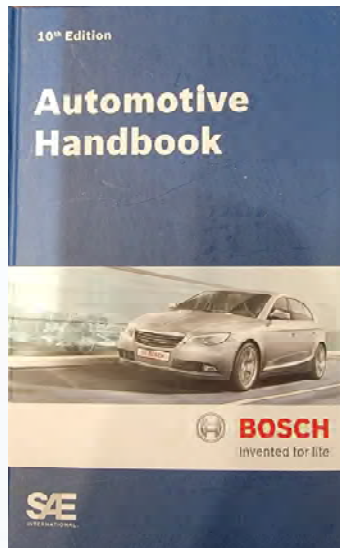


5

# Network Info

6

## The Bosch Automotive Handbook aka The Automotive Bible

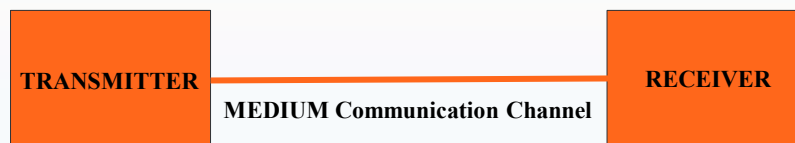


7

## Communication System

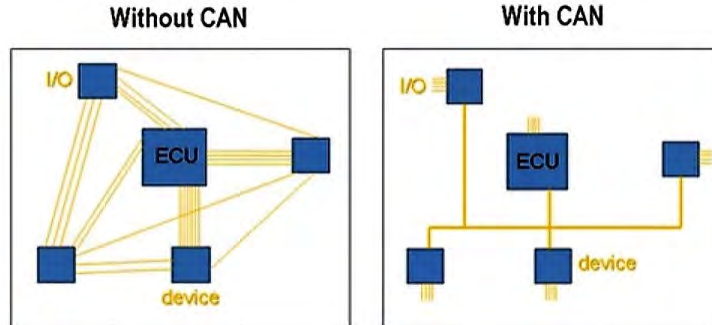
**All electronic communication systems consist of three basic components:**

1. Transmitter
2. Communication Channel
3. Receiver



8

## Multiplex - CAN - Information

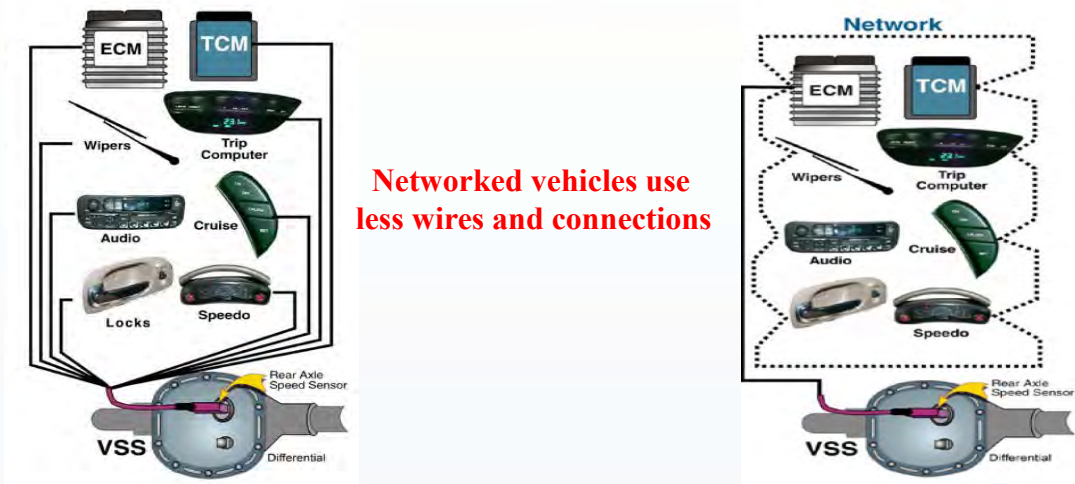


Courtesy Engineer Ambitiously

**CAN networks significantly reduce wiring**

9

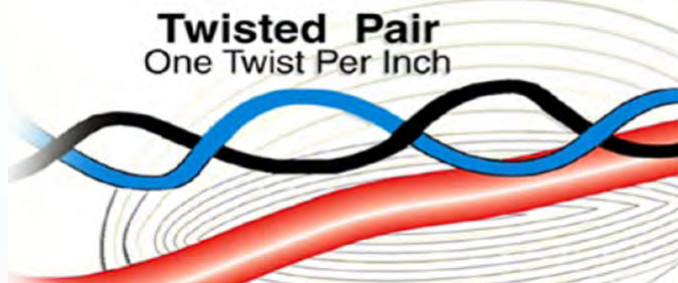
## Data BUS Info



**Networked vehicles use less wires and connections**

10

## Things You Should Know About Networks

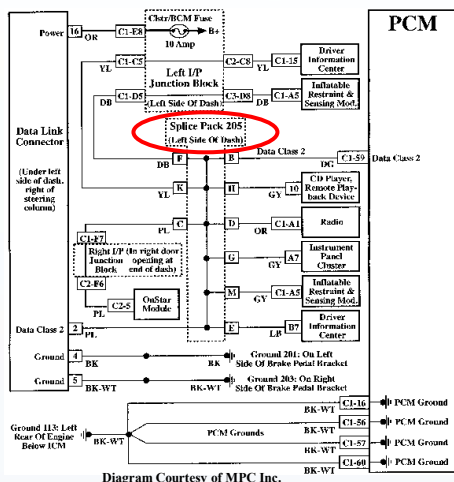


What are the benefits of a twisted pair?

**Twisted pair is wiring where two conductors of a single circuit are twisted together for the purposes of improving electromagnetic compatibility. A twisted pair reduces electromagnetic radiation from the pair and crosstalk between other pairs that improves rejection of external electromagnetic interference.**

11

## Data BUS Info



**To Disconnect from Network unplug the Splice Pack**

12

# Class 2 Info

13

## Data BUS Info

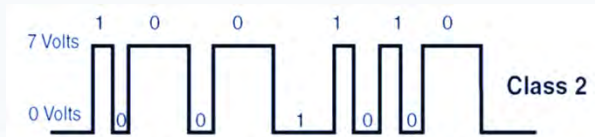


14

## Data BUS Info

**Class 2 Serial Data is used on many GMs**

- Transmitted on a signal wire at 10.4 kbps
- **Variable pulse width signal**
- 7 volt signal that utilizes an average voltage
- **Uses a floating BUS**



15

## Data BUS Info



**GM Data Bus  
Low**



**GM Data Bus  
Normal**



**GM Data Bus  
High**

16



# Case Study

## Class 2

### Class 2 - 2012 Chevy Colorado 2.9L Network DTC

**Complaint: Stabilitrac and ABS message displayed on dash.**

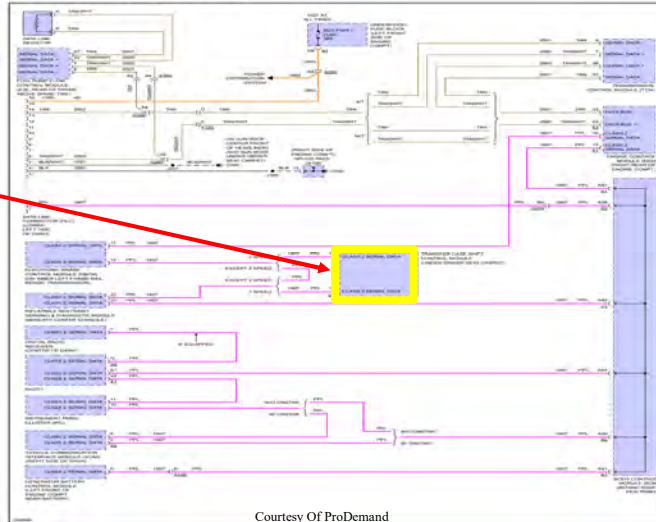
**Code: U1000 - Class 2 Data BUS Code ABS and Instrument Cluster & voltage codes in BCM and TPMS**

Researching the system showed that the BCM monitors voltage over multiple modules and is also the common "HUB" for most modules on the Class 2 BUS. **Tested Powers and grounds at BCM checked out OK.**



## Class 2 - 2012 Chevy Colorado 2.9L Network DTC

Fig 1: Computer Data Lines Circuit



Traced wires with voltage out of range back to Transfer Case control module.

Courtesy Of ProDemand

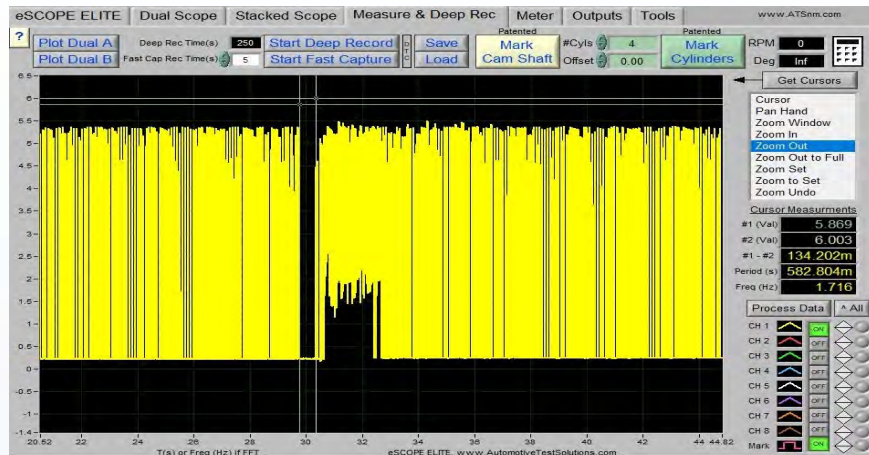
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19

19

## Class 2 - 2012 Chevy Colorado 2.9L Network DTC

Connected a labscope at DLC to check waveform on Class 2 data BUS and found 0 - 5v waveform. The voltage needs to be 7 volts - something is pulling it down. Went to next easiest module (ABS) and scoped both Class 2 wires at the module.



Found a break in the data along with two different voltage ranges at the wires.

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20

20

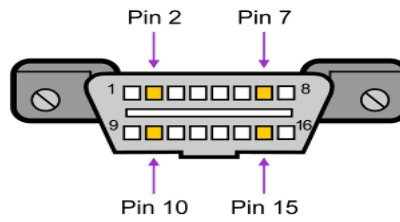
## Class 2 - 2012 Chevy Colorado 2.9L Network DTC



**Problem: Transfer Case module under driver's seat submerged in water.**

# Communication Information

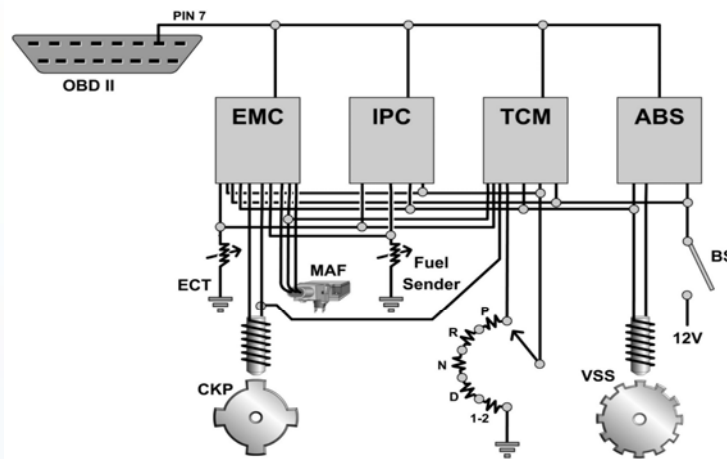
## DLC Connector



Standard	Pin 2	Pin 6	Pin 7	Pin 10	Pin 14	Pin 15
J1850 PWM	must have	-	-	must have	-	-
J1850 VPW	must have	-	-	-	-	-
ISO9141/14230	-	-	must have	-	-	optional
ISO15765 (CAN)	-	must have	-	-	must have	-

23

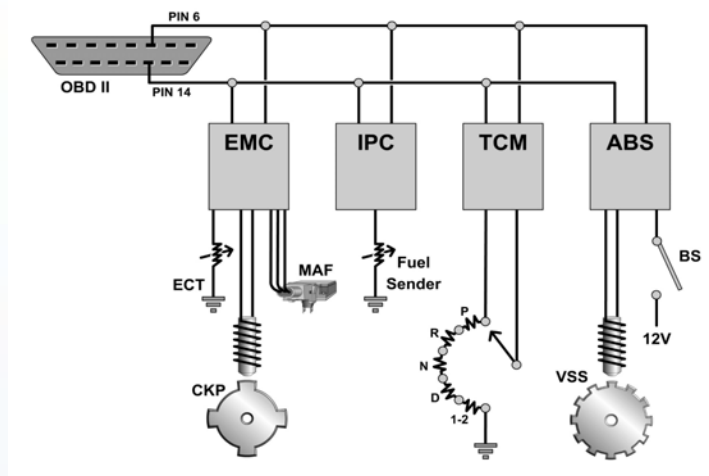
## Non CAN - DLC - Components



**Non CAN Network - Many Wires - Slower To Transfer Information**

24

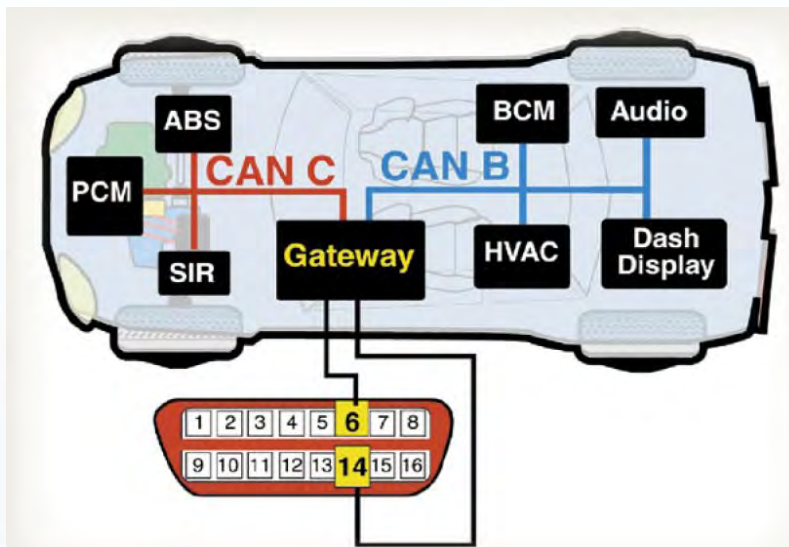
## CAN - Controller Area Network - DLC - Components



**CAN Network - high speed - less wires**

25

## CAN - Controller Area Network



26

## SAE Classifications

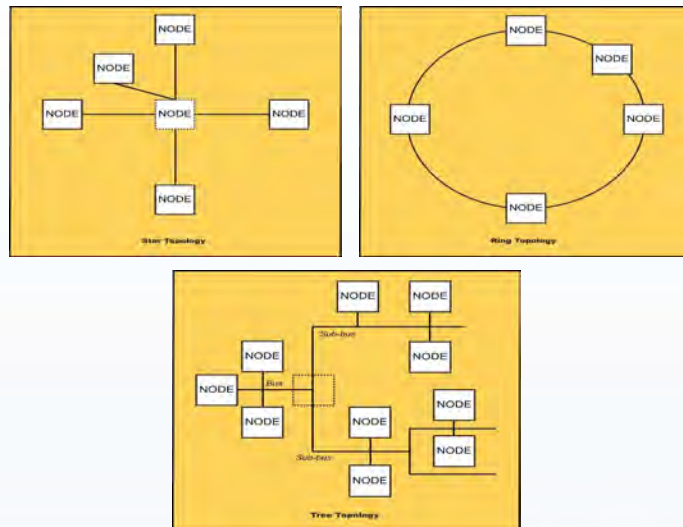
- **Class A - low speed (<10kbit/s) maximum message rate is about 100ms or less than 10 messages per second**
- **Class B - medium speed (10 to 125 kbit/s) maximum message rate is about 20ms or less than 50 messages per second**
- **Class C - high speed (125kbit/s to 1Mbit/s) maximum message rate is <5ms or less than 200 messages per second**
- **Class D - high speed (1Mbit/s to 150 Mbit/s) example ethernet (future automotive use) (X-by wire) - (Flexray) - (CAN with flexible data-rate - CAN FD)**



27

## BUS Access Topology

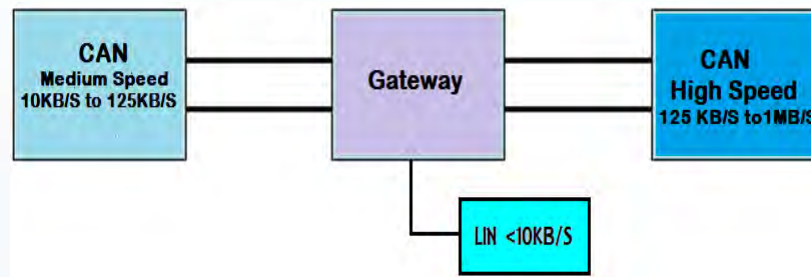
- **Master - Slave**
- **Round Robin or Token Ring**
- **Arbitration**



28

## GATEWAY

Vehicles will have several different BUS systems. High speed systems will be used on a system where speed is needed. Such as engine and transmission systems. Low speed systems will be used on a system where speed is not needed. Such as seat and door systems.

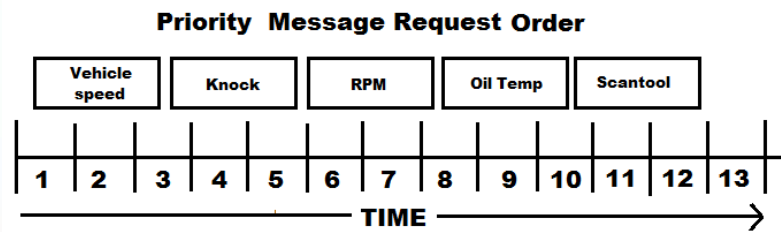


29

## CAN Priority

Wake up a Sleeping BUS by Turning ON the 4 Way Flashers

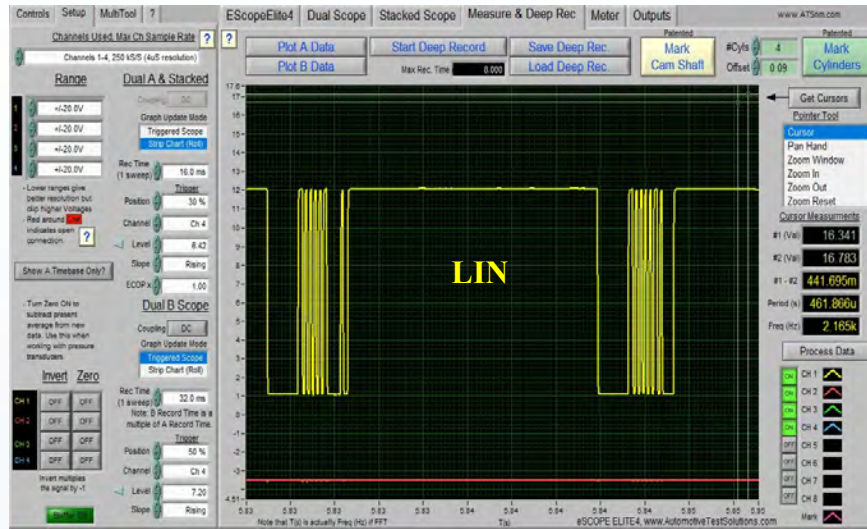
- Vehicle Speed
- Knock
- RPM
- Oil Temp
- Scantool



**Note: The Scantool always has the lowest priority!**  
The CAN transceiver will set the priority for the outgoing messages.

30

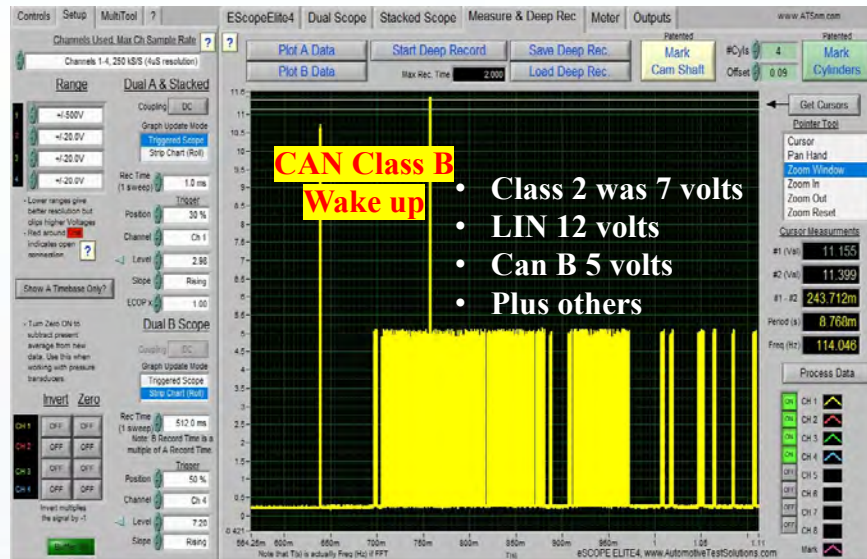
## Local Interconnect Network (LIN)



Courtesy Bernie Thompson

31

## CAN Class B Single Wire



32



## CAN Class C Important Information

**CAN C uses a 5 volt reference**

**Pin 6 CAN High 2.5 to 3.5 volts**

**Pin 14 CAN Low 2.5 to 1.5 volts**

Perform the voltage test with a Voltmeter or a **Labscope (preferred tool to use)**.

CAN either serial or parallel...will have 120  $\Omega$  terminator resistors. Divide them in parallel equals roughly 60  $\Omega$ . **Example:  $1 \div 120 \Omega = 0.008333$  or .008.** Next add the two .008  $\Omega$  resistors together = .016. **Followed by dividing  $1 \div .016 = 0.0625$  or 62.5  $\Omega$**

**Perform the  $\Omega$  test with the battery disconnected.**



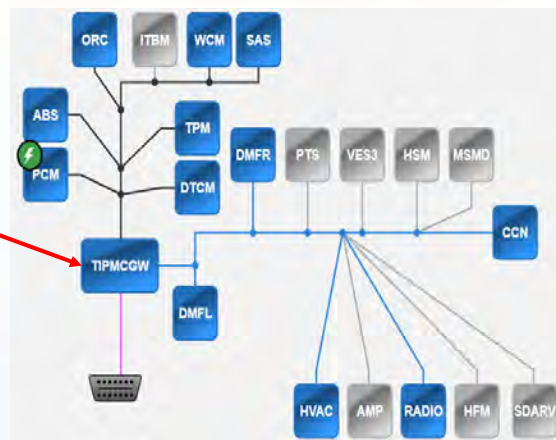
Courtesy Bernie Thompson

33

## CAN Class C Important Information

**Testing at the DLC will not always test the CAN system especially if there is a Gateway module in the system.**

Example to the right a 2017 and later FCA vehicle with a Gateway module. **Does your scan tool connect and perform Code Clear and Bi-direction control without using the FCA software or having a scan tool registered at [AutoAuth.com](http://AutoAuth.com)?**



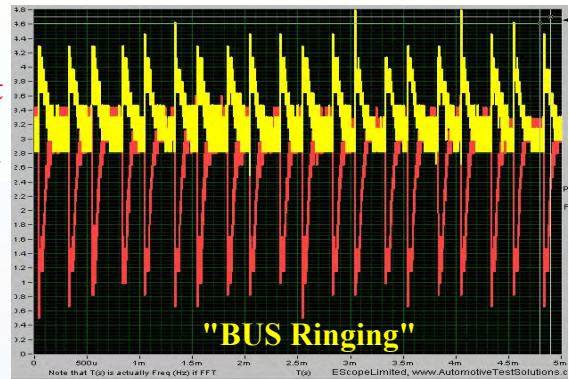
34

## CAN Class C Important Information

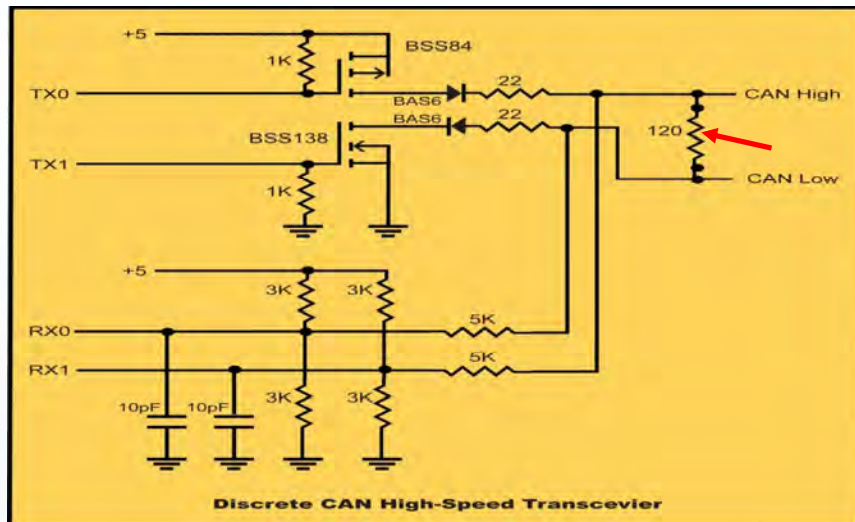
**Terminator resistors kill noise on the circuit.**

If there is no voltage reading on the DLC for the CAN BUS go to the individual modules. **Disconnect the wires (KOEO) and connect meter or labscope in series. If you cannot find a network problem, try disconnecting one module at a time from the BUS.**

Always disconnect the battery when performing the Ohm test. Otherwise just opening a door or putting something on will turn on BUS voltage.



## CAN Class C



# Case Study

37

## 2008 Toyota Tundra No Start - No Communication



38

## 2008 Toyota Tundra No Start - No Communication



Open / Broken Wire To A **Shorted** AIR Pump  
Caused No Start And No Communication

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39

39

## 2008 Toyota Tundra No Start - No Communication



Load Testing The Circuit Making  
Sure It Can Carry The Load

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40

40

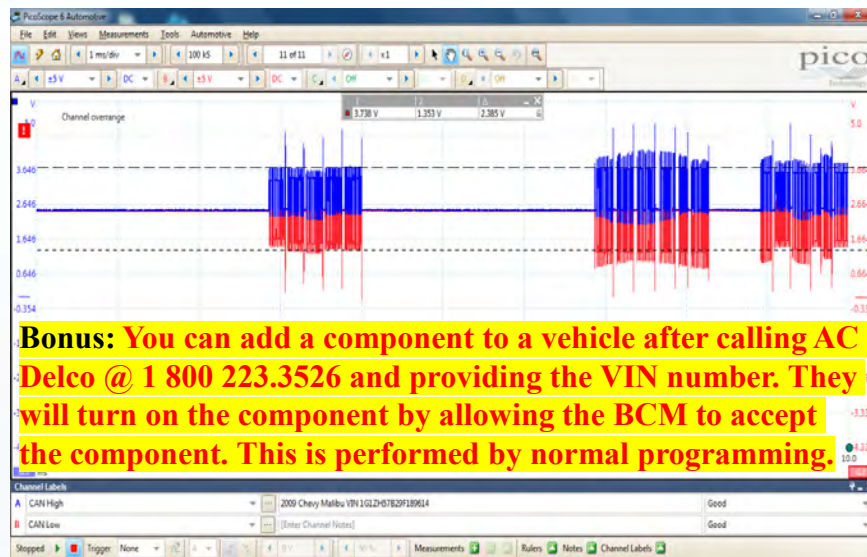
## 2008 Toyota Tundra No Start - No Communication

**Fix:** Repaired the wire and recommend the AIR Pump be replaced since it was pulling too much amperage.



41

## 2009 Chevy Malibu CAN C Good Signal



42



43

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by engineering exclusive, labor-saving  
and cost-effective repair solutions.



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44

44