How to Interpret Data from the Controller Area Network (CAN) Bus

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The CAN protocol is used in many industries including automotive, aerospace, industrial automation, and more. Understanding how to decode data from the bus can be valuable to anyone interested in these fields because it is so widely used. In addition, it can also be useful for mechanics and hobbyists who tinker with their vehicles at home.

 *Caution*	There is always a risk of electric shock or damage to components when working with electronics. It is recommended to have previous electronics and oscilloscope experience before attempting to read data from the CAN bus.

Useful Terms to Know	
Term	Definition
Controller Area Network (CAN)	A vehicle bus standard that allows the various computers and devices to communicate with each other without going through a host computer.
Bus	An electrical connection that is shared by multiple different devices to transmit and receive data.
OBD-II	The On-Board Diagnostic port equipped on all vehicles of model year 1996 and beyond.
Oscilloscope	A tool used to display various electrical signals.
Trigger	The setting in the oscilloscope that marks the start of the signal capture.
Bit	A single piece of data used in electronics, either a ‘1’ or ‘0’.

You Will Need	
	About 30 minutes
	A vehicle with an OBD-II port (1996 and newer)
	A portable oscilloscope with at least 2 channels

1. With the vehicle turned off, locate the OBD-II port. The port is usually located somewhere below the steering wheel as seen in Figure 1.

Figure 1. The OBD-II port location in a 2008 Nissan Altima.

2. Determine which pins are CAN HI (CANH), CAN LO (CANL), and Ground. This may vary, however in most cases pin 6 is CANH and pin 14 is CANL. An example of the pin locations can be seen in Figure 2.

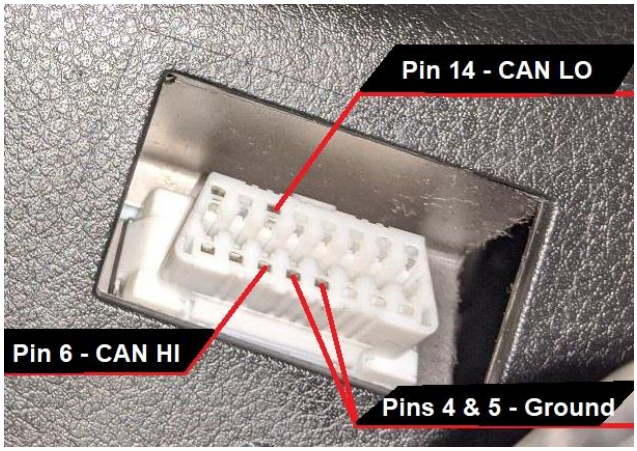

Figure 2. The ground, CAN HI, and CAN LO pins in a 2008 Nissan Altima.

3. Using the oscilloscope, probe the CANH pin on one channel and the CANL pin on another channel. The scope probes can be grounded at one of the ground pins or somewhere on the chassis of the vehicle.

4. Set the CANH probe to trigger on the rising edge and the CANL probe to trigger on the falling edge. Figure 3 illustrates how the pair of signals work together to form the data bus.

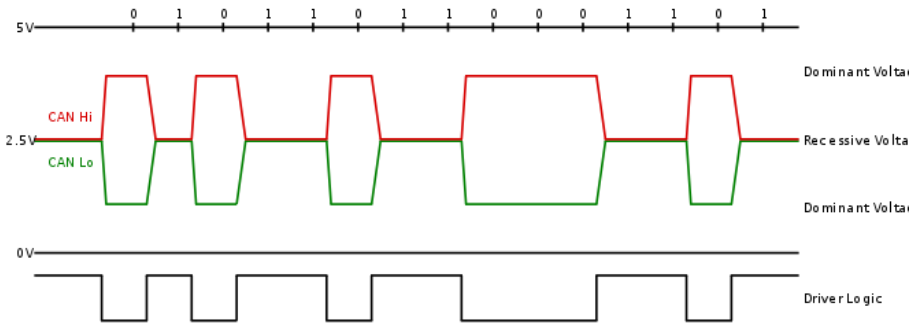

Figure 3. An example of the CAN protocol.

5. Start the vehicle and capture a frame of data from the bus with the oscilloscope. The format of a typical CAN frame can be seen in Figure 4.

Figure 4. The format of a typical CAN frame.

6. Identify the start of frame bit (CANH driven high and CANL driven low,) then determine the frame ID. The frame ID indicates which device sent the message, and it will be either 11 or 29 bits. The start of a CAN frame can be seen in Figure 5.

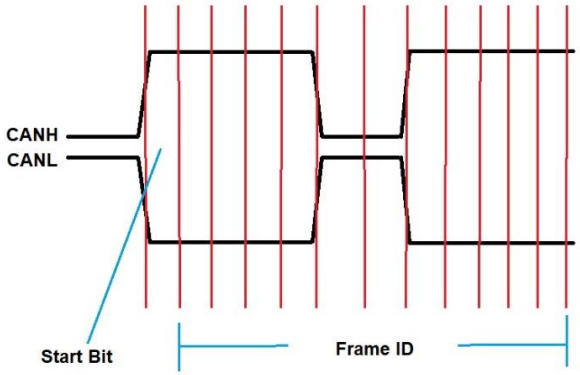

Figure 5. The start of a CAN message and decoding the ID.

7. Determine if the frame is sending or receiving data by locating the Remote Transmission Request (RTR) bit which comes after the frame ID. Note: The IDE and Reserved bits that come after can be ignored.

8. Determine how many bytes of data are in the message by decoding the 4 data length bits.

9. Depending on the data length bits, decode the data included in the message.

10. Locate and decode the 16 bits used for the Cyclic Redundancy Check (CRC.)

11. Identify the 2 acknowledge bits (ACK) and the 7 bits that mark the end of the frame.

Conclusion

Once the 7 end of frame bits are identified, the CAN message has been decoded! The data likely look like gibberish to you; however, it is important to whatever device on the bus is intended to read it.

References

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