AutoTeacher News

Ohm’s Law Busted?

“Is Ohm’s Law busted?” That was the question posed to ATech by an automotive instructor who had downloaded our Virtual SET demo. After building and measuring the demo circuit, he sent an email, “Mr. Ohm must be turning over in his grave with the circuit in your demo. (Ha Ha) The measured resistance value of the lamp does not match the voltage - current values! Is the actual product more accurate?”

We have had many instructors who have asked for assistance with this apparent disparity. At ATech we attempt to build all simulation and demonstration products as realistic as possible. The simulation circuit is modeled from the values that would be measured on the actual General Motor’s SET hardware breadboard system.

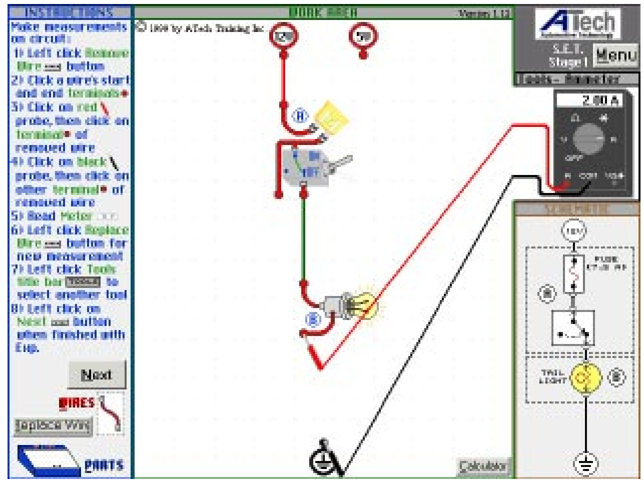


Figure 2

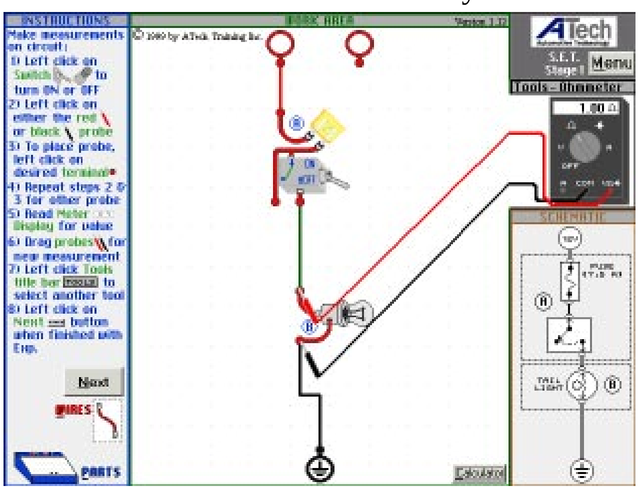


Figure 1

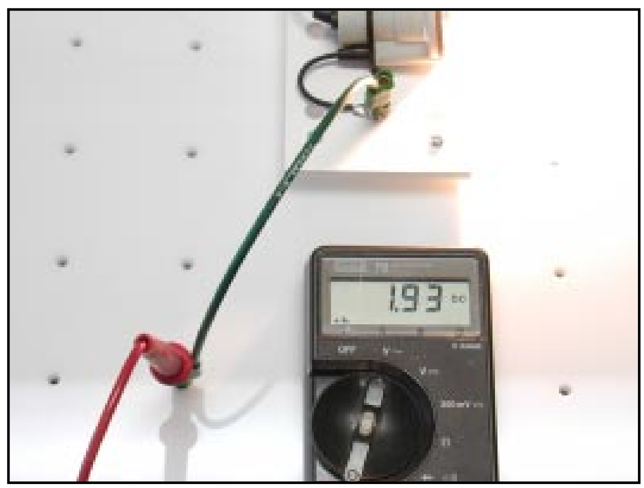


Figure 3

In figure 1, the resistance of the lamp is measured as 1 ohm. When voltage is applied to the circuit and current measured, the current value is 2 amps. The current measurement on the virtual breadboard is shown in figure 2 and on the hardware SET board in figure 3. Using Ohm’s Law, I = E / R, the current value should be 12 volts / 1 ohm = 12 amps. But, the current value measured is only 2 amps. To have 2 amps of current flow with 12 volts applied, the lamp resistance would need to be R= E / I, 12 volts / 2 amps = 6 ohms!

The answer is in the properties of the material that is used for the lamp filament. The filament temperature goes from the ambient temperature when no current is flowing to several hundred degrees when current is flowing. Most material used for lamp filaments has a positive temperature coefficient. This means as its temperature increases, so does its resistance. Conversely, as its temperature decreases, its resistance goes down. If you place an ohmmeter across the lamp immediately after the voltage is removed, you can watch the resistance decrease as the filament cools down.

The graph in figure 4 compares voltage dropped across the lamp to resistance of the lamp. As can be seen on the graph, the relationship is non-linear. This means the resistance does not increase the same amount for a given increase in voltage. In this case, each voltage step is 1 volt. If you continued applying voltage to the lamp, you will find the lamp resistance flattens out. The rate of change becomes smaller and smaller until the lamp filament overheats and destructs.

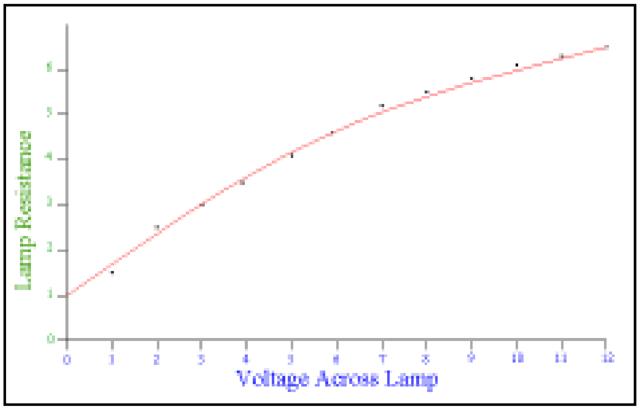


Figure 4

Let's take another lamp used for experiments in the SET program, module c, and investigate its properties. The lamp on module c is a marker light as opposed to module b which is a tail light. Figure 5 shows the resistance measure-

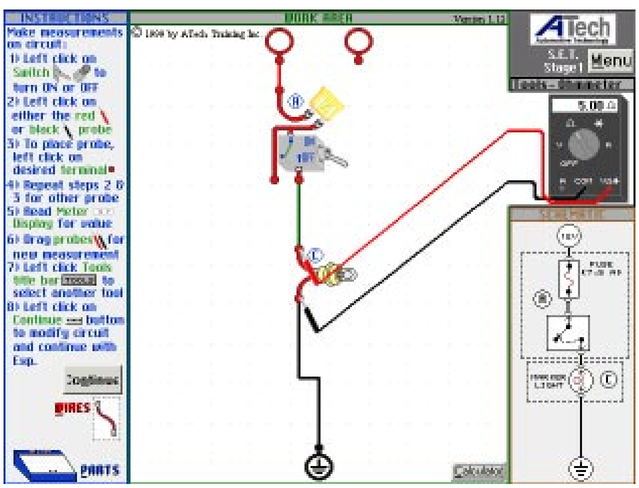


Figure 5

ment of lamp c to be 5 ohms. When 12 volts is applied to the lamp, a current flow of 240 milliamps results as shown in figure 6. The hot resistance of lamp c is R = E / I, 12 volts / .240 amps = 50 ohms. This lamp has a larger resistance change from cold state to hot state than the lamp used on module b.

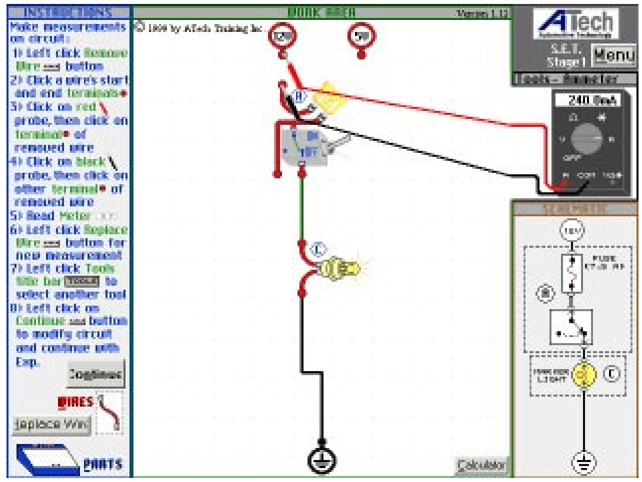


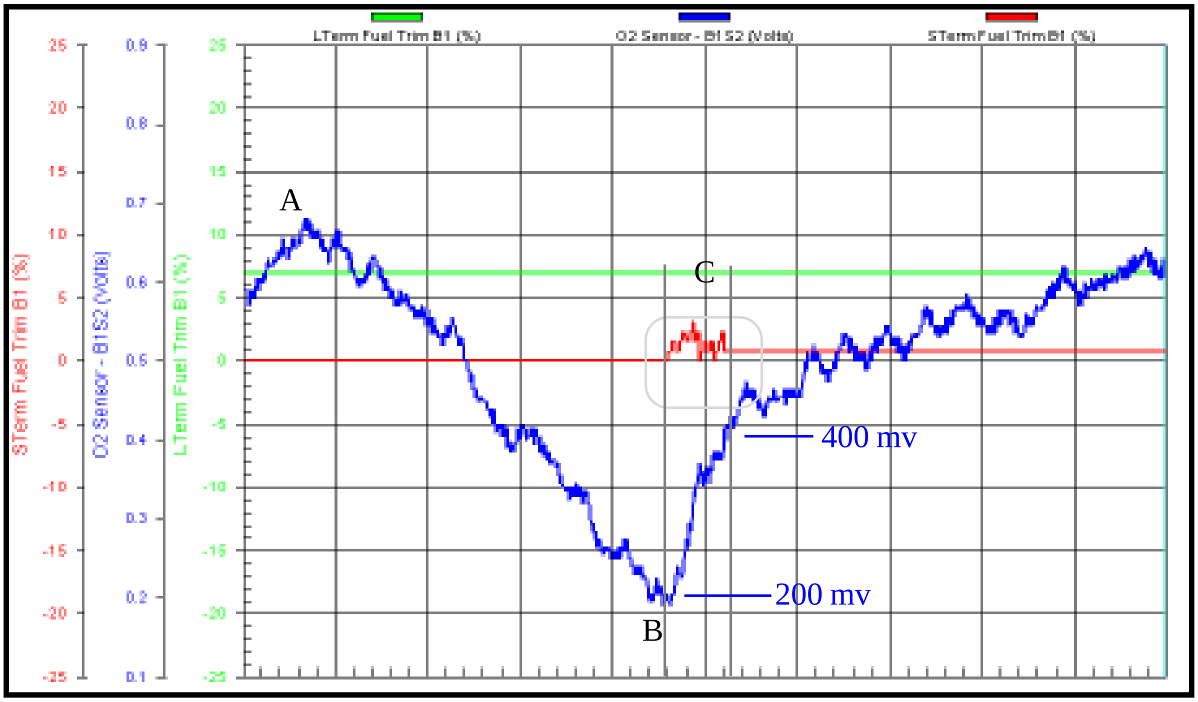
Figure 6

GM OBDII in a Suitcase

GM OBDII Suitcase Trainer

ATech has taken the large floor model GM OBDII trainer and placed it in a locking suitcase. The trainer can still be driven in the service manual specified manner to run all OBDII monitors (Drive Cycle). A locking fault panel is included which contains standard hard faults and OBDII Drive Cycle faults. For example, a slow switching fuel control oxygen sensor fault can be selected which will result in an oxygen sensor fault code when the Drive Cycle is attempted. More info is available at ATech's website.

PCM Control of Cat Convertor Temperature



Waveforms from ATech's General Motors OBDII Demonstrator

Over the years, ATech's involvement with the OEMs has resulted in many interesting and, at times, frustrating experiences. The process of developing system demonstrators using actual vehicle components usually requires that engineers from the OEM get involved. Most projects require knowledge and information that is not readily available to Training Departments. Even with the direct involvement of the system engineers, unusual and interesting things are often discovered. Some examples follow:

During the development of one of ATech's OBDII Engine Control trainers, it was discovered that a major manufacturer scan tool read A/C malfunction codes when the fault was knock sensor related. Could have resulted in some expensive repairs!

Another OBDII trainer cost ATech personnel three weeks effort trying to make the misfire detection work as stated in the service manual. Finally, the software designer who wrote the misfire computer code was located and he readily admitted that it did not work. His actual words were "It is next to impossible to create a misfire code on the system at the present time". The OEM Training Department was not aware of this until the ATech Demonstrator was built.

On an ABS demonstrator, the manufacturer's Training Department was not aware of a difference in deceleration trigger rates between front and rear wheels until it was shown on an ATech system.

ATech's demonstrator/trainers often show system operations that go unnoticed by everyone. The figure above from the GM OBDII suitcase demonstrator is a case in point. From point A to point B the downstream oxygen sensor (cat monitor) moves from the rich area (above .45v) to the lean area (below .45v). This indicates to the PCM that more oxygen is being released by the convertor. The time from A to B is approximately 160 seconds. Considering the time and the level of oxygen output, the PCM "thinks" the convertor may be cooling off. If the convertor is cool, it cannot recombine the oxygen in the exhaust stream with the carbon monoxide and hydrocarbons. At point B the PCM produces an increase in the injector pulse width for approximately 20 seconds. The increase is accomplished by a tweak of the short term fuel trim (C). The increase in fuel acts to raise the temperature of the convertor, which reduces the oxygen output and moves the sensor output back toward the center area. The PCM holds the increase in short term fuel trim until the downstream oxygen sensor's output signal returns to a value indicating correct operation. This PCM strategy occurs so seldom and so quickly that no Training Center instructors had ever witnessed it. Graphs were made by an AutoTap Scantool available from ATech.

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ATech Training is a member of:

Automotive Industry Planning Council

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And actively supports:

Automotive Instructors Needed

Visit ATech's website for details - www.atechtraining.com

Why Don't They ...?

Remember the **third tail light**? How much was highway safety improved by that federal mandate? For about the cost of that tail light, a system can be added to the vehicle that would save hundreds of lives and millions of property damage each year! What is it? A Radio Frequency link, like a garage door opener, that is triggered when an airbag is activated or when the driver activates the vehicle's hazard lights. It would only need a 100 yards effective distance to prevent fog/ blizzard pile ups, emergency vehicle-civilian collisions, train/vehicle collisions, ... You add to the list. Could even have hazard warning levels on the dashboard of approaching vehicles to indicate the severity of what lies ahead, i.e. airbag activation or hazard lights. The next time you're sitting stopped on the highway in a fog or snowstorm, think about it. Wouldn't you feel better knowing the vehicle behind you has some indication you're there? **Hey**, if you use the idea, you gotta give ATech credit.

Pondering Point:

"Can education be substituted for intelligence?"