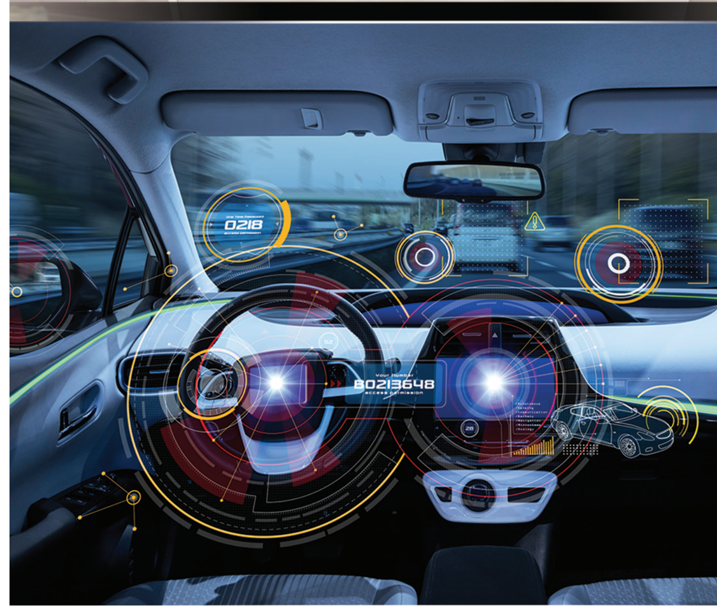

CHAPTER 2
Basically Electrical

What’s an OHM and why do I care

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My Uncle worked in the aerospace and oil industries as an electrician. I remember a time when I was a boy, he explained how a relay circuit worked. I had no clue what he was saying to me as I nodded my head up and down to show him, I understood, which I did not. Fast forward a few years, I really wished I would have asked him more questions about electrical circuits. Early in my career electrical kind of kicked my butt as my approach was simply all wrong. I did struggle with electrical and still do in some cases, but please allow me to explain, doing my best to keep it simple.

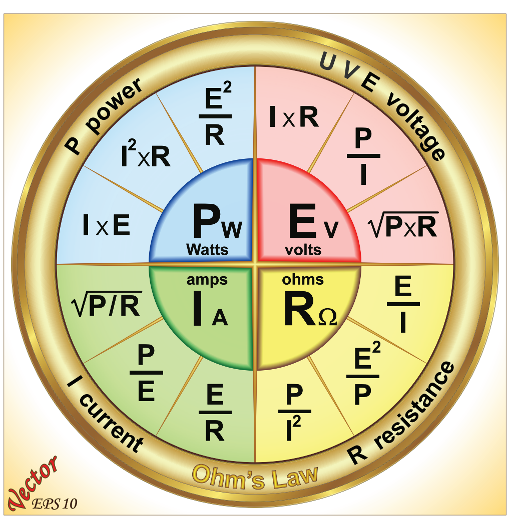
So, what is an ohm and why should I care? Well, I don’t. I don’t recall using ohm law to aid me in the diagnosis of an electrical problem. In fact, I never recalled my uncle explaining this to me either, but I have taught Ohm’s law all the way down to the flow of electrons. Again, who cares? Many of you have been beat to death about this, and some of you may still today be confused about what happens when electrons flow. So, let me explain it a different way.

To start with, I want you to keep this in mind during my explanation:

E = Electromotive Force: “Voltage” is pressure to push amperage.

I = Intensity: “Amperage” is the current flow of electrons.

R = Resistance: “Resistance” is simply resisting current flow.



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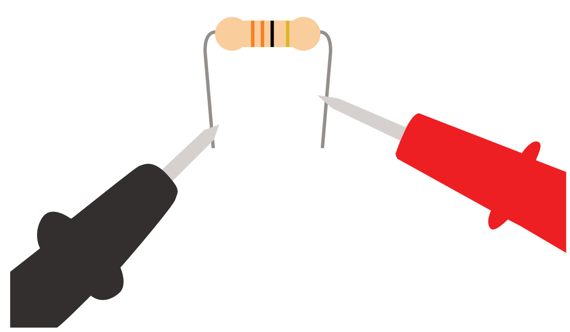

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Imagine it's a beautiful spring day, you're sitting back, relaxing, having a cold one looking at your dirty car, contemplating if you should wash it or not. Your car is parked next to a garden hose and the hose is connected to a water faucet. So, you finish your cold one, grab another, and head over to the hose to wash your car. Now, you pick up the hose, and point it at your car, but nothing comes out. You think to yourself, "Did I pay the water bill?" I am sure you did, and I am also sure there is water to that faucet where the garden hose is connected. Water will flow once you turn the valve on at the faucet and enough water pressure will be there to push that water out of the hose and get your car wet because you did pay your water bill.

Now, think of this scenario as the electrical circuit has an open circuit causing no electron flow. The voltage is present but has nowhere to push the amperage through the circuit just as the water at the hose faucet has pressure, but has nowhere to go because the valve on the faucet is closed. Meaning, as long as you pay your water bill, you will have water under pressure as goes with a good electrical battery, you will have voltage present and ready to flow.

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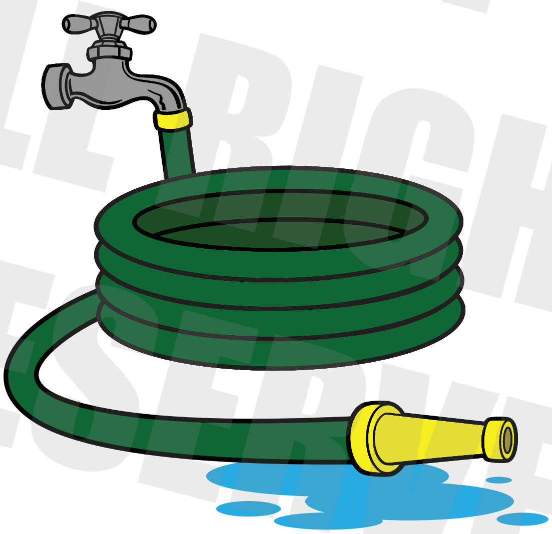

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Now that we open the valve on the water faucet and since pressure is above atmospheric, we now have water flowing and washing your car. Also, true if we close the switch in an electrical circuit current will flow because circuit is now complete.

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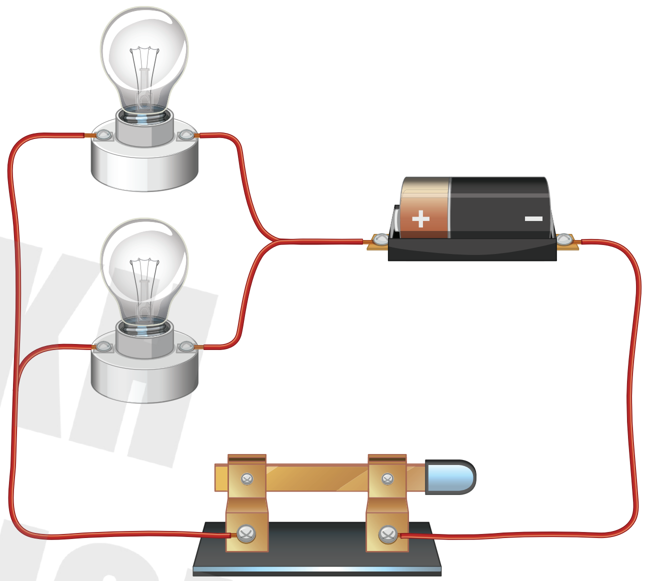

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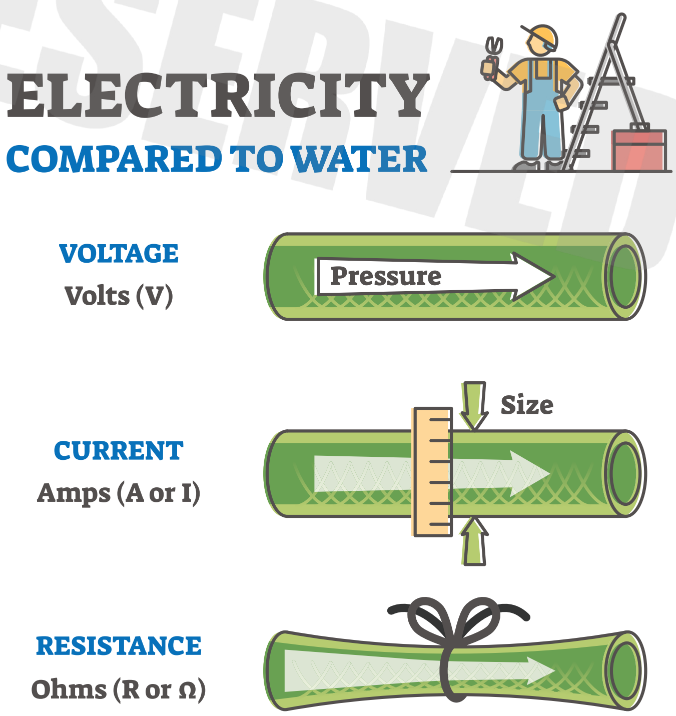
As you are washing your car you will now notice the current flow of water has reduced. As you look at the hose, you notice it is slightly kinked. This is simply a resistance to the flow of water through your garden hose and in most cases an unwanted resistance.



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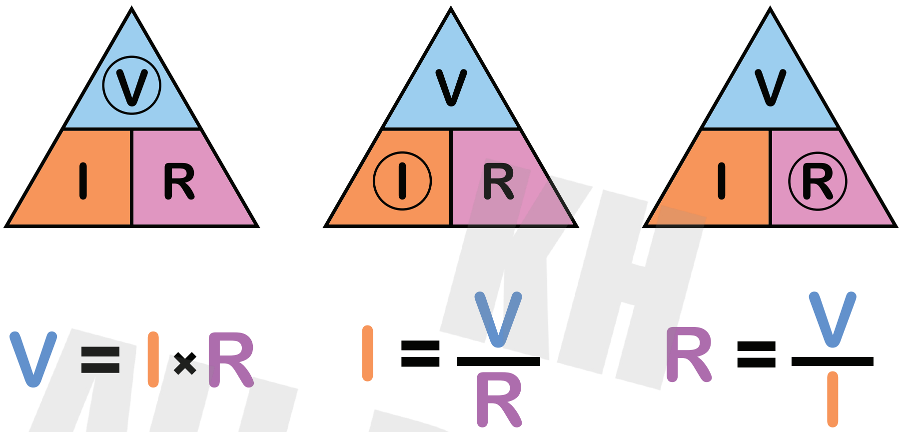
Remove the kink and water goes back to flowing as before. Same in an electrical circuit. If there is an unwanted increase of resistance, the current is reduced. I hate to do this to you, but let me show you.

If we have a twelve-volt 12 v battery and a resistance to current flow in the circuit at 6 ohms, we will have a total of 2 amps flowing through every part of the circuit using the illustration below to calculate the current, 12/6 = 2.



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Let's kink that water hose a bit by adding some unwanted resistance to the electrical circuit. Let's say we have a corroded wire in series in the circuit measuring 6 ohms. If we add the original circuit resistance of 6 ohms to the unwanted resistance of 6 ohms, we now have a total of 12 ohms of resistance in the circuit. Now, using the Ohm's law chart, we would divide the total resistance of 12 ohms into the battery voltage of 12 volts and we would get a total current flow of 1 amp. Also think of this as the kink in the garden hose causing less water flow due to resistance of current flow. So, our circuit went from 2 amps of electron flow to 1 amp of flow because of that unwanted resistance.

Now, check this out…Let's say the original resistance was a light bulb in the circuit with a measured resistance of 6 ohms. Now, we all know what a watt is, as it is a measurement of power or illumination. So, if we take the voltage 12 and multiply it by the circuit amperage 2, we will get 24 watts. Now, with the unwanted resistance added to the circuit we would now take the voltage 12, and multiply it by the circuit amperage 1, we would get 12 watts. Which is brighter? 24 watts.

While driving at night, we have all seen a set of headlights where one is normal, and one is very dim. The dim light more than likely has unwanted resistance in the circuit; somewhere such as the kinked garden hose has less water flow.

So, do I still care what an ohm is? No, I do not, but I do know the importance of resistance in an electrical circuit, especially the unwanted kind.

Pressure is present all the way to the open

I want you to say to yourself "voltage is present all the way to the open" three times, so your brain will not forget this very important statement. In fact, remembering this will not only help you diagnose electrical faults, but it will also certainly help you when taking an exam. As long as you pay your water bill, water will also flow from a faucet when turned on, as I previously stated. In our case, as long as the vehicle has a good, charged battery, voltage is always present. Well, until it's not. Once again, the voltage is the pressure that pushes those little **electron dudes** we call amperage through the evil dude we call resistance. So, let's take a look at this…

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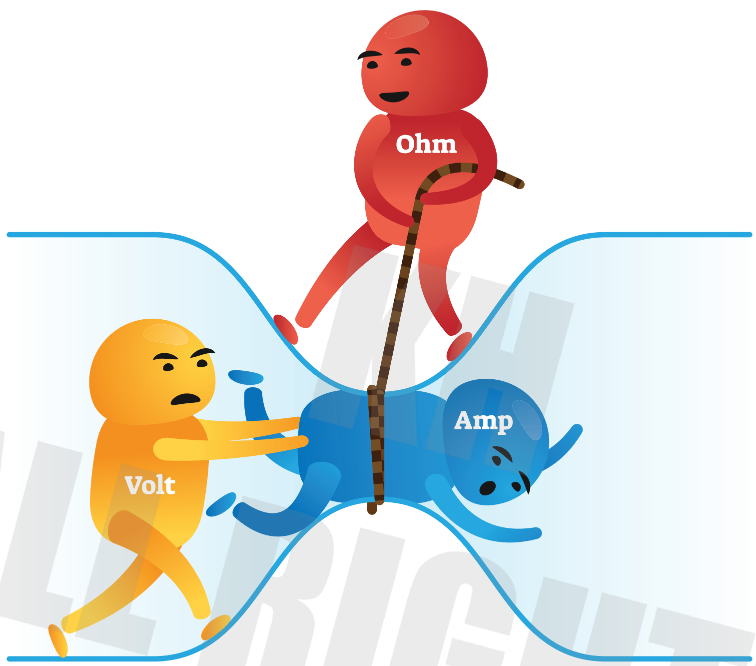
OHM'S LAW



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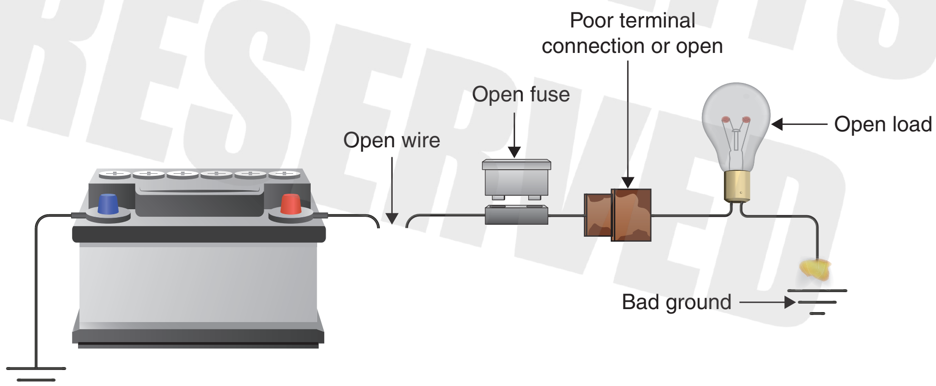

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The above illustration shows various locations of an open circuit. I do want to point out that this is an easy representation in a two-dimensional form, and I know when looking at a vehicles circuit is much different than a three-dimensional representation, the vehicle. More on that later, but for now, let's look at this sucker above.

The first open in this circuit is between the battery positive terminal and the circuit protection we all call a fuse. If you put a test light or a voltmeter both in parallel to this circuit on the battery side before the open, the test light will illuminate, or the voltmeter will show battery voltage. However, if you put the tester after the open before the fuse, you would not see voltage, nor would the test light illuminate. Just like if you paid your water bill but the faucet is turned off. The water is there just like the voltage is always present in the open. Looking at the poor terminal connection/open and pretend all the opens in this illustration do not exist, you will find voltage on the battery side of the terminal and not on the ground side of the terminal connection. Again, voltage is always present to the open and since we have an open circuit, there is no way current can flow just like if your water faucet at home is turned off.

I'd say it's time to trash another question because it's just fun. So, here we go…

A vehicle owner brings their vehicle into your shop with a complaint that neither headlight is working. Technician A checks the fuse in the headlight circuit and then tests the circuit for shorts. Technician B checks the fuse in the headlight circuit and then tests the operation of the headlight switch. Which technician is correct?

I just love this question because, for lack of better words, it truly punches the hole in a donut. However, I really hate to see this type of question because it has too much information. Allow me to simply break this question down. Customer complains none of the headlights work. As soon as you read that part of the question you should automatically know there is no current flow, probably due to an open in the circuit somewhere. Now, both Tech A and Tech B both state to check the fuse first before doing anything else. Going back to the two-dimensional illustration of open circuits and now think of a three-dimensional vehicle, where do you believe is the most accessible location to test for an open circuit on a vehicle. If you thought the fuse, you would be correct. Imagine the time you could waste checking for an open in the circuit between the battery and the fuse? I'm not saying that's where the open is as I am saying, what a pain in the butt that could be. So, continuing the breakdown of this question, wouldn't you think at this point both Tech A and Tech B are both correct by stating to check the fuse first? I certainly would because in most cases this would be the easiest work to do. After both tech's have stated to check the fuse first, whatever they may state after is completely hogwash or designed to make your mind wonder. Lights don't work…open circuit…check fuse for an open…and that's it on this question, because both techs' are correct about checking the fuse and leave it at that and move on. However, I must bash on Tech B because wouldn't all of us verify the vehicle owner knows how to turn the lights on first? Trust me, I would.

Did they just short me?

How many times have you heard "you must have a short" in a conversation about an electrical fault? In my many years in automotive I have found this is the answer for everyone. Electrical shorts do indeed exist, but what are they? Well, it's a shorten pathway in a circuit for electrons to flow. Meaning, the electrons found a fork in the road and these little dudes will absolutely find the shortest and least resistance path in that fork because they are lazy. Now, electrons flow from the negative to the positive. Wait!!! I know what I just did there and I am here to tell you we do not care which way these little dudes flow because we technicians for whatever reason think positive to negative and we will leave it at that. Now, we all know fuses blow because they are designed to protect the wiring of a circuit from overheating and possible starting an electrical fire. So, back to an open circuit. A fuse opens the circuit when more amperage is flowing through that circuit higher than the fuse is rated at. You find the fuse has indeed created an open in the circuit, so you replace the fuse, but the fuse immediately blows again once the current is allowed to flow again. This is caused by a short somewhere in the circuit causing less resistance in the circuit causing an increase in current flow. Now, we have absolute geniuses in our motoring public, and they are generally Volkswagen Bug owners. These vehicle owners are known to replace blown fuses with a higher rated fuse or at the very least use a silver gum wrapper in place of a fuse. I must say it is one heck of a site to see a VW bug with a magnesium engine on the side of the freeway burning down. A very colorful site. Some of you just laughed out loud because you know exactly what I mean. For you younger pups, **DO NOT** install a fuse higher rated than the vehicles manufacture rating and **DO NOT** install a high current rated circuit breaker and look for the smoke.

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Now, let's look at different type of shorts…

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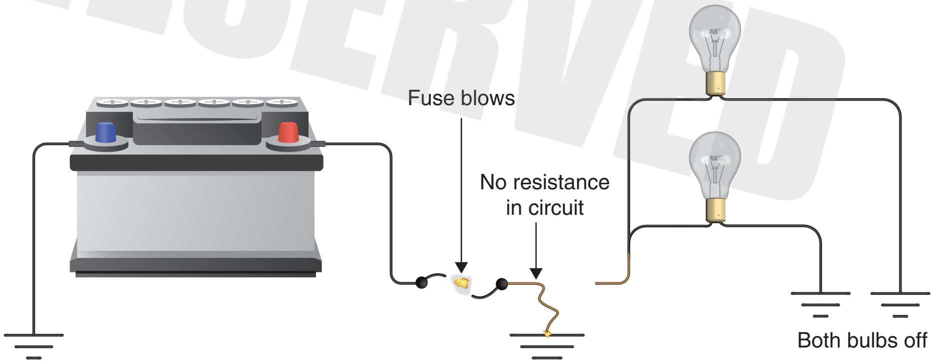

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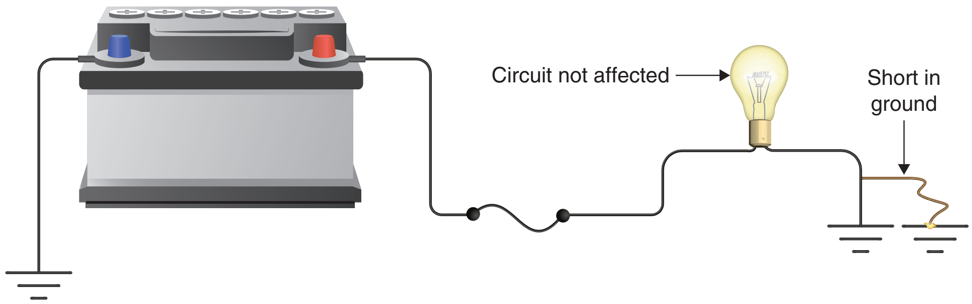
The illustration above shows a shorten pathway directly to ground. This type of short will immediately blow the fuse. In fact, if this short was after the battery and before the fuse or circuit protector, it could be one heck of a ride, to say the least. That type of short can cause a battery to explode in some cases, such as the positive battery cable shorting to an exhaust manifold before the starter motor.



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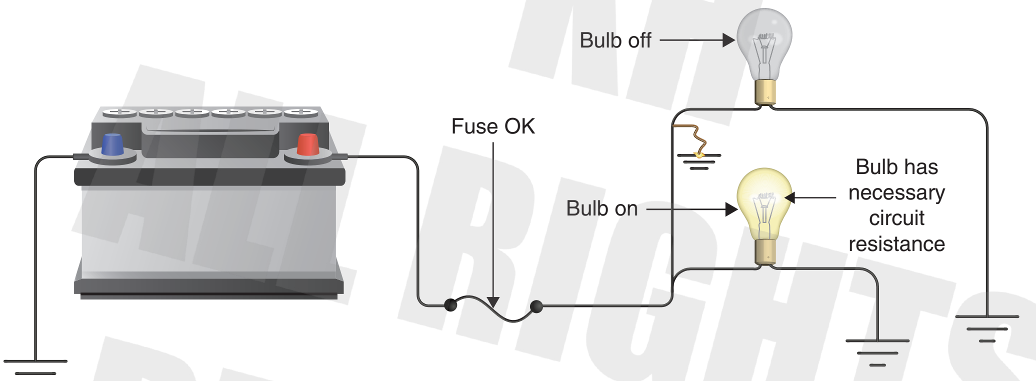
The illustration above just simply shows a shorter pathway to ground and generally the vehicle owner would not know there is a problem because a ground is a ground as the circuit remains complete.



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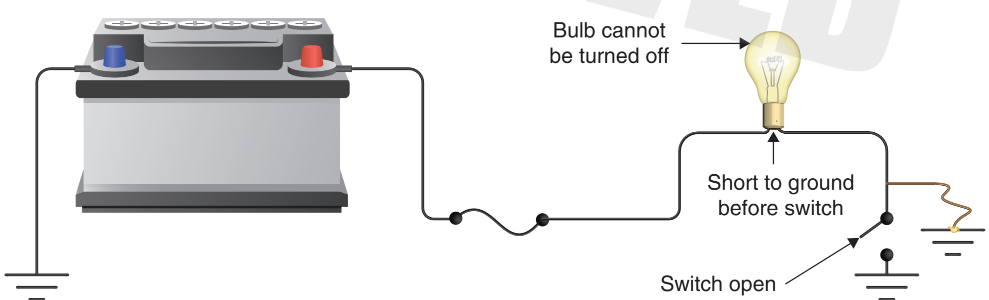
Now, this illustration above does show a shorten pathway to ground, but now the vehicle owner will certainly know there is a problem with their vehicle since the Police Officer just explained why they pulled them over. Heck, the Cop may have seen them coming a mile away thinking it was a motorcycle driving at night.



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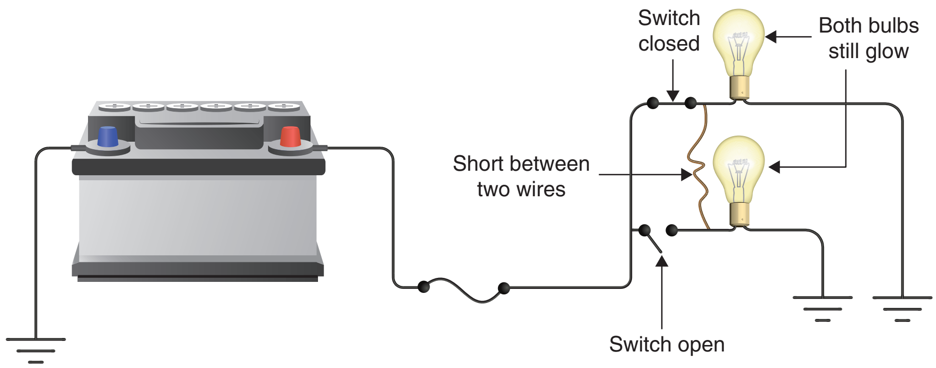
Have you ever seen a vehicle where one light is always illuminated? Well, the illustration above shows a shorter pathway to ground before the switch causing that circuit to always be complete and functioning. In fact, a vehicle owner probably has to jump start their vehicle every morning.



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This above illustration I like to call a short to power. Such as when you turn your headlights on, and the windshield wipers also turn on. These two loads (light bulbs) are in parallel, and both have their own switch, but somehow this circuit did get its wires crossed up, causing both loads to function when only the load on the bottom should be functioning.

ASE style question time because once again, it's just pure fun!

Technician A says a short circuit can be caused by a conductor touching ground. Technician B says a short circuit can be caused by a conductor touching another conductor. Which technician is correct?

See how the question used "conductor" instead of using wire in a circuit. The reason for using conductor is to be objective or neutral, for all that read this question can comprehend it easily, or this exam writer works for the Railroad. A conductor is simply a material that has very low resistance for electrons to flow easily through, such as a wire. Also, the writer seems a bit lazy to me in the question because using a conductor is easier than explaining a chaffed wire. So, Tech A is not very specific because, at some point in an electrical circuit a conductor/wire touches a ground to complete a circuit and for that circuit to function? We will get back to Tech A in a second. Tech B is simply stating that if two conductors or let's say, two chaffed wires touch, it becomes a short. Well, Tech B is correct, I suppose because this type of short can and will happen. Now, back to Tech A. Since the writer of this question used "can be caused" in both Tech A and B statements, we must now think it can happen. Again, the question is missing specific information, but I think and believe we can all simply go with the flow on this one. No pun intended, of course. So, both Tech A and B are correct because "***can be caused***" is stated, and we will keep this sweet and simple, at least in our minds.

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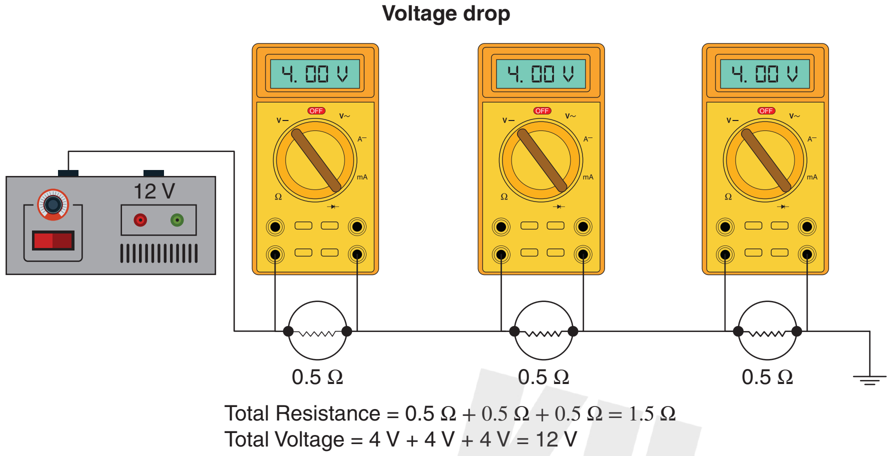
Voltage Drop? Drop this!!!

What exactly is a voltage drop? Well, since voltage is the pressure to push electrons through a conductor, or shall I say, current to flow through an electrical circuit, once in a while, that current smacks into some resistance which we will call a load. A load could be anything that resists current flow, and when that happens, we will drop some or all of the applied voltage. When testing for voltage drops with a voltmeter, you are pretty much seeking for the resistance in the circuit you are testing. A vehicle's Powertrain Control Module (PCM) pretty much does the same thing. Granted, a computer has no idea what a Volt is, but we do as technicians. We always test for voltage with our meters in parallel to the circuit we are testing. A PCM does the same. More on this later, because for now, let's get a really good concept of a voltage drop. Now, applied voltage is what our battery puts out and applies the voltage to a load. Since I am certainly not a math major, we are going to keep this simple and refer to a 12-volt battery as 12 volts.



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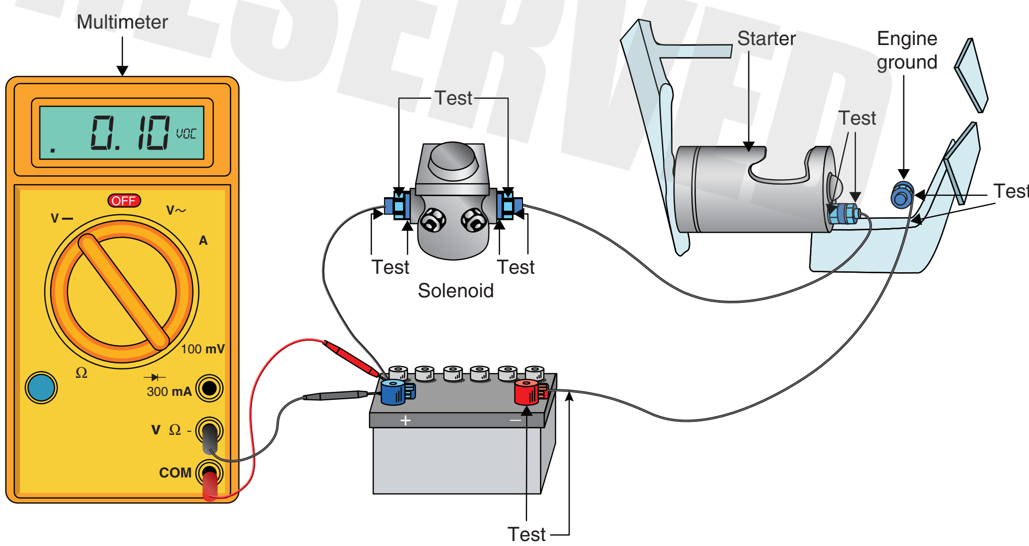
The illustration above clearly shows voltage dropping when it encounters a load. Notice that meters are connected in parallel to the resistance. This shows three loads in series and each load has the resistance to current at half an ohm each for a total of 1.5 ohms of total circuit resistance. We always add the resistance of each load together for the total resistance in a series circuit. When we start with the applied voltage from the battery at 12 volts, we must end with zero volts on the ground side after all the loads in the circuit. Looking at each voltmeter we can see each load drops 4 volts. Three meters times three loads dropping 4 volts each equals 12 volts. So, we used up all the voltage. Now, to get creative just for fun, what would the total current in amps be? We have 12 volts and a total circuit resistance of 1.5 ohms. Well, using Ohm's law, we would divide the total resistance into the voltage to equal 8 amps. So, there is a total of 8 amps everywhere in this circuit, on the positive and on the ground side. Now, check this out…looking at the first meter from the battery as it shows 4 volts, and we know the total current of the circuit is 8 amps, what is .5 ohms times 8 amps? You guessed it…4 volts! Let's move on and take a look at a more practical voltage drop test.



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The illustration above shows a two-dimensional view trying to represent a three-dimensional representation of an actual vehicle showing voltage drop testing. So, pretend for a moment you are performing this test on a vehicle or actually go outside and do it. This test looks for unwanted resistance

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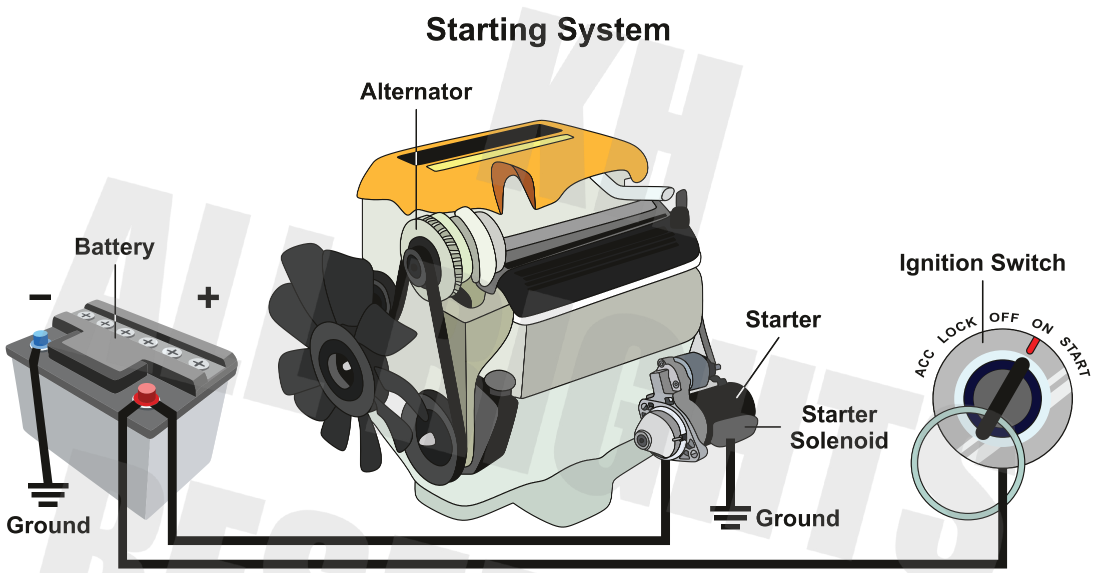
by connecting the positive lead of your voltmeter to the positive battery terminal and the negative lead to the battery cable connector. The meter shows a tenth of a volt drop, which is fine for this application. I would rather see no voltage dropping here, but that's just me. If this was a computer circuit on the ground side, for example, this would be bad, very bad. Computer circuits have high resistance and very low current, and why would that example be bad. This illustration shows all the test points for a low resistance high current circuit. The vehicle owner or you may find a starter motor issue and checking for voltage drops is a great way to figure out the problem. So, the voltmeter did in fact find a little bit of resistance. Maybe if the vehicle owner would maintain their vehicle as we all tell them to do, the meter may just read zero. Clean your battery terminals occasionally and maybe you will not have a starting problem!



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Let's move on to dissecting another exam question.

A customer complains that both brake lights do not function on their vehicle. It has been found the battery has 12 volts and the circuit fuse is good. A voltage drop test across the brake switch while the brake pedal is depressed shows 12 volts. Technician A says the brake switch is functioning as designed. Technician B says there must be an open in the circuit past the brake switch. Which Technician is correct?

Once again we will look at this type of question as true or false for each technician. Tech A says the switch is good since we dropped all the voltage across the brake switch. Tech A is false in their statement and will have to find another line of work since there is something terribly wrong with the brake switch. Remember, voltage drops when it encounters resistance in a complete circuit, and last I looked, switches should have very little to no resistance at all. As for Tech B, I'm not sure what this tech is thinking. If we lose all the voltage at the switch since the switch has become the load in the circuit, how can there be an open in the circuit since there is a pathway to ground that allows voltage to drop. Meter would read zero volts since there is an open to the pathway to ground as Tech B stated. Voltage does not drop if the circuit is not complete; voltage is simply present in the open. Tech B is out of here!

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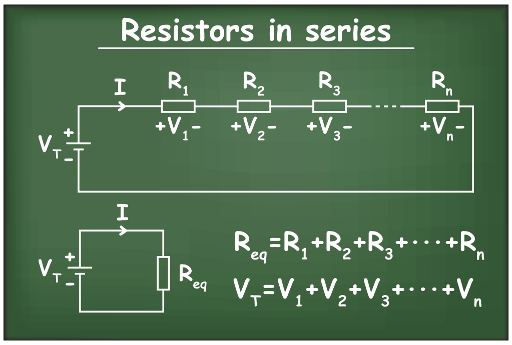
I have a math headache



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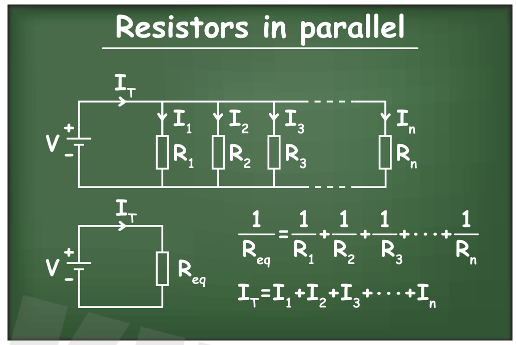

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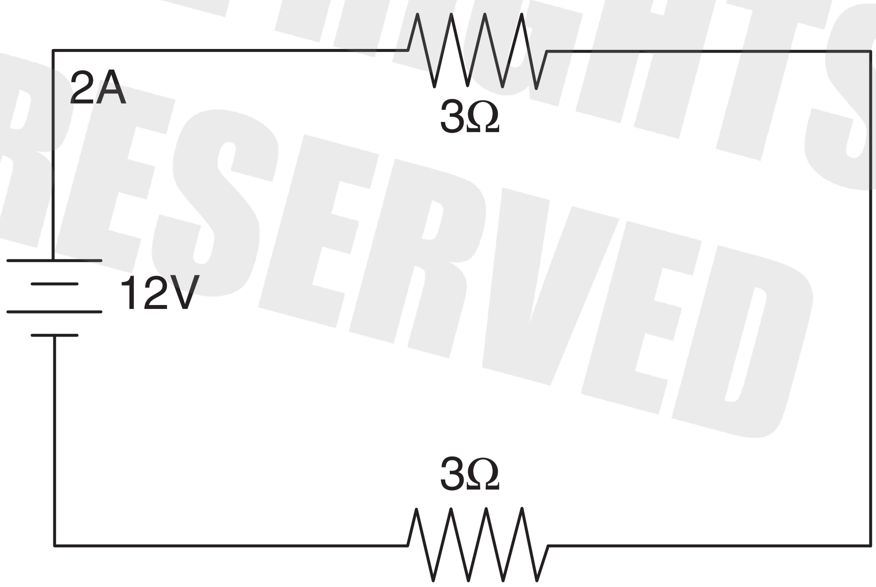
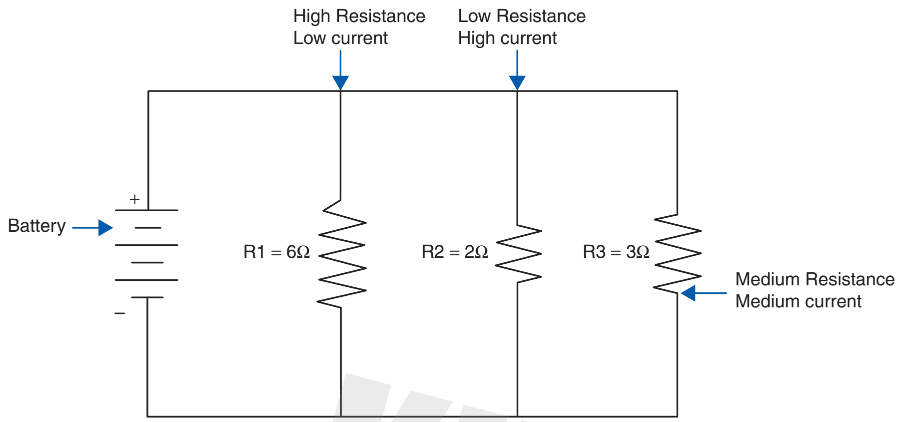
Do you see what I did here with the above math equations? Many of you have seen this before and many of you know how to use it, but did you ever need it while taking an exam? I can say I have never needed to know this above equation to take an exam except once during Honda Factory training as a PACT instructor. I can say I used this equation to see how many ceiling fans I can install in my house on a 20-amp circuit. There is nothing wrong knowing how to use this at all. Knowing how to use this equation will help you figure out the total resistance in a series circuit, parallel circuit, and how to figure the total resistance in a series-parallel circuit. There is a simple way to look at this and allow me to explain.



Source: Dorothy Anderson

The above illustration shows a series circuit. Since the loads in the circuit are one after the other, you would simply add all the loads together to find the total resistance. Each load is 3 ohms and since there are only two loads, we would add them together for a total resistance of 6 ohms or known as resistance total (R_T). Knowing the total circuit resistance, we can now figure out the circuit current by dividing the R_T into the voltage of 12 volts giving us 2 amps throughout the circuit. We can even connect our ammeter is series to this circuit showing us 2 amps and we can divide the amperage into the voltage that would show us R_T would equal 6 ohms. As we add more loads into a series circuit, the higher the resistance will become in the circuit and the lower the current flow becomes.



Source: Dorothy Anderson

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Looking at this illustration above shows us a parallel circuit. Since each of the loads have their own pathway for current to flow, unlike a series circuit, we cannot add the loads together for the Rt. Please note that this circuit has a 15-amp fuse (not shown). Looking at the first load that is High Resistance, we will call it resister 1 (R1) and its measured resistance is 6 ohms. The second load is Low Resistance and measured at 2 ohms (R2). The third load as Medium Resistance is measured at 3 ohms (R3). Now, if we divide each load into voltage (12v) we can figure out the total current of the circuit.

R1 of 6 ohms divided into 12 volts equals 2 amps.

R2 of 2 ohms divided into 12 volts equals 6 amps.

R3 of 3 ohms divided into 12 volts equals 4 amps.

This shows the current in amperage through each pathway; current will flow through each load. If we add each path together, 2amps+6amps+4amps would equal 12 amps. Now, to figure out the Rt in this circuit, take the total circuit amperage of 12 amps and divide into the 12 volts. This would equal 1 ohm. This proves that the more you add a pathway for a circuit to flow, the lower the Rt in the circuit becomes. I'll prove it by adding an additional path for current to flow and we will call it R4. R4 has a measured resistance of 1 ohm. Taking R4 of 1 ohm and dividing it into 12 volts gives us 12 amps flowing through load number 4. Now, let's add the current flow of 12 amps from R4 load to the circuit total of 12 amps. This will give us a total circuit current of 24 amps. If we divide 24 amps into the circuit voltage of 12, this will give us an Rt equaling .5 ohms. What do you all think happened to that 15-amp fuse in the circuit? If you answered, "letting the smoke out of the fuse", you are correct. As resistance/loads are added in parallel into a circuit, the total circuit resistance (Rt) will go down. Therefore, our modern volt meters have a resistance of 10 million ohms, because we connect our meters in parallel when checking for the presence of voltage, and please, keep basic test lights away from computer circuits since they have a very low resistance to current flow.

Now, let's take a look at a series-parallel circuit. I am going to take a break at this point and hand this over to the very lovely and beautiful Professor Dorothy "Mrs. D" Anderson. Mrs. D, please if you will…

The Offspring of a Parallel and Series Circuit by Dorothy Anderson…

Yep, you heard the title right, series – parallel circuits are basically a combination of the two circuits you have already become so very fond of.

Highlights of the series circuit.

- Rt is determined by adding all resistors together. Since they are all in series, each having a direct effect on the other. If one blows, nothing will work.
- Current is constant.

- As resistance increase, current decreases.
- Low voltage will affect current readings/output

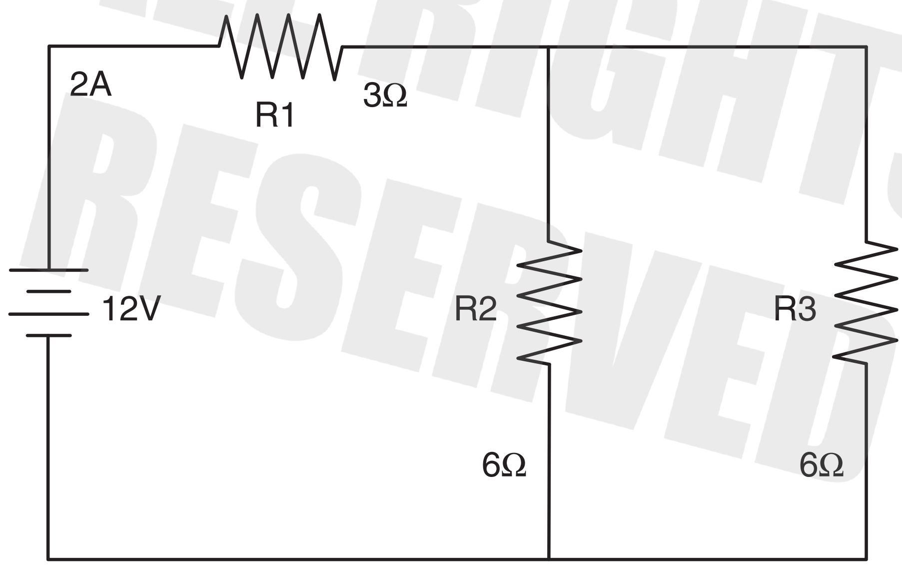
Highlights to the beloved parallel circuits

- Current is constant for each leg
- Current is divvied up between the legs
- Low voltage will affect current readings/outputs
- As resistance increase, current decreases.
- Rt is determined one of three common ways
  - Find the current of each leg, by dividing R and E
  - Simplify. If there are three legs to the parallel circuit, and each leg was 3Ω, ask yourself, “self, how many times does 3 go into 3?” Of course, yourself would answer “well, that would be once.” Rt = 1Ω

$$R_T = \frac{R_1 \times R_2}{R_1 + R_2}$$

  - Finally, the beloved reciprocal method

Now that we are all on the same page, let me introduce you to the topic at hand. When calculating values of a series – parallel circuit, you must use a combination of both series and parallel calculations. However, you must eat the veggies first and complete the parallel portion prior to the series.



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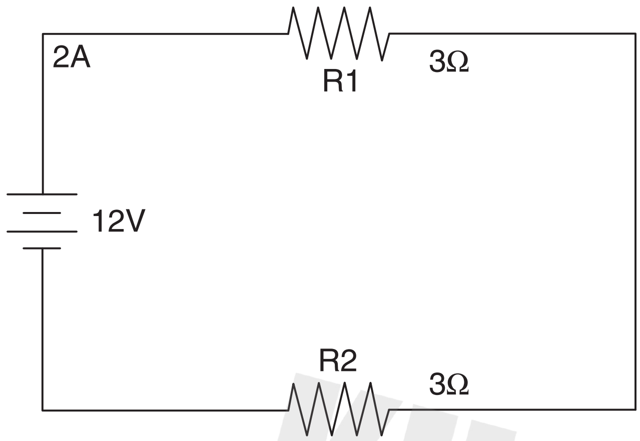
Just look at the problem first, and ask your better self, “self, what do I know?” Well, you know, the Et is 12V, you know, amperage total (I_T 2A. What you do not know, and what you need to know is the Rt of the parallel portion of this circuit. Without that, there is no determining the Rt of the total circuit. Yes, I completely understand that you can determine the Rt by calculating Amps into Volts, but this book is not about how to solve a math problem, it is about how to answer questions about diagnosis of math problems... I mean electrical problems.

Recall our parallel circuits highlights, the simplify method? There are two legs of this circuit that are 6Ω each. How many times does 2 (two legs) go into 6(Ω)? If your calculator says 3, you are correct. Rt of the parallel portion is 3Ω. Right! Mind blown. Our new circuit looks like this



Now we have found our safe space, a simple series circuit, remembering our highlights, ask yourself, "self, what do we know?" You know

- Et = 12V
- It = 2A
- Rt = 6Ω

Granted, this type of circuit is not commonly found in certain systems due to the nature of the beast. For example, take the original series – parallel circuit; all resistors were light bulbs, and R1 blew out, would any of the lights in the parallel portion work? You must keep this in mind when answering questions that want to know the values of a circuit; you verify all portions of the series – parallel circuit are functioning as designed.

Thank you, Dorothy, for that mess as you are aspirin to my headache. Now, you may see a question regarding this math headache in a form like this:

A vehicle owner complains while driving at night their vehicles headlights go dim when accelerating and the engine runs poorly. Vehicle is fine during the day. What is the most likely cause?

A. Vehicle owner is using wrong octane fuel causing fuel pump issues.
B. Vehicle owner installed an 8-track sound system in parallel to the headlight circuit.
C. The chassis ground has a short to ground in parallel.
D. The engine ground has unwanted resistance in series.

Once again, we can find the two wrong answers first. Answer A is wrong because Octane Rating has nothing to do with chassis electrical. Answer B is wrong because this very old dude installed an 8-track cassette player in parallel, which would cause more current, not less. Answer C is the distractor, or the trick answer, and it does not matter if the ground is shorted to a ground, since a ground, is a ground. Some may fall for answer B, too. D could possibly and "most likely" cause this issue since a load has been added in series reducing the amount of current flow. This could most likely cause lights to go dim and an engine to run poorly. So, knowing Ohm's law or at least knowing how electrical circuits work is very helpful for us when taking exams and diagnosing electrical problems. We certainly do not have to use math or the Ohm's law equation to do so, but it does help us understand.

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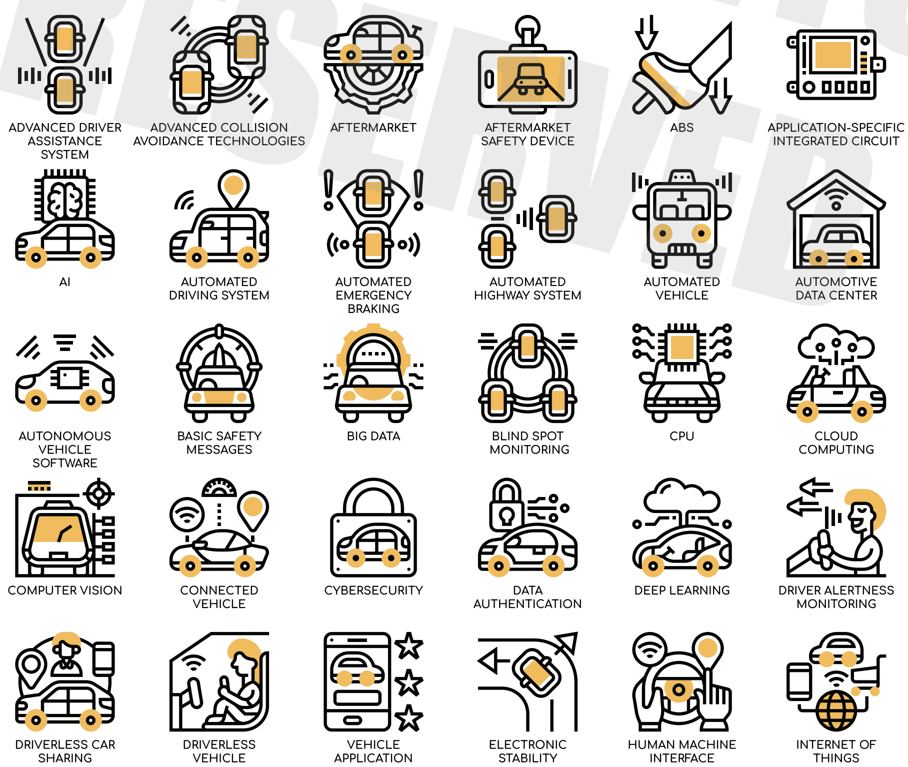
Don't you give me feedback or else

A few years ago, my grandfather gave me a magazine he thought might interest me. It turned out he gave me the very first issue of Discover magazine, dated October 1980. There is an article in this first issue titled "Detroit's Brainy" by Natalie Angier. The article explains how vehicle manufacturers will start using computers on vehicles to reduce tailpipe emissions and improve fuel economy. Vehicles have had computers on them before this article was written for a variety of reasons, but now, Detroit will use computers to control the amount of fuel delivery to the combustion process based on the amount of air the engine will pump. And, of course, they will do this electronically with various computer input sensors and computer output actuators.

General Motors came up with the CCC system, Computer Command Control. Vehicle manufacturers were under pressure to reduce emissions and one way was installing a catalytic converter in the mid 1970's, but the converter did not function to its full potential and could easily overheat if a vehicle ran too rich, as this could cause fires, and did in fact do that, especially in the dry areas of Southern California. So, a feedback system like GM's CCC could swing fuel mixtures lean to rich and rich to lean by using various sensor inputs. This would cause a higher oxygen content in the exhaust stream when running lean-oxidizing Hydrocarbons (HC) and Carbon Monoxide (CO) and store oxygen in the converter to help oxidize these bad gases on the rich side by releasing oxygen. This all seemed to work just fine until it didn't. That's where we come in.

The Electronic Control Unit (ECU) that we now call the Powertrain Control Module (PCM) was designed to catch various engine operations via inputs, take those inputs, and then make an output to, let's say, the mixture control solenoid on a carburetor. Inputs would include engine revolutions per minute (RPM), engine loads such as the Manifold Absolute Pressure (MAP), position of the throttle (TPS), engine coolant and air intake temperature, (ECT)(IAT), barometric pressure (BARO), and exhaust oxygen content sensor (O_2S). One of the best things manufacturers did was install an Assembly Line Data Link (ALDL) for them to check if the vehicle had any feedback issues or problems before the vehicle was sent to dealers to be sold. We as technicians could access the ALDL when there was something wrong with the feedback system if the manufacturers gave us their data. This was actually the birth of On-Board Diagnostics (OBD). GM was pretty cool about it and pretty simple to access. Ford and



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Toyota required an analog meter and counted the swings of the meter for codes. Honda gave us a light at their ECU, we could count. Nissan required the entire disassembly of the vehicle to access their ECU so we can count the many lights in the many different positions. Again, GM was pretty cool about it, but not so much with other manufacturers.

The illustration above shows the many computers controlling various items on the modern-day vehicle. We have come a long way since the first feedback control modules of yesteryear. For now, though, let's move forward on the importance of this guide. Oh, I must make a statement. I no longer want to hear the term OBD Zero (OBD0) from you young people. You know who you are. You are the ones that takes a perfectly fine On-Board Diagnostics Generation Two (OBDII) vehicle and drops in an older engine and makes it OBDI. When you use the term OBD0 to an old guy like me, I can only think you actually did install non-feedback carburetor engine in your vehicle such as this wreck below. It is important that we technicians stay on the same page.

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