QRP-ARCI QRP Quarterly Beginner's Column "QRV?"

January, 2000

Ever since I started the North Georgia QRP Club website (http://www.qsl.net/~nogaqrp), Jim Stafford, W4QO, has been bugging me to write a column for "beginners." Personally, I hope I always consider myself a "beginner." I think that one of the greatest things about amateur radio is that there's always something new to learn.

Now, I might as well start off by letting you know that I'm a Yellow Jacket—GA Tech Class of '82 (BSICS). I must also admit that I learned absolutely *nothing* of value to amateur radio while I was at Tech. In fact, I nearly slept through EM Physics (you know, point charges in space, isotropic dipoles and stuff like that) my sophmore year—something I very much regretted the day I took my first (of a couple) Advanced Class license exam.

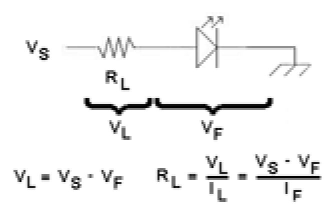
Fast forward 20 years. Man, have I found myself struggling to catch up sometimes! Good thing I have some very patient Elmers! But time and again, I have found it most rewarding when sitting in my shack, partially completed circuit in hand, it suddenly dawns on me about how a particular theory works. I'm one of those folks that learns as much with my hands as with my eyes.

Above all else, the thing I love most about amateur radio is being able to build your own stuff. I imagine that's what attracts us most of us to QRP. QRP's great because it is well within the abilities of the average ham to "home brew" reasonably well performing equipment at QRP levels. It's important, though, to understand your own abilities, and to remember that skill grows with practice. So, let's get ready! Time to QRV!

This Issue's Project

With publication deadlines and such, this issue's column is being written around the time of the Tuna Tin 2 Black Cat event (Halloween). My 11-year old daughter found the mask in this photo for dear old Dad to wear as he escorted her for trick-or-treating in the neighborhood.

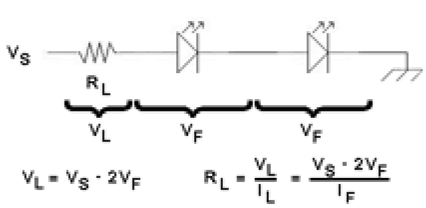
Not one to leave things well enough alone, I decided that it would be really fun to put some super-bright LED's inside the mask to make it look really eerie. Sounds like a great application for Ohm's Law!



Here's how it goes. The radioshack.com catalog shows a circuit similar to this one and then shows some typical values for the *series limiting resistor*, R_L. Problem is, I wanted to use 6 LED's—how do I wire them up and what value of limiting resistor do I use?

The basic application of Ohm's Law says, **E = I * R**, or put another way, a certain amount of current (**I**) will flow through a resistor (**R**) and the source voltage will drop by a certain amount (**E**).

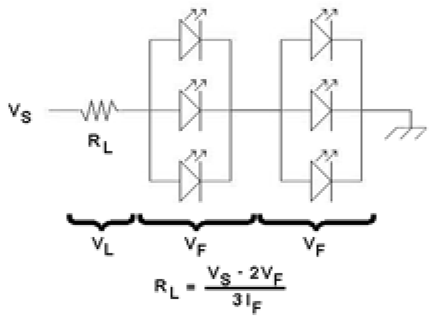
According to the catalog, the Super-Bright LED (900-6114) that I chose requires 2.1V at 20mA (milliamperes) to operate. Let's say I've got a 12V gel cell I want to use to light the LED. What's the value of R_L? Well, if the LED drops the voltage by 2.1V, then R_L must drop the voltage by 9.9V, since the two devices must drop the source voltage V_S to ground. Also, since they are in series, the same current must flow through both devices, that is I_L (resistor current) = I_F (LED current). Rearranging Ohm's Law, we can easily calculate that $R_L = V_L / I_L = (V_S – V_F) / I_F = 495$ Ohms. Another application of Ohm's Law is that power (**P**) is dissipated (as heat) by **P = I * E**. 20mA flowing through the 495 Ohm resistor will drop the voltage by 9.9V and dissipate 0.198Watts, so a standard value, 510 Ohm, ¼ Watt resistor will work just fine!



Now, here's the tricky part! You might think that if you put two LED's in series, you'd cut R_L in half, right? Well, not quite. Two LED's in series are going to combine to drop the voltage by twice the amount that one will, so the resistor now has to drop the source voltage V_S according to the formula $V_L = V_S – 2 * V_F$. Substituting this for V_L

and $R_L = (V_S – 2 * V_F) / I_F = 7.8/.020 = 390$ 0hms. How big does the 390 Ohm resistor have to be? P = 7.8 * .020 = .156, so a ¼ Wattresistor will do nicely.

OK, time for the big leap! What if we were to replace each of the individual LED's with three LED's in parallel? If we can do this, we get the 6 LED's we wanted in the first place.



In this circuit, we find that since each LED must carry 20mA, three combined in parallel must carry three times the current as just a single LED. But, just as when there were only two LED's in series, the same amount of current that passes through the first set of LED's, passes through the second set of LED's. Therefore, the total current that passes through R_L is three times the current passing through just one LED. Think this through and you will see that $R_L = (V_S – 2 * V_F) / 3 * I_F = 7.8/.060 = 130$ Ohms. The power dissipated is .468 Watts, so use a ½ Watt resistor.

This is almost the circuit I used for my Halloween mask. I made a slight adjustment to account for the fact that when fully charged, my gel cell is at 13.5V (I used a 160 Ohm ½ Watt resistor which provides a safe current limit for up to 13.8V—the standard supply in my shack).

What good is this to QRP you might ask? Well, first of all, you'll find that no matter what you do, you can't get away from Ohm's Law. Secondly, go ahead and build this circuit—if nothing else, it's great practice hooking up components and soldering--practice builds your confidence for tougher circuits. Try different LED's (Radio Shack stores carry a good selection) and calculate the new value for the limiting resistor. Also, this little circuit will put out quite a bit of light, for only 60 mA of current—quite useful for operating at night in the field. Construct it in a box with a small battery (gel cell, NiCad's, dry cells, etc.) along with a NoGaPiG (see the NOGA QRP website) and you are QRV!

72 de Mike, KO4WX