LED Modifications

Below are directions on how I modify LED strings for repairs, upgrade to full wave rectification, or custom lengths/number of LEDs.

Caution! Working with electricity and modifying electrical components is dangerous. Do this at your own risk and always utilize safety first!

LED Calculations

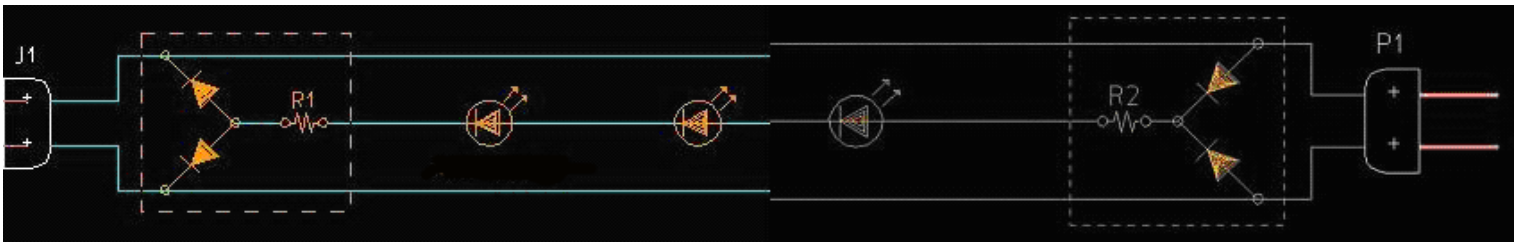
1. Peek Voltage - Peek voltage out of the full wave rectifier from 120VAC RMS equals 170V minus the voltage dropped by the diodes. This would result in about 167V.
    a. Rounded voltages, **120VAC *1.414 = 170V.**
    b. **170V - 2.8V = 167V**
2. LED Voltage and Current
    a. Voltage varies by manufacturer and color for LEDs. The most common current is near 20mA. You must look up the specifications for your LED string.
    b. In my examples below, I'll be using: Red = **2.0V**, **17mA** or **0.017A**
3. Resistor Calculation (Example using a shortened string of 26 Red LEDs.)
    a. Calculate voltage drop of LEDs
        i. **2.0V x 26 = 52V**
    b. Calculate peek voltage minus voltage dropped by the LEDs
        i. **167V – 52V = 115V**
    c. Calculate Resistor(s) needed to drop remaining voltage
        i. Ohms - **115V / 0.017A = 6.764KOhm** (Use next higher standard value, for example, 8.2KOhm)
        ii. Watts - **115V * 0.017A = 1.955Watt** (Use a minimum of 2 watt resistor)
4. Rectification – You will need 4 diodes per string to make the full wave rectifiers.
    a. I use 600V/1A diodes. Mouser part number 821-1N4005
5. Here is a link to a handy online calculator which I use: http://www.horrorseek.com/home/halloween/wolfstone/Lighting/litlec_LEDCalc.html

Limitations: This example does not utilize any voltage doubling circuits. You are limited to using the number of LEDs that add up to or just below 167V. For example, I could build a string using a maximum of 83 Red LEDS which drop 2.0V each. This would utilize 166V of the available 167V. Other LED colors drop higher voltages. For long strings, you must divide the string in half and build full wave rectifiers for each section.

Tip: When purchasing resistors, you can use one or more. Rather than just using the one 8.2KOhm resistor, you could use two resistors, one on each end that adds up to at least 6.8KOhms or just over that value. I'd also recommend purchasing resistors in bulk where you can. I calculated the resistor sizes needed for each of my strings based on number or LEDs and voltage differences based on color. I then purchased resistors with a value common to all of my strings, but within the closest range of my

requirements. This allows me to use the same resistors for most strings, and I commonly only use two different resistor sizes. For example, I have purchased both 3.6KOhm/2watt and 2.7KOhm/2watt resistors for all of my strings. I may use one, two, or a combination of these values depending on my needs.

Example Schematic

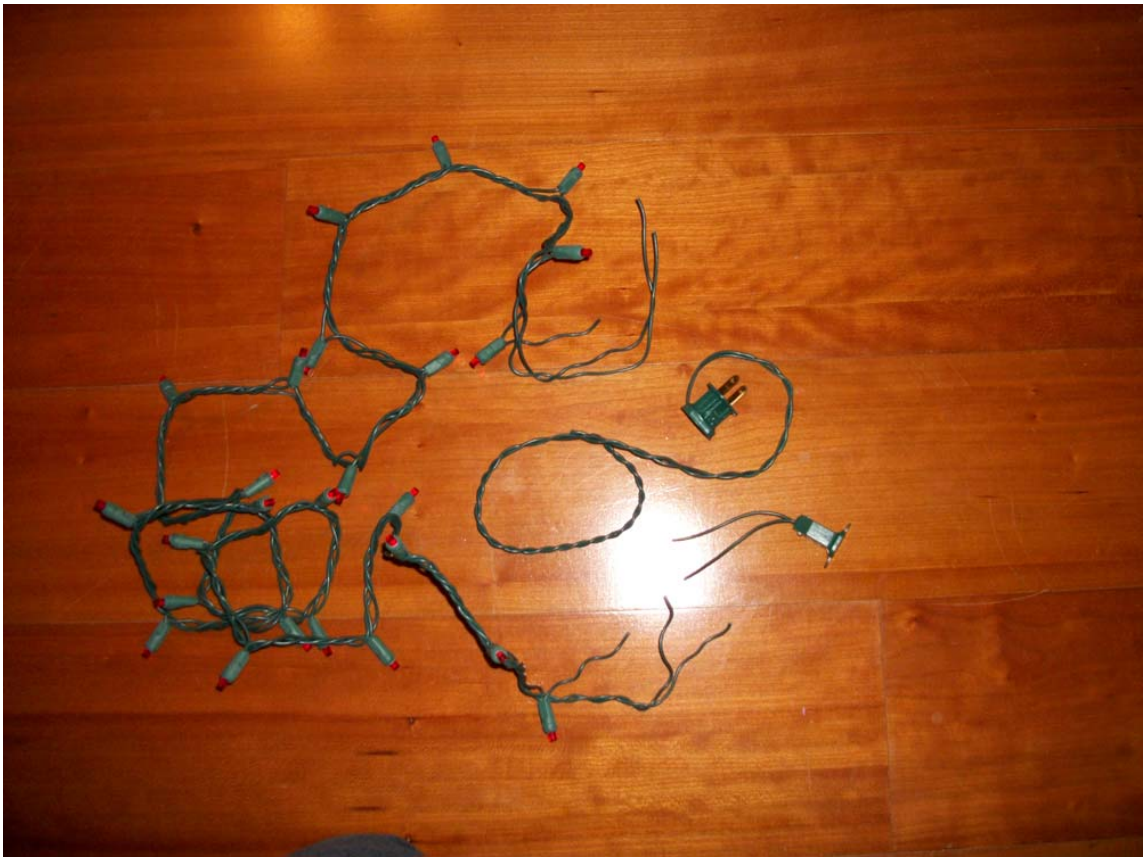


Building the Strings

Parts:

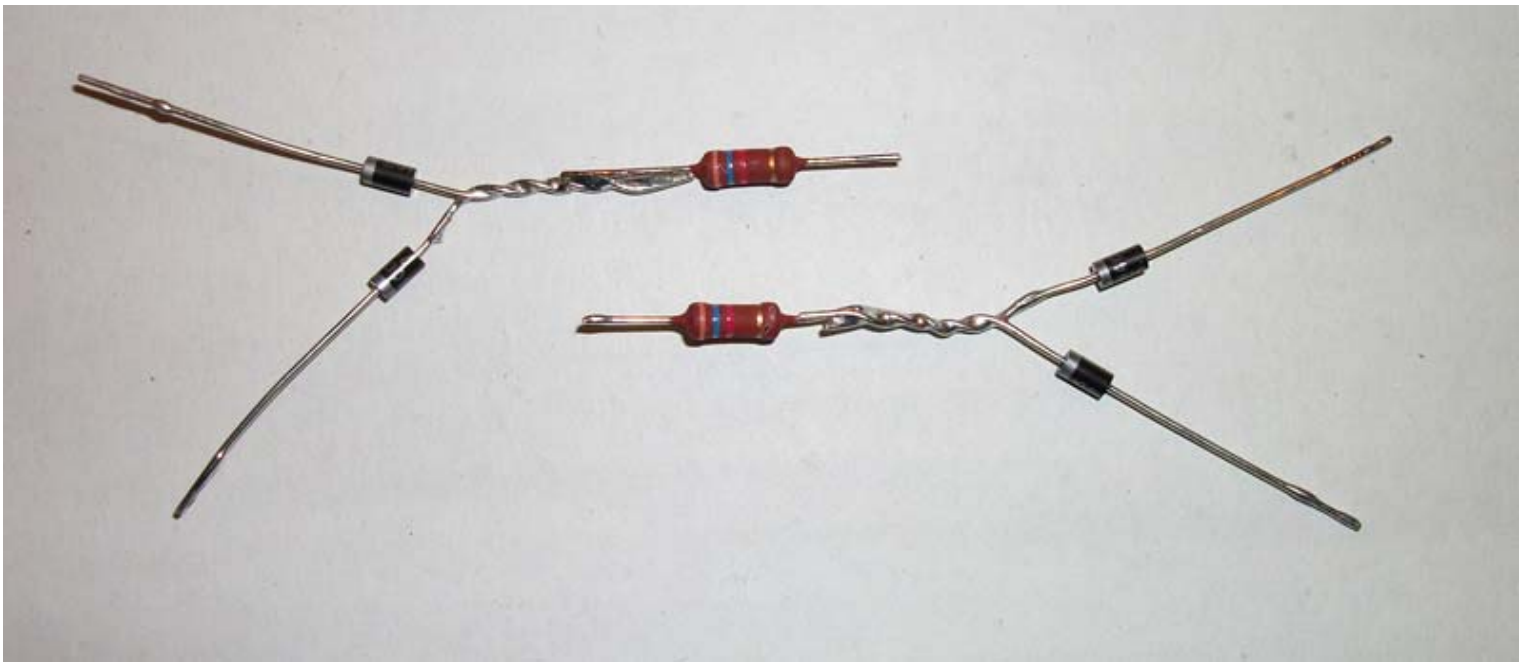
- 4 x 1N4005 diodes
- 2 x 3.6KOhm/2watt Resistors
- LED string shortened to 26 count

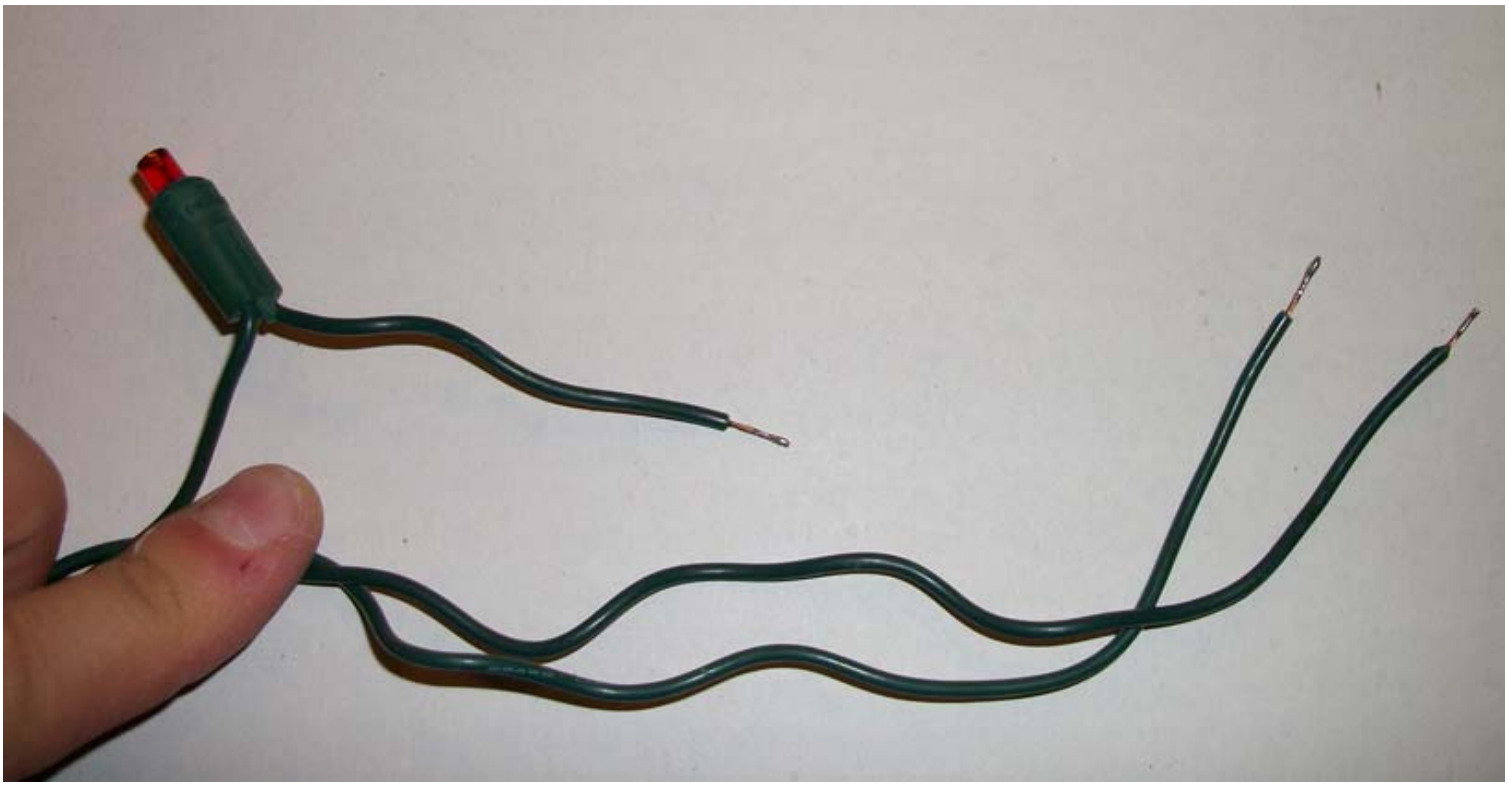
1. In my example, I am shortening a string of Red LEDS to only use 26 LEDs and still allow AC voltage pass through to the female plug end (J1) above.
2. Cut off and retain the male and female plug ends. Discard any existing rectifiers (blobs) that came with your strings.
3. Shorten the string to the number of LEDs you require. Note: this is dependant upon your need.

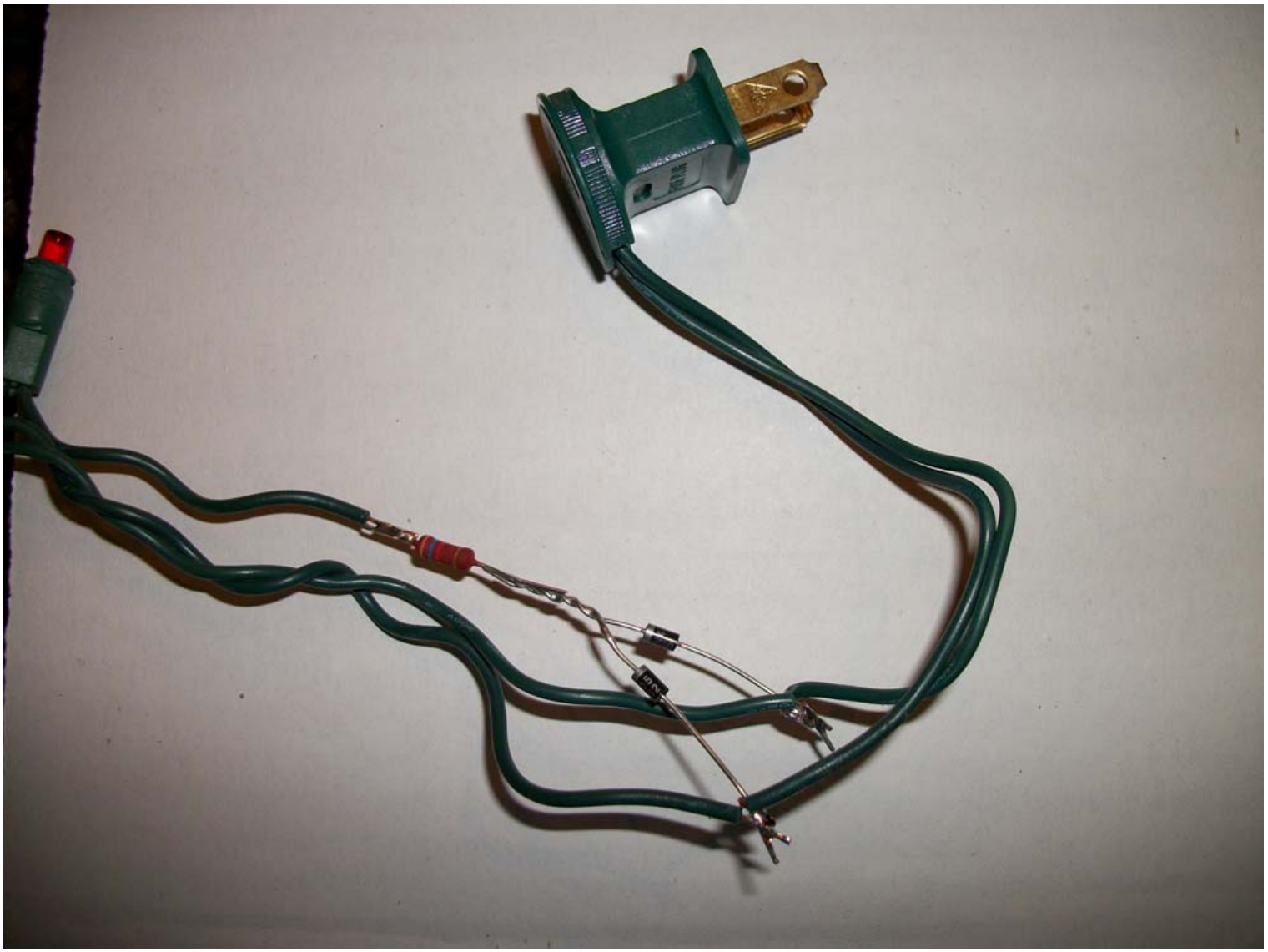


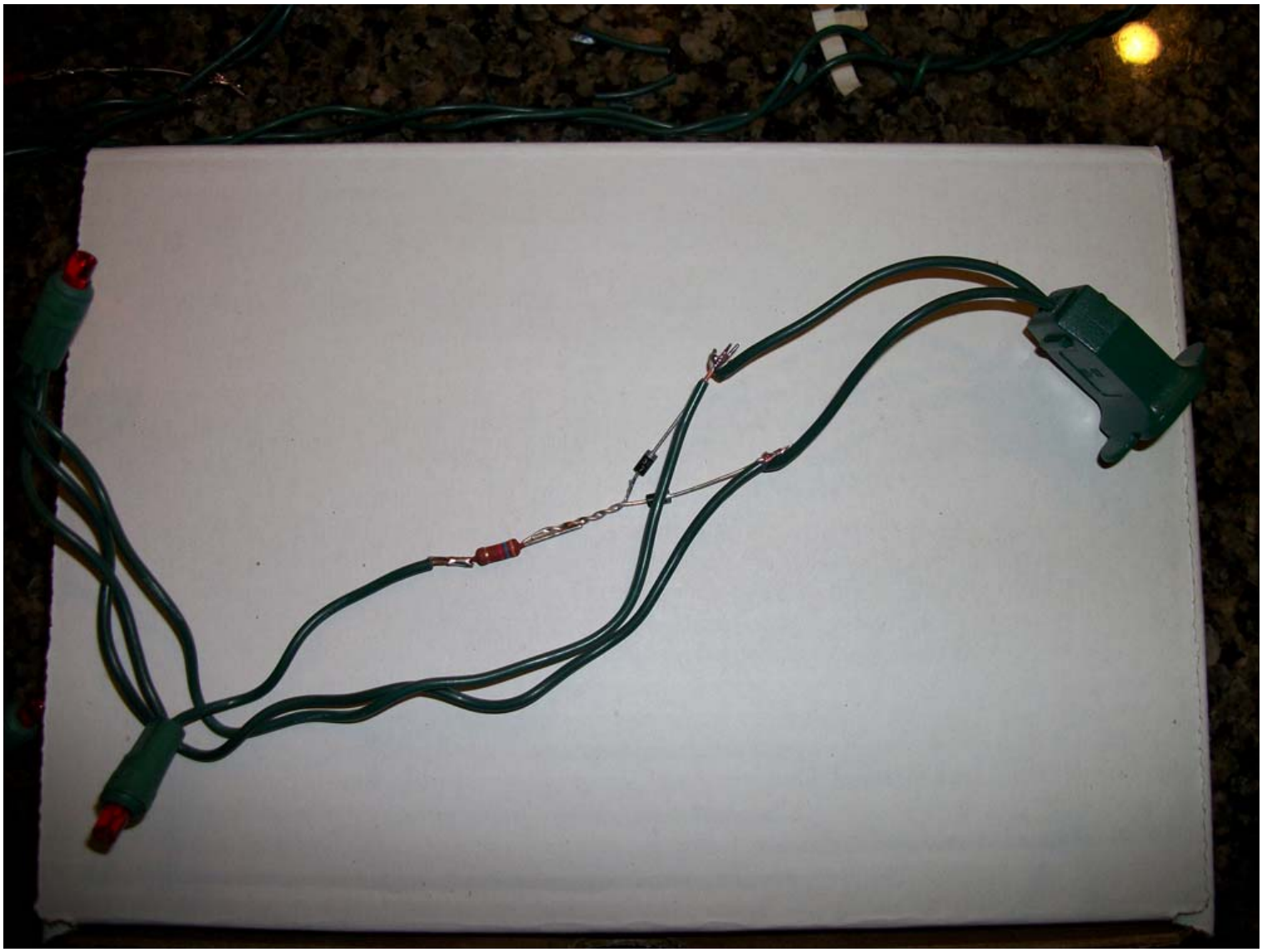
4. Assemble the male and female end rectifier components (2 x diodes, 1 x resistor for each end). Tin the ends and solder the diodes together and the resistor in place. Note: you can place the resistors at any location within the rectifier. When using two, I place one on each end of the circuit, this is just my preference.
    a. Reference the below image for proper orientation of the diodes in relation to the male and female ends as well as connection to LED strings. Also reference schematic above.

5. Solder the components to the male and female ends. Ensure you have the orientation of anode/cathode of the diodes correct. Note, if you plan to use heat shrink for the components, place the pieces as required before soldering to any wires. I use electrical tape.
    a. Diodes to AC power from male plug
    b. LED to resistor
    c. AC pass through wires to female end

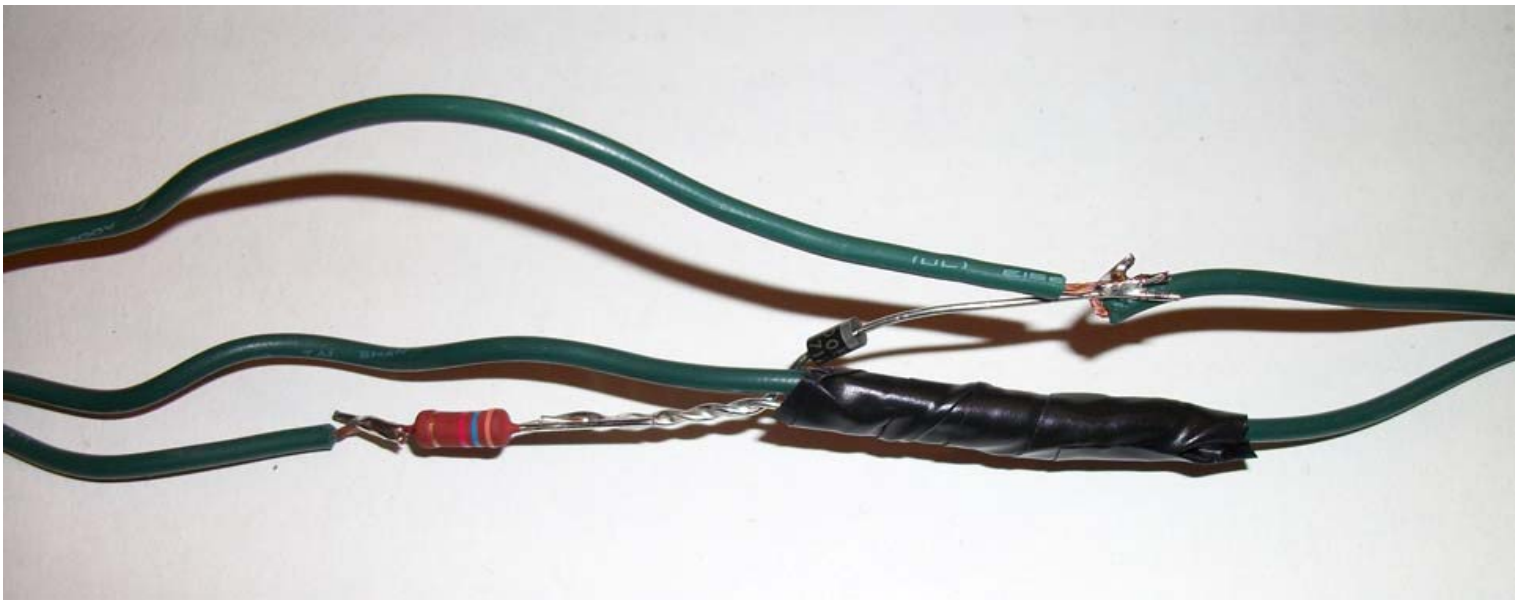








6. You must now wrap with tape or protect with heat shrink tubing, one leg of the diodes so that they don't short together. This is before they are joined as part of the bridge. See picture below.



7. Thoroughly protect any exposed components and wires with electrical tape if you are not using heat shrink.

8. Wrap the entire sections with electrical tape. Note: I have not had any issues only using electrical tape. Moisture is not a factor here, protection from exposed wires and heat from the resistors are my concerns.

Results