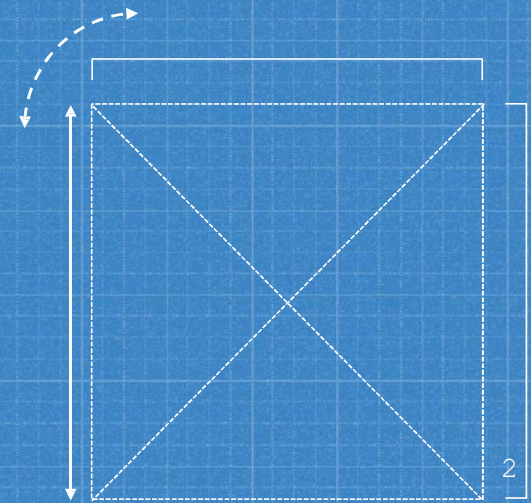


Power Grid Project

Om Patel

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Sketches, Multisims, & Theoretical Calculations

39 *Power Grid Project Part 1*

① $V_T = 2N \cdot 0.02(A) = 12$
 $R_T = 15N + R$
 $I_T = 0.2A$
 $P = I^2 R$
 $12 = (0.2)^2 \cdot (R + 15N)$
 $12 = 0.004R + 0.006N$
 $\frac{12}{0.02} = 600\Omega = R_T$
 $2N = 12 - 0.02(A)$
 $N = 6 - 0.01R$
 $N = 5$ Gross check

② $600\Omega = R = 15(6)$
 $600\Omega - R = 75$
 $600 - 600 = 0$
 $R = 525\Omega$

③ You can't add more LEDs. The current is less than our maximum supply.

④ $V_T = 12$
 $I_T = 1A$
 $R = 100\Omega$
 $N = 50$
 $12 - 2 = 10$
 $\frac{10}{0.02} = 500\Omega$
 $\frac{1000}{20} = 50$

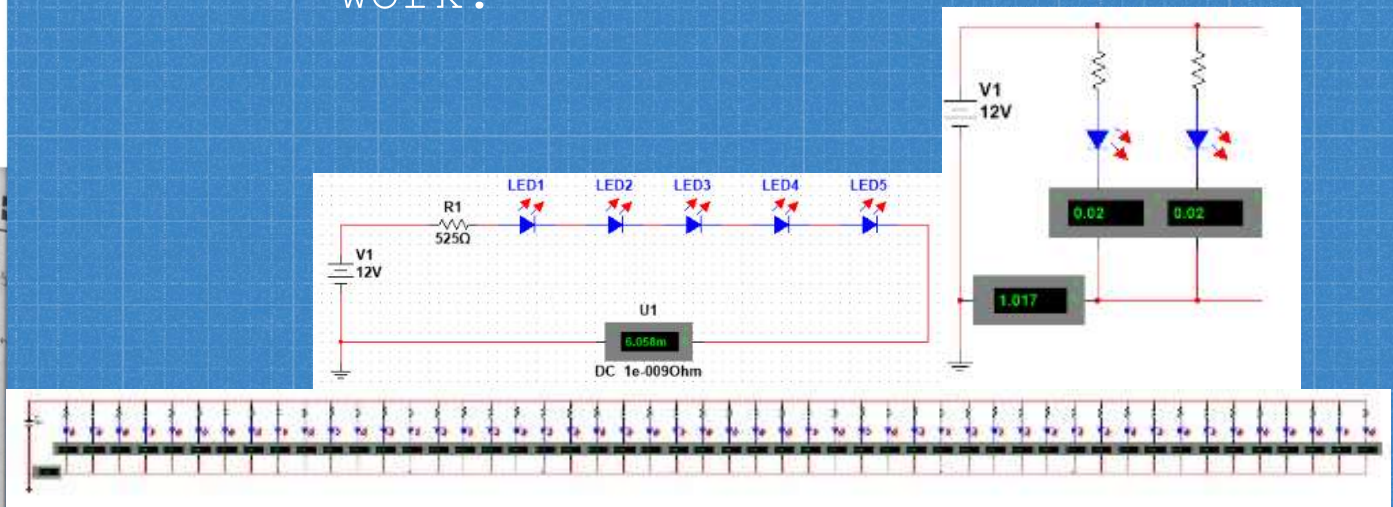
40 *Power Grid Project Part 1*

① The current is equal to the minimum supply. Yes, you can add more LEDs as you can add 5 LEDs per branch giving you 250 LEDs.

② Series current from question 1 with the parallel circuit from question 4.
 $50 \times 5 = 250 \text{ LEDs}$

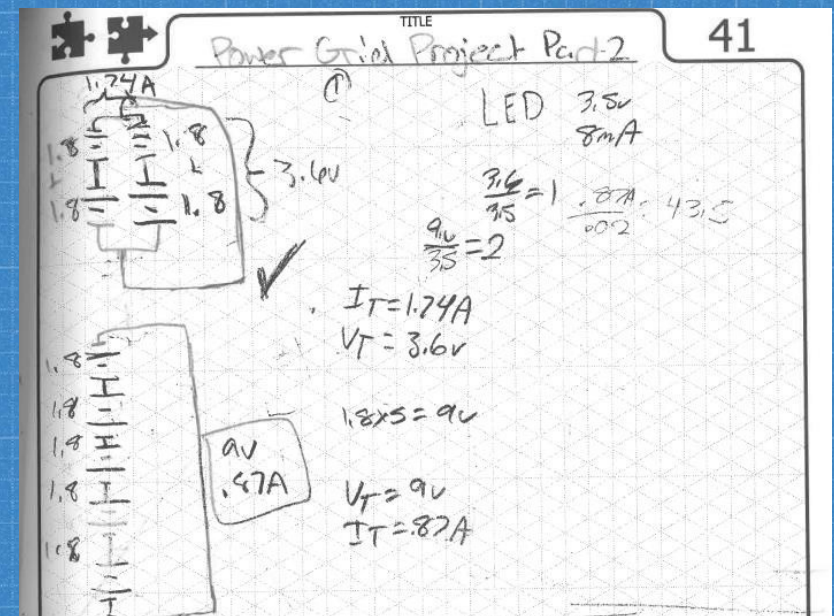
③ Skip ④ No you cannot add more LEDs. Theoretically this design works.

In this activity I practiced my skills of calculating theoretical maximum power grids. I also used Multisim to check my work.



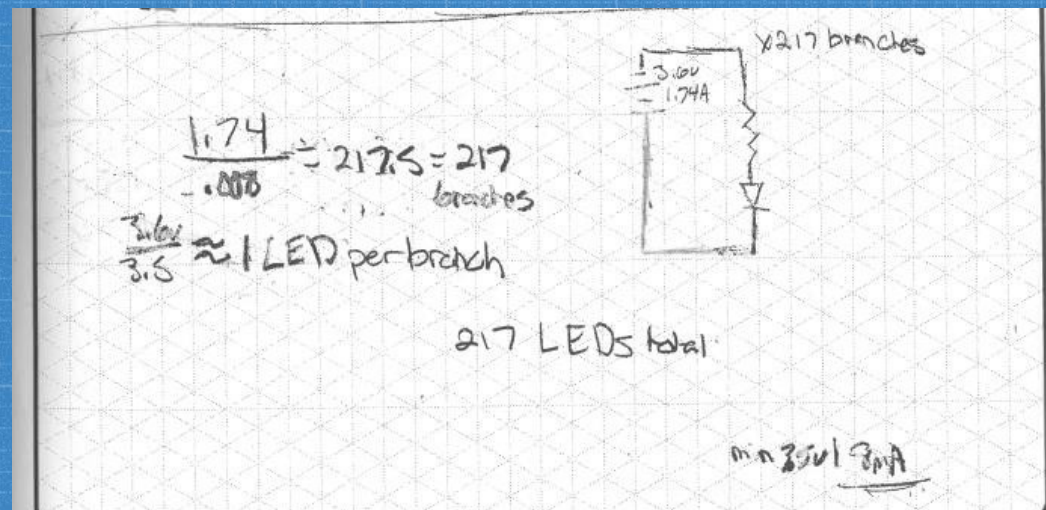
Theoretical Maximum Power Supply Design & Calculations

Using the minimum current and voltage for the LED to power and the generators maximum output voltage and current, I tried to calculate and design the maximum power supply.



Theoretical Maximum Grid Design & Calculations

With the power supply I designed, I tried to create a the maximum number of branches while maintaining a specified LED's minimum voltage and current. This grid will contain a 100 ohm resistor for each LED.



Handwritten calculations and circuit diagram on graph paper:

Calculations:

$$\frac{1.74}{0.008} = 217.5 = 217 \text{ branches}$$
$$\frac{3.6}{3.5} \approx 1 \text{ LED per branch}$$

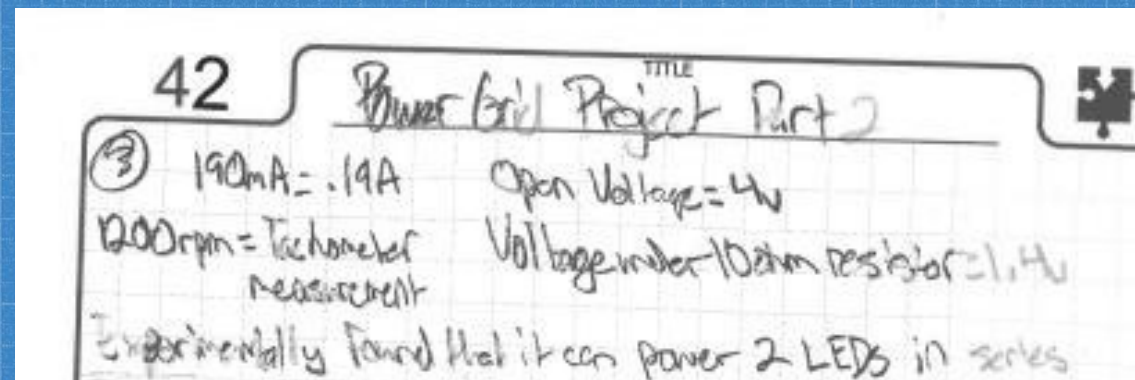
217 LEDs total

min 3.5V / 3mA

Circuit diagram showing a branch with a 3.00V source, a 1.74A current, and a resistor (indicated by a zigzag line) connected to an LED (indicated by a diode symbol). The diagram is labeled "x217 branches".

Experimental Maximum Power Supply Measurements

With a power supply picked and built in real life it allowed me to get measurements of voltage, current, and rpm.



Grid Redesign

With the voltage and current found in the experiments, I could the amount of branches and leds in a branch. Allowing me maximum number of LEDs for that power supply.

④

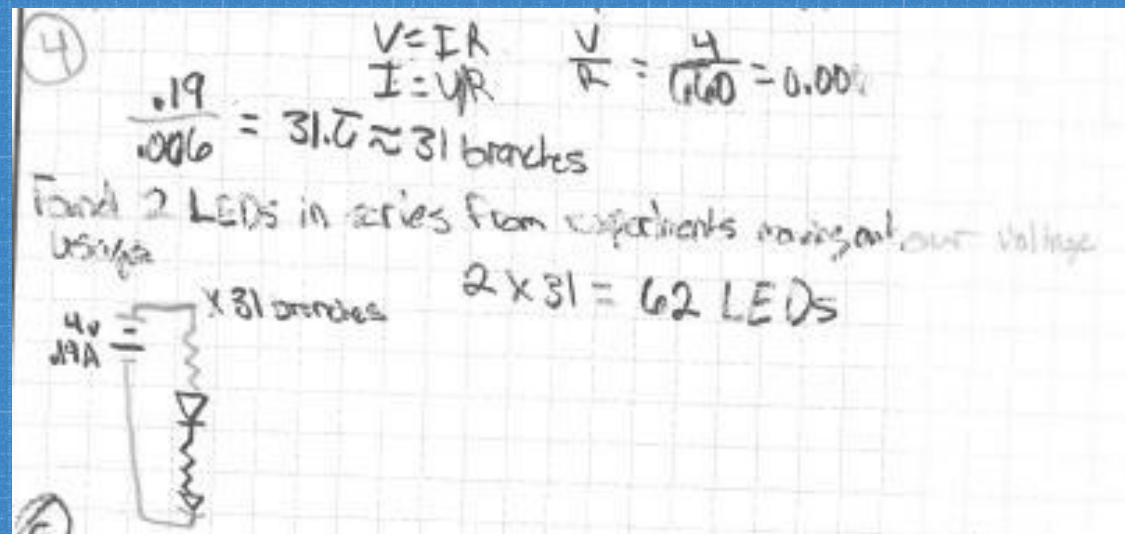
$$\frac{V}{I} = \frac{4}{0.126} = 31.7 \approx 31 \text{ branches}$$

Found 2 LEDs in series from experiments making out our voltage usage

4V
0.126A

X 31 branches

2 x 31 = 62 LEDs



Final Grid Design

With my calculations, I created breadboards with LEDs in a series parallel combination. The final amount of LEDs that could light up were 62.

