

# 141A Electronics Online Challenge

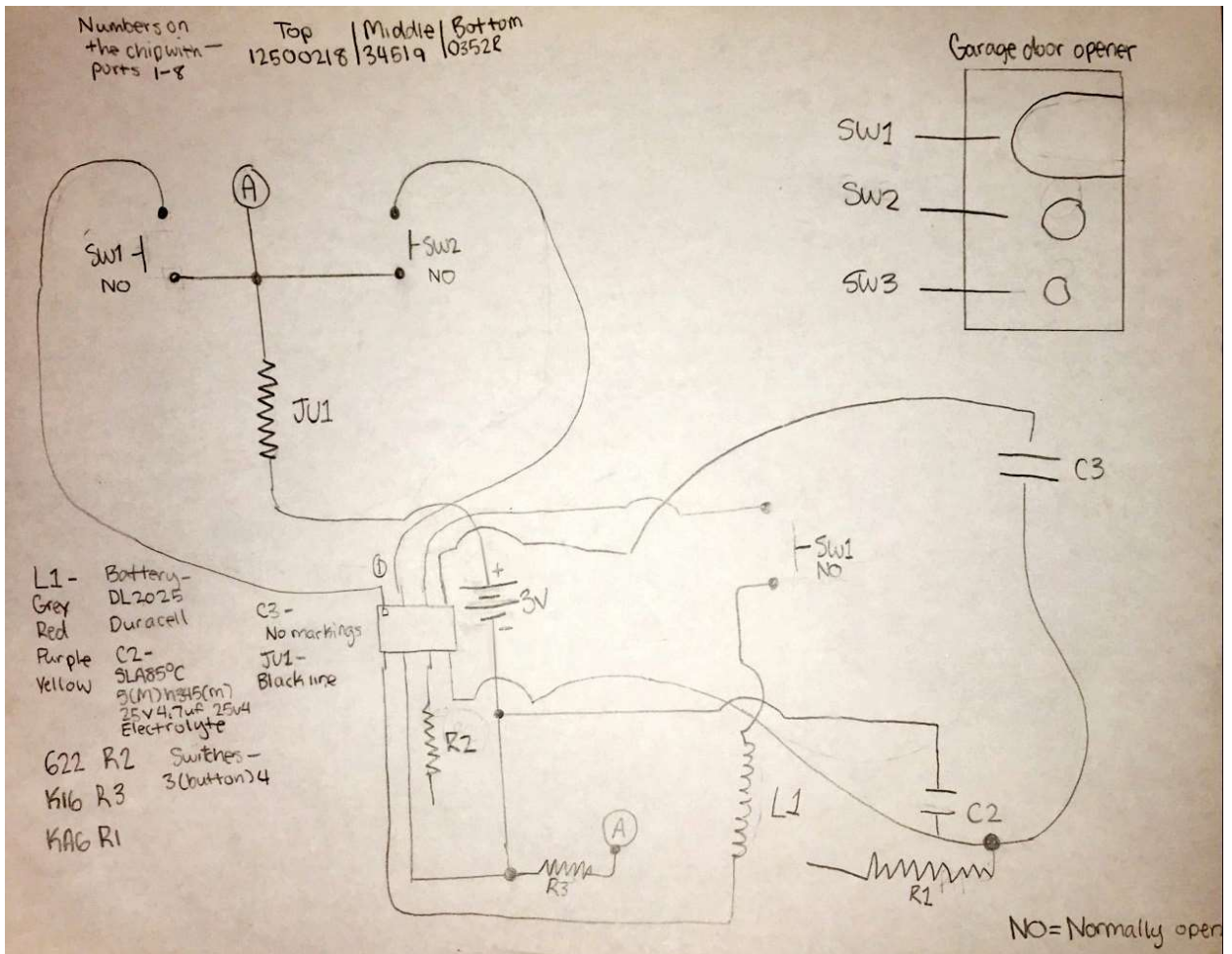
## Garage Door Opener Remote

Team 141A reverse engineered a Craftsman garage door opener remote to learn how a circuit board works. Many components were inside, including a battery, four resistors, an integrated circuit (IC), two capacitors, an inductor, and three switches. A multimeter determined how the components fit together electrically. For example, since switch three and IC pin one are connected, the multimeter would beep when one wire was placed on switch three, and the other on pin one.

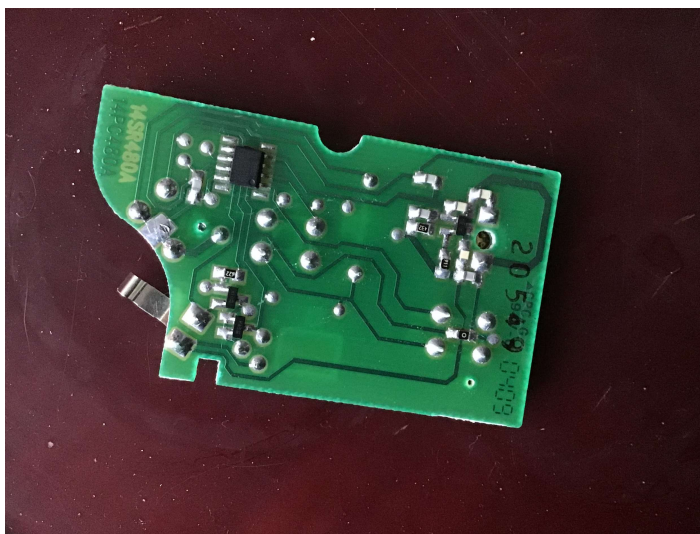
A schematic diagram was created showing how the components connect to form. A multimeter was used to confirm connectivity on the backside of the circuit board. Unfortunately, we could not find where one end of R1 and R2 were connected. Most of the components could be seen on the front of the circuit board. They were labeled L1 (inductor), SW1 (switch), SW2 (switch), SW3 (switch), JU1 (resistor), C2 (capacitor), C3 (capacitor), R1 (resistor), R2 (resistor), R3 (resistor), and E1 (power source). No TI components were found. The schematic diagram we created, shown below, demonstrates how each of the components connected, and what the various markings on the components show.

The markings show multiple things, such as the induction in inductors, which is measured in Henries (H). The inductor had the color bands yellow, violet, red, silver. This converts to 4.7 mH 10%. JU1 looks like a resistor, but normally, resistors have color bands like the inductor where this only had one black stripe on it. The other resistors are surface mount (they don't have wires that go through the board). The surface mount resistors are R1 (part number KA6), R2 (part number 622), and R3 (part number K16). There were two capacitors, C2 and C3. C2 is an electrolytic capacitor, which operates similar to a battery with a compound between the anode and cathode. This capacitor, according to the side, is a 25 volt 4.7 uF part number h345(M). C3, the other capacitor, has no markings, and simply has a blue plastic cover. The integrated circuit has eight pins. On it was printed three sets of numbers; 12500218 (top), 34519 (middle), and 0352R (bottom). We researched the part numbers, and could not find this IC. Finally, there were three normally open momentary switches. The battery is Duracell part number DL2025. Looking at the schematic, the components are to provide input to the IC, which, based on switches, sends a signal to the receiver in the garage door opener.

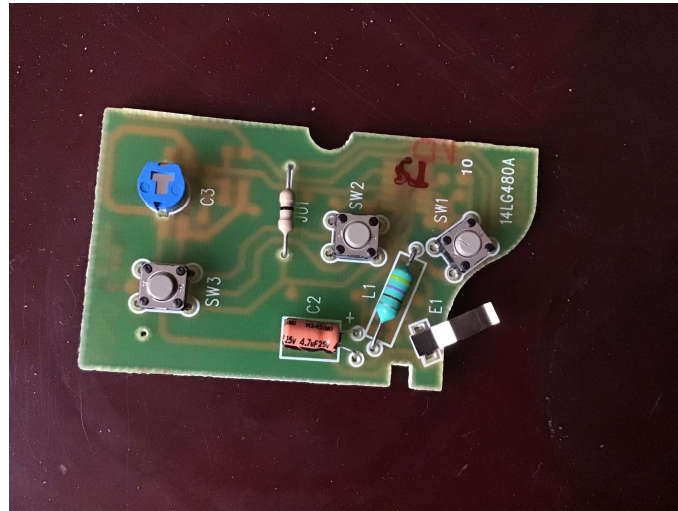
From this experiment, we learned how the components on a circuit board work together to provide a transmitter. We also learned how to decode resistors and inductors, and learned how a garage door opener works. Finally, we learned how to identify the components and how they're connected, how to use a multimeter, how to decode inductors and resistors, and what an electrolytic capacitor is.



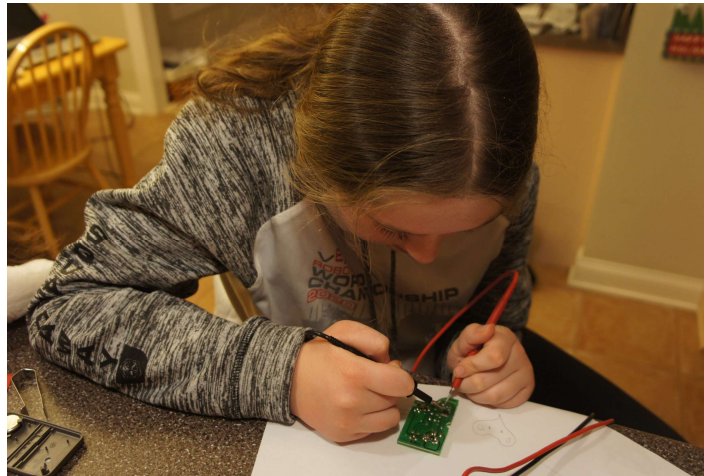
Schematic diagram (an electrical roadmap)



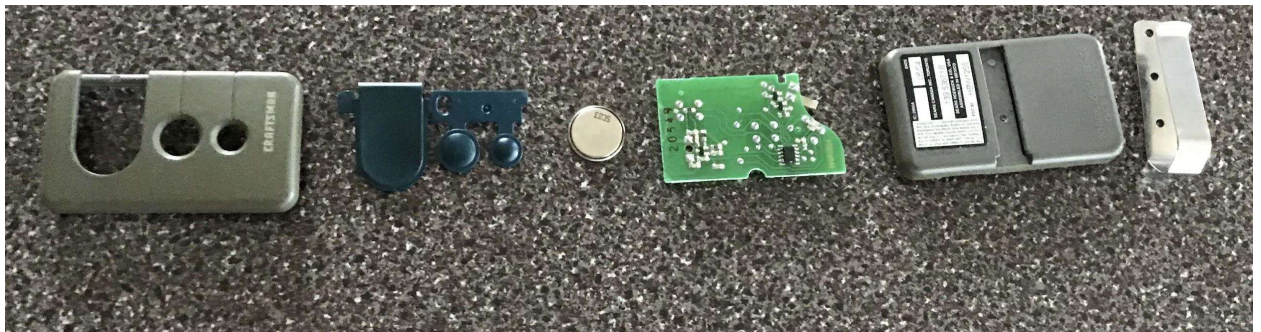
Backside of the circuit board



Frontside of the circuit board



One of the 141A team members, Aurora Kennedy, using the multimeter to determine which parts fit together.



Garage door opener parts Figure 1





Garage door opener parts Figure 2