

# Figuring Out a Calculator



## Introduction

We are team 121A from Oak Grove Upper Elementary in Hattiesburg, MS. Our names are Katie Roark and Jacob Roark. We started robotics as part of our EXCEL gifted program when we were in the 2<sup>nd</sup> grade. We are in the 4<sup>th</sup> grade this year. For the Texas Instruments challenge, we chose to take apart a Tectron calculator to see how it works. We chose the calculator because it is able to do lots of calculations quickly.

## Summary of Components

We used small screwdrivers to take out the screws on the back of the case. The outside contained the front and back of the case, the buttons, and the screws. When we took it apart, we found a small circuit board with one processor inside. The inside also contained a battery, keyboard sensors, liquid crystal display, keyboard membrane, and solar power window. There was less stuff than we expected inside. The keyboard sensors (9708/9808/9712), the circuit board (9808D-8), and the battery (Lr1130) were the only parts that had numbers on them. None of the parts were from Texas Instruments.

## **Research Findings**

We used the internet to look up the part numbers for the parts that were labeled. The only part number that had information was the battery, though. Then, we decided to use the internet to find out what the other components were and how they work. What we found out is that all the wiring in the calculator (from the display, keyboard, and battery) goes to the processor.

What we learned from our research is that when you press a button on the calculator it presses the keyboard membrane onto the keyboard sensor. The touch-sensitive keyboard sensors inside are conductors, which complete a circuit when they are pushed by the keyboard membrane. That completed circuit is detected by the processor. The processor then figures out what buttons were pushed and does the calculations.

We found out the processor uses binary code, 1's and 0's, to make calculations. After the calculations, it sends signals to the liquid crystal display. We found out that the liquid crystal display is a reflective LCD. It uses the light in the room, which is why you can't see it in the dark. We also found out that the liquid crystal display works by changing the direction of light when electricity goes through them. This blocks some of the light, which causes that part of the display to look dark, and that's how we see the numbers. We also learned that the battery connects to the processor, and the processor powers the display and the keyboard.

## **Conclusion**

It was a fun taking apart the calculator. It helped us understand how electronic devices are put together and how they work. We learned that the processor is very important and how it is connected to everything.

## Parts List

Liquid Crystal Display (no number)

Circuit Board (9808D-8)

Keyboard Sensors (9708/9808/9712)

Processor (no number)

Battery Case

Screws

Battery (Lr1130)

Keyboard Membrane

Solar Panel window

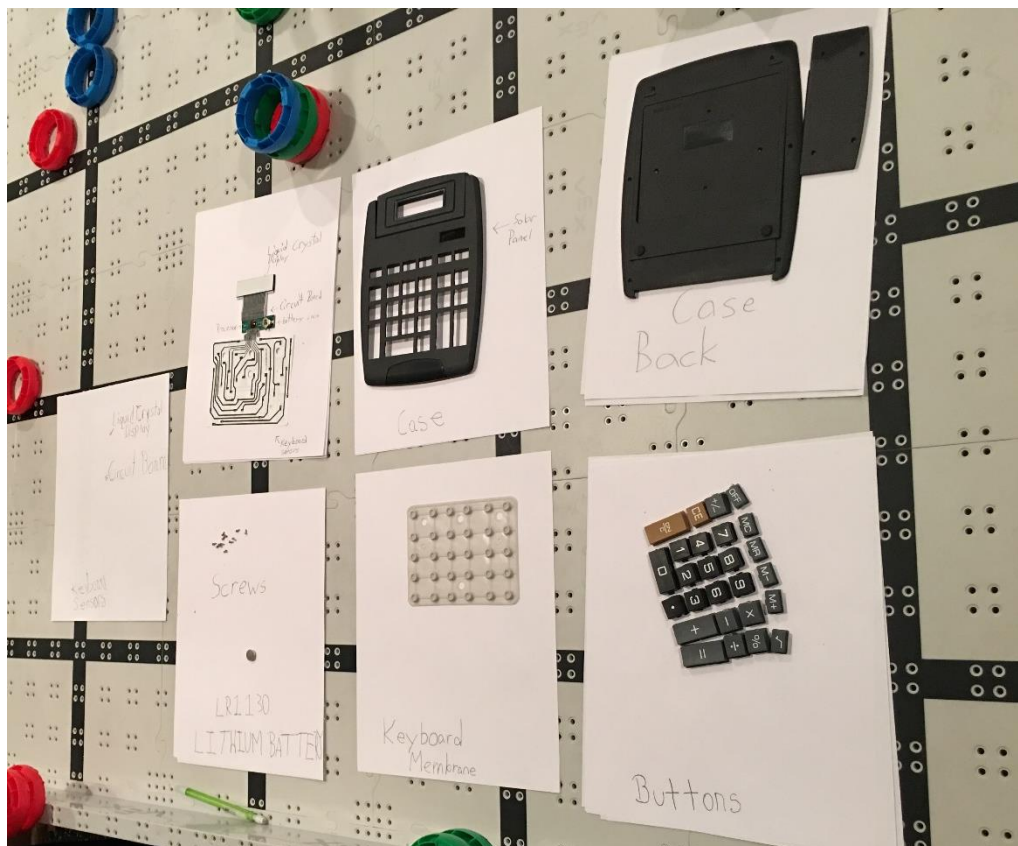
Case

Case Back

Buttons

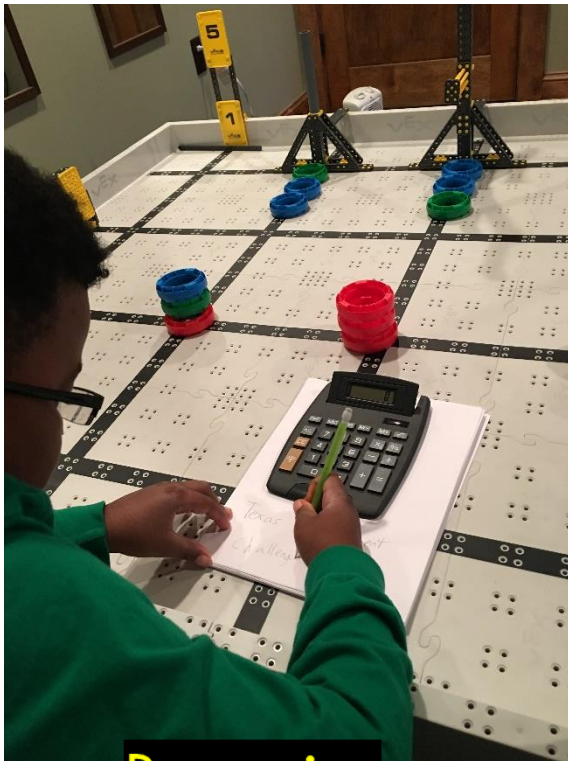


**Project Calculator**

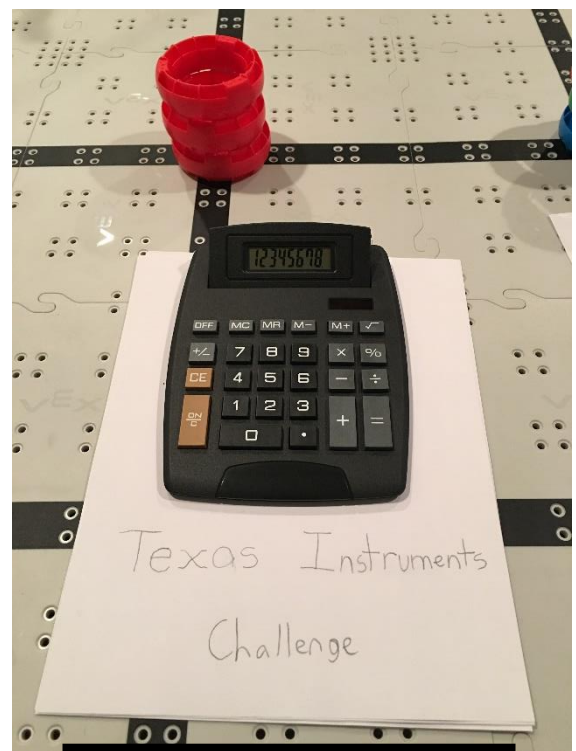


**Calculator Parts**

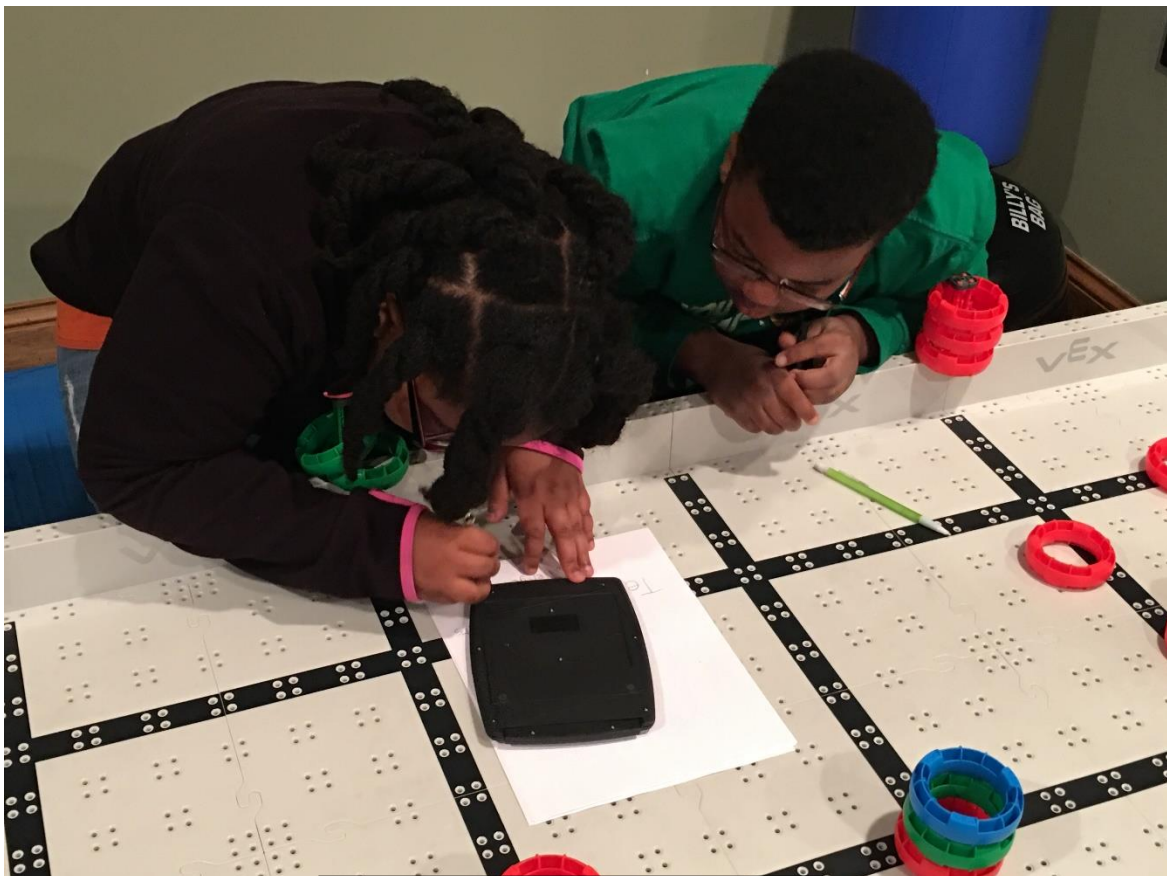




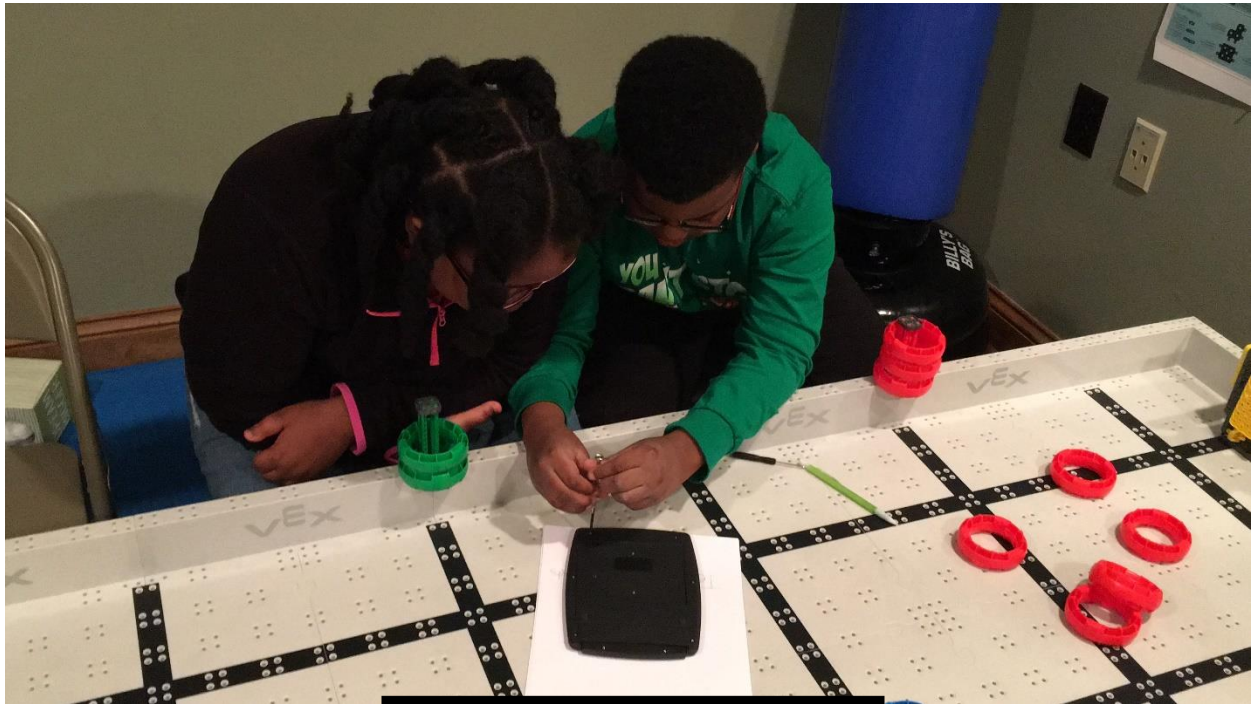
**Preparing**



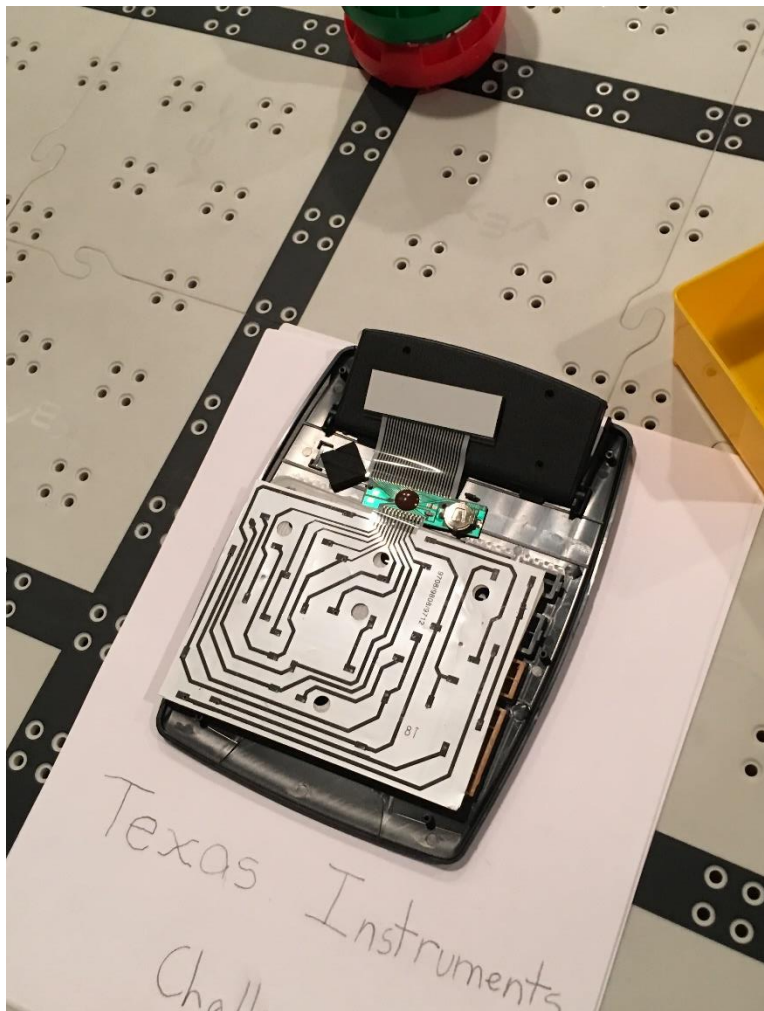
**Project Calculator**



**Opening Calculator**

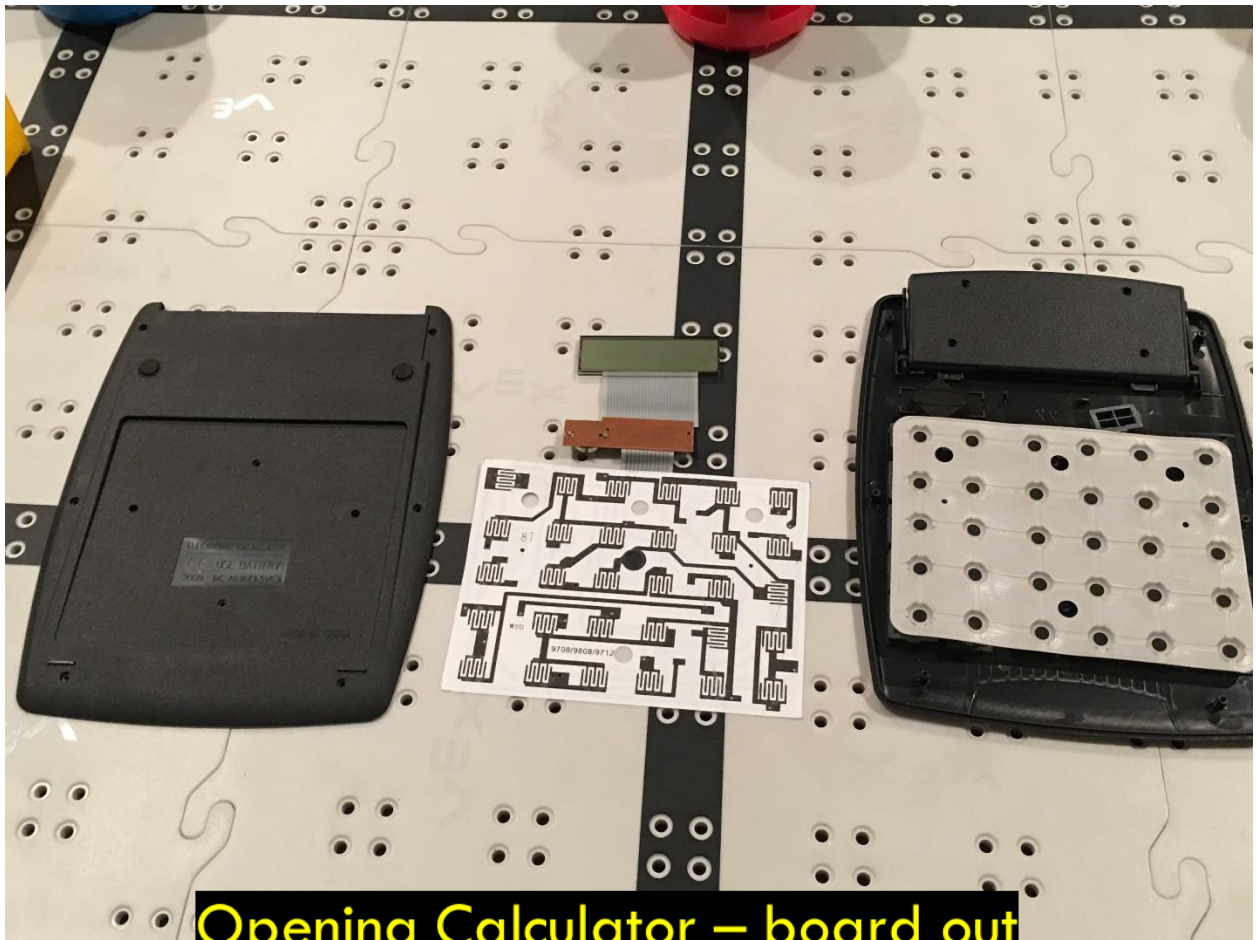


Opening Calculator

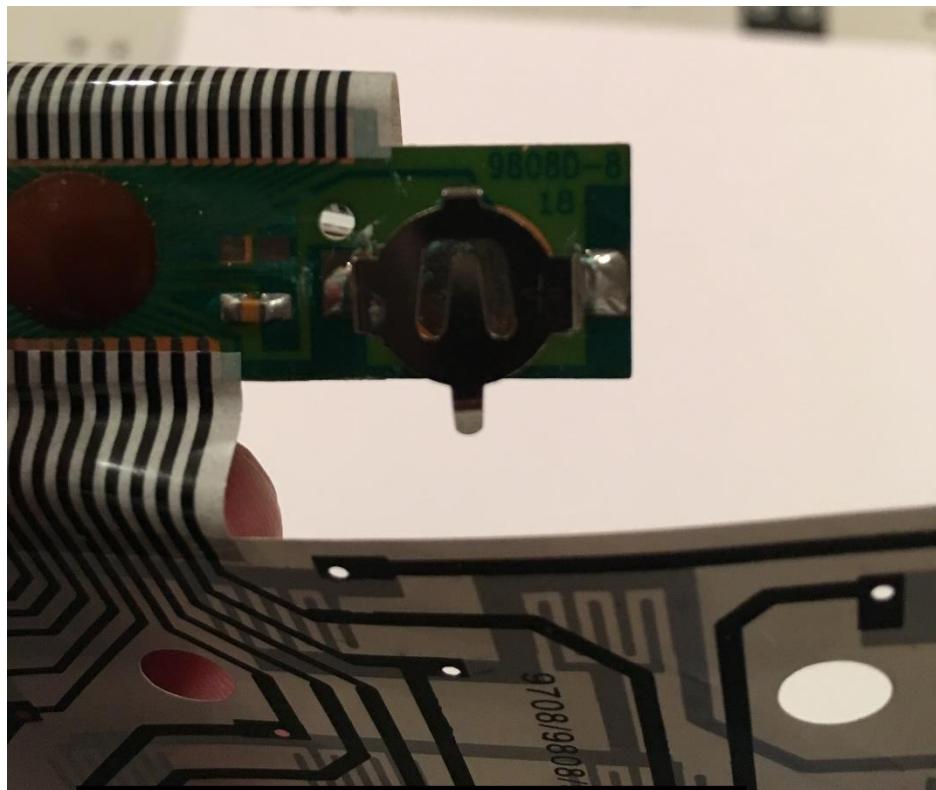


Opening Calculator – back off



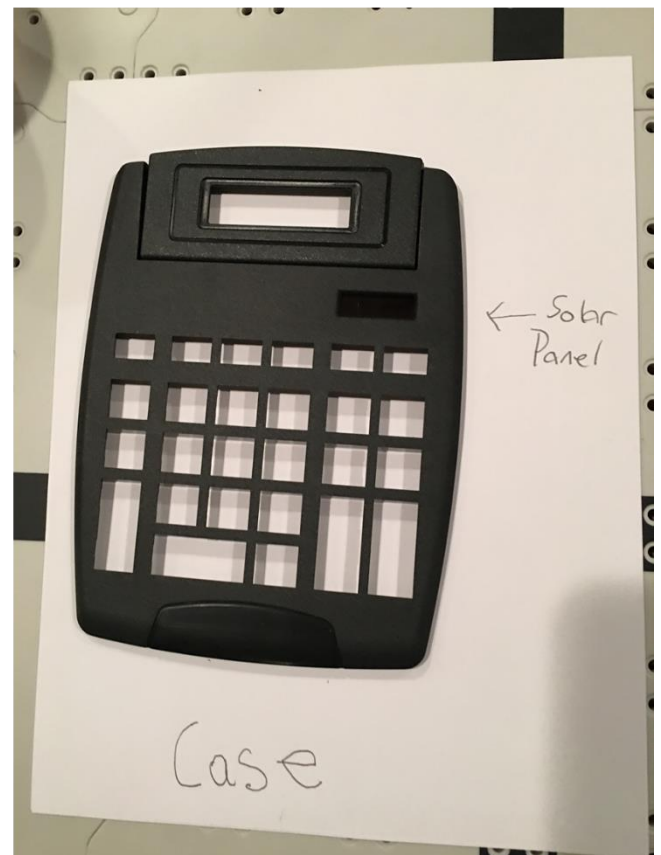
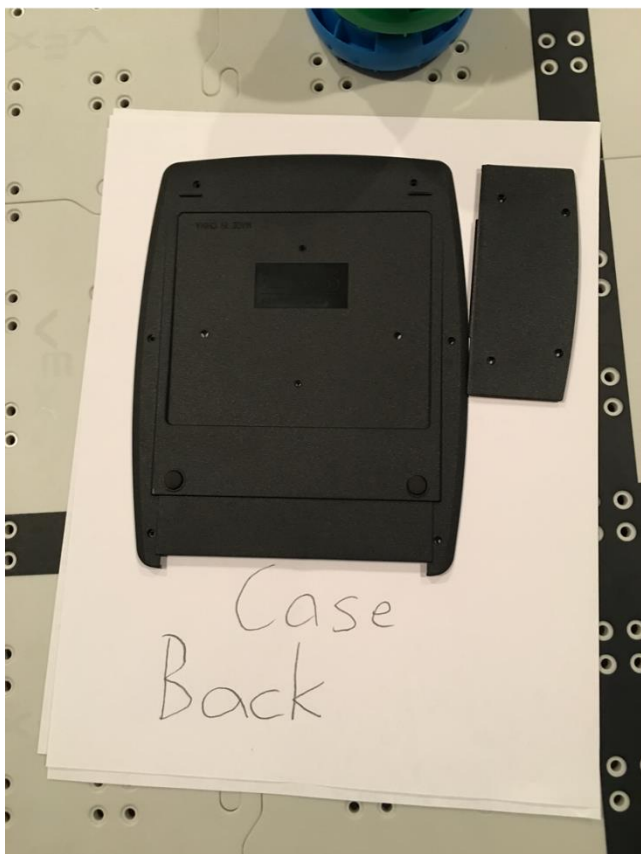
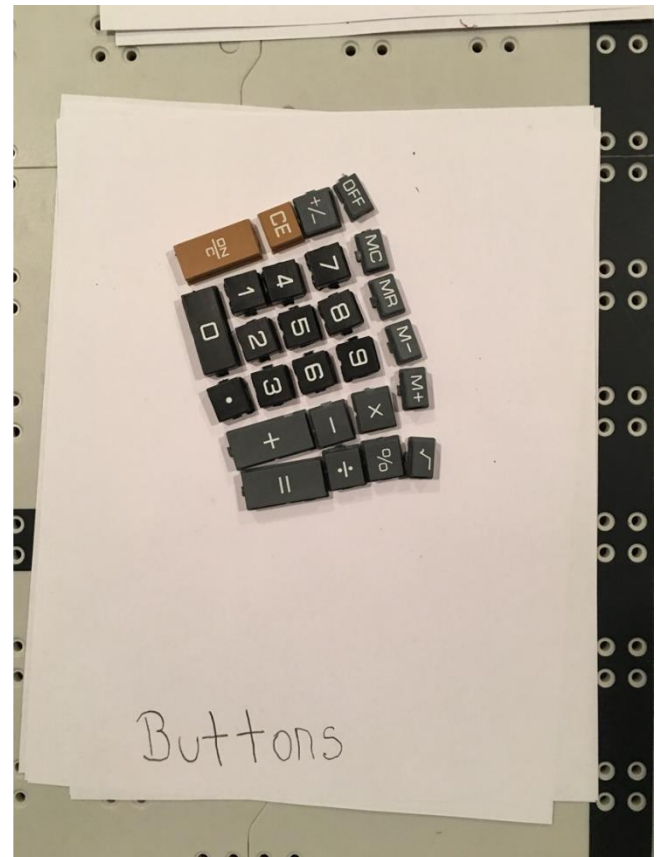
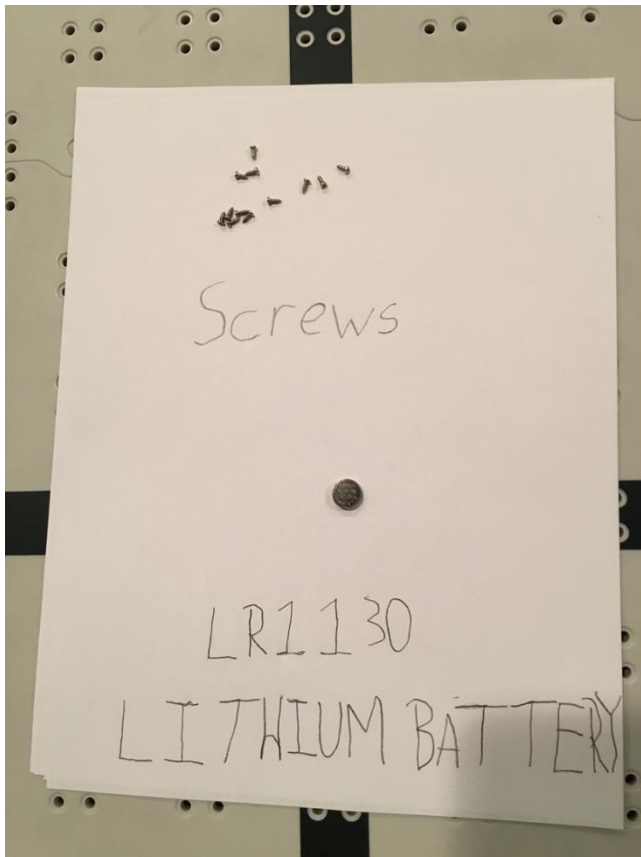


Opening Calculator – board out

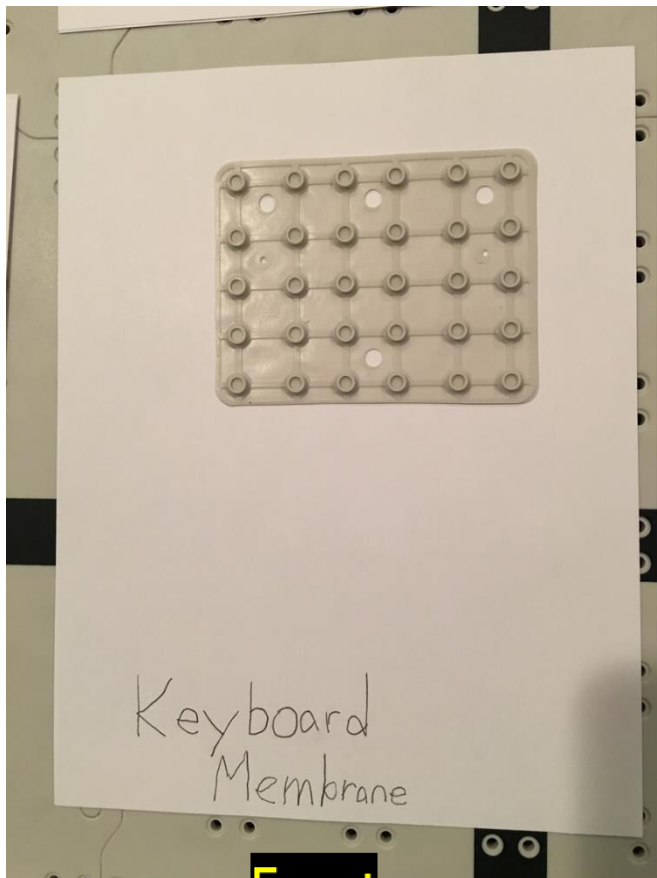


Circuit board part number

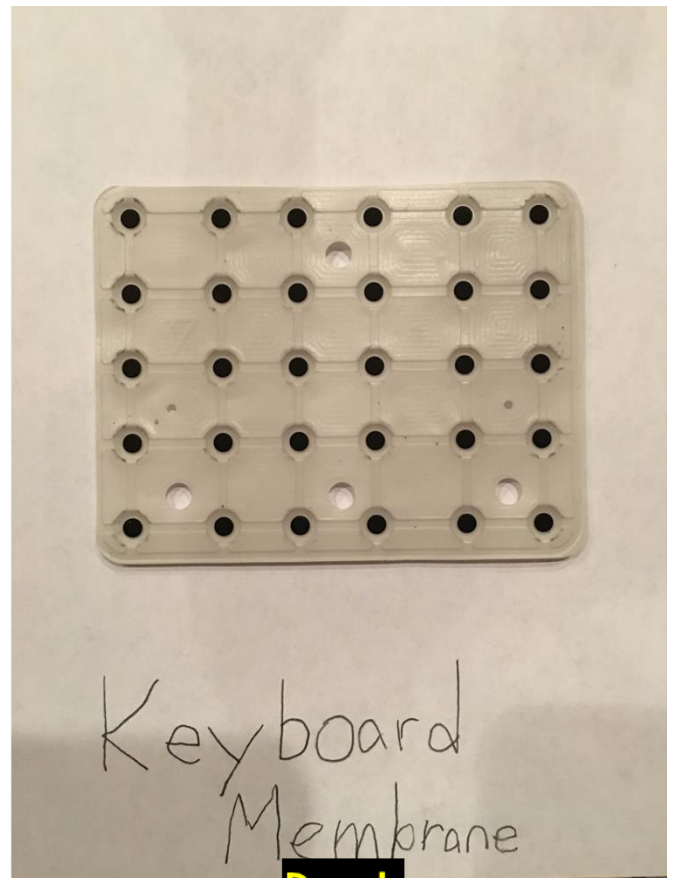
# Separated and Labeled Parts



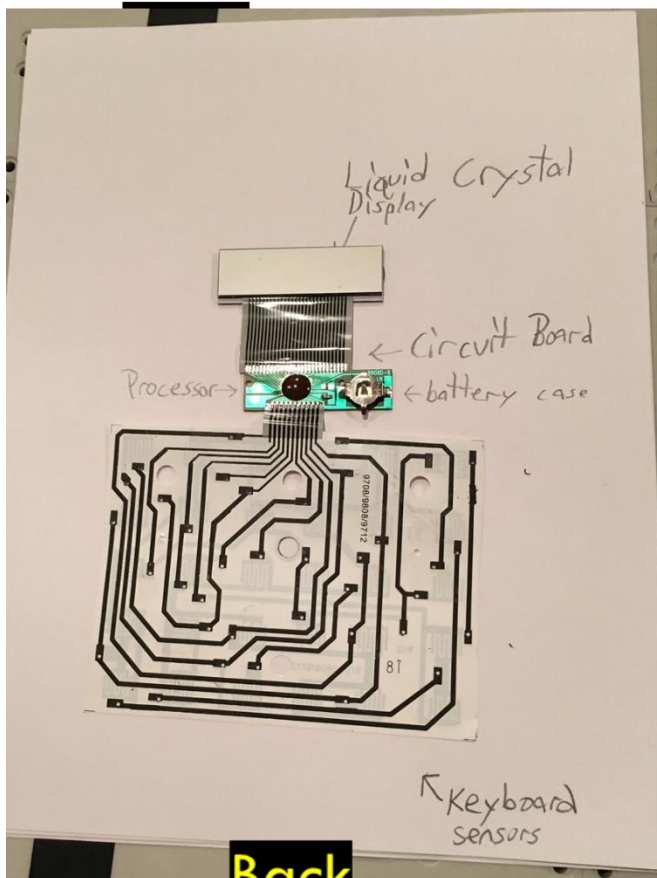
# Separated and Labeled Parts



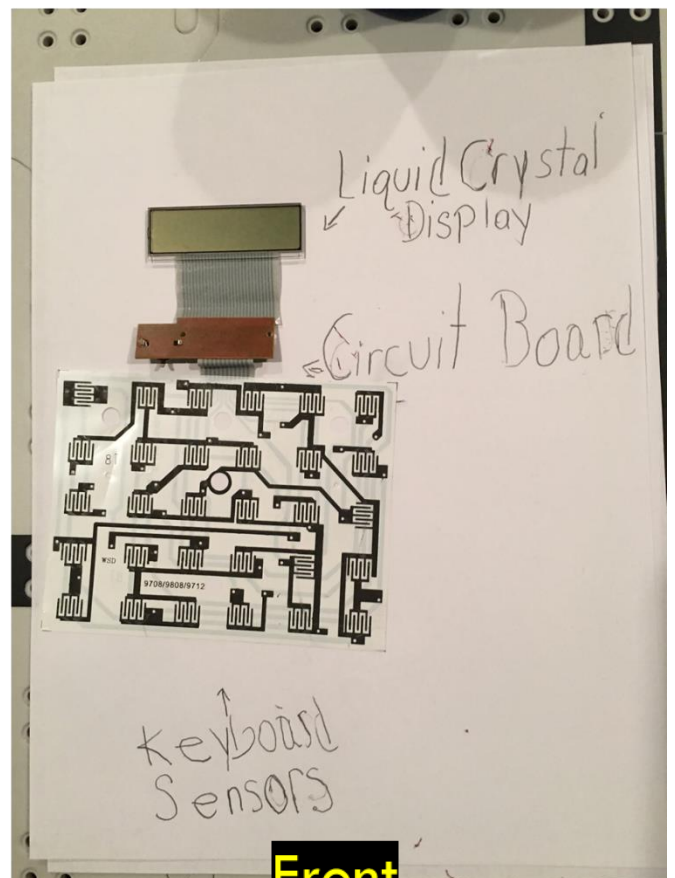
**Front**



**Back**

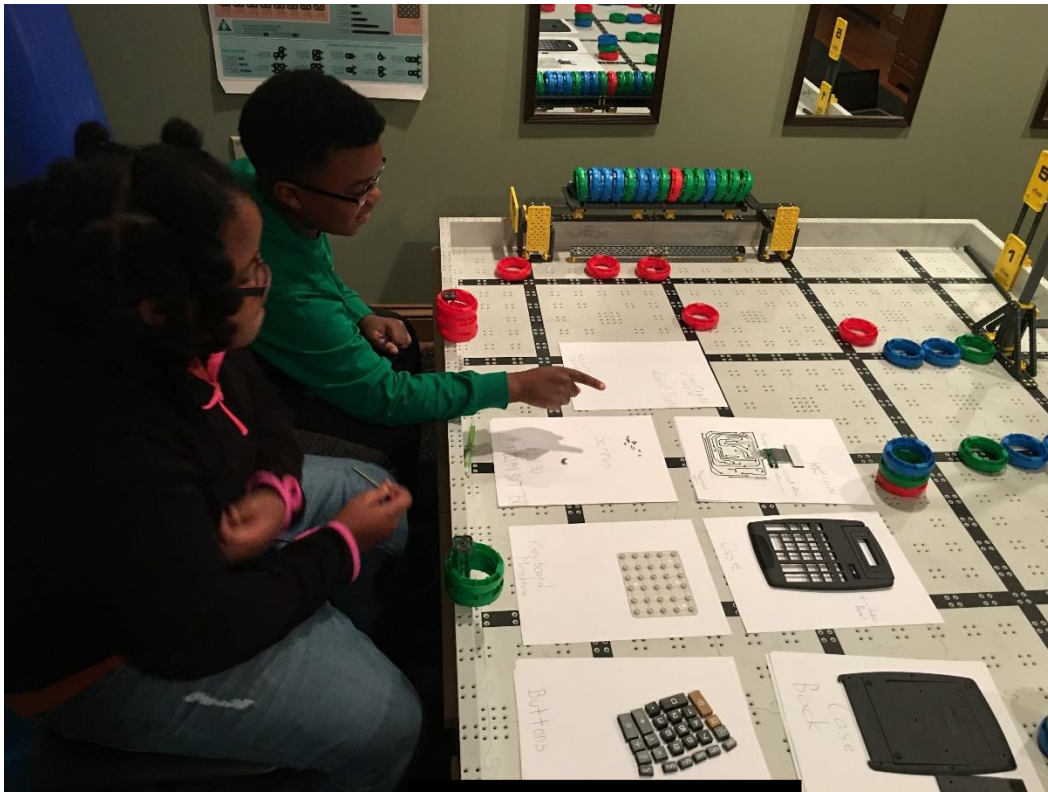


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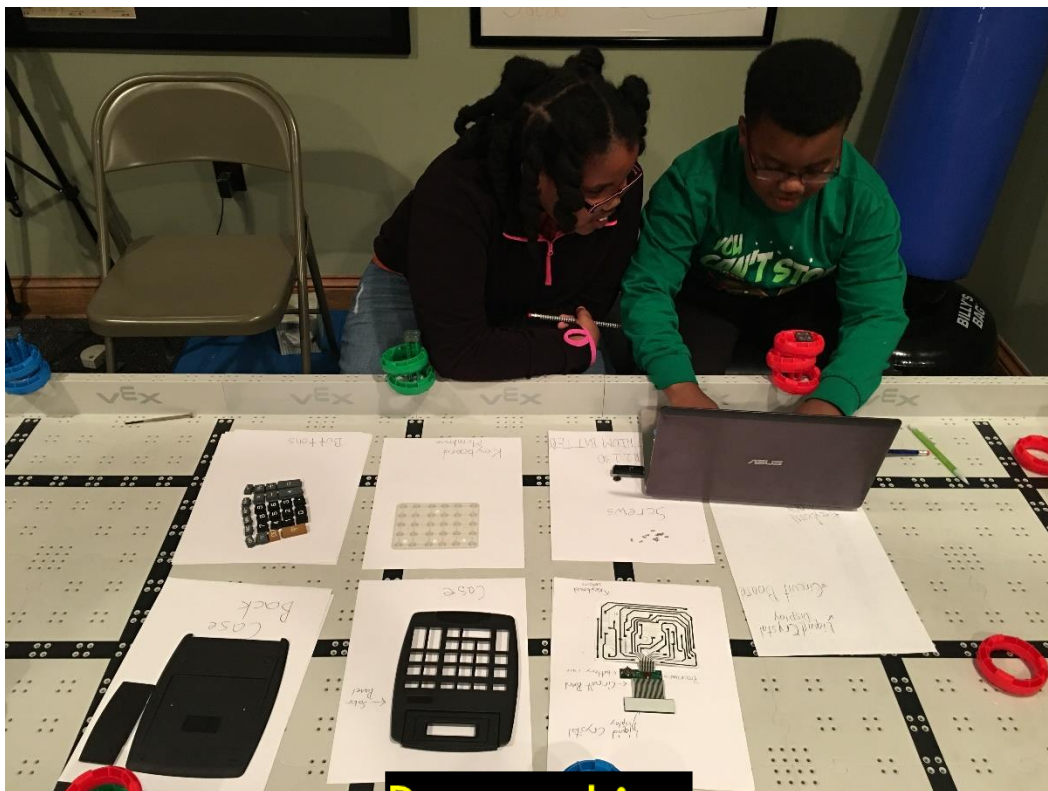


**Front**





Discussing Parts



Researching



THANK YOU!

