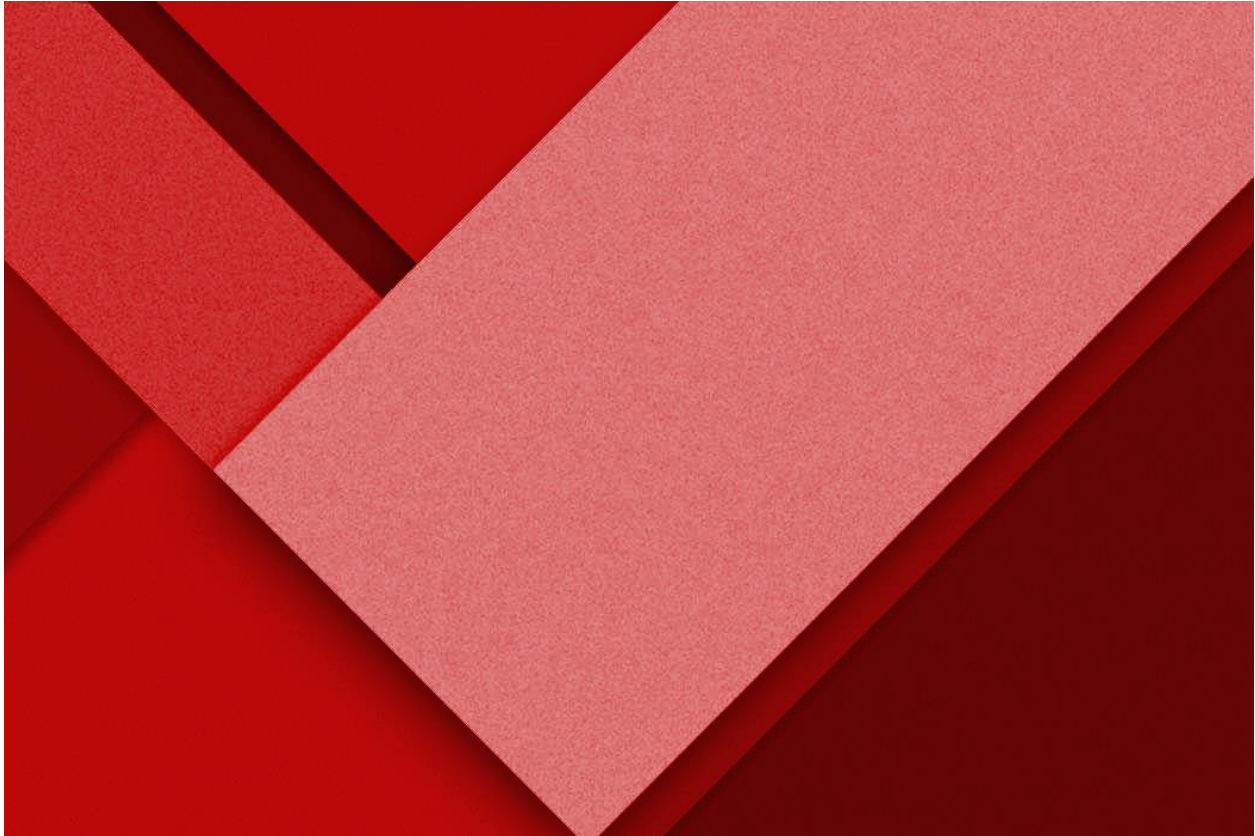


**VEX IQ**  
**CHALLENGE**



**TEXAS  
INSTRUMENTS**



***VIQC Elementary School - Reverse Engineering Online  
Challenge sponsored by Texas Instruments***

**Sandpiper Elementary School - Redwood City, California**

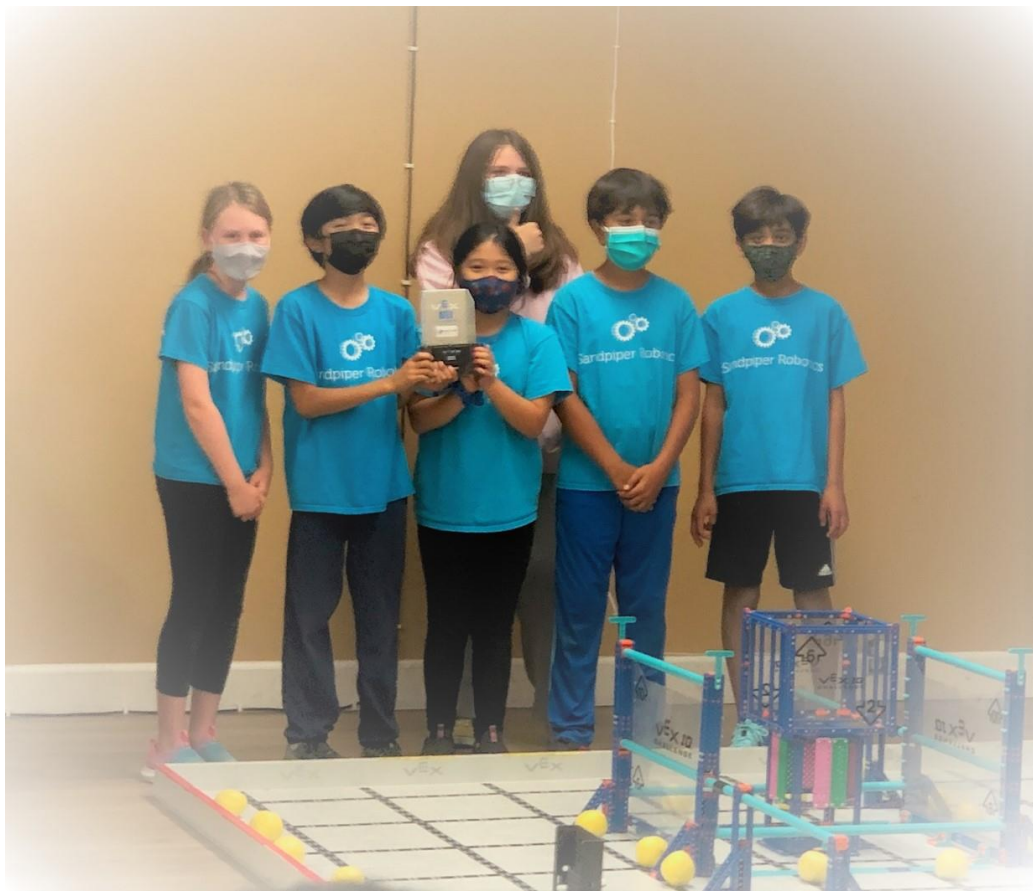
**TEAM 2014S - The Cherry Bombs**

**Written By: Claire Conway and Arjun Sood**

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# TEAM 2014S - The Cherry Bombs



## About the Team

This is our team, The Cherry Bombs/2014S. We are in fifth grade at Sandpiper Elementary School in Redwood City, California. We have been together as a team since third grade. We didn't know much about each other in the beginning, but now we are all close friends. Overall, we have learned a lot during our time doing robotics, and we hope to continue it.

## Motivation for the Device



The Texas Instruments 2021-2022 reverse engineering challenge turned out to be as much fun as it was a challenge. We began working with our mentor to choose an electrical device to learn more about. Because the VEX tournament challenge this year for elementary schools was to build a robot that could quickly collect objects on the field, we thought that learning how a handheld vacuum collects dirt and debris off the floor would be good to see! Here is our version of reverse engineering the Welikera handheld vacuum.

## Vacuum Deconstruction Process



This is a Welikera vacuum. This was the vacuum we chose to take apart for the challenge this year. This is a very simple, straight forward vacuum. The vacuum has a simple on/off switch, a charge port, and a handle.

The model is H-03, and the power is 100 W. The charge input is 100-240v =, and the input is 13.5 volts.



When we started to do the deconstruction we separated it into 3 different parts, the easiest parts to take off. Here, we have the vacuum, filter, and then nozzle. The filter is a stainless steel filter.



We started to look at where the screws are along the vacuum. There were 9 screws in total.



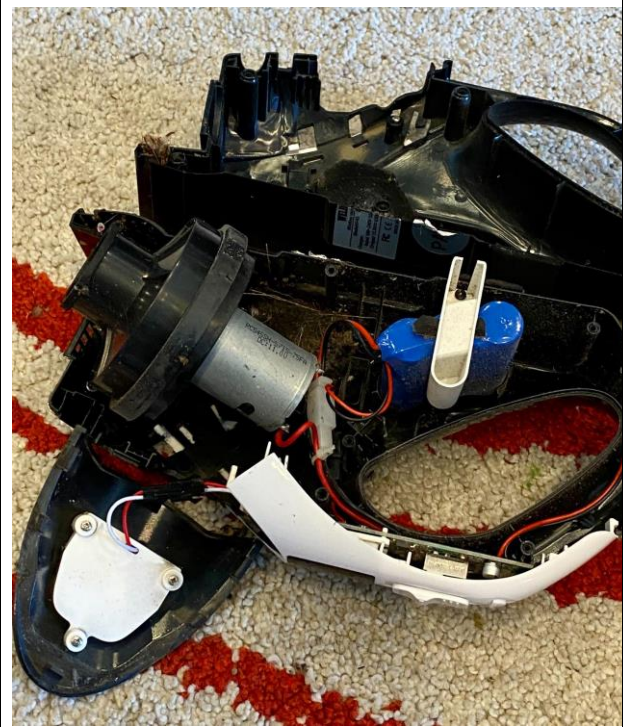
We got a screwdriver and started to take out the screws. We used a crosshead phillips screwdriver.







Not only was the vacuum held together by screws, it was also held by clips, so we carefully took apart the vacuum.





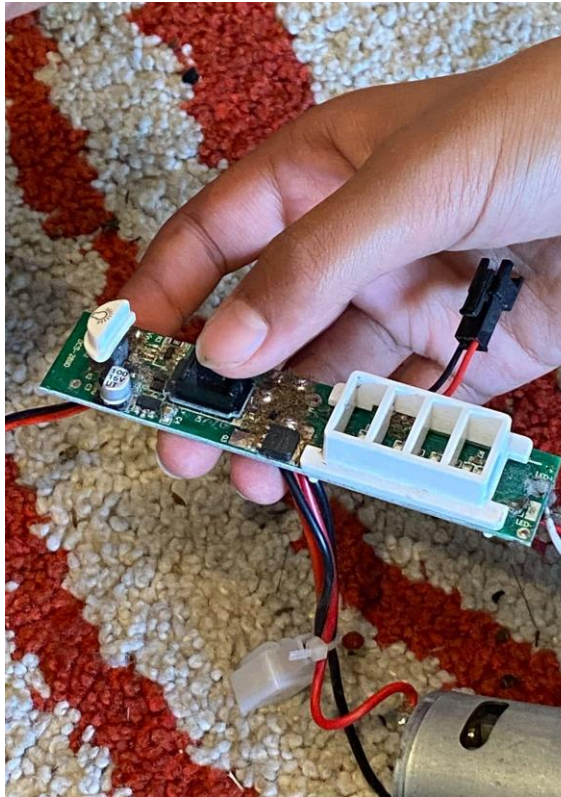
We got to open it. It was very filthy before this photo.



In this photo, we saw the fan. We used a metal saw to cut it open. We ended up successfully sawing the fan away from the motor.

## Documentation of the Parts

	<p style="text-align: center;">Main Parts</p> <p>There are 3 main parts in the handheld vacuum cleaner. They were</p> <ol style="list-style-type: none"><li>1. Main Compartment</li><li>2. Filter</li><li>3. Nozzle</li></ol>
	<p style="text-align: center;">Battery</p> <p>These are the batteries we found in the vacuum. We cut off all of the casing for the batteries, and the battery number is FST18650-2600mAh. The batteries are also rechargeable nickel-metal hydride. In total, we found three batteries in the casing.</p> <p>Each Battery had a charge of 2.6Ah</p> <p>With 3 Batteries we had the total charge of 7.8Ah</p>
	<p style="text-align: center;">Main Circuit Board</p> <p>The circuit board has wires connected to it that control about 4 of the vacuum. It is about 70 different little pieces that</p>



control it. If even one was lost the vacuum would not work properly. There are 8 wires attached to the board 4 black and 4 red. It will tell the other pieces with an electric charge to start the vacuum and turn it off as well. The board turns electric energy into mechanical energy.

Part Numbers-

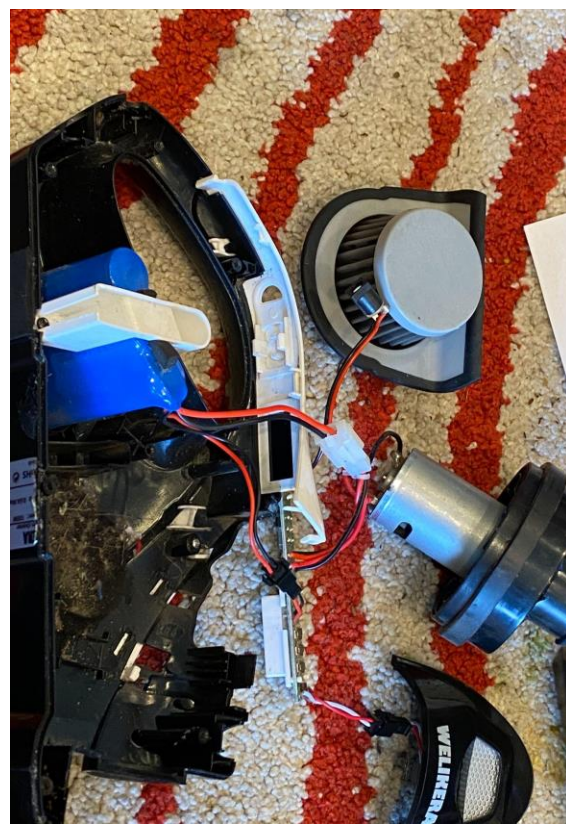
Main Circuit Board Part Number - DSC-289D

- There are 36 different resistors (R)
- There are 10 transistors (Q)
- There are 11 capacitors (C)
- There are 4 diodes (D)
- There are 5 light emitting diode(LED)
- There are 3 integrated circuits.
- 
- There are 2 switches (K)
  - Switch 1 - Is for turning on and off the vacuum
  - Switch 2 is for turning on the LED light
- Main Power Supply from the batteries (Vin+)
- There is 1 ground connection.(GND)
- R8726 integrated circuit board



Part number - 100 16v UT

The capacitor is for storing electricity and ac flowing instead of dc.



### Filter

The filter makes it so that nothing comes into the inside and damages any other pieces like the circuit board. But as we see there was a lot of gunk inside of the vacuum. We had to clean up the inside to actually see inside of it. It felt like there was more trash in the vacuum than in the storage. It was designed to let air out and still keep out the gunk.



### Main Motor

In the motor, there are three different parts. Gasket, black plastic, and the motor. The motor is important because it converts electrical power into mechanical power, allowing the vacuum to function, which is very similar to our robot from robotics. The purpose of the gasket is creating the seal to keep suction. And the black plastic is a casing for the motor to direct air flow.

The motor number is: RC545SH-5715-75FA DC: 11.0V.



In our vacuum motor, we found one rotating fan. The rotating fan's purpose is to force outside air in through the round  $\frac{1}{4}$  inch opening at the bottom of the shell. At the top, the air goes through the exhaust.



## Motor

Picture of a brushless motor that we found in our vacuum.

### How does a motor work

In the middle of the motor, we have the magnets. On the sides of the magnet, there are coils. When the current goes through the coils it causes the rotation because of the magnet. The coil generates a magnetic field that attracts the rotor's permanent magnet. The coil uses the current of electricity.

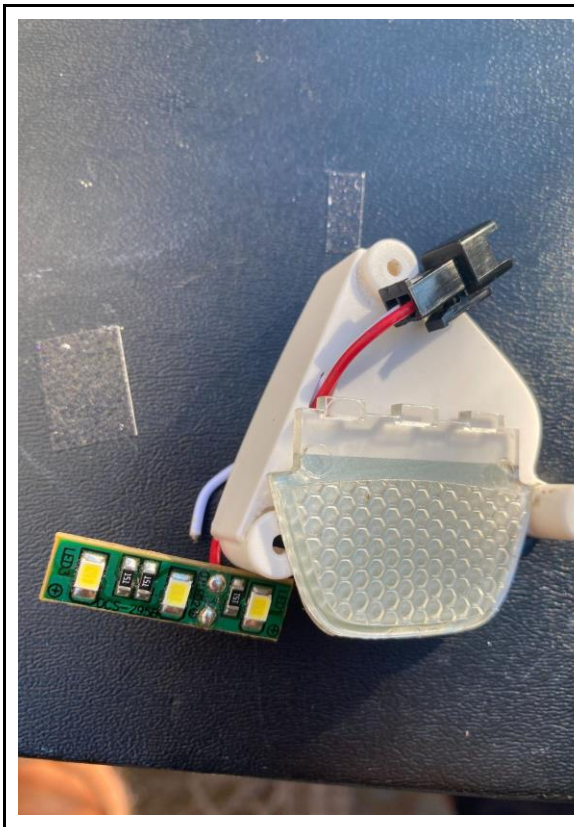




LED Light

There is a small light that shines when turned on and off. The importance of having a light is that if you are vacuuming in darker places you can see what you are suckin and where you are sucking up and also if you are sucking in the dark.





### LED Circuit Board

The LED circuit board has 2 wires attached to it and 6 little pieces of metal. It is very important to the light and controls the on and off switch.

Circuit Board Part Number

- DCS-2958

## Conclusion

In conclusion, after this we felt like we learned a lot doing this and want to do it again. We now know what is in the vacuum and how it really operates. We saw the inside and figured out how it sucks up the dust particles. Our parents/mentors typically do not let us rip apart gadgets so we loved how we could take this one apart. We found out how a modern hand held vacuum actually works. Moving forward, when we see a vacuum we can imagine how the inside works with motors, circuit boards, filters and batteries. The chamber in the vacuum is very much like the chamber on our robot. We also use a lot more motors than the handheld vacuum cleaner.