Reverse Engineering a Vex V5 Motor

By: 6978 D

Contributors: Michael, Hailey, Anna

Location: Highland High School, at
1300 OH-314, Marengo, OH 43334

About us.

We are a team of six seniors with six years of VRC experience.

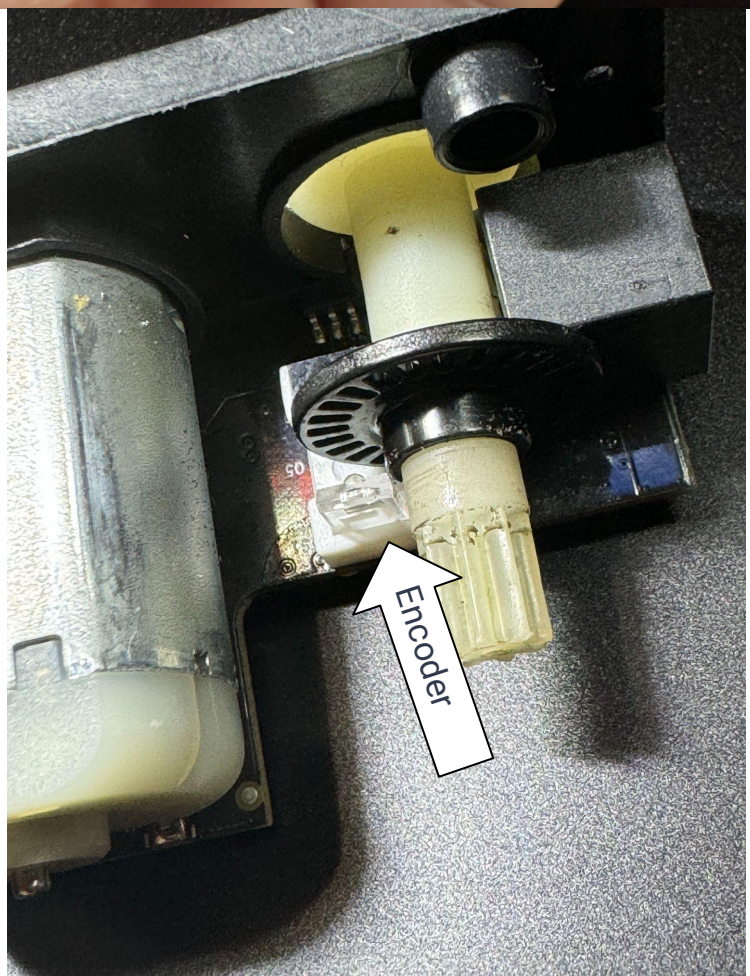
Why we chose a Vex V5 motor.

We chose a Vex V5 motor because we rely on them in many situations in this year's game, Over Under. We wanted to increase our knowledge on how they work. So if needed we could make a quick repair, or at the very least understand how and why they work.

Internal gears and encoder.

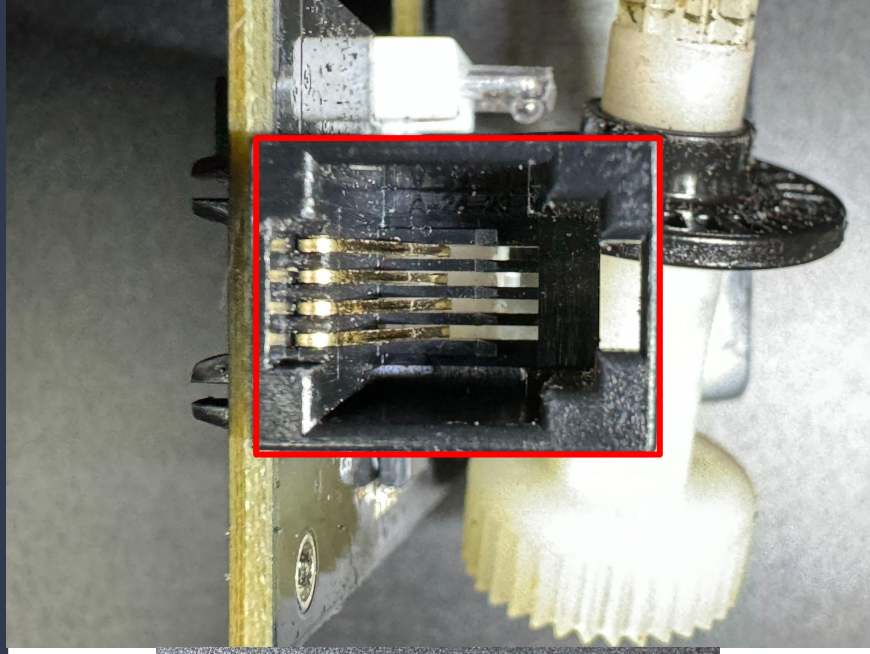
The Vex V5 motor itself has internal gears, as shown on the right giving it a gear ratio of 3.6:1 thus changing the output speed and torque.

The Vex V5 Motor encoder is what gives the ability to turn to a very specific degree. This is possible by a laser and a light reader, meaning that every time the laser reaches the light reader it's counting that as a tic on the encoder, which can be converted to degrees. This is very useful for autonomous. The higher gear ratio you have the more precise the motor. Since the encoder counts 1800 ticks per revolution with a 36:1 gear ratio, 900 ticks per revolution with a 18:1 gear ratio, and 300 ticks per revolution with a 6:1 gear ratio.

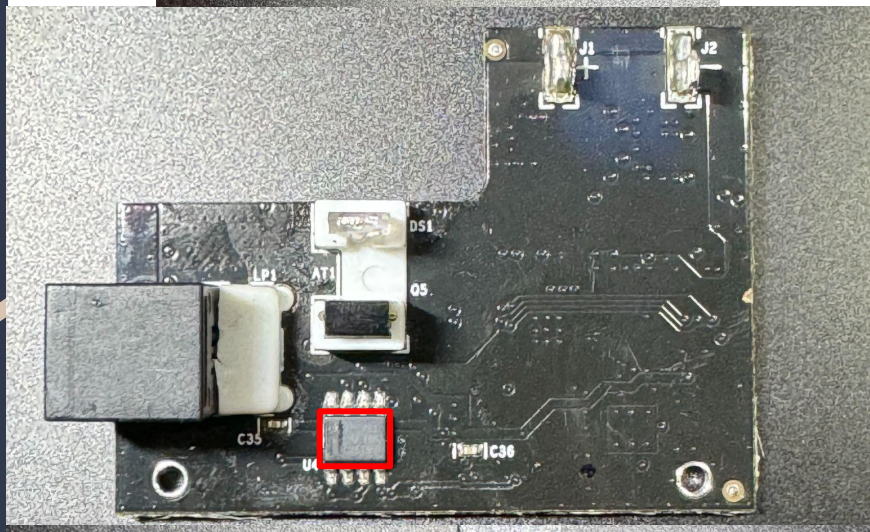


Internal Electronics

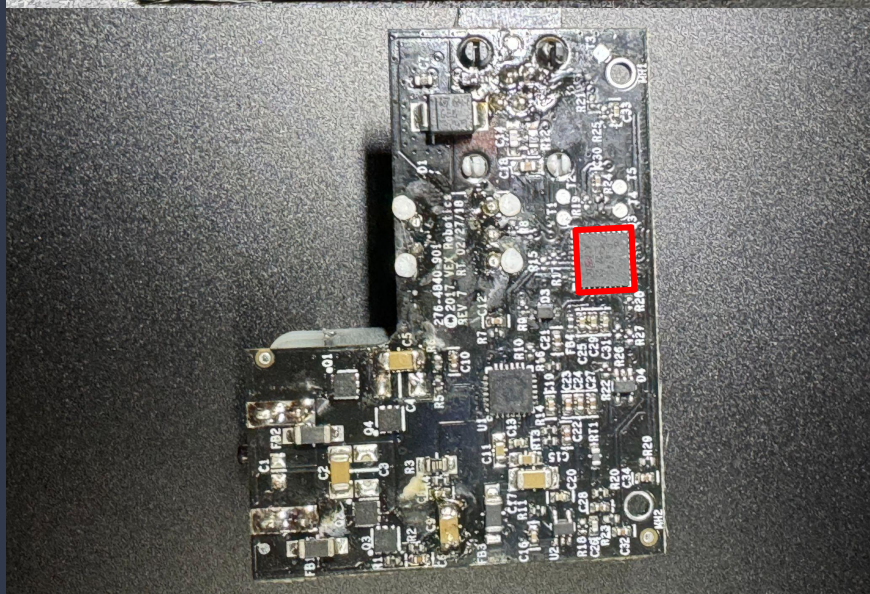
This is the RJ11 port that is used to power and send information (code) to the to the motor.



Vex V5 motors use a full H-Bridge. Which gives us the huge advantage of bidirectional motor control. Without bidirectional motor control we would only be able to use the motor in one direction based on the electrical circuit.



The Vex V5's Cortex M0 microcontroller is essentially the brains of the motor; as it monitors everything. For example, it monitors things like position, speed, direction, voltage, current, and temperature. This enable us to have a much more consistent speed and stopping point, helping us in coding the autonomous.



What we learned

We learned how an H-Bridge works, and how it benefits our team. Without it we wouldn't be able to move anything forward and backward with a motor, we would probably end up having to enable the motor to go back with rubber bands.

We learned how the Vex V5's Cortex M0 microcontroller works and how much it can truly do. This will help us use some of the sensor features that we didn't know that the Vex V5 motors have.

We also have learned how to fully take apart a Vex motor and all three cartridges; meaning, we can fix motor or cartridge issues very efficiently. In the process of researching we also learned how to make an RJ11 cable. If we have a bad cable, we could fix it.

Resources Used

https://wiki.purduesigbots.com/vex-electronics/vex-electronics/motors

https://kb.vex.com/hc/en-us/articles/360044325872-Understanding-V5-Smart-Motor-11W-Performance

https://aosmd.com/sites/default/files/res/data_sheets/AO4818.pdf

https://www.linkedin.com/pulse/maximizing-efficiency-h-bridge-circuits-comprehensive-overview-wmpcc/