



VEX VRC – 2023-2024

Reverse Engineering Challenge

Winters High School Robotics
Team 39599H
Winters High school
Winters, California, USA

By: Aydarri, Maddy, and Josie

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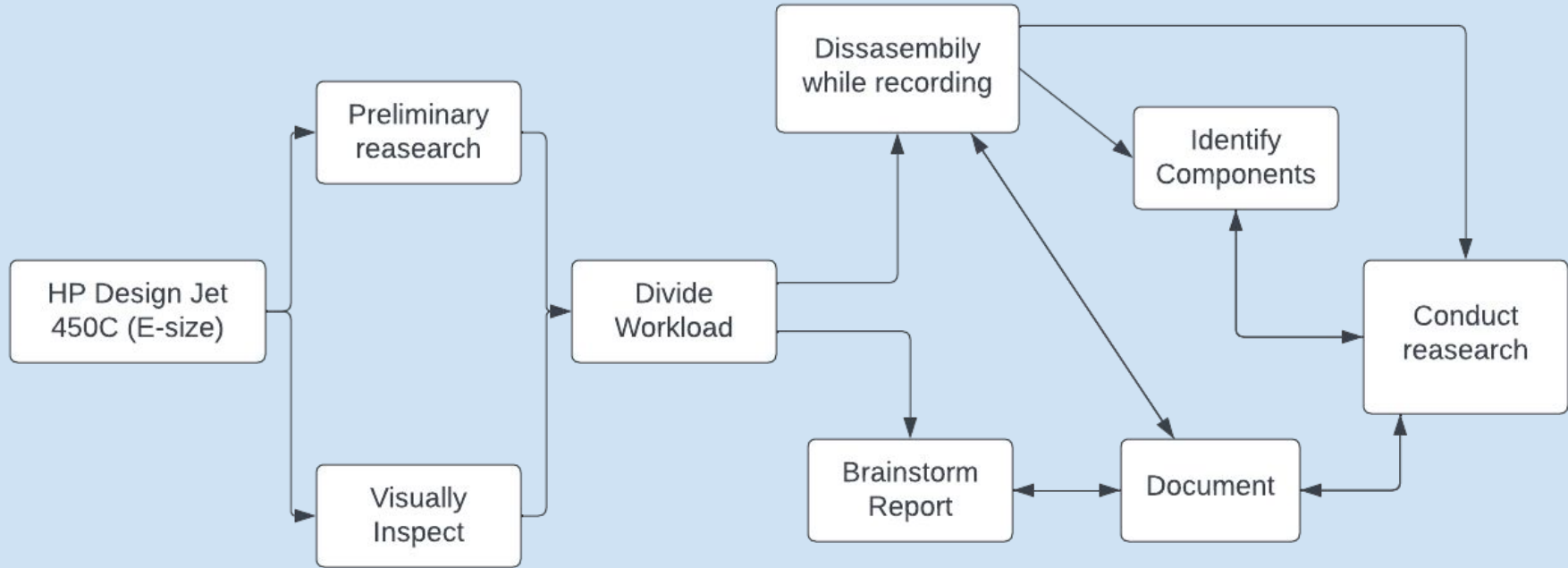
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1. Introduction

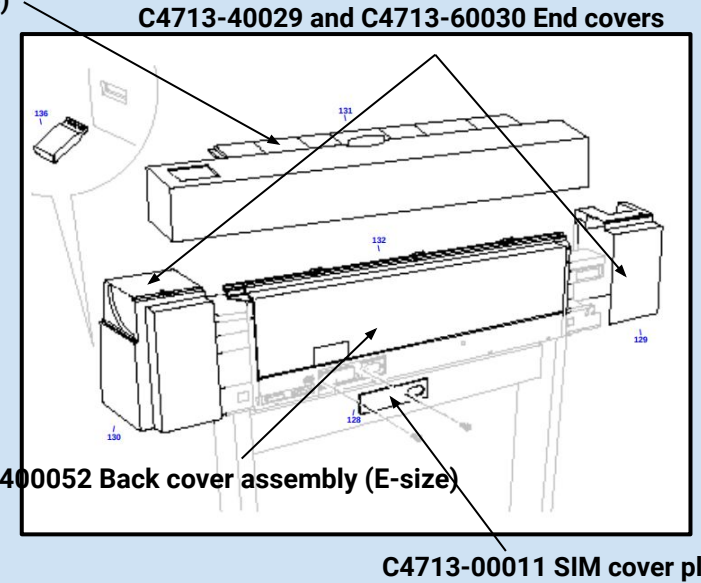
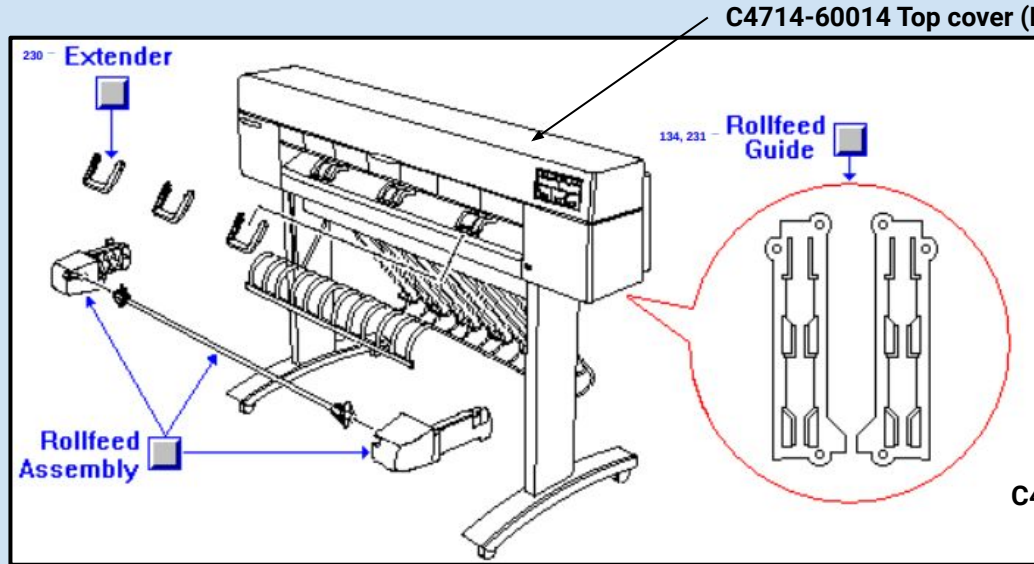
Our VEX team is a 3 member all girls team. We work on our robot out of our coach's classroom at our high school. For the last few months our coach has had a broken HP printer in the classroom. As a team we decided this would be our reverse engineering project because it wasn't working and we hoped that when we took it apart we would be able to see the broken components and find a solution to the problem so it could be used again.



2. Approach



3.1 External View



3.2 External Components

C4714-60014 Top cover (E-size)

- Protects the internal components on the top from damage



C4713-40029 Left end cover

- Holds the computer and sides of the printer together



C4713-40052 Back cover assembly (E-size)

- Back panel protects inside components on the back of the printer from damage

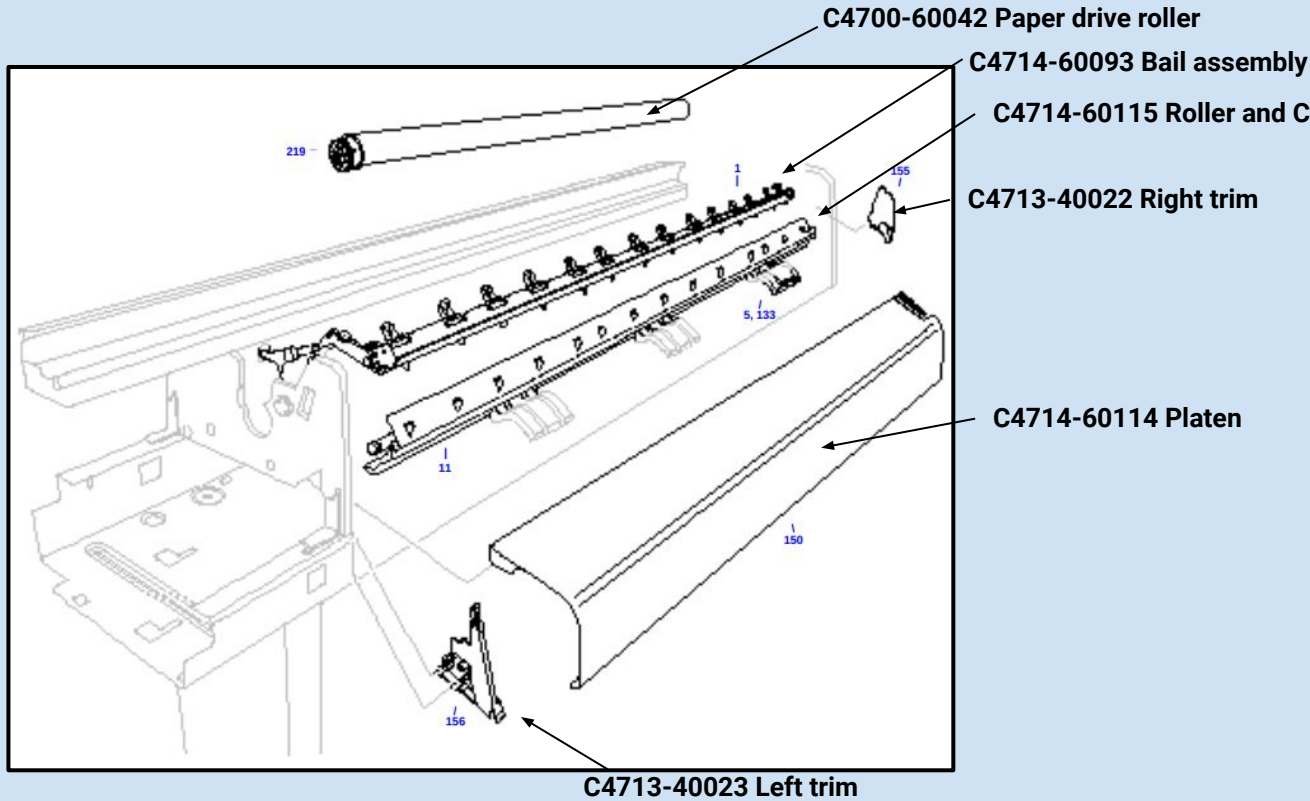


C4713-00011 SIM cover plate

- This cover plate protects the SIM from any damage.



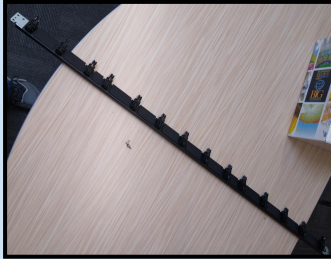
3.3 Internal and External View



3.4 Internal and External Components

C4714-60093 Bail assembly

- Guides printer paper through inoperable situations



C4714-60114 Platen

- Curved cover/guide that is next to the paper drive (Platen) roller

C4713-40022 Right trim and C4713-40023 Left trim

- Stationed on the left and right sides of the platen

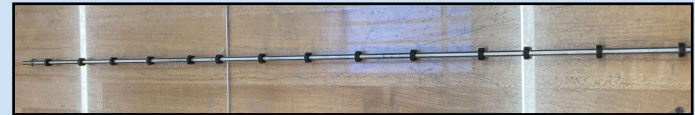
C4714-60115 Roller and C4713-60117 Deflector

- Black roller drive is built in with a metal protector piece and an overdrive assembly, it rolls over sheets of paper to straighten and line them up for printing

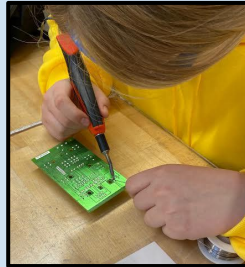
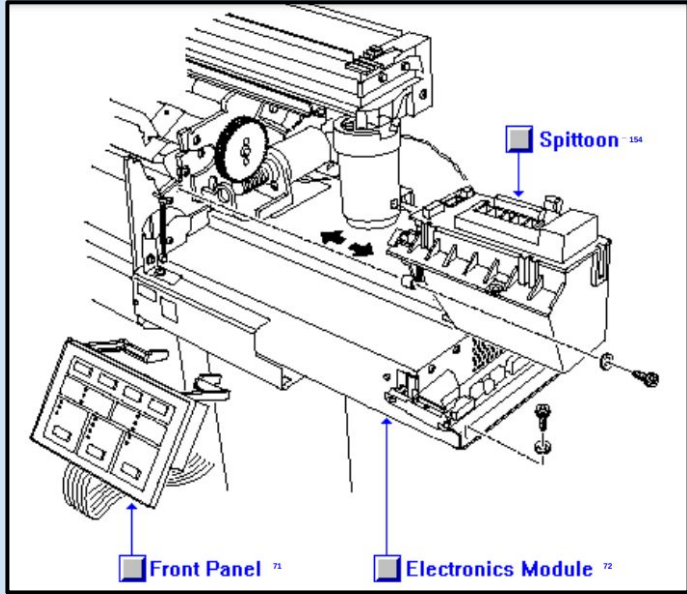


C4700-60042 Roller

- Long gear driven roller - Includes roller and mark encoder
- Small rubber wheels inside the printer move sheets of paper through



3.5 Internal and Electronics View



C4713-69203 Electronics module

- Contains power supply, main logic board, interface connectors, and fan

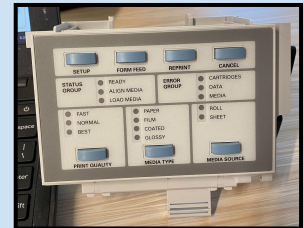
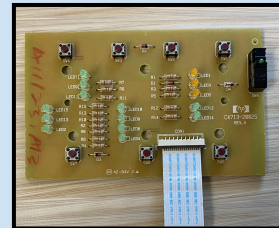
C4713-60017 Spittoon

- Contains absorbers which hold excess ink from cartridges



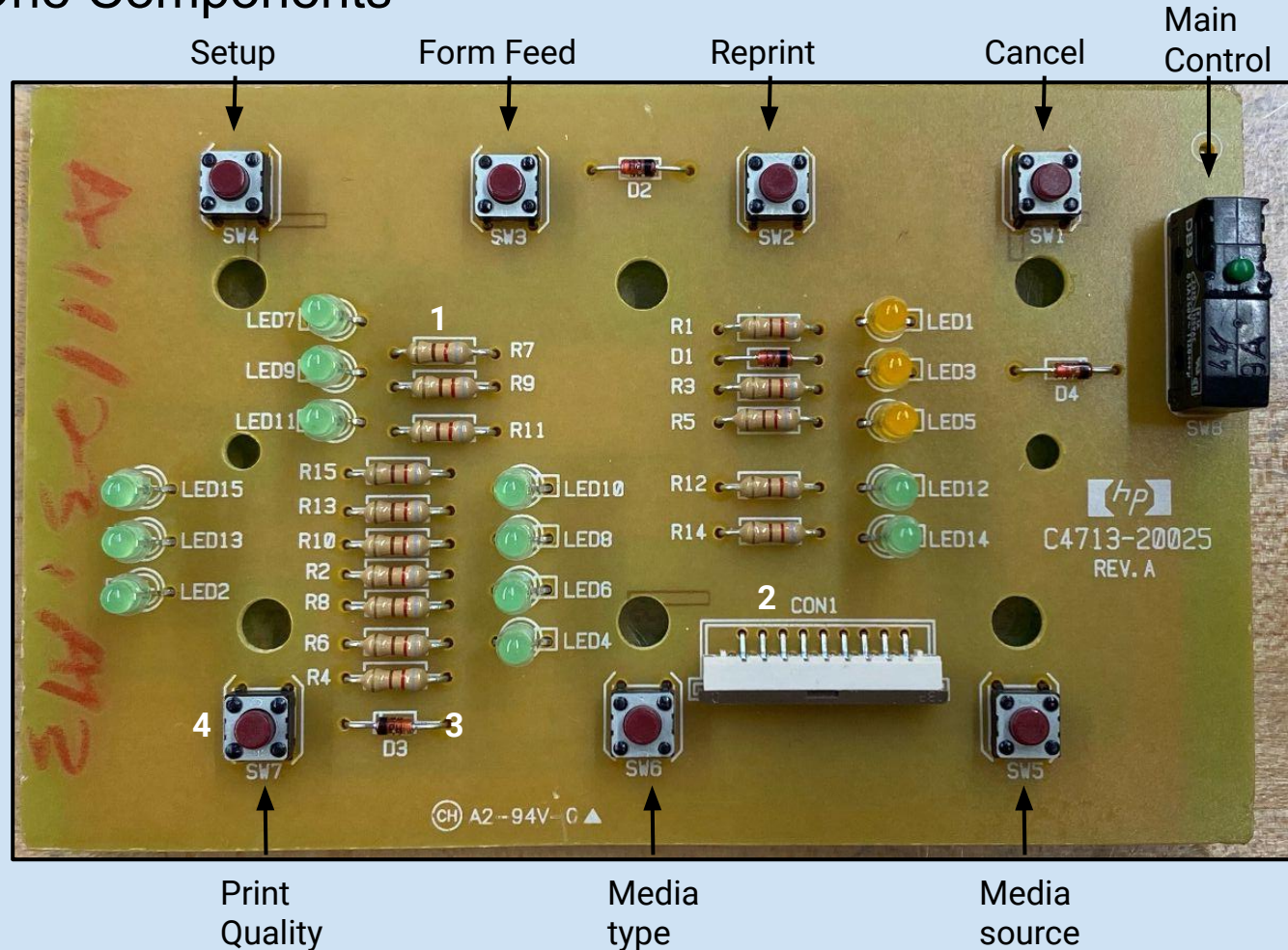
C4713-60091 Front Panel and overlay

- The front panel has buttons that you can press for different settings and lights that react with the circuit board when the labeled action is going on.
- The overlay is the sticker that labels all of the components on the panel.



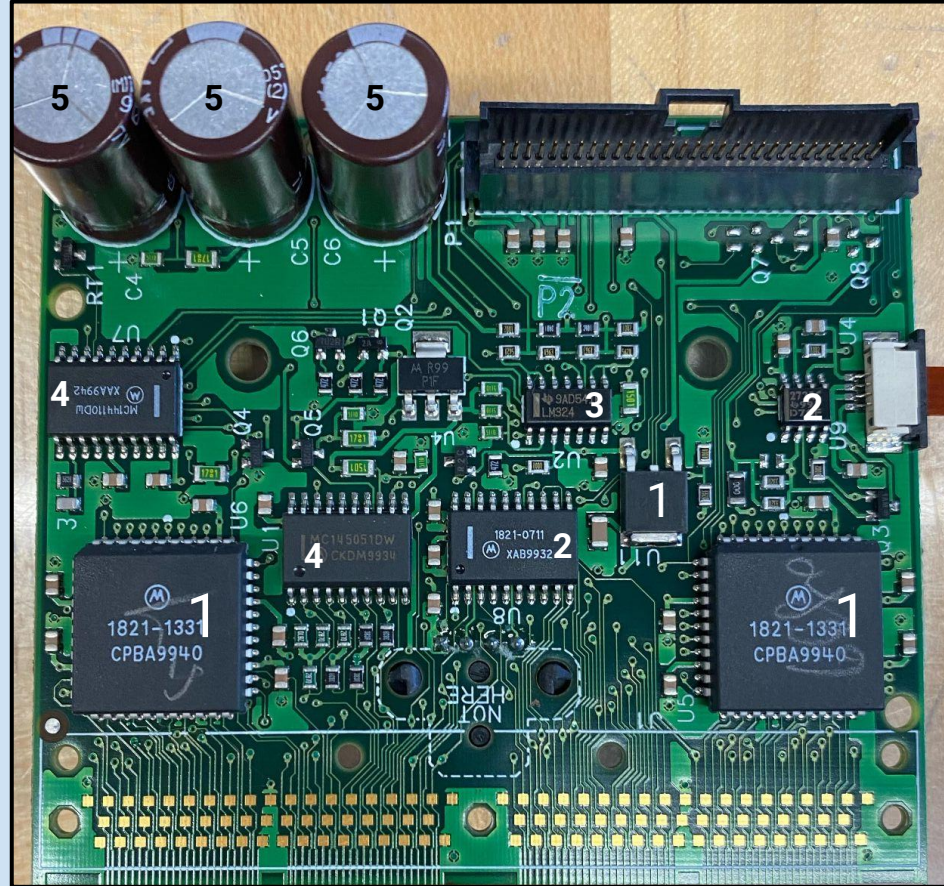
3.6 Circuit Board One Components

1. The circuit board uses 15 820 ohm resistors to limit the current.
2. The CON1 connector transfers power and signals from one circuit to another.
3. The pin diode and are used for Radio Frequency protection circuits
4. The SW switches react with buttons on the overlay to turn on and off the reactions.

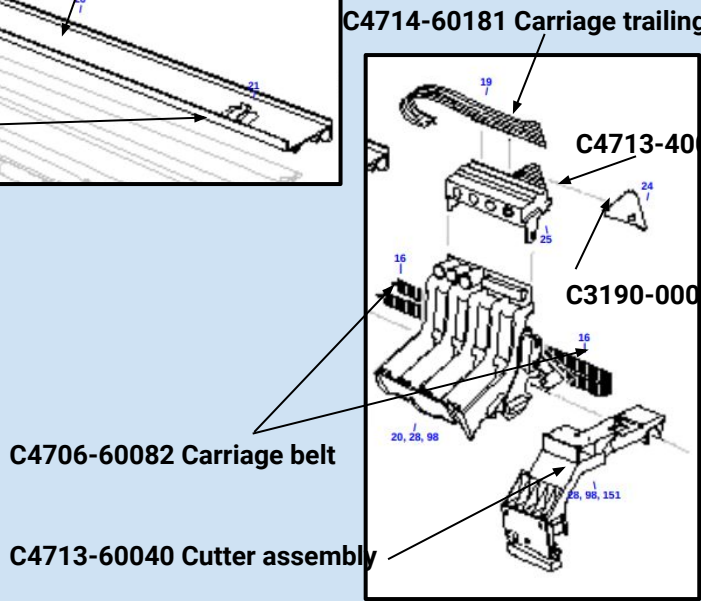
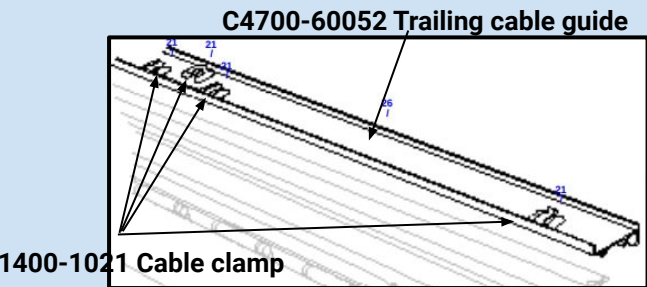


3.7 Circuit Board Two Components

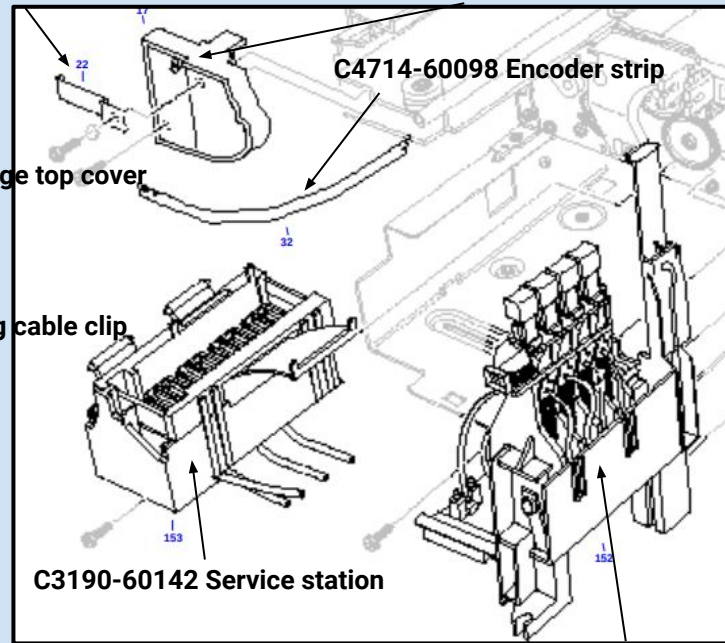
1. Semiconductors make it so only a certain amount of electricity can flow through based on how much voltage is applied. Smaller versions contain less power.
2. The integrated circuit can act as an amplifier, logic gate, timer, counter, and microcontroller for the printer.
3. The quad amplifier serves as a voltage amplifier and comparator
4. Digital to analog converter changes a computers signal into voltage for the circuit.
5. There are 3, 25 volt and 820 microfarad capacitors which temporarily store energy and distribute it through the circuit.



3.8 Carriage Drive and Internal View



C3190-00012 Left encoder clip C3190-40040 Left encoder bracket



C4713-60023 Primer assembly

3.9 Carriage Drive and Internal Components

C4700-60052 Trailing cable guide

- Tray used to hold and guide trailing cables



C4714-60181 Carriage trailing cable

- Has 60 pin (F)connectors-1.9m(6.2ft) long

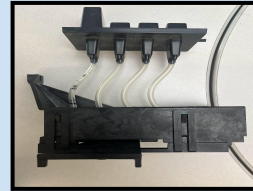
C4713-40038 Carriage top cover

- This is the ink cartridge selector. This component selects the desired ink and dispenses it where it is needed.



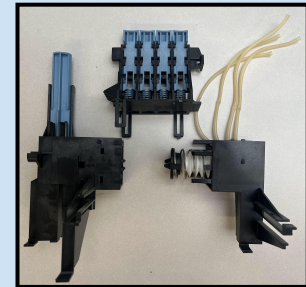
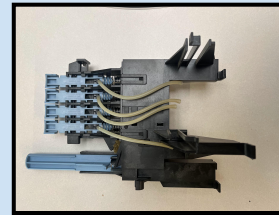
C3190-60142 Service station

- Used to extract a few drops of ink from the nozzles to activate the printheads when a print job is sent to the printer.

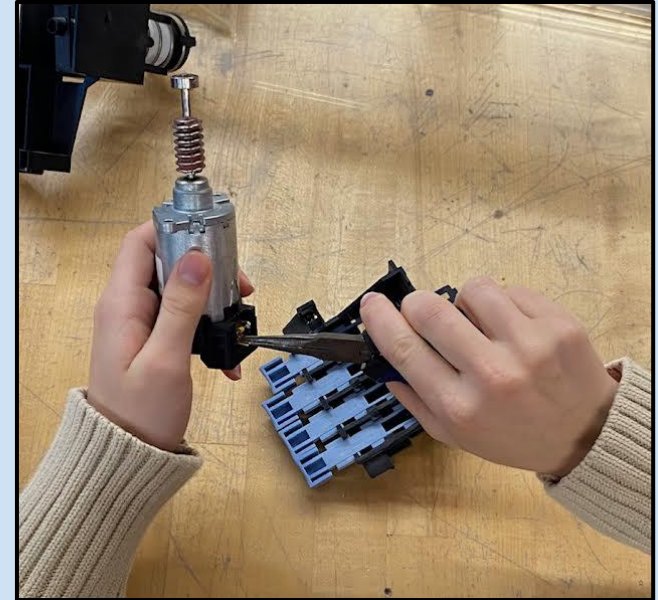
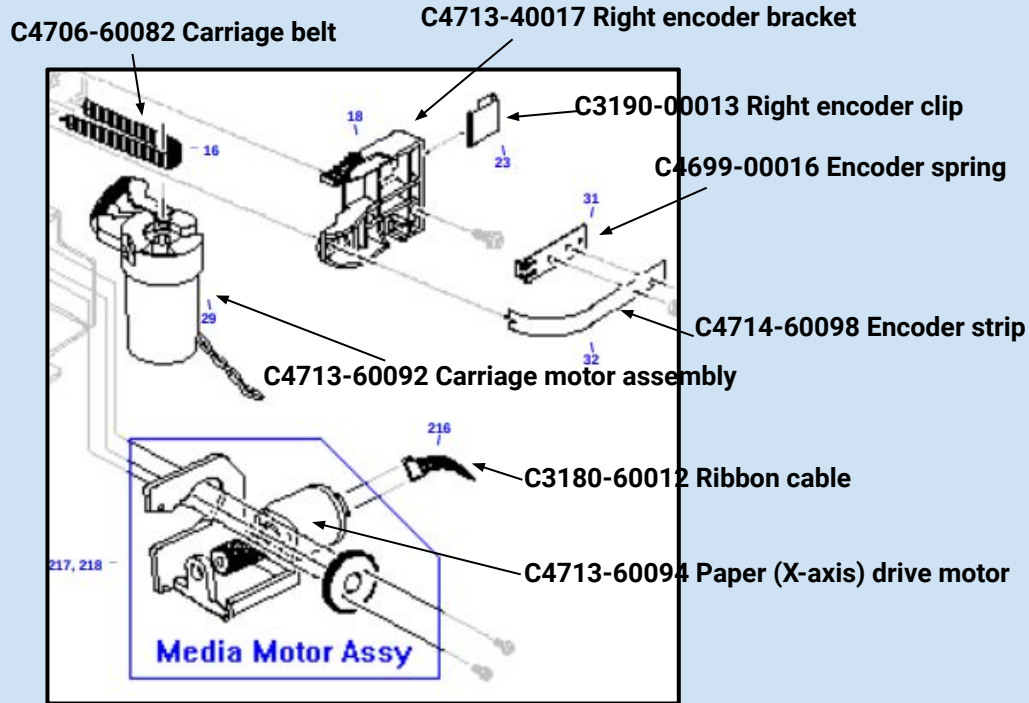


C4713-60023 Primer

- Long Blue slide pushes down on a hinged lever which pushes the spring and pumps the ink.



3.10 Carriage Drive and Paper Drive View



3.11 Carriage Drive and Paper Drive Components

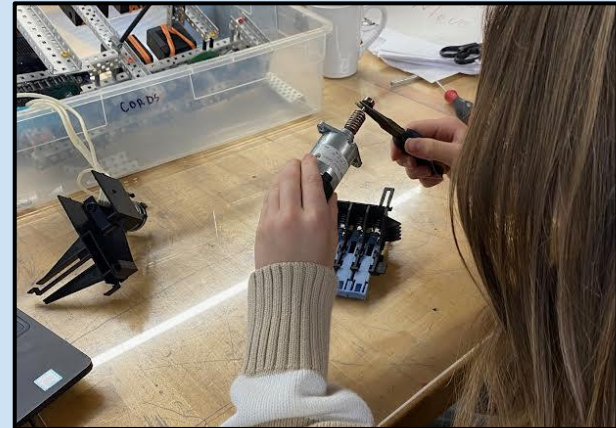
C4713-60092 Carriage Motor Assembly

- This motor spins the roll wheel feeder that intakes the paper to the printer. This motor has a worm gear on the end that attaches to a worm gear to change the height of the drive shaft.
- In the opened view of the motor you can see the rotor, drive shaft, stator, bracket, and power cord. You can also see the outer metal shell that houses the components of the motor.



C4713-60094 Motor/Gear

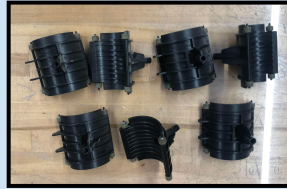
- Paper (X-axis) drive motor (Includes helical drive gear)



3.12 Additional Components

C4699-60081 Pincharm

- Curved black plastic plate that shows the function of the front panel buttons and indicator lights.



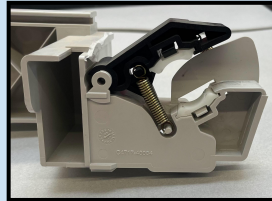
C4713-40046 Power switch button/keycap

- For computers in hard to reach areas this is a way to switch the computer on.



C4719A E/A0 roll feed kit and C4713-40025 Pinchwheel manual lift handle

- Includes left and right housing, hubs, spindle, end caps, screwdriver, and screws
- Springs hold the paper roll in place and allow it to spin.
- These handles are used to load paper into the printer



C4713-60129 Clutch and Small gear

- The clutch is used to stop annoying delays. Used in paper-feeding applications.
- The small gear attaches to the larger gear that rotates the printer roller. This increases the torque mechanical advantage of the printer roller.



4. Summary

Have you ever wondered how something works that you use on a day to day basis? For instance, a coffee machine or a printer, we know what it does, but not how it works on the inside. While we can just look it up, reverse engineering can give a better understanding of how it works, and not just what it does. Reverse engineering is the process of analyzing a product or system to understand how it works, its components, and its functions. This is usually done by taking apart the product, examining its structure, and studying its behavior. The objective of reverse engineering is to gain insights into the design and functionality of a system by disassembling the product and documenting our own comprehension, without having access to its original blueprints or documentation. During this project, we took a lot away, we learned how to disassemble a printer in an organized, timely fashion. We also improved our skills on analyzing and documenting the components, and then reporting on them. This is a similar strategy to the one used in our engineering notebook. This helped us improve our documentation process and reporting in our notebook for robotics. We also learned how to efficiently communicate to each other about different components and teach each other so we could have a collective understanding about how the printer works as a whole rather than only knowing about the components that we each disassembled. Our team was able to disassemble the HP DesignJet Printer through following precise and careful procedures to stay clear of damaging the printer or causing injuries. We started by dismantling the legs and the media bin arm from the printer. This allowed us to lay it on a large desk and begin to take off the outer protective shell of the printer. Once inside, our team was able to gut the internal components. Our first challenge was trying to take out the ink cartridges because they were attached to a long metal shaft. We were not able to detach the metal shaft until we carefully removed the printhead, rollers, and control board. Once the printer was broken up into smaller, detached pieces, we all separated and worked on our own jobs analyzing, documenting, and reporting on different components. We effectively finished deconstructing all of the parts and worked together to document and analyze them on the way. Other jobs like the title page, intro, and summary were divided across team members and were collaboratively developed. Throughout the project, we found it a struggle to keep track of different size and length screws. This project benefited our team as a whole and allowed us to improve collaboration skills, as well as allowing us to develop a process in which the task was organized in an efficient manner.

5. Sources

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