Reverse Engineering Online Challenge 2023

Disassembly and Analysis of a Laser Printer

Model: Samsung SL-M2024W

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1.0 Summary Report

We decided to choose a printer because it is pretty hard to dismantle and would serve as a challenge, and it would be interesting to know, because it is something we use every day, and we don't often get a chance to dismantle a printer otherwise!

We learned that raw material for laser printer is color powder called Toner, which is heated and baked onto a piece of paper. It starts with two rollers. The charging roller, and the OPC drum. The charging roller applies a negative charge onto the OPC drum while it spins. On the negatively charged drum surface, the laser applies the desired drawing to be printed by turning some of the charges positive. Sponge roller delivers toner to the developer roller and cleans up toner particles that are not delivered to the drum. The Transfer roller pulls down the toner with negative charges which allows the toners to be attached onto the paper. The attached toners are baked with heat and pressure from the heat roller, and the pressure roller and the final image is made. We were able to dismantle rollers and see them, but wished we could see them in action!

The Power Port, located on the right side of the printer, is how it gets its energy. The resistors regulate the flow of energy of an electrical circuit. A transistor is a miniature semiconductor that regulates or controls current or voltage flow in addition to amplifying and generating these electrical signals and acting as a switch/gate for them. A capacitor is an analog electrical component that stores electrical energy - nobody got shocked as we were careful. An inductor is defined as a passive component that is used in most electrical circuits to store energy in the form of magnetic energy when electric current flows through it.

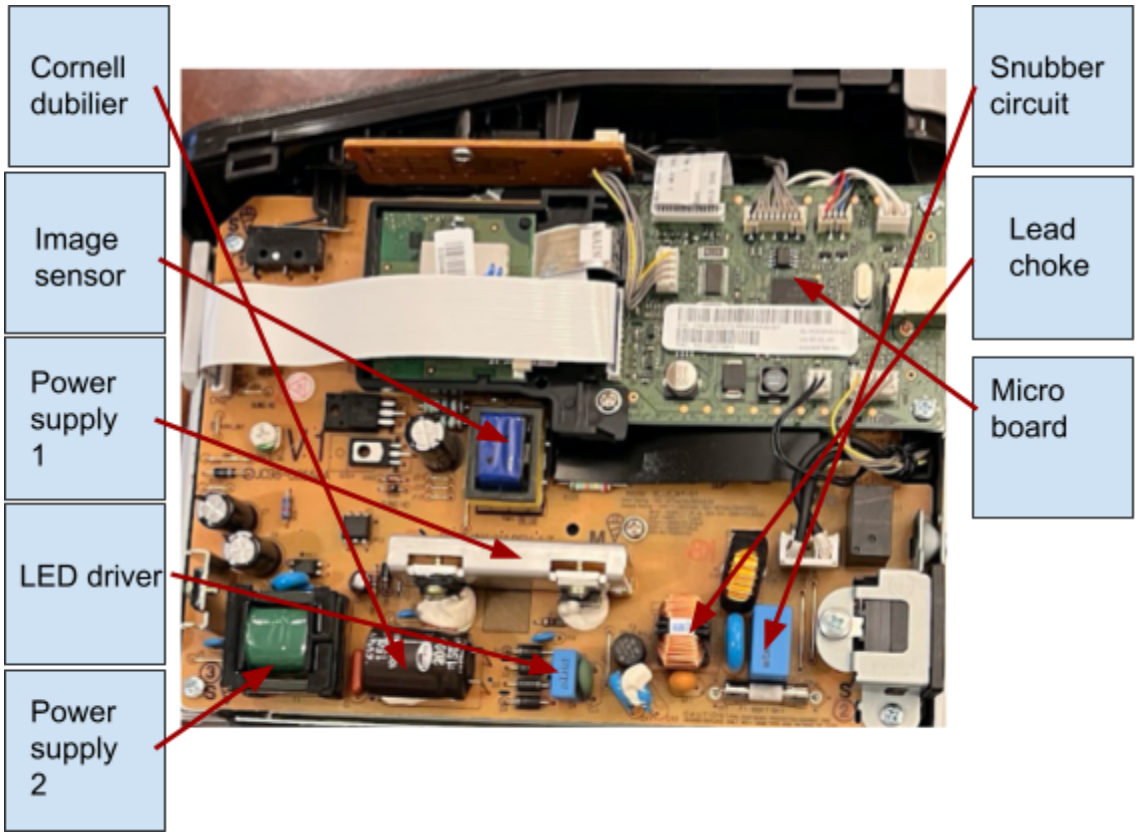
Once on, the printer connects to Bluetooth, or any signals, to find files to print. Document feeder is at the bottom of the provided diagram, and it is what moves in the paper so the roller can put the toner and image on the paper.

We concluded that in addition to newfound knowledge about the printer, we also learned the importance of perseverance, because even though it was very enlightening, it was also not easy to get into. We also had to improvise as we couldn't open the printer from left side, so had to start with right and then get back to left. We also learned that many of these parts are interchangeable with other electronic devices such as gaming consoles and phones. Lastly, research was very time-consuming. We had to read a lot of material to find useful information. But also found some really useful animated videos that showed the mechanical parts in action. This has inspired us to learn animation as a way to share ideas effectively.

Word count: 474

2.0 Complete Part List

2.1 Architecture of motherboard



2.2 Description of parts

The Power Port, located on the right side of the printer, is how it gets its energy. It gives energy to the copper lines which go through ribbon cables to provide energy to the entire printer. This provides energy to the printer enough to turn on and connect to your computer, the laser jet, and lets the buttons, resistors, transistors, capacitors, and inductors function.

The resistors regulate the flow of energy of an electrical circuit. A transistor is a miniature semiconductor that regulates or controls current or voltage flow in addition to amplifying and

generating these electrical signals and acting as a switch/gate for them. A capacitor is an analog electrical component that stores electrical energy. We were advised to be careful around them to not get shocked. An inductor is defined as a passive component that is used in most electrical circuits to store energy in the form of magnetic energy when electric current flows through it.

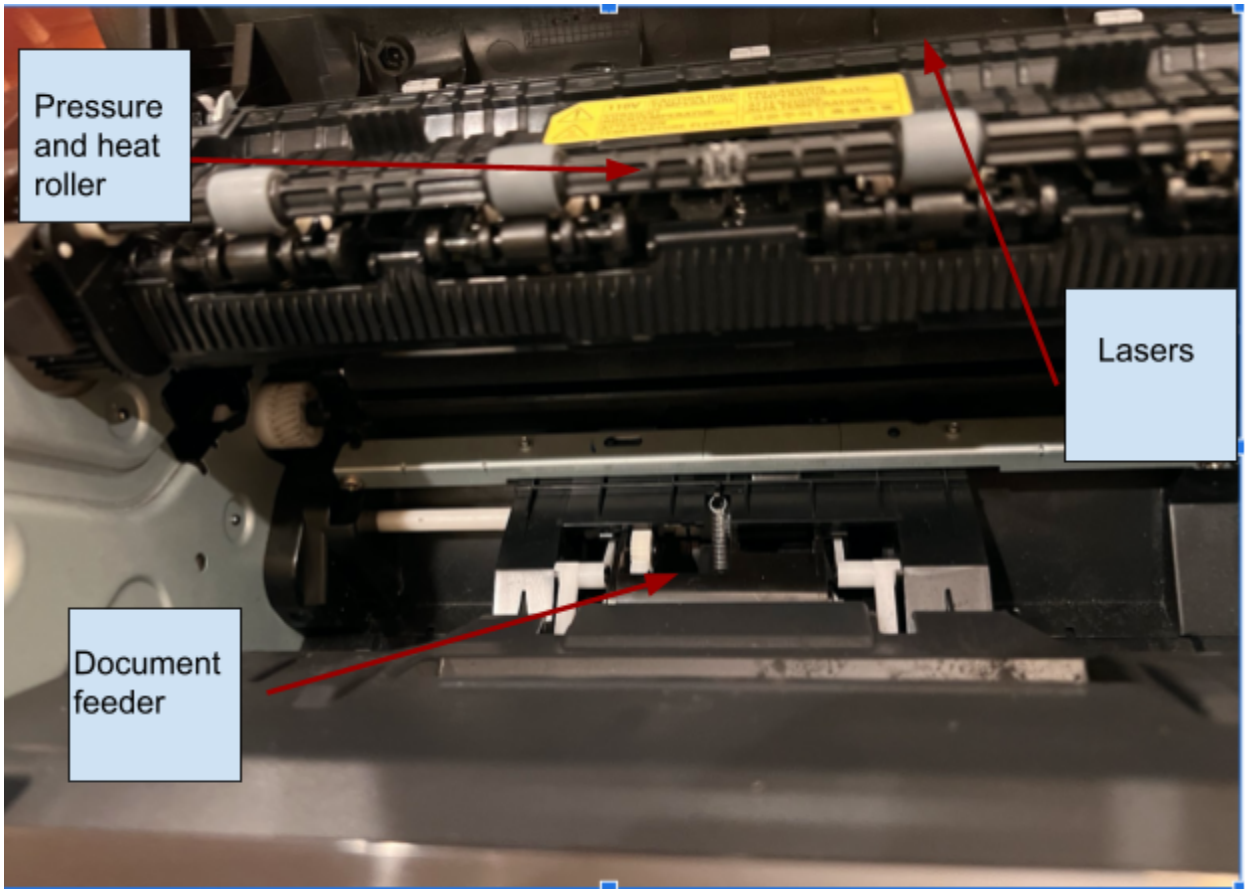
Once on, the printer connects to Bluetooth, or any signals, to find files to print. The lasers move left and right fast enough to get your image onto the paper. After finished, it sends a notification, or data that the print has finished, so the person can go pick it up.

Once the side of the printer was removed, the motherboard was exposed. A small green micro board on the motherboard was removable. On this board, there was a marked H and C5. There was also a barcode with a serial number. The button mechanism that turns the printer on and off was located under the small green board that was part of the whole board. These buttons included an arrow pointing in a circle, which may have been a restart button. After examining the motherboard and button mechanism, we moved onto the middle part of the printer.

The middle of the motherboard first has this blue piece. After looking into it, we can see it is an image sensor that directs the laser to the right places. There is a ribbon cable connected to the micro board that lets it turn on immediately when the printer turns on, as the ribbon cable is connected to the on switch. The power supply is located under the image sensor. That is where the power from the cable goes to distribute to all the other components on the motherboard.

The first power supply does not manage to distribute the power everywhere, so the little green roll is another power supply for all the things at the bottom. The black cylinder next to the second power supply is a Cornell Dubilier which Increases Snap-in Aluminum Electrolytic Capacitor Voltages to 600 Vdc. What we thought was a copper wheel happened to be a lead choke. The left blue piece next to the Cornell Dubilier is an led driver that lights up when turned on. And the rightmost blue piece is a snubber circuit module.

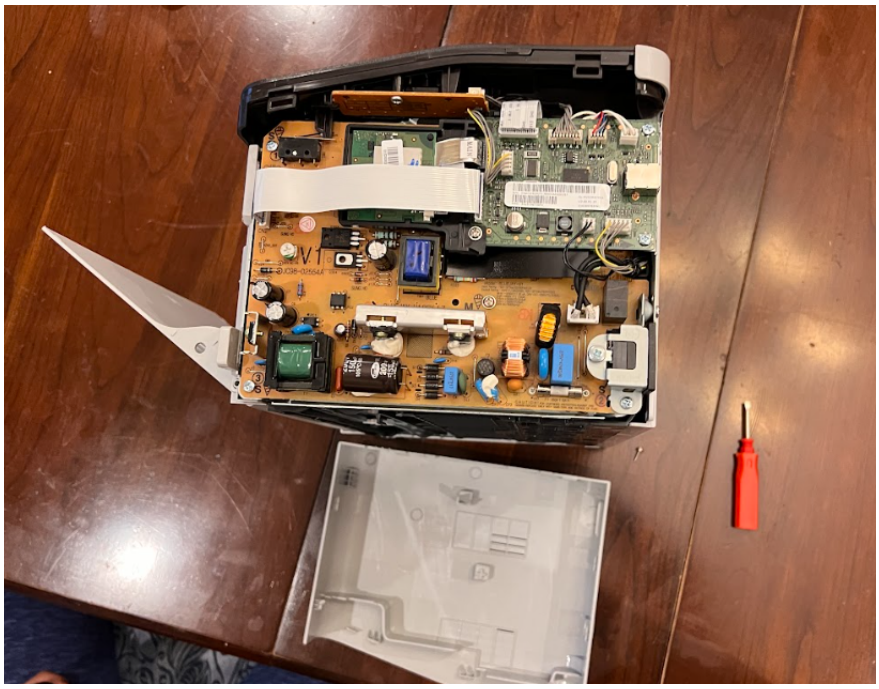
At the top of the mechanical section of parts, we have rollers that spread toner onto a paper, and lasers place toner particles exactly where needed. The full roller mechanism is fascinating and we describe it in the summary report and also later with roller and drum assembly. Document feeder feeds out finished paper. The black lines that reside above the rollers are the lasers that print images on the paper. The document feeder is at the bottom of the provided diagram, and it is what moves in the paper so the roller can put the toner and image on the paper.



2.3 Disassembly steps

Fully intact printer to start

Had to improvise to start from this side as other side wouldn’t open

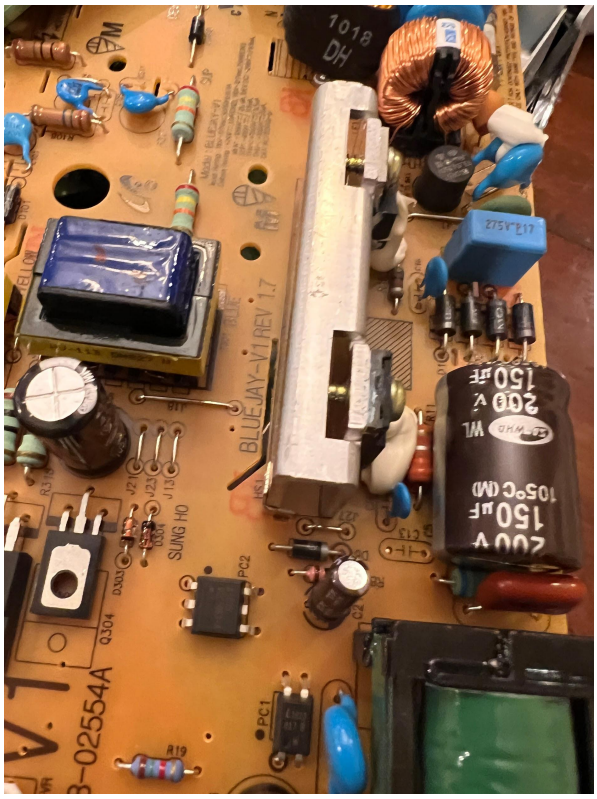


Success. Opened the side. As step 1 of disassembly

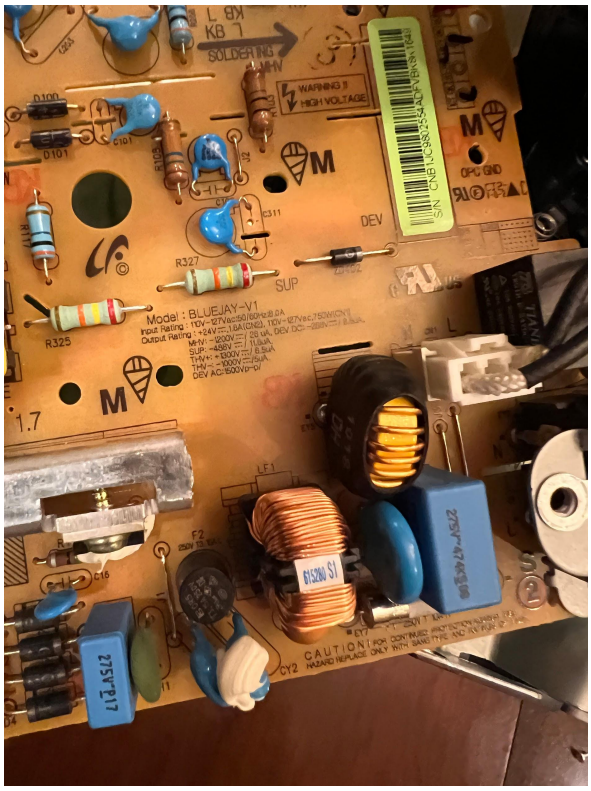
Supplementary board with data port connected on top of motherboard with flat wire connector

Second supplementary board detached

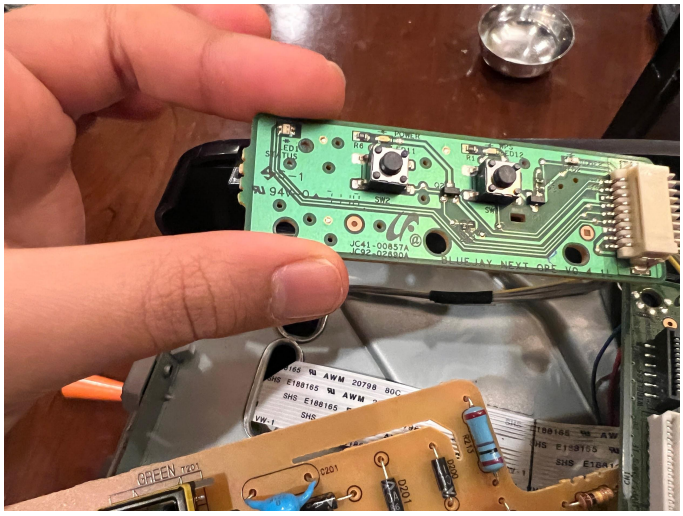
Motherboard removed



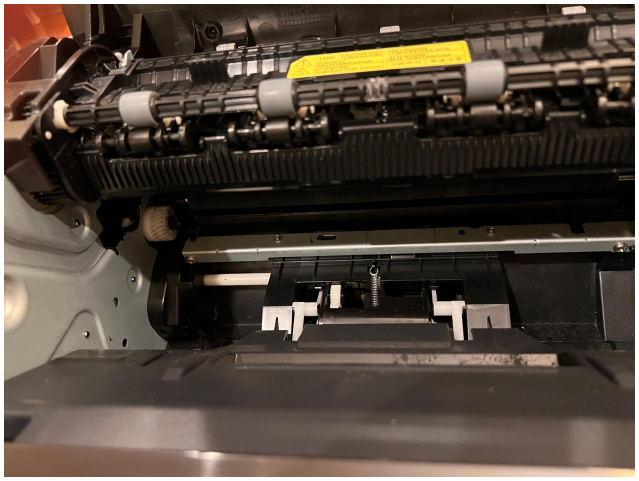
A different angle of motherboard



Lead choke coil



On/off and wifi sync Button mechanism



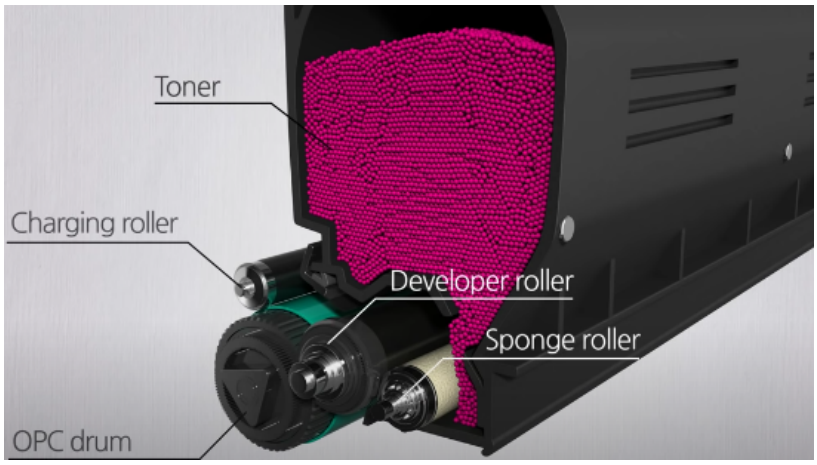
Roller assembly

Toner cartridge prior to disassembly

OPC Drum

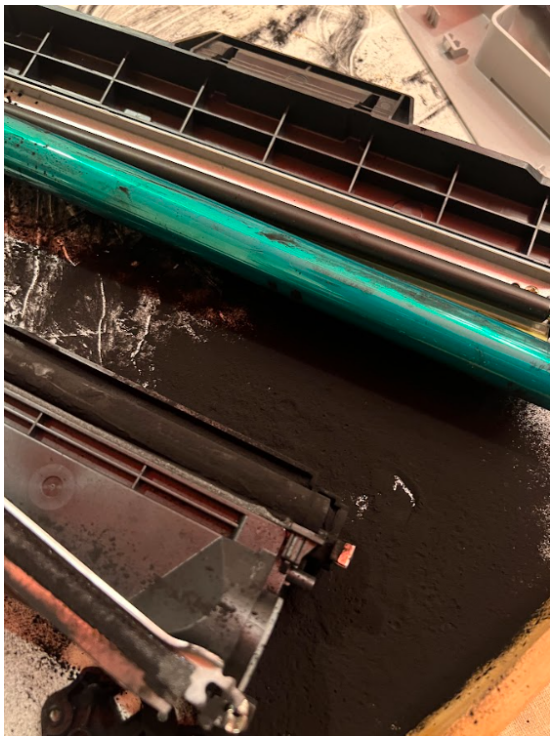
Gear mechanisms to drive the drums at different speeds

All rollers visible - charging roller next to OPC Drum on right side. Developer roller and sponge roller on the left side

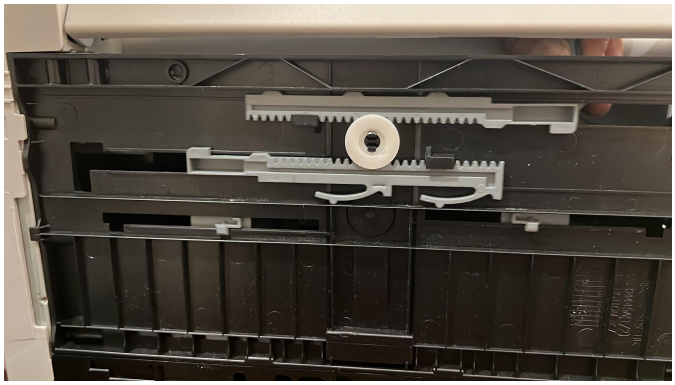


Illustrative diagram of print roller/drum mechanism, that we used to learn, alongwith a video.

It starts with two rollers. The charging roller, and the OPC drum. The charging roller applies a negative charge onto the OPC drum while it spins. On the negatively charged drum surface, the laser applies the desired drawing to be printed by turning some of the charges positive. Sponge roller delivers toner to the developer roller and cleans up toner particles that are not delivered to the drum. The Transfer roller pulls down the toner with negative charges which allows the toners to be attached onto the paper. The attached toners are baked with heat and pressure from the heat roller, and the pressure roller and the final image is made. We were able to dismantle rollers and see them, but wished we could see them in action!



OOPS! Toner powder fell out. What a mess!



Gear mechanism for paper sizer. Allows single-handed operation.

Inside of the paper sizer mechanism.

3.0 Citations

Lots of searches on Google. Some reading and many videos