Reverse Engineering Online Challenge 2022

Disassembly and Analyses of Nintendo Wii Console

Team 939A

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1.0 Summary Report

The Nintendo Wii brought the casual gaming experience to families all across the world to enjoy which led to over 100 million units sold. Ultimately, it was common to see a Nintendo Wii in households which leads to where we are now. A team of video game-loving students taking disassembling a Nintendo Wii to learn and report about the components of the Wii. We decided to use the Nintendo Wii because it was related to video games which was something we were passionate about.

It starts with the Power Jack, which supplies the whole system with enough electricity to perform its job. The Power Jack gives electricity to the system through Traces which are the copper lines you see on every circuit board. Along the traces are the Voltage Regulators. These Voltage Regulators consist of small components such as Resistors, Transistors, Capacitors, and Inductors.

The resistors limit the flow of electricity in the traces to ensure each component does not get too much electricity. Transistors are like switches that can stop the flow of electricity. Capacitors keep the power output of the electricity outlet smooth, and Inductors keep the current flowing for a short time even when there is no input electricity. This is useful when there is no input electricity for a fraction of a second. Instead of everything shutting down for a moment, the system keeps running.

Once the system has power, A CD can be inserted into the Optical Drive to allow the console to read the data of the game. The data on the CD is read by the Lens while the CD is being spun by the spindle that has attached itself to the CD. The lens is also on a rail that moves it up and down the CD to read all the data. This data is sent to the RAM which then sends the data to the CPU at a certain pace to process the data without too much load. Simultaneously, the CPU gives data to the GPU so an output can be produced. This output is the data for the arrangement of pixels on the display the Wii is connected to.

Aside from the obvious knowledge we obtained about how all components worked and interacted with each other to create a working console, we also learned about the significance of good research and perseverance. We remember having trouble researching the purposes of all the components and how they interacted with each other. However, after changing keywords and skimming through countless articles and documents we found what we looked for. We also learned to improvise. While taking the Wii apart, we came across a tri-wing screw when we did not have a tri-wing screwdriver. We improvised by using a flat-bladed screwdriver at an angle to turn the screw out. The time we spent working on this improved our attitude when facing problems and we also obtained knowledge about electronics. This can help our future as we pursue our dreams of being engineers.

Word Count: 499

2.0 Architecture Diagram

This diagram shows how different parts interact with each other to create a successful system. We used this Diagram to help identify and understand components in the Wii.

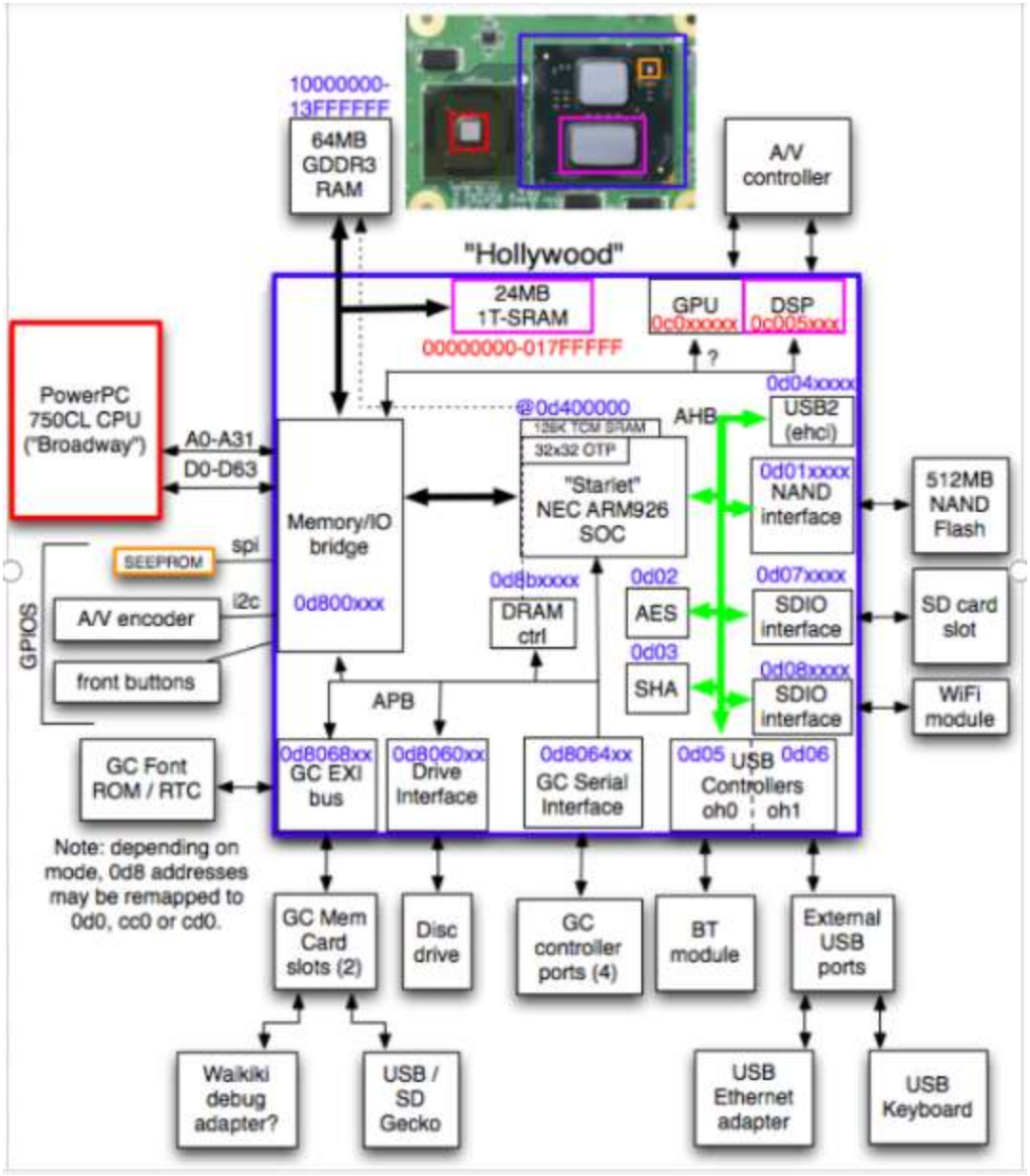


Figure 1: Architecture Diagram of Nintendo Wii Console

3.0 External anatomy of the Nintendo Wii Console

Figure 2.1 Top View

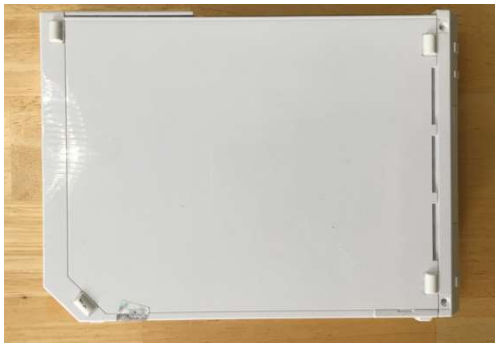


Figure 2.2 Bottom View

Figure 2.3: Front View

Figure 2.4: Front and Back View

Figure 2.5.1: Left Side View

Figure 2.5.2: Left Side View with flap down

Figure 2.6: Right Side View

Figure 2.7: Wii Product Label

4.0 Disassembly Process

Step1: Wear safety equipment such as safety goggles and gloves to ensure the safety of team member.

Step 2: Removed the BIOS memory Battery by removing a screw

Figure 3.1: Removing Screwed socket

Step 3: Remove the white cover flap and the screws holding the black plastic cover that is covering the GameCube ports. Once these are removed, the black plastic cover can be removed.

Figure 3.2: Remove the white cover flap

Figure 3.3: Remove the black plastic cove

Step 4: Some screws are under the rubber feet so the rubber feet were removed as well.

Figure 3.4: the rubber feet

Step 5: Once all the exterior screws are removed the faceplate and cover can be easily pulled out and removed.

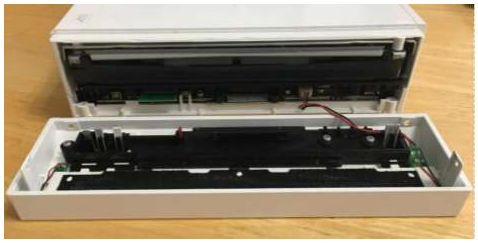


Figure 3.5: The Faceplate

Figure 3.6: The Cover

Step 6: Remove the metal cover above the Optical Drive after removing the screws on it and the fan.

Figure 3.7.1: Removal of the metal cover

Figure 3.7.2: Removal of the fan

Step 7: Remove the screws on the Optical Drive and take off the Optical Drive lid

Figure 3.8: Removal of the Optical Drive Lid

Step 8: Remove the Optical Drive

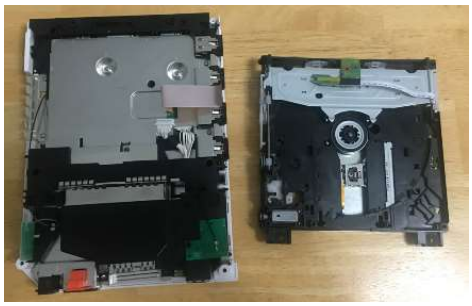


Figure 3.9: Removal of the Optical Drive

Step 9: Unscrew these screws to take off the black plastic casing and rims

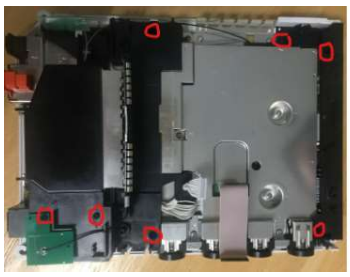


Figure 3.10.1: Screw locations

Figure 3.10.2: Removal of the black plastic casing

Step 10: Remove all visible screws on the motherboard cover to remove the cover.

Figure 3.11: Removed motherboard cover

Step 11: Remove screws on the fin and lift it off to remove it

Figure 3.11.1: Location of screws on the fin

Figure 3.11.2: Removed fin

Step 12: Lift the motherboard out of the Case (Figure 3.12)

Figure 3.12: Removed Motherboard from the case

5.0 Analysis Process

We did research to identify what each component looked like on a PCB, and we used what we found to identify the components on the motherboard. Later, we learned about these components and wrote a quick summary of what they did. The charts and tables below show our findings.

5.1 Motherboard

Table of components and Quantity

Components	Quantity	%
Capacitors	12	2.4%
Inductors	6	1.2%
Integrated Circuite	14	2.8%
Resistors	419	82.5%
Transistor	49	9.6%
Unidentified	8	1.6%

Note: These numbers are approximations

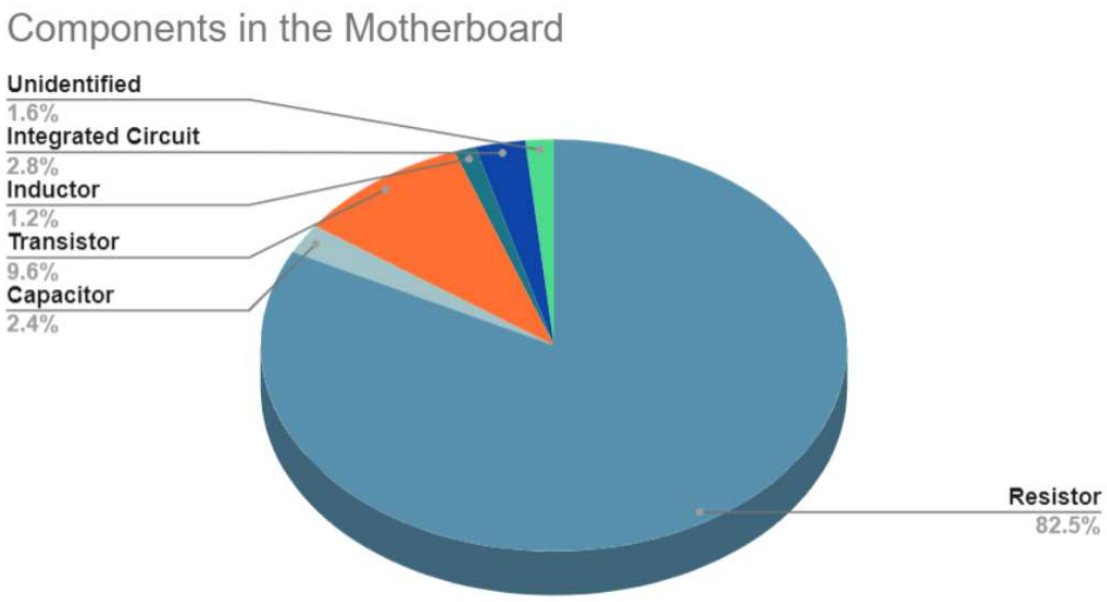


Figure 4.1 Pie chart for the components on the motherboard

5.1.1 Labelled images of circuit board (Front View)

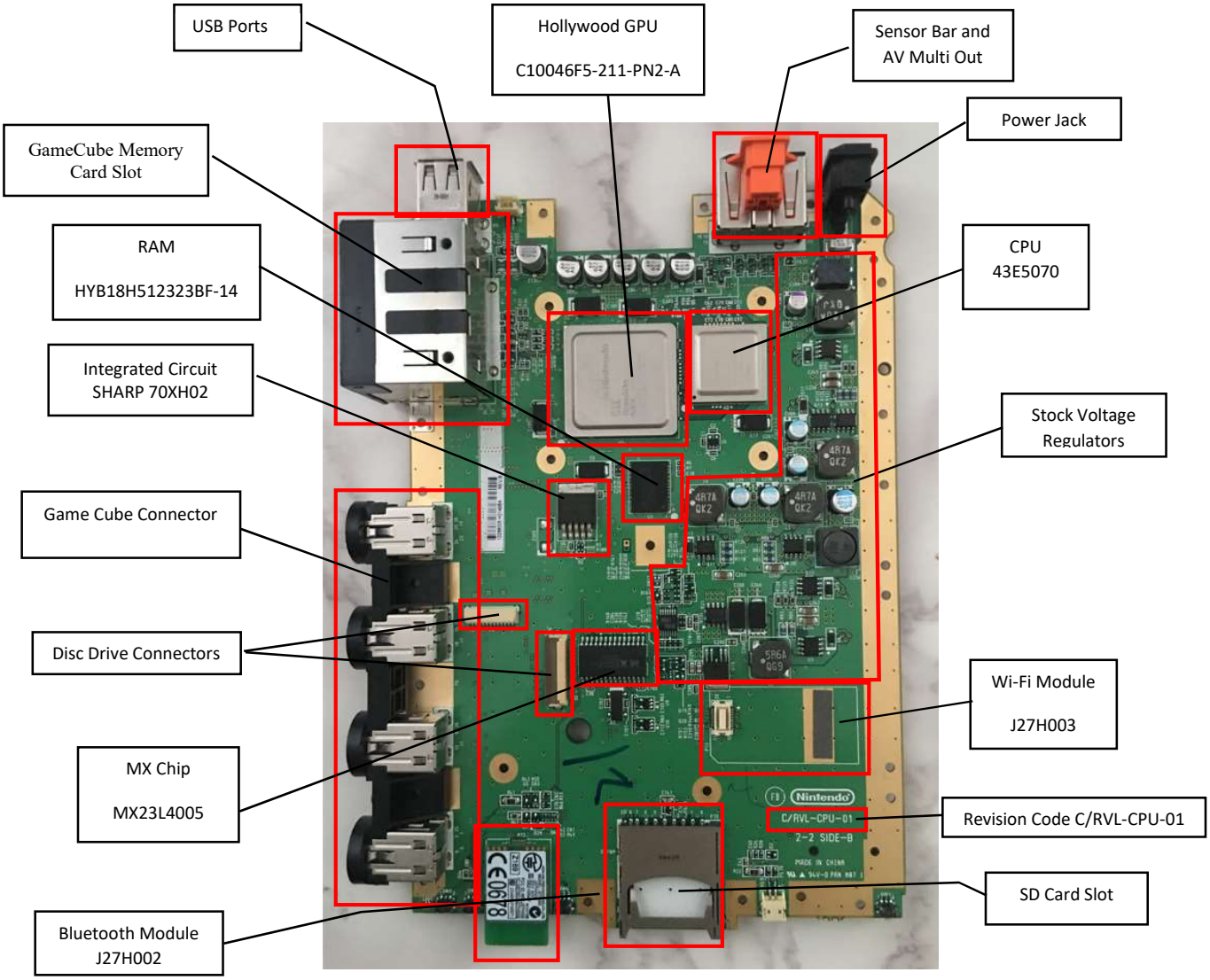


Figure 4.2: Front view of motherboard

5.1.2 Motherboard: Labelled images of circuit board (Back View)

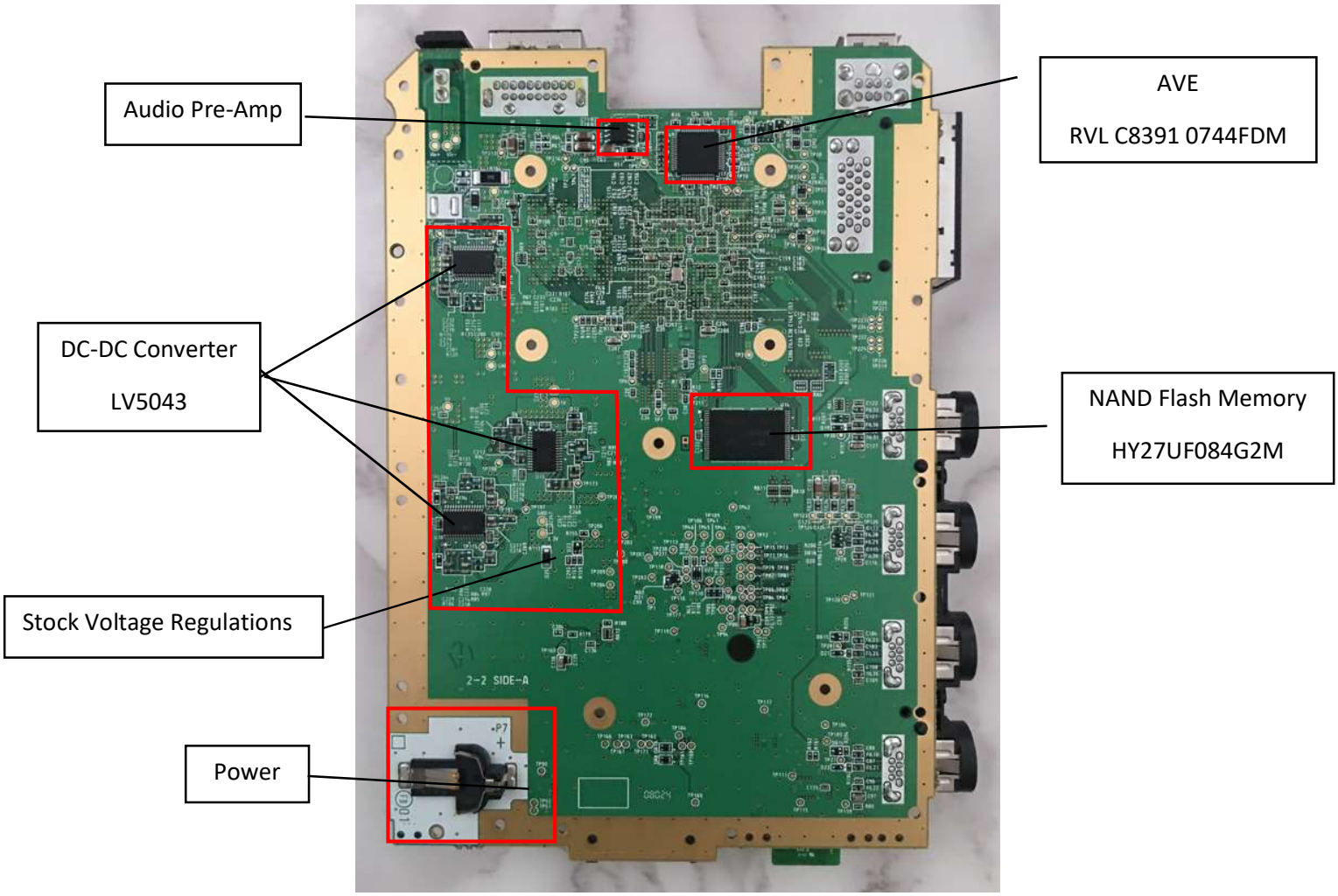
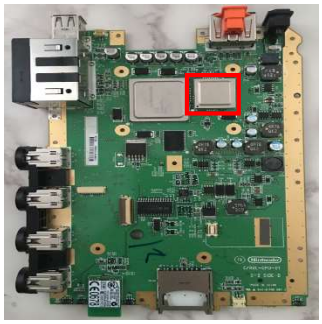
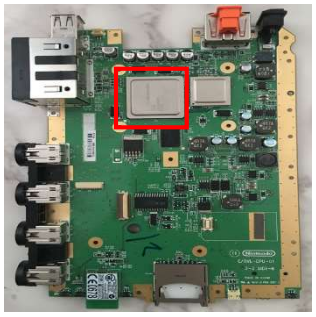
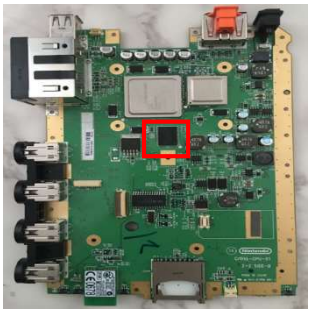
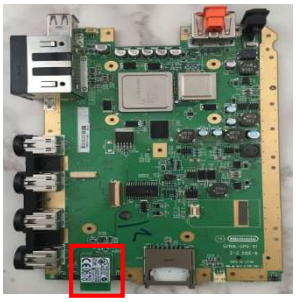
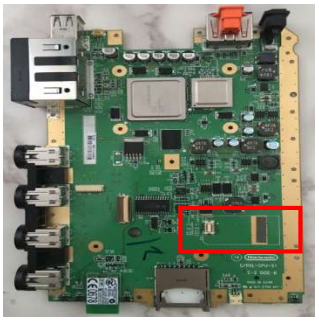
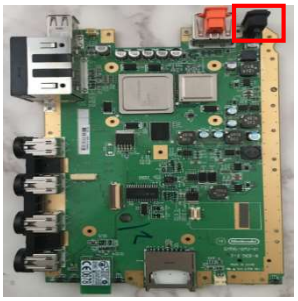
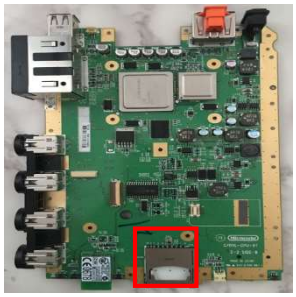
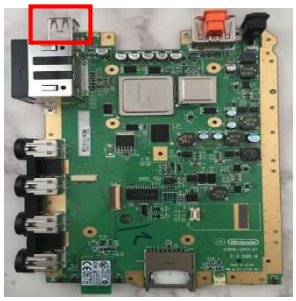
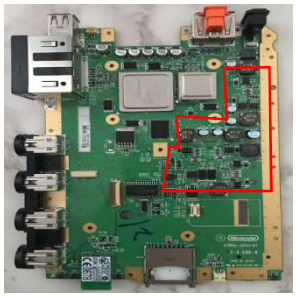
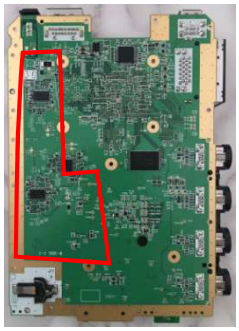
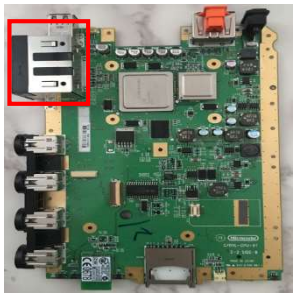


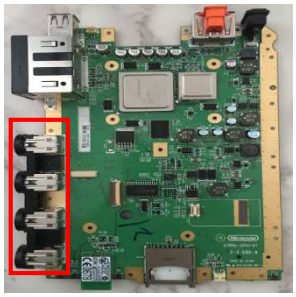
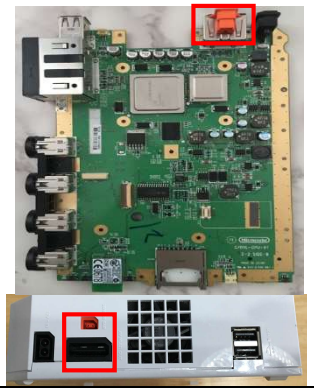
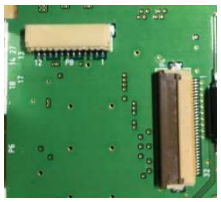
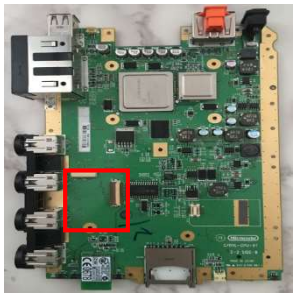
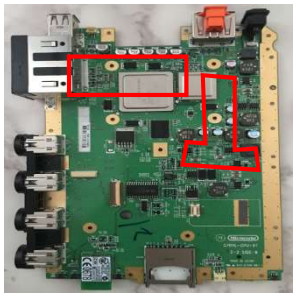
Figure 4.3 Back view of motherboard

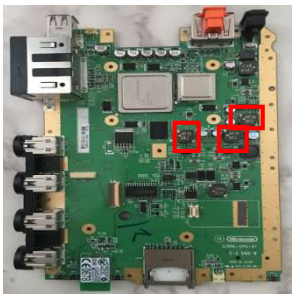
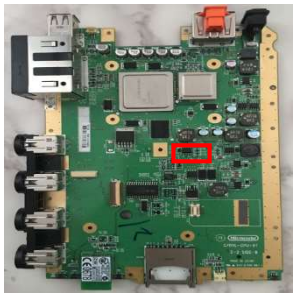
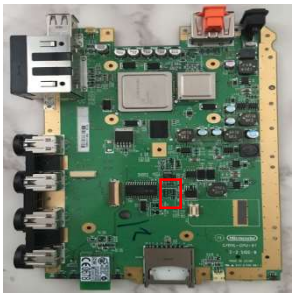
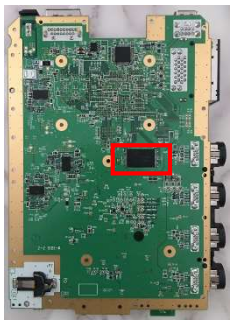
5.1.3 Motherboard Components Analysis

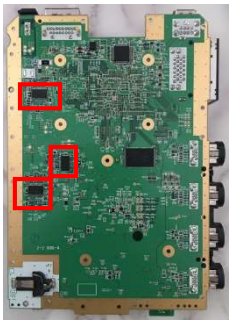
Part and Description	Image	Location
Central Processing Unit (CPU) **43E5070** The Broadway Central Processing Unit as the name suggests, is the main piece of electronic that processes the calculations a computer needs to do. It is one of the most important components in the device.		
Graphics Processing Unit (GPU) **ATI HOLLYWOOD** **C10046F5-211-PN2-A** The Graphics Processing Unit is similar to the Central Processing Unit but it specializes in processing the graphics in a computer. The GPU receives the information it needs to process from the CPU.		
Random Access Memory (RAM) **HYB18H512321BF-14** Random Access Memory or RAM for short, is responsible for bringing information to the CPU to process. RAM receives information from the applications being run on the computer and gives the information to the CPU at a pace the CPU can handle.		
Bluetooth Module **J27H002** The Bluetooth Module uses Bluetooth technology to connect the Wii to its controllers which are the Wii Remote. The Bluetooth modules in devices communicate through radio waves of varying wavelengths.		

Wi-Fi Module **J27H003** Wi-Fi module allows Wii to connect to the internet with Wi-Fi technology. It communicates with other Wi-Fi-Modules similar to the way Bluetooth Modules communicate. The main difference is the number of modules it can communicate with and distance of which they can communicate. Both of which Wi-Fi is superior to Bluetooth. Datasheet[1]		
MX Chip **MX23L4005** The MX23L4005 is a Chip that has RTC (Real Time Clock) and power management functions.		
Power Jack The power jack is responsible for bringing electricity to the console. Without it, the console would not have any energy and thus will not be able to do anything.		
SD Card Slot A Hard Drive is not always enough to store all the bytes a device needs. This is where the SD Card comes in. It is a removable storage device that can be plugged into whatever has an SD Card Slot to give it more bytes to store. This gives the user more freedom when it comes to installing things on their device.		

USB Port The USB Port is used to connect the Wii to any device with a USB Port. I can use the Wi-Fi of the PC or whatever device. Without Wi-Fi the game may not work correctly or not even work at all. It also will just be able to connect to a device. Datasheet[3]		
Voltage Regulators The Voltage Regulators control the power flow and distribute it from the plugs attached to the wall when playing. Datasheet[4]	Front  Back 	Front  Back 
GameCube Memory Card Slot The GameCube Memory Card Slot allows GameCube games to be played on the Wii. A GameCube Memory Card is inserted into this slot and a GameCube Controller can bee connected to play the game.		

GameCube Controller Ports These ports allow 4 GameCube Controllers to be plugged in the Wii to play GameCube games and some Wii games.		
Sensor Bar and AV Multi Out The Sensor Bar Port connects the Sensor Bar which detects the Wii mote's movements. The AV Multi Out is responsible for the video and audio output of the Wii.		
Disc Drive Connectors These Disc drive connectors give enough bandwidth for the SSD (Solid-State Drive).		
Capacitor Capacitors are responsible for smoothing out the Electricity input. Since power outlets cannot always have consistent electricity coming out, Capacitors store energy when there is too much and release the energy into the system when there is not enough.		

Inductor Sometimes the electricity coming from power outlets stop completely for a split second. Usually, the device would shut off for a split second. However, Inductors keep the current flowing for a short time even when there is no input electricity. This allows the device to keep running for a short time even when there is no input electricity.		
Resistor Resistors limit the flow of electricity through them by getting rid of excess electricity by turning them into heat energy. They need to do this to ensure each component does not get too much electricity and cause undesired outcomes because of it.		
Transistors Transistors are resistors but instead of limiting the flow of electricity, they either allow the flow of electricity to move freely or stop it completely.		
Flash Memory **HY27UF084G2M** The Flash memory is a non-volatile storage device. This means it can store information even when there is no power. The Nintendo Wii uses this to store the OS. Datasheet[5]		

DC-DC converter **LV5043** This chip changes the voltage of power to give what the game console needs. For example, if there is a lot of data being processed by the CPU, it will use a lot of power. The DC-DC Converter controls the voltage to give the CPU more power.		
AVE **AVE-RVL C8391 0744 FDM** The AVE is an audio/video encoder chip that encodes digital data streams or signals. It encodes video and audio files to compress them and make them smaller in storage. It also decodes the video and audio files to play the files.		

5.2 Optical Drive

Table of components and Quantity

Components	Quantity	%
Capacitors	8	10.0%
Diode	1	1.3%
Integrated Circuite	7	8.8%
Resistors	56	70.0%
Transistor	8	10.0%

Note: These numbers are approximations

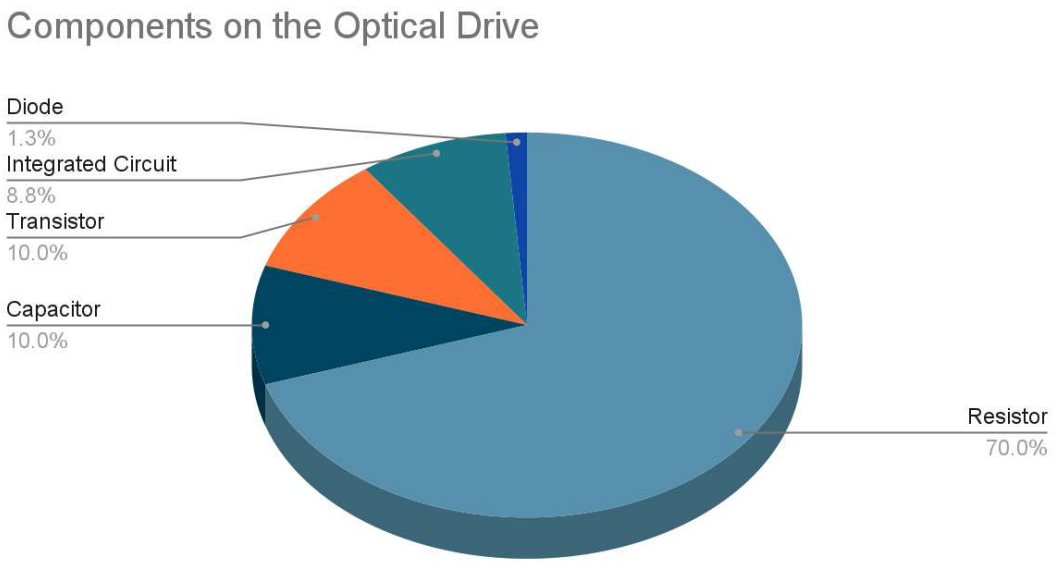


Figure 5.1 Pie chart for the components on optical drive's circuit board

5.2.1 Front and Back View of Optical Drive

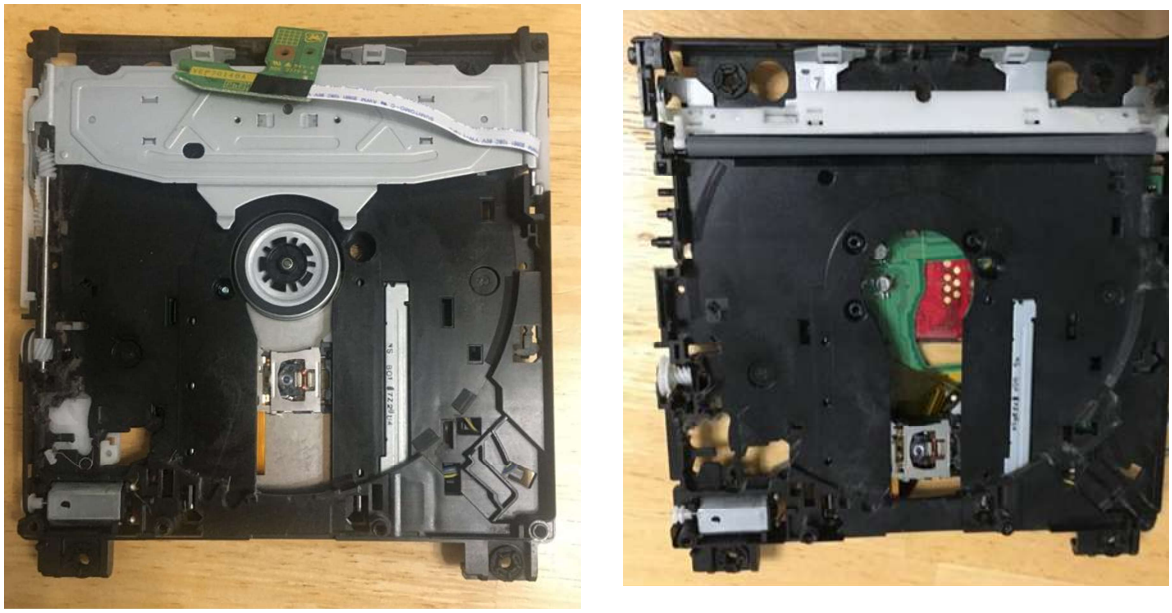


Figure 5.2: Front of Optical Drive

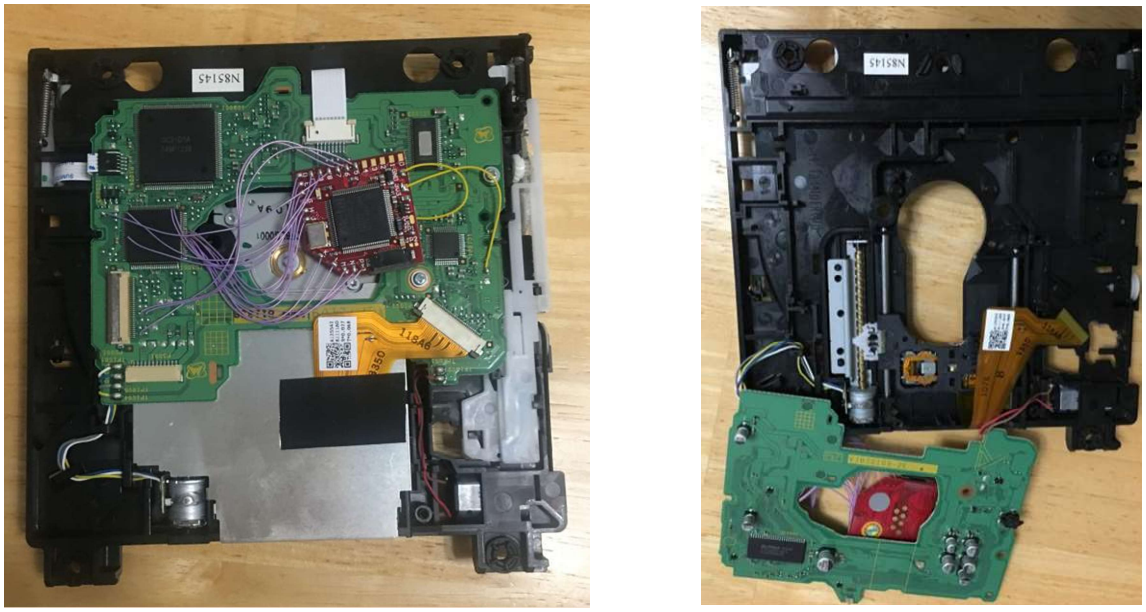


Figure 5.3: Back of optical Drive

5.2.2 Labelled images of Optical circuit board (Front View)

Nintendo Wii DVD Drive Board VEP72109

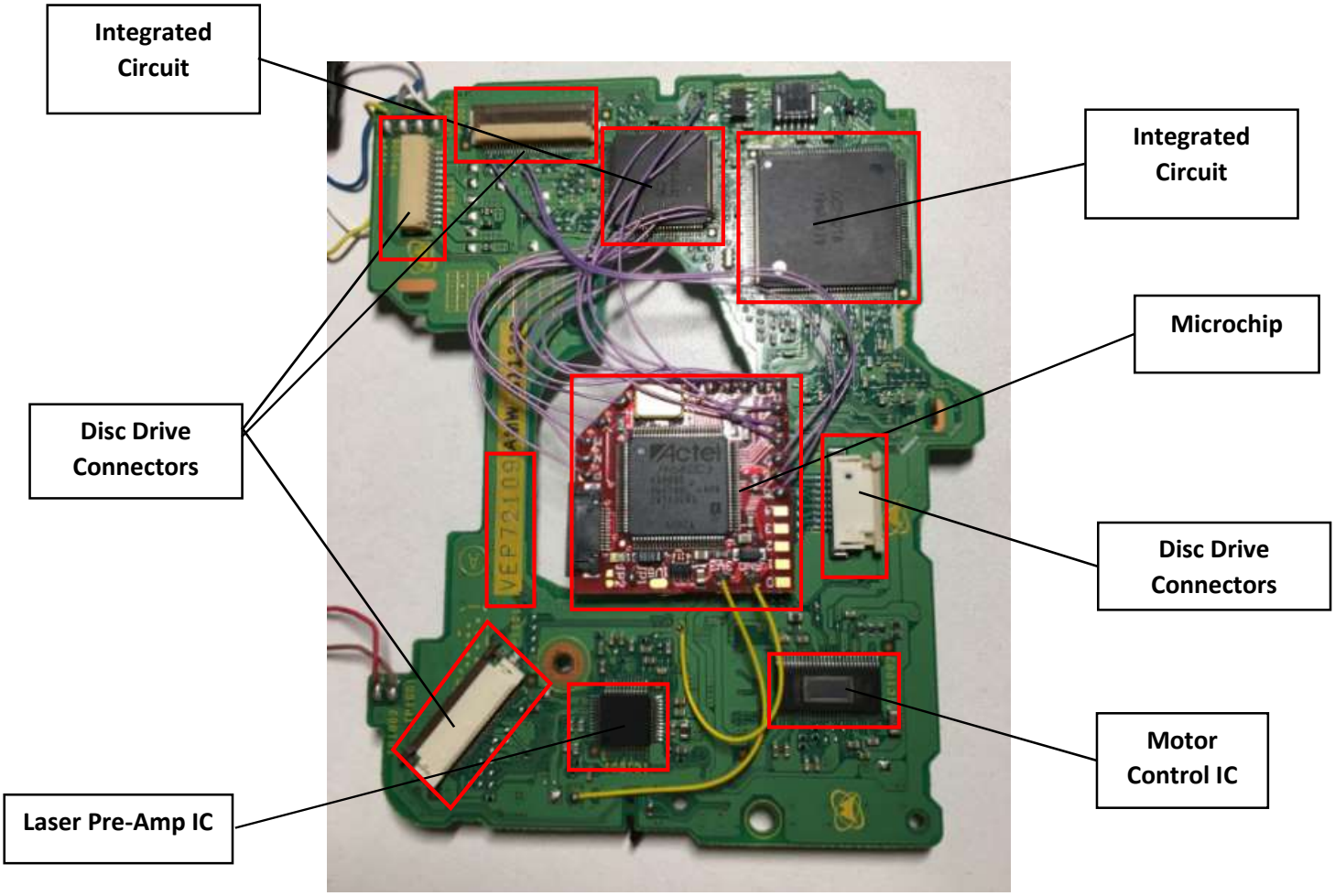


Figure 5.4: Front view of optical drive

5.2.3 Labelled images of Optical circuit board (Back View)

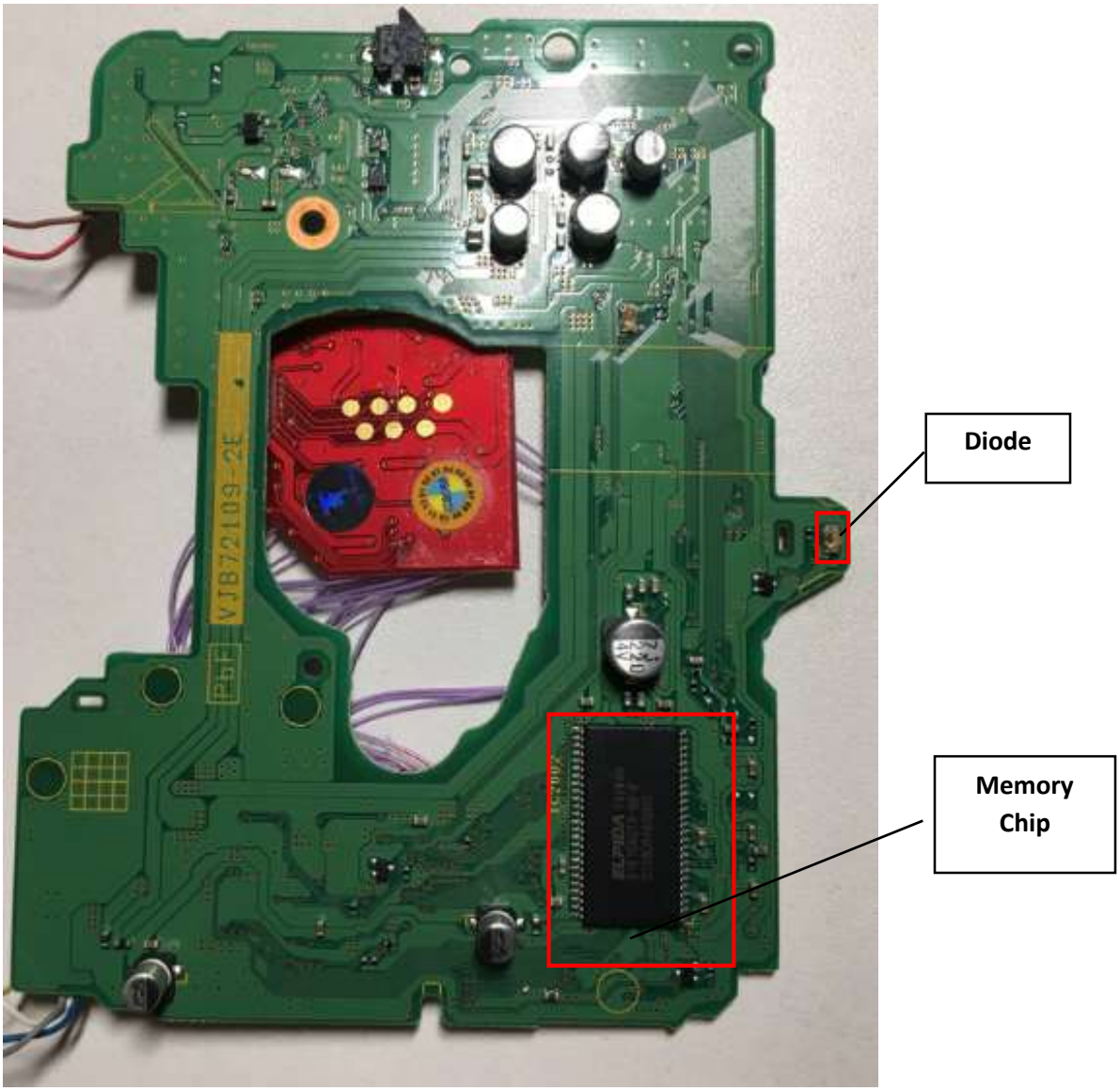
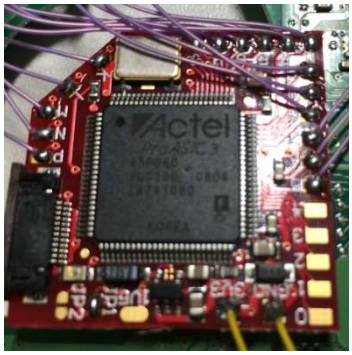
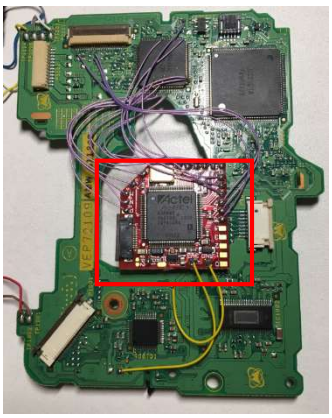
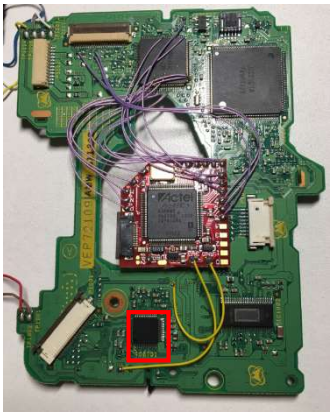
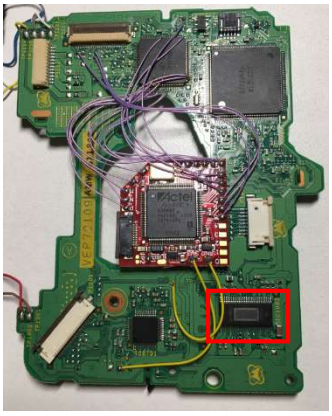
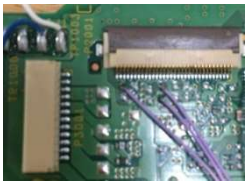
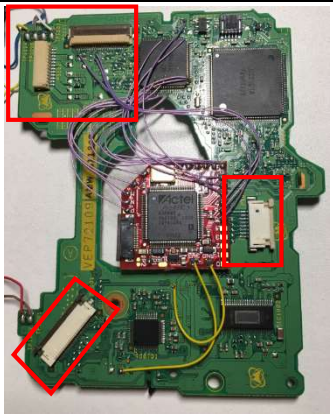
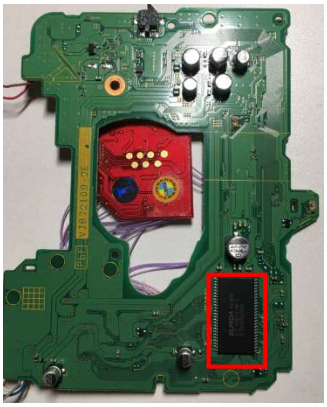
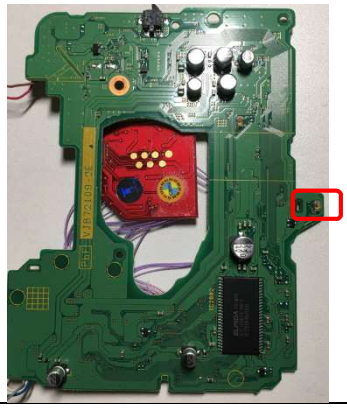
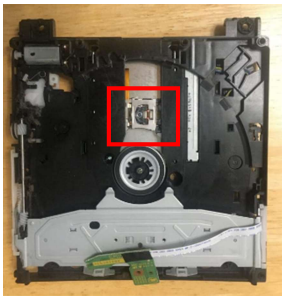


Figure: 5.5 Back view of optical drive

5.2.4 Optical Drive Components Analysis

Part and Description	Image	Location
Microchip **A3P060** The Microchip is the main unit that performs the operations in the Optical Drive.		
Laser Pre Amp IC **AN22023 749P60E** This Integrated Circuit processes the output of the lens that reads the data on the CD. Datasheet[6]		
Motor Control IC **750C2191** This Integrated Circuit controls the motors in the Optical Drive. There are two, one for the roller and another for the rail.		

Disc Drive Connectors These disc drive connectors give enough bandwidth for the SSD (Solid-State Drive).		
Memory Chip **S1616AGTA-6B-E** The memory chip stores data and also processes the data from the Lens that is reading the CD.		
Diode A diode makes sure the electricity is flowing the correct way.		
Lens The Lens will read the game disc. It then lets you play a game. Without the Lens you cannot play game discs. You can only play games downloaded on the console.		

Spindle The Spindle spins the disc so that the lens can read the disc. If the spindle was broken the Lens could only read part of the disc.	  Front Back	
Roller Once the CD is inserted, the Roller makes sure the CD is fully inside the Optical Drive.		
Rail The rail moves the lens up and down to make sure it reads all data on the area of the CD.		
Motor The motor is powered by DC battery's and is used whenever something is required power and force. It also spins the spindle by spinning gears.	  Top Right Side	

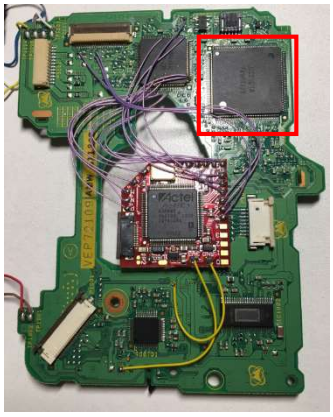
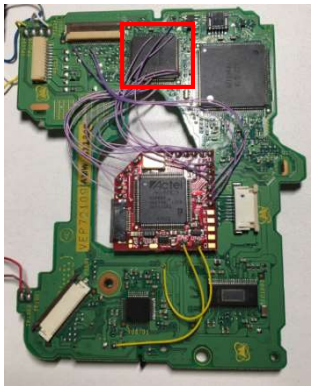
Gear The gears are attached to both the roller and motor. This way, the roller can spin when the motor spins.		
Laser Membrane Connector The Laser Membrane Connector connects the lens and the Microchips. The Lens sends data to the Microchip through this.		

5.3 Other Components

Part and Description	Image	Location
Faceplate It has the power button and is where you insert the game discs. It is also just a cover for the optical drive.	  Front Back	
Fan **Nidec D03R-05BS1** The fan cools down the system so it does not overheat. Especially when the CPU is under heavy load, it can heat up and the Fan keeps the temperatures under control.		
Fins The fin is made out of metal which conducts heat very well. It is above the CPU which transfers the heat to the fins. The fan in front of it blows air into the fins to cool it down. When the Fins are cooled down, the CPU cools down as well.		

Thermal Paste The thermal paste eliminates air gaps or spaces from the interface area in order to maximize heat transfer and dissipation.		

5.4 Unidentified Components

Part	Image	Location
Integrated Circuit We could not find what this Integrated Circuit did.		
Integrated Circuit We could not find the product number of this Integrated Circuit.		

Note: All photos were original from Team 939A.

6.0 References

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