2023 REVERSE ENGINEERING ONLINE CHALLENGE

Grace Brethren ROBOTICS Team 986A

DECONSTRUCTING THE SONY CD/DVD PLAYER DVP-SR200P SUMMARY REPORT

TEAM 986A Lancers
Simi Valley, California
USA

By:
Project Leads: Ian Nelson & Peter Wang
Layout Leads: Kyle Zahn & Dante Sweis
Graphics Lead: Owen Zahn

TABLE OF CONTENTS

*Word Count: 463 (excluding title page, parts list, and image captions)

1. INTRODUCTION

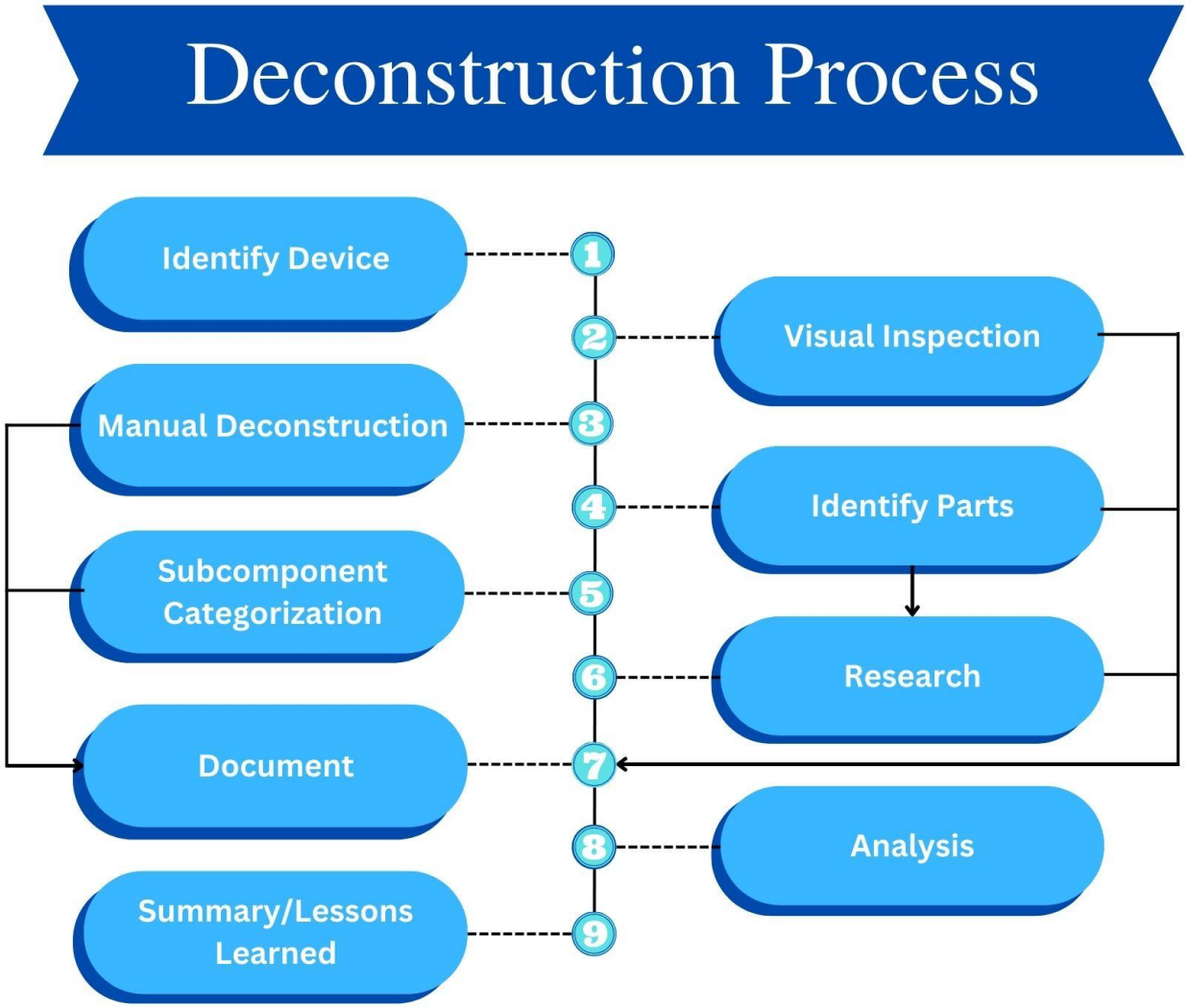
Team986A gathered at team member Peter's house to strategize and decide on the electronic machine for the Reverse Engineering Online Challenge. Being an adventurous team, we started debating between deconstructing a brand-new Tesla or Dante's new laptop. Realizing these were ambitious and expensive options, we started to consider recycling electronic items from the past. Our goal was to start the deconstruction that day, so we needed to get serious. We began by rummaging through boxes around Peter's house and shortly Owen struck gold. "I found our online challenge!" Owen discovered the CD/DVD Player in the back of Peter's garage that was collecting dust and sitting in a plastic container filled with mismatched wires and empty DVD cases. It was perfect! The Sony CD/DVD Player was a perfect sample of electronic history that was a popular entertainment device in many living rooms. The player allowed families and friends to enjoy their favorite music or bring the movie theater into their home to enjoy the most current movies or vintage titles that we love to watch over and over. We have a passion for listening to music and enjoy being swept away by a captivating movie. Now we will know how CD/DVD players changed the function and quality of home entertainment. So, we had our deconstruction project underway and were ready for the dismantling discoveries to begin. First, we checked with Peter's Grandmother for permission to disassemble the player and she laughed and said "Oh, Peter broke it years ago anyways."

Figure 1. Deconstructed DVD player with team members

2. WHAT IS A CD/DVD PLAYER?

A CD/DVD player is an electronic device that plays compact discs (CDs) or digital video/versatile discs (DVDs). CDs/DVDs are storage mediums that can be used to record, store, and playback audio, video, and other digital information. CDs store approximately 700MB while DVDs store up to 17 GB.

3. DECONSTRUCTION FLOW CHART



Flow Chart 1: Reverse Engineering Action Plan for CD/DVD Player Deconstruction

4. DISASSEMBLY PROCESS

Tools Used: Safety Glasses, Phillips Screwdriver, ESD Wrist Strap

Step 1: Disassemble panel/chassis structures

Figure 2. Front view of Sony DVD Player

Figure 3. Take out three screws from back panel

Figure 4. Take out one screw from each side panel

Figure 5. Remove top panel, exposing subcomponents

Step 2: Remove Board 1

Figure 6. Take out 2 screws from Board 1

Figure 7. Remove Board 1

Step 3: Remove Board 2 & DVD Drive

Figure 8. Take out 2 screws from Board 2

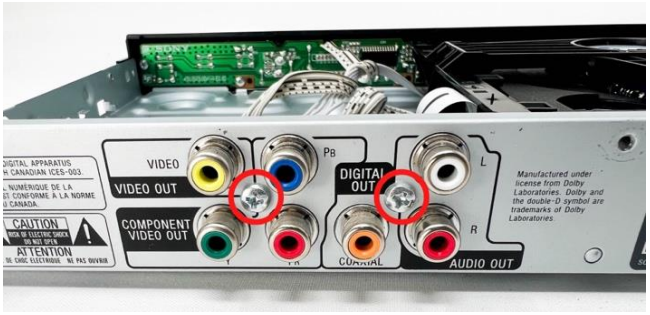


Figure 9. Take out two back panel screws from the rear panel

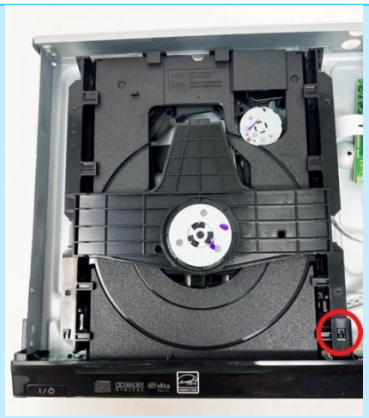


Figure 10. Unclip the DVD Drive

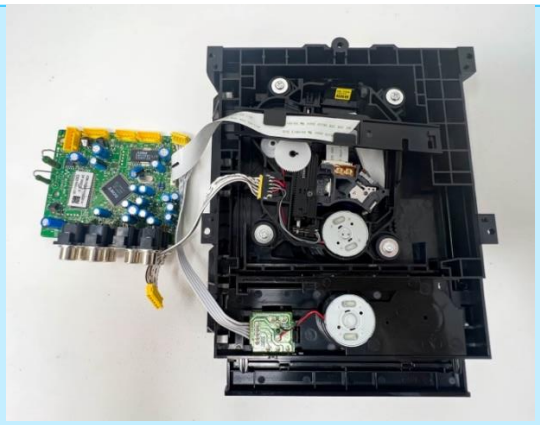


Figure 11. Remove Board 2 and DVD Drive

Step 4. Take Apart Disk Drive

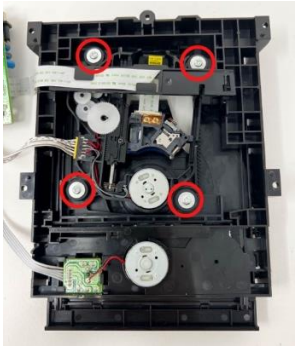


Figure 12. Take out four screws connecting the Laser and Lens Assembly

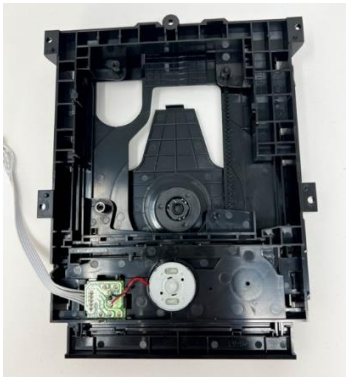


Figure 13. Independent CD/DVD Drive

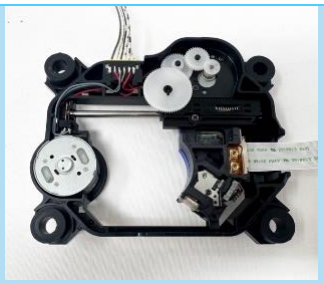


Figure 14. Independent Laser & Lens Assembly

Step 5. Remove Board 3

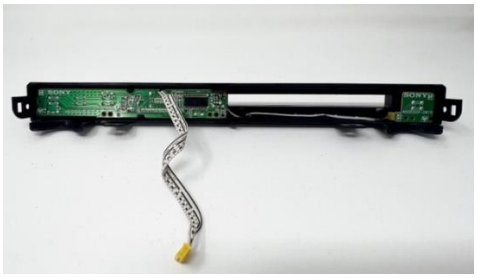


Figure 15. Snap off front panel from bottom panel

Figure 16. Front Panel

Figure 17. Snap off Board 3 from the front panel

Step 6. Remove power cord

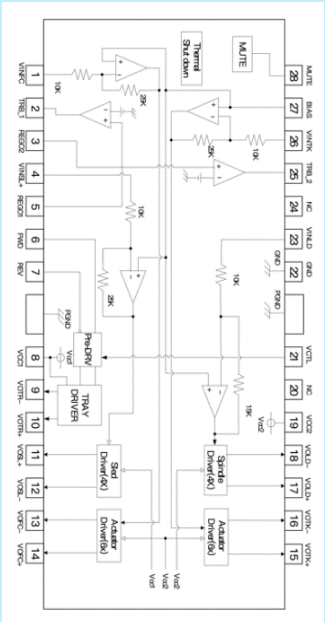
Figure 18. Snap off power cord from the bottom chassis

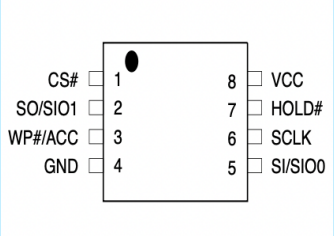
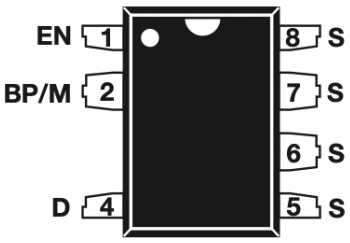
5. COMPONENT ANALYSIS

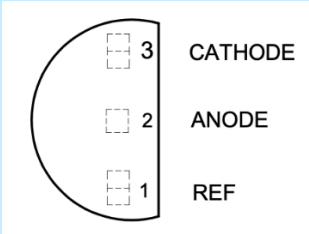
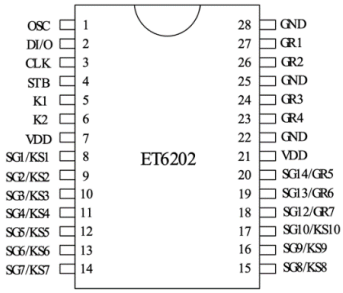
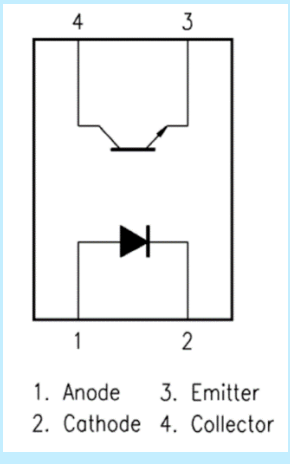
5.1 DIMENSIONS

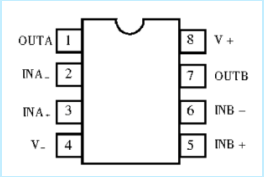
ID	Dimensions	Measurements	
1	Height	1.26 inches	 Figure 19. Sony CD/DVD Player Dimensions
2	Width	8.23 inches	
3	Length	12.6 inches	
4	Weight	2.64 lbs	

5.2 INTEGRATED CIRCUITS

ID	Manufacturer/ Part Marking/ Picture	Part Description/ Role in System/ Datasheet	Qty	Pin-Out Diagrams: A cross reference between the pins and their functions
1	AMTEK SEMICONDUCTOR AM5888S 	A five-channel BTL driver for driving motors and actuators. This chip has two independent precision voltage regulators. Its role is a motor controller and precisely controls the direction and speed of motors. DATASHEET	1	

ID	Manufacturer/ Part Marking/ Picture	Part Description/ Role in System/ Datasheet	Qty	Pin-Out Diagrams: A cross reference between the pins and their functions
2	SONY CXD9932R 	This is the CPU (Central Processing Unit) that controls all the functions of the microcontroller board. This chip pulls index commands from the EEPROM. (See #3 IC) No Datasheet	1	Not Available
3	MACRONIX INT'L 25L1605DM2I 	This is a serial flash memory chip which is a type of EEPROM (Electrically Erasable Programmable Read-Only Memory) that stores commands for the microcontroller board even when power is shut-off. DATASHEET	1	
4	POWER INTEGRATIONS TNY176PN 	This is an energy efficient, offline switcher. This chip regulates or controls the Pulse Width Modulation and uses a simple ON/OFF control to regulate output voltage. DATASHEET	1	

ID	Manufacturer/ Part Marking/ Picture	Part Description/ Role in System/ Datasheet	Qty	Pin-Out Diagrams: A cross reference between the pins and their functions
5	DIODES INC AZ431 	This chip is an adjustable precision shunt regulator which acts like a Zener diode that allows current to flow in one direction toward a certain point. Then, above a certain point, it allows current to flow in both directions. DATASHEET	1	
6	ETEK MICROELECTRONICS ET6202 	The Control LED (Light Emitting Diode) drive circuit drives the power to one or more LEDs. DATASHEET	1	
7	Various Manufacturer B0935 	The B0935 is an opto-isolator that transfers an electrical signal between isolated circuits using light. It samples output voltage and regulates during different load conditions. DATASHEET	1	

ID	Manufacturer/ Part Marking/ Picture	Part Description/ Role in System/ Datasheet	Qty	Pin-Out Diagrams: A cross reference between the pins and their functions
8	Unknown Manufacturer 	No data found. We peeled off the sticker and no markings were found. In our research of other CD/DVD players, this might be a video and audio processing chip that processes and converts signals to the TV and stereo. NO DATASHEET	1	Not Available
9	Unclassified Manufacturer F4558 7FTC3L 	It is a dual operational amplifier for a wide range of supply voltage. It amplifies or boosts the signals. The datasheet is in Chinese, translated by Peter for the team to understand. DATASHEET	1	

5.3 INTEGRATED CIRCUIT LOCATIONS

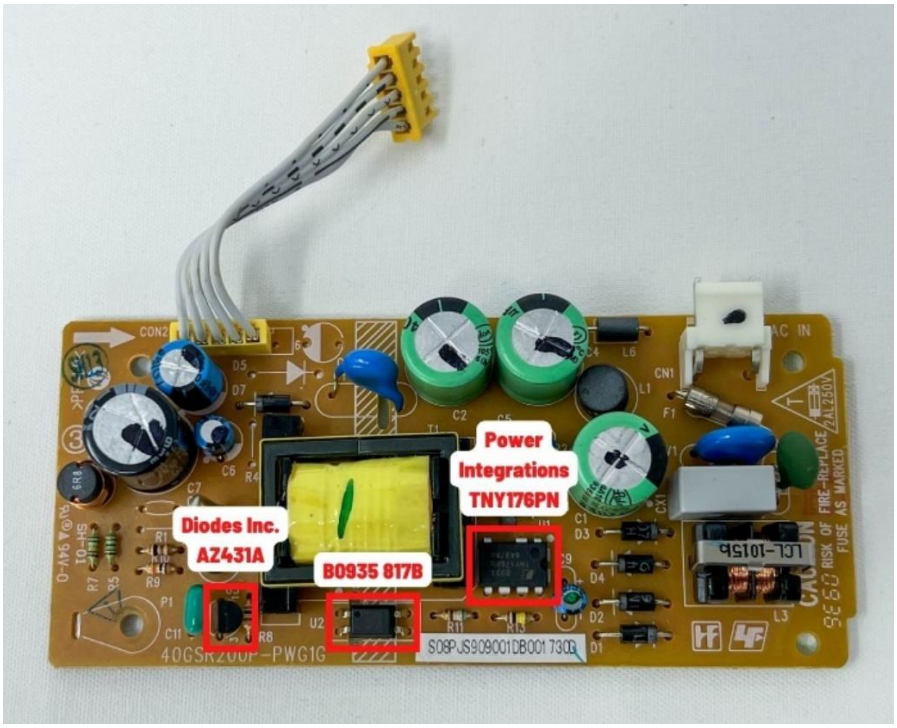


Figure 20. IC locations on Power Supply Board

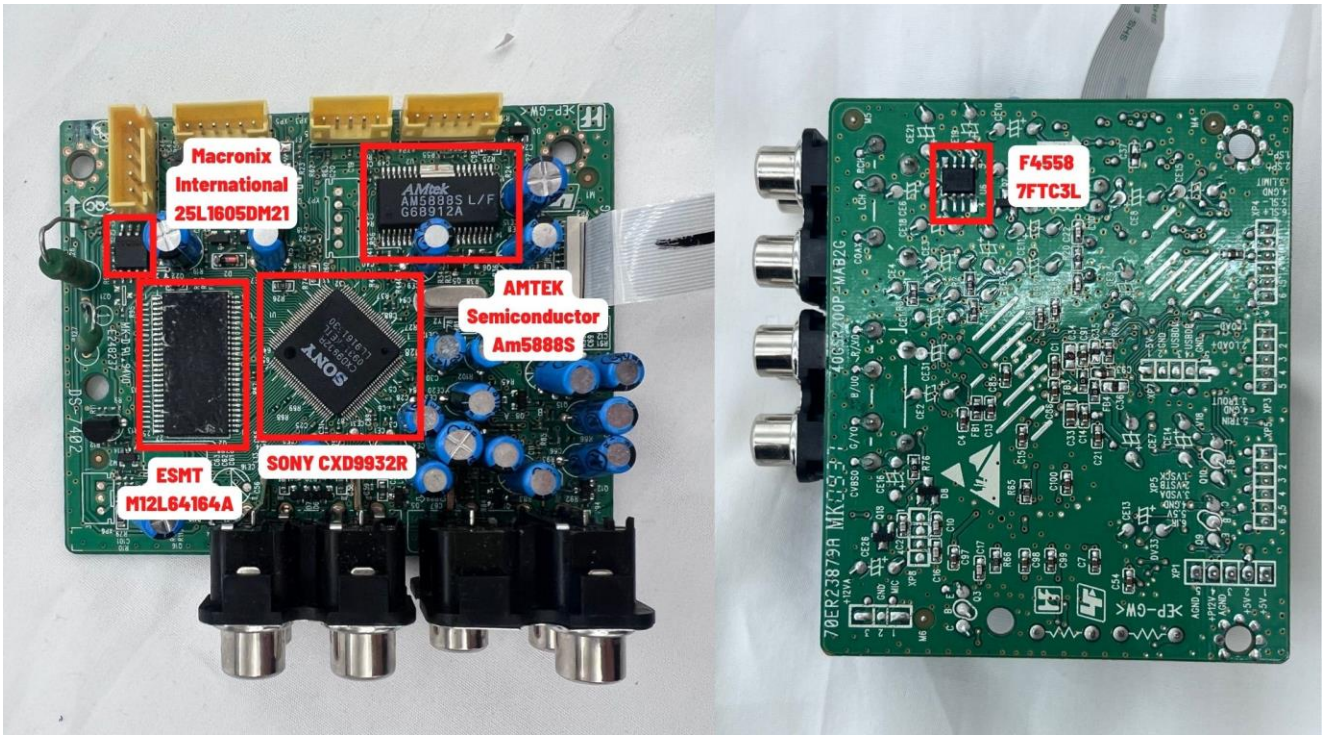


Figure 21. IC locations on Microcontroller Board. On the left is the front side of Microcontroller Board, and on the right side is the bottom side of Microcontroller Board.

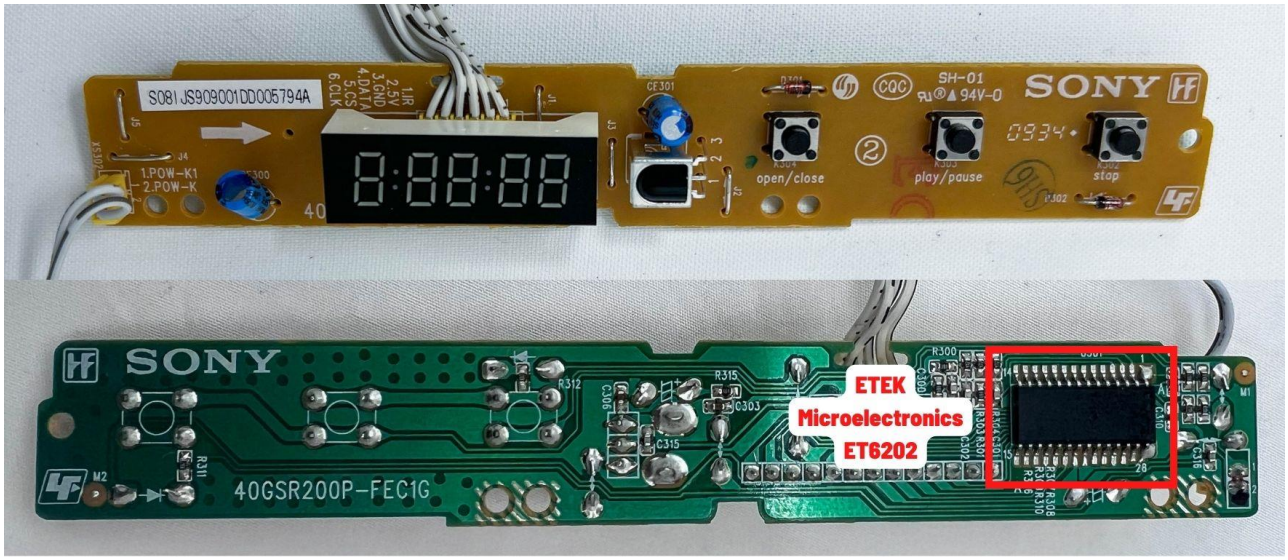
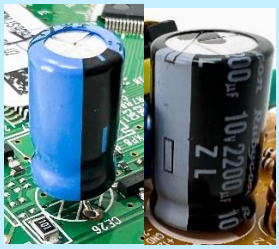
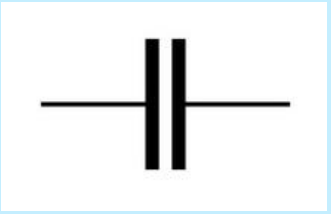
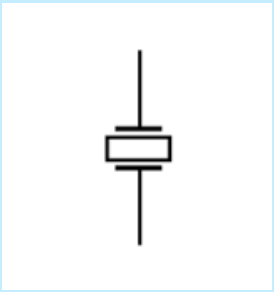
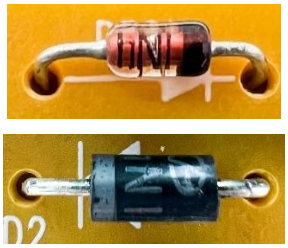
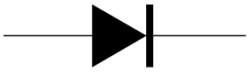
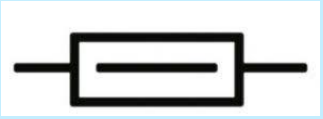
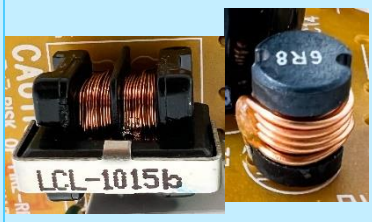
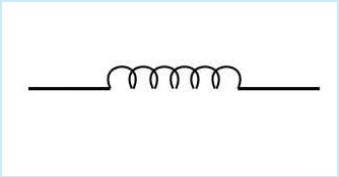
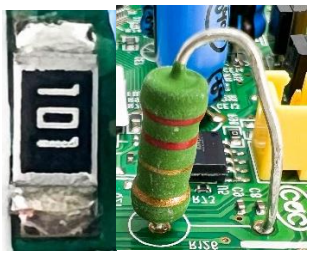
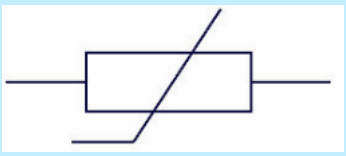


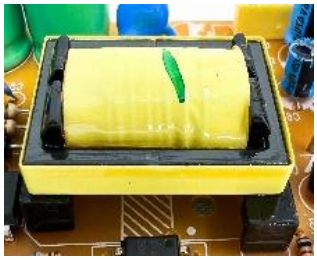
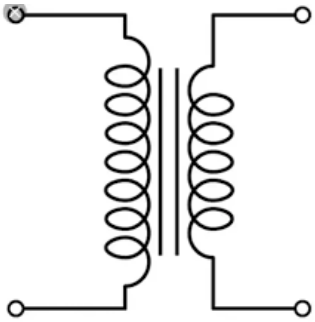
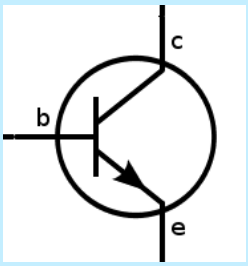
Figure 22. IC locations on Button Controller Board. On the top is the front side of Button Controller Board, and on the bottom is the back side of the Button Controller Board.

5.4 ELECTRICAL COMPONENTS

ID	Component/ Picture	Part Description/ Role in System	Qty	Schematic Symbol: A graphical representation of electrical components
1	Capacitors 	A passive component that stores energy. It is used to suppress voltage spikes and filter signals.	113	
2	Connector 	A connector/socket is an opening that fits another specific device with matching pins or other connectors.	8	

ID	Component/ Picture	Part Description/ Role in System	Qty	Schematic Symbol: A graphical representation of electrical components
3	Crystal Oscillator 	This is the clock chip. It provides a stable clock signal and has a low phase noise. It allows the microcontroller board to synchronize itself to make sure data being read are in place and in sync.	1	
4	Diodes 	Diodes allow the current to flow in one direction but not the other. Its role is to prevent overvoltage.	14	
5	Ferrite Bead 	A ferrite bead is a passive power supply device. It improves PCB's power quality and is designed to suppress high-frequency signals on a power supply line.	3	
6	Fuse 	A fuse is a safety device that provides overcurrent protections in case of a short circuit.	1	

ID	Component/ Picture	Part Description/ Role in System	Qty	Schematic Symbol: A graphical representation of electrical components
7	Inductors 	An inductor stores electrical energy in the form of magnetic energy. The coiled inductor is used to filter noise from the high-frequency power supply.	8	
8	Resistors 	Resistors help regulate the amount of current that flows in the circuit and lower the voltage in any particular portion of the circuit.	99	
9	Thermistor SCK102 	A power thermistor is a thermally sensitive resistor whose resistance changes as the temperature in a system changes. Its function is to suppresses inrush currents of electrical circuits.	1	

ID	Component/ Picture	Part Description/ Role in System	Qty	Schematic Symbol: A graphical representation of electrical components
10	Transformer 	This high frequency transformer transfers electrical energy from one circuit to another by electromagnetic induction and reduces or increases the electric voltage.	1	
11	Transistor  	A transistor is used for switching or for amplifying. It acts as a gate for electronic signals to make sure the circuit is on if the current is flowing and off if no current is flowing.	19	
12	Varistor 10D471K 	A varistor is a voltage dependent resistor. It changes its resistance depending upon the voltage applied across it, in order to protect a circuit from high unwanted voltage surges.	3	

5.5 LOCATION OF ELECTRICAL COMPONENTS

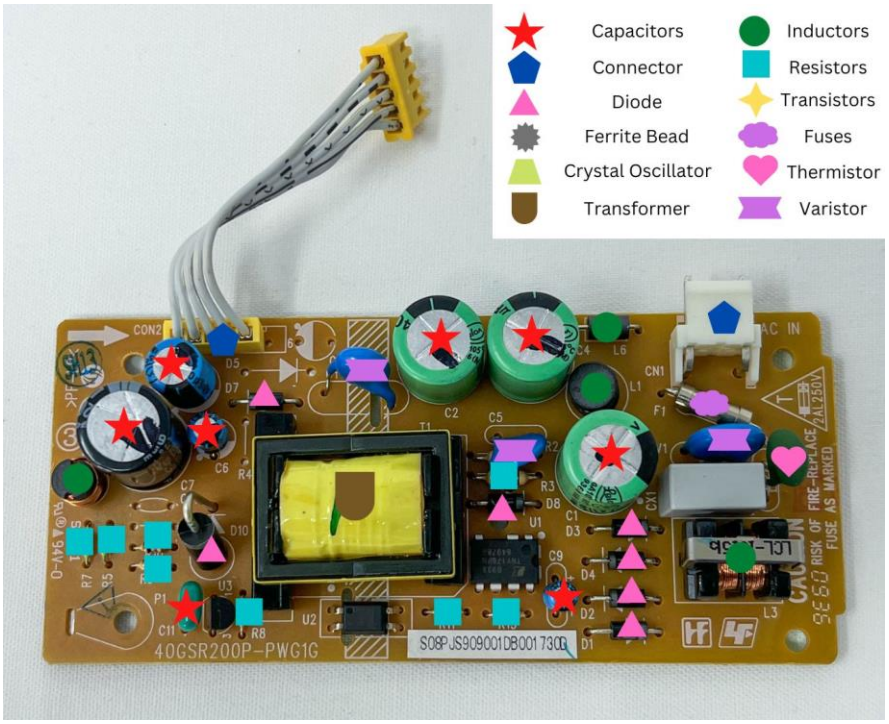


Figure 23. Electrical component locations on Power Supply Board

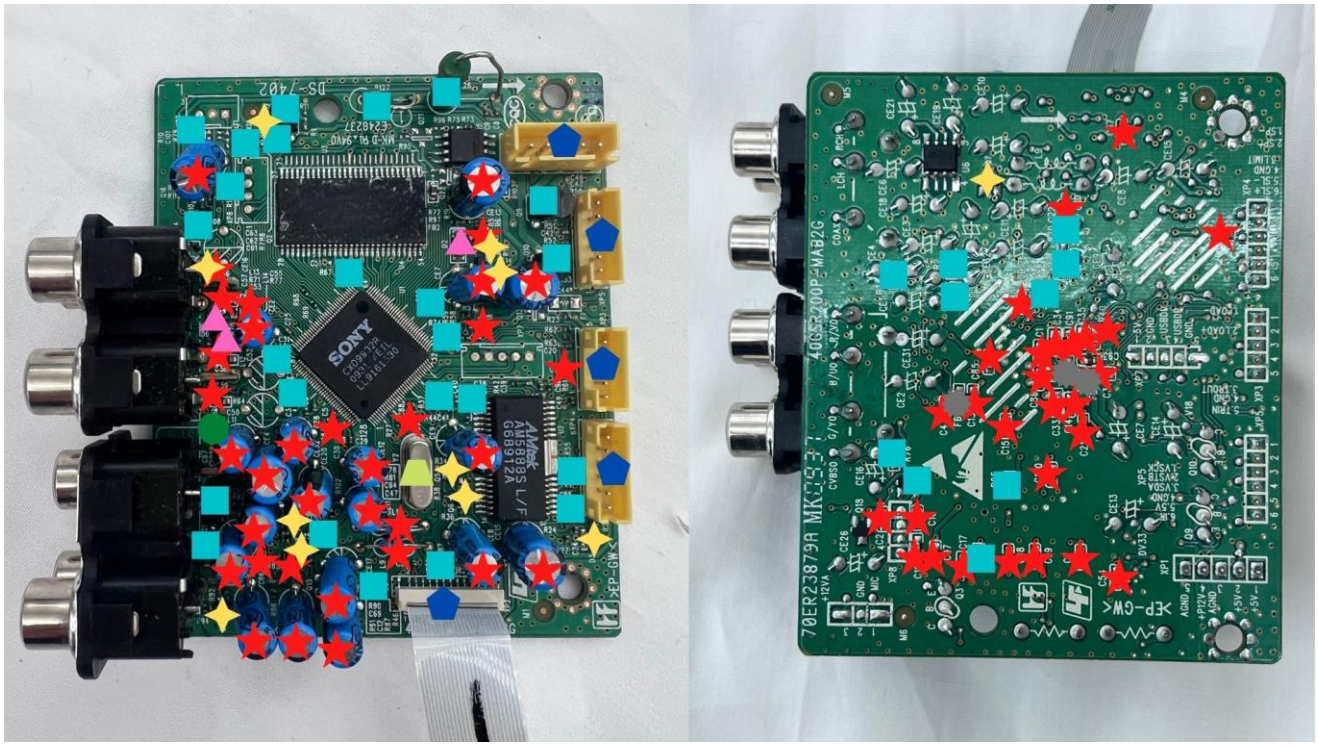


Figure 24. Electrical component locations on Microcontroller Board. On the left is the front side of Microcontroller Board, and on the right side is the bottom side of Microcontroller Board.

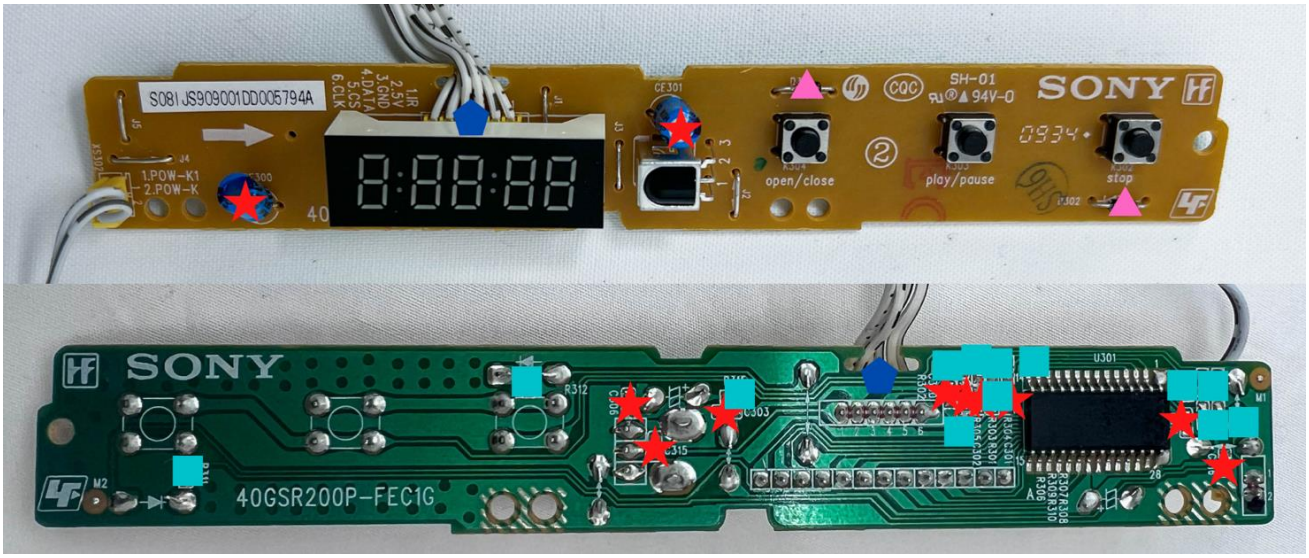


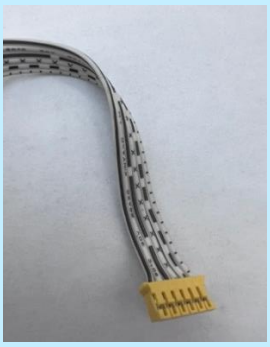
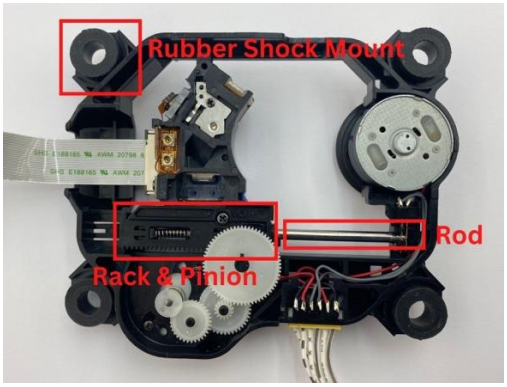
Figure 25. Electrical component locations on Button Controller Board. On the top is the front side of Button Controller Board, and on the bottom is the back side of the Button Controller Board.

5.6 OTHER COMPONENTS

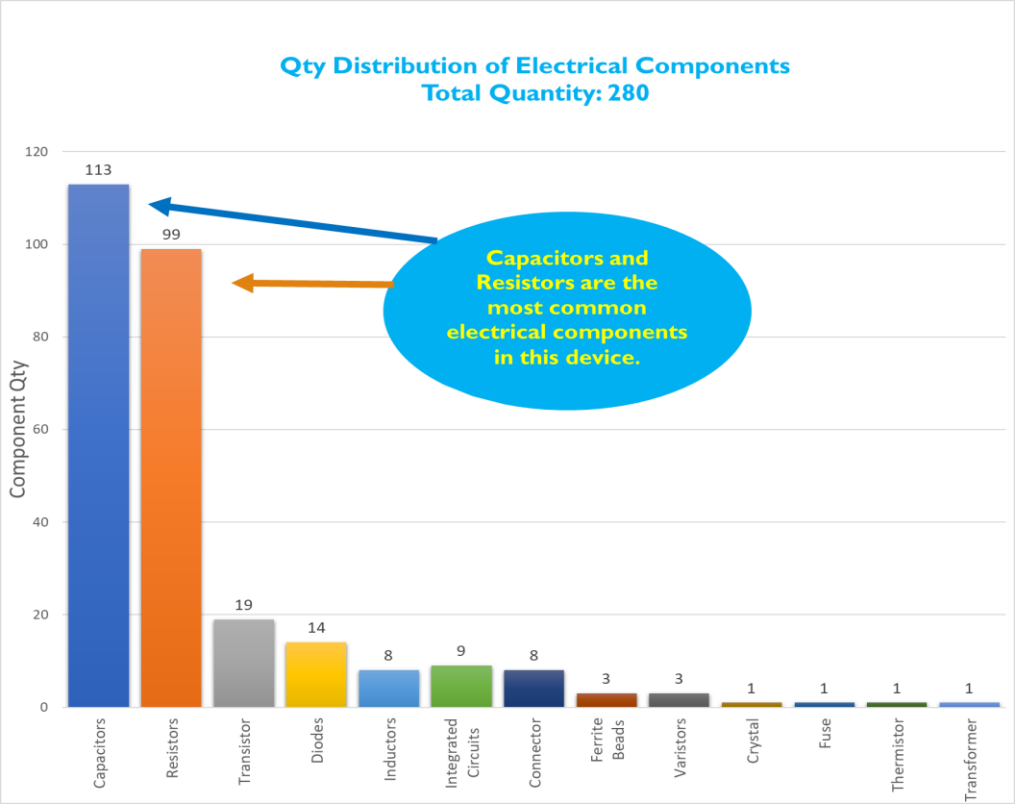
ID	Component Picture	Qty	Part Description Role in System
1	Front panel 	1	A plastic piece that houses the slot through which the CD tray comes out off. On top, it has a power button, eject, play, and pause button molds. It has tabs that snap into the frame and are easy to attach. It has a spot for an LED to indicate if on or off.
2	Bottom chassis 	1	The chassis houses and holds the electrical components. Its function is to protect of internal electrical components and prevents electrical shock to users. It is made of rigid sheet-metal.

ID	Component Picture	Qty	Part Description Role in System
3	Top chassis 	1	The chassis houses and stabilizes the electrical components.
4	Rear panel 	1	It protects and stabilizes the internal electrical components,as well as providing information regarding to the manufacturing and product functions (logo, outputs, certifications).
5	Phono Jacks 	7	The phono jacks are located on the rear panel, and it drives a signal either digital or analog into another device's audio input.
6	Power cord 	1	A power cord is an electrical cable that connects the CD/DVD player to a wall socket. It transfers energy from a power source to the device.

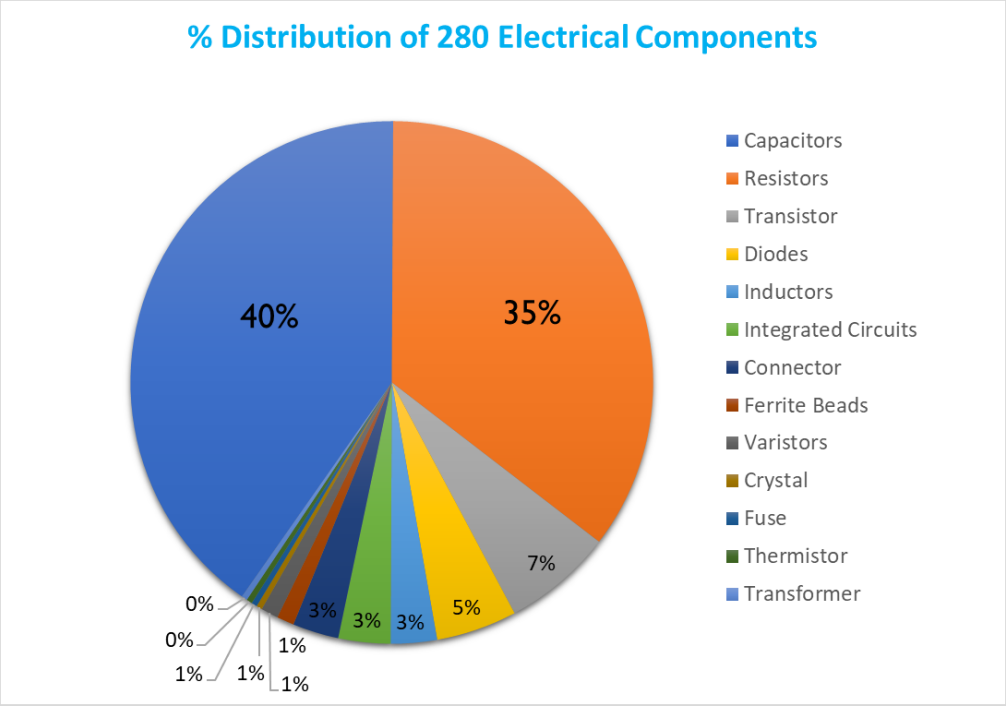
ID	Component Picture	Qty	Part Description Role in System
7	Open/close button 	1	It opens and closes the disk tray to insert or remove DVD or CD from the device.
8	Play/Pause Button 	1	It plays and pauses the progress of DVD or CD within the device.
9	Stop Button 	1	It stops the processing of DVD or CD disk.
10	Display LED3751G-A1 	1	The display is located on the front panel. The display sends messages like NO DISC, INSERT DICS and DISC ERROR. It also displays time.

ID	Component Picture	Qty	Part Description Role in System
11	Ribbon Cables 	8	Ribbon cables are used for internal connections. Some ribbon cables have fine wires that allow different signals to be sent and has a stiff plastic at the end to be plug in to narrow slots.
12	LASER & LENS ASSEMBLY FRONT  BACK 	1	The laser and lens assembly are mounted on a plastic bracket to lock in place and stability. The Capstone Motor spins the DVD or CD disk very quickly. The Slide Motor is responsible for turning gears that moves the DVD or CD physically. The Laser reads and writes data at different points on the disc. A rack and pinion (round gear and straight edge) convert rotational motion from the motor into linear motion. A rod is smooth and polished to allow the laser to track in a smooth pattern. The four rubber shock mounts are used as shock absorbers for stabilization.

5.7 ELECTRICAL COMPONENT DISTRIBUTION



Graph 1: Quantity distribution of electrical components



Graph 2: Percent distribution of electrical components

5.8 INNER WORKINGS OF THE CD/DVD PLAYER

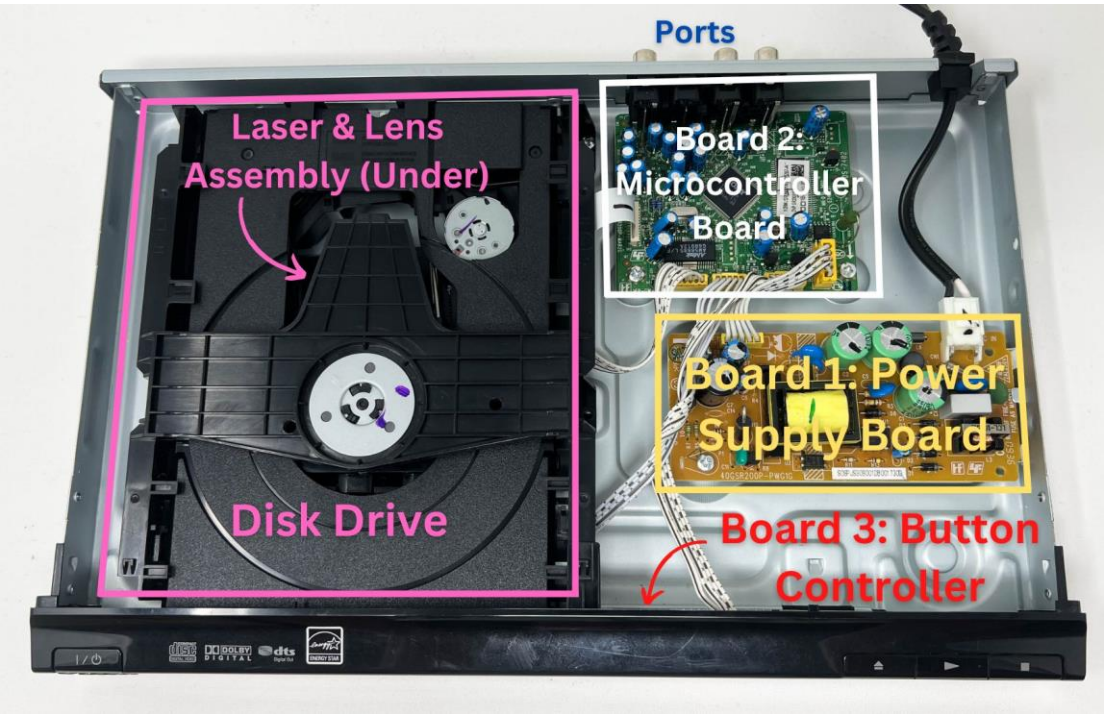
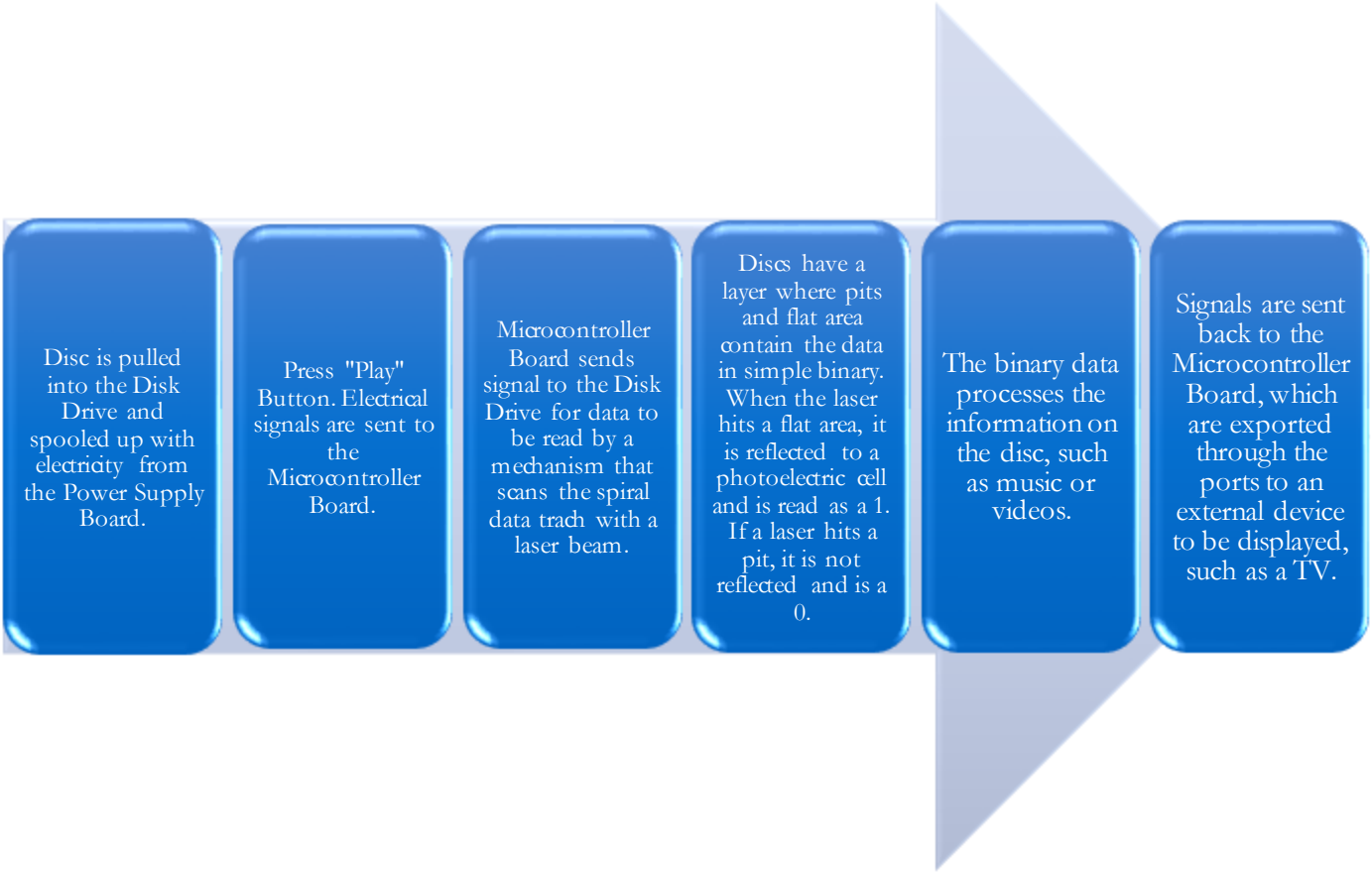


Figure 26: Internal layout of the Sony CD/DVD Player DVP-SR200P



Flow Chart 2: CD/DVD Player function flowchart

6. CONCLUSIONS AND LESSONS LEARNED

Deconstructing the Sony CD/DVD Player DVP-SR200P provided us with intricate knowledge of the circuit functions of a household electrical device.

Lessons Learned:

- We learned that teamwork, planning, and time management helped us complete the challenge on schedule.
- We learned how to document and stay organized.
- We learned how to correctly identify all electrical components based on their reference designators and find out how they worked from their datasheets.
- We understood the roles within the system based on datasheets.
- We learned about the schematic symbols and pin-out diagrams of the integrated circuits.

7. REFERENCES AND SOURCES

"Academy.org/Science/Electrical-Engineering/Reverse-Engin#Dvd-Player." Khan Academy, Khan Academy, https://www.khanacademy.org/science/electrical-engineering/reverse-engin.

Alldatasheet.com. "MX25L1605DM2I-12g PDF, MX25L1605DM2I-12G Description, MX25L1605DM2I-12G Datasheet, MX25L1605DM2I-12G View ::: Alldatasheet :::" *ALLDATASHEET*, 1 Oct. 2008, https://pdf1.alldatasheet.com/datasheet-pdf/view/267910/MCNIX/MX25L1605DM2I-12G.html.

"Control LED Drive Circuit." *ET6202 Datasheet*, Etek Microelectronics, 6 June 2004, https://datasheetspdf.com/pdf-file/705432/EtekMicroelectronics/ET6202/1.

"Datasheet PDF Search Site for Electronic Components and Semiconductors." *PDF.com*, Oct. 2005, https://www.datasheet-pdf.com/.

Datasheetq.com. "817B Datasheet PDF Download - Liteon Technology." *DatasheetQ.com - Datasheet PDF, Electronic Components Database*, https://www.datasheetq.com/datasheet-download/2652/1/LiteOn/817B.

E DQ8 NC VSS VDD LDQM DQ7 SSQ D D Q Esmt M12l64164a (2Y). https://www.esmt.com.tw/upload/pdf/ESMT/datasheets/M12L64164A(2Y).pdf.

"Ref Anodecathode - Diodes Incorporated." *ADJUSTABLE PRECISION SHUNT REGULATORS*, Diodes Incorporations, Mar. 2018, https://www.diodes.com/assets/Datasheets/AZ431A.pdf.

"Sinusoidal Oscillators - Introduction." *Tutorials Point*, https://www.tutorialspoint.com/sinusoidal_oscillators/sinusoidal_oscillators_introduction.htm.

Storr, Wayne. "Varistor and the Metal Oxide Varistor Tutorial." *Basic Electronics Tutorials*, 2 Aug. 2022, https://www.electronics-tutorials.ws/resistor/varistor.html.

"Thermistor Basics ." *Wavelength Electronics*, Wavelength Electronics, 11 Feb. 2020, https://www.teamwavelength.com/thermistor-basics/.

"TNY174-180 TinySwitch-Lt Family - Mouser Electronics." *TNY174-180 TinySwitch-LT Family*, Power Integrations, Aug. 2016, https://www.mouser.com/datasheet/2/328/PI-3009414_TNY-LT-1198698.pdf.

Woodford, Chris. Https://Www.explainthatstuff.com/Cdplayers.html, 17 Feb. 2022, https://www.explainthatstuff.com/cdplayers.html.