Electronics Online Challenge

PJ551D DLP Projector Teardown – Team 95070B

Introduction

Our team decided to tear down the ViewSonic© PJ551D projector, because we were curious how the projected images are created, and why they always overheat. While deconstructing it, we found PCBs, chips, fans, bulbs, a DMD chip, and copper.

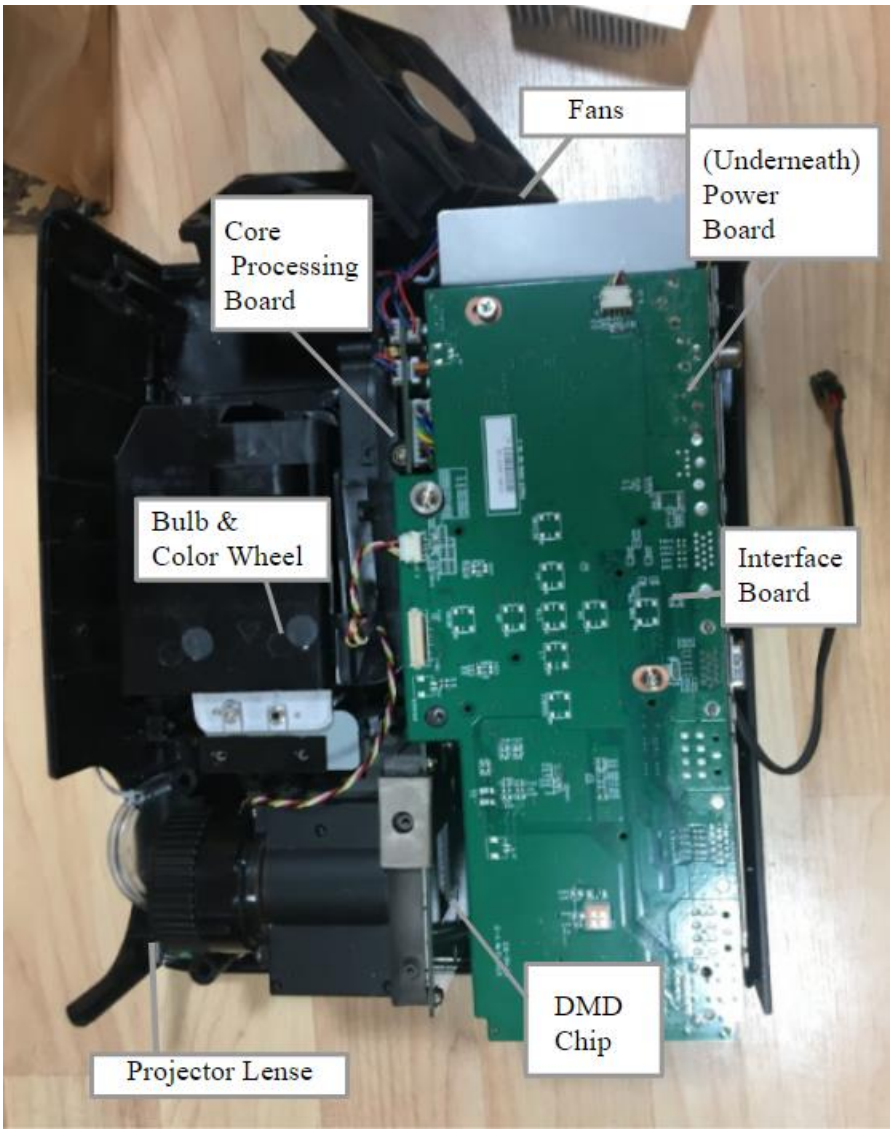


Figure 1: Picture of the projector with the cover, the bulb and color wheel, and the copper cover on the interface board removed.

Interface Board

The interface board allows the user to interact with the projector. This double-sided PCB connects to various cables and the buttons on the cover via a ribbon cable.

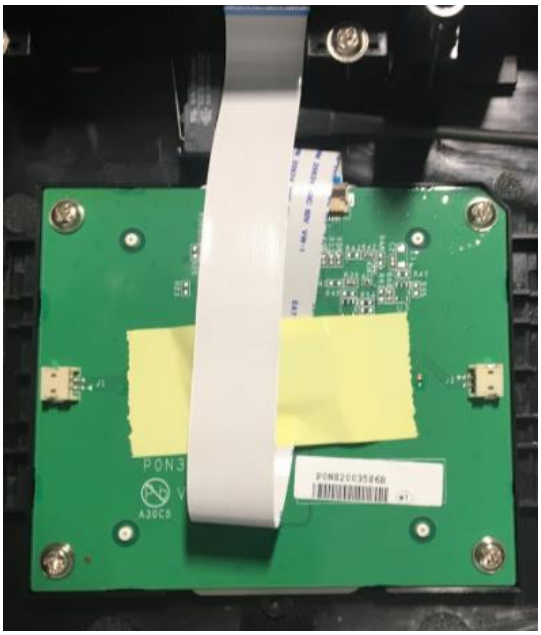


Figure 2: The ribbon cable transfers data from the input buttons to the interface board.

Figure 3: The various cable inputs are connected to the interface board.

The left bubble contains capacitors, metal traces, an LDO regulator which controls output voltage, and Zener diodes which reverse the current at a certain level. This board is designed to create specific voltages with only one power input. There is also a Texas Instruments (TI) video card which is likely used to collect graphic data from the input. The right bubble contains a chip by TI and Mouser Electronics for measuring voltage drops.

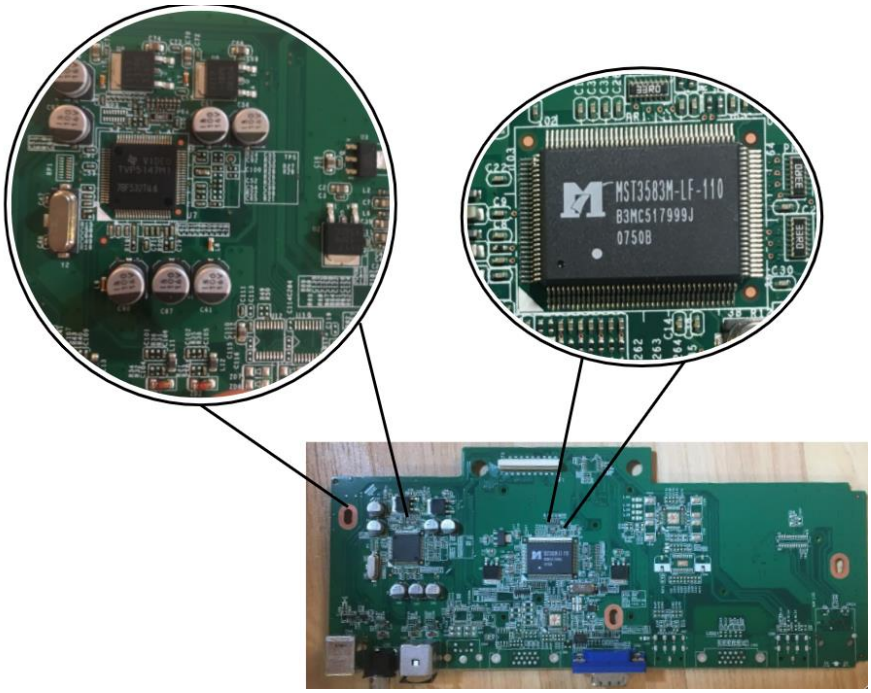


Figure 2: Back of the Interface Board. On the bottom are the connectors which connect to input cables.

Processing Board

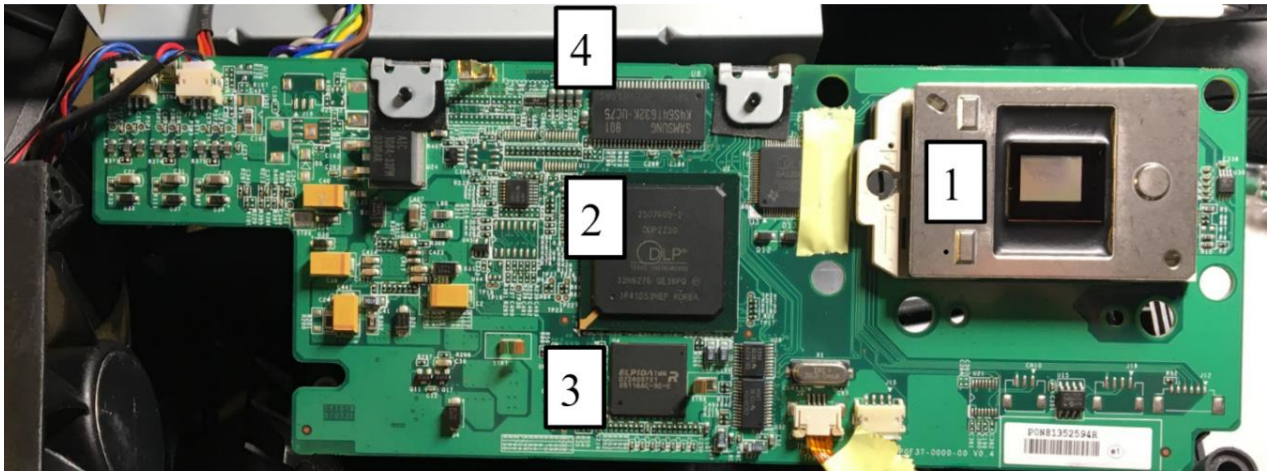


Figure 3: Main processing board. 1 - DMD chip. 2 - DLPC. 3 - ELPIDA RAM chip. 4 - CMOS chip by Samsung

The processing board directly controls the projector's output.

The DMD chip allows the projector to project the desired pattern of light. It is comprised of thousands of mirrors that are 16 micrometers across and are mounted on yolks. Each mirror is controlled by a pair of electrodes on hinges that use electrostatic connection and have a range of motion of -12°~12. The back of the DMD chip has many connectors which transfer electricity from metal traces on the processing board to power the electrodes beneath each micromirror.

Figure 4: Back of DMD Chip

The DLPC is a chip created by TI to control the movement of the micromirrors. It works with the CMOS memory chip, which allows for non-live-input projections to be projected. Using the Dual CMOS memory cells under each micromirror, the micromirrors' positions are determined by the preloaded memory of group pixels.


Figure 5: Metal traces on back of DMD chip

It has an electromagnetic copper cover to prevent radiation from escaping.

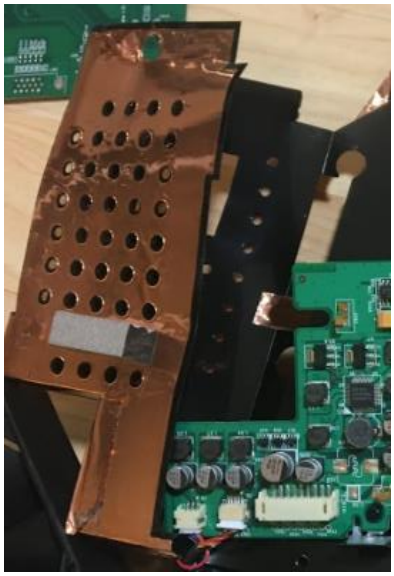


Figure 6: Copper Cover

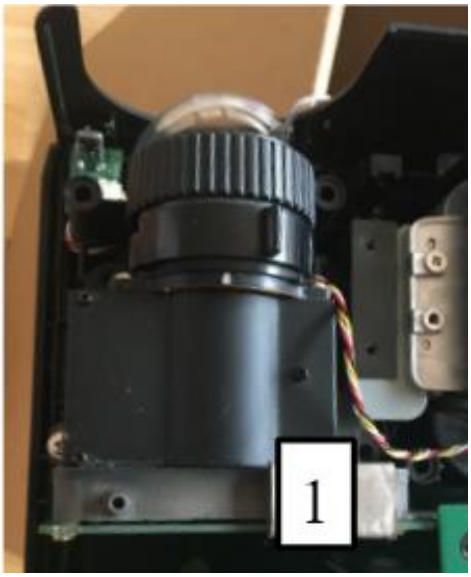


Figure 7: Projector Lens. 1 - DMD Chip and Holder, which are right behind the projector lens.

The Commodity IC handles repetitive processing routines between data terminal and communication hardware.

The BIOS chip communicates between hardware and processors, which in this case, are the video card and the ports, and the DLPC.

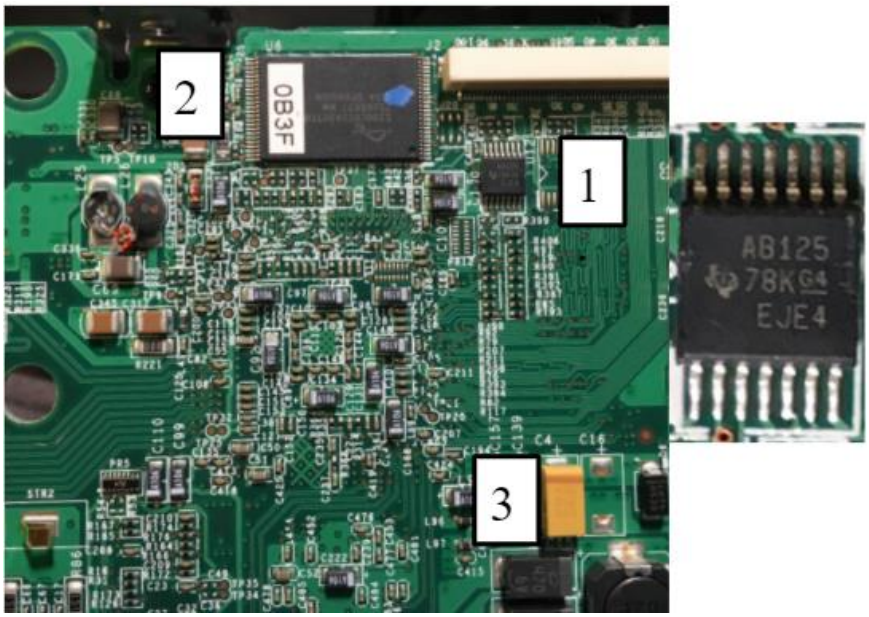


Figure 8: Main processing board, on the right is an enlarged image of 1–Commodity IC by TI. 2–BIOS chip by Spansion. 3 – LDO Regulator (pg.3)

Color Wheel

Connected to the processing board, is the color wheel responsible for creating the colors that are projected. The wheel moves synchronized with the DMD chip, creating images so quickly that the brain combines them into one.

Figure 9: Color Wheel

Bulb

The light is produced by a Xenon Arc Lamp.

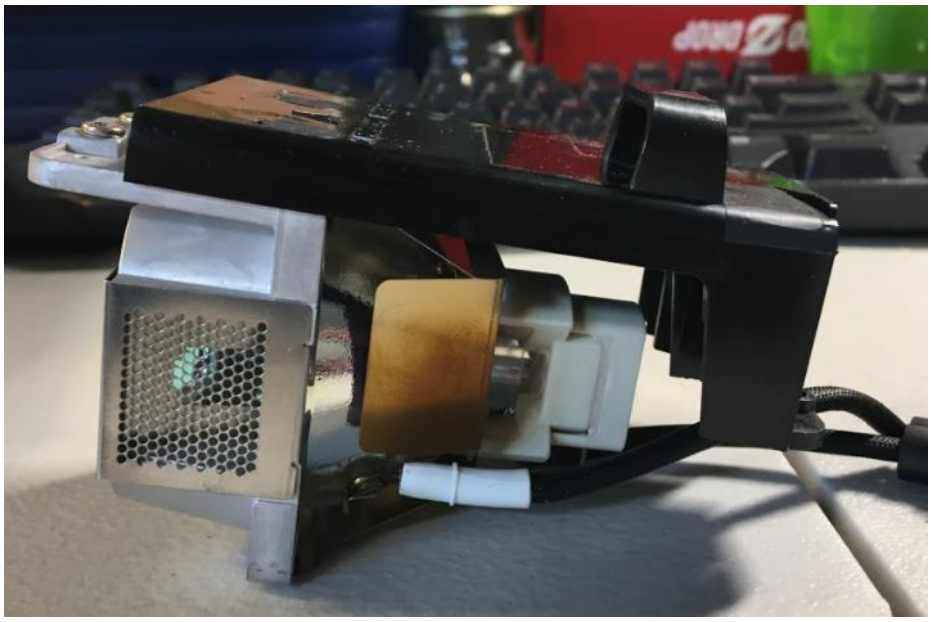


Figure 10: Xenon Arc Lamp

Power Board

The transformers change the electrical currents that are used by the projector. The Ballast Board regulates power level and is probably designed to operate no matter what voltage is plugged in.

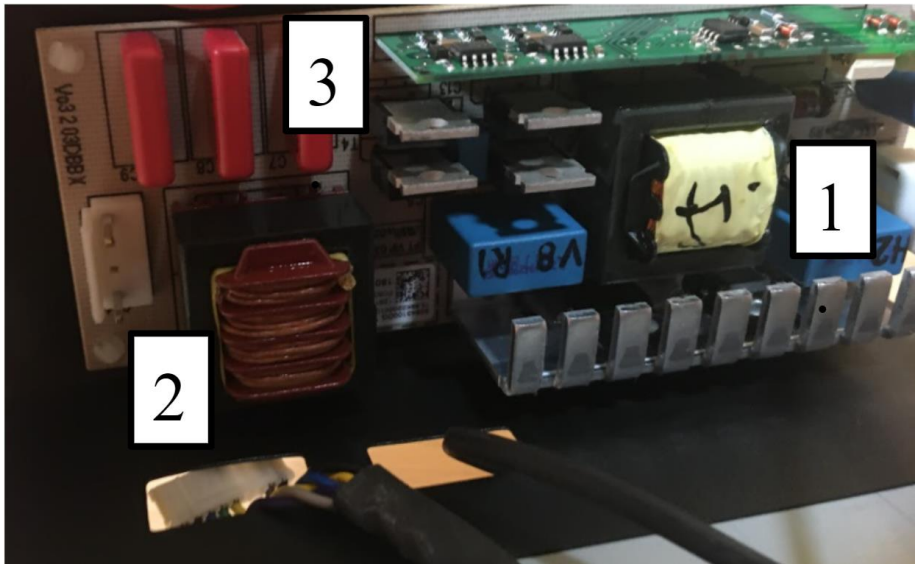


Figure 11: Power Board. 1 - Transformer. 2 - Transformer. 3 - Ballast Board

Fans and Heat Sink

This projector uses a lamp, LDO regulators, a color wheel, and copper, which all produce a lot of heat. To prevent it from overheating, there are both fans and a heat sink. The fans blow out hot air and the heat sink releases heat through its many pieces of metal.

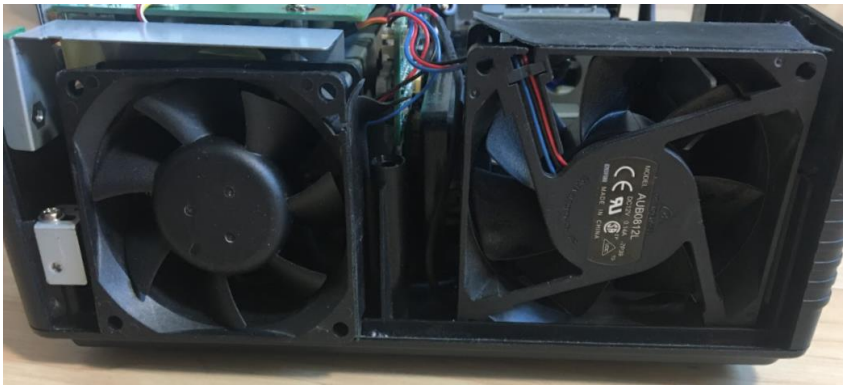


Figure 12: Fans

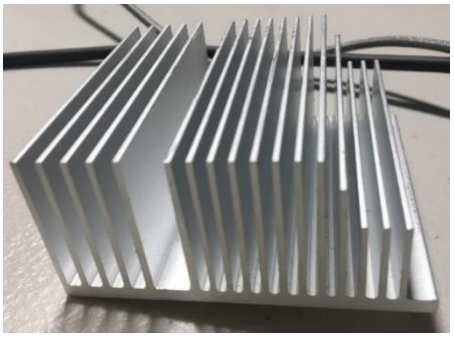
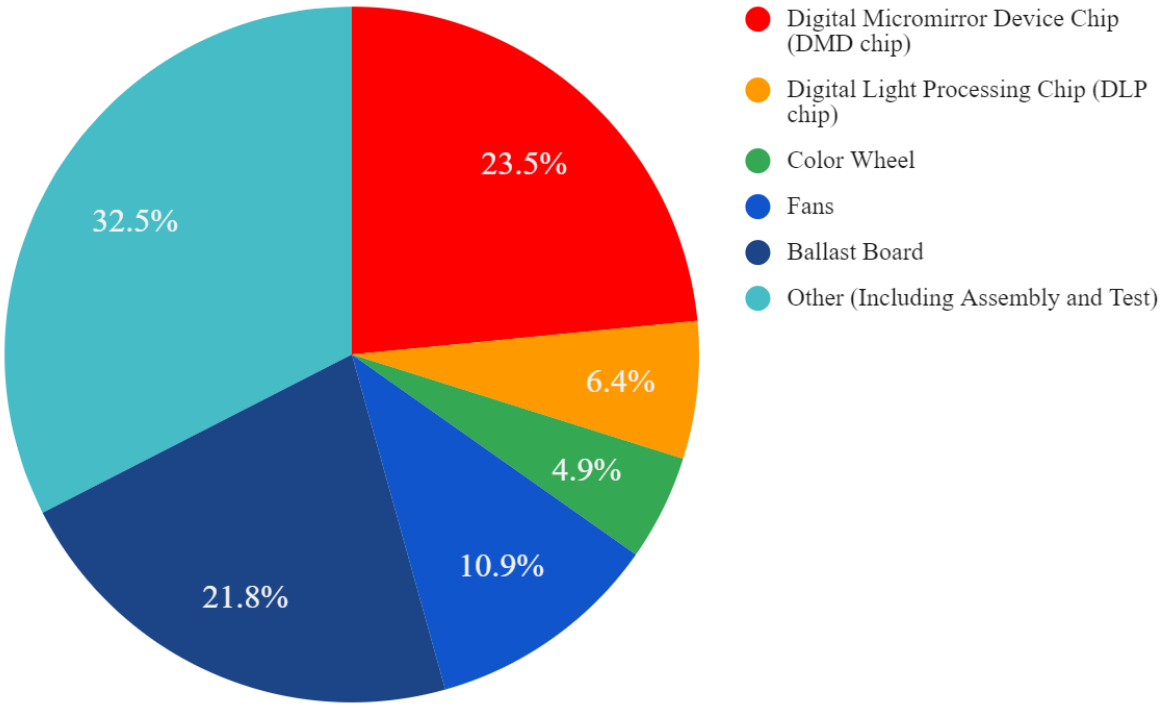


Figure 13: Heat Sink

Price Breakdown



Conclusion

One lesson we learned is that there are always ways to improve. For example, since this projector was bought in 2003, components like the Xenon arc lamp would be better replaced with an LED bulb which would not produce as much heat or have such a low efficacy.