Team 3050-A's Texas Instruments Challenge

The Inner Workings of the Samsung Syncmaster 2253BW

Why We Chose a Monitor

It took upwards of a full day of nonstop debate to make the decision for the Samsung SyncMaster to be the one in our surgeon chair. In the end we based the decision off of some research we did behind Texas Instruments and their areas of expertise. We found that they are one of the lead suppliers of power inverters around the globe, which we connected with the fact that AC/DC converters are commonly found in computer monitors. One of our teammates had a broken monitor lying around that we figured to be perfect for this project due to the fact that all the charge in its capacitors would already be drained, deeming it perfectly safe. We did not know much at all about electrical engineering going into this project, but through some reliable forums online and extensive research we are confident in saying we now have much more than just a basic understanding of it.

Broad list of components found (chips later)

Identification	Purpose
Front Bezel	Help protect the LCD screen and give some design
Back Plate	Protect the circuit boards and help stylize the monitor
Monitor Stand	Give a bicg surface area at the bottom of the monitor to reduce risk of tipping
Metal Cover for the Circuit Boards	Provide protection and support for the boards
Power Inverter Board	Convert AC current to DC current to feed to the backlight and the main processing board
Main Processing Board	Converts VGA or DVI input signal into something the LCD screen can interpret, also allows user to customize display settings
Backlight	Illuminates the LCD screen so the user can see it
LCD Screen	Display what the main processing board tells it to

First look at the monitor

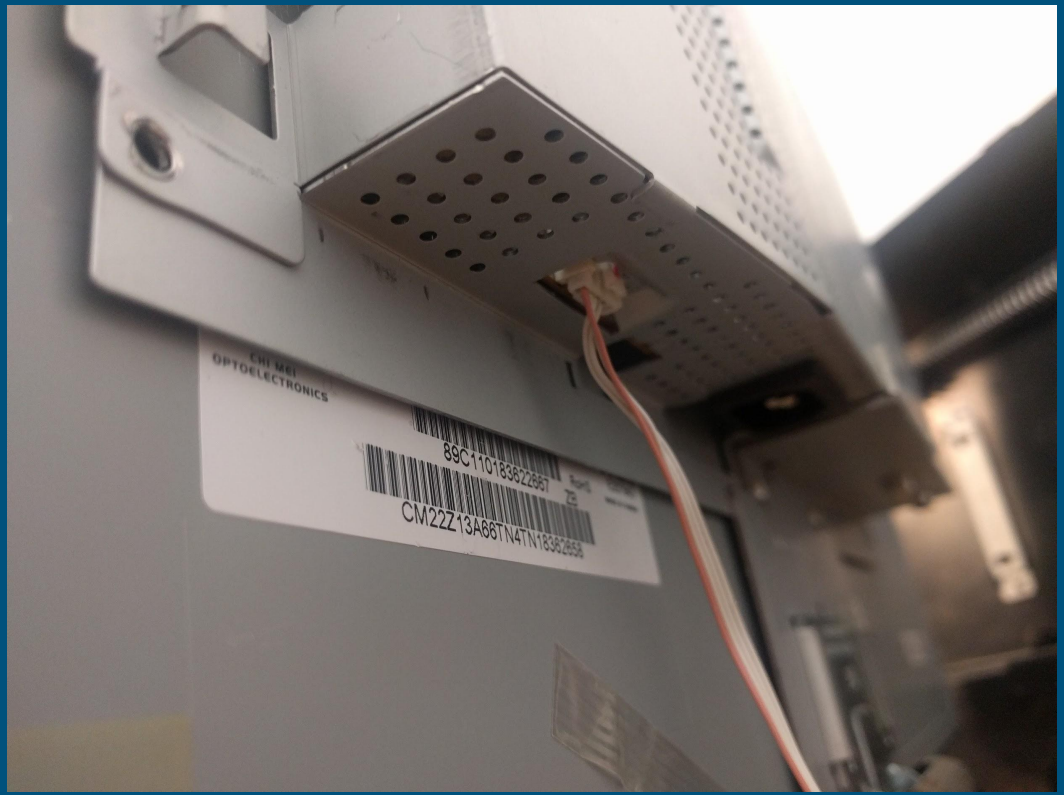
Backside

First look at ports

Front bezel off

A look at the side ports leading to the LCD

This port lead to some buttons on the front bezel which we left out because they weren't too interesting



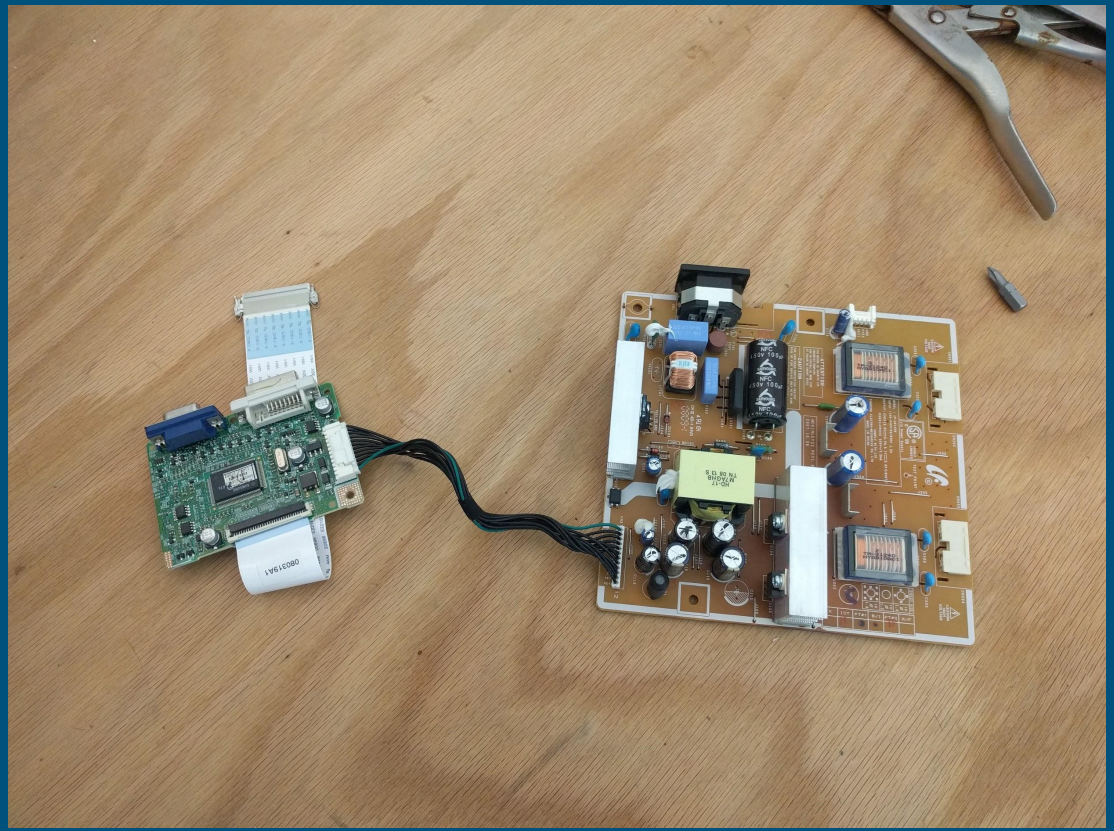
We found two distinctly separate circuit boards on the monitor stand

What they look like detached in their relative positions

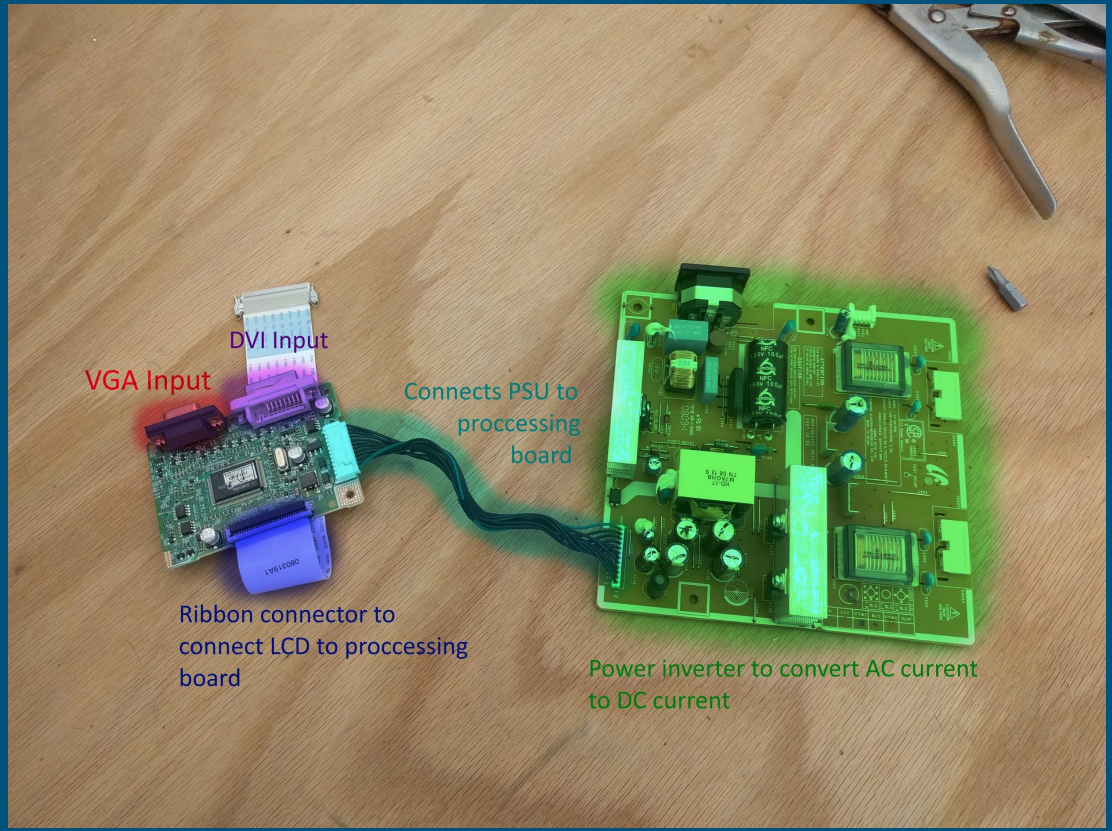
Our Thoughts at This Point

After the initial disassembly of the monitor and the isolation of the two boards, we quickly realized what we got ourselves into. We had no idea what we were looking at and we nearly decided to choose a simpler item to disassemble. However, we persevered through many days to better comprehend how this system operated. We had to teach ourselves all the different components and what they contribute to the circuit. The most difficult task of this entire project was learning to name components solely over what they look like. The really small components on the main processing board were especially difficult because there was no lettering on them for identification. Even so, if it was a component that we could look up we still would have to dig through seemingly inscrutable datasheets in order to determine what it was and how it contributed to the circuit. We looked at the two boards side by side and developed a plan to examine them separately because we knew that they had vastly different jobs in the working of the monitor.

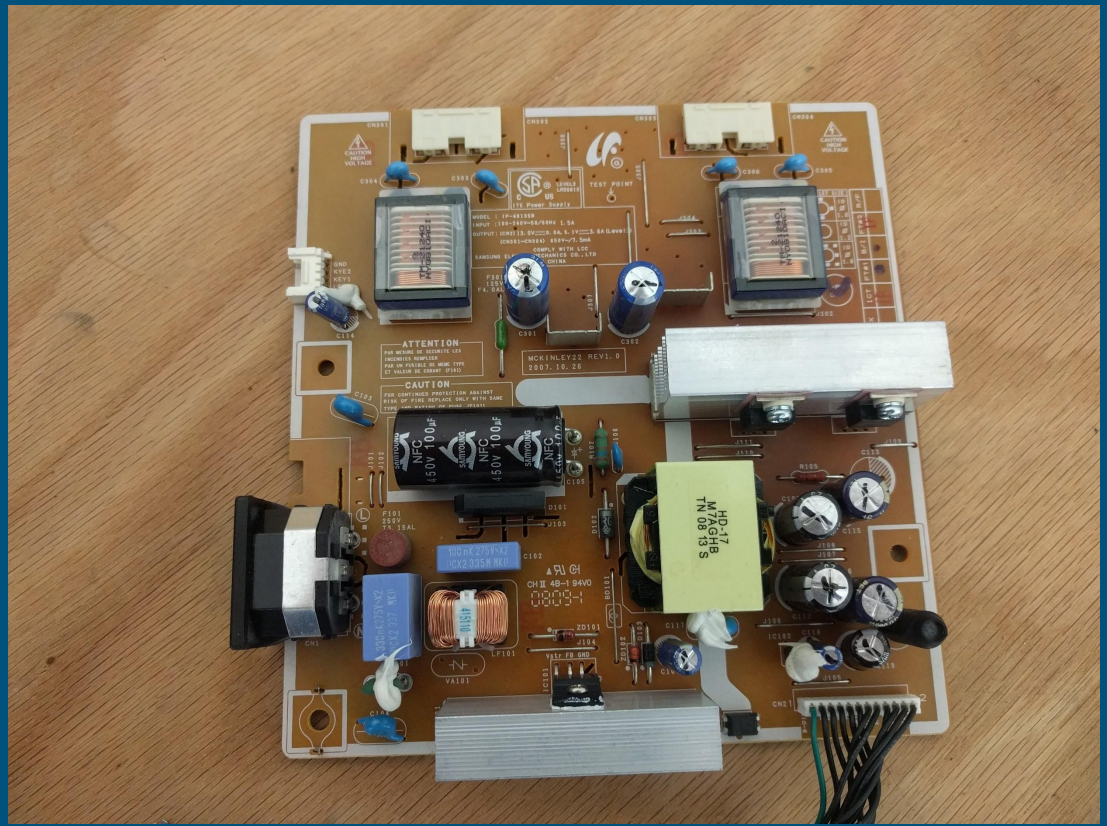
We classified them as the main processing board (left) and the power converter (right)



Broad Analysis of Components

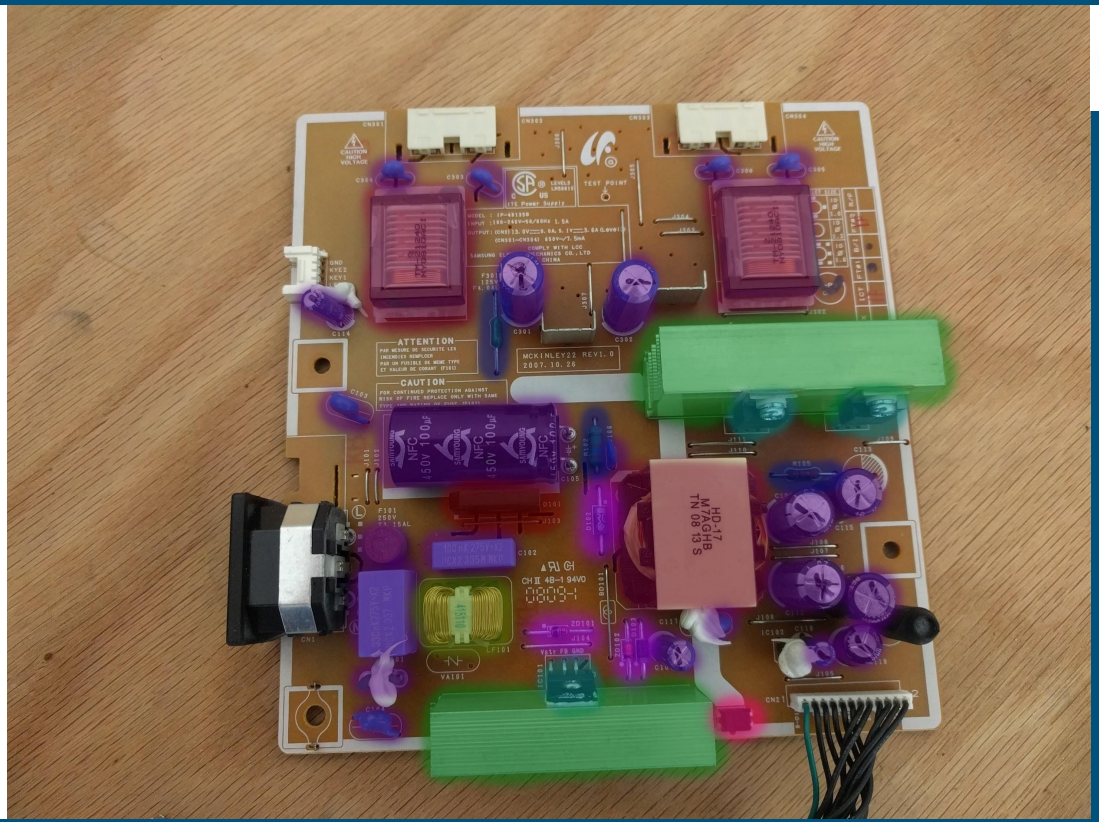


Closer Look at the Power Converter



After quite some time, and too much research, we developed an understanding of what each part does to help convert AC voltage to DC voltage

- Transformers used to change the AC voltage
- Capacitors used to store DC energy to feed the main processing board
- Resistors used to measure the DC voltage most likely for the power transistors
- Power transistors used to regulate DC voltage (3 because board outputs 3 seperate voltages)
- Heatsinks used to dissipate excess heat energy from the power transistors
- Choke inductor used to condition the AC input signal
- Bridge rectifier used for a rough conversion of AC voltage to DC voltage
- No datasheets found anywhere, possibly a diode

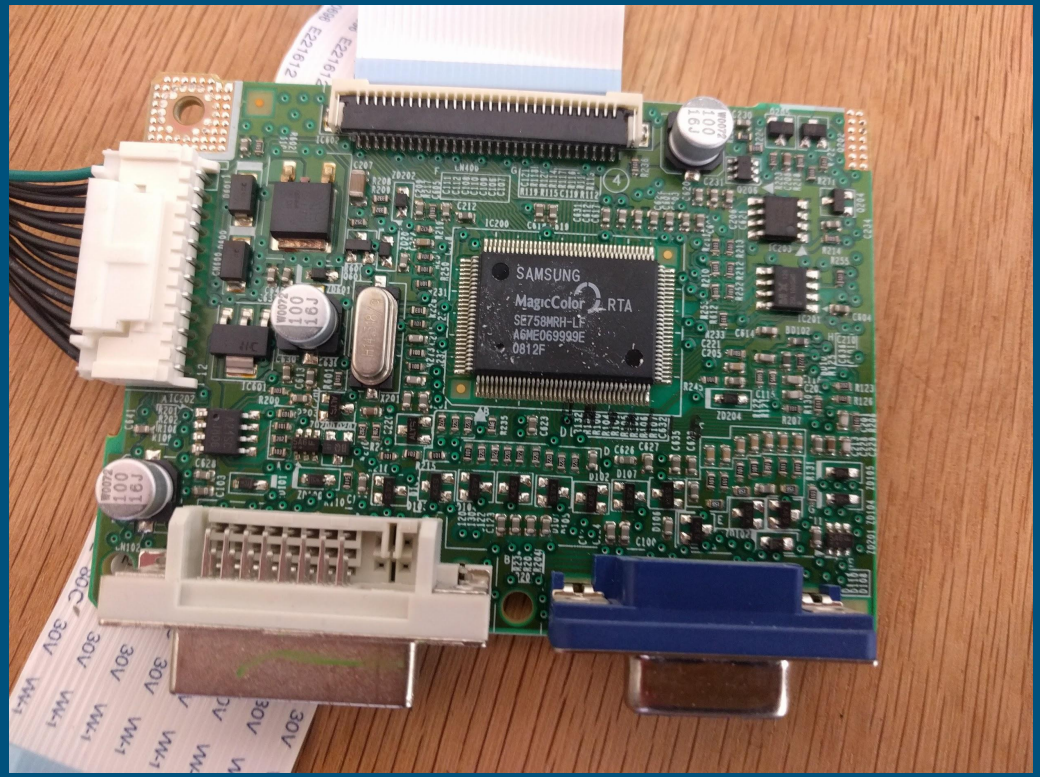


- Diodes used to keep current flowing in the direction it's supposed to

Summary of Chips and Components on Power Inverter Board

Identification	Quantity	Manufacturer	Purpose
Capacitors	24	Samyoung	Store energy in the circut
Transformers	3	N/A	Change AC voltage
Resistors	3	N/A	Measure DC voltage
Power Transistors	3	Fairchild	Regulate DC voltage
Heatsinks	2	N/A	Dissipate excess heat
Choke Inductor	1	N/A	Condition AC input signal
Bridge Rectifier	1	Shindengen	Convert AC voltage to DC voltage
Diodes	4	Vishay	Keep current flowing one direction
Strange Transistor	1	L-shaped logo	Possibly a diode

The analysis of the main processing circuit was exponentially longer due to the inscrutable datasheets we had to decipher

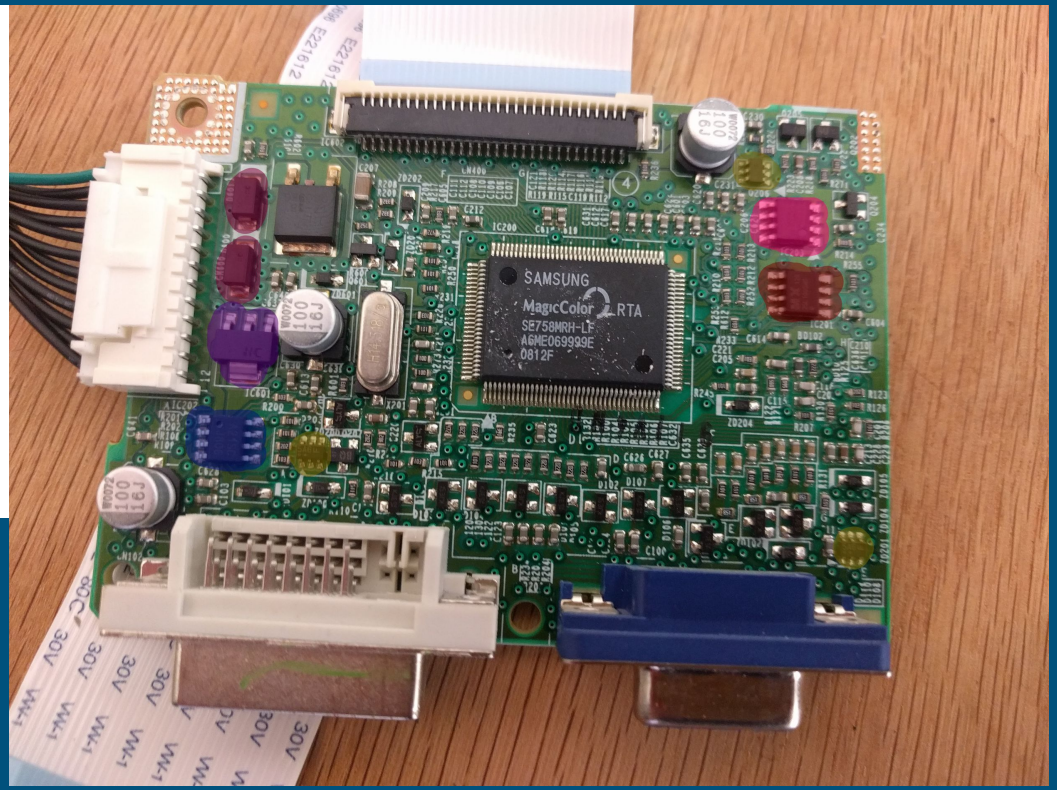


In depth look at main components of the board excluding most IC's (that's later)

- Samsung MagicColor, allows the user to customize gamma, RGB, and color tone
- Capacitors used to store electrical energy
- Crystal oscillator used to generate a precise signal frequency
- Diodes used to direct electrons to where they need to go
- Smaller capacitors used to store electrical energy for when it is needed
- Resistors used to regulate current
- 0809BG positive voltage regulator used to generate fixed voltages

Integrated Circuits Found on the Main Processing Board

- Power diodes used to keep high voltages going in the direction they're supposed to
- Voltage regulator used to convert voltages
- EEPROM probably used to store settings when there's no power being given to the monitor
- No datasheets found, most likely an IC with three seperate diodes
- Flash memory most likely used as configuration for the main chip

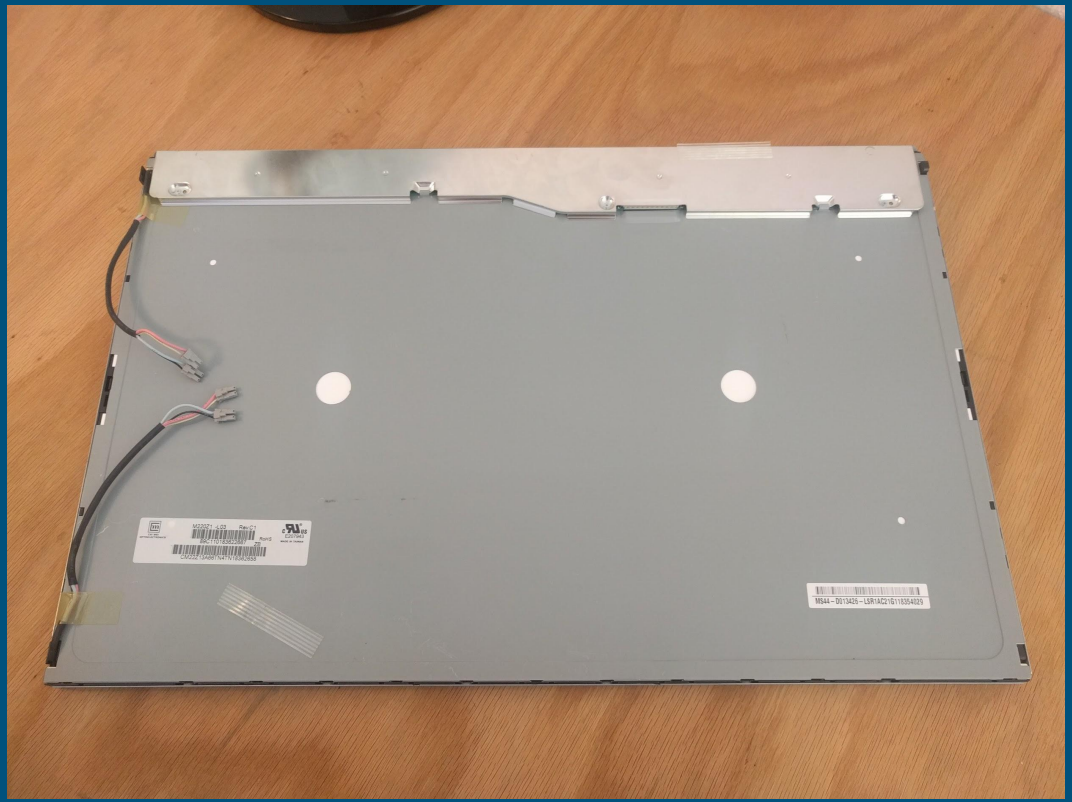


Components Found on the Main Processing Board

Identification	Manufacturer	Quantity	Purpose
MagicColor SE758MRH-LF	Samsung	1	Lets user adjust RGB balance, gamma, and color tone
809S1G Diode	Vishay	2	Power diodes used to direct high voltages
17-33G Transistor	Anpec	1	Voltage regulator used to convert voltages
A21SC EEPROM	Atmel	1	Probably stores settings when there's no power given to the monitor
25L1005 Integrated Circuit	Macronics	1	131KB memory most likely used as configuration for the main chip
S24CS08A EEPROM	SII	1	EEPROM most likely for the main processing chip after being brought back from having no power
Crystal Oscillator	N/A	N/A	Used to generate a precise signal frequncy
Capacitors	N/A	N/A	Used to store electric energy for when the circuit needs it
Resistors	N/A	N/A	Used to change voltages
KJEV2 Diodes	N/A	N/A	Used to direct electrons to where they need to go

We decided to have some fun after all our hard work, so we decided to further take apart the LCD screen

Back of the LCD screen



Removal of a cover reveals a board inside

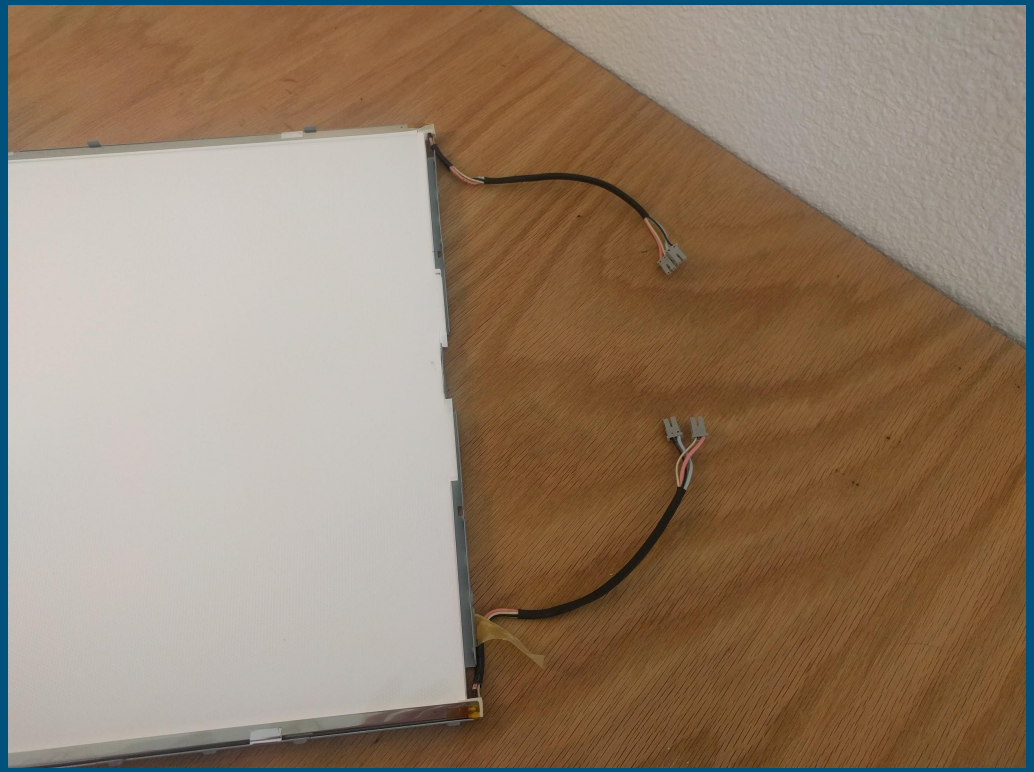
We inferred that they are driving circuits for the LCD as we could not find any datasheets on most of the IC’s

Separating the backlight from the actual display

Backlight and LCD screen side-by-side

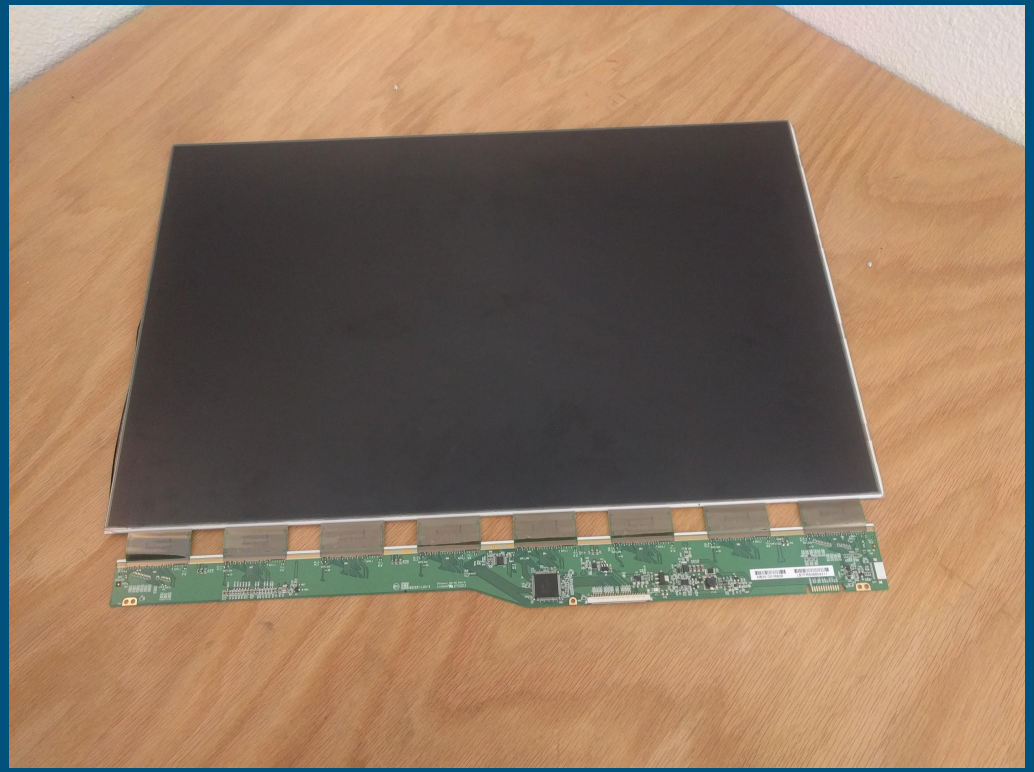
Closer look at the backlight

The disassembly reveals the side ports on the monitor stand lead to the backlight to be used as a power source



Three film layers found on top of backlight, the middle one had crazy light distortion characteristics

Closer look at the LCD attached to the board



We quickly realized the LCD was transparent, as demonstrated here

We wondered what it would look like if it were broken, so with exceedingly adequate safety precautions we dealt some damage to it

What We Learned

After classifying each and every component that made up the monitor our team was more than disappointed to find that there were no Texas Instruments parts involved in this monitor. We nearly decided to restart and try to find something that did, but that project wouldn't have the same impact on our lives as this monitor had. We can now look at any circuit board and give a rough identification of any part on it, which is something that everybody should be able to do with the rise of electronics in the world. One of the most important things that we learned from this project is that semiconductors aren't tailor-made for each circuit board, something all of us had previously assumed. Rather, they are standardized for specific tasks and are grouped together to create nearly every electronic device in existence; we found that really cool.

Works Cited

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http://www.alldatasheet.com/datasheet-pdf/pdf/84822/FAIRCHILD/FSDM0565RB.html

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Vishay Diodes on the Power Inverter:
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