



Franklin High School

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Introduction

When cars were invented, their electronics were simple. Over time, the introduction of various new features lead to the creation of automotive head units, featuring a stereo and A/C control. These stereos are a play quite the role in American culture, whether it be someone showing off their car or a mechanic playing music. These devices really improved the driving experience for many.



Stock Nissan 350Z 2008 Stereo - A small stereo unit used in various vehicles. It features a CD drive, radio, and LCD.

Today, automotive stereos are everywhere, from cheap trucks to high end vehicles, but how do they work? This is question we aimed to answer with this document.

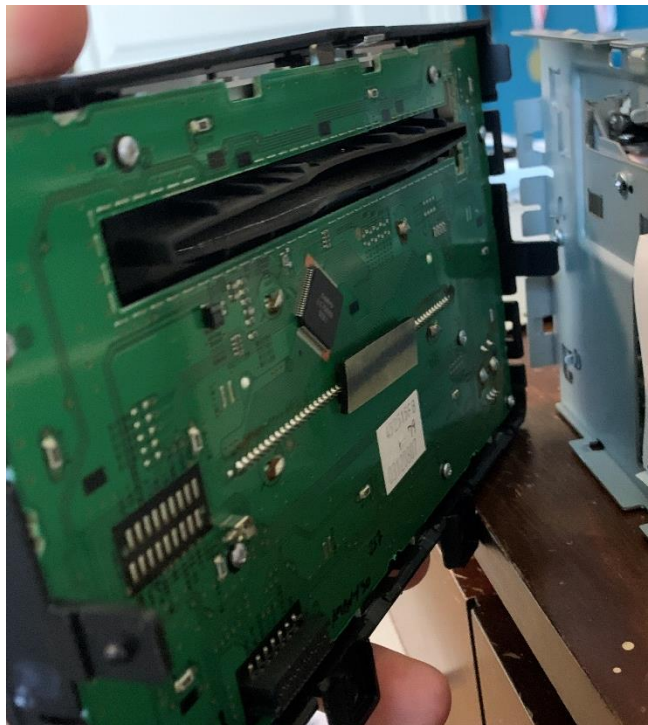
Summary and Breakdown

Front Panel

The first part to come away is the front panel, revealing a ribbon cable and a PCB. This PCB contains an LCD driver that also receives button inputs and communicates with the mainboard via a 14-pin connector. There is also an unpopulated header, likely used for programming.



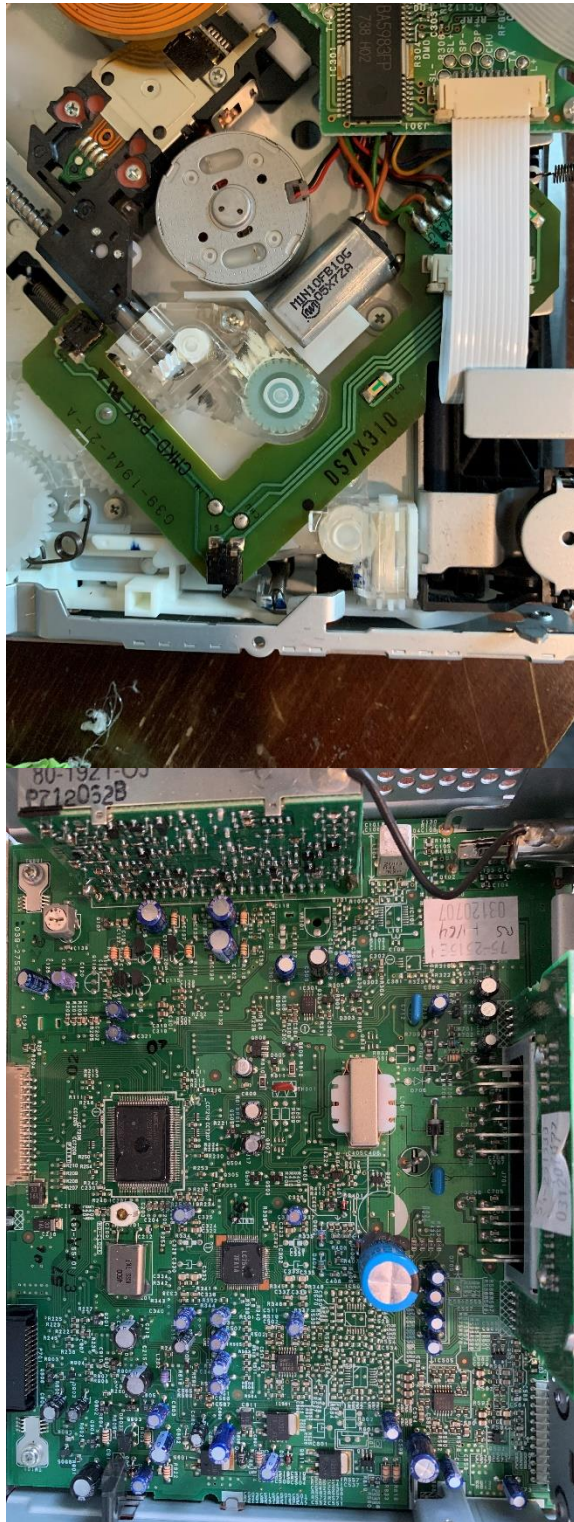
Top View of the front panel PCB



Side view of front PCB

A pad is placed behind the header pins of the LCD to prevent the sharp pins from damaging the ribbon cable. There is some soldering flux residue, which is curious for something that should have been mass-produced as it implies manual soldering.

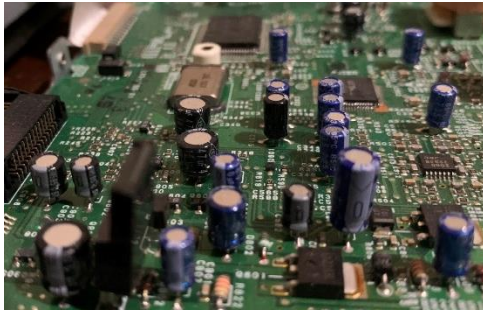
Logic Board



Views of Logic Board and accompanying CD drive daughterboards

Next up is the inside. The manufacturer chose to use a pre-made CD drive module, then used an adapter PCB with the appropriate driver to communicate with the mainboard. The mainboard features an 8-bit microcontroller that handles all the logic, and a “volume controller”. This controller creates the analog signals necessary for driving the speakers, with inputs from the microcontroller and antenna. It also doubles as an equalizer and has 4 audio channels, which sets it apart from a DAC. The vertical PCB on the right of the lower image is for the back I/O as well as heatsinking.

Some Component Pictures with Captions

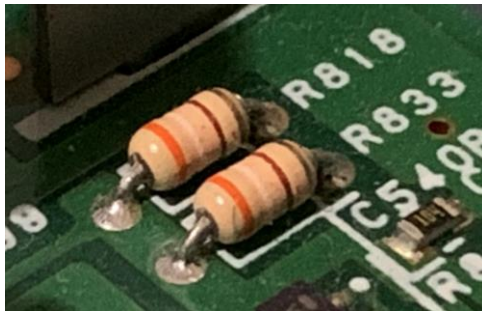
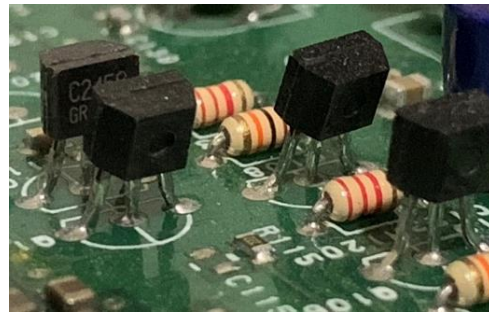


Capacitors:

These passive components hold charge and let AC pass through them, which is detrimental to the function of a car's head unit.

Transistors:

These devices behave as electronic switches, which is required to fulfill the requirements of the internal logic of this head unit.



Resistors:

These passive components resist changes in voltage, which can help a lot with both digital and analog logic alike.

Integrated Circuits (Chips):

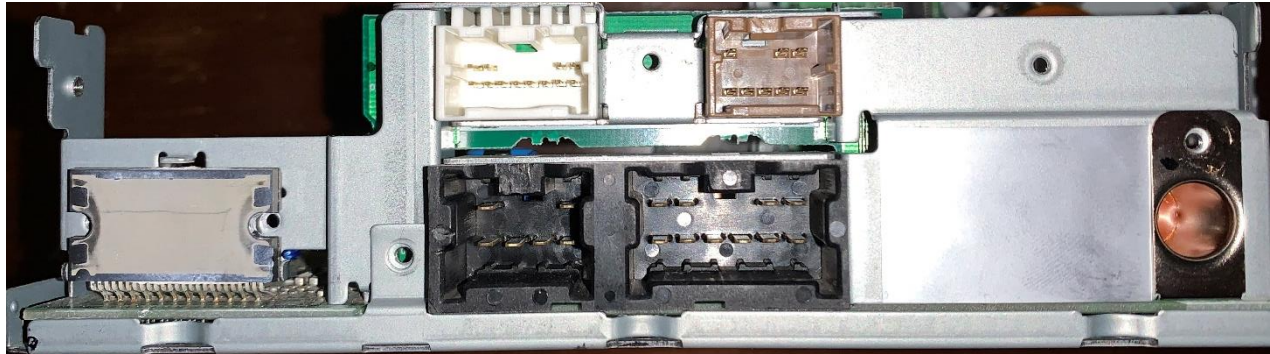
These components integrate many circuits, complete with internal passives and logic gates, to carry out a task.



Diodes:

These units are polarized, which means they only allow the flow of electrons in one direction. This is important for logic and input protection.

Logic Board (continued) and Back I/O



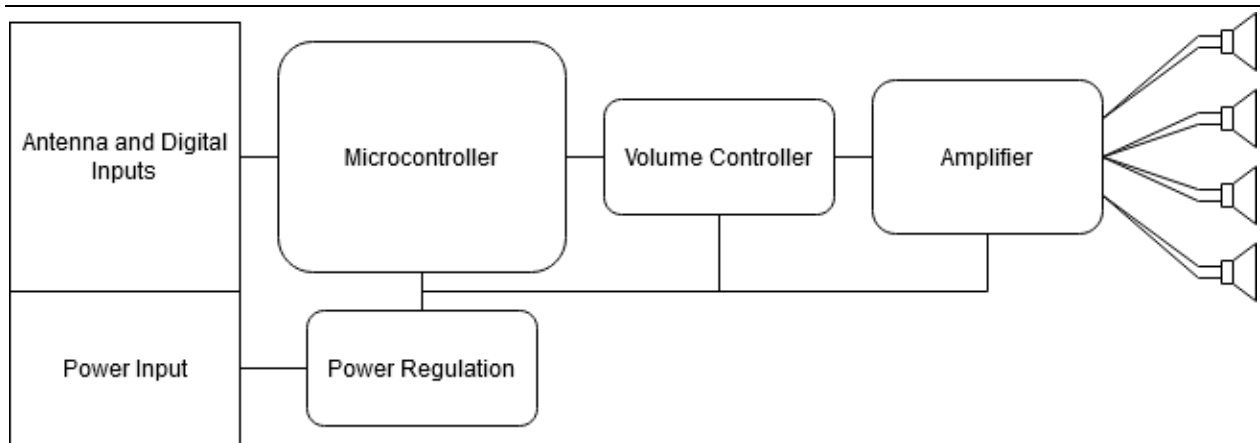
From left to right: Sound chip, I/O for the rest of the car, Antenna Jack.

The chip on the left is the audio amplifier, which takes the analog signals from the “volume controller” and boosts them enough to drive the speakers, which explains the transformer present on the mainboard. The other inputs are for interfacing with the rest of the vehicle (along with supplying power to this unit). The connector on the right is for an antenna specifically tuned to receive AM and FM radio waves. This explains the op-amps on the board, as they condition the signals received from the antenna.

Component List:

LC75412E	Volume Controller
NEC D178078GF	Microcontroller
JRC 4558	Op-Amp
NJM 2060	Op-Amp
LC75883	LCD Driver
BA5983FP	CD Driver
Heatsinked IC (ground off part number)	Audio Amp
Various Connectors	
Various Transistors	
Capacitors	
Diodes	
Resistors	

Conclusion



While our team isn't super experienced when it comes to electronics, we find it interesting that the equalizer function is implemented with a purpose-made IC. We found it surprising to see manual soldering, though it is not surprising at all to see a mix of pre-made and custom components. Some of us thought it was rather funny that CD drives maintain a high level of accuracy with none other than linear encoders based on inductors.

