



THE COMBINATOR

Electric Guitar Effects Combiner

Project Demonstration – April 30th 2010



Musictronics Team

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Agenda

Motivation

Overview

Business Aspects

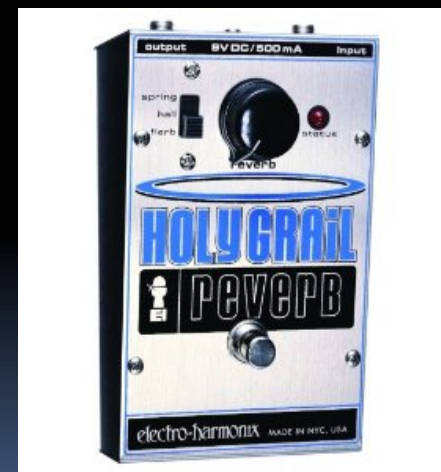
Technical Details

Conclusion and Discussion



Motivation

- For a guitarist analog Stompbox effects are the best due to the “fat” sound quality and ease of use.



Motivation

□ Problems?



Motivation

- Turning multiple effects is a hassle especially during live performances.





Motivation

Existing Solution Drawbacks

- Multi Effects – Expensive and hard to use. (~\$800)

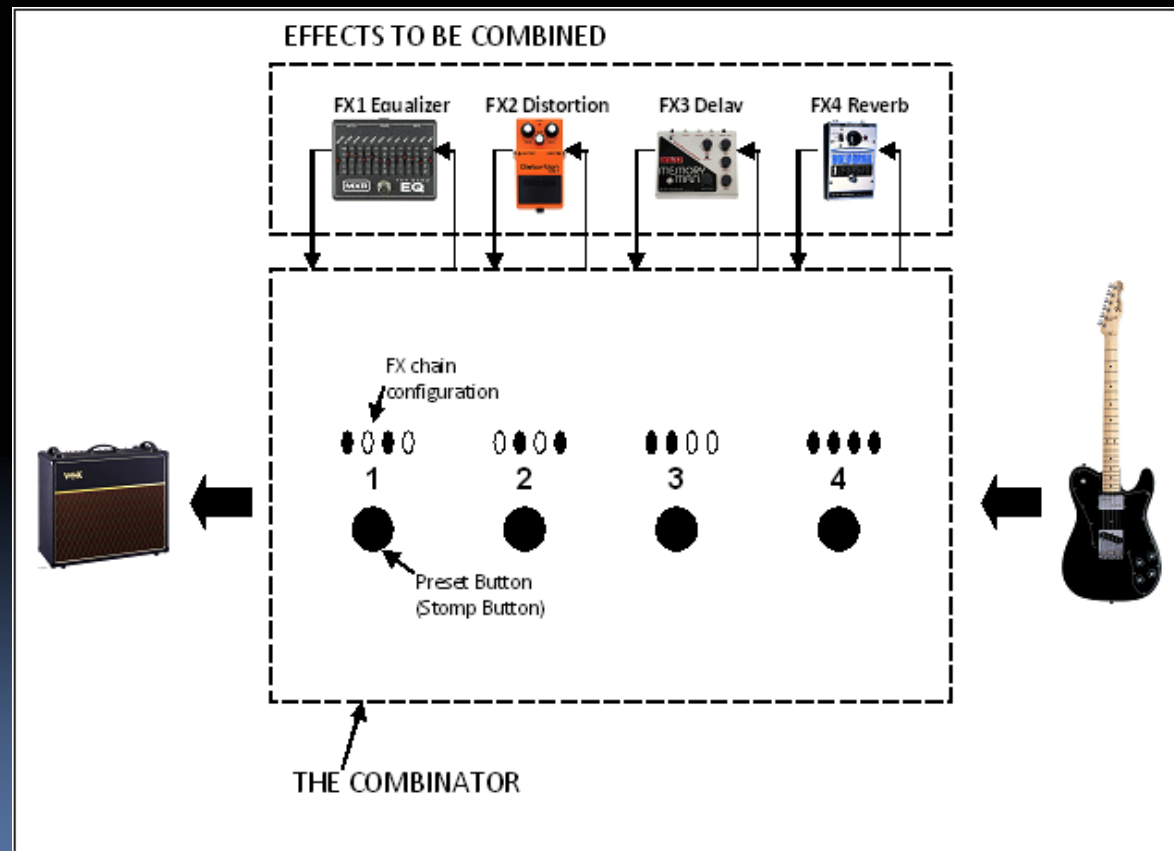


- Morley switching – Cheap but inefficient, only directs the guitar signal into 2 separate path.



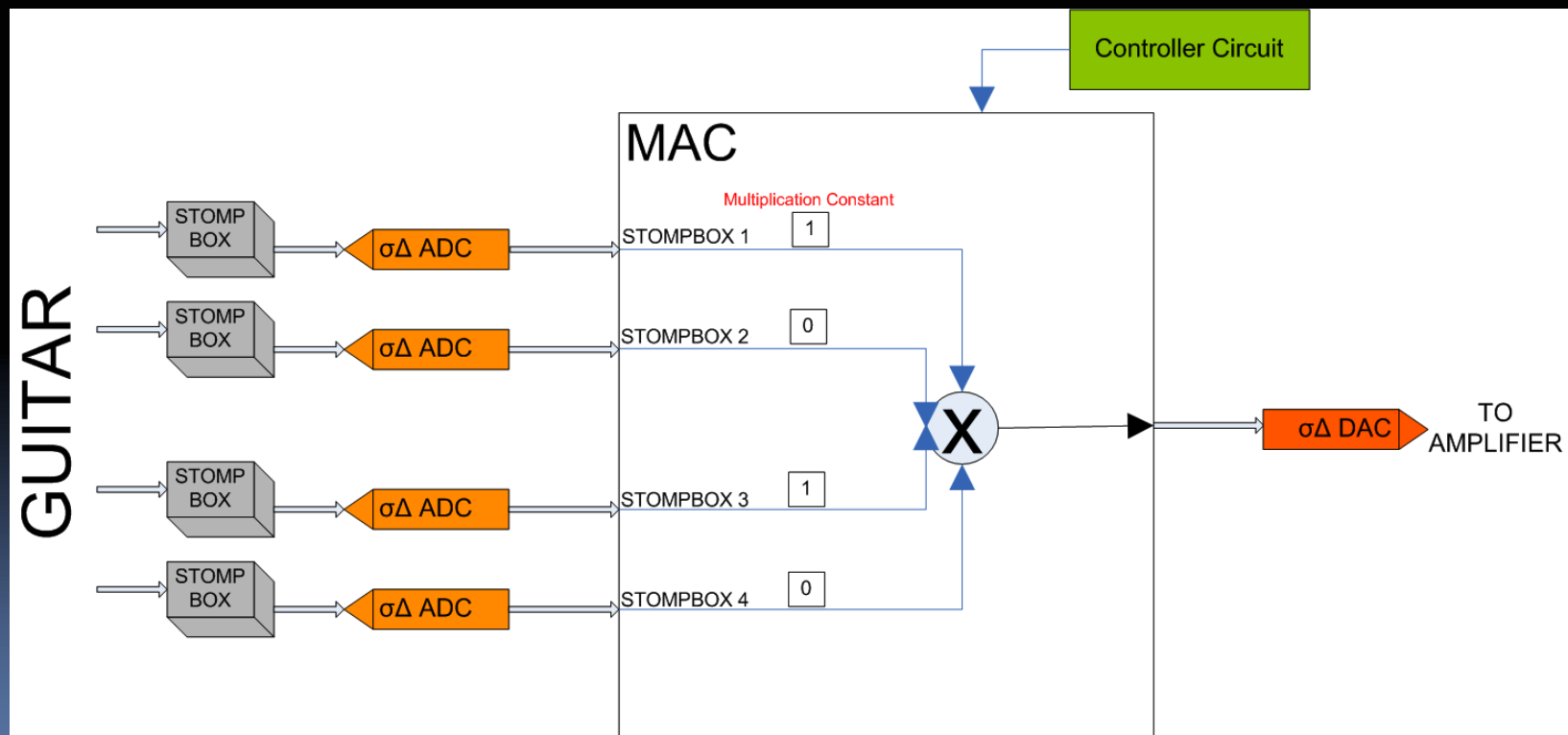
Motivation

□ Our Solution



Initial Design

- In our initial design we wanted to use the Altera DE2-70 as the mixing component (in digital).



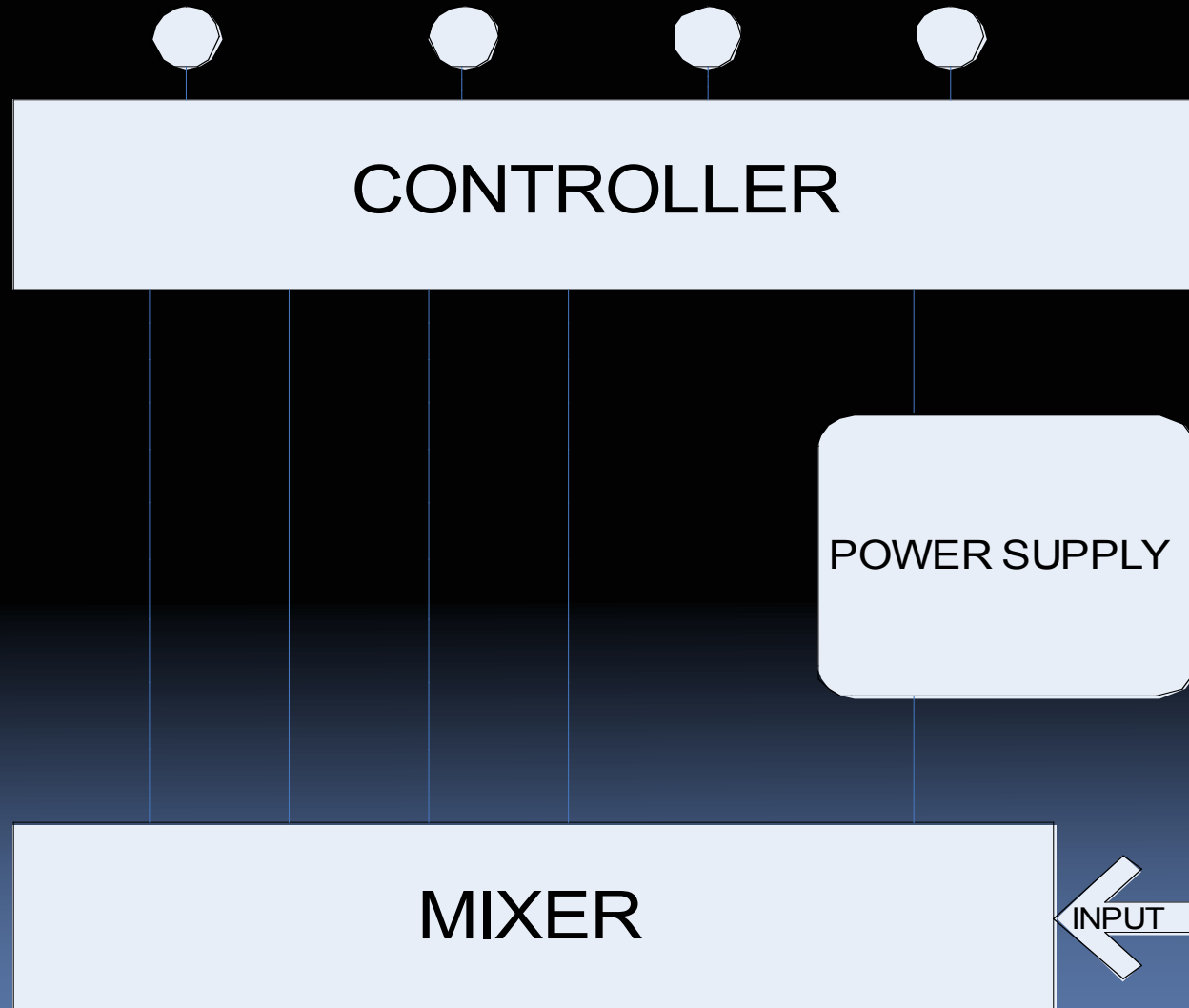


Initial Design

- ❑ Our design with the FPGA produces a less than desired sound quality and major difficulties in debugging the code (since we use VHDL).
- ❑ We also realize that FPGA board an expensive option for our project.
- ❑ So to alleviate both problems we decide to implement our signal mixing in analog.



Overview





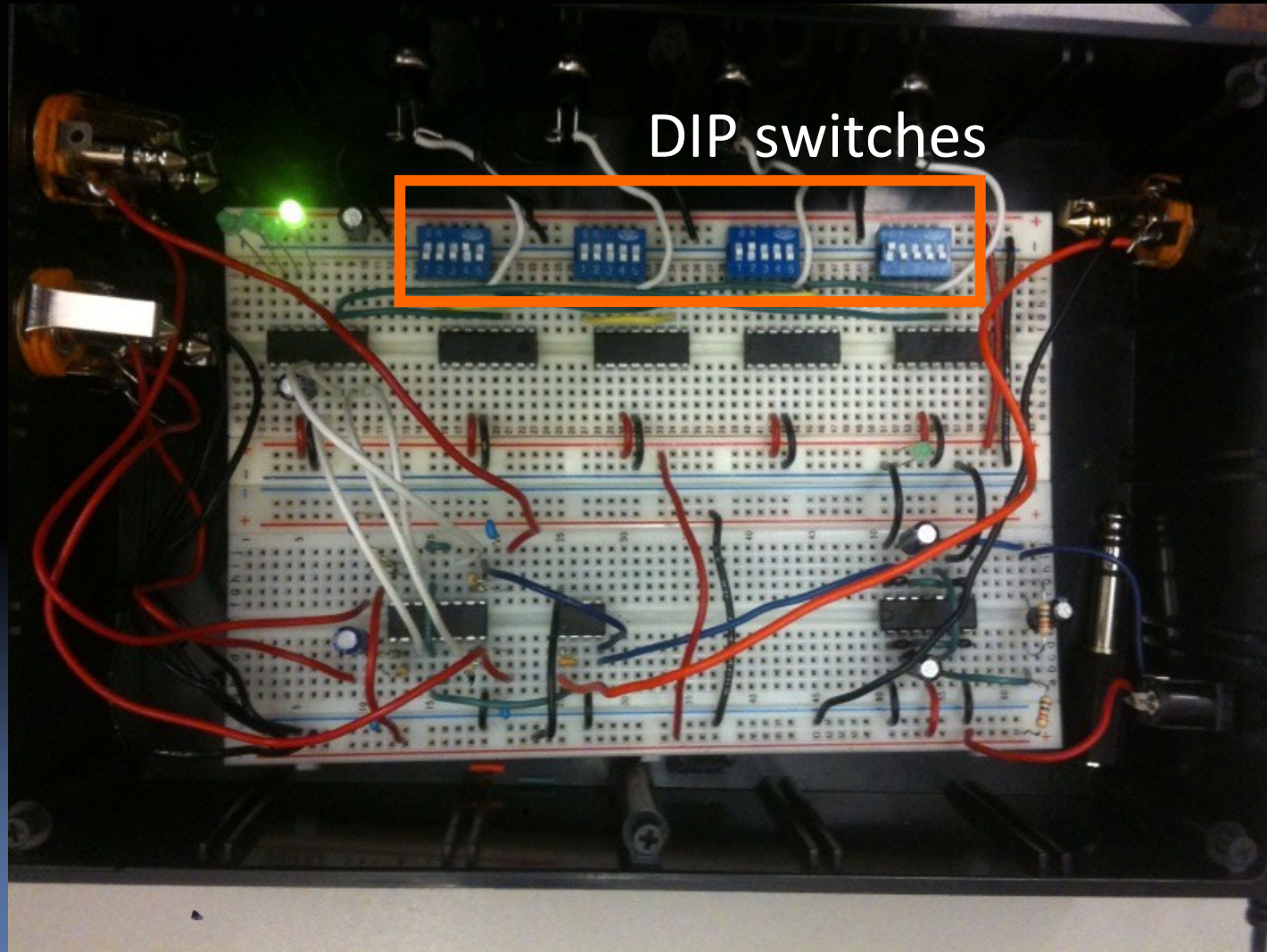
Overview

□ Front Side



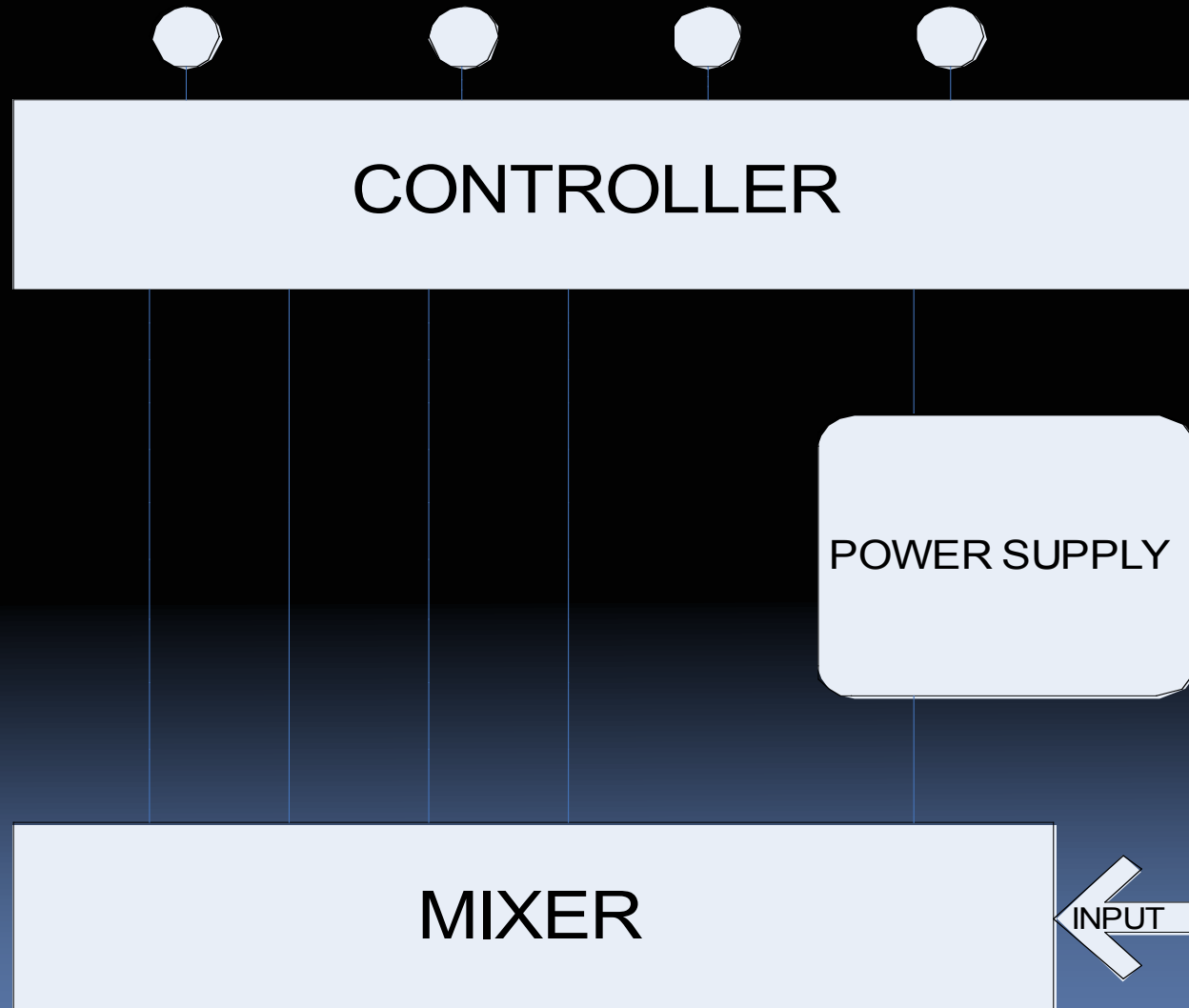
Preset Button

Overview





Overview





Overview

❑ Controller Parts

- ❑ Microcontroller Unit (MC9S08QG8 by Freescale).
- ❑ 5 input DIP switches.
- ❑ 4 LEDs.

❑ Mixer Parts

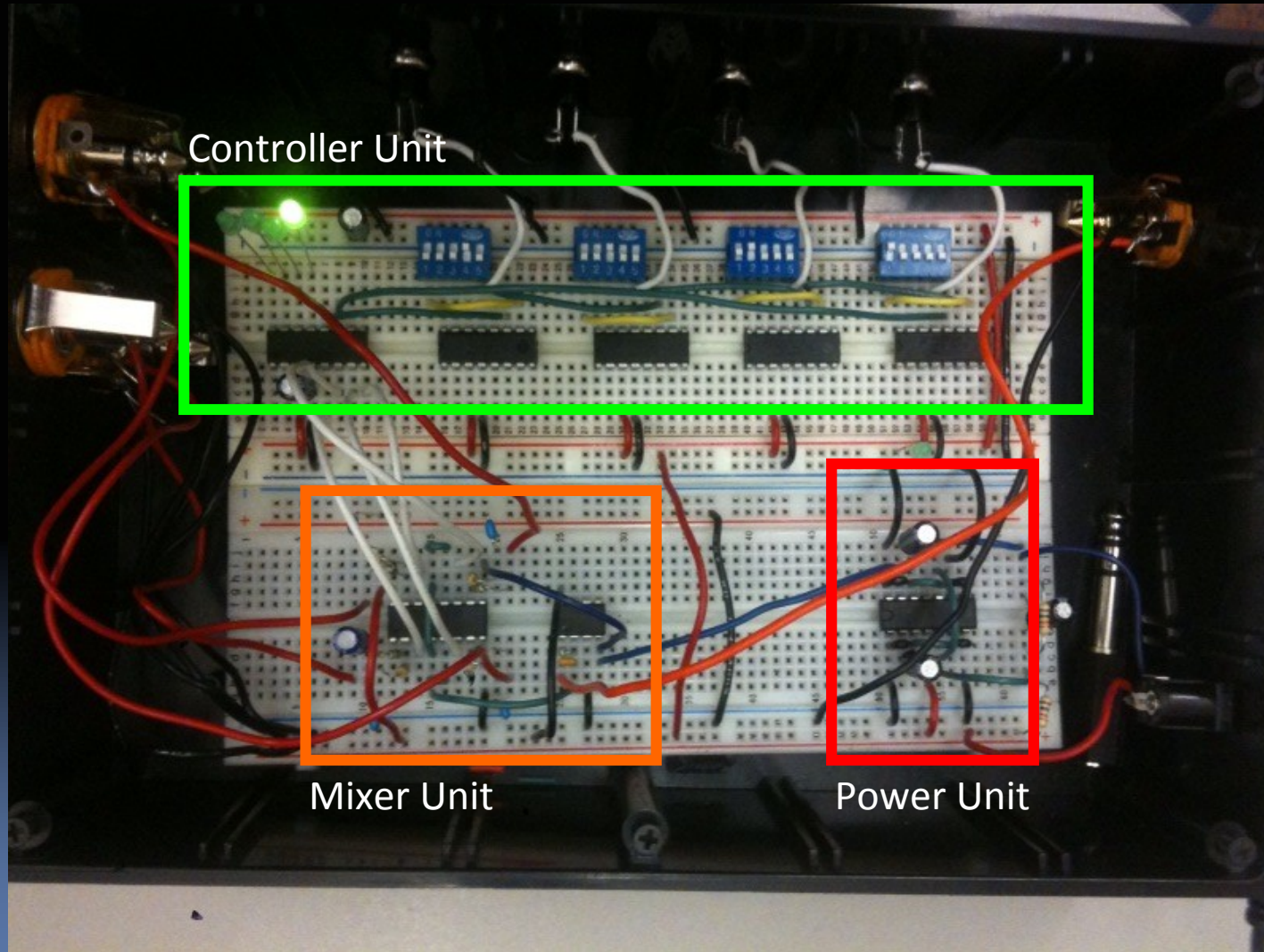
- ❑ Voltage Controlled Amplifier (SSM 2164 by Analog Devices).
- ❑ High Fidelity Audio Op-Amp (LME 49720 by National Semiconductor)
- ❑ 5 x ¼ in female input/output port



Overview

- Power Supply Parts
 - Low Power Op-Amp (LM324 by National Semiconductor)

Overview



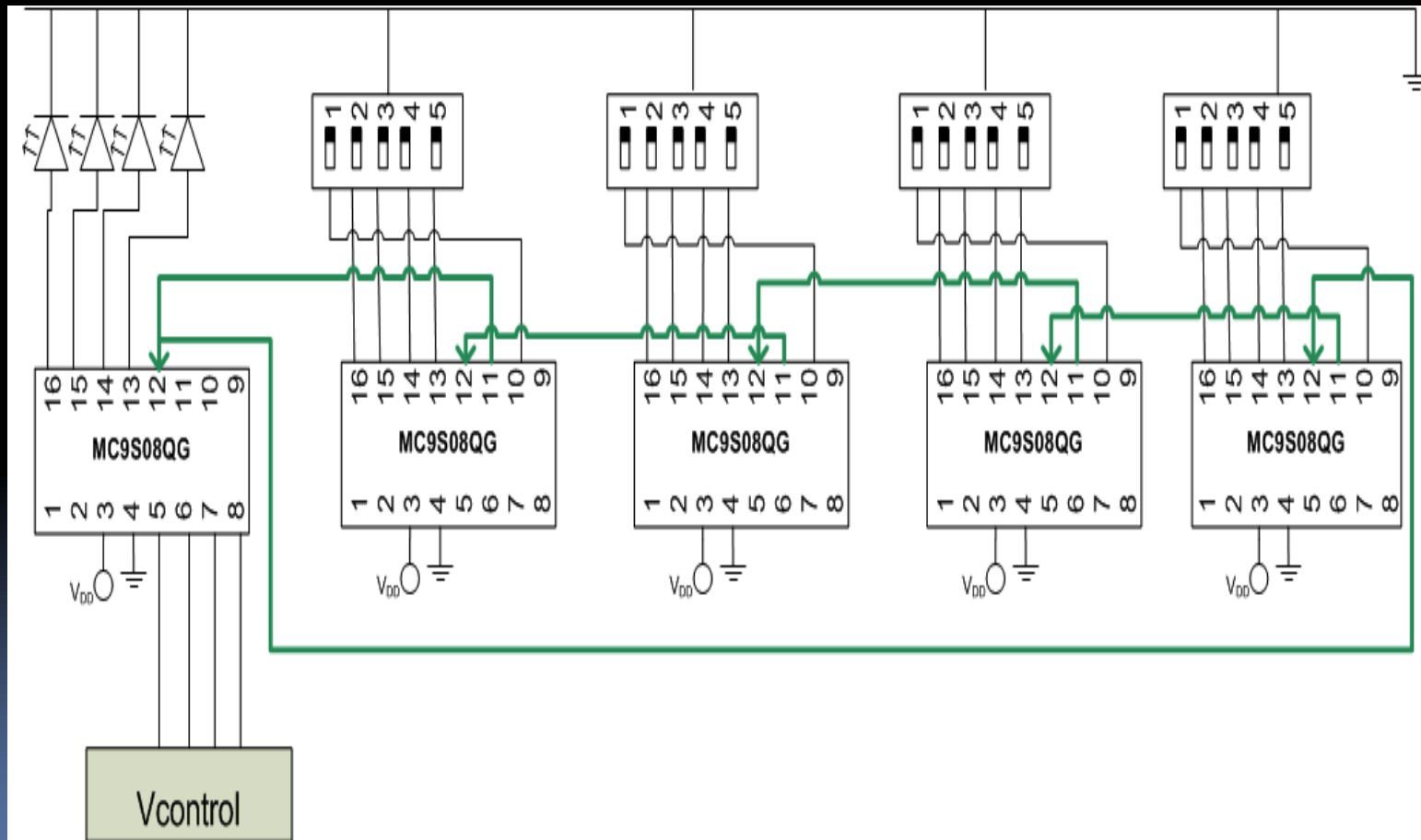
Controller Unit

Mixer Unit

Power Unit

Technical Details

Controller Schematics





Technical Details

- ❑ The leftmost MCU acts as the Master and the rest are the slaves.
- ❑ The 5 MCUs are connected in a Ring Network and they communicate via 8-bit packages
- ❑ The 8-bit packages are divided into
 - ❑ 4 bit – To store the Dip Switches Value (1 to 4)
 - ❑ 1 bit – Preset Button Flag
 - ❑ 3 bit – Address for every MCU

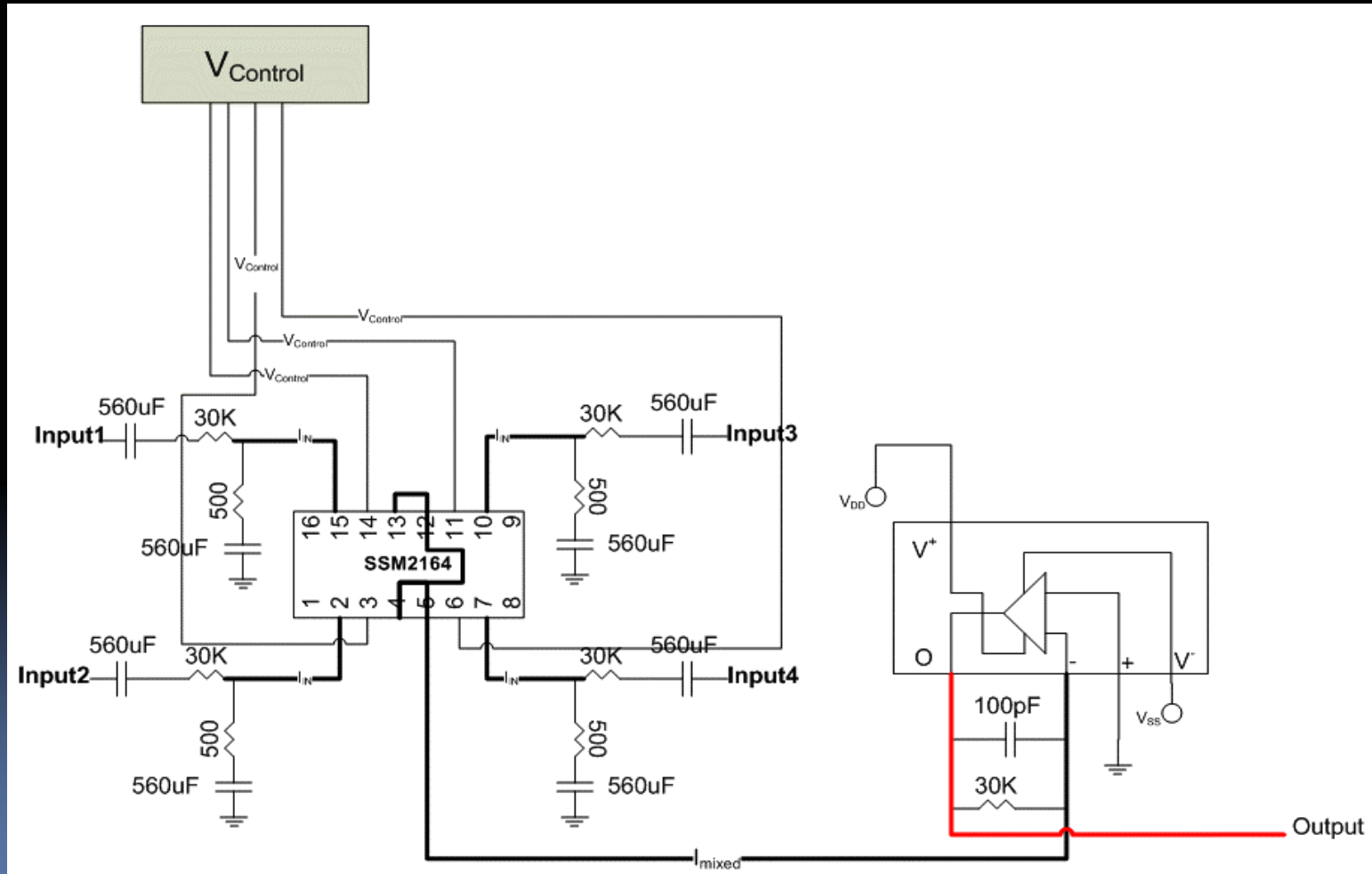


Technical Details

- ❑ The task of the Master MCU is to “Poll” the slave MCUs to give the master updated information on the value of the DIP switches and the preset button value.
- ❑ The master polls the slave with frequency rate of > 10 kHz.
- ❑ At any given moment when a value of preset button of a slave MCU goes high. The Master MCU will output the DIP switches value of that particular MCU into the mixer.

Technical Details

□ Mixer Schematic



Technical Details

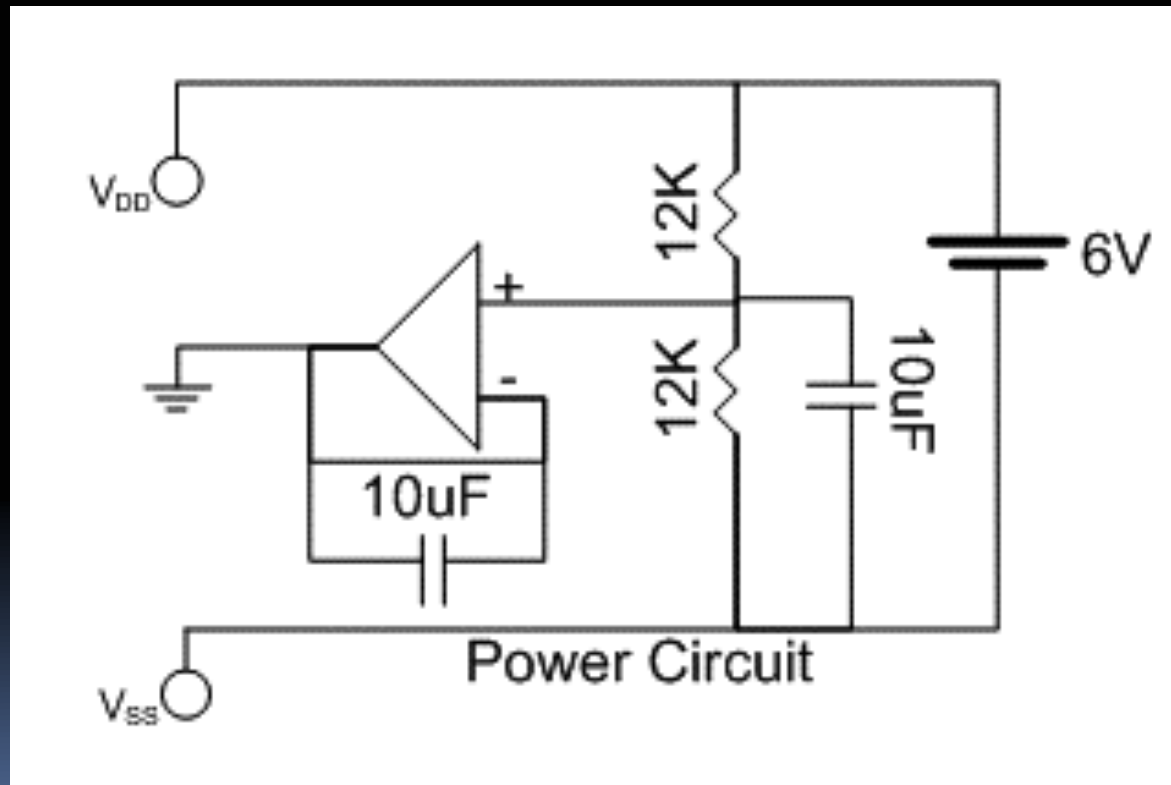
- The mixer is a voltage controlled amplifier.
 - Input signals are converted to currents.
 - Selected currents are mixed based on the voltage signals from MCU .

Technical Details

- Once the mixing is accomplished.
 - The mixed currents are converted back to voltage signals by using high performance, audio operational amplifier.
 - The output of the operational amplifier is then fed to an external amplifier or directly to a speaker via 5 x ¼ in female output port .

Technical Details

□ Power Circuit Schematics



Technical Details

- Our device uses 6V adapter.
- Power supply circuit consists of a voltage divider and an operational amplifier.
- Results in having a proper ground and a constant V_{cc}/V_{ss} of $\pm 3V$.



Business Aspects - Market

- Music Industry
 - Professional Music Players
 - Bands and Singers
 - Recording Studios



Business Aspects - Cost

Budget Table

Materials	Price
Resistors and Capacitors	\$15
ICs	\$30
Microcontrollers	\$10
Breadboards	\$20
Switches and Connectors	\$15
Casing	\$10
Total	\$100



Business Aspects - Competition

- Morley Selector/Mixer/Combiner (\$95 - \$159)



- Route one signal to two outputs or two inputs to one output.
- Choose A, B or A & B combined.
- LED's show you which signal is active
- Unit is True Bypass and passive (will work without battery). One 9 Volt battery is required for LED indication only
- Cold Rolled Steel housing
- Dimensions: 5.25"(L) X 3.25"(W) X 2"(H)
- Two-year warranty
- DO NOT use on powered speaker lines. You WILL damage your amp, speakers or both.

ABY Selector / Combiner (Model ABY)
MSRP \$95

- DigiTech Multi-Effects (\$499)

RP1000 Multi-Effects Switching System





Future Improvements

- ❑ Independent volume control for each effects in our combinator for a more flexible and balanced output mix.
- ❑ Implement the circuit on PCB board to reduce interference noise from surrounding electrical equipment.
- ❑ Encase the circuit on a more robust packaging (Aluminum)



Questions?



Acknowledgements

- Dr. Lakshman One
- Dr. Lesley Shannon
- Dr. Andrew Rawicz
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