Modular Analog Synthesizer

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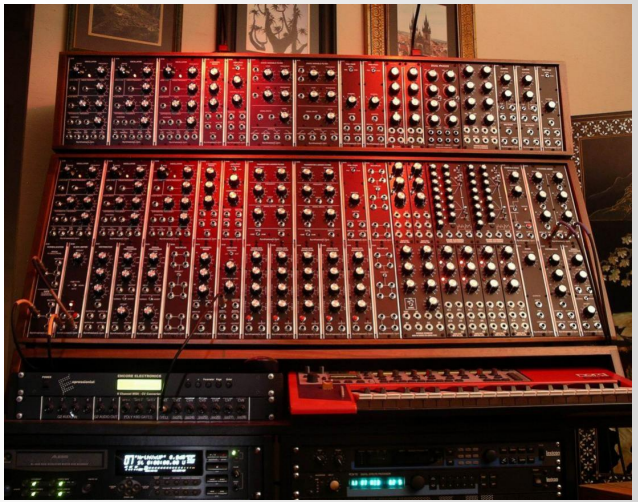
What is a Analog Synth?

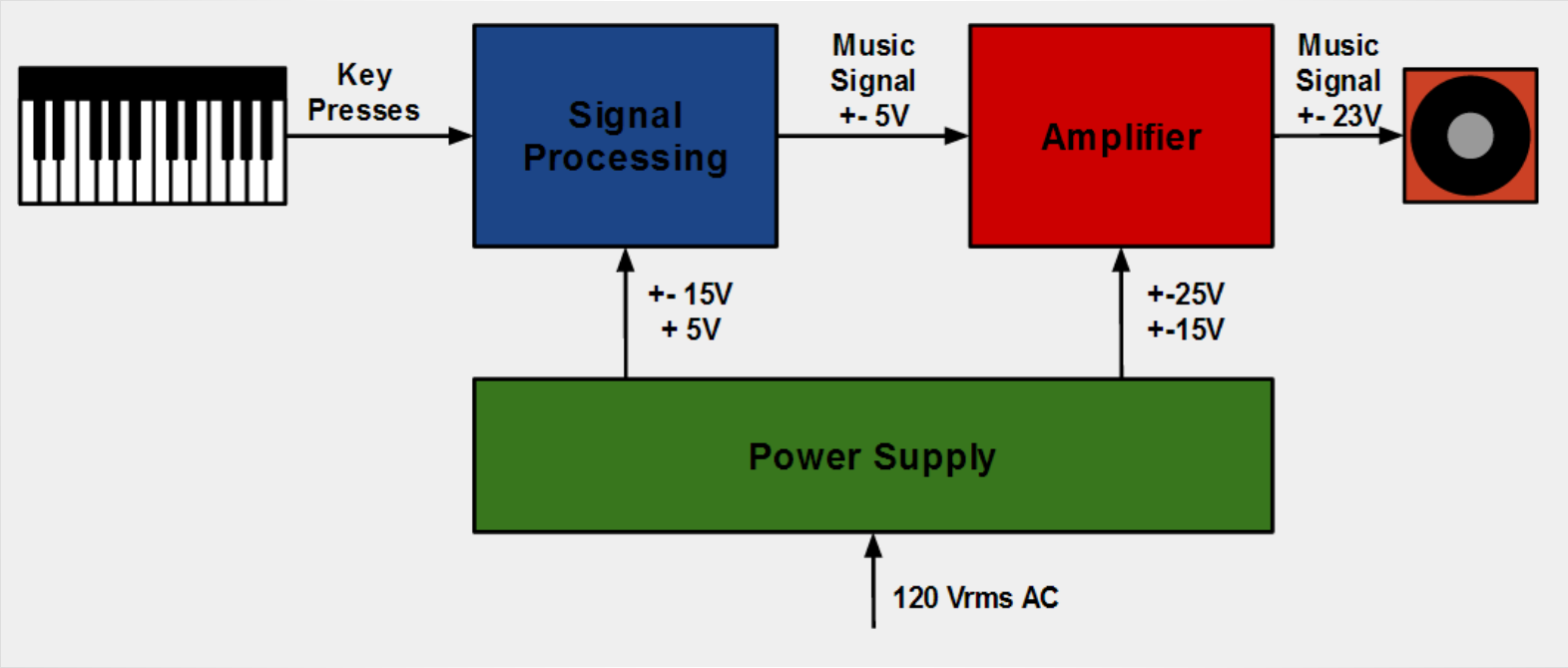
- First Purely Electronic Instrument
- Collection of modules
- Produce, Modify, and Control Music Signals
- Unlimited Sounds



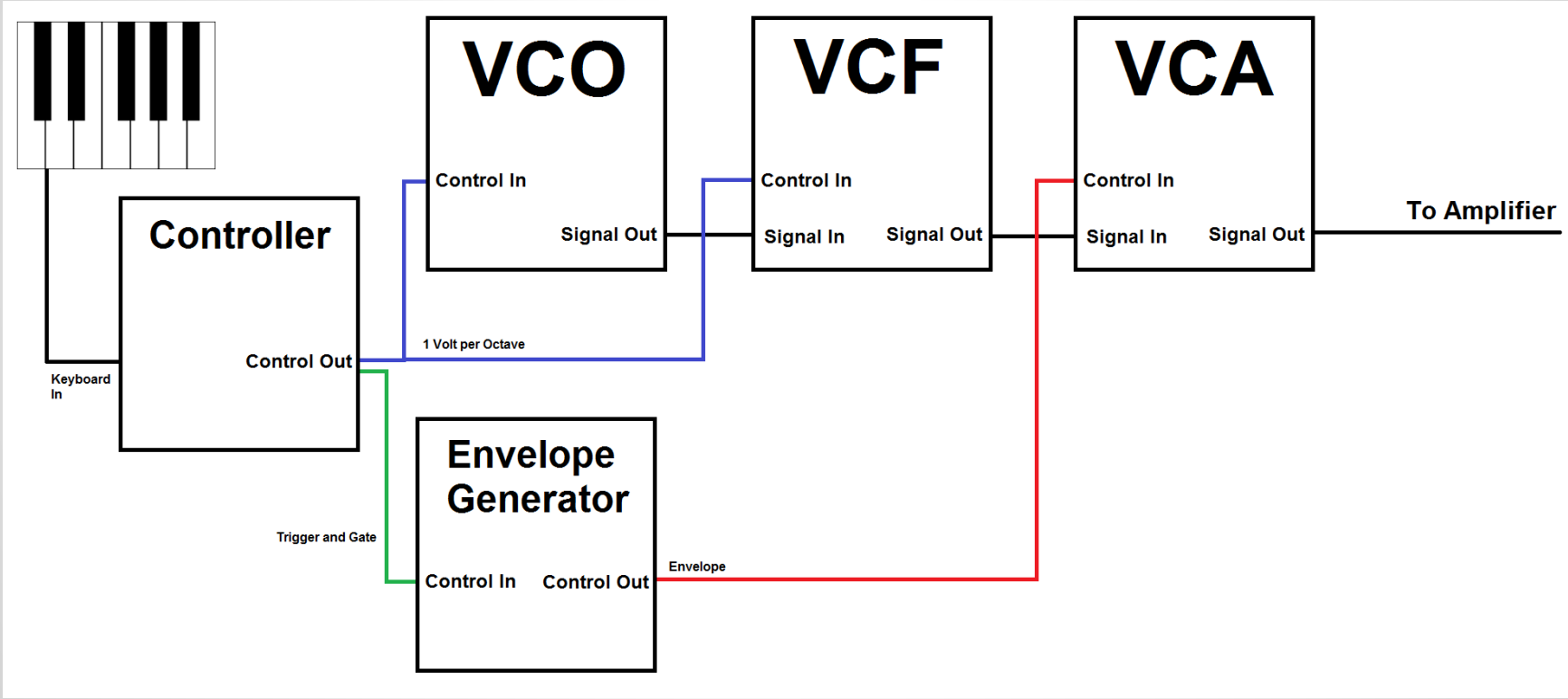
Why Build an Analog Synth?

- Resurgence in Popularity
- Introduction to Music Engineering
- Interesting Application of a Wide Range of EE Concepts
- Personal Interest

Overall System Design



Signal Processing System



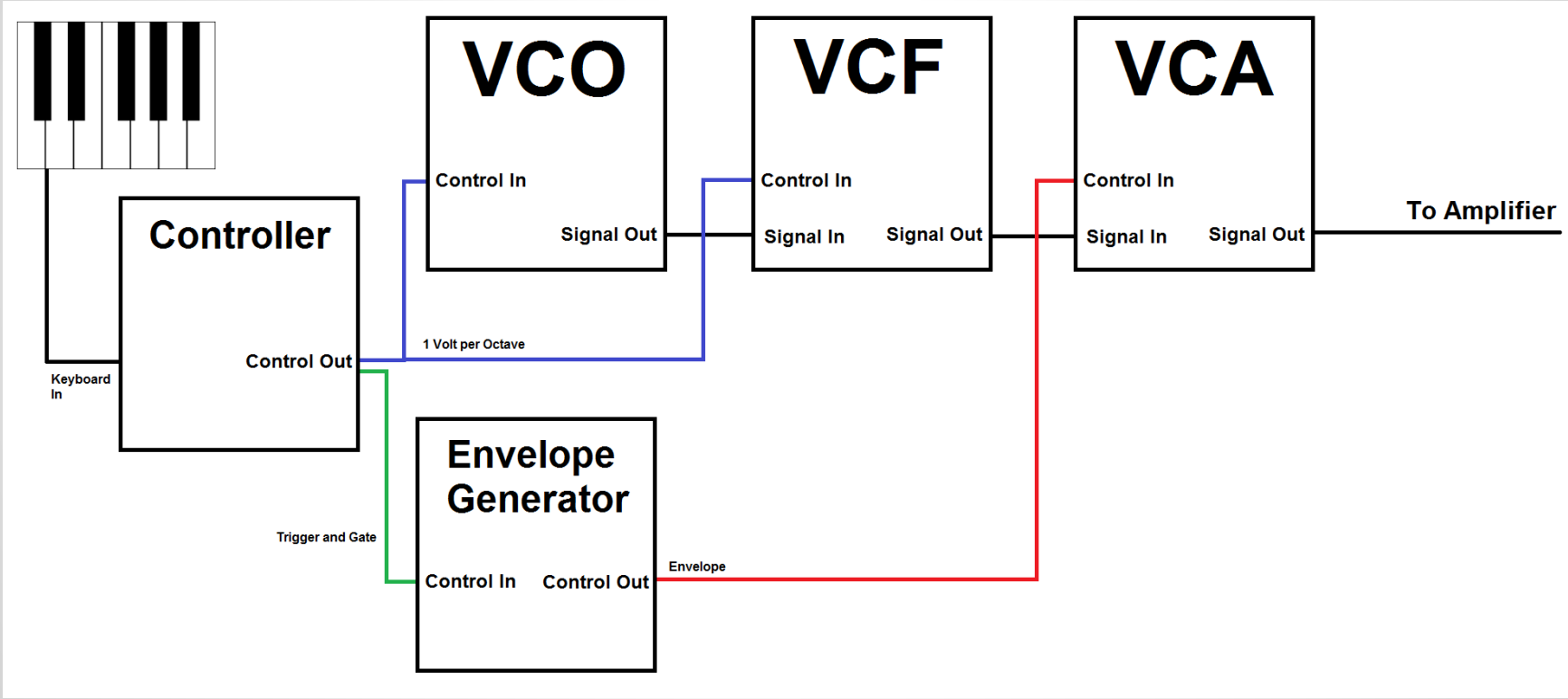
Signal Processing Modules

- Controller
- Voltage Controlled Oscillator
- Voltage Controlled Filter
- Voltage Controlled Amplifier
- Envelope Generator

Module I/O Signal Types

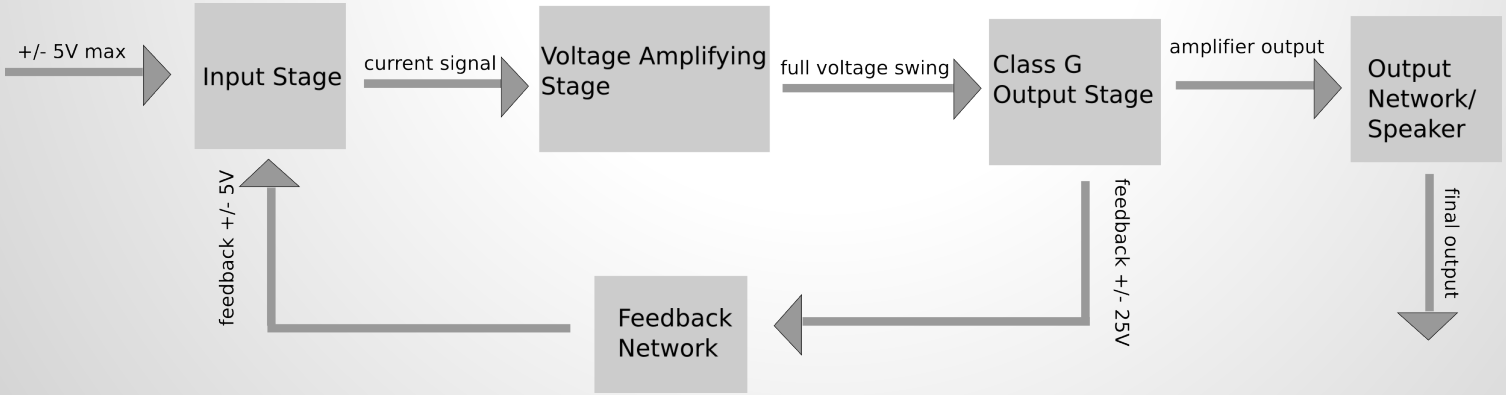
- Music Signal
  - -5V to +5V
- Control Signal
  - Gate, Trigger, Envelope
  - 1V per Octave
  - 0 to +5V

Example Patch



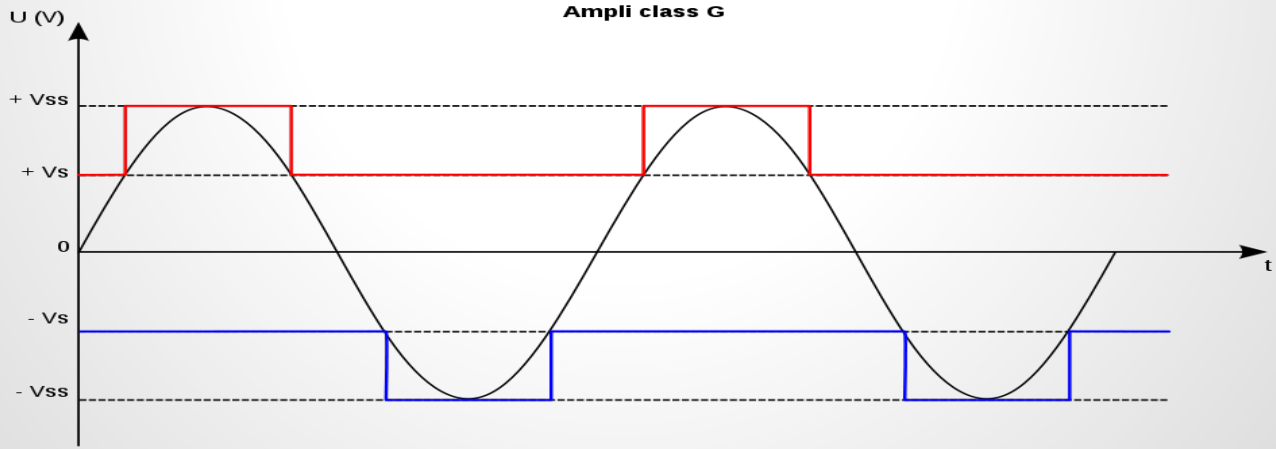
The Power Amplifier

- Gain of 4.5
- Bandwidth of 20Hz - 20kHz
- High Slew Rate, Maintain Linearity, Stability, Low Distortion



Class G Amplifier

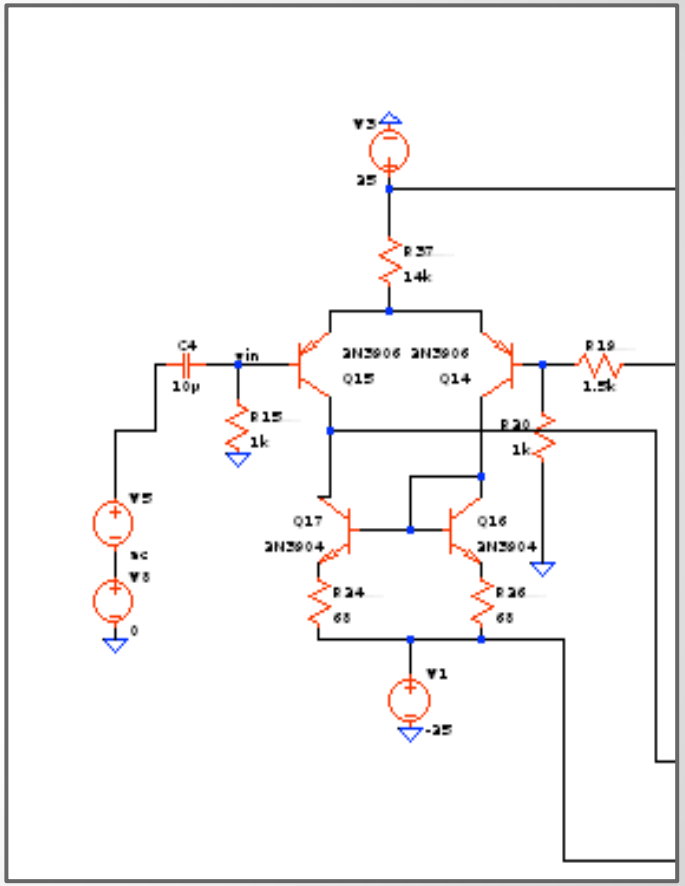
- Utilizes two sets of supply rails in the output stage, reducing the power consumption but maintaining linearity.



Input Stage

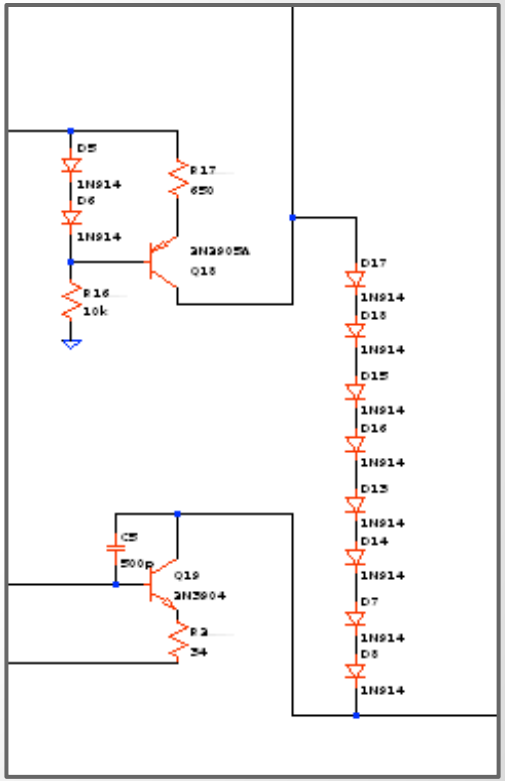
- Allows for feedback from the output, improving linearity.

- Slew Rate is determined in the Input Stage: ICC/Cdom.

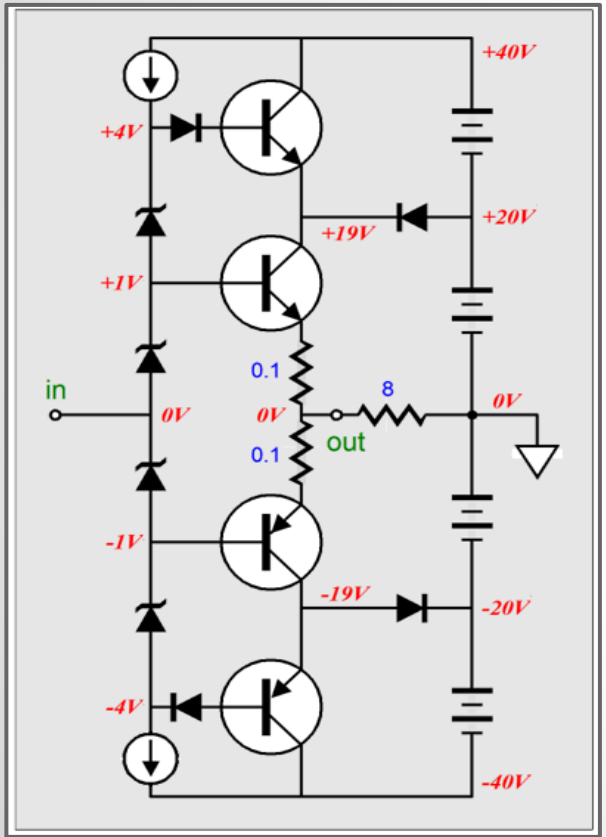


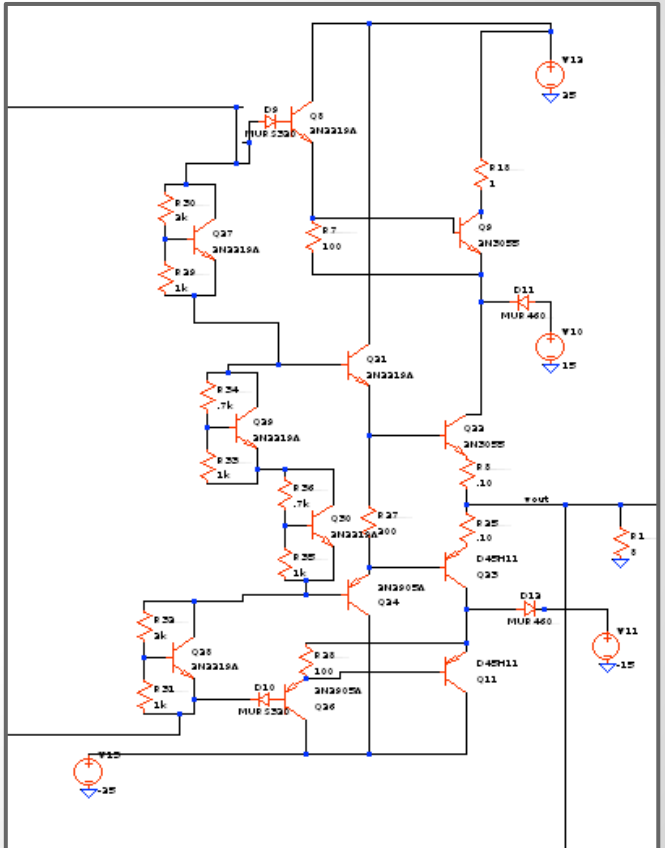
Voltage Amplifying Stage

- Need to set the dominant pole (Cdom). Bandwidth = gm1/ (2*pi*Cdom*gain).
- Want open loop gain to fall below unity before enough phase accumulates.



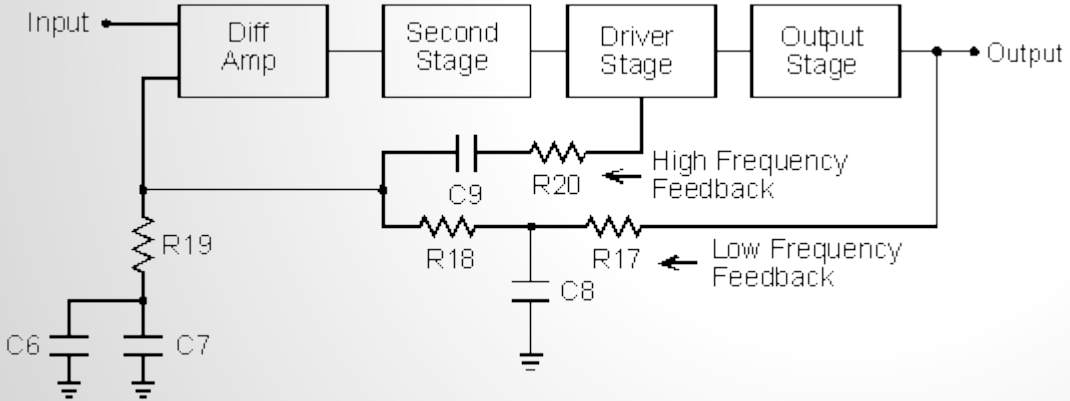
Class G Output Stage



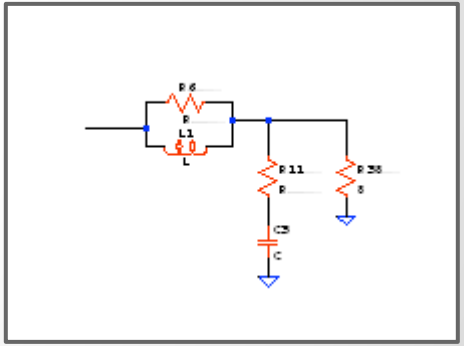


Output Network, Feedback

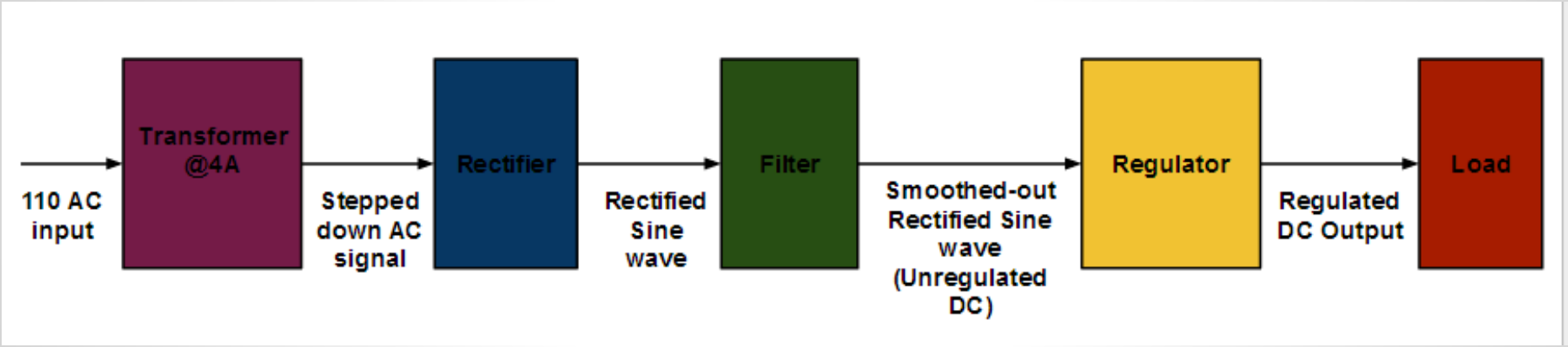
Possible Feedback Adjustment



Output Network



AC/DC Power Supply

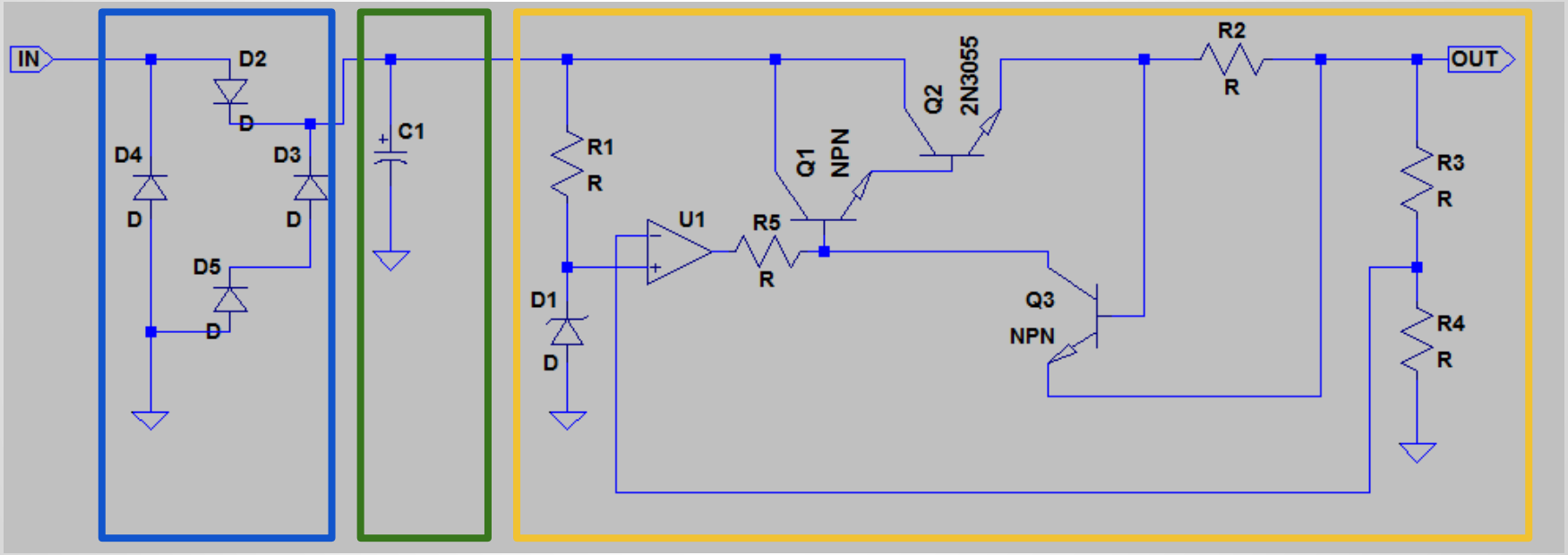


+/-25V

Bridge Rectifier

Smoothing Capacitor

Voltage Regulator



Specifications + Challenges

Supplying 25V@3.2A

Supplying 15V@4A

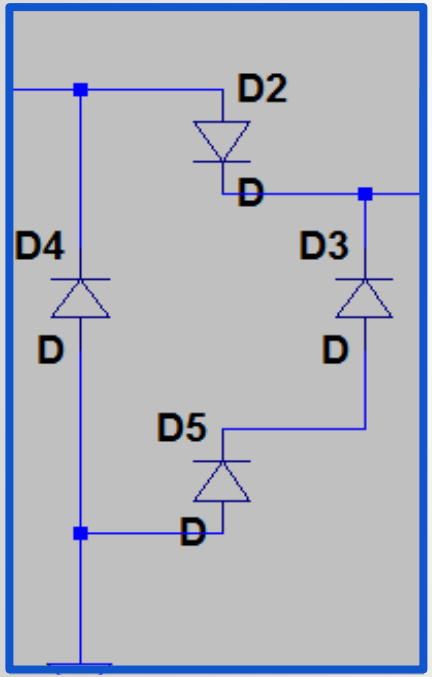
Limited selection of transformers

Voltage drop of Regulation Circuitry

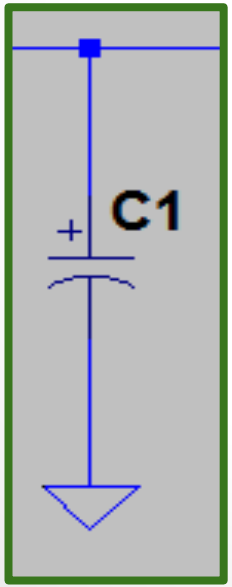
Heatsinking

+/-15V & +/-10V

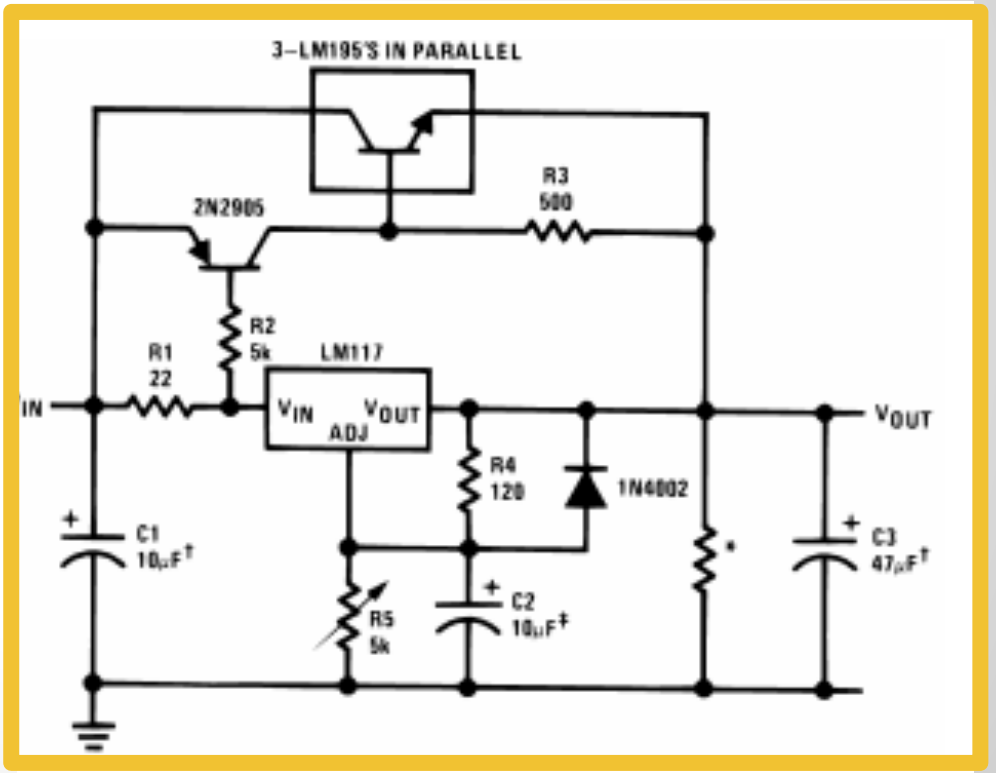
Bridge Rectifier



Smoothing Capacitor



Voltage Regulator



Timeline

- Week of the:
  - 3/31- Design modules
  - 4/7 - Breadboard + Test
  - 4/14 - Finalize Designs, Order Parts + Testing
  - 4/28- Order parts and a PCB + Build Controller, Power Supply, and Amplifier
  - 5/5 - Test + Construct PCB + Integrate

Conclusion

- An Analog Synthesizer is a fun project that will provide us with valuable experience in addition to a nice final product.