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
Signal Processing System

Controller

VCO

VCF

VCA

Keyboard In

Control In

Signal Out

1 Volt per Octave

Control In

Signal In

Signal Out

Signal In

Signal Out

Trigger and Gate

Control In

Control Out

Control In

Envelope

To Amplifier
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 (C_{dom}). Bandwidth = \frac{gm1}{2\pi C_{dom} \cdot \text{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
Specifications + Challenges

Supplying 25V@3.2A
Supplying 15V@4A
Limited selection of transformers
Voltage drop of Regulation Circuitry
Heatsinking
$\pm 15V \ & \pm 10V$ Voltage Regulator

Bridge Rectifier

Smoothing Capacitor

Diagram of voltage regulator circuit with components labeled.
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.