Violin Pickup, Amp and Effects

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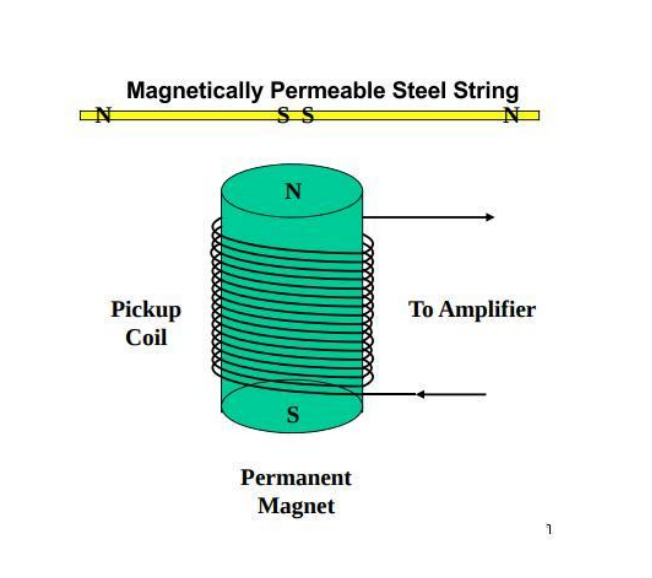
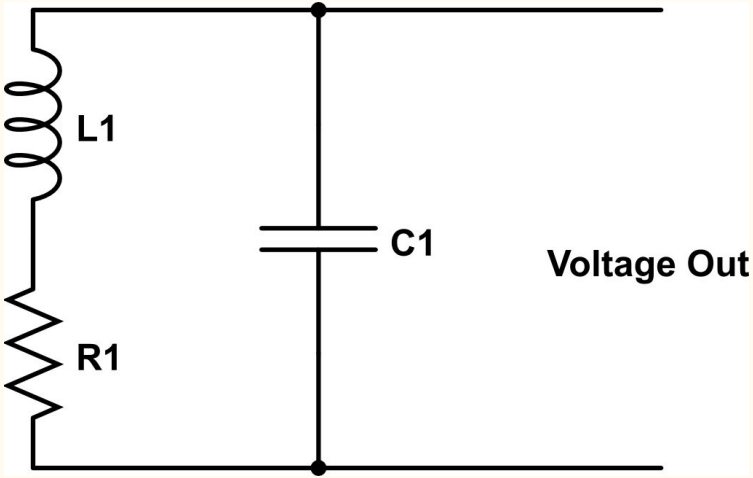
Top Level View

- Design is implemented as a set of modular units that can be worked on independently.
- Magnetic pickup picks up sound from violin, cleans signal, sends to preamp.
- Preamp applies variety of togglable effects.
- Class D amplifier amplifies signal to audible levels suitable for a performance.
- If one component is not finished, others still function!
- Large focus on presentation and product appeal - our entire team is course 2A, don't judge.

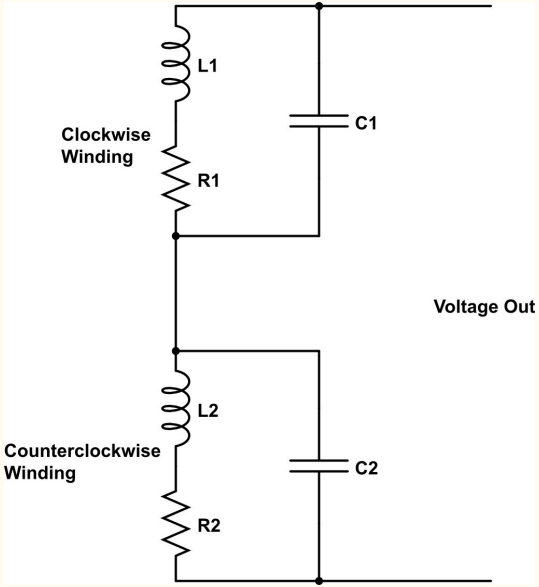
Magnetic Pickup





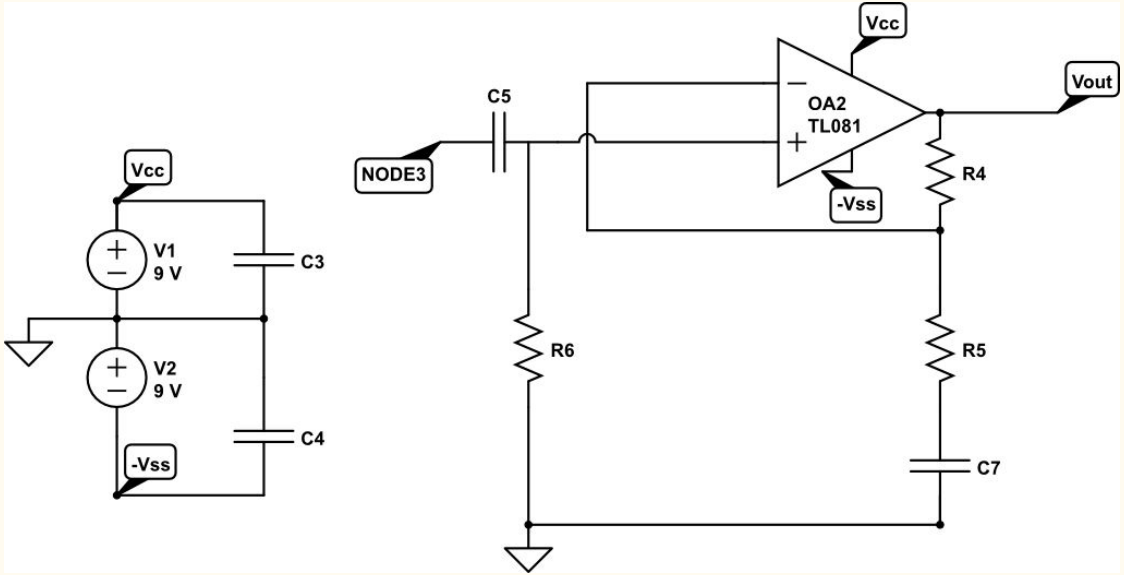
Magnetic Pickup Design Concerns

- LRC circuit has self-resonance.
- Picking up noise.
- Proximity to steel string.



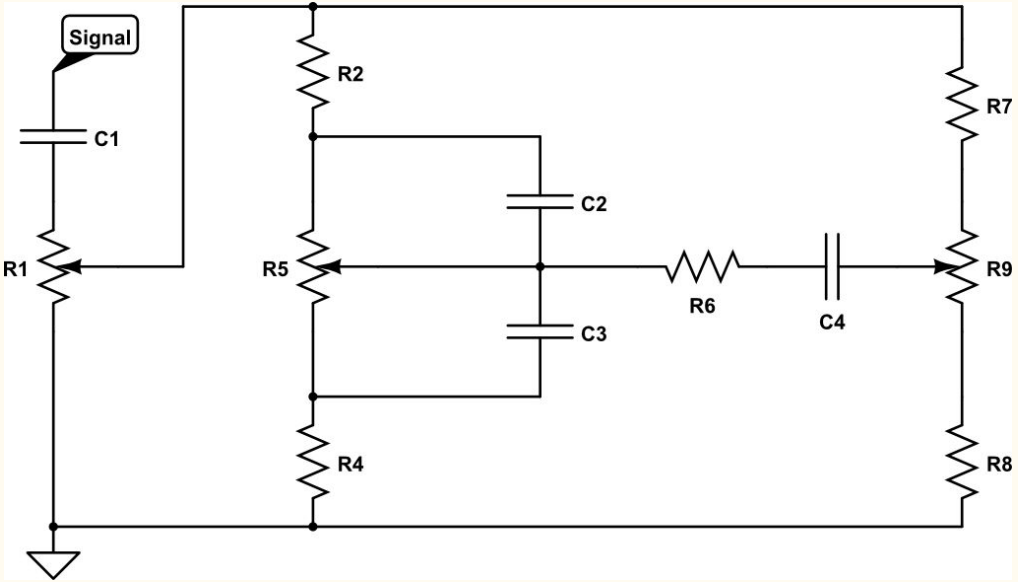
Preamplifier

- Powered by two 9V batteries
- Gain = 1 + R4/R5
- Role of C5 and R6:
  - Coupled to ground
  - High input impedance
  - High pass filter



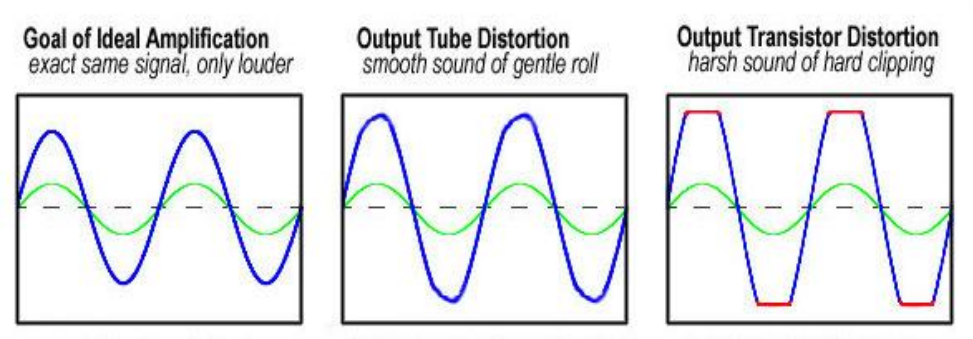
Tone Control

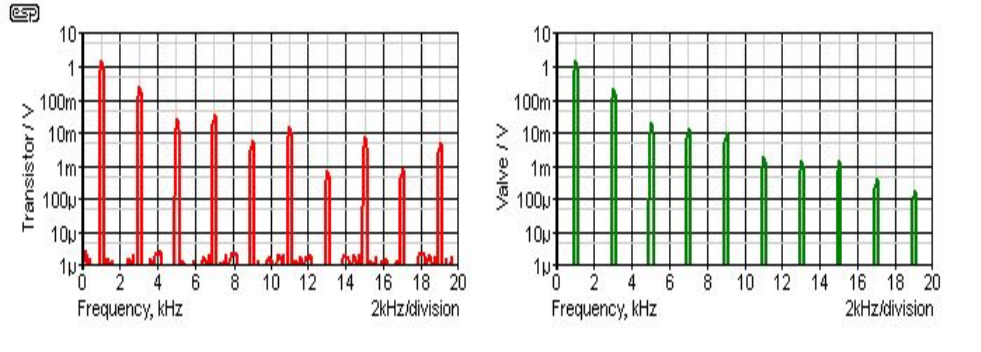
- Baxendall tone control network
- Overall gain control R1
- Bass: R5
- Treble: R9



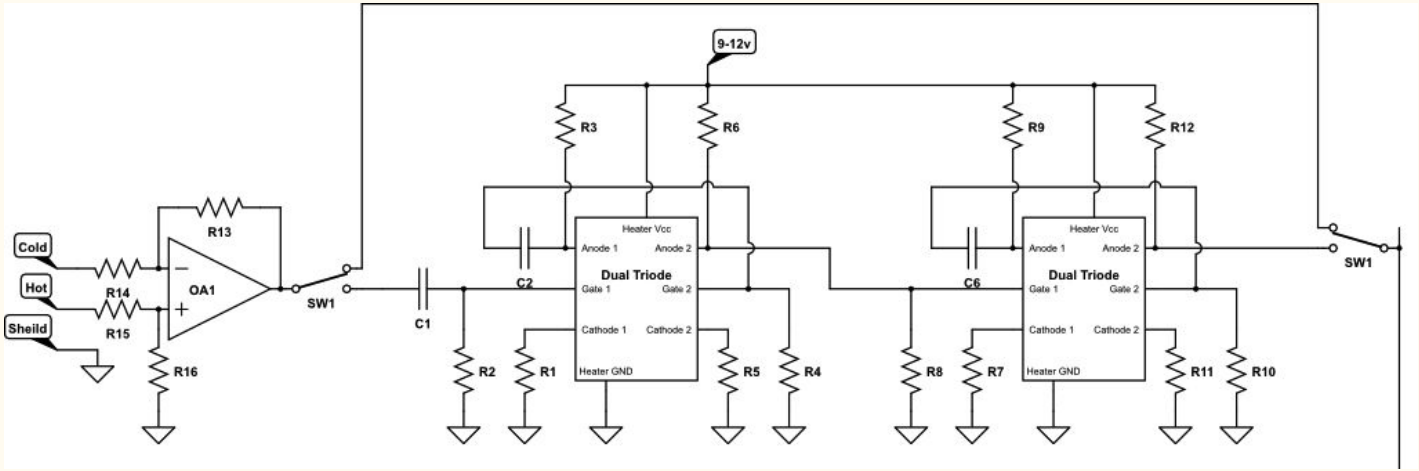
Tube Compressor and Overdrive Principles

- Tubes produce primarily 2nd order harmonics and few higher order harmonics
- Low order harmonics sound more pleasing than higher order harmonics
- Greater dynamic range
- Tubes can operate in starved cathode mode with a low voltages supply
- Line in/line out levels compensated to produce 1v RMS line level





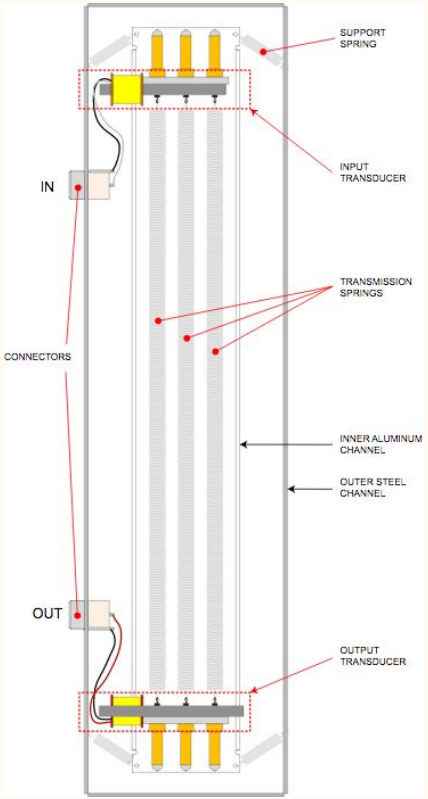
Tube Compressor and Overdrive Circuit



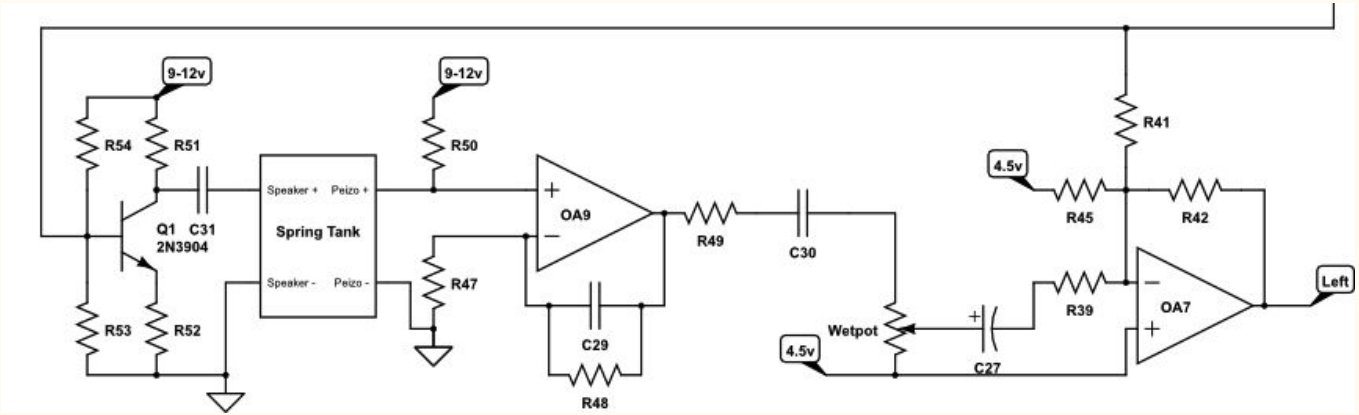
- Input op-amp converts balanced audio standard to single ended
- Balanced signal used for long runs
- Initial triode used to boost signal, second triode used to clip
- Third and fourth triode provide voltage/current gain and additional distortion
- User controlled switch can bypass overdrive stage

Spring Tank Reverb

- Spring tanks operate via a linear transducer and pickup
- Transducer is effectively a speaker driver coupled to a spring
- Physical waves reflect back and forth in the spring
- Low input impedance to drive the transducer
- High output impedance and low current on the output requires buffer/preamp stage



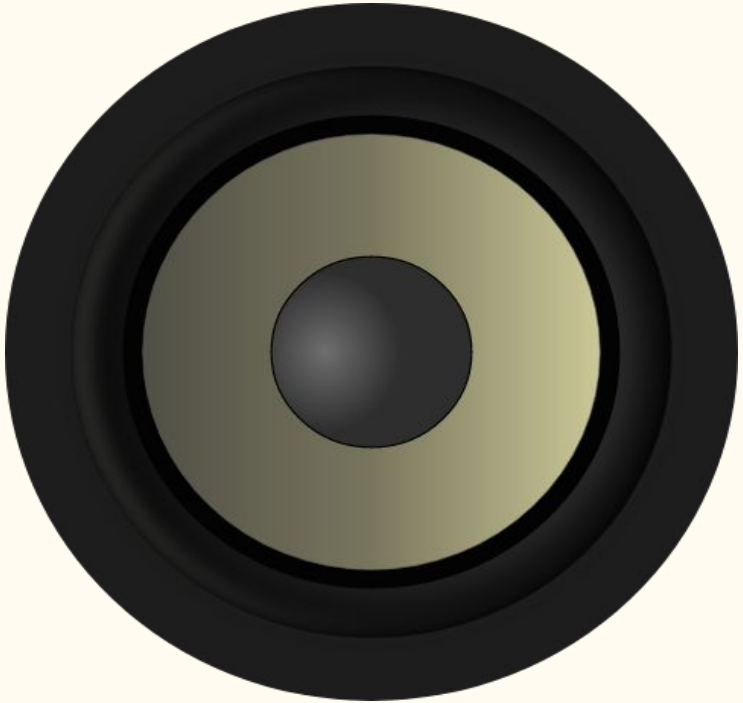
Spring Tank Driver and Pickup



- Spring transducer is low power and can be driven by a simple class A amplifier
- Traditional piezo style op-amp stage can provide gain for high impedance signal
- Low pass filter controls ringing, high pass controls bumps
- Mixing stage combines “wet” and “dry” signal, controllable via pot
- Stereo signal can be produced via a passive panpot

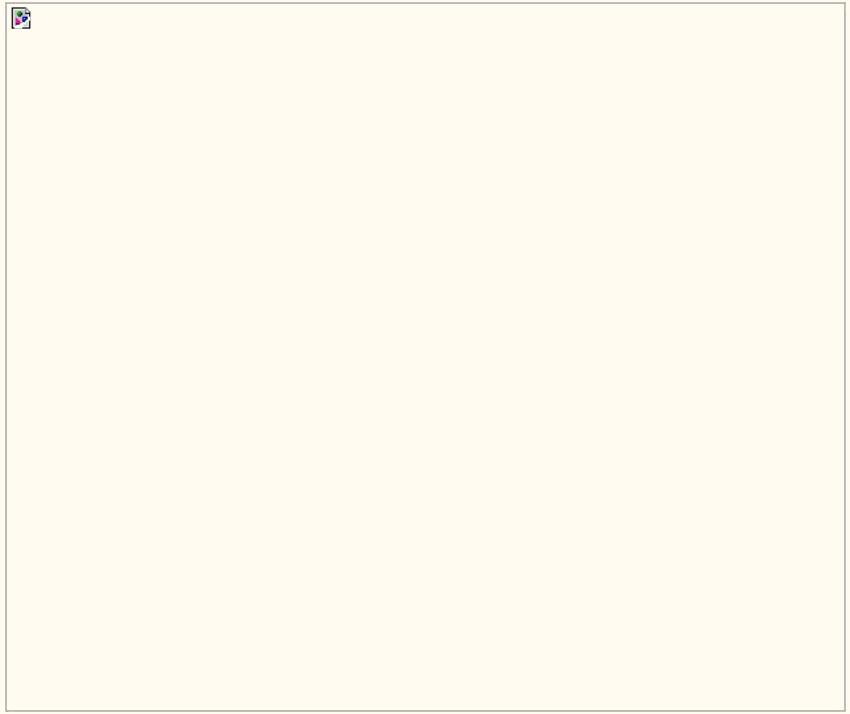
Amplifier Stage - Design Considerations

- Should take in stereo line-level signal
- Should amplify to levels suitable for a live performance - around 100W
- Should provide basic volume adjustment
- Should have good frequency response from 100Hz to 10kHz
- Power dissipation, noise & distortion are a major concern
- Stretch goal would be to include built-in power supply w/ galvanic isolation



Amplifier Stage - High Level

- Forward converter powers circuit (can be dropped if needed)
- Class D amplifier architecture used to reduce power dissipation
- Signal is pre-amped, turned into a PWM signal with a varying duty cycle, amplified through a MOSFET full bridge, and then filtered.
- Theoretical efficiency of 100%! Allows for low size.



Amplifier Stage - Low Level

- Implemented with audio-grade op-amps, comparators
- Triangle wave compared to input signal, amplified with gate drive IC + H-bridge, filtered to remove modulating PWM
- Heavy use of decoupling caps
- PCB w/ short traces used to reduce noise