Analog Laser Harp
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Distance sensor Module Checklist:

- This module will detect the vertical position of the hand using two ultrasonic transducers. The receiver should be able to trigger a sample and hold circuit when a signal is detected.
    - Able to send and receive ultrasonic signal
    - Can output a voltage proportional to distance
    - Can use voltage to operate VCO

Light Sensor Module Checklist:

- This module will detect whether a particular laser has been broken. A photodiode will be connected in a transimpedance amplifier for each beam, and the output voltage will be compared to one from a photodiode measuring only ambient light. The output voltage will control switching between synth voices, and also switching on the appropriate distance sensor.
    - Can produce an output that consistently reports whether a beam is broken
    - Can use output to control distance sensor.
    - Can use output to control synth voice

Synthesizer Module Checklist

1. Voltage Controlled Oscillator: This module will take in a DC voltage input and based on that input, it will output a waveform that has a frequency that increases with increasing DC voltage. A logarithmic amplifier will be used as an input to this circuit so that the output frequencies will scale musically. This can be tested by inputting a range of DC values and checking the output frequencies. It will output both a triangle wave and a square wave.
2. Digital to Analog Converter: This module will take a digital input and convert it to an analog signal, this will be used to select which effect circuit to use. This can be tested by sending a digital input to one of the inputs and seeing the output response.
3. Tremolo Effect: This effect will cause the signal that is input into this circuit to undergo an oscillation in volume, ranging from near silence to full volume. This can be tested by inputting a waveform (sine, square, ramp) from a signal generator and looking at the output on a oscilloscope. It will show the waveform oscillating in volume at some rate controlled by the potentiometer. In summary, it takes one input signal and a supply voltage and outputs a modified version of the input signal.
4. Armstrong Green Ringer Effect: This effect produces a sound that is similar to a ring modulator but this circuit is not a true ring modulator, it is a full-wave rectifier. If a sine wave is input, the ringer will cause distortion at higher frequencies. With square waves it produces a loud ringing sound. In summary, it takes one input signal and a supply voltage and outputs a modified waveform.
5. Big Muff Distortion Effect: This effect produces a sound that is distorted due to the signal being clipped. This will produce a sound that is similar to the input signal, but with

some fuzziness. It can be tested using a signal generator to input a waveform and then the output waveform should be a distorted version of the input signal.

6. Phaser Effect: This effect will produce a sound that is the result of shifting the phase of the input waveform. This could be tested by inputting a waveform using the signal generator and examining the output waveform using an oscilloscope. It should produce a sound that sounds very wavy.

Class G Amplifier Module Checkoff:

- Produce at least 50 Watts into an 8-ohm load
  - Observe output waveform
- Output clips at approximately 25V due to base-emitter voltage drops of the output stage
- Show class G operation (switching to higher voltage rail)
  - Probe base of Q18/Q21 on schematic
  - Q16/Q17 15-35V operation
- Bandwidth 20Hz-20kHz
  - Output waveform little attenuation over range of frequencies
- No crossover distortion
  - Observe output waveform
- 6mA current source from Q5 (Input Tail Current Source)
- 10mA current source from Q7 (VAS Current Source)
- Overload Protection Q12/Q13 shunts current from output
  - Test by reducing load impedance and probe current through Q12/Q13
  - By reducing load impedance, the current through the output stage increases and the overload protection should “sense” the change
- Voltage Amplifying Stage has a gain of approximately 25
  - Probe input stage and probe collector of Q8 and compare to find gain
- Demonstrate how the zener diodes bias Q16/Q17 to determine when the rail switching occurs as the inner device emitters approach the lower voltage rail of 15V
  - Zener diodes increases the voltage for the higher rail so it switches on without a discontinuity (decreases voltage for lower rail)