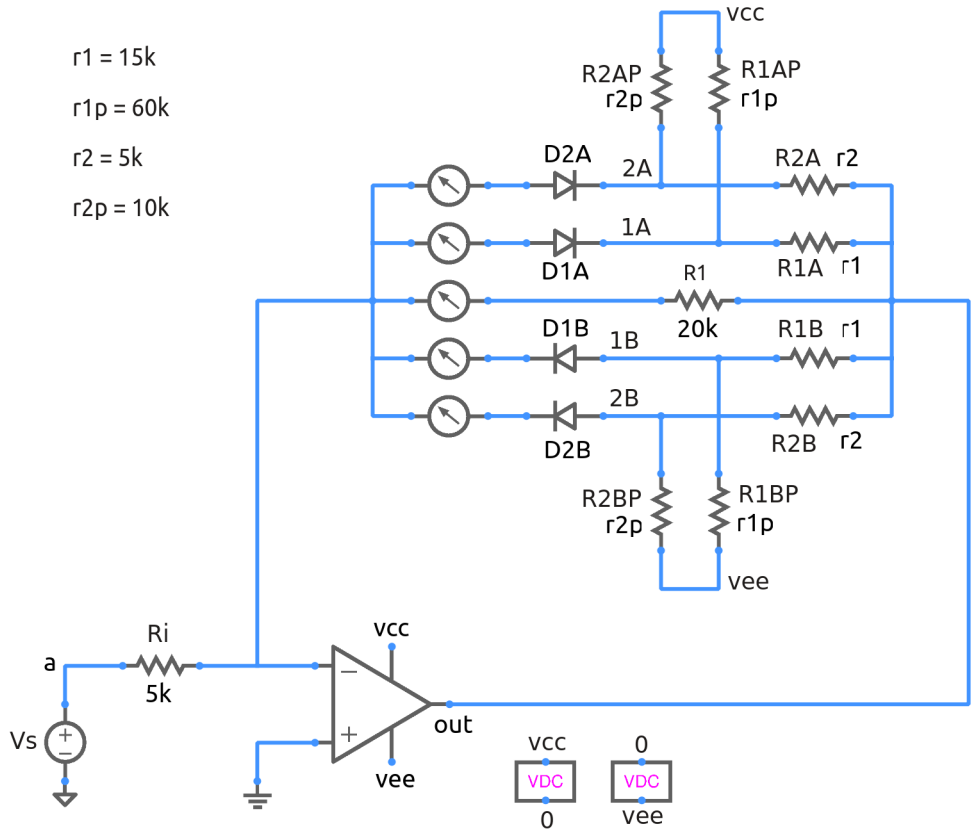
ee101_wave_shaper.sqproj



Shown in the figure is a triangle-to-sine converter circuit. It is essentially an inverting amplifier circuit with the feedback resistor replaced by the diode network. The I-V relationship of the diode network has been designed such that, for a triangular input voltage (going from $-5\,\mathrm{V}$ to $5\,\mathrm{V}$), the output voltage is nearly sinusoidal.

The inverting terminal of the Op Amp is at virtual ground; therefore, the voltage across the diode network is equal to V_{out}. If we know how the input current i_{in} (the current through R_i) varies with V_{out}, we can obtain a relationship between V_i and V_{out} using $i_{\mathrm{in}} = V_i/R_i$.

To understand the circuit operation, simulate the circuit and plot i_{in} versus V_{out} along with the individual diode branch currents (measured by the ammeters connected in series with the diodes). Observe how the total current is affected as each diode turns on.

(See `ee101_diode_circuit_10.sqproj` for the behaviour of the diode network.)

Exercise Set

1. Consider $V_{\text{out}} > 0\,\text{V}$. As V_{out} increases, the diode $D1B$ turns on at some point. Assuming V_{on} to be $0.7\,\text{V}$ for the diodes, calculate the value of V_{out} at which $D1B$ just turns on. Check against the simulation plot mentioned above.

2. As V_{out} increases further, the diode $D2B$ also turns on at some point. Calculate the value of V_{out} at which $D2B$ just turns on. Check against the simulation plot mentioned above.

   Similarly, calculate the values of V_{out} at which diodes $D1A$ and $D2A$ just turn on.

3. Simulate the circuit and plot V_i and V_{out} versus time. Note that the output voltage is approximately sinusoidal.

4. Plot the Fourier spectrum for V_i and V_{out} (individually) and observe that V_{out} has a lower harmonic distortion.

References

1. J. M. Fiore, *Op Amps and Linear Integrated Circuits,* Delmar, 2001.