ENGR-356 Electronics I
Lab 3
Function Generator Design

Goal: Design and build a function generator that creates square, triangle, and sine waves.

Specs: Frequency will be fixed at 1000 hz.
Use +/- 10v power
Square wave duty cycle should be 50/50
Square wave magnitude will be the saturation voltages (+ and -) of the opamp
Triangle wave magnitude needs to be less than saturation but no spec given for it
Sine wave output magnitude should be variable.

Extra: Add adjustable DC to the sine wave output.

Parts: Use TL074 opamps.

Info: Function generator design provides experience with comparators, integrators, filters and analog signal processing in general. Figure 1 below shows the concept for a generator that uses a hysteresis oscillator composed of a comparator with hysteresis and an integrator that creates a triangle wave output. The triangle wave output is then filtered with a low pass filter to obtain the fundamental frequency which becomes the sine wave output.

Approach

Opamp U1a that creates a square wave causes very little time delay in the oscillation feedback loop, so establishing the frequency of oscillation primarily depends on U1b the second op-amp and the switching threshold of the comparator. Comparator switching thresholds are determined by the hysteresis. An approach to design might be to choose a magnitude for the triangle wave, design the hysteresis of the first stage, and then calculate a capacitor and resistor combination for the integrator to obtain the desired frequency of oscillation.

Recommendation:

Design, implement, and debug the oscillator first. Then worry about design and implementation of the low-pass filter to create the sine output. Purity of the sine wave output will depend on the filter order, i.e. 1st, 2cd, 3rd, order etc. where increasing the order of the filter means adding another reactive component (capacitor) and/or cascading fiter stages. Note that low impedance opamp outputs isolate one stage from the next assuming the input impedance of the next stage is not low compared with the opamp output.

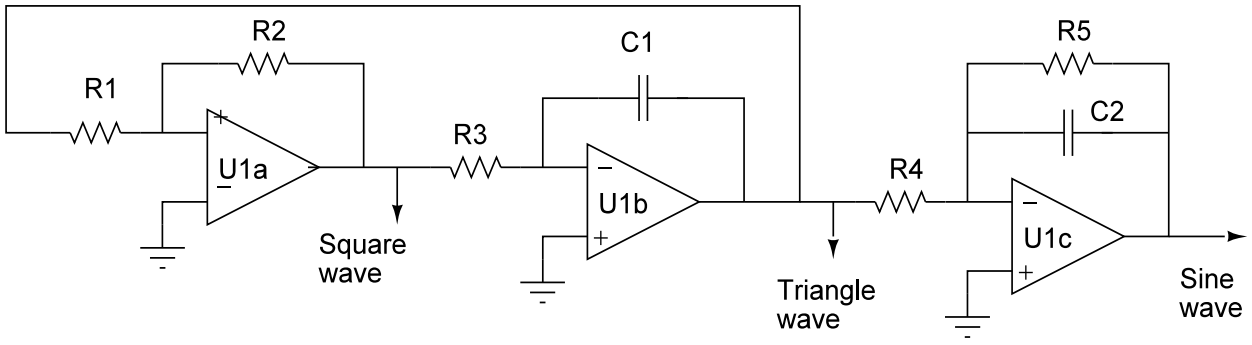

Figure 1