ECEN405 Lab 1

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I. Deliverables

A. 1)

$$
\begin{aligned}
30k &= \frac{10k}{32.8k(1k)C_1} \\
30k &= \frac{10k}{32.8M\ C_1} \\
\frac{1}{C_1} &= \frac{30k \cdot 32.8M}{10k} \\
C_1 &= \frac{10k}{30k \cdot 32.8M} \\
C_1 &= 10.1626nF \\
C_1 &\approx 10nF
\end{aligned}
$$

B. 2)

In order to find the minimum frequency, R_3 needs to be minimized and R_4 needs to be maximized. By entering the formula into desmos and assigning R_3 to be the X axis and R_4 an adjustable slider, the entire range of frequencies can be investigated.

Fig. 1. Minimum frequency at $R_3 = 0\Omega$ and $R_4 = 100k\Omega$

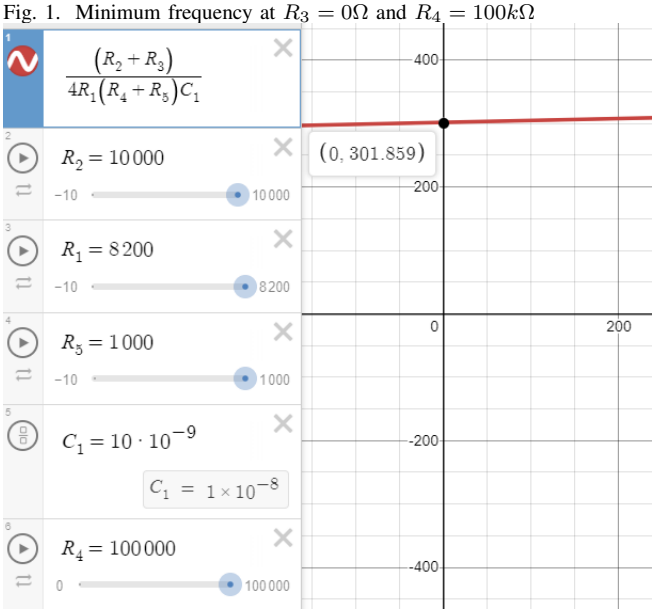
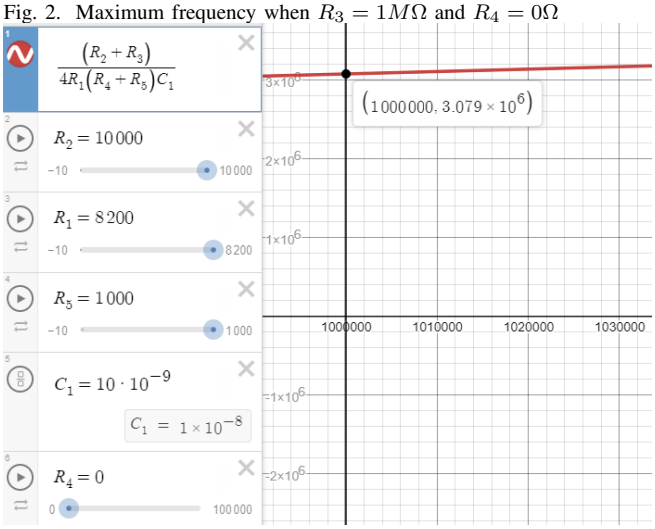


Fig. 2. Maximum frequency when $R_3 = 1M\Omega$ and $R_4 = 0\Omega$



These two figures show that the minimum frequency is 301Hz while the max is 3MHz.

C. 3)

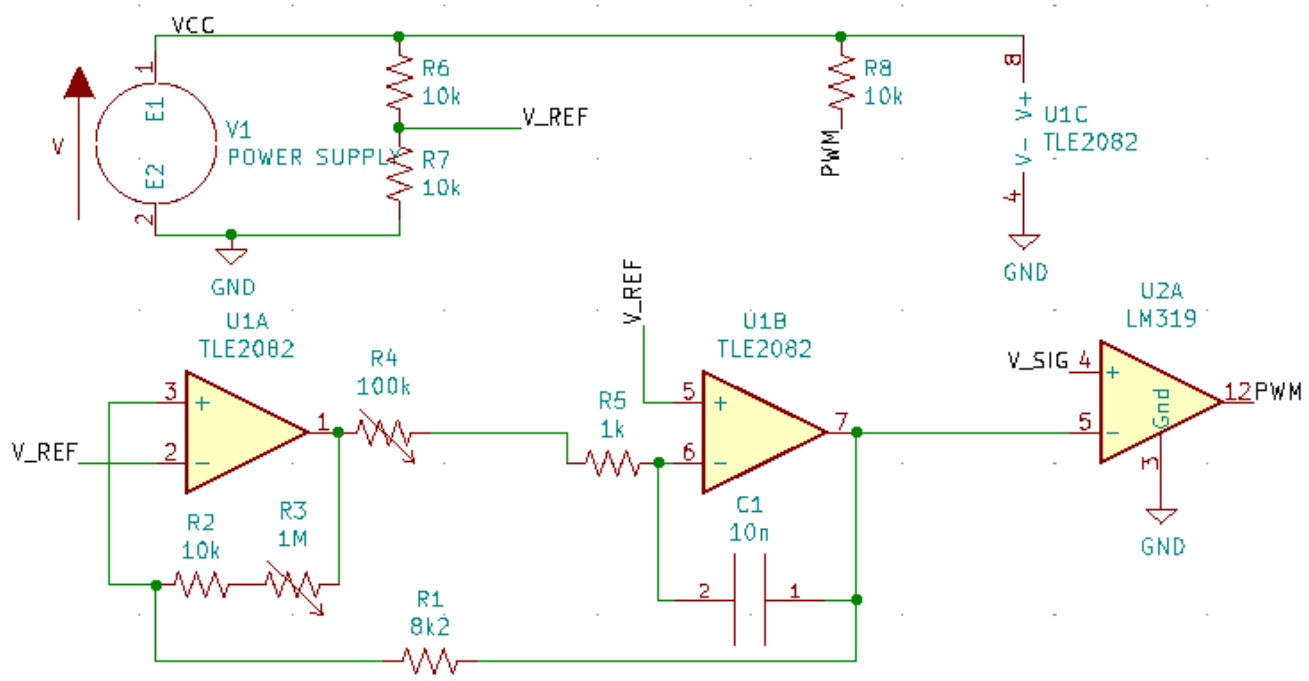
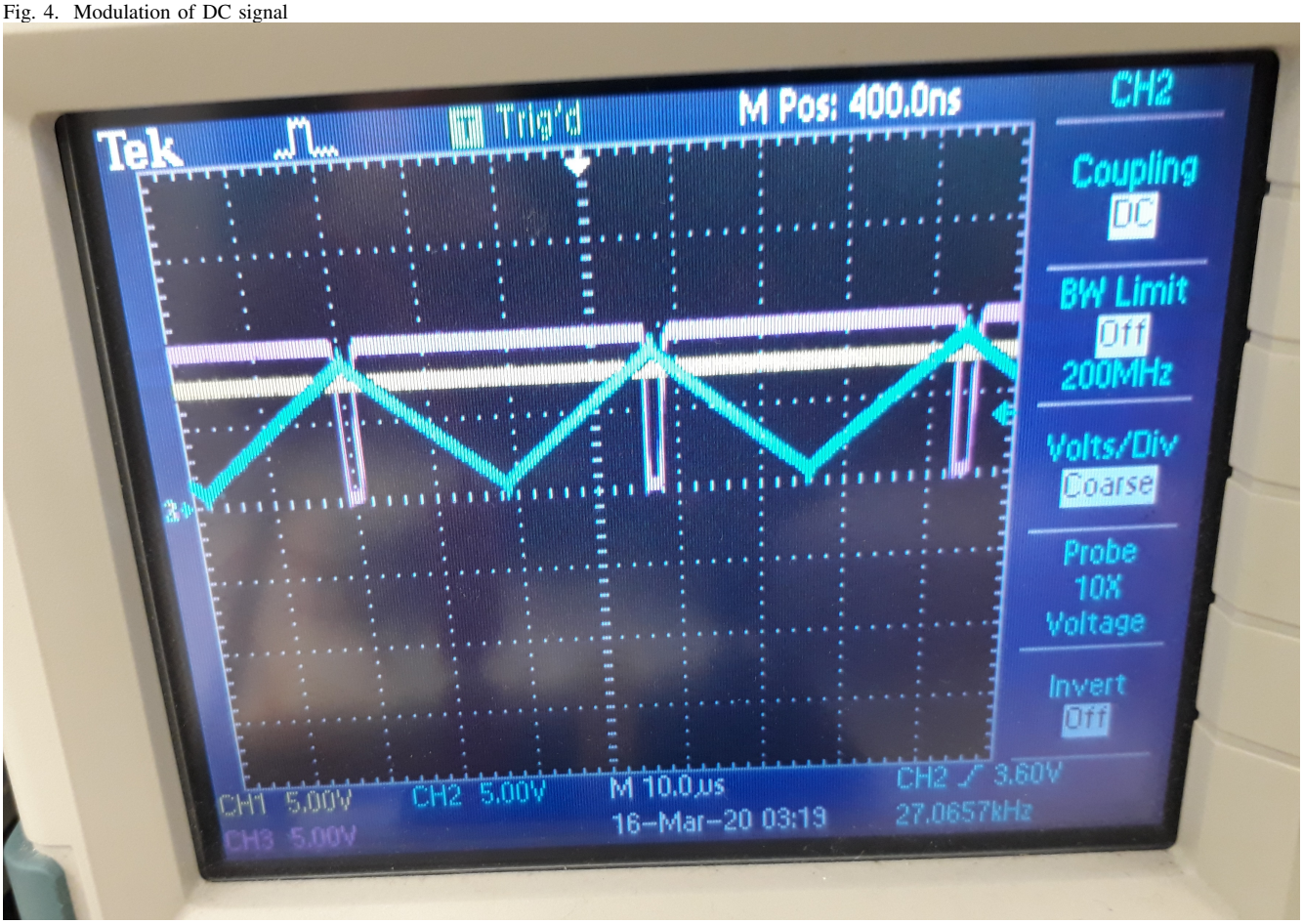


Fig. 3. Schematic of PWM Generator

D. 4)

Fig. 4. Modulation of DC signal



E. 5)

All op-amps have a drop off in gain with increasing frequency, eventually as the frequency gets so high, the op-amp's gain attenuates too much too be seen on the output. Also the frequency response of some of the components used such as the resistors and capacitors would prevent the realization of high frequency signals and would most likely just filter them out.

F. 6)

Rather than having a single comparator, one can have two with the second one with its inputs swapped (input signal goes to inverting input and triangle wave goes to non-inverting input), this would allow a non-inverted and an inverted signal to be generated. Otherwise one could use a logic inverter to achieve the same.