1.

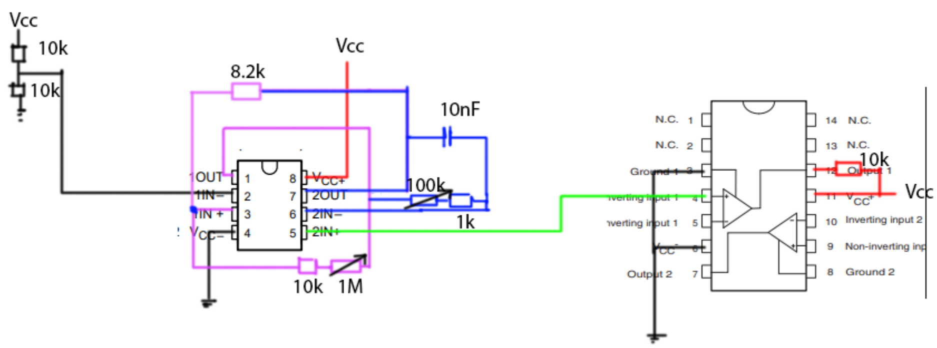
10nF

2.

The range of the frequencies is 30kHz to 3 kHz

3.

The 100kohm and 1m variable resistor was removed in the final breadboarding



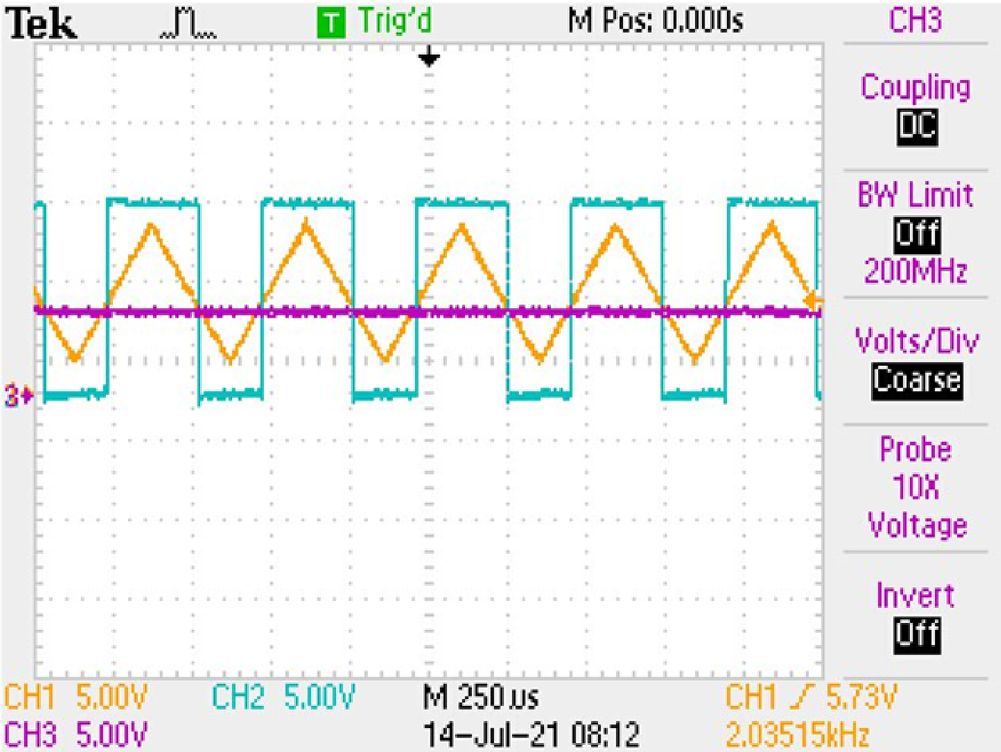
4.

There’s been an alteration made in the schematic provided since removing the 1Mohm and 100kohm resistor gives us a better view of the waveform inside the oscilloscope.

Conduction loss = 1.2*0.5*1^2 = 0.6W;
Switching losses at 297Hz = 11.97504W
Switching losses at 29.7kHz = 10.692W

5. Shown hamish how the frequency behave when the variable resistor is changed

6.



Changing the voltage causes the shift in the frequency. The duty cycle is dependent on the triangle as the point where the DC voltage meets the triangle will trigger the duty cycle's next movement.

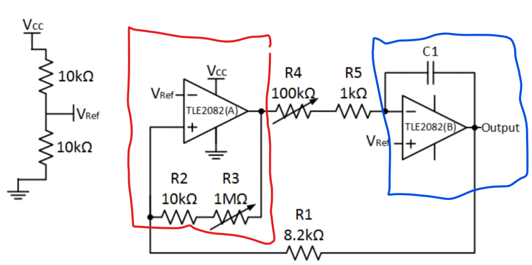
7.

The theoretical frequencies cannot be met because of the removal of the 100k ohm and the 1m ohm resistor as well as the variability of the resistor and capacitor value. In addition, switching losses and conduction loss can happen.

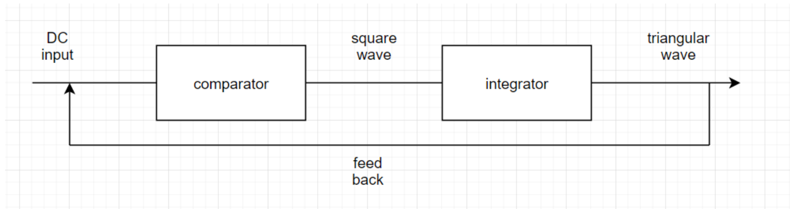
8.

When the inputs of the comparator are switched, the expected output is an inverted signal.

9.



The subcircuit on the left converts DC into square waveforms through an OpAmp. In addition, the subcircuit on the right converts the square waveform into a triangular waveform through an OpAmp creating a duty cycle effect.



Appendix

1.

$$30kHz = \frac{10k\Omega + 1M\Omega}{(4*8.2k\Omega)(100k\Omega + 1k\Omega)*C} \therefore C = 1 * 10^{-8} or\, 0.01\mu F$$

2.

$$3.4kHz = \frac{10k\Omega}{(4*8.2k\Omega)(1k\Omega)*C}$$

3.

4.

$$P_{cond} = R_{DS(on)} d I^2$$

Using this formula and Rds = 1.2
I = 1
D = 0.5 (duty cycle of 50%)

Switching losses: $P_{sw} = \frac{1}{2} V_{in} I_o (t_{c,on} + t_{c,off}) f_s$

Using this formula to calculate switching loss is

At f = 297Hz	At f = 29.7kHz
V = 12	V = 12
I = 1	I = 1
Tc, on/off = 0.00336700336	Tc, on/off = 0.00003367003

Switching losses = 11.97504 W	Switching losses = 10.692 W

5.