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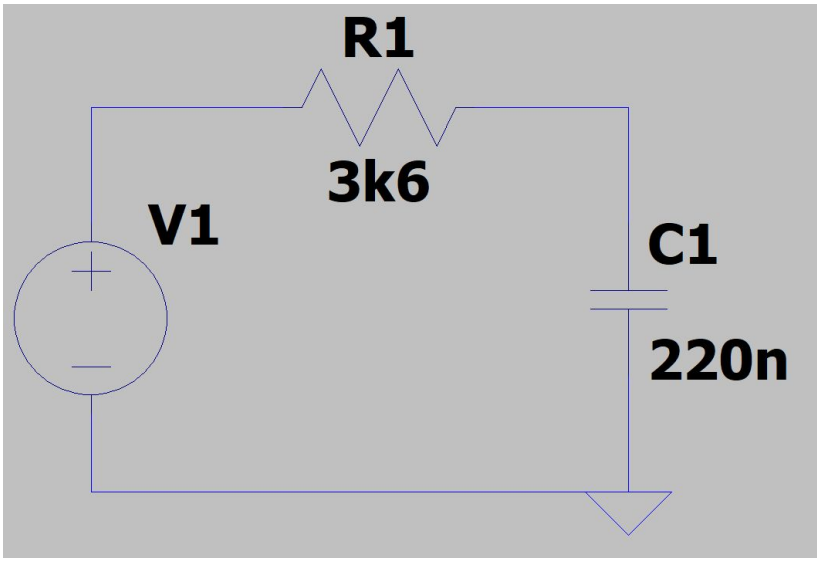
ECEN 203 Analogue Circuits and Systems
Lab 3
Hi-Fi Audio Circuit Design

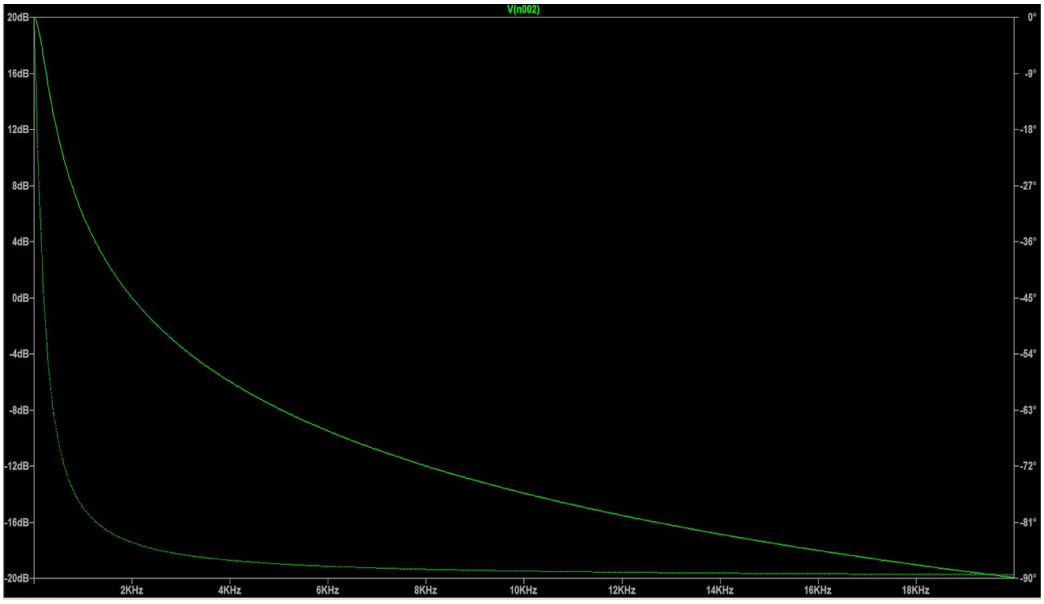
Part 1: Filter Design

1.1



w_0 = 200Hz = 400π rad.s^{-1}
w_0 = 1/RC
R(C) = 1/400π*C
R(C=220n) = 3617Ω

1.2



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1.2

$$H(w) = \frac{\frac{1}{jwC}}{R+\frac{1}{jwC}} = \frac{1}{1+jwRC}$$

For ideal setup, RC = 1

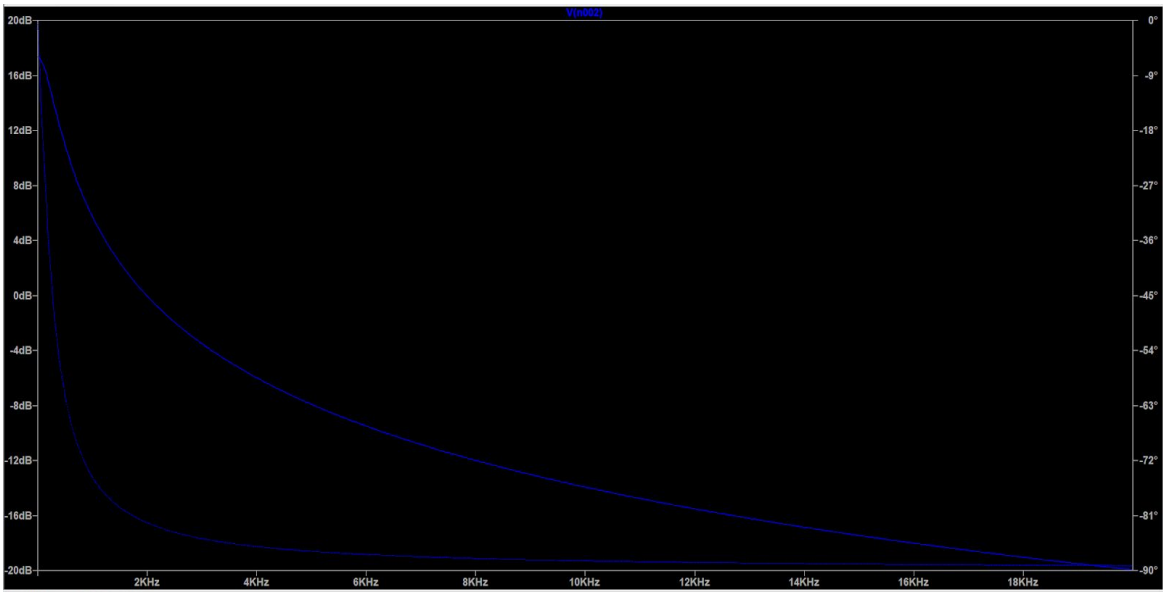
$$H(1w) = \frac{1}{1+j} = \frac{1}{\sqrt{2}} \angle -45°$$

$$H(w/10) = \frac{1}{1+j/10} = 1 \angle -5.1°$$

$$H(100w) = \frac{1}{1+10j} = 0.1 \angle -84.3°$$

As seen at higher f. The gain value is lower, and vis versa for the lower f. Characteristic for a low pass filter.

1.3



New cutoff f. is approx. 270Hz.
This is due to the Loading Effect, as the load circuit is of higher impedance (10k) than that of the driving/source circuits impedance (R + 1/jwC, approx. 6k)

1.4

The voltage follower negates the loading effect, isolating the load circuit from the

rest of the circuit. This allows the time constant to be unaffected by an added load, as it is independant via the follower.

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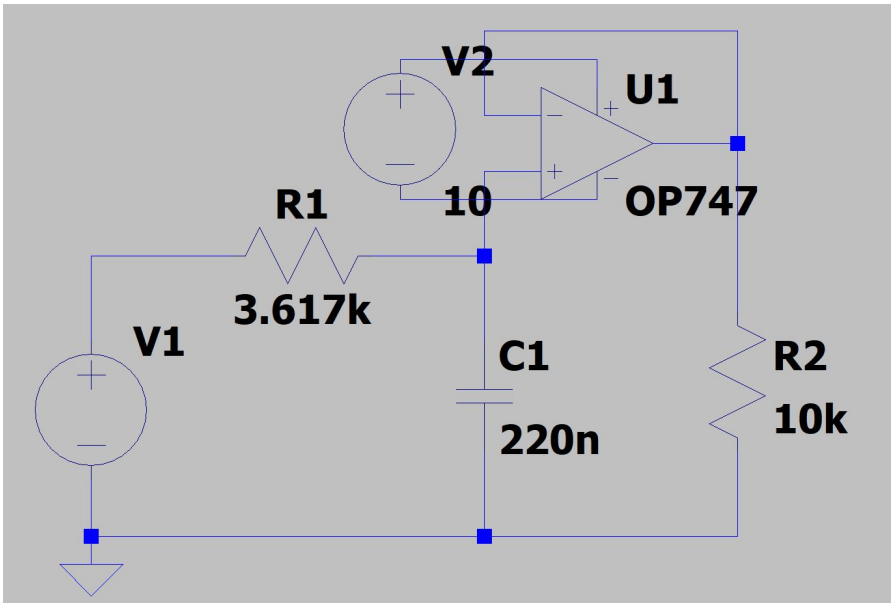
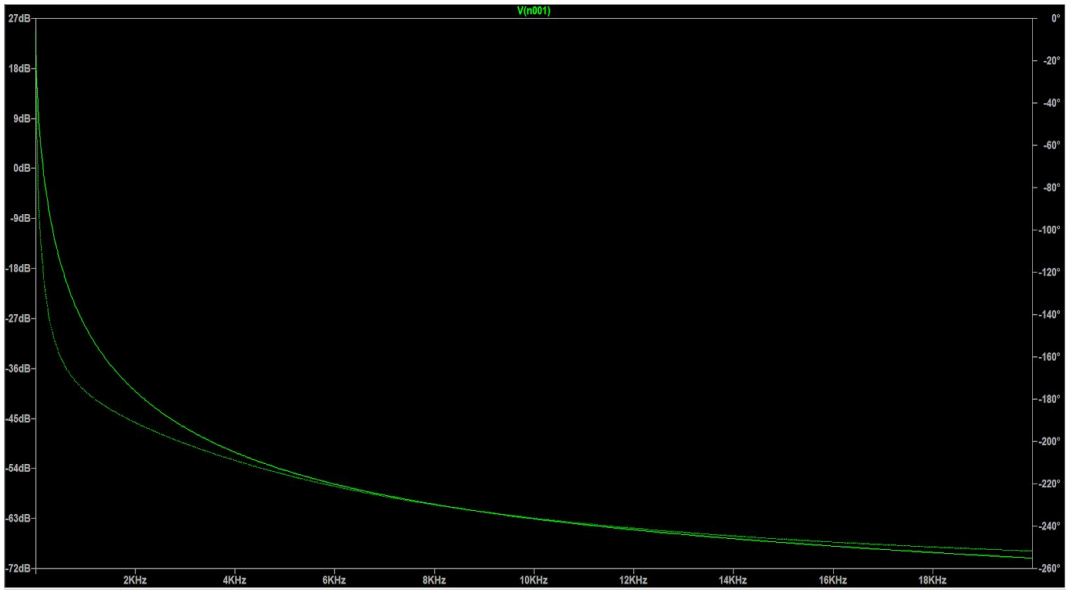


Op-amp V follower implementation



Part 2: Audio Effects Unit

V_i = sinwt v_o = -1/R_1C intgl(sinwt) V_o = 1/R_1C coswt

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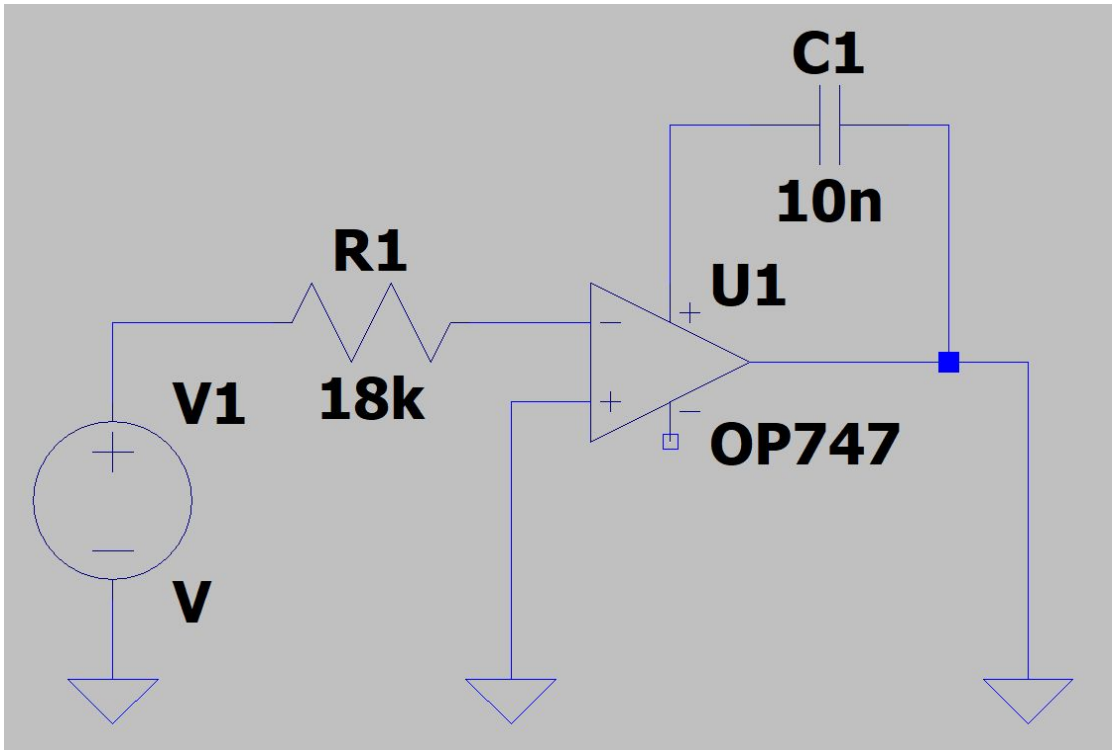
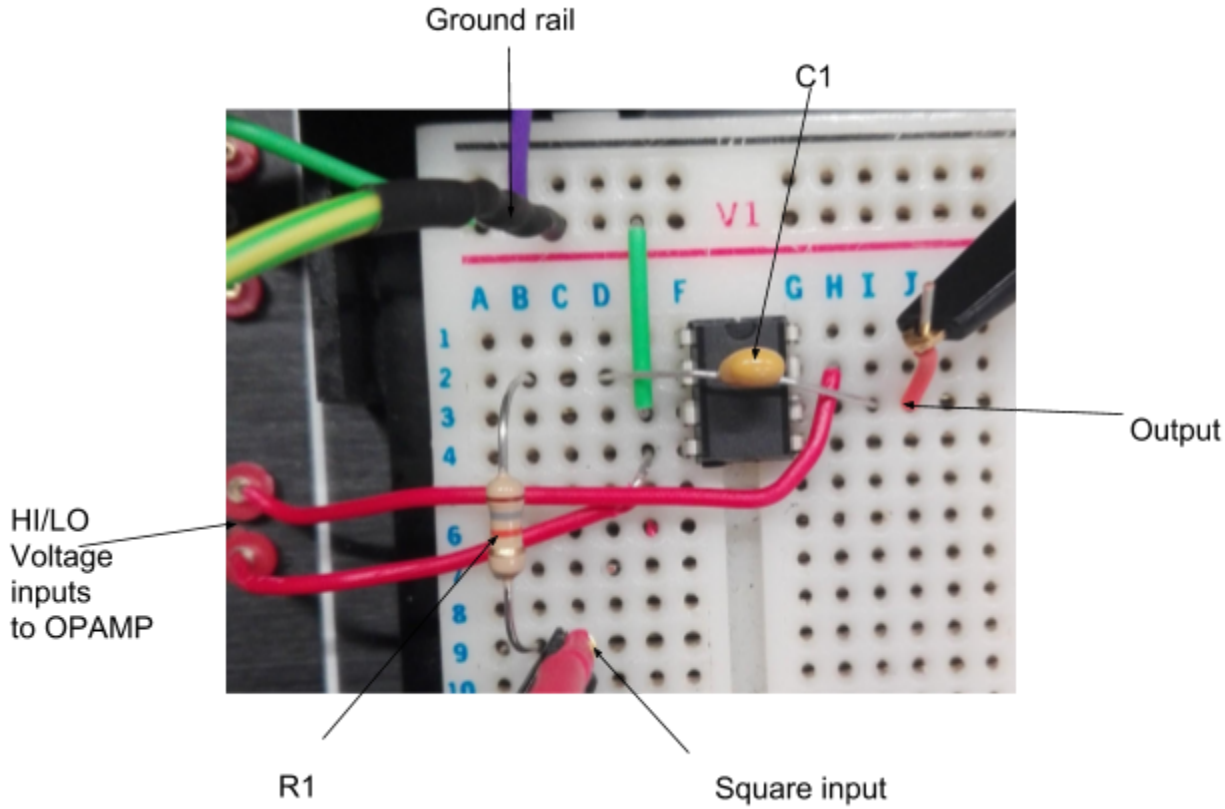


Unloaded integrator circuit design, should transform a square signal into a triangle



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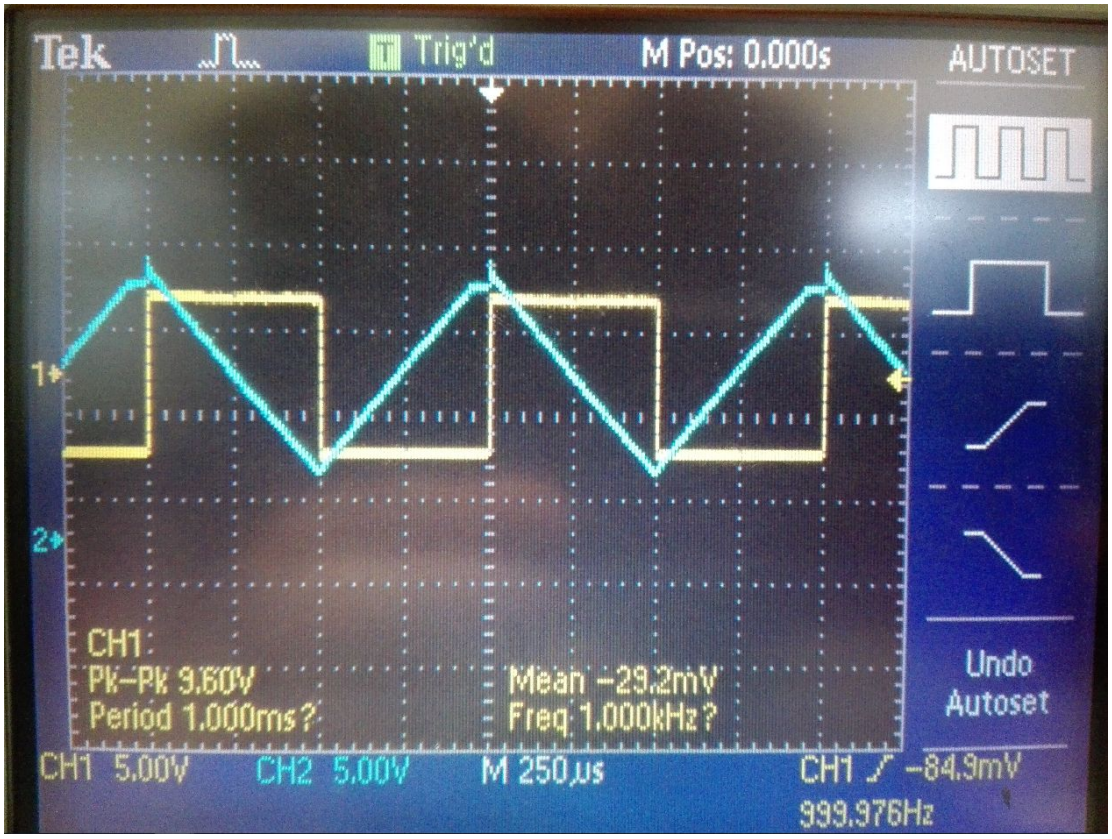
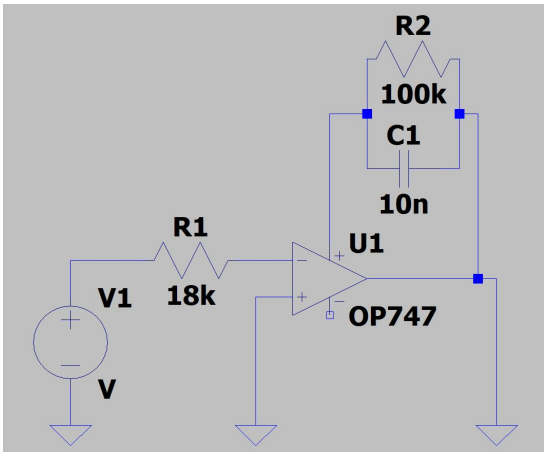
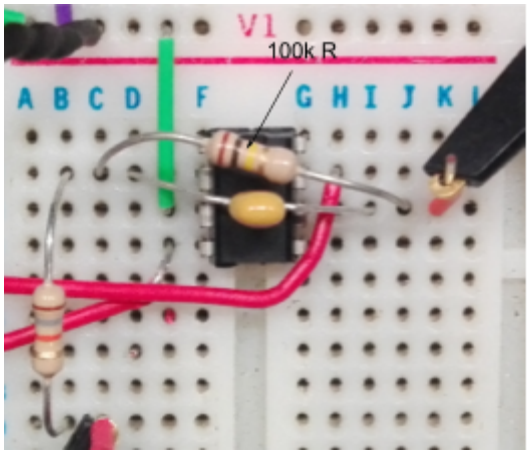


Output (ch2:blue) and input (ch1:yellow)
Visible gain of about 1.3

1.2 wind-up

I observed a visible snapping to voltage extremes of the output when a DC offset was introduced(both positive and negative)





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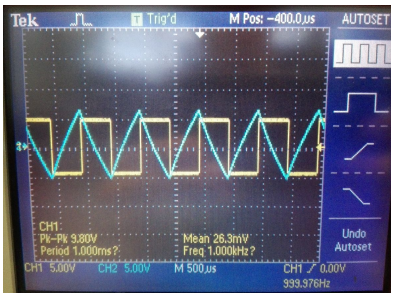
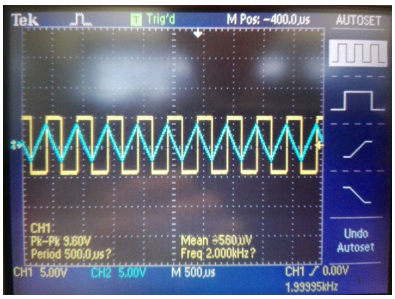
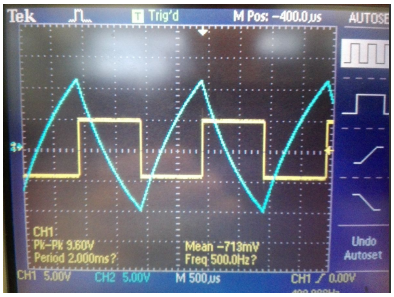
The new design rendered the below output, adding greater stability, smother output and no rail snapping. The below O/P also demonstrate the low pass characteristics



1kHz



2kHz



0.5kHz

This is the addition of gain control to add stability, with some gain sacrifice (seen as the curving at lower frequencies)