Electronic Devices and Circuits I - EE2CJ4

Lab #3

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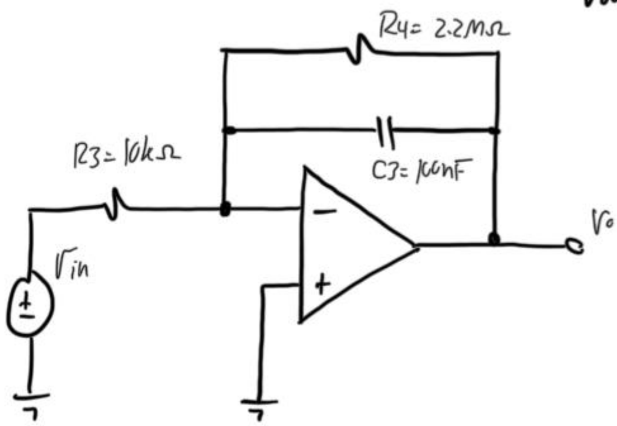
vii. Build the circuit in Figure 4 using the analog discovery 2 and measure the corresponding outputs. Compare your theoretical analysis with your measured responses.

$$V_{out} = \frac{-1}{R_3 C} \int_0^t V_{in}(l)\, dt$$



① Sinusoidal input

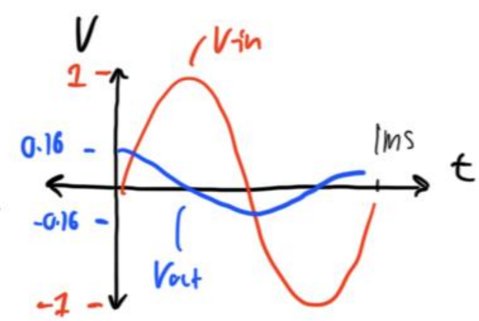
$V_{in} = 1 \sin(2\pi \cdot 1000 t)$

$V_{in} = \sin(2000 \pi t)$

$$V_{out} = \frac{-1}{(10\times10^3 \Omega)(100\times10^{-9} F)} \int \sin(2000\pi t)\, dt$$

$$V_{out} = -\frac{1000}{2000\pi} \cdot -\cos(2000\pi t)$$

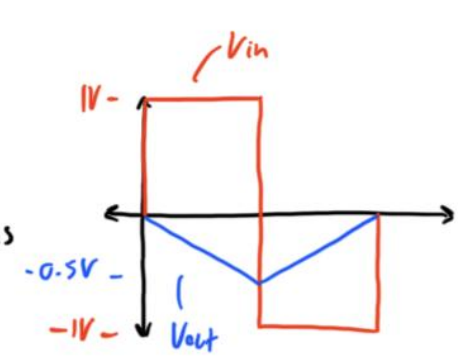
$V_{out} = 0.16 \cos(2000 \pi t)$



② Square input

$$V_{in} = \begin{cases} 1V \ ; & 0ms \le t \le 0.5ms \\ -1V \ ; & 0.5ms \le t \le 1ms \end{cases}$$

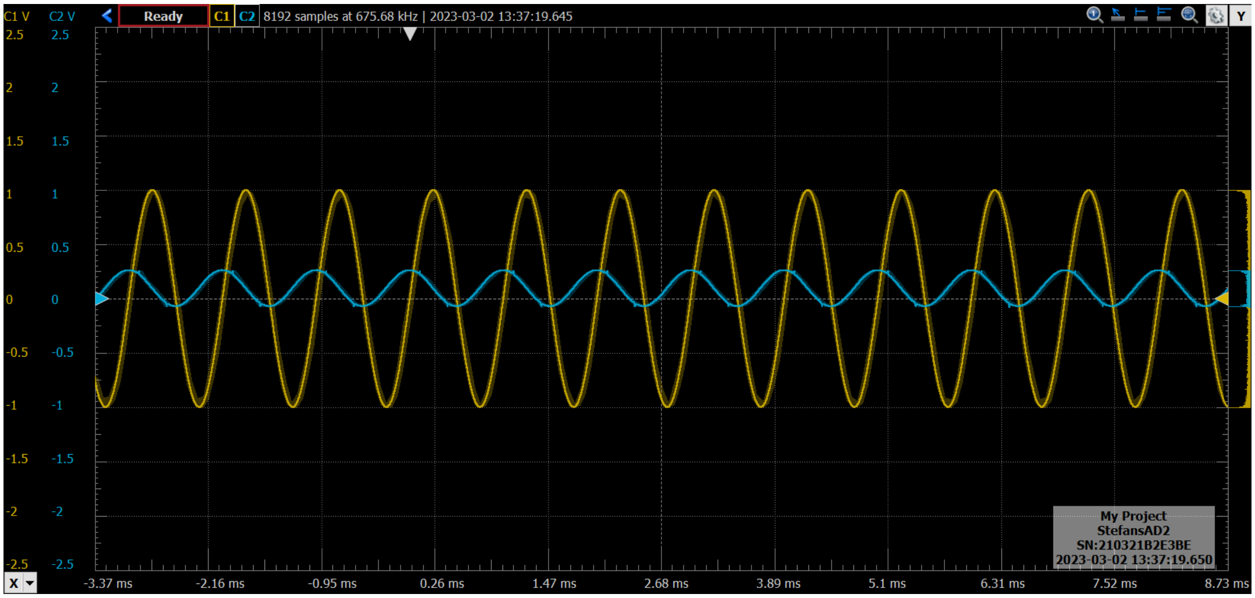
$V_{out-1} = -1000 \int 1\, dt = -1000t \quad 0ms \le t \le 0.5ms$



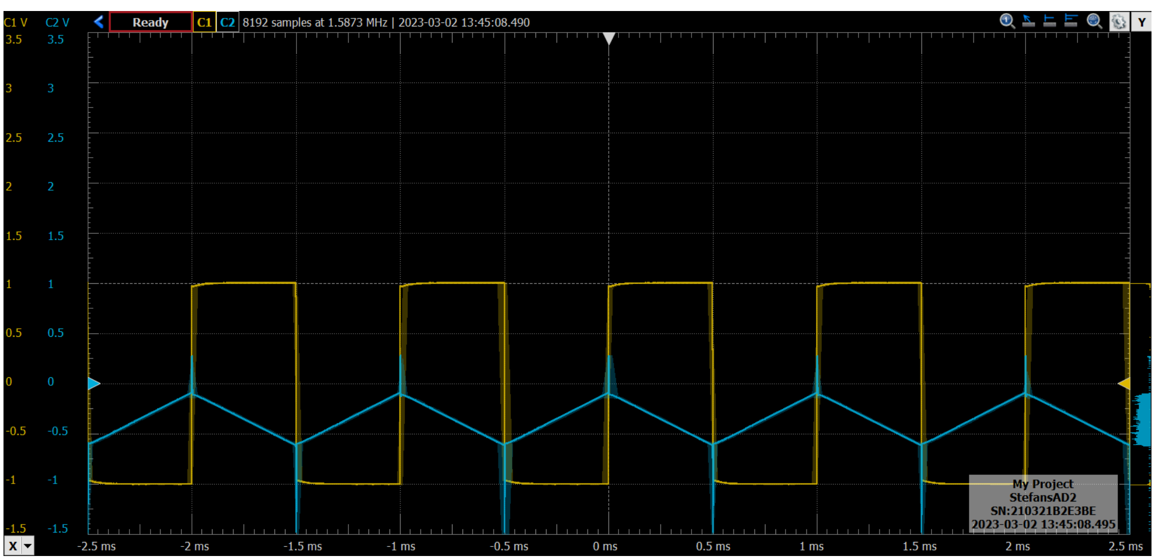
$V_{out-2} = -1000 \int -1\, dt = 1000t \quad 0.5ms \le t \le 1ms$

$$V_{out} = \begin{cases} -1000t \ ; & 0ms \le t \le 0.5ms \\ 1000t \ ; & 0.5ms \le t \le 1ms \end{cases}$$

The below graph depicts the output of the integrator circuit (channel 2, Blue waveform) and the input waveform (channel 1, Yellow waveform, $V_{in} = sin(2000\pi)t$)



The below graph depicts the output of the integrator circuit (channel 2, Blue waveform) and the input waveform (channel 1, Yellow waveform, 2VPP Square, 1KHz)

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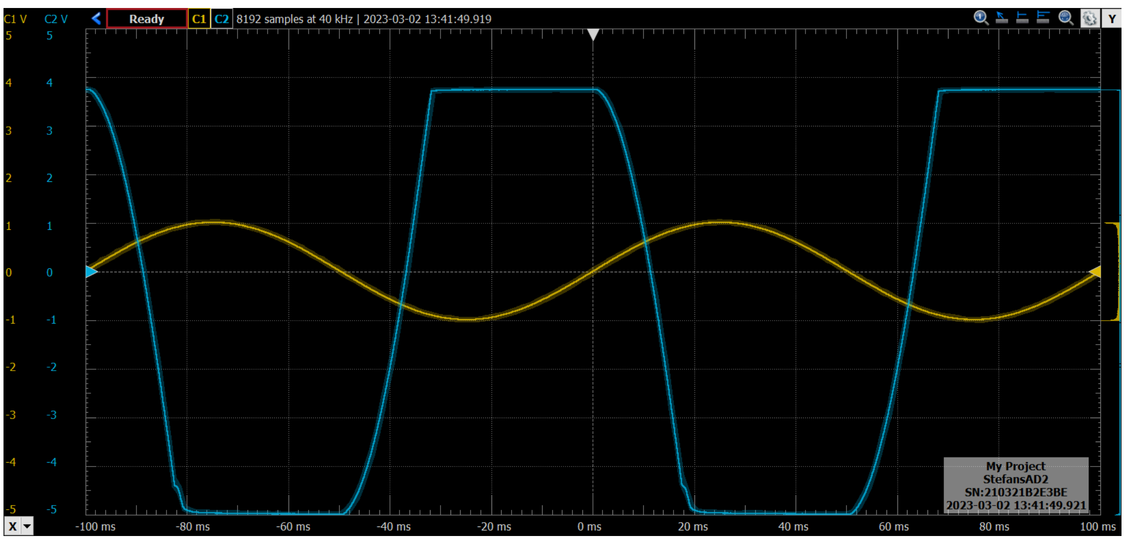
viii. Set the frequency to 10 Hz or lower. Check whether the integrator functions properly and explain your finding.

When the frequency of the input function into the integrator circuit dropped below a certain threshold frequency, it appeared to stop operating properly. We experimentally determined that this threshold frequency is around 50Hz. This occurs because of the nature of the equation for V_{out}

We know that $V_{out} = \frac{-R4}{R3}\left(\frac{1}{1 + j\omega C_3 R_4}\right)$, as omega goes to 0 (I.e. we lower the frequency) the value of V_{out} goes to infinity, which would make sense based on our output graphs, as it can be seen that V_{out} becomes extremely large in comparison to V_{in}

The below graph depicts the output of the integrator circuit (channel 2, Blue waveform) and the input waveform (channel 1, Yellow waveform, Sin wave, 2VPP, 10Hz)



The below graph depicts the output of the integrator circuit (channel 2, Blue waveform) and the input waveform (channel 1, Yellow waveform, Square wave, 2VPP, 10Hz)