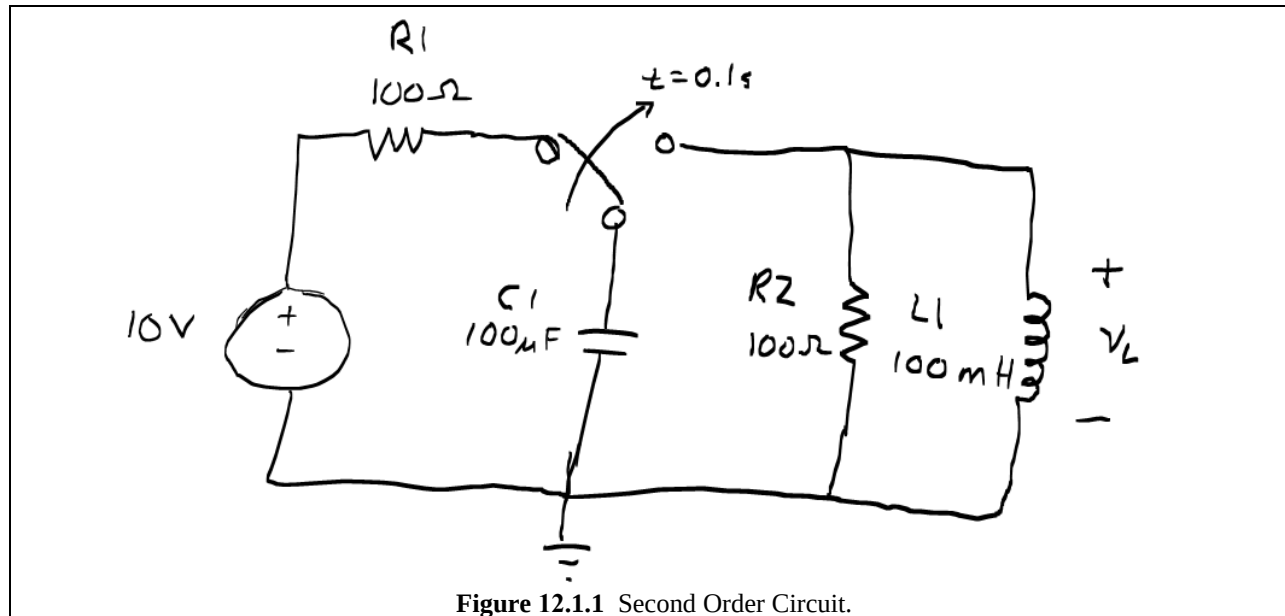


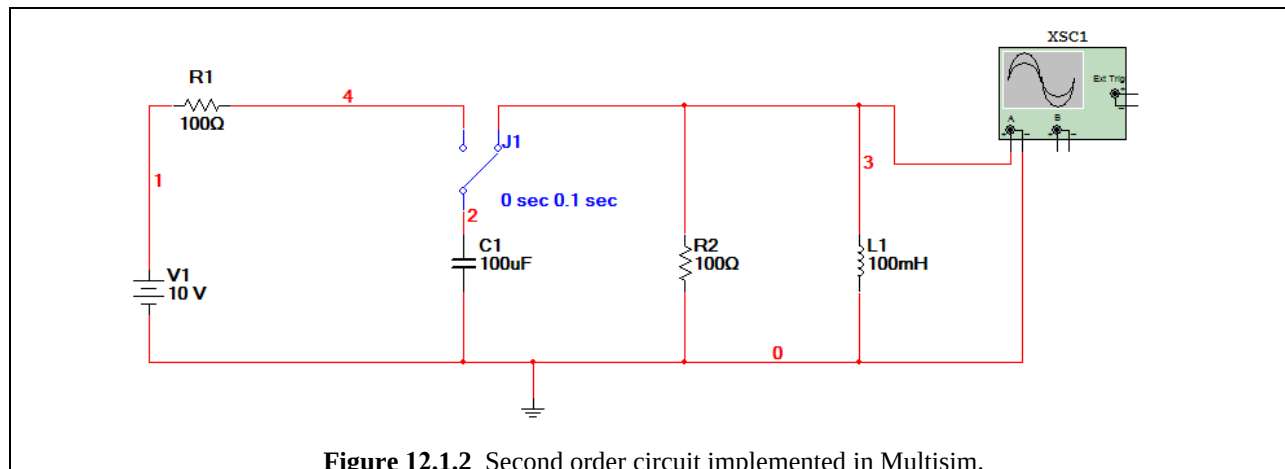
### MULTISIM DEMO 12.1: PARALLEL RLC CIRCUIT ANALYSIS

*As far as Multisim goes, there isn't too much to learn for Chapter 12. The basic details and techniques which are overviewed in the Demos in Chapter 5 apply just the same here.*

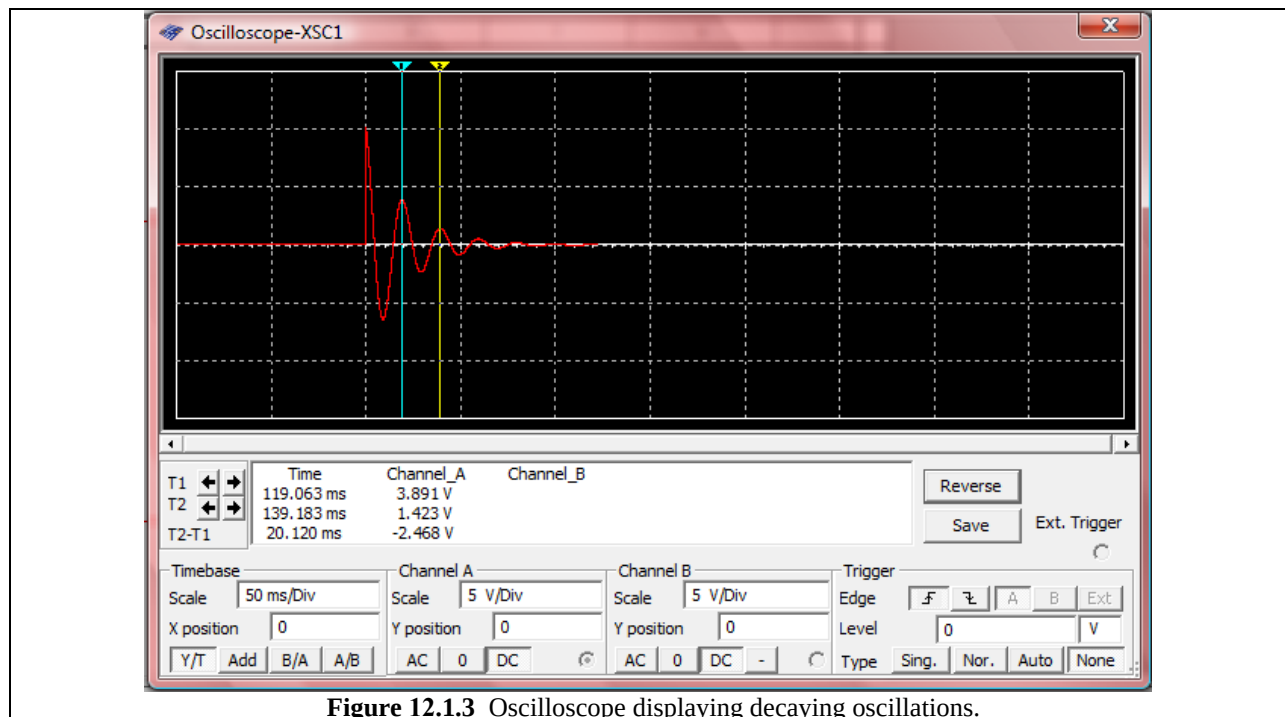
Still, just for the sake of practice (and because second order circuits are a lot of fun), we'll simulate a second order circuit here. Build the circuit shown in Fig. 12.1.1 below. Use the time-dependent SPDT switch that we utilized in Multisim Demo 5.1.



We want to measure the voltage across the inductor as a function of time, so let's do it using an Oscilloscope in the Interactive Simulation. When you're ready to move on, your circuit should look like Fig. 12.1.2 below. Note that the time-dependent switch TC\_SW1 looks like it is starting in the wrong position, but actually, at 0 seconds, it immediately jumps over to the other side, and then at 0.1 seconds moves to its final resting position in accordance with the schematic in Fig. 12.1.1.



Once you're ready, open up the oscilloscope screen, and run the Interactive Simulation by pressing F5 or one of the appropriate buttons. You will need to adjust the Timebase of the oscilloscope in order to obtain a readable graph. Additionally, once the signal has appeared, you may want to pause the Interactive simulation either through pressing F6 or the **||** button on the Interactive Simulation control panel. This will prevent the oscilloscope from continually jumping further and further on in time, while you are trying to look at something which happened at around 0.1 s. You should observe an decaying oscillation after 0.1 s as shown in Fig. 12.1.3 below.



**Figure 12.1.3** Oscilloscope displaying decaying oscillations.

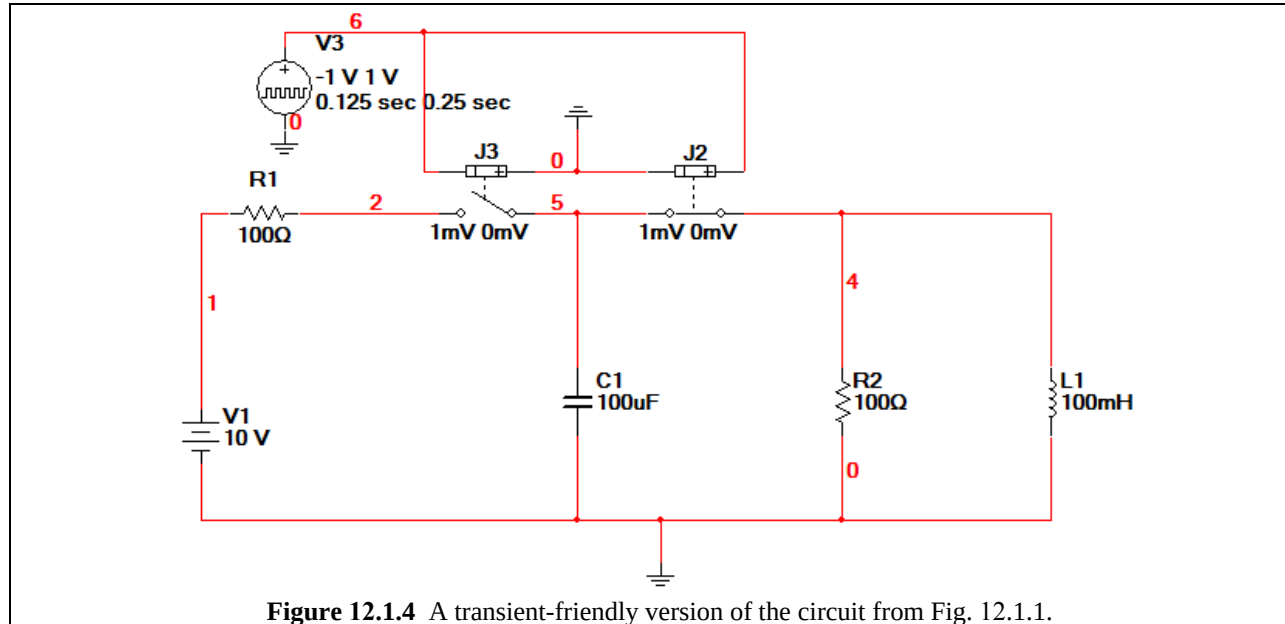
Using the cursors, we see that the frequency of the oscillations is about 49.702 Hz. From theory we know that the frequency should be:

$$f = \frac{1}{2\pi\sqrt{L \cdot C}} = \frac{1}{2\pi\sqrt{100 \times 10^{-6} \cdot 100 \times 10^{-3}}} = 50.33 \text{ Hz.}$$

These two values are about equal. The difference is due to the limited resolution of the simulation.

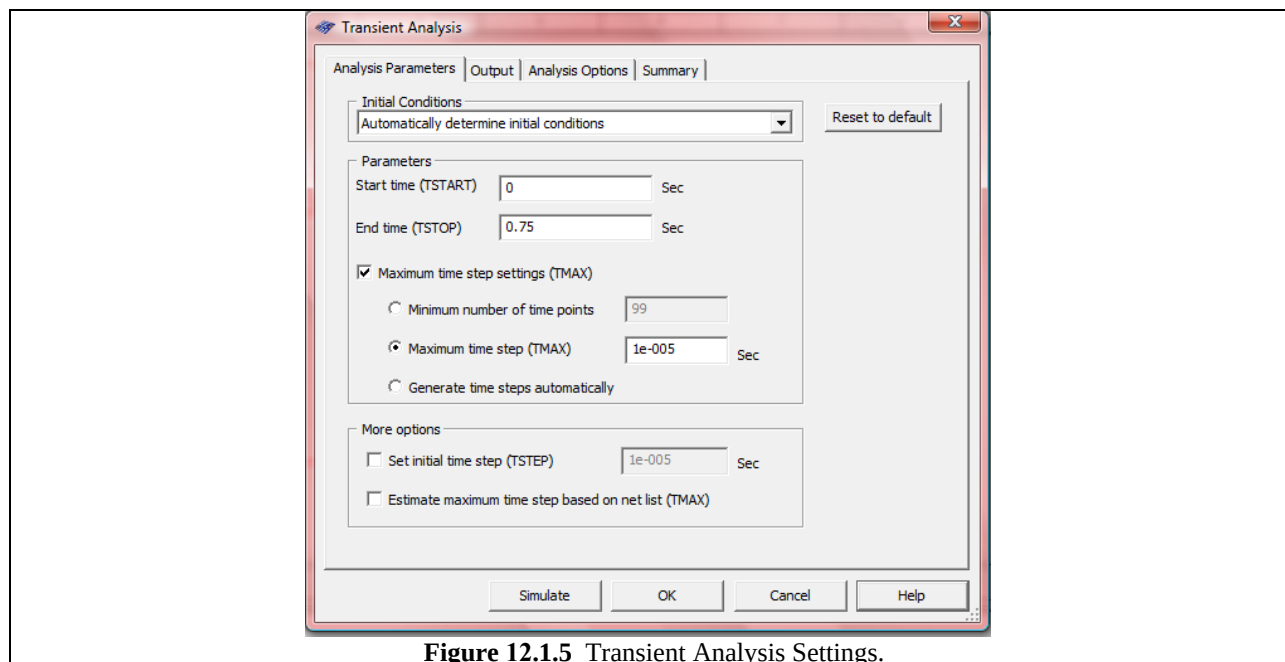
Now again, just like in the last chapter, the switch we currently have in the schematic will not work in a Transient Analysis, even though a transient analysis might give us nicer plotting abilities. So, just for practice, let's re-build the circuit in Fig. 12.1.1 for Transient Analysis using the VOLTAGE\_CONTROLLED\_SWITCH and PULSE\_VOLTAGE components. Since the switch is a SPST (single-pole-single-throw) and we need a SPDT (single-pole-double-throw) component we need to use two of them as we did in Multisim Demo 5.3. the resulting circuit should look like that in Fig. 12.1.4 on the next page.

Set the PULSE\_VOLTAGE component to have a period of 0.125 seconds and a pulse width of 0.25 seconds. Set the Initial value to -1 V and the Pulsed value to +1V. Make sure that the polarities of the voltage sensors on the switches are in agreement with those shown in Fig. 12.1.4.



**Figure 12.1.4** A transient-friendly version of the circuit from Fig. 12.1.1.

Now we are ready to set up the Transient Analysis. As shown in Fig. 12.1.5, set TSART to 0 seconds and TSTOP to 0.75 seconds. Set TMAX to 1e-005 seconds. Don't forget to select the voltage V(4) for analysis under the Output tab. When you are ready, press Simulate. The generated plot should be similar to Fig. 12.1.6, which is found on the next page.



**Figure 12.1.5** Transient Analysis Settings.

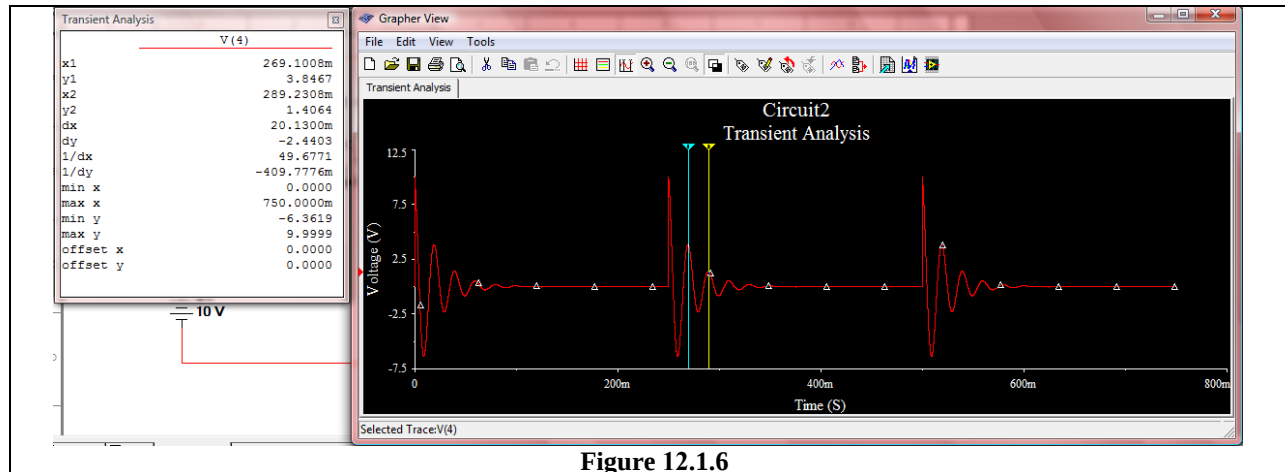


Figure 12.1.6

The cursor value  $1/dx$  can be used to determine frequency because it measures the inverse of the difference in time between the two cursors. So if we place each of the cursors at adjacent maxima in the decay, the difference value  $dx$  will equal the period of oscillation. Consequently  $1/dx$  will be the frequency!

As the cursor value  $1/dx$  shows, the frequency of oscillations is measured to be 49.68 Hz, which again is within a reasonable amount of the value we expect from theory: 50.33 Hz.