EEE 202 - Lab 2 Report - Voltage Spikes

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Design a passive linear circuit to generate high voltage spikes from 10V peak-to-peak square wave with a source resistance of 50Ω and frequency less than 5MHz.

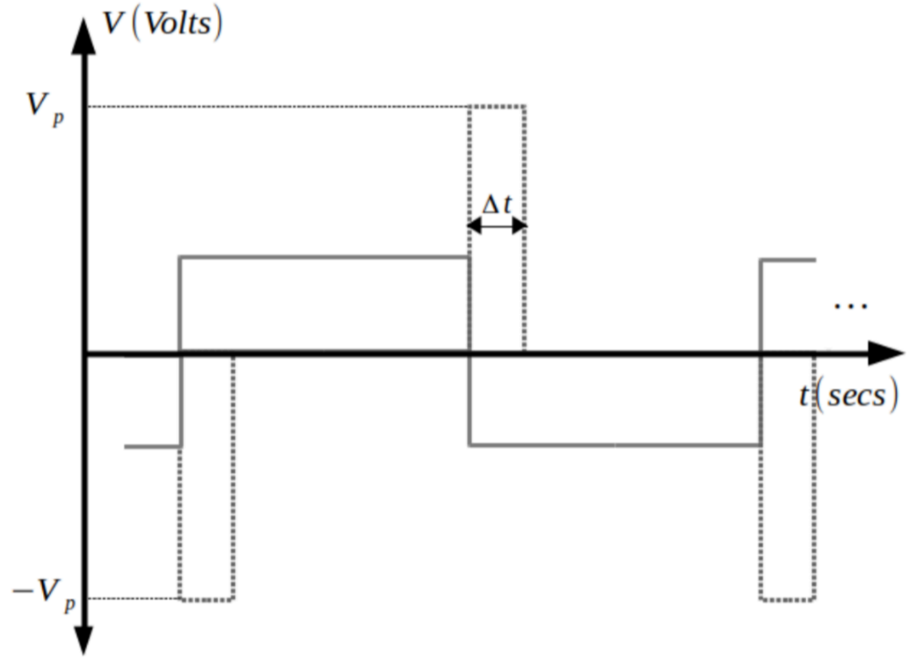

Figure 1.1: Lab Assignment Exampe Graph

- Introduction:

In this lab, we are asked to generate voltage spikes with a amplitude of ~25V to 30V from a square wave using only passive components. There are a different methods one can utilise to generate a voltage spike. Inductive spikes are being utilised in this lab due to its configurability and simplicity.

- Theory:

A simple inductive spike can be generated when the current in an inductor drops almost instantaneously. This can be inferred from the voltage formula of an inductor.

$$V = L\frac{di}{dt}$$

When we assume the current drop is instantaneous and the current through the inductor is non-zero, we can assume dt approaches '0'. The current drops to zero therefore we can assume $di = i_0$ Therefore, the equation becomes:

$$V = L\frac{i}{0} = \infty$$

In an ideal setting where dt is 0 the output voltage would be infinite. However, due to the resistance of inductors and wires etc. the voltage spike is not as high.

- Methodology and Software Implementation

To produce this drop in current, the given square wave generator is enough by itself as seen in Figure 2.1. However, the voltage spikes do not have the desired amplitude

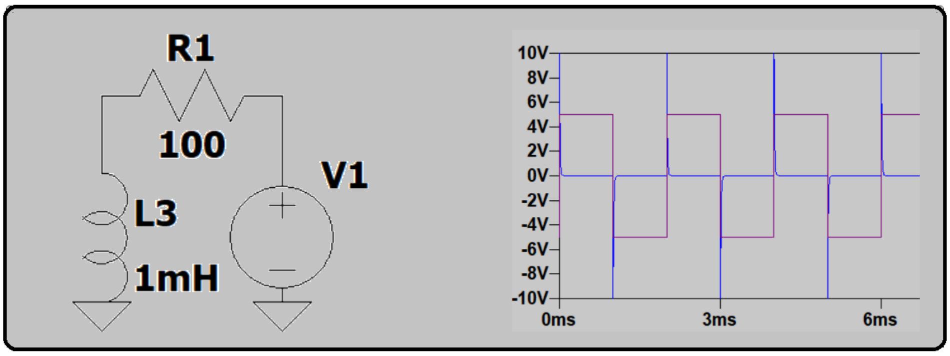

Figure 2.1: Basic inductive spike circuit and output waveform

To control the output amplitude, we can just implement a transformer instead of the inductor. The secondary side can increase the voltage to observe a higher amplitude.

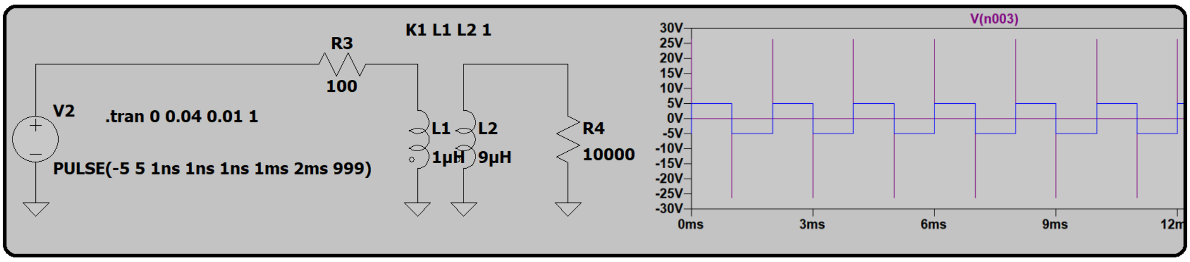

Figure 2.2: Inductive spike circuit with controlled amplitude and output waveform

- Hardware Implementation

To implement this circuit using real life components, we need to adjust the values to match non-ideal components.

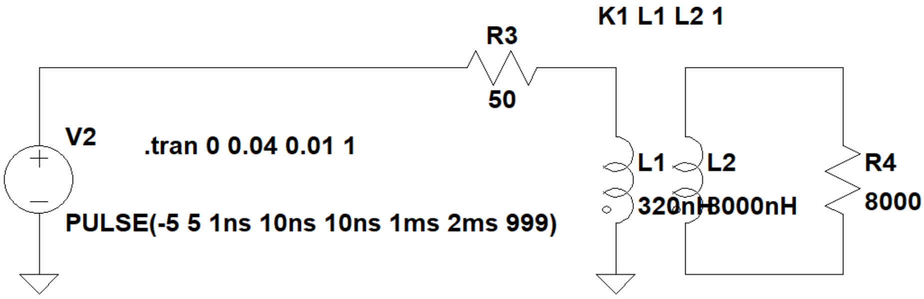

Figure 3.1: Circuit with adjusted values

Using the serial resistance of the signal generator as the resistance in this circuit allows us to connect the signal generator directly to the inductor which makes the circuit easier to implement. As for the inductor, a transformer with a ⅓ turn ratio would suffice. However, to minimise the loss spread out windings are preferred. Finally, the 10kΩ resistor is connected directly to the secondary of the transformer. The output voltage is the voltage across the 10kΩ resistor.