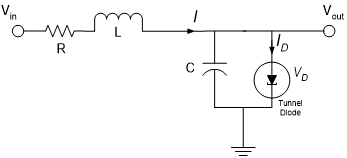
Jessica Chen

Kristina Ming

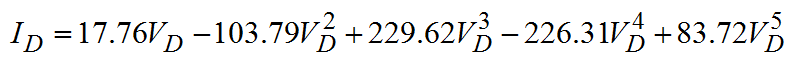
**Tunnel Diode GUI User Guide**

Background

The following circuit uses a tunnel diode to produce high speed switching of the output voltage as the input voltage increases from zero.

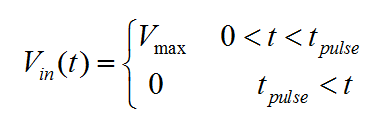


The current going through the tunnel diode is given by:

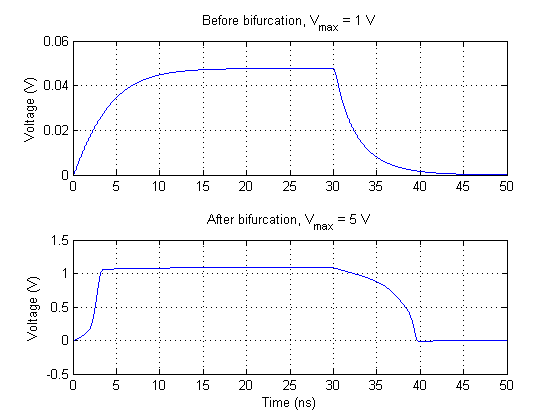


with in mA and in V.

The circuit has a pulse input voltage of the following form:

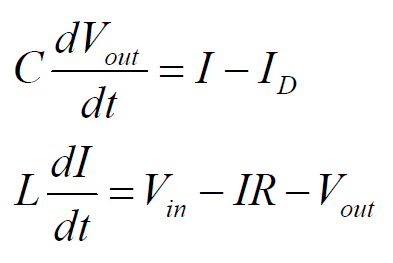


and should be long enough and low enough, respectively, such that the output voltage can reach its maximum before falling back to zero. This is most easily witnessed by the output voltage reaching a plateau (see below).



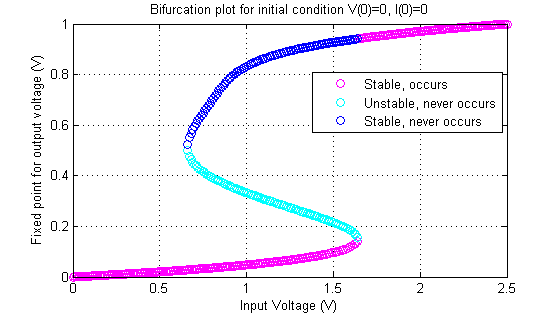
For combinations of and that reach the maximum output voltage, the rise time should come out to be about 10 ns.

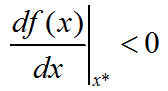
The circuit equations are:



and the state variables are .

Below is the bifurcation plot for the system. The fixed points for the output voltage reflect the peak output voltage that is expected given of the input voltage. If the peak output voltage is not reached, then should be increased until it has been reached. The lower and upper branches are stable and the middle of the “S” never occurs given the initial conditions that voltage and current are zero at t=0.



For , there are three fixed points. The fixed point is stable if the gradient  so the lower and upper fixed points are stable (the magenta and blue), and the intermediate fixed point is unstable (cyan). Since the initial conditions are and , the fixed point is the lowest stable value as the input voltage increases from zero.

When , there is only one real fixed point. The output voltage jumps to this upper stable fixed point at the bifurcation value of 1.64 V. After this bifurcation point, the output voltage’s rise time starts to decrease.

Usage

Upon first starting the GUI, the user can enter and to dictate the input voltage. Only numbers can be entered. To plot the output voltage as a function of time, the “calculate” button should be pressed.

Points of interest that should be tested are ’s ranging from 1.60 to 1.70, with about = 40 ns. A variety of behaviors from the tunnel diode can be seen in this region, where the bifurcations occur. Other maximum voltages outside of this range should be tested as a comparison.

If reset is pressed, and will be reset to its default value of 30 ns and 1 V.