

Experiment 14

Diode Reverse Recovery as Observed in SPICE

Introduction

The purpose of this experiment is to gain practical experience with the mechanics of a transient SPICE simulation. The reverse recovery transient of a diode is observed by simulation, and by laboratory experiment.

Pre-Lab

There is no pre-lab for this experiment.

Equipment Needed

- Current version of PSpice
- 1N4002 1-A 100-V Diode (or other from the series 1N4001-07)
- Oscilloscope and Function Generator

Procedure

Turn on the PC and open the current version of PSpice. All simulations will be done using a transient analysis. Use the transient voltage source VPULSE (V1=+5 V2=-5 TD=1 us TR=0 TF=0 PW=5 us) to generate a pulse voltage source which steps between the values +5 V and -5 V.

1. Do a transient simulation of the circuit of Fig. 1 using a 1N4002 diode model from the device library. Set the run time for 5 μ s. Allow the transient step ceiling (under Setup; Analysis Setup; Transient) to take its default value. (This is end time divided by 50.) Use probe to display the function generator (FG) voltage and the diode voltage on one axis, and the diode current on another. Record the resulting plot.

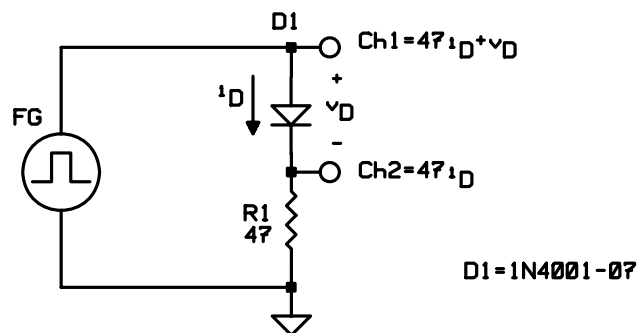


Fig. 1 Diode reverse recovery demonstration circuit.

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2. Repeat the previous simulation, changing only the transient step ceiling. Try runs with step size ceilings of 2 ns and 0.2 ns. Record one of these runs, and observe the difference in run time needed, and the appearance of the simulation results.
3. Connect the circuit of Fig. 1. Set the function generator to produce a 5-V 100-kHz square wave. Use the oscilloscope to verify that the FG is producing the expected output voltage waveform in the circuit. Connect channels 1 and 2 as indicated: the ground clips of the two scope input cables both go to the grounded node in Fig. 1. With the oscilloscope set to display channels 1 and 2, you can observe the diode current and the FG output voltage together. Record these waveforms.
4. Use the input menu for channel 1 to remove this waveform from the display. Then use the waveform math menu to display in its place (Ch 1-Ch 2). This is the diode voltage. Record the display showing the diode voltage/current pair.

Report

No formal report is required for this experiment. Simply summarize the results you have obtained in a homework format. Briefly answer the following questions:

1. Several simulation runs were made using SPICE (for several different transient step size ceilings). Were there any significant differences among the results obtained, or among the run times needed to complete the simulations?
2. Compare the simulated waveforms with the experimental waveforms. Compare both the voltage and current levels.
3. The diode is supposed to block the flow of current in the reverse direction. Did that happen at all times in this experiment? Write a one paragraph explanation of why the diode exhibits this reverse-recovery phenomenon (consult an electronics text).