Pulse and Exponential Waveforms in PSPICE

In this tutorial, we will describe the use of the pulse and exponential waveforms as voltage sources in PSPICE. In previous tutorials we have described the DC voltage source, VDC, and the sinusoidal voltage source, VSIN. In each case we will want to observe voltages and/or currents as a function of time. Thus, the Transient Analysis will be used.

Pulse Waveform

A voltage pulse or pulse train can be applied as an independent source in PSPICE using the VPULSE element. VPULSE has seven parameters that describe its shape as shown in figure 1.

As an example we will simulate the simple RL circuit shown in figure 2 below. Note that the voltage input is a single 1-volt pulse that is 1 second in duration.

Figure 1. Parameters of VPULSE

Figure 2. Circuit with Pulse Input
The PSPICE schematic for this circuit is shown in figure 3.

![PSPICE Schematic](image)

Figure 3. PSPICE Schematic

Note that the pulse parameters are set to be:

- **TD** = 0 (no delay, start the pulse train at t = 0)
- **TR** = **TF** = 1E-9 (10⁻⁹ makes the rise and fall times almost zero)
- **V1** = 0 (pulse starts at zero)
- **V2** = 1 (rises to one volt)
- **PW** = 1 (pulse width is 1 second)
- **PER** = 10 (the pulse will repeat every 10 seconds)

The transient analysis is set to run for 10 seconds and the initial inductor current is set to zero. Note that even though the pulse repeats in 10 seconds, the analysis ends before this repeat occurs. Thus, we are effectively simulating a single pulse input. The results of the analysis showing the input pulse voltage and the inductor current are shown in figure 4.

![Input and Output of RL Circuit with Pulse Input](image)

Figure 4. Input and Output of RL Circuit with Pulse Input
**Exponential Waveform**

A voltage pulse or pulse train can be applied as an independent source in PSPICE using VEXP. The VEXP voltage source generates a waveform as shown in figure 5, where TC1 and TC2 are the time constants of the rising and falling exponentials, respectively.

![Figure 5. VEXP Model](image)

The RL circuit shown above is modified to have an exponential input as shown in figure 6.

![Figure 6. PSPICE Schematic with VEXP source](image)

In this example we want to model a decaying exponential with a time constant of 1 second and an initial value of 1 volt. In order to eliminate the rising portion of the VEXP waveform we have set TD1, TD2 and TC1 equal to 1E-9. The resulting input exponential waveform and inductor current found in the simulation are shown in figure 7.
Figure 7. Input and Output of RL Circuit with Exponential Source

Note that the pulse and exponential are also available as independent current sources using IPULSE and IEXP respectively.