

QSPICE How 2's



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QSPICE: How 2 use PWL sources

Abstract

This tutorial provides a comprehensive guide on how to use PWL sources in QSPICE and why you should use them.

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1 Introduction

There are multiple sources in QSPICE; however, the PWL is one of the sources that offers the most control. This is extremely useful when working with very complex models, as some models tend to reduce the timestep too much in an attempt to maintain accuracy, causing their mathematical models to choke.

2 Definition and use

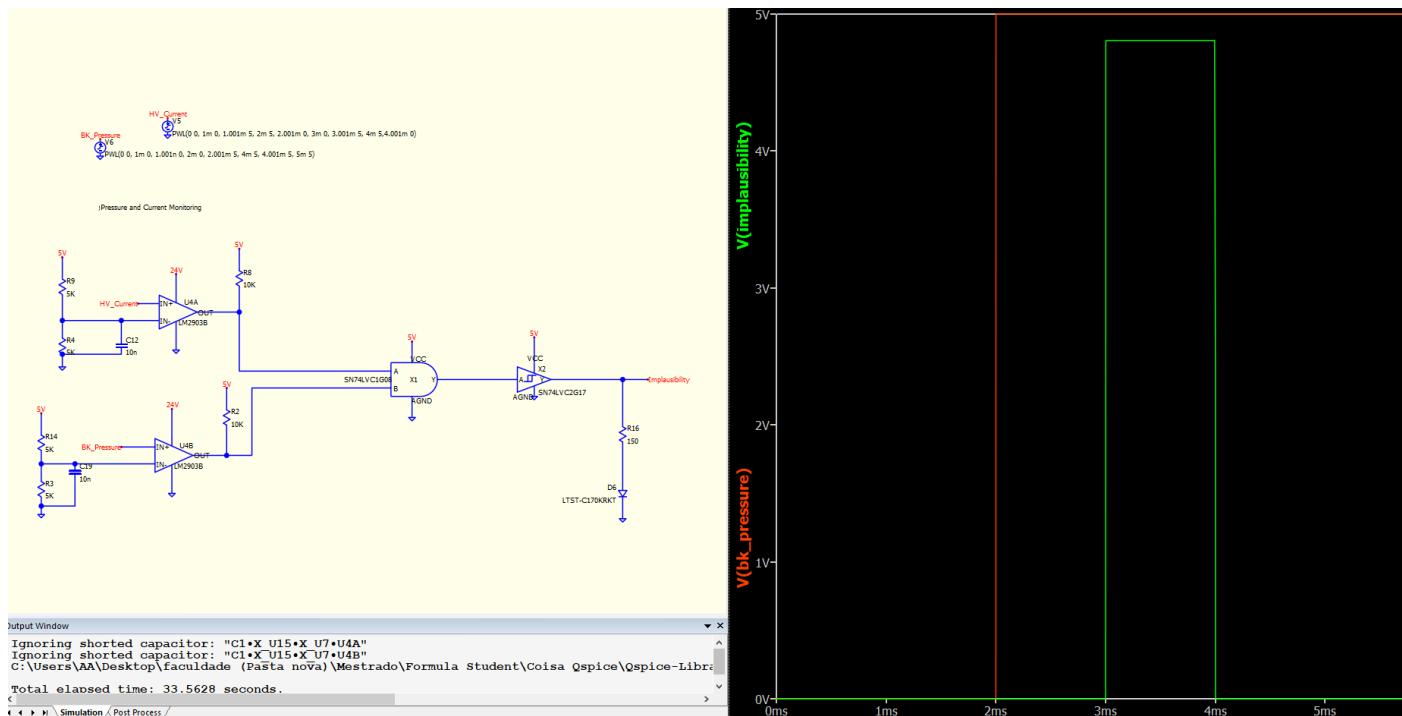
PWL (Piecewise Linear) sources are defined using a sequence of pairs. Each pair represents a specific point in the simulation timeline, and the simulator draws a straight line between them.

Taking a example, the command `PWL(0 0, 0.1ms 0, 0.101ms 3.3, 2ms 3.3, 2.001ms 0)` can be broken down as follows:

- **(0 0):** The initial state. At $t = 0$, the voltage is 0 V.
- **(0.1ms 0):** The wait period. The signal stays at 0 V until $t = 0.1$ ms, defining the start of the event.
- **(0.101ms 3.3):** The Rise Time. In exactly 1 μ s, the voltage ramps up to 3.3 V. This finite slope is what prevents the solver from "choking."
- **(2ms 3.3):** The Pulse Width. The signal remains constant at 3.3 V for the duration of the activity.
- **(2.001ms 0):** The Fall Time. The signal ramps back down to 0 V over another 1 μ s buffer.

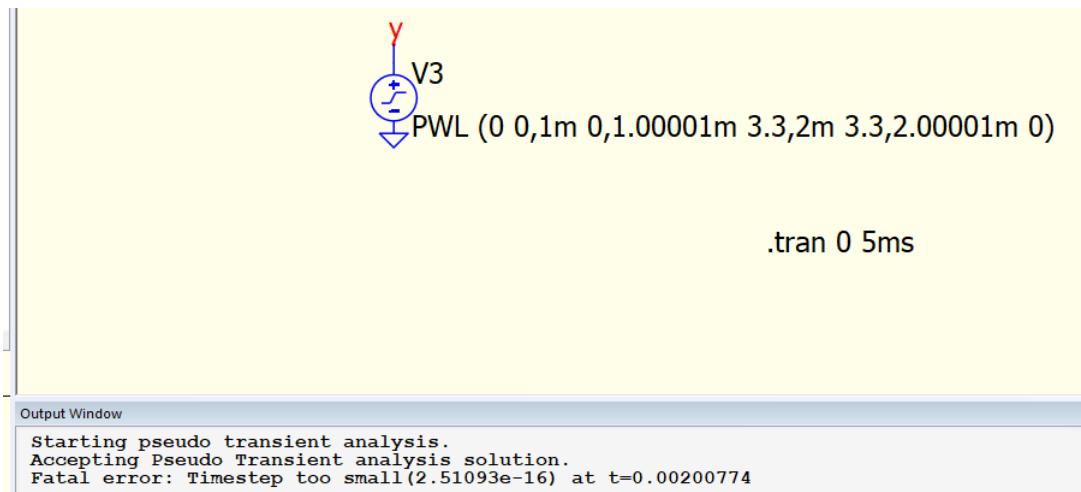
3 Example

Now suppose this example circuit, even using the LM2903B that is a very complex model, the simulation time was only 30 seconds.



4 What not do with PWL sources

When using PWL sources it is important to avoid steep transition steps, the slower the transitions the faster the simulation will be, as in some extreme cases you can go pass the lowest time step QSPICE allows as shown in the following image.



The scale of the simulation time significantly impacts convergence stability. For instance, if the simulation was performed in the nanosecond range, the transition times would need to be relatively longer than the minimum possible step to allow the mathematical engine to calculate the intermediate points.