DC Offset Issue in Channel Transient Simulation Using Cadence

For the course projects you may need to import the s-parameter characterization of some channels (e.g. B1, C4, T20) in Cadence. The channel test setup using s4p import block in Cadence is shown in Figure 1.

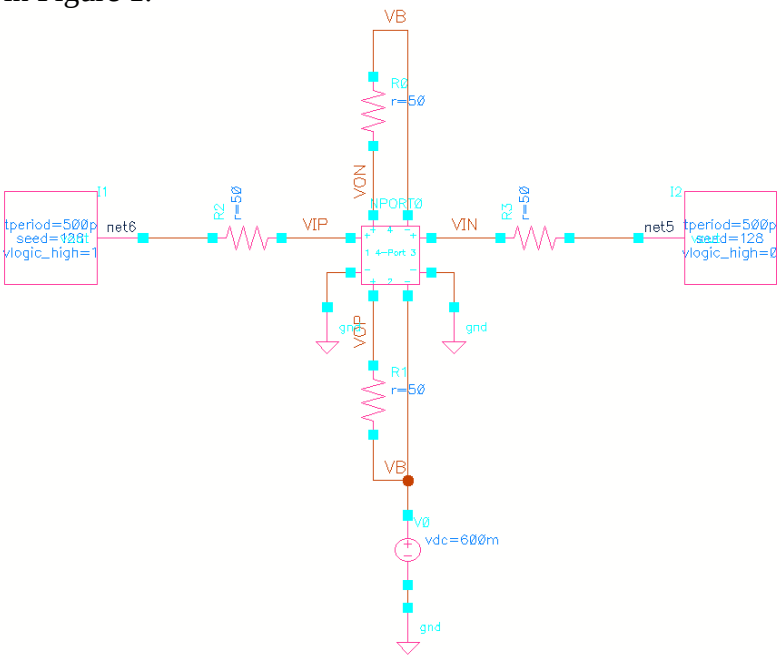

Figure 1 Simplified channel transient test setup in Cadence

The two single-ended transient signals at the output of channel T20 (20” Backplane) are shown in Figure 2 for a 2Gb/s PRBS input. The DC levels of both output signals are not equal to 600mV, which is the expected value based on Figure 1.

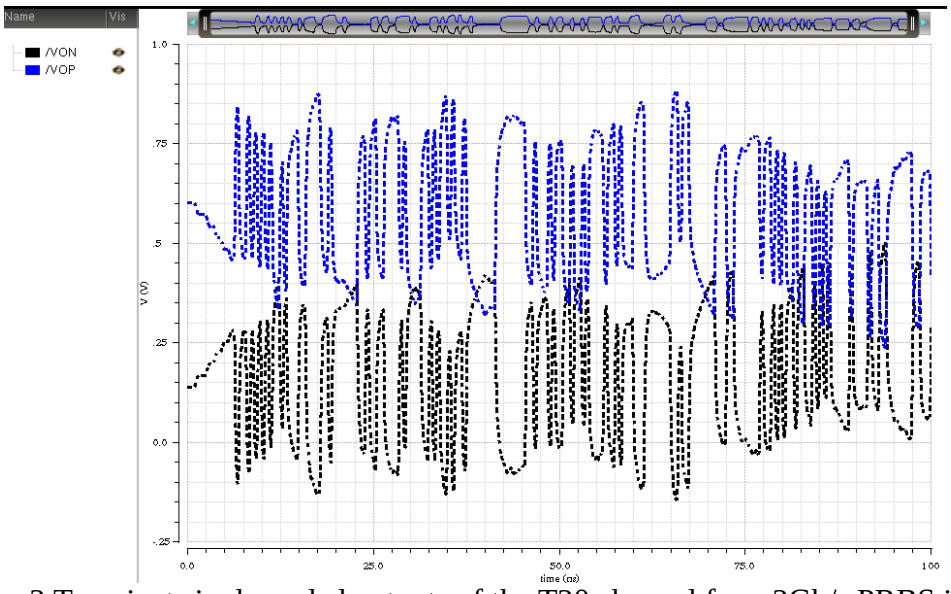

Figure 2 Transient single-ended outputs of the T20 channel for a 2Gb/s PRBS input

This issue may arise from the fact that s-parameter file (s4p) for the T20 channel (or other channels such as B1 and C4) does not include any information at DC (0 Hz). One possible way to resolve this issue for transient simulation purposes is using a large AC coupling capacitor at the output of the channel as shown in Figure 3. A large enough capacitor (e.g., 1mF in Figure 3) should be used to pass the data in the desired frequency range without any attenuation.

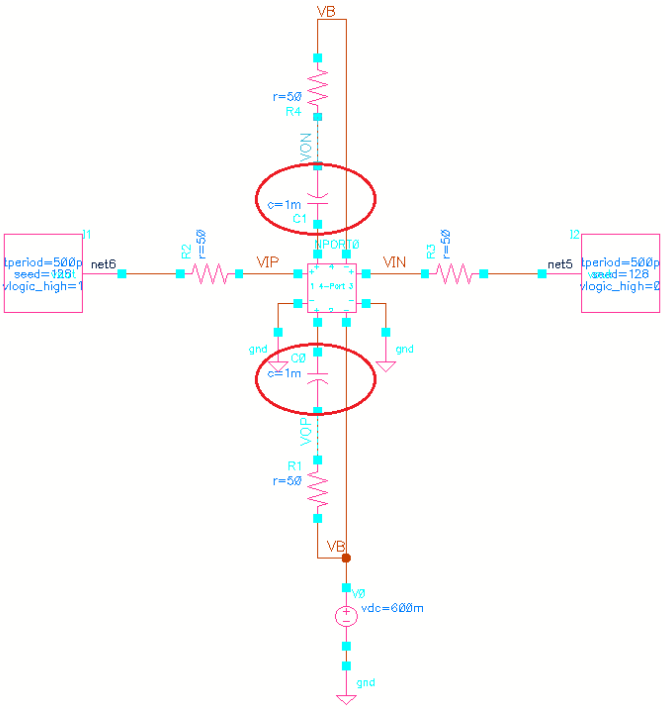

Figure 3 Test setup in Cadence using AC-coupling capacitors to resolve the DC offset issue

The transient output waveforms after the T20 channel is shown in Figure 4 after using the AC coupling capacitors. As expected, the output DC level of both signals is equal to 600mV.

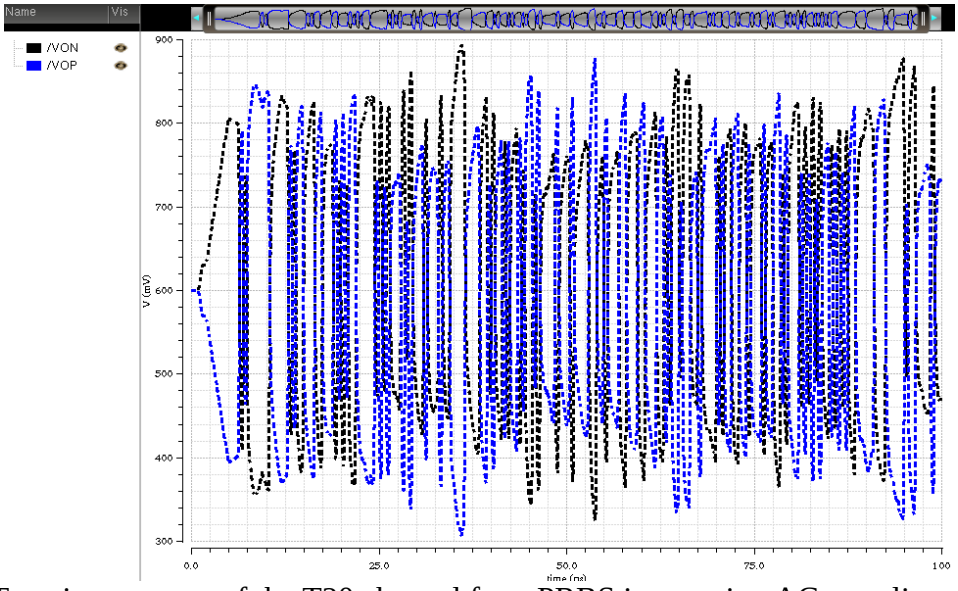

Figure 4 Transient outputs of the T20 channel for a PRBS input using AC-coupling capacitors

A more elegant solution is to extrapolate the missing DC information from the rest of the data in s-parameter file. This can be accomplished in Cadence using the "nport" cell in "analogLib" library as shown in Figure 5.

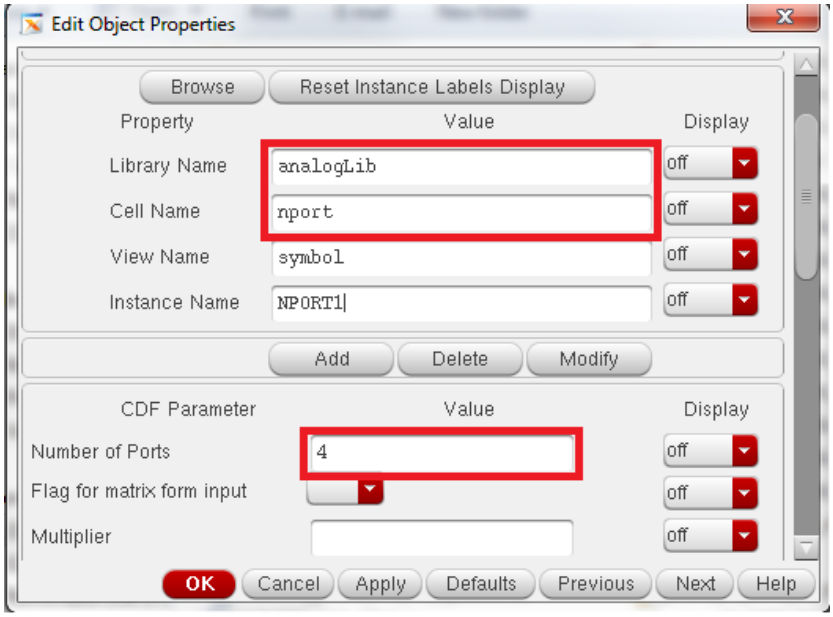

Figure 5 Use "nport" cell with 4 ports to import the touchstone s4p file in Cadence

In order to extrapolate the most optimum DC information, set the "DC extrapolation" parameter to "unwrap" in nport Properties window as shown in Figure 6.

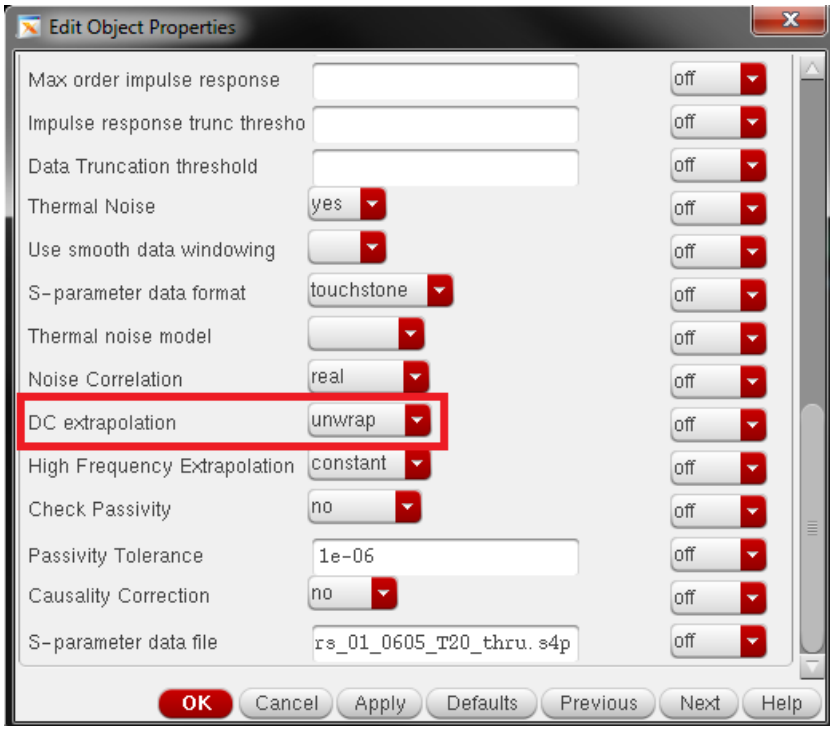

Figure 6 Set "DC extrapolation" parameter to "unwrap" in nport cell properties window

The new test setup with the channel DC coupled to the 100Ω differential resistor at the output is shown in Figure 7.

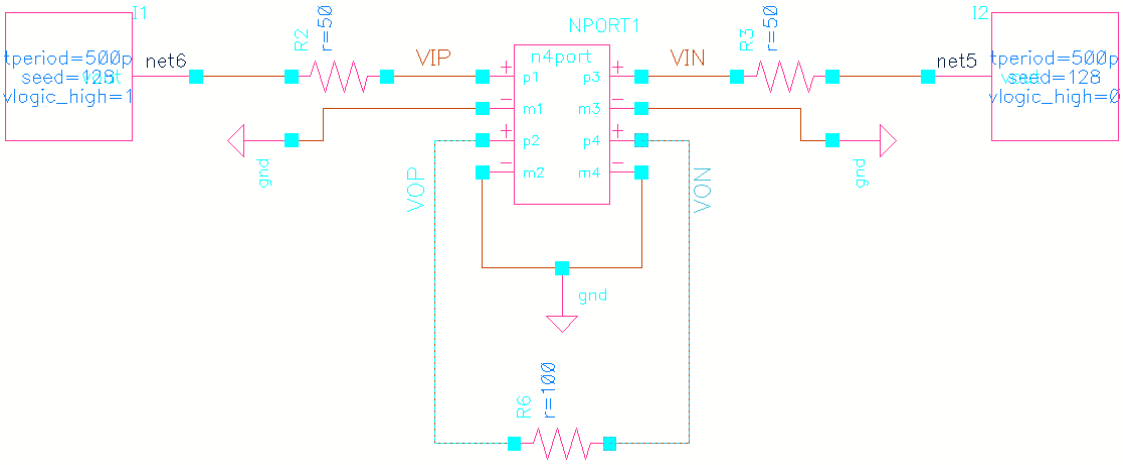

Figure 7 Test setup in Cadence using nport cell to resolve the DC offset issue

The transient output waveforms for the above test setup after the T20 channel is shown in Figure 8. The DC offset issue is obviously resolved.

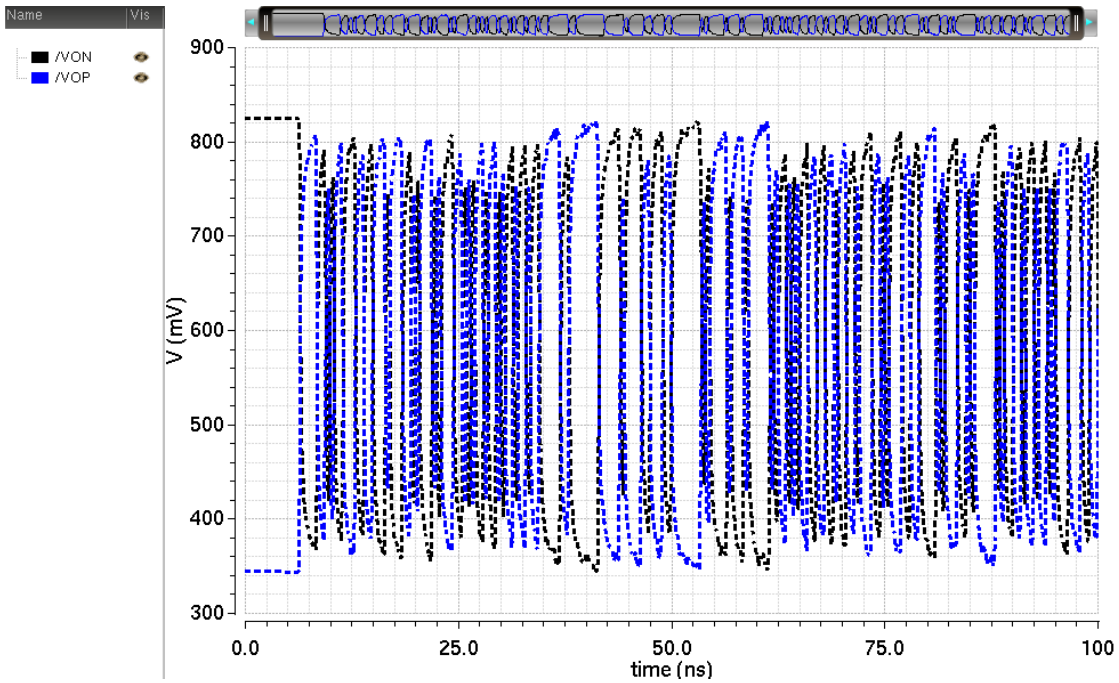

Figure 8 Transient outputs of the T20 channel using nport cell with DC extrapolation