Tutorial 5
Power Measurement

In this tutorial, we will use a simple CMOS inverter to demonstrate how to measure circuit power dissipation.

Waveform Calculator Tutorial

Waveform calculator can be used to perform many different measurements and transformations on the waveforms displayed in the waveform window. This includes – computing the average of a waveform (e.g. power) over the entire length of the simulation or in a given period of time, finding the propagation delay of between input and output signals, or addition/subtraction/multiplication/division of waveforms, etc.

In this tutorial, we will compute the average power consumed in a circuit during time 0 to 20ns. To do this, make sure that before simulation you select the Outputs > Save All > power (all) option in the ADE window. Then simulate the circuit as usual, with simulation time more than 20ns.
The picture below shows the “:pwr” (the instantaneous power consumed by the whole circuit) and “Din” and “Qout” signals from an inverter simulations displayed in the waveform window.

Note, the waveforms are selected for displaying using the Result Browser tool.

From Virtuoso Analog Design Environment, click **Tools ➤ Results Browser**…
Double click **tran-tran**, you will see signal list as below. Then double click: **pwr, Din** and **Qout**. Signal waveforms will be displayed.

To invoke the calculator tool, click on its icon in the waveform display window. The icon is located right below the “Marker” pull-down menu.

The calculator window shown below appears. Make sure the “**Wave**” and “**Clip**” are selected.
Now switch back to the waveform window and left click the mouse once on the power waveform. Then switch back to the calculator window.

Next, we will choose the operation to be performed on the waveform. To get the average power between 0 and 20ns, we first clip the waveform to the time interval of interest. To do this, click on the “clip” function in the list of functions towards the bottom of the calculator. That should result in a window
Enter \textbf{From} = 0 and \textbf{To} = 20n in the fields. Then click on apply. Notice that the white box is updated now with the clip function applied. Now this expression needs to be evaluated/plotted. To do so, click on \textbf{Tools} > \textbf{Plot} in the calculator window. Switch back to the waveform window. Now there is the clipped waveform in a new sub window,
We now need to compute the average of this waveform. Switch back to the calculator window. If the clip function is still active in the bottom of the calculator, click on quit. The white box in the calculator should now read like

```plaintext
clip(getData("pwr" ?result "tran-tran") 0 20n )
```

Select the `average` function from the list of functions in the calculator. Then click on Tools > Plot. This will print the average value in the white box in the calculator: 2.827507e-04 (is about 282 uW)