CND 101 - LAB [6] At home

LAB 6 AT HOME DIODE APPLICATIONS

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Section #: 16

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A- Clipper circuit

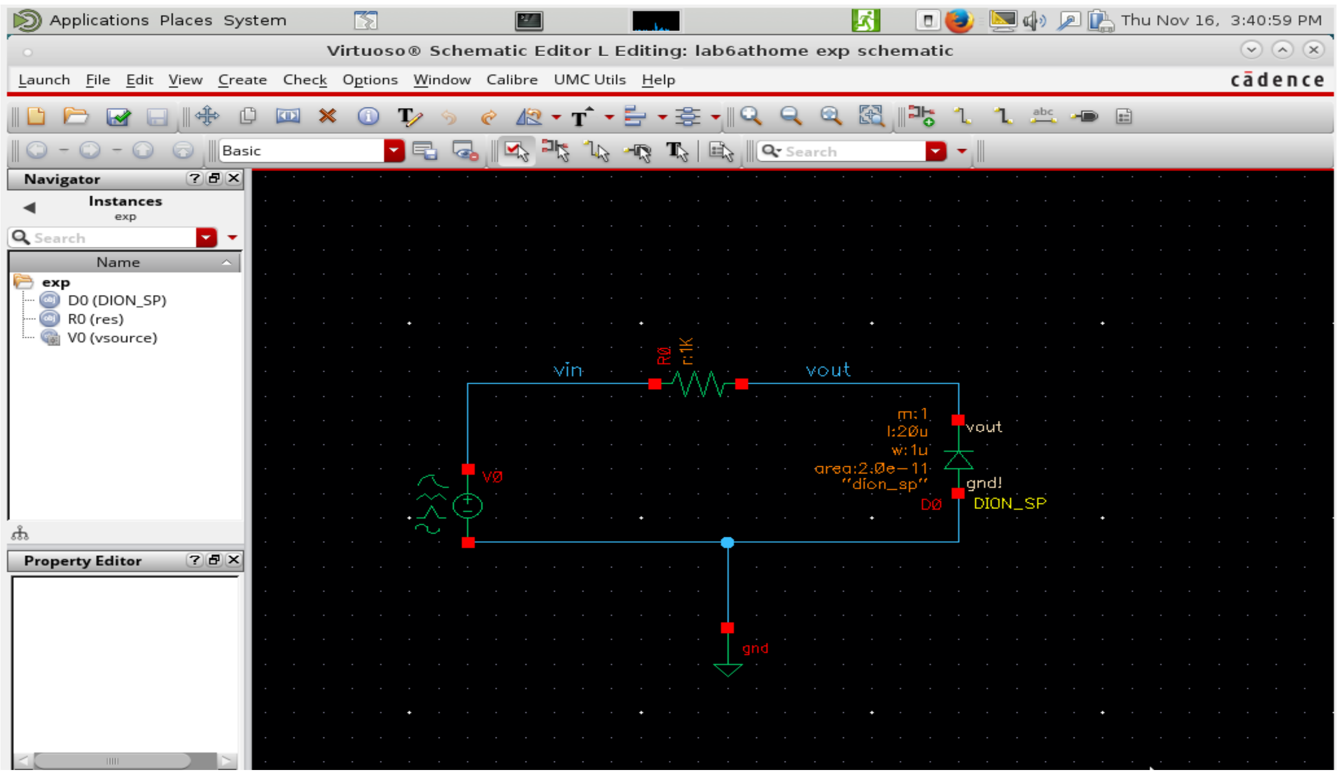

Figure 1 schematic of clipper diode circuit.

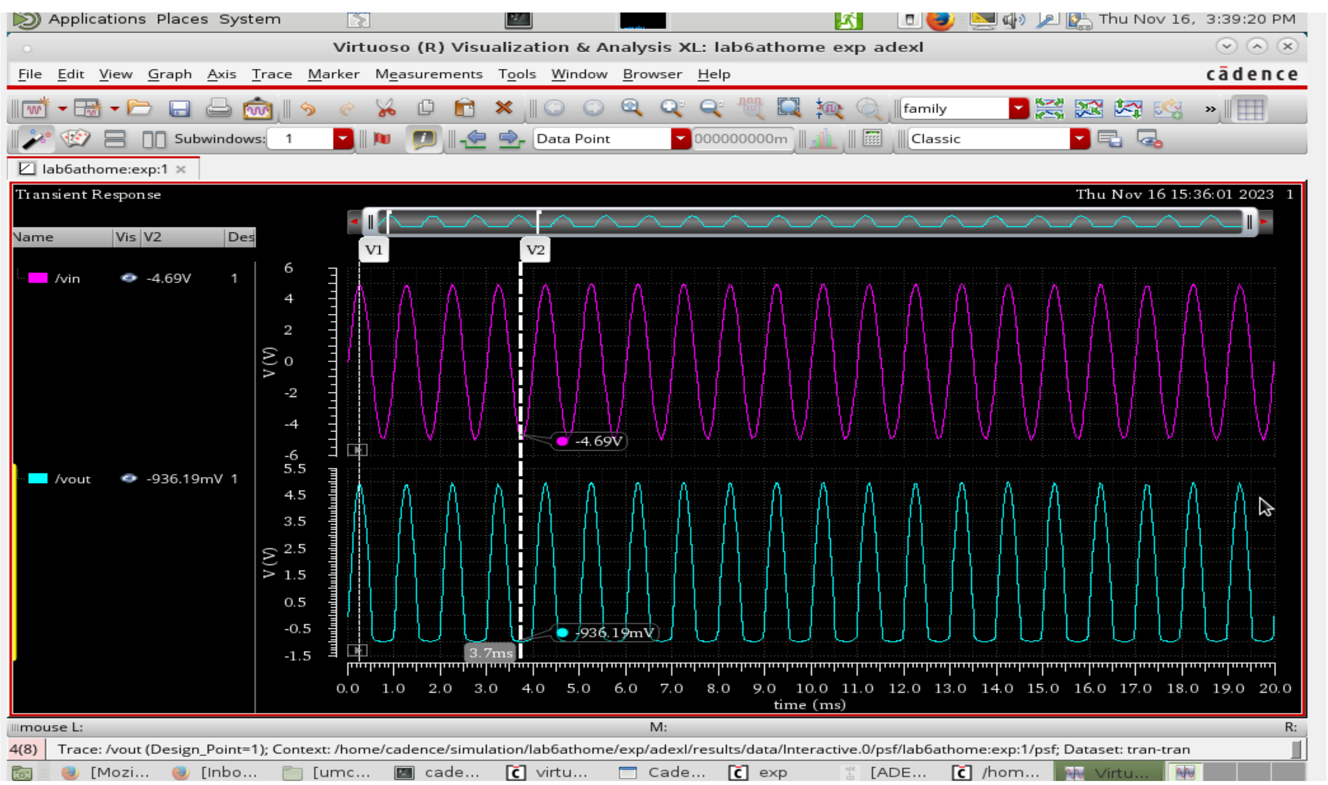

Figure 2 transient analysis of clipper diode circuit.

Comments

A clipper circuit, featuring a diode, serves as a straightforward electronic circuit designed to either clip or limit the voltage amplitude of an input signal. In Figure 1, during the application of the positive half of the wave, the diode becomes reverse-biased and functions as an open circuit. Consequently, the output voltage will mimic the input voltage in this scenario. However, in the negative half of the wave, the diode undergoes forward bias, resulting in the output voltage being equal to VD_on=0.9V, as illustrated in Figure 2.

Clipper circuit 2

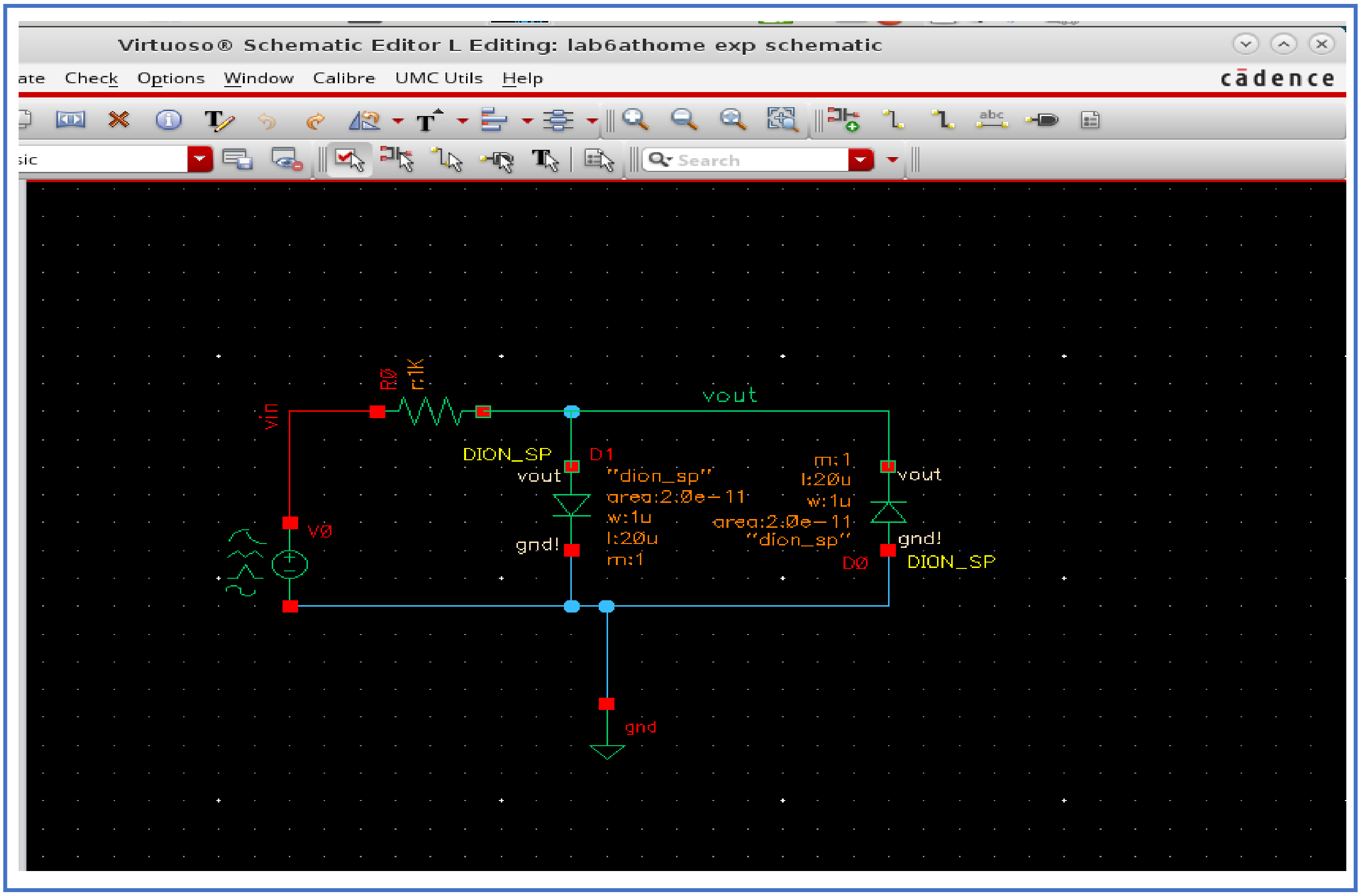

Figure 3 circuit implementation of clipper circuit using 2 diodes.

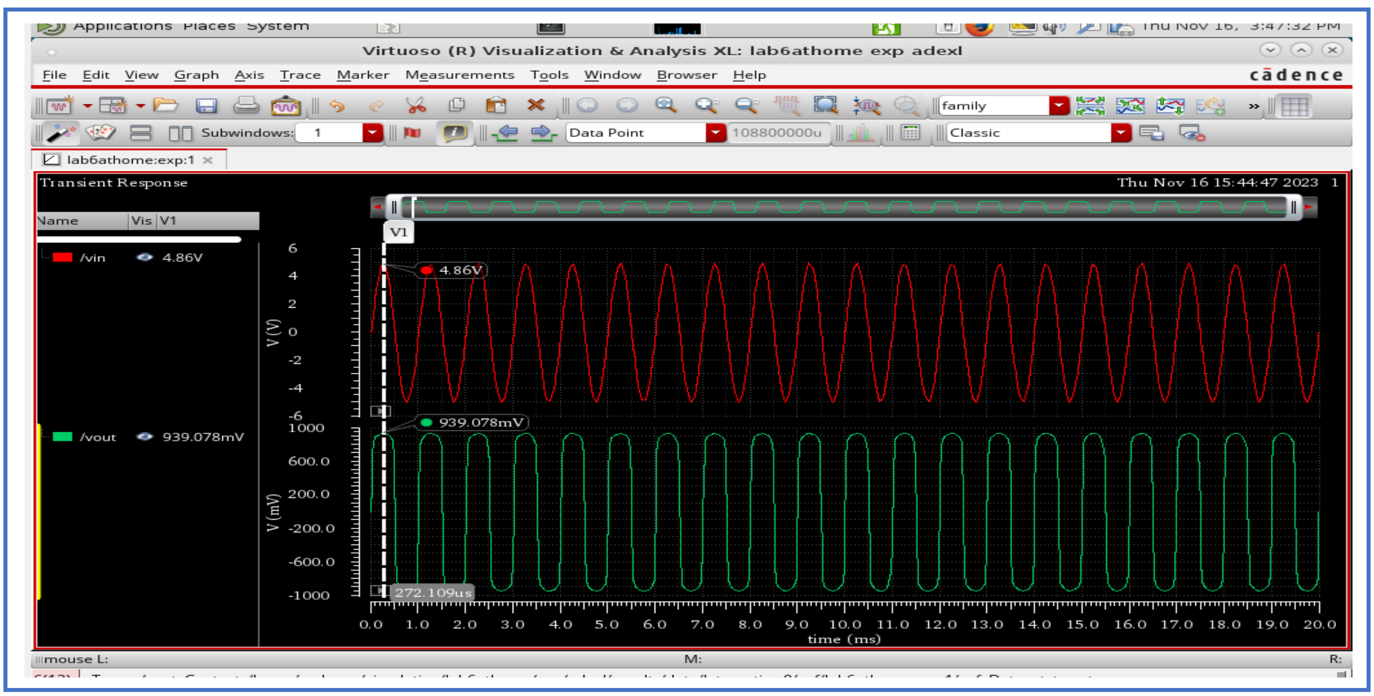

Figure 4 output from clipper circuit using 2 diodes circuit.

Comments

In Figure 3:

- Positive Half-Wave:
  - One diode is in the forward region.
  - The other diode is in the reverse region.
  - Output voltage maintains a constant value: VD_on=0.9V (Figure 4).
- Negative Half-Wave:
  - One diode is in the forward region.
  - The other diode is in the reverse region.
  - Output voltage maintains a constant value: VD_on=-0.9V.

Clipping circuit with DC voltages shift

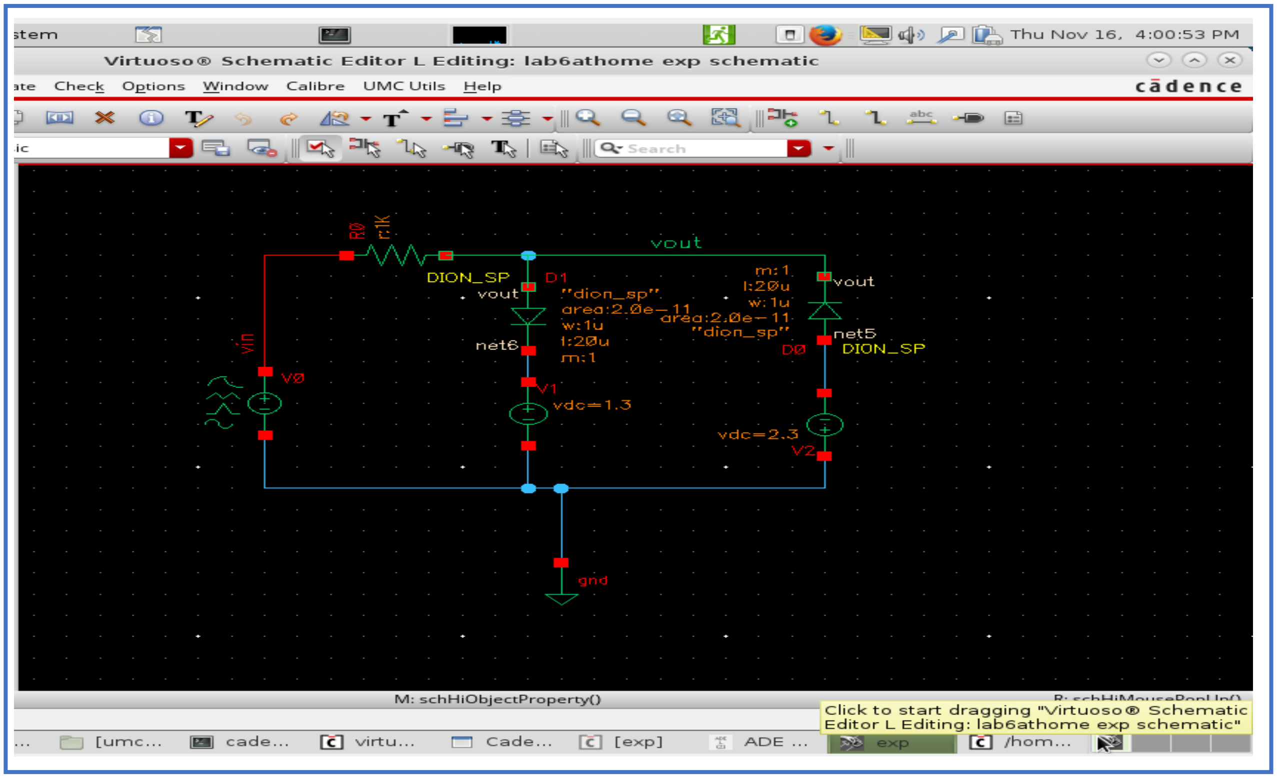

Figure 5 circuit clipper circuit with DC shift.

Figure 6 transient analysis of clipper circuit with DC shift.

Comments

In figure 5, in the +ve half of the wave one of the diode will be in the forward region and the other diode will be in the reverse region so the output voltage will have a constant value VDon=0.9v+ DC voltage shift of value 1.3v so the peak voltage will be approximately 2.2v as shown in figure 6 also in the -ve half of the wave also one of the diode will be in the forward region and the other diode will be in the reverse region so the output voltage will have a constant value VDon=-0.9v-2.3v DC voltage exists in series with the diode so the -ve peak voltage will be approximately -3.2v.

Clamper circuit

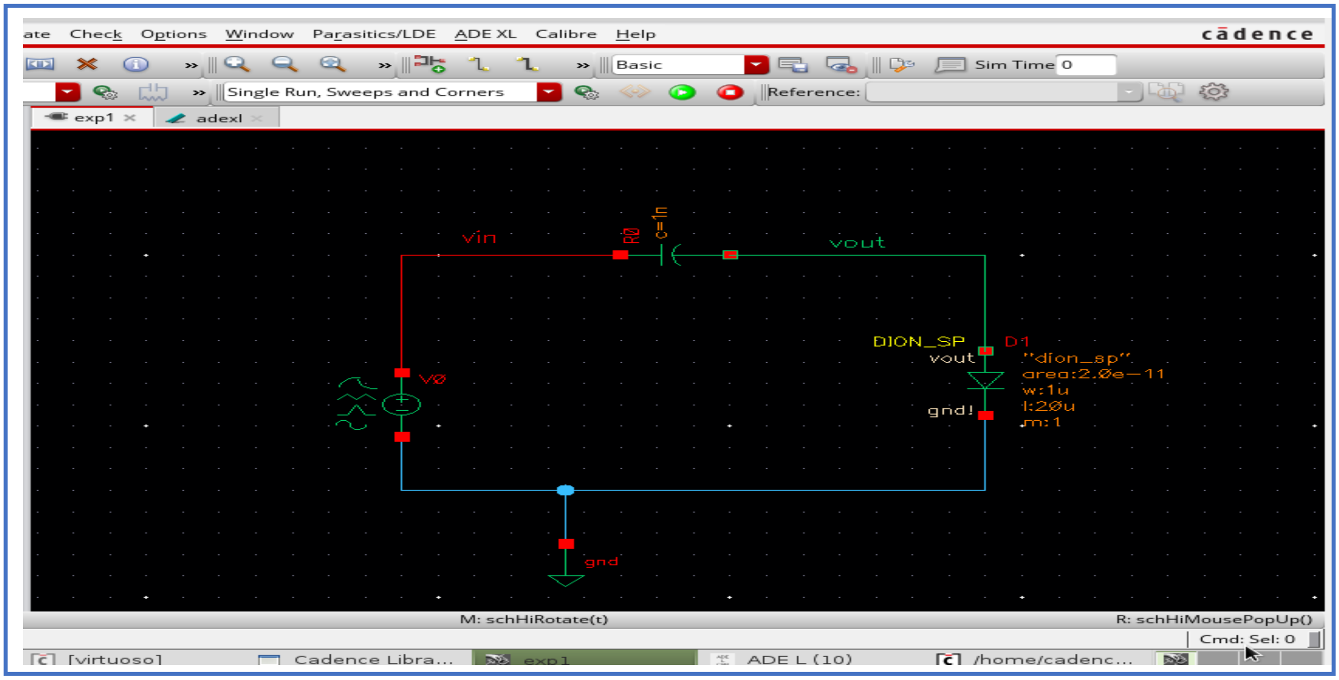

Figure 7 clamper circuit representation.

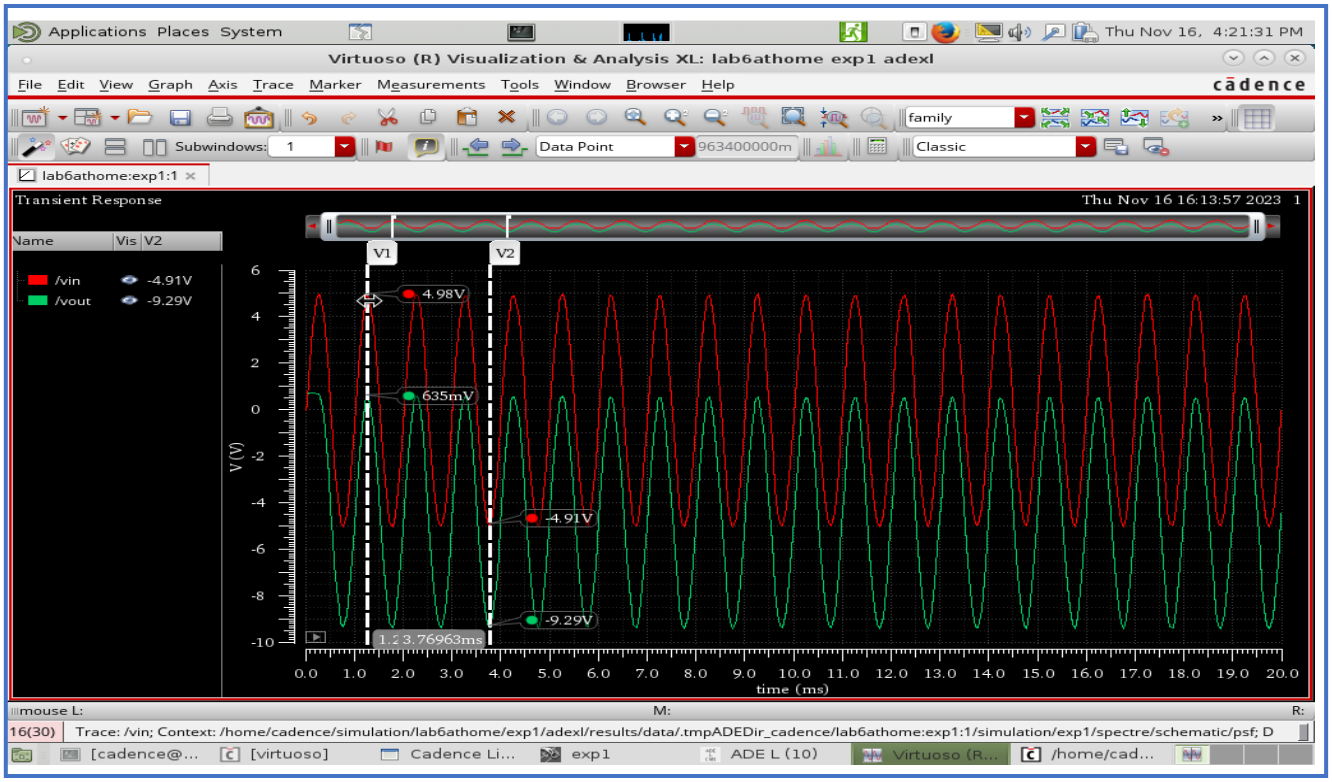

Figure 8 transient analysis of -ve clamper circuit.

Comments

A clamper circuit, also referred to as a DC restorer or level shifter, is a circuit designed to introduce a DC component to an input signal. Its primary function is to adjust the DC level of a waveform to a specified voltage. Here's an overview of its operation:

- Positive Half-Wave:
  - The diode is in the forward bias region.
  - Output voltage remains constant at VD_on (0.9V).
  - The capacitor charges, reaching a voltage drop of 4.1V (as VD_on=0.9V, and the peak input voltage is 5V).

- Negative Half-Wave:
  - The diode is in the reverse bias region.
  - The negative peak voltage of the output signal is calculated as -5V (peak input voltage) - 4.1V = -9.1V.
  - The signal is shifted downward by approximately 5V, as illustrated in Figure 8.

This circuit effectively shifts the DC level of the input waveform to the desired voltage level, providing a mechanism for level adjustment and restoration.

Clipper circuit before dc shift

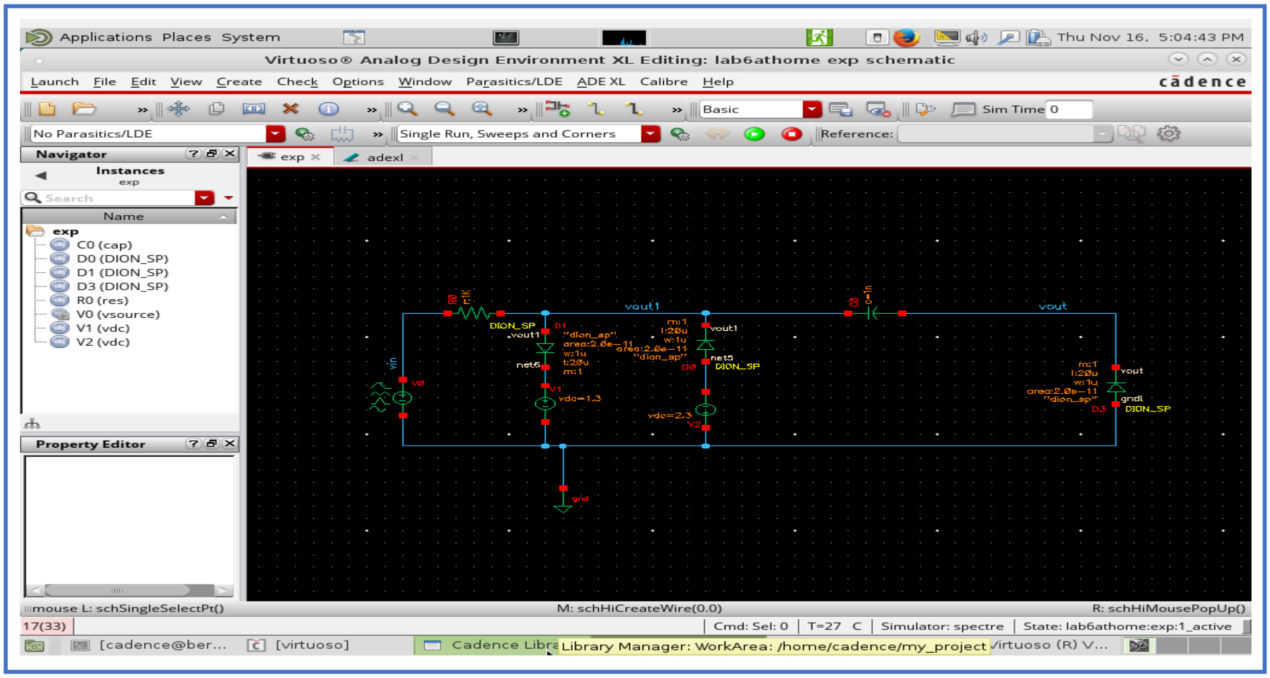

Figure 9 clipper circuit before adding DC shift.

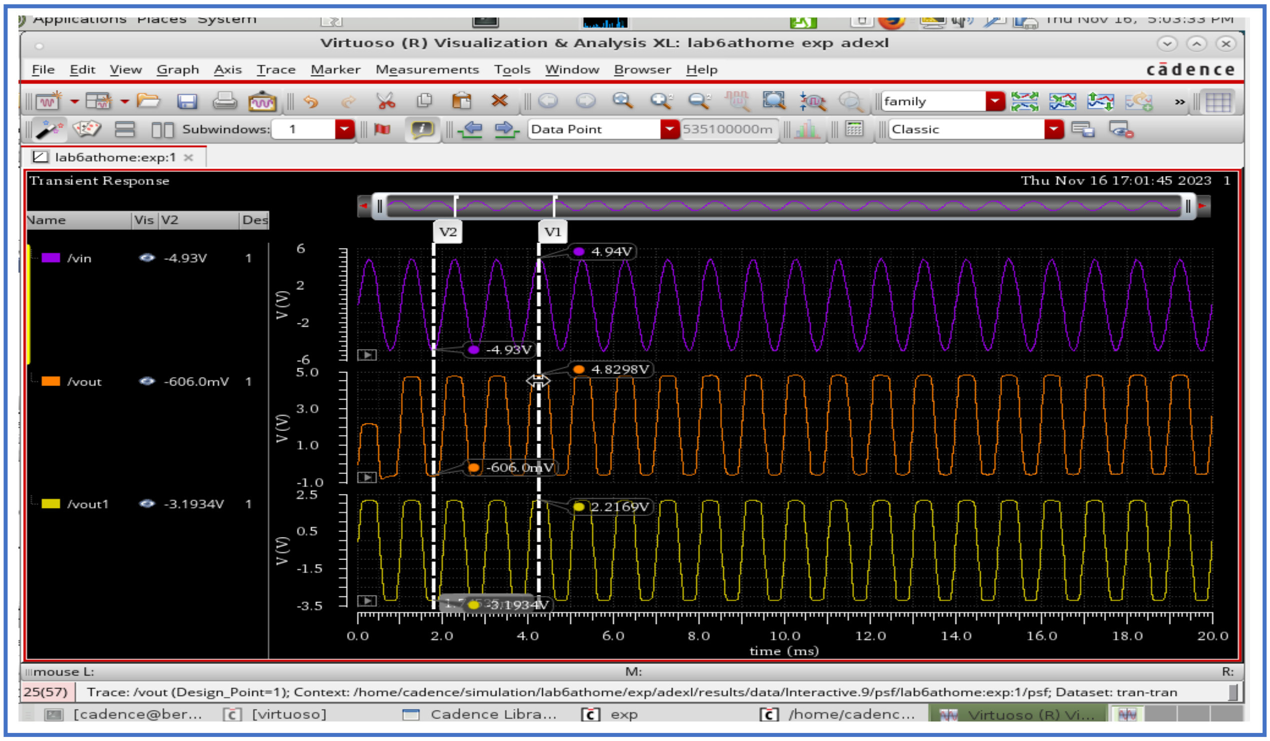

Figure 10 transient analysis of clipper circuit before adding DC shift.

Comments

Before incorporating the DC shift, the final output voltage from the clamper circuit is described in Figure 10 as having a positive peak of 4.8V and a negative peak of -3.19V. The process involves the following stages:

- Positive Half-Wave:
  - One diode is in the forward region, and the other is in the reverse region.
  - Output voltage remains constant at VD_on (0.9V) plus a DC voltage shift of 1.3V.
  - The peak voltage is approximately 2.2V (as shown in Figure 6).

- Negative Half-Wave:
  - One diode is in the forward region, and the other is in the reverse region.
  - Output voltage remains constant at VD_on (-0.9V) minus a DC voltage shift of 2.3V.
  - The negative peak voltage is approximately -3.2V.

By introducing the clamper circuit stage, the output voltage is further adjusted:

- The capacitor charges until it reaches 2.2V, effectively shifting the output voltage upward by approximately 2.2V.

Therefore, after the clamper circuit, the final output voltage is approximately 4.8V as the positive peak and -3.19V as the negative peak. Additionally, the output is shifted up by approximately 2.2V due to the capacitor charging process.

Clipper circuit with variable dc shift (to shift output by 5v)

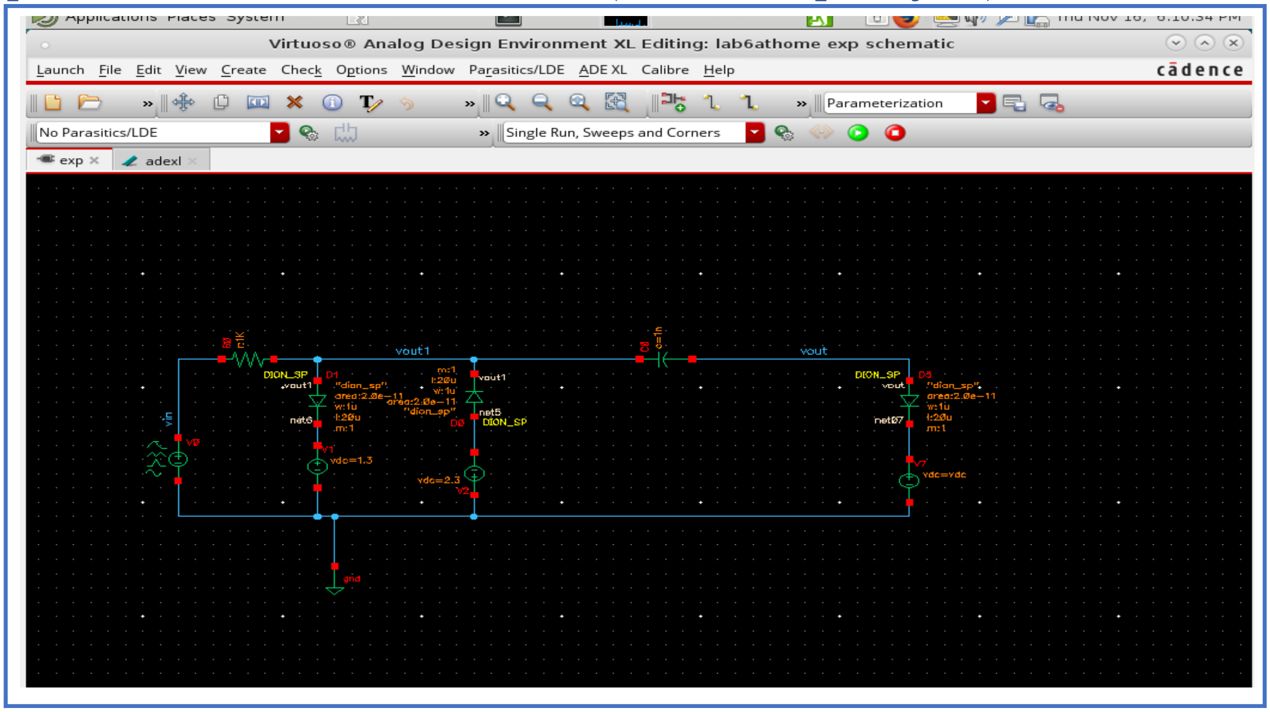

Figure 11 circuit with variable dc shift (to shift output by 5v).

Figure 12 transient analysis of circuit with variable dc shift (to shift output by 5v).

Comments

In Figure 12, the strategy to shift the output waveform by 5V involves utilizing an approximately 7V source. The resulting output voltage is measured as 7.586V for the positive peak and 2.15V for the negative peak. This approach successfully achieves the desired shift of the final output voltage by 5V, as intended.

Clipper circuit with variable dc shift (to shift output by 10v)

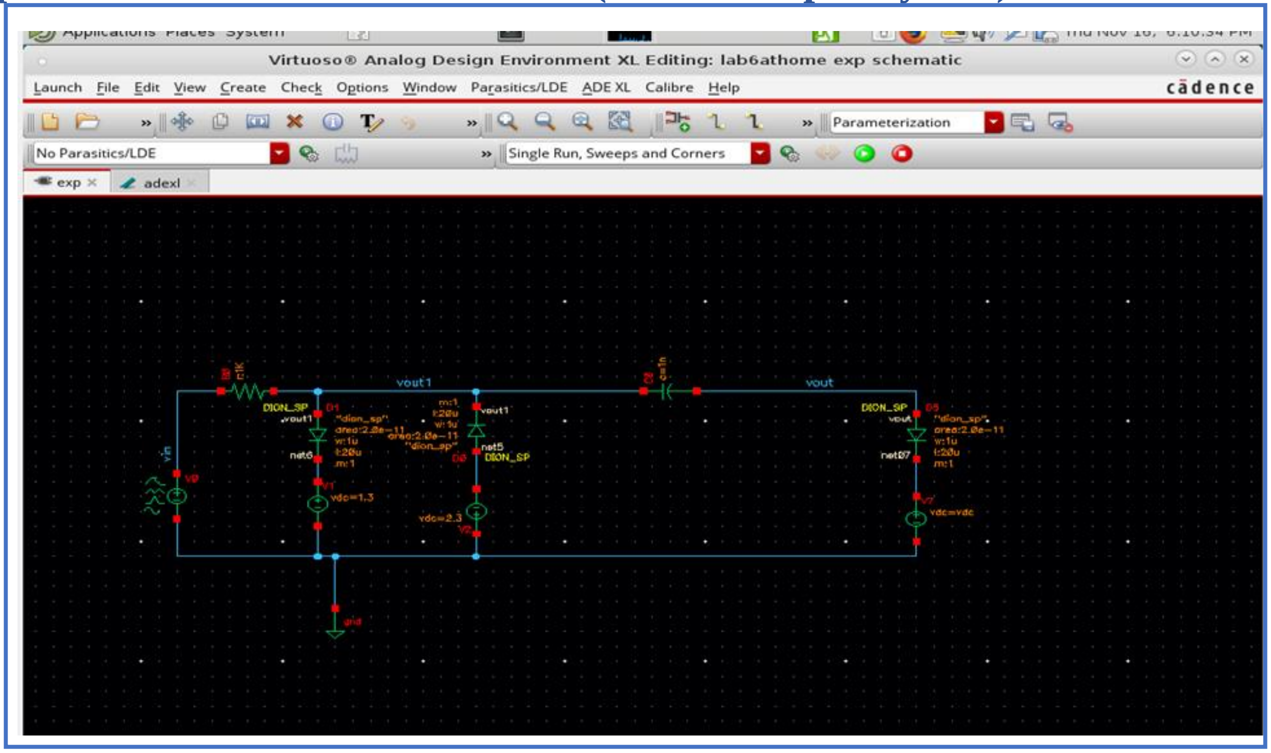

Figure 13 circuit with variable dc shift (to shift output by 10v)

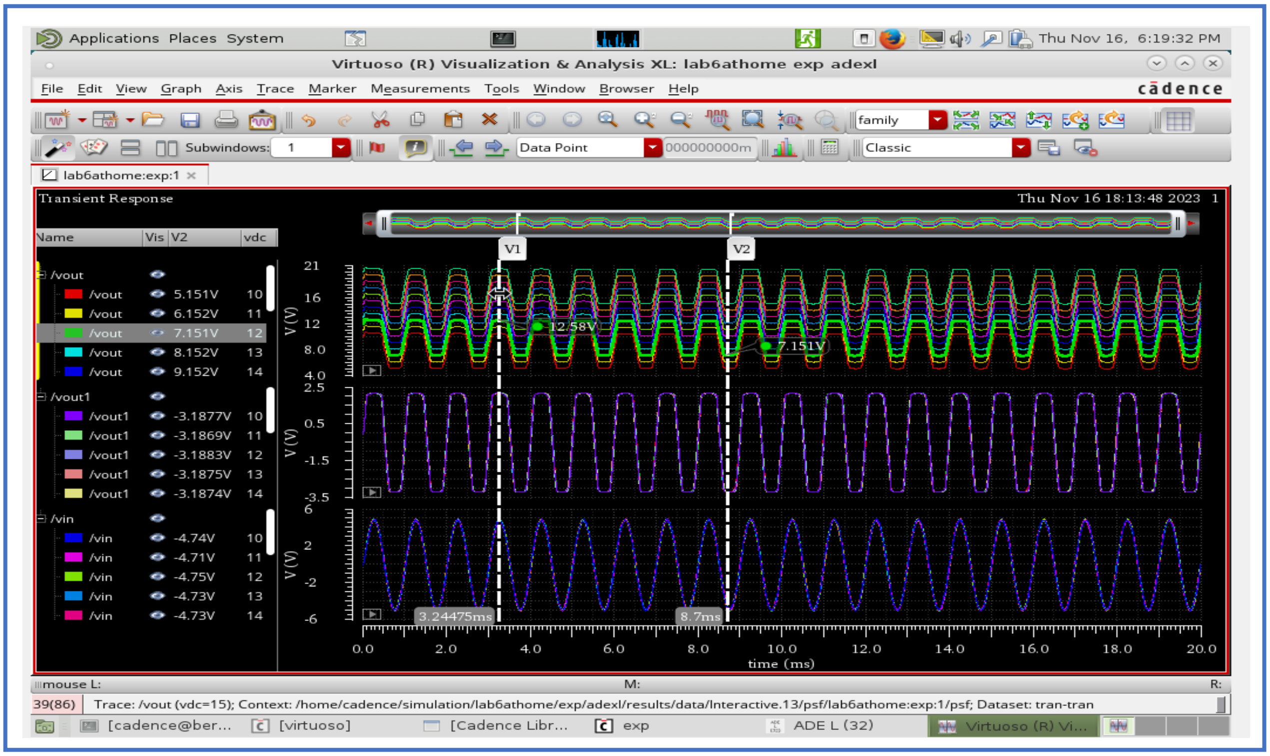

Figure 14 transient analysis of circuit with variable dc shift (to shift output by 10v).

Comments

In Figure 14, the depicted approach for shifting the output waveform by 10V involves employing an approximately 12V source. The observed output voltage is measured as 12.58V for the positive peak and 7.15V for the negative peak. This method effectively achieves the intended shift of the final output voltage by 10V.