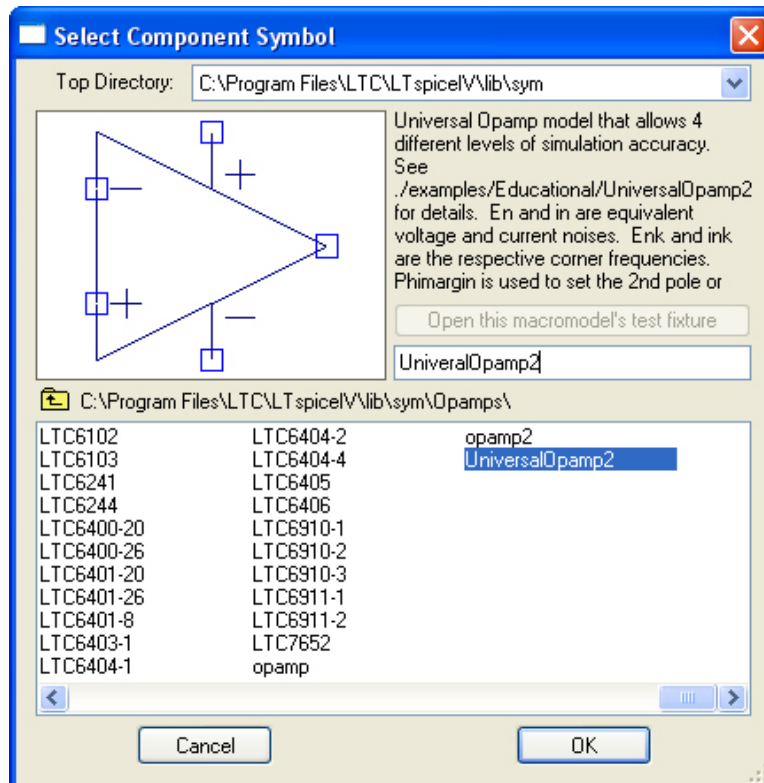
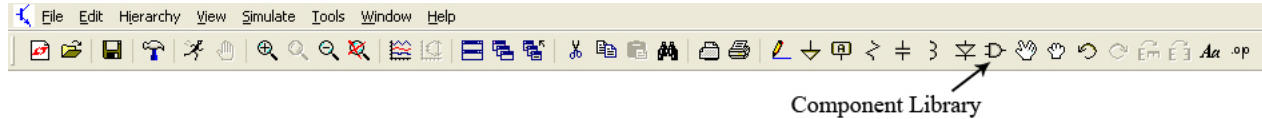
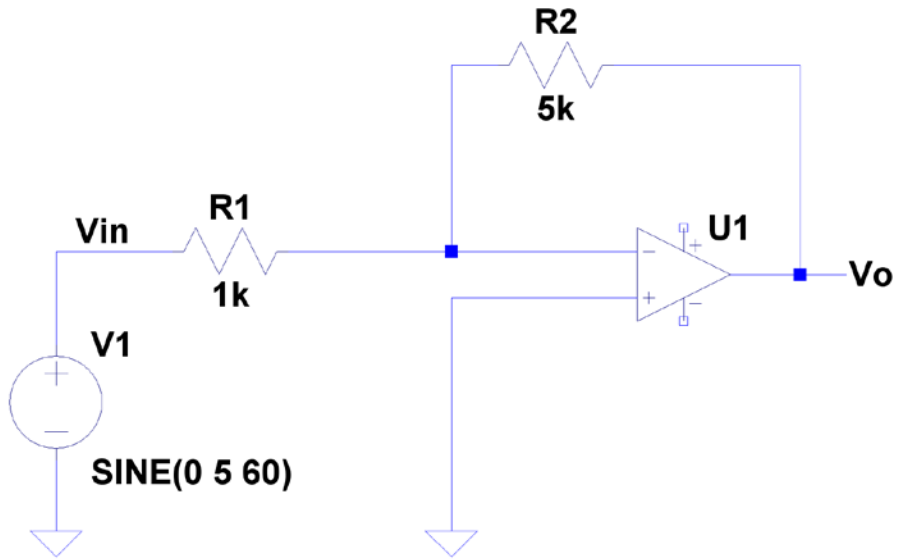


Simulating an op amp

To simulate an op amp in LTSpice, begin by opening the component library, searching for “UniversalOpamp2” and clicking ok.

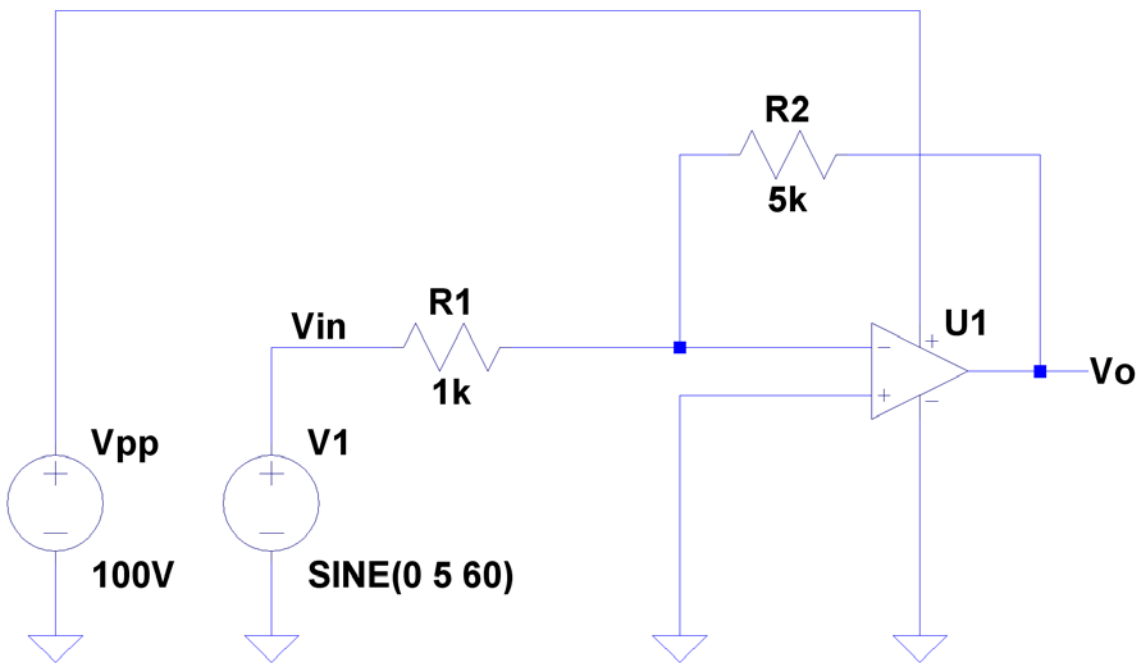


Connect the positive, negative, and output terminals of the op amp to the rest of the circuit.

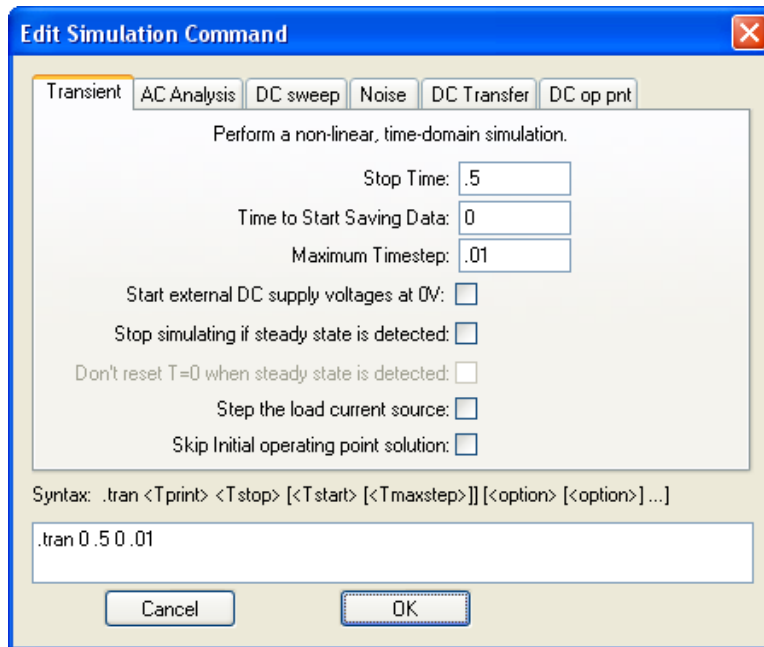
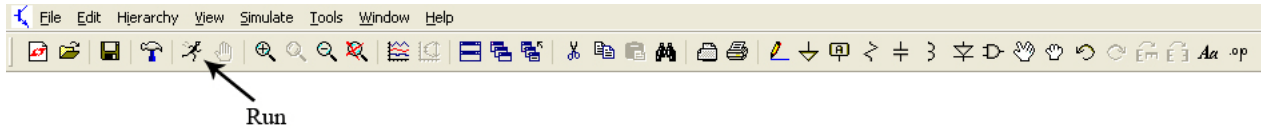


An additional step before simulating most integrated circuits (ICs) such as an op amp is to power the device. This is an important step because an op amp is only able to output a value between the ranges of voltages it is powered with. In this example the output signal should be an inverted and amplified signal to five times the size of the input waveform.

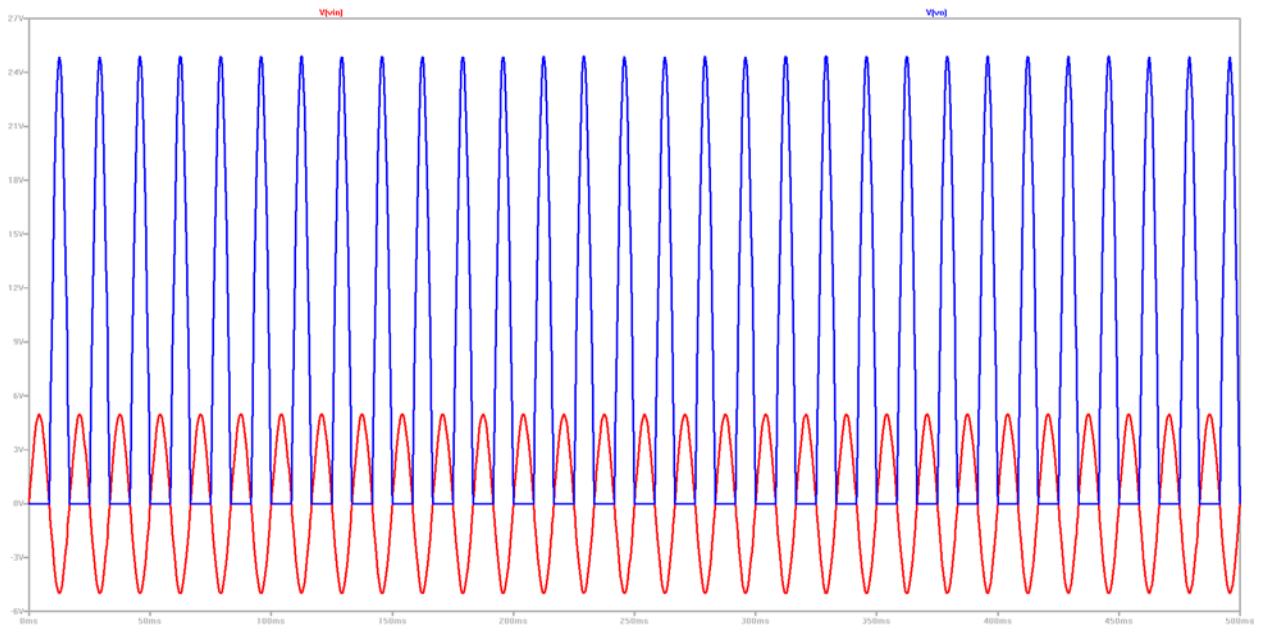
Power the positive rail of the op amp with a 100V DC source. This value can change depending on the experiment, but for this example it is assumed infinite (like an ideal op amp.) Connect the negative rail of the op amp to ground.



Click “Run,” enter the following simulation conditions for a transient analysis, and then click “OK”



Measuring the input voltage at “Vin” and the output voltage at “Vo” produces the following result:



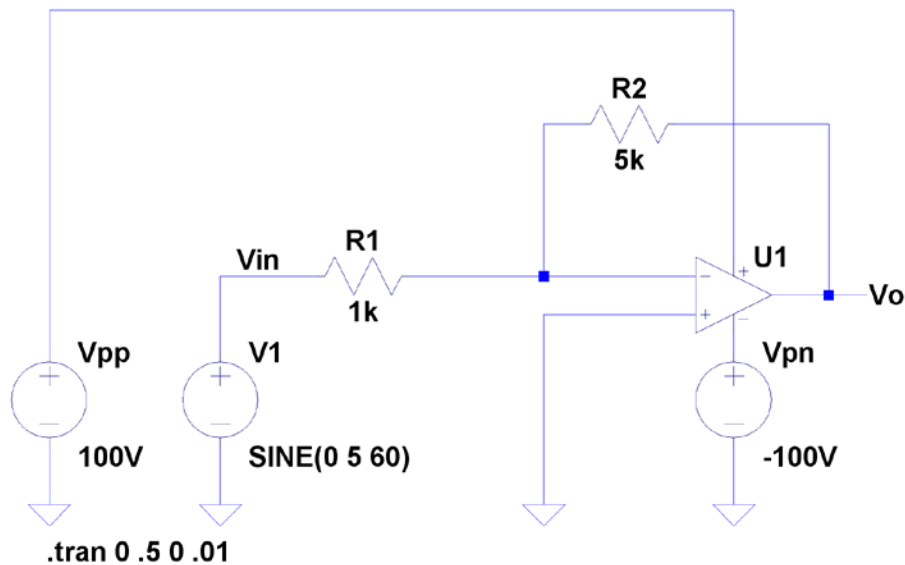
In this simulation it is clear to see that the input voltage varies between -5V and 5V as expected. The output voltage is inverted and amplified to five times the size of the input waveform, but only for half of the time. This is not the desired output waveform.

What happened was that although the op amp was able to supply +25V with an input voltage of -5V (because the positive rail of the op amp was powered with +100V) it was unable to supply -25V with an input voltage of +5V. This is because the negative rail of the op amp was connected to ground, which means that the lowest voltage this op amp can supply is 0V.

The behavior of the output waveform, which suddenly maintains a constant voltage as the result of undesired limitations is known as “clipping.” This is a common problem when dealing with op amps and can either be solved by introducing a DC offset to shift the signal up (in this case an output DC offset of +25V would be required to avoid clipping) or to change the device limitations.

In this example we will change the device limitations by powering the negative rail of the op amp with a -100V source. This will allow the output signal to vary between +100V and -100V.

Place another voltage source with the positive terminal connected to the negative rail of the op amp, the negative terminal to ground, and a value of -100V as shown below:



Re-simulate the circuit. As before measure the input voltage at “Vin” and the output voltage at “Vo.” Now the output is the desired waveform, inverted and five times larger than the input waveform as shown below:

