CET 323 LAB

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Class CET 323_01

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LAB_07

Operation Amplifiers :

Inverting Vs. Noninverting Configurations

Reading

Floyd, Electronic Devices, Ninth Edition, Chapter 12 and review Section 6-7, The Differential Amplifier.

Key Objectives

Part 2 : Construct voltage follower using 741C Op-amp, and measure Slew rate for a 741C op-amp.

Part 3 : Construct and test inverting and noninverting amplifiers using Op-amp.

Part 2 : Voltage Follower.

Voltage Follower is a special kind of simple configuration shown in Figure 12-8.

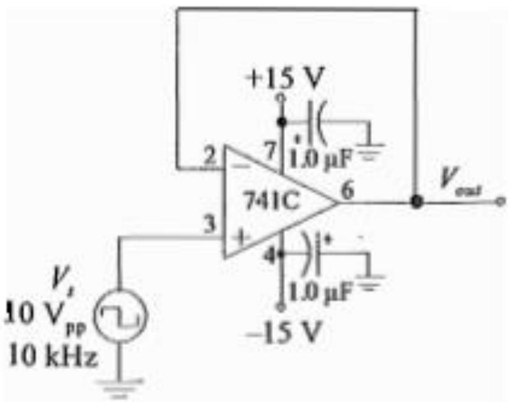


Figure 12-8 Slew-rate measurement.

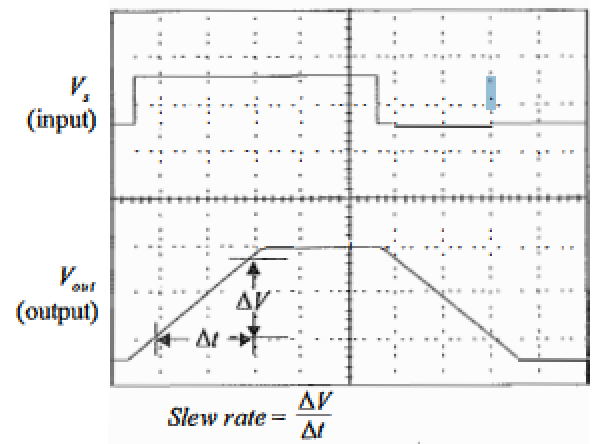
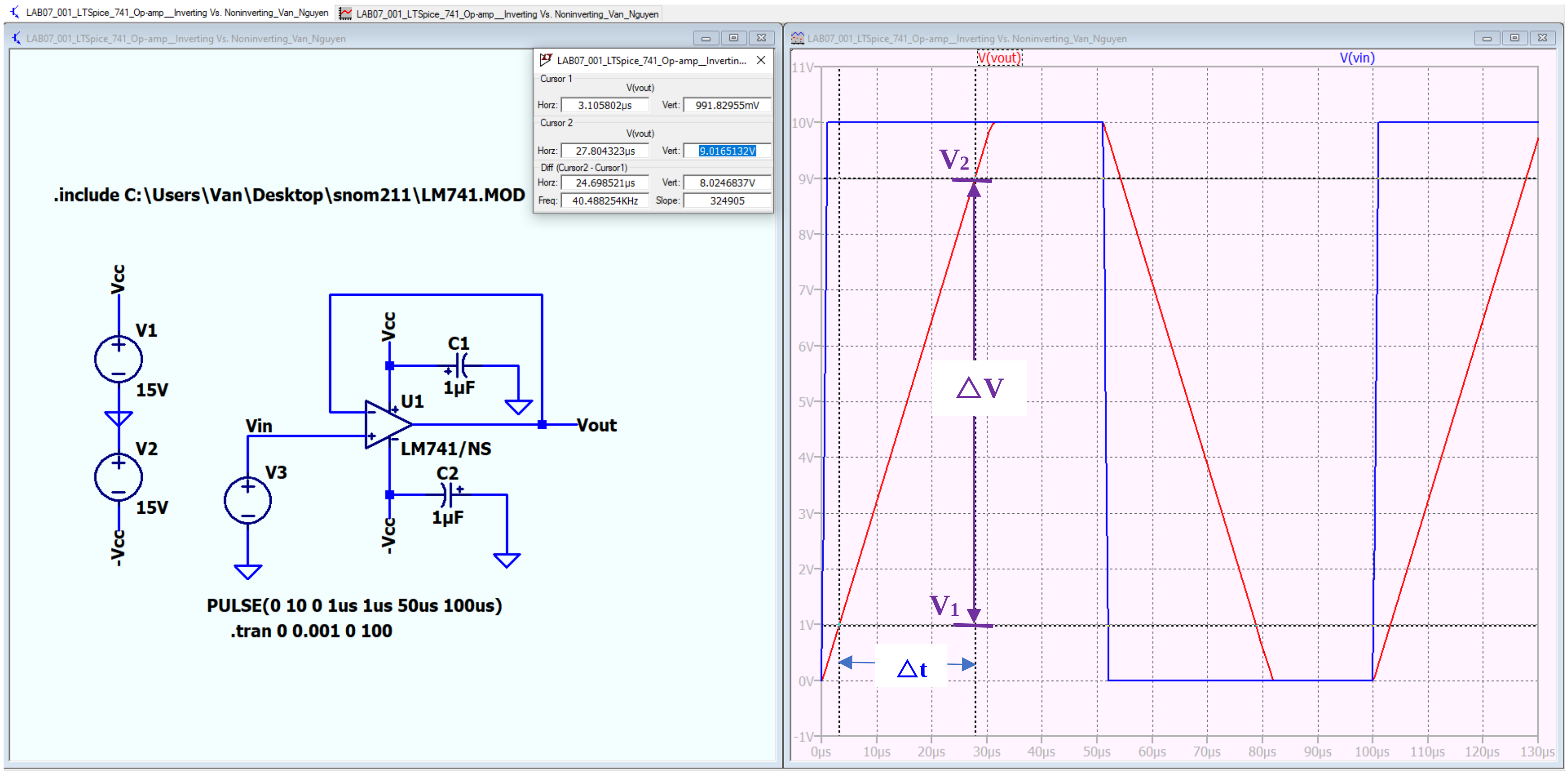


Figure 12-9

The slew rate can be measured by observing the change in voltage divided by the change in time at any two points on the rising output waveform as shown in Figure 12_9.



❖ In time at any two points on the rising output waveform and measuring them we have:

- V_2 = 9.0165 **V** and t_2 = 27.8043 **µs** (Cursor 2: Vert and Horz)
- V_1 = 999.2 mV = 0.9992 **V** and t_1 = 3.1058 **µs** (Cursor 1: Vert and Horz)

❖ We have $Slew\ rate = \frac{V_2 - V_1}{t_2 - t_1} = \frac{9.016\,5\ V - 0.999\,2\ V}{27.804\,3\ \mu s - 3.105\,8\ \mu s} = 0.324\,6\ V/\mu s$

Slew rate = 0.324 6 V/µs

Part 3: Basic Op-Amp Circuits

Inverting Amplifier.

1)- Connect the circuit shown in Figure 12-10. Set the input for a 500 mV_{pp} **SINE** wave at 1.0 kHz. Add more a resistor R_1 = 1.0 kΩ (input), and a resistor R_f = 10 kΩ (feedback) as Figure 12_10. Compute and Record the measured Table 12_9.

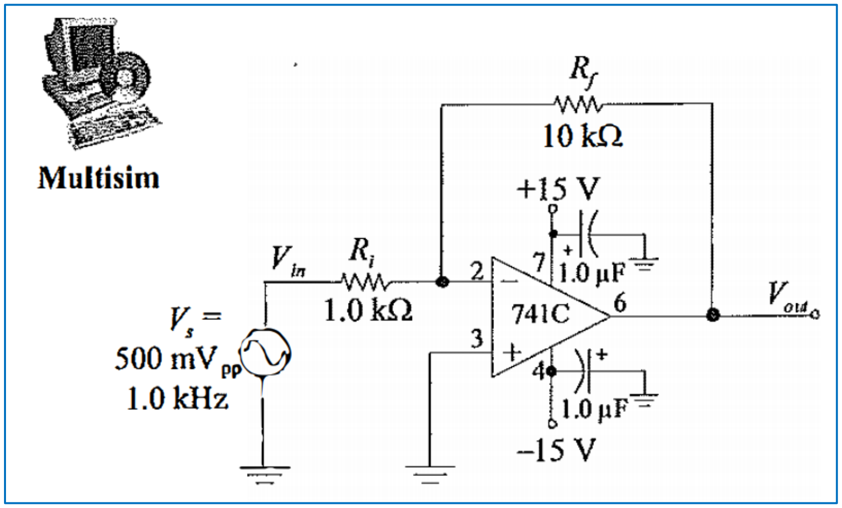


Figure 12-10

Table 12_9

Parameter	Computed Value	Measured Value
V_{in}	500 mV	249.53 mV
$A_{cl(I)}$	10	
V_{out}	5 V	2.506 6 V
$V_{(-)}$		3.535 3 mV
R_{IN}		

❖ Compute Table 12_9 .

1)- Compute value of $\mathbf{A}_{cl(NI)}$: Appy formula The closed-loop voltage gain is

We have

- $A_{cl(I)} = \frac{R_f}{R_1} = \frac{10\ k\Omega}{1.0\ k\Omega} = 10$ => $\boxed{A_{Cl(I)} = 10}$

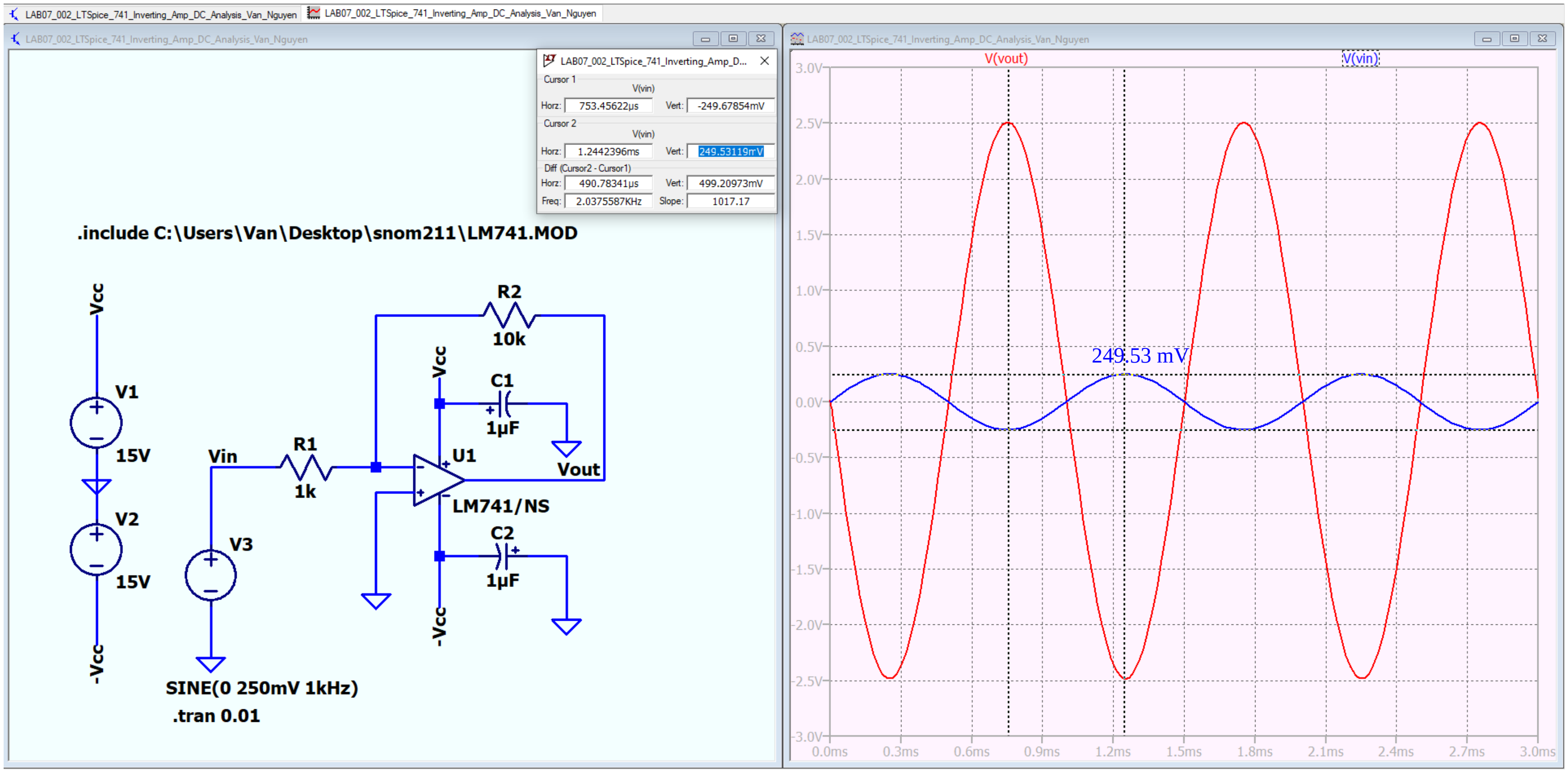
2)- Compute value of $\mathbf{V}_{out}$:

❖ Appy formula

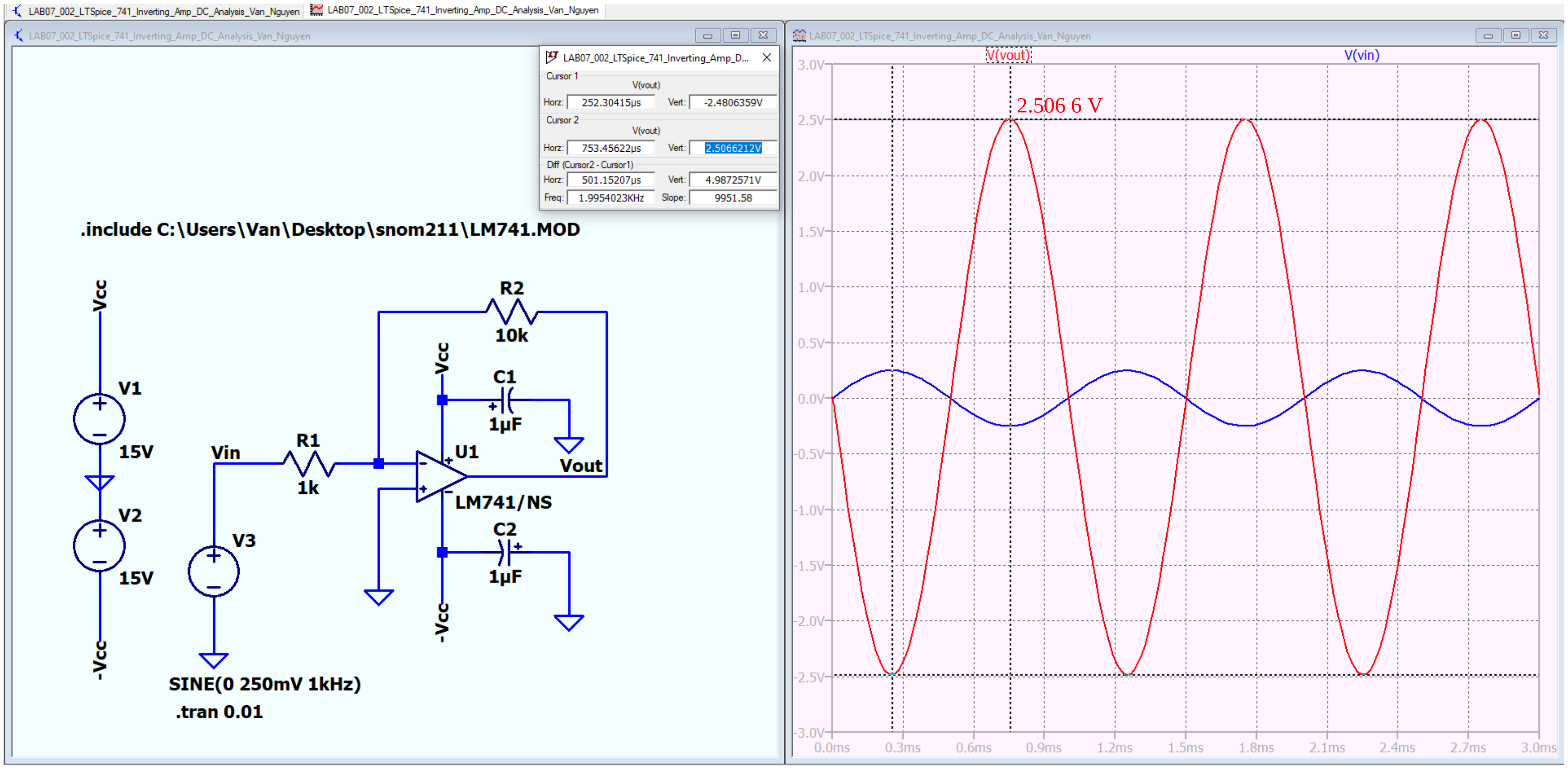
- $\frac{V_{out}}{V_{in}} = \frac{R_f}{R_1}$ => $V_{out} = \frac{R_f}{R_1} V_{in}$

- $\mathbf{V}_{out} = \frac{10\ k\Omega}{1.0\ k\Omega} 500\ mV$ = 5 000 mV = 5 V => $\boxed{V_{out} = 5\ \mathbf{V}}$

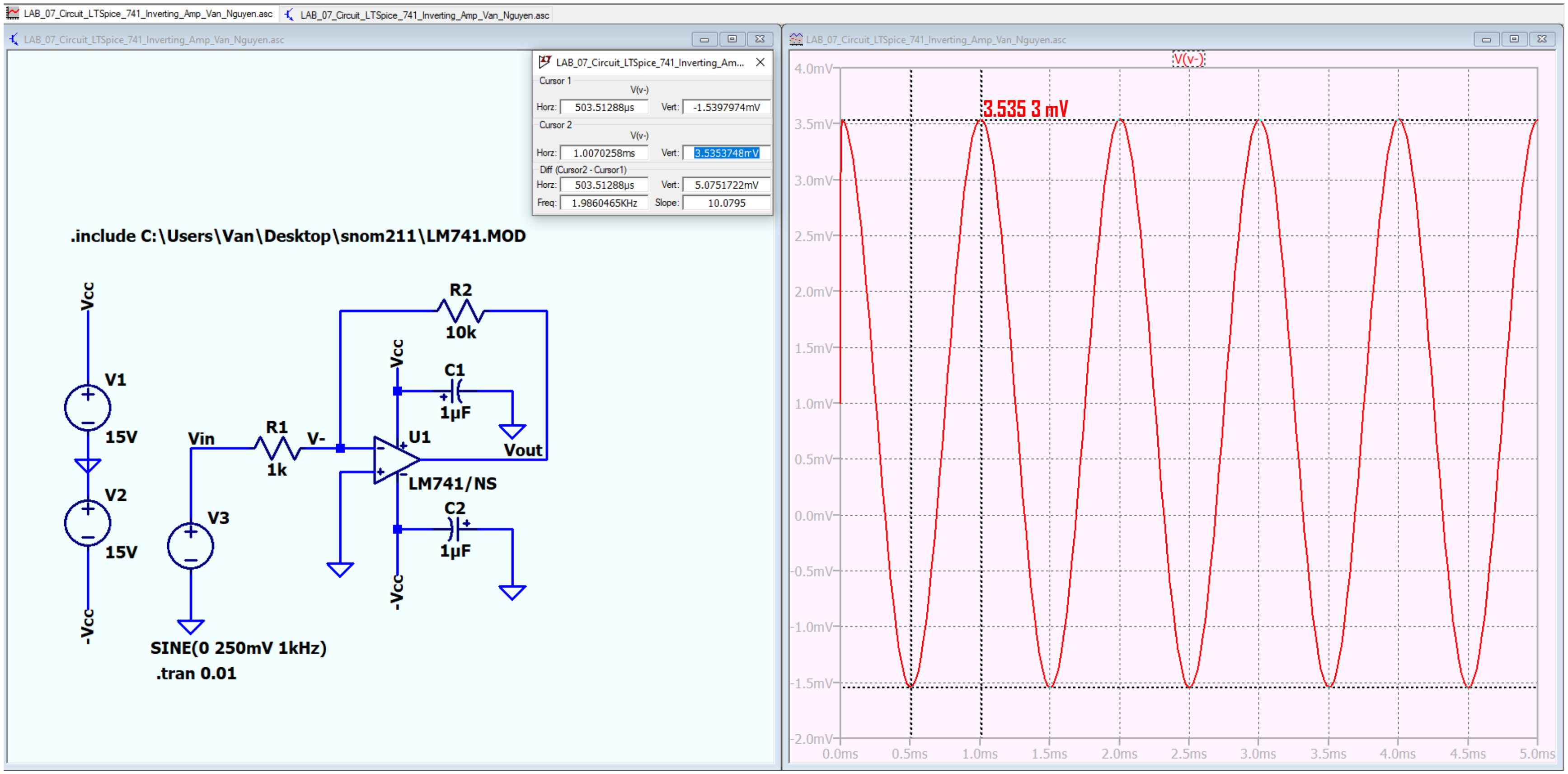
Measured Value of V_{in} = 2.506 6 V.



Measured Value of V_{out} = 2.506 6 V.



Measured Value of V(-) = 3.535 3 mV.



Noninverting Amplifier:

The circuit for this step is the noninverting amplifier shown in Figure 12-11.

Compute and Record the measured Table 12_10

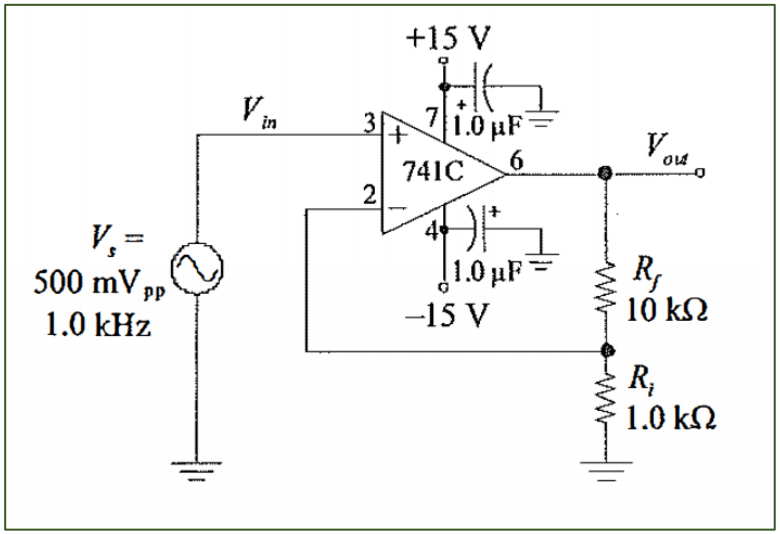


Figure 12-11

Table 12-10

Parameter	Computed Value	Measured Value
V_{in}	500 mV	248.8 mV
$A_{cl(NI)}$	10	
V_{out}	5.5 V	2.755 9 V
$V_{(-)}$		250.25 mV
R_{IN}		

❖ Compute Table 12_10 .

1)- Compute value of **A**$_{cl(NI)}$: Appy formula The closed-loop voltage gain is

We have

- $A_{\mathbf{cl(NI)}} = 1 + \frac{R_f}{R_1} = 1 + \frac{10\ k\Omega}{1.0\ k\Omega} = 11$ => $\boxed{A_{Cl(NI)} = 11}$

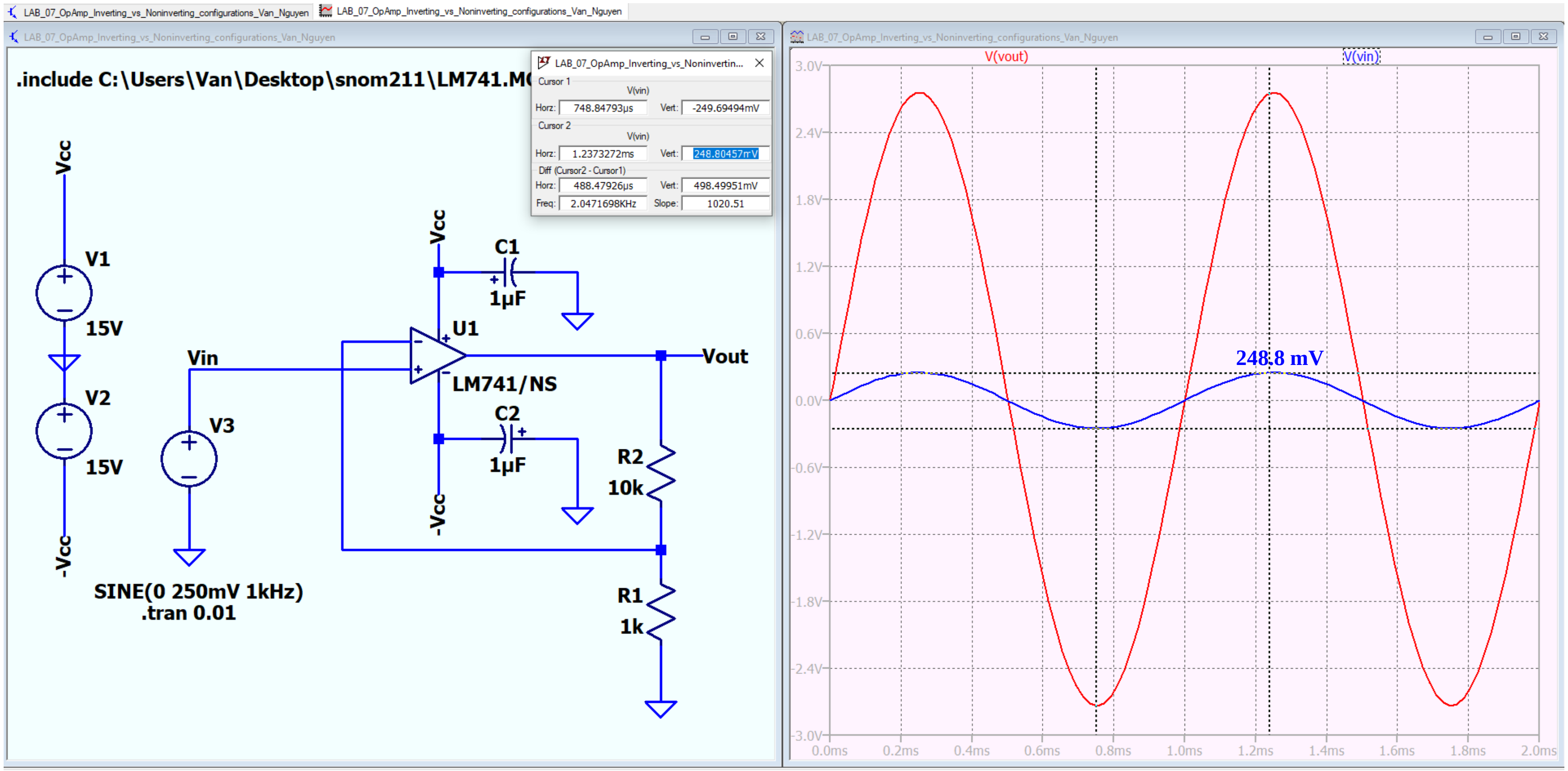
2)- Compute value of **V**$_{out}$:

❖ Appy formula

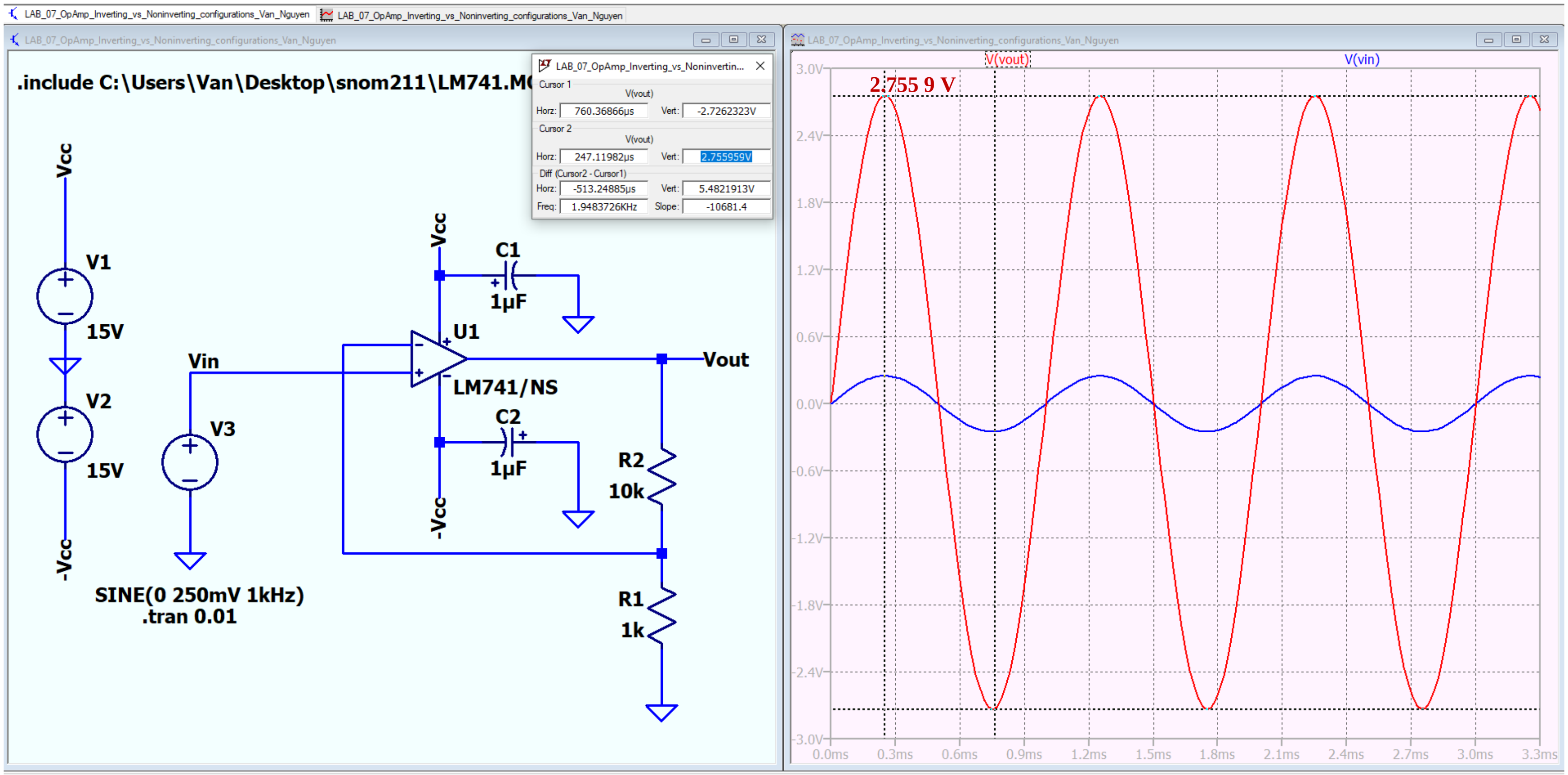
- $\frac{V_{out}}{V_{in}} = A_{CI}$ => $V_{out} = A_{CI}\,V_{in}$

- **V**$_{out}$ = $11 \times 500\ mV$ = 5 500 mV = 5.5 V => $\boxed{V_{out} = 5.5\ V}$

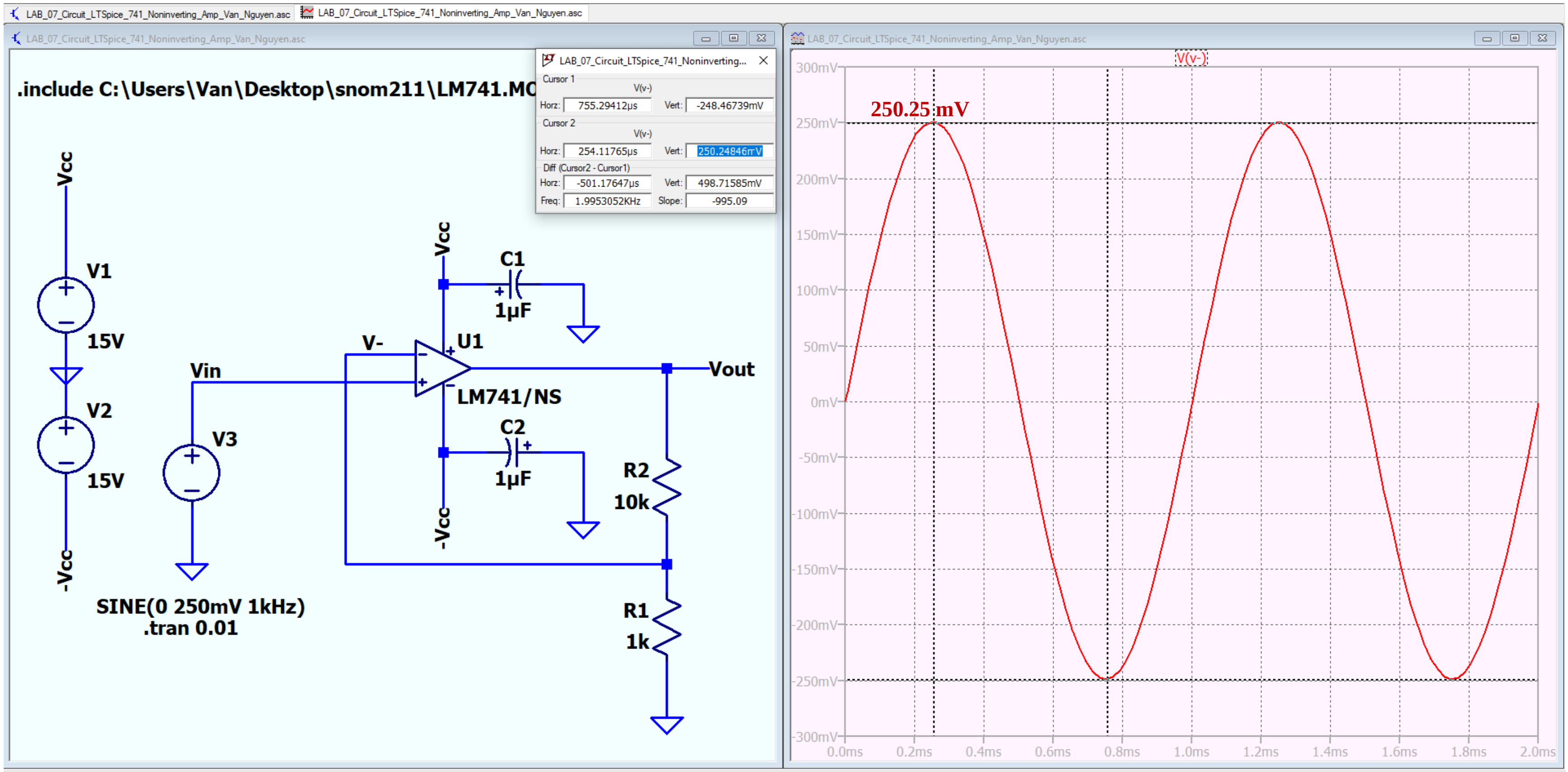
Measured Value of V_{in} = 248.8 mV



Measured Value of V_{out} = 2.755 9 V.



Measured Value of V(-) = 250.25 mV.



Change R_f to 150 kΩ and reduce the input signal to 50 mV_{rms} (141 mV_{pp}) as show in Figure 12-12. Check the gain at 1.0 kHz . Then raise the frequency to 10 kHz. Describe your observations. The gain change is due to the higher frequency.

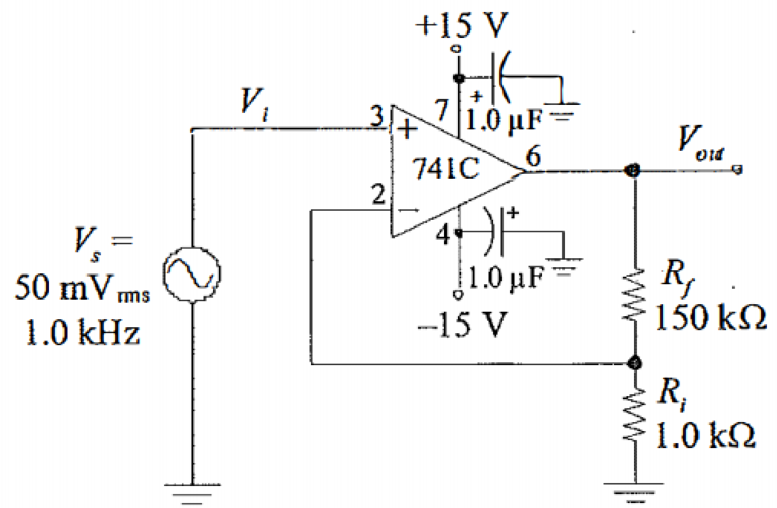
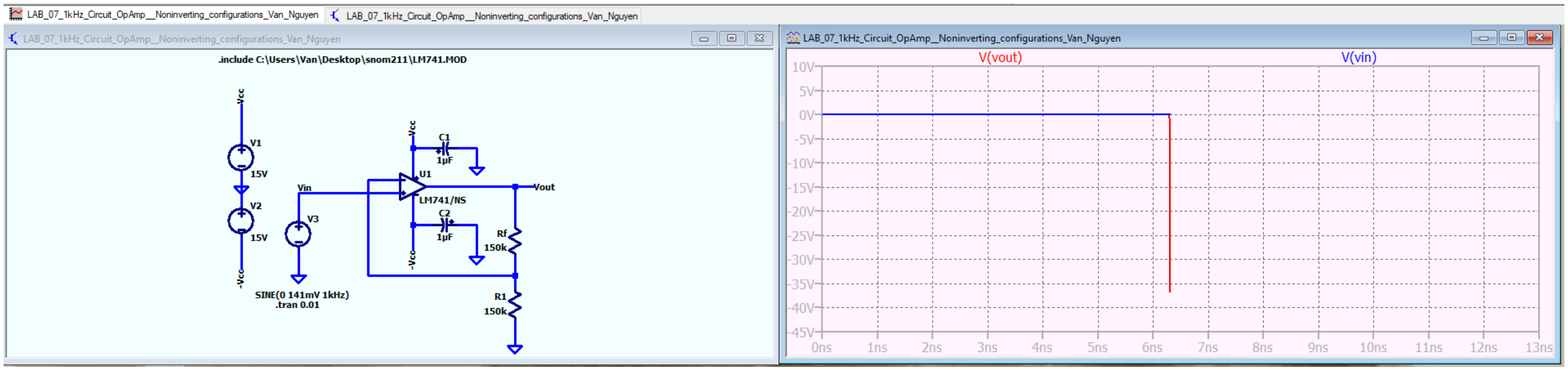


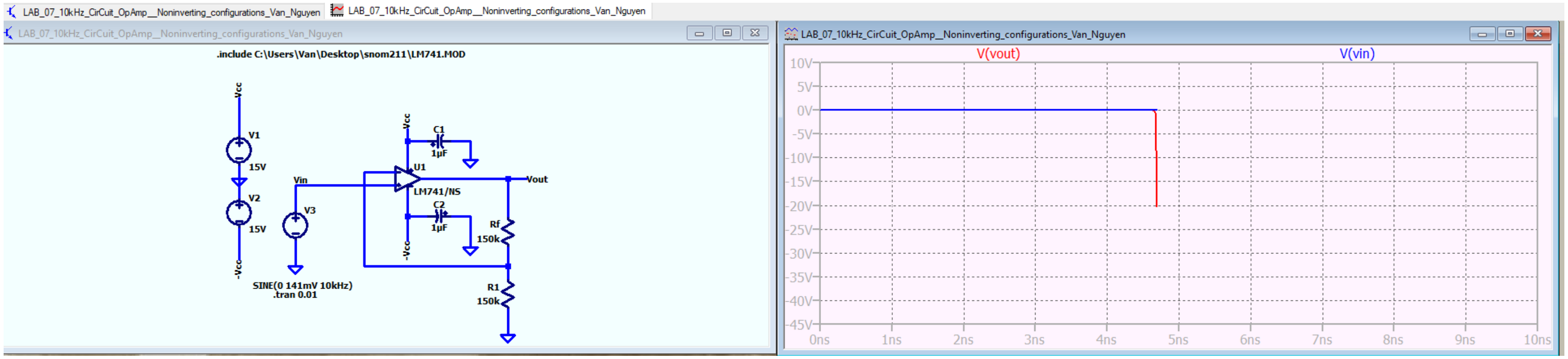
Figure 12-12

Compare : Frequency from 1 kHz to 10 kHz Vs 141 mVpp.

- Frequency 1 kHz



- Frequency 10 kHz



Compare : Circuit 741_Voltage_Follower, Circuit 741_Inveting_Amp, and Circuit 741_ Noninverting Amp.