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Electronics Laboratory

Experiment 08 - Operational Amplifier Characterization

Pre-Lab Questions

1. What is the input bias current of the LM741? **80nA**
2. What is the maximum common-mode voltage that it can be subjected to? **85 dB to 105 dB**
3. What is the Gain-Bandwidth product of the operational amplifier?

Gain Bandwidth Product is a constant that allows us to calculate either the Bandwidth or Gain if the designer has the knowledge of the "Unity Gain Bandwidth Product". But there is catch to this, though GBW is a constant it has impact on the systems latency.

Laboratory Experiment Simulation

Part-I

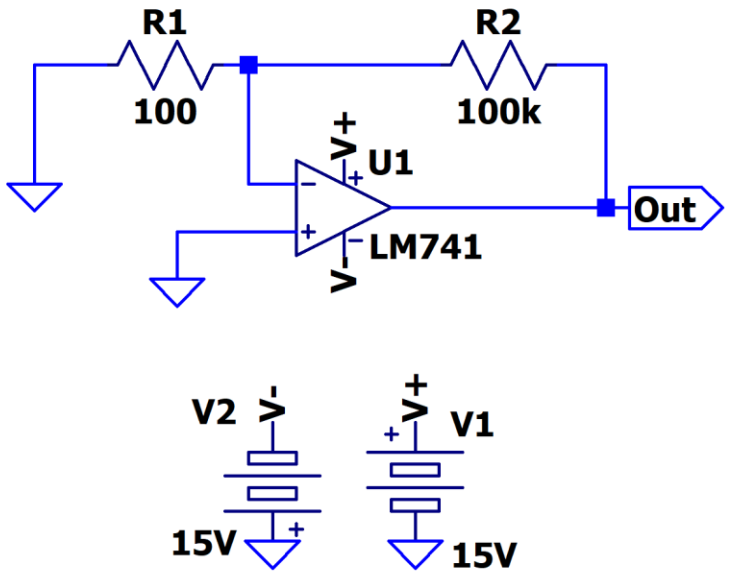


Fig 1. Circuit Diagram

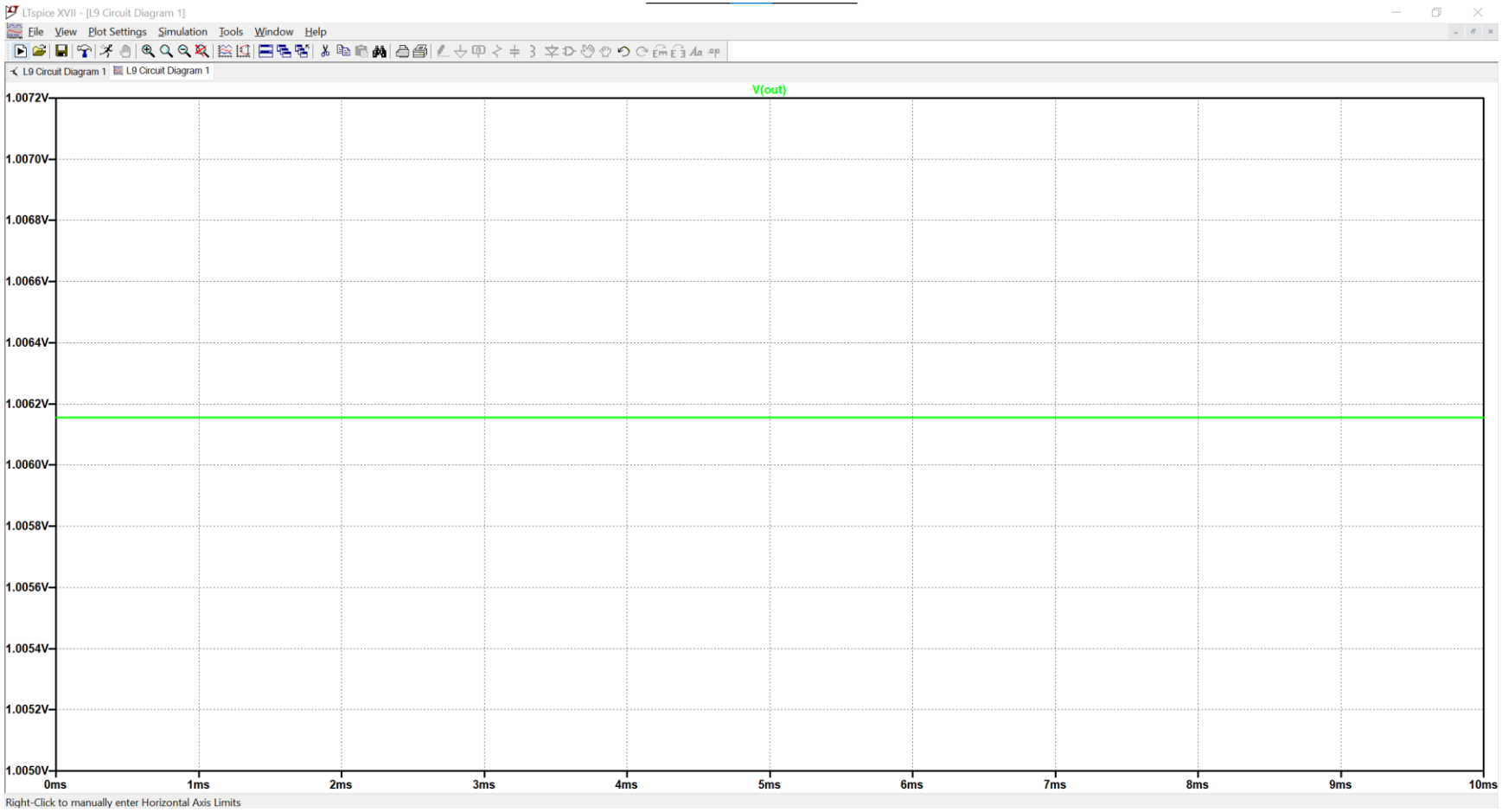


Fig 2. Output Waveform for R2 100 kOhms

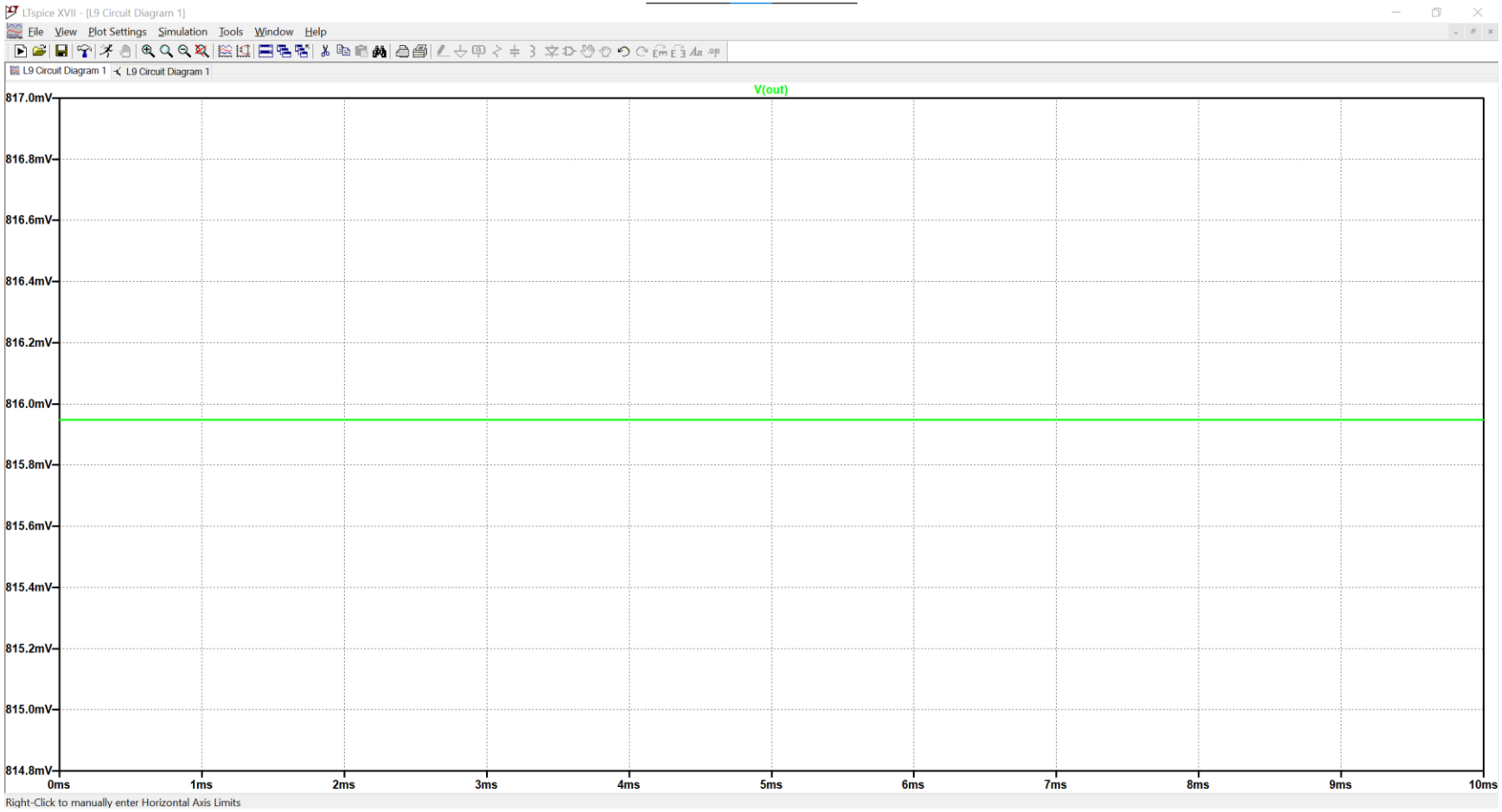


Fig 3. Output Waveform for R2 81 kOhms

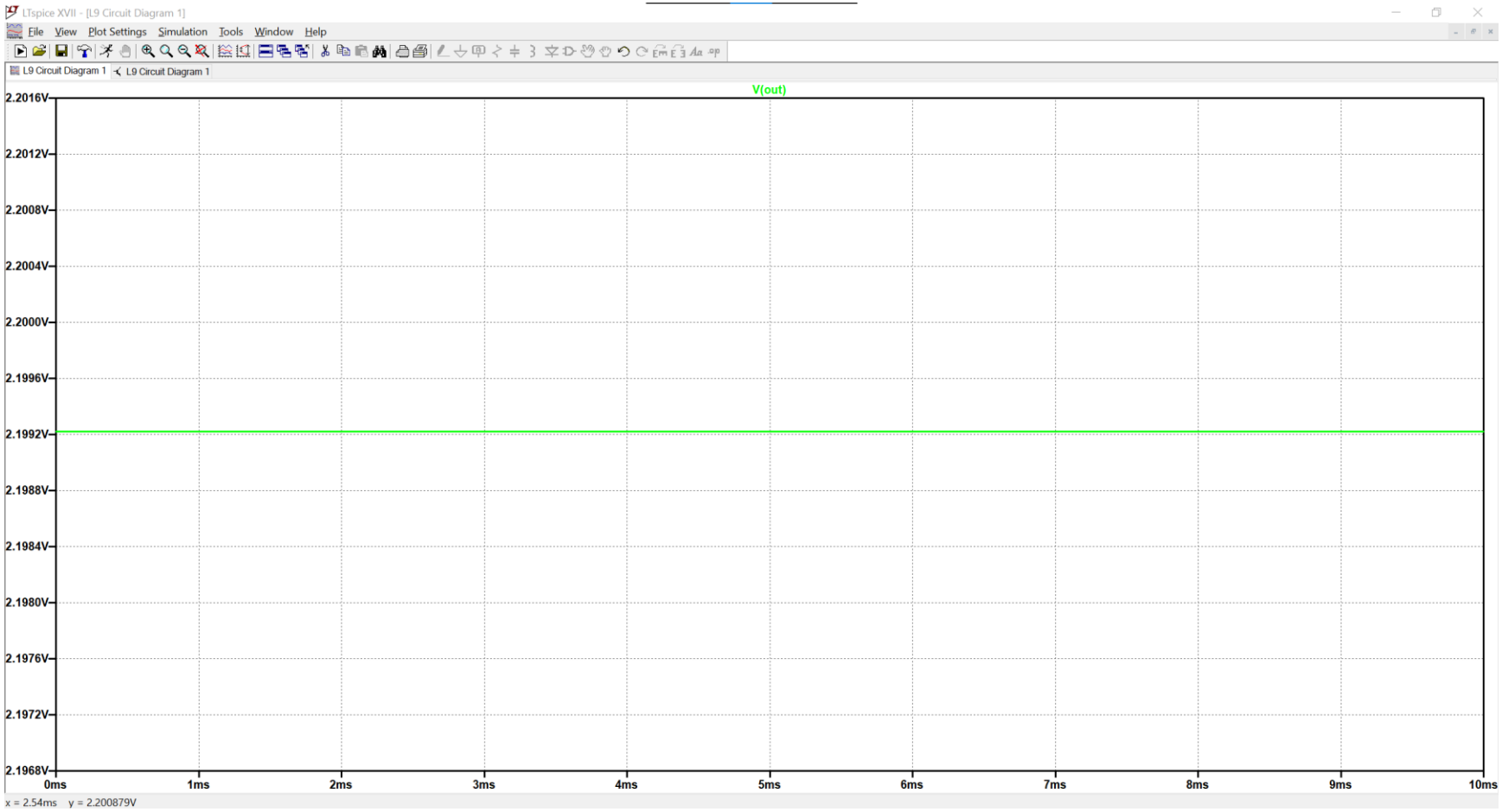


Fig 4. Output Waveform for R2 220 kOhms

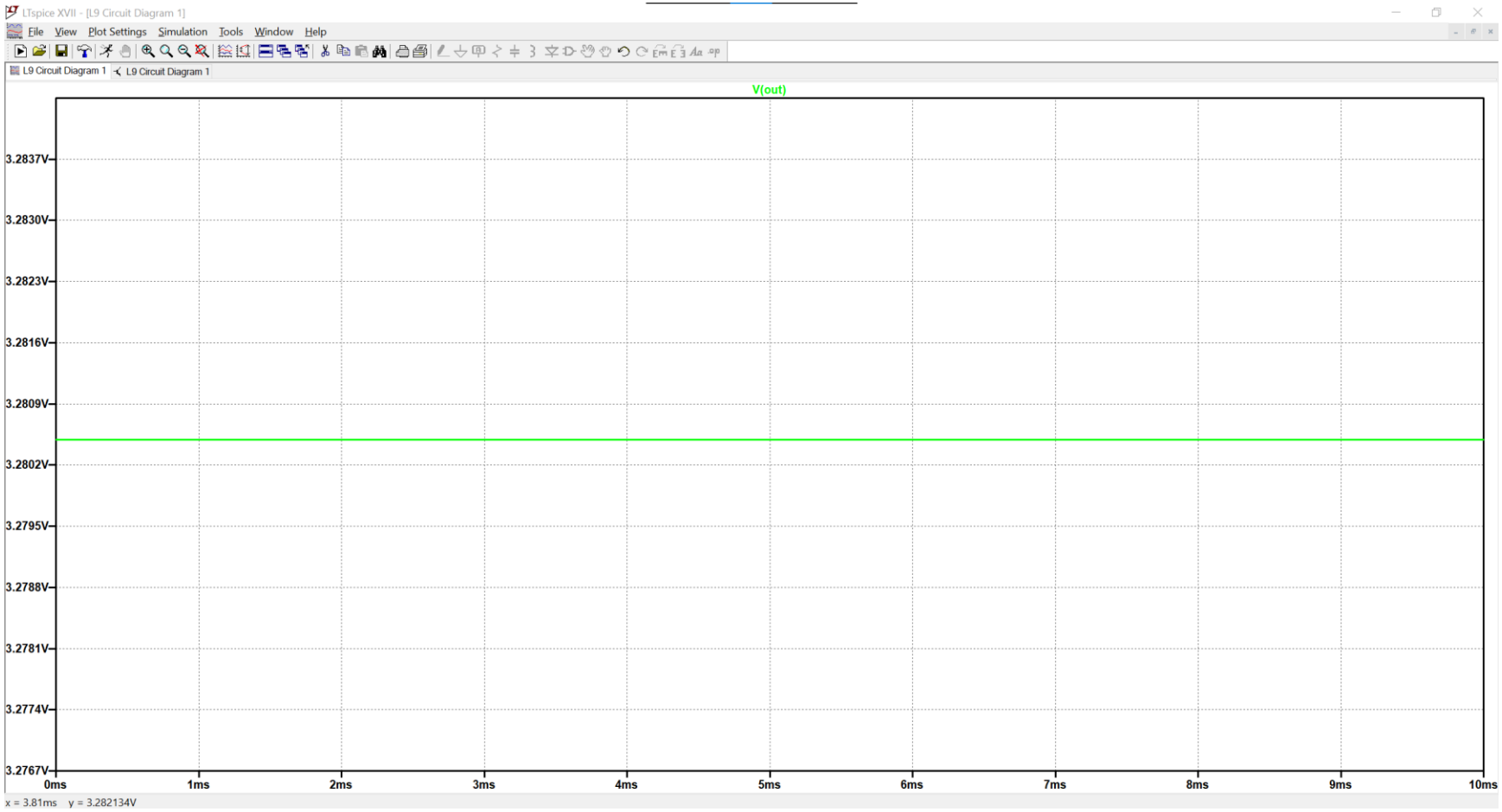


Fig 5a. Output Waveform for R2 330 kOhms

Fig 5b. Output Waveform for R2 560 kOhms

Part-II

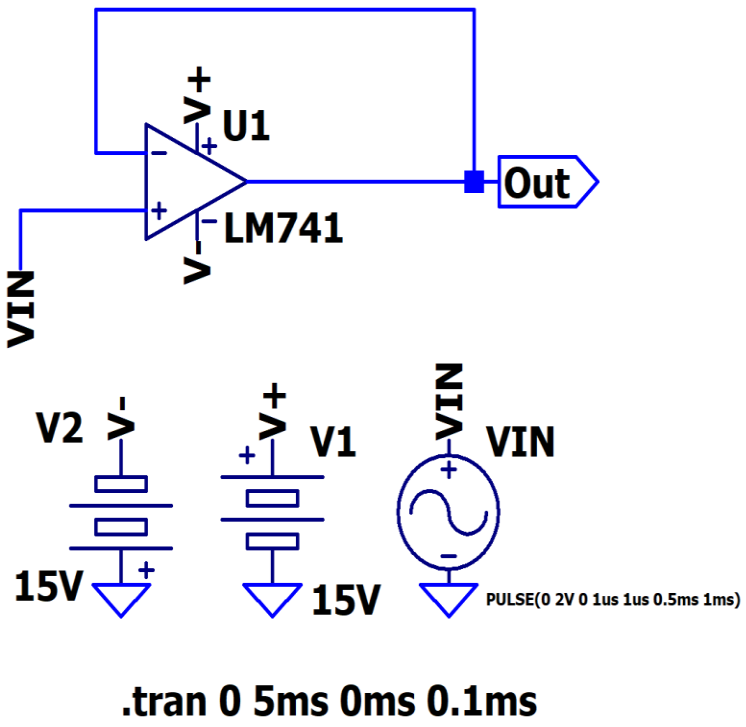


Fig 6. Circuit Diagram

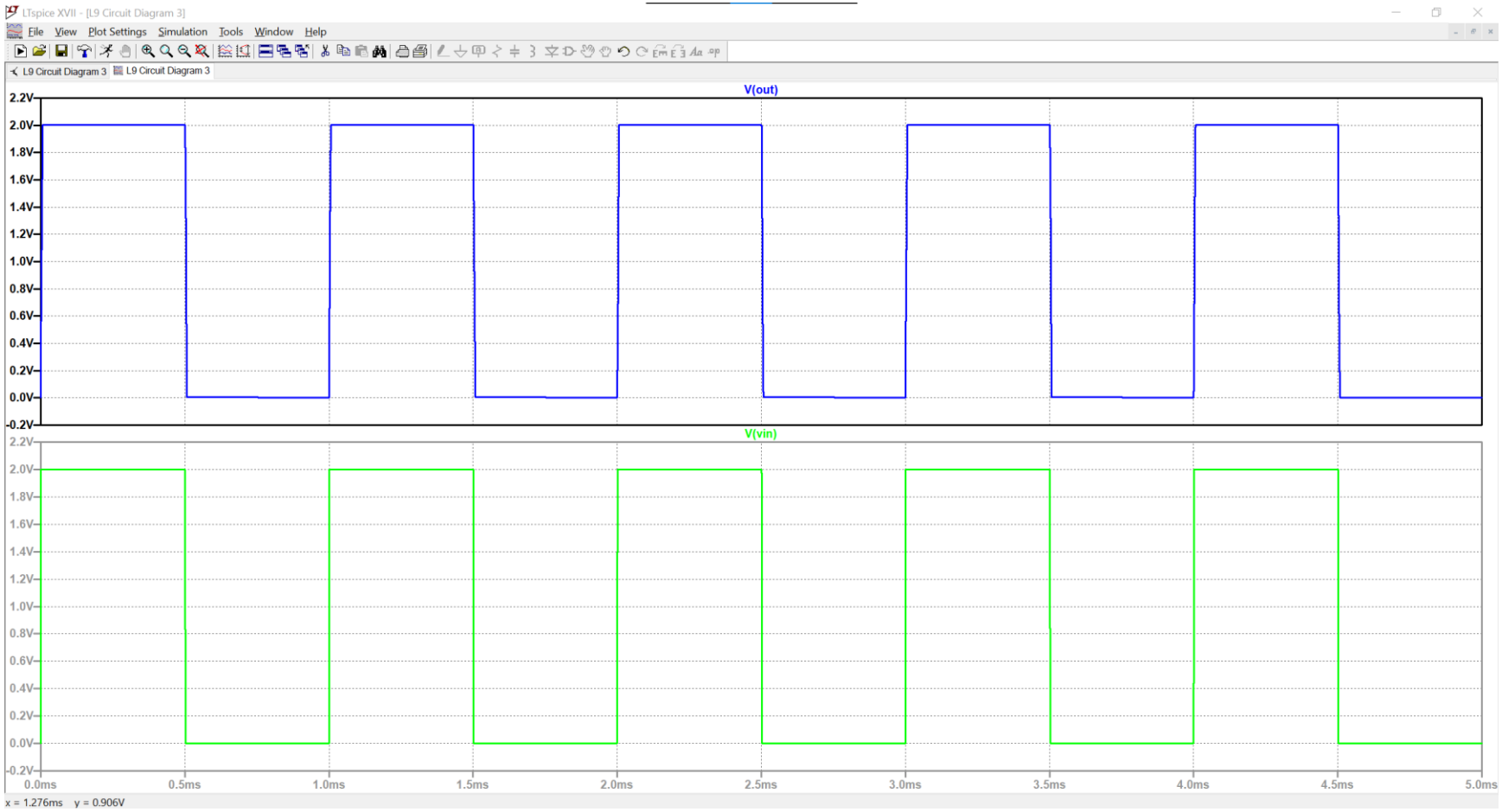


Fig 7a. Output Waveform for Input Voltage 2V

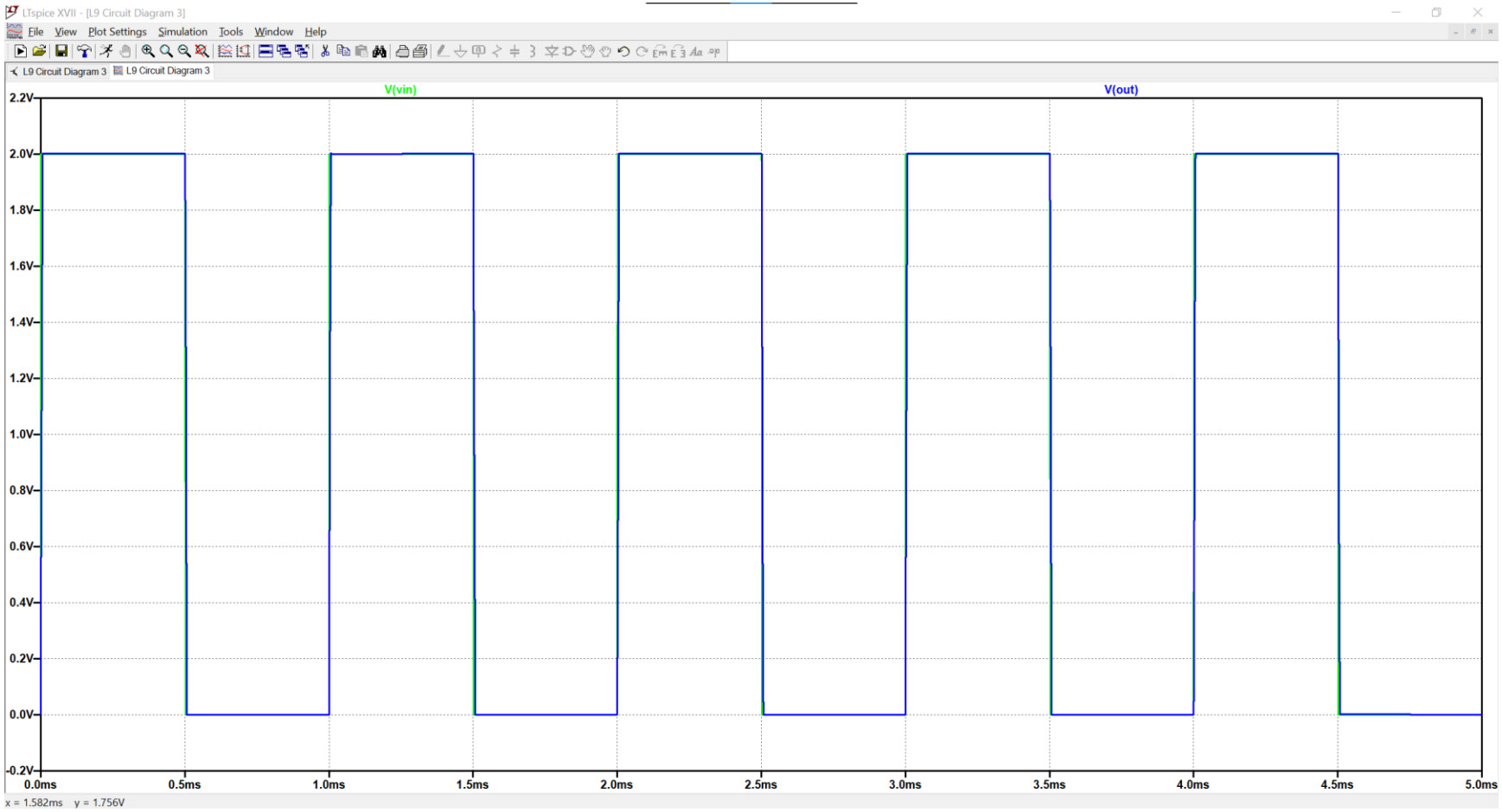


Fig 7b. Output Waveform for Input Voltage 2V

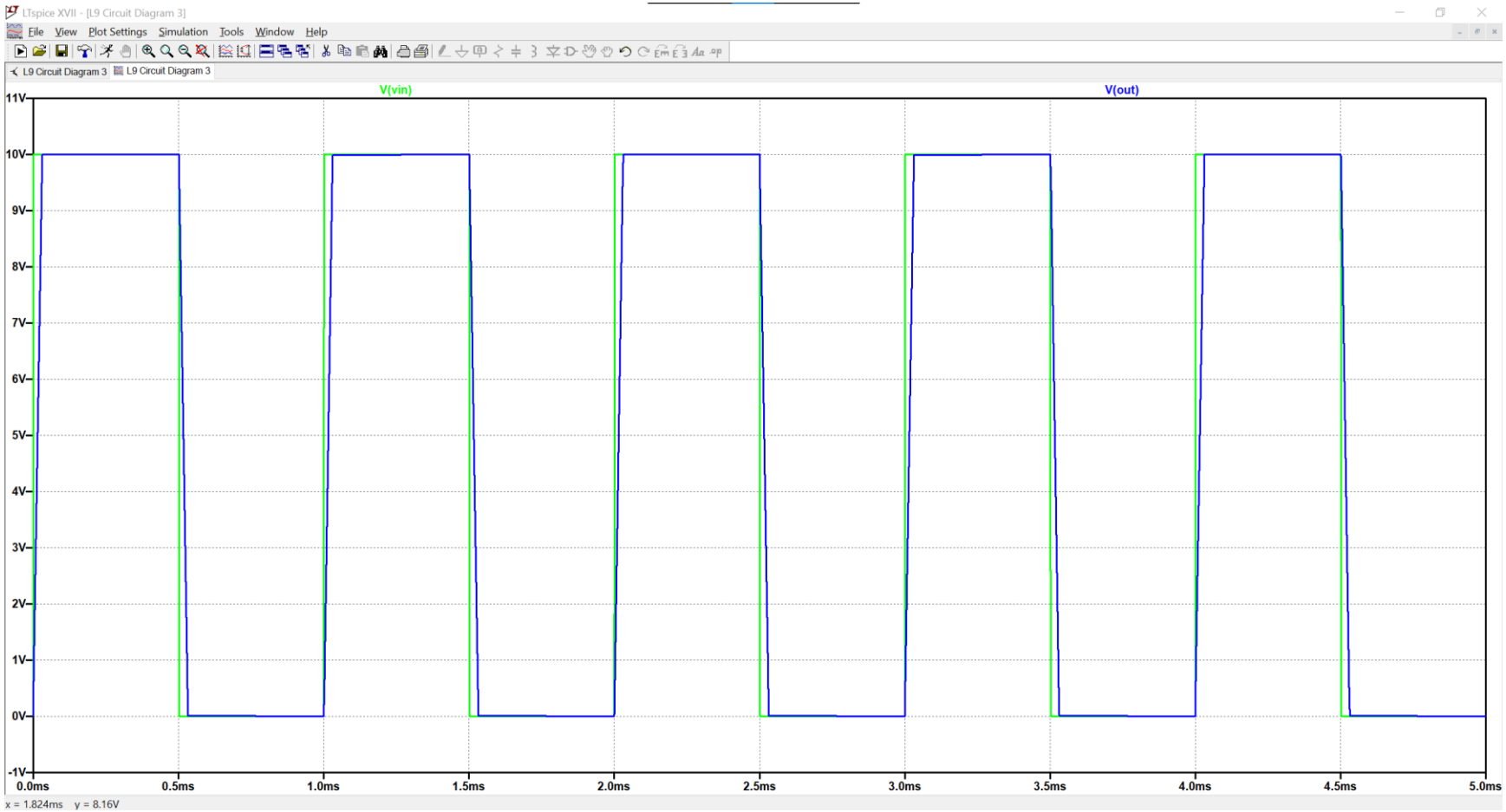


Fig 8. Output Waveform for Input Voltage 10V and Slewing of the Output

Part-III

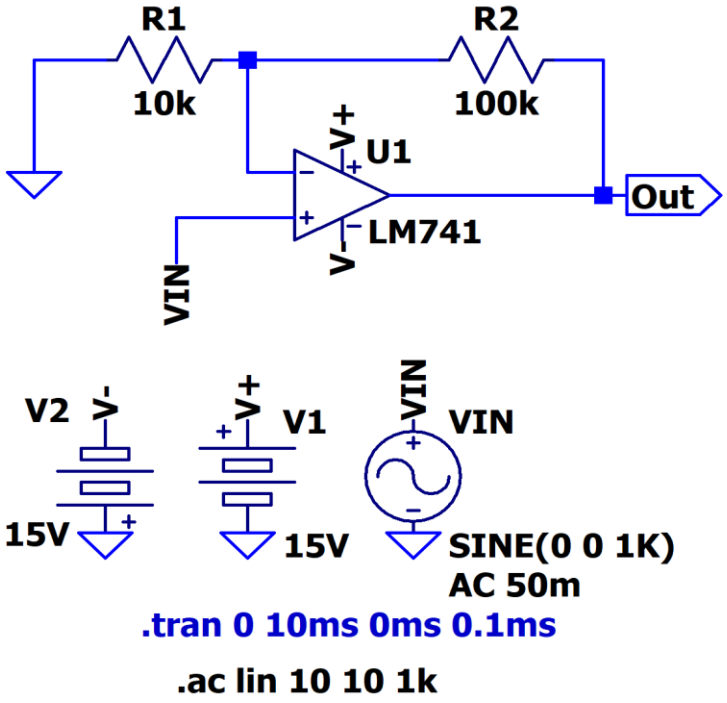


Fig 9. Circuit Diagram

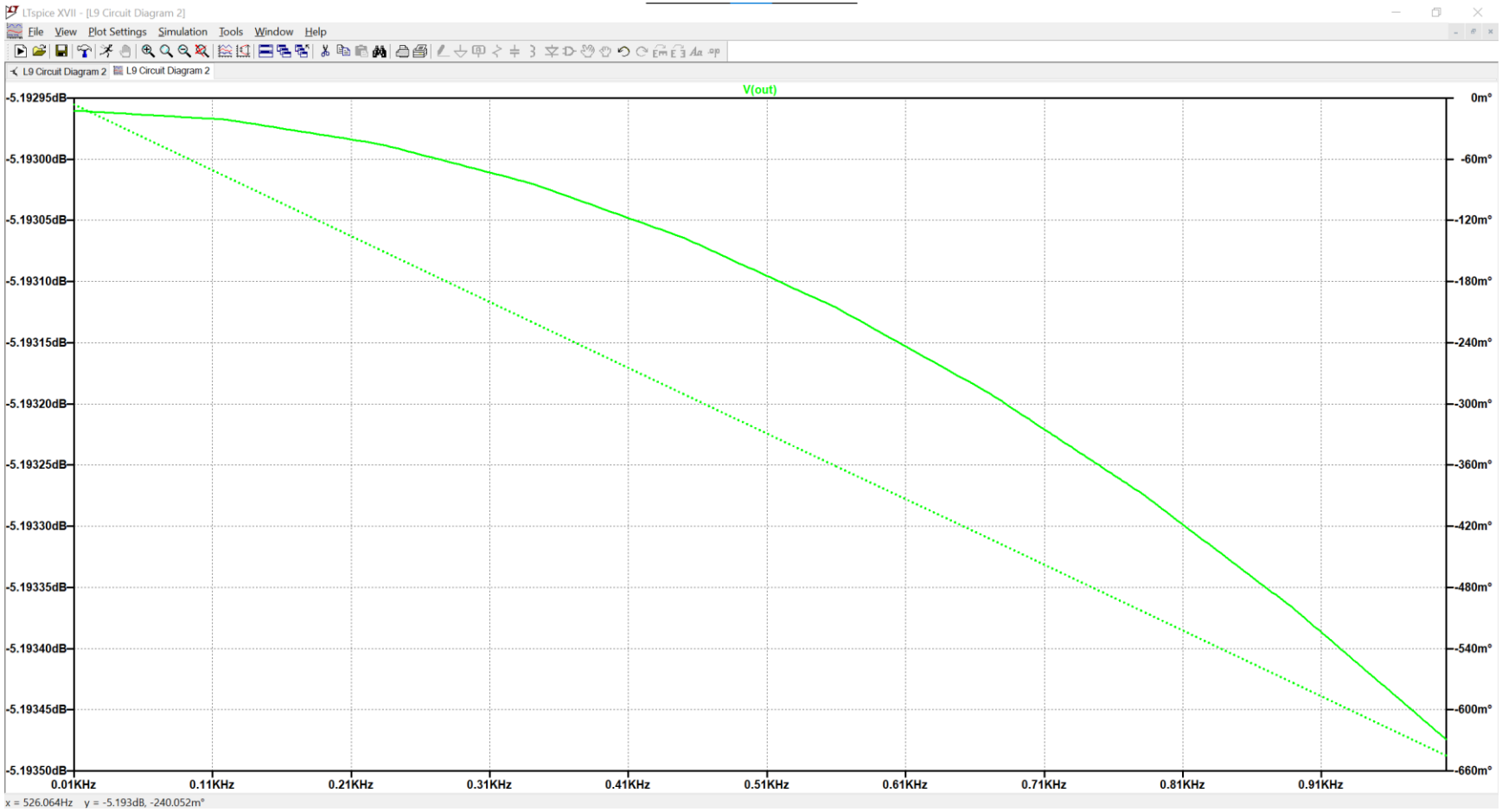


Fig 10. Frequency Response between 10Hz to 1kHz

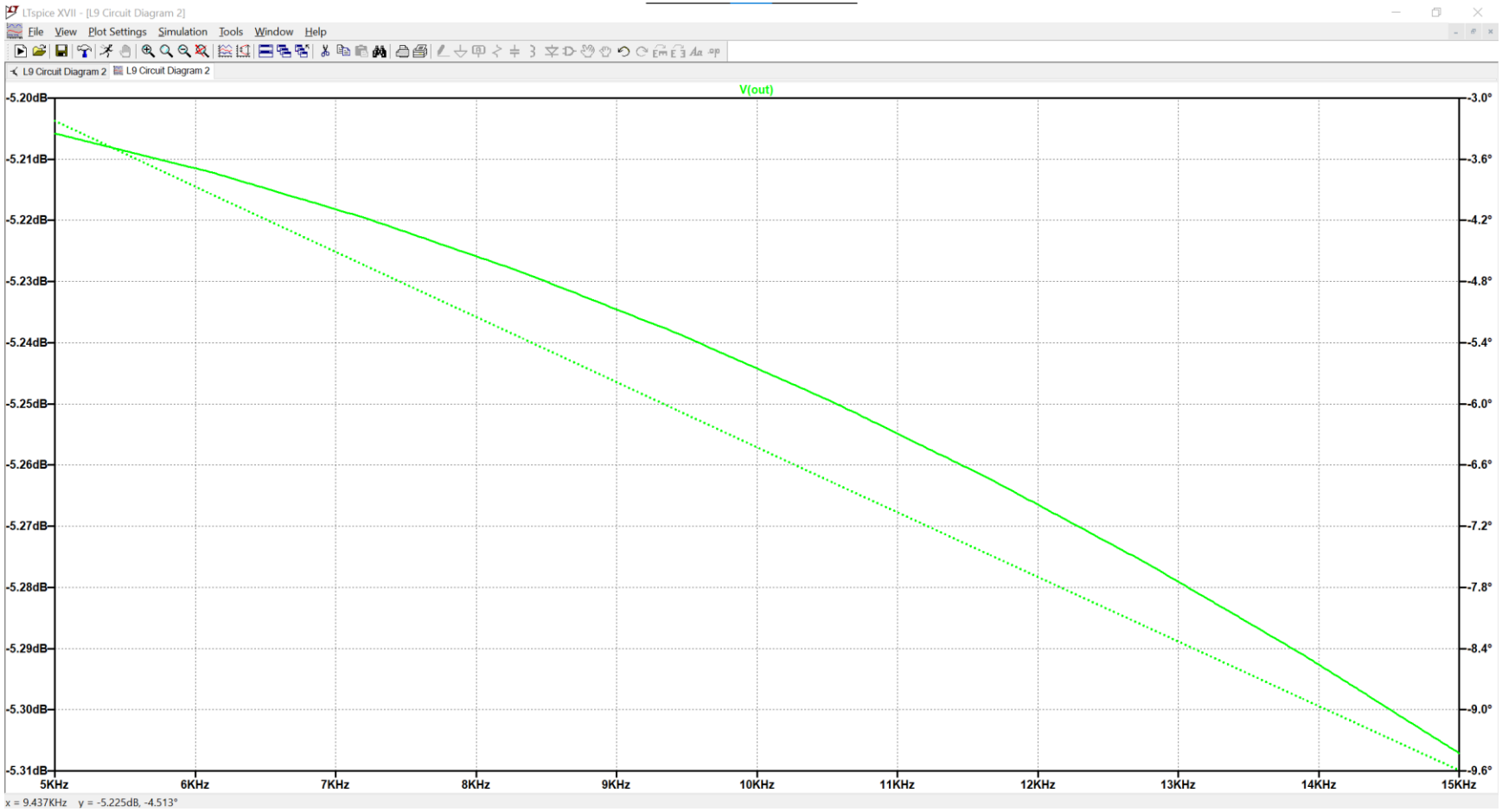


Fig 11. Frequency Response between 5kHz to 15kHz

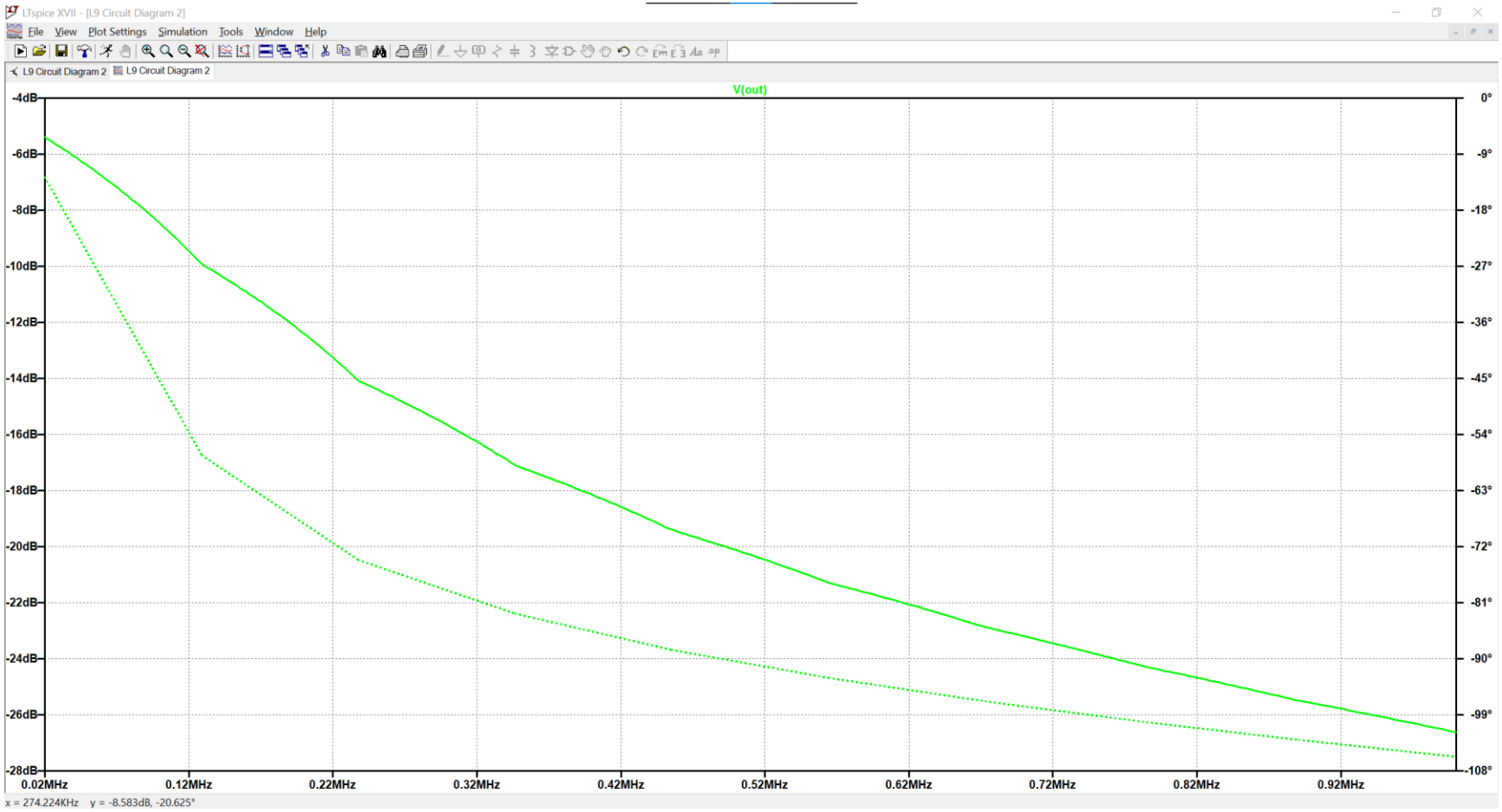


Fig 12. Frequency Response between 20kHz to 1MHz

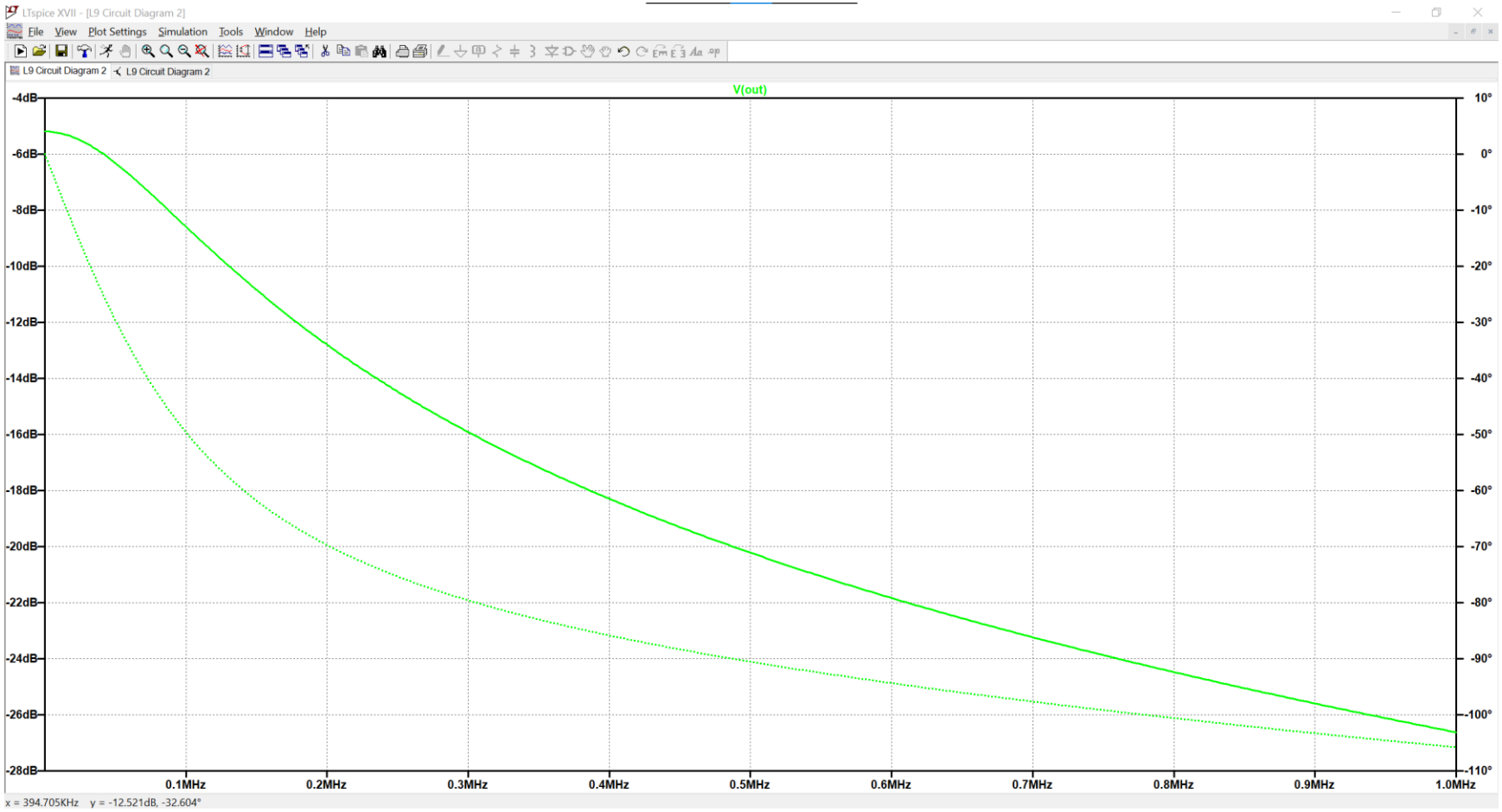


Fig 13. Frequency Response for R2 100 kOhms

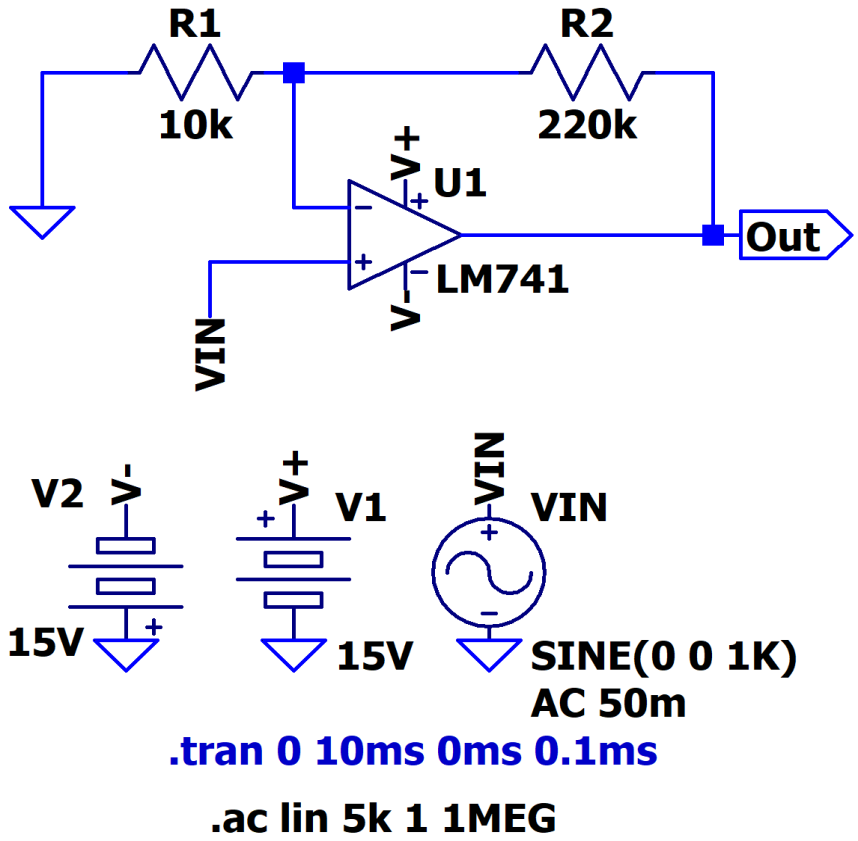


Fig 14. Circuit Diagram

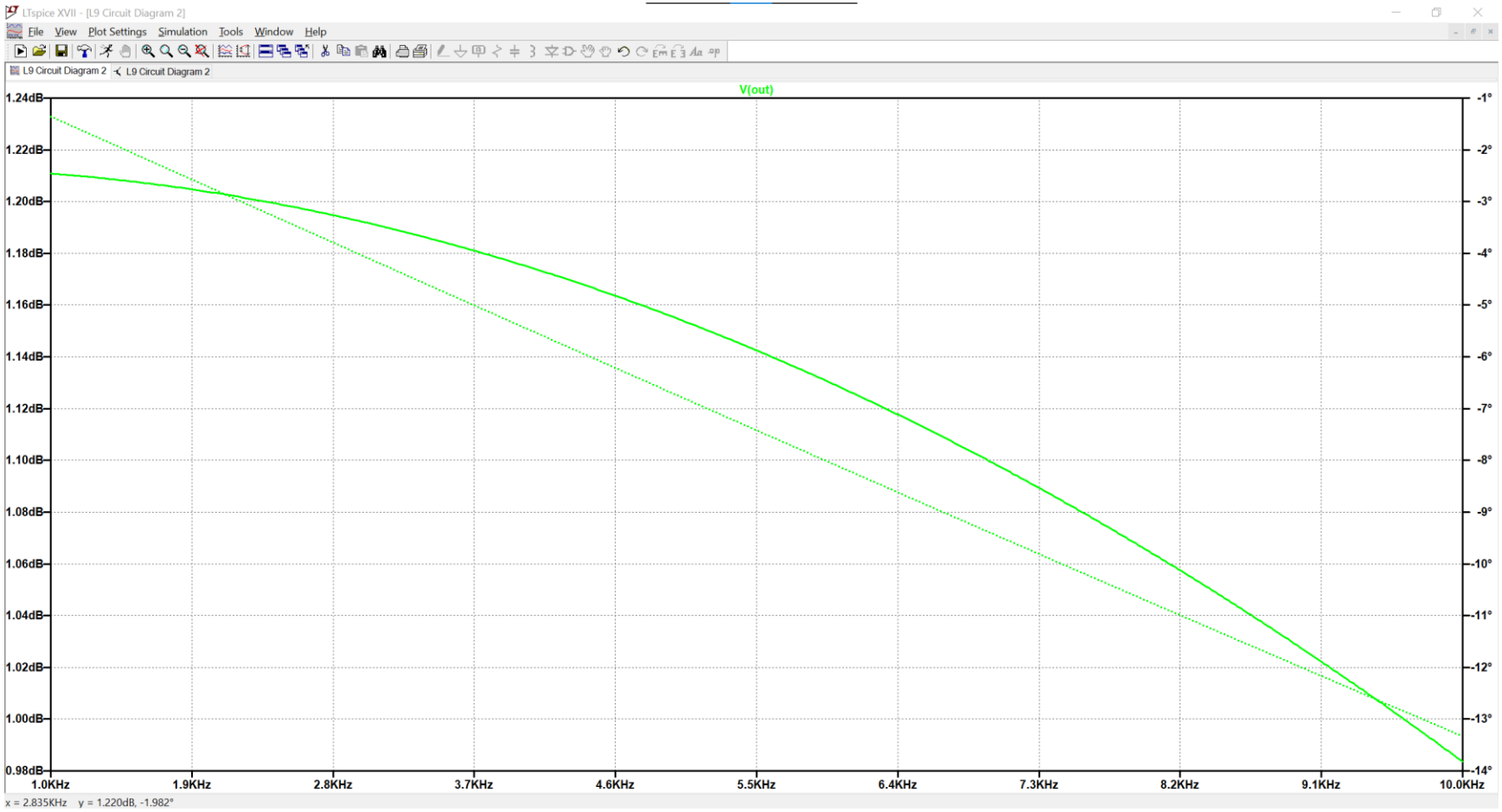


Fig 15. Frequency Response between 1kHz to 10kHz

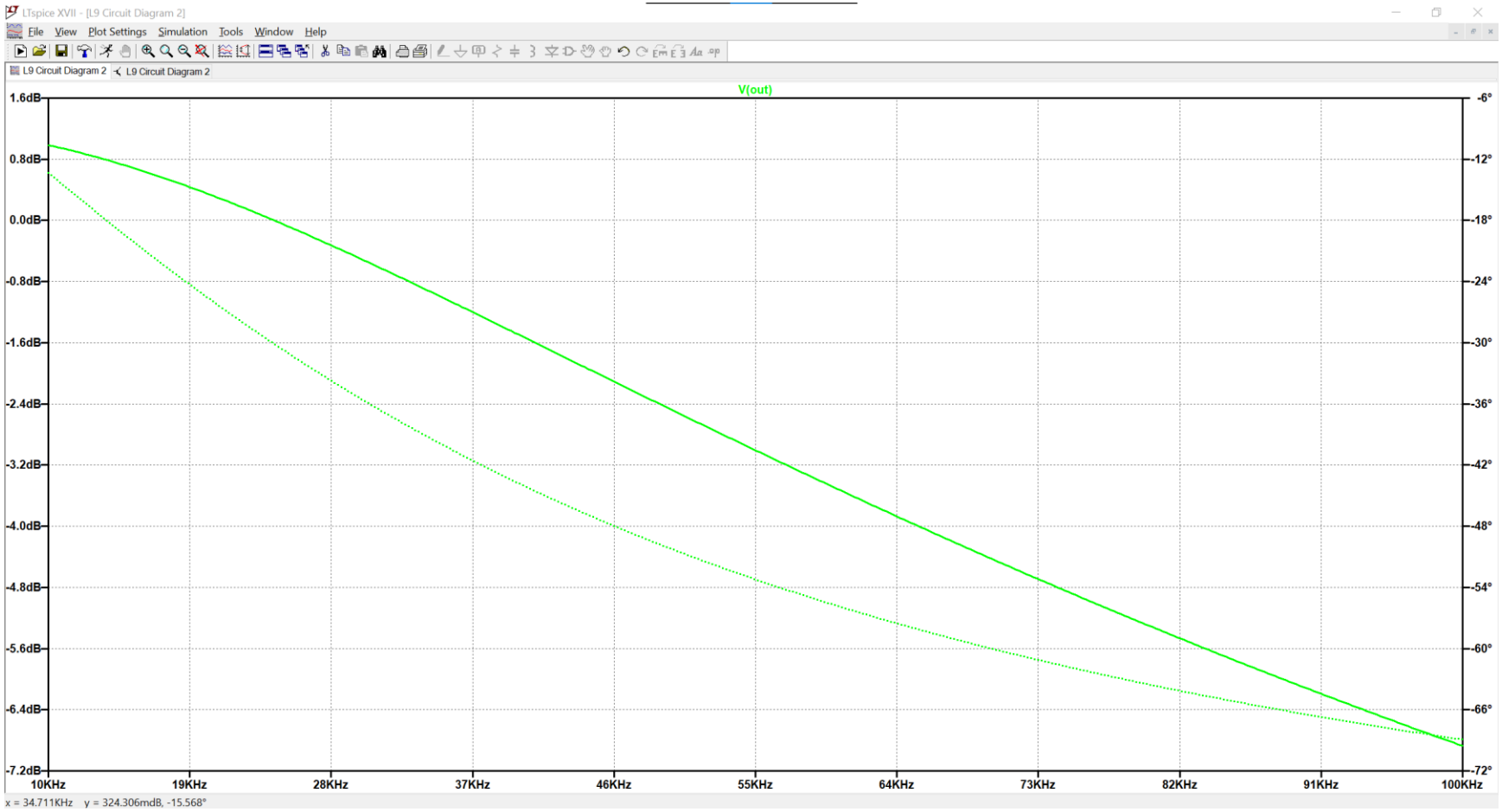


Fig 16. Frequency Response between 10kHz to 100kHz

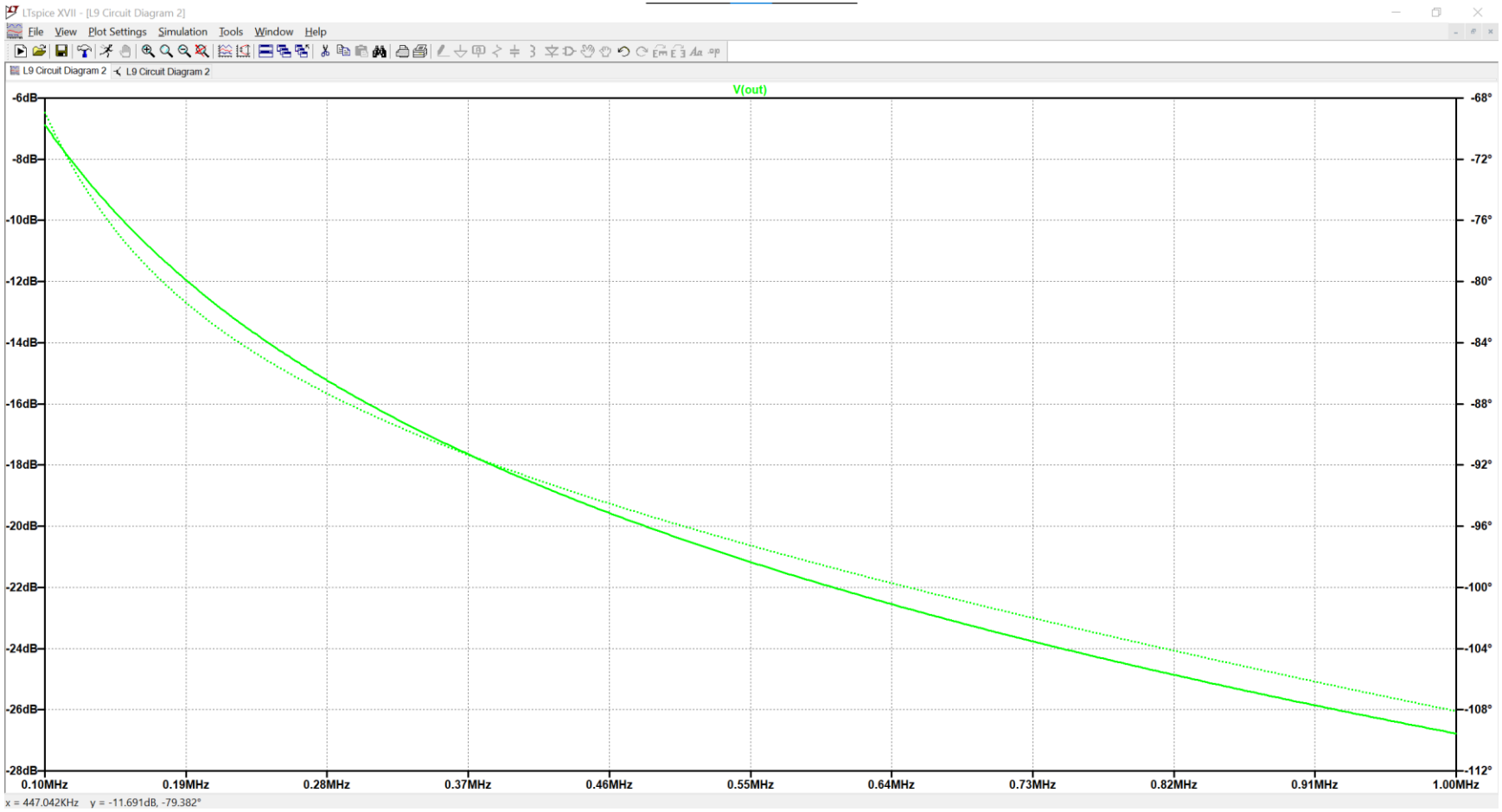


Fig 17. Frequency Response 100kHz to 1MHz

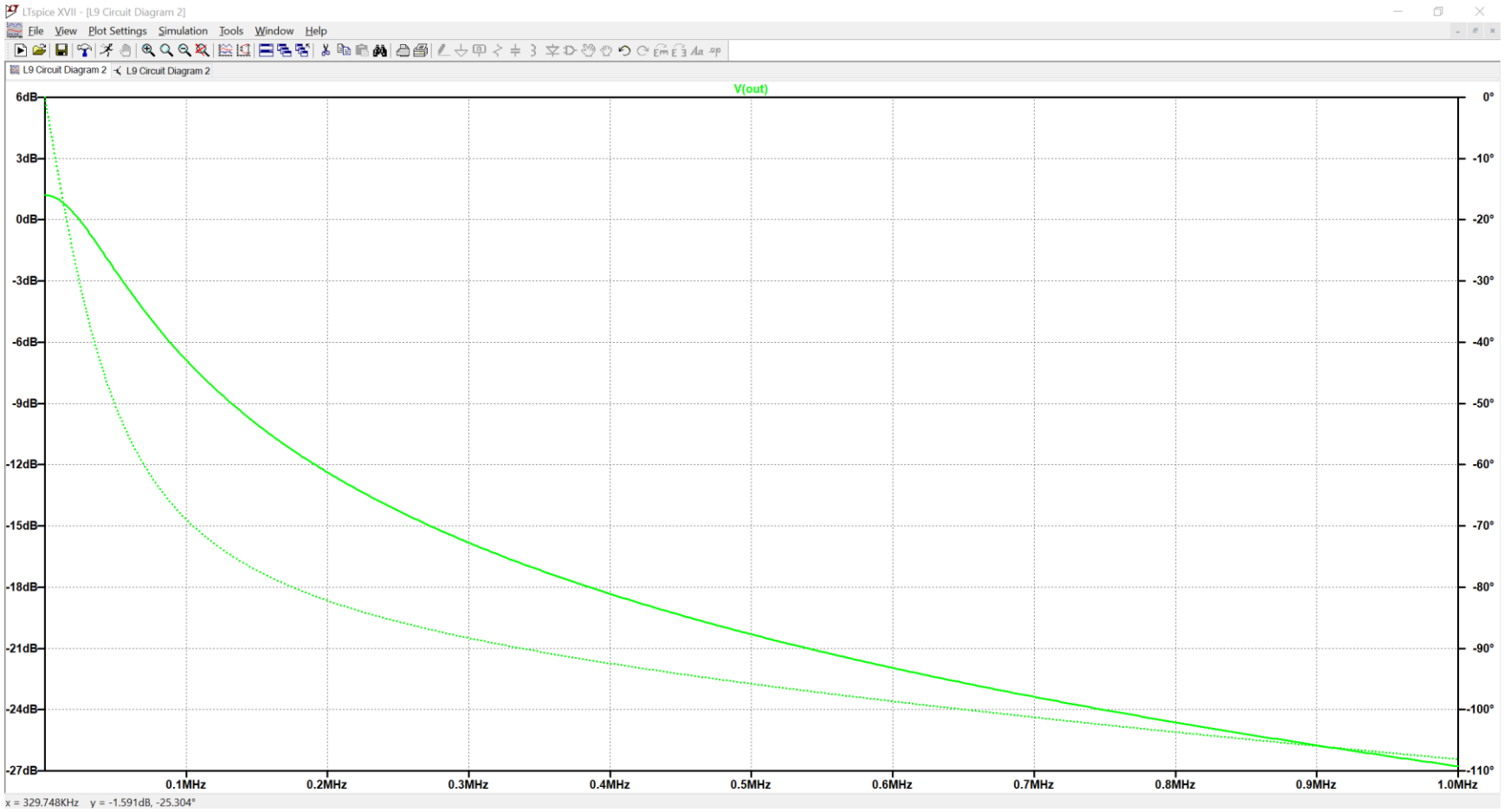


Fig 18. Frequency Response for 220 kOhms

Post-Lab Question

1. What is the input offset voltage of the OPAMP? How can this be nullified or compensated?

$$\text{Offset Voltage } (V_{OS}) = V_{os}\ 1\left(+\frac{R2}{R1}\right)$$

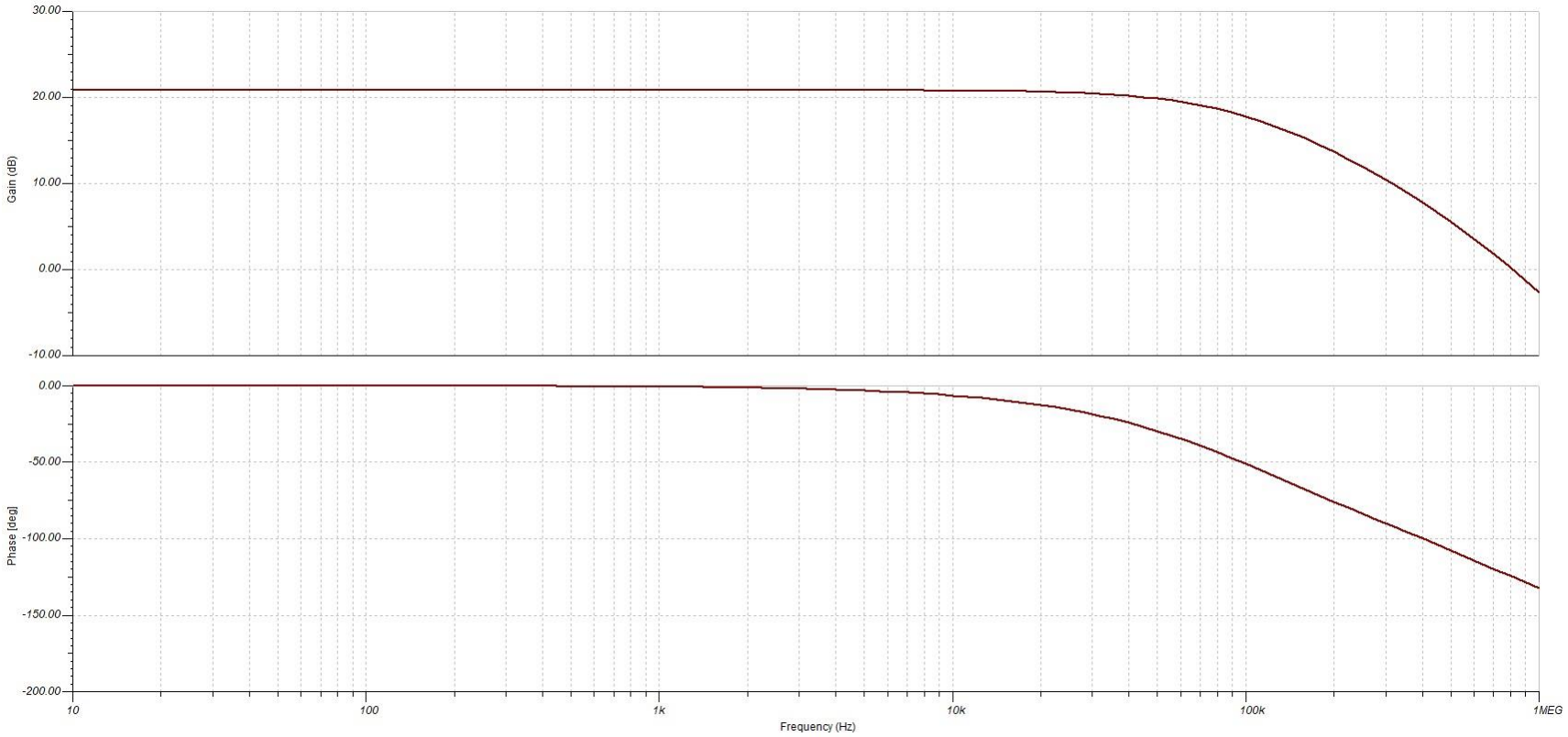
Input Voltage is Zero

Resistance R2	Input Offset Voltage (Approximated)
100 kOhms	1.05 mV
81 kOhms	1.0049 mV
220 kOhms	0.995 mV
330 kOhms	0.9936 mV
560 kOhms	0.98 mV
Average	**1.005 mV**

2. What is the Gain-Bandwidth product of the OPAMP given to you? Given an amplifier particular gain, how will this parameter influence your design?

Yes, this parameter will influence the design because as the Gain decreases the BW of the amplifier increases. So, for a given gain the BW of operation will vary due to this. In order to achieve an improved gain cascaded systems can be used.

Gain and Bandwidth	Product
10 V/V and Around 100 kHz	Appx. 1000K



3. If the input of the circuit of Fig 3 is a sinusoid of 1V and Frequency of 100 kHz what will be the output and experimentally verify your answers.

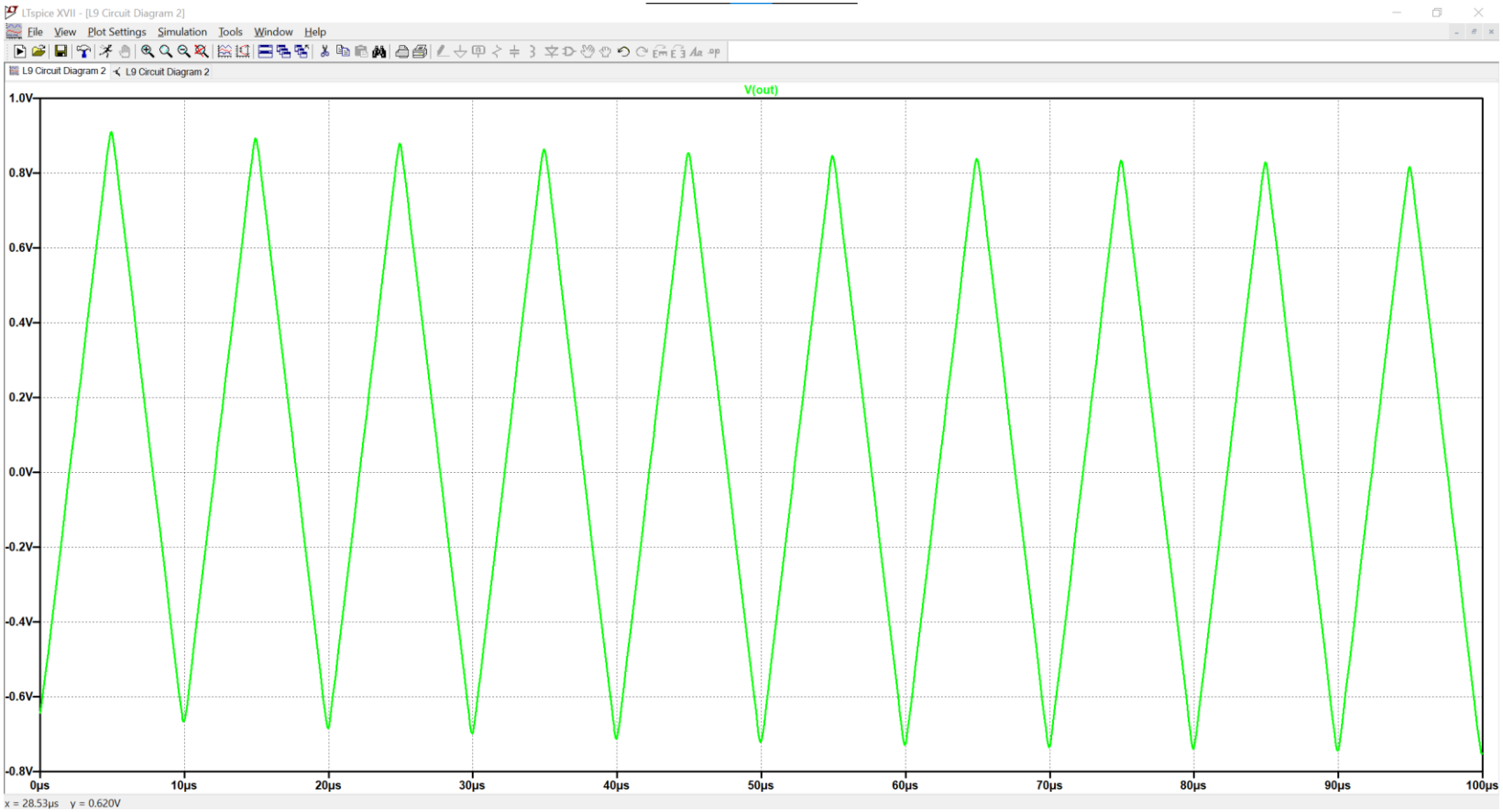


Fig 19. Output Waveform for Experiment Question [3]

$$SR \geq \omega_H V_{PEAK} \qquad \text{Units } \frac{V}{\mu s}$$

Though a sinusoidal input is given the above condition is not satisfied and the amplifier slews and the output waveform become a triangular wave.

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Experiment-08 Operational Amplifier Characterization

Figure 3 - Bode Plot

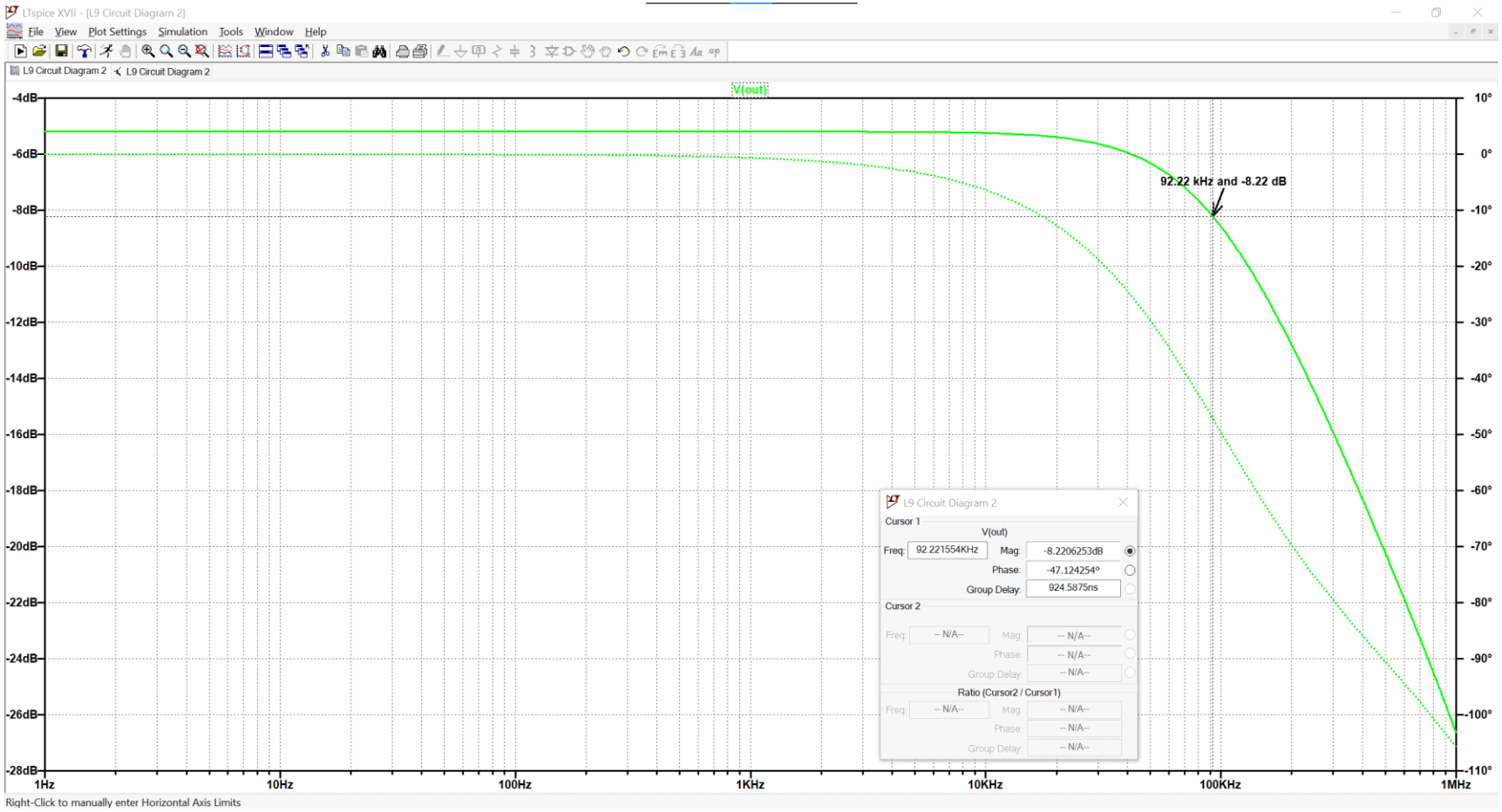

Fig 1. Bode Plot for 100 kOhms

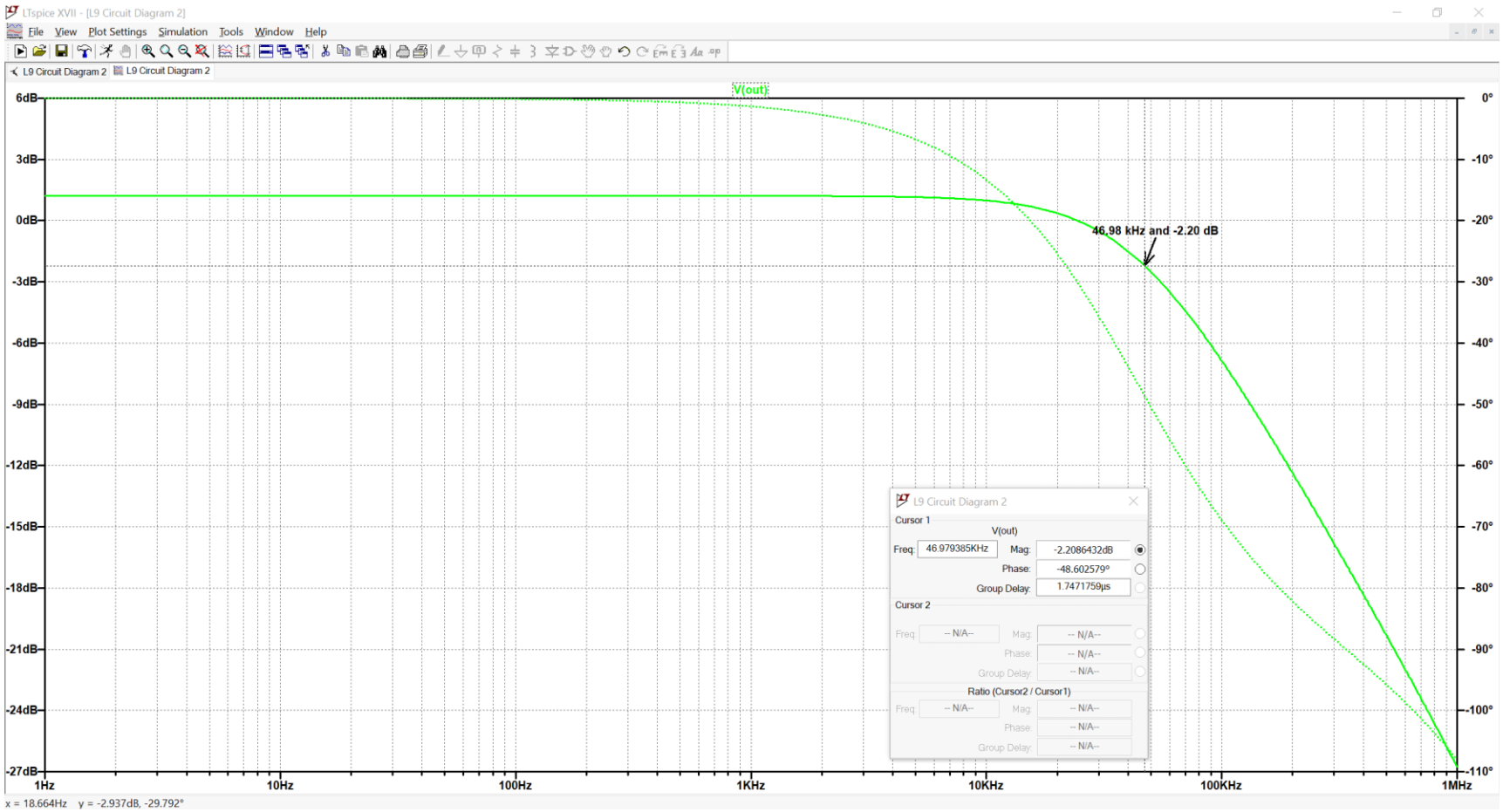

Fig 2. Bode Plot for 220 kOhms