Laboratory WORK REPORT №2

«Operational amplifiers circuits design»

**Principles of Circuits**

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# Work purpose: to study parameters of Operational Amplifier and basis of Operational amplifiers circuits design

Goals:

1) Design amplifier model on the basis of operational amplifier «Inverting amplifier»

2) Simulate amplifier scheme and analyze dependencies of output voltage from load and resistor values variation

3) Analyze time domain and frequency domain of amplifier

4) Simulate underpower state/power supply check

# Starting data

* **Required gain of amplifier** -2.000
* **Required tolerance**3%
* **Operational Amplifier : Inverting amplifier**
* **Voltage source power supply** VPP+ (V) / VPP(V)
* **Frequency for time domain simulation**

(Hz)

2000 (Hz)

200000 (Hz)

* **Test signal voltage magnitude**

(V)

* **Resistor parameters**

(Ω)

(Ω)

(Ω)

(Ω)

1000000 (Ω)

* **Amplifier scheme:** Inverting amplifier

# Simulation

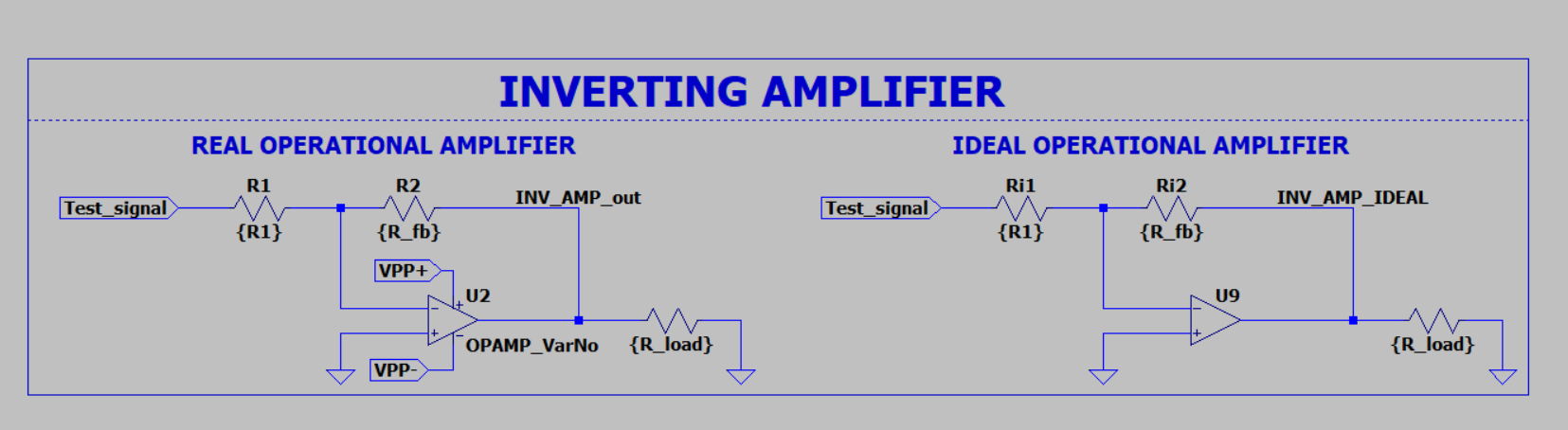


Figure 3.1 – Inverting amplifier scheme

## Gain evaluation:

Gain evaluation with new resistors

Define maximum deviation from defined by resistance tolerance

max of =

Table 1. Parameters of the amplifier

|  |  |  |  |
| --- | --- | --- | --- |
| Обозначение | Simulation | | |
|  | Nominal | With tolerance variation | |
| R1, kΩ | 11 | 1% | |
| R2, kΩ | 6 | 1% | |
| RLoad, kΩ | 1 000 k (ideal) | 100, 1000, 10000, 100000 | |
|  | -0.5455 | 0.0202 | |
|  | -0.5565 | 0.0202 | |
|  | -0.5347 | 0.0198 | |
|  | 0.0202 | | 0 |

## Time domain simulation results

### (Hz)

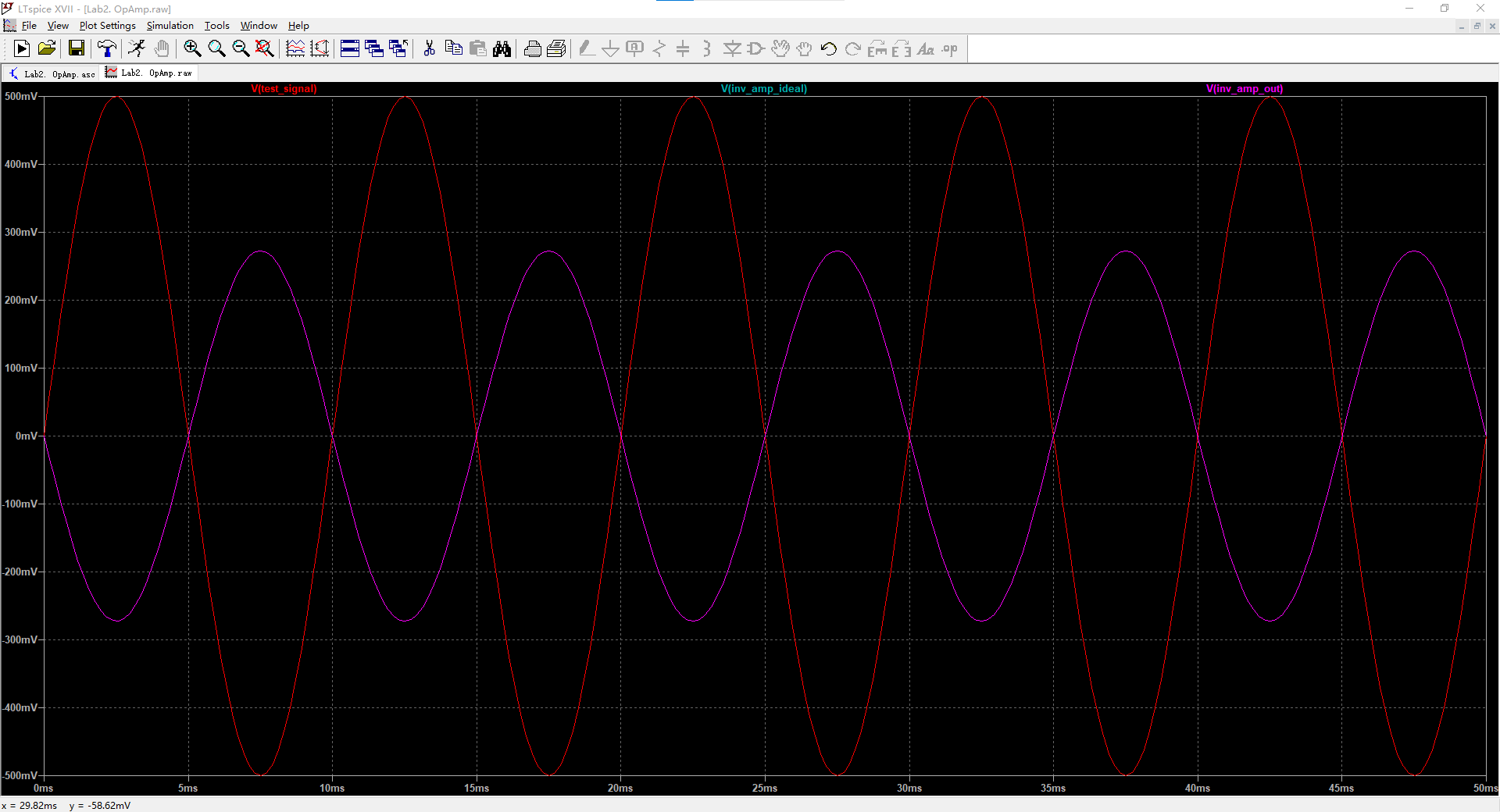


Figure 3.2 – Input and output voltages of ideal and real operational amplifiers

, , variation 1%, variation 1%

### (Hz)

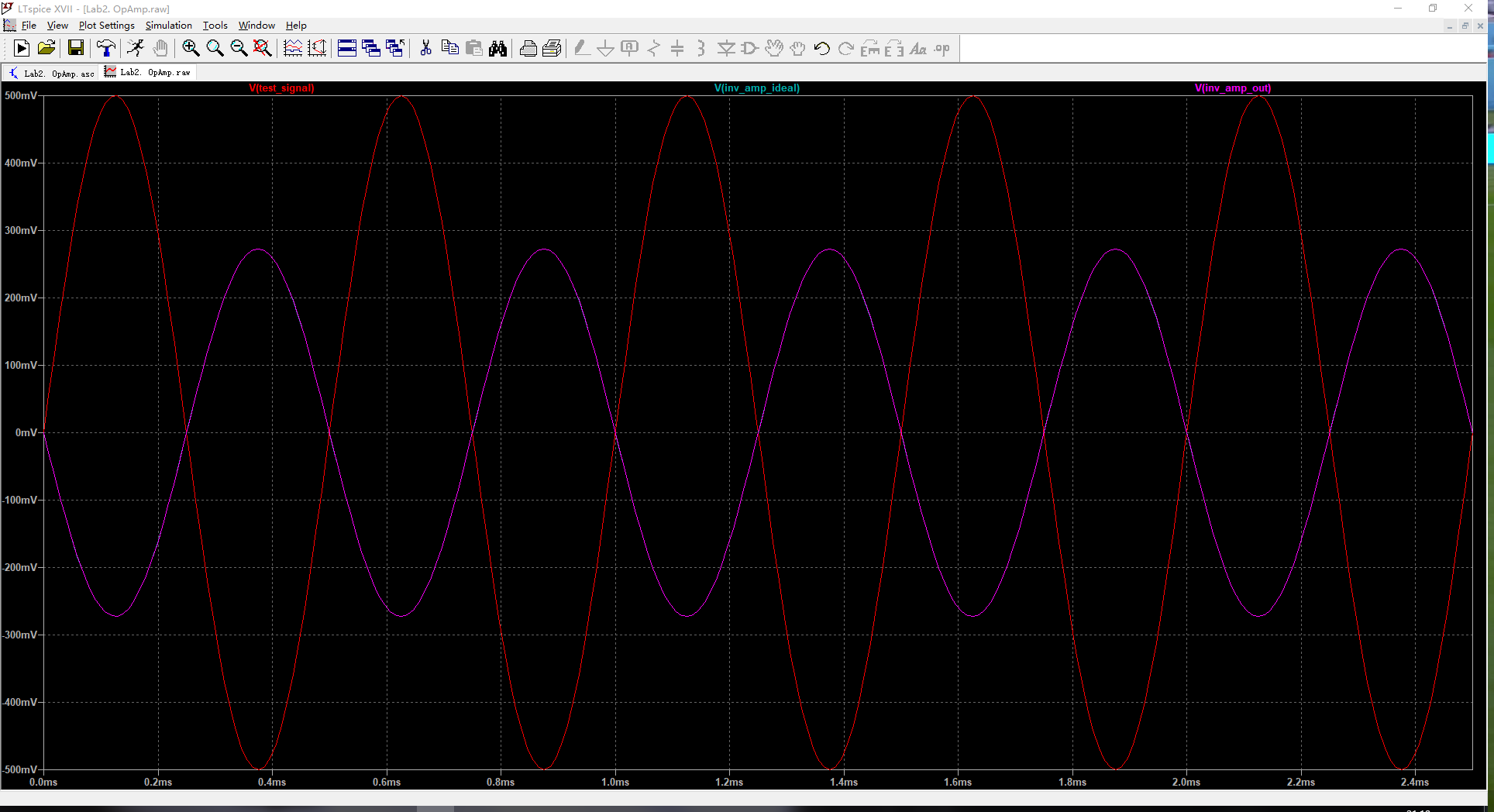


Figure 3.3 – Input and output voltages of ideal and real operational amplifiers

, , variation 1%, variation 1%

### (Hz)

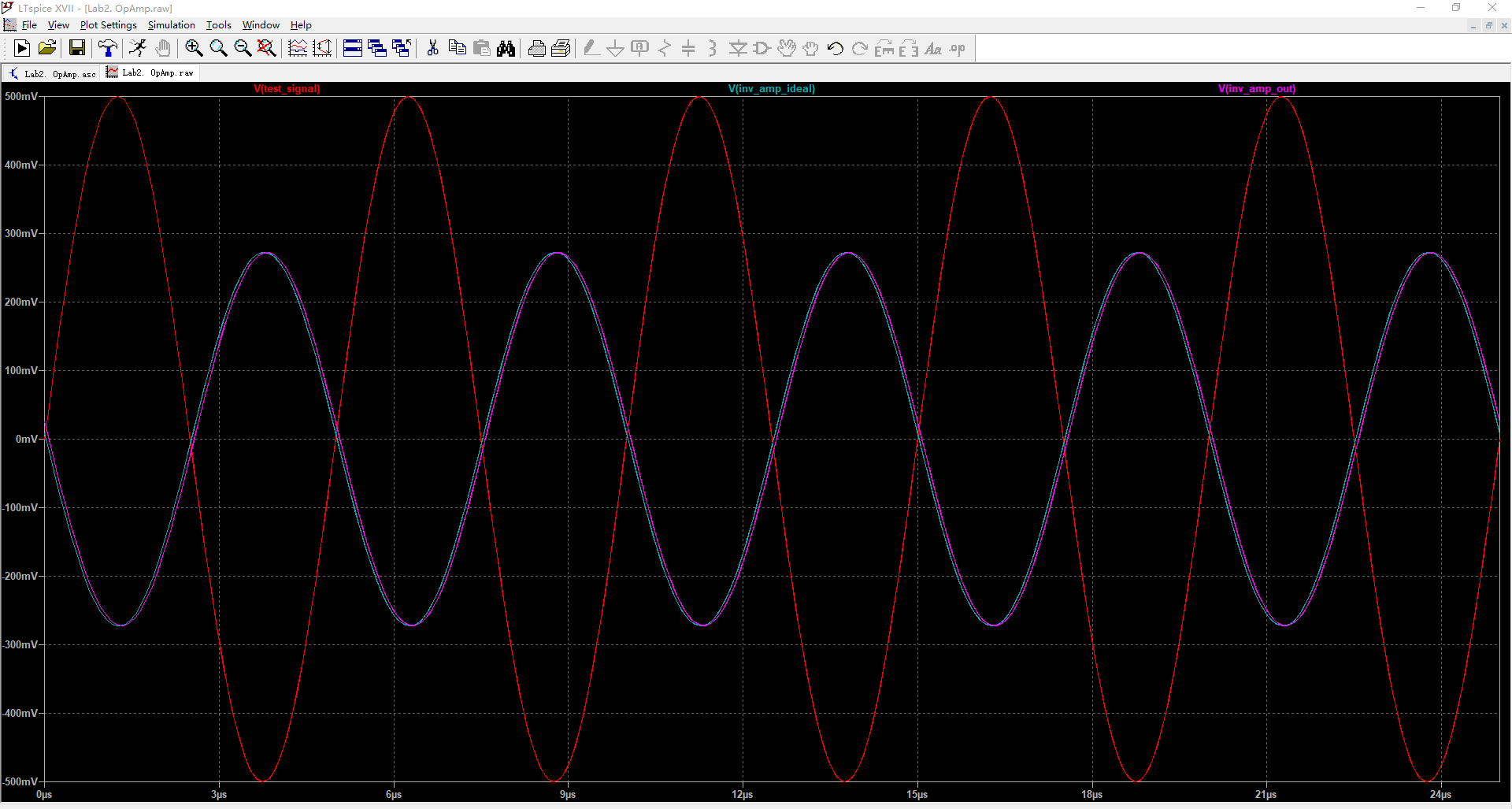


Figure 3.4 – Input and output voltages of ideal and real operational amplifiers

, , variation 1%, variation 1%

## Frequency domain simulation results

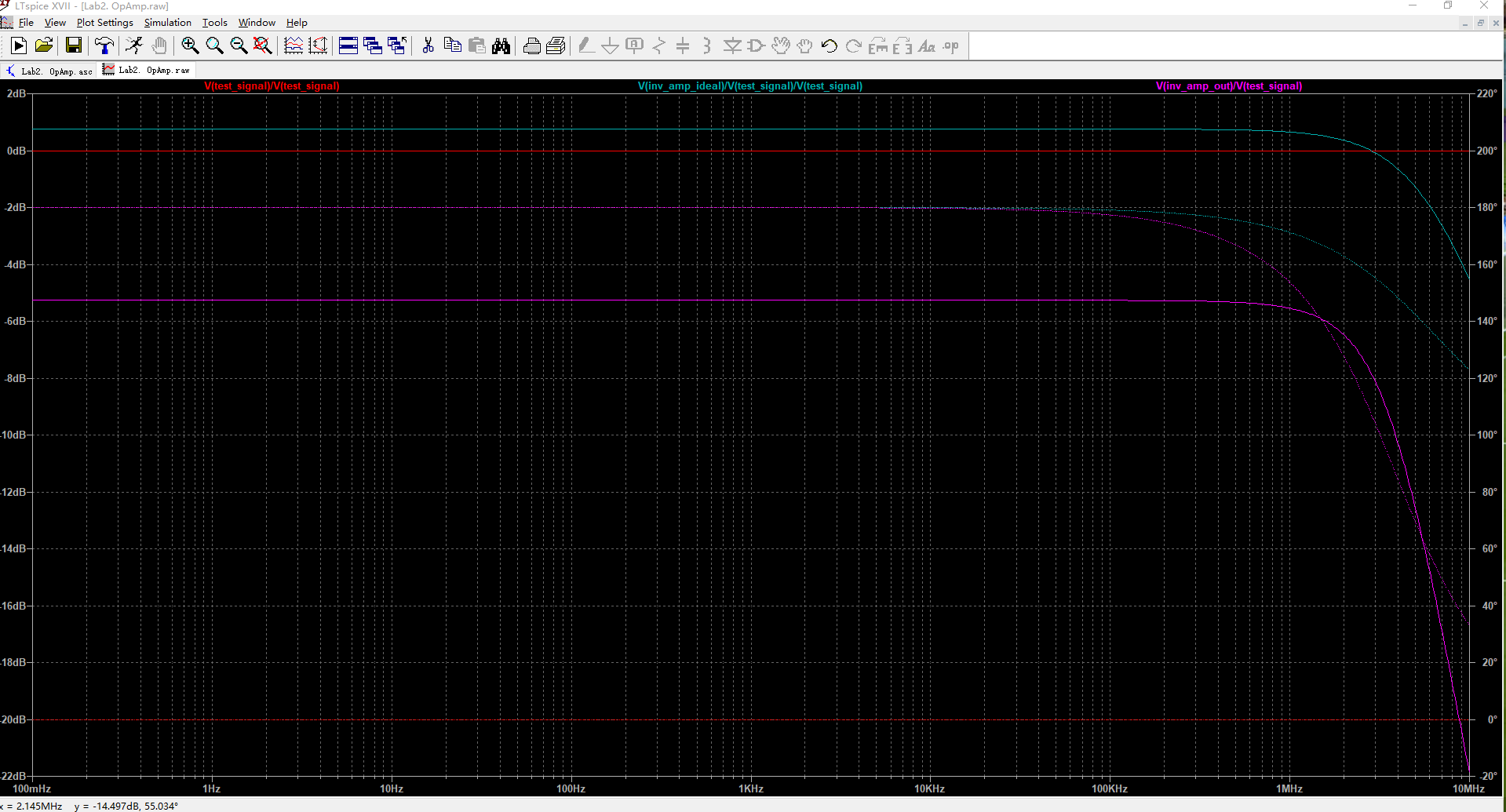


Figure 3.5 – Input and output voltages of ideal and real operational amplifiers

, variation 1%, variation 1%



Figure 3.6 – Input and output voltages of ideal and real operational amplifiers

, variation 1%, variation 1% and variation

### Simulation results

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Ideal** | **VarNo** | **Ideal** | **VarNo** | **Ideal** | **VarNo** |
| **frequency, kHz** | 100 | | **2000** | | **200000** | |
| **Vtest, V** | 0.5 | 0.499 | 0.5 | 0.501 | 0.5 | 0.5 |
| **Vout, V** | -0.27 | 0.269 | -0.27 | 0.271 | -0.27 | 0.27 |
| KNI\_exp | -0.55 | -0.54 | -0.55 | -0.54 | -0.55 | -0.55 |
| ΔKNI | 0.0202 | 0.0182 | 0.0202 | 0.0182 | 0.0202 | 0.0202 |
|  | 0.0202 | 0.0182 | 0.0202 | 0.0182 | 0.0202 | 0.0202 |
| KOL | -27.23 | -15.13 | -27.23 | -15.13 | -27.23 | -27.72 |

# Conclusions

Conclusions should contain:

1. Is it possible to realize amplifier with defined gain and gain tolerance?

Yes.

1. In which range can be load resintace variated?

10k ~ 100k

1. How was operational amplifier power supply modified?

By using vpp.