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Lab 5-Write Up

Introduction

The goal of this lab is to expose the properties of operational amplifiers and their applications through LTSpice simulation of op amps in common configurations. The different configurations of op amps introduce the varies uses and capability of op amps. The simulation reveals the features of an ideal op amp model while the physical model with the TLV272 demonstrates the variations in a physical design.

Discussion

5.6.1 Experimental Op Amp Measurements

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| --- | --- | --- | --- | --- |
| Table 1: Result from Physical Circuit | | | | |
| Parameter | Value |  |  | Percent Error |
| Offset (mV) | -1.5 mV |  |  | 81.1% |
| Slew Rate (V/µs) | 1/0.571 V/µs |  |  | 42.3% |
| Voltage Swing (V) | 10.015 V | Vmin: -5.016 V | Vmax:4.999 V | 0.15% |
| Effective Gain | 10.675 | Vin: 92.031 mV | Vout: 982.412 mV | 6.75% |

Table 1: Tabled result from testing the physical circuit design. Design is based on Figure 5.6 (a) in the lab manual. Percent error, using the pre-lab values as the theoretical and the in-lab values as experimental.

The percent errors from the table demonstrate a large difference between that of the ideal op amp created on LTspice and that of the physical design using the TLV272 chip for some parameters. The large percent errors in the parameters of offset and slew rate, the deviations are well above the natural 5% error, is mainly due to some incorrect calculations in the prelab thus influencing the value of the percent error. However, there were some reasonable percent errors as seen in the voltage swing and effective gain. For the voltage swing, the ideal range was a minimum of -5 V and a maximum of 5 V since that is what the power being supplied is, meaning the ideal swing is 10 V. But since in a physical circuit design, the tolerance of each resistors can vary, and the power being supplied might not be completely exact where this causes deviations minimum and maximum voltages thus affecting the voltage swing. It is noted that the percent error of the voltage swing is at 0.15%, a relatively small value that can hardly affect the circuit. For the effective gain, the ideal gain is 10 as there is a 10k ohm resistor on the loop and a 1k ohm resistor at the source. But, similarly to the voltage swing, the tolerance of each resistors can vary, and the power being supplied might not be completely exact thus able to cause deviations in the voltages going in and out of the circuit thus affecting the effective gain.

The ideal op amp, generated in LTSpice, should be used as a frame of reference to that of a physical model as to reduce the percent error of the values. In general, an ideal op amp is better to use because the values in an op amp are more exact and accurate. A physical circuit design should be used when testing applications to be implemented so that the variations of results are known and nothing “surprising” happens when the actual product is design. The accuracy of the LTspice op amp should be around 5% from a true ideal op amp.

Conclusion

In conclusion, properties of operational amplifiers and their applications were explored during the lab. LTSpice should be used to generate an ideal op amp as the percent error will be minimal, however the ideal op amp should be used as a reference rather than a true device. A physical op amp has inevitable human and mechanical error within the circuit design that influences the resulting values.