

ROBOTICS AND COMMUNICATIONS SYSTEMS ENGINEERING TECHNOLOGY
OPERATIONAL AMPLIFIERS LAB
3RD SEMESTER, SR. INSTRUCTOR TIM LEISHMAN

General Objective:

Upon completion of this lab, the student will be able to:

- A. Calculate voltages, currents, gains, slew rate, common mode rejection ratio for differential & operational amplifier circuits.
- B. Construct, measure, and demonstrate the proper use of the test equipment.

References:

- Theory notes
- First Year Text & Lab books
- [LM741 Datasheet with offset null](#)
- [MCP6002 Datasheet](#)
- [TL071 Datasheet](#)

Check-Off Sheet:

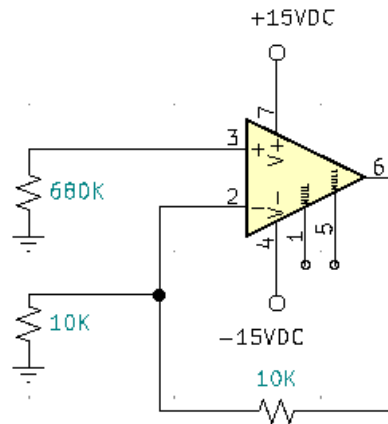
- [Check-Off Sheet](#)

Specific Objectives:

Notes.

- a. Theory Notes
 - b. First year Text & Lab books
1. Operational Amplifier Review
 - a. Write in your lab book the two rules for an Op-Amp.
 - b. Describe voltage gain open loop vs. closed loop.
 - c. Show Operational Amplifier common configurations.
 - d. Show steps for calculating voltage gain.
 - e. List the slew rate and CMRR specification found in the data sheet for the LM741, MCP6002, and TL071.
 - f. Show in your lab book how to test and measure slew rate.
 - g. Demonstrate a slew rate measurement.
 - h. **Instructor Check 1f.**

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2. Offset Null
 - a. Assemble the above circuit.
 - b. Measure the output DC offset voltage and record it in a table.
 - c. Calculate the balancing resistor that the circuit should have and replace R_B with the proper resistance. Re-measure the output DC offset voltage and record it in the table.
 - d. Properly connect the offset null pins for zeroing DC offset of the operational amplifier. Adjust for a zero-offset voltage. Document in your lab book the zeroing procedure and what you learned.
 - e. **Instructor Check**
3. Calculate and construct an Op-Amp Differential Amplifier with the same gains from your Transistor Differential Amplifier Lab. Compare the common mode and differential mode gains, and the CMRR of both circuits. **Instructor Check**
4. 3-Stage Operational Amplifier
 - a. Design a Single-Stage Operational Amplifier with the following specifications:
 - R_L is 10Ω
 - Voltage Gain Total is -425.
 - Prior to connecting to the circuit, the generator is set to 60mVpp (unloaded).
 - b. Show all calculations for your design including High Critical Frequency.
 - c. Repeat steps a & b with a second stage (one inverting & one non-inverting)
 - d. Repeat steps a & b with a three stage (one inverting, one non-inverting, your choice)
 - e. **Instructor Check**
 - f. Build, measure and annotate data in lab book.
 - g. **Instructor Check**

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~~5. Voltage Bounding~~

- ~~a. Design a voltage bounding circuit that will prevent output signal from varying above a specified (instructor assigned) level. The load resistance is 2.2K.~~
- ~~b. Build and test circuit.~~
- ~~c. **Instructor Check**~~

6. Comparators

- a. Design a circuit using Op-Amp Comparators to light one LED requiring 10mA, when a 5V supply goes above 6.0V or below 3.9V.
- b. **Instructor Check**
- c. Use Voltage Bounding to adapt the circuit to provide TTL high and low outputs.
- d. **Instructor Check**

7. Complete Conclusion and submit completed Check-Off sheet and Lab writeup in Moodle.