

Assignment 8

1 Design Exercises

Feel free to use Multisim to test and confirm your derivations. However, Multisim by itself does not prove anything! We need to see derivations.

1.1 (5 points)

Assume that someone sends an input of 1V DC to the input of an integrator. Select components of such integrator, so it will take the output to reach 15V (power rail) from 0 V value about 50 seconds.

1.2 (5 points)

Suppose someone gave you a capacitor and two resistors to build a differentiator with an OpAmp. Your goal is to replicate the **shape** of a signal derivative as good as possible in practice. Would you take a larger value or a smaller value resistor for this task. Why? Hint: you need to think about the limits set by the open loop gain frequency dependence of any practical OpAmp.

1.3 (10 points) (Can be done after the lab)

Someone has 3 independent signals to send into a circuit: $V_{in1}, V_{in2}, V_{in3}$. Design a circuit which output is $20 \times (V_{in1} + V_{in2}) - 10V_{in3}$. Hint: it is much easier to do with adders than with differential amplifiers.

2 Lab 8:

Always start with a circuit diagram and only then build it in hardware.

Your notebooks must be complete, understandable, and address all activities, design exercises, observations, and questions noted in the laboratory's procedures. Remember to use your notebook as a laboratory journal and record your data, design calculations, notes and scratch work. *Make sure to write a conclusion for each exercise and each week.*

Task 0

Demand

- a reminder/review about slew rate, how would it affect the differentiator or integrator
- a reminder about oscillating differentiators and how to compensate

Task 1 (20 points) Differentiator

Use LM741 to build a differentiator circuit. Make a set of measurements to confirm that it works: send sinusoidal, triangular, and square shapes to the differentiator input.

Do you see a deviation from the ideal behavior? Explain.

Task 2 (20 points) Integrator

Use another LM741 and build the integrator. Make a set of measurements to confirm that it works: send sinusoidal, triangular, and square shapes to the integrator input.

Do you see a deviation from the ideal behavior? Explain.

Do not disassemble yet.

Task 3 (10 points) Undo differentiation

Connect the output of your differentiator to the integrator. In ideal word you should see exactly the same (subject to some multiplier) signal at the output of the integrator as at the input of the differentiator. Is it so? Sinusoidal input is quite boring for this test, try triangular and square.

Do you see discrepancy? Explain.

Play with different components values and try to improve match of the input to the output. Remember that we care about shape replication not the size. Hint: smaller gain might be better. Explain your choices or/and observed behavior.