Unit 2 Report: Motor models, oscillators and PWM

Report overview

Lab assignments 5-9 have had you focus on new ways to more accurately model your motors, how to build oscillator circuits and how to use them to implement pulse width modulation. At the core of these labs you have made use of circuit building basics and motor control essentials that you covered in the first four assignments.

In this Unit 2 report we would like you to reflect on the circuit designs and concepts you have covered in lab 5 through 9. **Expand on how each assignment builds upon the prior one, culminating in a refined motor drive circuit**. Your report has no minimum or maximum length but you are expected to give a well-formatted report containing thoughtful evaluations *as well as measured data and plots* in support of your report.

Report requirements

Please review your prelab and lab outlines. Consider using the questions you've answered in lab to guide your comments and reflections. Please include data, plots, and figures as appropriate to clarify your point. Submit a report that is between 4 and 6 pages in length including text, data, plots, and figures.

In addition to your reflections and summaries, your report should preferably address some of the following aspects:

- Back-EMF suppression of the motor by using a diode (reference Experiment 8). Explain the function of the diode, which is connected in reverse parallel to the motor.

- All of the oscilloscope's black probes (ground leads) are connected internal to the scope. The issue of the earth ground connection of the oscilloscope (reference Experiment 8, Figure 1)

    o What would happen in the three possible measurement configurations:

        ▪ Both ground leads connected to the positive battery terminal

        ▪ Both ground leads connected to the MOSFET drains

        ▪ One ground lead connected to the positive battery terminal, the other ground lead connected to a MOSFET drain

    o How would each motor behave? What measurements would you expect to see on the oscilloscope?

- Pulse width modulation control of our motors

  o What are the advantages of PWM versus a variable voltage source? Make note of the physical properties of the motor.

- The improved IV models of the motor (reference Experiment 6)

  o Compare the Ohmic model, *Rm*, of the motor to the Thevenin Model (Experiment #1 vs. Experiment #6). In terms of physical properties, why do the ramp up and ramp down IV profiles differ? Are their slopes similar? Why or why not?

- The role of buffer circuits

  o What circuit elements in our overall design (reference Experiment 8, Figure 3) are acting as buffers? Why do we use them? What could happen if we did not include these buffers?

- Other items of interest you saw along the way (clean builds, hints for troubleshooting, etc.). Make your report individualized based on your interests!

Things to avoid

Your lab report should be clearly written and thorough. Avoid the following pitfalls:

- Vague, nonspecific statements.

  o Example of vague statement: The circuit performed better. What does that mean?

  o Instead, describe your circuit behavior clearly with references to appropriate voltage, current, and power values (with units included).

  o Example of a clear and supported statement: The addition of a capacitor in parallel reduced the variance of the voltage measured across the motor. This modification to the circuit made it easier to measure the DC voltage across the motor with the oscilloscope with little change in performance.

- Referring indirectly to circuit values

  o Instead, support your statements with values measured in lab by showing them in tables and plots. Refer to specific nodes and reference or include appropriate circuit diagrams.

- Poor formatting and grammar

  o Instead, proofread your report and make it easy to read. The report should clearly convey what you've learned in lab and your observations.

Just do your best and feel free to discuss these topics with classmates, but **do not just copy answers** or you will be penalized for plagiarism.