

16.317: Microprocessor Systems Design I

Spring 2013

Lab 4: Stepper Motor Control using PIC Microcontrollers

Due **Wednesday, 5/1/13**

Introduction

In this lab, you will use the PIC 16F684 microcontroller to control a bipolar stepper motor by generating a series of control signals that will rotate the motor. Because the motor is a current driven device, your microcontroller should connect to the motor through an H-bridge driver, using the schematic shown on page 2.

You may use the .asm file provided on the web (*bipolar_control.asm*) as a starting point.

For a detailed description of stepper motors and how they work, please visit either of the tutorials in references [2] and [3] given below.

Remember that each student must generate an individual report that follows the guidelines listed in the “Lab Report Format Guidelines”, and that the last page of this assignment contains a cover page each student must use as the first page of that report.

References

[1] PIC16F684 Microcontroller Datasheet

[2] R. Laidman, Stepper Motors and Control, Part II - Bipolar Stepper Motor and Control, <http://www.stepperworld.com/Tutorials/pgBipolarTutorial.htm>

[3] D. Jones, Stepping Motor Types, <http://www.cs.uiowa.edu/~jones/step/types.html>

Assignment Details

You will use the schematic shown on the next page, which shows the connection of the PIC16F684, driver circuit and bipolar stepper motor. The parts used in the design include a 0.1uF capacitor, one L293D dual H-bridge driver, one stepper motor, and 8 diodes. (Diodes and chip sockets are available from the stock room.). Note that $V_{dd} = 5V$.

Please note the following:

- You will complete this circuit on your own breadboard—you'll only use the PICkit to program your microcontroller in this assignment. All connections should be made directly on your board.
- Please use a chip socket to hold the microcontroller, rather than plugging the chip itself directly into the breadboard or PICkit evaluation board. Doing so will prevent you from damaging the microcontroller while moving it from one board to the other.

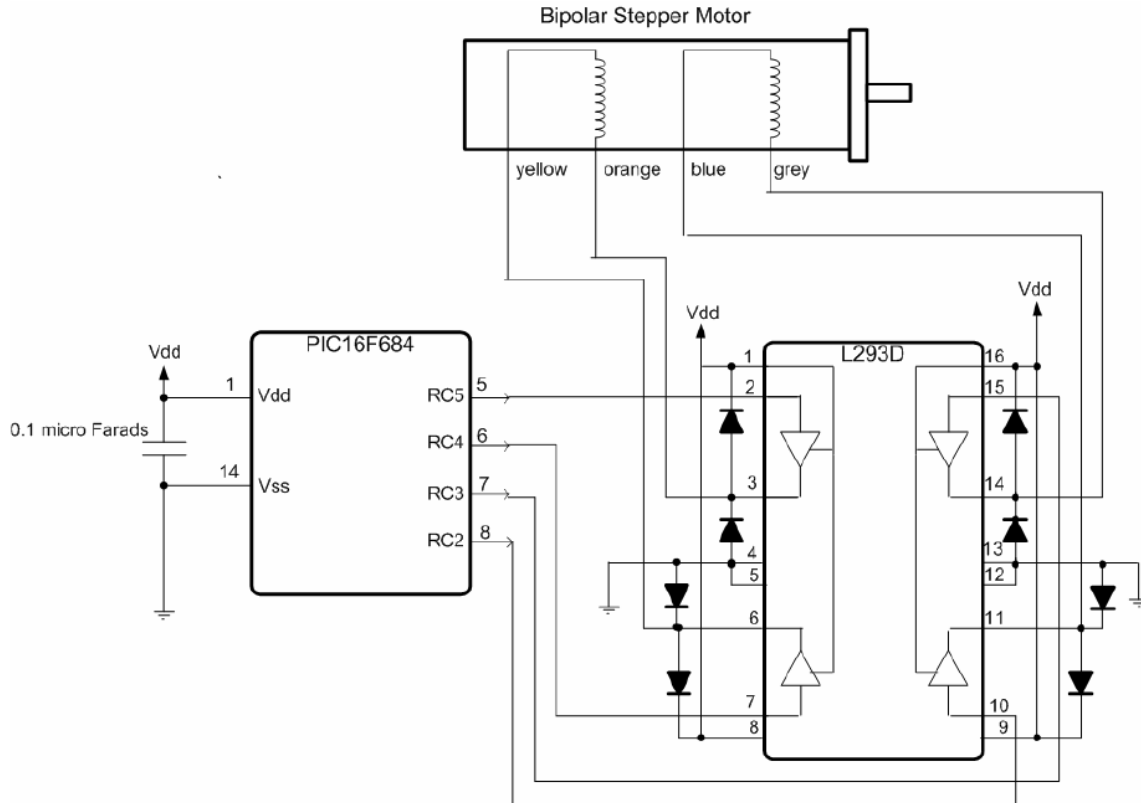


Figure 1: Circuit schematic for motor control circuit. Note that $V_{dd} = 5\text{ V}$.

Assignment notes (cont.)

- As noted below, you will be required to demonstrate that (a) your microcontroller outputs are correct and (b) your driver chip outputs are correct as part of the check-off process. **You must complete both of these steps before you will be allowed to test your circuit with a motor.**

Check off and deliverables

The check off requirements for this lab are listed below; note that some sections require you to generate data to be included in your report. **I strongly suggest reading the grading rubric on the next page to ensure your program meets all requirements for this lab.**

1. Demonstrate the pattern of the four output pins (RC2-5) of PIC16F684 using the oscilloscope. (10%)
 - Record the oscilloscope waveform and include it in your report.
2. Demonstrate the driver circuit wired on your breadboard and show the outputs of the driver chip (pins 3, 6, 11, 14) on the oscilloscope. (20%)
3. Demonstrate the rotation of the stepper motor (20%)
 - Measure the rotation speed and include it in your report (reporting either seconds/rotation or rotations/second is acceptable)
4. Vary the rotation speed of the stepper motor (30%)
 - Explain in your report how you change the speed and what new speed you use

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You must include this sheet as the cover page of your lab report. Fill in your name and your partner's name (if applicable). The table below provides the grading rubric for this assignment, as well as space for an instructor to record your grade for each section.

Student name: _____ **Student ID #** _____

Partner(s): _____

Grading rubric

| Item | Description | Max points | Actual points |
|--------------|---|------------|---------------|
| Demo 1 | Demonstrate the appropriate pattern on the output pins of the microcontroller. | 10 | |
| Demo 2 | Demonstrate the correct outputs from the driver chip after correctly wiring the entire circuit. | 20 | |
| Demo 3 | Demonstrate that your circuit correctly drives the stepper motor and causes it to rotate | 20 | |
| Demo 4 | Demonstrate that, after modifying your assembly program, you are able to modify the rotation speed of the motor | 30 | |
| Report | Complete your report according to the required format. Be sure to include all information described in the "Check off and deliverables" section of the lab. | 20 | |
| TOTAL | | 100 | |