School of Electrical Engineering and Computer Science

CptS466: Embedded Systems

Fall 2021

Project 5 (P5)

Code & Report Due: 11/08/2021 @ 11:59pm (Canvas)

Demo Due: 11/08/2021 in the class

1. Preparation

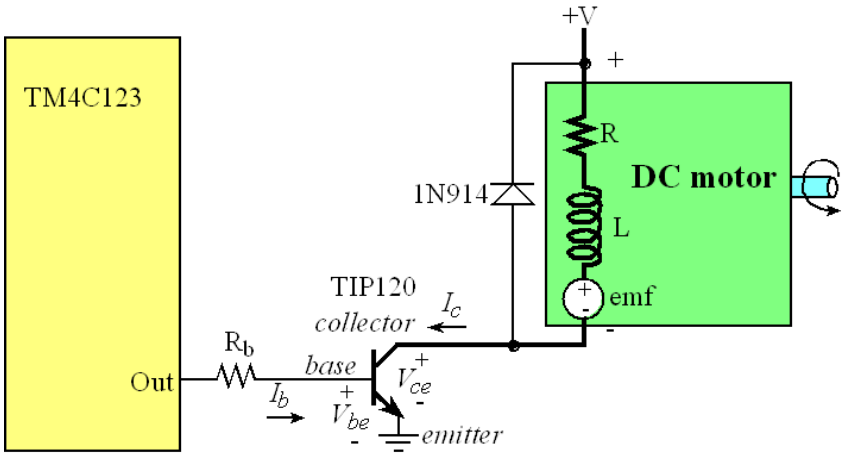
You will need the LaunchPad, Bluetooth module, DC motor, TIP120 transistor, IN914 diode, 3.7V LiPo battery, 1K resistor, switch, red LED, Breadboard, and some wires. You will use a terminal application such as CoolTerm to perform serial port communication on the PC.

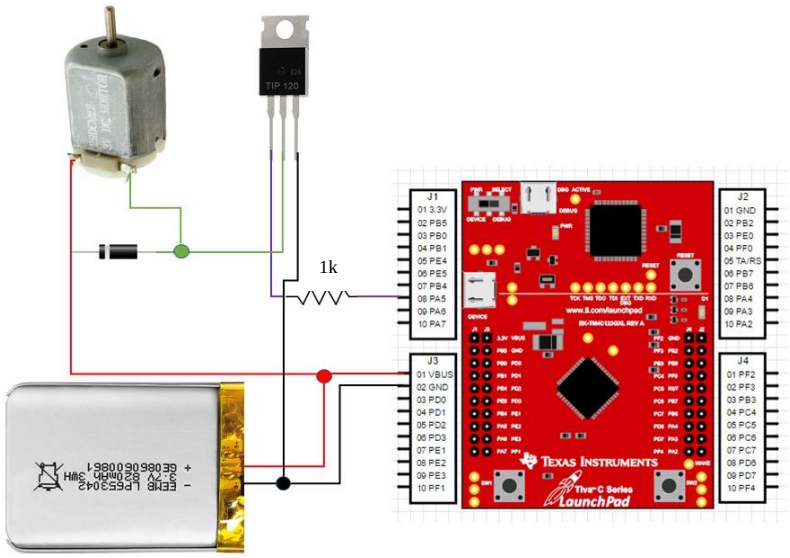
2. Project Description

In this project, you will design a system that can control the spin speed of a fan (DC motor). Your software will use a periodic interrupt to control the speed of the motor. Your hardware will provide the required energy for the DC motor to operate. In addition, we need to power the whole system through a battery. We determine the fan speed using both the switches on the launchpad and Bluetooth communications. As we know, the launchpad has two switches. Therefore, we can use one switch to gradually speed up the fan and the other switch to gradually slow down the fan. However, we can have more control while communicating with the launchpad. As a result, we can set our desired speed using a Bluetooth connection. We can also use Bluetooth communications to check the status of the motor by readings its current speed.

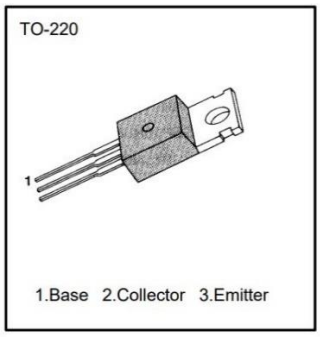
We need to use an external battery to power the motor because the DC motor requires more current than the launchpad could generate. Launchpad pins can provide an 8mA current, which cannot be used to derive the dc motor. The DC motor could draw about 500 mA current! Therefore, we use a TIP120 transistor which amplifies current. In addition, we use 1N914 diode as a snubber diode. This is used in systems running on DC current, and it utilizes a rectifier diode as the snubber. It basically works like this: the diode is wired in parallel with the load (like an electric motor), but it is set up so that it does not

conduct under regular use. When the current is interrupted, the inductor current flows through the diode instead. The stored energy is then slowly released via the diode voltage drop. The below circuits show the proper connections of the mentioned components.

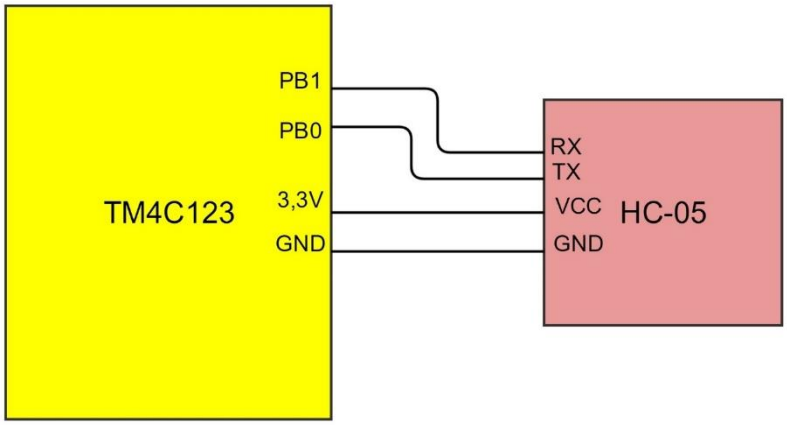




You can look up the datasheet of TIP120 to find the corresponding pins. As can be seen in the following figure, the left pin of TIP120 is the base, and the right pin is the emitter.



You can interface the HC-05 module similar to the previous project. You can choose any UART function except UART0 which is hardwired to the USB cable.



Here are some additional requirements.

- We will use the default settings of the Bluetooth module. The baud rate is 9600, 8-bit word length, no parity bits, one stop bit, FIFOs enabled. The password of the module is 1234 if you have not changed it.
- Use 80 MHz as the system clock.
- Interface a switch to turn on and off the motor for safety. In addition, turn on the LED, when the system is on!
- The motor speed level will be displayed via Bluetooth module on your computer/phone.
- Consider eight different levels for the motor speed.

3. What to submit?

Submit a .zip file with the following content:

- Your well commented C source code implementing the application described above.
- A report that documents your development process, explanation of the experiments conducted, discussion of your observations, and a discussion of your design decisions.
- All experimental data collected (the data files).

Show a demo of your application in the class on the due date.

4. Report

In a separate written document (in Word or PDF), compile sections A through C as follows:

System Design. Briefly, in one paragraph, describe your high-level design. Discuss any specific observations that you had, any difficulties that you ran into while designing or testing the system. Discuss various parameters of your Interrupts (edge-triggered, periodic, power control).

5. Grading

Assume that the whole assignment is worth 100 points.

- 35 pts for well commented and correct C source code satisfying the project requirements.
- 35 pts for report.
- 30 pts for demo.