

EECS 388 Laboratory Exercise #07

Pulse Width Modulator and Servos

Demonstrate in Lab the Week of: November 14, 2018

1 Introduction

In this lab you will write a task to configure a Pulse Width Modulator (PWM) and use the PWM signal to drive a small servo.

2 Rationale

Servos are used in many applications as an actuator, for example ailerons, elevator, and rudder control on radio controlled airplanes. PWM signals can also be used to control the speed of a motor such as found on quad-copters.

2.1 Program Modifications

Make a copy of the ADC project from Lab #05. You will add a task as described below. You should remove the ADC task that reads the potentiometer voltage.

2.2 PWM Background

The operation of the Pulse Width Modulator was described in class. The steps to program the PWM are outlined below. Additional information on the PWM hardware and DriverLib software are at:

http://www.ittc.ku.edu/~gminden/Embedded_Systems/PDFs/TI_ConnectedLaunchPad_UM_spmu365c.pdf,

http://www.ittc.ku.edu/~gminden/Embedded_Systems/PDFs/TI_TM4C1294NCPDT.pdf, and

http://www.ittc.ku.edu/~gminden/Embedded_Systems/PDFs/TI_TIVA_DriverLib_UG-2.1.0.12573.pdf.

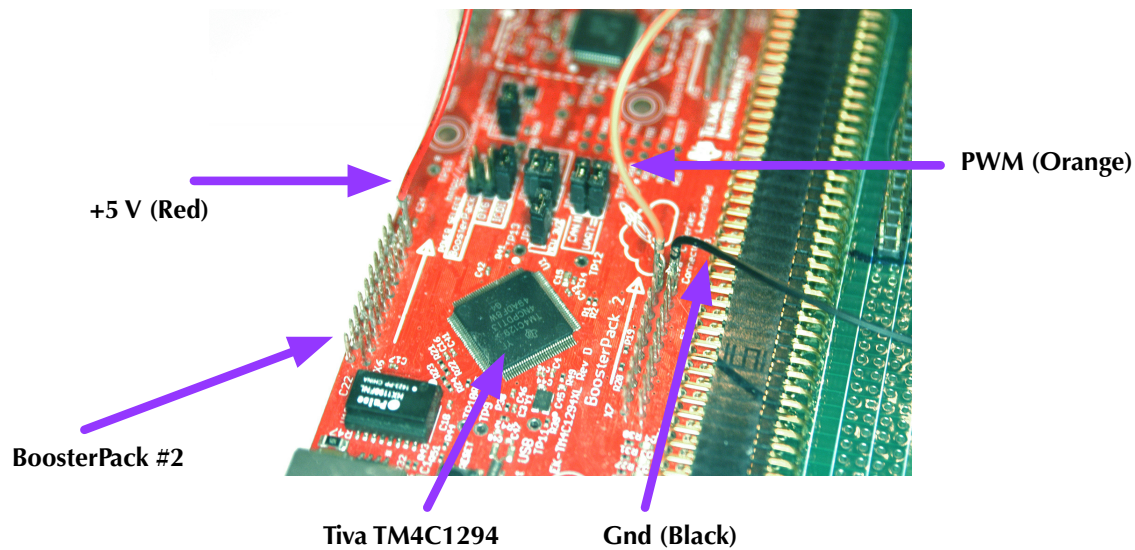
You should read those documents. In particular read the example PWM code in the DriverLib document.

Watch out for line-breaks in the URLs.

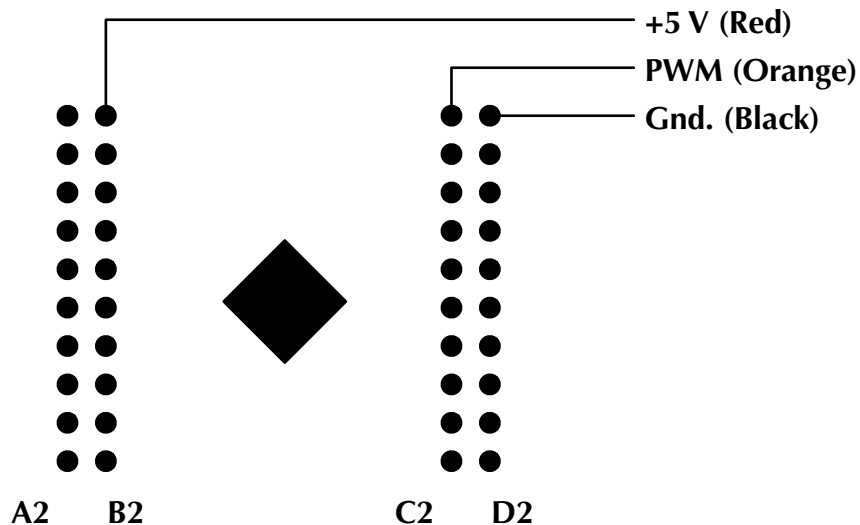
2.3 Connector Pin-outs and Servo Connections

Servos require three connections, Ground (Gnd), Power (5.0 V), and PWM signal.

For this laboratory we will connect the servo to three pins on the Tiva Evaluation Board. We will use pins in the BoosterPack #2 position. The following picture shows the BoosterPack #2 position on the board and wires connected to the necessary signals. Use jumpers provided in lab to connect the BoosterPack #2 pins to the servo.



The following schematic shows a top-down view of the pertinent servo connections to BoosterPack #2 pins. You do not need to use the same wire colors, just make sure you keep the connections straight.



Power and Ground are fixed on the Tiva Evaluation Board. We need to determine which PWM signal to use. Pin C2-1 (top of column) is connected to M0PWM5. M0PWM5 is PWM module 0 and PWM generator 2. See Figure 23-2 in the TM4C1294 datasheet. M0PWM5 will use the second output of generator #2 rather than the first (M0PWM4) output in the example code presented in lecture. The M0PWM5 signal is on GPIOG<1>, that is GPIO port G, pin 1. This is different from the example code presented in lecture.

3 New Tasks

Write a new FreeRTOS task to generate the PWM signal and control the servo. The PWM signal shall have a period of 20 ms. The pulse width shall vary between 1.0 ms and 2.0 ms with a period of 1.0 s.

The task will do the following steps (states):

1. Initialize the required peripherals.
2. Alternate between 1.0 ms, 1.5 ms, 2.0 ms, and 1.5 ms pulse width with a pause of 1.0 s between states.

3.1 Initialization Step

Initialize the required peripherals.

Configure M0PWM5 for a period of 20 ms.

Determine the values to generate either a 1.0 ms pulse, 1.5 ms, or 2.0 ms pulse. Use 1.5 ms as the initial pulse width.