Laboratory Worksheet #07
PWM - Frequency and Pulsewidth Exercise

On LMS, in the Lab 3 folder, the *worksheet_07.c* code is provided to demonstrate the operation of Pulse Width Modulation (PWM). The Pulse signals are characterized by two attributes, the period (T) of one cycle which is controlled by *PCA_Start* in the program and the pulse width (PW) which is controlled by *PW* in the program. A shorter period corresponds to a higher frequency. A high duty cycle, $DC = \frac{PulseWidth}{Period} \times 100\%$, corresponds to a relatively large pulse width.

Exercise 1: PCA When answering the following questions, refer to the *worksheet_07.c* code.

1) What is the size of the PCA counter (in bits)?

16

2) What triggers a count in the PCA?

SYSCLK/12 overflow

3) What is the interrupt priority of the PCA?

9

4) If *PCA_Start* = 47000, how many counts will occur before the counter overflows? What is the period for this setting (time it takes to count from 47000 until it overflows)?

18535, 10.06ms

5) Using the above start value, if PW = 3000, what is the pulse width in seconds? What is the Duty Cycle?

0.001628s, 16.19%

Now, for a different example, determine PCA_Start and PW for a pulse train with a 3 ms period and a 35% Duty Cycle using a 16 bit counter triggered by SYSCLK/4.

PCA_Start = 48946

PW = 5806

Exercise 2: Hardware

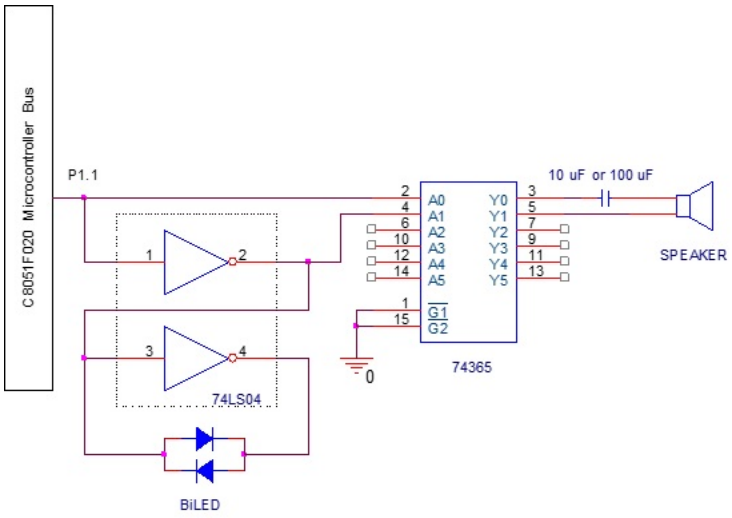

Figure 1: Potentiometer Circuit

1) Build the circuit as shown above. Note: you will need to obtain a speaker from the TAs. Speakers convert periodic electrical signals into corresponding tones. The buzzer you already have in your kits will NOT work since it only needs a voltage to provide a specific tone based on its internal circuit.

2) Download and run the sample program, Worksheet_07.c, from the LMS website.

a) Part A, changing duty cycle

a. Set *PCA_start* to 1000.

b. Change *PW*, the pulsewidth, and observe the effect on the LED..

At one extreme limit of the pulsewidth, the LED will be mostly green in color and at the other extreme limit, it will be mostly red in color. Explain this behavior.

As the BILED is wired to display the amount of high or low output of CEX1, the amount of one color will change when the duty cycle (PW/period) moves from 0% to 100%

b) Part B, changing duty cycle

a. Set the pulsewidth, *PW*, to 4000.

b. Change the PCA start value, *PCA_start*h, and observe the effect on the speaker output.

At one extreme limit of PCA_start, the frequency will be low and at the other extreme limit, it will be high. Explain this behavior.

Since the speaker vibrate accordingly to the output frequency of CEX1, when PCA_start increase, the period gets shorter therefore the frequency gets higher (f=1/T).

3) When you use the logic probe to test your PWM output, how does the indicator light behave?

Its blinking rate changes accordingly.

When complete, include Worksheet 6 with your Laboratory 2 Pre-lab submission.