EE 444/645

02/09/2023

Lab #1: MSP430: Clocks and Digital I/O

Report due: 02/16/2023, by 2:00 pm

INTRODUCTION

The main goal of this laboratory is to get familiar with the TI MSP-EXP430F5438A experimenter's board, CrossStudio, and the process of downloading, executing, and debugging programs on MSP430-based boards. In addition, you will use Digital IO capabilities of MSP430, timers, and interrupts to measure time intervals.

EQUIPMENT

CrossStudio for MSP430, TI MSP-EXP430F5438A board, Agilent mixed-signal oscilloscope

ASSIGNMENT

Set the MCLK of MSP430 as close as possible to 25 MHz and capture it using an oscilloscope to make sure you are running at the correct frequency. Remember that the pins used to measure the frequency of clocks are also used as general purpose I/O pins, which means that you will have to set them to perform a "special function."

To run at 25 MHz, the core voltage must be set to the maximum level. You can adjust the core voltage using the provided *IncrementVcore()* and *DecrementVcore()* functions that change the PMMCOREV value in the register PMMCTL0 located in the PMM module. Each time you call those functions from your program, they will increase or decrease core voltage by one step. You can monitor the PMMCTL0 register in the debugger. To use these functions, add them to your project. Before you proceed with the rest of this lab, measure the V_{CORE} voltage (there is a test point called VCORE on the board) for all levels of PMMCOREV and compare it to the voltage levels listed in the datasheet. For example, you can step through that part of the program and make a measurement at each level.

For the main part of this lab, you are asked to write a program that precisely measures the time between two consecutive button presses. Your program should use interrupts and *one of the Timers* to implement this functionality. As we learned, the higher the frequency of the clock, the more precise your measurements are going to be. On the other hand, high frequency will lower the length of the time intervals you can measure without additional software delays. For this assignment, it is acceptable to set the break point in order to check the time measurement results, or to display the results inside the debugger.

Use an oscilloscope to confirm the results of your time measurements. The easiest way to do this is to toggle a pin each time you press a button and capture that signal. Check carefully the datasheet for the MSP-EXP430F5438A board to find available pins that you can easily access on the board. Read the entire assignment before you start working on it.

Demonstrate the functionality of the program to the instructor/TA.

PREPARATIONS

To prepare for this lab:

1. Attend lectures on Timer A on Tuesday and Thursday
2. Review the slides after the lectures
3. Read the introduction into Chapter 8 and Section 8.3 from the Davies' book (if you have access to it). Alternatively (or in addition to) read Chapter 17 from the User's Guide for 5xx/6xx family, ending with at least the "17.2.4.1 Capture Mode" section.

REQUIREMENTS

Use the lab report template provided on Blackboard. The report should also include:

- A listing of your program(s) with a reasonable amount of comments
- Vcore voltage measurements (comparison table and an oscilloscope screenshot for one of the measurements).
- Comparisons of the measurements obtained using the MSP430 timer and the oscilloscope measurements; include relevant oscilloscope images.

PLEASE SUBMIT YOUR REPORTS AS MS WORD FILES, THROUGH BLACKBOARD