

# **Embedded Systems and Applications**

## **Lab – 2 Hello Launch pad**

### **PREPARATION**

You will need a LaunchPad and access to TM4C123\_LaunchPadUsersManual.pdf.

### **STARTER PROJECT**

Lab2\_HelloLaunchPad

### **PURPOSE**

When first learning a new programming language it is tradition to begin by running a program that outputs the message “Hello World”. Later you will write your own programs, but in this lab, you will simply run a program that is written for you. The input and output on the microcontroller come from physical devices like switches and LEDs. Consequently, our “Hello World” will ask you to push a switch and observe an LED. The purpose of this lab is to work through the process of configuring the development system for the microcontroller board.

In this lab you will not need to write any software (just run the software provided) or build any hardware (just use the LaunchPad with the switches and LED already connected). You will be installing the software required for the labs. You will run a program that is written for you.

### **SYSTEM REQUIREMENTS**

The system will have one input and three outputs. The input is a switch called SW1, which is connected port pin PF4. Three outputs (PF3, PF2, PF1) are connected to one multi-color LED. The color of the LED is determined by the 3-bit value written to the outputs. If SW1 is not pressed the LED toggles blue-red, and if SW1 is pressed the LED toggles blue-green.

### **GETTING STARTED (Installing the Software)**

**Part a)** The first step is to install the Keil uVision integrated development environment (IDE) for the ARM. This IDE includes the editor, compiler, simulator, and debugger. The **MDK-Lite (32KB) Edition** does not require a serial number or license key.

**Part b)** The second step is install Test EXecute and Simulate (**TExaS**). TExaS is a set of enhancements to Keil that will serve as your helper during this course. This installation will also setup the example projects and starter files for labs.

**Part c)** The third step will be to install the hardware device drivers for your LaunchPad. You will need the LaunchPad hardware to perform this step.

The instructions for all three steps can be found at:

<http://edx-org-utaustinx.s3.amazonaws.com/UT601x/download.html>

### **DEBUG IN SIMULATION (Running the lab in simulation mode) (40 Points)**

For each lab we will first design, develop, and debug in simulation. Since Lab 1 does not require you to build any hardware or software, all you will do here is run the example program in simulation mode. This step also verifies you have properly installed Keil and TExaS, and you can interact with the automatic grader. You will find the example files and starter codes for lab in the \Keil\Labware directory. In particular the Lab 2 starter code is in the directory \Keil\Labware\Lab2\_HelloLaunchPad

1) Open the Lab2 project file, which is the file Lab2.uvproj in the Lab2\_HelloLaunchPad directory.

2) Verify it is configured to run in the simulator

Click on **Project** → **OptionsForTarget** → Select **Debug** Tab → Select **Use Simulator** option

3) Build the project (F7)

4) Start the debugger (CTRL + F5) in simulation mode

5) Run the program and interact with the switches, notice the LED outputs

6) Hit the grade button and wait for the grader to finish. When it displays 100, your TA will give you 40/100 points in this lab.

If you do not see the window with the Port F input/output, execute Peripherals->TExASPortF. Another trick to reset all the windows in their default position is to execute Window->SetViewToDefault.

### **DEBUG ON THE REAL BOARD (Running the lab on the real board) (40 Points)**

After we have completed the lab in simulation, we will switch over and debug it on the real board. Again, Lab 1 does not require you to design any hardware or write any software, so in this lab we will simply run the existing software on the actual LaunchPad. Connect the Launchpad to the PC using the USB cable.

0) Open the project file, which is the file **Lab2.uvproj** in the Lab2 directory.

- 1) In Keil, execute **Project->OptionsForTarget**. In the **Target** tab, select **TExaS** in the **Operating System** drop-down menu.
- 2) In the **Debug** tab, click the Use radio on the right and select the **Stellaris ICDI**.
- 3) Compile the project by executing **Project->Build Target**
- 4) Download the object code into Flash EEPROM of the Launch Pad by executing **Flash->Download**
- 5) Start the debugger by executing **Debug->Start/StopDebuggingSession**
- 6) Show the TExaS real board grader by executing **Debug->OSsupport->TExaSGrader2.1**
- 7) Run your program executing by **Debug->Run**. At this point you can push the switches and watch the LEDs.
- 8) When you are ready to grade, press reset, and then run. Invoke the grader by clicking the **Grading** button
- 9) Follow directions in the ActionMsg Window. When you see a grade of 100, your TA will award 40/100 points for this lab.

### **QUESTIONS (20 Points)**

- 1) Find a shortcut button for performing the Build Target step. (Step 3 above) (10 Points)
- 2) Find a shortcut button to start/stop the Debugger. (10 Points)

### **INTERESTING QUESTIONS**

Things to think about but NOT implement in your lab:

- 1) How could you make the LED flash slower?
- 2) How could you make the LED flash blue-yellow instead of blue-red?

### **REFERENCES**

The lab is adopted from the 2015 Embedded Systems: Shape the World course on EdX.org by Jon Valvano and Ramesh Yerraballi.