

San José State University
Department of Computer Engineering
CMPE 146-03, Real-Time Embedded System Co-Design, Fall 2020

Lab Assignment 1

Due date: Sunday, 8/30/2020

1. Description

In this assignment, you will be familiarized with the Texas Instruments MSP432P401R LaunchPad Development Kit and the TI IDE (Integrated Development Environment). The development kit features the MSP432P401R, a 48MHz ARM Cortex-M4F MCU. You will also learn how to use the device driver functions provided by the TI SDK.

2. Resources

Detailed information about the kit and related documents can be found here:

<http://www.ti.com/tool/MSP-EXP432P401R>.

Detailed information about the MCU and related documents can be found here:

<http://www.ti.com/product/MSP432P401R>.

Key documents:

LaunchPad User's Guide: <http://www.ti.com/lit/ug/slau597f/slau597f.pdf>

MCU datasheet: <http://www.ti.com/lit/ds/symlink/msp432p401r.pdf>

MCU technical reference: <http://www.ti.com/lit/ug/slau356i/slau356i.pdf>

DriverLib User's Guide: http://dev.ti.com/tirex/explore/node?node=AJIAWhC7vhw.P.ggQJeRmw_z-IQYNj_LATEST

Code Composer Studio User's Guide: https://software-dl.ti.com/ccs/esd/documents/users_guide/index.html

3. Exercise 1

In this exercise, you will set up the TI IDE, CCS (Code Composer Studio).

Code Composer Studio User's Guide can be found at https://software-dl.ti.com/ccs/esd/documents/users_guide/index.html. The installation procedure can be found Chapter 3 of the user's guide, https://software-dl.ti.com/ccs/esd/documents/users_guide/ccs_installation.html.

First, go to the "Code Composer Studio Downloads" website: http://software-dl.ti.com/ccs/esd/documents/ccs_downloads.html. In the "Code Composer Studio Version 10 Downloads" section, you'll find files for various platforms for download. The current version is 10.1.0. If you have a Windows machine, for example, you can select the "Windows 64-bit-only" single-file (offline) installer. You will download the [CCS10.1.0.00010_win64.zip](#) file to your local disk. The file size is about 1 GB, so it may take at least a few minutes to complete the download. After the download is complete, unzip the file.

The setup executable file (for Windows) is [ccs_setup_10.1.0.00010.exe](#). Follow the instructions on the website to install the CCS. When you get to the “Select Components” screen, check “[SimpleLink™ MSP432™ low power + performance MCUs](#).” It is a pretty large installer, so the entire installation process may take more than half an hour.

Lab Report Submission

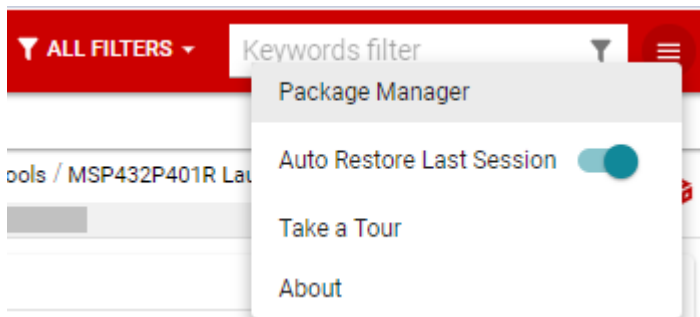
1. List any issues that you have encountered during the setup. Describe how they were resolved.
2. Include a screenshot of the TI folder showing at least the CCS and SDK folders.

4. Exercise 2

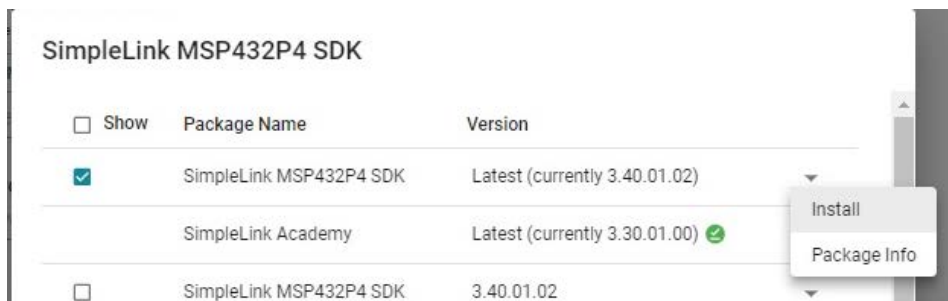
In this exercise, you will create a new project to have the LaunchPad send a simple message to the CCS debug console.

Quite often, it is much quicker to import a basic empty project and modify it to suit your needs than to create a new project from scratch. Before you can import a project, you’ll need to install the SimpleLink MSP432P4 SDK to the local hard drive.

On the CCS menu bar, click on <View><Resource Explorer>. Click on the upper-right icon and select the Package Manager.

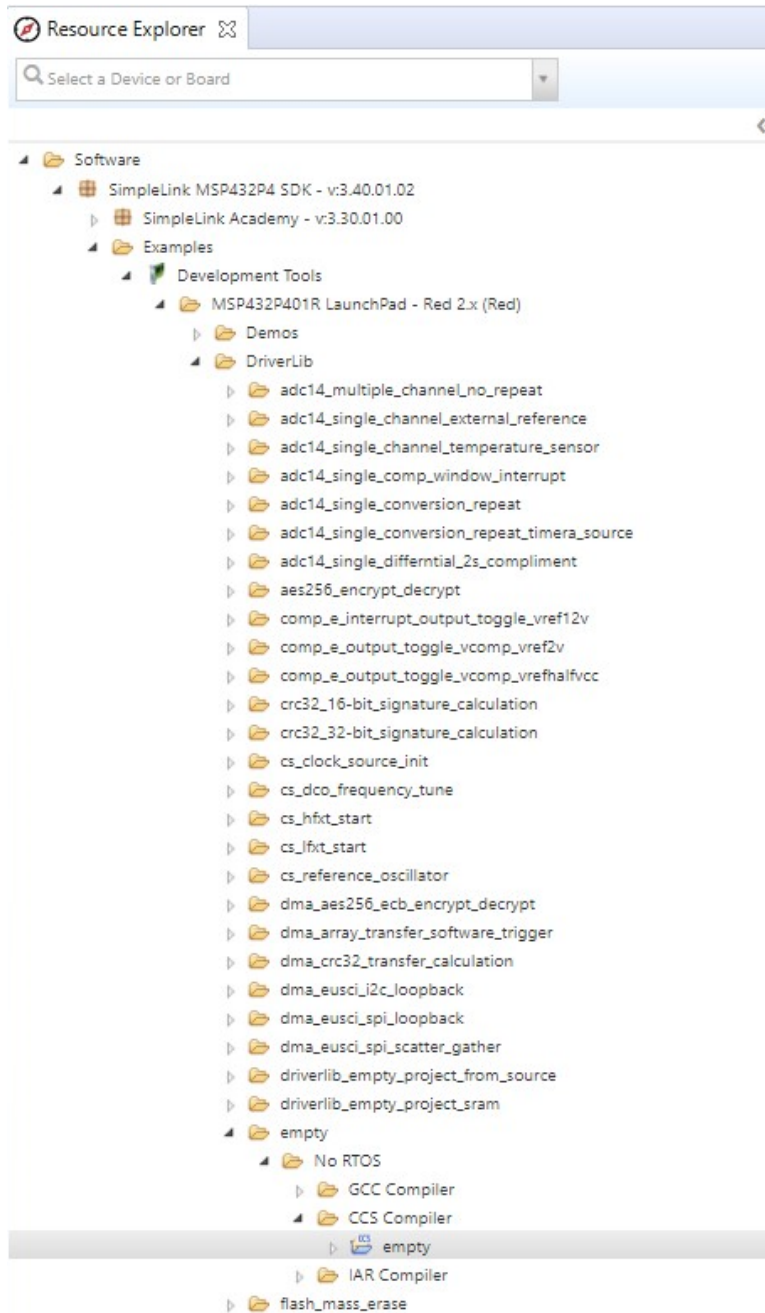


Scroll to “SimpleLink MSP432P4 SDK” and click on the small down arrow to select to install the latest package, version 3.40.01.02.

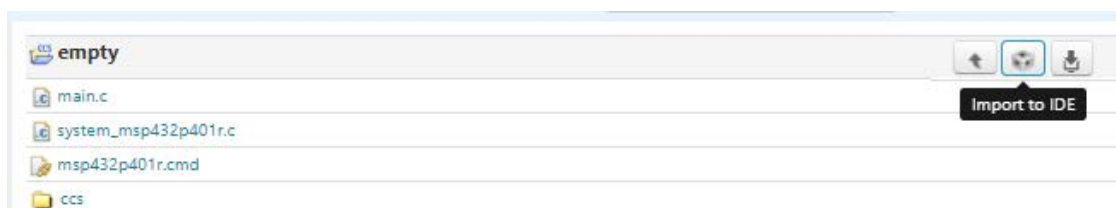


The installation will be done in the background. It may take at least a few minutes to complete. When it is done, you’ll see a new folder created in the TI software folder. On a Windows machine, you will see a new folder created, like `C:\ti\simplelink_msp432p4_sdk_3_40_01_02`. Unfortunately, there is no visual display of the installation’s progress, so you’ll need to check the folder from time to time to make sure that the installation is completed.

Once you have the SDK installed, on the CCS menu bar, click on <View><Resource Explorer Offline>. On the left pane, expand the tree structure from Software to <Software><SimpleLink MSP432P4 SDK ...><Examples><Development tools><MSP432P401R LaunchPad - Red...><DriverLib><empty><No RTOS><CCS Compiler><empty>.



Click on the “Import” icon on the upper-right corner of Resource Explorer.



Open the Project Explorer by clicking <View><Project Explorer> on the menu bar. Expand the project tree and double-click on *main.c* to bring it to the editor.

We are going to use the library function *printf*, so insert the following line in the *#include* section.

```
#include <stdio.h>
```

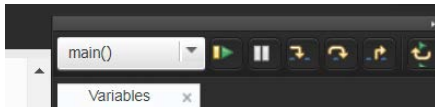
Replace the contents of function *main()* with just the following line:

```
printf("Hello World!!!\n");
```

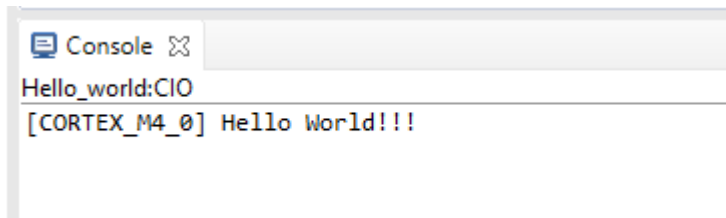
Connect the LaunchPad to your laptop/desktop with the USB cable. To build and run the program, click on the “Debug” button (the bug icon) on the toolbar. CCS will build and download the firmware to the LaunchPad.



After it finishes, click on the green arrow on the right pane to execute the program.



Section “5.6. Building and Running Your Project” in the user’s guide describes the steps to build and run the program. You should see the output displayed on the debug console in the lower part of the CCS window.



Lab Report Submission

1. Include a screenshot of the debug console showing the outputs.
2. List the entire program in the appendix.

5. Exercise 3

In this exercise, you will import a small example project to blink an LED. TI provides many example projects for various microcontrollers. Go Resource Explorer Offline. On the left pane, expand the tree structure from Software to <Software><SimpleLink MSP432P4 SDK ...><Examples><Development tools><MSP432P401R LaunchPad - Red...><DriverLib><gpio_toggle_output><No RTOS><CCS Compiler><gpio_toggle_output>. Import the project the same way in the previous exercise. Build and execute the program.

You should see LED1 on the board blinking very rapidly.



On the source file `gpio_toggle_output.c`, scroll to the end to find the *while* loop. Change the *for* loop count to 50000. Click on the Stop button (the red square icon) on the toolbar. Click on Debug to rebuild and the green button to run. You should see the blinking is much slower.

You have successfully used the TI MSP432 Peripheral Driver Library (DriverLib) to build a small application!

Lab Report Submission

1. Include a picture showing the LED lit.
2. List the entire program in the appendix.

List any issues that you have encountered during the exercise. Explain how they were resolved.

6. Exercise 4

In this exercise, you'll find out some device information about the MCU.

There is some specific information about the MCU that is stored in the device's non-volatile memory. They are contained in a table called Device Descriptor Table. Consult the MCU datasheet for its address. Create a new project (by importing the example *empty* project) to read and print the information to the debug console. Just print out the information from the top 3 blocks of the table, i.e., up to the Die Record block (the 3rd block). There should be 17 data items. Note that each data item is stored as a 32-bit word.

You are not allowed to use any library function to access the information. With the address you found, create a pointer to read different fields in the table. Use a character string array to store the descriptions. Print one item on one line. Each line contains the description, the address, and the value in 8-digit hexadecimal (just like the way they are shown in the table).

Note that some values in the table are constant; they are the same in all devices manufactured. Others may vary from device to device, so they are displayed as "Per unit" in the table. So, you can use the constant values to check if your program works properly.




Lab Report Submission

1. The code snippet that reads and print the information.
2. List the outputs on the debug console. Do not take a screenshot; copy and paste the text outputs.
3. List the entire program in the appendix.

7. Submission Requirements

Write a formal report that contains at least what are required to be submitted in the exercises. Submit the report in PDF to Canvas by the deadline. Include source code in your report. As for the report contents, do not use screenshots to show your codes. In the report body, list the relevant codes or screenshots only for the exercise you are discussing. Put the entire program listing in the appendix. Use single-column format.

8. Grading

Lab 1 Rubric   					
Criteria	Ratings				Pts
Exercise 1	2 to >0 pts Full Marks Screenshot proof of successful installation.		0 pts No Marks Not attempted or reported.		2 pts
Exercise 2	2 to >0 pts Full Marks Screenshot of the debug console outputs. Entire program listing in the appendix.			0 pts No Marks Not attempted or reported.	2 pts
Exercise 3	2 to >0 pts Full Marks Picture showing the LED lit. Entire program listing in the appendix.			0 pts No Marks Not attempted or reported.	2 pts
Exercise 4	4 to >3 pts Full Marks Correct and proper program implementation.	3 to >2 pts Outputs All required items shown correctly or reasonably.	2 to >0 pts Code snippet Relevant code snippet shown. Program listing in appendix.	0 pts No Marks Not attempted or reported.	4 pts
Total Points: 10					

Grading Policy

The lab's grade is determined by the report. If you miss the submission deadline for the report, you will get zero point.