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Application Note

ECE 480

Design Team 7

Programming Altimeters

Using

MSP 430 Launch Pad

11/8/2013

Executive Summary

This document will provide a guide of how to use the MSP 430 Launch Pad while specifically programming an altimeter. The MSP 430 is a Texas Instrument manufactured microcontroller that can be easily found in electronics. In order to gain the accurate pressure and altitude of our rocket during a rocket launch, first the altimeter must be properly programmed to do so.

Keywords

MSP 430 Launch Pad, Code Composer Studio, Altimeter

Table of Contents

Introduction and Background.....	3
Procedure	5
Using Code Composer Studio	5
Implementation of Altimeter Programming.....	7
Conclusion	9
References.....	10

Introduction and Background

The MSP 430 is a Texas Instruments produced microcontroller that adds analog to digital converters, comparators, and programmable timers. The microcontroller takes the digital or analog inputs, use them to create functionalities in C programming, and lastly create digital outputs. The MSP 430 is a low powered 16 bit microcontroller that includes advanced peripherals such as high performance analog systems, optimized serial communications, and operate in low power modes along with three adjustable clock cycles (MCLK, SMCLK, and ACLK). The MSP 430 can be connected to a computer via USB. Also, this microcontroller is available for purchase at low cost. Below is Figure 1 and 2 of MSP 430.



Figure 1: MSP 430 Launch Pad

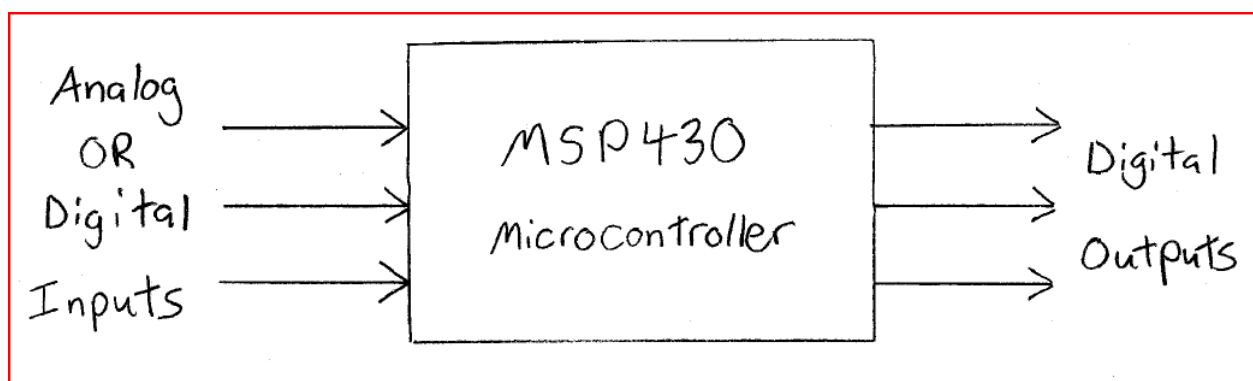


Figure 2: MSP 430 Schematic View

An altimeter is an electronic sensor that is specifically used to measure altitude of an object above a fixed level. Altitude can actually be determined by measuring atmospheric pressure. The measurable object in this case is a model rocket. The altimeter would be built onto the MSP 430 Launch Pad and programmed accordingly to output accurate data during and after a rocket launch. This program will be pre-written with algorithms which will control the altimeters functions. Below are Figure 3 and 4 different views of the MPX2102 Altimeter that is used during the team's design process.



Figure 3: MPX 2102 Altimeter

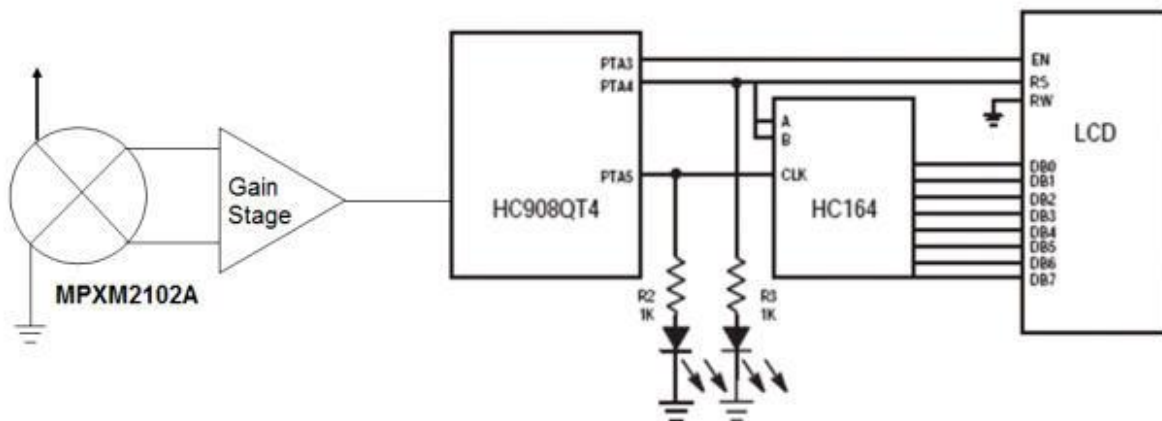


Figure 4: Block Diagram of MPX 2102 Altimeter

Procedure

Programming the Altimeter

The team plan was to create a C program code that would allow the altimeter to display accurate measurements during and after the rocket launch. Using our design, hobbyist should be able to generate precise measurements of the altitude.

Using Code Composer Studio

The team decided to use Texas Instrument's Code Composer Studio to create the code. Code Composer Studio is a tool that Texas Instrument designed to program the MSP 430. Code Composer Studio is now licensed to Michigan State University Engineering College with unrestricted student access. This software package is popular used throughout the engineering industry, including in software and hardware programming in C. This tool combines software for editing and compiling code, programming microcontrollers, and debugging code.

Below are instructions on how to use Code Composer Studio while using a MSP 430

1. Open Code Composer Studio, located at: Start > All Programs > Texas Instruments > Code Composer Studio 5.4.0 > Code Composer Studio 5.4.0.
2. Select File > New > CCS Project.
3. In the Device section, Family: select MSP430
4. In Variant: click on the text box and type 2553. The text box to the right should show at least MSP430G2553.
5. Under Project templates and examples click on Empty Projects > Empty Project. The text box to the right should say Creates an empty project fully initialized for the selected device. Click Finish

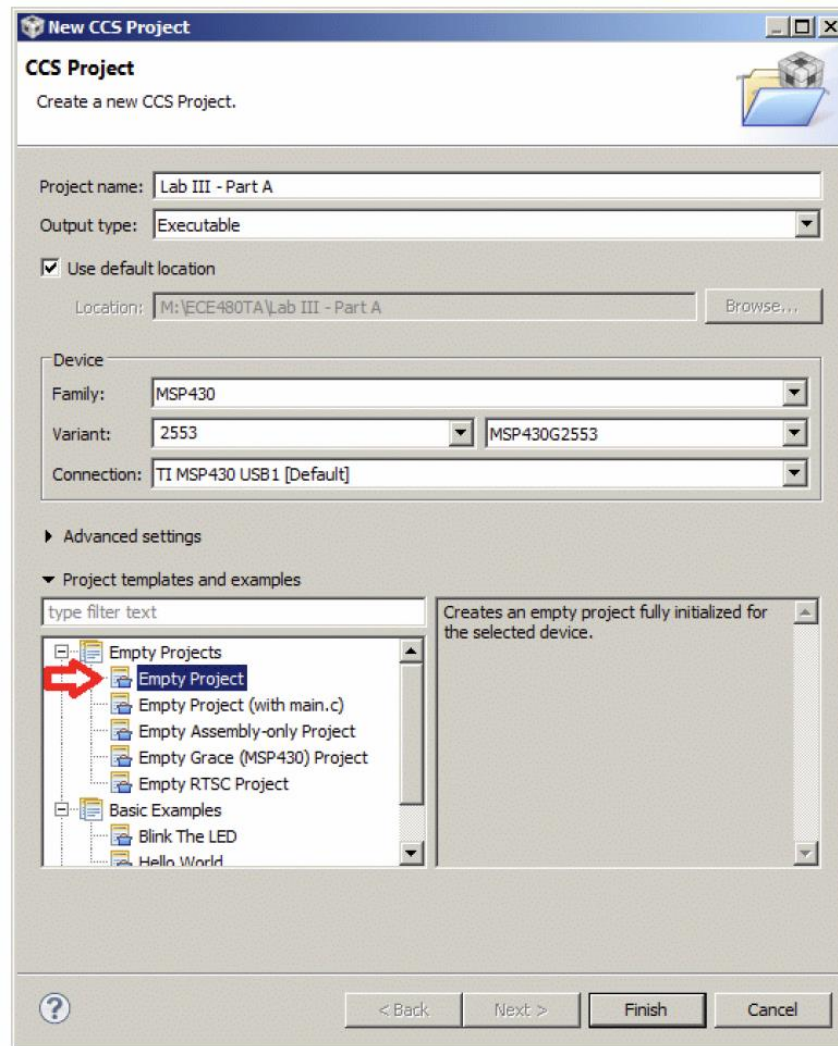


Figure 5: Code Composer Studio

6. Select File > New > Source File. Type a desired name for the Source File. The Click Finish
7. Click on CCS Debug. Switching to the CCS Debug perspective shows you the results of the debug session, and lets you step through the code line by line while watching variable, expression, or register values update dynamically.

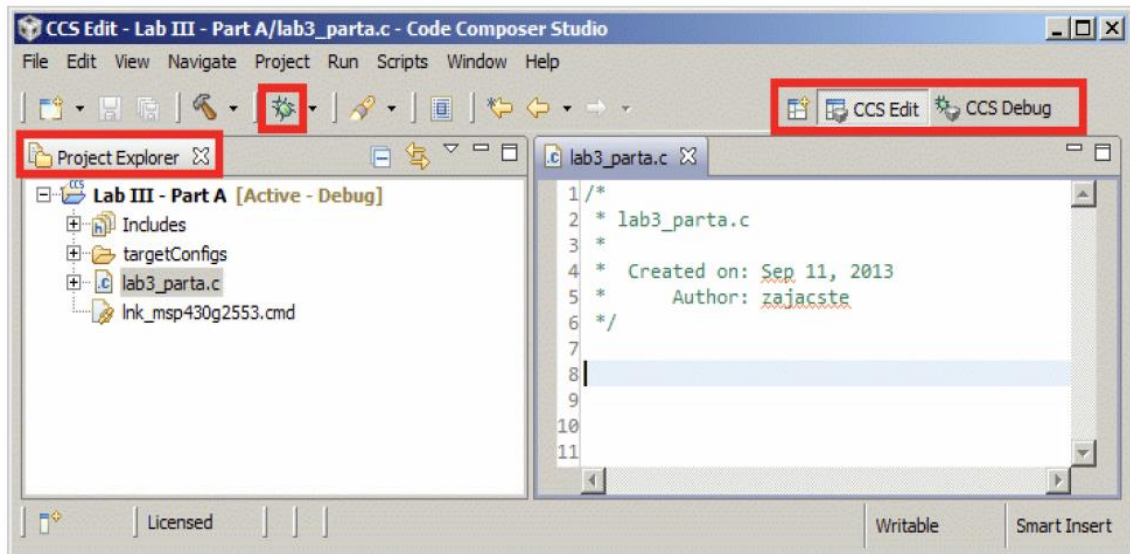


Figure 6: Code Composer Studio (Step7)

8. Add a header file right a line 8 in the .c file. Header file- #include <msp430g2553.h>
9. Take some time to familiarize yourself with the Code composer Studio IDE to create specific coding for the altimeter.
10. Now this is the appropriate time to implement the altimeter coding using the MSP 430 Launch Pad.

Implementation of Altimeter Programming

Now that we introduced the Code Composer Studio application for programming the MSP 430 Launch Pad next is to create a C program for various altimeters. This program can distinctively tell the altimeter what to do during rocket launches. Specific values and calculations can be included inside the program for accurate and precise data analyses after the rocket launches. The entire MSP430F270 has a software demo application that is contained in a single C file and is provided in versions for use with TI Code Composer Essentials (file name: F4270_Altimeter_SB_CCE.c). The advantage of using this demo application is to have a functioning altimeter program running your inputs values and restrictions. Below are Figures 7, 8, 9, and 10 are altimeter coding provided by Texas Instruments.


```

// Misc definitions
#define MODE_TIMEOUT      (240)                // Max time for A/P measurement
                                              // (in s)

enum
{
    PM_MEASURE_A,                // Mode - Measure Altitude
    PM_MEASURE_P,                // Mode - Measure Pressure
    PM_DISPLAY_TIME,             // Mode - Display Time
    PM_MEASURE_TEMP,             // Mode - Measure Temperature
    PM_DISPLAY_CONTR,            // Mode - Display Contrast
    PM_CAL_A,                    // Mode - Cal Altitude
    PM_CAL_P,                    // Mode - Cal Pressure
    PM_SET_TIME,                 // Mode - Set Time
    PM_CAL_TEMP,                 // Mode - Cal Temperature
    PM_SET_CONTR                 // Mode - Set Contrast
};

```

Figure 10: Useful Functions of the Altimeter

Using these functions and calculations are vital in programming C codes for the altimeter using the MSP 430. Most of the pressure equations are given to solve, but the equations must be configured properly to output the correct information during and after rocket launches.

Conclusion

In this document, a brief background of the MSP 430 Launch Pad and altimeters were given, along with specific steps needed to program altimeters using a MSP 430 Launch Pad. The important steps that were mentioned throughout the Application Note included basic functionalities of the MSP 430 Launch Pad, becoming accustomed with Texas Instruments Code Composer Studio application, and the useful altimeter programming demo also provided by Texas instruments. These steps would lead to programming efficient altimeters that output accurate data.

References

- Wierzba, Gregory. "Lab III: Digital Color Organ - Code Composer Studio and the MSP430." *YouTube*. YouTube, 24 Sept. 2013. Web. 30 Oct. 2013.
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