

EELE465 Real-Time Microcontroller Applications

Spring 2020

Final Exam 42 Points Total

April 30, 2020

Take Home - **Due Monday May 4, 2020 at 5:00 PM**

Please upload your solution to the Final Exam dropbox on the class website.

The purpose of this exam is to tie together all of the concepts that you have learned in this class and allow you to apply them in a real-world application. Your proposal score is equal to your final exam score for the class. Good Luck!

Neatness and Organization of your proposal are important. Clearly label each section and write, print or draw so I can read it.

Task: You are a design engineer with a premier design company and you are asked to design a precision temperature controller. Your company is quoting on the design job and needs from you a design to submit with the proposal. Your proposal will be judged/graded on the following criteria:

- (21 points) **A.** Schematic of the system in as much detail as you can provide. There are multiple solutions but using the minimum number of microcontrollers will be beneficial to your proposal.
- (14 points) **B.** A list of major software/firmware routines that need to be written and a brief description of each routine. **Do not write the routines.**
- (7 points) **C.** How you would physically reset and program the MSP430 devices in your design.

The total proposal score will be based on the completeness of the design, amount of detail included, ingenuity and applications of concepts learned during EELE465.

System Specifications:

You are limited to using only the MSP430FR2311 (you may use any number of these parts as required, **hint: check the part number**) and the DS1337 Real Time Clock.

Assume that you can calibrate the internal MSP430FR2311 temperature sensor to an accuracy of +/-0.5-degree C.

The system must output temperature and current values to an LCD that has a built in I2C interface instead of a parallel interface.

Use concepts found in the following application notes in your design: AN1775 and AN2701. **App Notes Available on D2L in Final Exam Folder.**

Inputs to the system are 5 individual keys. Up, Down, Left, Right and Select.

The system will be used to control an analog voltage controlled high current Thermo-Electric Controller (TEC) driver. Given an input analog voltage the device will produce a proportional analog output current to drive the thermo-electric cooler.

The Thermo-electric cooler (TEC) analog current will be monitored via the Current Sense Circuit to allow a safe range of operation. This circuit produces an analog voltage that is proportional to the current measured by the sense resistor.

Date and Time of Day as well as Run Time of Unit are required.

The Controlled Temperature Heatsink will be controlled to a temperature setpoint that is entered on the LCD using the push buttons.

Assume that all necessary power supplies are available and that you do not have to design these.

Available Parts:

I2C LCD

Analog Current Sense Circuit with Voltage Output

Analog Voltage Controlled Linear High Current TEC Driver

6 Individual Push Buttons

Unlimited supply of MSP430FR2311's

One DS1337 and associated crystal

Assorted Resistors

Assorted Capacitors

No other parts are to be used.

Precision Temperature Controller Block Diagram:

