

CSCI 4415 Lab # 6

Temperature Sensors

Created: February 27, 2011



Objective:

- Learn how to electrically connect a temperature sensors and read the temperature from the sensor.

Time Estimate:

- 5 hours.
- You should be prepared to start this after class 8 (analog & sensors) and this will be due by Midnight class 12.

Specific Requirements:

For this lab you connect two temperature sensors to the Z16. One sensor outputs an analog signal, the other outputs a pulse width modulated signal. You will need to find the proper datasheet for each sensor so that you can read the details on how to connect it and how to write software to read the temperature.

1. In the lab kit you will have 2 3-pin TO-92 parts (like the picture above). Ok, you might have several of them, find the 2 labeled like this:
 - **TMP 04**
 - **LM34**
2. You will need to read the marking on the chips, determine which is which, and then find the detailed datasheet for each. The data sheet will identify the pins and explain how to connect the sensor to a microcontroller and how a software applications needs to interact with it.
3. Insert the sensor chips into the prototype board and connect them to the appropriate pins on the Z16.
4. Connect the analog sensor output to ALG0 on the Z16.
5. Connect the PWM sensor output to T3IN (PD0) pin.
6. Write a library for each sensor for reading the temperature.
7. You will need to consult the ZNEO product specification (PS220) chapter on the “Analog Functions”, and possibly the “GPIO” and “Timers” chapter for configuring the IO pin alternate functions.
8. You can display the temperature on the LED display using the library you developed for Lab 1 **or** you can display temperature on a serial terminal using the CLI you developer for Lab 3. Its your choice, or you can do both.
9. If you opt to use the CLI you developed, modify your CLI from the previous lab to include the following new commands (and appropriate actions).

```
set temp [pwm|analog]
- select the PWM or ANALOG sensor for reading.

temp read
- get the temperature from the selected sensor and display the
temperature.
```

10. If you opt to use the LED display library, write your program so the pressing SW1 selected the analog sensor, pressing SW2 selected the PWM sensor.
11. Create a file named readme.txt file that includes any notes about the lab and answers to the questions below.
12. In the main.c file include the following information in a comment block

```
Author: [Your name]
Email:  [Your email]
Class:  [CSCI-4415]
Date:
Lab:    [Lab number]
Description: [short description of program. Include changes you made and
note any enhancements that you made to the lab]
Other files: [list other files that are necessary for this program]
Compile: [provide any special instructions for compiling. Only necessary if
there are special instructions]
Problems: [explaining what you did, what problems you had, how you solved them,
and what you might do differently if you had to do it again]
Comments: [Feel free to provide comments on how this lab went, what you think
is good or bad about it and how it could be improved or anything else you want
to say.]
Enhancements: [describe the enhancements you added to this lab]
```

13. Turn in a zip file (lastname-lab6.zip) of the entire project directory (include the entire ZDSII project directory and the readme.txt). Use BlackBoard to submit assignments (or if thats not working for some reason email the ZIP file).

References

1. ZNEO product specification (PS220) chapters on “Analog Functions”, “GPIO” and “Timers”.

Grading

- On time, in proper format (Zip file), named <lastname>-lab1.zip
- Compiles and runs without problems
- Meets lab requirements
- Reasonable code (partitioning of function, coding standard, readable)
- Reasonable comments
- PWM function
- Analog function
- Modular code (no side effects)
- Error detection and handling
- Proper use of Z16
- Answered questions

Enhancements:

- Add units to the temperature readings. If using the CLI

```
set units [C|F]
```

- Select the units to be displayed in degrees C or F.

13. Add units to the temperature readings. If displaying temperature on the LED, enable pressing SW3 to toggle between degrees C and F.

- Explain why the output of the LM34 varies and how to fix it.
- Something you thought of

Questions

Include with your lab submission (in the comments of your main.c file):

1. Were your temperature readings stable or did they vary some (room temperature shouldn't vary up/down rapidly)? If one or both varied, do you know why? Do you know how to fix this?
2. Give me a simple schematic (ASCII art is good) showing how you connected each memory to the Z16. Label all pins with signal name and pin numbers. What's voltage is Vdd for each device.
3. Did you have any problems finding the datasheets or getting the necessary information?
4. For the Analog sensor, did you use the internal or external voltage reference? If you used the external references, how did you adjust it?
5. Did you need any pull up resistors? Why?