EE712 - Embedded Systems Design
Electrical Engineering IIT Bombay

Laboratory Experiment - III

Problem set: 5 Date: January 30, 2022

LCD Interfacing and On-Chip Temperature Sensor

Problem 1

Aim: To get familiarized with the 16 X 2 LCD display and interface the LCD display with TIVA C Board.

Components to be used:
- TIVA C Board
- 16 X 2 LCD Display

Problem Statement:

- Given the snippet of a LCD interfacing code lcd.c.

- Complete all the tasks given inside the snippet. You can refer to the following pdf for more information about LCD. LCD_Control_Made_Easy

- After completing the tasks, flash the code into TIVA board and print first 3 letters of your teams member's name in the first row and ESD - IIT Bombay in the 2nd row.

- *E.g. If the member names are Luffy, Naruto and Goku , display on LCD:*
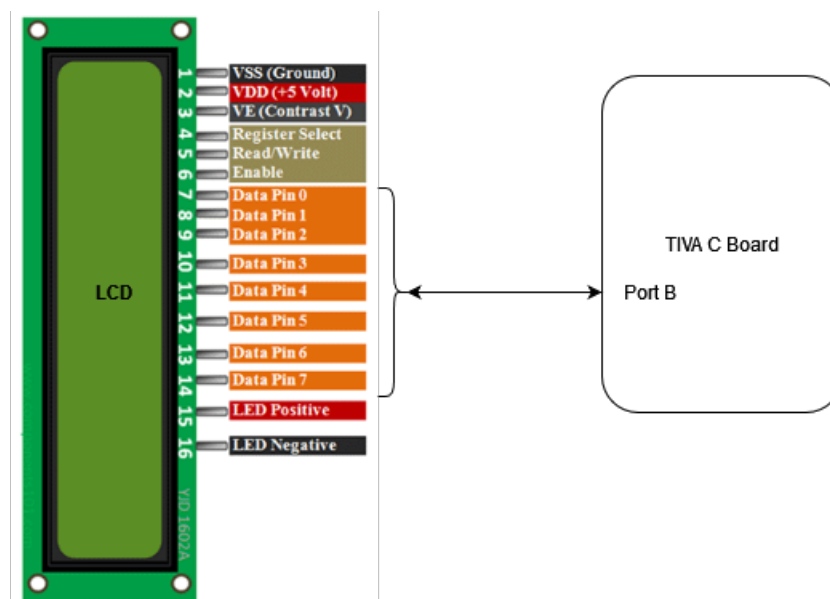
LUF-NAR-GOK
ESD-IIT Bombay

Figure 1: LCD connection to TIVA-C board

Problem 2

Aim: <mark>To measure the temperature of the room using the on-chip temperature sensor and on-chip ADC and display it on the LCD</mark>.

Components to be used:

- TIVA C Board
- 16 X 2 LCD Display

Problem Statement:

- Make appropriate changes to your code that you have written for the **LAB 2 - problem set 3 : ADC interfacing** so that you can read the value from the on-chip temperature sensor.

- Calculate the temperature reading (in $°C$) from the internal sensor using the formula:

  $$TEMP = 147.5 - ((75 * (VREFP - VREFN) * ADCValue)/4096)$$

- Refer TM4C123GH6PM Microcontroller datasheet, Page 812 for more details.

- Display the obtained value upto 2 decimal values on LCD display.

General Instructions

- Include the following header files in your code:
  "stdint.h", "stdbool.h", "inc/hw memmap.h", "inc/hw types.h", "driverlib/gpio.h", "driverlib/sysctl.h", "inc/hw ints.h", "driverlib/interrupt.h", driverlib/adc.h".

- Enable the system clock, ADC0 peripheral clock and the required port pins.

- Check the TM4C123GH6PM datasheet, Page 801 to find which pin can be configured as ADC input. Use GPIOPinTypeADC(), Page 266 to set.

- Set the enabled port pins to function as output pins.

- Configure the trigger source for ADC and priority of a sample sequence using the function ADCSequenceConfigure(), Page 38.

- Configure the ADC channel using the function ADCSequenceStepConfigure(),Page 42.

- Enable the sample sequence using the function ADCSequenceEnable(), Page41.

- Trigger a sample sequence with processor using the function ADCProcessorTrigger(), Page 36.

- Wait until the sample sequence has completed by checking ADCIntStatus(),Page 34.

- Read the digital value from the ADC using the function ADCSequenceDataGet(), Page 39.

- Triggering should be done after every sample conversion.

- Calculate the temperature reading (in○C) from the internal sensor using the formula:

  $$TEMP = 147.5 - ((75 * (VREFP - VREFN) * ADCValue)/4096)$$

- Refer TM4C123GH6PM Microcontroller datasheet, Page 812 for more details.

- <mark>Display the obtained digital value in decimal format on LCD screen</mark>.

Console configuration:
Go through **Page 5-13 to 5-15** to configure the variable to display it in the CCS console of the following link.
TM4C123G_LaunchPad_Workshop_Workbook

References:

1. TM4C123GH6PM : TM4C123GH6PM_Datasheet

2. TIVA Driver Library: TIVA_Driver_Library

3. TM4C123G LaunchPad Workshop Workbook TM4C123G_LaunchPad_Workshop_Workbook