

# Experiment 7: LCD Display

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Scarface, Brian De Palma (1983)

## 1 Introduction

In this experiment, you will learn how to use the 16x2 dot matrix LCD. You are given initializing configuration of the LCD at Part 0 and expected to write different programs to display dynamic strings in the later parts.

## 2 (20 pts) Part 1

There are two working modes of LCD display which require 8-bit and 4-bit connection bandwidth respectively. Connection between the LCD and the MSP430 LaunchPad is given in Figure 1. Since, the only upper nibble (D4-D7) of data bus are wired to micro-controller, we should use 4-bit working mode to utilize the LCD. Table 1 contains list of commands for driving LCD.

## Experiment 7: LCD Display

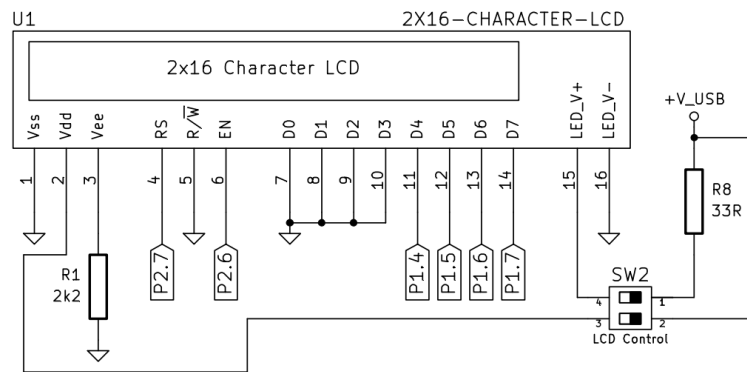


Figure 1: Connection between LCD and MSP430

Please, remember that the LCD works in 8-bit mode by default. To display any string on the LCD; Firstly, you should configure the LCD display in order to communicate in 4-bit mode. Secondly, you should send 8-bit ASCII characters as nibbles (4 bits) to display using the specific instruction. The flow chart that shows the steps of initialization and configuration of the LCD is given at the end of the experiment. More detail about this flow chart could be found in this link<sup>1</sup>.

In this part, you are given "display.asm" as a solution beforehand. You should try to run & analyze the given code to write " ITU Comp Eng \n MicroLab. 2022 " and understand how the LCD initialization and display are done. You will not be given any marks based on this part.

### 3 (30 pts) Part 2

At the first part, you are asked to write a program that switches the upper and lower lines of the displayed string with a frequency of 2 Hz. You can use the clock however it is not compulsory.

string: " ITU Comp Eng \n MicroLab. 2023 "

### 4 (50 pts) Part 3

For the second part, you are asked to write a program to repeat the pattern in Figure 2 repeatedly.

<sup>1</sup>[http://web.alfredstate.edu/faculty/weimandn/lcd/lcd\\_initialization/lcd\\_initialization\\_index.html](http://web.alfredstate.edu/faculty/weimandn/lcd/lcd_initialization/lcd_initialization_index.html)

Instruction	Code											Description	Execution time
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
Clear display	0	0	0	0	0	0	0	0	0	1		Clears display and returns cursor to the home position (address 0).	1.64mS
Cursor home	0	0	0	0	0	0	0	0	0	1	*	Returns cursor to home position (address 0). Also returns display being shifted to the original position. DDRAM contents remains unchanged.	1.64mS
Entry mode set	0	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction (I/D), specifies to shift the display (S). These operations are performed during data read/write.	40uS
Display On/Off control	0	0	0	0	0	0	1	D	C	B		Sets On/Off of all display (D), cursor On/Off (C) and blink of cursor position character (B).	40uS
Cursor/display shift	0	0	0	0	0	1	S/C	R/L	*	*		Sets cursor-move or display-shift (S/C), shift direction (R/L). DDRAM contents remains unchanged.	40uS
Function set	0	0	0	0	1	DL	N	F	*	*		Sets interface data length (DL), number of display line (N) and character font(F).	40uS
Set DDRAM address	0	0	1	DDRAM address							Sets the DDRAM address. DDRAM data is sent or received after this setting.		40uS
Read busy-flag and address counter	0	1	BF	DDRAM address							Reads Busy-flag (BF) indicating internal operation is being performed and reads address counter contents.		0uS
Write to CGRAM or DDRAM	1	0	write data							Writes data to CGRAM or DDRAM.		40uS	
Read from CGRAM or DDRAM	1	1	read data							Reads data from CGRAM or DDRAM.		40uS	

Table 1: Instruction Set of LCD, retrieved from <https://mil.ufl.edu/3744/docs/lcdmanual/commands.html>

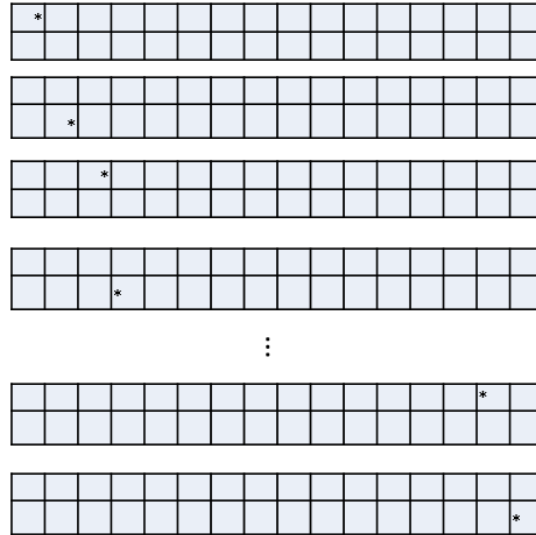


Figure 2: LCD Pattern