Assignment – ESE S4 Embedded Systems Software – week 4

Interfacing to an External LCD Module

This week, we discussed interfacing to an external character-mode LCD module using a GPIO-connected data bus. For this week's lab, you will connect to a typical character-mode LCD module to your Discovery board and write software to display messages on the module

As always, when building circuits and when working with active circuits, wear safety glasses.

Due: Wednesday 12 February 2020
Submit your code listing, schematic, timing analysis and required scope screen shots to the eConestoga dropbox by 11:59 pm

Submit lab report to dropbox including:

- Your commented c source code and header files
- Schematic showing the connections from the Discovery board to the LCD module, and the handling of the pins on the LCD module not connected to the Discovery board
- Labelled scope shots using the logic analyser, parallel bus decoder, and cursors for timing measurements showing port bit patterns for a single write cycle (two nibble transfers).
    - Show a scope shot for each measurement indicated in the write-cycle timing diagram as covered in class

Demo when completed or during inter-class period during the week

The basic steps of the lab are:

1. Connect an external LCD module to your Discovery Board as covered in class.

2. Write and debug code to initialize the required GPIO port pins, initialize the LCD module, and display text on the module

3. Demonstrate that the system works by displaying text with a fixed and variable portion as outlined below

4. With your bench oscilloscope, measure the timing parameters for a write cycle as listed on the last page of this document and verify that your software meets the specifications given.

You will need to write the following:

- Functions to initialize the GPIO ports connected LCD module appropriately, and to initialize the module itself

- Functions and macros as outlined in class to control the LCD module and send it commands and data

- Functions LCDputc(), LCDputs(), LCDprintf(), and LCDclear() as outlined in class to send a character, string, or formatted string to the display, or clear the display.

- A main() to do the following:

    - Call functions to initialize the ports and module
    - Clear the display
    - Print your name(s) on the top line of the display
    - Loop forever doing the following:
        - print the count variable on the second line of the display as a formatted 4-digit hexadecimal number
        - increment the count variable
        - possibly delay if the display is updating too quickly for the number to be readily visible

To receive maximum credit, use good coding style, appropriately separate your code into modules, and comment as outlined for previous labs.

Mode	Characteristic	Symbol	Min.	Typ.	Max.	Unit
Write Mode (Refer to Fig-6)	E Cycle Time	tc	500	-	-	ns
	E Rise / Fall Time	t_R,t_F	-	-	20	
	E Pulse Width (High, Low)	tw	230	-	-	
	R/W and RS Setup Time	tsu1	40	-	-	
	R/W and RS Hold Time	t_{H1}	10	-	-	
	Data Setup Time	tsu2	80	-	-	
	Data Hold Time	t_{H2}	10	-	-	

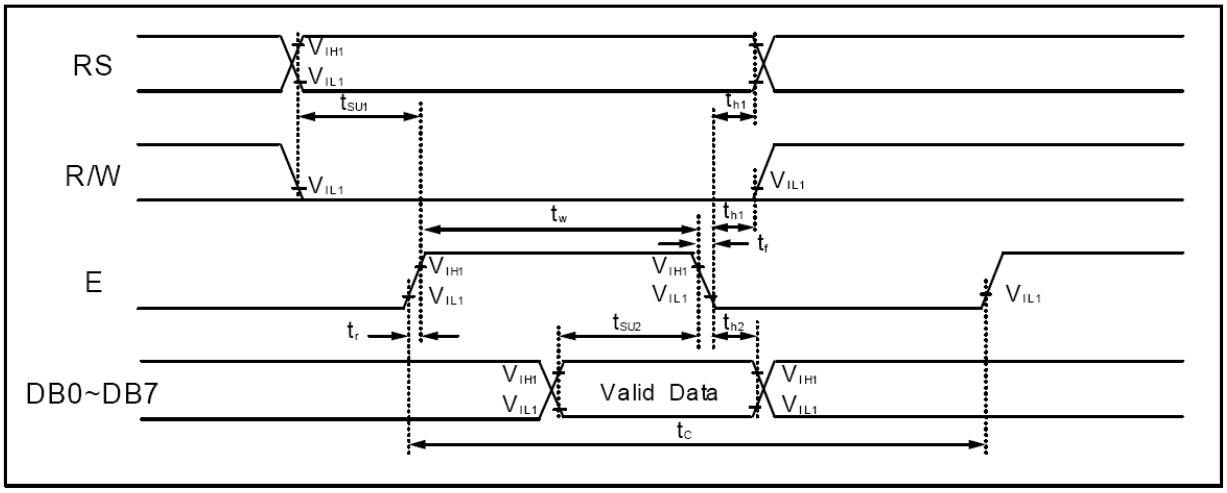

Figure 6 . Write Mode Timing Diagram

Notes:

1. You will not be able to measure timing for the R/W line since it is hard-wired low. The timing specification for the RS line is the same as that for the R/W line so measure the required parameters with reference to that signal only.

2. For rise and fall time measurements, you will need to use an analog channel of the scope.

3. Some parameters (e.g. rise and fall time) will require you to make two separate measurements for a single listed parameter.