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| ENGR 325 LAB 2  Interfacing with LCD Devices Systems.  12TH Sept 2019. | Abstract  This lab focusses on working with LCD devices, using the Signal Tap Logic Analyzer tool, and writing C language programs for the NIOS processor system using function calls provided by the Hardware Abstraction Layer (HAL) (or device drivers).  Daniel Ackuaku |

*Part 1: Printout of your C code that was written to display the “hello…”*

#include "altera\_up\_avalon\_character\_lcd.h"

int main(void)

{

alt\_up\_character\_lcd\_dev \* char\_lcd\_dev;

// open the Character LCD port

char\_lcd\_dev = alt\_up\_character\_lcd\_open\_dev ("/dev/Char\_LCD\_16x2");

if ( char\_lcd\_dev == NULL)

alt\_printf ("Error: could not open character LCD device\n");

else

alt\_printf ("Opened character LCD device\n");

/\* Initialize the character display \*/

alt\_up\_character\_lcd\_init (char\_lcd\_dev);

/\* Write "Welcome to" in the first row \*/

alt\_up\_character\_lcd\_string(char\_lcd\_dev, "Hello I'm");

/\* Write "the DE2 board" in the second row \*/

char second\_row[] = "is Daniel :)\0";

alt\_up\_character\_lcd\_set\_cursor\_pos(char\_lcd\_dev, 0, 1);

alt\_up\_character\_lcd\_string(char\_lcd\_dev, second\_row);

}

*Part 3: Analyzing the effect of the alt\_printf() function.*

The alt\_printf () function call dramatically increases the size of the program in addition to using up a large portion of the heap. The code was compiled and run with and without the alt\_printf () and the results are as follows.

*Before*:

14 KBytes program size (code + initialized data).

Info: 6680 Bytes free for stack + heap.

*After*:

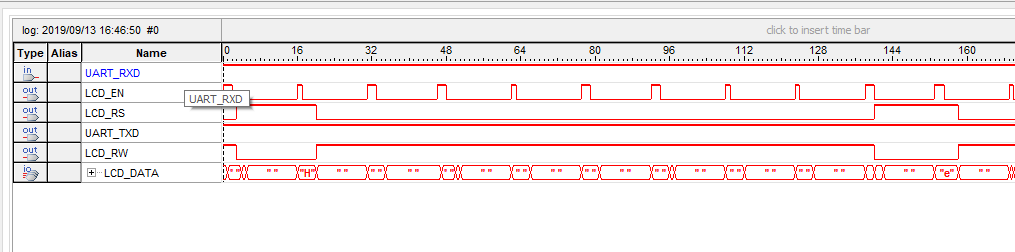
4848 Bytes program size (code + initialized data).

Info: 17 KBytes free for stack + heap.

*Part 4:* *Screen-capture printouts of the signal tap analysis.*

When LCD\_RW is low and the LCD\_EN is high, a new character is written into the LCD\_DATA register. The circled portion of the graph highlights when this happens and how the LCD\_DATA value changes from a Null pointer to the ASCII value of the displayed character.

The smaple occurs on 5 MHz clock, which means each every 2\*10-7 secs a sample occurs. Using the signal tap tool, it was determined that the distance between two subsequent characters in the LCD \_DATA registers were 137 samples. Which puts the time taken between these two signals as the product of 2\*10-7 secs per samples and 137 samples = 2.74 \*10-5 secs.



*Part 5: Analysis of the signal tap data.*

