

```
File Edit Setup Control Window Help
->Please try to enter valid values, extensive testing hurts me a lot and might
even break me.
->Please make sure before entering a hex value don't add 0x before it.
->As Described in the assignment, all values are in hexadecimal, any decimal en
tered will be treated as hex.
->Please look at all the choices and give the choice number as described.
->The Maximum address that can be entered is 7FF.
->Please Enter the First Address greater than last address(duh!!).
->I will try to give as many error condition as possible.
->Enough Chit-Chat and lets start with the program.

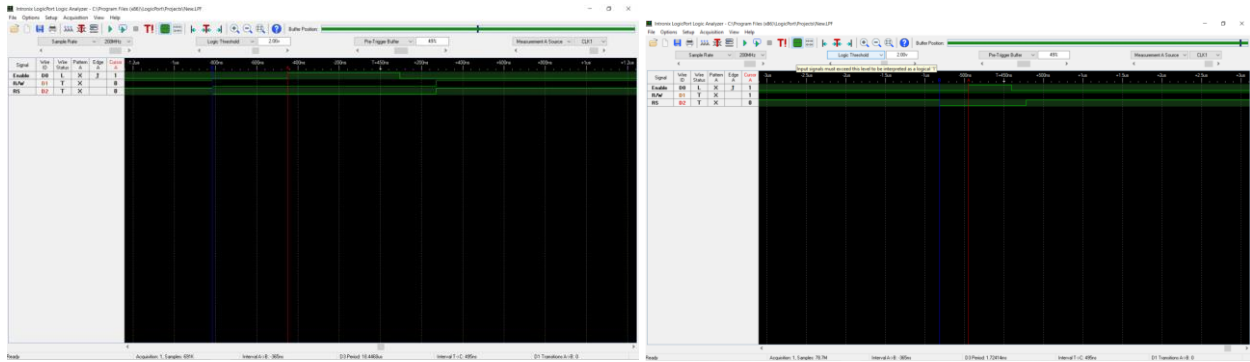
PRESS ANY KEY TO CONTINUE

So, Your Choices for the Program are:
1. Write a Byte value in the EEPROM.
2. Read a Byte value in the EEPROM.
3. Dump the values in the EEPROM between the given addresses using Sequential Rea
d.
4. Reset the EEPROM.
5. Help Menu.
6. Exit the program
Enter the valid choice: 1
```

User Interface for the I2C part.

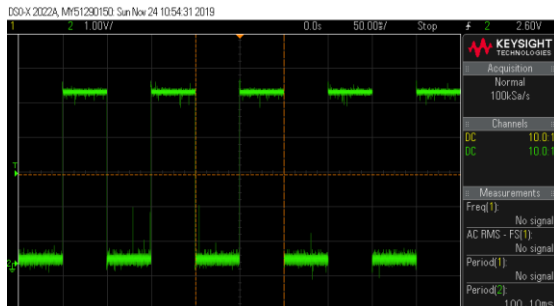
The major problem that we encountered during the I2C part was the timing between each function of the I2C, and taking care that it matches or satisfies the datasheet timing requirements. Other than that, the sign off was pretty smooth. All the functionalities were checked by the TA's.

Part 2



Timing diagrams of the read and write operations on the LCD.

The most testing part was how to connect the RS, R/W and the Enable pins LCD and interface it with the Microprocessor. After various iterations and discussions with classmates (especially with Abhijeet Dutt Shrivastava and Rakesh Kumar), we got to the conclusion of connecting with different address pins and making the logic differently uploading it to the SPLD logic.



We used timer 0 for getting the time stamp on the LCD. We calculated the values for the high and low value of the timer 0 and got the ISR working to toggle a pin inside the ISR to test the timing of the timer. Also we made a logic to calculate the time elapsed by incrementing a variable count and calculating seconds, minutes and hours.

```
Welcome to the World Of working(maybe) LCD.
There are some instructions to read before to proceed.
This lab was aimed to allow the students to learn the implementation of the LCD

The LCD has 4 rows and 16 columns.
Trying to go beyond that will give you an error.
if you want to print a character, we have an option for you.
As soon as you enter the program, the timer will start.
If you are here for the first time, The timer is stopped for now.
The timer is running continuously, if you want to print the character at timer's
place, its impossible.
Press Enter to Continue
Your Options Are:
1. Print the character at the starting.
2. Print the character at your place of choosing.
3. Reset The clock.
4. Stop The clock.
5. Restart The clock.
6. Clear the Screen.
7. DDRAM Dump
8. CGRAM Dump
9. Help Menu
10. Exit
Enter your choice: 1
```

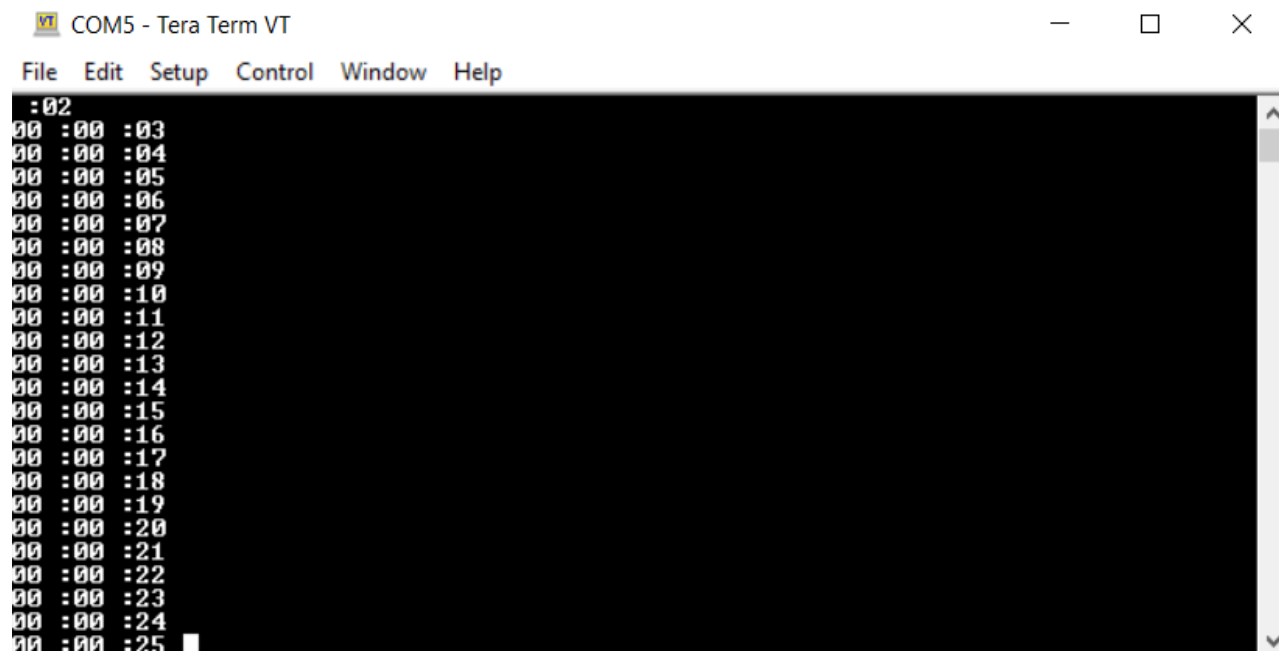
All the functionalities were working properly and were demonstrated to the TAs during the Signoff.

User Interface for the LCD and Clock combined.

Supplemental.

Till supplemental, everything was working fine, but after adding the DDRAM dump and CGRAM Dump, the write and the read part was working fine, but the clear function stopped working, I git the github code back from my previous option and still it didn't work.(FYI since I did it some moments before the signoff, there didn't had enough time to debug the problem. Asked the TAs about it but they also didn't had any clue without looking at the code).

Another Supplemental that I did was the real time clock, I did it on KL25Z board by NXP, but the resetting of time and date of the PC was really difficult, while in MSP432, using the RTC registers, which are both readable and writable, we can adjust the date and time of the Real time clock included in the MSP, and also tried to explore the Alarm functionality of the MSP.

A screenshot of a Tera Term VT window titled "COM5 - Tera Term VT". The window has a menu bar with "File", "Edit", "Setup", "Control", "Window", and "Help". The main display area shows a real-time clock output in a monospaced font. The output consists of a header line ":02" followed by 26 lines of time data. Each line shows the time in HH:MM:SS format, starting from 00:00:03 and incrementing by one second up to 00:00:25. The cursor is positioned at the end of the last line, 00:00:25.

```
COM5 - Tera Term VT
File Edit Setup Control Window Help
:02
00 :00 :03
00 :00 :04
00 :00 :05
00 :00 :06
00 :00 :07
00 :00 :08
00 :00 :09
00 :00 :10
00 :00 :11
00 :00 :12
00 :00 :13
00 :00 :14
00 :00 :15
00 :00 :16
00 :00 :17
00 :00 :18
00 :00 :19
00 :00 :20
00 :00 :21
00 :00 :22
00 :00 :23
00 :00 :24
00 :00 :25
```

Real time clock using the MSP432.

You will need to obtain the signature of your TA on the following items in order to receive credit for your lab assignment. Signatures are due by **Friday, November 15, 2019 (Part 1 Elements)** and **Friday, November 22, 2019 (Part 2 Elements)**.

Print your name below, sign the honor code pledge, circle your course number, and then demonstrate your working hardware & firmware in order to obtain the necessary signatures.

Student Name: Nitik Gupta

Honor Code Pledge: "On my honor, as a University of Colorado student, I have neither given nor received unauthorized assistance on this work. I have clearly acknowledged work that is not my own."

Student Signature: Gupta

Signoff Checklist

Part 1 Required Elements

- ☒ Pins and signals labeled and decoupling capacitors present on board
- ☒ C code for EEPROM functional, contents present after power cycle
- ☒ I²C diagram/timing analysis

TA signature and date

Part 2 Required Elements

- ☒ LCD functional, C code for basic LCD routines functional
- ☒ LCD control signal timing meets specifications (logic analyzer trace/diagram, analysis)
- ☒ Elapsed time stop, restart, reset to "00:00.0": < 1s over 3min DRAFT
- ☒ Good integration with previous code, all functions work, no irregularities

11/22

Part 2 Supplemental Elements

- ☒ LCD Hex/D0RAM/CGRAM dumps, custom LCD characters, fun logo SEE NOTES
- ☐ SPI interface, logic analyzer trace, compare with I²C.
- ☒ TI MSP432 ARM code development, 2 new features, ISR 3 REAT SEE NOTES
- ☐ PCF8574 I²C I/O Expander, input, output, ISR

FOR TA/INSTRUCTOR USE ONLY

Part 1 Elements

	Not Applicable	Poor/Not Complete	Meets Requirements	Exceeds Requirements	Outstanding
Schematics, SPLD code	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hardware physical implementation	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Required Elements functionality	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sign-off done without excessive retries	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Student understanding and skills	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overall Demo Quality (Part 1 elements)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

FOR TA/INSTRUCTOR USE ONLY

Part 2 Elements

	Not Applicable	Below Expectation	Meets Requirements	Exceeds Requirements	Outstanding
Schematics, SPLD code	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hardware physical implementation	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Required Elements functionality	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Supplemental Elements functionality	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sign-off done without excessive retries	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Student understanding and skills	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overall Demo Quality (Part 2 elements)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

TA/Instructor Comments

□ □ □

11/12 PT1

A1057

- NO POLLUPS IN SCHEMATIC (ON BOARD THOUGH)
- DECOUPLING CAP COULD BE CLOSER
- + CATCHES ALL INPUT ERRORS (TOO BIG, OUT OF RANGE, NON-HEX)
- + NICE FORMATTED DUMP
- + NICE MENU
- 61.43KHz I²C
- + TIMING ANALYSIS RT'S, FREQ, LOW/HIGH, SOME SETUP AND HOLD
- RESET NOT QUITE RIGHT (WRONG START CONDITION, SR WRONG)
- + DECENT RESET UNDERSTANDING (KNOW IT FIXES HANGS, BUT NOT HOW)
- NO NACK HANDLING
- + CROSS PAGE READS WORK

11/22 PT2

- ~ TIMING ANALYSIS OF RS/EN, BUT NO RECORDED VALS FOR OTHER SIGNALS. SAYS THEY WERE CHECKED THOUGH.
- ~ RAM DUMP ~~BREAKS~~ CLEAR SCREEN (CAN CLEAR SCREEN). STILL BROKEN
- ~ CHARACTER INPUT, NO STRING INPUT
STRING WRITE FUNCTION, BUT NOT IN INTERACTIVE PROGRAM.
- ~ HAS DDRAM DUMP BUT APPEARS NON FUNCTIONAL
NO CGRAM DUMP
- + RTC ON MSP432 PRINTS TIME EVERY SECOND

NO EEPROM CHECK NEEDED

