

# EE 3921 Lab 3: VGA

2 dedicated lab periods, 3 lab periods to complete

Name: \_\_\_\_\_

## Objectives

- Utilize Max 10 mega-functions
- Utilize third party IP
- Drive an external component (VGA)

## Prelab

- Review the ROM Mega Wizard
- Review the VGA class notes
- Review the VGA driver code

student  
check off

## Assignment

Part 1: Create a ROM verification block

Specifications:

- 1) The ROM will be configured as a Single-Port ROM
- 2) The ROM will have 256, 8 bit words
- 3) The rom will be initialized from a file
- 4) The clock will cycle through the ROM, one word per clock cycle
- 5) The cycling can be paused
- 6) Generics:
  - a. none
- 7) Input signals:
  - a. rstb
  - b. clk
  - c. pauseb (active low)
- 8) Output signals:
  - a. Current ROM address
  - b. ROM contents (1 word)

Additional Requirements:

- 1) Create the ROM using the Mega Wizard
- 2) Use the Alpha1.mif from the website for the contents of the ROM
- 3) Put the current address value on the LEDs on the DE10 (binary)
- 4) Put the ROM data on the seven segment displays in HEX on the DE10
- 5) Use one of the pushbutton switches as the pauseb signal
- 6) Operate the DE10 implementation with a 2Hz clock

Part 2: Create a VGA display block using the instructor provided VGA driver

Specifications:

- 1) The display block will utilize an internal character ROM
- 2) The design will run on two external clocks (one for the VGA, one for the Character Driver)
- 3) The design will output 1 character every second
- 4) The design will output each character to the same location
- 5) Input signals:
  - a. clk
  - b. rstb

- c. clk\_char (clock for advancing the character number)
- 6) Output Signals:
- a. Character number (binary)
  - b. VGA signals

Additional requirements:

- 1) Implement the DE10 version using the ROM and Alpha1.mif file from Part 1
- 2) Output 26 characters in an infinite loop
- 3) The VGA driver block must use a PLL for its clock
- 4) Use a VGA monitor (available in the tech-center) for displaying your VGA output
- 5) Output the current character count to the LEDs

Note: The ROM contains all the pixel information for the capital letters of the alphabet, plus a space. The information for each character is stored as eight 8-bit bytes, where each byte contains the bit pattern for a single row of that character. Each character is represented as a matrix of pixels 8-by-8. A '1' bit means the pixel is turned on, a '0' means it is off.

The VGA driver is available on the website. Read its documentation to determine the required clock frequency and the I/O signals.

Part 3: ~~Express yourself — choose one of the following~~

- ~~1) Instead of cycling through the characters, display some non-offensive message of your choice on the first line of the monitor. Use somewhere between 20 and 79 characters~~
- ~~2) Modify your design to select the location of the character using switches~~
- ~~3) Modify your design to select the color of the character using switches~~

### Check Off

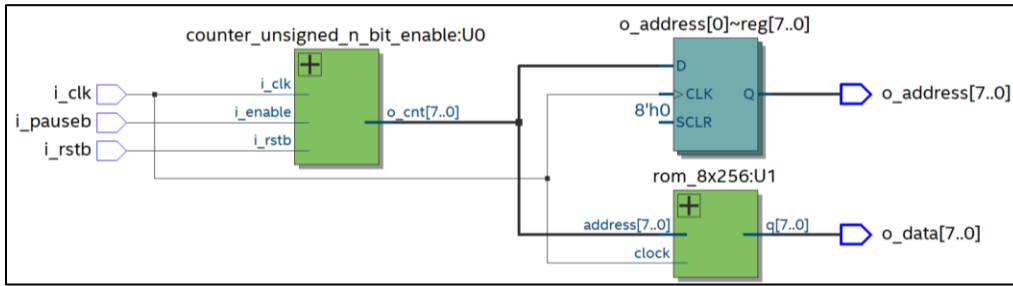
You must demonstrate your working design(s) prior to the end of the 2nd lab period

- Demo the ROM verification design (Simulation, DE10) 30% \_\_\_\_\_
- Demo your VGA character design (DE10 implementation) 50% \_\_\_\_\_
- ~~• Demo your part 3 selection (DE10 implementation) 10% \_\_\_\_\_~~

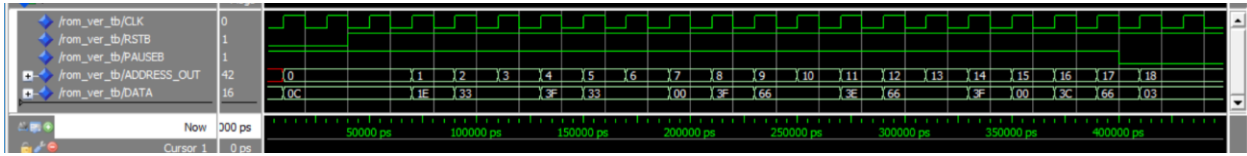
### Lab Report (informal)

- Due at 4:00 pm, 1 day after 3<sup>rd</sup> lab – in the box
- Include a properly documented informal lab report. 20% \_\_\_\_\_

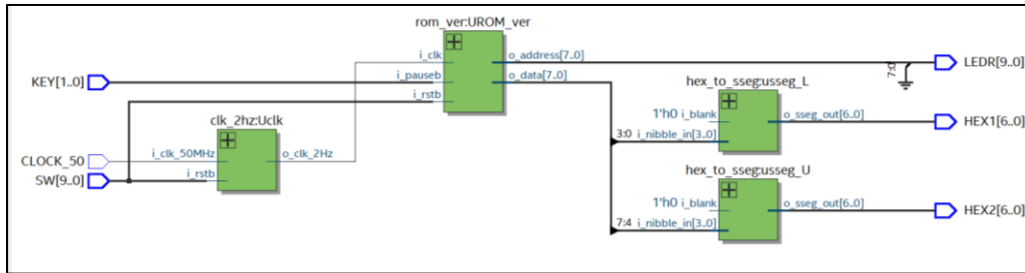
### rom\_ver.vhdl



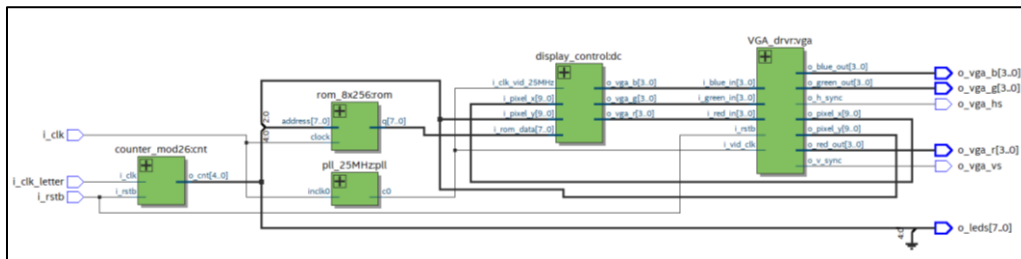
### rom\_ver\_tb



### rom\_ver\_de10.vhdl



### rom\_to\_vga.vhdl



### rom\_to\_vga\_de10.vhdl

