Logo

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**Design and Analysis or Reconfigurable Systems**

**Homework 7**

**VGA-FPGA Interface**

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**Part I – VGA implementation with DCM IP to set clock**

a.) Follow the instructions in the lab sheet and implement the design which draws two squares of different color to the screen using Altera’s IP catalogue to create a clock of different frequency (based on screen size and resolution). Create a short video demonstrating the working design

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| Marks |
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Resolution: 1920 x 1200

<https://youtu.be/96xAMJ0EhVM>

b.) Report the number of ALMs, ALUTs and critical path of the design from the synthesis report. Compute the maximum frequency.

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| Marks |
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ALM: 39

ALUTs: 55

Critical Path: 4.35 ns

Max Frequency: 

**Part II – Timing analysis**

c.) Open TimeQuest. 1) Netlist 🡪 Create Timing netlist. 2.) Read .sdc file from VGA project (Constraints 🡪 read sdc file). 3.) Update timing netlist (Netlist 🡪 Update Timing netlist)

Report the slack of the circuit. Is it positive or negative? Explain what that means (Reports 🡪 slack 🡪 Report setup summary and Report hold summary.

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Report Setup Summary:

A close up of a sign

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Report Hold Summary:



Positive Slack. This means the path of this design meets the timing constants.

e.) Reporting the skew. Task pane 🡪 Custom reports 🡪 report skew. Edit “From clock” and “To clock” combo boxes. Which clocks should you choose? Explain why.

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Choose sys\_clk\_in or FRACTIONAL PPL. These clocks had no skew. However, when choosing PLL Output Counter clock for Clock In and Clock Out, there exists a clock skew. This means that the arrival time of the clock is different for different parts of the circuit. This is not ideal since there will be an increase of timing violations if this happens.

f.) Is the slack positive or negative? What does the slack result obtained suggests?

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| Marks |
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Positive Slack. This means the path of this design meets the timing constants.

**Part III – Power Estimation**

1. Use the PowerPlay Excel sheet to estimate the total power of the design. Enter manually the resources used. Let the toggle rate at its default value. Annotate the estimated dynamic and static power, with the following values. Discuss the results.

(6 marks)

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| --- | --- | --- | --- | --- | --- | --- |
| Configs | Frequency  [MHz] | Temperature [oC] | Toggle rate [%] | Static power (Quiescent) [W] | Dynamic Power [W] | Total Power [W] |
| Config 1 | 50 | 50 | 12.5 | 0.461 | 0.241 | 0.702 |
| Config 2 | 60 | 50 | 12.5 | 0.461 | 0.242 | 0.703 |
| Config 3 | 70 | 50 | 12.5 | 0.461 | 0.244 | 0.705 |
| Config 4 | 50 | 55 | 12.5 | 0.472 | 0.240 | 0.712 |
| Config 5 | 50 | 60 | 12.5 | 0.483 | 0.241 | 0.724 |
| Config 6 | 50 | 65 | 12.5 | 0.495 | 0.241 | 0.736 |
| Config 7 | 50 | 50 | 13.75 | 0.461 | 0.242 | 0.703 |
| Config 8 | 50 | 50 | 15 | 0.461 | 0.242 | 0.703 |
| Config 9 | 50 | 50 | 16.25 | 0.461 | 0.243 | 0.704 |

* Increasing frequency will increase the dynamic power, but static power stays the same. Thus, total overall power increases.
* Increasing temperature will increase the static power, but dynamic power (relatively) stays the same. Thus, total overall power increases.
* Increasing Toggle Rate Percentage doesn’t change power much.

Compare the results obtained from Power Play Early Power Estimator (Excel spreadsheet) with the results obtained from Power Play Power Analyzer (Quartus II power estimation tool). Do the results match? Explain why yes/no.

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The dynamic power from both the excel spreadsheet and the power estimation tools matches.

A screenshot of a computer

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Static power is not found in the power estimation tool, thus

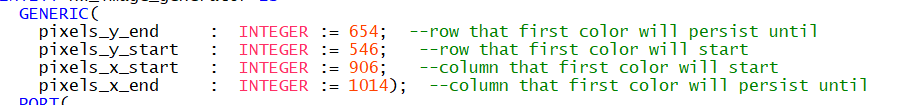
**Part IV – Re-doing VGA Output**

h.) Re-do the design and display a red 4cm2 square (2cm x 2 cm) on a white background (full display) at the center of the display. Write down the ‘if’ condition from the VHDL ‘hw\_image\_generator’ that allows the printing of the red square (code snippet. Adjust the monitor size parameters (porch values and horizontal and vertical pixels, etc..). Include the parameters settings here and a screenshot of the working design.

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| Marks |
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IF(row < pixels\_y\_end AND row > pixels\_y\_start AND column < pixels\_x\_end AND column > pixels\_x\_start)

NOTE:



**A screen with a red square on it

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**Bonus:**

Modify the design so that you write on the screen: ‘UT Dallas’. Append your code here (only the newly added code)

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| Marks |
| 5 bonus |
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