

**Digital Design and Computer Architecture LU**

# **Lab Protocol**

## **Exercise II**

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## Task 1: VBS Graphics Controller

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### Subtask 1

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#### VBS Oscilloscope Measurements

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Figure 1: Measurement showing scanline 3 with cursors marking the length (duration) of the whole line



Figure 2: Measurement showing scanline 3 with cursors marking the duration of the first synchronization pulse

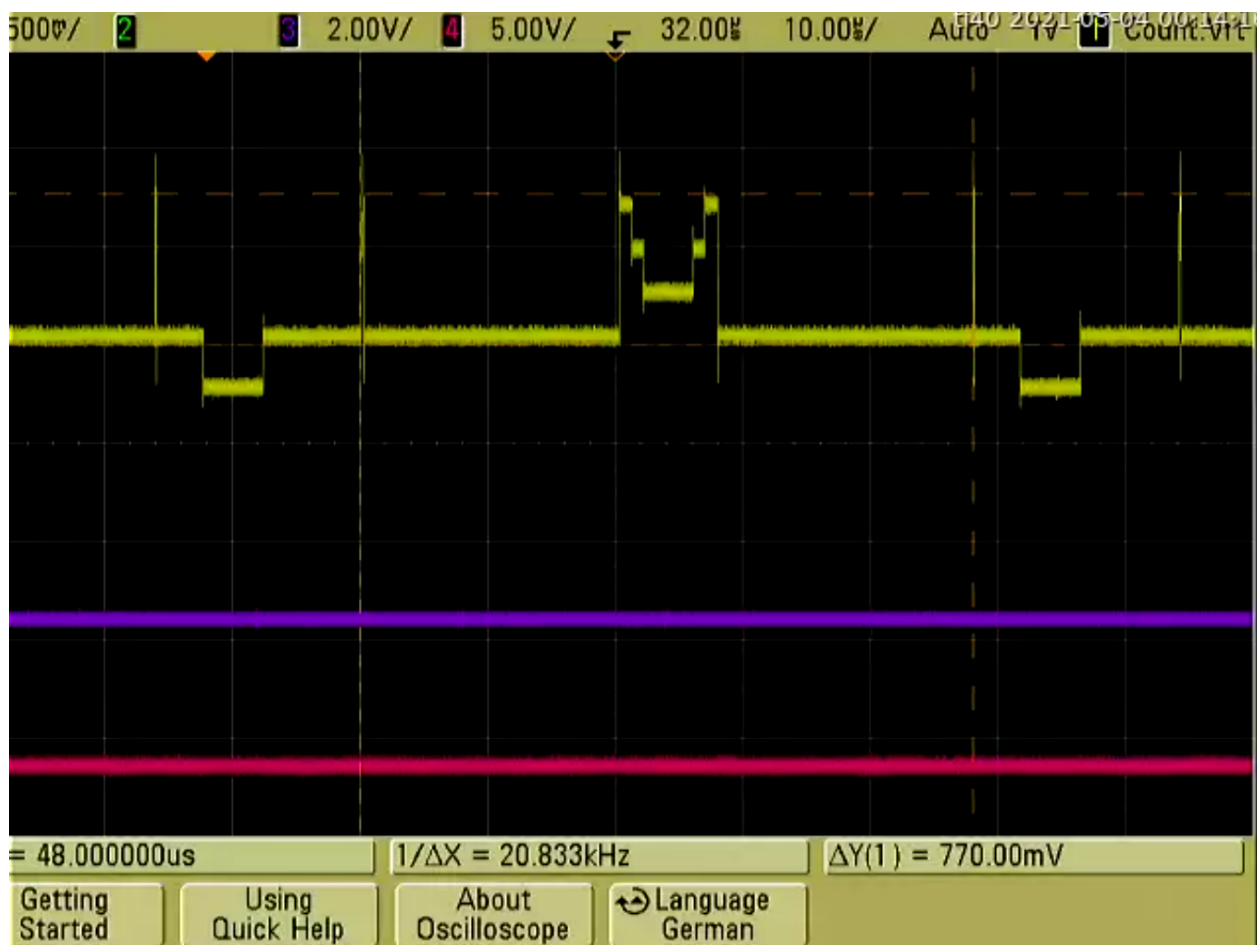


Figure 3: Measurement showing a scanline of the center of the test pattern with cursors marking the visible portion of the line

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END Subtask 1

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## Task 2: Ball Game module

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### Subtask 2

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Briefly describe the architecture of your `ball_game` module. Are there any submodules? What is their purpose? How many FSMs did you use?

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add your explanation here (approximately 8-10 sentences, you can also include figures) ...

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END Subtask 2

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## Task 3: Bonus: SignalTap Measurement

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### Subtask 3

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Trigger Condition

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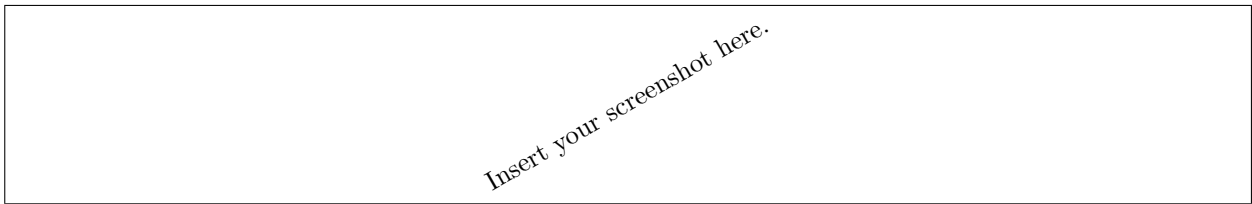


Figure 4: Screenshot showing the trigger condition

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END Subtask 3

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### Subtask 4

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Measurement Screenshot

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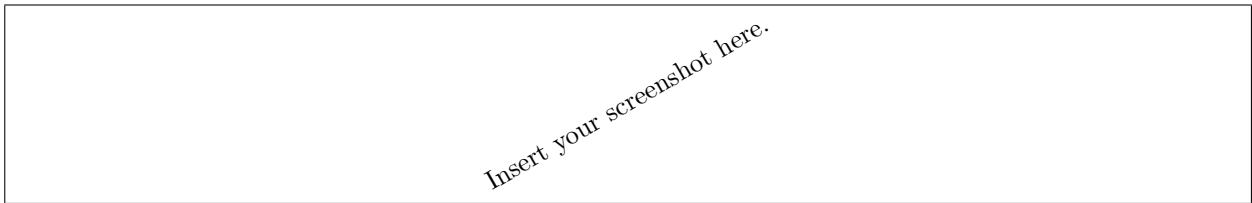


Figure 5: Screenshot showing at least the first 4 instructions (and their associated data items) issued to the graphics controller during one frame by the `ball_game` module.

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END Subtask 4

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### Subtask 5

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Instruction Decoding

gfx_instr	associated gfx_data items	Instruction	Description						
0x..	<ul style="list-style-type: none"><li>• 0x0001</li><li>• 0x0002</li><li>• 0x0003</li><li>• 0x0004</li></ul>	GFX_INSTR_??	...						
	0x..			<ul style="list-style-type: none"><li>• 0x0001</li><li>• 0x0002</li><li>• 0x0003</li><li>• 0x0004</li></ul>	GFX_INSTR_??	...			
				0x..			<ul style="list-style-type: none"><li>• 0x0001</li><li>• 0x0002</li><li>• 0x0003</li><li>• 0x0004</li></ul>	GFX_INSTR_??	...
							0x..		

— END Subtask 5 —

Subtask 6

What resources on the FPGA and board do you need to perform a measurement with a stand-alone logic analyzer (LA) measurement device and what for the SignalTap LA?

put your answer here ...

END Subtask 6