

# Lab 5 README.pdf

## Lab 5 Partners

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## Break Down

### 1. Directory path of SOF and solution:

rtl/dds\_and\_nios\_lab\_time\_limited.sof

rtl/Chain1.cdf

### 2. Status

Everything in the lab is working, and according to the provided instructions. There are some caveats, however, as we will discuss below.

Task 7:

- LFSR with correct sequence – Check

Task 8:

- Instantiate the DDS – Check

Task 9:

- Modulate DDS with LFSR – Check
- ASK – Check
- BPSK – Check

Task 10:

- Connect signals to VGA – Check
- ASK – Check
- BPSK – Check
- LFSR – Check
- Use cross clocking logic – Check

Task 11:

- Create PIOs – Check
- Write ISR – Check
- Write FSK to VGA screen – Check
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Latches:

There are latches in the provided code, and NOT from our code. As per

<https://piazza.com/class/kjkioroxku03a6?cid=370>

these latches will not be considered.

### **3. Annotated simulation screenshots as required by the lab**

The screenshots can be found lower in the document.

### **4. Information on how to run the simulations**

For “waveform\_gen\_TB.sv” and “sincos\_lut\_TB.sv” an installation of Quatus/ModelSim Altera 16.1 is required, as it is a system verilog testbench that calls a VHDL module.

### **5. Any additional information**

Modules were created, and each has their own respective file. These files were called upon by the main “dds\_and\_nios\_lab.v” file.

- “fast\_to\_slow.sv” for task 10,
- “slow\_to\_fast.sv” for task 10,
- “Nbit\_register\_async\_reset.sv” for flip flops
- “Nbit\_register\_async\_reset\_in.sv” as a special flip flop used in “fast\_to\_slow.sv”
- “LFSR.sv” the used LFSR module
- “lfsr\_ebi.sv” a generic LFSR module that can handle more than 5 bits
- “clock\_divider.sv”
- “mux4to1.sv”

Youtube video of the VGA screen:

[https://youtu.be/fl\\_4Vw-mmPA](https://youtu.be/fl_4Vw-mmPA)

There are rigorous comments in each code module that may be helpful for understanding the “what” & “why”s of the code.

Please note that comments containing “//&?&” is just a shorthand that I use to CTRL-F to areas in the professor’s code that requires adjustment.

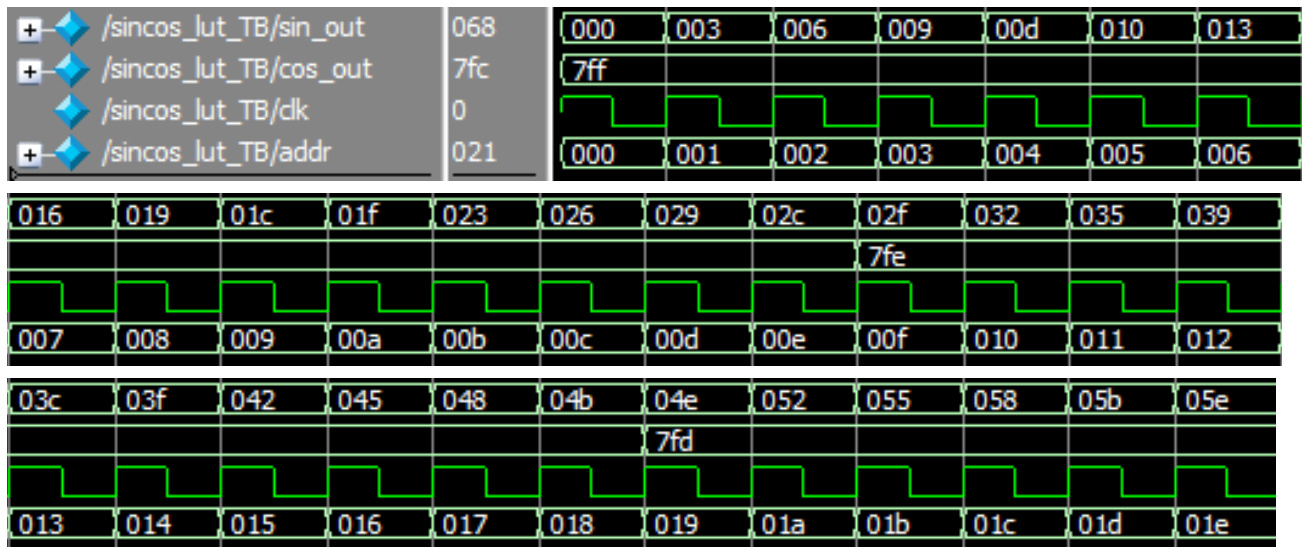
## **Annotated Screenshots**

Each FSM here is shown.

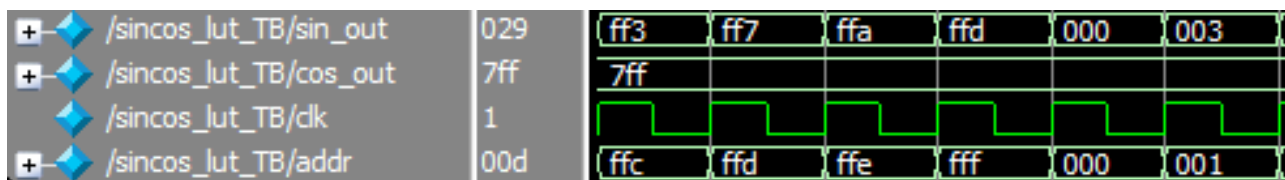
### **Waveform\_gen\_TB**

**sincos\_lut\_TB, sin cos lookup table**

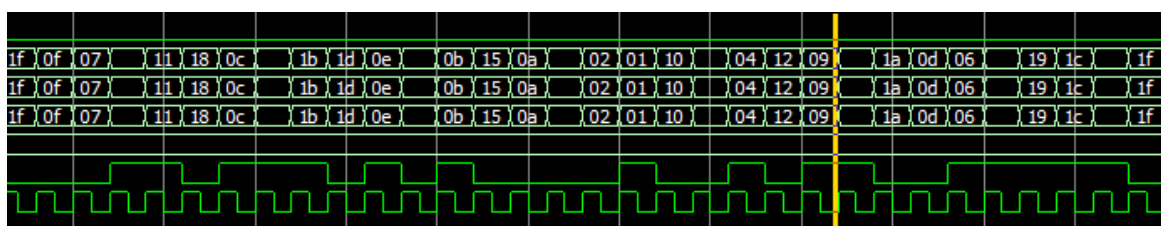
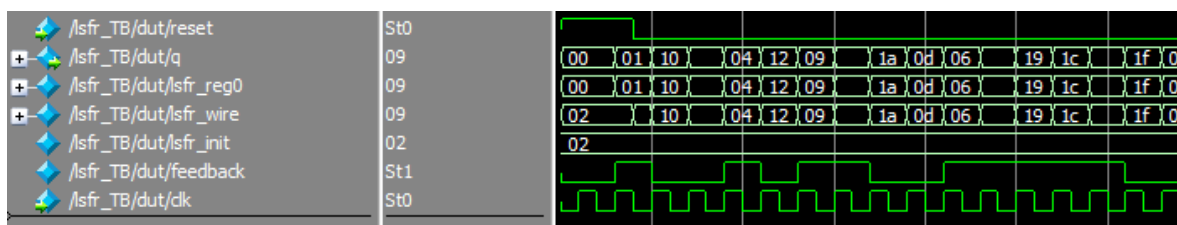
In this testbench I increment addr forever, and observe the values coming through.



The forever loop in the testbench will overflow and the test loops.

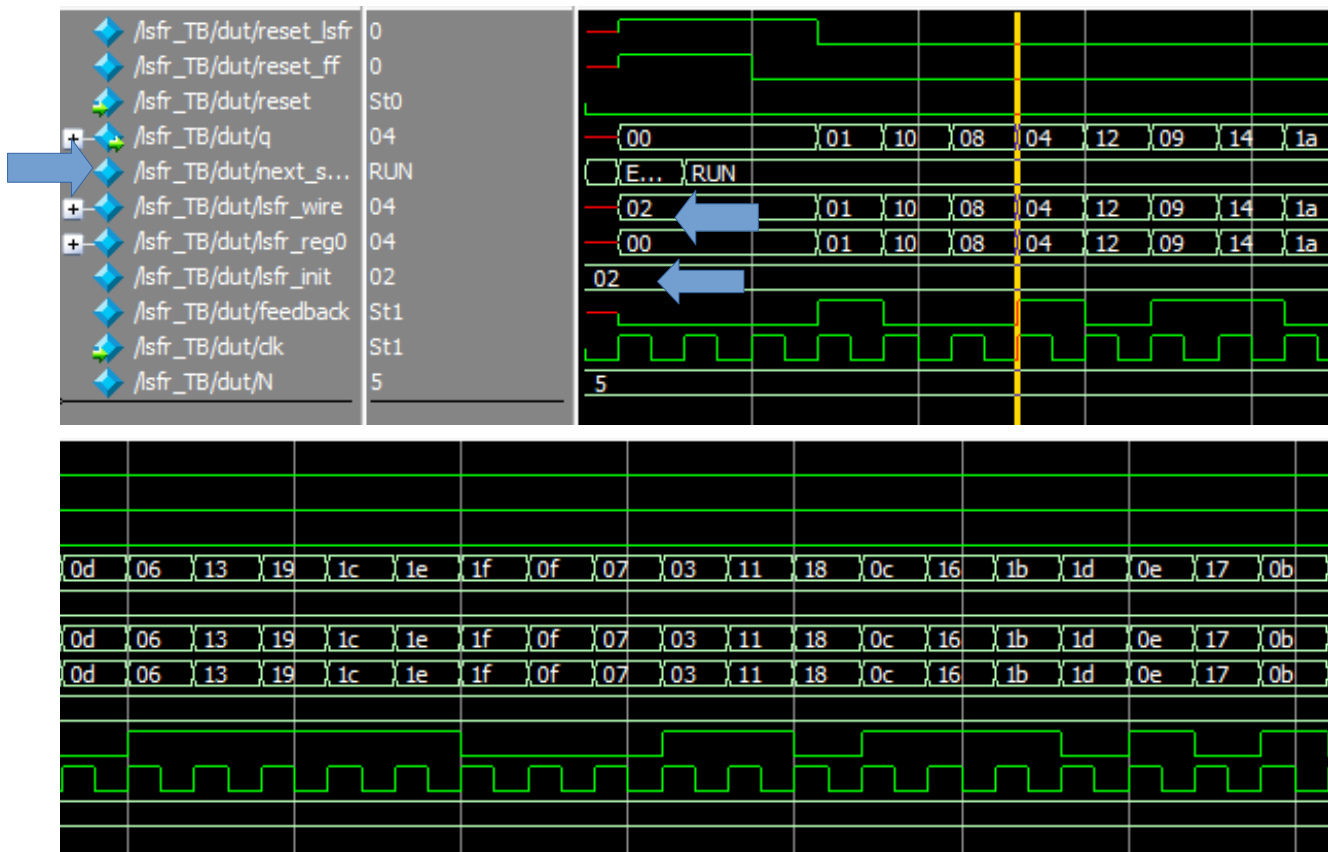


### LFSR – simple



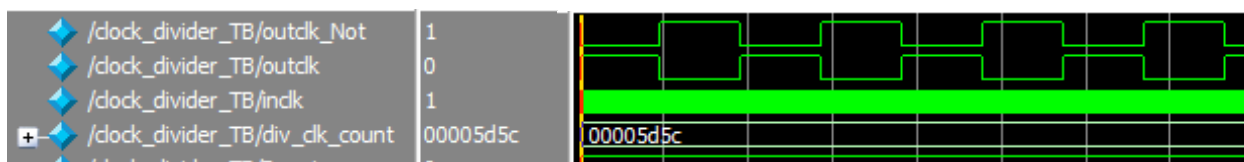
### LFSR – with self-initializing & reset handling FSM

Here we see the LFSR reset its flip flops when first starting, and setting the initial value.

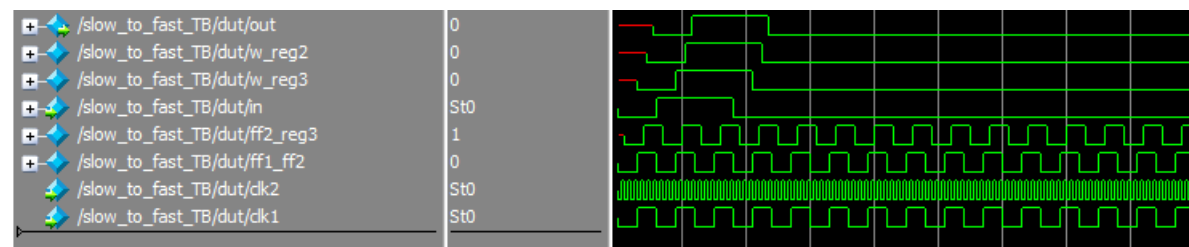


### Clock Divider

This is fairly self explanatory. The clock divider will wait until the provided number of clock cycles before swapping the outclk.



### Slow to fast, cross clocking logic



### Fast to slow, cross clocking logic

