

FPGA Design

Exercises

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- When possible, use a push button as reset signal in your designs.
- The UCF file of the board can be found here: <http://iihe.ac.be/~tlenzi/res/basys2.ucf>.
- The Spartan3E primitives can be found here: http://www.xilinx.com/support/documentation/sw_manuals/xilinx12_4/spartan3e_hdl.pdf.

1. LED Blinking

- Use the 50 MHz clock to blink a LED at a frequency of 1 Hz.

2. Counter

- Design a counter by 3 which result is shown on the LEDs and on the 7-segments display. The counter should increment every second.

3. Monostable

- Using the previously generated clock, design a monostable which when triggered lights a LED for 3 clock cycles and displays a count-down on the 7-segments display.
- Develop both a repeatable and a non-repeatable monostable. The repeatable version should reset its counter when triggered. The non-repeatable version should ignore the triggers while counting.

4. TDC

- Design a “TDC” with a Start and Stop input which uses the 7-segments display to show the number of seconds elapsed between the two signals.

5. Clock Bridges

- Create a design in which data and strobes have to be transmitted between two different clock domains.
- Test the design using in simulation.

6. 2-wire Transceiver

- Design a UART module which transmits/receives 8 bits.
- When data is received, it is shown on the 7-segment display.
- To send data, use the switches to encode 8 bits and a button to send them. Display the bits on the other half of the display.

7. 1-wire Transceiver

- Reproduce the previous example but use only a 1-wire interface.

8. FIFO

- Implement a FIFO (first-in first-out) in VHDL. The FIFO should:
 - assert a line when a write was successful;
 - assert a line when it is full;
 - assert a line when it is empty;
 - assert a line when a read operation is valid;
 - have a variable depth;
 - have a variable data size.

9. Clock Multiplexer

- Generate two slow clocks (\sim Hz) without using the PLLs.
- Bring the clocks on the clock network and use a pushbutton to switch between the two.
- Observe the clock switching using LEDs.

10. Radiation Hard Registers

- Implement a triplicated register system with variable data width and a voting system. You should also be able to inject bit-flips in the logic and detect them using an output signal.

11. PS2 Mouse

- Using a mouse connected to the PS2 input on the Basys2 board, control the LEDs. Start by turning on the central LED in the row and then move the active LED in function on the mouse's movements.