

# Zero-counting Circuit

## Signature and Grading Sheet

**Group #:**\_\_\_\_\_ **Name(s):**\_\_\_\_\_.

### Signature

Section 4.2(f): \_\_\_\_\_.

### Grading

- Section 4.1(a)(b): pseudo algorithm and registers (10 points):\_\_\_\_\_.  
Attach 1-page algorithm and explanation of registers
- Section 4.1(c): ASMD chart (20 points):\_\_\_\_\_.  
Attach 1-page detailed ASMD chart
- Section 4.1(d): VHDL code (30 points):\_\_\_\_\_.  
Attach code printout
- Section 4.1(e): Simulation (20 points):\_\_\_\_\_.  
Attach simulation timing diagram printout.
- Section 4.2 (e) (5 points):\_\_\_\_\_.  
Attach one-page report printout with # of LEs circled.
- Section 4.2 (f) : demo signature (15 points):\_\_\_\_\_.

**Total points:** \_\_\_\_\_.

# Experiment

## Zero-counting Circuit

### 1 Purpose

To use FSM/D methodology to design and implement an intermediate-sized digital circuit.

### 2 Reading

- Chapter 7 of *Embedded SoPC Design with Nios II Processor and VHDL Examples*

### 3 Project specification

The purpose of this project is to construct a circuit that counts number of 0's of a 10-bit input word. For example, the output returns "0100" if the input is "0111001110". In addition to the clock and reset signals, the input signals of this circuit are

- **start**: a pushbutton switch that initialize the counting.
- **a**: 10-bit input data word

The circuit outputs include LED indicators:

- **ready**: a green LED that indicates the circuit is ready.
- **count**: 4-bit number indicates the number of 0's in **a**.

The design must be synchronous or 50% will be deducted.

### 4 Design Procedures

#### 4.1 FSM/D design and simulation

- Derive a pseudo algorithm.
- Determine the registers needed.
- Derive the detailed ASMD chart according to the algorithm.
- Derive VHDL code according to the ASMD chart.
- Perform simulation on at least three input patterns.

#### 4.2 Implementation and testing

- Use the 50MHz oscillator for clock.
- Use 10 slide switches for the **a** signal and two pushbutton switches for **reset** and **start** (recall that a pushbutton switch outputs 1 when not pressed).
- Use 5 LEDs for **ready** and **count**.
- Perform pin assignment and synthesize the code.
- Look at the compiling report and determine the number of LEs used in circuit.
- Download the file to the FPGA device and verify the operation of physical circuit.  
Demonstrate the circuit to instructor and get signature.