EXPERIMENT # 9: Magnitude Comparator Circuit

Name: _____Date: _____

Equipment/Parts Needed:

PC (Altera Quartus II V9.1 installed)
DE-2 board

Objective:

- To build 1-bit and 2-bit Magnitude Comparator circuits using the Quartus II development software with the DE-2 board.
- To test the design by downloading the file into the DE-2 board, exercising the inputs with toggle switches and observing 3 individual LED's.

Discussion:

- A Magnitude Comparator compares one and two binary numbers and indicates whether the numbers are equal or which number is larger.
  - The Comparator will take inputs from 4 toggle switches (SW[0]~SW[3]) representing two 2 bit binary numbers and activate LEDG[0]~LEDG[3] in the DE-2 board.
  - The input numbers will be labeled A0, A1 and B0, B1 and the outputs will be labeled **AeqB**, **AltB**, and **AgtB**. The LED's are activated under the following condition.

INPUT	**AgtB** LED	**AeqB** LED	**AltB** LED
A>B	ON	OFF	OFF
A=B	OFF	ON	OFF
A<B	OFF	OFF	ON

Part 1: 1-bit Magnitude Comparator Circuit

1) Start the Quartus II software. Select **File – New Project Wizard**. And create a new project name under the directory C**:\altera\91sp2\quartus*your last name*\Lab9**. You need to go through the step from 1 through 8 in the Part 1 of **Lab6** manual. Don't forget to create the folder **Lab9** under the subfolder of your last name. Assign the project name **Lab9_1**, assign ***Cyclone II*** for the device family, and select the ***EP2C35F672C6*** chip in the Family & device settings.

2) Open a New Block Diagram/Schematic file and draw the circuit for 1-bit Magnitude Comparator circuit in the Figure 9-1. And compile the circuit and correct all errors if you have any.

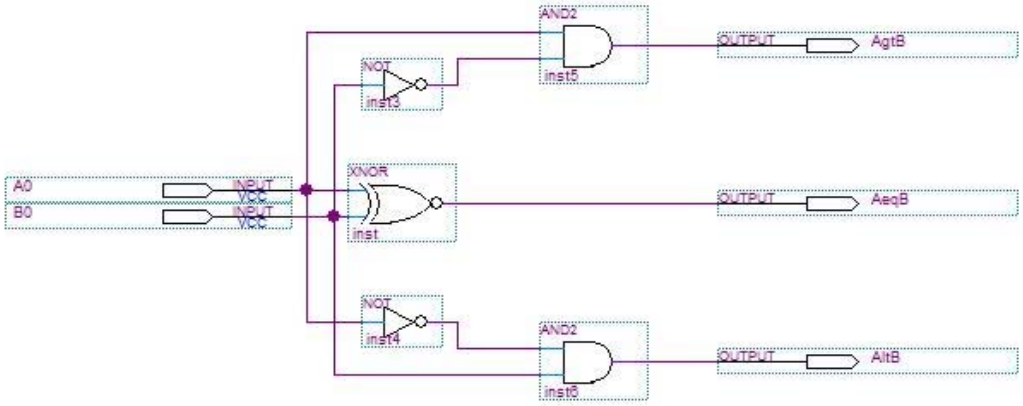

Figure 9-1 1-bit Magnitude Comparator Circuit.

3) Open a new Vector Waveform file and create waveforms A0 and B0 shown in Figure 8-1. And simulate the waveforms and analyze the output waveforms with respect to the inputs, and then complete the Truth table below.

Inputs		**Outputs**		
A0	**B0**	**AgtB**	**AeqB**	**AltB**
0	**0**			
0	**1**			
1	**0**			
1	**1**			

4) To program files and test it on DE-2 board, choose **Assignment > Pins** and then assign the pin numbers as shown in the tables below.

SWITCH INPUTS

Name	Pin Num.	Switches
A	PIN_N26	SW[1]
B	PIN_N25	SW[0]

LED OUTPUTS

Name	Pin Num.	LED
AgtB	PIN_W19	LEDG[2]
AeqB	PIN_AF22	LEDG[1]
AltB	PIN_AE22	LEDG[0]

5) Save and compile the design again before programming. Then connect DE-2 board to computer. (If you're not sure, refer to the Part 2 of Lab 7 manual.)

6) Now program the design and exercise the toggle switches and verify the proper LED is illuminated by filling in the table below. You need to show and explain it to your Instructor. (Remember that Input switches in the ON position mean a HIGH(1). Also remember that the DE-2 board has active-HIGH LEDs.)

Inputs		**LED Outputs**		
A	**B**	**AgtB**	**AeqB**	**AltB**
OFF (0)	**OFF (0)**			
OFF (0)	**ON (1)**			
ON (1)	**OFF (0)**			
ON (1)	**ON (1)**			

Instructor's Signature:_____, Date: _____

Part 2:2-bit Magnitude Comparator Circuit

1) For the part 2, you need create a new project name under the directory C**:\altera\91sp2\quartus*your last name*\Lab9**. Assign the project name **Lab9_2**, assign ***Cyclone II*** for the device family, and select the ***EP2C35F672C6*** chip in the Family & device settings.

2) Open a New Block Diagram/Schematic file and draw the circuit for 2-bit Magnitude Comparator circuit in the Figure 9-2. And compile the circuit and correct all errors if you have any.

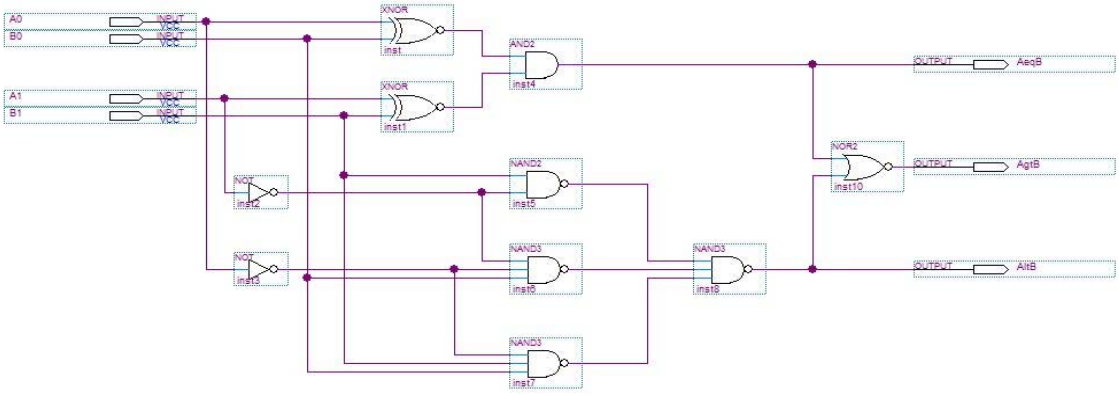

Figure 9-2 2-bit Magnitude Comparator Circuit.

3) Open a new Vector Waveform file and create waveforms A0, A1, B0, and B1 shown in the circuit. And simulate the waveforms and analyze the output waveforms with respect to the inputs, and then complete the Truth table below.

Inputs				**Outputs**		
A1	**A0**	**B1**	**B0**	**AgtB**	**AeqB**	**AltB**
0	**0**	**0**	**0**			
0	**0**	**0**	**1**			
0	**0**	**1**	**0**			
0	**0**	**1**	**1**			
0	**1**	**0**	**0**			
0	**1**	**0**	**1**			
0	**1**	**1**	**0**			
0	**1**	**1**	**1**			
1	**0**	**0**	**0**			
1	**0**	**0**	**1**			
1	**0**	**1**	**0**			
1	**0**	**1**	**1**			
1	**1**	**0**	**0**			
1	**1**	**0**	**1**			
1	**1**	**1**	**0**			
1	**1**	**1**	**1**			

4) To program files and test it on DE-2 board, choose **Assignment > Pins** and then assign the pin numbers as shown in the tables below.

SWITCH INPUTS

Name	Pin Num.	Switches
A1	PIN_AE14	SW[3]
A0	PIN_P25	SW[2]
B1	PIN_N26	SW[1]
B0	PIN_N25	SW[0]

LED OUTPUTS

Name	Pin Num.	LED
AgtB	PIN_W19	LEDG[2]
AeqB	PIN_AF22	LEDG[1]
AltB	PIN_AE22	LEDG[0]

5) Save and compile the design again before programming. Then connect DE-2 board to computer.

6) Now program the design and exercise the toggle switches and verify the proper LED is illuminated by filling in the table below. You need to show and explain it to your Instructor. (Remember that Input switches in the ON position mean a HIGH(1). Also remember that the DE-2 board has active-HIGH LEDs.)

Inputs				**Outputs**		
A1	**A0**	**B1**	**B0**	**AgtB**	**AeqB**	**AltB**
OFF (0)	**OFF (0)**	**OFF (0)**	**OFF (0)**			
OFF (0)	**OFF (0)**	**OFF (0)**	**ON (1)**			
OFF (0)	**OFF (0)**	**ON (1)**	**OFF (0)**			
OFF (0)	**OFF (0)**	**ON (1)**	**ON (1)**			
OFF (0)	**ON (1)**	**OFF (0)**	**OFF (0)**			
OFF (0)	**ON (1)**	**OFF (0)**	**ON (1)**			
OFF (0)	**ON (1)**	**ON (1)**	**OFF (0)**			
OFF (0)	**ON (1)**	**ON (1)**	**ON (1)**			
ON (1)	**OFF (0)**	**OFF (0)**	**OFF (0)**			
ON (1)	**OFF (0)**	**OFF (0)**	**ON (1)**			
ON (1)	**OFF (0)**	**ON (1)**	**OFF (0)**			
ON (1)	**OFF (0)**	**ON (1)**	**ON (1)**			
ON (1)	**ON (1)**	**OFF (0)**	**OFF (0)**			
ON (1)	**ON (1)**	**OFF (0)**	**ON (1)**			
ON (1)	**ON (1)**	**ON (1)**	**OFF (0)**			
ON (1)	**ON (1)**	**ON (1)**	**ON (1)**			

Instructor's Signature:_____, Date: _____

Questions/Report:

1. **Include the schematics, vector waveforms, truth tables, and pin outs in the lab report.**

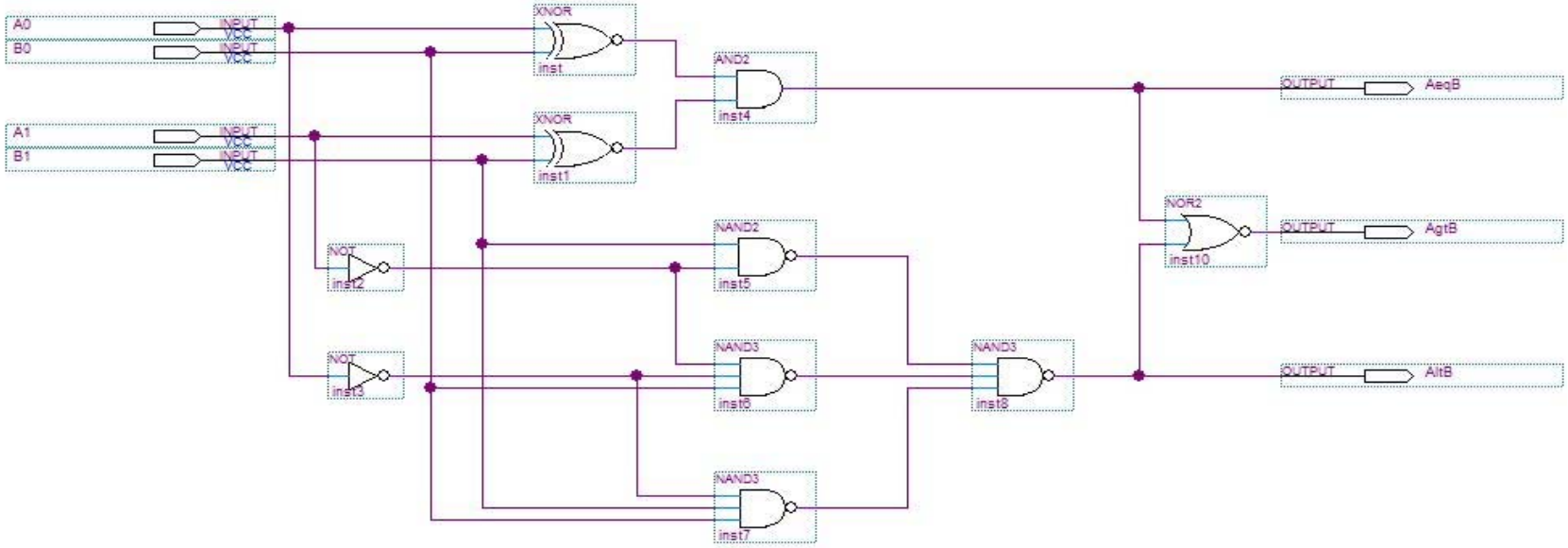

Figure 9-2 2-bit Magnitude Comparator Circuit.