TESTING ON THE DE2 BOARD

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CSC343
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PURPOSE

The DE2 board is a programmable board with an FPGA chip attached. FPGA stands for Field Programmable Gate array. This gives us the ability to program and reprogram the CPU on the DE2 board to perform the tasks we want it to. In our case, we will configure the board with VHDL code after we compile and simulate in Quartus. An image of the DE2 board is shown below.

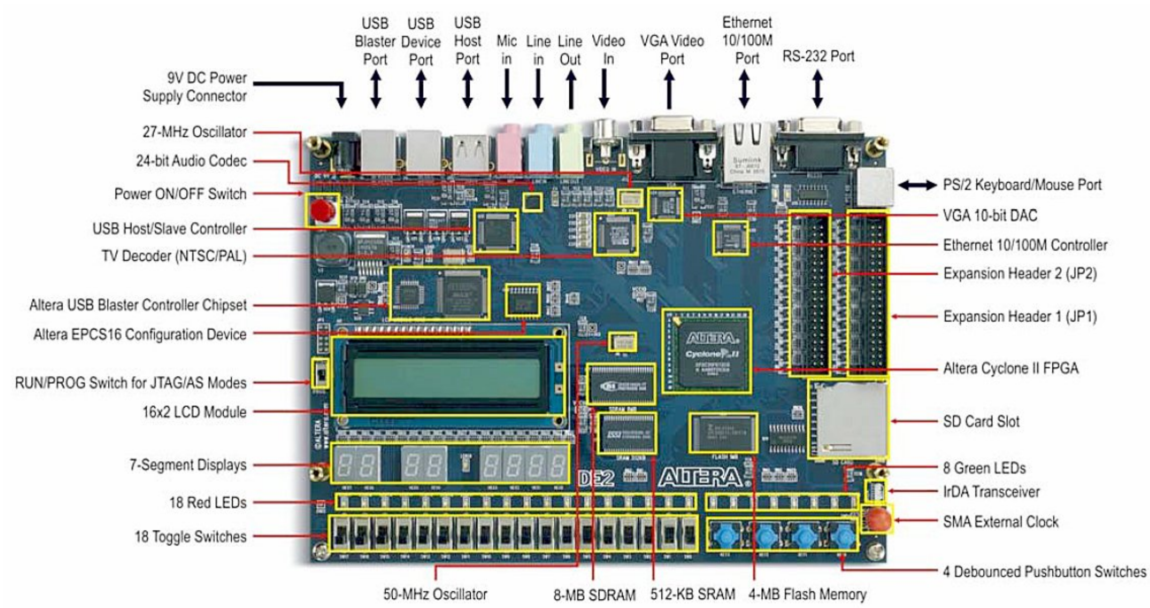

Figure 1: DE2 Board

PIN ASSIGNMENT FILES

Pin assignment files are files that assign the input and output pins in your design to various parts of the board. For example, I can assign input pins to switches or push buttons that change the binary value of my input from 0 to 1 or visa-versa. I could also assign output pins to LED's, seven-segment displays, or even an LCD. You must decide how you want to assign the pins in your Quartus design.

Pin assignment files are written simply as regular text files. This means you write them in a very simple application such as Notepad or WordPad. These files have the extension .txt. A sample pin assignment file is shown below.

```
To, Location
I0, PIN_N1
I1, PIN_A13
Carry_In, PIN_B13
a1, PIN_R2
a2, PIN_P4
a3, PIN_P3
a4, PIN_M2
a5, PIN_M3
a6, PIN_M5
a7, PIN_M4
b1, PIN_L3
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b2, PIN_L2
b3, PIN_L9
b4, PIN_L6
b5, PIN_L7
b6, PIN_P9
b7, PIN_N9
c1, PIN_V20
c2, PIN_V21
c3, PIN_W21
c4, PIN_Y22
c5, PIN_AA24
c6, PIN_AA23
c7, PIN_AB24
d1, PIN_Y23
d2, PIN_AA25
d3, PIN_AA26
d4, PIN_Y26
d5, PIN_Y25
d6, PIN_U22
d7, PIN_W24
e1, PIN_AB23
e2, PIN_V22
e3, PIN_AC25
e4, PIN_AC26
e5, PIN_AB26
e6, PIN_AB25
e7, PIN_Y24

The file ALWAYS starts out with the words "To, Location" at the top. Below that are the actual assignments. This pin assignment file happens to be for a full-adder. The first three assignments (I0, I1, and Carry_In) are the three inputs of the design. The pins they are assigned to (PIN_N1, PIN_A13, and PIN_B13) happen to be connected to dipswitches. Each dipswitch has only two possibilities; on or off. Off represents a logic value '0', and on represents a logic value '1'.

So what are all the rest of the pin assignments? That is the main purpose of adding our "dec_7seg" and "dec_7seg_hex" blocks. Those assignments are assigned to seven-segment displays that will display both the input values of I0 and I1, as well as the output values of "sum" and "Carry_Out". Assignments a1-a7 represent the output pins from the dec_7seg that outputs the sum on a seven-segment display on the DE2 board. The values b1 through b7 are assigned to pins that display the Carry_Out on another seven-segment display. All the rest (c1-c7, d1-d7, and e1-e7) simply display the values that are going into our full-adder.

What happens if there is an input with more than one bit? A sample of a pin assignment file for the ripple-carry adder is shown below.

To, Location
I0[0], PIN_U3
I0[1], PIN_U4
I0[2], PIN_V1
I0[3], PIN_V2
I1[0], PIN_N1
I1[1], PIN_P1
I1[2], PIN_P2
I1[3], PIN_T7

As you can see, both inputs are 4 bits long. Therefore, you must assign each bit separately with the format I0[0], I0[1], I0[2], and I0[3]. The same is done for the 4-bit input I1. Each bit of the inputs is assigned to a different dipswitch, But where do we get the actual assignments? We get the assignments from the Altera DE2 board user's manual, starting from page 28. The link for it is:

http://www.altera.com/education/univ/materials/boards/DE2_UserManual.pdf

QUARTUS TUTORIAL FOR USING DE2 BOARD

1) Write your pin assignment file. Save it as a text file in the same directory as your Quartus project.

2) Click assignments=>import assignments. A box will come up that looks as follows.

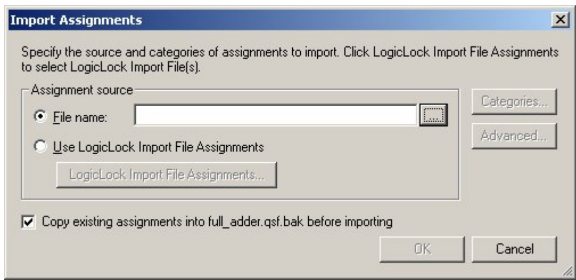

Figure 2: Import Assignments

2) Click on the box with the three dots to the right of the text box. Select the pin assignment file you just saved. Click OK. You should see your pin assignment appear on your block diagram file/

3) Compile your design,

4) Click Tools=>Programmer. The following screen will appear.

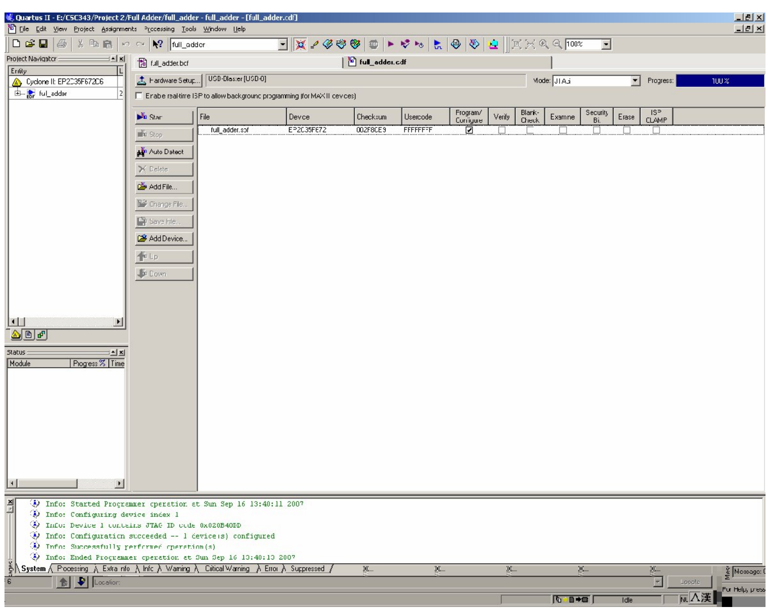

Figure 3: Programmer Screen

5) Check the box under “Programs/Configure”.

6) Click “Start”. If the blue bar on the upper-right hand corner, goes to 100%, you should see your design on the DE2 board.

TEST YOUR DESIGNS

You should test the following designs on the DE2 board.

1. Full-Adder
2. Ripple-Carry Adder
3. Adder/Subtractor

FULL-ADDER

Have the three inputs (which I happened to label I0, I1, and Carry_In) assigned to dipswitches SW10, SW9, and SW8, respectively. Those are not the actual pin assignments of those dip switches. They are the physical labels of those dipswitches written on the DE2 board. For the pin assignments, refer to the Altera manual. Also, have the values of the three inputs displayed on seven-segment displays labeled HEX3, HEX2, and HEX1.

Have the outputs displayed on the seven-segment displays HEX7 and HEX6. Make sure HEX7 displays the “Carry_Out” bit and HEX6 displays the “sum” bit.

RIPPLE-CARRY ADDER

Have one input connected to dip switches SW17-SW14, the second input to switches SW13-SW10, and the carry in inputs to SW9. Also, have them displayed on HEX3, HEX2, and HEX1.

Have the output displayed on HEX7 and HEX6.

ADDER/SUBTRACTOR

This one is the trickiest. Have the inputs and outputs displayed the same exact way as in the ripple-carry adder. However, have the “complimentor” input assigned to the push button KEY0.