Lab4

1 Introduction

1.1 Goals

- Design IC by using block diagram.
- Synthesize, simulate and test on FPGA developement kit.

1.2 Requirements

- Read datasheet of 74LS47.
- Follow the instructions from Tutorial 1 to install Quartus.

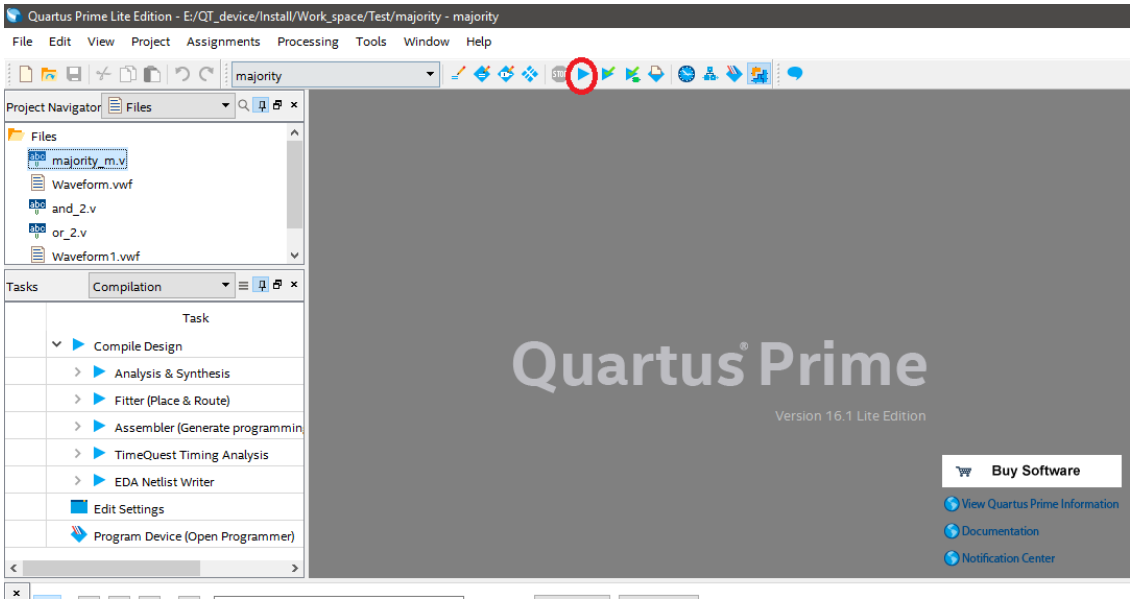
1.3 Contents

- Implement block diagram of 74LS47 by using FPGA technology with its schematic.

2 Installation

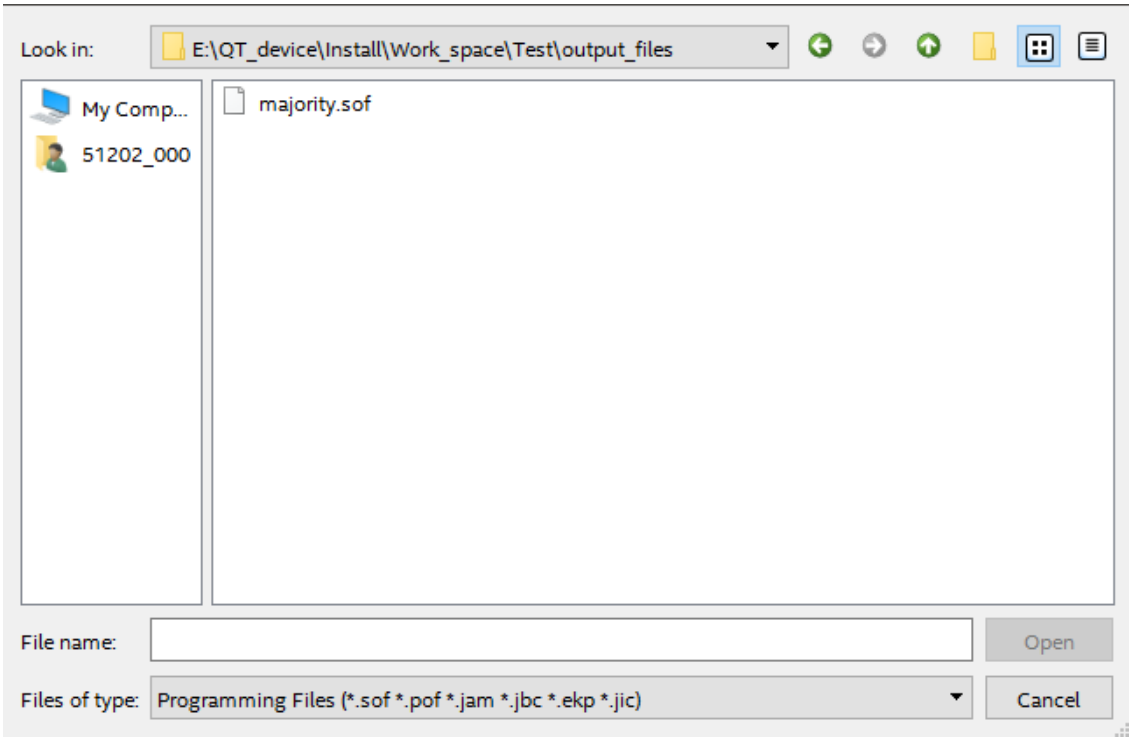
2.1 Synthesize and create bitfile

(Revise tutorial 1 for creating project and using schematic to implement circuits.)
After having a circuit's description by using Verilog, we begin to compile by pressing the button <Start Compilation> (see Fig.1).



Hình 1: Generate bitfile

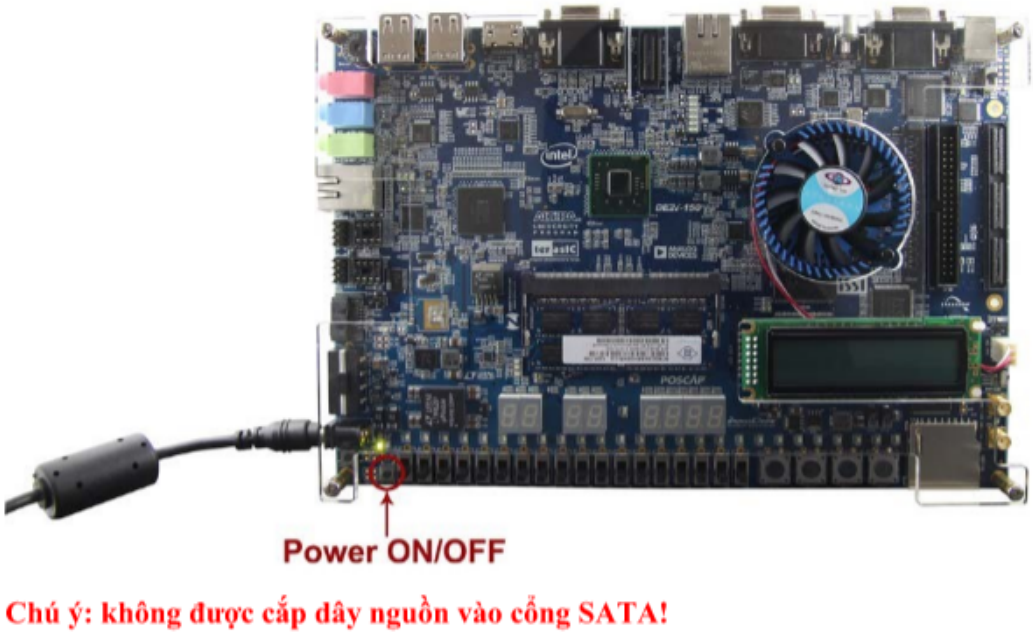
After the compilation process, a bitfile named *.sof has been generated in folder output_files.



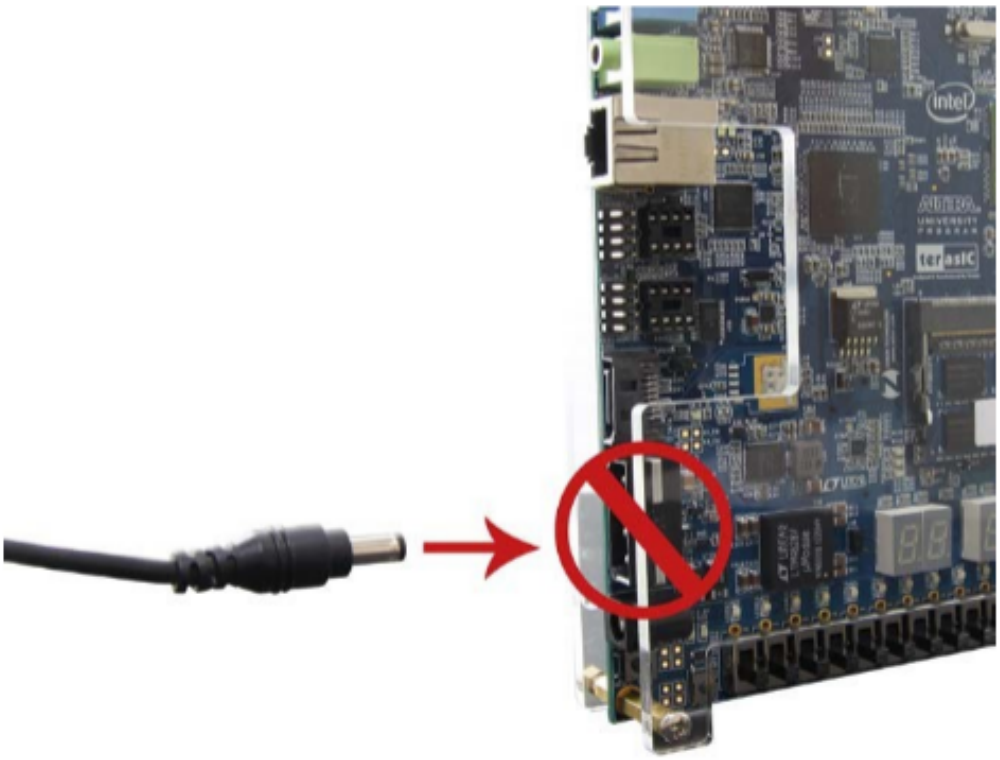
Hình 2: SOF file generated by compilation process

2.2 Operate experimental kit

2.2.1 Connect the power source



Hình 3: Connect the power source to the appropriate DC jack



Hình 4: (Important) Distinguish between SATA port and power connector

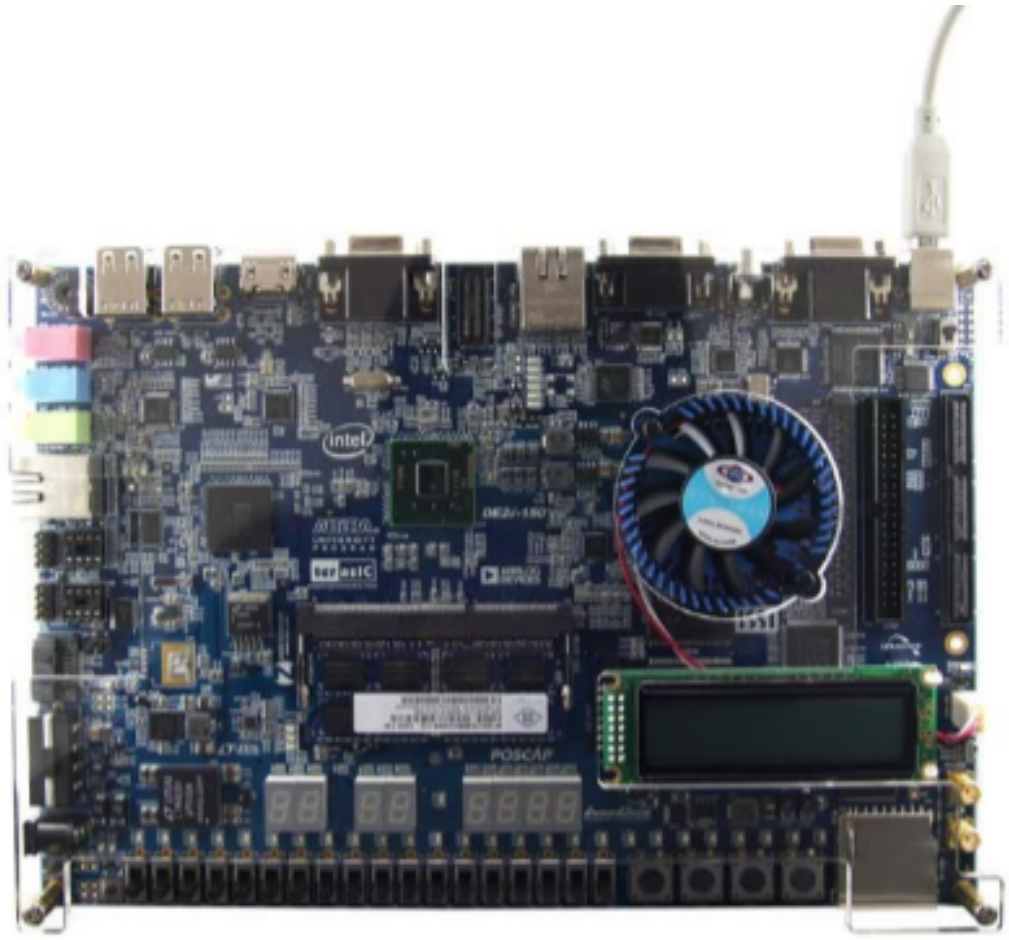
2.2.2 Start device by pressing <Power ON/OFF> button

Hình 5: Start device

Hold <POWER ON/OFF> button in a few seconds to turn off the kit.

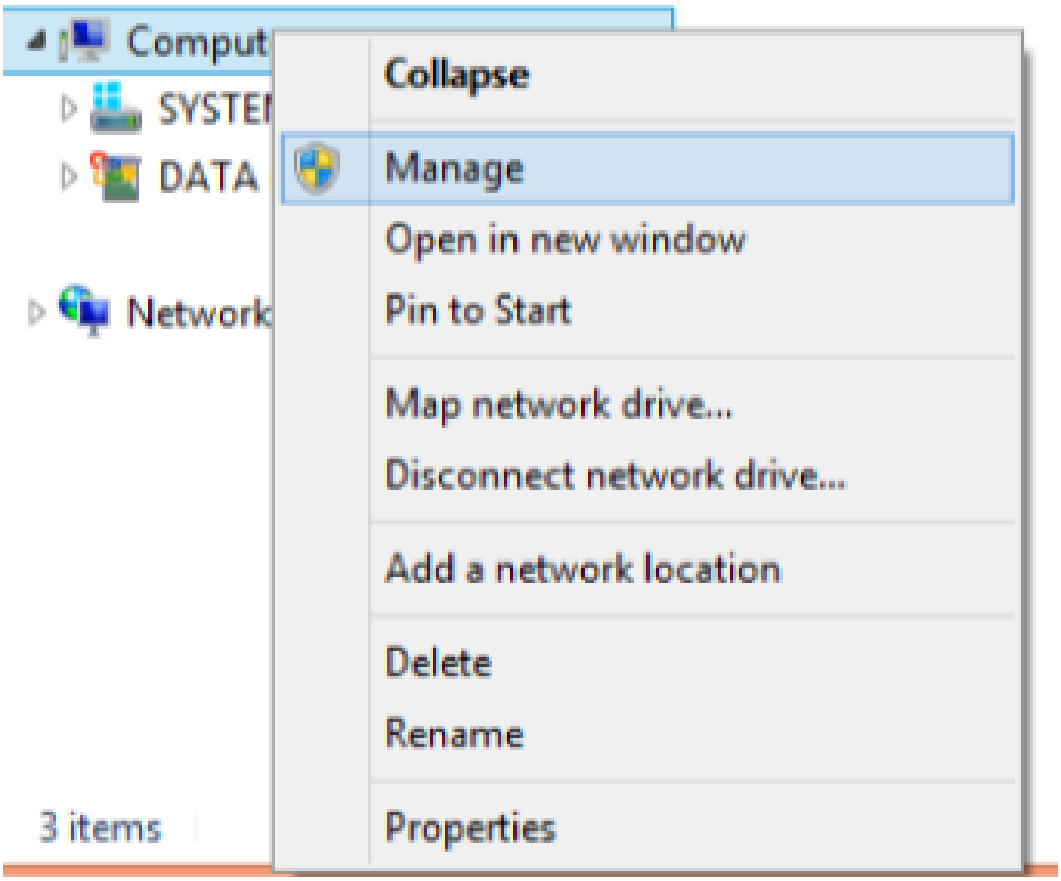
2.3 Install USB-Blaster driver (optional)

USB-Blaster is used to load bitfile into DE2i-150 it.
Connect the usb blaster by following the figure below.



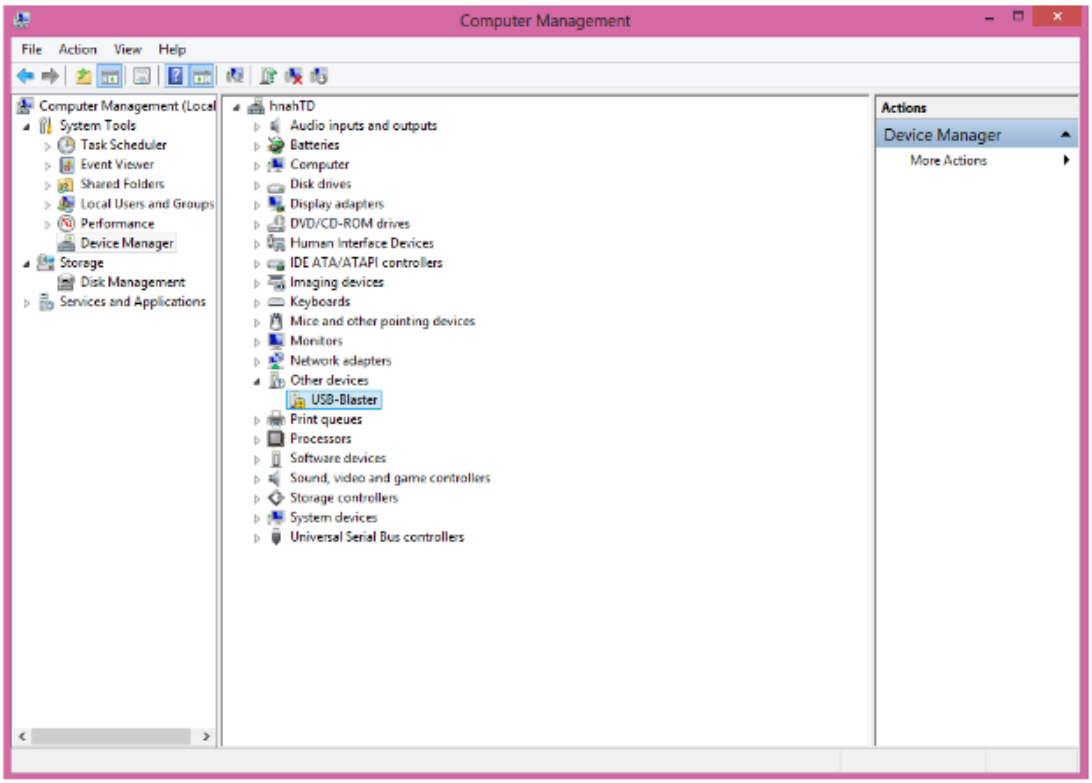
Hình 6: Connect to the build-in USB-Blaster on KIT

If your PC do not regconize USB-Blaster, follow the instructions below to install driver.
Right click on icon Computer > select Manage.



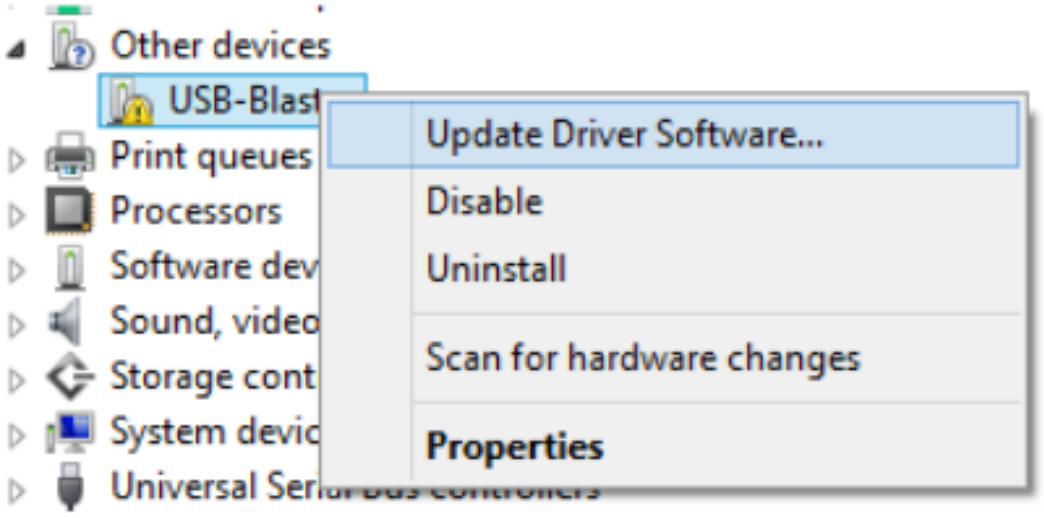
Hình 7: Manage tab

On computer magement device, select Device Manager and expand Other devices tab on the center workspace. (In case that usb-blaster is regconized, the notice of *USB-Blaster* will appear in Universal Serial Bus controller tab).



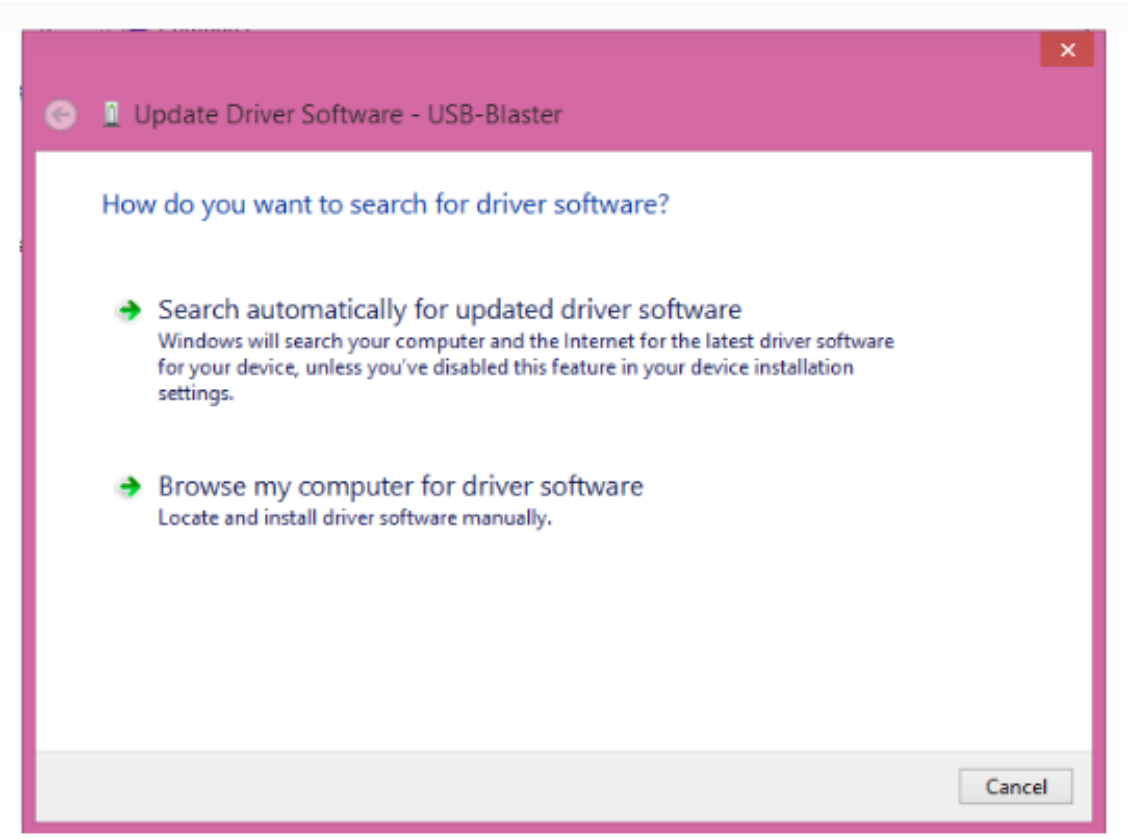
Hình 8: Management

Right click on USB-Blaster > select Update Driver Software.



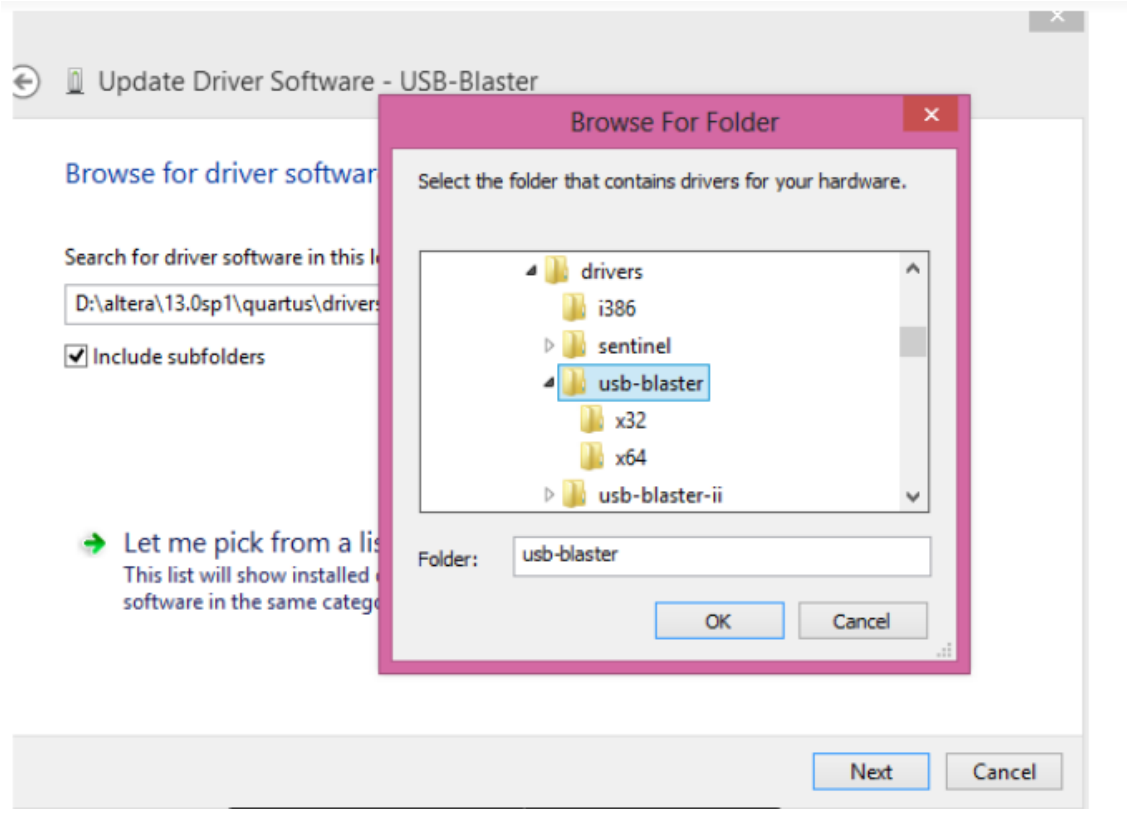
Hình 9: Update driver software

Select <Browse my computer for driver software> on the new appeared window.



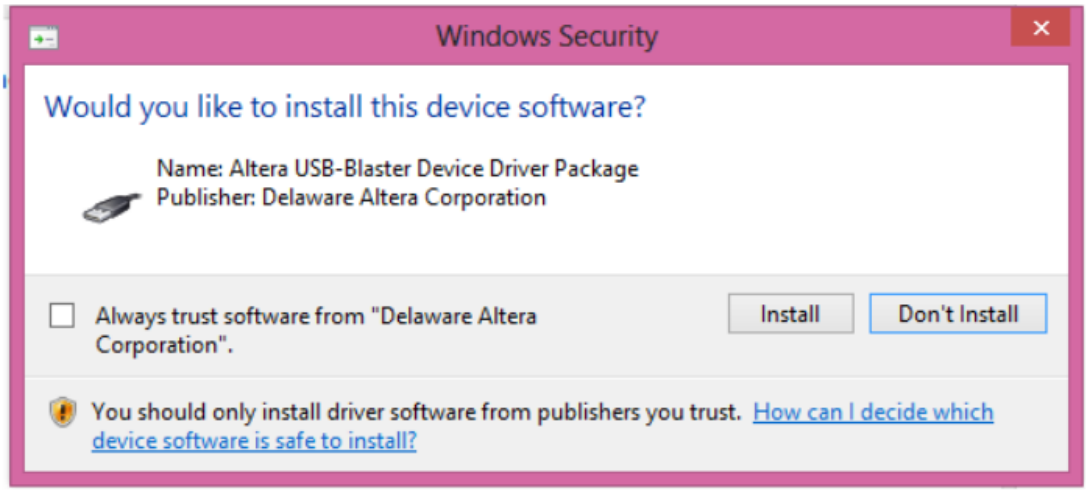
Hình 10: Install driver

Point to Quatus installation folder and select "/quartus/drivers/usb-blaster" (see figure 11):



Hình 11: Indicate the driver's folder

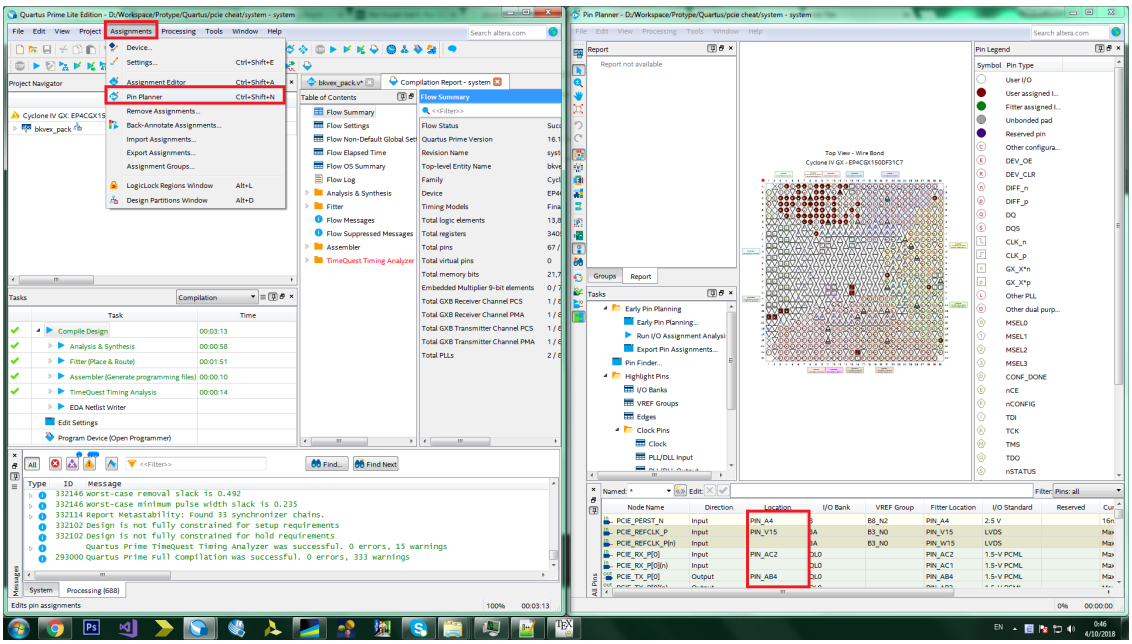
Accept the windows security announcement to install.



Hình 12: Accept windows security announcement

2.4 Assign pin

On the Menu, select Assignments > Pin planner.
When the <Pin Planner> window appears, assign your design's interface to the approriate pin on <Location> column (Follow the de2i-150 manual to select the right pin).

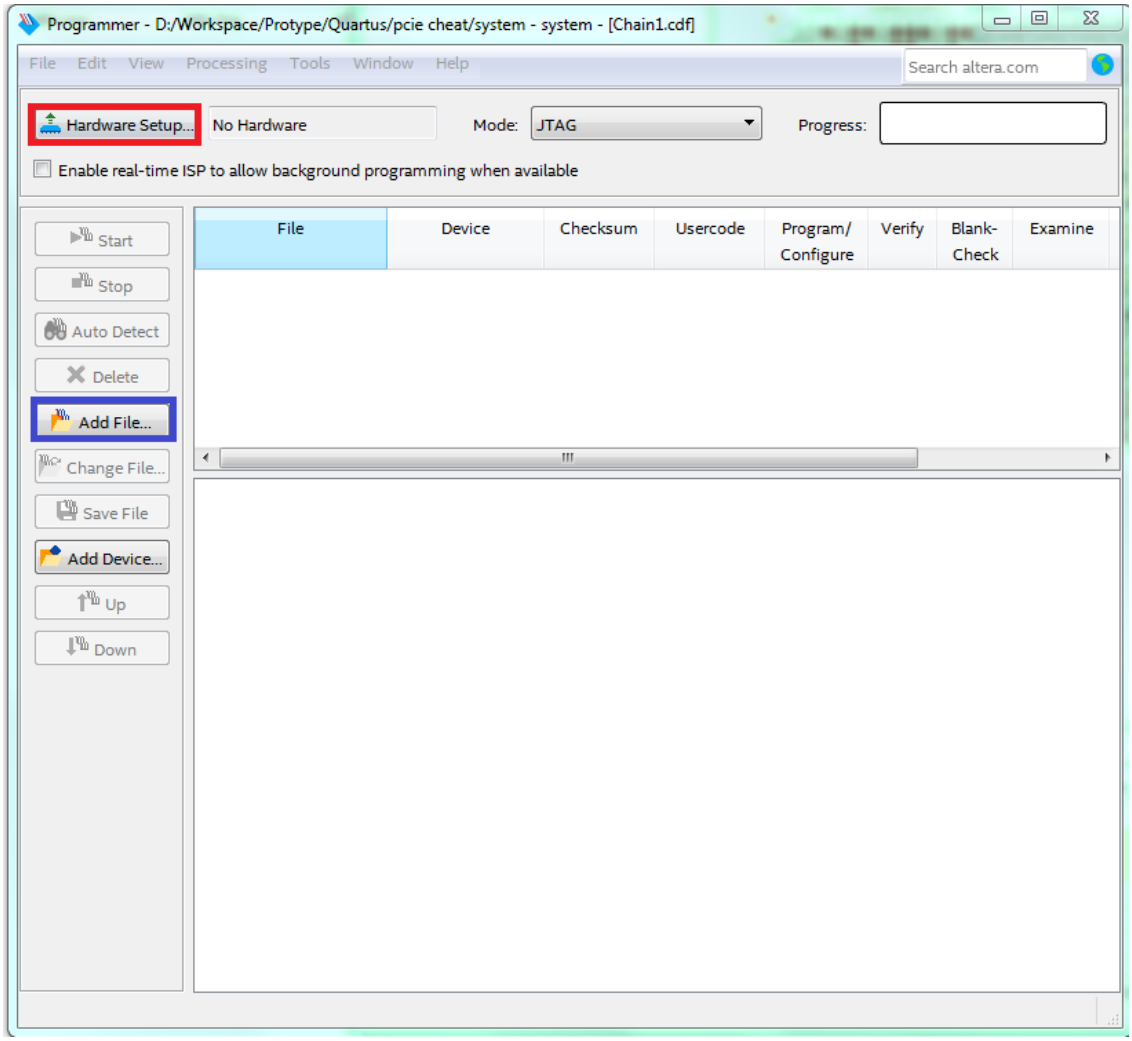


Hình 13: Pin assignment tab

2.5 Load bitfile

After assign all pins, compile your design.
And then select Tools on Menu > Programmer. When <Programmer> window appears, connect USB-Blaster and select <Hardware Setup> button to setup the connection. After that, select the

bitfile (*.sof) by selecting <Add file> button (Tip: you can find your *.sof file in output_files folder).



Hình 14: Pin assignment tab

After finishing all the above steps, press <Start> button to begin loading bitfile into experimental KIT.

3 Exercices

Question 1: (2 pts) Read 7447's datasheet and determine its functions and its schematic.

Question 2: (4 pts) Implement 7447 by using **schematic**. Simulate your design by using waveform.

Question 3: (1 pt) Compile and load your design into de2i-150, you should show to the tutor that your design works properly.

Question 4: (3 pts) Implement the full adder of 2 number 4 bits on FPGA and use you 7447's design to show the result on development board.
Tips: be careful that the result may be higher than 9, so you need more than one 7-seg led to

present it. In this case, you should divide your result into multi-single digits.
For example: 15 + 13 = 28 (2 digits). The result is splitted into **2** and **8**. These splitted single-numbers are the input of 2 7447 ICs.