Lab 3: Design of Digital Stop Watch (*counter0to9*)

Objective:

* To design a Digital Stop Watch using concepts of digital system partitioning

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Digital Stop Watch – *counter0to9*

1. Open Digital Stop Watch Project – *stopwatch*:

To start the Quartus II software.

cd
cd digital
source .cshrc_linux
quartus&

You should see a display similar to the one in Figure 3.1.

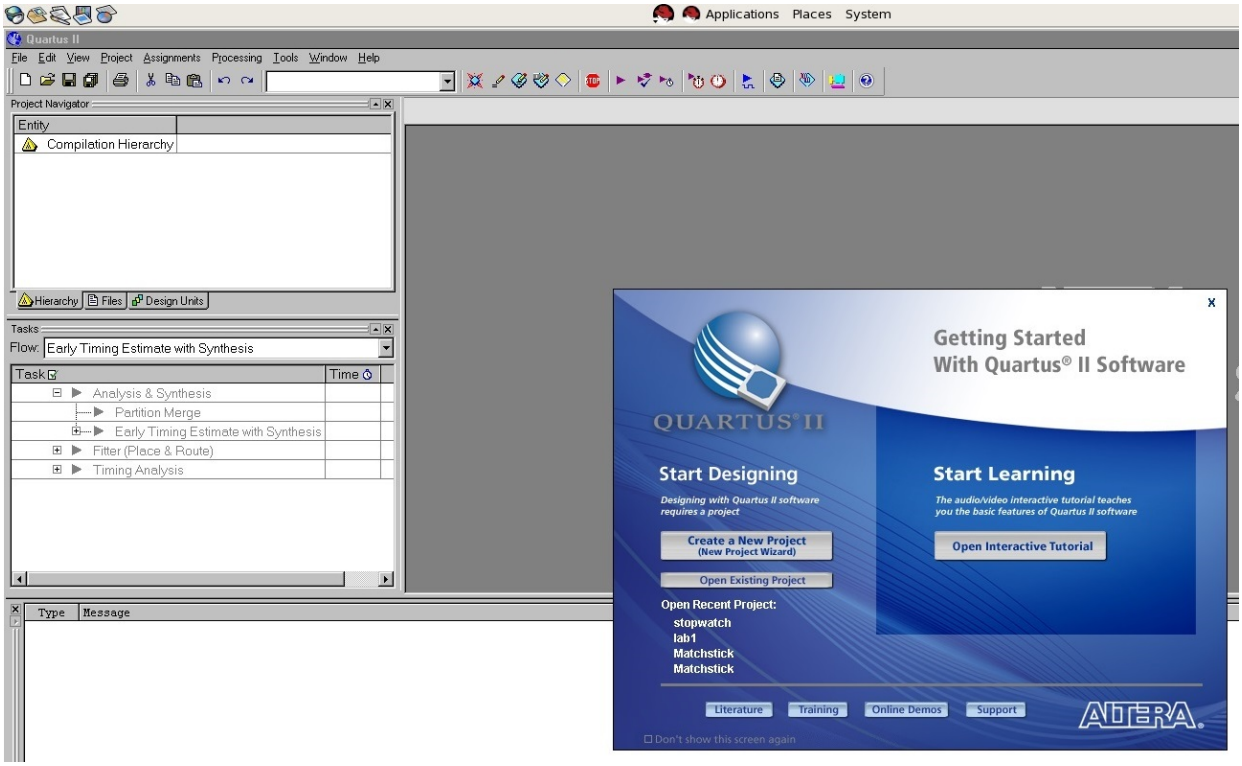


Figure 3.1 The main Quartus II display

To open the ***stopwatch*** project, Click ***Open Existing Project*** and you should see a display shown in Figure 3.2.

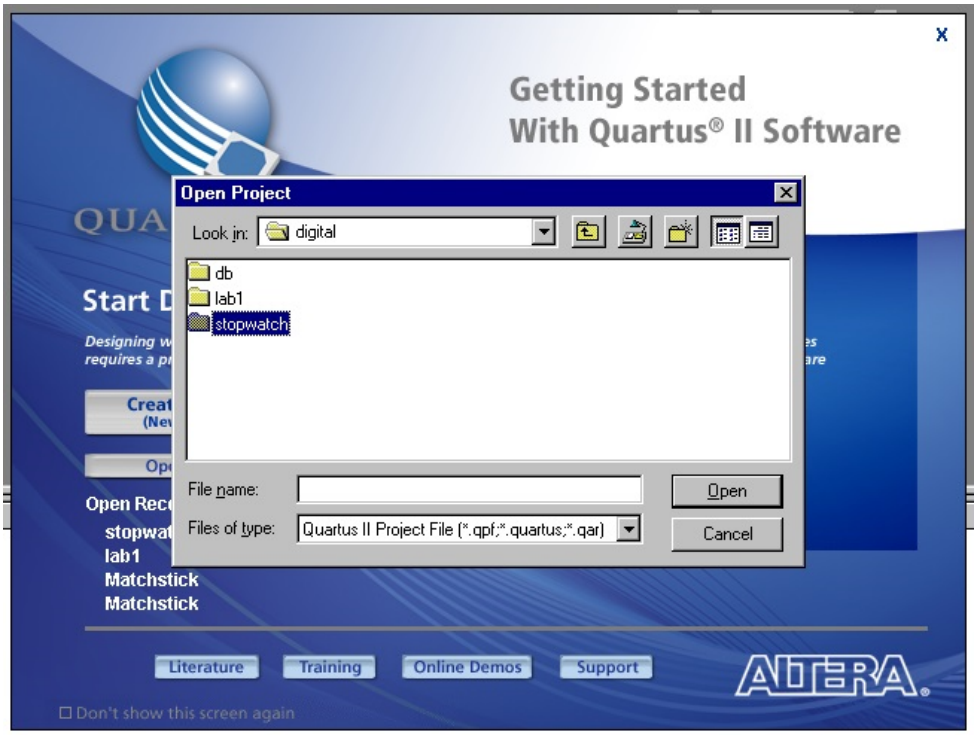


Figure 3.2 To open existing *stopwatch* folder

Double-click to open the *stopwatch* folder.

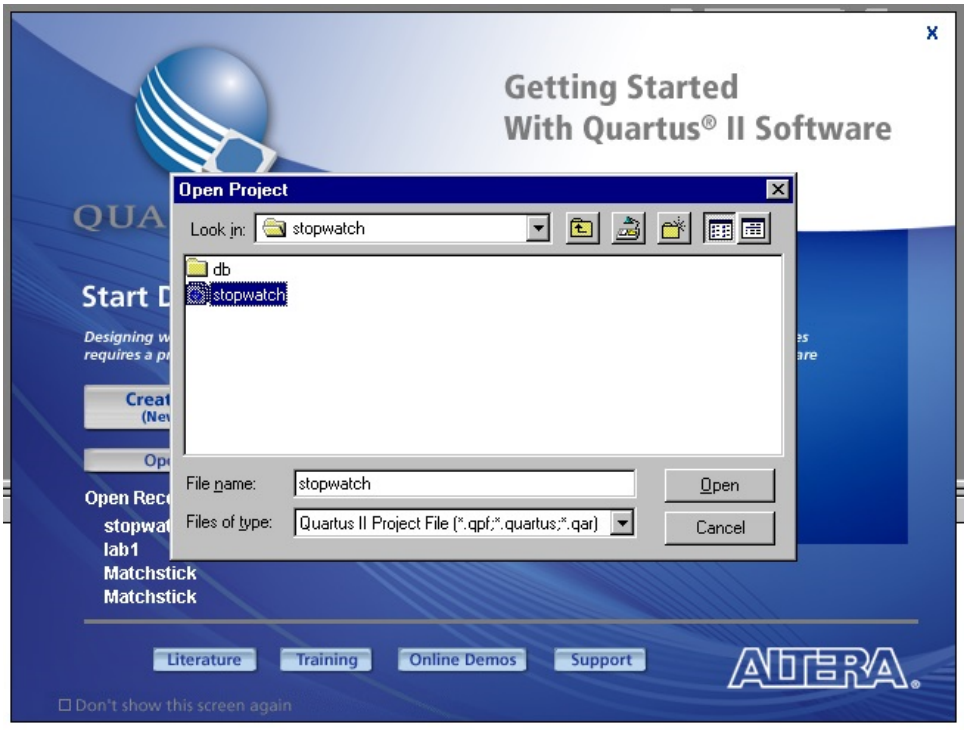


Figure 3.3 To open existing *stopwatch* project

Select the *stopwatch* project file and Click ***Open***.

2. Click ***OK*** if the below pop-up appear (ignore the pop-up). To draw the ***counter0to9*** circuit, Click ***Files*** and select to open ***counter0to9.bdf*** from the menu as shown in Figure 3.4.

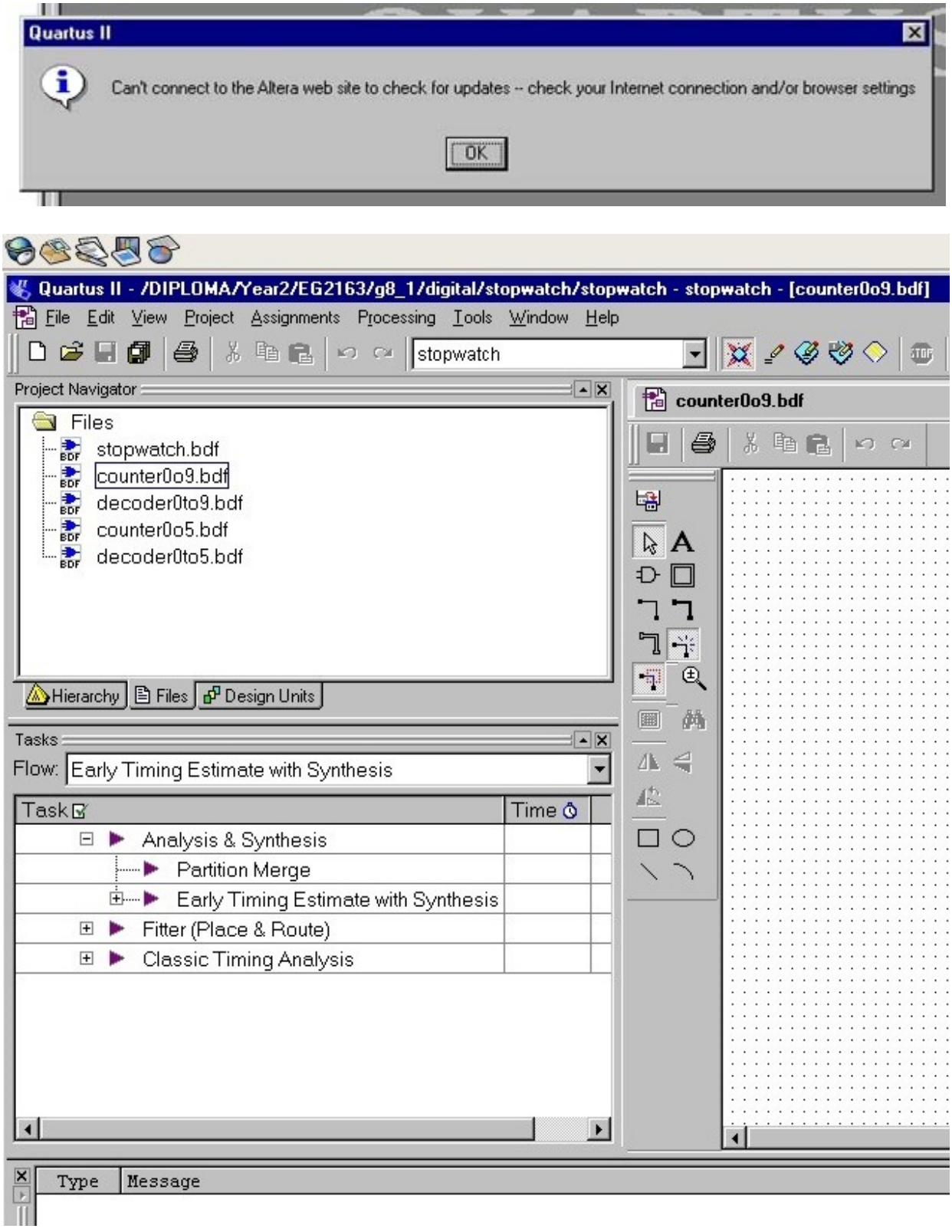


Figure 3.4 Select to open the *counter0to9.bdf*

Draw the ***counter0to9*** circuit as shown in Figure 3.5.

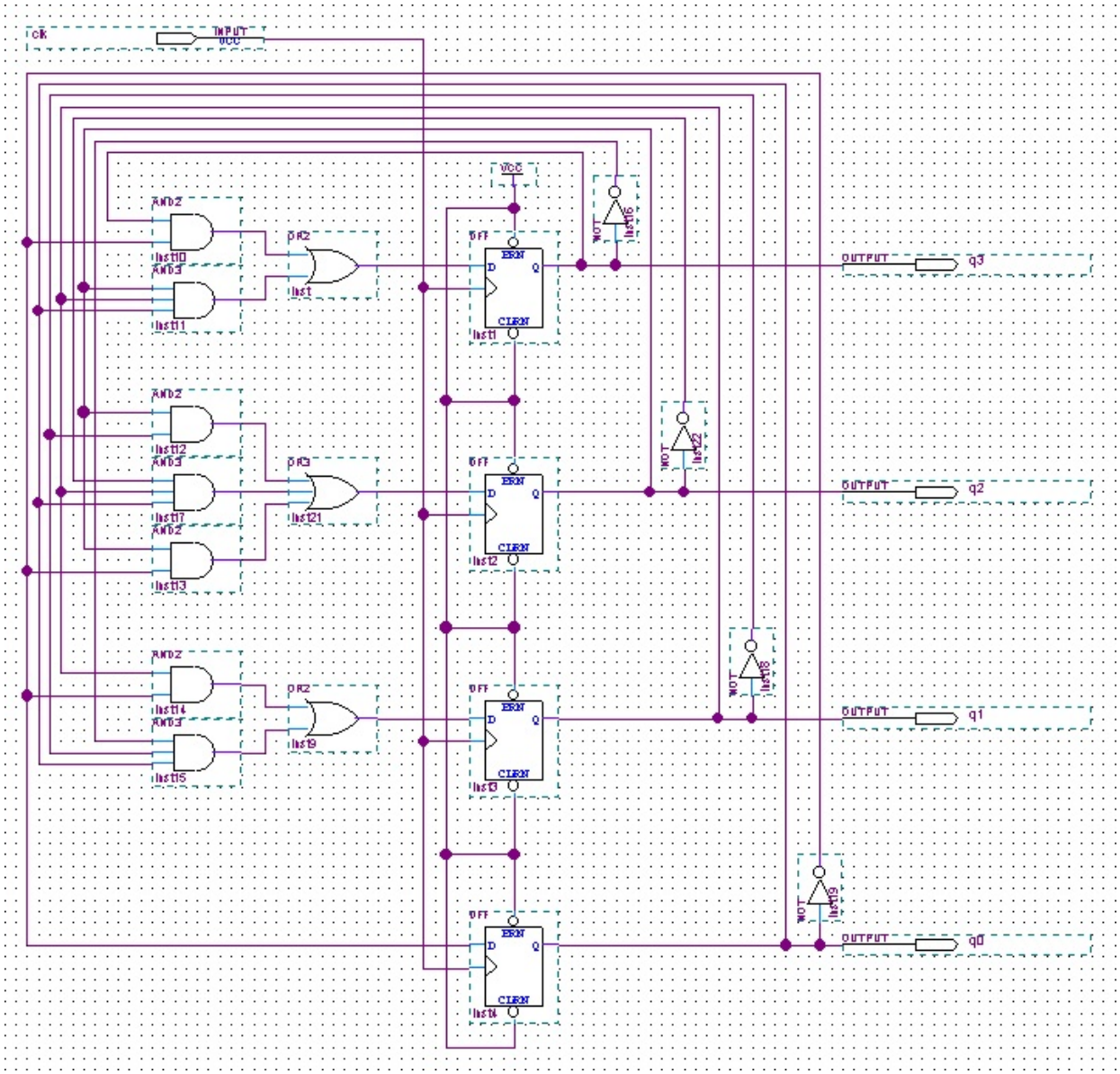


Figure 3.5 *counter0to9* circuit

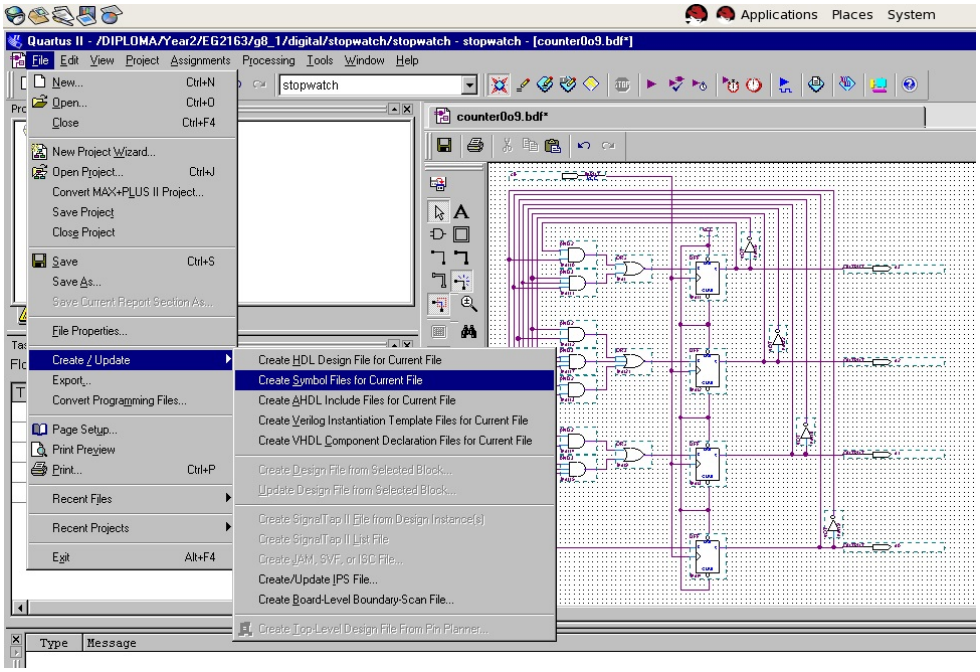
Symbols used: and2, and3, or2, or3, not, dff and vcc

Pins used: input and output

Input pin name: clk

Output pins names: q3, q2, q1 and q0

3. Create symbol for the ***counter0to9*** circuit. ***Select File > Create/Update > Create Symbol for Current File*** as shown in Figure 3.6.



Click ***Save*** and then Click ***OK***.

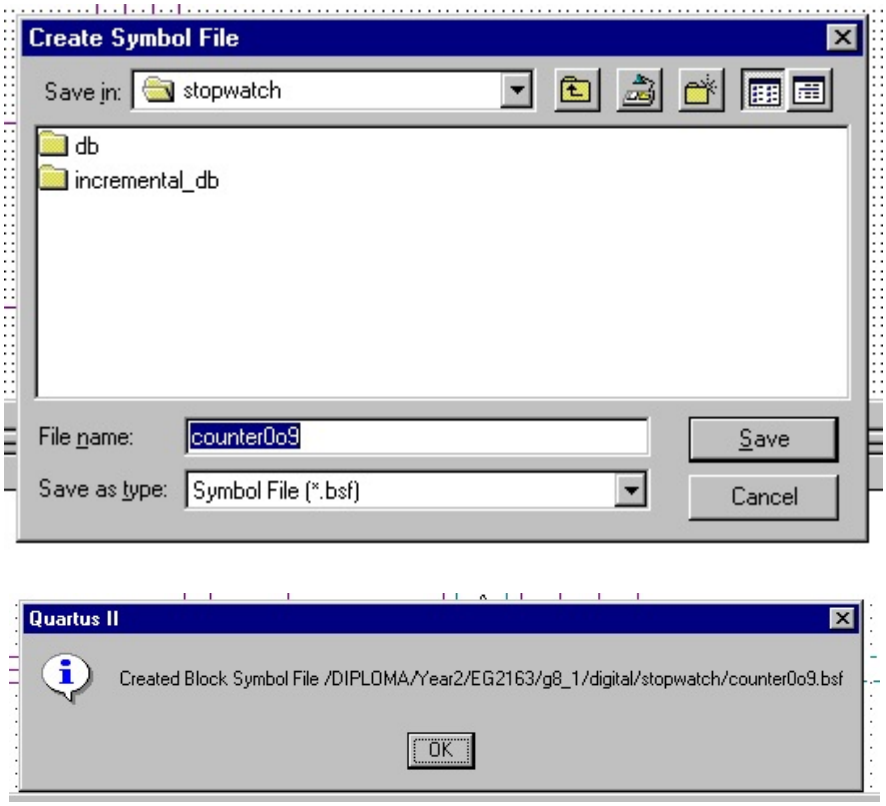


Figure 3.6 Create symbol for the *counter0to9* circuit

4. To place the ***counter0to9*** symbol onto the ***stopwatch*** circuit. Open the ***stopwatch.dbf*** from the menu shown in Figure 3.7.

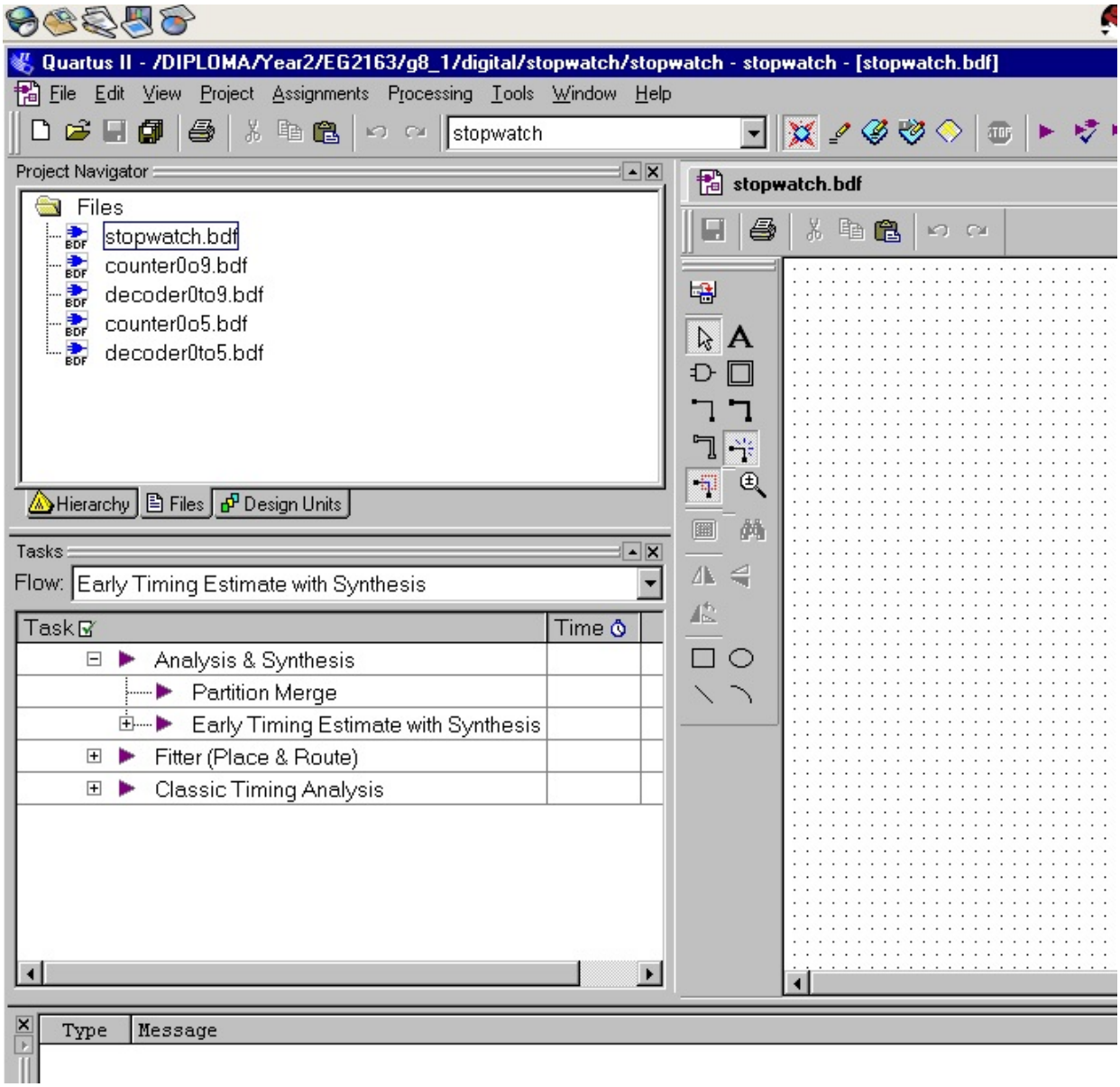


Figure 3.7 Open *stopwatch.bdf*

To insert the ***counter0to9*** symbol onto the ***stopwatch.bdf***, Click the Symbol Tool icon  and locate the *counter0to9* symbol under *Project* as shown in Figure 3.8 and Click ***OK***.

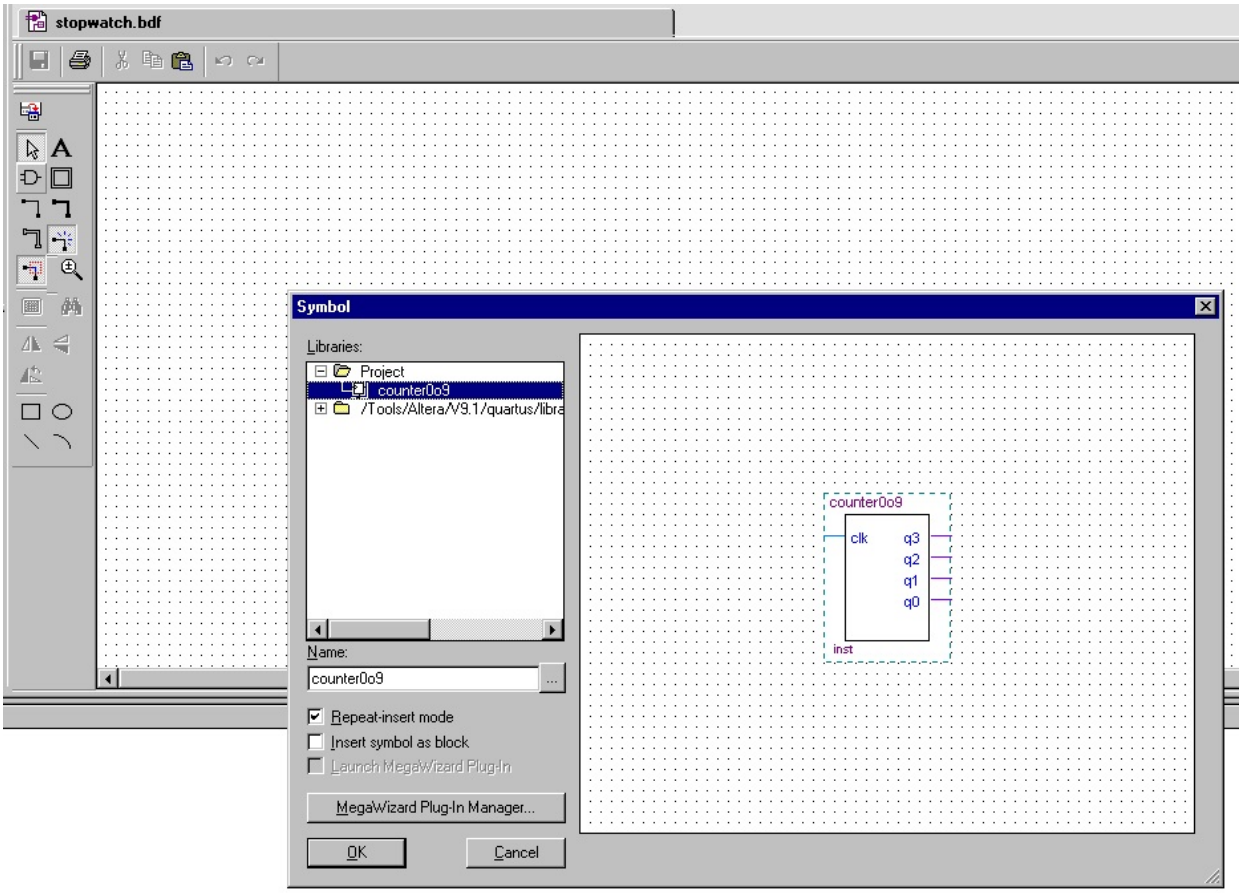


Figure 3.8 Insert *counter0to9* symbol onto *stopwatch* circuit

Place the *counter0to9* symbol onto the ***stopwatch*** circuit as shown in Figure 3.9.

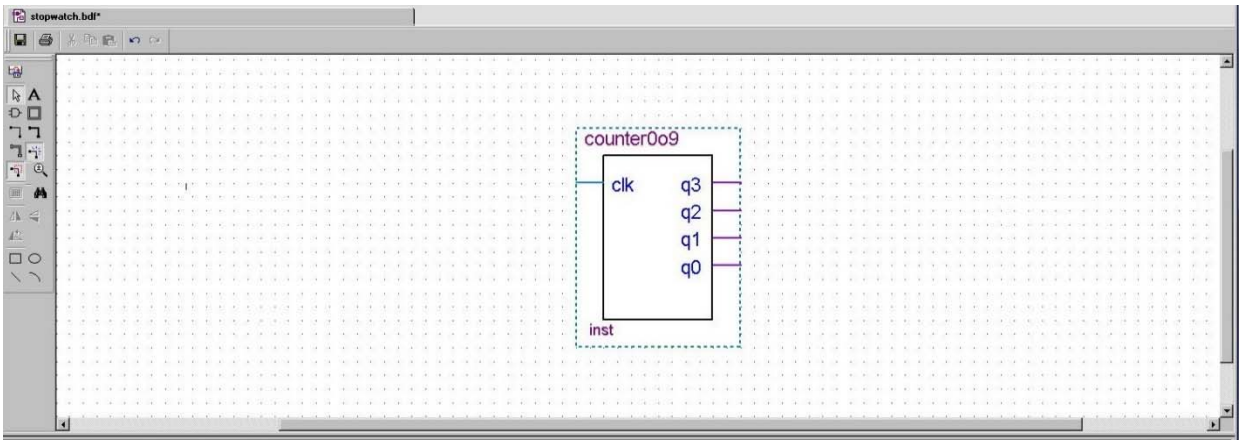


Figure 3.9 Inserting *counter0to9* symbol

5. Complete the circuit as shown in Figure 3.10 and Click ***File > Save***.

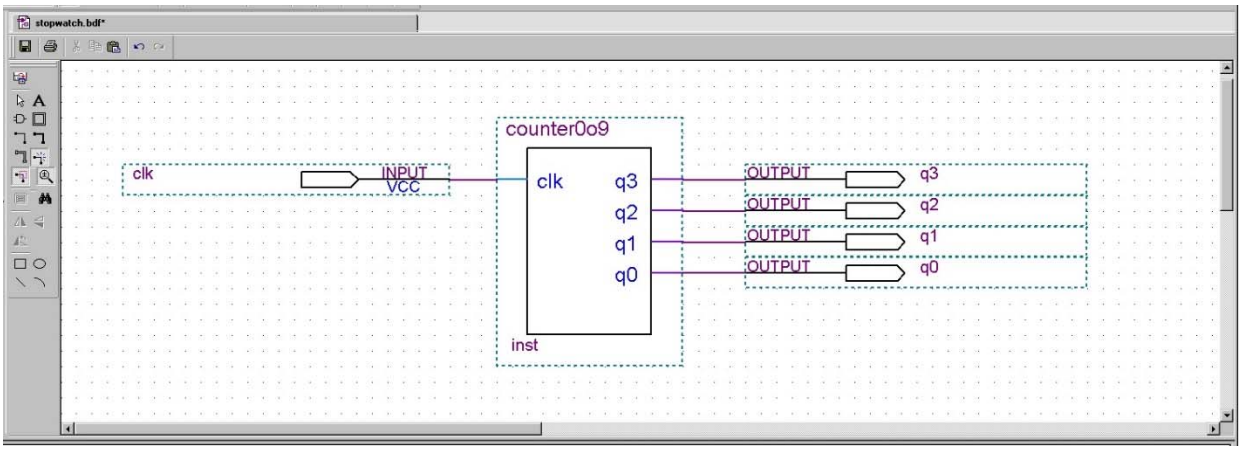


Figure 3.10 *stopwatch.bdf* with *counter0to9* symbol

6. Compile the circuit ***Processing > Start Compilation*** as shown in Figure 3.11 or Click the  toolbar icon.

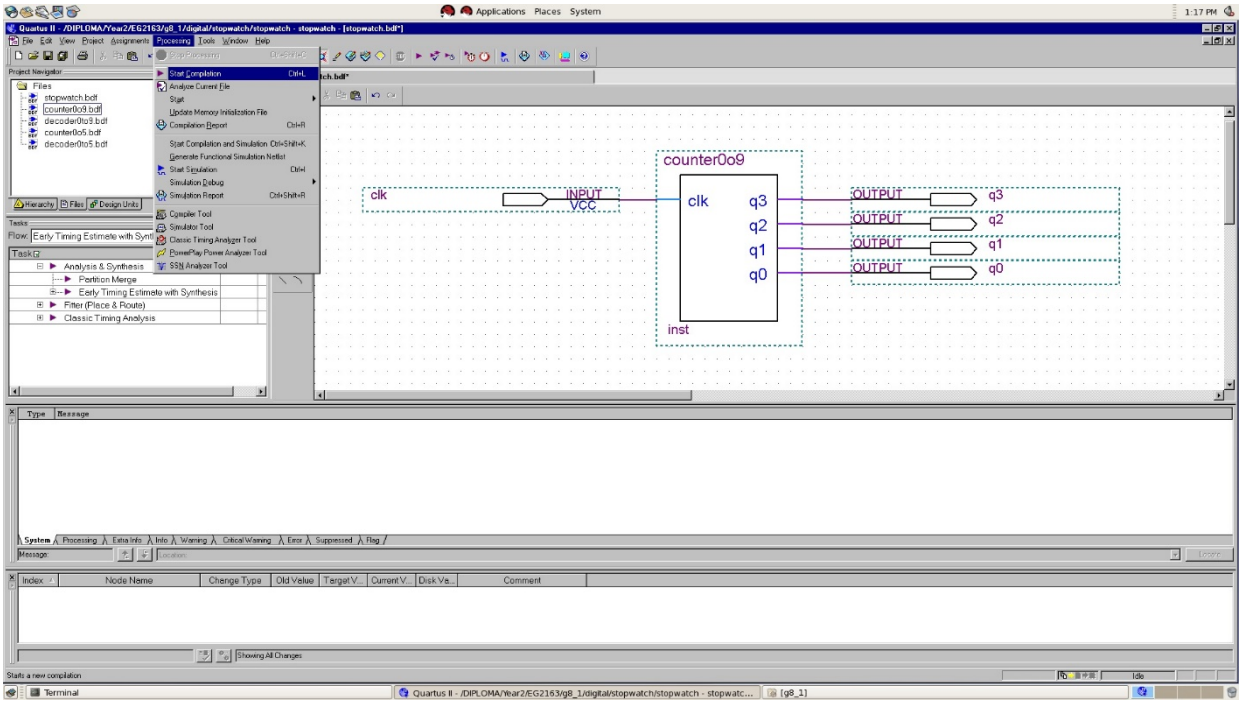


Figure 3.11 Compile the circuit

Make sure that there is no error as shown in Figure 3.12. Ignore warning/s.

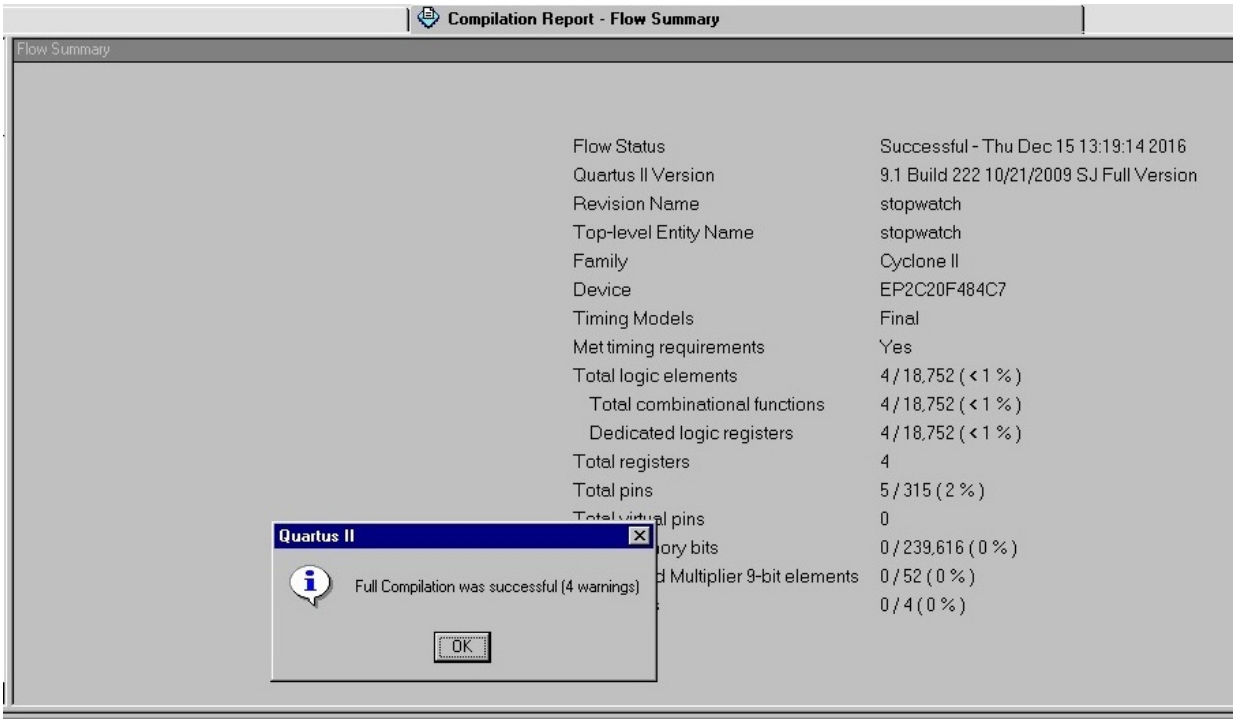


Figure 3.12 Full Compilation was successful

7. Create a Vector Waveform File – ***stopwatch.vwf*** to test the *counter0to9* circuit as shown in Figure 3.13. Create twenty 50% duty clock cycles (one clock cycle 100 ns). Hence set *End Time = 2000 ns* (20 x 100 ns) and *Grid Size = 50 ns*. (Refer to Lab 1 if you have forgotten how to create Vector Waveform File).

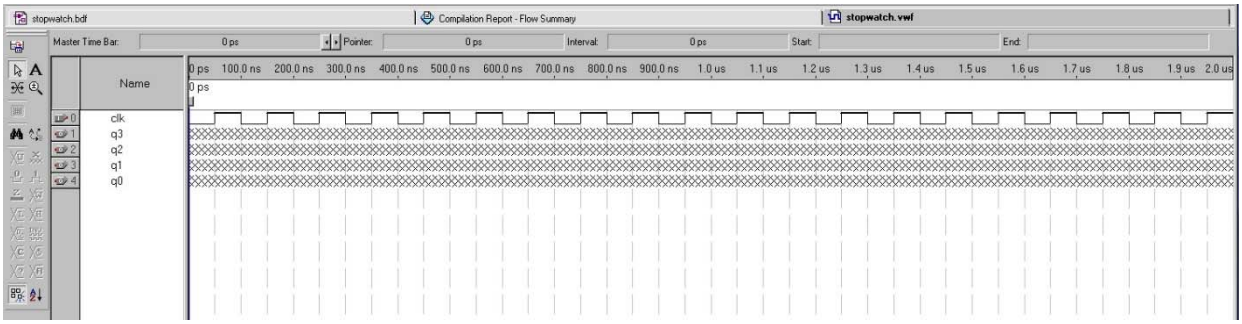
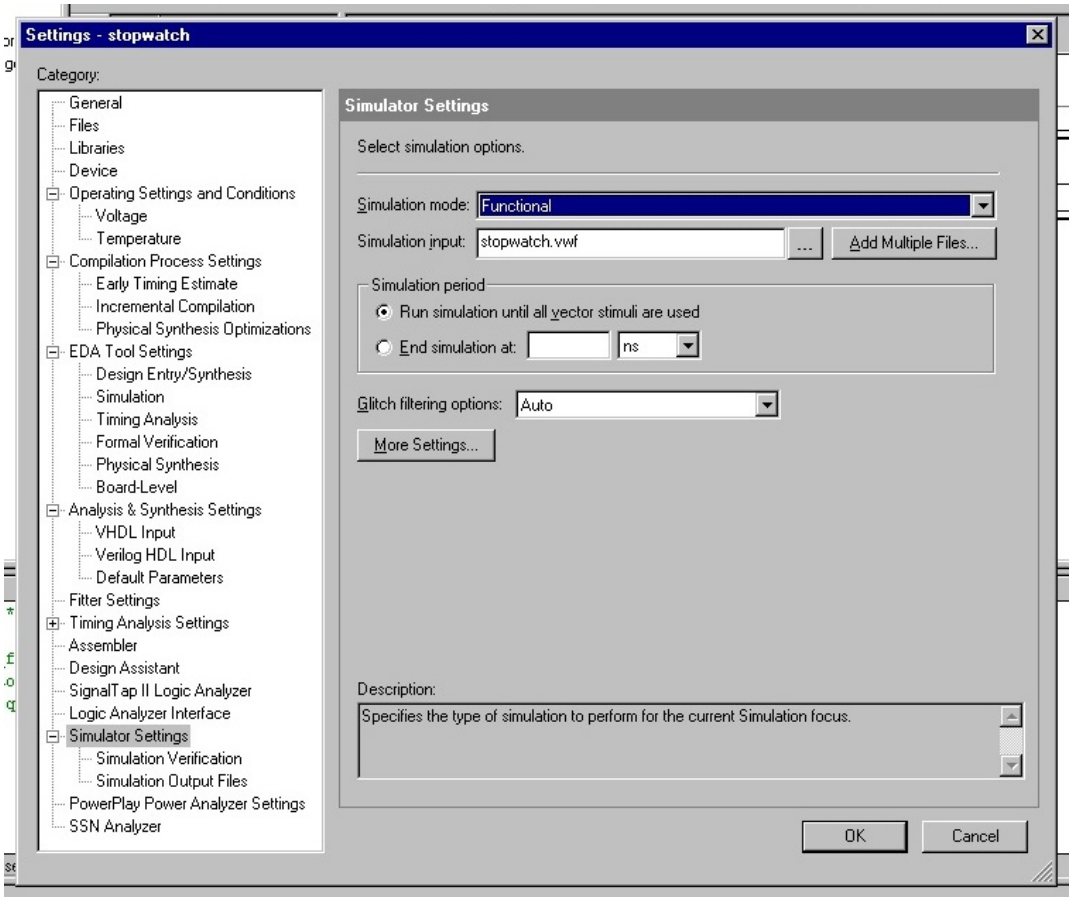


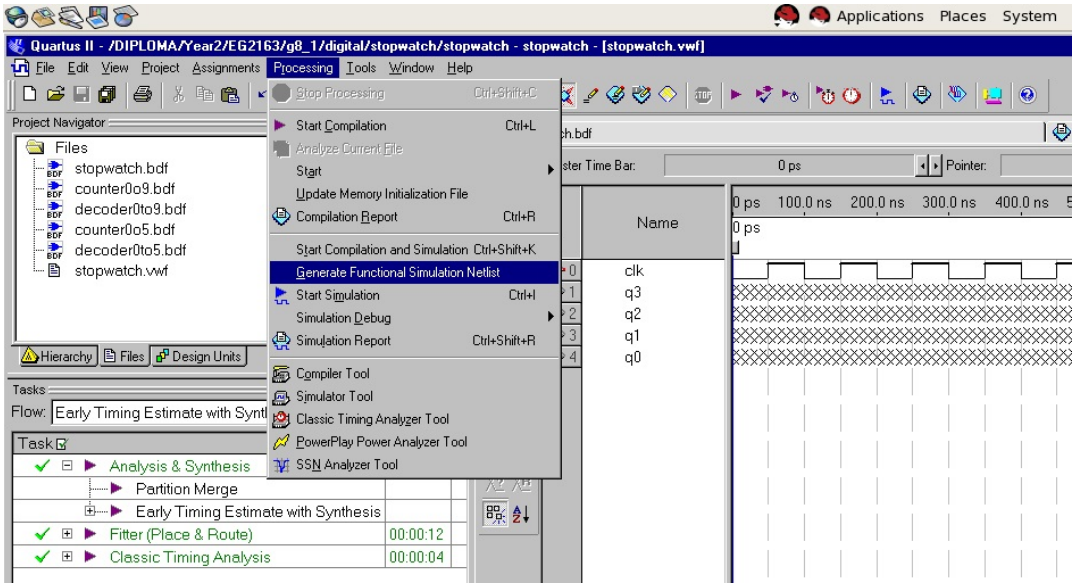
Figure 3.13 *stopwatch* Vector Waveform File

8. Simulate ***stopwatch – counter0to9*** as shown in Figure 3.14.

Assignments > Settings – *Simulation mode: Functional*



Processing > Generate Functional Simulation Netlist



Processing > Start Simulation

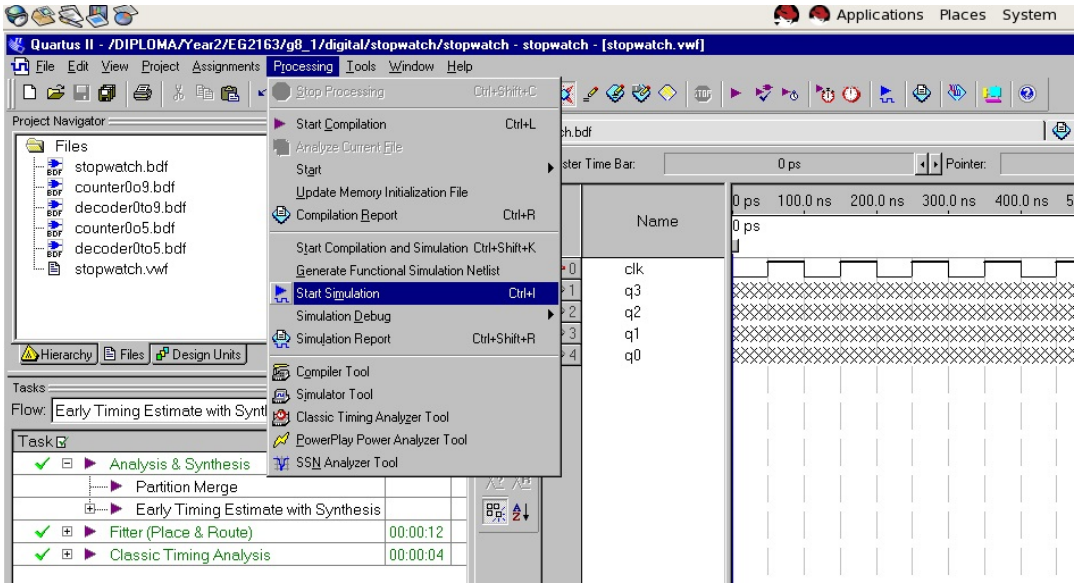


Figure 3.14 Simulate *stopwatch* (*counter0to9*)

Expected waveform is shown in Figure 3.15.

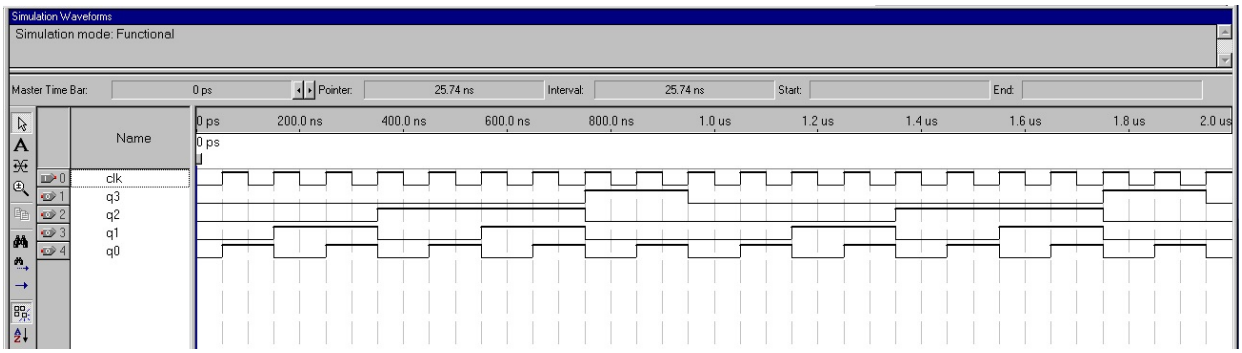


Figure 3.15 *stopwatch* (*counter0to9*) waveform