

Crowd Supply

Course Workbook

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About this Workbook

This workbook is designed to be used in conjunction with the Crowd Supply lab one workshop.

The contents of this workbook are created by Adiuvo Engineering & Training, Ltd.

If you have any questions about the contents, or need assistance, please contact Adam Taylor at adam@adiuvoengineering.com.

Pre-Lab

Workshop Pre-requisites

Required Hardware

The following hardware is required to complete this series of labs

1. Digilent [Basys3 Development board](#)

Downloads and Installations

Step 1 – Download and install the following at least one day prior to the workshop. This may take a significant amount of time and drive space.

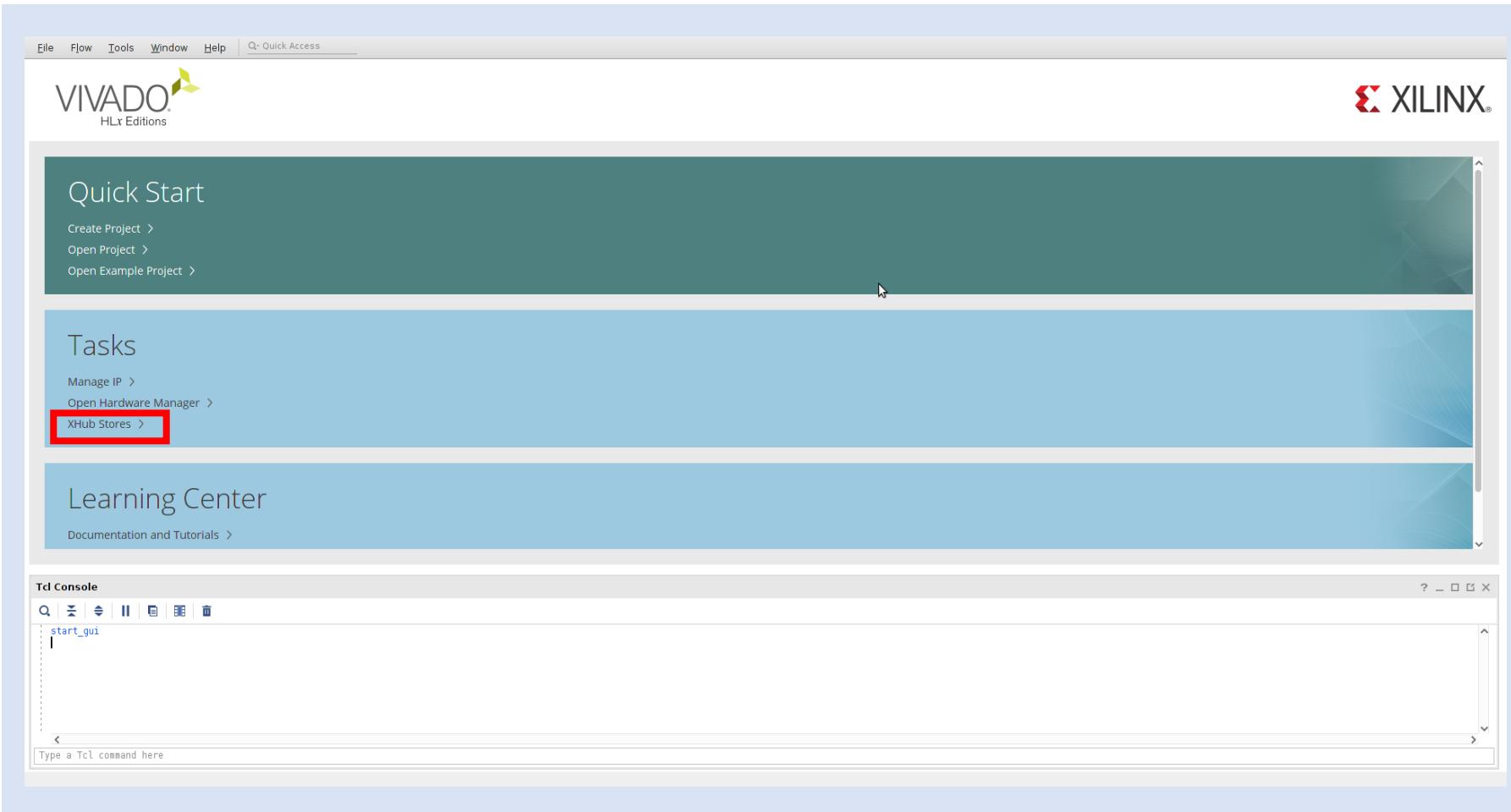
Vitis 2020.2 – Includes Vivado	Download
Source Project Files	Download

Lab

Creating Pong on the Basys3

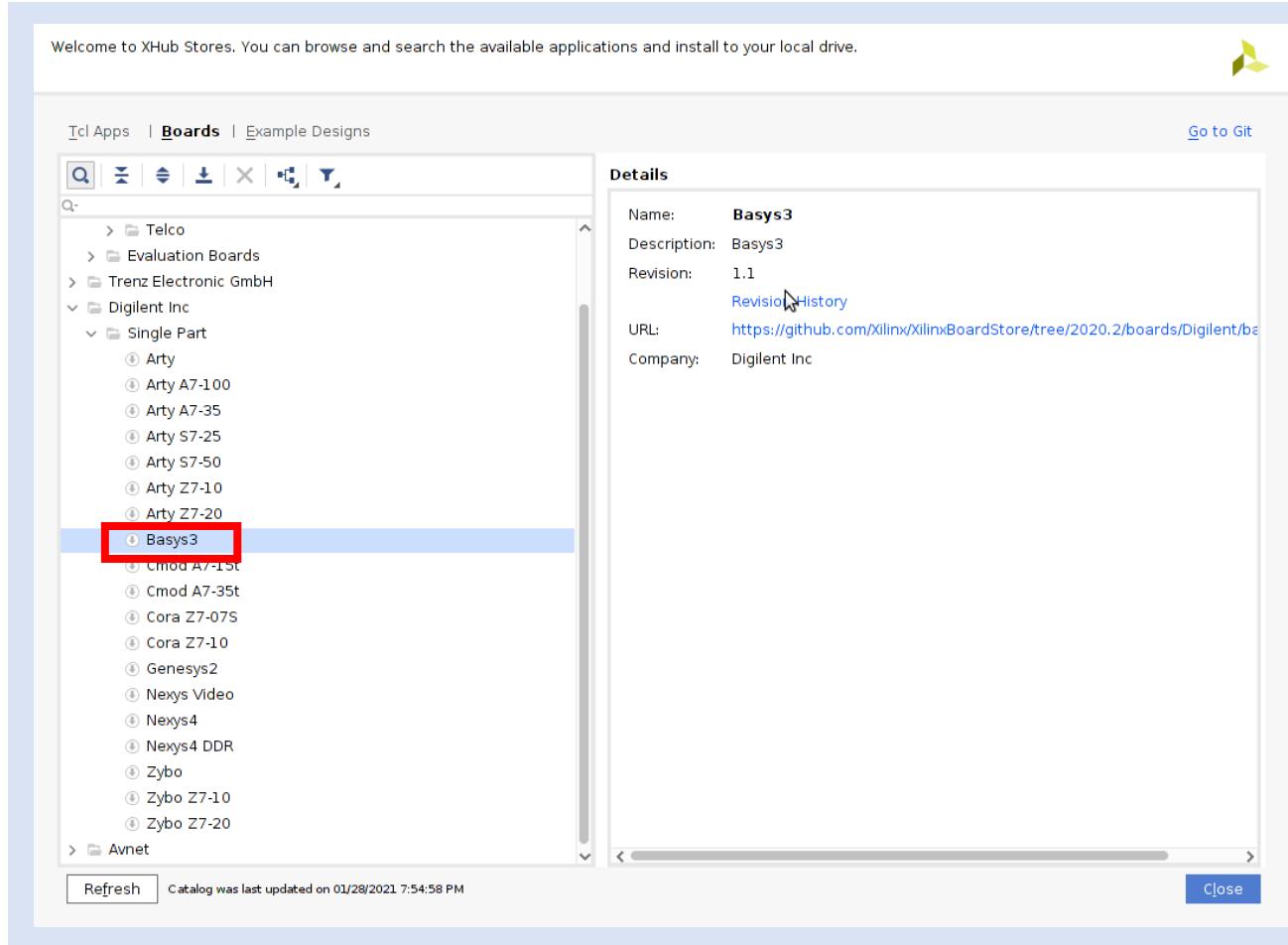
Crowd Supply: Lab One

Step 1 – Open Vivado 2020.2. Once Vivado opens, open the Xhub Store



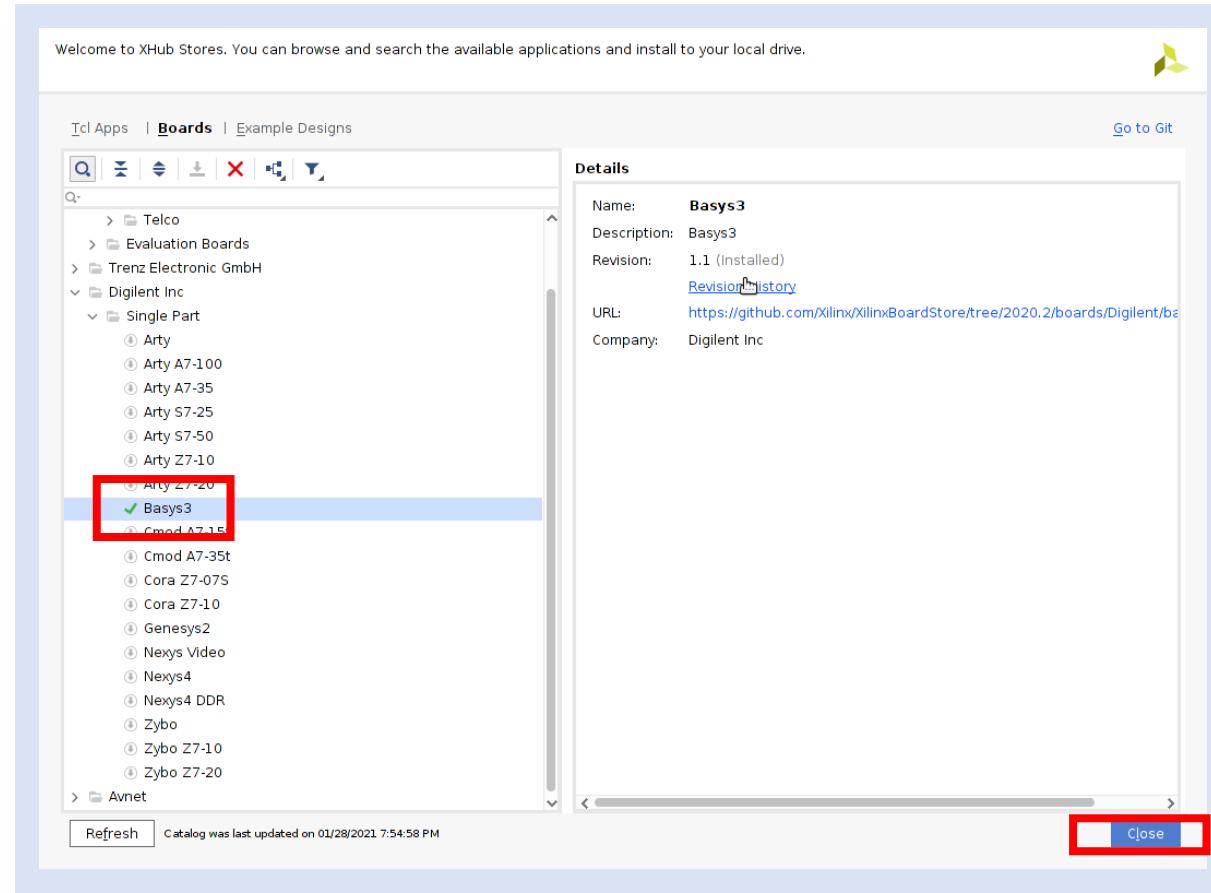
Crowd Supply: Lab One

Step 2 – Once the Xhub Stor Opens on the boards tab ensure Basys3 board is installed, right click to install



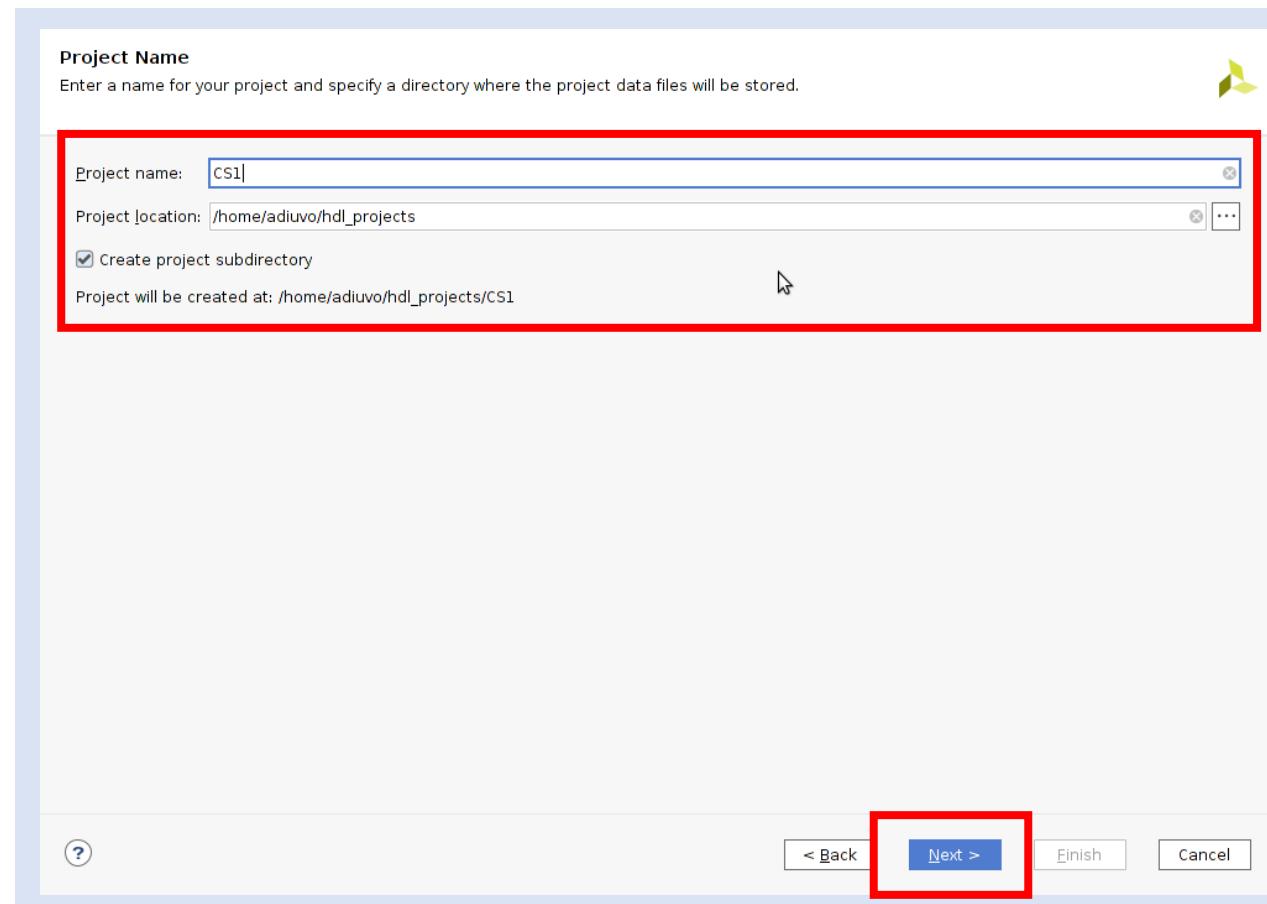
Crowd Supply: Lab One

Step 3 – When the Basys3 board is installed a green check will appear next to the board. Click close



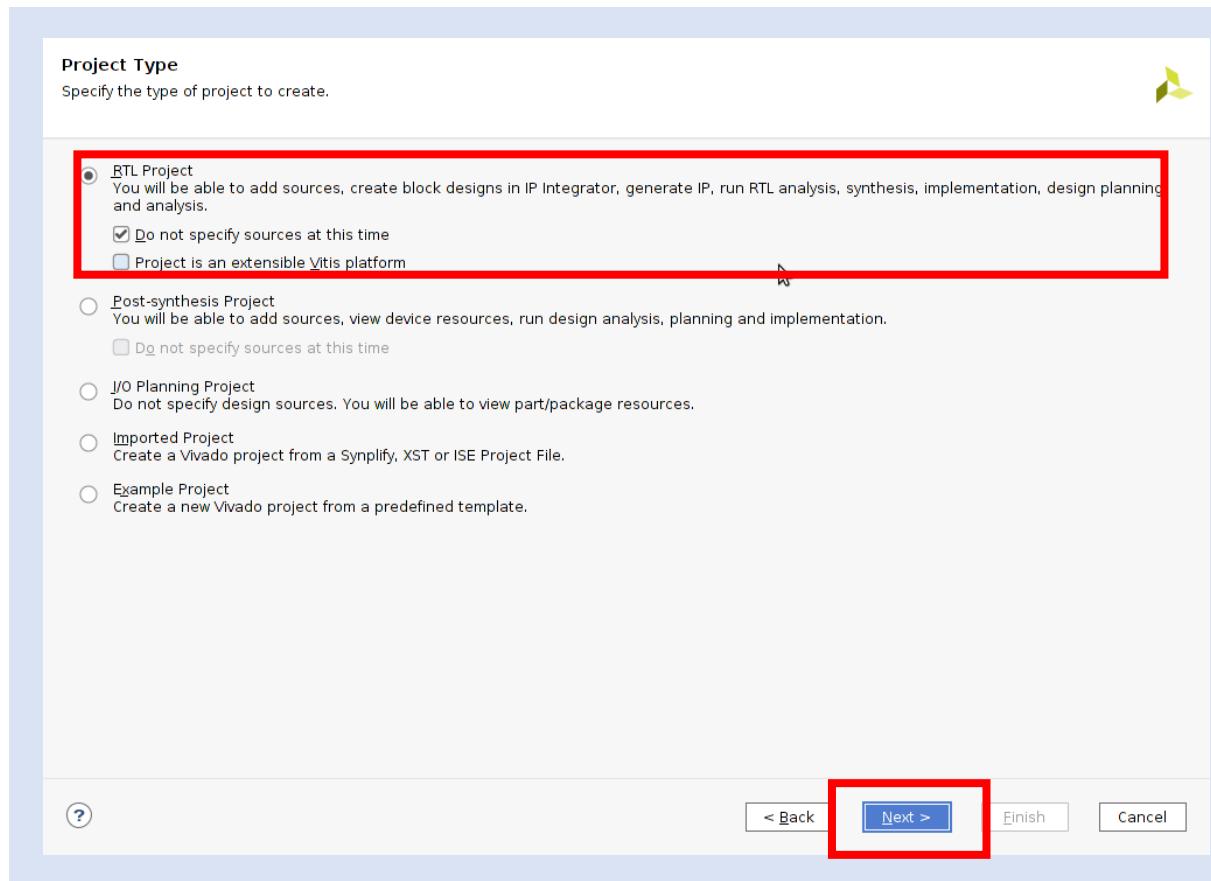
Crowd Supply: Lab One

Step 4 – Create a new project, in the dialog which follows enter a Project name and location click next



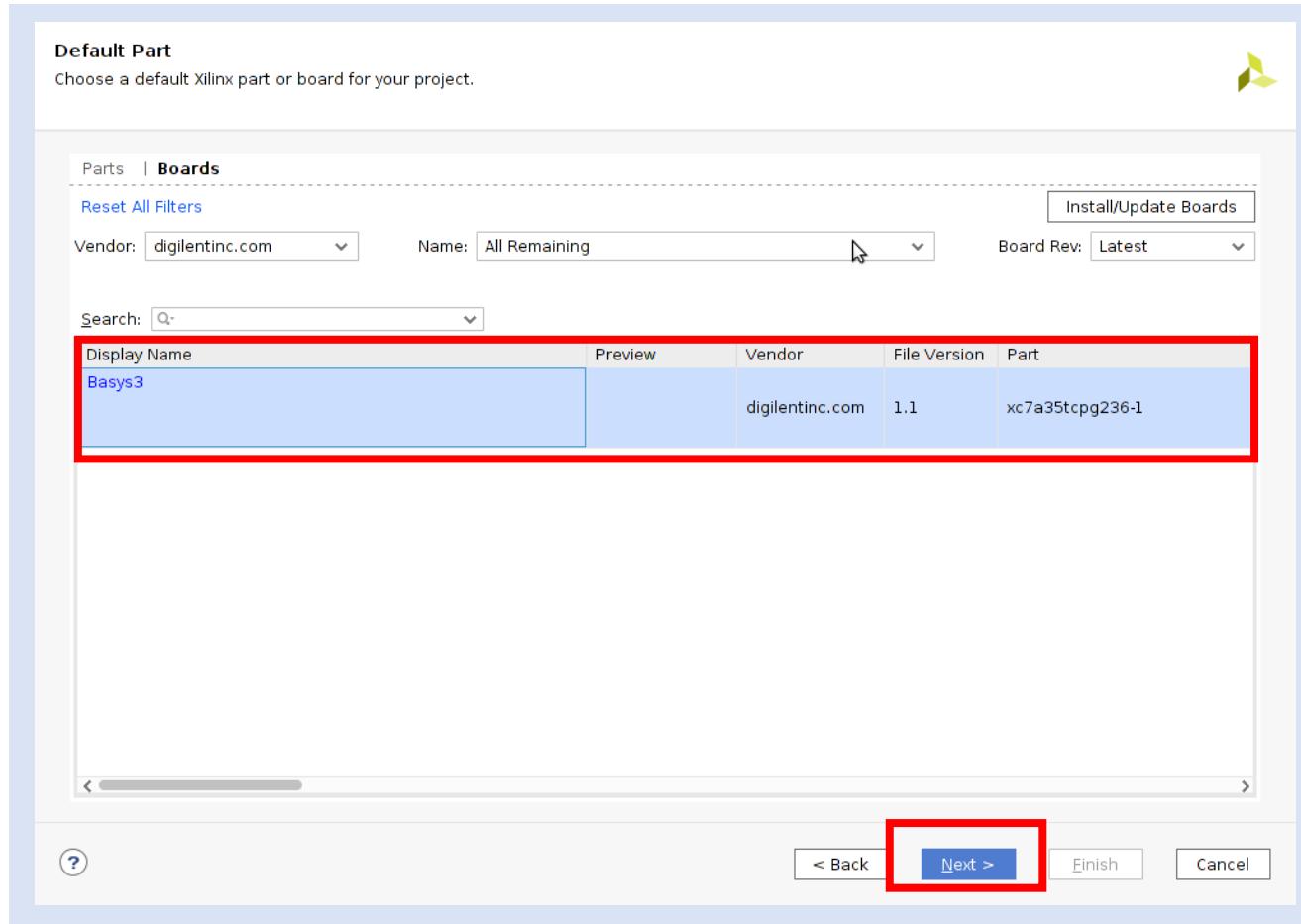
Crowd Supply: Lab One

Step 5 – On the next tab, select RTL Project and check “do no specify sources at this time”, click next



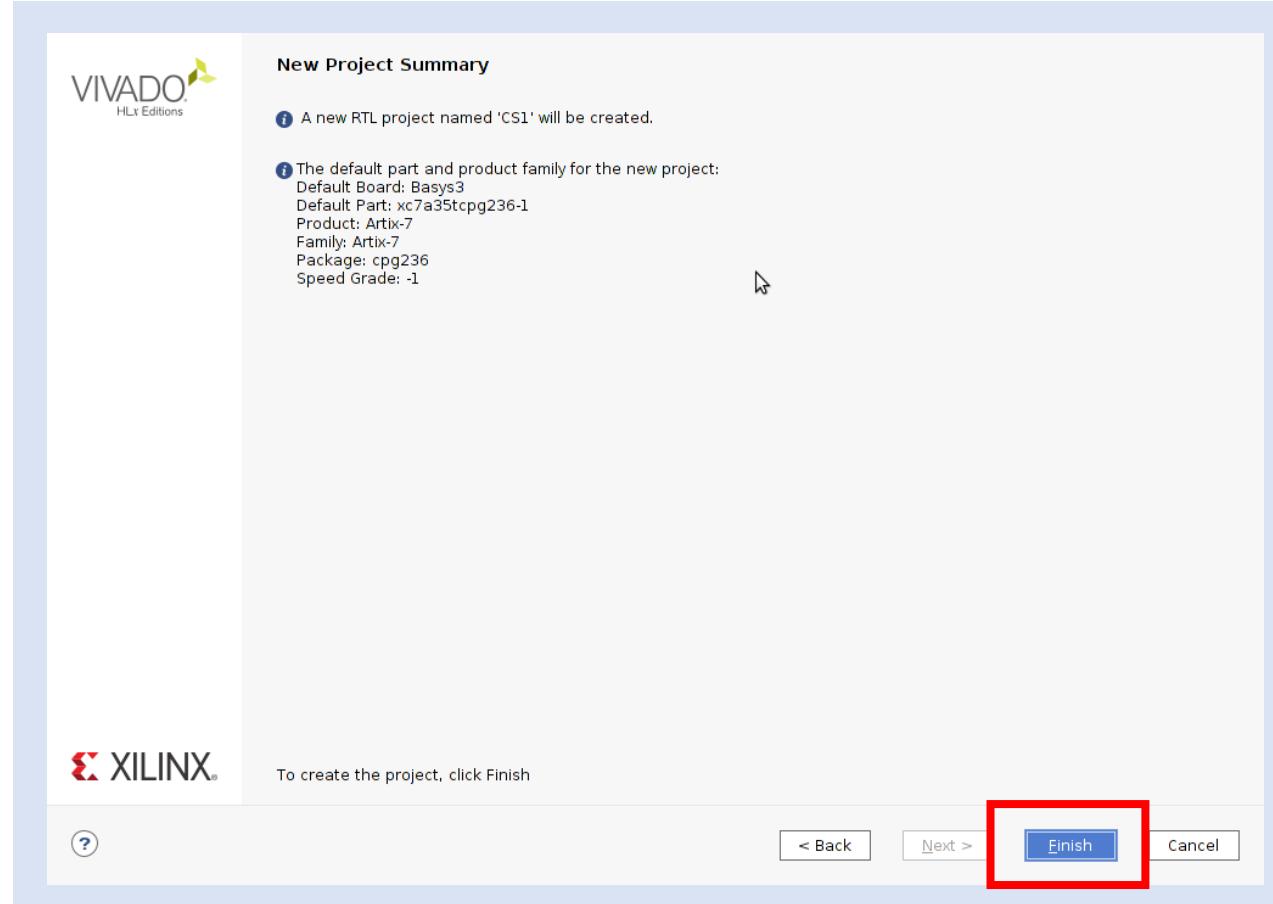
Crowd Supply: Lab One

Step 6 – On the next tab select the Basys3 board and click next



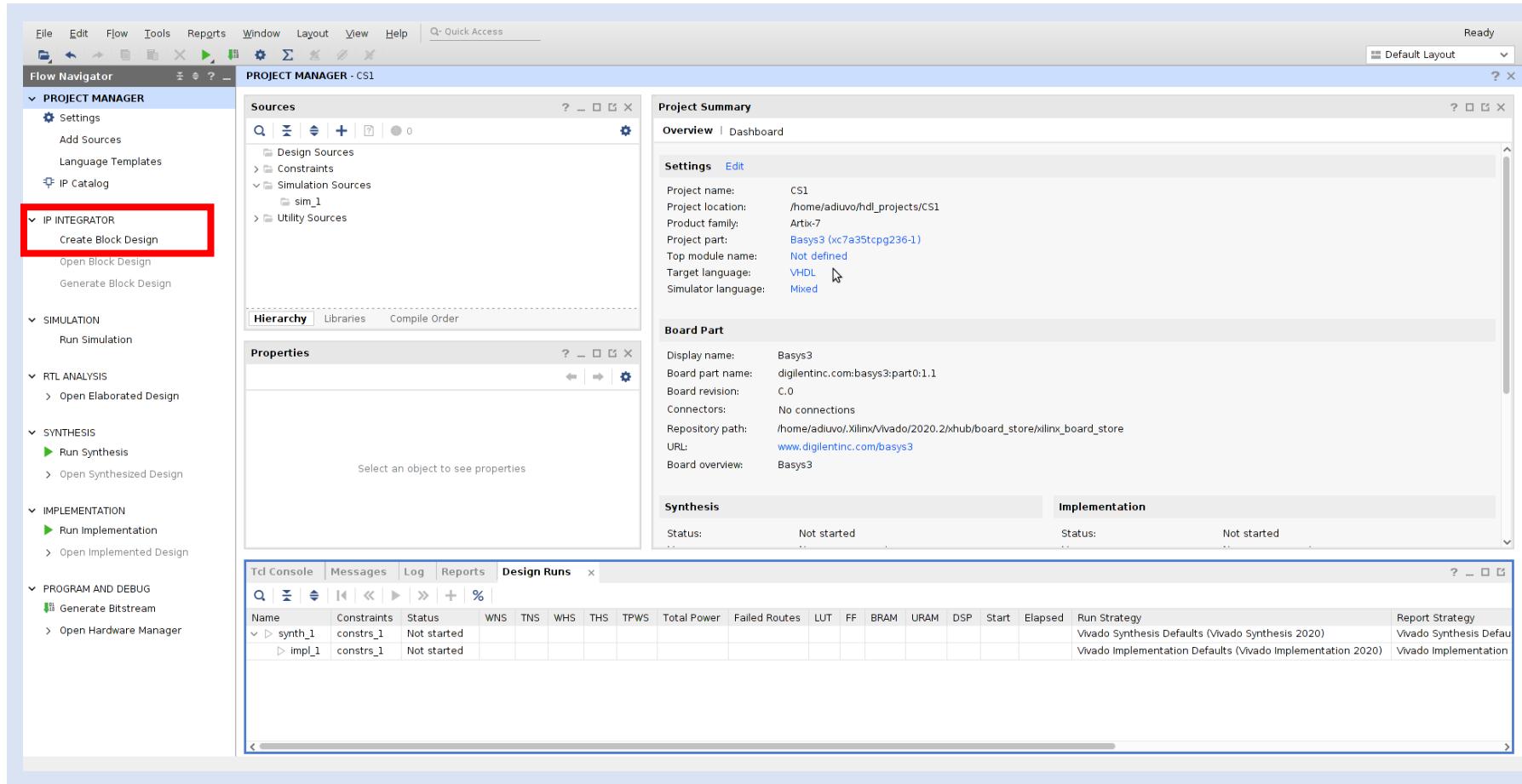
Crowd Supply: Lab One

Step 7 – On the project summary page click finish



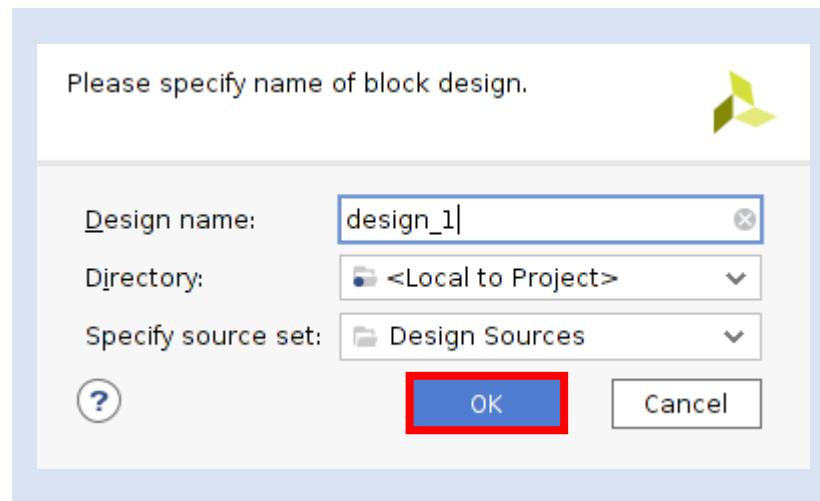
Crowd Supply: Lab One

Step 8 – When the project opens from IP Integrator select “Create Block Design”



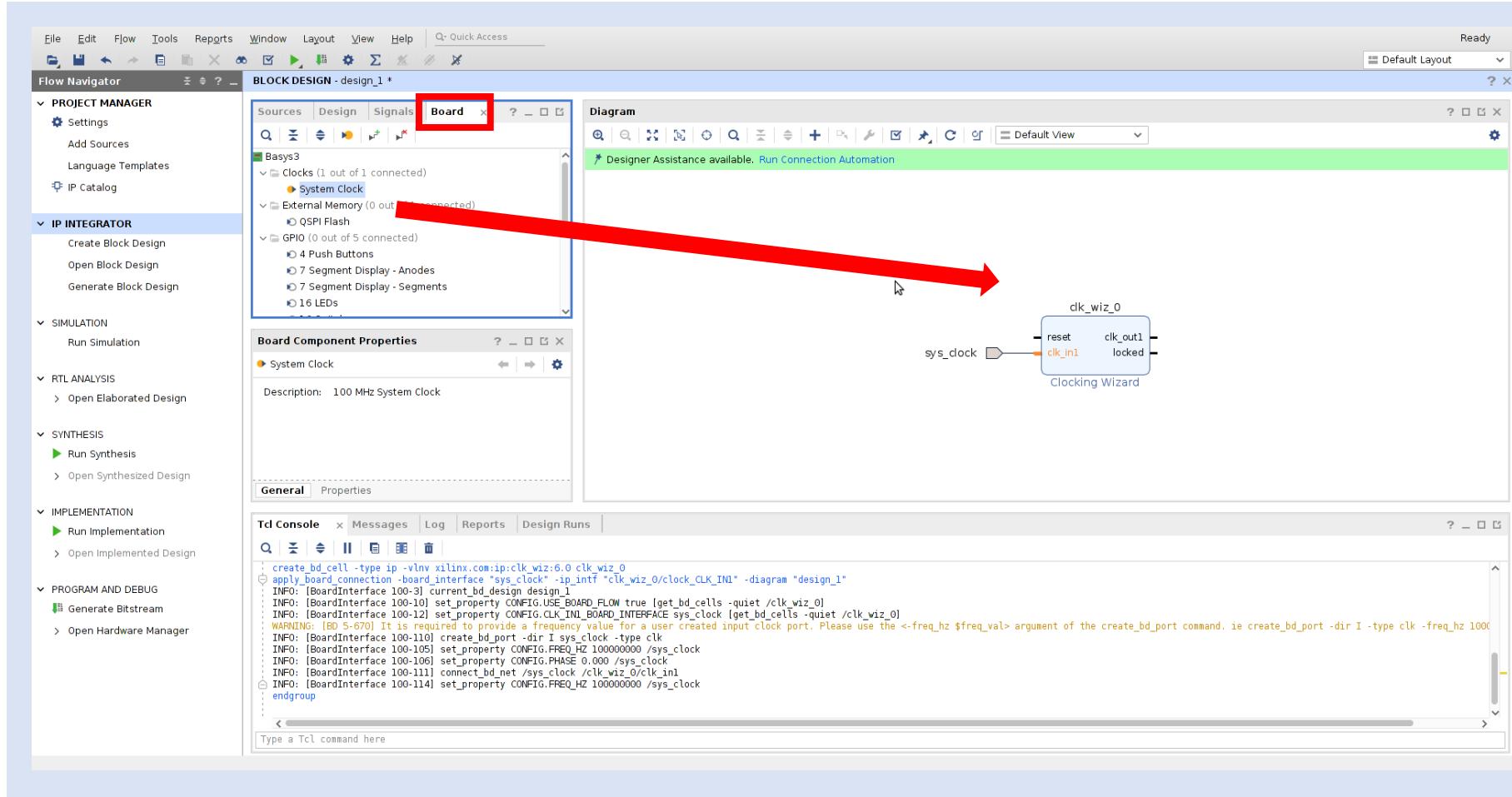
Crowd Supply: Lab One

Step 9 – Leave the defaults in the dialog box which appears, click OK



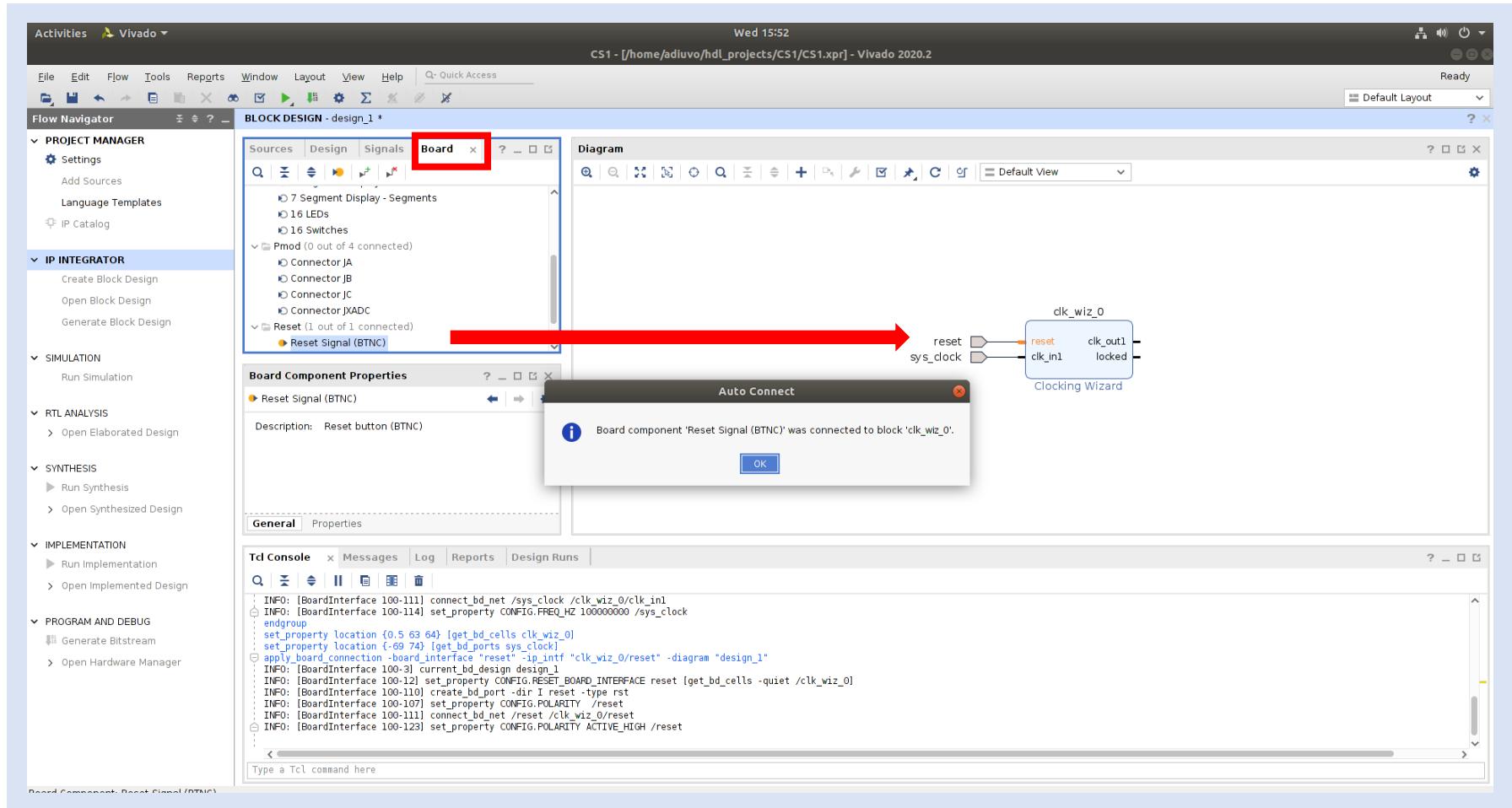
Crowd Supply: Lab One

Step 10 – Once the Block Design is created select the board tab and drag the system clock onto the block design



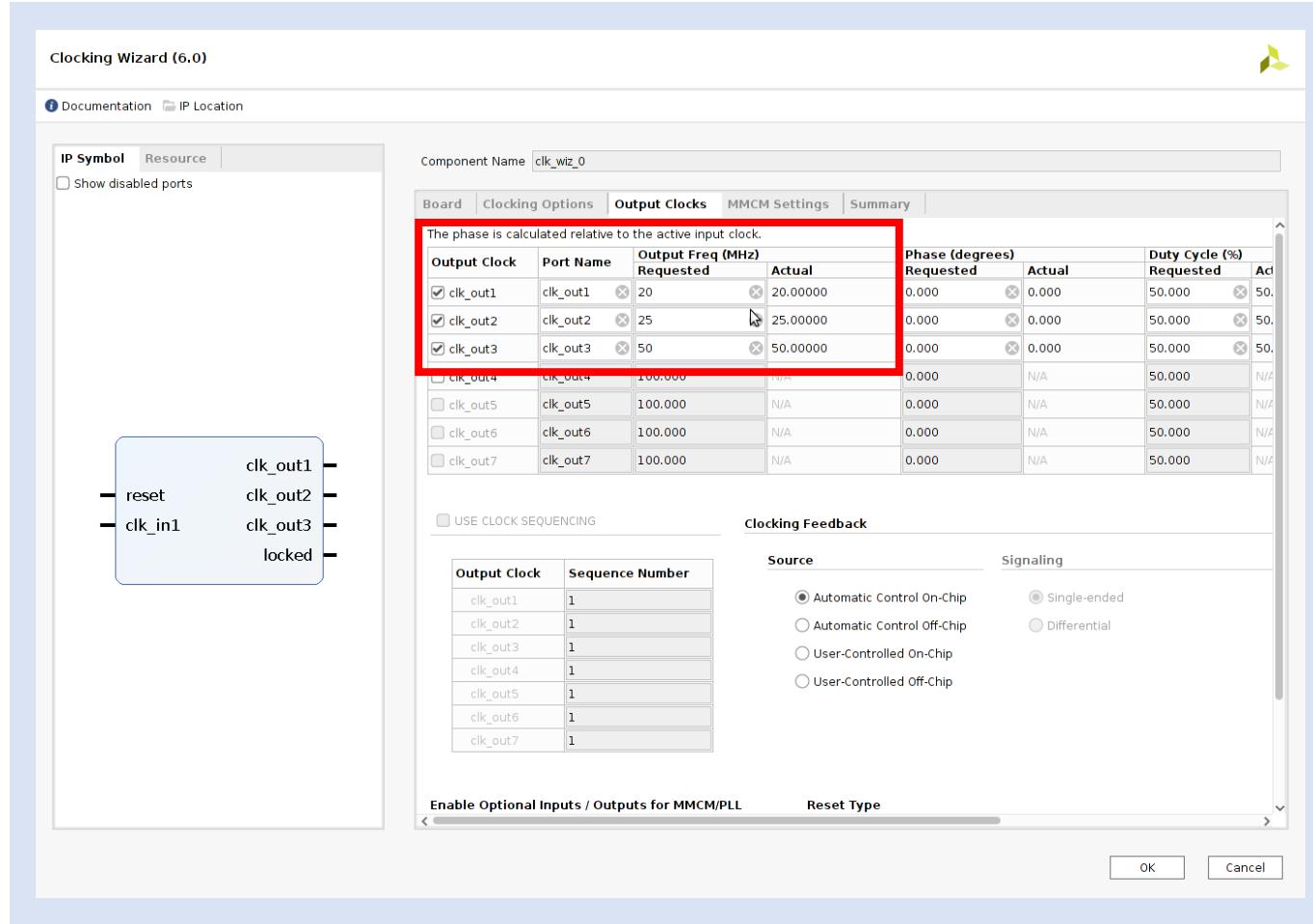
Crowd Supply: Lab One

Step 11 – From the board tab drag the Reset signal on to the Clock Wizard Reset Pin



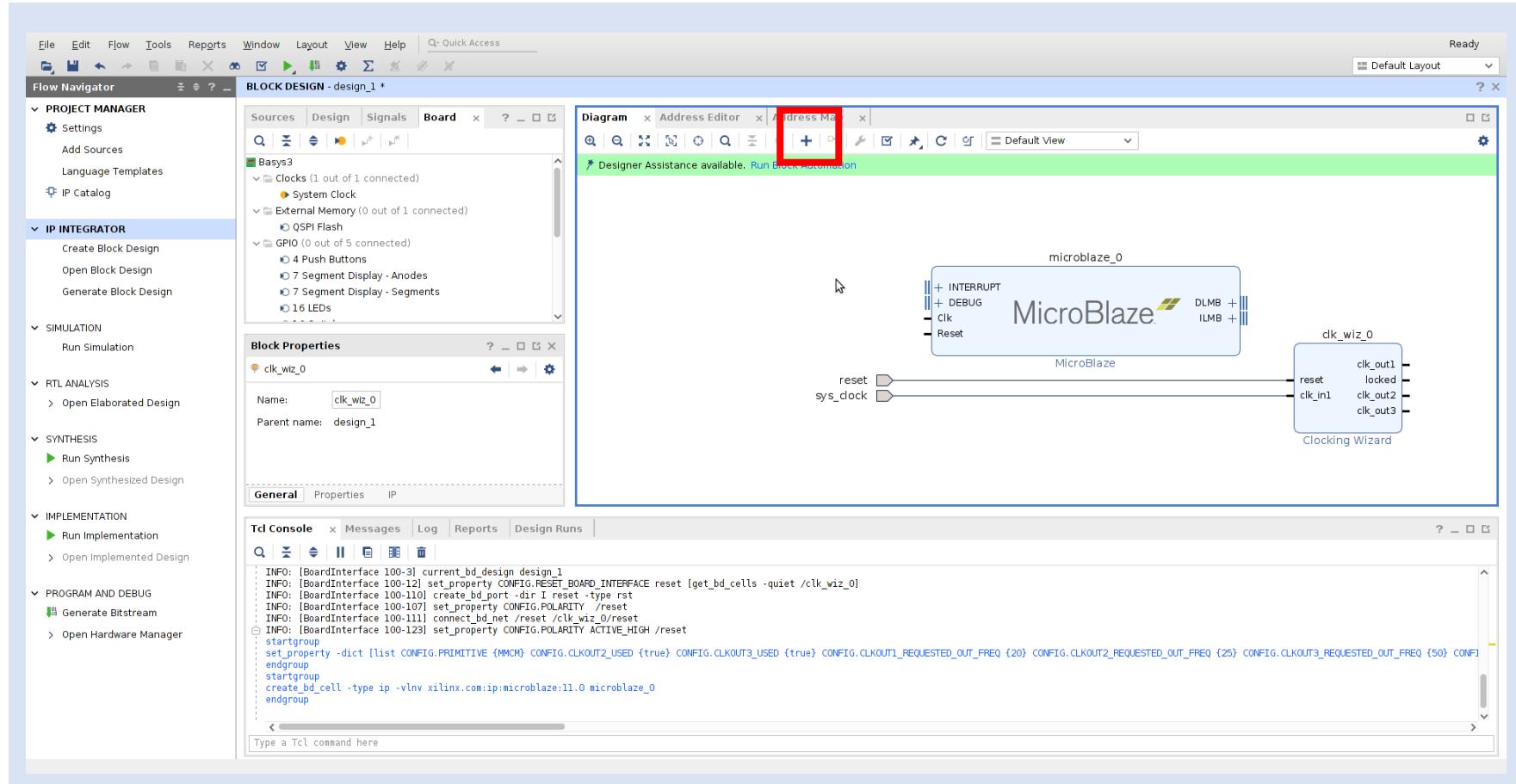
Crowd Supply: Lab One

Step 12 – Double click on the clock wizard and select CLK1 = 20 MHz, CLK2 = 25MHz, CLK3 = 50MHz



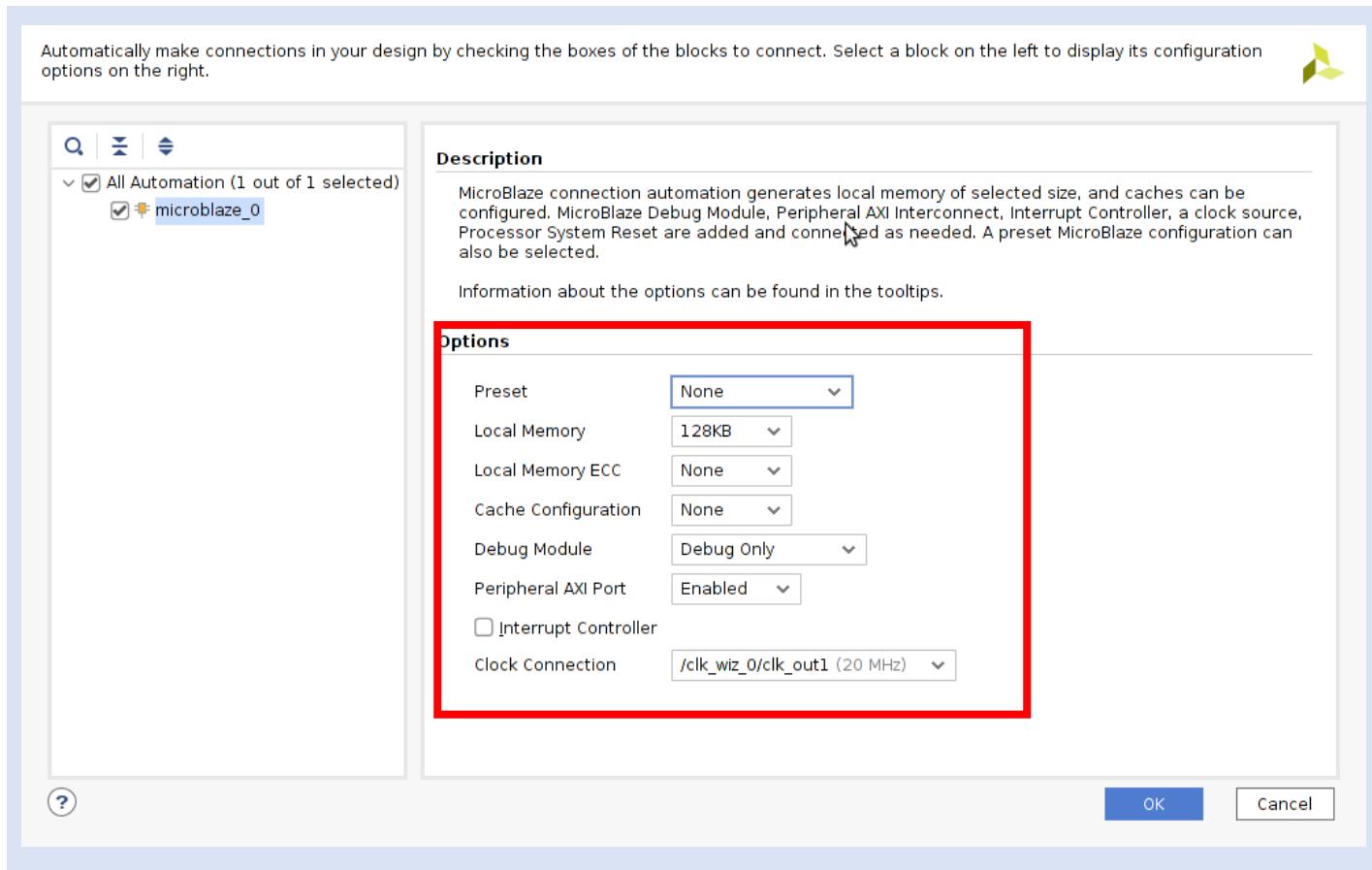
Crowd Supply: Lab One

Step 13 – Click on the + symbol and add a MicroBlaze to the block design



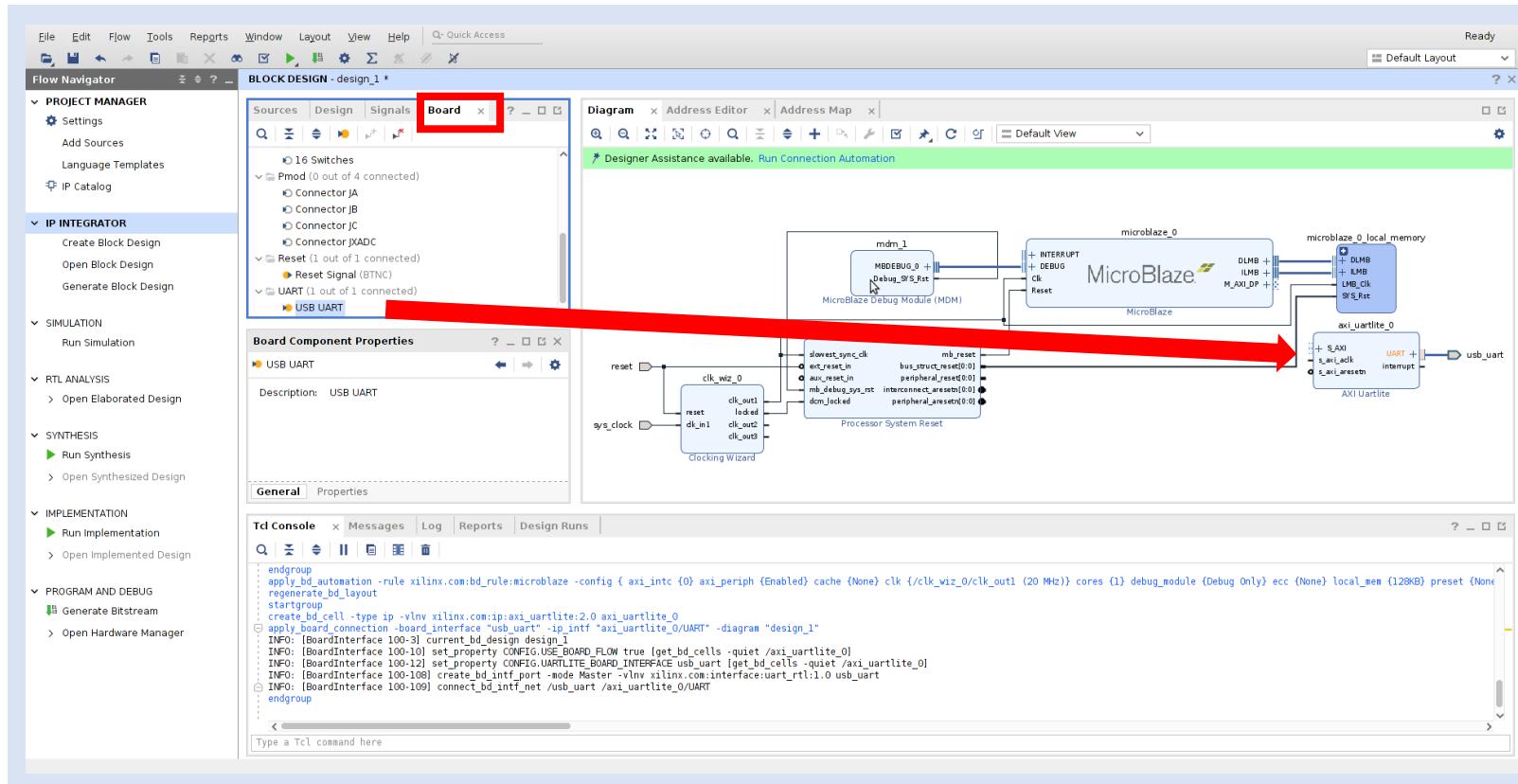
Crowd Supply: Lab One

Step 14 – Run the Block Automation and set the local memory to 128KB and ensure the Peripheral AXI Port is enabled



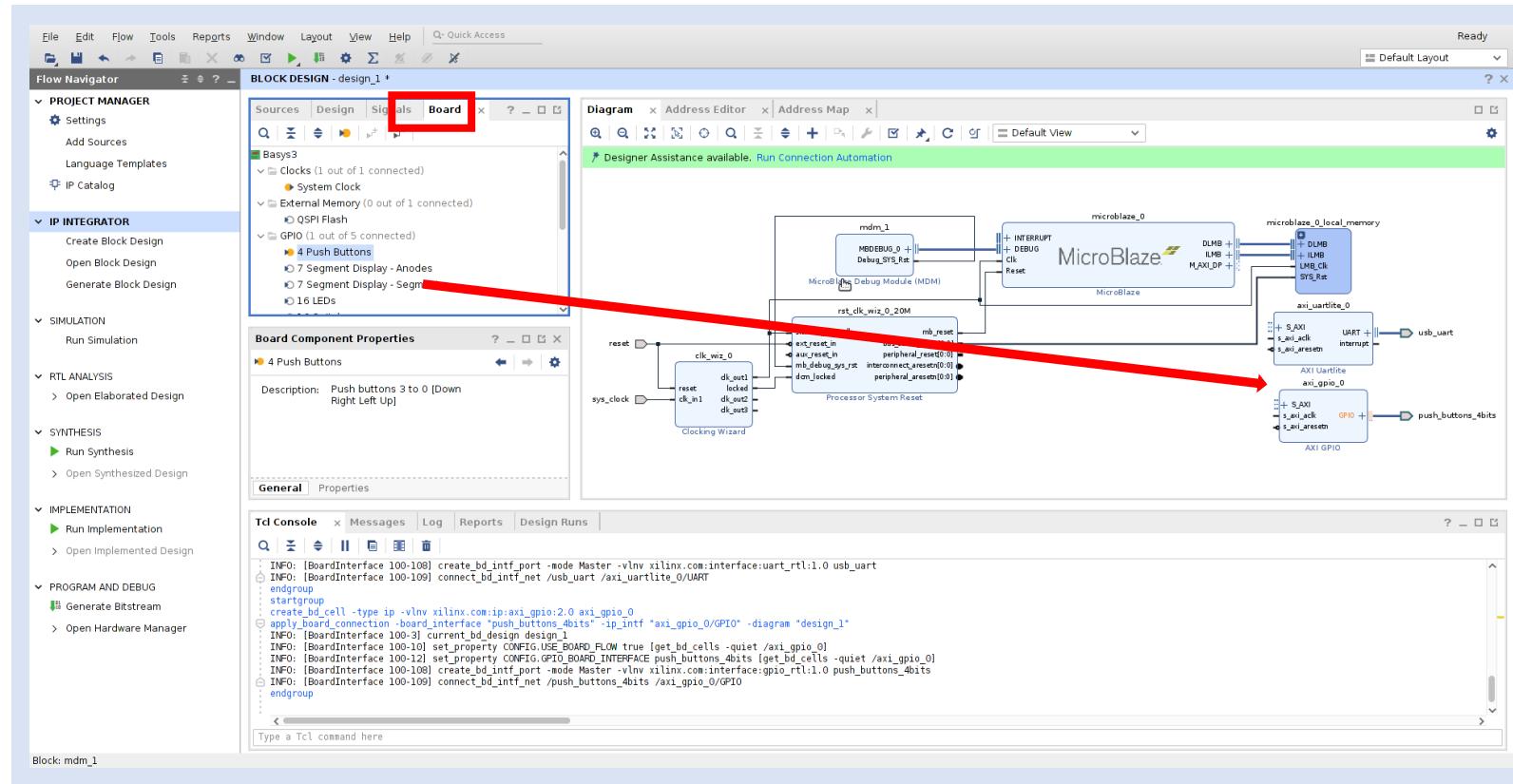
Crowd Supply: Lab One

Step 15 – This will create the MicroBlaze System as shown below. From the board tab drag the USB UART on to the block design.



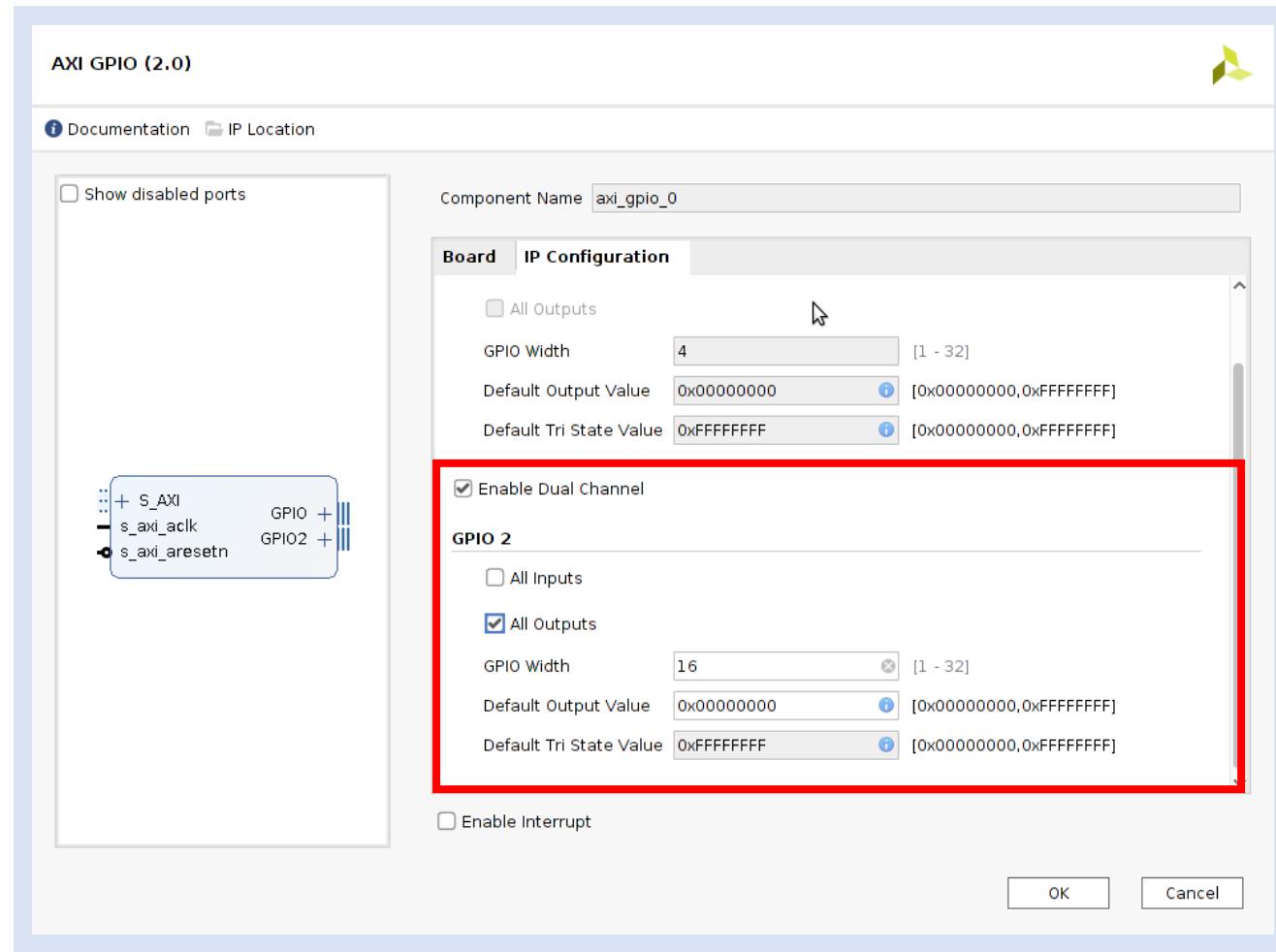
Crowd Supply: Lab One

Step 16 – From the boards tab drag and drop the 4 Push Buttons onto block diagram



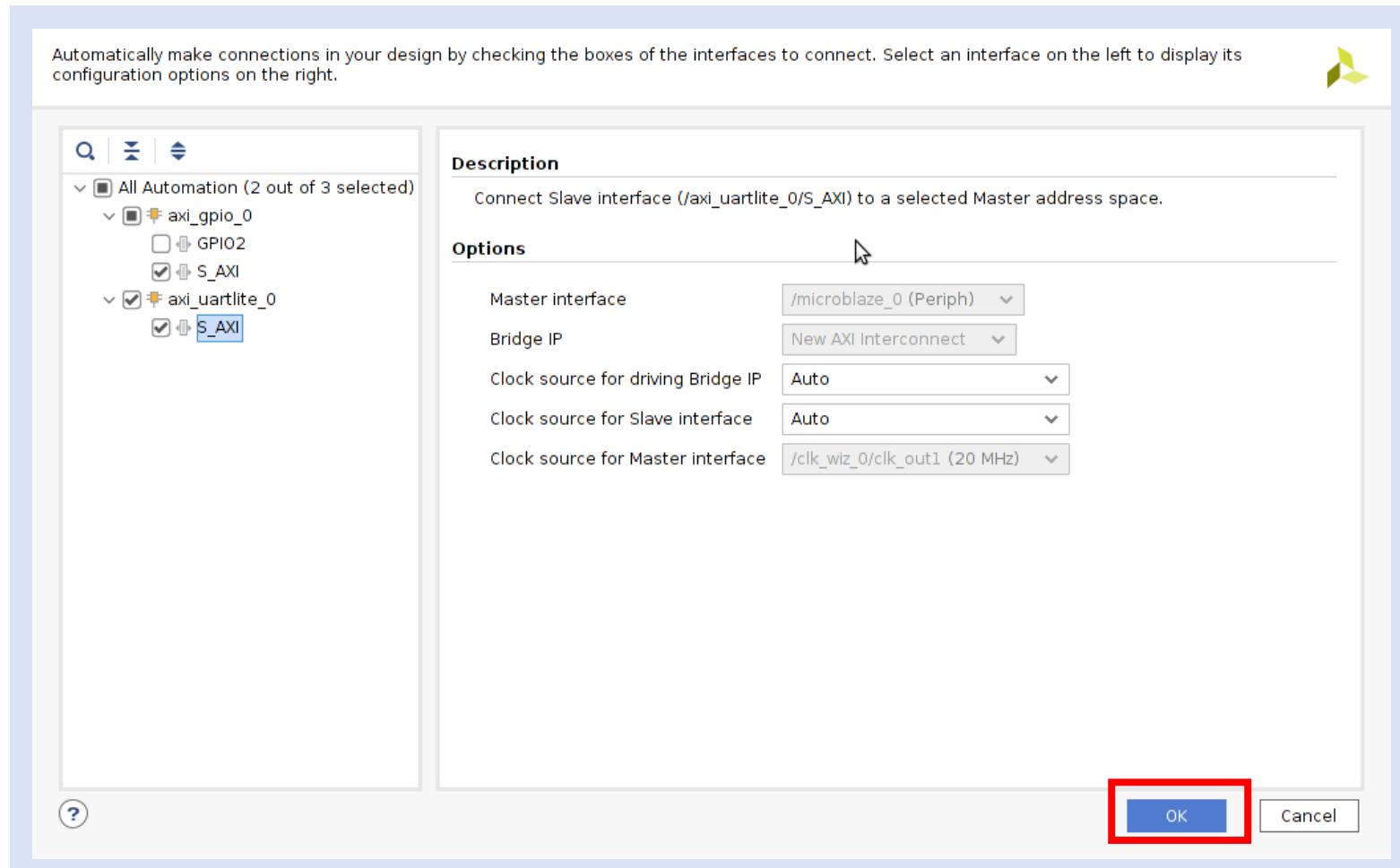
Crowd Supply: Lab One

Step 17 – Double click on the GPIO IP Block and re-customize it for a second channel of all outputs and width of 16 bits



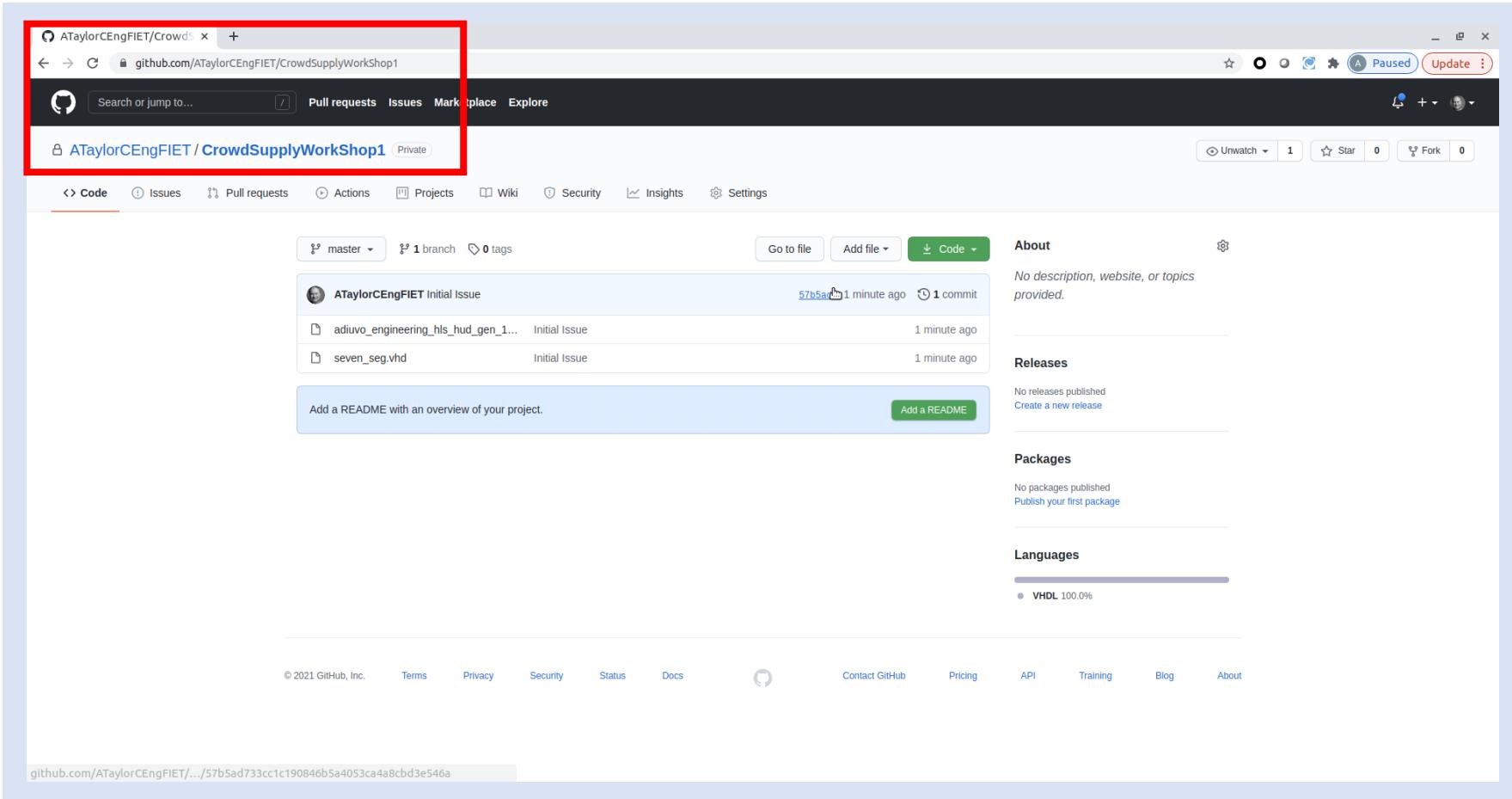
Crowd Supply: Lab One

Step 18 – Run the Connection Automation and connect the UART and GPIO S_AXI interfaces to the MicroBlaze



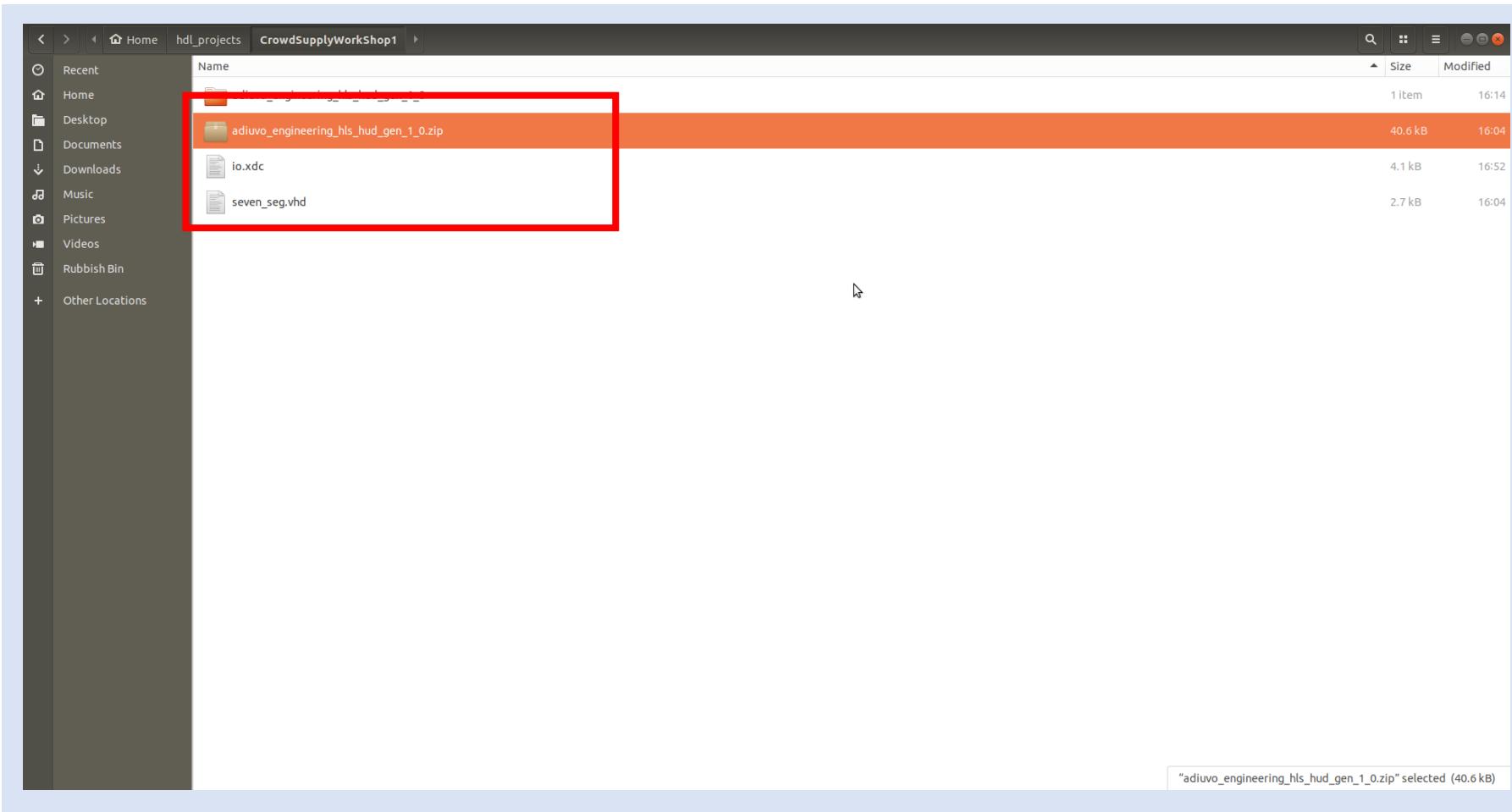
Crowd Supply: Lab One

**Step 19 – Open a web browser and clone the IP files from the GitHub
<https://github.com/ATaylorCEngFIET/CrowdSupplyWorkShop1>**



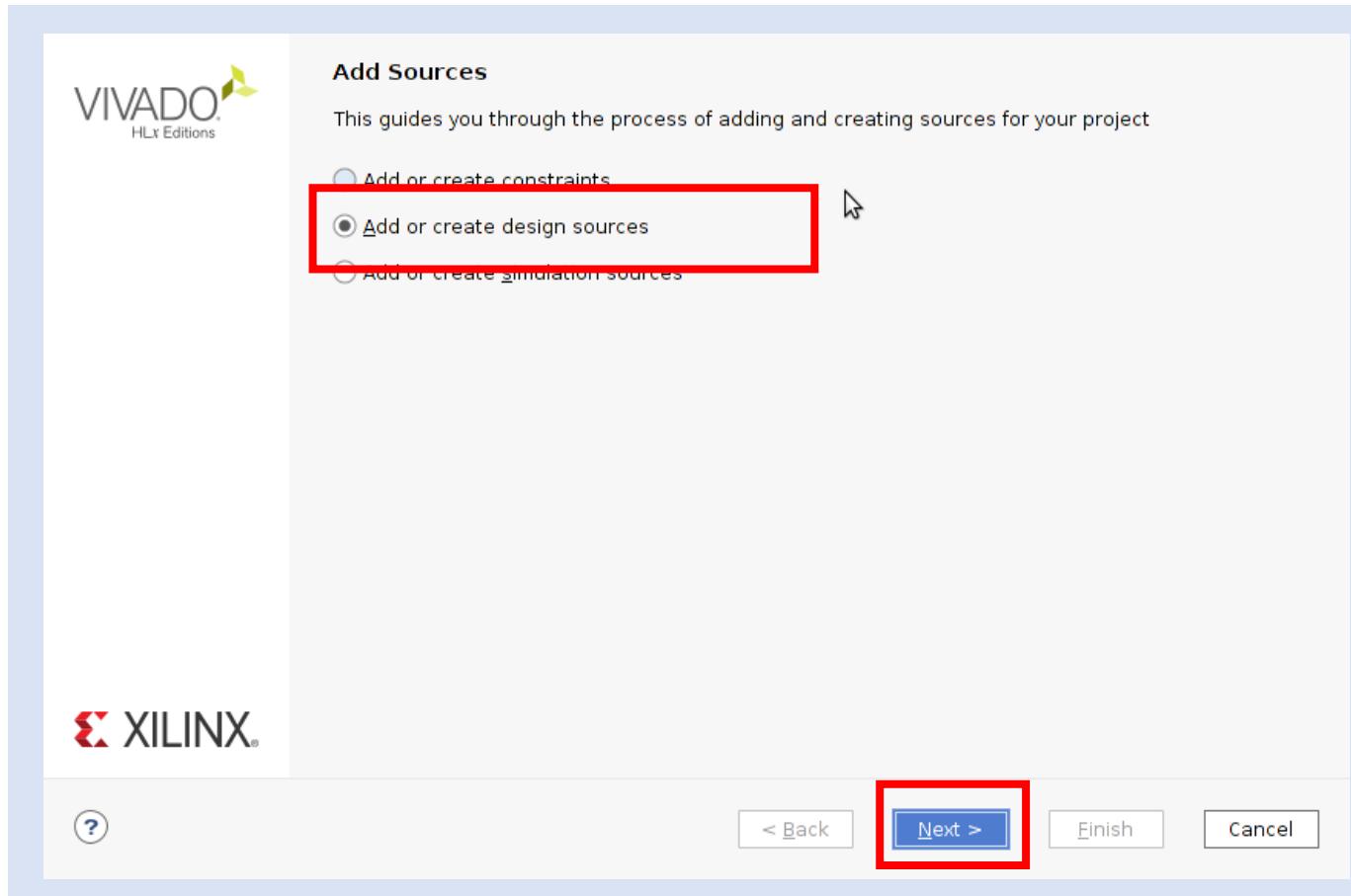
Crowd Supply: Lab One

Step 20 – This will clone three files one RTL File, a XDC constraints and an HLS IP core



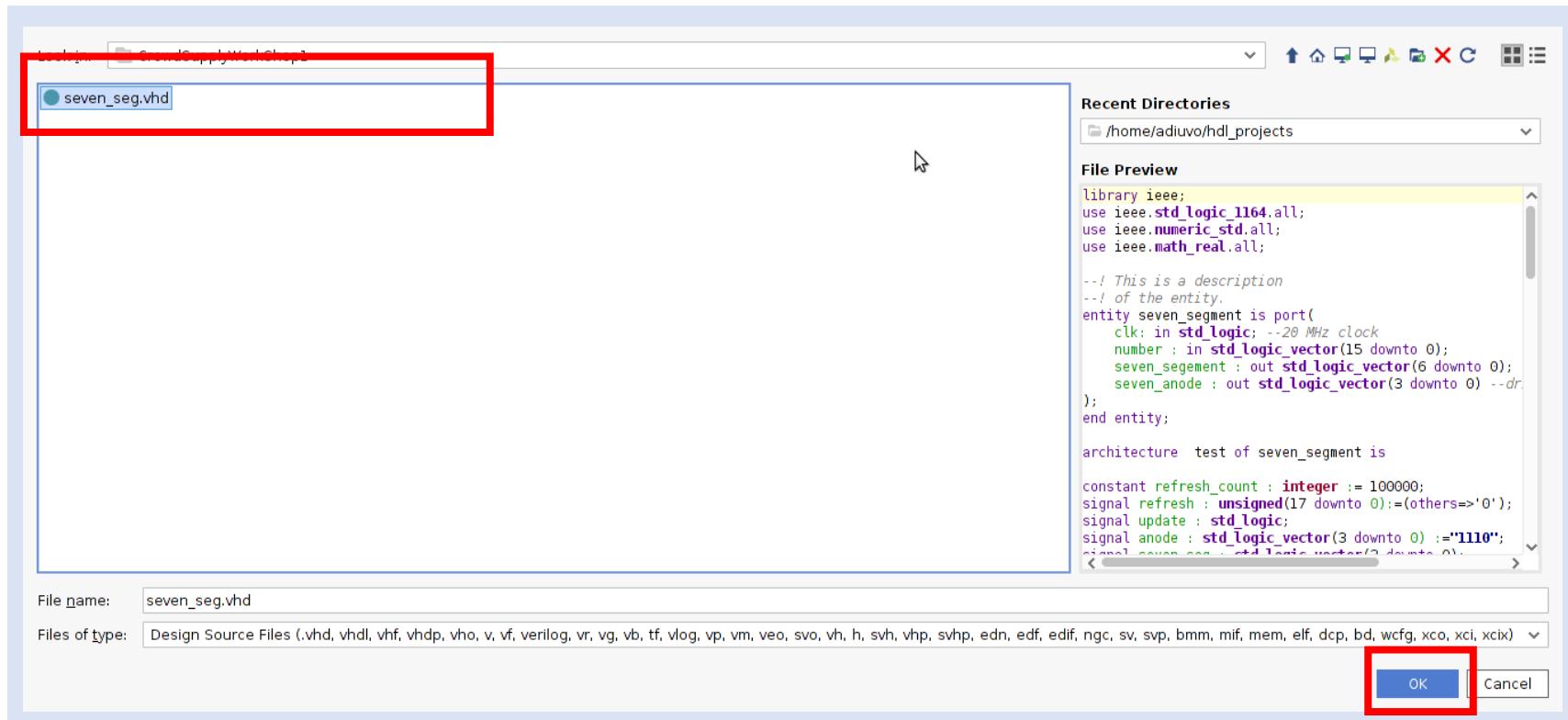
Crowd Supply: Lab One

Step 21 – Click on the Add or Create design sources tab and then next



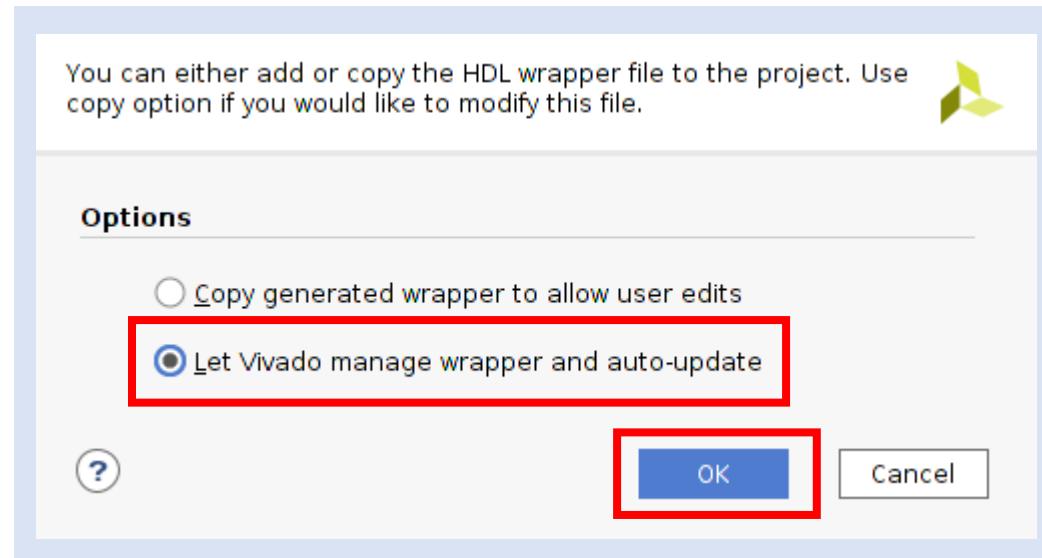
Crowd Supply: Lab One

Step 22 – Select the Seven_seg.vhd RTL file



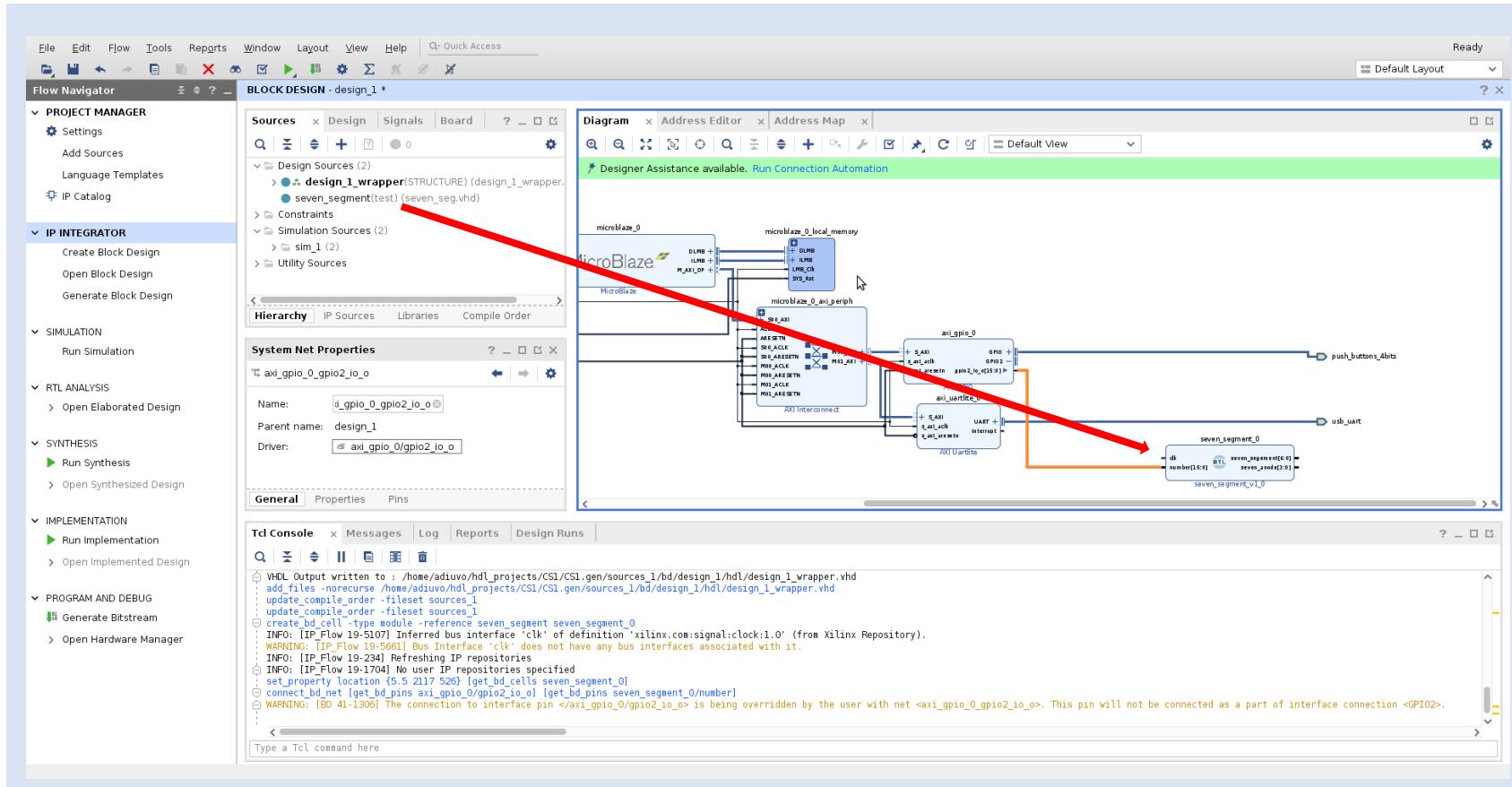
Crowd Supply: Lab One

Step 23 – Create an RTL Wrapper for the block diagram, by right clicking on the block diagram icon. In the dialog which pops up let Vivado Manage the wrapper. Click OK



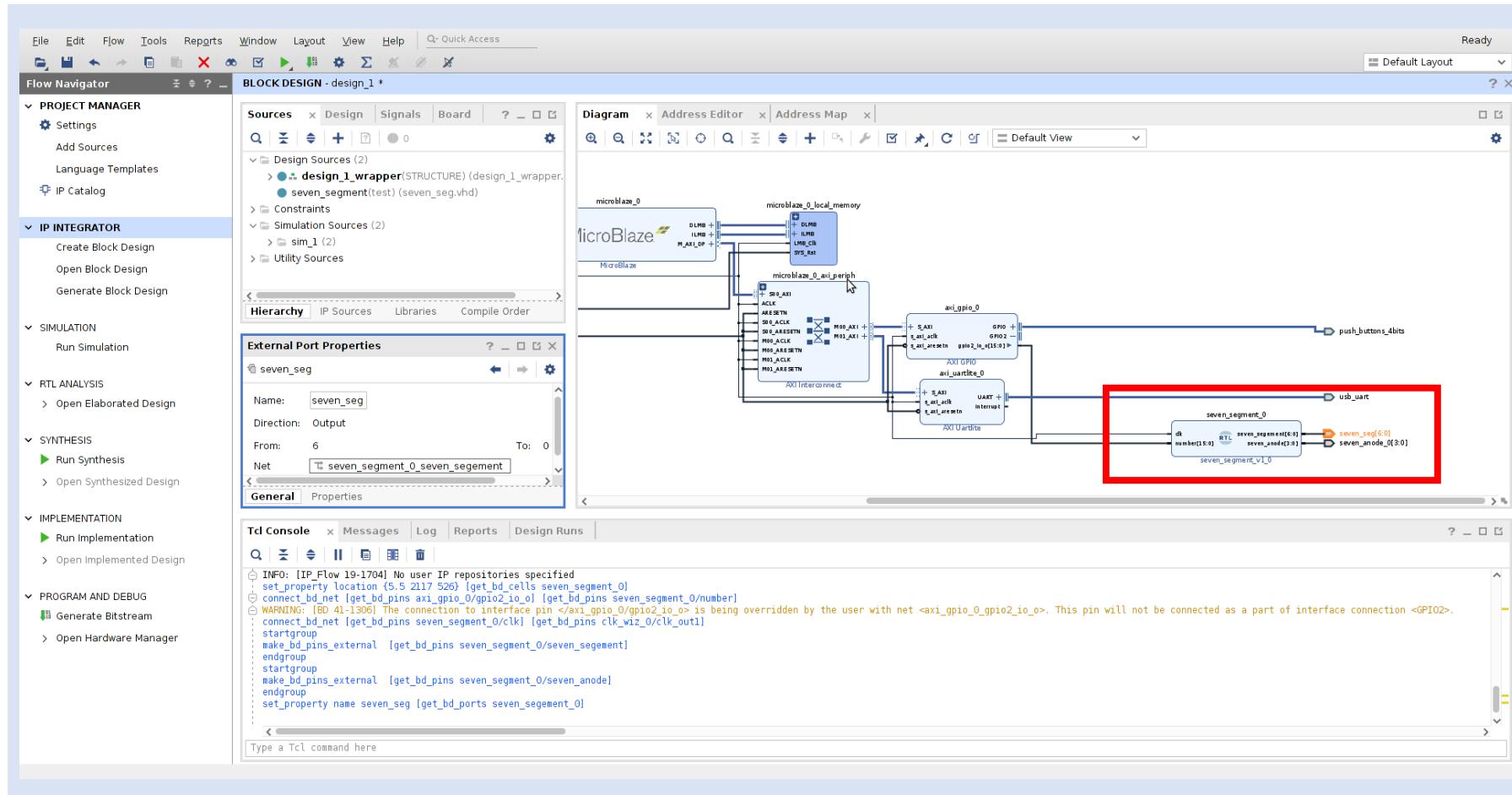
Crowd Supply: Lab One

Step 24 – Drag the Seven Seg RTL block onto the block diagram and connect the second output port from the GPIO IP to the input of the Seven Segment Input



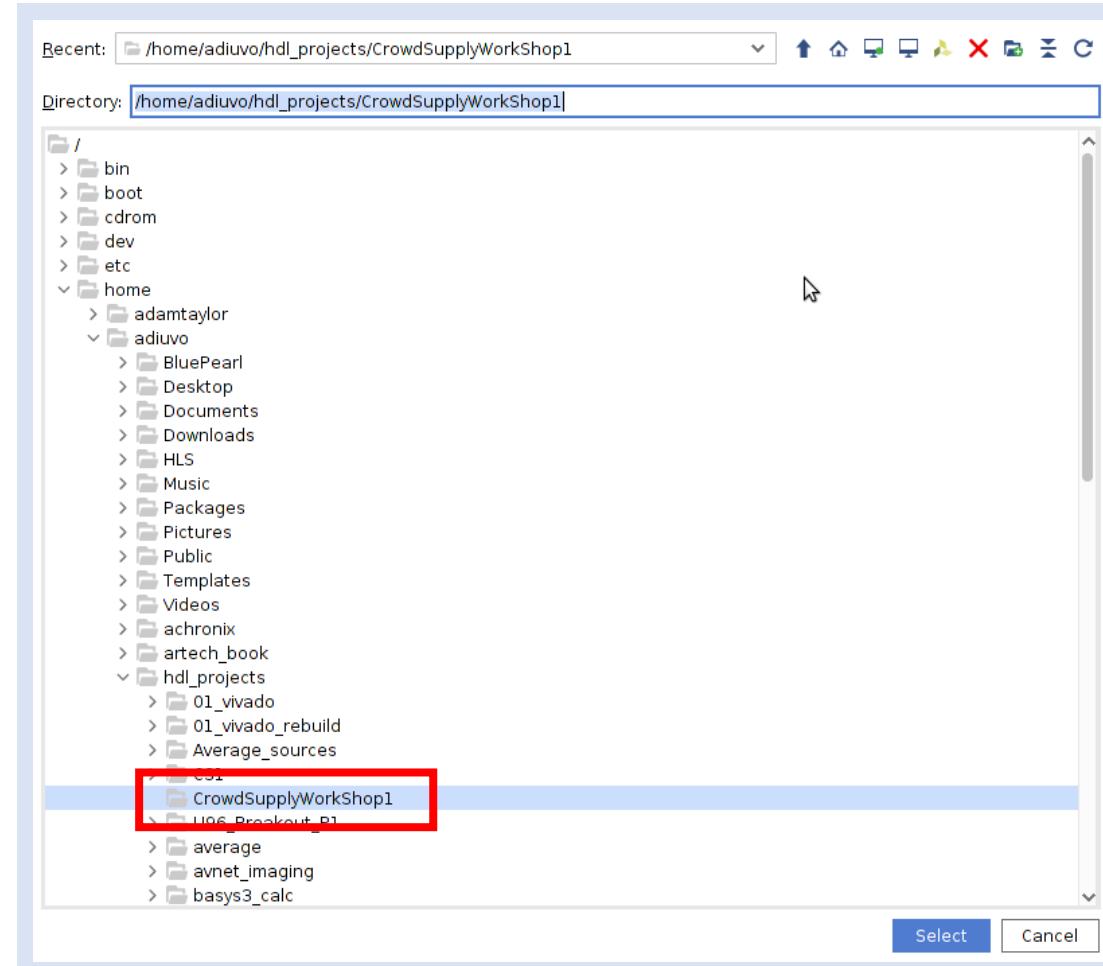
Crowd Supply: Lab One

Step 25 – Connect the clock of the Seven Segment to clock 1 (20 MHZ) and make the two ports external – Name them seven_seg & seven_seg_led_an



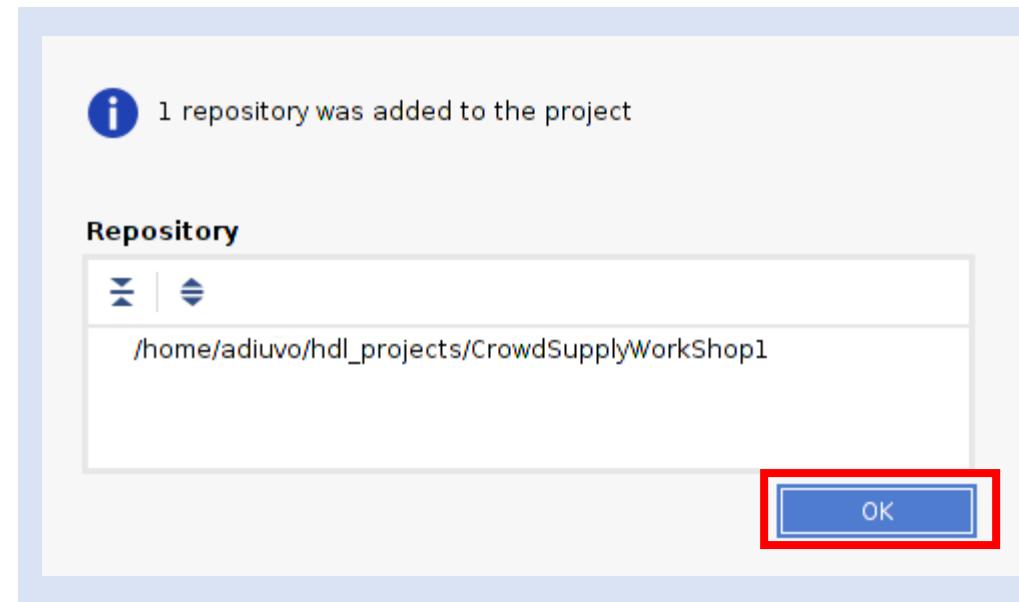
Crowd Supply: Lab One

Step 26 – Open the IP library, right click and select add repository – Select the Cloned Repository as the location



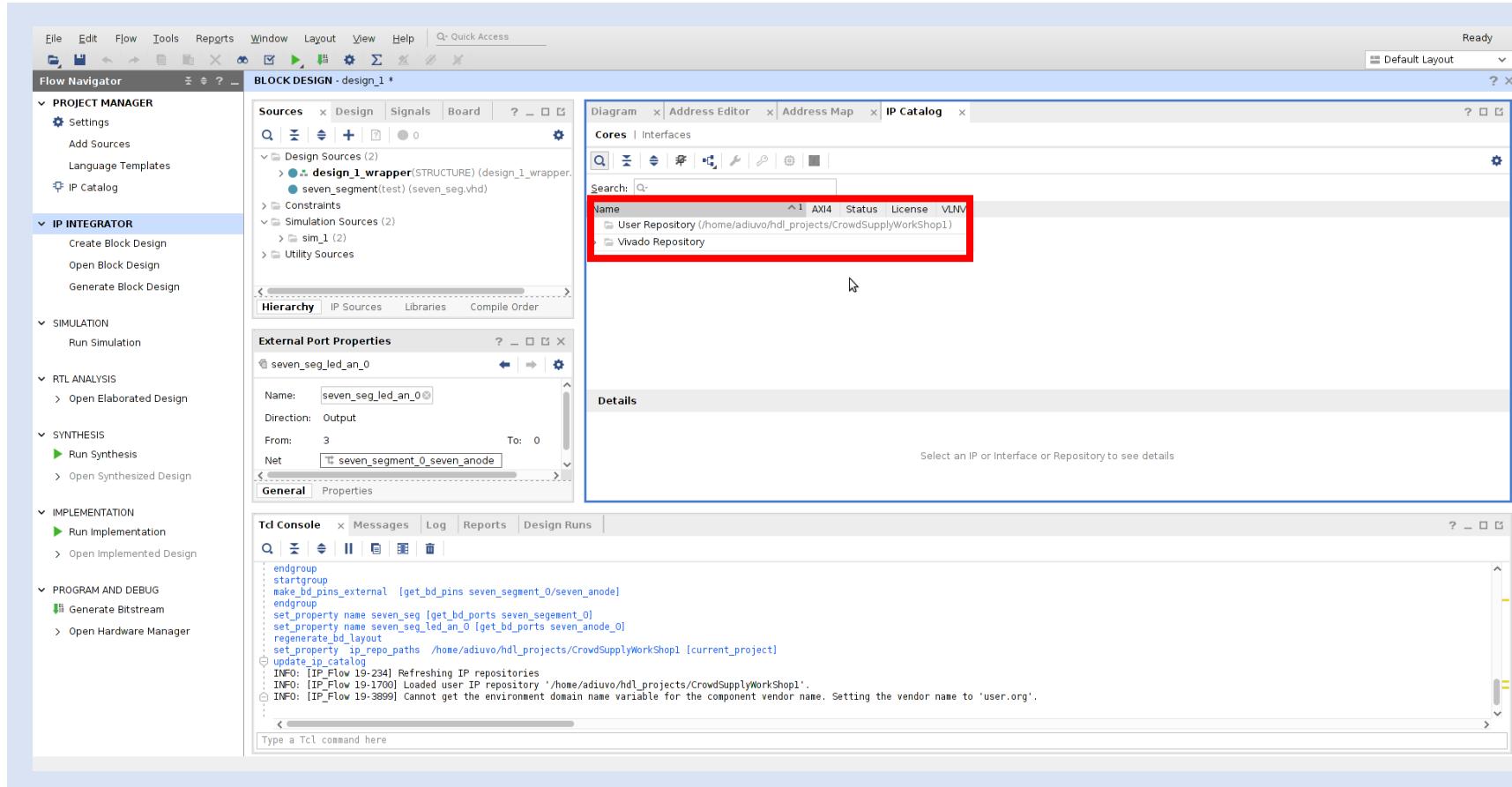
Crowd Supply: Lab One

Step 27 – This will add one repository to the project as shown by the dialog, click OK



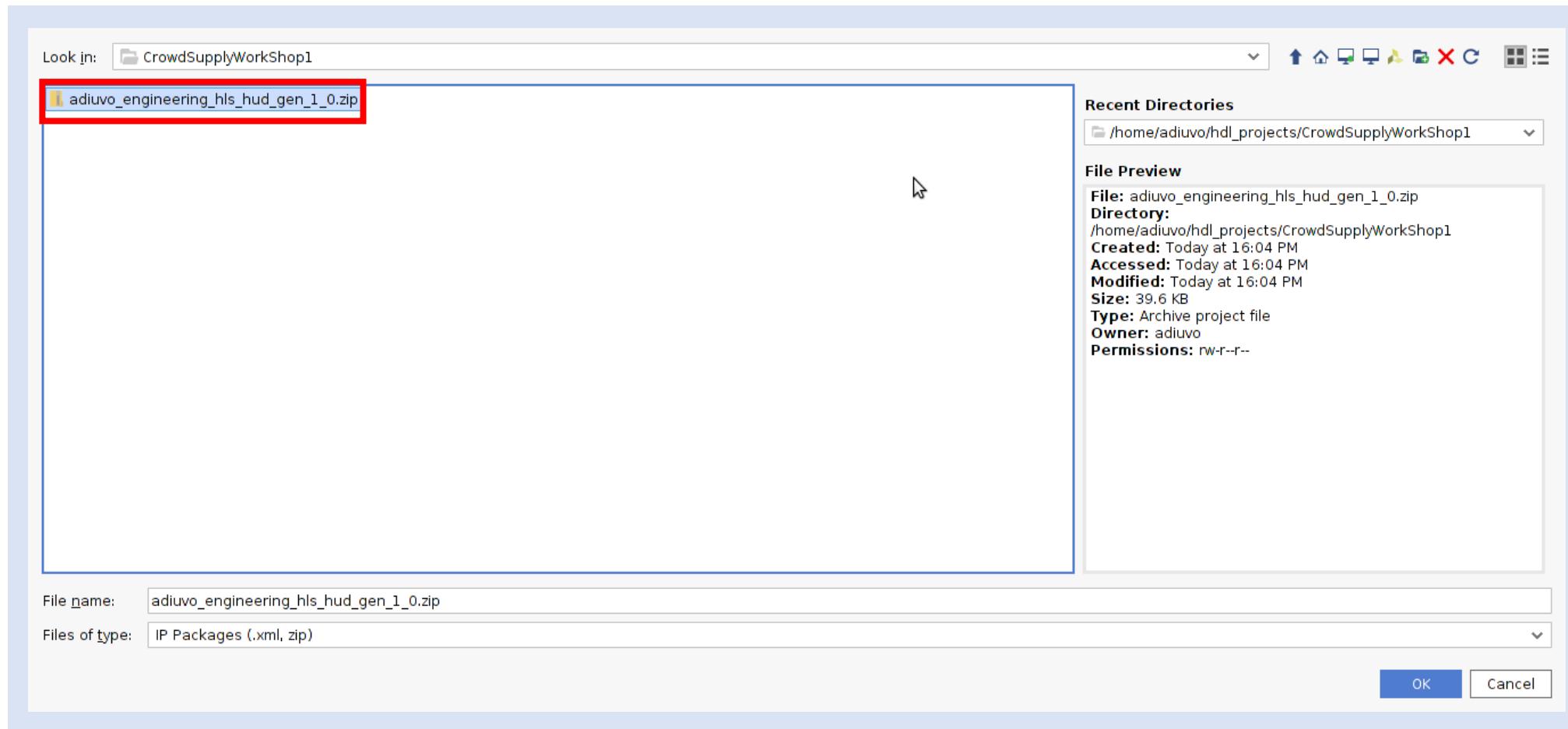
Crowd Supply: Lab One

Step 28 – Right click on the user repository and select add IP to repository



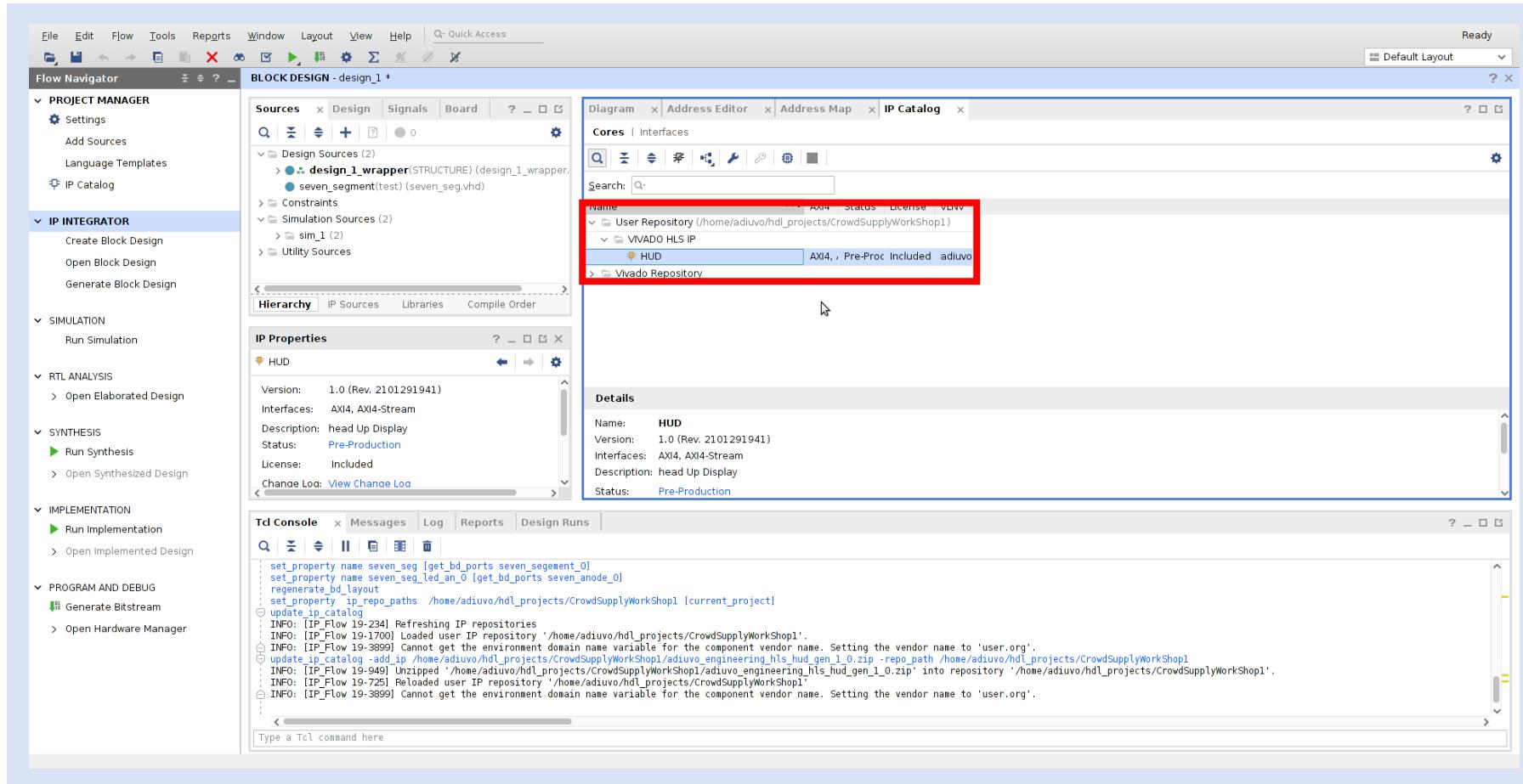
Crowd Supply: Lab One

Step 29 – Select the zip in the cloned directory



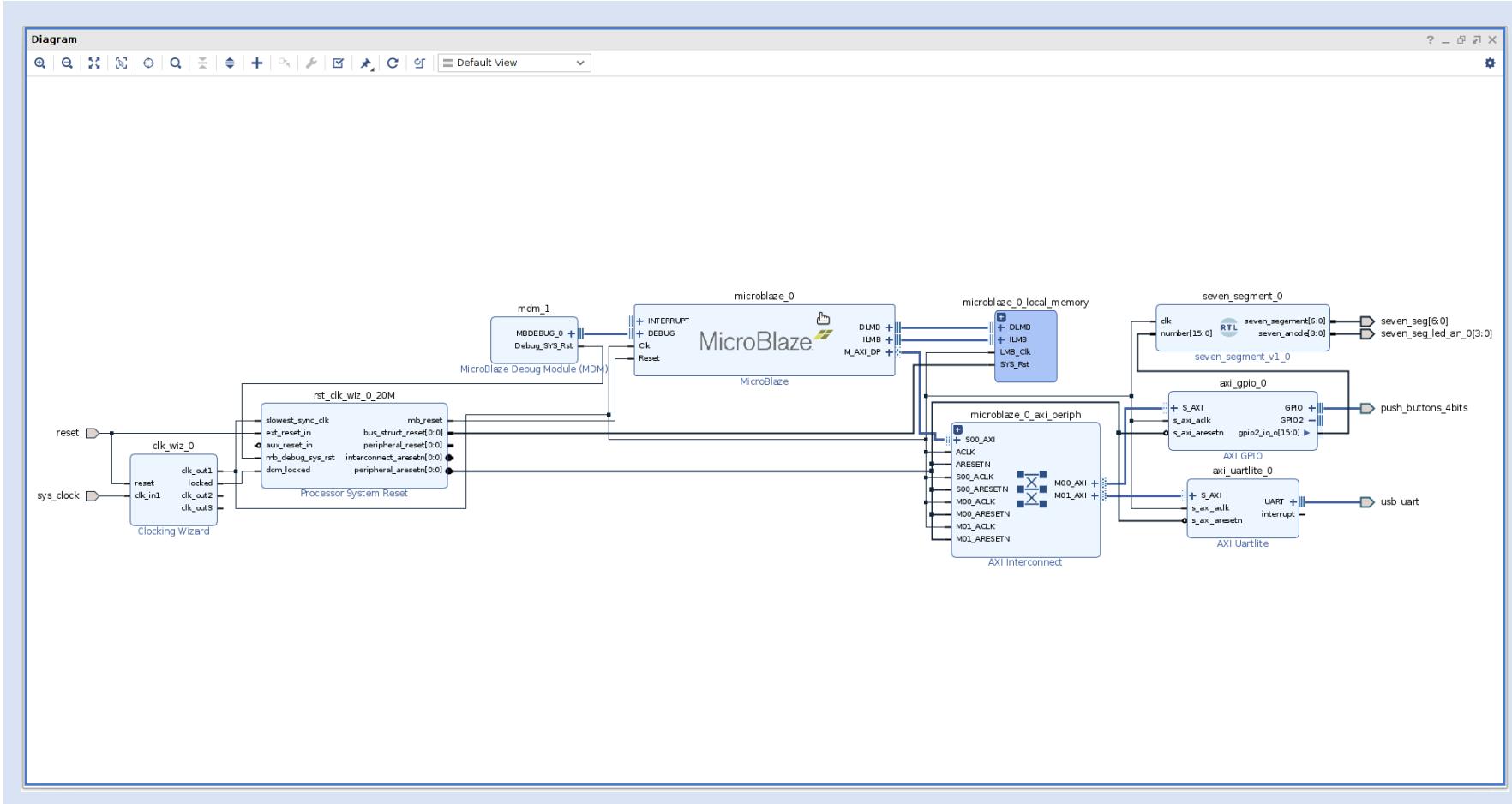
Crowd Supply: Lab One

Step 30 – Under the User Repository you should now see the HUD IP Block



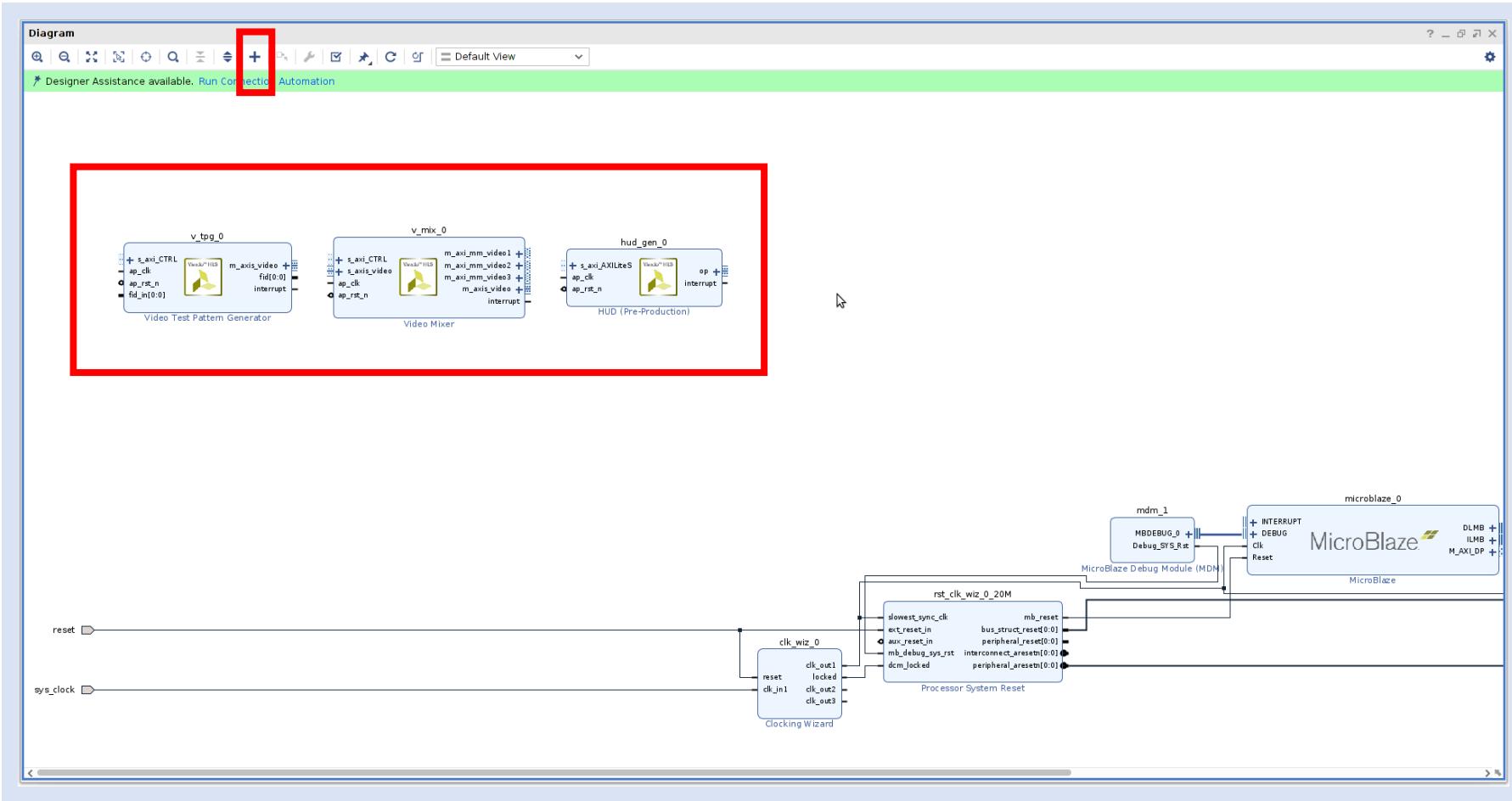
Crowd Supply: Lab One

Step 31 – Float the block diagram and maximize the window



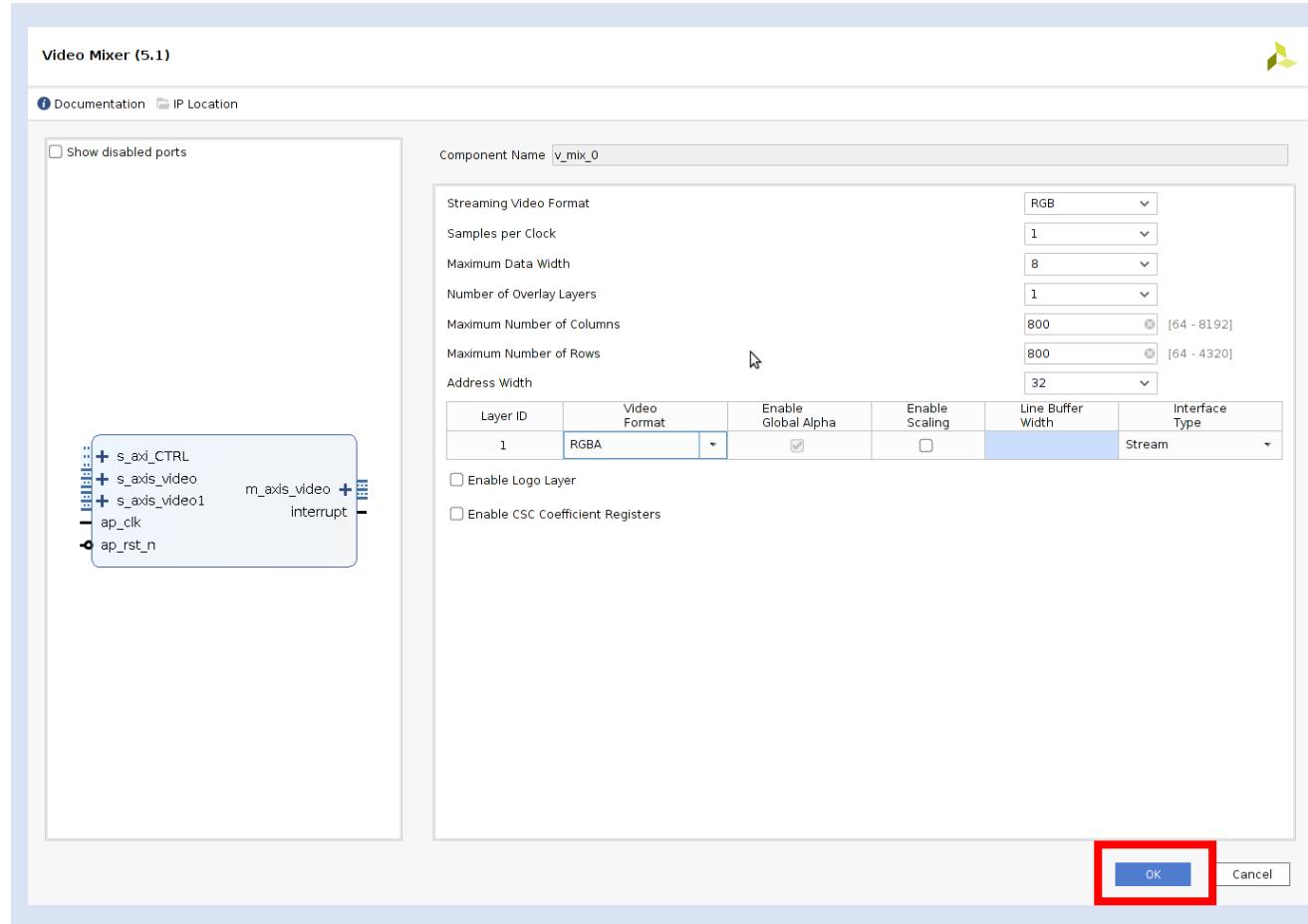
Crowd Supply: Lab One

Step 32 – Use the + Symbol to add in the Test Pattern Generator, Video Mixer and HUD



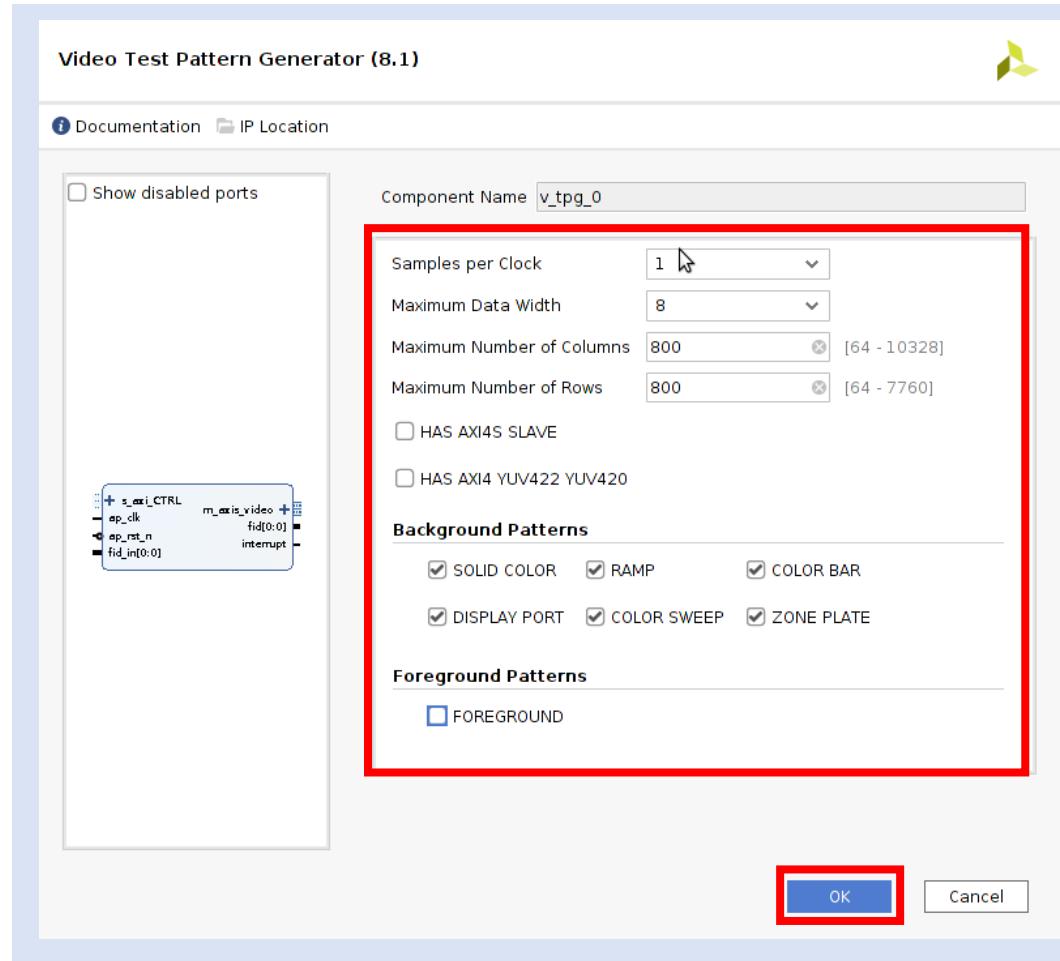
Crowd Supply: Lab One

Step 33 – Double click on the Video Mixer and configure it as below



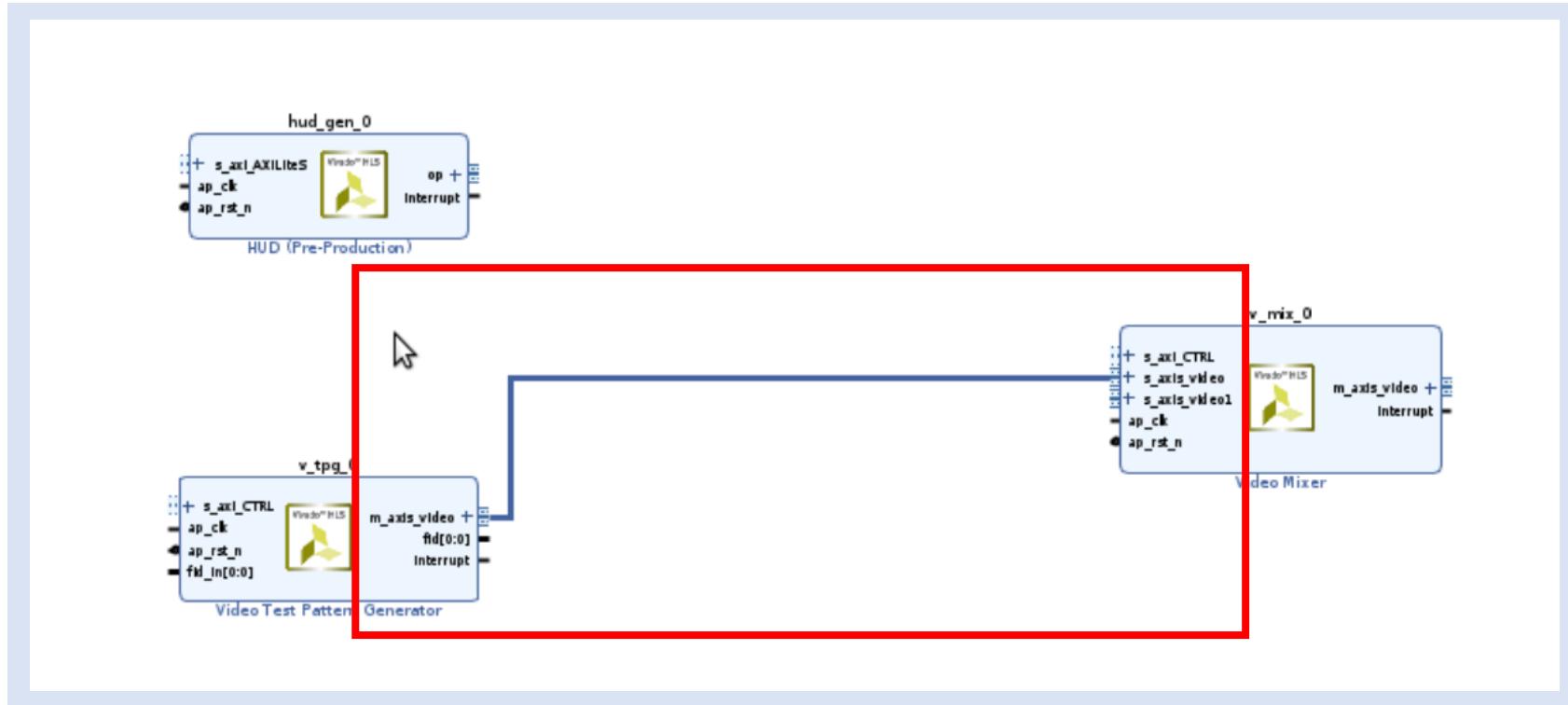
Crowd Supply: Lab One

Step 34 – Double click on the Test Pattern Generator and configure it as below



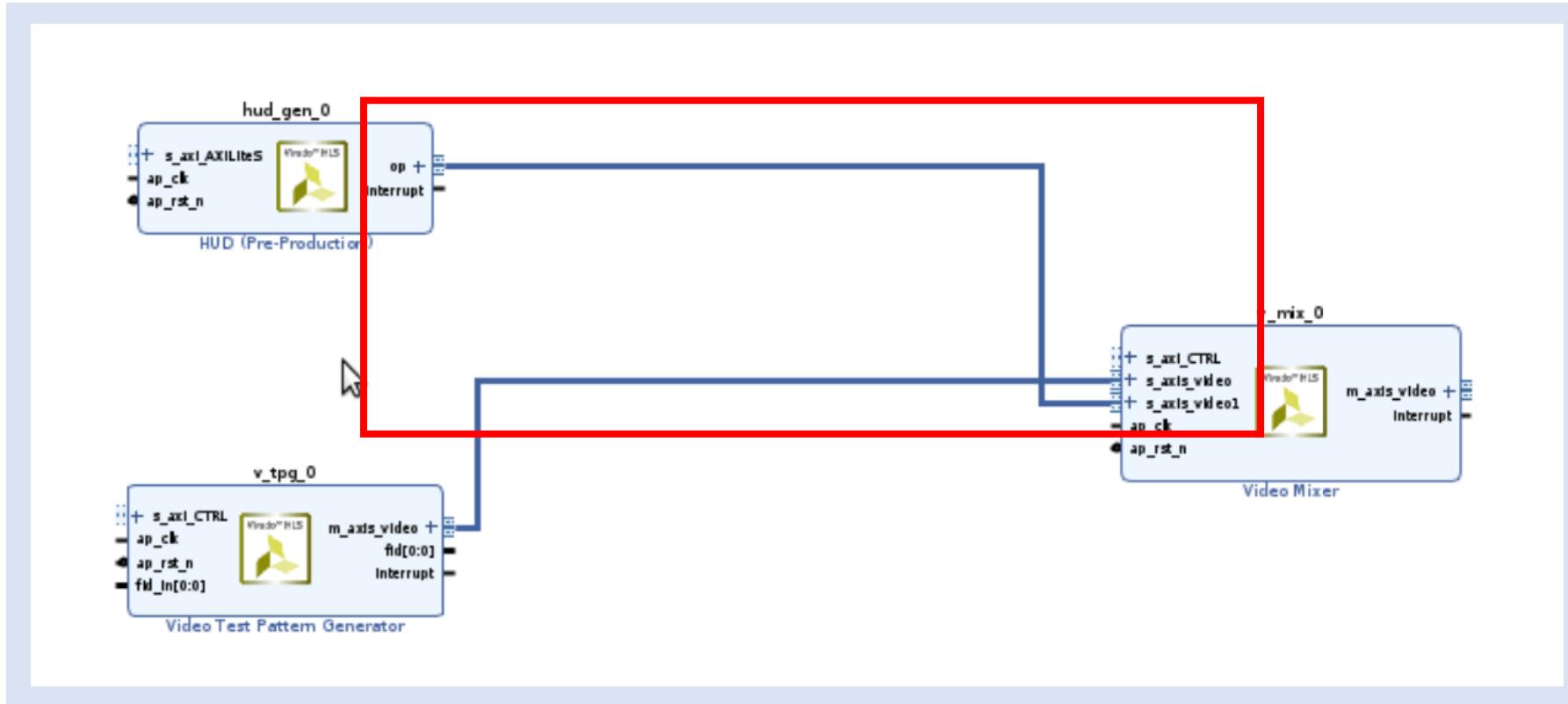
Crowd Supply: Lab One

Step 35 – Connect the Test Pattern Generator to the Stream Video in on the Video Mixer



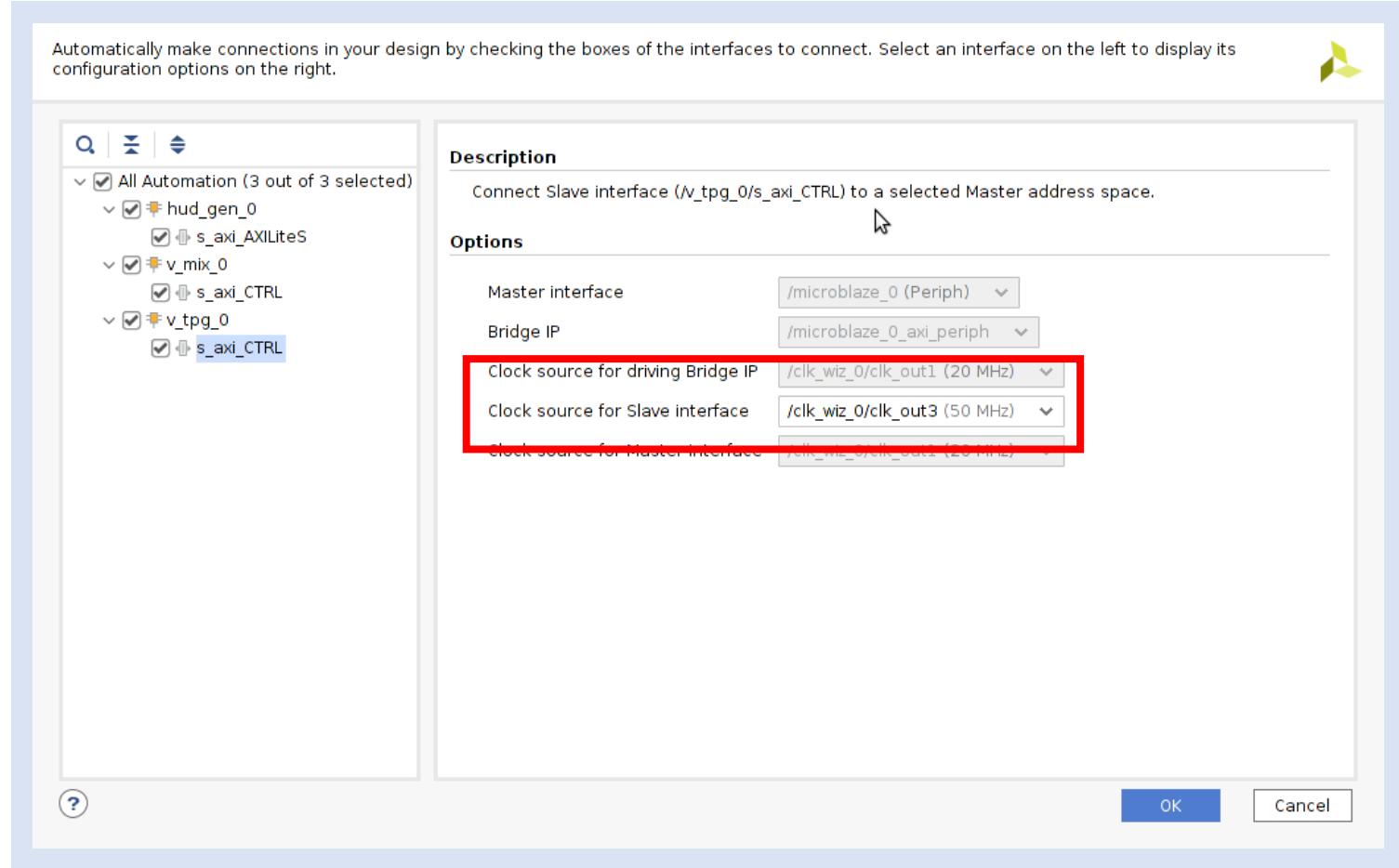
Crowd Supply: Lab One

Step 36 – Connect the HUD OP to Stream AXIS Video 1 on the Video Mixer



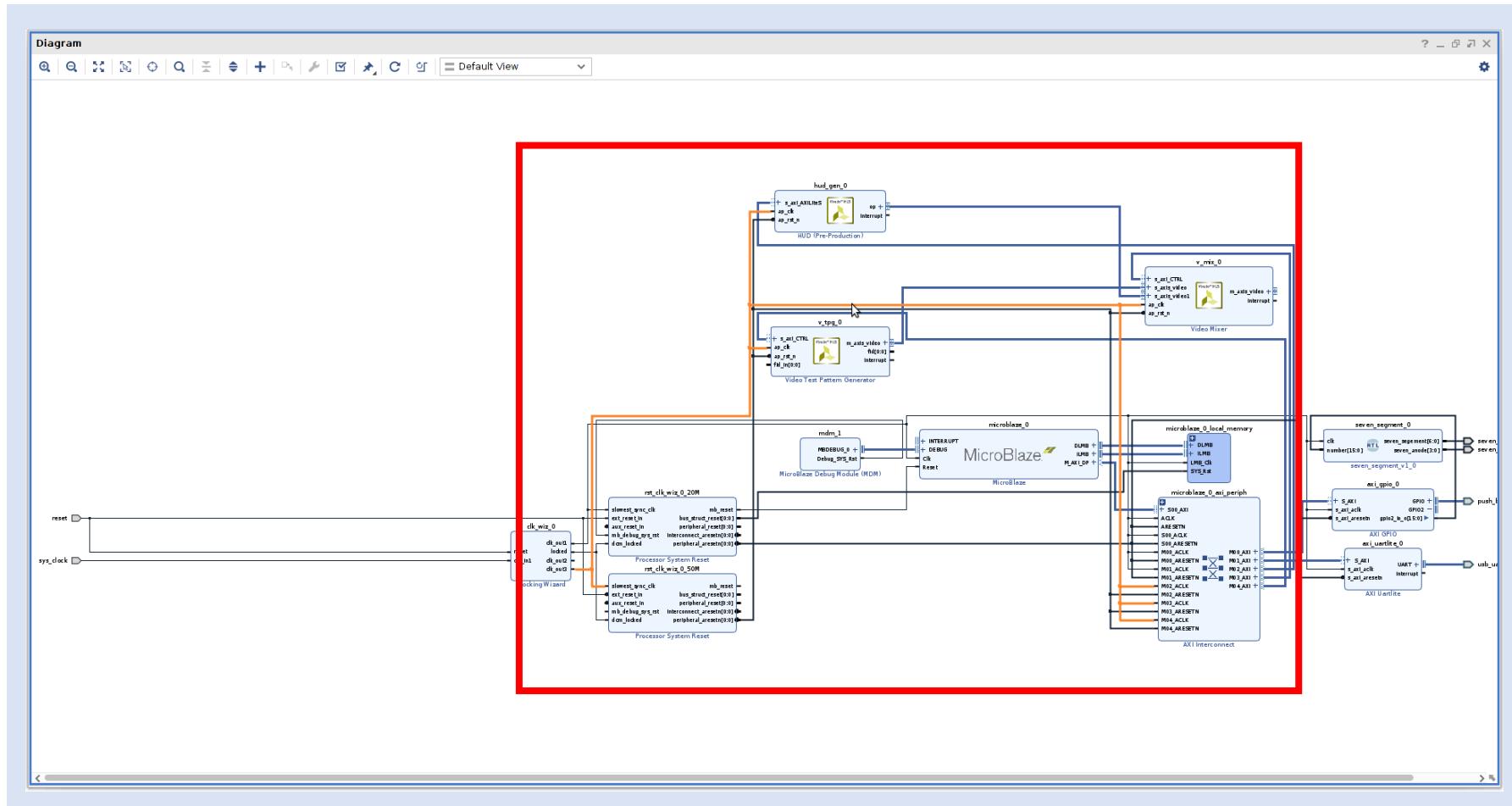
Crowd Supply: Lab One

Step 37 – Run the connection automation and for all three modules select the clock wizard OP3 50MHz



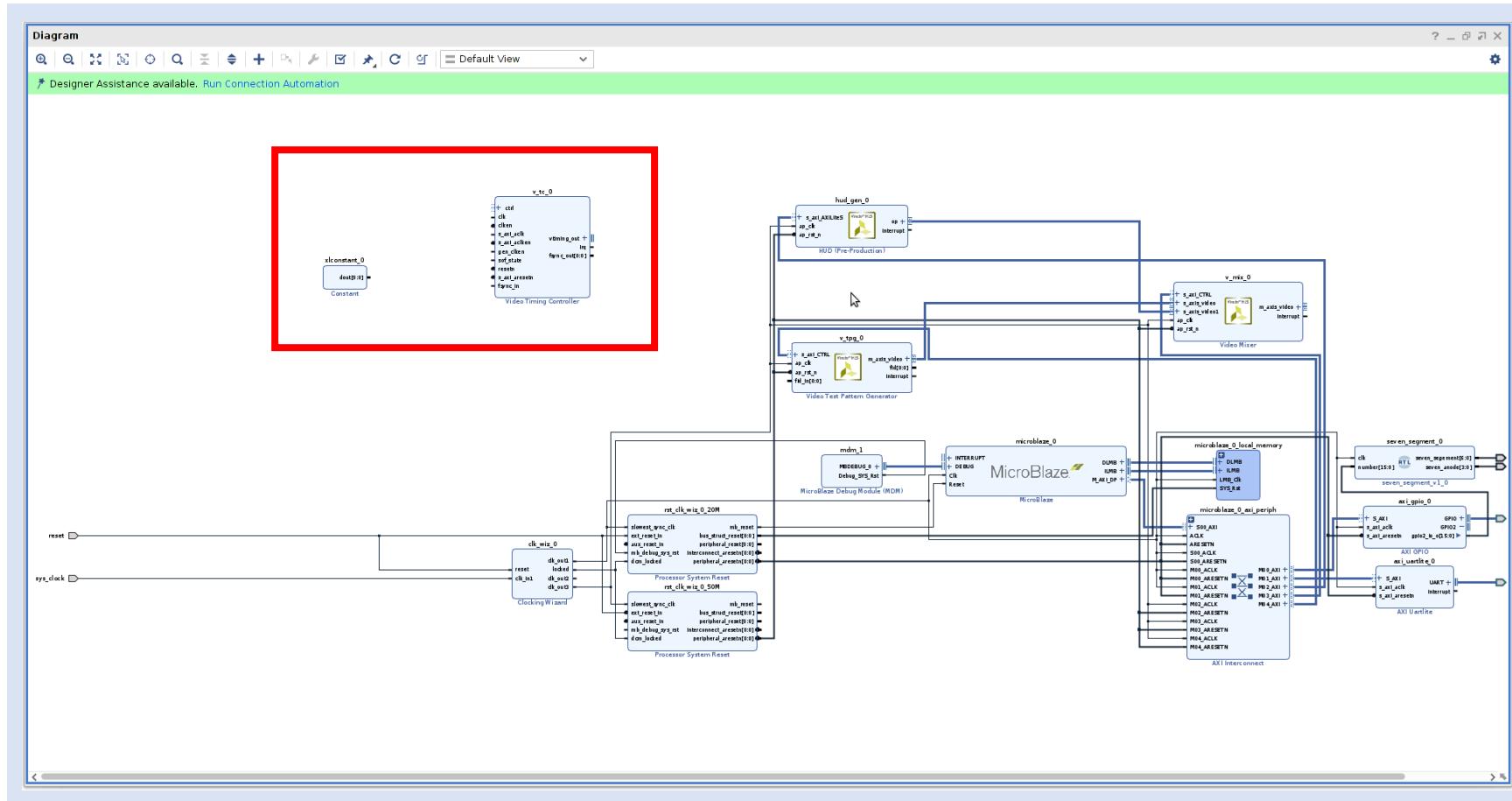
Crowd Supply: Lab One

Step 38 – Check the Clock network to the HUD, TPG and Vmixer and AXI Network are 50MHz



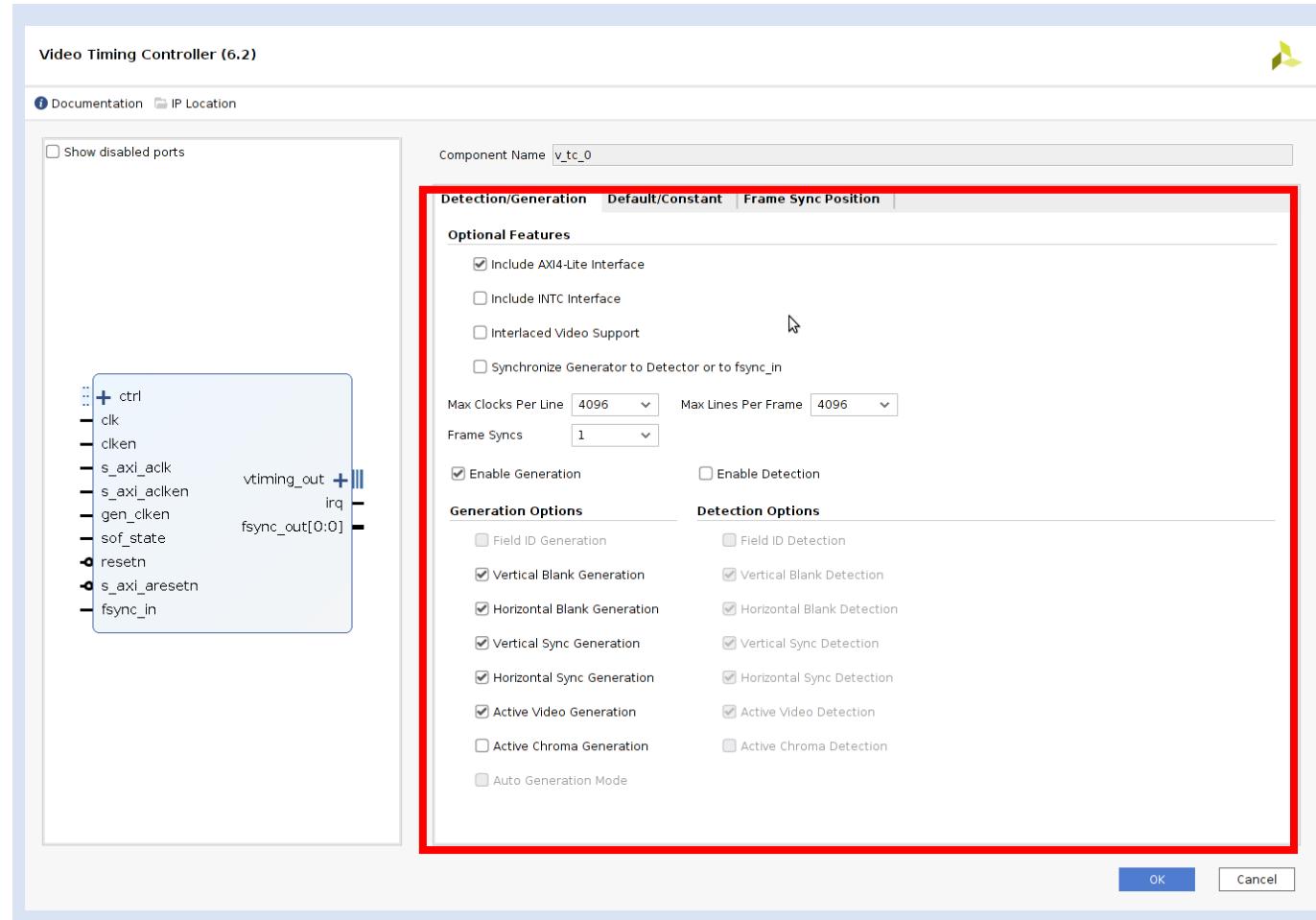
Crowd Supply: Lab One

Step 39 – Use the + button to add in a Video Timing Generator and Constant block



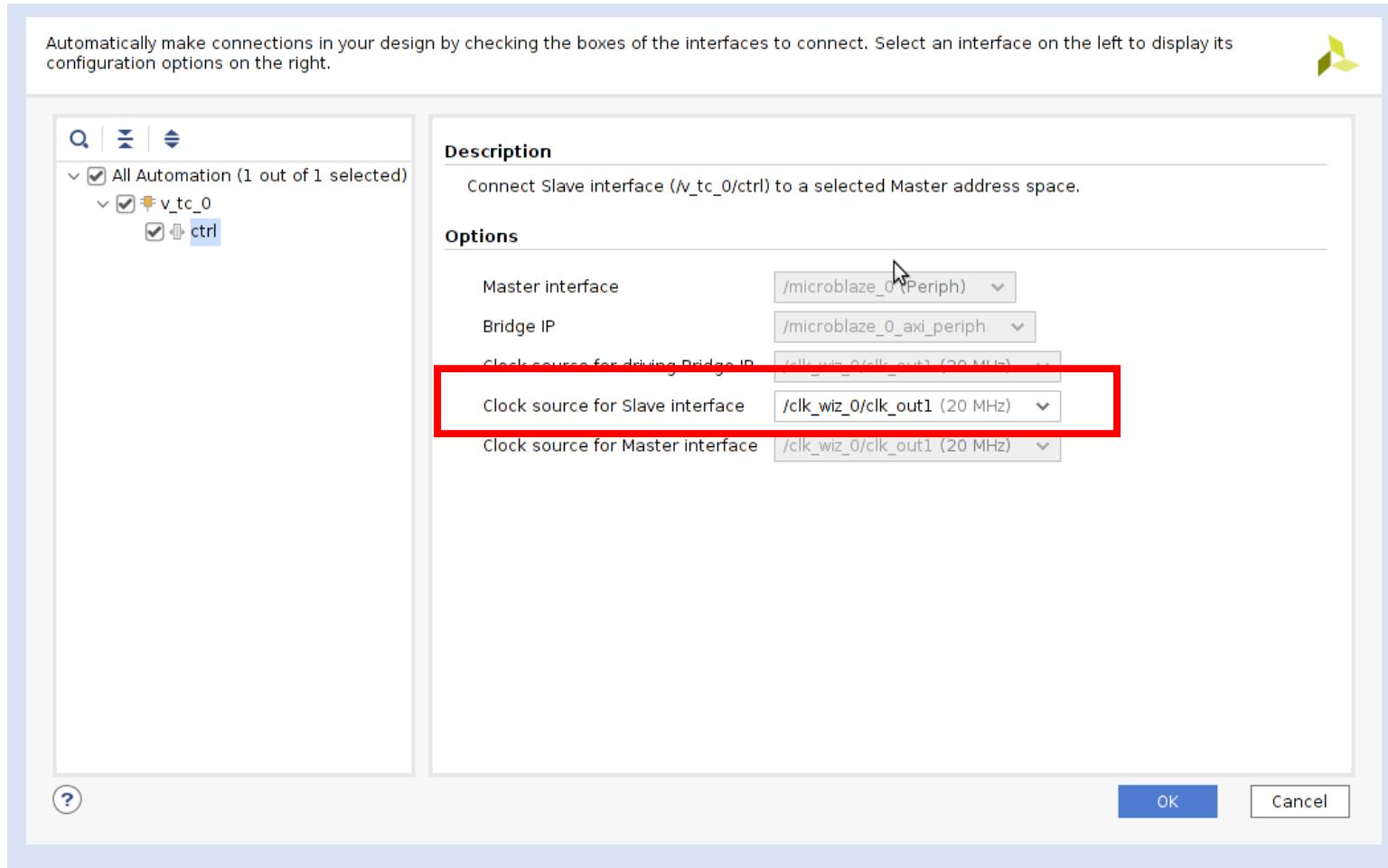
Crowd Supply: Lab One

Step 40 – Double click the Video Timing Controller on it to re-customise – as shown below



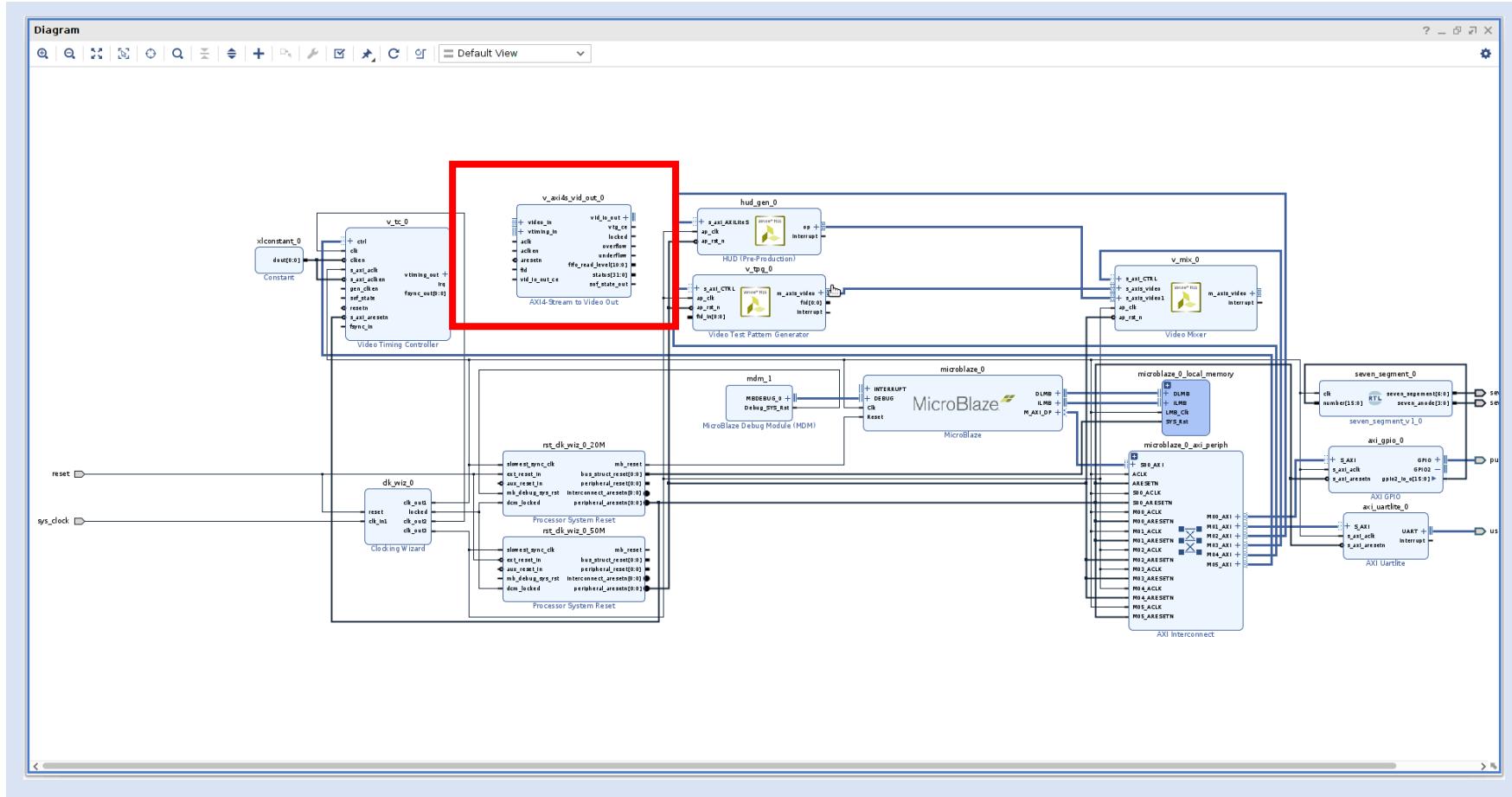
Crowd Supply: Lab One

Step 41 – Run the connection automation to connect the VTC into the AXI Network – Ensure the clock is Clock 1 20MHz



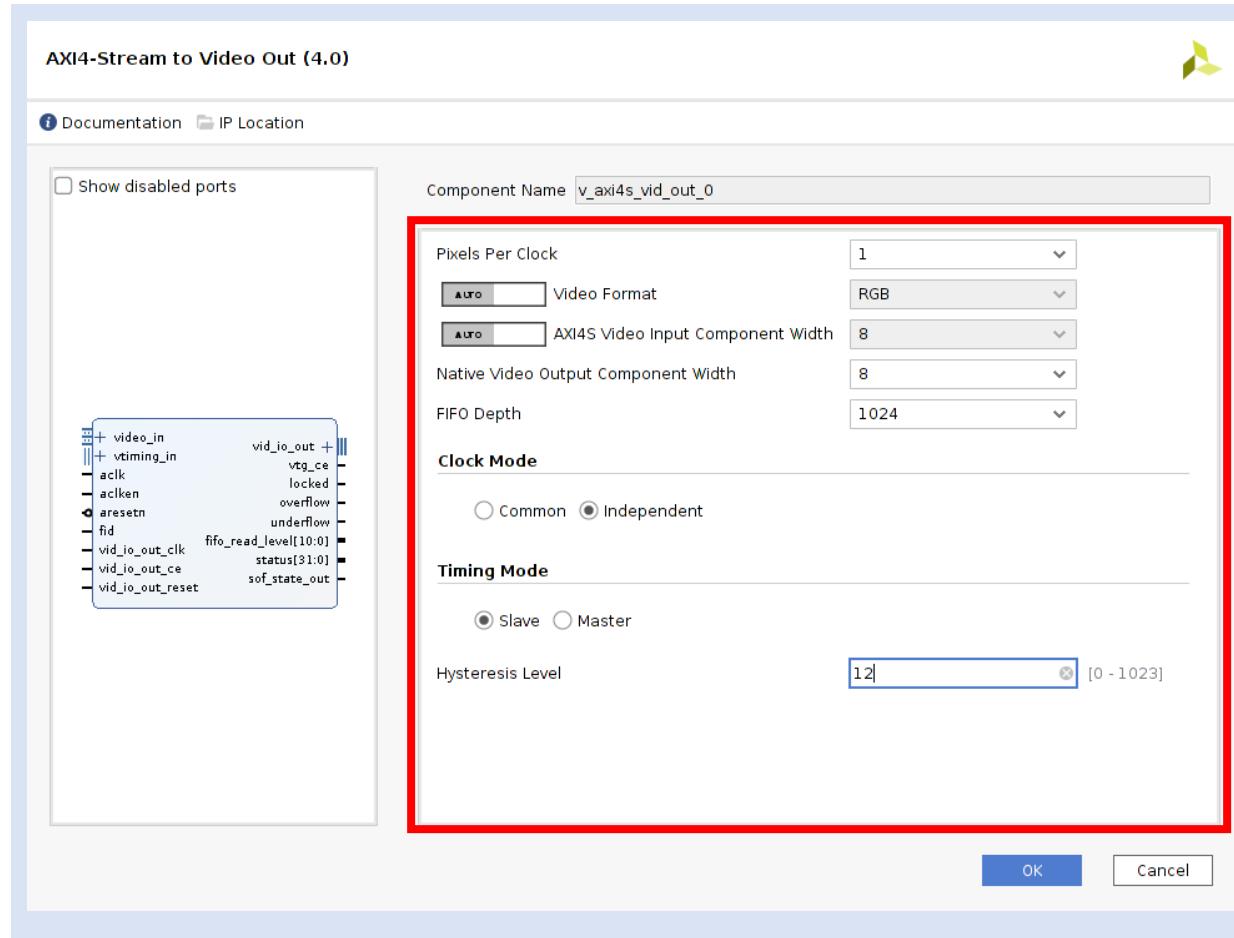
Crowd Supply: Lab One

Step 42 – Add in a AXI Stream to Video Out IP block



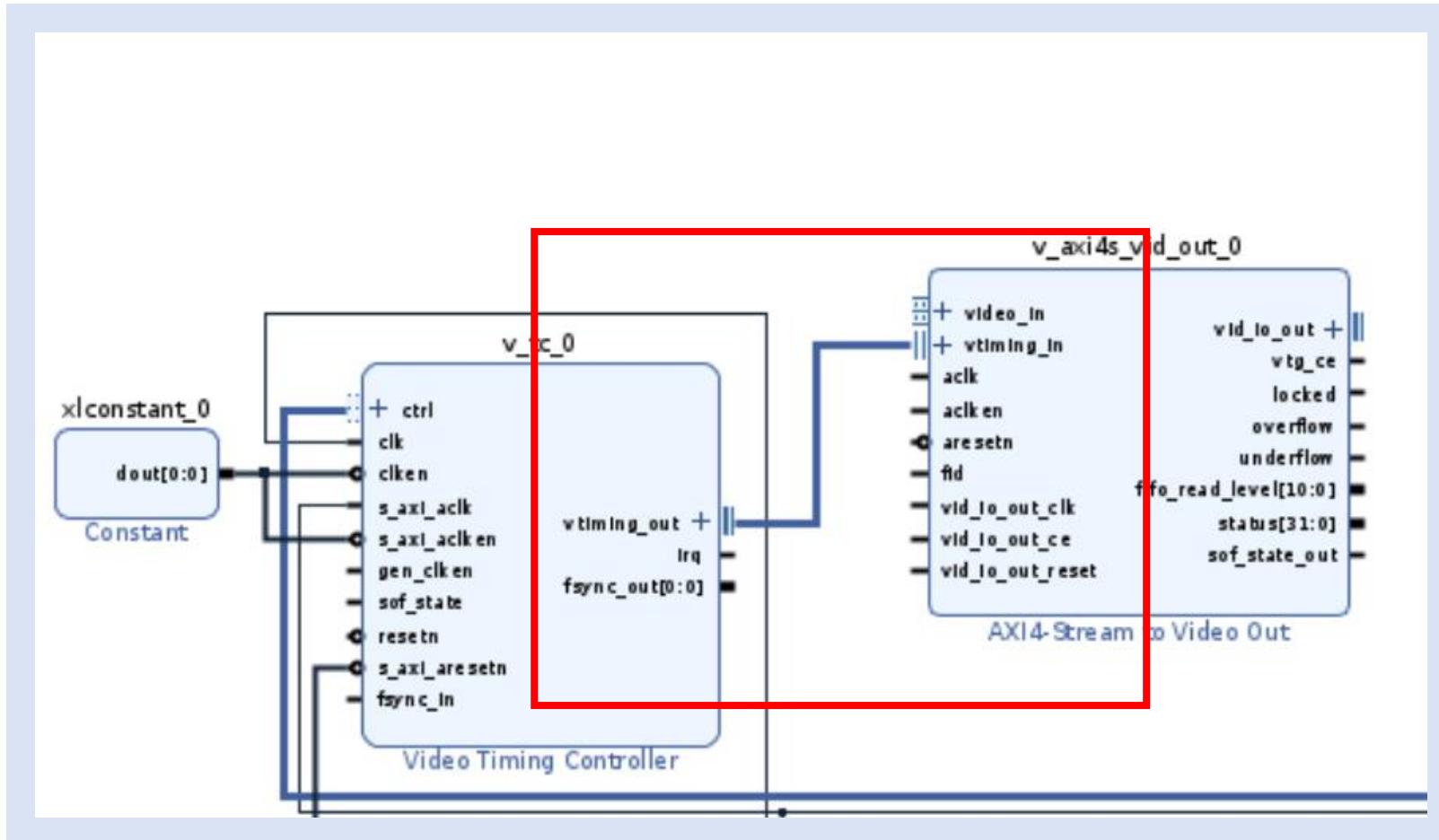
Crowd Supply: Lab One

Step 43 – Double click to re-cusomtise the AXI Stream to video out block and configure it as below



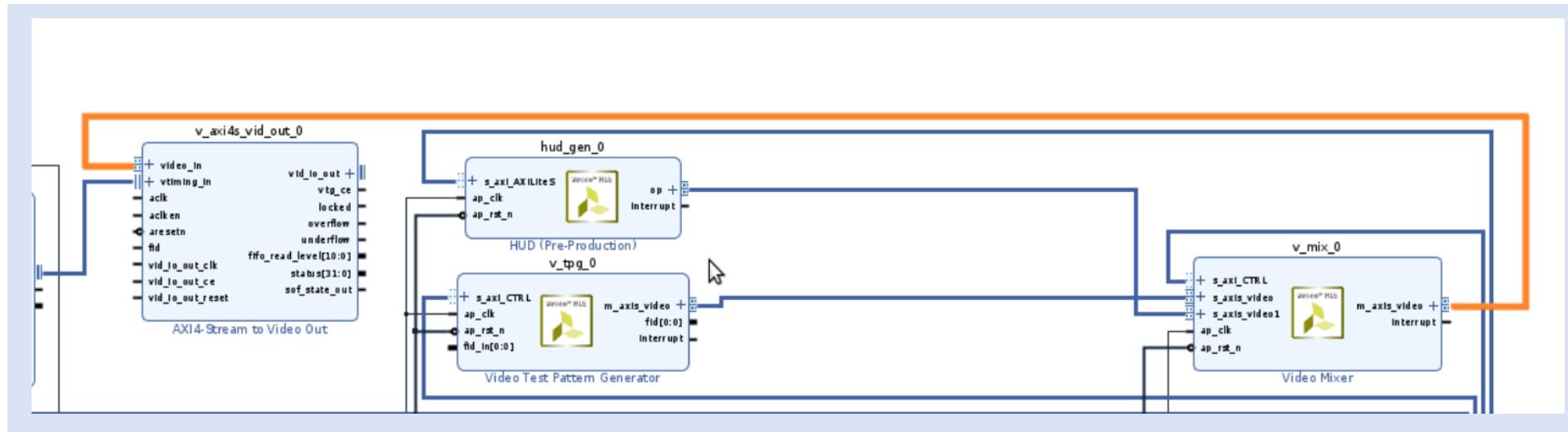
Crowd Supply: Lab One

Step 44 – Connect the Vtiming Out to the Vtiming In of the VTC and AXIS to Video Out



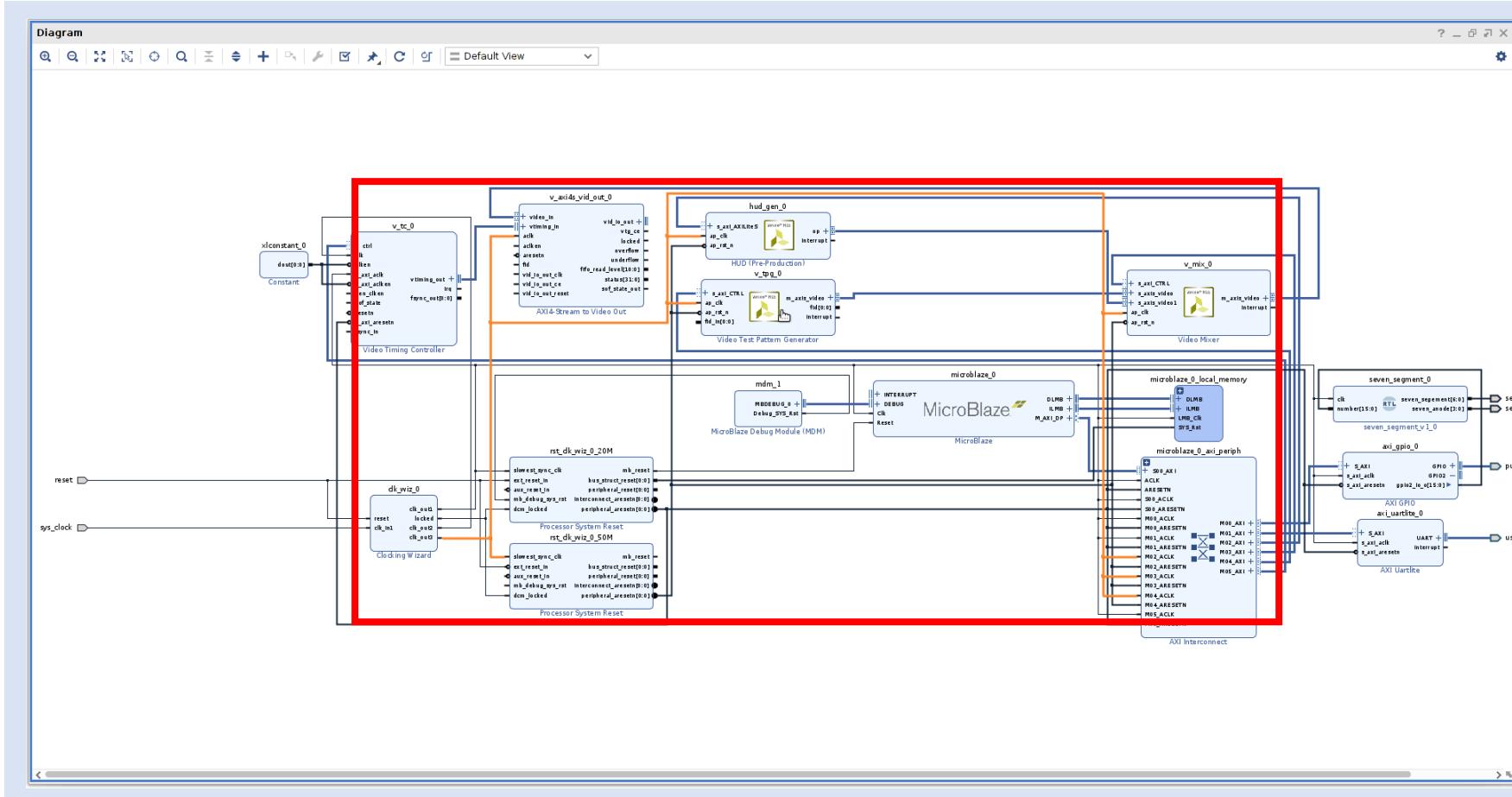
Crowd Supply: Lab One

Step 45 – Connect the output of the Video Mixer to the AXIS Video Out Input



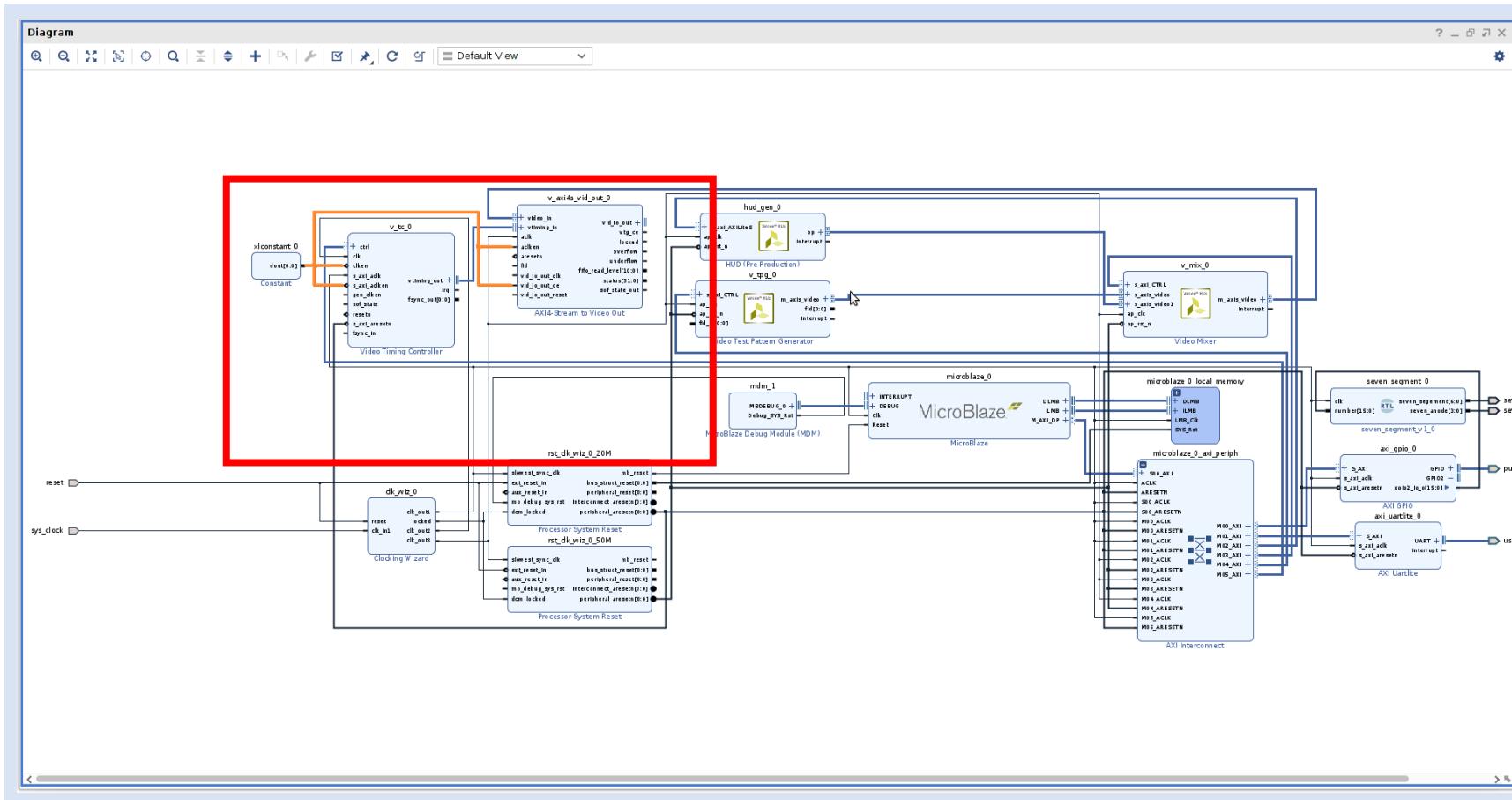
Crowd Supply: Lab One

Step 46 – Connect the clock out 3 to the ack of the AXIS Video Out IP Block



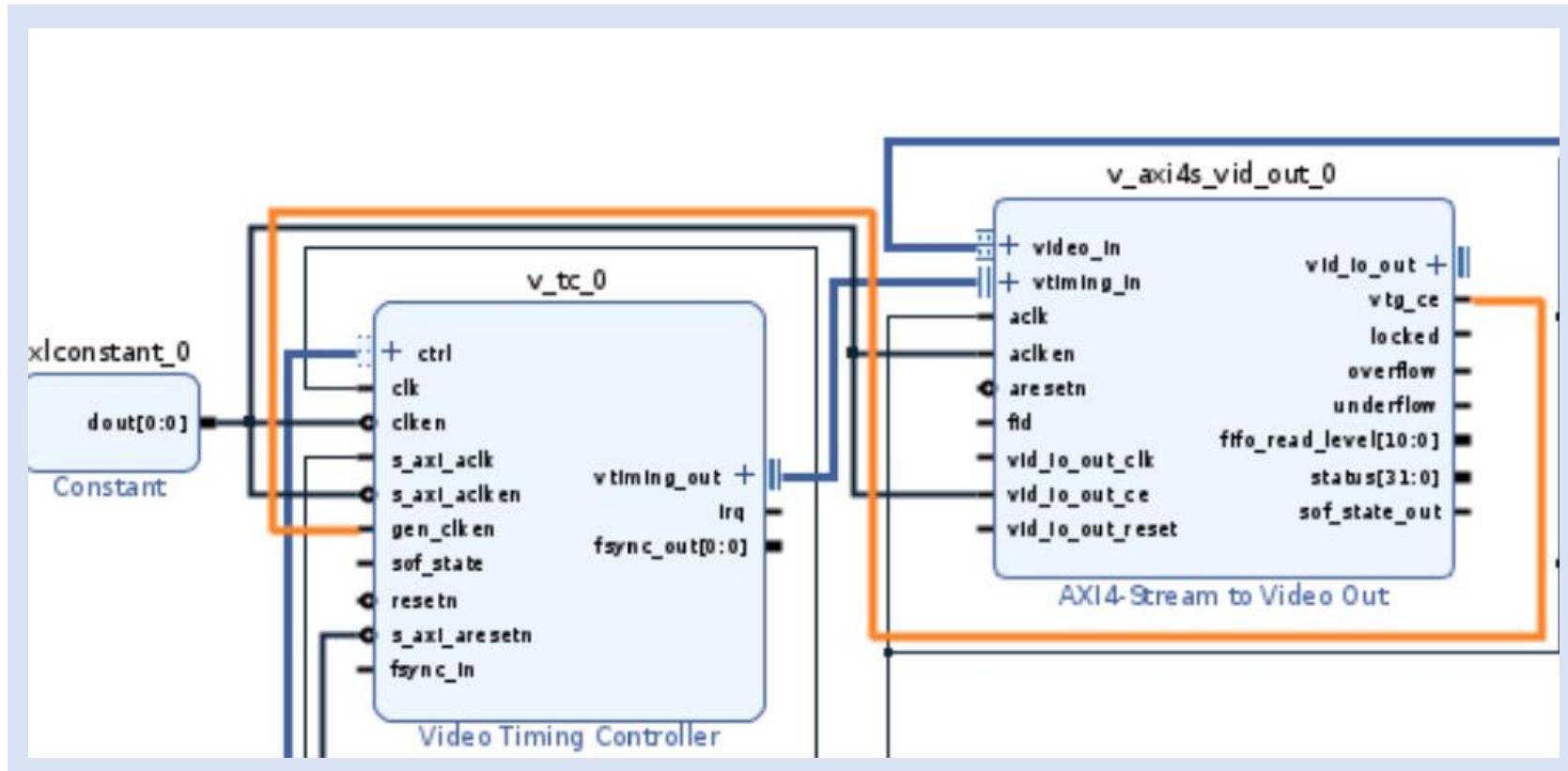
Crowd Supply: Lab One

Step 47 – Connect the constant block to the VTC clken & SAXI_aclk_en and aclken & vid_io_out_ce on the AXIS video out



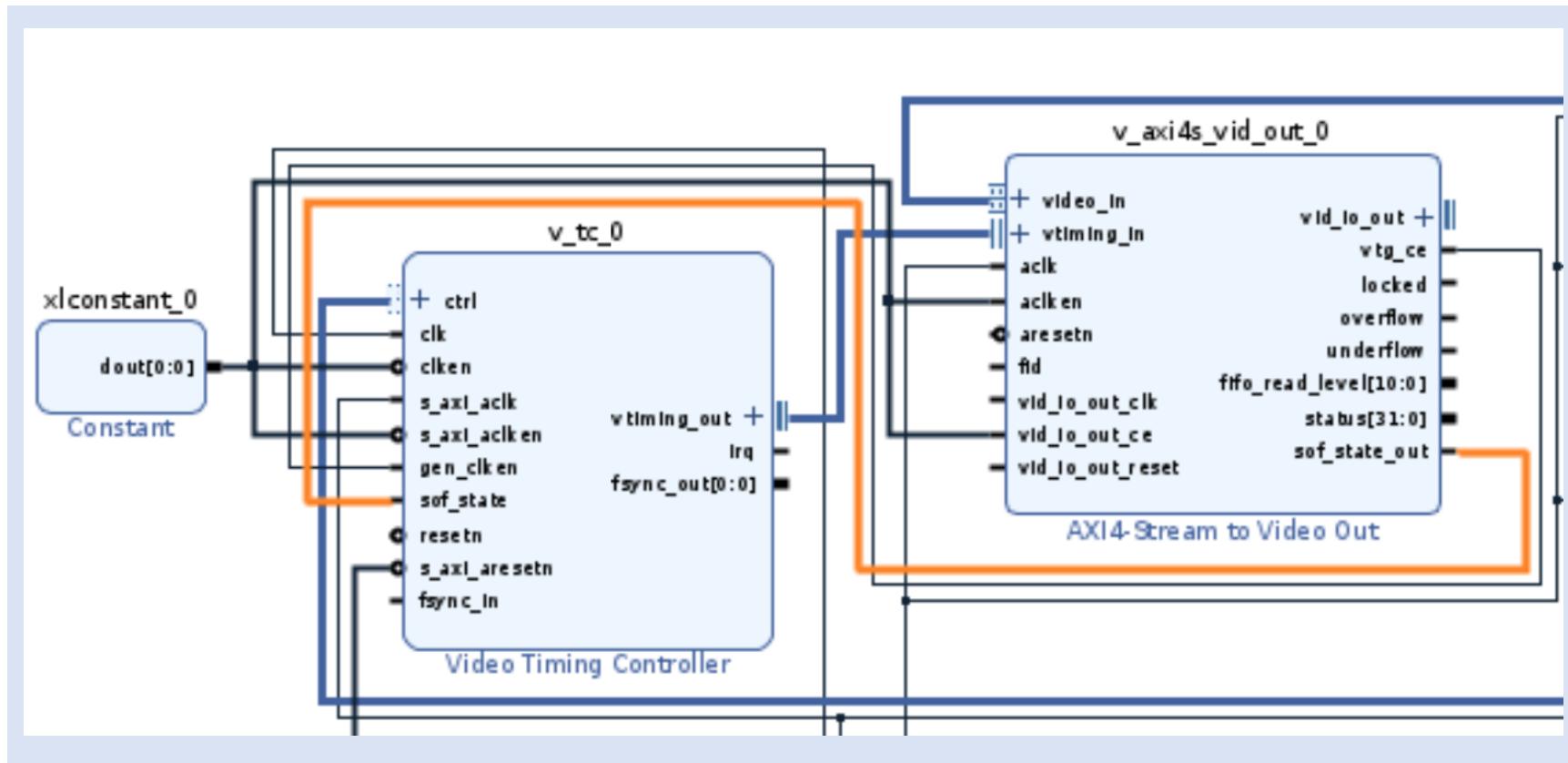
Crowd Supply: Lab One

Step 48 – Connect vtg_ce to gen_clken



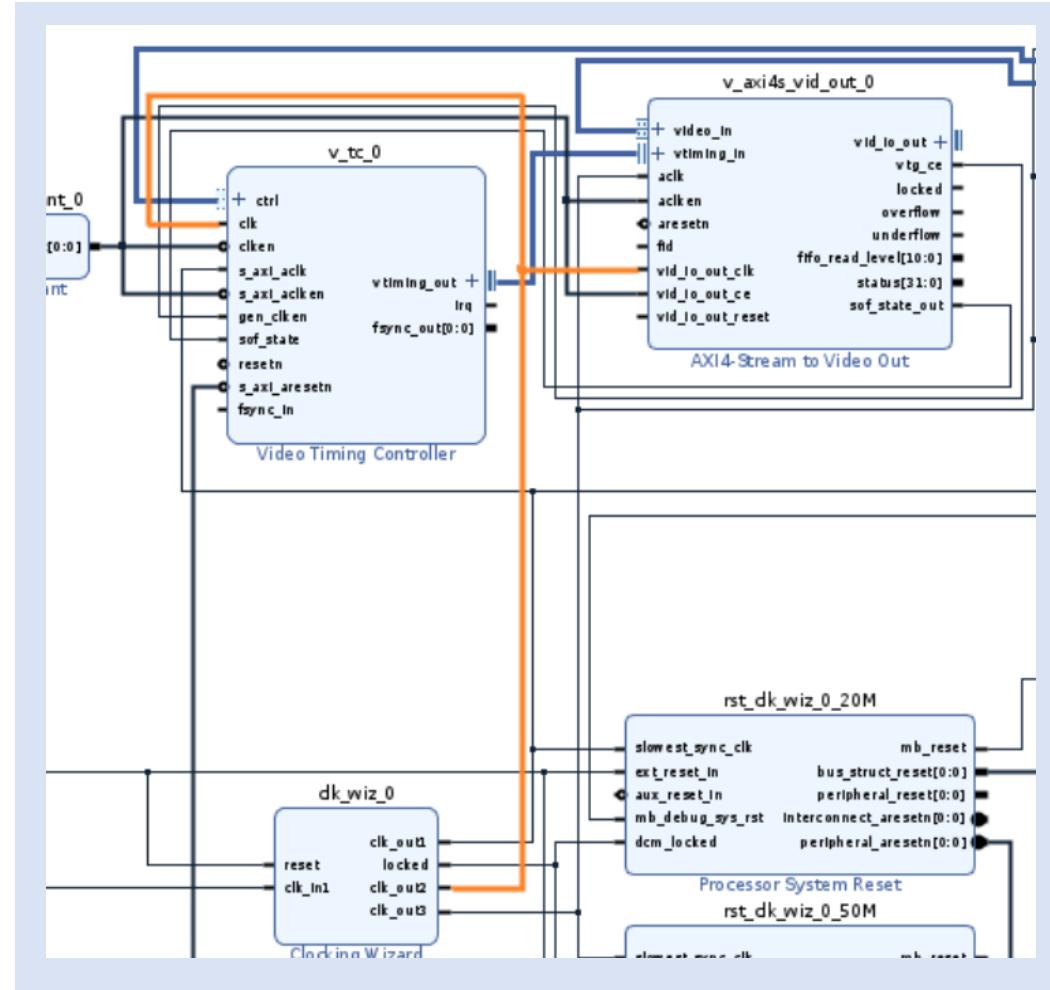
Crowd Supply: Lab One

Step 49 – Connect sof_state_out to sof_state



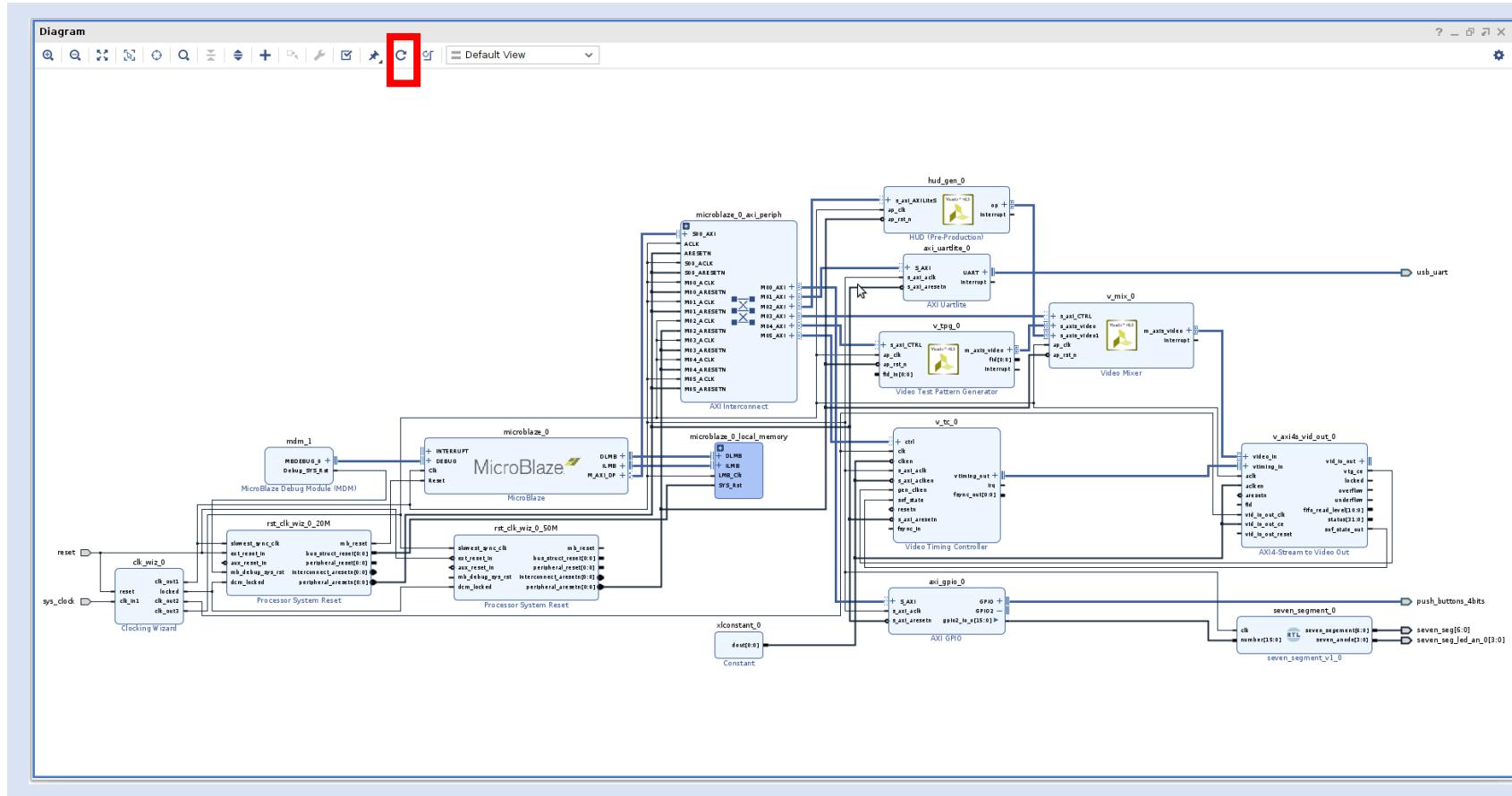
Crowd Supply: Lab One

Step 50 – Connect Clock 2 (25MHz) to the clk of the VTC and vid_io_out_clk on the AXIS video out



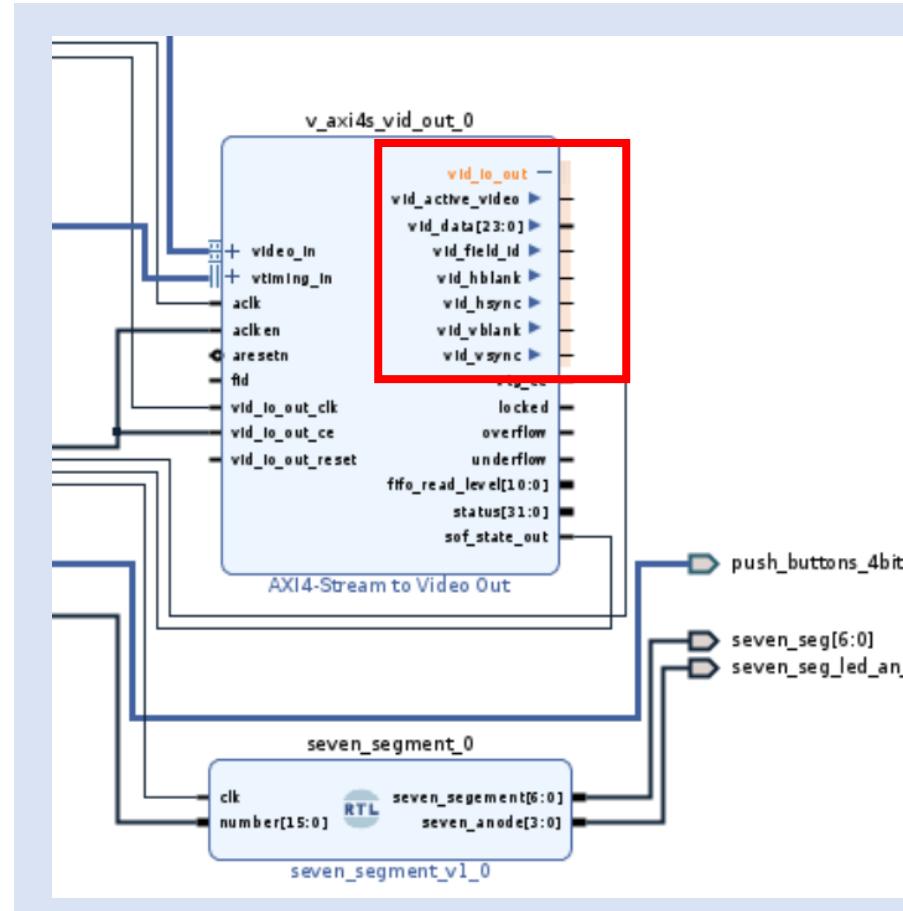
Crowd Supply: Lab One

Step 51 – Click on regenerate layout to make the diagram more understandable



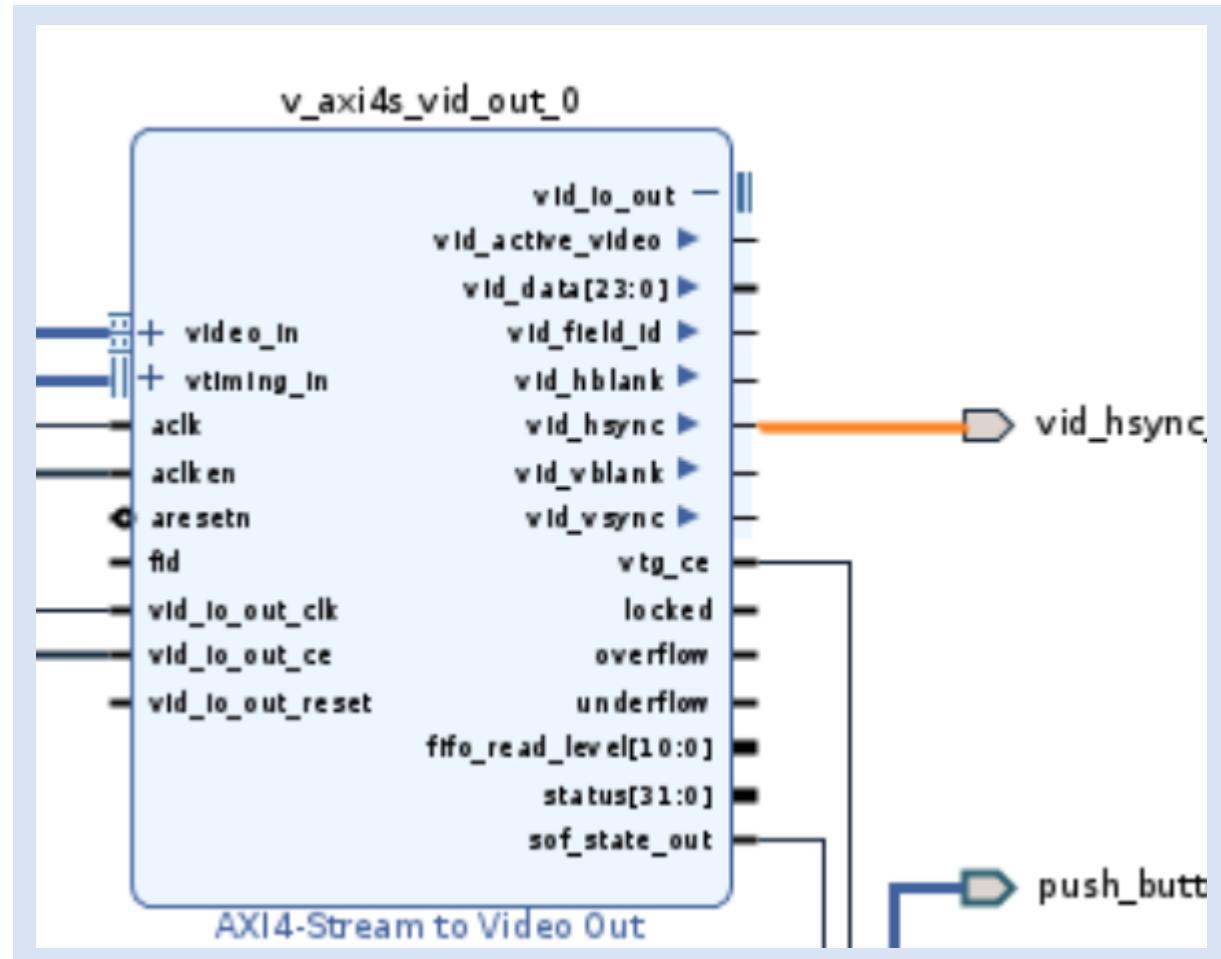
Crowd Supply: Lab One

Step 52 – Expand the vid_io_out on the AXIS Video Out block



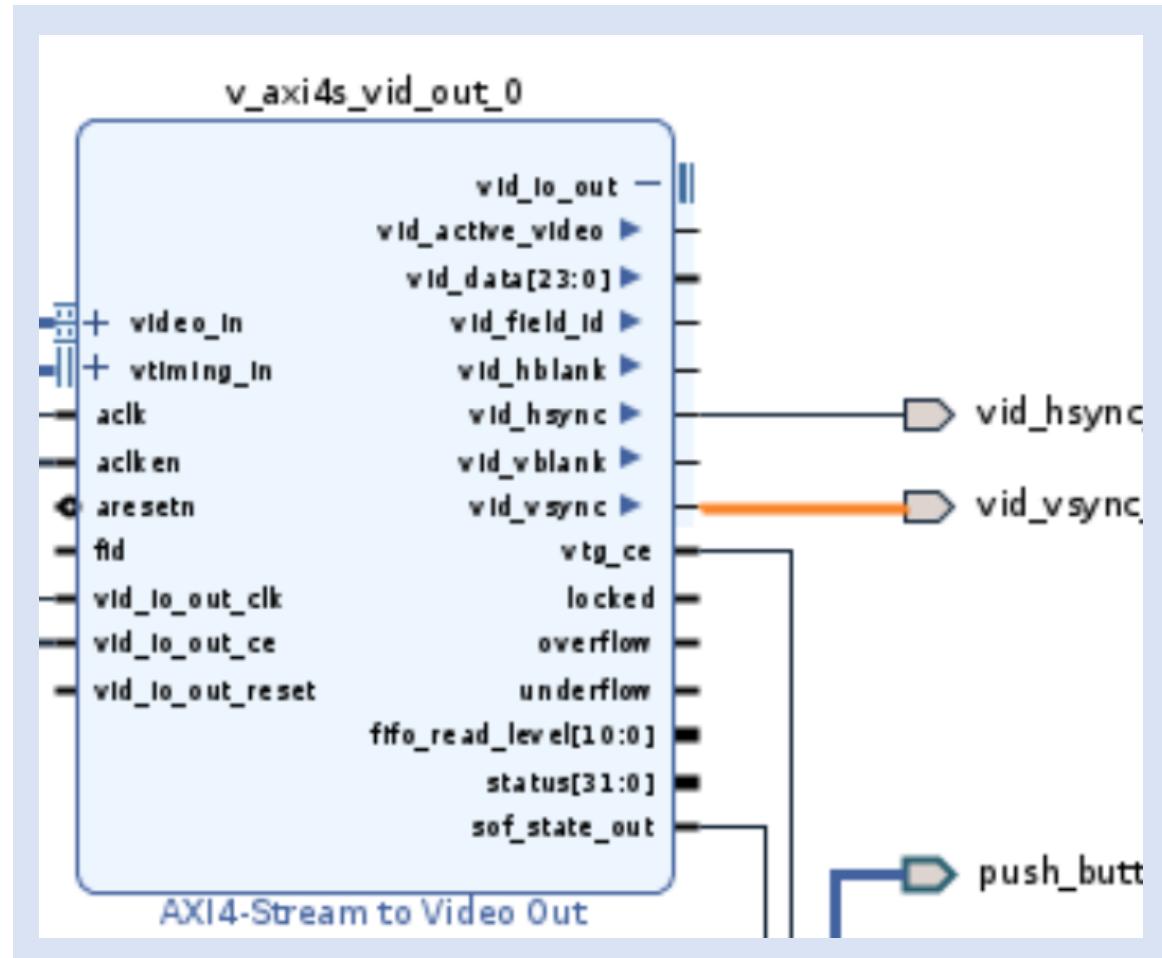
Crowd Supply: Lab One

Step 53 – Make the Vid_hsync external and re-name it Hsync



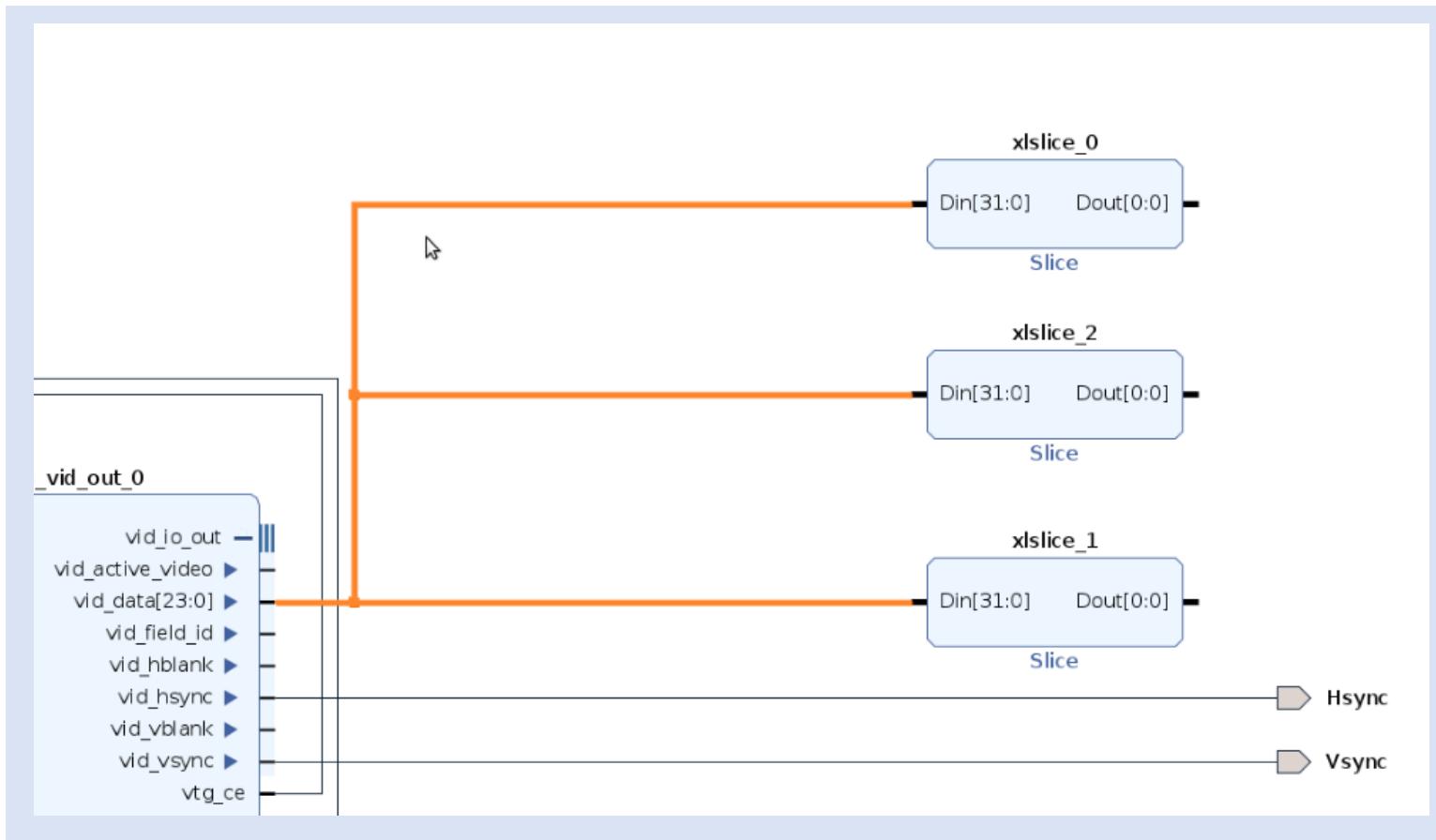
Crowd Supply: Lab One

Step 54 – Make the Vid_vsync external and re-name it Vsync



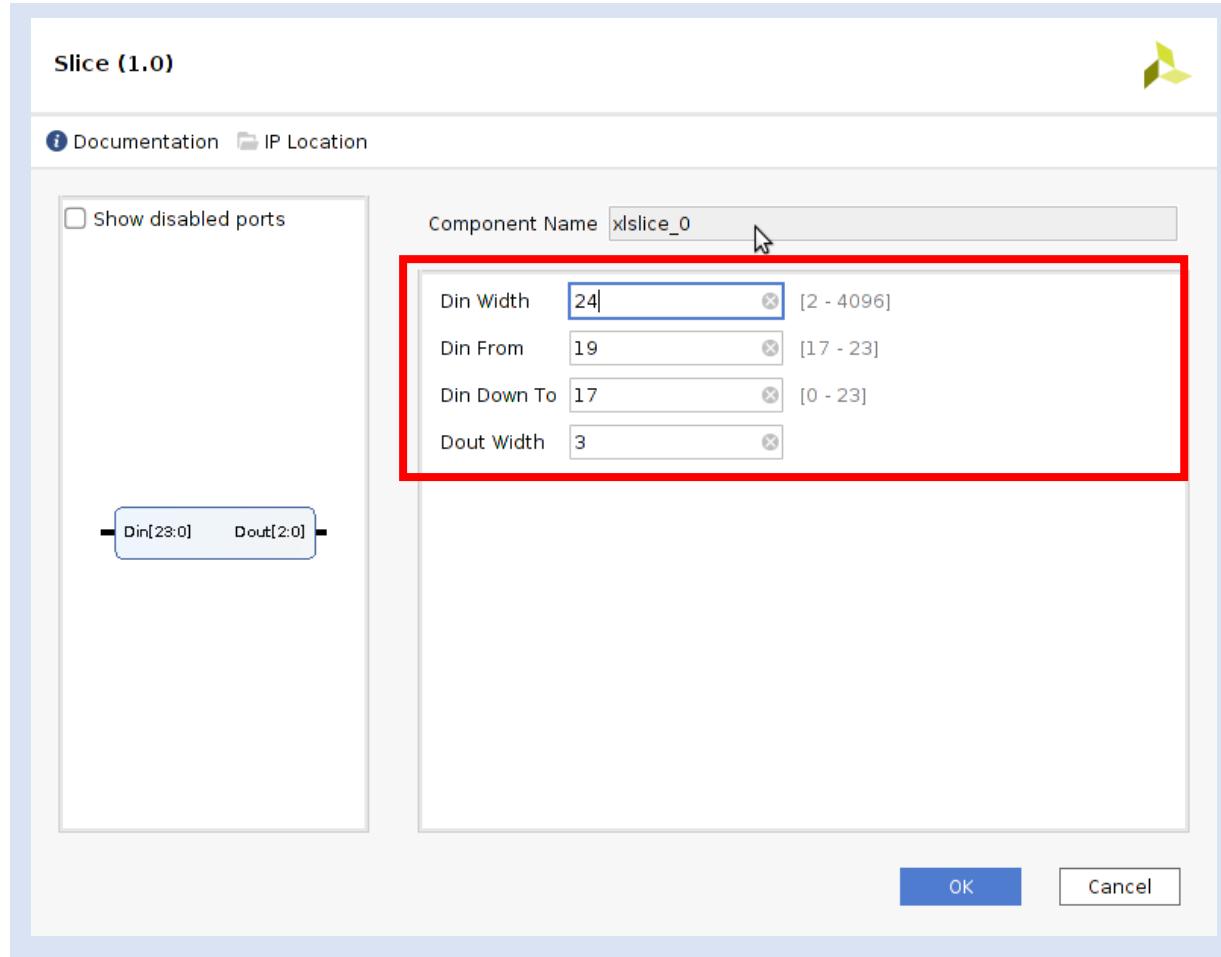
Crowd Supply: Lab One

Step 55 – Add in three slices and connect them to the Vid_data output



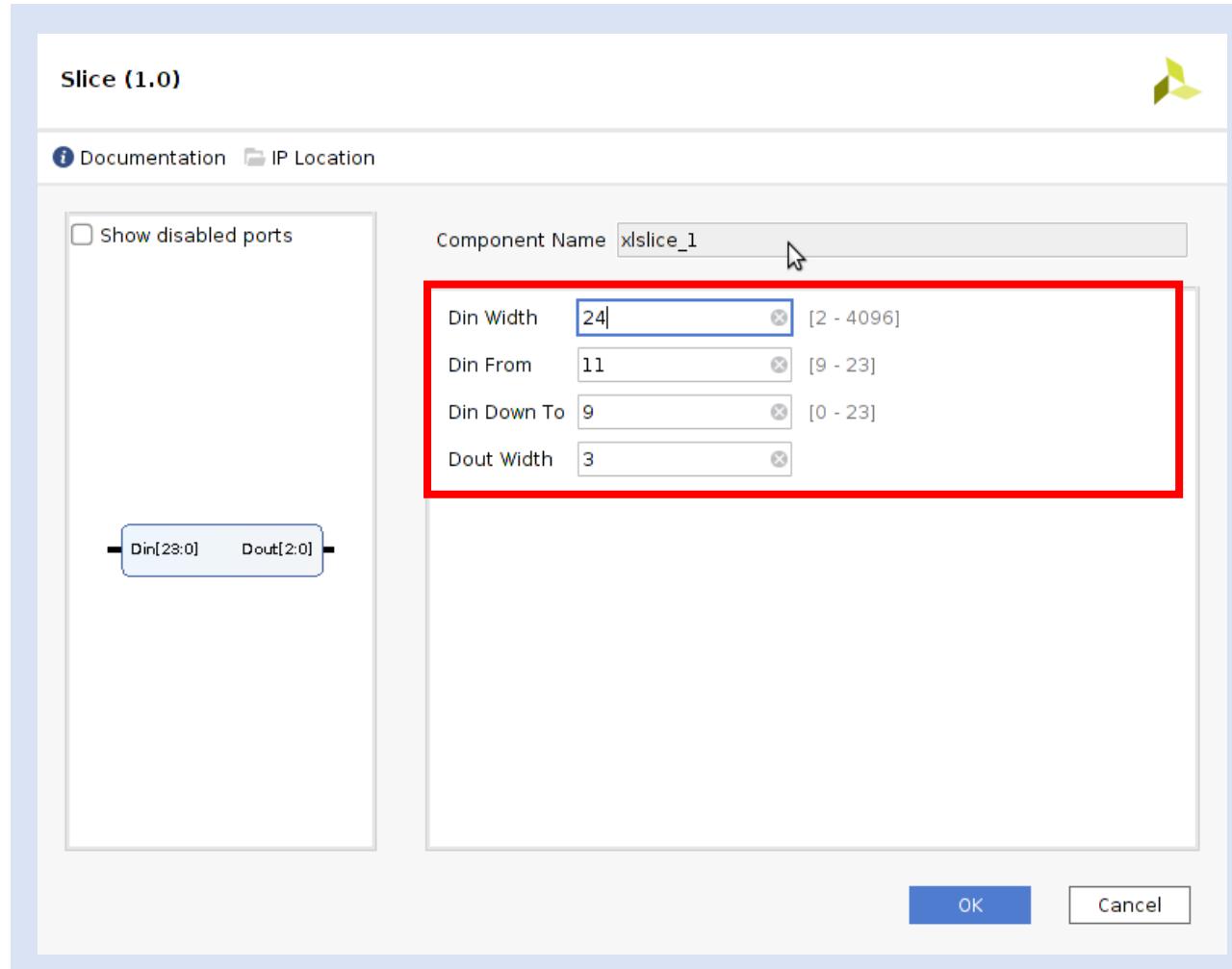
Crowd Supply: Lab One

Step 56 – Re-customize Slice 0 with the settings as below



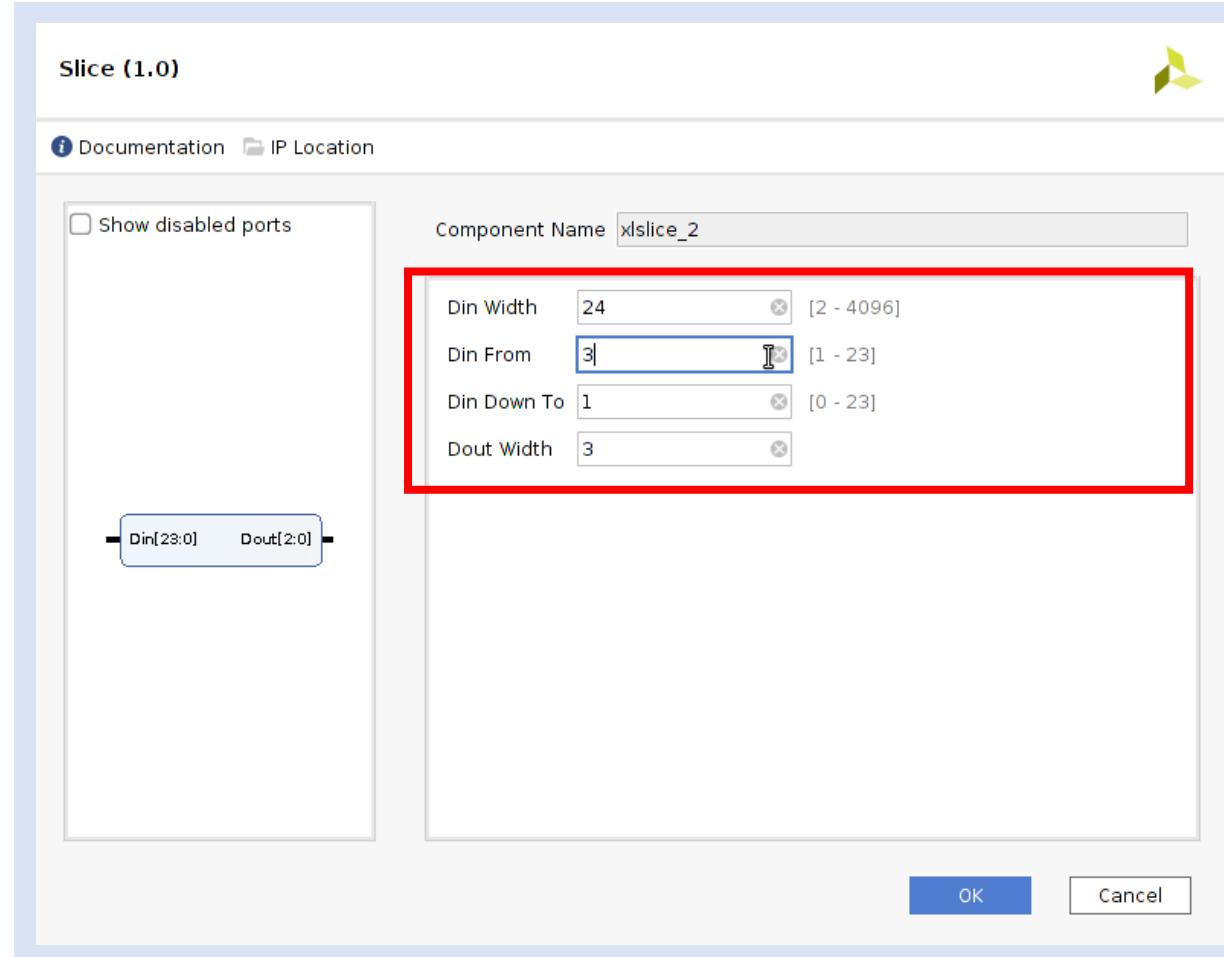
Crowd Supply: Lab One

Step 57 – Re-customize Slice 1 with the settings as below



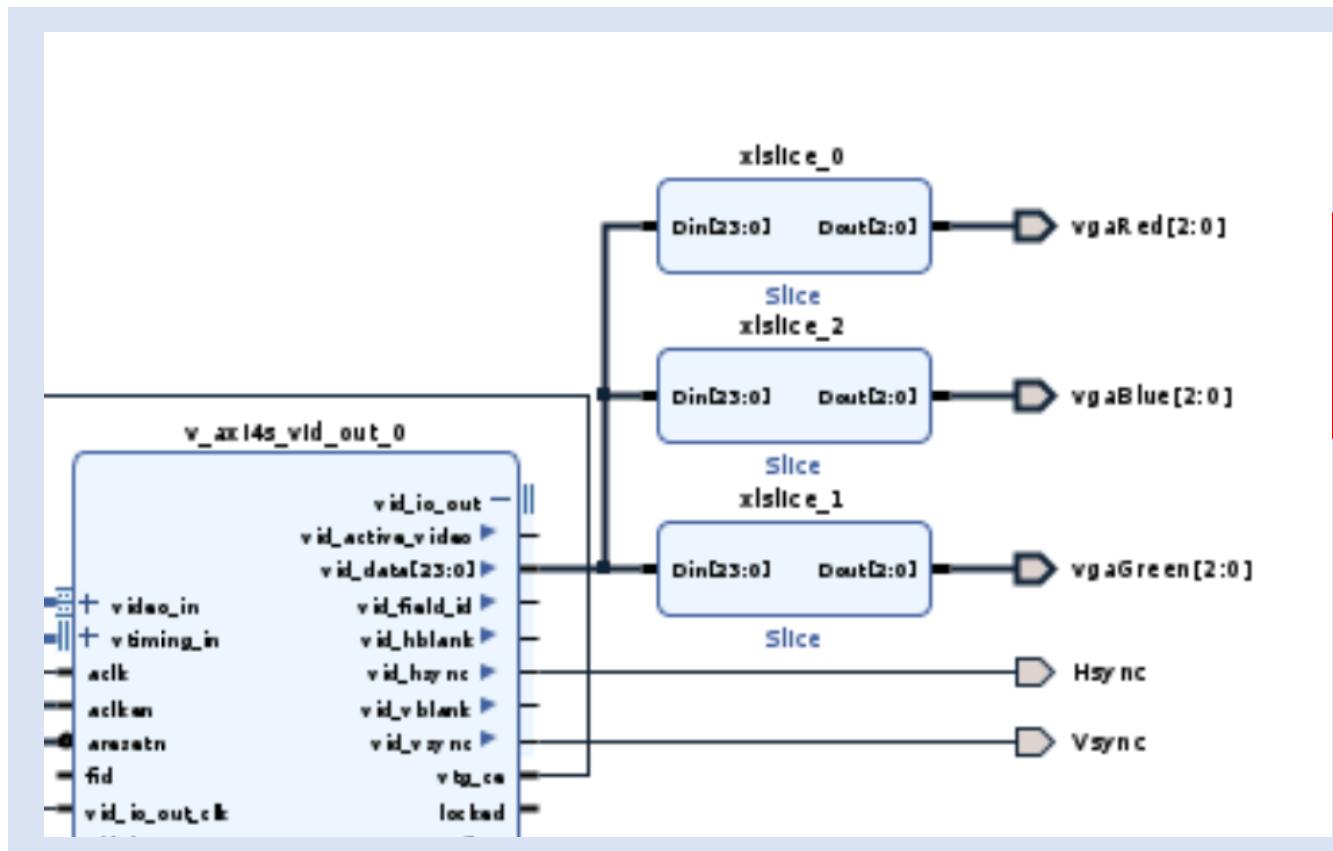
Crowd Supply: Lab One

Step 58 – Re-customize Slice 2 with the settings as below



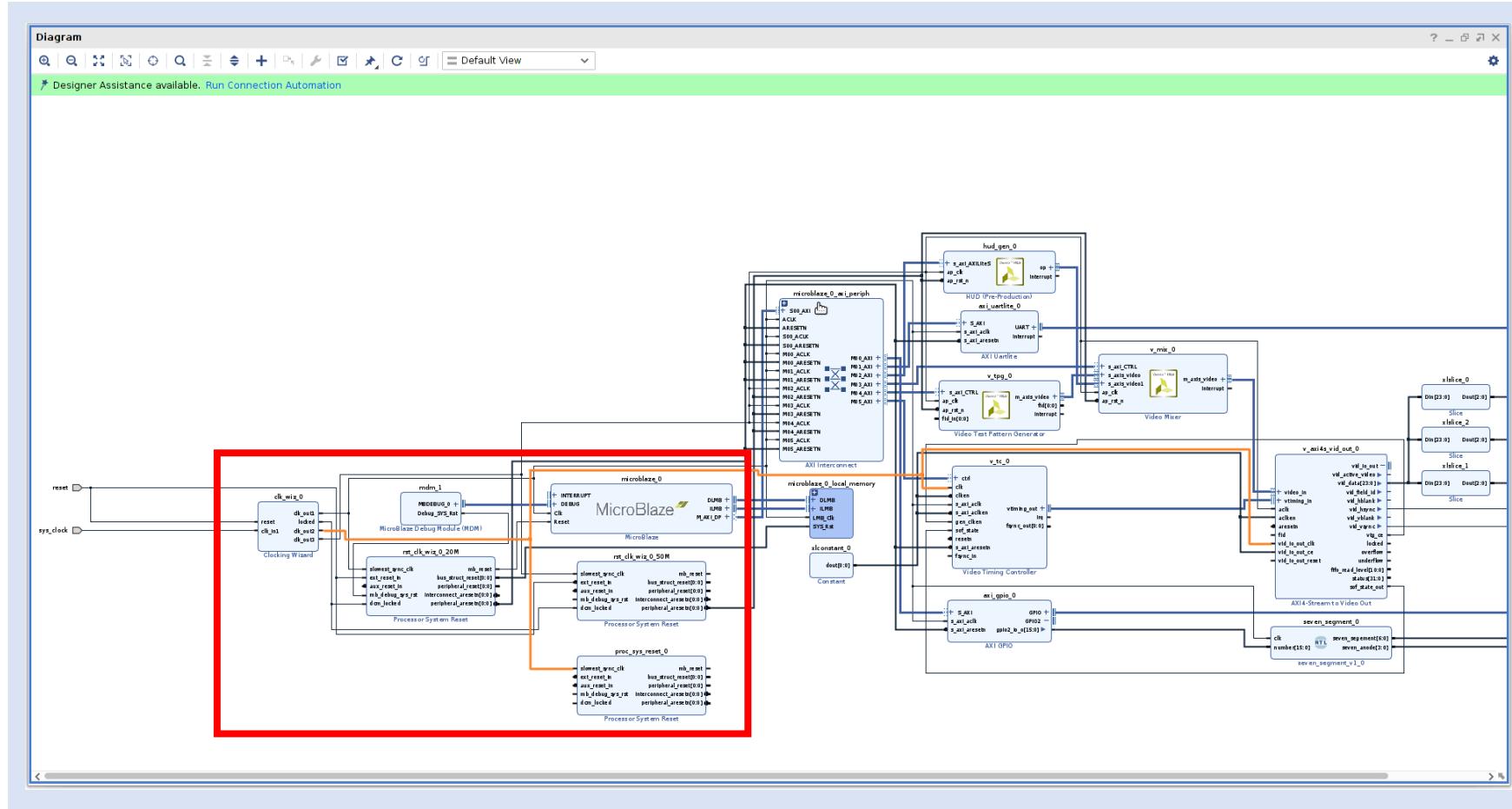
Crowd Supply: Lab One

Step 59 – Make the Three Slice outputs external name them Slice0 vgaRed, Slice1 vgaBlue and Slice2 vgaGreen



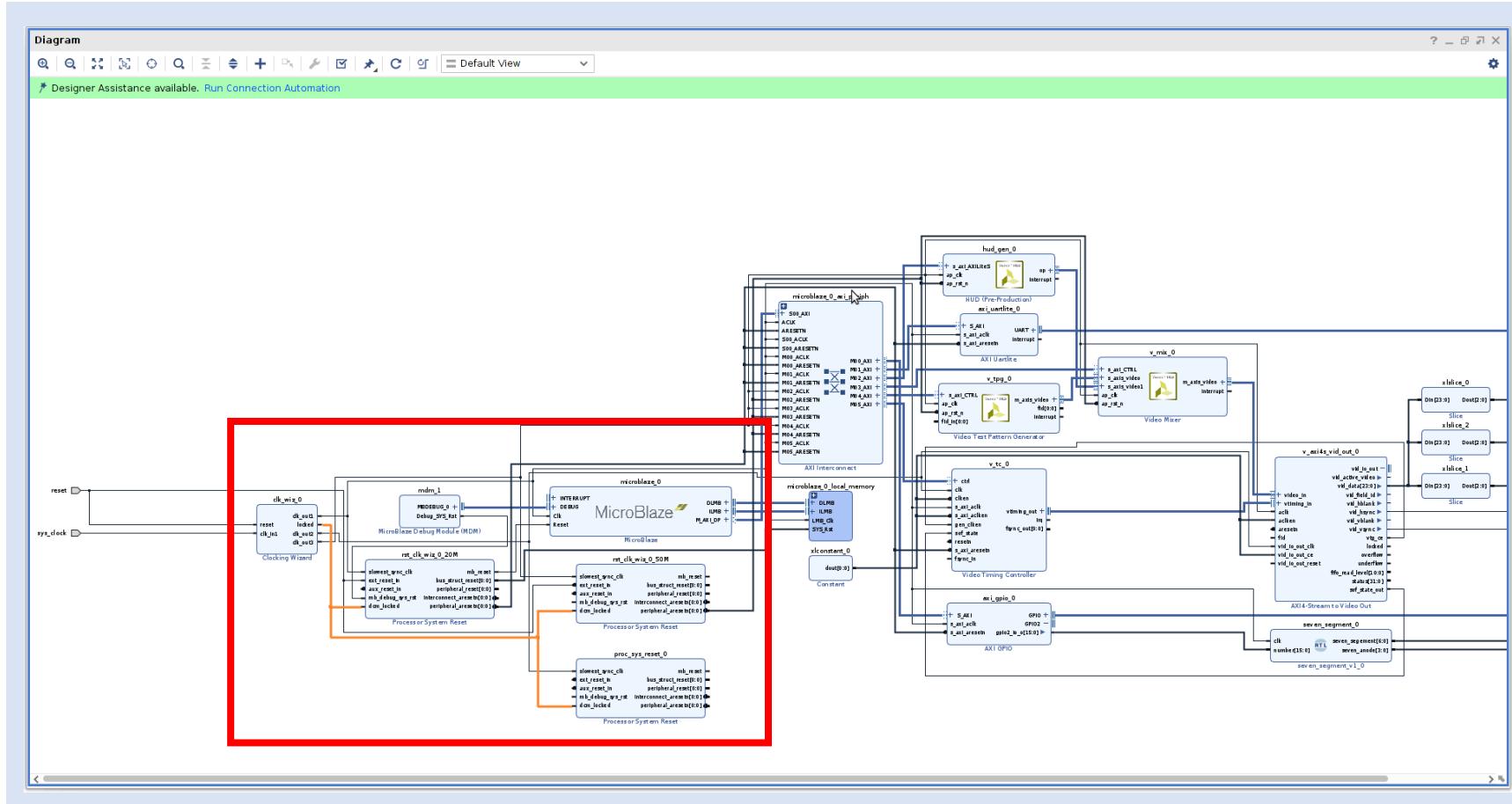
Crowd Supply: Lab One

Step 60 – Add in a New processor reset block and connect its clock input to clock 2



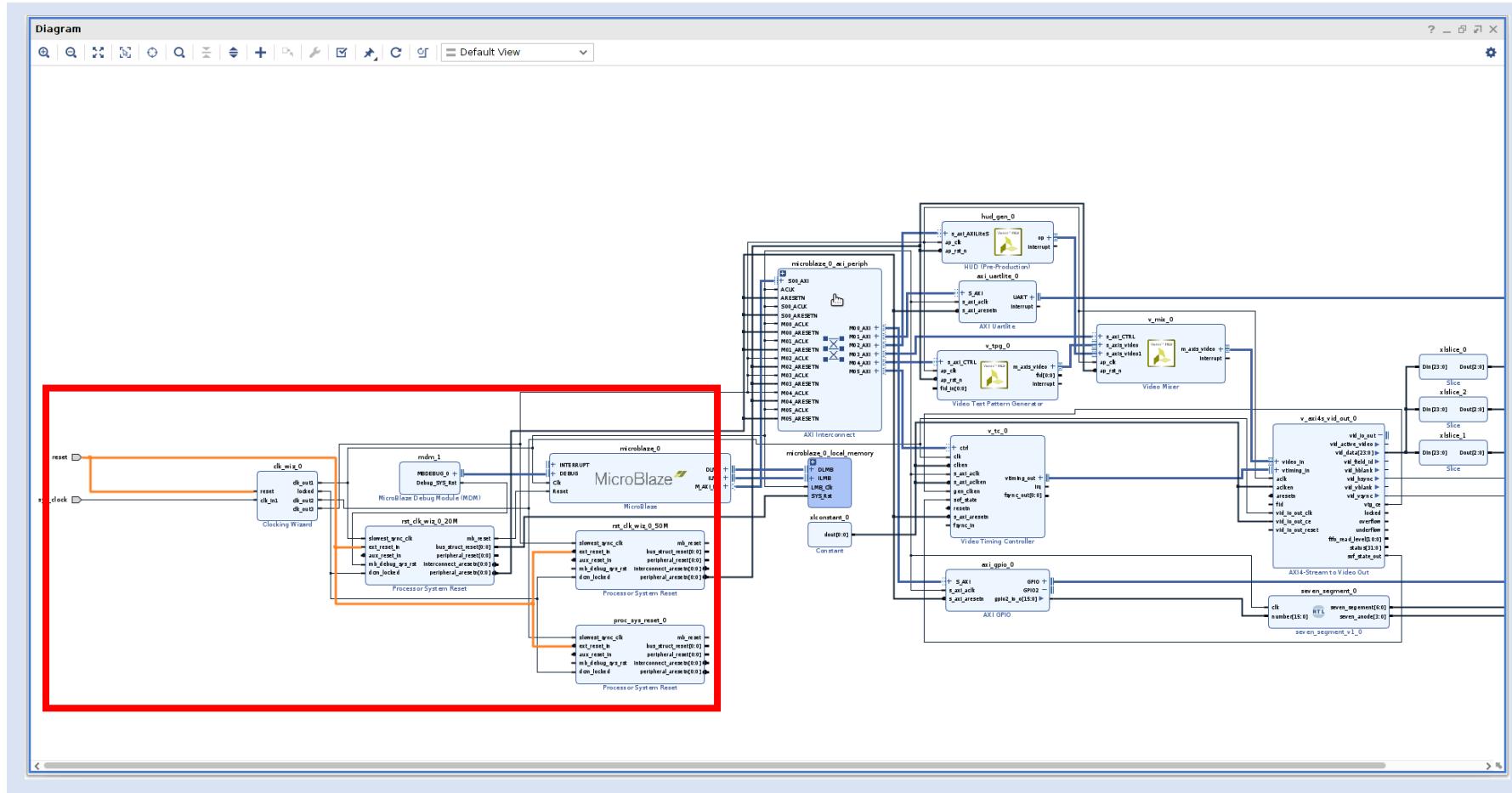
Crowd Supply: Lab One

Step 61 – Connect the DCM locked signal



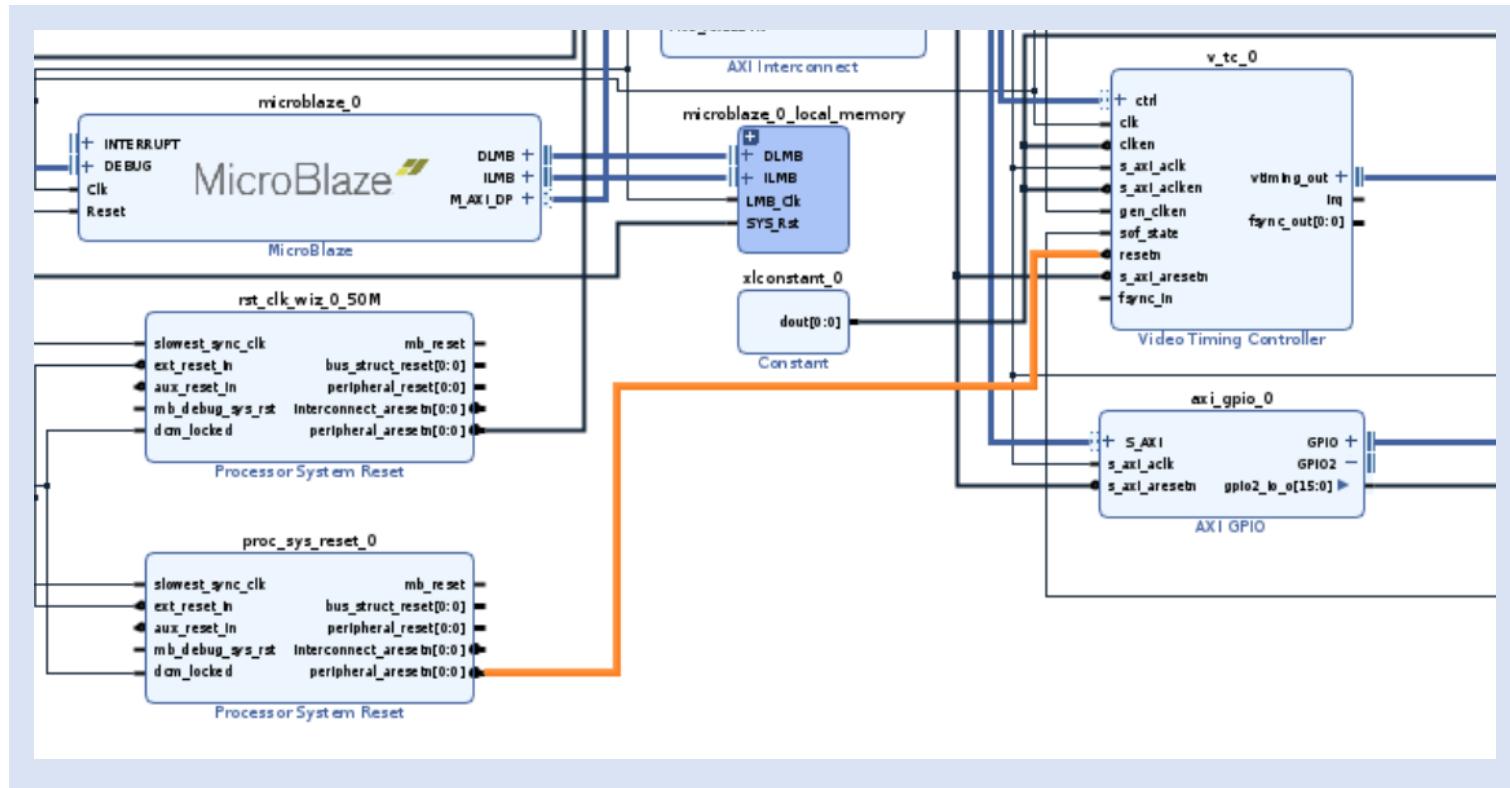
Crowd Supply: Lab One

Step 62 – Connect the Reset signal to the ext_reset_in of the new processor reset block



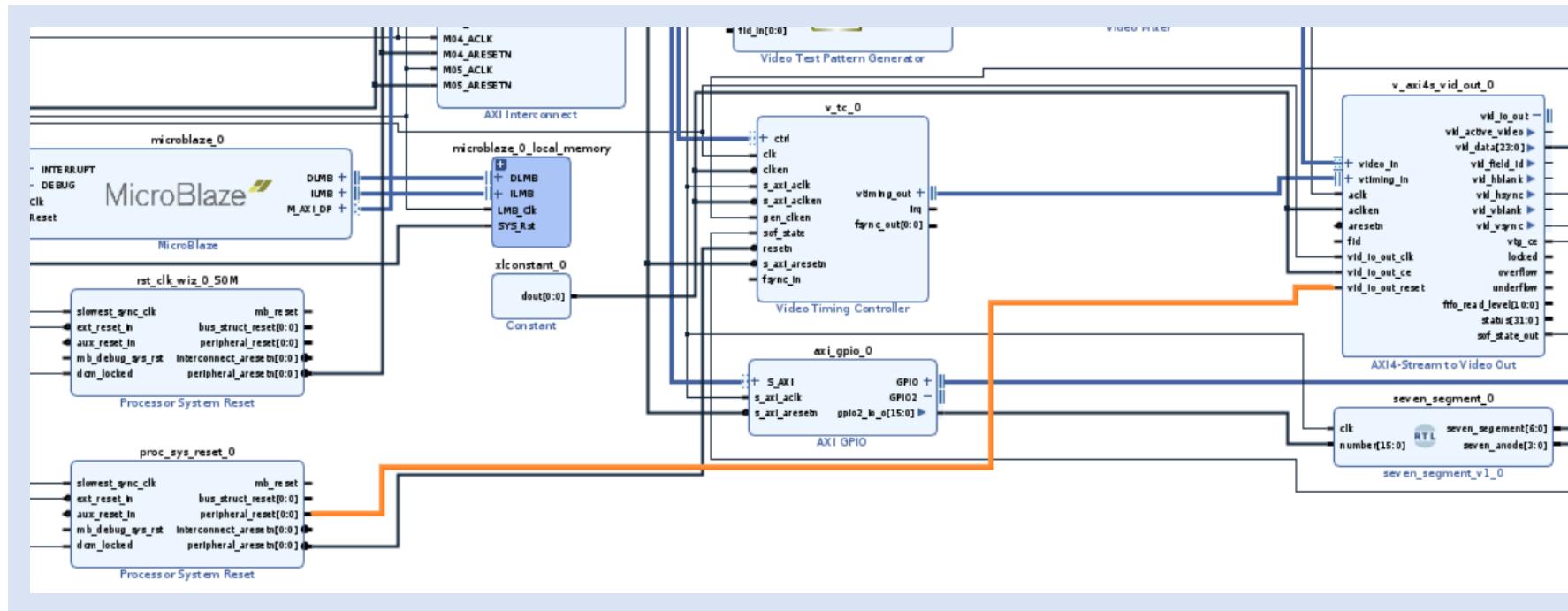
Crowd Supply: Lab One

Step 63 – Connect the peripheral_aresetn from the reset block to the VTC resetn



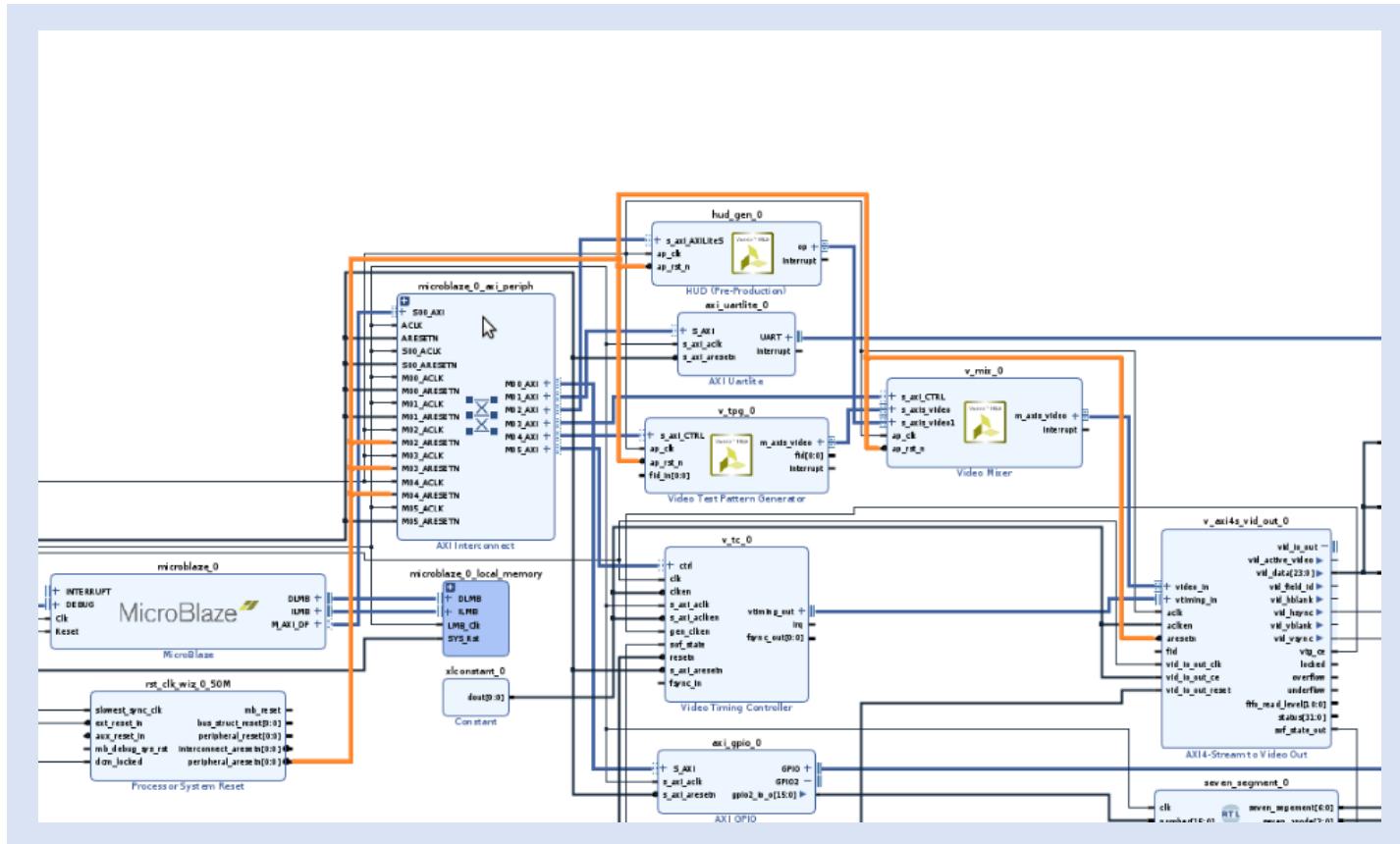
Crowd Supply: Lab One

Step 64 – Connect the peripheral_areset from the reset block to the AXIS Video Out vid_in_out_reset



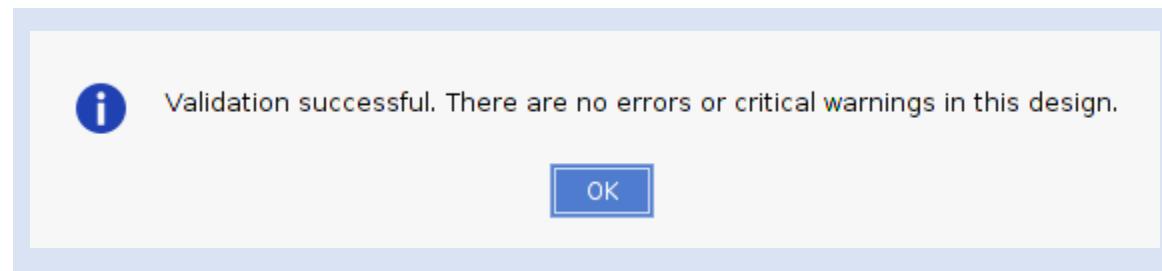
Crowd Supply: Lab One

Step 65 – Connect the peripheral_areset from the reset block associated with the clock 3 (50 Mhz) with the AXIS Video out aresetn input



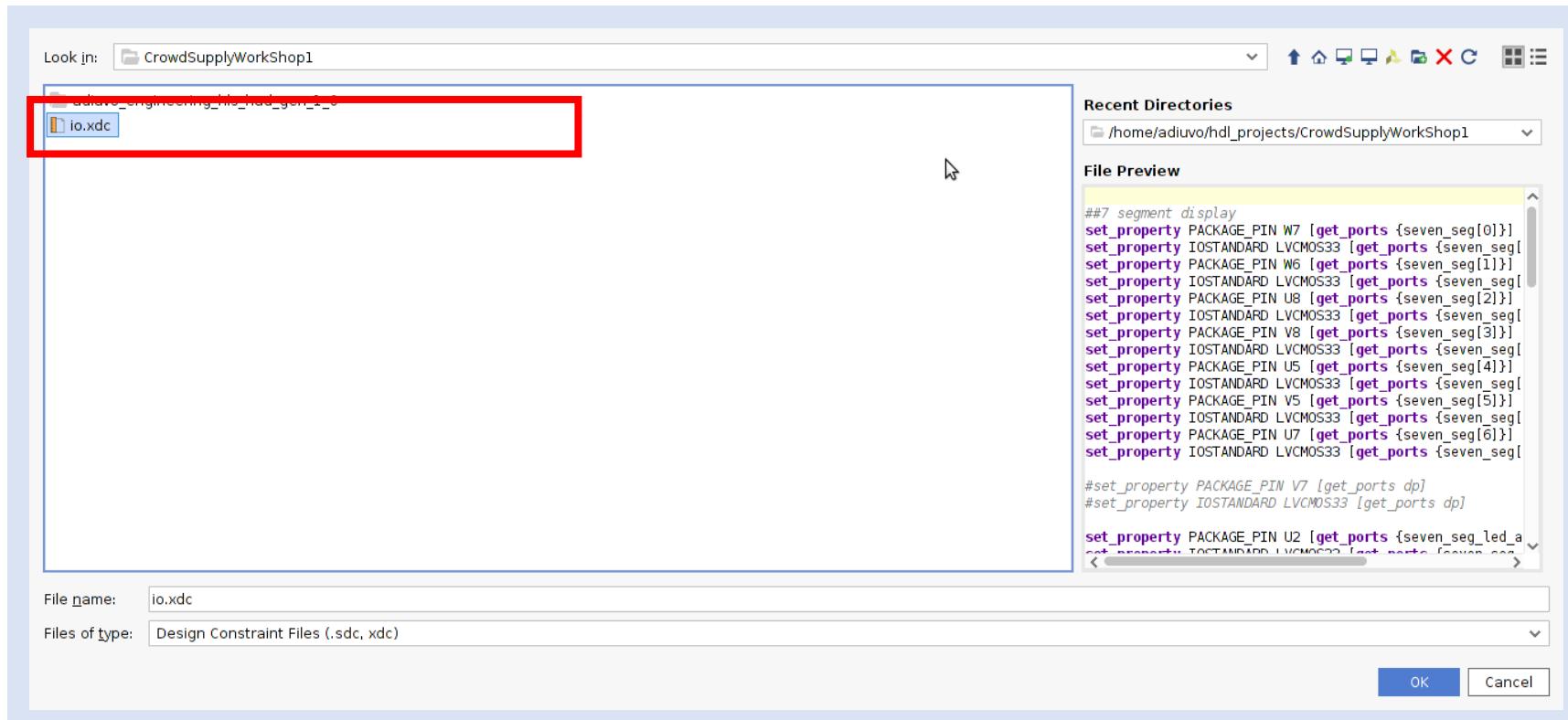
Crowd Supply: Lab One

Step 66 – Validate the design, we should see no errors or warnings



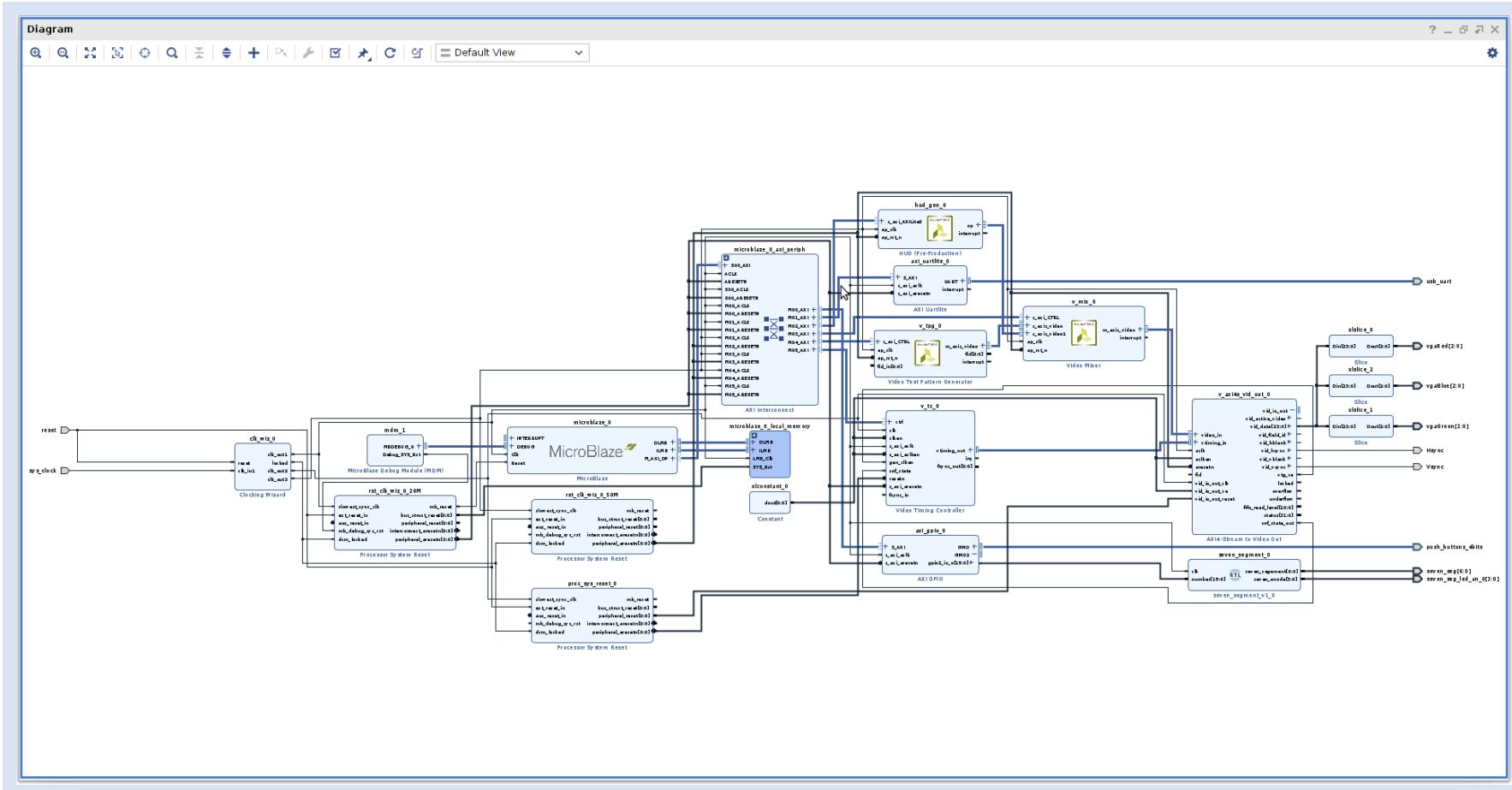
Crowd Supply: Lab One

Step 67 – Add in a new constraints source and select the IO constraints from the github repo



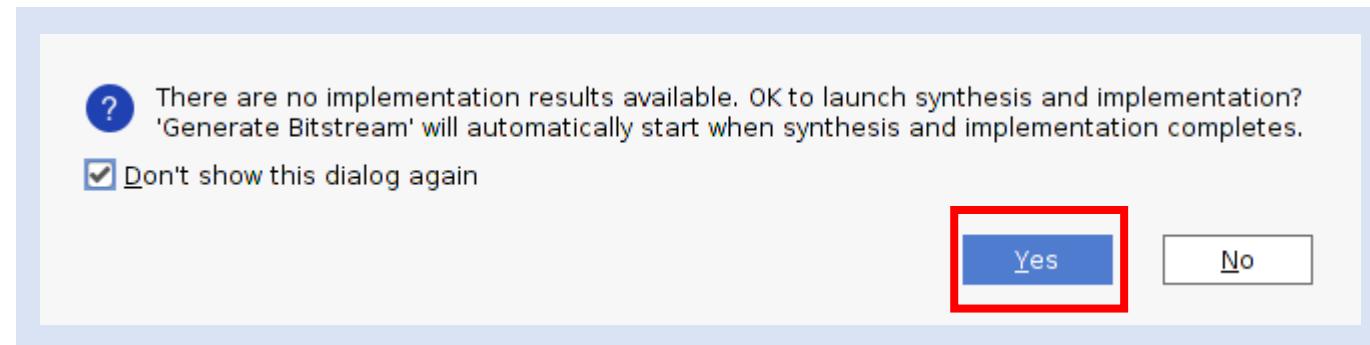
Crowd Supply: Lab One

Step 68 – The final block design should look as below



Crowd Supply: Lab One

Step 69 – Click on build the bit stream – If you see the following dialog select yes



Crowd Supply: Lab One

Step 70 – Click on build the bit stream – select the number of jobs and click run

