# AXI VIP Tutorial 1

## Introduction

The goal of this tutorial is to demonstrate how to use the Xilinx AXI Verification IP (VIP) to test and verify your custom AXI lite peripherals using the Xilinx Vivado Simulator. We will show you how to connect the VIP to your design and use it to write to and read from registers of the AXI GPIO IP.

## Step 1: Create a new project and block diagram

1. Create a new project for the **Nexys 4** board.

2. Create a new block design and name it **design_1**.

3. Add and wire the **AXI Verification IP**, **AXI GPIO**, and **Constant** IPs to the diagram as shown in Figure 1 below. Make sure that the port names match the figure.

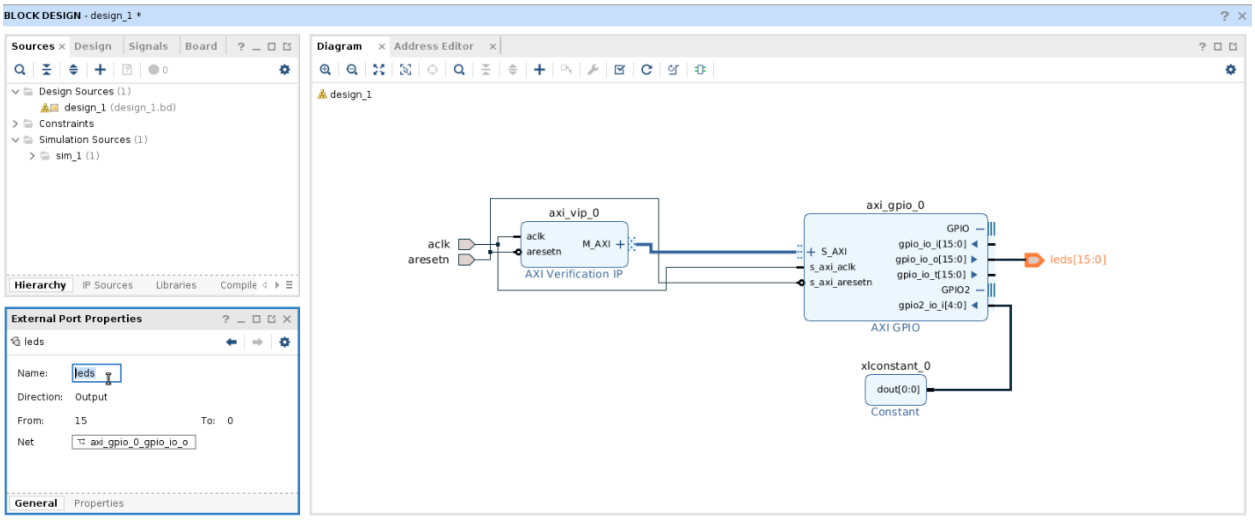


Figure 1: Block design.

4. Configure the **basic settings** tab of the **AXI VIP IP** as shown in the following figure. Leave the advance settings at their default values. This will set the VIP into AXI lite

mode.

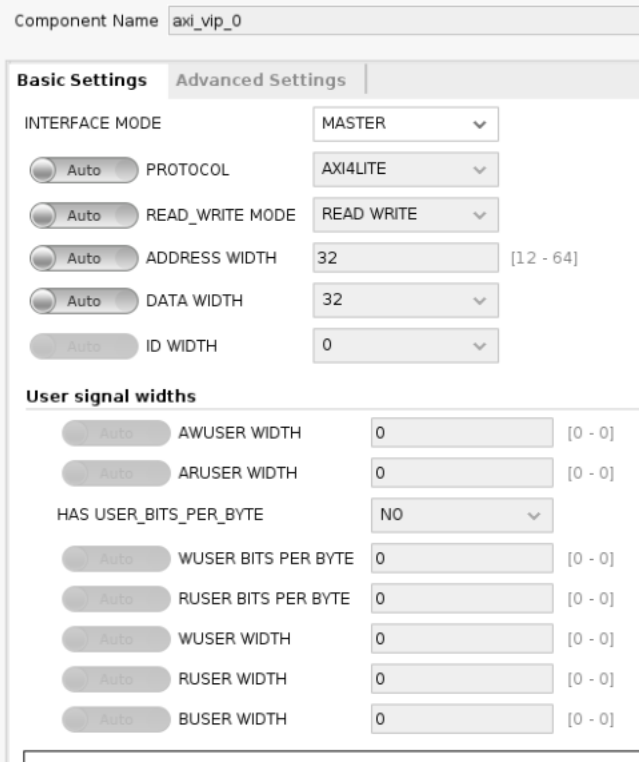


Figure 2: AXI VIP configuration window.

5. Configure the **AXI GPIO IP** as shown in the following figure. We will be using the VIP to set the LEDs and read from the push buttons.

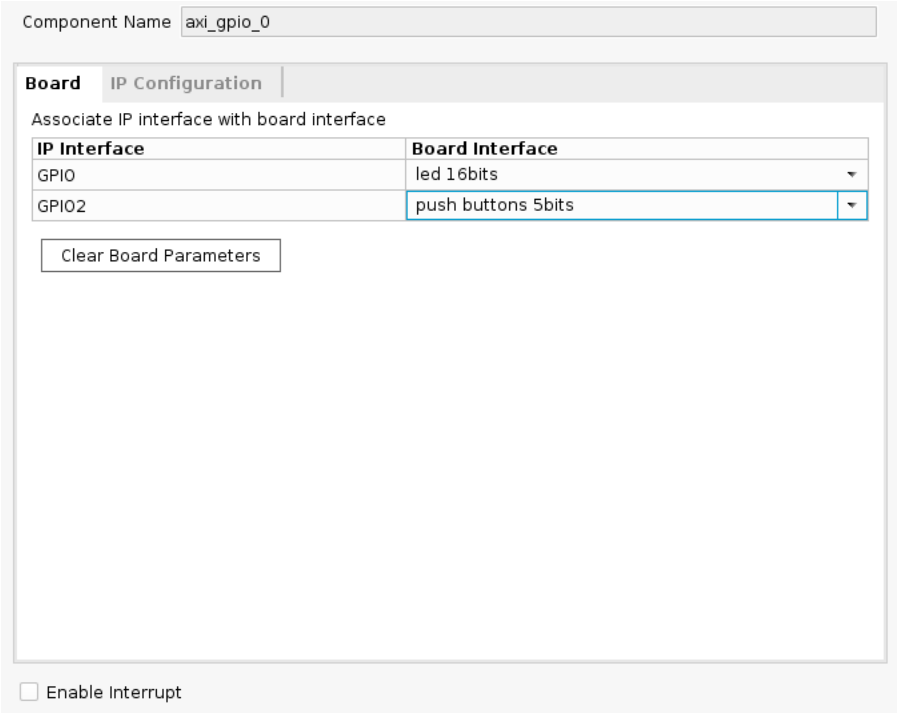


Figure 3: AXI GPIO configuration window.

6. Configure the **Constant** IP as shown in the following figure. The constant value of 5 will simulate pushing buttons 0 and 2.

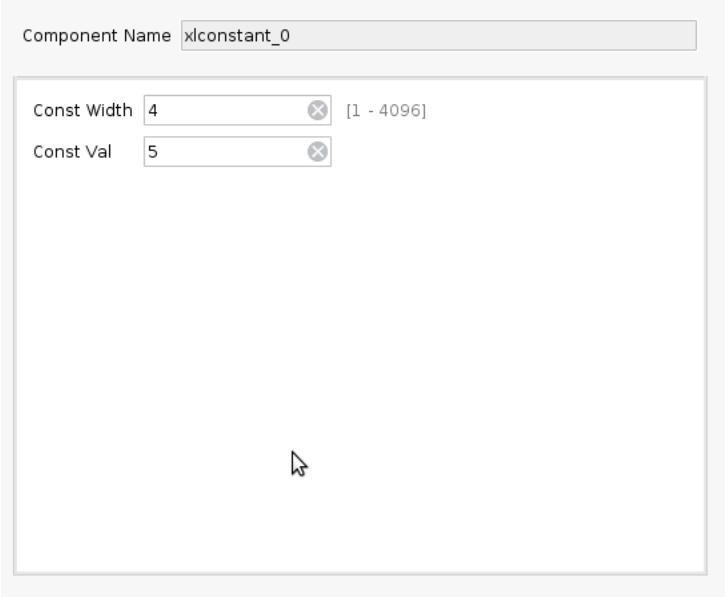


Figure 4: Constant configuration window.

7. Go the **address editor** tab and set the offset address to **0x40000000**.

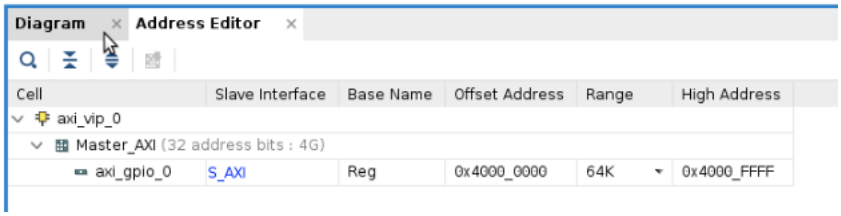


Figure 5: Address Editor

8. Validate the block design, create the HDL wrapper, and generate the block design.

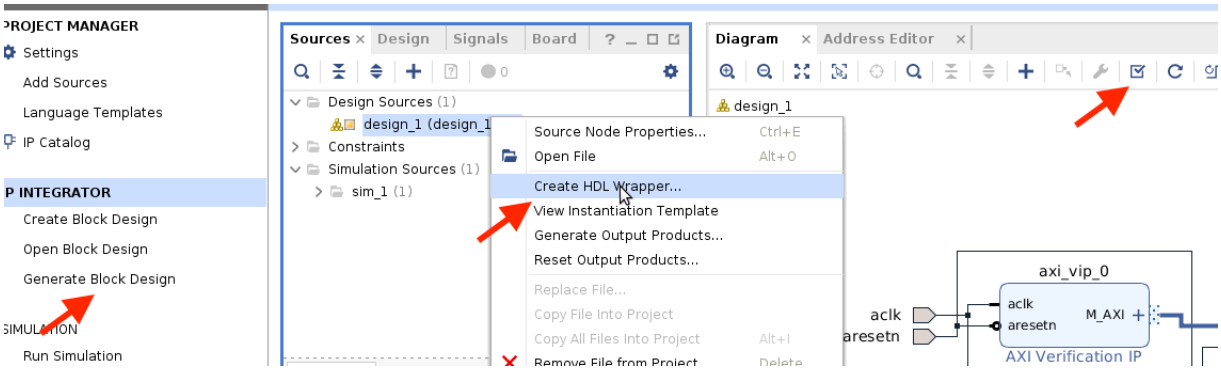


Figure 6: Generating the block design files.

# Step 2: Creating the testbench

1. Import **tb.sv** as a **simulation source**.

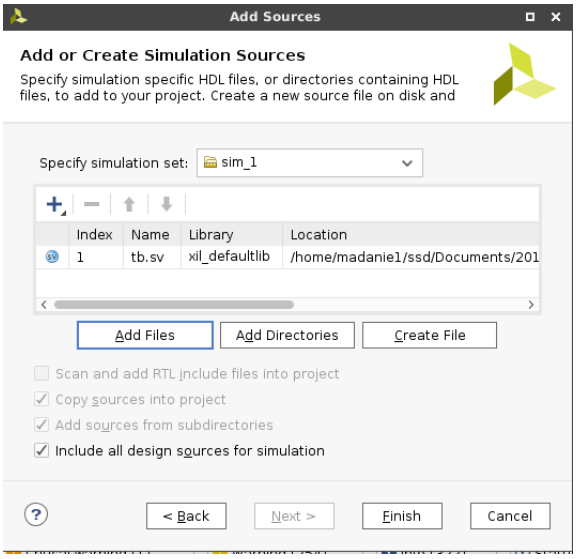


Figure 7: Importing testbench files.

2. Open the tb.sv file in Vivado text editor. Replace the **<vip_component_name>** in line 4 and 15 with the vip component name. Refer to Figure 10 to determine what the component name is for your design.

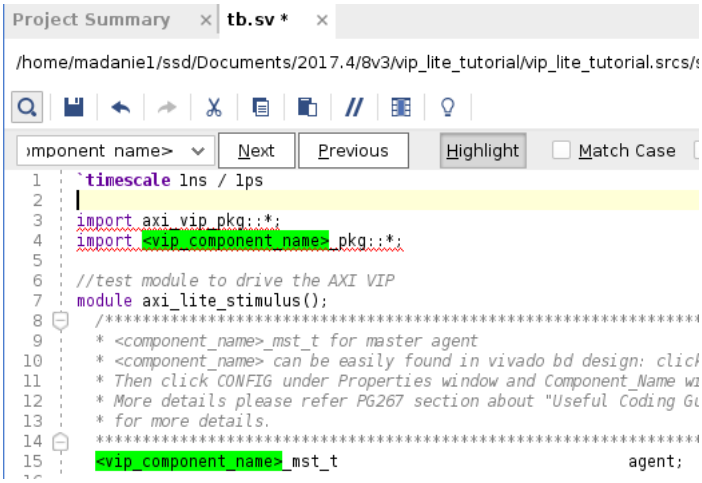


Figure 8: Replace lines 4 and 15 with the appropriate component name for your VIP.

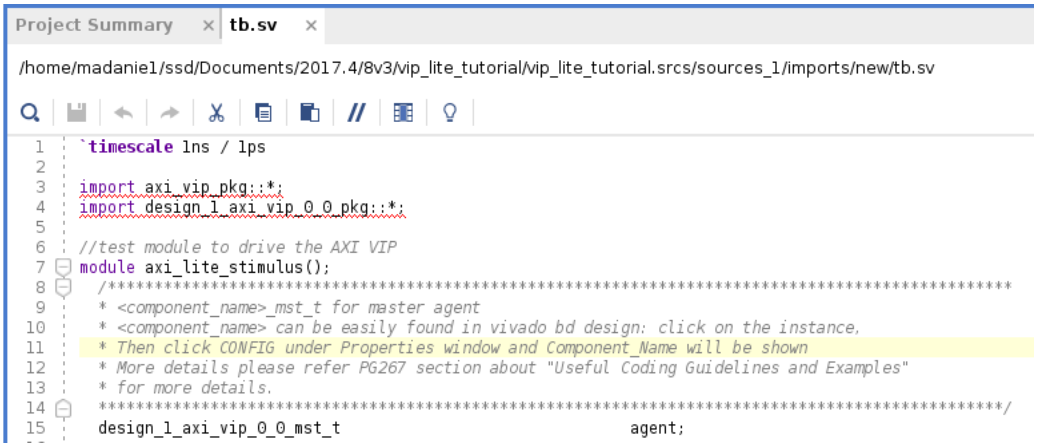


Figure 9: Example of what lines 4 and 15 should look like.

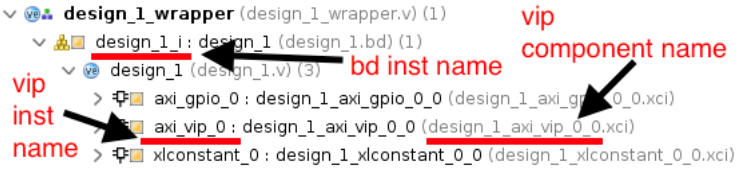


Figure 10: How to find the component and instance name.

3. Go to line 60, and replace **<bd_instance_name>** and **<vip_instance_name>** with the bd instance name and vip instance name. Refer to Figure 10 to determine what the instance names are for your design.

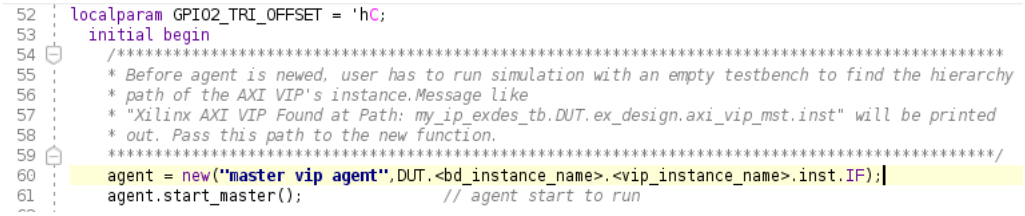


Figure 11: Replace line 60 with the appropriate instance names for your BD and VIP.


Figure 12: Example of what line 60 should look like.

4. Set tb instance under Simulation Sources as the top instance if it isn't already. The simulation source hierarchy should look like the figure below.

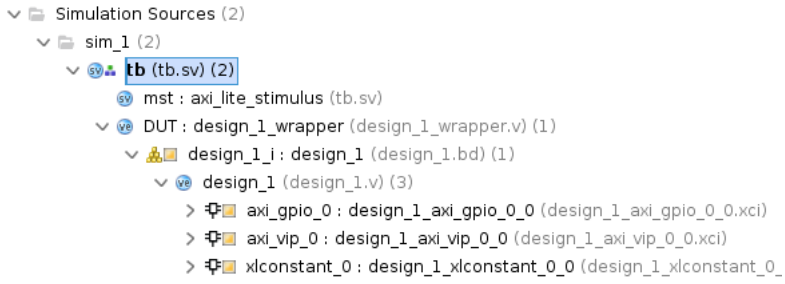


Figure 13: Simulation source hierarchy.

# Step 3: Simulate the testbench

1. Before simulation, go to tb.sv and analyze line 66 to 75. This is where our test vectors are located. We will be writing to the output register of the GPIO bank that is connected to the LEDs. Then we'll set the push button GPIOs to be inputs and then wait for all writes to finish. We will then read the GPIO data register for the push buttons, and print the value of that register to the tcl console.

```
66      //Turn on LED 0,1,3,5,7
67      writeRegister(GPIO_BASE_ADDRESS + GPIO_DATA_OFFSET, 'hAB);
68      //Set pushbutton GPIOs to input
69      writeRegister(GPIO_BASE_ADDRESS + GPIO2_TRI_OFFSET, 'hFFFFFFFF);
70      //Wait for all writes to complete
71      agent.wait_drivers_idle();
72      //Read push button values
73      readRegister(GPIO2_DATA_OFFSET, Rdatabeat);
74      //Print read data to tcl console (similar to printf)
75      $write("GPIO2 Data register value: 0x%08x\n", Rdatabeat[0]);
```

Figure 14: TB test vectors.

2. Start the simulation by clicking "Run Simulation" on the navigation pane. Add the AXI bus signals to the simulation window and click relaunch simulation. Make sure that you select the VIP instance in the scope window.

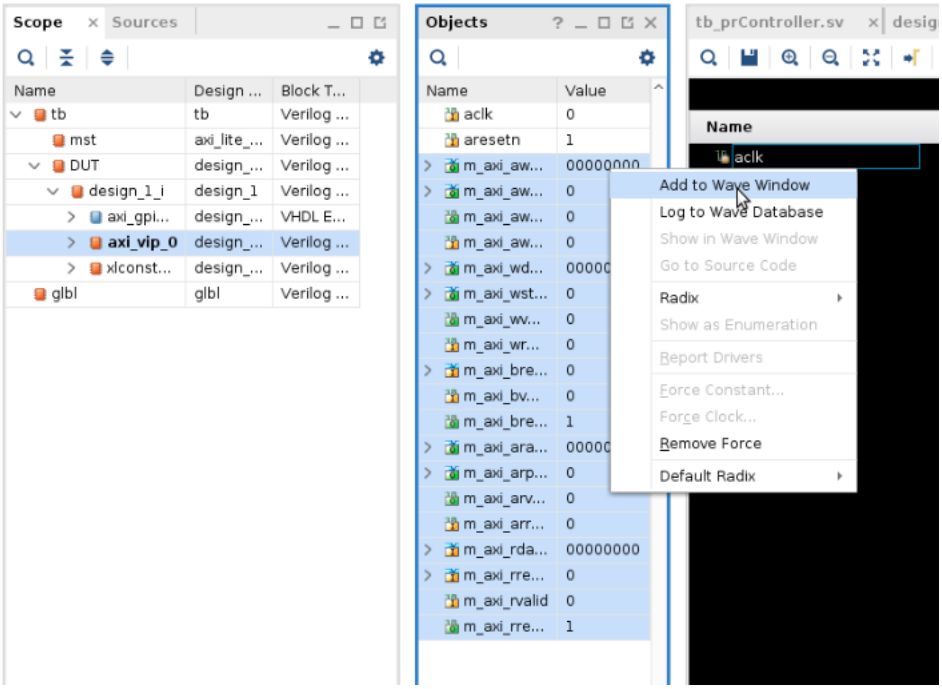


Figure 15: Adding AXI signals to the simulation.

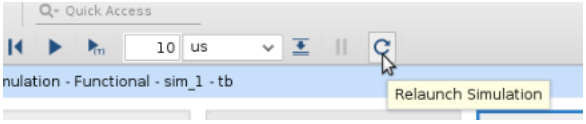


Figure 16: Relaunching the simulation.

3. Analyze the tb results...

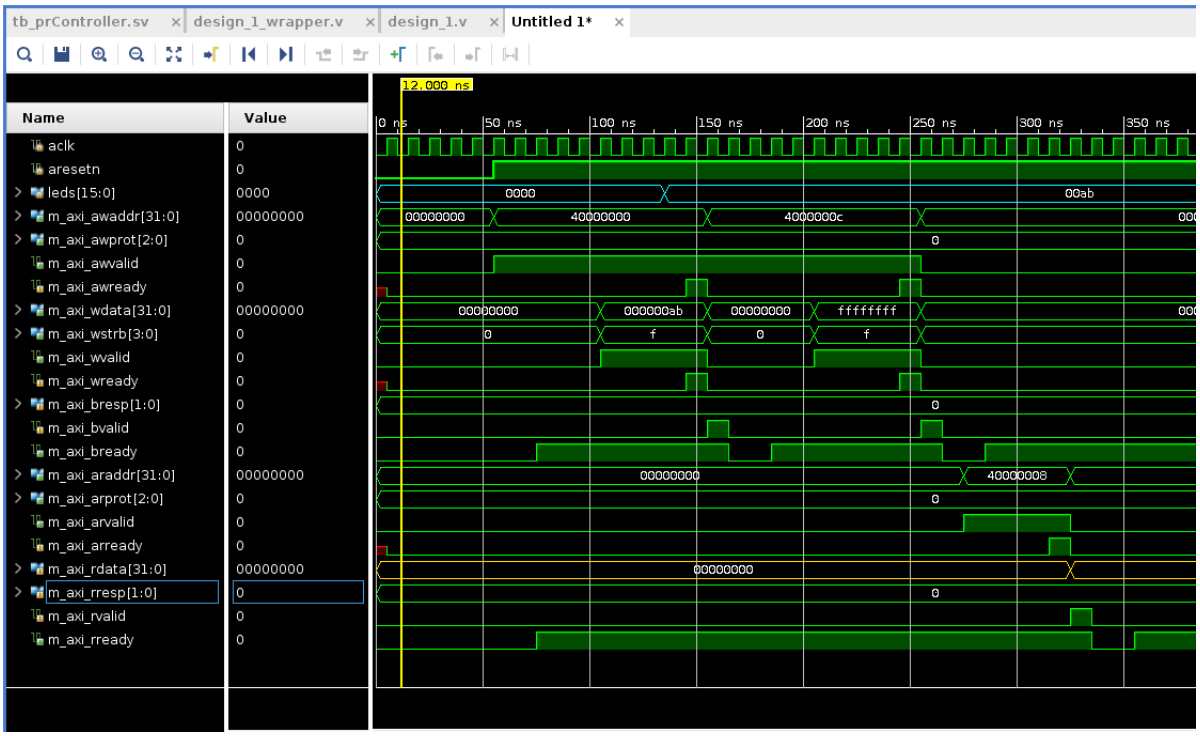


Figure 17: Simulation waveform.

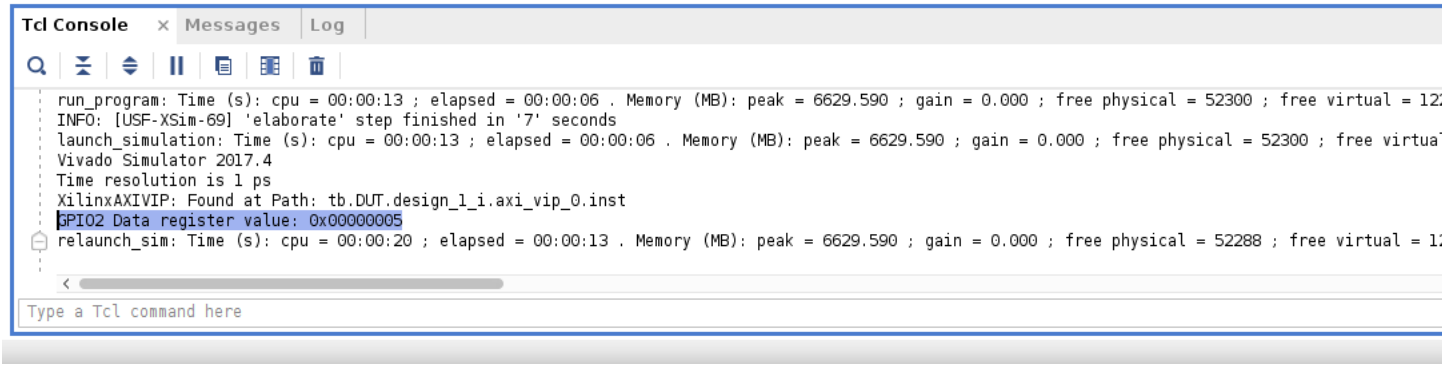


Figure 18: Tcl console print out of register.

# Troubleshooting

1. If the Vivado simulator bugs out and starts throwing errors that are not related to your source files, you can try to fix it by reseting your behaviour simulation.

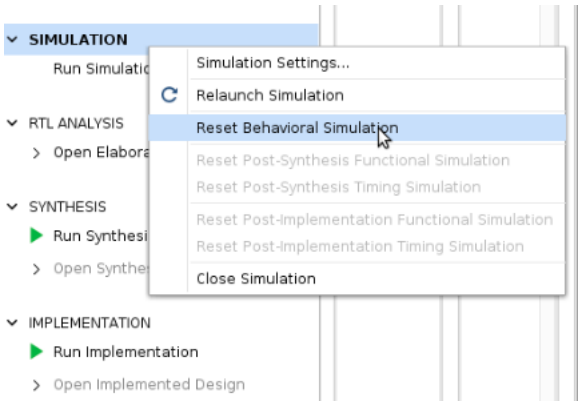


Figure 19: Resetting the simulation.

2. If you want to create more advanced AXI testbenches with the Vivado AXI VIP refer to their example design.

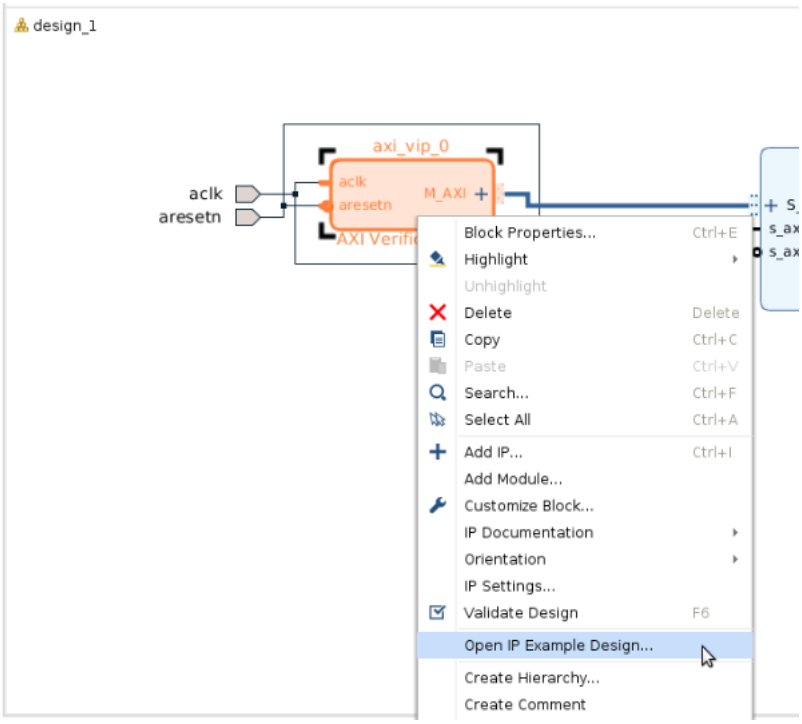


Figure 20: Advanced example design for the AXI VIP.