

KCU116 IP Integrator Application

May 2019



XTP460

Revision History

Date	Version	Description
05/29/19	8.0	Updated for 2019.1. Some screenshots not updated.
12/10/18	7.0	Updated for 2018.3. Some screenshots not updated.
06/18/18	6.0	Updated for 2018.2.
04/09/18	5.0	Updated for 2018.1.
12/20/17	4.0	Updated for 2017.4.
10/26/17	3.0	Updated for 2017.3.1.
06/20/17	2.0	Updated for 2017.2.
04/19/17	1.0	Initial version.

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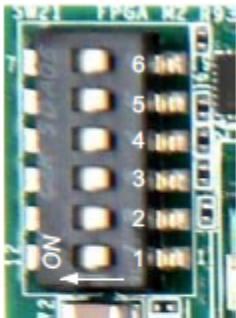
Overview

- > **KCU116 Board Self Test Demo**
- > **Xilinx KCU116 Board**
- > **Software Requirements**
- > **KCU116 Setup**
- > **KCU116 IPI Design**
- > **Compile KCU116 IPI Design**
- > **Program KCU116 with IPI Design**
- > **Run the LwIP Ethernet Design**
- > **References**

KCU116 Board Self Test Demo

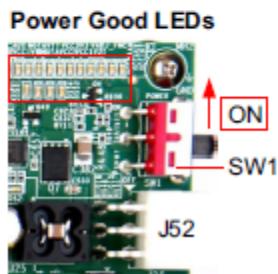
- > Follow the instructions in the KCU116 Quick Start Guide, XTP391

» https://www.xilinx.com/support/documentation/boards_and_kits/kcu116/xtp471-kcu116-quickstart.pdf



STEP 1: Set the FPGA Configuration Mode

Set the FPGA configuration mode DIP switch to load the BIST configuration by setting SW21-6 OFF as shown. (All switches in the photo are in the OFF position.)



STEP 2: Connect Power to the Board

Connect the 6-pin power supply plug to J52, and power up the board using the SW1 switch.

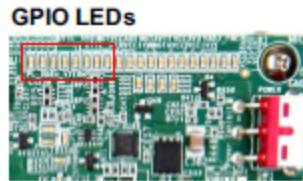
When the Power Good LEDs glow green, the power system is operating correctly.

When DONE LED DS32 glows green, the Kintex UltraScale+ FPGA is configured successfully.

KCU116 Board Self Test Demo

- > Follow the instructions in the KCU116 Quick Start Guide, XTP391

» https://www.xilinx.com/support/documentation/boards_and_kits/kcu116/xtp471-kcu116-quickstart.pdf



STEP 3: Run the Built-In Self-Test

The BIST consists of a set of pass/fail tests. On power-up, the Clock, DDR, BRAM, flash memory, and I2C tests are run without user input.

A passing test is indicated when the corresponding GPIO LED for each test is ON. See the following table for the LED that corresponds to each test. As a test starts, its corresponding LED flashes quickly.

The DIP and pushbutton (PB) tests require user interaction as described in the following section. The blinking LED indicates which test is waiting for user input.

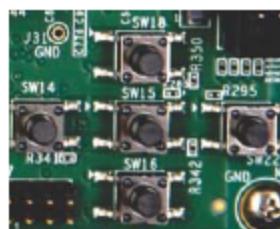
Board Self-Test Assignments for GPIO LEDs

GPIO LEDs							
7	6	5	4	3	2	1	0
Clock	DDR	BRAM	Flash	I2C	DIP	PB	All tests done



SW13 is the GPIO DIP switch. To complete the test, push all four switches to the ON position, and then back to OFF.

A passing test is indicated when GPIO LED 2 is ON.



The PB test checks pushbutton operation.

To complete the test, push the N, W, S, and E pushbuttons in any order. Then push the center pushbutton.

A passing test is indicated when GPIO LED 1 is ON.

KCU116 IPI Design Description

> **Description**

- » The IP Integrator (IPI) application uses an MicroBlaze system to verify board functionality. A UART based terminal program interface offers users a menu of tests to run.

> **Block Design Source**

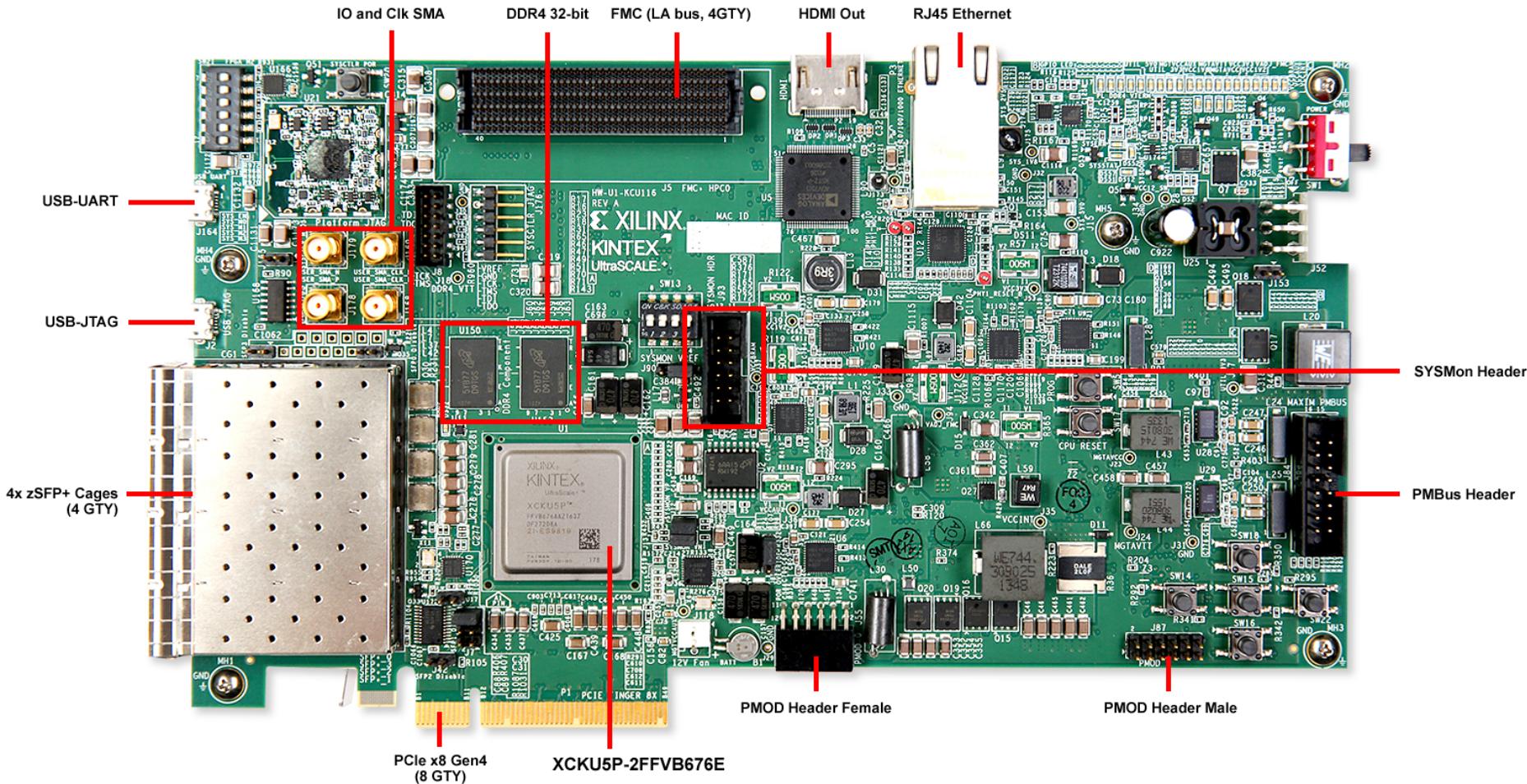
- » RDF0410 – KCU116 IPI Design Files (2019.1 C) ZIP file

KCU116 IPI Design Description

> Block Design IP

- » Processor and Subsystems: MicroBlaze, MicroBlaze Debug Module (MDM), Processor System Reset, AXI Interrupt Controller, Concat, MicroBlaze Memory
- » AXI Bus: AXI Interconnect, AXI Timer
- » Memory: DDR4 SDRAM (MIG), AXI BRAM Controller, Block Memory Generator
- » Video: AXI4-Stream to Video Out, Video Timing Controller, Video Test Pattern Generator, top_addr, Constant, AXI4-Stream Subset Converter
- » Peripherals: AXI Quad SPI, AXI IIC, AXI GPIO, AXI UART16550, System Management Wizard, DMA/Bridge Subsystem for PCI Express (PCIe)
- » Other IP: Utility Buffer, freq_counter, diff_freq_counter, gty_freq_counter, Clocking Wizard
 - [Vivado Design Suite Tcl Command Reference Guide](#) (UG835)
 - [Designing IP Subsystems Using IP Integrator](#) (UG994)

Xilinx KCU116 Board



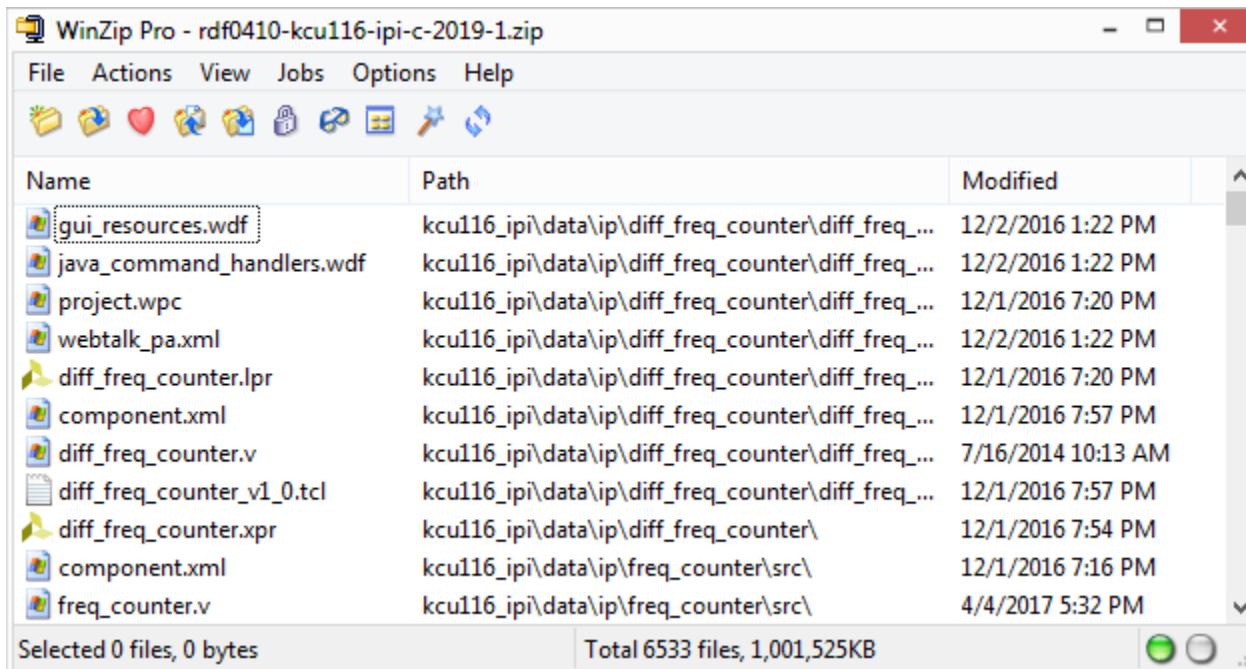
KCU116 Software Install and Board Setup

- > Refer to XTP464 – KCU116 Software Install and Board Setup for details on:
 - » Software Requirements
 - » KCU116 Board Setup
 - » UART Driver Install
 - » Optional Hardware Setup



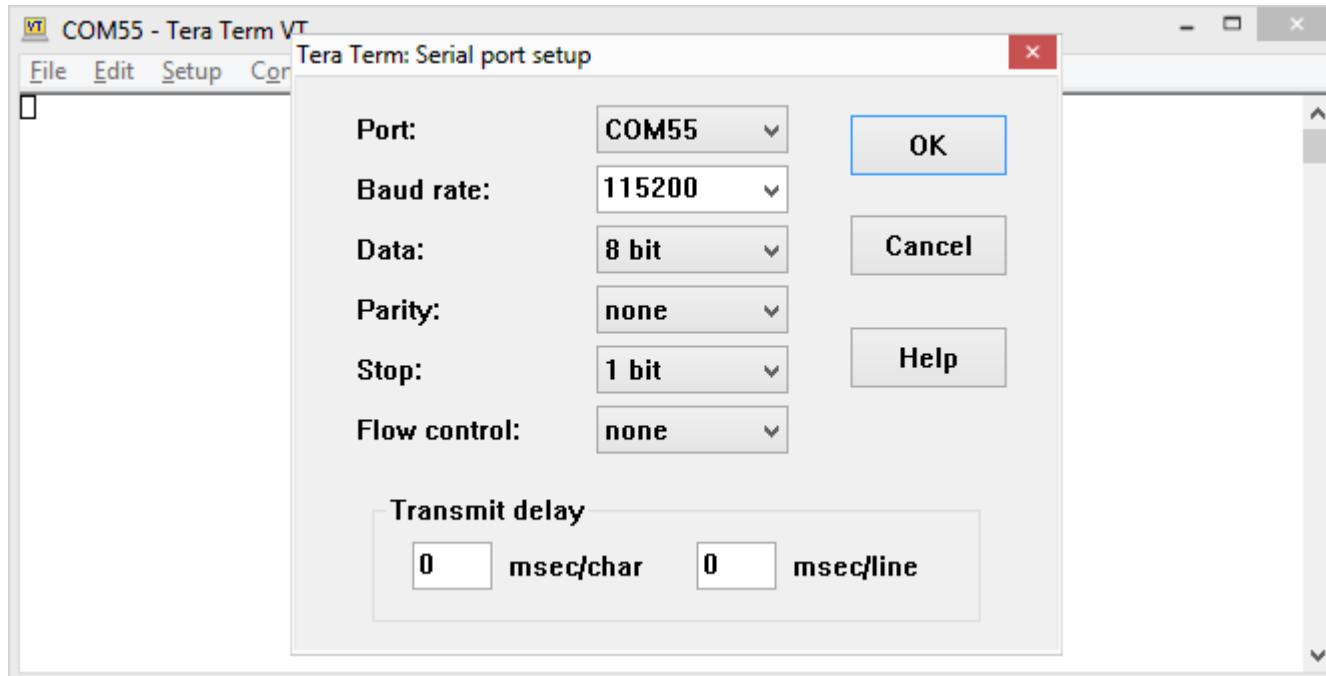
KCU116 Setup

- > Unzip the RDF0410 - KCU116 IPI Design Files (2019.1 C) ZIP file



KCU116 Setup

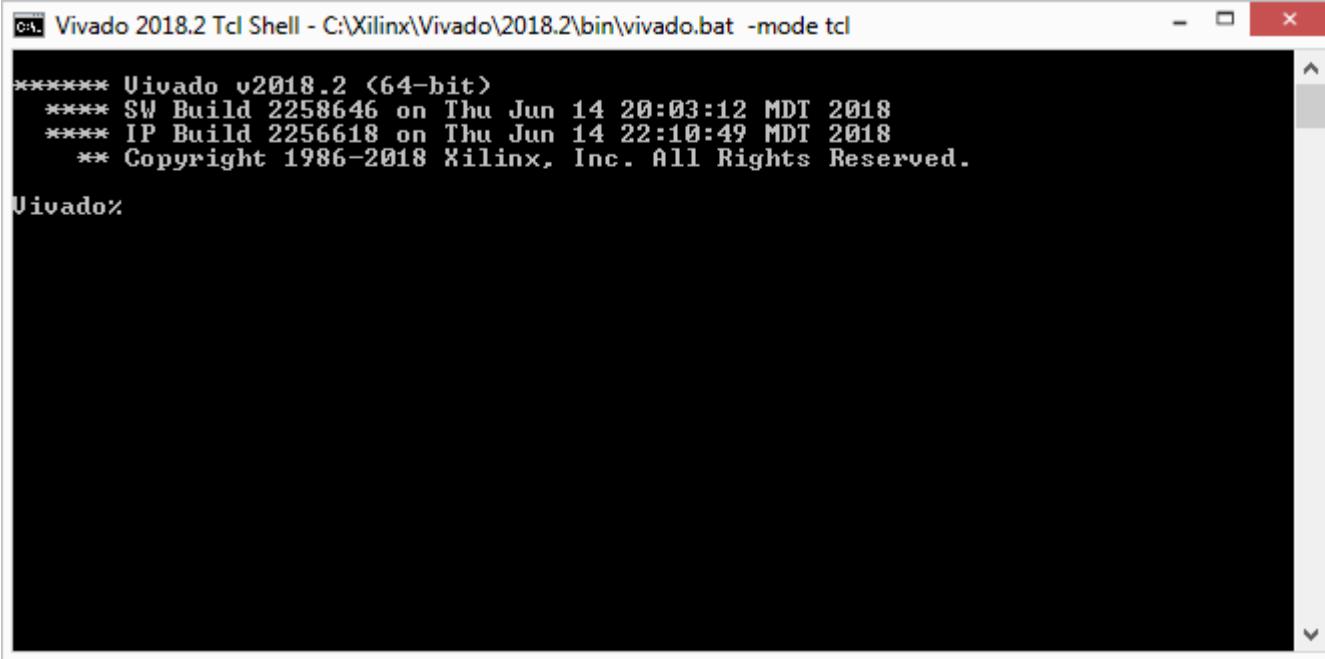
- > Open a Tera Term window for the FPGA UART
- > Set the baud to 115200



KCU116 IPI Design

> Open a Vivado Tcl Shell:

Start → All Programs → Xilinx Design Tools → Vivado 2019.1 →
Vivado 2019.1 Tcl Shell



Vivado 2018.2 Tcl Shell - C:\Xilinx\Vivado\2018.2\bin\vivado.bat -mode tcl

```
***** Vivado v2018.2 (64-bit)
***** SW Build 2258646 on Thu Jun 14 20:03:12 MDT 2018
***** IP Build 2256618 on Thu Jun 14 22:10:49 MDT 2018
** Copyright 1986-2018 Xilinx, Inc. All Rights Reserved.
```

Vivado>

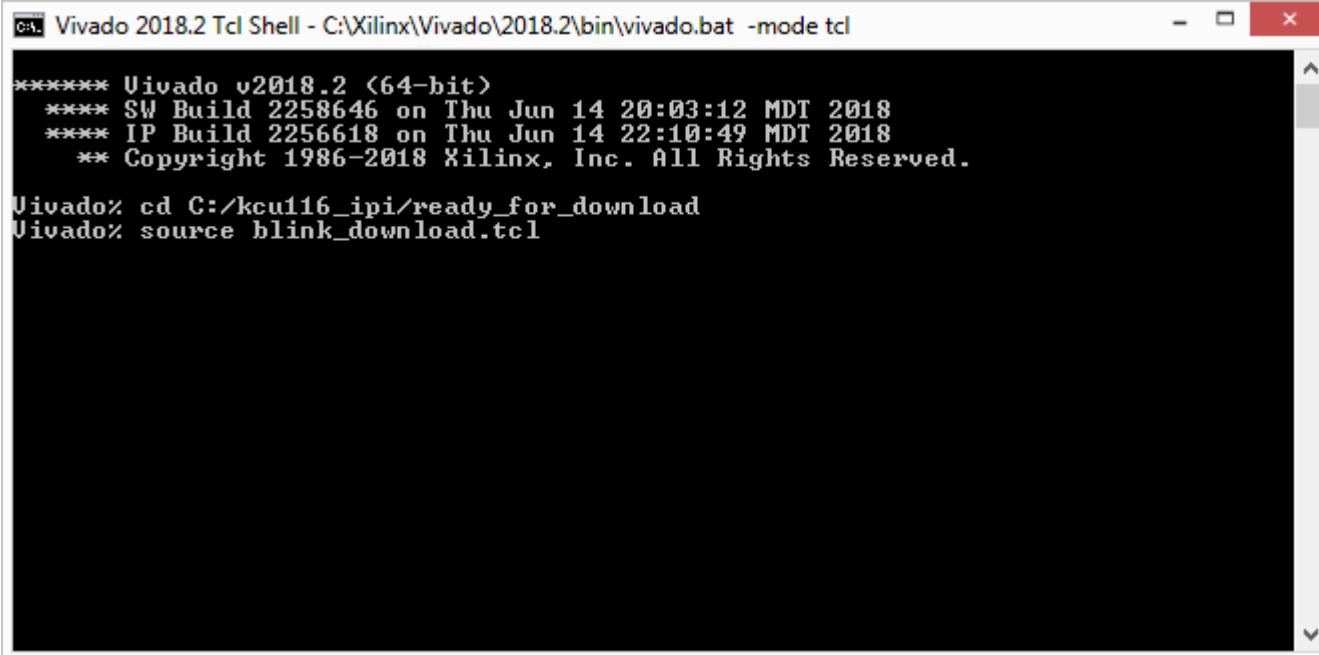
KCU116 IPI Design

> Download the blink bitstream

> In the Vivado Tcl Shell type:

```
cd C:/kcu116_ipi/ready_for_download
```

```
source blink_download.tcl
```



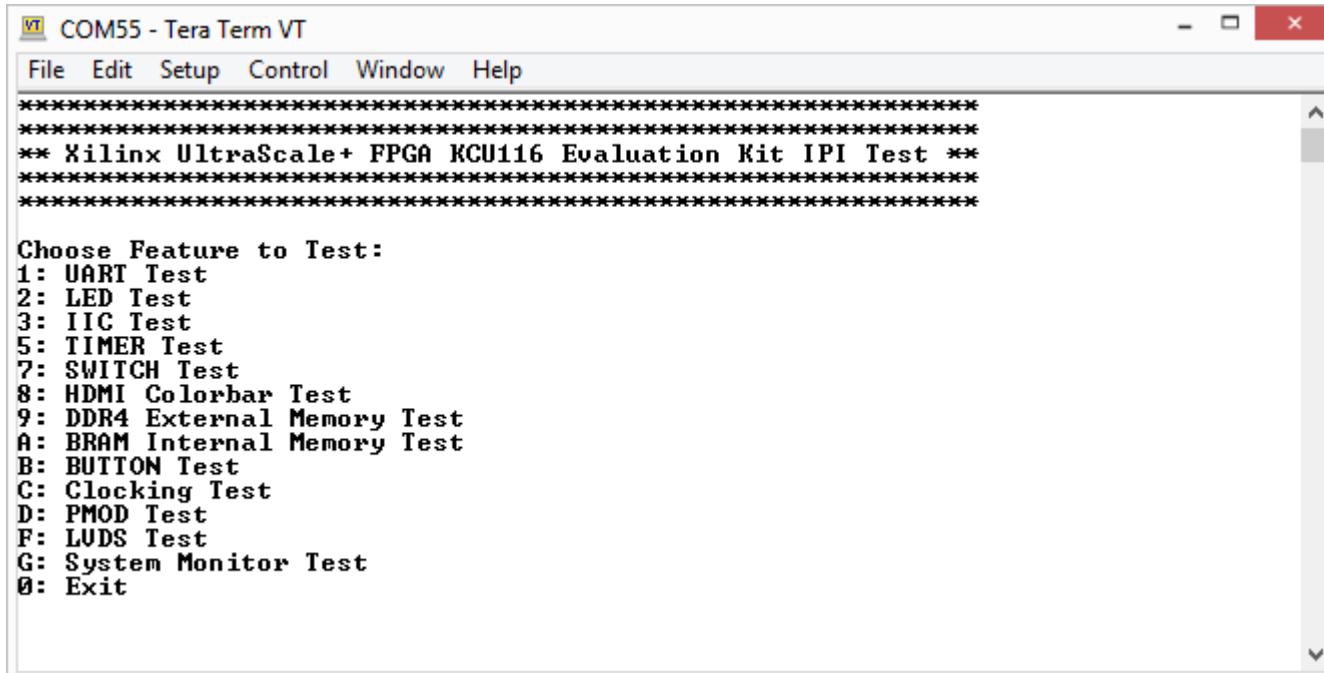
The screenshot shows a Windows command-line interface window titled "Vivado 2018.2 Tcl Shell - C:\Xilinx\Vivado\2018.2\bin\vivado.bat -mode tcl". The window displays the following text:

```
***** Vivado v2018.2 (64-bit)
***** SW Build 2258646 on Thu Jun 14 20:03:12 MDT 2018
***** IP Build 2256618 on Thu Jun 14 22:10:49 MDT 2018
** Copyright 1986-2018 Xilinx, Inc. All Rights Reserved.

Vivado> cd C:/kcu116_ipi/ready_for_download
Vivado> source blink_download.tcl
```

KCU116 IPI Design

- > After the Quick Start tests (see XTP471) are finished, view the initial IPI Test screen



KCU116 IPI Design

> UART Test

- » Type “1” to start the UART Test
- » After each test, press any key to return to the main menu

The screenshot shows a terminal window titled "COM55 - Tera Term VT". The window has a menu bar with "File", "Edit", "Setup", "Control", "Window", and "Help". Below the menu is a list of test options:

```
File Edit Setup Control Window Help
? : SWITCH Test
8 : HDMI Colorbar Test
9 : DDR4 External Memory Test
A : BRAM Internal Memory Test
B : BUTTON Test
C : Clocking Test
D : PMOD Test
F : LVDS Test
G : System Monitor Test
0 : Exit
1
```

Following the menu, there is a section with a double asterisk border:

```
*****
**          KCU116 - UART Test          **
*****
```

Then, the test results are displayed:

```
Testing UART
115200,8,N,1
Hello world!
UART Test Passed
```

At the bottom of the window, the text "Press any key to return to main menu" is visible.

KCU116 IPI Design

- > LED Test
 - » Type 2 to begin LED Test
- > View Walking 1's pattern on GPIO LEDs

The screenshot shows a terminal window titled "COM55 - Tera Term VT". The window has a menu bar with "File", "Edit", "Setup", "Control", "Window", and "Help". Below the menu is a list of test options:

```
1: UART Test
2: LED Test
3: IIC Test
5: TIMER Test
7: SWITCH Test
8: HDMI Colorbar Test
9: DDR4 External Memory Test
A: BRAM Internal Memory Test
B: BUTTON Test
C: Clocking Test
D: PMOD Test
F: LVDS Test
G: System Monitor Test
0: Exit
2
```

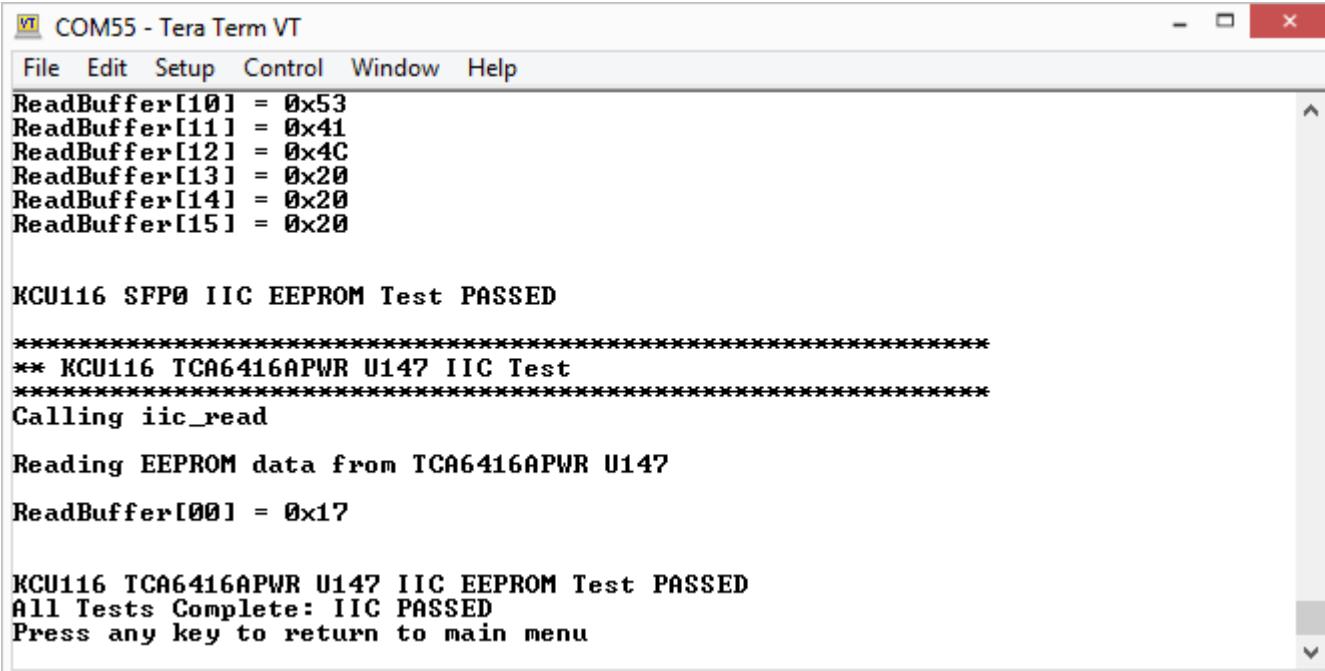
After option 2 is selected, the screen displays:

```
*****
**          KCU116 - GPIO LED Test      **
*****
Watch the LEDs
Press any key to return to main menu
```

KCU116 IPI Design

> IIC Test

» Type 3 to begin IIC Test



The screenshot shows a terminal window titled "COM55 - Tera Term VT". The window has a menu bar with File, Edit, Setup, Control, Window, and Help. The main pane displays the following text:

```
ReadBuffer[10] = 0x53
ReadBuffer[11] = 0x41
ReadBuffer[12] = 0x4C
ReadBuffer[13] = 0x20
ReadBuffer[14] = 0x20
ReadBuffer[15] = 0x20

KCU116 SFP0 IIC EEPROM Test PASSED
*****
** KCU116 TCA6416APWR U147 IIC Test
*****
Calling iic_read

Reading EEPROM data from TCA6416APWR U147

ReadBuffer[00] = 0x17

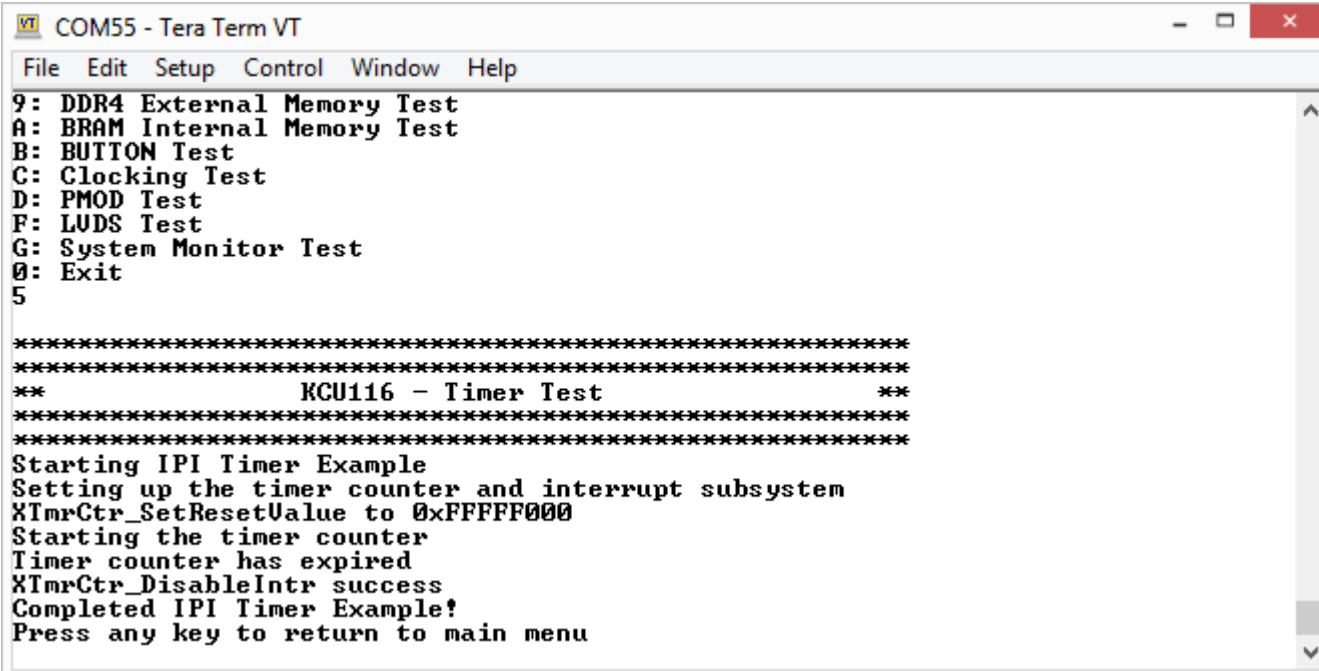
KCU116 TCA6416APWR U147 IIC EEPROM Test PASSED
All Tests Complete: IIC PASSED
Press any key to return to main menu
```

Note: This test expects 4 zSFP modules
and an XM107 to be installed

KCU116 IPI Design

> Timer Test

» Type 5 to begin Timer Test



The screenshot shows a terminal window titled "COM55 - Tera Term VT". The window has a menu bar with "File", "Edit", "Setup", "Control", "Window", and "Help". Below the menu is a list of test options:

```
9: DDR4 External Memory Test
A: BRAM Internal Memory Test
B: BUTTON Test
C: Clocking Test
D: PMOD Test
F: LVDS Test
G: System Monitor Test
0: Exit
5
```

Following the menu, the terminal displays the output of a timer test:

```
*****
**          KCU116 - Timer Test          **
*****
Starting IPI Timer Example
Setting up the timer counter and interrupt subsystem
XTmrCtr_SetResetValue to 0xFFFFF000
Starting the timer counter
Timer counter has expired
XTmrCtr_DisableIntr success
Completed IPI Timer Example!
Press any key to return to main menu
```

KCU116 IPI Design

> GPIO Switch Test

- » Set 4-position GPIO DIP Switch (SW13)
- » Type 7 to begin GPIO Switch Test

The screenshot shows a terminal window titled "COM55 - Tera Term VT". The window has a menu bar with "File", "Edit", "Setup", "Control", "Window", and "Help". Below the menu is a list of test options:

- 1: UART Test
- 2: LED Test
- 3: IIC Test
- 5: TIMER Test
- 7: SWITCH Test
- 8: HDMI Colorbar Test
- 9: DDR4 External Memory Test
- A: BRAM Internal Memory Test
- B: BUTTON Test
- C: Clocking Test
- D: PMOD Test
- F: LVDS Test
- G: System Monitor Test
- 0: Exit

After the menu, the number "7" is typed. This is followed by a series of asterisks (***) and the text "KCU116 - GPIO Switch Test". At the bottom of the window, it says "Data read from GPIO Input is 0xF" and "Press any key to return to main menu".

KCU116 IPI Design

> HDMI Test

» Type 8 to begin HDMI Test

The screenshot shows a terminal window titled "COM55 - Tera Term VT". The window has a menu bar with "File", "Edit", "Setup", "Control", "Window", and "Help". Below the menu is a list of test options:

```
A: BRAM Internal Memory Test
B: BUTTON Test
C: Clocking Test
D: PMOD Test
F: LVDS Test
G: System Monitor Test
Q: Exit
8
```

Following the menu, the terminal displays the start of the "KCU116 - HDMI Colorbar Test". It shows the initialization of the XU_tpg module and the successful completion of motion speed settings.

```
*****
**          KCU116 - HDMI Colorbar Test      **
*****
Begin XU_tpg_Initialize
XU_tpg_Initialize complete
Begin XU_tpg_Set_motionSpeed
XU_tpg_Set_motionSpeed complete
```

It then prompts the user to check the HDMI monitor for a colorbar test.

```
Check HDMI Monitor to verify
Colorbar Test completed successfully
```

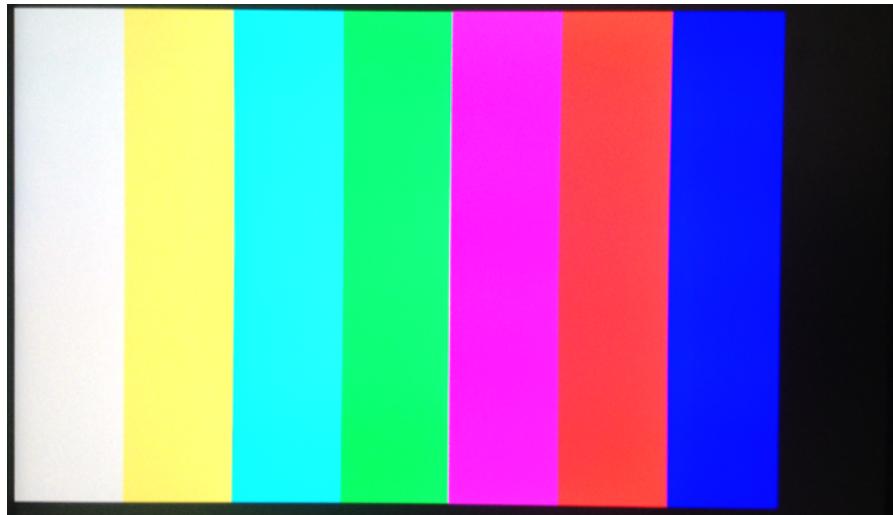
Finally, it prompts the user to press any key to return to the main menu.

```
Press any key to return to main menu
```

KCU116 IPI Design

> HDMI Test

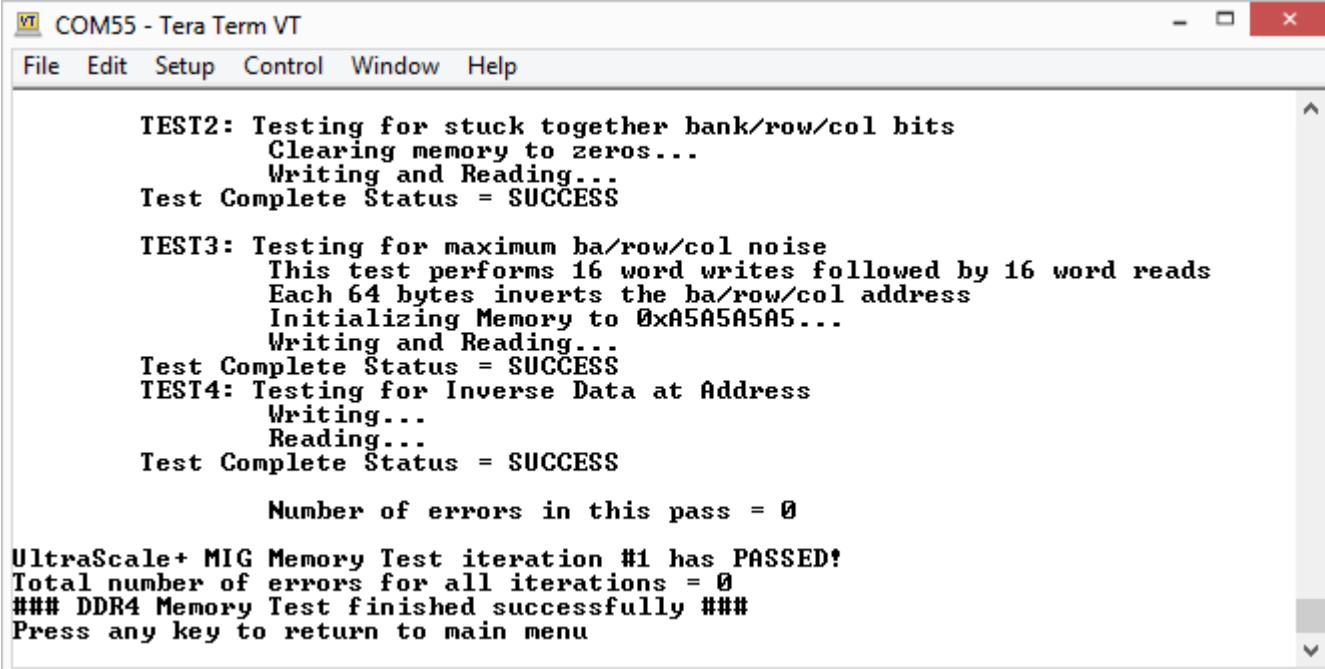
- » View various test patterns on monitor
- » Displays a series of patterns available in the Test Pattern Generator IP (see [PG103](#))



KCU116 IPI Design

> DDR4 External Memory Test

» Type 9 to begin DDR4 Memory Test



The screenshot shows a terminal window titled "COM55 - Tera Term VT". The window has a menu bar with "File", "Edit", "Setup", "Control", "Window", and "Help". The main text area displays the following output from a DDR4 memory test script:

```
TEST2: Testing for stuck together bank/row/col bits
      Clearing memory to zeros...
      Writing and Reading...
Test Complete Status = SUCCESS

TEST3: Testing for maximum ba/row/col noise
      This test performs 16 word writes followed by 16 word reads
      Each 64 bytes inverts the ba/row/col address
      Initializing Memory to 0xA5A5A5A5...
      Writing and Reading...
Test Complete Status = SUCCESS
TEST4: Testing for Inverse Data at Address
      Writing...
      Reading...
Test Complete Status = SUCCESS

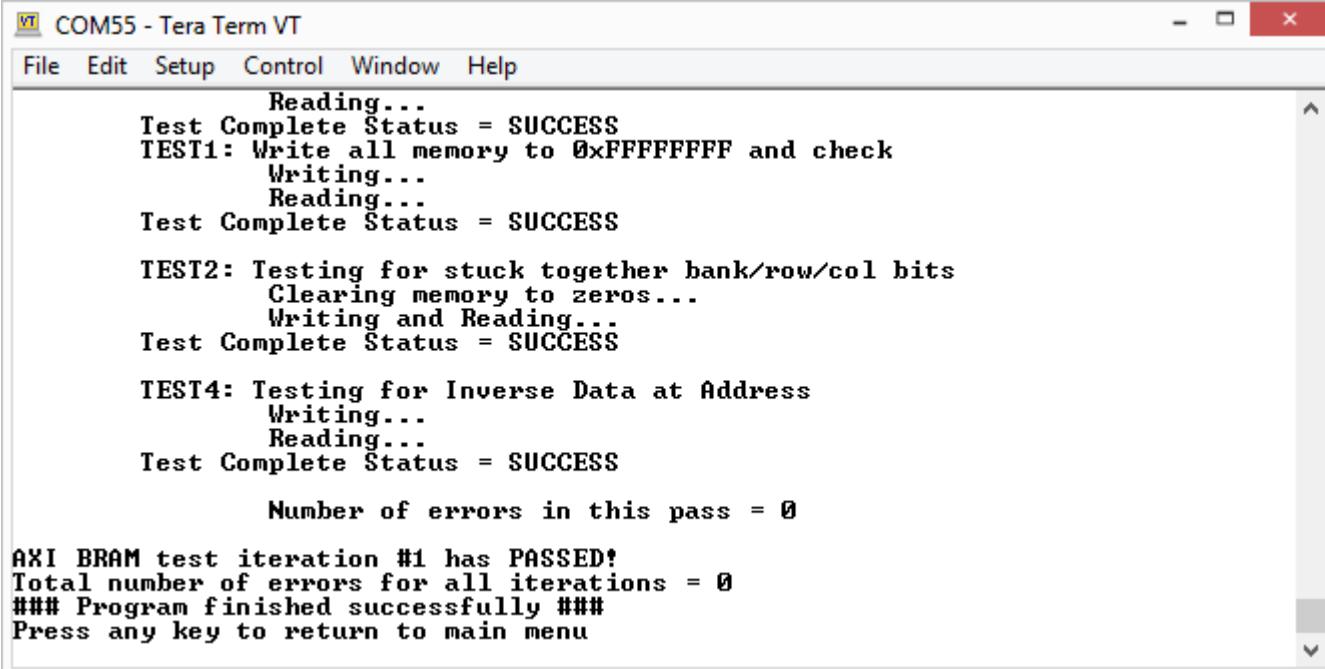
Number of errors in this pass = 0

UltraScale+ MIG Memory Test iteration #1 has PASSED!
Total number of errors for all iterations = 0
### DDR4 Memory Test finished successfully ####
Press any key to return to main menu
```

KCU116 IPI Design

> BRAM Internal Memory Test

» Type A to begin BRAM Memory Test



The screenshot shows a terminal window titled "COM55 - Tera Term VT". The window has a menu bar with "File", "Edit", "Setup", "Control", "Window", and "Help". The main pane displays the following text output:

```
Reading...
Test Complete Status = SUCCESS
TEST1: Write all memory to 0xFFFFFFFF and check
Writing...
Reading...
Test Complete Status = SUCCESS

TEST2: Testing for stuck together bank/row/col bits
Clearing memory to zeros...
Writing and Reading...
Test Complete Status = SUCCESS

TEST4: Testing for Inverse Data at Address
Writing...
Reading...
Test Complete Status = SUCCESS

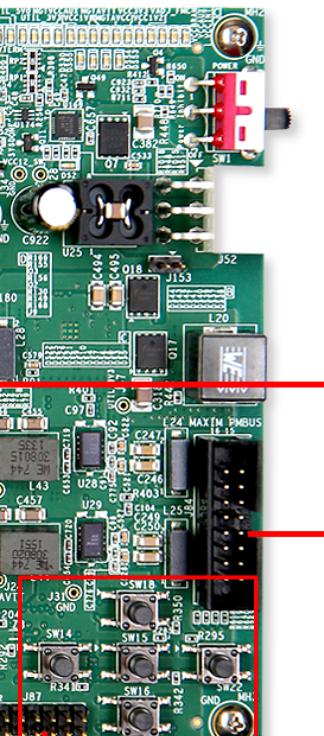
Number of errors in this pass = 0

AXI BRAM test iteration #1 has PASSED!
Total number of errors for all iterations = 0
### Program finished successfully ####
Press any key to return to main menu
```

KCU116 IPI Design

> Button Test

» Type B to begin Button Test



```
VT COM55 - Tera Term VT
File Edit Setup Control Window Help
G: System Monitor Test
Q: Exit
B

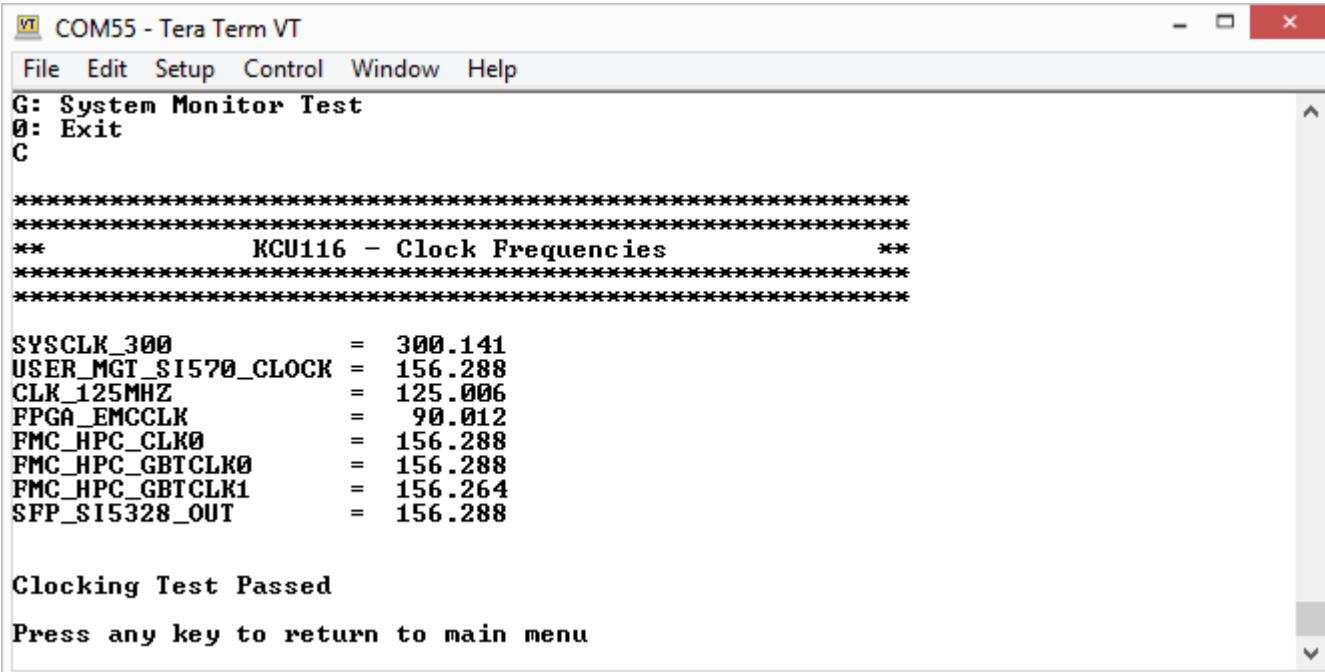
*****
**          KCU116 - Button Test          **
*****
Press west button
Press south button
Press east button
Press north button
Press center button
Press any button

Successfully ran GPIO Pushbutton Test
Press any key to return to main menu
```

KCU116 IPI Design

> Clock Test

- » This test requires the optional SMA cables and a second XM107 board
- » The clocks must be set up as detailed in XTP464
- » Type C to begin Clock Test



The screenshot shows a terminal window titled "COM55 - Tera Term VT". The menu bar includes File, Edit, Setup, Control, Window, and Help. The main window displays a "System Monitor Test" menu with options G: System Monitor Test, Q: Exit, and C. Below this, a section titled "KCU116 - Clock Frequencies" lists various clock frequencies:

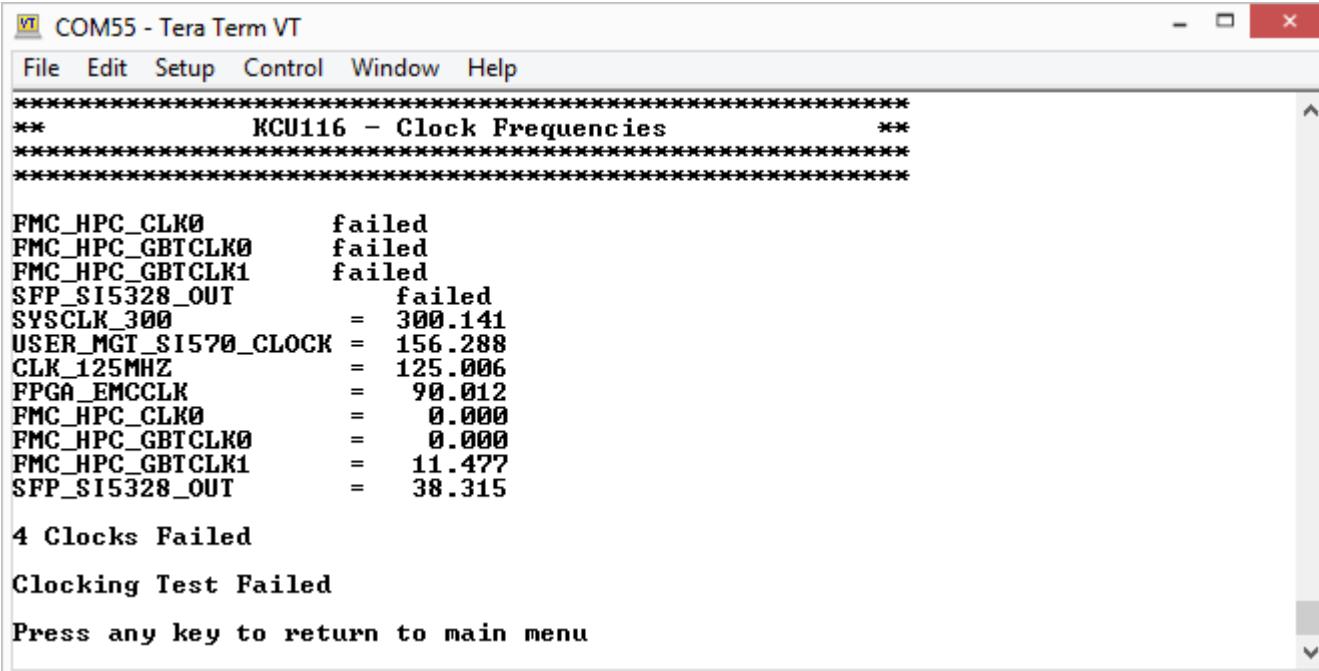
Clock Name	Frequency
SYSCLK_300	300.141
USER_MGT_SI570_CLOCK	156.288
CLK_125MHZ	125.006
FPGA_EMCCCLK	90.012
FMC_HPC_CLK0	156.288
FMC_HPC_GBTCLK0	156.288
FMC_HPC_GBTCLK1	156.264
SFP_SI5328_OUT	156.288

At the bottom of the window, the text "Clocking Test Passed" is displayed, followed by "Press any key to return to main menu".

KCU116 IPI Design

> Clock Test

- » Without the proper set up, and an XM107 board, several clocks will not show a correct frequency
- » The Si5328 must be set to 156.25 MHz after a power cycle



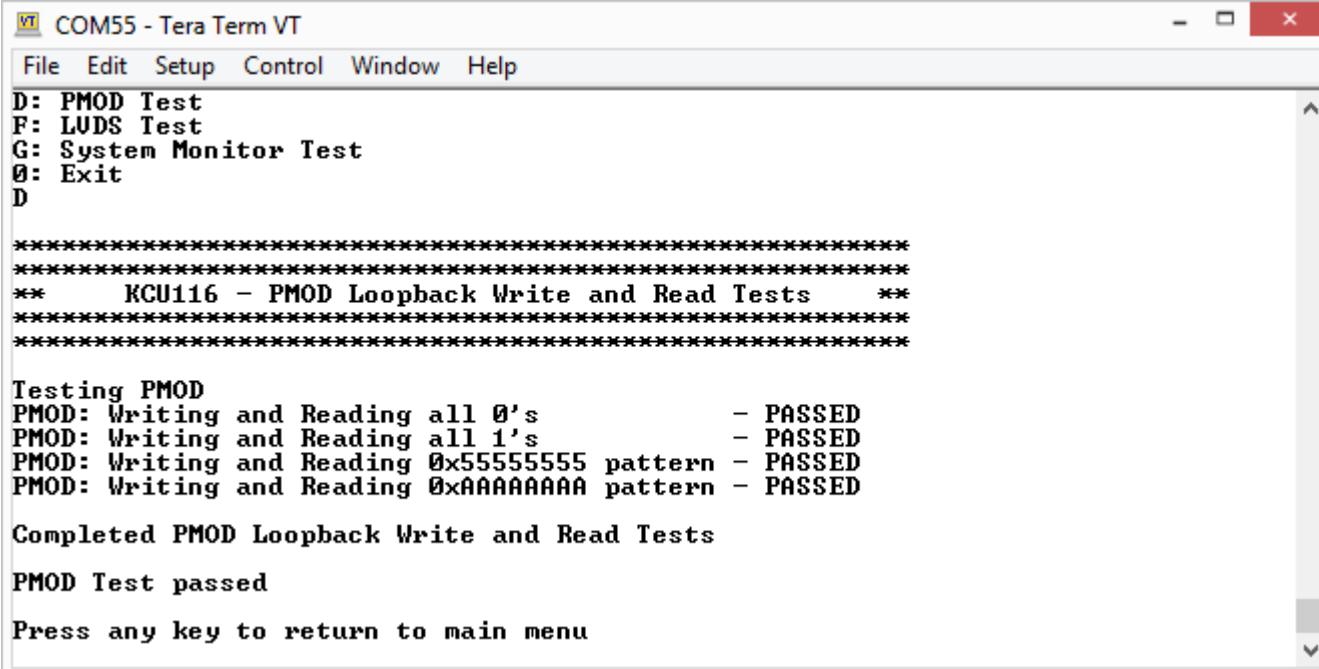
The screenshot shows a terminal window titled "COM55 - Tera Term VT". The window has a menu bar with File, Edit, Setup, Control, Window, and Help. The main text area displays the following output:

```
*****  
**          KCU116 - Clock Frequencies      **  
*****  
  
FMC_HPC_CLK0      failed  
FMC_HPC_GBTCLK0   failed  
FMC_HPC_GBTCLK1   failed  
SFP_SI5328_OUT    failed  
SYSCLK_300         = 300.141  
USER_MGT_SI570_CLOCK = 156.288  
CLK_125MHZ        = 125.006  
FPGA_EMCCCLK      = 90.012  
FMC_HPC_CLK0      = 0.000  
FMC_HPC_GBTCLK0   = 0.000  
FMC_HPC_GBTCLK1   = 11.477  
SFP_SI5328_OUT    = 38.315  
  
4 Clocks Failed  
  
Clocking Test Failed  
  
Press any key to return to main menu
```

KCU116 IPI Design

> PMOD Loopback Test

- » This test requires the optional PMOD jumpers
- » Type D to begin PMOD Loopback Test



The screenshot shows a terminal window titled "COM55 - Tera Term VT". The menu bar includes File, Edit, Setup, Control, Window, and Help. The main window displays the following text:

```
D: PMOD Test
F: LVDS Test
G: System Monitor Test
Q: Exit
D

*****
**      KCU116 - PMOD Loopback Write and Read Tests      **
*****
Testing PMOD
PMOD: Writing and Reading all 0's          - PASSED
PMOD: Writing and Reading all 1's          - PASSED
PMOD: Writing and Reading 0x55555555 pattern - PASSED
PMOD: Writing and Reading 0xAAAAAAA pattern - PASSED

Completed PMOD Loopback Write and Read Tests

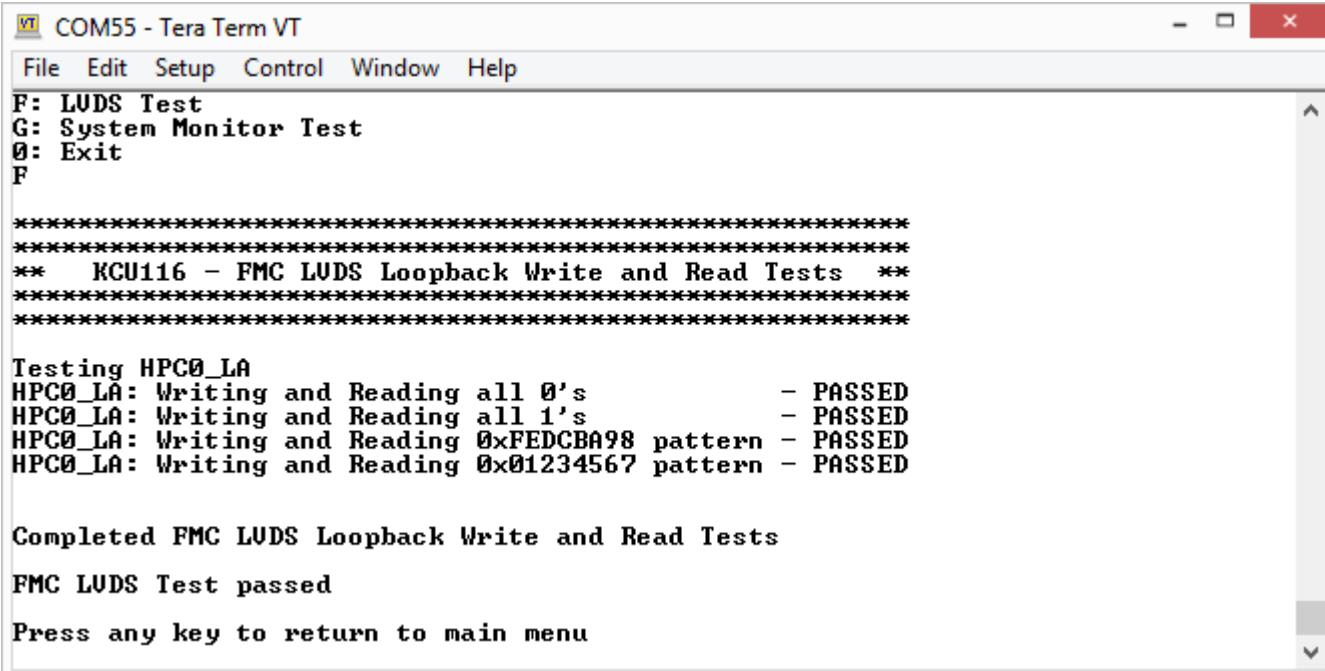
PMOD Test passed

Press any key to return to main menu
```

KCU116 IPI Design

> LVDS Loopback Test

- » This test requires an XM107 board
- » Type F to begin LVDS Loopback Test



The screenshot shows a terminal window titled "COM55 - Tera Term VT". The menu bar includes File, Edit, Setup, Control, Window, and Help. The main window displays the following text:

```
F: LVDS Test
G: System Monitor Test
Q: Exit
F

*****
** KCU116 - FMC LVDS Loopback Write and Read Tests **
*****

Testing HPC0_LA
HPC0_LA: Writing and Reading all 0's          - PASSED
HPC0_LA: Writing and Reading all 1's          - PASSED
HPC0_LA: Writing and Reading 0xFEDCBA98 pattern - PASSED
HPC0_LA: Writing and Reading 0x01234567 pattern - PASSED

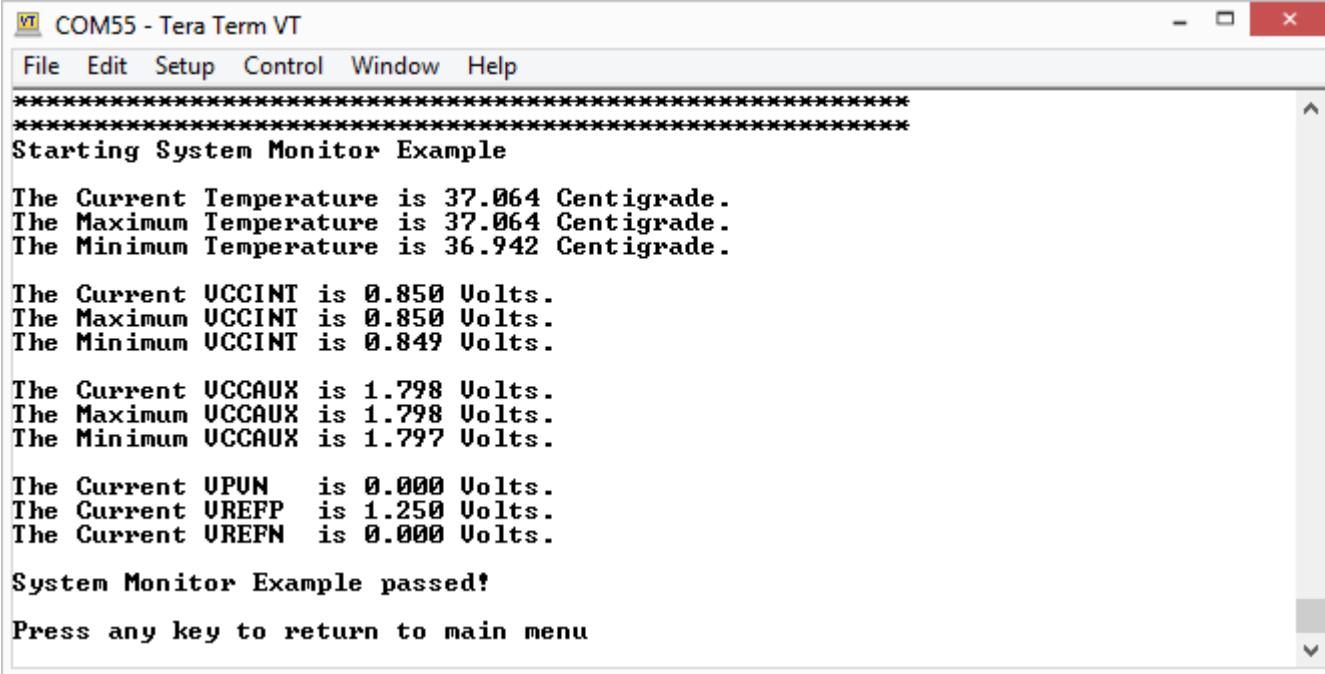
Completed FMC LVDS Loopback Write and Read Tests
FMC LVDS Test passed
Press any key to return to main menu
```

Note: VADJ must be set to 1.2 V or higher

KCU116 IPI Design

> System Monitor Test

» Type G to begin System Monitor Test



```
*****  
***** Starting System Monitor Example  
*****  
The Current Temperature is 37.064 Centigrade.  
The Maximum Temperature is 37.064 Centigrade.  
The Minimum Temperature is 36.942 Centigrade.  
  
The Current UCCINT is 0.850 Volts.  
The Maximum UCCINT is 0.850 Volts.  
The Minimum UCCINT is 0.849 Volts.  
  
The Current UCCAUX is 1.798 Volts.  
The Maximum UCCAUX is 1.798 Volts.  
The Minimum UCCAUX is 1.797 Volts.  
  
The Current UPUN is 0.000 Volts.  
The Current UREFP is 1.250 Volts.  
The Current UREFN is 0.000 Volts.  
  
System Monitor Example passed!  
Press any key to return to main menu
```

Compile KCU116 IPI Design



Compile KCU116 IPI Design

> Open Vivado

Start → All Programs → Xilinx Design Tools → Vivado 2019.1 → Vivado

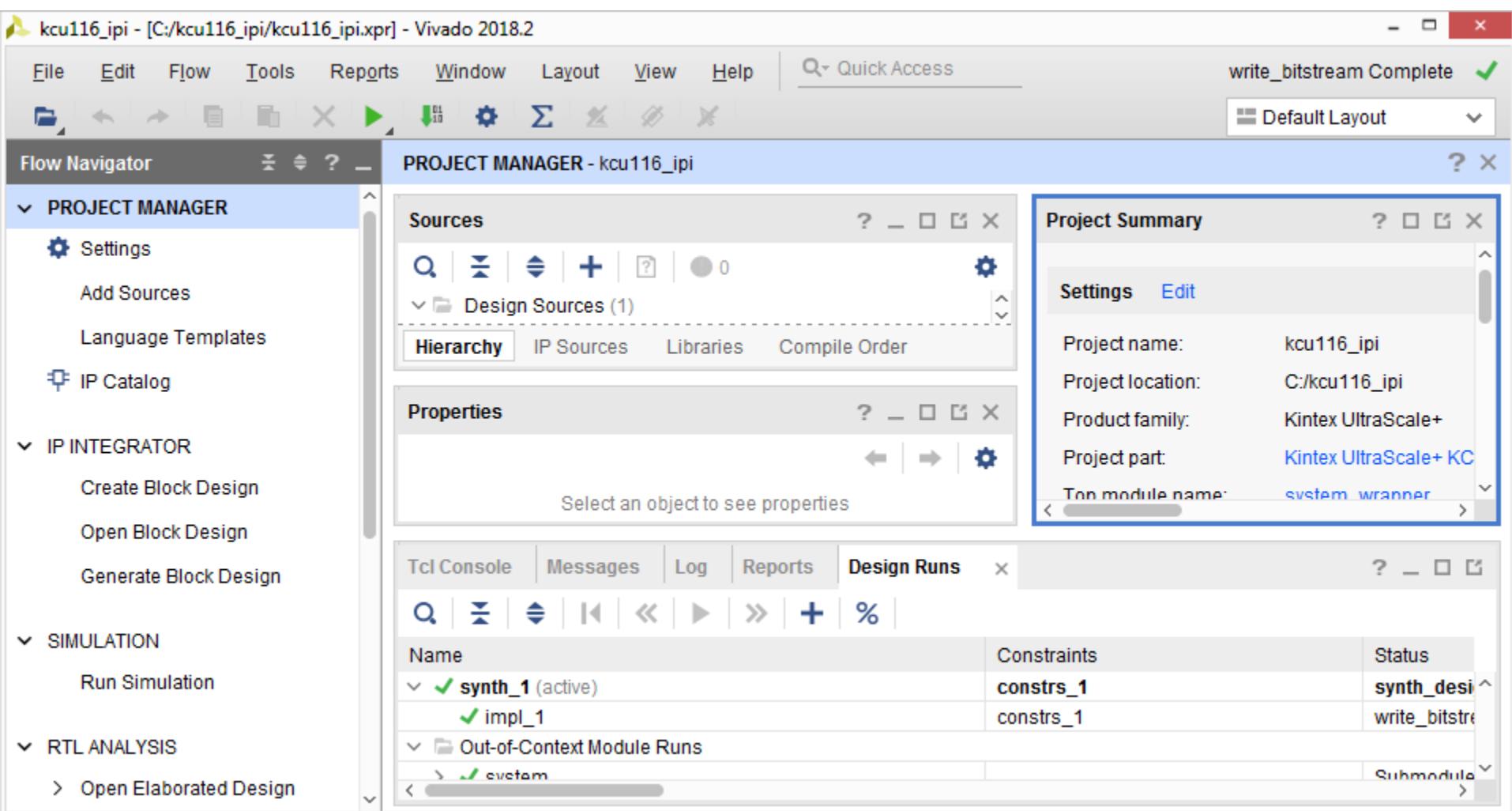
> Select Open Project



Compile KCU116 IPI Design

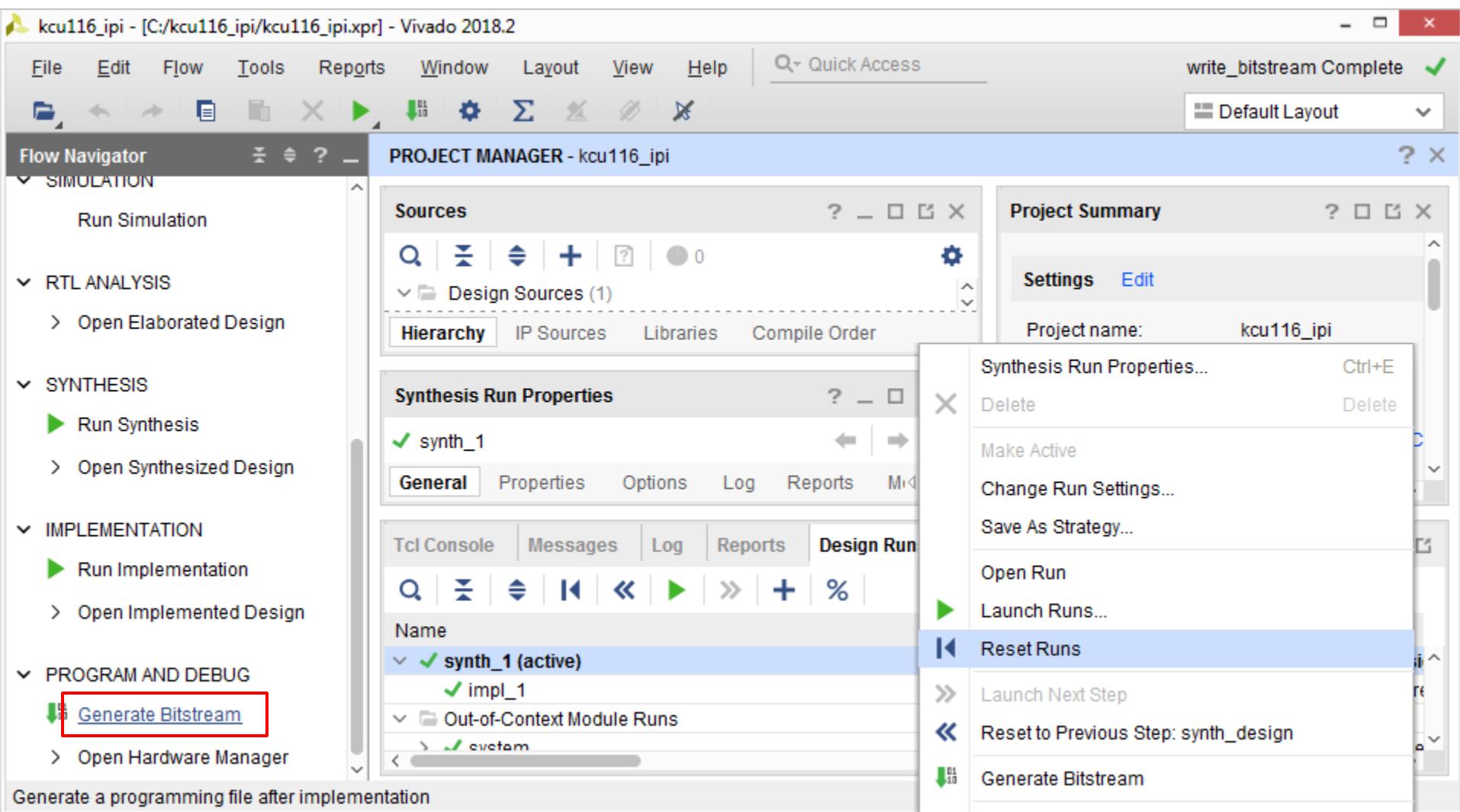
> Open the KCU116 Design:

» <Design Name>\kcu116_ipi\kcu116_ipi.xpr



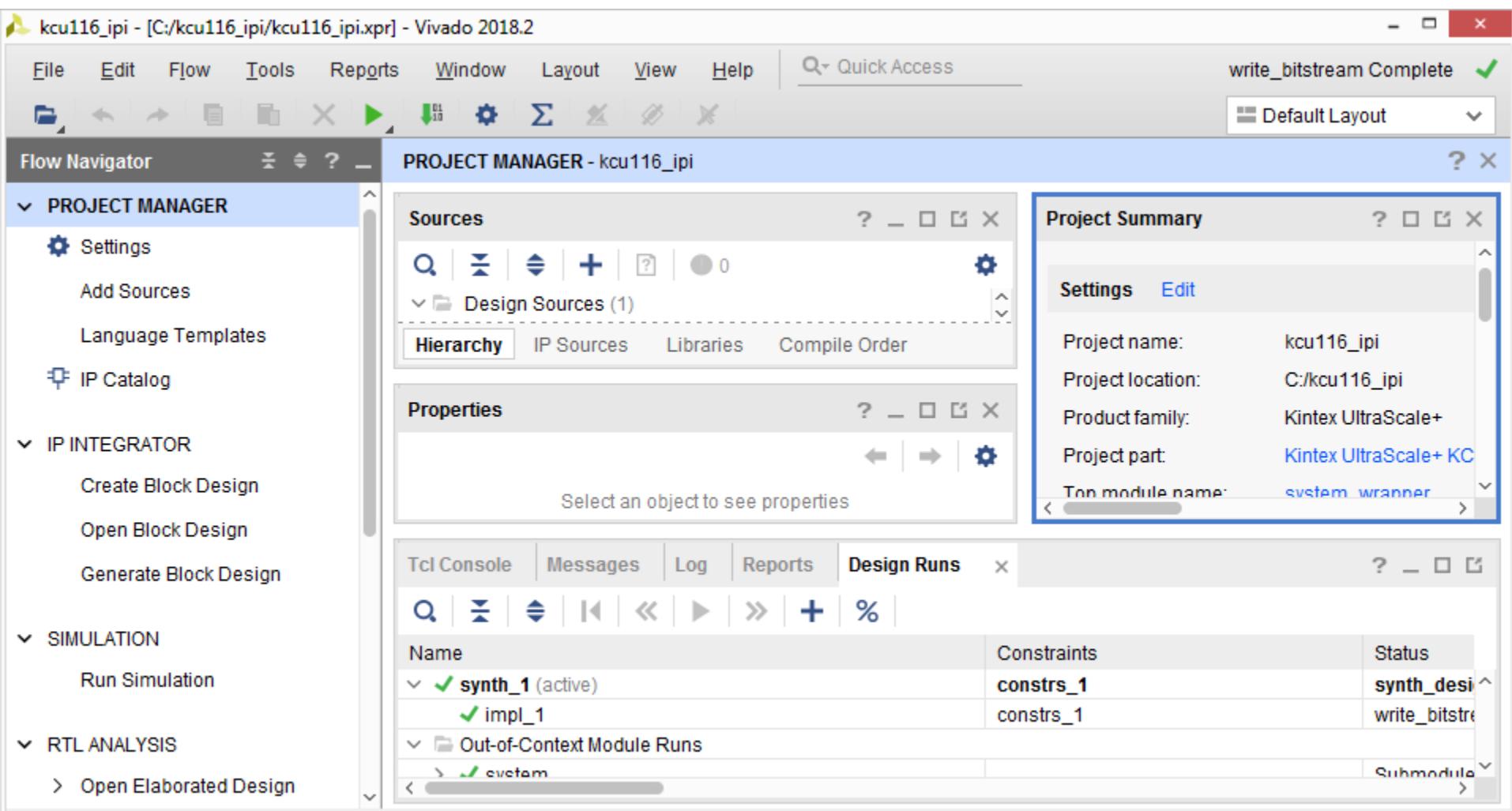
Compile KCU116 IPI Design

- > The design is fully implemented; you can recompile, or export to SDK
 - » To recompile, right-click synth_1, select Reset Runs then Generate Bitstream



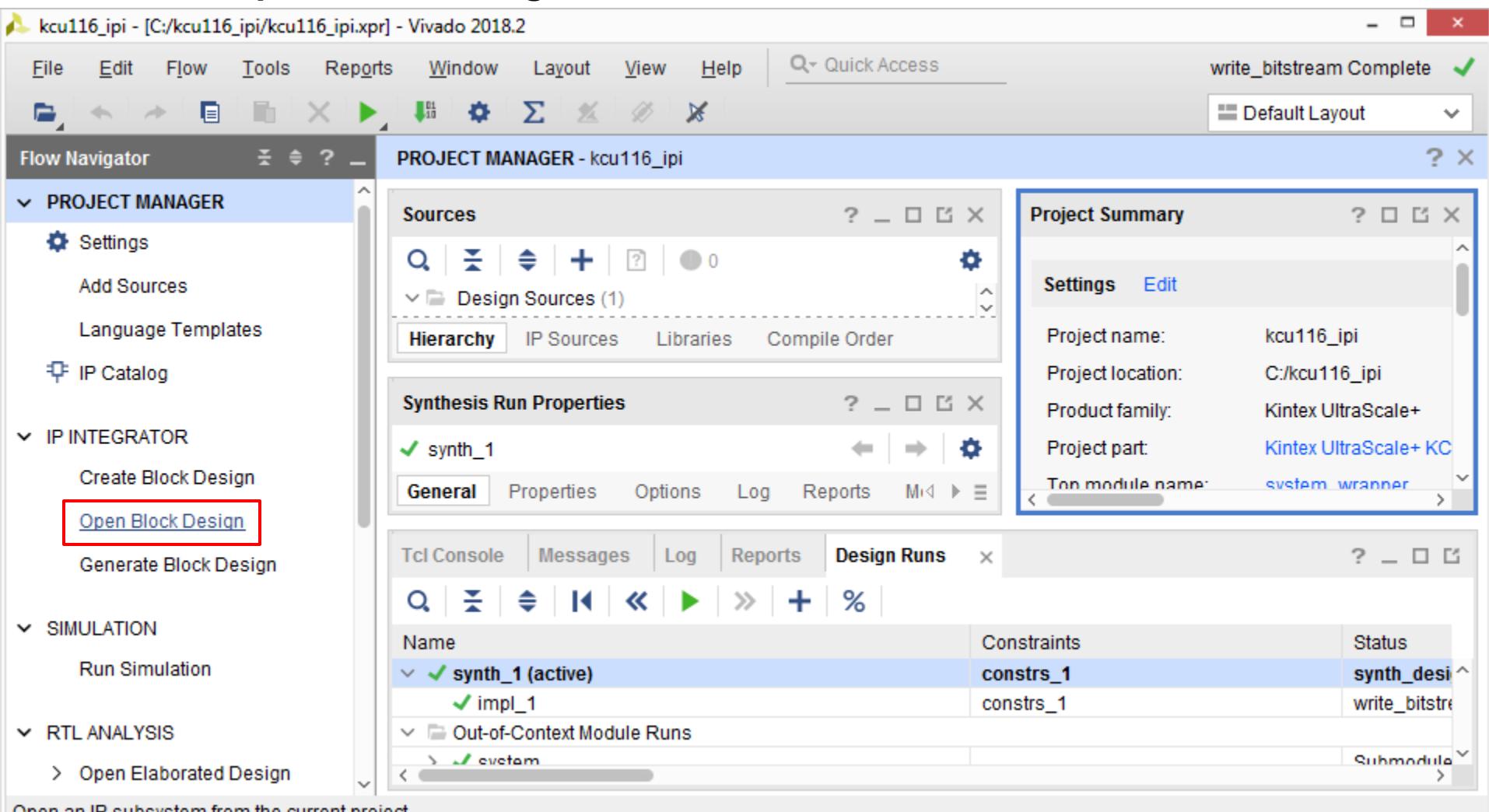
Compile KCU116 IPI Design

- Once done, both the Synthesis and Implementation will have green check marks



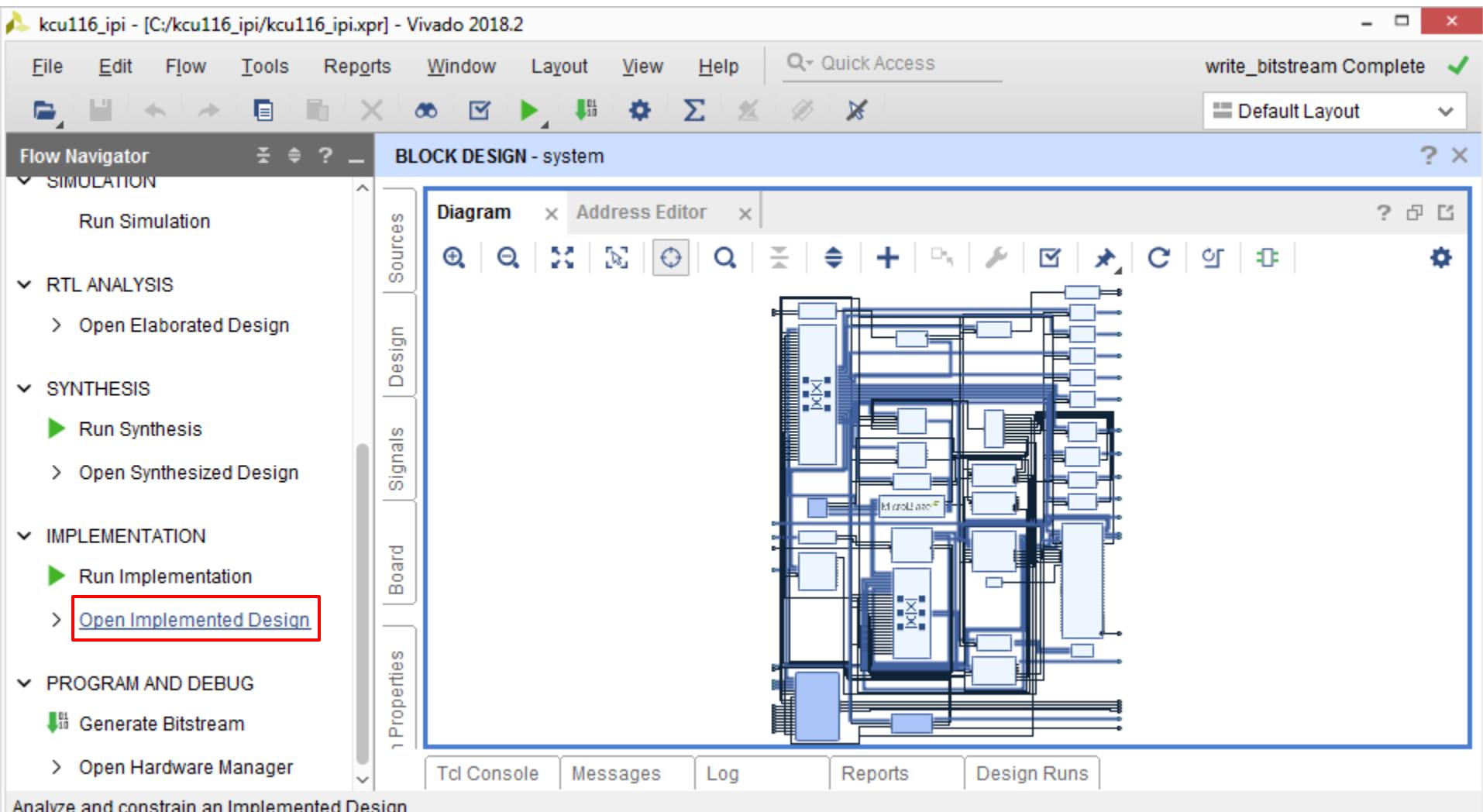
Compile KCU116 IPI Design

- > The IPI Design has been implemented with IP Integrator (IPI)
- > Click Open Block Design



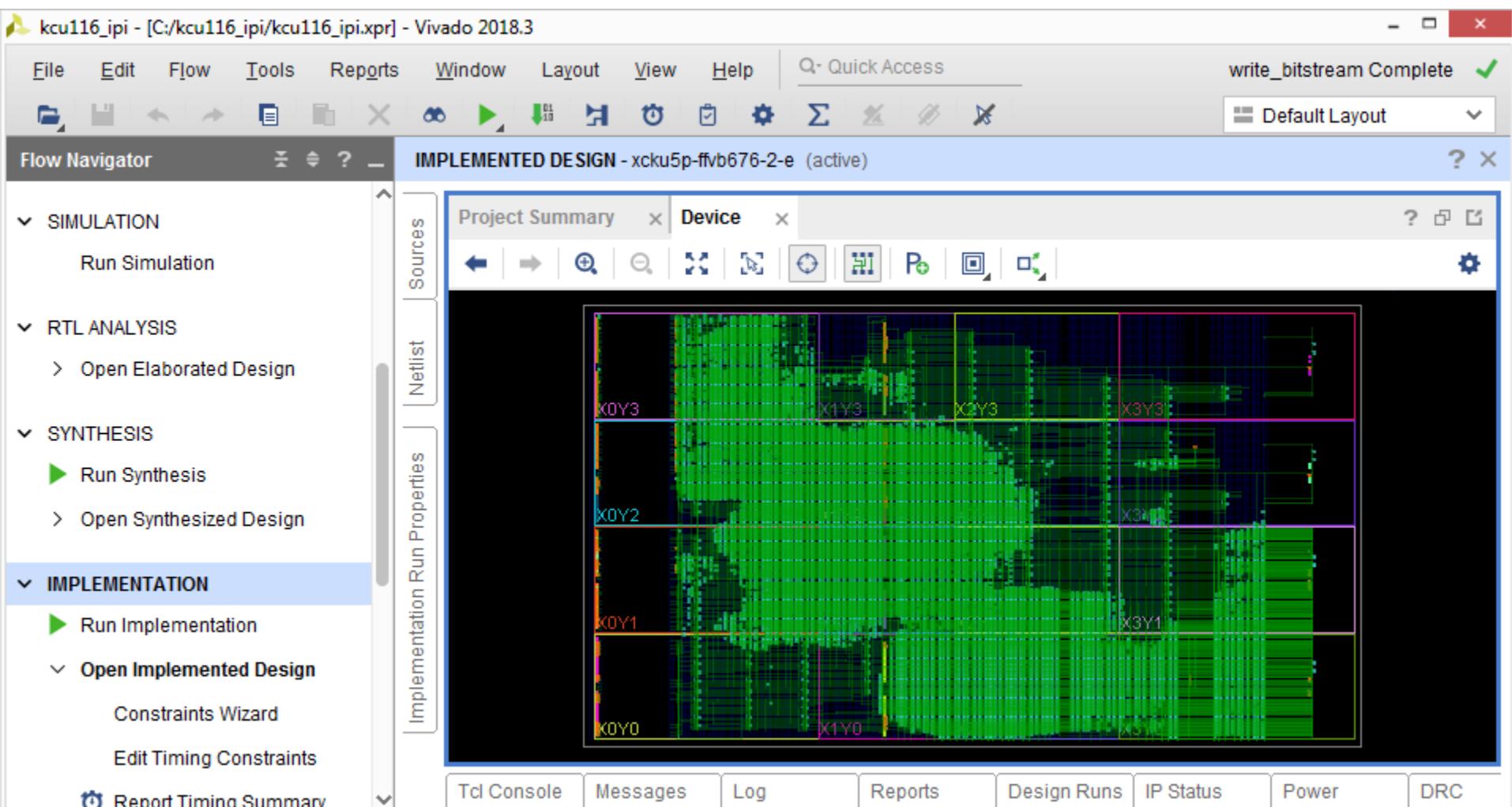
Compile KCU116 IPI Design

- > All the IP Blocks used in the design can be seen in this view
- > Click Open Implemented Design



Compile KCU116 IPI Design

> View Implemented Design

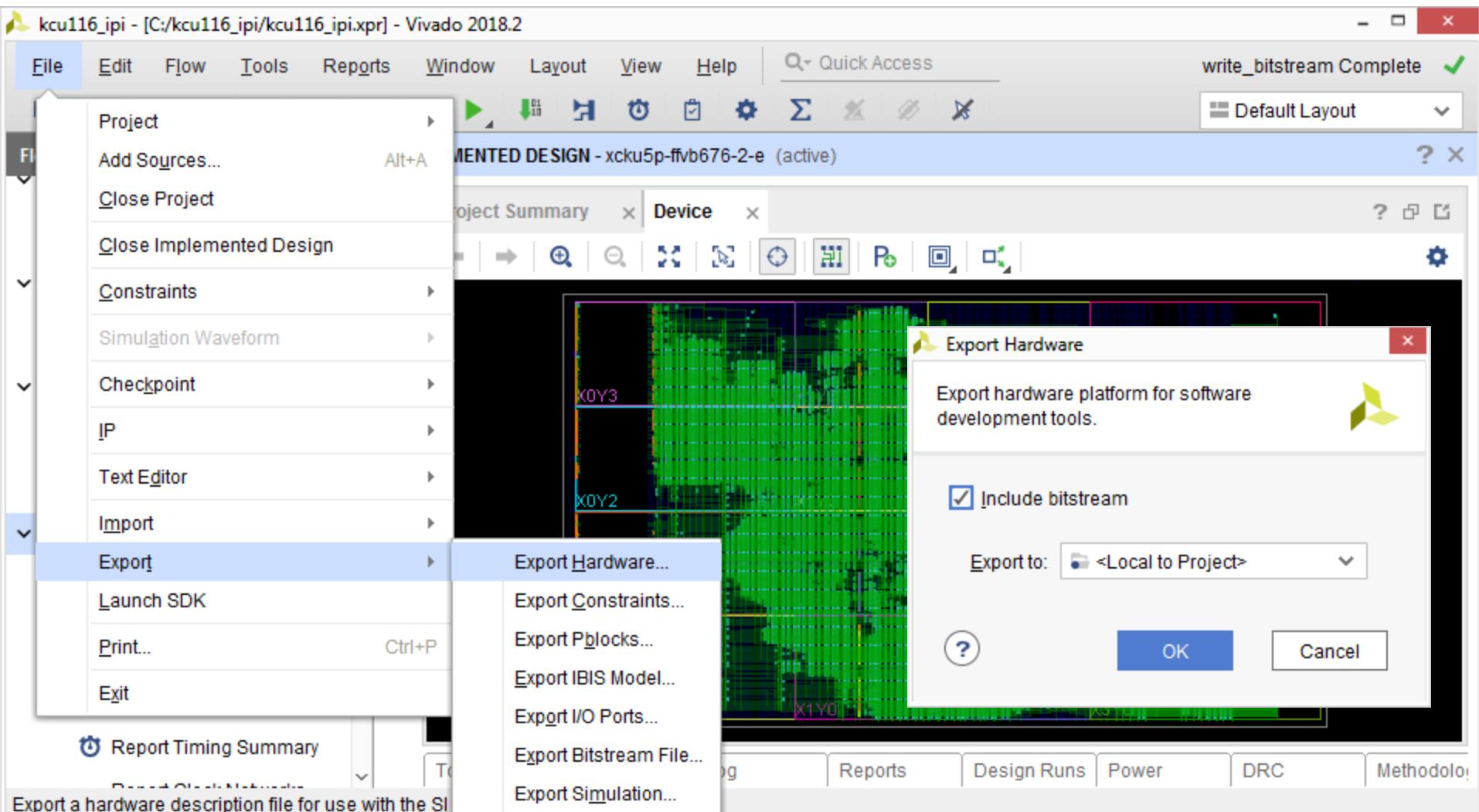


Note: Presentation applies to the KCU116

 XILINX

Compile KCU116 IPI Design

- > Select File → Export → Export Hardware
- > Click OK

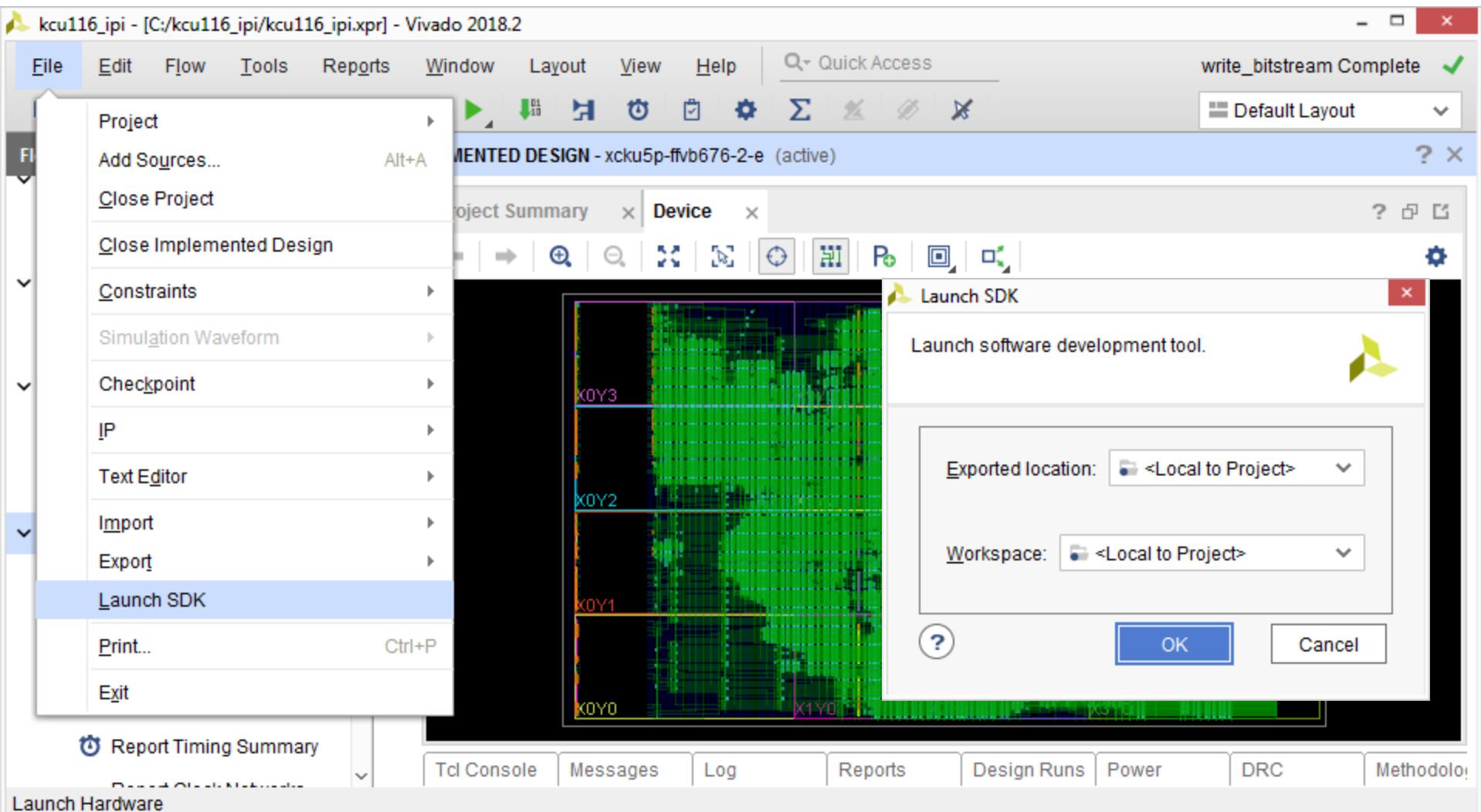


Note: Presentation applies to the KCU116

 XILINX

Compile KCU116 IPI Design

- > Select File → Launch SDK
- > Click OK



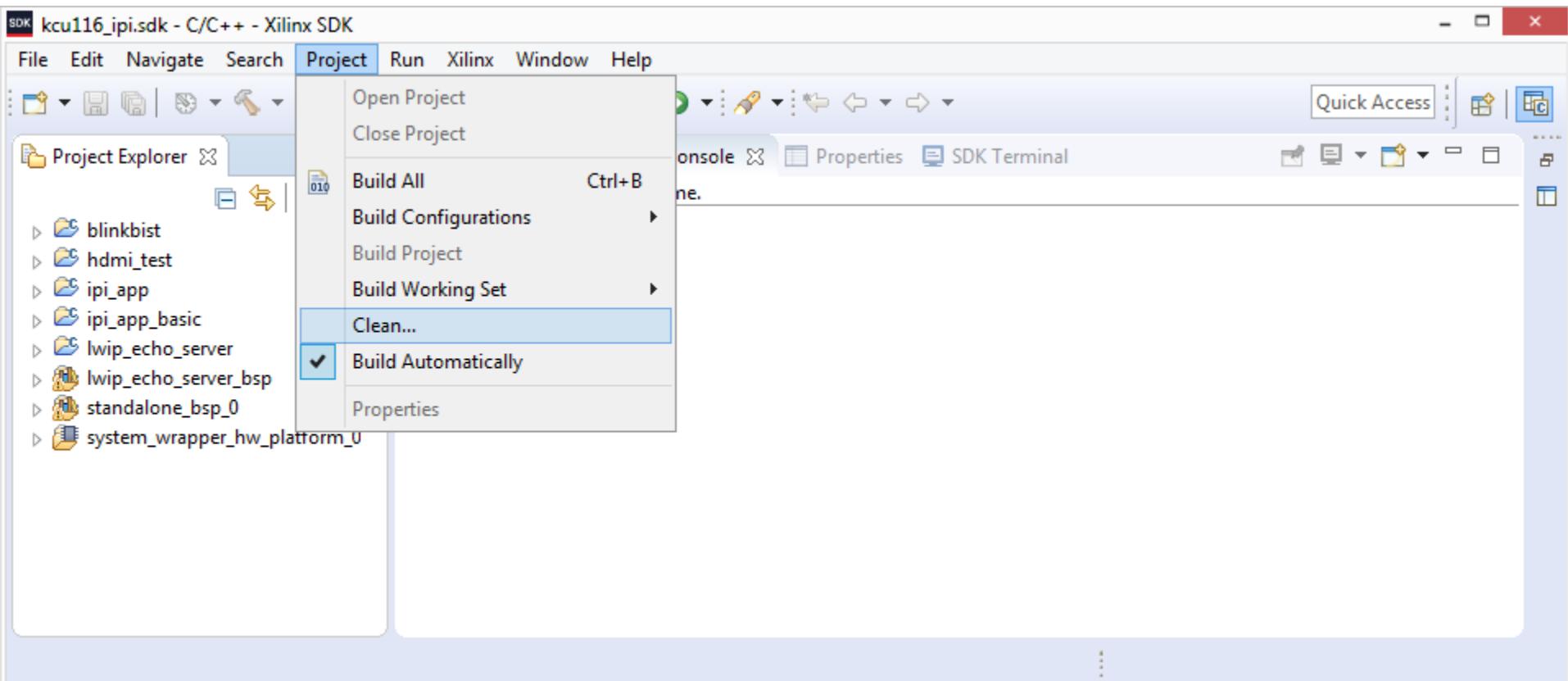
Note: Presentation applies to the KCU116

 XILINX

Compile KCU116 Software in SDK

> SDK Software Compile - Build ELF files in SDK

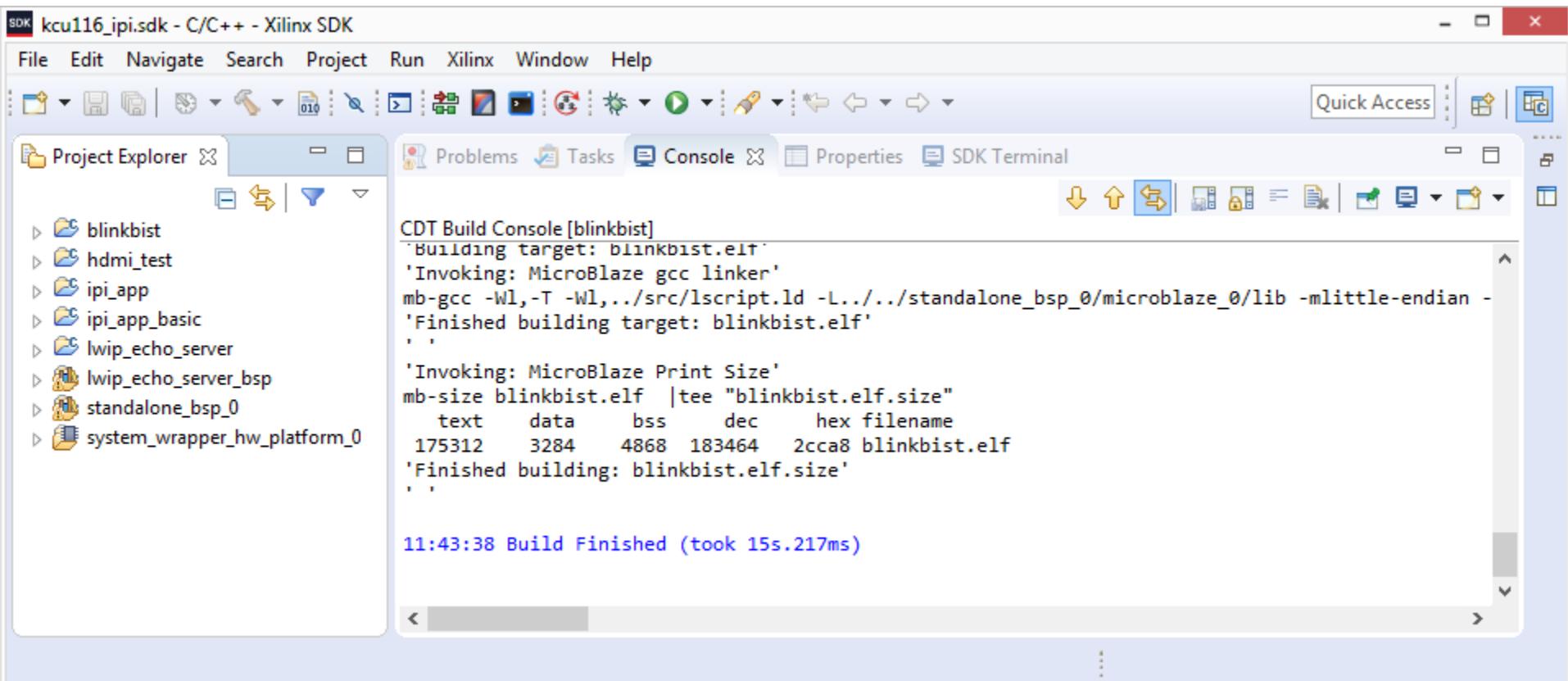
» Select Project → Clean...



Compile KCU116 Software in SDK

> SDK Software Compile - Build ELF files in SDK

» When done, close SDK and return to Vivado



The screenshot shows the Xilinx SDK interface with the title bar "SDK kcu116_ipi.sdk - C/C++ - Xilinx SDK". The menu bar includes File, Edit, Navigate, Search, Project, Run, Xilinx, Window, and Help. The toolbar has various icons for file operations. The left sidebar is the "Project Explorer" showing projects like blinkbist, hdmi_test, ipi_app, ipi_app_basic, lwip_echo_server, lwip_echo_server_bsp, standalone_bsp_0, and system_wrapper_hw_platform_0. The main area is the "Console" tab, which displays the build log for the "blinkbist" target:

```
CDT Build Console [blinkbist]
'Building target: blinkbist.elf'
'Invoking: MicroBlaze gcc linker'
mb-gcc -Wl,-T -Wl,../src/lscript.ld -L../../standalone_bsp_0/microblaze_0/lib -mlittle-endian -
'Finished building target: blinkbist.elf'
'

'Invoking: MicroBlaze Print Size'
mb-size blinkbist.elf |tee "blinkbist.elf.size"
    text      data      bss      dec      hex filename
 175312      3284     4868   183464   2cca8 blinkbist.elf
'Finished building: blinkbist.elf.size'
'

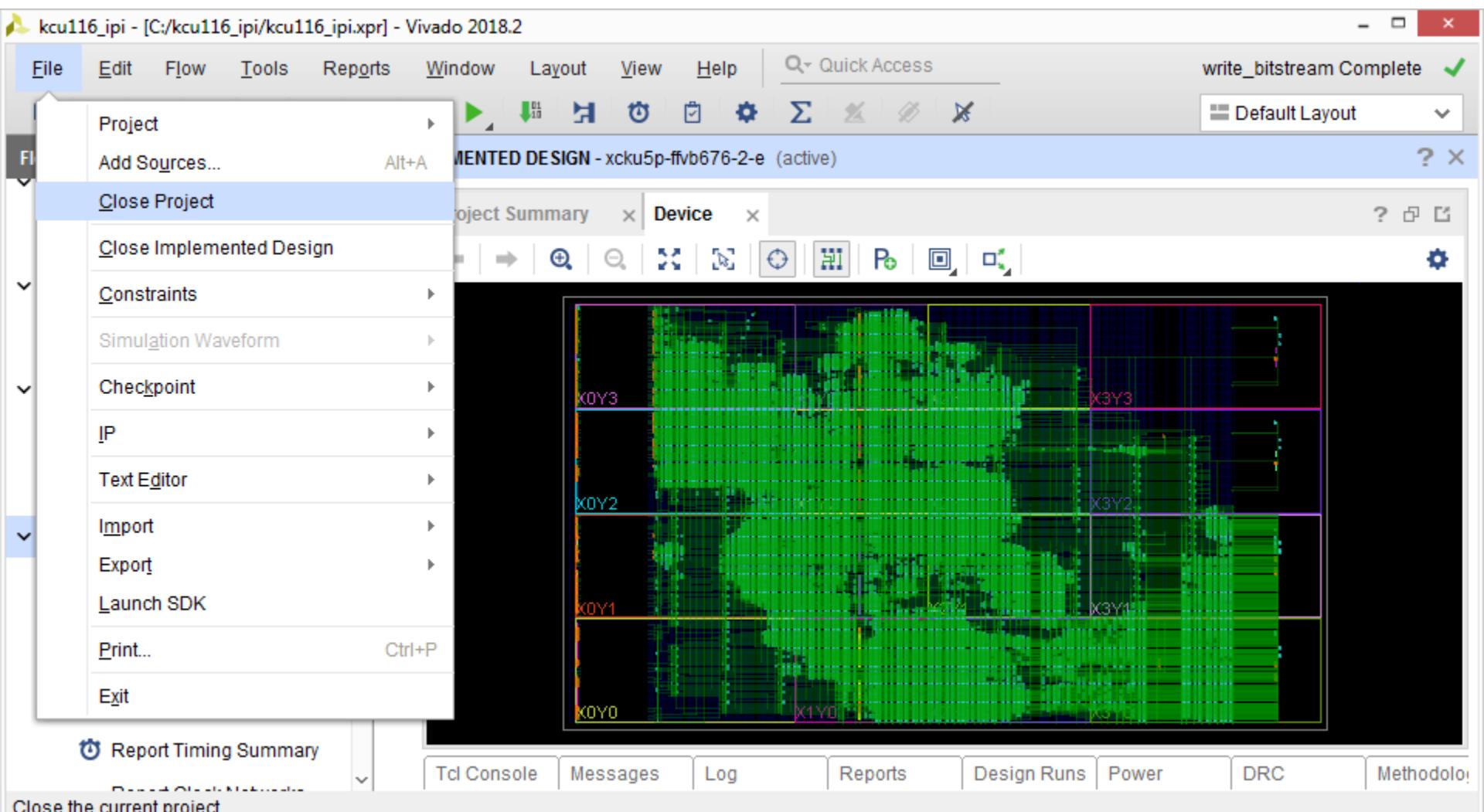
11:43:38 Build Finished (took 15s.217ms)
```

Program KCU116 with BlinkBIST/IPI Designs



Program KCU116 with BlinkBIST/IPI Designs

> Close the Project



Note: Presentation applies to the KCU116

 XILINX

Program KCU116 with BlinkBIST/IPI Designs

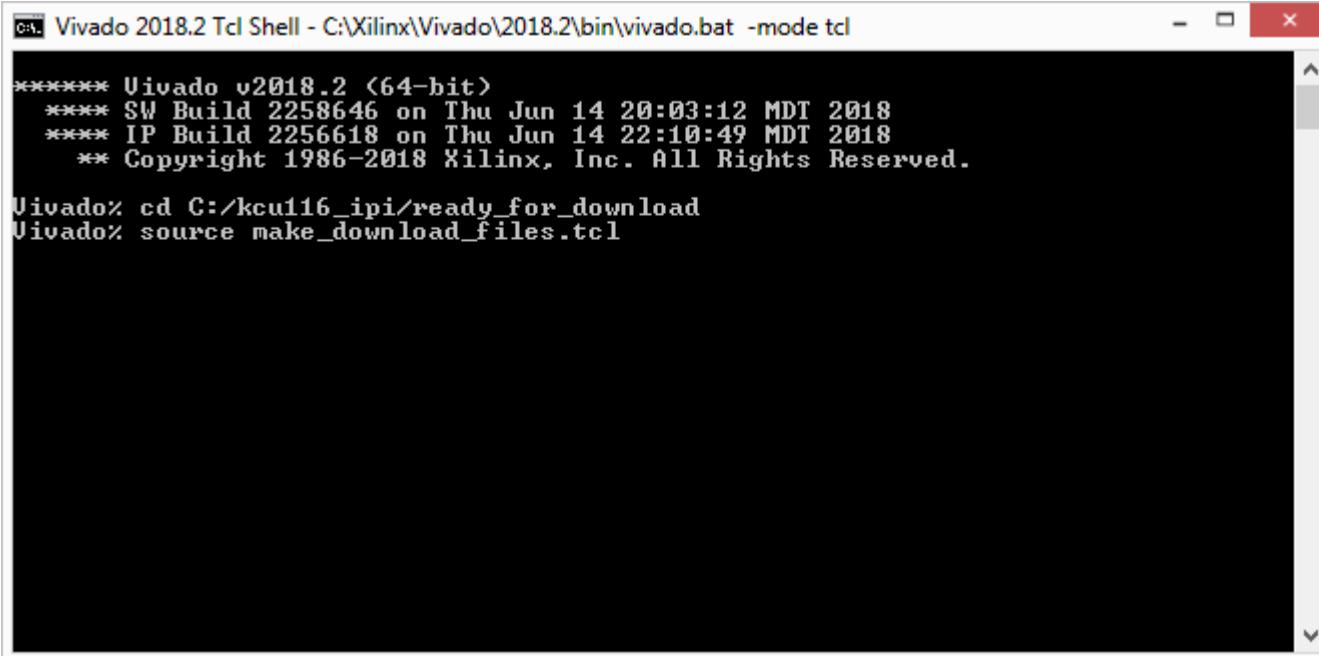
> Program the bitstreams with ELF files

> Open a Vivado Tcl shell and type:

```
cd C:/kcu116_ipi/ready_for_download
```

```
source make_download_files.tcl
```

> This script uses Tcl commands to add the ELF files to the IPI project, then generates the various bitstreams



The screenshot shows a Windows command-line interface window titled "Vivado 2018.2 Tcl Shell - C:\Xilinx\Vivado\2018.2\bin\vivado.bat -mode tcl". The window displays the following text:

```
***** Vivado v2018.2 (64-bit)
***** SW Build 2258646 on Thu Jun 14 20:03:12 MDT 2018
***** IP Build 2256618 on Thu Jun 14 22:10:49 MDT 2018
** Copyright 1986-2018 Xilinx, Inc. All Rights Reserved.

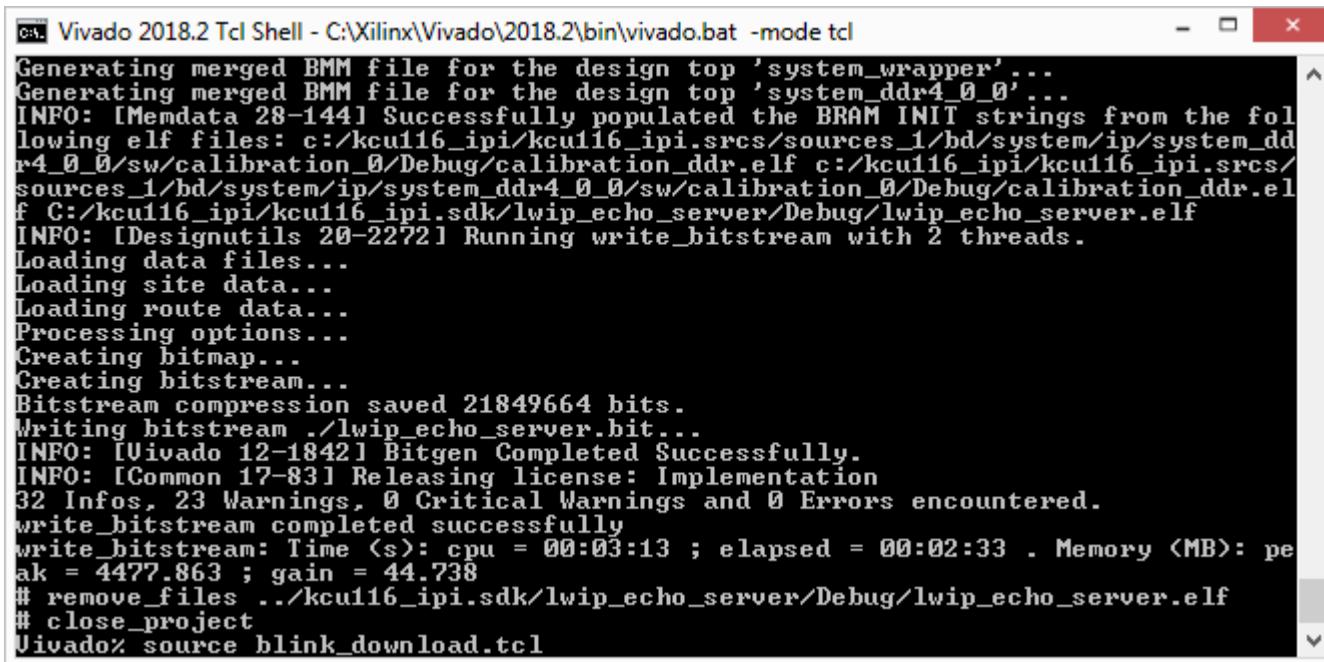
Vivado> cd C:/kcu116_ipi/ready_for_download
Vivado> source make_download_files.tcl
```

Program KCU116 with BlinkBIST/IPI Designs

> Download the BlinkBIST bitstream

> In the Vivado Tcl Shell type:

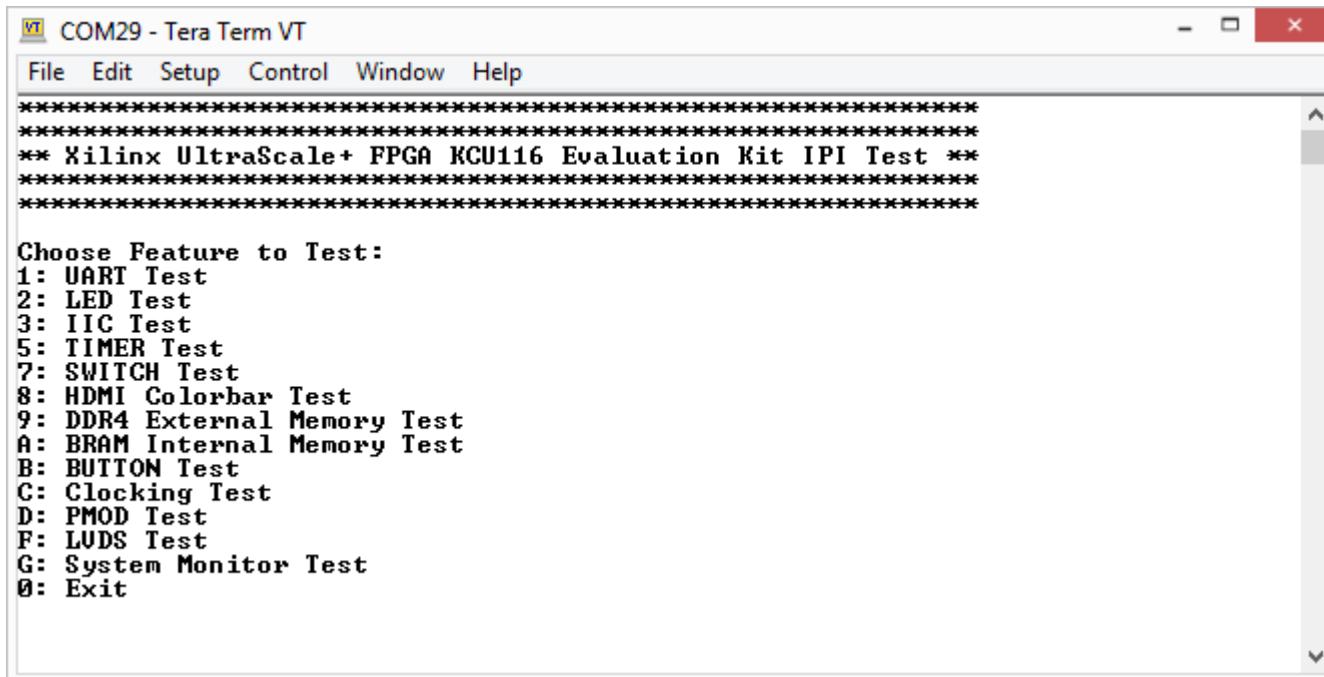
```
source blink_download.tcl
```



```
Vivado 2018.2 Tcl Shell - C:\Xilinx\Vivado\2018.2\bin\vivado.bat -mode tcl
Generating merged BMM file for the design top 'system_wrapper'...
Generating merged BMM file for the design top 'system_ddr4_0_0'...
INFO: [Memdata 28-144] Successfully populated the BRAM INIT strings from the following elf files: c:/kcu116_ipi/kcu116_ipi.srcs/sources_1/bd/system/ip/system_ddr4_0_0/sw/calibration_0/Debug/calibration_ddr.elf c:/kcu116_ipi/kcu116_ipi.srcs/sources_1/bd/system/ip/system_ddr4_0_0/sw/calibration_0/Debug/calibration_ddr.elf C:/kcu116_ipi/kcu116_ipi.sdk/lwip_echo_server/Debug/lwip_echo_server.elf
INFO: [Designutils 20-2272] Running write_bitstream with 2 threads.
Loading data files...
Loading site data...
Loading route data...
Processing options...
Creating bitmap...
Creating bitstream...
Bitstream compression saved 21849664 bits.
Writing bitstream ./lwip_echo_server.bit...
INFO: [Uvivo 12-1842] Bitgen Completed Successfully.
INFO: [Common 17-831] Releasing license: Implementation
32 Infos, 23 Warnings, 0 Critical Warnings and 0 Errors encountered.
write_bitstream completed successfully
write_bitstream: Time <s>: cpu = 00:03:13 ; elapsed = 00:02:33 . Memory <MB>: peak = 4477.863 ; gain = 44.738
# remove_files ../kcu116_ipi.sdk/lwip_echo_server/Debug/lwip_echo_server.elf
# close_project
Vivado% source blink_download.tcl
```

Program KCU116 with BlinkBIST/IPI Designs

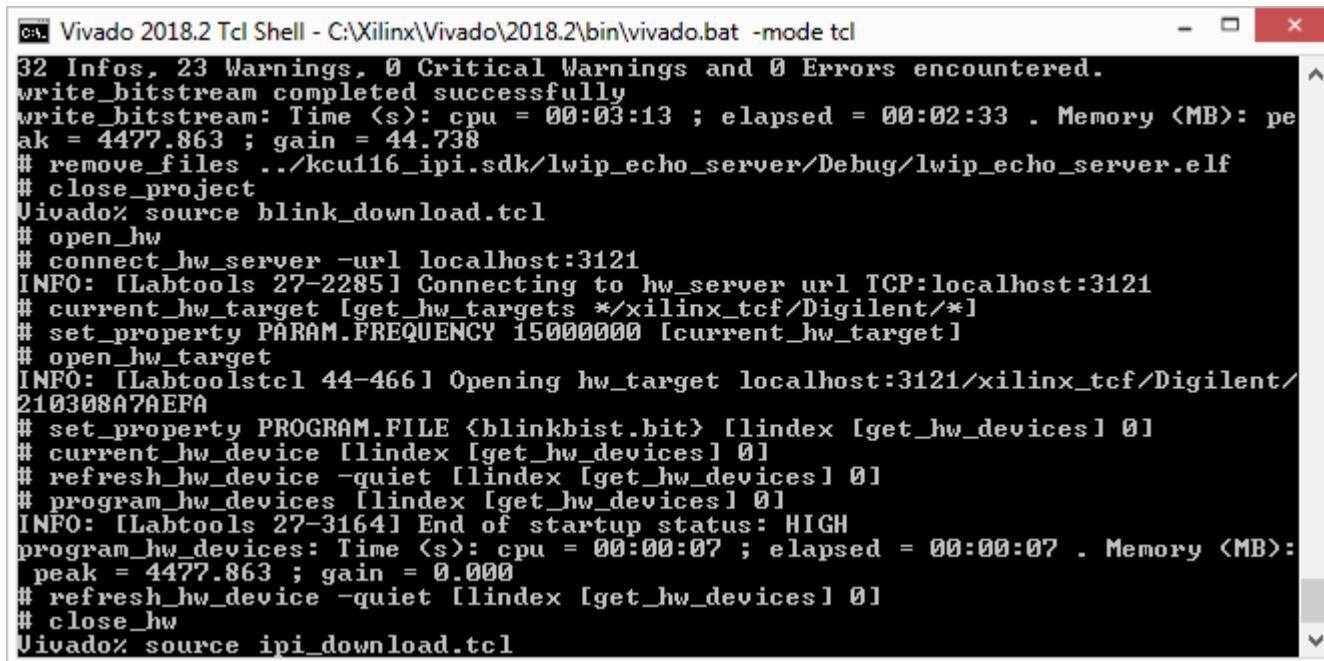
- > After the Quick Start tests are finished, view the initial IPI Test screen



Program KCU116 with BlinkBIST/IPI Designs

- > Download the IPI bitstream
- > In the Vivado Tcl Shell type:

```
source ipi_download.tcl
```

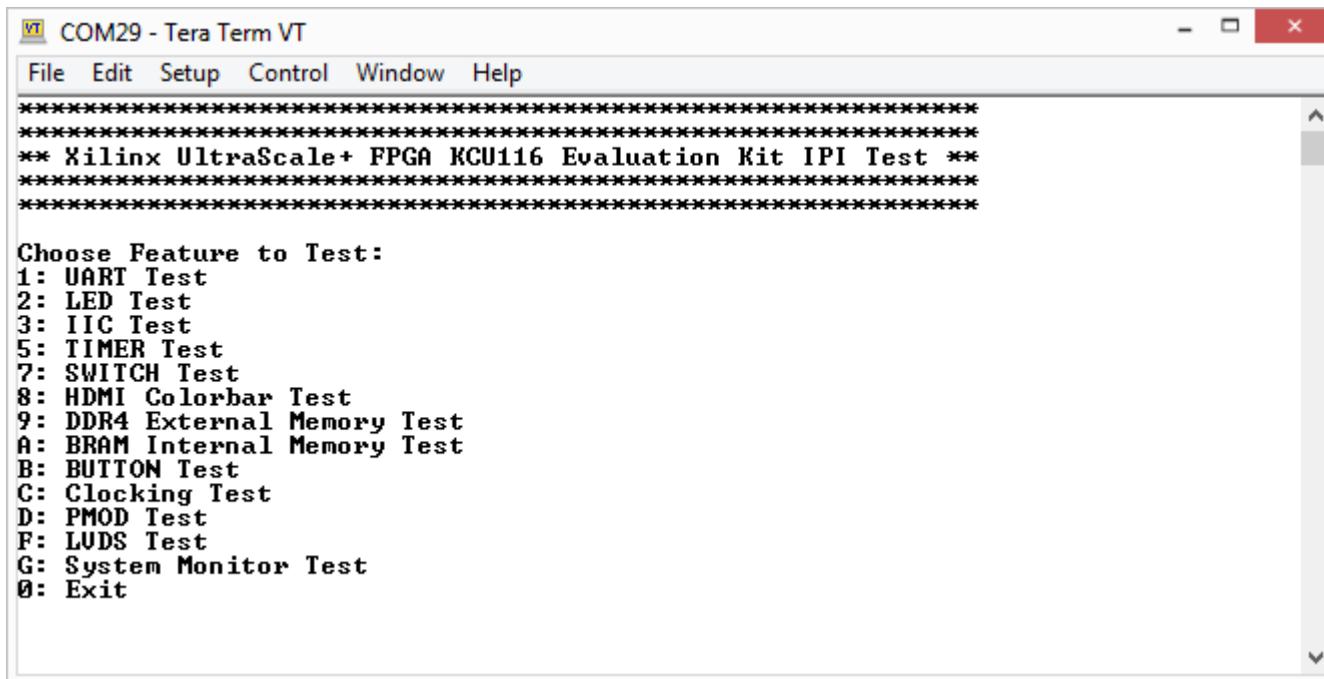


The screenshot shows a Windows command prompt window titled "Vivado 2018.2 Tcl Shell - C:\Xilinx\Vivado\2018.2\bin\vivado.bat -mode tcl". The window displays the output of a Tcl script named "ipi_download.tcl". The script performs several actions: it checks for infos, warnings, and errors; it writes a bitstream; it removes a specific ELF file; it closes the project; it sources "blink_download.tcl"; it opens hardware; it connects to a local server; it sets a target; it sets a frequency; it opens a hardware target; it programs the device with "blinkbist.bit"; it refreshes the device; and finally, it sources "ipi_download.tcl" again. The output includes timestamps and memory usage details.

```
32 Infos, 23 Warnings, 0 Critical Warnings and 0 Errors encountered.  
write_bitstream completed successfully  
write_bitstream: Time <s>: cpu = 00:03:13 ; elapsed = 00:02:33 . Memory <MB>: peak = 4477.863 ; gain = 44.738  
# remove_files ..../kcu116_ipi.sdk/lwip_echo_server/Debug/lwip_echo_server.elf  
# close_project  
Vivado% source blink_download.tcl  
# open_hw  
# connect_hw_server -url localhost:3121  
INFO: [Labtools 27-2285] Connecting to hw_server url TCP:localhost:3121  
# current_hw_target [get_hw_targets */xilinx_tcf/Digilent/*]  
# set_property PARAM.FREQUENCY 15000000 [current_hw_target]  
# open_hw_target  
INFO: [Labtools 44-466] Opening hw_target localhost:3121/xilinx_tcf/Digilent/  
210308A7AEFA  
# set_property PROGRAM.FILE {blinkbist.bit} [lindex [get_hw_devices] 0]  
# current_hw_device [lindex [get_hw_devices] 0]  
# refresh_hw_device -quiet [lindex [get_hw_devices] 0]  
# program_hw_devices [lindex [get_hw_devices] 0]  
INFO: [Labtools 27-3164] End of startup status: HIGH  
program_hw_devices: Time <s>: cpu = 00:00:07 ; elapsed = 00:00:07 . Memory <MB>:  
peak = 4477.863 ; gain = 0.000  
# refresh_hw_device -quiet [lindex [get_hw_devices] 0]  
# close_hw  
Vivado% source ipi_download.tcl
```

Program KCU116 with BlinkBIST/IPI Designs

- > The IPI Application runs in the terminal window, without the BlinkBIST self-test

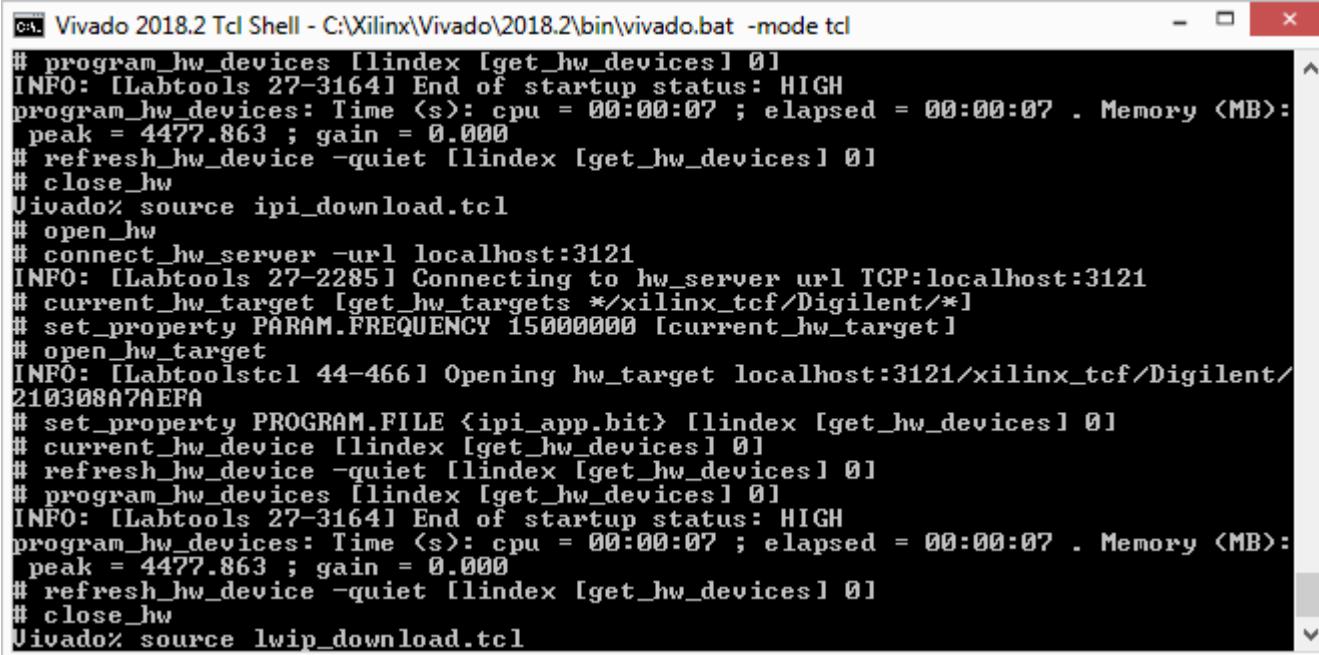


Run the LwIP Ethernet Design



Run the LwIP Ethernet Design

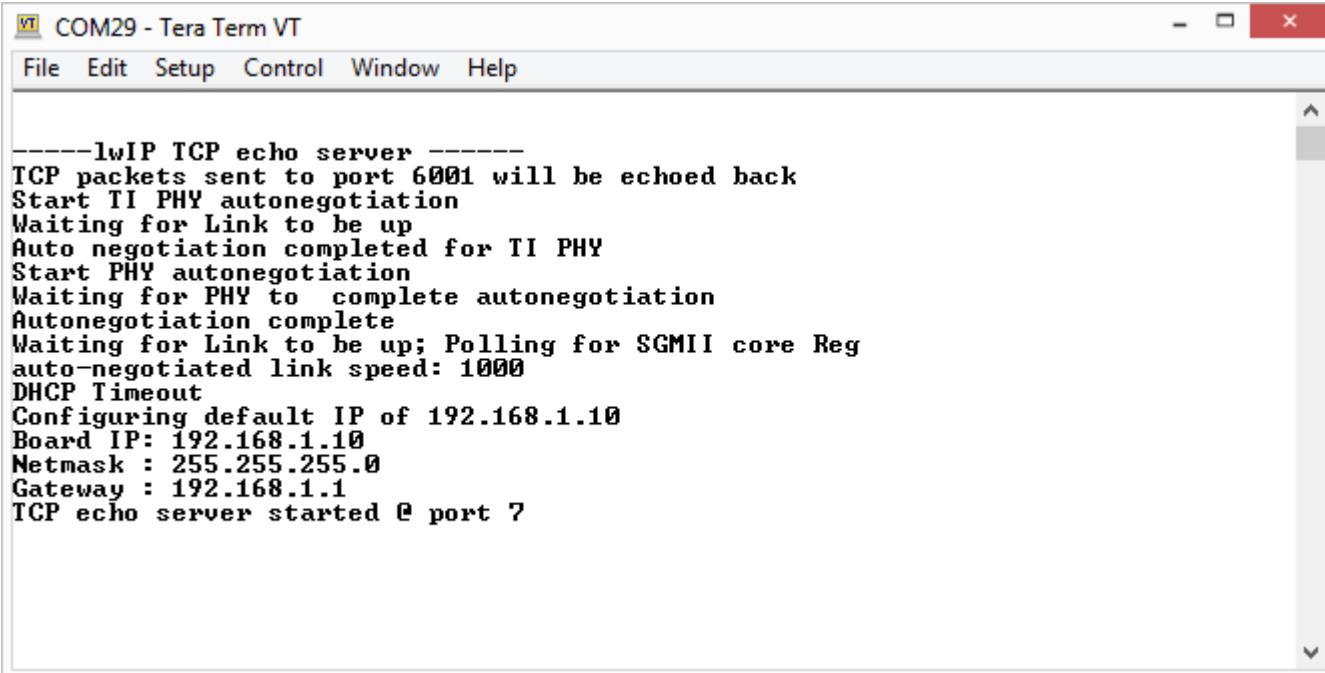
- > Download the LwIP bitstream
- > In the Vivado Tcl Shell type:
`source lwip_download.tcl`



```
Vivado 2018.2 Tcl Shell - C:\Xilinx\Vivado\2018.2\bin\vivado.bat -mode tcl
# program_hw_devices [lindex [get_hw_devices] 0]
INFO: [Labtools 27-3164] End of startup status: HIGH
program_hw_devices: Time <s>: cpu = 00:00:07 ; elapsed = 00:00:07 . Memory <MB>:
peak = 4477.863 ; gain = 0.000
# refresh_hw_device -quiet [lindex [get_hw_devices] 0]
# close_hw
Vivado% source ipi_download.tcl
# open_hw
# connect_hw_server -url localhost:3121
INFO: [Labtools 27-2285] Connecting to hw_server url TCP:localhost:3121
# current_hw_target [get_hw_targets */xilinx_tcf/Digilent/*]
# set_property PARAM.FREQUENCY 15000000 [current_hw_target]
# open_hw_target
INFO: [Labtools 44-466] Opening hw_target localhost:3121/xilinx_tcf/Digilent/
210308A7AEFA
# set_property PROGRAM.FILE <ipi_app.bit> [lindex [get_hw_devices] 0]
# current_hw_device [lindex [get_hw_devices] 0]
# refresh_hw_device -quiet [lindex [get_hw_devices] 0]
# program_hw_devices [lindex [get_hw_devices] 0]
INFO: [Labtools 27-3164] End of startup status: HIGH
program_hw_devices: Time <s>: cpu = 00:00:07 ; elapsed = 00:00:07 . Memory <MB>:
peak = 4477.863 ; gain = 0.000
# refresh_hw_device -quiet [lindex [get_hw_devices] 0]
# close_hw
Vivado% source lwip_download.tcl
```

Run the LwIP Ethernet Design

- > View LwIP echo server screen



The screenshot shows a terminal window titled "COM29 - Tera Term VT". The window has a menu bar with "File", "Edit", "Setup", "Control", "Window", and "Help". The main text area displays the following log output:

```
----lwIP TCP echo server ----
TCP packets sent to port 6001 will be echoed back
Start TI PHY autonegotiation
Waiting for Link to be up
Auto negotiation completed for TI PHY
Start PHY autonegotiation
Waiting for PHY to complete autonegotiation
Autonegotiation complete
Waiting for Link to be up; Polling for SGMII core Reg
auto-negotiated link speed: 1000
DHCP Timeout
Configuring default IP of 192.168.1.10
Board IP: 192.168.1.10
Netmask : 255.255.255.0
Gateway : 192.168.1.1
TCP echo server started @ port 7
```

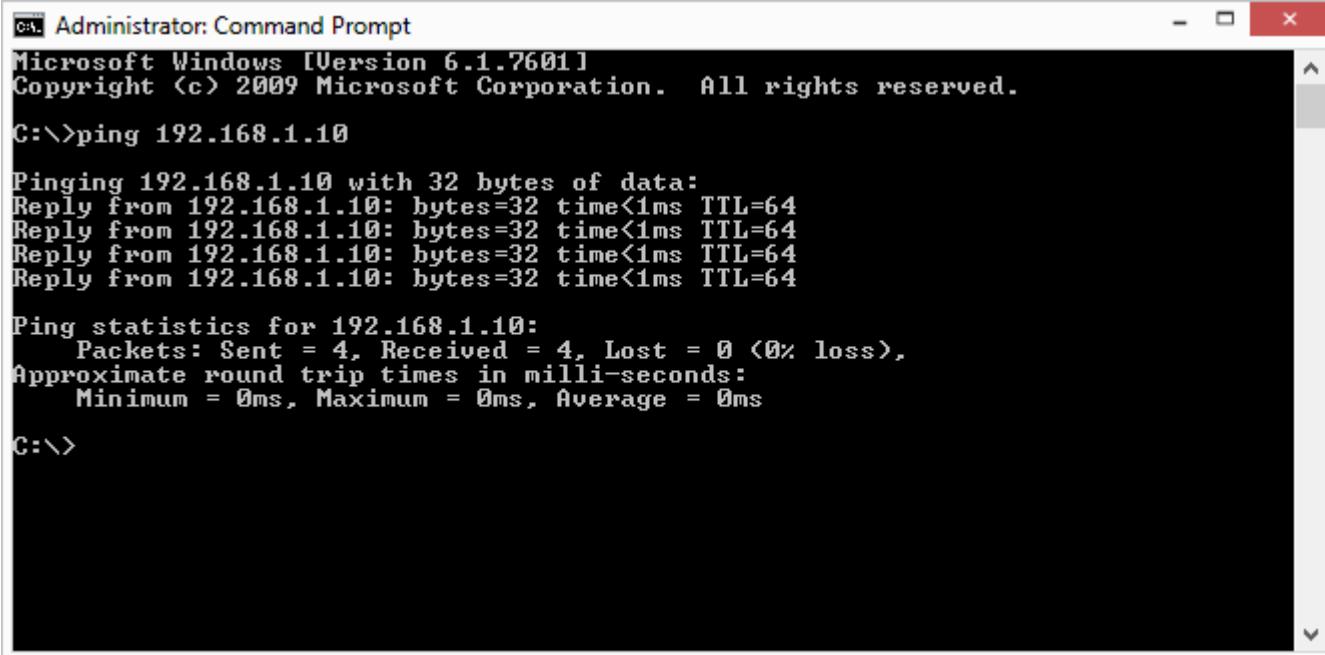
Note: Kit includes Crossover Ethernet cable; must use non-Crossover Ethernet cable for 1000 Mbps operation

Run the LwIP Ethernet Design

- > From a DOS window on the PC Host, enter the command:

ping 192.168.1.10

- » Ping from PC host 192.168.1.2 to KCU105 target 192.168.1.10



```
C:\>Administrator: Command Prompt
Microsoft Windows [Version 6.1.7601]
Copyright <c> 2009 Microsoft Corporation. All rights reserved.

C:>ping 192.168.1.10

Pinging 192.168.1.10 with 32 bytes of data:
Reply from 192.168.1.10: bytes=32 time<1ms TTL=64

Ping statistics for 192.168.1.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:>
```

Note: Don't ping LwIP while it is initializing

References



References

> IP Integrator Documentation

- » Vivado Design Suite Tcl Command Reference Guide – UG835
 - https://www.xilinx.com/support/documentation/sw_manuals/xilinx2019_1/ug835-vivado-tcl-commands.pdf
- » Designing IP Subsystems Using IP Integrator – UG994
 - https://www.xilinx.com/support/documentation/sw_manuals/xilinx2019_1/ug994-vivado-ip-subsystems.pdf

> Vivado Release Notes

- » Vivado Design Suite User Guide - Release Notes – UG973
 - https://www.xilinx.com/support/documentation/sw_manuals/xilinx2019_1/ug973-vivado-release-notes-install-license.pdf
- » Vivado Design Suite 2019 - Vivado Known Issues
 - <https://www.xilinx.com/support/answers/72162.html>

Documentation



Documentation

> Kintex UltraScale+

- » Kintex UltraScale+ FPGA Family
 - <https://www.xilinx.com/products/silicon-devices/fpga/kintex-ultrascale-plus.html>

> KCU116 Documentation

- » Kintex UltraScale FPGA KCU116 Evaluation Kit
 - <https://www.xilinx.com/products/boards-and-kits/ek-u1-kcu116-g.html>
- » KCU116 Board User Guide – UG1239
 - https://www.xilinx.com/support/documentation/boards_and_kits/kcu116/ug1239-kcu116-eval-bd.pdf
- » KCU116 Evaluation Kit Quick Start Guide User Guide – XTP471
 - https://www.xilinx.com/support/documentation/boards_and_kits/kcu116/xtp471-kcu116-quickstart.pdf
- » KCU116 - Known Issues Master Answer Record
 - <https://www.xilinx.com/support/answers/68360.html>