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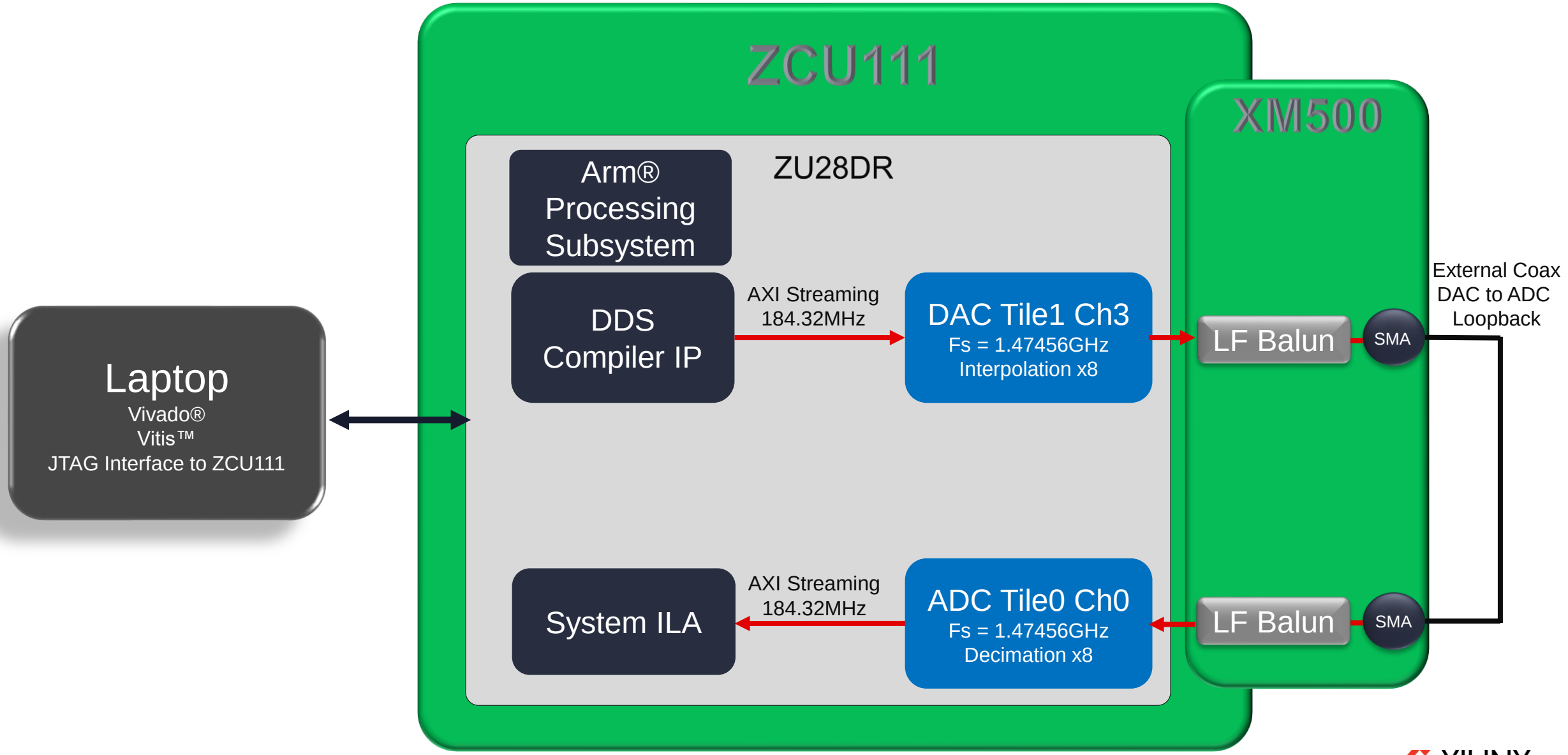
Zynq® UltraScale+™ RFSoC Example Design: ZCU111

DDS Compiler for DAC and System ILA for ADC Capture – 2020.2

Introduction

- This is an example starter design for the RFSoC.
- It uses the ZCU111 board.
- It uses a DAC and ADC sample rate of 1.47456GHz.
- The DAC will continuously play 10MHz sine wave from the DDS Compiler IP.
- The ADC output will be sent to a System ILA to be displayed in the Hardware Manager.
- DAC Tile1 Ch3 will be used (LF balun).
- ADC Tile0 Ch0 will be used (LF balun).
- 2020.2 Xilinx tools (Vivado® Design Suite and Vitis™ unified software platform).
- Design tested in the directory *c:\rfsoc\ex_des\zcu111\v4*
- This kit comes with the Vivado HW project and SW source files.

Demo Block Diagram



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ZCU111 Clocks

- This design automatically programs the clocks to 1.47456GHz via the SW application.
- ZCU111 ADC/DAC clocks are generated from LMK04208 feeding 3 LMX2594 in parallel. Review ‘RF Data Converter Clocking’ in UG1271 (ZCU111 board user guide).
- Clocking is configured via an I2C to SPI bridge.

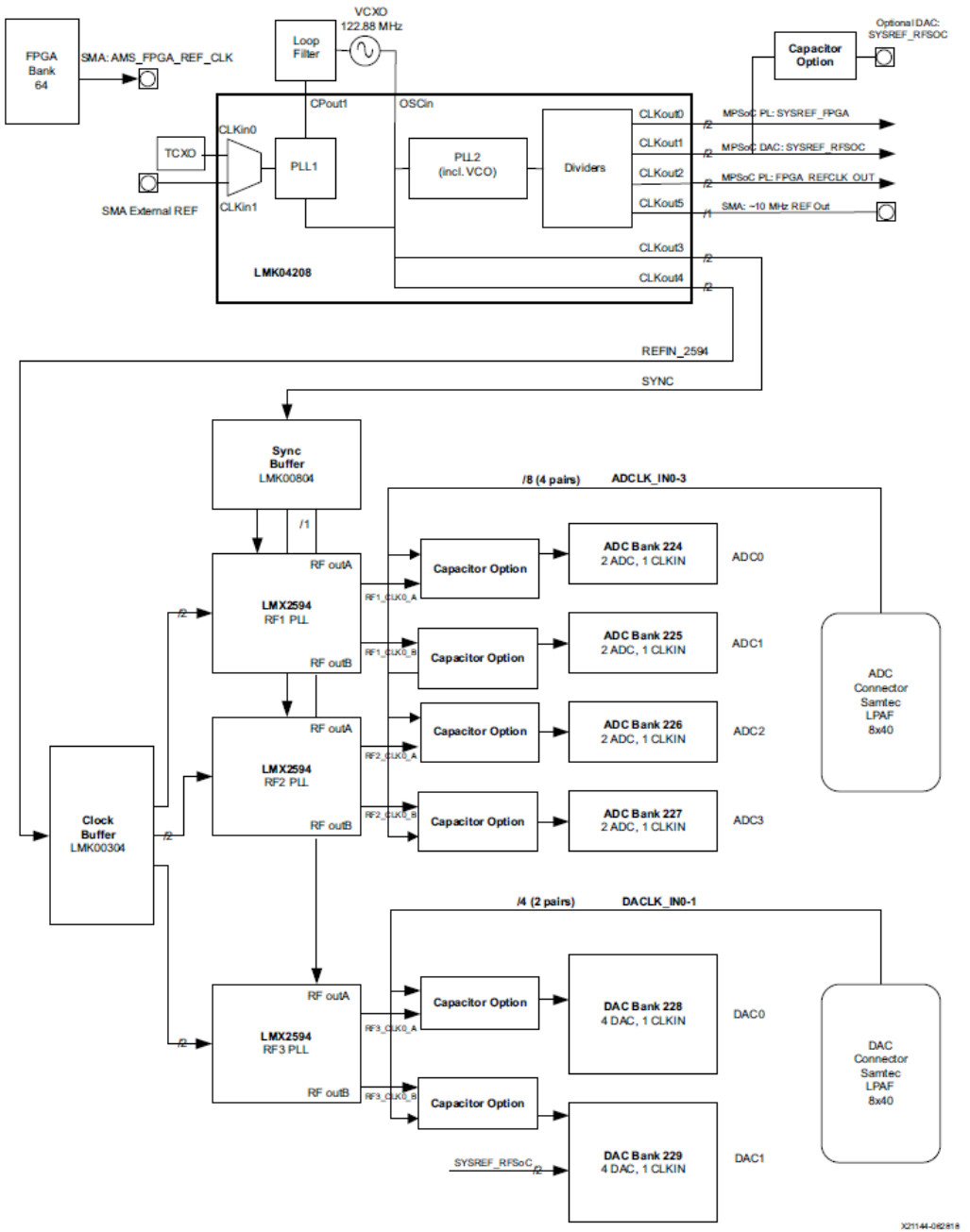

Figure 3-18: **RF Clocking Structure for ADC and DAC Banks**

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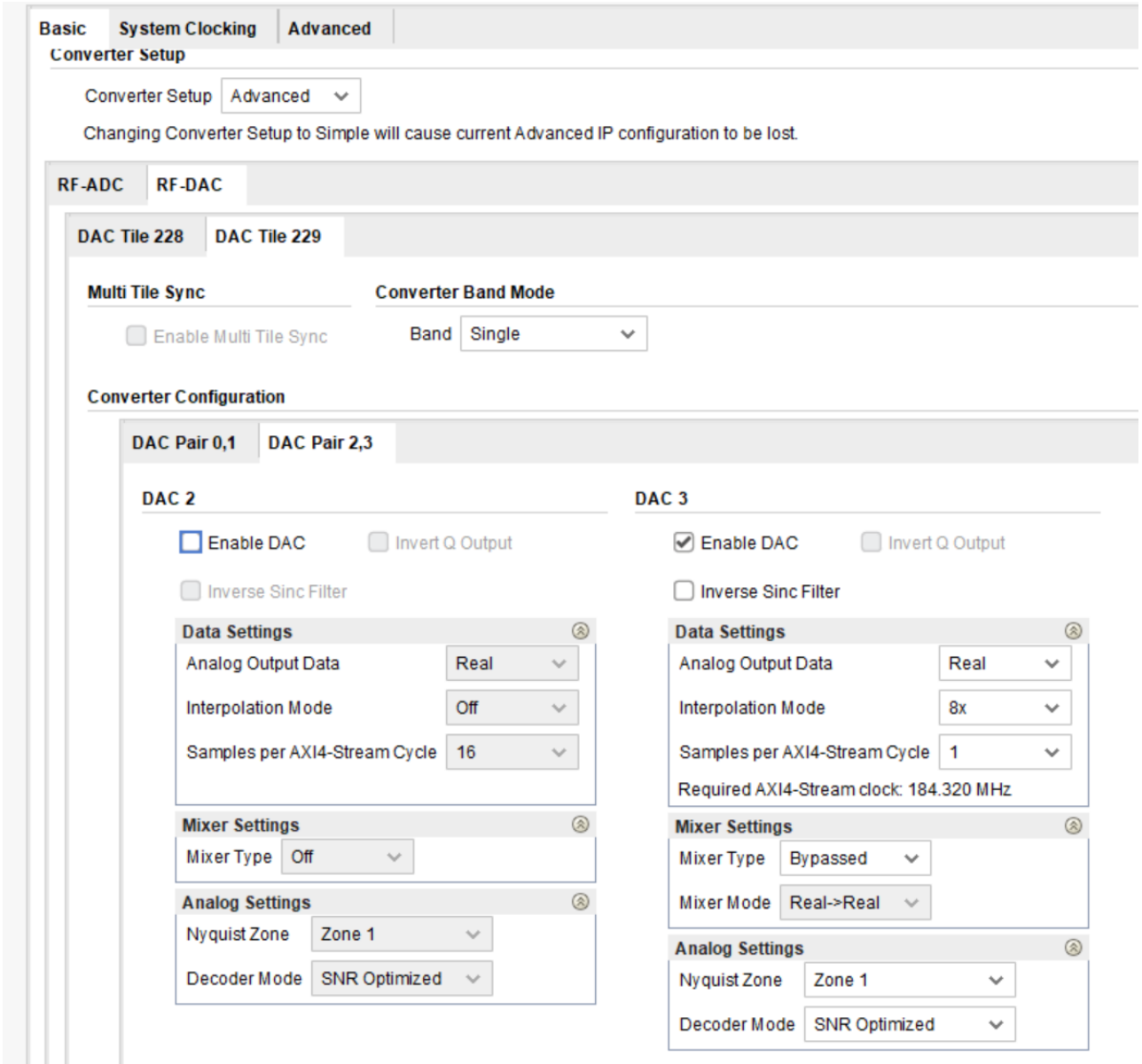
DAC Setup



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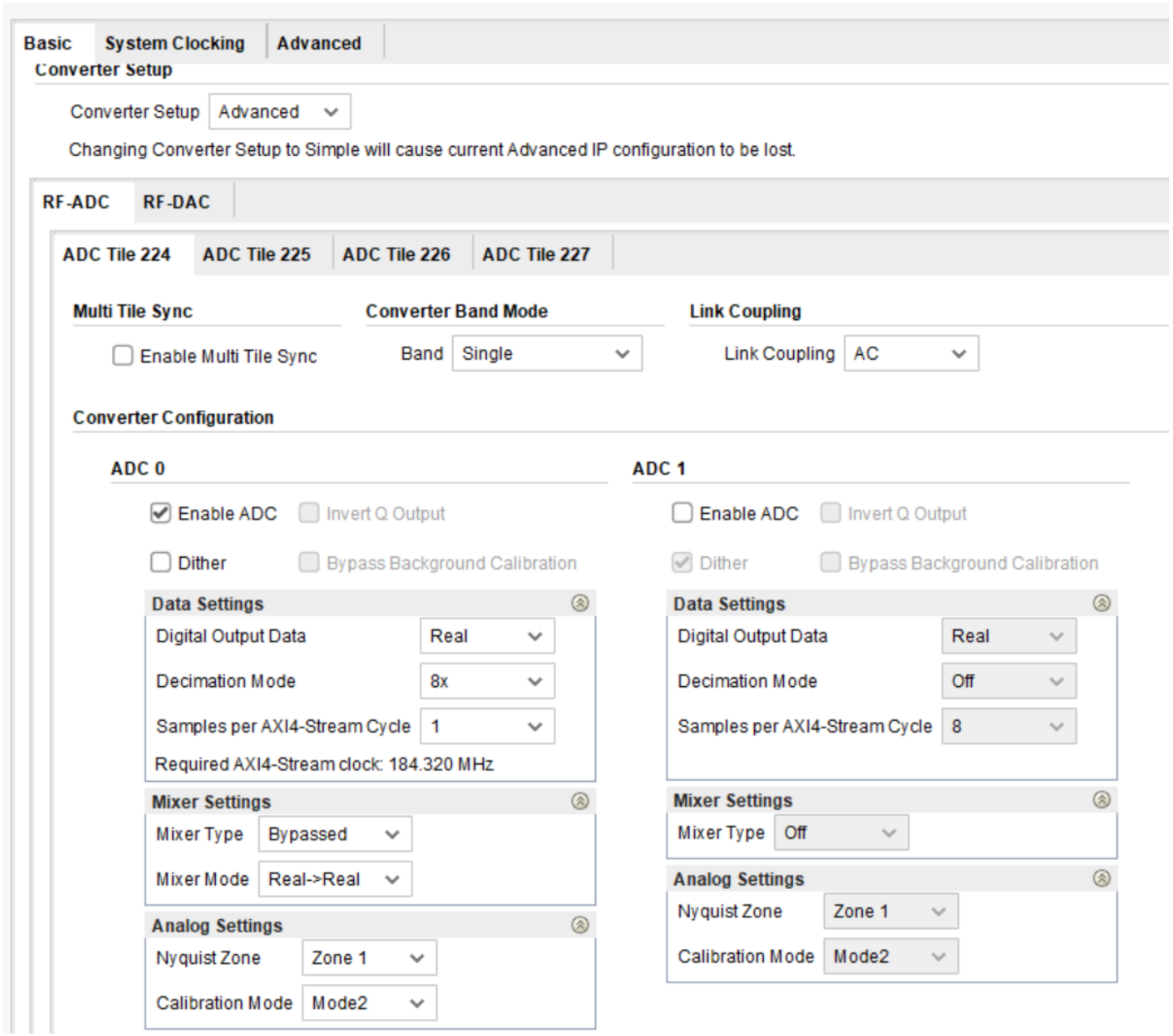
ADC Setup



Data Converter Clocking

Basic | System Clocking | Advanced

AXI4-Lite Interface Configuration

AXI4-Lite Clock (MHz) 100.0

Tile Clocking Settings

Tile	Sampling Rate (GSPS)	Max Fs (GSPS)	PLL	Reference Clock (MHz)	PLL Ref Clock (MHz)	Ref Clock Divider	Fabric Clock (MHz)	Clock Out (MHz)
ADC 224	1.47456	4.096	☐	1474.560	-	1	184.320	92.160
ADC 225	2.0	4.096	☐	2000.000	-	1	0.0	15.625
ADC 226	2.0	4.096	☐	2000.000	-	1	0.0	15.625
ADC 227	2.0	4.096	☐	2000.000	-	1	0.0	15.625
DAC 228	6.4	6.554	☐	6400.000	-	1	0.0	50.000
DAC 229	1.47456	6.554	☐	1474.560	-	1	184.320	184.320

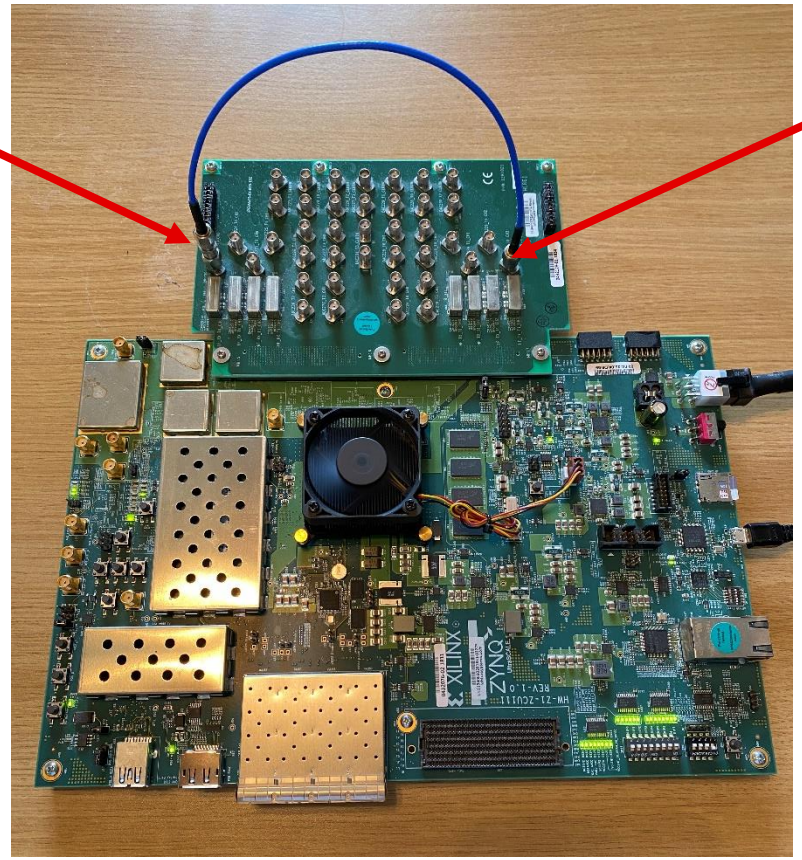
PLL Summary Settings

Tile	Vco (MHz)	Fb Div	M	R
ADC 224	-	-	-	-
ADC 225	-	-	-	-
ADC 226	-	-	-	-
ADC 227	-	-	-	-
DAC 228	-	-	-	-
DAC 229	-	-	-	-

Board Setup for the Upcoming Designs

- Connect DAC Tile 229 Ch3 output to ADC Tile 224 Ch0 input on XM500 (low frequency balun connections).
- Set SW6 to on,on,on,on (JTAG boot mode).
- Connect USB to host for JTAG, PS UART, and System Controller UART access.

ADC Tile0 Ch0



DAC Tile1 Ch3

SW6

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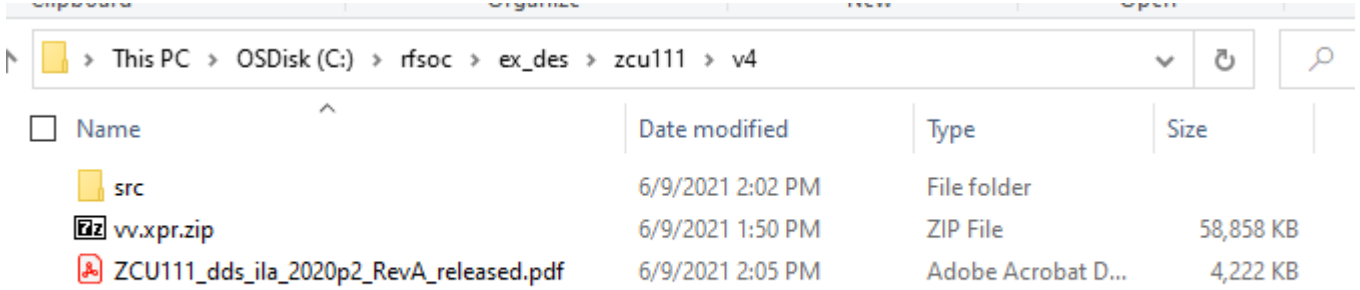
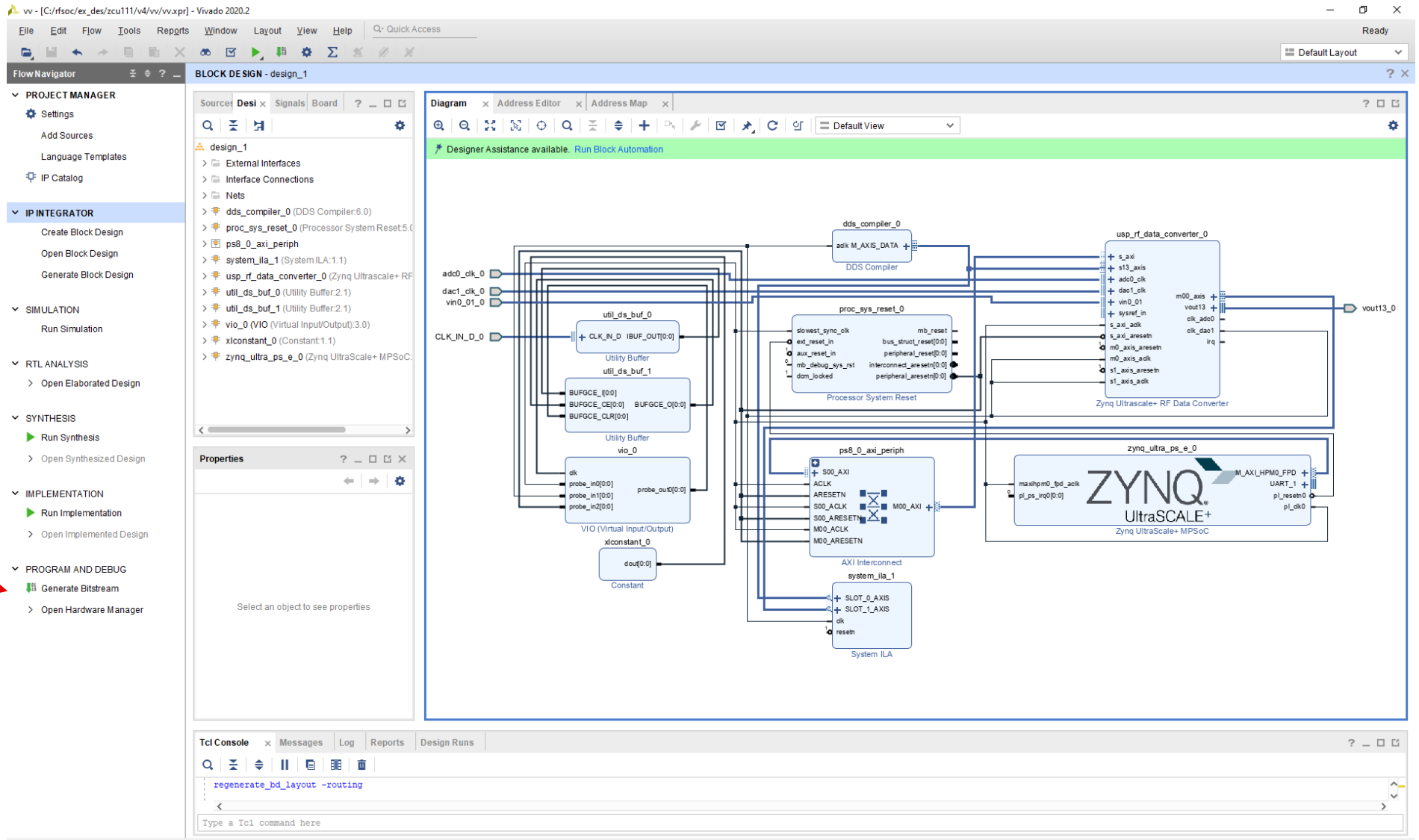
Design Kit Contents

1. Extract the design kit to an appropriate folder—be mindful of the Windows path length requirement.
2. Extract vv.xpr.zip, which is the Vivado® project.
3. Software source files in the “src” folder.
4. Design documentation in the .pdf file.



Open Hardware Design and Generate the Bitstream

Extract vv.xpr.zip, open the design in Vivado®, and generate the bitstream.



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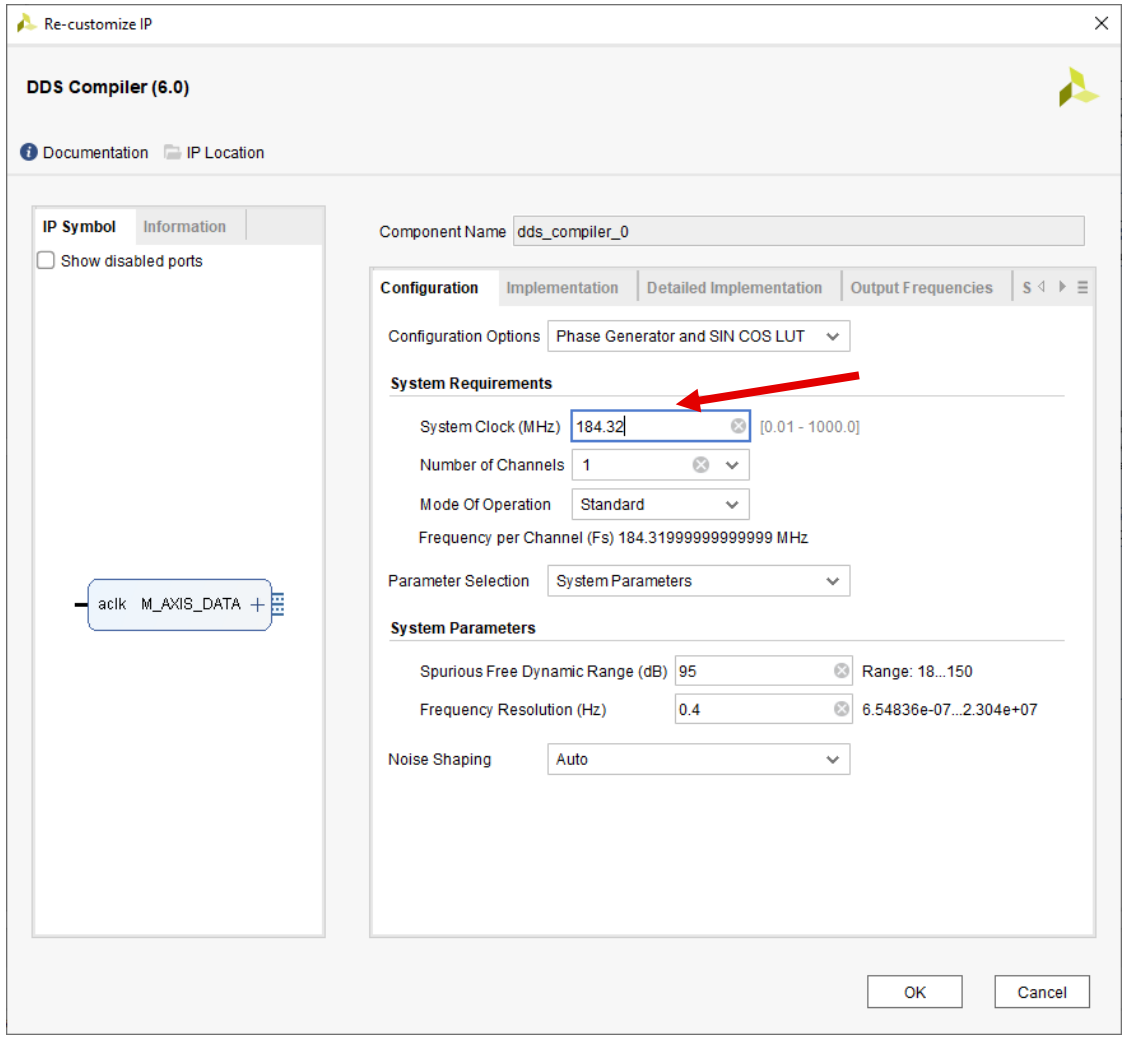
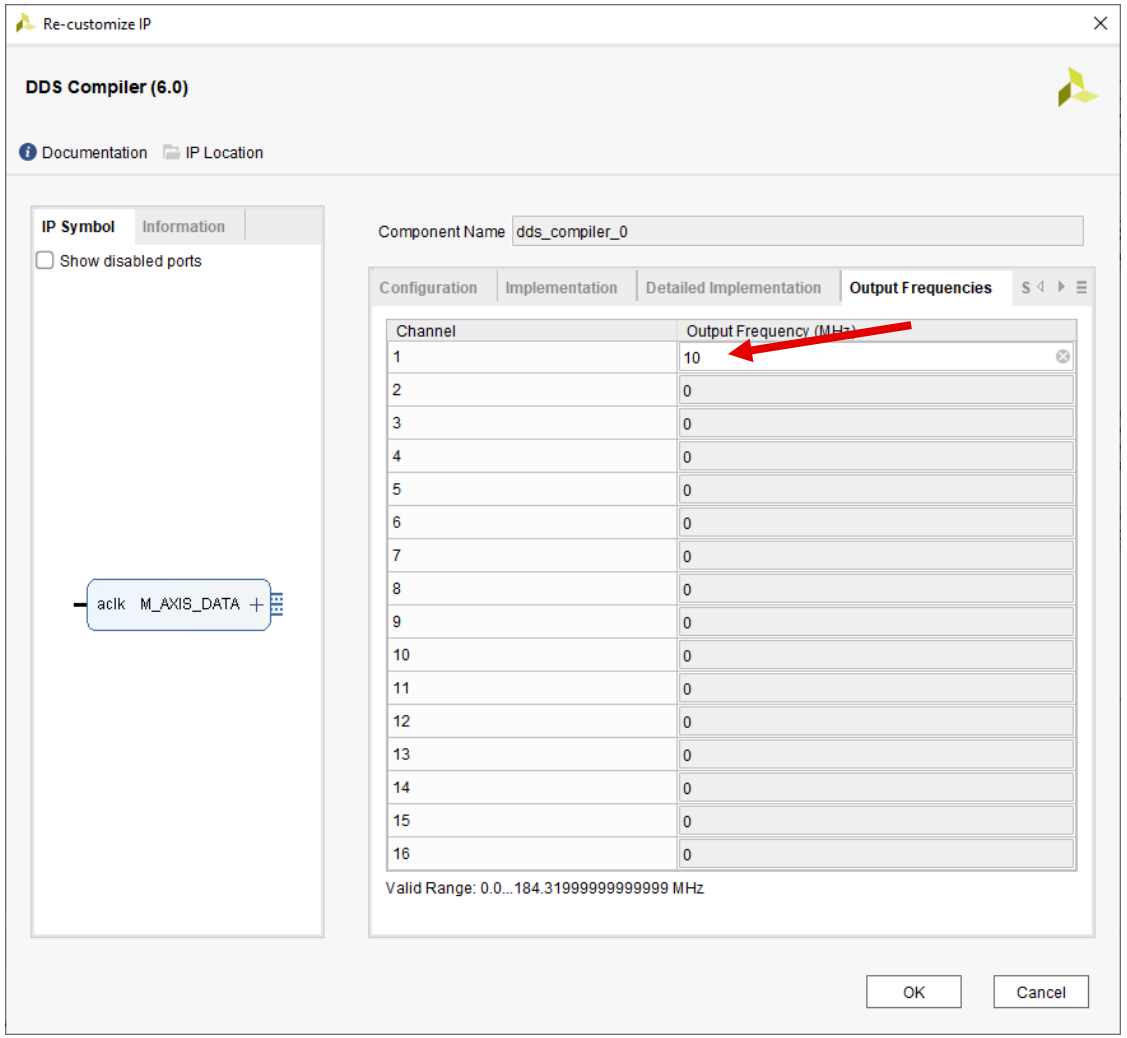
DAC Sine Wave Generator (DDS Compiler IP)





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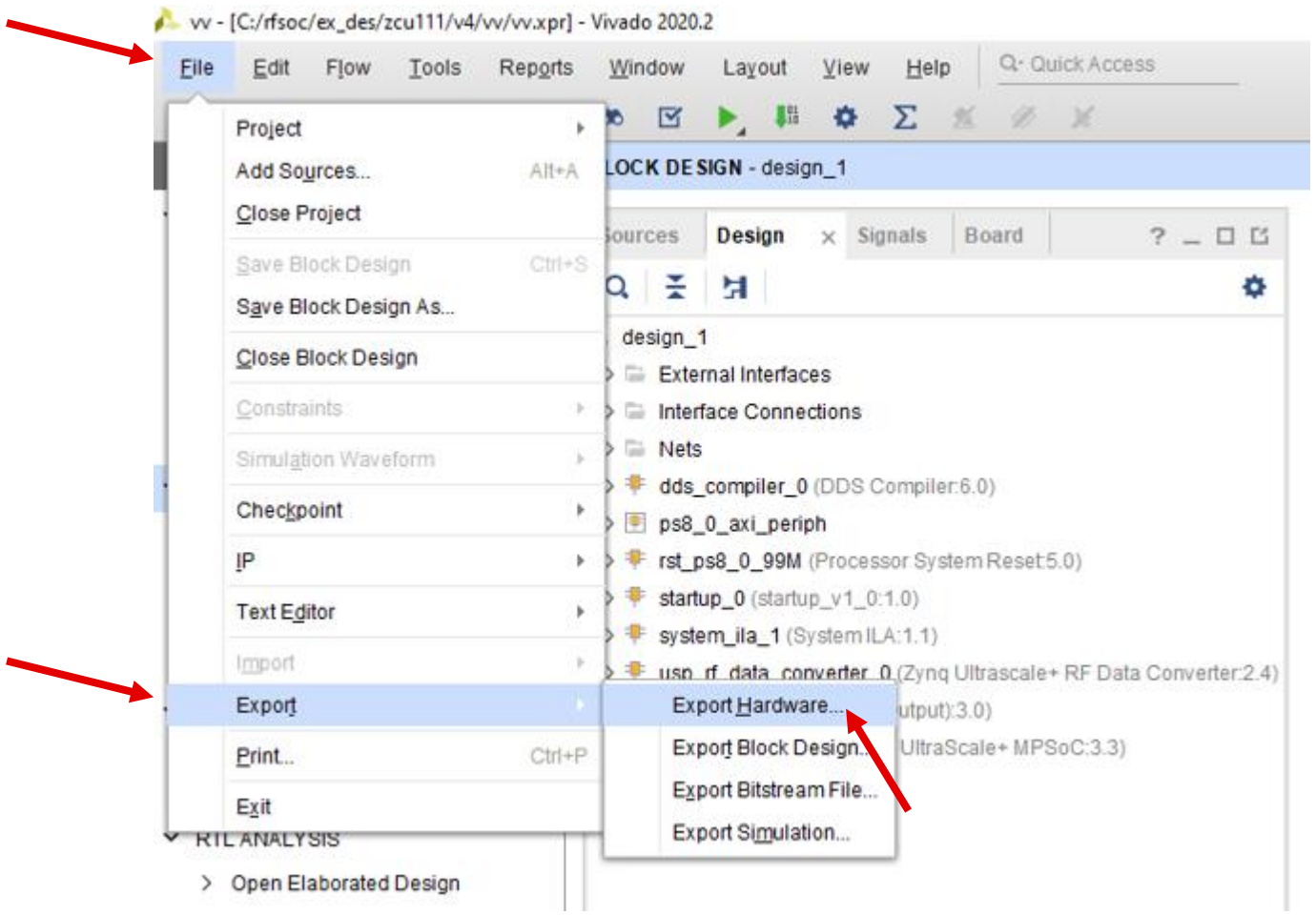
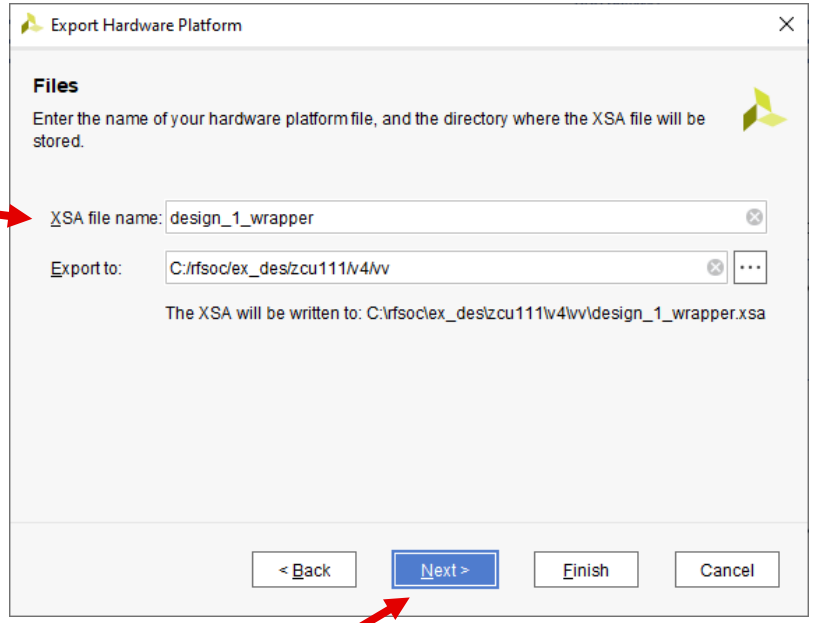
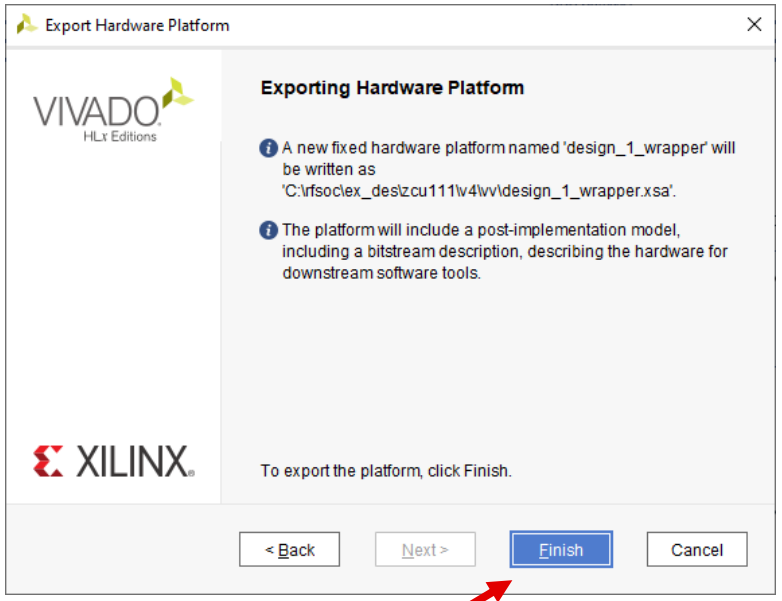
Export Hardware







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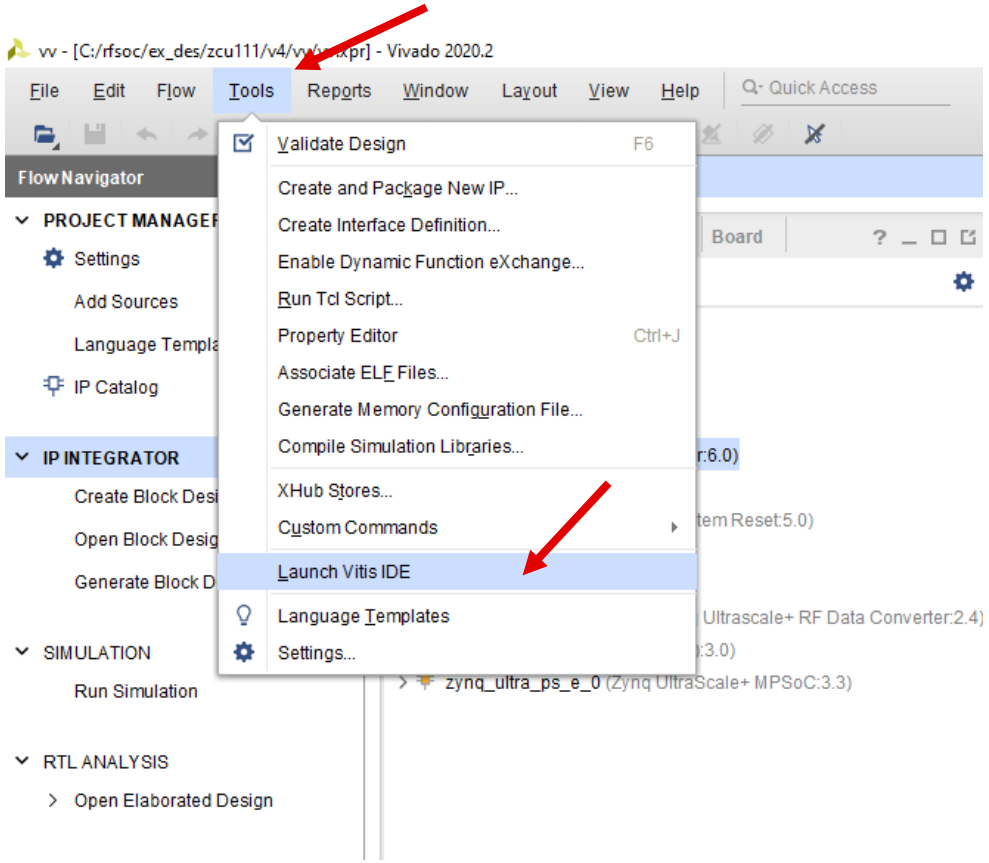
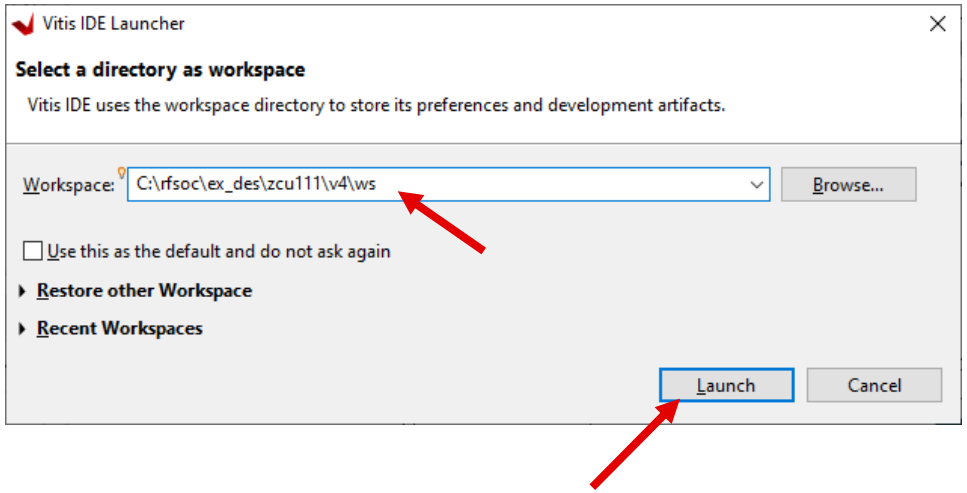
Open Vitis™ Software Platform





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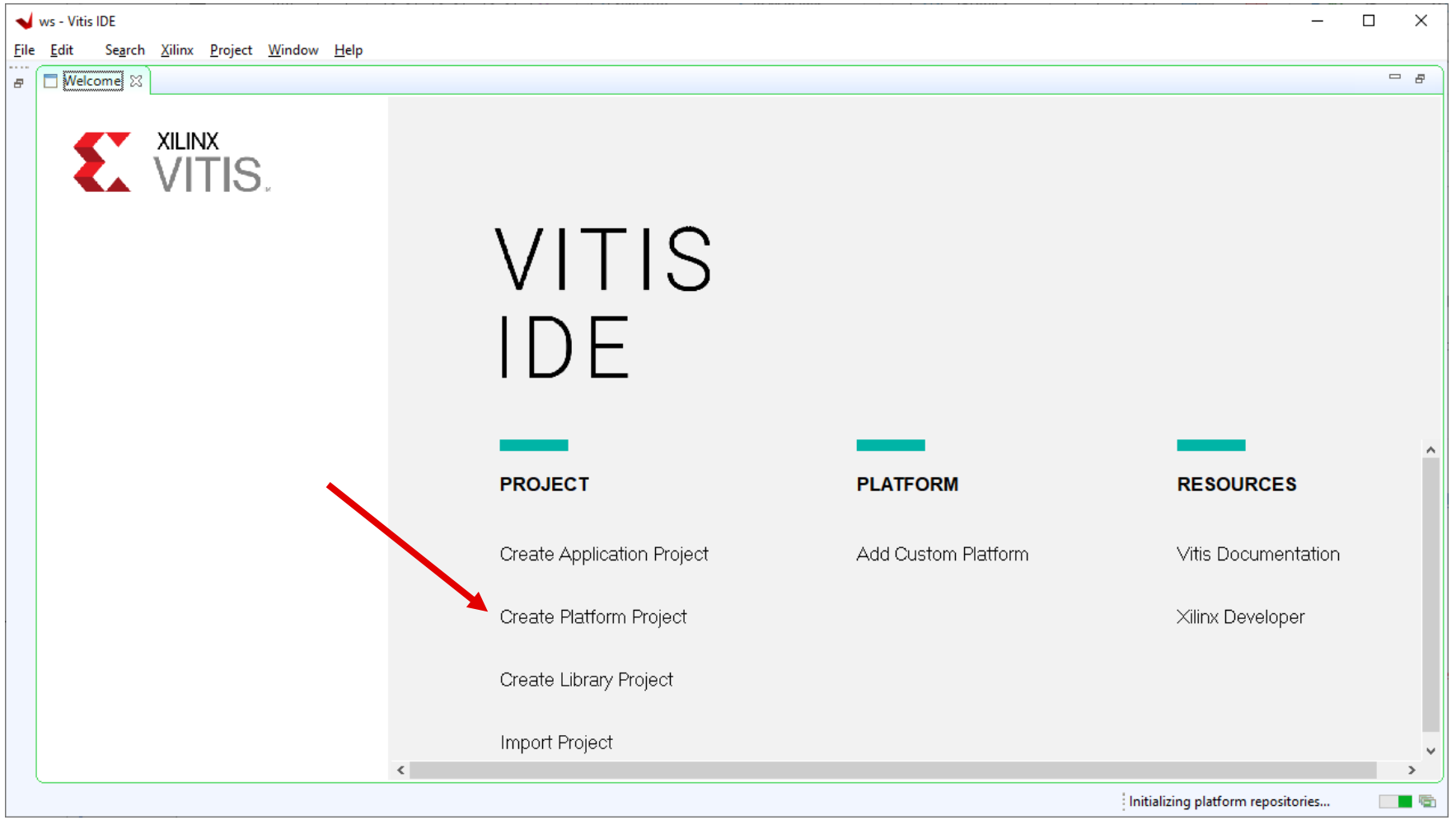
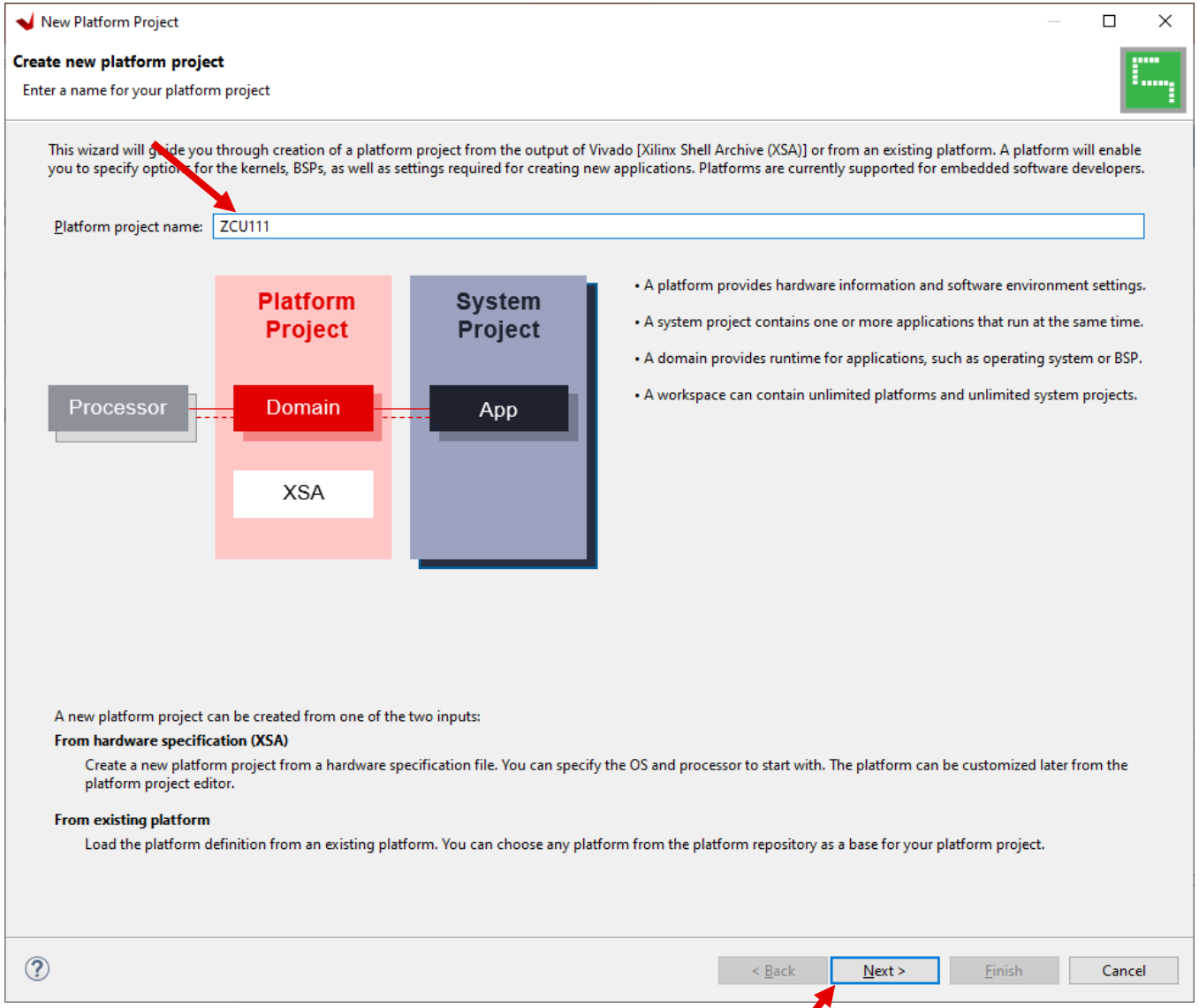
Create Platform Project



Create Platform Project Cont'd



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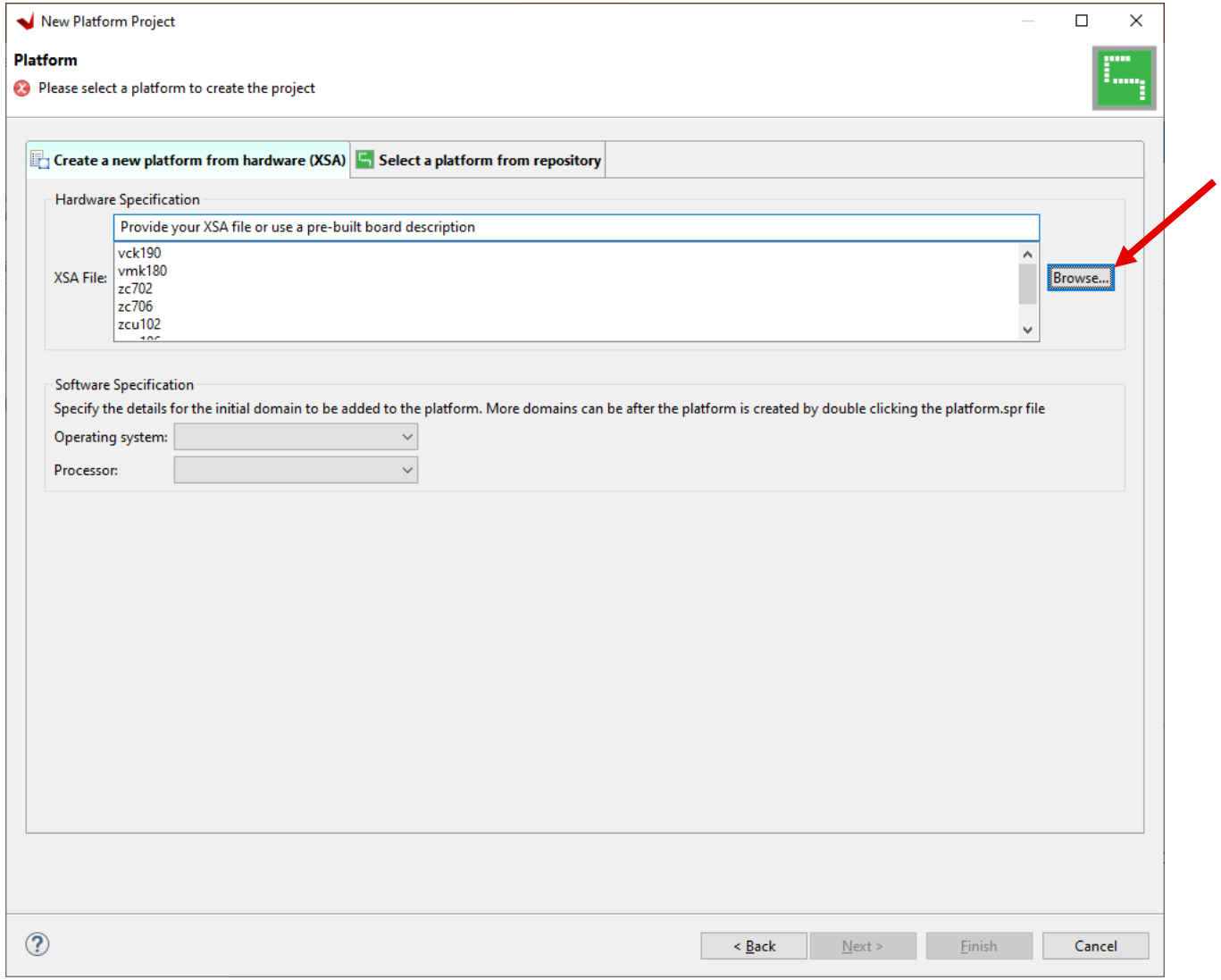

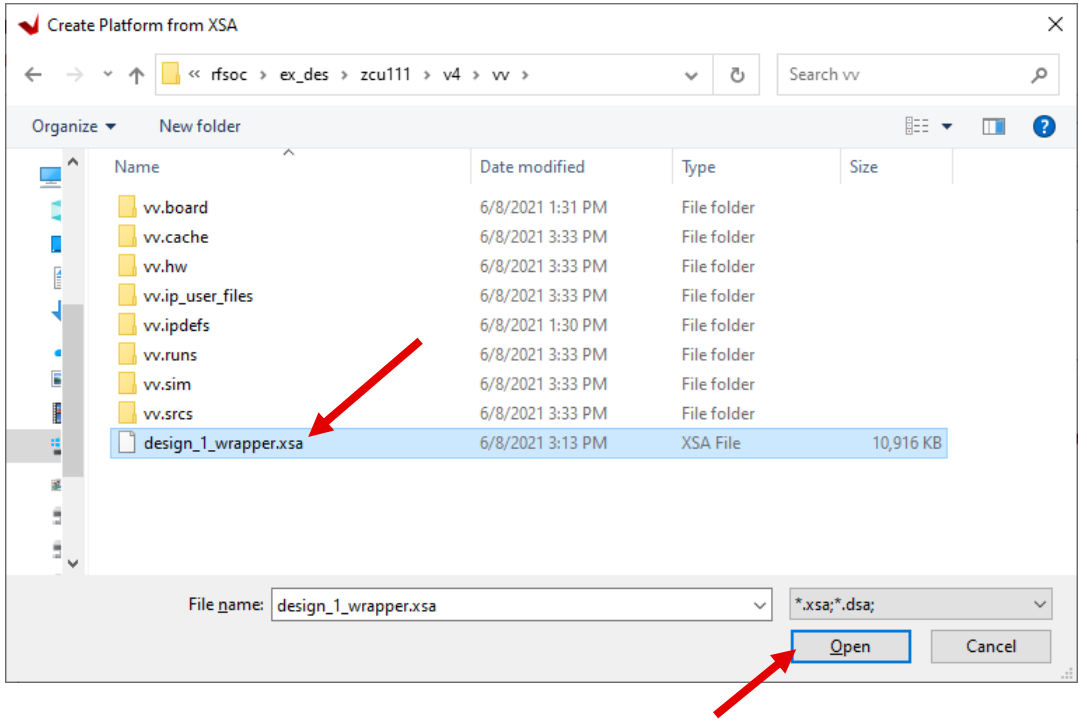

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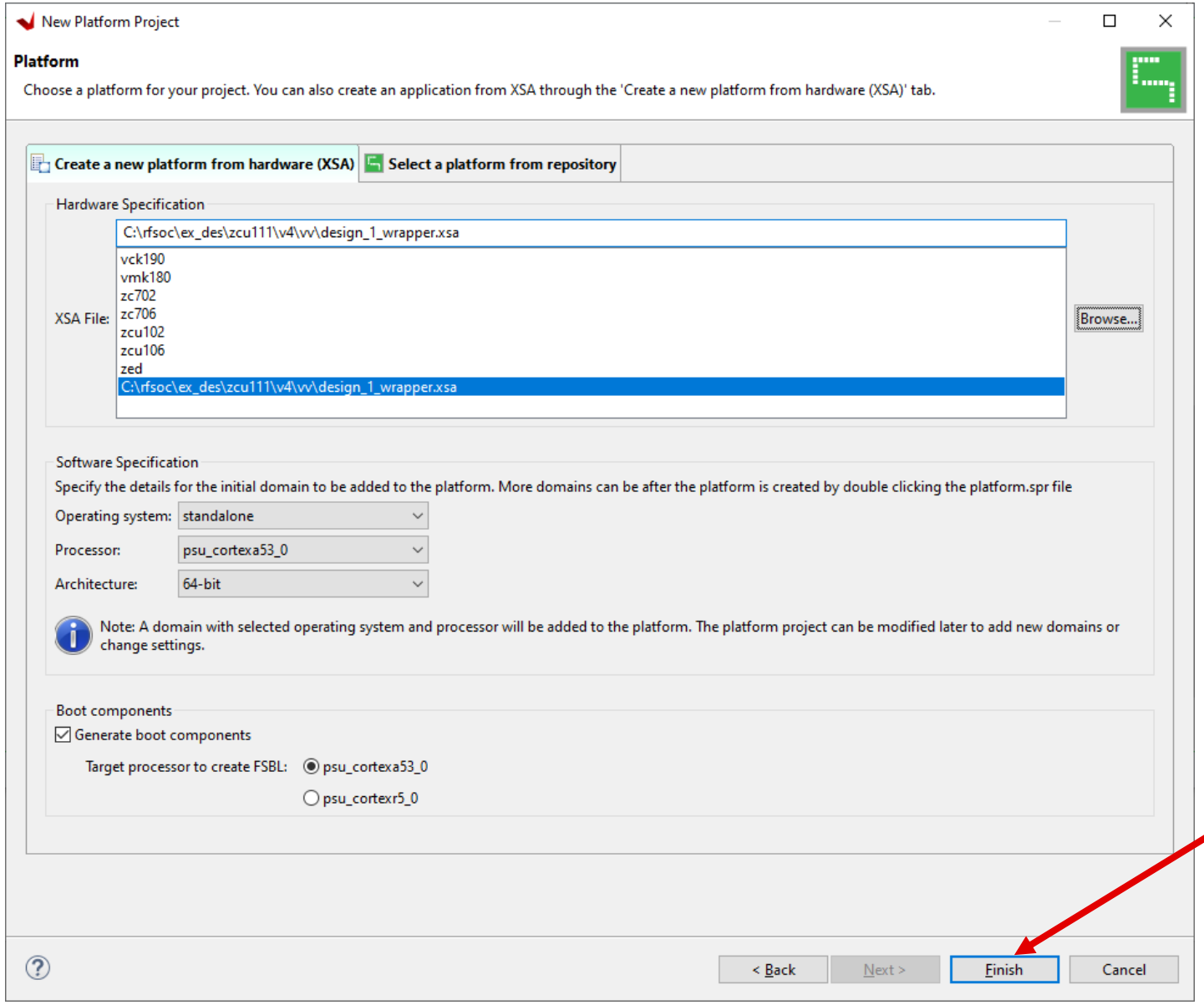

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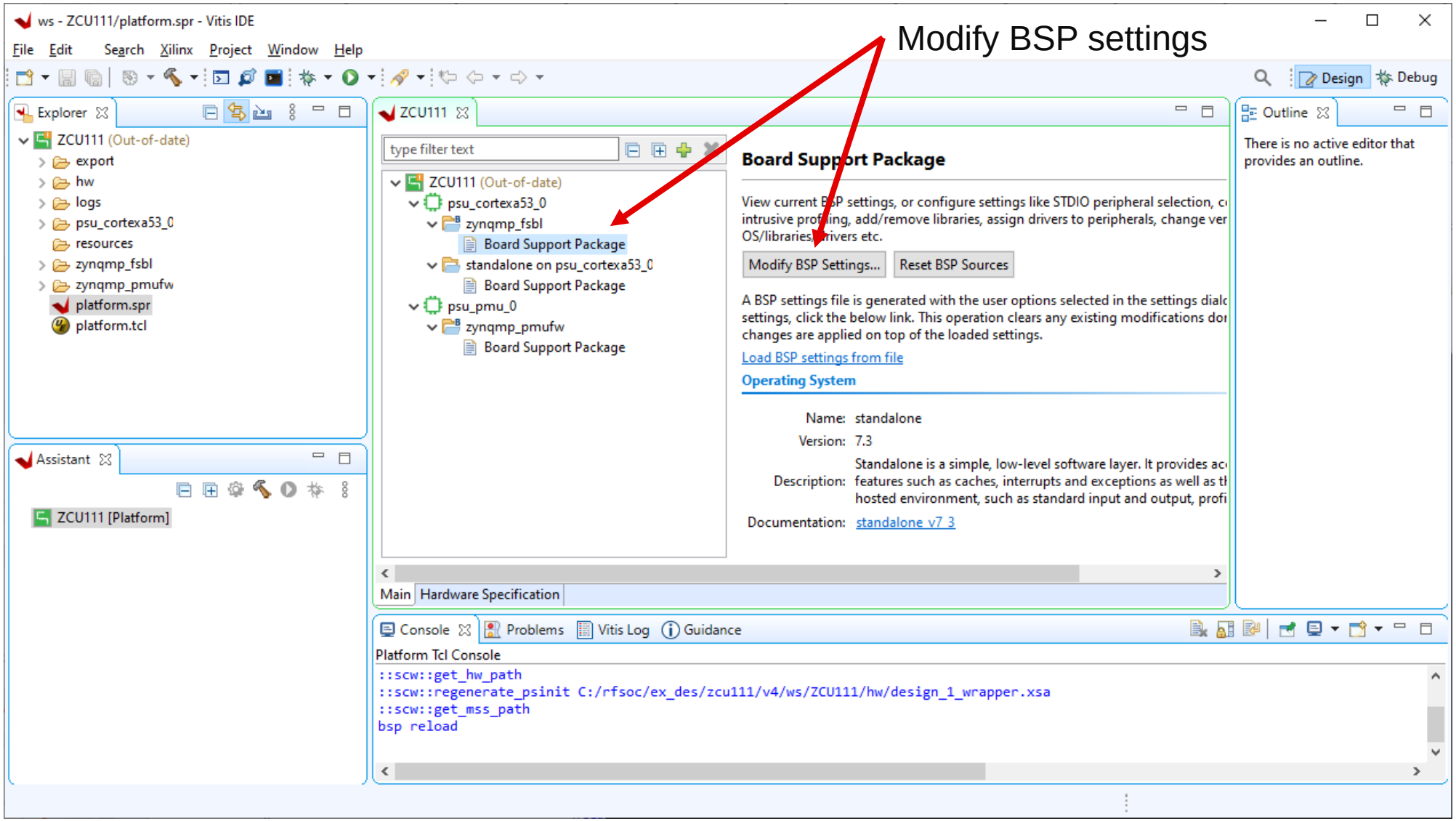
Create Platform Project Cont'd



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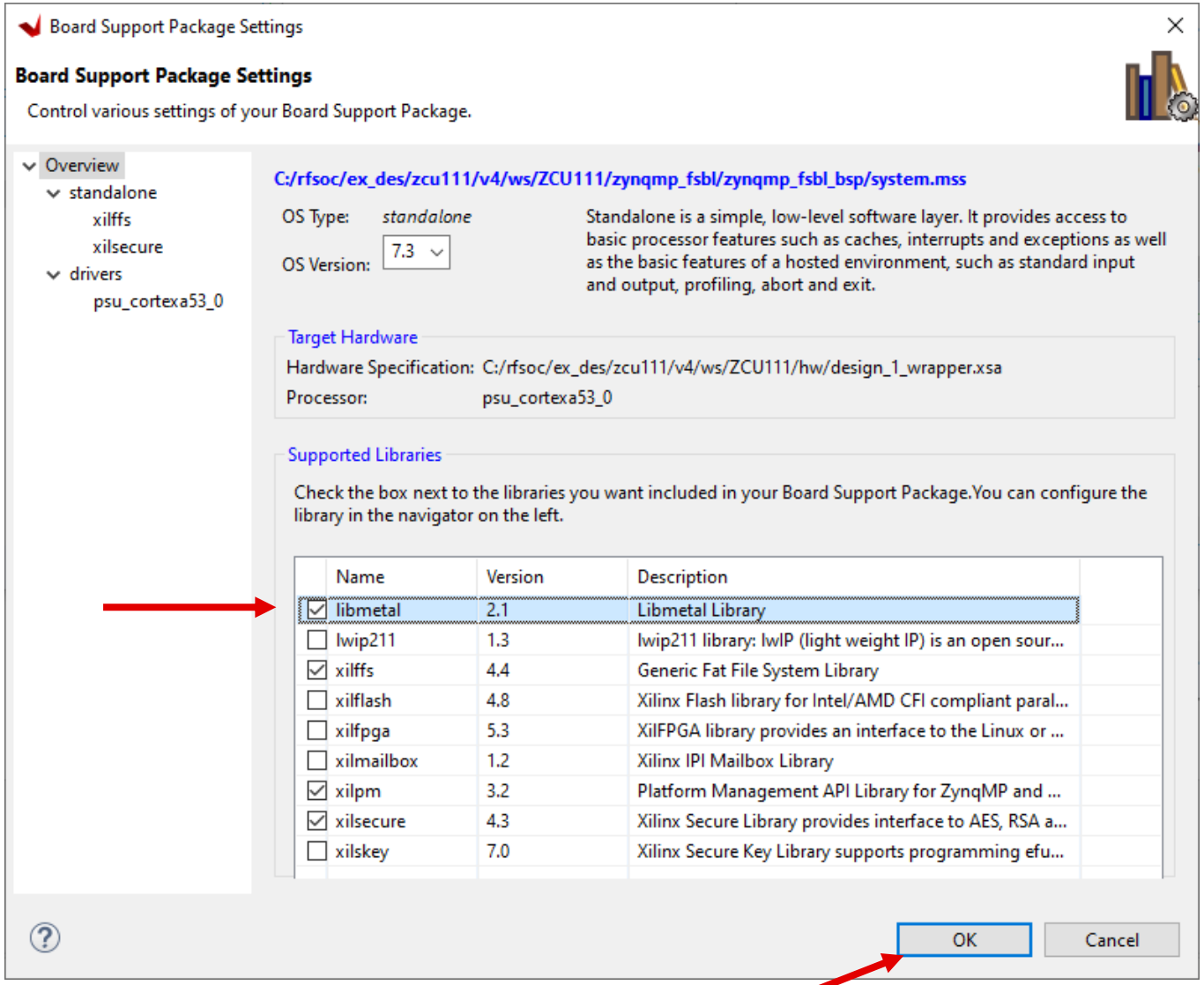
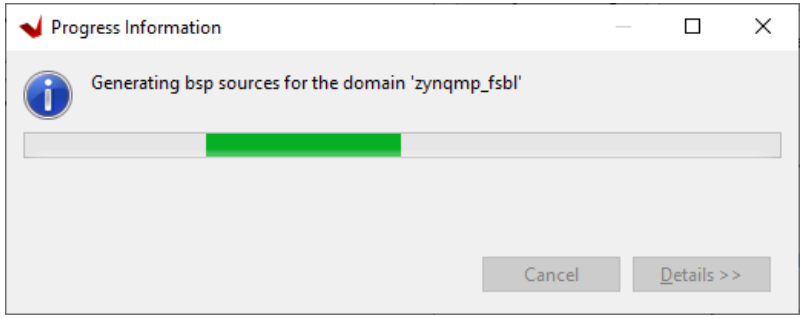
Enable libmetal





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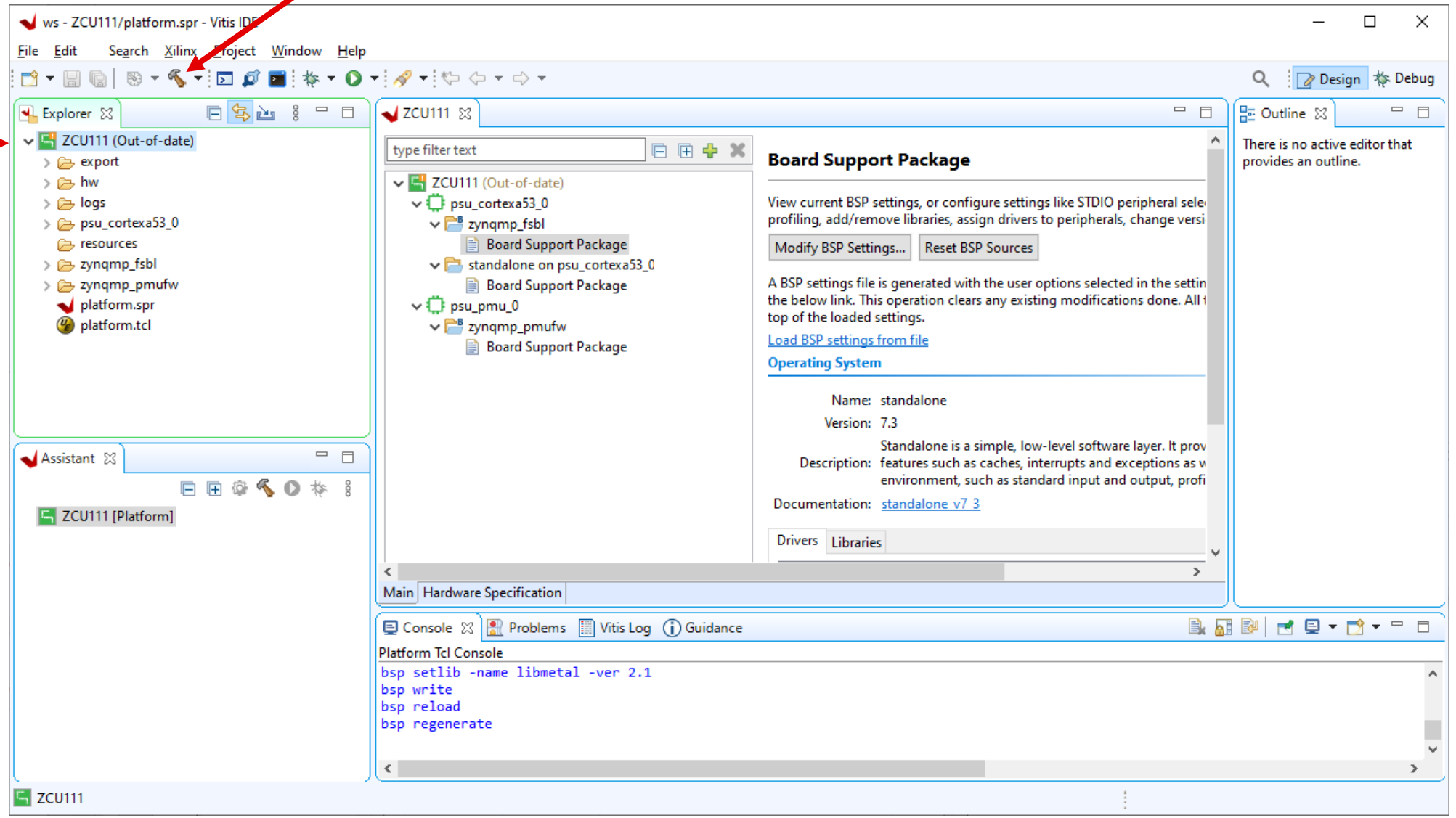
Build Project

This may take a few minutes.



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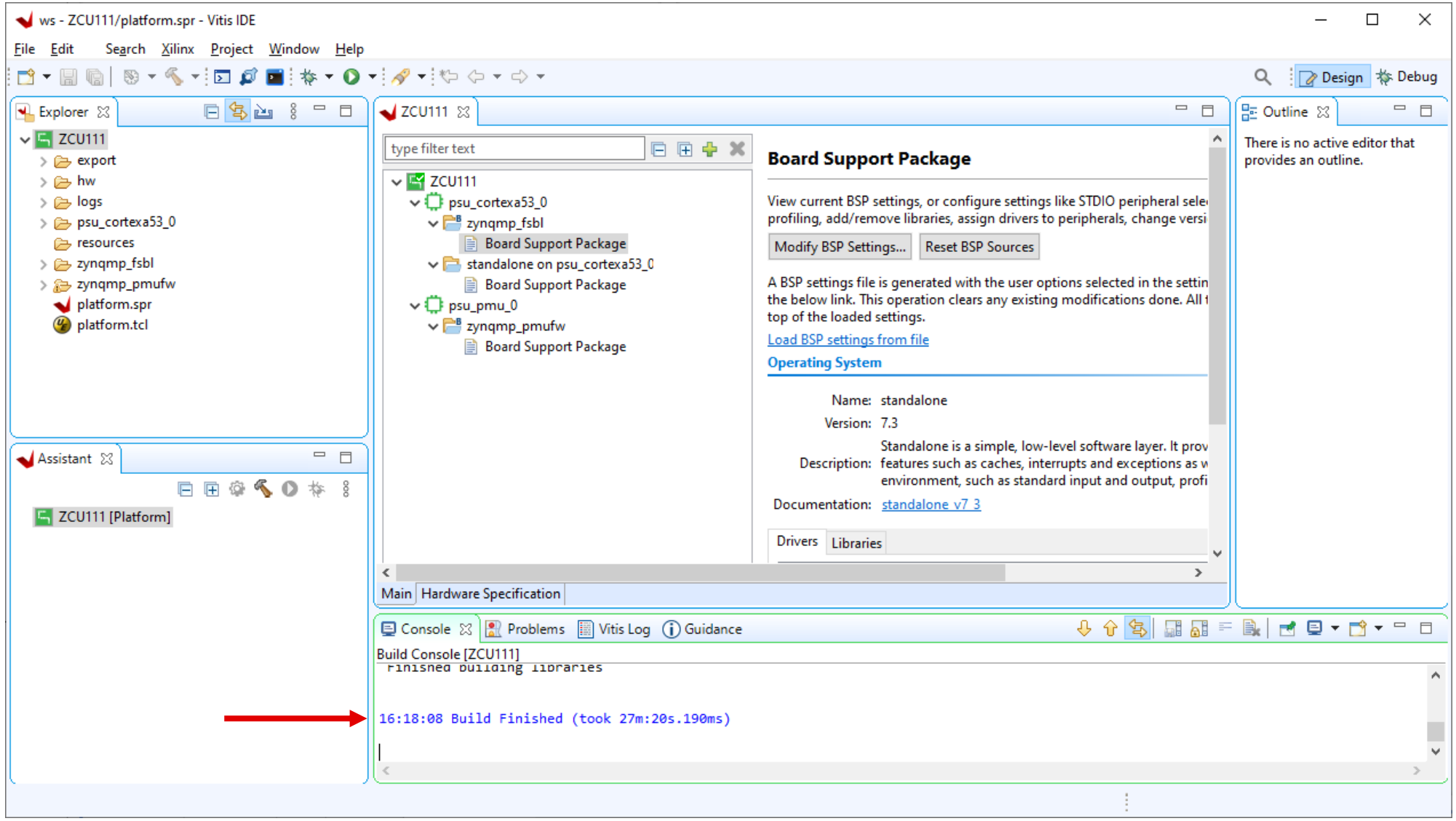
Build Complete



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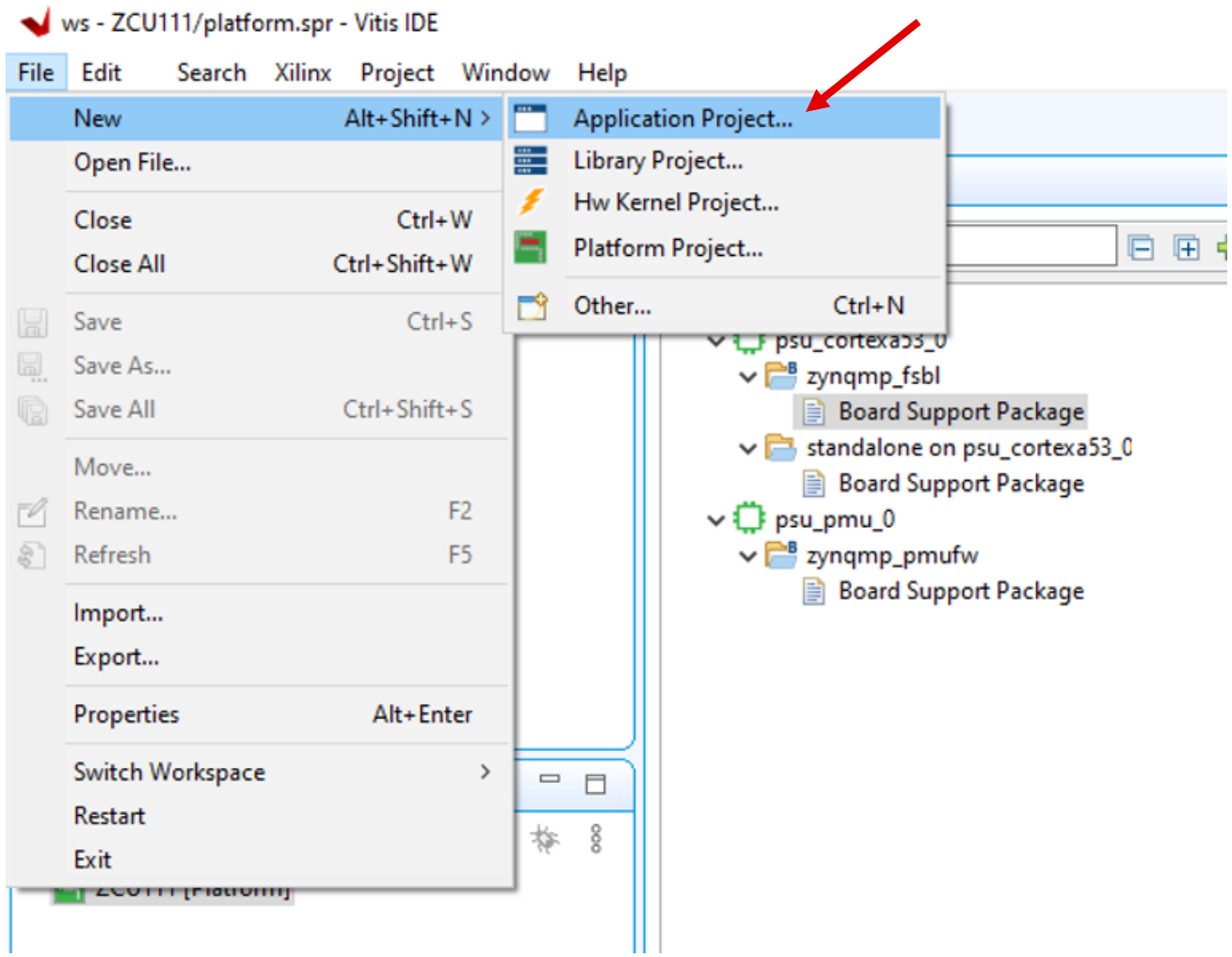
Create Application



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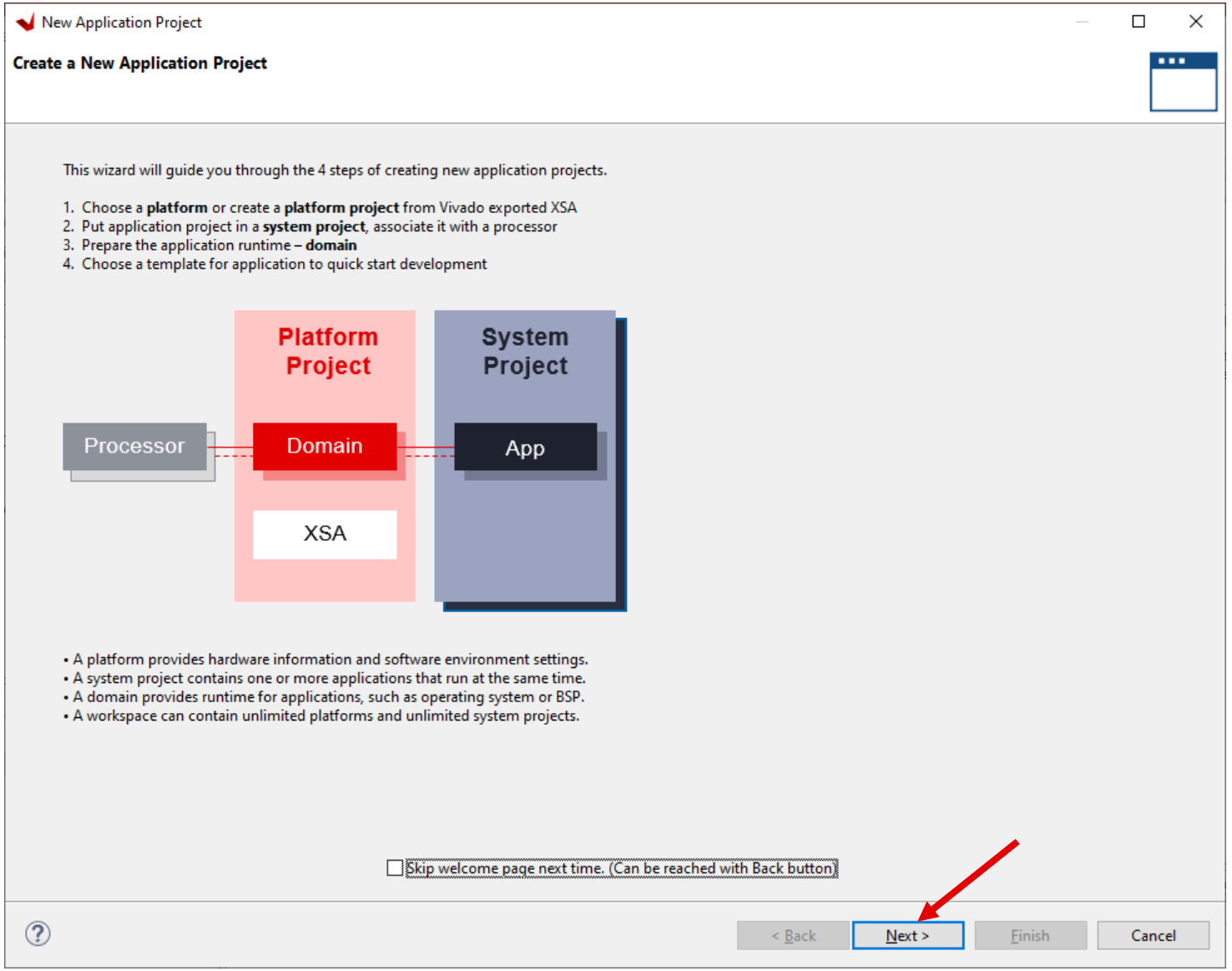

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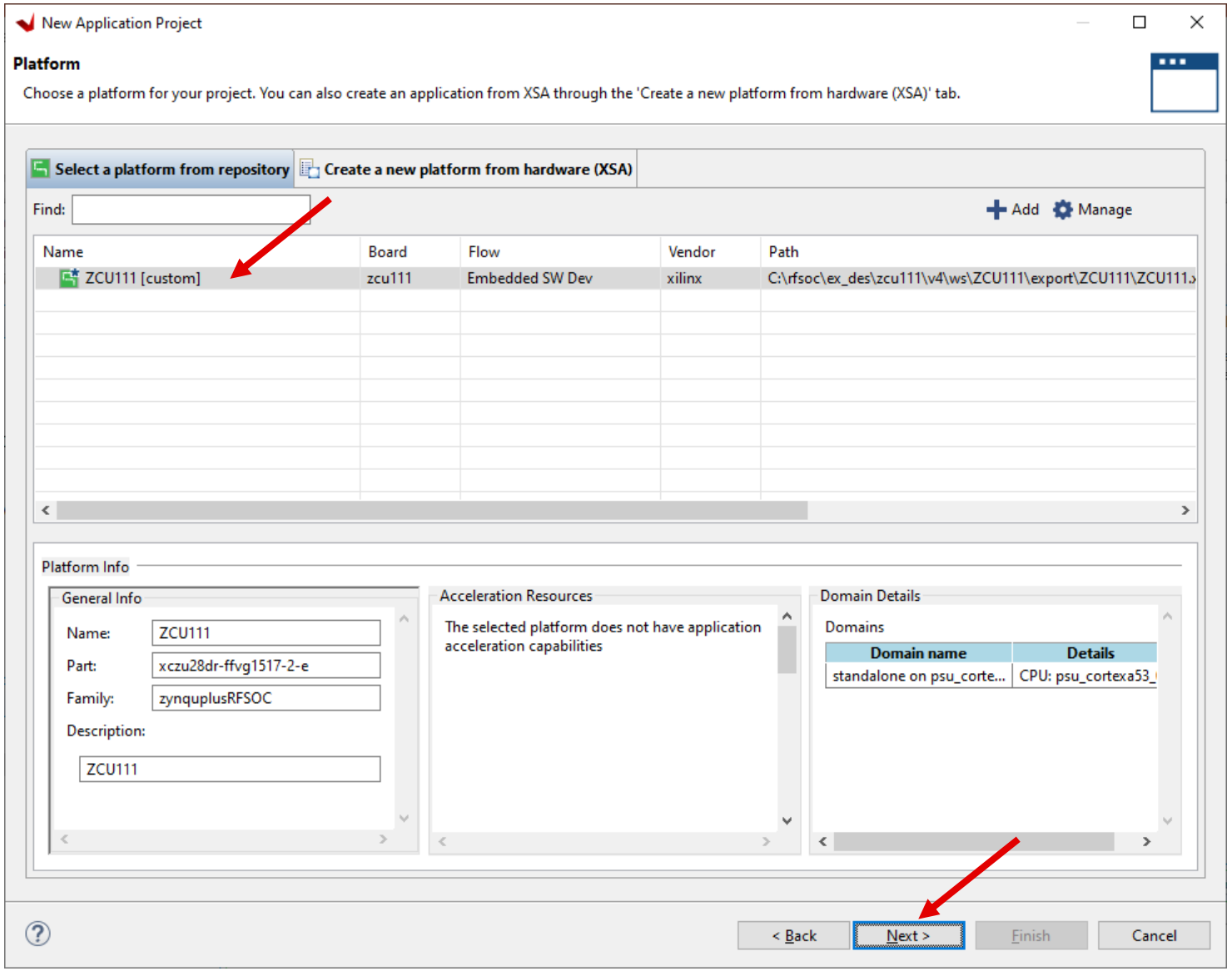

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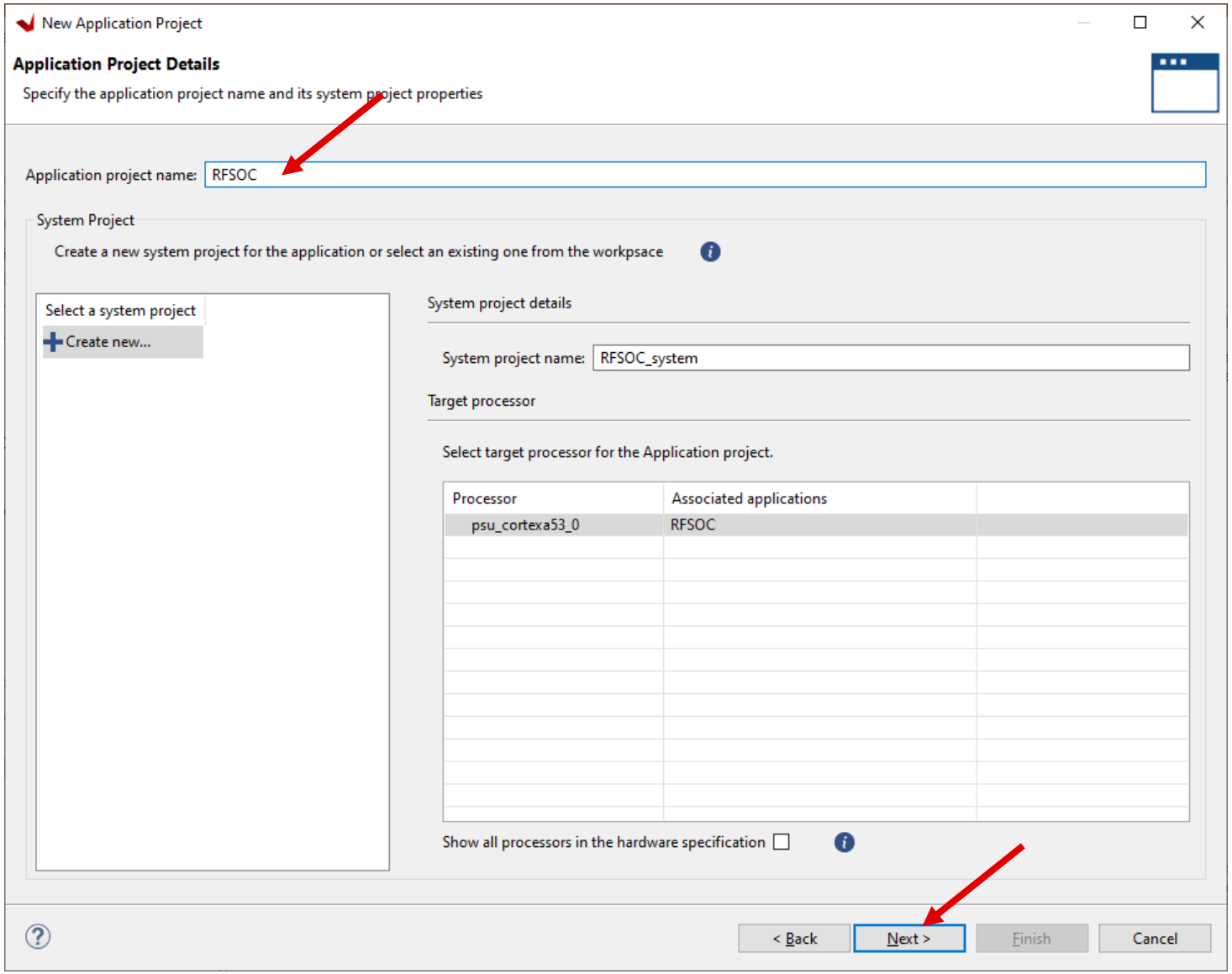

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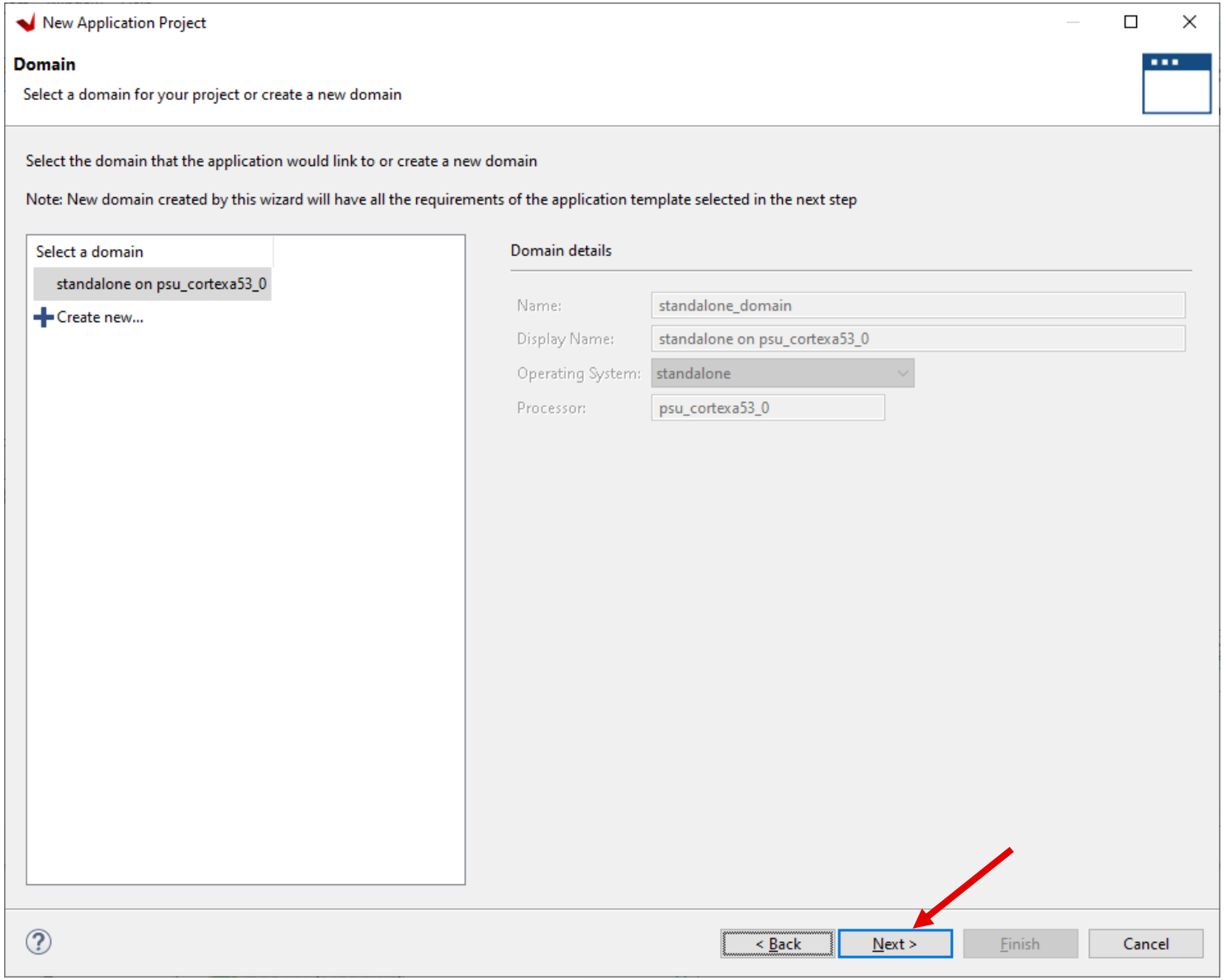

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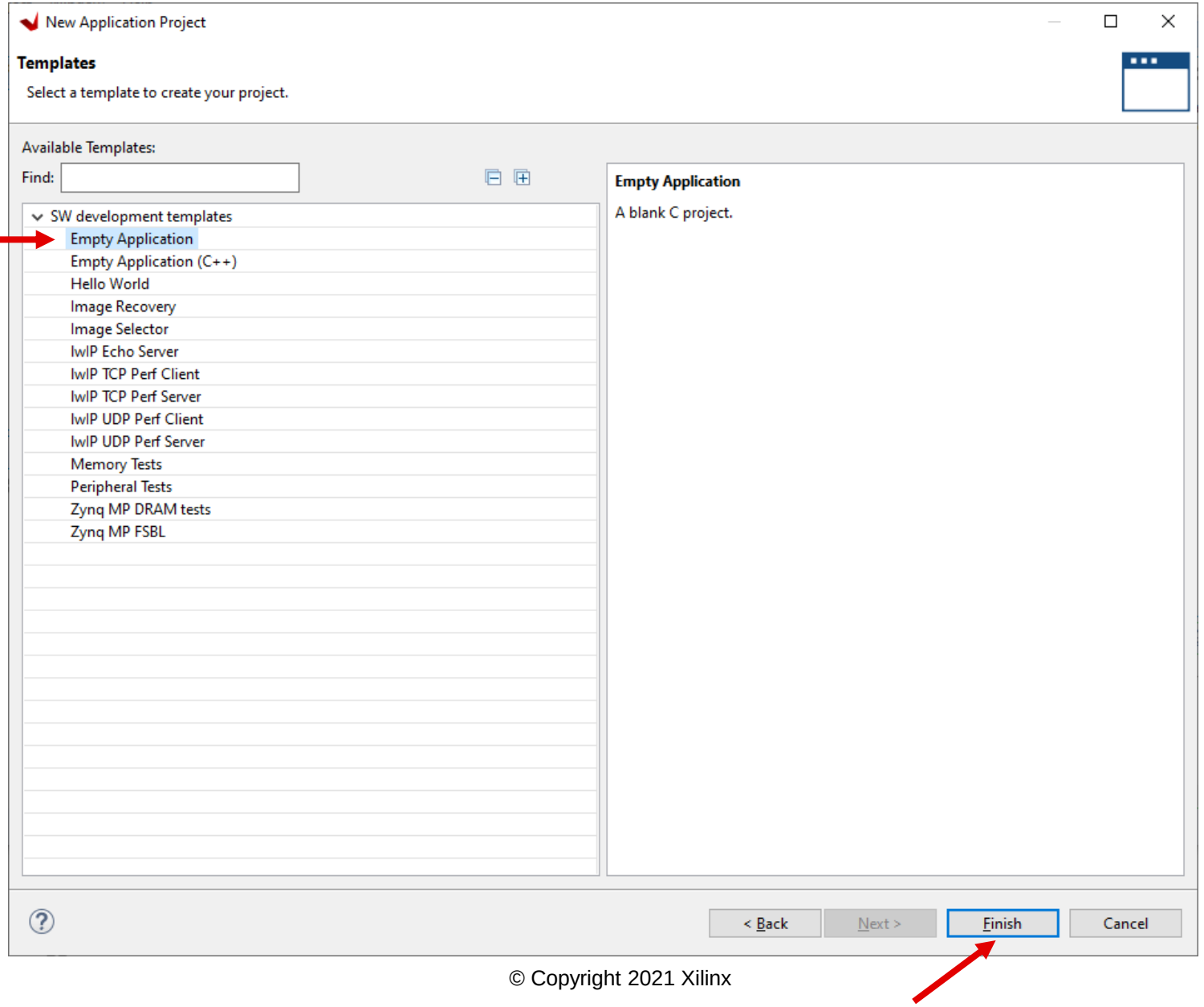

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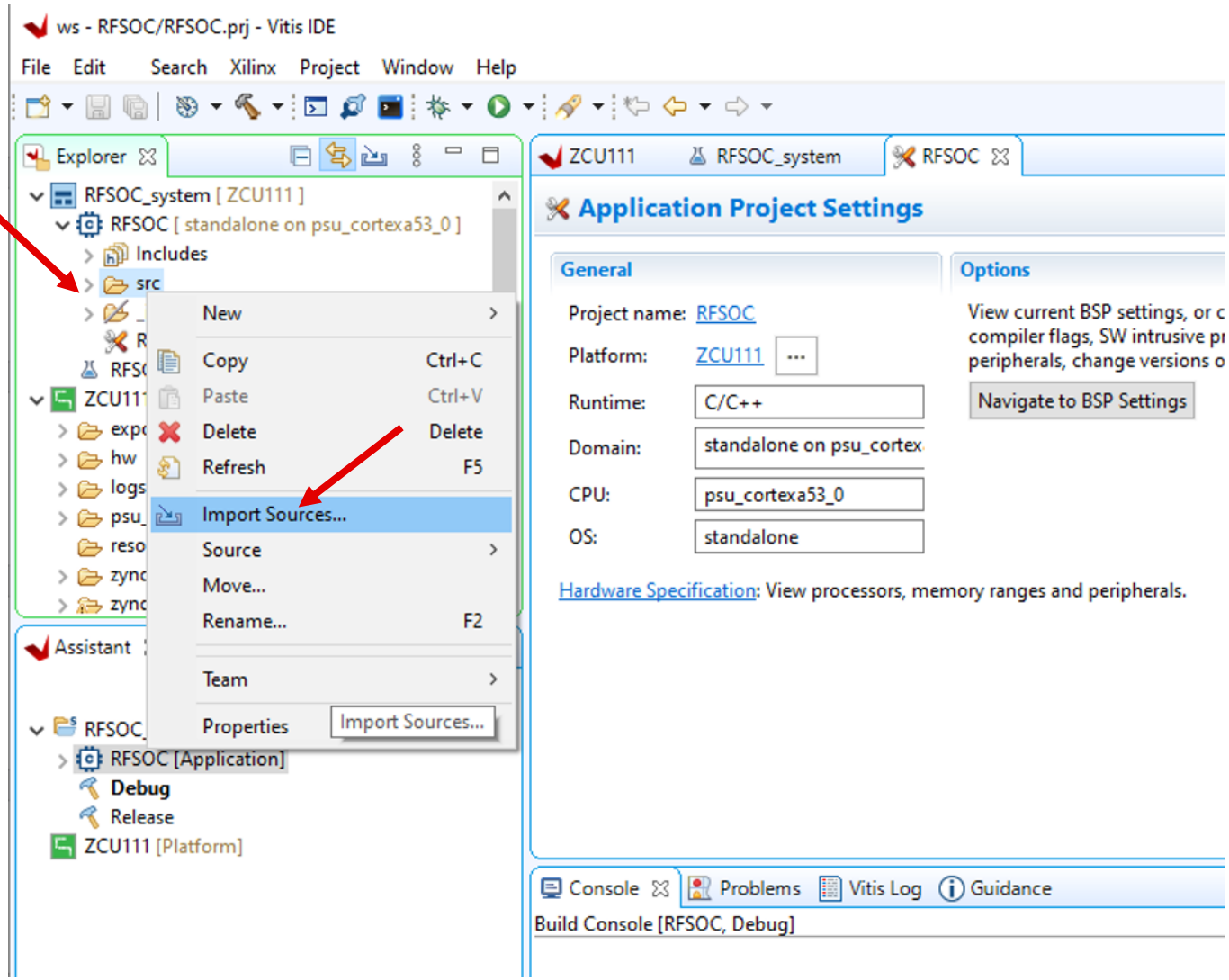
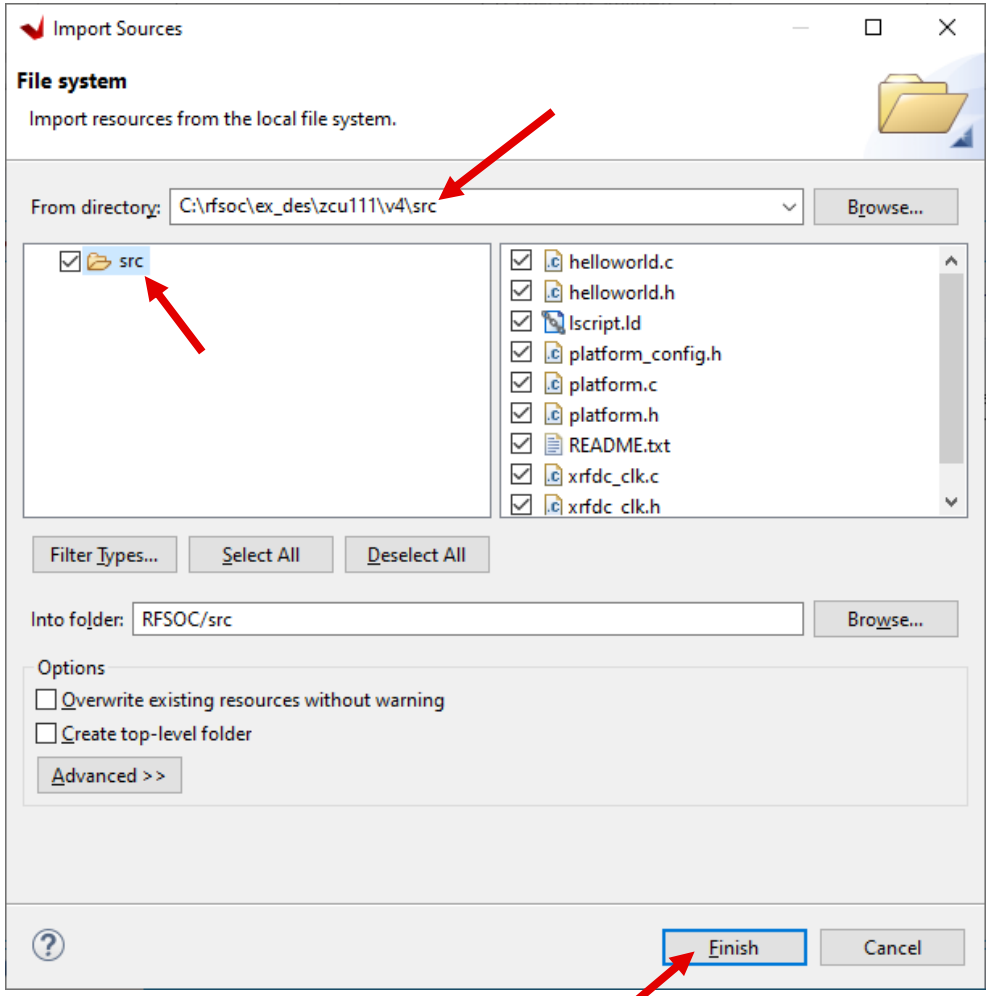
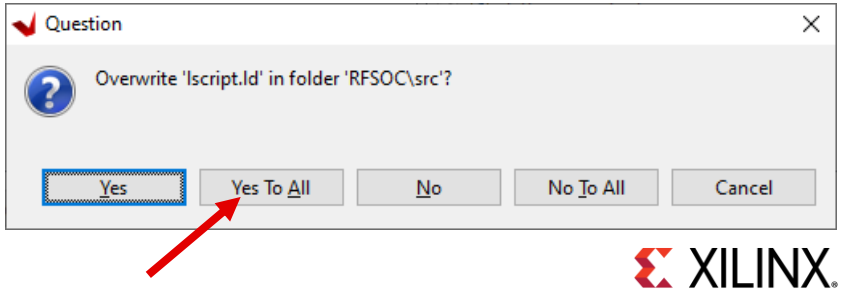
Import Sources







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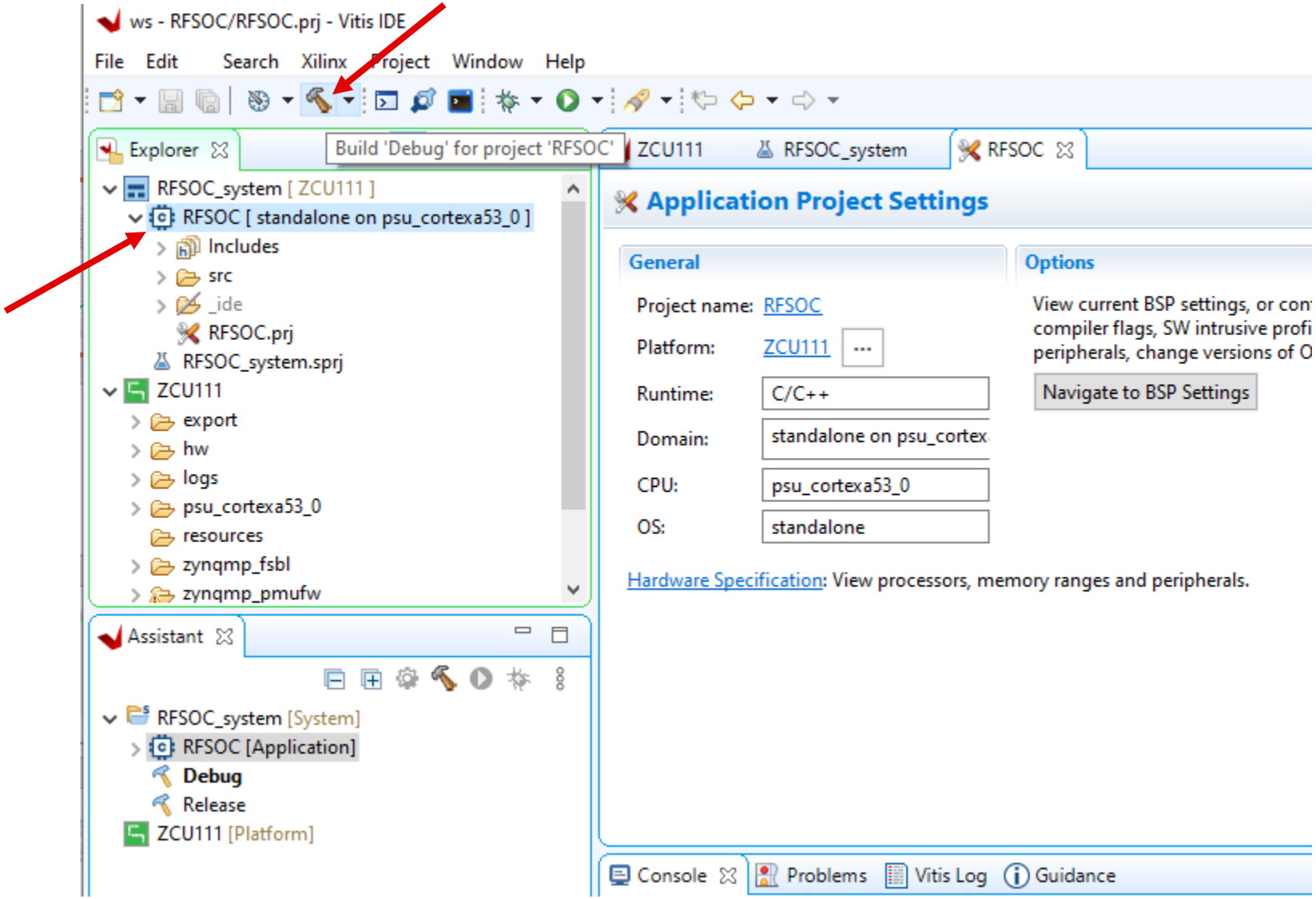
Build Application



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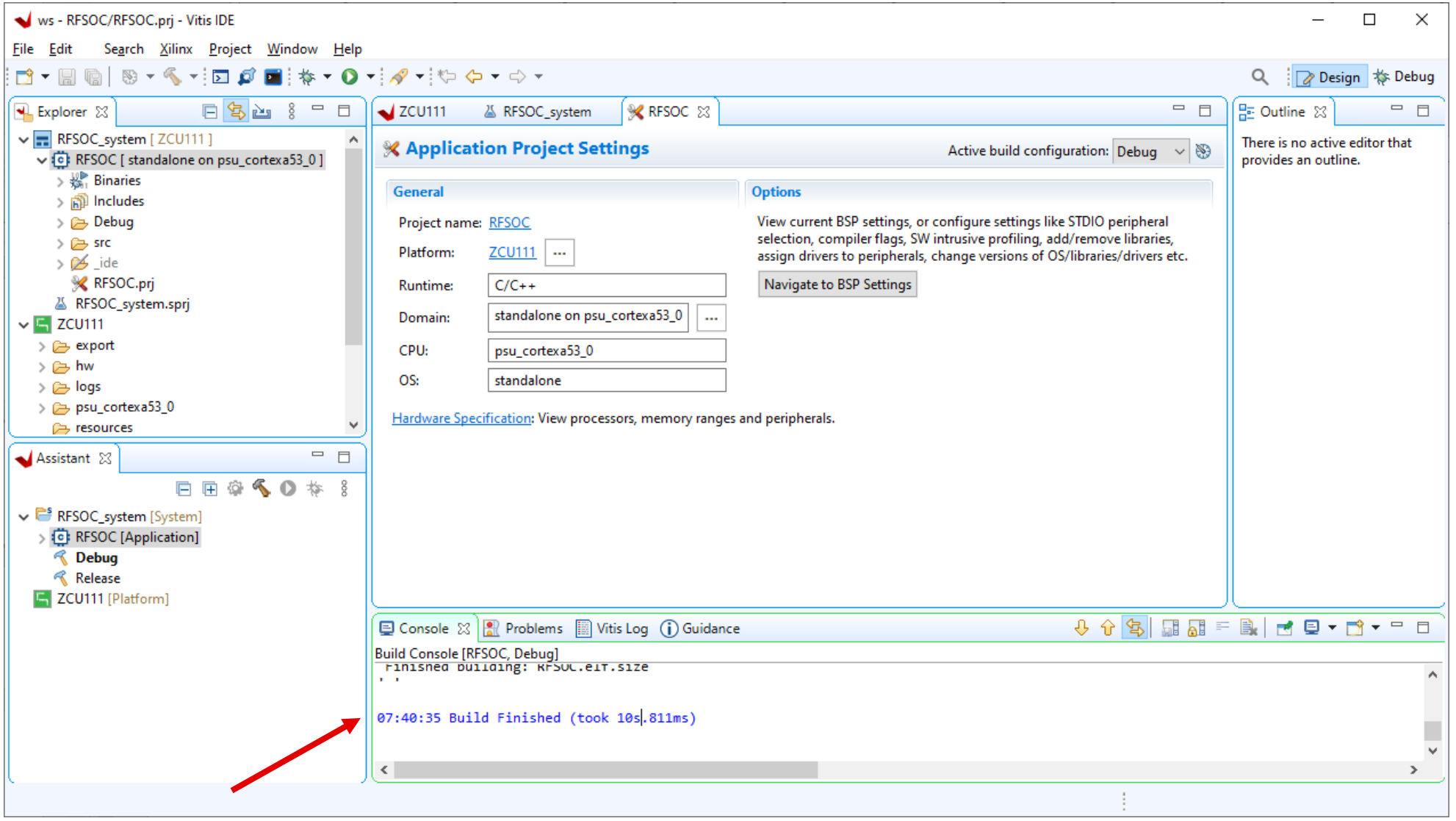
Build Complete



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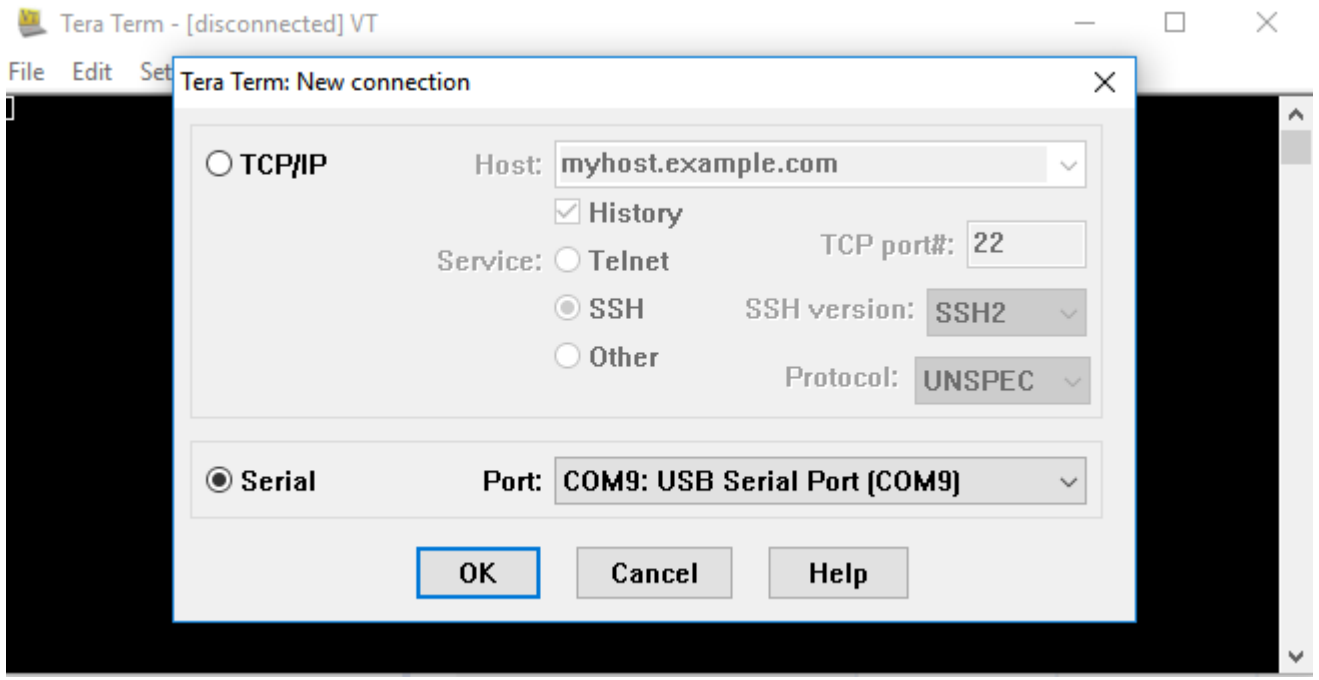
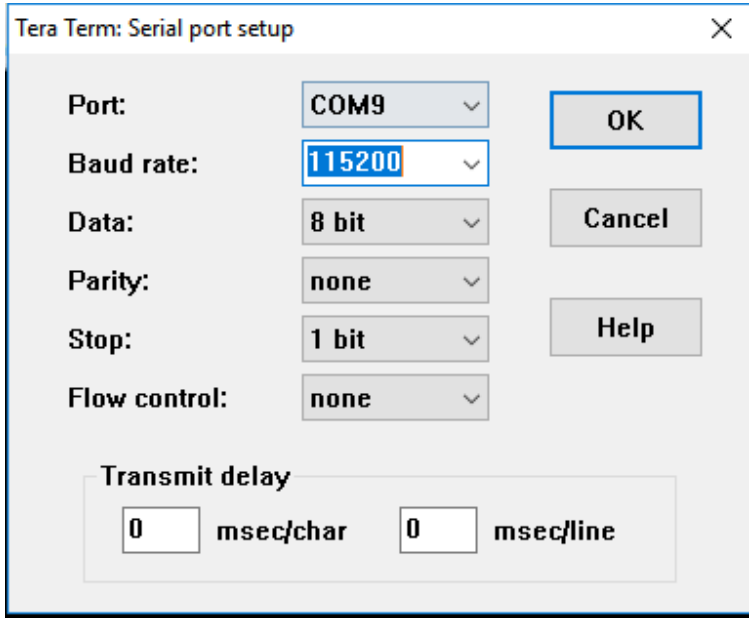
Run Design

Open a Terminal Window

Open the COM port on the compute and set the rate to 115200.

TeraTerm can be used. See UG1036.





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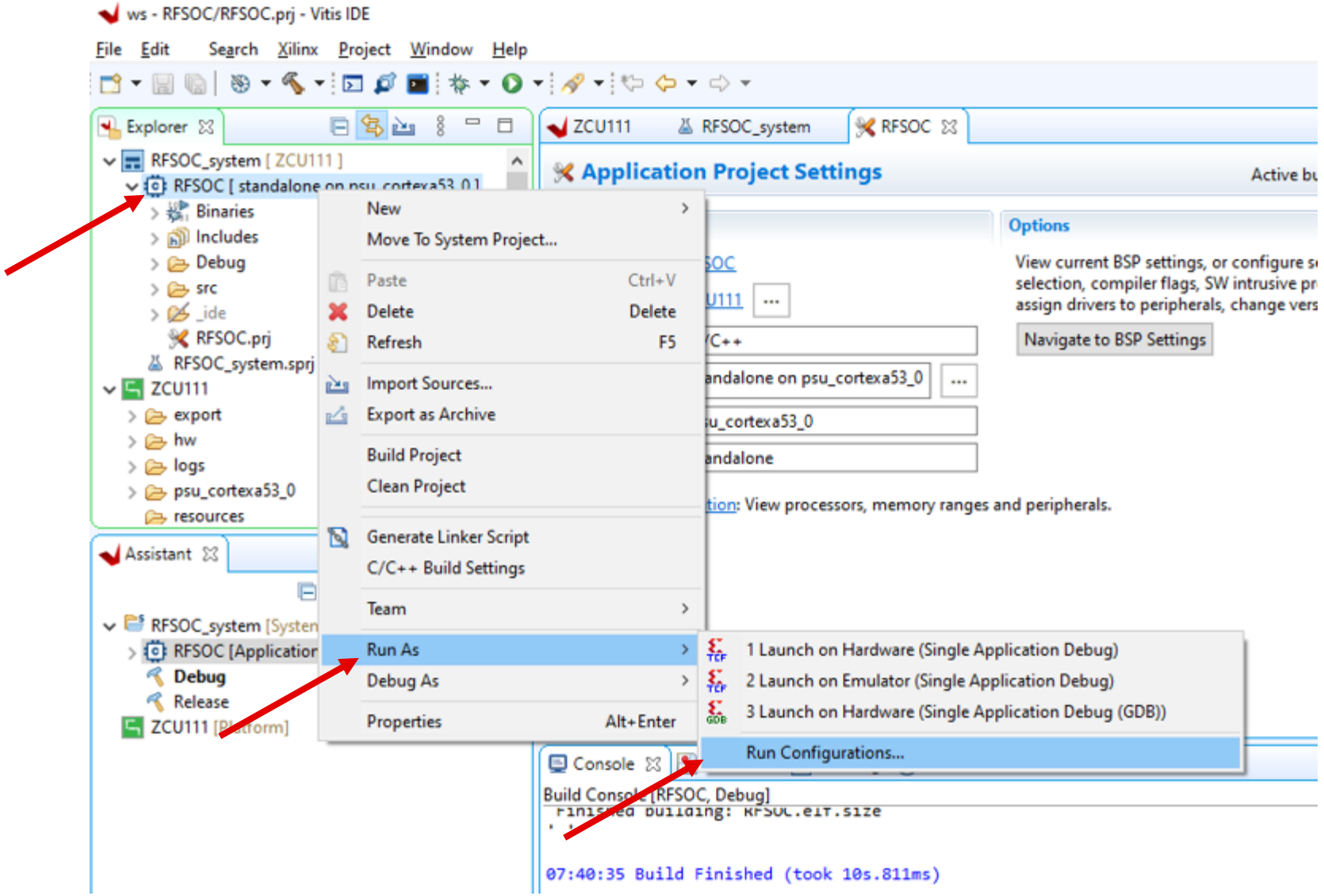
Setup Run Configuration



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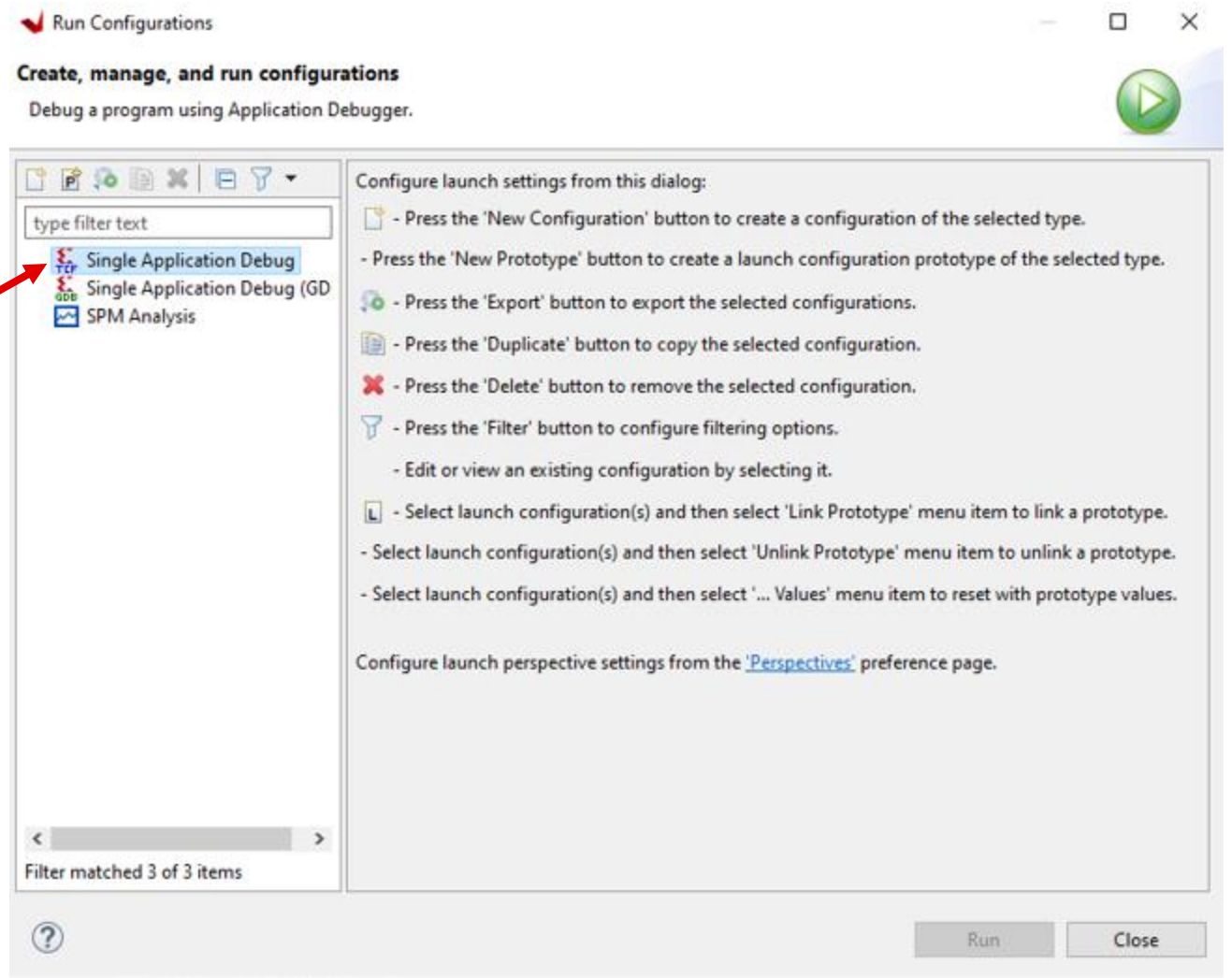
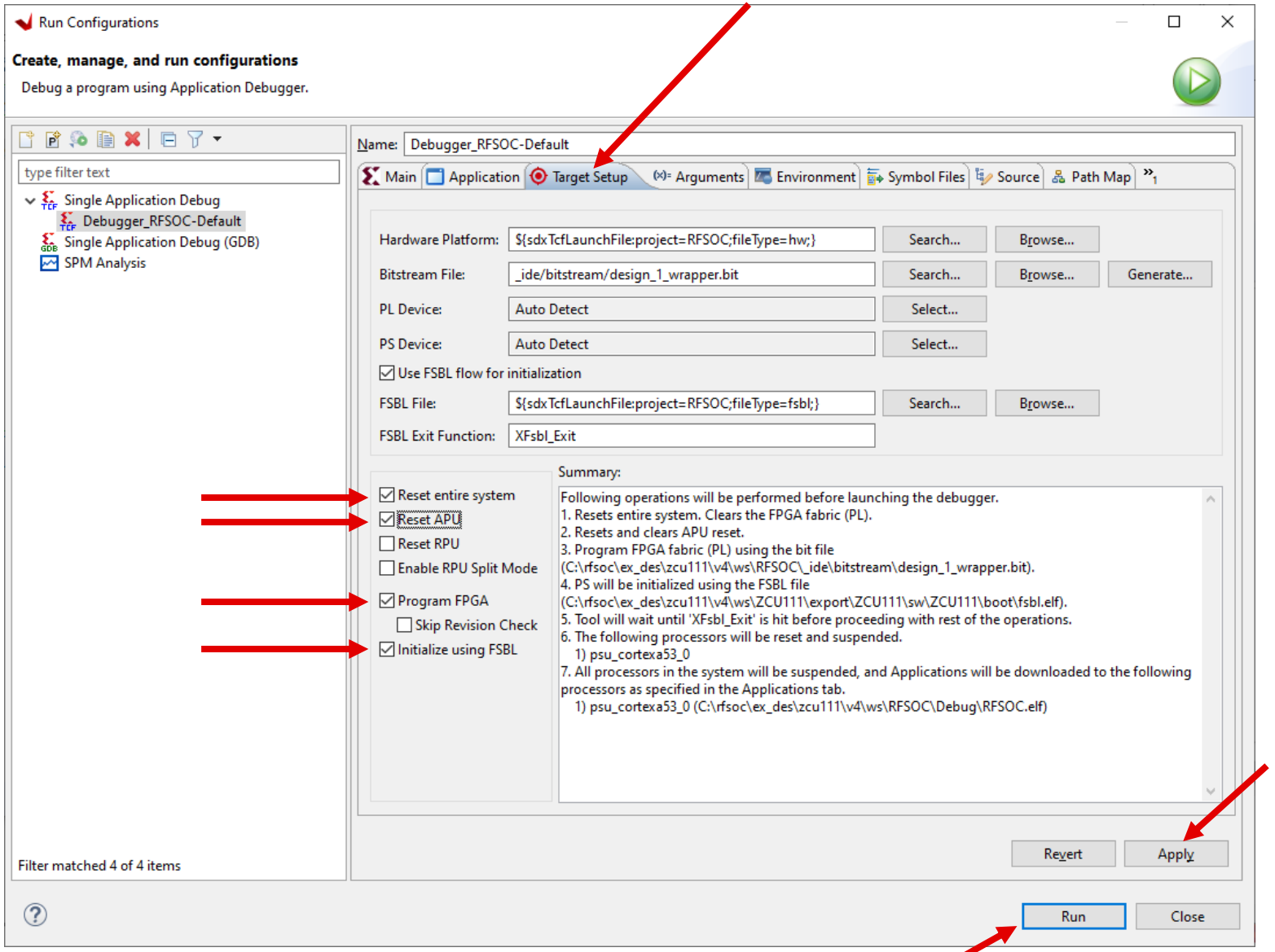
Run Configuration Cont'd

Double Click



Run Configuration Cont'd



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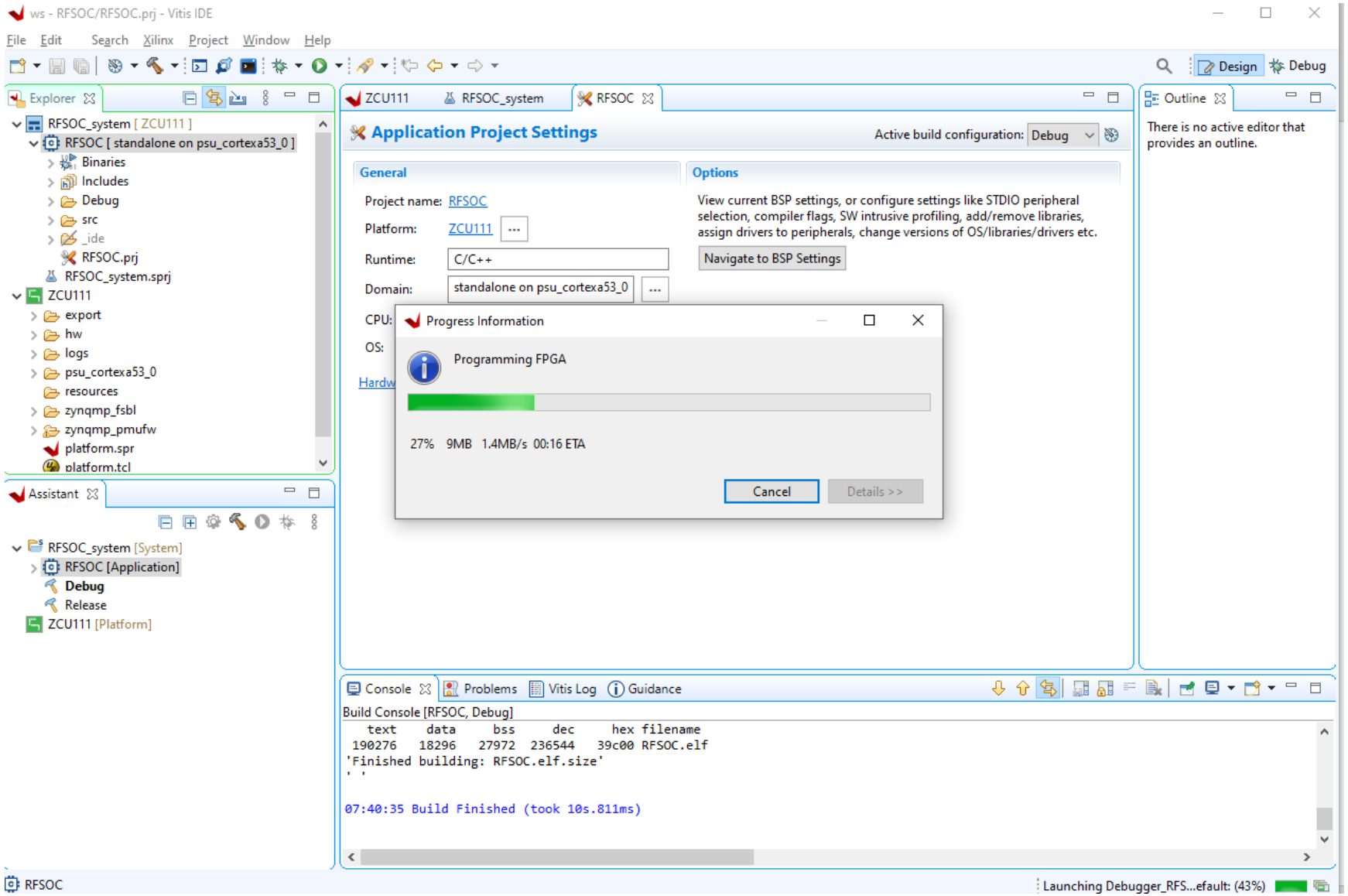
Run Design



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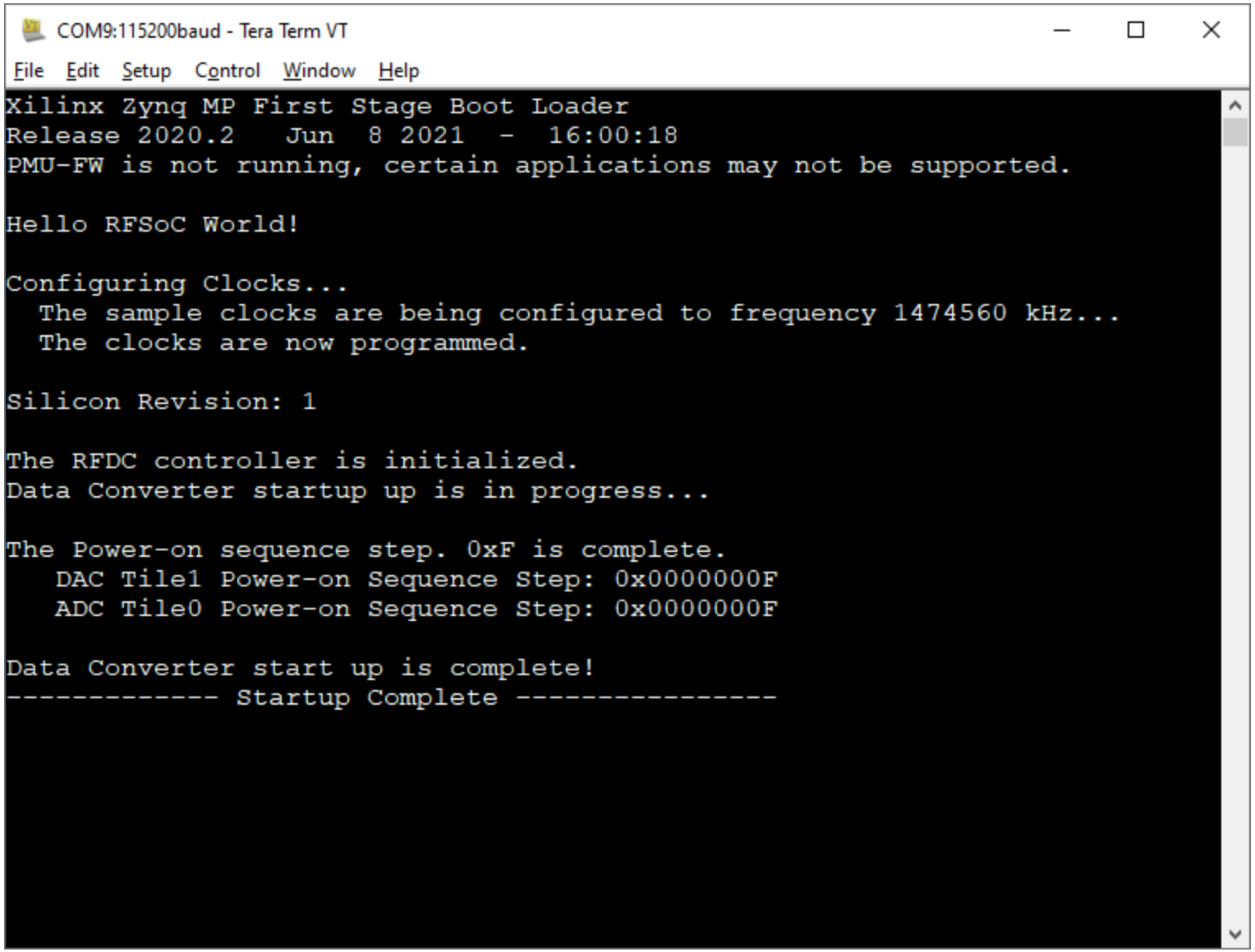
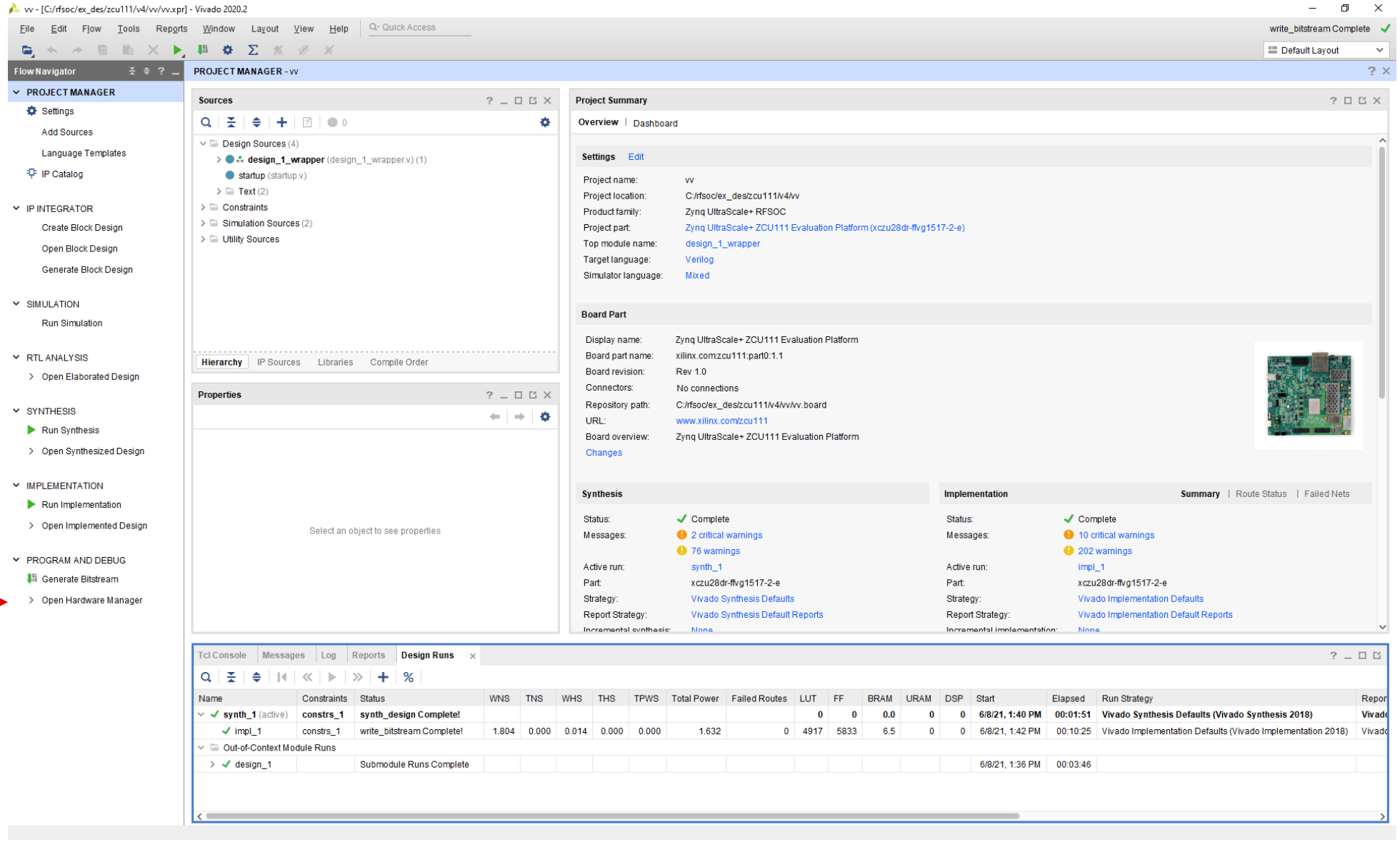
Application Startup

The application…

1. Programs the clocks.
2. Issues the data converters master reset.
3. Displays the Power-on Sequence Step of the data converters.



Open Hardware Manager



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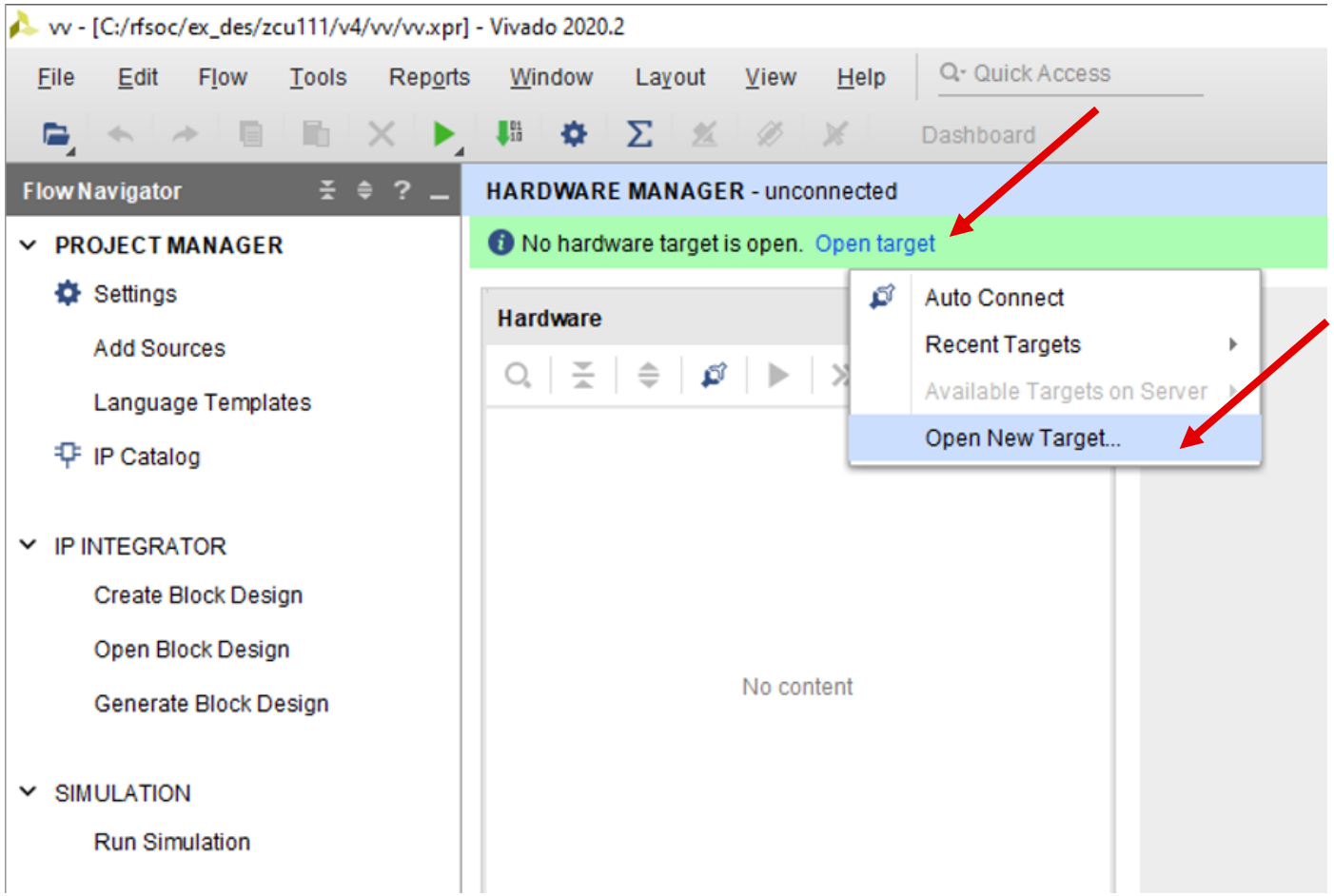
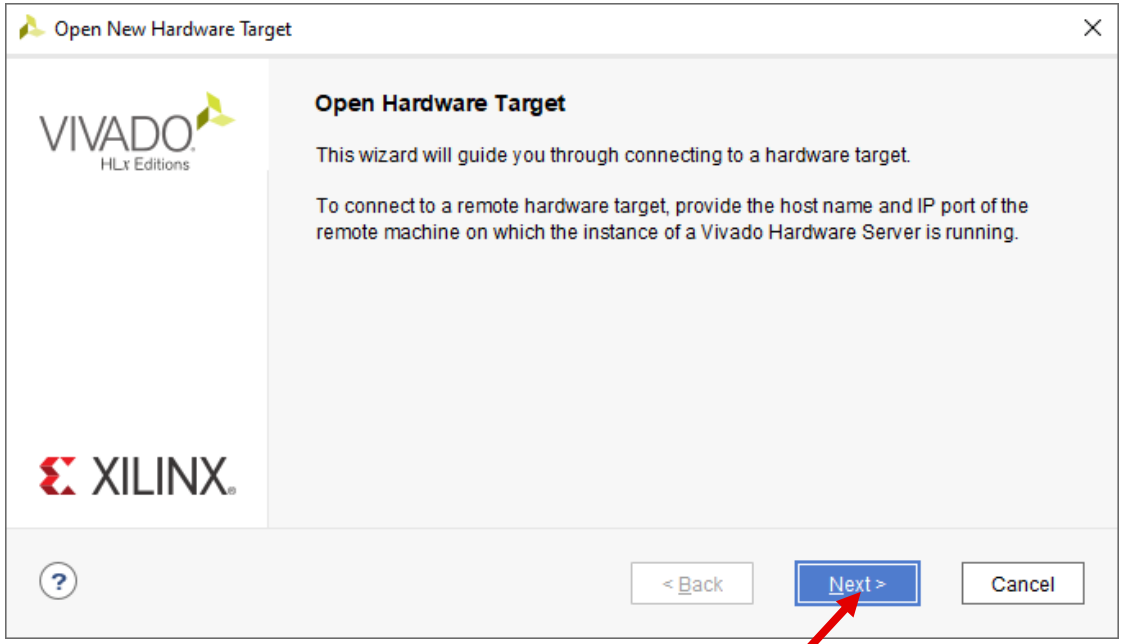
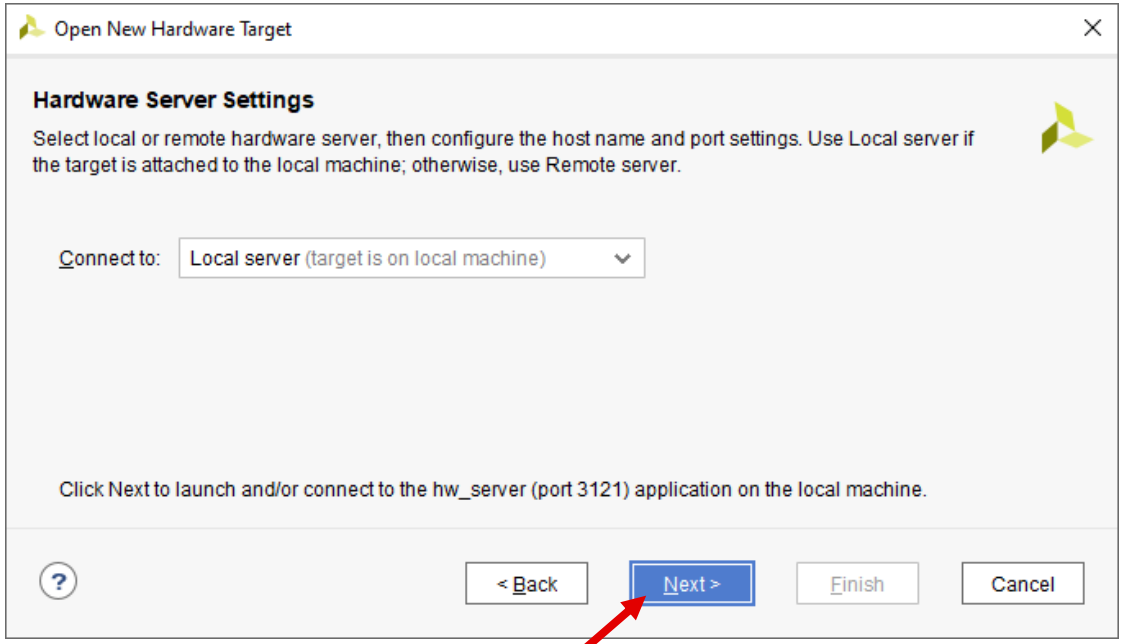
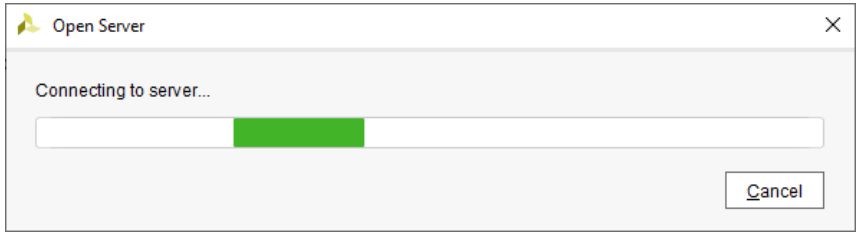
Open New Target



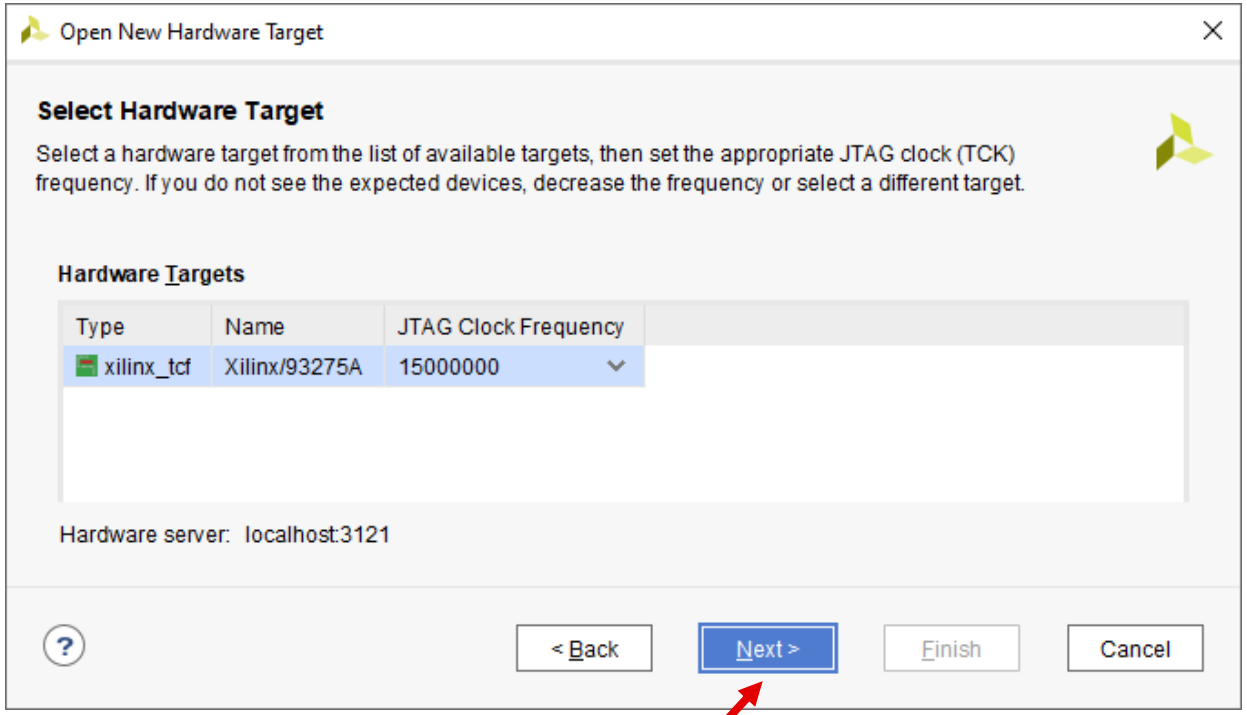
Open Hardware Target

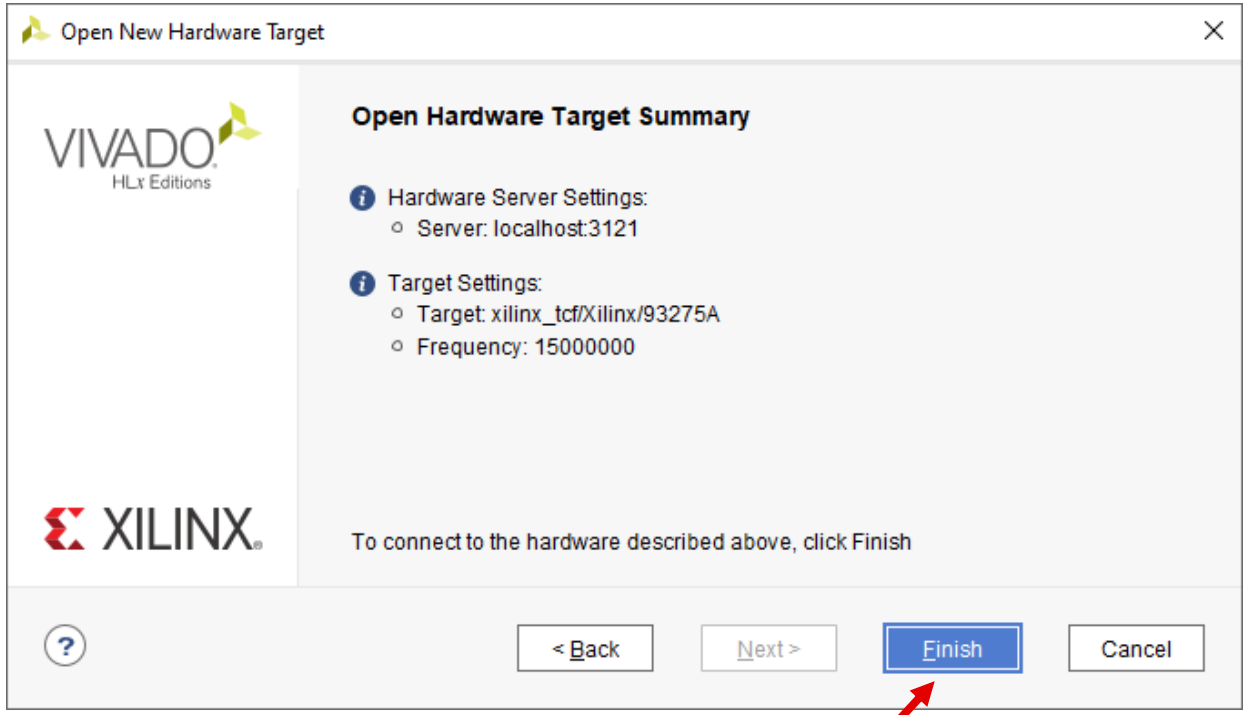






Open Hardware Target Cont'd





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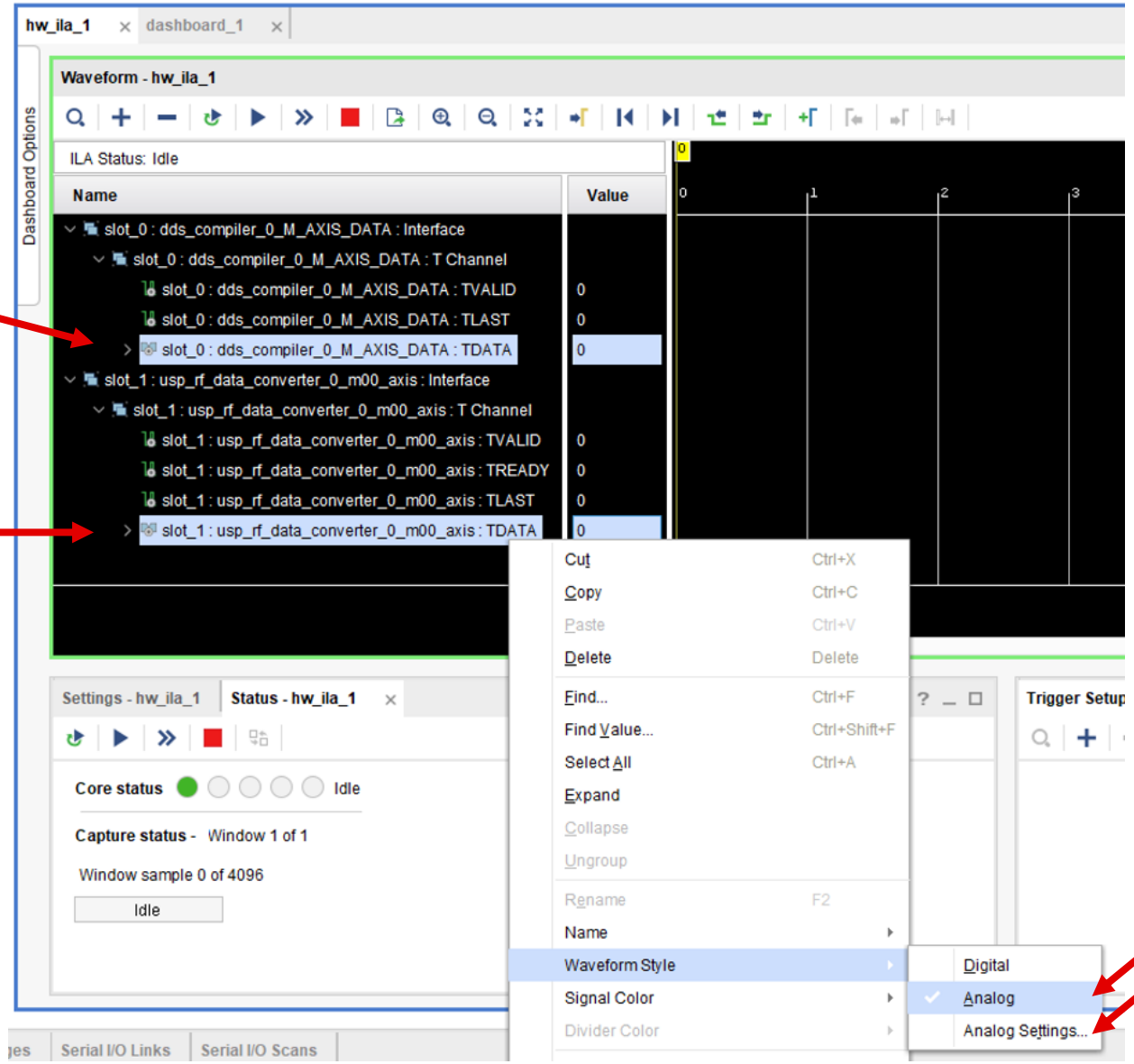
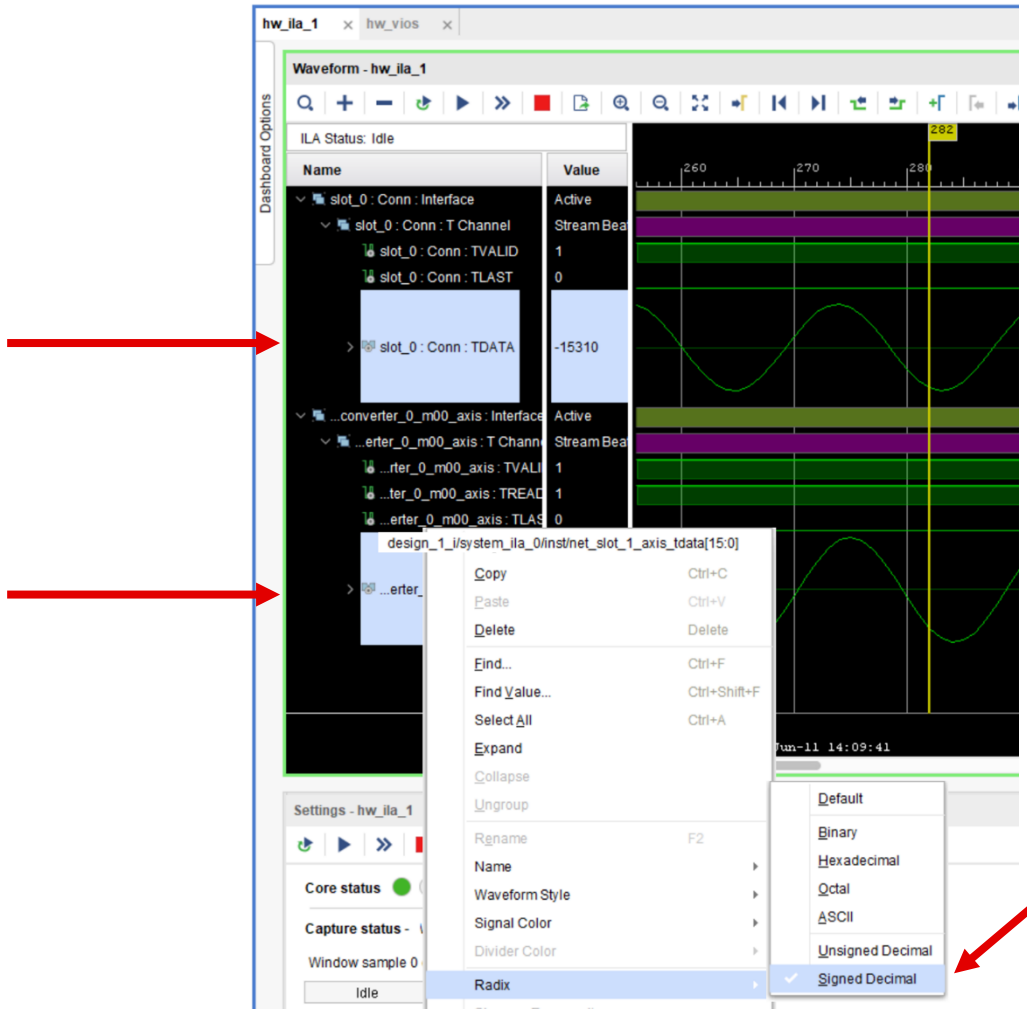
Convert Data to the Analog Waveform Style

10MHz sine wave going from the DDS compiler to the DAC.

ADC capture to the System ILA.



Radix



Use Radix of Signed Decimal.

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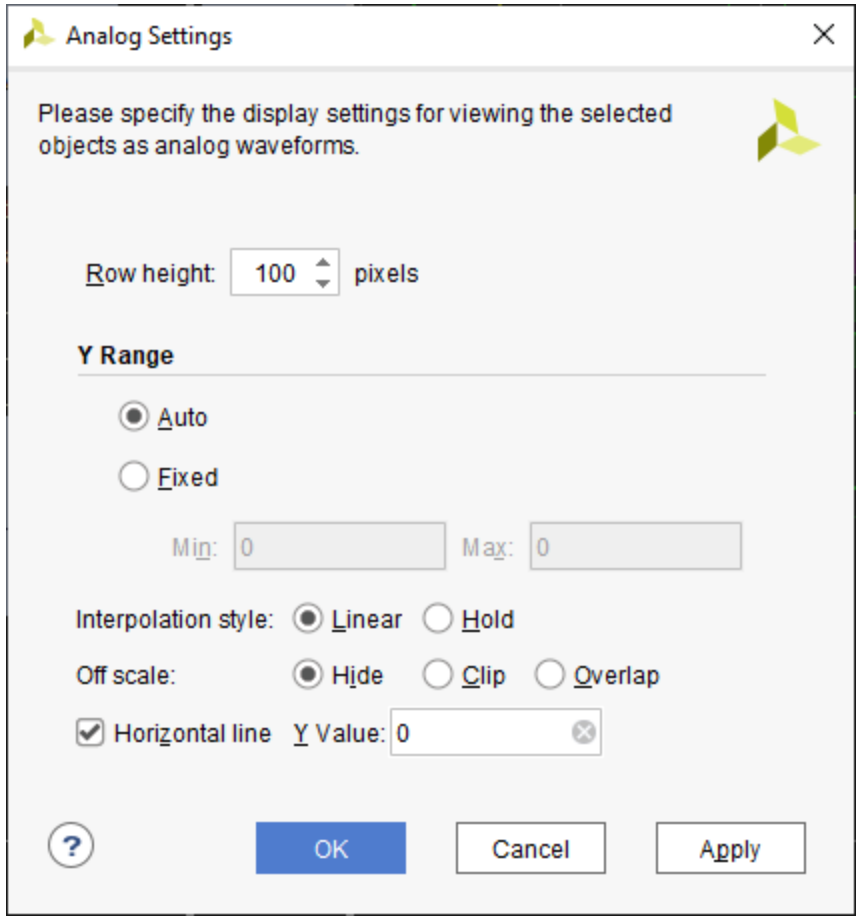
Analog Settings

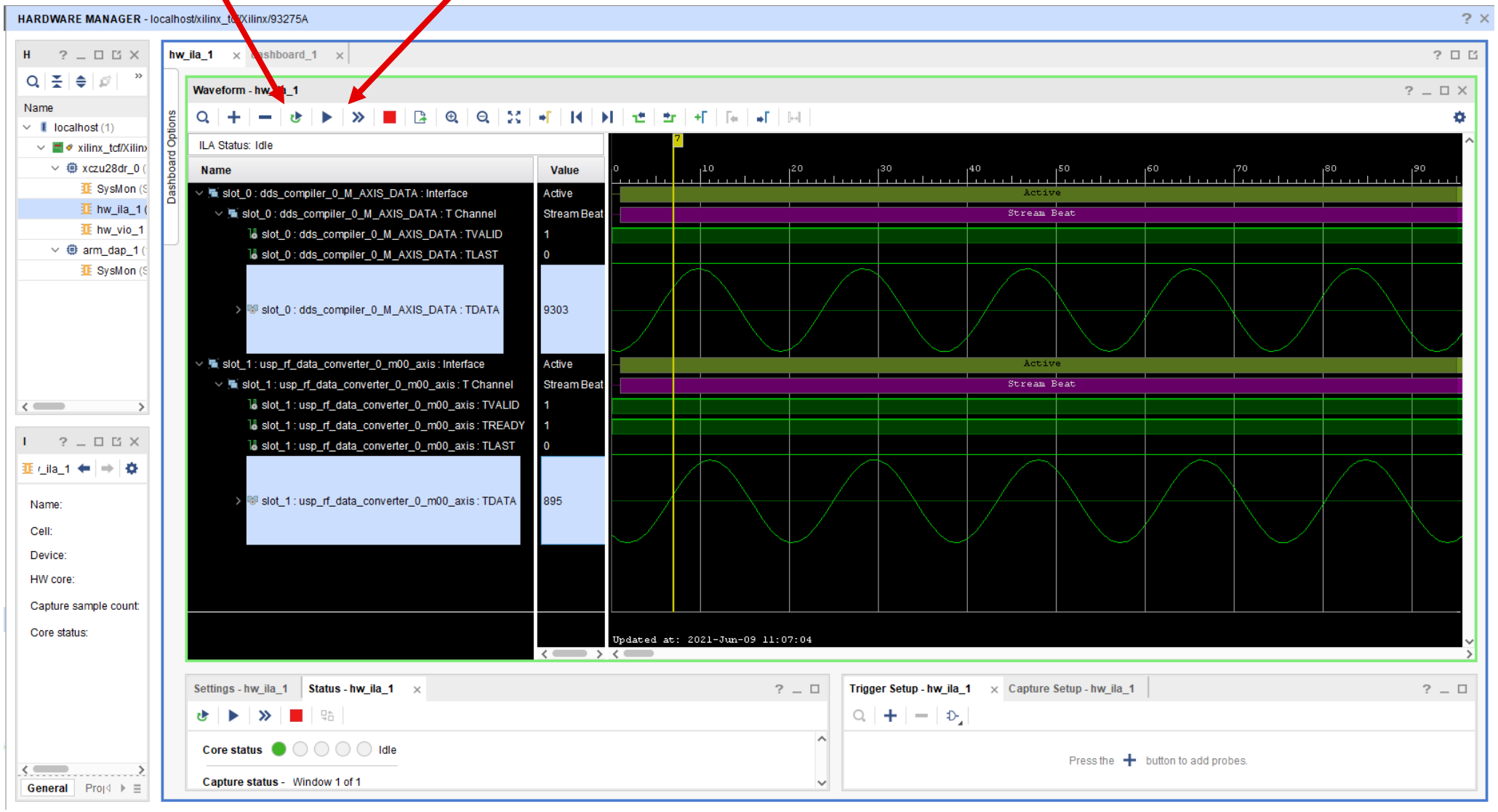
Set Row height to 100.



System ILA Capture

Automatically retrigger

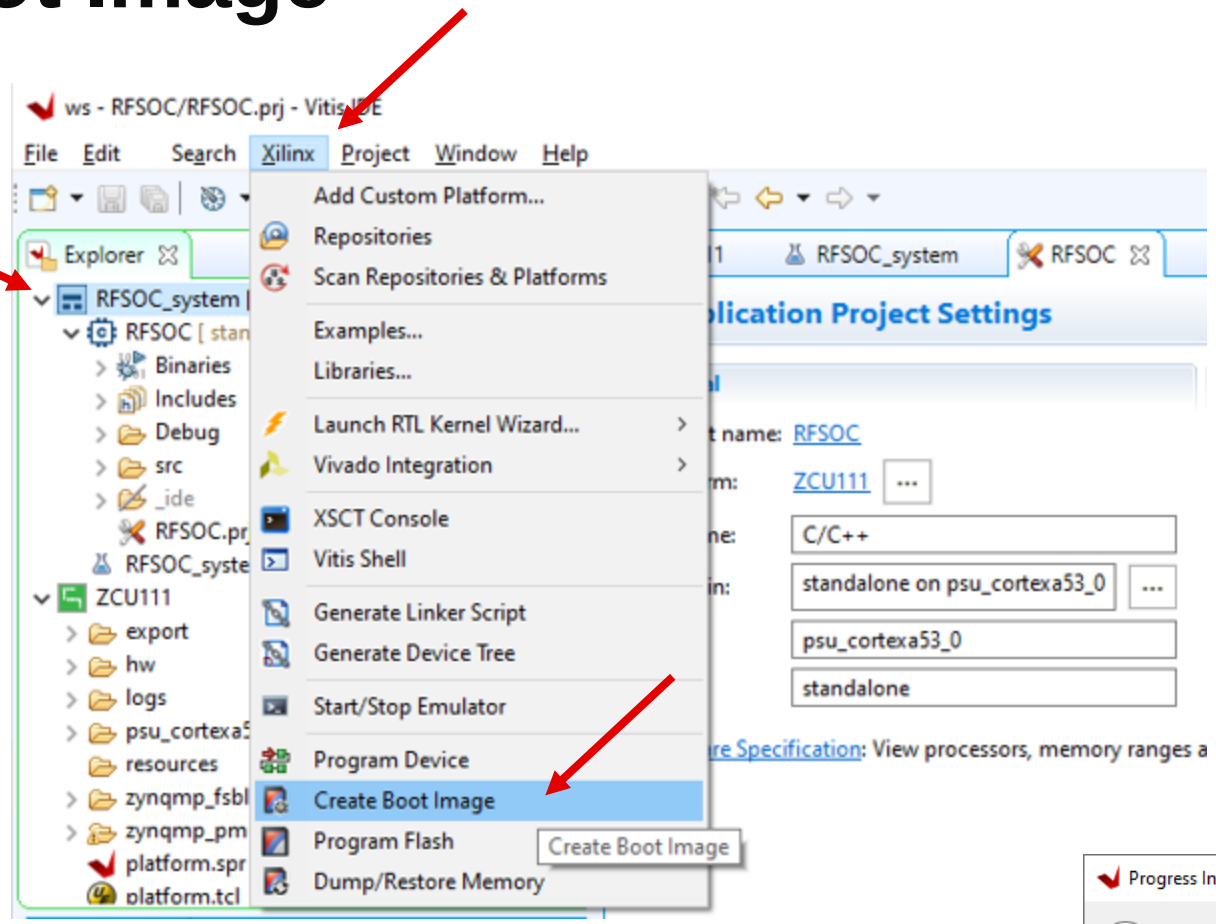
Trigger ILA capture

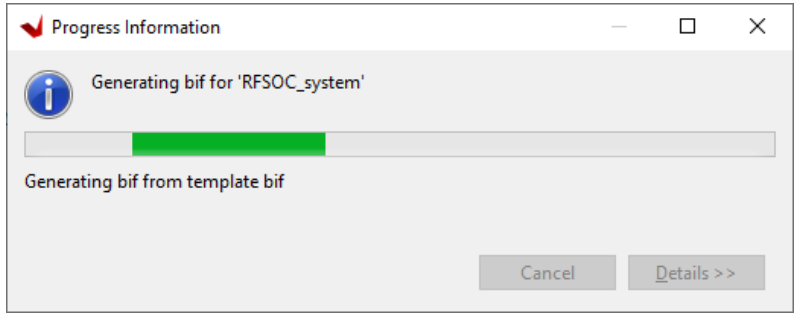


Boot Image

Create Boot Image

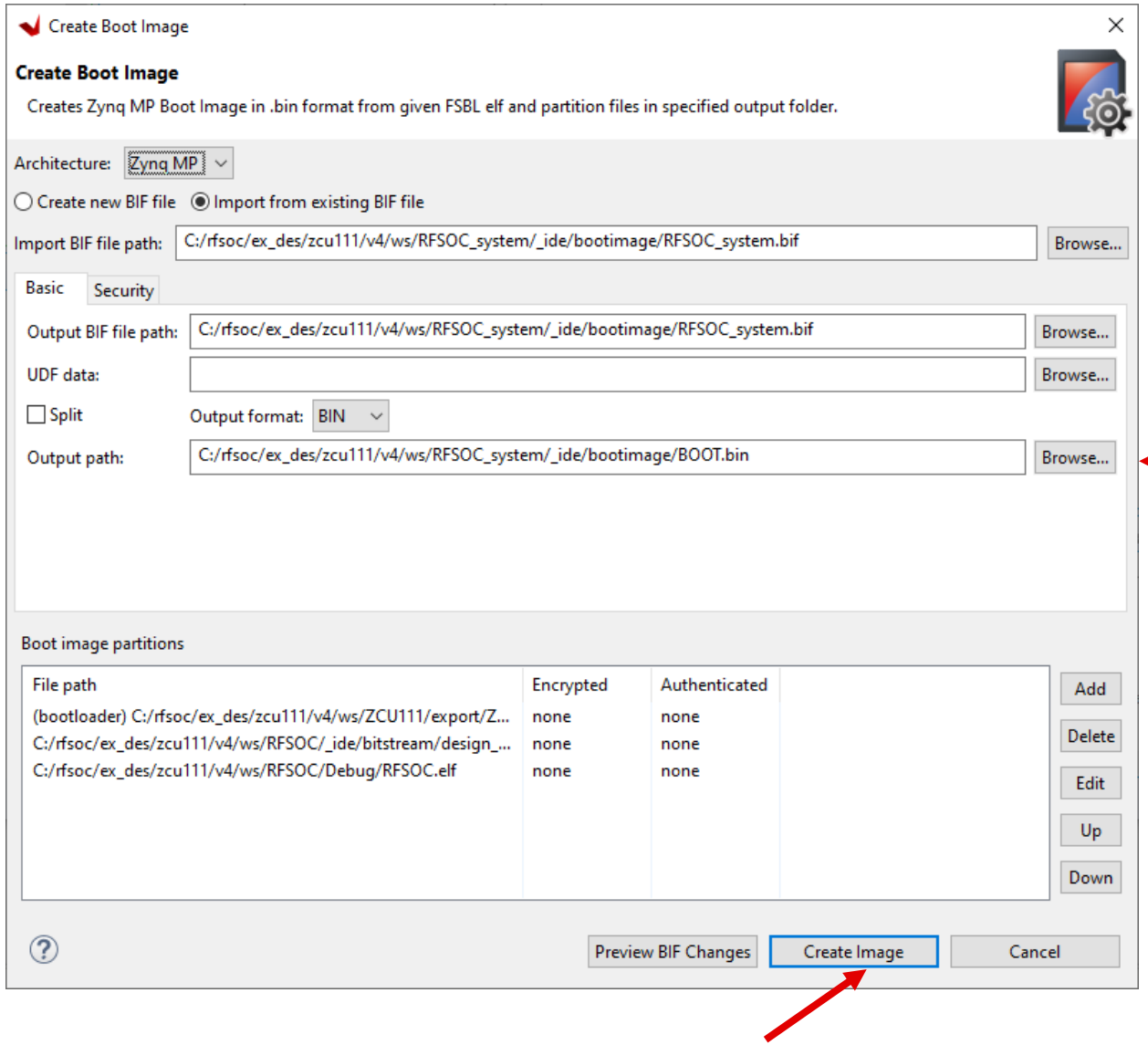
To run the application from the SD card rather than directly from Vitis™, create the boot.bin file





XILINX.

Create boot.bin file

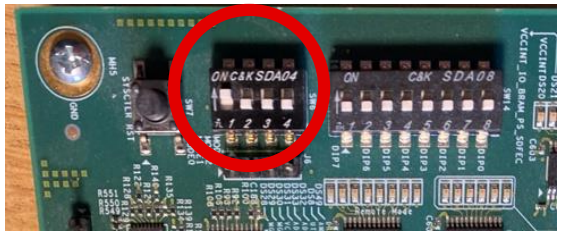


Note the location of the boot.bin file to put at the root level of the SD card.

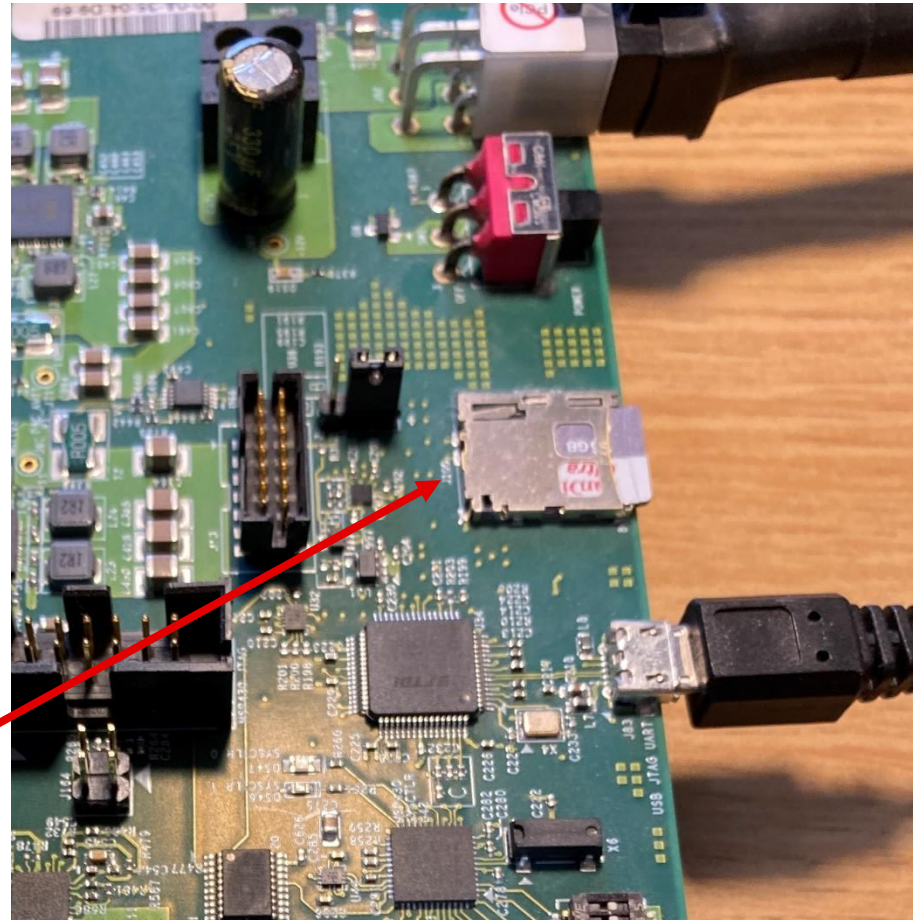
XILINX.

Boot from SD Card

Set SW6 to on,off,off,off (SD Card boot mode).



Load boot.bin on the SD card, insert it into the board, and turn on the power.



Thank You