

## Course Description

This course shows you how to build an effective FPGA design using synchronous design techniques, using the Vivado® IP integrator to create a sub-system, using proper HDL coding techniques to improve design performance, and debugging a design with multiple clock domains.

**Level** – FPGA 2

**Course Duration** – 2 days

**Course Part Number** – FPGA-VDES2-ILT

**Who Should Attend?** – Digital designers who have a working knowledge of HDL (VHDL or Verilog) and who are new to Xilinx FPGAs

**Prerequisites**

- *Designing FPGAs Using the Vivado Design Suite 1* course
- Working HDL knowledge (VHDL or Verilog)
- Digital design experience

**Optional Videos**

- Basic HDL Coding Techniques\*

**Software Tools**

- Vivado Design or System Edition 2017.3

**Hardware**

- Architecture: UltraScale™ and 7 series FPGAs\*\*
- Demo board (optional): Kintex®-7 FPGA KC705 board\*\*

\* Go to [www.xilinx.com/training](http://www.xilinx.com/training) and click the Online Training tab to view this video.

\*\* This course focuses on the UltraScale and 7 series architectures. Check with your local Authorized Training Provider for the specifics of the in-class lab board or other customizations.

After completing this comprehensive training, you will have the necessary skills to:

- Identify synchronous design techniques
- Build resets into your system for optimum reliability and design speed
- Create a Tcl script to create a project, add sources, and implement a design
- Describe and use the clock resources in a design
- Create and package your own IP and add to the Vivado IP catalog to reuse
- Use the Vivado IP integrator to create a block design
- Apply timing exception constraints in a design as part of the Baseline procedure to fine tune the design
- Describe how power analysis and optimization is performed
- Describe the HDL instantiation flow of the Vivado logic analyzer

## Course Outline

### Day 1

- UltraFast Design Methodology: Design Creation {Lecture}
- Synchronous Design Techniques {Lecture}
- Resets {Lecture, Lab}
- Register Duplication {Lecture}
- Scripting in Vivado Design Suite Project Mode {Lecture, Lab}
- Clocking Resources {Lectures, Lab}
- I/O Logic Resources {Lectures}
- Creating and Packaging Custom IP {Lecture, Lab}

### Day 2

- Using an IP Container {Lecture, Demo}
- Designing with the IP Integrator {Lecture, Lab, Demo, Case Study}
- Timing Constraints Editor {Lecture}
- Report Clock Networks {Lecture, Demo}
- Timing Summary Report {Lecture, Demo}
- Clock Group Constraints {Lecture, Demo}
- Introduction to Timing Exceptions {Lecture, Lab, Demo}
- Power Analysis and Optimization Using the Vivado Design Suite {Lecture, Lab}
- Configuration Process {Lecture}
- HDL Instantiation Debug Probing Flow {Lecture, Lab}
- Design Analysis Using Tcl Commands {Lecture, Demo, Lab}

## Topic Descriptions

### Day 1

- UltraFast Design Methodology: Design Creation – Overview of the methodology guidelines covered in this course.
- Synchronous Design Techniques – Introduces synchronous design techniques used in an FPGA design.
- Resets – Investigates the impact of using asynchronous resets in a design.
- Register Duplication – Use register duplication to reduce high fanout nets in a design.
- Scripting in Vivado Design Suite Project Mode – Explains how to write Tcl commands in the project-based flow for a design.
- Clocking Resources – Describes various clock resources, clocking layout, and routing in a design.
- I/O Logic Resources – Overview of I/O resources and the IOB property for timing closure.
- Creating and Packaging Custom IP – Create your own IP and package and include it in the Vivado IP catalog.

### Day 2

- Using an IP Container – Use a core container file as a single file representation for an IP.
- Designing with the IP Integrator – Use the Vivado IP integrator to create the `uart_led` subsystem.
- Timing Constraints Editor – Introduces the timing constraints editor tool to create timing constraints.
- Report Clock Networks – Use `report_clock_networks` to view the primary and generated clocks in a design.
- Timing Summary Report – Use the post-implementation timing summary report to sign-off criteria for timing closure.
- Clock Group Constraints – Apply clock group constraints for asynchronous clock domains.
- Introduction to Timing Exceptions – Introduces timing exception constraints and applying them to fine tune design timing.
- Power Analysis and Optimization Using the Vivado Design Suite – Use report power commands to estimate power consumption.
- Configuration Process – Understand the FPGA configuration process, such as device power up, CRC check, etc.
- HDL Instantiation Debug Probing Flow – Covers the HDL instantiation flow to create and instantiate a VIO core and observe its behavior using the Vivado logic analyzer.
- Design Analysis Using Tcl Commands – Analyze a design using Tcl commands.

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