

Course Description

Learn how to employ GTX serial transceivers in your 7 series FPGA design. Understand and utilize the features of the serial transceiver blocks, such as 8B/10B and 64B/66B encoding, channel bonding, clock correction, and comma detection. Additional topics include use of the Architecture Wizard, synthesis and implementation considerations, board design as it relates to the transceivers, and test and debugging. This course combines lectures with practical hands-on labs.

Level – Connectivity 3

Course Duration – 3 days

Course Part Number – RIO22000-13-ILT

Who Should Attend? – FPGA designers and logic designers

Prerequisites

- Verilog or VHDL experience (or the *Designing with Verilog* or the *Designing with VHDL* course)
- Familiarity with logic design (state machines and synchronous design)
- Basic knowledge of FPGA architecture and Xilinx implementation tools is helpful
- Familiarity with serial I/O basics and high-speed serial I/O standards is also helpful

Software Tools

- Xilinx ISE® Design Suite: System Edition 13.4
 - Labs use PlanAhead 13.4 flow
- ChipScope™ Pro software 13.4
- Mentor Graphics ModelSim simulator 10.0

Hardware

- Architecture: 7 series FPGAs*
- Demo board: Spartan®-6 FPGA SP605 or Virtex®-6 FPGA ML605 board*

* This course focuses on the Kintex™-7 architecture. 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:

- Describe and utilize the ports and attributes of the GTX transceiver in the Kintex-7 FPGA
- Effectively utilize the following features of the GTX:
 - 8B/10B and other encoding/decoding, comma detection, clock correction, and channel bonding
 - Pre-emphasis and linear equalization
- Use the 7 Series FPGAs Transceivers Wizard to instantiate GTX primitives in a design
- Access appropriate reference material for board design issues involving the power supply, reference clocking, and trace design

Course Outline

Day 1

- 7 Series FPGAs Overview
- Transceiver Overview (GTX)
- Transceiver Clocking and Resets
- 8B/10B Encoder and Decoder
- **Lab 1:** 8B/10B Encoding and Bypass
- Commas and Deserializer Alignment
- **Lab 2:** Commas and Data Alignment

Day 2

- RX Elastic Buffer and Clock Correction
- **Lab 3:** Clock Correction
- Channel Bonding

- **Lab 4:** Channel Bonding
- Transceiver Wizard Overview
- **Lab 5:** GTX Core Generation
- Simulating and Implementing a Transceiver Design
- **Lab 6:** Simulation and Implementation (GTX)
- Physical Media Attachments

Day 3

- 64B/66B Encoding and the Gearbox
- **Lab 7:** 64B/66B Encoding
- Transceiver Board Design Considerations
- Transceiver Test and Debugging
- **Lab 8:** System Lab or IBERT Lab Using Xilinx Boards
- Transceiver Application Examples

Lab Descriptions

- **Lab 1:** 8B/10B Encoder and Decoder – Utilize the 8B/10B encoder and decoder and observe running disparity. Learn how to bypass the 8B/10B encoder and decoder.
- **Lab 2:** Commas and Data Alignment – Use programmable comma detection to align a serial data stream.
- **Lab 3:** Clock Correction – Utilize the attributes and ports associated with clock correction to compensate for frequency differences in the TX and RX clocks.
- **Lab 4:** Channel Bonding – Modify a design to use two transceivers bonded together to form one virtual channel.
- **Lab 5:** GTX Core Generation – Use the 7 Series FPGAs Transceivers Wizard to create instantiation templates.
- **Lab 6:** Simulation and Implementation – Instantiate the GTX transceiver component in a design, synthesize the design, and implement the design.
- **Lab 7:** 64B/66B Encoding – Generate a 64B/66B GTX core by using the CORE Generator™ tool, simulate the design, and analyze the results.
- **Lab 8:** System – Perform all design steps from planning the design, generation of the core, integration of the core into a design, simulating, implementing and debugging the design, and optimizing the link parameter using an evaluation board.

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