Arria® GX Development Kit

Getting Started User Guide

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Contents

1. About This Kit

Introduction

The Arria® GX Development Kit provides everything you need to develop and test a complete x1 or x4 PCI Express system based on the Arria GX device.

The development kit includes these kit features and documentation:

- The Arria GX development board
- Altera Complete Design Suite DVD containing:
  - Quartus® II Web Edition Software
  - MegaCore® IP Library
  - Nios® II Embedded Software Design Tools
- Arria GX Development Kit CD-ROM
- Design examples
- Power supply, cables, and documentation

Kit Features

This section briefly describes the Arria GX Development Kit features.

- **The Arria GX Development Board**—a prototyping platform that allows you to develop and prototype high-speed bus interfaces as well as evaluate Arria GX transceiver performance.

For specific information about board components and interfaces, refer to the *Arria GX Development Board Reference Manual*.

- **Quartus II Web Edition Software**—The Quartus II software (available on the DVD) integrates into nearly any design environment, with interfaces to industry-standard EDA tools. The kit includes:
  - The SOPC Builder system development tool
  - Free Quartus II Web Edition software license, Windows platform only

For more information, refer to the Altera website at http://www.altera.com/products/software/products/quartus2web/sof-quarwebmain.html.

- **MegaCore IP Library**—This library (available on the DVD) contains Altera IP MegaCore functions. You can evaluate MegaCore functions by using the OpenCore® Plus feature to do the following:
  - Simulate behavior of a MegaCore function within your system

- Verify functionality of your design, andquickly and easily evaluate its size and speed
- Generate time-limited device programming files for designs that include MegaCore functions
- Program a device and verify your design in hardware

- **Nios II Embedded Software Design Tools**—This full-featured set of tools (available on the DVD) allows you to develop embedded software on the Nios II processor running on Altera field-programmable gate arrays (FPGAs).

- **Arria GX Development Kit Application & Drivers**—The application and drivers (available on the CD-ROM) allow you to execute memory read and write transactions to the board.

- **Design Examples**—The design examples (available on the CD-ROM) are useful for a variety of hardware applications and let you quickly begin board prototyping and device verification.

You only need to purchase a license for a MegaCore function when you are completely satisfied with its functionality and performance, and want to take your design to production.

The OpenCore Plus hardware evaluation feature is an evaluation tool for prototyping only. You must purchase a license to use a MegaCore function in production.

Documentation

The Arria GX Development Kit CD-ROM contains the following documents:

- **Readme file**—Contains special instructions and refers to the kit's documentation.
- ***Arria GX Development Kit Getting Started User Guide*** (this document) —Describes how to start using the kit.
- ***Arria GX Development Board Reference Manual***—Provides specific information about the board components and interfaces, steps for using the board, and pin-outs and signal specifications.

2. Getting Started

Introduction

The Arria GX Development Kit is a complete PCI Express prototyping and testing kit based on the Arria GX device. With this kit, you can perform device qualification testing, memory read and write transactions to the Arria GX development board, read the configuration registers, and use an example design to write to system DDR2 memory.

In addition to providing a development board, the kit also includes all of the hardware and software development tools, as well as the documentation and accessories you need to begin developing PCI Express systems using the Arria GX device.

This user guide familiarizes you with the contents of the kit and guides you through the Arria GX development board setup. Using this guide, you can do the following:

- Inspect the contents of the kit
- Install the development tool software
- Set up licensing
- Use the demo application and example design to:
  - Perform memory read and write transactions on the board
  - Read configuration registers
- Use the development software to:
  - Set up and prepare new application designs
  - Program new designs into the development board

Before You Begin

Before using the kit or installing the software, check the kit contents and inspect the board to verify that you received all of the items listed in this section. If any of the items are missing, contact Altera before you proceed.

Also verify that your computer hardware and software meet system requirements for the kit. You can use a single computer to run the demonstration application pre-installed on the Arria GX development board, but to develop PCI Express applications, Altera recommends using two computers:

- Computer #1, as the PCI Express host system, to communicate with the board and to support the graphical user interface (GUI) for the demonstration application.
- Computer #2, as the development host for application development and to support programming of the Arria GX development board.

You can use a single computer for application development, but it results in a more cumbersome process because it involves repeatedly powering down and restarting the computer as well as removing and reinserting the development board.

Check the Kit Contents

The Arria GX Development Kit (ordering code: DK-DEV-1AGX60N) contains the following items:

- Arria GX development board with an EP1AGX60DF780C6N Arria GX device
- Altera Complete Design Suite DVD containing:
  - Quartus II Web Edition Software
  - MegaCore IP Library
  - Nios II Embedded Software Design Tools
- Arria GX Development Kit CD-ROM, which includes:
  - PCI Express example design
  - Arria GX development kit application and device drivers
  - Design examples
  - *Arria GX Development Board Reference Manual*
  - *Arria GX Development Kit Getting Started User Guide* (this document)
  - Schematic and board design files
- USB-Blaster™ download cable
- Power supply and adapters for North America, Europe, the United Kingdom, and Japan
- Heatsink/fan combination and board standoff hardware

Inspect the Board

Place the board on an anti-static surface and inspect it to ensure that it has not been damaged during shipment.

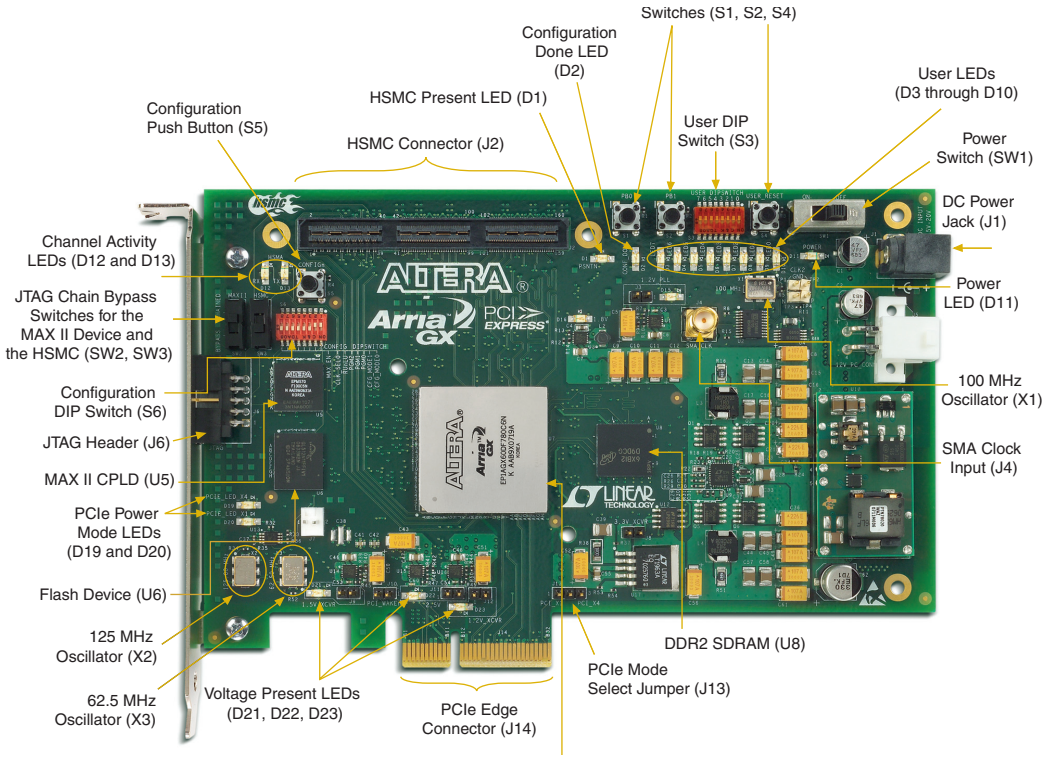
Without proper anti-static handling, the Arria GX development board can be damaged.

Verify that all components are on the board and appear intact.

In typical applications with the Arria GX development board, a heatsink is not necessary. However under extreme conditions the board may require the use of additional cooling to stay within operating temperature guidelines. Power consumption and thermal modeling should be done to determine whether additional cooling is necessary. In the event that it is, a heatsink/fan combination has been provided for your convenience.

Figure 2–1 shows the Arria GX development board.

Figure 2–1. Arria GX Development Board



Refer to the *Arria GX Development Board Reference Manual* (available on the Arria GX Development Kit CD-ROM) for information on the board components.

Hardware Requirements

To run the pre-installed demo application design requires only a single computer, Computer #1, with a x4 PCI Express slot to hold the Arria GX development board.

For application development, however, it is best to also use a second computer, Computer #2, that is loaded with the Quartus II software as a programming host. This setup provides the flexibility needed for downloading different device programming files to the development board.

The Quartus II software requires some minimum system requirements; refer to the Altera website at http://www.altera.com/products/software/products/quartus2web/sof-quarwebmain.html for details.

The Arria GX Development Kit provides all of the other hardware needed to use the board.

Software Requirements

This kit requires the following software:

- Windows XP operating system running on both computers
- Quartus II Web Edition software version 7.2 or later.

Although it is already available on the DVD included in the kit, you can also download the Quartus II software from the Altera website at http://www.altera.com/products/software/products/quartus2web/sof-quarwebmain.html.

Refer to the *Quartus II Installation & Licensing for Windows* document for further information on the Quartus II system software requirements, especially heeding the following:

- A web browser, Microsoft Internet Explorer version 5.0 or later or Firefox version 2.0 or later. You need a web browser to register the Quartus II software and request license files. Refer to "Licensing Considerations" on page 2–7.
- Version 2.0 or later of the .NET framework. Refer to page 2–9 for the .NET related issue.

Software Installation

The instructions in this section explain how to install the following:

- Arria GX Development Kit CD-ROM
- Arria GX Development Kit demo application and drivers
- The Quartus II Web Edition Software DVD, including MegaCore functions from the MegaCore IP Library

Installing the Arria GX Development Kit CD-ROM Contents

Perform this installation on Computer #1.

The Arria GX Development Kit CD-ROM contains the following items:

- Arria GX Development Kit GUI application and drivers
- Example design programming files

- *Arria GX Development Kit Getting Started User Guide* (this document)
- *Arria GX Development Board Reference Manual*

To install the Arria GX Development Kit CD-ROM contents, perform the following steps:

1. Insert the Arria GX Development Kit CD-ROM into your CD-ROM drive.

If the installer does not find the setup file, browse to the CD-ROM drive and double click on the **setup.exe** file.

2. Follow the online instructions to complete the installation process.

The installation program copies the Arria GX Development Kit files to your hard-disk, copies the software drivers and application, and in **Programs > Altera > Arria GX PCI Express Kit <*version*#>** in the Windows Start menu creates an icon , which you can use to launch the development kit GUI.

When the installation is complete, the Arria GX Development Kit installation program creates the directory structure shown in Figure 2–2, where <*path*> is the Arria GX Development Kit installation directory.

Figure 2–2. Arria GX Development Kit Installed Directory Structure

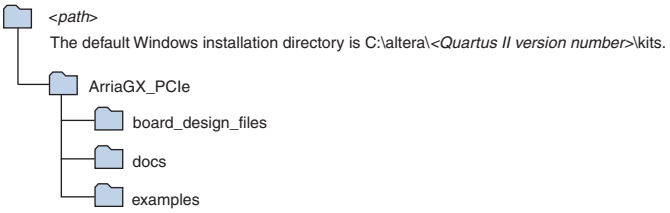


Table 2–1 lists the file directory names and a description of their contents.

Table 2–1. Installed File Directory Names and Description of Contents

Directory Name	Description of Contents
board_design_files	Contains the board design and production test files. You can use the board design files as a starting point for creating your own prototype board.
docs	Contains documentation related to the development kit, including a directory of some basic FPGA-related tutorials.
examples	Contains the example design files for the Arria GX Development Kit.

Installing the Quartus II Software and MegaCore Functions

Perform this installation on Computer #2, or on Computer #1 if using only one computer.

Load the Altera Complete Design Suite DVD into the DVD player, and click on **Install free package** on the startup screen (Figure 2–3). Follow the on-screen instructions and accept all defaults. After installing the software, request and install a license to enable it.

For information on obtaining a license file, refer to "Licensing Considerations" on page 2–7.

During installation of the Quartus II software, choose to install the MegaCore IP Library when presented the option and follow the on-screen instructions.

Figure 2–3. Quartus II Installation from DVD

Licensing Considerations

Before using the Quartus II software, you must request a license file from the Altera web site at www.altera.com/licensing and install it on your computer. When you request a license file, Altera emails you a **license.dat** file that enables the software.

To license the Quartus II software, you need your network interface card (NIC) ID, a 12-digit hexadecimal number that identifies your computer. Networked (or floating-node) licensing requires a NIC ID or server host ID. When obtaining a license file for network licensing, use the NIC ID from the computer that will issue the Quartus II licenses to distributed users over a network. You can find the NIC ID for your card by typing "`ipconfig /all`" at a command prompt. Your NIC ID is the number on the physical address line, without the dashes.

Using the Demo Application and Example Design

The kit provides an example design file and an easy-to-use demo application with a custom GUI. Using the demo application GUI you can:

- Specify endpoint (PCI Express x4 MegaCore function) read, write, and loop commands
- Specify memory read/write and loop commands
- Read various configuration registers

In this section, you perform the following tasks:

- Install the demo application drivers
- Install the Arria GX development board
- Perform memory read and write transactions on the board

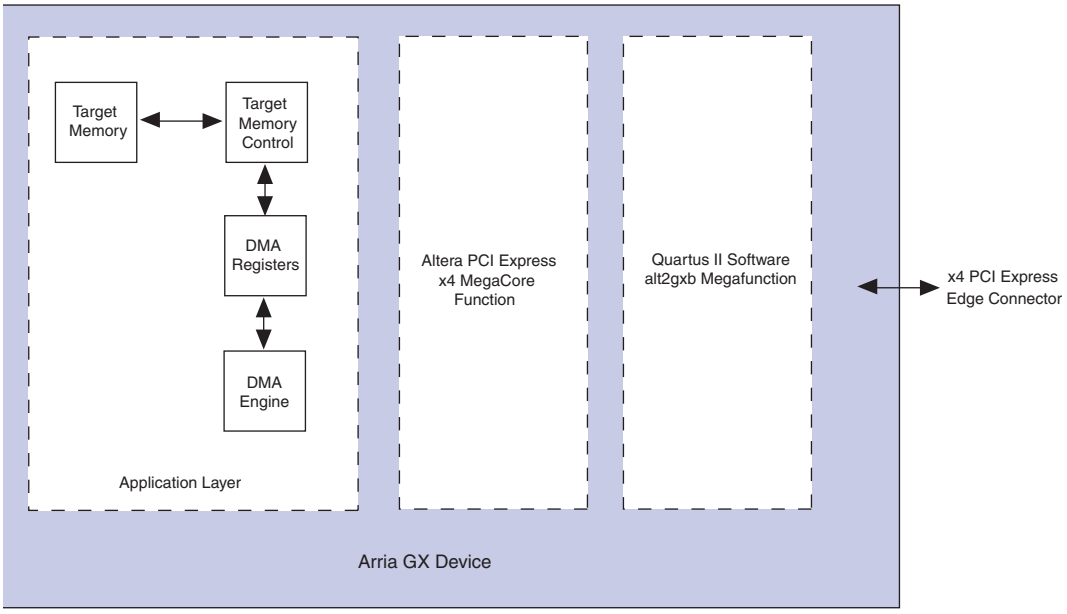
The Arria GX development board ships with a pre-installed example design. For instructions on installing the example design or any other design to the flash memory on the board, refer to Appendix A, Programming the Development Board.

Data Flow Block Diagram

Figure 2–4 shows a block diagram of the data flow from the x4 PCI Express edge connector through the Arria GX device block, which includes the application layer, Altera PCI Express x4 MegaCore function, and the Quartus II software alt2gxb megafunction.

The kit's demo application allows for memory read and write transactions to the development board. In addition, the kit's example design (**AGX_PCIe_Example_Design.sof**) has a DMA engine that allows the development board to write to on-chip memory.

Figure 2–4. Arria GX Device Block



Install Drivers and Arria GX Development Board

As stated in the "Hardware Requirements" on page 2–3, for a flexible setup that allows you to download different programming files to the on-board Arria GX device, Altera recommends that you use two computers: Computer #1 as the development board host computer, and Computer #2 as the Quartus II programming host computer.

This section discusses the example design and the development board host computer (Computer #1). For information on using the Quartus II programming host computer (Computer #2), refer to Appendix A, Programming the Development Board.

To install the demo application drivers and Arria GX development board, use the following steps:

To install the drivers, you need to have administrator privileges on your computer.

From Computer #1:

1. Install the Arria GX Development Kit CD-ROM.

2. Open the **..examples\Getting_Started\Software Application\JungoDrivers** directory, and double-click the **install.bat** file.

3. After the **install.bat** file finishes copying files and installing the drivers, shut down Computer #1.

4. Ensure that the Power slide switch is in the OFF position on the Arria GX development board and insert the board into a x4 (or wider) PCI Express slot.

Finish Installing the Drivers and the Development Board

Finish installing the demo application drivers and the Arria GX development board by performing the following steps:

If you want to download a programming file that is different than the kit's pre-installed example design file, refer to Appendix A, Programming the Development Board.

1. Start Computer #1.

2. When the Windows XP **Found New Hardware Wizard** appears, click **Next**.

3. When the **Hardware Installation** dialog box appears, click **Continue Anyway**.

4. Click **Finish** in the **Completing the Found New Hardware Wizard** to finish installing the drivers.

Run the Demo Application

Run the demo application by performing the following steps:

1. To start the demo application GUI, execute the **altpcie_demo.exe** file found in the *<path>* **\ArriaGX_PCIe\examples\Getting_Started\Software Application** directory.

If you receive an "`Application Error`" message when launching the demo application, please install **version 2.0 or later versions of the .NET** framework. Some Windows versions do not have runtime DLL for the .NET application. The .NET framework application can be downloaded from the following location: **http://www.microsoft.com/download**.

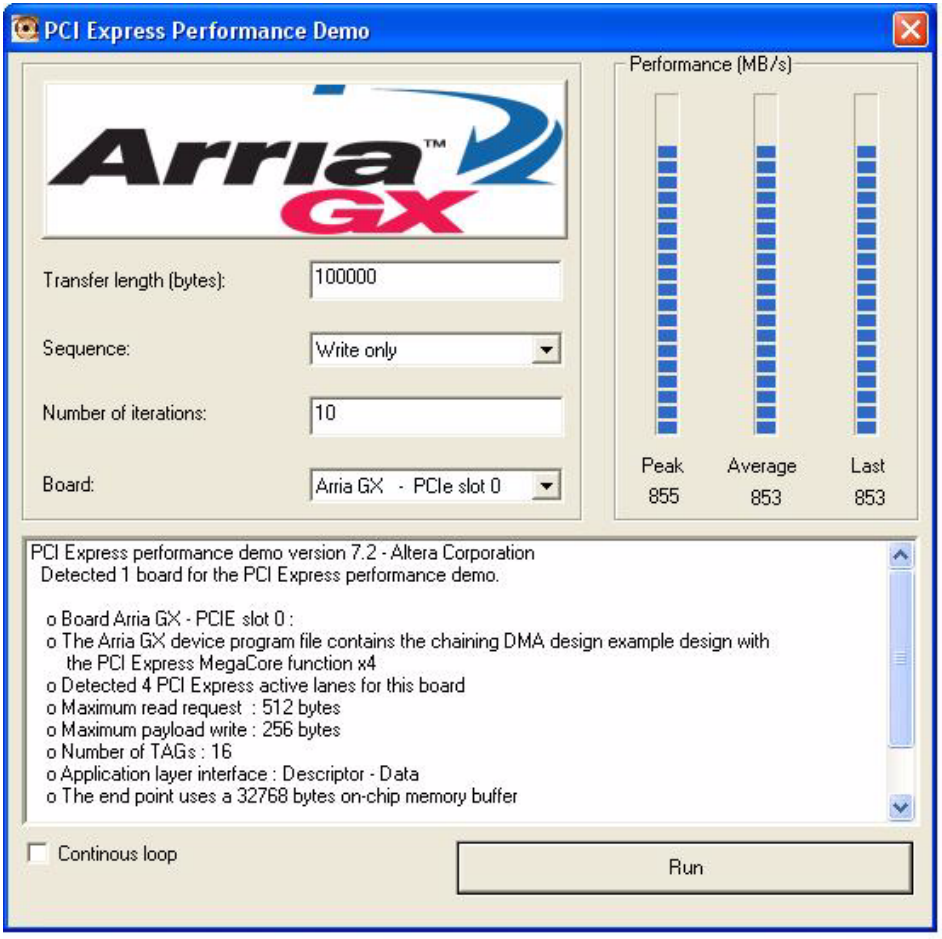
2. Configure the parameters in the Altera PCI Express High-Performance Demo Application (Figure 2–5) as follows:

- Confirm **Transfer length (bytes)** is 100000
- Confirm **Sequence** is Write only
- Confirm **Number of iterations** is 10
- Confirm Arria GX board is selected.

3. Click **Run**. A message appears indicating the transfer speed for the selected operational sequence.

You can configure the demo kit application to perform other tests including various memory read and write transactions on the board.

Figure 2–5. Altera PCI Express High-Performance Demo Application



Using the Arria GX Development Board for Your Applications

You can use the Arria GX development board to develop PCI Express as well as other applications.

PCI Express Applications

As you develop the application, at some point you program the FPGA with your design by downloading programming files to the development board. You can use the following programming methods:

- By SRAM Object File (SOF)

  With this method, you download an SOF directly into the FPGA with the development board installed in Computer #1. This method is faster to make changes and debug your application. One disadvantage of this method is that it requires a second computer. Another disadvantage is that the FPGA does not retain the downloaded programming file after the board is powered down.

- By Programmer Object File (POF)

  With this method, you download a POF to the on-board flash device. The advantage for this method is that whenever the development board powers up, the flash device configures the FPGA. Production systems can use this method of programming because the flash device would load the application when the shipped product powers up at the customer site.

SOF Programming

For SOF programming, perform the following steps:

1. With Computer #1 powered off, install the Arria GX development board into an open PCI Express slot.
2. Plug the external power supply into the DC Power Input (J1) on the development board.
3. Insert the 10-pin female USB-Blaster plug into the JTAG Header (J6) visible through the bracket on the side of the board.
4. Connect the USB cable between the USB-Blaster device and Computer #2, the computer that you will use to program the FPGA.

☞ Ensure that Computer #2 already has the Quartus II software loaded and licensed and the USB-Blaster drivers installed.

5. Slide the power switch (SW1) on the development board to ON to power up the board.

6. From the Quartus II Programmer running on Computer #2, download the SOF containing your application to the FPGA on the Arria GX development board.

7. Turn on Computer #1.

You may remove the external power supply from the Arria GX development board at this point. However, it is not necessary, because the on-board power multiplexer circuit disconnects the external power source when it detects power provided by the computer through the PCI Express bus.

POF Programming

To use the POF programming method, follow the directions described in Appendix A to program the flash device on the Arria GX development board with your application. Then perform the following steps:

1. With Computer #1 powered off, install the Arria GX development board into an open PCI Express slot.

2. Power up Computer #1 to load your application from the flash device into the FPGA. If your PCI Express application performs correctly, then the Arria GX development board is ready to communicate over the PCI Express bus of Computer #1.

Non-PCI Express Applications

When developing a non-PCI Express design, remove the board from Computer #1, install the stand-off support pegs, connect the provided separate power supply, and run any experiments in this stand-alone configuration using SOF or POF programming.

Appendix A. Programming the Development Board

Introduction

This appendix describes the method for programming the development board when using the board for application development.

Chapter 2, Getting Started, describes the procedure for starting up and running a pre-installed example design using Computer #1, the development board host computer. You can also use this computer for application development, but it involves a cumbersome process because it requires repeatedly powering down and restarting the computer as well as removing and reinserting the development board.

Therefore, for application development, Altera recommends that along with the development board host computer, Computer #1, you also use a second computer, Computer #2, as the Quartus II programming host and as a parallel flash loader (PFL). From Computer #2, you can download a programming file to the development board that is different from the kit's pre-installed example design file.

This appendix guides you through the following tasks:

- Installing the Altera PFL provided for flash memory programming and FPGA configuration.
- Using the PFL to write your application to the flash device, which then configures the FPGA.

Hardware Setup

Altera provides a USB-Blaster cable with the kit. You need this cable for the PFL to download an application to the on-board flash device. Prepare the Arria GX development board for downloading by performing the following steps:

1. Connect the 10-pin female plug of the USB-Blaster cable to the 10-pin male JTAG header (J6) visible through the bracket on the side of the development board.
2. Connect the other end of the USB-Blaster cable to the USB port of the computer running the Quartus II software.
3. Connect the 16 V power supply, provided in the kit, to the DC power input (J1) on the development board and to a power source.
4. Set the power switch (SW1) to ON to power up the Arria GX development board.

Using the Parallel Flash Loader

This section describes how to use the PFL to load an FPGA image into the Common Flash memory Interface (CFI) type flash device and configure the Arria GX type FPGA device on the Arria GX development board.

First, you use the Quartus II development tool to prepare and program the MAX® II device on the development board with the parallel flash loader. At the same time, you prepare and download an application to the flash device on the board. Finally, using the flash data, the PFL configures the FPGA and activates the application.

The tutorial uses two files included with the development kit under **Getting Started\Programming Files** on the CD-ROM:

- **pfl_3fe.pof**, which is the MAX II POF that contains a parallel flash loader design.
- **MyFirstFPGA.sof**, which contains a simple test design that forces the FPGA to display counting on the development board user LEDs. The **MyFirstFPGA.sof** file is used in the SOF-to-POF conversion in the "Prepare Application File for Downloading" part of the tutorial.

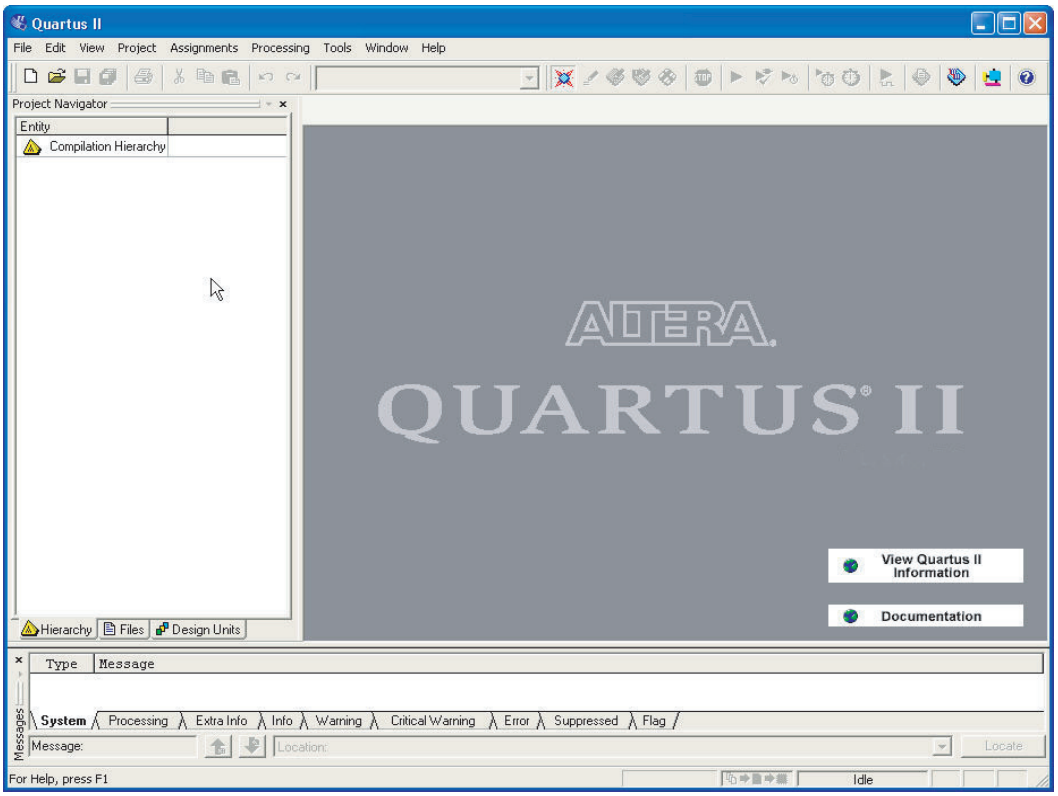
The tutorial contains three parts:

- Launch the Quartus II Development Tool
- Prepare Application File for Downloading
- Set Up the Programming Download

Launch the Quartus II Development Tool

Start the Quartus II software (Figure A–1).

Figure A–1. Quartus II Software Interface



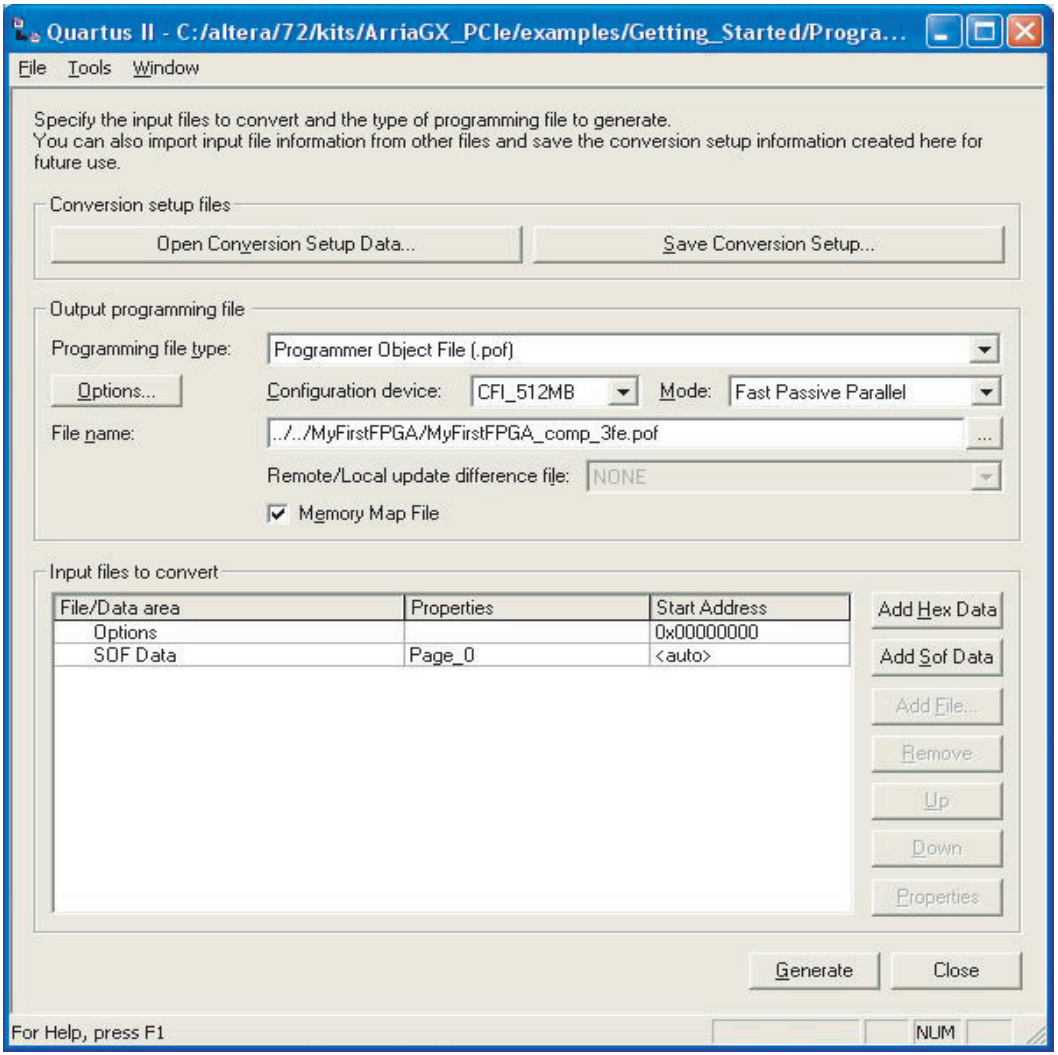
Prepare Application File for Downloading

To prepare the example application for downloading to the flash device, convert **MyFirstFPGA.sof** to a POF.

To convert an SOF to a POF, perform the following steps:

1. On the File menu, click **Convert Programming Files**.
2. Under **Output Programming File** (Figure A–2) select **Programmer Object File (.pof)** in the **Programming file type** box.

Figure A–2. Convert Programming Files Options

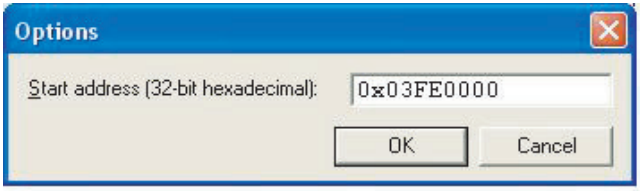


3. Select **CFI_512MB** as the flash size in the **Configuration device** box and set the mode in the **Mode** box to **Fast Passive Parallel.**

4. In the **File name** box, specify a file name for the resulting CFI flash POF. In this example, use **C:\altera\72\kits\ArriaGX_PCIe\examples\Getting_Started\Programming Files\MyFirstFPGA.pof**.

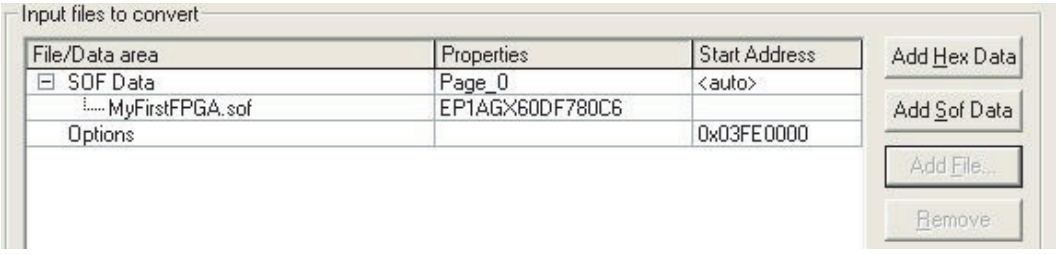
5. Click **Options** and set the option bit start address to 0x03FE0000 (Figure A–3), then click **OK**. This address must match the option bit address location specified in the PFL MegaWizard® interface.

Figure A–3. Options Dialog Box



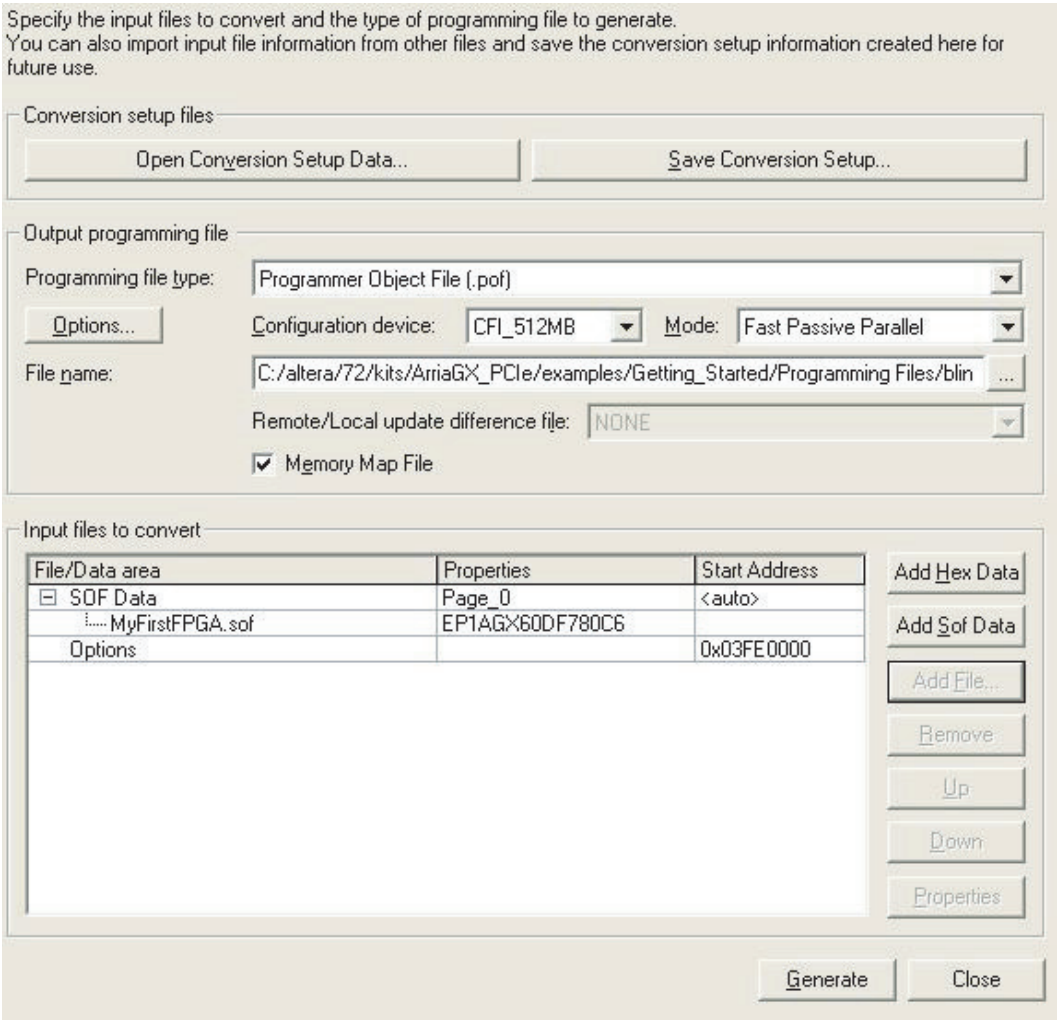
6. Under **Input files to convert,** click on the **SOF Data** cell, then click **Add File**. Browse to the directory **Examples\MyFirstFPGA**, highlight the **MyFirstFPGA.sof** file, and click **Open**. This adds **MyFirstFPGA.sof** to the **Input files to convert** list (Figure A–4).

Figure A–4. Setting Input Files to Convert



7. Confirm that the **Convert Programming Files** dialog box appears with the selections shown in Figure A–5.

Figure A–5. Convert Programming Files Selections



8. Click on **MyFirstFPGA.sof** to highlight it, then click the **Properties** button.

9. In the **SOF File Properties** dialog box, select **Compression** and click **OK** to close the box.

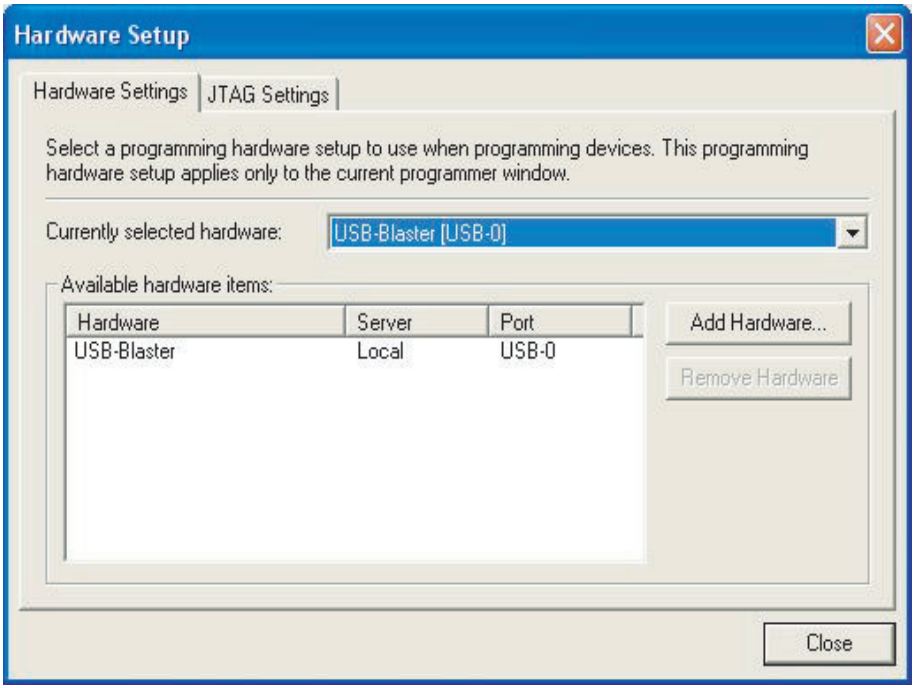
10. Click **Generate** to produce the POF that you will store in the flash device with the PFL.

Set Up the Programming Download

If you are using two computers for application development, then start this procedure with step 7. Otherwise, if you are using just one computer, you must first prepare the hardware as follows:

1. Turn off Computer #1 and remove the development board from the PCI Express slot.
2. Connect the board to the power supply provided in the kit.
3. Turn the on-board power supply switch to the ON position.
4. Power up the board.
5. Connect the USB-Blaster cable between the board and Computer #1, now used as the Quartus II programming host computer.
6. Follow the tutorial steps to program the flash memory, starting with step 7. After completion of all programming steps:
    a. Power down the board, remove the power supply, and set the power supply switch to OFF.
    b. Power down the computer and disconnect the USB-Blaster cable at both ends.
    c. Reinsert the board into the PCI Express slot in Computer #1 and turn the computer ON.
7. To open the programmer, click on **Programmer** in the Tools menu.
8. Click the **Hardware Setup** button.
9. In the **Hardware Setup** dialog box (Figure A–6), select the download cable you are using. In this example, in the **Currently selected hardware** box, select **USB-Blaster** and click **Close**.

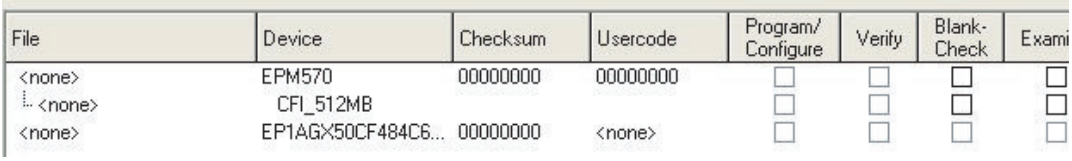
Figure A–6. Hardware Setup Selections



10. Click **Auto Detect** and, in the displayed JTAG chain (Figure A–7), verify the correct setup: the EPM570 MAX II device, the CFI_512MB flash chip, and the Arria GX FPGA, EP1AGX50CF484C6N. You will program the MAX II device and the flash chip with a POF.

You may have to press the **CONFIG** push-button switch (S5) on the board during this process before the flash chip appears in the chain.

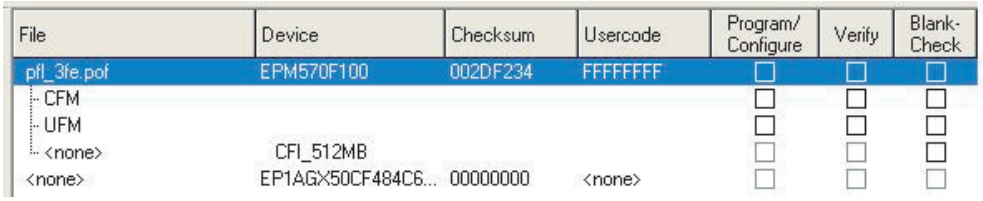
Figure A–7. JTAG Chain



11. Click on the **EPM570** device to highlight it, then right-click it and select **Change File** to select a file.

12. Find and select the **pfl_3fe.pof** file in the **Programming Files** directory, and click **Open**. The **pfl_3fe.pof** file defines the PFL design for the MAX II device, shown as EPM570F100 in Figure A–8.

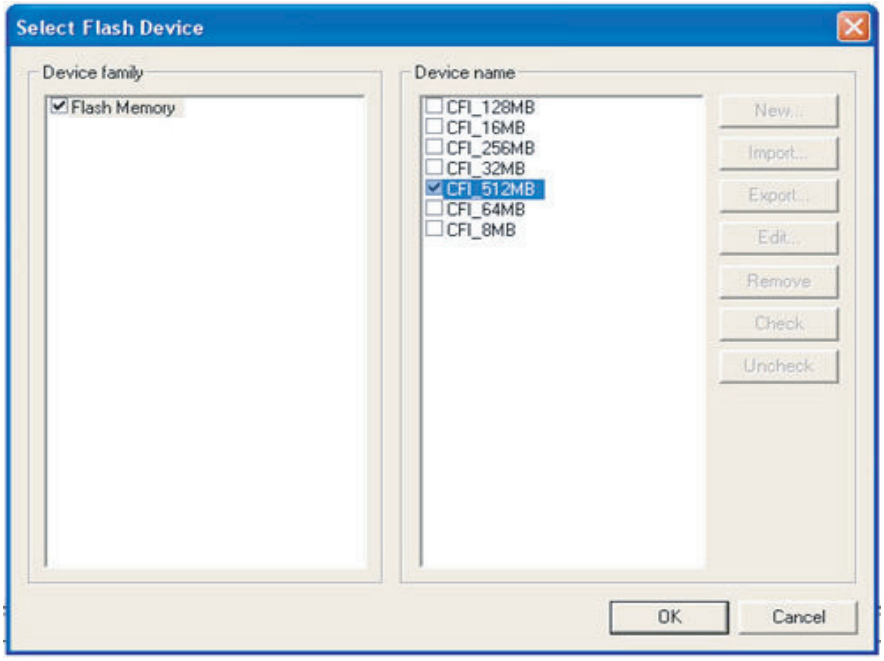
Figure A–8. Open the PFL Design File



13. If the CFI_512MB flash device is listed under the EPM570F100 device as shown in Figure A–8, go to step 15. Otherwise, highlight, then right-click **pfl_3fe.pof** in the **Programmer**, then click the **Attach Flash Device** option.

14. Highlight and check **CFI_512MB** (Figure A–9**)** and click **OK.**

Figure A–9. Selecting the Flash Device Size



15. Right-click **CFI_512MB** and select **Change File**. Browse to the location of the POF generated during the SOF-to-POF conversion and click **Open**. This step attaches the flash POF to the MAX II POF.

16. Turn on the check boxes for **Program/Configure** next to the **pfl_3fe.pof** items **CFM, UFM**, **Page_0**, and **OPTION_BITS** (Figure A–10). Also turn on the check boxes for **Verify** next to **Page_0** and **OPTION_BITS**.

Figure A–10. Program/Configure Check Boxes

File	Device	Checksum	Usercode	Program/ Configure	Verify
pfl_3fe.pof	EPM570F100	002DF234	FFFFFFFF	☐	☐
CFM				☑	☐
UFM				☑	☐
top_x4_comp_3fe.pof	CFI_512MB	F15B538D		☐	☐
Page_0				☑	☑
OPTION_BITS				☑	☑
<none>	EP1AGX50CF484C6...	00000000	<none>	☐	☐

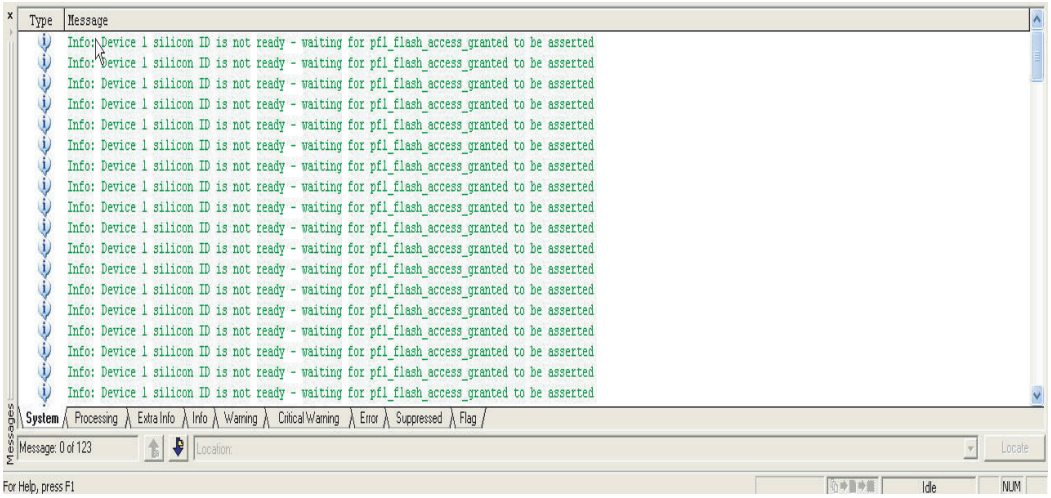
17. Click **Start** to program the PFL into the MAX II device as well as program the flash device with the FPGA image. After programming is completed, the PFL configures the FPGA with the data from the flash device. When completed, the application loaded into the FPGA causes the USER_LED[7..0] lights to display counting.

If the FPGA is already configured prior to performing the previous steps, the following message may appear in the Message Window:

```
Info: Device 1 silicon ID is not ready - waiting
for pfl_flash_access_granted to be asserted
```

Figure A–11 shows the error message. In this case, press the **CONFIG** push-button switch on the board to reset the FPGA. Operation resumes, allowing the PFL to access the flash device for programming.

Figure A–11. Error Message



18. After the PFL loads the application to the FPGA, the application program activates and the LEDs on the board display counting. If you cycle the power switch, the program reloads from the flash device to the FPGA.

To reconfigure the board for PCI Express experiments, repeat this procedure using top_x4_comp_3fe.pof as the flash POF.

Additional Information

Revision History

The table below displays the revision history for the chapters in this user guide.

Chapter	Date	Version	Changes Made
All	October 2007	7.2.0	First publication

How to Contact Altera

For the most up-to-date information about Altera products, refer to the following table.

Contact *(1)*	Contact Method	Address
Technical support	Website	www.altera.com/support
Technical training	Website	www.altera.com/training
	Email	custrain@altera.com
Product literature	Website	www.altera.com/literature
Altera literature services	Email	literature@altera.com
Non-technical support (General)	Email	nacomp@altera.com
(Software Licensing)	Email	authorization@altera.com

Note to table:
(1) You can also contact your local Altera sales office or sales representative.

Typographic Conventions

This document uses the typographic conventions shown below.

Visual Cue	Meaning
Bold Type with Initial Capital Letters	Command names, dialog box titles, checkbox options, and dialog box options are shown in bold, initial capital letters. Example: **Save As** dialog box.
bold type	External timing parameters, directory names, project names, disk drive names, filenames, filename extensions, and software utility names are shown in bold type. Examples: **\qdesigns** directory, **d:** drive, **chiptrip.gdf** file.
Italic Type with Initial Capital Letters	Document titles are shown in italic type with initial capital letters. Example: *AN 75: High-Speed Board Design.*

Visual Cue	Meaning
Italic type	Internal timing parameters and variables are shown in italic type. Examples: t_{PIA}, $n + 1$. Variable names are enclosed in angle brackets (< >) and shown in italic type. Example: *<file name>*, *<project name>***.pof** file.
Initial Capital Letters	Keyboard keys and menu names are shown with initial capital letters. Examples: Delete key, the Options menu.
"Subheading Title"	References to sections within a document and titles of on-line help topics are shown in quotation marks. Example: "Typographic Conventions."
`Courier type`	Signal and port names are shown in lowercase Courier type. Examples: `data1`, `tdi`, `input.` Active-low signals are denoted by suffix `n`, e.g., `resetn`. Anything that must be typed exactly as it appears is shown in Courier type. For example: `c:\qdesigns\tutorial\chiptrip.gdf`. Also, sections of an actual file, such as a Report File, references to parts of files (e.g., the AHDL keyword `SUBDESIGN`), as well as logic function names (e.g., `TRI`) are shown in Courier.
1., 2., 3., and a., b., c., etc.	Numbered steps are used in a list of items when the sequence of the items is important, such as the steps listed in a procedure.
■ ● •	Bullets are used in a list of items when the sequence of the items is not important.
✓	The checkmark indicates a procedure that consists of one step only.
☞	The hand points to information that requires special attention.
CAUTION	The caution indicates required information that needs special consideration and understanding and should be read prior to starting or continuing with the procedure or process.
	The warning indicates information that should be read prior to starting or continuing the procedure or processes
↵	The angled arrow indicates you should press the Enter key.
	The feet direct you to more information on a particular topic.