



Certus-NX Versa Evaluation Board Demo

User Guide

FPGA-UG-02133-1.1

November 2021

Disclaimers

Lattice makes no warranty, representation, or guarantee regarding the accuracy of information contained in this document or the suitability of its products for any particular purpose. All information herein is provided AS IS, with all faults and associated risk the responsibility entirely of the Buyer. Buyer shall not rely on any data and performance specifications or parameters provided herein. Products sold by Lattice have been subject to limited testing and it is the Buyer's responsibility to independently determine the suitability of any products and to test and verify the same. No Lattice products should be used in conjunction with mission- or safety-critical or any other application in which the failure of Lattice's product could create a situation where personal injury, death, severe property or environmental damage may occur. The information provided in this document is proprietary to Lattice Semiconductor, and Lattice reserves the right to make any changes to the information in this document or to any products at any time without notice.

Contents

Acronyms in This Document	5
1. Introduction	6
1.1. Learning Objectives	6
1.2. Linux Version of this Demo	6
2. Hardware and Software Requirements	7
2.1. Hardware Requirements	7
2.2. Software Requirements	7
3. Setting Up the Demo	8
3.1. Hardware Setup	8
3.1.1. Installing Hardware into a Different Slot	8
3.2. Software Setup	9
3.2.1. Installing the Drivers on the Host Machine	9
3.2.2. Editing bcdedit.exe	13
3.3. Software Setup on a Linux Machine	14
3.3.1. Building the User Interface Demo in Linux	14
3.4. Programming the Demo .bit File to the Certus-NX Versa Evaluation Board	15
4. Running PCIe Basic Demo	18
5. Running PCIe Memory Access Demo	20
6. Rebuilding the Demo	21
7. Regenerating the .bit File and Reprogramming the Board	22
8. Troubleshooting	23
Technical Support Assistance	24
Revision History	25

Figures

Figure 3.1. Welcome Screen	9
Figure 3.2. Select Destination Folder	10
Figure 3.3. Confirm Install.....	10
Figure 3.4. Device Driver Install Wizard	11
Figure 3.5. Windows Security	11
Figure 3.6. Driver Installation Completed Successfully.....	12
Figure 3.7. Correct Windows CMD Prompt	13
Figure 3.8. Correct Windows CMD Prompt	13
Figure 3.9. Radiant Programmer New Project	15
Figure 3.10. Main Interface	15
Figure 3.11. Device Properties.....	16
Figure 3.12. Programming Button	16
Figure 4.1. Device Info after Correct Software and Hardware Installation	18
Figure 4.2. User Interface Control of 7-Segment Display	19
Figure 4.3. Onboard 7-Segment Display	19
Figure 5.1. Memory Access Tab in GUI	20
Figure 7.1. Proper Project Properties Configuration	22

Tables

Table 3.1. List of Jumpers to be Set for Programming.....	8
---	---

Acronyms in This Document

A list of acronyms used in this document.

Acronym	Definition
PCIe	Peripheral Component Interconnect Express
SPI	Serial Peripheral Interface

1. Introduction

This guide describes how to start using the Certus™-NX Versa Evaluation Board, a low-cost platform for demonstrating the PCI Express® reference design and for evaluating solutions for your specific application.

The Certus-NX Versa Evaluation Board features the Certus-NX FPGA in the 256-ball caBGA package, which is built on the Lattice Nexus™ FPGA platform using low power 28 nm FDSOI technology. The board can expand the usability of the Certus-NX FPGA with DDR3, soft D-PHY, 1 Gbps Ethernet and 1× PCIe (Gen2) channel. Board resources such as jumpers, LED indicator, push button, and switch are available for user-defined applications.

This guide familiarizes you with the process of setting up your PCI Express development environment. It is assumed that you do not have any associated tools installed on your system.

The demos discussed in this document include the PCI Express Basic Demo and PCI Express Memory Access Demo.

1.1. Learning Objectives

After completing the steps in this guide, you will be able to perform the following:

- Set up the Certus-NX Versa Evaluation Board and become familiar with its main features
- Install all applicable development tools and PCI Express demos
- Establish communication between the Certus-NX Versa Evaluation Board through the PCI Express link
- Run the PCI Express Basic Demo that allows you to control a 7 segment LED on the Certus-NX Versa Evaluation Board. This demo is included in the user interface.
- Run the PCIe Memory Access Demo, which allows you to manipulate the onboard memory of the FPGA through the PCIe slot. This demo is included in the user interface.
- Use what the demo teaches you about designing Lattice PCI Express solutions.
- Modify and rebuild the PCI Express Basic Demo.
- Become familiar with the software development tools and major design flow steps employed in this kit.
- Use other existing documentation in conjunction with this guide.

This document assumes that you have already installed the Lattice Radiant™ design software. This document covers some of the basic of function of Lattice Radiant. If you would like to learn more about Lattice Radiant, refer to the Radiant Help system.

1.2. Linux Version of this Demo

On the Lattice Semiconductor website, you can download an archive of the files needed to run this demo on Ubuntu 18.04.6 LTS. The steps necessary to complete the Linux version of this demo are provided in the [Software Setup on a Linux Machine](#) section.

2. Hardware and Software Requirements

2.1. Hardware Requirements

To install the kit design and run the demo software, a single computer with a PCI Express ×16, ×8, ×4, or ×1 slot is required. You must also have a power USB port. All other hardware and drivers are included in the kit.

- USB Cable
- 12 V Power Adapter
- Bit file for the Certus-NX board SPI Flash (*LFD2NX40_PCl_e_Basic_Demo_impl_1.bit*)
- Lattice Radiant Programmer Software (version 2.2 or later)
<http://www.latticesemi.com/Products/DesignSoftwareAndIP/FPGAandLDS/Radiant>
- Windows 10 (use WDF 1.25 or earlier)
- *setup.exe* file for installing drivers and launching the user interface

2.2. Software Requirements

The following are the software required to obtain the expected results for the procedures described in this guide:

- Lattice Radiant 2.2 Programmer or later
Lattice Radiant can be obtained from the Lattice Radiant web page
- Certus-NX Basic Demo for Windows 10
- Minimum system requirements as described in the Radiant Installation Guide to develop PCI Express designs

Note: Depending on your system, all the files and dependencies for the Certus-NX Basic Demo are available in the .zip folder.

3. Setting Up the Demo

3.1. Hardware Setup

This section covers the steps in programming the demo to the SPI memory of the Certus-NX Versa Evaluation Board.

To program the demo to the SPI memory:

1. Install the jumpers listed in [Table 3.1](#). Note the difference between J and JP jumpers. If this is your first time utilizing the Certus-NX Versa Evaluation Board, the jumpers are already in this configuration.

Table 3.1. List of Jumpers to be Set for Programming

Jumper Checklist	Notes: Pin 1 is denoted with a small triangle.
J16	Connect Pins 1 and 2
J18	—
J19	—
J20	—
J21	—
J22	—
J23	—
J24	—
J25	—
J28	—
J29	—
J30	—
J31	—
J32	—
J46	—
J47	Connect Pins 2 and 3
J48	Connect Pins 1 and 1
JP4	—
JP25	—
jp26	—

2. Connect the 12 V power adapter to J11. The power LED D1, D2, D3, D4, D5, D6, D7, D8, D8, D9, D10, D11, D12, D13, D14, D15, D16 D17 glow.
3. Connect the USB cable to the computer and to J2. D26 glows. D26 is located closest to the micro USB slot on the Certus-NX Versa Evaluation Board.
4. At this point, the board is prepared to receive a bit stream from Radiant Programmer. Once the demo bit stream is written to the board, you can move the board into the PCIe X1 slot in the host machine.

3.1.1. Installing Hardware into a Different Slot

Windows identifies PCI/PCI Express hardware devices using the bus, slot, vendor ID, and device ID fields. If you install the board into a different slot, the slot number changes. This causes Windows to display the Found New Hardware screen when the system powers up.

Moving the Certus-NX Versa Evaluation Board into a different slot while the machine is powered on causes the demo to fail. You will not be able to run memory access tests nor control the seven segment display.

To restart the demo, ensure that the board is in the desired PCIe slot and restart the host machine. When the board is set up and hardware is installed on your computer, you can perform software installation, execution, and other tasks to complete the demo.

3.2. Software Setup

This section provides the procedure for installing software onto both your host machine and the Certus-NX Versa Evaluation Board. The Lattice Radiant Programmer is used to program a .bit file to the onboard memory. You can configure how your host PC interacts with PCIe endpoints and install the necessary drivers using the *Lattice Setup.exe* tool for the Certus-NX Windows/Linux Software.

3.2.1. Installing the Drivers on the Host Machine

To install the drivers on the host machine:

1. Go to the following path within the demo: <kit-location>\Demonstration\Windows10\Application\setup.exe.
2. The InstallShield Wizard for Certus-NX Basic Demo welcome screen opens. Click **Next**.

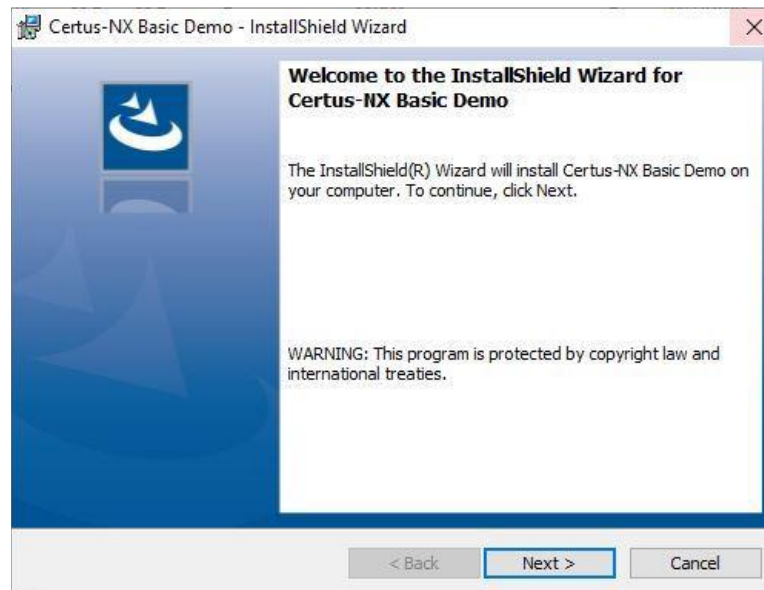


Figure 3.1. Welcome Screen

3. Provide the location where you want to install the application. Click **Next**.

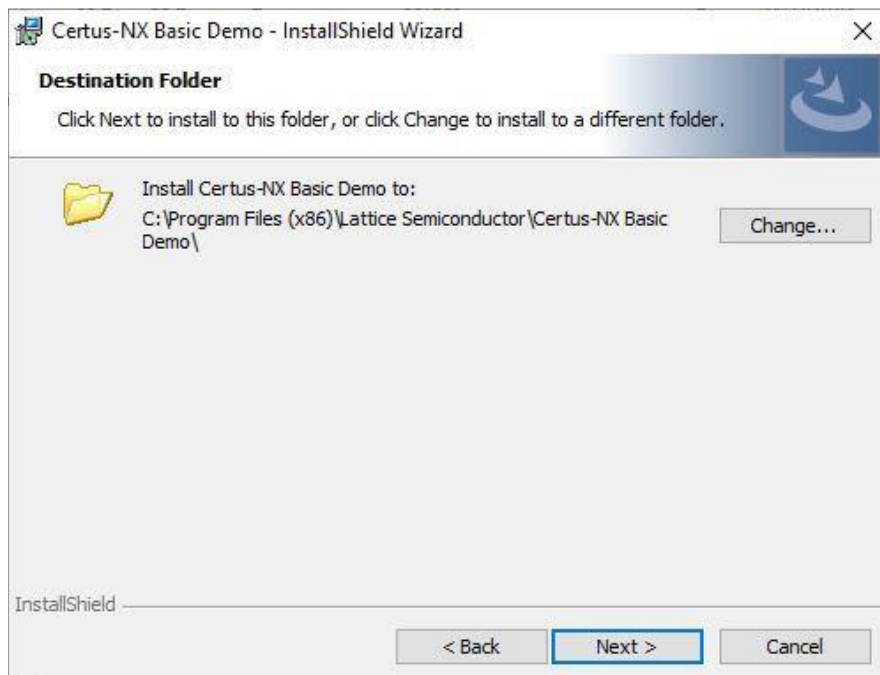


Figure 3.2. Select Destination Folder

4. Click the **Install** button.
Note: You need administrator access to run this command.

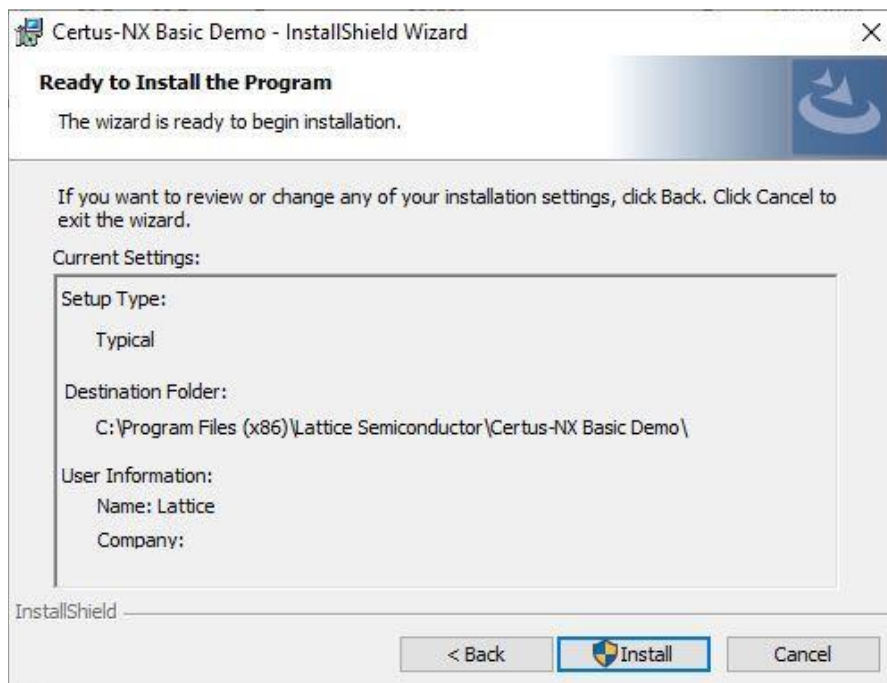


Figure 3.3. Confirm Install

5. The installation of the Certus-NX Basic Demo Application starts. When installation is completed, the drivers are installed.

6. A message box appears warning about installing drivers from unknown publishers. These drivers are required to complete the demo. Click **Yes**.
7. In the **Device Driver Installation Wizard**, click **Next**.

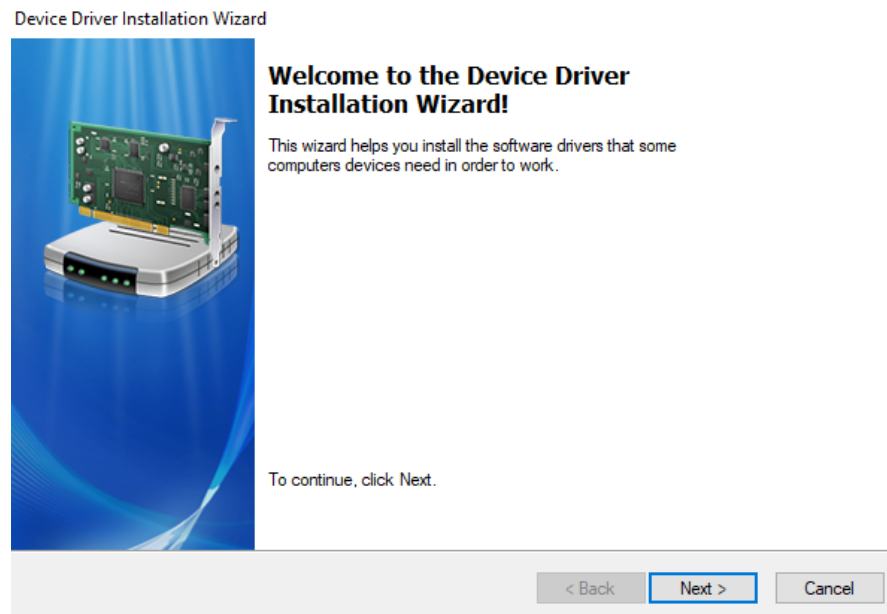


Figure 3.4. Device Driver Install Wizard

8. The Windows security box opens. Select **Install this driver software anyway**.

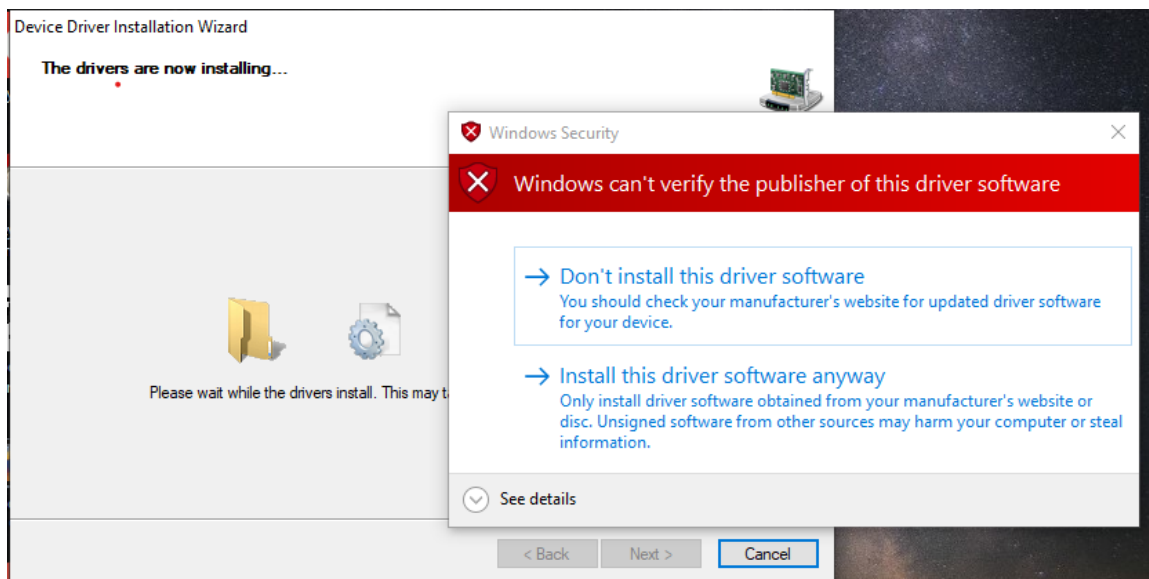


Figure 3.5. Windows Security

9. The wizard provides the status of the installation once completed.

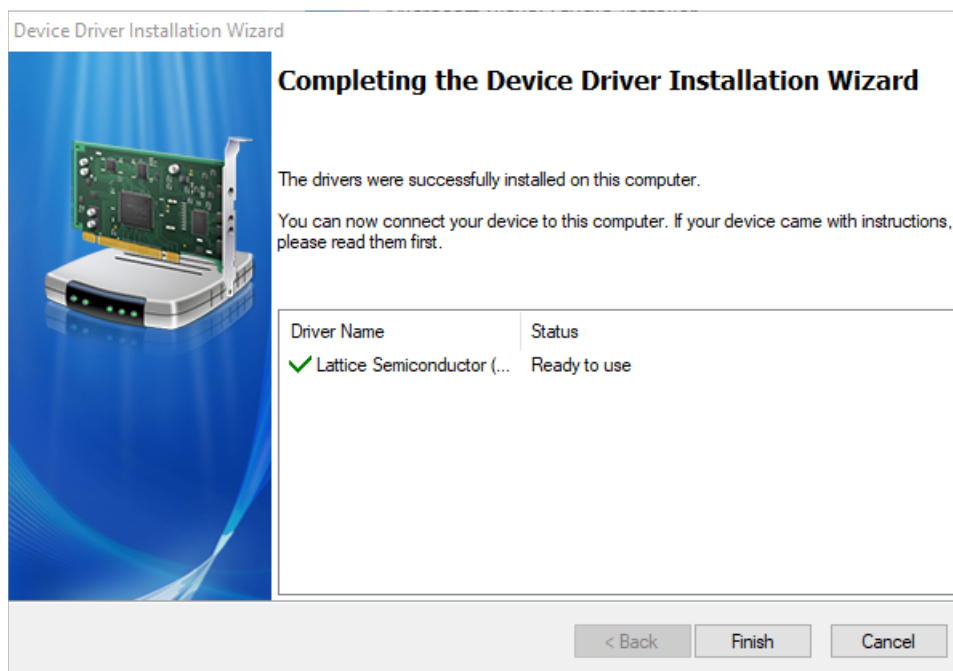


Figure 3.6. Driver Installation Completed Successfully

3.2.2. Editing bcdedit.exe

To edit *bcdedit.exe*:

1. Start the command prompt as an administrator
2. Enter the following command and press **Enter**

```
bcdedit.exe -set loadoptions DISABLE_INTEGRITY_CHECKS
```

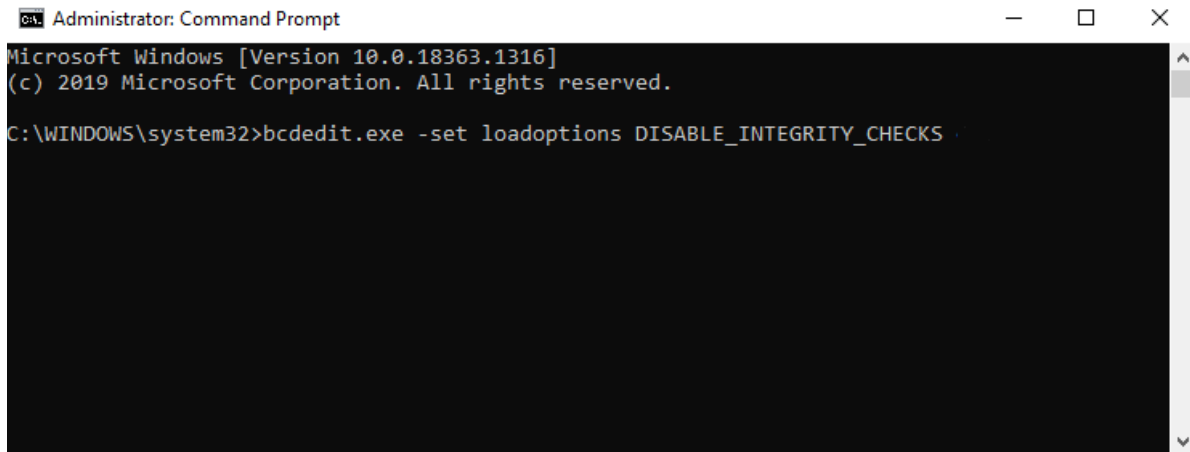


Figure 3.7. Correct Windows CMD Prompt

3. Enter the following command and press Enter.

```
bcdedit.exe -set TESTSIGNING ON
```

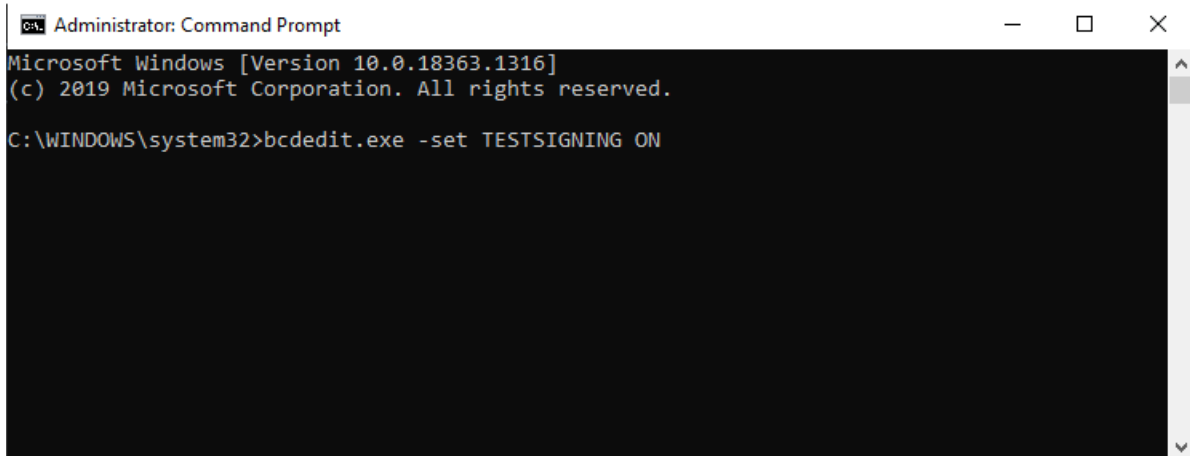


Figure 3.8. Correct Windows CMD Prompt

4. Close the command prompt and restart your machine.

3.3. Software Setup on a Linux Machine

Before you begin, ensure that you have downloaded the archive file for Linux systems from the Lattice website.

3.3.1. Building the User Interface Demo in Linux

To build the user interface demo in Linux:

1. In the terminal, open the demonstration folder provided in the .zip archive.
2. Run the following command.

```
sudo chmod 777 install.sh
```

3. Restart the machine.
4. In the terminal, open the demonstration folder.
5. Run the following command.

```
sudo ./install.sh
```

This generates the .KO files and installs the drivers necessary to complete the demo. This also opens the user interface discussed in the [Running PCIe Basic Demo](#) section.

3.4. Programming the Demo .bit File to the Certus-NX Versa Evaluation Board

To program the demo .bit file to the board:

1. Start the Radiant Programmer 2.2 software.
2. In the **Getting Started** dialog box, enter the **Project Name** and **Project Location**. Click **OK**.

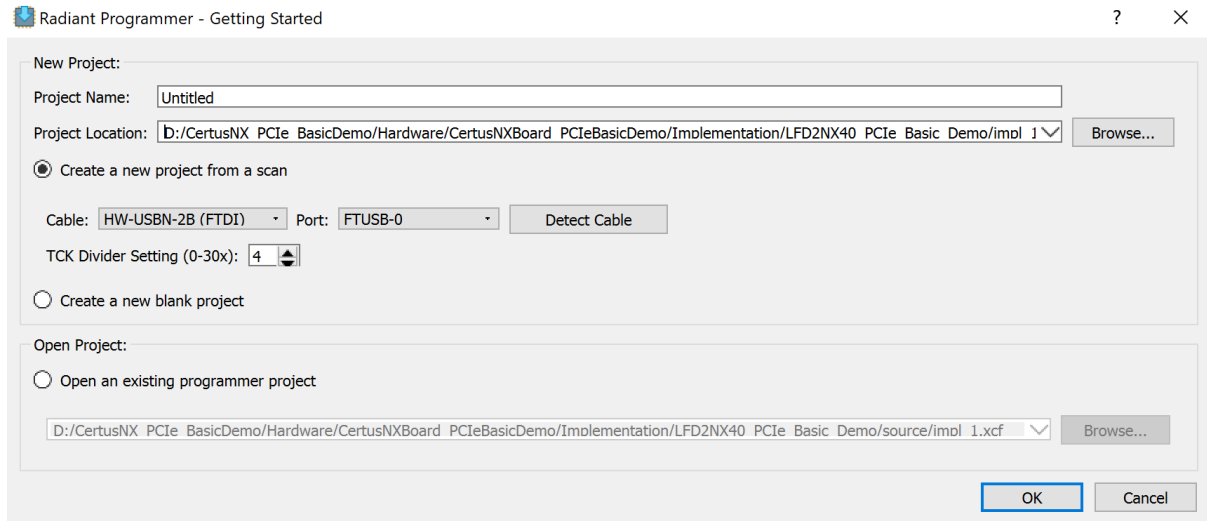


Figure 3.9. Radiant Programmer New Project

3. The Radiant Programmer main interface opens.

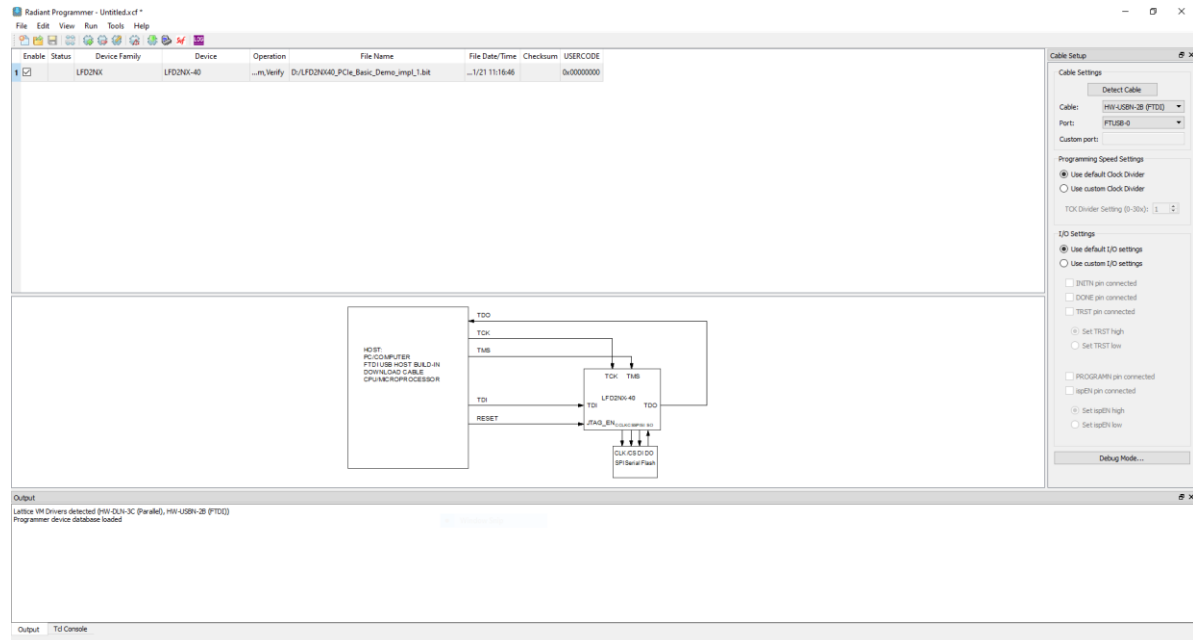


Figure 3.10. Main Interface

- Double-click under **Operation** to open the **Device Properties** dialog box.

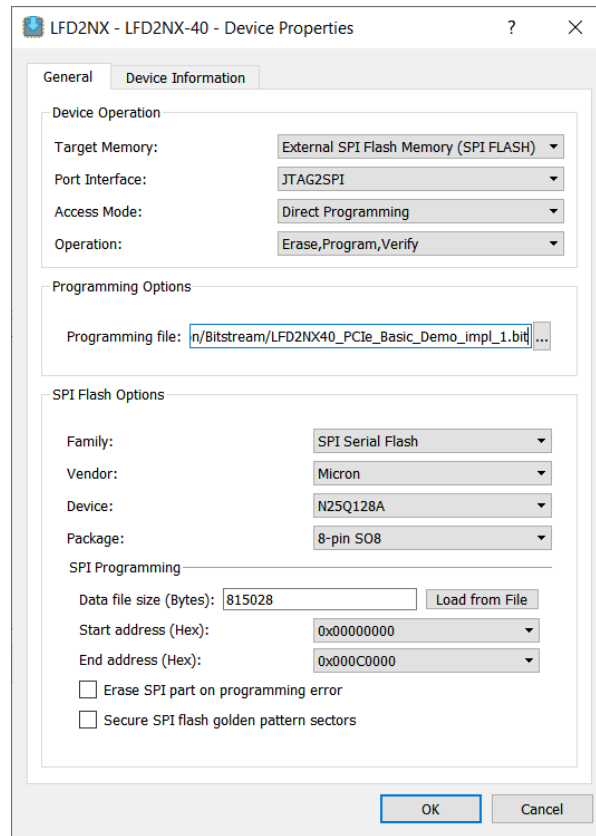


Figure 3.11. Device Properties

- Enter the settings as shown in [Figure 3.11](#).
Access mode: SPI Flash Background Programming
Operation: SPI Flash Erase, Program, Verify”
Programming File – LFD2NX40_PCl_e_Basic_Demo_impl_1.bit
Family – SPI Serial Flash
Vendor – Micron
Device – SPI-N25Q128A”
Package – 8-pin SO8

- All other settings are acceptable as default. Click **OK**.
- Click the **Programming** button highlighted in [Figure 3.12](#) to start programming.

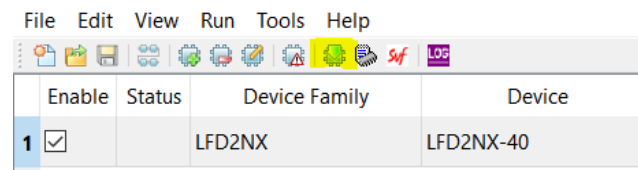


Figure 3.12. Programming Button

- When programming is successfully completed, the output console shows the status as **Operation Successful**.
- Remove the 12 V power adaptor.
- Reconnect the 12 V power adaptor. The D29 Done LED glows, indicating successful booting of FPGA from SPI flash.

11. To run the demo, remove the 12 V power adapter and Insert the board inside the PCIe slot of the PC.
12. Power on the PC. The D18, D19, D20, D21 and D22 LEDs glow.
 - D18 indicates that the transaction layer is ready to use the application layer.
 - D19 indicates the physical layer link up status.
 - D20 indicates the data link layer status.
 - D21 indicates the heartbeat signal (indication for the transaction layer clock).
 - D22 indicates that the initial re-configuration is completed.

4. Running PCIe Basic Demo

The PCIe Basic Demo allows you to manipulate the seven-segment display included on the Certus-NX Versa Evaluation Board. This demo showcases the capabilities of the Lattice FPGA and PCI Express endpoint IP core function in a Windows PC PCI Express slot.

To run the PCIe Basic Demo:

1. Before, starting this demo, ensure that the following operations are completed:
 - a. Lattice Radiant programmed the bitstream for this demo to the board. You can find the bitstream for Lattice Radiant at
`<Kit-Location>Lattice_certus_nx_pcie_basic_demo\Demonstration\Bitstream\LFD2NX40_PCl_e_Basic_Demo_impl_1.bit`
 - b. The board drivers included with *Setup.exe* are installed on the host machine. See the procedure described in the [Installing the Drivers on the Host Machine](#) section of this document.
2. Click the **Certus-NX Basic Demo Application** icon on the desktop.
3. The interface opens showing the **Device Info** tab. This page displays information about the device driver and PCI configuration registers. The data displayed is for information only and cannot be edited. If there is a problem in accessing the device driver or the device is not or improperly inserted, an error message appears on this page.

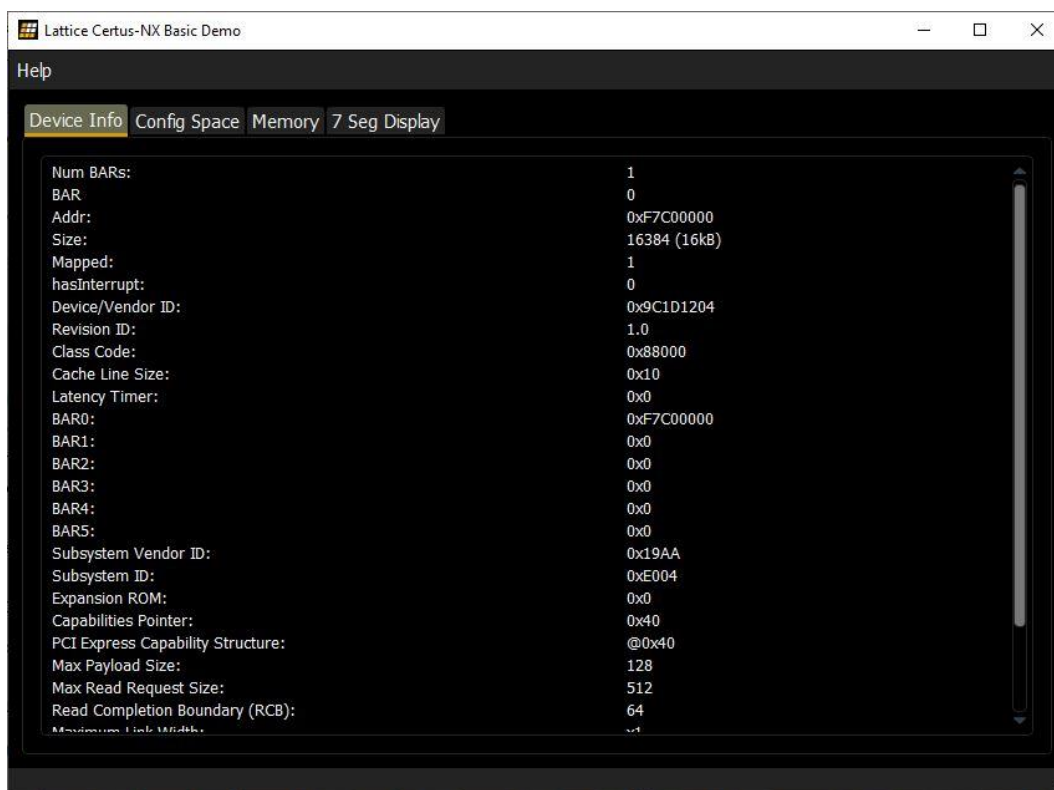


Figure 4.1. Device Info after Correct Software and Hardware Installation

4. Click the **Config Space** tab to display PCI Configuration registers in 8-bit, 16-bit and 32-bit mode. When the application starts, the 32-bit mode is selected and the PCI Configuration Space is displayed. Selecting the 8-bit, 16-bit, or 32-bit options displays the corresponding configuration space registers. The data displayed is for information only and cannot be edited.

5. To run the demo software, click on the **7 Seg Display** tab to view the contents of the 7 segment control page. In this page, you can run a demonstration LED sequence and control the display on your board from the console. The **7 Seg Display** page provides a way to interactively toggle segments on the display. You can present character sequences from this page or select single characters and run them to light the display.



Figure 4.2. User Interface Control of 7-Segment Display

6. Click on any segment in the interactive segment display in the 7 Seg Display page. Notice that any selection immediately causes the corresponding segment on the LED to light on your board's LED display. Clicking on a segment turns it on or off.
7. Click the **Reset** button to turn off all the LED displays.
8. Enter a number between 0 and F and click the **Set** button. This toggles on the respective segments both on the board and on the user interface.



Figure 4.3. Onboard 7-Segment Display

5. Running PCIe Memory Access Demo

The PCIe Memory Access demo allows the user to access FPGA memory through the PCIe bus.

This demo is included in the user interface installed in the [Hardware Setup](#) and [Software Setup](#) sections. Please be sure to complete all steps in these sections before continuing to use the PCIe Memory Access demo.

To run the PCIe memory access demo:

1. Click the **Memory** tab to access elements to control read/write processes. Data access can be specified as byte, short or word operations by selecting Data Width. Access is done to the selected Base Address Register (BAR).
2. Run the memory read/write functionality by selecting the **Single** and **Continuous** mode options.

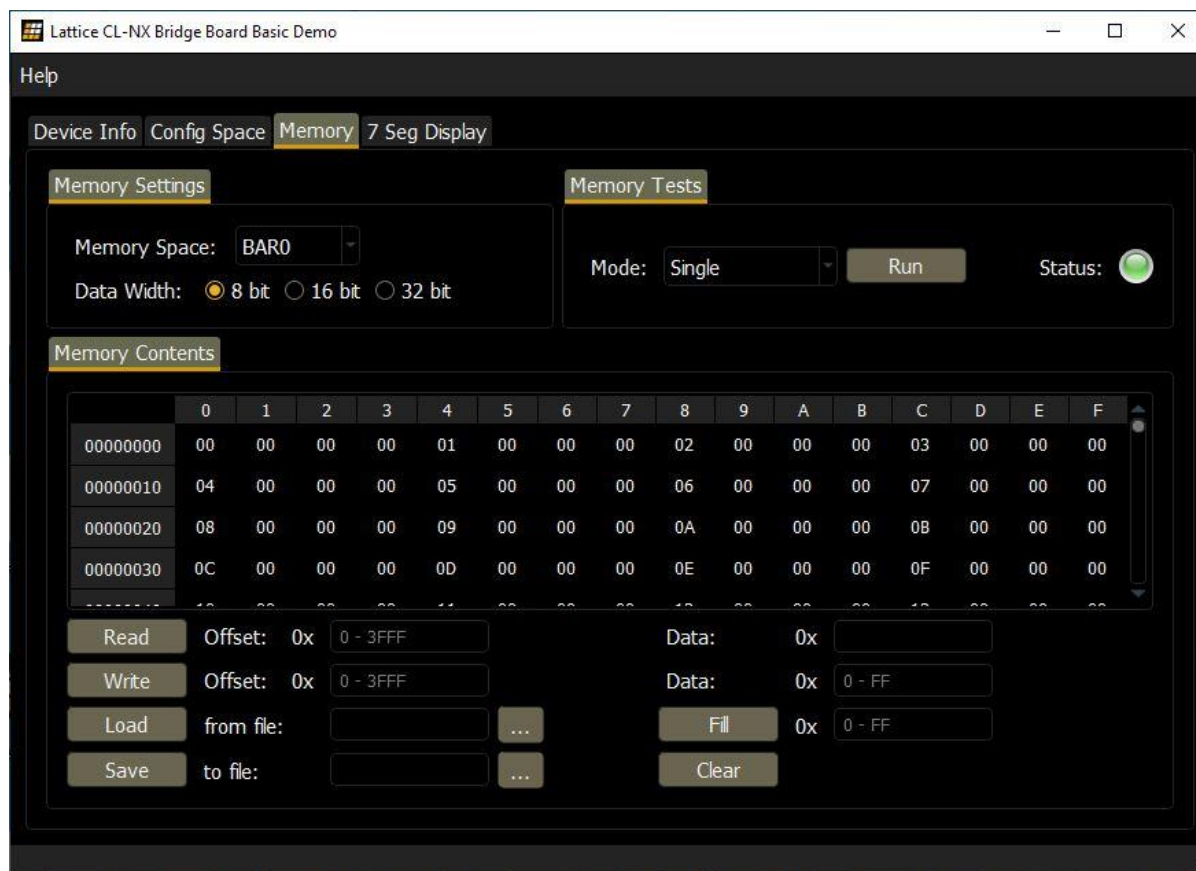


Figure 5.1. Memory Access Tab in GUI

6. Rebuilding the Demo

You can rebuild the demo after installing and completing the procedures in the previous sections. This section provides directions for rebuilding the user interface using the InstallShield Wizard and re-synthesizing your *.bit* file with Lattice Radiant.

To modify files in the demo before utilizing them in your own solutions, maintain a copy of the original files in this kit. This allows you to quickly move back to the original configuration as needed.

To rebuild the user interface:

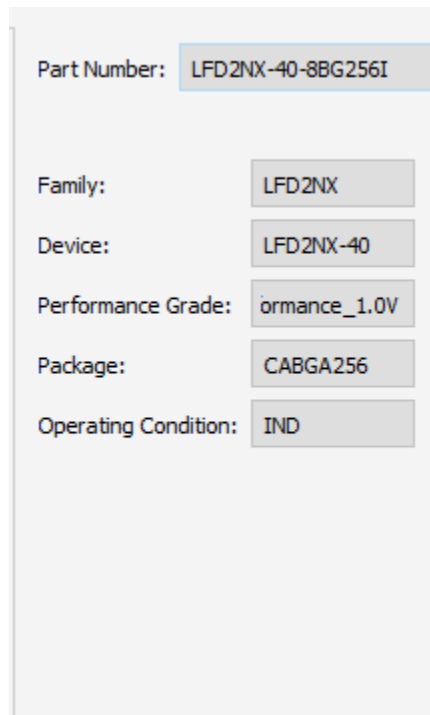
1. Navigate to `<kit_location>\Lattice_certus_nx_pcie_basic_demo\Demonstration\Windows10\Application\setup.exe` and double click the *setup.exe* icon.
2. This launched the Certus-NX Basic Demo InstallShield wizard. Click **Next**.
3. Select from the three options.
 - Modify** – present you with no options when clicked; proceeding reinstalls the Basic Demo user interface
 - Repair** – attempts to fix missing links or files in the existing program
 - Uninstall** – removes the program from your system; the drivers must be uninstalled separately
4. After completing the operation, click **Finish** in InstallShield.

7. Regenerating the .bit File and Reprogramming the Board

You can implement changes in design using the HDL source flow.

To regenerate the bit file following modifications to the source code:

1. Open the Lattice Radiant design software.
2. Click **Open Project**.
3. In the **Open Project** dialog box, navigate to and select the **LFD2NX40_PCl_e_Basic_Demo.rdf** file located in this kit at `<kit-location>\Lattice_certus_nx_pcie_basic_demo\Hardware\CertusNXBoard_PCl_eBasicDemo\Implementation\LFD2NX40_PCl_e_Basic_Demo\LFD2NX40_PCl_e_Basic_Demo.rdf`
4. Click **Open**. All the Verilog HDL files are imported into the project.
5. In **Project > Project Properties**, verify your settings as shown in [Figure 7.1](#).



Part Number:	LFD2NX-40-8BG256I
Family:	LFD2NX
Device:	LFD2NX-40
Performance Grade:	Performance_1.0V
Package:	CABGA256
Operating Condition:	IND

Figure 7.1. Proper Project Properties Configuration

6. Once your project loads, click **Task Detail View**. This shows a list of actions that Lattice Radiant will perform to build the .bit file.
7. Select the files and reports that you want to generate.
Note: The options needed to regenerate the .bit file are selected by default.
8. After selecting your preferred reports, click **Run All**.

This creates a .bit file with your project's current name in the `imp1` folder. Assuming you left the directory structure of this original project unchanged, the file becomes available in the following location:

`<kit_location>\Lattice_certus_nx_pcie_basic_demo\Hardware\CertusNXBoard_PCl_eBasicDemo\Implementation\LFD2NX40_PCl_e_Basic_Demo\<your_file>.bit`

9. Once the file is generated, click **Programmer**.

The process to reprogram the non-volatile memory onboard the FPGA is completed, similar to the initial install. This secondary pass, however, does not require you to create a new programmer project.

8. Troubleshooting

Device Not Detected in Scan Operation

Occasionally, the device is not detected when using the Scan tool in Lattice Radiant Programmer. In this case, two options are recommended:

- In the cable detection panel in Lattice Radiant programmer, increase the clock divider value and run the scan again.
- Hold down the Reset button on the Certus-NX Versa Evaluation Board. The Reset button on the board is labeled *Program*. This is the blue button closest to the edge of the board and opposite the micro USB port.

Technical Support Assistance

Submit a technical support case through www.latticesemi.com/techsupport.

Revision History

Revision 1.1, November 2021

Section	Change Summary
All	Changed document title from <i>Certus-NX Versa Development Board Demo</i> to <i>Certus-NX Versa Evaluation Board Demo</i> .
Acronyms in This Document	Corrected PCIE to PCIe.
Disclaimers	Updated description.
Introduction	- Changed <i>PCI Express Basic Demo</i> to <i>PCIe Memory Access Demo</i> in the Learning Objectives section. - Changed <i>Ubuntu 16.04 LTS</i> to <i>Ubuntu 18.04.6 LTS</i> in the Linux Version of this Demo section. - Removed Red Hat Enterprise Linux systems from the Linux Version of this Demo section.
Setting Up the Demo	Changed <i>run throughput tests</i> to <i>run memory access tests</i> in the Hardware Setup section.
Running PCIe Basic Demo	Changed <i>PCIe basic demo</i> to <i>PCIe Basic Demo</i> .
Running PCIe Memory Access Demo	Changed <i>PCIe throughput demo</i> to <i>PCIe Memory Access demo</i> globally, and updated contents and figure accordingly.
Rebuilding the Demo	Changed <i>Certus-NX basic demo</i> to <i>Certus-NX Basic Demo</i> .

Revision 1.0, August 2021

Section	Change Summary
All	Initial release.



www.latticesemi.com