

Getting Started with Intel's DE-Series Boards

For Quartus® Prime 21.1

1 Introduction

This document introduces the Intel® DE-series Development and Education Boards and the supporting materials provided by Intel Corporation. It also explains the installation process needed to use a DE-series board connected to a computer that has the Quartus® Prime CAD system installed on it.

Intel's DE-series Development and Education Boards have been developed to provide an ideal vehicle for learning about digital technology in a laboratory setting. The DE-series boards are highly suitable for use in courses on digital logic, computer organization, and embedded systems, as well as for design projects. In addition to the DE-series board and the associated software, Intel provides supporting materials that include tutorials and laboratory exercises.

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- Scope of a DE-Series Board and Supporting Material
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2 Purpose of a DE-Series Board

University and college courses on the design of logic circuits, computer organization, and embedded systems usually include a laboratory component. In a modern curriculum, the laboratory equipment should ideally exemplify state-of-the-art technology and design tools, but be suitable for exercises that range from the simple tasks that illustrate basic concepts to challenging designs that require knowledge of advanced topics. From the logistic point of view, it is ideal if the same equipment can be used in all cases. The DE-series board has been designed to provide the desired platform.

3 Scope of a DE-Series Board and Supporting Material

A DE-series board features a powerful Intel FPGA chip. All important components on a DE-series board are connected to the pins of this chip, allowing the user to configure the connection between the various components as desired. For simple experiments, a DE-series board includes a sufficient number of switches (of both slide and push-button variety), LEDs, and 7-segment displays. For more advanced experiments, DE-series boards include many types of peripheral devices, such as memory chips, audio and video input/output, ethernet, USB, and so on. For experiments that require an embedded processor, it is easy to instantiate Intel's Nios® II embedded processor, and some DE-series boards (designated as *SoC* boards) include embedded processors from ARM* Ltd within the FPGA chip. Finally, it is possible to connect expansion boards to a DE-series board by means of two general-purpose headers.

The main software tool needed to use the DE-series boards is the Intel Quartus Prime Lite Edition, and the ModelSim-Intel simulator. For processors implemented in the FPGA on a DE-series board, software code development is facilitated by the Monitor Program, which supports both Intel's Nios II embedded processor and the ARM A9 processor in Intel's SoC devices. Software development is also supported software provided by ARM Ltd.

Traditionally, manufacturers of educational FPGA boards have provided a variety of boards and the CAD tools needed to implement designs on these boards. However, there has been a paucity of supporting materials that could be used directly for teaching purposes. Intel's DE-series boards are a significant departure from this trend. In addition to the DE-series board, Intel Corporation provides a full set of associated exercises that can be performed in a laboratory setting for typical courses on logic design, computer organization, and embedded systems. In effect, the DE-series board and the available exercises can be used as a ready-to-teach platform for such laboratories. Of course, the DE-series board is also likely to be suitable for exercises that have been developed for other hardware platforms and can be ported to the DE-series platform.

4 Installation of Software and Drivers

The DE-series board is shipped in a package that includes all parts necessary for its operation. The only essential parts are the power adapter and the USB cable. There is also a protective plexiglass cover that may be used in the laboratory environment to protect the board from accidental physical damage.

The DE-series boards require the Intel Quartus Prime CAD software. The Intel FPGA University Program recommends installation of the version called the Quartus Prime Lite Edition. Install this software on the computer, and

ensure that the type of Intel FPGA family that is used on the board is included in the installation (the DE-series boards supported by the Quartus Prime Lite Edition software may use the Intel Arria® 10, Intel Max® 10, Stratix® IV, Stratix® V, Cyclone® IV, or Cyclone® V FPGAs). Plug in the power adapter that was included with the board. Use the provided USB cable to connect the connector on the DE-series board labeled **USB Blaster** to a USB port on the computer.

Press the power button to turn on the DE-series board. The computer will recognize the new hardware connected to its USB port, but it will be unable to proceed if it does not have the required driver already installed. The DE-series board is programmed by using Intel's USB-Blaster, or USB-Blaster II, driver software. If the driver software is not already installed, then follow the steps below to install the required driver.

4.1 Installing the USB-Blaster or USB-Blaster II Driver

The instructions below apply to computers running the Microsoft® Windows® 10 operating system. If Microsoft Windows 7 or 8 are being used, then the equivalent (similar) steps for that system should be followed.

After connecting the board to the computer via USB, the window in Figure 1 may appear to indicate that Windows does not recognize the device. Let this window finish processing. If a different notification appears indicating that the driver is being searched for in the Windows Update Web site, click the notification to open a window. Since the desired driver is not available on the Windows Update Web site, select the option to stop the search.

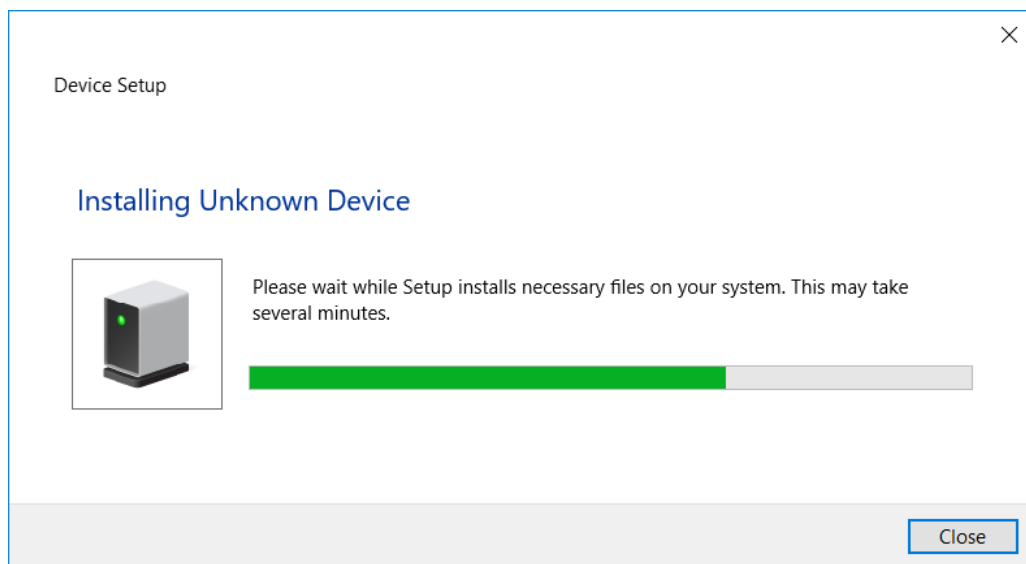


Figure 1. Notification for unsuccessful device driver installation.

Select **Start > Control Panel > Hardware and Sound** and click **Device Manager** under **Devices and Printers** to get the window in Figure 2. Expand the **Other devices** category and double-click the entry labeled **Unknown**

device to get the window in Figure 3. If there are multiple Unknown Devices, you may plug and unplug the DE-series board while observing the Device Manager window to see which Unknown Device corresponds to your board. If the USB device is listed as "FT232R USB UART" rather than "Unknown Device," you may be using the wrong USB cable. Use a Type-B USB cable, which should plug in right beside the power cable, depending on the particular board. Note that for some systems, the entry may be located at Universal Serial Bus controllers > Altera USB-Blaster. Also note that if a DE-SoC board is being used, then the entry may be labeled as USB-Blaster II or as DE-SoC.

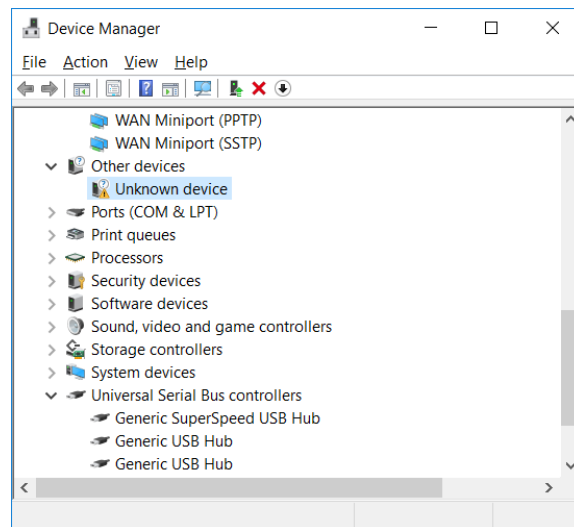


Figure 2. Click Unknown Device in the Device Manager.

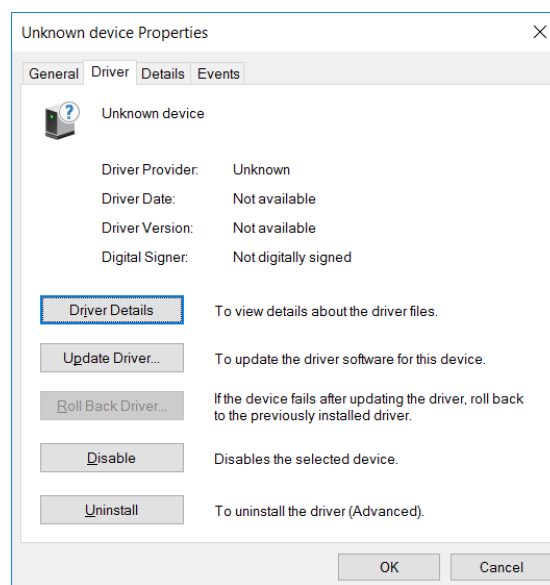


Figure 3. Click the Update Driver button.

In the Driver tab select **Update Driver**, which opens the window in Figure 4. The driver is available within the Quartus Prime software. Hence, select **Browse my computer for driver software**. In the window in Figure 5 check **Include subfolders** and click **Browse** to get the pop-up box in Figure 6.

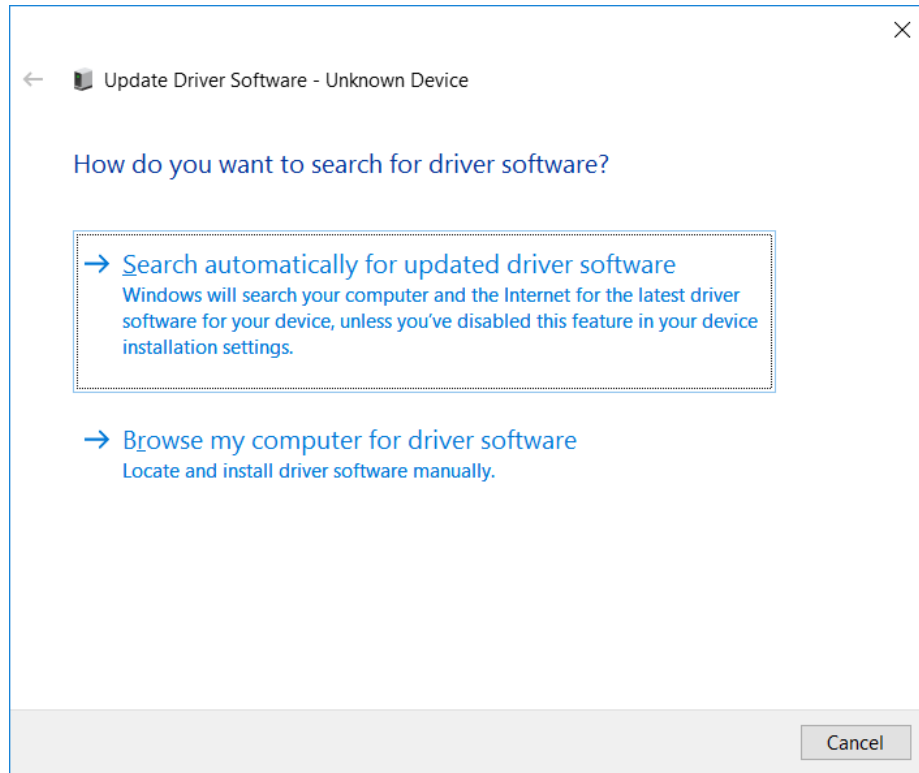


Figure 4. Browse your computer for the driver software.

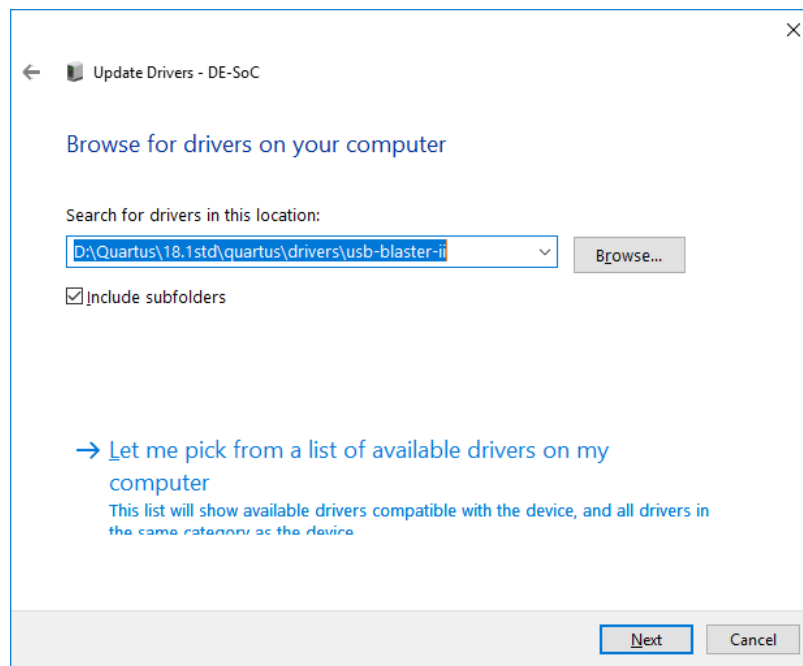


Figure 5. Specify the location of the driver.

Find the desired driver in your Quartus installation folder: $\langle \text{QUARTUS_ROOTDIR} \rangle \backslash \text{drivers}$, where QUARTUS_ROOTDIR is the Quartus Prime installation directory, such as $\text{C:\intelFPGA\21.1\quartus}$. Click OK and then upon returning to Figure 5 click Next.

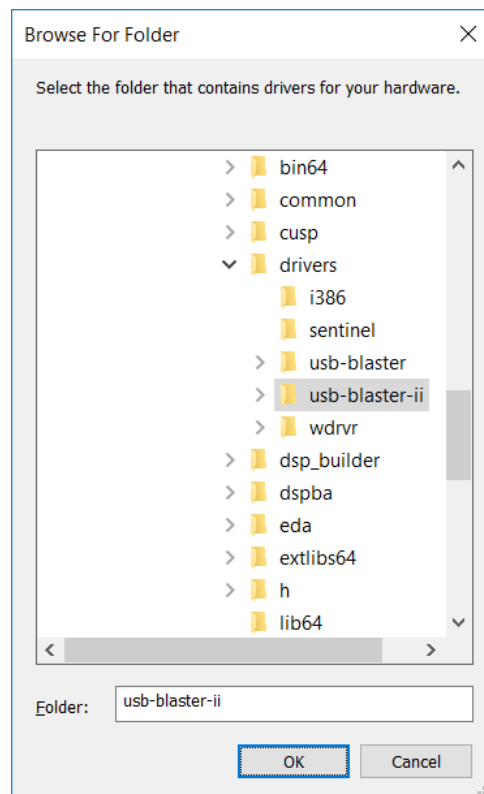


Figure 6. Browse to find the location.

At this point the installation will commence, but a dialog box in Figure 7 may appear indicating that Windows cannot verify the publisher of the driver software. Click **Install this driver software anyway**. The driver will now be installed as indicated in Figure 8. Click **Close** and you can start using the DE-series board.

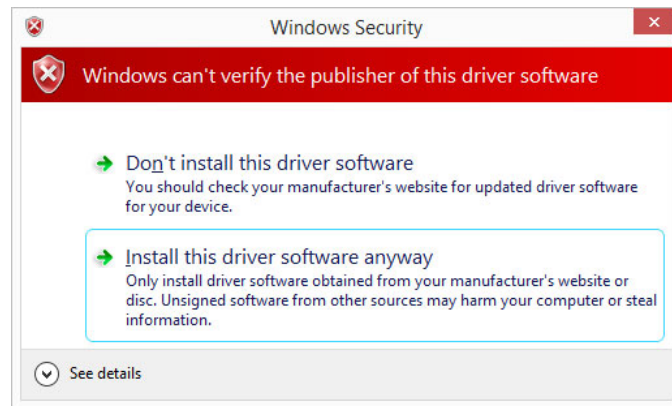


Figure 7. There is no need to verify the publisher of the driver.

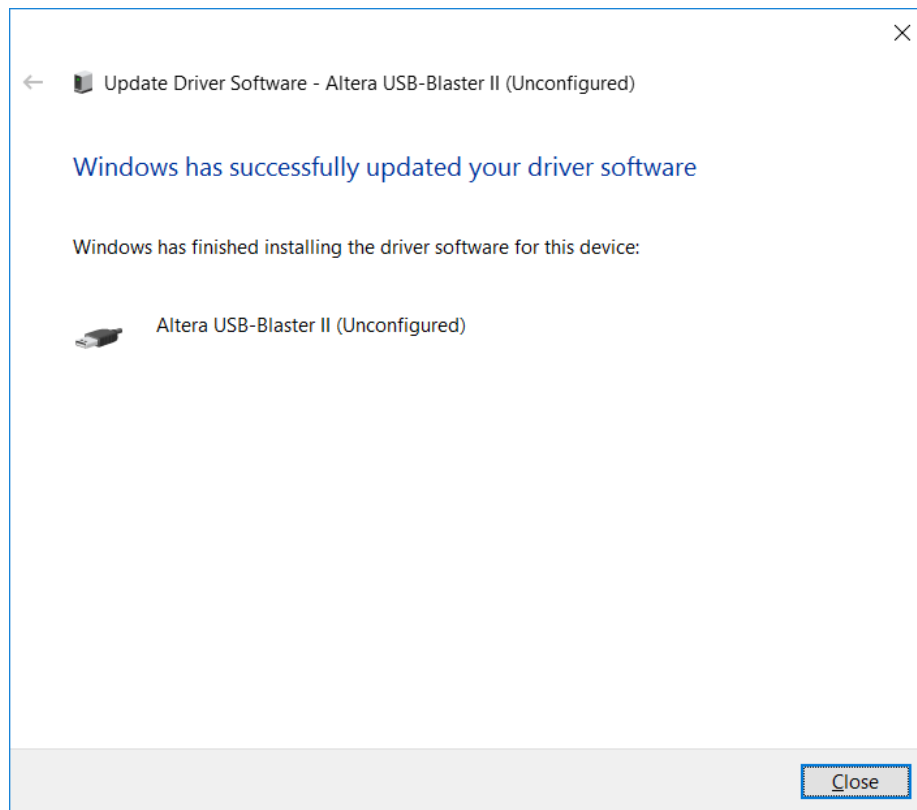


Figure 8. The driver is installed.

4.2 Errors installing Driver

You may be faced with errors causing the installation to fail, such as "Windows could not find drivers for your device" or "Windows found drivers for your device but encountered an error while trying to install them." To solve this issue, you may need to disable Device Driver Signing Enforcement. Complete the following steps to do so.

1. If your computer uses BitLocker encryption, write down the recovery key (somewhere not on this computer) to use later.
 - In the file explorer, right click on your hard drive.
 - Click Manage BitLocker.
 - Click Back up your recovery key.
 - Click Print the recovery key, Microsoft print to PDF, then email this PDF file to another device, for instance.
2. Select the start menu.
3. Open Settings.
4. Click on Update & Security.
5. Click on the Restart Now button under Advanced Startup (and also remember the next few steps if you are about to restart this computer).

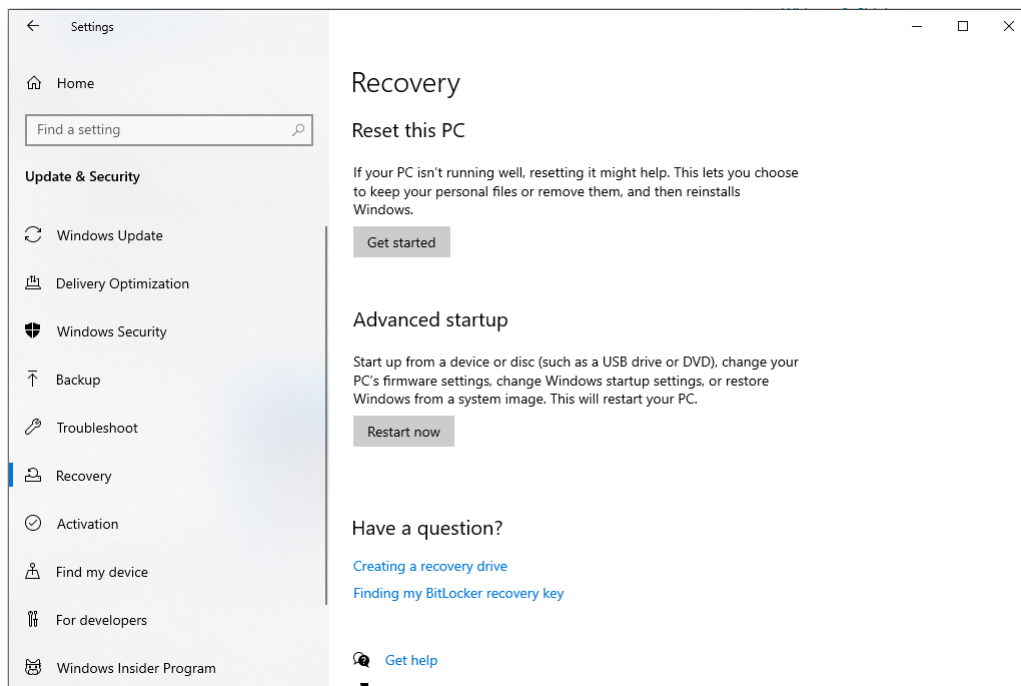


Figure 9. The settings menu before restart.

6. After your computer restarts, click Troubleshoot.
7. Click Advanced options.
8. Click Startup options.
9. Click restart.
10. Enter your BitLocker recovery key if/when prompted.
11. Upon the final menu appearing, press 7 to choose Disable Driver Signing Enforcement.

You should now be able to repeat the steps listed in section 4.1 to install the USB-Blaster or USB-Blaster II Driver with no issues.

5 Using a DE-series Board

A DE-series board is used in conjunction with the Quartus Prime software. A reader who is not familiar with this software should read an introductory tutorial. There are three versions of the tutorial:

- *Quartus Prime Introduction Using Verilog Designs*
- *Quartus Prime Introduction Using VHDL Designs*
- *Quartus Prime Introduction Using Schematic Designs*

Each of these tutorials cover the same aspects of the Quartus Prime software, differing only in the design entry method that is used. The tutorials illustrate the entire process of implementing a design targeted for a DE-series board.

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