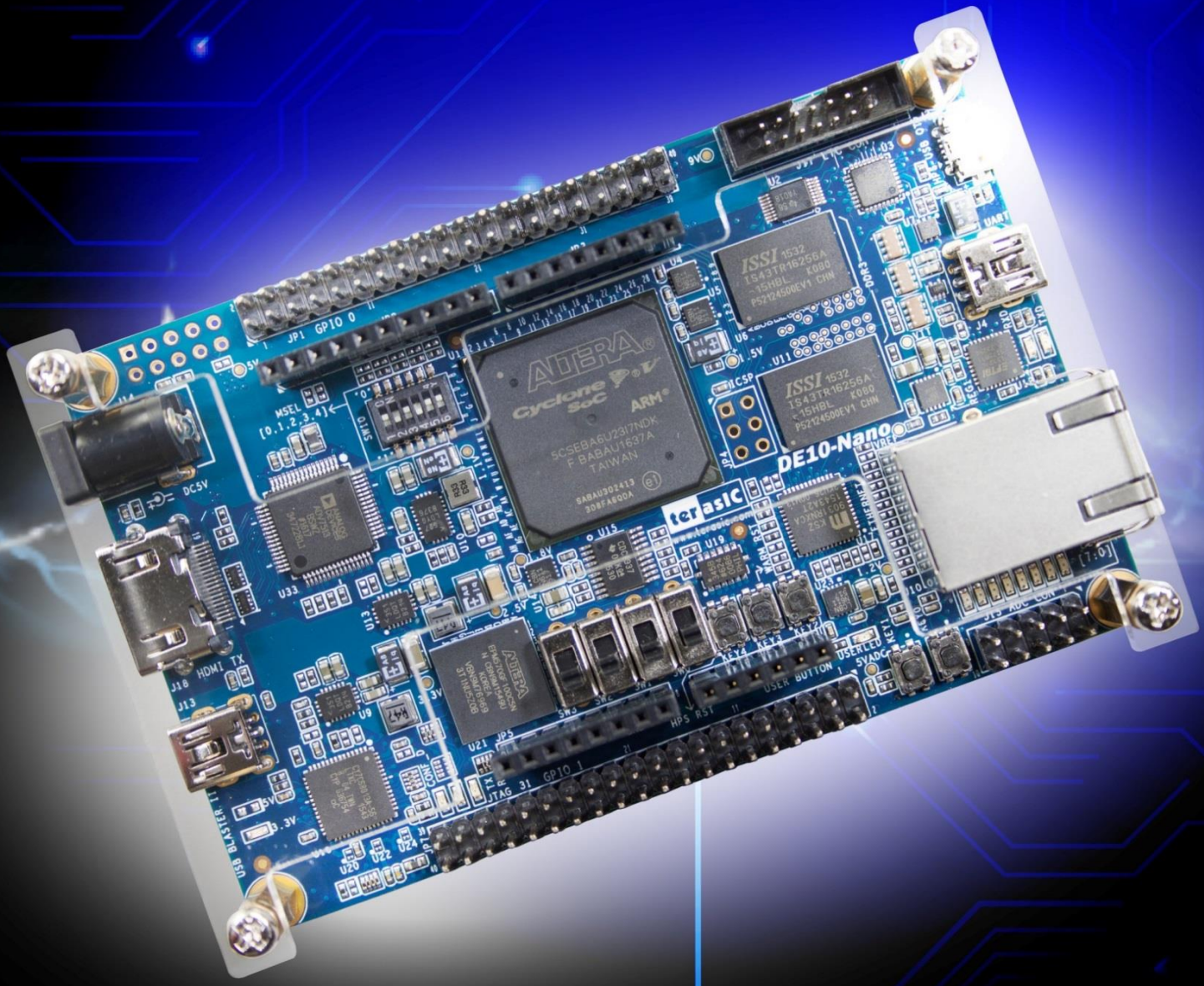
DE10-Nano

Getting Started Guide



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CONTENTS

Chapter 1

About this Guide

The DE10-Nano Getting Started Guide contains a quick overview of the hardware and software setup including step-by-step procedures from installing the necessary software tools to using the DE10-Nano board. The main topics this guide covers are listed below:

- Development Board Setup: Powering on the DE10-Nano
- Software Installation: Installing Quartus II and SoC EDS
- Perform FPGA System Test: Downloading a FPGA SRAM Object File (.sof)
- Running Linux on DE10-Nano Board via UART terminal.

Chapter 2

Development Board Setup

2.1 Introduction

The instructions in this section explain how to set up the DE10-Nano development board. The following pictures are the board overview of DE10-Nano.

2.2 MSEL Settings

■ FPPx32 Mode (Default)

The FPGA Configuration Mode Switch (MSEL) shown in **Figure 2-1** is by default set to **01010** (MSEL[4:0] = 01010). The setting corresponds to FPGA configured from HPS software (in the SD Card) in FPPx32 mode. **If users want to boot with Linux Xfce desktop, please setting MSEL switch in this mode**

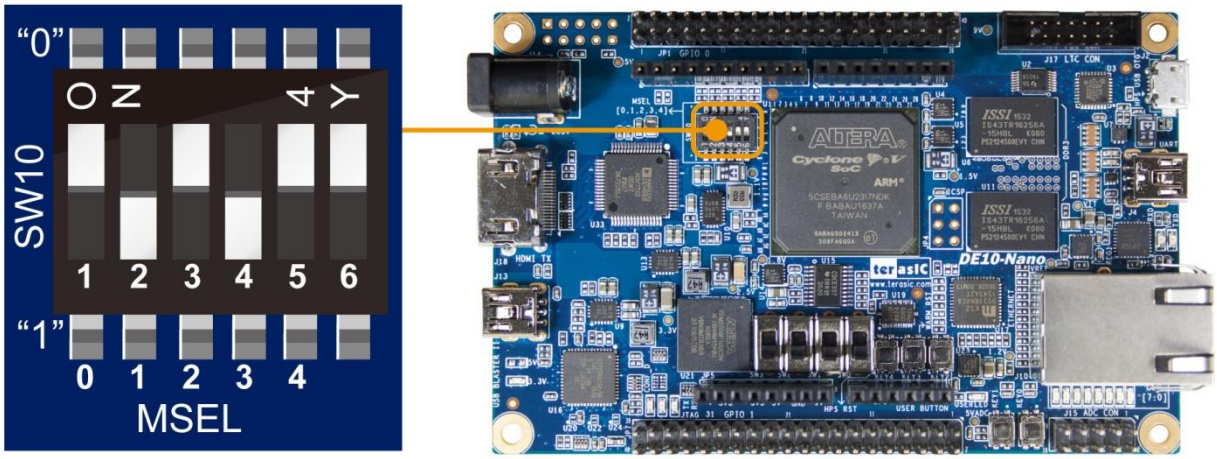


Figure 2-1 FPGA Configuration Mode Switch set in FPPx32 Mode

■ AS Mode

When the board is powered on and MSEL[4:0] set to "10010" (See **Figure 2-2)**, the FPGA is configured from EPCS.

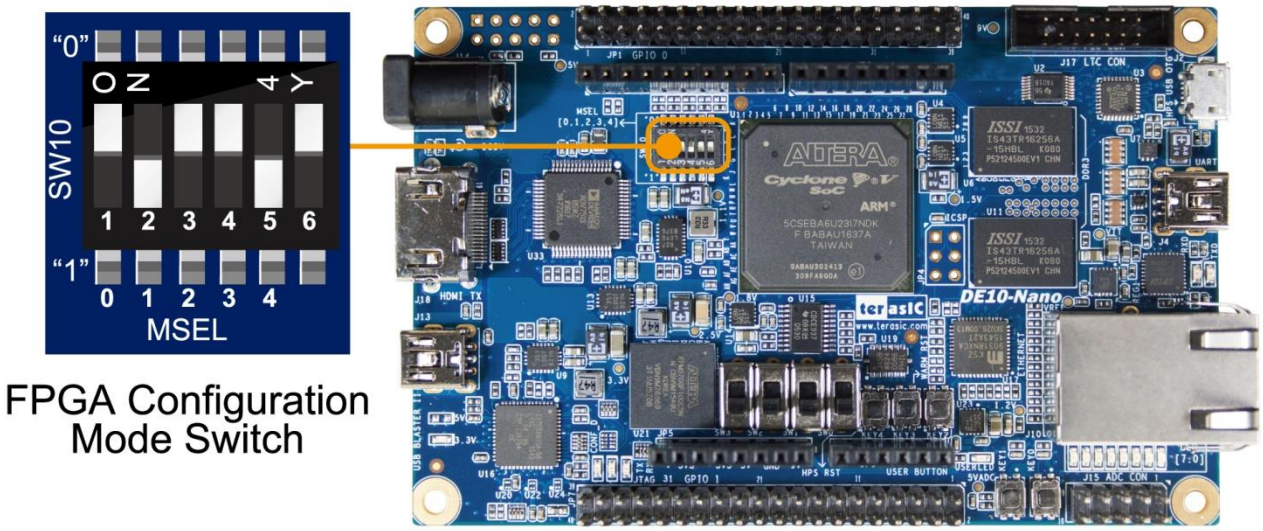


Figure 2-2 FPGA Configuration Mode Switch set in AS Mode

2.3 USB , HDMI Output and Power Cables

Cable connections are shown in **Figure 2-3**, as below:

Figure 2-3 USB, HDMI Output and Power Cables

2.4 Powering up the DE10-Nano Board with Xfce Desktop Environment

To power-up the board and run the Xfce desktop, perform the following steps below:

1. To perform this power up test, user will need some additional parts as list in below:
   i. A micro USB OTG cable.
   ii. HDMI Monitor and HDMI cable.
   iii. USB Mouse or Keyboard
2. Connect the HDMI port of DE10-Nano to a monitor with HDMI input.
3. Make sure the Factory SD Card is inserted in the SD Card socket.
4. Connect the supplied DE10-Nano power adapter to the power connector (J14) on the DE10-Nano board. At this point, you should see the 3.3V indicator LED (LED9) turned on.
5. It will take about 35 seconds to boot Linux. Finally, the screen will enter Xfce desktop on the monitor (See **Figure 2-5**).
6. After the Xfce system is ready, connect a Mouse/Keyboard to the USB OTG port (J2) via Micro USB OTG Cable (*1) (*2).
7. Now, user can use mouse/keyboard on the Xfce desktop.

(*1) Because the USB gadget function is enable by default in the Xfce system, any external USB device needs to be connected to the DE10-nano AFTER the Xfce boots up. Otherwise the external USB device will not be detected by the system. For how to enable/disable USB gadget function in the Xfce system, please refer to the section 6.4.
(*2)Some USB mouse or keyboard may have compatibility problem with the Xfce system, if user's mouse or keyboard don't get any response in the Xfce system, please re-plug the USB cable or change to other brand's USB mouse or keyboard.

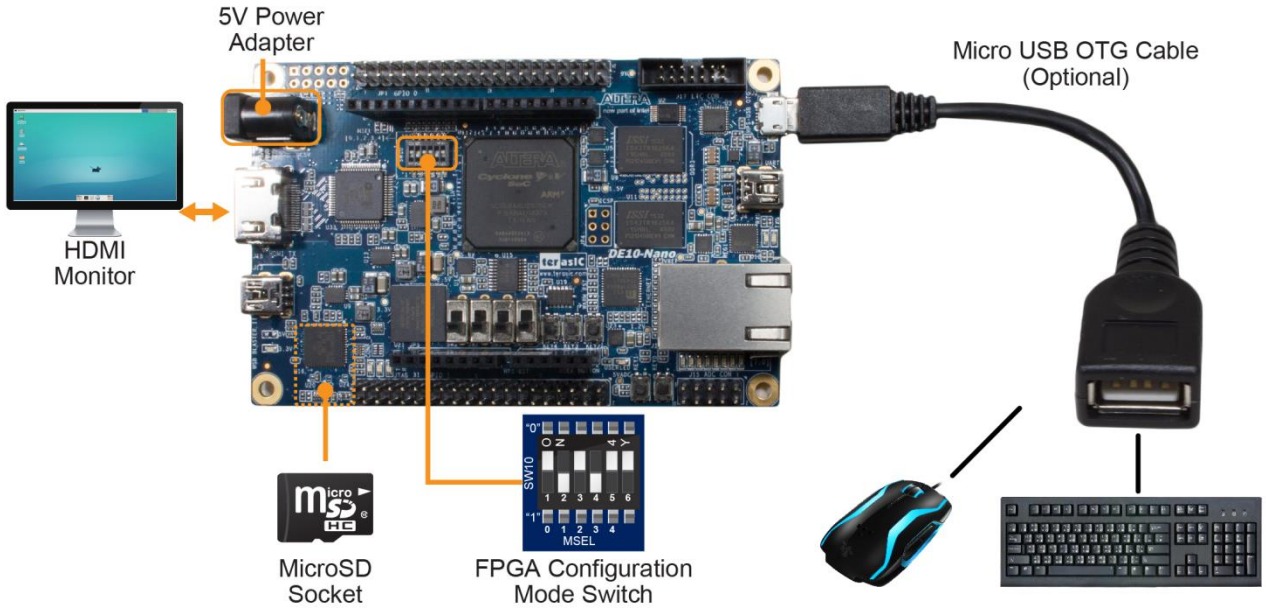


Figure 2-4 Setup for Xfce Desktop

Figure 2-5 Xfce Desktop Environment

Chapter 3

Software Installation

3.1 Introduction

This section explains how to install the following software:

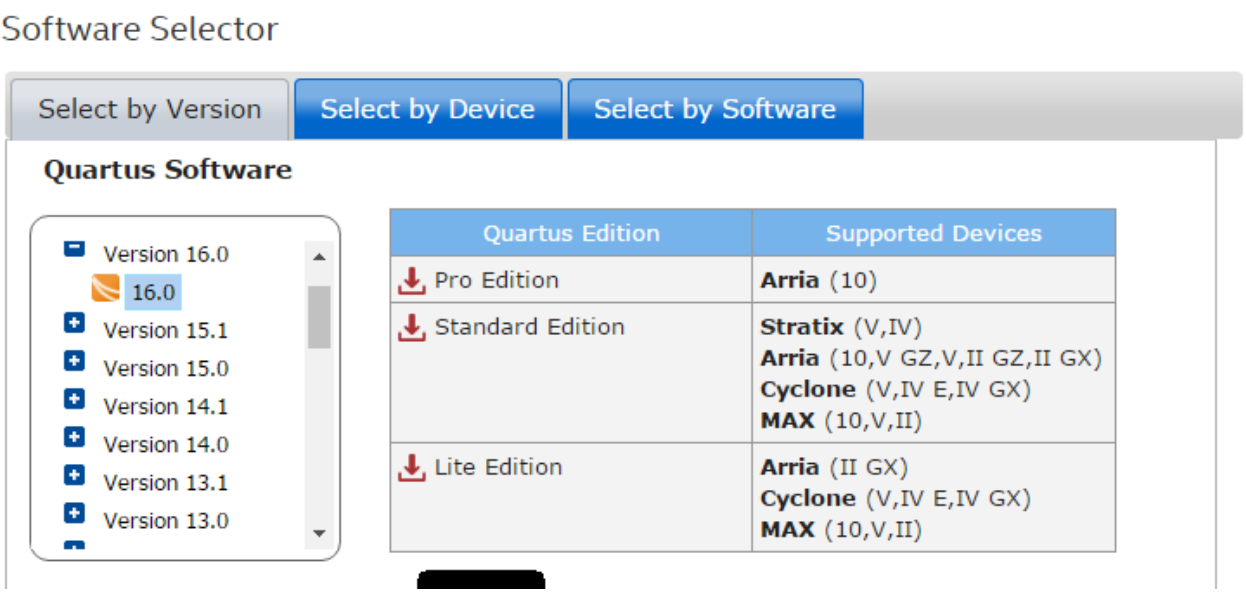
- Intel Quartus II software
- Intel SoC Embedded Design Suite

Note: 64-bit OS required

3.2 Installing Quartus II software

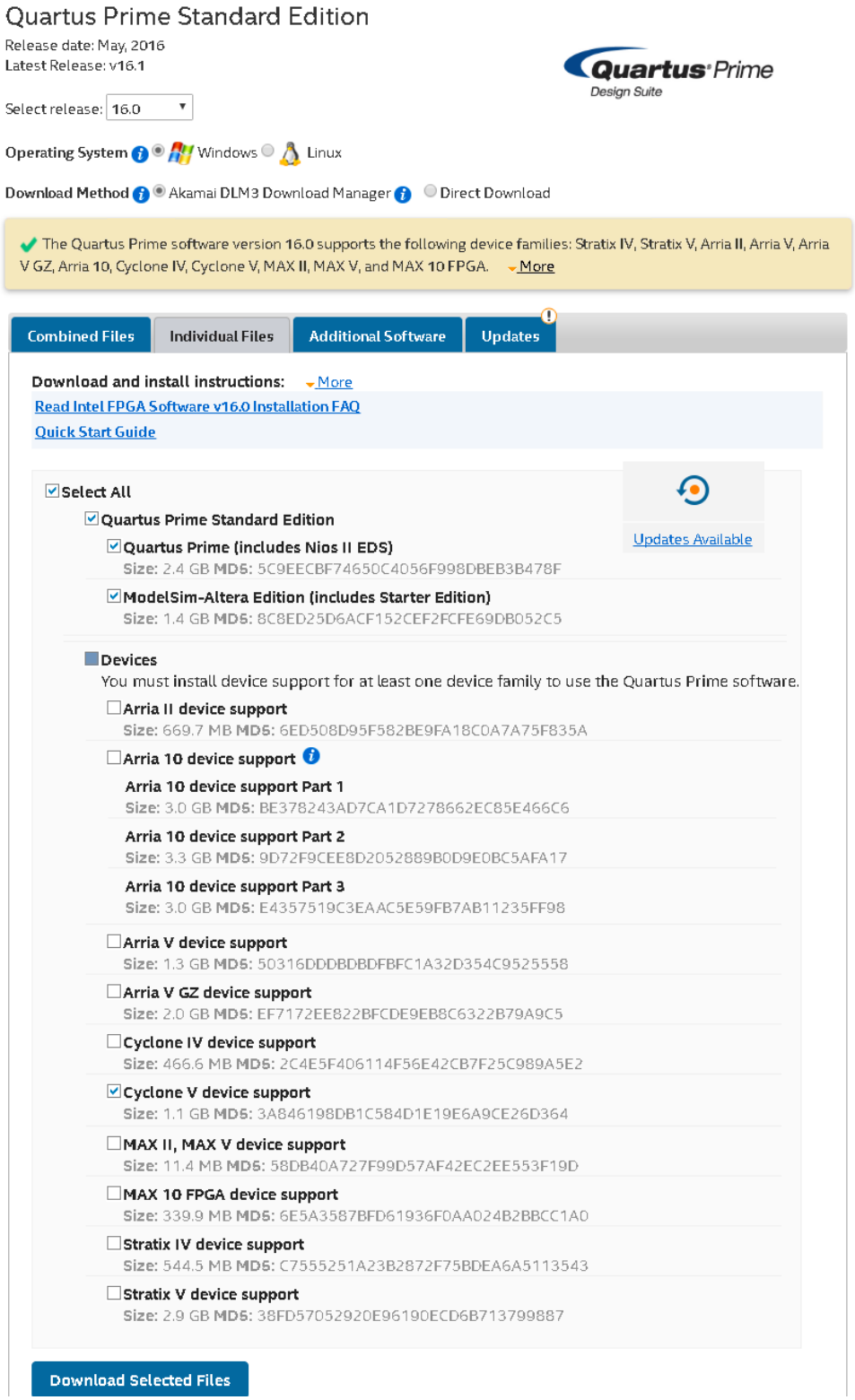
The Intel Complete Design Suite provides the necessary tools used for developing hardware and software solutions for Intel FPGAs. The Quartus II software is the primary FPGA development tool used to create reference designs along with the NIOS II soft-core embedded processor integrated development environment

User can download the latest software from:
http://url.terasic.com/quartus_download



- If you choose to install the Standard Edition, note that a purchased license will be required. Please go to the following link for more information regarding the Standard Edition: https://www.altera.com/support/support-resources/download/licensing.html

- Download files from Standard or Lite edition page. You must download the Quartus II Software (includes NIOS II EDS) and Cyclone V device support (includes all variations).



- After the file is downloaded, select the *.exe file, and install the software. All of the defaults are to be used.

3.3 Installing Intel SoC Embedded Design Suite

The Intel SoC Embedded Design Suite (EDS) contains development tools, utility programs, run-time software, and application examples to enable embedded development on the Intel SoC hardware platform. User can use the Intel SoC EDS to develop firmware and application software.
Users can download the software from the Intel webpage:
http://url.terasic.com/soceds_download

Intel® SoC FPGA Embedded Development Suite (SoC EDS) is available in two editions: **Standard Edition** and **Pro Edition**. Both Editions include ARM Development Studio 5 (DS-5) for Intel SoC FPGAs (license-managed). Please refer to the link list in below to get the comparison chart to compare both versions. After downloading the software, follow the corresponding guide in License Activation to activate your license.
https://www.intel.com/content/dam/www/programmable/us/en/pdfs/literature/ug/ug_soc_eds.pdf

Chapter 4

Performing a FPGA System Test

4.1 Introduction

This chapter shows how to install the USB-Blaster II driver and download a FPGA SRAM Object (.sof) file to your FPGA board.

4.2 Installing the USB-Blaster II Driver

The steps below outline the step-by-step process of installing the USB-Blaster II driver.

1. Connect your computer to the development board by plugging the USB cable into the USB connector (J13) of DE10-Nan0-SoC. (connection shown in **Figure 2-3**)
2. Power up the board and open the device manager in Windows. You will find an unknown device.

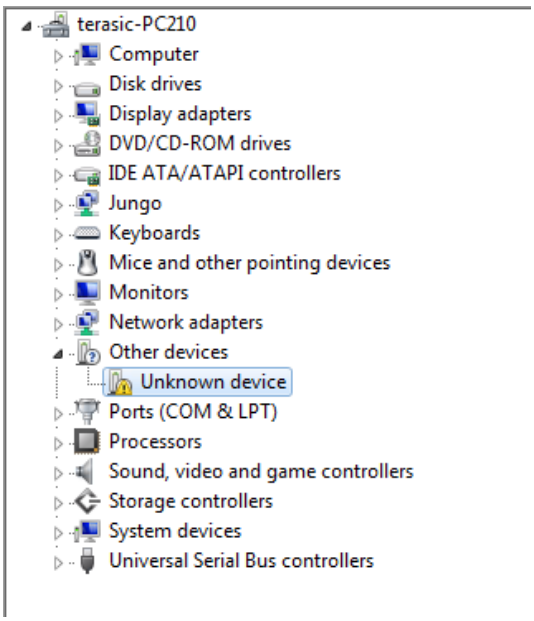


Figure 4-1 Unknown device on device manager

3. Select the unknown device to update the driver software. The driver file is in the \<Quartus II installation directory>\drivers\ usb-blaster-ii directory.

4. After the driver is correctly installed, the device will be recognized as Intel USB-Blaster II, as shown in following picture.

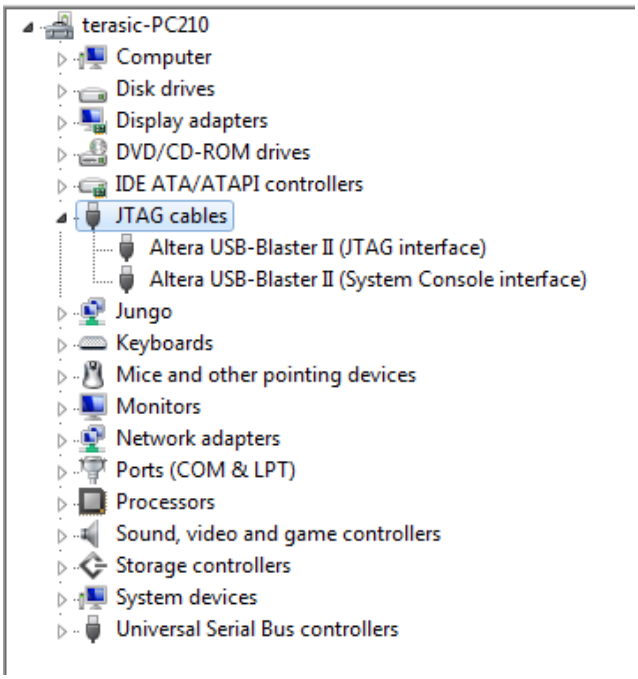


Figure 4-2 USB-Blaster II driver is installed correctly

4.3 Downloading a FPGA SRAM Object File

The Quartus II Programmer is used to configure the FPGA with a specific .sof file. Before configuring the FPGA, ensure that the Quartus II software and the USB-Blaster II driver are installed on the host computer.

If users would like to program their SRAM Object File (.sof) into the Cyclone V SOC FPGA device on the DE10-Nano board, there are two devices (FPGA and HPS) on the JTAG Chain. The configure flow is different from the one used with DE0-Nano. The section below shows the step-by-step procedure of programming flow with JTAG mode.

1. Connect your computer to the DE10-Nano board by plugging the USB cable into the USB connector (J13) of DE10-Nano and power up the board. (details shown in **Chapter 2**)
2. Open the Quartus II software and select Tools > Programmer. The Programmer window will appear.

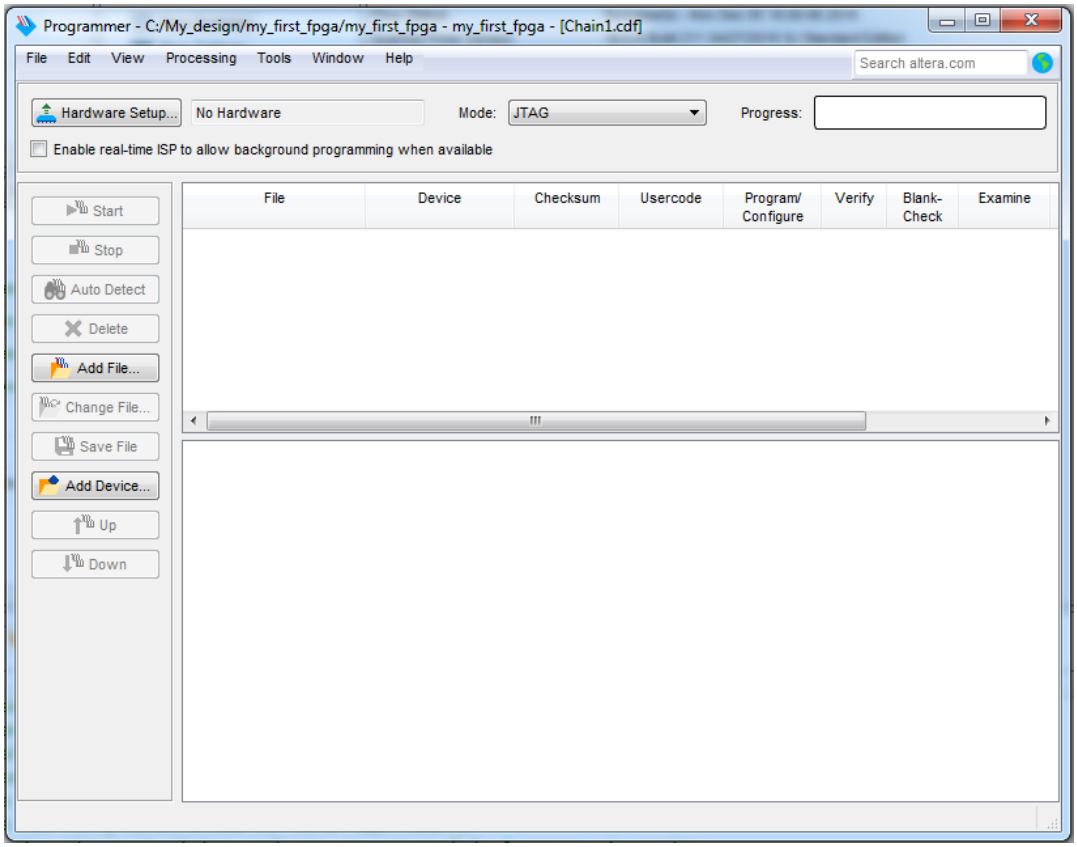


Figure 4-3 Quartus Programer

3. Click **Hardware Setup**.
4. If **DE-SoC [USB-1]** does not appear under **Currently Selected Hardware**, select that option and click **Close,** as illustrated below.

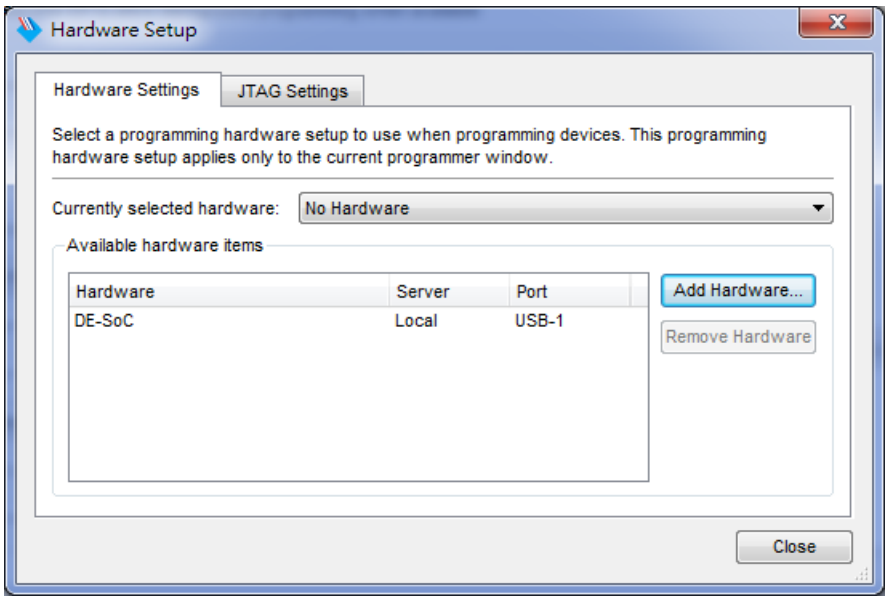


Figure 4-4 Hardware Setup

If the USB-Blaster II does not appear under hardware options list, please confirm if the USB-Blaster II driver has been correctly installed, and if the USB cable has been properly connected between the DE10-Nano board and host computer.

5. Click “Auto Detect”

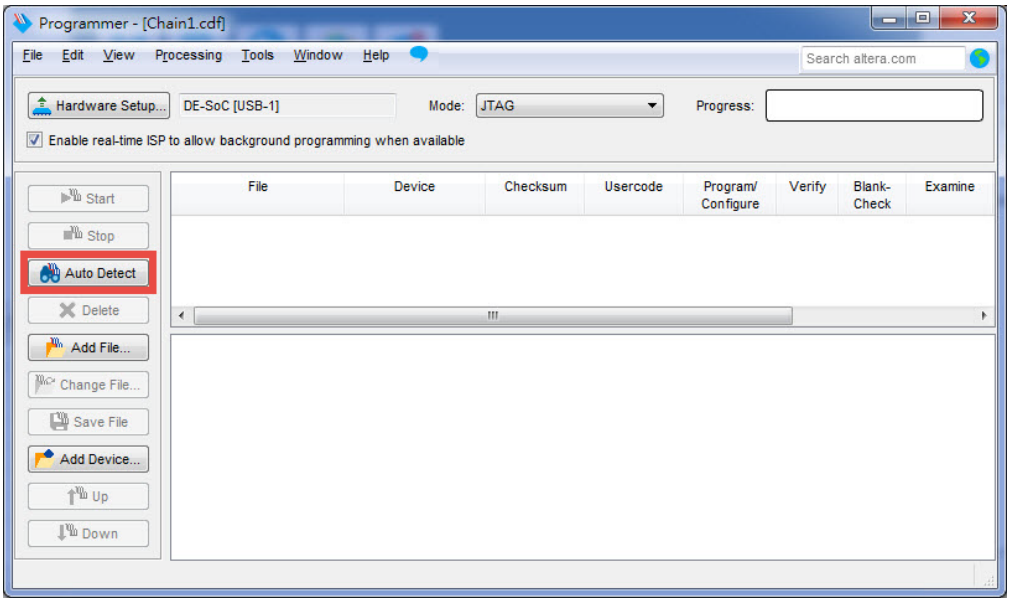


Figure 4-5 Auto detect FPGA device

6. Select the device associated with the board

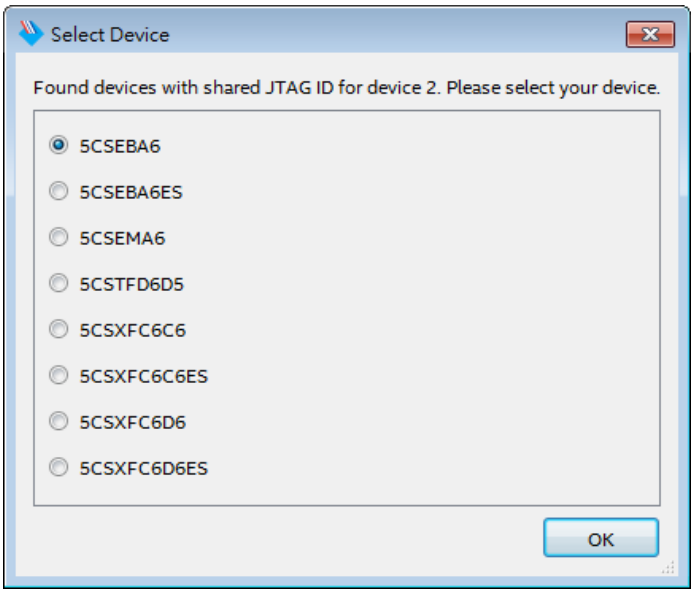


Figure 4-6 Select FPGA device

7. FPGA and HPS devices are shown in the JTAG chain

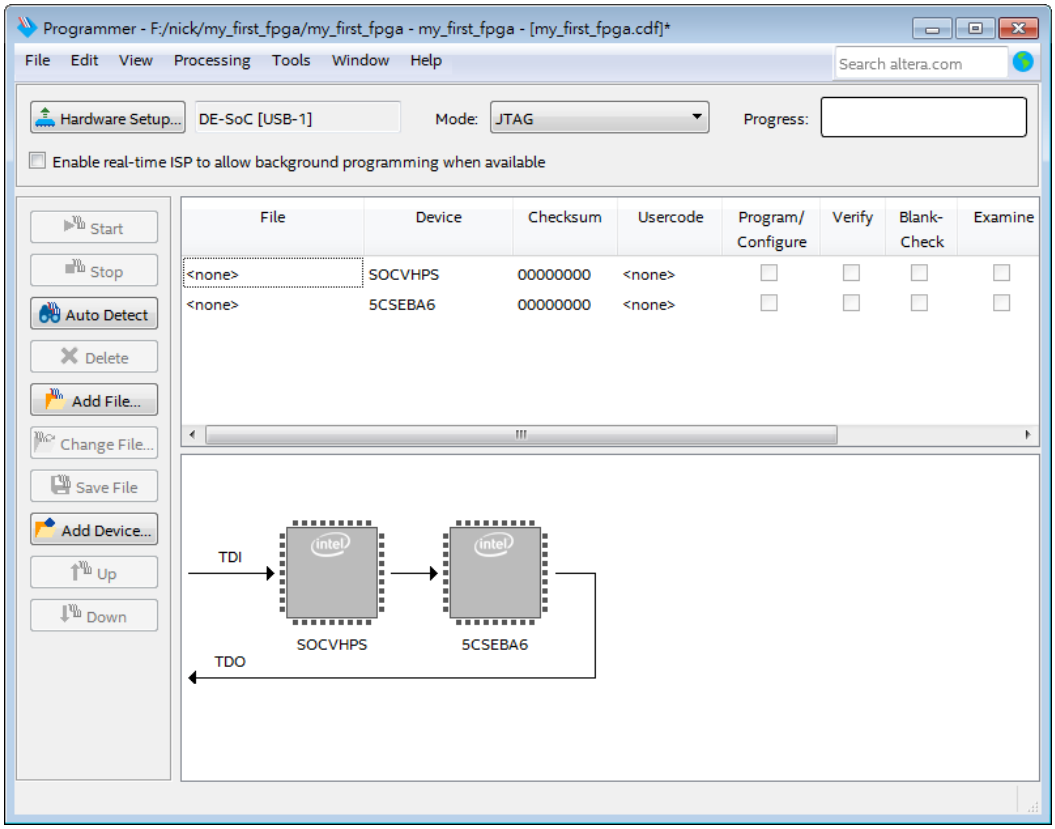


Figure 4-7 JTAG Chain on DE10-nano board

8. Click the FPGA device, click “Change File..”, and then select .sof file for FPGA

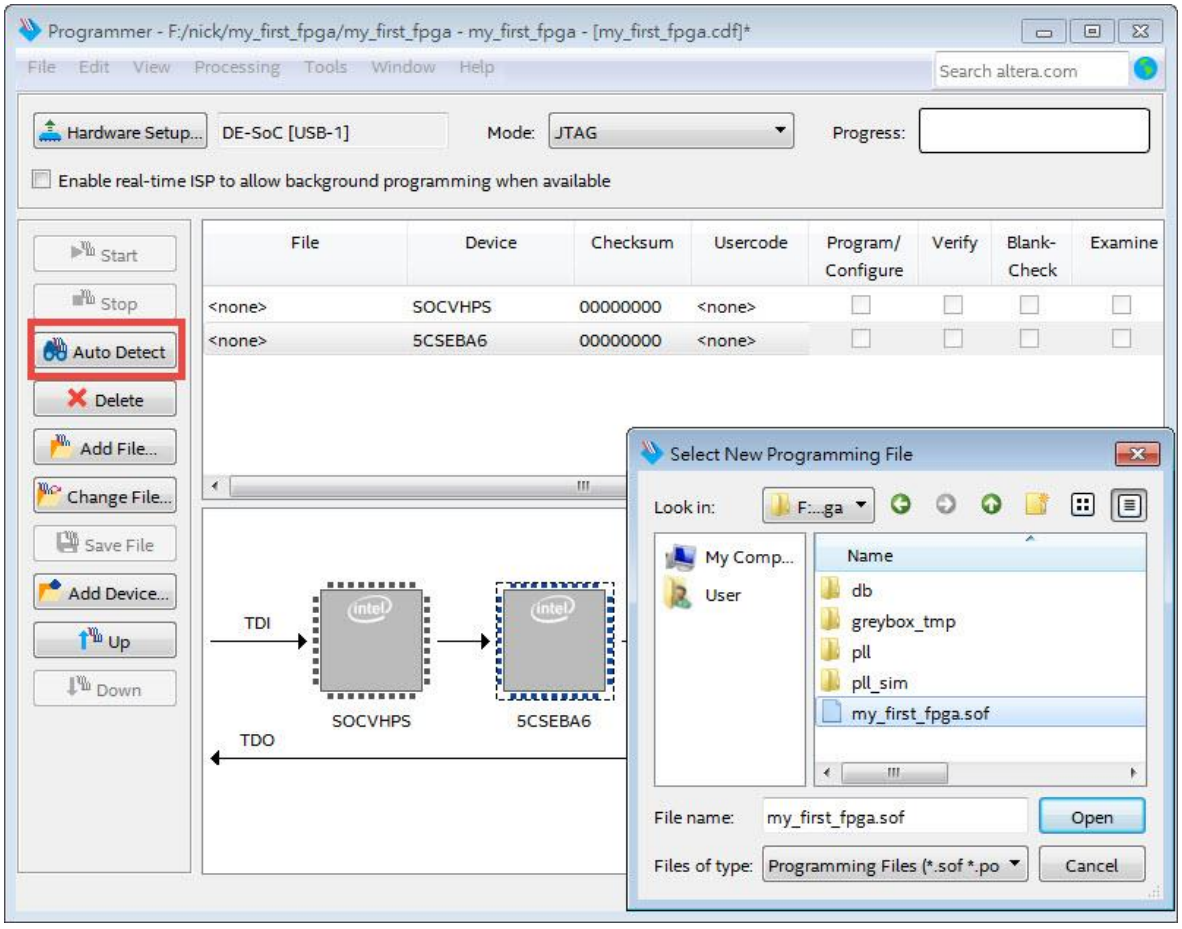


Figure 4-8 Add .sof file

9. Select \<CD directory>\Demonstration\FPGA\my_first_fpga\my_first_fpga.sof

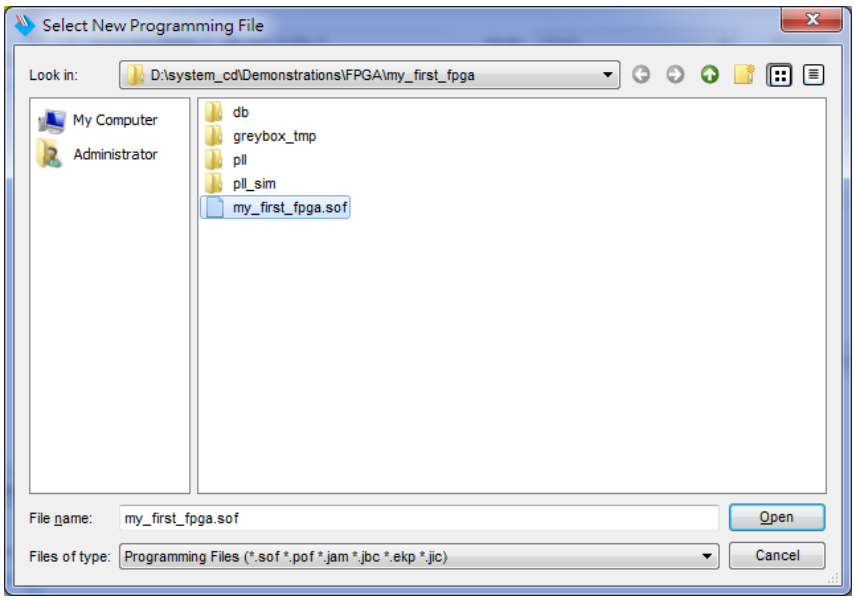


Figure 4-9 Select .sof file

10. Click “Program/Configure” check box, and then click “Start” button to download .sof file into FPGA

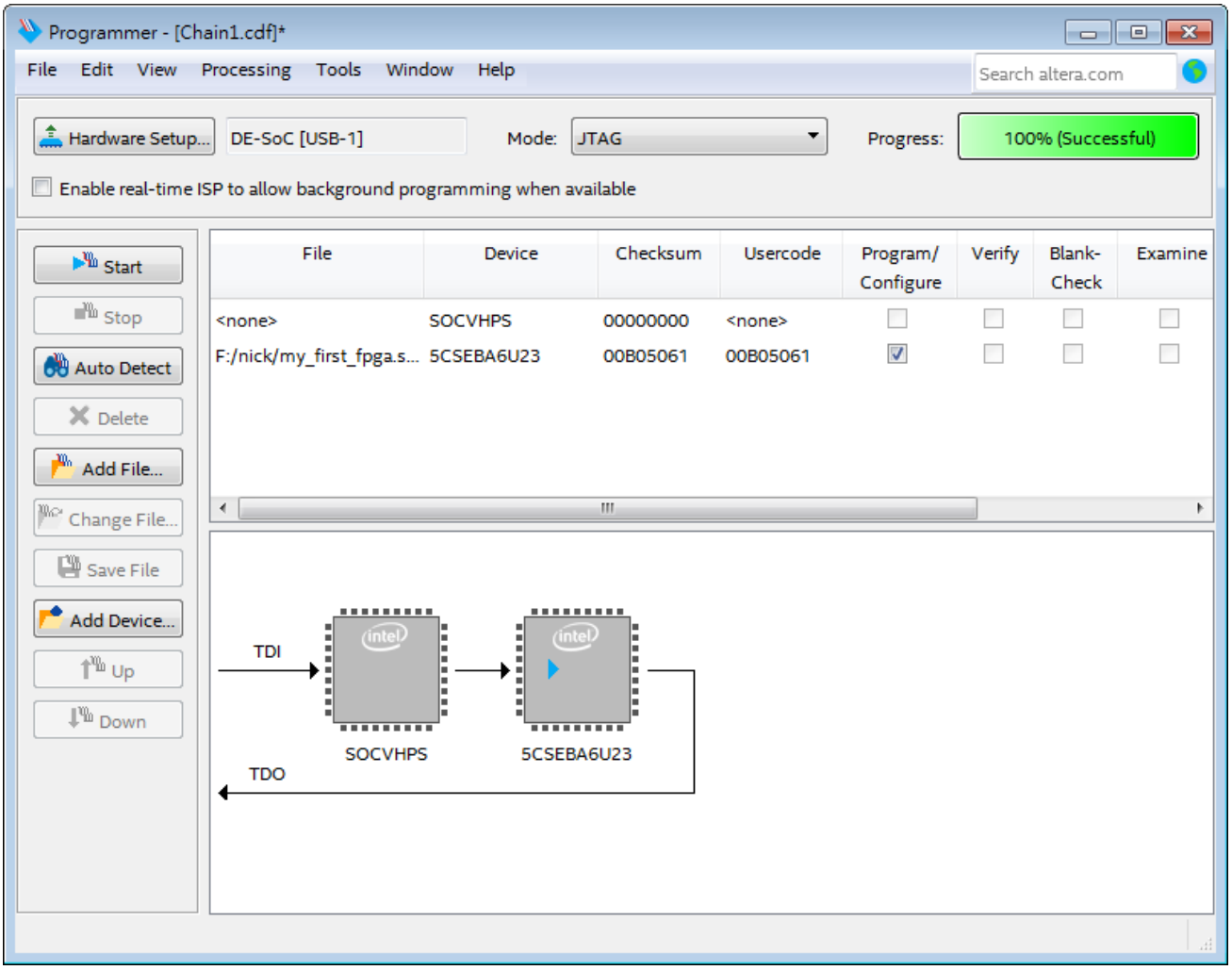


Figure 4-10 Downaload .sof file

Chapter 5

Running Linux on the DE10-Nano board via UART Terminal

5.1 Introduction

This chapter illustrates the process of setting up a UART Terminal and connecting it to DE10-Nano Board which will be running Linux at this moment. Also, the chapter will show how to create a Micro SD card image with another board support image (BSP), such us **Linux Console.** User can download the latest SD Card image file from Terasic's website: http://de10-nano.terasic.com/cd.

5.2 Setting Up UART Terminal

This section presents how to install the drivers for the USB to UART chip on the DE10-Nano board and how to set up the UART terminal on your host PC. The DE10-Nano board communicates with the PC through the micro USB connector J4. You should install the USB to UART driver and configure the UART terminal before you run Linux on the board.

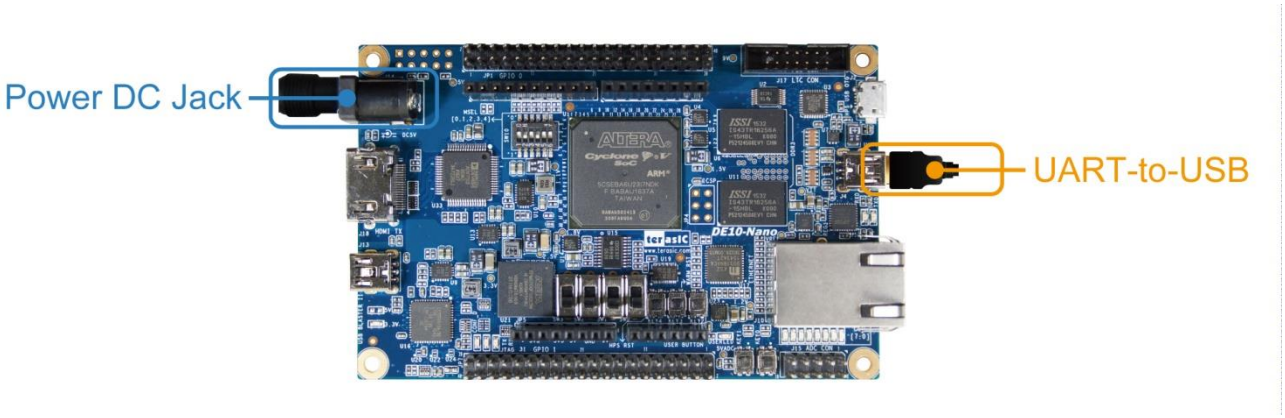


Figure 5-1 Hardware Setup for UART Terminal

■ Installing the Driver

This section explains how to install the drivers for USB to UART communication. The necessary steps on Windows 7 are:

1. Connect your computer to the development board by plugging the USB cable into the **micro USB connector** (J4) of DE10-Nano. (connection shown in **Figure 2-3**)
2. Power on the board and open the computer device manager in Windows. You will find an unrecognized FT232R USB UART.

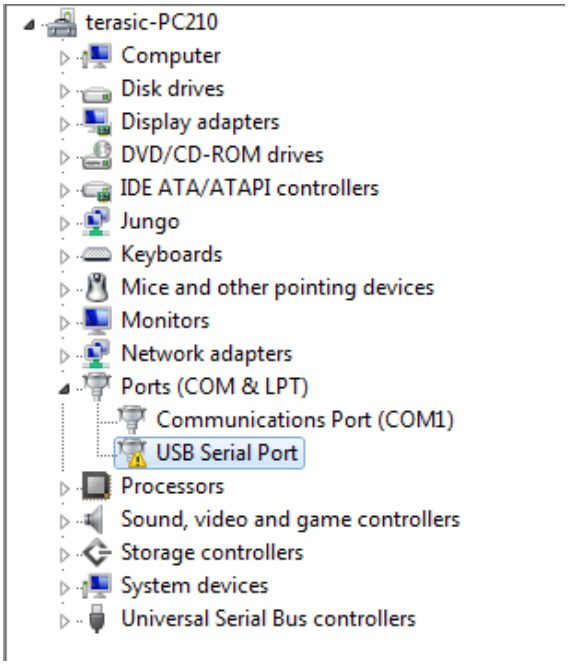


Figure 5-2 Unknown device on device manager

Select the FT232R USB UART to update the driver software. The driver can be downloaded from http://www.ftdichip.com/Drivers/VCP.htm.

3. After the driver has been correctly installed, the USB Serial Port is recognized as a port such as ***COM5*** *(Open the device manager to know which COM port assigned in your computer)*

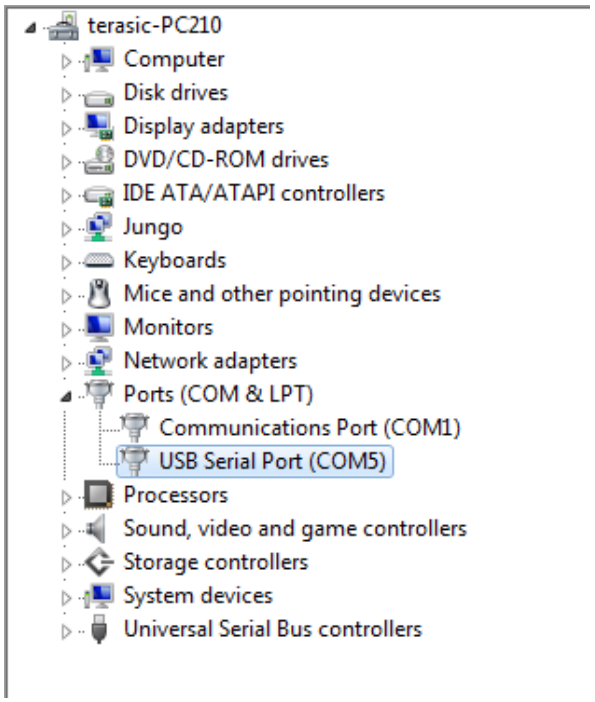


Figure 5-3 USB Serial Poet driver is installed correctly

4. Now you can power off the DE10-Nano board

■ Configure UART terminal UART terminal spec:

- 115200 baud rate
- no parity
- 1 stop bit
- no flow control settings

The following steps shows how to configure a PuTTY terminal window (can be downloaded from the link: http://the.earth.li/~sgtatham/putty/latest/x86/putty.exe)

1. Open putty.exe, click ***Serial*** go to a serial configure interface.
2. Configure the window like the flowing picture and click “save” button to save the configuration.

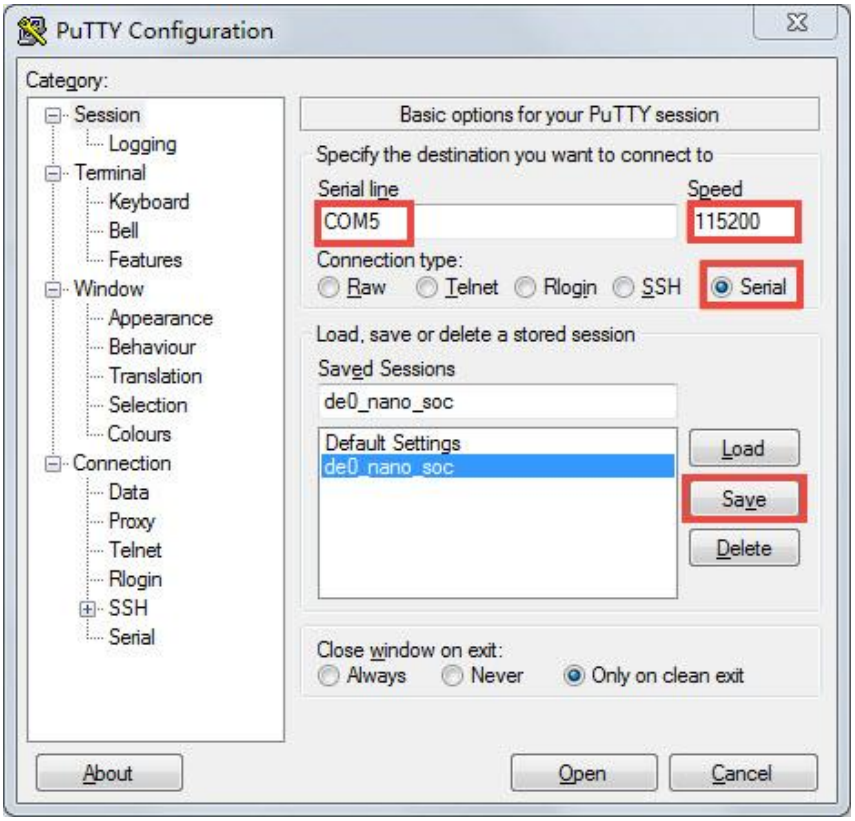


Figure 5-4 Putty Window

5.3 Running Linux on DE10-Nano board

This section presents how to run the pre-built Linux images on the DE10-Nano board. You can run the Linux by following the steps below:

1. Insert the factory microSD card with the pre-built image into the board (See Section 5.4 to prepare a microSD card)
2. Make sure the MSEL switch is set to “MSEL[4:0] = 01010”
3. Power up the board (See **Chapter 2** for details)
4. Open putty.exe, select the saved configuration **de10_nano** and click open button.
5. After the board is successfully booted, the Linux will ask for the login name. Type "**root**" and press the Enter key to skip the password

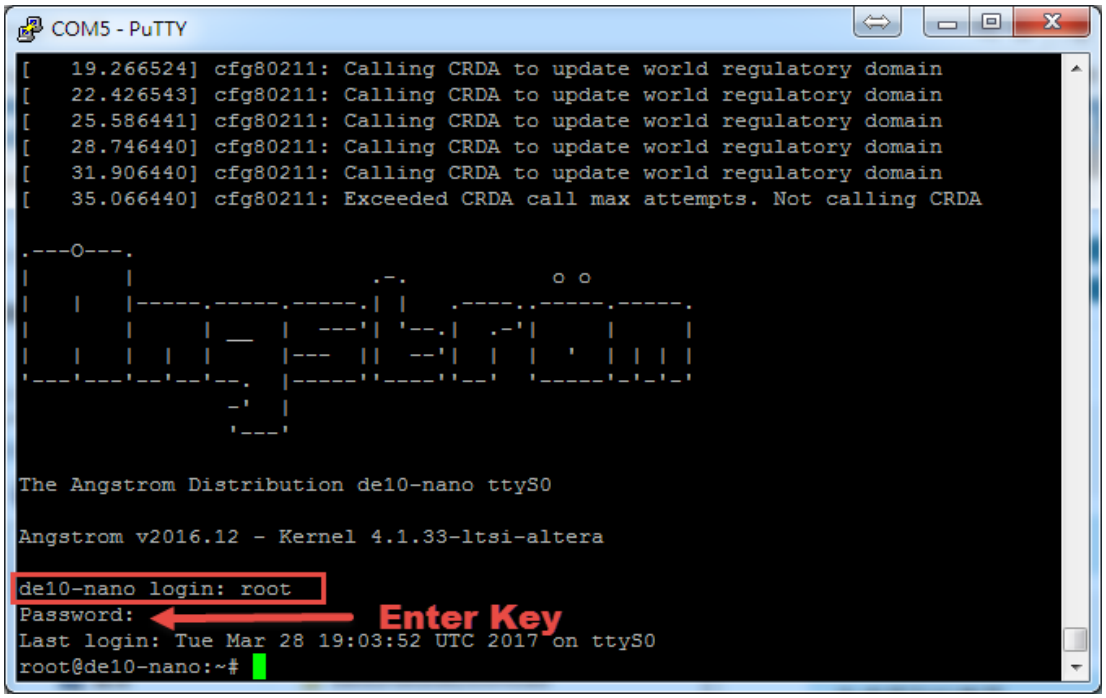


Figure 5-5 Putty Window

5.4 Creating a MicroSD Card Image

To program a microSD card Linux image you can use a free tool called **Win32DiskImager.exe** from http://sourceforge.net/projects/win32diskimager/ on a Windows machine.

■ MicroSD Specification

- Capacity: 8GB minimum
- Speed: Class 4 (at least)

■ Pre-Built SD Card Image

The pre-built binaries are delivered as an archive named DE10_Nano_XFCE.img. This SD card image file contains all the items that are needed to run Linux on DE10-Nano board. (You can download the compressed file from the link: http://www.terasic.com/downloads/cd-rom/de10-nano/linux_BSP/DE10_Nano_Xfce.zip. And extract file to get the image file after the download)

- SPL Pre-loader
- U-boot

- Device Tree Blob
- Linux Kernel
- Linux Root File system

The SD card image file needs to be programmed to a microSD card before it can be used. The steps below present how to create microSD card on a windows machine using Win32DiskImager.exe.

1. Connect the microSD card to a Windows PC
2. Execute Win32DiskImager.exe
3. Select the image file for microSD card
4. Select the microSD card device

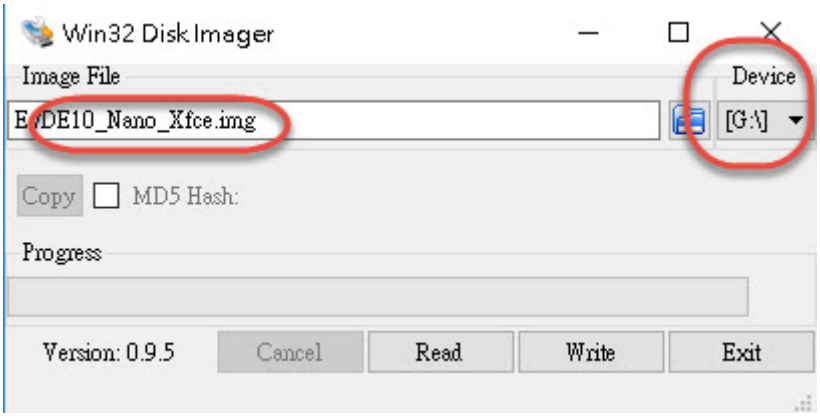


Figure 5-6 Win32 Disk Imager

5. Click “write” to start writing the image file to the microSD card. Wait until the image is successfully written.
6. There is also a Linux console image file which do not have desktop feature; it can be download on the link below: http://www.terasic.com/downloads/cd-rom/de10-nano/linux_BSP/de10_nano_linux_console.zip .
7.

Item	Linux BSP (Board Support Package)/Click to Download	Descriptions
1	DE10_Nano_LXDE.zip	LXDE desktop
2	DE10_Nano_Linux_Console.zip	Without desktop feature
3	DE10_Nano_Xfce.zip	Factory Image

Chapter 6

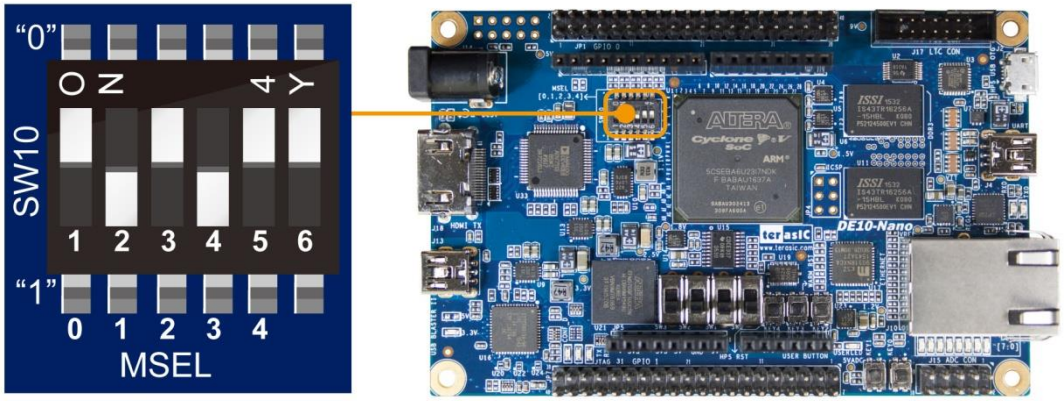
Running Web Server on the DE10-Nano

6.1 Introduction

Chapter 6 describes how to run the web server on the DE10-Nano. Users can connect the DE10-Nano to a computer via the micro USB cable and interact with the board through the website. The website will guide you through the steps of learning about the board from evaluation to full development. Next, we will describe how to run it on Windows OS as below. (In section 6.2, we will have detail descriptions on how to run the DE10-Nano on Window OS.)

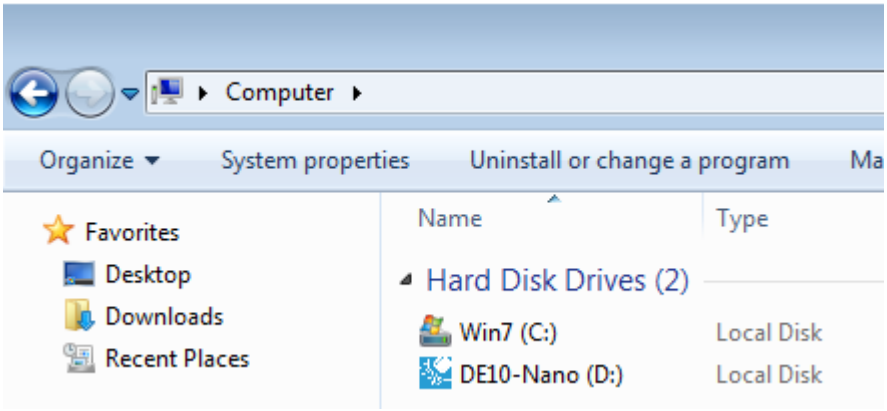
6.2 Hardware Setup and Driver Install

1. Make sure the Factory MircoSD card is inserted into the MircoSD card socket on the board and the MSEL[4:0] switch is set to “01010”.

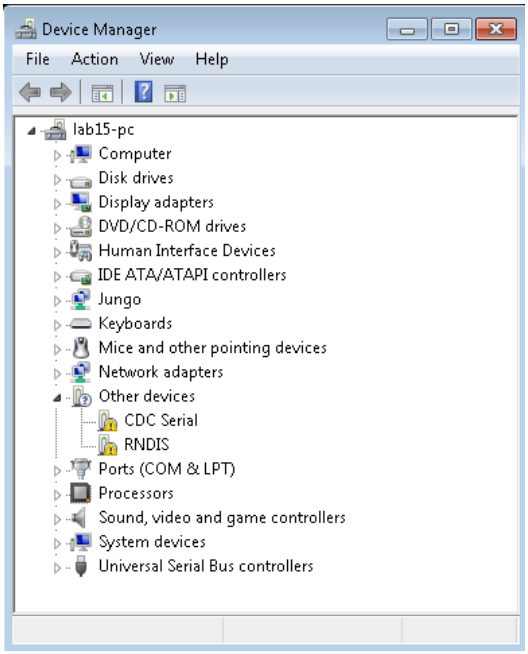


2. Use the Micro USB cable to connect the USB connector on the DE10-Nano board to a USB port on a computer. Once they are connected, plug in the 5-volt power adapter to power up the board.

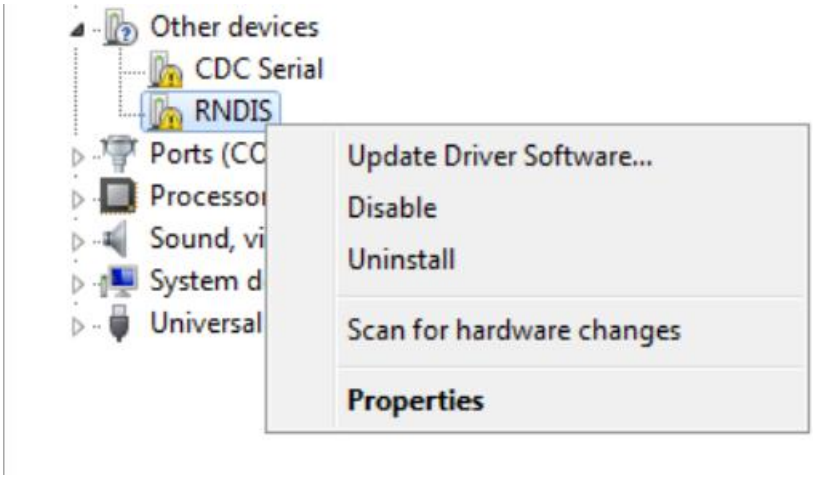
3. After they are connected, the DE10-Nano will display a USB Flash Drive feature in windows. The "**DE10-Nano"** will be shown in the Hard Disk Drives. The drivers and the web server related data will be used in the following steps.



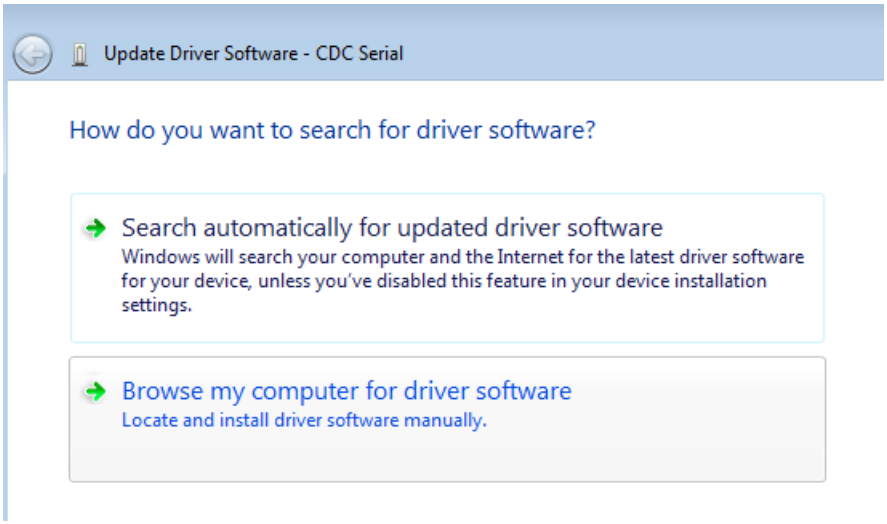
4. Your computer's Device Manger will automatically detect unknown devices.



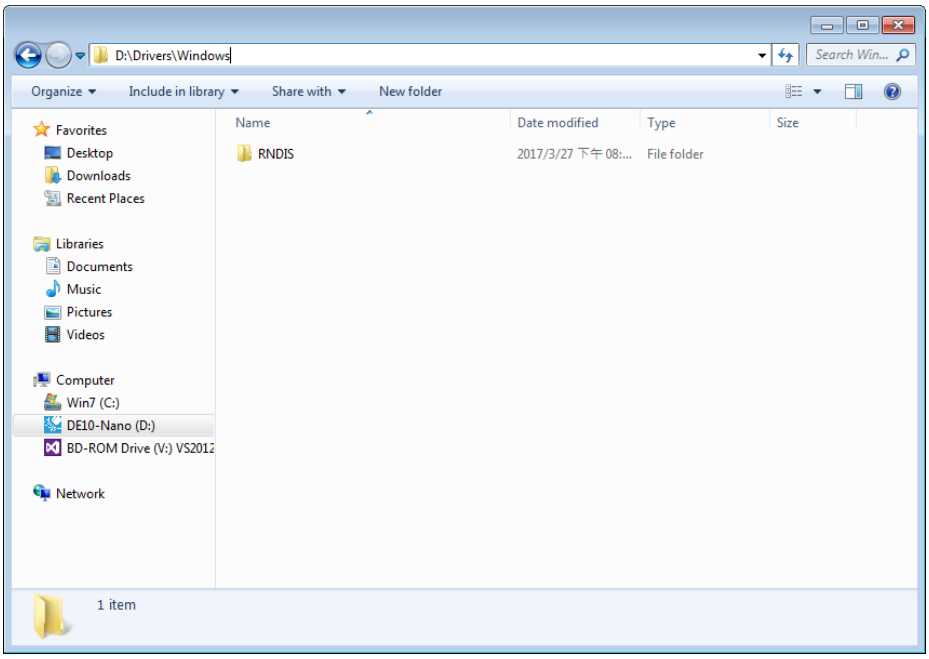
5. Right click unknown device, and select "**Update Driver Software**."



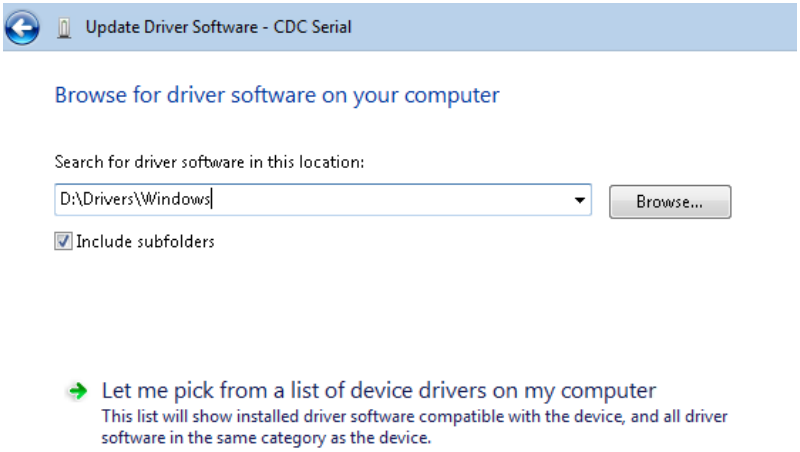
6. Choose "**Browse my computer for driver software**."



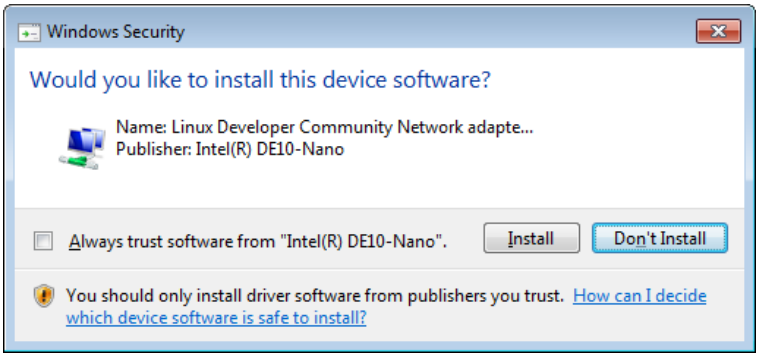
7. The driver for unknown devices is in the "**DE10-Nano.**"



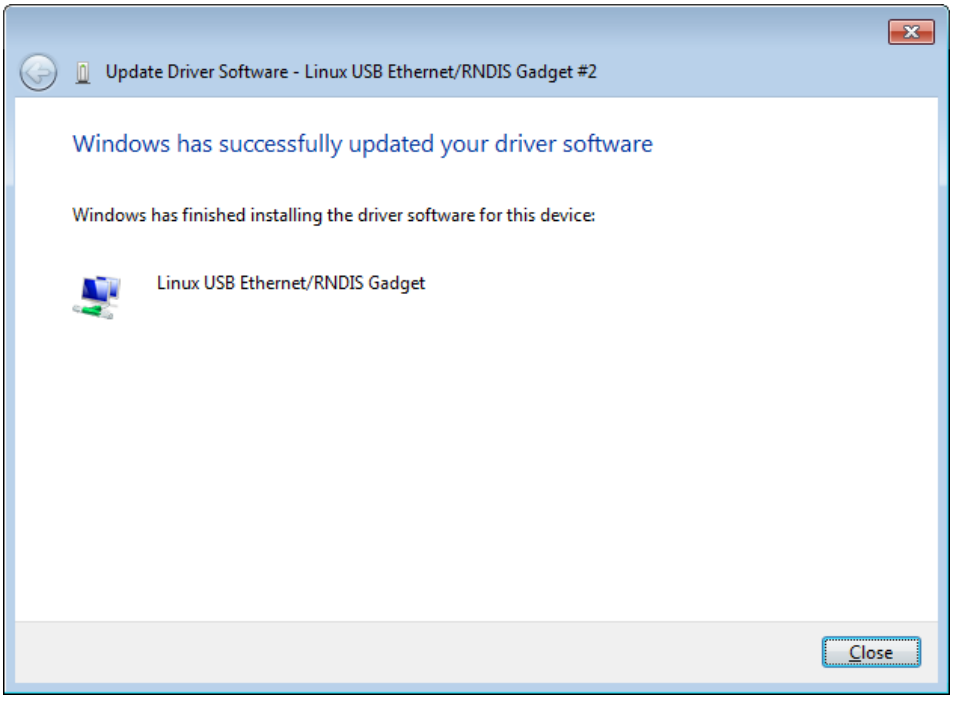
8. Choose "**Drivers\Windows**" in **DE10-Nano** when browse for driver software in the installation location.



9. Choose "**Install**."

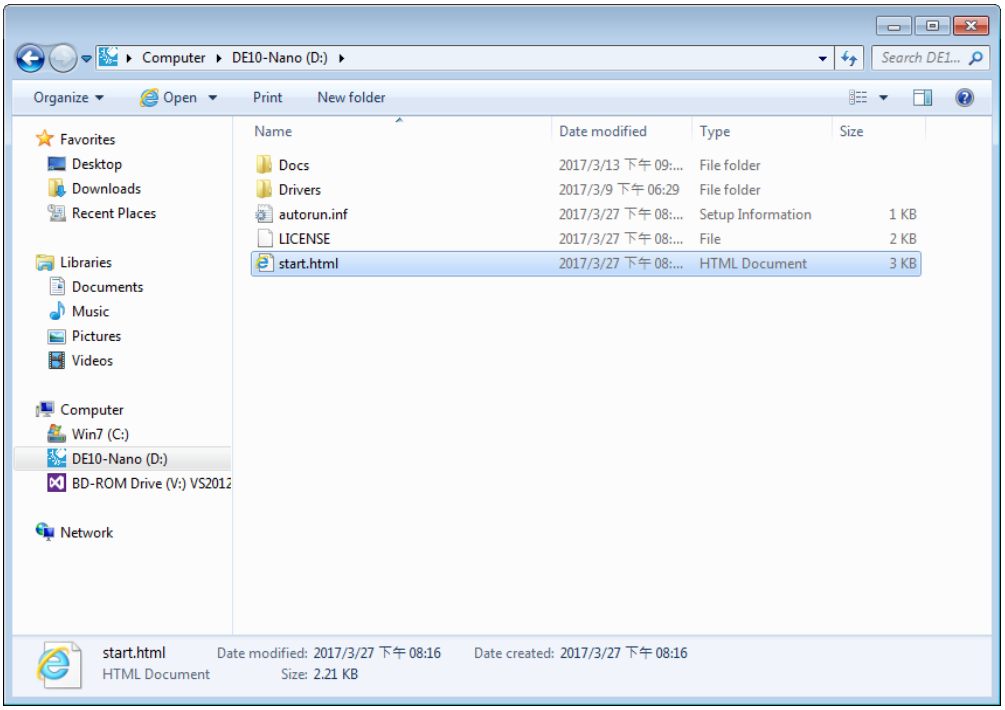


10. Complete the "**Gadget Serial**" installation.

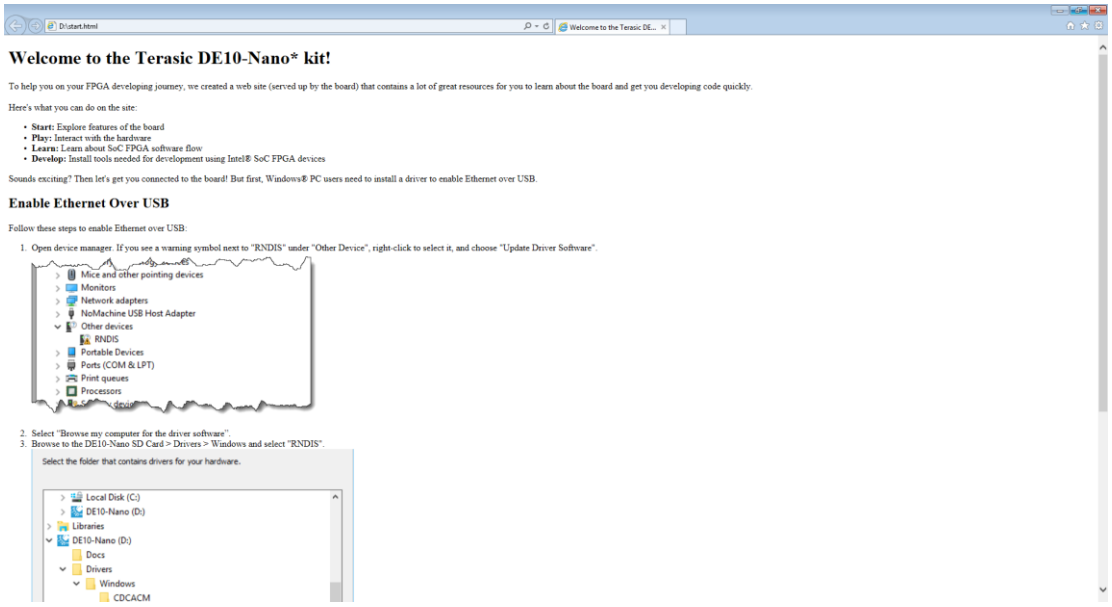


6.3 Using the Web Server

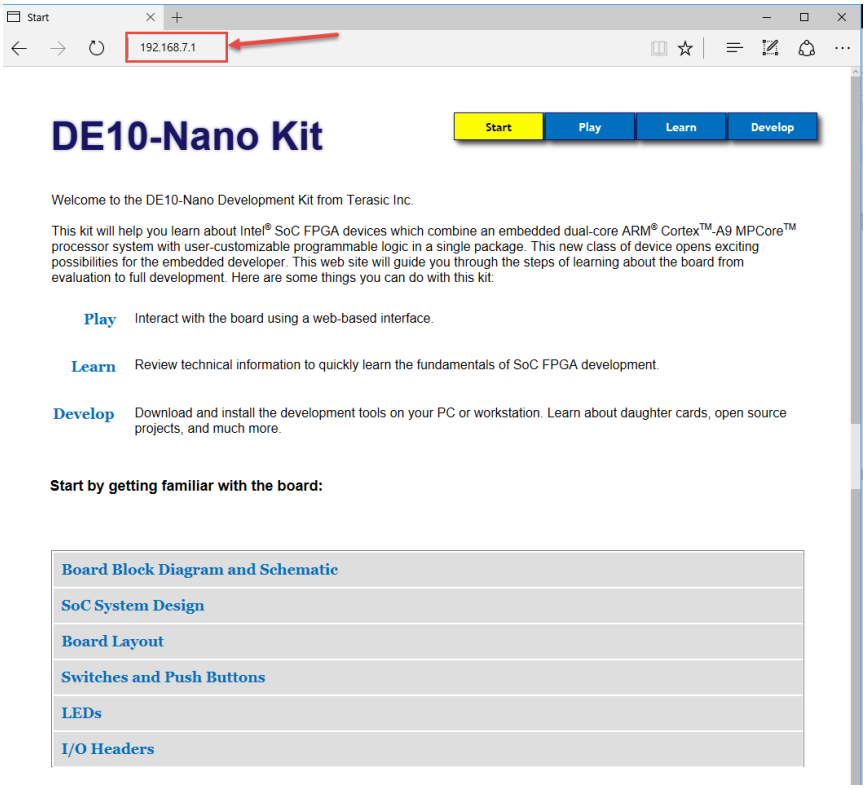
1. Users can use the web server after the drivers have been installed. Open the **DE10-Nano** and execute the start.html file.



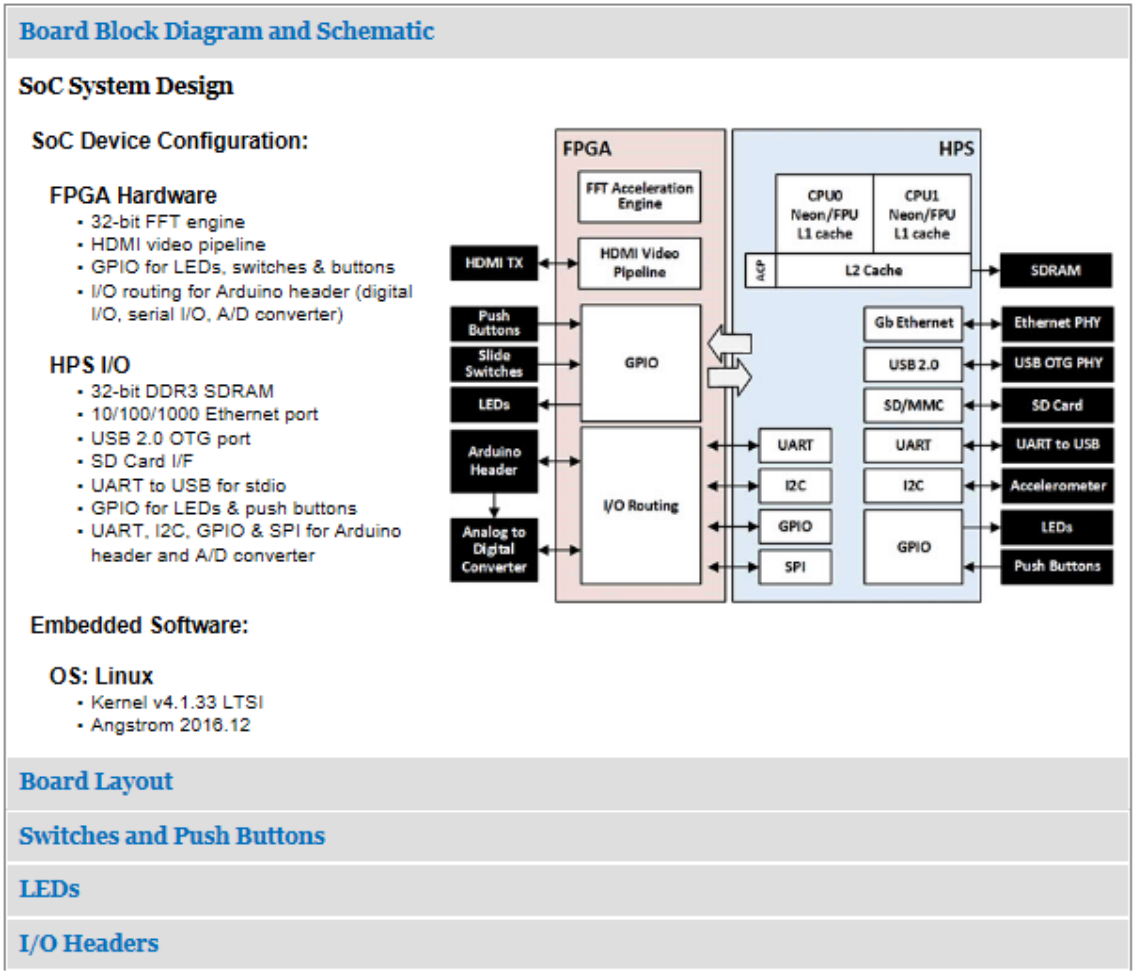
2. This webpage provides step-by-step procedure to guide users to install driver for USB Ethernet/RNDIS Gadget just like section 6.1. Users can enter "**192.168.7.1"** into browser and connect to the website served by the board.



3. Open the web server in the DE10-Nano; users can choose any pages to operate.

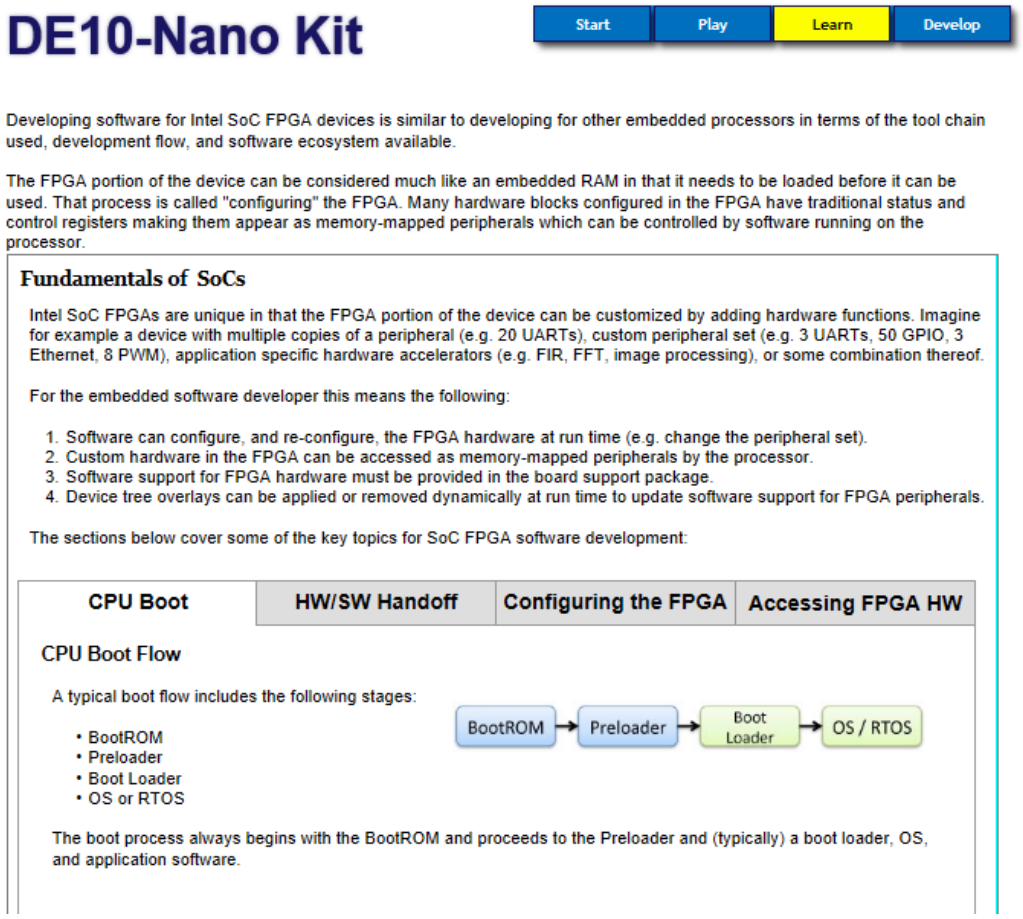


The "**Start**" page provides hardware data of the DE10-Nano board, such as Circuit diagram, Block diagram, and pin assignments of the peripherals.

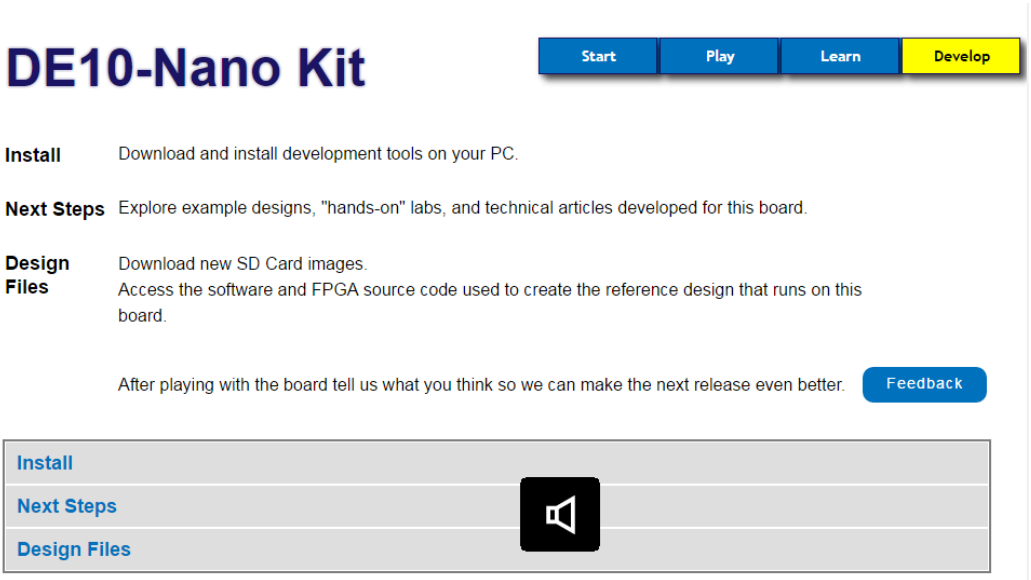


4. Enter the "**Play**" page, users can interact with the board in this page. For example, control the LEDs lights (turning lights on and off).

5. The “Learn” page contains the related documents and tools of SoC FPGA.



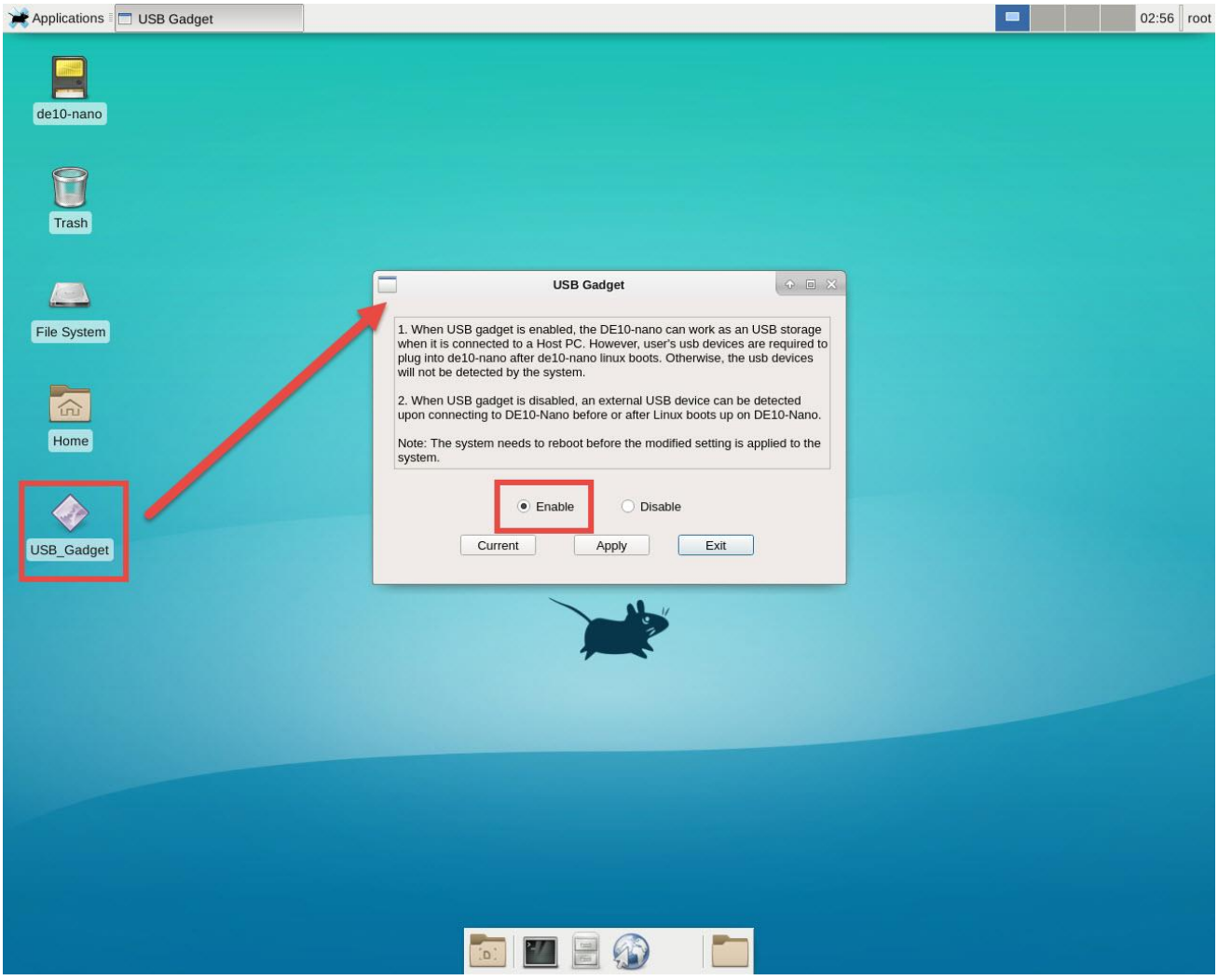
6. The “Develop” page provides users the download location for the DE10-Nano software.



6.4 Enable/Disable USB Gadget

Use can use the above features only when the USB Gadget function is enabled in the Xfce Desktop. When the USB gadget is enabled, the DE10-Nano acts as a USB storage after it is connected to a host PC.If it is unusable, please follow below steps to check if the USB Gadget is disabled:

1. Boot up the DE10-Nano with the Xfce Desktop.
2. Execute the USB_Gadget icon on the desktop.
3. Check if the USB Gadget is Enable.
4. Note that, any modified setting will be applied after the system is reboot.



Additional Information

Contact Terasic

Users can refer to the following table for technical support and more information of Terasic and our product:

Contact	Contact Method	Address
Technical Support	Email	support@terasic.com
	Website	www.terasic.com
	Address	9F., No.176, Sec.2, Gongdao 5th Rd, East Dist, Hsinchu City, 30070. Taiwan, 30070
Training Opportunity	Website	http://www.terasic.com.tw/cgi-bin/page/archive.pl?Language=English&No=200
Product Information	Website	http://www.terasic.com.tw/cgi-bin/page/archive.pl?Language=English&CategoryNo=13&List=Simple

Revision History

Date	Version	Changes
2017.01	V1.0	First Version
2017.02	V1.0.1	Update SD card download link
2017.03	V1.1	Change Default Linux image to Xfce desktop
2019.04	V1.2	Modify software download link
2019.05	V1.3	Delete step 2 in section 2.4