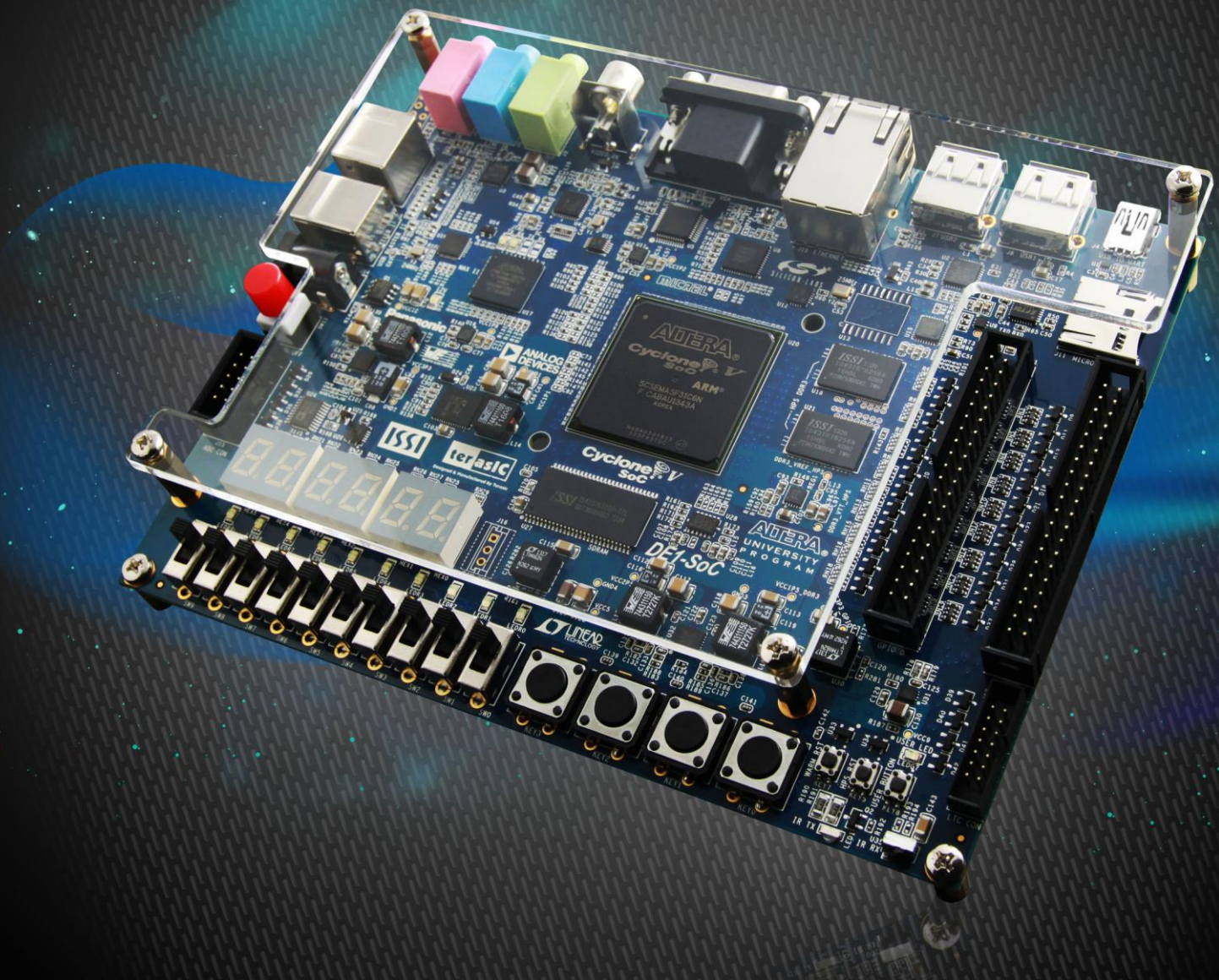
DE1-SoC

Getting Started Guide



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CONTENTS

Chapter 1

About this Guide

The DE1-SoC 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 DE1-SoC board. The main topics that this guide covers are listed below:

- Software Installation: Installing Quartus II and SoC EDS
- Development Board Setup: Powering on the DE1-SoC
- Perform FPGA System Test: Downloading a FPGA SRAM Object File (.sof)
- Running Linux on DE1-SoC Board

Chapter 2

Software Installation

2.1 Introduction

This section explains how to install the following software:

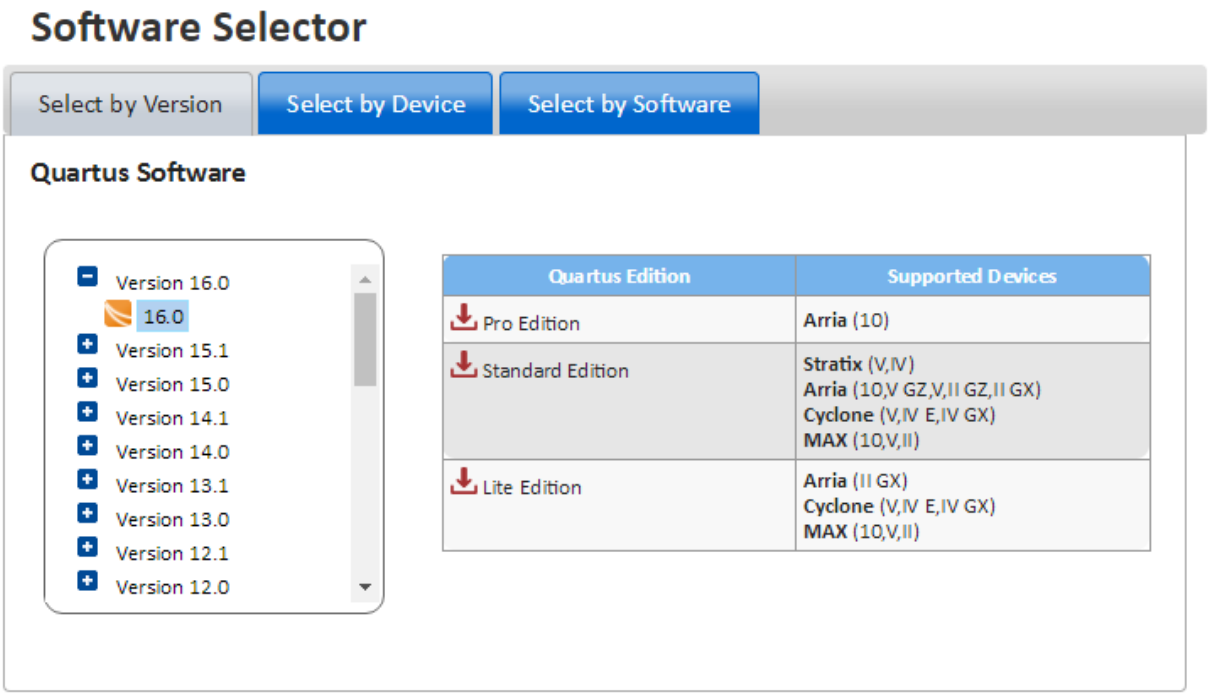
- Intel Quartus II software
- Intel SoC Embedded Design Suite

Note: 64-bit OS required

2.2 Installing Quartus II software

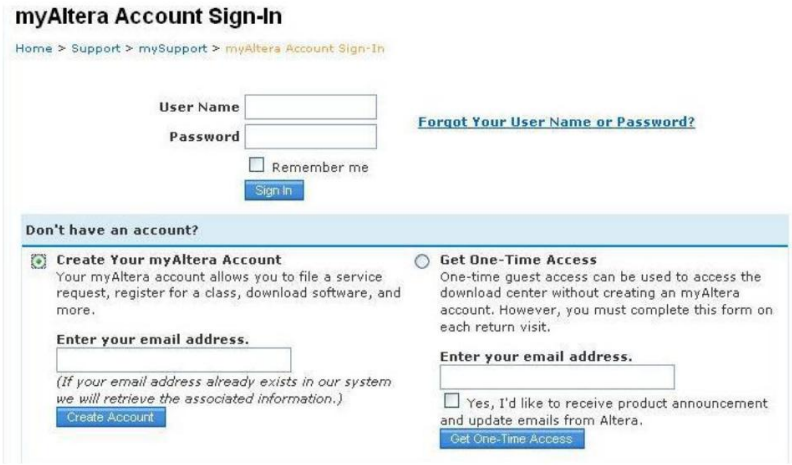
The Intel Complete Design Suite provides the necessary tools used for developing hardware and software solutions for Intel FPGAs. The Quartus II software is the primary FPGA development tool used to create reference designs along with the Nios II soft-core embedded processor integrated development environment

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



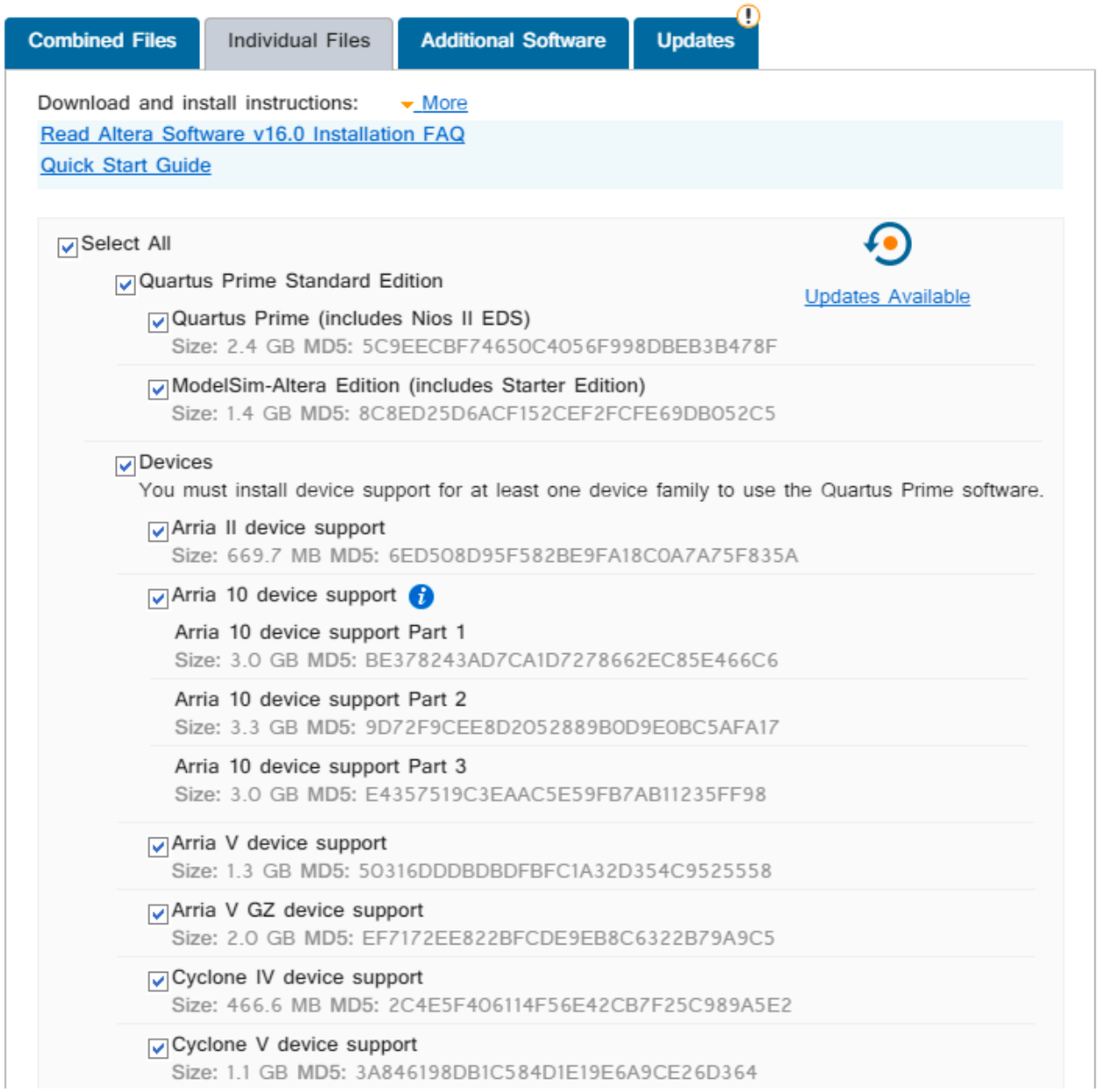
- If you choose to install the Standard Edition, please note that a purchased license will be required. Please go to the following link for more information: https://www.Intel.com/support/support-resources/download/licensing.html

- Select the latest software version for Subscription Edition or web Edition will into "myIntel Account Sign-In" page



- Use your existing login, or get a one-time Access.

- Download files from subscription or web 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 on the computer, select the *.exe file, and install the software. All of the defaults are to be used.

2.3 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://fpgasoftware.intel.com/soceds/

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/www/us/en/software/programmable/soc-eds/getting-started.html

Chapter 3

Development Board Setup

3.1 Introduction

The instructions in this section explain how to set up the DE1-SoC development board. The following pictures show the board overview of DE1-SoC board.

3.2 Default MSEL Settings

The FPGA Configuration Mode Switch (MSEL) shown in **Figure 3-1** is by default set to 10010 (MSEL[4:0] = 10010). The setting corresponds to FPGA working in Asx4 mode.

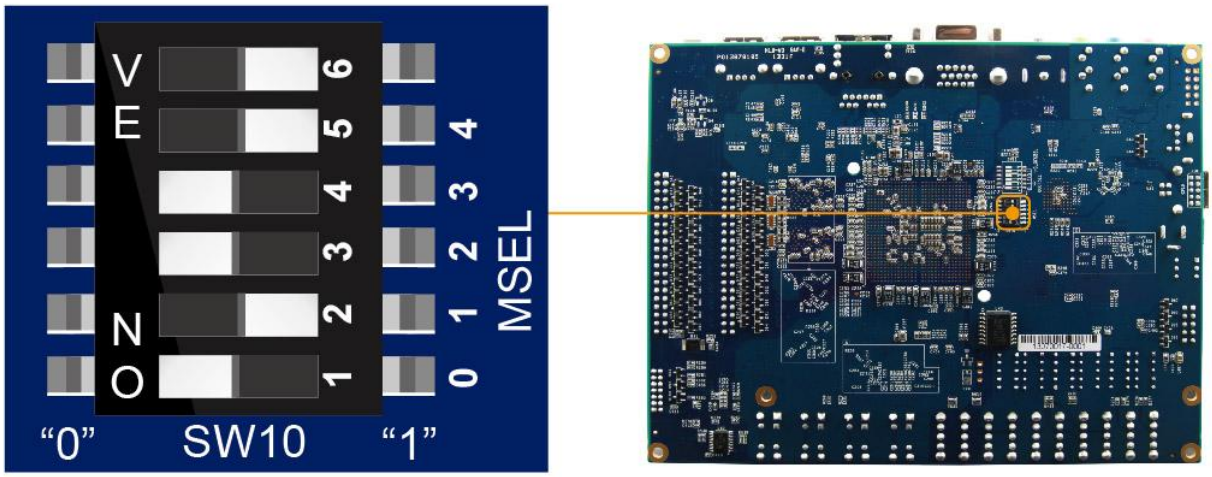


Figure 3-1 FPGA Configuration Mode Switch set in Asx4 Mode

3.3 USB and Power Cables

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

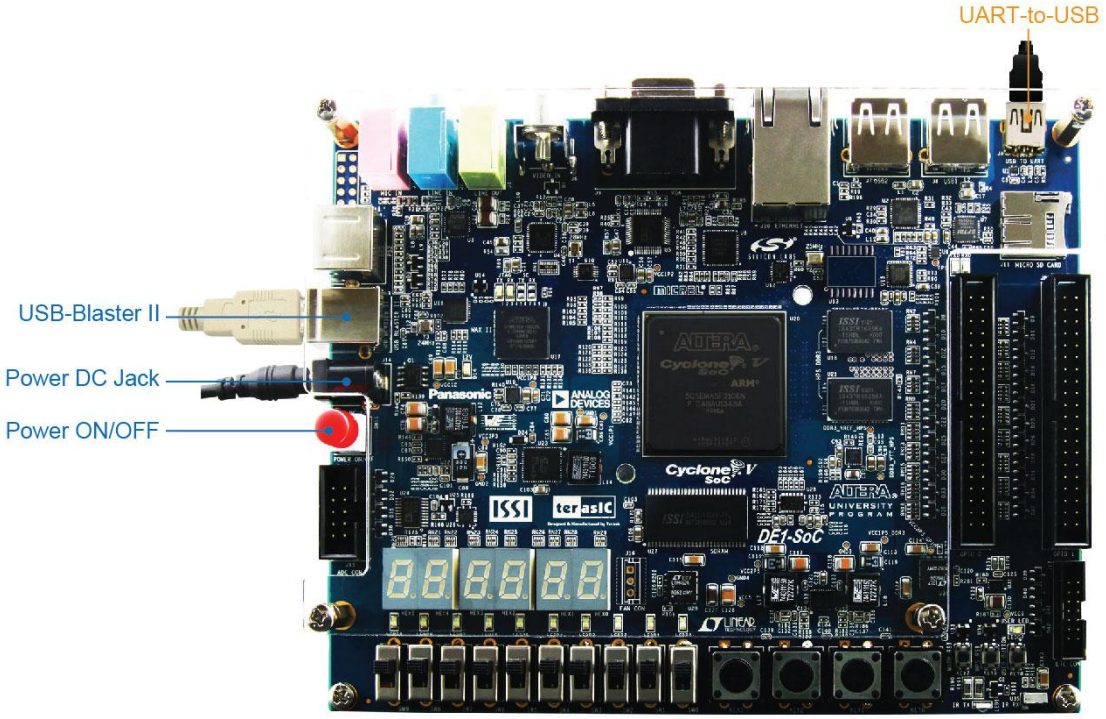


Figure 3-2 USB and Power Cables

3.4 Powering up the DE1-SoC Board

To power-up the board, perform the following steps below:

1. Connect the provided power cord to the power supply and plug the cord into a power outlet (verify the voltage supplied is the same as the specification on the power supply).

2. Connect the supplied DE1-SoC power adapter to the power connector (J14) on the DE1-SoC board. Press the power button (SW11). At this point, you should see the 12V indicator LED (D14) turned on.

Chapter 4

Performing a FPGA System Test

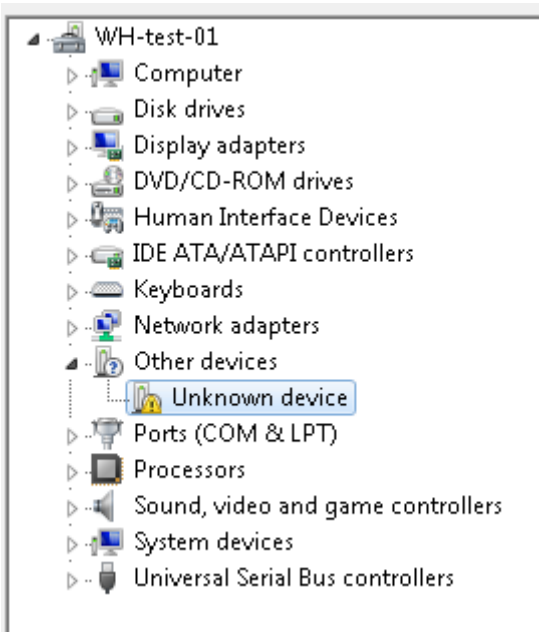
4.1 Introduction

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 how to install the USB-Blaster II driver.

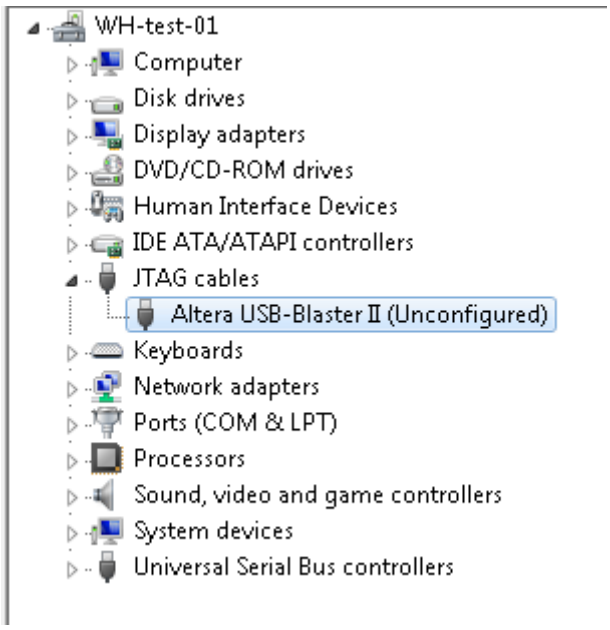
2. Connect your computer to the development board by plugging the USB cable into the USB connector (J13) of DE1-SoC (connection shown in **Figure 3-2**)
3. Power up the board and open the device manager in Windows. You will find an unknown device.



4. Select the unknown device to update the driver software. The driver file is in the \<Quartus II

installation directory>\drivers\ usb-blaster-ii directory.

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

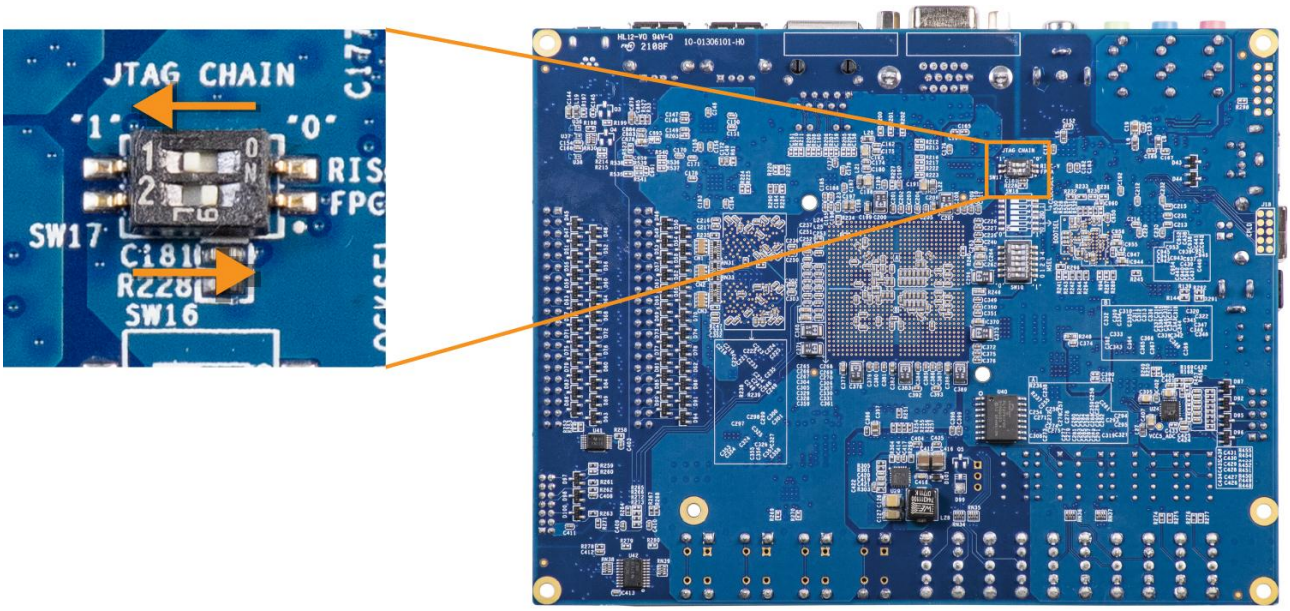


4.3 Downloading a FPGA SRAM Object File

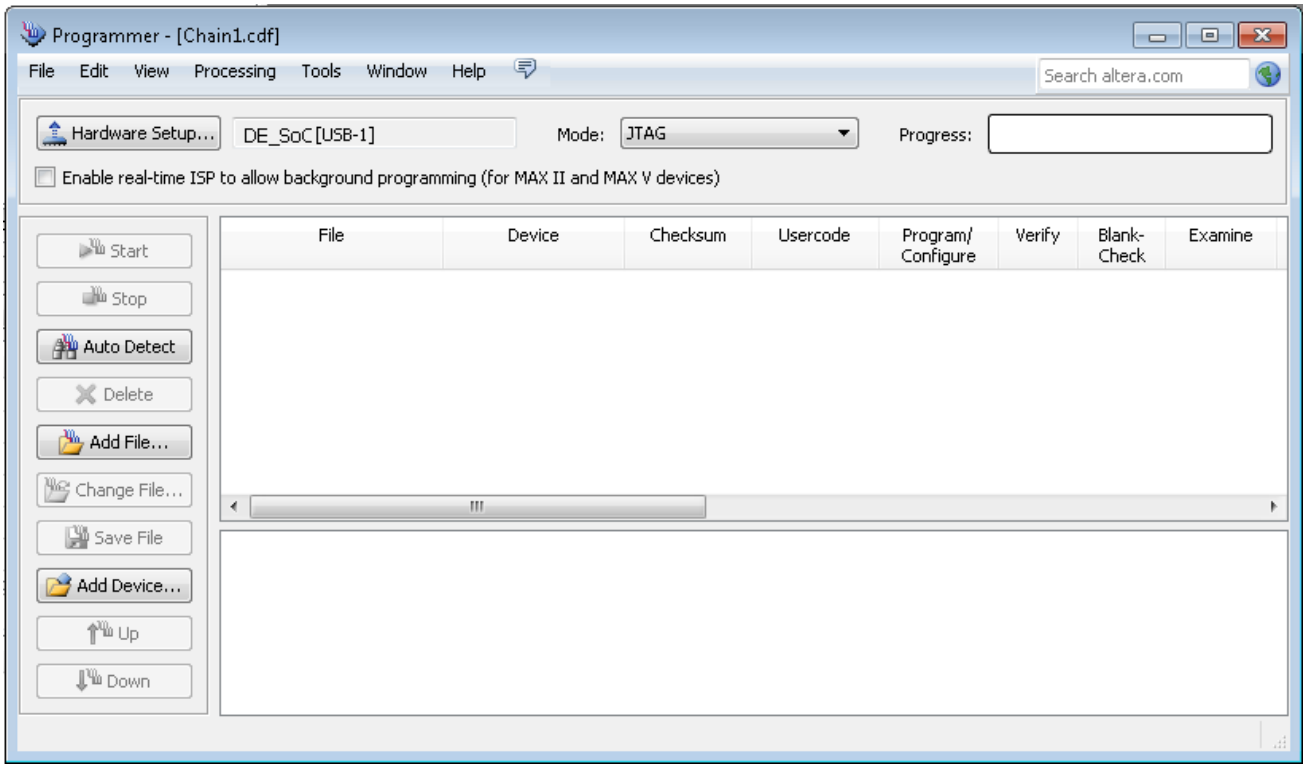
The Quartus II Programmer is used to configure the FPGA with a specific .sof file. Before configuring the FPGA, ensure that the Quartus II software and the USB-Blaster II driver are installed on the host computer.

If users would like to program their SRAM Object File (.sof) into the Cyclone V SOC FPGA device on the DE1-SoC board, There are two devices (FPGA and HPS) on the JTAG Chain, the configure flow is different from the one used with DE1. The following shows the programming flow with JTAG mode step by step.

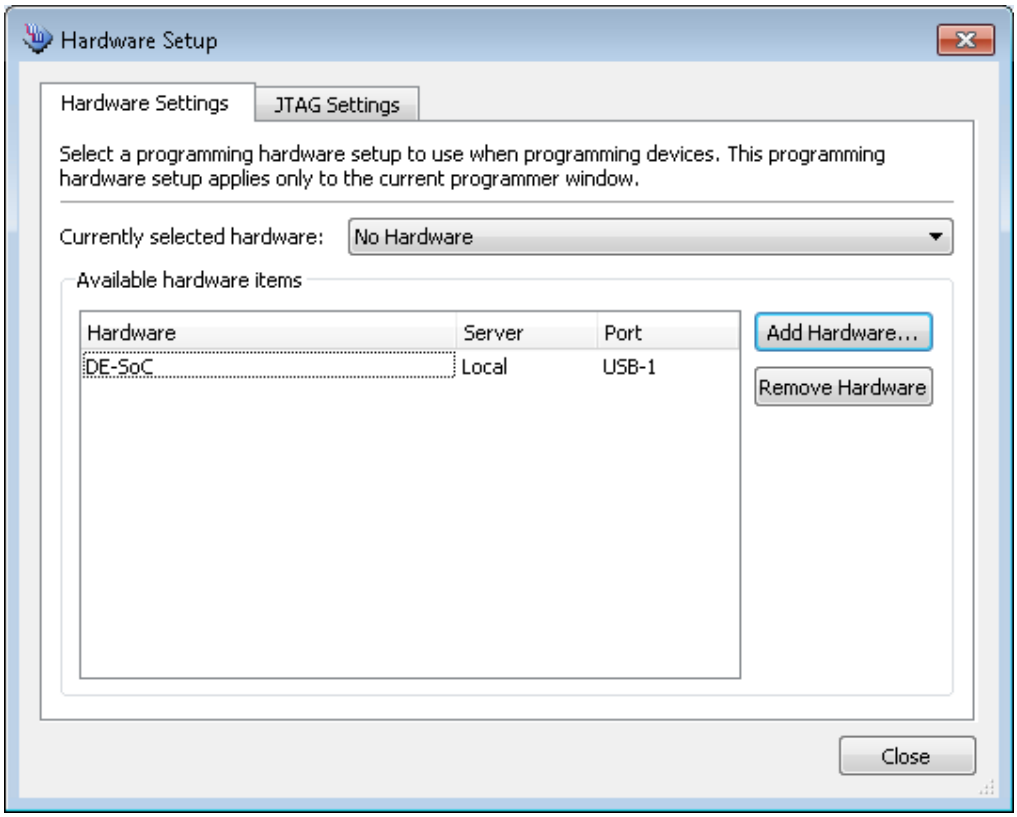
1. Make sure the JTAG switch SW17 is set to FPGA in chain: SW17.1=1; SW17.2=0.



2. Connect your computer to the DE1-SoC board by plugging the USB cable into the USB connector (J13) of DE1-SoC and power up the board (details shown in **Chapter 3**)
3. Open the Quartus II software and select Tools > Programmer. The Programmer window will appear.

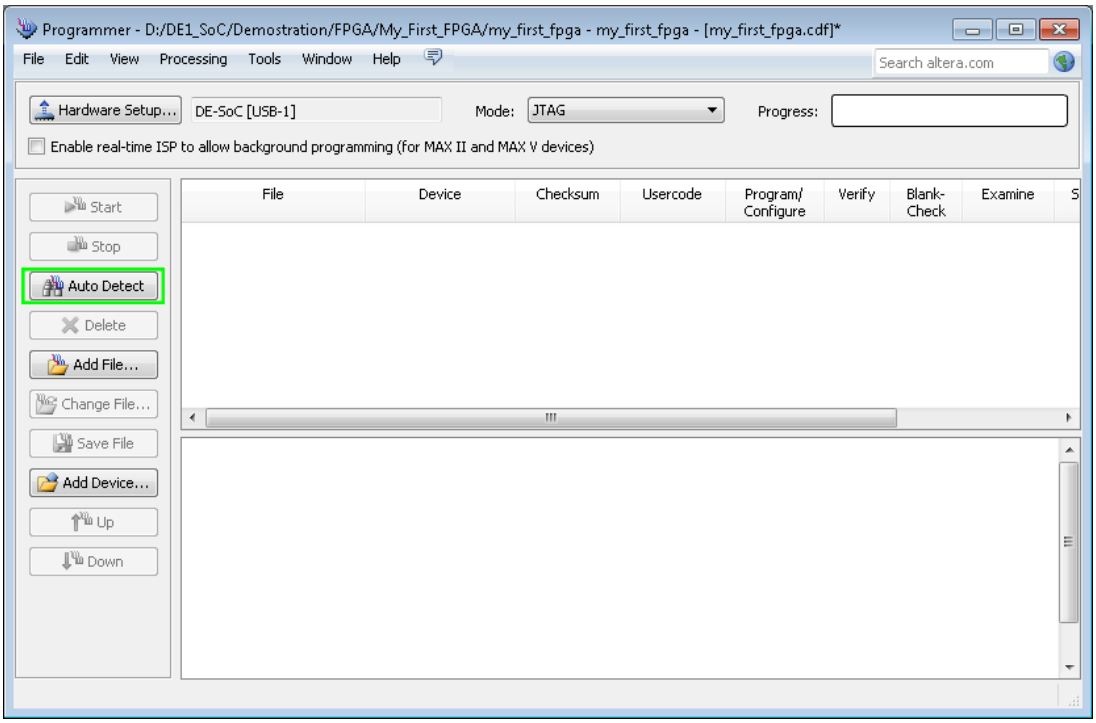


4. Click Hardware **Setup**.
5. If **DE-SoC [USB-1]** does not appear under **Currently Selected Hardware**, select that option and click **Close** as shown below.

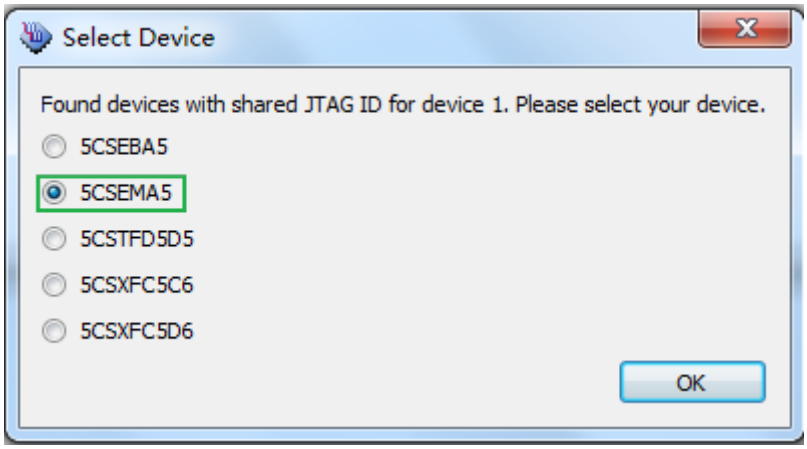


If the USB-Blaster II does not appear under hardware options list, please confirm if the USB-Blaster II driver has been correctly installed, and the USB cable has been properly connected between the DE1-SoC board and host computer.

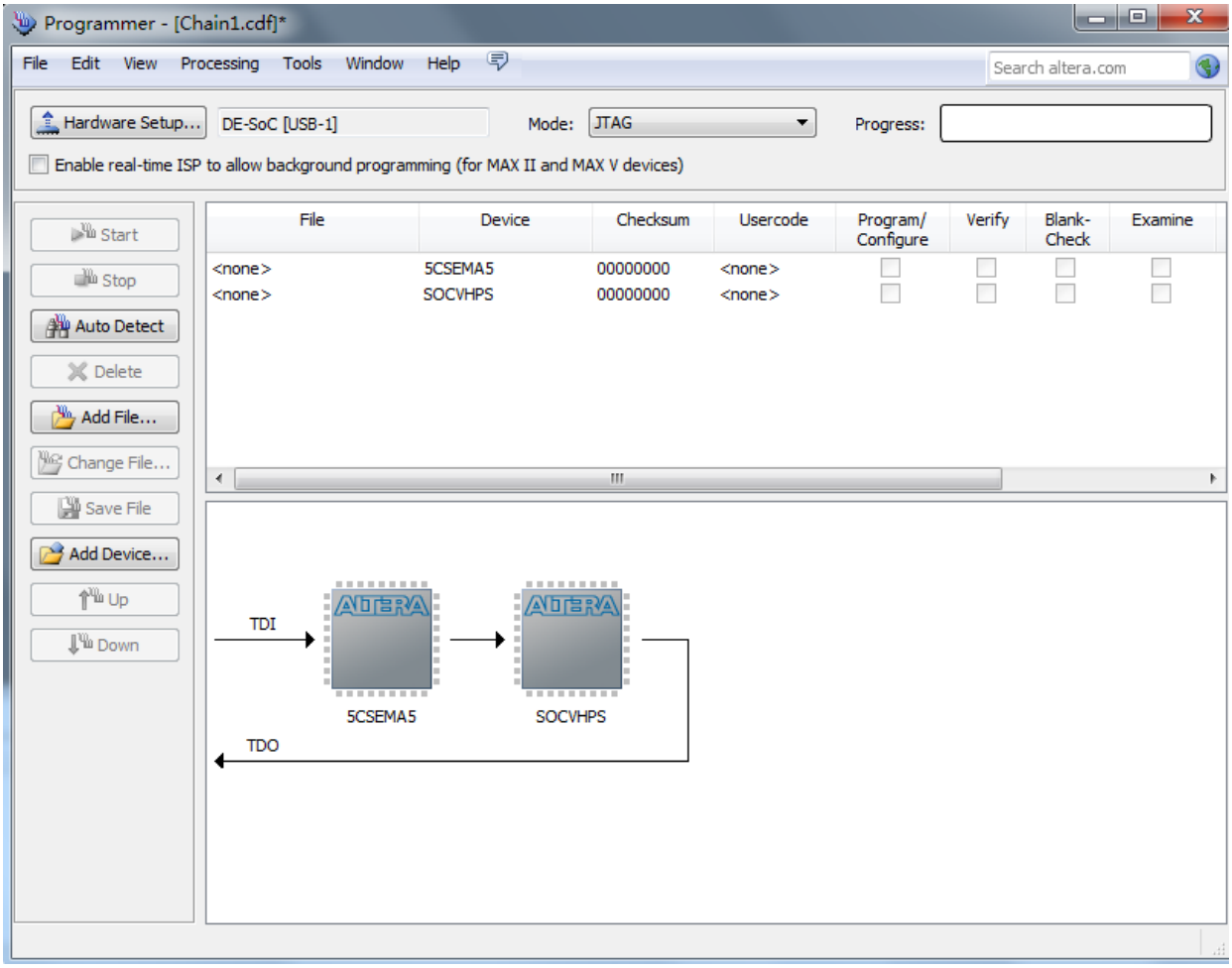
6. Click “Auto Detect”.



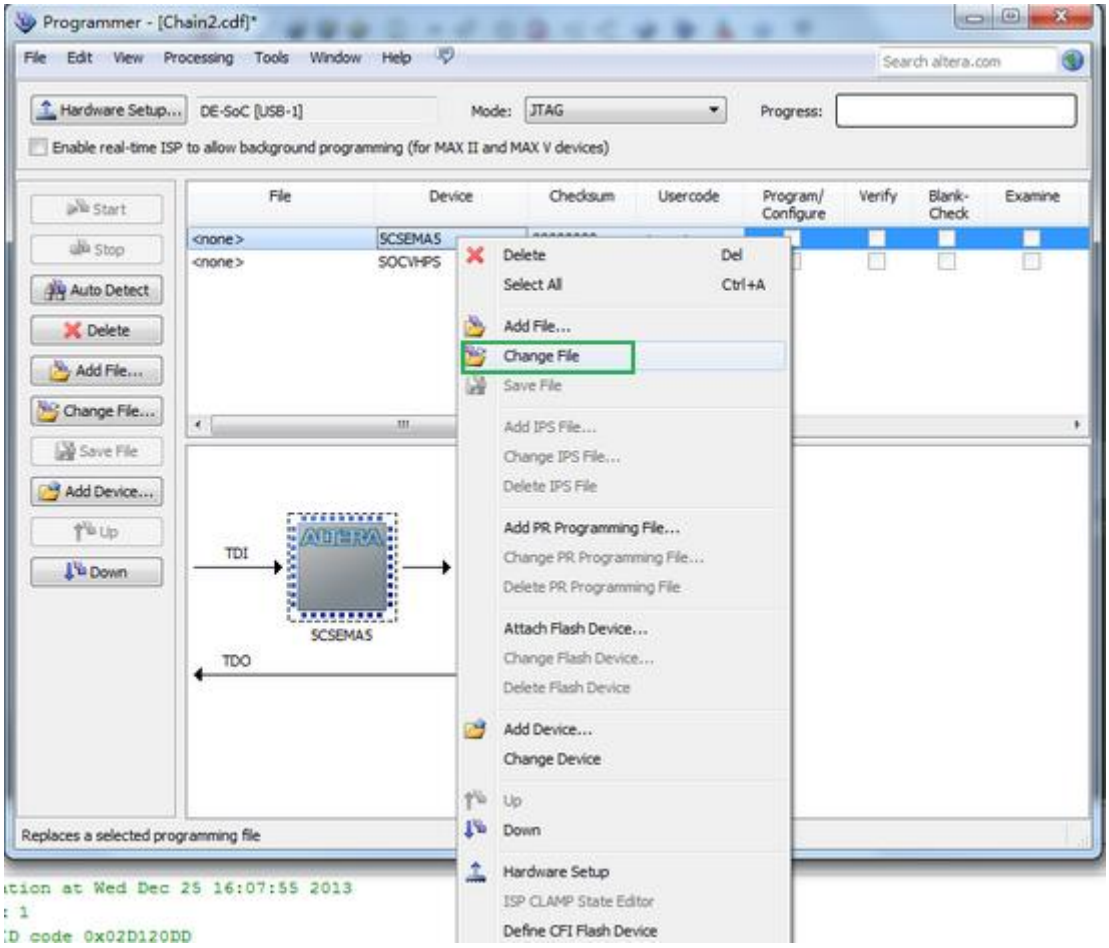
7. Select the device associated with the board



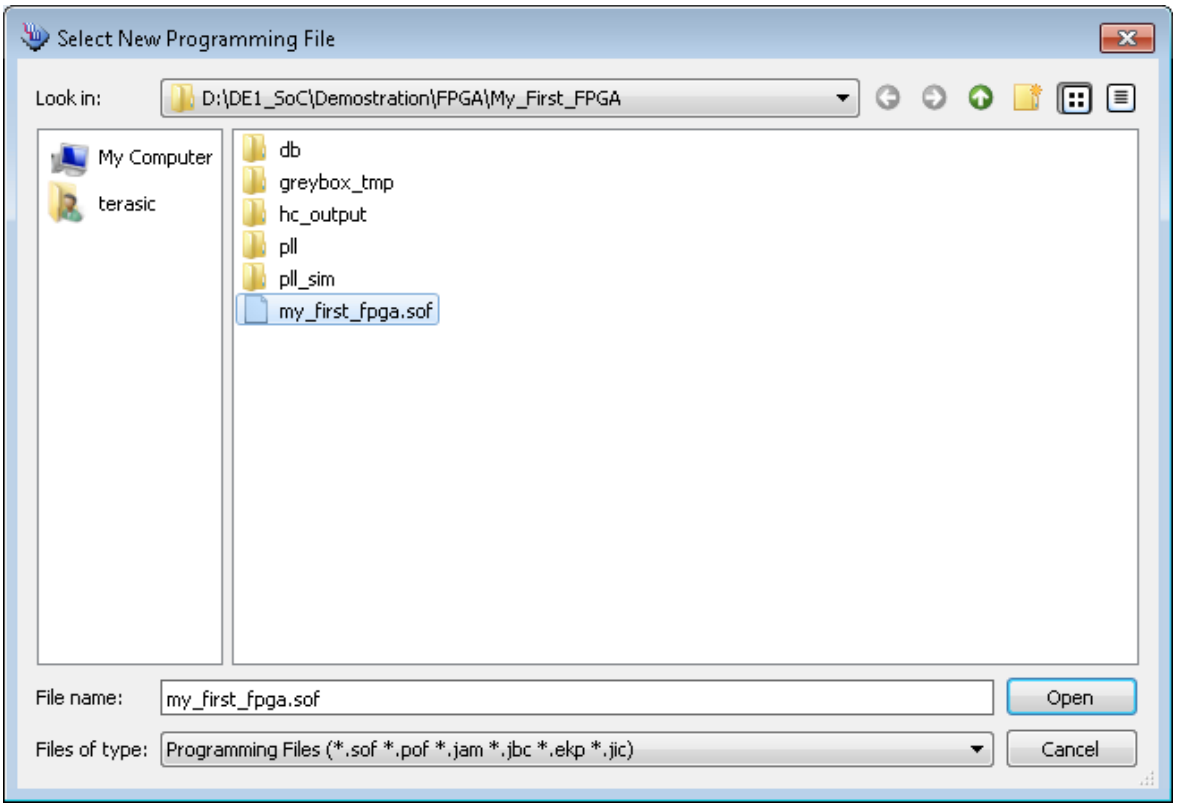
8. FPGA and HPS devices are all show in the jtag chain.



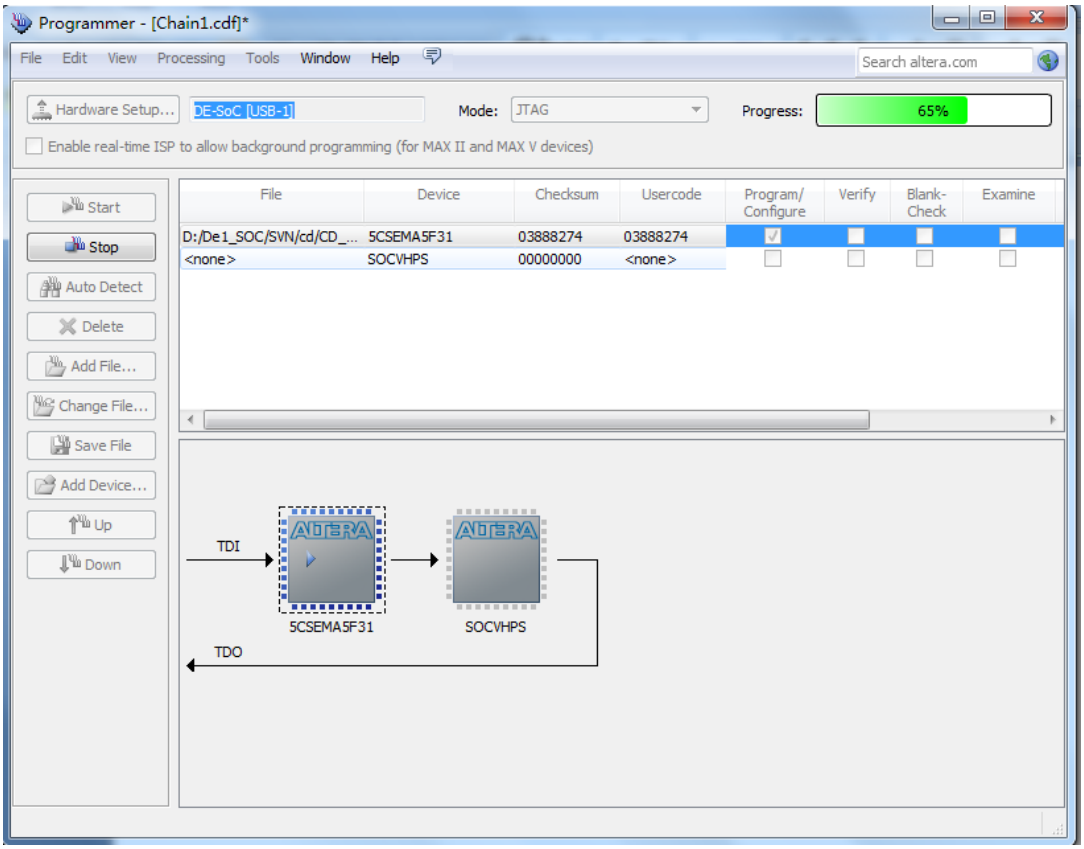
9. Click the FPGA device, right click mouse to popup the menu, and then select .sof file for FPGA



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



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


Programmer - [Chain1.cdf]*
File Edit View Processing Tools Window Help
Search altera.com
Hardware Setup...
DE-SoC [USB-1]
Mode: JTAG
Progress: 65%
Enable real-time ISP to allow background programming (for MAX II and MAX V devices)
Start
Stop
Auto Detect
Delete
Add File...
Change File...
Save File
Add Device...
Up
Down
File
Device
Checksum
Usercode
Program/ Configure
Verify
Blank-Check
Examine
D:/De1_SOC/SVN/cd/CD_...
5CSEMA5F31
03888274
03888274
<none>
SOCVHPS
00000000
<none>
TDI
5CSEMA5F31
SOCVHPS
TDO

Chapter 5

Running Linux on the DE1-SoC board

5.1 Introduction

This chapter demonstrates how to create a Micro SD card image, set up a UART Terminal, and run Linux on DE1-SoC Board. User can download the latest SD Card image file from Terasic's website (Choose **Linux Console** in Linux BSP (Board Support Package)): http://cd_de1-soc.terasic.com.

5.2 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: 4GB minimum
- Speed: Class 4 (at least)

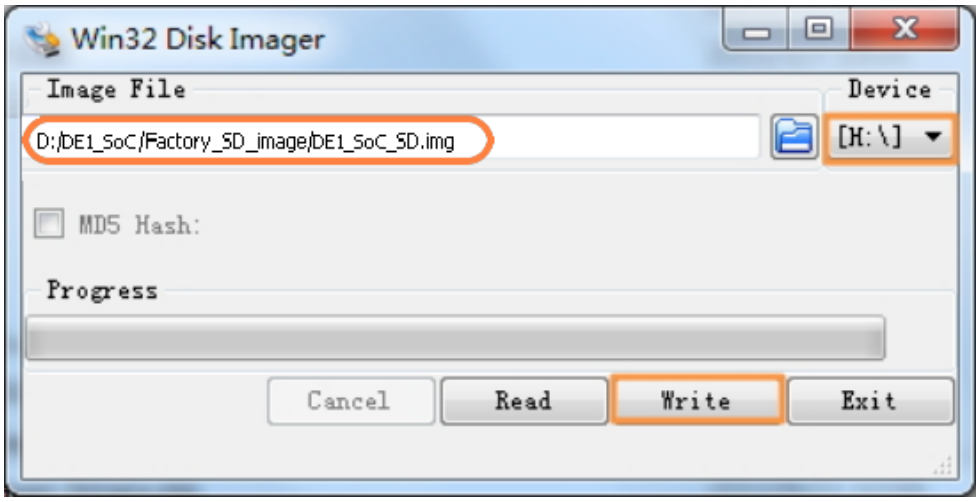
■ Pre-built SD Card Image

The pre-built binaries are delivered as an archive named DE1_SoC_SD.img. This SD card image file contains all the items that are needed to run Linux on DE1-SoC board. (You can download the compressed file from the link: http://www.terasic.com/downloads/cd-rom/de1-soc/linux_BSP/DE1_SoC_SD.zip. And extract file to get the image file after downloading)

- 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



5. Click “write” to start writing the image file to the microSD card. Wait until the image is written successfully.

5.3 Setting Up UART Terminal

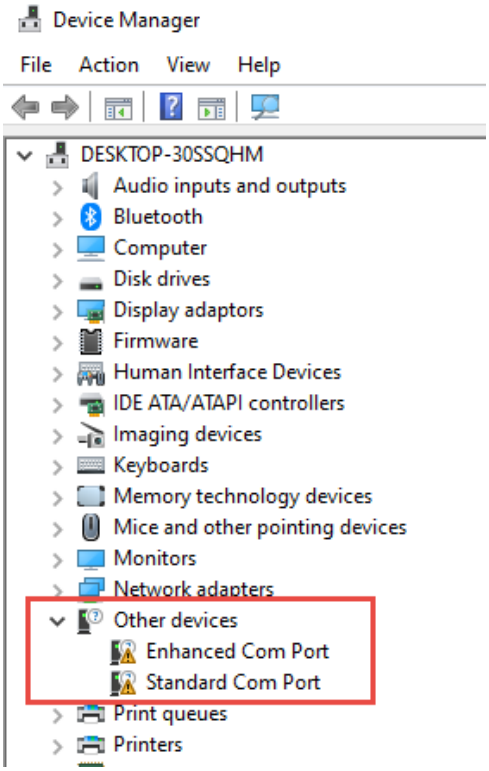
This section presents how to install the drivers for the USB to UART chip on the DE1-SoC board and set up the UART terminal on your host PC. The DE1-SoC board communicates with the PC through the micro USB connector J4.You should install the USB to UART driver and configure the UART terminal before you run Linux on the board.

■ Installing the Driver

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

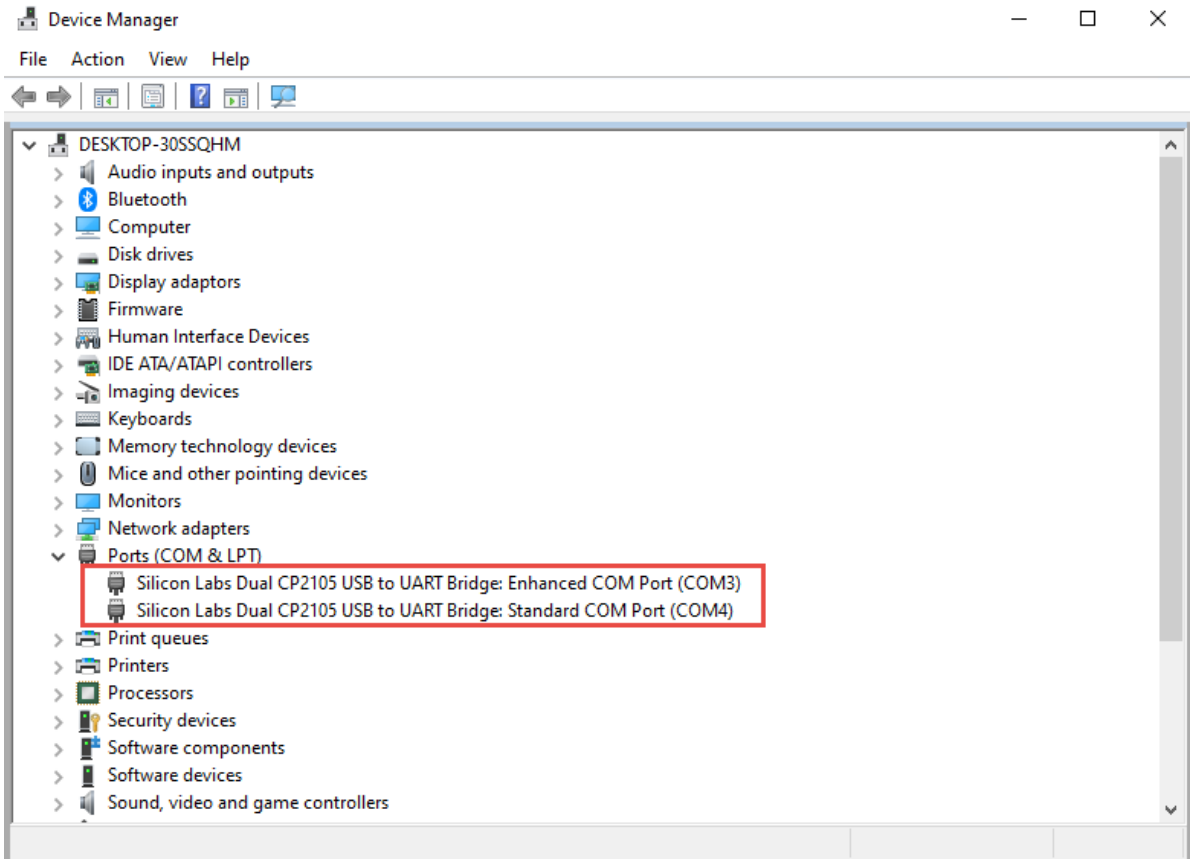
1. Connect your computer to the development board by plugging the USB cable into the micro USB connector (J4) of DE1-SoC (connection shown in **Figure 3-2**)

2. Power on the board then open the computer device manager in Windows. You will find an unrecognized Enhanced Com Port (For HPS) and Standard Com Port (For FPGA).



Select the CP2105 USB UART to update the driver software. The driver can be downloaded from https://www.silabs.com/developers/usb-to-uart-bridge-vcp-drivers.

3. After the driver has been installed correctly, two USB Serial Ports are recognized***: such as COM3 and COM4*** *(Open the Device Manager to know which COM port assigned in your computer).*
Note : Different Host may appear different com port number.



4. If user wants to communicate the **HPS** via com port, please remember the **Enhanced COM** Port number. For **FPGA** application, please use the **Standard COM** port number.
5. Now you can power off the DE1-SoC board

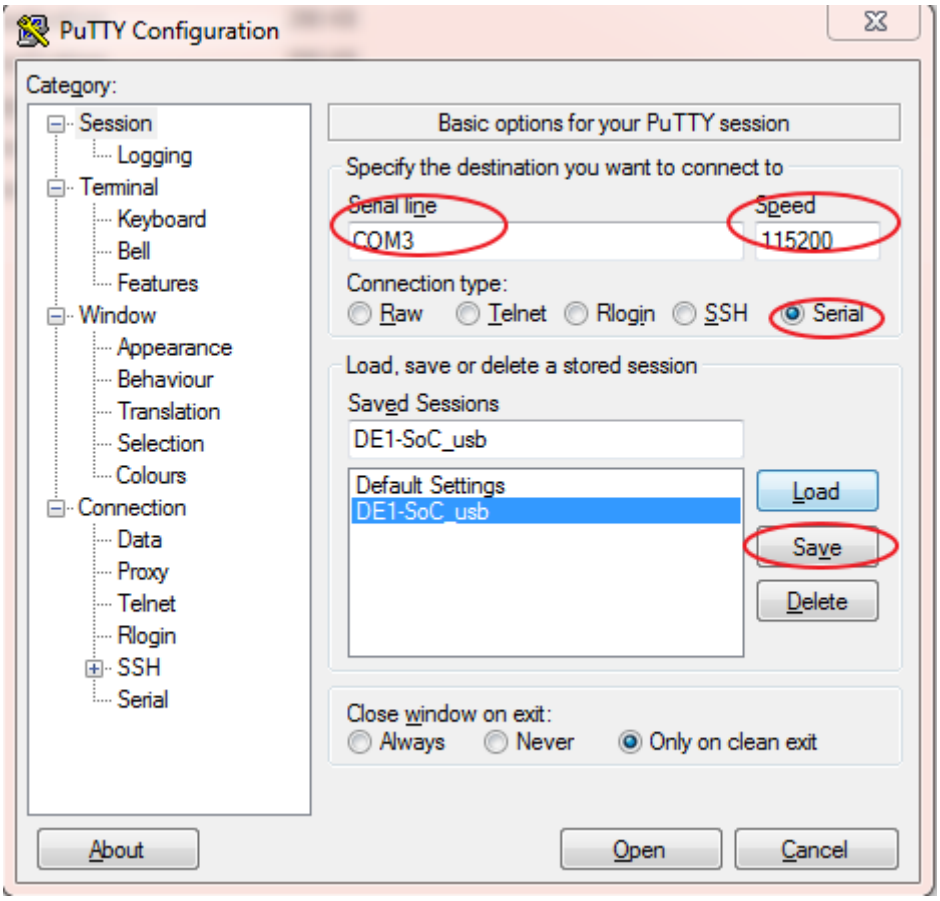
■ Configure UART terminal UART terminal spec:

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

The following steps present 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

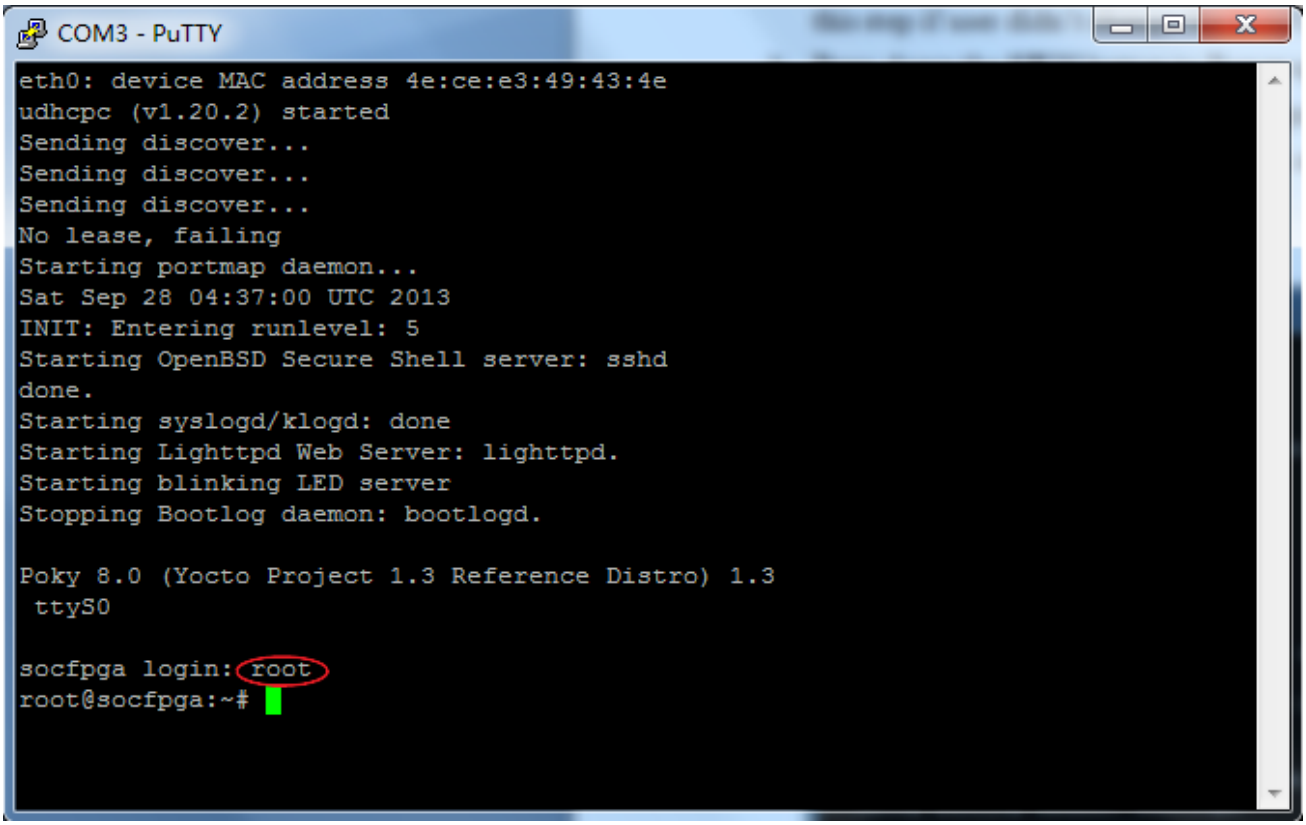
configuration.



5.4 Running Linux on DE1-SoC board

This section presents how to run the pre-built Linux images on the DE1-SoC board. You can run the Linux by following the steps below:

1. Insert the microSD card with the pre-built image into the board (See Section 5.2 to prepare a microSD card)
2. Make sure HPS is boot from SD card(BOOTSEL[2:0]=101,default settings)(Skip this step if user didn't change the BOOTSEL setting)
3. Press down the ***SW11*** button to Power up the board (See **Chapter 3** for details)
4. Open putty.exe, select the saved configuration **DE1-SoC_usb** and click open button.
5. After a successful boot, the Linux will ask for the login name. Type **root** and press **Enter** to login to the system.


COM3 - PuTTY
eth0: device MAC address 4e:ce:e3:49:43:4e
udhcpc (v1.20.2) started
Sending discover...
Sending discover...
Sending discover...
No lease, failing
Starting portmap daemon...
Sat Sep 28 04:37:00 UTC 2013
INIT: Entering runlevel: 5
Starting OpenBSD Secure Shell server: sshd
done.
Starting syslogd/klogd: done
Starting Lighttpd Web Server: lighttpd.
Starting blinking LED server
Stopping Bootlog daemon: bootlogd.
Poky 8.0 (Yocto Project 1.3 Reference Distro) 1.3
ttyS0
socfpga login: root
root@socfpga:~#

Chapter 6

Running LXDE on the DE1-SoC board

6.1 Introduction

This chapter presents how to boot LXDE Desktop on DE1-SOC board. LXDE is short for Lightweight X11 Desktop Environment. It is an extremely fast-performing and energy-saving desktop environment. LXDE uses less CPU and less RAM than other desktop environments. For further information about LXDE, you can visit the website: http://LXDE.org.

Figure 6-1 shows the hardware setup for booting LXDE Desktop on DE1-SOC. The requirement peripherals are list below:

- A VGA monitor
- A USB keyboard
- A USB mouse
- A Micro SD with minimum 8GB capacity

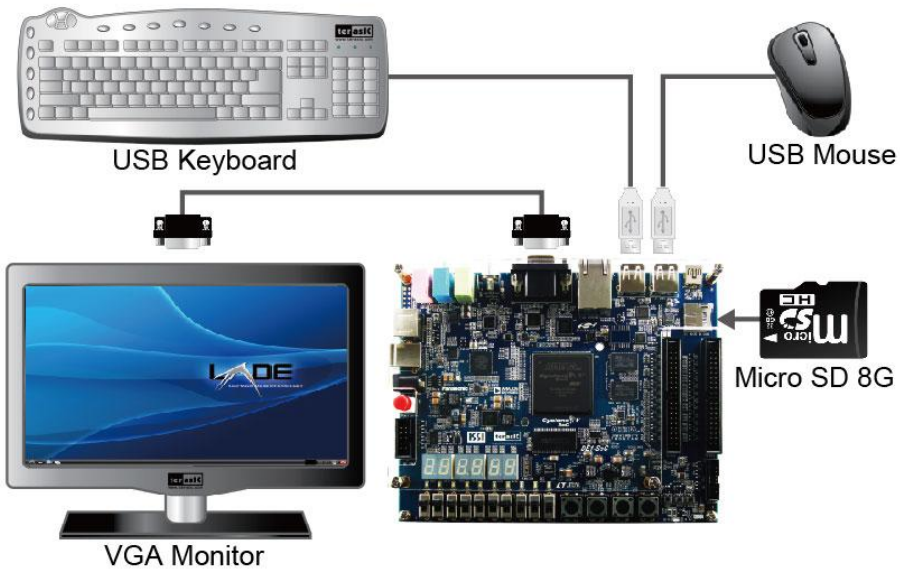


Figure 6-1 Hardware setting for LXDE on DE1-SOC board

6.2 Making LXDE Boot SD Card

To boot LXDE on DE1-SOC board user should make the boot SD card yourself. At first, user should get the SD image from the link:
http://www.terasic.com/downloads/cd-rom/de1-soc/linux_BSP/DE1_SoC_LXDE_SD.zip.
The file you download is compressed in .zip format, so you should decompress the file after downloading. Then you should write the image file to your boot SD card. You can refer to the **Section 5.2** for how to write the SD image in you SD card.

6.3 LXDE Setting Up Procedures

- Make sure the MSEL[4:0] is set to "00000" for HPS to configure FPGA (See **Figure 6-2**).

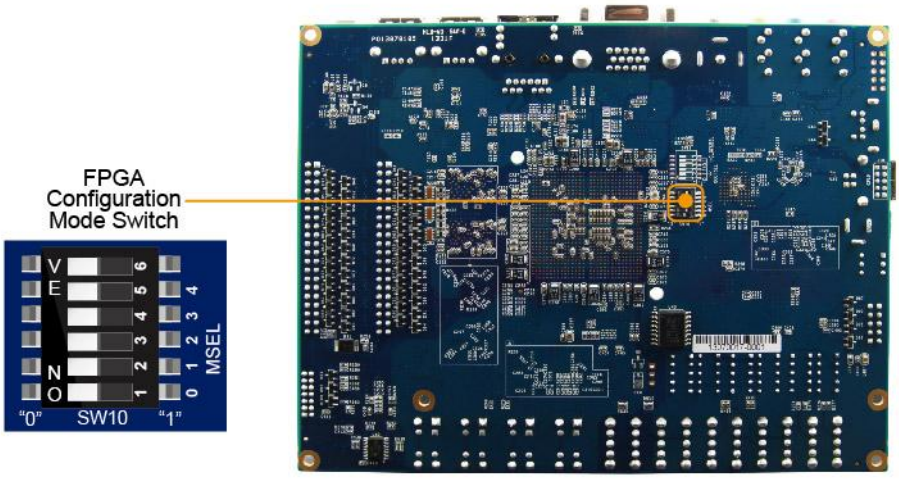


Figure 6-2 MSEL Setting

- Connect your USB mouse and keyboard to the USB connector (J7 and J8) on DE1-SoC board. Connect your VGA monitor to the VGA connector (J9).
- Insert the micro SD card with LXDE image into the DE1-SoC board.
- Power up the DE1-SoC board.
- You should find two penguins show on the VGA monitor when the Linux is booting.

- After a while, the login interface shows on the monitor as shown in **Figure 6-3**. You should choose more and type “root” when it requires your user name and press “Enter” on your USB keyboard and type “terasic” for password and press “Enter”. Now you should login in to the LXDE and try to get familiar with the GUI system. **Figure 6-4** shows a mp4 video playing in LXDE.

Figure 6-3 Login Interface of LXDE

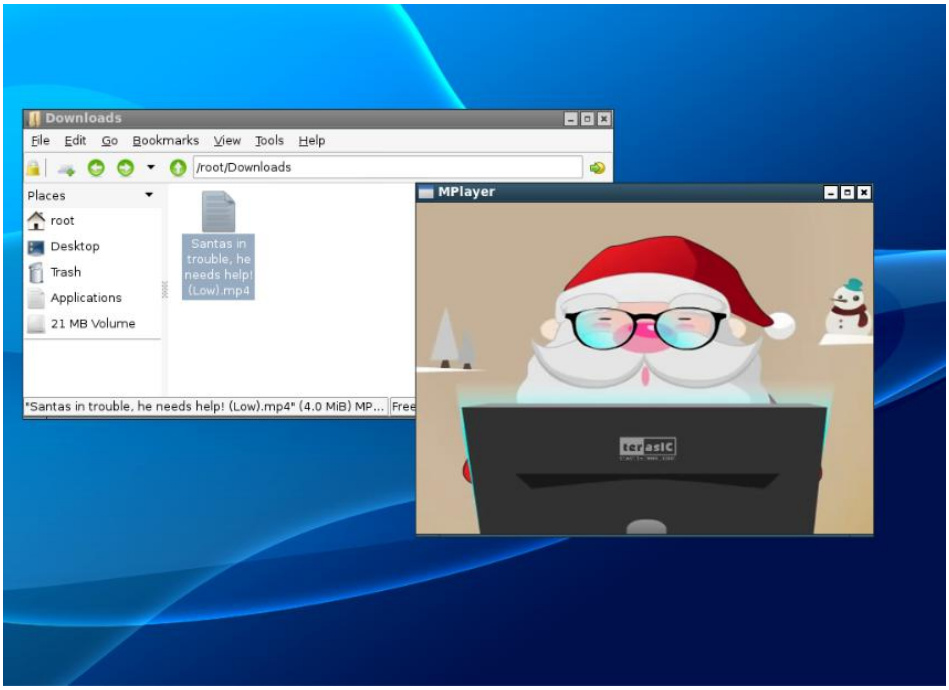


Figure 6-4 Using LXDE to Play a Video

Additional Information

Getting Help

Here are the addresses where you can get help if you encounter problems:

- Terasic Technologies
  9F., No.176, Sec.2, Gongdao 5th Rd, East Dist, Hsinchu City, 30070. Taiwan, 30070
  Email: **support@terasic.com**
  Web: **www.terasic.com**

Revision History

Date	Version	Changes
2014.01.03	V1.0	First Version
2014.01.12	V1.1	Update ch5 for modify board rate
2016.08.24	V1.2	Update Quartus information to V16.0
2019.04.11	V1.3	Modify software download link
2021.04.10	V1.4	Modify UART part