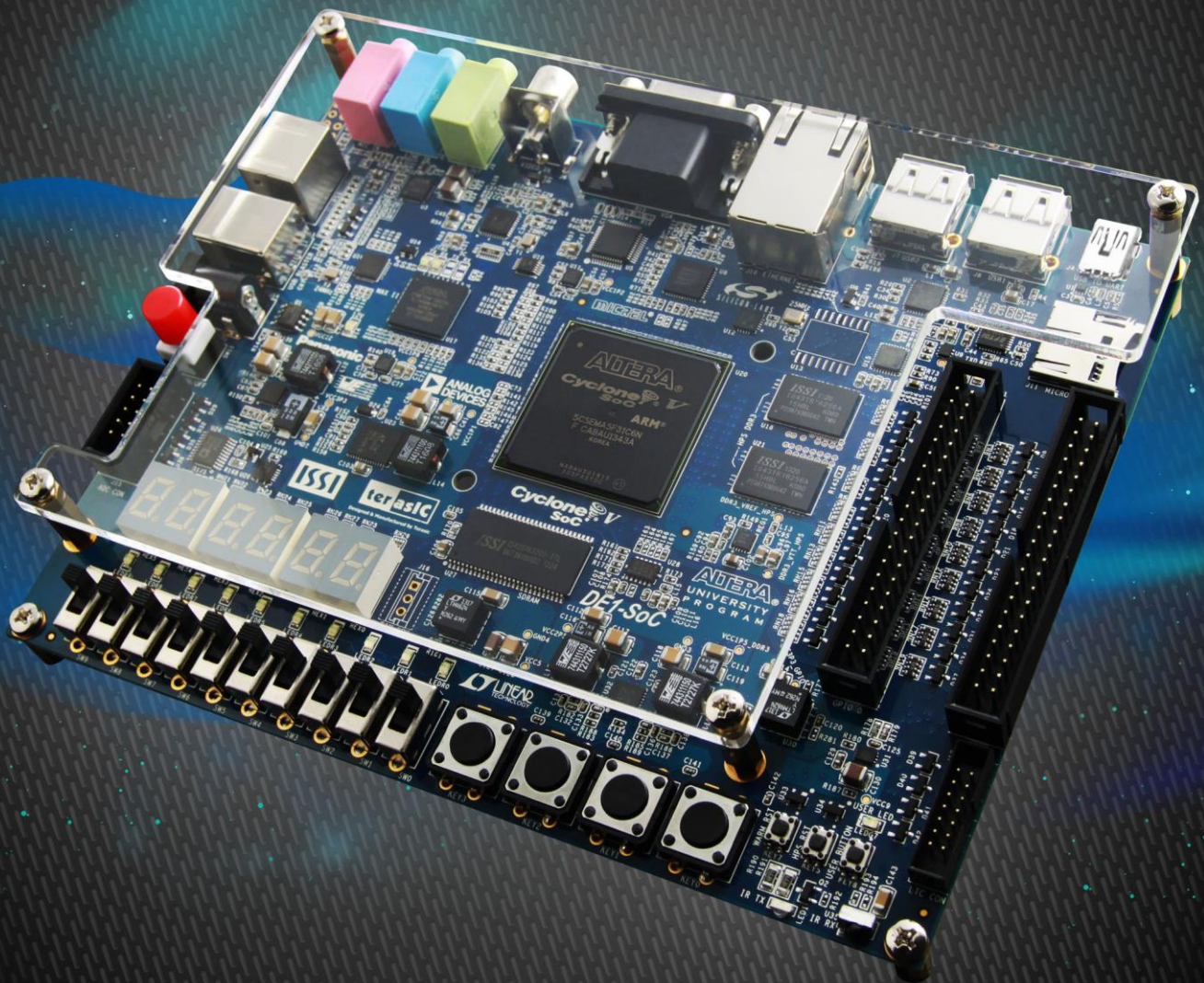


# DE1-SOC

## GETTING STARTED GUIDE



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## 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:

- Altera Quartus II software
- Altera SoC Embedded Design Suite

Note: 64-bit OS required

## 2.2 Installing Quartus II software

The Altera Complete Design Suite provides the necessary tools used for developing hardware and software solutions for Altera 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 <https://www.altera.com/download/dnl-index.jsp>



## Software Selector

Select by Version
Select by Device
Select by Software

### Quartus Software

- ☒ Version 13.1
- ☒ 13.1
- ☐ Version 13.0
- ☐ Version 12.1
- ☐ Version 12.0
- ☐ Version 11.1
- ☐ Version 11.0
- ☐ Version 10.1
- ☐ Version 10.0
- ☐ Version 9.1
- ☐ Version 8.0

Quartus II Edition	Supported Devices
<a href="#">Subscription Edition</a>	<b>Stratix</b> (V,IV,III) <b>Arria</b> (V GZ,V,II GZ,II GX) <b>Cyclone</b> (V,IV E,IV GX,III LS,III) <b>MAX</b> (V,II)
<a href="#">Web Edition</a>	<b>Arria</b> (II GX) <b>Cyclone</b> (V,IV E,IV GX,III LS,III) <b>MAX</b> (V,II)
<a href="#">Arria 10 Edition</a>	<b>Arria 10</b>

- If you choose to install the Subscription Edition, please note that a purchased license will be required. Please go to the following link for more information on the Subscription Edition:  
<http://www.altera.com/products/software/quartus-ii/subscription-edition/qts-se-index.html>
- Select the latest software version for Subscription Edition or web Edition will into "myAltera Account Sign-In" page

### myAltera Account Sign-In

Home > Support > mySupport > myAltera Account Sign-In

User Name

Password

☐ Remember me

[Sign In](#)

[Forgot Your User Name or Password?](#)

**Don't have an account?**

☒ **Create Your myAltera Account**

Your myAltera account allows you to file a service request, register for a class, download software, and more.

Enter your email address.

(If your email address already exists in our system we will retrieve the associated information.)

[Create Account](#)

☐ **Get One-Time Access**

One-time guest access can be used to access the download center without creating an myAltera account. However, you must complete this form on each return visit.

Enter your email address.

☐ Yes, I'd like to receive product announcement and update emails from Altera.

[Get One-Time Access](#)

- 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).

Combined Files

Individual Files

DVD Files

Additional Software

Updates

**Download and install instructions:**

1. Download Quartus II software, and any other software products you want to install, into a temporary directory.
2. Download device support files into the same directory as the Quartus II software installation file.
3. If you want to use add-on software, download the files from the **Additional Software** tab. Save the files to the same temporary directory as the Quartus II software installation file.
4. Run the **QuartusSetup-13.1.0.162.exe** file.

All software and components downloaded into the same temporary directory are automatically installed; however, stand-alone software must be installed separately.

[Read Altera Software v13.1 Installation FAQ](#)

[Quick Start Guide](#)

Quartus II Subscription Edition

Quartus II Software (includes Nios II EDS)

Size: 1.6 GB MD5: BC38BCB26C7E6E11C7ADA56940DC9269

ModelSim-Altera Edition (includes Starter Edition)

Size: 822.8 MB MD5: B97739CAD5FA9BE4156DFFC614AC9F26

UPDATE

↓

↓

**Devices**

You must install device support for at least one device family to use the Quartus II software.

Arria II device support (includes all variations)

Size: 595.6 MB MD5: 675B2B6BDCD7C892A59F84D8B4A5B6AF

↓

Arria V device support

Size: 1.2 GB MD5: 5CA879C0AD3E8E4933700153907D490F

↓

Arria V GZ device support

Size: 1.4 GB MD5: C0B21B60D53BB8B6C8161A7B38005D0F

↓

Cyclone III, Cyclone IV device support (includes all variations)


Size: 548.4 MB MD5: 2252CD4E2CBA75018F9B1325929F69EF

↓

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.



DE1-SoC Getting Started Guide  
February 18, 2014

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[www.terasic.com.tw](http://www.terasic.com.tw)

## 2.3 Installing Altera SoC Embedded Design Suite

The [Altera SoC Embedded Design Suite](https://www.altera.com/download/software/soc-eds) (EDS) contains development tools, utility programs, run-time software, and application examples to enable embedded development on the Altera SoC hardware platform. User can use the Altera SoC EDS to develop firmware and application software. Users can download the software from the Altera webpage:

<https://www.altera.com/download/software/soc-eds>

After you have installed the SoC Embedded Design Suite (EDS), you can start the ARM<sup>®</sup> Development Studio 5 (DS-5<sup>™</sup>) Altera Edition software. If this is your first time using the DS-5, a popup dialog will automatically ask if you wish to open the license manager.

For the free SoC EDS **Web Edition**, you will be able to use the DS-5 Altera Edition perpetually to debug Linux applications over an Ethernet connection. If you have purchased the SoC EDS **Subscription Edition**, you would have received an ARM license serial number. Or you can obtain a 30-day evaluation license. The following steps show how to obtain a web edition license or a 30-day evaluation license for subscription edition. [If the user does not need to design in the ARM DS-5, please skip the section below.](#)

### Obtain a Web Edition license or a 30-day evaluation license for Subscription Edition

In the section, we will introduce how to get a serial number from Altera website to active the ARM development Studio 5 (DS-5) Toolkit.

- Visit the website: Altera "SoC Embedded Design Suite"  
(<https://www.altera.com/download/software/soc-eds>)
- Browse the webpage to get the same information as the picture shows below, click the "activation code (Web Edition or 30-Day Evaluation) to link to the webpage: "DS-5 Community Edition".

### Web Edition

For the free SoC EDS **Web Edition**, you will be able to use the DS-5 Altera Edition perpetually to debug Linux applications over an Ethernet connection. Please get your ARM license [activation code](#) and enter it into the input field.

### 30-Day Evaluation

If you want to evaluate the SoC EDS Subscription Edition, you can get a **30-Day Evaluation** [activation code](#) here. Please enter this ARM license activation code into the input field to get the full DS-5 Altera Edition software capabilities for a limited time.

- In this page, record the Activation code displayed on the right of the picture below, such as "AC+70616421313438" as shown in the picture below.

## 2. License with Activation Code

Start ARM Development Studio 5 and open the license manager. If this is your first time using Development Studio, then a popup dialog will automatically ask you if you wish to open the license manager, otherwise it can be opened from the "Help" menu.

Choose "Add License...", and enter your Activation Code displayed on this page to obtain a license.

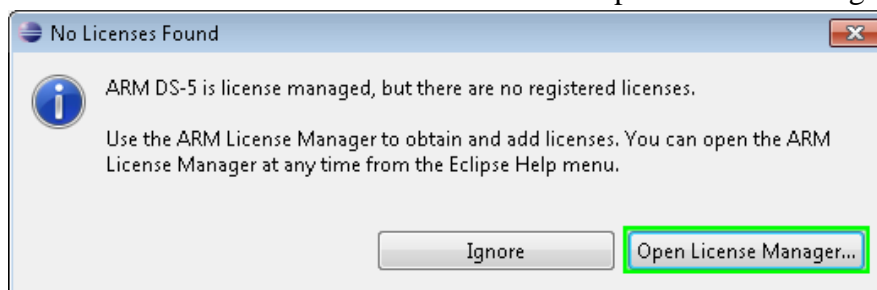
Work through the wizard to select the Host ID to lock your license to, and enter or create your ARM account details.

Once complete, the license manager can be closed as the product is ready to use.



After recording this Activation code, we will continue to introduce how to active DS-5 by using this code. The steps are as follows:

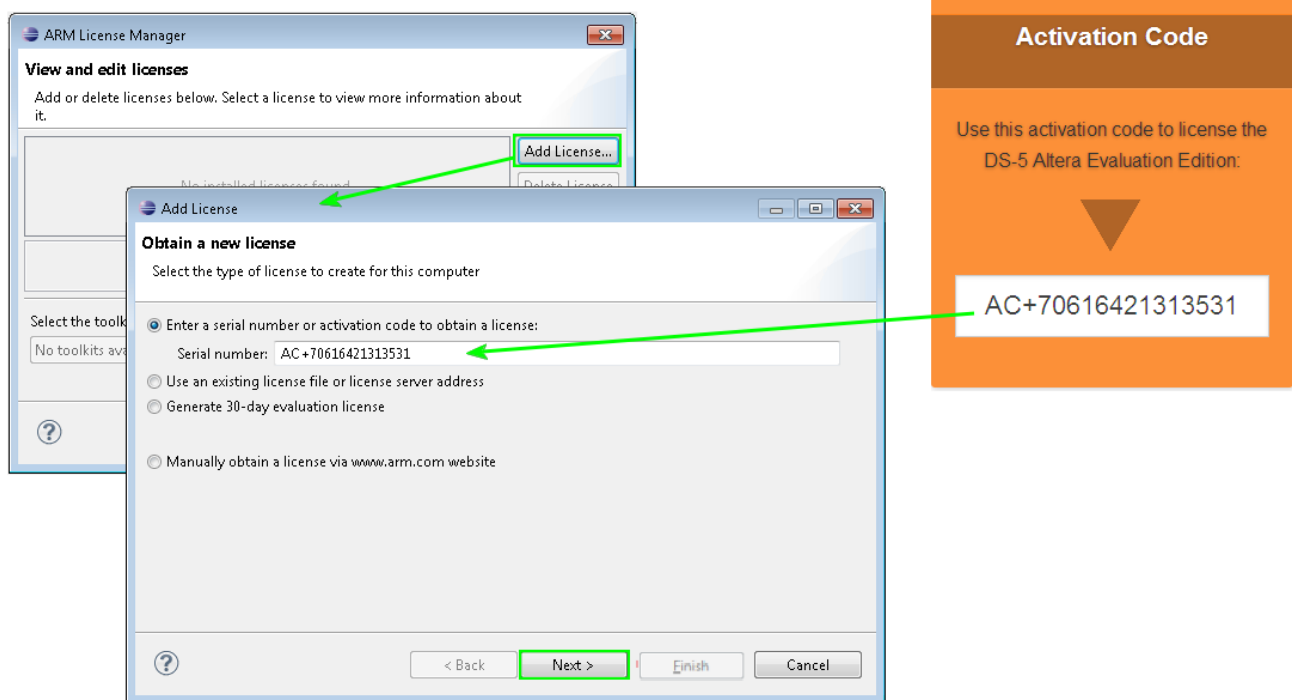
- Launch DS-5. Start --> All Programs --> ARM DS-5 --> Eclipse for DS-5
- A Workspace Launcher window will ask you to select a workspace.
- Press OK to select the default
- You will see a "No Licenses Found" Window. Select Open License Manager



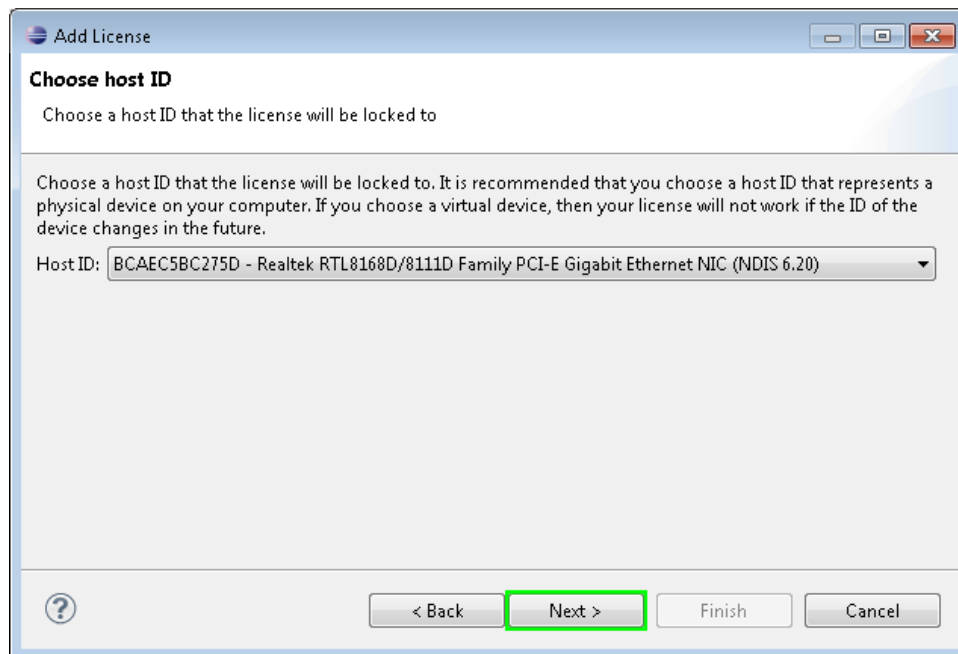
- Press the Add License Button in the ARM License Manager and Enter the activation code



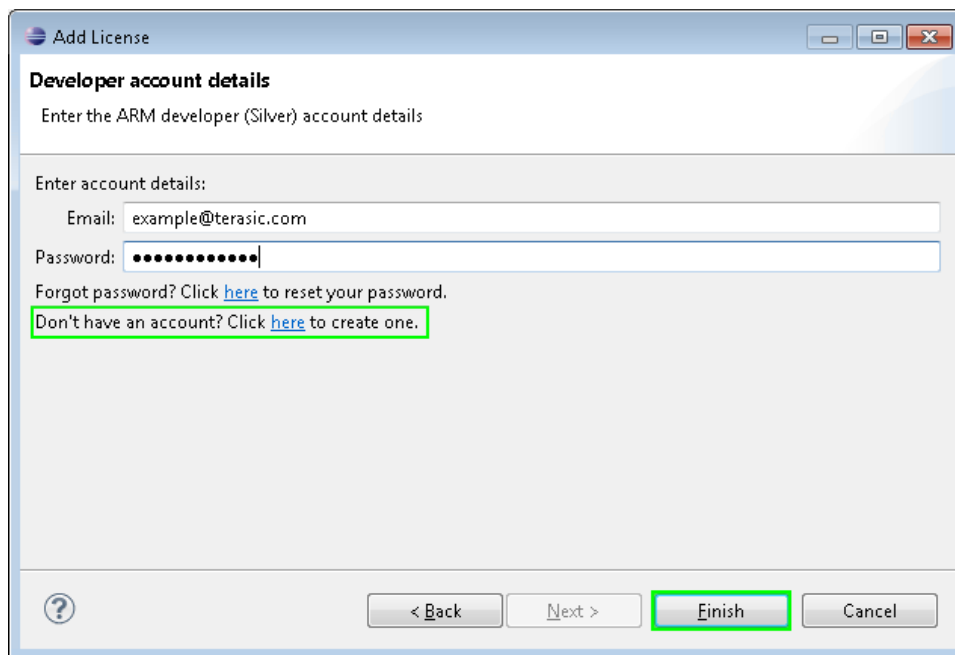
that you received earlier. Press the Next Button.



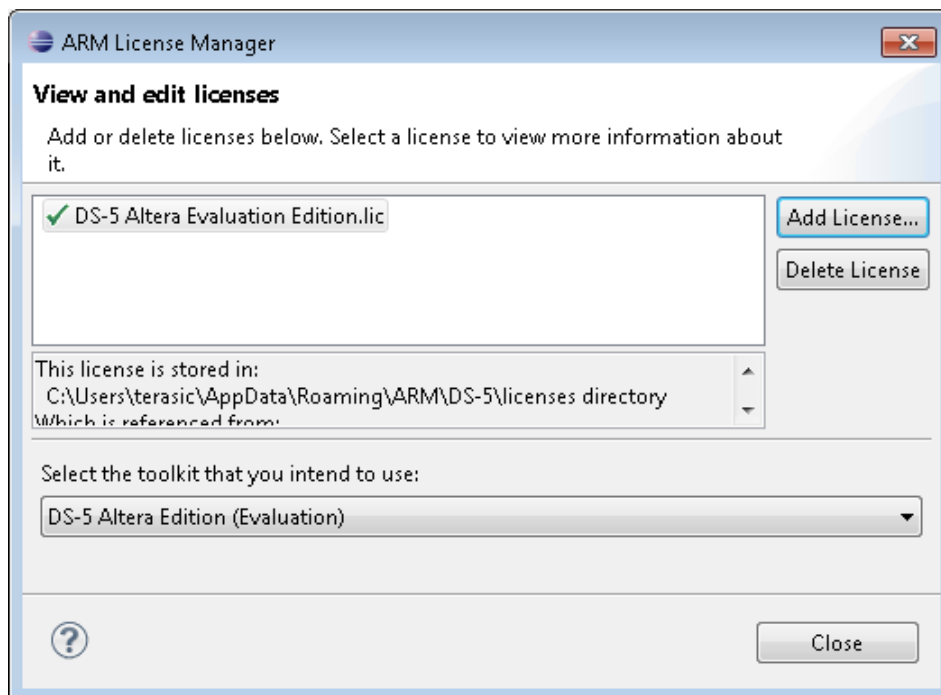
- Use the pull down menu to select a host ID. Press the Next button.



- Enter your ARM account email address and password.



- If you do not have an account then click on the link to create one.
- Press the Finish button.



- A web edition license or 30-day evaluation license for subscription edition is now successfully installed.

## 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.

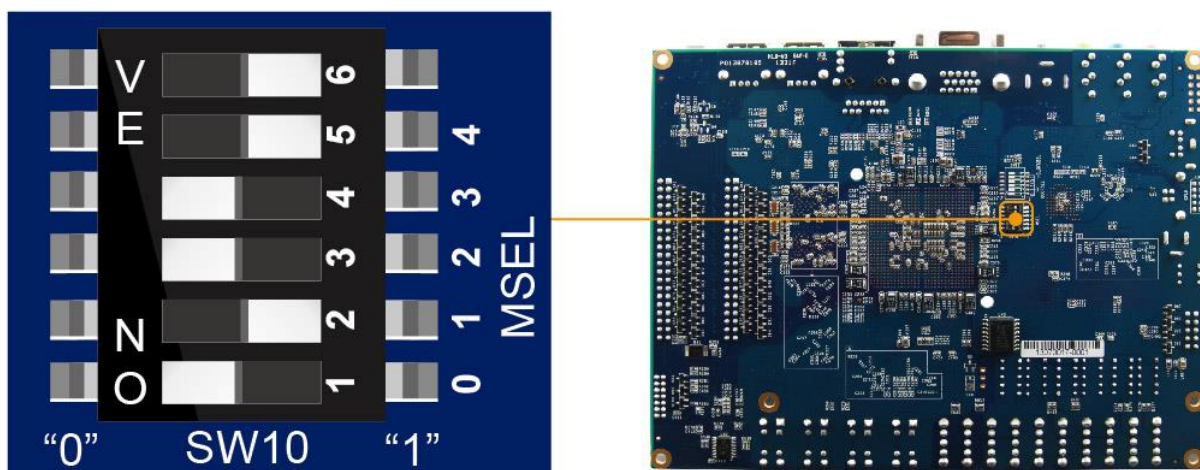


Figure 3-1 FPGA Configuration Mode Switch set in ASx4 Mode

## 3.3 USB and Power Cables

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

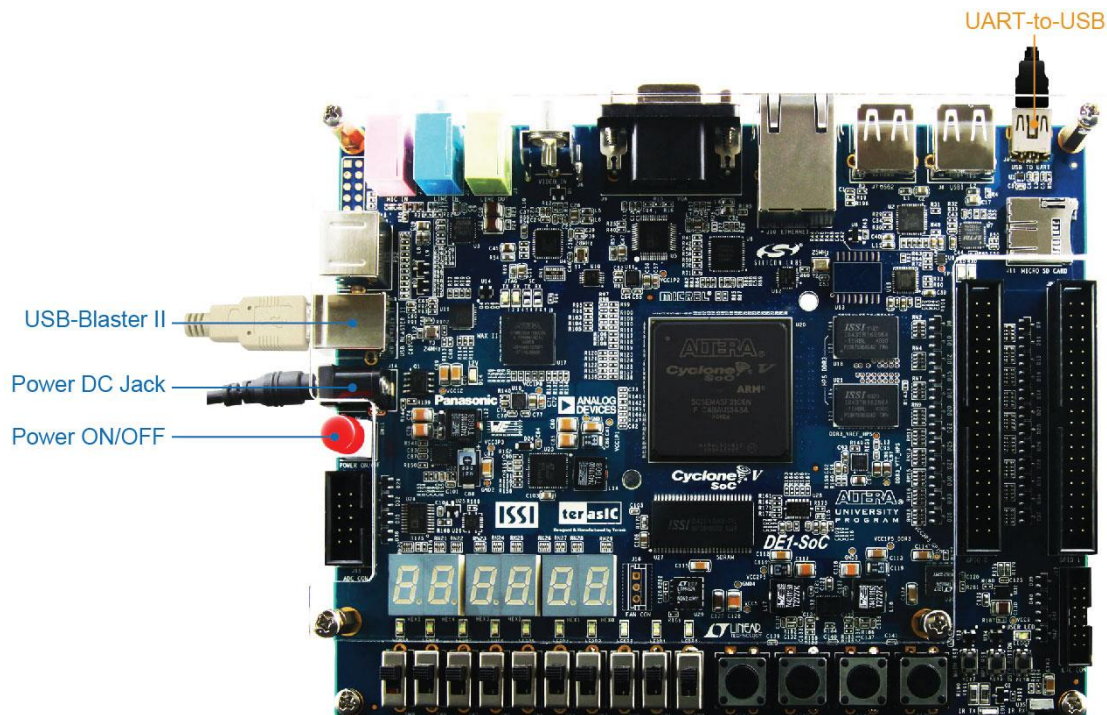


Figure 3-2 USB and Power Cables

## 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*

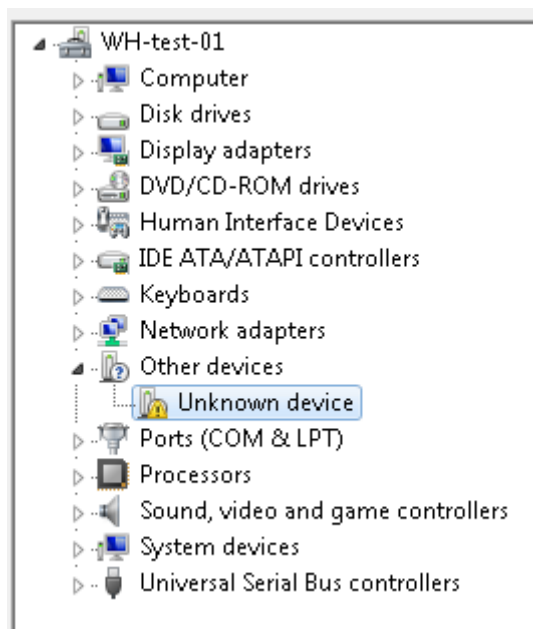
## 4.1 Introduction

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.

1. 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](#))
2. Power up the board and open the device manager in Windows. You will find an unknown device.

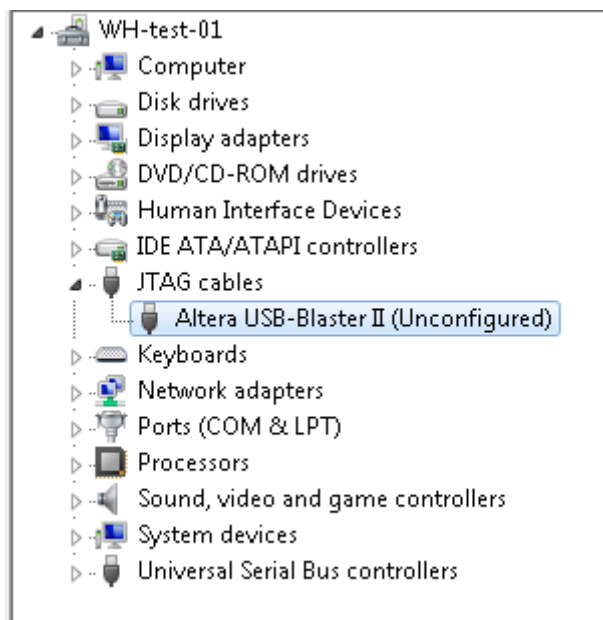


3. Select the unknown device to update the driver software. The driver file is in the \<Quartus II



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

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

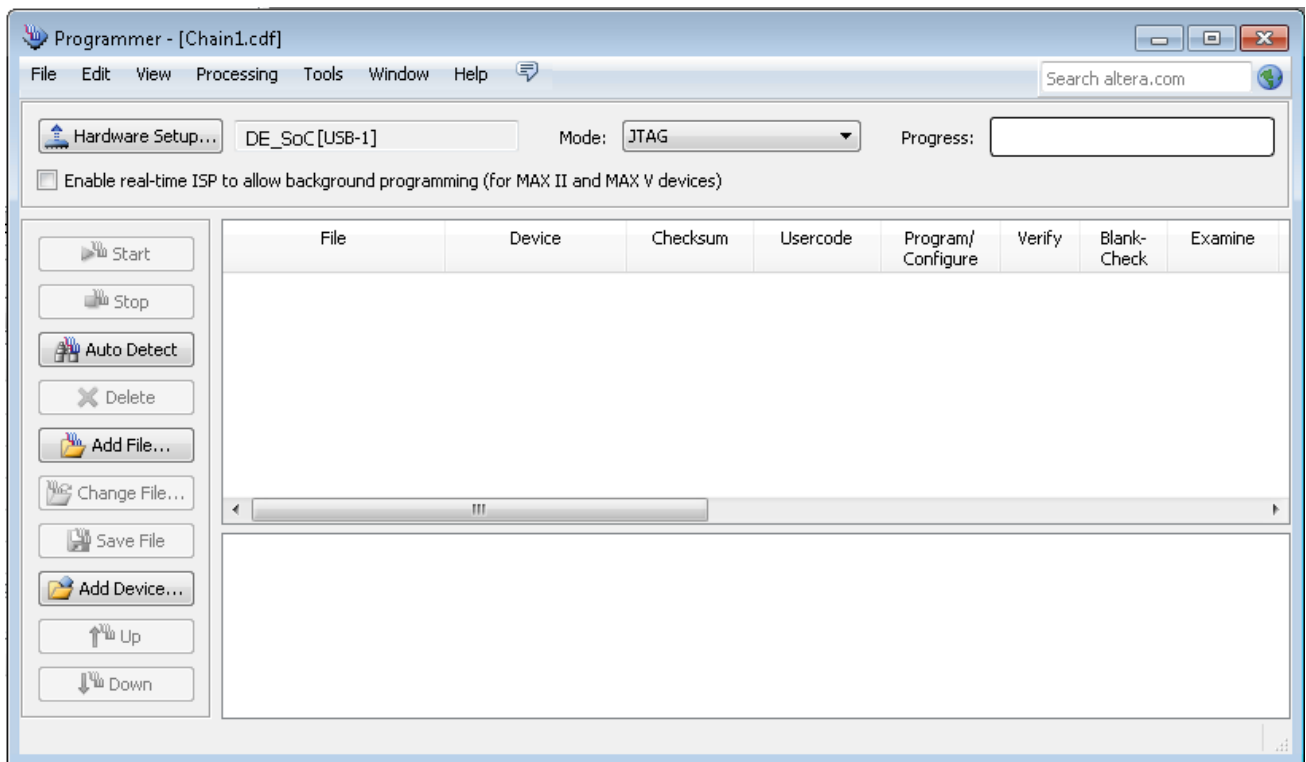


## 4.3 Downloading a FPGA SRAM Object File

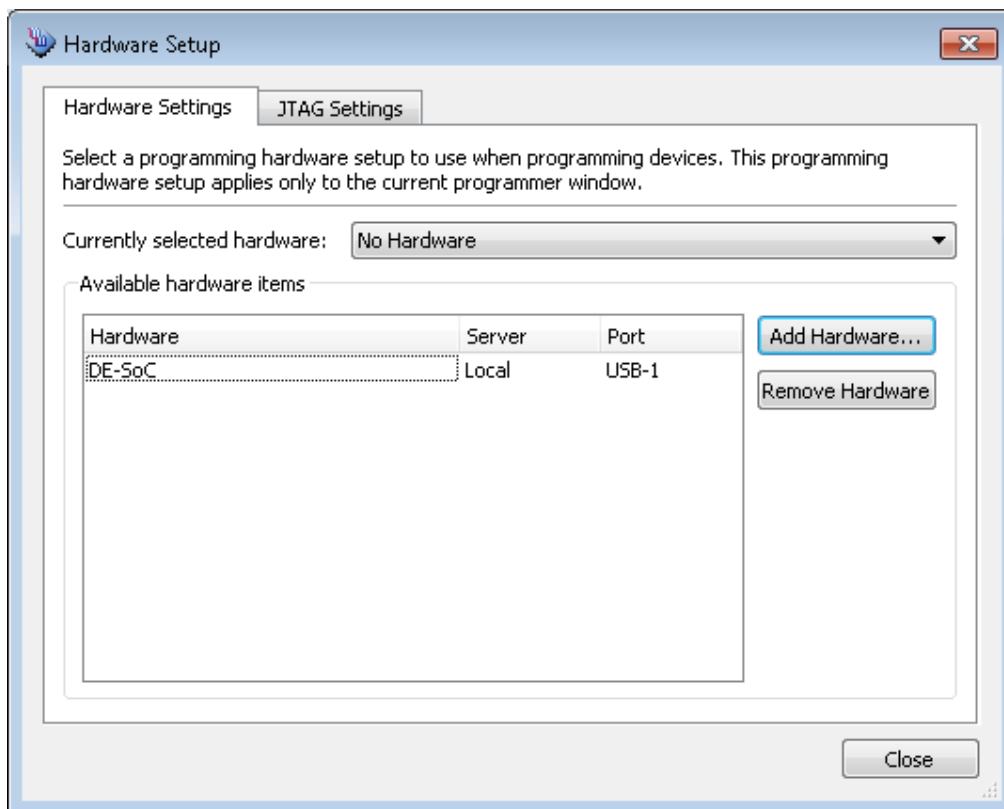
The Quartus II Programmer is used to configure the FPGA with a specific .sof file. Before configuring the FPGA, ensure that the Quartus II software and the USB-Blaster II driver are installed on the host computer.

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. 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**)
2. Open the Quartus II software and select Tools > Programmer. The Programmer window will appear.

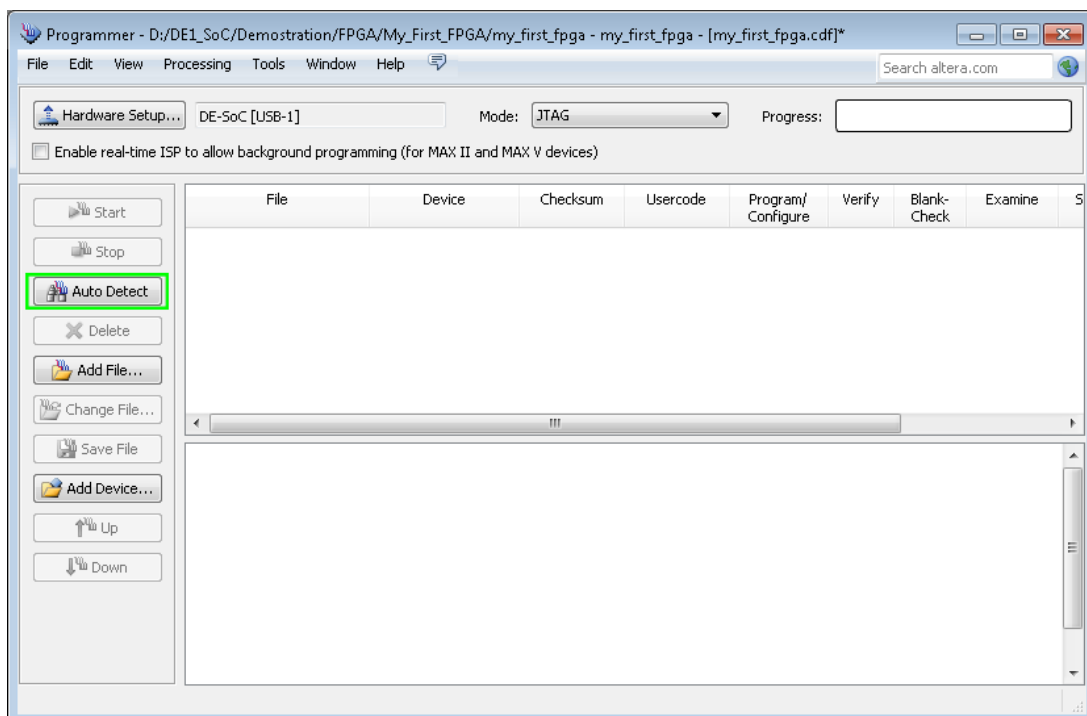


3. Click **Hardware Setup**.
4. If **DE-SoC [USB-1]** does not appear under **Currently Selected Hardware**, select that option and click **Close** as shown below.

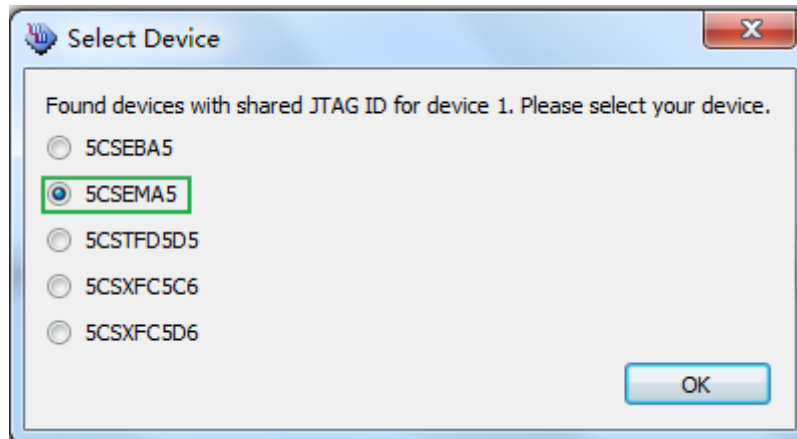


If the USB-Blaster II does not appear under hardware options list, please confirm if the USB-Blaster II driver has been correctly installed, and the USB cable has been properly connected between the DE1-SoC board and host computer.

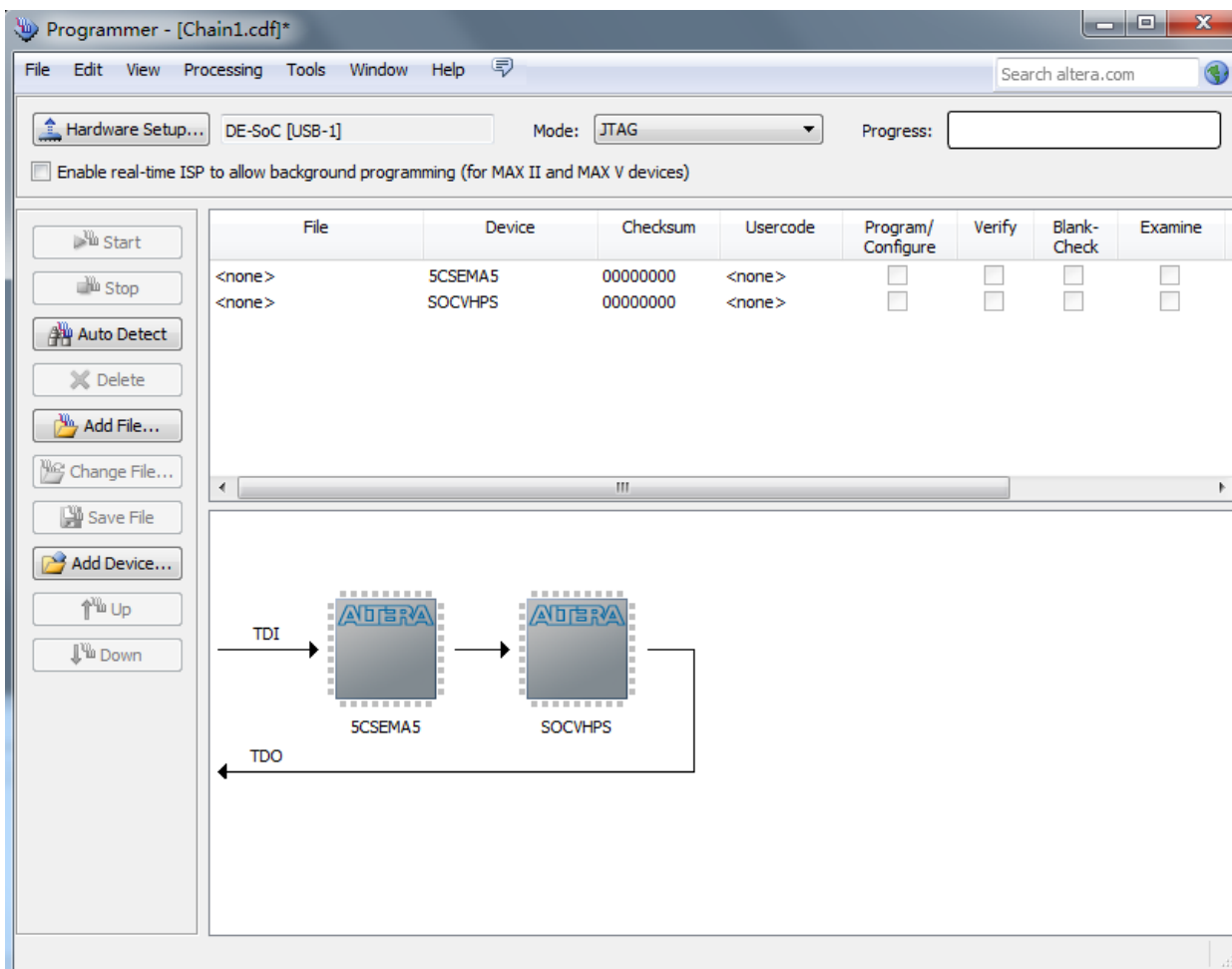
5. Click “Auto Detect”.



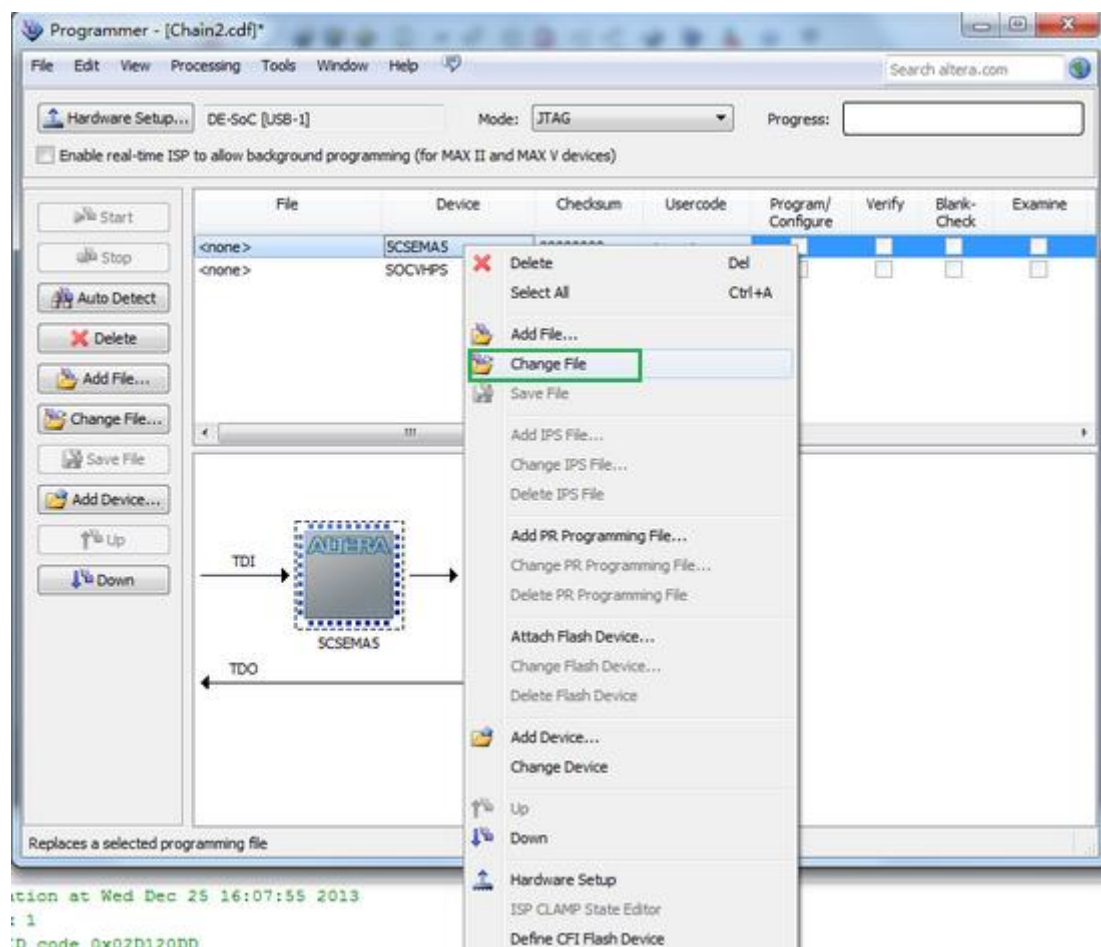
6. Select the device associated with the board



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

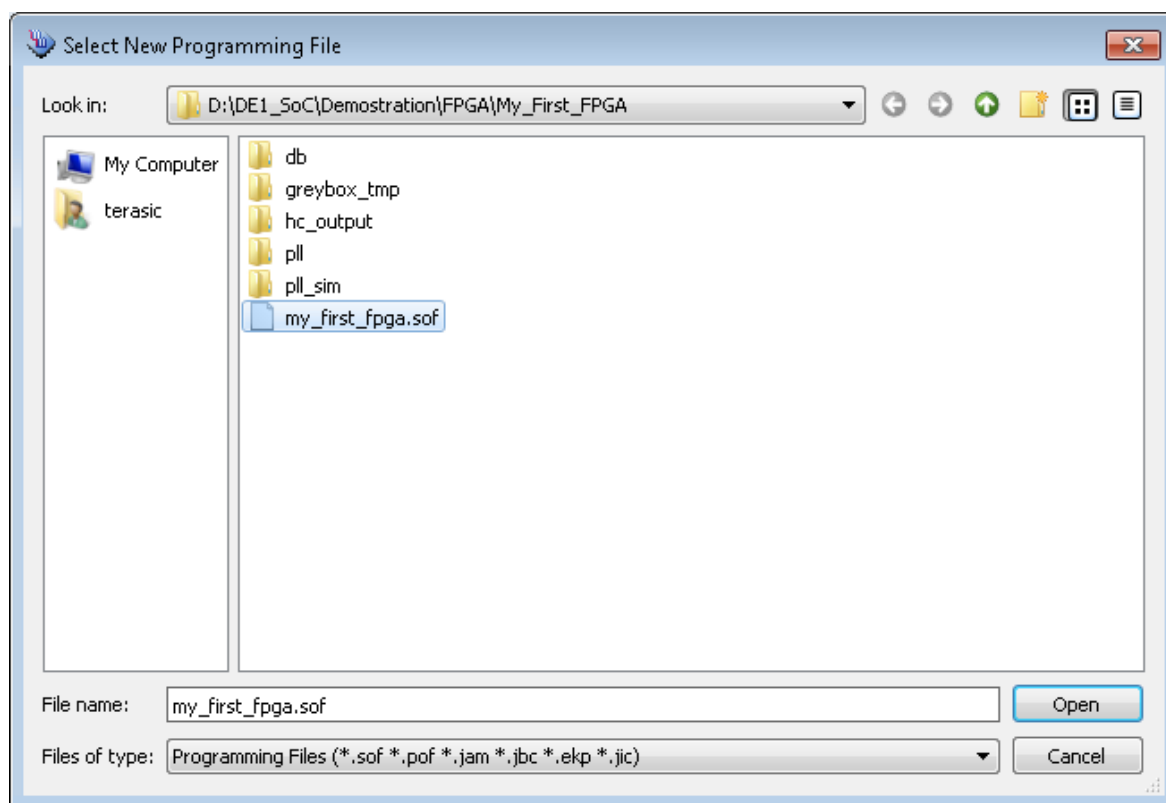


8. Click the FPGA device, right click mouse to popup the menu, and then select .sof file for FPGA

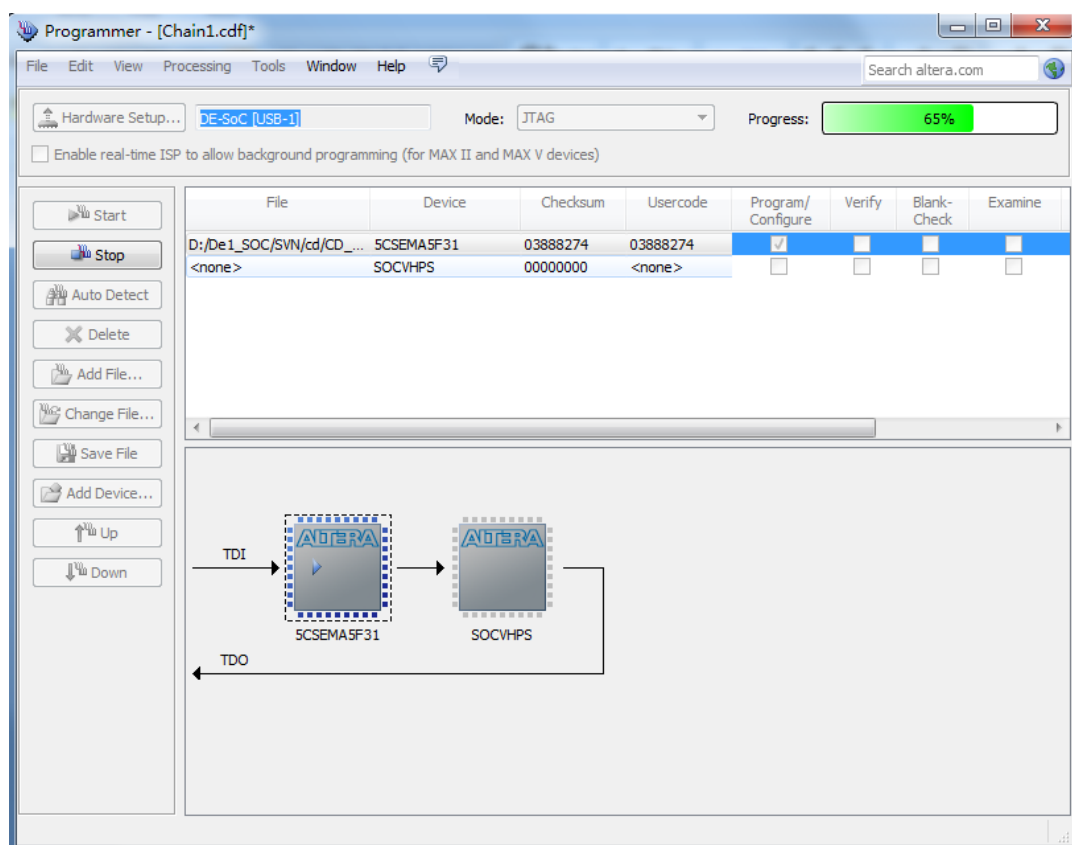


9. Select \<CD directory>\Demonstration\FPGA\my\_first\_fpga\my\_first\_fpga.sof.





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



# *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](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)

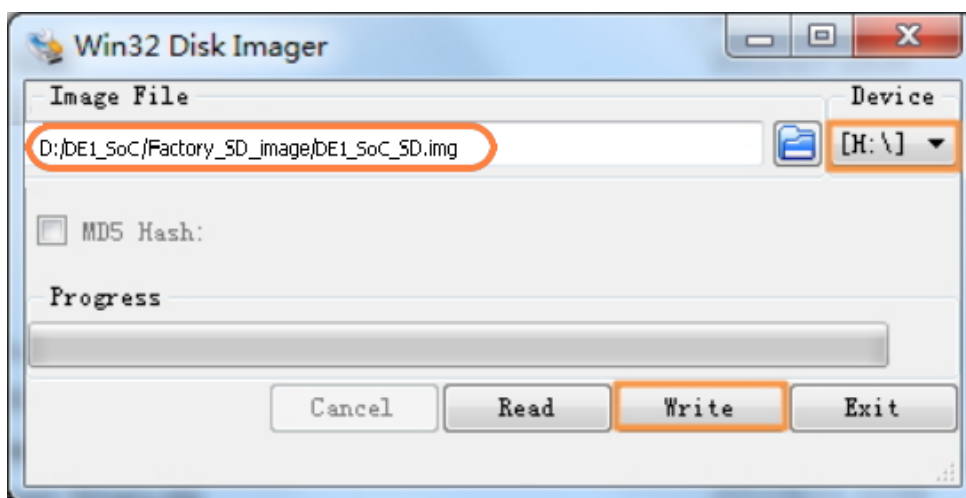
### ■ Pre-built SD Card Image

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](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

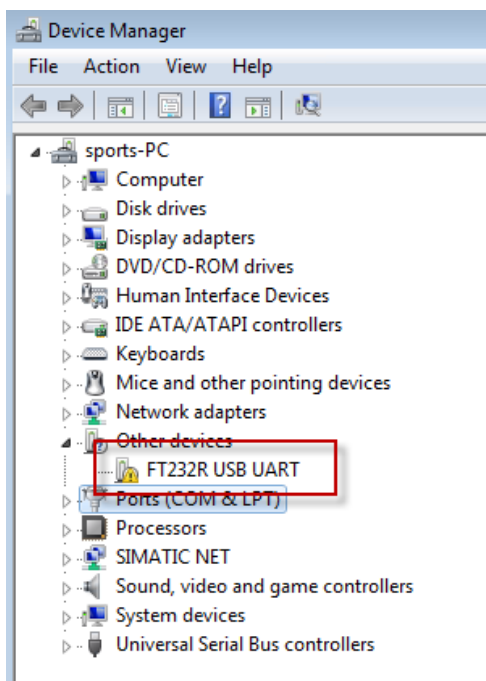
This section presents how to install the drivers for the USB to UART chip on the DE1-SoC board and set up the UART terminal on your host PC. The DE1-SoC board communicates with the PC through the micro USB connector J4. You should install the USB to UART driver and configure the UART terminal before 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 7 are:

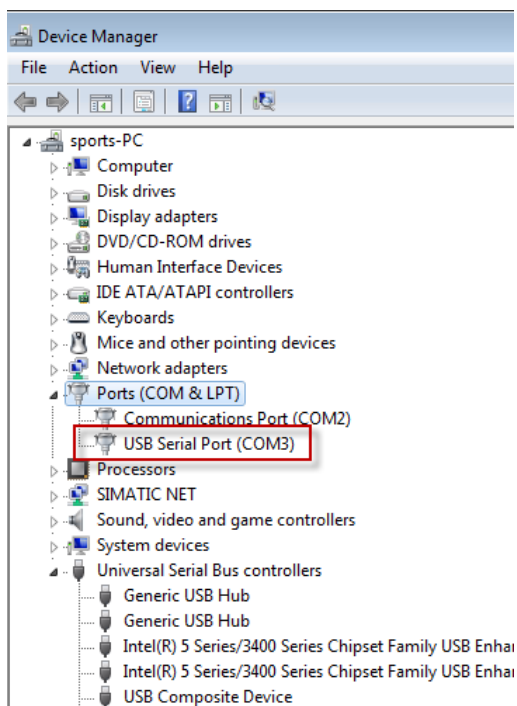
1. Connect your computer to the development board by plugging the USB cable into the micro USB connector (J4) of DE1-SoC (connection shown in [Figure 3-2](#))

2. Power on the board then open the computer device manager in Windows. You will find an unrecognized FT232R USB UART.



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 installed correctly, the USB Serial Port is recognized as a port such as **COM3** (Open the device manager to know which COM port assigned in your computer)





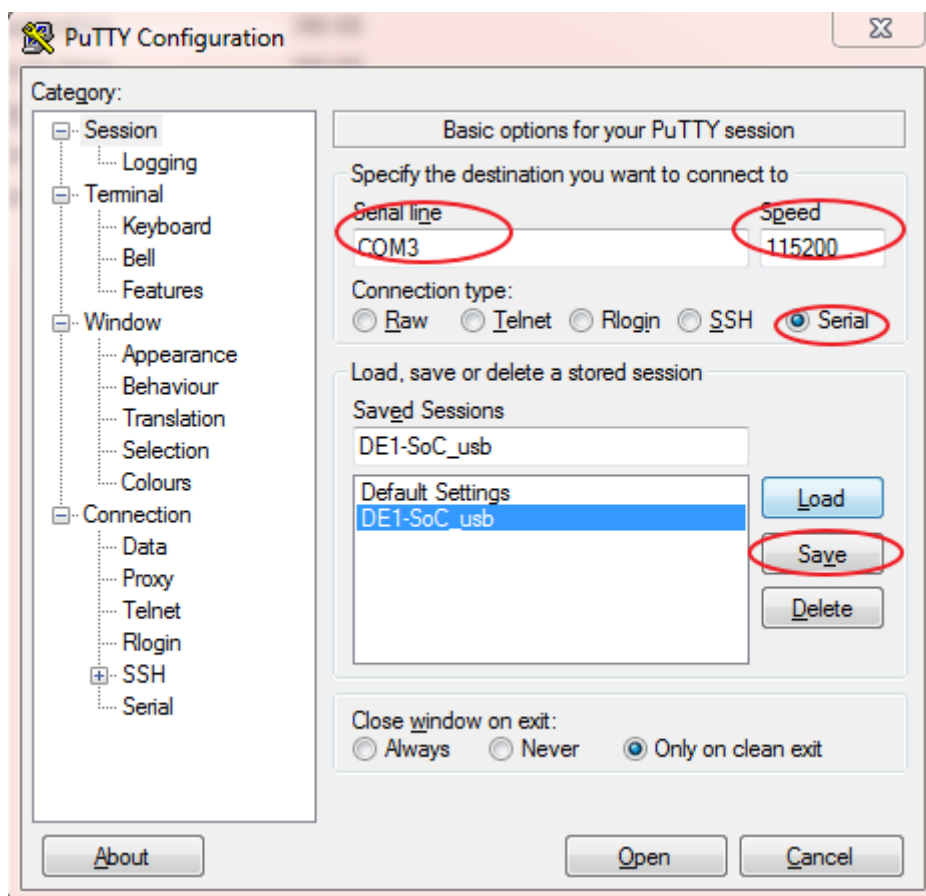
4. Now you can power off the DE1-SoC board

## ■ 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>)

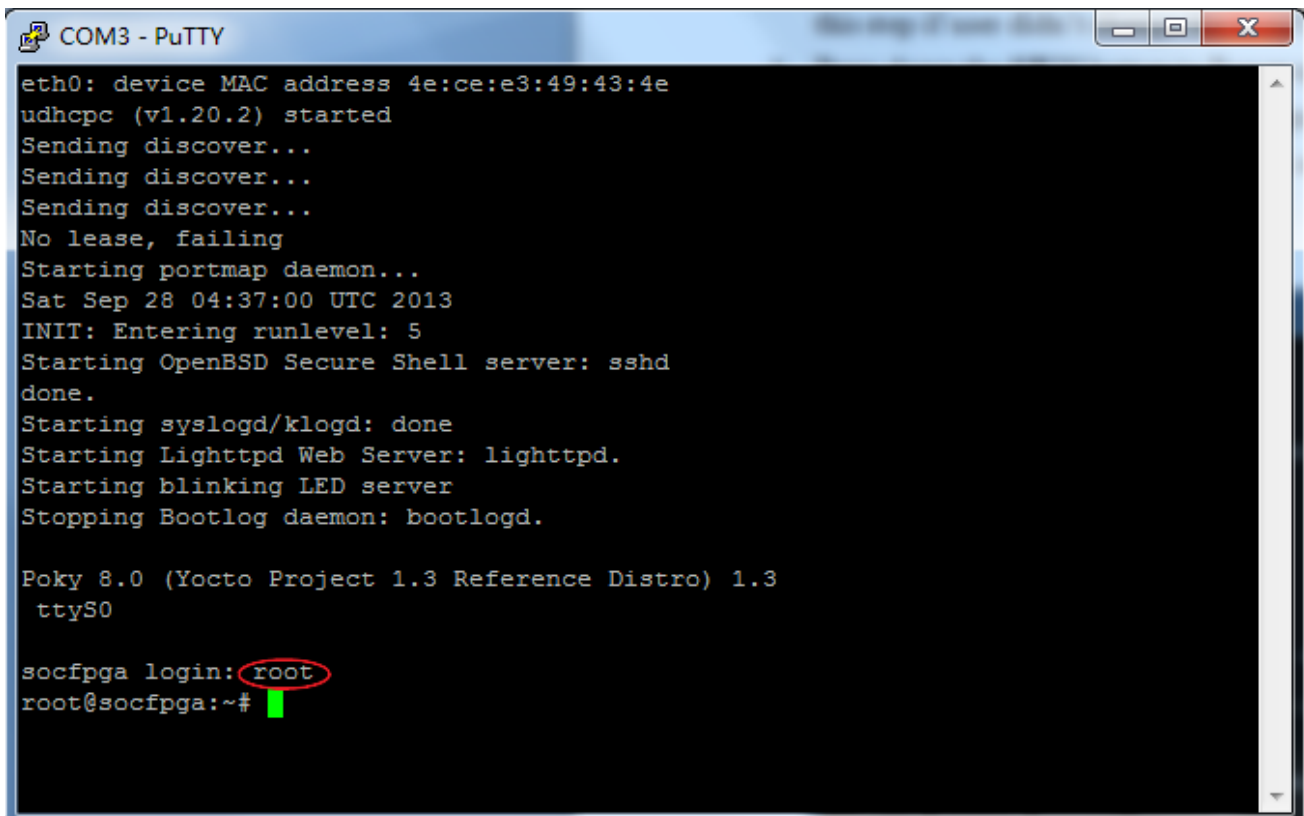
1. Open putty.exe, click **Serial** go to a serial configure interface.
2. Configure the window like the flowing picture and click save button to save the configuration.



## 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
udhcpd (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:~#
```

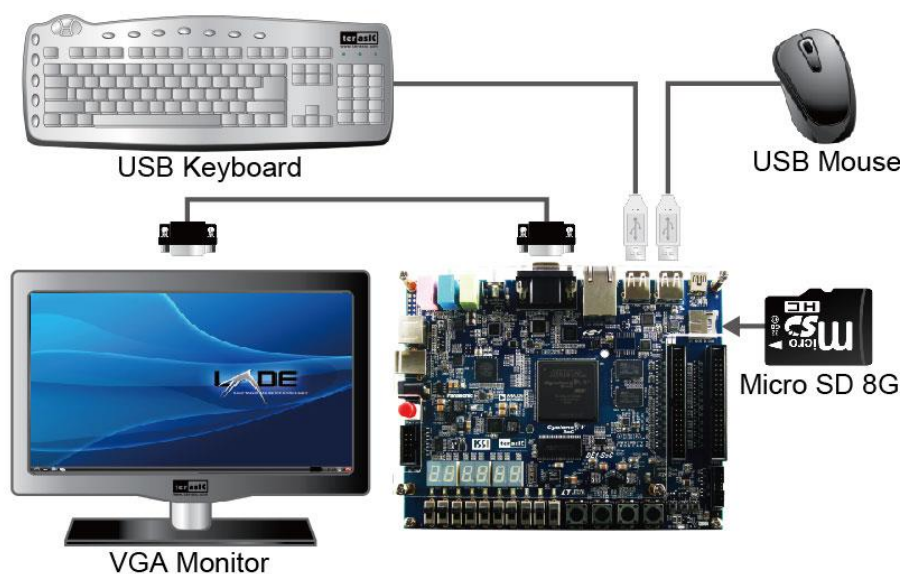
# *Running LXDE on the DE1-SoC board*

## 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](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).

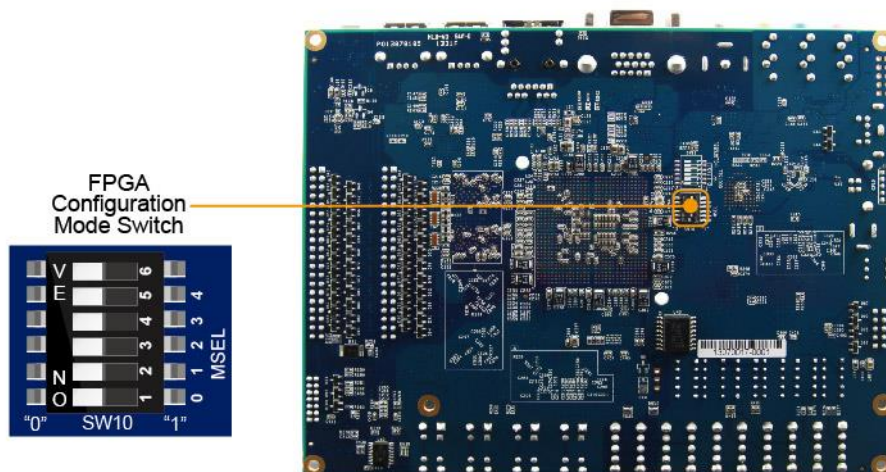


Figure 6-2 MSEL Setting

- 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.

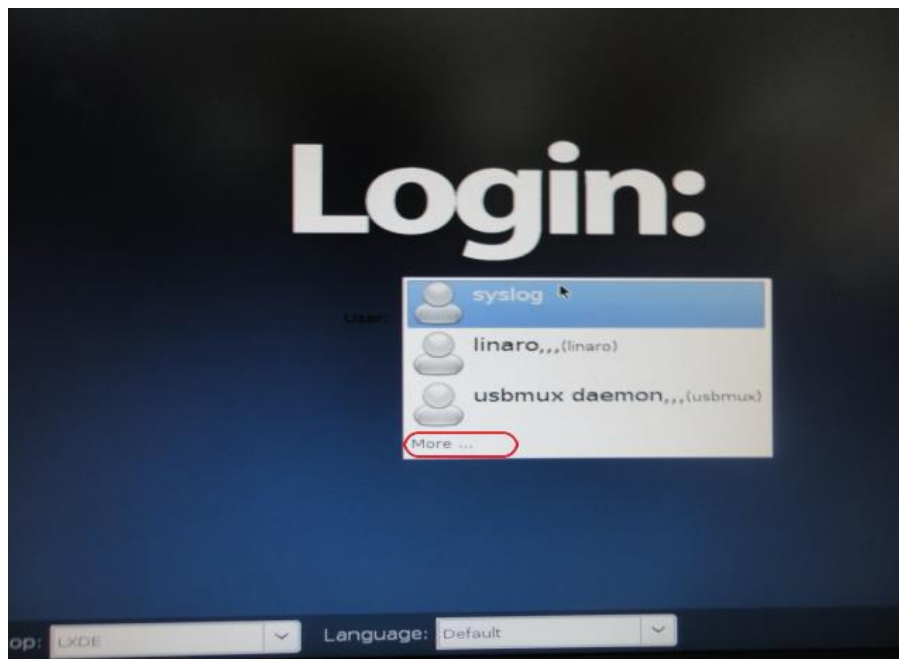


Figure 6-3 Login Interface of LXDE

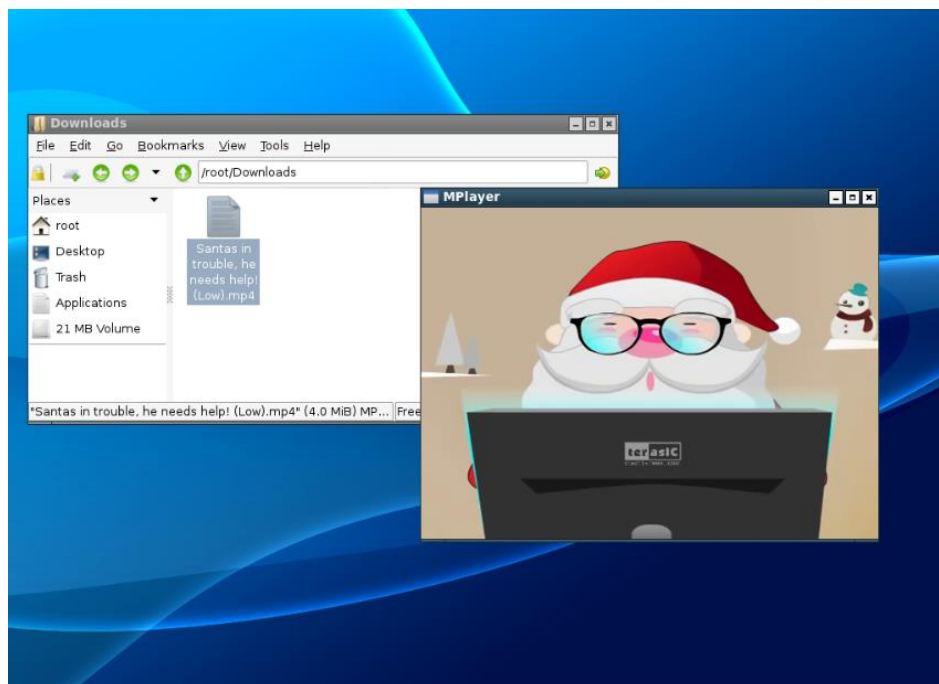


Figure 6-4 Using LXDE to Play a Video



## *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](mailto:support@terasic.com)  
Web: [www.terasic.com](http://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