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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
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:


Select the latest software version for Subscription Edition or web Edition will into "myAltera 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 Altera SoC Embedded Design Suite

The Altera SoC Embedded Design Suite (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® Development Studio 5 (DS-5™) 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".
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.

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

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

![FPGA Configuration Mode Switch set in ASx4 Mode](image)
3.3 USB and Power Cables

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

![Figure 3-2 USB and Power Cables](image)

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.

![Device Recognition](image)

### 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”.

![Hardware Setup Dialogue Box](image-url)

![Programming Setup Dialogue Box](image-url)
6. Select the device associated with the board

![Select Device](image)

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

![JTAG Chain](image)

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
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](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/](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](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.
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](image-url)
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).

- 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

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