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Chapter 1

Linux Booting on the DE10-Pro SX

1.1 Introduction

This guide describes how to connect the HPS daughter card to the DE10-Pro SX board, and how to boot the HPS on the DE10-Pro SX board using the Micro SD Card with Linux image, and use the UART interface to allow the host PC to communicate with the HPS of the DE10-Pro SX board.

1.2 Required hardware

To boot Linux on the DE10-Pro SX board, the following hardware is required:

- DE10-Pro SX board
- HPS Daughter Card
- Mini USB Cable
- Micro SD Card (At least 8GB capacity)

1.3 Install the HPS Daughter Card

HPS daughter uses 40-pin HPS I/O on the DE10-Pro SX board to provide peripheral interfaces such as UART, Gigabit Ethernet and USB OTG. Below shows that how to assemble the HPS daughter card to the DE10-Pro SX board.

- Connect the HPS daughter card to the 40-pin I/O connector (see Figure 1-1) of the DE10-Pro SX.
Figure 1-1 Connect the HPS daughter card to the DE10-Pro SX

- Lock the attachment screws to the HPS daughter card to secure it to the DE10-Pro SX (See Figure 1-2).

Figure 1-2 Lock the attachment screws to the HPS daughter card
**Figure 1-3** shows how the HPS daughter card is connected to the DE10-Pro SX board.

![HPS Daughter Card](image)

**Figure 1-3 HPS daughter card connected with DE10-Pro SX**

### 1.4 MSEL Settings

To boot Linux on the DE10-Pro SX board, user need to set MSEL[2:0] in AS mode (default setting is AVST x8 mode), as shown in **Figure 1-4**, set MSEL[2:0] to "001".

When the DE10-Pro is powered on, the SDM (Secure Device Manager) in the FPGA will read the data from the QSPI flash (If the MSEL is set to the AS mode) and start to configure the FPGA core, FPGA I/O and HPS. After the HPS initial is completed, the HPS will take over the rest of the boot flows. It will read the booting files from the Micro SD Card and boot the Linux on the DE10-Pro SX board.
1.5 Install the MicroSD Card

This section will show you how to download the Linux image file for the DE10-Pro SX board and how to write it into the microSD Card. Finally shows how to install it into the DE10-Pro SX board.

- Download Linux image file
The DE10-Pro SX board will be shipped with a microSD card that has been written with Linux image. If the user wants to copy or re-program the microSD card, you can download the Linux image file by referring to the link below:

http://url.terasic.com/de10_pro_sx_linux_console

- Download the programming tool
To program a microSD card Linux image you can use a free tool called Win32DiskImager.exe from http://url.terasic.com/win32diskimager on a Windows machine.

- Program the MicroSD Card
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 successfully written.
Install the MicroSD Card to the DE10-Pro SX board

Users can install the Micro SD Card on the DE10-Pro SX by referring to Figure 1-6.
1. Toggle right to unlock the Micro SD card socket
2. Pull up the socket
3. Insert the Micro SD Card
4. Pull down the socket
5. Toggle left to lock the Micro SD card socket

Figure 1-6 Steps for installing microSD card
1.6 Power On the DE10-Pro SX board

To power up the DE10-Pro SX board, there are two options available. The first method is to plug the DE10-Pro SX board into the PCIe slot of the host PC, then turn on the PC power to power on the DE10-Pro SX board (See Figure 1-7).

![Figure 1-7 Power on the DE10-Pro SX form PCIe slot](image)

The second method is to connect the 2x4 PCIe connector on the DE10-Pro SX board to the external 12V DC power supply, then turn on the power switch SW2 on the board to power on the DE10-Pro SX (See Figure 1-8).

![Figure 1-8 Power on the DE10-Pro SX form external Power](image)
1.7 Setting Up UART Terminal

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

![Figure 1-9 Hardware Setup for UART Terminal](image)

- Installing the Driver

1. Connect your computer to the development board by plugging the USB cable into the mini USB connector of DE10-Pro SX. (Connection setup is shown in Figure 1-9)

2. Power on the board and open the computer device manager in Windows. You will find an unrecognized FT232R USB UART (See Figure 1-10).
Select the FT232R USB UART to update the driver software. The driver can be downloaded from [http://www.ftdichip.com/Drivers/VCP.htm](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*).
Configure UART terminal UART terminal spec

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

The following steps show 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 setting and click “Open” to open the terminal window. Note that the “COM5” on the Serial Line column needs to be modified according to the actual com port on the user's computer.
3. After the board is successfully booted, the Linux will ask for the login name. Type "terasic" for account name and type “123” for the password (See Figure 1-13).
1.8 Appendix

This section will introduce what check items can be done if linux cannot be boot and the putty window does not print any messages.

1. Check if the USB Serial Port shows on the device manager on the computer.

![Hardware Setup for UART Terminal](image)

Figure 1-14 Hardware Setup for UART Terminal

2. Check if the MSEL[2:0] is set to AS mode : “001”.

3. The QSPI flash on the DE10-Pro SX board had programmed the boot file when shipped. After power on, user can check if the user LED (LED3) is flashing, and after 10 seconds of booting, the HPS LED has light on (See Figure 1-15). If not, you can check whether the MSEL is set in AS mode. If the setting is correct, please refer to following steps to re-program the QSPI flash with the factory code.

- Connect the Micro USB cable to USB blaster II connector of the DE10-Pro SX board.
- Copy the factory code from the system CD\Demonstrations\QSPI_Factory_Code\
- Execute “flash_program.bat” to erase and program the QSPI flash.

Figure 1-15 HPS LED and User LED3
Contact Terasic

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Revision History

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