

**phyCORE®-XScale/PXA270 Development Kit
(KPCM-027)
Loading a Linux Demo Image**

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1 Introduction

This Application Note provides instructions on how to start-up the phyCORE-PXA270, download U-Boot to the phyCORE-PXA270 and download a Linux image via TFTP server.

Please refer to the phyCORE-PXA270 and Development Board for phyCORE-PXA270 Hardware Manuals for specific information on such board-level features as jumper configuration, memory mapping, and pinout.

The included Linux image (*ulmage.phytec*) and the file system (*root.jffs2.phytec*) was created using **Viosoft's Arriba** environment. This demo includes support for:

- Flash Memory
- MMC external memory
- Ethernet LAN91C111
- USB host controller unit, only channel 1 is supported

Please refer to the Viosoft Arriba manual for more details regarding the included Linux image or for building a new image. This demo is meant for demonstration purposes only and may not suite all customer development needs.

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2 System Description

2.1 Hardware Description

The following PHYTEC hardware components are included in the phyCORE-PXA270 Basic Development Kit (part # KPCM-027-BASIC) and are necessary for completing the instructions in this application note:

- phyCORE-PXA270 (part # PCM-027-251EXMGRI)
- Development Board for phyCORE-PXA270 (PCM-990-P3)
- Interface Expansion Board (PCM-985)
- AC adapter supplying 12 VDC, 3.3A, center positive
- RS-232 null-modem cable
- cross-over Ethernet cable¹

2.2 System Requirements for loading Linux Image

This Application Note for the phyCORE-PXA270 requires:

- Linux host PC
- A terminal program on the host-PC such as Komport or Minicom for Linux
- TFTP services
- One available Ethernet port
- One available COM port (or USB to RS-232 adapter)

2.3 System Requirements for Loading U-Boot

The bootloader used for downloading the Linux kernel is the **Universal Bootloader: U-Boot**. The bootloader is pre-installed on the phyCORE-PXA270 and resides in the on-board Flash memory from address 0 to 0x40000. If U-Boot needs to be re-installed (see section 3.2 Downloading U-Boot), a Windows based PC is required to use the Jflash utility for programming the phyCORE-PXA270.

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A description of this Bootloader can be found at:

<http://sourceforge.net/projects/u-boot/>

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- 1: You may also use a straight Ethernet cable connected to a hub to establish network connection between the phyCORE-PXA270 hardware and the host-PC.

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3 Getting Started

Note: If the Bootloader U-Boot 1.1.4-ptx3-pcm027-3 is pre-installed on the phyCORE-PXA270, skip to section 2.3 and 2.4 for interfacing the phyCORE-PXA270 to a Linux Host and for loading a Linux image.

3.1 Interfacing the phyCORE-PXA270 to a Windows Host-PC

- Copy the folder **pC-PXA270** from the included Tools CD to the root of your PC.

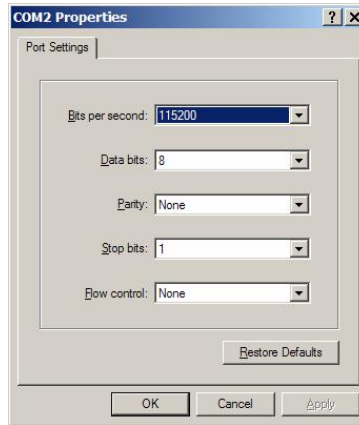
Note: All path and file statements within this QuickStart Instruction are based on the assumption that you choose **C:\PHYBasic** as the default path when copying files from Tool-CD to hard drive.

- Connect the JTAG adapter's 20-pin flat-band cable to the pin connector X29 on the Development Board. Please make sure that pin 1 on the connector mates with pin 1 (which is marked red) on the cable.
- Connect the JTAG adapter to the LPT interface on your PC using a parallel cable.
- Connect the included 12 VDC power adapter to the power socket X1 on the Development Board.
- Connect the included RS-232 null-modem cable to an available COM port on your Windows PC and DB-9 (P1) of the phyCORE development board.
- Create a new HyperTerminal session, indicate the correct COM setting for your system and set the parameters as follows: **Bits per second = 115200; Data bits = 8; Parity = None; Stop bits = 1; Flow control = None.**

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3.2 Downloading U-Boot

- Browse to and open (double click) the file **prog_viosoft.bat** located in **C:\PHYBasic\pC-PXA270\Linux\jflash**
- The batch file will invoke the **Jflash** program and show hardware recognition within the MS Command Prompt window. Please check to make sure that the **ACT** (Actual) and **EXP** (Expected) values of the recognized PXA270 device are the same and then press <Enter>.

```

C:\WINDOWS\system32\cmd.exe
C:\PHYBasic\pC-PXA270\Linux\jflash>jflashmm bulbcx u-boot_viosoft.bin P 0 PAR
JFLASH Version 5.01.003
COPYRIGHT (C) 2000 - 2003 Intel Corporation modified by PHYTEC 1

PLATFORM SELECTION:
Processor=      PXA27x
Development System=  Mainstone
Data Version=    1.00.002

ACT: 0111 1001001001100101 0000001001 1
EXP: *** 1001001001100101 0000001001 1

```

- After pressing <Enter>, the window will display: **PXA27x revision ??**

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```
C:\WINDOWS\system32\cmd.exe
C:\PHYBasic\pC-PXA270\Linux\jflash>jflashmm bulbcx u-boot_viosoft.bin P 0 PAR
JFLASH Version 5.01.003
COPYRIGHT (C) 2000 - 2003 Intel Corporation modified by PHYTEC 1

PLATFORM SELECTION:
Processor=      PXA27x
Development System=  Mainstone
Data Version=   1.00.002

ACT: 0111 1001001001100101 00000001001 1
EXP: **** 1001001001100101 00000001001 1

PXA27x revision ??
```

- Press <Enter> again to start the programming of **UBoot**.

```
C:\WINDOWS\system32\cmd.exe
C:\PHYBasic\pC-PXA270\Linux\jflash>jflashmm bulbcx u-boot_viosoft.bin P 0 PAR
JFLASH Version 5.01.003
COPYRIGHT (C) 2000 - 2003 Intel Corporation modified by PHYTEC 1

PLATFORM SELECTION:
Processor=      PXA27x
Development System=  Mainstone
Data Version=   1.00.002

ACT: 0111 1001001001100101 00000001001 1
EXP: **** 1001001001100101 00000001001 1

PXA27x revision ??

Found flash type: 28F128J3A

Erasing block at address 0
Starting programming
Using BUFFER programming mode...
Writing flash at hex address      6780, 16.12% done
```

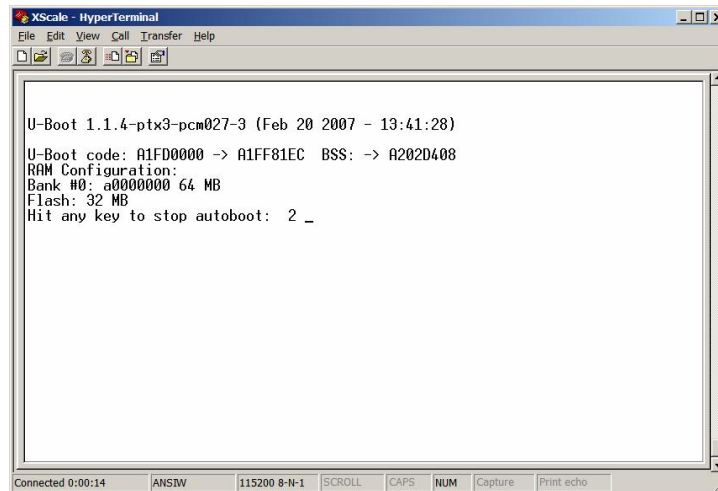
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The **U-Boot** utility has now been successfully downloaded and resides in the phyCORE-PXA270 on-board Flash memory from address 0 to 0x40000.

- Please verify that U-Boot executes correctly by viewing the serial output in the HyperTerminal window:



```
XScale - HyperTerminal
File Edit View Call Transfer Help
U-Boot 1.1.4-ptx3-pcm027-3 (Feb 20 2007 - 13:41:28)
U-Boot code: A1FD0000 -> A1FF81EC BSS: -> A202D408
RAM Configuration:
Bank #0: a0000000 64 MB
Flash: 32 MB
Hit any key to stop autoboot: 2 _
```

You are now ready to download the Linux kernel and file system into the onboard flash on the phyCORE-PXA270.

3.3 Interfacing the phyCORE-PXA270 to a Linux Host-PC

Downloading a Linux kernel and file system over the Ethernet from a Linux host-PC to the phyCORE-PXA270/Development Board combination (also referred to as target hardware) requires use of a terminal program, such as **Minicom** or **Komport**, and **TFTP networking** service installed and activated.

- Copy the Linux demo images **ulmage.phytec** and **root.jffs2.phytec** from the included Tools CD to your TFTP directory on your Linux machine.
- Connect the included RS-232 null-modem cable to an available COM port on your Linux PC and DB-9 (P1) of the phyCORE Development Board.

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- Connect the RJ-45 socket at X23 on the Development Board to the host-PC using a cross-over Ethernet cable¹.
- Open your terminal program of choice.
- Configure the terminal program as follows: **115200 baud, 8 data bits, no parity, 1 stop bit, no hardware handshake.**
- Connect the included 12 VDC power adapter to the power socket X1 on the Development Board.

In the terminal window, you will see U-Boot startup messages attempting to tftpboot over the network once power is applied to the target hardware.

U-Boot 1.1.4-ptx3-pcm027-3 (Feb 20 2007 - 13:41:28)

U-Boot 1.1.4-ptx3-pcm027-3 (Feb 20 2007 - 13:41:28)

U-Boot code: A1FD0000 -> A1FF81EC BSS: -> A202D408

RAM Configuration:

Bank #0: a0000000 64 MB

Flash: 32 MB

Hit any key to stop autoboot: 3

¹: You may also use a straight Ethernet cable connected to a hub to establish network connection between the phyCORE-PXA270 hardware and the host-PC.

3.4 Downloading a Linux Image

- After stopping the autoboot you should see the following in your Minicom window (note the `Pcm027>` prompt at the bottom):

```
U-Boot 1.1.4-ptx3-pcm027-3 (Feb 20 2007 - 13:41:28)
```

```
U-Boot code: A1FD0000 -> A1FF81EC BSS: -> A202D408
```

```
RAM Configuration:
```

```
Bank #0: a0000000 64 MB
```

```
Flash: 32 MB
```

```
Hit any key to stop autoboot: 0
```

```
Pcm027>
```

Note: A complete list of currently supported U-Boot commands is displayed after entering "help" in the command line.

- Configure U-Boot environmental variables using the following commands:

Note: In order to ensure proper execution of this demo you must set the IP address for the phyCORE-PXA270, the netmask, and the gateway IP. The network setup used for this example is:

```
IP = 192.168.1.104,  
netmask = 255.255.255.0,  
serverip = 192.168.1.105,  
gateway = 192.168.1.1
```

Be sure to enter the IP addresses specific to your network in the following steps. The values shown below are used as examples.

```
Pcm027> set serverip 192.168.1.105
```

(IP address of your TFTP server. Can be found by running ifconfig in a shell window)

```
Pcm027> set ipaddr 192.168.1.104
```

(IP address of the module. Make sure this IP is not in use by another machine on the network)

```
Pcm027> set netmask 255.255.255.0
```

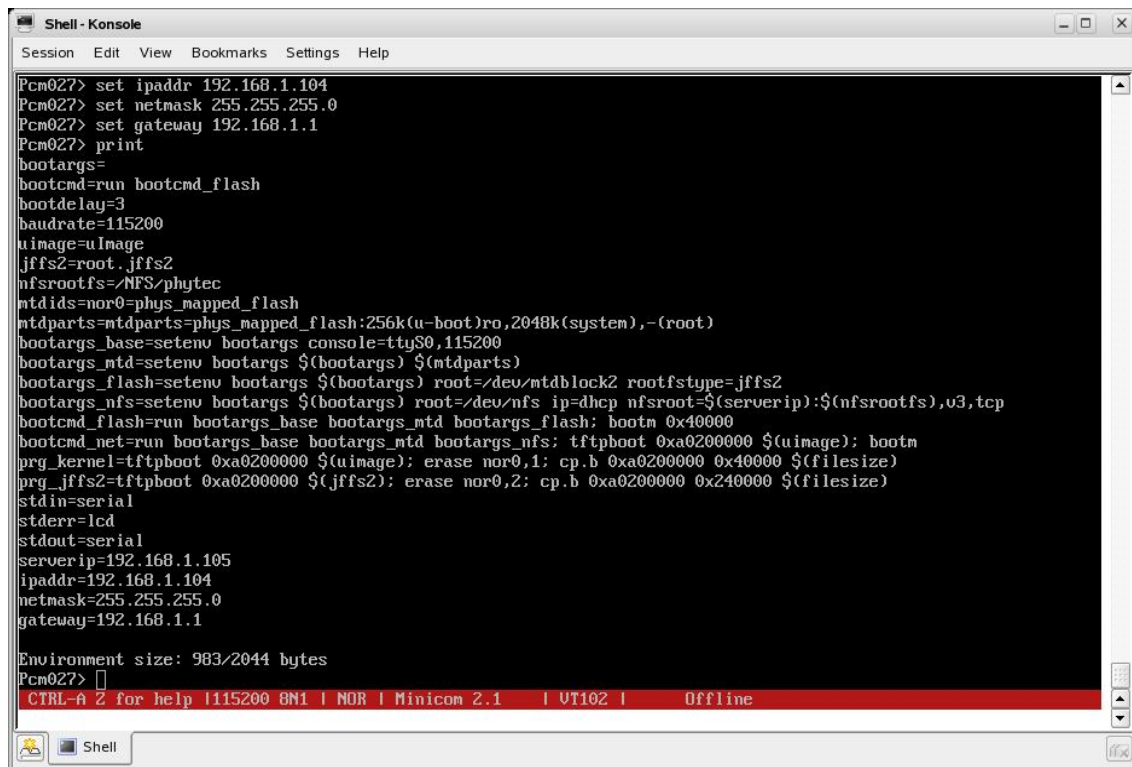
(net mask of the network system)

```
Pcm027> set gateway 192.168.1.1
```

(gateway of the network system)

- Enter the print command in the terminal window and verify that the environmental variables are set as displayed in the following figure. (Note that you may have to scroll or resize the window to view the environment variables.)

```
Pcm027> print
```



```
Shell - Konsole
Session Edit View Bookmarks Settings Help
Pcm027> set ipaddr 192.168.1.104
Pcm027> set netmask 255.255.255.0
Pcm027> set gateway 192.168.1.1
Pcm027> print
bootargs=
bootcmd=run bootcmd_flash
bootdelay=3
baudrate=115200
uimage=uImage
jffs2=root.jffs2
nfsrootfs=/NFS/phytec
mtdids=nor0=phys_mapped_flash
mtdparts=mtdparts=phys_mapped_flash:256k(u-boot)ro,2048k(system),-(root)
bootargs_base=setenv bootargs console=ttys0,115200
bootargs_mtd=setenv bootargs $(bootargs) $(mtdparts)
bootargs_flash=setenv bootargs $(bootargs) root=/dev/mtdblock2 rootfstype=jffs2
bootargs_nfs=setenv bootargs $(bootargs) root=/dev/nfs ip=dhcp nfsroot=$(serverip):$(nfsrootfs),u3,tcp
bootcmd_flash=run bootargs_base bootargs_mtd bootargs_flash; bootm 0x40000
bootcmd_net=run bootargs_base bootargs_mtd bootargs_nfs; tftpboot 0xa0200000 $(uimage); boot
prg_kernel=tftpboot 0xa0200000 $(uimage); erase nor0,1; cp.b 0xa0200000 0x40000 $(filesize)
prg_jffs2=tftpboot 0xa0200000 $(jffs2); erase nor0,2; cp.b 0xa0200000 0x240000 $(filesize)
stdin=serial
stderr=lcd
stdout=serial
serverip=192.168.1.105
ipaddr=192.168.1.104
netmask=255.255.255.0
gateway=192.168.1.1

Environment size: 983/2044 bytes
Pcm027>
CTRL-A Z for help | 115200 8N1 | NOR | Minicom 2.1 | UT102 | Offline
```

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Note: A text file containing the necessary environment variables required for U-Boot to boot the Linux image is included on the tools directory:

```
lpC-PXA270\Linux\Linux_Image\Viosoft\set_vars.txt
```

- When the environment variables are properly configured, they must be stored to nonvolatile memory so the configuration will remain after reboot.

```
Pcm027> saveenv
```

```
Saving Environment to EEPROM...
```

- When the environment variables are written to EEPROM the image can be transferred to RAM and then to flash. First the flash memory sectors which will be written to must be erased.

```
Pcm027> erase 00040000 01ffffff
```

```
Erasing sector 1 ... ok.
```

```
Erasing sector 2 ... ok.
```

```
Erasing sector 3 ... ok.
```

```
Erasing sector 4 ... ok.
```

```
Erasing sector 5 ... ok.
```

```
.
```

```
.
```

```
Erasing sector 127 ... ok.
```

- Load the file ulmage.phytec from your tftp server into RAM at address a3000000 by typing the following in the command line:

```
Pcm027> tftpboot a3000000 uImage.phytec
```

```
Using MAC Address 00:50:C2:5A:73:D8
```

```
TFTP from server 192.168.1.105; our IP address is 192.168.1.104
```

```
Filename 'uImage.phytec'.
```

```
Load address: 0xa3000000
```

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```

Loading: #####
.
.
#####
done
Bytes transferred = 1260212 (133ab4 hex)

```

- Copy the kernel from RAM address 0xa3000000 to flash memory starting at 0x40000. The length of memory to be copied is specified as 0x133ab4, as seen from the tftpboot procedure above. Note the length is reported after the file is loaded into ram. This will take a couple minutes:

```
Pcm027> cp.b a3000000 00040000 133ab4
```

```
Copy to Flash... done
```

- Next the file system must be copied to RAM address 0xa3000000.

```

Pcm027> tftpboot a3000000 root.jffs2.phytec
Using MAC Address 00:50:C2:5A:73:D8
TFTP from server 192.168.1.105; our IP address is 192.168.1.104
Filename 'root.jffs2.phytec'.
Load address: 0xa3000000
Loading: #####
.
.
#####
done
Bytes transferred = 13868052 (d39c14 hex)

```

- Copy the file system from RAM address 0xa3000000 to flash memory starting at 0x440000. The length of memory to be copied is specified as 0xd39c14. Note the length is reported after the file is loaded into ram. This will take a few minutes:

```
Pcm027> cp.b a3000000 00440000 d39c14
Copy to Flash... done
```

Now you have successfully downloaded the kernel and file system over a tftp Ethernet connection into RAM, copied the Linux kernel and file system from RAM into Flash, and set the environment variables to automatically boot the kernel from Flash upon a reset.

- Reset the module with the following command:

```
Pcm027> reset
```

- While U-boot is checking the image checksum you see the following:

```
U-Boot 1.1.4-ptx3-pcm027-3 (Feb 20 2007 - 13:41:28)

U-Boot code: A1FD0000 -> A1FF81EC BSS: -> A202D408
RAM Configuration:
Bank #0: a0000000 64 MB
Flash: 32 MB
Hit any key to stop autoboot: 0
## Booting image at 00040000 ...

Image Name: Linux-2.6.16-pcm027-2
Created: 2006-07-25 23:13:54 UTC
Image Type: ARM Linux Kernel Image (uncompressed)
Data Size: 1260148 Bytes = 1.2 MB
Load Address: a0008000
Entry Point: a0008000
Verifying Checksum ... OK
```

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- You should see the Linux image boot up in the Terminal window, this takes a couple minutes to complete. Once loaded the following login screen is displayed:

Welcome to the Viosoft's Arriba Development Environment

This package is distributed as part of:

*Arriba Embedded Linux Edition
for Phyttec phyCORE PXA2xx
<http://www.viosoft.com>
info@viosoft.com*

(none) login: root

[root@(none) ~]#

You are now running Linux from flash memory. The system will automatically load this image upon reset.

4 Getting More Involved

4.1 Using a Flash Drive

The following steps outline how to configure and use a USB flash drive with the PXA270. This demo has been tested using a CRUZER mini and PNY flash drives with 256 MB of capacity.

- Insert the USB memory device into a USB slot on the Phyttec carrier board.
- Load the USB storage module as follows:

```
[root@(none) ~]# modprobe ohci-hcd

pxa27x-ohci pxa27x-ohci: PXA27x OHCI
pxa27x-ohci pxa27x-ohci: new USB bus registered, assigned bus number 1
pxa27x-ohci pxa27x-ohci: irq 3, io mem 0x4c000000
usb usb1: configuration #1 chosen from 1 choice
hub 1-0:1.0: USB hub found
hub 1-0:1.0: 3 ports detected

[root@(none) ~]# usb 1-1: new full speed USB device using pxa27x-ohci
and address 2
usb 1-1: configuration #1 chosen from 1 choice
```

- Press enter. Then issue the command:

```
[root@(none) ~]# modprobe usb_storage
```

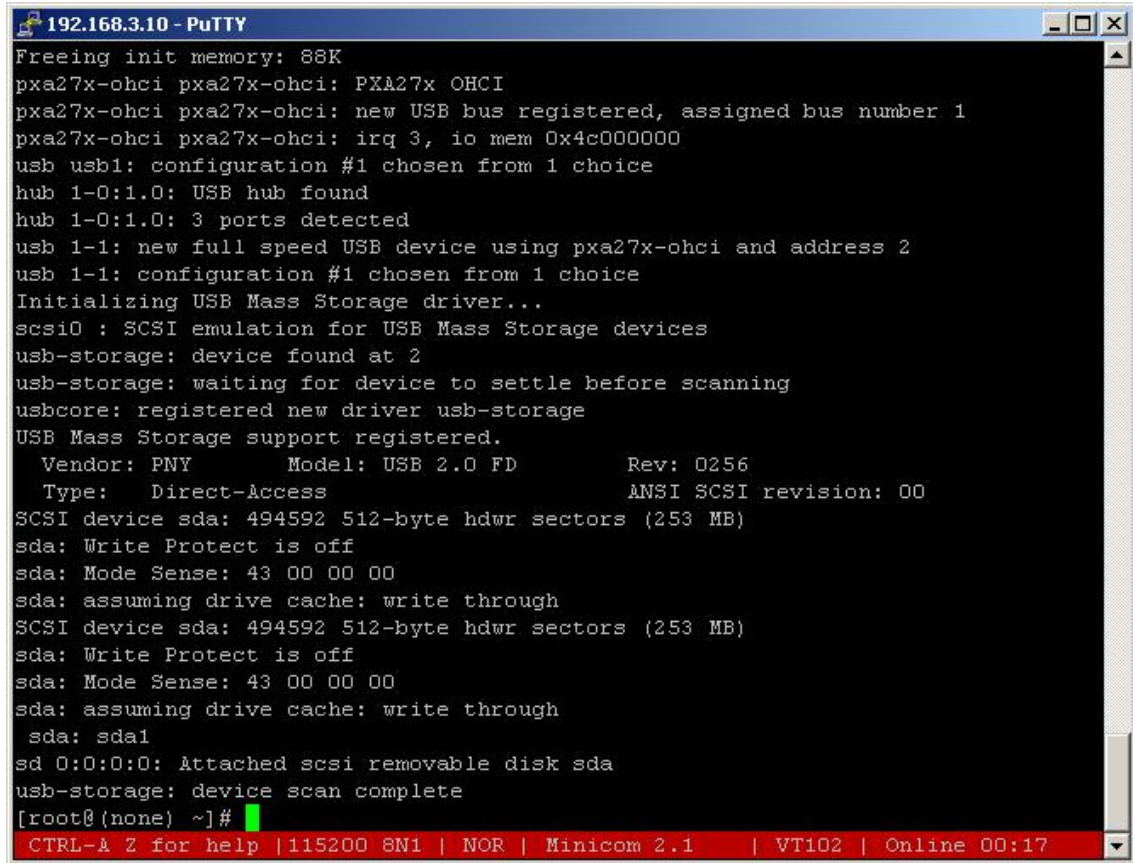
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- Press enter. Run dmesg and the USB storage should be successfully loaded. The included screen shot gives the example output after dmesg is run. Much of the output is omitted. however the end of the output is included for reference:

```
[root@(none) ~]# dmesg
```



```
192.168.3.10 - PuTTY
Freeing init memory: 88K
pxa27x-ohci pxa27x-ohci: PXA27x OHCI
pxa27x-ohci pxa27x-ohci: new USB bus registered, assigned bus number 1
pxa27x-ohci pxa27x-ohci: irq 3, io mem 0x4c000000
usb usb1: configuration #1 chosen from 1 choice
hub 1-0:1.0: USB hub found
hub 1-0:1.0: 3 ports detected
usb 1-1: new full speed USB device using pxa27x-ohci and address 2
usb 1-1: configuration #1 chosen from 1 choice
Initializing USB Mass Storage driver...
scsi0 : SCSI emulation for USB Mass Storage devices
usb-storage: device found at 2
usb-storage: waiting for device to settle before scanning
usbcore: registered new driver usb-storage
USB Mass Storage support registered.
 Vendor: PNY          Model: USB 2.0 FD          Rev: 0256
  Type:   Direct-Access          ANSI SCSI revision: 00
SCSI device sda: 494592 512-byte hdwr sectors (253 MB)
sda: Write Protect is off
sda: Mode Sense: 43 00 00 00
sda: assuming drive cache: write through
SCSI device sda: 494592 512-byte hdwr sectors (253 MB)
sda: Write Protect is off
sda: Mode Sense: 43 00 00 00
sda: assuming drive cache: write through
 sda: sda1
sd 0:0:0:0: Attached scsi removable disk sda
usb-storage: device scan complete
[root@(none) ~]#
CTRL-Å Z for help | 115200 8N1 | NOR | Minicom 2.1 | VT102 | Online 00:17
```

- Create a new directory to access the usb device.

```
[root@(none) /]# mkdir /mnt/usb
```

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- Mount the drive. The storage device can be accessed under /mnt/usb. The process of mounting the device is similar to any changing the current working directory to any other folder. The ls command simply shows the files contained on the storage device.

```
[root@(none) dev]# mount -t vfat /dev/sda1 /mnt/usb
[root@(none) dev]# cd /mnt/usb
[root@(none) usb]# ls
Coldfire.pdf*
Tutor.xls*
bootex.log*
lpc2294.pdf*
pC-MCF548x/
recommendation.doc*
```

- To remove the usb device first unmount the device then remove it from the system. To remount the device simply unmount the device using the umount command.

```
[root@(none) mnt]# cd /
[root@(none) /]# umount /mnt/usb
```

- The usb storage device can now be removed from the system.

4.2 Using a MMC Memory Card

- Insert the MMC card into the Phytec PXA270 MMC card slot or into the MMC card slot included on the Development Board.
- Connect the power to boot the device.
- Create a device to access the drive:

```
[root@(none) ~]# mkdir /mmc
```

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- Mount the drive. The files contained on the MMC card can be accessed in the `/mmc` folder by issuing the `ls` command from the `/mmc` directory.

```
[root@(none) ~]# mount -t vfat /dev/mmcblk0 /mmc
```

```
[root@(none) ~]# ls /mmc
```

```
Schematic_notes.xls* test.txt* test2.txt* tslib.h*
```

The MMC card has to be in place upon restart to be accessible due to initialization code that is run when Linux boots up. If the card is removed from the system it will become unreadable.