

## phyCORE®-XScale/PXA270 Development Kit (KPCM-027) Loading a Linux Image (demo.img)

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 Manual for specific information on such board-level features as jumper configuration, memory mapping, and pinout.*

The included Linux image (**demo.img**) was created using **SYSGO ElinOS** tools. This demo includes support for:

- MMC
- LCD Display
- Network (a web-server)
- USB Keyboard, Mouse, Memory-Stick
- IDE CF and Harddisk
- Realtime clock
- JFFS2 Filesystem
- sound (you can connect active loadspeakers to line out )

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



## 1 System Description

### 1.1 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 cable<sup>1</sup>

### 1.2 System Requirements for loading Linux Image

This Application Note for the phyCORE-PXA270 requires a Linux host PC, the use of a terminal program on the host-PC, such as Komport or Minicom for Linux, together with TFTP services.

### 1.3 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 2.2, "Downloading U-Boot"), a Windows based PC is required to use the Jflash utility for programming the phyCORE-PXA270.

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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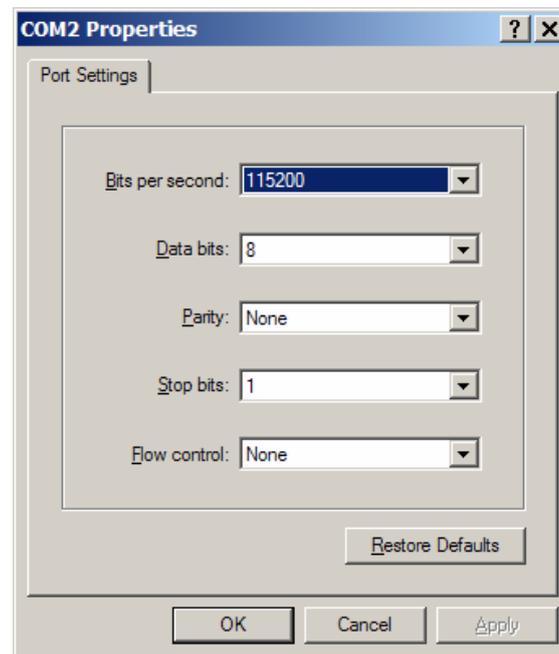
## 2 Getting Started

**Note:**

If the Bootloader is pre-installed on the phyCORE-PXA270, *skip to section 2.3 and 2.4 for loading a Linux image.*

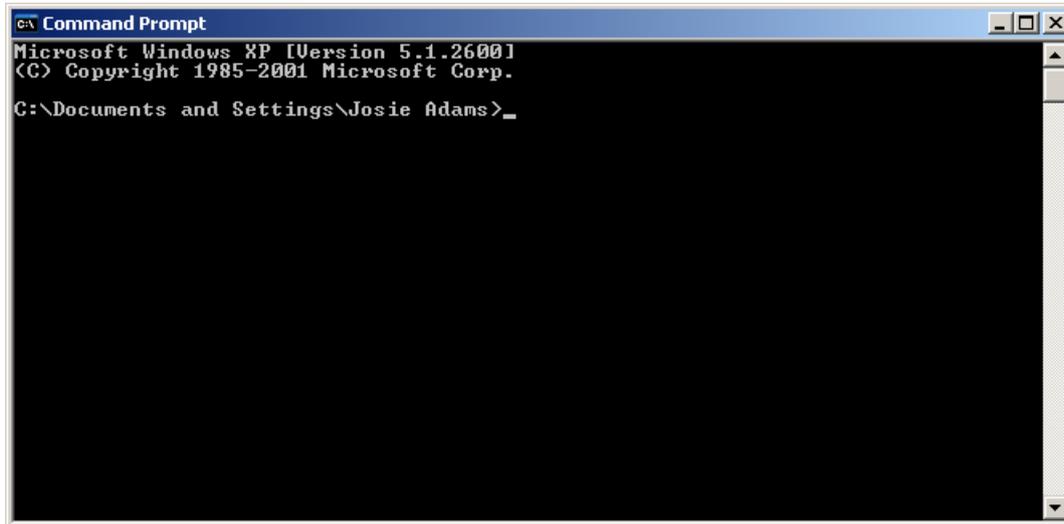
### 2.1 Interfacing the phyCORE-PXA270 to a Windows Host-PC

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



## 2.2 Downloading U-Boot

- Use the Windows Start button to open the Microsoft MS Command Prompt:  
***Start/Programs/Accessories/Command Prompt.***
- The following window should appear:

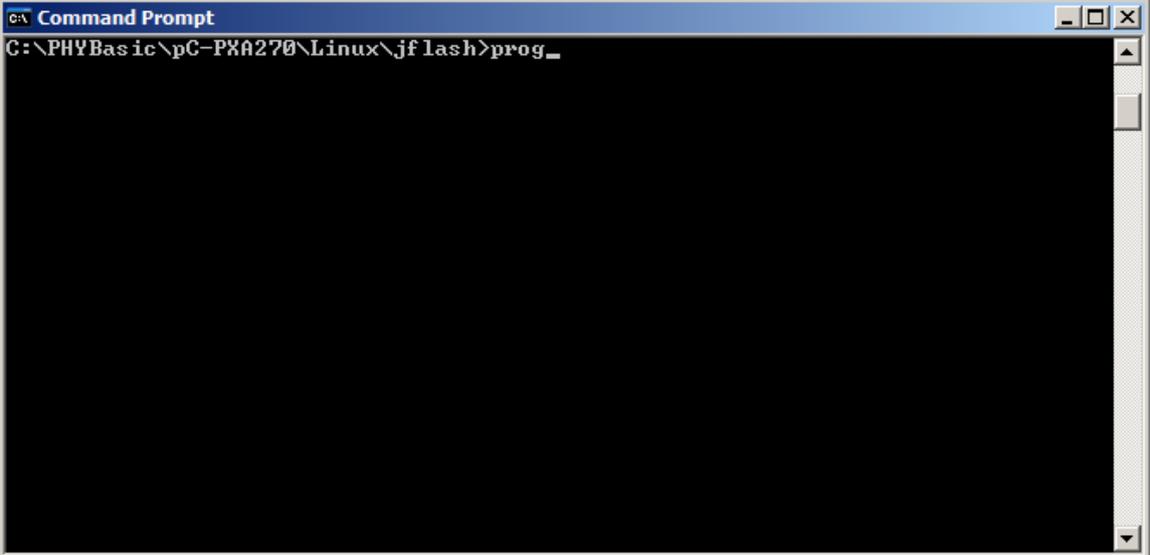


- Change directory to the location of **jflash** folder.



```
C:\PHYBas ic\pC-PXA270\Linux\jflash>
```

- Start the **Jflash** program, which will load **U-Boot**, by typing **prog** at the command prompt and then pressing <Enter>. The **prog** batch file contains all the necessary command line options and the U-Boot file name<sup>1</sup>.



```
C:\PHYBas ic\pC-PXA270\Linux\jflash>prog_
```

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<sup>1</sup>: For all phyCORE-PXA270 units shipped prior to March 2006 the U-Boot file name was **u-boot.bin**. phyCORE-PXA270 SBC modules built in March 2006 or later are populated with an Intel J3 embedded Flash device and require use of a different U-Boot file. The file name has been changed to **u-boot\_270\_J3D.bin**. Make sure the correct U-Boot file name is used in the **prog.bat** file.

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- 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:\PHYBasic\pC-PXA270\Linux\jflash>prog
C:\PHYBasic\pC-PXA270\Linux\jflash>jflashmm bulbcx u-boot_270_J3D.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
    
```

- After pressing <Enter>, the *PXA27x revision ??* should invoke in the MS Command Prompt window as below.

```

C:\PHYBasic\pC-PXA270\Linux\jflash>prog
C:\PHYBasic\pC-PXA270\Linux\jflash>jflashmm bulbcx u-boot_270_J3D.bin P 0 PAR
JFLASH Version 5.01.003
COPYRIGHT (C) 2000 - 2003 Intel Corporation modified by PHYTEC 1

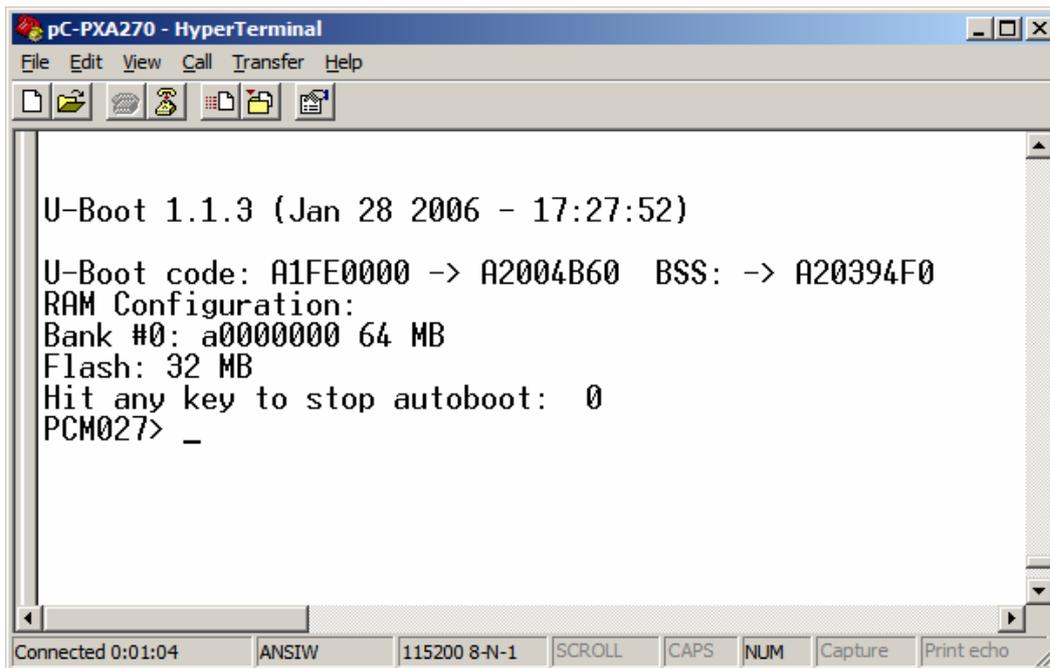
PLATFORM SELECTION:
Processor=           PXA27x
Development System= Mainstone
Data Version=       1.00.002

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

PXA27x revision ??
    
```

- Press <Enter> again.





```
pC-PXA270 - HyperTerminal
File Edit View Call Transfer Help
U-Boot 1.1.3 (Jan 28 2006 - 17:27:52)
U-Boot code: A1FE0000 -> A2004B60 BSS: -> A20394F0
RAM Configuration:
Bank #0: a0000000 64 MB
Flash: 32 MB
Hit any key to stop autoboot: 0
PCM027> _
```

Connected 0:01:04 ANSIW 115200 8-N-1 SCROLL CAPS NUM Capture Print echo

You are now ready to download the Linux demo image.

### 2.3 Interfacing the phyCORE-PXA270 to a Linux Host-PC

Downloading a Linux kernel 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 the TFTP networking service installed and activated.

- Copy the Linux demo image **demo.img** 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.
- Connect the RJ-45 socket at X23 on the Development Board to the host-PC using a cross-over Ethernet cable<sup>1</sup>.
- Open your terminal program of choice.

<sup>1</sup>: 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.

- Configure the terminal program to 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 1.1.3 (Jan 28 2006 - 17:27:52)*

*U-Boot code: A1FE0000 -> A2004B60- BSS: -> A20394F0*

*RAM Configuration:*

*Bank #0: a0000000 64 MB*

*Flash: 32 MB*

*Hit any key to stop autoboot: 3*

- Hit any key to stop tftpboot autoboot, as the environment settings for the target hardware must first be configured.

## 2.4 Downloading a Linux Image

- After stopping the autoboot you should see the following in your Minicom window:

```
U-Boot 1.1.3 (Jan 28 2006 - 17:27:52)

U-Boot code: A1FE0000 -> A2004B60- BSS: -> A20394F0
RAM Configuration:
Bank #0: a0000000 64 MB
Flash: 32 MB
Hit any key to stop autoboot:  0
PCM027>
```

- At the **PCM027>** command prompt, enter the following command to view the current environment variable settings:

```
PCM027> printenv
```

**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:**

Be sure to enter the IP address specific to your network. The values shown below are used as examples.

```
PCM027> setenv serverip 192.168.3.10
(IP address of your TFTP server)

PCM027> setenv ipaddr 192.168.3.11
(IP address of the module)

PCM027> setenv netmask 255.255.255.0
(net mask of the network system)
```

- Set the boot arguments to be passed to the Linux kernel by modifying the **bootargs** argument from the **bootargs.txt** file, located in the **Linux\_Image** folder on the PHYTEC Tool-CD. The IP values must match the settings made in the previous step. Copy the entire **bootargs** variable from the **.txt** file. All arguments **must** be in one line before copying to be pasted into the terminal window.

```
bootargs devfs=mount mem=64M rw rootfstype=tmpfs
root=/dev/ram
ip=192.186.3.11:192.168.3.10:192.168.3.1:255.255.0.0::eth0:
console=ttyS0,115200n8
```

**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 bootargs variable sets these values. The network setup for this example was:

```
IP = 192.168.3.11,
netmask = 255.255.255.0,
tftpserver = 192.168.3.10,
gateway = 192.168.3.1
```

- Enter **setenv** in the command prompt in the terminal window and paste the bootargs variable into the terminal window, as shown below.

```
PCM027> setenv bootargs devfs=mount mem=64M rw
rootfstype=tmpfs root=/dev/ram
ip=192.186.3.11:192.168.3.10:192.168.3.1:255.255.0.0::eth0:
console=ttyS0,115200n8
```

- Disable the autostart with the following command:
- Save environment settings with the following command:

```
PCM027> saveenv
```



- Set the environment variable **bootcmd** to copy image from flash at address 0x40000 with length 0x450000 into ram and boot from ram at 0xA3000000.

```
PCM027> setenv bootcmd cp.b 40000 a3000000 450000\;bootm a3000000
```

- Re-enable autostart

```
PCM027> setenv autostart yes
```

- Saving Environment to EEPROM...

```
PCM027> saveenv
```

- Print the environment variables to double-check your settings:

```
PCM027> printenv
```

Environment variables that appear in the terminal window should be similar as follows (**ipaddr** and **serverip** and are example values):

```
printenv
bootdelay=3
baudrate=115200
ethaddr=00:50:C2:48:55:A4
bootfile=uImage
bootcmd=cp.b 40000 a3000000 450000;bootm a3000000
bootargs=devfs=mount=mem=64M rw rootfstype=tmpfs
root=/dev/ram
ip=192.168.3.11:192.168.3.10:192.168.3.1:255.255.255.0::eth0
: console=ttyS0,115200n8
filesize=447a86
fileaddr=A3000000
netmask=255.255.0.0
ipaddr=192.168.3.11
serverip=192.168.3.10
autostart=yes
stdin=serial
stderr=lcd
stdout=serial
```

```
Environment size: 418/1020 bytes
```

```
PCM027>
```

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:

```
## Booting image at a3000000 ...
Image Name:   Multi-File Image
Created:      2005-11-30 14:32:54 UTC
Image Type:   ARM Linux Multi-File Image (gzip compressed)
Data Size:    4487750 Bytes = 4.3 MB
Load Address: a0008000
Entry Point:  a0008000
Contents:
Image 0:      994819 Bytes = 971.5 kB
Image 1:      3492918 Bytes = 3.3 MB
Verifying Checksum ... OK
Uncompressing Multi-File Image ... OK
```

```
Starting kernel ...
```

### Caution!

Don't use the "flash\_eraseall" command or any JFFS2 commands. If you do so, you will corrupt the "demo.img" inside the flash. If the demo.img is corrupted, you will get an DATA CRC error when U-boot is checking the image checksum. You will also see a checksum error if the image was not copied to the correct memory space.

- You should see the Linux image boot up in the Terminal window, this takes a couple minutes to complete. Please see a portion of the output below:

```
Linux version 2.6.12.6-elinos-218 (kilb@obelix) (gccversion
3.4.4 (ELinOS V4.0
3.4.4-11 2005-10-23)) #1 Wed Nov 30 15:11:41 CET 2005
```

```
.
.
.
```

***ELinOS Netconfig 4.0-14******=====******Checking if network driver installed: found unconfigured interface eth0******Interface configuration******=====******Enter an IP-Address for this machine [192.1.1.1]:***

To begin the demo, you have to setup the IP address, the netmask, and the gateway IP.

- Enter the IP address of the phyCORE-PXA270 at the prompt and then y for yes as prompted, for our demo we use IP Address **192.168.3.11**:

***Enter an IP-Address for this machine [192.1.1.1]:  
Your input was 192.168.3.11, is this ok (y/n)? [y] y***

- Enter the netmask for the phyCORE-PXA270, for our demo we use **255.255.255.0** and then y for yes as prompted:

***Enter the netmask for this machine [255.255.255.0]:  
Your input was 255.255.255.0, is this ok (y/n)? [y] y***

- Enter the default route for the phyCORE-PXA270, for this demo we use **192.168.3.1**, and then y for yes as prompted.

***Enter the default route for this machine [192.168.3.1]:  
Your input was 192.168.3.1, is this ok (y/n)? [y] y***

The web server should now execute and output the following to the Terminal window:

```
Executing </sbin/ifconfig eth0 192.168.3.11 netmask
255.255.255.0>...
eth0: link down
Executing </sbin/route add default gw 192.168.3.1>...
Netconfig done.
```

```
BusyBox v1.00 (2005.10.23-16:29+0000) Built-in shell (msh)
Enter 'help' for a list of built-in commands.
```

```
%rdy000000
```

```
=====
==
== Welcome to the Codeo Development Environment!
==
=====

=====
==
== Welcome to the X Demo Project!
==
== This demo provides a small X-Server, which
== directly operates on a framebuffer device.
==
== To start the demo application, please enter:
== # startx
==
== Note: Since there are no fonts installed with this
== demo, the application may complain about
== missing fonts. You can safely ignore these
== messages for this demo.
==
=====
```

```
# eth0: link up, 100Mbps, full-duplex, lpa 0x41E1
```

**Note:**

At this time PHYTEC does not have an X-Server demo. You can connect to the webserver on the board via a webbrowser.

- Open an Internet browser and enter the IP address of your phyCORE-PXA270. For this example we have used IP address **192.168.3.11**. You will see the Linux web server in the browser as below:

