

AN10901

Programming and booting from NAND flash on the EA3100

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Application note

Document information

Info	Content
Keywords	LPC3100, LPC3131, LPC3152, NAND Flash
Abstract	Example for programming NAND flash on an EA3131 (EA3152) board.

Revision history

Rev	Date	Description
01	20100105	Initial version.

Contact information

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1. Introduction

This application note briefly covers the necessary steps required to:

- Load the APEX bootloader via UART
- Store a binary image of an application into the EA3131's NAND flash
- Configure the EA3131 to boot from NAND flash

It is assumed that user is familiar on how to create a binary that is executable on the EA3131 and therefore it will not be covered in this application note.

Note that the bootable binary (Boot ROM) has a size restriction.

Execution Part			
Program code	0x80	Max. 128 kB	Program code. The maximum size of the image allowed by boot ROM is 128 kB (including header). For LPC3130 restrict the size to 80 kB. The final image has to be padded to the nearest 512 byte boundary

Fig 1. Boot ROM size restriction

Although this application note refers to the EA3131 specifically, the same details apply to the EA3152. The ordered process remains the same but the APEX bootloader itself would however be compiled for the EA3152.

2. Configuring the EA3131 board

2.1 EA3131 board configuration

In terms of jumper configurations the EA3131 development board is highly customizable. Fig 2 shows the location of the jumpers that may need modification.

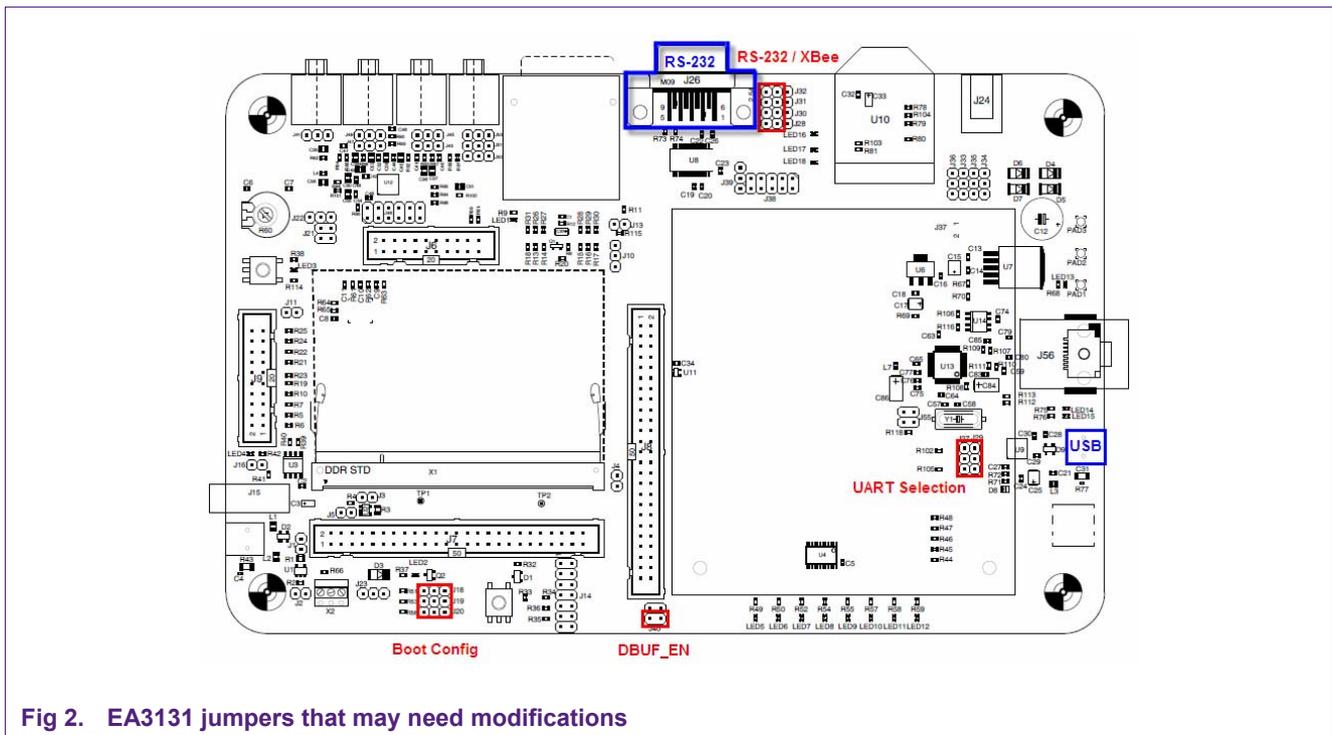


Fig 2. EA3131 jumpers that may need modifications

Table 1. Jumper descriptions

Jumpers	Description
Boot Config	These jumpers will determine in which boot mode the LPC313x will enter upon reset. UART Boot will attempt to boot an application from the UART interface. NAND Boot will attempt to boot an application from external NAND flash.
UART Selection	The UART selector routes the UART Tx/Rx pins to either the USB-to-UART chip or the RS-232 / XBee jumpers.
RS-232 / XBee	If the UART Tx/Rx pins are routed to these jumpers they can be then re-routed to either the RS-232 interface or the XBee module. XBee is not used in this application note; therefore select the RS-232 interface.
DBUF_EN	Enables or disables some control lines to the LCD and Ethernet modules. The LCD and Ethernet modules need to be disabled to avoid a bus contention during the NAND flash boot. This applies to LPC31xx Base Board versions 1.x and 2.0

2.1.1 Boot config

Fig 3 shows the boot configurations for UART and NAND boot.

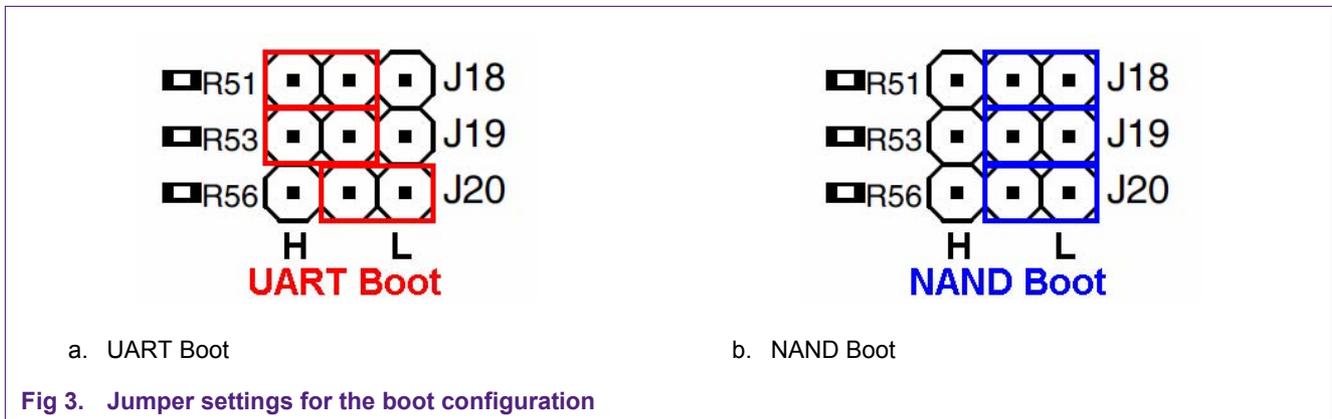
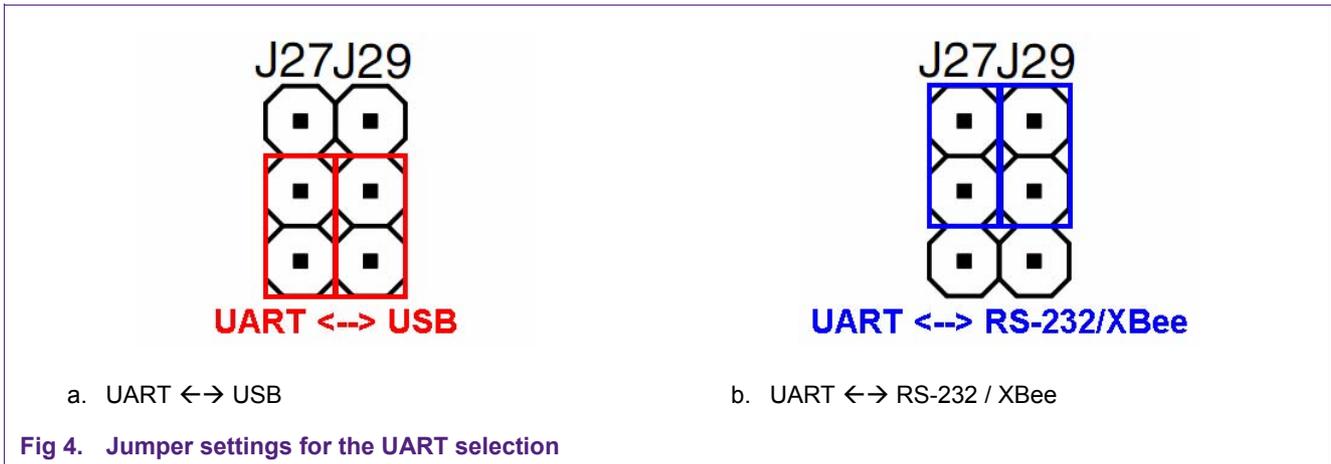


Fig 3. Jumper settings for the boot configuration

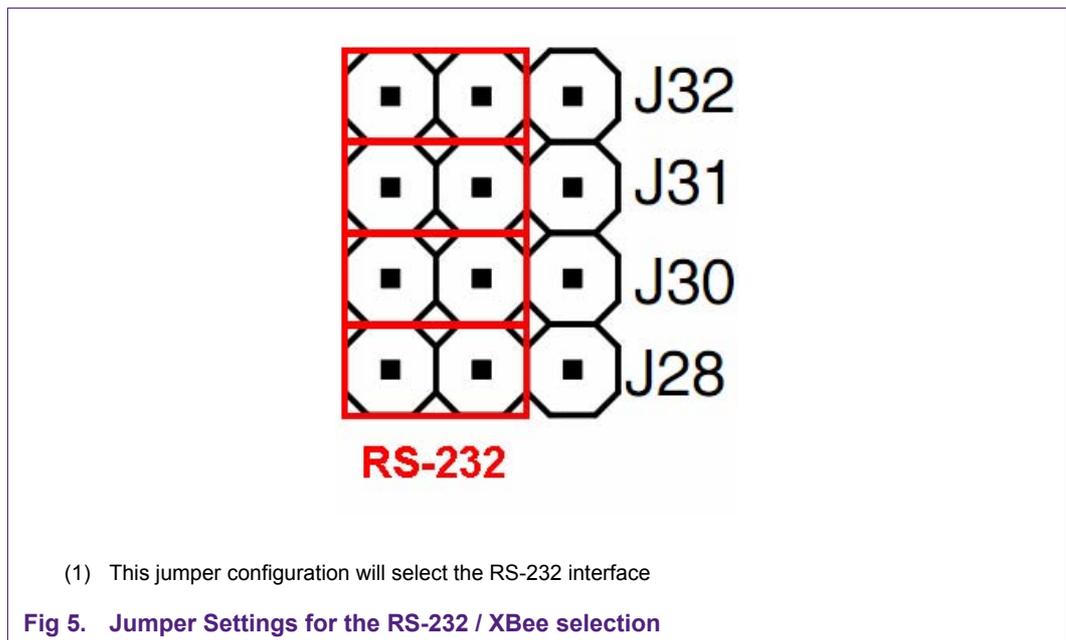
2.1.2 UART selection

Fig 4 shows the jumper settings to route the UART's Tx/Rx pins to either the UART-to-USB chip or the RS-232 / XBee jumpers.



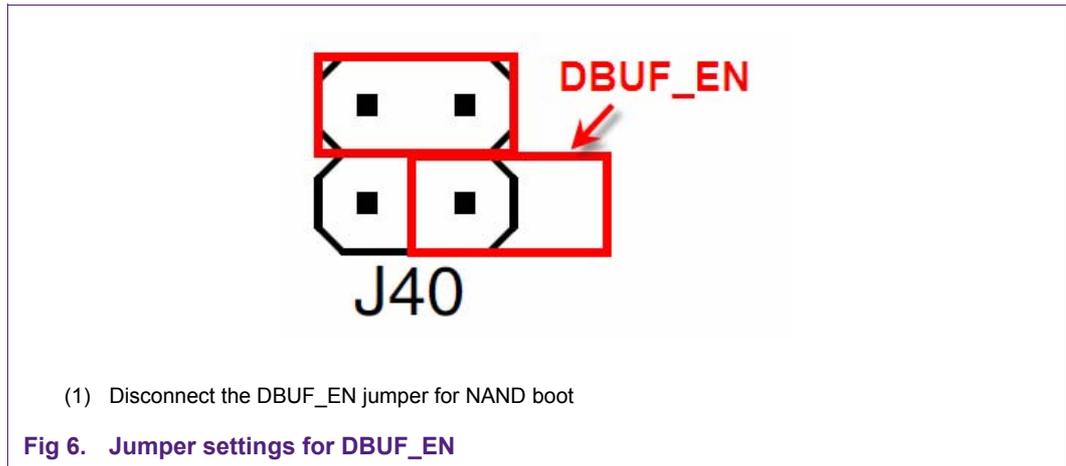
2.1.3 RS-232 / XBee

XBee isn't used in this application note; therefore, only the RS-232 configuration is shown.



2.1.4 DBUF_EN

To avoid a bus contention during the NAND boot the LCD and Ethernet modules need to be disabled. After the boot process, this jumper can be re-enabled if the LPC3131 has been initialized properly.

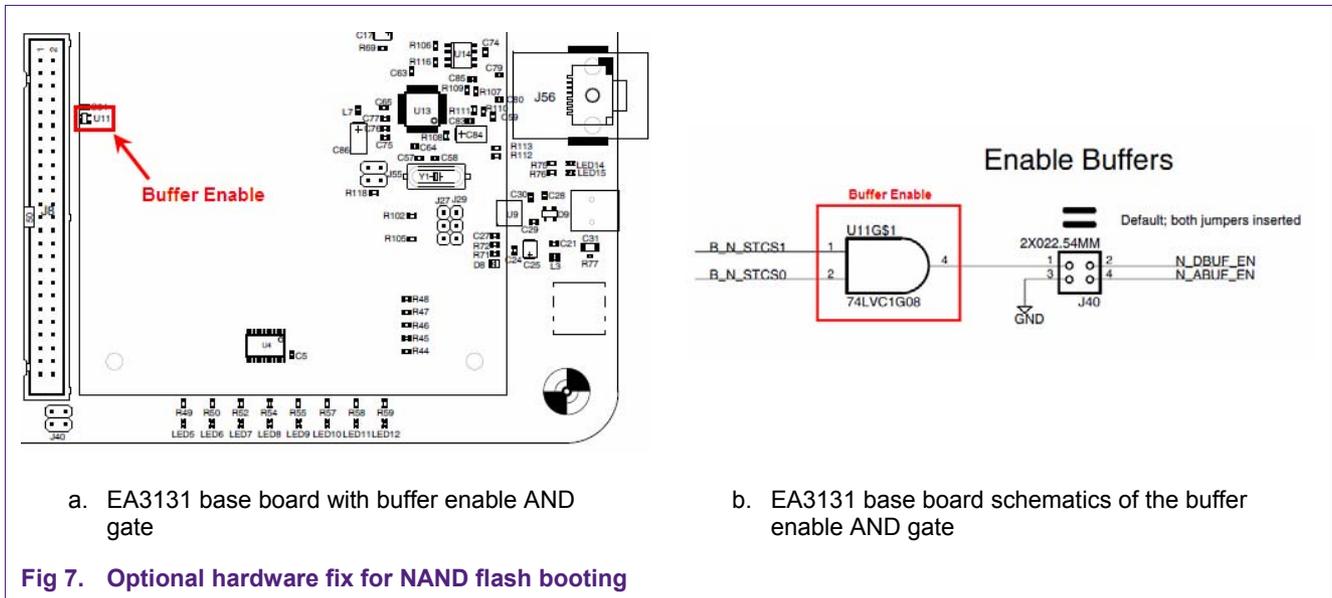


This applies to the LPC31xx Base Board versions 1.x and 2.0

2.1.4.1 Optional hardware fix

Instead of having to open the “DBUF_EN” jumper, the user may choose to perform a hardware fix for the NAND flash boot option.

The AND gate (U11) can be replaced by a XNOR gate.



2.2 UART Settings

Regardless if UART is to be connected via USB or the RS-232 interface, the default UART configurations are as follows: 115200kbps, 8, N, 1

2.2.1 UART via USB

The USB port shown in [Fig 2](#) has a dual function for this application note.

1. It provides electrical power to the EA3131 development board.
2. It allows for a serial UART connection to the LPC313x using a USB channel.

To configure the EA3131 board to use the UART via USB, ensure that the UART selection jumpers are set for “USB”. See [Fig 4a](#).

Connect the EA3131 to a windows workstation and install the drivers available from the Embedded Artist website.

Once the USB drivers have been installed, determine which COM port was assigned to this connection by viewing the available ports in the “Device Manager”.

Start→Settings→Control Panel→System→”Hardware” Tab→Device Manager

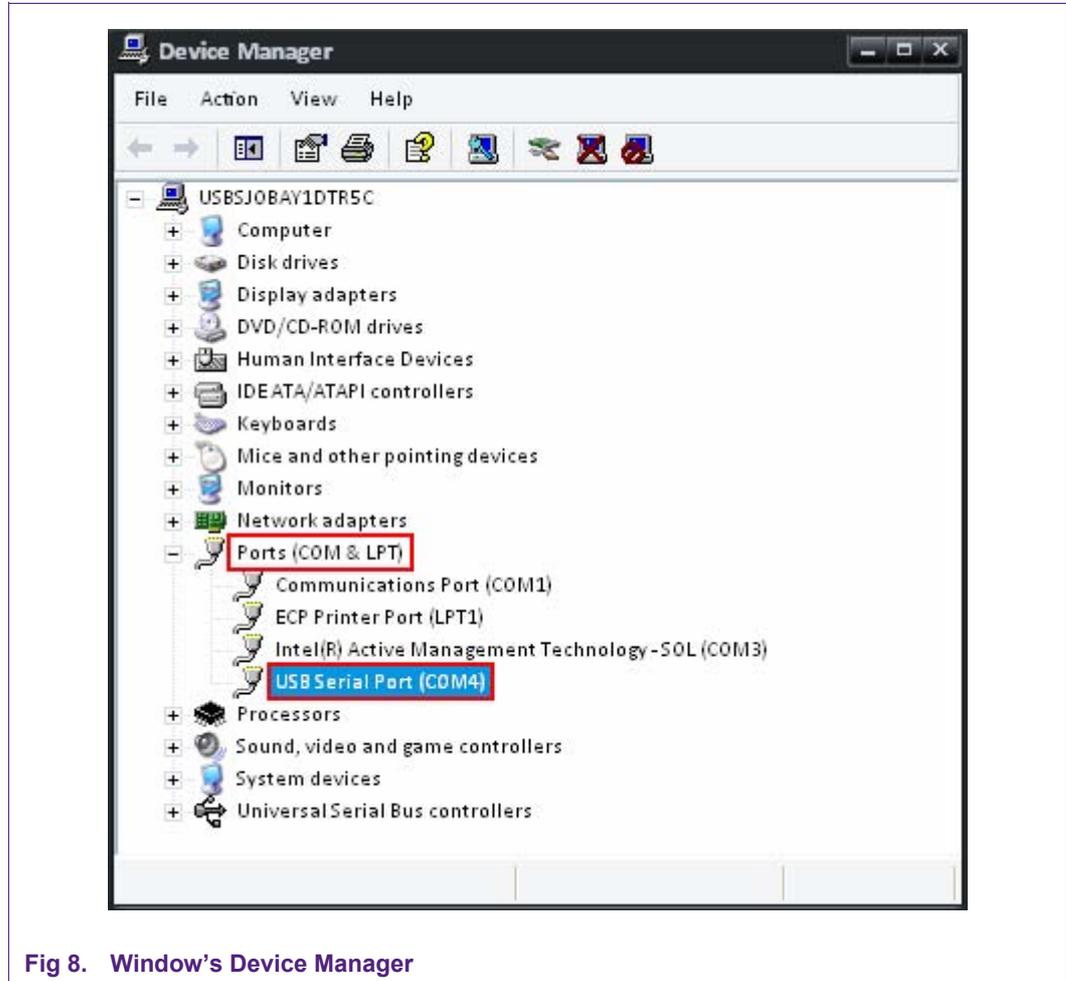


Fig 8. Window’s Device Manager

By using the COM port shown in the “Device Manager” you can now use a serial terminal application to communicate to the EA3131.

Note: Once the USB drivers have been installed, it is recommended to consistently use the same physical USB port on that workstation. If connected to a different USB port the next time, USB drivers will automatically be re-installed for that particular port – creating a new serial COM port.

2.2.2 UART via RS-232

To use UART via the RS-232 interface, we would simply re-route the UART Tx/Rx pins to the RS-232 / XBee headers as shown in [Fig 4b](#). Assuming that the RS-232 interface is selected as shown in [Fig 5](#), we can simply attach a RS-232 cable onto the male DB-9 connector shown in [Fig 2](#).

2.3 Booting the EA3131 from UART

Configure the “Boot Config” jumpers to UART mode. See [Fig 3a](#).

2.4 Booting the EA3131 from NAND flash

Configure the “Boot Config” jumpers to NAND mode. See [Fig 3b](#).

Disable the “DBUF_EN” jumper. See [Fig 6](#).

Disabling “DBUF_EN” only applies to the LPC31xx Base Board versions 1.x and 2.0.

3. Programming the NAND flash

3.1 Connect the EA313x board to the PC

Configure the EA313x board to boot from UART and then connect it via a RS-232 or USB cable to a PC.

[Fig 1](#) shows where the male DB9 and USB connectors are.

3.2 Launch Serial Terminal Application

Configure a terminal application (which should be able to transfer files in binary mode, such as TeraTerm Pro) with 115200-8-n settings. If using the UART-to-USB bridge on EA board, the appropriate Virtual COM port has to be selected. By the time the UART-to-USB chip enumerates, the bootROM of LPC313x would have transmitted the initial string. Hence reset the board using the "reset" button after opening the terminal application.

Notes

1. The default installation of TeraTerm Pro allows only up to COM4 ports. To increase the number of COM ports accessible by TeraTerm Pro, change the following line in TERATERM.INI (C:\Program Files\TTERMPRO):

```
MaxComPort=4 to MaxComPort=10
```

2. Don't use the Hyperterminal program, because it does not provide a way to send a file as binary.

3.3 Loading the APEX bootloader

The initial step is to load the APEX bootloader into memory. It is important to use APEX version 1.6.8 or higher because it includes support to program NAND flash.

Once the EA313x board is powered and connected to the PC, reset the board. [Fig 9](#) shows the message that should appear in the terminal window:

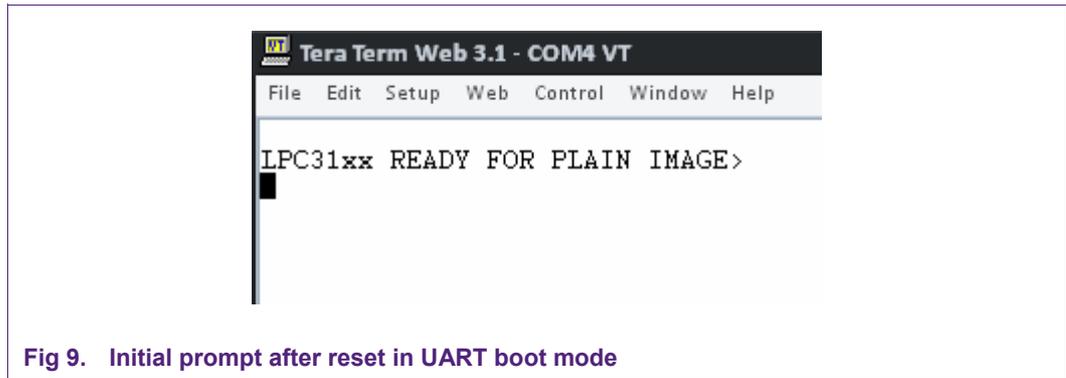


Fig 9. Initial prompt after reset in UART boot mode

Select **File** → **Send file** option from the terminal application’s menu and the next screen will appear:

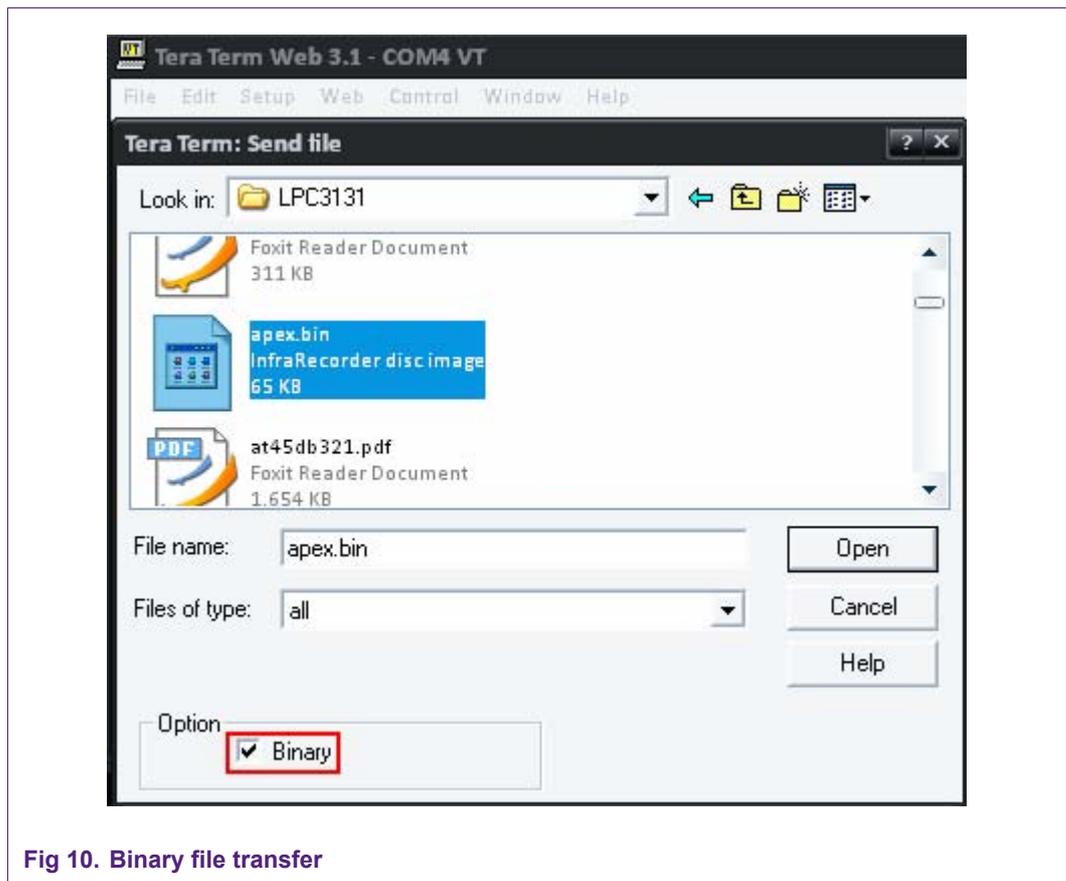
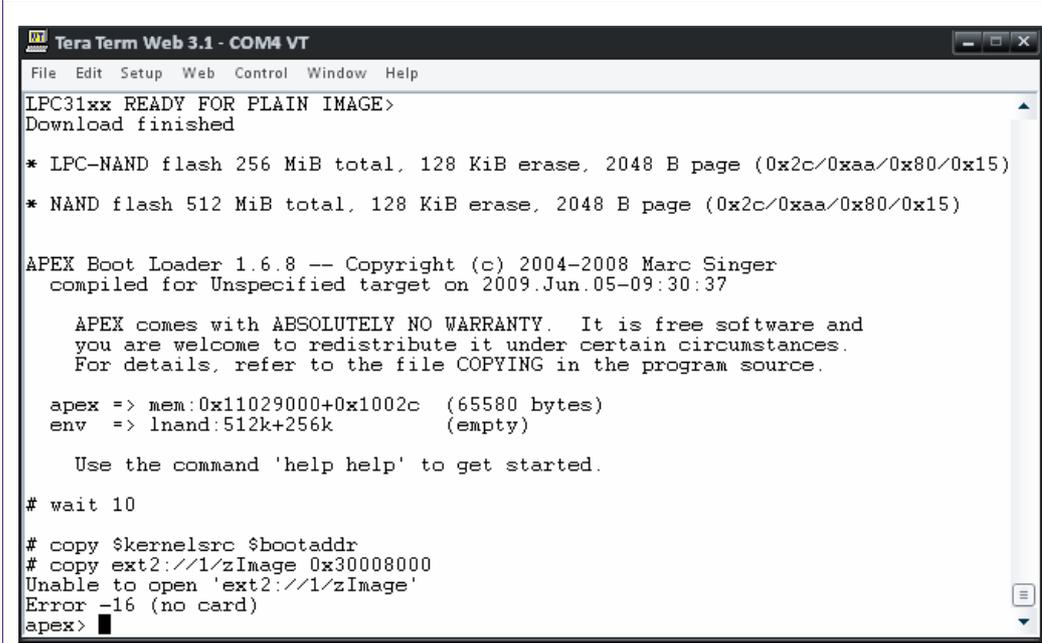


Fig 10. Binary file transfer

Select the “apex.bin” file, check the “Binary” option and press “Open” to start the file transfer. After the download, the following message will appear.



```
Tera Term Web 3.1 - COM4 VT
File Edit Setup Web Control Window Help
LPC31xx READY FOR PLAIN IMAGE>
Download finished

* LPC-NAND flash 256 MiB total, 128 KiB erase, 2048 B page (0x2c/0xaa/0x80/0x15)
* NAND flash 512 MiB total, 128 KiB erase, 2048 B page (0x2c/0xaa/0x80/0x15)

APEX Boot Loader 1.6.8 -- Copyright (c) 2004-2008 Marc Singer
compiled for Unspecified target on 2009.Jun.05-09:30:37

APEX comes with ABSOLUTELY NO WARRANTY. It is free software and
you are welcome to redistribute it under certain circumstances.
For details, refer to the file COPYING in the program source.

apex => mem:0x11029000+0x1002c (65580 bytes)
env => lnand:512k+256k (empty)

Use the command 'help help' to get started.

# wait 10

# copy $kernelsrc $bootaddr
# copy ext2://1/zImage 0x30008000
Unable to open 'ext2://1/zImage'
Error -16 (no card)
apex>
```

Fig 11. “APEX.bin” bootloader

At this point, the APEX bootloader is loaded and running from memory. The next step is to format the NAND flash.

3.4 Erasing the flash memory

Before the application binary can be loaded into the NAND flash we need to erase the existing content. It is not necessary to erase the entire NAND flash, but we do need to erase the flash memory at which the boot ROM (application) will reside.

Using the apex bootloader, the NAND flash is segmented into blocks of 128 kB (bytes) in size. Since the boot ROM is limited to 128 kB (bytes), erasing the NAND flash involves only erasing NAND flash block 1. NAND boot will attempt to boot from block 1. To erase block 1 type in:

```
erase lnand:128k+128k
```

With block 1 erased the next step is to load and copy the application binary.

3.5 Download the application binary file

Load the application binary into memory (external SDRAM) by typing in:

```
xreceive 0x30008000
```

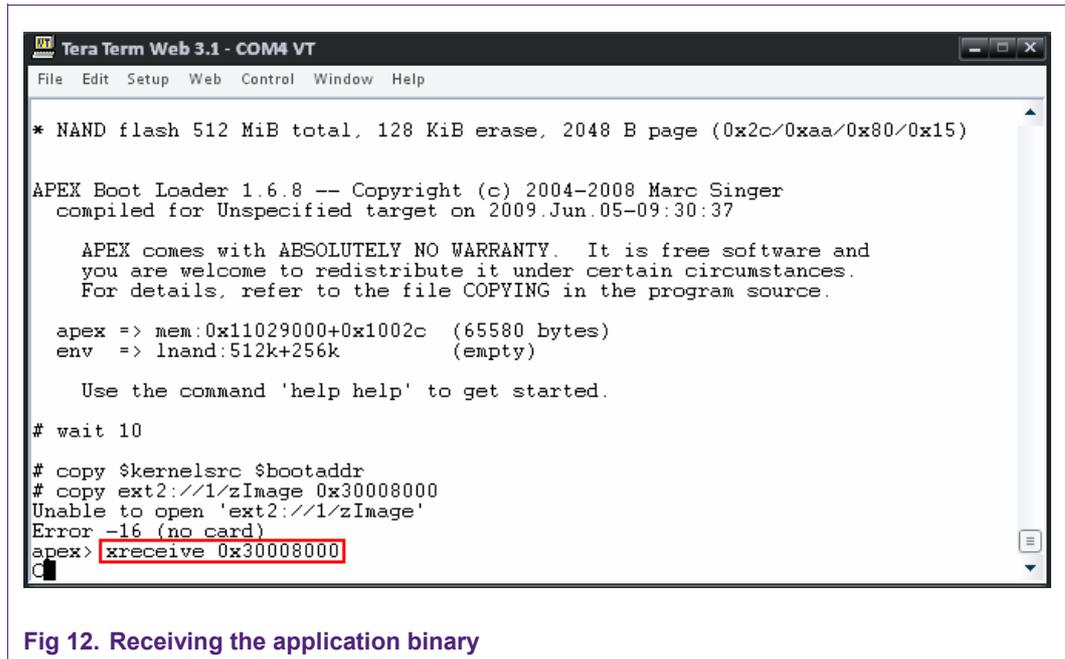


Fig 12. Receiving the application binary

Using the XMODEM (Checksum) protocol transfer the binary file.

File → Transfer → XMODEM → Send...

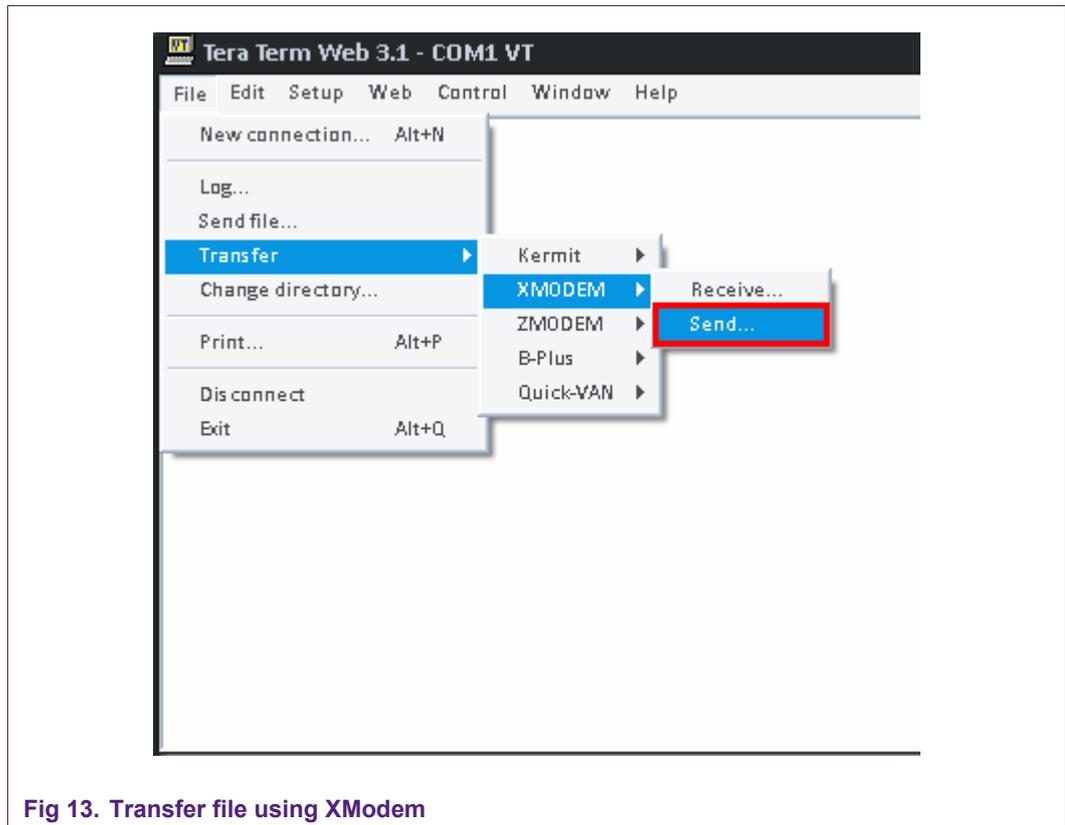


Fig 13. Transfer file using XModem

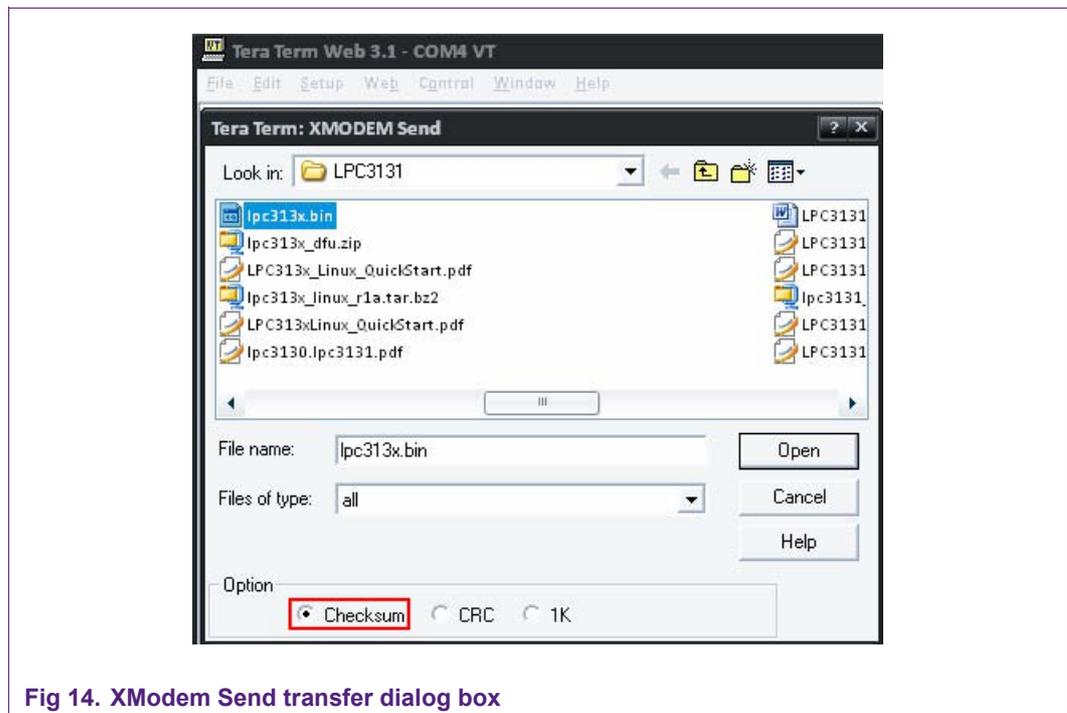


Fig 14. XModem Send transfer dialog box

Once completed, the APEX bootloader will show the number of bytes that have been transferred.

3.6 Flashing the application binary

The next step is to copy the contents from memory (SDRAM) into NAND flash. It is important to know how much data needs to be copied. Hence, refer to the number of bytes that have been transferred from the previous `xreceive` command.

```
copy 0x30008000+"number of bytes received" lnand:128k
```

The `lnand:128k` refers to NAND flash address location where the image should be copied to. In order to boot from the NAND flash the application binary needs to be stored starting at Block 1. With each block being 128kB in size, Block 1 begins at 128kB.

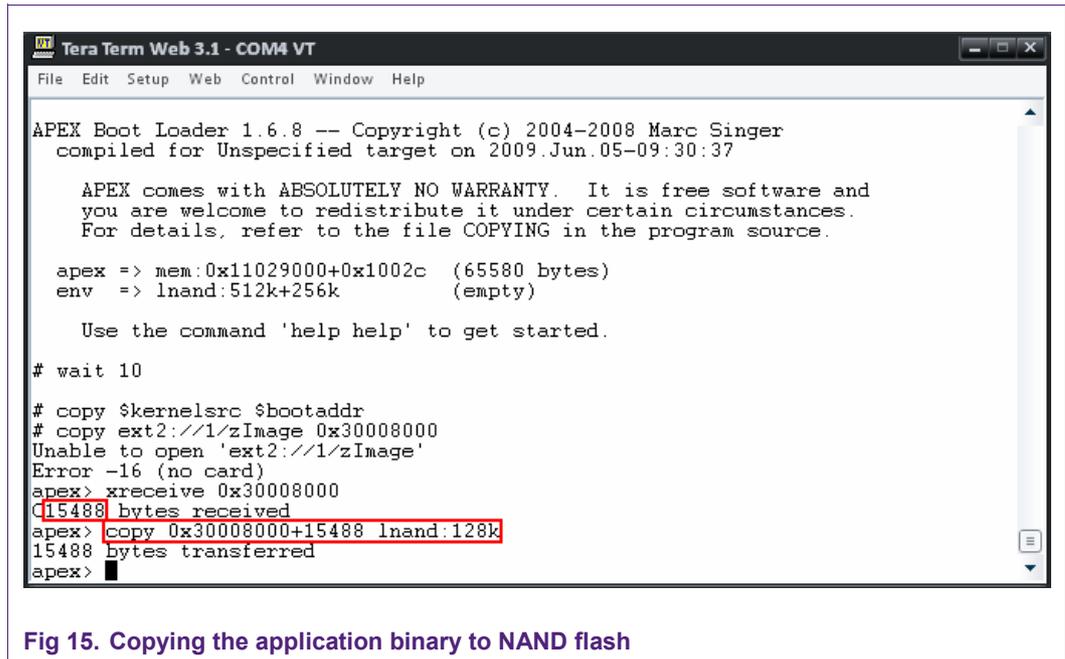


Fig 15. Copying the application binary to NAND flash

Lastly, reconfigure the EA3131 development board to boot from NAND flash as described in Section 2.4 and then perform a reset.

3.6.1 Optional methods for copying the application binary

Rather than using the UART channel, the apex bootloader also supports image transfers using an ext2 formatted SD Card and TFTP (on Base Board v2.x only)

Table 2. Optional image download methods

Method	Command
SD Card (ext2 formatted)	copy ext2://1/<image>.bin 0x30008000
TFTP (Base Board v2)	copy tftp://<TFTP server IP address>/<image>.bin 0x30008000

4. Additional Reference

See NXP’s application note AN10860 for more details on how the NAND flash is configured and managed:

<http://www.ics.nxp.com/support/documents/microcontrollers/pdf/an10860.pdf>

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