

## **BSP User Guide**

Texas Instruments AM335x  
BeagleBone  
Texas Instruments AM335x  
BeagleBone Black

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QNX Software Systems Limited  
1001 Farrar Road  
Ottawa, Ontario  
K2K 0B3  
Canada

Voice: +1 613 591-0931  
Fax: +1 613 591-3579  
Email: [info@qnx.com](mailto:info@qnx.com)  
Web: <http://www.qnx.com/>

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# About this guide

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## In this guide

*BSP User Guide: Texas Instruments AM335x BeagleBone* contains installation and start-up instructions for the QNX Board Support Package (BSP) for the Texas Instruments AM335x BeagleBone and Texas Instruments AM335x BeagleBone Black boards.



The BSP supports both boards, and instructions for one board are valid for the other. For simplicity, in this document we may refer to as simply the “BeagleBone board” .

To find out about:	See:
The resources available to you, and what you should know before starting to work with this BSP	<a href="#">Before you begin</a> (p. 9)
What's included in the BSP, and supported host OSs and boards	<a href="#">About this BSP</a> (p. 11)
Building and installing this BSP	<a href="#">Building and installing the BSP</a> (p. 14)
Starting the screen graphics sample applications	<a href="#">Starting the screen graphics sample applications</a> (p. 17)
Driver commands	<a href="#">Driver commands</a> (p. 19)

## Typographical conventions

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Throughout this manual, we use certain typographical conventions to distinguish technical terms. In general, the conventions we use conform to those found in IEEE POSIX publications.

The following table summarizes our conventions:

Reference	Example
Code examples	<code>if( stream == NULL)</code>
Command options	<code>-lR</code>
Commands	<code>make</code>
Constants	<code>NULL</code>
Data types	<code>unsigned short</code>
Environment variables	<b><i>PATH</i></b>
File and pathnames	<code>/dev/null</code>
Function names	<code>exit()</code>
Keyboard chords	<b>Ctrl–Alt–Delete</b>
Keyboard input	<code>Username</code>
Keyboard keys	<b>Enter</b>
Program output	<code>login:</code>
Variable names	<code>stdin</code>
Parameters	<code>parm1</code>
User-interface components	<b>Navigator</b>
Window title	<b>Options</b>

We use an arrow in directions for accessing menu items, like this:

You'll find the Other... menu item under **Perspective Show View**.

We use notes, cautions, and warnings to highlight important messages:



Notes point out something important or useful.



Cautions tell you about commands or procedures that may have unwanted or undesirable side effects.

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Warnings tell you about commands or procedures that could be dangerous to your files, your hardware, or even yourself.

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**Note to Windows users**

In our documentation, we typically use a forward slash (/) as a delimiter in pathnames, including those pointing to Windows files. We also generally follow POSIX/UNIX filesystem conventions.

## Technical support

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Technical assistance is available for all supported products.

To obtain technical support for any QNX product, visit the Support area on our website ([www.qnx.com](http://www.qnx.com)). You'll find a wide range of support options, including community forums.

# Chapter 1

## Before you begin

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Before you begin working with this BSP you should become familiar with the resources available to you when building QNX embedded systems.

### Essential information

Before you begin building and installing your BSP, you should review the following documentation:

- Information about your board's hardware and firmware, available at: <http://beagleboard.org>.
- General information about QNX BSP and instructions for tasks common to all BSPs, see *QNX SDP 6.6.0 BSPs* available on the the QNX Infocentre. This documentation includes:
  - an overview of QNX BSP
  - links to documentation about how to build QNX embedded systems, which you should read before you begin working with this BSP
  - what's new in the BSPs for this release
  - structure and contents of a BSP
  - how to prepare a bootable SD card
  - how to modify an older BSP to work with the current release

### Technical Support

To obtain technical support for any QNX product, visit the Support area on our website. You'll find a wide range of support options, including community forums.

### Latest version of this BSP

For the most up-to-date version of this user guide, log in to your myQNX account, and download it from the same location as the BSP.



# Chapter 2

## About this BSP

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These notes list what's included in the BSP, and identify the host OSs and boards it supports.

### What's in this BSP

This BSP contains the following components:

Component	Format	Comments
Startup	source	
Watchdog	source	
RTC	source	Real time clock utility
Serial driver	source	
I2C driver	source	
SPI driver	source	
USB host controller driver	binaries only	
USB device driver	source	CDC-ACM, USB mass storage, NCM
MMC/SD driver	source	
eMMC driver	source	
Network driver	Source	
LED driver	source	
Board ID driver	source	
Screen graphics	binaries only	
User Guide	PDF	This document

### Supported OSs and boards

In order to install and use this BSP, you must have installed the QNX Software Development Platform (SDP) 6.6, on either a Windows or Linux Host PC.

You will also need the following to work on your embedded target:

- a terminal emulation program (minicom, QNX Momentics IDE Terminal, tip, Hyperterminal, etc.)
- a USB-to-serial cable (BeagleBone) or FTDI Chip TTL-232R-3V3 cable (BeagleBone Black)
- an Ethernet link

This BSP supports the following target OS:

- QNX Neutrino<sup>®</sup> RTOS 6.6

This BSP supports the following boards:

- TI AM335x BeagleBone, revision A3
- TI AM335x BeagleBone Black, revisions A5C, A6 and A6A

# Chapter 3

## Installation notes

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These installation notes describe how to build, install and start this BSP.

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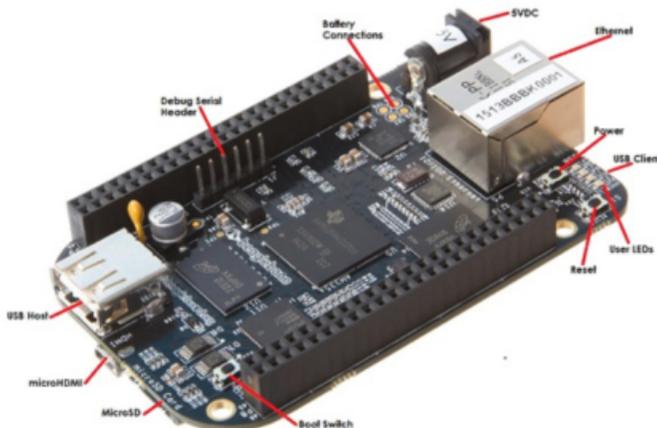
Please refer to the *QNX SDP 6.6.0 BSPs* guide, available as part of the QNX Software Development Platform OS Core Components documentation in the QNX Infocentre for detailed instructions how to extract and build a BSP, and how to prepare a bootable, DOS / FAT32 formatted SD card.

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## Building and installing the BSP

Building and installing the BSP requires the followings tasks, completed in order.

The image belwo shows a BeagleBone Black board. It should help you find interfaces you'll need to use when setting up your board.



**Figure 1: The TI AM335x BeagleBone Black**

### Connect the hardware

To connect to your board, start by connecting the serial port.

For the BeagleBone board:

1. The BeagleBone has a mini-B USB FTDI port labelled **P3**. Use the A to mini-B cable to connect this port to any USB port on your host machine .
2. Install the USB to serial drivers provided on the micro SD card included with the board. Once you have successfully installed these drivers, a new serial port will appear on your host.

For the BeagleBone Black board:

1. Connect the FTDI USB-to-TTL cable from the 6-pin TTL connector J1 on the board to an available USB port on the host machine. Ensure that the black wire on the TTL connector is connected to the pin closest to the white dot on the board.
2. Boot the device using the default Linux and a “BeagleBone Getting Started” drive will appear.
3. Copy and install on your host the drivers for the FTDI serial cable found in the “Drivers” folder. This will create a host serial port for the console.
4. Identify the host serial port:

On a Linux system, you can check which port is the host serial poor by looking at what port appears when the cable is inserted. Do do this, type the command:

```
$ ls /dev/ttyUSB*
```

On a Windows system, open the **Device Manager** and expand the “Ports (COM and LPT)” section.

After you have connected a serial port, on both the BeagleBone and the BeagleBone Black boards:

1. On your host machine, start your favourite terminal program with these settings:

- Baudrate: **115200**
- Data: **8 bit**
- Parity: **no**
- Stop: **1 bit**
- Flow control: **none**



When applying or removing power from the board, it is best to plug and unplug the adapter from the 110-220 VAC outlet.

Avoid connecting and disconnecting at the board’s power connector, as this may cause potentially damaging power spikes to the board’s power regulation circuitry.

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2. Connect the +5V power supply to the board.

## Build the BSP

For detailed instructions on how to extract and build a BSP, please refer to the *QNX SDP 6.6.0 BSPs* guide, available as part of the QNX Software Development Platform OS Core Components documentation in the QNX Infocentre.

## Prepare a bootable SD card

To enable booting the system from the SD card, you need create a DOS FAT32 partition (type 12) on the SD card. Please refer to the *QNX SDP 6.6.0 BSPs* guide, available as part of the QNX Software Development Platform OS Core Components documentation in the QNX Infocentre for detailed instructions on how to prepare a bootable, DOS / FAT32 formatted SD card.

## Copy the boot loader modules and the IFS boot image to the SD card

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MLO is a small program that is loaded into the processor’s static RAM. It does some minimal configuration of system memory and I/O pins, then loads the second-stage loader. If your card is freshly formatted, MLO must be the *first file to be copied onto the card*. Once MLO is on the card, subsequent copying order doesn’t matter.

If the card is freshly formatted and MLO is *not* the first file copied on the SD card, the board will not boot. The card will then need to be reformatted and the files copied in the correct order.

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To copy the boot loader modules and the IFS boot image to the micro SD card:

1. Download the correct MLO and `u-boot.img` binaries from the same location as you downloaded this BSP.
2. Copy the files below from the `images` directory, to the DOS/FAT32 partition of your SD card, *in the following order*:
  - a. MLO (first-stage loader)
  - b. `u-boot.img` U-Boot image (second-stage loader)
  - c. `ifs-ti-am335x-evm.bin` (QNX Neutrino IFS image, found in your BSP's `/images` directory).

### Load and run the QNX IFS from the micro SD card

To load and run the QNX IFS from the micro SD card:

1. Insert the card into the micro SD slot on the board.
2. Power up the board.
3. Reset the board by holding down the S2 switch and plugging in the power supply. This will force a boot from the Micro SD card.
4. The serial terminal should display the u-boot prompt. Enter the following commands to start the QNX Neutrino OS:

```
# mmcinfo
# fatload mmc 0 81000000 ifs-ti-am335x-beaglebone.bin
# go 81000000
```

QNX Neutrino should now be running on your target.

### Automating U-Boot commands

You can automate the U-Boot commands by creating a file on the micro SD card called `uEnv.txt`, and with the following line:

```
uenvcmd=mmcinfo;fatload mmc 0 81000000 ifs-ti-am335x-beaglebone.bin; go 81000000
```

## Starting the screen graphics sample applications

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The sample build file provided with this BSP starts the screen driver by default.

Starting the screen driver by default allows some of the sample graphical applications, such as `gles1-gears`, `gles2-gears` and `sw-vsync` to run on the target and provide output on the default display. To display moving gears, type the following command at the prompts:

```
# gles2-gears
302 frames in 5.003 seconds = 60.364 FPS
300 frames in 5.003 seconds = 59.964 FPS
300 frames in 5.003 seconds = 59.964 FPS
...
```

The specifics of a board's graphics configuration, such as the target output display port or the output resolution, is defined in the file `graphics.conf`, found in the `/usr/lib/graphics/omap4-5-j6` directory. It can be modified at run time, after which you must slay and restart screen:

```
# slay screen
# screen
```

The default video port for this board is the HDMI port (connector J7). The default output resolution is 1280 x 760 at 60FPS.

For more information about graphics, please refer to the *Screen Developer's Guide*, available in the QNX Infocentre.



# Chapter 4

## Driver commands

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The tables below provide a summary of driver commands.

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Some of the drivers are commented out in the default build file in the startup directory. To use the drivers in the target hardware, you'll need to uncomment them in your build file, rebuild the image, and load the image onto the board.

For more information about these and other commands, see the *Neutrino Utilities Reference*.

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### Startup

Device	STARTUP
Command	<code>startup-beaglebone -d</code>
Required binaries	<code>startup-beaglebone</code>
Required libraries	
Source location	<code>src/hardware/startup/boards/ti-am335x/beaglebone</code>

### Watchdog

Device	WATCHDOG
Command	<code>dm814x-wdtkick -a 0x44E35000</code>
Required binaries	<code>dm814x-wdtkick</code>
Required libraries	
Source location	<code>src/hardware/support/dm814x-wdtkick</code>

### Real time clock

Device	RTC
Command	<code>rtc phoenix</code>
Required binaries	<code>rtc, date</code>
Required libraries	
Source location	<code>src/utis/r/rtc</code>

**Serial**

Device	SERIAL
Command	<code>devc-seromap -e -F -b115200 -c48000000/16 0x44E09000^2,72</code>
Required binaries	<code>devc-seromap</code>
Required libraries	
Source location	<code>src/hardware/devc/seromap</code>

**I2C**

Device	I2C0, I2C1, I2C2
Command	<code>i2c-omap35xx-j5 -i 70 -p0x44E0B000 --u0</code>
Command	<code>i2c-omap35xx-j5 -i 71 -p0x4802A000 --u1</code>
Command	<code>i2c-omap35xx-j5 -i 30 -p0x4819C000 --u2</code>
Required binaries	<code>i2c-omap35xx-j5</code>
Required libraries	
Source location	<code>src/hardware/i2c/omap35xx</code>

**SPI**

Device	SPI0, SPI1
Command	<code>spi-master -d dm816x base=0x48030100, irq=65, edma=1, edmairq=529, edmachannel=17</code>
Command	<code>spi-master -d dm816x base=0x481A0100, irq=125, edma=1, edmairq=555, edmachannel=43</code>
Required binaries	<code>spi-master</code>
Required libraries	<code>spi-dm816x.so</code>
Source location	<code>src/hardware/spi/dm816x, src/hardware/spi/master</code>

**USB**

Device	USB OTG (Host mode)
Command	<code>io-usb -vvv -d dm816x-mg ioport=0x47401c00,irq=19</code>
Required binaries	<code>io-usb, usb, devb-umass</code>
Required libraries	<code>devu-dm816x-mg.so, libusbdi.so</code>

Source location	Prebuilt only
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### MMC/SD

Device	MicroSD Card Interface
Command	devb-mmcsd-jacinto5 cam blk automount=hd0t12:/fs/sd0 mmcsd verbose=3, ioport=0x48060100, irq=64, ioport=0x49000000, dma=24, dma=25
Required binaries	devb-mmcsd-jacinto5
Required libraries	libcam.so, cam-disk.so, io-blk.so, fs-qnx6.so
Source location	src/hardware/devb/mmcsd

### eMMC

Device	eMMC
Command	devb-mmcsd-jacinto5 cam blk automount=hd1t12:/fs/sd1 mmcsd verbose=5, ioport=0x481d8100, irq=28, ioport=0x49000000, dma=2, dma=3
Required binaries	devb-mmcsd-jacinto5
Required libraries	libcam.so, cam-disk.so, io-blk.so, fs-qnx6.so
Source location	src/hardware/devb/mmcsd

### Ethernet

Device	NETWORK (LAN9730 USB – Ethernet bridge)
Command	io-pkt-v4-hc -d dm814x-am335x deviceindex=0,p0mode=gmi
Required binaries	io-pkt-v4-hc, ifconfig, dhcp.client
Required libraries	devnp-dm814x-am335x.so, libsocket.so
Source location	prebuilt only

### LEDs

Device	LEDs
Command	am335x-leds &
Required binaries	am335x-leds
Required libraries	
Source location	hardware/support/am335x-leds

**Board ID**

Device	Board ID
Command	am335x-boardid &
Required binaries	am335x-boardid
Required libraries	
Source location	hardware/support/am335x-boardid

## USB device class drivers

The tables below provide a summary of USB class driver commands supported by this BSP.



For complete details on using these drivers, please refer to the additional notes and instructions in the BSP's build file, which can be found in the BSP's /images directory.

For more information about these and other commands, see the *Neutrino Utilities Reference*.

### CDC-ACM (serial) USB device class driver

Device	USB Serial Device
Command	<code>io-usb-dcd -dusbser-am335x-musbmhdrc ioport=0x47401400,irq=18,nodma,force_device_mode,inherit_cfg</code>
Required binaries	<code>io-usb-dcd</code>
Required libraries	<code>devu-usbser-am335x-musbmhdrc.so, libusbdc1.so</code>
Source location	<code>src/hardware/devu/dc</code>

### USB mass storage device class driver

Device	USB Umass Device
Command	<code>io-usb-dcd -dusbumass-am335x-musbmhdrc ioport=0x47401400,irq=18,nodma,force_device_mode,inherit_cfg</code>
Required binaries	<code>io-usb-dcd</code>
Required libraries	<code>devu-usbumass-am335x-musbmhdrc.so, libusbdc1.so</code>
Source location	<code>src/hardware/devu/dc</code>

### NCM (network) USB device class driver

Device	USB NCM Device
Command	<code>io-usb-dcd -dusbncm-am335x-musbmhdrc ioport=0x47401400,irq=18,nodma,force_device_mode,inherit_cfg</code>
Required binaries	<code>io-usb-dcd</code>
Required libraries	<code>devu-usbncm-am335x-musbmhdrc.so, libusbdc1.so</code>

Source location	<code>src/hardware/devu/dc</code>
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